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CONTENTS

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Normally only one copy per institute will be mailed. By default, it will be sent to the institute's library; please name a contact person if this is not desirable.

Acknowledgements: The Be Star Newsletter is produced at and financially supported by the European Southern Observatory. We thank Pam Bristow and Bruno Jørgensen for their active help in administrative and technical matters.

EDITORIAL

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It is my pleasure to send you the 25th issue of the *Be Star Newsletter* and the first of two-three issues that are planned for 1992. In this issue we continue with the new format including sections containing Working Group Matters, Contributions, What's Active/Inactive?, What's Happening?, Preprints Received, and Bibliography. Thanks again to all who contributed to this issue and especially those who helped with the compilation of the bibliography. As usual if we missed one of your papers or abstracts, or made a clerical or printing error, please let me know about it and I will correct the omission/error in the next issue.

Some exciting new observations and theoretical results are reported in this *Newsletter*. These include the first study of the photometric behavior of some apparently classical Be stars in an external galaxy (the Small Magellanic Cloud), the discovery of transient activity of the "dimple-type" (originally identified in λ Eri) in four other Be and two non-emission B stars, and theoretical calculations that provide new insight into the formation of the familiar *winebottle* Hα emission profiles. The *What's Active* section contains reports on recent activity in X Per, λ Eri, κ Dra, γ Cas, and other Be stars of current interest.

I would like to encourage graduate students who are studying Be stars to submit reports on the results from their Ph.D. dissertations. Short summaries as well as more formal dissertation abstracts similar in format to those published by the *P.A.S.P.* are invited.

Since I anticipate publishing the next issue of the *Newsletter* around July-August, contributions for Issue N° 26 should be received by:

June 15, 1992

We request that lengthy contributions containing illustrations be submitted in a camera-ready format (see papers in the current issue for style). For short communications I especially recommend Electronic Mail (SPAN/DECnet - CYGNUS::PETERS, 5546::GPETERS, ASTRON::GPETERS), telefax (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.

Best wishes for a productive and happy 1992 and I look forward to receiving your contributions for Issue N° 26. I would like to thank the European Southern Observatory for their continued financial support.

Gerrie Peters, Editor

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Summary of the Meeting of the Working Group on Be stars

The Working Group on Be stars held a meeting on the morning of 31 July 1991 at the IAU general assembly in Buenos Aires chaired by Baade. At that meeting, a new SOC was elected: Balona (chair), Dachs, Gies, Harmanec, Percy, Peters, Smith and Waters. A symposium on Be and related stars planned for October 1993 at the Côte d'Azur was discussed. Peters will continue to be editor of the *Be Star Newsletter* with financial support from ESO.

The first half of the scientific session, chaired by Baade, consisted of a review of the differences between Be and non-Be stars by Balona and a talk by Hearn on what theorists would like observers to do. Ringuelet and Doazan presented short contributions. The second half consisted of a lively discussion of new ideas on the Be phenomenon chaired by Hearn. These included pulsation versus rotational modulation, the bi-stability mechanism, spectral transients, the effect of increased iron opacities, etc.

L.A. Balona.

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PERIODIC Be STARS IN THE SMC

L.A. Balona
South African Astronomical Observatory
P.O. Box 9, Observatory 7935, Cape, South Africa

The recent revision of metal opacities (Iglesias & Rogers 1991) has, for the first time, opened the possibility of understanding the mechanism which drives pulsations in early-type stars (Cox & Morgan 1990). The sudden appearance of a tremendous number of iron lines at a temperature of about 150,000 K gives a high sensitivity of opacity to temperature at the very low densities found in B-type stars. This mechanism may explain the β Cephei variables, but the iron abundance must be somewhat higher than the solar value for the mechanism to work (Cox *et al.* 1992). Can the same mechanism be responsible for the periodic light variations in Be stars?

To answer this question, Balona (1992) made intensive CCD observations of the metal-poor cluster NGC 330 in the SMC. This young cluster is extremely rich in Be stars (Feast 1972). In fact, Grebel *et al.* (1991) found that the majority of B stars in this cluster are Be stars. This in itself is a puzzle because the low metallicity is expected to give a lower radiative acceleration to the stellar wind which produces smaller mass-loss rates than in corresponding stars with solar abundances (Kudritzki *et al.* 1991). The metal abundance in the SMC as a whole is about 1/5 the solar value, but the stars in NGC 330 are thought to have even smaller abundances (Grebel & Richtler 1991).

From 137 frames of the same field taken during six nights, I was able to detect amplitudes as small as 0.02 mag for stars as faint as V = 17. This resulted in the discovery of several short-period variables, but no stars with periods characteristic of β Cephei variables. However, 19 periodic Be stars (I call them λ *Eri* variables) were found. The Be nature of some of them are confirmed by spectrographic observations or the work of Grebel *et al.* (1991), but the majority still need observations to prove that they are Be stars. The periods of these λ Eri variables are all in the range 0.5-0.9 days; amplitudes often exceed 0.1 mag.

The fact that periodic Be stars with very low metal abundances exist indicates that the mechanism being proposed for the β Cephei stars cannot apply to the Be stars. If nonradial pulsations are responsible for the light variations, then the mechanism of Lee & Saio (1986) is to be preferred since this presumably does not depend on the metal abundance. The periods found for λ Eri stars in NGC 330 are in keeping with the rotational modulation hypothesis. It gives a mean equatorial velocity of 375 km s^{-1} for stars in NGC 330 as opposed to 265 km s^{-1} for Be stars in the solar neighborhood. The higher rotational velocities in NGC 330 may be required to offset the lower mass-loss rates caused by the smaller metal abundances.

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LOOK, MA, IT DIMPLES

Myron Smith, National Science Foundation
Washington, DC 20550; USA

During the course of a long spectroscopic monitoring effort on the He I 6678Å line in the B2e star λ Eri, we noticed that erratic "spectral transients" appear frequently in this line (Smith, *Ap. J. Suppl.*, 71, 357, 1989). By far the most frequent type of transient is the formation and disappearance of structures we call "dimples." A dimple is the simultaneous appearance of an "absorption" feature flanked by subtle emission wings. When one appears, the equivalent width of the 6678Å line is preserved and it is generally more or less stationary on the profile. We have been observing scores of these features in this profile, sometimes two or three at once. We have been able to simulate them with a crude model consisting of an optically thick (in the line) "slab" that appears, suspended at some distance above the stellar disk. In this model line radiation is intercepted by the slab, backscattered towards a "penumbral" ring on the star, and then rescattered back into the line of sight once again. In this last scattering the photons are blue/red-shifted by the local projected doppler motion to this star's rapid rotation, accounting for the weak re-emission to either side of the central absorption.

In the course of surveying the He I 4388/6678 line ratios for a number of B/Be stars in November, we encountered several other stars that seem to show transients that appear similar to the dimples in λ Eri (in our limited data we cannot be sure they are all dimplers yet, but we will bet most are!). Four of these stars are known Be stars: 8 Lac A, HR 1423, 120 Tau, and 56 Eri. Two are not known to be Be stars: HR 987, HR 1011. All have V sin i's of at least 250 km s^{-1}.

Our current plans are, first, to confirm our initial conclusion that dimples are a signature of a phenomenon that is widespread among classical-Be and related stars. Second, note that dimples have so far only been observed in 6678Å. Therefore, Thomas Meylan (*IUE* Observatory) and I plan to monitor dimples in the 4388Å and 6678Å lines of λ Eri simultaneously. The 4388Å line has a gf-value 15 times smaller than 6678Å's value. We hope that a comparison of their variations in time-serial spectra will tell us how the formation of these features depend on stratification in the atmospheres of these stars!

* *

A new Interpretation of Winebottle-Type Emission-Line Profiles

(W. Hummel, Astronomisches Institut, Ruhr-Universität Bochum,
Postfach 10 21 48, D-4630 Bochum 1)

By high-resolution, high signal-to-noise ratio spectroscopy, important fine structure, such as shell-type absorption components or symmetric flank inflections can be detected in Hα and Hβ emission lines of Be stars (Hanuschik et al., 1988). Previously, flank inflections ("winebottle-type" profiles) of symmetric Hα emission lines were believed to be a superposition of line emission from two concentric circumstellar disk components with different mean rotational velocities (Kogure, 1969). Based on 3D-radiative line-transfer calculations, a new interpretation of winebottle-type emission-line profiles is presented :

The spatially implicit first-order volume technique (Adam et al., 1990) for solving the radiative transfer equation in three dimensions is used to calculate emission-line profiles of a homogeneous ($\varkappa^l$ = const.), isothermal (T_{env} = 20 000 K, λ_0 = 6563 Å, Δv_{therm} = 22 km s^{-1}) Keplerian disk for a two-level-atom with complete redistribution. The circumstellar gaseous disk is illuminated by a central star of spectral type B (T_{eff} = 20 000 K) and is extended from $r = R_*$ to $r = 20\,R_*$ with a constant height of $2\,R_*$. The velocity inside the envelope is given by $V_\varphi(r) = V_{\varphi crit}\,(r/R_*)^{-1/2}$, with $V_{\varphi crit}$ = 590 km s^{-1}. The scattering parameter ($\varepsilon = 0.01$), the continuous absorption coefficient ($\varkappa^c = 1/(100\,R_*)$; $\tau^c = 0.01$) and the passive continuum source function ($S^c = B_\lambda(T_{env})$) are constant in the disk. A stellar absorption profile has not been taken into account.

The resulting line source function S^l is given in Fig. 1 for two different optical depths (τ^l = 1, 10) as a function of the radius in the equatorial layer of the circumstellar disk , r and in the vertical direction, z. The corresponding emission-line profiles are given in Fig. 2 (τ^l = 1) and in Fig. 3 (τ^l = 10) for different inclination angles ($\vartheta = 0^o$, 15^o, 30^o, 60^o).

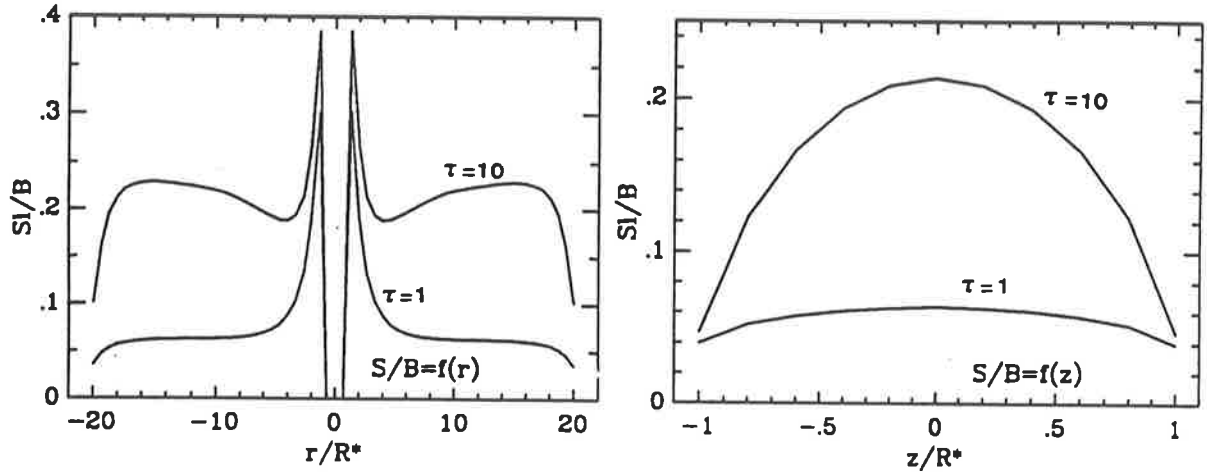

Fig. 1 : Line source function of a Keplerian circumstellar disk for τ^l = 1, 10.

For optically thick line radiation from Keplerian disks, the line source function S^l is increasing with r, reflecting the decreasing photon escape probability, caused by the decreasing velocity gradient: $\partial v_\varphi(r)/\partial r = v_\varphi(r)/2r$. As expected, S^l increases with τ^l, because of the increasing influence of the central star (Fig. 1).

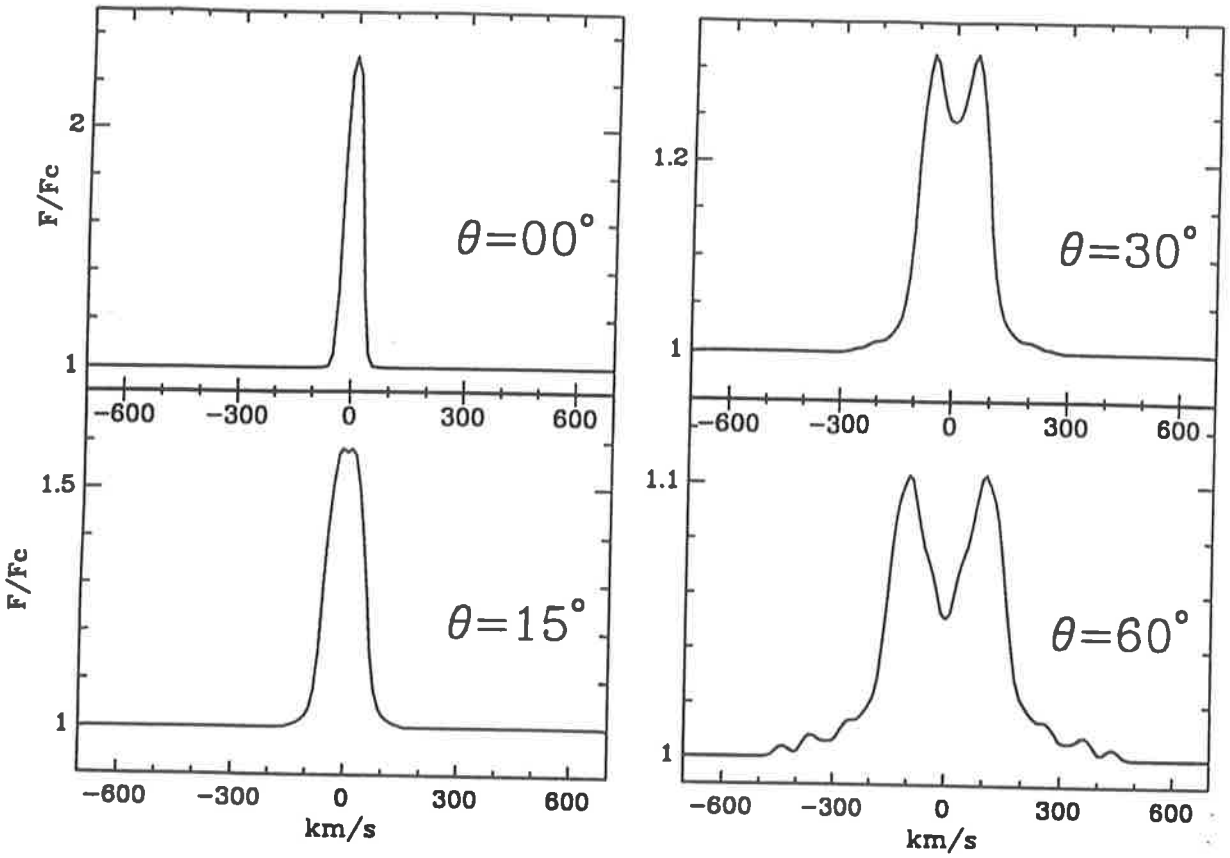

Fig. 2 : Emission-line profiles from a Keplerian circumstellar disk for $\tau^1 = 1$.

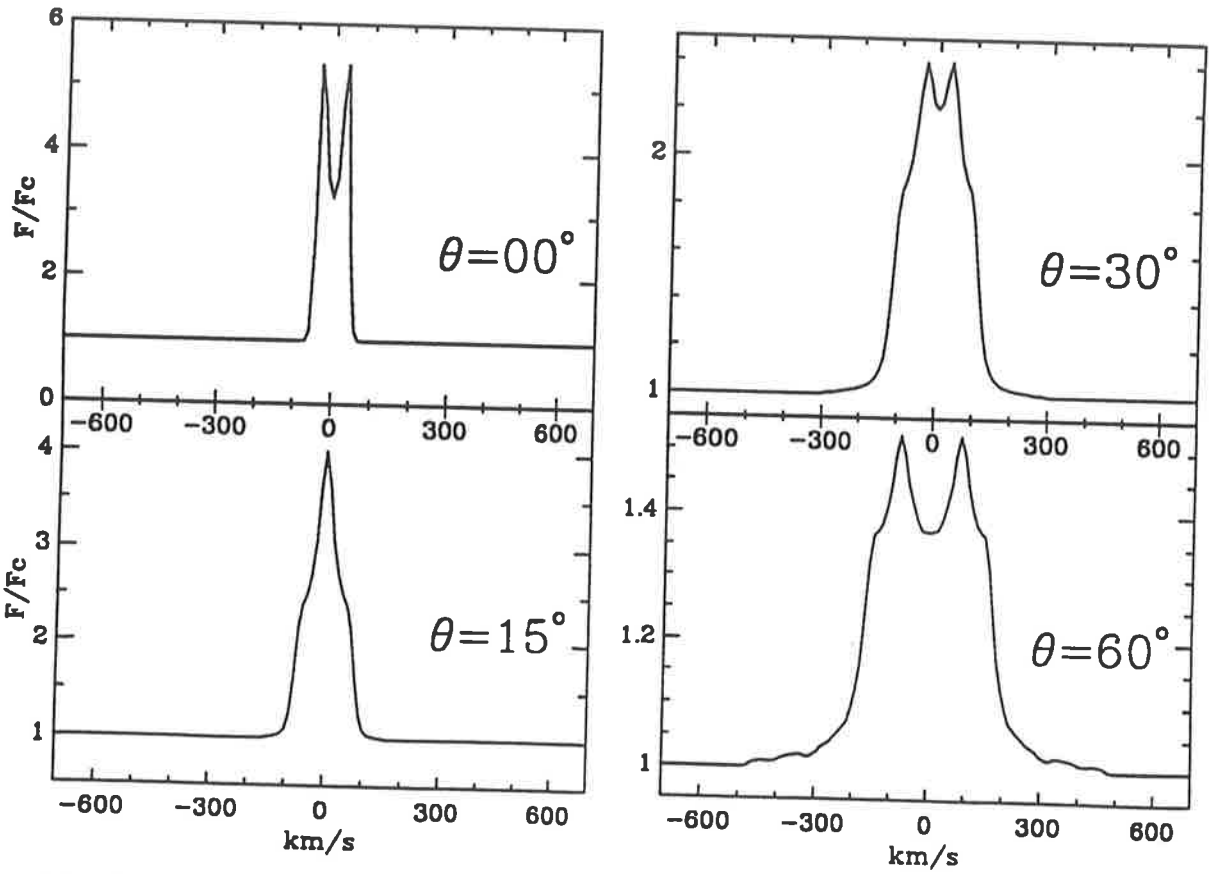

Fig. 3 : Emission-line profiles from a Keplerian cirumstellar disk for $\tau^1 = 10$.

Emission lines from optically thick disks are influenced by the following effects :

1) The anisotropic opacity $\tau^l(\varphi)$ in directions perpendicular to the rotation axis (shear broadening) generates a deep central depression ("shell-type") in the emission-line profile (Horne and Marsh, 1986). This effect is dominant for $i \geq 60^o$ (Fig. 2, $\vartheta = 60^o$).

2) If the line radiation F_λ ($\vartheta \approx 0^o$) is optically thick (double peak characteristic in Fig. 3, $\vartheta = 0^o$), then winebottle-type profiles (Fig. 3, $\vartheta = 15^o$) and flank inflections (Fig. 3, $\vartheta = 30^o, 60^o$) appear in the emission-line profiles as a natural consequence of optically thick line radiation in a slab. From the sequence shown in Fig. 3 the formation of this emission line feature can be explained by Keplerian rotation broadening of the F_λ ($\vartheta = 0^o$) emission-line profile. This explanation is at variance with the two-disk model (Kogure, 1969), where flank inflections of observed emission-line profiles are interpreted as a consequence of two concentric disks and have been called "two-component-structure".

Acknowledgements

Many thanks go to J. Dachs, R. Wehrse and H. Störzer for helpful discussions.

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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 from 1991 September 15 - 17 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 $(I_V - I_{cont})/(I_R - I_{cont})$).

γ Cas - The Hα emission feature displayed a triangular profile skewed to the red. Its peak intensity remained at 4.0±0.1 I_{cont} as reported in *BSN 23*. P Cygni emission is still seen in He I 6678 with R=1.03 I_{cont}.

28 Tau - The Hα emission was slightly weaker than seen in 1991 February (*BSN 23*). Its peak intensity was 4.8±0.1 I_{cont}, compared with 5.6 I_{cont} earlier in 1991 (V/R=0.85). There has been no change in He I 6678 (still purely in absorption).

λ Eri - Contrary to its absence in 1991 February (*BSN 24*), prominent Hα emission (~1.2 I_{cont}) with a deep central core extending to r_v~0.85 was present. Several reversals in V/R were seen. Profile variability and structure indicative of on-going NRP and transient activity were seen in He I 6678 and double emission was present.

HR 2855 - The profile of the Hα emission line was inverse P Cygni with V/R ~ 1.10. The overall strength of the feature varied by about 10% during the three days of the observing run (V ≤ 2.1 I_{cont}) but the overall profile remained constant within observational uncertainties (the airmass was large,≤6). He I 6678 also contained an inverse P Cygni emission feature with V=1.05±.02 I_{cont}.

66 Oph - The peak intensity of the Hα emission remains below its record of 10.0 I_{cont} observed in March-April of 1990 (*BSN 22*). In September 1991 its intensity was 9.0±.10 I_{cont} (earlier in 1991 the peak intensity was ~7.2 I_{cont}, and the profile suggested infall of material, *BSN 23*). A weak central reversal was seen and V≈R. Weak emission (~1.02 I_{cont}) was visible on the violet side of the He I 6678 profile.

59 Cyg - P Cygni Hα emission with V/R=0.90±0.02 (R=1.8 I_{cont}) was observed. The He I 6678 feature appeared to be generally filled with emission, and weak R emission was barely detectable.

π Aqr - Hα was a centrally-reversed P Cygni feature with V/R~0.80 (R~2.75 I_{cont}). The emission was significantly weaker than reported in *BSN 22*, but the profile was similar. Weak double emission flanked the He I 6678 absorption (V~1.03 I_{cont}, R~1.01 I_{cont}).

Gerrie Peters

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X PERSEI ACTIVE AGAIN!

The variable Be star X Persei is the optical counterpart of the 835s X-ray pulsar 4U0352+30 (the slowest known), a neutron star accreting matter from the wind of X Persei. After 4 years of quiescence, during which the Hα emission disappeared completely and the IR flux decreased by more than one magnitude (Norton *et al.* 1991 - see "Preprints" section in this *Newsletter* - ed.), X Persei is now active again: a spectrum of X Persei, obtained at l'Observatoire de Haute Provence in France with the 1.52-m telescope and Aurelie spectrograph on 25 October 1991, clearly shows double peaked emission on top of the underlying (photospheric) Hα absorption profile. The spectrum is shown in the Figure below, overdrawn on a spectrum obtained almost one year earlier (30 October 1990) with the Coudé spectrograph at the 2.2-m telescope at Calar Alto, Spain, which shows only marginal evidence for emission. IAU Circular No. 5372 (24 October 1991) revealed that R. Corbet and B. Thomas detected the emission already on 16 and 18 October 1991 (BMO). The double peaked emission suggests that a (new?) disk is present around the Be star.

Lex Kaper and Marten van Kerkwijk
Astronomical Institute, University of Amsterdam

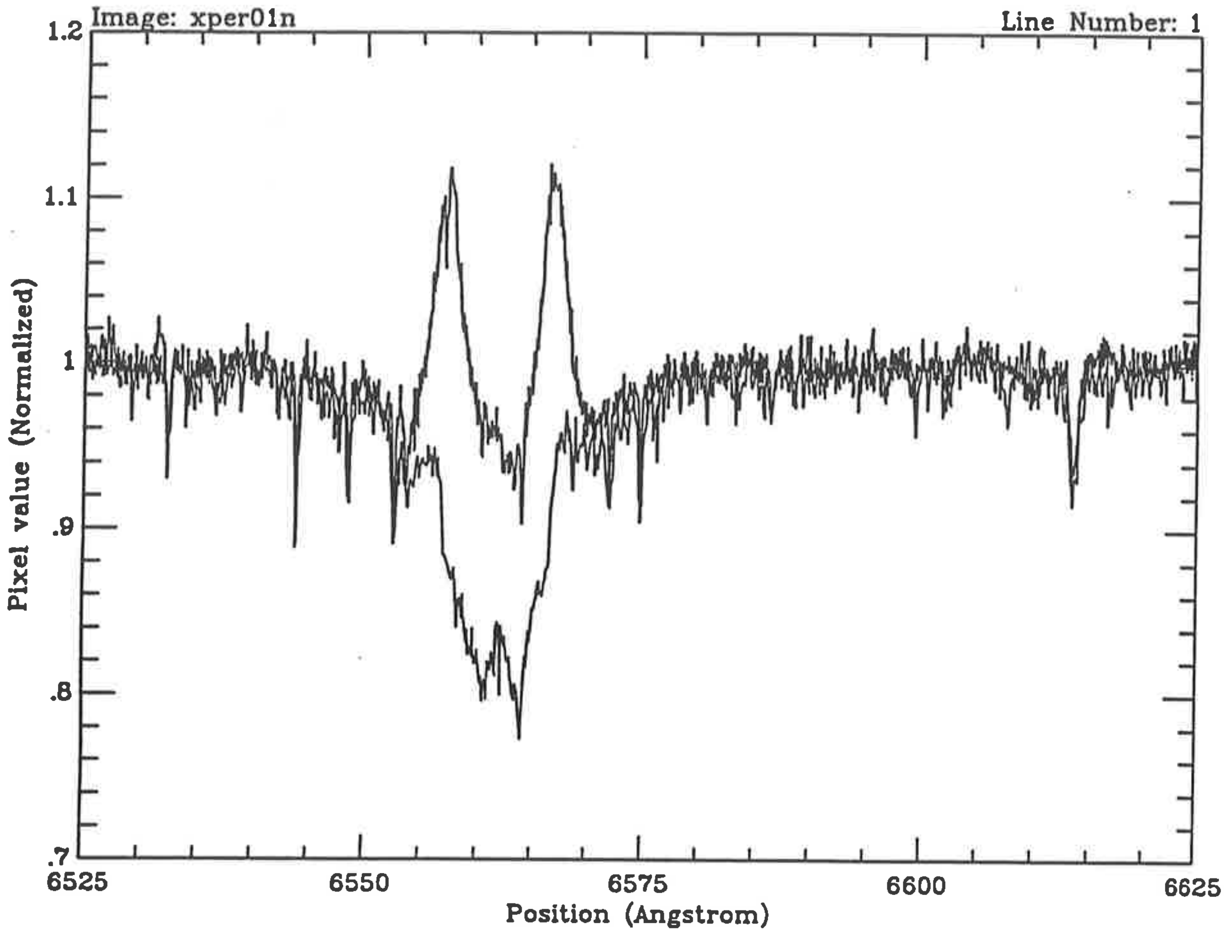

Figure - The Hα region in X Persei on 1991 October 25 compared with its appearance on 1990 October 30.

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H_α OBSERVATIONS OF λ Eri AND κ Dra

Guo Xiaozhen Hao Jinxin

Joint Laboratories for Optical Astronomy of Beijing Astronomical Observatory, Shanghai Astronomical Observatory and Yunnan Astronomical Observatory, chinese Academy of Science

1991, July

We observed λ Eri and κ Dra during January 27 to 29, 1991. Total of 21 H_α profiles were obtained. The observations were made with the coudè spectrograph and the think CCD detector on 100-cm reflector at Yunnan observatory. We used a 632 grooves mm^{-1} grating and the spectra have a reciprocal dispersion of 4.23 $Åmm^{-1}$. The results are as following:

λ Eri—No H_α emission was seen during our observing run. However, it had a very wide and shallow absorption line profile, which suggests that the absorption profile was being filled. The fine structure variations are seen in the observations of January 28 and 29, but they are not conspicuous. In conclusion, We can say that an outburst might be forthcoming. The spectra of λ Eri are show in Figure 1, 2 and 3, respectively, for observations of January 27, 28 and 29. The H_α profile of the comparison star, γ Ori, are also given at the bottoms of these figures.

κ Dra—Our observations show that H_α has very strong and double emission features. V$\simeq$R and variable fine structures are seen. The spectra are shown in Figure 4.

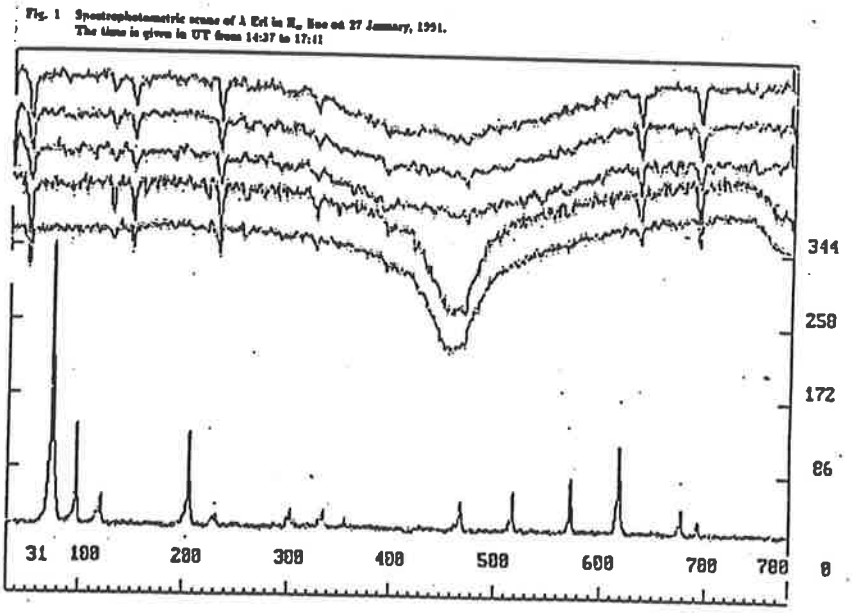


Fig. 1 Spectrophotometric scans of λ Eri in H_α line on 27 January, 1991. The time is given in UT from 14:37 to 17:11

Spectrophotometric scans of λ Eri in H_α line on 28 January, 1991.
The time is given in UT from 13:32 to 19:33

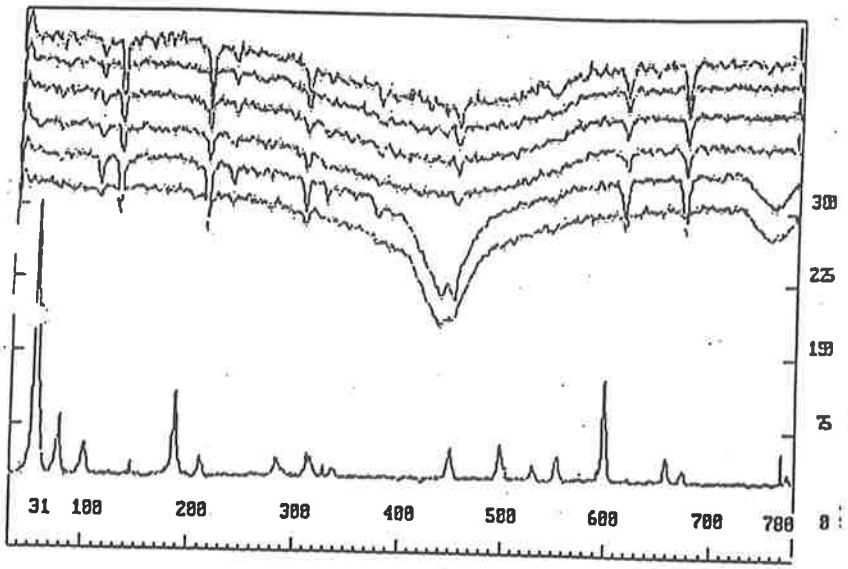


Fig. 3 Spectrophotometric scans of λ Eri in H_α line on 29 January, 1991.
The time is given in UT from 12:32 to 18:11

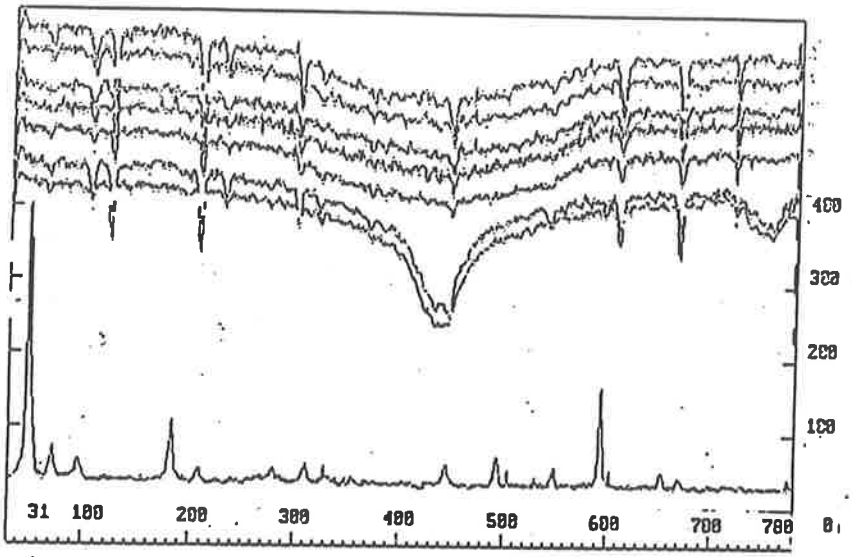
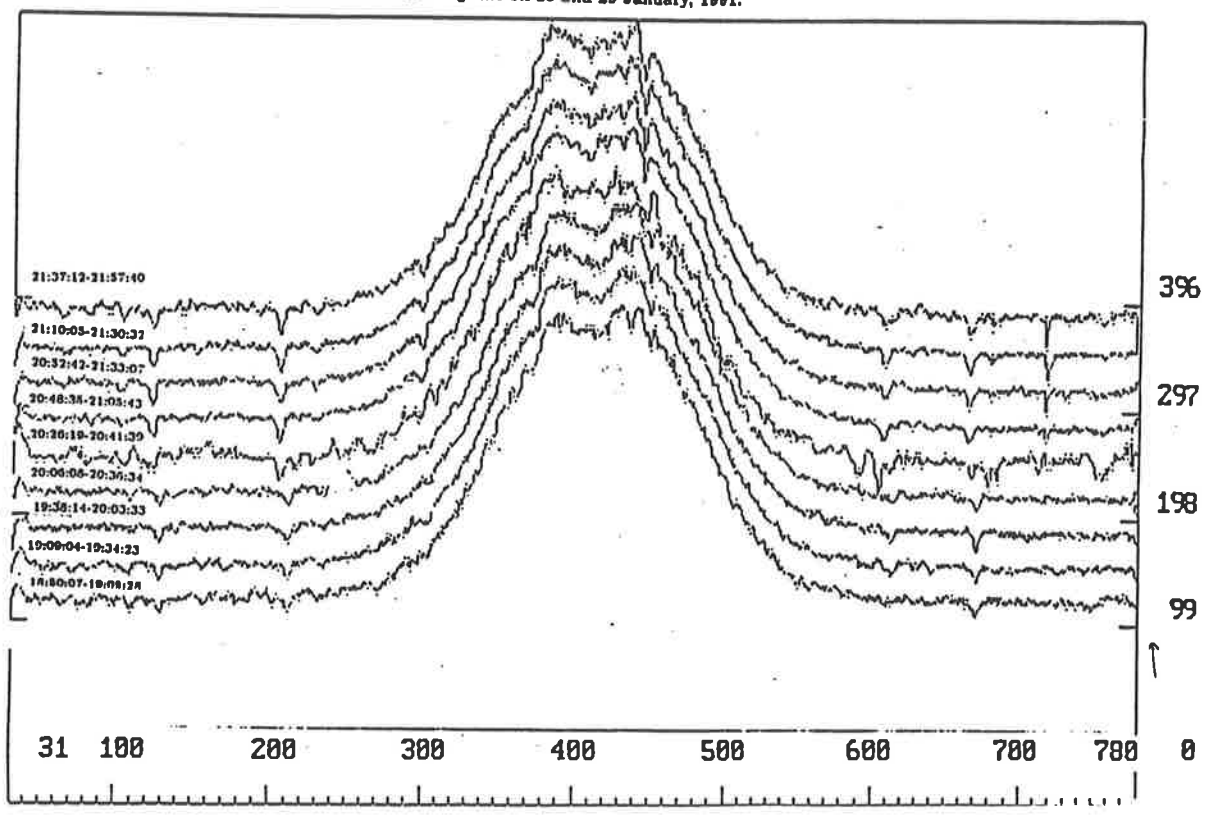


Fig. 4 Spectrophotometric scans of κ Dra in H_α line on 28 and 29 January, 1991.



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REQUEST FOR Hα SPECTRA AND NEAR-IR PHOTOMETRY TO SUPPORT VLA OBSERVATIONS

Over the last 12 months we have been observing three Be stars (γ Cas, β Mon A, and EW Lac) at 3.6 cm using the VLA as part of a monitoring program that includes observations of the Hα line and near-IR continuum. Unfortunately, the weather did not comply and we obtained few Hα and IR observations. We are writing to the *Newsletter* in search of Hα spectra and near-IR photometry (J,H,K and L bands) of any of these three Be stars over the course of the last 15 months. If anyone has any data of these stars we would be grateful if you would send e-mail to: (Internet) sean%ras.ucalgary.ca. Thanks. Sean M. Dougherty and A.R. Taylor, Department of Physics and Astronomy, 2500 University Dr. NW., Calgary T2N 1N4, Alberta, Canada.

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ARCHIVING AND DISTRIBUTION OF SPECTROSCOPIC DATA

Recently two meetings were held to discuss problems concerning the archiving and distribution of spectroscopic data. The first took place on 25 July 1991 at the IAU General Assembly in Buenos Aires, and the proceedings (edited by R. Viotti and G. Battista Baratta) have recently been published. Copies can be obtained from R. Viotti. Included were contributions from R. Viotti, E. Terlevich, M. Albrecht, R. Garrison, W. Wamsteker, C. Jaschek, and e-mail communications from several directors of major observatories. The second workshop was organized by Roberto Viotti and George Coyne S.J. (Istituto Astrofisica Spaziale and the Vatican Observatory) and was held in Castelgandolfo on 3-5 December 1991. The aim of the workshop was to determine strategies for archiving astronomical spectroscopic data, both from ground-based and space observatories, and to determine the means for their distribution to the Astronomical Community. Included were discussions on the following themes: archives of ground-based observatories, archives of space observatories, discussion on spectroscopic plates, laboratory data, standard spectra, data format, documentation, data retrieval, strategies.

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Eiji Kambe (Department of Geoscience, National Defense Academy, Hashirimizu, Yokosuka, Kanagawa 239, Japan) completed a Ph.D. thesis "On the Connection of Short-Term Line-Profile Variations with Its Quasi-Periodic Mass Loss in a Be Star Zeta Oph" in 1991 March at the University of Tokyo. The abstract appears in the "Preprints" section of this *Newsletter*.

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PREPRINTS RECEIVED

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Photoelectric Observations of Some Bright Be Stars
ADELMAN S.J.; Department of Physics, The Citadel, Charleston, SC 29409, USA.
Submitted to: *Publications of the Astronomical Society of the Pacific*
Preprints: S. Adelman at above address.

Abstract: Differential Stromgren uvby photometry of several bright Be stars obtained with the Four College Automated Photoelectric Telescope are presented both to the examine the quality of data obtained with this telescope and to study the variability of these stars during 1990-91.

Binary Be Stars and Be Binaries
BAADE D.; European Southern Observatory, Karl-Schwarzschild-Str. 2, D-W-8046 Garching, Germany.
To be Published in: Proceedings from *Evolutionary Processes in Interacting Binary Stars (IAU Symposium No. 151)* held in Cordoba, Argentina, August 5-8, 1991.
Preprints: D. Baade at above address.

Abstract: Two hypotheses have been put forward for the role of binarity in Be stars: (1) All Be stars are interacting binaries. (2) Roughly one-half of the observed Be stars are post-mass exchange binaries with compact companions. Contrary to (1), (2) does not attempt to explain also the existence of disks in Be stars. After the spin-up by mass and angular momentum transfer, the B star somehow has to succeed to form and maintain the disk. Since rapid rotation is only necessary but not sufficient for this transformation, the effect of duplicity would merely by to give more stars the opportunity to become a Be star. Model (1) is not nearly realistic as is also underlined by a new spectroscopic survey for cool companions. The verification of (2) on the basis of the *ROSAT* All-Sky-Survey has just begun; but a serious deficiency of white dwarf companions is already apparent. Binarity currently provides no extra clue on the origin of the Be phenomenon.

Short-Period Variables in the SMC Cluster NGC 330
BALONA L.A.; South African Astronomical Observatory, P.O. Box 9, Observatory 7935, Cape, South Africa.
To be Published in: *Monthly Notices of the Royal Astronomical Society*
Preprints: L. Balona at above address.

Abstract: In this paper we present results of intensive CCD monitoring of the blue globular cluster NGC 330 in the SMC. From 137 V frames on 6 nights, we have found many short-period variables. Most of these occur among the B-type stars. Since the cluster is very rich in Be stars, we surmise that they are periodic Be stars (λ Eri variables). A few eclipsing binaries, including an early-type contact binary were found. We have found a Cepheid with a 1.19 d period, one of the shortest known in the Magellanic Clouds. We also found some short-period late-type variables which cannot be classified. An interesting result is the absence of an β Cep variables with an amplitude in excess of 0.02 mag. This could be due to the low metal abundance or presumed rapid rotation of the early B-type stars.

The Wind Compressed Disk Model of Be Stars
BJORKMAN J.E. - CASSINELLI J.P.; Department of Astronomy, University of Wisconsin, 475 N. Charter St., Madison, WI 53706, USA.
To be Published in: Proceedings from the workshop *Nonisotropic and Variable Outflows from Stars*, held in Baltimore, MD at the STScI October 8-10, 1991.
Preprints: J. Bjorkman at above address.

Abstract: We have developed a 2-D model for the radiatively driven wind which originates on a rapidly rotating early-type star. This model predicts the formation of a dense equatorial disk around rapidly rotating B stars. The high densities are caused by shock compression of the wind as it enters the equatorial region, and the ram pressure of the wind confines the material to a very narrow equatorial zone, producing a "wind compressed disk". We present an approximate calculation of the shock location which we use to estimate the disk properties. We find that the shock temperature is sufficient to produce the observed degree of superionization in the winds of Be stars. Furthermore, the shock location explains the observations of Grady *et al.* (1987, 1989) and K.S. Bjorkman (1989) which indicate that C IV is concentrated towards the equator at small radii. We also find that there is a correlation of shock temperature with rotation rate; therefore, the highest observed ionization stage will depend on the rotation rate of the star.

A Southern Be Star Survey: Spectra and Envelope Radii
JASCHEK C. - JASCHEK M.; Observatoire de Strasbourg, URA 1280 CNRS, 11, Rue de l'Université, 67000 Strasbourg, France.
To be Published in: *Astronomy and Astrophysics Supplement*
Preprints: C. Jaschek at the above address.

Abstract: We describe the hydrogen line spectra of 63 southern Be stars, obtained at ESO, Chile, in one observational run in August 1978. The spectra were recorded on photographic plates. We also provide the outer radii of the line emission forming region for a number of stars, based upon the emission peak separation of the H4 and H5 lines. Average values so obtained are in good agreement with other determinations based upon a smaller number of objects.

A Catalogue of Radii of Be Star Line Emitting Regions
JASCHEK C. - JASCHEK M.; Observatoire de Strasbourg, URA 1280 CNRS, 11, Rue de l'Université, 67000 Strasbourg, France.
To be Published in: *Astronomy and Astrophysics Supplement*
Preprints: C. Jaschek at the above address.

Abstract: We present a bibliographic catalogue of the radii of the line emitting regions around Be stars, based upon modern measurements of the separations of double line peaks. More than 470 determinations are listed. The catalogue is also available from CDS.

On the Connection of Short-Term Line-Profile Variations with Its Quasi-Periodic Mass Loss in a Be Star Zeta Oph

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Ph.D. thesis (Department of Astronomy, Faculty of Science, The University of Tokyo, Bunkyo-ku, Tokyo 113, Japan)
Copies: Available from E. Kambe at the first address.

Abstract: The high-resolution spectra have been obtained for one of rapidly rotating early-type stars, ζ Oph, from 1987 to 1990. The observations cover its recent emission episode in 1990 spring. The spectra were analyzed with the method which was developed by Gies and Kullavanijaya (1988) and was extended by Kambe *et al.* (1990b). We found at least two modes have been excited throughout our observations. They are an $\ell = -m = 4$ mode with a period of 3.33 hr and an $\ell = -m = 7$ mode with 2.43 hr. The oscillation with small order ($\ell = -m = 2$) may have been excited from several seasons, but it needs further confirmation. The hypotheses other than nonradial pulsations on the origin of line-profile variations are critically discussed.

No significant change in its rotational velocity has been observed throughout our observations. The time scale of acceleration of equatorial region by the observed nonradial pulsations is estimated and is shown to correspond almost to the Be quasi-periodic mass loss cycle in the star. It is supposed that the star rotates almost with its break-up velocity and hence no significant change in rotational velocity has been observed.

The relation between amplitudes of line-profile variations and mass loss phase is clearly seen in this star. The amplitude of line-profile variations has increased toward the beginning of mass loss and reached its maximum during emission episodes, and decreased with the end of the emission episodes. This strongly suggests the connection between the line-profile variations and its quasi-periodic mass loss in this star; that is, acceleration of the equatorial region by nonradial pulsations many lead to the mass loss from the equator.

Spectroscopic Stare of the Be Star ζ Tau in 1976 - 1986

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Submitted to: *Publications of the Astronomical Society of Japan*
Preprints: T. Kogure at first address.

Abstract: The long-term variations of the radial velocities (RV) of the shell absorption lines and the violet-to-red ratio (V/R) of the emission double peaks of ζ Tau are examined, based on the spectrograms taken at the Okayama Astrophysical Observatory. It is found that the pseudo-periodic variation has been terminated since 1980 and ζ Tau seems to have entered a new quiet phase in its long-term activity.

A Phase Change in X Persei
NORTON A.J.[1] - COE M.J.[1] - ESTELA A.[2] - FABREGAT J.[2] - GORROD M.J.[1] - KASTNER J.[3] - PAYNE B.J.[1] - REGLERO V.[2] - ROCHE P.[1] - UNGER S.J.; 1. High Energy Astrophysics Group, Physics Department, University of Southampton, Southampton, SO9 5NH, U.K., 2. Departamento de Matemática Aplicada y Astronomía, Universidad de Valencia, 46100 Burjassot (Valencia), Spain, 3. Department of Astronomy, University of California, Los Angeles, CA 90024, USA.
To be Published in: *Monthly Notices of the Royal Astronomical Society*
Preprints: M. Coe at first address.

Abstract: We present a series of optical spectroscopic and infrared photometric observations of the Be/X-ray binary system X Per made over the last four years. Over this period the Hα line profile changed from emission to absorption, accompanied by a decrease in the infrared flux by over a magnitude and a flattening of the infrared spectrum. Such behavior is consistent with the loss of the circumstellar disk or shell of material around the Be star and the reversion to a "normal" O/B-type star. Whilst such behavior has been seen in the optical spectra of many other Be/B stars before, this is only the second time such observations have been made for a star in a high mass X0-ray binary system. Furthermore, the contemporaneous optical and infrared data provide some of the first direct evidence that the near infrared excess and Balmer line emission do indeed arise in the sam circumstellar material.

Investigating Short-Term Variability in Be Stars Through International Multiwavelength Campaigns
PETERS G.J.; Space Sciences Center, University of Southern California, University Park, Los Angeles, CA 90089-1341, USA.
To be Published in: Proceedings from the workshop *Nonisotropic and Variable Outflows from Stars*, held in Baltimore, MD at the STScI October 8-10, 1991.
Preprints: G.J. Peters at above address.

Abstract: During the past four years we have carried through six multiwavelength campaigns to investigate the cause for the short-term optical light variability in Be stars and whether it is linked to the mass loss mechanism. The observations reveal that the light variations result from a modulation in the star's photospheric temperature, the mass loss is enhanced when the star is bright, and the absolute intensity of the C IV emission is anticorrelated with the flux level and wind absorption and support the nonradial pulsation (NRP) model which has been proposed to explain the photometric variability.

Physical Properties of Be-Star Envelopes from Balmer and Fe II Emission Lines
SLETTEBAK A. - COLLINS II G.W. - TRUAX R.; Department of Astronomy, The Ohio State University, 174 W. 18th Avenue, Columbus, OH 43210, USA.
To be Published in: *Astrophysical Journal, Supplement Series*
Preprints: A. Slettebak at above address.

Abstract: Balmer Hα, Hβ, Hγ and Fe II 6516 line profiles with resolution of 0.45 Å were obtained for 41 bright Be stars with a CCD detector at the Kitt Peak coudé feed telescope during two observing periods in 1989. Emission profiles were derived by subtracting from the underlying star photospheric line profiles which were computed from rotating model atmospheres, taking into account shape

distortion, gravity darkening, and change of spectral type due to rotation.

Analysis of the structure of the emission profiles leads to the following conclusions: (1) The Be-star emitting envelope is most likely axially symmetric, consistent with a rotating, equatorial disk; (2) Some Be stars appear to have a two-component emitting envelope: an inner disk, possibly turbulent, and an outer extended disk; (3) Be stars showing weak Hα emission have smaller emission disks than those with strong Hα emission; (4) Assuming Keplerian rotation of the gas in the emitting disks, Hα emission arises, on average, in the range 7-19 stellar radii from the central star, Hβ emission 5-12 stellar radii, Hγ emission 5-11 stellar radii, and Fe II emission 3-4 stellar radii from the central star. There is a correlation of disk size with excitation potential, except for the Fe II line, which may form in the same part of the disk as Lyman α due to a fluorescence process. Some shell stars appear to have smaller, more compact disks than "normal" Be stars.

From the Balmer emission decrements we find that (1) Be-star envelopes with T_e near 10,000 K have electron densities in the range 10^{11} to 10^{13} cm^{-3}; (2) Be stars with weak Balmer emission have, on average, somewhat flatter Balmer decrements than stars with strong emission, suggesting that they have envelopes with higher electron densities; (3) Early-type Be stars have, on average, flatter Balmer decrements that the later-type stars, suggesting envelopes with higher electron densities for the hotter stars; (4) There is no obvious correlation between Balmer decrements and either luminosity class or $v \sin i$ of the underlying stars; (5) Be-shell stars have much steeper Balmer decrements than "normal" Be stars, suggesting that their envelopes have lower electron densities. Their envelopes may be systematically different from those of normal Be stars; (6) The temporal spread of most of the measured parameters for individual Be stars is comparable to differences from star to star, suggesting that it may be possible to understand typical Be-star envelopes (not including the shell stars) as similar structures that simply evolve in time.

A Model for "Dimples" in the B2e Star λ Eri

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To be Published in: Proceedings from the workshop *Nonisotropic and Variable Outflows from Stars*, held in Baltimore, MD at the STScI October 8-10, 1991.
Preprints: M.A. Smith at above address.

Abstract: We show that a common type of spectral transient in the He I λ6678 line of λ Eri can be understood as a consequence of doppler-mapping of backscattered line flux around the edge of an opaque cloud suspended over the star. Such structures appear suddenly and are reminiscent of solar quiescent prominences.

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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
IAUC	IAU Circular
IBVS	Information Bulletin on Variable Stars
IKAO	Izvestia Krimskoj Astrofiziceskoj Observatorii
MNRAS	Monthly Notices of the Royal Astronomical Society
NATO	*Active Close Binaries*, ed. C. Ibanoglu, NATO ASI Series C - Vol. 319
PASP	Publications of the Astronomical Society of the Pacific
PPMO	Publications of the Purple Mountain Observatory

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104th ASTRONOMICAL SOCIETY of the PACIFIC Annual Meeting

Massive Stars: Their Lives in the Interstellar Medium

University of Wisconsin - Madison
June 23-25, 1992

MEETING INFORMATION

This is the first announcement of the scientific symposium, *Massive Stars: Their Lives in the Interstellar Medium*, to be held in Madison, Wisconsin, on June 23-25, 1992. This symposium is sponsored by the ASP and hosted by the University of Wisconsin.

Massive stars are closely coupled to the interstellar medium from their births to their deaths. During their lives the stars are responsible for many of the fundamental physical processes as well as some of the most spectacular phenomena occurring in galaxies. The goal of this meeting is to bring together experts on either massive stars or interstellar medium physics to discuss our current understanding of the interaction phenomena. These interactions include the rather poorly understood topic of the formation of massive stars in the molecular clouds, the effects of the stellar radiation and winds on the ISM, and the terminal supernovae phase as seen in the explosion of SN 1987A. The collective action of massive stars is also a topic of discussion because of its importance in starburst and Wolf-Rayet galaxy phenomena. The scientific symposium will be organized as a combination of invited presentations and contributed posters. A preliminary list of speakers is attached. We are seeking funds to support a very limited number of students, young researchers and other participants. The proceedings of the scientific symposium will be published by the Astronomical Society of the Pacific as part of the ASP Conference series. Both invited talks and poster papers closely related to the topic of the meeting will be published.

SCIENTIFIC SESSIONS

Among the topics to be covered by invited speakers are the following general areas:

- Young Massive Stars and Molecular Clouds
- The Evolution and Populations of Massive Stars
- Effects of Massive Star Winds and Radiation on the ISM
- Terminal Phases of Massive Stars
- The Effects on Galaxies and Broader Issues

SCIENTIFIC ORGANIZING COMMITTEE:

J. Cassinelli (U Wisconsin; chair), R. Chevalier (U Virginia), E. Churchwell (U Wisc.), P. Conti (U Colorado), K. Davidson (U Minnesota), J. Gallagher (U Wisc.), M. Jura (UCLA), F. Shu (UC Berkeley), S. Woosley (UC Santa Cruz)

LOCAL ORGANIZING COMMITTEE:

K. Bjorkman, R. Bless, L. Doherty, R. Mathieu (Chair), K. Stittleburg

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AGENDA: Scientific Meeting to be held in Conjunction with ASP Meeting 1992

I. "Massive Stars: Their Lifecycles and Interactions with the ISM"

Invited Speaker List

Session 1: "Young Massive Stars and Molecular Clouds" (Tuesday Morning, June 23)

1. Jack Welch	"Formation and Early Evolution of Young Massive Stars"
2. David Hollenbach	"Models of the Star Forming Molecular Clouds"
3. Ed Churchwell	"Observations of Newly Formed Massive Stars"
4. Harold Yorke	"The Formation of Massive Stars, Recent Theoretical Results"
5. Fred Adams	"Accretion Disks Around Forming Massive Stars"

Session 2. "The Evolution and Populations of Massive Stars" (Tuesday Afternoon, June 23)

1. Norbert Langer	"Massive Star Evolution"
2. Phil Massey	"The Massive Star Content of the Magellanic Cloud and the Milky Way Galaxy"
3. Roberta Humphreys	"The Most Luminous Stars"
4. Steve Shore	"The Perplexing Variety of Massive Stars and the Possible Connection to Interstellar Environments"

Session 3. "Effects of Massive Star Winds and Radiation on the ISM" (Wednesday Morning, June 24)

1. John Castor	"Wind Mass, Momentum, and Energy Deposition"
2. Mike Jura	"Interstellar Chemical Enrichment by the Winds"
3. Dave Van Buren	"Wind Bow Shocks and Related Phenomena"
4. Mike Shull	"Hot Phases of the ISM As Produced By Winds"
5. Ron Reynolds	"The Radiative Ionization of the ISM"

Session 4. "The Terminal Phases of Massive Stars" (Thursday Morning, June 25)

1. Roger Chevalier	"SN Expansion, Shocks and Remnants"
2. Don Cox	"Late Stages in the SN Remnant Expansion"
3. Jay Elias	"Observations of SN 1987A"
4. Nino Panagia	"Interactions in the Outflow from SN 1987A"

Session 5. "The Effects on Galaxies and Broader Issues" (Thursday Afternoon, June 25)

1. Peter Conti	"Wolf-Rayet Galaxies"
2. Jay Gallagher	"Starburst Galaxies"
3. Paul Hodge	"Giant H II Regions"
4. Kris Davidson	"Unresolved Questions Regarding the Massive Stars and Their Interactions with the ISM"

II. Historical Session (Wednesday Afternoon, June 24)

1. JoAnne Eisberg	"The Eddington Limit"
2. Arthur Code	"Photocells, Hot Stars and Spiral Arms"