Daugianarės žvaigždės Paukščių Tako Galaktikoje

Binary stars in the Milky Way Galaxy

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Stellar multiplicity is a key parameter for many astrophysical questions. Several interesting astronomical phenomena, such as gravitational waves or gamma-ray bursts, arise from binary stars, and the knowledge of multiplicity could provide constraints on possible channels of star formation and evolution in the Milky Way galaxy [1]. For ongoing and coming large spectroscopic surveys, such as RAVE, SEGUE, LAMOST, Gaia-ESO, GALAH and 4MOST, it is important to identify the binaries to clean the survey products from potentially faulty results.

All stars are formed in binary or multiple systems and the minority of single stars might be result from the decay of multiple systems. Binary star surveys suggest that the frequency of multiple systems is in the range of about 22 % to 80 %, where the binary fraction is higher for more massive stars [2]. Raghavan et al. (2010) work suggest that 54% ± 2% of solar-type (~F6–K3) stars in the solar neighborhood are single [3]. However, little is known about the binary frequency in Milky Way field stars, particularly outside the solar neighborhood.

We present our models of the effect of binaries on high-resolution spectroscopic surveys, in order to determine how many binaries will be observed, whether unresolved binaries will contaminate measurements of chemical abundances, and how we can use spectroscopic surveys to better constrain the population of binaries in the Galaxy.

Binary and single star evolution is performed by the rapid binary-star evolution (BSE) algorithm [4].

As an application we make mock APOGEE observations of red giants and subgiants. Our stars selection function mimics the selection function of APOGEE [5]. APOGEE is a high-resolution (R ~ 22 500), high signal-to-noise (S/N ~ 100/pixel) infrared (1.51–1.70 microns) spectroscopic survey targeting 146000 stars and enabling the determination of precise (~100 m/s) radial velocities as well as stellar parameters and elemental abundances.

In Fig 1. we see that the variation of RV scatter with log(g) and $T_{\rm eff}$ are similar in the model (a, b) and observations (c, d), suggesting that binaries are the cause of large RV scatter in APOGEE observations. We see a trend of decreasing velocity scatter with decreasing temperature (more evolved stars) in both the model and observations. Giants are on average in larger binary orbits than the early-type stars so the orbital periods are longer and consequently the RV scatter lower.

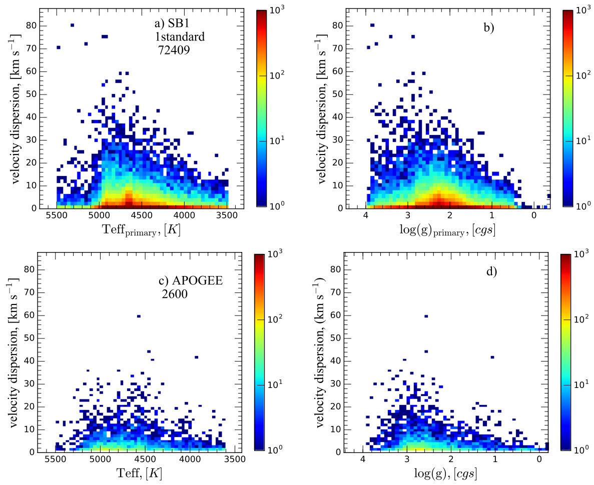

Fig. 1. Velocity scatter versus main atmospheric parameters $T_{\rm eff\ \it Primary}$ and $\log(g)_{Primary}$ from model shown in panels (a), (b) and in panels (c), (d) we show the same parameters form APOGEE observations.

We intend to investigate to what extent we can constrain the frequency of binaries, and whether we can detect any systematic variation with metallicity the Milky Way galaxy. The detailed results will be presented in Stonkutė, Church & Feltzing 2017 (in prep.).

Key words: binary stars, Galaxy evolution, large spectroscopic surveys.

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