EXOPLANETS FROM OUT OF MILKYWAY

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Abstract

Our research aims to investigate exoplanets' host stars' population analysis and possible Galactic origins by using NASA's exoplanet archive. We obtained the data of 240 exoplanets' host stars' atmospheric model parameters, proper motions, radial velocities, parallaxes, element abundances and 320 exoplanets' orbital and structural parameters. Our sample stars define the Solar Neigbourhood because all stars' distances are less than 500 pc. We examined extraordinary stars in the Solar Neigbourhood by using the following constraints: e_p greater than 0.10, Z_{max} greater than 825 pc and $[Fe/H]$ less than -0.20 dex. We found 4 extraordinary host stars in the Solar Neigbourhood and discussed their galactic origins.

DATA SELECTION

The sample stars were obtained from NASA's exoplanet archive. The archive consists of 2507 host stars and 3374 exoplanets with stellar atmospheric model parameters (T_{eff}, $\log g$, Fe/H), parallaxes, proper motions, radial velocities, exoplanet structure and orbital parameters. We limited our sample to stars with metallicities, parallaxes, proper motions and radial velocities,. According to this criterion, we obtained a catalog with 240 exoplanets' host stars and 320 exoplanets. The sample's distance histogram is shown in Fig 1.

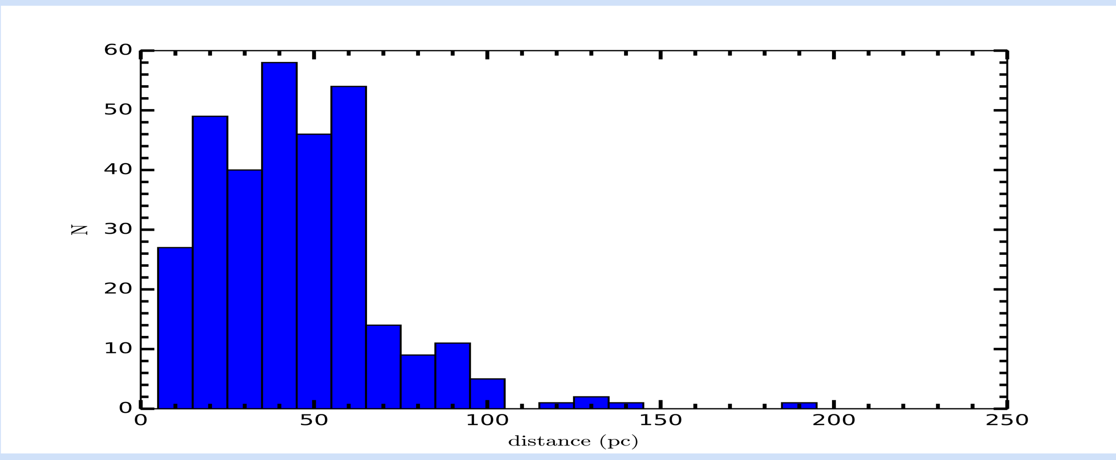

Figure 1: Distance histogram of sample stars.

SPACE VELOCITIES & GALACTIC ORBITS

We combined the distances, radial velocities and proper motions and applied the standard algorithms and transformation matrices of Johnson & Soderblom (1987) to obtain their Galactic space velocity components, U, V and W. Here, only the results we obtained are given. Correction for differential Galactic rotation is necessary to determine U, V and W velocity components accurately. We applied the procedure of Mihalas & Binney (1981) to the distribution of the sample stars and estimated the first-order Galactic differential corrections for the U and V velocity components of the sample stars. The velocity component W is not affected by Galactic differential rotation Mihalas & Binney (1981).

We used *MWpotential2014* code of *Galpy* (Bovy, 2015) to calculate the Galactic orbit parameters of the sample stars. The orbital parameters used in this study are Z_{max}: maximum vertical distance to the Galactic plane, R_a and R_p: apogalactic and perigalactic radial distances, respectively, R_m: the arithmetic mean of R_a and R_p, $R_m = (R_a + R_p)/2$ and e_p: the planar eccentricity. The orbital parameters of the sample stars were calculated within the integration time of 3 Gyr. We showed our sample stars' e_p histogram with Fig 2 and Toomre diagram with Fig 3.

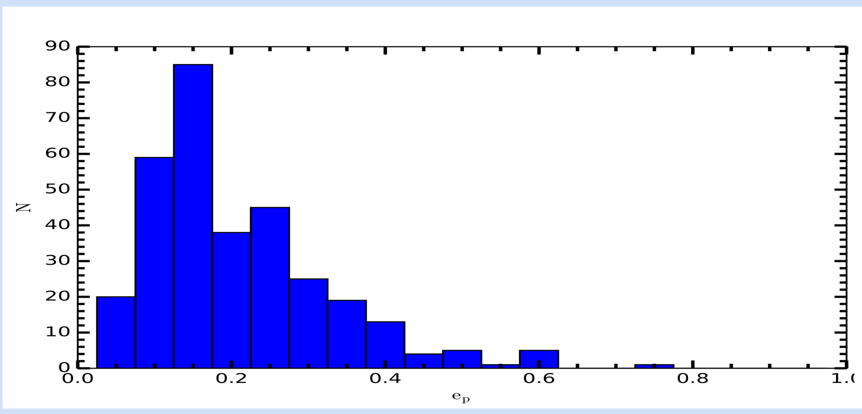

Figure 2: e_p histogram of sample stars.

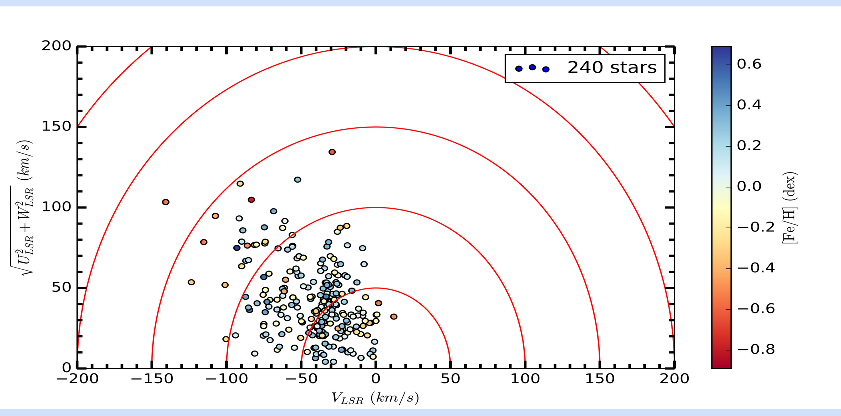

Figure 3: Toomre diagram of sample stars.

FINDING EXTRAORDINARY STARS

We aimed to search for extragalactic exoplanet host stars in Solar Neigbourhood. We found 4 extraordinary stars in the Solar Neigbourhood sample with these constraints $e_p > 0.1$, $Z_{max} > 825$ pc (opposite to Plevne et al., 2015) and $[Fe/H] \leq -0.2$ dex. We discuss the Galactic origins of these stars in next section and we showed extraordinary host stars with red star marker in Figure 4, 5, 6, 7.

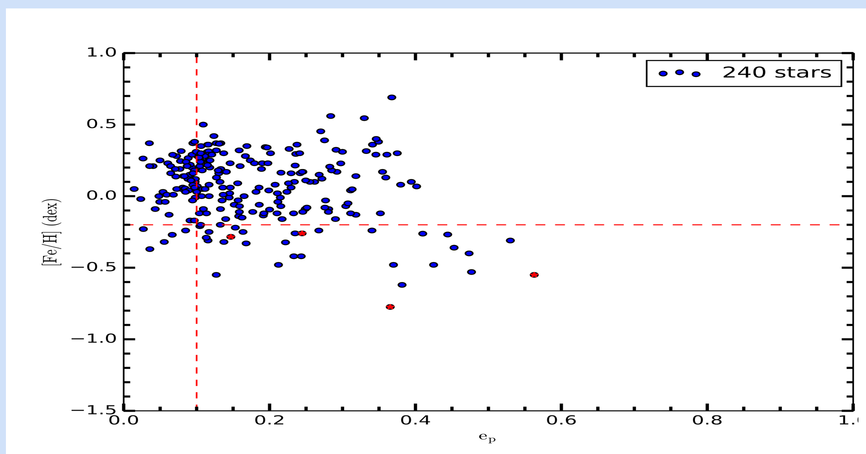

Figure 4: e_p - $[Fe/H]$ diagram of sample stars.

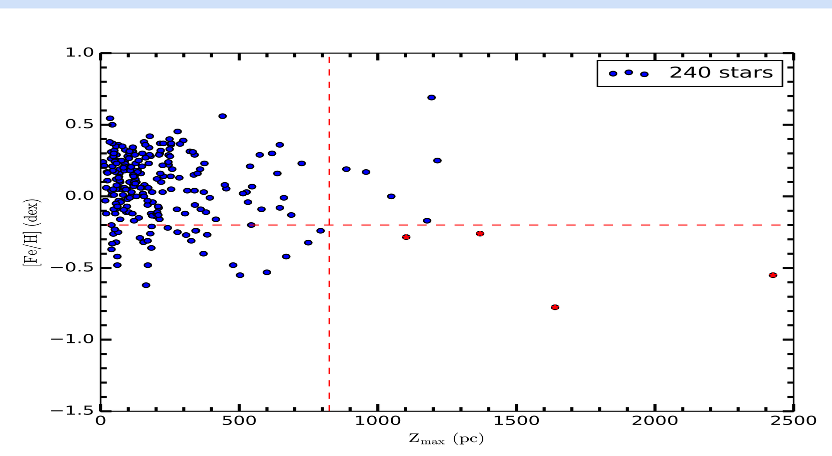

Figure 5: Z_{max} - $[Fe/H]$ diagram of sample stars.

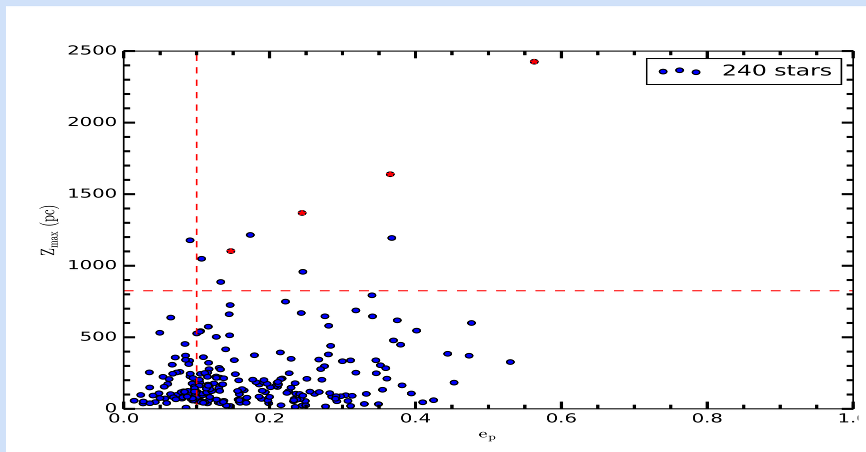

Figure 6: e_p - Z_{max} diagram of sample stars.

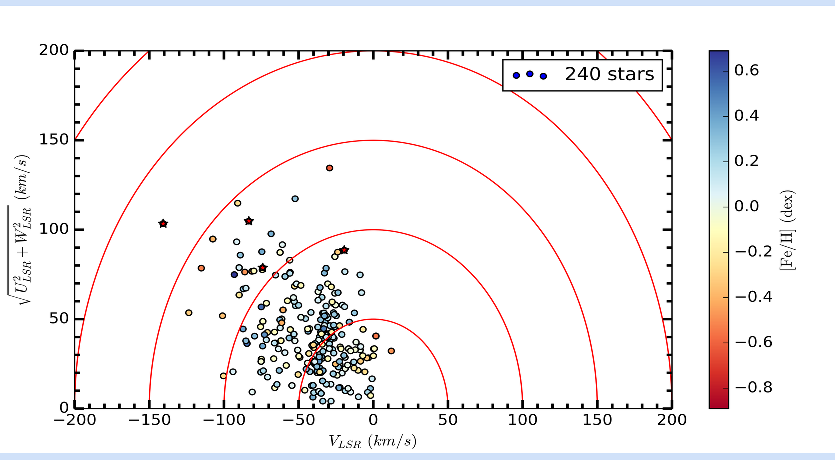

Figure 7: Toomre diagram of sample stars.

DISCUSSION

We aimed to search for extragalactic exoplanet host stars in Solar Neigbourhood. We found 4 extraordinary stars in the Solar Neigbourhood sample with these constraints $e_p > 0.1$, $Z_{max} > 825$ pc (opposite to Plevne et al., 2015) and $[Fe/H] \leq -0.2$ dex. We discuss the Galactic origins of these stars in next section and we showed extraordinary host stars with red star marker in Figure 4, 5, 6, 7.

Another explanation is metal poor dwarf galaxy interactions. This scenario suggests that extraordinary stars come from dwarf galaxies to the Solar Neighborhood as a result of an interaction between Milky Way and a metal poor dwarf galaxy. This scenario is a more possible explanation than radial migration, because metal poor dwarf galaxy interaction explains all properties of extraordinary stars. Therefore, extraordinary exoplanet systems are possible to be of extragalactic origin.

Table 1: Extraordinary stars orbital and metallicities.

Name	[Fe/H] (dex)	Z_{max} (kpc)	e_p
HD114762	-0.77	1.64	0.37
HD4208	-0.28	1.01	0.15
HIP109384	-0.26	1.37	0.24
Kepler-444	-0.55	2.43	0.56

Resume

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