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Fifteen Hypervelocity Stars Whose Gaia *G* Magnitudes are Less Than 16.0 and Radial Velocities Less Than—600 km per second

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Fifteen hypervelocity stars (HVS) whose Gaia G magnitudes are less than 16.0 and radial velocities less than -600 km per second

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Abstract

From Gaia DR3 data using a simple search criteria fifteen hypervelocity stars (HVS) are detected. These stars have radial velocities less than -600 km per second, Gaia G magnitudes less than 16.0 and RUWE values less than 1.4. The U, V, W velocities also indicate that these stars are HVS. The effective temperatures of these stars indicate that they are F and G type stars. Gaia DR3 4094201579559138 56 and Gaia DR3 2198292118993038464 seems to be metal-poor HVS. High resolution spectroscopy of these stars is needed to derive the atmospheric parameters, chemical composition and to understand their evolutionary status and origin. The progenitors of these stars may be close binary systems with white dwarf companions. When the white dwarf companions became Type Ia supernovae and their F-G companion stars have become HVS. Or they may be the result of other unknown processes.

Keywords: Hypervelocity stars (HVS) - Parallaxes - Radial Velocities - Gaia DR3

Introduction

The first hypervelocity star (HVS) was discovered by Brown et al. (2005) (see Hills 1988). Lateron from systematic surveys many HVS were discovered. Our Galactic Center (GC) may produce HVS by various processes. Brown (2015) published a review paper on HVS. The presence of HVS beyond the GC may be high velocity runaways ejected by supernovae in close-binary stars (Blaauw 1961). The causes for the presence of many HVS and high velocity stars in the GC and all over in the Galaxy are still not well understood. Gaia DR3 has revealed many HVS which include HVS white dwarfs (Gaia Collaboration et al. 2021, 2022). (see also Shen et al. 2018, Evans et al. 2023 (references therein), Liao et al. 2023 (refrences therein)).

In this paper I report fifteen HVS selected from the search of Gaia DR3 data using a simple search criteria.

Selected HVS candidates

I have searched the Gaia DR3 data for HVS with radial velocities (RV) less than -600.0 km per second, Gaia G magnitudes less than 16.0 and RUWE (Renormalized Unit Weight Error) values less than 1.4. The RUWE is the primary astrometric goodness-of-fit indicator (Lindegren et al. 2021). The choice of less than -600.0 km per sec as the limit is to select stars with high radial velocities there by to select true hypervelocity stars (HVS) and not to confuse with high velocity stars and also it is based on the review paper of Brown (2015). Brown (2015) states that no one velocity threshold can define an unbound star, whether a star of a given speed is unbound or not depends on its location in the Milky Way. In this report I have not included HVS with postive radial velocities as it is a relatively lengthy paper it will not fit in this research note. They are reported in a separate paper (Parthasarathy 2023).

The above mentioned search criteria has resulted eight HVS with accurate Gaia DR3 parallaxes. For these eight stars I derived their distances (D) from their parallaxes (Table 1). For the remainig seven HVS I used the distances given in Bailer-Jones et al. 2021) (see Table 1). I have derived for these 15 stars their U,V, W velocities and and tangential velocities (see Table 1). The U, V, W velocities also indicate they are hyper-velocity stars. The Teff, log g and [Fe/H] values of these stars (see also Gaia DR3 data of these stars from the SIMBAD database) indicate they are F-G stars. Gaia DR3 4094201527955913856 in this sample seems to be a very metal-poor HVS (Table 1). High resolution spectroscopy of these stars is needed to derive their atmospheric parameters, chemical composition and to understand their evolutionary status and origin.

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2000,A&AS,143,9 , "The SIMBAD astronomical database", Wenger et al.

(see http://simbad.u-strasbg.fr/simbad/sim-basicIdent=m33&submit=SIMBAD+search)

The data presented in this paper is available for any one requesting for it.
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Table 1. Fifteen hypervelocity stars detected
from an analysis of Gaia DR3 data

Gaia DR3 No.	l	b	parallax	e	mu-RA	mu-DEC	RUWE	G	D e
	o	o	mas		mas per year	--	m	pc	
4065480978657619968	7.3	-03.0	2.3202	0.0506	-6.172	-25.272	1.066	15.47	431 9
5305975869928712320	280	-03.3	0.3347	0.0212	-7.992	4.839	1.224	14.14	2987 189
5951114420631264640	342.3	-05.6	1.0612	0.0336	2.587	2.927	1.003	15.50	942 30
2198292118993038464	101.6	01.1	0.0459	0.0342	-2.027	-1.33	1.159	15.9	8560
4062883829092182144	2.8	-03.1	0.3817	0.1594	-5.240	-5.696	1.043	14.9	4101
5959019801816582272	347.9	-05.1	0.1639	0.0493	-2.74	-1.089	1.043	15.9	4844
4065791380145075072	6.0	-02.2	0.0526	0.0486	-2.967	-8.965	1.051	15.7	7671
4105689496051901440	21.4	-05.1	0.1032	0.0499	-1.227	-7.136	1.064	15.93	6187
5883971746674851840	325.1	-02.1	0.1372	0.0330	-6.282	-3.804	1.070	15.40	5677
1809832393157398016	57.4	-08.0	0.2211	0.0240	-2.759	-8.101	0.972	14.80	3898
5953456066818230528	345.5	-03.6	0.6990	0.0153	-5.720	-1.343	0.835	12.9	1431 31
4063258144073821184	3.96	-02.6	0.0927	0.0384	-2.618	-1.354	0.946	14.75	6826
1814359288672674560	64.5	-13.5	0.1195	0.0115	-0.840	-8.031	0.914	12.8	8368 805
4100838558128545664	19.0	-07.7	0.1420	0.0269	-4.464	-3.465	1.043	15.1	5716
4094201527955913856	10.2	-0.86	0.2773	0.0275	-0.439	-1.561	1.126	14.59	3006 358

Radial Velocities, U, V, W and tangential velocities of HVS

Gaia DR3 No.	RV	e	U	V	W	Vtan
----------	km per second		km per second			

4065480978657619968 -681 2 -676 -78 32 65.2

5305975869928712320 -831 6 257 789 43 132.3

5951114420631264640 -984 3 -605 772 86 17.5

2198292118993038464 -928 5 23 -926 -16 98.4

4062883829092182144 -909 1 -907 -40 45 150.5

5959019801816582272 -902 3 -615 656 73 67.7

4065791380145075072 -882 3 -878 -84 30 343.4

4105689496051901440 -737 10 -694 -242 59 212.3

5883971746674851840 -713 1 -274 658 23 197.6

1809832393157398016 -653 4 -402 -508 82 158.0

5953456066818230528 -634 5 -415 478 36 40.0

4063258144073821184 -631 1 -629 -39 26 95.4

1814359288672674560 -618 1 -320 -513 130 320.3

4100838558128545664 -601 6 -570 -176 72 153.0

4094201527955913856 -677 11 -668 9 91 23.1

---- Teff, log g, [Fe/H] values of HVS ----------

Gaia DR3 No.	Teff (K)	log g	[Fe/H]	Comment
4065480978657619968	4515	4.574	+0.010	------
5305975869928712320	5256	2.913	-0.790	Gaia Spectrum
5951114420631264640	5356	4.548	-0.328	----------
2198292118993038464	7123	2.565	-1.079	-------
4062883829092182144	--	---	----	Gaia light curves
5959019801816582272	4842	---	---	
4065791380145075072	4933	2.658	0.034	---------
4105689496051901440	4981	3.519	-0.056	---------
5883971746674851840	4858	2.304	-0.428	----------

1809832393157398016	4498	2.154	0.019	Gaia Spectrum
5953456066818230528	4837	2.842	-0.053	Gaia Spectrum
4063258144073821184	4739	2.435	-0.191	---------
1814359288672674560	----	----	----	Gaia Spectrum
4100838558128545664	5024	2.915	-0.100	----------
4094201527955913856	8400	2.854	-1.762	Gaia Spectrum, light curve

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