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PHOTOMETRIC VARIABILITY OF THE NONRADIAL PULSATOR 53 PERSEI

It has been shown recently (Smith 1977) that line profile variations in many sharp-lined early to mid B-type stars (Petrie and Pearce, 1962, Smith and Karp 1976) can be mimicked easily and quantitatively by a traveling wave velocity field which is characteristic of a nonradial pulsation. The photometric behaviour of these stars (see also Percy 1970) is of interest because it gives information on the surface temperature variation during the wave cycle. This note reports evidence for a small light variability in 53 Persei (HR 1350, B4.5V; M_V=4.88) which exhibits large amplitude profile variations. Smith and McCall (1978)have observed the star over several months and concluded that it exhibits a complex, time dependent period spectrum, with usually one period present with a value of from 3.6 to 14.45 hours.

Differential photometry in the Strömgren v-filter was carried out on the nights of December 23 and 24, 1976 on the 30-inch telescope of McDonald Observatory. The Strömgren v-filter was used as a compromise between the requirements of a larger expected amplitude in the ultraviolet and the more stable extinction properties in the blue wavelength region. Each "observation" consists of an average of six ten-second star-sky integrations. The average r.m.s. error was computed by averaging through the night the r.m.s. from the individual integrations in an observation. For the three stars figures are $\pm$ 0.0023 (night 1) and $\pm$ 0.0011 (night 2). Observations were not continued past 1.6 air masses.

Our standard observing sequence consists of a Standard 1, Program Star, Standard 2 cycle. We chose as standards λ Per

(HR 1261, B9V) and HR 1482 (AOV) two stars with no known history of variability and in a nonvariable region of the H-R Diagram.

The results are depicted in Figure 1, displayed both in terms of the difference between two standards (Figs. 1b and 1d) and of the program star minus the average of the two standards (Figs. 1a and 1c). From the first night one can conclude that a decrease of 0.01 mag. occurs in about four hours. This result is nearly identical to the July, 1976 results of Percy and Lane (1977) for this star, which may be a coincidence since it is not clear that the star exhibited the same period during both times. The observations of the second night show smaller scatter, but since the star was monitored for only two hours no variability is evident.

In Figure 2 we have drawn in a curve by means of an assumed 7.29 hour period (phase convention due to Osaki 1971) which was determined a few nights later (December 28-31) by Smith and McCall spectroscopically. At this point one can say only that our data are consistent with their period. It is also too early to decide whether the light curve is sinusoidal or not.

The unravelling of the complex period behavior in 53 Per (which may be due to nonlinear coupling between physically driven nonradial modes (Smith and McCall 1978)) is a long-term observational problem with fruitful rewards. When the excited nonradial modes can be identified correctly in this and other B stars it will be possible to isolate the region of the star which excites the oscillations. It is to be wholeheartedly recommended that 53 Per be put on photometric variability programs, particularly since photometricists with easily accessible small telescopes will be able to add vastly to the data pool for this object. However, they should be advised, first, that the periods for this class of objects appear to be about <u>twice</u> that of the β Cepheids (Smith, unpublished) and, second, that the photometric variations of the smaller amplitude line profile variable B stars may well escape detection.

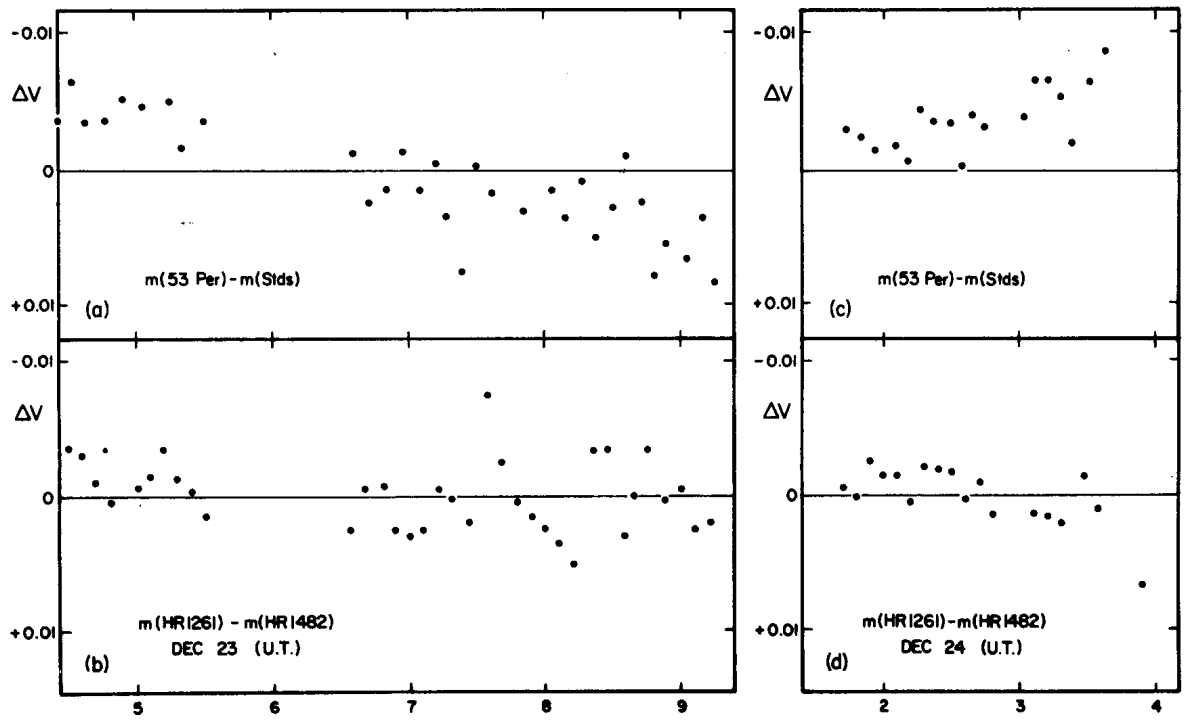

Fig.1 : Photometric results (Strömgren v-filter) for 53 Persei during December 23 and 24,1976. Panels (c) and (d) give the differences as a function of time of the apparent magnitudes between two standards, HR 1261 and HR 1482 (zero level is arbitrary). Panels (c) and (d) give the magnitude differences between 53 Persei and the average of the two standards; the zero level is determined from Figure 2.

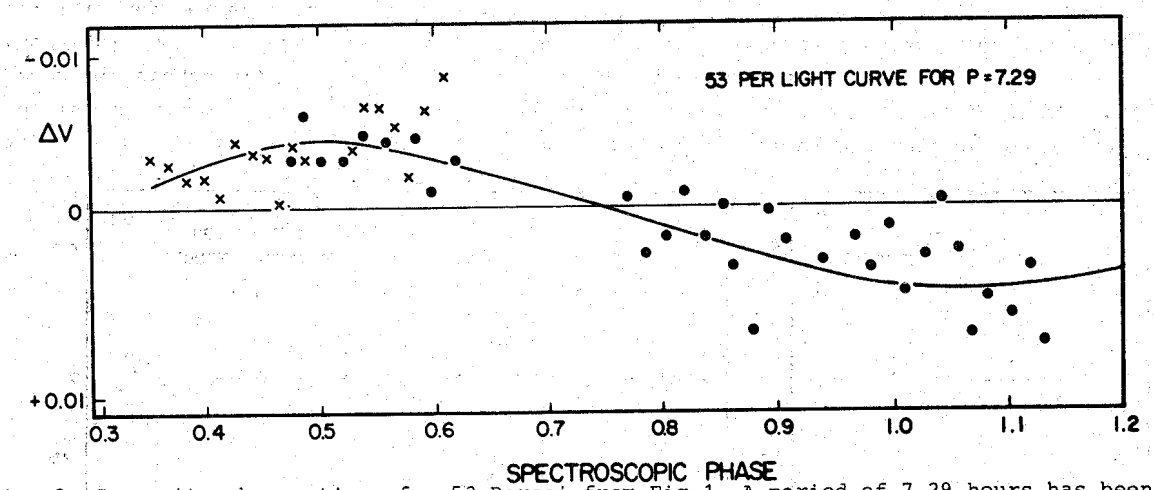

Fig. 2: Composite observations for 53 Persei from Fig.1. A period of 7.29 hours has been assumed, based on a separate spectroscopic study. The zero magnitude level is set at the average apparent magnitude.

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