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Two new close (*sep*≈3 arcsec) and nearby common parallax and proper motion pairs at *d*≈15 pc (F1+M4$_{phot}$) and *d*≈11 pc (M4.5+T1$_{phot}$) in *Gaia* EDR3

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Abstract

There are 88 stars with lacking colours but measured parallaxes in *Gaia* EDR3 that place them within 20 pc from the sun. Among them we found two new common parallax and proper motion (CPPM) companions separated from their primaries by about 3 arcsec. The CPPM companion of a nearby (*d* = 14.98 pc) F1 star, HD 105452 B, was already imaged with the *Hubble Space Telescope* and was now confirmed with *Gaia* data and photometrically classified by us as M4 dwarf. The other CPPM companion, SCR J1214-2345 B orbiting an M4.5 dwarf at *d* = 10.77 pc, represents the faintest brown dwarf discovery made by *Gaia* so far. It was also imaged by the VISTA Hemisphere Survey and partly detected in the near-infrared. Our photometric classification led to an uncertain spectal type of T1±3 and needs to be confirmed by spectroscopic follow-up.

Confirmed nearby F1 star companion

The relatively bright star Gaia EDR3 3489338019474046720, hereafter HD 105452 B (*Gmag*≈11.70, *Plx*=66.23±0.17 mas, *pmRA*=+23.99±0.29 mas/yr, *pmDE*=−59.66±0.45 mas/yr), was measured at an angular separation of 3.1 arcsec from the known very bright F1 star (Gray et al. 2006) HD 105452 = Gaia EDR3 3489338019475637760 (*Gmag*≈3.95, *Plx*=66.77±0.18 mas, *pmRA*=+96.98±0.18 mas/yr, *pmDE*=−40.02±0.21 mas/yr).

Fortunately, HD 105452 was selected by Duchêne et al. (2014) as a point spread function (PSF) reference star in their investigation of a debris disk around another star. They mentioned an apparent companion at a separation of 2.2 arcsec, when they observed HD 105452 with the *Hubble Space Telescope (HST)* advanced camera for surveys (ACS) using the high resolution channel (HRC). Figure 1 shows that this companion, marked as HD 105452 B, appeared relatively bright in the observation with the red F814W filter. Duchêne et al. (2014) noted problems caused by this obviously red companion in their applied PSF subtraction technique with the F814W filter, whereas these problems were less acute with the F435W and F606W filters. We conclude that HD 105452 B is not a WD but a red dwarf. According to Cifuentes et al. (2020, their Table 7), the average absolute magnitude of M4 dwarfs in *Gaia* DR2 was M_G=10.88 mag. Therefore, we assign a photometric spectral type of M4V to HD 105452 B.

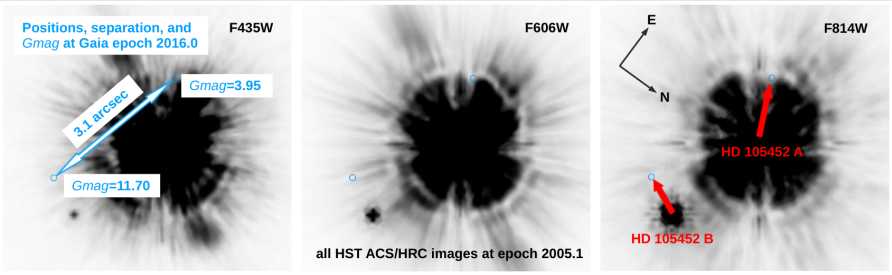

Fig.1: *HST* ACS/HRC images of HD 105452, used as PSF star in Duchêne et al. (2014), from the original observing program 10244 of Mark Wyatt (PI) extracted from https://archive.stsci.edu/hst/preview/. The positions of two objects detected in *Gaia* EDR3 are overplotted with blue open circles. In the left panel, their separation and *G* magnitudes are overlayed. The red arrows in the right panel illustrate the proper motions of the two components over the time baseline of about 11 years, which are consistent with the *Gaia* EDR3 measurements and probably indicate orbital motion.

New brown dwarf companion SCR J1214-2345 B

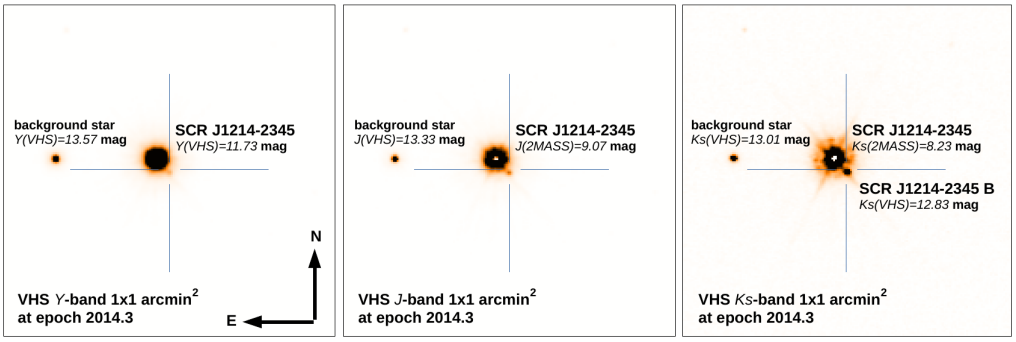

Fig.2: VHS *YJK*$_s$-band images (epoch 2014.3) centered on the *Gaia* EDR3 position (epoch 2016.0) of SCR J1214-2345 B. The measured VHS or 2MASS magnitudes of SCR J1214-2345, SCR J1214-2345 B, and a background star are marked.

The faint CPPM object Gaia EDR3 3489874340630661248, herafter SCR J1214-2345 B (*Gmag*≈20.58, *Plx*=94.18±1.08 mas, *pmRA*=+58.67±1.17 mas/yr, *pmDE*=+53.39±0.94 mas/yr), was measured next (separation 3.5 arcsec) to the nearby M4.5 dwarf (Riaz et al. 2006) SCR J1214-2345 = Gaia EDR3 3489874340631095936 (*Gmag*≈12.29, *Plx*=92.89±0.03 mas, *pmRA*=+44.18±0.03 mas/yr, *pmDE*=+84.32±0.04 mas/yr).

Optical and near-infrared images of SCR J1214-2345 were found in the VISTA Hemisphere Survey (VHS; McMahon et al. 2013) (Fig.2). The VHS catalogue lists only K_s=12.83 mag (AperMag3), but no *YJ* magnitude measurements for SCR J1214-2345 B, although one can see its fainter counterparts in the images, where a background star with simlar K_s but brighter *YJ* magnitudes iis marked for comparison. Using the relations between absolute magnitudes and spectral types given in Reylé (2018) led to a spectral type of T4-T5 from M_G=20.45 mag but only L8 from M_{K_s}=12.70 mag. Therefore, we provide an uncertain photometric classification of SCR J1214-2345 B as T1±3 dwarf. It was not included in the 20 pc census of LTY dwarfs of Kirkpatrick et al. (2020) and is the faintest new brown dwarf discovery in *Gaia* data so far (cf. Scholz 2020).

References

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