New SB2 orbital elements for accurate masses with Gaia: HD 9312, HD 9313 and HD 183255

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Introduction. Gaia will provide the opportunity to derive stellar masses with errors around 1 %, by combining Gaia astrometry with accurate SB2 orbital elements.

A large observation program is on going at the OHP observatory with the T193/Sophie in order to improve the orbital elements of known SB.

We expect to derive accurate orbital elements for about 70 SB2. The orbits published in the past are used to compute ephemerides in order to optimize the selection of the targets during the observation runs. However, some of these orbits are too obsolete for that purpose, and they were revised on the basis of our first observations.

We present hereafter three revised orbits obtained from ancient observations and from at least 4 Sophie spectra, providing at least 4 radial velocity (RV) measurements per component.

Calculation of revised orbits. Since our aim is to compute reliable ephemerides, an approximate preliminary reduction of the Sophie spectra is sufficient. The RV of the components were derived by fitting normal distributions to the cross-correlation function of each spectrum. This method provides RV with estimations of the uncertainty which are heavily underestimated.

The RV uncertainties of both the ancient and of the Sophie measurements are revised as follows:

• The orbital elements are derived from the ancient measurements, taken from the SB9 catalogue (http://sb9.astro.ulb.ac.be/). The calculation is repeated, adding a noise to the uncertainties in order to obtain a solution with the nominal goodness-of-fit F_2=0. The uncertainties of the ancient RV measurements are then the quadratic sums of their previous estimations and of the noise thus obtained.

• The procedure above is applied to the Sophie RV alone. It is worth noticing that a SB2 solution involves 7 unknowns (P, e, T_0, ω, V_γ, K_1, K_2), and that a total of 4 spectra, ie 8 RV measurements, is the minimum input required to derive a solution.

• The revised solution is derived from the ancient and from the Sophie measurements, taken together. A shift between the two sets of measurements, D_0, is added to the unknowns. Again, the uncertainties are modified by adding a noise in order to get F_2=0.

Table 1. Orbital elements of the revised orbits

	HD 9312 (HIP 7143)	HD 9313 (HIP 7134)	HD 183255 (HIP 95575)
Period (d)	36.51836 ±0.00068	53.51155 ±0.00025	166.8349 ±0.0170
T_0 (JD-2400000)	54094.16 ±1.39	39810.73 ± 0.11	47744.59 ±3.66
e	0.110 ±0.042	0.39640 ±0.00555	0.1393 ±0.0136
ω (°)	200.2 ±13.5	279.14 ±0.92	58.8 ±8.4
V_γ (km/s)	-4.05 ±1.06	-14.814 ±0.114	-64.438 ±0.145
K_1 (km/s)	31.00 ±1.29	24.361 ±0.170	13.810 ±0.315
K_2 (km/s)	43.85 ±2.50	33.83 ±0.56	16.519 ±0.588
D_0 (km/s)	5.51 ±1.38	1.19 ±0.26	-0.522 ±0.320

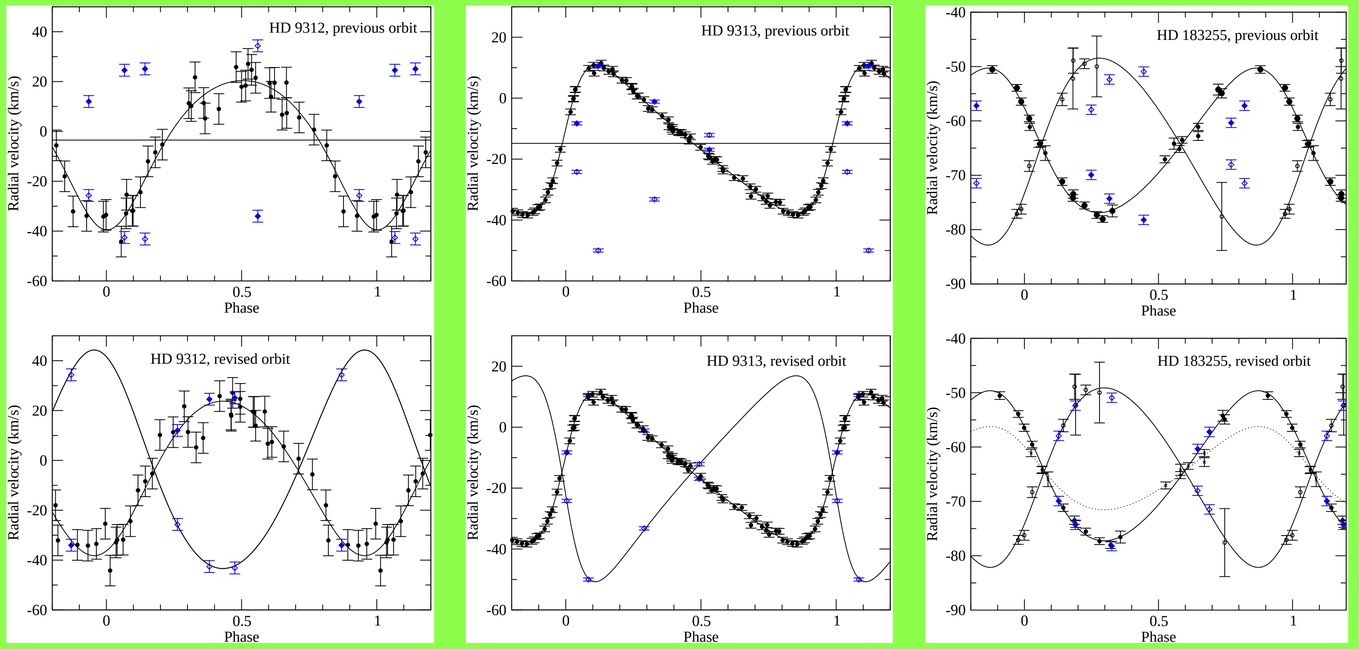

Fig.1 to 3: The old (top row) and the revised (bottom row) orbits of HD 9312, HD 9313 and HD 183255. The black circles refer to the ancient RV measurements, and the blue diamonds are preliminary estimations of the RV obtained from Sophie. The filled and open symbols refer to the primary and to the secondary components, respectively. The asterisks (HD 183255, revised orbit, dotted line) refer to ancient blended measurements used to derive C_0 .

Notes to individual objects

HD 9312 and HD 9313 were only known as SB1 prior to our observations. We have found secondary components with mass ratios 0.72 and 0.71, respectively.

Some ancient RV measurements of HD 183255 obviously refer to blends of the two components. Instead of considering them as measurements of the primary RV, we use them to derive the blend coefficient of the system: $C_0 = 0.797 \pm 0.032$

Concluding remarks

We have significantly improved the orbital elements of 3 SB systems, for which it is now possible to compute reliable ephemerides. The RV measurements and the three new orbits will be included in the on-line SB9 catalogue.

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