THE $\mathrm{H}^{\star}\mathrm{O}^{\mathrm{T}}$ STAR NEWSLETTER

An electronic publication dedicated to A, B, O, Of, LBV and Wolf-Rayet stars and related phenomena in galaxies

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eenens@carina.astro.ugto.mx http://www.star.ucl.ac.uk/~hsn/index.html

Contents of this newsletter

From the editor

Books

• The book `'Introduction to Stellar Winds'` (Lamers and Cassinelli) is now available from Cambridge University Press.

Paper back: ISBN 0-521-59565-7
Hardbound: ISBN 0-521-59398-0

• The Proceedings of `IAU Symposium No. 193` are in press and will be available in early August. The Table of Contents can be downloaded from ftp://saturn.sron.nl/pub/karelh/PROC/TOC.PS
Individual papers should be referred to as:
....., 1999, in: K.A. van der Hucht, G. Koenigsberger & P.R.J. Eenens (eds.), Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies, Proc. IAU Symp. No. 193 (San Francisco: ASP), p. ...

Job

A post doctoral position is opening in Liège (Belgium): details are provided on the last page of this newsletter.

Meetings

In this newsletter, we give information on several meetings:
• `The Interplay between Massive Stars and the ISM` (France, September 1999)
• `Massive Star Birth` (IAU General Assembly, Manchester, August 2000)
• `Eta Carinae and other mysterious stars: A hidden opportunity for emission spectroscopy` (Sweden, August 2000)

Accepted Papers

Hubble Space Telescope Imaging Polarimetry of η Carinae

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Linear polarization measurements have been a key to our understanding of the massive star system η Carinae and its surrounding Homunculus nebula. We here present the results of (linear) polarimetric imaging of η Carinae in the V (F555W) band with the Hubble Space Telescope's Wide Field Planetary Camera 2 (HST/WFPC2). The data agree well with previous ground-based measurements of the large-scale polarization across the Homunculus, allowing us to confirm that it is primarily a reflection nebula. The HST observations add information on the variation of the polarization across the lobes on small spatial scales. We provide measurements of the polarization in a variety of structures such as the jet, the skirt, the paddle, the southern ridge, and the spot, and discuss the properties of the polarization of the Homunculus on large and small spatial scales. Using a simple Mie-scattering model, we argue that of three previously proposed geometries for the three-dimensional structure of the Homunculus only the double-flask geometry represents a dust distribution which is consistent with our polarization map.

Accepted by AJ, Sept. 1999 issue
Preprints on the web at http://www.phyast.pitt.edu/∼rsl/reginas_research.html

Long-term visual spectrophotometric behaviour of Be stars. II. Correlations with fundamental stellar parameters and interpretation

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The long-term visual spectrophotometric (SPh) behaviour of Be stars as a function of fundamental stellar parameters is studied. Some previous SPh results obtained by other authors are confirmed. Moreover, a tendency for temperature and aspect angle dependency of SPh variations is found. From the characteristics of visual SPh behaviour in Be stars we derive constraints for models of regions in

circumstellar envelopes where the visual continuum spectrum is formed: (*i*) The SPh emission and absorption phases should not imply preferential aspect angles, as they can both appear whatever the stellar inclination. This phenomenon cannot be always accounted for by strongly flattened circumstellar envelopes; (*ii*) Radii of the visible continuum forming regions cannot be larger than a few R_*; (*iii*) Electron densities of these regions should not exceed $N_e \sim 10^{13}$ cm^{-3}; (*iv*) Electron temperature of circumstellar layers producing the SPh emission phases compare with the stellar Balmer continuum radiation temperature and it is much lower in those producing the SPh absorption phases. Three scenarios were studied to produce the observed characteristics of emissions in the V magnitude and in the second component of Balmer discontinuity (ΔD) during the SPh emission phases: (a) expansion of a massive circumstellar shell that preserves circumstellar envelope flattening; (b) expansion of a circumstellar shell which increases the global flattening, so that a disc-like structure is formed; (c) continuous mass ejection that increases the storage of mass in a constant volume with a given flattening. Mechanisms (a) and (b) produce a double valued ($\Delta V, \Delta D$) SPh relation, while (c) produces a single valued relation. Only mechanisms (a) and (c) can easily produce the observed amounts of emission ΔV and ΔD without violating the modeling constraints from (*i*) to (*iv*) imposed by observations. The model SPh slopes of ($\Delta V, \Delta D$) show the global $\sin i$ and $T_{\rm eff}$ observed dependencies. The scenarios used to describe the double valued ($\Delta V, \Delta D$) suggest another possible way how to build up circumstellar envelopes around Be stars.

Accepted by Astronomy & Astrophysics
Preprints from Zorec@iap.fr

Light variations of massive stars (α Cyg variables) XVII. The LMC supergiants R 74 (LBV), R 78, HD 34664 = S 22 (B[e]/LBV), R 84 and R 116 (LBV?)

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Multi-colour photometry (Walraven system) of five super- and hypergiants in the LMC, viz. R 74, HD 34664 = S 22, R 84 and R 116, is searched for variability and periods, and discussed. Apart from R 84, of which the claimed variability in the past must be due to a number of faint field stars at the edge of the apertures, all are variable.

R 74 and HD 34664 are weak-active LBVs with superimposed microvariations. HD 34664 is the second known B[e] star which is also an LBV. The first reported one is R 4 in the SMC. This could alter some views on the evolutionary history of B[e] stars and LBVs.

R 78 is an α Cyg variable, but presumably no LBV. R 116 appears to be a close counterpart of the galactic ex-/dormant LBV ζ^1 Sco, also showing an intricate α Cyg-type multi-period microvariability.

Accepted by A&A
Preprints from genderen@strw.leidenuniv.nl

Recurrent X-ray Emission Variations of η Carinae and the Binary Hypothesis

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Recent studies suggest that the super-massive star η Carinae may have a massive stellar companion although the dense ejecta surrounding the star make this claim hard to test using conventional methods. Settling this question is critical for determining the current evolutionary state and future evolution of the star. We address this problem by an unconventional method: If η Carinae is a binary, X-ray emission should be produced in shock waves generated by wind-wind collisions in the region between η Carinae and its companion. Detailed X-ray monitoring of η Carinae for more than 2 years shows that the observed emission generally resembles colliding-wind X-ray emission, but with some significant discrepancies. Briefly, the presence of enhanced absorbing material – such as a circumstellar disk – has been examined to explain the discrepancies. Furthermore, periodic X-ray "flaring" may provide an additional clue to determine the presence of a companion star and for atmospheric pulsation in η Carinae.

Accepted by Astrophysical Journal
Preprints from `bish@ast1.spa.umn.edu`

Determining the Physical Properties of the B Stars I. Methodology and First Results

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We describe a new approach to fitting the UV-to-optical spectra of B stars to model atmospheres and present initial results. Using a sample of lightly reddened stars, we demonstrate that the Kurucz model atmospheres can produce excellent fits to either combined low dispersion *IUE* and optical photometry or *HST* FOS spectrophotometry, as long as the following conditions are fulfilled:

1. an extended grid of Kurucz models is employed,
2. the *IUE* NEWSIPS data are placed on the FOS absolute flux system using the Massa & Fitzpatrick (1999) transformation, and
3. all of the model parameters *and* the effects of interstellar extinction are solved for *simultaneously*.

When these steps are taken, the temperatures, gravities, abundances and microturbulence velocities of lightly reddened B0-A0 V stars are determined to high precision. We also demonstrate that the same procedure can be used to fit the energy distributions of stars which are reddened by any UV extinction curve which can be expressed by the Fitzpatrick & Massa (1990) parameterization scheme.

We present an initial set of results and verify our approach through comparisons with angular diameter measurements and the parameters derived for an eclipsing B star binary. We demonstrate that the metallicity derived from the ATLAS 9 fits to main sequence B stars is essentially the Fe abundance. We find that a near zero microturbulence velocity provides the best-fit to all but the hottest or most luminous stars (where it may become a surrogate for atmospheric expansion), and that the use of white dwarfs to calibrate UV spectrophotometry is valid.

Accepted by Astrophysical Journal
Preprints on the web at `astro-ph/9906257`

Fundamental parameters of galactic luminous OB stars III. Spectroscopic analysis of O stars in Cygnus OB2

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We present the results of the spectral analysis of 11 OB stars in Cyg OB2, among them seven giants and supergiants. The projected rotational velocities of these stars are low or moderate. We find that only one of the stars (previously classified as luminosity class V) shows helium enhancement, and that this turns out to be compatible with standard evolutionary models without rotation. Only a second object gives an abundance that could be larger than solar. In addition, these two stars are found to be the most luminous in the sample. In summary, no helium discrepancy is found for the stars analyzed in Cyg OB2. The cause of this result is speculated to be due to: a) the youth of the stars studied, b) the low rotational velocity of the sample observed, or c) a combination of both. The massive stars in Cyg OB2 are found to have ages between 1 and 5 Myr, and the most massive ones have initial evolutionary masses in excess of 100 $M_{\odot}$. Thus we confirm that Cyg OB2 is a young association rich in very massive stars. We study a possible correlation between the helium abundance and the stellar rotation and conclude that present data are consistent with the hypothesis that mixing processes probably related to rotation are present in the massive stars and in some cases strongly influence their early evolutionary phases.

Accepted by Astronomy & Astrophysics
Preprints from `ahd@ll.iac.es`
or on the web at `http://www.iac.es/publicaciones/preprints.html`

HST/NICMOS Observations of Massive Stellar Clusters Near the Galactic Center

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We report *Hubble Space Telescope* (*HST*) Near-infrared Camera and Multi-object Spectrometer (NICMOS) observations of the Arches and Quintuplet clusters, two extraordinary young clusters near the Galactic Center. For the first time, we have identified main sequence stars in the Galactic Center with initial masses well below 10 $M_\odot$. We present the first determination of the initial mass function (IMF) for any population in the Galactic Center, finding an IMF slope which is significantly more positive ($\Gamma \approx -0.65$) than the average for young clusters elsewhere in the Galaxy ($\Gamma \approx -1.4$). The apparent turnoffs in the color-magnitude diagrams suggest cluster ages which are consistent with the ages implied by the mixture of spectral types in the clusters; we find $\tau_{\rm age} \sim 2\pm1$ Myr for the Arches cluster, and $\tau_{\rm age} \sim 4\pm1$ Myr for the Quintuplet. We estimate total cluster masses by adding the masses of observed stars down to the 50% completeness limit, and then extrapolating down to a lower mass cutoff of 1 $M_\odot$. Using this method, we find $\gtrsim 10^4$ $M_\odot$ for the total mass of the Arches cluster. Such a determination for the Quintuplet cluster is complicated by the double-valued mass-magnitude relationship for clusters with ages $\gtrsim$ 3 Myr. We find a lower limit of 6300 $M_\odot$ for the total cluster mass, and suggest a best estimate of twice this value which accounts for the outlying members of the cluster. Both clusters have masses which place them as the two most massive clusters in the Galaxy.

Accepted by ApJ
Preprints from `http://www.astro.ucla.edu/~figer/papers.html`

High Resolution Infrared Imaging and Spectroscopy of the Pistol Nebula: Evidence for Ejection

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We present new infrared images, obtained with the *Hubble Space Telescope* (*HST*) Near-infrared Camera and Multi-object Spectrometer (NICMOS), and Br-α (4.05 μm) spectroscopy, obtained using CGS4 on UKIRT, of the Pistol Star and its associated nebula. We find strong evidence to support the hypothesis that the Pistol Nebula was ejected from the Pistol Star. The Pa-α (1.87 μm) NICMOS image shows that the nebula completely surrounds the Pistol Star, although the line intensity is much stronger on its northern and western edges. The Br-α CGS4 spectra show the classical ring-like signature of quasi-spherical expansion. The blueshifted emission ($V_{\rm max} \approx -60$ km s^{-1}) is much weaker than the redshifted emission ($V_{\rm max} \approx +10$ km s^{-1}), where the velocities are with respect to the velocity of the Pistol Star; further, the redshifted emission spans a very narrow range of velocities, i.e., it appears "flattened" in the position-velocity diagram. These data suggest that the nebula was ejected from the star several thousand years ago, with a velocity between the current terminal velocity

of the stellar wind (95 $\mathrm{km\,s^{-1}}$) and the present expansion velocity of gas in the outer shell of the nebula (60 $\mathrm{km\,s^{-1}}$). The Pa-α image reveals several emission-line stars in the region, including two newly-identified emission-line stars north of the Pistol Star, both of which are likely to be the hottest known stars in the Galactic center with spectral types earlier than WC8 and $T_{\rm eff} > 50{,}000$ K). The presence of these stars, the morphology of the Pa-α emission, and the velocity field in the gas suggest that the side of the nebula furthest from us is approaching, and being ionized by, the hot stars of the Quintuplet, and that the highest velocity redshifted gas has been decelerated by winds from the Quintuplet stars. We also discuss the possibility that the nebular gas might be magnetically confined by the ambient magnetic field delineated by the nearby nonthermal filaments.

Accepted by ApJ
Preprints from `figer@astro.ucla.edu`
or by anonymous ftp to `ftp://quintup.astro.ucla.edu/pistol2/`
or on the web at `http://www.astro.ucla.edu/~figer/papers.html`

Spectral observations of AG Draconis during quiescence and outburst (1993 – 1995)

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High and intermediate resolution observations of the blue and the Hα spectral regions of the symbiotic star AG Dra at quiescence and during an active phase in 1994 and 1995 were performed. Variations of profiles, fluxes and radial velocity data of a number of emission lines are investigated. The width (FWHM) of all of these lines was very large at times close to the 1994 light maximum. The emission measure of the surrounding nebula was also calculated using Balmer continuum emission on the basis of U photometric observations from the literature. It turned out that at the times of the 1994 and 1995 visual light maxima the emission measure has increased by a factor of 15 and 8 respectively, compared with its quiescent maximal value. After the 1995 light maximum the profiles of the=A0 Hβ and Hγ lines contained a broad emission component that indicated a hot stellar wind. The velocity of this wind and the mass-loss rate of the hot secondary giving its rise, were equal to 800 $\mathrm{km\,s^{-1}}$ and $2\,10^{-7}$ $\mathrm{M_\odot\,yr^{-1}}$. A view that the observed presence of a hot wind and the increase of the emission measure together can be considered as an argument in support of the thermonuclear outburst model is discussed. Moreover, we argue that a shocked wind region with X-ray luminosity of about 10 $L_\odot$must be present in this system when the hot wind exists.

Accepted by Astronomy and Astrophysics Main Journal
Preprints from `rozhen@mbox.digsys.bg=A0`

Submitted Papers

Hot Star Polarimetric Variability and the Nature of Wind Inhomogeneities

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The problem is addressed of how much hot star polarisation variability can result from density redistribution processes within the wind as opposed to localised enhancement of stellar mass loss rate, such as ejections of wind inhomogeneities. For optically thin electron scattering, we present a theory for the relative polarisation arising from particle redistribution and consider several specific cases relevant to interpreting observations of wind variability. It is concluded that, allowing for partial cancellation of the contribution from compressed and evacuated regions, density redistribution internal to the wind can produce significant polarisation *but only* for processes that redistribute wind material over relatively large radial or angular scales. This conclusion favors extended spatial structures (e.g., from strong radiatively driven shocks) over localised condensations (e.g., from radiative instabilities).

Submitted to Astronomy & Astrophysics

Preprints from `rico@astro.gla.ac.uk`
or by anonymous ftp to `ftp.astro.gla.ac.uk; cd pub/rico; get polvar.ps`

Scattering polarization due to light source anisotropy I. Large spherical envelope

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Expressions are developed for the flux and polarization of radiation scattered by a spherically symmetric envelope for a central point stellar light source that radiates anisotropically. These are obtained in terms of the components of the spherical harmonics of the flux anisotropy from the source. Such anisotropy can arise from stellar spots, or from distortion of the star through rotation, pulsation, or magnetic effects. Explicit expressions for the Stokes parameters are obtained in the case of an ellipsoidal star of uniform surface brightness. It is thus shown that even when the scattering envelope is spherical, observationally significant polarization can arise from stars with physically realistic degrees of distortion. The time dependence of the polarization is computed for models of ellipsoidal stars in the cases of pure rotation, pure pulsation, and both rotation and pulsation.

Submitted to Astronomy & Astrophysics

Preprints from `rico@astro.gla.ac.uk`
or by anonymous ftp to `ftp.astro.gla.ac.uk; cd pub/rico; get almalki.ps`

On the evolutionary status of Be stars

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We present a study of the abundance of Be stars in open clusters as a function of the cluster age, using whenever possible ages determined through Strömgren *uvby* photometry. For the first time in studies of this kind we have considered separately classical and Herbig Be stars.

The main results can be summarized as follows:

- Clusters associated to emitting nebulosities and undergoing stellar formation are rich in emission line objects, which most likely are all pre main-sequence objects. No bona fide classical Be star has yet been identified among them.
- Clusters younger than 10 Myr and without associated nebulosity are almost completely lacking Be stars, despite they have a complete unevolved B main sequence.
- Classical Be stars appear at an age of 10 Myr, and reach the maximum abundance in the age interval 14-25 Myr.

We interpret our results in the sense that the Be phenomenon is an evolutionary effect which appears in the second half of the main sequence lifetime of a B star. We propose that it can be related to main structural changes happening at this evolutionary phase, which also lead to the recently discovered non-monotonic helium abundance enhancement. The semiconvection or turbulent difussion responsible of the surface helium enrichment, coupled with the high rotational velocity, can generate magnetic fields via the dynamo effect and thereby originate the Be phenomenon. Observational tests to this hypothesis are proposed.

Submitted to Astronomy & Astrophysics
Preprints from `juan@pleione.uv.es`
or on the web at `http://pleione.uv.es/recent.html`

Proceedings

Super star clusters in the Galactic Center as revealed by *HST*/NICMOS

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The three massive clusters in the Galactic Center are not only the most massive young clusters in the Galaxy, but they harbor more Wolf-Rayet stars than any other starburst region in the Local Group.

An understanding of their stellar content will be valuable for extending models to starburst regions in other galaxies. We present *HST*/NICMOS images, luminosity functions, and color-magnitude diagrams of two of these: the Quintuplet and Arches clusters. The images allow the detection of stars over 6 magnitudes fainter than ever before and reveal previously undetected multiple star systems. For the first time, we clearly identify the main sequence in the Quintuplet cluster, and we extend earlier detections of the main sequence in the Arches cluster to $M_{\rm initial} < 10$ M$_\odot$. We estimate that the Arches cluster has an initial mass function slope which is greater than the Salpeter value. Given their stellar content, the Galactic Center clusters provide both the best nearby examples of super star clusters and the best nearby locale in which to investigate Wolf-Rayet phenomena in starburst galaxies and galactic nuclei. We discuss the content of the Galactic Center clusters, with a particular emphasis on how they compare to other massive clusters of the local group. We expect that many of the massive stars in the Galactic Center will soon evolve to become Wolf-Rayet stars, and eventually become supernovae at a rate of ≈ 1 per 20,000 years for the next several Myr. We note that our preliminary N-body simulations suggest that such dense clusters are short-lived in the strong tidal field of the Galactic Center, consistent with the fact that no older dense clusters are seen in the central 50 pc. This implies a star formation rate of $5(10^{-3})$ M$_\odot$ yr^{-1} in the Galactic Center.

To appear in Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies, Proc. IAU Symposium No. 193
Preprints from `http://www.astro.ucla.edu/~figer/papers.html`

Meetings

The Interplay between Massive Stars and the ISM

Parallel Session I of JENAM99
Joint Meeting of the European Astronomical Society and the French Astronomical Society
September 7-11, 1999, Toulouse, France
Session I on September 10-11, 1999

JENAM99 Web page: http://www.omp.obs-mip.fr/omp/umr5572/JENAM99/

Additional information on Session I: http://www.obs-mip.fr/omp/astro/people/schaerer/jenam99/

Scope of session I:

The interplay between massive stars and the ISM plays a fundamental role in the formation and evolution of galaxies. In addition to providing ionizing photons and newly synthesized elements, massive stars inject copious amounts of kinetic energy and momentum to their surrounding gas through stellar winds and supernovae. Considerable progress has been made in the recent years on our understanding of the nature and physics of these feedback mechanisms and their importance. The aim of this session is to gather specialists from different fields which allow to contribute to a consistent picture of these phenomena.

Scientific program and contributions:

The scientific program includes three main topics: * Stellar content and physics of massive star-forming regions (giant HII regions, starbursts) * Chemical enrichment by massive stars * The dynamical impact of star formation on the ISM from small to large scales

Some review talks will be invited. Oral contributions and posters are welcome.

Scientific Organizing committee of Session I:

F. Ferrini (Italy), R. Gonzalez-Delgado (Spain, co-chair), M. Heydari-Malayeri (France), D. Lutz (Germany), A. Maeder (Switzerland), D. Schaerer (France, chair), R. Terlevich (United Kingdom)

Registration etc.:

Informations on registration, accommodation, etc. are found on the central JENAM99 page. This page also includes the scientific program of the plenary session and all parallel sessions. All registrations are handled centrally through this page.

Birth of Massive Stars

Joint Discussion
IAU General Assembly
Manchester, August 2000

Contact Persons:

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Scientific Organizing Committee

Peter S. Conti (co-Chair), Edward Churchwell (co-Chair), John Dyson, Guido Garay, Tom Hartquist, Karl Menten, Ewine van Dishoeck, Malcolm Walmsley.

Main topics of Preliminary Scientific Program

This JD will consider the birth processes of massive stars, with initial masses larger than 10 solar masses. While similar phenomena are found in low mass star formation (accretion discs, outflows, etc.) additional physics must be considered given the ionization of the interstellar environment by Lyman continuum photons, stellar winds from the hot star(s), and their deeper gravitational potentials. This Joint Discussion will bring together experts from several disparate astronomical communities: stellar astrophysics, interstellar medium, radio astronomy, and stellar dynamics. The concept is to contrast observations of very young stars and star formation regions over various wavelengths with theoretical expectations.

(Draft) Program

During the one day meeting we plan to have 6 - 8 speakers, with sufficient time allowed for discussion. Following each broad topic is a list of confirmed and suggested speakers.

I. The Natal Environment (molecular clouds; embedded sources; etc)

Leo Blitz, Riccardo Cesaroni, Ewine van Dishoeck, Lee Mundy, Johnathan Williams, David Wilner

II. Star Formation Processes (GHII and UCHII regions; etc)

Edward Churchwell, John Dyson, Marcello Felli, Robert Kennicutt, Luis Rodriguez

III. Relationship of Discs and Jets to Massive Star Evolution

James Caswell, James Cohen, Lincoln Greenhill, Susana Lizano, Karl Menten, Debra Shepard

IV. Early Evolutionary Phases of Massive Stars

Robert Blum, Catherine Dougados, Dan Gezari, Margaret Hanson, Melvin Hoare, Bringfield Stecklum

Footnote

Although there is some overlap in specific topics with the Elba Workshop (June 2000, "High Mass Star Formation: An Origin in Clusters?"), the latter has greater emphasis on cluster formation whereas ours emphasizes the impact of hot, luminous stars on the birth environments.

Eta Carinae and other mysterious stars
A hidden opportunity for emission spectroscopy

Hven, Sweden
August 24-26, 2000

Introduction

A conference will be arranged by the University of Lund and held on the island of Hven, Tycho's island, August 24-26, 2000. Hven is located in Oeresund between Denmark and Sweden, and the most suitable airport is Copenhagen. The conference will follow directly after the P Cygni meeting at Armagh University, Ireland, allowing one day for travel between Ireland and Sweden.

For more information and pre-registration, please, visit the Web page:
http://ferrum.fysik.lu.se/hven2000

The Programme

The meeting is a continuation of the workshops on Eta Carinae arranged in 1997 and 1998 by the University of Minnesota. We will focus on the latest work on Eta Carinae, with an emphasis on spectroscopy, and also include spectroscopic emission line problems in similar objects. The topics are:
Eta Carinae:

- Spectroscopy from X-rays to radio
- The central star – eruptions, binarity?
- Modelling and plasma diagnostics
- Spectral variation in time and space

Spectroscopy of other strange emission line objects
Fluorescence and similar radiative processes

Location and Accommodation

The conference site is a holiday village including 40 houses, restaurant, conference hall and recreation facilities. Each house can host 3-4 persons, and the rent for each cottage depends on the number of occupants. We strongly recommend people to share a house in order to keep the cost low and to allow for as many attendants to the meeting as possible. There are no other accommodation facilities on the island, but hotel rooms are available on the mainland (the city of Landskrona), which is reached by regular boat traffic. The reservation of the cottages will be arranged by the organizers on a first come, first serve basis.

Registration

At this stage we urge people to fill in a pre-registration form in order to give us an idea of the approximate number of attendants. Please forward this announcement to other colleagues, who might be interested in this conference.

Sveneric Johansson, Torgil Zethson and Henrik Hartman
Atomic Spectroscopy, Department of Physics, Lund University, Lund, Sweden

Jobs

Post doctoral position in "Studies of Massive Stars with the XMM Satellite with a Special Emphasis on Binary Systems" at the Department of Astrophysics and Geophysics of Liège University

Applications are invited for a post doctoral research assistant to work in the Hot Stars' group of the Department of Astrophysics and Geophysics of the Liège University which is an equal opportunities employer. This position is funded by Federal Research Grants and the appointment will initially be made for one year, with the possibility of a renewal for another year. The commencement date is foreseen on 1 January 2000, i.e. close to the launch date of XMM. Nevertheless it could be earlier by mutual agreement, and also depending on the background of the candidate.

Candidates from all areas will be considered but previous experience in high energy astrophysics will be considered as an advantage. The successful candidate is expected to interact strongly with the local research staff and devote his/her time to the analysis of XMM data acquired in the context of the Guaranteed Time Program of XMM. Before the release of the data, he/she should participate in the implementation and the development of the codes which will be used to interpret the data. For this part of the project, strong links already exist with Birmingham University. There is also an ongoing collaboration with SRON, Utrecht, for other aspects of the project.

Candidates should have a PhD in Astronomy/Astrophysics. The exact salary will depend on various parameters (age, marital status, scientific career,...). It would probably be of the order of 20000 euros/year with various additional social security contributions (like a basic health insurance for the family) paid by the employer.

Applicants should send by **September 30, 1999** a full curriculum vitae, including an outline of previous research experience and a statement of research interest, as well as the names of three references to :
Dr. Jean-Marie VREUX
Institut d'Astrophysique et de Géophysique
5, avenue de Cointe
B-4000 Liège, Belgium.

Informal enquiries about the position can be made to :
Dr. Gregor RAUW (rauw@astro.ulg.ac.be).