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HR 7671: A UU HERCULIS STAR OR ANOTHER IMITATION?

HR 7671 is a luminous F-type star at a high galactic latitude of $-21^{\circ}5'$. Though bright ($6^m.4$) it has a number of various classifications and poorly understood variability, as shown recently by Fernie (1985). Spectral types ranging from gF4 to F3 Ib can be found. The most recent MK spectral classification by R. Garrison yields F2 (shell) as quoted by Fernie. It is a low-amplitude long-period (?) variable known as BV 592 but monitored more extensively only recently by Fernie.

Thus HR 7671 fulfils in general most of the criteria for membership in the group of the UU Her stars - variable F-type supergiants at high galactic latitudes having long periods and low amplitudes (Sasselov, 1984). Fernie (1985) doubts HR 7671 should be considered a UU Her star because of its low metal content and much shorter periods. However, no high-dispersion spectroscopic study of HR 7671 has been published yet, except the abstract by McDonald (1976) which cannot provide the entire necessary information about the star. In case it is not a UU Her star, HR 7671 becomes one of the candidates for membership in the group of imitations of normal supergiants. We consider as an imitation every low-mass object sustaining a pseudophotosphere (for a decade or more) of supergiant's dimension and luminosity, and producing the corresponding absorption spectrum. Two examples seem to be PU Vul and HD 46703, masquerading quite well as F-supergiants. More details on the existence of imitations and the ways to distinguish them can be found elsewhere (Sasselov, 1985).

Hence we have included HR 7671 in our high-dispersion spectroscopic investigation of established and suspected UU Her stars. We obtained two spectrograms on 26 and 29 July 1985 respectively, using the Coudé spectrograph to the 2 m telescope of the Bulgarian National Astronomical Observatory (NAO) on Mt. Rozhen. The first spectrogram covers the red region from 4800 to 6900 Å with a nominal resolution of 0.36 Å. The second one covers the blue region from 3500 to 4900 Å with a resolution of 0.18 Å. At the same time we have started UB_V photometry of HR 7671 with the 0.6 m telescope of NAO-Rozhen. Two estimates made so far are given below. The errors shown are internal ones.

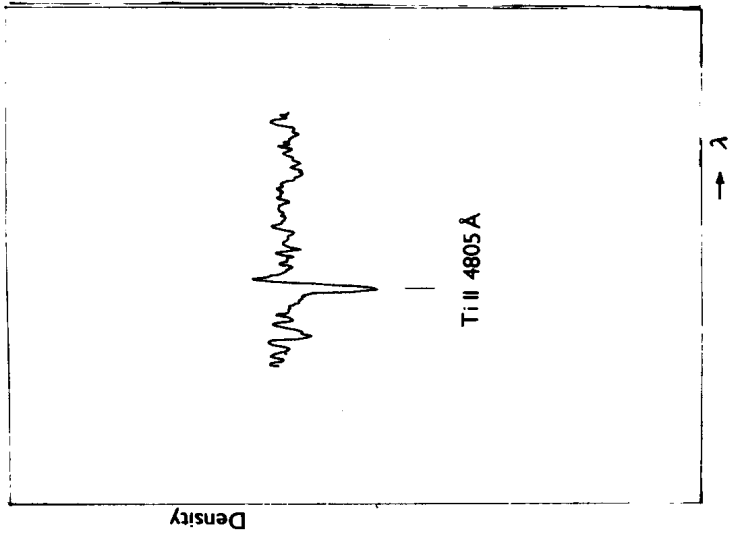


Figure 2

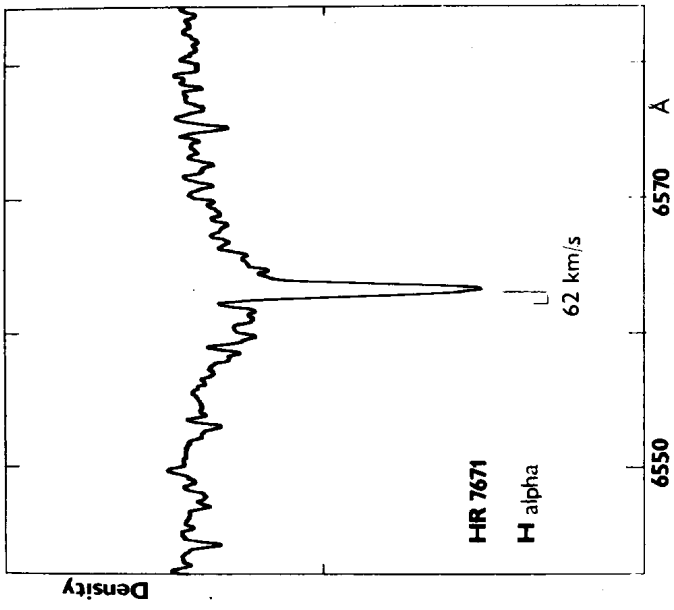


Figure 1

JD 2446274.42	(V) 6.398 ± 0.008	(B-V) +0.55 ± 0.010
JD 2446275.37	6.368 .008	+0.53 ± .010

We have used the comparison star suggested by Fernie - HR 7715 with $V=5.867$. Unfortunately it has no reliable B-V color index yet. We have used the rough value of 0.5 from Hirshfeld and Sinnott (1982).

A detailed abundance analysis of HR 7671 will be published elsewhere while here we would like to draw attention to some peculiarities found in the obtained spectra and important for its classification. As a whole the spectrum of HR 7671 is that of a typical F-supergiant, except for the somewhat weaker metallic lines, thus resembling the spectrum of PU Vul and unlike the one of UU Her (all spectra were obtained at NAO-Rozhen during July this year). The shell features noted by R.Garrison seem to be confirmed, especially in the appearance of the H α line. This line has an interesting profile (Figure 1) with a well seen emission on the blue side of the absorption core. It is shifted some 60 km per second from the photospheric rest velocity of the H α absorption. Slight emissions flanking the central absorption seem to be present also in the Na D line at 5895.92 Å. The H α absorption profile itself has peculiar wide wings and a narrow core, thus resembling the H α profile of the UU Her star HD 161796 - the latter showing no observable emission (Arellano Ferro, 1983). To some extent the H α profile of HR 7671 has also much in common with the one of another UU Her star HR 4912 (Luck et al., 1983). However only the H α line of the possible imitation HD 46703 has a dominating blue emission (Luck and Bond, 1984) which might indicate to the different structure and dynamics of the atmospheres of both types of stars. H α emission is common in F-K supergiants including the UU Her stars and the long-period Cepheids (Climenthaga et al., 1981). However, emission is almost always present on the red side only.

It is moreover curious that the blue emission H α line in HR 7671 is complemented by a couple of Fe II and Ti II lines near H β exhibiting pure P Cygni profiles. As an example the line of Ti II at 4805.10 Å is shown in Figure 2.

All these spectral features do not seem to favour the classification of HR 7671 as a UU Her star, bringing it closer to the small group of objects masquerading as supergiants, moreover if its low metal content and variability period(s) are also considered. According to the theoretical models of Shibahashi and Osaki (1981) normal supergiants blueward of the instability strip are unstable against low-harmonic nonradial f modes and periods longer

than 40 days are expected (as observed in all UU Her stars). The imitations, having a totally different structure inwards apparently pulsate in a different way, as well (e.g. Fadeyev, 1984).

The exact status of HR 7671 remains as yet not finally established. Further photometry and radial velocities, as well as monitoring for possible changes in the profile of H α are most desirable.

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