IS HR 9070 REALLY PULSATING ?

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As Be stars and classical β CMa variables both have a distribution peak at B2,one can wonder if there is a connection between these two phenomena. A way to solve this problem could be to carry out a systematic survey of emission on short periodic B variables,over months and years.
Another way,chosen by our groups in Nice,Ensenada and Meudon,is to improve time resolution in photometric and spectrographic observations on the Be stars already known to have short time scale variations. Special attention is paid to longitude cooperation,essential to detect or measure longer time constants.

HR 9070(B4Ven) was first found to vary by Provin in 1953. Most of the available photometry has been done by Percy since 1975 (Percy,1983) who found a stable period of 0.307 day with an amplitude of 0.03 magnitude, and no color variation. Harmanec(1984) found on the same data a better fit with a double wave light curve of 0.623 day period.

Our 1983-84-85 photometric observations,analyzed by a least squares fit to sine curves and PDM methods,show a clear 0.310 day period,although a 0.620 double wave curve gives similar r.m.s. errors (Fig.1).
We obtain a mean ephemeris:
HJD(Light maxima)= 2445618.606 + 0.310037 E ,
with a possible amplitude decrease in 1985.
When analyzed by a double wave sinusoid of 0.62 and 0.31 day periods (amplitudes A1 and A2),a year by year increase trend of the A2/A1 ratio seems to appear from 1983 on.
The same procedure on the 1975-81 data does not give any advantage to the double wave curve,although a 0.309791(or a 0.619582 double wave) day periodic curve fits the data slightly better than the 0.310037(and the 0.620074)periods. 1975 to 1985 data,together,give a maximum probability for the above ephemeris.

Hα radial velocities(RV) show a good agreement with the 0.310 day period, when the line gravity center GC,the central absorption C and the red peak PR RV are plotted in a phase diagram(Fig.2). Large positive and negative discontinuities appear in the RV curves at phases 0 and 0.6,respectively.

We still cannot conclude whether this star is a spotted rotator or a pulsating variable: even a multiple spot rotator could show a 0.3 day period. On the other hand,as a high order g mode is necessary to explain a 0.3 day pulsation,one cannot expect color variations...

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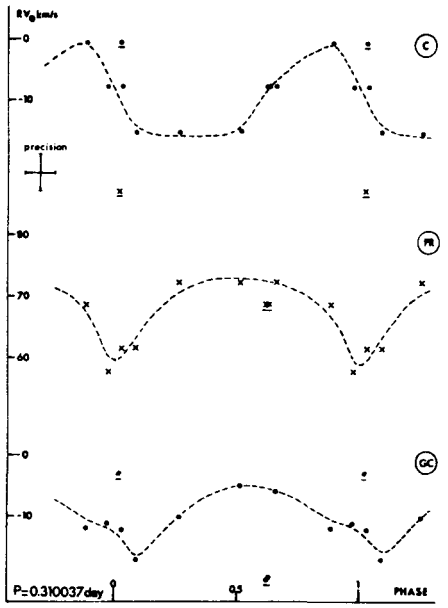
In fact,we are one more time faced with rather unusual pulsation modes VS a spotted star model.

In that latter case,an exclusion mechanism between the β CMa and the Be phenomena has to be found,probably in relation to equator-on sight and/or fast rotation.

Fig.2: Hα Radial Velocities.



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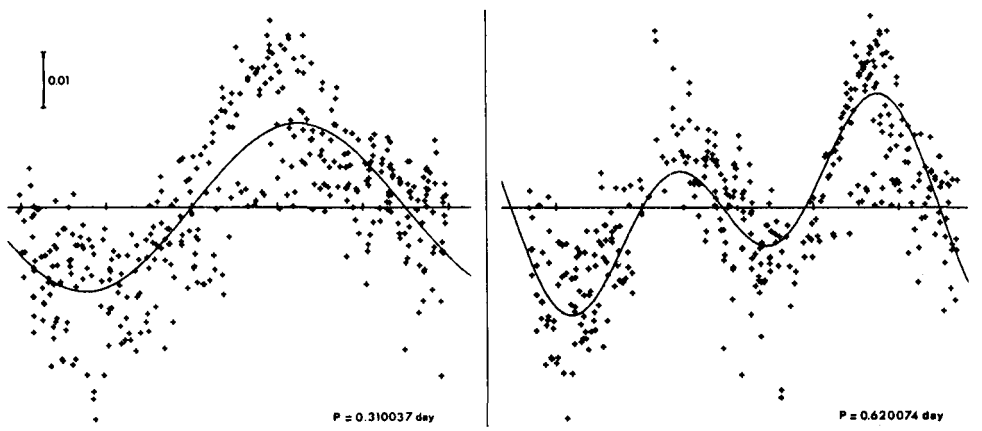
Percy,J.R.(1983).Astron.J.,88,427.

Fig.1: Δ(magnitude) VS phase plot of our 1983 to 1985 observations.



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DISCUSSION FOLLOWING SAREYAN

Torres:

Why can't you interpret your results as a combination of pulsation and rotation?

Sareyan:

Of course we can! The only problem is to find a preliminary explanation as simple as possible, as we don't have any convincing model. I must add that nonradial pulsator models, by an eventual adjustment of their parameters, give you a large number of degrees of freedom to account for the observations. This is true of course also for a spotted rotator, as we can adjust the number of spots (streams), their apparent surface area and even latitude versus differential rotation.

Buscombe:

What spectroscopic resolving power can you achieve? (e.g. in km s^{-1} and time interval) and for which spectral lines - emission or absorption?

Sareyan:

We only studied Hα (strong emission with a central absorption feature). The radial velocity precision as measured on the different features of this line is about + 3 km s^{-1}. The time interval between spectra was essentially one day (as short period spectrographic variations were not searched for, then) and integration time about one hour. Dispersion at Hα is 11 Å/mm.

Buscombe:

Can your observations be fit as line-doubling rather than "bumps" and "wiggles" in line profiles?

Sareyan:

No, because the Hα line profile remained essentially constant.

Harmanec:

May I ask you to show also the phase diagram for the 0.62- day light curve? I have always suspected a phase separation of the minimum to be about 0.45d, and 0.55d on the longer (0.62- day) period.

Sareyan:

These diagrams are shown in our poster. We explored 0.05 to 1 day periods. We didn't find any convincing probability peak in the 0.4 - 0.55 day range. Futhermore a simple look at the light curves shows that such periods are unlikely.

Baade:

Did you see V/R variations in the Hα emission?

Sareyan:

No, as far as observations made one day apart can show such variations (integration time was about one hour), with classical photographic plates.

Percy:

Could you be sure that the period which you quoted (0.310037 day) is the *only* period which would fit the 1975 to 1985 data?

Sareyan:

No, it is only the best we found (with the double period and a double wave curve). In the 1975 to 1981 (your observations, mostly) data, we have found a slightly shorter period

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(0.309791) as giving a somewhat better probability. We have a strong peak at 0.31004 day in our 1983 to 1985 data. (When analyzing all available 1975-85 observations together, of course this peak plays a role for a final (unique?) determination).

Waelkens:

We indeed observe photometric variations with periods of the order of days in narrow lined mid-B stars, but apart from the periods there are some marked differences with the stars you are reporting on. First, we consistently observe color variations, which seem not to occur in Be stars like o And. Second, all our stars turn out to be truly narrow-lined, despite there being not any selection effect concerning vsini in our approach. In fact, in terms of a spotted star model, our stars all would have very low inclinations, so that one would not expect any oblique rotator variability to be seen.

Sareyan:

OK, this is a strong argument for pulsation, at least for the mid-B variables you observed. However, one has to deal with rather large periods, i.e. with rather unusual pulsation modes.

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