

Gaia satellite observations of NGC 6819 open cluster

HMY Hamed



orcid.org/0000-0002-3841-5450

Dissertation accepted in fulfilment of the requirements for the
degree *Master of Science in Physics* at the North-West
University

Supervisor: Dr PA Oyirworth

Graduation: May 2021

Student number: 33625506

ACKNOWLEDGEMENTS

I would like to thank Allah for giving me the strength to complete this work during the hard times. I would also like to express a special thanks to my supervisor, Dr. Oyirwoth Patrick Abedigamba, who offered valuable guidance and was a great advisor to me. I really appreciate Mr. Armand's help in enhancing my programming skills. I also gratefully acknowledge Prof. Amare Abebe, Dr. Zolile Mguda, and Dr. Getatchew Mekonnen for their tremendous support. Lastly, I would like to thank Ms. Heba Sami for giving me this opportunity in South Africa and helping me with the registration and accommodation processes.

DEDICATION

I dedicate this work to my parents. I would never have managed to achieve what I have without your support. To my lovely brother Yassin, and my friends Ahmed, Anna-Mia, Innocentia- thank you for always being there for me.

Abstract

In this work, *Gaia* DR2 was used to redefine the membership of the moderately old open cluster NGC 6819 and to study the cluster's parameters. The membership is defined by comparing the values of the distance modulus and proper motion of the NGC 6819 *Kepler*, well-known members within the value of the standard deviation (σ), with the original sample that is downloaded from *Gaia* DR2. The number of new members in the cluster with known luminosities and effective temperatures is 64 stars. The new NGC 6819 members are combined with the well-known ones to give a new mean distance modulus of 12.173 ± 0.007 mag.

The second part of this work is the mass loss estimation. The mass loss at the tip of the Red Giant Branch is considered to be an unsolved problem for the NGC 6819 open cluster. In this work, I combined the asteroseismic *Kepler* data with the luminosity and the effective temperature that were obtained from the astrometric *Gaia* data to fill this gap. The chosen sample of Red Giant (RG) stars was separated into RGB and Red clumps (RC) according to the value of the logarithm of the surface gravity $\log g$. The mass of each individual star is calculated using three different scaling relations to obtain the mass loss. In addition, the mass loss was calculated using Chi-squared (χ^2) minimisation method. The significant results of the mass loss were $0.017 M_{\odot}$ and $0.006 M_{\odot}$.

This work was limited by *Gaia* DR2 magnitudes as well as the stars that have known parallax and proper motion values only.

Contents

Declaration	i
Acknowledgements	i
Dedication	ii
Abstract	iii
1 Introduction	2
1.1 Background	2
1.2 Stellar instruments	3
1.2.1 <i>Kepler</i> satellite	4
1.2.2 <i>Gaia</i> satellite	4
1.3 Problem statement	5
1.4 Aim and objectives	6
1.5 Outline of the dissertation	6
2 Literature review	8

2.1	Stellar evolution	8
2.1.1	The Hertzsprung–Russell diagram	9
2.2	Red Giant (RG) Phase	12
2.2.1	The uniqueness of the RG stars	13
2.2.2	RG separations	15
2.2.3	RG Metal abundance	17
2.3	Stellar pulsation	18
2.3.1	Solar-like stars	19
2.3.2	RG oscillation	21
2.3.3	Scaling relation	22
2.4	NGC 6819	28
2.4.1	NGC 6819 properties	31
2.4.2	RG in NGC 6819	39
2.5	Mass loss in stars	41
3	Data and Methods	44
3.1	Data	44

3.1.1	Astrometric data	44
3.1.1.1	<i>Gaia</i> luminosity and effective temperature (T_{eff})	45
3.1.2	Asteroseismic data	49
3.2	Method	50
3.2.1	The theoretical isochrone	51
3.2.2	RG sample	52
3.2.3	Mass loss calculations	55
3.2.3.1	Chi-squared (χ^2) minimisation	55
4	Results and discussion	57
5	Conclusion	66
	References	95
A	Appendix A	96
B	Appendix B	103
C	Appendix C	129

1. Introduction

1.1 Background

Our universe has billions of galaxies. Each galaxy contains a number of groups of stars which are called star clusters (Gott III et al., 2005; Lada and Lada, 2003). The cluster members are formed from the same cloud of gas and dust with the same age and space velocity. The properties of a member of one cluster are similar to the other members in the cluster and different from the non-members of the cluster. There are many techniques for defining the members that belong to the cluster (Stello et al., 2011b). Techniques include photometric membership, which depends on the color-magnitude diagram (Stetson et al., 2003), kinematic membership which is built upon the space velocity (Hole et al., 2009), and the Unsupervised Photometric Membership Assignment (UPMASK) code (Cantat-Gaudin et al., 2018a). Stello et al. (2010) found a correlation between oscillation properties and the cluster membership. They analysed the oscillation data from the *Kepler* satellite to determine the cluster membership and compared the new members with those which have been obtained with the photometric method.

The New General Catalogue (NGC) is a database that lists the celestial bodies such as galaxies and clusters according to their properties. NGC 6819, NGC 6811, and NGC 6791 are examples of the NGC (Dreyer, 1888) and NGC 6819 is one of the star clusters within our Milky Way galaxy (Bossini et al., 2019). According to Basu et al. (2011), the distance modulus of the NGC 6819 open cluster is 11.85 ± 0.05 mag, and

it has an average mass of $1.68 \pm 0.03 M_{\odot}$. It is considered to be a moderately old cluster (Balona et al., 2013b), which makes it a good target to study since there is a high possibility to find stars in different evolutionary stages (Prialnik, 2000).

NGC 6819 has a number of Red Giant (RG) stars with solar-like oscillations (Komucyeya et al., 2018; Hekker et al., 2011a; Balona et al., 2013b; Stello et al., 2010). The RG phase is one of the stellar evolution phases at which the Red Giant Branch (RGB) stars tend to lose part of their mass during the transition to the Red Clump (RC) phase (Reimers et al., 1975; Reimers, 1977). Estimating the mass loss, its rate, and its mechanism provides us with information about the initial mass and help us to determine the evolutionary phase (Willson, 2000), which helps us to understand the open cluster NGC 6819 better (Höfner and Olofsson, 2018). The mass loss in the RGB in the open cluster NGC 6819 has been estimated using asteroseismic data from the *Kepler* space mission and together with some statistical techniques to be $-0.027 \pm 0.033 M_{\odot}$ for $Z = 0.017$ with a cluster age of 2.5 Gyr (Abedigamba et al., 2015). Handberg et al. (2017) also used asteroseismic data from the *Kepler* space mission and found the estimated mass loss $-0.03 \pm 0.01 M_{\odot}$. The negative value shows that these results are not significant and the asteroseismic method is not sufficient for estimating the mass loss (Abedigamba et al., 2015).

1.2 Stellar instruments

In the past, astronomers tried to observe celestial bodies with the naked eye. Later, Galileo Galilei built the first telescope to get a clearer image of the sky. After

Galileo's telescope, scientists began to design improved telescopes for specific missions (Greivenkamp and Steed, 2011). Some telescopes have been designed to detect habitable planets in the habitable zone of solar-like stars, such as the *Kepler* space mission, which uses photometric data (Koch et al., 2004).

1.2.1 *Kepler* satellite

Kepler satellite was launched in March 2009 by NASA, since then about 165000 stars and over 4700 planets were observed. To date, over 2300 confirmed or validated planets and over 2100 eclipsing binaries have been identified (Fanelli et al., 2011).

The primary mission of *Kepler* was to detect Earth-like planets using the transit method. The transit method is based on measuring the brightness of the star. Since the *Kepler* mission provided us with accurate photometry data of stars in the *Kepler* field, this data has been used to study the different types of stars (Meibom et al., 2011). The photometric data allowed us to plot the periodogram, which covers all the frequencies for any star, and obtain the values of the frequency of the maximum amplitude ν_{max} and the large separation $\Delta\nu$ (Balona et al., 2013b). *Kepler* has a magnitude limit of between 6 and 18 (Batalha et al., 2010). NGC 6866, NGC 6819, NGC 6791, and NGC 6811 were four open clusters located within the *Kepler* field (Meibom et al., 2011).

1.2.2 *Gaia* satellite

Gaia used to be written as GAIA, which stands for Global Astronomic Interferometer for Astrophysics, but was then changed to *Gaia* because the final design was based on a monolithic mirror and direct imaging instead of the interferometer image. *Gaia*'s mission is part of The European Space Agency (ESA) science programme, which was

launched in December 2013, and arrived at its operating point in July 2014. The main aims of the *Gaia* mission are to obtain three-dimension (3-D) spatial, 3-D velocity distribution, and some physical properties such as the surface gravity, to understand the future and past evolution of the Galaxy. *Gaia* provides accurate radial velocity, parallax and photometric values.

Gaia DR2 maps 1.7 billion stars and provides five astrometric parameters, including proper motion, declination, and parallax. The precision value in parallax is 0.02 mas and in proper motion is 0.05 mas yr^{-1} . *Gaia* also covers a large magnitude range ($G = [6.0 - 20.0]$) (Martín-Fleitas et al., 2014)) with a precision ten times better than that of The Tycho-Gaia Astrometric Solution (TGAS) (Cantat-Gaudin et al., 2018a). Recently, using *Gaia* DR2, astronomical parameters for 1229 clusters have been obtained. New members of NGC 6819 and other open clusters in the Milky Way have also been discovered (Cantat-Gaudin et al., 2018a). In the future, *Gaia* DR3 is expected to map a larger number of stars with a wider limit of magnitude.

Gaia provides more precise data and a larger magnitude limit than *Kepler* which allows *Gaia* to map more stars than *Kepler*.

1.3 Problem statement

The research problem to address is the mass loss in RGB stars at the tip of the RGB phase in the open cluster NGC 6819. Red Giant stars are expected to lose mass at the tip of the RGB phase. Abedigamba et al. (2015) attempted to address the problem with asteroseismic data from the *Kepler* satellite, which has yielded unsatisfactory

results. This work attempts to address this problem by using the recently released astrometric data from the *Gaia* space mission combined with asteroseismic data from the *Kepler* satellite. Statistical techniques, where the goodness-of-fit criterion is defined by applying Chi-square (χ^2) minimisation to the observational data and stellar model.

1.4 Aim and objectives

The aim of this research is to estimate the mass loss at the tip of the RGB in NGC 6819 using *Gaia* astrometric data and *Kepler* asteroseismic data. To achieve this aim, the specific objectives were to:

1. Redefine the NGC 6819 members using *Gaia* parallax and proper motion;
2. Divide the sample of RG stars into RGB and RC according to the value of $\log g$;
3. Estimate the difference between the average mass of the RGB and RGC stars;
4. Perform the Chi-square (χ^2) minimisation technique to estimate the mass loss with astrometric data.

1.5 Outline of the dissertation

This work is divided into five chapters. In Chapter two I will discuss the previous information related to my project, such as stellar evolution, the star clusters, the NGC 6819 open cluster, star mass loss, and other sections. The methods that I choose

for my calculations, as well as the available data and its sources, will be explained in detail in Chapter three. The discussion of the result will be covered in Chapter four. Finally, the conclusion and future research will be discussed in Chapter five.

2. Literature review

This chapter presents a detailed literature review and is divided into five sections. The first section discusses the stellar evolutionary phases and HR diagram. The second section provides important information about the RG phase and the different subphases. The third section shows the properties of the solar-like stars and the motivation for studying solar-like stars. The fourth section describes the NGC 6819 open cluster. Finally, the last (fifth) section discusses the mass-loss problem in the RGB and the relevant gaps in the literature.

2.1 Stellar evolution

Stars have different masses, luminosities, colours, and brightnesses. The formation of any star begins with a cloud of gas and dust which is called a stellar nebula. Due to gravity, this cloud contracts and forms a giant, spherical-shaped ball. This stage is called the pre-main sequence (Abell et al., 1987). In this stage, the temperature increases until it reaches 15 million degrees Celsius, and nuclear fusion takes place, fusing the hydrogen into helium and forming a proto-star. This star is called a main-sequence star. The main-sequence is the longest and most stable stage. In this stage, there is a balance between the contraction inward force due to gravity and the outward expansion due to the pressure of the nuclear reaction. The amount of gas and dust will determine the size of the star, and the surface temperature will determine its colour. The bigger the mass of the star, the brighter and hotter it is (Abell et al., 1987; Apfel, 1988; Kippenhahn et al., 1990).

After millions to billions of years, the hydrogen in the core is depleted. Gravity overcomes the nuclear force, which makes the outer layer shrink and the center of the star collapse. After a certain temperature, the star begins to fuse the helium in the core into heavier elements while the outer layer still fuses the hydrogen into helium. At this stage the star is called red giant (Abell et al., 1987; Apfel, 1988; Kippenhahn et al., 1990).

Depending on the size of the stars, there are two ways in which a star's life ends. For medium-sized stars (sun size), the helium fuses into carbon in the core. The carbon in the core is difficult to be compressed by the surrounding material. The outward pressure overcomes the downward gravitational contraction which makes the outer layer shed, leaving only 20% of the star's mass, and this core is called a white dwarf. After some time, the white dwarf loses its energy and turns into a brown dwarf, while for massive stars ($5M_{\odot}$), the red giant becomes supergiant. These stars are hotter and denser.

The helium fuses into heavy elements in the core until it reaches the iron, which is the heaviest. The temperature at this stage exceeds the 100 billion degrees Celsius and the repulsive force overcomes the gravity, which causes supernova explosion. The star then becomes a neutrino star or black hole with a very high gravity (Abell et al., 1987; Apfel, 1988; Kippenhahn et al., 1990).

2.1.1 The Hertzsprung–Russell diagram

The HR diagram (Figure 2.1) is a plot between absolute magnitudes and the spectral types or between luminosity and temperature. The study of this relation shows that each stellar evolution has its unique location on the HR diagram. In Figure 2.1, the longest line represents the main sequence stars. The region above the main sequence line represents subgiant, giant, and super giant stars, while the region below represents

the dwarf stars ([Karttunen et al., 2016](#)).

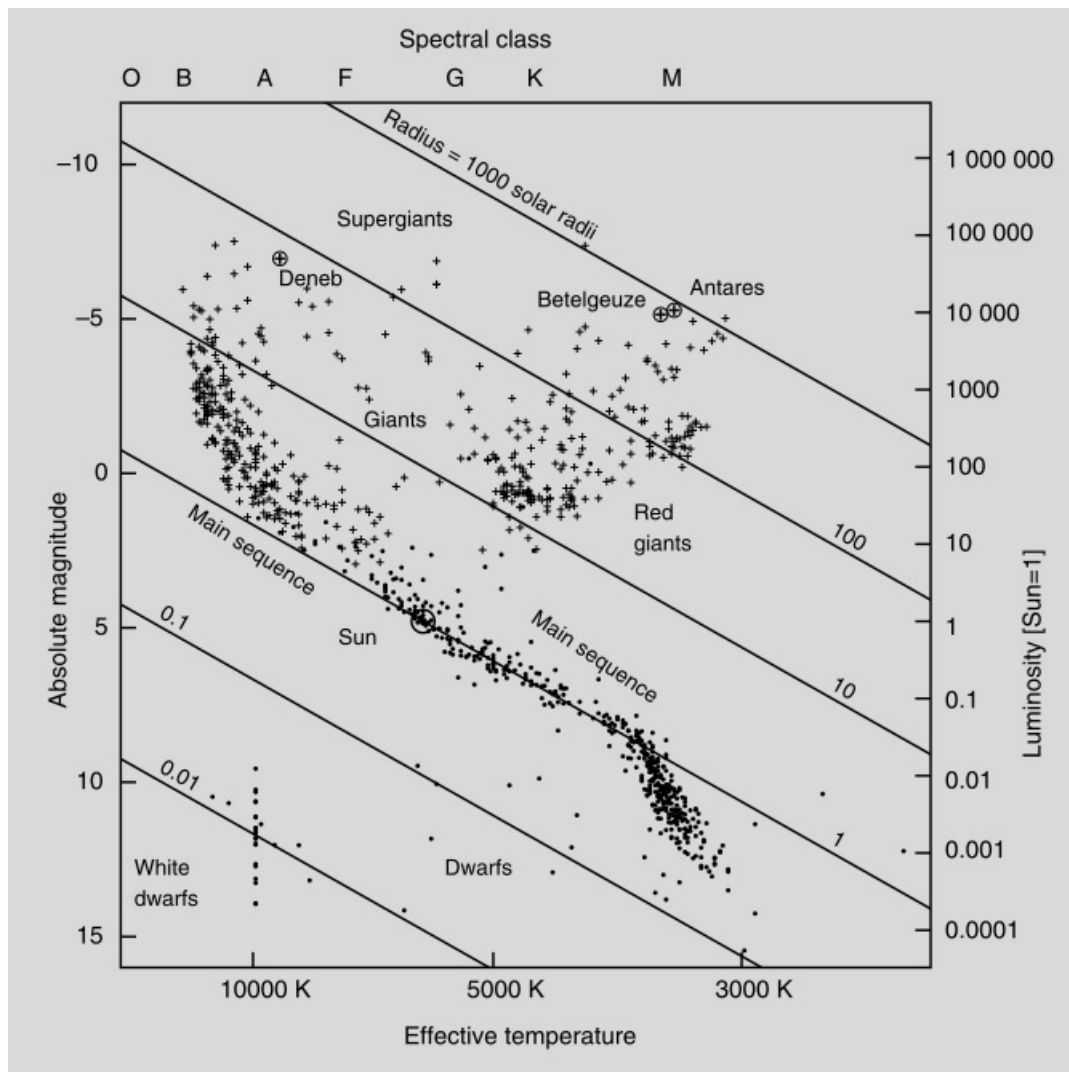


Figure 2.1: HR diagram shows the different stellar evolutions. Taken from: [Karttunen et al. \(2016\)](#).

Figure 2.2 shows the evolution of stars with the same initial composition and different masses on the HR diagram. The values of the mass effect on the position of the turning points and the fate of the stars after the main sequence phase are also indicated ([Iben, 1967](#)).

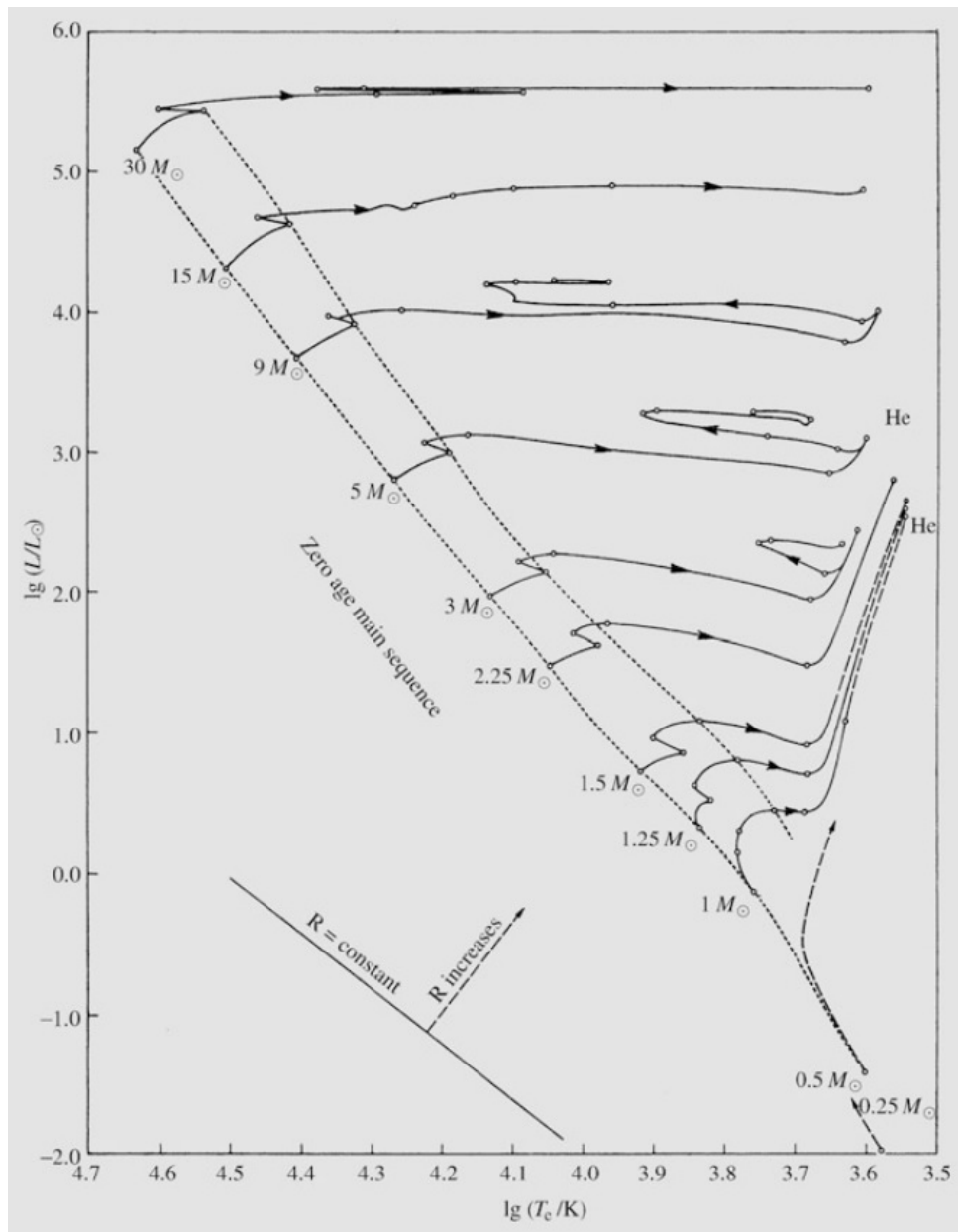
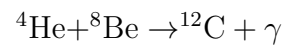
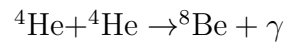


Figure 2.2: The HR diagram for different masses. The stars with low initial masses, tend to die in the early stages and they do not spend much time in each evolution phase. The stars with high initial masses spend more time in each evolution phase and die in the late stages. For more details see (Iben (1967), Karttunen et al. (2016)).

2.2 Red Giant (RG) Phase

At the RG phase, the star burns the helium (He) in the core while on the shell it still fuses the hydrogen (H) into He. This process happens through different subphases during this period. The time that the star spends in each subphase depends on the initial stellar mass. The first subphase is the red giant branch (RGB). This is when all the H in the core is fused while the shell begins to burn H into He. The RGB phase has a wide range of luminosities. The tip of the red giant branch (TRGB) is the phase at which there is no degeneracy in the He core region. He fuses rapidly in the core, which makes the star evolve into the RC phase (Abell et al., 1987; Apfel, 1988). After the RGB phase the star with high metallicity ascend to the RC phase, where the core begins to fuses the He into other heavy elements such as Carbon (C) and Oxygen (O) through a process called triple α (Oberhummer, 1998; Salaris and Cassisi, 2005; Adams and Grohs, 2017).



In the triple α process (as shown in the previous chemical equation), three helium atoms fuse into carbon with a release of energy in the form of gamma-rays. This reaction takes place by producing Beryllium ${}^8\text{Be}$ from the fusion of two alpha particles. Then the ${}^8\text{Be}$ fuses with another alpha particle to form ${}^{12}\text{C}$, but this intermediate process happens in very short time (Fushiki and Lamb, 1987; Salaris and Cassisi, 2005). This process increases the temperature and pressure in the core, which makes it expand. As a result of the core expansion, the temperature of the core decreases. Then, the

temperature of the degenerate core increases until it reaches a certain value, and at this moment, the He-flash occurs. In stars with masses of more than $2 M_{\odot}$, the helium fuses smoothly without He-flash occurrence (Iben, 1967). If this process happens to a metal-poor star ($[Fe/H] < -0.3$), then the star is called a Horizontal Branch (HB) star (Faulkner, 1966; Zhao et al., 2001). Girardi (1999) studied the Colour Magnitude Diagram (CMD) and the theoretical model of the RC stars and found an extension on the CMD from the main RC stars with 0.4 mag below the main red clump called the secondary clump. The secondary red clump and the red clump (the main one) follow the RGB evolutionary state but with a different location on the CMD. Secondary red clumps can be found in a field of 1 Gyr and have a metallicity of $Z > 0.004$ (Rodrigues et al., 2017). The core mass controls the stellar evolution after the Horizontal Branch (Sweigart and Gross, 1976). The helium fuses in the shell around the core, which is called the Asymptotic Giant Branch (AGB).

The dredge-up is the phase at which the fused materials are mixed with the other layers (Iben, 1967). There are three dredge-ups that take place in intermediate stars. The first one occurs at the RGB phase, while the second and the third dredge-ups occur at the AGB phase (Becker and Iben, 1979; Salaris and Cassisi, 2005). The RG stars have a few large convection cells (Paladini et al., 2018) and have spectral types from G to K (Jorissen et al., 1997). The position of the different RG phases in the HR diagram is shown in Figure 2.2.

2.2.1 The uniqueness of the RG stars

The (K-band) luminosity of 238 RC stars by using their parallaxes obtained from the Hipparcos has been estimated by David R. Alves, for more details see Alves (2000). In his study, he used the RC stars as candles to estimate the Galactic radius. The

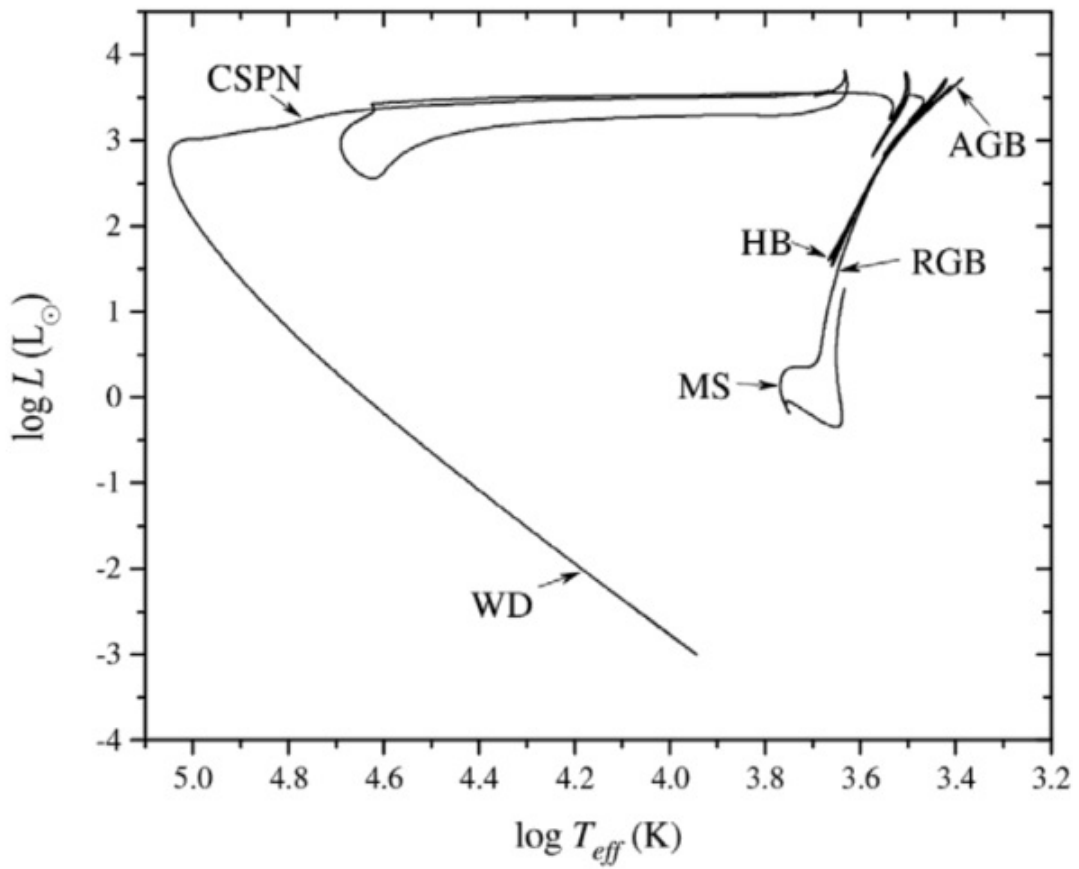


Figure 2.3: This figure shows the position of the different RG phases in the HR diagram (MacDonald, 2015).

TRBG stars were used as candles by Beaton et al. (2019) to estimate the distance of M 101 due to the high luminosities of these stars. They have been used to correct the systematic error in *Gaia* parallax (Davies et al., 2017). The luminosity of the RGB is important in estimating the distance (Lee et al., 1993).

The advantage of using a sample of RG stars in a cluster is that they have the same age, similar metallicities and mass ranges (Basu et al., 2011; Miglio et al., 2012). Gaulme et al. (2020) worked on a sample of 4500 RG stars. Out of the sample, 34

stars were detected as binaries, 30 stars did not show oscillations, and 370 stars were rapidly rotating. They used the oscillation properties to estimate the stellar mass and evolutionary phase of the stars and used the result to explain the reasons behind the activity of the stars. They found that the magnetic activity of RGB with intermediate masses, are more active than those with low masses while the magnetic activity for the RC stars with low masses is much higher than those with large masses. As the RGB stars evolve to the RC phase, the RGB with high masses lose angular momentum and the ones with low-masses gain angular momentum.

Using *Gaia*, The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), and a sample of 150000 RC stars, Wang et al. (2020) studied the kinematics of the Galactic disk within a radius between 12 and 15 kpc. Other recent studies used RC stars to study the Milky Way Galaxy (Navarro et al., 2020; Nogueras-Lara et al., 2019; Saito et al., 2020) The RC stars were used to search for hypervelocity stars (HVS) in the Galactic bulge (Luna et al., 2019). Mosser et al. (2010) studied the light curves of about 4600 Convection, Rotation and planetary Transits (CoRoT) stars, and 1800 of them were found to be red giants. They were able to estimate the mass and the radius of the RC by using the asteroseismic data from CoRoT.

2.2.2 RG separations

When the stars have narrow ranges of age and metallicity, it is easier to separate the RGB and RC stars using the colour-magnitude diagram, but when they have a wide range, they overlap on the colour-magnitude diagram and it is not easy to separate them (Elsworth et al., 2019). For the RC stars, it is challenging to separate the main clump and the secondary clump if the photometric errors are greater than 0.2 mag (Girardi, 1999). These problems have been solved by the asteroseismological data

([Elsworth et al., 2019](#)). The next paragraph presents a summary of the methods that have been used to separate the stars in the different RG phases.

The separation in the R method which was developed by [Iben and Rood \(1969\)](#), is based on the initial helium abundance. The secondary RC stars have lower average luminosity compared to the RC stars, which can be used to distinguish them ([Girardi, 1999](#)). Another method was used by [Kallinger et al. \(2012\)](#). They found that the phase shift (ϵ) for a particular $\Delta\nu$ differs in RGB from a RC star. They managed to distinguish between RGB, AGB, RC, and secondary RC using this method. The value of the period spacing in RC stars was greater than that of the RGB ([Dupret et al., 2009](#)) due to the difference in the envelope density ([Montalbán et al., 2010](#)). [Elsworth et al. \(2017\)](#) agreed with [Montalbán et al. \(2010\)](#) regarding the different period spacing of the RGB and RC and they used this information to distinguish between RC and RGB but they could not separate the secondary RC stars from the main RC stars. Another method, based on the period spacing of the mixed modes, was developed by [Bedding et al. \(2011\)](#), [Mosser et al. \(2011\)](#), [Mosser et al. \(2012a\)](#), [Mosser et al. \(2015\)](#), [Vrard et al. \(2016\)](#) which separated the RGB, RC, and the secondary RC stars using the asymptotic period spacing ($\Delta\Pi$). The envelope in the RGB is very extensive and convective, which makes it easy to penetrate the inner region of the star ([Li, 2015](#)). The fused material is mixed with the surface material, which is considered a unique property of the RGB ([Elsworth et al., 2019](#)). The RGB and RC stars can also be separated by an [C/N] ratio because this ratio of the RC stars is lower than that of the RGB stars ([Mosser et al., 2017](#)).

A sample of 6661 stars was classified in [Elsworth et al. \(2019\)](#) as 3372 RGB stars, 1984 RC stars, 286 secondary RC stars, and the other stars had no classification. They

calculated the mass of these stars using the scaling relation from [Kjeldsen and Bedding \(1994\)](#). It is not possible to distinguish between RGB and AGB neither by $\Delta\nu$ alone ([Elsworth et al., 2019](#)) nor by the period spacing because they have similar values ([Stello et al., 2013](#)). [Hekker and Christensen-Dalsgaard \(2017\)](#) presented a method of separation using $\nu_{\max}$, $\Delta\nu$, T_{eff} , and the metallicity in the grid-based method. This method also failed to separate the secondary RC from the main RC stars. [Pinsonneault et al. \(2018\)](#) found that the surface gravity of the RGB stars, $\log g < 2.38$, can be used to isolate the RGB and RC stars. [Hekker et al. \(2011c\)](#) separated the RGB and RC stars according to the value of $\log g > 2.7$ for RGB and $2.3 \leq \log g \leq 2.7$ for RC stars.

2.2.3 RG Metal abundance

The first to find lithium (Li) abundance in RG stars was [Wallerstein and Sneden \(1982\)](#). The researchers could not determine whether the Li-rich giants were RC or RGB stars. The asteroseismic data from the *Kepler* provided information that shows that the He-rich giants are classified as RC stars ([Silva Aguirre et al., 2014](#); [Carlberg et al., 2015](#); [Kumar et al., 2018](#); [Singh et al., 2019](#)). Some other studies such as that by [Reddy \(2019\)](#) came up with the same result using *Gaia* data. [Aguilera-Gómez et al. \(2020\)](#) modeled the abundance of ^6Li and ^7Li in the RG stars and they found that the metal-rich stars burn ^6Li very rapidly. [Deliyannis et al. \(2019\)](#) used astrometric data from *Gaia* to map the Li evolution of 333 stars. [Kallinger et al. \(2010\)](#) found that most of the RG stars had an initial composition that was similar to that of the sun.

2.3 Stellar pulsation

Variable stars are those which change their brightness or colour with time. They can be studied with photometric or spectroscopic methods. The light curves that are received from the variable stars provide useful information about brightness variation, possible period, and shape of the light curves ([Christensen-Dalsgaard, 2003](#)).

The spectrum provides information about star temperature and stellar luminosity. There are two types of variable stars. The first one is intrinsic variable stars. Their brightness changes due to changes in their physical properties. The intrinsic variables include pulsating, eruptive, and cataclysmic variables. The second main type of variable star is extrinsic, which is formed by external causes such as eclipsing and rotation. Eclipsing binaries and rotating variables are examples of extrinsic variable stars. The pulsating star expands and contracts, which affects the data that is received from its light curve ([Christensen-Dalsgaard, 2003](#)).

Studying the stellar pulsation is important for two reasons- firstly, to know the reason for and the mechanism of the pulsation, and secondly, to use it to estimate the general properties of the pulsating stars. Cepheid stars pulsate in a simple manner while other stars have complicated pulsations and more than one oscillation mode. The sun has the maximum number of modes. About $\simeq 10^6$ of the sun's modes can be estimated precisely ([Christensen-Dalsgaard, 1997](#)). The stellar oscillation can be studied by luminosity measurements or velocity measurements ([Kjeldsen and Bedding, 1994](#)). [Christensen-Dalsgaard and Frandsen \(1983\)](#) have provided a model for estimating the stellar amplitudes.

When the star pulsates only in one mode, it is easy to estimate its period accurately. For the stars that pulsate in a number of modes with a small amplitude, Fourier analysis has to be used to separate the frequencies. The oscillation can be radial or non-radial. The non-radial oscillation is characterised by the degree l , azimuthal order m , and the radial order n (Christensen-Dalsgaard, 1997).

2.3.1 Solar-like stars

The solar oscillation was observed for the first time by Leighton (1960). The sun has a fundamental oscillation that has a radial period of $\simeq 1$ hour with no nodes, and another oscillation of $\simeq 5$ minutes with 20-30 nodes. The solar oscillations are either acoustic p-modes or g-modes. The solar oscillation can be described by a harmonic oscillation $Y_l^m(\theta, \phi)$. Figure 2.4 shows the harmonic oscillations for different degrees (Christensen-Dalsgaard, 2003).

Kjeldsen and Bedding (1994) studied the power spectrum of the solar oscillation and found that the amplitude has a Gaussian distribution. The maximum value of the amplitude depends on the cut-off frequency (Kjeldsen and Bedding, 1994). The frequency of the maximum power (or amplitude) ($\nu_{\max}$), the large frequency separation ($\Delta\nu$), and the small frequency separation ($\delta\nu$) as shown in Figure 2.5

Stars with surface temperature < 7000 K and convection layers near the surface are expected to have solar-like oscillations (Gray and Nagel, 1989). There are several stellar instruments which have observed solar-like stars, such as The Wide-Field Infrared Explorer (WIRE) (Hacking et al., 1997; Buzasi et al., 2000), Microvariability and Oscillation of Stars Telescope (MOST) satellite (Walker et al., 2003; Matthews et al., 2004), and the *Kepler* satellite (Koch et al., 2010; Gilliland et al., 2010).

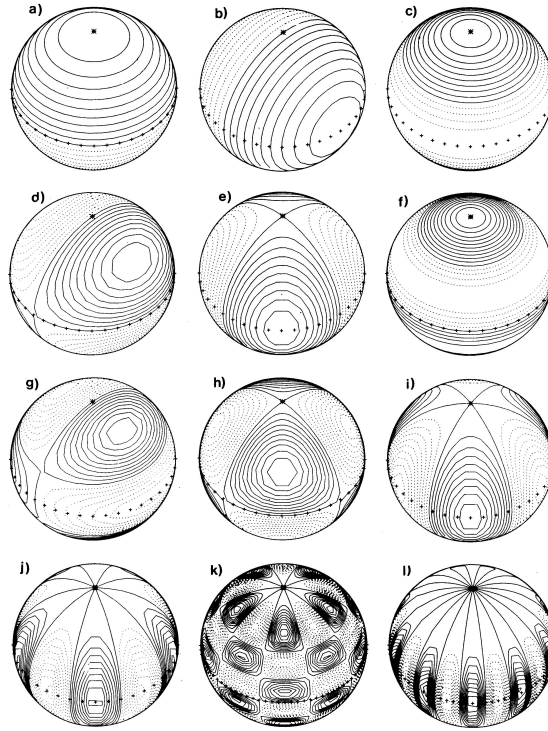


Figure 2.4: It shows some of the spherical harmonics for different values of l , while “++++” represents the equator, the continuous lines represent the positive contours, and the dashed lines represent the negative contours. a) $l = 1, m = 0$ b) $l = 1, m = 1$ c) $l = 2, m = 0$ d) $l = 2, m = 1$ e) $l = 2, m = 2$ f) $l = 3, m = 0$ g) $l = 3, m = 1$ h) $l = 3, m = 2$ i) $l = 3, m = 3$ j) $l = 5, m = 5$ k) $l = 10, m = 5$ l) $l = 10, m = 10$ (Christensen-Dalsgaard, 2003).

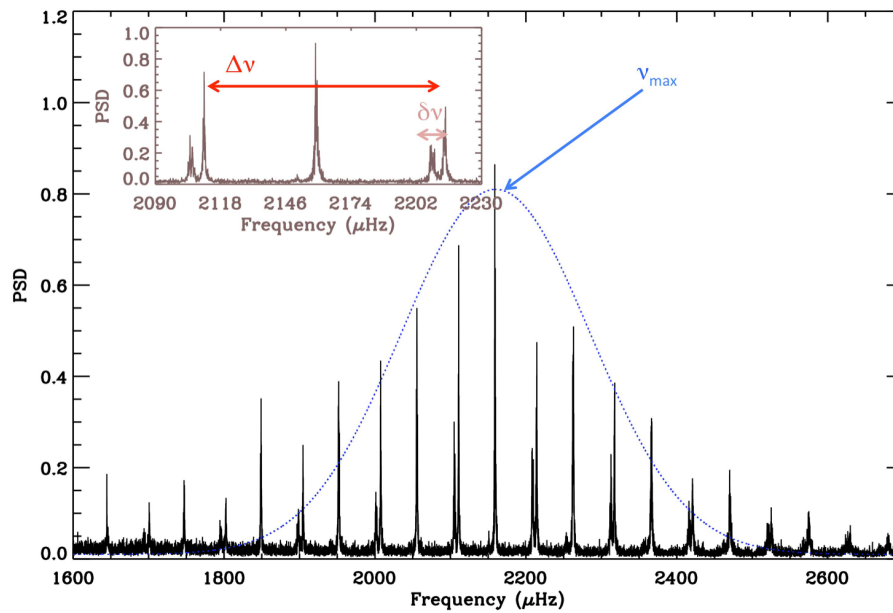


Figure 2.5: A periodogram shows the values of $\Delta\nu$ and $\nu_{\max}$ (García, 2015).

are the characteristics that we use to study stellar oscillations. The mentioned quantities are very useful in determining other stellar parameters when using the scaling relations (subsection. 2.3.3).

The stellar oscillation happens in the sun, low mass main-sequence stars, giants, and in the convection zones of supergiants. The stellar mass does not affect the metallicity of the star but it does affect the $\nu_{\max}$ and $\Delta\nu$ values (Hekker et al., 2011b).

2.3.2 RG oscillation

CoRoT and *Kepler* satellites (De Ridder et al., 2009; Bedding et al., 2010) have observed red giant stars with solar-like oscillations. *Kepler* data provided a lot of information on the oscillation of RG stars within the *Kepler* field. This oscillation has been studied in detail by Borucki et al. (2010), Bedding et al. (2010), Huber et al. (2010), Kallinger et al. (2010), and Stello et al. (2010).

It was proposed by Gray (1981) that the rotation of the K and G giants stars slow down due to the magnetic field which is followed by mass loss. The rotation of the core of the RG is faster than the rotation of their envelopes (Beck et al., 2012; Mosser et al., 2012b). Kitchatinov and Nepomnyashchikh (2019) applied a model to a sample of red giants from one solar mass and found the core's rate of rotation to be ten times faster than the envelope and that this rate increased with the increase in radius. They concluded that this differential rotation is due to the compact transmission of the angular momentum by the turbulent convection.

The convective envelope of the RC star is thinner than that of the RGB (Charbonnel et al., 2017). The convection in the outer layer of the RG stars excites the acoustic waves stochastically, which causes the appearance of the pressure mode in the spectra

(Vrard and Cunha, 2019). The regularity of this pressure mode is described by $\nu_{\max}$, and $\Delta\nu$. The spectra of the RG stars are considered to be a complex spectrum because they show p-modes and mixed modes (De Ridder et al., 2009). The mixed model in the RG stars was first detected by Bedding et al. (2010) using the asteroseismology from *Kepler data*. The oscillations modes are g-modes in the core and p-modes on the surface. This has been used to differentiate between RGB and RC stars (Beck et al., 2011; Bedding et al., 2011; Mosser et al., 2012b). When the values of the g- and p-modes are the same, the mixed mode takes place in red giant and sub-giant phases (Corsaro et al., 2012). Burning helium in the core of the star can be known by the dipole mode, as this changes due to the change in the core properties (Corsaro et al., 2012). The mixed modes have amplitudes lower than the p-modes alone (Mosser et al., 2012c).

Hon et al. (2019) studied 21000 RG stars which have been observed by *Kepler* space mission and identified the oscillation of 92% of that sample using *Kepler* and *Gaia* data. Carlberg et al. (2011) conducted a spectroscopic study of a sample of 1300 K giant stars and found that only 2% of this sample was rapidly rotating. Corsaro et al. (2012) found that the behaviour of $\delta\nu$ in the RC stars changes from one cluster to another.

2.3.3 Scaling relation

The stellar mass is one parameter that is essential in providing us with a better understanding of stellar physics and dynamics (Wang and Zhong, 2018). Estimating the stellar mass directly is a challenge. It can be estimated by its relation to other parameters, as shown in this subsection.

The scaling relations connect the asteroseismic quantities with stellar properties such as mass, radius, and luminosity. These relations are important to understanding the composition and evolution of the stars and the physics behind the stellar pulsation (Stello et al., 2011a).

Wang and Zhong (2018) modified the mass-luminosity relation for G & K binary stars in the main sequence phase. Torres et al. (2010) worked on binary non-interacting systems and came up with a relation to estimate the stellar mass accurately, which depended on the radial velocity. North et al. (2007) were able to calculate the mean density from the asteroseismic data and combined this with the radius in one relation to estimate the stellar mass of β Hydri stars. The magnitude of the star has been used in two previous studies to estimate the stellar mass. The mass-magnitude relation by Henry and McCarthy Jr (1993) was limited to stars with masses between 0.08-2 $M_{\odot}$ and V, J, H, and K stars. Benedict et al. (2016) used astrometry combined with radial velocity data to obtain a mass-magnitude relation, but this study was limited to 0.08-0.62 $M_{\odot}$ for V and K bands only. The first amplitude relation was used by Kjeldsen and Bedding (1994). Stello et al. (2011a) came up with a scaling relation for the amplitude, given by

$$A_{\lambda} = \frac{((L/L_{\odot})(M/M_{\odot}))^s}{\lambda/500nm (T_{\text{eff}}/5777K)^r} A_{500 \text{ nm}, \odot}, \quad (2.3.1)$$

where $s = 1$, $r = 1.5$, A_{λ} is the amplitude in intensity, λ is the central wavelength of the photometric bandpass, 5777 is the T_{eff} of the sun in K and $A_{500 \text{ nm}, \odot}$ is the amplitude in intensity of the sun at 500 nm. Then Zinn et al. (2019) assumed that

Eqn. (2.3.1) can be written as:

$$\sqrt{A_{\max}} = 2.5 (L/L_{\odot})^{0.9} (M/M_{\odot})^{-1.7} (T_{\text{eff}}/T_{\text{eff},\odot})^{-2.0} \quad (2.3.2)$$

Stello et al. (2011a) analysed the asteroseismic *Kepler* data for a sample of 100 solar-like red giant stars for the three open clusters NGC 6811, NGC 6791, and NGC 6819. They discovered a number of red giant binaries in NGC 6819 and NGC 6791. They used the study to improve the mass-luminosity relation and obtained Eqn. (2.3.3) which depends on the amplitude as well.

$$A_{\lambda} \propto L^s M^{-t} T_{\text{eff}}^{-2}, \quad (2.3.3)$$

where $s = 0.9 \pm 0.02$ and $t = 1.7 \pm 0.1$.

Balona et al. (2013b) were able to obtain three empirical formulas given by Eqn. (2.3.4) - Eqn. (2.3.6) to estimate the mass, radius, and the luminosity for each star.

$$\log M/M_{\odot} = -7.6056 + \frac{3}{2} \log T_{\text{eff}} + 3 \log \nu_{\max} - 4 \log \Delta\nu, \quad (2.3.4)$$

$$\log R/R_{\odot} = -1.1151 + \frac{1}{2} \log T_{\text{eff}} + \log \nu_{\max} - 2 \log \Delta\nu, \quad (2.3.5)$$

$$\log L/L_{\odot} = -17.274 + 5 \log T_{\text{eff}} + 2 \log \nu_{\max} - 4 \log \Delta\nu. \quad (2.3.6)$$

By using the solar values, the mass and the radius of solar-like stars can be determined by the direct method using the scaling relations or using statistical methods such as

the grid-based or Bayesian methods.

Another scaling relation given by Eqn. (2.3.7) is connecting the frequency of the maximum amplitude, the mass, the radius, and the effective temperature, was developed by (Kjeldsen and Bedding, 1994).

$$\nu_{\max} = \nu_{\max,\odot} \frac{M/M_{\odot}}{(R/R_{\odot})^2 \sqrt{T_{\text{eff}}/T_{\text{eff},\odot}}}, \quad (2.3.7)$$

where $\nu_{\max,\odot} = 3.05$ mHz and $T_{\text{eff},\odot} = 5777$.

Kallinger et al. (2010) studied the oscillations of a sample of RG from CoRoT and Eqn. (2.3.7) to develop a new scaling relation given by Eqn. (2.3.8) that depends on the large frequency separation.

$$\Delta\nu = \Delta\nu_{\odot} \sqrt{\frac{M/M_{\odot}}{(R/R_{\odot})^3}}. \quad (2.3.8)$$

Stello et al. (2009) and Huber et al. (2010) derived the following scaling relation as shown in Eqn. (2.3.9) which has no dependence on metallicity and no adiabatic effect.

$$\frac{\Delta\nu}{(\nu_{\max})^{0.75}} = \frac{\Delta\nu_{\odot}}{(\nu_{\max,\odot})^{0.75}} \left(\frac{M}{M_{\odot}} \right)^{-0.25} \left(\frac{T_{\text{eff}}}{T_{\text{eff},\odot}} \right)^{0.375}. \quad (2.3.9)$$

Miglio et al. (2012) developed the other three following scaling relations in Eqn.

(2.3.10) - Eqn. (2.3.12) for the stellar mass estimation.

$$\frac{M}{M_{\odot}} \simeq \left(\frac{\Delta\nu}{\Delta\nu_{\odot}} \right)^2 \left(\frac{L}{L_{\odot}} \right)^{3/2} \left(\frac{T_{\text{eff}}}{T_{\text{eff},\odot}} \right)^{-6}, \quad (2.3.10)$$

$$\frac{M}{M_{\odot}} \simeq \frac{\nu_{\text{max}}}{\nu_{\text{max},\odot}} \frac{L}{L_{\odot}} \left(\frac{T_{\text{eff}}}{T_{\text{eff},\odot}} \right)^{-7/2}, \quad (2.3.11)$$

$$\frac{M}{M_{\odot}} \simeq \left(\frac{\Delta\nu}{\Delta\nu_{\odot}} \right)^{12/5} \left(\frac{\nu_{\text{max}}}{\nu_{\text{max},\odot}} \right)^{-14/5} \left(\frac{L}{L_{\odot}} \right)^{3/10}. \quad (2.3.12)$$

Later, [Stello et al. \(2011b\)](#) derived the other two scaling relations given by Eqn. (2.3.13) - Eqn. (2.3.14) to use the asteroseismic data ($\Delta\nu$ and ν_{max}) to obtain the stellar mass.

$$\nu_{\text{max}} \simeq \frac{M/M_{\odot} (T_{\text{eff}}/T_{\text{eff},\odot})^{3.5}}{L/L_{\odot}} \nu_{\text{max},\odot}, \quad (2.3.13)$$

where $T_{\text{eff},\odot} = 5777$ K and $\nu_{\text{max},\odot} = 3100$ μHz .

$$\Delta\nu \simeq \frac{(M/M_{\odot})^{2.5} (T_{\text{eff}}/T_{\text{eff},\odot})^3}{(L/L_{\odot})^{0.75}} \Delta\nu_{\odot}, \quad (2.3.14)$$

where $\Delta\nu_{\odot} = 135$ μHz . [Christensen-Dalsgaard and Frandsen \(1983\)](#) suggested a scaling relation that combined the radial velocity magnitude with the mass and luminosity of the near-main sequence stars.

[Stello et al. \(2007\)](#), [Dupret et al. \(2009\)](#), [Mosser et al. \(2010\)](#), [Montalbán et al. \(2010\)](#), [Di Mauro et al. \(2011\)](#), and [Baudin et al. \(2011\)](#) tried to get the best mass-luminosity exponent relation for RG stars. They found the average mass of the open cluster

NGC 6819 to be $1.68 \pm 0.03 M_{\odot}$. In their paper, they derived the mass-luminosity relation as

$$\frac{L}{M} \propto \frac{T_{\text{eff}}^{7/2}}{\nu_{\text{max}}} \quad (2.3.15)$$

Rodrigues et al. (2017) used $\Delta\nu$ and ΔP , which have been evaluated using the grid and the stellar isochrones and Bayesian method to estimate some stellar parameters such as mass and age. They got relations as shown in Eqn. (2.3.16) and Eqn. (2.3.17) which were used to determine the mass and the radius of the star as a function of ν_{max} , $\Delta\nu$ and the effective temperature.

$$\Delta\nu \propto \rho^{-0.5} \propto M^{0.5}/R^{1.5}, \quad (2.3.16)$$

$$\nu_{\text{max}} \propto g T_{\text{eff}}^{-0.5} \propto (M/R^2) T_{\text{eff}}^{-0.5}. \quad (2.3.17)$$

Using the previous scaling relations in Eqn. (2.3.7) and Eqn. (2.3.8), they obtained Eqn. (2.3.18),

$$24 \log \nu_{\text{max}} = 28 \log \Delta\nu + 10 \log M - 3 \log L. \quad (2.3.18)$$

They also obtained a relation between the bolometric magnitude, luminosity and distance modulus. According to the literature, before Bellinger (2020), there was no scaling relation to estimate the age of the RG stars. Bellinger (2020) used a sample of 1000 RG stars to derive precise scaling relation for age determination and mass-radius relation.

2.4 NGC 6819

Observing the galaxies shows that there are groups of stars moving together. The stars in the one group have the same chemical composition and age which means they are formed from the same nebula. These groups of population have different types according to their masses, types of stars, and the distribution of the stars (appearance) in the sky. OB-associated groups and embedded star clusters are examples of the clusters while the main two types in our Galaxy are the globular cluster and the open cluster (Freeman et al., 1985).

An open cluster is a group of relatively loose stars and its number of stars is fewer compared to a globular cluster. They are called Galactic Clusters because they are found in the galaxy disk (Abell et al., 1987). They were first observed by the naked eye then, by the Galileo Galilei telescope (Maran and Marschall, 2009). The first open cluster catalog was by Lynga (1982). The range of age and distance that the open clusters cover is wide (Friel, 1995). Studying the open cluster properties helps to obtain more information about the structure, dynamics, and chemical composition of the Milky Way (Moraux, 2016). The stars in the open clusters are formed from the same cloud, so they have the same age and initial composition. For this reason, the stellar parameters which have been estimated from the stellar cluster are more precise than the ones that have been estimated for a single star (Stello et al., 2011a; Slumstrup et al., 2017; Rangwal et al., 2019). The members of the star cluster have common properties, which helps astrophysicists to develop models to describe the clusters and estimate the stellar parameters (Wu et al., 2014a). The open clusters provide information about the Galactic disk such as the chemical composition, average

age, initial mass, and distance (Mayor, 1976; Panagia and Tosi, 1981; Friel, 1995; Luhman et al., 2000). For studying the cluster better, it is important to identify its members and estimate its parameters, in particular age, distance, metallicity, and reddening (Rangwal et al., 2019).

Rangwal et al. (2019) combined the photometric and astrometric data to study three open clusters. They defined the clusters' membership using the kinetic properties of the clusters and the colour-magnitude diagram. Kharchenko et al. (2013) listed 30006 stellar objects, most of them being open clusters. They determined the cluster center position, the apparent size, proper motion, and age of each confirmed cluster. The highly precise kinematic properties were needed to distinguish between the cluster members and the field stars (Rangwal et al., 2019). Kharchenko et al. (2013) were able to estimate the radial velocities for more than 30% of the confirmed clusters. Bica and Bonatto (2011) studied 15 challenging stellar targets, and eight of them were found to be open clusters. NGC 6819 and 18 other open clusters have been observed in our Milky Way Galaxy by JSKI (Kalirai et al., 2001).

NGC 6819 is one of the four clusters that lie within the *Kepler* field (Meibom et al., 2011). It is considered a good target to study due to the members' brightness, metallicity, which is close to the metallicity of the sun, and available data from the *Kepler* satellite. Platais et al. (2013) studied the proper motion and membership of the cluster for a sample of 15750 stars. They calculated the average proper motions to be -2.6 ± 0.5 the value of the proper motion in RA and -4.2 ± 0.5 mas/yr the value of the proper motion in Dec. Several researchers have tried to study the cluster using the data that was provided by the *Kepler* mission. Some studies (eg: Uytterhoeven et al. (2010) and Molenda-Żakowicz et al. (2010)) attempted to estimate the stellar param-

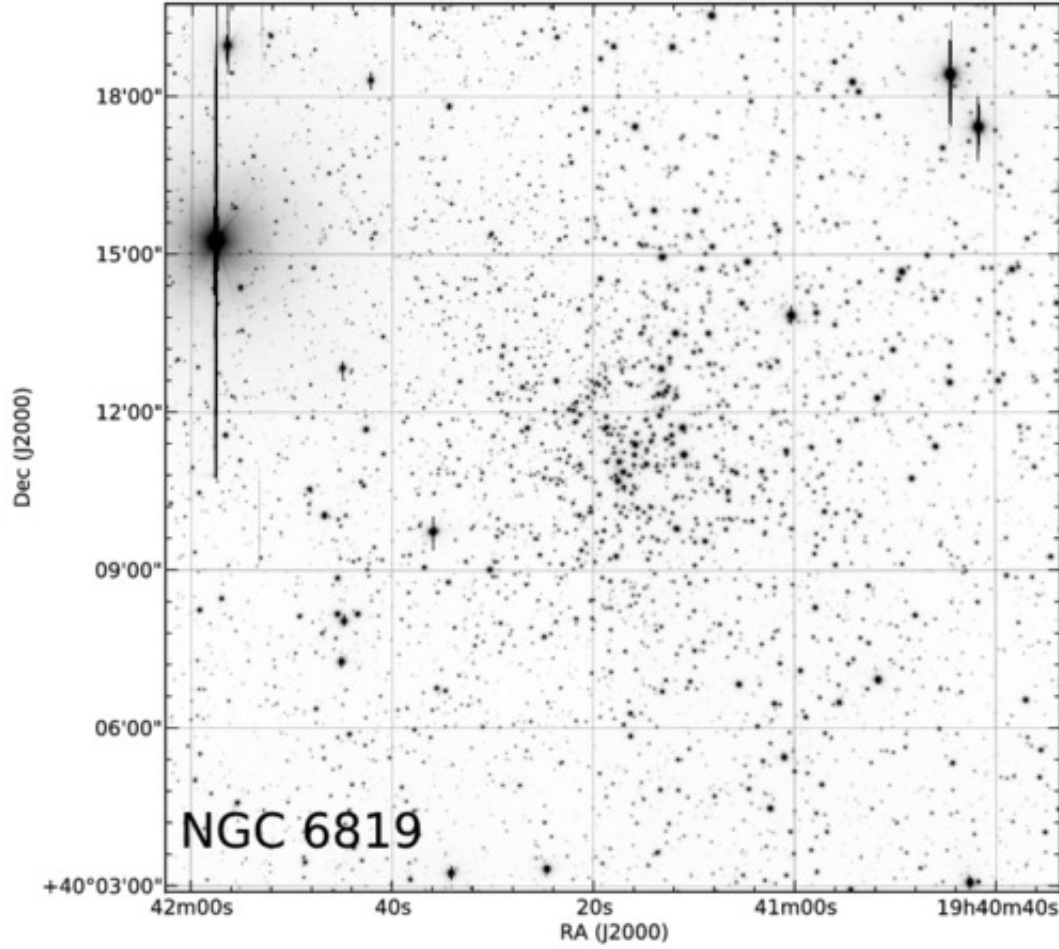


Figure 2.6: The open cluster NGC 6819 as observed from a field of view 17 arcmin on a side. North is up, East to the left (Carraro et al., 2013).

eters such as T_{eff} , L , $\log g$ and Z precisely using the asteroseismic data from the *Kepler* satellite. Likewise, Stello et al. (2010) presented an asteroseismic study for NGC 6819 using the first *Kepler* data. However, the *Kepler* data was not accurate enough to obtain reliable global oscillation parameters. It was able to observe objects in a field of a 105-square degree in the direction of Cygnus and Lyra. Hekker et al. (2011a) used the asteroseismic parameters and T_{eff} to estimate the mass, radius, and luminosity for the three *Kepler* open clusters NGC 6791, NGC 6811, and NGC 6819. They found that

the mass was strongly dependent on $\Delta\nu$ and $\nu_{\max}$, while the metallicity did not affect it much. However, the stellar mass and metallicity affect do the position of the stars on the HR diagram, especially for the old NGC 6791 and the middle-aged NGC 6819 open clusters.

Handberg et al. (2016) used the asteroseismic *Kepler* data for 50 solar-like red giants to derive the stellar parameters of the open cluster NGC 6819. They used the values of the bolometric correction from Casagrande and Vandenberg (2014) to estimate the distance modulus and the effective temperature. Jørgensen et al. (2020) constructed a grid for modeling NGC 6819 with masses between 0.7 and 2.5 $M_{\odot}$ in a step of 0.02 $M_{\odot}$ and metallicity between -2.7 and 0.2 dex with step 0.10 and 0.15 dex. They checked the best-fit model using χ^2 technique. Jørgensen et al. (2020) used the asteroseismic data to compare the different relations of the surface correction.

2.4.1 NGC 6819 properties

Yang et al. (2012) studied the CMD of the cluster and fitted two isochrones with different metallicities, as shown in Figure 2.7, and obtained the values of 12.36 mag for the distance modulus, 2.6 Gyr for the cluster age, 3542.4 $M_{\odot}$ of the cluster tidal mass, and $\langle M_C \rangle \sim 2700 M_{\odot}$. They also used three algorithms (DAOPHOT II, four-quadrants method, Monte Carlo) to identify the center of the cluster and they obtained $RA = 19 : 41 : 17.5$ and $Dec = +40 : 11 : 47$ which agreed with Hole et al. (2009) results. The age of the cluster has been estimated by Basu et al. (2011) to be 2-2.4 Gyr. Meibom et al. (2015) used a sample of 300 cool stars to determine the age of NGC 6819 with the gyrochronology, method based on the stars' rotation periods and masses.

Kalirai et al. (2008) used the metallicity and age of NGC 6819 to derive the initial and final mass relation. In the center of the NGC 6819 open cluster, the density distribution of the upper main sequence and giant stars is high. Based on a study which was done by Hole et al. (2009), they chose the star members in this study using the radial velocity. They used the scaling relations in Eqn. (2.3.7) by Kjeldsen and Bedding (1994) to estimate the stellar mass and radius of the cluster's members.

Bragaglia and Tosi (2006) used three different models, namely the Bressan, Bertelli & Chiosi (BBC), the Frascati Raphson Newton evolutionary code (FRA), and the Full Spectrum Turbulence (FST) to derive the age, distance modulus, and reddening of the cluster. The value of the estimated radius in that study was $9'.5$

Kalirai and Tosi (2004) used three different models to estimate the cluster parameters- FST with $\zeta = 0.03$, age of 2.30 ± 0.15 Gyr, the Frascati Raphson Newton Evolutionary Code (FRANEC) with an age rang 1.6-1.8 Gyr, and the BBC94 model by choosing the age to be 2 Gyr. The values of the distance moduli corresponding to each model were 12.0, 12.0, and 12.2 and the reddening values 0.10, 0.15, and 0.12, respectively. The three models were not accurate enough to describe the CMD of the cluster because they did not consider any mass loss. Their study found that the present number of stars in NGC 6819 is less than the formed number. They also found that the cluster is metal-rich ($Z = 0.02$). Other properties of the cluster that were evaluated in that study are the angular diameter = 19 arcmin, the linear diameter = 15.2 pc, the cluster mass = $4000 M_{\odot}$, the cluster's age= 2 Gyr, and $(m-M) = 12.20$ mag.

Külebi et al. (2013) used correlation of the proper motion of the Magnetic White Dwarf (MWDs) with the cluster's proper motion to identify the membership. They

chose $E(B-V) = 0.10-0.14$ and obtained the value of 12.3 ± 0.12 mag to be the distance modulus. In addition to this, they presented a detailed study of the white dwarfs in NGC 6819.

Before *Gaia*, information on the open clusters was limited. The *Gaia* space mission is revolutionary in the astrophysics. [Castro-Ginard et al. \(2018\)](#) and [Cantat-Gaudin et al. \(2018a\)](#) used *Gaia* DR2 data to study new open clusters in our Galaxy. [Cantat-Gaudin et al. \(2018b\)](#) obtained the membership, proper motion, and parallax of NGC 6819 and 127 other open clusters using TGAS combined with the fourth U.S. Naval Observatory of the charged coupled device (CCD) Astrograph Catalog (UCAC4) and the Two Micron All-Sky Survey (2MASS), and by applying the Bayesian/Markov Chain Monte Carlo technique. [Cantat-Gaudin et al. \(2018a\)](#) used UPMASK code on the data from *Gaia* DR2 to obtain some parameters for 1229 open clusters and redefine their members. This study was limited to sources brighter than $G \sim 18$. The mean distance and proper motions of the 1229 open clusters have been estimated in [Cantat-Gaudin et al. \(2018a\)](#). The average parallax of NGC 6819 in that study was 0.356 mas. [Bossini et al. \(2019\)](#) improved the members of NGC 6819 and 268 other open clusters and determined their parameters using *Gaia* DR2. They chose the open clusters located within 4.5 kpc with *Gaia* magnitudes G , G_{BP} (for blue photometry), and G_{RP} (for red photometry) and derived their age, distance, and extinction by the isochrone fitting using Bayesian Analysis for Stellar Evolution with Nine Parameters (BASE-9). [Soubiran et al. \(2018\)](#) derived the kinematics of 861 open clusters using *Gaia* data. NGC 6819 was one from that sample, and they found the mean radial velocity to be 3.31 ± 0.28 km/s.

The grid-based method is one of the methods that can be used to determine the

stellar mass, radius, and age by comparing the observed parameters $\nu_{\max}$, $\Delta\nu$, T_{eff} and the metallicity to the corresponding values which have been calculated from the stellar evolution theoretical model (Hekker and Basu, 2019). Hekker and Basu (2019) verified the effect of the uncertainty of T_{eff} on the age determination of the RG using the grid-based method.

Anthony-Twarog et al. (2014), analysed the CCD on vbyCaH β data to estimate the parameters of NGC 6819 and the proper motion to define the membership of the cluster. The cluster's reddening was $E(B - V) = 0.160 \pm 0.007$, the metallicity $[\text{Fe}/\text{H}] = -0.116 \pm 0.101$, the age $= 2.3 \pm 0.2$ Gyr, and the distance modulus $(m - M) = 12.40 \pm 0.12$ mag.

The spectroscopic analysis was another method for studying the NGC 6819 open cluster. Slumstrup et al. (2017) analysed the spectroscopy of NGC 6811, M67, NGC 182, and NGC 6819. They found that these clusters have metallicity close to solar metallicity. Slumstrup et al. (2017) used signal-to-noise ratio N/O spectroscopic data from Nordic Optical Telescope (NOT) and Keck I telescope to obtain the stellar parameters of the four mentioned open clusters. They used Eqn. 2.4.1 to estimate $\log g$, which was 2.55 ± 0.02 , $[\text{Fe}/\text{H}] = -0.02 \pm 0.01$, $[\alpha/\text{Fe}] = -0.02 \pm 0.02$ and $Y/\text{Mg} = 0.08 \pm 0.03$.

$$\log g = \log \left(\frac{\nu_{\max}}{3100} \left[\frac{T_{\text{eff}}}{5777} \right]^{0.5} \right) + 4.44. \quad (2.4.1)$$

Sandquist et al. (2012) studied the parameters of binary stars in NGC 6819 and used the χ^2 method to find the best-fit model. They found the average stellar mass in the cluster to be $1.68 \pm 0.05 M_{\odot}$ using the grid-based method.

One method for estimating the distance modulus is to use red clumps as candles, as in [Garnavich et al. \(1994\)](#). It can also be estimated with the direct method ([Basu et al., 2011](#); [Miglio et al., 2012](#); [Balona et al., 2013b](#)). [Brogaard et al. \(2011\)](#) and [Jeffries Jr et al. \(2013\)](#) used binary systems to drive the distance moduli of the clusters and a period-luminosity relation of pulsators. The distance modulus by [Jeffries Jr et al. \(2013\)](#) was 12.00 ± 0.05 mag and the reddening 0.12 ± 0.03 .

[Friel and Janes \(1993\)](#) studied the spectroscopics of 24 open clusters, of which NGC 6819 was one. They estimated the main parameters of the cluster, including age, metallicity, and reddening. $[\text{Fe}/\text{H}] = +0.05$ was the estimated value of the metallicity. Later, [Friel et al. \(2002\)](#) presented another spectroscopic study for 39 open clusters. For the NGC 6819, the metallicity was -0.11 and the reddening 0.16 .

The first determination of the metallicity of the open cluster NGC 6819 was $[\text{Fe}/\text{H}] = -0.1$ ([Friel et al., 1989](#)) by studying the CCD spectra of a sample of giant stars in this cluster and 12 other clusters. Then, it was corrected to $[\text{Fe}/\text{H}] = +0.05 \pm 0.11$ ([Friel and Janes, 1993](#)). Using the same CCD spectra data, the metallicity was $+0.07 \pm 0.05$ ([Twarog et al., 1997](#)). [Bragaglia et al. \(2001\)](#) found $[\text{Fe}/\text{H}] = +0.09 \pm 0.03$ and the reddening 0.142 ± 0.044 by studying the spectra of three RC stars in NGC 6819 using the high resolution spectrograph (SARG). The different values of the NGC 6819 metallicity are due to developing the astronomical tools and choosing bigger samples in each new study. The estimated $\log g$ for the 3 RC stars was 2.3 and the average reddening was 0.142 ± 0.044 . [Basu et al. \(2011\)](#), used the asteroseismological data to study the distance modulus of the cluster and found that for the same metallicity, the distance modulus changed with the changing reddening values as seen in Table 2.2.

Rosvick and Vandenberg (1998) used the BV photometry of a sample of stars and a theoretical isochrone to find the metallicity of the cluster $[\text{Fe}/\text{H}] = -0.05$, $(m-M) = 12.35$ mag, and the reddening 0.16. Meibom et al. (2015) found the reddening $E(B - v)_o$ has range = 0.41-0.89 for period range 4.4-23.3 d and mass range $0.85\text{-}1.4 M_{\odot}$.

Balona et al. (2013b) and Wu et al. (2014b) found the value of the distance modulus of NGC 6819 to be $11.8 \simeq 12$ mag by using the asteroseismic *Kepler* data and the scaling relations given in Eqn. (2.3.4) - Eqn. (2.3.6). Abedigamba (2015) also used the asteroseismic *Kepler* data for a sample of RC stars and obtained the distance modulus of values 11.52 ± 0.105 mag and 11.747 ± 0.086 mag for different values of the extinction (A_v).

$(m - M)_0$ mag	Reference
12.35	Rosvick and Vandenberg (1998)
12.0	Kalirai and Tosi (2004) (FST)
12.0	Kalirai and Tosi (2004) (FRANEC)
12.2	Kalirai and Tosi (2004) (BBC94)
11.85 ± 0.05	Basu et al. (2011)
12.36	Yang et al. (2012)
12.3 ± 0.12	Külebi et al. (2013)
12.00 ± 0.05	Jeffries Jr et al. (2013)
$11.8 \simeq 12$	Balona et al. (2013b) and Wu et al. (2014b)
11.88 ± 0.14	Wu et al. (2014a)
11.52 ± 0.105	Abedigamba (2015)
11.747 ± 0.086	Abedigamba (2015)
11.9	Rodrigues et al. (2017)

Table 2.1: A summary of the distance modulus values from the literature.

Hekker et al. (2011a) evaluated the apparent magnitude, which was 12.32 ± 0.02 mag. Wu et al. (2014a) used solar-like RGB stars to determine the distance modulus of NGC 6791 and NGC 6819 and the value was found to be 11.88 ± 0.14 mag for NGC 6819 using the asteroseismic parameters $\Delta\nu$ and ν_{max} . They also found a correlation between

E(B-v)	$(m - M)_0$ mag
0.15	11.85 ± 0.05
0.10	11.87
0.20	11.83

Table 2.2: The values of the distance moduli for different reddening values and the same metallicity was $[\text{Fe}/\text{H}] = +0.09$ (Basu et al., 2011).

E(B - V)	Refrence
0.12	Burkhead (1971)
0.30	Lindoff (1972)
0.28	Auner (1974)
0.15	Canterna et al. (1986)
0.28	Friel and Janes (1993)
0.16	Rosvick and Vandenberg (1998)
0.142 ± 0.044	Bragaglia et al. (2001)
0.16	Friel et al. (2002)
0.10	Kalirai and Tosi (2004) (FST)
0.15	Kalirai and Tosi (2004) (FRANEC)
0.12	Kalirai and Tosi (2004) (BBC94)
0.12 ± 0.03	Jeffries Jr et al. (2013)

Table 2.3: A summary of the reddening values in the literature.

the distance modulus and the metallicity of the cluster. Other values of the distance modulus was determined by Handberg et al. (2017) as $(m-M) = 12.43 \pm 0.01$ mag and by Sandquist et al. (2012) and Brogaard et al. (2015) as the value of 12.42 ± 0.07 mag.

Hekker et al. (2011a) obtained the average mass $1.4 < M/M_{\odot} < 2.1$ and $5 < \nu_{\text{max}} < 15 \mu\text{Hz}$ for NGC 6819. They noted that NGC 6819 has stars with higher masses than that of the old cluster NGC 6791.

Heinke et al. (2020) considered NGC 6819 as low-density cluster. They calculated the

density of the cluster to be $54 M_{\odot}/pc^3$ using $2600 M_{\odot}$ as the mass of the cluster, which is considered to be low-mass cluster (Kalirai et al., 2001), and $2.25 pc$ to be the radius Gosnell et al. (2011). Deliyannis et al. (2019) also estimated the luminosity of the cluster to be $0.012 \pm 0.006 L_{\odot}$. The stellar interaction rate in NGC 6819 is 2×10^{-7} . There is a probability for finding the Neutron Star Low Mass. X-ray Binaries (NSLMXBs) in NGC 6819 (Heinke et al., 2020).

For 332 star members of NGC 6819, the Wisconsin-Indiana-Yale-NOAO (WIYN)/HYDRA spectra have been obtained in Li 7608 $\text{\AA}$. By analysing these spectra, they found a Li depletion from the top of the turn to the base of the RGB. They discovered Li-rich giants in NGC 6819. The cluster spectra covers a wavelength of 6550 to 6840 $\text{\AA}$ and a pixel resolution of $0.5 \text{\AA} = 2.7$. The effective temperature, $\log g$, the microturbulent velocity (v_t), $[\text{Fe}/\text{H}]$, reddening, distance modulus, and age are the parameters which affect the Li abundance value (Anthony-Twarog et al., 2013).

Rodrigues et al. (2017) used the magnitudes of the Sloan Digital Sky Survey (SDSS) and the W1 and W2 filters from the Wide-field Infrared Survey Explorer (WISE) telescope JHKs to estimate the mean distance $\mu_0 = 11.9 \pm 0.04 \text{ mag}$ and $A_v = 0.475 \pm 0.003 \text{ mag}$. They also estimated the mean age to be $2.22 \pm 15 \text{ Gyr}$ (extinctions in the V-band). They used T_{eff} , $[\text{Fe}/\text{H}]$, $\Delta\nu$ and ν_{max} to estimate the parameters of 52 stars and another 20 stars using their period spacing (ΔP). Rodrigues et al. (2017) also redefined the members of the clusters and excluded three stars as non-members. They predicted that adding the luminosity from *Gaia* parallax with $\Delta\nu$ will allow us to deduce the mass by 5% to 15% independently on ν_{max} .

Basu et al. (2011) studied the two open clusters NGC 6791 using a sample of 34 RG

stars and 21 in NGC 6819. They used *Kepler* data to derive the stellar mass and radii of the stars in each cluster and studied their oscillations. They found the value of the distance modulus of NGC 6819 to be $(m - M)_0 = 11.85 \pm 0.05$ mag.

The summary of the distance modulus values in Table 2.1 shows that the values range from 11.7 mag to 12.36 mag, while Table 2.3 shows that the values of the reddening were between 0.1 and 0.30.

2.4.2 RG in NGC 6819

Rodrigues et al. (2017) estimated individual masses and ages for 52 RC stars in NGC 6819. They also estimated the mean mass of RGB to be $1.61 \pm 0.04 M_\odot$ and the mean mass of RC to be $1.62 \pm 0.03 M_\odot$, which agreed with Miglio et al. (2016) and Handberg et al. (2016). The average mass of the RG stars in NGC 6819 was estimated by Basu et al. (2011) to be $1.68 \pm 0.03 M_\odot$. Yang et al. (2012) found that $V \sim 1.5$ mag for the RGB stars and $V \sim 13$ mag for the RC stars as shown in Figure 2.7. Hekker et al. (2011a) studied the magnitude of the RG stars in NGC 6819 and found it to be $13.5 < V_{RG} < 14.3$.

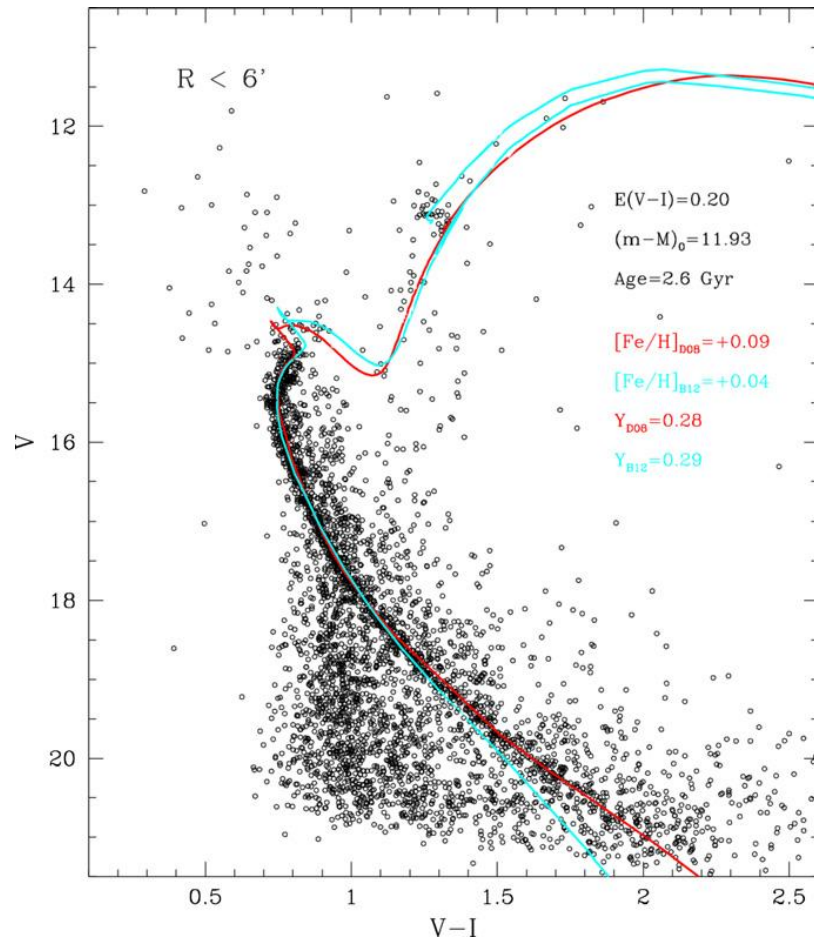


Figure 2.7: CMD ($R < 6'$) reveals the cluster. The two strong lines are the theoretical isochrones. The red one produced from Dartmouth Stellar Evolution Database (Dotter et al., 2007, 2008) while the blue one from PAdova & TRieste Stellar Evolution Code (Bressan et al., 2012). They both represent the best-fitting isochrones for the open cluster NGC 6819 (Yang et al., 2012)

Street et al. (2003) analysed the light curves of more than 38000 stars in the NGC 6819 field. They found that 20.3% of the sample consists of variable stars, three of them showed single eclipsing and eight stars have short duration transits like eclipsing, and another 67 stars could not be explained (Aerts et al., 2010; Chaplin and Miglio, 2013).

Jørgensen et al. (2020) derived the mean mass and other stellar parameters for 19 RGB which were NGC 6819 members with $[\text{Fe}/\text{H}] = 0.02 \pm 0.1$ dex.

The average mass of the RGB in NGC 6819 has been calculated to be $1.61 \pm 0.02 M_{\odot}$ by Handberg et al. (2017) and Miglio et al. (2012), 1.61 ± 0.01 (Jørgensen et al., 2020), and $1.55 \pm 0.06 M_{\odot}$ (Sandquist et al., 2012; Brogaard et al., 2015).

Corsaro et al. (2012) studied the asteroseismology of NGC 6819 and three other clusters using a sample of RG stars. They found that the value of the phase shift (ϵ) is lower in RC than RGB at $\Delta\nu = 4.8 \mu\text{Hz}$ and at the same $\Delta\nu$, the average small spacing of RC star is different from that of the RGB.

2.5 Mass loss in stars

In the 1980s, astrophysicists began to consider the mass loss of stars as an interesting research gap to work on. They found that the bigger the mass, the faster and the more mass it loses. The very low-mass stars do not evolve to the advanced evolutionary phases (Abbott et al., 1981; Falk and Mitalas, 1981).

It so happens that the stars lose mass during their evolution for different reasons. It takes place in the RGB stars (Handberg et al., 2017) stars, the AGB stars (Schönberner, 1983), and the T Tu stars (Cohen et al., 1982).

The stars with masses from $1-10^{-4} M_{\odot}$ tend to lose mass in the RGB before the He flash. The envelopes of these stars have a low H mass. These H atoms move by convection to the He-burning region and fuse into He. As a result, the amount of H

increase and the He increase in the star which makes these stars lose the mass of their envelope either by transferral, ejection, or stellar wind due to the rotation (Paczynski, 1976; Sweigart, 1997; Han et al., 2003).

The first empirical formula given by Eqn. (2.5.1) that can be used for estimating the rate of the mass loss in the RGB stars was presented by Reimers et al. (1975)

$$\dot{M} = 4 \times 10^{-13} \eta L M^{-1} R, \quad (2.5.1)$$

where η is the mass loss efficiency (Reimers) parameter.

The mass-loss is at its highest rate in the red giant phase. The mass loss rate varies from one star to another which forms the variation in stars' luminosities at the tip of the RGB phase (Schönberner, 1983). The luminosity of the TRGB changes by less than 0.1% due to the increase of the stellar mass which was a result of the overflow of the gas giant planet and 0.5% by the metallicity (Jimenez et al., 2020). Jimenez et al. (2020) assumed that the mass loss happens due to environmental (external) effects .

Vink (2011) predicted the mass loss in stars with masses 60-300 $M_{\odot}$. They were able to produce a mass-rate relation as a function of luminosity/mass (L), star metallicity (Z), and the effective temperature. There is a correlation between rotation and mass loss which affects the properties, the stellar evolution, and fate of massive stars (Zhao and Fuller, 2020). The mass loss in single stars occurs as a result of the driven winds (Castor et al., 1975; Vink and Gräfener, 2012; Gräfener et al., 2012; Owocki, 2014).

Ge et al. (2020) constructed a thermal equilibrium mass-loss (slow mass-loss rate)

model. It is challenging to compare the stars before the RC phase to any model due to the non-negligible mass loss. The highest rate of mass loss happens at the tip of the RGB stars, which changes change their luminosities (Jimenez et al., 2020). This rate varies from one star to another (Jimenez et al., 2020). The He-core mass of the RGB has an impact on the luminosity, which affects the mass-loss rate (Fusi-Peccì and Renzini, 1976).

Studying the mass loss and deducing the initial to the final mass relation is important in studying the stellar populations (Külebi et al., 2013). Handberg et al. (2017) derived the stellar parameters for 54 RGs in NGC 6819, and managed to distinguish between RGB and RC. They estimated the mass loss at the RGB phase by the direct method and with asteroseismic data. The value of the mass loss was $= -0.03 \pm 0.01 M_{\odot}$. Abedigamba et al. (2015) used the asteroseismic data and χ^2 minimisation method and found a value of $-0.027 \pm 0.033 M_{\odot}$. The results from the two previous pieces of research were not significant (negative values). In this work, the recently released astrometric data from *Gaia* will be used to study mass loss for the first time.

3. Data and Methods

This chapter discusses the data (astrometric and asteroseismic) sources, method of data reduction, method of defining astrometric cluster membership, studying the stellar properties of the open cluster NGC 6819, and finally, the techniques of estimating the mass loss at the TRGB.

3.1 Data

3.1.1 Astrometric data

The astrometric data depends on the positions of the stars which are represented in the Right Ascension (RA), Declination (Dec), and the distance, which equals the inverse of the parallax ($\frac{1}{\varpi}$), and kinematics that characterised by the proper motions, the transverse velocities, and parallaxes (Gaia Collaboration et al., 2016).

Centuries before, the astronomers tried to estimate the stellar parallax using fundamental tools (Toomer, 1974). The first telescope that observed astrometric data from 1989 to 1993, was the Hipparcos space mission. It provided astrometric data for more than 100000 stars of magnitudes brighter than 13 mag in the B filter (Perryman, 1986).

The proper motion is the apparent angular motion of the star with respect to another star (Tucker, 1921), while the parallax (ϖ) is the angle that resulted from the intersection of the two lines that represent two different positions on the stellar object as

shown in Figure 3.1 (Tucker, 1921; Lang, 2013).

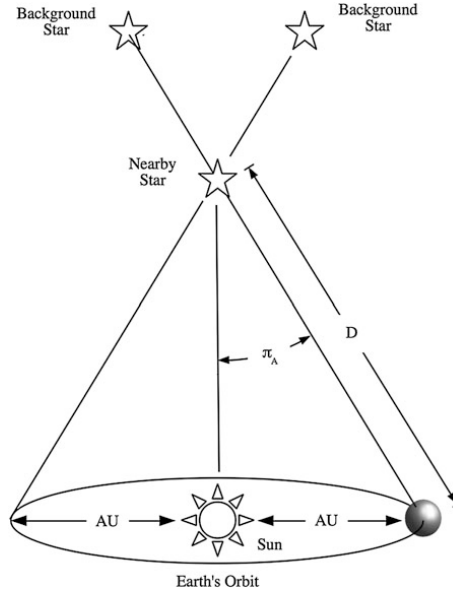


Figure 3.1: Annual parallax. Taken from Lang (2013).

3.1.1.1 *Gaia* luminosity and effective temperature (T_{eff})

All the parameters that were estimated in *Gaia* DR2 were developed using *Gaia* data only. The observed objects had a magnitude $G = 17$ (faint objects). The luminosity in *Gaia* DR2 was calculated by obtaining the absolute G band magnitude using Eqn. (3.2.1) then converting it into luminosity using Eqn. (3.1.2) (Andrae et al., 2018).

$$M_G = G - 5 \log_{10} r + 5 - A_G, \quad (3.1.1)$$

where r is the distance $= \frac{1}{\varpi}$.

$$-2.5 \log_{10} \mathcal{L} = M_G + BC_G(T_{\text{eff}}) - M_{\text{bol}\odot}, \quad (3.1.2)$$

$M_{\text{bol}\odot}$ is the solar bolometric magnitude $= 4.74$ mag, $BC_G(T_{\text{eff}})$ is the temperature-dependent bolometric correction in (mag) unit and $\mathcal{L}$ is the luminosity in the units of the $\mathcal{L}_{\odot}$.

Gaia T_{eff} was estimated using the ExtraTrees regression (Andrae et al., 2018).

By choosing the center of the open cluster NGC 6819 at RA = 19 : 41 : 18, Dec = 40 : 11 : 12 (BERTONE and Ch´avez, 2015) and a radius of 12 arcminutes, *Gaia* DR2 data was downloaded from VizieR^a as shown in Figure A.38. The figure shows the default setting of the website before selecting the necessary columns. Choosing the radius of 12 arcminutes gave the chance to check the probability of a large number of stars to be new members of the NGC 6819 open cluster.

Gaia DR2 offers 101 columns of data and errors. This data is based on 22 months of data collection which is much longer than the collection period of *Gaia* DR1 (14 months). The source detection in *Gaia* DR2 is much cleaner than that of *Gaia* DR1. In *Gaia* DR1, the detection was based on matching the nearest source, while that of *Gaia* DR2, is based on the direct detection of the source. The RMS has been reduced from 0.67 in *Gaia* DR1 to 0.2 – 0.3 in *Gaia* DR2 due to the improvement of the astrometric models. *Gaia* DR2 observed a larger sample of stars than *Gaia* DR1. *Gaia* DR2 represents an improvement over *Gaia* DR1 regarding the effective angular

^a<https://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=I/345/gaia2>

resolution (reaches 0.4 arcsec) and the uncertainties at the bright end (Brown et al., 2016, 2018).

I selected RA, error in RA, Dec, error in Dec, *Gaia* ID, ϖ , error in ϖ , proper motion in RA (μ_σ), error in μ_σ , proper motion in Dec (μ_δ), error in μ_δ , T_{eff} , and L to be used in my calculations. The stars with negative parallax values give meaningless negative distance. The stars with no or negative parallax values were excluded from the large sample from the *Gaia* mission. The sample was filtered by removing the stars which have no proper motions values.

A sample of 198 well-known members of the NGC 6819 in Table 3.1 were downloaded from Hole et al. (2009). I used their KIC number, RA, and Dec to obtain the corresponding *Gaia* ID source. After obtaining the *Gaia* DR2 ID, the values of the ϖ , μ_σ , and μ_δ were downloaded from *Gaia* DR2^b.

KIC	RA	eRA	Dec	eDec	Gaia Source	ϖ	e ϖ	μ_σ	e μ_σ	μ_δ	e μ_δ	T	L
5025228	295.43865624	0.0222	40.18162337	0.0291	2076392700791982336	0.3822	0.0281	-2.853	0.051	-4.044	0.064	5709.00	3.167
5112481	295.30502117	0.0159	40.24905188	0.0213	2076581713708054656	0.3715	0.0200	-3.031	0.035	-4.139	0.044	4073.95	260.915
5112754	295.34416107	0.0178	40.21938920	0.0224	2076393937742517120	0.3543	0.0222	-3.047	0.0400	-3.826	0.045	5522.67	5.937
5113295	295.43358947	0.0232	40.21330304	0.0300	2076393147468598912	0.9524	0.0280	-4.503	0.0500	-1.075	0.056	5192.20	0.501
5113344	295.44073708	0.0295	40.23947426	0.0371	2076393491066003584	0.4035	0.0378	-3.004	0.063	-3.675	0.071	5905.61	1.757
4936897	295.28321634	0.0140	40.07841765	0.0166	2076298314591962624	1.0470	0.0173	-8.886	0.031	-32.457	0.032	5779.00	1.019
4937447	295.40746107	0.0715	40.09943215	0.0999	2076295668892210048	0.3189	0.0881	-3.097	0.168	-3.874	0.195	5612.10	-
5023858	295.22572672	0.0184	40.12187015	0.0207	2076297936634830336	0.4020	0.0222	-2.951	0.042	-3.885	0.039	5753.00	4.460
5024149	295.27723558	0.0160	40.16636068	0.0183	2076299585902421760	0.3183	0.0189	-2.937	0.036	-3.789	0.035	5015.00	9.745
5024268	295.29592726	0.0214	40.18655917	0.0208	2076299993911496320	0.4032	0.0238	-3.075	0.044	-3.808	0.039	4728.24	162.886
5024404	295.31515533	0.0158	40.16957891	0.0191	2076299719033591424	0.3268	0.0190	-2.898	0.034	-3.931	0.037	4570.44	61.871
5024405	295.31559982	0.0119	40.19330747	0.0158	2076300032578973952	0.3544	0.0143	-2.912	0.026	-3.797	0.029	4907.50	23.945
5024512	295.32814988	0.0117	40.19852434	0.0148	2076300066938728832	0.3530	0.0148	-3.129	0.026	-3.937	0.027	5018.67	31.299
5024575	295.33723745	0.0155	40.19243918	0.0202	2076299860780302464	0.3320	0.0188	-2.993	0.035	-3.768	0.039	5798.33	8.679
5024750	295.36076663	0.0166	40.19492215	0.0215	2076393624194561152	0.3687	0.0204	-2.784	0.037	-3.815	0.041	4477.55	133.518
5111949	295.20915978	0.0191	40.21968228	0.0245	2076488323940775680	0.3142	0.0253	-3.026	0.042	-3.845	0.043	4807.44	68.282
5112288	295.27181786	0.0183	40.23448384	0.0231	2076488049062931328	0.3652	0.0232	-2.737	0.0400	-3.858	0.043	4818.61	49.417
5112730	295.33946183	0.0159	40.23257330	0.0207	2076393937742523904	0.3499	0.0200	-3.003	0.034	-3.872	0.040	4702.10	58.833
5112751	295.34353344	0.0175	40.20092338	0.0215	2076393692921636992	0.3319	0.0212	-3.229	0.038	-3.992	0.041	4939.26	63.534
5112948	295.37256652	0.0176	40.23886002	0.0229	2076393869023076608	0.3230	0.0218	-2.974	0.035	-3.686	0.042	4564.48	65.128

5113261	295.42647909	0.0165	40.26098829	0.0215	2076394315699729536	0.3570	0.0212	-2.801	0.036	-3.871	0.039	4953.25	8.085
4936741	295.25231500	0.0227	40.09866367	0.0264	2076297661756927104	0.3536	0.0277	-2.923	0.051	-3.932	0.052	5820.45	3.352
4937359	295.38817411	0.0166	40.04055980	0.0216	2076294844258425984	0.3204	0.0213	-2.925	0.038	-3.859	0.041	5236.35	9.679
4937770	295.47658427	0.0200	40.03600381	0.0284	2076294294502430720	0.4432	0.0267	-2.856	0.045	-3.536	0.054	4979.42	22.293
4937861	295.49824688	0.0143	40.08338794	0.0192	2076388337105190144	0.3613	0.0185	-2.985	0.032	-3.825	0.039	5332.00	10.294
5023732	295.20013283	0.0176	40.13566704	0.0202	2076485678240859136	0.3606	0.0216	-2.978	0.038	-3.831	0.038	4548.88	74.370
5023760	295.20557420	0.0180	40.15192873	0.0211	2076487155709622784	0.2981	0.0221	-2.987	0.041	-3.920	0.041	5842.67	7.355
5023890	295.23167740	0.0137	40.19085286	0.0160	2076487499307051008	0.3869	0.0169	-2.687	0.031	-3.911	0.031	5429.00	9.486
5024060	295.26047688	0.0159	40.17188511	0.0185	2076487258788894208	0.3392	0.0195	-2.871	0.036	-3.904	0.036	6044.28	7.581
5024076	295.26371932	0.0195	40.12659389	0.0208	2076299379743863936	0.3649	0.0223	-2.950	0.043	-4.084	0.039	5760.00	5.207
5024143	295.27587592	0.0122	40.18144674	0.0157	2076299963859451136	0.3492	0.0157	-3.003	0.028	-4.081	0.028	4776.51	22.667
5024150	295.27742059	0.0138	40.17208865	0.0169	2076299963859446016	0.3562	0.0170	-3.354	0.030	-3.595	0.031	5334.73	11.690
5024239	295.29132280	0.0284	40.11933086	0.0315	2076299207945183360	0.3594	0.0332	-2.912	0.064	-3.912	0.062	5846.12	2.418
5024295	295.30069585	0.0220	40.16814484	0.0248	2076299929499724672	0.3277	0.0265	-2.914	0.049	-3.654	0.050	5715.38	4.605
5024327	295.30602505	0.0185	40.19890895	0.0245	2076300101294355968	0.3468	0.0238	-2.832	0.042	-3.987	0.053	4775.85	56.838
5024372	295.31176311	0.0153	40.19756679	0.0212	2076300028271316224	0.3445	0.0185	-2.737	0.034	-3.834	0.041	5597.84	9.780
5024497	295.32645590	0.0153	40.14648609	0.0196	2076299654621822720	0.3348	0.0189	-2.888	0.034	-3.892	0.037	5496.67	9.132
5024503	295.32696648	0.0259	40.12441683	0.0303	2076298864347823872	0.4033	0.0306	-2.832	0.058	-3.817	0.062	5763.33	2.236
5024556	295.33452587	0.0155	40.14035006	0.0191	2076298898707580416	0.3387	0.0188	-3.035	0.034	-3.787	0.037	5542.05	8.243
5024557	295.33460977	0.0148	40.16986366	0.0182	2076299757701064960	0.3496	0.0182	-2.979	0.032	-3.794	0.035	4923.00	10.140
5024641	295.34626557	0.0164	40.15190227	0.0193	2076299001786815104	0.3589	0.0196	-3.056	0.036	-3.897	0.038	5607.74	7.338
5024961	295.39174365	0.0309	40.19770089	0.0354	2076393010029604352	0.3350	0.0382	-3.061	0.079	-4.068	0.074	5664.00	3.091
5024975	295.39466894	0.0303	40.10053742	0.0387	2076295703251935744	0.3715	0.0385	-3.034	0.067	-4.031	0.075	5477.65	2.094
5025113	295.42238342	0.0325	40.13546650	0.0509	2076389604105237248	0.4536	0.0423	-3.029	0.074	-3.915	0.105	5461.98	1.116
5025385	295.47122453	0.0209	40.15389191	0.0282	2076389848933704832	0.3775	0.0272	-2.864	0.048	-3.886	0.052	5727.00	4.293
5111940	295.20687616	0.0132	40.24200659	0.0159	2076488427020005632	0.3541	0.0167	-2.843	0.028	-3.716	0.029	4771.03	43.162
5112012	295.22082481	0.0300	40.21170447	0.0363	2076487602386274304	0.3456	0.0382	-2.864	0.069	-4.041	0.073	5760.25	2.517
5112198	295.25792007	0.0342	40.25946391	0.0404	2076488117782414208	0.4319	0.0430	-3.457	0.076	-4.101	0.077	5612.20	5.341
5112368	295.28303761	0.0268	40.21528377	0.0301	2076487774185021184	0.3304	0.0313	-2.850	0.063	-3.964	0.059	5645.50	3.246
5112391	295.28908028	0.0161	40.21950133	0.0183	2076487774185027328	0.3447	0.0194	-3.001	0.036	-3.842	0.035	5745.80	7.862
5112555	295.31633280	0.0170	40.26265273	0.0212	2076581748067808384	0.3790	0.0208	-4.533	0.037	-6.391	0.041	5823.75	5.147
5112567	295.31983514	0.0306	40.20935433	0.0366	2076300066938729856	0.3748	0.0373	-3.086	0.068	-3.774	0.072	5541.65	2.041
5112604	295.32426419	0.0156	40.25318824	0.0194	2076581679348332544	0.3644	0.0195	-2.931	0.034	-3.702	0.039	5442.00	6.806
5112786	295.34870379	0.0182	40.20984816	0.0213	2076393692914035456	0.4101	0.0222	-3.445	0.040	-3.815	0.040	4286.64	155.672
5112816	295.35391839	0.0158	40.23681672	0.0192	2076394040821753344	0.3400	0.0192	-2.826	0.035	-3.979	0.037	5652.75	8.819
5112907	295.36723669	0.0231	40.26004280	0.0342	2076394075181516416	0.4168	0.0289	-3.046	0.049	-3.913	0.065	5759.20	2.463
5112974	295.37612287	0.0181	40.25599518	0.0235	2076394448828275584	0.3315	0.0226	-2.998	0.038	-4.020	0.045	4817.87	68.246
5113001	295.38052965	0.0154	40.21942162	0.0203	2076393765944335104	0.3662	0.0190	-3.036	0.033	-3.713	0.039	5295.25	7.671
5113041	295.38876364	0.0189	40.20966727	0.0224	2076393010029609984	0.3117	0.0226	-2.786	0.041	-4.068	0.042	4552.54	73.176
5113456	295.46516598	0.0170	40.26030388	0.0214	2076395002894914176	0.3527	0.0212	-2.920	0.036	-3.771	0.039	5830.00	6.309
5113601	295.50076715	0.0264	40.20530281	0.0327	2076390226890883456	0.2886	0.0337	-2.974	0.059	-3.620	0.060	5746.77	4.994
5199746	295.25741911	0.0218	40.32664176	0.0252	2076583049434694016	0.3361	0.0278	-2.815	0.045	-3.839	0.044	5811.00	5.766
5199843	295.27926691	0.0169	40.34286513	0.0193	2076583191176842880	0.3181	0.0212	-2.865	0.035	-3.763	0.036	5741.16	9.933
5200152	295.34939417	0.0202	40.36233676	0.0248	2076582710140560000	0.3639	0.0244	-2.931	0.040	-3.861	0.047	4848.37	54.642
4936180	295.11368400	0.0196	40.07114413	0.0230	2076485162844678784	0.3752	0.0240	-2.905	0.046	-3.870	0.045	5899.00	4.213
4936244	295.12701502	0.0149	40.07140131	0.0176	2076485197204427776	0.3506	0.0183	-2.906	0.034	-3.827	0.035	5664.87	9.119
4936335	295.14870599	0.0111	40.08437700	0.0133	2076485094125237376	0.1222	0.0139	-3.759	0.025	-3.462	0.026	4427.98	-
4936524	295.20134248	0.0160	40.04130671	0.0199	2076297112001073408	0.6930	0.0202	-0.539	0.036	-7.927	0.037	7097.50	9.246
4936688	295.24113072	0.0474	40.07308616	0.0546	2076297558677695360	0.6494	0.0581	-2.898	0.108	-3.917	0.107	5744.77	1.748
4936788	295.26246019	0.0217	40.05179188	0.0245	2076296802763452544	0.2778	0.0257	-3.053	0.049	-4.053	0.047	5615.00	8.923
4937011	295.30693867	0.0098	40.06059327	0.0119	2076298039714190976	0.3545	0.0121	-3.035	0.022	-3.899	0.022	4760.66	35.626
4937056	295.31796852	0.0175	40.09745065	0.0261	2076298383311466368	0.3214	0.0217	-2.658	0.038	-4.201	0.051	4891.01	63.093

4937140	295.33855882	0.0138	40.00783582	0.0178	2076294741179169408	0.5718	0.0172	-3.500	0.031	-7.545	0.034	5960.00	5.434
4937192	295.34915843	0.0200	40.01593978	0.0270	2076294741179177088	0.4194	0.0256	-2.967	0.045	-3.746	0.050	5860.00	4.058
4937546	295.42915253	0.0153	40.05811281	0.0230	2076294603740304256	0.3507	0.0199	-2.904	0.034	-3.983	0.046	5178.15	8.756
5023711	295.19562595	0.0281	40.19904951	0.0333	2076488216554641536	0.3243	0.0344	-2.664	0.063	-4.005	0.063	5766.00	2.985
5023712	295.19586073	0.0317	40.13283498	0.0357	2076485643881116416	0.3703	0.0380	-2.862	0.072	-3.807	0.073	5644.50	1.894
5023845	295.22307268	0.0112	40.16731493	0.0136	2076487185762261888	0.3541	0.0140	-2.576	0.025	-3.701	0.024	4969.25	23.116
5023849	295.22432792	0.0170	40.19756989	0.0189	2076487499307049984	0.3392	0.0208	-2.925	0.035	-3.814	0.035	5811.00	9.604
5023863	295.22648972	0.0311	40.15213120	0.0374	2076487086990161024	0.4150	0.0387	-2.820	0.070	-3.696	0.072	5665.36	1.490
5023872	295.22790595	0.0207	40.16911716	0.0231	2076487190069388672	0.3809	0.0246	-3.011	0.045	-3.876	0.044	5836.67	3.753
5023874	295.22808813	0.0198	40.14316821	0.0226	2076487086990155520	0.3607	0.0237	-2.910	0.045	-3.805	0.043	5620.71	4.364
5023889	295.23166345	0.0172	40.10809810	0.0204	2076297867910941568	0.6772	0.0214	-0.206	0.038	-5.135	0.039	4622.86	31.573
5024043	295.25845738	0.0174	40.10777847	0.020	2076299139225684096	0.4099	0.0211	-0.682	0.037	-4.739	0.038	4774.91	39.680
5024122	295.27289965	0.0238	40.14121172	0.0276	2076299482823091200	0.4280	0.0285	-2.940	0.053	-3.825	0.053	5610.36	2.093
5024177	295.28108361	0.0165	40.13284632	0.0198	2076299276664661248	0.3780	0.0203	-3.102	0.037	-3.938	0.036	5804.25	5.562
5024242	295.29149867	0.0148	40.12452809	0.0165	2076299207945186048	0.3499	0.0173	-2.972	0.032	-3.733	0.031	5820.00	10.813
5024272	295.29646424	0.0181	40.19506563	0.0204	2076299998219216256	0.3507	0.0219	-3.026	0.040	-3.914	0.038	4575.51	236.515
5024287	295.29911251	0.0159	40.17328897	0.0186	2076299929499804288	0.3395	0.0192	-2.994	0.036	-3.687	0.037	5418.43	9.328
5024310	295.30334255	0.0176	40.11519531	0.0204	2076298452030943360	0.3141	0.0218	-2.892	0.038	-3.826	0.037	5744.00	8.423
5024329	295.30664667	0.0159	40.15940432	0.0180	2076299688981554688	0.4166	0.0196	-3.018	0.036	-3.884	0.037	4851.63	8.690
5024354	295.31020799	0.0306	40.17044608	0.0421	2076299723337152512	0.3301	0.0383	-2.529	0.070	-3.963	0.089	5816.50	2.265
5024369	295.31134939	0.0210	40.18823622	0.0315	2076300032578962944	0.3830	0.0266	-2.720	0.050	-3.701	0.067	5810	6.333
5024414	295.31635568	0.0194	40.18650020	0.0233	2076300028271234816	0.3501	0.0235	-2.680	0.045	-3.966	0.044	4852.25	60.221

Table 3.1: Part of the *Kepler*'s well-known members and their corresponding values for the *Gaia* source, ϖ (mas), $e\varpi$ (mas), μ_σ (mas/yr), $e\mu_\sigma$ (mas/yr), μ_δ (mas/yr), $e\mu_\delta$ (mas/yr), T_{eff} (K), and $L(L_\odot)$. The (-) means that the star has no luminosity value in the *Gaia* data. All 198 members are presented in Tables [B.13-B.14](#).

3.1.2 Asteroseismic data

Asteroseismology is the science of studying the internal stellar properties by using their pulsations. Astronomers use the light that we receive from stars to study them. The time-dependent light output of the variable stars can be observed on a time scale shorter than the time that the star takes to change its phase, which makes the variable stars a suitable target to observe and study their physics. These variable stars pulsate in different modes. The light curves of the variable stars can be converted to frequencies, and for every frequency value, there is a corresponding amplitude. There are different methods for analysing the frequency. The autocorrelation method was used in this

work. This method correlates the observed variables during a specific time interval and gives a pattern with a clear signal that can be used in the data analysis (Balona et al., 2010).

For solar-like star, $\nu_{\max}$ and $\Delta\nu$ can be estimated from the frequency/amplitude data (Handler, 2012). The study of the stars' characters (asteroseismology) help astrophysicists to study the internal structure of the stars and estimate the stellar parameters precisely (Jørgensen et al., 2020). As was discussed in the previous chapter, there are some scaling relations that depend on the $\nu_{\max}$ and $\Delta\nu$, by which one can calculate the mass, the radius, and the luminosity of the star. The *Kepler* satellite provided four years time-series asteroseismic data while Transiting Exoplanet Survey Satellite (TESS) provided one year only (Hekker and Basu, 2019).

The asteroseismic *Kepler* data was downloaded from Mikulski Archive for Space Telescopes^c. I chose the long-cadence mode (LC) fit files and converted them into .dat using a C program. Then, I ran another FORTRAN program to convert the raw data into magnitudes and another code to fix the drifts and jumps. I then proceeded to develop the periodogram data using FORTRAN code.

3.2 Method

The proper motion is the same for the members in the same cluster, but the stars within the field of the cluster might also have the same proper motion value. Hence, the proper motion is not enough to identify the cluster members, and using the distance modulus

^c<http://archive.stsci.edu/>

gives a more accurate definition of the cluster's members (Balona et al., 2013a).

The 198 well-known members in NGC 6819 cluster were used to obtain the distance moduli values from the relation $\mu = 5 + 5 \log d$ where d is the distance which equals $\frac{1}{\varpi}$. The average μ_σ , and μ_δ and their standard deviations (σ) were also calculated for these well-known members. The filtered *Gaia* sample was filtered again considering the values of the average distance modulus and proper motions of the well-known members within σ to obtain the probable cluster members. There was no significant difference when the median value of distance modulus was used instead of the average distance modulus.

As mentioned before in subsection 2.4.1, Cantat-Gaudin et al. (2018a) defined the membership of the open cluster NGC 6819. Cantat-Gaudin et al. (2018a) downloaded and filtered data according to the membership probability. They considered the stars with probabilities ≥ 0.5 as cluster members. The filtered *Gaia* members from my sample that were not in Cantat-Gaudin et al. (2018a) members were considered as new members of the open cluster NGC 6819.

A new average distance modulus was calculated for the cluster after adding the cluster's new members together with the well-known members.

3.2.1 The theoretical isochrone

The word isochrone is derived from iso, which means the same, and chrone, which means age. In Astrophysics, the isochrone is a theoretical model that represents the stellar evolution track for the stars of the same age on the HR or the CDM diagram. The theoretical isochrones have been used in many previous studies to estimate the stellar parameters by comparing the observed data with the model (Bergbusch and Van-

denberg, 1992; Salaris et al., 1993; Abedigamba et al., 2015; Jørgensen and Lindegren, 2005). Figure 2.7 shows the two fitted isochrones of different ages for NGC 6819.

I tried over 30 isochrones with different parameters and versions to get the best-fitted one. A suitable isochrone of $\log \text{Age} = 9.65$, $Z \simeq 0.16$, PARSEC version 1.2S^d, $\eta_{\text{Reimers}} = 0$, and $A_V = 0.3$ was selected to be plotted with the HR diagram of the cluster's members to show the different stages of the sample of the stars.

3.2.2 RG sample

The separation of the RG stars from the HR diagram was not sufficient, so, the RG sample was selected from Yu et al. (2016). Recently, the period spacing was used to separate the RGB and the RC stars. However, the values of the period spacing was not available for the RG stars that I have in my sample. The metallicity of the RGB star changes when it becomes an RC star which directly affects the value of the surface gravity (g). The RG sample was divided into RGB stars with $\log g > 2.7$ and RC stars with $2.3 \geq \log g \geq 2.7$ (Hekker et al., 2011c).

Plotting the periodogram, the Gaussian shape appears clearly for the solar-like oscillating stars. The limits of the Gaussian shape were guessed for each star and obtained with the FORTRAN code which is based on the autocorrelation function. This code takes the limit values and fits the Gaussian shape on the highest peak within that limit. Then, it returns the values of ν_{max} , $\Delta\nu$. After this step, I managed to plot the best fit of the Gaussian shape on the periodogram as shown in Figure 3.2 (the rest are shown in Appendix A), and the value of A_{max} was estimated from the periodogram.

^d<http://stev.oapd.inaf.it/cgi-bin/cmd>

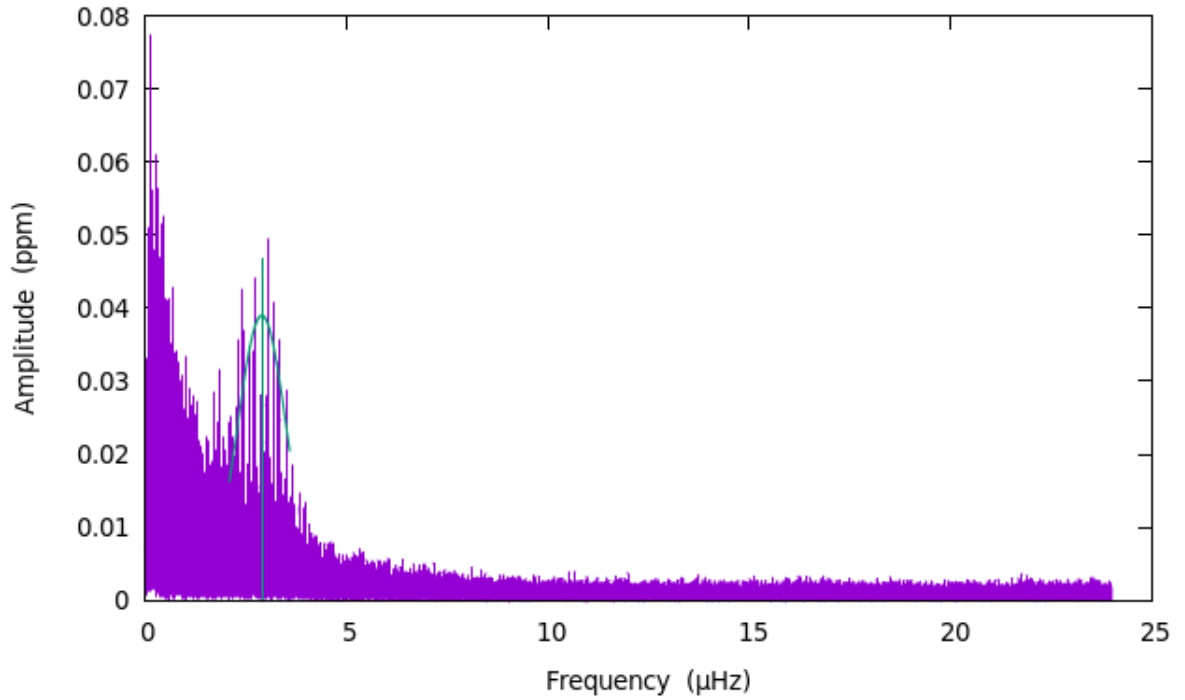


Figure 3.2: The periodogram of one of the RG stars. The green Gaussian shape was the best fit obtained by the autocorrelation function. The green vertical line shows the value of the maximum amplitude frequency.

Using the SIMBAD astronomical database^e, the *Gaia* DR2 source was found for each corresponding KIC number. The asteroseismic data was compiled with the T_{eff} and the luminosities that were observed by the *Gaia* in addition to the data that was obtained from Yu et al. (2016). The values that I estimated for ν_{max} , $\Delta\nu$ were very close to those of Yu et al. (2016), as shown in Figure 3.3 and Figure 3.4. The outlier points on those graphs are due to the systematic error in some of the parameters that were used to obtain ν_{max} and $\Delta\nu$.

^e<http://simbad.u-strasbg.fr/simbad/>

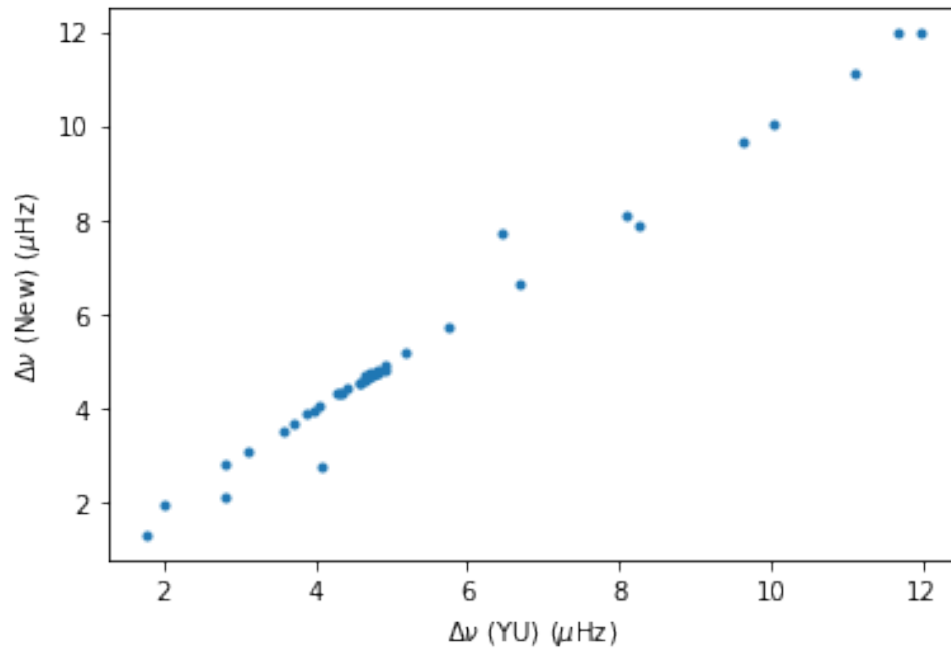


Figure 3.3: A relation between the values of $\Delta\nu$ that were estimated by Yu et al. (2016) on the x axis and the ones I estimated using the autocorrelation method on the y axis.

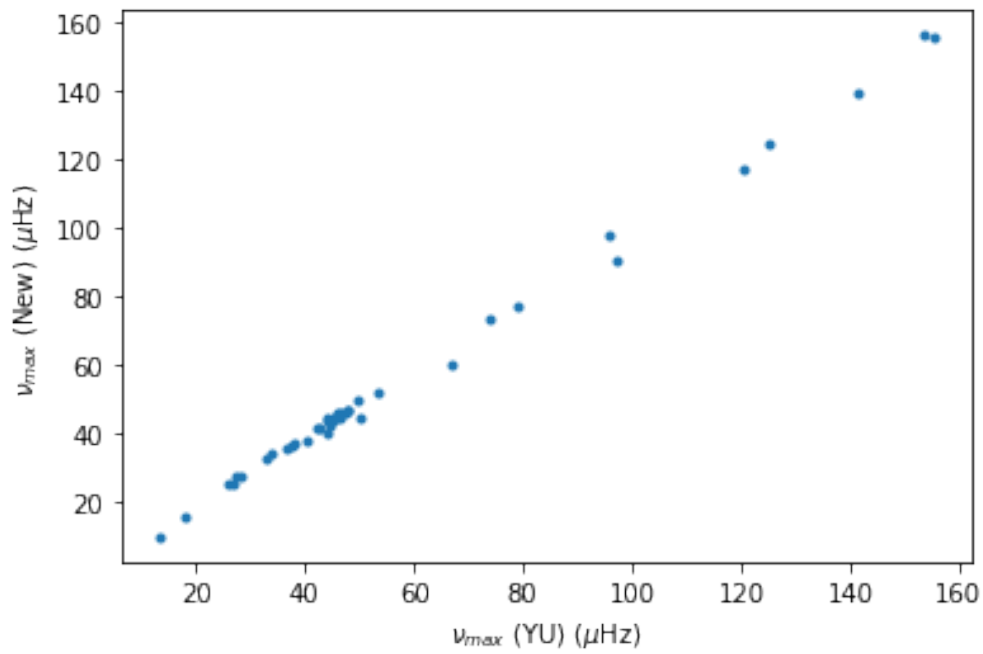


Figure 3.4: A relation between the values of $\nu_{\max}$ that were estimated by Yu et al. (2016) on the x axis and the ones I estimated using the autocorrelation method on the y axis.

3.2.3 Mass loss calculations

The stellar mass for every star was calculated using four different methods. First, by using Eqn. (2.3.13), which depends on $\nu_{\max}$ from *Kepler*, T_{eff} , and L from *Gaia*. In the second method, the masses of the RGB and RC stars were calculated from Eqn. (2.3.14), which depends on $\Delta\nu$ from *Kepler*, T_{eff} , and L from *Gaia*. In the mentioned two methods I used the asteroseismic data that was obtained from the autocorrelation method and that of Yu et al. (2016). The third method was to use the scaling relation given by Eqn. (2.3.2), which depends on $A_{\max}$.

The mass loss was estimated in the three mentioned methods by determining the average mass of the RGB and the average mass of the RC stars and subtracting them for each method. The resulted value is the mass loss, as shown in next chapter.

3.2.3.1 Chi-squared (χ^2) minimisation

In the fourth method, the stellar masses of the RG sample were determined using the Bayesian technique^f. The chosen isochrone of $\log \text{Age} = 9.65$, $Z \simeq 0.16$ was used again in the χ^2 minimisation technique to calculate the mass loss. This technique is used by fitting the observed data on the theoretical isochrone and assuming zero mass loss, and the deviation of the RC stars from the isochrone represents the amount of the mass loss. M , L , and T in Eqn. (3.2.1) are the values on the isochrone, while m , l , and t are the observed values. If the observed data fits the isochrone perfectly, the first and the second terms will be zero and the deviation will equal the third term, which is the mass loss at the TRGB.

^fhttp://stev.oapd.inaf.it/cgi-bin/param_1.4

A FORTRAN program was used to calculate the mass loss using the χ^2 minimisation technique.

$$\chi^2 = \sum_{i=1}^n \left(\frac{(t_i - T)^2}{2\sigma_t^2} + \frac{(l_i - L)^2}{2\sigma_l^2} + \frac{(m_i - M)^2}{2\sigma_m^2} \right). \quad (3.2.1)$$

All the mentioned PYTHON codes are shown in Appendix C.

4. Results and discussion

The number of stars that were downloaded from *Gaia* DR2^a (sample 1) was 15180. After excluding the stars that have no parallax, non-positive parallax, and no proper motion, sample 1 was reduced to sample 2, which contains 12312 stars.

Using the values of ϖ , μ_σ , μ_δ and their errors of the 198 well-known members, the mean distance modulus was 12.151 ± 0.167 mag with a standard deviation (σ_{m-M}) = 0.6 mag, the mean $\mu_\sigma = -2.907 \pm 0.054$ with a standard deviation (σ_{μ_σ}) = 1.110, and the mean $\mu_\delta = -3.985 \pm 0.057$ with a standard deviation (σ_{μ_δ}) = 6.974.

The previous mean values of ϖ , μ_σ , μ_δ were used to filter sample 2 within σ . The number of probable members from this reduction was 2116 stars (sample 3), as seen in Table B.16-B.26. Out of that sample, 1181 stars were already defined as members in the sample by Cantat-Gaudin et al. (2018a) and 906 stars (Table B.1-B.12) were new members.

The stars with no T_{eff} , and/or no luminosity were excluded and the remaining 812 stars were used to plot the HR diagram. The suitable isochrone that produced the best fit (as shown in Figure 4.1) for the observed results from *Gaia* was of logAge 9.6 and metallicity $Z = 0.016$. Including a larger number of stars to the cluster members leads to a new value of the estimated age to be $\simeq 4$ Gyr.

In the region of the δ Scuti stars, I found 11 stars. They have the following *Gaia* DR2 ID: 2076294019624475648, 2076297627397174528, 2076299001786810624, 20762996889-

^a<https://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=I/345/gaia2>

81549312, 2076299826420527232, 2076299826420542080, 2076299963859447936, 2076390604848025728, 2076393594145246080, 2076393834663321344, 20764850941252-43136. Only one of them (20762976273-97174528) was defined as a variable star in Balona et al. (2013b) and the others are new δ Scuti stars.

By excluding the stars in sample 3 that match the same *Gaia* DR2 ID source in Cantat-Gaudin et al. (2018a), I found the new members of NGC 6819 to be 64 (sample 4) stars (shown in Table 4.2) which appear as red stars in Figure 4.1. In sample 2, *Kepler* observed 98 of the stars (Shown in Table 4.1) but they were not defined as NGC 6819 members according to the different approaches that other researchers used to define the cluster's membership. For the same reason, some of the well-known *Kepler* members (94 stars) were not defined as members in the *Gaia* data.

The HR diagram (Figure 4.1) showed the distribution of the stars on the different stellar evolutions. Most of the stars were in the main sequence region and some of them (a smaller number) were in the RG region. This is due to the moderate age of the cluster.

In sample 3, catalogue other than *Kepler*, defined 41 of the stars as NGC 6819 members.

The *Gaia* mission can observe objects with faint magnitudes and *Kepler* were able to observe bright magnitudes. This is the reason that some stars in the open cluster NGC 6819 were missed in the *Kepler* sample and very few were missed in the *Gaia* sample. However, the stars that were well-known members identified with the *Kepler* and which are not in the *Gaia* sample were in fact observed by *Gaia* but not defined as members according to the different approaches of defining the cluster's members. I was able to find new members in the open cluster NGC 6819 using the distance modulus

Gaia source ID	membership	KIC	Gaia ID	membership	KIC
2076294019624475648		4937435	2076394139593796992		5112871
2076294672459697536		4937217	2076295527145521792		4937356
2076296283062879616		4936643	2076297627397174528		4936680
2076297799195859072		5023754	2076297867915351040		5023926
2076297829248112256		5023847	2076298207205146240		4937119
2076298344644182528		4936948	2076298447723274880		5024322
2076298589469910784		4937169	2076298761268676352		5024851
2076298864347818624		5024447	2076298795628347392		5024550
2076298898707587584		5024544	2076298898707576448		5024549
2076299100558429568		4936891	2076299306716879744		5024280
2076299448463334144		5023953	2076299512875311872		5024182
2076299482823088000		5024084	2076299654621826176		5024476
2076299826416672384		5024482	2076299792060832640		5024696
2076299860780291456		5024489	2076299860780293376		5024506
2076299826420588288		5024450	2076299998219211136		5024227
2076299993911704064		5024231	2076299993911705088		5024252
2076300032578972800		5024429	2076300066938718592		5024461
2076300028271234816	✓	5024414	2076389294867531136	✓	4937576
2076393044389355008	✓	5113053	2076485815679780096		5023552
2076393697224337792		5024668	2076485948811870976		5023666
2076393697224343424		5112814	2076393692917498496	✓	5024582
2076389574055739904		5025074	2076389745854474880		5025271
2076389780214232192		5025472	2076393731584089856		5112836
2076393658557409792		5024787	2076393731584091264		5112812
2076393692914036608		5112741	2076395964967226752		5200660
2076393899075928960		5112687	2076394964224349568		5113644
2076394040821752576	✓	5112840	2076394173950855424		5113146
2076487121349903360		5023875	2076487155709634688		5023796
2076487185762452096		5023899	2076487121349914752	✓	5023948
2076487258788889344		5024008	2076487563719615744		5111939
2076487563719615744		5111939	2076487808544779776		5112451
2076488044756008576		5112268	2076488049062939648		5112300
2076488323940764032		5111908	2076488427020005632	✓	5111940
2076488701897902592	✓	5111834	2076488869389770368		5112146
2076582057305467392		5112507	2076583706572966656		5199997
2076393731584089856		5112836	2076393658557409792		5024787
2076393692914036608		5112741	2076393697224337792		5024668
2076393697224343424		5112814	2076393692917498496	✓	5024582
2076393731584091264		5112812	2076393899075928960		5112687
2076394040821752576	✓	5112840	2076394139593796992		5112871
2076394173950855424		5113146	2076394964224349568		5113644
2076395964967226752		5200660	2076485815679780096		5023552
2076485948811870976		5023666	2076487121349903360		5023875
2076487155709634688		5023796	2076487185762452096		5023899
2076487121349914752	✓	5023948	2076487258788889344		5024008
2076487808544779776		5112451	2076488044756008576		5112268
2076488049062939648		5112300	2076488323940764032		5111908
2076488701897902592	✓	5111834	2076488869389770368		5112146
2076582057305467392		5112507	2076583706572966656		5199997

Table 4.1: The members that have been observed by *Kepler* and the ✓ means that they were defined as members.

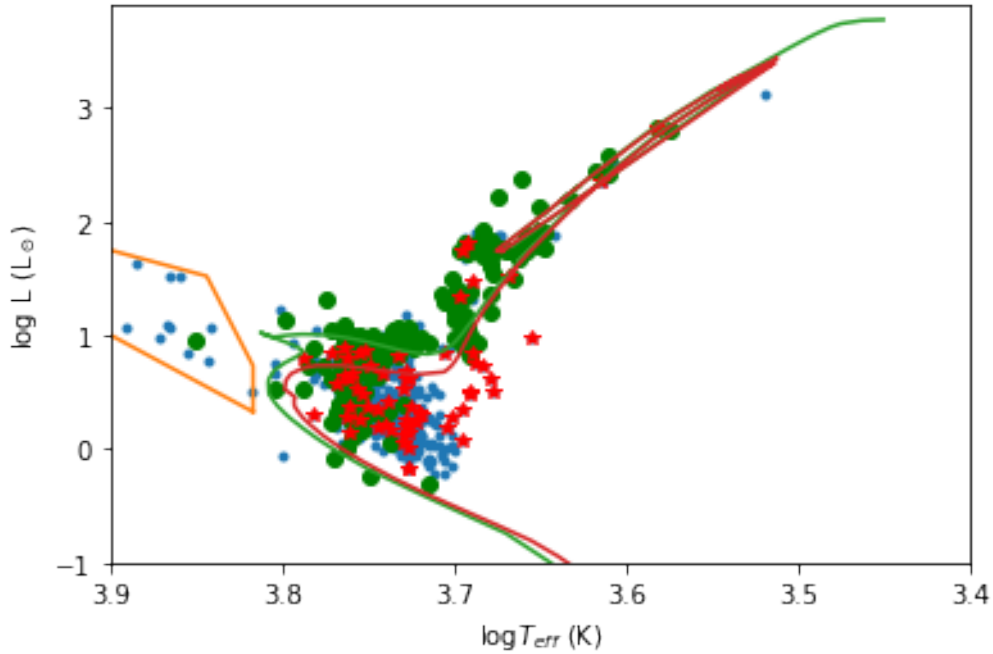


Figure 4.1: The HR diagram and two isochrones of the best fit. The stars inside the trapezoidal shape represent the δ Scuti stars according to Balona (2018). The red stars represent the new members that have known T_{eff} and L . The green big dots represent the well-known *Kepler* members and the blue ones are the probable Cantat-Gaudin et al. (2018a) members.

and the proper motions of the well-known ones. The large number of stars (new and old members) helped me to calculate more accurate values for the mean distance modulus and the mean proper motions of the cluster, and using them in choosing the best isochrone fitting helped in obtaining an accurate age estimation.

Using all the known and the new members, the mean distance modulus was corrected to be 12.173 ± 0.007 mag, where the error is the standard error of the mean. The new value of the distance modulus is still within the range of the estimated values that were previously estimated in Table 2.1. Compared to the magnitude values that were mentioned in Chapter three, there is a significant improvement in the magnitude

value as a result of the accurate estimation of the distance modulus. The mean proper motion in RA was -2.880 ± 0.244 mas/yr and the mean proper motion in Dec was -4.035 ± 0.253 mas/yr. The value of the mean proper motion in RA was notably higher than that of Platais et al. (2013) while the one of the mean proper motion in Dec was lower.

By plotting the ϖ , μ_σ , μ_δ Figure (4.2) for the large *Gaia* sample (sample 2), the radius of the cluster was found to be almost 11 arcmin.

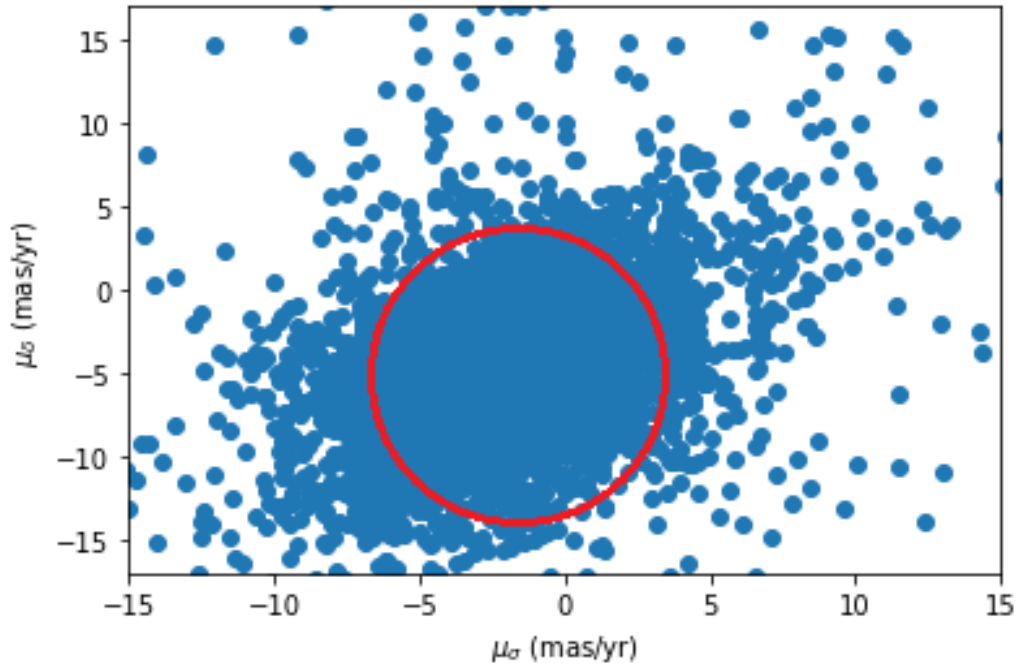


Figure 4.2: A relation between μ_σ and μ_δ that was used to determine the cluster's radius. The red circle shows the area at which most of the stars are located according to their proper motion values.

The average mass of the RGB using Eqn 2.3.2 is $0.002 M_\odot$ and that of the RC is $0.000 M_\odot$ which gave $0.000 M_\odot$ as a mass loss.

RA	eRA	Dec	eDec	Gaia source ID	ϖ	e ϖ	μ_{σ}	e μ_{σ}	μ_{δ}	e μ_{δ}	T	L	m-M
295.4256609	0.0446	40.00825792	0.0558	2076294191423402880	0.4027	0.0551	-2.600	0.099	-3.895	0.114	5335.50	1.019	11.975
295.4765843	0.0200	40.03600381	0.0284	2076294294502430720	0.4432	0.0267	-2.856	0.045	-3.536	0.054	4979.42	22.293	11.767
295.4473506	0.0324	40.03942362	0.0485	2076294535020829184	0.3989	0.0422	-2.667	0.072	-4.157	0.095	5063.84	1.51	11.996
295.4526135	0.0149	40.05751816	0.0199	2076294569380590080	0.4179	0.0192	-2.72	0.034	-3.317	0.038	4665.75	33.863	11.895
295.4052491	0.0200	40.06623565	0.0261	2076295325294794368	0.3966	0.0258	-3.082	0.044	-5.733	0.051	4779.00	4.097	12.008
295.4383106	0.0323	40.08772849	0.0428	2076295394014323328	0.4207	0.0418	-3.711	0.072	-5.893	0.084	5359.00	1.298	11.880
295.1888269	0.0319	40.05130619	0.0451	2076297318159501696	0.3635	0.0397	-3.886	0.074	-5.913	0.097	5236.61	2.036	12.197
295.2937697	0.0224	40.09348219	0.0269	2076298344644182528	0.2951	0.0277	-2.608	0.050	-4.714	0.051	5680.50	6.97	12.650
295.2897841	0.0454	40.06596878	0.0563	2076298245872483840	0.4374	0.0587	-3.265	0.105	-6.260	0.117	5326.75	0.671	11.796
295.3137313	0.0315	40.10478826	0.0381	2076298417671205504	0.3601	0.0378	-1.918	0.071	-4.396	0.079	6049.71	1.992	12.218
295.3405927	0.0222	40.10231344	0.0270	2076298589469912576	0.3952	0.0271	-3.61	0.049	-5.416	0.052	5666.40	3.005	12.016
295.3710287	0.0237	40.12656948	0.0292	2076298722601233792	0.3003	0.0287	-3.417	0.053	-3.293	0.057	5333.50	4.319	12.612
295.3659920	0.0293	40.14296847	0.0362	2076298933067351936	0.3023	0.0363	-3.707	0.066	-3.836	0.074	4906.00	3.215	12.598
295.2352087	0.0361	40.12799461	0.0380	2076299414103588224	0.3899	0.0423	-2.857	0.081	-3.938	0.072	5873.00	3.761	12.045
295.2672629	0.0180	40.17315281	0.0204	2076299585902317952	0.3348	0.0214	-2.868	0.039	-3.973	0.039	5791.00	6.393	12.376
295.3225885	0.0209	40.16248578	0.0243	2076299654621830164	0.3457	0.0242	-2.813	0.047	-3.890	0.047	5512.00	4.718	12.307
295.3511275	0.0189	40.17869202	0.0207	2076299792060827648	0.3427	0.0217	-3.571	0.041	-3.253	0.040	5805.00	7.636	12.325
295.3084979	0.0158	40.19289358	0.0217	2076300032578964608	0.3513	0.0193	-2.905	0.035	-3.670	0.043	5641.64	7.269	12.272
295.3090864	0.0182	40.19116127	0.0253	2076300032574863616	0.3059	0.0222	-2.861	0.041	-4.507	0.050	5901.33	6.85	12.572
295.3227201	0.0254	40.21594995	0.0310	2076300135658216448	0.4573	0.0277	-2.871	0.055	-3.282	0.059	5555.08	2.218	11.699
295.4943976	0.0241	40.06808495	0.0310	2076388234025963904	0.3193	0.0316	-2.768	0.055	-6.554	0.061	5804.67	4.308	12.479
295.5300779	0.0197	40.11735197	0.0274	2076388783781833856	0.3158	0.0258	-3.737	0.044	-5.563	0.050	4886.72	7.074	12.503
295.5381755	0.0320	40.12017308	0.0417	2076388783781841536	0.3851	0.0417	-2.249	0.069	-6.509	0.076	5034.50	1.928	12.072
295.5150053	0.0323	40.15718628	0.0446	2076389161738971776	0.4119	0.0432	-3.709	0.071	-5.782	0.082	5325.00	1.381	11.926
295.4449883	0.0218	40.09041882	0.0310	2076389230458351232	0.4327	0.0273	-2.313	0.053	-5.352	0.063	5359.00	3.38	11.819
295.4209118	0.0211	40.15319313	0.0294	2076389608415499392	0.3715	0.0269	-2.828	0.048	-3.941	0.056	5766.00	4.101	12.150
295.4873723	0.0193	40.14090396	0.0281	2076389780214232192	0.3199	0.0252	-3.709	0.041	-4.578	0.050	4928.53	66.619	12.475
295.5137303	0.0395	40.17171056	0.0530	2076389917653224320	0.3975	0.0520	-3.748	0.088	-2.545	0.098	4955.50	1.164	12.003
295.5341157	0.0156	40.19036543	0.0221	2076391429481741568	0.3806	0.0221	-2.225	0.034	-5.990	0.043	4513.21	9.757	12.098
295.5064779	0.0319	40.21591438	0.0399	2076391704359643392	0.4145	0.0405	-2.158	0.070	-4.285	0.076	5504.00	1.615	11.912
295.3978790	0.0238	40.14293412	0.0286	2076392528993234048	0.3653	0.0288	-3.495	0.052	-4.800	0.056	5339.2	4.204	12.187
295.3388812	0.0181	40.19921044	0.0226	2076393692917498496	0.3568	0.0229	-2.325	0.041	-4.055	0.050	4959.00	55.269	12.238
295.3791653	0.0229	40.22404927	0.0309	2076393765943856128	0.4517	0.0281	-2.524	0.052	-4.820	0.059	5320.00	2.298	11.726
295.5113622	0.0172	40.28013936	0.0220	2076394964224349568	0.4447	0.0219	-2.131	0.036	-4.948	0.043	4898.25	29.699	11.760
295.5026180	0.0471	40.30567567	0.0571	2076395174693266560	0.4528	0.0589	-2.922	0.100	-3.560	0.116	5332.00	0.689	11.720
295.4251041	0.0243	40.33146045	0.0286	2076396205485384704	0.3188	0.0285	-2.957	0.051	-4.819	0.053	5350.00	4.747	12.482
295.4713653	0.0204	40.35159190	0.0263	2076396446003592704	0.3540	0.0252	-3.653	0.043	-4.864	0.049	4870.00	5.635	12.255
295.1464590	0.0137	40.06701961	0.0161	2076484922326532224	0.4550	0.0167	-2.350	0.031	-4.925	0.031	6134.50	6.281	11.710
295.1598754	0.0262	40.07037092	0.0300	2076485025405759744	0.3893	0.0316	-2.093	0.061	-3.840	0.059	5757.33	2.287	12.049
295.1894132	0.0303	40.15887167	0.0369	2076485884399295616	0.3173	0.0390	-2.287	0.069	-5.156	0.073	4907.50	3.005	12.493
295.1850926	0.0309	40.13981759	0.0388	2076485850039542400	0.4338	0.0403	-2.598	0.072	-1.913	0.085	5467.33	1.458	11.814
295.2459094	0.0313	40.20248443	0.0366	2076487327508380416	0.3903	0.0389	-2.522	0.072	-4.605	0.073	5278.33	1.705	12.043
295.3043170	0.0212	40.23431722	0.0258	2076487808544791296	0.3802	0.0254	-2.002	0.047	-5.332	0.050	5706.67	3.341	12.100
295.3002593	0.0288	40.23234030	0.0343	2076487808544785024	0.3550	0.0346	-3.069	0.062	-3.512	0.064	5474.00	2.537	12.249
295.2735585	0.0268	40.26704371	0.0302	2076488152142173312	0.2883	0.0314	-2.924	0.060	-3.346	0.058	5738.75	4.711	12.701
295.2579201	0.0342	40.25946391	0.0404	2076488117782414208	0.4319	0.0430	-3.457	0.076	-4.101	0.077	5612.20	5.341	11.823
295.1956953	0.0309	40.22167979	0.0375	2076488392660242048	0.3983	0.0396	-2.205	0.070	-3.553	0.077	5355.00	1.809	11.999
295.2027208	0.0276	40.24580999	0.0320	2076488427020146304	0.4469	0.0353	-2.256	0.062	-6.464	0.060	5689.14	1.821	11.749
295.2040752	0.0270	40.27365858	0.0301	2076489011135579264	0.2918	0.0319	-2.295	0.059	-1.901	0.057	4831.00	5.253	12.675
295.0648722	0.0399	40.20706943	0.0486	2076489732689937024	0.4088	0.0490	-2.648	0.094	-5.290	0.098	5357.5	1.154	11.942
295.1336106	0.0344	40.25056472	0.0416	2076491553756143872	0.4040	0.0424	-1.888	0.079	-2.225	0.083	5341.00	1.595	11.968
295.1208832	0.0395	40.25384816	0.0464	2076491553756138240	0.3865	0.0485	-2.123	0.092	-6.523	0.092	5763.76	1.361	12.064
295.1507571	0.0316	40.31477175	0.0355	2076492309670447744	0.3591	0.0388	-3.551	0.067	-2.014	0.067	5639.67	2.327	12.224
295.3177153	0.0334	40.26516107	0.0396	2076581748067811584	0.3887	0.0404	-2.420	0.071	-3.728	0.077	5399.10	6.480	12.052
295.2803808	0.0286	40.26938435	0.0343	2076581984282789504	0.3671	0.0362	-1.900	0.063	-2.780	0.062	4760.00	3.188	12.176
295.3017694	0.0353	40.27572585	0.0422	2076581954226237440	0.3462	0.0414	-2.403	0.078	-4.438	0.085	5251.10	2.105	12.303
295.3200558	0.0391	40.29147243	0.0490	2076582057305473792	0.3741	0.0487	-2.487	0.082	-5.821	0.092	5327.25	1.583	12.135
295.3726575	0.0389	40.32469724	0.0461	2076582400902908288	0.3784	0.0467	-3.445	0.080	-4.897	0.088	5552.00	1.524	12.110
295.3376210	0.0290	40.33469278	0.0356	2076582572701584128	0.3194	0.0358	-1.926	0.058	-1.974	0.070	5332.00	4.083	12.478
295.3484801	0.0202	40.31865387	0.0260	2076582503982578944	0.3368	0.0252	-2.040	0.041	-6.073	0.049	4118.00	229.291	12.363
295.2977251	0.0275	40.32574624	0.0350	2076582916298938112	0.3006	0.0315	-4.055	0.054	-5.027	0.067	5070.33	7.036	12.610
295.2842686	0.0353	40.32550125	0.0348	2076582950658667264	0.4314	0.0404	-2.915	0.072	-3.492	0.063	3815.88	664.956	11.826
295.2612378	0.0282	40.35881230	0.0321	2076583259896317056	0.4386	0.0348	-3.101	0.061	-4.714	0.060	5796.00	1.937	11.790
295.2826108	0.0358	40.37267310	0.0412	2076583637853460096	0.3578	0.0448	-2.207	0.075	-2.461	0.081	4965.00	2.177	12.232

Table 4.2: The new members that have know luminosity and effective temperature.

The average mass of the RGB using Eqn. (2.3.13) and Yu (2019) data is $1.707 M_{\odot}$ and that of the RC is $1.690 M_{\odot}$, which produced $0.017 M_{\odot}$ as a mass loss value. The average mass of the RGB using Eqn. (2.3.13) and my data is $1.651 M_{\odot}$ and that of the RC is $1.645 M_{\odot}$, which produced $0.006 M_{\odot}$ as a mass loss value. The average mass of the RGB using Eqn. (2.3.14) and the asteroseismic data from Yu (2019) is $1.735 M_{\odot}$ and that of the RC is $1.627 M_{\odot}$, which produced $0.108 M_{\odot}$ as a mass loss value. The average mass of the RGB using Eqn. (2.3.14) and my data is $1.708 M_{\odot}$ and that of the RC is $1.756 M_{\odot}$, which produced $-0.048 M_{\odot}$ as a mass loss value.

The two tables, Table 4.3 and Table 4.4 contain the values of the mass from the model, T_{eff} , L , ν_{max} , and $\Delta\nu$ that were used in the χ^2 minimisation method that gave the value of the mass loss of $0.006 \pm 1.275 M_{\odot}$. The value of χ^2 that is equivalent to log the mass loss was 1.014 ± 0.053 . This value leads to an antilog of -1.275 due to the very small value of uncertainty in $\log M/M_{\odot}$. The accuracy of the result is much better than the previously estimated ones. However, the use of the asteroseismic data from *Kepler* might affect the accuracy of the mass loss due to the uncertainty in ν_{max} and $\Delta\nu$.

KIC	ν_{max}	$e\nu_{\text{max}}$	$\Delta\nu$	$e\Delta\nu$	$A(\text{ppm})$	eA	T_{eff}	g	eg	RA	DEC	A_{max}	ν_{max}	$\Delta\nu$	Gaia source ID	T_{eff}	L	$\log L$	$\log T_{\text{eff}}$	m(nu-max)	m(Dnu)	m(model)
5024143	120.350	2.720	9.630	0.020	24.2	1.6	4876	2.992	0.012	295.27591	40.1814689	0.002	116.995	9.629	2076299963859451136	4776.51	22.667	1.355	3.679	1.712	1.719	1.61
5024240	153.380	2.280	11.963	0.021	27.5	1.9	4943	3.100	0.009	295.29144	40.1515619	0.007	156.327	11.959	2076299311024414592	5002.50	15.818	1.199	3.699	1.295	1.172	1.62
5024312	96.010	1.530	8.085	0.017	35.0	2.0	4795	2.890	0.009	295.30341	40.1915019	0.008	97.860	8.101	2076300032578958464	4994.00	25.551	1.407	3.698	1.318	1.110	1.91
5024405	97.310	1.440	8.267	0.012	37.5	1.6	4714	2.892	0.009	295.31564	40.1933211	0.008	90.701	7.895	2076300032578973952	4907.50	23.945	1.379	3.691	1.330	1.169	1.58
5024414	78.900	1.340	6.444	0.032	33.1	1.1	4996	2.814	0.01	295.31638	40.1865200	0.011	79.384	8.539	2076300028271234816	4852.25	60.221	1.780	3.686	2.822	3.033	-
5024476	66.780	1.780	5.738	0.039	38.8	1.3	4950	2.739	0.013	295.32401	40.1544000	0.011	68.324	8.830	2076299654621826176	4942.21	72.724	1.862	3.694	2.705	2.858	-
5024512	73.860	1.170	6.683	0.011	43.9	2.0	4740	2.774	0.009	295.32819	40.1985400	0.011	73.342	6.658	2076297283799760640	5018.67	31.299	1.496	3.701	1.220	0.998	1.87
5112072	125.220	0.790	10.026	0.020	41.5	1.8	4901	3.010	0.007	295.23337	40.2276611	0.012	124.781	10.044	2076487976036241536	4949.23	22.289	1.348	3.695	1.547	1.468	1.69
5112403	141.670	1.950	11.118	0.026	26.1	1.9	5039	3.070	0.009	295.29187	40.2189789	0.007	139.202	11.118	2076487774185029504	5080.33	19.35	1.287	3.706	1.387	1.248	1.57
5113441	155.350	1.440	11.690	0.037	35.3	1.7	4837	3.101	0.007	295.46100	40.2669600	0.010	156.135	11.962	2076395002894525952	4779.60	16.038	1.205	3.679	1.560	1.502	1.60

Table 4.3: The RC stars sample. m(nu-max) is the mass calculated using ν_{max} scaling relation. m(Dnu) is the mass calculated using $\Delta\nu$ scaling relation. m(model) is the mass calculated from the model. All the frequencies are in μHz , the maximum amplitude in ppm, the luminosity in solar luminosity, and the effective temperature in K.

KIC	$\nu_{\max}$	$\nu_{\max}$	$\Delta\nu$	$e\Delta\nu$	A(ppm)	eA	T_{eff}	g	eg	RA	DEC	A_{max}	$\nu_{\max}$	$\Delta\nu$	Gaia source ID	T_{eff}	L	$\log L$	$\log T_{\text{eff}}$	m(nu-max)	m(Dnu)	m(model)
4937011	28.05	0.88	4.070	0.072	123.4	7.2	4730	2.353	0.015	295.30695	40.0606119	0.0414	27.025	2.729	2076298039714190976	4760.66	35.626	1.552	3.678	0.635	0.617	-
4937576	33.61	0.70	3.565	0.011	89.6	3.6	4545	2.423	0.011	295.43445	40.0979800	0.0389	33.636	3.516	2076388294867531136	4444.99	58.855	1.770	3.648	1.597	1.517	1.42
5023732	27.42	0.46	3.115	0.012	109.0	5.2	4565	2.335	0.010	295.20013	40.1356889	0.0553	27.137	3.098	2076485678240859136	4548.88	74.370	1.871	3.658	1.518	1.433	1.60
5023931	50.33	1.11	4.906	0.020	47.2	3.3	4707	2.605	0.011	295.23767	40.1685600	0.0157	44.620	4.890	2076487224429134592	4599.21	47.456	1.676	3.663	1.711	1.696	1.48
5023953	49.43	1.14	4.768	0.015	60.8	2.7	4772	2.601	0.012	295.24155	40.1381800	0.0233	49.505	4.749	2076299448463334144	4701.47	74.942	1.875	3.672	2.458	2.786	2.25
5024268	26.97	0.61	2.801	0.054	60.0	2.6	4899	2.343	0.012	295.29596	40.1865689	0.0221	24.814	2.824	2076299993911496320	4728.24	162.886	2.212	3.675	2.857	2.977	2.82
5024297	46.38	0.39	4.566	0.016	71.3	3.6	4619	2.566	0.007	295.30103	40.1927411	0.0319	45.780	4.549	2076300101298433792	4677.23	56.317	1.751	3.670	1.764	1.717	1.73
5024327	44.17	1.00	4.717	0.026	72.2	2.9	4849	2.555	0.012	295.30606	40.1989289	0.0237	43.409	4.691	2076298383311466368	4775.85	56.838	1.755	3.679	1.576	1.639	1.57
5024404	47.61	0.59	4.828	0.033	74.0	2.4	4684	2.580	0.008	295.31519	40.1695900	0.0247	46.539	4.791	2076299719033591424	4570.44	61.871	1.791	3.660	2.157	2.538	1.74
5024583	37.98	0.38	3.889	0.015	71.6	2.9	4609	2.479	0.008	295.33902	40.1833919	0.0292	36.998	3.862	2076299792060819328	4638.48	56.371	1.751	3.666	1.489	1.311	1.53
5024601	32.98	1.18	3.703	0.015	66.4	3.4	4678	2.421	0.017	295.34113	40.1968189	0.0269	32.182	3.693	2076393692914037248	4824.00	83.705	1.923	3.683	1.674	1.700	1.88
5024967	45.60	1.10	4.733	0.023	58.7	3.0	4749	2.565	0.012	295.39352	40.1461719	0.0171	44.137	4.715	2076392528993233024	4777.77	67.803	1.831	3.679	1.939	2.145	1.79
5111940	53.44	0.89	5.176	0.012	55.1	2.7	4718	2.632	0.010	295.20691	40.2420311	0.0192	51.943	5.153	2076488427020005632	4771.03	43.162	1.635	3.679	1.454	1.314	1.55
5111949	47.91	0.88	4.926	0.028	75.8	3.0	4776	2.587	0.010	295.20917	40.2197111	0.0263	46.354	4.780	2076488323940775680	4807.44	68.282	1.834	3.682	2.007	2.262	1.89
5112288	47.12	0.82	4.814	0.028	56.0	2.9	4787	2.581	0.010	295.27182	40.2345089	0.0186	45.728	4.767	2076488049062931328	4818.61	49.417	1.694	3.683	1.417	1.312	1.62
5112373	44.20	0.77	4.646	0.028	80.4	2.9	4729	2.550	0.010	295.28577	40.2249789	0.0342	44.063	4.591	2076487838597288320	4806.00	63.085	1.800	3.682	1.713	1.790	1.68
5112387	46.02	0.8	4.727	0.033	77.2	2.8	4746	2.568	0.010	295.28860	40.2454611	0.0329	45.282	4.678	2076487872957025408	4752.37	54.322	1.735	3.677	1.597	1.584	1.61
5112401	36.51	0.62	4.057	0.033	82.1	3.4	4720	2.467	0.010	295.29129	40.2637711	0.0293	35.123	4.043	2076581919866484224	4860.8	65.811	1.818	3.687	1.419	1.359	1.56
5112467	45.70	0.59	4.703	0.044	65.1	2.5	4785	2.567	0.008	295.30331	40.2066381	0.0225	45.532	4.738	2076300101298449280	4822.25	67.071	1.827	3.683	1.861	1.971	1.89
5112491	44.91	0.68	4.675	0.035	62.4	2.6	4782	2.559	0.009	295.30646	40.2057111	0.0233	43.503	4.665	2076300101294387584	4969.33	56.385	1.751	3.696	1.384	1.253	1.57
5112730	44.21	0.80	4.572	0.027	73.0	2.7	4733	2.550	0.010	295.33948	40.2325900	0.0295	39.671	4.535	2076393937742523904	4702.10	58.833	1.770	3.672	1.725	1.780	1.47
5112744	44.40	0.56	4.413	0.014	71.4	2.8	4643	2.548	0.008	295.34259	40.2789611	0.0299	41.905	4.412	2076581816787312896	4737.69	55.818	1.747	3.676	1.601	1.465	1.50
5112938	45.45	0.74	4.828	0.059	74.7	3.2	4756	2.563	0.009	295.37146	40.2178000	0.0314	44.548	4.762	2076393765943846656	4916.00	52.213	1.718	3.692	1.347	1.271	1.61
5112948	41.98	0.53	4.285	0.017	67.5	4.2	4643	2.524	0.008	295.37262	40.2388919	0.0218	41.710	4.318	2076393869023076608	4564.48	65.128	1.814	3.659	2.012	2.176	1.88
5112950	42.58	0.83	4.352	0.023	72.4	3.0	4756	2.535	0.011	295.37308	40.2058600	0.0266	41.621	4.343	2076393662864626176	4632.80	55.835	1.747	3.666	1.661	1.630	1.50
5112974	40.45	0.66	4.329	0.029	67.4	2.5	4650	2.508	0.01	295.37616	40.2560619	0.0208	37.760	4.322	2076394448828275584	4817.87	68.246	1.834	3.683	1.681	1.723	1.64
5113041	37.32	0.49	3.979	0.014	83.3	3.5	4587	2.470	0.009	295.38879	40.2097089	0.0327	36.240	3.961	2076393010029609984	4552.54	73.176	1.864	3.658	2.028	2.271	1.88
5200152	46.50	0.51	4.642	0.086	73.9	3.0	4849	2.578	0.008	295.34943	40.3623581	0.0294	44.086	4.678	2076582710140560000	4848.37	54.642	1.738	3.686	1.514	1.367	1.58

Table 4.4: The RGB stars sample. $m(\text{nu-max})$ is the mass calculated using $\nu_{\max}$ scaling relation. $m(\text{Dnu})$ is the mass calculated using $\Delta\nu$ scaling relation. $m(\text{model})$ is the mass calculated from the model. All the frequencies are in μHz , the maximum amplitude in ppm, the luminosity in solar luminosity, and the effective temperature in K.

The mass loss that was calculated from the scaling relation that depends on the maximum amplitude was not significant - not only because the difference between the mean RGB mass and the mean RC mass is almost zero, but also because the masses of every single star was not within the range of the expected RG masses. As a result, the scaling relation that depends on the maximum amplitude that was tested in this work for the first time was not sufficiently accurate to be used in the stellar mass calculation.

Separating the RGB and the RC stars confirmed the classification of some stars and changed the classification of others according to the literature. One of the mass loss

values was $-0.048 M_{\odot}$, which is still not a significant value as the ones that were estimated before in the literature ($= -0.03 \pm 0.01 M_{\odot}$ (Handberg et al., 2017)). The other values that were calculated using the difference between the average masses of the RGB and the RC stars were significant ($0.108 M_{\odot}$ and $0.006 M_{\odot}$). The χ^2 minimisation technique has been used before to estimate the mass loss at the TRGB but did not produce a significant result ($-0.027 \pm 0.033 M_{\odot}$ (Abedigamba et al., 2015)). In this work, it produced a value of $0.006 M_{\odot}$. Obtaining the value $0.006 M_{\odot}$ twice from two different methods gives it a greater likelihood to be the correct mass-loss value.

5. Conclusion

Coming out with advanced instruments helps in getting more accurate data and a better understanding of the universe by analysing this data. In this work, I used *Gaia* DR2 that is considered the latest trend in astrometric measurements. The new members of known effective temperature and luminosity were 64 stars. These new members contributed to the accurate estimation of the distance modulus to be 12.173 ± 0.007 mag, $\mu_\sigma = -2.880 \pm 0.244$ mas/yr, and $\mu_\delta = -4.035 \pm 0.253$ mas/yr. It also affected the fitted theoretical isochrone to be of age $\simeq 4$ Gyr.

The asteroseismic data from *Kepler* and the astrometric one from *Gaia* were used for a larger sample of RG stars (compared to the other studies) to estimate the mass loss at the TRGB the method that was discussed in Chapter four. Between the different values of the estimated mass loss, 0.006 is the more tolerable one.

The use of *Gaia* data affected the mass loss result at the TRGB. As it was expected for the TRGB stars to lose some of their masses when you evolve to the RC evolution phase. The significant result of the mass loss is a result of some factors. The first factor was using accurate luminosity and effective temperature from *Gaia*. Second, the approaches that were used to separate the RGB and the RC stars. Third, using more than one method to compare them and obtain an accurate significant result.

Gaia provided high-precision astrometric data for a large sample of stars; some of the stars in that sample have unknown parallax, proper motion, luminosity, or effective temperature, which affected the precision of identifying the stellar properties and calculating the mass loss. Having this information in the future will help to obtain more

precise results regarding the clusters' members, the mean distance modulus, and the mass loss calculation. For future work, the available data from the *Gaia* mission (such as *Gaia* DR3) can be used to create a suitable model that will establish a connection between the cluster stellar parameters and this can be applied to different clusters. Finding a relation that connects between the astrometric parameters and the mass of the star is one of the future works that will definitely help in estimating mass loss at the TRGB accurately and figuring out the mechanism of this process.

References

- D. C. Abbott, J. H. Bieging, and Ed Churchwell. Mass loss from very luminous ob stars and the cygnus superbubble. *APJ*, 250:645, 1981.
- O. P. Abedigamba. *Solar and solar-like oscillations*. PhD thesis, North-West University (South Africa), Mafikeng Campus, 2015.
- O. P. Abedigamba, L. A. Balona, and T. R. Medupe. Red clump stars in kepler open cluster ngc 6819. In *EPJ Web of Conferences*, volume 101, page 06001. EDP Sciences, 2015.
- G. O. Abell, D. Morrison, and S. C. Wolff. *Exploration of the Universe*. Saunders, 1987.
- F. C. Adams and E. Grohs. Stellar helium burning in other universes: A solution to the triple alpha fine-tuning problem. *Astropart. Phys.*, 87:40, 2017.
- C. Aerts, J. Christensen-Dalsgaard, and D. W. Kurtz. *Asteroseismology*. Springer Science & Business Media, 2010.
- C. Aguilera-Gómez, J. Chanamé, and M. H. Pinsonneault. On lithium-6 as a diagnostic of the lithium-enrichment mechanism in red giants. *APJL*, 897:L20, 2020.
- D. R. Alves. K-band calibration of the red clump luminosity. *ApJ*, 539:732, 2000.
- R. Andrae, M. Fouesneau, O. Creevey, C. Ordenovic, N. Mary, A. Burlacu, L. Chaoul, A. Jean-Antoine-Piccolo, G. Kordopatis, A. Korn, et al. Gaia data release 2-first stellar parameters from apsis. *A & A*, 616:A8, 2018.

- B. J. Anthony-Twarog, C. P. Deliyannis, E. Rich, and B. A. Twarog. A lithium-rich red giant below the clump in the kepler cluster, ngc 6819. *ASTROPHYS J LETT*, 767:L19, 2013.
- B. J. Anthony-Twarog, C. P. Deliyannis, and B. A. Twarog. A $uvbyc\alpha\beta$ analysis of the old open cluster, ngc 6819. *AJ*, 148:51, 2014.
- N. H. Apfel. Nebulae: the birth & death of stars. *New York: Lothrop, Lee & Shepard Books, c1988. 1st ed.*, 1988.
- G. Auner. Photographic photometry of the galactic cluster ngc 6819. *A & AS*, 13: 143, 1974.
- L. A. Balona. Gaia luminosities of pulsating af stars in the kepler field. *MNRAS*, 479: 183–191, 2018.
- L. A. Balona, M. Cunha, D. Kurtz, I. M. Brandao, M. Gruberbauer, H. Saio, R. Ostensen, V. Elkin, W. Borucki, J. Christensen-Dalsgaard, et al. Kepler observations of a roap star: delta scuti and gamma doradus pulsations in ap stars. *arXiv preprint arXiv:1006.4013*, 2010.
- L. A. Balona, S. Joshi, Y. C. Joshi, and R. Sagar. Pulsation and rotation of kepler stars in the ngc 6866 field. *MNRAS*, 429(2):1466–1478, 2013a.
- L. A. Balona, T. R. Medupe, O. P. Abedigamba, G. Ayane, L. Keeley, M. Matsididi, G. Mekonnen, M. D. Nhlapo, and N. Sithole. Kepler observations of the open cluster ngc 6819. *MNRAS*, 430:3472, 2013b.
- S. Basu, F. Grundahl, D. Stello, T. Kallinger, S. Hekker, B. Mosser, R. A. García, S. Mathur, K. Brogaard, H. Bruntt, et al. Sounding open clusters: Asteroseismic

- constraints from kepler on the properties of ngc 6791 and ngc 6819. *ASTROPHYS J LETT*, 729:L10, 2011.
- N. M. Batalha, W. J. Borucki, D. G. Koch, S. T. Bryson, M. R. Haas, T. M. Brown, D. A. Caldwell, J. R. Hall, R. L. Gilliland, D. W. Latham, et al. Selection, prioritization, and characteristics of kepler target stars. *ApJL*, 713:L109, 2010.
- F. Baudin, C. Barban, K. Belkacem, S. Hekker, T. Morel, R. Samadi, O. Benomar, M. J. Goupil, F. Carrier, J. Ballot, et al. Amplitudes and lifetimes of solar-like oscillations observed by corot-red-giant versus main-sequence stars. *A & A*, 529:A84, 2011.
- R. L. Beaton, M. Seibert, D. Hatt, W. L. Freedman, T. J. Hoyt, I. S. Jang, M. G. Lee, B. F. Madore, A. J. Monson, R. J. Neeley, et al. The carnegie-chicago hubble program. vii. the distance to m101 via the optical tip of the red giant branch method. *ApJ*, 885:141, 2019.
- P. G. Beck, T. R. Bedding, B. Mosser, D. Stello, R. A. García, T. Kallinger, S. Hekker, Y. P. Elsworth, S. Frandsen, F. Carrier, et al. Kepler detected gravity-mode period spacings in a red giant star. *Sci*, 332:205, 2011.
- P. G. Beck, J. Montalbán, T. Kallinger, J. De Ridder, C. Aerts, R. A. García, S. Hekker, M-A. Dupret, B. Mosser, P. Eggenberger, et al. Fast core rotation in red-giant stars as revealed by gravity-dominated mixed modes. *Nat*, 481:55, 2012.
- S. A. Becker and I. Jr. Iben. The asymptotic giant branch evolution of intermediate-mass stars as a function of mass and composition. i-through the second dredge-up phase. *ApJ*, 232:831, 1979.

- T. R. Bedding, H. Kjeldsen, T. L. Campante, T. Appourchaux, A. Bonanno, W. J. Chaplin, R. A. García, M. Martić, B. Mosser, R. P. Butler, et al. A multi-site campaign to measure solar-like oscillations in Procyon. ii. mode frequencies. *ApJ*, 713:935, 2010.
- T. R. Bedding, B. Mosser, D. Huber, J. Montalbán, P. G. Beck, J. Christensen-Dalsgaard, Y. P. Elsworth, R. A. García, A. Miglio, D. Stello, et al. Gravity modes as a way to distinguish between hydrogen- and helium-burning red giant stars. *Nat*, 471:608, 2011.
- E. P. Bellinger. A seismic scaling relation for stellar age ii: the red giant branch. *MNRAS: Letters*, 492:L50, 2020.
- G. F. Benedict, T. J. Henry, O. G. Franz, B. E. McArthur, L. H. Wasserman, Wei-Chun Jao, P. A. Cargile, S. B. Dieterich, A. J. Bradley, E. P. Nelan, et al. The solar neighborhood. xxxvii. the mass–luminosity relation for main-sequence m dwarfs. *AJ*, 152:141, 2016.
- P. A. Bergbusch and D. A. Vandenberg. Oxygen-enhanced models for globular cluster stars. ii-isochrones and luminosity functions. *APJS*, 81:163–220, 1992.
- T. A. Berger, D. Huber, J. L. van Saders, E. Gaidos, J. Tayar, and A. L. Kraus. The gaia–kepler stellar properties catalog. i. homogeneous fundamental properties for 186,301 kepler stars. *AJ*, 159:280, 2020.
- E. BERTONE and M. Ch´avez. Chromospheric activity and age of solar analogs in open clusters. *MEXICO-USA OBSERVATORY*, page 3, 2015.

- E. Bica and C. Bonatto. Star clusters or asterisms? 2mass cmd and structural analyses of 15 challenging targets. *A & A*, 530:A32, 2011.
- W. J. Borucki, D. G. Koch, G. Basri, N. M. Batalha, T. M. Brown, D. Caldwell, J. Caldwell, J Christensen-Dalsgaard, W. D. Cochran, E. DeVore, et al. Kepler planet-detection mission: introduction and first results. *Sci*, 327:977, 2010.
- D. Bossini, A. Vallenari, A. Bragaglia, T. Cantat-Gaudin, R. Sordo, L. Balaguer-Núñez, C. Jordi, A. Moitinho, C. Soubiran, L. Casamiquela, et al. Age determination for 269 gaia dr2 open clusters. *A & A*, 623:A108, 2019.
- A. Bragaglia and M. Tosi. The bologna open cluster chemical evolution project: midterm results from the photometric sample. *AJ*, 131:1544, 2006.
- A. Bragaglia, E. Carretta, R. G. Gratton, M. Tosi, G. Bonanno, P. Bruno, A. Calì, R. Claudi, R. Cosentino, S. Desidera, et al. Metal abundances of red clump stars in open clusters. i. ngc 6819. *AJ*, 121:327, 2001.
- A. Bressan, P. Marigo, L. Girardi, B. Salasnich, C. Dal Cero, S. Rubele, and A. Nanni. Parsec: stellar tracks and isochrones with the padova and trieste stellar evolution code. *MNRAS*, 427:127–145, 2012.
- K. Brogaard, H. Bruntt, F. Grundahl, J. V. Clausen, S. Frandsen, D. A. Vandenberg, and L. R. Bedin. Age and helium content of the open cluster ngc 6791 from multiple eclipsing binary members-i. measurements, methods, and first results. *A & A*, 525:A2, 2011.
- K. Brogaard, E. L. Sandquist, J. Jessen-Hansen, F. Grundahl, and S. Frandsen. Ex-

- exploiting the open clusters in the kepler and corot fields. In *Asteroseismology of Stellar Populations in the Milky Way*, page 51. Springer, 2015.
- A.G.A. Brown, A. Vallenari, T. Prusti, J.H.J. De Bruijne, F. Mignard, R. Drimmel, C. Babusiaux, C.A.L. Bailer-Jones, U. Bastian, M. Biermann, et al. Gaia data release 1-summary of the astrometric, photometric, and survey properties. *A & A*, 595:A2, 2016.
- A.G.A. Brown, A. Vallenari, T. Prusti, J.H.J. De Bruijne, C. Babusiaux, C.A.L. Bailer-Jones, M. Biermann, D. W. Evans, L. Eyer, F. Jansen, et al. Gaia data release 2-summary of the contents and survey properties. *A & A*, 616:A1, 2018.
- M. S. Burkhead. Photometric observations of the star cluster ngc 6819. *AJ*, 76:251, 1971.
- D. Buzasi, J. Catanzarite, R. Laher, T. Conrow, D. Shupe, T. N. Gautier III, T. Kreidl, and D. Everett. The detection of multimodal oscillations on α ursae majoris. *ASTROPHYS J LETT*, 532:L133, 2000.
- T. Cantat-Gaudin, C. Jordi, A. Vallenari, A. Bragaglia, L. Balaguer-Núñez, C. Soubiran, D. Bossini, A. Moitinho, A. Castro-Ginard, A. Krone-Martins, et al. A gaia dr2 view of the open cluster population in the milky way. *A & A*, 618:A93, 2018a.
- T. Cantat-Gaudin, A. Vallenari, R. Sordo, F. Pensabene, A. Krone-Martins, A. Moitinho, C. Jordi, L. Casamiquela, L. Balaguer-Núñez, C. Soubiran, et al. Characterising open clusters in the solar neighbourhood with the tycho-gaia astrometric solution. *A & A*, 615:A49, 2018b.

- R. Canterna, D. Geisler, H. C. Harris, E. Olszewski, and R. Schommer. Washington photometry of open cluster giants-the metal-rich clusters. *AJ*, 92:79, 1986.
- J. K. Carlberg, S. R. Majewski, R. J. Patterson, D. Bizyaev, V. V. Smith, and K. Cunha. The frequency of rapid rotation among k giant stars. *ApJ*, 732:39, 2011.
- J. K. Carlberg, V. V. Smith, K. Cunha, S. R. Majewski, S. Mészáros, M. Shetrone, C. A. Prieto, D. Bizyaev, K. G. Stassun, S. W. Fleming, et al. The puzzling li-rich red giant associated with ngc 6819. *ApJ*, 802:7, 2015.
- G. Carraro, A. Buzzoni, E. Bertone, and L. Buson. Ub ccd photometry of the old, metal-rich, open clusters ngc 6791, ngc 6819, and ngc 7142. *AJ*, 146:128, 2013.
- L. Casagrande and D. A. Vandenberg. Synthetic stellar photometry–i. general considerations and new transformations for broad-band systems. *MNRAS*, 444:392, 2014.
- I. J. Castor, D. C. Abbott, and R. I. Klein. Radiation-driven winds in of stars. *ApJ*, 195:157, 1975.
- A. Castro-Ginard, C. Jordi, X. Luri, F. Julbe, M. Morvan, L. Balaguer-Núñez, and T. Cantat-Gaudin. A new method for unveiling open clusters in gaia-new nearby open clusters confirmed by dr2. *A & A*, 618:A59, 2018.
- W. J. Chaplin and A. Miglio. Asteroseismology of solar-type and red-giant stars. *AnnRev*, 51:353, 2013.
- C. Charbonnel, T. Decressin, N. Lagarde, F. Gallet, A. Palacios, M. Aurière, R. Konstantinova-Antova, S. Mathis, R. I. Anderson, and B. Dintrans. The magnetic strip (s) in the advanced phases of stellar evolution-theoretical convective turnover

- timescale and rossby number for low-and intermediate-mass stars up to the agb at various metallicities. *A & A*, 605:A102, 2017.
- J. Christensen-Dalsgaard. Lecture notes on stellar oscillations. 1997.
- J. Christensen-Dalsgaard. Stellar oscillations. *Institut for Fysik og Astronomi, Aarhus Universitet, Denmark*, 2003.
- J. Christensen-Dalsgaard and S. Frandsen. Stellar 5 min oscillations. In *IAU Colloquium*, volume 66, page 469. Cambridge University Press, 1983.
- M. Cohen, J. H. Bieging, and P. R. Schwartz. Vla observations of mass loss from tauri stars. *ApJ*, 253:707, 1982.
- P. Collinder. On structural properties of open galactic clusters and their spatial distribution. catalog of open galactic clusters. *Annals of the Observatory of Lund*, 2:B1, 1931.
- E. Corsaro, D. Stello, D. Huber, T. R. Bedding, A. Bonanno, K. Brogaard, T. Kallinger, O. Benomar, T. R. White, B. Mosser, et al. Asteroseismology of the open clusters ngc 6791, ngc 6811, and ngc 6819 from 19 months of kepler photometry. *AJ*, 757:190, 2012.
- G. R. Davies, M. N. Lund, A. Miglio, Y. P. Elsworth, J. S. Kuszlewicz, T.S.H. North, B. Rendle, W. J. Chaplin, T. S. Rodrigues, T. L. Campante, et al. Using red clump stars to correct the gaia dr1 parallaxes. *A & A*, 598:L4, 2017.
- J. De Ridder, C. Barban, F. Baudin, F. Carrier, A. P. Hatzes, S. Hekker, T. Kallinger, W. W. Weiss, A. Baglin, M. Auvergne, et al. Non-radial oscillation modes with long lifetimes in giant stars. *Nature*, 459:398, 2009.

- C. P. Deliyannis, B. J. Anthony-Twarog, D. B. Lee-Brown, and B. A. Twarog. Li evolution and the open cluster ngc 6819: A correlation between li depletion and spindown in dwarfs more massive than the f-dwarf li-dip. *AJ*, 158:163, 2019.
- P. Demarque, J. H. Woo, Y. C. Kim, and K. Y. Sukyoung. Y2 isochrones with an improved core overshoot treatment. *ApJS*, 155:667, 2004.
- M. P. Di Mauro, D. Cardini, G. Catanzaro, R. Ventura, C. Barban, T. R. Bedding, J. Christensen-Dalsgaard, J. De Ridder, S. Hekker, D. Huber, et al. Solar-like oscillations from the depths of the red-giant star kic 4351319 observed with kepler. *MNRAS*, 415:3783, 2011.
- A. Dotter, B. Chaboyer, J. W. Ferguson, H. Lee, G. Worthey, D. Jevremović, and E. Baron. Stellar population models and individual element abundances. i. sensitivity of stellar evolution models. *AJ*, 666(1):403, 2007.
- A. Dotter, B. Chaboyer, D. Jevremović, V. Kostov, E. Baron, and J. W. Ferguson. The dartmouth stellar evolution database. *ApJS*, 178:89, 2008.
- J. L. E. Dreyer. A new general catalogue of nebulæ and clusters of stars, being the catalogue of the late sir john fw herschel, bart, revised, corrected, and enlarged. *Mem. R. Astron. Soc.*, 49:1, 1888.
- M-A. Dupret, K. Belkacem, R. Samadi, J. Montalbán, O. Moreira, A. Miglio, M. Godart, P. Ventura, H-G. Ludwig, A. Grigahcène, et al. Theoretical amplitudes and lifetimes of non-radial solar-like oscillations in red giants. *A & A*, 506:57–67, 2009.
- Y. P. Elsworth, S. Hekker, S. Basu, and G. R. Davies. A new method for the aster-

- oseismic determination of the evolutionary state of red-giant stars. *MNRAS*, 466: 3344, 2017.
- Y. P. Elsworth, S. Hekker, J. A. Johnson, T. Kallinger, B. Mosser, M. Pinsonneault, M. and Hon, J. Kuzlewicz, A. Miglio, A. Serenelli, et al. Insights from the apokasc determination of the evolutionary state of red-giant stars by consolidation of different methods. *MNRAS*, 489:4641, 2019.
- K. J. Falk and R. Mitalas. Evolution of a $30\text{ m}_{\odot}$ star with mass loss–i. core h burning phases. *MON NOT RASTRON SOC*, 196:225, 1981.
- M. N. Fanelli et al. Kepler data processing handbook (ksci-19081-001). *Kepler Project Office, NASA/Ames Research Center, Moffett Field, California*, 2011.
- j. Faulkner. On the nature of the horizontal branch. i. *ApJ*, 144:978, 1966.
- K. C. Freeman, D. C. Heggie, G. L. H. Harris, G. Lynga, P. E. Nissen, C. Pilachowski, and G. N. Salufcvadze. Commission 37: Star clusters and associations. *Transactions of the I.A.U.*, 19:521, 1985.
- E. D. Friel. The old open clusters of the milky way. *AnnRev*, 33:381, 1995.
- E. D. Friel and K. A. Janes. Metallicities and radial velocities of old open clusters. *A & A*, 267:75, 1993.
- E. D. Friel, T. Liu, and K. A. Janes. Radial velocities of more old open clusters. *PASP*, 101:1105, 1989.
- E. D. Friel, K. A. Janes, M. Tavaréz, J. Scott, R. Katsanis, J. Lotz, L. Hong, and N. Miller. Metallicities of old open clusters. *AJ*, 124:2693, 2002.

- I. Fushiki and D. Q. Lamb. S-matrix calculation of the triple-alpha reaction. *ApJ*, 317: 368, 1987.
- F. Fusi-Peccì and A. Renzini. On total mass loss in stars with masses not exceeding about 8 solar masses. *A & A*, 46:447, 1976.
- Gaia Collaboration et al. The gaia mission. *arXiv preprint arXiv:1609.04153*, 2016.
- R. A. García. Observational techniques to measure solar and stellar oscillations. *EAS Publications Series*, 73:193, 2015.
- P. M. Garnavich, D. A. Vandenberg, D. R. Zurek, and J. E. Hesser. Red-giant branch of the old, metal-rich open cluster ngc 6791. *AJ*, 107:1097, 1994.
- P. Gaulme, J. Jackiewicz, F. Spada, D. Chojnowski, B. Mosser, J. McKeever, A. Hedlund, M. Vrad, M. Benbakoura, and C. Damiani. Active red giants: close binaries versus single rapid rotators. *A & A*, 2020.
- H. Ge, R. F. Webbink, and Z. Han. The thermal equilibrium mass loss model and its applications in binary evolution. *ApJS*, 249:9, 2020.
- R. L. Gilliland, T. M. Brown, J. Christensen-Dalsgaard, H. Kjeldsen, C. Aerts, T. Appourchaux, S. Basu, T. R. Bedding, W. J. Chaplin, M. S. Cunha, et al. Kepler asteroseismology program: introduction and first results. *PASP*, 122:131, 2010.
- L. Girardi. A secondary clump of red giant stars: why and where. *MNRAS*, 308:818, 1999.
- N. M. Gosnell, D. Pooley, A. M. Geller, J. Kalirai, R. D. Mathieu, P. Frinchaboy, and E. Ramirez-Ruiz. An unexpected discovery in the rich open cluster ngc 6819 using xmm-newton. *APJ*, 745(1):57, 2011.

- J. R. Gott III, M. Jurić, D. Schlegel, F. Hoyle, M. Vogeley, M. Tegmark, N. Bahcall, and J. Brinkmann. A map of the universe. *AJ*, 624:463, 2005.
- G. Gräfener, S.P. Owocki, and J.S. Vink. Stellar envelope inflation near the eddington limit-implications for the radii of wolf-rayet stars and luminous blue variables. *A & A*, 538:A40, 2012.
- D. F. Gray. Rotation and turbulence in g giant stars. *ApJ*, 251:155, 1981.
- D. F. Gray and T. Nagel. The granulation boundary in the hr diagram. *ApJ*, 341:421, 1989.
- J. E. Greivenkamp and D. L. Steed. The history of telescopes and binoculars: an engineering perspective. In *Novel Optical Systems Design and Optimization XIV*, volume 8129, page 812902. International Society for Optics and Photonics, 2011.
- P. Hacking, T. Herter, C. Stacey, J. R. Houck, D. L. Shupe, C. Lonsdale, T. N. Gautier, H. R. Schember, M. W. Werner, B. T. Soifer, et al. The wide-field infrared explorer (wire) mission. In *Diffuse Infrared Radiation and the IRTS*, volume 124, page 432, 1997.
- Z. Han, Ph. Podsiadlowski, P. F. L. Maxted, and T. R. Marsh. The origin of subdwarf b stars—ii. *MNRAS*, 341:669, 2003.
- R. Handberg, A. Miglio, K. Brogaard, D. Bossini, and Y. P. Elsworth. Peakbagging in the open cluster ngc 6819: Opening a treasure chest or pandora’s box? *Astron. Nachr*, 337:799, 2016.
- R. Handberg, K. Brogaard, A. Miglio, D. Bossini, Y. P. Elsworth, D. Slumstrup, G. R.

- Davies, and W. J. Chaplin. Ngc 6819: testing the asteroseismic mass scale, mass loss and evidence for products of non-standard evolution. *MNRAS*, 472:979, 2017.
- G. Handler. Asteroseismology. *arXiv preprint arXiv:1205.6407*, 2012.
- C. O. Heinke, M. G. Ivanov, E. W. Koch, R. Andrews, L. Chomiuk, H. N. Cohn, S. Crothers, T. de Boer, N. Ivanova, A. K. H. Kong, et al. The x-ray emissivity of low-density stellar populations. *MNRAS*, 492:5684, 2020.
- S. Hekker and S. Basu. Asteroseismic ages of red-giant stars from grid-based modelling: the impact of systematics in effective temperature or metallicity. *arXiv preprint arXiv:1910.14108*, 2019.
- S. Hekker and J. Christensen-Dalsgaard. Giant star seismology. *A & AR*, 25:1, 2017.
- S. Hekker, S. Basu, D. Stello, T. Kallinger, F. Grundahl, S. Mathur, R. A. García, B. Mosser, D. Huber, T. R. Bedding, et al. Asteroseismic inferences on red giants in open clusters ngc 6791, ngc 6819, and ngc 6811 using kepler. *A & A*, 530:A100, 2011a.
- S. Hekker, R. L. Gilliland, S. Basu, J. De Ridder, W. J. Chaplin, and Y. P. Elsworth. Ensemble asteroseismology of red-giant stars. *arXiv preprint arXiv:1109.0144*, 2011b.
- S. Hekker, R. L. Gilliland, Y. P. Elsworth, W. J. Chaplin, J. De Ridder, D. Stello, T. Kallinger, K. A. Ibrahim, T. C. Klaus, and J. Li. Characterization of red giant stars in the public kepler data. *MNRAS*, 414:2594, 2011c.
- T. J. Henry and D. W. McCarthy Jr. The mass-luminosity relation for stars of mass 1.0 to 0.08 solar mass. *AJ*, 106:773, 1993.

- F. Herwig, T. Bloeker, N. Langer, and T. Driebe. On the formation of hydrogen-deficient post-agb stars. *arXiv preprint astro-ph/9908108*, 1999.
- S. Höfner and H. Olofsson. Mass loss of stars on the asymptotic giant branch. *A & AR*, 26:1, 2018.
- K. T. Hole, A. M. Geller, R. D. Mathieu, I. Platais, S. Meibom, and D. W. Latham. Wiy open cluster study. xxiv. stellar radial-velocity measurements in ngc 6819. *AJ*, 138:159, 2009.
- M. Hon, D. Stello, R. A. García, S. Mathur, S. Sharma, I. L. Colman, and L. Bugnet. A search for red giant solar-like oscillations in all kepler data. *MNRAS*, 485:5616, 2019.
- D. Huber, T. R. Bedding, D. Stello, B. Mosser, S. Mathur, T. Kallinger, S. Hekker, Y. P. Elsworth, D. Buzasi, J. De Ridder, et al. Asteroseismology of red giants from the first four months of kepler data: global oscillation parameters for 800 stars. *ApJ*, 723:1607, 2010.
- I. Jr. Iben. Stellar evolution. vii. the evolution of a $2.25 m_{\odot}$ star from the main sequence to the helium-burning phase. *ApJ*, 147:650, 1967.
- I. Jr. Iben and R. T. Rood. Age and initial helium abundance of globular cluster stars. *Nat*, 223:933, 1969.
- M. W. Jeffries Jr, E. L. Sandquist, R. D. Mathieu, A. M. Geller, J. A. Orosz, K. E. Milliman, L. N. Brewer, I. Platais, K. Brogaard, F. Grundahl, et al. Wocs 40007: a detached eclipsing binary near the turnoff of the open cluster ngc 6819. *AJ*, 146:58, 2013.

- R. Jimenez, U. G. Jorgensen, and L. Verde. Giants eating giants: Mass loss and giant planets modifying the luminosity of the tip of the giant branch. *JCAP*, 2020(10): 027, 2020.
- A. C. S. Jørgensen, J. Montalbán, A. Miglio, B. M. Rendle, G. R. Davies, G. Buldgen, R. Scuflaire, A. Noels, P. Gaulme, and R. A. García. Investigating surface correction relations for rgb stars. *MNRAS*, 2020.
- B. R. Jørgensen and L. Lindegren. Determination of stellar ages from isochrones: Bayesian estimation versus isochrone fitting. *A & A*, 436:127–143, 2005.
- A. Jorissen, N. Mowlavi, C. Sterken, and J. Manfroid. The onset of photometric variability in red giant stars. *A & A*, 324:578, 1997.
- J. S. Kalirai and M. Tosi. Interpreting the colour–magnitude diagrams of open star clusters through numerical simulations. *MNRAS*, 351:649, 2004.
- J. S. Kalirai, H. B. Richer, G. G. Fahlman, J-C. Cuillandre, P. Ventura, F. D’Antona, E. Bertin, G. Marconi, and P. R. Durrell. The cfht open star cluster survey. ii. deep ccd photometry of the old open star cluster ngc 6819. *AJ*, 122:266, 2001.
- J. S. Kalirai, B. M. S. Hansen, D. D. Kelson, D. B. Reitzel, R. M. Rich, and H. B. Richer. The initial-final mass relation: Direct constraints at the low-mass end. *ApJ*, 676:594, 2008.
- T. Kallinger, W. W. Weiss, C. Barban, F. Baudin, C. Cameron, F. Carrier, J. De Ridder, M. J. Goupil, M. Gruberbauer, A. P. Hatzes, et al. Oscillating red giants in the corot exofield: asteroseismic mass and radius determination. *A & A*, 509:A77, 2010.

- T. Kallinger, S. Hekker, B. Mosser, J. De Ridder, T. R. Bedding, Y. P. Elsworth, Gruberbauer. M., D. B. Guenther, D. Stello, S. Basu, et al. Evolutionary influences on the structure of red-giant acoustic oscillation spectra from 600d of kepler observations. *A & A*, 541:A51, 2012.
- H. Karttunen, P. Kröger, H. Oja, M. Poutanen, and K. J. Donner. *Fundamental astronomy*. Springer, 2016.
- N. V. Kharchenko, A. E. Piskunov, E. Schilbach, S. Röser, and R-D. Scholz. Global survey of star clusters in the milky way-ii. the catalogue of basic parameters. *A & A*, 558:A53, 2013.
- R. Kippenhahn, A. Weigert, and A. Weiss. *Stellar structure and evolution*. Springer, 1990.
- L. Kitchatinov and A. Nepomnyashchikh. Modelling differential rotation of red giants: the case of the evolved sun. *MNRAS: Letters*, 490:L71, 2019.
- H. Kjeldsen and T. R. Bedding. Amplitudes of stellar oscillations: the implications for asteroseismology. *arXiv preprint astro-ph/9403015*, page 293, 1994.
- D. G. Koch, W. J. Borucki, E. W. Dunham, J. Geary, R. L. Gilliland, J. Jenkins, D. W. Latham, E. Bachtell, D. Berry, W. Deiningen, et al. Overview and status of the kepler mission. In *Optical, Infrared, and Millimeter Space Telescopes*, volume 5487, page 1491. International Society for Optics and Photonics, 2004.
- D. G. Koch, W. J. Borucki, G. Basri, N. M. Batalha, T. M. Brown, D. Caldwell, J. Christensen-Dalsgaard, W.D. Cochran, E. DeVore, E. W. Dunham, et al. Kepler

- mission design, realized photometric performance, and early science. *ASTROPHYS J LETT*, 713:L79, 2010.
- E. Komucyeya, O. P. Abedigamba, E. Jurua, and S. K. Anguma. New red giant star in the kepler open cluster ngc 6819. *New Astronomy*, 61:65, 2018.
- C. A. Kuehn III, J. Drury, D. Stello, and T. R. Bedding. Photometry using kepler" superstamps" of open clusters ngc 6791 & ngc 6819. *IAU. Proceedings of the IAU*, 9:445, 2013.
- B. Külebi, J. S. Kalirai, S. Jordan, and F. Euchner. The progenitors of magnetic white dwarfs in open clusters. *A & A*, 554:A18, 2013.
- Y. B. Kumar, R. Singh, B. E. Reddy, and G. Zhao. Two new super li-rich core he-burning giants: A new twist to the long tale of li enhancement in k giants. *ApJ*, 858, 2018.
- C. J. Lada and E. A. Lada. Embedded clusters in molecular clouds. *ARA & A*, 41: 57–115, 2003.
- K. R. Lang. *Essential astrophysics*. Springer, 2013.
- M. G. Lee, W. L. Freedman, and B. F. Madore. The tip of the red giant branch as a distance indicator for resolved galaxies. *ApJ*, 417:553, 1993.
- RB Leighton. —rb leighton. In *Symposium-IAU*, volume 12, page 321. Cambridge University Press, 1960.
- Y. Li. Effect of overshooting mixing below the base of the convective envelope on the rgb bump. *IAUGA*, 29:2245441, 2015.

- U. Lindoff. The old open cluster ngc 6819. *A & AS*, 7:497, 1972.
- M. Lucey, Y. S. Ting, N. S. Ramachandra, and K. Hawkins. From the inner to outer milky way: A pristine sample of 4.3 million red clump stars. *arXiv preprint arXiv:2002.02961*, 2020.
- K. L. Luhman, G. H. Rieke, E. T. Young, A. A. Cotera, H. Chen, M. J. Rieke, G. Schneider, and R. I. Thompson. The initial mass function of low-mass stars and brown dwarfs in young clusters. *ApJ*, 540:1016, 2000.
- A. Luna, D. Minniti, and J. Alonso-García. Candidate hypervelocity red clump stars in the galactic bulge found using the vvv and gaia surveys. *ASTROPHYS J LETT*, 887:L39, 2019.
- G. Lynga. Open clusters in our galaxy. *Astronomy and Astrophysics*, 109:213–222, 1982.
- J. MacDonald. Evolution from red giant to white dwarf. In *Structure and Evolution of Single Stars*. Morgan & Claypool Publishers, 2015.
- Stephen P Maran and Laurence A Marschall. *Galileo's New Universe: The Revolution in Our Understanding of the Cosmos*. BenBella Books, 2009.
- J. Martín-Fleitas, J. Sahlmann, A. Mora, R. Kohley, B. Massart, J. L'hermitte, M. Le Roy, and P. Paulet. Enabling gaia observations of naked-eye stars. In *Space Telescopes and Instrumentation 2014: Optical, Infrared, and Millimeter Wave*, volume 9143, page 91430Y. International Society for Optics and Photonics, 2014.
- J. M. Matthews, R. Kusching, D. B. Guenther, G. Walker, A. F. J Moffat, S. Rucin-

- ski, D. Sasselov, and W. W. Weiss. No stellar p-mode oscillations in space-based photometry of procyon. *Nat*, 430:51, 2004.
- M. S. Mayor. Chemical evolution of the galactic disk and the radial metallicity gradient. *Astronomy and Astrophysics*, 48:301, 1976.
- S. Meibom, S. A. Barnes, D. W. Latham, N. M. Batalha, W. J. Borucki, D. G. Koch, G. Basri, L. M. Walkowicz, K. A. Janes, J. Jenkins, et al. The kepler cluster study: Stellar rotation in ngc 6811. *ASTROPHYS J LETT*, 733:L9, 2011.
- S. Meibom, S. A. Barnes, I. Platais, R. L. Gilliland, D. W. Latham, and R. D. Mathieu. A spin-down clock for cool stars from observations of a 2.5-billion-year-old cluster. *Nat*, 517:589, 2015.
- A. Miglio, K. Brogaard, D. Stello, W. J. Chaplin, F. D'antona, J. Montalbán, S. Basu, A. Bressan, F. Grundahl, M. Pinsonneault, et al. Asteroseismology of old open clusters with kepler: direct estimate of the integrated red giant branch mass-loss in ngc 6791 and 6819. *MNRAS*, 419:2077, 2012.
- A. Miglio, W. J. Chaplin, K. Brogaard, M. N. Lund, B. Mosser, G. R. Davies, R. Handberg, A. P. Milone, A. F. Marino, D. Bossini, et al. Detection of solar-like oscillations in relics of the milky way: asteroseismology of k giants in m4 using data from the nasa k2 mission. *MNRAS*, 461:760, 2016.
- J. Molenda-Żakowicz, H. Bruntt, S. Sousa, A. Frasca, K. Biazzo, D. Huber, M. J. Ireland, T. R. Bedding, D. Stello, K. Uytterhoeven, et al. Asteroseismology of solar-type stars with kepler: lii. ground-based data. *Astron. Nachr*, 331:981, 2010.
- J. Montalbán, A. Miglio, A. Noels, R. Scuflaire, and P. Ventura. Seismic diagnostics of

- red giants: first comparison with stellar models. *ASTROPHYS J LETT*, 721:L182, 2010.
- E. Moraux. Open clusters and associations in the gaia era. *EAS Publications Series*, 80:73, 2016.
- B. Mosser, K. Belkacem, M. J. Goupil, A. Miglio, T. Morel, C. Barban, F. Baudin, S. Hekker, R. Samadi, J. De Ridder, et al. Red-giant seismic properties analyzed with corot. *A & A*, 517:A22, 2010.
- B. Mosser, K. Belkacem, M. J. Goupil, E. Michel, Y. P. Elsworth, C. Barban, T. Kallinger, S. Hekker, J. De Ridder, R. Samadi, et al. The universal red-giant oscillation pattern-an automated determination with corot data. *A & A*, 525:L9, 2011.
- B. Mosser, Y. P. Elsworth, S. Hekker, D. Huber, T. Kallinger, S. Mathur, K. Belkacem, M. J. Goupil, R. Samadi, C. Barban, et al. Characterization of the power excess of solar-like oscillations in red giants with kepler. *A & A*, 537:A30, 2012a.
- B. Mosser, M. J. Goupil, K. Belkacem, J. P. Marques, P. G. Beck, S. Bloemen, J. De Ridder, C. Barban, S. Deheuvels, Y. P. Elsworth, et al. Spin down of the core rotation in red giants. *A & A*, 548:A10, 2012b.
- B. Mosser, M. J. Goupil, K. Belkacem, E. Michel, D. Stello, J. P. Marques, Y. P. Elsworth, C. Barban, P. G. Beck, T. R. Bedding, et al. Probing the core structure and evolution of red giants using gravity-dominated mixed modes observed with kepler. *A & A*, 540:A143, 2012c.
- B. Mosser, M. Vrad, K. Belkacem, K. Deheuvels, and M. J. Goupil. Period spacings

- in red giants-i. disentangling rotation and revealing core structure discontinuities. *A & A*, 584:A50, 2015.
- B. Mosser, K. Belkacem, C. Pincon, M. Takata, M. Vrad, C. Barban, M. J. Goupil, T. Kallinger, and R. Samadi. VizieR online data catalog: Kic red giants showing depressed mixed modes (mosser+, 2017). *VizieR Online Data Catalog*, 359, 2017.
- B. Mosser, C. Gehan, K. Belkacem, R. Samadi, E. Michel, and M. J. Goupil. Period spacings in red giants-iv. toward a complete description of the mixed-mode pattern. *A & A*, 618:A109, 2018.
- M. G. Navarro, R. C. Ramos, D. Minniti, J. Pullen, R. Capuzzo-Dolcetta, and P. W. Lucas. Vvv survey microlensing: Catalog of best and forsaken events. *AJ*, 893:65, 2020.
- F. Nogueras-Lara, R. Schödel, F. Najarro, A. T. Gallego-Calvente, E. Gallego-Cano, B. Shahzamanian, and N. Neumayer. Variability of the near-infrared extinction curve towards the galactic centre. *A & A*, 630:L3, 2019.
- J. R. North, J. Davis, T. R. Bedding, M. J. Ireland, A. P. Jacob, J. O’Byrne, S. M. Owens, J. G. Robertson, W. J. Tango, and P. G. Tuthill. The radius and mass of the subgiant star β hyi from interferometry and asteroseismology. *MNRAS: Letters*, 380:L80, 2007.
- H. Oberhummer. and its anthropic significance. *Nuclei in the cosmos V*, page 119, 1998.
- S.P. Owocki. Theory of winds from hot, luminous massive stars. *arXiv preprint arXiv:1409.2084*, 2014.

- B. Paczynski. Common envelope binaries. In *Symposium-International Astronomical Union*, volume 73, page 75. Cambridge University Press, 1976.
- C. Paladini, F. Baron, A. Jorissen, J-B. Le Bouquin, B. Freytag, S. Van Eck, M. Witkowski, J. Hron, A. Chiavassa, J-P. Berger, et al. Large granulation cells on the surface of the giant star π 1 gruis. *Nat*, 553:310, 2018.
- N. Panagia and M. Tosi. Galactic metal abundance gradient in young stellar population. *Astronomy and Astrophysics*, 96:306, 1981.
- M. A. C. Perryman. Hipparcos—the esa space astrometry mission: Overview and status. *Highlights of Astronomy*, 7:673, 1986.
- M. Pinsonneault, Y. P. Elsworth, V. Silva Aguirre, W. J. Chaplin, R. A. García, S. Hekker, J. Holtzman, D. Huber, J. Johnson, T. Kallinger, et al. Empirically calibrated asteroseismic masses and radii for red giants in the kepler fields. In *American Astronomical Society Meeting Abstracts# 231*, volume 231, 2018.
- I. Platais, N. M. Gosnell, S. Meibom, V. Kozhurina-Platais, A. Bellini, C. Veillet, and M. S. Burkhead. Wiyn open cluster study. iv. astrometry and membership in ngc 6819. *AJ*, 146:43, 2013.
- D. Prialnik. *An introduction to the theory of stellar structure and evolution*. Cambridge University Press, 2000.
- G. Rangwal, R. K. S. Yadav, A. Durgapal, D. Bisht, and D. Nardiello. Astrometric and photometric study of ngc 6067, ngc 2506, and ic 4651 open clusters based on wide-field ground and gaia dr2 data. *MNRAS*, 490:1383, 2019.

- B. E. Reddy. Study of lithium-rich giants with the galah spectroscopic survey. *MNRAS*, 484:2000–2008, 2019.
- D. Reimers. Observational evidence for mass-loss from k giants, g and k supergiants. *A & A*, 57:395, 1977.
- D. Reimers et al. Circumstellar absorption lines and mass loss from red giants. 1975.
- T. S. Rodrigues, D. Bossini, A. Miglio, L. Girardi, J. Montalbán, A. Noels, M. Trabucchi, H. R. Coelho, and P. Marigo. Determining stellar parameters of asteroseismic targets: going beyond the use of scaling relations. *MNRAS*, 467:1433, 2017.
- J. M. Rosvick and D. A. Vandenberg. Bv photometry for the 2.5 gyr open cluster ngc 6819: more evidence for convective core overshooting on the main sequence. *AJ*, 115:1516, 1998.
- R. K. Saito, D. Minniti, R. A. Benjamin, M. G. Navarro, J. Alonso-García, O. A. Gonzalez, R. Kammers, and F. Surot. Vvv win 1733- 3349: a low extinction window to probe the far side of the milky way bulge. *MNRAS: Letters*, 494:L32, 2020.
- M. Salaris and S. Cassisi. *Evolution of stars and stellar populations*. Wiley Online Library, 2005.
- M. Salaris, A. Chieffi, and O. Straniero. The alpha-enhanced isochrones and their impact on the fits to the galactic globular cluster system. *AJ*, 414:580–600, 1993.
- E. L. Sandquist, R. D. Mathieu, K. Brogaard, S. Meibom, A. M. Geller, J. A. Orosz, K. E. Milliman, M. W. Jeffries Jr, L. N. Brewer, I. Platais, et al. A long-period totally eclipsing binary star at the turnoff of the open cluster ngc 6819 discovered with kepler. *ApJ*, 762:58, 2012.

- D. Schönberner. Late stages of stellar evolution. ii-mass loss and the transition of asymptotic giant branch stars into hot remnants. *ApJ*, 272:708, 1983.
- V. Silva Aguirre, G. R. Ruchti, S. Hekker, S. Cassisi, J. Christensen-Dalsgaard, A. Datta, A. Jendrieck, J. Jessen-Hansen, A. Mazumdar, B. Mosser, et al. Old puzzle, new insights: a lithium-rich giant quietly burning helium in its core. *ASTROPHYS J LETT*, 784:L16, 2014.
- R. Singh, B. E. Reddy, Y. B. Kumar, and H. M. Antia. Survey of li-rich giants among kepler and lamost fields: Determination of li-rich giants' evolutionary phase. *ASTROPHYS J LETT*, 878:L21, 2019.
- D. Slumstrup, F. Grundahl, K. Brogaard, A. O. Thygesen, P. E. Nissen, J. Jessen-Hansen, V. Van Eylen, and M. G. Pedersen. The $[y/mg]$ clock works for evolved solar metallicity stars. *A & A*, 604:L8, 2017.
- I. Soszynski, R. Poleski, A. Udalski, M. K. Szymanski, M. Kubiak, G. Pietrzynski, L. Wyrzykowski, O. Szewczyk, and K. Ulaczyk. The optical gravitational lensing experiment. the ogle-iii catalog of variable stars. i. classical cepheids in the large magellanic cloud. *arXiv preprint arXiv:0808.2210*, 2008.
- I. Soszynski, R. Poleski, A. Udalski, M. K. Szymanski, M. Kubiak, G. Pietrzynski, L. Wyrzykowski, O. Szewczyk, and K. Ulaczyk. The optical gravitational lensing experiment. the ogle-iii catalog of variable stars. vii. classical cepheids in the small magellanic cloud. *arXiv preprint arXiv:1003.4518*, 2010.
- C. Soubiran, T. Cantat-Gaudin, M. Romero-Gómez, L. Casamiquela, C. Jordi, A. Valenari, T. Antoja, L. Balaguer-Núñez, D. Bossini, A. Bragaglia, et al. Open cluster kinematics with gaia dr2. *A & A*, 619:A155, 2018.

- D. Stello, H. Bruntt, H. Kjeldsen, T. R. Bedding, T. Arentoft, R. L. Gilliland, J. Nuspl, S.-L. Kim, Y. B. Kang, J.-R. Koo, et al. Multisite campaign on the open cluster m67–ii. evidence for solar-like oscillations in red giant stars. *MNRAS*, 377:584, 2007.
- D. Stello, W. J. Chaplin, S. Basu, Y. P. Elsworth, and T. R. Bedding. The relation between δv and v max for solar-like oscillations. *MNRAS: Letters*, 400:L80, 2009.
- D. Stello, S. Basu, H. Bruntt, B. Mosser, I. R. Stevens, T. M. Brown, J. Christensen-Dalsgaard, R. L. Gilliland, H. Kjeldsen, T. Arentoft, et al. Detection of solar-like oscillations from kepler photometry of the open cluster ngc 6819. *ASTROPHYS J LETT*, 713:L182, 2010.
- D. Stello, D. Huber, T. Kallinger, S. Basu, B. Mosser, S. Hekker, S. Mathur, R. A. García, T. R. Bedding, H. Kjeldsen, et al. Amplitudes of solar-like oscillations: Constraints from red giants in open clusters observed by kepler. *ASTROPHYS J LETT*, 737:L10, 2011a.
- D. Stello, S. Meibom, R. L. Gilliland, F. Grundahl, S. Hekker, B. Mosser, T. Kallinger, S. Mathur, R. A. García, D. Huber, et al. An asteroseismic membership study of the red giants in three open clusters observed by kepler: Ngc 6791, ngc 6819, and ngc 6811. *ApJ*, 739:13, 2011b.
- D. Stello, D. Huber, T. R. Bedding, O. Benomar, L. Bildsten, Y. P. Elsworth, R. L. Gilliland, B. Mosser, B. Paxton, and T. R. White. Asteroseismic classification of stellar populations among 13,000 red giants observed by kepler. *ASTROPHYS J LETT*, 765:L41, 2013.

- P. B. Stetson, H. Bruntt, and F. Grundahl. Homogeneous photometry. iii. a star catalog for the open cluster ngc 6791. *PASP*, 115:413, 2003.
- R. A. Street, K. Horne, T. A. Lister, A. J. Penny, Y. Tsapras, A. Quirrenbach, N. Safizadeh, D. Mitchell, J. Cooke, and A. C. Cameron. Searching for planetary transits in the field of open cluster ngc 6819—i. *MNRAS*, 340:1287, 2003.
- A. V. Sweigart. Effects of helium mixing on the evolution of globular cluster stars. *ASTROPHYS J LETT*, 474:L23, 1997.
- A. V. Sweigart and P. G. Gross. Horizontal-branch evolution with semiconvection ii. theoretical sequences. *ApJS*, 32:367, 1976.
- G. J. Toomer. Hipparchus on the distances of the sun and moon. *ARCH HIST EXACT SCI*, page 126, 1974.
- G. Torres, J. Andersen, and A. Giménez. Accurate masses and radii of normal stars: modern results and applications. *A & AR*, 18:67, 2010.
- R. H. Tucker. The parallactic motion of the stars in zones. *Popular Astronomy*, 29: 327, 1921.
- B. A. Twarog, K. M. Ashman, and B. J. Anthony-Twarog. Some revised observational constraints on the formation and evolution of the galactic disk. *arXiv preprint astro-ph/9709122*, 1997.
- K. Uytterhoeven, M. Briquet, H. Bruntt, P. De Cat, S. Frandsen, J. Gutiérrez-Soto, L. Kiss, D. W. Kurtz, M. Marconi, J. Molenda-Żakowicz, et al. Ground-based follow-up in relation to kepler asteroseismic investigation. *Astron. Nachr*, 331:993, 2010.

- J. S. Vink. Mass loss and fate of the most massive stars. *Proceedings of the IAU*, 7: 29, 2011.
- J. S. Vink and G. Gräfener. The transition mass-loss rate: calibrating the role of line-driven winds in massive star evolution. *ASTROPHYS J LETT*, 751:L34, 2012.
- M. Vrad and M. S. Cunha. Influence of structural discontinuities present in the core of red-giant stars on the observed mixed-mode pattern and characterization of their properties. *arXiv preprint arXiv:1911.05175*, 2019.
- M. Vrad, B. Mosser, and R. Samadi. Period spacings in red giants-ii. automated measurement. *A & A*, 588:A87, 2016.
- G. Walker, J. M. Matthews, R. Kuschnig, R. Johnson, S. Rucinski, J. Pazder, G. Burley, A. Walker, K. Skaret, R Zee, et al. The most asteroseismology mission: Ultraprecise photometry from space. *PASP*, 115:1023, 2003.
- G. Wallerstein and C. Sneden. A giant with an unusually high abundance of lithium-hd 112127. *ApJ*, 255:577, 1982.
- H. F. Wang, M. López-Corredoira, Y. Huang, J. L. Carlin, B. Q. Chen, C. Wang, J. Chang, H. W. Zhang, M. S. Xiang, H. B. Yuan, et al. Mapping the galactic disc with the lamost and gaia red clump sample: ii. 3d asymmetrical kinematics of mono-age populations in the disc between 6–14 kpc. *MNRAS*, 491:2104, 2020.
- J. Wang and Z. Zhong. Revisiting the mass-luminosity relation with an effective temperature modifier. *A & A*, 619:L1, 2018.
- L. A. Willson. Mass loss from cool stars: impact on the evolution of stars and stellar populations. *AnnRev*, 38:573, 2000.

- T. Wu, Y. Li, and S. Hekker. Asteroseismic study on cluster distance moduli for red giant branch stars in ngc 6791 and ngc 6819. *ApJ*, 786:10, 2014a.
- T. Wu, Y. Li, and S. Hekker. New asteroseismic scaling relations based on the hayashi track relation applied to red giant branch stars in ngc 6791 and ngc 6819. *ApJ*, 781:44, 2014b.
- S-C. Yang, A. Sarajedini, C. P. Deliyannis, A. R. Sarrazine, S. C. Kim, and J. Kyeong. Wiyn open cluster study lii: wide-field ccd photometry of the old open cluster ngc 6819. *ApJ*, 762:3, 2012.
- J. Yu. Asteroseismology of 20,000 kepler red giants. 2019.
- J. Yu, D. Huber, Timothy R. Bedding, D. Stello, S. J. Murphy, M. Xiang, S. Bi, and T. Li. Asteroseismology of 1523 misclassified red giants using kepler data. *MON NOT R ASTRON SOC*, 463:1297–1306, 2016.
- G. Zhao, HM. Qiu, and S. Mao. High-resolution spectroscopic observations of hipparcos red clump giants: Metallicity and mass determinations. *APJ*, 551:L85, 2001.
- X. Zhao and J. Fuller. Centrifugally driven mass-loss and outbursts of massive stars. *MNRAS*, 495:249, 2020.
- J. C. Zinn, D. Stello, D. Huber, and S. Sharma. The bayesian asteroseismology data modeling pipeline and its application to k2 data. *ApJ*, 884:107, 2019.

A. Appendix A

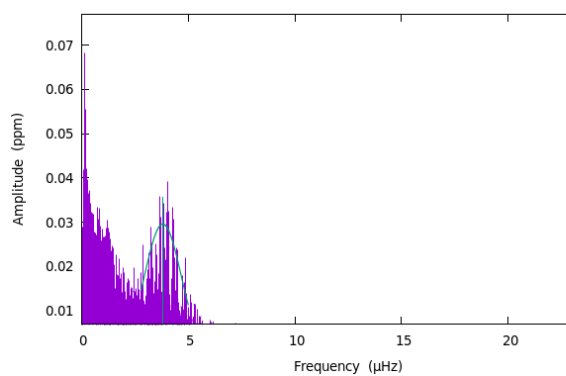


Figure A.1: KIC 5200152.

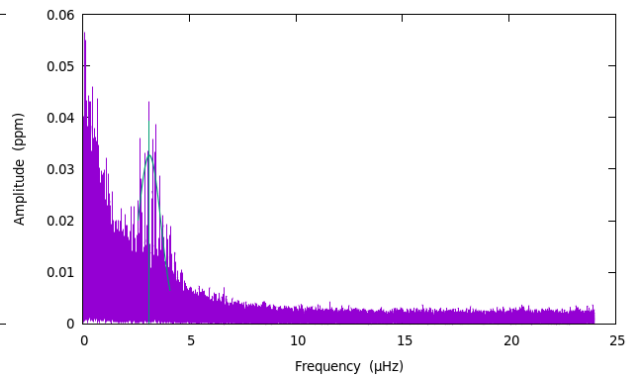


Figure A.2: KIC 5113041.

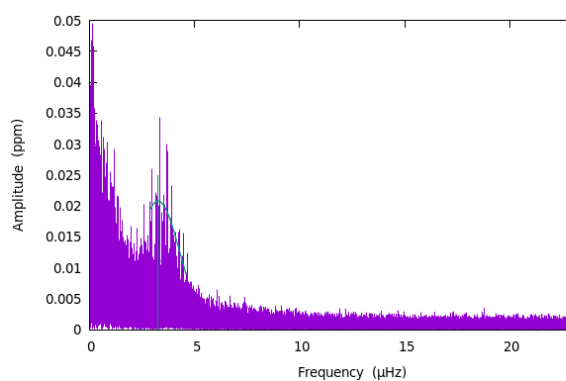


Figure A.3: KIC 5112974.

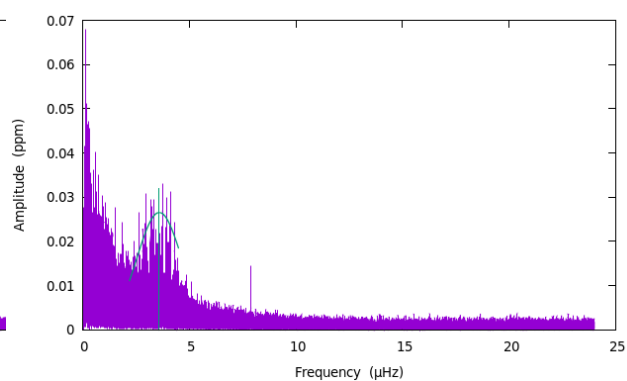


Figure A.4: KIC 5112950.

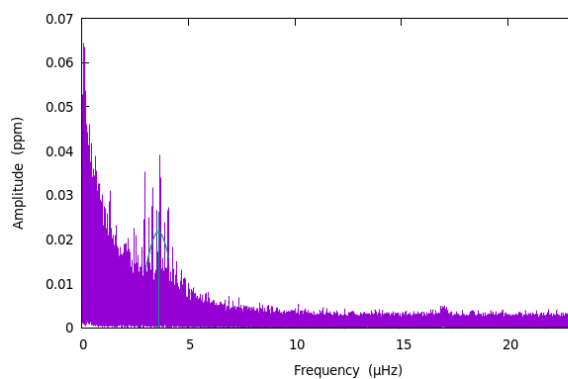


Figure A.6: KIC 5112948.

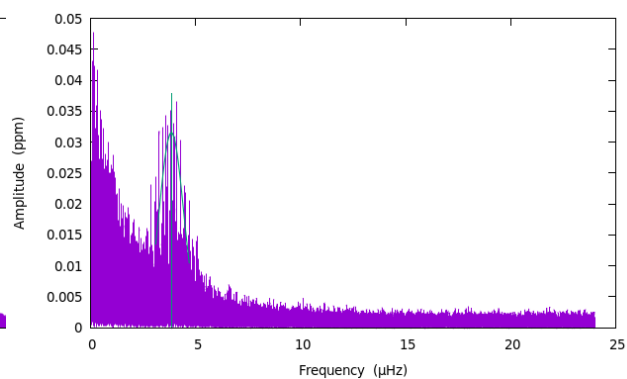


Figure A.7: KIC 5112938.

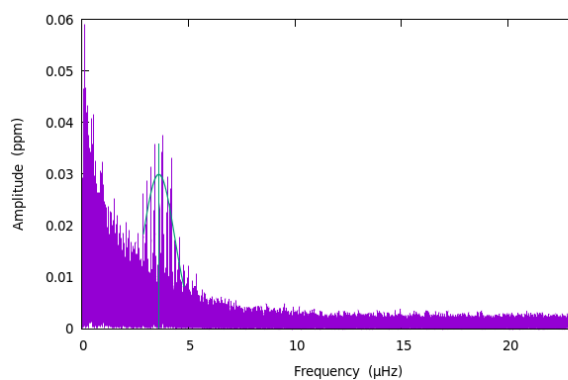


Figure A.8: KIC 5112744.

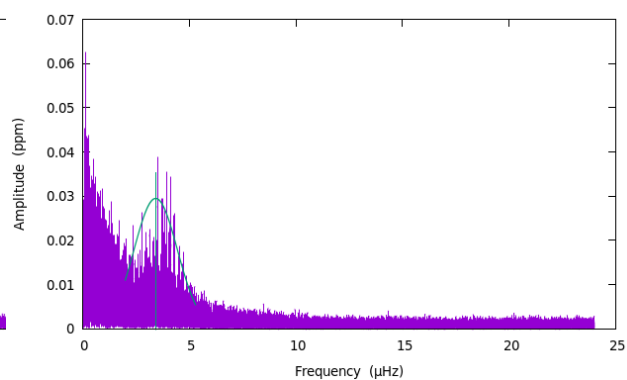


Figure A.9: KIC 5112730.

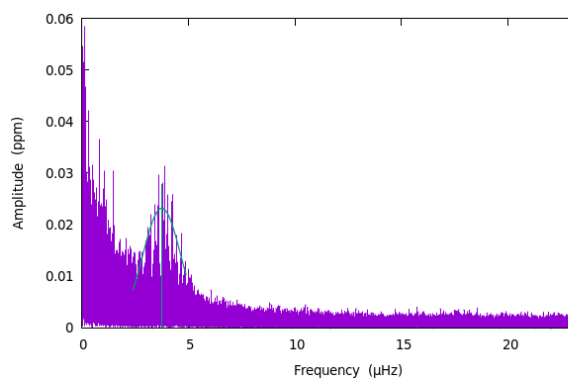


Figure A.10: KIC 5112491.

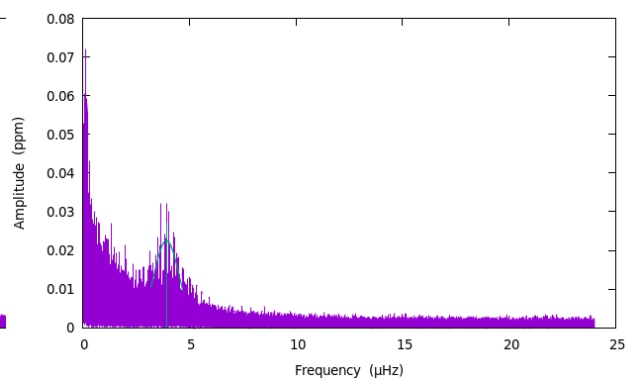


Figure A.11: KIC 5112467.

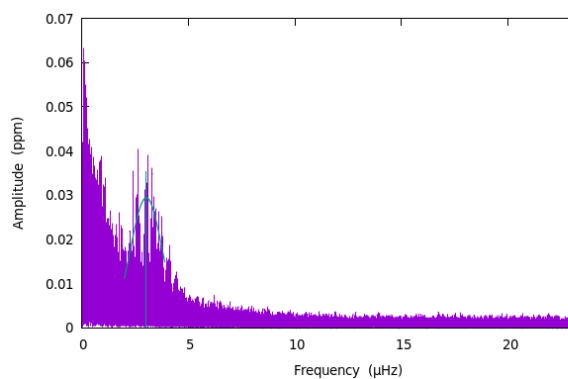


Figure A.13: KIC 5112401.

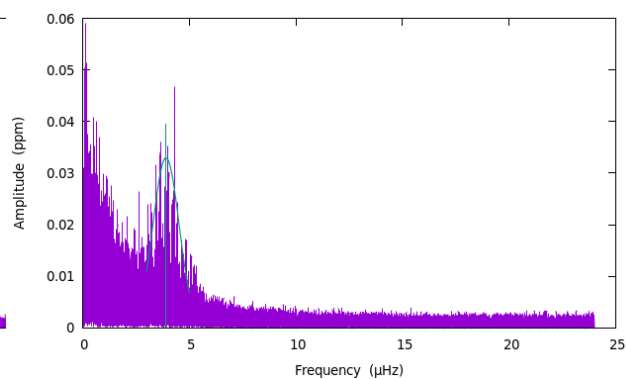


Figure A.14: KIC 5112387.

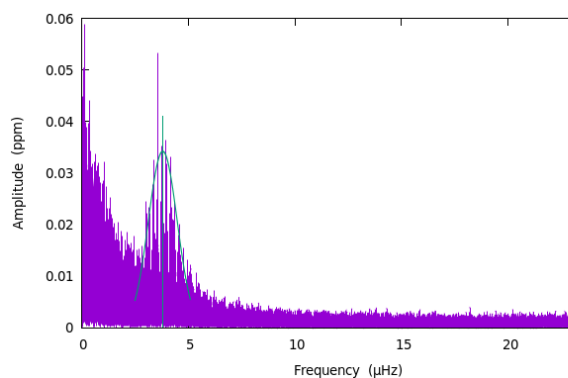


Figure A.15: KIC 5112373.

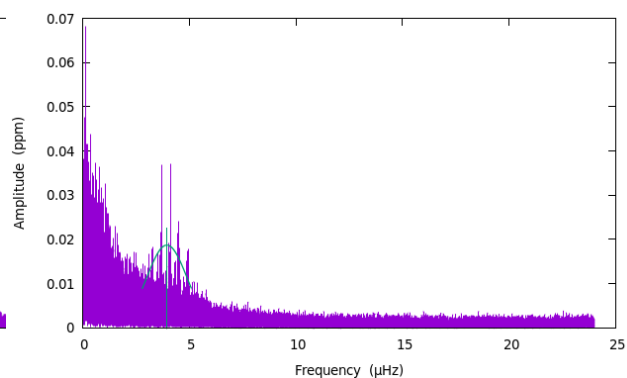


Figure A.16: KIC 5112288.

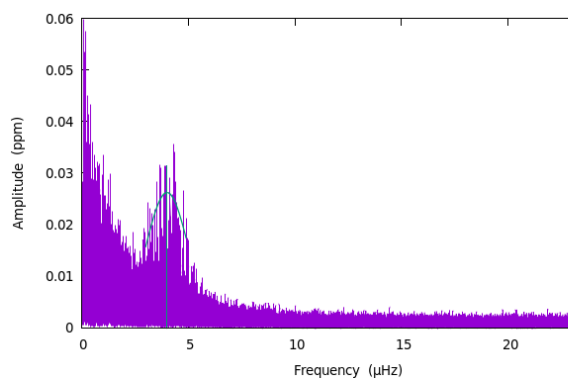


Figure A.17: KIC 5111949.

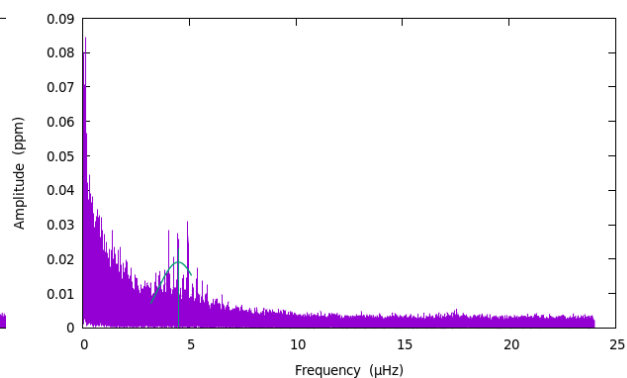


Figure A.18: KIC 5111940.

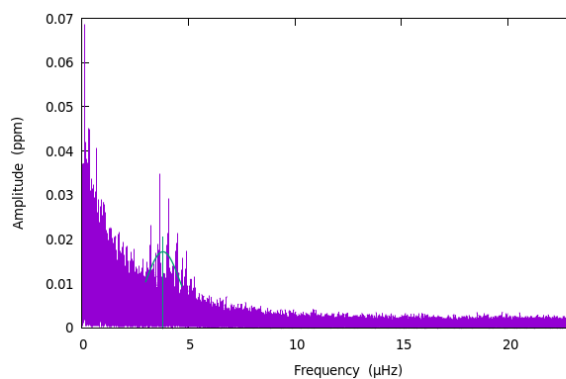


Figure A.20: KIC 5024967.

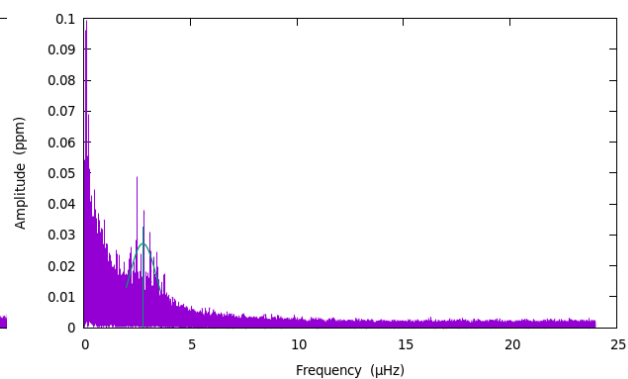


Figure A.21: KIC 5024601.

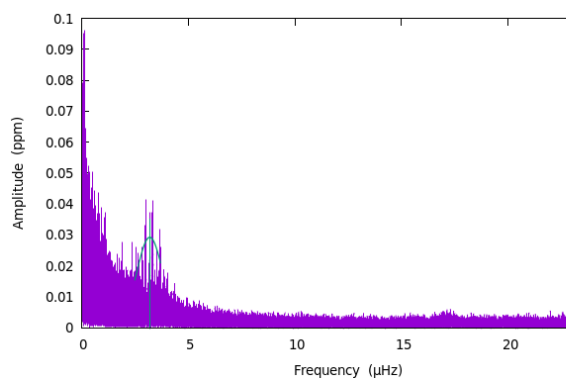


Figure A.22: KIC 5024583.

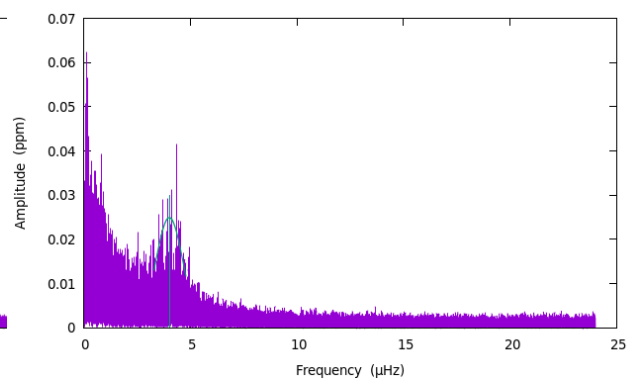


Figure A.23: KIC 5024404.

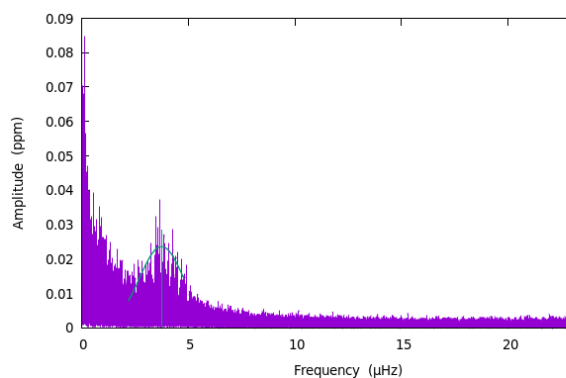


Figure A.24: KIC 5024327.

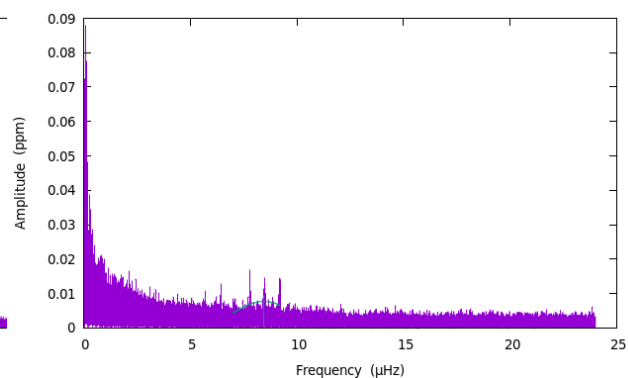


Figure A.25: KIC 5024312.

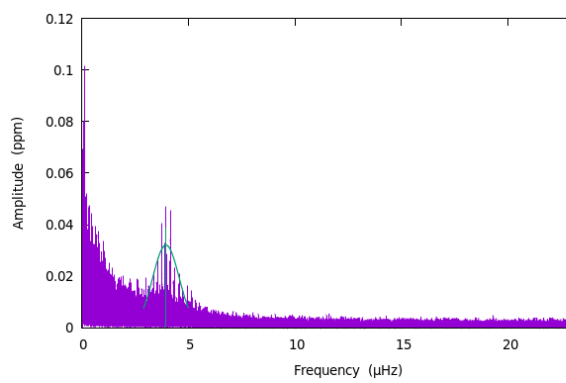


Figure A.27: KIC 5024297.

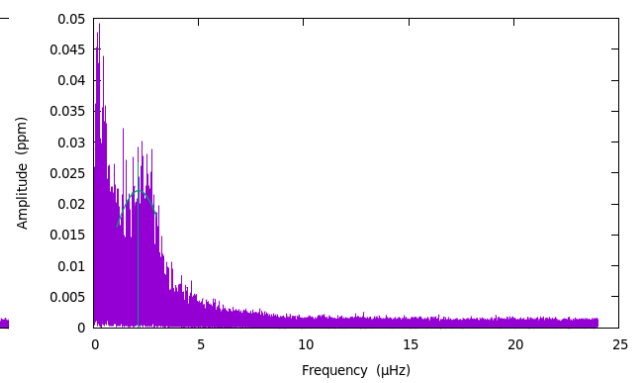


Figure A.28: KIC 5024268.

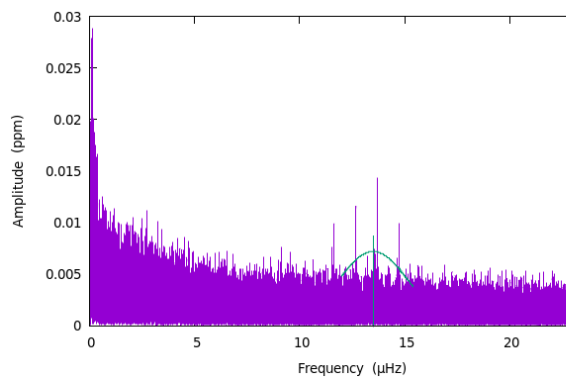


Figure A.29: KIC 5024240.

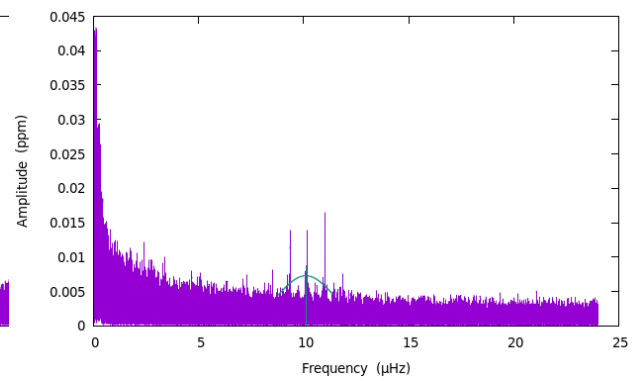


Figure A.30: KIC 5024143.

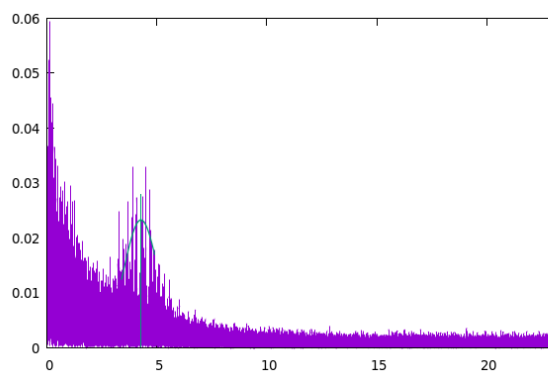


Figure A.31: KIC 5023953.

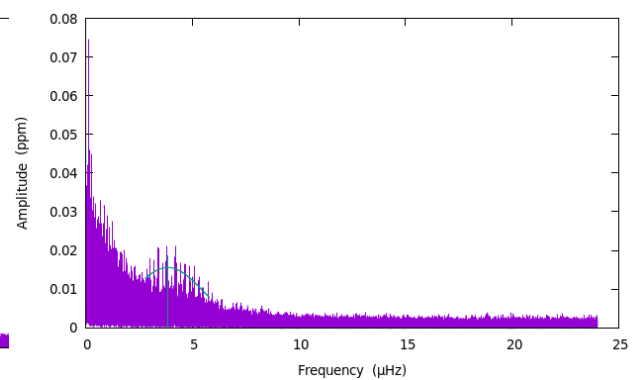


Figure A.32: KIC 5023931.

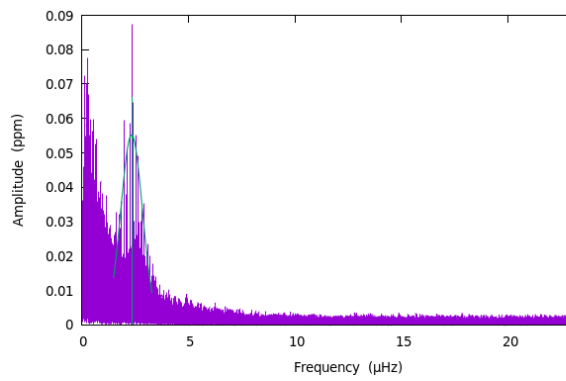


Figure A.34: KIC 5023732.

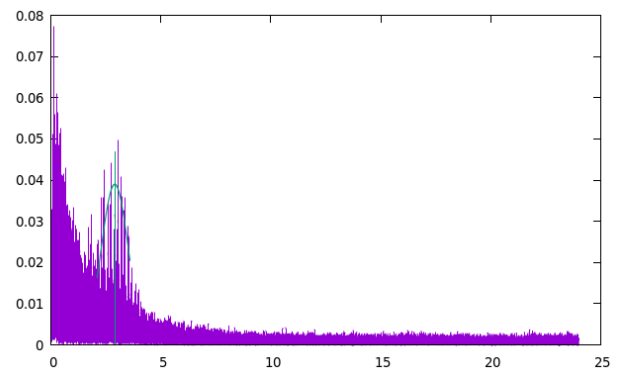


Figure A.35: KIC 4937576.

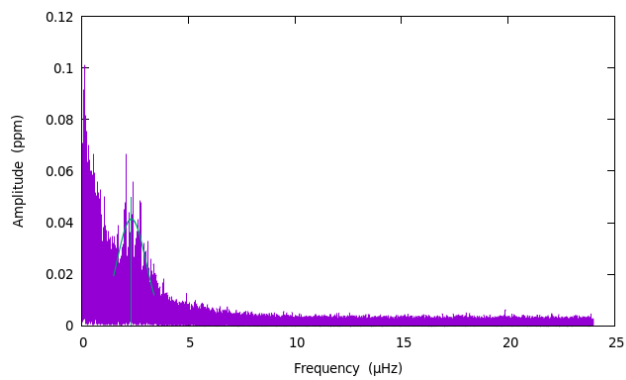


Figure A.36: KIC 4937011.

B. Appendix B

RA	eRA	Dec	eDec	Gaia source ID	Plx	ePlx	PRA	ePRA	PDec	ePDec	T	L	m
295.3473743	0.0961	39.99429097	0.1199	2076293190685668736	0.2839	0.1188	-2.838	0.214	-2.835	0.230	-	-	12.734
295.3330740	0.0578	39.99624389	0.0688	2076293263710410496	0.2854	0.0699	-2.585	0.133	-6.321	0.135	-	-	12.723
295.2917841	0.4248	39.99554757	0.4957	2076293396844515968	0.4539	0.5202	-2.513	0.965	-4.849	0.942	-	-	11.715
295.3030514	0.8679	39.98901624	1.1002	2076293332425408768	0.3036	1.2558	-2.884	2.115	-3.725	1.947	-	-	12.588
295.2926218	0.1108	40.00678839	0.1390	2076293499923740288	0.3968	0.1407	-3.456	0.260	-3.848	0.265	-	-	12.007
295.3216592	0.9282	40.01774586	1.3480	2076293469864458368	0.3502	1.0376	-2.086	1.962	-3.126	2.910	-	-	12.278
295.3895315	0.1203	40.00289988	0.1485	2076294053984198016	0.4221	0.1503	-3.054	0.283	-4.280	0.302	-	-	11.873
295.4008342	0.1538	40.00573114	0.2031	2076293980959308672	0.4137	0.2028	-2.372	0.330	-3.558	0.368	-	-	11.917
295.4002122	0.0814	39.99562519	0.0948	2076293980959301504	0.3145	0.1002	-2.019	0.207	-3.886	0.196	-	-	12.512
295.3913624	0.1062	40.00727950	0.1338	2076294049678786688	0.3277	0.1380	-2.720	0.231	-3.843	0.275	-	-	12.423
295.3878887	0.2154	40.01539546	0.2744	2076294049678791936	0.4901	0.2761	-2.079	0.463	-1.602	0.574	-	-	11.549
295.4074933	0.1298	40.01492026	0.1824	2076294019619459968	0.4202	0.1622	-3.114	0.286	-3.555	0.376	-	-	11.883
295.4079577	0.0795	40.02304335	0.0964	2076294088339960320	0.4003	0.1011	-3.204	0.176	-4.247	0.208	-	-	11.988
295.4256609	0.0446	40.00825792	0.0558	2076294191423402880	0.4027	0.0551	-2.600	0.099	-3.895	0.114	5335.50	1.019	11.975
295.4242305	0.1666	40.00926129	0.2078	2076294191418172032	0.3253	0.2103	-4.005	0.353	-5.291	0.454	-	-	12.439
295.4364258	0.0645	40.02235726	0.0852	2076294225782929792	0.3493	0.0835	-2.826	0.142	-3.882	0.164	-	-	12.284
295.4397271	0.3805	40.02465178	0.5088	2076294225782931840	0.3620	0.5036	-3.320	0.876	-6.051	0.923	-	-	12.206
295.4430445	0.4565	40.02669368	0.6045	2076294225782933504	0.3467	0.6084	-2.587	1.018	-2.856	1.067	-	-	12.300
295.4435787	0.3074	40.01925474	0.3954	2076294225777985408	0.3656	0.3945	-3.179	0.658	-4.729	0.734	-	-	12.185
295.4261063	0.2977	40.00532962	0.4246	2076294191418169216	0.3790	0.4102	-2.131	0.618	-4.474	0.738	-	-	12.107
295.4611020	0.1530	40.04578893	0.2055	2076294363218262528	0.4228	0.2045	-2.359	0.337	-5.268	0.381	-	-	11.870
295.4534037	0.1315	40.02468475	0.1738	2076294328862153344	0.4544	0.1704	-2.434	0.289	-3.548	0.330	-	-	11.713
295.4659179	0.0237	40.04201677	0.0312	2076294363221905536	0.3019	0.0306	-2.782	0.052	-3.839	0.065	5664.00	4.683	12.601
295.4765843	0.0200	40.03600381	0.0284	2076294294502430720	0.4432	0.0267	-2.856	0.045	-3.536	0.054	4979.42	22.293	11.767
295.3446195	0.6684	40.01601369	0.7828	2076294741174825600	0.4060	0.8273	-2.379	1.408	-3.260	1.245	-	-	11.957
295.3475582	0.2035	40.01810991	0.2717	2076294741174835584	0.3249	0.2668	-3.158	0.481	-6.553	0.473	-	-	12.441
295.3600146	0.1197	40.00546033	0.1555	2076294702514161792	0.2841	0.1541	-2.822	0.273	-5.510	0.289	-	-	12.733
295.3808333	0.0670	40.04855224	0.0928	2076294912977902464	0.3990	0.0904	-3.145	0.150	-5.016	0.181	-	-	11.995
295.3827624	0.2883	40.03523139	0.3766	2076294844254171136	0.4719	0.3836	-1.945	0.684	-4.941	0.693	-	-	11.631
295.3664441	0.4454	40.02257937	0.5297	2076294878613837056	0.4913	0.5409	-2.433	1.009	-2.615	0.978	-	-	11.543
295.3842711	0.1650	40.04133966	0.2344	2076294908672266752	0.3607	0.2433	-3.493	0.418	-3.685	0.445	-	-	12.214
295.3763736	0.0965	40.03847449	0.1256	2076294908672262144	0.3851	0.1243	-2.895	0.215	-3.532	0.239	-	-	12.072
295.3754208	0.0946	40.05005579	0.1253	2076294908672270976	0.2876	0.1230	-2.646	0.210	-5.810	0.254	-	-	12.706
295.3770641	0.2986	40.01517791	0.5489	2076294809894367872	0.3602	0.4243	-3.662	0.631	-3.396	1.186	-	-	12.217
295.3837984	0.4841	40.01537693	0.5907	2076294809894384128	0.4910	0.6056	-3.872	1.089	-5.605	1.106	-	-	11.545
295.3260716	0.1144	40.04758387	0.1490	2076295046111560704	0.3489	0.1462	-3.025	0.257	-3.879	0.298	-	-	12.286
295.3397191	0.0793	40.02135203	0.0985	2076294947333255424	0.3522	0.0987	-2.992	0.185	-4.216	0.191	-	-	12.266
295.3190890	0.1392	40.03628018	0.2075	2076295011752242432	0.2968	0.1790	-2.317	0.304	-3.627	0.423	-	-	12.638
295.3139375	1.3197	40.03323366	1.2041	2076295016052698624	0.3592	1.4613	-2.392	2.508	-5.532	2.569	-	-	12.223
295.3363460	0.2349	40.01946645	0.3523	2076294943032335232	0.2904	0.2964	-2.431	0.544	-3.594	0.746	-	-	12.685
295.3472503	0.1130	40.03936068	0.1528	2076294977392080640	0.4196	0.1475	-2.880	0.249	-4.487	0.289	-	-	11.886
295.3448115	0.1233	40.04113029	0.1608	2076294977392081152	0.4530	0.1587	-3.033	0.272	-4.150	0.311	-	-	11.720
295.3335944	0.6398	40.03755381	0.7400	2076295050412487680	0.3542	0.8545	-2.125	1.569	-5.767	1.285	-	-	12.254
295.3362550	0.0898	40.04599547	0.1238	2076295050416830720	0.3806	0.1207	-2.680	0.200	-5.080	0.224	-	-	12.098
295.3536189	0.0863	40.05810080	0.0975	2076295149190778112	0.2895	0.1121	-3.531	0.171	-6.285	0.180	-	-	12.692
295.3637363	0.5011	40.05232180	0.6401	2076295119132069376	0.4660	0.6566	-3.301	1.215	-4.434	1.278	-	-	11.658
295.3627765	0.4979	40.07077170	0.6080	2076295187851582208	0.4649	0.6430	-3.762	1.198	-4.189	1.232	-	-	11.663
295.3645460	0.2315	40.06712475	0.3097	2076295183548236544	0.4616	0.3124	-3.588	0.514	-3.392	0.620	-	-	11.679
295.3422868	0.1358	40.06335299	0.1731	2076295149188421760	0.3048	0.1707	-3.299	0.302	-3.919	0.349	-	-	12.580
295.3398383	0.4411	40.06076054	0.5140	2076295153491758720	0.3788	0.5436	-2.200	1.063	-5.008	1.018	-	-	12.108
295.4023818	0.0553	40.07399349	0.0721	2076295320987085952	0.3042	0.0713	-1.864	0.123	-5.071	0.139	-	-	12.584
295.4052491	0.0200	40.06623565	0.0261	2076295325294794368	0.3966	0.0258	-3.082	0.044	-5.733	0.051	4779.00	4.097	12.008
295.4085523	0.1954	40.05361777	0.2616	2076295256571153152	0.3348	0.2573	-3.051	0.425	-5.727	0.494	-	-	12.376
295.4023583	0.0952	40.05612811	0.1169	2076295252269657088	0.3390	0.1186	-2.056	0.207	-4.380	0.223	-	-	12.349
295.4149304	0.0920	40.07867485	0.1221	2076295424066303872	0.3387	0.1198	-2.474	0.205	-6.342	0.233	-	-	12.351
295.4383106	0.0323	40.08772849	0.0428	2076295394014323328	0.4207	0.0418	-3.711	0.072	-5.893	0.084	5359.00	1.298	11.880
295.1840886	0.1960	40.05688583	0.2350	2076297313852005760	0.3239	0.2448	-2.135	0.499	-4.299	0.519	-	-	12.448
295.2362485	0.1103	40.04671300	0.1247	2076297451290952704	0.3930	0.1330	-3.454	0.273	-3.994	0.266	-	-	12.028
295.2169293	0.2597	40.05252656	0.3034	2076297485650694144	0.3316	0.3237	-4.060	0.649	-5.874	0.666	-	-	12.397
295.2274729	0.1941	40.06924596	0.2244	2076297520010445184	0.3051	0.2374	-2.487	0.430	-5.381	0.476	-	-	12.578
295.2307414	0.2068	40.07004627	0.2353	2076297520010446208	0.3287	0.2507	-2.501	0.458	-3.893	0.511	-	-	12.416
295.2193596	0.2456	40.07505305	0.2879	2076297524313475968	0.3801	0.3047	-2.854	0.609	-4.422	0.652	-	-	12.101
295.2184544	0.2750	40.05505510	0.3266	2076297489953708544	0.4539	0.3500	-2.627	0.717	-6.245	0.718	-	-	11.715
295.2954881	0.3874	40.32690293	0.4726	2076582911995741056	0.2897	0.4624	-2.690	0.868	-2.923	0.840	-	-	12.690

Table B.1: New members.

295.4673437	0.1292	40.08202530	0.1743	2076388435880184576	0.3341	0.1702	-2.575	0.306	-5.968	0.328	-	-	12.381
295.4583898	0.1451	40.08912357	0.1933	2076388474536107648	0.4012	0.1921	-2.502	0.325	-3.724	0.384	-	-	11.983
295.4824696	0.3405	40.08851575	0.4634	2076388538953287680	0.3029	0.4554	-3.214	0.758	-3.342	0.909	-	-	12.594
295.4844203	0.7102	40.09136080	1.1138	2076388543255677312	0.3320	1.1037	-2.284	1.939	-3.005	2.668	-	-	12.394
295.5231601	0.0617	40.09361121	0.0850	2076388676398418176	0.3818	0.0821	-3.693	0.136	-6.601	0.155	-	-	12.091
295.5219004	0.1967	40.10511413	0.2673	2076388745111725696	0.2820	0.2670	-1.889	0.430	-4.665	0.473	-	-	12.749
295.5300779	0.0197	40.11735197	0.0274	2076388783781833856	0.3158	0.0258	-3.737	0.044	-5.563	0.050	4886.72	7.074	12.503
295.2500877	0.1158	40.09564132	0.1302	2076297657449415424	0.2852	0.1379	-3.055	0.251	-4.473	0.247	-	-	12.724
295.2440744	0.2565	40.07131408	0.3164	2076297558673256192	0.3056	0.3130	-3.691	0.600	-3.562	0.676	-	-	12.574
295.2263287	0.0860	40.08215842	0.1033	2076297623089670016	0.3528	0.1061	-2.261	0.197	-4.423	0.210	-	-	12.262
295.2472123	0.2775	40.09001826	0.3235	2076297661752509952	0.2826	0.3420	-2.460	0.685	-5.610	0.689	-	-	12.744
295.2499565	0.1871	40.09022317	0.2468	2076297661752516736	0.3427	0.2385	-3.023	0.439	-3.297	0.509	-	-	12.325
295.2133475	0.1444	40.10568498	0.1687	2076297897967589632	0.3749	0.1703	-3.042	0.319	-1.445	0.324	-	-	12.130
295.2287822	0.0768	40.11181473	0.0915	2076297932327331712	0.3785	0.0942	-3.673	0.178	-6.068	0.186	-	-	12.110
295.2241166	0.2722	40.11789493	0.3387	2076297932327333504	0.3594	0.3372	-2.253	0.645	-2.821	0.709	-	-	12.222
295.2393333	0.3275	40.10883463	0.3733	2076297867910964608	0.3269	0.4097	-4.019	0.767	-5.226	0.772	-	-	12.428
295.2259155	0.1544	40.10735792	0.1948	2076297867910926080	0.2891	0.1860	-2.957	0.338	-4.915	0.349	-	-	12.695
295.2243309	0.2001	40.10668593	0.2484	2076297932327380992	0.2823	0.2501	-3.350	0.458	-3.061	0.490	-	-	12.746
295.2217509	0.0772	40.09980211	0.0960	2076297829248110464	0.4632	0.1040	-2.505	0.169	-2.238	0.170	-	-	11.671
295.4383946	0.0881	40.08719768	0.0984	2076295394010354432	0.4889	0.1034	-2.464	0.190	-3.743	0.186	-	-	11.554
295.4264665	0.1151	40.08009499	0.1528	2076295394014304256	0.3768	0.1498	-2.261	0.258	-3.531	0.289	-	-	12.119
295.4285862	0.0816	40.08106608	0.1089	2076295394014307840	0.3525	0.1064	-2.793	0.183	-6.598	0.210	-	-	12.264
295.3837046	0.1009	40.06903444	0.1321	2076295492785776896	0.4306	0.1301	-3.306	0.223	-2.998	0.251	-	-	11.830
295.3878237	0.2995	40.08395772	0.4104	2076295527145520512	0.4585	0.4099	-2.087	0.675	-2.803	0.740	-	-	11.693
295.3705000	0.0432	40.07027475	0.0599	2076295497093460352	0.3467	0.0581	-3.589	0.096	-3.341	0.110	5109.85	-	12.300
295.3878766	0.0924	40.08675318	0.1304	2076295527145521792	0.2917	0.1245	-3.179	0.206	-3.588	0.239	-	-	12.675
295.3775885	0.0993	40.06089702	0.1367	2076295492787830144	0.3151	0.1327	-3.355	0.220	-2.625	0.251	-	-	12.508
295.3685966	0.3093	40.07746325	0.4222	2076295561505285504	0.2971	0.4013	-3.166	0.687	-4.419	0.832	-	-	12.635
295.3705378	0.1302	40.08315701	0.1719	2076295565812946304	0.4476	0.1697	-2.141	0.307	-5.826	0.320	-	-	11.746
295.3693622	0.0599	40.09205576	0.0764	2076295595865029248	0.3563	0.0759	-3.567	0.140	-6.485	0.152	-	-	12.241
295.4040491	0.1231	40.10746893	0.1613	2076295664590015744	0.4299	0.1542	-2.461	0.295	-3.237	0.318	-	-	11.833
295.3901781	0.1518	40.10164734	0.1857	2076295703248061824	0.4212	0.1879	-1.982	0.332	-5.248	0.346	-	-	11.878
295.3990792	0.2801	40.08909467	0.3677	2076295630224737024	0.3631	0.3794	-2.702	0.626	-4.802	0.681	-	-	12.200
295.4084976	0.0785	40.11674524	0.1015	2076295737611703424	0.2994	0.1001	-2.742	0.178	-5.208	0.196	-	-	12.619
295.4110568	0.1116	40.10716348	0.1391	2076295668888219136	0.3555	0.1394	-3.199	0.246	-3.928	0.265	-	-	12.246
295.3875154	0.1277	40.11314171	0.1554	2076295698944223616	0.4138	0.1589	-2.908	0.313	-4.300	0.307	-	-	11.916
295.2393244	0.1243	40.00730565	0.1373	2076296218643354624	0.4488	0.1411	-2.522	0.292	-6.310	0.275	-	-	11.740
295.2314399	0.4094	40.01648173	0.4172	2076296283062553344	0.4076	0.4466	-2.542	0.921	-4.303	0.799	-	-	11.949
295.2193556	0.5460	40.01484534	0.4595	2076296287363681280	0.3672	0.5971	-2.451	1.294	-6.548	0.868	-	-	12.175
295.2230119	0.1833	40.01502060	0.2038	2076296287367544960	0.4295	0.2132	-2.718	0.443	-6.234	0.425	-	-	11.835
295.2254302	0.1205	40.01162605	0.1375	2076296287367351296	0.3460	0.1419	-2.248	0.286	-4.876	0.277	-	-	12.305
295.2564571	0.1549	40.01216067	0.1816	2076296390442080896	0.3870	0.1869	-3.067	0.380	-5.135	0.395	-	-	12.061
295.2579522	0.7120	40.00793996	0.7632	2076296390442076416	0.4849	0.8060	-2.164	1.539	-2.770	1.480	-	-	11.572
295.2710512	0.3846	40.00905799	0.4301	2076296356086841472	0.3626	0.4635	-2.604	0.941	-3.029	0.947	-	-	12.203
295.2581468	0.1319	40.00226323	0.1508	2076296386142088448	0.4789	0.1528	-2.933	0.309	-5.691	0.304	-	-	11.599
295.2698881	0.3901	40.02952284	0.4280	2076296420501836032	0.4079	0.4507	-2.012	0.936	-2.733	0.873	-	-	11.947
295.2678849	0.1299	40.00072172	0.1529	2076296321727100416	0.4866	0.1583	-2.855	0.311	-6.409	0.315	-	-	11.564
295.2729827	0.4300	40.03468445	0.5033	2076296527881097216	0.4125	0.5250	-3.569	1.038	-6.291	1.025	-	-	11.923
295.2944001	0.2522	40.04460494	0.3152	2076296562240900480	0.3046	0.3188	-3.486	0.568	-3.663	0.654	-	-	12.581
295.2664775	0.3617	40.03079435	0.4037	2076296420501836160	0.4362	0.4325	-2.617	0.862	-5.572	0.816	-	-	11.802
295.2618224	0.2992	40.03125200	0.3723	2076296626660266624	0.3188	0.3861	-3.179	0.738	-5.229	0.731	-	-	12.482
295.2389741	0.1639	40.03162172	0.1755	2076296661019682432	0.3485	0.1838	-2.960	0.383	-5.713	0.347	-	-	12.289
295.2314120	0.2962	40.04048987	0.3573	2076296661017041536	0.3462	0.3743	-2.470	0.742	-3.558	0.740	-	-	12.303
295.2582888	0.0740	40.02204638	0.0915	2076296630964748032	0.4685	0.0976	-2.897	0.181	-5.874	0.173	-	-	11.646
295.2415604	0.1464	40.04295688	0.1692	2076296695376706304	0.3568	0.1725	-2.932	0.344	-3.904	0.332	-	-	12.238
295.2672301	0.1980	40.04666340	0.2311	2076296729736447104	0.4483	0.2431	-1.971	0.495	-4.042	0.479	-	-	11.742
295.2611392	0.0801	40.06760871	0.0981	2076296837123196032	0.3035	0.1004	-2.502	0.181	-2.916	0.194	-	-	12.589
295.1979240	0.3024	40.01263822	0.3336	2076296905838071040	0.3879	0.3546	-2.281	0.739	-3.467	0.719	-	-	12.056
295.1946491	0.4408	40.02441059	0.4697	2076297077636772352	0.4618	0.4929	-4.048	1.070	-4.849	1.002	-	-	11.678
295.1986433	0.0939	40.03918784	0.1215	2076297111996534144	0.3325	0.1245	-2.207	0.230	-5.078	0.240	-	-	12.391
295.2101900	0.2675	40.04586898	0.3124	2076297107693642112	0.4861	0.3307	-2.719	0.670	-3.650	0.663	-	-	11.566
295.1990922	0.2450	40.04223954	0.3051	2076297111996540672	0.3903	0.3120	-2.587	0.627	-2.396	0.595	-	-	12.043
295.1599921	0.3361	40.03245356	0.3681	2076297180720534912	0.4108	0.3794	-3.535	0.844	-3.702	0.806	-	-	11.932
295.1889149	0.4278	40.06316243	0.6707	2076297318154980992	0.4515	0.5577	-3.718	1.060	-5.327	1.468	-	-	11.727
295.1732090	0.2358	40.04687761	0.2866	2076297279492260352	0.4802	0.2966	-2.616	0.592	-3.813	0.600	-	-	11.593
295.1868139	0.2246	40.06318239	0.3101	2076297313852077568	0.4249	0.2968	-3.577	0.572	-2.812	0.654	-	-	11.859
295.1834477	0.5479	40.07790733	0.6477	2076297382571557760	0.4774	0.6768	-3.082	1.390	-1.931	1.338	-	-	11.606
295.1888269	0.0319	40.05130619	0.0451	2076297318159501696	0.3635	0.0397	-3.886	0.074	-5.913	0.097	5236.61	2.036	12.197
295.1840886	0.1960	40.05688583	0.2350	2076297313852005760	0.3239	0.2448	-2.135	0.499	-4.299	0.519	-	-	12.448
295.2362485	0.1103	40.04671300	0.1247	2076297451290952704	0.3930	0.1330	-3.454	0.273	-3.994	0.266	-	-	12.028
295.2169293	0.2597	40.05252656	0.3034	2076297485650694144	0.3316	0.3237	-4.060	0.649	-5.874	0.666	-	-	12.397
295.2274729	0.1941	40.06924596	0.2244	2076297520010445184	0.3051	0.2374	-2.487	0.430	-5.381	0.476	-	-	12.578
295.2307414	0.2068	40.07004627	0.2353	2076297520010446208	0.3287	0.2507	-2.501	0.458	-3.893	0.511	-	-	12.416
295.2193596	0.2456	40.07505305	0.2879	2076297524313475968	0.3801	0.3047	-2.854	0.609	-4.422	0.652	-	-	12.101

295.2499565	0.1871	40.09022317	0.2468	2076297661752516736	0.3427	0.2385	-3.023	0.439	-3.297	0.509	-	-	12.325
295.2133475	0.1444	40.10568498	0.1687	2076297897967589632	0.3749	0.1703	-3.042	0.319	-1.445	0.324	-	-	12.130
295.2287822	0.0768	40.11181473	0.0915	2076297932327331712	0.3785	0.0942	-3.673	0.178	-6.068	0.186	-	-	12.110
295.2241166	0.2722	40.11789493	0.3387	2076297932327333504	0.3594	0.3372	-2.253	0.645	-2.821	0.709	-	-	12.222
295.3319607	0.1704	40.06887377	0.2123	2076298104125922816	0.338	0.2166	-2.815	0.392	-3.381	0.442	-	-	12.355
295.3237637	0.1800	40.07966638	0.2297	2076298172845404416	0.423	0.2357	-2.413	0.404	-4.267	0.472	-	-	11.868
295.2134119	0.1686	40.04964271	0.2009	2076297489958200960	0.4855	0.2048	-2.150	0.402	-6.577	0.401	-	-	11.569
295.4601916	0.0404	40.08956042	0.0525	2076388508903856128	0.2857	0.0512	-3.703	0.090	-6.072	0.104	5635.63	-	12.720
295.4803631	0.2008	40.07480039	0.2387	2076388440176404096	0.3762	0.2540	-3.634	0.415	-3.953	0.442	-	-	12.123
295.4641485	0.5155	40.09913683	0.6686	2076388508895897344	0.3060	0.6814	-3.190	1.194	-2.463	1.139	-	-	12.571
295.4683711	0.1891	40.09083527	0.2493	2076388508895887872	0.3908	0.2453	-2.648	0.421	-3.957	0.470	-	-	12.040
295.3239845	0.1056	40.08629274	0.1277	2076298172845405568	0.399	0.1266	-2.943	0.246	-3.583	0.244	-	-	11.994
295.3328881	0.0902	40.09434256	0.1101	2076298207205146240	0.417	0.1086	-3.155	0.202	-3.987	0.212	-	-	11.899
295.3398308	0.4158	40.09647427	0.4863	2076298207205284736	0.426	0.5265	-3.014	1.169	-6.228	0.940	-	-	11.853
295.2902472	0.2335	40.10228170	0.2789	207629834644187008	0.404	0.2873	-2.414	0.539	-3.368	0.574	-	-	11.970
295.2937697	0.0224	40.09348219	0.0269	2076298344644182528	0.295	0.0277	-2.608	0.050	-4.714	0.051	5680.50	6.970	12.650
295.2781461	0.0719	40.08253629	0.0902	2076298310284438656	0.366	0.0909	-2.144	0.172	-4.321	0.176	-	-	12.183
295.2818108	0.1448	40.08395266	0.1703	2076298310284439168	0.419	0.1721	-2.609	0.334	-3.776	0.320	-	-	11.888
295.2799899	0.2872	40.07210329	0.3579	2076298310284492800	0.489	0.3528	-2.601	0.649	-4.290	0.720	-	-	11.556
295.2770198	0.0907	40.07893085	0.1215	2076298310287835776	0.385	0.1175	-2.256	0.203	-3.688	0.227	-	-	12.072
295.3064526	0.1279	40.08651694	0.1484	2076298275924702592	0.363	0.1568	-2.479	0.275	-4.145	0.274	-	-	12.199
295.2897841	0.0454	40.06596878	0.0563	2076298245872483840	0.437	0.0587	-3.265	0.105	-6.260	0.117	5326.75	0.671	11.796
295.3134960	0.1997	40.12342256	0.3112	2076298486390691712	0.380	0.2677	-3.431	0.470	-3.809	0.712	-	-	12.101
295.3096645	0.1832	40.11860038	0.2487	2076298482083148544	0.343	0.2359	-2.802	0.435	-4.960	0.557	-	-	12.326
295.3124913	0.0687	40.12620939	0.0832	2076298486390692864	0.453	0.0823	-2.288	0.156	-3.713	0.176	-	-	11.718
295.3138929	0.0978	40.11037018	0.1308	2076298482083144448	0.379	0.1193	-3.070	0.221	-3.366	0.261	-	-	12.110
295.3049447	0.1209	40.11401424	0.1421	2076298452026676352	0.427	0.1496	-2.098	0.269	-3.304	0.249	-	-	11.849
295.3137313	0.0315	40.10478826	0.0381	2076298417671205504	0.360	0.0378	-1.918	0.071	-4.396	0.079	6049.71	1.992	12.218
295.3256582	0.1045	40.11548444	0.1263	2076298413363586176	0.368	0.1258	-2.735	0.243	-3.951	0.252	-	-	12.172
295.3146483	0.2636	40.11297399	0.3506	2076298482083196416	0.348	0.3340	-2.379	0.610	-3.898	0.816	-	-	12.292
295.3405927	0.0222	40.10231344	0.0270	2076298589469912576	0.395	0.0271	-3.610	0.049	-5.416	0.052	5666.40	3.005	12.016
295.3447000	0.2135	40.09711491	0.2704	2076298585162268672	0.321	0.2710	-3.238	0.490	-5.558	0.578	-	-	12.466
295.3519379	0.1738	40.11946879	0.2248	2076298619522015360	0.300	0.2288	-2.780	0.403	-4.410	0.446	-	-	12.617
295.3441415	0.2359	40.09964149	0.2988	2076298585167763456	0.426	0.2991	-3.539	0.545	-5.950	0.676	-	-	11.852
295.3899344	0.0954	40.12492126	0.1104	2076298692545174400	0.392	0.1128	-3.047	0.214	-3.759	0.226	-	-	12.031
295.3882872	0.3492	40.12968565	0.4130	2076298692549192960	0.385	0.4371	-4.001	0.883	-5.765	0.805	-	-	12.070
295.3832719	0.1267	40.12177347	0.1480	2076298658185389056	0.472	0.1531	-2.551	0.285	-4.140	0.296	-	-	11.636
295.3827368	0.0944	40.13609628	0.1147	2076298756960944256	0.296	0.1164	-3.072	0.231	-3.688	0.230	-	-	12.644
295.3869960	0.1095	40.14440769	0.1288	2076298756960945536	0.396	0.1332	-2.520	0.247	-4.161	0.264	-	-	12.013
295.3710287	0.0237	40.12656948	0.0292	2076298722601233792	0.300	0.0287	-3.417	0.053	-3.293	0.057	5333.50	4.319	12.612
295.3906831	0.1201	40.12595485	0.1474	2076298692545179136	0.392	0.1482	-2.546	0.265	-3.594	0.296	-	-	12.031
295.3196032	0.2569	40.12792606	0.3522	2076298864343606400	0.469	0.3288	-2.645	0.607	-2.934	0.854	-	-	11.643
295.3333260	0.1114	40.15330907	0.1412	2076298898707588736	0.414	0.1372	-2.306	0.243	-3.927	0.258	-	-	11.917
295.3377326	0.5224	40.13604748	0.6116	2076298898703425792	0.398	0.6736	-3.510	1.317	-4.123	1.085	-	-	12.000
295.3414689	0.0835	40.13494058	0.1066	2076298829983954176	0.434	0.1089	-2.569	0.208	-4.609	0.214	-	-	11.811
295.3475095	0.1597	40.13230801	0.1993	2076298829983969664	0.346	0.2035	-3.283	0.376	-5.976	0.410	-	-	12.305
295.3463824	0.2047	40.13401299	0.2587	2076298829983970304	0.459	0.2641	-2.506	0.481	-3.928	0.528	-	-	11.691
295.3420124	0.4144	40.11777148	0.4794	2076298795624172928	0.440	0.4969	-3.612	1.055	-3.502	0.960	-	-	11.783
295.3244709	0.1067	40.14172231	0.1285	2076298894399932544	0.385	0.1265	-3.182	0.241	-3.611	0.246	-	-	12.072
295.3361044	0.2820	40.12744901	0.3373	2076298795624182912	0.425	0.3466	-2.009	0.663	-4.482	0.693	-	-	11.856
295.3270544	0.4593	40.14011407	0.4940	2076298898703403008	0.317	0.5372	-3.504	1.144	-6.051	0.957	-	-	12.492
295.3298352	0.0920	40.13797026	0.1128	2076298898703406464	0.454	0.1116	-3.172	0.208	-4.084	0.214	-	-	11.716
295.3255846	0.1266	40.13033987	0.1609	2076298864343633920	0.447	0.1612	-2.670	0.287	-3.380	0.342	-	-	11.747
295.3445820	0.4113	40.13138446	0.4992	2076298825680584448	0.432	0.5143	-2.699	1.045	-3.967	0.926	-	-	11.824
295.3477234	0.1091	40.16395005	0.1393	2076299001782780544	0.320	0.1323	-2.758	0.244	-4.126	0.253	-	-	12.476
295.3476196	0.2326	40.16590709	0.2813	2076299036142531968	0.422	0.2851	-3.130	0.567	-4.219	0.595	-	-	11.873
295.3688419	0.1076	40.16062047	0.1291	2076298963119377408	0.353	0.1285	-3.263	0.251	-3.761	0.247	-	-	12.261
295.3659920	0.0293	40.14296847	0.0362	2076298933067351936	0.302	0.0363	-3.707	0.066	-3.836	0.074	4906.00	3.215	12.598
295.3662112	0.2703	40.16666560	0.3413	2076299031839021056	0.340	0.3410	-2.140	0.648	-2.553	0.671	-	-	12.340
295.3621493	0.0871	40.14587535	0.1063	2076298933067350144	0.435	0.1046	-2.795	0.195	-3.688	0.202	-	-	11.809
295.2615439	0.1232	40.11989428	0.1458	2076299169277916160	0.486	0.1470	-2.928	0.281	-3.846	0.283	-	-	11.567
295.2843572	0.1375	40.10206110	0.1601	2076299100558431232	0.373	0.1635	-3.210	0.305	-3.340	0.303	-	-	12.144
295.2685969	0.1781	40.09142666	0.1985	2076299066204073728	0.306	0.2161	-2.718	0.379	-4.005	0.396	-	-	12.570
295.2633544	0.1321	40.08760767	0.1613	2076299070501819264	0.307	0.1609	-2.012	0.289	-3.704	0.295	-	-	12.565
295.2545287	0.3164	40.09780066	0.3965	2076299139221298048	0.309	0.3935	-2.936	0.715	-5.248	0.755	-	-	12.547
295.2619652	0.1379	40.10086088	0.1633	2076299134918223104	0.405	0.1643	-2.707	0.312	-3.998	0.314	-	-	11.961
295.2822886	0.0907	40.09859605	0.1066	2076299100558429568	0.474	0.1085	-2.462	0.203	-3.765	0.203	-	-	11.622
295.2801129	0.6907	40.11776694	1.2875	2076299207940865664	0.374	0.8657	-1.955	1.715	-4.748	2.629	-	-	12.136
295.2890275	0.1915	40.10924510	0.2313	2076299203637649280	0.476	0.2381	-2.481	0.449	-3.087	0.487	-	-	11.614
295.2723208	0.0430	40.13002721	0.0506	2076299276664655360	0.335	0.0536	-2.101	0.098	-2.866	0.100	5333.00	-	12.373
295.2864431	0.1426	40.13845853	0.1698	2076299306716922752	0.349	0.1710	-2.943	0.324	-4.073	0.325	-	-	12.286
295.2903350	0.1397	40.14944635	0.1684	2076299306716926080	0.393	0.1636	-3.374	0.335	-4.192	0.311	-	-	12.030
295.2887992	0.1167	40.14408584	0.1472	2076299306716924544	0.388	0.1441	-2.681	0.269	-3.611	0.270	-	-	12.054
295.2937573	0.2640	40.11372912	0.3011	2076299207940887296	0.329	0.3192	-2.943	0.646	-5.856	0.596	-	-	12.414
295.2845646													

295.2286615	0.1365	40.12908641	0.1521	2076299414103585920	0.288	0.1636	-3.467	0.314	-5.807	0.308	-	-	12.700
295.2352087	0.0361	40.12799461	0.0380	2076299414103588224	0.390	0.0423	-2.857	0.081	-3.938	0.072	5873.00	3.761	12.045
295.2526350	0.1103	40.14710211	0.1260	2076299448463344896	0.451	0.1268	-2.833	0.250	-3.501	0.238	-	-	11.728
295.2497334	0.2761	40.14363931	0.3321	2076299448459021056	0.478	0.3357	-3.111	0.669	-4.685	0.703	-	-	11.604
295.2859810	0.1278	40.15606088	0.1586	2076299512875314944	0.486	0.1529	-2.239	0.288	-3.650	0.281	-	-	11.567
295.2602257	0.0992	40.16940052	0.1225	2076299581594795008	0.287	0.1217	-3.175	0.231	-4.415	0.244	-	-	12.711
295.2643233	0.1992	40.17184137	0.2329	2076299581594795648	0.399	0.2418	-1.900	0.470	-3.113	0.485	-	-	11.994
295.2708352	0.1791	40.16455681	0.1960	2076299585898070528	0.442	0.2052	-3.223	0.398	-4.025	0.380	-	-	11.773
295.2566198	0.1103	40.16534924	0.1269	2076299551538296832	0.334	0.1328	-3.234	0.251	-4.056	0.255	-	-	12.383
295.2835261	0.1546	40.15893491	0.1937	2076299512880676480	0.3909	0.1904	-2.321	0.342	-4.808	0.329	-	-	12.040
295.2870338	0.2217	40.15426361	0.2847	2076299517178611072	0.3700	0.2871	-3.867	0.525	-5.941	0.557	-	-	12.159
295.2720185	0.0933	40.17060978	0.1100	2076299581594795136	0.4129	0.1130	-3.033	0.215	-3.865	0.222	-	-	11.920
295.2642066	0.0989	40.15647896	0.1145	2076299547235053440	0.3263	0.1166	-3.582	0.226	-4.732	0.219	-	-	12.432
295.2672629	0.0180	40.17315281	0.0204	2076299585902317952	0.3348	0.0214	-2.868	0.039	-3.973	0.039	5791.00	6.393	12.376
295.3095546	0.0771	40.16996551	0.1029	2076299723341302528	0.2956	0.0919	-2.604	0.176	-4.457	0.204	5601.00	-	12.646
295.3225885	0.0209	40.16248578	0.0243	2076299654621830144	0.3457	0.0242	-2.813	0.047	-3.890	0.047	5512.00	4.718	12.307
295.2959928	0.1167	40.15210349	0.1326	2076299684674006016	0.3324	0.1374	-3.501	0.260	-5.985	0.263	-	-	12.392
295.3098532	0.2265	40.14753029	0.2691	2076299615954570880	0.3591	0.2790	-3.303	0.533	-4.264	0.565	-	-	12.224
295.3199338	0.2986	40.16101302	0.3807	2076299654617686016	0.3440	0.3721	-2.723	0.718	-4.362	0.786	-	-	12.317
295.3280009	0.1287	40.15231423	0.1568	2076299654617686912	0.4137	0.1525	-3.140	0.285	-4.078	0.298	-	-	11.917
295.3208719	0.0985	40.14355979	0.1150	2076299615954438400	0.4453	0.1186	-2.840	0.231	-2.051	0.233	-	-	11.757
295.3007474	0.2779	40.14417449	0.3258	2076299684674046336	0.3851	0.3468	-3.071	0.743	-3.805	0.668	-	-	12.072
295.3170381	0.1793	40.13854907	0.2045	2076299620257873664	0.3050	0.2101	-2.283	0.442	-4.622	0.416	-	-	12.579
295.3231237	0.1367	40.16173794	0.1644	2076299654617694720	0.2894	0.1620	-2.982	0.311	-3.649	0.314	-	-	12.693
295.3105770	0.1354	40.14415350	0.1626	2076299620262068352	0.3931	0.1591	-2.662	0.312	-4.172	0.312	-	-	12.027
295.3246136	0.0936	40.16597770	0.1082	2076299757696929152	0.3679	0.1127	-2.859	0.223	-3.961	0.219	-	-	12.171
295.3330224	0.1545	40.18826260	0.1766	2076299860776273024	0.4408	0.1861	-3.188	0.376	-3.965	0.385	-	-	11.779
295.3253794	0.0802	40.18741671	0.0969	2076299826416672512	0.4153	0.1082	-3.236	0.230	-4.687	0.242	-	-	11.908
295.3199939	0.1006	40.17209162	0.1125	2076299826420527488	0.4067	0.1139	-3.160	0.233	-4.211	0.215	-	-	11.954
295.3384515	0.1190	40.16368572	0.1264	2076299757701062656	0.3275	0.1320	-2.617	0.251	-3.668	0.234	-	-	12.424
295.3332707	0.0990	40.17106632	0.1190	2076299757701064320	0.3287	0.1198	-2.365	0.232	-4.064	0.242	-	-	12.416
295.3261130	0.0284	40.17922529	0.0365	2076299826420541184	0.2902	0.0385	-2.848	0.080	-4.308	0.091	5719.82	-	12.687
295.3341590	0.1040	40.17804250	0.1239	2076299757701071360	0.2971	0.1293	-3.323	0.242	-4.357	0.252	-	-	12.635
295.3366549	0.2290	40.16646136	0.2767	2076299757696981888	0.4685	0.2841	-2.889	0.518	-4.919	0.680	-	-	11.646
295.3341784	0.1733	40.20047459	0.1967	2076299860776326912	0.4312	0.1970	-3.434	0.425	-4.541	0.377	-	-	11.827
295.3347890	0.1566	40.19850088	0.1821	2076299856472755584	0.2933	0.1833	-2.836	0.365	-4.070	0.349	-	-	12.663
295.3274791	0.1288	40.18013594	0.1524	2076299826416476416	0.3393	0.1551	-2.697	0.305	-3.051	0.335	-	-	12.347
295.3511275	0.0189	40.17869202	0.0207	2076299792060827648	0.3427	0.0217	-3.571	0.041	-3.253	0.040	5805.00	7.636	12.325
295.3444753	0.1307	40.17904163	0.1578	2076299792056810240	0.3589	0.1553	-2.787	0.282	-4.127	0.302	-	-	12.225
295.2908523	0.1590	40.16030420	0.1775	2076299895135756800	0.4897	0.1881	-2.510	0.347	-5.422	0.348	-	-	11.550
295.2732764	0.1021	40.18422167	0.1220	2076299963859451008	0.3630	0.1237	-3.134	0.233	-3.834	0.224	-	-	12.200
295.2919142	0.1000	40.20156007	0.1073	2076299998219217536	0.4576	0.1177	-2.886	0.227	-3.814	0.217	-	-	11.698
295.3085149	0.1558	40.18141587	0.2006	2076299929495891200	0.3198	0.1882	-3.131	0.352	-3.628	0.369	-	-	12.476
295.2942744	0.1235	40.18700821	0.1502	2076299998215370880	0.4790	0.1587	-2.665	0.273	-4.165	0.260	-	-	11.598
295.2855326	0.4018	40.19586689	0.8362	2076299998215054592	0.4471	0.5670	-3.501	1.011	-4.383	1.936	-	-	11.748
295.2885116	0.0918	40.17596229	0.1073	2076299890832483200	0.3557	0.1105	-2.790	0.219	-3.650	0.216	-	-	12.245
295.2974455	0.1219	40.17518843	0.1453	2076299925192221056	0.4065	0.1490	-2.703	0.282	-4.538	0.298	-	-	11.955
295.2929103	0.2208	40.16831624	0.2508	2076299890832440192	0.2847	0.2640	-1.988	0.480	-4.484	0.482	-	-	12.728
295.2861010	0.1952	40.19524232	0.2280	2076299998215056384	0.4534	0.2383	-2.048	0.477	-3.737	0.478	-	-	11.718
295.3054094	0.1235	40.20910698	0.0931	2076300101298453376	0.3114	0.1132	-3.403	0.245	-3.947	0.181	-	-	12.533
295.3199361	0.1573	40.19562920	0.1683	2076300066934670336	0.3397	0.1644	-3.194	0.490	-3.670	0.423	-	-	12.345
295.3072775	0.1884	40.20000648	0.2193	2076300101294368768	0.3935	0.2281	-2.574	0.445	-3.701	0.472	-	-	12.025
295.3273066	0.0629	40.20956002	0.0800	2076300066934760832	0.3170	0.0831	-3.008	0.171	-3.454	0.202	-	-	12.495
295.3219206	0.2253	40.19090892	0.2436	2076300028271441536	0.4873	0.2517	-2.407	0.506	-3.142	0.481	5549.50	5549.500	11.561
295.3020957	0.1284	40.20261805	0.1275	2076300101294354304	0.4591	0.1436	-2.649	0.270	-4.205	0.243	-	-	11.690
295.3123471	0.1523	40.21282618	0.1701	2076300131350663296	0.3788	0.1773	-1.985	0.352	-5.548	0.322	-	-	12.108
295.3084979	0.0158	40.19289358	0.0217	2076300032578964608	0.3513	0.0193	-2.905	0.035	-3.670	0.043	5641.64	7.269	12.272
295.3239481	0.1389	40.19396669	0.1810	2076300066934687232	0.3856	0.1775	-2.193	0.325	-4.020	0.364	-	-	12.069
295.3307189	0.2422	40.20301425	0.3039	2076300062631135360	0.2878	0.3079	-3.591	0.570	-4.341	0.583	-	-	12.705
295.3090864	0.0182	40.19116127	0.0253	2076300032574863616	0.3059	0.0222	-2.861	0.041	-4.507	0.050	5901.33	6.850	12.572
295.3087222	0.2242	40.19122159	0.4843	2076300032574863744	0.3746	0.3391	-3.264	0.464	-5.578	0.827	-	-	12.132
295.3246183	0.6526	40.20822133	0.7508	2076300066934744448	0.3874	0.6763	-2.134	1.618	-3.966	1.414	-	-	12.059
295.3176222	0.0944	40.21766148	0.1131	2076300131350532992	0.3894	0.1153	-3.291	0.221	-3.987	0.230	-	-	12.048
295.3158078	0.1526	40.20555665	0.1976	2076300062631055232	0.4744	0.1817	-3.292	0.345	-3.805	0.353	-	-	11.619
295.3227201	0.0254	40.21594995	0.031	2.076300135658216448	0.4573	0.0277	-2.871	0.055	-3.282	0.059	5555.08	2.218	11.699
295.3218582	0.1458	40.19937560	0.1597	2076300062631054720	0.3491	0.1650	-2.502	0.358	-3.464	0.304	-	-	12.285
295.5121924	0.1604	40.05526090	0.2201	2076376513050800512	0.3897	0.2224	-2.877	0.347	-3.946	0.384	-	-	12.046
295.5514872	0.1799	40.08750903	0.2620	2076376964022948352	0.4046	0.2827	-2.463	0.683	-4.855	0.387	-	-	11.965
295.4905894	0.2018	40.05262848	0.2704	2076388126642347904	0.3975	0.2701	-2.705	0.438	-6.301	0.515	-	-	12.003
295.4943976	0.0241	40.06808495	0.0310	2076388234025963904	0.3193	0.0316	-2.768	0.055	-6.554	0.061	5804.67	4.308	12.479
295.4809643	0.2128	40.07236566	0.2715	2076388234017968512	0.2944	0.2775	-2.972	0.506	-3.874	0.535	-	-	12.655
295.4935071	0.1573	40.06362411	0.2141	2076388229721628928	0.3521	0.2071	-3.006	0.347	-4.130	0.396	-	-	12.267
295.4797967	0.0594	40.04934815	0.0799	2076388199665911680	0.3626	0.0776	-2.384	0.132	-3.724	0.154	-	-	12.203
295.4894497	0.1738	40.07203743	0.2270	2076388229721681280	0.3								

295.5381755	0.0320	40.12017308	0.0417	2076388783781841536	0.3851	0.0417	-2.249	0.069	-6.509	0.076	5034.50	1.928	12.072
295.5210769	0.0627	40.09768062	0.086	2076388749422077312	0.4855	0.0821	-2.471	0.142	-3.052	0.159	5019.39	-	11.569
295.5481545	0.2822	40.13836592	0.3883	2076388916910460928	0.3191	0.3945	-2.456	0.638	-4.196	0.688	-	-	12.480
295.5512752	0.0758	40.14704767	0.1025	2076388921220824832	0.4440	0.1003	-1.946	0.159	-4.654	0.186	-	-	11.763
295.5557444	0.2424	40.11816870	0.3063	2076388813831215232	0.3299	0.3362	-2.362	0.530	-1.891	0.554	-	-	12.4082
295.5490518	0.3487	40.11779307	0.4351	2076388813831214464	0.3793	0.4656	-2.601	0.747	-5.543	0.732	-	-	12.105
295.5484244	0.0593	40.13264614	0.0761	2076388882550713344	0.3523	0.0753	-3.915	0.130	-4.581	0.138	-	-	12.265
295.5492393	0.1718	40.13128374	0.2190	2076388886853368960	0.4326	0.2173	-2.806	0.375	-4.930	0.378	-	-	11.820
295.5660985	0.2889	40.13999590	0.4203	2076388848190986496	0.4320	0.4182	-2.345	0.643	-5.066	0.725	-	-	11.822
295.5162883	0.0518	40.13263922	0.0670	2076388989932484736	0.3564	0.0695	-3.623	0.139	-3.820	0.120	-	-	12.240
295.5070101	0.0942	40.11513789	0.1245	2076388955580508544	0.4428	0.1220	-3.790	0.208	-5.423	0.226	-	-	11.769
295.5051412	0.0714	40.14249253	0.1003	2076389058659738880	0.4801	0.0960	-2.031	0.161	-5.318	0.180	-	-	11.593
295.5127716	0.2104	40.10958147	0.2969	2076388951270160384	0.2816	0.2910	-3.192	0.475	-6.348	0.525	-	-	12.752
295.5328822	0.0815	40.16076637	0.1115	2076389196099122304	0.3793	0.1161	-2.996	0.188	-1.448	0.191	-	-	12.105
295.5407237	0.1654	40.15278860	0.2223	2076389123068925440	0.4864	0.2212	-3.232	0.359	-4.339	0.389	-	-	11.565
295.5150053	0.0323	40.15718628	0.0446	2076389161738971776	0.4119	0.0432	-3.709	0.071	-5.782	0.082	5325.00	1.381	11.926
295.5301327	0.0877	40.14785164	0.1136	2076389093019500288	0.3065	0.1159	-2.603	0.189	-5.411	0.202	-	-	12.568
295.4390486	0.3805	40.09992687	0.4916	2076389226151135872	0.3476	0.4850	-2.440	0.858	-4.004	0.941	-	-	12.295
295.4497615	0.0897	40.09083066	0.1251	2076389230458354944	0.3681	0.1207	-3.179	0.203	-5.084	0.228	-	-	12.170
295.4398193	0.1616	40.09421452	0.2091	2076389226148057344	0.4873	0.2108	-3.076	0.383	-4.344	0.389	-	-	11.561
295.4506074	0.0590	40.09302671	0.0810	2076389226148056960	0.4491	0.0779	-2.826	0.131	-6.109	0.150	-	-	11.738
295.4524354	0.3256	40.10862152	0.4350	2076389260507807616	0.4083	0.4294	-3.744	0.722	-4.092	0.827	-	-	11.945
295.4482609	0.0439	40.10159338	0.0643	2076389226148062592	0.3115	0.0556	-3.354	0.099	-6.555	0.126	5445.85	-	12.533
295.4572184	0.6553	40.10972141	0.9391	2076389264810148096	0.3519	0.8018	-2.641	1.534	-4.766	1.670	-	-	12.268
295.4449883	0.0218	40.09041882	0.0310	2076389230458351232	0.4327	0.0273	-2.313	0.053	-5.352	0.063	5359.00	3.380	11.819
295.4738728	0.6986	40.12915025	0.8405	2076389402249207424	0.4506	0.9188	-3.736	1.588	-3.832	1.526	-	-	11.731
295.4585147	0.7028	40.12842927	0.9102	2076389436608894464	0.3847	0.9093	-1.890	1.578	-3.689	1.671	-	-	12.074
295.4205196	0.1196	40.13879902	0.1485	2076389604105241216	0.4647	0.1493	-2.769	0.267	-4.168	0.297	-	-	11.664
295.4220522	0.5779	40.15294820	0.8258	2076389608415499904	0.4259	0.7957	-3.739	1.467	-5.766	1.288	-	-	11.853
295.4209118	0.0211	40.15319313	0.0294	2076389608415499392	0.3715	0.0269	-2.828	0.048	-3.941	0.056	5766.00	4.101	12.150
295.4296846	0.4886	40.14050242	0.6547	2076389608407530624	0.3231	0.6685	-3.240	1.204	-4.499	1.074	-	-	12.453
295.4041950	0.1439	40.12954472	0.1780	2076389569748521984	0.4207	0.1793	-3.027	0.331	-3.652	0.355	-	-	11.880
295.4239933	0.2137	40.11126848	0.2843	2076389501025980800	0.4564	0.2793	-3.085	0.477	-3.643	0.531	-	-	11.703
295.4284851	0.2630	40.12930040	0.3367	2076389535385743744	0.4096	0.3289	-2.473	0.599	-3.419	0.643	-	-	11.938
295.4067680	0.1606	40.13254970	0.2004	2076389574047689856	0.4270	0.2056	-2.937	0.374	-4.002	0.405	-	-	11.848
295.4336858	0.1293	40.12462109	0.1824	2076389535385735168	0.3351	0.1799	-2.831	0.292	-4.398	0.330	-	-	12.374
295.4256417	0.0962	40.13525428	0.1324	2076389604105237376	0.3604	0.1241	-2.879	0.217	-6.042	0.250	-	-	12.216
295.4363028	0.4399	40.16350987	0.5414	2076389711486830208	0.3241	0.5526	-2.125	1.089	-5.770	1.261	-	-	12.447
295.4468489	0.2665	40.15315614	0.3665	2076389672824747264	0.4316	0.3712	-2.582	0.614	-2.828	0.663	-	-	11.825
295.4547973	0.1719	40.14777001	0.2245	2076389677127107200	0.3738	0.2212	-3.184	0.380	-4.628	0.414	-	-	12.137
295.4503813	0.1075	40.15987466	0.1413	2076389672824764672	0.3427	0.1402	-2.535	0.246	-3.750	0.328	-	-	12.325
295.4518876	0.1364	40.16486851	0.1654	2076389741544254976	0.4835	0.1698	-2.608	0.308	-4.378	0.333	-	-	11.578
295.4597849	0.8034	40.14999575	1.0254	2076389677127124352	0.4274	1.1843	-3.811	1.834	-4.055	1.675	-	-	11.846
295.4267794	0.0915	40.15063113	0.1038	2076389711486764032	0.4918	0.1066	-2.544	0.215	-5.741	0.211	-	-	11.541
295.4317057	0.1278	40.16446397	0.1583	2076389707184515840	0.3398	0.1624	-2.631	0.284	-3.506	0.306	-	-	12.344
295.4316225	0.2502	40.15760009	0.3279	2076389707184498176	0.3022	0.3297	-3.806	0.605	-3.838	0.662	-	-	12.599
295.4932247	0.3780	40.13951907	0.5203	2076389775907310592	0.3278	0.5170	-2.598	0.836	-3.953	0.904	-	-	12.422
295.4774894	0.1191	40.15821674	0.1542	2076389844623451264	0.3407	0.1568	-2.911	0.253	-5.199	0.272	-	-	12.338
295.4873723	0.0193	40.14090396	0.0281	2076389780214232192	0.3199	0.0252	-3.709	0.041	-4.578	0.050	4928.53	66.619	12.475
295.5027765	0.4624	40.14895952	0.6688	2076389814566208896	0.4441	0.6702	-2.633	1.114	-1.851	1.048	-	-	11.763
295.4881538	0.0438	40.17007708	0.0602	2076389883293465344	0.3653	0.0579	-3.343	0.096	-5.826	0.110	5324.00	-	12.187
295.4817775	0.0944	40.17211598	0.1300	2076390085141659648	0.4892	0.1258	-3.108	0.209	-3.547	0.235	-	-	11.553
295.5182892	0.4163	40.18026621	0.5884	2076389952005302912	0.3328	0.5506	-2.692	0.924	-4.002	1.094	-	-	12.389
295.5079731	0.2276	40.17051562	0.3915	2076389917653219968	0.3342	0.3104	-2.990	0.483	-5.504	0.691	-	-	12.380
295.5137303	0.0395	40.17171056	0.0530	2076389917653224320	0.3975	0.0520	-3.748	0.088	-2.545	0.098	4955.50	1.164	12.003
295.4696996	0.1936	40.17045324	0.2683	2076390055084332672	0.3858	0.2691	-2.336	0.454	-4.532	0.470	-	-	12.068
295.4598821	0.0737	40.16720568	0.0941	2076390055092135424	0.4217	0.0937	-3.732	0.160	-5.718	0.179	-	-	11.875
295.4801103	0.1198	40.17906978	0.1634	2076390089444127232	0.3253	0.1596	-2.861	0.264	-6.412	0.292	-	-	12.439
295.4658164	0.1628	40.19855340	0.2116	2076390153861234048	0.3541	0.2144	-3.072	0.380	-4.380	0.428	-	-	12.254
295.4636337	0.1684	40.18415757	0.2320	2076390158171363456	0.4325	0.2189	-2.933	0.390	-3.721	0.421	-	-	11.820
295.4718552	0.2899	40.17224529	0.4020	2076390050781917952	0.3203	0.3932	-2.004	0.645	-6.621	0.719	-	-	12.472
295.4729834	0.1762	40.17597983	0.2485	2076390085141670272	0.4515	0.2494	-2.834	0.399	-4.710	0.444	-	-	11.727
295.4556102	0.1210	40.17413833	0.1516	2076390119501405440	0.4032	0.1222	-2.637	0.279	-3.792	0.299	-	-	11.972
295.4740093	0.1652	40.17880393	0.2257	2076390085141680896	0.2929	0.2547	-2.305	0.368	-3.705	0.396	-	-	12.666
295.4816337	0.1173	40.21456332	0.1468	2076390291300265344	0.4127	0.1484	-2.213	0.268	-4.839	0.284	-	-	11.922
295.5001246	0.2356	40.19824113	0.3228	2076390222580707200	0.4122	0.3233	-2.883	0.527	-4.013	0.578	-	-	11.924
295.4881661	0.1118	40.19967442	0.1456	2076390188220974976	0.4610	0.1440	-2.978	0.255	-3.613	0.282	-	-	11.681
295.4773418	0.1769	40.20266452	0.2288	2076390256940480768	0.3128	0.2332	-2.596	0.405	-2.667	0.457	-	-	12.523
295.4863917	0.2428	40.22373605	0.2993	2076390295602704768	0.3340	0.3136	-2.240	0.574	-6.066	0.620	-	-	12.381
295.4977516	0.3516	40.21250725	0.4247	2076390226883232640	0.2848	0.4705	-2.240	0.966	-2.470	0.835	-	-	12.727
295.4792876	0.0571	40.19207182	0.0747	2076390192531117312	0.4679	0.0732	-1.858	0.130	-2.881	0.147	5230.54	-	11.649
295.5563857	0.1575	40.19241297	0.2060	2076390703617011968	0.2932	0.0886	-3.975	0.153	-4.115	0.176	-	-	12.664
295.5606982	0.2619	40.19099408	0.3455	2076390703617004672	0.3433	0.3571	-2.552	0.579	-4.692	0.628	-	-	12.322
295.2740912	0.2094	40.24138586	0.2680	2076488049055863936	0.3172	0.2661</							

295.5682616	0.1728	40.21052370	0.2379	2076390806696303744	0.3135	0.2267	-3.588	0.380	-4.591	0.437	-	-	12.519
295.5660020	0.2885	40.21261055	0.3753	2076390806696312832	0.3982	0.3887	-2.044	0.636	-6.064	0.654	-	-	11.999
295.5778883	0.1320	40.18922330	0.1658	2076390737976736128	0.3819	0.1743	-2.562	0.290	-3.454	0.299	-	-	12.090
295.5803018	0.3841	40.22629853	0.3791	2076391223315914368	0.4661	0.4116	-2.087	1.015	-3.709	0.741	-	-	11.658
295.5471106	0.0703	40.20864421	0.0943	2076391463841499392	0.3274	0.0972	-2.501	0.156	-3.170	0.179	-	-	12.425
295.5327013	0.3587	40.20672188	0.4749	2076391528250793344	0.4325	0.4794	-2.523	0.826	-3.828	0.795	-	-	11.820
295.5264006	0.4286	40.18887283	0.5897	2076391429474103168	0.4718	0.5682	-4.043	0.991	-1.384	1.001	-	-	11.631
295.5388285	0.1030	40.20858157	0.1452	2076391459531339136	0.3807	0.1381	-2.419	0.228	-3.767	0.254	-	-	12.097
295.5341157	0.0156	40.19036543	0.0221	2076391429481741568	0.3806	0.0221	-2.225	0.034	-5.990	0.043	4513.21	9.757	12.098
295.5446045	0.1975	40.22418232	0.2620	2076391635640199168	0.4899	0.2679	-3.126	0.478	-4.147	0.470	-	-	11.549
295.5467427	0.1328	40.23657561	0.1866	207639166999944960	0.4024	0.1822	-3.974	0.299	-5.604	0.386	-	-	11.977
295.5403463	0.5720	40.22440229	0.7625	2076391635632655232	0.3972	0.8032	-3.849	1.565	-6.464	1.360	-	-	12.005
295.5516124	0.1271	40.22753030	0.1714	2076391635640204672	0.4666	0.1666	-3.305	0.284	-4.703	0.330	-	-	11.655
295.5589984	0.1126	40.23934146	0.1475	2076391665689907840	0.2818	0.1481	-2.161	0.251	-4.840	0.266	-	-	12.750
295.5109489	0.0734	40.24197407	0.0925	2076391807438878464	0.3945	0.0957	-3.395	0.167	-6.057	0.181	-	-	12.020
295.5101358	0.0944	40.24927572	0.1214	2076391803136658944	0.2944	0.1286	-2.132	0.213	-3.688	0.229	-	-	12.655
295.5287346	0.0735	40.22826915	0.1050	2076391738719406208	0.3066	0.1033	-3.164	0.166	-4.470	0.178	-	-	12.567
295.5010724	0.0892	40.23764592	0.1120	2076391768769129856	0.2895	0.1102	-2.345	0.198	-1.885	0.247	-	-	12.692
295.5208875	0.2430	40.22822232	0.3070	2076391734424380288	0.3322	0.3180	-2.133	0.568	-4.807	0.615	-	-	12.393
295.5064779	0.0319	40.21591438	0.0399	2076391704359643392	0.4145	0.0405	-2.158	0.070	-4.285	0.076	5504.00	1.615	11.912
295.5046890	0.2243	40.24024737	0.3363	2076391807431288832	0.3443	0.3195	-3.383	0.537	-4.886	0.772	-	-	12.315
295.5332595	0.0724	40.24680705	0.0927	2076391837496434432	0.3449	0.0975	-2.747	0.169	-5.610	0.186	-	-	12.312
295.5339375	0.2991	40.26691384	0.3544	2076391944870390912	0.4248	0.3912	-3.503	0.653	-3.417	0.751	-	-	11.859
295.5288028	0.2491	40.23581947	0.2926	2076391841791081728	0.4329	0.3231	-2.587	0.578	-5.988	0.585	-	-	11.818
295.5394576	0.4641	40.24717994	0.4468	2076391876150885504	0.4853	0.5417	-3.244	0.953	-3.845	0.890	-	-	11.570
295.5653373	0.3341	40.26086866	0.4639	2076392043647141888	0.3956	0.4707	-2.260	0.731	-2.425	0.860	-	-	12.014
295.5384057	0.3168	40.28294327	0.3617	2076392318525188736	0.3796	0.4037	-3.066	0.705	-5.313	0.735	-	-	12.103
295.5499958	1.0377	40.27260135	1.1395	2076392322827572736	0.2928	1.3587	-2.073	2.282	-6.041	1.568	-	-	12.667
295.4004098	0.2047	40.13180916	0.2856	2076392524686022016	0.3575	0.2700	-3.491	0.464	-4.273	0.534	-	-	12.234
295.4041499	0.4118	40.16620012	0.5375	2076392632064498816	0.3442	0.5599	-2.848	0.985	-3.674	0.874	-	-	12.316
295.3811190	0.3288	40.15725083	0.4366	2076392597704652672	0.4530	0.4475	-3.383	0.856	-3.523	0.765	-	-	11.720
295.3978790	0.0238	40.14293412	0.0286	2076392528993234048	0.3653	0.0288	-3.495	0.052	-4.800	0.056	5339.20	4.204	12.187
295.3950682	0.3734	40.13695547	0.4731	2076392524682997760	0.3640	0.4737	-2.115	0.958	-2.911	0.894	-	-	12.194
295.4158902	0.2663	40.18248944	0.3239	2076392735143794816	0.4143	0.3343	-2.233	0.631	-3.041	0.661	-	-	11.913
295.4192683	0.1995	40.18059356	0.2581	2076392730841547264	0.3098	0.2624	-3.034	0.475	-5.327	0.518	-	-	12.545
295.4368364	0.1449	40.17611451	0.1779	2076392700791977856	0.4761	0.1804	-1.880	0.340	-3.437	0.375	-	-	11.612
295.4236954	0.0842	40.19478888	0.1069	2076392765201345280	0.3641	0.1061	-2.372	0.188	-4.675	0.207	-	-	12.194
295.4390913	0.1081	40.18408188	0.1470	2076392700791984768	0.4285	0.1409	-2.259	0.243	-2.742	0.307	-	-	11.840
295.4222891	0.1116	40.17022677	0.1370	2076392662122034304	0.4342	0.1384	-3.949	0.256	-6.454	0.273	-	-	11.812
295.4238041	0.1413	40.17350180	0.1726	2076392662122046208	0.3473	0.1760	-4.026	0.324	-2.618	0.343	-	-	12.296
295.4258391	0.0761	40.17965665	0.0981	2076392696481805312	0.3234	0.0977	-2.133	0.173	-3.590	0.202	-	-	12.451
295.4091251	0.2398	40.18341866	0.3082	2076392735143774080	0.4211	0.3126	-2.909	0.574	-6.249	0.615	-	-	11.879
295.4132620	0.1108	40.18227745	0.1426	2076392730841555712	0.2915	0.1350	-2.899	0.250	-3.693	0.260	-	-	12.677
295.3777897	0.1136	40.19054000	0.1349	2076392902640286080	0.4255	0.1353	-2.914	0.261	-4.101	0.257	-	-	11.856
295.3790372	0.2706	40.18618295	0.3516	2076392902640271744	0.4499	0.3452	-2.663	0.664	-4.441	0.815	-	-	11.734
295.3741009	0.1385	40.18996248	0.1641	2076392902640302336	0.4149	0.1642	-2.642	0.311	-4.187	0.306	-	-	11.910
295.3708113	0.3192	40.16883806	0.3563	2076392803863082752	0.3332	0.3999	-2.784	0.765	-2.703	0.718	-	-	12.386
295.3651224	0.1786	40.18677551	0.2312	2076392868283420288	0.3658	0.2266	-2.122	0.432	-4.976	0.473	-	-	12.184
295.3595569	0.1338	40.18097735	0.1533	2076392872582556416	0.3121	0.1568	-3.583	0.309	-3.855	0.310	-	-	12.529
295.3675417	0.1539	40.18184429	0.1653	2076392872582588416	0.4368	0.1676	-2.682	0.349	-3.914	0.307	-	-	11.799
295.3640805	0.1155	40.17486707	0.1322	2076392868283949696	0.3438	0.1362	-3.158	0.252	-4.406	0.249	-	-	12.318
295.3724261	0.5100	40.18060259	0.5939	2076392872582602368	0.3729	0.6192	-2.244	1.256	-3.914	0.986	-	-	12.142
295.3851022	0.2087	40.17759231	0.3094	2076392833920771712	0.4060	0.2716	-3.131	0.534	-4.062	0.664	-	-	11.957
295.3828951	0.1216	40.17597692	0.1493	2076392833920771584	0.4721	0.1477	-2.664	0.268	-4.064	0.266	-	-	11.630
295.4051035	0.1243	40.21037110	0.1511	2076393044381481216	0.3350	0.1495	-2.705	0.291	-3.516	0.295	-	-	12.375
295.4134055	0.0954	40.20007072	0.1146	2076392971359796224	0.3932	0.1147	-2.502	0.214	-3.544	0.223	-	-	12.027
295.4148965	0.1285	40.20825649	0.1579	2076392975662028416	0.4149	0.1533	-2.735	0.287	-3.955	0.279	-	-	11.910
295.4010018	0.3296	40.18155787	0.6814	2076392941302175616	0.3948	0.4762	-2.323	0.794	-5.496	1.842	-	-	12.018
295.3998417	0.1362	40.20960223	0.1684	2076393040079320320	0.3344	0.1671	-2.693	0.306	-3.528	0.307	-	-	12.379
295.4259099	0.1086	40.20493122	0.1293	2076393147468588032	0.4759	0.1311	-3.150	0.238	-3.944	0.237	-	-	11.612
295.4471704	0.1060	40.22202880	0.1351	2076393177518326784	0.3423	0.1349	-3.389	0.241	-4.459	0.260	-	-	12.328
295.4361824	0.1457	40.18892122	0.1802	2076393078749108480	0.3113	0.1824	-3.357	0.331	-3.774	0.363	-	-	12.534
295.4491241	0.2373	40.22072594	0.2895	2076393181820596864	0.3960	0.3028	-3.647	0.546	-6.226	0.585	-	-	12.012
295.4441744	0.0528	40.19760715	0.0671	2076393078749120384	0.2835	0.0662	-1.937	0.118	-2.290	0.135	-	-	12.737
295.4375600	0.1477	40.20543828	0.2104	2076393147468596864	0.3209	0.1794	-3.348	0.339	-3.414	0.400	-	-	12.468
295.4394810	0.3017	40.22046844	0.3679	2076393177521084928	0.4123	0.3903	-2.040	0.650	-2.261	0.812	-	-	11.924
295.4671008	0.4222	40.22168931	0.4919	2076393216180393344	0.4397	0.5165	-2.935	1.120	-1.453	0.880	-	-	11.784
295.4581091	0.0933	40.22345734	0.1206	2076393284907576960	0.2871	0.1201	-2.859	0.212	-3.504	0.232	-	-	12.710
295.4805082	0.2365	40.22960371	0.2828	2076393250540202624	0.4714	0.3166	-2.802	0.527	-3.831	0.573	-	-	11.633
295.4624713	0.0741	40.23963013	0.0952	2076393319267733504	0.3693	0.0943	-3.151	0.172	-6.186	0.185	-	-	12.163
295.4363439	0.2679	40.21934050	0.3188	2076393387978984832	0.3923	0.3322	-2.714	0.626	-4.323	0.685	-	-	12.032
295.4151187	0.2714	40.24374720	0.3190	2076393452396352256	0.3317	0.3423	-3.066	0.597	-3.828	0.667	-	-	12.396
295.4138317	0.0394	40.22638851	0.0493	2076393422346500224	0.3306	0.0496	-2.629	0.089	-3.749	0.101	5223.50	-	12.403
295.4185612	0.0874	40.22234468	0.1045	2076393349319779328	0.4717	0.1077	-3.079	0.198	-3.719	0.211	-	-	11.63

295.5674555	0.2297	40.21582175	0.3085	2076390845358736128	0.4764	0.3182	-2.293	0.485	-6.526	0.600	-	-	11.610
295.4448451	0.4200	40.26075821	0.4867	2076393594137573760	0.2943	0.5212	-3.724	0.952	-3.173	0.923	-	-	12.656
295.4471247	0.5529	40.25664446	0.5403	2076393594137553280	0.3012	0.6143	-1.965	1.333	-4.365	0.961	-	-	12.606
295.4398534	0.1833	40.23359851	0.2575	2076393486763209216	0.3002	0.2457	-2.498	0.425	-2.895	0.516	-	-	12.613
295.3671417	0.0854	40.19803976	0.1044	2076393658557409792	0.4832	0.1060	-2.051	0.197	-5.062	0.207	-	-	11.579
295.3553035	0.3802	40.19820494	0.4954	2076393624197671040	0.3000	0.4864	-2.171	0.897	-4.646	0.926	-	-	12.614
295.3755934	0.1186	40.20669865	0.1404	2076393658557413504	0.3029	0.1404	-2.119	0.272	-5.369	0.263	-	-	12.594
295.3489380	0.1072	40.20242238	0.1638	2076393697218331520	0.4798	0.1436	-3.097	0.256	-4.022	0.316	-	-	11.595
295.3446907	0.1901	40.20097225	0.5337	2076393697218523520	0.4669	0.2691	-1.994	0.509	-4.918	1.452	-	-	11.654
295.3643347	0.0798	40.20775396	0.0872	2076393662865120384	0.2848	0.0937	-3.015	0.167	-4.572	0.185	-	-	12.727
295.3449577	0.2397	40.21194953	0.2816	2076393697216324352	0.4362	0.3001	-2.661	0.644	-2.958	0.529	-	-	11.802
295.3453024	0.1360	40.19699722	0.1594	2076393697224333312	0.4639	0.1616	-2.807	0.289	-2.741	0.292	-	-	11.668
295.3388812	0.0181	40.19921044	0.0226	2076393692917498496	0.3568	0.0229	-2.325	0.041	-4.055	0.050	4959.00	55.269	12.238
295.3376945	0.0647	40.20324037	0.0785	2076393697224331648	0.2839	0.0792	-3.218	0.153	-3.738	0.162	-	-	12.734
295.3870362	0.1014	40.23966652	0.1271	2076393869023086592	0.3013	0.1239	-3.059	0.226	-4.472	0.246	-	-	12.605
295.3862047	0.0434	40.22826166	0.0546	2076393800303603328	0.3803	0.0542	-2.871	0.099	-4.973	0.111	4932.83	-	12.099
295.3961371	0.1737	40.23092421	0.2141	2076393800295753984	0.3993	0.2148	-2.202	0.416	-6.449	0.451	-	-	11.994
295.3705108	0.1193	40.22473657	0.1428	2076393830353385088	0.3966	0.1433	-3.697	0.267	-5.960	0.267	-	-	12.008
295.3786899	0.0541	40.24641762	0.0699	2076393864715876480	0.3378	0.0711	-3.395	0.114	-6.421	0.130	5575.31	-	12.357
295.3791653	0.0229	40.22404927	0.0309	2076393765943856128	0.4517	0.0281	-2.524	0.052	-4.820	0.059	5320.00	2.298	11.726
295.3704505	0.1711	40.22739370	0.2118	2076393834655401984	0.2944	0.2214	-2.838	0.426	-4.452	0.424	-	-	12.655
295.3347145	0.1053	40.23100455	0.1215	2076394002154816256	0.3719	0.1267	-2.822	0.224	-3.199	0.230	-	-	12.148
295.3357529	0.1892	40.20896665	0.2389	2076393903374712192	0.3276	0.2443	-2.659	0.445	-4.120	0.454	-	-	12.423
295.3264628	0.2806	40.22485222	0.3243	2076393972094206464	0.3656	0.3389	-2.495	0.691	-4.424	0.647	-	-	12.185
295.3522978	0.0959	40.22664700	0.1154	2076393933435627264	0.2839	0.1148	-3.077	0.215	-3.820	0.218	-	-	12.735
295.3368447	0.3209	40.22288895	0.3435	2076393903374758912	0.2845	0.3760	-2.420	0.741	-5.506	0.734	-	-	12.730
295.3270774	0.1438	40.22694046	0.1707	2076393972094214272	0.4812	0.1719	-3.284	0.321	-3.667	0.319	-	-	11.588
295.3302127	0.2619	40.23507342	0.3182	2076394006453987584	0.4827	0.3263	-2.572	0.612	-4.447	0.682	-	-	11.582
295.3305653	0.6522	40.20962104	0.8079	2076393903382760704	0.4546	0.8775	-2.352	1.665	-4.097	1.389	-	-	11.712
295.3256661	0.1915	40.23920637	0.2328	2076394002159281152	0.3204	0.2397	-2.467	0.445	-3.914	0.491	-	-	12.472
295.3700150	0.1495	40.26076072	0.1906	2076394070871762176	0.3381	0.1826	-2.863	0.356	-3.985	0.376	-	-	12.355
295.3550783	0.4772	40.26081030	0.5136	2076394143893095936	0.3249	0.5734	-3.233	1.116	-2.941	0.992	-	-	12.441
295.3479199	0.1520	40.26365973	0.1894	2076394139593794688	0.4124	0.1914	-2.674	0.350	-3.521	0.402	-	-	11.923
295.3433242	0.1419	40.24696969	0.1705	2076394105234044032	0.3141	0.1701	-2.229	0.318	-2.745	0.320	-	-	12.515
295.3614527	0.5892	40.26826896	0.6683	2076394143893131776	0.3666	0.7488	-3.311	1.872	-3.143	1.307	-	-	12.179
295.3715867	0.1976	40.25722359	0.2597	2076394075173655936	0.3163	0.2474	-3.263	0.453	-4.134	0.552	-	-	12.410
295.3464596	0.1051	40.23959564	0.1240	2076394036514562176	0.3403	0.1245	-3.113	0.240	-4.383	0.236	-	-	12.341
295.3645520	0.0999	40.26784404	0.1273	2076394143893141632	0.2955	0.1247	-3.391	0.226	-2.447	0.265	-	-	12.647
295.3608449	0.1777	40.26994380	0.2254	2076394139593799808	0.3612	0.2270	-3.411	0.406	-3.736	0.456	-	-	12.211
295.3465886	0.1124	40.25842993	0.1337	2076394105234052992	0.3972	0.1336	-2.833	0.255	-4.286	0.252	-	-	12.005
295.3505194	0.1518	40.23671752	0.1823	2076394040821751424	0.4920	0.1841	-1.987	0.379	-3.156	0.322	-	-	11.541
295.3571654	0.1670	40.24181622	0.1837	2076394040821758464	0.3341	0.1946	-2.330	0.349	-3.577	0.345	-	-	12.381
295.3661372	0.1061	40.26306024	0.1346	2076394070878759552	0.2898	0.1296	-2.753	0.237	-3.795	0.250	-	-	12.690
295.3911175	0.0794	40.26563789	0.1089	2076394281332165504	0.4077	0.1061	-3.623	0.182	-5.608	0.195	-	-	11.948
295.4045384	0.2258	40.25972838	0.2766	2076394281332194816	0.3439	0.2832	-2.722	0.532	-3.625	0.572	-	-	12.318
295.4015992	0.0993	40.25499911	0.1180	2076394277030136064	0.4246	0.1190	-3.069	0.215	-3.332	0.221	-	-	11.860
295.4040976	0.1281	40.26664131	0.1623	2076394277030200448	0.4409	0.1617	-2.606	0.287	-3.460	0.288	-	-	11.778
295.3955567	0.5103	40.24243654	0.5795	2076394178252907904	0.3573	0.6374	-3.000	1.387	-5.453	1.146	-	-	12.235
295.4113919	0.1811	40.25915128	0.2228	2076394212612738944	0.4458	0.2288	-2.360	0.420	-6.561	0.460	-	-	11.754
295.4165973	0.2359	40.25198459	0.2866	2076394208310638208	0.3678	0.2962	-3.390	0.528	-3.835	0.575	-	-	12.172
295.3901675	0.4002	40.25862131	0.4851	2076394246980224768	0.3964	0.5011	-2.957	0.904	-2.802	0.865	-	-	12.009
295.4029011	0.1146	40.27268500	0.1272	2076394277030238976	0.2877	0.1351	-3.422	0.244	-3.243	0.238	-	-	12.705
295.3953837	0.1188	40.24167027	0.1574	2076394178252904320	0.4713	0.1479	-2.595	0.264	-3.800	0.296	-	-	11.633
295.3964557	0.2442	40.26237795	0.3364	2076394277030189568	0.4543	0.3213	-2.127	0.553	-3.620	0.616	-	-	11.713
295.4111393	0.4779	40.25488877	0.5173	2076394208313587584	0.4348	0.5642	-3.016	1.179	-3.811	0.951	-	-	11.809
295.4390874	0.0401	40.27650154	0.0494	2076394345749746560	0.2890	0.0506	-2.780	0.084	-1.596	0.095	5542.05	-	12.696
295.4336069	0.1034	40.28810712	0.1329	2076394345749812608	0.4197	0.1307	-2.752	0.224	-3.826	0.246	-	-	11.885
295.4336477	0.1716	40.28237920	0.2273	2076394350051829376	0.3200	0.2119	-2.007	0.364	-4.461	0.421	-	-	12.474
295.4158490	0.2465	40.27264758	0.3187	2076394380109449344	0.3795	0.3388	-2.567	0.537	-6.400	0.558	-	-	12.104
295.4240915	0.0746	40.25937409	0.0969	2076394315699725824	0.4224	0.0957	-3.226	0.166	-5.571	0.185	-	-	11.871
295.4225324	0.0953	40.25436857	0.1164	2076394311389883520	0.3668	0.1163	-3.130	0.212	-6.300	0.218	-	-	12.178
295.4218054	0.1179	40.26322989	0.1469	2076394315691995904	0.4141	0.1488	-2.735	0.262	-4.242	0.265	-	-	11.914
295.4335404	0.0603	40.28306776	0.0801	2076394350059488512	0.4187	0.0776	-3.514	0.128	-6.212	0.163	-	-	11.890
295.3865524	0.1038	40.26459776	0.1243	2076394453130842496	0.2850	0.1255	-2.497	0.238	-3.787	0.232	-	-	12.726
295.3713762	0.2190	40.27138431	0.2839	2076394521858126080	0.3537	0.2874	-2.255	0.508	-5.573	0.572	-	-	12.257
295.3786299	0.1068	40.26611662	0.1266	2076394453138650880	0.4283	0.1284	-2.957	0.233	-3.617	0.241	-	-	11.841
295.3652661	0.1124	40.26765507	0.1543	2076394521858118016	0.3258	0.1441	-3.523	0.258	-3.859	0.341	-	-	12.435
295.3738511	0.1291	40.29348380	0.1456	2076394556217878784	0.2939	0.1477	-3.174	0.278	-4.228	0.271	-	-	12.659
295.3780360	0.0985	40.27961876	0.1105	2076394551908198400	0.4228	0.1171	-2.781	0.210	-3.893	0.206	-	-	11.869
295.3991294	0.0874	40.30460041	0.1077	2076394689347321344	0.4248	0.1090	-2.934	0.187	-5.187	0.212	-	-	11.859
295.4015034	0.4195	40.30927084	0.4566	2076394693649185664	0.4590	0.4996	-3.807	0.937	-4.580	0.876	-	-	11.691
295.4008881	0.1565	40.31963074	0.1820	2076394693649213696	0.4562	0.1877	-2.353	0.336	-3.492	0.312	-	-	11.704
295.4186217	0.1599	40.29832449	0.1804	2076394624929733760	0.3234	0.1888	-2.132	0.344	-4.646	0.326	-	-	12.451
295.4168434	0.3465	40.30058762	0.3911	2076394624937394688	0.4206	0.4306	-3.200	0.821	-5.885	0.776	-	-	

295.4977093	0.2597	40.26973703	0.3329	2076394934167531136	0.3180	0.3411	-2.295	0.584	-4.166	0.635	-	-	12.488
295.5091245	0.1242	40.29418306	0.1382	2076394964225126016	0.4677	0.1529	-2.721	0.247	-4.423	0.280	-	-	11.650
295.5161965	0.0978	40.28400917	0.1145	2076394964225058688	0.3585	0.1204	-2.292	0.213	-4.727	0.231	-	-	12.228
295.4743552	0.0930	40.27219035	0.1085	2076395032947316352	0.3864	0.1160	-3.898	0.208	-5.040	0.213	-	-	12.065
295.4574105	0.2086	40.26501773	0.2415	2076394998587253120	0.3192	0.2677	-2.350	0.481	-4.850	0.495	-	-	12.480
295.5026180	0.0471	40.30567567	0.0571	2076395174693266560	0.4528	0.0589	-2.922	0.100	-3.560	0.116	5332.00	0.689	11.720
295.4780430	0.5721	40.31264831	0.6047	2076395209045496832	0.4156	0.6840	-2.016	1.354	-5.236	1.086	-	-	11.907
295.5084908	0.4064	40.30246049	0.4466	2076395174685816064	0.3811	0.4912	-2.138	0.894	-2.906	0.820	-	-	12.095
295.5331186	0.2600	40.30330275	0.2920	2076395380844312832	0.3254	0.3363	-2.716	0.559	-3.891	0.565	-	-	12.438
295.5391466	0.1326	40.28569208	0.1573	2076395277772493952	0.4032	0.1684	-3.110	0.286	-2.914	0.305	-	-	11.972
295.5177225	0.1668	40.29360883	0.1880	2076395342182243072	0.3594	0.2118	-2.046	0.348	-3.887	0.364	-	-	12.222
295.5023975	0.3550	40.31562909	0.4327	2076395552650394368	0.3147	0.4816	-1.942	0.765	-4.738	0.732	-	-	12.511
295.5103109	0.2707	40.31194698	0.2841	2076395548340799744	0.3059	0.3446	-2.224	0.559	-2.936	0.577	-	-	12.572
295.4381856	0.1764	40.30129807	0.2194	2076395896240124160	0.4196	0.2241	-3.128	0.379	-6.251	0.372	-	-	11.886
295.4412272	0.1893	40.30913577	0.2523	2076395926297919872	0.3966	0.2553	-3.229	0.414	-3.452	0.513	-	-	12.008
295.4537368	0.3433	40.30589731	0.3897	2076395861880433664	0.3338	0.4331	-2.184	0.775	-4.902	0.762	-	-	12.383
295.4377449	0.1078	40.28669339	0.1263	2076395827528243200	0.4029	0.1377	-3.087	0.234	-3.789	0.243	-	-	11.974
295.4255928	0.1315	40.30280361	0.1429	2076395891944906624	0.4248	0.1529	-3.131	0.278	-4.095	0.264	-	-	11.859
295.4618748	0.6077	40.31487404	0.6639	2076395964959703424	0.4537	0.6673	-2.701	1.387	-1.757	1.272	-	-	11.716
295.4620351	0.3413	40.34467246	0.3909	2076396068046461184	0.4350	0.4234	-2.263	0.717	-3.832	0.816	-	-	11.808
295.4762122	0.1228	40.31573131	0.1525	2076395995017475328	0.3675	0.1515	-2.922	0.263	-3.615	0.295	-	-	12.173
295.4251041	0.0243	40.33146045	0.0286	2076396205485384704	0.3188	0.0285	-2.957	0.051	-4.819	0.053	5350.00	4.747	12.482
295.4290033	0.2720	40.32426317	0.3216	2076396132456455040	0.4585	0.3451	-1.965	0.609	-5.510	0.649	-	-	11.693
295.4425511	0.3268	40.35256310	0.3824	2076396342916861696	0.4530	0.4137	-3.602	0.748	-5.453	0.748	-	-	11.720
295.4546137	0.4779	40.33814635	0.4942	2076396239837644032	0.3017	0.5664	-2.695	1.095	-2.783	0.923	-	-	12.602
295.4515702	0.1325	40.36061465	0.1554	2076396342924369152	0.4759	0.1608	-2.458	0.286	-3.978	0.295	-	-	11.612
295.4496918	0.5893	40.34017802	0.6814	2076396235538181632	0.3880	0.7781	-3.201	1.596	-5.659	1.228	-	-	12.056
295.4358042	0.1939	40.35894423	0.2300	2076396304255362432	0.3645	0.2493	-2.357	0.434	-5.948	0.471	-	-	12.192
295.4713653	0.0204	40.35159190	0.0263	2076396446003592704	0.3540	0.0252	-3.653	0.043	-4.864	0.049	4870.00	5.635	12.255
295.1534517	0.1007	40.05826167	0.1212	2076484918019993984	0.4694	0.1191	-3.318	0.239	-3.719	0.243	-	-	11.642
295.1464590	0.0137	40.06701961	0.0161	2076484922326532224	0.4550	0.0167	-2.350	0.031	-4.925	0.031	6134.50	6.281	11.710
295.1541703	0.0440	40.05690420	0.0591	2076484922326531200	0.3177	0.0545	-2.517	0.105	-2.555	0.120	5218.00	-	12.490
295.1470822	0.0923	40.08678534	0.1306	2076485089818318976	0.3012	0.1175	-2.906	0.233	-4.234	0.294	-	-	12.606
295.1714599	0.1755	40.07841965	0.1951	2076485059765513600	0.4885	0.2029	-2.397	0.420	-5.383	0.395	-	-	11.556
295.1598754	0.0262	40.07037092	0.0300	2076485025405759744	0.3893	0.0316	-2.093	0.061	-3.840	0.059	5758.33	2.287	12.049
295.1292882	0.4543	40.07544559	0.5097	2076485197196642432	0.4537	0.5434	-2.860	1.201	-5.653	1.133	-	-	11.716
295.1169258	0.2509	40.09267919	0.3064	2076485265916129536	0.3378	0.3121	-2.628	0.663	-4.837	0.691	-	-	12.357
295.0991326	0.0979	40.08769682	0.1177	2076485227257273088	0.4139	0.1258	-2.842	0.250	-3.799	0.261	-	-	11.916
295.1044247	0.1915	40.07964266	0.2286	2076485227257264896	0.4214	0.2370	-2.963	0.503	-5.717	0.506	-	-	11.877
295.1465601	0.0753	40.10420231	0.0893	2076485334643419008	0.4655	0.0922	-3.367	0.179	-6.235	0.196	-	-	11.660
295.1409983	0.1015	40.11323164	0.1254	2076485399055991936	0.2923	0.1184	-3.803	0.232	-3.821	0.245	-	-	12.671
295.1291197	0.3394	40.10269600	0.3992	2076485368995411456	0.3037	0.4098	-3.390	0.822	-2.886	0.861	-	-	12.588
295.1313678	0.2074	40.10004229	0.2500	2076485300275934464	0.3815	0.2603	-3.925	0.548	-3.927	0.545	-	-	12.093
295.1502589	0.0973	40.10840831	0.1054	2076485330336512896	0.3210	0.1158	-2.799	0.217	-3.917	0.229	-	-	12.467
295.1880173	0.1865	40.11031140	0.2432	2076485467775827712	0.3433	0.2388	-3.160	0.441	-6.609	0.579	-	-	12.322
295.1896665	0.1721	40.10746967	0.1984	2076485467775826304	0.3806	0.2120	-3.459	0.404	-5.248	0.421	-	-	12.098
295.1888990	0.3440	40.09306882	0.4597	2076485433416082048	0.4138	0.4189	-2.281	0.858	-2.097	1.056	-	-	11.916
295.1905112	0.0816	40.12227285	0.0961	2076485639574172160	0.3793	0.0996	-2.272	0.188	-4.608	0.194	-	-	12.105
295.2024360	0.5134	40.14650754	0.5841	2076485673934274688	0.3830	0.6154	-2.515	1.407	-2.831	1.161	-	-	12.084
295.2008095	0.1663	40.14894837	0.2025	2076485673933938816	0.4697	0.2004	-3.641	0.383	-2.570	0.378	-	-	11.641
295.2082368	0.1183	40.14110588	0.1355	2076485673933930496	0.3825	0.1356	-3.345	0.270	-4.163	0.260	-	-	12.087
295.1587860	0.2267	40.13506018	0.2969	2076485811373222272	0.2836	0.2926	-3.401	0.544	-5.500	0.596	-	-	12.736
295.1561103	0.0945	40.14408910	0.1182	2076485811372886144	0.4244	0.1185	-2.562	0.226	-3.867	0.253	-	-	11.861
295.1630429	0.1482	40.12363731	0.1857	2076485712592944384	0.4509	0.1812	-2.218	0.351	-4.462	0.363	-	-	11.730
295.1578966	0.1149	40.13907286	0.1439	2076485811372881024	0.3128	0.1389	-3.028	0.264	-3.936	0.272	-	-	12.523
295.1458303	0.2003	40.13434322	0.2270	2076485777013138176	0.4369	0.2341	-2.742	0.469	-3.584	0.492	-	-	11.798
295.1712725	0.1163	40.15207219	0.1352	2076485914452110592	0.2995	0.1376	-3.108	0.266	-2.483	0.261	-	-	12.618
295.1995380	0.2337	40.15184882	0.2801	2076485880092371840	0.3322	0.2886	-2.856	0.556	-3.822	0.576	-	-	12.393
295.1894132	0.0303	40.15887167	0.0369	2076485884399295616	0.3173	0.0390	-2.287	0.069	-5.156	0.073	4907.50	3.005	12.493
295.1850926	0.0309	40.13981759	0.0388	2076485850039542400	0.4338	0.0403	-2.598	0.072	-1.913	0.085	5467.33	1.458	11.814
295.0953931	0.0676	40.12104473	0.0775	2076486090557634304	0.3147	0.0812	-2.022	0.155	-2.114	0.161	-	-	12.511
295.0874788	0.8038	40.11388084	0.8297	2076486090549815296	0.3021	0.8699	-3.902	2.032	-4.783	1.868	-	-	12.599
295.0924696	0.1524	40.09814515	0.1631	2076485983172087680	0.4316	0.1731	-3.474	0.356	-5.160	0.334	-	-	11.825
295.1166724	0.2627	40.14574695	0.3231	2076486223698869376	0.3056	0.3151	-1.868	0.608	-2.854	0.690	-	-	12.574
295.1241185	0.0530	40.12093278	0.0616	2076486154970245120	0.3029	0.0649	-2.927	0.120	-5.513	0.126	5016.84	-	12.594
295.1054224	0.2271	40.13593447	0.2589	2076486193629148288	0.2990	0.2660	-2.776	0.537	-3.566	0.561	-	-	12.622
295.1117373	0.1204	40.14679666	0.1416	2076486227996618752	0.3377	0.1418	-2.759	0.274	-4.000	0.278	-	-	12.357
295.1089798	0.0871	40.11973853	0.0985	2076486124917382528	0.4803	0.1043	-2.255	0.204	-5.426	0.203	-	-	11.592
295.0867412	0.0981	40.13404769	0.1216	2076486292409211776	0.3157	0.1251	-2.937	0.224	-3.920	0.244	-	-	12.504
295.0766159	0.1119	40.14219069	0.1324	2076486361128699008	0.3874	0.1327	-2.387	0.254	-3.783	0.262	-	-	12.059
295.0920286	0.2386	40.16570484	0.2827	2076486498567677568	0.4614	0.2847	-3.193	0.576	-4.585	0.617	-	-	11.680
295.0927630	0.0370	40.13892949	0.0469	2076486395488432000	0.2913	0.0482	-2.242	0.082	-6.434	0.090	5363.00	-	12.678
295.0916880	0.1992	40.14504208	0.2392	2076486399787563008	0.4831	0.2387	-3.229	0.472	-5.407	0.526	-	-	11.580
295.1286143	0.1961	40.15192470	0.2369	2076486601646876416	0.3639	0.2							

295.1714048	0.1298	40.17172686	0.1520	2076486704726561408	0.3450	0.1533	-2.336	0.297	-3.911	0.292	-	-	12.311
295.1164146	0.2975	40.16927707	0.3554	2076486807805328896	0.3164	0.3482	-3.066	0.713	-6.016	0.756	-	-	12.499
295.1115945	0.3145	40.17067800	0.3844	2076486812104541952	0.3646	0.3767	-2.532	0.738	-4.249	0.787	-	-	12.191
295.1084374	0.2986	40.18722804	0.3425	2076486915191407104	0.3041	0.3513	-2.410	0.724	-4.615	0.757	-	-	12.585
295.1286615	0.0636	40.18686525	0.0758	2076486846471945088	0.3927	0.0814	-2.590	0.136	-4.336	0.158	-	-	12.030
295.1196027	0.5412	40.16292714	0.6494	2076486807805648256	0.3195	0.6729	-2.342	1.623	-5.714	1.262	-	-	12.478
295.1224309	0.1057	40.17933036	0.1298	2076486842165078528	0.2910	0.1256	-2.732	0.240	-5.734	0.247	-	-	12.681
295.1310181	0.2328	40.19321507	0.2922	2076486949543615232	0.4580	0.2898	-2.024	0.558	-3.045	0.590	-	-	11.696
295.1370718	0.0854	40.19960868	0.1036	2076486945244321152	0.3009	0.1068	-3.598	0.204	-5.164	0.226	-	-	12.608
295.1442200	0.1337	40.21175951	0.1554	2076486979604366464	0.4600	0.1578	-2.272	0.291	-4.547	0.299	-	-	11.686
295.1368593	0.0635	40.21004170	0.0747	2076487048323559296	0.3163	0.0784	-2.984	0.147	-5.452	0.149	-	-	12.500
295.1265276	0.0983	40.19678494	0.1126	2076487013963793280	0.3584	0.1167	-2.873	0.233	-4.134	0.235	-	-	12.228
295.2436055	0.1783	40.15466332	0.2050	2076487121342555520	0.3461	0.2117	-2.920	0.439	-3.782	0.442	-	-	12.304
295.2366147	0.2938	40.16249116	0.3478	2076487121342555392	0.4840	0.3578	-2.468	0.706	-4.144	0.723	-	-	11.576
295.2273956	1.0616	40.13536671	1.7454	2076487086983683584	0.4716	1.6902	-3.975	3.394	-5.585	3.359	-	-	11.632
295.2276900	0.1930	40.16706520	0.2291	2076487185762774016	0.3114	0.2370	-2.871	0.469	-3.784	0.485	-	-	12.533
295.2288247	0.1044	40.14142188	0.1181	2076487086982728192	0.4576	0.1203	-3.039	0.240	-3.962	0.227	-	-	11.698
295.2367556	0.6437	40.17950108	1.0005	2076487293141290496	0.4413	0.8248	-2.320	2.104	-6.140	2.237	-	-	11.776
295.2459094	0.0313	40.20248443	0.0366	2076487327508380416	0.3903	0.0389	-2.522	0.072	-4.605	0.073	5278.33	1.705	12.043
295.2450911	0.0903	40.15909251	0.1055	2076487220122178176	0.4090	0.1094	-2.487	0.206	-3.853	0.211	-	-	11.941
295.2438532	0.4209	40.19162670	0.4403	2076487327501094272	0.4565	0.4962	-2.893	1.135	-3.923	0.888	-	-	11.703
295.2388313	0.1798	40.19260519	0.2156	2076487327501079680	0.3333	0.2213	-1.921	0.446	-4.174	0.461	-	-	12.386
295.2501825	0.1511	40.18284398	0.1781	2076487258781612160	0.3091	0.1788	-3.694	0.347	-4.379	0.329	-	-	12.550
295.2547575	0.1014	40.19243593	0.1149	2076487323201435904	0.2946	0.1157	-3.029	0.219	-4.177	0.215	-	-	12.654
295.2425213	0.1189	40.19349545	0.1302	2076487323201436288	0.4648	0.1347	-2.790	0.263	-3.628	0.246	-	-	11.664
295.2399450	0.2294	40.18016145	0.2688	2076487293141304064	0.2843	0.2896	-2.192	0.611	-4.391	0.558	-	-	12.731
295.2495488	0.0944	40.17736947	0.1071	2076487254481930972	0.3912	0.1125	-3.040	0.224	-3.588	0.220	-	-	12.038
295.2442887	0.1517	40.16125591	0.1784	2076487220122181504	0.4496	0.1788	-3.369	0.346	-4.561	0.342	-	-	11.736
295.2490652	0.1290	40.19271700	0.1411	2076487327508376960	0.3986	0.1471	-2.674	0.288	-2.799	0.269	-	-	11.997
295.2486532	0.1213	40.19356851	0.1431	2076487327508377088	0.4207	0.1412	-3.294	0.264	-3.685	0.277	-	-	11.880
295.2110008	0.0528	40.19410501	0.0632	2076487464947300608	0.3479	0.0669	-2.184	0.122	-3.396	0.126	5351.00	-	12.293
295.1922340	0.1040	40.18423413	0.1190	2076487426280638848	0.3209	0.1222	-2.319	0.233	-5.685	0.226	-	-	12.468
295.1969999	0.2215	40.18447466	0.2530	2076487430580132608	0.4536	0.2690	-3.445	0.574	-3.124	0.508	-	-	11.716
295.2120203	0.5542	40.17038691	0.6221	2076487396220402688	0.2811	0.6611	-1.987	1.487	-3.392	1.286	-	-	12.756
295.2149535	0.1285	40.21415180	0.1534	2076487568026532480	0.3450	0.1532	-3.258	0.288	-4.271	0.290	-	-	12.311
295.2365298	0.3047	40.20146963	0.3494	2076487533659528320	0.4477	0.3711	-3.302	0.744	-2.652	0.718	-	-	11.745
295.2306218	0.0896	40.22087426	0.1077	2076487598079380864	0.3569	0.1115	-3.156	0.207	-3.480	0.218	-	-	12.237
295.2144387	0.2780	40.20954474	0.3320	2076487563719627008	0.4463	0.3376	-2.697	0.683	-5.067	0.703	-	-	11.752
295.2380217	0.2941	40.19796623	0.3229	2076487533659523968	0.3843	0.3484	-3.354	0.690	-3.001	0.679	-	-	12.077
295.2263931	0.1229	40.19454466	0.1432	2076487495000435200	0.3380	0.1450	-3.699	0.281	-4.146	0.271	-	-	12.355
295.2566990	0.4133	40.19701064	0.4320	2076487705458279808	0.3083	0.4847	-1.931	1.070	-4.889	0.831	-	-	12.555
295.2590618	0.0459	40.19943392	0.0504	2076487705458295168	0.3655	0.0528	-3.058	0.110	-5.736	0.103	-	-	12.186
295.2604829	0.6972	40.21135537	0.5901	2076487705458339840	0.3695	0.7314	-3.074	1.630	-2.268	1.063	-	-	12.162
295.2889066	0.1150	40.20246674	0.1324	2076487671105801344	0.3995	0.1350	-2.989	0.265	-3.869	0.252	-	-	11.992
295.2611483	0.1843	40.21061093	0.2217	2076487705465522816	0.3737	0.2233	-2.964	0.435	-1.912	0.418	-	-	12.137
295.2664527	0.2523	40.22568494	0.2831	2076487739818148736	0.3111	0.3075	-2.677	0.585	-5.099	0.562	-	-	12.535
295.2740376	0.1277	40.18975762	0.1407	2076487632439078400	0.2977	0.1505	-1.969	0.284	-2.670	0.295	-	-	12.631
295.2688898	0.3412	40.18784698	0.4359	2076487632439383168	0.3278	0.4324	-3.998	0.843	-4.345	0.821	-	-	12.422
295.2985553	0.2130	40.21997158	0.2258	2076487808537713408	0.4004	0.2440	-3.388	0.548	-3.768	0.481	-	-	11.988
295.2788818	0.7953	40.23418799	1.0207	2076487842897428736	0.4008	1.0436	-2.985	2.036	-2.150	1.544	-	-	11.985
295.3036114	0.1500	40.23729623	0.1776	2076487808544792064	0.2863	0.1790	-3.170	0.334	-4.000	0.340	-	-	12.716
295.3043170	0.0212	40.23431722	0.0258	2076487808544791296	0.3802	0.0254	-2.002	0.047	-5.332	0.050	5706.67	3.341	12.100
295.3002593	0.0288	40.23234030	0.0343	2076487808544785024	0.3550	0.0346	-3.069	0.062	-3.512	0.064	5474.00	2.537	12.249
295.3073576	0.1168	40.23334308	0.1554	2076487804238103296	0.4569	0.1399	-2.448	0.277	-6.062	0.345	-	-	11.701
295.2978564	0.0813	40.22932606	0.0981	2076487804237824256	0.3479	0.1017	-2.455	0.188	-3.455	0.189	-	-	12.293
295.2983732	0.1624	40.21886078	0.1755	2076487769878073856	0.3638	0.1919	-2.581	0.383	-3.584	0.347	-	-	12.196
295.2854355	0.1977	40.21904312	0.2242	2076487769878071936	0.3547	0.2470	-3.004	0.524	-2.977	0.444	-	-	12.251
295.2831729	0.1152	40.22219791	0.1309	2076487842904501504	0.3397	0.1378	-2.338	0.256	-3.828	0.243	-	-	12.345
295.2696328	0.1067	40.22753100	0.1199	2076487838597838080	0.4875	0.1244	-2.607	0.238	-3.707	0.218	-	-	11.560
295.2828996	0.1574	40.21980016	0.1729	2076487838597832960	0.3944	0.1808	-3.987	0.363	-2.077	0.323	-	-	12.020
295.2773617	0.4861	40.22453627	0.5233	2076487842897400832	0.3865	0.5764	-3.835	1.405	-2.072	1.010	-	-	12.064
295.3054683	0.2001	40.23217961	0.2455	2076487808537778688	0.4805	0.2499	-2.084	0.473	-3.514	0.532	-	-	11.592
295.2839707	1.4202	40.24402530	1.5182	2076487877257219072	0.4103	1.4627	-1.982	3.376	-3.154	3.602	-	-	11.934
295.2452599	0.3278	40.20645587	0.3635	2076487911616694144	0.4431	0.3867	-2.908	0.765	-3.007	0.755	-	-	11.767
295.2328044	0.0756	40.22938929	0.0942	2076487980336203136	0.4860	0.0968	-2.727	0.173	-2.931	0.179	-	-	11.567
295.2453740	0.2061	40.22738888	0.2704	2076487976036521856	0.3011	0.2568	-4.058	0.463	-4.528	0.514	-	-	12.606
295.2415885	0.3009	40.21994453	0.3598	2076487911616729344	0.4648	0.3672	-2.330	0.711	-3.653	0.744	-	-	11.664
295.2399653	0.1051	40.21394591	0.1186	2076487907317017344	0.3261	0.1229	-2.155	0.240	-4.345	0.222	-	-	12.433
295.2581881	0.1104	40.23824162	0.1279	2076487941676791168	0.3628	0.1328	-2.604	0.251	-3.396	0.243	-	-	12.202
295.2655701	0.0816	40.22527874	0.0928	2076487945983705856	0.3359	0.1018	-2.381	0.185	-3.690	0.183	5442.67	-	12.369
295.2615688	0.1872	40.22496508	0.2217	2076487941677053312	0.3404	0.2323	-2.350	0.439	-3.769	0.482	-	-	12.340
295.2367265	0.1195	40.21512901	0.1386	2076487907317305088	0.3621	0.1424	-2.672	0.267	-3.705	0.259	-	-	12.206
295.2580684	0.1408	40.22954917	0.1626	2076487941676776832	0.3807	0.1710	-2.760	0.326	-4.014	0.321	-	-	12.097
295.2557794	0.0801	40.23276662	0.0983	2076487941682836224	0.2947	0.1005	-2.841	0.186	-3.072	0.207	-	-	

295.2579201	0.0342	40.25946391	0.0404	2076488117782414208	0.4319	0.043	-3.457	0.076	-4.101	0.077	5612.20	5.341	11.823
295.2593934	0.1089	40.26214608	0.1210	2076488117782416896	0.3019	0.128	-2.669	0.229	-3.596	0.227	-	-	12.601
295.2508309	0.1346	40.25112691	0.1546	2076488113475499648	0.4761	0.159	-2.993	0.305	-3.605	0.291	-	-	11.612
295.2659008	0.1381	40.26977022	0.1562	2076488147835261696	0.4685	0.158	-2.604	0.321	-3.624	0.292	-	-	11.646
295.2569909	0.1089	40.25282346	0.1191	2076488113475514496	0.3047	0.127	-2.935	0.229	-4.092	0.223	-	-	12.581
295.1772474	0.0863	40.19376655	0.1143	2076488186501779712	0.2936	0.115	-2.172	0.223	-4.373	0.220	-	-	12.661
295.1825525	0.2347	40.20323455	0.3031	2076488220854122752	0.4094	0.290	-3.322	0.560	-4.544	0.707	-	-	11.939
295.1956953	0.0309	40.22167979	0.0375	2076488392660242048	0.3983	0.040	-2.205	0.070	-3.553	0.077	5355.00	1.809	11.999
295.2108903	0.2450	40.21542995	0.2902	2076488323933461888	0.3840	0.296	-3.281	0.566	-3.794	0.598	-	-	12.078
295.2163948	0.1167	40.23255664	0.1367	2076488353993641344	0.4595	0.139	-2.377	0.262	-3.572	0.254	-	-	11.689
295.2190233	0.1775	40.22276529	0.2134	2076488353993626880	0.4414	0.218	-2.996	0.420	-4.800	0.439	-	-	11.776
295.1897986	0.1189	40.22480607	0.1437	2076488388353367936	0.4097	0.146	-2.583	0.261	-3.983	0.257	-	-	11.938
295.1994414	0.1032	40.22153376	0.1334	2076488319633886336	0.2948	0.124	-2.697	0.233	-3.773	0.258	-	-	12.652
295.1978850	0.1569	40.21256813	0.1798	2076488319634165248	0.4883	0.184	-3.105	0.353	-4.469	0.342	-	-	11.557
295.1966300	0.4385	40.23964867	0.4683	2076488427012706176	0.3872	0.516	-2.966	1.076	-1.412	0.913	-	-	12.060
295.2058490	0.0887	40.21126642	0.1080	2076488319633874048	0.4072	0.111	-2.805	0.203	-3.635	0.219	-	-	11.951
295.2187678	0.0681	40.23464201	0.0810	2076488731950766080	0.4458	0.087	-2.876	0.159	-3.745	0.161	-	-	11.754
295.2027208	0.0276	40.24580999	0.0320	2076488427020146304	0.4469	0.035	-2.256	0.062	-6.464	0.060	5689.14	1.821	11.749
295.1372091	0.5271	40.22774518	0.5567	2076488525792603520	0.2899	0.591	-4.024	1.326	-2.955	1.138	-	-	12.689
295.1601345	0.2612	40.23319548	0.3214	2076488564451519360	0.3930	0.322	-2.972	0.610	-2.945	0.631	-	-	12.028
295.1497677	0.2334	40.23651130	0.2787	2076488525792609792	0.4784	0.278	-3.549	0.555	-3.646	0.587	-	-	11.601
295.1749452	0.0638	40.23048292	0.0743	2076488495739623936	0.4011	0.076	-2.655	0.147	-5.328	0.154	-	-	11.984
295.1880644	0.0985	40.25777042	0.1170	2076488628871582976	0.3908	0.119	-2.765	0.232	-3.955	0.242	-	-	12.040
295.1765613	0.3087	40.26189428	0.4318	2076488697591313408	0.2988	0.385	-1.899	0.755	-3.868	1.005	-	-	12.623
295.1841161	0.0955	40.25105513	0.1131	2076488628871832448	0.4583	0.116	-2.730	0.223	-6.142	0.229	-	-	11.694
295.1884783	0.7678	40.25038643	1.2423	2076488633171140992	0.4778	0.868	-3.951	1.874	-3.451	2.586	-	-	11.602
295.1756634	0.1069	40.25493447	0.1525	2076488667538156544	0.2990	0.135	-2.616	0.253	-4.980	0.351	-	-	12.622
295.2229743	0.1907	40.26730099	0.2239	2076488835030026752	0.3525	0.225	-2.600	0.425	-2.520	0.435	-	-	12.264
295.2181244	0.2229	40.25151297	0.2736	2076488800670266880	0.4238	0.270	-3.770	0.507	-5.146	0.518	-	-	11.864
295.2349894	0.3213	40.24879061	0.3947	2076488766310526080	0.2891	0.392	-1.979	0.763	-4.694	0.876	-	-	12.695
295.2397997	0.3481	40.25862702	0.4623	2076488770610312448	0.3482	0.436	-2.768	0.828	-5.728	0.912	-	-	12.291
295.2251027	0.0742	40.27460921	0.0882	2076488835030036864	0.4379	0.090	-2.794	0.177	-6.366	0.180	-	-	11.793
295.2480651	0.1693	40.27507919	0.1784	2076488869389772800	0.3170	0.190	-2.803	0.378	-4.271	0.337	-	-	12.495
295.2430968	0.3439	40.26897076	0.3624	2076488869390009088	0.3425	0.392	-3.704	0.767	-4.468	0.723	-	-	12.327
295.2567284	0.3457	40.27639972	0.4031	2076488908049373056	0.4019	0.412	-2.450	0.769	-5.369	0.816	-	-	11.979
295.2586172	0.2201	40.28046634	0.2631	2076488908049391232	0.3881	0.263	-3.106	0.535	-3.516	0.549	-	-	12.055
295.2492717	0.1215	40.26548566	0.1402	2076488869389762688	0.4550	0.143	-2.533	0.271	-4.038	0.277	-	-	11.710
295.2552783	0.1801	40.26335032	0.2132	2076488869389760512	0.3911	0.216	-2.715	0.412	-3.523	0.429	-	-	12.039
295.2534148	0.1730	40.27663868	0.1857	2076488903749513472	0.3850	0.198	-2.244	0.385	-6.198	0.349	-	-	12.073
295.2072827	0.1331	40.27420837	0.1441	2076489041188462976	0.4655	0.152	-2.613	0.289	-4.115	0.268	-	-	11.660
295.2061817	0.1854	40.27319501	0.2057	2076489041188702720	0.4719	0.213	-2.466	0.414	-4.755	0.384	-	-	11.631
295.2103297	0.1599	40.26615982	0.1818	2076489011128390784	0.3482	0.184	-2.380	0.364	-3.084	0.339	-	-	12.291
295.2040752	0.0270	40.27365858	0.0301	2076489011135579264	0.2918	0.032	-2.295	0.059	-1.901	0.057	4831.00	5.253	12.675
295.2074382	0.4786	40.29031702	0.5166	2076489109908187008	0.4436	0.562	-2.554	1.226	-5.103	1.096	-	-	11.765
295.2016356	0.1898	40.28791704	0.2148	2076489109907954304	0.4239	0.226	-2.306	0.421	-4.043	0.416	-	-	11.864
295.2074870	0.1998	40.26532438	0.2299	2076489006828715136	0.4574	0.235	-3.280	0.471	-4.391	0.472	-	-	11.698
295.2215181	0.4097	40.30408045	0.3321	2076489217286976896	0.3009	0.471	-2.001	0.812	-4.802	0.879	-	-	12.607
295.2166840	0.1342	40.29276284	0.1638	2076489217286935168	0.4230	0.163	-2.863	0.298	-4.278	0.324	-	-	11.868
295.2311589	0.2499	40.31819641	0.2976	2076489251653803392	0.3649	0.321	-3.290	0.549	-3.840	0.587	-	-	12.189
295.2196653	0.2708	40.29852243	0.3307	2076489217286957952	0.3594	0.342	-1.910	0.631	-5.103	0.642	-	-	12.222
295.2231608	1.1970	40.28137321	1.6035	2076489148567448832	0.3212	1.829	-2.353	2.999	-2.110	4.156	-	-	12.466
295.2214814	0.0886	40.30370529	0.1015	2076489212987187072	0.4354	0.109	-4.025	0.190	-6.083	0.201	-	-	11.806
295.2288533	0.2821	40.29104078	0.3415	2076489148567488000	0.4204	0.388	-2.590	0.690	-4.687	0.704	-	-	11.882
295.2323638	0.1156	40.31505286	0.0964	2076489251653861632	0.3518	0.110	-2.928	0.265	-2.021	0.192	-	-	12.269
295.0722199	0.2231	40.17049385	0.2657	2076489423452271872	0.4279	0.267	-3.249	0.539	-4.483	0.577	-	-	11.843
295.0741697	0.1093	40.17812338	0.1294	2076489453505191808	0.3722	0.129	-4.058	0.250	-4.612	0.254	-	-	12.146
295.0648722	0.0399	40.20706943	0.0486	2076489732689937024	0.4088	0.049	-2.648	0.094	-5.290	0.098	5357.50	1.154	11.942
295.1064773	0.1271	40.23730183	0.1502	2076490037620825856	0.3557	0.149	-2.607	0.289	-4.361	0.297	-	-	12.245
295.1064580	0.1993	40.24050130	0.2422	2076490071980568576	0.3071	0.239	-3.522	0.470	-3.966	0.565	-	-	12.564
295.1301261	0.1264	40.22345416	0.1491	2076490003261067264	0.3049	0.150	-2.795	0.284	-4.871	0.286	-	-	12.579
295.1019497	0.1242	40.23225969	0.1404	2076490037620816896	0.3070	0.146	-1.897	0.287	-1.736	0.290	-	-	12.564
295.1278667	0.2869	40.22006302	0.3375	2076490003261062784	0.3111	0.342	-1.999	0.674	-3.478	0.709	-	-	12.535
295.1243853	0.1876	40.22973504	0.2218	2076490007567898496	0.3138	0.224	-2.060	0.445	-3.906	0.465	-	-	12.517
295.0781972	0.4645	40.23925710	0.5043	2076490209419521280	0.3889	0.545	-2.788	1.107	-4.407	1.066	-	-	12.051
295.0931893	0.1094	40.24819803	0.1255	2076490243779271552	0.3062	0.126	-2.848	0.249	-4.034	0.246	-	-	12.570
295.0924908	0.2400	40.23363635	0.2623	2076490243779249408	0.3724	0.277	-2.699	0.578	-5.375	0.564	-	-	12.145
295.1025574	0.2030	40.24011736	0.2480	2076490243779259520	0.3622	0.241	-3.034	0.486	-5.622	0.539	-	-	12.205
295.0880233	0.1438	40.26267605	0.1659	2076490346858504576	0.3439	0.165	-3.472	0.330	-3.636	0.325	-	-	12.318
295.1308489	0.1093	40.25773633	0.1266	2076491549449342976	0.4886	0.130	-2.872	0.246	-3.506	0.239	-	-	11.555
295.1336106	0.0344	40.25056472	0.0416	2076491553756143872	0.4040	0.042	-1.888	0.079	-2.225	0.083	5341.00	1.595	11.968
295.1499684	0.1230	40.24976037	0.1410	2076491515089594112	0.3046	0.146	-3.035	0.279	-3.388	0.268	-	-	12.581
295.1208832	0.0395	40.25384816	0.0464	2076491553756138240	0.3865	0.049	-2.123	0.092	-6.523	0.092	5763.76	1.361	12.064
295.1503468	0.1230	40.26257996	0.1519	2076491622475643264	0.3834	0.148	-2.509	0.283	-6.032	0.274	-	-	12.082
295.1197187	0.3262	40.28715162	0.3996	2076491862986427392	0.3905	0.410	-2.493	0.751	-3.252	0.825	-	-	12.042
295.1210528	0.201												

295.1727184	0.2448	40.29840473	0.3499	2076492099205201152	0.3945	0.3284	-2.158	0.566	-5.518	0.809	-	-	12.020
295.1907102	0.1472	40.31685087	0.1575	2076492240951007232	0.3073	0.1815	-1.993	0.320	-5.044	0.305	-	-	12.562
295.1926538	0.3964	40.32301734	0.4488	2076492236644175744	0.3552	0.4764	-3.177	0.934	-3.118	0.850	-	-	12.248
295.1507571	0.0316	40.31477175	0.0355	2076492309670447744	0.3591	0.0388	-3.551	0.067	-2.014	0.067	5639.67	2.327	12.224
295.1430258	0.0955	40.32112811	0.1138	2076492378389922560	0.4099	0.1218	-2.927	0.200	-5.754	0.205	-	-	11.937
295.1566969	0.1689	40.33175119	0.1828	2076492408442873984	0.2846	0.2027	-2.298	0.360	-4.445	0.343	-	-	12.729
295.1698400	0.2722	40.31638253	0.3372	2076492339723385216	0.3745	0.3484	-3.387	0.597	-5.120	0.639	-	-	12.133
295.1856523	0.2121	40.34560117	0.2456	2076492477162567040	0.3281	0.2684	-2.270	0.466	-3.910	0.519	-	-	12.420
295.1742722	0.1429	40.34437289	0.1617	2076492515821826688	0.3807	0.1751	-2.081	0.306	-3.037	0.297	-	-	12.097
295.2978240	0.7683	40.25252933	0.8218	2076581713697346560	0.4181	0.8916	-3.553	2.689	-3.581	1.426	-	-	11.893
295.3134489	0.1108	40.25285338	0.0932	2076581679337658496	0.4555	0.0740	-2.429	0.237	-4.155	0.218	-	-	11.707
295.3263437	0.1710	40.25785133	0.1967	2076581679337708160	0.4690	0.2130	-3.664	0.378	-3.768	0.423	-	-	11.644
295.3170613	0.1071	40.23479357	0.1263	2076581640685054336	0.3467	0.1275	-3.124	0.231	-4.237	0.237	-	-	12.300
295.2943694	0.0624	40.25601542	0.0801	2076581713697338240	0.3778	0.0819	-3.604	0.135	-2.406	0.140	5215.18	-	12.114
295.3244636	0.2100	40.25408761	0.2469	2076581679337694592	0.4428	0.2633	-3.264	0.440	-4.113	0.479	-	-	11.769
295.3177153	0.0334	40.26516107	0.0396	2076581748067811584	0.3887	0.0404	-2.420	0.071	-3.728	0.077	5399.10	6.480	12.052
295.3156267	0.1254	40.26842963	0.1265	2076581743764276096	0.3755	0.1365	-3.169	0.265	-3.630	0.240	-	-	12.127
295.3147402	0.4952	40.23895532	0.5761	2076581644977885312	0.3792	0.5844	-3.149	1.349	-4.714	1.117	-	-	12.106
295.3305832	0.1772	40.27411090	0.2225	2076581851136454144	0.4598	0.2204	-3.274	0.394	-5.934	0.393	-	-	11.687
295.3368176	0.5356	40.27122580	0.5662	2076581782416986752	0.3013	0.6325	-3.607	1.305	-2.927	1.108	-	-	12.605
295.3398100	0.1802	40.29397991	0.2060	2076581885496260608	0.4472	0.2118	-3.421	0.380	-6.335	0.377	-	-	11.747
295.3463098	0.1056	40.27840823	0.1100	2076581816776766080	0.3085	0.1177	-2.278	0.272	-4.095	0.234	-	-	12.553
295.3460161	0.3682	40.28354772	0.4150	2076581812484397312	0.4539	0.4354	-2.597	0.833	-2.452	0.862	-	-	11.715
295.3520430	0.1682	40.28163507	0.1906	2076581812483754752	0.3288	0.1998	-2.884	0.362	-2.791	0.361	-	-	12.415
295.3385131	0.1105	40.27427953	0.1339	2076581812483753600	0.4537	0.1361	-3.015	0.253	-3.616	0.274	-	-	11.716
295.3203207	0.1302	40.26984195	0.1720	2076581846843491456	0.3898	0.1553	-2.210	0.281	-5.925	0.327	-	-	12.046
295.3268624	0.5353	40.27688007	0.5942	2076581851136450560	0.3798	0.6192	-2.621	1.317	-5.392	1.109	-	-	12.102
295.2766504	0.1148	40.28344046	0.1381	2076581984282791808	0.3999	0.1385	-3.007	0.261	-3.666	0.250	-	-	11.990
295.3057276	0.2578	40.27469861	0.3581	2076581949923051776	0.4736	0.3364	-1.923	0.613	-4.465	0.822	-	-	11.623
295.2803808	0.0286	40.26938435	0.0343	2076581984282789504	0.3671	0.0362	-1.900	0.063	-2.780	0.062	4760.00	3.188	12.176
295.3005825	0.2170	40.26593372	0.2660	2076581949923050496	0.4284	0.2749	-2.543	0.507	-3.780	0.551	-	-	11.841
295.2804616	0.1814	40.26981174	0.1729	2076581988585956992	0.2868	0.2072	-3.448	0.388	-3.429	0.308	-	-	12.712
295.3080126	0.3047	40.27484814	0.4259	2076581949923349120	0.4732	0.3972	-2.691	0.721	-3.113	0.963	-	-	11.625
295.3017694	0.0353	40.27572585	0.0422	2076581954226237440	0.3462	0.0414	-2.403	0.078	-4.438	0.085	5251.10	2.105	12.303
295.3136469	0.3253	40.28334899	0.3771	2076582057294857984	0.3491	0.3900	-1.986	0.730	-1.645	0.762	-	-	12.285
295.3200558	0.0391	40.29147243	0.0490	2076582057305473792	0.3741	0.0487	-2.487	0.082	-5.821	0.092	5327.25	1.583	12.135
295.3120637	0.1733	40.30687343	0.1949	2076582160374126720	0.3569	0.2020	-3.942	0.371	-5.911	0.363	-	-	12.237
295.3043922	0.1174	40.29516073	0.1503	2076582121721748480	0.4170	0.1370	-3.858	0.244	-5.876	0.292	-	-	11.900
295.3237442	0.0442	40.30794112	0.0527	2076582091665719168	0.3907	0.0546	-3.366	0.093	-2.886	0.109	5293.33	-	12.041
295.3231906	0.2512	40.30163124	0.3274	2076582091654667008	0.3318	0.3192	-1.927	0.564	-5.374	0.752	-	-	12.396
295.3010275	0.4049	40.29046953	0.4583	2076582121722043776	0.3812	0.5185	-2.593	0.912	-5.942	0.859	-	-	12.094
295.3054080	0.1170	40.29244504	0.1492	2076582057305465088	0.4409	0.1361	-3.308	0.246	-4.025	0.293	-	-	11.778
295.3670130	0.6779	40.30343040	0.6419	2076582229093736576	0.3251	0.7653	-2.140	1.547	-3.369	1.194	-	-	12.440
295.3494888	0.1010	40.29902758	0.1240	2076582259160358784	0.4329	0.1253	-2.881	0.217	-3.602	0.241	-	-	11.818
295.3645997	0.8050	40.31080572	0.6617	2076582297813227648	0.3898	0.7849	-2.669	1.710	-5.289	1.225	-	-	12.046
295.3711074	0.2852	40.30333218	0.4255	2076582229093750016	0.4768	0.4033	-3.085	0.640	-4.838	0.973	-	-	11.608
295.3500185	0.1654	40.31470507	0.1908	2076582293520102400	0.4143	0.1955	-3.233	0.350	-3.402	0.349	-	-	11.913
295.3593302	0.1701	40.30923068	0.2013	2076582293520099712	0.4913	0.2016	-3.373	0.361	-5.629	0.359	-	-	11.543
295.3461090	0.2901	40.29798631	0.3625	2076582263453409280	0.4132	0.3553	-3.053	0.640	-4.071	0.792	-	-	11.919
295.3892001	0.1352	40.31437056	0.1519	2076582366543174016	0.3032	0.1559	-3.358	0.289	-6.380	0.280	-	-	12.591
295.3726575	0.0389	40.32469724	0.0461	2076582400902908288	0.3784	0.0467	-3.445	0.080	-4.897	0.088	5552.00	1.524	12.110
295.3804943	0.3794	40.32766860	0.4325	2076582366532792448	0.3372	0.4561	-2.354	0.830	-3.472	0.862	-	-	12.361
295.3376210	0.0290	40.33469278	0.0356	2076582572701584128	0.3194	0.0358	-1.926	0.058	-1.974	0.070	5332.00	4.083	12.478
295.3484801	0.0202	40.31865387	0.0260	2076582503982578944	0.3368	0.0252	-2.040	0.041	-6.073	0.049	4118.00	229.291	12.363
295.3343013	0.1427	40.31288754	0.1549	2076582465319137792	0.3602	0.1666	-2.323	0.302	-3.763	0.287	-	-	12.217
295.3298874	0.1612	40.30964984	0.1791	2076582469613968768	0.3967	0.1853	-2.412	0.341	-6.166	0.325	-	-	12.008
295.3227431	0.3757	40.31588357	0.4233	2076582538331294848	0.3388	0.4629	-3.435	0.844	-4.137	0.868	-	-	12.350
295.3297479	0.2172	40.34337989	0.2549	2076582572701583616	0.3754	0.2636	-2.261	0.475	-4.794	0.553	-	-	12.128
295.3406044	0.2632	40.32908926	0.3177	2076582499678535424	0.4615	0.3194	-3.075	0.588	-6.284	0.713	-	-	11.679
295.3383194	0.2337	40.32714528	0.2752	2076582499678534400	0.3340	0.2790	-2.015	0.536	-5.425	0.573	-	-	12.381
295.3339558	0.1332	40.32209081	0.1409	2076582465318794752	0.4768	0.1507	-2.022	0.280	-4.396	0.277	-	-	11.608
295.3306784	0.2566	40.32304120	0.2837	2076582534038271616	0.3904	0.3019	-2.222	0.566	-1.538	0.616	-	-	12.042
295.3278972	0.1419	40.33492824	0.1472	2076582568398013696	0.3034	0.1556	-3.230	0.302	-4.862	0.273	-	-	12.590
295.3508176	0.1534	40.34249610	0.1872	2076582607061335296	0.3171	0.1885	-2.640	0.326	-2.904	0.388	-	-	12.494
295.3432169	0.3811	40.35159851	0.4377	2076582675770394112	0.4368	0.4941	-1.927	0.818	-1.951	0.835	-	-	11.799
295.3583292	0.1373	40.35892430	0.1773	2076582710140563712	0.4385	0.1756	-3.587	0.294	-3.623	0.316	-	-	11.790
295.2565808	0.1590	40.30035585	0.1693	2076582813208977664	0.3429	0.1851	-3.930	0.340	-2.679	0.312	-	-	12.324
295.2572311	0.0662	40.31131786	0.0754	2076582813219688064	0.3291	0.0797	-2.529	0.134	-5.692	0.137	-	-	12.413
295.2577926	0.1139	40.31090836	0.1279	2076582813209012864	0.3988	0.1368	-2.906	0.235	-3.872	0.241	-	-	11.996
295.2697590	0.0993	40.29450898	0.1166	2076582744500209408	0.3551	0.1238	-2.987	0.215	-3.959	0.230	-	-	12.248
295.2658787	0.1528	40.29616063	0.1734	2076582740197038848	0.3412	0.1861	-2.857	0.327	-4.018	0.300	-	-	12.335
295.2736867	0.2281	40.29152094	0.3042	2076582740197037312	0.4822	0.2988	-3.269	0.508	-3.967	0.676	-	-	11.584
295.2701768	0.1309	40.28519857	0.1513	2076582740197036288	0.2903	0.1555	-3.292	0.291	-6.288	0.281	-	-	12.686
295.2549745	0.1804	40.30027033	0.2047	2076582808916812416	0.4481</								

295.2395313	0.3346	40.31851551	0.3896	2076583088097586816	0.2894	0.4233	-3.563	0.737	-3.312	0.761	-	-	12.693
295.2598830	0.1188	40.31815466	0.1322	2076583053737862016	0.3604	0.1418	-2.654	0.254	-4.146	0.237	-	-	12.216
295.2416735	0.2836	40.33280585	0.3255	2076583118154463104	0.3532	0.3688	-2.926	0.630	-2.577	0.635	-	-	12.260
295.2395742	0.1166	40.34002717	0.1342	2076583118154174336	0.3963	0.1465	-2.414	0.250	-5.148	0.269	-	-	12.010
295.2612378	0.0282	40.35881230	0.0321	2076583259896317056	0.4386	0.0348	-3.101	0.061	-4.714	0.060	5796.00	1.937	11.790
295.2745345	0.2898	40.34063611	0.3262	2076583156806519040	0.3266	0.3652	-3.782	0.635	-3.930	0.642	-	-	12.430
295.2518953	0.1072	40.35296795	0.1290	2076583221233394304	0.4199	0.1358	-3.244	0.230	-3.710	0.242	-	-	11.884
295.2662835	0.0996	40.35261424	0.1174	2076583221233394048	0.3519	0.1238	-2.476	0.213	-3.489	0.219	-	-	12.268
295.2533796	0.1593	40.34757584	0.1772	2076583221233392256	0.2905	0.1933	-3.318	0.345	-4.289	0.322	-	-	12.684
295.2687487	0.1597	40.34747223	0.1844	2076583152513915648	0.3476	0.1988	-2.585	0.344	-3.988	0.339	-	-	12.295
295.2653733	0.1301	40.34167449	0.1476	2076583152513913344	0.2952	0.1623	-3.288	0.278	-5.362	0.270	-	-	12.649
295.2964641	0.2342	40.34530154	0.2721	2076583362965014784	0.3322	0.2959	-3.100	0.519	-5.422	0.538	-	-	12.393
295.3149346	0.2393	40.35059238	0.3082	2076583324312262784	0.3978	0.3156	-3.371	0.533	-5.937	0.643	-	-	12.002
295.3128007	0.5223	40.37265870	0.6625	2076583397324860416	0.4406	0.6981	-3.952	1.226	-3.532	1.453	-	-	11.780
295.3156549	0.0913	40.35790007	0.1085	2076583397335304064	0.4617	0.1187	-2.114	0.187	-5.120	0.219	-	-	11.678
295.3080753	0.2137	40.33956573	0.2419	2076583289960616576	0.3127	0.2596	-3.635	0.473	-3.837	0.492	-	-	12.524
295.3196859	0.0929	40.37069599	0.1193	2076583496110959872	0.4252	0.1212	-2.946	0.201	-4.040	0.239	-	-	11.857
295.3279273	0.4287	40.38140702	0.5236	2076583496110962944	0.4061	0.5597	-2.353	0.984	-5.894	0.971	-	-	11.957
295.2830473	0.2586	40.37066402	0.2990	2076583633550548224	0.3065	0.3260	-2.719	0.553	-1.629	0.586	-	-	12.568
295.2826108	0.0358	40.37267310	0.0412	2076583637853460096	0.3578	0.0448	-2.207	0.075	-2.461	0.081	4965.00	2.177	12.232
295.3077149	0.1503	40.37366529	0.1841	2076583603483280128	0.4415	0.1918	-2.512	0.327	-4.497	0.347	-	-	11.775
295.4146516	0.1247	40.34367914	0.1445	2076583878361401984	0.3357	0.1512	-1.967	0.255	-3.792	0.256	-	-	12.370
295.3834939	0.1820	40.34957320	0.2116	2076583912721080704	0.2990	0.2221	-2.605	0.374	-3.841	0.377	-	-	12.622
295.3878683	0.1305	40.35618611	0.1506	2076583908425662848	0.4083	0.1572	-2.060	0.265	-5.382	0.264	-	-	11.945
295.3965205	0.2102	40.35211931	0.2579	2076583908425661696	0.3688	0.2699	-2.783	0.473	-5.545	0.509	-	-	12.166
295.4030402	0.2327	40.35012871	0.2871	2076583874065921152	0.3495	0.3014	-2.500	0.520	-2.518	0.572	-	-	12.283
295.3859854	0.2328	40.35000562	0.2857	2076583908425659904	0.3477	0.3005	-3.075	0.527	-1.596	0.568	-	-	12.294
295.4245721	0.6868	40.36854371	0.7509	2076583981440687872	0.3693	0.8747	-2.462	1.635	-3.874	1.335	-	-	12.163
295.4116531	0.0540	40.36913347	0.0659	2076584045864620672	0.4676	0.0684	-3.456	0.117	-3.985	0.122	5347.25	-	11.651
295.3768216	0.2634	40.37860401	0.3326	2076584217670526848	0.4499	0.3524	-2.553	0.594	-1.710	0.653	-	-	11.734
295.3748896	0.2403	40.35703309	0.2849	2076584114584093312	0.4552	0.2998	-2.837	0.512	-1.786	0.578	-	-	11.709
295.3754383	0.1690	40.37419141	0.2290	2076584187599018624	0.3768	0.2295	-2.896	0.371	-5.403	0.463	-	-	12.119
295.2225477	0.2943	40.34646076	0.3380	2076586038736396032	0.4731	0.3699	-1.970	0.649	-6.312	0.665	-	-	11.625
295.2296196	0.1622	40.33909306	0.1896	2076586038731935360	0.3365	0.2113	-2.895	0.355	-4.106	0.335	-	-	12.365
295.2415164	0.4788	40.34633737	0.5512	2076586077384201856	0.4298	0.5845	-2.431	1.101	-5.363	1.033	-	-	11.834
295.2267507	0.6354	40.35815760	0.8349	2076586146103665536	0.3449	0.8769	-4.047	1.560	-3.521	2.059	-	-	12.312
295.2414866	0.1218	40.34729167	0.1436	2076586077394844032	0.4817	0.1545	-2.966	0.261	-3.670	0.284	-	-	11.586
295.2325282	0.0407	40.36040513	0.0489	2076586146114322304	0.2986	0.0508	-3.058	0.089	-4.265	0.102	5365.00	-	12.625
295.2608817	0.0978	40.37300554	0.1159	2076586210530642304	0.3151	0.1234	-3.582	0.210	-5.818	0.231	-	-	12.508
295.2534725	0.2429	40.37618117	0.2777	2076586210530643712	0.3987	0.3021	-3.972	0.522	-5.123	0.551	-	-	11.998
295.2512117	0.0576	40.35581540	0.0687	2076586180474070528	0.4065	0.0735	-3.787	0.123	-2.016	0.137	-	-	11.955
295.2552381	0.0671	40.37813327	0.0763	2076586214833824512	0.3471	0.0827	-2.197	0.141	-6.212	0.152	-	-	12.298
295.2042032	0.3050	40.35670568	0.3762	2076586313610137472	0.4094	0.3928	-2.916	0.678	-4.700	0.745	-	-	11.939
295.2393333	0.3275	40.10883463	0.3733	2076297867910964608	0.3269	0.4097	-4.019	0.767	-5.226	0.772	-	-	12.428
295.2259155	0.1544	40.10735792	0.1948	2076297867910926080	0.2891	0.1860	-2.957	0.338	-4.915	0.349	-	-	12.695
295.2243309	0.2001	40.10668593	0.2484	2076297932327380992	0.2823	0.2501	-3.350	0.458	-3.061	0.490	-	-	12.746
295.2217509	0.0772	40.09980211	0.0960	2076297829248110464	0.4632	0.1040	-2.505	0.169	-2.238	0.170	-	-	11.671
295.2284688	0.1641	40.10303576	0.1927	2076297863607849728	0.2969	0.1935	-3.317	0.372	-4.690	0.375	-	-	12.637
295.2238501	0.0875	40.10441493	0.1080	2076297829248112256	0.4698	0.1096	-2.548	0.197	-4.121	0.209	-	-	11.640
295.3062012	0.3380	40.06317193	0.4134	2076298039709713152	0.2981	0.4295	-3.657	0.848	-4.081	0.831	-	-	12.628
295.3146895	0.1131	40.05936149	0.1387	2076298005354324352	0.3608	0.1352	-2.639	0.252	-4.084	0.258	-	-	12.214
295.3290118	0.0823	40.06229901	0.0977	2076298005354334080	0.4850	0.0999	-2.545	0.178	-5.499	0.195	-	-	11.571
295.3234919	0.1272	40.05426198	0.1843	2076298001046703616	0.3191	0.1617	-2.619	0.298	-3.728	0.396	-	-	12.480
295.2440744	0.2565	40.07131408	0.3164	2076297558673256192	0.3056	0.3130	-3.691	0.600	-3.562	0.676	-	-	12.574
295.2263287	0.0860	40.08215842	0.1033	2076297623089670016	0.3528	0.1061	-2.261	0.197	-4.423	0.210	-	-	12.262
295.2472123	0.2775	40.09001826	0.3235	2076297661752509952	0.2826	0.3420	-2.460	0.685	-5.610	0.689	-	-	12.744
295.2367447	0.0918	40.13942466	0.1087	2076299409796093056	0.310	0.1123	-3.040	0.215	-3.659	0.220	-	-	12.546
295.2469611	0.1741	40.14656621	0.2024	2076299444155834112	0.396	0.2111	-3.001	0.414	-6.282	0.426	-	-	12.012
295.2386857	0.2201	40.14305609	0.2550	2076299444155877504	0.441	0.2649	-3.044	0.546	-3.635	0.547	-	-	11.779
295.5630737	0.1169	40.17334576	0.1494	2076390639200181376	0.3853	0.1519	-2.959	0.255	-3.519	0.268	-	-	12.071
295.5364567	0.3605	40.17833671	0.4666	2076390673561360000	0.3347	0.4728	-2.555	0.823	-5.250	0.806	-	-	12.377
295.5500742	0.1880	40.18707584	0.2516	2076390707927610368	0.2855	0.2589	-2.744	0.416	-5.416	0.453	-	-	12.722
295.3007170	0.1140	40.06223985	0.1338	2076298035406584064	0.3036	0.1381	-3.049	0.254	-2.639	0.255	-	-	12.588
295.4561971	0.1076	40.24140298	0.1366	2076393319259632768	0.3054	0.1308	-2.810	0.243	-4.052	0.286	-	-	12.576
295.4530609	0.2691	40.25115511	0.3425	2076393525418081664	0.3169	0.3516	-3.660	0.621	-3.582	0.688	-	-	12.495
295.4468577	0.0785	40.25459569	0.0999	2076393525425758208	0.3690	0.1024	-3.048	0.179	-2.493	0.190	-	-	12.165
295.5099929	0.4801	40.26456215	0.6128	2076394865455606144	0.3196	0.6177	-2.332	1.036	-1.817	1.134	5079.90	-	12.477
295.5295454	0.0443	40.27924756	0.0532	2076394899815362944	0.3267	0.0553	-3.717	0.094	-5.251	0.102	4940.00	-	12.429
295.5113622	0.0172	40.28013936	0.0220	2076394964224349568	0.4447	0.0219	-2.131	0.036	-4.948	0.043	4889.25	29.699	11.760
295.1847791	0.0970	40.29501810	0.1210	2076492030485721728	0.3391	0.121	-2.070	0.217	-3.926	0.231	-	-	12.348
295.1538550	0.0403	40.18544877	0.0478	2076486777752486144	0.2971	0.0498	-2.144	0.095	-5.012	0.097	5761.25	-	12.635
295.1538244	0.1144	40.19135676	0.1370	2076486773445928448	0.3898	0.1360	-3.485	0.258	-5.040	0.261	-	-	12.046
295.1569212	0.5243	40.20045929	0.6460	2076486773445929984	0.4253	0.6499	-1.929	1.455	-2.984	1.195	-	-	11.857
295.2735585	0.0268	40.26704371	0.0302	2076488152142173312	0.2883	0.0314	-2.924	0.060	-3.346				

KIC	RA	eRA	Dec	eDec	Gaia source	ϖ	e ϖ	μ_α	$e\mu_\alpha$	μ_δ	$e\mu_\delta$	T_{eff}	L
5024354	295.30955458	0.0771	40.16996551	0.1029	2076299723341302528	0.2956	0.0919	-2.604	0.176	-4.457	0.204	5601.00	
5113436	295.45908108	0.0170	40.24583175	0.0234	2076393525425762944	0.3692	0.0224	-2.864	0.036	-3.876	0.041	5676.50	6.054
5024524	295.32993393	0.0114	40.15910766	0.0149	2076299654621834112	0.3278	0.0143	-2.866	0.025	-3.892	0.028	5096.00	23.063
5113517	295.47978724	0.0230	40.23935130	0.0287	2076394728016615680	0.4618	0.0290	-2.860	0.049	-3.832	0.055	3754.12	641.958
4937456	295.40914882	0.0129	40.05201477	0.0176	2076295256575310464	0.9576	0.0170	-0.574	0.028	5.702	0.033	5869.00	2.143
5024202	295.28521287	0.0184	40.16452268	0.0222	2076299895139969536	0.3283	0.0222	-2.983	0.041	-3.933	0.042	5735.25	5.594
5024157	295.27856454	0.0342	40.16286939	0.0360	2076299517182944640	0.1504	0.0395	-3.143	0.079	-4.200	0.072	5908.67	-
5025237	295.44006675	0.0233	40.12837235	0.0312	2076389539696509952	0.3831	0.0299	-3.024	0.052	-3.832	0.058	5761.33	3.181
5199710	295.25080364	0.0161	40.33986130	0.0194	2076583122457345792	1.2004	0.0210	-8.212	0.033	-19.849	0.034	5884.71	0.814
5025769	295.54793388	0.0140	40.19405489	0.0189	2076390707927247104	0.7343	0.0186	3.767	0.030	6.488	0.034	5764.25	2.932
5112880	295.36280136	0.0185	40.20785182	0.0216	2076393658554297600	0.3793	0.0216	-2.967	0.041	-3.834	0.042	4473.60	85.000
5025675	295.52851156	0.0911	40.16612856	0.1164	2076389196098727552	1.1710	0.1198	-3.314	0.201	-4.074	0.218	5606.64	0.577
5024138	295.27409055	0.0498	40.19540590	0.0577	2076487636738856704	0.2663	0.0609	-2.229	0.115	-4.400	0.115	5305.80	-
5112978	295.37679411	0.0166	40.22039544	0.0214	2076393765943851904	0.3618	0.0204	-3.045	0.037	-3.564	0.040	5612.10	6.897
5023931	295.23766199	0.0168	40.16854331	0.0185	2076487224429134592	0.3580	0.0193	-2.788	0.037	-3.790	0.035	4599.21	47.456
5112910	295.36757399	0.0122	40.21510426	0.0160	2076393662864627840	0.3663	0.0156	-2.995	0.027	-3.902	0.030	6292.00	13.756
5112705	295.33579692	0.0142	40.20472036	0.0182	2076393697224330752	0.3257	0.0176	-3.042	0.031	-4.007	0.035	5802.50	12.577
4936672	295.23678279	0.0175	40.06721828	0.0206	2076297455598475520	0.3735	0.0221	-2.993	0.038	-3.723	0.037	5791.00	5.992
5024650	295.34726985	0.0175	40.17293803	0.0216	2076299792060818560	0.4042	0.0213	-2.809	0.039	-3.619	0.042	5555.50	4.473
4937257	295.36375232	0.0118	40.08186393	0.0158	2076295565813027328	0.2148	0.0154	-2.897	0.026	-4.705	0.030	4472.32	61.066
5023413	295.12928342	0.0195	40.10735104	0.0220	2076485369003144960	0.3466	0.0232	-2.939	0.045	-3.799	0.042	5832.75	5.943
5024240	295.29142959	0.0122	40.15153629	0.0140	2076299311024414592	0.3619	0.0146	-3.018	0.027	-3.799	0.027	5002.50	15.818
5024456	295.32103458	0.0190	40.18105347	0.0246	2076299826420536320	0.3412	0.0246	-2.935	0.042	-3.680	0.045	4078.32	376.082
5024517	295.32883630	0.0129	40.19470302	0.0165	2076299860780295936	0.2812	0.0165	-2.990	0.030	-3.734	0.038	4434.33	78.165
5111847	295.18570155	0.0126	40.20935140	0.0167	2076488289581010816	1.1716	0.0164	-6.817	0.027	0.701	0.031	6364.50	3.303
5024173	295.28027376	0.0153	40.19810377	0.0186	2076487671105791872	0.3554	0.0190	-2.822	0.035	-3.827	0.039	5691.53	8.433
5024297	295.30098830	0.0160	40.19272887	0.0190	2076300101298433792	0.3309	0.0197	-2.956	0.035	-4.030	0.036	4677.23	56.317
5024312	295.30338338	0.0109	40.19148245	0.0125	2076300032578958464	0.3494	0.0130	-3.038	0.024	-3.800	0.024	4994.00	25.551
5025295	295.45122701	0.0187	40.17079186	0.0234	2076389745854485504	0.3524	0.0237	-2.974	0.042	-4.013	0.046	6101.99	5.454
5112938	295.37142241	0.0169	40.21778613	0.0211	2076393765943846656	0.3535	0.0209	-3.040	0.037	-3.937	0.041	4916.00	52.213
5113441	295.46101163	0.0135	40.26693427	0.0170	2076395002894525952	0.3697	0.0172	-2.961	0.029	-3.808	0.032	4779.60	16.038
5113612	295.50440212	0.0248	40.26696277	0.0285	2076394865455603456	0.3695	0.0299	-2.911	0.052	-3.770	0.054	5821.75	3.867
5112248	295.26447901	0.0180	40.21499327	0.0196	2076487739825266304	0.3714	0.0210	-2.848	0.040	-3.973	0.037	5673.64	5.882
5112409	295.29388117	0.0164	40.21419231	0.0191	2076487774185027456	0.3598	0.0201	-2.960	0.037	-3.900	0.038	4926.52	7.282
4936597	295.21843395	0.0220	40.08899890	0.0258	2076297833555597952	0.3341	0.0268	-3.015	0.049	-3.930	0.050	5811.50	3.751
4937576	295.43445144	0.0196	40.09794284	0.0260	2076389294867531136	0.3718	0.0237	-2.831	0.043	-3.858	0.050	4444.99	58.855
4937775	295.44979295	0.0187	40.19826757	0.0256	2076393113108862080	0.3492	0.0254	-3.007	0.043	-3.873	0.052	5642.02	5.821
5023548	295.15682186	0.0167	40.19539937	0.0207	2076486777752493056	0.3262	0.0216	-2.851	0.036	-3.922	0.037	4923.41	11.455
5024519	295.32902629	0.0138	40.16247831	0.0177	2076299757701051648	0.3757	0.0171	-2.957	0.030	-3.908	0.033	5308.91	10.040
5025288	295.44979295	0.0187	40.19826757	0.0256	2076393113108862080	0.3492	0.0254	-3.007	0.043	-3.873	0.052	5642.02	5.821
5111971	295.21387240	0.0292	40.21713973	0.0331	2076488358300516864	0.4027	0.0352	-2.938	0.064	-3.931	0.062	5676.50	2.037
5112361	295.28413888	0.2985	40.25235867	0.3340	2076488083422693888	0.3472	0.3505	0.396	0.666	-2.474	0.635	4851.95	-
5112403	295.29185366	0.0123	40.21895655	0.0141	2076487774185029504	0.3392	0.0151	-3.066	0.027	-3.876	0.027	5080.33	19.350
5112446	295.30174649	0.0311	40.21555200	0.0304	2076300101298456320	0.3319	0.0353	-2.985	0.070	-3.913	0.060	5801.67	3.446
5112468	295.30351944	0.0158	40.23307465	0.0186	2076487808544789504	0.3027	0.0184	-2.816	0.035	-3.782	0.036	5399.60	11.703
5112499	295.30793515	0.0245	40.25838855	0.0303	2076581748067801088	0.3197	0.0293	-2.790	0.048	-3.995	0.059	5811.00	4.755
5112734	295.34066476	0.0168	40.20308561	0.0210	2076393692917498368	0.3569	0.0204	-2.871	0.037	-3.791	0.041	4550.40	55.208
4936727	295.25013651	0.0142	40.08633076	0.0168	2076297661756920192	0.3737	0.0175	-2.948	0.031	-3.870	0.032	5678.31	7.497
5023822	295.21956177	0.0140	40.14508882	0.0154	2076487086990151296	0.3688	0.0160	-2.839	0.031	-3.846	0.029	5691.79	10.103
5024493	295.32614074	0.0160	40.11780611	0.0201	2076298795628342144	0.3445	0.0200	-3.109	0.036	-3.881	0.042	5472.35	7.611
5024601	295.34111310	0.0171	40.19681359	0.0212	2076393692914037248	0.3241	0.0207	-3.031	0.037	-3.912	0.040	4824.00	83.705
5024967	295.39349951	0.0194	40.14611709	0.0251	2076392528993233024	0.3115	0.0245	-2.603	0.042	-3.788	0.049	4777.77	67.803
5024717	295.35641136	0.0291	40.14037748	0.0335	2076298933067338112	0.3342	0.0338	-2.976	0.064	-3.828	0.065	5769.69	3.582
5024870	295.37914408	0.0141	40.10034091	0.0175	2076295600172704512	0.3540	0.0173	-2.852	0.031	-3.931	0.035	4947.25	10.840
5024943	295.38912990	0.0169	40.17677715	0.0235	2076392838230896384	0.3505	0.0216	-2.810	0.038	-3.760	0.047	5735.00	7.189
5024984	295.39715194	0.3721	40.19604087	0.4784	2076392941310130176	1.4443	0.4821	-7.658	0.928	-1.503	0.976	4868.50	-
5111525	295.10558836	0.0178	40.24311698	0.0206	2076490282445801216	0.3906	0.0217	-2.884	0.040	-3.977	0.043	5791.00	6.375
5111718	295.15349947	0.0137	40.25477429	0.0165	2076491515089601408	0.3486	0.0171	-3.003	0.030	-3.663	0.029	4971.65	20.411
5111807	295.17470046	0.0269	40.20444803	0.0339	2076488255221261696	0.3530	0.0344	-2.970	0.058	-3.782	0.061	5745.53	3.023
5111820	295.17935707	0.0153	40.25209553	0.0187	2076488667538158208	0.3319	0.0184	-2.850	0.034	-3.926	0.036	5015.00	13.661
5111849	295.18593252	0.0166	40.21443752	0.0194	2076488289581014400	0.3780	0.0213	-2.912	0.038	-3.923	0.042	5713.01	7.832
5111938	295.20655843	0.0235	40.22473410	0.0294	2076488358300516352	0.3650	0.0296	-2.916	0.052	-3.993	0.055	5762.00	3.322
5112064	295.23180353	0.0174	40.20456959	0.0202	2076487533666801408	0.3339	0.0214	-2.841	0.038	-3.699	0.038	5778.75	8.160
5112072	295.23335039	0.0130	40.22763754	0.0151	2076487976036241536	0.3428	0.0161	-2.864	0.028	-3.739	0.028	4949.23	22.289
5112104	295.23883880	0.0170	40.27429471	0.0204	2076488942416130688	0.3473	0.0209	-2.898	0.036	-3.765	0.037	5783.01	8.889
5112182	295.25471535	0.0270	40.28879177	0.0338	2076488976775894656	0.3945	0.0327	-2.920	0.058	-3.801	0.061	5858.00	2.482
5112200	295.25706195	0.0162	40.21603219	0.0194	2076487911623953920	0.3232	0.0205	-2.939	0.037	-3.730	0.037	5725.51	9.421
5112232	295.26089851	0.0398	40.27551141	0.0472	2076488908056482176	0.4323	0.0486	-2					

5112948	295.37256652	0.0176	40.23886002	0.0229	2076393869023076608	0.323	0.0218	-2.974	0.035	-3.686	0.042	4564.48	65.128
5113261	295.42647909	0.0165	40.26098829	0.0215	2076394315699729536	0.357	0.0212	-2.801	0.036	-3.871	0.039	4953.25	8.085
4936741	295.25231500	0.0227	40.09866367	0.0264	2076297661756927104	0.354	0.0277	-2.923	0.051	-3.932	0.052	5820.45	3.352
4937359	295.38817411	0.0166	40.04055980	0.0216	2076294844258425984	0.320	0.0213	-2.925	0.038	-3.859	0.041	5236.35	9.679
4937770	295.47658427	0.0200	40.03600381	0.0284	2076294294502430720	0.443	0.0267	-2.856	0.045	-3.536	0.054	4979.42	22.293
4937861	295.49824688	0.0143	40.08338794	0.0192	2076388337105190144	0.361	0.0185	-2.985	0.032	-3.825	0.039	5332.00	10.294
5023732	295.20013283	0.0176	40.13566704	0.0202	2076485678240859136	0.361	0.0216	-2.978	0.038	-3.831	0.038	4548.88	74.370
5023760	295.20557420	0.0180	40.15192873	0.0211	2076487155709622784	0.298	0.0221	-2.987	0.041	-3.920	0.041	5842.67	7.355
5023890	295.23167740	0.0137	40.19085286	0.0160	2076487499307051008	0.387	0.0169	-2.687	0.031	-3.911	0.031	5429.00	9.486
5024060	295.26047688	0.0159	40.17188511	0.0185	2076487258788894208	0.339	0.0195	-2.871	0.036	-3.904	0.036	6044.28	7.581
5024076	295.26371932	0.0195	40.12659389	0.0208	2076299379743863936	0.365	0.0223	-2.950	0.043	-4.084	0.039	5760.00	5.207
5024143	295.27587592	0.0122	40.18144674	0.0157	2076299963859451136	0.349	0.0157	-3.003	0.028	-4.081	0.028	4776.51	22.667
5024150	295.27742059	0.0138	40.17208865	0.0169	2076299963859446016	0.356	0.0170	-3.354	0.030	-3.595	0.031	5334.73	11.690
5024239	295.29132280	0.0284	40.11933086	0.0315	2076299207945183360	0.359	0.0332	-2.912	0.064	-3.912	0.062	5846.12	2.418
5024295	295.30069585	0.0220	40.16814484	0.0220	2076299929499724672	0.328	0.0265	-2.914	0.049	-3.516	0.050	5715.38	4.605
5024327	295.30602505	0.0185	40.19890895	0.0245	2076300101294355968	0.347	0.0238	-2.832	0.042	-3.987	0.053	4775.85	56.838
5024372	295.31176311	0.0153	40.19756679	0.0212	2076300028271316224	0.345	0.0185	-2.737	0.034	-3.834	0.041	5597.84	9.780
5024497	295.32645590	0.0153	40.14648609	0.0196	2076299654621822720	0.335	0.0189	-2.888	0.034	-3.892	0.037	5496.67	9.132
5024503	295.32696648	0.0259	40.12441683	0.0303	2076298864347823872	0.403	0.0306	-2.832	0.058	-3.817	0.062	5763.33	2.236
5024556	295.33452587	0.0155	40.14035006	0.0191	2076298989707580416	0.339	0.0188	-3.035	0.034	-3.787	0.037	5542.05	8.243
5024557	295.33460977	0.0148	40.16986366	0.0182	2076299757701064960	0.350	0.0182	-2.979	0.032	-3.794	0.035	4923.00	10.140
5024641	295.34626557	0.0164	40.15190227	0.0193	2076299001786815104	0.359	0.0196	-3.056	0.036	-3.897	0.038	5607.74	7.338
5024961	295.39174365	0.0309	40.19770089	0.0354	2076393010029604352	0.335	0.0382	-3.061	0.079	-4.068	0.074	5664.00	3.091
5024975	295.39466894	0.0303	40.10053742	0.0387	2076295703251935744	0.372	0.0385	-3.034	0.067	-4.031	0.075	5477.65	2.094
5025113	295.42238342	0.0325	40.13546650	0.0509	2076389604105237248	0.454	0.0423	-3.029	0.074	-3.915	0.105	5461.98	1.116
5025385	295.47122453	0.0209	40.15389191	0.0282	2076389848933704832	0.378	0.0272	-2.864	0.048	-3.886	0.052	5727.00	4.293
5111940	295.20687616	0.0132	40.24200659	0.0159	2076488427020005632	0.354	0.0167	-2.843	0.028	-3.716	0.029	4771.03	43.162
5112012	295.22082481	0.0300	40.21170447	0.0363	2076487602386274304	0.346	0.0382	-2.864	0.069	-4.041	0.073	5760.25	2.517
5112198	295.25792007	0.0342	40.25946391	0.0404	2076488117782414208	0.432	0.0430	-3.457	0.076	-4.101	0.077	5612.20	5.341
5112368	295.28303761	0.0268	40.21528377	0.0301	2076487774185021184	0.330	0.0313	-2.850	0.063	-3.964	0.059	5645.50	3.246
5112391	295.28908028	0.0161	40.21950133	0.0183	2076487774185027328	0.345	0.0194	-3.001	0.036	-3.842	0.035	5745.80	7.862
5112555	295.31633280	0.0170	40.26265273	0.0212	2076581748067808384	0.379	0.0208	-4.533	0.037	-6.391	0.041	5823.75	5.147
5112567	295.31983514	0.0306	40.20935433	0.0366	2076300066938729856	0.375	0.0373	-3.086	0.068	-3.774	0.072	5541.65	2.041
5112604	295.32426419	0.0156	40.25318824	0.0194	2076581679348332544	0.364	0.0195	-2.931	0.034	-3.702	0.039	5442.00	6.806
5112786	295.34870379	0.0182	40.20984816	0.0213	2076393692914035456	0.410	0.0222	-3.445	0.040	-3.815	0.040	4286.64	155.672
5112816	295.35391839	0.0158	40.23681672	0.0192	2076394040821753344	0.340	0.0192	-2.826	0.035	-3.979	0.037	5652.75	8.819
5112907	295.36723669	0.0231	40.26004280	0.0342	2076394075181516416	0.417	0.0289	-3.046	0.049	-3.913	0.065	5759.20	2.463
5112974	295.37612287	0.0181	40.25599518	0.0235	2076394448828275584	0.332	0.0226	-2.998	0.038	-4.020	0.045	4817.87	68.246
5113001	295.38052965	0.0154	40.21942162	0.0203	2076393765944335104	0.366	0.0190	-3.036	0.033	-3.713	0.039	5295.25	7.671
5113041	295.38876364	0.0189	40.20966727	0.0224	2076393010029609984	0.312	0.0226	-2.786	0.041	-4.068	0.042	4552.54	73.176
5113456	295.46516598	0.0170	40.26030388	0.0214	2076395002894914176	0.353	0.0212	-2.920	0.036	-3.771	0.039	5830.00	6.309
5113601	295.50076715	0.0264	40.20530281	0.0327	2076390226890883456	0.289	0.0337	-2.974	0.059	-3.620	0.060	5746.77	4.994
5199746	295.25741911	0.0218	40.32664176	0.0252	20765830494364694016	0.336	0.0278	-2.815	0.045	-3.839	0.044	5811.00	5.766
5199843	295.27926691	0.0169	40.34286513	0.0193	2076583191176842880	0.318	0.0212	-2.865	0.035	-3.763	0.036	5741.16	9.933
5200152	295.34939417	0.0202	40.36233676	0.0248	2076582710140560000	0.364	0.0244	-2.931	0.040	-3.861	0.047	4848.37	54.642
4936180	295.11368400	0.0196	40.07114413	0.0230	2076485162844678784	0.375	0.0240	-2.905	0.046	-3.870	0.045	5899.00	4.213
4936244	295.12701502	0.0149	40.07140131	0.0176	2076485197204427776	0.351	0.0183	-2.906	0.034	-3.827	0.035	5664.87	9.119
4936335	295.14870599	0.0111	40.08437700	0.0133	2076485094125237376	0.122	0.0139	-3.759	0.025	-3.462	0.026	4427.98	-
4936524	295.20134248	0.0160	40.04130671	0.0199	2076297112001073408	0.693	0.0202	-0.539	0.036	-7.927	0.037	4428.98	9.246
4936688	295.24113072	0.0474	40.07308616	0.0546	2076297558677695360	0.649	0.0581	-2.898	0.108	-3.917	0.107	4429.98	1.748
4936788	295.26246019	0.0217	40.05179188	0.0245	2076296802763452544	0.278	0.0257	-3.053	0.049	-4.053	0.047	4430.98	8.923
4937011	295.30693867	0.0098	40.06059327	0.0119	2076298039714190976	0.355	0.0121	-3.035	0.022	-3.899	0.022	4431.98	35.626
4937056	295.31796852	0.0175	40.09745065	0.0261	2076298383311466368	0.321	0.0217	-2.658	0.038	-4.201	0.051	4432.98	63.093
4937140	295.33855882	0.0138	40.00783582	0.0178	207629471179169408	0.572	0.0172	-3.500	0.031	-7.545	0.034	4433.98	5.434
4937192	295.34915843	0.0200	40.01593978	0.0270	2076294741179177088	0.419	0.0256	-2.967	0.045	-3.746	0.050	4434.98	4.058
4937546	295.42915253	0.0153	40.05811281	0.0230	2076294603740304256	0.351	0.0199	-2.904	0.034	-3.983	0.046	4435.98	8.756
5023711	295.19562595	0.0281	40.19904951	0.0333	2076488216554641536	0.324	0.0344	-2.664	0.063	-4.005	0.063	4436.98	2.985
5023712	295.19586073	0.0317	40.13283498	0.0357	2076485643881116416	0.370	0.0380	-2.862	0.072	-3.807	0.073	4437.98	1.894
5023845	295.22307268	0.0112	40.16731493	0.0136	2076487185762261888	0.354	0.0140	-2.576	0.025	-3.701	0.024	4438.98	23.116
5023849	295.22432792	0.0170	40.19756989	0.0189	2076487499307049984	0.339	0.0208	-2.925	0.035	-3.814	0.035	4439.98	9.604
5023863	295.22648972	0.0311	40.15213120	0.0374	2076487086990161024	0.415	0.0387	-2.820	0.070	-3.696	0.072	4440.98	1.49
5023872	295.22790595	0.0207	40.16911716	0.0231	2076487190069388672	0.381	0.0246	-3.011	0.045	-3.876	0.044	4441.98	3.753
5023874	295.22808813	0.0198	40.14316821	0.0226	2076487086990155520	0.361	0.0237	-2.910	0.045	-3.805	0.043	4442.98	4.364
5023889	295.23166345	0.0172	40.10809810	0.0204	2076297867910941568	0.677	0.0214	-0.206	0.038	-5.135	0.039	4443.98	31.573
5024043	295.25845738	0.0174	40.10777847	0.0200	2076299139225684096	0.410	0.0211	-0.682	0.037	-4.739	0.038	4444.98	39.68
5024122	295.27289965	0.0238	40.14121172	0.0276	2076299482823091200	0.428	0.0285	-2.940	0.053	-3.825	0.053	4445.98	2.093
5024177	295.28108361	0.0165	40.13284632	0.0198	2076299276664661248	0.378	0.0203	-3.102	0.037	-3.938	0.036	4446.98	5.562
5024242	295.29149867	0.0148	40.12452809	0.0165	2076299207945186048	0.350	0.0173	-2.972	0.032	-3.733	0.031	4447.98	10.813
5024272	295.29646424	0.0181	40.19506563	0.0204	2076299998219216256	0.351	0.0219	-3.026	0.040				

5024667	295.34887612	0.0167	40.13365318	0.0210	2076298829988109952	0.343	0.0202	-2.880	0.037	-3.840	0.041	4459.98	6.571
5112861	295.35993116	0.0224	40.27195842	0.0278	2076394143900995200	0.3391	0.0274	-2.953	0.049	-3.798	0.053	5794.67	3.591
5112932	295.37080562	0.0290	40.20569366	0.0361	2076393662864624384	0.3490	0.0361	-2.857	0.066	-3.924	0.073	5362.25	2.426
5112950	295.37305382	0.0185	40.20580943	0.0246	2076393662864626176	0.3657	0.0238	-2.840	0.041	-3.917	0.048	4632.80	55.835
5113058	295.39242122	0.0160	40.26593931	0.0211	2076394281339968256	0.3656	0.0200	-2.867	0.035	-3.909	0.040	5752.60	6.637
5113061	295.39329621	0.0189	40.29670321	0.0221	2076394659297111552	0.3916	0.0224	-2.825	0.039	-3.804	0.041	4140.12	272.560
5113071	295.39541498	0.0208	40.28011785	0.0247	2076394483188725376	0.3700	0.0248	-3.010	0.043	-3.935	0.047	5866.75	3.949
5113275	295.42968664	0.0252	40.25997112	0.0324	2076393559785487232	0.3607	0.0321	-3.001	0.056	-3.852	0.059	5746.33	2.767
5113393	295.45070715	0.0181	40.20860796	0.0235	2076393113108869248	0.3458	0.0227	-3.032	0.040	-3.985	0.045	5535.54	6.072
5113457	295.46548713	0.0280	40.25646126	0.0372	2076395002894523136	0.3352	0.0353	-2.968	0.063	-3.825	0.067	5799.67	2.856
5113733	295.53562447	0.0160	40.25959211	0.0206	2076391944877856768	0.3377	0.0207	-2.908	0.033	-3.781	0.039	4902.80	10.045
5113793	295.55166917	0.0174	40.26651075	0.0217	2076392254115515392	0.3779	0.0221	-3.027	0.036	-3.926	0.042	4900.00	6.677
5199633	295.23337217	0.0151	40.31085253	0.0163	2076489182934322816	0.7102	0.0176	4.241	0.031	1.391	0.030	6134.00	3.319
5199859	295.28426865	0.0353	40.32550125	0.0348	2076582950658667264	0.4314	0.0404	-2.915	0.072	-3.492	0.063	3815.88	664.956
5200088	295.33652061	0.0184	40.33314766	0.0227	2076582572701582208	0.3300	0.0229	-3.040	0.037	-3.973	0.045	4935.47	14.858
5200172	295.35405954	0.0162	40.33908678	0.0206	2076582607061335424	0.3650	0.0189	-2.926	0.032	-3.993	0.037	5438.50	11.167
5200187	295.35755279	0.0190	40.33061760	0.0230	2076582607061332864	0.3584	0.0229	-2.953	0.039	-3.872	0.041	5411.56	8.094
5200422	295.40563934	0.0190	40.32193178	0.0227	2076396171125625984	0.3445	0.0223	-2.849	0.039	-3.865	0.041	5835.00	6.475
5200436	295.40830265	0.0167	40.32294568	0.0202	2076396171125628672	0.3501	0.0196	-3.000	0.035	-3.856	0.037	5361.84	8.813
5200544	295.43204056	0.0154	40.32594347	0.0204	2076396136765909504	0.3499	0.0183	-2.933	0.032	-3.913	0.038	5899.48	11.185
5200701	295.46829916	0.0212	40.31583428	0.0263	2076395964967236096	0.4033	0.0264	-3.023	0.044	-3.870	0.046	5787.00	4.107
5025228	295.43865624	0.0222	40.18162337	0.0291	2076392700791982336	0.3822	0.0281	-2.853	0.051	-4.044	0.064	5709.00	3.167
5112481	295.30502117	0.0159	40.24905188	0.0213	2076581713708054656	0.3715	0.0200	-3.031	0.035	-4.139	0.044	4073.95	260.915
5112754	295.34416107	0.0178	40.21938920	0.0224	2076393937742517120	0.3543	0.0222	-3.047	0.040	-3.826	0.045	5522.67	5.937
5113295	295.43358947	0.0232	40.21330304	0.0300	2076393147468598912	0.9524	0.0280	-4.503	0.050	-1.075	0.056	5192.20	0.501
5113344	295.44073708	0.0295	40.23947426	0.0371	2076393491066003584	0.4035	0.0378	-3.004	0.063	-3.675	0.071	5905.61	1.757
4936897	295.28321634	0.0140	40.07841765	0.0166	2076298314591962624	1.0470	0.0173	-8.886	0.031	-32.457	0.032	5779.00	1.019
4937447	295.40746107	0.0715	40.09943215	0.0999	2076295668892210048	0.3189	0.0881	-3.097	0.168	-3.874	0.195	5612.10	-
5023858	295.22572672	0.0184	40.12187015	0.0207	2076297936634830336	0.4020	0.0222	-2.951	0.042	-3.885	0.039	5753.00	4.460
5024149	295.27723558	0.0160	40.16636068	0.0183	2076299585902421760	0.3183	0.0189	-2.937	0.036	-3.789	0.035	5015.00	9.745
5024268	295.29592726	0.0214	40.18655917	0.0208	2076299993911496320	0.4032	0.0238	-3.075	0.044	-3.808	0.039	4728.24	162.886
5024404	295.31515533	0.0158	40.16957891	0.0191	2076299719033591424	0.3268	0.0190	-2.898	0.034	-3.931	0.037	4570.44	61.871
5024405	295.31559982	0.0119	40.19330747	0.0158	2076300032578973952	0.3544	0.0143	-2.912	0.026	-3.797	0.029	4907.50	23.945
5024512	295.32814988	0.0117	40.19852434	0.0148	2076300066938728832	0.3530	0.0148	-3.129	0.026	-3.937	0.027	5018.67	31.299
5024575	295.33723745	0.0155	40.19243918	0.0202	2076299860780302464	0.3320	0.0188	-2.993	0.035	-3.768	0.039	5798.33	8.679
5024750	295.36076663	0.0166	40.19492215	0.0215	2076393624194561152	0.3687	0.0204	-2.784	0.037	-3.815	0.041	4477.55	133.518
5111949	295.20915978	0.0191	40.21968228	0.0245	2076488323940775680	0.3142	0.0253	-3.026	0.042	-3.845	0.043	4807.44	68.282
5112288	295.27181786	0.0183	40.23448384	0.0231	2076488049062931328	0.3652	0.0232	-2.737	0.040	-3.858	0.043	4818.61	49.417
5112730	295.33946183	0.0159	40.23257330	0.0207	2076393937742523904	0.3499	0.0200	-3.003	0.034	-3.872	0.040	4702.10	58.833
5112751	295.34353344	0.0175	40.20092338	0.0215	2076393692921636992	0.3319	0.0212	-3.229	0.038	-3.992	0.041	4939.26	63.534

Table B.15: The full well-known *Kepler* sample.

RA	eRA	Dec	eDec	Gaia source ID	ϖ	e ϖ	μ_{α}	e μ_{α}	μ_{δ}	e μ_{δ}	T	L	m-M
295.40473520	0.0189	40.01189474	0.0242	2076294019624475648	0.4365	0.0241	-2.865	0.041	-4.362	0.050	7347.25	32.513	11.800
295.42566088	0.0446	40.00825792	0.0558	2076294191423402880	0.4027	0.0551	-2.600	0.099	-3.895	0.114	5335.50	1.019	11.975
295.46591791	0.0237	40.04201677	0.0312	2076294363221905536	0.3019	0.0306	-2.782	0.052	-3.839	0.065	5664.00	4.683	12.601
295.47658427	0.0200	40.03600381	0.0284	2076294294502430720	0.4432	0.0267	-2.856	0.045	-3.536	0.054	4979.42	22.293	11.767
295.40952440	0.0411	40.03325620	0.0540	2076294466301314176	0.4402	0.0530	-3.179	0.091	-3.696	0.105	5209.53	0.791	11.782
295.42915253	0.0153	40.05811281	0.0230	2076294603740304256	0.3507	0.0199	-2.904	0.034	-3.983	0.046	5178.15	8.756	12.275
295.44735059	0.0324	40.03942362	0.0485	2076294535020829184	0.3989	0.0422	-2.667	0.072	-4.157	0.095	5063.84	1.510	11.996
295.45261349	0.0149	40.05751816	0.0199	2076294569380590080	0.4179	0.0192	-2.720	0.034	-3.317	0.038	4665.75	33.863	11.895
295.45322822	0.0228	40.05907944	0.0298	2076294569380592000	0.3618	0.0294	-3.007	0.050	-3.757	0.059	5642.75	3.643	12.208
295.35416128	0.0221	40.00291540	0.0307	2076294672459697536	0.3173	0.0290	-2.913	0.050	-3.723	0.056	5695.00	5.354	12.493
295.34915843	0.0200	40.01593978	0.0270	2076294741179177088	0.4194	0.0256	-2.967	0.045	-3.746	0.050	5860.00	4.058	11.887
295.35507282	0.0273	40.01797044	0.0343	2076294775538919680	0.3572	0.0344	-2.975	0.060	-3.648	0.067	5626.00	2.720	12.235
295.38817411	0.0166	40.04055980	0.0216	2076294844258425984	0.3204	0.0213	-2.925	0.038	-3.859	0.041	5236.35	9.679	12.472
295.36868851	0.0293	40.02294345	0.0366	2076294878618145536	0.2903	0.0363	-2.923	0.064	-3.929	0.071	5373.25	3.687	12.686
295.32335604	0.0359	40.03920603	0.0471	2076295016057081472	0.3989	0.0461	-2.792	0.080	-4.058	0.092	5375.00	1.220	11.996
295.34998620	0.0243	40.03112503	0.0319	2076294981697354752	0.3848	0.0311	-2.704	0.054	-3.556	0.062	5343.20	2.635	12.074
295.36924863	0.0475	40.06741245	0.0615	2076295119136335744	0.4621	0.0622	-3.052	0.107	-3.856	0.127	5141.11	0.623	11.676
295.35071540	0.0262	40.06560768	0.0334	2076295187855800960	0.3676	0.0332	-2.838	0.060	-3.937	0.065	5796.00	2.610	12.173
295.34190195	0.0316	40.05212194	0.0394	2076295153496051968	0.4011	0.0400	-3.050	0.069	-3.970	0.078	5445.85	1.648	11.984
295.35301066	0.0243	40.03844438	0.0311	2076295084776574336	0.2956	0.0309	-2.855	0.056	-3.937	0.061	5812.00	4.495	12.646
295.35358929	0.0256	40.07018780	0.0275	2076295187855804800	0.4058	0.0294	-2.866	0.056	-3.855	0.055	5762.00	3.784	11.958
295.40691241	0.0394	40.05839369	0.0512	2076295256575313536	0.4282	0.0515	-2.699	0.088	-4.166	0.099	5382.50	0.936	11.842
295.40959930	0.0258	40.05727641	0.0374	2076295256575314944	0.3841	0.0341	-2.871	0.057	-3.799	0.075	5659.81	2.466	12.078
295.40524912	0.0200	40.06623565	0.0261	2076295325294794368	0.3966	0.0258	-3.082	0.044	-5.733	0.051	4779.00	4.097	12.008
295.43831060	0.0323	40.08772849	0.0428	2076295394014323328	0.4207	0.0418	-3.711	0.072	-5.893	0.084	5359.00	1.298	11.880
295.41785576	0.0197	40.09061579	0.0254	2076295462733781632	0.3567	0.0241	-2.806	0.044	-3.902	0.050	5330.07	5.195	12.238
295.37109368	0.0265	40.08193583	0.0351	2076295565812944384	0.4597	0.0343	-2.825	0.059	-3.826	0.068	5612.10	1.524	11.688
295.37914408	0.0141	40.10034091	0.0175	2076295600172704512	0.3540	0.0173	-2.852	0.031	-3.931	0.035	4947.25	10.840	12.255
295.38069047	0.0320	40.10864828	0.0372	2076295698944222720	0.3839	0.0380	-2.901	0.071	-3.755	0.075	5235.50	1.829	12.079
295.40379621	0.0296	40.08924353	0.0387	2076295634532457728	0.4040	0.0384	-2.652	0.066	-3.926	0.075	5229.78	1.829	11.968
295.41050681	0.0277	40.10623588	0.0356	2076295668892218112	0.3801	0.0350	-2.749	0.063	-3.787	0.069	5445.85	2.323	12.101
295.39466894	0.0303	40.10053742	0.0387	2076295703251935744	0.3715	0.0385	-3.034	0.067	-4.031	0.075	5477.65	2.094	12.150
295.22875385	0.0200	40.01881761	0.0221	2076296283062879616	0.3752	0.0234	-2.837	0.048	-3.823	0.042	6365.50	4.491	12.129
295.29915726	0.0262	40.01870877	0.0294	2076296459166071424	0.3564	0.0320	-2.983	0.058	-3.838	0.057	5784.45	3.789	12.240
295.25804608	0.0401	40.05082061	0.0446	2076296802759001984	0.4228	0.0475	-2.893	0.096	-3.656	0.089	5571.50	1.081	11.869
295.28228679	0.0390	40.04850438	0.0462	2076296764096187264	0.3536	0.0473	-2.910	0.089	-3.813	0.092	5402.67	1.353	12.257
295.25054086	0.0207	40.06027481	0.0254	2076296802763450112	0.3604	0.0259	-2.827	0.046	-3.820	0.047	5795.00	3.718	12.216
295.27136357	0.0124	40.05347965	0.0147	2076296734043979392	0.2865	0.0152	-2.780	0.027	-3.314	0.028	4893.00	20.689	12.714
295.27106394	0.0391	40.07088524	0.0448	2076296837123202944	0.4117	0.0469	-2.848	0.087	-3.757	0.089	5031.89	1.101	11.927
295.26814360	0.0454	40.07616557	0.0543	2076296837123203968	0.4208	0.0558	-2.747	0.103	-3.798	0.106	5337.00	0.800	11.880
295.28399106	0.0358	40.05399625	0.0455	2076296764096190976	0.4476	0.0451	-2.821	0.082	-3.722	0.091	5376.00	0.953	11.746
295.17582599	0.0232	40.06635807	0.0280	2076297386878978688	0.3708	0.0279	-2.913	0.055	-3.928	0.054	5801.00	3.030	12.154
295.18882687	0.0319	40.05130619	0.0451	2076297318159501696	0.3635	0.0397	-3.886	0.074	-5.913	0.097	5236.61	2.036	12.197
295.19556536	0.0393	40.06008363	0.0465	2076297318159506560	0.4846	0.0486	-3.445	0.094	-4.184	0.093	5074.86	0.784	11.573
295.23678279	0.0175	40.06721828	0.0206	2076297455598475520	0.3735	0.0221	-2.993	0.038	-3.723	0.037	5791.00	5.992	12.139
295.23882562	0.0125	40.08218886	0.0149	2076297627397174528	0.3468	0.0154	-2.966	0.028	-3.937	0.029	7364.00	12.174	12.300
295.25013651	0.0142	40.08663076	0.0168	2076297661756920192	0.3737	0.0175	-2.948	0.031	-3.870	0.032	5678.31	7.497	12.137
295.25231500	0.0227	40.09866367	0.0264	2076297661756927104	0.3536	0.0277	-2.923	0.051	-3.932	0.052	5820.45	3.352	12.257
295.20358717	0.0324	40.10457241	0.0380	2076297799195859072	0.3612	0.0403	-2.915	0.073	-3.721	0.075	5461.40	1.855	12.211
295.20782363	0.0236	40.07006061	0.0274	2076297696116635648	0.3624	0.0291	-2.867	0.055	-3.935	0.056	5819.00	3.213	12.204
295.21843395	0.0220	40.08899890	0.0258	2076297833555597952	0.3341	0.0268	-3.015	0.049	-3.930	0.050	5811.50	3.751	12.381
295.23486142	0.0325	40.09701257	0.0364	2076297867915346816	0.3956	0.0399	-2.634	0.070	-3.986	0.076	5449.83	1.715	12.014
295.23753582	0.0174	40.09835186	0.0195	2076297867915349248	0.3745	0.0213	-2.987	0.038	-3.809	0.037	5830.50	5.745	12.133
295.23411551	0.0314	40.10744281	0.0366	2076297867915351552	0.3532	0.0391	-2.909	0.071	-3.905	0.072	5501.25	2.042	12.260
295.23964271	0.0184	40.10966396	0.0211	2076297867915356032	0.3398	0.0222	-2.779	0.041	-3.771	0.041	5856.50	5.350	12.344
295.22572672	0.0184	40.12187015	0.0207	2076297936634830336	0.4020	0.0222	-2.951	0.042	-3.885	0.039	5753.00	4.460	11.979
295.30342924	0.0371	40.06738262	0.0426	2076298039714059904	0.3777	0.0448	-2.931	0.083	-3.826	0.084	5063.84	1.543	12.114
295.31136020	0.0275	40.04445629	0.0360	2076297966689744000	0.3483	0.0355	-2.901	0.060	-3.894	0.066	5768.01	2.550	12.290
295.31258736	0.0206	40.07753514	0.0248	2076298074073809152	0.3144	0.0254	-2.806	0.046	-3.886	0.048	5795.88	4.810	12.513
295.30693867	0.0098	40.06059327	0.0119	2076298039714190976	0.3545	0.0121	-3.035	0.022	-3.899	0.022	4760.66	35.626	12.252
295.31687494	0.0352	40.07613787	0.0499	2076298074073810944	0.3440	0.0449	-3.067	0.080	-3.933	0.106	5868.27	1.572	12.317
295.32645584	0.0301	40.06189183	0.0383	2076298005354332672	0.3734	0.0385	-2.948	0.067	-3.742	0.077	5557.00	2.026	12.139
295.31542651	0.0260	40.06996373	0.0333	2076298074073807744	0.3085	0.0315	-3.012	0.059	-3.772	0.065	5803.45	3.612	12.554
295.34631317	0.0215	40.08920606	0.0267	2076298142793309952	0.3523	0.0268	-2.856	0.050	-3.754	0.053	5582.06	3.870	12.265
295.34714898	0.0243	40.08877840	0.0301	2076298142793310208	0.3824	0.0302	-3.051	0.056	-4.226	0.061	5333.10	2.753	12.087
295.32800975	0.0236	40.07834455	0.0288	2076298177153032960	0.3068	0.0294	-2.872	0.053	-4.034	0.056	5806.67	4.228	12.566
295.32536520	0.0273	40.08245185	0.0325	2076298177153033344	0.3254	0.0328	-2.861	0.058	-3.73	0.064	5601.00	3.008	12.438
295.33077714	0.0149	40.08560790	0.0189	2076298177153037056	0.3633	0.0184	-2.939	0.033	-3.821	0.037	5038.00	7.728	12.199
295.													

295.38497035	0.0318	40.14061795	0.0400	2076298761268677248	0.3816	0.0399	-2.738	0.075	-3.768	0.079	5320.00	1.795	12.092
295.38138969	0.0317	40.11596958	0.0384	2076298658189435904	0.3326	0.0392	-2.812	0.074	-3.977	0.077	5412.00	2.522	12.390
295.37187315	0.0160	40.13319529	0.0189	2076298726908918016	0.3236	0.0192	-2.958	0.034	-3.895	0.037	5411.00	10.243	12.450
295.38161565	0.0246	40.12898957	0.0305	2076298692549186560	0.3123	0.0304	-2.796	0.056	-3.947	0.062	5960.00	3.688	12.527
295.39095545	0.0197	40.13177018	0.0248	2076298692549198336	0.4011	0.0246	-2.974	0.044	-3.999	0.050	5771.00	3.453	11.984
295.36609809	0.0323	40.12603779	0.0404	2076298726908904832	0.3171	0.0402	-3.134	0.073	-3.925	0.082	5403.00	2.246	12.494
295.38250337	0.0172	40.12611152	0.0215	2076298692549185152	0.3724	0.0213	-3.036	0.039	-3.808	0.044	6064.21	5.245	12.145
295.38140552	0.0389	40.13256465	0.0489	2076298692549189504	0.3677	0.0475	-2.892	0.094	-3.793	0.099	5370.00	1.397	12.173
295.37102868	0.0237	40.12656948	0.0292	2076298722601233792	0.3003	0.0287	-3.417	0.053	-3.293	0.057	5333.50	4.319	12.612
295.37508511	0.0240	40.14793594	0.0274	2076298761268673024	0.3259	0.0287	-2.948	0.053	-3.596	0.053	5610.93	5.073	12.435
295.37628469	0.0172	40.15012544	0.0217	2076298761268676352	0.3586	0.0210	-2.697	0.037	-3.432	0.042	4054.16	326.967	12.227
295.32696648	0.0259	40.12441683	0.0303	2076298864347823872	0.4033	0.0306	-2.832	0.058	-3.817	0.062	5763.33	2.236	11.972
295.32614074	0.0160	40.11780611	0.0201	2076298795628342144	0.3445	0.0200	-3.109	0.036	-3.881	0.042	5472.35	7.611	12.314
295.32018089	0.0184	40.12429437	0.0238	2076298864347818624	0.4212	0.0218	-3.183	0.041	-3.952	0.044	5749.75	4.421	11.878
295.34052600	0.0150	40.13451487	0.0195	2076298829988104832	0.3867	0.0201	-2.879	0.035	-3.923	0.039	5349.00	9.158	12.063
295.33452587	0.0155	40.14035006	0.0191	2076298898707580416	0.3387	0.0188	-3.035	0.034	-3.787	0.037	5542.05	8.243	12.351
295.32973710	0.0183	40.14757987	0.0221	2076298898707581824	0.3935	0.0217	-2.869	0.044	-3.812	0.043	5399.60	5.089	12.025
295.33413096	0.0225	40.11748681	0.0262	2076298795628347392	0.3568	0.0268	-2.937	0.051	-3.677	0.054	5634.00	3.895	12.238
295.34887612	0.0167	40.13365318	0.0210	2076298829988109952	0.3425	0.0202	-2.880	0.037	-3.840	0.041	5527.05	6.571	12.327
295.33273513	0.0206	40.15265516	0.0259	2076298898707587584	0.3426	0.0254	-2.895	0.045	-3.981	0.048	5799.45	5.117	12.326
295.33371319	0.0296	40.13132941	0.0361	2076298864347835520	0.3833	0.0367	-2.982	0.075	-3.620	0.072	5401.50	2.180	12.082
295.33395773	0.0203	40.13477641	0.0250	2076298898707576448	0.3606	0.0241	-2.901	0.048	-3.903	0.047	5676.50	5.284	12.215
295.32254878	0.0321	40.13694163	0.0394	2076298860040192128	0.3924	0.0404	-2.755	0.083	-4.020	0.086	5214.50	1.812	12.031
295.32623356	0.0203	40.13115771	0.0249	2076298864347827456	0.3547	0.0250	-3.288	0.046	-3.828	0.051	5760.00	4.338	12.251
295.36910614	0.0204	40.16405511	0.0244	2076298967427112448	0.3884	0.0240	-2.937	0.046	-3.932	0.049	5753.00	4.360	12.054
295.33842083	0.0180	40.15133158	0.0220	2076299001786806912	0.3958	0.0219	-2.933	0.039	-4.046	0.042	5929.32	4.674	12.030
295.33585378	0.0331	40.15539912	0.0411	2076299001786808064	0.3916	0.0420	-2.817	0.072	-3.914	0.079	5612.10	1.585	12.036
295.34167566	0.0241	40.15032762	0.0290	2076299001786809088	0.3587	0.0288	-2.951	0.053	-4.127	0.056	5154.80	3.240	12.226
295.33836406	0.0140	40.15630206	0.0165	2076299001786810624	0.3462	0.0165	-2.961	0.031	-3.823	0.033	7336.25	11.718	12.303
295.34676756	0.0246	40.14746616	0.0312	2076299001786811392	0.3515	0.0304	-3.056	0.054	-3.857	0.059	5698.33	3.051	12.270
295.37423908	0.0192	40.15261344	0.0260	2076298967427107072	0.3476	0.0242	-2.445	0.045	-3.997	0.056	5572.25	5.430	12.295
295.35641136	0.0291	40.14037748	0.0335	2076298933067338112	0.3342	0.0338	-2.976	0.064	-3.828	0.065	5769.69	3.582	12.380
295.34626557	0.0164	40.15190227	0.0193	2076299001786815104	0.3589	0.0196	-3.056	0.036	-3.897	0.038	5607.74	7.338	12.225
295.35939390	0.0305	40.16186474	0.0386	2076299036146576384	0.3608	0.0393	-2.921	0.070	-3.770	0.083	5640.21	1.951	12.214
295.37326945	0.0203	40.16054042	0.0252	2076298967427355392	0.3566	0.0252	-2.958	0.047	-3.818	0.052	5473.54	4.576	12.239
295.36125224	0.0199	40.14537906	0.0249	2076298933067348736	0.3595	0.0242	-2.974	0.044	-3.922	0.048	5733.00	4.125	12.222
295.34934202	0.0282	40.16424970	0.0351	2076299036146569344	0.3391	0.0348	-2.892	0.065	-3.825	0.071	5514.36	2.591	12.348
295.36600395	0.0280	40.14874453	0.0371	2076298967427094656	0.3333	0.0348	-2.785	0.063	-3.625	0.080	5572.25	2.951	12.386
295.36599202	0.0293	40.14296847	0.0362	2076298933067351936	0.3023	0.0363	-3.707	0.066	-3.836	0.074	4906.00	3.215	12.598
295.34771519	0.0292	40.16268972	0.0381	2076299001786827136	0.3915	0.0384	-3.040	0.064	-3.764	0.071	5527.41	2.169	12.036
295.36298994	0.0307	40.16417939	0.0396	2076299036142588032	0.3360	0.0402	-2.999	0.069	-3.934	0.081	5359.76	2.593	12.368
295.35686550	0.0171	40.15988063	0.0208	2076299036146572288	0.3421	0.0208	-2.788	0.037	-4.053	0.042	5769.00	6.886	12.329
295.35781428	0.0254	40.15991277	0.0300	2076299036146572416	0.2937	0.0307	-2.875	0.056	-4.174	0.059	5727.11	4.973	12.660
295.35592936	0.0396	40.16132676	0.0458	2076299036146572928	0.3491	0.0470	-3.026	0.089	-3.939	0.093	5139.00	1.593	12.285
295.35155209	0.0277	40.15206785	0.0335	2076299001786821632	0.3336	0.0343	-2.932	0.061	-3.892	0.065	5477.77	3.289	12.384
295.37304212	0.0326	40.15267944	0.0406	2076298967427105920	0.4810	0.0405	-2.746	0.074	-3.659	0.081	5376.77	1.015	11.589
295.37117375	0.0208	40.16184422	0.0262	2076298967427112576	0.3472	0.0259	-2.889	0.047	-3.895	0.053	5741.00	4.094	12.297
295.26853764	0.0373	40.08502538	0.0452	2076299070506202496	0.3783	0.0469	-2.996	0.086	-3.629	0.092	5297.95	1.354	12.111
295.29862561	0.0246	40.13907137	0.0284	2076299242304934912	0.3384	0.0295	-2.882	0.055	-3.674	0.055	5789.00	3.083	12.353
295.29142959	0.0122	40.15153629	0.0140	2076299311024414592	0.3619	0.0146	-3.018	0.027	-3.799	0.027	5002.50	15.818	12.207
295.29132280	0.0284	40.11933086	0.0315	2076299207945183360	0.3594	0.0332	-2.912	0.064	-3.912	0.062	5846.12	2.418	12.222
295.28770708	0.0404	40.12447509	0.0490	2076299207945184128	0.3853	0.0506	-2.819	0.091	-3.715	0.095	5339.70	1.116	12.071
295.28108361	0.0165	40.13284632	0.0198	2076299276664661248	0.3780	0.0203	-3.102	0.037	-3.938	0.036	5804.25	5.562	12.113
295.28774556	0.0193	40.12718321	0.0213	2076299207945185152	0.3455	0.0227	-3.126	0.044	-4.074	0.041	5693.70	5.668	12.308
295.29149867	0.0148	40.12452809	0.0165	2076299207945186048	0.3499	0.0173	-2.972	0.032	-3.733	0.031	5820.00	10.813	12.280
295.29728978	0.0285	40.12596371	0.0328	2076299242304928256	0.3717	0.0341	-3.099	0.063	-3.990	0.060	5610.00	2.195	12.149
295.29063378	0.0339	40.11237763	0.0384	2076299207945180160	0.3911	0.0407	-3.143	0.076	-3.634	0.076	5370.00	1.545	12.039
295.29170234	0.0188	40.13715252	0.0225	2076299311024407936	0.3594	0.0226	-2.800	0.042	-3.775	0.041	5823.00	5.384	12.222
295.29377754	0.0309	40.13502404	0.0394	2076299311024408192	0.3438	0.0395	-2.918	0.070	-3.754	0.073	5615.83	2.119	12.318
295.23196199	0.0248	40.13550120	0.0287	2076299414103590016	0.3264	0.0302	-2.893	0.056	-3.705	0.057	5794.33	3.375	12.431
295.24151152	0.0162	40.13816355	0.0195	2076299448463334144	0.3292	0.0203	-2.728	0.035	-3.770	0.037	4701.47	74.942	12.413
295.25908630	0.0208	40.12855078	0.0230	2076299379743862528	0.2854	0.0244	-2.867	0.046	-3.725	0.044	5784.00	6.660	12.723
295.25822265	0.0265	40.13058584	0.0311	2076299379743863040	0.3324	0.0321	-3.133	0.060	-3.862	0.059	5258.67	3.052	12.392
295.25098042	0.0217	40.14541725	0.0241	2076299448463343488	0.3651	0.0250	-2.941	0.049	-3.942	0.046	5787.67	3.669	12.188
295.24407737	0.0398	40.14847801	0.0473	20762994484633468416	0.4048	0.0490	-3.419	0.092	-3.688	0.095	5514.79	0.978	11.964
295.23520875	0.0361	40.12799461	0.0380	2076299414103588224	0.3899	0.0423	-2.857	0.081	-3.938	0.072	5873.00	3.761	12.045
295.24227685	0.0224	40.12887395	0.0242	2076299414103591936	0.2960	0.0263	-2.884	0.050	-3.957	0.046	5825.25	5.754	12.644
295.26371932	0.0195	40.12659389	0.0208	2076299379743863936	0.3649	0.0223	-2.950	0.043	-4.084	0.039	5760.00	5.207	12.189
295.28372077	0.0359	40.15710844	0.0445	2076299517182842880	0.3972	0.0451	-2.980	0.080	-3.740	0.08			

295.31228121	0.0247	40.14434354	0.0340	2076299620262070400	0.3304	0.0300	-2.919	0.055	-3.691	0.068	5254.25	3.391	12.405
295.31485213	0.0246	40.16328483	0.0341	2076299723341302272	0.4486	0.0300	-2.836	0.055	-3.817	0.068	5613.33	1.951	11.741
295.30879122	0.0272	40.14026576	0.0309	2076299620262064768	0.3132	0.0328	-3.058	0.065	-3.785	0.064	5630.41	3.704	12.521
295.32398211	0.0179	40.15438848	0.0211	2076299654621826176	0.3357	0.0212	-3.205	0.038	-4.046	0.041	4942.21	72.724	12.370
295.31008549	0.0181	40.16633725	0.0240	2076299723341299968	0.3783	0.0210	-2.986	0.039	-4.029	0.048	5759.38	5.232	12.111
295.31481814	0.0352	40.16673198	0.0405	2076299723341305088	0.3140	0.0384	-3.068	0.078	-3.809	0.087	5516.52	2.905	12.515
295.32655000	0.0176	40.15353025	0.0210	2076299654621828480	0.3455	0.0211	-2.900	0.038	-3.908	0.041	5615.04	6.276	12.308
295.29625905	0.0321	40.15894853	0.0348	2076299688981544576	0.3845	0.0377	-2.855	0.071	-3.785	0.071	5535.54	1.951	12.076
295.32258846	0.0209	40.16248578	0.0243	2076299654621830144	0.3457	0.0242	-2.813	0.047	-3.890	0.047	5512.00	4.718	12.307
295.30798937	0.0210	40.14892910	0.0244	2076299620262070144	0.3646	0.0255	-2.868	0.046	-3.790	0.047	5777.33	3.825	12.191
295.31981017	0.0242	40.16693791	0.0243	2076299723341307904	0.3623	0.0250	-2.895	0.051	-3.907	0.047	5634.00	4.572	12.205
295.31461499	0.0265	40.14208263	0.0421	2076299620262070528	0.3276	0.0315	-2.806	0.063	-3.910	0.085	5678.31	3.369	12.423
295.31812498	0.0236	40.13875485	0.0268	2076299620262070912	0.3427	0.0270	-2.851	0.056	-3.883	0.058	5758.00	4.266	12.325
295.32336227	0.0216	40.16413544	0.0264	2076299654621832448	0.3591	0.0258	-2.840	0.047	-3.857	0.052	5746.50	3.599	12.224
295.31692931	0.0221	40.14207710	0.0312	2076299620262072064	0.3648	0.0271	-2.878	0.051	-3.857	0.062	5612.10	3.503	12.190
295.30582602	0.0295	40.15523223	0.0347	2076299688981549440	0.4047	0.0363	-2.904	0.067	-3.982	0.070	5152.33	1.685	11.964
295.32993393	0.0114	40.15910766	0.0149	2076299654621834112	0.3278	0.0143	-2.866	0.025	-3.892	0.028	5096.00	23.063	12.422
295.32087400	0.0245	40.17001075	0.0257	2076299723341311616	0.3692	0.0267	-2.853	0.049	-4.101	0.049	5745.00	3.957	12.164
295.31659877	0.0333	40.14455812	0.0403	2076299620262074112	0.4532	0.0409	-2.923	0.074	-3.886	0.086	5249.92	1.147	11.719
295.31085973	0.0152	40.15343262	0.0200	2076299688981553280	0.3112	0.0186	-2.723	0.034	-4.276	0.042	5350.20	10.436	12.535
295.30978261	0.0216	40.15564327	0.0264	2076299688981554432	0.3335	0.0262	-2.837	0.048	-4.057	0.055	5675.36	4.397	12.385
295.32093108	0.0285	40.14637294	0.0312	2076299654621818240	0.3593	0.0322	-2.891	0.063	-3.636	0.061	5200.00	2.816	12.223
295.30902870	0.0237	40.16052534	0.0289	2076299723341295616	0.3589	0.0284	-3.060	0.053	-3.675	0.056	5600.00	3.851	12.225
295.30583094	0.0433	40.16745496	0.0497	2076299723341297792	0.3867	0.0522	-3.158	0.097	-3.625	0.099	5061.15	1.030	12.063
295.31297416	0.0229	40.16040487	0.0314	2076299723341298560	0.3463	0.0285	-2.865	0.051	-3.924	0.063	5748.00	3.537	12.303
295.31441167	0.0215	40.15901563	0.0292	2076299723341298688	0.3347	0.0260	-2.897	0.050	-3.665	0.058	5760.67	4.202	12.377
295.31020799	0.0306	40.17044608	0.0421	2076299723337152512	0.3301	0.0383	-2.529	0.070	-3.963	0.089	5816.50	2.265	12.407
295.30718054	0.0414	40.15996977	0.0466	2076299688977374080	0.3852	0.0501	-3.121	0.099	-3.775	0.100	5033.00	1.312	12.072
295.30664667	0.0159	40.15940432	0.0180	2076299688981554688	0.4166	0.0196	-3.018	0.036	-3.884	0.037	4851.63	8.690	11.901
295.32645590	0.0153	40.14648609	0.0196	2076299654621822720	0.3348	0.0189	-2.888	0.034	-3.892	0.037	5496.67	9.132	12.376
295.30422469	0.0231	40.16929801	0.0254	2076299723341297920	0.4011	0.0271	-2.941	0.049	-3.758	0.048	5757.00	2.847	11.984
295.29882048	0.0173	40.16309603	0.0190	2076299688981549312	0.3382	0.0197	-2.762	0.038	-3.541	0.036	7682.00	42.615	12.354
295.31330964	0.0400	40.13543736	0.0559	2076299615954435072	0.4275	0.0503	-2.773	0.091	-3.560	0.118	5335.50	0.888	11.845
295.30209510	0.0236	40.16500721	0.0276	2076299688981555072	0.3718	0.0287	-2.909	0.054	-3.666	0.056	5622.50	2.855	12.148
295.31515533	0.0158	40.16957891	0.0191	2076299719033591424	0.3268	0.0190	-2.898	0.034	-3.931	0.037	4570.44	61.871	12.429
295.32217214	0.0198	40.16820095	0.0216	2076299723341311360	0.3640	0.0209	-2.895	0.046	-3.838	0.043	5461.91	6.312	12.194
295.32473315	0.0174	40.18713581	0.0209	2076299826416672384	0.3205	0.0207	-2.908	0.041	-4.077	0.041	5449.83	8.931	12.471
295.31632719	0.0273	40.17569913	0.0327	2076299826420526976	0.3390	0.0327	-3.151	0.064	-3.483	0.073	5286.90	3.037	12.349
295.31762148	0.0154	40.17434555	0.0191	2076299826420527232	0.3884	0.0186	-2.773	0.034	-3.799	0.037	6958.67	6.095	12.054
295.32902629	0.0138	40.16247831	0.0177	2076299757701051648	0.3757	0.0171	-2.957	0.030	-3.908	0.033	5308.91	10.040	12.126
295.31664846	0.0215	40.17678178	0.0281	2076299826420528512	0.3698	0.0268	-3.092	0.049	-4.024	0.055	5530.33	4.050	12.160
295.35307370	0.0173	40.18223860	0.0308	2076299792060832640	0.3792	0.0217	-2.885	0.039	-3.894	0.059	5704.00	5.221	12.106
295.33484837	0.0203	40.20155978	0.0271	2076299860780309120	0.3989	0.0263	-2.871	0.047	-3.742	0.053	5782.25	3.884	11.996
295.32402126	0.0182	40.17045584	0.0222	2076299826420530048	0.3809	0.0213	-2.847	0.042	-3.856	0.042	5338.40	6.209	12.096
295.33221177	0.0191	40.16183881	0.0241	2076299757701053952	0.3573	0.0233	-2.631	0.042	-3.707	0.045	5762.00	4.941	12.235
295.34553913	0.0180	40.18822631	0.0226	2076299792060829824	0.3889	0.0218	-3.232	0.040	-3.687	0.043	5701.77	5.107	12.051
295.32351971	0.0333	40.17529731	0.0400	2076299826420533760	0.3939	0.0413	-2.893	0.079	-3.686	0.076	5325.88	1.949	12.023
295.32103458	0.0190	40.18105347	0.0246	2076299826420536320	0.3412	0.0246	-2.935	0.042	-3.680	0.045	4078.32	376.082	12.335
295.34837096	0.0191	40.17719199	0.0226	2076299792060823040	0.3882	0.0227	-2.95	0.042	-3.919	0.044	5711.61	4.717	12.055
295.33426792	0.0148	40.16852185	0.0184	2076299757701062784	0.3294	0.0179	-2.934	0.033	-3.762	0.036	5355.00	9.669	12.411
295.34610556	0.0330	40.17804686	0.0338	2076299792060821760	0.4029	0.0365	-2.626	0.069	-3.850	0.065	5735.00	2.358	11.974
295.32419290	0.0239	40.17998293	0.0268	2076299826420539648	0.3524	0.0276	-3.213	0.045	-3.705	0.050	5381.00	11.033	12.265
295.33460977	0.0148	40.16986366	0.0182	2076299757701064960	0.3496	0.0182	-2.979	0.032	-3.794	0.035	4923.00	10.140	12.282
295.33980514	0.0263	40.18111948	0.0290	2076299792060818048	0.3662	0.0299	-2.555	0.055	-3.746	0.056	5635.50	3.063	12.181
295.33925285	0.0132	40.16735349	0.0157	2076299757701067264	0.3493	0.0164	-2.953	0.029	-3.987	0.033	6338.00	17.053	12.284
295.34104506	0.0307	40.16757516	0.0386	2076299757701068800	0.3189	0.0382	-2.772	0.070	-4.057	0.078	5352.57	2.447	12.482
295.33672764	0.0186	40.17936598	0.0207	2076299792060813696	0.4062	0.0213	-3.017	0.039	-3.925	0.040	5763.67	5.208	11.956
295.34157676	0.0269	40.18258656	0.0302	2076299792060820864	0.2938	0.0304	-3.039	0.057	-3.795	0.058	5750.00	4.574	12.660
295.34726985	0.0175	40.17293803	0.0216	2076299792060818560	0.4042	0.0213	-2.809	0.039	-3.619	0.042	5555.50	4.473	11.967
295.34434128	0.0197	40.18395331	0.0289	2076299792060824960	0.3952	0.0240	-2.970	0.044	-3.667	0.052	5921.23	4.077	12.016
295.32275018	0.0189	40.18429416	0.0231	2076299826420542080	0.3958	0.0226	-2.941	0.039	-3.952	0.041	7236.00	32.303	12.013
295.32791289	0.0193	40.19525416	0.0234	2076299856476070784	0.4100	0.0233	-3.554	0.041	-3.448	0.043	4377.00	74.448	11.936
295.33515923	0.0205	40.16826438	0.0249	2076299757701063552	0.3594	0.0251	-2.858	0.045	-4.010	0.050	5761.75	4.189	12.222
295.32085451	0.0143	40.17630007	0.0147	2076299822113010560	0.3557	0.0149	-2.900	0.031	-3.909	0.028	5945.00	20.368	12.245
295.33539185	0.0325	40.19416316	0.0401	2076299860780325760	0.3368	0.0403	-3.187	0.073	-3.884	0.080	5343.34	2.157	12.363
295.32504465	0.0205	40.18876345	0.0248	2076299826420588160	0.3893	0.0247	-2.889	0.047	-3.874	0.047	5740.55	3.661	12.049
295.31664521	0.0165	40.18331757	0.0192	2076299826420588416	0.3369	0.0211	-3.038	0.034	-4.007	0.040	5260.93	12.395	12.362
295.34072827	0.0278	40.16286869	0.0335	2076299757701063936	0.3675	0.0332	-3.097	0.061	-3.810	0.065	5549.50	2.229	12.174
295.32334873	0.0457	40.17830931	0.0557	2076299826416438016	0.4094	0.0525	-2.698	0.104	-3.425				

295.34335877	0.0197	40.18620717	0.0236	2076299792060826624	0.3435	0.0235	-2.988	0.046	-4.046	0.052	5849.25	5.434	12.320
295.35112752	0.0189	40.17869202	0.0207	2076299792060827648	0.3427	0.0217	-3.571	0.041	-3.253	0.040	5805.00	7.636	12.325
295.31896947	0.0219	40.17996712	0.0276	2076299826420533248	0.2804	0.0283	-2.663	0.052	-3.834	0.069	5651.43	6.701	12.761
295.32075260	0.0180	40.18735545	0.0228	2076299826420588288	0.3919	0.0223	-3.069	0.041	-3.940	0.042	5601.67	4.940	12.034
295.35396733	0.0152	40.17921064	0.0192	2076299792060831360	0.3104	0.0173	-3.380	0.032	-3.878	0.038	5347.50	15.007	12.540
295.34002685	0.0316	40.19712393	0.0358	2076299860780325504	0.4181	0.0367	-2.717	0.071	-3.439	0.066	5409.00	1.959	11.894
295.34800735	0.0332	40.18813153	0.0416	2076299792060833792	0.3555	0.0410	-2.888	0.077	-3.924	0.087	5113.00	2.051	12.246
295.29097737	0.0224	40.16637459	0.0262	2076299895139975424	0.2938	0.0283	-2.995	0.052	-3.757	0.052	5740.55	6.380	12.660
295.29307073	0.0297	40.16035754	0.0324	2076299895139972992	0.3989	0.0343	-3.012	0.066	-3.597	0.065	5448.84	1.912	11.996
295.28521287	0.0184	40.16452268	0.0222	2076299895139969536	0.3283	0.0222	-2.983	0.041	-3.933	0.042	5735.25	5.594	12.419
295.28502452	0.0198	40.19573780	0.0246	2076299998219207808	0.3493	0.0249	-2.830	0.045	-3.734	0.050	5628.00	4.830	12.284
295.27761894	0.0129	40.17509376	0.0163	2076299963859447936	0.3670	0.0159	-2.924	0.028	-3.898	0.029	6934.00	11.660	12.177
295.30275399	0.0319	40.17985464	0.0388	2076299929499734272	0.3542	0.0393	-2.846	0.075	-3.548	0.079	5313.25	2.019	12.254
295.28952931	0.0202	40.19487181	0.0277	2076299998219211136	0.3584	0.0263	-2.843	0.047	-3.849	0.064	5787.00	5.023	12.228
295.27587592	0.0122	40.18144674	0.0157	2076299963859451136	0.3492	0.0157	-3.003	0.028	-4.081	0.028	4776.51	22.667	12.285
295.28183258	0.0189	40.17501421	0.0232	2076299963859451392	0.3365	0.0233	-2.856	0.043	-3.835	0.046	5786.50	5.465	12.365
295.28700362	0.0339	40.17479226	0.0397	2076299890832483072	0.3413	0.0417	-2.610	0.078	-3.781	0.078	5410.50	1.888	12.334
295.27742059	0.0138	40.17208865	0.0169	2076299963859446016	0.3562	0.0170	-3.354	0.030	-3.595	0.031	5334.73	11.690	12.242
295.30411717	0.0303	40.18306644	0.0357	2076299929499736960	0.3914	0.0377	-3.114	0.072	-3.773	0.075	5714.95	1.733	12.037
295.30330160	0.0441	40.18507602	0.0454	2076299929499737600	0.4130	0.0513	-2.848	0.100	-4.011	0.094	5204.60	1.144	11.920
295.29575403	0.0334	40.19379047	0.0329	2076299998219214592	0.3863	0.0376	-2.867	0.067	-3.844	0.061	5575.00	2.310	12.065
295.28021944	0.0297	40.18127338	0.0375	2076299963859454464	0.4029	0.0379	-2.818	0.071	-3.754	0.073	5449.83	1.768	11.974
295.29646424	0.0181	40.19506563	0.0204	2076299998219216256	0.3507	0.0219	-3.026	0.040	-3.914	0.038	4575.51	236.515	12.275
295.30061621	0.0149	40.19013845	0.0178	2076299929499739648	0.3719	0.0187	-2.880	0.034	-3.972	0.036	5787.00	8.789	12.148
295.30731505	0.0203	40.18284009	0.0257	2076299929499740032	0.3263	0.0250	-2.765	0.045	-3.779	0.049	5573.67	5.099	12.432
295.30150624	0.0387	40.18971906	0.0450	2076299929495612160	0.3584	0.0475	-2.878	0.092	-3.595	0.093	5765.00	1.421	12.228
295.29592726	0.0214	40.18655917	0.0208	2076299993911496320	0.4032	0.0238	-3.075	0.044	-3.808	0.039	4728.24	162.886	11.972
295.30069585	0.0220	40.16814484	0.0248	2076299929499724672	0.3277	0.0265	-2.914	0.049	-3.654	0.050	5715.38	4.605	12.423
295.29263084	0.0407	40.17880819	0.0465	2076299929499725568	0.3597	0.0490	-3.046	0.096	-3.899	0.099	5331.12	1.333	12.220
295.29225169	0.0295	40.16255476	0.0343	2076299890832438656	0.3573	0.0358	-2.834	0.067	-3.841	0.070	5501.27	2.306	12.235
295.29441848	0.0277	40.17928092	0.0340	2076299929499727232	0.3480	0.0340	-2.735	0.064	-3.949	0.070	5365.00	2.540	12.292
295.29027194	0.0346	40.18407251	0.0422	2076299998219204096	0.4342	0.0440	-2.770	0.083	-3.944	0.084	5334.47	1.180	11.812
295.27943907	0.0339	40.18294277	0.0409	2076299959551918848	0.3353	0.0423	-2.807	0.082	-3.637	0.086	5347.50	2.251	12.373
295.30677349	0.0277	40.18361815	0.0311	2076299929495609088	0.3570	0.0327	-2.999	0.060	-3.909	0.060	5668.00	2.783	12.237
295.28191240	0.0317	40.16631951	0.0381	2076299895140066560	0.3719	0.0390	-3.006	0.074	-3.840	0.075	5443.00	1.876	12.148
295.29034451	0.0188	40.18257646	0.0212	2076299993911704064	0.3047	0.0226	-3.020	0.044	-3.798	0.043	5623.60	7.041	12.581
295.30676939	0.0205	40.18132327	0.0266	2076299929499804032	0.4227	0.0261	-2.967	0.046	-4.002	0.052	5846.16	3.052	11.870
295.30568020	0.0288	40.18115661	0.0358	2076299929499804160	0.3572	0.0362	-2.811	0.065	-4.143	0.070	5501.25	2.319	12.235
295.29911251	0.0159	40.17328897	0.0186	2076299929499804288	0.3395	0.0192	-2.994	0.036	-3.687	0.037	5418.43	9.328	12.346
295.29651233	0.0270	40.17323304	0.0320	2076299929499804416	0.3495	0.0334	-3.083	0.061	-3.889	0.064	5601.00	2.706	12.283
295.29315783	0.0265	40.17263468	0.0303	2076299895140066304	0.3421	0.0323	-2.786	0.060	-3.692	0.060	5361.50	2.900	12.329
295.29231762	0.0338	40.17528484	0.0397	2076299895139984384	0.3905	0.0415	-2.935	0.077	-3.838	0.080	5370.00	1.450	12.042
295.27963995	0.0309	40.18472631	0.0378	2076299963859456000	0.3800	0.0384	-2.882	0.071	-3.958	0.077	5394.65	1.751	12.101
295.28268645	0.0152	40.18593850	0.0231	2076299963859460736	0.3660	0.0188	-2.999	0.034	-3.991	0.045	5445.85	7.595	12.183
295.28478462	0.0223	40.17892757	0.0267	2076299963859456128	0.3743	0.0263	-3.079	0.049	-3.843	0.052	5610.13	3.185	12.134
295.30039450	0.0267	40.18548091	0.0281	2076299929499736192	0.3374	0.0308	-2.992	0.058	-3.788	0.053	5745.00	3.465	12.359
295.30197146	0.0379	40.19164071	0.0516	2076300032574836352	0.4555	0.0488	-3.175	0.085	-4.048	0.093	5825.33	1.120	11.708
295.30098830	0.0160	40.19272847	0.0190	2076300101298433792	0.3309	0.0197	-2.956	0.035	-4.030	0.036	4677.23	56.317	12.402
295.30338338	0.0109	40.19148245	0.0125	2076300032578958464	0.3494	0.0130	-3.038	0.024	-3.800	0.024	4994.00	25.551	12.283
295.31246694	0.0168	40.22697996	0.0240	2076300135658216192	0.3752	0.0207	-2.744	0.037	-3.714	0.045	5890.50	5.663	12.129
295.30119473	0.0162	40.19588503	0.0206	2076300101298436480	0.3648	0.0197	-3.027	0.036	-3.791	0.038	5529.41	6.530	12.190
295.31134939	0.0210	40.18823622	0.0315	2076300032578962944	0.3830	0.0266	-2.720	0.050	-3.701	0.067	5810.00	6.333	12.084
295.30971849	0.0166	40.19059469	0.0221	2076300032578963584	0.4041	0.0199	-2.998	0.038	-3.888	0.044	5412.63	5.485	11.968
295.30003225	0.0262	40.20412324	0.0291	2076300101298442496	0.3582	0.0317	-3.040	0.060	-3.981	0.056	5668.67	2.800	12.229
295.31036163	0.0264	40.22260164	0.0368	2076300135658209152	0.4031	0.0321	-2.827	0.059	-3.896	0.072	5785.50	2.117	11.973
295.31359613	0.0359	40.19064346	0.0447	2076300032578967680	0.4029	0.0448	-3.043	0.082	-3.889	0.088	5347.50	1.347	11.974
295.29885675	0.0420	40.20779330	0.0487	2076300101298445184	0.4145	0.0512	-2.999	0.097	-3.731	0.097	5328.00	0.901	11.912
295.31134843	0.0265	40.21689839	0.0355	2076300135658204672	0.4502	0.0350	-2.916	0.061	-3.814	0.082	5753.00	1.740	11.733
295.30404980	0.0331	40.20486937	0.0367	2076300101298448768	0.4467	0.0396	-2.608	0.084	-3.726	0.073	5680.80	1.290	11.750
295.30328058	0.0217	40.20662621	0.0216	2076300101298449280	0.3164	0.0234	-2.980	0.047	-3.781	0.040	4822.25	67.071	12.499
295.31751105	0.0206	40.19063686	0.0243	2076300032578972800	0.3282	0.0238	-2.937	0.050	-3.745	0.046	5670.00	8.025	12.419
295.30219701	0.0162	40.20806833	0.0179	2076300101298449792	0.3770	0.0186	-2.751	0.036	-4.052	0.034	5570.67	6.791	12.118
295.32692396	0.0203	40.20927477	0.0231	2076300066938738176	0.3419	0.0240	-2.851	0.045	-3.840	0.045	5800.00	5.526	12.331
295.31559982	0.0119	40.19330747	0.0158	2076300032578973952	0.3544	0.0143	-2.912	0.026	-3.797	0.029	4907.50	23.945	12.253
295.30857219	0.0229	40.20482367	0.0307	2076300101298452864	0.3030	0.0260	-2.953	0.051	-3.828	0.059	5852.00	5.728	12.593
295.30441074	0.0339	40.20982624	0.0348	2076300101298453504	0.3986	0.0376	-2.710	0.067	-3.747	0.066	5793.33	1.890	11.997
295.30174649	0.0311	40.21555200	0.0304	2076300101298456320	0.3319	0.0353	-2.985	0.070	-3.913	0.060	5801.67	3.446	12.395
295.32814988	0.0117	40.19852434	0.0148	2076300066938728832	0.3530	0.0148	-3.129	0.026	-3.937	0.027	5018.67	31.299	12.261
295.31402634	0.0176	40.22485108	0.0211	2076300135654236160	0.3774	0.0208	-2.688	0.038	-3.636				

295.32160490	0.0277	40.19507483	0.0381	2076300066938718592	0.3365	0.0373	-2.870	0.064	-4.126	0.066	5651.43	3.325	12.365
295.31876150	0.0242	40.19812884	0.0333	2076300066938719744	0.3151	0.0293	-2.912	0.056	-4.084	0.063	5790.67	4.399	12.508
295.30531497	0.0219	40.21377522	0.0246	2076300135658196864	0.3807	0.0241	-3.449	0.048	-3.524	0.045	4102.26	220.522	12.097
295.31495236	0.0297	40.20831257	0.0358	2076300135658201216	0.3532	0.0363	-2.860	0.068	-4.085	0.073	5714.45	2.148	12.260
295.30602505	0.0185	40.19890895	0.0245	2076300101294355968	0.3468	0.0238	-2.832	0.042	-3.987	0.053	4775.85	56.838	12.300
295.31983514	0.0306	40.20935433	0.0366	2076300066938729856	0.3748	0.0373	-3.086	0.068	-3.774	0.072	5541.65	2.041	12.131
295.32769423	0.0256	40.20513812	0.0292	2076300066938734464	0.3033	0.0301	-3.121	0.055	-3.843	0.057	5542.05	4.421	12.591
295.32147206	0.0295	40.21250917	0.0341	2076300066938735360	0.3381	0.0370	-2.876	0.069	-3.982	0.073	5610.13	2.972	12.355
295.32173455	0.0159	40.21350726	0.0193	2076300066938736128	0.3485	0.0195	-2.928	0.035	-3.899	0.037	4921.00	8.839	12.289
295.29919058	0.0197	40.20546044	0.0200	2076300096990710144	0.3557	0.0221	-3.079	0.042	-3.637	0.039	5668.00	7.452	12.245
295.31635568	0.0194	40.18650020	0.0233	2076300028271234816	0.3501	0.0235	-2.680	0.045	-3.966	0.044	4852.25	60.221	12.279
295.32272012	0.0254	40.21594995	0.0310	2076300135658216448	0.4573	0.0277	-2.871	0.055	-3.282	0.059	5555.08	2.218	11.699
295.31149038	0.0218	40.18353776	0.0291	2076300028278728448	0.3401	0.0293	-3.087	0.045	-3.833	0.061	4717.23	74.641	12.342
295.49439761	0.0241	40.06808495	0.0310	2076388234025963904	0.3193	0.0316	-2.768	0.055	-6.554	0.061	5804.67	4.308	12.479
295.49824688	0.0143	40.08338794	0.0192	2076388337105190144	0.3613	0.0185	-2.985	0.032	-3.825	0.039	5332.00	10.294	12.211
295.51057404	0.0421	40.07202449	0.0586	2076388268385715712	0.4090	0.0552	-2.988	0.095	-3.848	0.115	5269.59	1.02	11.941
295.46511813	0.0276	40.07239835	0.0368	2076388405824633216	0.3786	0.0356	-2.837	0.063	-3.808	0.072	5635.00	2.228	12.109
295.49452878	0.0285	40.11210438	0.0389	2076388577623375360	0.3670	0.0373	-2.880	0.063	-3.819	0.072	5535.54	2.297	12.177
295.53007790	0.0197	40.11735197	0.0274	2076388783781833856	0.3158	0.0258	-3.737	0.044	-5.563	0.050	4886.72	7.074	12.503
295.53817547	0.0320	40.12017308	0.0417	2076388783781841536	0.3851	0.0417	-2.249	0.069	-6.509	0.076	5034.50	1.928	12.072
295.54239275	0.0174	40.14121711	0.0244	2076388886861074944	0.3545	0.0220	-3.121	0.039	-3.653	0.045	5105.00	7.812	12.252
295.51500530	0.0323	40.15718628	0.0446	2076389161738971776	0.4119	0.0432	-3.709	0.071	-5.782	0.082	5325.00	1.381	11.926
295.53725259	0.0353	40.17088878	0.0481	2076389196098736640	0.3889	0.0468	-2.988	0.078	-4.247	0.088	5467.27	1.309	12.051
295.44838869	0.0300	40.12393233	0.0412	2076389333537593600	0.3045	0.0398	-2.864	0.066	-3.840	0.076	5435.25	3.173	12.582
295.43445144	0.0196	40.09794284	0.0260	2076389294867531136	0.3718	0.0237	-2.831	0.043	-3.858	0.050	4444.99	58.855	12.148
295.44498826	0.0218	40.09041882	0.0310	2076389230458351232	0.4327	0.0273	-2.313	0.053	-5.352	0.063	5359.00	3.38	11.819
295.43922673	0.0277	40.09698695	0.0347	2076389230458351872	0.4178	0.0339	-2.962	0.061	-3.935	0.068	5635.63	2.009	11.895
295.44123378	0.0341	40.08683497	0.0453	2076389230458344064	0.3717	0.0441	-2.887	0.076	-3.900	0.089	5357.00	1.547	12.149
295.48359638	0.0373	40.13474708	0.0521	2076389402257102976	0.4513	0.0497	-3.018	0.084	-3.774	0.095	5357.41	0.918	11.728
295.46536024	0.0295	40.11305509	0.0393	2076389367897336576	0.4228	0.0381	-2.967	0.066	-4.033	0.077	5341.80	1.591	11.869
295.41283868	0.0263	40.13439952	0.0330	2076389574055739904	0.3970	0.0328	-2.983	0.059	-4.039	0.067	5580.07	2.148	12.006
295.42091177	0.0211	40.15319313	0.0294	2076389608415499392	0.3715	0.0269	-2.828	0.048	-3.941	0.056	5766.00	4.101	12.150
295.44006675	0.0233	40.12837235	0.0312	2076389539696509952	0.3831	0.0299	-3.024	0.052	-3.832	0.058	5761.33	3.181	12.083
295.42238342	0.0325	40.13546650	0.0509	2076389604105237248	0.4536	0.0423	-3.029	0.074	-3.915	0.105	5461.98	1.116	11.717
295.42630598	0.0308	40.15204070	0.0439	2076389711494717824	0.4266	0.0397	-2.887	0.070	-3.779	0.009	5445.85	1.395	11.850
295.42703897	0.0188	40.15006633	0.0245	2076389711494716800	0.3446	0.0247	-2.894	0.042	-3.797	0.051	5454.99	5.946	12.313
295.45122701	0.0187	40.17079186	0.0234	2076389745854485504	0.3524	0.0237	-2.974	0.042	-4.013	0.046	6101.99	5.454	12.265
295.43832052	0.0277	40.15366708	0.0324	2076389711494726912	0.3450	0.0338	-2.865	0.062	-4.032	0.065	5612.10	2.967	12.311
295.48927793	0.0333	40.17804863	0.0458	2076389883293470464	0.3347	0.0442	-2.904	0.073	-3.792	0.084	5422.00	2.017	12.377
295.47122453	0.0209	40.15389191	0.0282	2076389848933704832	0.3775	0.0272	-2.864	0.048	-3.886	0.052	5727.00	4.293	12.115
295.48737229	0.0193	40.14090396	0.0281	2076389780214232192	0.3199	0.0252	-3.709	0.041	-4.578	0.050	4928.53	66.619	12.475
295.51675935	0.0405	40.18493516	0.0587	2076389947702744448	0.4275	0.0539	-2.895	0.089	-3.993	0.106	5332.00	0.908	11.845
295.50964042	0.0241	40.19772592	0.0324	2076390020732454528	0.3152	0.0317	-2.964	0.052	-4.001	0.060	5664.00	4.215	12.507
295.51373027	0.0395	40.17171056	0.0530	2076389917653224320	0.3975	0.0520	-3.748	0.088	-2.545	0.098	4955.50	1.164	12.003
295.51006849	0.0296	40.20151213	0.0393	2076390020732457216	0.3361	0.0389	-2.775	0.065	-3.934	0.072	5308.14	2.621	12.368
295.46295123	0.0383	40.16181961	0.0474	2076390055092133888	0.3716	0.0482	-2.853	0.081	-4.049	0.091	5289.19	1.535	12.150
295.47824651	0.0322	40.17627795	0.0437	2076390089451891968	0.3220	0.0424	-2.593	0.072	-3.776	0.080	5433.13	2.613	12.461
295.46400450	0.0243	40.18653768	0.0320	2076390158171365248	0.3413	0.0314	-2.968	0.055	-4.030	0.062	5713.01	3.221	12.334
295.46057294	0.0353	40.18521487	0.0463	2076390123811623680	0.4562	0.0455	-2.870	0.079	-3.956	0.089	5258.98	0.963	11.704
295.47042600	0.0432	40.20594897	0.0511	2076390261250597248	0.4194	0.0542	-3.003	0.093	-4.061	0.097	5360.79	0.999	11.887
295.48215749	0.0275	40.20444969	0.0351	2076390261250605824	0.3033	0.0350	-2.883	0.060	-3.943	0.067	5615.59	3.532	12.591
295.50076715	0.0264	40.20530281	0.0327	2076390226890883456	0.2886	0.0337	-2.974	0.059	-3.620	0.060	5476.77	4.994	12.699
295.55428162	0.0249	40.17333444	0.0340	2076390604848025728	0.3356	0.0333	-3.024	0.055	-3.910	0.062	6567.42	3.182	12.371
295.56769130	0.0227	40.17902296	0.0305	2076390639207774848	0.3332	0.0300	-2.942	0.049	-3.783	0.056	5744.00	4.081	12.386
295.56371401	0.0240	40.20300103	0.0324	2076390811006478592	0.3369	0.0317	-3.055	0.053	-3.711	0.060	5309.00	3.618	12.362
295.53798017	0.0200	40.21970532	0.0278	2076391532560976256	0.3670	0.0266	-2.798	0.043	-3.979	0.051	5830.00	4.617	12.177
295.51538740	0.0444	40.20021318	0.0678	2076391493891032704	0.4561	0.0611	-3.077	0.097	-3.882	0.115	5332.00	0.724	11.705
295.53411566	0.0156	40.19036543	0.0221	2076391429481741568	0.3806	0.0221	-2.225	0.034	-5.990	0.043	4513.21	9.757	12.098
295.50647792	0.0319	40.21591438	0.0399	2076391704359643392	0.4145	0.0405	-2.158	0.070	-4.285	0.076	5504.00	1.615	11.912
295.53562447	0.0160	40.25959211	0.0206	2076391944877856768	0.3377	0.0207	-2.908	0.033	-3.781	0.039	4902.80	10.045	12.357
295.54348159	0.0182	40.24618579	0.0226	207639187615837984	0.3794	0.0225	-2.986	0.040	-4.067	0.043	5745.00	5.346	12.105
295.55637378	0.0188	40.26446595	0.0231	2076392254115516928	0.4099	0.0237	-2.878	0.039	-3.844	0.044	5719.67	4.198	11.937
295.55166917	0.0174	40.26651075	0.0217	2076392254115515392	0.3779	0.0221	-3.027	0.036	-3.926	0.042	4900.00	6.677	12.113
295.39063427	0.0277	40.15947100	0.0377	2076392597712716160	0.3549	0.0351	-3.015	0.063	-3.926	0.075	5465.00	2.33	12.249
295.40946583	0.0295	40.16309062	0.0386	2076392563352997632	0.3515	0.0381	-2.908	0.070	-3.875	0.097	5759.25	2.572	12.270
295.40490782	0.0395	40.16508377	0.0483	2076392632072471808	0.4312	0.0486	-2.796	0.096	-3.661	0.098	5152.00	1.098	11.827
295.39945109	0.0189	40.17429757	0.0234	2076392627762314624	0.3331	0.0229	-2.694	0.042	-3.924	0.045	5633.50	5.526	12.387
295.39349951	0.0194	40.14611709	0.0251	2076392528993233024	0.3115	0.0245	-2.603	0.042	-3.788	0.049	4777.77	67.803	12.533
295.39787905	0.0238	40.14293412	0.0286	2076392528993234048	0.3653	0.0288	-3.495	0.052	-4.800	0.056</			

295.38041961	0.0364	40.19480791	0.0414	2076392902640313088	0.3594	0.0424	-2.649	0.087	-3.929	0.084	5741.00	1.812	12.222
295.36321035	0.0404	40.17364484	0.0491	2076392868283415680	0.3712	0.0505	-2.803	0.093	-3.917	0.099	5331.40	1.222	12.152
295.37830026	0.0468	40.17381706	0.0492	2076392799561006720	0.4232	0.0538	-2.885	0.094	-4.180	0.095	5270.40	1.08	11.867
295.36663399	0.0173	40.17846270	0.0214	2076392872590617984	0.3724	0.0210	-2.857	0.038	-3.625	0.041	5741.33	5.534	12.145
295.36762157	0.0184	40.18297672	0.0231	2076392872590621184	0.3154	0.0219	-2.941	0.041	-3.866	0.044	5745.00	7.632	12.506
295.38309158	0.0232	40.16394755	0.0288	2076392803871143808	0.4273	0.0282	-3.070	0.052	-3.957	0.056	5625.43	2.202	11.846
295.37285292	0.0291	40.16293868	0.0365	2076392803871133440	0.2964	0.0363	-3.011	0.067	-3.720	0.074	5719.00	3.058	12.641
295.39751247	0.0214	40.18202381	0.0269	2076392838230907392	0.3318	0.0261	-2.892	0.048	-3.799	0.052	5439.50	4.34	12.396
295.37299975	0.0216	40.16626223	0.0264	2076392803871137152	0.3670	0.0263	-3.007	0.050	-3.842	0.051	5757.00	4.117	12.177
295.37471284	0.0169	40.19244487	0.0212	2076392906950372224	0.3838	0.0206	-3.046	0.038	-3.941	0.041	5623.33	5.365	12.079
295.38930252	0.0210	40.18514533	0.0270	2076392838230909396	0.2948	0.0260	-2.698	0.046	-3.920	0.051	5617.28	5.896	12.652
295.38912990	0.0169	40.17677715	0.0235	2076392838230896384	0.3505	0.0216	-2.810	0.038	-3.760	0.047	5735.00	7.189	12.277
295.38627132	0.0335	40.17940436	0.0450	2076392838230895744	0.4301	0.0417	-2.864	0.080	-3.771	0.088	5528.91	1.396	11.832
295.39483326	0.0333	40.18560932	0.0402	2076392937000009216	0.4045	0.0409	-3.128	0.078	-4.087	0.08	5474.00	1.502	11.965
295.39174365	0.0309	40.19770089	0.0354	2076393010029604352	0.3350	0.0382	-3.061	0.079	-4.068	0.07	5664.00	3.091	12.375
295.39299758	0.0206	40.18937166	0.0251	2076392941310124032	0.3643	0.0241	-2.980	0.048	-3.731	0.05	5748.00	5.343	12.193
295.39394655	0.0315	40.19101791	0.0405	2076392937000024192	0.3193	0.0372	-2.978	0.077	-4.144	0.08	5665.80	3.045	12.479
295.41206817	0.0208	40.19686657	0.0276	2076392975669881088	0.3452	0.0255	-2.820	0.045	-3.884	0.05	5620.28	4.802	12.310
295.40884869	0.0181	40.19125702	0.0245	2076392941310135680	0.3662	0.0234	-2.621	0.041	-3.540	0.05	5748.00	5.689	12.181
295.38876364	0.0189	40.20966727	0.0224	2076393010029609984	0.3117	0.0226	-2.786	0.041	-4.068	0.04	4552.54	73.176	12.531
295.40379761	0.0234	40.20138074	0.0329	2076392975669876992	0.3139	0.0303	-2.922	0.051	-3.821	0.06	5777.33	4.418	12.516
295.39134343	0.0218	40.21671815	0.0269	2076393044389355008	0.3431	0.0267	-3.138	0.047	-4.050	0.05	5273.50	4.362	12.323
295.39928898	0.0255	40.20537670	0.0332	2076393044389353088	0.3785	0.0322	-2.933	0.056	-3.760	0.06	5642.02	2.347	12.110
295.40974939	0.0287	40.20879645	0.0347	2076392971359841152	0.3679	0.0354	-2.903	0.063	-3.838	0.07	5439.50	2.231	12.171
295.40650704	0.0373	40.21091083	0.0491	2076393044389362176	0.4040	0.0471	-2.923	0.083	-3.638	0.10	5308.50	1.150	11.968
295.41062755	0.0227	40.19827098	0.0292	2076392975669880704	0.3490	0.0276	-2.916	0.051	-3.994	0.06	5759.20	3.977	12.286
295.39248116	0.0300	40.20312263	0.0415	2076393010029607936	0.3202	0.0404	-2.664	0.068	-4.145	0.09	5478.31	2.661	12.473
295.42780792	0.0291	40.19867367	0.0368	2076393147468585344	0.3424	0.0366	-2.907	0.065	-3.774	0.08	5555.08	2.300	12.327
295.43715967	0.0284	40.21024021	0.0376	2076393147468599296	0.3600	0.0356	-2.859	0.062	-3.720	0.08	5555.08	2.352	12.218
295.45601570	0.0219	40.19814055	0.0292	2076393108798736384	0.3339	0.0282	-2.569	0.049	-4.460	0.06	5920.23	4.244	12.382
295.45747014	0.0326	40.20425726	0.0401	2076393113108871296	0.3504	0.0401	-2.933	0.081	-3.864	0.08	5354.55	2.498	12.277
295.45070715	0.0181	40.20860796	0.0235	2076393113108869248	0.3458	0.0227	-3.032	0.040	-3.985	0.05	5535.54	6.072	12.306
295.43848869	0.0184	40.20175751	0.0249	2076393147468596224	0.3989	0.0230	-3.007	0.043	-3.900	0.05	5612.10	4.637	11.996
295.44979295	0.0187	40.19826757	0.0256	2076393113108862080	0.3492	0.0254	-3.007	0.043	-3.873	0.05	5642.02	5.821	12.285
295.43400611	0.0308	40.21244462	0.0380	2076393147460788864	0.3662	0.0378	-3.034	0.069	-3.738	0.08	5556.00	2.008	12.181
295.47629501	0.0329	40.22414389	0.0421	2076393250547853056	0.4305	0.0411	-2.744	0.074	-3.858	0.08	5234.33	1.331	11.830
295.45933839	0.0280	40.23056705	0.0370	2076393284907582592	0.3646	0.0363	-2.742	0.062	-3.920	0.07	5516.52	2.294	12.191
295.47039074	0.0375	40.24572455	0.0489	2076393319267340288	0.4118	0.0488	-2.759	0.082	-3.953	0.09	5284.75	1.087	11.927
295.41070275	0.0360	40.23582469	0.0447	2076393422346504192	0.3625	0.0448	-2.947	0.080	-3.803	0.09	5316.00	1.473	12.203
295.45908108	0.0170	40.24583175	0.0234	2076393525425762944	0.3692	0.0224	-2.864	0.036	-3.876	0.04	5676.50	6.054	12.164
295.44672769	0.0374	40.25337101	0.0486	2076393521115881984	0.4061	0.0478	-2.887	0.083	-3.928	0.09	5317.00	1.127	11.957
295.44073708	0.0295	40.23947426	0.0371	2076393491066003584	0.4035	0.0378	-3.004	0.063	-3.675	0.07	5905.61	1.757	11.971
295.42968664	0.0252	40.25997112	0.0324	2076393559785487232	0.3607	0.0321	-3.001	0.056	-3.852	0.06	5746.33	2.767	12.214
295.44308296	0.0164	40.27553668	0.0207	2076393594145246080	0.3808	0.0204	-2.904	0.034	-3.986	0.04	7169.50	7.152	12.097
295.35978595	0.0163	40.20389119	0.0209	2076393662864611840	0.3154	0.0201	-2.944	0.036	-3.811	0.04	5520.84	9.821	12.506
295.35483419	0.0362	40.20916988	0.0432	2076393731584088192	0.3755	0.0446	-2.904	0.083	-4.094	0.09	5516.00	1.599	12.127
295.35710540	0.0228	40.20911078	0.0261	2076393731584089856	0.3036	0.0266	-2.855	0.051	-3.931	0.05	5821.50	5.535	12.588
295.36407764	0.0390	40.19798736	0.0484	2076393662864610688	0.4225	0.0489	-2.621	0.090	-3.609	0.10	5349.00	1.011	11.871
295.36766912	0.0276	40.20472461	0.0390	2076393662864620672	0.4264	0.0342	-2.880	0.062	-4.095	0.07	5555.08	1.723	11.851
295.36011019	0.0174	40.21723554	0.0220	2076393731584100736	0.3443	0.0218	-2.881	0.038	-3.793	0.04	5727.00	5.922	12.315
295.34353344	0.0175	40.20092338	0.0215	2076393692921636992	0.3319	0.0212	-3.229	0.038	-3.992	0.04	4939.26	63.534	12.395
295.36757399	0.0122	40.21510426	0.0160	2076393662864627840	0.3663	0.0156	-2.995	0.027	-3.902	0.03	6292.00	13.756	12.181
295.37305382	0.0185	40.20580943	0.0246	2076393662864626176	0.3657	0.0238	-2.840	0.041	-3.917	0.05	4632.80	55.835	12.184
295.37661690	0.0208	40.20414370	0.0258	2076393662864627072	0.3389	0.0258	-2.857	0.047	-3.987	0.05	5753.00	4.645	12.350
295.35640833	0.0356	40.18101537	0.0450	2076393628504853888	0.3492	0.0432	-2.892	0.082	-3.883	0.09	5350.00	2.111	12.285
295.34161122	0.0170	40.20056177	0.0209	2076393692914036608	0.3411	0.0207	-2.861	0.037	-3.789	0.04	4877.00	78.071	12.336
295.36280136	0.0185	40.20785182	0.0216	2076393658554297600	0.3793	0.0216	-2.967	0.041	-3.834	0.04	4473.60	85.000	12.105
295.34870379	0.0182	40.20984816	0.0213	2076393692914035456	0.4101	0.0222	-3.445	0.040	-3.815	0.04	4286.64	155.672	11.936
295.33884431	0.0288	40.20523009	0.0354	2076393697224861056	0.3683	0.0356	-2.950	0.065	-3.972	0.07	5545.99	2.102	12.169
295.34598578	0.0339	40.19878657	0.0387	2076393697224860672	0.3642	0.0407	-2.661	0.072	-3.795	0.08	5579.00	1.905	12.193
295.35837315	0.0336	40.20799966	0.0393	2076393731584598528	0.4001	0.0412	-3.142	0.076	-3.947	0.08	5324.00	1.606	11.989
295.36090642	0.0228	40.20922662	0.0252	2076393731584598016	0.3156	0.0260	-2.848	0.050	-3.738	0.05	5676.50	5.567	12.504
295.35762680	0.0224	40.20621793	0.0271	2076393731584598400	0.3893	0.0277	-2.927	0.050	-3.921	0.05	5164.23	3.523	12.049
295.36963781	0.0415	40.19663884	0.0555	2076393658554571264	0.4258	0.0529	-3.173	0.096	-4.032	0.11	5017.34	0.988	11.854
295.36076663	0.0166	40.19492215	0.0215	2076393624194561152	0.3687	0.0204	-2.784	0.037	-3.815	0.04	4477.55	133.518	12.167
295.34111310	0.0171	40.19681359	0.0212	2076393692914037248	0.3241	0.0207	-3.031	0.037	-3.912	0.04	4824.00	83.705	12.447
295.34066476	0.0168	40.20308561	0.0210	2076393692917498368	0.3569	0.0204	-2.871	0.037	-3.791	0.04	4550.40	55.208	12.237
295.34911338	0.0232	40.19666509	0.0282	2076393697224337792	0.3512	0.0282	-2.857	0.052	-3.945	0.06	5756.50	3.427	12.272
295.35476042	0.0215	40.18998835	0.0276	2076393628504860288	0.3842	0.0262	-2.884	0.048	-3.902	0.05	5821.25	3.952	12.077
295.370805													

295.37916531	0.0229	40.22404927	0.0309	2076393765943856128	0.4517	0.0281	-2.524	0.052	-4.820	0.059	5320.00	2.298	11.726
295.37114394	0.0224	40.21349687	0.0286	2076393765944335232	0.3389	0.0279	-3.152	0.049	-3.845	0.055	5702.00	3.726	12.350
295.39474969	0.0229	40.22474898	0.0288	2076393800304073088	0.3838	0.0285	-2.856	0.051	-3.868	0.063	5815.00	3.069	12.079
295.39561451	0.0435	40.22913552	0.0551	2076393795993678336	0.4143	0.0551	-2.645	0.098	-4.350	0.121	5093.01	0.898	11.913
295.37413896	0.0327	40.24230348	0.0452	2076393869023080192	0.3496	0.0421	-2.901	0.072	-3.896	0.086	5270.40	1.979	12.282
295.33460867	0.0259	40.22692364	0.0316	2076393903382776576	0.3236	0.0313	-2.897	0.057	-3.782	0.061	5713.67	3.012	12.450
295.33151781	0.0276	40.22790012	0.0345	2076393972102252160	0.3849	0.0346	-2.966	0.060	-3.664	0.070	5400.00	1.936	12.073
295.34416107	0.0178	40.21938920	0.0224	2076393937742517120	0.3543	0.0222	-3.047	0.040	-3.826	0.045	5522.67	5.937	12.253
295.34158678	0.0306	40.21645953	0.0358	2076393903382775168	0.3273	0.0366	-2.983	0.069	-4.050	0.073	5727.49	2.612	12.425
295.33612739	0.0164	40.22107564	0.0201	2076393903382774016	0.3888	0.0198	-2.945	0.037	-3.910	0.039	5766.00	5.571	12.051
295.33597273	0.0227	40.22564619	0.0261	2076393903382776704	0.4055	0.0268	-3.046	0.047	-3.746	0.053	5629.27	2.984	11.960
295.33946183	0.0159	40.23257330	0.0207	2076393937742523904	0.3499	0.0200	-3.003	0.034	-3.872	0.040	4702.10	58.833	12.280
295.34333221	0.0295	40.23516758	0.0366	2076393937742530048	0.3470	0.0367	-3.106	0.065	-4.108	0.074	5555.08	2.184	12.298
295.33094109	0.0287	40.21207419	0.0332	2076393903382762240	0.3734	0.0338	-2.725	0.065	-3.999	0.064	5664.00	2.212	12.139
295.33441390	0.0205	40.23694100	0.0242	2076394006461998336	0.3404	0.0240	-2.672	0.046	-3.364	0.047	5405.00	4.878	12.340
295.33405869	0.0332	40.20673362	0.0428	2076393903382761088	0.4195	0.0436	-2.773	0.076	-4.331	0.088	5408.23	1.454	11.886
295.32850573	0.0187	40.21084850	0.0208	2076393903382760192	0.3231	0.0221	-2.919	0.041	-3.636	0.040	5783.00	8.524	12.453
295.32207569	0.0261	40.22596771	0.0302	2076393967795074048	0.3374	0.0305	-3.148	0.057	-3.955	0.058	5569.33	3.278	12.359
295.32938548	0.0380	40.22073981	0.0460	2076393903383291520	0.3472	0.0467	-3.015	0.088	-3.991	0.094	5309.67	1.503	12.297
295.34719206	0.0293	40.23425302	0.0375	2076393933435342720	0.3112	0.0370	-2.834	0.064	-3.789	0.076	5592.00	2.589	12.535
295.33095386	0.0313	40.20863744	0.0339	2076393903374692992	0.4912	0.0369	-3.190	0.074	-3.464	0.079	5802.00	4.520	11.544
295.33301173	0.0207	40.20619409	0.0258	2076393899075928960	0.3243	0.0256	-2.794	0.047	-3.659	0.050	5669.09	5.902	12.445
295.32427199	0.0422	40.22551214	0.0495	2076393972102245120	0.4170	0.0510	-2.819	0.095	-3.733	0.098	5348.00	1.055	11.899
295.31892304	0.0253	40.22904797	0.0308	2076393972102242944	0.3534	0.0307	-2.986	0.058	-3.922	0.063	5774.00	3.052	12.259
295.32291908	0.0209	40.22375717	0.0244	2076393972102242432	0.2998	0.0244	-2.903	0.047	-3.858	0.047	5939.75	5.965	12.616
295.32838291	0.0304	40.21331147	0.0370	2076393903382761344	0.3890	0.0377	-3.053	0.069	-4.057	0.075	5190.55	1.818	12.050
295.33201599	0.0187	40.20933237	0.0204	2076393903382760576	0.3871	0.0217	-2.798	0.040	-3.851	0.040	5498.75	6.593	12.061
295.33405895	0.0183	40.20982589	0.0213	2076393903382764032	0.2934	0.0224	-2.755	0.042	-3.768	0.050	4920.00	11.327	12.663
295.35757602	0.0110	40.23091746	0.0137	2076394040821752576	0.3540	0.0134	-3.059	0.024	-4.286	0.027	4984.91	25.752	12.255
295.34495930	0.0169	40.25559522	0.0211	2076394109541235072	0.3652	0.0212	-3.060	0.037	-3.860	0.043	5782.00	5.730	12.187
295.35901275	0.0180	40.24348719	0.0219	2076394040821761152	0.3352	0.0214	-2.776	0.042	-3.861	0.043	5640.75	7.052	12.373
295.37412625	0.0183	40.25495562	0.0233	2076394075181517312	0.3597	0.0227	-2.867	0.040	-3.902	0.047	5664.00	4.984	12.220
295.35993116	0.0224	40.27195842	0.0278	2076394143900995200	0.3391	0.0274	-2.953	0.049	-3.798	0.053	5794.67	3.591	12.348
295.36723669	0.0231	40.26004280	0.0342	2076394075181516416	0.4168	0.0289	-3.046	0.049	-3.913	0.065	5759.20	2.463	11.900
295.34691335	0.0448	40.26151108	0.0535	2076394109541240448	0.4025	0.0538	-2.877	0.099	-3.873	0.109	5320.00	0.898	11.976
295.35760274	0.0176	40.23563829	0.0222	2076394040821754880	0.3703	0.0214	-3.019	0.039	-3.735	0.043	5615.83	5.129	12.157
295.35028688	0.0182	40.23704592	0.0225	2076394036514561664	0.3516	0.0220	-3.012	0.041	-3.873	0.044	5670.00	5.414	12.270
295.37224303	0.0160	40.25333798	0.0216	2076394070871725568	0.3694	0.0201	-2.769	0.035	-3.830	0.043	5675.00	6.835	12.163
295.35136211	0.0365	40.25020425	0.0432	2076394109541236352	0.3751	0.0451	-3.103	0.078	-3.848	0.088	5259.25	1.461	12.129
295.35391839	0.0158	40.23681672	0.0192	2076394040821753344	0.3400	0.0192	-2.826	0.035	-3.979	0.037	5652.75	8.819	12.343
295.40454280	0.0153	40.23938594	0.0197	2076394173950841088	0.3471	0.0192	-2.819	0.033	-3.915	0.037	5741.33	7.405	12.298
295.40698112	0.0178	40.24237466	0.0220	2076394173950855424	0.3622	0.0220	-3.111	0.037	-3.749	0.042	5623.33	5.248	12.205
295.39665366	0.0167	40.23637346	0.0216	2076394178260737920	0.3451	0.0206	-2.787	0.036	-3.761	0.042	5765.40	6.060	12.310
295.39788909	0.0414	40.24351746	0.0523	2076394178260743552	0.4299	0.0526	-3.161	0.088	-3.951	0.107	5334.00	0.985	11.833
295.39571526	0.0255	40.24095581	0.0339	2076394178260740224	0.3529	0.0327	-2.833	0.055	-4.014	0.067	5680.00	2.924	12.262
295.40714798	0.0197	40.26121249	0.0249	2076394281339975680	0.3659	0.0243	-2.999	0.043	-3.919	0.048	5830.00	3.963	12.183
295.40137225	0.0342	40.25104105	0.0429	2076394178260750464	0.3772	0.0428	-2.937	0.077	-4.061	0.086	5461.26	1.461	12.117
295.39242122	0.0160	40.26593931	0.0211	2076394281339968256	0.3656	0.0200	-2.867	0.035	-3.909	0.040	5752.60	6.637	12.185
295.40516942	0.0357	40.28034254	0.0420	2076394384419201920	0.3616	0.0436	-2.846	0.075	-3.817	0.084	5262.67	1.704	12.209
295.42647909	0.0165	40.26098829	0.0215	2076394315699729536	0.3570	0.0212	-2.801	0.036	-3.871	0.039	4953.25	8.085	12.237
295.40410915	0.0223	40.28036811	0.0263	2076394384419199616	0.3519	0.0266	-2.913	0.046	-3.818	0.050	5691.88	3.864	12.268
295.43708378	0.0344	40.27222207	0.0458	2076394350059484544	0.3441	0.0442	-2.873	0.072	-3.851	0.090	5668.63	2.051	12.317
295.43736419	0.0297	40.27797099	0.0399	2076394350059488128	0.3053	0.0369	-3.040	0.062	-3.856	0.075	5822.67	3.301	12.576
295.37229755	0.0373	40.26552934	0.0487	2076394453138645888	0.4343	0.0480	-2.950	0.083	-3.856	0.094	5356.50	0.965	11.811
295.38481146	0.0262	40.26030359	0.0327	2076394453138652288	0.3282	0.0321	-2.900	0.058	-3.904	0.066	5772.75	3.032	12.419
295.37612287	0.0181	40.25599518	0.0235	2076394448828275584	0.3315	0.0226	-2.998	0.038	-4.020	0.045	4817.87	68.246	12.398
295.39541498	0.0208	40.28011785	0.0247	2076394483188725376	0.3700	0.0248	-3.010	0.043	-3.935	0.047	5866.75	3.949	12.159
295.39329621	0.0189	40.29670321	0.0221	2076394659297111552	0.3916	0.0224	-2.825	0.039	-3.804	0.041	4140.12	272.560	12.036
295.38929238	0.0340	40.31265657	0.0378	2076394659297118976	0.3999	0.0390	-2.779	0.073	-4.010	0.077	5782.00	1.692	11.990
295.47978724	0.0230	40.23935130	0.0287	2076394728016615680	0.4618	0.0290	-2.860	0.049	-3.832	0.055	3754.12	641.958	11.678
295.48326351	0.0348	40.26425380	0.0412	2076394831095848960	0.3560	0.0423	-2.882	0.073	-3.746	0.080	5670.47	1.895	12.243
295.49127048	0.0197	40.23904445	0.0252	2076394728016625024	0.3790	0.0253	-2.905	0.043	-3.965	0.048	5753.00	4.079	12.107
295.50043794	0.0270	40.25014217	0.0363	2076394762376375424	0.3237	0.0352	-2.951	0.059	-3.734	0.070	5713.67	2.780	12.449
295.50440212	0.0248	40.26696277	0.0285	2076394865455603456	0.3695	0.0299	-2.911	0.052	-3.770	0.054	5821.75	3.867	12.162
295.51136217	0.0172	40.28013936	0.0220	2076394964224349568	0.4447	0.0219	-2.131	0.036	-4.948	0.043	4889.25	29.699	11.760
295.45824366	0.0278	40.27253085	0.0342	2076395071614004608	0.3842	0.0341	-3.019	0.058	-3.855	0.063	5545.99	2.233	12.077
295.46516598	0.0170	40.26030388	0.0214	2076395002894914176	0.3527	0.0212	-2.920	0.036	-3.771	0.039	5830.00	6.309	12.263
295.46101163	0.0135	40.26693427	0.0170	2076395002894525952	0.3697	0.0172	-2.961	0.029	-3.808	0.032	4779.60	16.038	12.161
295.46548713	0.0280	40.25646126	0.0372	2076395002894523136	0.3352	0.0353	-2.968	0.063	-3.825	0.			

295.15943542	0.0329	40.08471539	0.0352	2076485128484985216	0.3401	0.0380	-2.752	0.080	-3.931	0.071	5804.91	2.441	12.342
295.14816069	0.0142	40.09299745	0.0166	2076485094125243136	0.3788	0.0176	-2.867	0.033	-3.699	0.033	7781.25	11.624	12.108
295.15987538	0.0262	40.07037092	0.0300	2076485025405759744	0.3893	0.0316	-2.093	0.061	-3.840	0.059	5758.33	2.287	12.049
295.12701502	0.0149	40.07140131	0.0176	2076485197204427776	0.3506	0.0183	-2.906	0.034	-3.827	0.035	5664.87	9.119	12.276
295.11368400	0.0196	40.07114413	0.0230	2076485162844678784	0.3752	0.0240	-2.905	0.046	-3.870	0.045	5899.00	4.213	12.129
295.12928342	0.0195	40.10735104	0.0220	2076485369003144960	0.3466	0.0232	-2.939	0.045	-3.799	0.042	5832.75	5.943	12.301
295.18107695	0.0219	40.11136163	0.0254	2076485540801875712	0.4730	0.0268	-2.772	0.049	-3.857	0.051	5799.00	2.186	11.626
295.18972854	0.0228	40.11217637	0.0271	2076485472082405888	0.3739	0.0274	-2.816	0.051	-3.983	0.053	5852.00	2.950	12.136
295.20395558	0.0364	40.14004596	0.0418	2076485678240864000	0.4362	0.0432	-2.868	0.085	-3.813	0.080	5426.77	1.166	11.802
295.20013283	0.0176	40.13566704	0.0202	2076485678240859136	0.3606	0.0216	-2.978	0.038	-3.831	0.038	4548.88	74.370	12.215
295.19699399	0.0454	40.11306860	0.0561	2076485575161627264	0.4699	0.0558	-2.767	0.104	-3.826	0.111	5076.83	0.621	11.640
295.19586073	0.0317	40.13283498	0.0357	2076485643881116416	0.3703	0.0380	-2.862	0.072	-3.807	0.073	5644.50	1.894	12.157
295.20291401	0.0295	40.12805910	0.0345	2076485575161641472	0.3499	0.0362	-2.885	0.067	-3.737	0.068	5545.99	2.237	12.280
295.19178764	0.0373	40.13449897	0.0450	2076485643881113856	0.3782	0.0473	-2.647	0.086	-3.626	0.094	5269.00	1.303	12.111
295.15744231	0.0235	40.13334570	0.0281	2076485815679780096	0.3720	0.0296	-2.812	0.052	-4.086	0.051	5836.00	3.418	12.147
295.18941317	0.0303	40.15887167	0.0369	2076485884399295616	0.3173	0.0390	-2.287	0.069	-5.156	0.073	4907.50	3.005	12.493
295.18525437	0.0333	40.15467562	0.0434	2076485884399290624	0.3842	0.0432	-2.835	0.076	-3.833	0.092	5617.67	1.555	12.077
295.18967689	0.0236	40.15781706	0.0282	2076485884399294976	0.3800	0.0293	-2.871	0.053	-3.770	0.054	5833.50	2.854	12.101
295.17909034	0.0251	40.14968020	0.0322	2076485850039545088	0.3826	0.0315	-2.949	0.056	-3.748	0.064	5782.00	2.513	12.086
295.18509260	0.0309	40.13981759	0.0388	2076485850039542400	0.4338	0.0403	-2.598	0.072	-1.913	0.085	5467.33	1.458	11.814
295.11271942	0.0212	40.11911383	0.0236	2076486124917385472	0.3182	0.0255	-2.745	0.046	-3.824	0.045	5801.50	6.013	12.486
295.10907311	0.0306	40.12884893	0.0370	2076486193636864896	0.3581	0.0397	-3.052	0.069	-3.803	0.073	5761.33	2.250	12.230
295.09263727	0.0184	40.14684721	0.0226	2076486395488440576	0.3688	0.0238	-2.948	0.041	-3.667	0.044	5796.00	5.525	12.166
295.14016250	0.0256	40.16285215	0.0300	2076486640313507840	0.3953	0.0317	-3.024	0.059	-3.800	0.058	5779.50	2.510	12.015
295.15172585	0.0193	40.14770837	0.0237	2076486571594029440	0.3502	0.0255	-2.825	0.043	-3.746	0.042	5835.00	6.083	12.278
295.13022140	0.0245	40.16117957	0.0302	2076486605953761024	0.4085	0.0305	-2.842	0.056	-3.661	0.056	5753.00	2.522	11.944
295.15314351	0.0249	40.19484435	0.0306	2076486777752490496	0.3792	0.0318	-2.960	0.054	-3.990	0.055	5736.00	3.051	12.106
295.15682186	0.0167	40.19539937	0.0207	2076486777752493056	0.3262	0.0216	-2.851	0.036	-3.922	0.037	4923.41	11.455	12.433
295.16248763	0.0232	40.16008601	0.0277	2076486670366364544	0.3632	0.0292	-2.995	0.052	-3.889	0.057	5814.00	3.404	12.199
295.10835860	0.0394	40.17702132	0.0481	2076486880831662848	0.4665	0.0498	-3.007	0.091	-3.502	0.097	5381.00	0.854	11.656
295.12083763	0.0233	40.20666856	0.0277	2076487018263096576	0.3816	0.0291	-2.971	0.053	-3.960	0.054	5628.00	3.178	12.092
295.14168085	0.0202	40.21289290	0.0245	2076487052630612992	0.3705	0.0260	-2.890	0.044	-3.678	0.047	5835.67	5.256	12.156
295.13882478	0.0433	40.22055997	0.0535	2076487052630403712	0.3983	0.0542	-2.718	0.100	-4.003	0.107	5183.30	1.051	11.999
295.14511266	0.0387	40.20523693	0.0481	2076486979604067456	0.3892	0.0483	-2.606	0.090	-4.040	0.095	5362.33	1.370	12.049
295.13618633	0.0258	40.19507330	0.0318	2076486945244314752	0.4812	0.0338	-2.936	0.057	-4.089	0.061	5797.50	2.701	11.588
295.22455467	0.0370	40.16873338	0.0430	2076487190069385600	0.3836	0.0451	-2.783	0.084	-3.809	0.086	5113.24	1.340	12.081
295.21113819	0.0280	40.15638963	0.0327	2076487155709629312	0.3829	0.0346	-2.954	0.064	-3.851	0.066	5770.00	1.998	12.085
295.22808813	0.0198	40.14316821	0.0226	2076487086990155520	0.3607	0.0237	-2.910	0.045	-3.805	0.043	5620.71	4.364	12.214
295.22920760	0.0295	40.15916586	0.0351	2076487121349905280	0.3450	0.0368	-2.731	0.067	-3.890	0.068	5718.62	2.334	12.311
295.21956177	0.0140	40.14508882	0.0154	2076487086990151296	0.3688	0.0160	-2.839	0.031	-3.846	0.029	5691.79	10.103	12.166
295.22790595	0.0207	40.16911716	0.0231	2076487190069388672	0.3809	0.0246	-3.011	0.045	-3.876	0.044	5836.67	3.753	12.096
295.22081908	0.0435	40.16060412	0.0515	2076487190069377408	0.4574	0.0533	-2.782	0.101	-4.200	0.104	5022.05	0.719	11.699
295.22307268	0.0112	40.16731493	0.0136	2076487185762261888	0.3541	0.0140	-2.576	0.025	-3.701	0.024	4969.25	23.116	12.254
295.20557420	0.0180	40.15192873	0.0211	2076487155709622784	0.2981	0.0221	-2.987	0.041	-3.920	0.041	5842.67	7.355	12.628
295.23291957	0.0180	40.16796097	0.0205	2076487185762452096	0.3516	0.0216	-2.978	0.039	-3.724	0.039	6013.33	5.593	12.270
295.22648972	0.0311	40.15213120	0.0374	2076487086990161024	0.4150	0.0387	-2.820	0.070	-3.696	0.072	5665.36	1.490	11.910
295.23476951	0.0347	40.16391574	0.0402	2076487121349914624	0.3545	0.0418	-2.956	0.078	-3.770	0.078	5602.54	2.559	12.252
295.24093780	0.0171	40.15758924	0.0198	2076487121349914752	0.3670	0.0207	-2.915	0.038	-3.724	0.038	5506.00	5.629	12.177
295.22521034	0.0198	40.16515811	0.0230	2076487190069383296	0.3667	0.0239	-2.865	0.044	-3.932	0.044	5879.00	3.887	12.178
295.23760236	0.0241	40.17585794	0.0268	2076487293148614656	0.3305	0.0282	-2.597	0.054	-3.982	0.051	5529.03	3.734	12.404
295.24190422	0.0204	40.17476392	0.0238	2076487293148617600	0.3626	0.0246	-2.961	0.046	-3.813	0.046	5829.00	3.817	12.203
295.23622100	0.0328	40.17108506	0.0364	2076487293148611840	0.3772	0.0391	-3.036	0.076	-4.011	0.072	5675.00	1.940	12.117
1295.25535932	0.0347	40.16715852	0.0393	2076487224429147264	0.3505	0.0421	-2.700	0.077	-3.948	0.078	5570.67	1.750	12.277
295.23766199	0.0168	40.16854331	0.0185	2076487224429134592	0.3580	0.0193	-2.788	0.037	-3.790	0.035	4599.21	47.456	12.231
295.25422027	0.0214	40.16767031	0.0242	2076487224429146624	0.4243	0.0259	-2.800	0.047	-3.932	0.048	5785.50	2.814	11.862
295.23859124	0.0205	40.18034740	0.0231	2076487293148618880	0.3462	0.0245	-2.987	0.046	-3.922	0.044	6033.42	4.553	12.303
295.24033686	0.0284	40.17933746	0.0332	2076487293148619648	0.3545	0.0349	-2.890	0.065	-3.931	0.066	5357.00	2.323	12.252
295.24590942	0.0313	40.20248443	0.0366	2076487327508380416	0.3903	0.0389	-2.522	0.072	-4.605	0.073	5278.33	1.705	12.043
295.26047688	0.0159	40.17188511	0.0185	2076487258788894208	0.3392	0.0195	-2.871	0.036	-3.904	0.036	6044.28	7.581	12.348
295.25074448	0.0214	40.18161208	0.0243	2076487258788893184	0.3372	0.0254	-2.934	0.047	-4.062	0.047	5832.00	4.172	12.361
295.25524731	0.0202	40.17088525	0.0244	2076487258788889216	0.3592	0.0251	-2.931	0.046	-3.746	0.048	5842.75	3.989	12.223
295.26456859	0.0236	40.17659188	0.0276	2076487258788900864	0.3847	0.0289	-2.875	0.054	-3.925	0.055	5808.27	2.591	12.074
295.26204316	0.0187	40.17890202	0.0213	2076487258788900608	0.3489	0.0223	-2.896	0.043	-4.003	0.040	5723.75	5.171	12.286
295.25799973	0.0237	40.18106785	0.0280	2076487258788898944	0.3253	0.0283	-2.889	0.055	-3.837	0.053	5812.00	3.825	12.439
295.26294681	0.0226	40.17546431	0.0261	2076487258788898816	0.3577	0.0275	-2.962	0.050	-3.709	0.051	5753.00	3.413	12.232
295.25341908	0.0170	40.18659235	0.0206	2076487258788899456	0.3197	0.0204	-2.841	0.038	-3.898	0.039	5695.00	7.249	12.476
295.21301835	0.0350	40.20667310	0.0419	2076487568026524160	0.3842	0.0451	-2.722	0.080	-3.827	0.082	5322.00	1.697	12.077
295.22621052	0.0384	40.18147330	0.0461	2076487499307041664	0.3631	0.0479	-2.978	0.092	-3.980	0.098	5262.25	1.431	12.200
295.22432792	0.0170	40.19756989	0.0189	2076487499307049984	0.3392	0.0208	-2.925	0.035	-3.814	0.035			

295.28149660	0.0203	40.20214726	0.0236	2076487671105795712	0.3788	0.0248	-2.947	0.046	-3.761	0.046	5857.09	3.719	12.108
295.27991110	0.0217	40.21372807	0.0234	2076487666798850560	0.3656	0.0251	-2.998	0.049	-4.016	0.045	5790.33	3.921	12.185
295.28027376	0.0153	40.19810377	0.0186	2076487671105791872	0.3554	0.0190	-2.822	0.035	-3.827	0.039	5691.53	8.433	12.246
295.25698026	0.0422	40.20003927	0.0493	2076487701164667776	0.4478	0.0516	-2.890	0.098	-4.018	0.099	5324.00	0.820	11.745
295.27781672	0.0206	40.20209725	0.0243	2076487671105792512	0.3189	0.0249	-2.966	0.047	-3.857	0.049	5796.00	5.190	12.482
295.27490951	0.0177	40.19506043	0.0207	2076487632439087616	0.3604	0.0218	-2.770	0.040	-3.774	0.040	5701.40	5.574	12.216
295.25439689	0.0313	40.20032718	0.0370	2076487705465508992	0.3168	0.0389	-2.951	0.072	-3.732	0.072	5721.49	2.422	12.496
295.30351944	0.0158	40.23307465	0.0186	2076487808544789504	0.3027	0.0184	-2.816	0.035	-3.782	0.036	5399.60	11.703	12.595
295.30431699	0.0212	40.23431722	0.0258	2076487808544791296	0.3802	0.0254	-2.002	0.047	-5.332	0.050	5706.67	3.341	12.100
295.30025926	0.0288	40.23234030	0.0343	2076487808544785024	0.3550	0.0346	-3.069	0.062	-3.512	0.064	5474.00	2.537	12.249
295.28576972	0.0174	40.22495960	0.0197	2076487838597288320	0.3271	0.0206	-2.895	0.037	-4.000	0.037	4806.00	63.085	12.427
295.28858350	0.0191	40.24543639	0.0209	2076487872957025408	0.3520	0.0210	-2.756	0.041	-3.907	0.038	4752.37	54.322	12.267
295.28831864	0.0223	40.23308204	0.0248	2076487877264252416	0.3480	0.0263	-2.854	0.052	-3.965	0.048	5695.00	3.843	12.292
295.30174381	0.0152	40.21713047	0.0158	2076487808544774400	0.3714	0.0167	-2.745	0.034	-4.044	0.030	5762.00	11.209	12.151
295.29540662	0.0227	40.22442579	0.0272	2076487808544774784	0.3496	0.0286	-2.770	0.051	-3.736	0.049	5785.00	4.467	12.282
295.29092582	0.0303	40.22185137	0.0365	2076487774185030272	0.3520	0.0380	-2.580	0.069	-4.050	0.083	5339.70	2.156	12.267
295.29034563	0.0308	40.24057102	0.0372	2076487877264260352	0.3707	0.0381	-3.160	0.069	-3.735	0.074	5188.86	1.868	12.155
295.29514132	0.0315	40.22829917	0.0367	2076487808544777856	0.3102	0.0387	-3.041	0.070	-3.759	0.072	5445.85	2.720	12.542
295.28545189	0.0210	40.23788235	0.0242	2076487877264253696	0.3587	0.0255	-3.058	0.047	-3.987	0.047	5753.00	4.021	12.226
295.30202162	0.0214	40.22228406	0.0250	2076487808544779776	0.3087	0.0265	-2.855	0.050	-4.053	0.047	5732.47	5.536	12.552
295.28386889	0.0247	40.21190836	0.0270	2076487774185019520	0.2998	0.0287	-3.010	0.056	-4.038	0.052	5812.00	4.586	12.616
295.28908028	0.0161	40.21950133	0.0183	2076487774185027328	0.3447	0.0194	-3.001	0.036	-3.842	0.035	5745.80	7.862	12.313
295.29388117	0.0164	40.21419231	0.0191	2076487774185027456	0.3598	0.0201	-2.960	0.037	-3.900	0.038	4926.52	7.282	12.220
295.29185366	0.0123	40.21895655	0.0141	2076487774185029504	0.3392	0.0151	-3.066	0.027	-3.876	0.027	5080.33	19.350	12.348
295.27808703	0.0282	40.22616708	0.0313	2076487842904499968	0.3861	0.0328	-3.126	0.063	-3.891	0.060	5757.00	2.041	12.067
295.28303761	0.0268	40.21528377	0.0301	2076487774185021184	0.3304	0.0313	-2.850	0.063	-3.964	0.059	5645.50	3.246	12.405
295.29894639	0.0175	40.23874343	0.0208	2076487877264266752	0.3216	0.0215	-2.954	0.038	-3.902	0.038	5787.33	6.715	12.463
295.25706195	0.0162	40.21603219	0.0194	2076487911623953920	0.3232	0.0205	-2.939	0.037	-3.730	0.037	5725.51	9.421	12.453
295.24468361	0.0204	40.23817433	0.0244	2076488014703175296	0.3251	0.0254	-2.770	0.047	-3.869	0.045	5740.55	6.750	12.440
295.23350309	0.0130	40.22763754	0.0151	2076487976036241536	0.3428	0.0161	-2.864	0.028	-3.739	0.028	4949.23	22.289	12.325
295.27355848	0.0268	40.26704371	0.0302	2076488152142173312	0.2883	0.0314	-2.924	0.060	-3.346	0.058	5738.75	4.711	12.701
295.27849425	0.0272	40.24375318	0.0319	2076488083422682240	0.3446	0.0338	-2.959	0.062	-3.895	0.062	5659.00	2.970	12.313
295.26027289	0.0323	40.25552026	0.0378	2076488117782413440	0.3969	0.0396	-2.750	0.071	-3.783	0.075	5772.25	1.711	12.007
295.25792007	0.0342	40.25946391	0.0404	2076488117782414208	0.4319	0.0430	-3.457	0.076	-4.101	0.077	5612.20	5.341	11.823
295.28083371	0.0236	40.24467413	0.0278	2076488083422685440	0.3628	0.0288	-2.979	0.051	-3.869	0.052	5667.95	3.105	12.202
295.27954819	0.0266	40.24631898	0.0313	2076488083422685568	0.3294	0.0326	-2.886	0.058	-3.742	0.059	5618.33	3.096	12.411
295.27181786	0.0183	40.23448384	0.0231	2076488049062931328	0.3652	0.0232	-2.737	0.040	-3.858	0.043	4818.61	49.417	12.187
295.27371318	0.0219	40.24504408	0.0267	2076488049062939648	0.3584	0.0273	-3.005	0.048	-3.787	0.050	5865.50	4.106	12.228
295.18593252	0.0166	40.21443752	0.0194	2076488289581014400	0.3780	0.0213	-2.912	0.038	-3.923	0.042	5713.01	7.832	12.113
295.16275745	0.0199	40.20250242	0.0246	2076488255221252224	0.3863	0.0256	-3.115	0.043	-3.784	0.044	5830.95	4.632	12.065
295.17470046	0.0269	40.20444803	0.0339	2076488255221261696	0.3530	0.0344	-2.970	0.058	-3.782	0.061	5745.53	3.023	12.261
295.19562595	0.0281	40.19904951	0.0333	2076488216554641536	0.3243	0.0344	-2.664	0.063	-4.005	0.063	5766.00	2.985	12.445
295.19729021	0.0320	40.20229518	0.0366	2076488220861538432	0.3694	0.0401	-2.870	0.069	-3.748	0.072	5803.50	2.148	12.163
295.19569529	0.0309	40.22167979	0.0375	2076488392660242048	0.3983	0.0396	-2.205	0.070	-3.553	0.077	5355.00	1.809	11.999
295.20915978	0.0191	40.21968228	0.0245	2076488323940775680	0.3142	0.0253	-3.026	0.042	-3.845	0.043	4807.44	68.282	12.514
295.20478385	0.0368	40.22272417	0.0449	2076488323940773760	0.3881	0.0472	-2.648	0.085	-3.770	0.088	5579.87	1.342	12.055
295.20272080	0.0276	40.24580999	0.0320	2076488427020146304	0.4469	0.0353	-2.256	0.062	-6.464	0.060	5689.14	1.821	11.749
295.20655843	0.0235	40.22473410	0.0294	2076488358300516352	0.3650	0.0296	-2.916	0.052	-3.993	0.055	5762.00	3.322	12.189
295.21387240	0.0292	40.21713973	0.0331	2076488358300516864	0.4027	0.0352	-2.938	0.064	-3.931	0.062	5676.50	2.037	11.975
295.21234930	0.0275	40.22277851	0.0324	2076488358300519040	0.3955	0.0341	-2.850	0.061	-3.553	0.061	5771.67	2.147	12.014
295.20687616	0.0132	40.24200659	0.0159	2076488427020005632	0.3541	0.0167	-2.843	0.028	-3.716	0.029	4771.03	43.162	12.254
295.22370785	0.0408	40.22914448	0.0475	2076488358300532608	0.4174	0.0508	-2.953	0.092	-3.723	0.093	5422.00	1.090	11.897
295.17346501	0.0202	40.23549793	0.0254	2076488495739451136	0.3143	0.0253	-2.859	0.046	-3.993	0.050	6054.21	6.227	12.513
295.16827443	0.0238	40.24552278	0.0260	2076488667538145792	0.3430	0.0295	-2.991	0.050	-3.738	0.050	5823.00	5.655	12.324
295.17935707	0.0153	40.25209553	0.0187	2076488667538158208	0.3319	0.0184	-2.850	0.034	-3.926	0.036	5015.00	13.661	12.395
295.18464101	0.0223	40.24941997	0.0244	2076488633178423424	0.3205	0.0257	-2.793	0.051	-3.867	0.046	5820.25	6.484	12.471
295.23243689	0.0198	40.25936167	0.0226	2076488770617529088	0.3237	0.0238	-2.881	0.043	-3.828	0.042	5899.25	7.100	12.449
295.21148619	0.0278	40.25181261	0.0315	2076488804977268096	0.3591	0.0329	-2.960	0.062	-3.771	0.059	5767.33	2.762	12.224
295.23761350	0.0229	40.26063495	0.0288	2076488770617429632	0.4052	0.0287	-2.974	0.051	-3.830	0.053	5886.25	3.481	11.962
295.21515945	0.0220	40.25500542	0.0251	2076488804977145216	0.4083	0.0261	-2.889	0.049	-3.873	0.047	5772.00	3.347	11.945
295.22315778	0.0184	40.24106727	0.0218	2076488736257664128	0.3359	0.0230	-2.962	0.041	-3.747	0.041	5799.25	6.445	12.369
295.22816113	0.0189	40.23480526	0.0223	2076488736257663872	0.3149	0.0243	-2.962	0.042	-3.895	0.044	5835.91	7.794	12.509
295.25471535	0.0270	40.28879177	0.0338	2076488976775894656	0.3945	0.0327	-2.920	0.058	-3.801	0.061	5858.00	2.482	12.020
295.24836619	0.0242	40.28050999	0.0285	2076488976775881984	0.3147	0.0293	-2.866	0.053	-3.837	0.051	5572.25	5.282	12.511
295.23883880	0.0170	40.27429471	0.0204	2076488942416130688	0.3473	0.0209	-2.898	0.036	-3.765	0.037	5783.01	8.889	12.296
295.26089851	0.0398	40.27551141	0.0472	2076488908056482176	0.4323	0.0486	-2.945	0.086	-3.844	0.094	5747.00	1.229	11.821
295.20407521	0.0270	40.27365858	0.0301	2076489011135579264	0.2918	0.0319	-2.295	0.059	-1.901	0.057	4831.00	5.253	12.675
295.22932339	0.0351	40.31262138	0.0402	2076489251653796736	0.3626	0.0404	-2.983	0.073	-3.875	0.077	5820.25	2.500	12.203
295.23008206	0.0358	40.29705462	0.0418	2076489182934308096	0.4134	0.0416	-2.868	0.075	-3.847	0			

295.12088320	0.0395	40.25384816	0.0464	2076491553756138240	0.3865	0.0485	-2.123	0.092	-6.523	0.092	5763.76	1.361	12.064
295.16414479	0.0221	40.27131345	0.0248	2076491656835398016	0.3578	0.0264	-3.011	0.050	-3.955	0.047	5780.75	4.675	12.232
295.13019075	0.0331	40.27804672	0.0389	2076491794274328064	0.3296	0.0407	-2.831	0.076	-3.882	0.077	5669.10	2.492	12.410
295.15075708	0.0316	40.31477175	0.0355	2076492309670447744	0.3591	0.0388	-3.551	0.067	-2.014	0.067	5639.67	2.327	12.224
295.15022167	0.0244	40.31561818	0.0259	2076492309670447872	0.3095	0.0294	-2.772	0.050	-3.833	0.048	6368.35	5.574	12.547
295.30793515	0.0245	40.25838855	0.0303	2076581748067801088	0.3197	0.0293	-2.790	0.048	-3.995	0.059	5811.00	4.755	12.476
295.30502117	0.0159	40.24905188	0.0213	2076581713708054656	0.3715	0.0200	-3.031	0.035	-4.139	0.044	4073.95	260.915	12.150
295.31439782	0.0168	40.25334597	0.0196	2076581675049058176	0.3479	0.0201	-2.994	0.037	-3.933	0.038	5601.67	7.498	12.293
295.31118147	0.0368	40.23640868	0.0394	2076581644988574592	0.3762	0.0434	-2.895	0.073	-3.802	0.080	5513.00	1.654	12.123
295.31084002	0.0246	40.23038344	0.0332	2076581644988570112	0.3352	0.0289	-2.914	0.055	-3.823	0.065	5809.00	3.518	12.373
295.32426419	0.0156	40.25318824	0.0194	2076581679348332544	0.3644	0.0195	-2.931	0.034	-3.702	0.039	5442.00	6.806	12.192
295.30202021	0.0194	40.24009103	0.0235	2076581644988569984	0.3342	0.0236	-2.958	0.042	-3.865	0.045	5817.00	4.739	12.380
295.30416585	0.0135	40.24924052	0.0178	2076581713708596352	0.4215	0.0174	-2.763	0.029	-3.832	0.035	5315.45	9.006	11.876
295.31253787	0.0309	40.23774318	0.0385	2076581644988576384	0.4853	0.0383	-2.881	0.068	-3.498	0.078	5668.43	1.464	11.570
295.31771532	0.0334	40.26516107	0.0396	2076581748067811584	0.3887	0.0404	-2.420	0.071	-3.728	0.077	5399.10	6.48	12.052
295.31145393	0.0190	40.25287866	0.0220	2076581713708061696	0.3251	0.0222	-2.935	0.040	-3.751	0.043	5566.89	6.827	12.440
295.30563399	0.0187	40.25184388	0.0227	2076581713708057088	0.3285	0.0221	-2.985	0.039	-3.724	0.047	5612.10	7.642	12.417
295.34339597	0.0189	40.28761011	0.0211	2076581885506794368	0.3632	0.0223	-2.764	0.039	-3.762	0.040	5814.01	6.294	12.199
295.33819838	0.0221	40.28978259	0.0246	2076581885506792704	0.3571	0.0252	-2.856	0.046	-3.687	0.047	5789.50	4.679	12.236
295.34691396	0.0327	40.26979151	0.0408	2076581816787309824	0.3922	0.0408	-2.866	0.073	-4.005	0.083	5340.33	1.489	12.032
295.34626457	0.0181	40.26689989	0.0225	2076581816787307392	0.3201	0.0221	-2.910	0.039	-3.796	0.043	5760.00	6.162	12.474
295.32405297	0.0317	40.28617396	0.0360	2076581851147043328	0.3976	0.0371	-3.132	0.065	-4.078	0.066	5654.72	2.033	12.003
295.33152705	0.0171	40.27112037	0.0212	2076581782427562368	0.3525	0.0209	-2.978	0.037	-3.942	0.041	5744.00	5.719	12.264
295.32978652	0.0295	40.27065399	0.0368	2076581782427561088	0.3342	0.0366	-2.885	0.065	-4.03	0.075	5654.72	2.377	12.380
295.33592281	0.0162	40.26096937	0.0203	2076581782427559808	0.3837	0.0199	-2.808	0.035	-3.703	0.039	5767.67	5.413	12.080
295.33288317	0.0291	40.26151052	0.0364	2076581782427558272	0.2989	0.0364	-3.001	0.065	-4.046	0.074	5579.87	2.990	12.622
295.33163213	0.0316	40.25900868	0.0392	2076581782427556096	0.3065	0.0393	-2.913	0.070	-4.037	0.079	5370.00	2.551	12.568
295.33268023	0.0362	40.25521146	0.0420	2076581782427554816	0.3836	0.0441	-2.840	0.076	-3.802	0.085	5340.50	1.515	12.081
295.34258719	0.0160	40.27893164	0.0195	2076581816787312896	0.3301	0.0201	-2.960	0.034	-3.866	0.038	4737.69	55.818	12.407
295.28452518	0.0230	40.27573752	0.0266	2076581984282790528	0.3478	0.0285	-2.943	0.050	-3.866	0.050	5830.00	4.306	12.293
295.28038079	0.0286	40.26938435	0.0343	2076581984282789504	0.3671	0.0362	-1.900	0.063	-2.780	0.062	4760.00	3.188	12.176
295.29127655	0.0197	40.26373994	0.0221	2076581919866484224	0.3476	0.0243	-2.743	0.041	-3.897	0.041	4860.80	65.811	12.295
295.30176943	0.0353	40.27572585	0.0422	2076581954226237440	0.3462	0.0414	-2.403	0.078	-4.438	0.085	5251.10	2.105	12.303
295.28319582	0.0246	40.28711919	0.0284	2076582022946242816	0.3418	0.0293	-2.899	0.053	-3.642	0.054	5373.45	3.705	12.331
295.28240339	0.0280	40.28706297	0.0316	2076582022946242688	0.3270	0.0330	-3.065	0.063	-4.119	0.060	5670.00	3.314	12.427
295.32005576	0.0391	40.29147243	0.0490	2076582057305473792	0.3741	0.0487	-2.487	0.082	-5.821	0.092	5327.25	1.583	12.135
295.31466992	0.0428	40.29478053	0.0510	2076582057305472128	0.4510	0.0528	-3.005	0.090	-3.926	0.105	6305.08	0.879	11.729
295.31905270	0.0500	40.28615406	0.0544	2076582057305469568	0.4512	0.0586	-3.290	0.108	-3.902	0.107	5099.43	0.858	11.728
295.35131457	0.0204	40.29669632	0.0237	2076582263463926656	0.3769	0.0238	-2.776	0.042	-4.028	0.045	5757.00	4.745	12.119
295.37265752	0.0389	40.32469724	0.0461	2076582400902908288	0.3784	0.0467	-3.445	0.080	-4.897	0.088	5552.00	1.524	12.110
295.38215081	0.0340	40.34566862	0.0405	2076582435262665088	0.3584	0.0417	-2.937	0.071	-3.877	0.079	5663.74	2.096	12.228
295.33762101	0.0290	40.33469278	0.0356	2076582572701584128	0.3194	0.0358	-1.926	0.058	-1.974	0.070	5332.00	4.083	12.478
295.32422885	0.0402	40.32608345	0.0452	2076582538341832704	0.3583	0.0479	-2.848	0.086	-3.886	0.094	5718.62	1.841	12.229
295.34848015	0.0202	40.31865387	0.0260	2076582503982578944	0.3368	0.0252	-2.040	0.041	-6.073	0.049	4118.00	229.291	12.363
295.33652061	0.0184	40.33314766	0.0227	2076582572701582208	0.3300	0.0229	-3.040	0.037	-3.973	0.045	4935.47	14.858	12.407
295.37053478	0.0225	40.34994150	0.0263	2076582641421089408	0.2971	0.0269	-2.937	0.045	-3.855	0.048	5815.50	6.966	12.635
295.35405954	0.0162	40.33908678	0.0206	2076582607061335424	0.3650	0.0189	-2.926	0.032	-3.993	0.037	5438.50	11.167	12.189
295.35755279	0.0190	40.33061760	0.0230	2076582607061332864	0.3584	0.0229	-2.953	0.039	-3.872	0.041	5411.56	8.094	12.228
295.37309129	0.0271	40.35152439	0.0341	2076582641421093120	0.3710	0.0333	-2.790	0.054	-3.823	0.065	5787.33	2.985	12.153
295.34939417	0.0202	40.36233676	0.0248	2076582710140560000	0.3639	0.0244	-2.931	0.040	-3.861	0.047	4848.37	54.642	12.195
295.27010479	0.0215	40.30579800	0.0256	2076582847579431168	0.3337	0.0255	-2.995	0.044	-3.859	0.049	5854.00	5.774	12.383
295.29772509	0.0275	40.32574624	0.0350	2076582916298938112	0.3006	0.0315	-4.055	0.054	-5.027	0.067	5070.33	7.036	12.610
295.28581737	0.0426	40.32010519	0.0479	2076582881939188736	0.4336	0.0524	-2.689	0.092	-3.958	0.092	5427.00	1.131	11.815
295.28426865	0.0353	40.32550125	0.0348	2076582950658667264	0.4314	0.0404	-2.915	0.072	-3.492	0.063	3815.88	664.956	11.826
295.25741911	0.0218	40.32664176	0.0252	2076583049434694016	0.3361	0.0278	-2.815	0.045	-3.839	0.044	5811.00	5.766	12.368
295.26123775	0.0282	40.35881230	0.0321	2076583259896317056	0.4386	0.0348	-3.101	0.061	-4.714	0.060	5796.00	1.937	11.790
295.24778759	0.0316	40.34950207	0.0408	2076583225536564992	0.3526	0.0431	-2.937	0.067	-3.718	0.075	5613.54	2.174	12.264
295.27926691	0.0169	40.34286513	0.0193	2076583191176842880	0.3181	0.0212	-2.865	0.035	-3.763	0.036	5741.16	9.933	12.487
295.32303958	0.0291	40.38379017	0.0380	2076583500414537856	0.3620	0.0371	-3.076	0.060	-3.872	0.069	5820.67	2.516	12.206
295.33774181	0.0290	40.36930973	0.0410	2076583431695062400	0.3626	0.0382	-2.932	0.060	-3.793	0.073	5786.67	2.419	12.203
295.28261082	0.0358	40.37267310	0.0412	2076583637853460096	0.3578	0.0448	-2.207	0.075	-2.461	0.081	4965.00	2.177	12.232
295.31919113	0.0197	40.38536132	0.0264	2076583706572966656	0.3796	0.0255	-2.798	0.041	-3.661	0.057	5830.50	5.696	12.103
295.38996247	0.0324	40.35650359	0.0407	2076583912731424000	0.3687	0.0409	-2.889	0.066	-3.776	0.075	5617.09	2.175	12.167
295.22879457	0.0386	40.35881623	0.0460	2076586146114319104	0.3919	0.0487	-2.977	0.082	-3.959	0.092	5475.33	1.278	12.034
295.30334255	0.0176	40.11519531	0.0204	2076298452030943360	0.3141	0.0218	-2.892	0.038	-3.826	0.037	5744.00	8.423	12.515
295.31796852	0.0175	40.09745065	0.0261	2076298383311466368	0.3214	0.0217	-2.658	0.038	-4.201	0.051	4891.01	63.093	12.465
295.31658297	0.0417	40.10360581	0.0568	2076298417671207040	0.4183	0.0545	-3.043	0.096	-3.748	0.133	5354.33	1.020	11.893
295.31373128	0.0315	40.10478826	0.0381	2076298417671205504	0.3601	0.0378	-1.918	0.071	-4.396	0.079	6049.71	1.992	12.218
295.31884374	0.0241	40.10848234	0.0289	2076298417671211136	0.3430	0.0300	-2.897	0.055	-3.905	0.			

295.26726288	0.0180	40.17315281	0.0204	2076299585902317952	0.3348	0.0214	-2.868	0.039	-3.973	0.039	5791.00	6.393	12.376
295.34921054	0.0430	40.17908178	0.0539	2076299792060826240	0.4091	0.0513	-2.807	0.093	-3.728	0.116	5111.15	1.081	11.941
295.37672742	0.0283	40.23789505	0.0389	2076393869023079296	0.3986	0.0364	-2.984	0.061	-3.786	0.08	5404.15	1.774	11.997
295.37256652	0.0176	40.23886002	0.0229	2076393869023076608	0.3230	0.0218	-2.974	0.035	-3.686	0.04	4564.48	65.128	12.454
295.37680978	0.0186	40.24569257	0.0237	2076393869023084288	0.4017	0.0233	-2.773	0.039	-4.189	0.05	5624.20	4.468	11.980
295.48908162	0.0345	40.33808974	0.0411	2076396377284119936	0.3424	0.0424	-3.195	0.076	-3.895	0.081	5476.76	2.052	12.327
295.14645903	0.0137	40.06701961	0.0161	2076484922326532224	0.4550	0.0167	-2.350	0.031	-4.925	0.031	6134.50	6.281	11.710
295.26792702	0.0206	40.19182629	0.0227	2076487636746037504	0.3822	0.0241	-2.768	0.045	-3.828	0.042	5807.00	4.790	12.089
295.25342163	0.0339	40.20843132	0.0401	2076487705465514624	0.4635	0.0418	-2.894	0.078	-3.842	0.080	5439.50	1.022	11.670
295.27374425	0.0210	40.22151007	0.0268	2076487739825279616	0.3636	0.0259	-2.735	0.046	-3.876	0.050	5809.26	3.785	12.197
295.27435171	0.0184	40.20839592	0.0219	2076487666798844288	0.3587	0.0225	-2.820	0.042	-4.037	0.044	5729.30	5.273	12.226
295.26563214	0.0239	40.20814657	0.0274	2076487739825262592	0.3164	0.0286	-2.921	0.054	-3.804	0.052	5504.00	4.927	12.499
295.26447901	0.0180	40.21499327	0.0196	2076487739825266304	0.3714	0.0210	-2.848	0.040	-3.973	0.037	5673.64	5.882	12.151
295.37142241	0.0169	40.21778613	0.0211	2076393765943846656	0.3535	0.0209	-3.040	0.037	-3.937	0.04	4916.00	52.213	12.258
295.42510409	0.0243	40.33146045	0.0286	2076396205485384704	0.3188	0.0285	-2.957	0.051	-4.819	0.053	5350.00	4.747	12.482
295.40830265	0.0167	40.32294568	0.0202	2076396171125628672	0.3501	0.0196	-3.000	0.035	-3.856	0.037	5361.84	8.813	12.279
295.43204056	0.0154	40.32594347	0.0204	2076396136765909504	0.3499	0.0183	-2.933	0.032	-3.913	0.038	5899.48	11.185	12.280
295.47136534	0.0204	40.35159190	0.0263	2076396446003592704	0.3540	0.0252	-3.653	0.043	-4.864	0.049	4870.00	5.635	12.255
295.5262167	0.0573	40.08465475	0.0813	2076388302745473536	0.2934	0.0772	-2.415	0.128	-6.076	0.149	-	-	12.663
295.39300884	0.0294	40.22973110	0.0378	2076393800303608576	0.3908	0.0371	-2.813	0.066	-3.994	0.08	5599.31	1.900	12.040
295.38052965	0.0154	40.21942162	0.0203	2076393765944335104	0.3662	0.0190	-3.036	0.033	-3.713	0.04	5295.25	7.671	12.181
295.38967479	0.0171	40.23908518	0.0218	2076393800303612032	0.3503	0.0213	-2.967	0.037	-3.690	0.04	6048.68	5.636	12.278
295.35190589	0.0289	40.22215292	0.0322	2076393731584096256	0.3819	0.0334	-3.642	0.060	-3.601	0.06	5605.00	2.804	12.090
295.35802345	0.0202	40.21451434	0.0252	2076393731584095872	0.3557	0.0249	-2.924	0.045	-3.986	0.05	5759.33	4.260	12.245

Table B.26: Sample 3.

C. Appendix C

Code 1

November 7, 2020

```
[1]: #A PYTHON program to calculate the distance modulus and the proper motions of
     ↳ the well-known Kepler members.

[19]: import numpy as np

[20]: import matplotlib.pyplot as plt

[21]: import math

[22]: import pylab

[23]: import pandas as pd

[24]: f=pd.read_csv('C:\\Users\\Hend\\Downloads\\Well known Kepler.csv') #to read the
     ↳ data of the well-known Kepler members.

[35]: f
```

	Unnamed: 0	KIC	RA	eRA	DEC	eDEC	s	\
0	0	5024354	295.309555	0.0771	40.169966	0.1029	2.076300e+18	
1	1	5113436	295.459081	0.0170	40.245832	0.0234	2.076394e+18	
2	2	5024524	295.329934	0.0114	40.159108	0.0149	2.076300e+18	
3	3	5113517	295.479787	0.0230	40.239351	0.0287	2.076395e+18	
4	4	4937456	295.409149	0.0129	40.052015	0.0176	2.076295e+18	
..	...	...	...	...	...	...	...	
193	193	5200187	295.357553	0.0190	40.330618	0.0230	2.076583e+18	
194	194	5200422	295.405639	0.0190	40.321932	0.0227	2.076396e+18	
195	195	5200436	295.408303	0.0167	40.322946	0.0202	2.076396e+18	
196	196	5200544	295.432041	0.0154	40.325943	0.0204	2.076396e+18	
197	197	5200701	295.468299	0.0212	40.315834	0.0263	2.076396e+18	

	p	ep	pr	epr	pd	epd	x	t	l
0	0.2956	0.0919	-2.604	0.176	-4.457	0.204	6024.27	5601.00	NaN
1	0.3692	0.0224	-2.864	0.036	-3.876	0.041	178.26	5676.50	6.054
2	0.3278	0.0143	-2.866	0.025	-3.892	0.028	136.18	5096.00	23.063
3	0.4618	0.0290	-2.860	0.049	-3.832	0.055	749.35	3754.12	641.958
4	0.9576	0.0170	-0.574	0.028	5.702	0.033	168.74	5869.00	2.143

```

..      ""      ""      ""      ""      ""      ""      ""      ""      ""
193  0.3584  0.0229 -2.953  0.039 -3.872  0.041  146.82  5411.56  8.094
194  0.3445  0.0223 -2.849  0.039 -3.865  0.041  185.84  5835.00  6.475
195  0.3501  0.0196 -3.000  0.035 -3.856  0.037  149.80  5361.84  8.813
196  0.3499  0.0183 -2.933  0.032 -3.913  0.038  156.44  5899.48  11.185
197  0.4033  0.0264 -3.023  0.044 -3.870  0.046  236.87  5787.00  4.107

```

```
[198 rows x 16 columns]
```

```
[26]: v=f['p']/1000 #to convert the parallax unit from mas to pc.
```

```
[27]: x = 1/v #to calculate the distance (1/parallax).
```

```
[28]: m= -5 + 5 *np.log10(x)
```

```
[29]: m.mean() #the mean of the distance modulus.
```

```
[29]: 12.15063069647128
```

```
[36]: pra = f['pr']
```

```
[37]: pra.mean() #the mean of the proper motion in RA.
```

```
[37]: -2.9068737373737377
```

```
[38]: np.std(pra) #the standard deviation of the proper motion in RA.
```

```
[38]: 1.1102299558041213
```

```
[50]: pdec = f['pd']
```

```
[51]: pdec.mean() #the mean of the proper motion in Dec.
```

```
[51]: -3.984904040404042
```

```
[52]: np.std(pdec) #the standard deviation of the proper motion in Dec.
```

```
[52]: 2.6409411709785435
```

Code 2

November 7, 2020

```
[1]: #A PYTHON program to find the new NGC6819 members, estimate the new distance,
      ↪ modulus and proper motions, and plot the H-R diagram.

[1]: import pandas as pd

[2]: import pylab

[3]: import math

[4]: import numpy as np

[5]: import matplotlib.pyplot as plt

[6]: a = pd.read_csv('E:\\Research\\New data\\Gaia.csv') #to read the downloaded
      ↪ Gaia data.

[7]: a
```

	D1	D2	D3	D4	D5	D6	\
0	295.331622	0.2166	39.989818	0.2749	2076293263705989376	0.2568	
1	295.323856	0.4409	39.996588	0.7388	2076293263705984896	1.8825	
2	295.326747	0.6718	39.987015	1.4471	2076293229346233728	-0.0276	
3	295.321669	0.8137	39.989482	2.0371	2076293229346230528	-0.8287	
4	295.349520	0.0606	39.989720	0.0764	2076293194990940032	0.3671	
...	...	...	...	...	...	...	
15175	295.200361	0.7589	40.357960	0.8304	2076586317902273792	-0.3374	
15176	295.209470	0.4547	40.361077	0.5732	2076586317902312192	0.1980	
15177	295.206261	0.6502	40.362496	0.7523	2076586317902306944	0.4423	
15178	295.270100	0.6248	40.379509	0.7442	2076586592780434176	-1.3017	
15179	295.268286	0.1466	40.376754	0.1835	2076586588487766656	0.1884	

	D7	D8	D9	D10	D11	D12	D13	D14
0	0.2911	-3.939	0.543	-4.781	0.511	213.53	NaN	NaN
1	0.5397	3.668	1.020	-3.561	1.508	204.06	NaN	NaN
2	0.7844	-0.466	1.568	-11.412	2.825	142.70	NaN	NaN
3	1.0066	-1.495	1.770	1.203	3.998	177.16	NaN	NaN
4	0.0781	-2.740	0.147	-4.275	0.148	227.11	NaN	NaN

```

...      ...      ...      ...      ...      ...      ...      ...
15175  0.8963 -3.177  1.729  -3.189  1.528  166.13  NaN  NaN
15176  0.5834 -3.484  1.061  -4.976  1.045  188.54  NaN  NaN
15177  0.8350 -2.896  1.450  -0.932  1.346  227.01  NaN  NaN
15178  0.7810 -8.694  1.498  -9.657  1.361  222.91  NaN  NaN
15179  0.1940 -2.402  0.317  -3.888  0.354  201.41  NaN  NaN

```

[15180 rows x 14 columns]

```

[8]: pd.options.display.max_columns = None #to insurt None in the empty cells.
[9]: p = a[a['D6'] > 0] #to remove the stars that have negative parallax value.
[10]: pnon = p[pd.notnull(p['D6'])] #to remove the stars that have no parallax.
[11]: ppr = pnon[pd.notnull(pnon['D8'])] #to remove the stars that have proper motion
      ↪ in RA.
[12]: ppd = ppr[pd.notnull(ppr['D10'])] #to remove the stars that have proper motion
      ↪ in Dec.
[13]: ppd

```

```

[13]:
      D1      D2      D3      D4      D5      D6 \
0      295.331622  0.2166  39.989818  0.2749  2076293263705989376  0.2568
1      295.323856  0.4409  39.996588  0.7388  2076293263705984896  1.8825
4      295.349520  0.0606  39.989720  0.0764  2076293194990940032  0.3671
6      295.338026  0.1476  39.997671  0.1283  2076293263706022144  0.1897
7      295.346623  0.4013  39.991012  0.5049  2076293194986553344  0.1855
...      ...      ...      ...      ...      ...      ...
15173  295.200979  0.2520  40.359627  0.3078  2076586313609850112  0.3087
15174  295.200421  0.0466  40.354496  0.0538  2076586313609847680  0.3361
15176  295.209470  0.4547  40.361077  0.5732  2076586317902312192  0.1980
15177  295.206261  0.6502  40.362496  0.7523  2076586317902306944  0.4423
15179  295.268286  0.1466  40.376754  0.1835  2076586588487766656  0.1884

      D7      D8      D9      D10      D11      D12      D13      D14
0      0.2911 -3.939  0.543 -4.781  0.511  213.53      NaN      NaN
1      0.5397  3.668  1.020 -3.561  1.508  204.06      NaN      NaN
4      0.0781 -2.740  0.147 -4.275  0.148  227.11      NaN      NaN
6      0.1383 -2.581  0.325 -4.721  0.252  200.75      NaN      NaN
7      0.5416 -5.610  0.980 -2.196  0.931  252.76      NaN      NaN
...      ...      ...      ...      ...      ...      ...      ...
15173  0.3201  1.296  0.545 -3.426  0.612  387.86      NaN      NaN
15174  0.0575  0.660  0.100 -4.650  0.110  201.26  5357.25      NaN
15176  0.5834 -3.484  1.061 -4.976  1.045  188.54      NaN      NaN
15177  0.8350 -2.896  1.450 -0.932  1.346  227.01      NaN      NaN

```

```
15179  0.1940 -2.402  0.317 -3.888  0.354  201.41      NaN  NaN
```

```
[10895 rows x 14 columns]
```

```
[14]: x=1000/ppd['D6'] #to convert the parallax unit from mas to pc and get distance.
```

```
[15]: m= -5 + 5*np.log10(x) #to calculate the distance modulus for each star.
```

```
[16]: ppd["m"]=m #to insert the distance modulus column in the data file.
```

```
[17]: ppd
```

```
[17]:
```

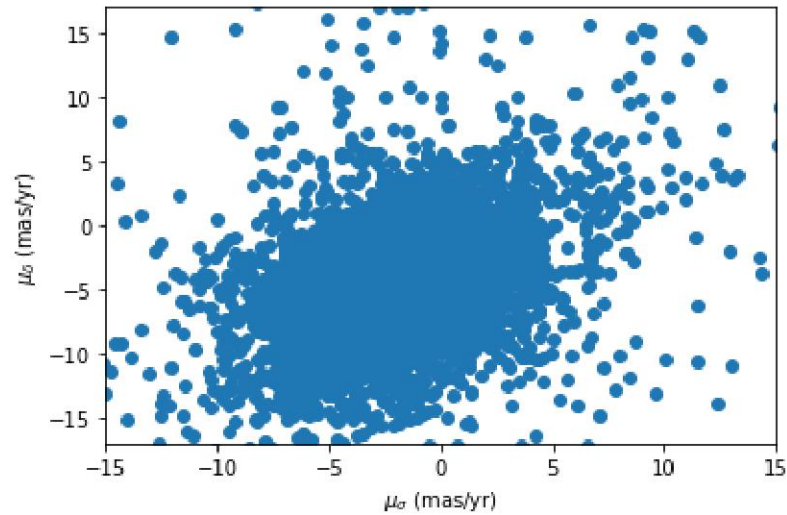
	D1	D2	D3	D4	D5	D6	\
0	295.331622	0.2166	39.989818	0.2749	2076293263705989376	0.2568	
1	295.323856	0.4409	39.996588	0.7388	2076293263705984896	1.8825	
4	295.349520	0.0606	39.989720	0.0764	2076293194990940032	0.3671	
6	295.338026	0.1476	39.997671	0.1283	2076293263706022144	0.1897	
7	295.346623	0.4013	39.991012	0.5049	2076293194986553344	0.1855	
...	...	...	...	...	...	...	...
15173	295.200979	0.2520	40.359627	0.3078	2076586313609850112	0.3087	
15174	295.200421	0.0466	40.354496	0.0538	2076586313609847680	0.3361	
15176	295.209470	0.4547	40.361077	0.5732	2076586317902312192	0.1980	
15177	295.206261	0.6502	40.362496	0.7523	2076586317902306944	0.4423	
15179	295.268286	0.1466	40.376754	0.1835	2076586588487766656	0.1884	

	D7	D8	D9	D10	D11	D12	D13	D14	m
0	0.2911	-3.939	0.543	-4.781	0.511	213.53	NaN	NaN	12.952025
1	0.5397	3.668	1.020	-3.561	1.508	204.06	NaN	NaN	8.626325
4	0.0781	-2.740	0.147	-4.275	0.148	227.11	NaN	NaN	12.176078
6	0.1383	-2.581	0.325	-4.721	0.252	200.75	NaN	NaN	13.609663
7	0.5416	-5.610	0.980	-2.196	0.931	252.76	NaN	NaN	13.658280
...	...	...	...	...	...	...	...	...	...
15173	0.3201	1.296	0.545	-3.426	0.612	387.86	NaN	NaN	12.552317
15174	0.0575	0.660	0.100	-4.650	0.110	201.26	5357.25	NaN	12.367657
15176	0.5834	-3.484	1.061	-4.976	1.045	188.54	NaN	NaN	13.516674
15177	0.8350	-2.896	1.450	-0.932	1.346	227.01	NaN	NaN	11.771415
15179	0.1940	-2.402	0.317	-3.888	0.354	201.41	NaN	NaN	13.624596

```
[10895 rows x 15 columns]
```

```
[18]: plt.plot(ppd['D8'],ppd['D10'],'o')
plt.xlim(-15,15)
plt.ylim(-17,17)
plt.xlabel("$\mu_{\sigma}$ (mas/yr)")
plt.ylabel("$\mu_{\delta}$ (mas/yr)")
# to plot a graph between the proper motion in RA and the proper motion in Dec.
```

```
[18]: Text(0, 0.5, '$\\mu_\\delta$ (mas/yr)')
```



```
[19]: z = ppd[ppd['m'] >= 11.5399]
      c = z[z['m'] <= 12.7613]
      d = c[c['D8'] >= -4.077]
      e = d[d['D8'] <= -1.8566]
      f = e[e['D10'] <= -1.344]
      filt = f[f['D10'] >= -6.6258]
      #to filter the data according to the distance modulus and the proper motions of
      #the well-known members within the standard
      #deviations values.
```

```
[20]: filt
```

```
[20]:
```

	D1	D2	D3	D4	D5	D6 \
4	295.349520	0.0606	39.989720	0.0764	2076293194990940032	0.3671
14	295.347374	0.0961	39.994291	0.1199	2076293190685668736	0.2839
26	295.333074	0.0578	39.996244	0.0688	2076293263710410496	0.2854
45	295.291784	0.4248	39.995548	0.4957	2076293396844515968	0.4539
73	295.303051	0.8679	39.989016	1.1002	2076293332425408768	0.3036
...	...	...	...	...	...	...
15144	295.260882	0.0978	40.373006	0.1159	2076586210530642304	0.3151
15145	295.253473	0.2429	40.376181	0.2777	2076586210530643712	0.3987
15161	295.251212	0.0576	40.355815	0.0687	2076586180474070528	0.4065

```

15168 295.255238 0.0671 40.378133 0.0763 2076586214833824512 0.3471
15170 295.204203 0.3050 40.356706 0.3762 2076586313610137472 0.4094

```

```

          D7      D8      D9      D10      D11      D12 D13 D14      m
4      0.0781 -2.740 0.147 -4.275 0.148 227.11 NaN NaN 12.176078
14     0.1188 -2.838 0.214 -2.835 0.230 249.00 NaN NaN 12.734173
26     0.0699 -2.585 0.133 -6.321 0.135 191.55 NaN NaN 12.722730
45     0.5202 -2.513 0.965 -4.849 0.942 240.95 NaN NaN 11.715199
73     1.2558 -2.884 2.115 -3.725 1.947 159.56 NaN NaN 12.588491
...
15144 0.1234 -3.582 0.210 -5.818 0.231 199.95 NaN NaN 12.507758
15145 0.3021 -3.972 0.522 -5.123 0.551 200.82 NaN NaN 11.996769
15161 0.0735 -3.787 0.123 -2.016 0.137 245.35 NaN NaN 11.954697
15168 0.0827 -2.197 0.141 -6.212 0.152 199.17 NaN NaN 12.297727
15170 0.3928 -2.916 0.678 -4.700 0.745 242.05 NaN NaN 11.939261

```

```
[2117 rows x 15 columns]
```

```
[21]: filt.to_csv("all")
```

```
[22]: allall = pd.read_csv('C:\\Users\\Hend\\Documents\\allall.csv') #to read the
      ↪ data that combine Gaia and Kepler members.
```

```
[23]: y=1000/allall['D6']
```

```
[24]: mall= -5 + 5*np.log10(y)
```

```
[25]: mall.mean() #to calculate the new mean of the distance modulus.
```

```
[25]: 12.173199931144701
```

```
[26]: bew = np.sqrt(2211)
```

```
[27]: bewbew = np.std(mall)
```

```
[28]: bewbew
```

```
[28]: 0.3417735143798322
```

```
[29]: bewbew/bew #the standard error of the mean of the new distance modulus.
```

```
[29]: 0.007268487249007388
```

```
[30]: prall=allall['D8'].mean() #to calculate the new mean of the proper motion in RA.
```

```
[31]: pralle=allall['D9'].mean() #to calculate the error of the proper motion in RA.
```

```

[32]: prall
[32]: -2.879672998643152
[33]: pralle
[33]: 0.24394391677973726
[34]: pdecall=allall['D10'].mean() #to calculate the new mean of the proper motion in
    ↪ RA.
[35]: pdecalle=allall['D11'].mean() #to calculate the error of the proper motion in
    ↪ RA.
[36]: pdecall
[36]: -4.035341474445959
[37]: pdecalle
[37]: 0.2529018543645409
[38]: nol = filt[pd.notnull(filt['D14'])] #to filter Gaia members that have no
    ↪ luminosity.
[39]: nolt = nol[pd.notnull(nol['D13'])] #to filter Gaia members that have no
    ↪ effective temperature.
[40]: nolt
[40]:
      D1      D2      D3      D4      D5      D6  \
239  295.404735  0.0189  40.011895  0.0242  2076294019624475648  0.4365
266  295.425661  0.0446  40.008258  0.0558  2076294191423402880  0.4027
352  295.465918  0.0237  40.042017  0.0312  2076294363221905536  0.3019
356  295.476584  0.0200  40.036004  0.0284  2076294294502430720  0.4432
394  295.409524  0.0411  40.033256  0.0540  2076294466301314176  0.4402
...      ...      ...      ...      ...      ...      ...
14782 295.337742  0.0290  40.369310  0.0410  2076583431695062400  0.3626
14789 295.282611  0.0358  40.372673  0.0412  2076583637853460096  0.3578
14857 295.319191  0.0197  40.385361  0.0264  2076583706572966656  0.3796
14894 295.389962  0.0324  40.356504  0.0407  2076583912731424000  0.3687
15100 295.228795  0.0386  40.358816  0.0460  2076586146114319104  0.3919

      D7      D8      D9      D10      D11      D12      D13      D14      m
239  0.0241 -2.865  0.041 -4.362  0.050  501.28  7347.25  32.513  11.800079
266  0.0551 -2.600  0.099 -3.895  0.114  222.90  5335.50  1.019  11.975092
352  0.0306 -2.782  0.052 -3.839  0.065  181.95  5664.00  4.683  12.600684

```

```

356    0.0267 -2.856  0.045 -3.536  0.054  469.03  4979.42  22.293  11.767001
394    0.0530 -3.179  0.091 -3.696  0.105  227.52  5209.53   0.791  11.781750
...
14782  0.0382 -2.932  0.060 -3.793  0.073  171.36  5786.67   2.419  12.202861
14789  0.0448 -2.207  0.075 -2.461  0.081  166.31  4965.00   2.177  12.231798
14857  0.0255 -2.798  0.041 -3.661  0.057  146.28  5830.50   5.696  12.103369
14894  0.0409 -2.889  0.066 -3.776  0.075  188.86  5617.09   2.175  12.166634
15100  0.0487 -2.977  0.082 -3.959  0.092  206.82  5475.33   1.278  12.034124

```

[812 rows x 15 columns]

```

[41]: logl = np.log10(nolt['D14'])
      logt = np.log10(nolt['D13'])

[42]: b = pd.read_csv('C:\\Users\\Hend\\Documents\\all.csv') #to read the first
      ↪ isochrone data.

[43]: d = pd.read_csv('C:\\Users\\Hend\\Documents\\tryiso31.csv') #to read the
      ↪ second isochrone data.

[44]: c = pd.read_csv('C:\\Users\\Hend\\Documents\\dsctEdges.csv') #to read the
      ↪ trapezoid data that locate the delta Scoti stars.

[45]: ff = pd.read_csv('C:\\Users\\Hend\\new-members65.csv') #to read the data of
      ↪ the new members that have known luminosity and effective temperature.

[46]: logl1 = np.log10(ff['D14'])
      logt1 = np.log10(ff['D13'])

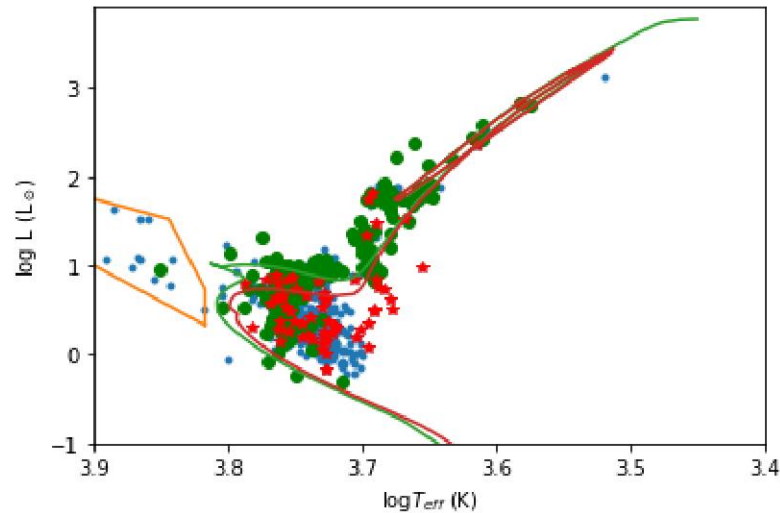
[47]: kk = pd.read_csv('C:\\Users\\Hend\\Downloads\\Well known Kepler.csv') #to read
      ↪ the well known members data.

[48]: logk1 = np.log10(kk['l'])
      logkt = np.log10(kk['t'])

[68]: plt.plot(logt, logl, '-')
      plt.plot(c['a'], c['b'], '-')
      plt.plot(logkt, logk1, 'o', color='green')
      plt.plot(logt1, logl1, '*', color='red')
      plt.plot(b['t'], b['l'], '-')
      plt.plot(d['logTe'], d['logL'], '-')
      plt.xlim(3.9, 3.4)
      plt.ylim(-1, 3.9)
      plt.xlabel("$\\log T_{eff}$ (K)")
      plt.ylabel("log L (L$_{\\odot}$)")
      #to plot the two isochrones, the known members, Canant 2018 members, and the
      ↪ new members that were found in this study.

```

```
[68]: Text(0, 0.5, 'log L (L $\odot$ )')
```



```
[69]: nolt.to_csv("812-members")
```

```
[70]: deltaxc= nolt[ 3.9 >= logt]
deltasc1= deltaxc[ logt >= 3.81]
delta2= deltaxc1[ logl >= 0.1]
delta3= delta2[ 1.8 >= logl] #to get the probable delta Scuti stars in the
↳ trapezoid region.
```

C:\Users\Hend\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: UserWarning:
Boolean Series key will be reindexed to match DataFrame index.

This is separate from the ipykernel package so we can avoid doing imports
until

C:\Users\Hend\Anaconda3\lib\site-packages\ipykernel_launcher.py:4: UserWarning:
Boolean Series key will be reindexed to match DataFrame index.

after removing the cwd from sys.path.

```
[71]: delta3
```

```
[71]:
```

	D1	D2	D3	D4	D5	D6	\
239	295.404735	0.0189	40.011895	0.0242	2076294019624475648	0.4365	
2151	295.238826	0.0125	40.082189	0.0149	2076297627397174528	0.3468	
3144	295.338364	0.0140	40.156302	0.0165	2076299001786810624	0.3462	

Code 3

November 7, 2020

```

[1]: #A PYTHON program to calculate the mass loss.

[2]: import pandas as pd

[3]: import pylab as pl

[4]: import math

[5]: import numpy as np

[6]: import matplotlib.pyplot as plt

[7]: mass = pd.read_csv('C:\\Users\\Hend\\Downloads\\redsample.csv') #to read the
    ↪ red giants data.

[8]: divT=mass['T']/5777
    TP = (divT)**(3.5)
    maq = 3100*TP
    m=mass['numax']* mass['L']/maq #to calculate the mass of each single star using
    ↪ the scaling relation that depend of nu_max (Yu numax).

[9]: mass["m-nu"]=m #to insert the mass column in the table of red giants data.

[10]: mnewnu=mass['nmu']* mass['L']/maq #to calculate the mass of each single star
    ↪ using the scaling relation that depend of nu_max (the one I got form the
    ↪ periodogram).

[11]: mass["mnewnu"]=mnewnu

[12]: dnu = mass['Dnu']/135
    Tpower=divT**(-3)
    LLL=mass['L']**(0.75)
    mmm=dnu*LLL*Tpower
    masss=mmm**(2) #to calculate the mass of each single star using the scaling
    ↪ relation that depend of delta nu (Yu delta nu).

[13]: mass["m(Dnu)"]=masss #to insert the mass column in the table of red giants data.

```

```

[14]: dnu2 = mass['nde']/135
      bbb=dnu2*LL*Tpowers
      mnewd=bbb**(2) #to calculate the mass of each single star using the scaling
      ↪relation that depend of delta nu (the one I got form the periodogram).

[15]: mass["mnewd"]=mnewd #to insert the mass column in the table of red giants data.

[16]: T = mass['T']**2
      L = mass['L']**0.9
      Am= mass['Amax']
      A= Am**0.5
      Mpower = T*L*A/2.5
      MMpower = 1/Mpower
      Mspower = MMpower**0.588 #to calculate the mass of each single star using the
      ↪scaling relation that depend of the maximum aplitude (the one I got form the
      ↪periodogram).

[17]: mass["m(Amp)"]=Mspower #to insert the mass column in the table of red giants
      ↪data.

[18]: p = mass[mass['g'] - mass['eg'] > 2.7 ] #to filter the red clump stas.

[19]: p.to_csv("Latex-RC") #to move the red clump data to a csv file.

[20]: o = mass[(2.3 <= mass["g"] - mass["eg"]) & (mass["g"] - mass["eg"] <= 2.7 )]
      ↪#to filter the red clump stas.

[21]: o.to_csv("Latex-RGB") #to move the red giant branch data to a csv file.

[22]: mnuav1=p['m-nu'].mean() #the mean mass of the red giant clumps.

[23]: mnuav1

[23]: 1.6896933942697654

[24]: mdav1=p['m(Dnu)'].mean() #the mean mass of the red giant clumps.

[25]: mdav1

[25]: 1.627638477189651

[26]: mnuav2=o['m-nu'].mean() #the mean mass of the red giant branch stars.

[27]: mnuav2

[27]: 1.7068941034892653

```

```

[28]: mdav2=o['m(Dnu)'].mean() #the mean mass of the red giant branch stars.

[29]: mnuav2-mnuav1 #the mass-loss that depends on nu max values.

[29]: 0.0172007092194999

[30]: mdav2-mdav1 #the mass-loss that depends on delta nu values.

[30]: 0.1081197146166819

[31]: mamprc=p['m(Amp)'].mean() #the mean mass of the red giant branch stars.

[32]: mamprg=o['m(Amp)'].mean() #the mean mass of the red giant branch stars.

[33]: mamprg-mamprc #the mass-loss that depends on the maximum amplitude values.

[33]: 0.00021692707595252205

[34]: mnewnup= p['mnewnu'].mean() #the mean mass of the red giant branch stars.

[35]: mnewnumo= o['mnewnu'].mean() #the mean mass of the red giant branch stars.

[36]: mnewnumo - mnewnup #the mass-loss that depends on nu max values.

[36]: 0.006181259433728048

[37]: mnewdp= p['mnewd'].mean() #the mean mass of the red giant branch stars.

[38]: mnewdo= o['mnewd'].mean() #the mean mass of the red giant branch stars.

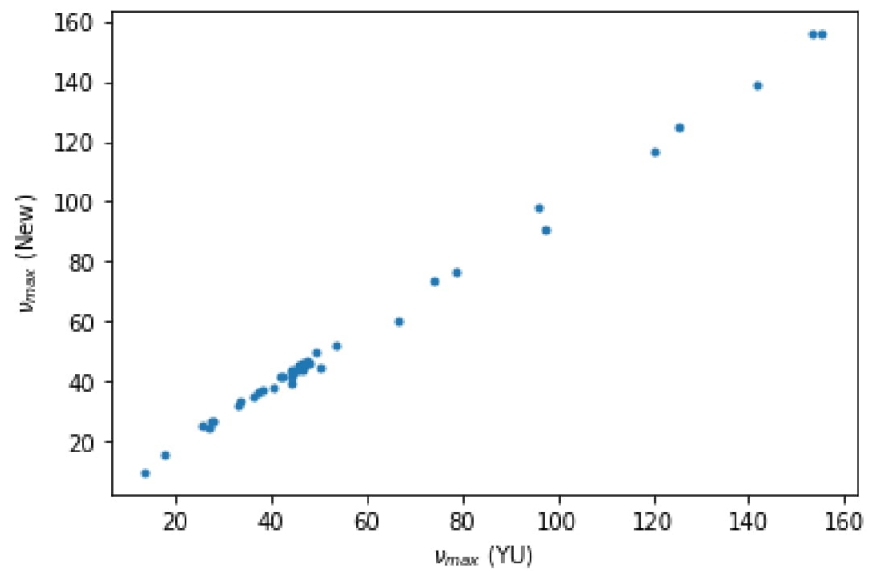
[39]: mnewdo - mnewdp #the mass-loss that depends on delta nu values.

[39]: -0.04216760686535692

[42]: plt.plot(mass['numax'],mass['nmu'],'.')
plt.xlabel(r'$\nu_{\{max\}}$ (YU) ($\mu$Hz)')
plt.ylabel(r'$\nu_{\{max\}}$ (New) ($\mu$Hz)')#to plot a graph between the values_
↳ of nu max that calculated by Yu and the one I estimated.

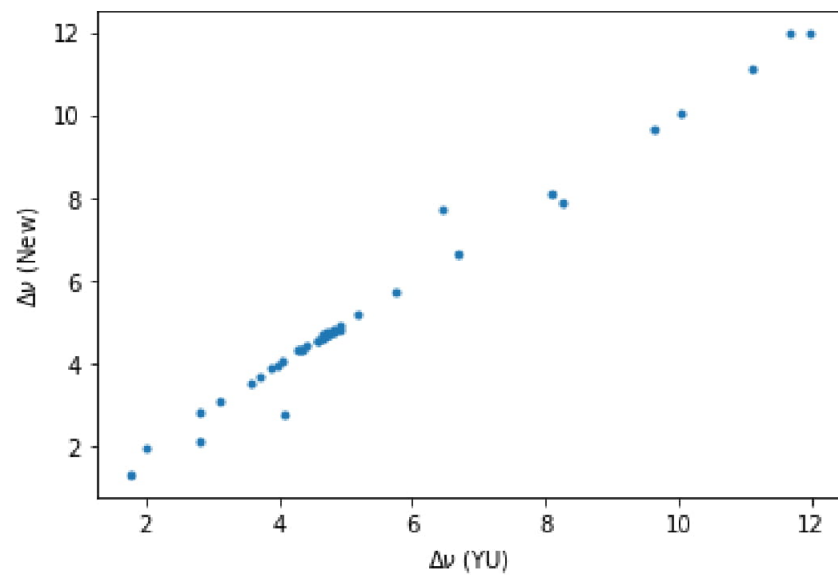
[42]: Text(0, 0.5, '$\nu_{\{max\}}$ (New) ($\mu$Hz)')

```



```
[41]: plt.plot(mass['Dnu'],mass['nde'],'.')
plt.xlabel(r'$\Delta \nu$ (YU)')
plt.ylabel(r'$\Delta \nu$ (New)') #to plot a graph between the values of delta_
    ↪nu that calculated by Yu and the one I estimated.
```

```
[41]: Text(0, 0.5, '$\Delta \nu$ (New)')
```



[]:

