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## 1. INTRODUCTION

The late B-supergiant HR 4049 is peculiar in different respects: (1) It is located far from the galactic plane ( $b = 23^\circ$ ); (2) It is a variable with a large amplitude and on a long time scale (Waelkens and Rufener, 1983); (3) It has a spectacular infrared excess (Lamers et al., 1986). Two models were proposed: (i) HR 4049 is a runaway hypergiant embedded in a dust cloud, or (ii) HR 4049 is a low-mass star in a post-AGB stage of evolution. In this paper we present evidence that favours the second hypothesis. This evidence consists of new observational data on HR 4049 itself and of the discovery of a second very similar object, that is located still farther from the galactic plane.

## 2. SPECTROSCOPIC DATA ON HR 4049.

We have secured two 12 A/mm blue spectra of HR 4049 with the Coudé spectrograph attached at the 1<sup>m</sup>52 telescope at ESO, at different phases of the light curve. The low gravity of the object is confirmed by the presence of 28 Balmer lines. A reversed and variable Balmer progression is observed.

Apart from the Balmer lines, the only conspicuous lines in the spectra are the (essentially interstellar) Ca K line and several lines of CI and one line of OI. Such lines are also conspicuous for the high-latitude supergiant HD 46703, which is thought to be a post-AGB object (Luck and Bond, 1984). The presence of CI and OI lines in HR 4049 and the observation of CO emission in some other high latitude supergiants (Omont, this conference) lend support to the leftward post-AGB evolution hypothesis for these stars. One would then have a picture in which the CO-envelope is still prominent in the coolest stars (like HD 161796), is partly dissociated in early F-supergiants (like 89 Herculis) and is dissociated completely in HR 4049.

(\*) Based on observations made at the European Southern Observatory

## 3. A TWIN TO HR 4049

The southern late B-supergiant HD 213985 is very similar to HR 4049. It presents the same kind of variability (Figure 1): amplitude, time scale and color behavior are similar in both objects. IRAS data reveal that also HD 213985 shows a spectacular IR excess (Figure 2). As yet the star has not been observed in the near infrared. From the IRAS data it is however clear that the dust around HD 213985 is cooler than that around HR 4049 ( $T_{BB} = 350$  K to be compared with 1250 K) and that the size of the emitting volume is larger for HD 213985 ( $R_{dust} = 260 R_{\star}$  to be compared with  $28 R_{\star}$ ). If HD 213985 were a truly high mass star, its apparent faintness ( $m_V = 9$ ), spectral class (B9Ib) and high latitude ( $b = -57^{\circ}$ ) would put it at more than 5 kpc from the plane, so that it could not have been formed in the plane. It is therefore probable that both HR 4049 and HD 213985 are low mass stars.

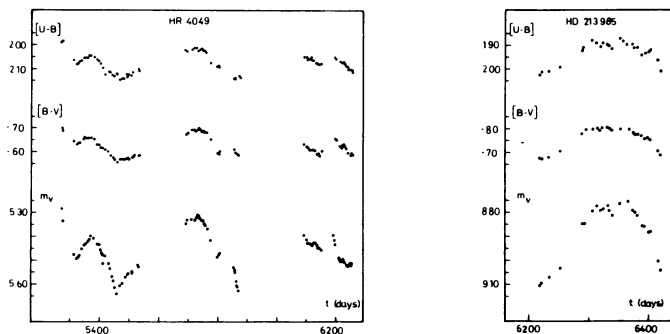


Fig. 1: Photometric variability of HR 4049 and HD 213985.

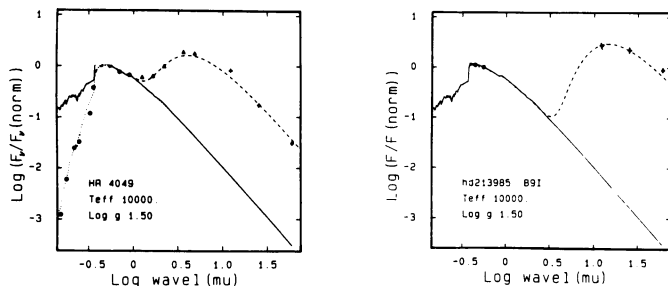


Fig. 2: Energy distribution for HR 4049 and HD 213985

## REFERENCES

- Lamers, H.J.G.L.M., et al. (1986), *Astron. Astrophys.* 154, L20-L22.  
 Luck, R.E., Bond, H.E. (1984), *Astrophys. J.* 279, 729-737.  
 Waelkens, C., Rufener, F. (1983), *Hvar Obs. Bull.* vol.7, no.1, p. 29.