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CHARACTERIZATION OF SB1 DETECTED IN THE GAIA-ESO SURVEY IDR5

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Abstract. Multiplicity among field and cluster stars is ubiquitous. This property is needed to explain entire classes of stars with photometric or chemical peculiarities (Ba stars, extrinsic S stars, blue stragglers, etc.). After having efficiently detected multiple-component spectroscopic binaries (∼350 SB2, SB3 and SB4) in the Gaia-ESO Survey iDR4 using a new method based on the successive derivatives of the cross-correlation functions (Merle et al. 2017), we now search the GES iDR5 for SB1 using temporal variations of their single-lined cross-correlation functions. Tracking variability in the GES time series of radial-velocity measurements allows us to find ∼ 650 new SB1s. We characterize them using Gaia DR2 parallaxes and photometry.

Keywords: stars, solar-type, atomic data, spectroscopic data, line profiles, astronomical databases

1 The Gaia-ESO Survey

The Gaia-ESO Survey (GES; Gilmore et al. 2012; Randich et al. 2013) is an on-going ground-based large spectroscopic survey at medium and high resolution covering the visible and the near-IR wavelengths. It is designed to complement the Gaia mission in terms of precise radial velocities and chemical abundances for 10^5 stars in the main stellar populations of the Milky Way. It is not designed as a monitoring survey, however. Nevertheless, four observations per target are generally available covering two different epochs and distributed over less than ten days, biasing the binary detection toward very short orbital periods.

2 Data selection

We focus the detection on the most often used GIRAFFE setups, namely HR10 centered on 5500 Å and HR21 centered on the Ca II triplet in the near-IR with an average resolution of 20 000. We also require to have a signal-to-noise ratio larger than three. The analysis is performed on about 200 000 single exposures corresponding to 43 000 stars. For each exposure, we compute its cross-correlation function (CCF) with synthetic masks carefully designed to get narrow CCF peaks (see Van der Swaelmen et al., in prep.; Van der Swaelmen, Merle et al, this volume). The radial velocity at each epoch is obtained by fitting the core of the CCF with a Gaussian function using the DOE code (Merle et al. 2017).

3 Methods

We apply a statistical χ^2-test on the radial velocity time series of each star, carefully estimating the uncertainties attached to each radial velocity (see Merle et al., in prep., for a detailed explanation on the uncertainty estimations). Stars that show temporal variations of the radial velocities larger than 1500 km/s/d are also discarded. The statistical test is performed at the 3 σ (resp. 5 σ) significance level providing ∼1 400 (resp., ∼800) radial-velocity variables. In this sample, contamination by photometric variability induced by jitter, convection and pulsation is also present. We therefore use the Gaia DR2 fluxes and their dispersion to clean the sample from variability induced-jitter.

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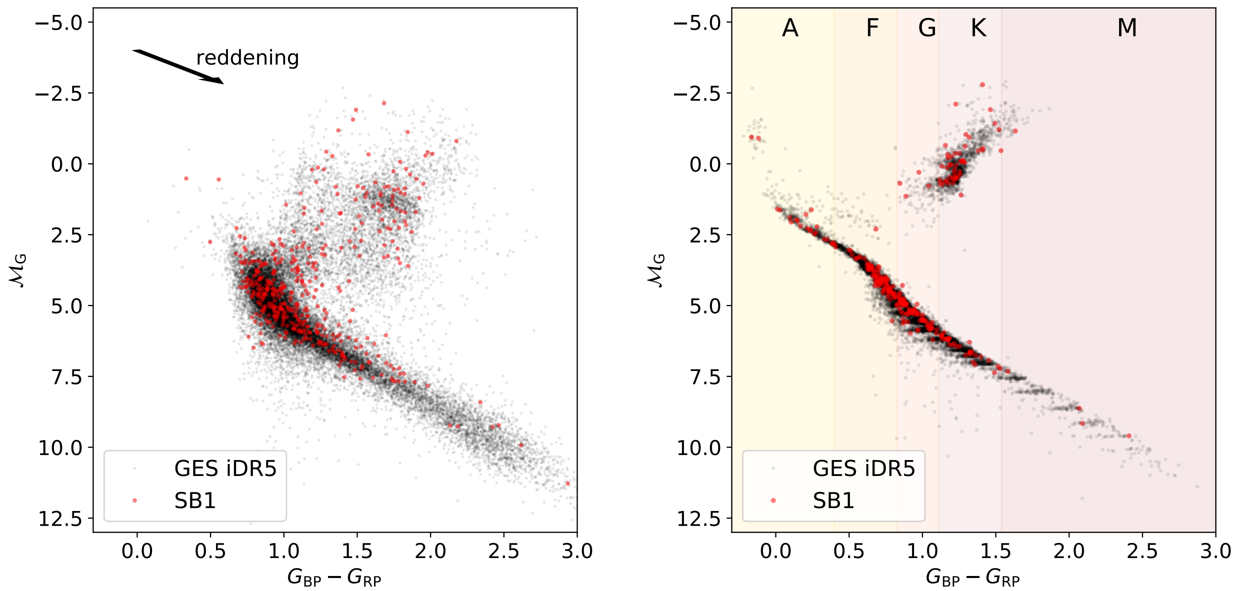

Fig. 1. Color-absolute magnitude diagrams of GES iDR5 stars (grey dots), with the SB1 candidates (red dots) without (left) and with (right) correction for the extinction and reddening. The horizontal stripes on the right panel are due to the degeneracy between extinction and temperature for late-type stars (see Bailer-Jones 2011; Andrae et al. 2018).

4 Results

After cleaning for photometric variability, there remain about 650 SB1 candidates depending on the selected confidence level. The smallest radial-velocity variation detected is about 2 km/s. Using Gaia DR2 parallaxes and G, BP and RP photometry (Gaia Collaboration et al. 2018), we may locate the SB1 detected on the main sequence and the red giant branch (left panel of Fig. 1). If we correct for extinction and reddening, the main sequence, giant branch and red clump of GES iDR5 stars become thinner and more compact (right panel of Fig. 1). Nevertheless, for late-type stars, a strong degeneracy between extinction and effective temperature from broad-band photometry remains and accounts for the spurious horizontal stripes on the main sequence (Bailer-Jones 2011; Andrae et al. 2018). We find that about 80% of SB1 candidates are on the main sequence and 20% on the giant branch. On the main sequence, the GES SB1 frequency increases with increasing effective temperatures. We also investigated the trend of the SB1 fraction with metallicity and preliminary results show an increase of this fraction with decreasing metallicity in agreement with recent results from the APOGEE (El-Badry et al. 2018; Badenes et al. 2018) and LAMOST (Gao et al. 2017) surveys. According to Moe & Di Stefano (2017), 30% of solar-type SB1 have white dwarf companions, the remaining being M dwarfs. From the small number of SB1 falling below the main sequence (Fig. 1), we qualitatively assert that the fraction of detected SB1 with white dwarf companion is marginal.

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