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Abundance and kinematic analysis of the CH star CD-62°1346. The first hypervelocity red giant?

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Abstract. We report on the results of the detailed spectroscopic and kinematic analysis of the high-velocity carbon-enriched metal-poor ([Fe/H]=−1.59) star CD-62°1346. CD-62°1346 is also a lead star. Detailed kinematic analysis based on dynamical calculations, showed that CD-62°1346 is on a highly eccentric retrograde orbit (e = 0.91). The extreme retrograde motion may suggest that CD-62°1346 has an extragalactic origin. However, the high α-element abundances, typical of halo stars of such metallicity, do not support this suggestion. The Galactic rest frame velocity ($V_{\rm GRF}$ = 570 km s^{-1}), close to the Galaxy escape velocity, indicates that the star may be bound or unbound according to the adopted Galactic potential. The possibility of CD-62°1346, an evolved red giant star, to join the restricted group of hypervelocity stars, formerly consisting of B-type stars only, is discussed.

Key words. Stars: abundances – stars: atmospheres – stars: Population II – stars: individual (CD-62°1346, HD 5223)

1. Introduction

The kinematics of stars is a way to constrain the gravitational potential of our Galaxy. For the region near the sun this was shown by Oort (1960) using the dispersion velocity of star populations. One of the main problems was the amount of dark matter in the disk of the Milky Way. This continues to be a problem today when we try to determine the amount of dark matter in the Galaxy as a whole. The rotation curve of the Galaxy is one of the quantities used to tackle this question. Other possibilities exist however.

One of these is the study of the kinematics of the hypervelocity stars. These stars probe

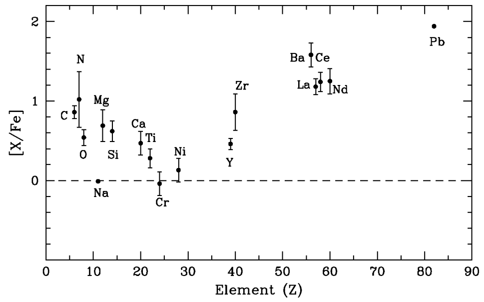

Fig. 1. Abundance pattern of CD-62°1346.

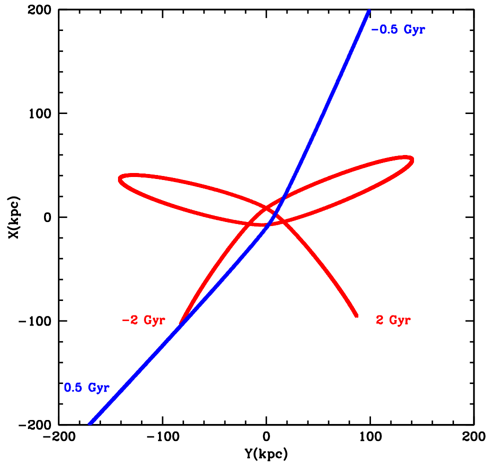

Fig. 2. Trajectory of CD-62°1346 (red) and HD 5223 (blue) in the *XY* plane.

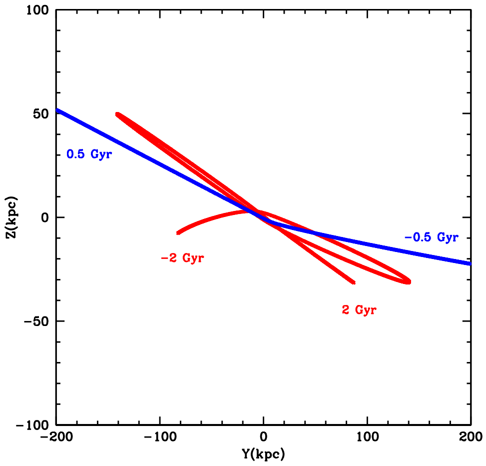

Fig. 3. Trajectory of CD-62°1346 (red) and HD 5223 (blue) in the *YZ* plane

great distances in the halo and the analysis of their orbits and determination of the escape velocity at the relevant positions of the stars can provide constraints on the gravitational potential. In the present work a detailed spectroscopic and kinematic analysis of the star CD-62°1346 was performed.

The spectroscopic analysis shows that this star is a metal-poor giant star with enhancements of the s-process elements, typical characteristic of CH stars (Pereira et al. 2012). The abundance pattern of CD-62°1346 is shown in Figure 1.

The kinematical analysis of CD-62°1346 reveals its nature as a hypervelocity star, the first of the red giant class known to us, different from the well known B-type group of hipervelocity stars (Tillich et al. 2011). Calculated past and future orbits of CD-62°1346 and HD 5223, another CH star also investigated by us, in the *XY*- and *YZ*-planes are shown in Figs. 2 and 3.

Different models of the gravitational potential of the galaxy were tried giving different escape velocity at the star position. The analysis showed that CD-62°1346 could be bound or unbound depending on the potential used. This again shows the importance of constraining the mass distribution of the Galaxy. On the other hand, the kinematical behavior of the CH star HD 5223, showed that it is unbound in any of the potentials employed.

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