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A NEW Be PHASE OF PLEIONE

The well known Be-shell star Pleione (BU Tauri, HD 23862, B7-8IV-Ve, v*sin*i=320 km/s) passed through several B, Be and Be-shell phases since 1888. The last Be-shell phase began in 1972 (Delplace and Hubert, 1973; Hirata and Kogure, 1976), reached a maximum around 1982 and entered a decrease in 1984 (Ballereau et al., 1988). In 1987-88, emission lines were strong, shell lines almost completely disappeared (with the exception of FeII multiplet No. 42), while the photospheric component of Balmer lines, weak and shallow in 1982, became deeper and wider (Ballereau et al., 1994). The disappearance of the shell lines goes along with the increase of their negative RVs (higher terms of the Balmer lines and metallic ions), which indicates that the surrounding envelope of gas gradually expands in space over several years. Recent observations of Hα emission component made by Menchenkova and Luthardt (1993) confirm the gradual increase of its equivalent width until 1991-92 and the faintness of the central reversal.

On Aug. 9, 1994, we obtained the Hβ and FeII λ4924Å line profiles of Pleione, with the AURELIE receptor attached to the coudé focus of the 1.52m telescope of Haute-Provence Observatory (Figure 1). The parameters of the spectrum are as follows:

Resolution=$\lambda/\Delta\lambda$=16400
Signal to noise ratio=S/N=200
Recorded spectral wavelength range=$\lambda\lambda$4806-4952Å

The spectroscopic parameters measured on the Hβ and FeII emission profiles (radial velocities (RV) in km/s, intensities (I) in fraction of stellar continuum intensity) give the following results:

Hβ

Violet peak: RV=−140, I=1.13; central reversal: −79, 1.09; red peak: +15, 1.44; V/R=0.78; emission peak separation, Δe=155 km/s. RV and total width of the emission line at the junction with the photospheric profile: −91, 617; at the intensity level 1.00: −53, 328; at the intensity level 1.10: −36, 254.

FeIIλ4924Å

Violet peak: RV=−220, I=1.02; central reversal: −86, 0.99; red peak: +28, 1.11; V/R=0.92; Δe=248km/s.

From comparison of the present data with those obtained these last years, several remarks can be emphasized:

1. The decrease and vanishing of shell lines on Balmer series and metallic ion spectra, simultaneously with the strengthening of the emission components observed since 1984 until the nineties are monotonic phenomena, which translate the gradual spatial development of the surrounding emitting/absorbing envelope of Pleione.

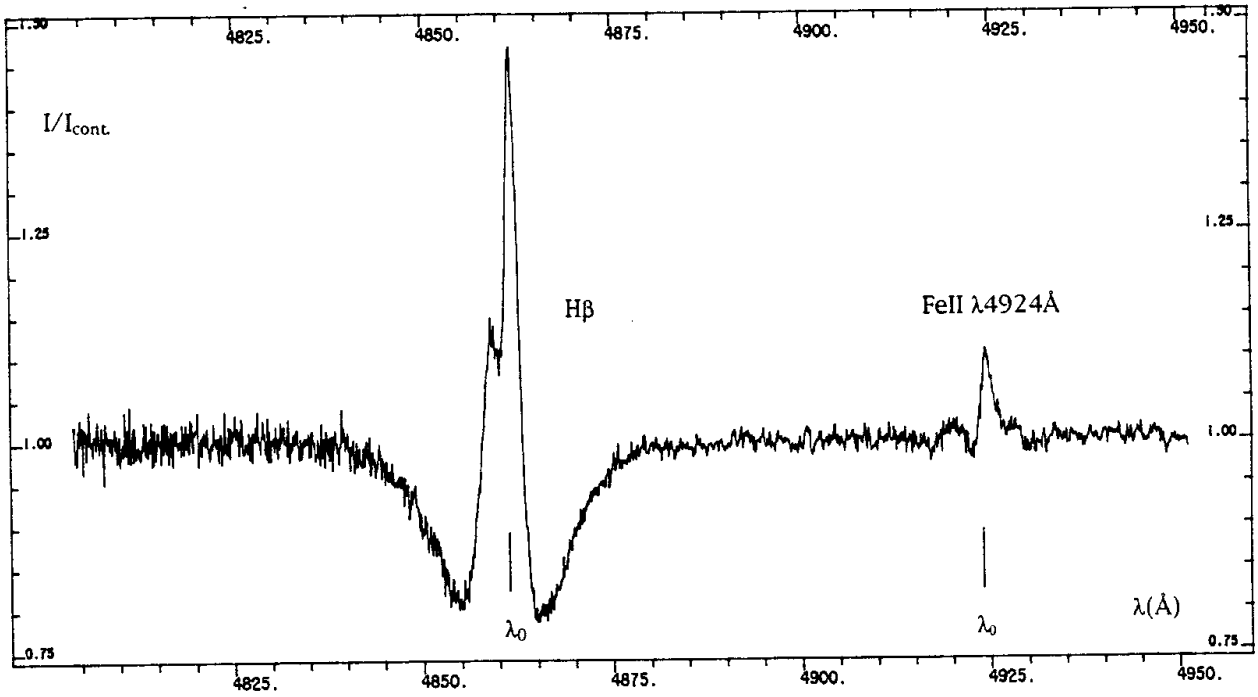

Figure 1. Normalized intensity tracing of the Hβ and FeIIλ4924Å lines of Pleione, on Aug. 9, 1994. The vertical bars give the rest wavelengths of each line.

2. The progressively negative RVs of emission/shell-absorption lines of the optical spectrum from 1984 indicate the onset of a new instability which leads to a gradual expansion of the envelope, as well in the equatorial plane, then, as probably, vertically on both sides of this plane. In 1994, the RVs of the absorption-like remaining depression in the Hβ and FeII lines (Figure 1, respectively -79 and -86 km/s) suggest a rather rapid expansion, while before 1984, during the "quiet and strong shell phase", they were small with periodic variations (Ballereau et al., 1988).

3. Measurements of peak separation (Δe) on Hβ obtained by ourselves since the seventies, and used in Huang's (1972) formula in the case of a Keplerian rotational motion in the envelope, permit to obtain the outer radius of the Hβ emitting envelope: R(Hβ)/R$_\star$=2.0 (1973); 5.5 (1981); 10.0 (1987-88); 17.0 (1994). The 1992 Hα emission profile of Menchenkova and Luthard (1993) has Δe=2.77Å, which gives R(H$_\alpha$)/R$_\star$=25.6. All these data confirm the expanding movement of the envelope of Pleione.

4. The fading of the Balmer photospheric profiles during the "quiet and strong shell phase", before 1984, and their gradual strengthening after, show that at first the envelope is probably compact, cool and optically thick, while its spectrum dominates the one of the underlying B8 star. It looks the one of an A-F star. The expansion of the envelope on both sides of the equatorial plane makes the central star more visible, which can also explain the reappearance of the Balmer photospheric spectrum of Pleione.

5. The equivalent width of the emission in the Hβ line increases progressively: W(Hβ)$_{em}$= 0.42Å(1981); 1.80Å(1987-88); 2.70Å(1994).

6. The peak separation of the FeII emission line in 1994 (248 km/s) gives an outer radius of the FeII emitting disc of 6.7 $R_\star$. This indicates that this disc is nearer to the stellar surface than the Hβ emitting disc, as generally observed in Be star envelopes.

7. All these changes in the structure of the Pleione shell claim in favour of the phase-change model proposed by Kogure (1989), where the envelope responsible for a shell phase should be a compact thin/thick disc-like one, which has to expand to transform itself into an extended spheroidal/doughnut shape to produce a spectrum characteristic of a Be phase. The same type of model was also proposed by Zorec and Briot (1991) to explain the photometric variations during the phase changes of Be stars.

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