

Double-lined spectroscopic heartbeat system: Asterix & Obelix, KIC 9163796

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1 KIC 9163796

Asterix & Obelix is an red giant heartbeat system with an orbital period 121.3 days and an eccentricity of 0.69. The names are assigned, following the definition, $M_{\text{Asterix}} < M_{\text{Obelix}}$. Spectroscopy with the HERMES spectrograph shows a clear double-lined binary (SB2, cf. Fig. 3). The power spectrum reveals a complex low amplitude power excess at $153 \mu\text{Hz}$. This analysis is listed as WG8 project [84].

2 Analysis potential

2.1 Mass determination and confrontation of methods

We therefore can use three different techniques to determine and compare the masses.

- Seismology: The power spectrum seems to contain two power excesses.
- SB2 solution: ratio of RV-amplitudes
- Binary modelling: Although no eclipses are visible, the heartbeat effect allows for the determination of the mass ratio and inclination. As both stars seem to be of equal size and radii, it should be investigated, if the heartbeat phenomenon is actually present in both stars.

2.2 Complementary analysis

- Surface rotation and/or spot modeling (cf. Fig. 2).
- Groundbased photometric data.
- Spectroscopic disentangling and fundamental parameters for both components.
- Light factors and rotational profile (cf. Fig. 4).

3 Light and Radial Velocity curves

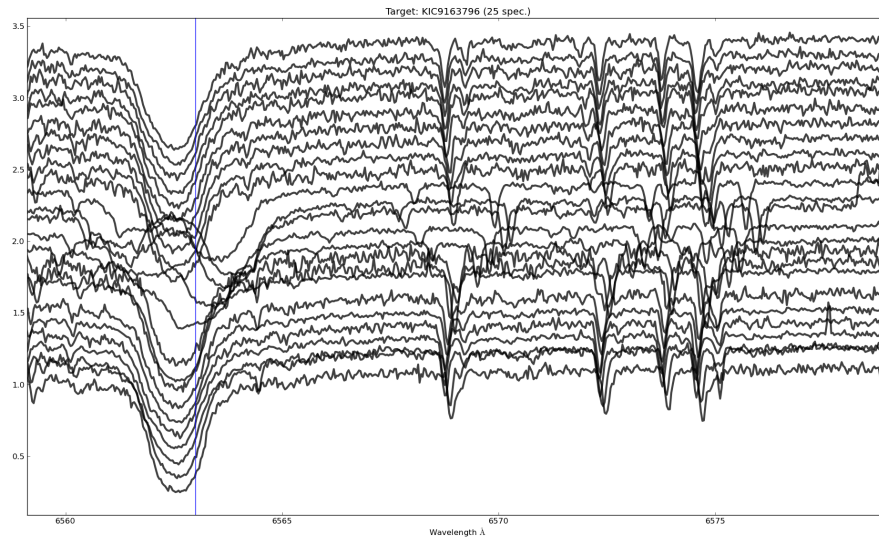


Figure 1: Timeseries of 25 HERMES spectra. The vertical blue line marks the rest wavelength of H_{α} .

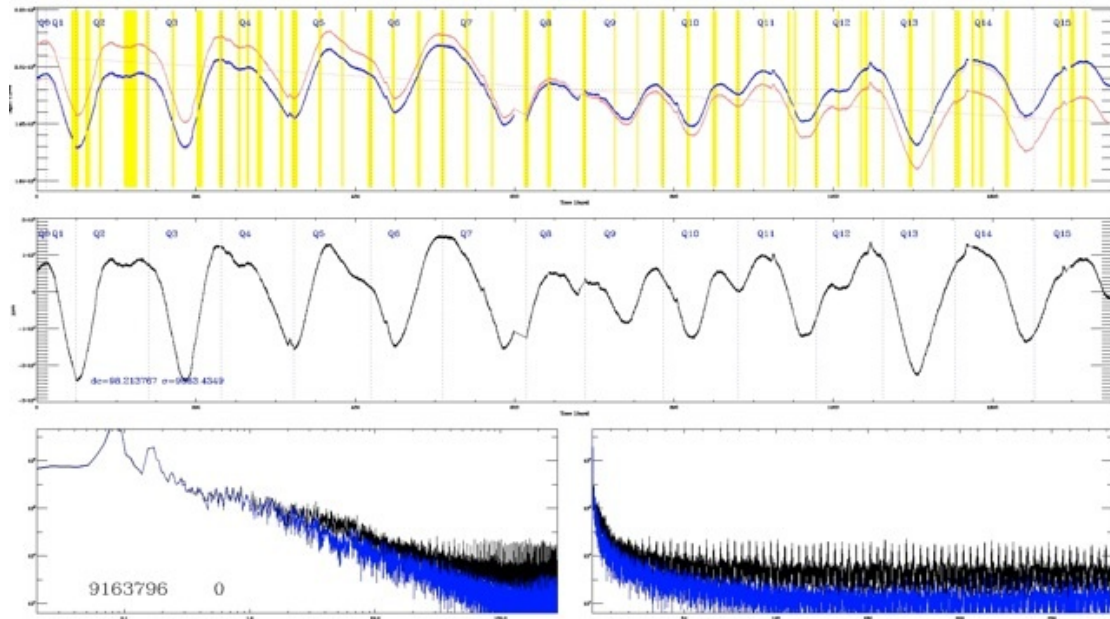


Figure 2: The light curve and power spectrum of KIC9163796. The top and middle panel reveal the likely presence of spots. The bottom panels compare the power density spectrum from original data (black) and data treated by inpainting techniques (blue).

4 Preliminary SB2 solution

A preliminary curve of the radial velocities of both components is shown in Fig. 3. RVs were derived by fitting two Gaussian Profiles to the double peaked output of the cross correlation with HERMES spectrum with the Arcturus mask (Fig. 4). When fitting orbital solutions to both components, we find the following orbital parameters:

p =	121.30 +/- 0.00 (0.00%)	bounds =	120.30 <-> 122.30 (fixed)
t0 =	2456381.09 +/- 0.05 (0.00%)	bounds =	2456260.36 <-> 2456502.96 (fit)
e =	0.69 +/- 0.00 (0.35%)	bounds =	0.60 <-> 0.80 (fit)
omega =	6.20 +/- 0.01 (0.11%)	bounds =	0.00 <-> 6.28 (fit)
k1 =	35.19 +/- 0.21 (0.61%)	bounds =	-60.00 <-> 60.00 (fit)
v01 =	-10.62 +/- 0.11 (1.08%)	bounds =	-80.52 <-> 60.52 (fit)
k2 =	-35.68 +/- 0.21 (0.60%)	bounds =	-60.00 <-> 60.00 (fit)
v02 =	-10.94 +/- 0.11 (1.04%)	bounds =	-80.52 <-> 60.52 (fit)

This allows us to derive the mass ratio of the two components from RV amplitudes,

$$\frac{RV_{Asterix}}{RV_{Obelix}} = \frac{k_2}{k_1} = 1.01 \pm 0.01. \quad (1)$$

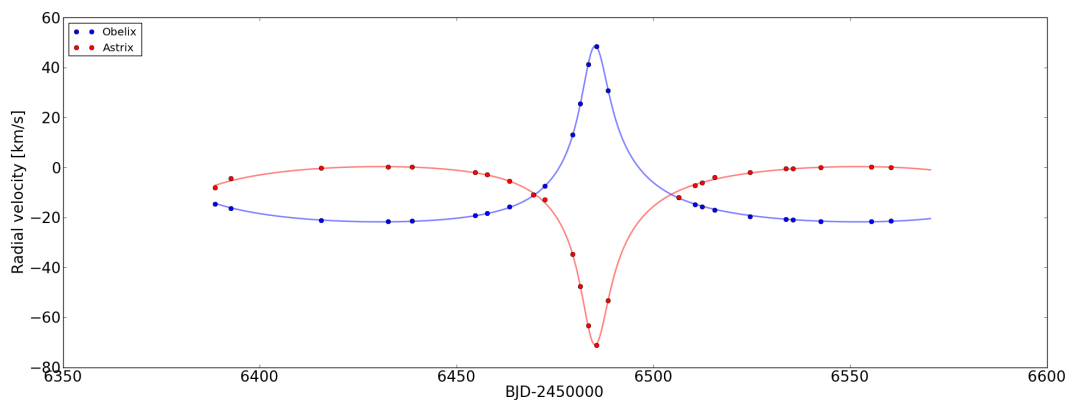


Figure 3: Radial velocity curve for KIC 9163796. *Obelix*, the more massive component is shown in blue, while the less massive component, *Asterix* is shown in red.

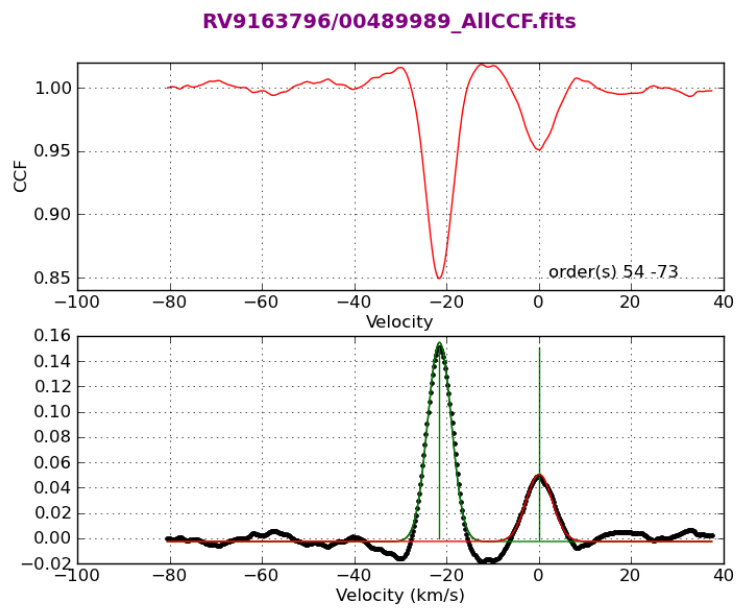


Figure 4: Response of the cross correlation of the spectrum with the HERMES Arcturus mask. The main peak originates from *Obelix*.