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# VARIABILITY AMONG MAGNETIC AND NONMAGNETIC STARS

WERNER SCHÖNEICH and ELIA ŽELWANOWA
Astrophysikalisches Institut Potsdam
Rosa-Luxemburg-Str. 17a, 1590 Potsdam-Babelsberg

ABSTRACT The present paper concentrates on several seemingly nonstandard cases of variability related to CP stars. Variability of magnetic CP stars with time scales different from rotational period, variability among the HgMn stars, variability of normal stars with variations similar to CP stars, and a relation between Be and CP stars are shortly discussed.

## 1. INTRODUCTION

The chemically peculiar (CP) stars of the upper main sequence populate the spectral interval from about B2 to F2 (F3). Different groups of CP stars lie in different, but to a high degree overlapping, parts of this interval. In fact, the hottest known magnetic stars, the helium-strong stars, have spectral types close to B2V-III although helium lines in their spectra are anomalously strong for their colors. Examples of the hottest CP stars are HD 64740, HD 37776, HD 96446, and HD 37479 ($\sigma$ Ori E).

At the cool end of the interval we have the well known magnetic CP stars: $\beta$ CrB (=HD 137909A, A9 SrEuCr), $\gamma$ Equ (=HD 201601, A9 SrEu), as well as other CP stars, like HD 125081 (F3 SrCrEu or Am), HD 134214 (F2 SrEuCr), HD 159560 (A4-F3), and HD 197451 (F1 SrEuCr or Am?) (the spectral types are from P. Renson's "*Catalogue des étoiles Ap et Am*", listing 1989, unless otherwise indicated).

Among the variable stars of the upper main sequence only a minority varies due to rotation - these are, besides CP stars, elliptical variables (most often encountered in close binary systems) and Be stars, which is in contrast to the lower main sequence where nonuniformities of the stellar surface seem to be very common.

Light curves of rotating stars having surface nonuniformities are very characteristic and hard to misidentify with curves produced by other variability mechanisms (e.g. pulsa-



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tion, eclipses, or presence of circumstellar matter), if the signal to noise ratio is sufficient.
One can therefore wonder whether other stars, not known as CP, with light curves classified in the *"General Catalogue of Variable Stars"* (G.C.V.S.) as "$\alpha$ CVn type" or "SX Ari type" do not vary due to the same mechanism as the CP variables.

The present paper concentrates on several seemingly non-standard cases of variability, related to CP stars. The first part discusses briefly variability of magnetic CP stars with time scales different from rotation period. Then an overview of variability of HgMn stars is given. In particular, all stars of this type reported (in available to us literature) as variable are presented. Later, examples of the normal stars of the upper main sequence with detected light variations similar to CP stars are discussed. In the end a relation between Be stars and CP stars is underlined.

## 2. THE NONROTATIONAL VARIABILITY OF THE CP STARS

Nearly all of the observed light curves of CP variables can be explained as due only to rotational modulation. However, in some of them we observe other kinds of variability, not directly connected with rotation. The most widely known examples are the rapidly oscillating CP stars (ro Ap) with periods of the order of 10 minutes and amplitudes of the order of 0.01 mag or less. Up to now about 20 such stars are discovered. They all lie in the cool part of the spectral interval populated by CP stars. In this region of spectral classes, $\delta$ Scuti variables can also be found. The rapidly oscillating CP stars are discussed in other papers on this Conference (for example by Kurtz) or e.g. in the review by Weiss(1986)

HD 219749 (ET And; B9 Si) is another example of a star with not only rotational variability. The star shows light variations on two different time scales: one with the rotation period P = 1.6 days, and the other with a time scale of about 0.1 day and an amplitude of about 0.01 mag. The observed light variability due to the shorter time scale cannot be explained with only one period (Panov, 1978; Hildebrandt et al., 1985). On top of it, Gerth (1986) reported radial velocity variations of this star with a period of 0.2 day.
The dependence of the amplitude of the light variations on the orbital phase of the binary system suggested by Hildebrandt (1981) could not be confirmed later (Hildebrandt et al., 1985). The nature of ET And, a star lying between the regions of the $\delta$ Sct and $\beta$ Cep pulsating variables, is obscure. At least one more star with similar photometric characteristics, HD 224801 (B9 SiEu), is known (Hildebrandt et al., 1985).

Other properties are shown by HD 65575 = ϰ Car (B3 Si). Its spectral type is typical of β Cep stars, as is the light curve with the period of about 0.101 day and the amplitude of about 0.015 mag. The star shows, however, enhanced silicon lines which put it among the CP stars.

Finally, we like to draw attention to the well known magnetic CP star 52 Her = HD 152107 (A3 SrCrEu). If its magnetic field varies in a time scale of about ten years (see Lehmann, 1988), long time variability, not directly correlated with rotation, should be assumed because the rotation period of 52 Her has been established from photometry to be 3.8575 days (Wolff and Preston, 1978; Schöneich et al., 1988). Long term variable CP stars are under photometric monitoring (see the invited paper by Hensberge, this Conference).

## 3. VARIABILITY AMONG THE CP STARS WITH HgMn PECULIARITIES

Usually Am stars and stars with mercury-manganese peculiarity are called nonmagnetic CP stars. Contrary to magnetic CP stars, we do not observe in them global measurable magnetic fields. They also do not show appreciable rotational variability, typical for magnetic CP stars. This fact can be treated as an additional criterion besides the systematic difference of chemical composition, differentiating between magnetic and nonmagnetic CP stars.

On the other hand, more and more indications of the presence of variability among the MnHg stars can be found in the literature (see e.g.: Schneider, 1987). The picture is hence not clear. Let us try to give a short overview of this problem.

In the G.C.V.S. and the NSV we found 39 variable or suspected variable stars with MnHg peculiarities. The data on these stars are collected in Tables Ia and Ib. Table Ia contains data on the photometric variability and Table Ib gives the data on the binarity of the same stars. In the first column of Table Ia the HD number of the star is given (G.C.V.S. names or BS numbers of the stars are given in notes), in the second its spectral type. The v sin i values in the 3rd column are from the *Bright Star Catalogue* (Hoffleit, 1982) and from Renson's catalogue. If available, both values are given.

In the next column the published periods are given. They are generally taken from Catalano, and Renson (1984, 1988) and Catalano, et al. (1991). The variable parameters are shown as in the "*Catalogue of observed periods of Ap stars*" by "l" for light, "m" for magnetic field, "s" for line intensity and "v" for radial velocity. The raw values for periods and amplitudes of HD 33904 and HD 75333 were suggested by Renson, Manfroid, Heck (1976). The period of HD 78316 has been suggested by Preston et al. (1969) on the basis of the magnetic field measurements. For the suspected variable stars periods are not

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known. They are marked by their NSV number. Three stars are already listed in G.C.V.S. as variable but not named (in Table Ia - NSV without number). The amplitudes were taken from the original papers. For the NSV stars the amplitudes given in the NSV are listed. In the last column the existence of observations not supporting the variability of the star is noted by "+C.". In addition, remarks on spectroscopic binarity are repeated from Table Ib.

Table Ib contains data on binarity of the stars from Table Ia. For stars which appear in the "*Eighth Catalogue of the Orbital Elements of Spectroscopic Binary Systems*" (Batten et al., 1989) the consecutive columns give (besides the name of the star) its catalogue number, orbital period in days, eccentricity of the orbit and quality rating. The quality rating is given in 5 classes from "a" (definitive orbit) to "e" (very poor and unreliable orbit). The 6th column contains spectral data on separate components, if available in the literature. The last column gives remarks based on the catalogue. For other stars suspected spectroscopic binarity is noted and, in a few cases, the information about membership in a close visual binary is given.

For the stars: HD 33904, HD 35548A, HD 71066, HD 75333, HD 106625, HD 144844, HD 172044, HD 173524, HD 174933, and HD 221507 the available data are still now very scanty. The stars are not even included in the catalogue of periods (Catalano et al., 1984, 1988, 1991). Rotation periods of HD 77350 and HD 78316 were obtained spectroscopically. The star HD 34364 is the eclipsing binary AR Aur and the tabulated period is the orbital. We have no information about variability of its HgMn peculiar component.

We have two or more independent sets of observations for the following five stars: HD 21699, HD 49606, HD 175362, HD 358, and HD 179761, which give more or less consistent results. The first three ones show rotational variability of brightness, spectral lines and magnetic fields, similarly to the other magnetic CP stars. The two last ones are discussed later in more detail.

Among HgMn stars, the largest amplitude ($\Delta u$ = 0.07 mag) has been observed by Winzer (1974) in the case of HD 210071. This star shows light curves typical for silicon stars. Together with the three other "magnetic" stars in our list, HD 210071 demonstrates the difficulty of separating magnetic and nonmagnetic(?) CP stars by spectral classification only.

Another interesting case is the star HD 179761. Different authors attach different spectral types to it. Babcock (1958) found the star to be a normal B7V star. Cowley (1972) relates it to the MnHg stars by giving B8 II-III(Hg)? type. According to the spectral type, given by Searle and Sargent (1964) HD 179761 is a silicon star. Morgan (1932,1933) had reported variations of the helium lines, which were not later confirmed

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TABLE 1a Bright Stars With HgMn Peculiarities in the G.C.V.S. Data on Photometric Variability and Rot. Velocity

| Star | Sp | v sin i [km/s] | Period [d] | Ampl. [mag] | Remarks | |
|---|---|---|---|---|---|---|
| HD 358 | B9 MnHg | 55 | 0.9636(l,s,v) | 0.06 | +C. | SB1 |
| HD 1909 | B9 Mn | 25;12 | 7.2(l) | u:0.015 | | SB1 |
| HD 3322 | B8 HgMn | 28;30 | 4.69(l) | | +C. | SB1 |
| HD 7374 | B9 SiHgMn | 28;25 | 2.8(l) | v:0.02 | | SB1 |
| HD 21699 | B8 He w,Mn | 59;45 | 2.49(l,m,s) | u:0.05 | | RV var? |
| HD 23950 | B9 MnHgSi* | 85;165 | 1.1?(l) | u:0.01 | *shell | SB? |
| HD 27295 | B9 Mn | 2;0 | 4.42(l) | u:0.01 | | SB1 |
| HD 27376 | B9 MnHg | 12 | 8.5/1.9/.9(l) | u:0.03 | | SB2 |
| HD 32964A | B9 Hg | 20;41 | 7.86(l) | u:0.01 | | SB2 |
| HD 33647A | B9 MnHg | 39;45 | 0.57?(l) | <0.01 | 312obs. | 2Sp |
| HD 33904 | B9 MnHg | 12;15 | 2:(l) | ~0.01 | | |
| HD 34364 | B9 MnHg | 58;45 | 4.1347(l) | 0.6 | EA/DM | SB2 |
| HD 35548A | B9 HgMn | 5;8 | NSV | | | RV var? |
| HD 42657A | B9 MnHg | 74;75 | 0.72(l) | u:0.04 | | |
| HD 47152 | A0 EuCrHg | 29;35 | 2.8(l) | v:0.02 | | |
| HD 49606 | B8 MnHgSi* | 35;30 | 3.35?(m,l,s) | | *He weak | |
| HD 71066 | A0 SiMn | | NSV | | | |
| HD 75333 | B9 MnHgEu | 35;25 | 6/9(l) | ~0.01 | | RV var? |
| HD 77350 | B9 SrCrHgSi* | 23 | 4.191(s,v) | const. | *SrCr | SB1 |
| HD 78316 | B8 MnHg | 9;7 | 5.0035(m) | const. | | SB1 |
| | λ Boo type | | | | | |
| HD 89822 | A0 HgSiSr | 15;5 | 7.56(l) | | +C. | SB2 |
| HD 106625 | B8 HgMn* | 41;35 | NSV5515 | 0.04? | *shell | SB |
| HD 110073 | B8 Mn | 57;20 | 0.45?? | (0.05)? | | SB1 |
| HD 129174 | B9 MnHg | 22;16 | 2.24(s,l) | u:0.01 | | SB |
| HD 143807 | A0 MnHg | 12;5 | 20-30?? | 0.01 | | SB2 |
| HD 144844 | B9 MnPGa* | 180;20 | NSV7470 | 0.03 | *He weak | SB2 |
| HD 145389 | B9 MnHg | 10;10 | 7.83?(l) | 0.03 | +C. | SB1 |
| HD 172044 | B8 HgMn | 46;40 | NSV11113 | 0.05? | +C. | SB1: |
| HD 173524 | A0 HgMn | (5+5)** | NSV11273 | 0.01 | +C. | SB2 |
| HD 174933 | B9 HgMn | (8+15)** | NSV | | +C. | SB2 |
| HD 175362 | B6 HgMnSi* | 170;20 | 3.674(s,m,v,l) | | *He w;RV var | |
| HD 177517 | B9 HgSi | 100;200 | 0.4:?(l) | | | SB |
| HD 179761 | B8 Hg | 19;12 | 1.7(l) | u:0.02 | +C. | RV var |
| HD 191110 | A0 Hg | <30 | 6.279(l) | u:0.01 | | SB2 |
| HD 207857 | B8 HgMn | 12;15 | 20.7(l) | v:0.01 | +C. | SB1 |
| HD 210071 | B9 SiCrHg | 100 | 0.677?(l) | u:0.07 | | RV var? |
| HD 216494 | B9 HgMn | 5;7 | .7/1.3/3.4(l) | 0.005 | | SB2 |
| HD 220933 | A0 HgMn | 40;30 | 7.0?(l) | u:0.01 | +C. | |
| HD 221507 | B9 MnHg | 37;20 | NSV14608 | 0.04 | | |
| HD 225289 | B8 HgMn | 50;40 | 6.43(l) | u:0.01 | +C. | RV var |

*:see remarks in the table; **: v sin i of both components; (l,s,m,v) for light, spectrum, magnetic field and radial vel..

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TABLE 1b Bright Stars With Hg-Mn Peculiarities in the G.C.V.S. Data on Orbital Periods and notes on Rad. Velocities

| Star | Eighth Cat. of SB Systems Nr. | P orb. [d] | e | Q | Components | Remarks |
|---|---|---|---|---|---|---|
| HD 358 | 4 | 96.696 | 0.52 | b | | SB1 |
| HD 1909 | - | | | | | SB1;7.3:d |
| HD 3322 | 29 | 339.6 | 0.57 | d | | SB1 |
| HD 7374 | 66 | 800.9 | 0.31 | d | | SB1 |
| HD 21699 | - | | | | | RV var? |
| HD 23950 | - | | | | | SB? |
| HD 27295 | 234 | 4.4551 | 0.06 | b | | SB1 |
| HD 27376 | 235 | 5.0105 | 0.01 | b | B8CP3+B9.5 | SB2 |
| HD 32964A | 296 | 5.2727 | 0.10 | b | B9CP3+A1V | SB2; i<80$^0$ |
| HD 33647A | 2Sp.(B $\Delta$m 0.4 mag at 0.1") | | | | | RV 21.4d |
| HD 33904 | - | | | | | - |
| HD 34364 | 311 | 4.1346 | 0.0 | b | B8CP3+B9V | SB2;EA/DM |
| HD 35548A | vis.bin.(B 7.5mag at 0.2";P)194.28Y | | | | | RV var? |
| HD 42657A | vis.bin.($\Delta$m 1.7 mag at 0.8") | | | | | |
| HD 47152 | vis.bin.($\Delta$m 0.0 mag at 0.1") | | | | | |
| HD 49606 | - | | | | | - |
| HD 71066 | - | | | | | - |
| HD 75333 | - | | | | | RV var? |
| HD 77350 | 550 | 1401.4 | 0.35 | d | | SB1 |
| HD 78316 | 554 | 6.3933 | 0.13 | a | | SB1 |
| HD 89822 | 608 | 11.5791 | 0.26 | c | B8CP+Am | SB2 |
| HD 106625 | - | | | | | SB |
| HD 110073 | - | | | | | SB1 |
| HD 129174 | - | | | | | SB |
| HD 143807 | 878 | 35.47 | 0.56 | d | | SB2;+RV 384d? |
| HD 144844 | - | | | | B9CP3+A0 | SB2 |
| HD 145389 | 887 | 560.5 | 0.47 | c | | SB1 |
| HD 172044 | 1071 | 1675 | 0.16 | e | | SB2? |
| HD 173524 | 1077 | 9.8107 | 0.2 | b | MnHgSr+Hg | SB2;i=23$^0$ |
| HD 174933 | 1094 | 6.3624 | 0.12 | b | B7MnHg+A3Vp | SB2 |
| HD 175362 | - | | | | | RV 7.34d |
| HD 177517 | - | | | | | SB |
| HD 179761 | - | | | | | RV var |
| HD 191110 | 1205 | 9.3464 | 0.01 | c | HgMn+HgPtY | SB2 |
| HD 207857 | 1337 | 2.7257 | 0.03 | b | | SB1;+RV 340d? |
| HD 210071 | - | | | | | RV var? |
| HD 216494 | 1403 | 3.4298 | 0.05 | c | HgMn+Hg | SB2 |
| HD 220933 | - | | | | | - |
| HD 221507 | - | | | | | - |
| HD 225289 | - | | | | | RV var |

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Notes to TABLE I

| | | |
|---|---|---|
| HD 358=α And | HD 47152=BS 2425 | HD 173524=NSV 11273 |
| HD 1909=AV Scl | HD 49606=OV Gem | HD 174933=BS 7113 |
| HD 3322=BS 149* | HD 71066=BS 3302 | HD 175362=V686 Cra |
| HD 7374=BS 364 | HD 75333=KX Hya | HD 177517=BS 7230 |
| HD 21699=V396 Per | HD 77350=NSV 4356 | HD 179761=V1288 Aql |
| HD 23950=BS 1185 | HD 78316=κ Cnc | HD 191110=AV Cap |
| HD 27295=V1024 Tau | HD 89822=NSV 4839 | HD 207857=V1619 Cyg |
| HD 27376=BS 1347 | HD 106625=NSV 5515 | HD 210071=BS 8434 |
| HD 32964A=EN Eri | HD 110073=NSV 5835 | HD 216494=HI Aqr |
| HD 33647A=V1085 Ori | HD 129174=NSV 6762 | HD 220933=HV Peg |
| HD 33904=μ Lep | HD 143807=NSV 7396 | HD 221507=NSV 14608 |
| HD 34364=AR Aur | HD 144844=NSV 7470 | HD 225289=V567 Cas |
| HD 35548A=BS 1800A | HD 145389=NSV 7490 | |
| HD 42657A=V638 Mon | HD 172044=NSV 11113 | |

*BS 149 is a new variable, not yet included into G.C.V.S., see Catalano and Leone (1990)

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by Deutsch (1947). Provin (1953) and Winzer (1974) could not find light variability in this star. Stępień (1968) and Vetö (1980) found the star to be variable and determined similar parameters of the light curve.

Contradictory data exist for HD 358 (α And). At first Rakosch (1971a,b) obtained photometrically the period 0.9696 of a day. Winzer (1974) found the star to be constant. However, Rakosch et al. (1981) confirmed the period obtained earlier using extremely narrow band ($\Delta\lambda = 2$ Å) photometry at $\lambda$3431 Å.

For the large fraction of the remaining stars there exists only one set of observations. Generally the observed amplitudes of the discussed stars are very small. Moreover, Winzer (1974) gives "negative" results for eight of these stars by saying that he could not detect any variability of them.
We can conclude that the existence of photometric variability among the nonmagnetic MnHg stars is still questionable. On the other hand, 312 observations of good quality, obtained by North (1984) for HD 33647A cannot be neglected altogether. So the question "are the HgMn stars variable ?" remains still open. To this we can add another question: "is the (possible) variability of HgMn stars due to rotational modulation?"
If we exclude the possible magnetic CP stars of our sample from the discussion, the amplitudes of the remaining stars are too small for a investigation of the shape of the light curves. The periods are in the same interval as for the magnetic CP stars, but the v sin i versus 1/P relation for the stars of Table I shows clearly that the distribution of the stars differs strongly from the distribution expected for rotational periods. The values of v sin i are nearly independent of the

suggested periods. This is a strong argument against the rotational character of the variability of the typical HgMn stars.

The data on binarity and orbital periods in Table Ib are given for comparison of the orbital periods and the periods determined photometrically. Surprisingly, 75% of the photometrically suspected variable stars are known spectroscopic binaries or show indication of radial velocity variations. Of course, the spectroscopic and the photometric period of the eclipsing binary HD 34364 are identical. The period found from the variations of radial velocity of the magnetic star HD 175362 is twice the rotational period determined from spectrum, magnetic and light variations.
The photometric and orbital periods of the other stars in the Table I do not show any correlation. Hence, the effects typical for binary systems, like ellipticity of the components, mutual heating or reflection can be ruled out as cause for the possible small amplitude variability of the HgMn stars.

## 4. ROTATIONAL VARIABILITY AMONG NORMAL STARS

This problem was born, when Stępień (1968) found that one of the comparison stars, used for photometric observations of magnetic stars, HD 19216, is variable and has light curves very similar to those of the magnetic CP stars. Preston (1969) took a high dispersion spectrogram (unfortunately only one) of this star and found it to be a sharp lined normal B9V star. Rotational variability of normal stars without chemical peculiarities and, possibly, without magnetic field, would suggest physical processes for the formation of nonuniformities over star's surface very different from those working on magnetic stars. A search for additional cases by standard photoelectric observation programs seems to be rather hopeless.
Želwanowa (1981) searched the literature for informations about variability of comparison stars used for magnetic star photometry. In the interval of spectral classes B5 - F0 data for 212 comparison stars were available at that time. 27 of them, i.e. more than 10%, were suspected to be variable. 9 of these could be identified as Ap, $\delta$ Sct or SB stars, whereas 18 stars were of unknown type. Now, ten years later, additional information exists for some further stars of this sample:

HD 19216 - V383 Per, B9V, $\alpha$ CVn type
HD 24832 - DL Eri, $\delta$ SctC type
HD 30861 - TV Pic, Elliptical
HD 54475 - B9, B3V, B9e, 53 Per star?
HD 55892 - QW Pup, F0V, F0IVs, $\alpha$ CVn:
HD 65270 - V342 Pup, B6V, SX Ari:
HD 111604 - NSV 5983 $\delta$ Sct?
HD 192044 - NSV 12890 rapid var?

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Since the observations reported by Stępień (1968) and Preston (1969) HD 19216 has not been observed. On the basis of the light curve it has been classified in the G.C.V.S. as $\alpha$ CVn type. Magnetic and spectral measurements of it are urgently needed to find out the nature of this star. A similar example is the star HD 65270 which has been classified in the G.C.V.S. as SX Ari type solely on the basis of its light curve, although its spectral type is that of a normal main sequence star. Here also additional spectroscopic observations are necessary, to show the relation of this star to magnetic CP stars.

Another problem is the star HD 55892. Hensberge et al. (1981) noted: mild Ap?. In the G.C.V.S. the classification "$\alpha$ CVn type" is given with the note: belongs to the group of early F type stars with unexplained light curves. The existence of such an independent group of stars with periods of the order of days and amplitudes of the order of a few hundredths of magnitude is still under discussion (see Krisciunas and Guinan, 1990) . Spottiness seems to be favoured to explain the light variability of the prototype of the group 9 Aur and its some other possible members. The problem is, that if it can be proven that 9 Aur shows indeed rotational variability: "*....then we need to explain how such variability results on a star with non reported spectroscopic anomalies (e.g. evidence of magnetic fields)*" (Krisciunas et al., 1991).

The star HD 54475 points to another group of variable stars, which can possibly be related to magnetic CP stars. Waelkens and Rufener (1985) identified a new class of variable B type stars from a survey of the Geneva photometric data. They include HD 54475 as a possible member. The prototype of this group is 53 Per. Their periods are in the range of 1 to 3 days. The amplitudes are some hundredths of magnitudes. The main properties differing them from the magnetic CP stars seem to be variations of the amplitudes of the 53 Per stars. But as Cuypers (1990) pointed out in his review paper, the known silicon star HD 123515, included by Waelkens and Rufener (1985) in the primary sample observed in this connection for more than 7 years, "*is by means of photometry not distinguishable from the other multiperiodic variable stars (except for its later spectral type B8V)*".

## 5. THE RELATION BETWEEN MAGNETIC CP STARS AND Be STARS

A direct relation between this two types of variable stars is given by the known magnetic He strong star $\sigma$ Ori E (HD 37479). A description of its observed specific features is given by Bolton et al. (1987). This star has all properties typical of a hot magnetic star but with pronounced double peaked emission in H$\alpha$, typical of Be stars. The emission undergoes strong

variations with the rotational period indicating two corotating clouds or "spokes" which produce, when passing in front of the stellar disc, eclipsing phenomena in the continuum and a shell spectrum in the hydrogen lines. However, contrary to Be stars, the structure of this circumstellar gas around $\sigma$ Ori E is extremely stable (no changes over an interval of at least 4000 rotation cycles!), obviously due to a supporting, stationary stellar magnetic field.
Recently, similar variable emission profiles of H$\alpha$ have been detected in another star, $\delta$ Ori C = HD 36485 (Bohlender et al., 1991), which suggests a similar mechanism as for $\sigma$ Ori E.

Less than ten years ago, the rotator hypothesis, very successful in case of magnetic CP stars, came back in relation to Be stars, where it had been used to explain the first photometric observations of these variables (e.g. Walker, 1953). Presently a discussion is going on the non radial pulsation hypothesis versus hypothesis of rotational modulation. We will not go into this discussion but refer only to some observational facts supporting the rotational modulation, which remains in the relation to the magnetic CP stars.
According to Harmanec et al., (1987) the light curves of a Be star o And show a double wave which can be modelled by two nearly identical hot spots, symmetrically placed on the opposite sides of the star (or by the cooler belt between them). Many examples of light curves of variable Be stars, with single and double waves not distinguishable from that of typical magnetic CP stars can be found in the literature (e.g. Balona and Engelbrecht, 1986; van Vuuren et al., 1988). In many cases the shape of the light curve has been found to vary with time. A statistical analysis of the P versus v sin i relation of the Be stars with periodic light variability carried out by Balona (1990a) supports the rotational modulation hypothesis, at least for the group of $\lambda$ Eri stars (see also Balona, 1990b). Rotational variability is produced by inhomogeneities of the stellar surface, asymmetrically distributed relative to the axis of rotation. In single stars the magnetic field is the most common cause for such a non uniform distribution. However no mean regular magnetic field has been detected on any classical Be star (Barker, 1987).

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