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THE MASSIVE STAR NEWSLETTER

formely known as *the hot star newsletter*

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Contents of this newsletter

News

Call for data on Cyg OB2 #9

To the massive star community :

As announced in two recent papers (Van Loo et al., and Naze et al., A&A, in press, see page 2 of this newsletter, or http://arxiv.org/abs/0803.2607 and http://arxiv.org/abs/0803.3176), the non-thermal radio emitter Cyg OB2 #9 is a very eccentric binary with a long period (∼2.4 yrs). In order to derive a full orbital solution, more data are clearly needed, especially close to the periastron passages. If you have any archival optical data of this star (spectroscopy, photometry), we would like to invite you to contact us.

Best regards, Yael Naze, Michael De Becker & Gregor Rauw

Email contact: naze@astro.ulg.ac.be

Accepted Papers

Non-thermal radio emission from O-type stars III. Is Cyg OB2 No. 9 a wind-colliding binary?

S. Van Loo (1), R. Blomme (2), S. M. Dougherty (3)and M. C. Runacres (4)

(1) School of Physics and Astronomy, University of Leeds, Leeds LS2 9JT, UK

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(4) Erasmus University College, Nijverheidskaai 170, 1070 Brussel, Belgium

The star Cyg OB2 No. 9 is a well-known non-thermal radio emitter. Recent theoretical work suggests that all such O-stars should be in a binary or a multiple system. However, there is no spectroscopic evidence of a binary component. Re-analysis of radio observations from the VLA of this system over 25 years has revealed that the non-thermal emission varies with a period of 2.35+-0.02 yr. This is interpreted as a strong suggestion of a binary system, with the non-thermal emission arising in a wind-collision region. We derived some preliminary orbital parameters for this putative binary and revised the mass-loss rate of the primary star downward from previous estimates.

Reference: Astronomy and Astrophysics

Preprints from: svenvl@ast.leeds.ac.uk

A binary signature in the non-thermal radio-emitter Cyg OB2 #9

Y. Naze (1), M. De Becker (1), G. Rauw (1), C. Barbieri (2)

1- IAGL, ULg, Belgium ; 2 - Univ. Padova, Italy

Aims: Non-thermal radio emission associated with massive stars is believed to arise from a wind-wind collision in a binary system. However, the evidence of binarity is still lacking in some cases, notably Cyg OB2 #9 .

Methods: For several years, we have been monitoring this heavily-reddened star from various observatories. This campaign allowed us to probe variations both on short and long timescales and constitutes the first in-depth study of the visible spectrum of this object.

Results: Our observations provide the very first direct evidence of a companion in Cyg OB2 #9, confirming the theoretical wind-wind collision scenario. These data suggest a highly eccentric orbit with a period of a few years, compatible with the 2yr-timescale measured in the radio range. In addition, the signature of the wind-wind collision is very likely reflected in the behaviour of some emission lines.

Reference: accepted by A&A

On the web at: http://arxiv.org/abs/0803.3176

Preprints from: naze@astro.ulg.ac.be

HD148937: a multiwavelength study of the third Galactic member of the Of?p class

Y. Naze (1), N.R. Walborn (2), G. Rauw (1), F. Martins (3), A.M.T. Pollock (4), H.E. Bond (2)

1=IAGL, ULg, 2=STScI, 3=GRAAL, 4=ESA

Three Galactic O-type stars belong to the rare class of Of?p objects: HD108, HD191612, and HD148937. The first two stars show a wealth of phenomena, including magnetic fields and strong X-ray emission, light variability, and dramatic periodic spectral variability. We present here the first detailed optical and X-ray study of the third Galactic Of?p star, HD148937. Spectroscopic monitoring has revealed low-level variability in the Balmer and HeII4686 lines, but constancy at HeI and CIII4650. The Ha line exhibits profile variations at a possible periodicity of ∼7d. Model atmosphere fits yield $T_{\rm eff}$=41000+-2000K, log(g)= 4.0 ± 0.1, $M_\odot$ $yr^{-1}{}_{\rm sph}$ $<\sim 10^{-7} M_\odot$/yr and a surabondance of nitrogen by a factor of four. At X-ray wavelengths, HD148937 resembles HD108 and HD191612 in having a thermal spectrum dominated by a relatively cool component (kT=0.2keV), broad lines (>1700km/s), and an order-of-magnitude overluminosity compared to normal O stars (log $[L_X^{\rm unabs}/L_{\rm BOL}] \sim -6$).

Reference: accepted by AJ

On the web at: `http://arxiv.org/abs/0803.0605`

Preprints from: `naze@astro.ulg.ac.be`

The Ionizing Stars of the Galactic Ultra-Compact HII Region G45.45+0.0

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Using the NIFS near–infrared integral–field spectrograph behind the facility adaptive optics module, ALTAIR, on Gemini North, we have identified several massive O–type stars that are responsible for the ionization of the Galactic Ultra–Compact HII region G45.45+0.06. The sources "m" and "n" from the imaging study of Feldt et al. (1998) are classified as hot, massive O–type stars based on their K-band spectra. Other bright point sources show red and/or nebular spectra and one appears to have cool star features that we suggest are due to a young, low–mass pre–main sequence component. Still two other embedded sources ("k" and "o" from Feldt et al.) exhibit CO bandhead emission that may arise in circumstellar disks which are possibly still accreting. Finally, nebular lines previously identified only in higher excitation planetary nebulae and associated with KrIII and SeIV ions are detected in G45.45+0.6.

Reference: AJ, in press

On the web at: `http://xxx.lanl.gov/abs/0802.2895`

Preprints from: `rblum@noao.edu`

High Spatial Resolution Spectroscopy of W51 IRS2E and IRS2W: Two Very Massive Young Stars in Early Formation Stages

C. L. Barbosa (1), R. D. Blum (2), P. S. Conti (3), A. Damineli (4) and E. Figueredo (5)

(1) IP&D-UNIVAP, (2) NOAO GSC, (3) JILA U. Colorado, (4) IAG - USP, (5) Open University

We present K-band spectra of the near infrared counterparts to IRS2E and IRS2W which is associated with the ultracompact HII region W51d, both of them embedded sources in the Galactic compact HII region W51 IRS2. The high spatial resolution observations were obtained with the laser guide star facility and Near infrared Integral Field Spectrograph (NIFS) mounted at the Gemini North observatory. The spectrum of the ionizing source of W51d shows the photospheric features NIII (21155 Å) in emission and HeII (21897 Å) in absorption which lead us to classify it as an young O3 type star. We detected CO overtone in emission at 23000 Å in the spectrum of IRS2E, suggesting that it is a massive young object still surrounded by an accretion disc, probably transitioning from the hot core phase to an ultracompact HII region.

Reference: ApJL, in press

On the web at: `http://arxiv.org/abs/0803.3853`

Preprints from: `cassio@univap.br`

Near-infrared integral field spectroscopy of the Homunculus nebula around Eta Carinae using Gemini/CIRPASS

M. Teodoro[1], A. Damineli[1], R. G. Sharp[2], J. H. Groh[3], C. L. Barbosa[4]

[1]IAG/USP-Brazil, [2]AAO-Australia, [3]MPIfR-Germany, [4]IP&D/UNIVAP-Brazil)

This work presents the first integral field spectroscopy of the Homunculus nebula around Eta Carinae in the near-infrared spectral region (J band). We confirmed the presence of a hole on the polar region of each lobe, as indicated by previous near-IR long-slit spectra and mid-IR images. The holes can be described as a cylinder of height (i.e. the thickness of the lobe) and diameter of 6.5 and 6.0x10^{16} cm, respectively. We also mapped the blue-shifted component of He I 10830 seen towards the NW lobe. Contrary to previous works, we suggested that this blue-shifted component is not related to the Paddle but it is indeed in the equatorial disc. We confirmed the claim of Smith (2005) and showed that the spatial extent of the Little Homunculus matches remarkably well the radio continuum emission at 3 cm, indicating that the Little Homunculus can be regarded as a small HII region. Therefore, we used the optically-thin 1.3 mm radio flux to derive a lower limit for the number of Lyman-continuum photons of the central source in Eta Car. In the context of a binary system, and assuming that the ionising flux comes entirely from the hot companion star, the lower limit for its spectral type and luminosity class ranges from O5.5 III to O7 I. Moreover, we showed that the radio peak at 1.7 arcsec NW from the central star is in the same line-of-sight of the 'Sr-filament' but they are obviously spatially separated, while the blue-shifted component of He I 10830 may be related to the radio peak and can be explained by the ultraviolet radiation from the companion star.

Reference: MNRAS (in press)

Comments: A version of this paper with high-resolution figures (1.1 MB) is available at ftp://astro.iag.usp.br/pub/mairan/homunc.pdf

On the web at: http://arxiv.org/abs/0804.0240

Preprints from: mairan@astro.iag.usp.br

Wra 751, a luminous blue variable developing an S Doradus cycle

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The object Wra 751 is a luminous blue variable that lately exhibits strong changes in light and color.

We summarise the available photometry of Wra 751, present new photometric observations, and discuss these data with special attention on the systematic differences between the various data sources. In addition, we establish an empirical relationship between $b-y$ and $B-V$ for this class of stars.

Wra 751 is a strong-active member of the S Dor class, and it exhibits very-long term S Doradus phases with an amplitude of about two magnitudes in V and a cycle length of several decades. The associated $B-V$ colour-index amplitude is about 0.4 mag.

At this moment this LBV, which is the reddest member of the class, is going through the bright (and red) stage of a long-term S Dor cycle. The S Dor behaviour of this system shows some resemblence to the temporal characteristics of the Galactic LBV AG Car, because the time scales and amplitudes of light and colour variability are very similar.

Reference: accepted A&A

Preprints from: csterken@vub.ac.be

The blue supergiant Sher 25 and its intriguing hourglass nebula

M. A. Hendry (1,2), S. J. Smartt (1), E. D. Skillman (3), C. J. Evans (4), C. Trundle (1), D. J. Lennon (5,6), P. A. Crowther (7), I. Hunter (1)

(1) Queen's University Belfast (2) IoA, University of Cambridge (3) University of Minnesota (4) UKATC, Edinburgh (5) STScI, Baltimore (6) IAC, Tenerife (7) University of Sheffield

The blue supergiant Sher 25 is surrounded by an asymmetric, hourglass-shaped circumstellar nebula. Its structure and dynamics have been studied previously through high-resolution imaging and spectroscopy, and it appears dynamically similar to the ring structure around SN 1987A. Here we present long-slit spectroscopy of the circumstellar nebula around Sher 25, and of the background nebula of the host cluster NGC 3603. We perform a detailed nebular abundance analysis to measure the gas-phase abundances of oxygen, nitrogen, sulphur, neon and argon. The oxygen abundance in the circumstellar nebula ($12 + \log\mathrm{O/H} = 8.61 \pm 0.13$ dex) is similar to that in the background nebula (8.56 ± 0.07), suggesting the composition of the host cluster is around solar. However, we confirm that the circumstellar nebula is very rich in nitrogen, with an abundance of 8.91 ± 0.15, compared to the background value of 7.47 ± 0.18. A new analysis of the stellar spectrum with the FASTWIND model atmosphere

code suggests that the photospheric nitrogen and oxygen abundances in Sher 25 are consistent with the nebular results. While the nitrogen abundances are high, when compared to stellar evolutionary models they do not unambiguously confirm that the star has undergone convective dredge-up during a previous red supergiant phase. We suggest that the more likely scenario is that the nebula was ejected from the star while it was in the blue supergiant phase. The star's initial mass was around $50M_{\odot}$, which is rather too high for it to have had a convective envelope stage as a red supergiant. Rotating stellar models that lead to mixing of core-processed material to the stellar surface during core H-burning can quantitatively match the stellar results with the nebula abundances.

Reference: Accepted by MNRAS, arXiv:0803.4262

On the web at: `http://star.pst.qub.ac.uk/~sjs/papers/sher25/`

Preprints from: `cje@roe.ac.uk`

SN 2005gj: Evidence for LBV supernovae progenitors?

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There is mounting observational evidence in favour of Luminous Blue Variables (LBVs) being the direct progenitors of supernovae. Here we present possibly the most convincing evidence yet for such progenitors. We find multiple absorption component P-Cygni profiles of hydrogen and helium in the spectrum of SN 2005gj, which we interpret as being an imprint of the progenitor's mass-loss history. Such profiles have previously only been detected in Luminous Blue Variables. This striking resemblance of the profiles, along with wind velocities and periods consistent with those of LBVs leads us to connect SN 2005gj to an LBV progenitor.

Reference: Accepted as a letter to A&A, arXiv:0804.2392

On the web at: `http://au.arxiv.org/abs/0804.2392`

Preprints from: `c.trundle@qub.ac.uk`

The Effects of Clumps in Explaining X-ray Emission Lines from Hot Stars

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It is now well established that stellar winds of hot stars are fragmentary and that the X-ray emission from stellar winds has a strong contribution from shocks in winds. Chandra high spectral resolution observations of line profiles of O and B stars have shown numerous properties that had not been expected. Here we suggest explanations by considering the X-rays as arising from bow shocks that occur where the stellar wind impacts on spherical clumps in the winds. We use an accurate and stable numerical hydrodynamical code to obtain steady-state physical conditions for the temperature and

density structure in a bow shock. We use these solutions plus analytic approximations to interpret some major X-ray features: the simple power-law distribution of the observed emission measure derived from many hot star X-ray spectra and the wide range of ionization stages that appear to be present in X-ray sources throughout the winds. Also associated with the adiabatic cooling of the gas around a clump is a significant transverse velocity for the hot plasma flow around the clumps, and this can help to understand anomalies associated with observed line widths, and the differences in widths seen in stars with high and low mass-loss rates. The differences between bow shocks and the planar shocks that are often used for hot stars are discussed. We introduce an "on the shock" (OTSh) approximation that is useful for interpreting the X-rays and the consequences of clumps in hot star winds and elsewhere in astronomy.

Reference: to appear in the Astrophysical Journal (available at astroph/0804.4680)

On the web at: `http://xxx.lanl.gov/abs/0804.4680`

Preprints from: `ignace@etsu.edu`

Proceedings

Can pulsational instabilities impact a massive star's rotational evolution?

Rich Townsend Jim MacDonald

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We investigate whether angular momentum transport due to unstable pulsation modes can play a significant role in the rotational evolution of massive stars. We find that these modes can redistribute appreciable angular momentum, and moreover trigger shear-instability mixing in the molecular weight gradient zone adjacent to stellar cores, with significant evolutionary impact.

Reference: To appear in Proc. IAU Symposium 250: "Massive Stars as Cosmic Engines", Hawaii, Dec 2007

On the web at: `http://arxiv.org/abs/0803.0347`

Preprints from: `rhdt@bartol.udel.edu`

3-D SPH simulations of colliding winds in eta Carinae

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[3]NASA/GSFC, USA

We study colliding winds in the superluminous binary eta Carinae by performing three-dimensional, Smoothed Particle Hydrodynamics (SPH) simulations. For simplicity, we assume both winds to be

isothermal. We also assume that wind particles coast without any net external forces. We find that the lower density, faster wind from the secondary carves out a spiral cavity in the higher density, slower wind from the primary. Because of the phase-dependent orbital motion, the cavity is very thin on the periastron side, whereas it occupies a large volume on the apastron side. The model X-ray light curve using the simulated density structure fits very well with the observed light curve for a viewing angle of $i = 54$ degrees and $\phi = 36$ degrees, where i is the inclination angle and ϕ is the azimuth from apastron.

Reference: Proc. IAU Symp. 250 "Massive Stars as Cosmic Engines", F. Bresolin, P. Crowther & J. Puls (eds.), Cambridge: Cambridge University Press

On the web at: `http://arxiv.org/abs/0803.3977`

Preprints from: `okazaki@elsa.hokkai-s-u.ac.jp`

Clumping in hot-star winds. Proceedings of International Workshop held in Potsdam, Germany, 18 - 22 June 2007

Wolf-Rainer Hamann, Achim Feldmeier, Lidia M. Oskinova

University of Potsdam Germany

Stellar winds play an important role for the evolution of massive stars and their cosmic environment. Multiple lines of evidence, coming from spectroscopy, polarimetry, variability, stellar ejecta, and hydrodynamic modeling, suggest that stellar winds are non-stationary and inhomogeneous. This is referred to as 'wind clumping'.

The urgent need to understand this phenomenon is boosted by its far-reaching implications. Most importantly, all techniques to derive empirical mass-loss rates are more or less corrupted by wind clumping. Consequently, mass-loss rates are extremely uncertain. Within their range of uncertainty, completely different scenarios for the evolution of massive stars are obtained. Settling these questions for Galactic OB, LBV and Wolf-Rayet stars is prerequisite to understanding stellar clusters and galaxies, or predicting the properties of first-generation stars.

In order to develop a consistent picture and understanding of clumped stellar winds, an international workshop on 'Clumping in Hot Star Winds' was held in Potsdam, Germany, from 18 - 22 June 2007. About 60 participants, comprising almost all leading experts in the field, gathered for one week of extensive exchange and discussion. The Scientific Organizing Committee (SOC) included John Brown (Glasgow), Joseph Cassinelli (Madison), Paul Crowther (Sheffield), Alex Fullerton (Baltimore), Wolf-Rainer Hamann (Potsdam, chair), Anthony Moffat (Montreal), Stan Owocki (Newark), and Joachim Puls (Munich). These proceedings contain the invited and contributed talks presented at the workshop, and document the extensive discussions.

Reference: Potsdam: Univ.-Verl., 2008 URN:nbn:de:kobv:517-opus-13981 ISBN 978-3-940793-33-1

Comments: While these proceedings are published mainly electronically, a few printed copies are available upon request.

On the web at: `http://opus.kobv.de/ubp/doku/tagungen/clumping.htm`

Preprints from: `wrh@astro.physik.uni-potsdam.de`

Jobs

Postdoctoral Researcher

Dr Jorick S Vink (jsv_AT_arm.ac.uk)
Armagh Observatory Northern Ireland (UK)

A fixed-term up to 3 years postdoctoral research position is available from 2008 October 1, or as soon as possible thereafter. The Observatory has full access to all UK facilities and is a member of the UK SALT Consortium.

Applicants must have, or be about to obtain, a PhD in an appropriate discipline. It is desirable that candidates have expertise in massive star radiative transfer and/or hydrodynamics, although suitable candidates with expertise in observations and spectral modeling of massive stars and related objects are also encouraged to apply. Full details of the positions are available from the Armagh Observatory web-site.

Starting salary in the range 24,599 to 33,112 pounds (from 2008 May 1), depending on qualifications and experience.

The initial closing date is 2008 May 31. Late applications may be considered until the position is filled. Applicants should obtain an application pack from the Administrator or from the Observatory web-site, and send the completed application form together with a full curriculum vitae, statement of research interests and complete bibliography to: The Administrator, Armagh Observatory, College Hill, Armagh BT61 9DG, Northern Ireland (Tel: +44-(0)28-3752-2928; FAX: +44-(0)28 3752-7174; e-mail: lfy_AT_arm.ac.uk). References from at least two referees should be sent to the Administrator to arrive by the initial closing date or as soon as possible thereafter.

The Armagh Observatory is an equal opportunities employer.

Weblink: `http://star.arm.ac.uk/`

Email contact: `jsv@arm.ac.uk`

Closing date: 2008 May 31

Meetings

Massive Stars: A Lifetime of Influence

October 13-15
Lowell Observatory

Massive stars are extremely rare, due both to their short lifetimes and the exponential nature of the initial mass function. Yet, they exert a disproportionate influence over their environments during their

lifetimes. Lowell Observatory is proud to host the workshop "Massive Stars: A Lifetime of Influence", honoring the scientific achievements of Peter S. Conti, who has had a lifetime of influence on the field of massive star research. Our 3-day workshop will be devoted roughly half to invited review talks and half to contributed talks, with space for poster presentations. Sessions will include unevolved massive stars (OBs), evolved massive stars (WRs, LBVs, RSGs), massive stars in starbursts, young massive stars, and broader topics. Space is limited, and pre-registration is required; it will remain open until May 15th. Please visit our website at http://www.lowell.edu/workshops/Contifest for more information.

Weblink: `http://www.lowell.edu/workshops/Contifest`

Email contact: `Phil.Massey@lowell.edu`

Hot and Cool: Bridging Gaps in Massive Star Evolution

November 10 - 12, 2008
Pasadena, CA

This meeting aims to bridge the gap between researchers studying stars in the upper blue and red sections of the Hertzsprung-Russell diagram (HRD). While morphologically separated, stars occupying these extremes of the HRD are intimately related via evolution, as well as both having atmospheric properties affected by extension and stellar wind outflow. At cosmological scales, like in distant starburst galaxies, the historical distinction between blue and red stellar populations becomes obsolete, and understanding the complex relation between the red and blue parts of the HRD is mandatory.

Weblink: `not yet available`

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