ISSN 1783-3426

# THE MASSIVE STAR NEWSLETTER

formely known as the hot star newsletter

*

No. 119 2010 September-October

Editors: Philippe Eenens (University of Guanajuato) eenens@gmail.com

Raphael Hirschi (Keele University) http://www.astroscu.unam.mx/massive_stars

# CONTENTS OF THIS NEWSLETTER:

# PAPERS

# Abstracts of 10 accepted papers

## Observational evidence for a correlation between macroturbulent broadening and line-profile variations in OB Supergiants

**Simón-Díaz, S.(1,2); Herrero, A.(1,2); Uytterhoeven, K.(3); Castro, N.(1,2); Aerts, C.(4,5); Puls, J.(6)**

(1) IAC, (2) ULL, (3) CEA (4) KULeuven (5) IMAPP (6) USM

The spectra of O and B supergiants are known to be affected by a significant form of extra line broadening (usually referred to as macroturbulence) in addition to that produced by stellar rotation. Recent analyses of high resolution spectra have shown that the interpretation of this line broadening as a consequence of large scale turbulent motions would imply highly supersonic velocity fields in photospheric regions, making this scenario quite improbable. Stellar oscillations have been proposed as a likely alternative explanation. As part of a long term observational project, we are investigating the macroturbulent broadening in O and B supergiants and its possible connection with spectroscopic variability phenomena and stellar oscillations. In this letter, we present the first encouraging results of our project, namely firm observational evidence for a strong correlation between the extra broadening and photospheric line-profile variations in a sample of 13 supergiants with spectral types ranging from O9.5 to B8.

**Reference:** ApJL
Status: Manuscript has been accepted

**Weblink:** http://adsabs.harvard.edu/abs/2010arXiv1008.0712S

**Comments:**

**Email:** ssimon@iac.es

Back to contents

## Discovery of Twin Wolf-Rayet Stars Powering Double Ring Nebulae

**Jon Mauerhan, Stefanie Wachter, Pat Morris, Schuyler Van Dyk, D. W. Hoard**

Spitzer Science Center, California Institute of Technology, Pasadena, CA, USA

We have spectroscopically discovered a pair of twin, nitrogen-type, hydrogen-rich, Wolf-Rayet stars (WN8-9h) that are both surrounded by circular, mid-infrared-bright nebulae detected with the Spitzer Space Telescope and MIPS instrument. The emission is probably dominated by a thermal continuum from cool dust, but also may contain contributions from atomic line emission. There is no counterpart at shorter Spitzer/IRAC wavelengths, indicating a lack of emission from warm dust. The two nebulae are probably wind-swept stellar ejecta released by the central stars during a prior evolutionary phase. The

nebulae partially overlap on the sky and we speculate on the possibility that they are in the early stage of a collision. Two other evolved massive stars have also been identified within the area subtended by the nebulae, including a carbon-type Wolf-Rayet star (WC8) and an O7-8 III-I star, the latter of which appears to be embedded in one of the larger WN8-9h nebulae. The derived distances to these stars imply that they are coeval members of an association lying 4.9 (1.2) kpc from Earth, near the intersection of the Galaxy's Long Bar and the Scutum-Centaurus spiral arm. This new association represents an unprecedented display of complex interactions between multiple stellar winds, outflows, and the radiation fields of evolved massive stars.

**Reference:** Astrophysical Journal Letters
Status: Manuscript has been accepted

**Weblink:** http://arxiv.org/abs/1009.0747

**Comments:**

**Email:** mauerhan@ipac.caltech.edu

Back to contents

# The RMS Survey: The Bolometric Fluxes and Luminosity Distributions of Young Massive Stars

**J.C. Mottram[1,2], M.G. Hoare[1], J.S. Urquhart[3], S.L. Lumsden[1], R.D. Oudmaijer[1] T.P. Robitaille[4], T.J.T. Moore[5], B. Davies[6,1], J. Stead[1]**

1=School of Physics and Astronomy, University of Leeds, Leeds, LS2 9JT, UK.
2=Department of Physics and Astronomy, University of Exeter, Exeter, Devon, EX4 4QL, UK.
3=Australia Telescope National Facility, CSIRO Astronomy and Space Science, Sydney, NSW 2052, Australia.
4=Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA.
5=Astrophysics Research Institute, Liverpool John Moores University, Twelve Quays House, Egerton Wharf, Birkenhead, CH41 1LD, UK.
6=Rochester Institute of Technology, 54 Lomb Memorial Drive, Rochester, NY 14623, USA.

Context: The Red MSX Source (RMS) survey is returning a large sample of massive young stellar objects (MYSOs) and ultra-compact (UC) Hii regions using follow-up observations of colour-selected candidates from the MSX point source catalogue.
Aims: To obtain the bolometric fluxes and, using kinematic distance information, the luminosities for young RMS sources with far-infrared fluxes.
Methods: We use a model spectral energy distribution (SED) fitter to obtain the bolometric flux for our sources, given flux data from our work and the literature. The inputs to the model fitter were optimised by a series of investigations designed to reveal the effect varying these inputs had on the resulting bolometric flux. Kinematic distances derived from molecular line observations were then used to calculate the luminosity of each source.
Results: Bolometric fluxes are obtained for 1173 young RMS sources, of which 1069 have uniquely constrained kinematic distances and good SED fits. A comparison of the bolometric fluxes obtained using SED fitting with trapezium rule integration and two component greybody fits was also undertaken, and showed that both produce considerable scatter compared to the method used here.
Conclusions: The bolometric flux results allowed us to obtain the luminosity distributions of YSOs and UCHii regions in the RMS sample, which we find to be different. We also find that there are few MYSOs with L>=10^5 Lsol, despite finding many MYSOs with 10^4 Lsol >= L >= 10^5 Lsol.

**Reference:** A&A
Status: Manuscript has been accepted

**Weblink:** http://adsabs.harvard.edu/abs/2010arXiv1009.1774M

**Comments:**

**Email:** joe@astro.ex.ac.uk

Back to contents

# Isolated Wolf-Rayet Stars and O Supergiants Identified in the Galactic Center Region via Paschen-alpha Excess

**Jon Mauerhan (1), Angela Cotera (2), Hui Dong (3), Mark Morris (4), Daniel Wang (3), Susan Stolovy (1), Cornelia Lang (5)**

(1) Spitzer Science Center, California Institute of Technology, Pasadena, CA, USA
(2) SETI Institute, USA
(3) University of Massachusetts, USA
(4) University of California, Los Angeles, USA
(5) University of Iowa, USA

We report the discovery of 19 hot, evolved, massive stars near the Galactic center region (GCR). These objects were selected for spectroscopy owing to their detection as strong sources of Paschen-alpha emission-line excess, following a narrowband imaging survey of the central 0.65 x 0.25 degress (l, b) around Sgr A* with the Hubble Space Telescope. Discoveries include 6 carbon-type (WC) and 5 nitrogen-type (WN) Wolf-Rayet stars, 6 O supergiants, and 2 Be supergiants. Two of the O supergiants have X-ray counterparts having properties consistent with solitary O stars and colliding-wind binaries. The infrared photometry of 17 stars is consistent with the Galactic center distance, but 2 of them are located in the foreground. Several WC stars exhibit a relatively large infrared excess, which is possibly thermal emission from hot dust. Most of the stars appear scattered throughout the GCR, with no relation to the three known massive young clusters; several others lie near the Arches and Quintuplet clusters and may have originated within one of these systems. The results of this work bring the total sample of Wolf-Rayet stars in the GCR to 88. All sources of strong P-alpha excess have been identified in the area surveyed with HST, which implies that the sample of WN stars in this region is near completion, and is dominated by late (WNL) types. The current WC sample, although probably not complete, is almost exclusively dominated by late (WCL) types. The observed Wolf-Rayet subtype distribution in the GCR is a reflection of the intrinsic rarity of early subtypes (WNE and WCE) in the inner Galaxy, an effect that is driven by metallicity.

**Reference:** Astrophysical Journal
Status: Manuscript has been accepted

**Weblink:** http://arxiv.org/abs/1009.2769

**Comments:**

**Email:** mauerhan@ipac.caltech.edu

Back to contents

# Numerical models of collisions between core-collapse supernovae and circumstellar shells

**Allard Jan van Marle$^{1,2}$**
**Nathan Smith$^3$**
**Stan Owocki$^2$**
**Bob van Veelen$^4$**

1-Centre for Plasma Astrophysics, K.U. Leuven, Celestijnenlaan 200B, B-3001, Leuven, Belgium
2-Bartol Research Institute, University of Delaware, Newark, DE 19716, USA
3-Astronomy Department, University of California, 601 Campbell Hall, Berkeley, CA 94720, USA
4-Astronomical Institute, Utrecht University, P.O. Box 80,000, 3508 TA Utrecht, the Netherlands

Recent observations of luminous Type IIn supernovae (SNe) provide compelling evidence that massive circumstellar shells surround their progenitors. In this paper we investigate how the properties of such shells influence the SN lightcurve by conducting numerical simulations of the interaction between an expanding SN and a circumstellar shell ejected a few years prior to core collapse. Our parameter study explores how the emergent luminosity depends on a range of circumstellar shell masses, velocities, geometries, and wind mass-loss rates, as well as variations in the SN mass and energy. We find that the shell mass is the most important parameter, in the sense that higher shell masses (or higher ratios of M_shell/M_SN) lead to higher peak luminosities and higher efficiencies in converting shock energy into visual light. Lower mass shells can also cause high peak luminosities if the shell is slow or if the SN ejecta are very fast, but only for a short time. Sustaining a high luminosity for durations of more than 100 d requires massive circumstellar shells of order 10~M_sol or more. This reaffirms previous comparisons between pre-SN shells and shells produced by giant eruptions of luminous blue variables (LBVs), although the physical mechanism responsible for these outbursts remains uncertain. The lightcurve shape and observed shell velocity can help diagnose the approximate size and density of the circumstellar shell, and it may be possible to distinguish between spherical and bipolar shells with multiwavelength lightcurves. These models are merely illustrative. One can, of course, achieve even higher luminosities and longer duration light curves from interaction by increasing the explosion energy and shell mass beyond values adopted here.

**Reference:** MNRAS in press, published online
Status: Manuscript has been accepted

**Weblink:** http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2966.2010.16851.x/full

**Comments:** Full tables of results available online with the paper.

**Email:** AllardJan.vanMarle@wis.kuleuven.be

Back to contents

# Spectrophotometric Distances to Galactic HII Regions

**A. P. Moisés$^{1}$, A. Damineli$^{1}$, E. Figuerêdo$^{1}$, R. D. Blum$^{2}$, P. S. Conti$^{3}$ and C. L. Barbosa$^{4}$**

$^{1}$IAG-USP, Rua do Mat~ao, 1226, 05508-900, S~ao Paulo, SP Brazil
$^{2}$NOAO Gemini Science Center, 950 N Cherry Ave., Tuczon, AZ 85719 USA.
$^{3}$JILA, University of Colorado, Boulder, CO 80309-0440, USA.
$^{4}$IP&D-UNIVAP, Av. Shishima Hifumi, 2911, 12244-000 S. J. dos Campos, SP Brazil

We present a near infrared study of the stellar content of 35 HII regions in the Galactic plane, 24 of them have been classified as giant HII regions. We have selected these optically obscured star forming regions from the catalogs of Russeil (2003), Conti & Crowther (2004) and Bica et al. (2003). In this work, we have used the near infrared domain J−, H− and Ks− band color images to visually inspect the sample. Also, color-color and color-magnitude diagrams were used to indicate ionizing star candidates, as well as, the presence of young stellar objects such as classical TTauri Stars (CTTS) and massive young stellar objects (MYSOs). We have obtained Spitzer IRAC images for each region to help further characterize them. Spitzer and near infrared morphology to place each cluster in an evolutionary phase of development. Spitzer photometry was also used to classify the MYSOs. Comparison of the main sequence in color-magnitude diagrams to each observed cluster was used to infer whether or not the cluster kinematic distance is consistent with brightnesses of the stellar sources. We find qualitative agreement for a dozen of the regions, but about half the regions have near infrared photometry that suggests they may be closer than the kinematic distance. A significant fraction of these already have spectrophotometric parallaxes which support smaller distances. These discrepancies between kinematic and spectrophotometric distances are not due to the spectrophotometric methodologies, since independent non-kinematic measurements are in agreement with the spectrophotometric results. For instance, trigonometric parallaxes of star-forming regions were collected from the literature and show the same effect of smaller distances when compared to the kinematic results. In our sample of HII regions, most of the clusters are evident in the near infrared images. Finally, it is possible to distinguish among qualitative evolutionary stages for these objects.

**Reference:** Accepted for publication in MNRAS
Status: Manuscript has been accepted

**Weblink:** http://adsabs.harvard.edu/abs/2010arXiv1009.3924M

**Comments:**

**Email:** apmoises@astro.iag.usp.br

Back to contents

# Upper Limit for the Mass Loss Rate of Rapidly Rotating Single Main-Sequence O9-B4 Stars.

**E.I. Staritsin**

Astronomical Observatory, Ural State University, Yekaterinburg, Russia

An upper limit for the mass loss rate of rapidly rotating main-sequence O9-B4 stars has been determined. The maximum mass loss rate of a rotating star is determined by the ability of radiation pressure in lines to remove matter from the gravitational potential well of the star. The maximum mass loss rate in the case of extremely rapid stellar rotation is a factor of 3-7 higher than that in the case of nonrotating star. A simple formula for determining the ratio of the maximum mass loss rate of a rotating star to the maximum mass loss rate of a nonrotating star with the same mass, luminosity, and volume is suggested.

**Reference:** Astronomy Letters, 2010, Vol.36
Status: Manuscript has been accepted

**Weblink:**

**Comments:**

**Email:** Eugenij.Staritsin@usu.ru

Back to contents

# A Five-year Spectroscopic and Photometric Campaign on the Prototypical alpha Cygni Variable and A-type Supergiant Star Deneb

**N. D. Richardson, N. D. Morrison, E. E. Kryukova, S. J. Adelman**

Georgia State University, University of Toledo, University of Toledo, The Citadel

Deneb is often considered the prototypical A-type supergiant, and is one of the visually most luminous stars in the Galaxy. A-type supergiants are potential extragalactic distance indicators, but the variability of these stars needs to be better characterized before this technique can be considered reliable. We analyzed 339 high resolution echelle spectra of Deneb obtained over the five-year span of 1997 through 2001 as well as 370 Stromgren photometric measurements obtained during the same time frame. Our spectroscopic analysis included dynamical spectra of the H-alpha profile, H-alpha equivalent widths, and radial velocities measured from Si II 6347, 6371. Time-series analysis reveals no obvious cyclic behavior that proceeds through multiple observing seasons, although we found a suspected 40 day period in two, non-consecutive observing seasons. Some correlations are found between photometric and radial velocity data sets, and suggest radial pulsations at two epochs. No correlation is found between the variability of the H-alpha profiles and that of the radial velocities or the photometry. Lucy (1976) found evidence that Deneb was a long period single-lined spectroscopic binary star, but our data set shows no evidence for radial velocity variations caused by a binary companion.

**Reference:** Astronomical Journal
Status: Manuscript has been accepted

**Weblink:** http://arxiv.org/abs/1009.5994

**Comments:** 49 pages, 9 figures, 5 tables

**Email:** richardson@chara.gsu.edu

Back to contents

# Plaskett's Star: Analysis of the CoRoT photometric data

**L. Mahy(1), E. Gosset(1), F. Baudin(2), G. Rauw(1), M. Godart(1), T. Morel(1), P. Degroote(3), C. Aerts(3,5), R. Blomme(4), J.
Cuypers(4), A. Noels(1), E. Michel(6), A. Baglin(7), M. Auvergne(8), C. Catala(8), and R. Samadi(8)**

1 - Institut d'Astrophysique et de Geophysique, University of Liege, Belgium
2 - Institut d'Astrophysique Spatiale (IAS), France
3 - Instituut voor Sterrenkunde, K.U. Leuven, Belgium
4 - Royal Observatory of Belgium, Belgium
5 - Department of Astrophysics, IMAPP, University of Nijmegen, The Netherlands
6 - LESIA, CNRS, Observatoire de Paris, France
7 - Laboratoire AIM, CEA/DSM-CNRS-Universit´e Paris Diderot; CEA, IRFU, SAp, France

8 - LESIA, UMRR8109, Oservatoire de Paris, France

Context. The second short run (SRa02) of the CoRoT space mission for Asteroseismology was partly devoted to stars belonging to the Mon OB2 association. An intense monitoring has been performed on Plaskett's Star (HD47129) and the unprecedented quality of the light curve allows us to shed new light on this very massive, non-eclipsing binary system.
Aims. We particularly aimed at detecting periodic variability which might be associated with pulsations or interactions between both components. We also searched for variations related to the orbital cycle which could help to constrain the inclination and the morphology of the binary system.
Methods. An iterative Fourier-based prewhitening and a multiperiodic fitting procedure have been applied to analyse the time series and extract the frequencies of variations from the CoRoT light curve. We describe the noise properties to tentatively define an appropriate significance criterion and, in consequence, to only point out the peaks at a certain significance level. We also detect the variations related to the orbital motion and study them by using the NIGHTFALL program.
Results. The periodogram computed from Plaskett's Star CoRoT light curve mainly exhibits a majority of peaks at low frequencies. Among these peaks, we highlight a list of about 43 values, including notably two different sets of harmonic frequencies whose fundamental peaks are located at about 0.07 and 0.82 d−1. The former represents the orbital frequency of the binary system whilst the latter could probably be associated with non-radial pulsations. The study of the 0.07 d−1 variations reveals the presence of a hot spot most probably situated on the primary star and facing the secondary.
Conclusions. The investigation of this unique dataset constitutes a further step in the understanding of Plaskett's Star. These results provide a first basis for future seismic modelling and put forward the probable existence of non-radial pulsations in Plaskett's Star. Moreover, the fit of the orbital variations confirms the problem, already mentioned in previous works, of the distance of this system. The existence of a hot region between both components renders the determination of the inclination ambiguous.

**Reference:** A&A
Status: Manuscript has been accepted

**Weblink:** http://arxiv.org/abs/1010.4959

**Comments:** 13 pages, 7 figures, 2 tables

**Email:** mahy@astro.ulg.ac.be

Back to contents

# The mass-loss rates of red supergiants and the de Jager prescription

**N. Mauron and E. Josselin**

GRAAL, CNRS and Univ. of Montpellier, Place Bataillon, 34095 Montpellier, France

Mass loss of red supergiants (RSG) is important for the evolution of massive stars,
but is not fully explained. Several empirical prescriptions have been proposed, trying to express the mass-loss rate as a function of fundamental stellar parameters (mass, luminosity, effective temperature). Our goal is to test whether the de Jager et al. (1988) prescription, used in some stellar evolution models, is still valid in view of more recent mass-loss determinations. By considering 40 Galactic RSGs presenting an infrared excess and an IRAS 60-micron flux larger than 2 Jy, and assuming a gas-to-dust mass ratio of 200, it is found that the de Jager rate agrees within a factor 4 with most mass-loss rate estimates based on the 60-microns signal. It is also in agreement with 6 of the only 8 Galactic RSGs for which the mass-loss rate can be measured more directly through observations of the circumstellar gas. The two objects that do

not follow the de Jager prescription (by an order of magnitude) are mu Cep and NML Cyg. We have also considered the RSGs of the Magellanic Clouds. Thanks to the works of Groenewegen et al. (2009) and Bonanos et al. (2010), we find that the RSGs of the Small Magellanic Cloud have mass-loss rates consistent with the de Jager rate scaled by (Z/Zsun)**(alpha), where Z is the metallicity and alpha is 0.7. The situation is less clear for the RSGs of the Large Magellanic Cloud. In particular, for L > 160000 solar luminosities, one finds numerous RSGs (except WOH-G64) having mass-loss rates significantly smaller than the de Jager rate and indicating that it would no longer increase with L. Before this odd situation is confirmed through further analysis of LMC RSGs, we suggest to keep the de Jager prescription unchanged at solar metallicity in the stellar evolutionary models and to apply a (Z/Zsun)**(0.7) dependence.

**Reference:** Astronomy and Astrophysics
Status: Manuscript has been accepted

**Weblink:** http://arxiv.org/abs/1010.5369

**Comments:**

**Email:** mauron@graal.univ-montp2.fr

Back to contents

# Abstracts of 2 conference proceedings

## The Upper Initial Mass Function from Ultraviolet Spectral Lines

**Claus Leitherer**

STScI

The space-ultraviolet wavelength region contains strong spectral lines from massive, hot stars. These features form in winds and are sensitive to luminosity and mass, and ultimately provide constraints on the initial mass function. New radiation-hydrodynamical models of stellar winds are used to construct a theoretical spectral library of massive stars for inclusion in population synthesis. The models are compared to observations of nearby star clusters, of starburst regions in local galaxies, and of distant star-forming galaxies. The data are consistent with a near-universal Salpeter-type initial mass function. We find no evidence of environmental effects on the initial mass function. Some model deficiencies are identified: stellar rotation and binary evolution are not accounted for and may become increasingly important in metal-poor systems.

**Reference:** To appear in UP2010: Have Observations Revealed a Variable Upper End of the Initial Mass Function?, M. Treyer, J. C. Lee, M. H. Seibert, T. Wyder, & D. Neill, eds
Status: Conference proceedings

**Weblink:** http://xxx.lanl.gov/abs/1009.0245

**Comments:**

**Email:** leitherer@stsci.edu

Back to contents

## OB-stars as extreme condition test beds

**J. Puls, J.O. Sundqvist, and J.G. Rivero Gonzalez**

University of Munich, Germany

Massive stars are inherently extreme objects, in terms of radiation, mass loss, rotation, and sometimes also magnetic fields. Concentrating on a (personally biased) subset of processes related to pulsations, rapid rotation and its interplay with mass-loss, and the bi-stability mechanism, we will discuss how active (and normal) OB stars can serve as appropriate laboratories to provide further clues.

**Reference:** To be published in the proceedings book of the IAUS 272, Cambridge University Press.
Editors C. Neiner, G. Wade, G. Meynet and G. Peters
Status: Conference proceedings

**Weblink:** http://arxiv.org/abs/1009.0364

**Comments:**

**Email:** jon@usm.uni-muenchen.de

Back to contents

---

# MEETINGS

## Four Decades of Research on Massive Stars
## A Scientific Meeting in the Honour of Anthony F.J. Moffat

**11-15 July 2011**

**Venue:** Québec, Canada

We are organizing a meeting to celebrate four decades of contributions of Professor Anthony F.J. Moffat to massive-star research. Since his first papers on open clusters in the early 70's, Tony's research interests have expanded in many directions to cover a multitude of aspects of massive stars. The meeting will encompass the following main subjects on which he has worked during his career:

1. Young open star clusters: keys to understanding massive stars
2. Galactic structure and dynamics; runaway stars
3. Massive binaries: orbits, masses, mass-loss rates, binary frequency, colliding winds, dust formation
4. The most massive stars
5. The true nature of clumping in hot stellar winds and its consequences
6. Rotation and magnetic fields
7. Pulsations (e.g. MOST and soon BRITE-Constellation)
8. WR surveys (Galactic and extra-galactic)

We invite you to the Auberge du Lac Taureau in the beautiful region of Lanaudière, Québec, Canada to present your latest research and for stimulating discussions on the above-listed topics.

Important dates:

Web site opens and start of pre-registration: 18 October 2010
Deadline for early registration: 1 March 2011
Abstract submission deadline: 3 April 2011
Registration fee and hotel reservation deadline: 16 May 2011

The Scientific Organizing Committee

Nicole St-Louis, Université de Montréal
Laurent Drissen, Université Laval
Carmelle Robert, Université Laval
Paul Crowther, The University of Sheffield
Doug Gies, Georgia State University, CHARA
Stan Owocki, The Bartol Research Institute, University of Delaware
Julian Pittard, The University of Leeds
Mike Shara, The American Museum of Natural History, New York
Gregg Wade, Royal Military College of Canada, Kingston
Hans Zinnecker, Astrophysikalisches Institut Potsdam

The Local Organising Committee:

Nicole St-Louis, Université de Montréal
Laurent Drissen, Université Laval
Carmelle Robert, Université Laval
Robert Lamontagne, Université de Montréal
Luc Turbide, Université de Montréal
Antoine de la Chevrotière, Université de Montréal
Rémi Fahed, Université de Montréal
Alexandre David-Uraz, Université de Montréal
Sébastien Desforges, Université de Montréal

**Weblink:** http://craq-astro.ca/moffat/

**Email:** stlouis@astro.umontreal.ca

Back to contents