RNAAS RESEARCH NOTES OF THE AAS

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To cite this article: Mudumba Parthasarathy 2024 *Res. Notes AAS* **8** 111

Forty hypervelocity stars (HVS) from Gaia DR3

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Abstract

Forty hypervelocity stars (HVS) are detected from a search for HVS in Gaia DR3 data whose G magnitudes are less than 17.0 and radial velocities are more +400 km/sec. The Gaia DR3 astrophysical parameters and spectra indicate that most of the HVS reported in this study are F, G, and K type metal-poor stars. Eleven stars are at high galactic latitudes. Included in this study are the B components of six nearby visual double stars BD-6 885B, HD 47503B, HD 53229B, HD 95123B, HD 180683B, and HD 202276B which are found to be hypervelocity stars (HVS).The A components of these six visual doubles are less massive late-type stars with normal radial velocities. The source of hypervelocity of the B components is not clear. They may have less luminous and relatively massive degenerate component stars which are not yet detected. Further study of all these HVS is needed.

Keywords: Hypervelocity stars (HVS) – Radial Velocities – metal-poor stars

1. Introduction

I have been searching the Gaia EDR3 and DR3 (Gaia Collaboration 2021, 2022) data and SIMBAD (Strasbourg, France) data base for hypervelocity stars (HVS) adopting a simple search criteria (Parthasarathy 2023, 2024a, b, c). This paper is a continuation of that study. In this paper I present 40 HVS that I detected which includes six HVS B components of six visual double stars. These six visual doubles were identified in these forty HVS. I have not used separate search criteria to look for HVS in visual doubles. There may be more such HVS visual doubles if one cross correlates Gaia data base and visual double stars catalogues which is not the aim of this research note. Table 1 is a complete list of stars that I detected.

Table 1. Detected HVS from Gaia DR3

Gaia DR3 No	l deg	b deg	mu mas/yr	G mag	RV km/sec	d pc	T eff. K	log g	[Fe/H]
4092328917916154368	14.6	-6.3	3.501	16.26	938	1040			

4057347680607821696	0.7	-1.1	2.447	13.41	899	2167			
6101369964484138752	324.3	16.0	26.991	14.92	870	597	4736	4.506	-0.060
5625102999536111872	259.3	3.7	5.807	15.68	769	5452	5251	3.265	-0.912
4296894160078561280	46.0	-11.	7.732	15.65	760	1017	5262	4.608	-0.137
1827795080271815040	59.3	-1.6	6.085	16.75	739	3551	7984	3.504	-0.066
4098291913093819776	15.2	-7.4	7.669	14.62	714	3905			
6101408687905214208	324.8	15.8	4.864	12.82	708	858			
4504337678883284096	43.8	5.0	5.283	16.07	694	5084			
4051413483316567552	4.4	-6.9	9.962	15.85	689	4250	4684	3.088	0.012
4265444618530378240	33.1	-1.2	19.808	14.84	680	499			
1825842828672942208	57.4	-1.8	5.486	14.82	642	1366	6269	3.689	-0.211
5936466825463371904	336.5	-6.0	3.506	15.87	637	3161	4900	2.725	-0.281
6077622510498751616	300.0	8.8	6.787	13.06	624	6704			
5544764712854179840	252.8	-0.8	4.449	12.90	604	3839			
5227401642246690432	296.8	-10.	6.646	13.51	603	3695	6127	2.825	-1.480
5325632011075073408	271.4	-1.1	10.652	12.24	601	2405	6483	1.688	-2.217
5843949763886962304	304.8	-7.3	15.013	12.53	597	3561			
2921543205513614208	235.8	-9.2	26.931	12.08	591	1525			
5515555464906936192	265.1	-6.0	2.375	13.28	585	6818			
6418433113222352000	322.8	-26.	1.611	13.25	569	8211	4435	0.937	-1.570
5430581735975161344	263.0	6.7	5.369	12.59	563	5666	5729	1.906	-0.170
4320112542823692288	47.7	1.6	6.735	16.18	562	2540			
5358307297639362304	200.8	4.5	6.567	13.42	560	6649			
5352190302148489088	284.8	2.2	27.491	12.78	558	2125			
3207963476278403200	207.5	-25.	0.810	14.89	515	275			
3071792530296554240	228.9	21.2	47.212	16.89	503	1569	5417	4.632	-0.969
1752925794453337600	54.3	-17.	61.465	13.90	493	86			
5337630706626747648	291.1	-0.2	7.157	14.70	478	1476	6846	4.067	-0.710
577305349033028352	227.6	29.8	30.028	16.192	431	2800	6488	4.454	-2.329
3083340636500707072	222.7	17.4	15.544	15.64	422	2230	6314	4.371	-1.157
3095854143977215616	216.4	20.0	13.681	15.58	417	2424	6427	4.411	-1.375
3699067143758039936	279.1	61.5	33.126	16.10	409	1799	5849	4.597	-1.567
1774513537034328704	74.3	-32.	36.959	15.41	402	108			
BD-6 885B	199.82	-35.7	9.655	13.03	429	727			
HD 47503B	280.79	-27	17.1	13.45	415	143			
HD 53229B	181.12	18.28	46.02	9.94	568	52			
HD 95123B	293.38	-9.26	29.823	12.03	-716	65			
HD 180683B	70.08	12.07	237.24	14.06	501	64			
HD 202276B	55.64	-28.8	25.612	12.0	724	399			

2. Results

Only four stars have RUWE values more than 1.4. However their parallaxes are accurate. Rest of the stars have RUWE values less than 1.4. For some of the stars the distances are from Bailer-Jones et al. (2021). Stars which have highly accurate parallaxes their distances are derived from their parallaxes. Most of the radial velocities given in Table 1 are from Gaia DR3 (Gaia Collaboration 2022). (See also Hodgkin et al. 2021 and Seabroke et al. 2021). The errors in radial velocities are of the order of 10 km/sec and for some of the stars they are of the order of 5 km/sec. The astrophysical parameters are from the Gaia DR3 data (Gaia Collaboration, 2021, 2022). The Teff, and [Fe/H] values given in Table 1

indicate these HVS are F, G, K type low-mass metal-poor stars. Some are low gravity metal-poor stars. The U, V, W and Vt (tangential velocity) velocities of the stars are calculated using the data given in Table 1. These velocities clearly indicate the stars listed in Table 1 are HVS. There is hardly any literature on these stars. Further study of these stars is important.

While searching the Gaia DR3 data (Gaia Collaboration 2021, 2022) and SIMBAD (Strasbourg, France) data for relatively bright hypervelocity stars (HVS) (Parthasarathy 2023, 2024a,b, c) I came across six relatively nearby visual double stars whose B components have very high (hyper) radial velocities (HVS). In this paper details of these six visual double stars are also presented and discussed.

The radial velocities, distances and G magnitudes of the B components of six visual doubles are given in the end of Table 1. All the six stars are nearby high galactic latitude stars. The RUWE value of BD-6 885B is 1.431. The other five stars have RUWE values less than 1.4. All the six stars have very accurate Gaia DR3 parallaxes (distances) and radial velocities (Gaia Collaboration 2021, 2022)

3. Notes

BD-6 885B (Gaia DR3 3202308378739431936)

The error in the radial velocity is 4.05 km/sec and the error in the distance is 29.771 parsecs. The Washington visual double star catalogue (Mason et al. 2001) number is WDS J04221-0551B. The spectral type, radial velocity and distance of component A are K0, 44.7 km/sec and 776.3 parsecs respectively. The separation between the components A and B is about 50 parsecs but the radial velocity difference is very large.

HD 47503B (Gaia DR3 5278812297694617728)

The error in the radial velocity is 1.41 km/sec and the error in the distance is 0.4557 parsec. The radial velocity of component A is -0.73 km/sec. and the distance is 143.544 parsecs. The separation between the components is only 0.907 parsecs. The component A is a F6 dwarf (Teff = 6334K, log g =4.46, and [Fe/H] = -0.043) (Gaia Collaboration 2022).

HD 53229B (Gaia DR3 939821616976287104) (WDS J07059+3603B)

Error in the radial velocity is only 0.78 km/sec and the error in the distance is only 0.0716 parsecs. The G-K colour is 3.13 indicating that it is a very cool star. The spectral type, radial velocity and distance of the component A are G0, 13.92 km/sec and 52.458 parsecs respectively. The separation between the components is only 0.025 parsecs. The hypervelocity of HD 53229B may be the result of dynamical interaction with component A.

HD 95123B (Gaia DR3 5231593594752514304) (WDS J10572-6959B)

The errors in the radial velocity and the distance are 1.03 km/sec and 0.0527 parsecs respectively. The G-K colour = 3.536 indicates it is a very cool star. The spectral type, radial velocity and distance of

component A are K0IV/V, 27.11 km/sec and 64.827 parsecs respectively. The separation between the components is only 0.133 parsecs.

HD 180683B (Gaia DR3 2099408640249926016) (WDS J19158+3823B)

The errors in the radial velocity and the distance are 1.28 km/sec and 0.2012 parsecs respectively. The radial velocity and distance of component A are -16.15 km/sec and 63.670 parsecs respectively. For component A Stonkute et al. (2020) derived Teff = 5924K, log g = 4.06 and [Fe/H] = -0.35. The separation between the components is only 0.042 parsecs. The dynamical interaction may the source for the hypervelocity of HD 180683B.

HD 202276B (Gaia DR3 1732532430739244544) (WDS J21145+0441B)

The errors in the radial velocity and the distance are 7.2 km/sec and 4.256 parsecs respectively. The astrophysical parameter from Gaia DR3 data (Gaia Collaboration 2022) are Teff = 5510K, log g = 4.1554, and [Fe/H] = -1.0505. Gaia DR3 spectrum is available. It is found to be a nearby metal-poor hypervelocity star. The spectral type, radial velocity and distance of component A are K2V, -57.33 km/sec and 394.79 parsecs respectively. The component A is an IRAS source (IRAS 21120+0428). Its 12-miron flux is 1.98 Jy, and 25-micron flux is 0.535 Jy. The 60 and 100 micron fluxes have flux flags of 3 and are not useful. The V-K colour of component A is 4.1. It seems to have hot and cold circumstellar dust shell. The separation between the components A and B is 3.713 parsecs.

The source for the hypervelocity of these stars is not clear, they may have massive less luminous degenerate component stars which are not yet detected. Further study of these stars is needed.

3. Acknowledgements

This research has made use of the Gaia DR3 and SIMBAD databases, operated at CDS, Strasbourg, France and I have used the NASA ADS. No funding for this research.

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