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The (B0+?)+O6 system FN CMa†: a case for tidal-pulsational interaction?

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Abstract. FN CMa is visually double with a separation of ∼0.6 arcsec. Sixty high-cadence VLT/*UVES* spectra permit the A and B components to be disentangled, as the relative contribution of each star to the total light entering the spectrograph fluctuates between exposures due to changes in seeing. Component A exhibits rapid line-profile variations, leading us to attribute the photometric variability seen by HIPPARCOS (with a derived $P = 0.08866$ d) to this component. From a total of 122 archival and new echelle spectra it is shown that component A is an SB1 binary with an orbital period of 117.55 days. The eccentricity of 0.6 may result in tidal modulation of the pulsation(s) of component Aa.

Keywords. stars: binaries: general, stars: oscillations (including pulsations), stars: early-type

1. Introducing FN CMa

FN CMa (HD 53 974) is a bright ($V = 5.4$ mag) B0.5 III star and visually double. Within about a century, the relative position of components A and B, which are separated by ∼0.6 arcsec, has changed marginally at most. A is brighter than B by about 1.2 mag.

2. Observations and data reduction

The ESO Science Archive contains 60 VLT/*UVES* echelle spectra of FN CMa obtained within 1.4 hours for a study of interstellar medium, and three more spectra from *FEROS* at the 2.2-m ESO/MPG telescope, La Silla. In 2009 and 2010, an additional 59 echelle spectra were secured with the *BESO* spectrograph, a clone of *FEROS* mounted on the Bochum 1.5-m Hexapod Telescope on Cerro Armazones.

As a result of variable seeing and imperfect guiding, some UVES spectra contain a significantly higher fraction of light from component B than others. Since the light combination is geometric it has no spectral dependency, and thus, under the assumption that certain spectral features are due to either A (e.g., Si III 4553) or B (e.g., He II 4540) alone, a simple linear set of equations can be used for the disentangling of the spectra from the two stars over the entire wavelength range. The inferred spectral light ratios, between 0.75 and 0.85, are in good agreement with the known magnitude difference.

3. Results

FN CMa B: This component has a spectrum typical of mid-O main-sequence stars. Compared to the B0.5III primary, it would be considerably underluminous if the pair were physical. However, assuming an O subdwarf companion does not help because,

† Based on data from ESO programs 076.C-0431, 076.C-0164, and the BESO spectrograph.

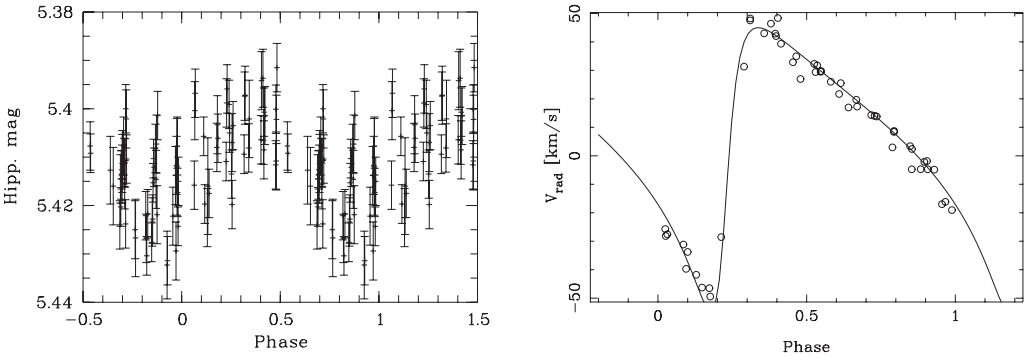

Figure 1. Left panel: *HIPPARCOS* photometry of FN CMa phased with a period of 2.13 h. Right panel: The radial velocity curve of FN CMa Aa (P = 117.55 d).

then, component B would be about 2 mag *over*luminous. Components A and B display the same set of interstellar Ca sc ii K lines except that the redmost one is significantly stronger in B. Considering also incipient emission in N III and Hα, we conclude that component B is best described as an O6V((f)) background star.

FN CMa A: In the literature, FN CMa has a record of low-amplitude photometric variability and modulated spectral line profiles. But there is no consensus about its nature. Our analysis of the *HIPPARCOS* photometry yields a period of 0.08866 d (2.13 h; see left panel of Fig. 1) with ∼0.02 mag amplitude. The combination of spectral type, period, and amplitude makes FN CMa a β Cephei star candidate, as already suggested by other observers. This is further supported by the rapid spectral line-profile variability of component A (however, at just 1.4 h, the *UVES* data string is too short and the *BESO* spectra are not sufficiently densely sampled to attempt an independent period determination). In any case, given the spectral variations seen in component A, we attribute the photometric variability to this component as well.

Much larger-amplitude long-term radial-velocity variability is apparent from the *BESO* data: FN CMa A is itself an SB1 binary with the following properties:

Period [d]	117.55 ± 0.33
Periastron epoch [JD]	2 453 779.5 ± 4
Periastron longitude [deg]	247 ± 7
e	0.60 ± 0.05
K_1 [km/s]	49.8 ± 3.5
γ [km/s]	5.9 ± 1.5

The radial-velocity curve of FN CMa Aa is shown in Fig. 1 (right panel). Its relatively large amplitude suggests that the so-far (directly) undetected component FN CM Ab is a fairly massive star. However, it appears too faint to be the carrier of the rapid variability.

4. Discussion

The high eccentricity and moderate orbital period of the subsystem FN CMa Aa+Ab may enable searches for a tidal modulation of the pulsation of component Aa. Since FN CMa is bright and situated in a region with numerous other pulsating OB stars, it might be worthwhile including it in the target lists of wide-angle asteroseismology satellites such as BRITE.

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