PHASE CHANGES IN Be STARS:

The Be-shell and Be phases of Pleione

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Phase changes from Be to Be-shell and/or B normal, and conversely, presently remain unpredictable in Be stars (except in some binaries where the transition to a shell phase seems to be associated with the orbital period). Because of their unpredictable character, these phenomena have been monitored in very few cases and are still very poorly understood. However, the existence of phase transitions have strong modelling implications. Under the disk model, the inclination of the star's rotation axis determines the type of spectrum, Be or Be-shell, that a given Be star may exhibit. It is obvious that this picture is contradicted by phase transitions (Doazan 1982).

In view of investigating the phenomena occurring during phase transitions and the changes between the Be and Be-shell phases, we undertook systematic coordinated observations in both photometry and high dispersion spectroscopy, in the far UV and optical spectral regions, for the two phases, Be-shell and Be, of Pleione which is the only Be star for which such simultaneous observations exist.

Regular observations made in the Geneva photometric system showed that the excursion of Pleione in the HR diagram in 1960-1992 starts out from the vicinity of the main-sequence B6V–B8V stars (Be phase, 1960-1972), "evolves" up to the luminous supergiant branch among the A5Ia–A7Iab stars (maximum shell phase, 1983), and finally returns to its initial place among the late main sequence B stars in the well-developed Be phase (1992) (Cramer et al. 1993).

In this paper we summarize results obtained from our coordinated observations made in the time-interval 1979-1991 when the star exhibited a strong shell phase (1979) and a well developed Be phase (1991).

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Between 1979, when Pleione exhibited a strong shell spectrum, and 1991, when it showed a Be-type spectrum:

1. The CIV and SiIV resonance lines, which were not present/detectable during the shell phase, appeared and strengthened as the shell spectrum vanished and the Be phase developed (Doazan et al. 1988,1991)
2. The absorption bump at 2200 Å showed large changes, clearly indicating that it cannot be used confidently for measuring the interstellar component of extinction for Be stars (Doazan et al. 1993a)
3. The observed far UV radiative flux increased by more than a factor of two (Doazan et al. 1993b)
4. The observed dereddened absolute energy distribution, from the far UV to the optical spectral regions increased in all the observed wavelengths between the Be-shell and Be phases
5. A fit of the Kurucz models (ATLAS 9) to the normalized absolute dereddened energy fluxes from the far UV and optical wavelength range gave the following results (Doazan et al. 1993c):
   - The 1979 data of the shell phase are best fitted with a model with $T_{eff} = 11,000°$ K and $\log g = 4$.
   - The 1991 data of the Be phase are best fitted with a model with $T_{eff} = 12,500°$ K and $\log g = 4$.

These data and analysis would imply that shell phases cannot be said to be characterized by a far UV deficiency, as is often stated. Rather, we observe, when coordinated far UV and optical data are used, a complete change in the energy distribution, from the far UV to the optical regions, suggesting/simulating a temperature change of the star.

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