ON THE BINARY NATURE OF PLEIONE

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ABSTRACT. From analysis of radial velocity measurements the binary nature of Pleione is discussed. A possible orbital period of about 35 yr was detected.

Key words: Stars: Binaries: Pleione

Pleione (BU Tau, 28 Tau, HD 23862) is one of the best investigated Be stars. It shows significant long term variations in its spectrum. Observations of Pleione over more than 100 years show that the active phases appear periodically: 1887–1904 (Be phase), 1904–1938 (B phase), 1938–1955 (Shell phase), 1955–1972 (Be phase), 1972–1989 (Shell phase), 1989– (Be phase). There are many investigations of the envelope of Pleione. At the same time, the nature of the underlying star have been investigated only very poorly, because of the complicate analysis of the shallow and broad lines observed in the spectrum of the rapid rotating star. Most of time in the spectrum of Pleione a great number of shell lines formed in the envelope of the star have been observed. It makes analysis of the spectrum of Pleione some more complicate problem. In the end of 1980s the shell spectrum of Pleione became considerable weak and the conditions for investigation of the underlying stellar spectrum, determination of the parameters of the stellar atmosphere and search for lines of an assumed companion became much better.

We obtained spectral observations of Pleione with the 6-m telescope of the SAO (Zelenchykskay) on April 5, 1990 and the 2.6-m telescope of the Crimean Astronomical Observatory (Nauchny) on December 10, 1990.

Our observations show, that during 1990

1. The lines of the shell spectrum of Pleione disappeared completely.

2. The spectral type of Pleione was equal to B8.

3. There are variations of the equivalent widths (more than two times) and the profiles of the hydrogen lines (Fig.1). The observed variations cannot be a result of variations of the stellar luminosity, because the photometric variability of Pleione is less than 0.6 mag. This effect may be an evidence that the envelope was more developed in april and the profiles of the hydrogen lines were more distorted.

4. The electron density, obtained for layers with different optical depths in december 1990 was equal to the value typical for main sequence stars with spectral type B8. In april 1990 the electron density in the Pleione atmosphere for layers with $\tau \approx 0.3$ was considerably smaller and corresponds to the value typical for supergiant of spectral type B8. This result can witness both about the change of the physical conditions in the Pleione atmosphere and the variation of the strength of the envelope that leads to a change of the influence of the envelope to the profiles of the hydrogen lines.

5. No lines of the secondary component were discovered.

Detailed analyses of all published radial velocities measurements was carried out separately for hydrogen and for lines of metals. The observational data from the time interval 1938...1990 enable us to search for long term periodical variations of radial velocities. The radial velocities of the H lines show a larger scatter than metal lines. A number of lines show very negative values during the epochs 33000...34000 and 46000...47000. These intervals represent the shell phase of Pleione. Such

a scatter also occurs for several metal lines, especially Ca II and Fe I. These data were not used for period search. Two methods for period determination were used:

1. Method of Lafler and Kinman (1965).
2. "Fourier transform" (one–harmonic least squares fit by using the program FOUR by Andronov (1994)).

The search was carried out for period intervals 5000...15000 days (13.7...41 years). The best results were obtained for the metal lines because of the smaller scatter in the data. Both methods yielded almost the same results:

Lafler & Kinman	Fourier analysis
metal lines	
6411^d (17.6 yr)	6580^d (18 yr)
12450^d (34 yr)	12856^d (35yr)
H lines	
6500^d	4670^d
12400^d	11468^d

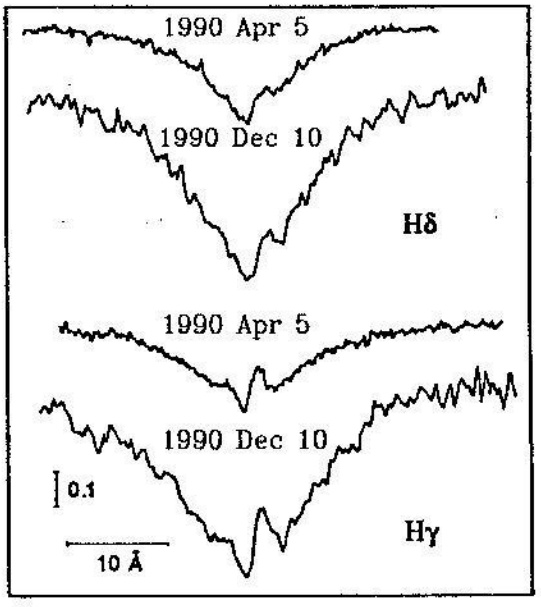

Figure 1: Variations of the profiles of the hydrogen lines $H\gamma$. and $H\delta$ in the spectrum of Pleione in 1990.

The calculated value of the orbital period of Pleione ($\approx$ 35yr) agree well with the variations of the spectral properties of the star (shell – non–shell phase). Our results agree well also with the conclusions published by Gies et al. (1990). In this work time resolved H_α spectroscopy was carried out during an occultation of Pleione by the moon. The observations concluded to an asymmetric envelope which is explained by a companion with $M = 2M_\odot$. During the periastron passage of the companion mass exchange by the primary star increases and a new shell phase begins. The semimajor axis was determined to be $a = 19.1$ A.U., the excentricity $e = 0.46$ and the inclination $0° < i < 43°$.

For an exact determination of the orbital parameters more radial velocity measurements are necessary.

References

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RHO CASSIOPEAE – GIANT OR SUPERGIANT ?

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ABSTRACT. Variable polarization of ρ Cassiopeae is found, with an amplitude of about 0.2 % in the V bánd and up to 1 % in R. It is drew attention on a conflict of luminosity from a spectral analysis (about -8 magnitude) and from a trigonometrical parallax (an average from four measurings corresponds to +0.5 magnitude). The paper submitted to *Astronomische Nachrichten.*

Key words: Stars: individual – rho Cas: luminosity–polarization.