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SPECTROSCOPIC OBSERVATIONS OF THE Be STAR PHI-PER

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ABSTRACT: *Based on a series of high dispersion Coude spectra taken with 188-cm telescope of Okayama Astrophysical Observatory over an extensive period of time (nearly 20 years),spectroscopic behaviours were measured and discussed. Synchronous variations of V/R (intensity ratio of violet to red emission peaks)variability with the radial velocity curves (RV) for Balmer and HeI 3888 shell absorption lines were confirmed. Using the peak separations of the Balmer emission lines , envelope extension was also estimated. Main difficulty was found in explaining the envelope extension of the primary star of the system which overflows the Roche-lobe limit when we consider the binary nature of the system.*

INTRODUCTION

Phi-Per is a well known spectroscopic binary Be Shell star with the spectral type B2 IV ep (Lesh, 1968).Radial velocity variations of this star were first noted by Campbell(1902) and were attributed to binary motion by Lundendorff (1910) and Cannon (1910).Lockyer (1925,1926) was the first to notice its V/R variability synchronous with phase.Poeckert (1981) and Suzuki (1980) have derived the orbital parameters of the system and found that the masses of the systemic components are $20M_{\odot}$ *and* $4M_{\odot}$ *with the separation 1.42 AU.*

In this paper we present our new spectroscopic observations (Coude spectra) taken with 188-cm telescope of Okayama Astrophysical Observatory . The dispersion was 10A/mm. All the observational data were folded for the orbital period of 126.696 days with the epoch T_0 = *JD(Hel)* 2424473.500 *(Hickok,1969).*

The radial velocity (RV) and V/R (intensity ratio of violet to red emission components) variability for the Balmer and HeI 3888 shell absorption lines were determined. Using the peak separations of emission components of Balmer lines the extension of the envelope was estimated.

OBSERVATIONS and MEASUREMENTS

Nearly 100 Coude spectrograms taken with 188-cm reflector of Okayama Astrophysical Observatory (1968-1986) were analysed. PDS(PE) microdensitometer measurements were done at Kwasan Observatory, Kyoto University. The data were processed at the Computer Centre of the Kanazawa Institute of Technology and Kyoto with the help of a software developed by one of our authors M.Suzuki. University. Computer plots of intensity curve in units of both the radial velocity and wavelengths were obtained for individual spectra. From these plots RV values at different points of the line profiles

were measured. Correspondingly,intensity values for the emission components were also measured to study the V/R variability. The RV curve for the Balmer (H_β, H_γ, H_δ) and HeI 3888 shell lines are shown in Figures 1 and 2. A plot of log V/R against phase is shown in Fig 3.The peak separations was varying between 150 to 250 km/s. The envelope extension R_e was determined using $R_e = 4GM_1/V_p^2$ (Poeckert,1981),where M_1 is the mass of the primary and V_p is the peak separation of the emission line.

RESULTS and DISCUSSIONS

From Figs. 1,2 and 3 ,it is clear that the radial velocity and V/R both vary with phase synchronously.There is no phase lag.Occasionally this star exhibits quadrupole peaks with two peak separations (Kogure et. al. 1991) suggesting some complicated structure of the envelope which can be interpreted in terms of a double ring structure. If we calculate the envelope extension using Poeckert(1981) expression, we find that the envelope extends upto $265R_\odot$ for a peak separation of 200 km/sec and goes beyond the Roche-lobe of the primary star of the system.

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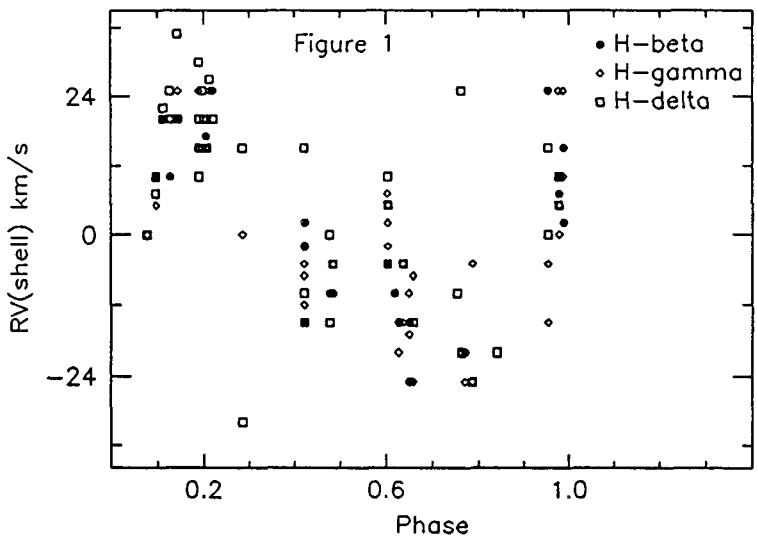

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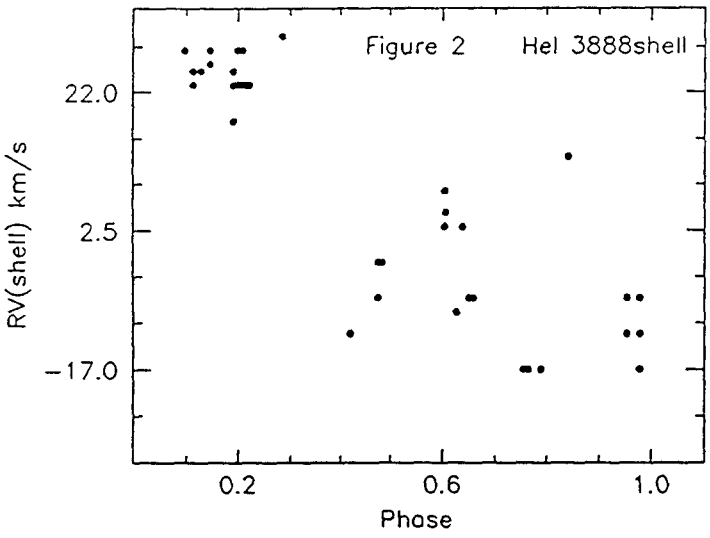

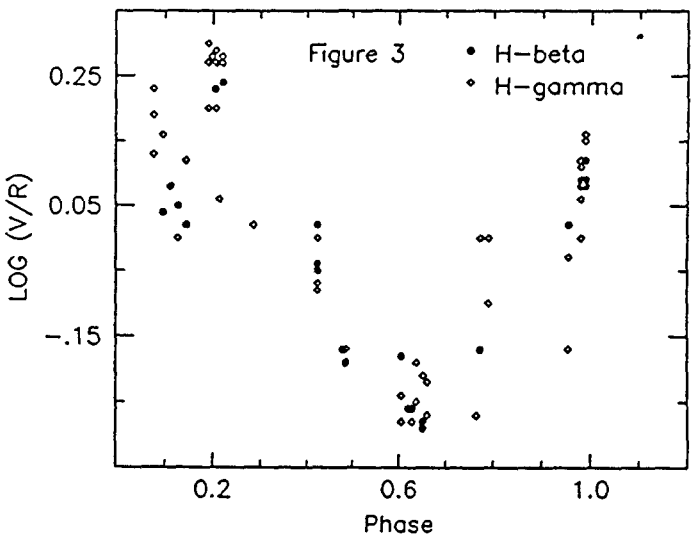

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