SYNOPSIS OF BY Dra AND II PEG LIGHT CURVES: VARIABILITY AND POSSIBLE EVIDENCE OF DIFFERENTIAL ROTATION(+)

M. Rodonò, V. Pazzani and G. Cutispoto
Osservatorio Astrofisico and Università di Catania, Italy

BY Dra (MOVe+MOVe) and II Peg (K2IV-III) are well known non-eclipsing spectroscopic binary systems showing the low-amplitude quasi-periodic photometric variability that is typical of spotted stars.

Since the discovery of their variability (Chugainov 1966, Eggen 1968) additional accurate photometry has been carried out (cf. Rodonò 1982). On account of their highly variable light curves (LC), we have reanalyzed all the available observations and divided the original data into shorter time-interval sets, so that overlapping LCs with different shape could be separated. Additional LCs obtained at Catania Observatory till 1981 were also included.

Notable and systematic changes of both BY Dra and II Peg LCs, from almost pure sinusoidal, to double-peaked to almost flat, on time-scales of the order of one month, are apparent. Representative examples are shown in Fig. 1 and Fig. 2. Wherever possible, the phase of the light minimum (ϕ_{min}), and the amplitude and mean level of the LC were obtained by expanding the observed LC with a truncated Fourier series.

For BY Dra, the phase of the light minimum appears to migrate cyclically on the LC in about 5-6 years, i.e. the photometric period (P_{ph}) undergoes similar changes with respect to the mean value 3.83624 days, very close to the value given by Chugainov (1966). If the cyclical variation of ϕ_{min}, or P_{ph}, is attributed to latitude migration of spotted areas in a differentially rotating star, a lower limit of 4.4×10^{-10} rad s^{-1} deg^{-1} for the latitude shear can be inferred from the gradient of ϕ_{min} variation. The latter is accompanied by a sizable, but

(+) Partly based on observations by the IUE collected at the Villafranca Satellite Tracking Station of the ESA.

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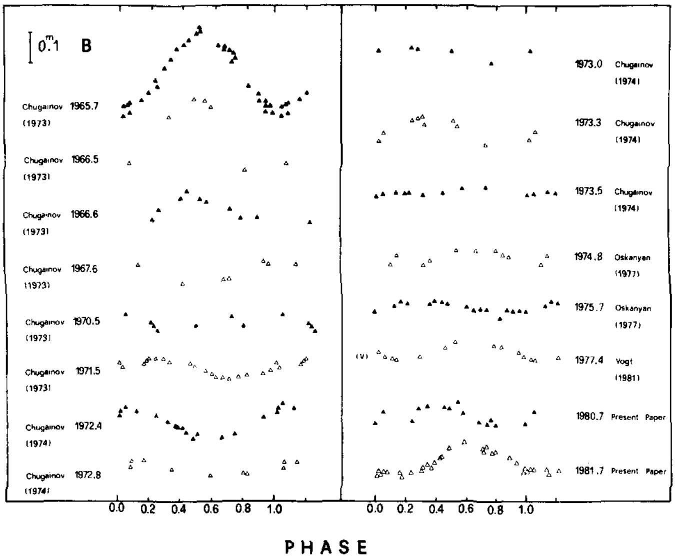

Figure 1. BY Dra light curves. Phases are reckoned from JD 2438983.612 and photometric period $3^{d}.836$ days.

apparently uncorrelated, variation of the mean luminosity of BY Dra (Fig 3). The long-term variability discovered by Phillips and Hartmann (1978) is confirmed and the most recent observations are consistent with a variability cycle of about 50 years (Fig. 4).

Similar changes are displayed by the LC of II Peg. However, its main features, viz. light maximum and minimum, show quite different migration rates: the maximum migrates towards decreasing orbital phases at a rate several times faster than the minimum, the latter being almost synchronous with the orbital motion (Fig. 5, lower plot). This fact makes the LC of II Peg continuously variable. The magnitudes of II Peg at maximum and at minimum have been decreasing since its variability was discovered (Fig. 5, upper plot). This monotonic light decrease, together with the variation of the LC amplitude, suggest that the activity level of II Peg, as far as spottedness is concerned, has been ever increasing since then. Assuming, as for BY Dra, that the observed migration of the LC features is due to latitude migration of surface inhomogeneities on a differentially rotating star, a lower limit of $1.7\text{x}10^{-10}$ rad s^{-1} deg^{-1} for the latitude shear on II Peg is obtained. The values obtained for both BY Dra and II Peg turn out to be somewhat higher than the solar one $0.6\text{x}10^{-10}$ rad s^{-1} deg^{-1} (Rodonò 1982).

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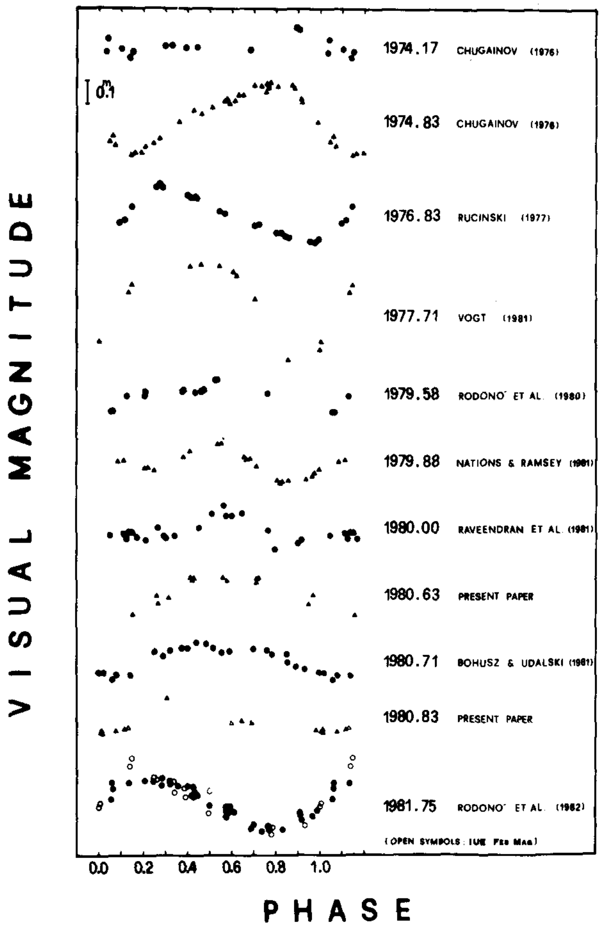

Figure 2. II Peg light curves. Phases are reckoned from JD 2442021.7264 and orbital period 6.724464 days, i.e. from the inferior conjunction given by Raveendran et al. (1981).

In Fig. 6 we also show the II Peg surface fluxes in several UV emission lines obtained from the IUE spectra LWR 8991 and SWP 10328 collected at VILSPA in 1980. At chromospheric and TR levels, II Peg appears to be more active than " *very active*" solar regions, with the higher excitation emission species more enhanced than the low excitation ones. This behaviour is qualitatively similar to the relative enhancement of emission lines in solar active regions with respect to quiescent ones.

An extended version of the present paper will be submitted to Astron. Astrophys.

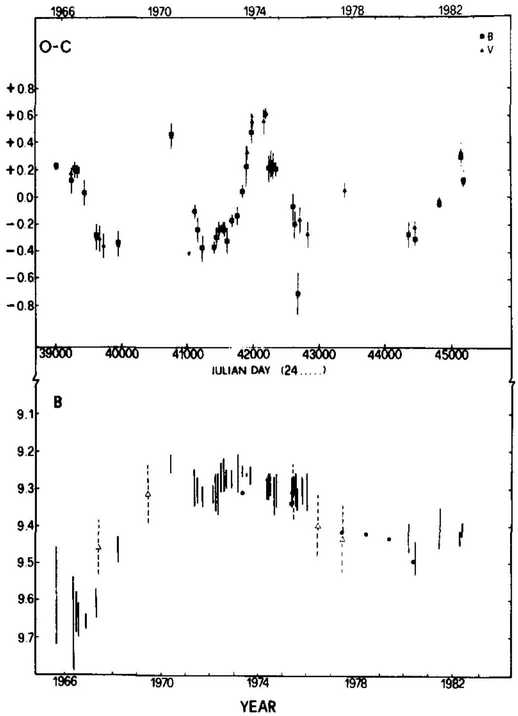

Figure 3. O-C for the phase of the light minimum of BY Dra with respect to the relation $\phi_{min} =$ $= -1.682 + 6.338 \times 10^{-5} \times JD$ vs. time (upper inset). B magnitude vs. time (lower inset). Bars: range of variation from pe. observations. Dots: mean seasonal magnitudes (Mavridis et al. 1982). Triangles: Harvard plate magnitudes (Hartmann and Londono 1982).

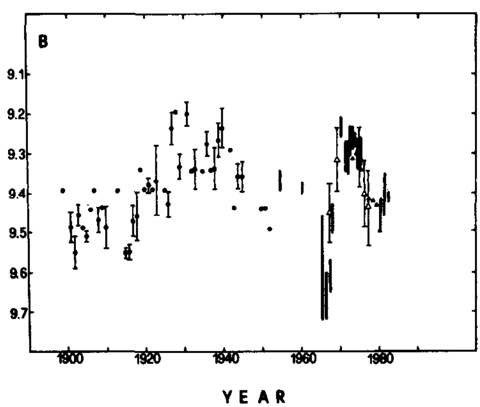

Figure 4. Long term variability of BY Dra from Phillips and Hartmann (1978) and from recent photoelectric photometry. Dots: Harvard plates. Heavy bars: range of seasonal pe. variability. Triangles: seasonal pg. averages.

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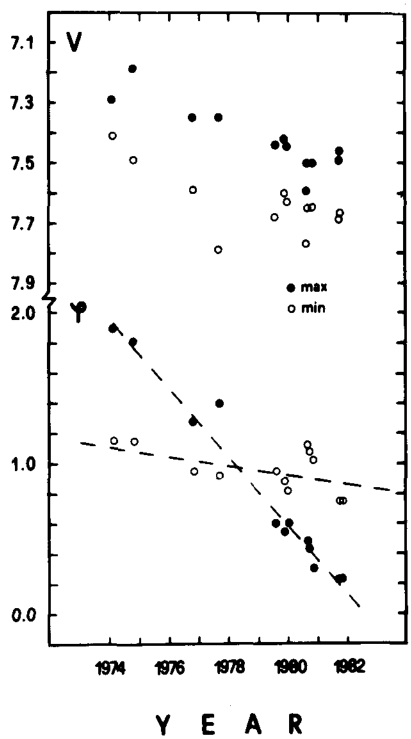

Figure 5. V magnitudes of II Peg at light maximum and minimum (upper plots) and the different migrations of these light curve features with respect to orbital phase (ϕ) (lower plots) versus time. Phases are reckoned from inferior conjunction as in Figure 2.

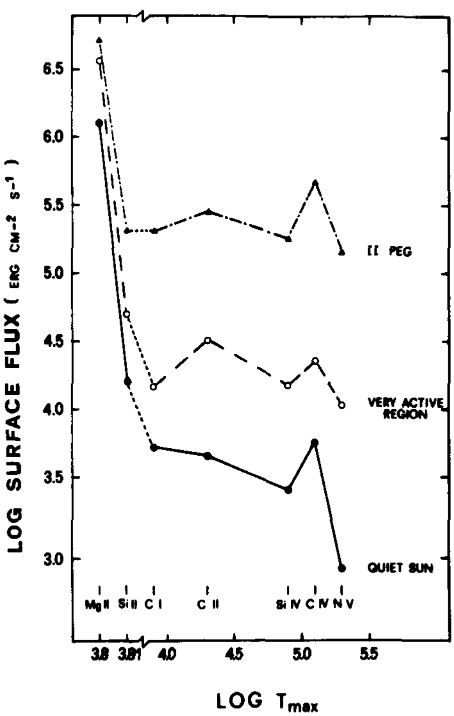

Figure 6. Surface fluxes in UV emission lines from IUE spectra of II Peg compared with those of a "very active" solar region and of the quiet Sun.

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