New SB2 for accurate masses with Gaia

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

A large observation program was undertaken at the OHP observatory with the T193/Sophie in order to improve the orbital elements of known SB

• 208 target stars, including 156 SB1

• 265 RV measurements in 1.25 year; 123 stars (29 SB2 and 94 SB1) with at least 1 measurement

• No secondary component for > 30 SB1 observed in the best phase conditions

• The secondary component is detected for 16 SB previously known as SB1.

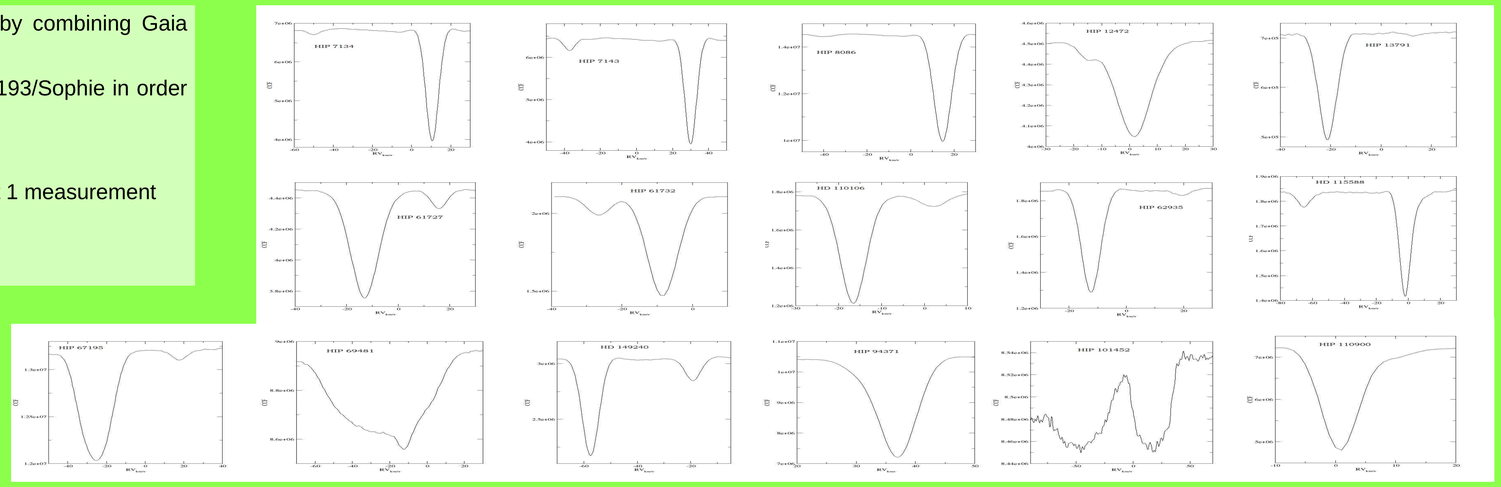

Fig.1: The cross-correlation functions (CCF) of the 16 SB showing evidence of the secondary component

The secondary dip is clearly visible on the vast majority of the 16 cross-correlation functions shown in Fig. 1.

A few ones deserve explanations:

• HIP 8086: the secondary dip is very small, but it was observed at 3 different epochs, and its position is moving as expected. The detection is then certain.

• HIP 69481: A narrow secondary dip is emerging from a wide primary dip. A second observation, at another phase, confirms the detection.

• HIP 94371: Only one dissymmetric dip is visible, and the detection must still be confirmed.

• HIP 110900: The secondary dip is in the wing of the primary one, and it has to be confirmed.

Mass ratios of the new SB2

Since the barycentric velocities of the systems are already known, it is possible to derive preliminary estimations of the mass ratios. We remind that, with spectrographs earlier than the CCD era, the luminosity ratio of binary star components generally prevents detection of secondaries with mass ratio smaller than 0.7.

Star	$q = M_2/M_1$
HIP 7134	0.72
HIP 7143	0.58
HIP 8086	0.5 :
HIP 12472	0.68

Star	$q = M_2/M_1$
HIP 13791	0.53
HIP 61727	0.64
HIP 61732	0.66
HD 110106	0.75

Star	$q = M_2/M_1$
HIP 62935	0.71
HD 115588	0.36
HIP 67195	0.65
HIP 69481	0.2 :

Star	$q = M_2/M_1$
HD 149240	0.42
HIP 94371	0.9 :
HIP 101452	0.92
HIP 110900	0.85

It is then verified that Sophie is able to detect secondaries with q smaller than 0.7. However, three SB receive a mass ratio well above this limit :

• HIP 101452. The primary is a A0p-type star, and its radial velocity, obtained in the past from photographic plates, was probably measured thanks to the peculiar lines of the spectrum. These lines could be missing in the secondary spectrum. The two components are clearly visible on the CFF obtained with an early-type mask.

• HIP 94371 and HIP 110900. If the secondary is confirmed in the future, it seems to be underluminous. It is obvious that the relation between the mass ratio and the luminosity ratio is not unique: for instance, the secondary dip of HD 149240 (q=0.42) is much more visible than that of HIP 62935 (q=0.71).

Conclusion

We have now a selection of 52+16=68 SB2, ie 136 stars for which we expect to derive the masses with an accuracy near 1 % at the end of the Gaia mission.

Thanks to the ability of the Sophie spectrograph, the detection limit in mass ratio is shifted from around 0.7 to around 0.4.

Since 62 SB1 remain to be measured, we still expect to find around 10 new SB2.

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