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A selection of twenty three bright hypervelocity Gaia DR3 stars

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Abstract

From the Gaia DR3 data twenty three bright hypervelocity stars (HVS) that have Tycho catalogue numbers are presented. All these stars are of high galactic latitude and some may be galactic halo stars. All of them have accurate Gaia DR3 parallaxes and radial velocities. There is hardly any relevant literature on some of these stars. The Gaia DR3 astrophysical parameters of some of these stars indicate that they are of late spectral types and some are metal-poor. The astrophysical parameters are available for some of these stars in the literature but they differ from the Gaia DR3 results. Detailed chemical composition determination of these stars from an analysis of high resolution spectra is very much needed to further understand the evolutionary status and how these stars acquired such high radial velocities.

Keywords : Hypervelocity stars – Radial velocities- Metal-Poor stars

1. Introduction

I have searched Gaia EDR3 and Gaia DR3 data (Gaia Collaboration 2020 ,2022) for hypervelocity stars (HVS) adopting a simple search criteria. This paper is a continuation of that work. For more details of search criteria see Parthasarathy (2023, 2024a, b) and there is no need to repeat them here. In this research note I present twenty three Tycho-2 catalogue stars (Hog et al. 2000) with Gaia G-magnitudes between 10 to 12 and Gaia radial velocities between +400 km/sec to +582 km/sec that I found (Table 1). I have excluded by manual inspection OB runaways, Be stars, known variable and binary stars in the present research note to keep it within the page and table limits. They will be presented in a separate paper. Stars with only Gaia radial velocities are considered. Stars with radial velocities from other surveys are not included in this research note. Stars with accurate parallaxes (much more than five sigma) are only considered. The justification to include only the Tycho stars is that these 23 stars are of high galactic latitude late-type stars and seem to form a homogenous group and secondly the search criteria of stars with Gaia radial velocities between +400 to +600 yielded only these 23 Tycho stars. Other HVS were already reported in the RNAAS papers (Parthasarathy 2023, 2024a, b)

2. Discussion

The selected HVS candidates are given in Table 1. Only three stars in Table 1 have RUWE values little bit more than 1.4 (TYC 223-1260-1, TYC 6630-1505-1 and TYC 7288-311-1) for all other stars the RUWE values are less than 1.4. The column headings of Table 1 are Gaia DR3 number, TYC number (Tycho catalogue, Hog et al. 2000), galactic longitude, galactic latitude, Gaia G-magnitude, Gaia radial velocity (RV, km/sec), distance (parsecs), proper motion (mas/year), and galactic U, V, W, V_t (tangential) velocities in km/sec respectively. All the stars given in Table 1 are of high galactic latitude and some of

6701417100927166080	8743-1923-1	340.06	-15.02	10.43	409	4909	8.005	371	-135	-106
186										
5249116172266308992	8950-40-1	285.15	-8.78	10.90	478	1139	30.754	123	-456	-73
166										

The errors in radial velocities are of the order of 1.0 km/sec. The parallaxes are much larger than five sigma. The astrophysical parameters T_{eff} , $\log g$ and $[\text{Fe}/\text{H}]$ given in the notes are from Gaia DR3 data (Gaia Collaboration 2022). For many stars in Table 1 Gaia DR3 spectra are available.

3. Notes

TYC 223-1260-1 : $T_{\text{eff}} = 5910\text{K}$, $\log g = 2.91$, and $[\text{Fe}/\text{H}] = -0.219$.

TYC 276-429-1 : $T_{\text{eff}} = 5923\text{K}$, $\log g = 2.44$, and $[\text{Fe}/\text{H}] = -0.07$. It is likely a galactic halo star but Gaia value of $[\text{Fe}/\text{H}]$ indicates that it is not very metal-poor. It is a variable star (Period = 5.18189 days). High resolution spectroscopy of this star is very important. It may be a chemically peculiar star (Dietz et al. 2020). TYC 311-961-1 : $T_{\text{eff}} = 4459\text{K}$, $\log g = 1.35$, and $[\text{Fe}/\text{H}] = -1.118$. The distance for this star given in Table 1 is from Bailer-Jones et al. (2021).

TYC 4707-283-1 : It is a high proper motion star (Table 1). Its $T_{\text{eff}} = 4821\text{K}$, $\log g = 2.33$, $[\text{Fe}/\text{H}] = -0.825$.

TYC 4861-1053-1 : $T_{\text{eff}} = 4602\text{K}$, $\log g = 1.47$, and $[\text{Fe}/\text{H}] = -1.075$.

TYC 4912-1-1 : It may be a galactic halo chemically peculiar star (Dietz et al. 2020). Its $T_{\text{eff}} = 6023\text{K}$, $\log g = 2.63$, and $[\text{Fe}/\text{H}] = -0.34$. Further study of this star is needed to confirm its metallicity and abundance pattern.

TYC 4863-221-1 : There is no literature on this star. The distance of this star given in Table 1 is from Bailer-Jones et al. (2021).

TYC 4931-266-1 : This is also a chemically peculiar star in the galactic halo. Its $T_{\text{eff}} = 5833\text{K}$, $\log g = 2.62$, and $[\text{Fe}/\text{H}] = -0.045$. For the above mentioned three stars the astrophysical parameters derived by Dietz et al (2020) does not agree with the astrophysical parameters from the Gaia DR3 data. Dietz et al. find them to be very metal-poor and whereas Gaia DR3 data shows they are not metal-poor.

TYC 5925-1142-1: Dietz et al. (2020) derived $[\text{Fe}/\text{H}] = -1.567$. Further detailed study of this high galactic latitude star is needed.

TYC 6571-226-1 is a high radial velocity star (Table 1). Its $T_{\text{eff}} = 4832\text{K}$, $\log g = 1.57$, and $[\text{Fe}/\text{H}] = -1.95$.

TYC 6592-790-1 : $T_{\text{eff}} = 4761\text{K}$, $\log g = 1.35$, and $[\text{Fe}/\text{H}] = -0.468$.

TYC 6630-1505-1 : it may be a r-process elements enhanced galactic halo star (Holmbeck et al. 2020). They derive $T_{\text{eff}} = 4939\text{K}$, $\log g = 2.11$ and $[\text{Fe}/\text{H}] = -1.99$. Whereas Gaia DR3 data gives $T_{\text{eff}} = 5899\text{K}$, $\log g = 3.89$, and $[\text{Fe}/\text{H}] = -0.55$. High resolution spectroscopic analysis is need to confirm the T_{eff} , $\log g$ and $[\text{Fe}/\text{H}]$ values. Same is the case with TYC 6643-94-1. Dietz et al. (2020) derived $T_{\text{eff}} = 4318\text{K}$, $\log g = 0.36$, and $[\text{Fe}/\text{H}] = -1.806$. Whereas Gaia DR3 data gives $T_{\text{eff}} = 4787\text{K}$, $\log g = 1.49$, and $[\text{Fe}/\text{H}] = -0.24$. Redetermination of T_{eff} , $\log g$ and $[\text{Fe}/\text{H}]$ is needed for this halo star.

TYC 7288-311-1 : It is a high proper motion star (Table 1). There is no literature on this star. Determination of chemical composition of this high galactic latitude star is important.

The astrophysical parameters of TYC 7614-938-1 and TYC 7657-1253-1 available in the literature differ from the Gaia DR3 data. A reanalysis of high resolution spectra of these two high galactic latitude stars is needed.

For TYC 7913-279-1 Gaia DR3 data gives $T_{\text{eff}} = 4590\text{K}$, $\log g = 1.62$, and $[\text{Fe}/\text{H}] = 0.118$. There is no literature on this star. Further study of this star is needed.

TYC 8502-1656-1: The Gaia DR3 data gives $T_{\text{eff}} = 6470\text{K}$, $\log g = 4.26$, and $[\text{Fe}/\text{H}] = -2.83$ which indicates that it is a very metal-poor and likely a galactic halo star. There is no literature on this star. Detailed chemical composition analysis from high resolution spectroscopy of this very metal-poor star is important.

TYC 8743-1923-1: There is no literature on this star.

TYC 8950-40-1: There is no literature on this star.

Detailed spectroscopic study of all the stars listed in Table 1 is very much needed to further understand their chemical composition, evolutionary status and the sources for their high radial velocities. There may be more such stars in Tycho catalogue.

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