COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 2970

Konkoly Observatory
Budapest
29 December 1986
HU ISSN 0374-0676

THE 1985/86 LIGHT CURVE OF II PEGASI: TWO MAXIMA OF UNEQUAL BRIGHTNESS

The single-line spectroscopic binary II Pegasi (HD 224085, BD $+27^{\circ}4642$; K2 IV; $\langle V \rangle = +7.5$ mag) was observed photoelectrically on 19 nights from 1985 September 14 UT through 1986 January 22 UT at Villanova University Observatory. A description of the instrumentation, observing procedure, data reduction technique, and explanation of the differential color indices has been given elsewhere (Guinan and Wacker, 1985). The comparison star was HD 223332 (BD $+27^{\circ}4625$, SAO 091503; K5; V = +7.05 mag). Monitoring of this star with respect to SAO 091593 (V = +9.40 mag) by Vogt (1981) has established its constancy in light and color. Nightly mean differential magnitudes were computed, in the sense variable minus comparison, for the intermediate band blue, yellow and red observations, from which nightly mean differential color indices were formed. The mean errors for the nightly λλ 4530, 5500, 6600, $\Delta(b-y)'$ and $\Delta(b-r)'$ data sets are, respectively: 0.012, 0.008, 0.010, 0.015 and 0.016 mag.

The upper half of Figure 1 presents the light curve of the nightly mean differential yellow magnitudes. The orbital phases were calculated according to the ephemeris of Vogt (1981):

$$HJD = 2443033.47 + 6^{d}.72422 \cdot E$$

where zero phase corresponds to the moment of superior conjunction (primary component farthest from the earth). The light curve possesses two maxima, as well as two minima, all of unequal brightness. The deeper of the two minima has a value of 0.57 mag, occurring near 0.28P. The brighter of the two maxima equals 0.36 mag and occurs about 0.21P later, producing a very steep ascending branch and a corresponding light amplitude of 0.21 mag. The blue and red light curves (not shown) are identical in shape to the yellow light curve. The red light amplitude is approximately 0.19 mag, while the blue light amplitude is

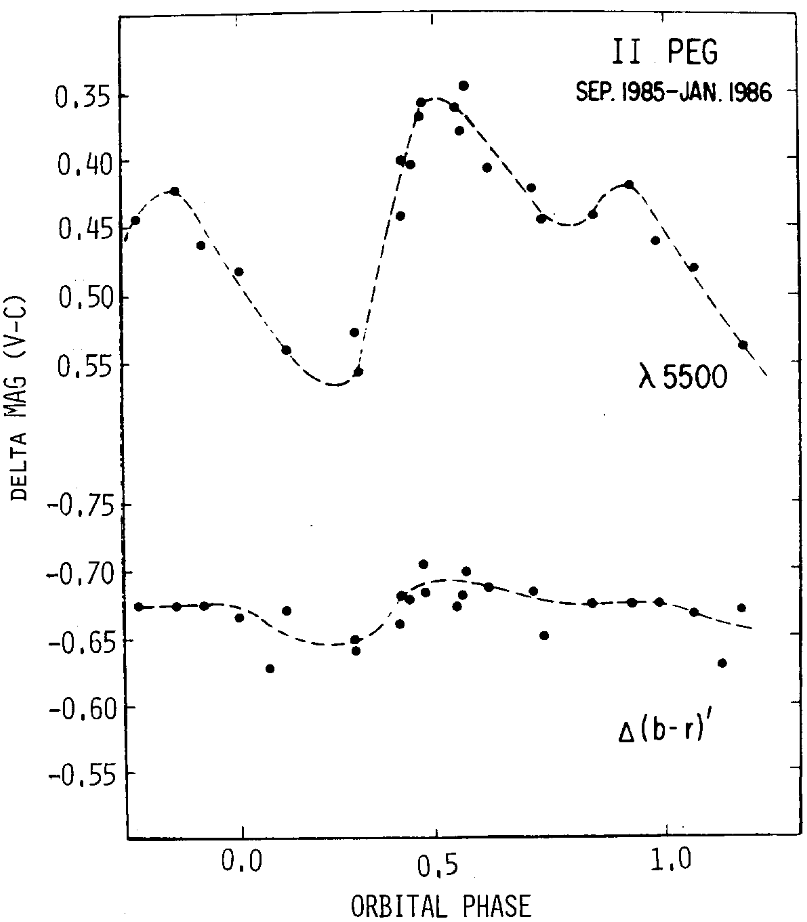

Figure 1 : The 1985/86 photoelectric observations of II Peg, made with respect to the comparison star HD 223332, are presented. The top panel is a plot of the nightly mean differential yellow magnitudes. The bottom panel is a plot of the differential color index formed from the intermediate-band blue and red observations.

about 0.23 mag.

The lower half of Figure 1 presents the differential color index $\Delta(b-r)'$ The mean value of the $\Delta(b-r)'$ data set = -0.669 mag. Despite a considerable degree of observational scatter, the color curve exhibits a noticeable discontinuity between 0.05P and 0.50P, coinciding with the minimum of the photometric wave. Similar behavior is also displayed by the $\Delta(b-y)'$ color curve (not presented).

Our light curve of II Pegasi presented in Figure 1 is very similar to that obtained for DM Ursae Majoris during early 1981 by Mohin et al. (1985), as well as the October/November 1979 light curve of II Pegasi obtained by Nations and Ramsey (1981). For chromospherically active stars such as II Pegasi and DM Ursae Majoris, the photometric variations are attributed to the rotational modulation of subluminous photospheric regions (i.e. starspots). Implementing the computer code developed at Villanova (cf. Dorren et al. 1981), we have carried out exploratory starspot modeling of our 1985/86 observations. Assuming two major spots or spot groups of different areas located at different latitudes, the amplitude and shape of the light curve can be reproduced providing the spot groups have a longitude separation between 120° and 170°. More extensive light curve modeling is planned.

Utilizing identical filters and instrumentation, intermediate band blue and red photometry of II Pegasi has been obtained at Villanova during three observing seasons: Autumn 1981 (unpublished), 1985/86 (this study), and Autumn 1986 (in progress). For each season, the blue observations were plotted versus the red observations, from which a correlation coefficient was computed. the values of the correlation coefficient for the 1985/86 and Autumn 1986 observations are essentially equivalent, while the value for the Autumn 1981 observations differs by approximately 17%. This difference corresponds to a change in the wavelength dependence of the light variation. This is suggestive of a change in the starspot temperature by a few hundred degrees, assuming the temperature of the unspotted photosphere remains constant. Albregtsen, Joras and Maltby (1984) find evidence for a correlation between the sunspot umbra/photosphere intensity ratio and the phase of the solar cycle. However, they were unable to find any significant correlation between the umbral intensity and the other sunspot parameters such as size, age, maximum magnetic field strength, or type of sunspot. Many of the previous studies of chromospherically active stars involving light curve modeling employing the starspot hypothesis have assumed the starspot temperature to remain constant from season-to-season. The validity of this assumption in its application to II Pegasi can only be established by obtaining further observations at both blue and red wavelengths in order to ascertain if the seasonal color changes reported here are real.

SCOTT W. WACKER

EDWARD F. GUINAN

Department of Astronomy and Astrophysics
Villanova University
Villanova, PA 19085 U.S.A.

References:

Albregtsen, F., Joras, P.B. and Maltby, P., 1984, Solar Physics 90. 17
Dorren J.D., Siah, M.J., Guinan, E.F. and McCook, G.P., 1981, Astron. J.86.572
Guinan, E.F. and Wacker, S.W., 1985, Inf. Bull. Var. Stars No. 2777
Mohin, S., Raveendran, A.V., Mekkaden, M.V., Hall, D.S., Henry, G.W., Lines, R.D., Fried, R.E., Louth, H. and Stelzer, H.J., 1985, Astrophys. Sp. Sci. 115.353
Nations, H.L. and Ramsey, L.W., 1981, Astron. J. 85.433
Vogt, S.S., 1981, Astrophys. J. 247.975