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The photometric variability of the B9p star HD 137509

Cowley & Houk (1975) first pointed out the interesting nature of the B9pSiCrFe star HD 137509 (= CPD −70° 2069 = SAO 257290) which exhibits very strong Cr II, Fe II and Ti II lines in its spectrum. This star was introduced in photometric programs, but it was only recently that its variability was reported on the basis of 10 UBV measurements (Lodén & Sundman 1989). Simultaneously Mathys (1991) discovered a strong reversing longitudinal magnetic field, and he noted that the spectrum of HD 137509 undergoes fast and spectacular variations. Most magnetic Bp stars are known to be photometric variables, but the spectropolarimetric observations reported by Mathys (1991) revives our interest for this star. This star should indeed have quite large surface chemical inhomogeneities, and furthermore its two magnetic poles are visible during a whole rotation cycle, which is the most favourable circumstance for surface mapping. Before any further study of the spectrum variations, we need to determine precisely the rotation period. This could be done most efficiently with new photometric observations. At the moment the 9 measurements of the longitudinal magnetic field recorded by Mathys are too few to derive safely a period, but they will be quite useful to avoid spurious periods or to remove ambiguities between different values coming out from the photometry alone.

In March and April 1991, we got 36 new measurements of HD 137509 in the Geneva seven-color photometric system with the photometer P7 attached to the 0.7 m Swiss telescope located at La Silla (Chile). They were reduced in the general reduction frame at Geneva Observatory. The accuracy of the data for several nights appears to be somewhat

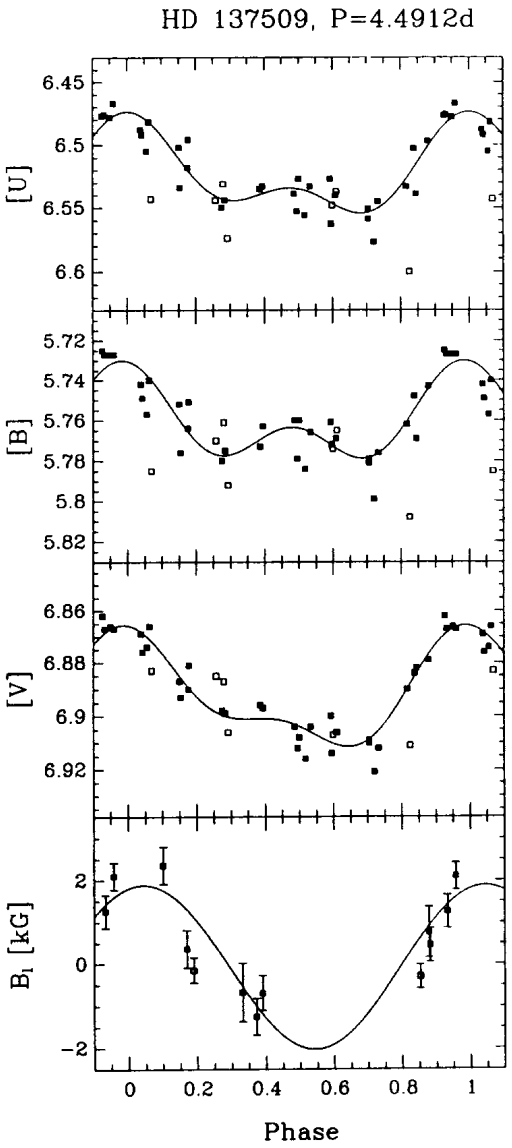

Figure 1: Photometric and longitudinal magnetic field variations of HD 137509. The phase origin is HJD 2448344.575. Open squares are data excluded from the period analysis and from the least-squares fits (low weight photometric data or polarimetric data of Bohlender & Landstreet).

lower due to poor weather and to the very southern declination of the star. Accordingly low weights were assigned to these measurements. We discarded for further analysis only the measurements with a null weight (7 measurements).

HD 137509 undergoes quite large variations for a magnetic Bp star, with $\Delta U \simeq 0.1$ mag and $\Delta V \simeq 0.05$ mag. The phase dispersion method (Stellingwerf 1978) and Renson's (1978) θ_1 test were applied separately to U, B and V magnitudes to determine the period P. Then least-squares fits of the observations were computed with a modified Newton method, assuming that the model function is a sine wave and its first harmonic. The ultimate accuracy on the period P was achieved by slightly varying P and looking for the minimum of the least-squares fit standard deviation for the three magnitudes. The best period coming out from the photometry is $P = 4.5568$ days, but this value is not supported by the magnetic data. Other possible values of the period from the photometry alone are 4.491, 4.505 and 4.594 days. The only one that satisfactorily represents the magnetic variations is:

$$P = 4.4912 \pm 0.0010 \text{ days}$$

which is adopted as the rotation period of HD 137509. A minimum of U occurred at HJD 2448344.575. Two more polarimetric measurements (Bohlender & Landstreet, private communication) support our period, as well as data on the crossover effect derived from the spectropolarimetry (Mathys, in preparation). The figure shows the photometric and the magnetic variations, and the least-squares fits with the adopted period.

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