THE MASSIVE STAR NEWSLETTER

formely known as *the hot star newsletter*

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http://www.astroscu.unam.mx/massive_stars

http://www.star.ucl.ac.uk/~hsn/index.html

ftp://ftp.sron.nl/pub/karelh/UPLOADS/WRBIB/

Contents of this newsletter

News

I just want to bring to your attention a problem that the astronomical community in Ireland is experiencing which is very serious for the development of astronomy in this country, especially at a moment in which joining ESO seems to be a concrete prospect. It was decided in a totally undemocratic way to close to research the ONLY Observatory in the Republic of Ireland which is also the only institute entirely dedicated to astronomy in Ireland and the only place where astronomy outreach is happening. The whole astronomical community is against this and has already signed a petition to the Minister to stop this process. Please take a moment of your time to look at the petition that continues internationally and has already been signed by very well known atronomical names. The petition can be read and signed at:

http://www.petitiononline.com/save_obs

Best Regards

Laura Norci

Accepted Papers

Inferring Hot-Star-Wind Acceleration from Line Profile Variability

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The migration of profile sub-peaks identified in time-monitored optical emission lines of Wolf-Rayet (WR) star spectra provides a direct diagnostic of the dynamics of their stellar winds via a measured $\Delta v_{LOS}/\Delta t$, a line-of-sight velocity change per unit time. Inferring the associated wind acceleration scale from such an apparent acceleration then relies on the adopted intrinsic velocity of the wind material at the origin of this variable pattern. Such a characterization of the Line Emission Region (LER) is in principle subject to inaccuracies arising from line optical depth effects and turbulence broadening. In this paper, we develop tools to quantify such effects and then apply these to reanalyze the LER properties of time-monitored WR stars. We find that most program lines can be fitted well with a pure optically thin formation mechanism, that the observed line-broadening is dominated by the finite velocity extent of the LER, and that the level of turbulence inferred through Line Profile Variability (*lpv*) has only a minor broadening effect in the overall profile. Our new estimates of LER velocity centroids are systematically shifted outwards closer to terminal velocity compared to previous determinations, now suggesting WR-wind acceleration length scales βR_* of the order of $10 - 20\,R_\odot$, a factor of a few smaller than previously inferred. Based on radiation-hydrodynamics simulations of the line-driven-instability mechanism, we compute synthetic *lpv* for CIII5696Å for WR 111. The results match well the measured observed migration of 20-30 $\mathrm{m\,s^{-2}}$, equivalent to $\beta R_* \sim 20\,R_\odot$. However, our model stellar radius of $19\,R_\odot$, typical of an O-type supergiant, is a factor 2–10 larger than generally expected for WR core radii. Such small radii leave inferred acceleration scales to be more extended than expected from dynamical models of line driving, which typically match a "beta" velocity law $v(r) = v_\infty(1 - R_*/r)^\beta$, with $\beta \approx 1 - 2$; but the severity of the discrepancy is substantially reduced compared to previous analyses. We conclude with a discussion of how using lines formed deeper in the wind would provide a stronger constraint on the key wind dynamics in the peak acceleration region, while also potentially providing a diagnostic on the radial variation of wind clumping, an issue that remains crucial for reliable determination of O-star mass loss rates.

Accepted by A&A

Preprints available at www.mpa-garching.mpg.de/~luc/aa1461.pdf

On the α-element abundance gradients in the disk of the Sculptor spiral galaxy NGC 300

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We have carried out a detailed spectral analysis of six early B-type supergiants in the Sculptor Group spiral galaxy NGC 300. To this end, we used state-of-the-art unified blanketed Non-Local Thermodynamic Equilibrium model atmospheres (computed with the code FASTWIND), aimed at the determination of the stellar parameters and of detailed surface abundance patterns. We discuss the individual evolutionary stage of each star in view of their CNO surface abundance, which we compare to massive star evolutionary models with rotation. Although the quantitative comparison does not yield a good agreement, the qualitative behaviour is consistent with the model predictions. This issue supports the idea that, although rather evolved, the stars are directly evolving from the Main Sequence and therefore they are in a pre red supergiant phase. We derive the stellar abundance gradients in the disk of NGC 300 for the elements O, Mg and Si. Using the available literature data on H 2 regions in NGC 300, we carry out a detailed comparison of nebular oxygen abundances resulting from different, widely used empirical calibrations. Finally, we compare the abundance gradients derived from the ISM to those derived from the blue supergiants studied in this paper. We find a O/H abundance gradient of -0.033 ± 0.026 dex arcmin^{-1} over a distance equal to the isophotal radius of the galaxy. This trend is also followed in good agreement by Mg and Si abundances. The abundance gradients derived from our stellar data are shallower than those obtained from most previous H 2 region analyses, and we obtain a lower oxygen abundance in the central region of the galaxy (8.57 ± 0.13 dex), which is, however, in agreement with the H 2 region abundance results derived with recent calibrations of several statistical indicators.

Accepted by The Astrophysical Journal
Preprints on the web at `http://www.ifa.hawaii.edu/publications/preprints`

Doppler tomography of the Little Homunculus: High resolution spectra of [Fe II] 16435 around Eta Carinae

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High-resolution spectra of [Fe II] λ16435 around Eta Carinae provide powerful diagnostics of the geometry and kinematics of the "Little Homunculus" (LH) growing inside the larger Homunculus nebula. The LH expansion is not perfectly homologous: while low-latitudes are consistent with linear expansion since 1910, the polar caps imply ejection dates around 1920-1930. However, the expansion speed of the LH is much slower than the post-eruption wind, so the star's powerful wind may accelerate the LH. With an initial ejection speed of 200 km s^{-1} in 1890, the LH would have been accelerated to its present speed if the mass is roughly 0.1 $M_{\odot}$. This agrees with an independent estimate of the LH mass based on its density and volume. In any case, an ejection after 1930 is ruled out. Using the LH as a probe of the 1890 event, then, it is evident that its most basic physical parameters (total mass and kinetic energy; 0.1 $M_{\odot}$ and $10^{46.9}$ ergs, respectively) are orders of magnitude less than during the giant eruption in the 1840s. Thus, the ultimate energy sources were different for these two events – yet their ejecta have the same bipolar geometry. This clue may point toward a collimation mechanism separate from the underlying causes of the outbursts.

Accepted by MNRAS
Preprints from nathans@fsu.colorado.edu
or on the web at http://arXiv.org/abs/astro-ph/0412580

Massive Stars in the SGR 1806-20 Cluster

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We report the discovery of additional hot and massive stars in the cluster surrounding the soft gamma repeater SGR 1806-20, based upon UKIRT and Keck near-infrared spectroscopy. Of the newly identified stars, three are Wolf-Rayet stars of types WC8, WN6, and WN7, and a fourth star is an OB supergiant. These three stars, along with four previously discovered, imply a cluster age of 3.0-4.5 Myr, based on the presence of WC stars and the absence of red supergiants. Assuming coevality, this age suggests that the progenitor of SGR 1806-20 had an initial mass greater than 50 Msun. This is consistent with the suggestion that SGRs are post-supernovae end states of massive progenitors, and may suggest that only massive stars evolve into magnetars that produce SGRs. It also suggests that very massive stars can evolve into neutron stars, not just black holes, as recently predicted by theory. The cluster age also provides constraints on the very high mass object, LBV 1806-20.

Accepted by ApJ Letters
Preprints from figer@stsci.edu
or on the web at http://www-int.stsci.edu/f̃iger/web/private/papers/1806-20/

The nearest star of spectral type O3: a component of the multiple system HD150136

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¿From radial velocities determined in high signal-to-noise digital spectra, we report the discovery that the brightest component of the binary system HD 150136 is of spectral type O3. We also present the first double-lined orbital solution for this binary. Our radial velocities confirm the previously published spectroscopic orbital period of 2.6 days. He II absorptions appear double at quadratures, but single lines of N V and N IV visible in our spectra define a radial velocity orbit of higher semi-amplitude for the primary component than do the He II lines. From our orbital analysis, we obtain minimum masses for the binary components of 27 and $18 M_{\odot}$. The neutral He absorptions apparently do not follow the orbital motion of any of the binary components, thus they most probably arise in a third star in the system.

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Preprints from rgamen@dfuls.cl
or on the web at http://www.dfuls.cl/∼rgamen/downloads/mnr8513-974-978.pdf

Type IIP Supernovae as Cosmological Probes: A SEAM Distance to SN 1999em

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Due to their intrinsic brightness, supernovae make excellent cosmological probes. We describe the SEAM method for obtaining distances to Type IIP supernovae (SNe IIP) and present a distance to SN 1999em for which a Cepheid distance exists. Our models give results consistent with the Cepheid distance, even though we have not attempted to tune the underlying hydrodynamical model, we have simply chosen the best fits. This is in contradistinction to the expanding photosphere method (EPM) which yields a distance to SN 1999em that is 50% smaller than the Cepheid distance. We emphasize the differences between SEAM and EPM. We show that the dilution factors used in the EPM analysis were systematically too small at later epochs. We also show that the EPM blackbody assumption is suspect.

Since SNe IIP are visible to redshifts as high as $z \lesssim 6$, with the *JWST*, SEAM may be a valuable probe of the early universe.

Ap. J. (Letters), (2004), 616, L91-L94
Preprints from `baron@nhn.ou.edu`
or on the web at `http://arxiv.org/abs/astro-ph/0410153`

Co-moving frame radiative transfer in spherical media with arbitrary velocity fields

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Recently, with the advances in computational speed and availability there has been a growth in the number and resolution of fully 3-D hydrodynamical simulations. However, all of these simulations are purely hydrodynamical and there has been little attempt to include the effects of radiative transfer except in a purely phenomenological manner because the computational cost is too large even for modern supercomputers. While there has been an effort to develop 3-D Monte Carlo radiative transfer codes, most of these have been for static atmospheres or have employed the Sobolev approximation, which limits their applicability to studying purely geometric effects such as macroscopic mixing. Also the computational requirements of Monte Carlo methods are such that it is difficult to couple with 3-D hydrodynamics. Here, we present an algorithm for calculating 1-D spherical radiative transfer in the presence of non-monotonic velocity fields in the co-moving frame. Non-monotonic velocity flows will occur in convective, and Raleigh–Taylor unstable flows, in flows with multiple shocks, and in pulsationally unstable stars such as Mira and Cepheids. This is a first step to developing fully 3-D

radiative transfer than can be coupled with hydrodynamics. We present the computational method and the results of some test calculations.

A&A (2004), 427, 987–994.
Preprints from `baron@nhn.ou.edu`
or on the web at `http://arxiv.org/abs/astro-ph/0408212`

Improved discretization of the wavelength derivative term in CMF operator splitting numerical radiative transfer

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We describe two separate wavelength discretization schemes that can be used in the numerical solution of the comoving frame radiative transfer equation. We present an improved second order discretization scheme and show that it leads to significantly less numerical diffusion than previous scheme. We also show that due to the nature of the second order term in some extreme cases it can become numerically unstable. We stabilize the scheme by introducing a mixed discretization scheme and present the results from several test calculations.

A&A (2004), 417, 317–324.
Preprints from `baron@nhn.ou.edu`
or on the web at `http://arxiv.org/abs/astro-ph/0401164`

Triggered massive star formation in the vicinity of WR 48a

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We utilise *Midcourse Space Experiment* mid-IR imaging and published data to discuss the (massive) star formation region at galactic longitude $\sim 305^o$, apparently associated with the Wolf Rayet WR 48a and the attendant clusters Danks 1 & 2. A spectacular three lobed wind blown bubble surrounds the aforementioned sources, for which we may infer a minimum age of ∼3Myr from the presence of the WCL star. Near IR data reveals the presence of numerous embedded sources on the periphery of the wind blown bubble. The presence of coincindent H_2O, OH and methanol maser emission is suggestive of ongoing massive star formation, which is suppported by the fluxes of the associated IR sources, and the requisite LyC flux required to support the emission from the subset that have associated ucH II regions. Consideration of the integrated radio flux of the complex implies that a *minimum* of 31 O7V stars must be present, under the assumption of no photon leakage. Given the age and morphology of the complex and in particular the observation that the central exciting clusters have entirely cleared

their natal material, we expect this assumption will be violated, and hence that the true population of massive stars is likely to be significantly larger. If confirmed, the G305 complex represents one of the most massive regions of ongoing triggered star formation currently identified in the galaxy.

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Statistical Confirmation of a Stellar Upper Mass Limit

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We derive the expectation value for the maximum stellar mass ($m_{\rm max}$) in an ensemble of N stars, as a function of the IMF upper-mass cutoff ($m_{\rm up}$) and N. We statistically demonstrate that the upper IMF of the local massive star census observed thus far in the Milky Way and Magellanic Clouds clearly exhibits a universal upper mass cutoff around $120 - 200$ $M_\odot$ for a Salpeter IMF, although the result is more ambiguous for a steeper IMF.

Accepted by The Astrophysical Journal Letters

Preprints from `msoey@umich.edu`

or on the web at `http://www.astro.lsa.umich.edu/~msoey/publications` and `astro-ph/0501135`

Hierarchical Triggering of Star Formation by Superbubbles in W3/W4

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It is generally believed that expanding superbubbles and mechanical feedback from massive stars trigger star formation, because there are numerous examples of superbubbles showing secondary star formation at their edges. However, while these systems show an age sequence, they do not provide strong evidence of a causal relationship. The W3/W4 Galactic star-forming complex suggests a three-generation hierarchy: the supergiant shell structures correspond to the oldest generation; these triggered the formation of IC 1795 in W3, the progenitor of a molecular superbubble; which in turn triggered the current star-forming episodes in the embedded regions W3-North, W3-Main, and W3-OH. We present UBV photometry and spectroscopic classifications for IC 1795, which show an age of 3 – 5 Myr. This age is intermediate between the reported 6 – 20 Myr age of the supergiant shell system, and the extremely young ages ($10^4 - 10^5$ yr) for the embedded knots of ultracompact H 2 regions, W3-North, W3-Main, and W3-OH. Thus, an age sequence is indeed confirmed for the entire W3/W4 hierarchical system. This therefore provides some of the first convincing evidence that superbubble action and mechanical feedback are indeed a triggering mechanism for star formation.

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Preprints from msoey@umich.edu
or on the web at http://www.astro.lsa.umich.edu/~msoey/publications and astro-ph/0501136

Ambient Interstellar Pressure and Superbubble Evolution

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High ambient interstellar pressure is suggested as a possible factor to explain the ubiquitous observed growth-rate discrepancy for supernova-driven superbubbles and stellar wind bubbles. Pressures of $P/k \sim 10^5$ cm^{-3} K are plausible for regions with high star formation rates, and these values are intermediate between the estimated Galactic mid-plane pressure and those observed in starburst galaxies. High-pressure components also are commonly seen in Galactic ISM localizations. We demonstrate the sensitivity of shell growth to the ambient pressure, and suggest that superbubbles ultimately might serve as ISM barometers.

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or on the web at http://www.astro.lsa.umich.edu/~msoey/publications and astro-ph/0403713

Triggered massive-star formation on the borders of Galactic H II regions - I. A search for 'collect and collapse' candidates

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Young massive stars or clusters are often observed at the peripheries of H II regions. What triggers star formation at such locations? Among the scenarios that have been proposed, the 'collect and collapse' process is particularly attractive because it permits the formation of massive objects via the fragmentation of the dense shocked layer of neutral gas surrounding the expanding ionized zone. However, until our recent article on Sh 104, it had not been convincingly demonstrated that this process actually takes place. In the present paper we present our selection of seventeen candidate regions for this process; all show high-luminosity near-IR clusters and/or mid-IR point sources at their peripheries. The reality of a 'collect and collapse' origin of these presumably second-generation stars and clusters will be discussed in forthcoming papers, using new near-IR and millimetre observations.

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Preprints from lise.deharveng@oamp.fr

Single and Binary Massive Stars Close to the Zero Age Main Sequence

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We present data for single and binary massive stars, both from new analyses (Trapezium stars, O stars in NGC 6611, and the massive binary system V478 Cyg) and collected from the literature. We show that data for single stars depart from the theoretical ZAMS, while those for binary systems are consistent with a ZAMS formed through a linearly mass-dependent accretion rate. In spite of this difference, spectroscopic and dynamical analyses give consistent results in several binary systems.

Published in the proceedings of the International Workshop on Massive Stars in interacting binaries (2004, Quebec, Canada)

For preprints, contact `ahd@iac.es`

Interaction between Massive Stars and the ISM in galactic H II regions:
Chapter I: Oxygen abundances in Orion nebula cluster stars

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Using Fastwind, a state-of-the-art model atmosphere program, we derive new stellar oxygen abundances for the brightest stars of Orion nebula cluster that point towards values lower than presently assumed and very close to those obtained for the ionized gas phase. This has strong consequences for the dust content and the assumed total oxygen abundance of the nebula.

These results are part of an ongoing project aimed at the study of ionising massive stars and the surrounding ionized gas in Galactic H II regions.

To be published in the proceedings of the JENAM 2004 meeting on The many scales on the Universe (Granada, Spain)

For preprints, contact `ssimon@iac.es`

Jobs

Postdoctoral Position, University of Oklahoma

Applications are invited for a postdoctoral position in astrophysics at the University of Oklahoma, pending approval. The successful candidate will be free to work on a variety of topics emphasizing spectroscopy. Candidates wishing to help develop the JDEM proposal JEDI (see http://jedi.nhn.ou.edu) are also encouraged to apply. The position is open to both theorists and observers. Projects being pursued at OU include the development of a 3-D radiative transfer code, an ambitious project to perform first principle population synthesis, as well applications of quantitative spectroscopy to supernovae, stars, and AGN. The candidate should hold a Ph.D. in physics, astronomy, or a closely related field. Previous experience in one or more of the following areas are desired: radiative transfer, numerical methods, hydrodynamics, supernovae, stellar atmospheres, optical design, or IR detectors. The position is available for two years.

Applicants should send a curriculum vitae, brief summary of research experience, bibliography, and three letters of recommendation sent directly to Eddie Baron, at Dept. of Physics and Astronomy, University of Oklahoma, 440 W. Brooks, Rm 131 Norman, OK 73019-2061 USA. Inquiries can be directed to baron@nhn.ou.edu. OU is an affirmative action/equal opportunity employer, and encourages applications from women, minorities, veterans, and disabled persons.

Meetings

JENAM 2005 "Distant Worlds"
Workshop on Massive Stars and
High-Energy Emission in OB Associations
July 4 - 5, 2005
Liège (Belgium)
First Announcement

In the framework of the Joint European and National Astronomy Meeting (JENAM) to be held in Liège (Belgium) from July 4 – 7, 2005, one of the five mini-symposia will focus on Massive Stars and High-Energy Emission in OB Associations. The meeting addresses recent developments in several hot topics related to massive star research. Recent analyses of the fundamental parameters of these important objects, of their interactions within binary systems as well as with their surroundings (including the feedback of massive stars on the formation of other stars) will be presented during this session. Special emphasis will be put on the results of the studies of OB associations and young open clusters with current high-energy space observatories (XMM-Newton, Chandra and INTEGRAL) which provide not only information on the massive stars, but also on pre-main sequence stars, supernovae, micro-quasars and their link to ultra-luminous X-ray sources.

This workshop is scheduled for the afternoon sessions of the JENAM on July 4 and 5 and two review talks are foreseen for the morning plenary sessions of the same days. Contributed papers will either be scheduled as oral presentations of 15 minutes (plus 5 minutes for discussion) or poster presentations. A limited number of EAS travel grants will be available to support young participants.

Important deadlines:

January 2005 : 1st Announcement
April 15th 2005 : deadline for submission of preliminary abstracts of contributed papers
June 1st 2005 : deadline for registration with reduced fare
June 1st 2005 : deadline for final abstract submission

Practical information as well as registration forms and regular updates of the workshop programme can be found on the conference web page

`http://www.astro.ulg.ac.be/JENAM/`

Jean-Pierre Swings (Chairman of the JENAM 2005 SOC) & Gregor Rauw (coordinator of this mini-symposium, `rauw@astro.ulg.ac.be`)

Active OB-Stars: Laboratories for Stellar & Circumstellar Physics
August 29–September 2, 2005
Sapporo, Japan

Scientific Motivation

Extensive monitoring from both ground-based and orbiting observatories has provided several lines of evidence that many hot, luminous, OB-type stars, and their accompanying mass outflows, are highly structured and variable on a range of spatial and temporal scales. A central theme of this meeting is to utilize these active OB-stars as laboratories for studying the underlying physical processes for such activity – magnetic fields, pulsation, rotation, radiative instabilities, binarity – with focus on implications for the structure and evolution of the central star, as well as any associated circumstellar envelope, disk, and mass outflow. Such a broad range of physical processes mandates consideration of several specific observational classes of Active OB-stars, including classical Be stars, magnetic Bp stars, β Cepheid pulsators, slowly-pulsating B (SPB) stars, Be X-ray binaries, and B[e] stars.

The meeting will build upon substantial recent advances in both observational and theoretical modeling of structure and activity in these stars, augmented by new and emerging observational techniques and by ever-increasing computer power. Some key examples include: a unified interpretation of the complex variations in photospheric lines of Be and other active stars in terms of non-radial pulsations; direct detection of stellar magnetic field in several non-chemically peculiar hot stars; the renewed possibility of Be-star rotation being close to critical; applications of interferometric techniques to resolve not only circumstellar disks but also central stars; and availability of massive numerical simulations to model radiative, electromagnetic and gas dynamical interactions in these stars.

To guide and constrain development of physical models, a general theme is to exploit several new and emerging observational techniques and facilities, including both space- and ground-based spectra over wavebands ranging from the infrared to X-ray, with also a special emphasis on taking advantage of recent advances in interferometric techniques for direct spatial resolution of both central stars and their circumstellar emission.

Some of the key issues to be discussed are:

- What mechanism(s) are responsible for driving material from the stellar surface and the oft-observed reappearance and disappearance of circumstellar emission over times scales ranging from months to years?
- Under what circumstances is the material propelled directly into an outflowing wind, extended over a broad "cloud" or confined in a thin disk?

  into an outflowing wind, extended over a broad "cloud" or confined in a thin disk?
- Are the processes feeding circumstellar material impulsive or steady?
- In the case of Be stars, how close is the stellar rotation to the critical rate?
- Is the development of a disk one common phase in the evolution of rapidly rotating stars, or is it an evolutionary branch?
- Is rapid rotation an intrinsic consequence of massive star evolution, or might it sometimes depend on external factors like cluster membership, metallicity, or an earlier phase of close binary mass exchange?
- How does binarity influence the ejection and evolution of circumstellar and/or disk material?

To exchange various ideas and enhance the interaction between participants, a thematic discussion session will take place at the end of each half day.

Although thematically focused on Active OB-Stars, the phenomena and processes being examined – disks, radiatively driven mass loss, non-radial pulsation, rapid rotation, magnetic activity – are, in various combinations, also of central importance to a wide range of astrophysical systems. In particular, the rapid and perhaps even near-critical rotation of Be stars provides a well-observed prototype for studying the effects of rapid rotation on stellar mass loss. For example, the combination of a centrifugally ejected equatorial disk and strong radiatively driven polar wind – which is a key developing paradigm for many classical Be stars – might likewise represent a potential model for the observed form of mass ejection from Luminous Blue Variables like η Carina. Such considerations reflect an emerging perspective that Be stars could represent a manifestation of the rotational Ω limit inferred in evolutionary models of massive stars. This embodies another specific example within the broad meeting theme to explore Active OB-Stars as *laboratories* for stellar and circumstellar physics.

Preliminary Programme

1. Active OB-stars: past, present and future
   Overview of Active OB-Stars – Stan Owocki
   Statistical inference of Be star periodicity – Anne-Marie Hubert
2. Dynamical processes
   Coupling of rotation and pulsation in OB stars – Umin Lee
   B-field measurements of OB stars – Coralie Neiner
   Dynamical tides of close binaries – Bart Willems
3. Stellar mass loss as origin of circumstellar material
   Links between photospheric activity and formation of circumstellar structures of Be stars – Thomas Rivinius
   Radiatively driven winds of OB stars – Jiri Krticka

4. Structure and dynamics of circumstellar disks
   Polarimetric observations of the circumstellar matter and their interpretation – Karen Bjorkman
   Interferometric measurements of fast rotating OB stars and circumstelar disks – Olivier Chesneau
   Theory vs. observation of circumstellar disks and their formation – John Porter

5. Evolutionary effects in active OB-stars
   The role of multiplicity – Doug Gies
   Rotational evolution of massive stars – Georges Meynet
   Activity of OB stars and their evolution (to be confirmed)

Important Dates

1 March, 2005: Second announcement which includes call for papers and information on the registration and hotel reservation.

30 April, 2005: Deadline for the grant application and the abstract submission for oral presentations. Also the deadline for the abstract submission of people applying for the grant.

30 June, 2005: Deadline for the registration, the hotel reservation, and the abstract submission for poster presentations.

28 August, 2005: Welcome reception.

29 August - 2 September, 2005: Conference.

Preliminary Registration

http://www.kwasan.kyoto-u.ac.jp/be2005/

Scientific Organizing Committee

Conny Aerts (Belgium), Dietrich Baade (Germany), Jon Bjorkman (USA), Mike Marlborough (Canada), Ignacio Negueruela (Spain), Atsuo Okazaki (Japan), Stan Owocki (USA, Co-Chair), Philippe Stee (France), Stanislav Štefl (Chile, Co-Chair), Richard Townsend (USA)

Local Organizing Committee

Ryuko Hirata (Kyoto Univeristy), Toshihiro Horaguchi (National Science Museum), Eiji Kambe (National Defense Academy), Umin Lee (Tohoku Univeristy), Daisaku Nogami (Kyoto University), Akemi Okazaki (Secretary), Atsuo Okazaki (Hokkai-Gakuen University, Chair), Hideyuki Saio (Tohoku Univeristy)

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