α and β Crucis as seen by BRITE and SMEI

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α and β Crucis (Acrux and Mimosa respectively) are the brightest stars in the constellation of the Southern Cross. Both of them are multiple stars harboring the eccentric spectroscopic binary systems, containing massive primary components of early-B spectral type. The photometric variability of the former was not yet known while the latter is well-known β Cep-type pulsator. Using BRITE and SMEI data, the new pulsation frequencies were discovered showing that Acrux and Mimosa are so-called *hybrid pulsators* with both g and p modes present.

1 Source of Data

The light curves of Acrux and Mimosa was analysing. Data come from the BRITE (Weiss et al., 2014) and SMEI (Eyles et al., 2003) satellites (see Fig. 1 for more details).

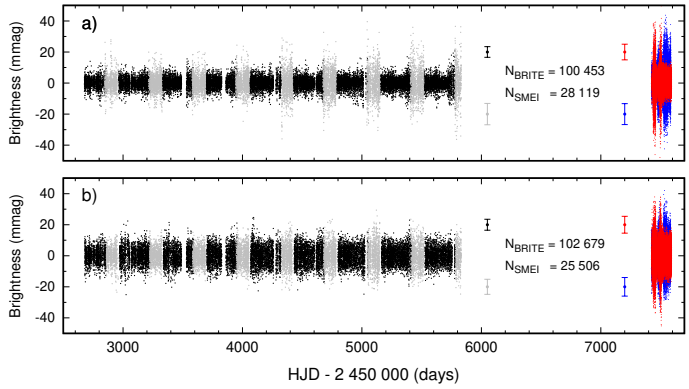

Fig. 1: Panel a): decorrelated SMEI and BRITE light curves of α Cru after zero-level subtraction. Black and grey points represent SMEI data from cameras number 2 and 3, respectively. For comparison purposes in both pictures the BRITE red (red points) and blue (blue points) passband combined light curves are shown. Single points with error bars represent an average brightness error for every color-coded part of the light curve. Panel b): the same as a), but for β Cru. It is worth to notice nearly eight years of SMEI observations.

2 α Cru – Acrux

Acrux consists of two visually separable components: α^1 Cru (α Cru A, HD 108248, $V = 1.28$ mag) and α^2 Cru (α Cru B, HD 108249, $V = 1.58$ mag, spectral type B1 V) located nearly $4.4''$ further away from the first one. α^1 Cru is itself a single-lined

spectroscopic binary where the primary component has the spectral type B0.5 IV (Brown & Verschueren, 1997). Although α^1 Cru possible photometric variability was not yet known, it had been observed spectroscopically many times in order to determine it's radial velocity curve (e.g. Luyten, 1935; Thackeray & Hill, 1974; Thackeray & Wegner, 1980). The least squares fit to radial velocity data performed by Thackeray & Wegner (1980) suggests elliptical orbit with $e \approx 0.46$ and period $P \approx 75.78$ days. The results of Fourier analysis is presented below in Fig. 2 with values of extracted frequencies. Five new pulsation frequencies have been found, two of them are probably gravity modes.

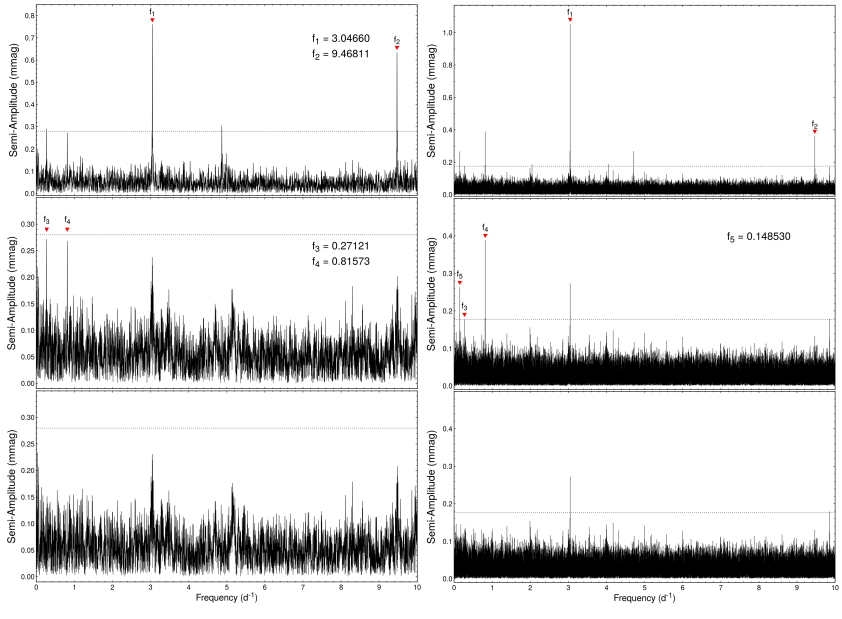

Fig. 2: Fourier spectra related to the pre-whitening steps of Acrux's light curves. Left: periodograms of combined BRITE data. Right: periodograms of combined SMEI data. Red triangles denote newly found modes. The dashed line denotes $4 \times N$ detection threshold. The numbering of the consecutive frequencies reflects decreasing amplitude of the modes.

3 β Cru – Mimosa

Similarly to the α^1 Cru system, Mimosa (HD111123, HR4853, $V = 1.25$ mag) is a single-lined spectroscopic binary characterized by spectral type of primary component B0.5 III (Brown & Verschueren, 1997). It is also the well known β Cep-type pulsator, correctly classified by Pagel (1956) who has identified single dominant frequency ~ 5.230 d^{-1} basing on radial velocity measurements. Aerts et al. (1998) performed detailed analysis of this system, including mode identification, showing that all of them are non-radial pulsations. Fig. 3 presents the results of Fourier analysis of the Mimosa's BRITE and SMEI light curves. Ten new pulsation frequencies have been found, five of them are probably gravity modes detected for the first time.

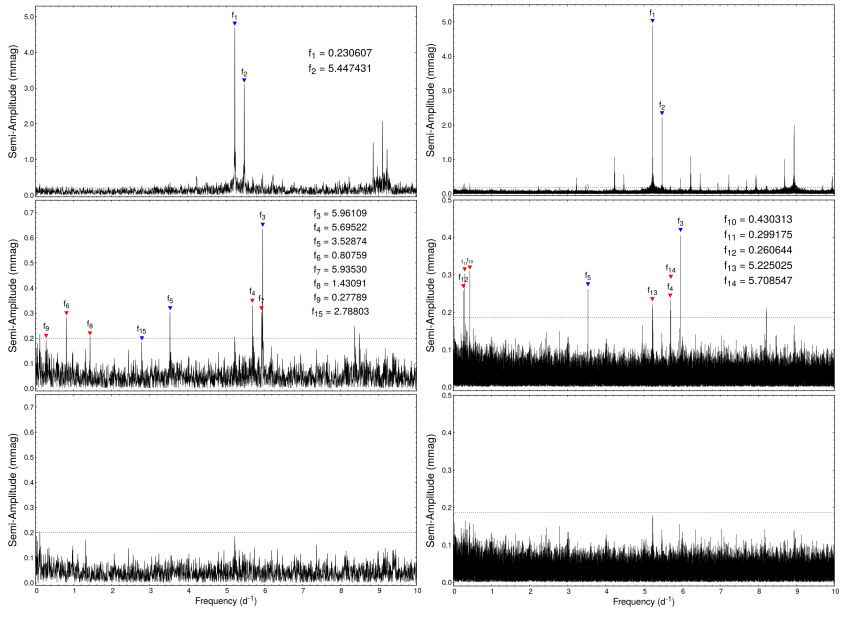

Fig. 3: The same as Fig. 2 but for the BRITE and SMEI light curves of β Cru. Blue triangles denote already known modes.

4 Variation of Amplitudes over Time

Due to the very long time-span of SMEI light curves, it was possible to examine the variation of pulsations' amplitudes over time. To achieve this goal, the Fourier analysis has been performed on the smaller time window of the whole light curve which was moving along time axis in order to 'scan' entire time series. In the case of Acrux, it came out that all modes significantly vary over time. The similar view emerges for Mimosa, where undoubtedly $f_1, f_5, f_{10}, f_{11}, f_{12}, f_{13}, f_{14}$ amplitudes change with time, while amplitudes of f_2, f_3 and f_4 modes seem to stay almost constant.

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