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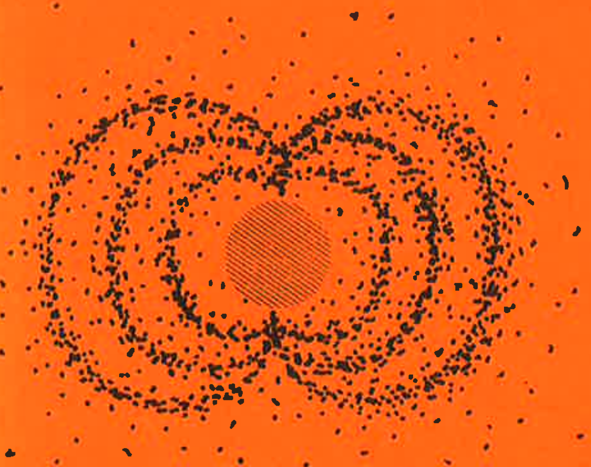
Be STAR NEWSLETTER



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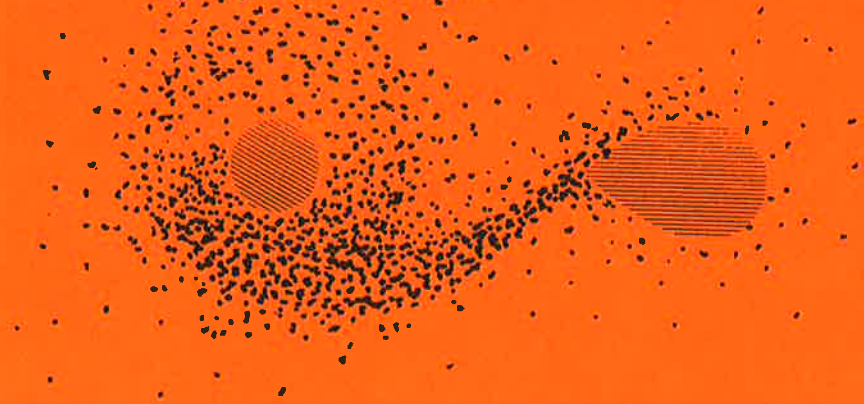

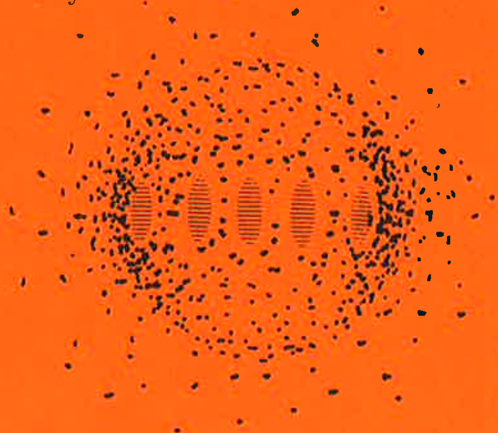

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The Be Star Newsletter is open to all contributions concerning early-type stars. Please send manuscripts and all correspondence to the editor's address given on the front page. In the case of very urgent late contributions directly contact the technical editor via one of the fast links listed below. The Newsletter is distributed free of charge to all astronomical institutions which request it. If you wish that the Newsletter is also received at your institute, write to the technical editor:

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EDITORIAL

* * * * *

As promised in the last issue of the *Newsletter* we are publishing this special issue prior to the forthcoming IAU General Assembly in Buenos Aires. Included are the ballot for the election of the new Scientific Organizing Committee for the Working Group on Be Stars and additional timely information on meetings to be held during the general assembly. You will also notice that a new section has been introduced which I call "What's Happening?". This section has replaced the former "Observations ... Theoretical Support Wanted/Available" and is meant to be broader in scope. We anticipate including short items announcing on-going research and stars that are most frequently being observed whether or not there is interest in seeking additional data or collaborators. Let me know if you like the new format, and I look forward to receiving contributions.

I would like to thank those who sent contributions and helped with the compilation of the bibliography. Some papers may not have been cited due to the tight publication schedule of this issue, but we will include them in the next *Newsletter*. However please call our attention to any omissions.

Our *invited* contributions in this issue present the views of leading advocates of each of the two foremost competing models that have been offered to explain the phenomenon of short-term (*rapid*) variability in Be stars. Each author has read the other's paper, and has had a chance to offer rebuttal either separately or by revising his original paper. Compelling arguments have been presented on each side and it is clear that a definitive consensus on a model will not occur in the near future. In addition from another paper in this issue it appears that a discrepancy has been uncovered: the $H\alpha$ emission in Be stars is systematically smaller than implied by the IR excess, if the IR emission is due to free-free and bound-free transitions. We expect to hear more about this in future issues of the *Newsletter*.

Since we hope to publish the third issue of the *Be Star Newsletter* for 1991 in mid-November, please send contributions for Issue N° 25 by:

October 15, 1991

Lengthy contributions should be submitted in a camera-ready format (see papers in the current issue or Issue N° 14, p. 3 for style), but for short communications let me recommend Electronic Mail (SPAN-CYGNUS::PETERS, 5546::GPETERS, ASTRON::GPETERS), Fax (telephone number: 213-740-6342), or telex (4720490 USC LSA). Please note that our Fax number has been changed and that the Internet address given in previous issues of the *Newsletter* continues to be inoperative. In addition my telephone number has been changed to: 213-740-6336.

I look forward to seeing all of you at the IAU General Assembly in Buenos Aires, and hope your summer is happy and productive. I would like to thank the European Southern Observatory for their continued financial support.

Gerrie Peters, Editor

*****

We are now rapidly approaching the time of the IAU General Assembly in Buenos Aires. Among many other things this also implies the election of a new Organising Committee (OC) for our Working Group. On the last page of this issue of the Newsletter a ballot form is provided for those of you who will *not* be able to attend the meeting of the Working Group in Buenos Aires.

Everyone with an active research interest in Be- or closely related stars is eligable to participate in the ballot. There are no formal candidates. You can nominate up to seven people who you would think most suitable to represent the Working Group. It is not possible to name one person more than once. The seven people who have received the largest number of votes will be considered elected and determine the chair person from among them. If you permit me to so, I would like to suggest that you use the possibility to vote for several people so that a reasonable balance between both different geographical and scientific domains is achieved.

It is a good practice not to let OC members serve more than two consecutive terms. Accordingly, D. Baade, V. Doazan, J.M. Marlborough, and G.J. Peters cannot be re-elected for the 1991-1994 period. We use this opportunity to thank Vera, Gerrie, and Mike for their long and dedicated efforts to support the Working Group in many matters! Furthermore, the present OC finds it useful that the editor of the Newsletter should be member of the Organizing Committee ex office. Presently this means that although she cannot be re-elected, Gerrie Peters will remain member of the OC. All members who are now leaving the OC will of course be available for consultations if desirable. Present members of the OC who are only completing their first term and, therefore, can be nominated again are L.A. Balona, J. Dachs, and J.R. Percy.

Please make sure your ballot form arrives in Garching on July 19th at the latest so that I can take it to Buenos Aires. Some of you may find it difficult to meat this deadline. Gerrie Peters and I therefore sincerely apologize that for a number of reasons we were unable to produce this issue of the Newsletter any earlier.

The OC has begun to define format and scope of the next IAU-level meeting. A second iteration will probably take place in Buenos Aires where also first contacts to potentially interested other groups will be established because the general consensus is that such a meeting should by no means be restricted to Be stars only. This topic could also mark the transition zone between the business and the scientific part of the meeting of the Working Group in Buenos Aires.

The preliminary schedule for the General Assembly shows this meeting to take place on July 30th. But please check the final schedule for any changes. After the business meeting which I shall try to limit to half an hour, the remainder of the total of two times 1.5 hours will be devoted to subjects of more immediate scientific interest. This part of the meeting will be organised by Luis Balona. You can find an announcement by him in this issue of the Newsletter.

This issue of the Newsletter and the meeting in Buenos Aires also mark the end of my 'official' work for the Working Group. This work was made rather easy because I could rely on much support. Arne Slettebak as the previous chairman of the OC provided valuable advice in the beginning. As did the members of the OC at all times. Most important has been the Newsletter without which the Working Group might not exist at all. This issue happens to be the tenth issue edited by Gerrie Peters - a nice jubilee she deserves to be congratulated on. The most valuable feature of the Newsletter has been the bibliography which has been compiled by Anne Marie Hubert, Jun Jugaku, Pavel Koubský, Gerrie Peters, Mare Ruusalepp, and Arne Slettebak for so many issues that I did not attempt to count them. On behalf of all members of the Working Group I thank these colleagues and all those who could not be named individually for their engagement for the interests of the community. It would be nice if the new OC found equally much support, perhaps also by some new people.

I hope that many of you will have the possibility to come to Buenos Aires. I am looking forward to see you there. Have a good trip!

Dietrich Baade

*****

ROTATIONAL MODULATION IN Be STARS[1]

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Be stars are active. This statement is self-evident to anyone familiar with the subject - it is what makes these stars so interesting. The activity occurs on time scales of hours to years and is evident in the line profiles and light variations. While some of this activity occurs in the circumstellar envelope, it is clearly driven by events in the star itself. It is fair to assume that much of this activity is localized on or above the photosphere. Since the active areas, whatever they are, are bound to differ in surface brightness from their surroundings, it follows that there is a non-uniform distribution in surface brightness. As the star rotates, the integrated brightness from the visible hemisphere changes, leading to a periodic variation in light. This is the essence of the rotational modulation (RM) model. We see that it follows logically from the known fact that Be stars are active. Indeed, one cannot escape the logical consequence of RM unless one assumes that the activity is at all times cylindrically symmetric, that it is at too low a level to be observed or that the active areas are too small and too numerous to be visible in integrated light.

When I first started photometric observations of these stars, I found it quite natural that so many Be stars were periodically variable, particularly since the periods were more or less what one expects for the periods of rotation. Spectroscopic observers, on the other hand, began seeing nonradial pulsations (NRP) because the line profile variations resembled in all respects those seen in other stars where NRP is thought to occur; to them this was a natural explanation as well. This is the controversy. In this article I will explain why I believe RM is the correct interpretation and why I feel the NRP model needs to be abandoned.

In searching for the underlying cause of the Be phenomenon, we look for effects which are peculiar to Be stars. For example it is well-known that, as a group, the Be stars are rotating considerably faster than non-Be stars. Rotation must play an important role in enhancing the mass loss rate. Another characteristic of Be stars, which is not so well known because it was discovered only a few years ago, is that they exhibit *low-order* line profile variations. I stress the word low-order because high-order line profile variations (moving bumps) are also found in non-Be stars. Low-order line profile variations with periods of about one day are only found in Be stars. This was discovered by Penrod (1986). The low-order line profile variations and the periodic light variations are different aspects of the same physical mechanism. High-order variations may or may not be caused by the same mechanism, but they clearly do not play a major role in the Be process.

Over the past five years, my colleagues and I at the SAAO and Jan Cuypers at ESO have been collecting data on the periodic light variations of a moderately large sample of bright Be stars. In any one season, every star was observed intensively, sometimes for as long as a month at a stretch but always for a minimum period of two weeks. Also, most stars were observed for at least two seasons. In this way we were able to extract much information regarding the low-order variations (photometry is not sensitive to the high-order variations). The analysis was published by Balona (1990). One of the things we were keen to do was to search for evidence of multiperiodicity, a hallmark of NRP. Nearly all Be stars showed irregular variations (flickering) characteristic of an active star, but no coherent variations were found besides the basic period. This always remained unchanged season

[1]One of a series of invited contributions currently appearing in the *Be Star Newsletter*.

after season. Perhaps the most important outcome of this analyses was the demonstration that the photometric period and the rotational period do not differ by more than 7 percent (r.m.s. error). This has a rather interesting implication for NRP as we will now explain.

Let us assume that the pulsation period is precisely the same as the rotational period. To an observer rotating with the star, the period is infinite and the pulsational velocity is therefore zero. It is doubtful whether NRP is a useful concept in this case because this is nothing more than a permanent distortion or a stationary non-uniform surface brightness distribution. This is merely a description of the "starspot" model. Supporters of NRP will say: "we accept that the pulsation period is close to the period of rotation - but you have not shown it is precisely the same." Of course, no matter how accurately one might measure the two periods, one can always claim that they are different.

Let us assume that the difference is 10 percent (I take this value for convenience; the argument will not be significantly altered if a larger value is used). For a typical period of one day, the pulsation period in the rotating frame will be ten days. Assuming that the star has a radius of 5 solar radii, the phase velocity of an $m = -1$ mode will be 25 km s^{-1}. If the pulsation amplitude is 0.1, the pulsational velocity amplitude is no more than 2.5 km s^{-1}. The observed radial velocity amplitude is found by integrating over the visible hemisphere and will be even less than this. Two well-known Be stars λ Eri (Bolton 1981) and 28 CMa (Baade 1982) have been observed with $2K = 50$ and 80 km s^{-1} respectively. It is quite clear that the pulsational velocity is unable to account for these high amplitudes. If NRP is correct, the line profile variations must be dominated by the temperature perturbation; the pulsational velocity plays a very minor role. In other words, it is not going to be possible to discriminate between the NRP and starspot models with the techniques available at present. Also, the pulsation parameters which have been derived in the past are incorrect because the effect of temperature perturbations have been ignored.

For me, one of the most convincing pieces of evidence in favour of RM is a serendipitous observation of κ CMa made some years ago (Balona 1990). It shows the star in a relatively quiescent state for a few nights followed by a sudden steep rise in light and a gradual fading, all in the space of one month. What is so interesting is that short-period variations are visible immediately after the outburst and die away shortly after the star has reached maximum light. This is easily understood in terms of a flaring event being carried around by rotation. In terms of the NRP model one has to assume the sudden onset of pulsation followed by an equally sudden stopping of pulsation all within four days!

In parallel with the SAAO/ESO photometric survey, I have been monitoring 4 Be stars in the cluster NGC 3766 with the intention of studying the long-term behaviour of the short-period variations. The shapes and amplitudes of the light curves change markedly from season to season and even on a time scale as short as one week; yet the period is very stable. Furthermore, there is a high degree of phase locking, i.e. a prominent feature of the light curve such as a maximum or minimum remains in phase even after the amplitude has passed through zero. To me this is indicative of a very stable clock. On the other hand the frequency spectrum for NRP is so dense that I find it difficult to understand why there is no period wandering. After all, period wandering and mode switching seems to be a rule for the 53 Per stars.

It is known that about half the periodic Be stars (I call them λ Eri variables) show double-wave light curves. I interpret this as evidence for the presence of a large-scale dipole magnetic field. Quite possibly, it may be just the presence of a weak magnetic field which is at the heart of the Be phenomenon. Some support for this view comes from Poe & Friend (1986) who found that a combination of magnetic field and rapid rotation is able to account for the enhanced mass loss rate in Be stars.

In conclusion, I find the concept of NRP to be superfluous in stars which are quite clearly active and for which RM is expected. Furthermore, the proponents of NRP must accept the result that their model is observationally indistinguishable from a starspot model. Whether a starspot model is adequate for explaining the large ratio of radial velocity amplitude to projected rotational velocity in 28 CMa and other stars is open to doubt. A top priority for all observers is to obtain simultaneous line profile and photometric observations so that this can be tested. I believe that the NRP/starspot model has too many shortcomings and that the true picture involves a magnetic field. In particular, I find a model in which the short-period variations are caused by obscuring matter trapped into co-rotation by a magnetic field very appealing.

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VARIABILITY IN Be STARS: SURELY NRP AND NOT RM[2]

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The 1980's were certainly kind to our understanding of "classical" early-type Be stars: from the launch of the *IUE*, to the establishment of monitoring campaigns, to the development of new detectors that show variability over a range in timescales of at least three million. The challenge now is to separate the periodic and nonperiodic signals over various timescales and to compare these behaviors in different wavelength ranges. I believe that the short timescale (<1 day) variations in Be stars arise from at least two independent processes, chaotic surface magnetism (which may account for the ejections themselves, photometric flickering, spectral line transients) and nonradial pulsations (NRP). I believe the latter to be responsible for periodic line profile and light variability in most Be stars. The demonstration of the existence of either process is not an argument for the absence of another.

Except for this paragraph, I will focus on the current NRP vs. rotational-modulation (RM) controversy. Work by Bolton *et al.* (1987) on Hα variations in σ Ori E, as well as Hα behavior of active late-type stars such as the dKe variable AB Dor (Collier-Cameron and Robinson 1989) provides convincing evidence that orbiting lobes explain the variability of these stars but NOT Be stars. Corotating lobes around these types of stars (which incidentally are associated with RM-spots on the stellar surfaces) produce well-defined modulations of Hα but only modest changes in the continuum flux. This difference is a consequence of the large ratio of line-to-continuum opacity, $>10^4$. Thus, we can expect to see the effects of a corotating lobe from Hα modulations first. Actually, Hα variations of active Be stars are found not to be periodic (Baade 1991) over relevant timescales, even in previously claimed cases.

The excitation of NRP in at least some B stars is widely accepted. The basic supporting arguments are: (1) the close spacing of modes in several β Cephei variables, (2)(related to #1) the observations of multiperiodicities, especially the discovery of closely spaced modes in several Southern B stars (Waelkens *et al.* 1991), and (3) the success of NRP models in explaining long sequences of line profile variations (LPVs). Two more detailed supporting arguments come from the comparatively well-studied B0.7 III star ϵ Persei. In this star Smith, Fullerton and Percy (1987) found consistency between photometric and spectroscopic amplitudes. Moreover, Gies and Kullavanijaya (1988) demonstrated a neat sequence of modes having $-m,\ell = 3, 4, 5, 6$. Also, the LPVs of the prototype star 53 Per are so large compared to rotational broadening (a factor of 3 in width) that a vector velocity field must be at work. Finally, although selection effects still mar the evaluation of a representative sample of NRP B stars, it is clear that the same types of periods and mode descriptions can be used to describe light, color, RV, and LP variations over a continuous range of $v \sin i$ -- including Bn stars that rotate as rapidly as Be stars (Penrod 1986, 1987).

The study of NRP in several types of stars has uncovered unexpected properties of NRP itself. Some of these "oddities" were found among the B stars first. Examples include the excitation of single *m*-states in what should be a rotationally-split multiplet, periods much longer than the radial fundamental, isolated modes in a period range, high degree modes, and mode-switching or period wandering. Most of these characteristics have been found in certain NRP white dwarfs (PG1159+35; Winget *et al.* 1991), (ro)Ap (Kreidl *et al.* 1991), and δ Scuti stars. Although the NRP interpretation has been criticized both for having highly stable and unstable periods (!), examples of both behaviors can be found in even the same comparatively well understood NRP white dwarf (G29-38; Winget *et al.* 1990). Nonlinear effects also complicate the interpretation of certain large-amplitude NRP stars (ϵ Per), just as they do among Cepheid-strip variables, semiregular red supergiants, and β Cephei stars. The NRP interpretation for Be stars is particularly problematical because so far there is no clear-cut case of multiperiodicity among low-degree modes (Cuypers 1991). This is indeed "irritating" for the NRP advocacy. On the other hand, it is increasingly clear in several classes of NRP

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[2]One of a series of invited contributions currently appearing in the *Be Star Newsletter*.

variables that rotation plays a role in the channeling of NRP energy into single modes. Also, the presence of high-degree modes, which cannot at all be described by spots (unless they are highly elongated and pointed toward the poles), is a strong argument that the two types of line profile phenomena have a common cause, NRP.

Another problem with the NRP interpretation affects B stars with long periods, including Be stars. That is the competition of NRP-induced modulations in velocity and temperature. For line profiles one must consider two separate temperature effects (changes in the continuum flux level and changes in the atomic occupation levels) as well as a probable microturbulence variation. Contrary to some statements in the literature, it is possible to distinguish velocity from temperature "spots". For example, the periodic variation of the wavelengths of the profile "footpoints" at the approach to the continuum suggest very strongly the presence of pulsational velocities. Otherwise, discrimination between velocity and temperature spots requires careful planning. So far the right set of clear skies and observing techniques (photometry and spectroscopy on lines with different temperature dependences) haven't been assembled to do this job. A related problem concerns the evaluation of horizontal and vertical NRP velocities; in some regimes thermal variations from the two velocities cancel, and NO light variations are produced. The greatest uncertainty in evaluating these effects is the stellar radius, which enters in determining the pulsation frequency in the star's corotating frame. The uncertain sin *i* factor enters the NRP equations along with the radius.

The R_* and sin *i* factors are so uncertain that one can lead to radically different qualitative interpretations. As an example, let us take the issue of "excess NRP horizontal velocities" that Luis Balona brings up in the companion article on our mutually favorite Be star, λ Eri. My choice of different numbers in his example leads to very different conclusions. I take the directly modeled NRP velocities, and not RV amplitudes, for the putative $\ell = 2$ NRP mode in this star (3 km s^{-1}) and combine them with Peters's (1991) results from *IUE* observations and Lee *et al.*'s (1991) results from LPV modeling that velocity effects are less important than temperature effects in a rapidly rotating B star. This indicates that the likely NRP horizontal velocity is only about 1 km s^{-1}. Combining this result with the corotation period (assumed from a radius of $6R_\odot$ and a sin *i* near unity), I determine a corotating-frame period of only 1.6 days and a fluid displacement during a NRP cycle of $0.02R_*$. This is a reasonable result from the NRP model. Moreover, for a long period the photometric variation produced by a NRP mode can be estimated roughly as the difference between the horizontal and vertical displacements, or (2% - 1%). Observations indeed suggest that 0.01 mag is a typical amplitude for λ Eri.

A related issue is Balona's (1990) impressive correlation between *v* sin *i* periods and photometric periods, the P(rot) - P(var) Diagram for Be stars. An unavoidable ambiguity arises over how to treat double- and triple-wave variables on this diagram. Additionally, we already know that if NRP is the correct explanation for "traveling bumps" on the line profiles of Be stars that rotational advection is the cause for most of the motion of the bumps. In the NRP picture, the equatorial waves responsible for the bumps progress in a retrograde direction, so we observe the net result of wave advection that is larger than the NRP motions with respect to an anchored point on the surface. The issue then becomes which R_*/sin *i* to select choose for Be stars. Errors in estimating the radii of Be stars are 20% or so (cf. Harmanec 1991), and herein lies the difference between Luis's interpretation of this diagram and my own. For a very few stars, perhaps one can derive good estimates of R_*/sin *i*. The most recent calibration of radii for B main sequence stars comes from Wolff's (1990) study of cluster C-M Diagrams. Let us take her results and apply them to our paradigm, λ Eri, to demonstrate the problem with RM, since λ Eri is a point on Balona's P(rot) - P(var) Diagram. Applying Wolff's calibration to a star of λ Eri's colors, one can fix its radius as $5R_*$ if its age is 1×10^7 yrs, or $6R_*$, if its age >1.5×10^7 yrs. (Harmanec's (1991) calibration brackets this same range.) The younger age seems a little low, for λ Eri does not have a high space velocity nor is it a member of a young association. Moreover, contrary to Balona, Sterken, and Manfroid (1991), I take the sin *i* of this star to be about 1, not π/4. (Smith, Peters, and Grady (1991) have shown a near equator-on geometry can best explain the disappearance in early-1988 of self-absorption in λ Eri's Hα emission profile as a consequence of an ejected disk/ring "clearing" the projected disk.) Combining these estimates, $R_* = 6R_\odot$ and sin *i* = 1, one finds a significant difference between the star's variability period and this estimate of its rotational period, which are 16.84 hr and 23 hr, respectively (cf. Peters 1991). To summarize, for targeted examples on this diagram, it does not appear that RM fully explains the observed light, RV, and LP periods of Be stars. The evidence favors the "spots" moving across the star.

There is an interesting characteristic of the light curves of single-wave Be stars that seems to challenge the RM hypothesis and yet which can be explained by a quasi-sinusoidal NR oscillation. This is the fraction of the cycle over which the light is below the light maximum plateau. Consider a quasi-stable "starspot" fixed to the star's surface, which, if Bp stars are a guide, is probably a DARK spot. Then if the spot is small and near the equator, the "dimming fraction" of the cycle may only be 40-50%, because of limb darkening and spot occultation behind the limb. If one selects typical examples of Be light-variables (and eliminates the double-wave occurrences), then one finds among Ahmed #1, #15, #240 in NGC 3766 (Van Vuuren *et al.* 1988, Balona *et. al.* 1991), 48 Lib (Cuypers 1991), o And, and LQ And (Stagg *et al.* 1988) that the "dimming fraction" of their cycles is in the range of 60-75%. For all these fractions to be >50% would require a highly unlikely series of circumstances. There are two ways out of the dilemma. First, one can imagine a spot to be at an intermediate latitude on the near-hemisphere on a star tilted with respect to the observer, so that it is visible most of the time. Alternatively, one can imagine the spot to be elongated in the azimuthal ("E/W") direction. The amplitude of the photometric variations places rigid constraints on the first option because the spot is seldom close to the disk center. Moreover, for each such case there should be complementary case for which the spot is on the "lower" hemisphere, which would produce a small dimming fraction once again. The second way out of the dilemma could be decided by profile monitoring of these particular stars. If as is true for other LPV B-stars the profile bumps turn out to require models of "spots" elongated in latitude (Vogt and Penrod 1983), rather than longitude, then it is unlikely that the second alternative is viable. Finally, Stagg *et al.* have noted that a 24 hr change in the light curve of EW Lac, which is difficult to explain by a starspot or anchored magnetic loops.

The Germans have a saying, "the Devil lies in the details." It appears that nothing less than the understanding of nitty-gritty details as these can decide whether the NRP or RM picture is correct; perhaps the answer is either in different stars. Because there is evidence both for NRP and chaotic magnetic field structures, I believe that the two can coexist on some Be stars. We know that RM-producing spots exist on some peculiar B variables. It would not be surprising to find that they exist on a minority of classical Be and Bn stars as well.

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VARIABLE DENSITY STRUCTURE IN THE BETA PICTORIS CIRCUMSTELLAR GAS[3]

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HST GHRS spectra of the candidate protoplanetary system β Pictoris obtained in January and February 1991 gave an unprecedented look at both the velocity and density structure of the gas within 1-2 AU of the star. In addition to the high density gas, two resolved low-density ($n<10^3$ cm^{-3}) components were detected at 10.3 and 27: km s^{-1} (Boggess *et al.* 1991). The velocities of these features did not agree with the predicted velocity of features associated with the local interstellar wind (Crutcher 1982), suggesting that some of this material might be circumstellar (CS) rather than interstellar. We have explored the possibility that variation in the 10.3 km s^{-1} feature, which is well resolved from the higher velocity absorption in the GHRS echelle data might be detectable at the S/N and resolution of *IUE* high dispersion data. Our analysis suggests that the shift in velocity centroid, and change in equivalent width is marginally detectable (2σ) in *IUE* data.

Based on our numerical experiment, we searched for archival *IUE* spectra obtained at times when there was a) minimal high-density absorption at low velocities, and b) the star was well centered in the *IUE* large aperture, ensuring that the radial velocity scale of the *IUE* data from one spectrum to another is accurate to 4-5 km s^{-1}. Two *IUE* spectra obtained in 1986, LWP 7918 and LWP 8132, meet these criteria. After reprocessing to ensure uniform handling of the data, we find:

1. No significant variation at the transition of Fe II (UV63) at 2739.546 Å, implying that the high-density ($n\sim10^8$-10^9 cm^{-3}) gas did not vary during the study period.

2. Significant variation in Fe II (UV1) 2599.396 Å in the velocity range 10-25 km s^{-1} which was not seen in the lines at 2598.37 and 2607.086 Å, implying that the variable gas had densities below 10^3 cm^{-3}.

These results suggest that in addition to high-density gas which is close to the star, β Pictoris may be surrounded by a low-density envelope. If we use the GHRS data obtained on 12 January 1991 to estimate a typical column density of such gas, we derive $N(H)=10^{17}$ cm^{-2}, assuming no depletion of iron. A lower bound to the line forming region can be estimated by assuming $n=10^3$ cm^{-3}. This would imply that the low-density gas occupies a region which is strictly larger than 10^{14} cm, or a few AU or larger. Based on this size estimate, it is plausible that the low-density gas overlaps spatially with the region producing the silicate emission recently reported by Telesco and Knacke (1991). We plan to test our hypothesis with upcoming HST observations.

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[3]Presented at the 178th Meeting of the American Astronomical Society, 1991 May 26-30, Seattle, WA, USA. (*Bull.A.A.S.* 23, 914, 1991)

Origin of the Infrared Excess in Be stars

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Infrared excess in Be stars in the 1-60μ wavelength region was noted by several observers (see Lamers,1987 for references). The energy in the infrared emission is dependent on the spectral type and in the range 10^{34} ergs s^{-1} - 10^{36} ergs s^{-1} at the near IR wavelengths (Ashok et al, 1984). The origin of the IR excess is usually attributed to free-free and free-bound emission from a slow moving wind or an expanding gas disk around the equatorial region of of the Be star (Waters,1986;Waters et al, 1987). Using IR fluxes observed by IRAS satellite and the model mentioned above,Waters et al(1987) have obtained the emission measure needed to produce the IR emission and these are shown in Table 1 for different spectral types (see Lamers,1987). We have calculated the expected energy in H_α emission from these emission measures and given in column 3 of Table 1. The observed range of energy in H_α emission (Ashok et al, 1984) is also given in column 4 of Table 1.

Table 1.

Spectral Type	Log(EM)⊛ (cm^{-3})	Log $E(H_\alpha)$ (calc.) (ergs s^{-1})	Log $E(H_\alpha)$ (obs.) (ergs s^{-1})	L_{IR}/L_L †	L_{IR}/L_* ($\times 10^{-2}$)
B0-B1.5	60.6-61.1	36-36.5	33.6-34.4	0.04-0.54	0.57-6.67
B2-B3	59.4-60.4	34.8-35.8	33.1- 34.0	0.09-1.13	0.57-5.27
B4-B5	59.2-59.9	34.6-35.3	32.2-33.7	2.02-5.57	2.68-3.75
B6-B7	58.2-59.5	33.6-34.9	32.1-33	9.26-11.67	3.53-4.14
B8-B9	57.7-58.2	33.1-33.6	32.4-32.8	15.42-22.56	1.67-2.44

⊛from Lamers (1987) ; †see Ashok et al (1984).

It is seen from Table 1 that the values of H_α emission claculated from the emission measures implied by IR emission are larger than the observed values. Thus the H_α emission implied by the free-free model of infrared emission is not observed. Another consideration is the energetics of the IR emission. In column 5 of Table 1 are listed the ratio of the observed luminosity in IR emission to the energy in Lyman continuum (L_L) for different spectral types (Ashok et al,1984). These values indicate that the energy in the near IR emission is larger than the energy in the Lyman continuum for spectral types later than B4. This indicates that the emission measure obtained from the ionisation of the disk gas by the Lyman continuum of the star is not sufficient to produce the IR emission.

It seems from the above considerations, that the IR excess emission from Be stars may not be from the ionised region of the gas disk. The gas disk with the densities and dimensions usually assumed is not compeletely ionised by the Lyman continuum of the Be stars. Apparao and Tarafdar (1988) have considered the existence of cool gas outside the ionised region, termed the CII region, in order to explain the CalciumII and CarbonII (Ghosh, Apparao and Tarafdar,1989) and FeII (Tarafdar and Apparao, 1991) emission from Be stars. The far ultraviolet light from the Be stars produces the singly and in some cases doubly ionised states of these and other elements. There are many excited states of various singly and doubly charged elements which produce IR photons (Kurucz and Peytermann,1975). In column 6 of Table 1 we we have given the ratio of the IR emission to the stellar bolometric luminosity (L_*). The IR emission is only a few percent of the stellar luminosity and can arise from conversion of the UV and visible photons to IR photons by absorption and reemission by various excited states of partially ionised elements. We are investigating this possibility.

In this note we have indicted that the H_α emission implied by the IR emission is higher than the energy in the observed emission, if it is assumed that the IR photons are from free-free and free-bound emission. However the observations of the IR and H_α are in general not simultaneous. Though it seems likely that this cannot be the explanation of the problem,simulataneous observations should be performed in order to confirm that the IR emission may not be from the ionised regions of the gas disk around the Be star.

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IR/OPTICAL MONITORING PROGRAMME OF Be STARS IN X-RAY BINARIES

In order to try and further understand the interaction between Be star behaviour and the production of X-rays in the X-ray pulsator systems, we started in October 1990 to monitor a collection of such objects - though we do have data on many of our targets gathered over the previous years. This programme is a collaboration between the University of Southampton, England and the University of Valencia, Spain. Observations are now taking place four times a year from the IR telescope on Tenerife and the INT optical telescope on La Palma - both in the Canary Islands. The systems being studied are: γ Cassiopeiae, 4U0115+63, 2S0114+65, LSI+61 303, V0332+53, X Persei, H0521+373, A0535+26, 4U0728-25, 4U1909+09 and 4U 2205+54. We would welcome hearing from anyone else interested in these targets, especially people who could provide more frequent observations of targets that are in an anomalous state.

Please contact Malcolm Coe at the Physics Department, The University, Southampton, SO9 5NH, UK. My e-mail address is 19460::mjc on SPAN or mjc@uk.ac.soton.phastr on the UK's JANET network. Fax: (44)-703-585813.

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ANNOUNCEMENT OF A MULTIWAVELENGTH CAMPAIGN ON ζ TAURI AND ψ PERSEI

From October 7-10, 1991 we will be carrying through multiwavelength observations of the Be-shell stars ζ Tau and ψ Per. To further explore the cause for rapid photometric and spectroscopic variability in the Be-shell stars, we plan 56 hours of continuous repeated *IUE* observations, which will be supported by ground-based spectroscopic, photometric, and polarimetric observations. We have also requested *Voyager UVS* coverage. The *IUE* observations are currently scheduled to begin at 5:00 UT on October 7 and end at 13:00 UT on October 9.

Participants in this project include J. R. Percy, H. F. Henrichs, D. R. Gies, D. McDavid, R. C. Dempsey, and G. J. Peters, and we invite interested observers to join our effort. In addition to simultaneous observations, we are especially interested in the behavior of the program stars *before* and *after* the campaign. For ψ Per we need confirmation of its period. If you are interested in participating in this campaign, please contact either John Percy, Department of Astronomy, University of Toronto, Toronto, Ontario M5S 1A1; Canada (photometric observations) or Gerrie Peters, Space Sciences Center, University of Southern California, Los Angeles, CA 90089-1341; USA (spectroscopic observations).

* *

OBSERVING CAMPAIGN NOTICE: β PICTORIS

We will be obtaining HST GHRS spectra of β Pictoris on 1991 July 3, and will be supplementing these spectra by an extended *IUE* observing campaign beginning 1991 June 16 and continuing through early August. Optical observations, particularly with velocity resolution in the range 1-5 km s^{-1} and high S/N of Ca II, Na I, the Balmer lines of hydrogen would be particularly useful in interpreting the HST data.

If you are interested in observing Beta Pictoris, please contact Carol Grady at Department of Physics, The Catholic University of America, Washington, DC 20064, USA or via E-mail on SPAN at IUE::GRADY or HRS::HRSGRADY.

* *

SPECTROPOLARIMETRY OF Be STARS FROM PBO

The Pine Bluff Observatory (PBO) of the University of Wisconsin is located approximately 15 miles west of Madison, WI, in the town of Pine Bluff. There are a number of observational facilities at PBO, one of which is a 0.9m Cassegrain telescope with a dedicated spectropolarimeter attached. This instrument, designed by K.H. Nordsieck, was used as a prototype and ground-based support instrument for the Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE), which was one of the telescopes aboard the Astro-1 mission of the space shuttle Columbia in December 1990.

As a part of our ground-based support observation program for WUPPE, we have been observing a number of Be stars at PBO. This program has developed into an ongoing project to observe and monitor Be stars spectropolarimetrically. The objectives of our program are two-fold: to develop insight into the detailed spectropolarimetric nature of Be stars by examining linear polarization as a function of wavelength, and to determine the nature of polarization variations with time in Be stars. Given that they vary in almost all other respects, polarimetric variability is almost certain. In fact, of the 15 Be stars for which we have multiple observations so far, 10 (67%) show evidence for significant variability in their polarization levels. Our instrument provides us with simultaneous spectra and polarimetry over a wavelength range of about 3300 - 7800 Å, with a spectral resolution of about 25 Å. Typical polarimetric signal-to-noise levels for Be stars are about 500 - 1000, with much higher spectral S/N.

The purpose of this note is to update the Be star community on the progress of our observing program. To date we have observed a total of 28 Be stars. Nineteen of these stars have multiple observations (some of which are not yet reduced). Observations are continuing, and we intend to publish a series of papers detailing the observational data for some of the particularly interesting stars. Ultimately we plan to produce a catalog of spectropolarimetric observations of Be stars in the hope that this data may be of use to numerous researchers in the field, especially since such wide spectral coverage and high spectropolarimetric resolution has been obtained previously for only a handful of stars. Persons interested in more details about the data are welcome to contact the author for more information.

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* *

Malcolm Coe (Physics Department, The University, Southampton, SO9 5NH, UK, E-mail (SPAN) 19460::mjc) writes:

"We have some exciting data on X Persei taken in the last year and 1988 showing dramatic correlated changes in the optical and IR. Unfortunately we don't have any data in the period summer 1989 to summer 1990 at either waveband. It clear that X Per did something unusual during this period. I was wondering if by any chance anyone observed this star in the IR/optical in that period. We would be very interested in collaborating if that were the case."

* *

Mary Lou Whitehorne (53 Zinck Ave., Lr. Sackville, Nova Scotia B4C 1V9, Canada) is an amateur astronomer interested in spectroscopy of Be stars. She has been observing ϕ Per and other bright northern Be stars for two years at Saint Mary's University in Halifax with their 40 cm f/11 cassegrain telescope and spectrograph (reciprocal dispersion of 84 Å mm^{-1}, limiting magnitude 5.0) and is interested in collaborating in projects in which long-term monitoring is desired.

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Hα OBSERVATIONS AT KITT PEAK NATIONAL OBSERVATORY

This report continues a series of updates on the variations in Hα and He I 6678 in selected Be stars of current interest to the community. Observations were made with the Coude Feed Telescope at KPNO during 1991 February 26 - March 7 with the TI3 CCD detector, grating B, and camera 5. The resolution for a line width of 2 pixels is 0.44 Å, and the S/N for the observations range from 100 - 200 averaged over twenty pixels. The observations described below will be compared with those reported in previous issues of the *Be Star Newsletter (BSN)*. As in previous reports, the V/R that is quoted is I_V/I_R (not the historical $(I_V - I_{cont})/(I_R - I_{cont})$).

λ Eri - No Hα emission was seen, but there may have been some filling (central depth of absorption line was ~0.75). There was the usual structure and variability in He I 6678 indicative of on-going NRP and transient activity.

HR 2855 - Hα showed a P Cygni profile with V/R = 0.70 (R = 2.5 I_{cont}). He I 6678, which varied considerably over the course of the observing run, was also a P Cygni feature with R ~ 1.22 I_{cont} at the beginning of the run and ~1.10 at the end. By the end of the run a conspicuous core had developed in the He I line.

μ Cen - Weak double emission in Hα was present (I_{peak}~1.05 I_{cont}). Weak emission (at most 1.015 I_{cont}) was present in He I 6678, and there was evidence of NRP. The degree of profile activity varied from night to night.

η Cen - Double Hα emission was observed (V slightly less than R) with a peak strength of ~1.3 I_{cont}. The central core was 0.70 I_{cont}. No emission, but variability was present in the He I line.

66 Oph - The Hα emission was considerably weaker than observed a year ago (*BSN* 22,23). The peak intensity was 7.2±0.2 and a weak core could be seen on the R side of the profile. He I 6678 showed a red asymmetry suggesting infall of material.

HIGH RESOLUTION OBSERVATIONS OF γ CAS AND β ORI NEAR ONE MICRON

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Within a program of high resolution investigation of nonthermal phenomena in stellar atmospheres, we have observed the near-infrared spectra of the early-type stars γ Cas and β Ori. Observations were made on 1990 December 27.9 UT with the 1.52 m telescope of the Observatoire de Haute Provence using the *AURELIE* spectrometer with a 1200 mm^{-1} grating, and a 2048 pixels Barrette Thomson detector. The resolution was of 33,500 in the range 996-1014 nm. The spectrum of the B supergiant β Ori shows, in addition to the strong and broad Pδ photospheric absorption, a weak and narrow emission at 999.8 nm which is identified with the high excitation Fe II transition ($z^4F^o_{9/2}$ - $b^4G_{11/2}$). The presence of this emission is of particular interest, being the line excited by fluorescence from the Lyα envelope emission. The near-IR spectrum of the classical Be star γ Cas is quite fascinating. It is characterized by two strong emissions of Pδ and Fe II 999.8 nm. The two lines have nearly the same strength and profile indicating that the corresponding formation regions should be physically associated, in agreement with the results of the near-IR survey of Be stars of A.N. Damineli (*Mem.Soc.Astr.Ital.* 61, p.101, 1990). Once again, Fe II appears to be a useful tool to investigate the structure of the outer atmospheric envelopes of astrophysical objects.

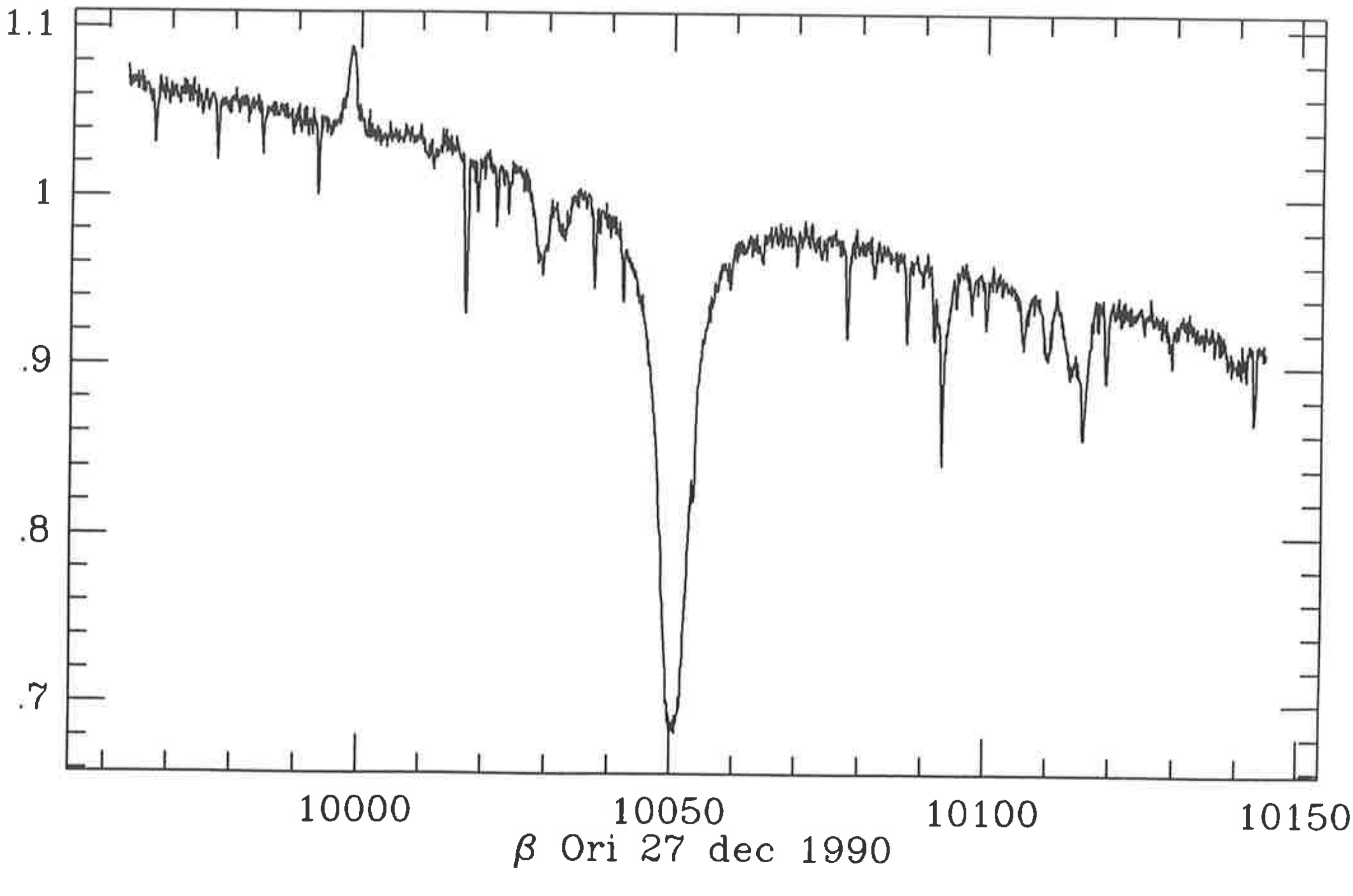

Figure 1

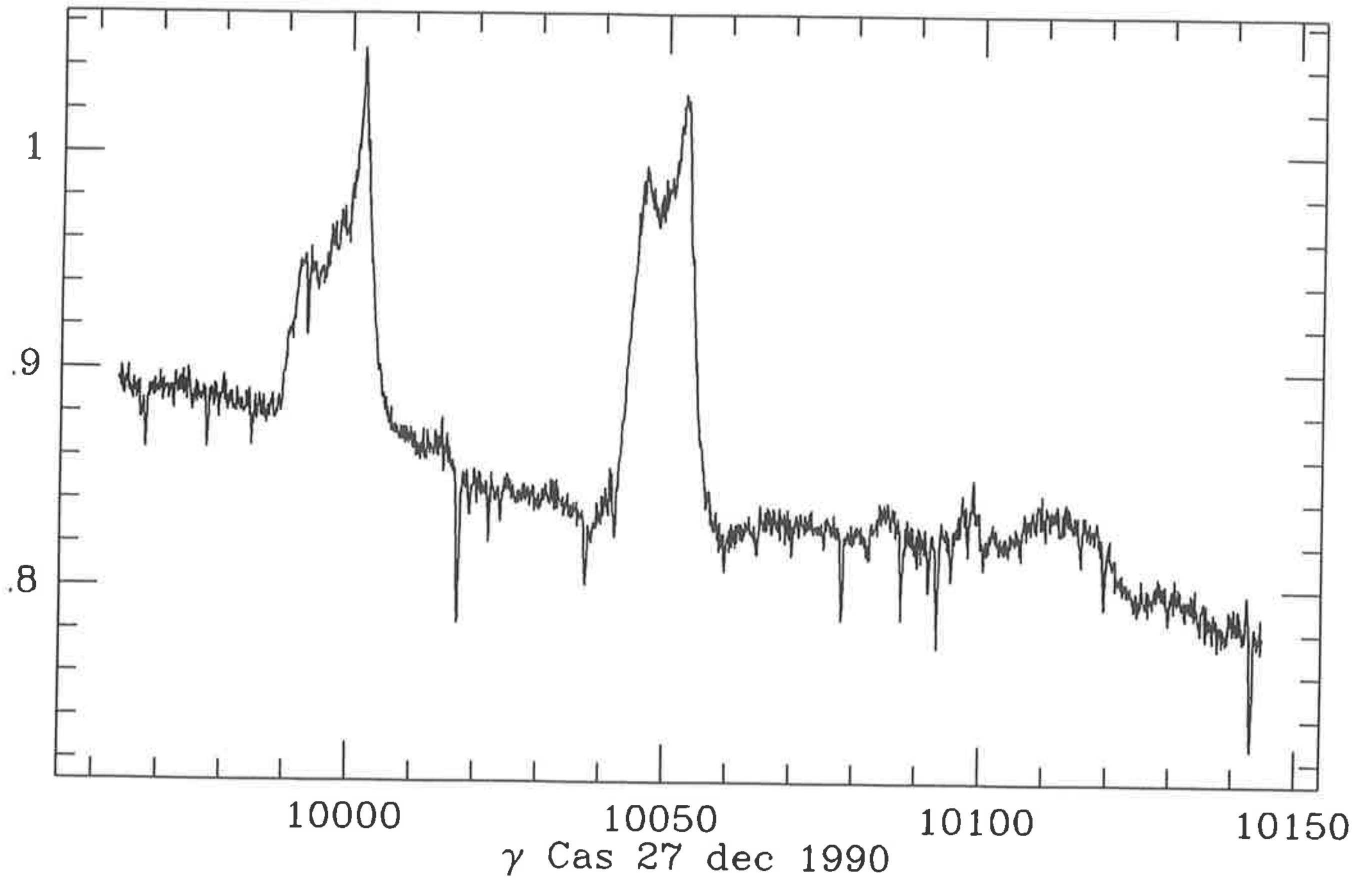

Figure 2

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Appearance of beta Cephei Pulsations in the Be Star 27 CMa

BALONA L.A. - ROZOWSKY J.; South African Astronomical Observatory, P.O. Box 9, Observatory 7935, Cape Town, South Africa.

To be Published in: *Monthly Notices of the Royal Astronomical Society*
Preprints: L. Balona at above address.

Abstract: We present intensive photometry for the Be star 27 CMa for the 1990 and 1991 season. This shows the presence of a periodicity of 0.0918 d in addition to one of 1.257 d. The longer period is characteristic of a large fraction of Be stars and is already known from observations made in 1986 and 1987. However, the short period pulsation is not seen in the early data. The star is unique for two reasons: it is the first time the growth of β Cep pulsations has been witnessed and it is the only Be star which shown such pulsations.

Intensive Photometry of Southern Periodic Be Variables. II - Summer Objects

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To be Published in: *Astronomy and Astrophysics Supplement Series*
Preprints: L. Balona at first address.

Abstract: In this paper we present further results of an intensive photometric campaign on some bright southern Be stars to search for periodic light variations. In order to obtain good phase coverage, many observations were conducted from two sites with different longitude: ESO and SAAO. As in Paper I, we found a large fraction of early-Be stars to be variable with periods close, or equal to their rotational periods. Particular attention was devoted to the late-Be stars. Unlike the hotter members of this class, the late-Be stars do not seem to have detectable periodic light variations except for one or two stars of very small amplitude.

First Results from the Goddard High Resolution Spectrograph: Resolved Velocity and Density Structure in the Beta Pictoris Circumstellar Gas

BOGGESS A.[1] - BRUHWEILER F.C.[2] - GRADY C.A.[2] - EBBETS D.C.[1] - KONDO Y.[1] - TRAFTON L.M.[1] - BRANDT J.C.[1] - HEAP S.R.[1]; 1. NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA; 2. Department of Physics, The Catholic University of America, Washington, DC 20064, USA.

To be Published in: *Astrophysical Journal (Letters), 1991 September*
Preprints: C.A. Grady at second address.

Abstract: We present the first HST Goddard High Resolution Spectrograph (GHRS) observations of circumstellar (CS) gas around β Pictoris, providing the first evidence for resolved velocity and density structure in the CS gas. Two low-density features are visible in both observations. Comparison with *IUE* spectra suggests that at least one component may vary on timescales longer than the 23-day interval between the HST observations, implying that some of the low-density gas is CS. The high-density, infalling gas shows considerable velocity structure which varied dramatically between the two HST observations. The HST and *IUE* data are consistent with 2-3 infalling clumps of material per week. From these data we infer an infall rate of 100-150 events per year, a rate which is broadly consistent with, but higher than previously inferred infall rates. Collectively, the GHRS

data imply the presence of a more complex and dynamically active gaseous envelope than previously anticipated.

Dependence of the Values of Balmer Jump of Be Stars on Rotational Parameters

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To be Published in: Proceedings of the Nordic-Baltic Astronomy Meeting, Uppsala, Sweden, 1990
Preprints: M. Ruusalepp at above address.

Abstract: The rotational velocity of stars is generally estimated by the value of $v \sin i$. In the 1970s methods for separate determination of the values of v and i for rotating stars were elaborated. The determined values for i and reduced angular rotational velocity for rotating early type stars, available up to 1989 have been included in the catalogue by Ruusalepp (1989). In this paper on the basis of this catalogue we are searching for correlations between the observed values of the Balmer discontinuities of Be stars and rotational parameters of the stars. It becomes evident that the values of stellar Balmer discontinuity of rapidly rotating Be star depend on the inclination angle of rotational axes i. Such kind of correlations may be used for i determinations, if the Balmer discontinuity is measured from observations. This correlation is also an evidence that in the atmospheres of rapidly rotating stars the theoretically predicted gravity darkening is really existing.

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The Structure of Circumstellar Discs of Be Stars Millimeter Observations
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Absolute Magnitudes of B Emission Line Stars: Correlation between the Luminosity Excess and the Effective Temperature
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Abbreviations used for the Publications

AA	Astronomy and Astrophysics
AASS	Astronomy and Astrophysics Supplement Series
AAS	Acta Astrophysica Sinica
AJ	Astronomical Journal
APJ	Astrophysical Journal
APJS	Astrophysical Journal Supplement
ASS	Astrophysics and Space Science
BAAS	Bulletin of the American Astronomical Society
BAC	Bulletin of the Astronomical Institutes of Czechoslovakia
ESOWS	"Rapid Variability of OB-Stars: Nature and Diagnostic Value" Proceedings of the ESO Workshop held in Munich, Germany from 15-17 October 1990.
IAUC	IAU Circular
IBVS	Information Bulletin on Variable Stars
IUEEA	"Evolution in Astrophysics: *IUE* Astronomy in the Era of New Space Missions", Proceedings of an International Conference held in Toulouse, France, 29 May - 1 June 1990.
MNRAS	Monthly Notices of the Royal Astronomical Society
MSAI	Memorie della Societa Astronomica Italiana
NBAM	"Nordic - Baltic Astronomy Meeting", Proceedings of a meeting held at the Astronomical Observatory of the Uppsala University, 17-21 June 1990, celebrating the 250th anniversary of the Celsius Observatory
PASJ	Publications of the Astronomical Society of Japan
PASP	Publications of the Astronomical Society of the Pacific
PBAO	Publications of the Beijing Astronomical Observatory
RMAA	Revista Mexicana de Astronomia y Astrofisica

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SPECIAL MEETING ON Be STARS

The scientific part of the meeting of the Working Group on Be stars will be held on July 30th (provisional date). The topic will be *"Current Observational and Theoretical Problems in Be star Research"* and will be in two parts. In the first part, two speakers (one observer, one theorist) will try to define the problems to be solved and suggest how solutions might be obtained. Luis Balona and Tony Hearn have agreed to speak for about 20 minutes each. In the second part of the meeting, you the participant, are invited to comment on the talks and, more importantly, suggest practical ways of solving these problems. The idea of the meeting is to identify questions concerning Be stars and to provide some guidelines for future research. Persons from outside the Be community are particularly welcome and in this respect it is appropriate that the discussion should occur at a General Assembly. Please inform your colleagues about this meeting.

There should be some time available for short contributions of duration not exceeding 10 m. If you wish to make such a presentation, please contact either Dietrich Baade or myself before the meeting and we will try to accommodate you if time allows.

Luis A. Balona

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ARCHIVING AND DISTRIBUTION OF SPECTROSCOPIC DATA

IAU Commission #29 Meeting, Buenos Aires, 25 July 1991
SECOND CIRCULAR (April 1991)

Dear Colleague,

Since the first announcement of the meeting I have received a large number of answers from many different countries. Up to now about 30 people are planning to attend, but I am still waiting for more answers especially from distant countries. I thank all of you for your collaboration in this important effort. Let me make a short summary of what I have so far learned.

Nearly all people recognized the need for SPECTROSCOPIC DATA ARCHIVE(S) (SDA) at some Astronomical Data Centers. One has however to distinguish between original data and reduced and digitized spectrograms (from plates or electronic data). The latter generally are in the hands of the observer who might (or might not) put them at the disposal of the astronomical community at a Data Center, together with a lengthy explanation (which should be included in the FILE HEADEAR). A SDA CATALOGUE should be compiled with the essential information on each file (e.g. observatory, observer, date, object name, object type, telescope/aperture setting, coordinates, instrument, units, spectral range, quality index). In this regard many astronomers told me that they are willing to archive their spectrograms in the future SDA(s), so that it might be expected that a rather comprehensive archive of reduced spectra could be prepared in a short time. The preparation of SPECTROPHOTOMETRIC ATLASES and of SPECTROSCOPIC STANDARDS should be in particular encouraged. Actually, someone noted that even a small archive is better than nothing. Obviously, the SDAs should also include space observations. We hope to have the Catalogues and the SDAs' data remotely accessible, like in the *IUE* case, which should at least partly reduce manpower needs and costs. It should be also recalled that the analysis of spectrograms produces extensive lists of line measurements, which it could be convenient to put at the disposal to the astronomical community via the SDAs. A large effort should be especially made to have a correct estimate of the data uncertainty due to the photon statistics, calibration errors, weather conditions, telescope setting, etc., all to be quantitatively indicated in all the data files.

All agreed that the observatories should preserve the original data. A computer legible OBSERVATORY LOGBOOK of all the observations, which should include a comprehensive OBSERVATION HEADER, is always requested; it would be more useful if remotely accessible and if an OBSERVATORY CATALOGUE of the original data were available in the SDAs. It has also been noted that the presently available Observation Headers differ from each other, and do not contain all the required information. The distribution of the original data is a problem. We should however note that a big effort has been made by the La Palma Isaac Newton Group to construct an archive of both the original spectroscopic and image data. The archive can be read and the data retrieved via the computer network system. I think that this should be considered a reference example in our future discussions.

Concerning the spectroscopic plates, their small dynamical range does not necessarily prevent us making accurate line measurements, which have been and are basic for much research. Spectroscopic plates taken with a particular camera represent a far more uniform set of data than do digital datasets from electronic detectors, and at some observatories they are much more numerous (and are better preserved) though less directly accessible by computer. In addition they give the unique opportunity to study several years and decades of the history of a source. We thus think that the problem of the documentation of the existing spectroscopic plates and of what to do with them should be a major question to be discussed during the Meeting.

As written in the title, the Meeting will be held on July 25 afternoon. The meeting will be organized around the following questions:

1. How ground based observatories are presently organizing their electronic and photographic spectroscopic material. What do we request?

2. How spectroscopic observations with space experiments are organized. The case of *IUE*. Their liaison with ground data.

3. Documentation on observations. Our needs.

4. How to organize spectroscopic archives. What should be archived and where.

5. What to do with spectroscopic plates.

6. Recommendations.

In fact the Meeting should end with a number of recommendations. Points 1-5 should be introduced by a speaker and be followed by (I hope) lively discussions. I would like to collect all the discussions and contributions to the Meeting in a quickly printed booklet.

Could you please give your further contributions about the matter well in advance of the Buenos Aires Meeting? We are considering organizing before July a small European Workshop at least to meet those who will be unable to attend the Buenos Aires Assembly. I would like to remind you that there will be in Buenos Aires a Joint Commission Meeting on Archiving of Current Observational Data (Chairman: B. Hauck), where the general problem will be discussed.

Looking forward to hearing soon from you, with my best regards,

Roberto Viotti - Istituto Astrofisica Spaziale, Via Enrico Fermi, 21, 00044 Frascati RM, Italy
FAX +39.6.941.6847 E-Mail B: UVSPACE@IRMIAS S: 40609::VIOTTI (also B: VIOTTI@IRMIAS S: SAT2::VIOTTI and 40058::VIOTTI)

Ballot Form

Use this form only if you will not be able to attend the meeting of the Working Group Be Stars during the IAU General Assembly in Buenos Aires.

Please do not tear out this page: Other members of the working group reading this issue may also wish to participate in the ballot. Therefore, kindly photocopy this page.

Enter up to seven names, put the form into a plain, unmarked envelope and mail in a second envelope to:

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Dietrich Baade
European Southern Observatory
Karl-Schwarzschild-Str. 2
W-8046 Garching bei Muenchen
Germany
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I propose the following colleagues as members of the Organizing Committee of the Working Group Be Stars for the period 1991–1994:

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