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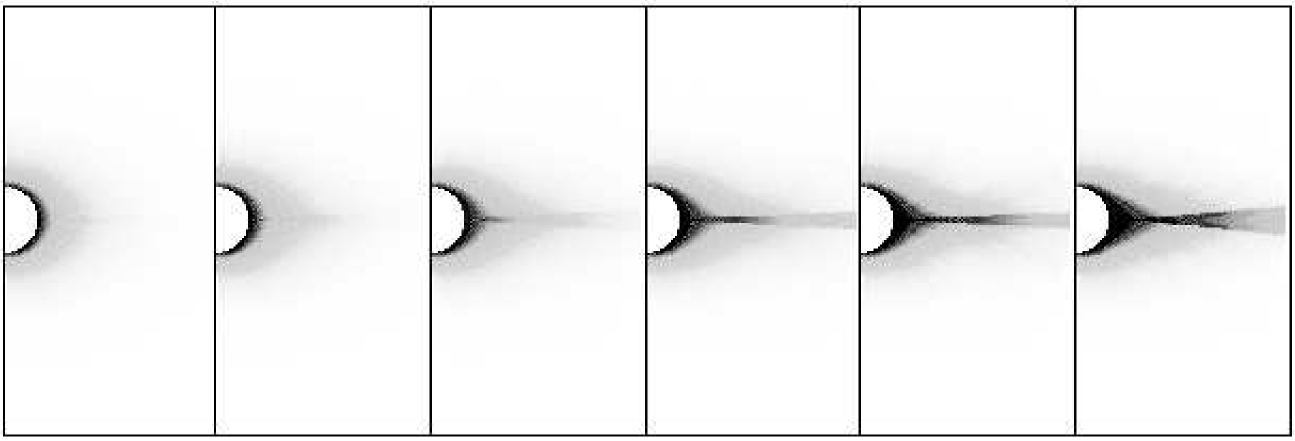

Be STAR NEWSLETTER

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the World Wide Web (`http://www.chara.gsu.edu/BeNews/intro.html`)
or by anonymous ftp (`ftp chara.gsu.edu, cd BeNews`).

1. EDITORIAL

With this Issue I am sad to report that Mercedes Jaschek, the founder and first editor of the *Be Star Newsletter* passed away in Salamanca, Spain in late November 1995 after a long illness. Responding to a consensus of the members of the Working Group on Be Stars that a newsletter would be useful, Mercedes undertook the formation of the *Be Star Newsletter* and published the first issue in January 1980. From that time until her resignation in 1986, she produced 13 issues and established a character and high quality for the *Newsletter* that we strive to maintain today. Mercedes will be truly missed in the Be star community and we send our condolences to her husband Carlos and their family. A summary of Mercedes' career appears in this issue.

Our electronic *Newsletter* continues to evolve. One can browse the current and recent issues at our web site at Georgia State University and/or ftp a PostScript file of the entire *Newsletter*. Please continue to send us your comments and suggestions for improvement as this is the only way we can determine whether we are producing a publication that it interesting, useful, convenient to read, and ultimately serves the community.

The problems surrounding the interpretation of the short-term photometric and line profile variability in Be stars are further discussed in this issue, No. 31, in two contributions. The discovery of an apparent detached binary consisting of a Be star and a B1-B2 object is also announced. Transient activity observed in Be stars just might hold the clue to the cause(s) for the mass loss as well as dynamics in the circumstellar disk and in this issue of the *Newsletter* we learn of the short-lived presence of narrow optical absorption components in Fe II in a Be-shell star and their unexpected behavior. In our section "What's Happening?" we include preliminary reports on multiwavelength campaigns on γ Cas and ω Ori that were carried through earlier this year. As usual, we thank all who sent contributions and helped compile the bibliography.

We plan to continue a publication frequency of two issues per year for the immediate future and anticipate that Issue No. 32 will go to press in October/November 1996. In order that we can achieve a timely publication please send copies of your contributions and abstracts to the editor-in-chief and technical editor by:

September 30, 1996.

Send contributions by e-mail (gjpeters@mucen.usc.edu, gies@chara.gsu.edu). As mentioned in the last *Newsletter*, beginning with Issue No. 32, we are **requiring** that abstracts be submitted as LaTeX files. A template for their preparation is provided in this issue and can also be downloaded from our web site. Illustrations should be sent by E-mail as a PostScript file. If it is not possible to transmit your contribution electronically, please send or fax (213-740-6342) a dark camera-ready copy.

I hope your summer is happy and productive and that you consider announcing your discoveries and new ideas in the next *Be Star Newsletter*.

Gerrie Peters, Editor-in-Chief

2. WORKING GROUP MATTERS

2.1. Working Group News

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Congratulations to Our New (and Current) Be NL Editor!

Following the overwhelming recommendation of the B/Be Working Group and Organizing Committee, I have reappointed Gerrie Peters as Scientific Editor of the *Be Star Newsletter* for the period 1996-98. Doug Gies will remain as Technical Editor. I'm sure you will all join me in congratulating Gerrie for her job over the last few years! It is also appropriate to express our appreciation to her for continuing in a job which must at times seem frustrating and deadline-driven.

Our Affiliations:

I'm pleased to announce that Dr. Marcello Rodono, President of the IAU Commission on Close Binary Stars (C42) has informed me that our Working Group has been granted affiliation status with this Commission. This brings to three our affiliations, the other two being with C27 (Variable Stars, Pres: M. Jerzkiewicz) and C45 (Stellar Classification, Pres: H. Levato). Our application for affiliation with C36, Theory of Stellar Atmospheres, has been declined because the OC did not want to attach itself to WGs for disparate stellar groups. I have attempted to make affiliate our WG to the Division of Variable and Binary Stars but the OC of this Division may not be ready to attach itself to WGs of particular stellar groups either. There does not seem to be any official pressure for WGs to reattach themselves at the Divisional level at this time, so I have not pursued this issue.

Upcoming Meetings (and Nonmeetings):

I'm sorry to report that the organizers of the informal workshop on SupraThermal Processes in Be Stars, originally planned to be held in conjunction with the AAS meeting in Madison in June (c.f., *Be Star Newsletter* No. 30, p. 4), have decided to cancel this ad hoc meeting. The announcement of this meeting was met with enthusiasm among a number of quarters among members of our own B star Working Group. I received about 12 notes from our own membership (three from outside North America), and several from people who thought it was a good idea but who could not attend. However, we received no responses at all from the 600 members of the AAS HEAD members with whom we would share the meeting's agenda. I have not been able to come up with an alternate site for such a meeting.

I communicated with Neil Gehrels, the Chair of the HEAD who was surprised himself with this result. Neil pointed out to me that there is a strong tradition of HEAD members preferentially attending the January meeting. I conclude that this is not the right time for a workshop on this subject.

On a related note, Dr. Mike Jerzykiewicz, the President of the IAU Commission on Variable Stars (C27) has made a request for a meeting room at the August 1997 IAU

GA meeting in Kyoto.

The Passing of Dr. Richard Thomas:

I have been informed that Dr. Richard Nelson Thomas succumbed to a stroke on April 8th. One of Dick's special interests in the last several years was physics of Be stars. Many of us came of age in this field under his intellectual shadow. We mourn his passing and will miss his passionate pursuit of scientific truth that has left its mark on our field.

2.2. Mercedes Jaschek

At the end of November 1995, we sadly learned that Mercedes Jaschek had died in Salamanca, Spain. Mercedes and Carlos Jaschek left Strasbourg Observatory in 1993, officially the date of their retirement, but they were still very active scientifically, though in Spain now. Working through till the last moment, while affected by an illness which exhausted her more day after day, Mercedes gave us a real lesson of courage.

Many readers of the Be Star Newsletters know Mercedes from her work on the Be stars; the latter, however, represents only a fraction of her enormous scientific production, a result of forty years of work conducted daily in close collaboration with her husband Carlos Jaschek.

The leading idea of Mercedes scientific work was to show constantly the fundamental contribution of the stellar classification to the development of astrophysics. As a fruitful consequence of that work, different spectral subgroups were discovered and their spectral peculiarities put in evidence. This has been clearly illustrated by her work in the field of stellar spectroscopy, first in the optical range, later in the UV and IR, progressing along with the acquisition of a larger number of data in these wavelength ranges. Hence one of the main preoccupations of Mercedes Jaschek was to develop classification methods adapted to each newly accessible wavelength range. Her "Classification of Stars" (1987) written in collaboration with Carlos Jaschek gives an excellent review of the successive contributions of the different classification systems as well as a detailed description of each stellar sub-group, ranging from the hottest to the coolest stars, hence underlining the riches of information obtainable from the stellar classification.

We have to mention here, for example, the personal works of Mercedes on the classification of Be, B[e], He-poor, He-rich, Ap and Am stars, her discovery together with Carlos Jaschek, of the ApSi4200 stars, the first detections of hot stars with an anomalous CNO, the difference between the supergiants in the Magellanic Clouds and in our Galaxy ... All this extraordinary work was conducted in collaboration with astronomers all over the world. Starting at La Plata in 1947, her career continued at Cordoba, Perkins, Yerkes, in Michigan, in Geneva, then at Strasbourg Observatory, which Mercedes and Carlos Jaschek joined in 1974. In the pursuit of her work, Mercedes collaborated with specialists of each technique or field of research and most often too with Carlos Jaschek. We are indebted to them for many precious tools, atlases and catalogues of wide interest, which will remain as reference works (atlases of stellar spectra in visible, UV and IR, catalogues of stellar spectral classification, catalogues of spectral groups, bibliographical catalogues, all those documents archived in the data base of the Strasbourg Centre of Stellar Data) particularly useful in this era of massive data acquisition.

Another activity of Mercedes and Carlos Jaschek was the organization of meetings for working groups on different categories of stars (cf. the "Journées de Strasbourg"). They also published review articles and books on spectral classification and on peculiar stars, such as "Cool Stars with Excesses of Heavy Elements" (M. Jaschek and P. C. Keenan eds., 1985), "The Classification of Stars" (C. and M. Jaschek eds., 1987), "The Behavior of Chemical Elements in Stars" (C. and M. Jaschek eds., 1995). In most of these books, it is difficult to distinguish the contribution of Mercedes from that of her husband, so close was their collaboration. I think, however, that Mercedes was one of the few people, maybe the only one for the time being, who could, in a few seconds, give the classification of a star by looking at its visible, UV, or IR spectrum.

Concerning the activity of Mercedes in the field of Be stars, I have chosen to remember here three essential aspects of her work. The first is the spectroscopic survey of Be stars in the southern hemisphere, at Cordoba and La Plata, between 1960 and 1970, together with a catalogue and a bibliography of 2000 Be stars for the period 1950-1970 (C. Jaschek, L. Ferrer, and M. Jaschek, 1964) written following the same line as the catalogues of Merrill and Burwell published between 1920 and 1943. The second is the reactivation of the Working Group on Be stars during the IAU General Assembly in Montréal, 1979, the creation of our bulletin "Be Star Newsletter" of which Mercedes was the successful editor till the summer of 1986, and the initiative of the IAU Symposium 98 "Be and Shell Stars" held in Munich in 1981, for which she was chairman of the scientific committee. Finally, the third is the pioneering work done by Yvette Andrillat, Mercedes and Carlos Jaschek on the determination of the fundamental properties of the Be, B[e], Ae, and shell stars in the near IR.

Mercedes was very enthusiastic in her research, but she remained very modest about it. Praising the work of others, she always made constructive and friendly comments. Many of us will remember the warm welcome Mercedes and Carlos Jaschek reserved for their guests and colleagues.

Anne Marie Hubert
Meudon, France

3. CONTRIBUTIONS

3.1. Short term variability of Be stars: more problems

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In two recent contributions to our Newsletter (No. 30, pp. 19 and 20), Luis Balona has drawn attention to a number of problems with the interpretation of the variability of Be stars. This matter is, in fact, very complex, and the following collection of examples aims at identifying additional potential pitfalls. However, it does not pretend to supply a solution of whatever kind.

Mean errors

Balona (Be Star Newsletter No. 30, p. 20) states that the ratio, 0.61, of the period of the observed line profile variability to the rotation period, which follows from the assumptions made by Gies and Hahula for λ Eri (Be Star Newsletter No. 28, p. 7) differs by 9 standard errors from the mean ratio of unity derived by Balona (MNRAS 245, 92) from a relatively large sample. He implies that this is a serious failure of the NRP model. A minor observation is that with the standard error of 0.07 following from his earlier work (MNRAS 245, 92), the difference of 0.42 (= 1.03–0.61) seems to correspond to only 6 standard deviations. The more salient point is what this means.

In a more recent paper (MNRAS 277, 1547), Balona compiles an enlarged sample of observed photometric periods, P, and computed rotation periods, $P_{\rm rot}$, of Be stars. In his analysis, he concludes that $P_{\rm rot}/P = 1.01 \pm 0.05$. He only provides the <u>standard error</u> of the mean, namely 0.05 (which would make λ Eri an 8σ case). But using his values of the dispersion of the two distributions of v_e values and eliminating outliers with $v_e > 500$ km/s, one estimates a <u>dispersion</u> of roughly 0.4 (= 40%) about their mean of unity. This is, and makes, a big difference.

Perhaps it is permissible to illustrate this difference by a trivial example, namely the height of male adults in a given region. The larger the number of men is, whose height has been measured, the more accurate will be the computed mean height. In other words, the standard error of the mean will become smaller and smaller with the size of the sample. For instance, the numbers might become 1,742.8±0.3 mm. The practical value of this accuracy is less obvious, even though it might be easy to 'improve' it further by obtaining more measurements. More specifically, a man who stands 1,850 mm would deviate from the mean by roughly 350 times the standard error of the mean but only twice the intrinsic dispersion of the distribution of heights if the latter amounts to ~55 mm.

Obviously, if a sample has a natural dispersion it is it which is more relevant for the characterization of the sample as a whole and also determines the probability of individual values. For example, the mean photometric period and the mean rotation period of Be stars are not very useful physical quantities because the radius of Be stars changes by more than a factor of two from early to late spectral subclasses.

The individual ratios of these two periods form a more interesting sample. The 40% dispersion mentioned above is significantly less than what one would expect under the hypothesis of these two periods being uncorrelated. On the other hand, a 40% dispersion is too large to establish the *general* equality of the two periods in Be stars and, therefore, does not suffice as an observational confirmation of the rotational modulation model. To rely exclusively on the *standard error* of the mean period ratio makes sense only if we know already that the two periods are equal in all Be stars so that the mean ratio of unity has a physical meaning. Such evidence does not seem to exist so far.

Remember also that, to zeroth order, pulsation periods depend on the mean density, ρ, as $P_{\rm puls} \sim 1/\rho^{1/2}$. Since in this segment of the main sequence mass is roughly proportional to radius (R), this becomes $P_{\rm puls} \sim R$. If Be stars have about the same angular momentum per unit mass and similar mass and rotation profiles, their rotation periods will crudely follow a relation $P_{\rm rot} \sim R^2$. Since the range in R only covers a factor of 2.5 (4.5 if luminosity classes V-III are considered, cf. Table 2 in Balona, MNRAS, 277, 1547), a 40% dispersion in the ratio $P_{\rm rot}/P_{puls}$ is not necessarily astonishing. Why the average ratio would be so close to unity is still awaiting an explanation. But the main point is that at this moment the dispersion as the more significant quantitity does not identify a particular model and the transition from $P_{\rm rot}/P_{puls} \approx 1$ to $P_{\rm rot}/P_{puls} \equiv 1$ is not justified.

After this discussion, λ Eri's deviation of 6 (or even 8) standard errors from the mean period ratio appears to lack physical relevance whereas expressed as 1.05 times the dispersion of the distribution ($0.42 = 1.05 * 0.40$) it is absolutely normal and does not require specific attention.

Different distributions and distributed differences

Balona (MNRAS 277, 1547, Fig. 3) compares two different reconstructions of the distribution of equatorial rotation velocities, v_e, from two different samples:

- For the 1975 sample (Balona, MNRAS 173, 449, Fig. 6) the observed distribution of 164 $v_e \sin i$ values was statistically deconvolved under the assumption of randomly oriented rotation axes.
- For the 57 stars of the 1995 sample (Balona, MNRAS 277, 1547, Tab. 1), individual v_e values were derived from the observed $v_e \sin i$, a spectral type-radius calibration, the observed photometric period, the single- or double-wave nature of the light curve, and the assumption that the photometric period is the rotation period.

He concludes that the consistency of the two resulting distributions gives further credence to the procedures used for deriving them.

However, a much simpler health check, which unlike Balona's approach does not involve a variety of assumptions and data transformations, is to test whether the two observed $v \sin i$ distributions used as the original input for the two derived samples are compatible. As can be seen in Fig. 1, the mean values of these two data sets differ by 20 %. A χ^2 test applied to the two histograms admits the hypothesis, that the two

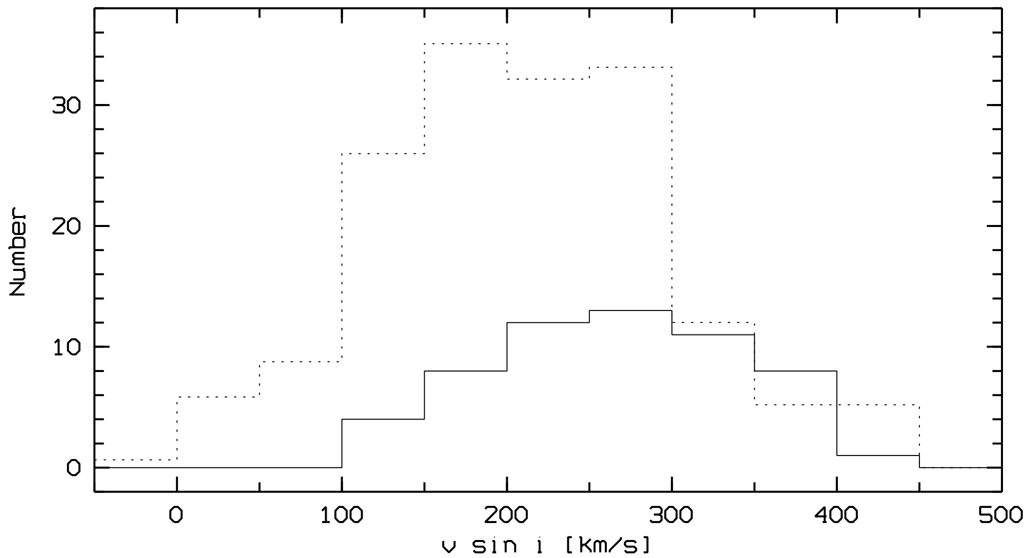

FIGURE 1. Solid line: The distribution of observed $v \sin i$ values in Balona's 1995 sample (MNRAS 277, 1547). Dashed line: Ditto for Balona's 1975 sample (adapted from Fig. 6 in MNRAS 173, 449).

distributions were drawn from the same sample, with less than 0.5 % probability.

Furthermore, the implied 20% *systematic* uncertainty in the mean equatorial velocity may be compared with Balona's result that rotation and photometric periods agree to within 1 % with a standard error of 5 % (cf. above).

Random inclinations

Another more direct check on Balona's result is to study the geometric projection factors, $\sin i$, which can be derived from his second sample (ratio of columns $v_e \sin i$ and v_e in Table 1 of MNRAS 277, 1547). The corresponding histogram is plotted in Fig. 2 where also the distribution is shown which one would expect from a sample with random i's and constant v_e.

These 57 Be stars constitute a randomly drawn sample although there may be some bias towards large inclination angles because the majority of the variabilities was discovered photometrically which within most of the models considered would be less probable for pole-on stars. But one would expect that the distribution of the implied $\sin i$ values still bears resemblance with a truly random sample. This being an absolute test, it should, similarly to the one made in the previous section, have a higher significance than Balona's comparison of the distributions which were reconstructed in different, complex ways from two different samples.

Even considering the possible bias against pole-on stars, one does not feel very comfortable with the claim (MNRAS 277, 1547) that rotation and variability periods statistically agree to within 1%, when one realizes (Fig. 2) that this conclusion is based on $\sin i$ values which in 22 out of 51 stars (stars with $v_e > 500$ km/s were excluded) are greater than 1, greater than 1.2 still in 17 cases. Note that this census is also a degradation with respect to the initial (sub-)sample, in which only 9 out of 33 $\sin i$ values exceeded 1.2 (MNRAS 245, 92), whereas because of the increase of the sample the standard error of the mean period ratio went down from 7% to 5%.

Balona has emphasized that there is some ambiguity between single- and double-

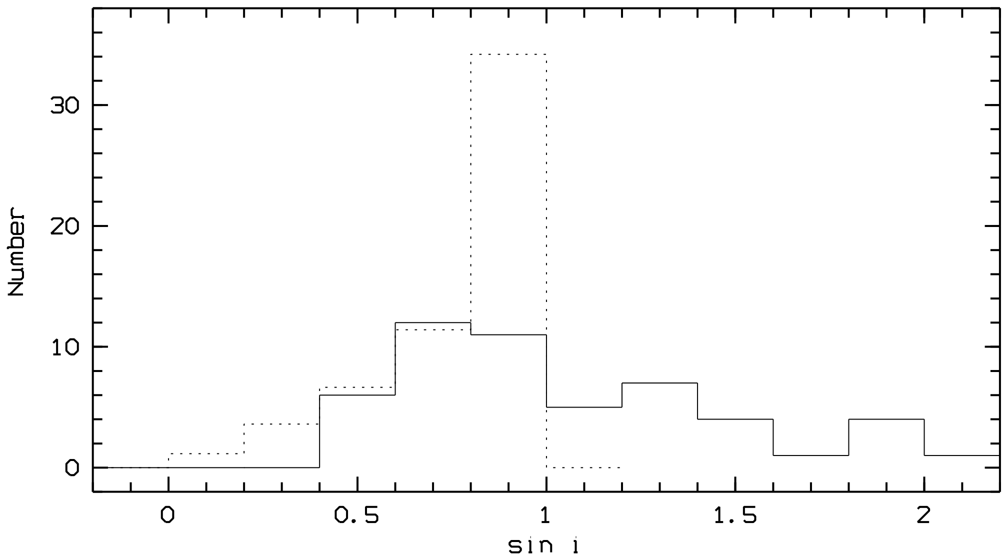

FIGURE 2. Solid line: The distribution of $\sin i$ values deduced from Balona's Table 1 (MNRAS 277, 1547); stars with $v_e > 500\,\mathrm{km/s}$ were omitted. Dashed line: The expected distribution if i is random and v ($\equiv v_e$) is constant.

wave light curves. He has, therefore, argued that the 7 outliers with $v_e > 500\,\mathrm{km/s}$ in his analysis of the derived v_e values could possibly be removed if their true light curves were of the double-wave type. To fix the $\sin i > 1$ problem, one might resort to the inverse argument, namely that the light curves of the stars concerned actually are single-waved which would double the estimate of the equatorial velocity. But this would mean that now 7+17 stars, i.e. 40% of the total sample, had their light curves wrongly classified with an impact of a factor of two on the "true" period in every case. Furthermore, looking at the classifications provided in Balona's Table 1 (MNRAS 277, 1547), one realizes that 2 of the 7 exceptional stars in his analysis are already characterized as exhibiting a double-wave light curve and that 12 of the other 17 exceptional stars are already classified as single-wave variables. For the remaining ill-fitting stars, changing the classification would remedy the primary difficulty by definition, but it might well introduce the respective other problem.

On the other hand, the interpretation of Fig. 2 is quite straightforward, if Balona's assumption of the equality of rotation and photometric periods is not imposed on it.

Conclusion

The path from the bewildering multitude of observational details to an understanding of the short-term variability of Be stars may still be long and laborious. The condensation of the available information to little more than two numbers, one of which appears ill chosen, does not look like a promising shortcut. To model the spectroscopic variability is difficult. But to ignore the bulk of the observational information is even more difficult. Spectroscopic phenomena that need to be addressed by any model include:

- alternating broad and narrow (⋃- and ⋁-shaped) line profiles,
- variability extending over full width of profiles,
- stronger variability (more power in the variance spectra) in the line wings than in the line cores,

- apparently stronger modulation of line profiles in narrow- than in broad-lined stars (incl. features that move from red to blue but with the same absolute progation speed),
- frequent simultaneous presence of two or more variabilities with fairly different spatial frequencies,
- incommensurability of multiple periods in some stars (but the reason may possibly be that higher-order variations are not periodic).

Acknowledgement: I thank Doug Gies for having sensitized me to the issue of the different $v_e \sin i$ distributions and Stan Štefl for useful suggestions for improvements of the text.

3.2. Line Profile Variations due to NRP Velocity and Temperature Fields

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In the last Newsletter, Balona (Balona, L. A. 1995, Be Star Newsletter, 30, 20) argued that that models we presented for the line profile variations in λ Eri (Gies, D. R. & Hahula, M. E. 1994, Be Star Newsletter, 28, 7) are flawed because the model underestimates the temperature variations associated with nonradial pulsations (NRP). Balona pointed out our mistake of using the observed period rather than the corotating period in the derivation of radial displacement. I am grateful for his discovery of the error, and I wish to show here how our results are modified by the correction.

The longer corotating period results in a larger overall radial displacement, and, as pointed out by Balona, this will increase the role of temperature-related, flux variations in the observed line profile variations. Balona suggests that these temperature-related variations overwhelm those associated with NRP velocity fields, so that the latter can be ignored. However, this is only true in the cases where the corotating period tends to infinity, i.e., where the observed period is the rotation period (Balona, L. A. 1995, MNRAS, 277, 1547). In the case of λ Eri, we can get a reasonable result without insisting that the rotation and observed periods are the same. For example, in my numerical realization of NRP (which includes Roche distortion of the star's shape, gravity darkening, temperature related equivalent width variations, and local temperature variations based on radial displacements calculated using the corotating period), a model with NRP velocity amplitudes $A_r = 0.14$ km s^{-1} and $A_h = 3.4$ km s^{-1} for radial and horizontal components, respectively, yields a full variation of 0.075 magnitude in V and 24.3 km s^{-1} in centroid velocity of He I λ4921 (the average velocity variations found by Bolton, C. T., & Stefl, S. 1990, in Angular Momentum and Mass Loss for Hot Stars, ed. L. A. Willson & R. Stalio, Dordrecht: Kluwer Academic, 191). The light curve amplitude in this model is somewhat larger than has

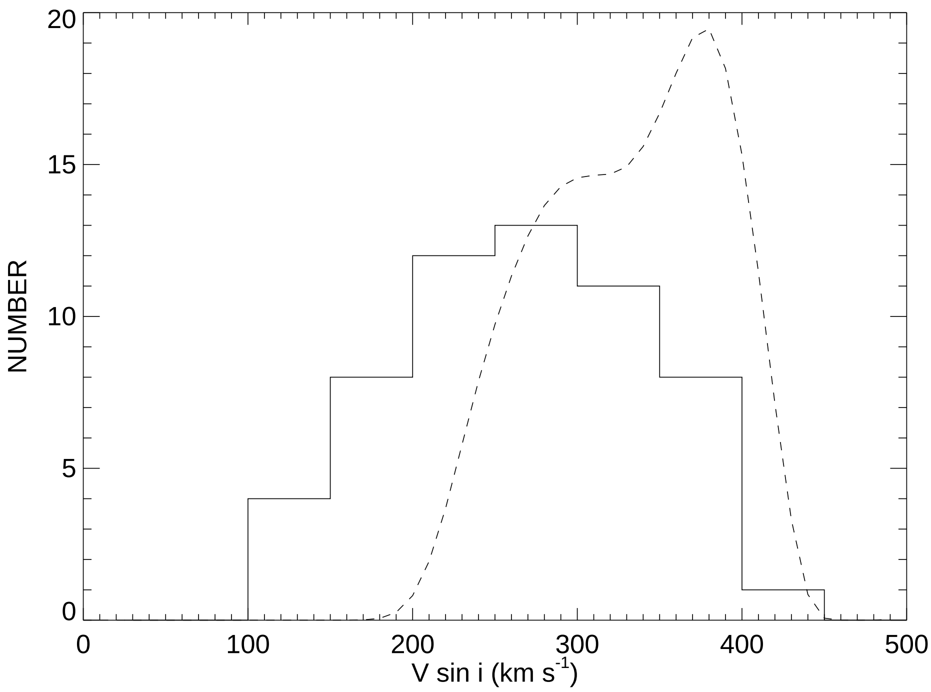

FIGURE 1. Solid line: The distribution of observed $v \sin i$ values in Balona's 1995 sample. Dashed line: Statistical deconvolution of the distribution assuming random orientations.

been observed (0.02 to 0.05 mag in B), but it is close enough to make the model worth pursuing further.

The fact that the line profile variations attain their greatest amplitude in the line wings demonstrates that velocity-related variations must be more important than temperature-related variations, since the variations would be strongest in line center if temperature-related variations dominated (because of limb darkening). Thus, it is unrealistic to assume that the line profile variations result solely from temperature variations in the photosphere.

Finally, I suggest that the case for the equality of the observed and rotational periods in Be stars is not as strong as Balona (1995, MNRAS, 277, 1547) claims. Balona's case is based on a comparison of the mean value of his derived equatorial rotational velocities, 270 km s^{-1} (from the photometric periods and estimated radii), with the mean equatorial velocity, 265 km s^{-1}, derived from a statistical deconvolution of projected rotational velocities for another sample of early-type stars (Balona, L. A. 1975, MNRAS, 173, 449). However, the mean projected rotational velocity for 57 Be stars listed by Balona (1995) is also 265 km s^{-1}, and so the actual mean equatorial velocity (without the $\sin i$ dependence) must be significantly larger than this. A histogram of the distribution of Balona's projected rotational velocities (*solid line*) is shown in the accompanying figure together with a deconvolution based on the assumption of random orientation (*dashed line*, using the algorithm of Lucy, L. B. 1974, AJ, 79, 745); the mean of this deconvolved distribution is 331 km s^{-1}. Thus, the statistical basis for claiming that the photometric periods are rotational contains a much larger systematic error than estimated by Balona.

3.3. A Be star in the binary system CR Cas

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We observed the detached binary system CR Cas within the framework of a *uvby* and Hβ monitoring program of low mass eclipsing binaries, carried out in the past five years. CR Cas was selected as a program object on the basis of its spectral classification as a G5 star by Leung & Schneider (1977).

This system was observed in three photometric campaigns: August 91, January 92 and September 95, with the 1.5m telescope of the Centro Astronómico Hispano-Alemán at the Calar Alto Observatory, Almería, Spain. A one channel photometer equipped with the Strömgren *uvby* as well as the Crawford Hβ filters was used.

The good-quality differential light curves we obtained cover both eclipses. The comparison star mesured, SAO 35044, showed no variation with time. We used the ephemeris 2440526.279+2.840147E (Danielkiewicz-Krośniak & Kurpińska-Winiarska 1994) to calculate the phases. In Figure 1 we present the light curve in the *y* filter.

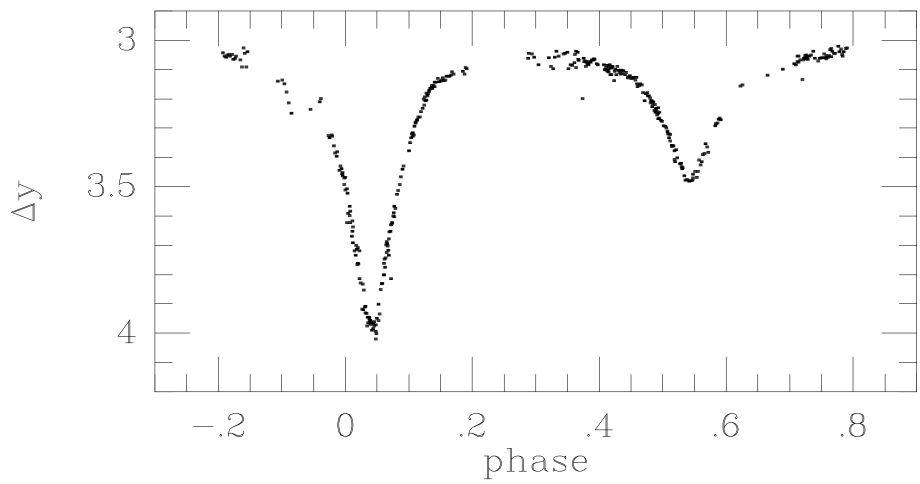

FIGURE 1. Light curve in the *y* filter.

A first analysis of the *uvby* photometry showed that the system is actually a highly reddened early-type binary (Clement et al. 1993). Spectroscopic observations show the presence of He I lines, confirming this conclussion (Popper 1994).

The differential light curves show several peculiarities. The depth of the primary minimum is variable, mainly in the *u* filter (see Figure 2). This variability is also present in the *v* and *b* filters and is almost nonexistent in the *y* filter. The β index is highly variable at all phases, with a dispersion at least three times higher than the dispersion obtained for the other stars measured at the same time. The photometric analysis lead us to the decoupling of the contribution of both components to the photometric indices. The *uvby* indices of the secondary star indicate a spectral type B1-B2. In contrast the derived β value, 2.56, is much lower than the value corresponding to this

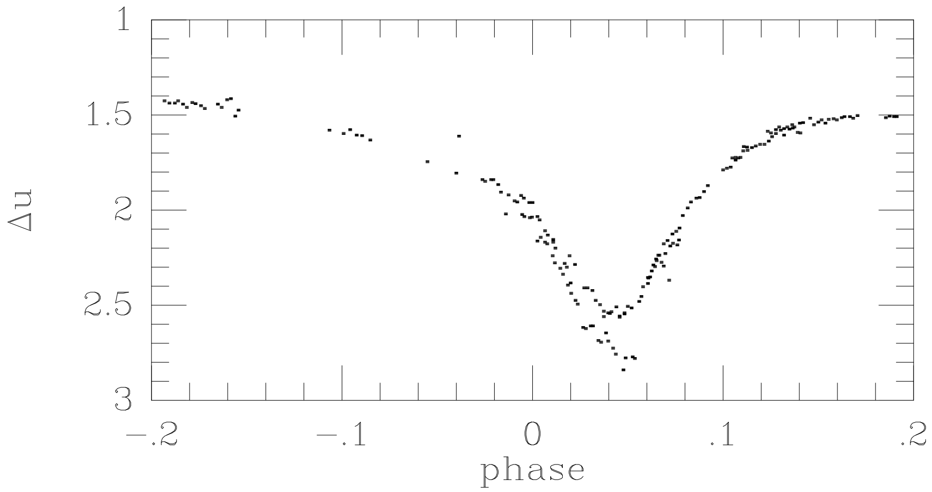

FIGURE 2. Partial light curve in the u filter.

spectral type indicating that the Hβ line presents some degree of emission. All the photometric anomalies described can be explained by assuming that the secondary star is a Be star. The indices calculated for the primary component are compatible with a B0V type star without any anomalies.

From our photometric analysis we conclude that CR Cas is a detached binary system containig a Be star. Further spectroscopic observations will be very valuable to confirm this result. The detailed photometric analysis will be published elsewhere.

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Popper D.M. 1994, private communication

3.4. Narrow Optical Absorption Components in 48 Lib

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We report on observations[1] of optical shell lines in 48 Lib = HR 5941 (B3IV e-sh, $v \sin i = 400$ km s^{-1}), a well-known shell star which has been studied for decades (see Aydin & Faraggiana 1978, Guo 1994 for further references).

[1]Based on observations obtained at the European Southern Observatory, La Silla, Chile, at the Observatoire de Haute-Provence (CNRS), St. Michel, France, and at the German-Spanish Astronomy Centre, Calar Alto, Spain

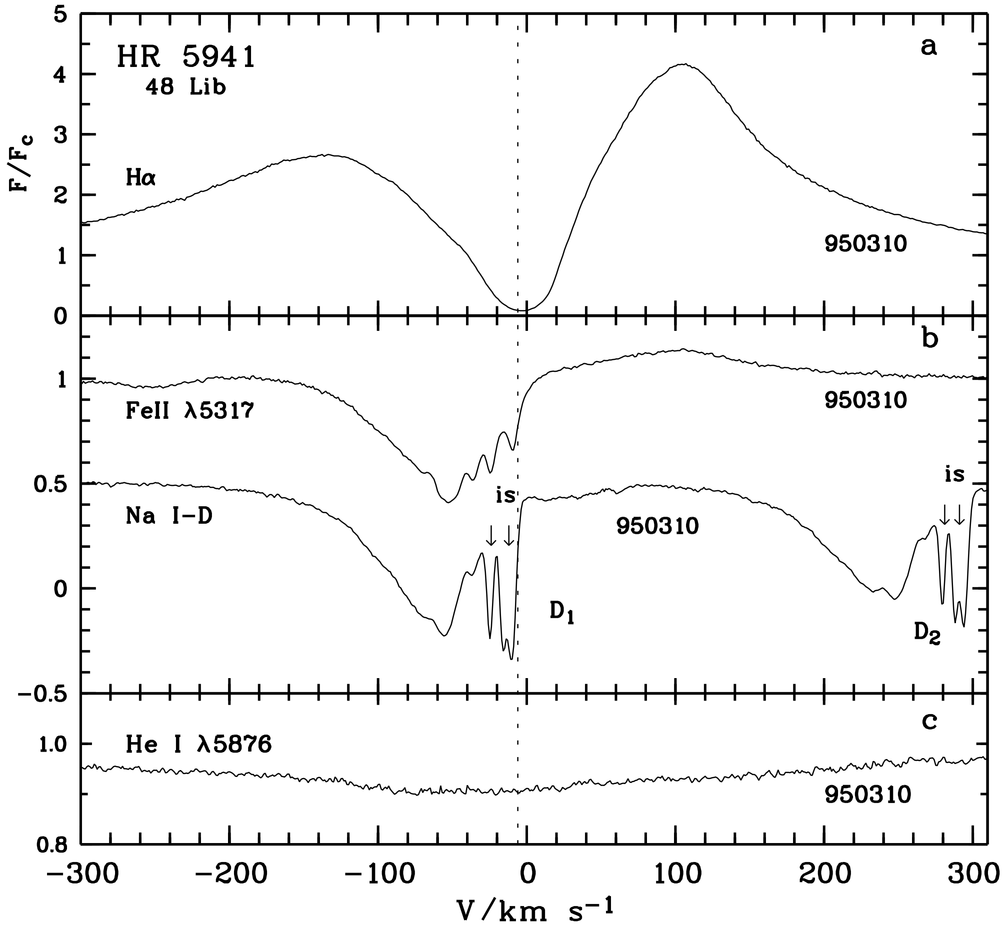

FIGURE 1. High-resolution spectra of 48 Lib in March 1995. Velocity scale is heliocentric; the dotted line marks the stellar RV from the Bright Star Catalogue (-6 $\mathrm{km\,s^{-1}}$). The arrows in **b** mark interstellar absorption.

In the course of our long-term spectroscopic survey of Be and shell stars (Hanuschik et al. 1996), we have used ESO's 1.4m Coudé Auxiliary Telescope on March 7–10, 1995, equipped with the Coudé Echelle Spectrograph and a CCD. The resolving power was $R = 50\ 000 - 120\ 000$. Three further runs were perfomed in 1995 April and May at the 1.52m telescope of the Observatoire de Haute-Provence/France, and in July 1995 at the 2.2m telescope of the German-Spanish Astronomy Centre on Calar Alto/Spain. We have measured the spectral region of three shell lines in 48 Lib: Hα, Fe II λ5317, and Na I$-D_1, D_2$.

A representative profile of Hα on a strongly expanded scale is shown in Fig. 1a. The profile is double peaked, with the blue peak flux considerably lower than the red one, $V/R = 0.51$. *There is no small-scale structure in the Hα profile*, nor in the He I λ5876 line (Fig. 1c).

The Fe II lines offer a completely different picture. One such λ5317 measurement is shown in Fig. 1b, and a larger subset is seen in an expanded scale in Fig. 2. The line profile is dominated by an asymmetric blueshifted shell feature of typical width 90 $\mathrm{km\,s^{-1}}$. Several satellite absorption features are embedded in the central part of the shell trough and its low-velocity flank. These will be called *narrow optical absorption*

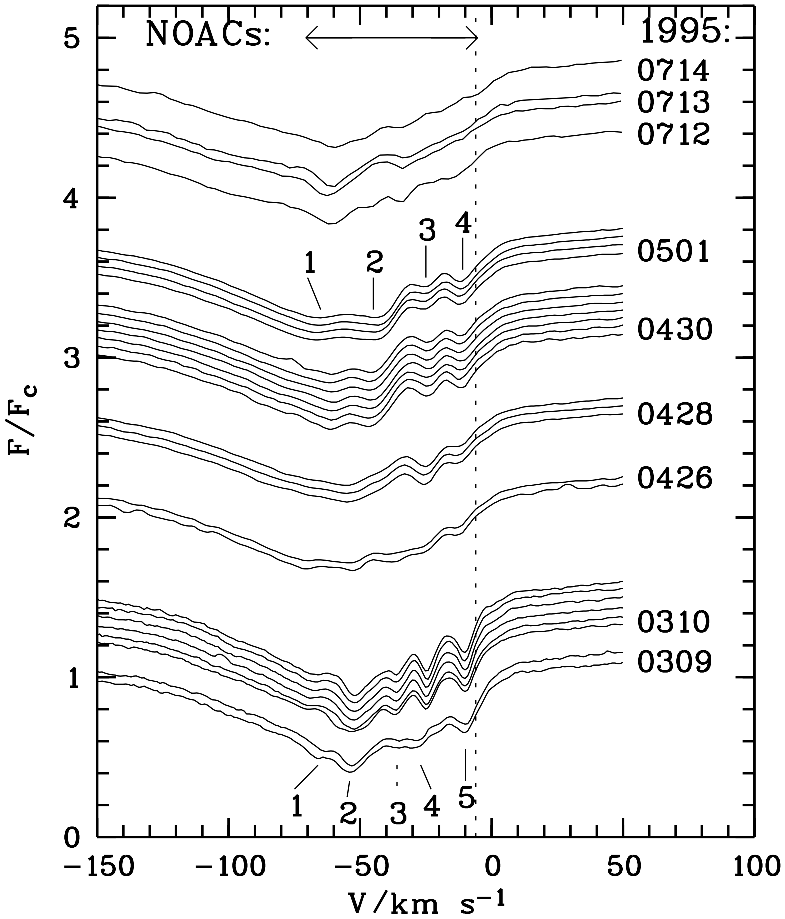

FIGURE 2. Selected Fe II λ5317 spectra in 48 Lib in March–July 1995. Flux scale is for the lowermost spectrum

components (NOACs) in the following.

We typically count 4–5 NOACs. They show up in the subrange $V_{\rm hc}$ = –80 to –10 km s^{-1} of the shell trough. Their typical width is $\leq$ 10 km s^{-1}. The NOAC with lowest radial velocity has a fully-resolved width of only 4 km s^{-1}.

In nights with multiple exposures (e.g., March 10, April 30, Fig. 2) we observe slow variability of the NOAC features both in RV and depth on a timescale of hours. RV changes are always such that a feature moves *towards less blueshifted velocities.* Much larger, though, are the variations of the overall appearance of the NOACs from night to night.

Since the NOACs are not visible in stellar absorption features, we conclude that they have nothing to do with NRP-induced variability. Their behaviour, especially their stationarity or drift to *smaller* velocities and their occurrence in optical lines of low-ionization species, clearly distinguishes them from the well-known DACs in stellar wind lines.

We believe that we have found a new rare and transient important spectroscopic phenomenon in Be star disks (no such features have been detected in our earlier spectra from 1987, 1992, and 1993). The NOACs might be due to local clumps in the circumstellar disk drifting across the stellar surface, or they may be associated with higher-order modes of a density wave which causes the cyclically changing line profile asymmetries in 48 Lib (see Hanuschik et al. 1995). We strongly urge other observers with access to a high-resolution spectrograph to continue the time record of these conspicuous features.

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4. WHAT'S HAPPENING?

4.1. First Results from the 1996 February Campaign on ω Orionis: Request for Observational Support of a Second Campaign

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As announced in Issue No. 30 of the *Be Star Newsletter*, we were granted 144 hours of *IUE* observing time during the 19th Episode to investigate the origin of the Discrete Absorption Components (DACs) in the wind in ω Ori (B2 IIIe). Participants in this project include H. F. Henrichs, D. R. Gies, E. F. Guinan, D. McDavid, and G. J. Peters. Photometric observations at Villanova University reveal that this star has been undergoing quasi-periodic outbursts (every 8-10 months) for at least the past 15 years (E. Guinan, personal communication). The goal was to observe the behavior of the wind through two rotational periods ($\sim$3 days) at epochs of maximum and minimum mass loss.

The first series of *IUE* observations of ω Ori began on Feb. 2 (14:36 UT) and continued for the next 72 hours. Repeated high dispersion SWP images were secured throughout this interval except for three 4-5 hour interruptions when the target was earth-blocked. In total we obtained 73 high dispersion SWP images. In order to avoid problems with likely "corrupted data", we adjusted the exposures so that the maximum DN was less than 159. It appeared that an exposure time of 1m 10s worked well, and inspection of the data confirm that it is quite good despite the reduced exposure.

Well, I must say that we were *extremely* lucky in that the star apparently went into outburst just prior to the *IUE* run! This is astounding considering the fact that outbursts in ω Ori are quasi–periodic. We could not have planned it any better.

From ground-based photometry, Ed Guinan concluded that the star definitely experienced an outburst prior to the *IUE* run but it was a weak one (better weak than not at all!). David McDavid reported that the polarization was slightly higher on Feb.

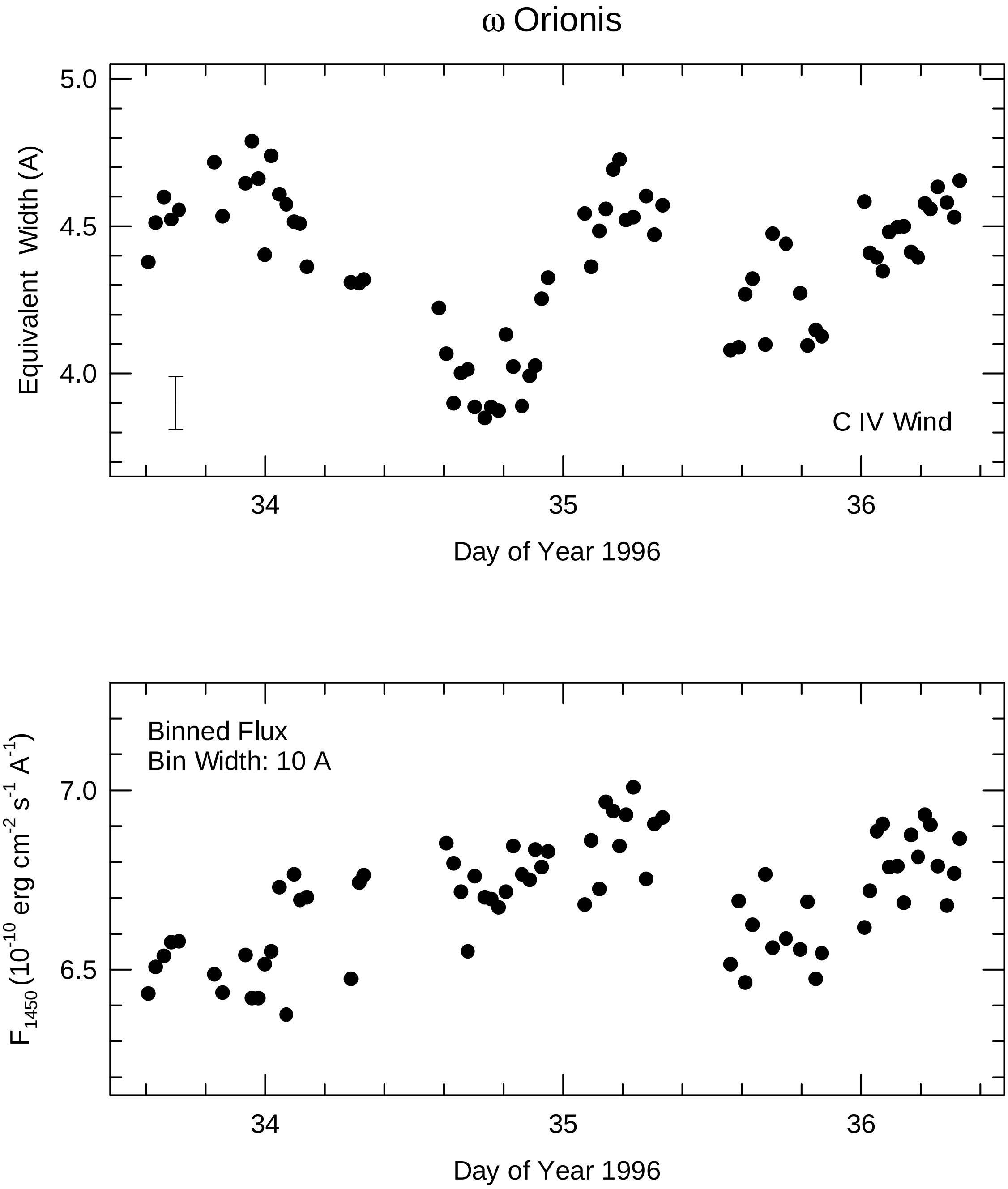

Fig. 1 - The EW of the C IV wind line and the flux at 1450 A versus time during the 1996 February campaign.

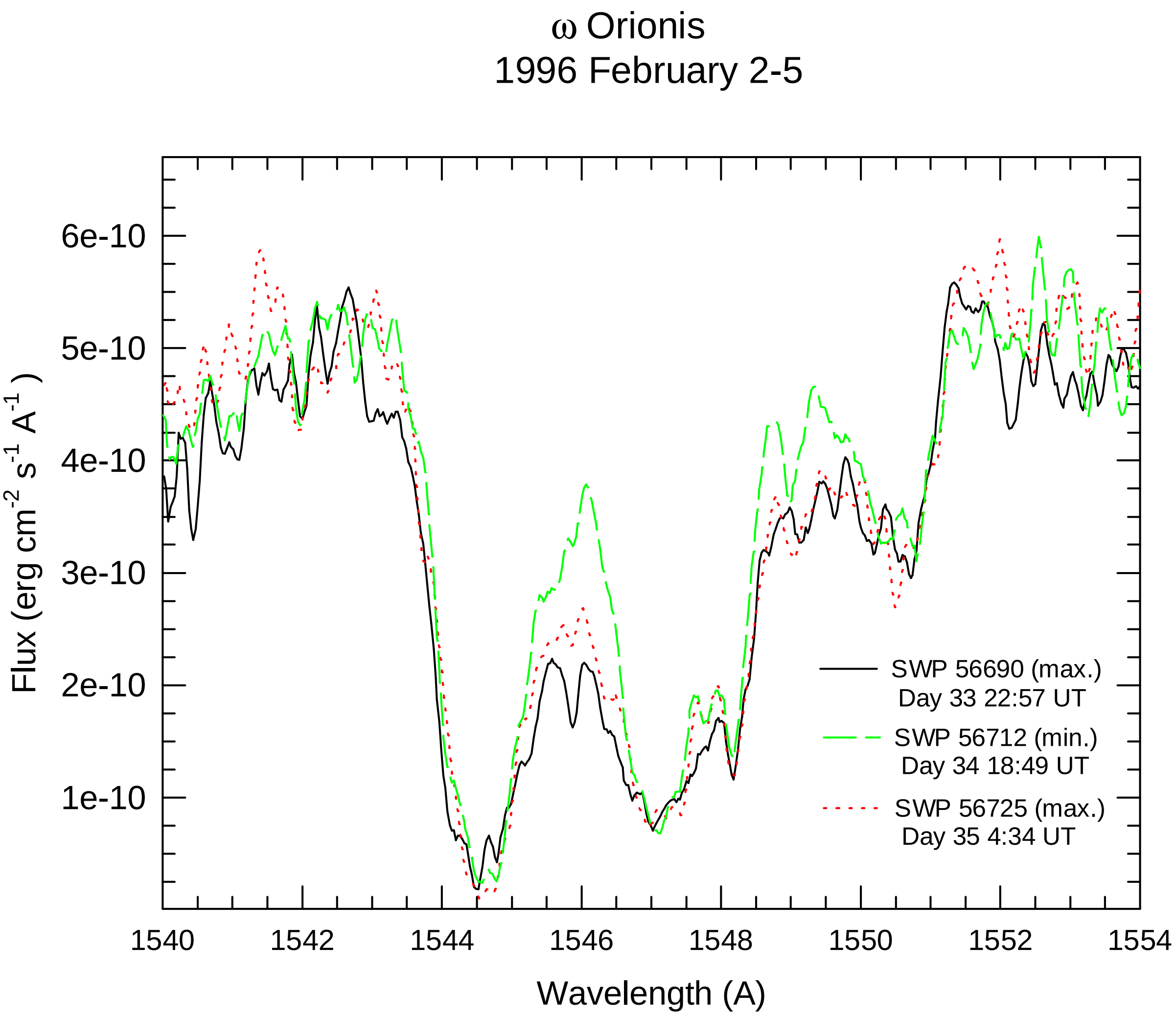

Fig. 2 - Representative C IV wind profiles observed at maximum and minimum FUV light.

5 than it was in January 1996 (e.g., %p/dp in the *B*-filter was 0.28/0.03 in January and 0.50/0.06 on Feb. 5). McDavid's polarimetry for this star during the past decade indicates that in "quiescence" a typical value for the *B* polarization is 0.10–0.14%.

From echelle spectra taken at the Ritter Observatory, Chris Mulliss observed the peak flux and EW of the Hα emission to steadily increase prior to and during the *IUE* run (e.g., I/I_{cont} and EW were 1.13 & -2.55 on Jan. 22, 1.19 & -2.75 on Jan. 30, 1.23 & -2.99 on Feb. 1, 1.24 & -3.21 on Feb. 3, 1.23 & -3.43 on Feb. 4, and 1.26 & -3.54 on Feb. 5). Chris also observed the He I lines $\lambda\lambda$5876, 6678 and reports that the V emission in He I λ5876 was stronger than the R emission during the campaign, contrary to the status in January when R > V or R=V. Of course our experience with μ Cen and λ Eri demonstrates that V/R changes in the He I emission can occur on a time scale of a few hours or less and it is usually the R emission that is most variable.

I have extracted the C IV, Si IV, and 1450Å spectral regions from the new *IUE* images and performed some initial analysis of the data. Plots of the C IV EW and the 1450Å flux versus time are shown in Figure 1. The results are interesting although the interpretation is not immediately obvious. The C IV wind line underwent a modulation of about 21% in a period of about 1.20 days. The depth of the second minimum was only about 75% that of the first and it was not as well-defined. Inspection of the C IV and Si IV profiles reveals that it was the portion of the wind between -330 to -530 km s^{-1} that varied NOT the DACs! The FUV flux at 1450Å (binned in 10 Å intervals) varied by only 9% and at best is weakly correlated with the wind strength. It should be kept in mind that σ is on the average 7% of the mean 1450Å flux! Representative profiles of the C IV wind lines observed at maximum and minimum light are shown in Figure 2.

The second *IUE* run (also 72 hours in duration) is currently scheduled for September 1996. As you most likely already know, *IUE* suffered a gyro failure in March & ESA will not support *IUE* observations beyond September. I have been informed that ω Ori can be observed with the one-gyro system, however. We invite members of the community to join our campaign. We are especially in need of ground-based spectroscopic, photometric, and polarimetric observations from observing sites that have a good distribution in longitude. If you are interested in participating in the September campaign, please contact any of the individuals mentioned above.

4.2. Preliminary Report of the 1996 Multi-Site and Multi-Satellite Campaign on γ Cas

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Because of persistent reports of variability in X-ray, UV, and optical wavelengths a number of TACs were persuaded to grant time to monitor the prototypical Be star γ Cas simultaneously. The breakthrough came with 14 orbits of nearly continuous HST/GHRS time to be granted to Richard Robinson and myself. This allocation made it easier for our colleagues to get time at various optical sites around the globe plus major successes in getting time with the XTE (X-ray Timing Explorer) and IUE satellites. Robin Corbet also requested that his allocation of 10 ksec with ASCA be scheduled at the same time.

For a while the schedule held together and was set for Jan 18-19, 1996. However, when the XTE launch was scrubbed at T minus 2 seconds on December 23rd, it no longer became possible to hang on to our January plans for XTE and HST time. This caused some of our plans to unravel. A decision was made to split the program in two. The optical and the IUE schedules were retained in January. The HST/GHRS and XTE schedules were reconfigured to March 14-15th (ASCA time could not be accommodated successfully within either). With hindsight, this was a good decision. For example the failure of the Gyro No. 5 on IUE in early March would have prevented us from obtaining any IUE coverage at all.

The optical campaign had the usual bad trends in weather except for the SW US. Doug Gies and David Gray were weathered out completely in the eastern US. During 1/18-19/96 Robinson and Smith had success at McDonald and Kitt Peak as did Hirata (Japan), Anand (India) and Howarth (LaPalma). On nights either just preceding or after 1/18-19 observers were successful in Japan (Hirata), LaPalma, Victoria (A. Reid), India, and Czech Republic (S. Stefl). Meanwhile the IUE obtained 32 spectra some of which were corrupted with the "159 DMU" anomaly to a still unknown degree.

To date I am aware of the McDonald, the McMath, Indian, and Czech data being substantially processed. These data show clearly the progression of the "migrating subfeatures" that have become the hallmarks of the line profile variations of the optical line profiles of γ Cas.

The HST and XTE data were carried out on a substantially simultaneous schedule (γ Cas was not in the Continuous Viewing Zone for XTE as it was for HST) on 3/14/96. In addition Stefl was able to cover the He I 6678Å line from the ground during the HST/XTE campaign. The HST/GHRS spectra were centered at the Si IV 1394-1403Å doublet. In order to include both lines and get rapid readouts, we relaxed our spectral resolution to 11,000 and obtained spectra every 1 second. The resulting spectra (1025 spectra) have an extremely high SNR and time resolution. They show features in both the photospheric and wind components. The migrating features seem to be visible in neighboring weak photospheric lines but perhaps not in the Si IV lines themselves. In addition to this surface-related activity, narrow absorption features occasionally appear at -200 km s^{-1} and accelerate into the primary DAC component over several hours.

We also obtained a light curve from a continuous flux "window" near the lines. We see two dips in the light curve, 1% and 2% deep, respectively, that are separated by about 10 hours. The Si IV photospheric lines deepen when the star is brighter, indicating the light dips are real and due to a temperature change. The overall period appears to be close to 24 hours, a period similar to the 23 hours I have derived from assuming the migrating subfeatures in optical lines are rooted on the star's surface. Low-degree NRP has not been reported in this star because there is no tell-tale variation in the lines' widths and velocities. If the light curve dips are due to a rotation period, if one assumes a $V \sin i$ of 350 km s^{-1} and an inclination of 45° (optical interferometery), then a stellar radius of 9-10 $R_\odot$ can be inferred. In any case now that we know what to look for, I invite interested photometrists to get busy and demonstrate the existence of a stable period in optical continuum flux!

5. PREPRINTS RECEIVED

B[e] Stars. II. MWC 349 A

Yvette Andrillat, Mercedes Jaschek, and Carlos Jaschek *A&A* (submitted)

We analyze spectroscopic CCD material obtained at the Haute Provence Observatory. We provide line identifications and equivalent width measurements in the wavelength region 3700-8790 Å. Over 300 emission features are identified and a comparison of our results with those of other authors is provided, as well as a table of all elements which have been identified in the object. The pattern of elements present is analogous to that of B-type stars, but some exceptions are noted, like the absence of C, Al and Mn.

We review the present knowledge of spectrum variability. The observations indicate that the equivalent widths of the lines of many elements vary by factors of up to two. We also provide a list of diffuse interstellar features observed. These features lead to an average (B–V) excess of about two magnitudes, which is less than what is expected for an object having an interstellar extinction of 10–11 magnitudes.

A Search for Multiperiodic Line Profile Variations in the Be Star 48 Lib

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A&A (accepted)
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High resolution, high signal-to-noise ratio CCD spectra of the Be-shell star 48 Lib allowed the investigation of rapid variability in the photospheric He I 4471 and Mg II 4481 lines. Though our sample was limited (51 spectra over four nights), 48 Lib has revealed itself to be a good candidate to display multiperiodic spectroscopic variations. Three frequencies, 1.86, 3.09 and 10.64 c/d, have been detected in the He I line and seem to be present in Mg II 4481 though this latter, strongly blended in its core with a marked shell feature, is not appropriate for this kind of study. The higher frequency 10.64 c/d has been deduced from a time series analysis with two methods and from a residual analysis. It has been associated with a $\ell = \mid m \mid = 8 \pm 2$ sectorial g mode in the frame of non-radial oscillation. We did not succeed in finding in our data the most probable photometric frequency 2.49 c/d, previously given by McDavid (1988) and Cuypers et al. (1989), and recently detected in the UV flux by Peters (1994), however this photometric frequency and the lower frequency seem to be mutually linked.

Atlas of High-Resolution Emission and Shell Lines in Be Stars. I. Line Profiles and Short-Term Variability

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A&AS, in press (accepted: September 25, 1995)
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We present an atlas of high-S/N, high-resolution ($\Delta v \leq 6$ km s^{-1}) data of Be star emission and shell profiles. We have collected profiles of Hα and of Fe II, mostly of the λ5317 transition. These lines have been selected to provide measures for the overall emission strength and for the velocity field in these disks. We have collected data for 77 southern and equatorial programme stars, covering the period 1982–1993. This is the most comprehensive overview of profile shapes in Be disks.

We propose a three-dimensional scheme in which most observed profiles can be classified. The parameters are (i) inclination, (ii) optical depth, and (iii) the pattern of the velocity field.

A search for short-term variability (timescales between five days and a few minutes) in six stars ended with negative result. Shortest observed timescale for variability is a few days for well-developed disks in binary systems (HR 1910, HR 2142).

The atmospheric variations of the peculiar B[e] star HD 45677 (FS CMa)

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We have studied spectra of the peculiar B[e] star HD 45677. Examination of the Balmer wings enabled us to determine a value of $\log g = 3.9$ indicating a possibly luminosity class V. The weak He I lines together with the Si II 4128 and 4130 Å doublet indicate a low rotation velocity in the order of 70 km s^{-1}, which is much lower than the previously claimed value of 200 km s^{-1} by Swings & Allen (1971). We have examined high-resolution profiles of the strong He I line at 5876 Å and found on one hand that we can explain the variation of the profile by the motions of clouds, some of which accreted. The Balmer lines on the other hand show the presence of an accelerated wind plus absorption by a disk seen edge-on.

B[e] Stars. I. HD 51585 (= OY Gem)

Carlos Jaschek, Yvette Andrillat, and Mercedes Jaschek
A&A (accepted)

We analyze CCD spectroscopic material obtained at the Haute Provence Observatory between 1990 and 1993, covering the wavelength region 3800–11000 Å. Three hundred twenty emission lines were measured and identified. Of these about 40% correspond to permitted or forbidden lines of ionized iron. Many forbidden lines (20% of the total) are present, including many classic nebular lines. We also provide a comparison of our results with those of other authors.

The equivalent width measurements permit to follow in detail the variations of the lines of several elements over the three years and to compare them to variations reported by other authors. On our material the largest variations correspond to helium, which varied by a factor of two and are not in phase with the variations of hydrogen. Many helium lines exhibit P Cyg type profiles, indicating strong outflow of matter from the star. The lines of other elements follow either the variations of the helium or of the hydrogen lines. The radial velocity varies over the years, with an amplitude of more than 60 km s^{-1}.

B[e] stars. III. MWC 645

Mercedes Jaschek, Yvette Andrillat, and Carlos Jaschek
A&A (accepted)

We analyze spectroscopic CCD material obtained at the Haute Provence Observatory. We provide identifications and equivalent width measurements in the wavelength region 3740-8790. About 350 emissions lines were measured and about 88% of them were identified. A comparison of our results with those of other authors is provided, as well as a table of elements identified in the spectrum of this star. The pattern of elements present is analogous to that of a late B-type star, but some exceptions are noted, such as the absence of Ne and Mg lines and the presence of K, Cu and Zr lines which appear usually in later type stars.

We review the little which is known concerning this object and we also present a quantitative account of the variations in equivalent widths. The observations indicate that the spectrum, is highly variable, so that in two different years only half of the lines appear on both spectra. Furthermore variations by at least a factor of two in the equivalent widths are present in many lines. The radial velocity derived from the emission lines (-76 km s^{-1}) corresponds to that of the shell which probably has a velocity of about 50 km s^{-1} with respect to the underlying star.

Long- and short-term variability in O-star winds I. Time series of UV spectra for 10 bright O stars

L. Kaper, H.F. Henrichs, J.S. Nichols, L.C. Snoek, H. Volten, and G.A.A. Zwartheod

An atlas of time series of ultraviolet spectra is presented for 10 bright O stars. The spectra were obtained with the International Ultraviolet Explorer during seven obeseving campaigns lasting several days over a period of 6 years. The UV P Cygni lines in 9 out of 10 studied stars exhibit a characteristic pattern of variability in the form of discrete absorption components (DACs) migrating through the absorption troughs on a timescale of a day to a week. This pattern is significantly different for each star, but remains relatively constant during the time span of our observations for a given star. A quantitative evalution of the statistical significance of the variabililty is given.

The winds of a number of stars appear to vary over the full range of wind velocities: from 0 $\mathrm{km\,s^{-1}}$ up to velocities exceeding the terminal velocity v_∞ of the wind as measured by the asymptotic velocity reached by DACs. The amplitude of variability reaches a maximum at about 0.75 v_∞ in the unsaturated resonance lines of stars showing DACs. In saturated resonance lines we find distinct changes in the steep blue edge. This edge variability is also found, although with smaller amplitude, in unsaturated resonance lines. The subordinate line of N IV 1718 in ξ Per shows weak absorption enhancements at low velocities in the blue-shifted absorption that are clearly associated with the DACs in the UV resonance lines.

We interpret these three manifestations of variation as reflecting a single phenomenon. The DACs are the conspicuous form of the variability. The changes at the edge can often be interpreted as DACs, but superposed on a saturated underlying wind profile; in many cases, however, at the same time two or more absorption events in different stages of their evolution can be identifed in the unsaturated profiles, hampering a detailed interpretation of the edge variability. The low velocity absorption enhancements in the subordinate lines are the precursors of DACs when they are formed close to the star.

The constancy of the pattern of variability over the years and the (quasi-)periodic recurrence of DACs strongly suggest that rotation of the star is an essential ingredient for controlling wind variability. The observation of low-velocity variations in subordinate lines, which are supposedly formed at the based of the stellar wind, indicate an origin of wind variability close to or at the photosphere of the star.

The Atypical Be/X-Ray Pulsar X Persei

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The Be star binary X-ray pulsar was observed by ASCA on two occasions in 1994 (23 February and 4 March). The intrinsic source luminosity in the 0.4-10.keV energy band is $\sim 5 \times 10^{34}$ ergs s^{-1}. The spectrum can be described by a power law with an exponential cutoff at higher energies. However, the value of the cutoff energy, which is much lower than the canonical value seen in the other binary pulsars, is variable and correlated with the photon index. The present observations also reveal for the first time the presence of a soft blackbody emission from the neutron star surface. The features can be naturally explained if the accreting gas is thermalized in a strong collisionless shock a few stellar radii above the surface of the neutron star. The radition, which is mainly dominated by cyclotron line emission, originates over a range of magnetic field values, giving rise to a variable photon index and cutoff energy. The X-ray emission emerges in a fan beam, part of which is reprocessed by the neutron star surface as a soft blackbody component. The timing analysis shows that the spin-down episode since 1978 is continuing and a pulse period of 839.629 sec was obtained.

Dynamic Processes in Be Star Atmospheres. IV. Common Attributes of Line Profile "Dimples"

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"Dimples" are transient central absorption features flanked by weak emissions commonly seen in the He I λ6678 line profile of the mild B2e star λ Eri. Smith and Polidan have found that these features can be reproduced with a model in which line photons are scattered within an optically thick (in the line) slab elevated over the surface of a rapidly rotating star. We have undertaken a series of simultaneous He I multi-line observations of this star at the McMath, McDonald, Lick, David Dunlap, and Ritter observatories to search for dimples in weak blue He I lines when they appear in λ6678. Four dimples were found during 15 hours of multi-observatory monitoring. In three cases a dimple was observed in a weak blue line of the same absorption series as λ6678. In the fourth instance, a dimple was observed only in λ5876 and λ5015 lines which, like λ6678, are strong and have weak wings. A joint IUE/optical campaign demonstrated that the He II λ1640 line shows weak emission just as new dimples appear in the λ6678 line.

Our observations confirm a previous report that dimples appear in the λ6678 line of four other Be stars. We also find that the resonance C IV double weakens when dimples appear, a result similar to that found for λ Eri. Our data also disclosed that "migrating subfeatures" similar to those found in γ Cas are present in the λ6678 line of the B5 star HR 1011. These features appear to be a more vigorous form of dimple activity than observed in λ Eri and other mild Be stars. These findings lend strong support to the slab model for the dimple phenomenon. They also suggest that this activity is endemic to the class of mild Be stars. The appearance of dimples in the weak blue He I lines suggests slab masses of at least 6×10^{-13} $M_\odot$ for most dimples.

The greatest enigma that characterizes classical Be stars is their highly variable and episodic mass loss histories. Our estimates of dimple-slab masses are high enough that this problem may be removed if the magnetic paradigm for Be activity is correct. In this picture exospheric flares trigger explosive ablations of plasma from the upper photosphere. The evaporated mass is trapped by overlying closed magnetic field loops where it cools, taking on characteristics of prominence-like structures. If the loops were opened for any reason, this mass would be free to escape from the star at a rate consistent with mass loss rates during active Be episodes. Then the essential difference between Be stars in active and inactive phases would be understood not as a difference in their mass release rates but rather in the prevailing geometries of their surface fields.

Rapid photometric and spectroscopic variability of the Be star DX Eri

S. Štefl and L. A. Balona
A&A (accepted)

We present results of nearly simultaneous monitoring of uvby light and He I 667.81 nm line-profile variations of the equatorial Be star DX Eri in November 1991. They are analyzed along with numerous *uvby* photometry in the period 1986 - 1995.

The brightness of DX Eri varies on three distinct time scales. The time scales of the rapid- and medium-term variations differ by a factor of ten and can only be separated if the time resolution is sufficiently high and if the phase is well covered. Our data meet these conditions on four observing seasons. The period of the rapid variation derived from data spanning almost ten years is 1.267080 d. Due to the complex nature of the variability, we cannot decide whether the period is secularly stable on a time scale of years or whether it varies within a few per cent from season to season. The light curve is slightly non-sinusoidal with a shallow light maximum at approximately $0.^P50$ after light minimum. It has an average peak-to-peak amplitude of $0.^m08 - 0.^m10$ in all passbands. The $u-b, c_1$ and $b-y$ indices vary with the same period but with amplitudes lower than $0.^m05$ and varying from season to season. The m_1 index is constant within the errors. The star is bluest in $u-b$ near light maximum.

The radial velocity (RV) of He I 667.81 nm, as measured in the line wings, exhibits a sinusoidal variation with a period which is the same as the photometric period of 1.26 d and with an amplitude of 42km s^{-1}. The first moment of the line profile has a somewhat lower amplitude and larger scatter. More data of better quality are needed to confirm the phase-dependent variations of equivalent width, FWHM and line depth of He I 667.81 nm. The shape of the RV curve differs significantly from the light curve. The RV minimum occurs at $0.^P20$ and the maximum at $0.^P65$ after light minimum.

The light and low-order line-profile variations are compared with those of η Cen (Štefl et al., 1995). The observations are discussed in terms of non-radial pulsation, rotational modulation and binarity. None of these models is able to explain the observed light, colour and radial velocity amplitudes.

The formation of rapidly rotating B-type stars in general, Be stars in particular, through close binary evolution, in the Galaxy and in the Magellanic Clouds.

J. Van Bever and D. Vanbeveren

Using recent evolutionary computations of intermediate mass close binaries we estimate the number of B-type binaries with subdwarf companions, white dwarf, and neutron star companions in regions of continuous star formation and in starburst regions, in the Galaxy and in the Magellanic Clouds. Linking possible fast rotation of the mass gainers in interacting binaries to the formation of disks during mass transfer, we further predict the number of fast rotating B-type stars formed through close binary evolution. We then critically evaluate the observed rotational velocity distributions of Be stars, Bn stars and 'normal' B-type stars. We conclude that on the average Be (and Bn) stars rotate at 75 % of their break up velocity whereas there are at least as many 'normal' B-type stars with the same rotational velocity distribution as Be and Bn stars. Comparison between the theoretically predicted and observed number of rapid rotators in general and Be stars in particular, in regions of continuous star formation and in starbursts in the Galaxy and in the MC's forces us to conclude that only a small percentage of all Be stars is formed through close binary evolution, i.e., less than 10 % and possibly as low as 3 %.

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7. MEETINGS

- 8-12 July 1996
  Variable Stars and the Astrophysical Returns of Microlensing Surveys, (12th IAP Astrophysics Colloquium/EARA Astrophysics Meeting), Paris, France.
  Contact: Mme Colette Douillet at IAP. Email: iapcoll@iap.fr-or-17649::iapcoll. WWW: http://www.iap.fr/

- 13-17 January 1997
  Fundamental Stellar Properties: The Interaction Between Observation and Theory (A Meeting to Mark the 80th Birthday of Emeritus Prof. R. Hanbury Brown), University of Sydney, Australia.
  Contact: Dr. A.J. Booth, School of Physics, A28, University of Sydney, NSW 2006, Australia. Tel: 61-2 351 3849 (please note (61)-2 9351 3849 from August 1996). Fax: (61) -2 660 2903 (please note (61)-2 9660 2903 from August 1996)

- 16-20 June 1997
  A Half Century of Stellar Pulsation Interpretations - A Tribute to Arthur N. Cox, Los Alamos, NM. Contact: Joyce A. Guzik, Los Alamos National Laboratory.
  E-mail: `joy@lanl.gov`.

- 18-30 August 1997
  XXIIIrd. General Assembly of the International Astronomical Union, Kyoto, Japan.
  Contact: Constanze la Dous. E-mail: iau@iap.fr

See WWW site `http://cadcwww.dao.nrc.ca/meetings/meetings.html` for more.

8. LATEX TEMPLATE FOR ABSTRACTS

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