ISSN 1783-3426

THE MASSIVE STAR NEWSLETTER

formerly known as the hot star newsletter

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No. 157 2017 January-February

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CONTENTS OF THIS NEWSLETTER:

News

Announcement of the Organizing Committe of Massive Stars on the travel ban issued by US president D. Trump

Recent executive order by the President of the United States suspended entry of all refugees to the United States for 120 days, and blocked entry to the U.S. for at least 90 days for citizens of seven countries. IAU is intrinsically an international organization comprising of citizens from every corner of the globe regardless of their national origin, religious beliefs or sexual orientations. Thus, such a ban impacts our activities directly and goes counter to our core beliefs. The organizing committee of the IAU massive stars commission discussed the situation. The IAU supports the International Council for Science (ICSU) rules on Freedom, Responsibility and Universality of Science, that include the freedom of movement. To deny participation in a meeting because of nationality, political or religious beliefs are in breach of the ICSU Principle of the Universality of Science, and all member states are expected to abide by this principle.

For this reason, the organizing committee of the IAU massive stars commission believes the IAU should temporarily suspend all IAU sponsored meetings in the USA and, if the order remains in effect in the future, cancel them all. Moreover, we think that new IAU sponsored meetings should not be approved while the order is in effect. Although holding other non-IAU sponsored astronomical meetings are left to individual organizing committees, we urge everyone to uphold the principle of Universality of Science. If it is at stake, consider appropriate actions, including the cancellation of the meeting.

The Organizing Committee of the IAU Massive Stars Commission
Artemio Herrero (president), Jorick Vink (vice-president), Nicole St.-Louis (Secretary), You-Hua Chu, Jose Groh, Gregor Rauw, Asif ud-Doula

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PAPERS

Abstracts of 5 accepted papers

Luminous and Variable Stars in M31 and M33. IV. Luminous Blue Variables, Candidates LBVs, B[e] Supergiants, and the Warm Hypergiants; How to Tell Them Apart

Roberta M. Humphreys (1), Michael S. Gordon (1), John C. Martin (2), Kerstin Weis (3), and David Hahn(1)

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In this series of papers we have presented the results of a spectroscopic survey of luminous stars in the nearby spirals M31 and M33. Here, we present spectroscopy of 132 additional stars. Most have emission line spectra, including LBVs and candidate LBVs, Fe II emission line stars, the B[e] supergiants, and the warm hypergiants. Many of these objects are spectroscopically similar and are often confused with each other. We examine their similarities and differences and propose the following guidelines to help distinguish these stars in future work: 1. The B[e] supergiants have emission lines of [O I] and [Fe II] in their spectra. Most of the spectroscopically confirmed sgB[e] stars also have warm circumstellar dust in their SEDs.2 Confirmed LBVs it do not have the [O I] emission lines in their spectra. Some LBVs have [Fe II] emission lines, but not all. Their SEDs shows free-free emission in the near infrared but no evidence for warm dust. Their most important and defining characteristic is the S Dor-type variability. 3. The warm hypergiants spectroscopically resemble the LBVs in their dense wind state and the B[e] supergiants. However, they are very dusty. Some have [Fe II] and [O I] emission in their spectra like the sgB[e] stars, but are distinguished by their A and F-type spectra. In contrast, the B[e] supergiant spectra have strong continua and few if any apparent absorption lines. Candidate LBVs should share the spectral characteristics of the confirmed LBVs with low outflow velocities and the lack of warm circumstellar dust.

Reference: To appear in the Astrophysical Journal
Status: Manuscript has been accepted

Weblink: http://adsabs.harvard.edu/abs/2016arXiv161107986H

Comments:

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A Modern Search for Wolf-Rayet Stars in the Magellanic Clouds. III. A Third Year of Discoveries

Philip Massey (1), Kathryn F. Neugent (1), and Nidia Morrell (2)

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For the past three years we have been conducting a survey for WR stars in the Large and Small Magellanic Clouds (LMC, SMC). Our previous work has resulted in the discovery of a new type of WR star in the LMC, which we are calling WN3/O3. These stars have the emission-line properties of a WN3 star (strong N V but no N IV), plus the absorption-line properties of an O3 star (Balmer hydrogen plus Pickering He II, but no He I). Yet these stars are 15× fainter than an O3 V star would be by itself, ruling out these being WN3+O3 binaries. Here we report the discovery of two more members of this class, bringing the total number of these objects to 10, 6.5% of the LMC's total WR population. The optical spectra of nine of these WN3/O3s are virtually indistinguishable from each other, but one of the newly found stars is significantly different, showing a lower excitation emission and absorption spectrum (WN4/O4-ish). In addition, we have newly classified three unusual Of-type stars, including one with a strong C III λ4650 line, and two rapidly rotating "Oef" stars. We also "rediscovered" a low mass x-ray binary, RX J0513.9-6951, and demonstrate its spectral variability. Finally, we discuss the spectra of ten low priority WR candidates that turned out not to have He II emission. These include both a Be star and a B[e] star.

Reference: ApJ, in press
Status: Manuscript has been accepted

Weblink: https://arxiv.org/pdf/1701.07815v1.pdf

Comments:

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The detection of variable radio emission from the fast rotating magnetic hot B-star HR7355 and evidence for its X-ray aurorae

P. Leto, C. Trigilio, L. Oskinova, R. Ignace, C.S. Buemi, G. Umana, A. Ingallinera, H. Todt, F. Leone

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In this paper we investigate the multiwavelengths properties of the magnetic early B-type star HR7355. We present its radio light curves at several frequencies, taken with the Jansky Very Large Array, and X-ray spectra, taken with the XMM X-ray telescope. Modeling of the radio light curves for the Stokes I and V provides a quantitative analysis of the HR7355 magnetosphere. A comparison between HR7355 and a similar analysis for the Ap star CUVir, allows us to study how the different physical parameters of the two stars affect the structure of the respective magnetospheres where the non-thermal electrons originate. Our model includes a cold thermal plasma component that accumulates at high magnetic latitudes that influences the radio regime, but does not give rise to X-ray emission. Instead, the thermal X-ray emission arises from shocks generated by wind stream collisions close to the magnetic equatorial plane. The analysis of the X-ray spectrum of HR7355 also suggests the presence of a non-thermal radiation. Comparison between the spectral index of the power-law X-ray energy distribution with the non-thermal electron energy distribution indicates that the non-thermal X-ray component could be the auroral signature of the non-thermal electrons that impact the stellar surface, the same non-thermal electrons that are responsible for the observed radio emission. On the basis of our analysis, we suggest a novel model that simultaneously explains the X-ray and the radio features of HR7355 and is likely relevant for magnetospheres of other magnetic early type stars.

Reference: Leto et al., 2017, eprint arXiv:1701.07679
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1701.07679

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How unique is Plaskett's star? A search for organized magnetic fields in short period, interacting or post-interaction massive binary systems

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Amongst O-type stars with detected magnetic fields, the fast rotator in the close binary called Plaskett's star shows a variety of unusual properties. Since strong binary interactions are believed to have occurred in this system, one may wonder about their potential role in generating magnetic fields. Stokes V spectra collected with the low-resolution FORS2 and high-resolution ESPaDOnS and Narval spectropolarimeters were therefore used to search for magnetic fields in 15 interacting or post-interaction massive binaries. No magnetic field was detected in any of them, with 0G always being within 2sigma of the derived values. For 17 out of 25 stars in the systems observed at high-resolution, the 90% upper limit on the individual dipolar fields is below the dipolar field strength of Plaskett's secondary; a similar result is found for five out of six systems observed at low resolution. If our sample is considered to form a group of stars sharing similar magnetic properties, a global statistical analysis results in a stringent upper limit of ~200G on the dipolar field strength. Moreover, the magnetic incidence rate in the full sample of interacting or post-interaction systems (our targets + Plaskett's star) is compatible with that measured from large surveys, showing that they are not significantly different from the general O-star population. These results suggest that binary interactions play no systematic role in the magnetism of such massive systems.

Reference: MNRAS, in press
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1701.05370

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The VLT-FLAMES Tarantula Survey XXVI: Properties of the O-dwarf population in 30 Doradus

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The VLT-FLAMES Tarantula Survey has observed hundreds of O-type stars in the 30 Doradus region of the Large Magellanic Cloud (LMC). We study the properties of 105 apparently single O-type dwarfs. To determine stellar and wind parameters, we used the IACOB-GBAT package, an automatic procedure based on a large grid of atmospheric models calculated with the FASTWIND code. In addition to classical techniques, we applied the Bayesian BONNSAI tool to estimate evolutionary masses. We provide a new calibration of effective temperature vs. spectral type for O-type dwarfs in the LMC, based on our homogeneous analysis of the largest sample of such objects to date and including all spectral subtypes. Good agreement with previous results is found, although the sampling at the earliest subtypes could be improved. Rotation rates and helium abundances are studied in an evolutionary context. We find that most of the rapid rotators (vsini higher than 300 km/s) in our sample have masses below 25 MSun and intermediate rotation-corrected gravities (log gc between 3.9 and 4.1). Such rapid rotators are scarce at higher gravities (i.e. younger ages) and absent at lower gravities (larger ages). This is not expected from theoretical evolutionary models, and does not appear to be due to a selection bias in our sample. We compare the estimated evolutionary and spectroscopic masses, finding a trend that the former is higher for masses below 20 MSun. This can be explained as a consequence of limiting our sample to the O-type stars, and we see no compelling evidence for a systematic mass discrepancy. For most of the stars in the sample we were unable to estimate the wind-strength parameter (hence mass-loss rates) reliably, particularly for objects with luminosity lower than logL/LSun about 5.1. Ultraviolet spectroscopy is needed to undertake a detailed investigation of the wind properties of these dwarfs.

Reference: arXiv:1702.04773
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1702.04773

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Abstracts of 1 submitted papers

Monitoring Luminous Yellow Massive Stars in M33: New Yellow Hypergiant Candidates

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7-Subaru Telescope, National Astronomical Observatory of Japan, 650 North Aohoku Place, Hilo, HI 96720, USA

The evolution of massive stars surviving the red supergiant (RSG) stage remains unexplored due to the rarity of such objects. The yellow hypergiants (YHGs) appear to be the warm counterparts of post-RSG classes located near the Humphreys-Davidson upper luminosity limit, which are characterized by atmospheric instability and high mass-loss rates. We aim to increase the number of YHGs in M33 and thus to contribute to a better understanding of the pre-supernova evolution of massive stars. Optical spectroscopy of five dust-enshrouded YSGs selected from mid-IR criteria was obtained, with the goal of detecting evidence of extensive atmospheres. We also analyzed BVI photometry for 21 of the most luminous YSGs in M33 to identify changes in the spectral type. To explore the properties of circumstellar dust, we performed SED-fitting of multi-band photometry of the 21 YSGs. We find three luminous YSGs in our sample to be YHG candidates, as they are surrounded by hot dust and are enshrouded within extended, cold dusty envelopes. Our spectroscopy of Star 2 shows emission of more than one Hα components, as well as emission of Ca II, implying expanding structures associated with large outflow velocities. In addition, the long-term monitoring of the star reveals a dimming in the visual light curve of amplitude larger than 0.5 mag, which caused an apparent drop in the temperature that exceeded 500 K. We suggest the observed variability to be analogous to that of the Galactic YHG ρ Cas. Five less luminous YSGs are suggested as post-RSG candidates showing evidence of hot or/and cool dust emission. We demonstrate that mid-IR photometry, combined with optical spectroscopy and time-series photometry, provide a robust method for identifying candidate YHGs. Future discovery of YHGs in Local Group galaxies is critical for the study of the late evolution of intermediate-mass massive stars.

Reference: A&A
Status: Manuscript has been submitted

Weblink: https://arxiv.org/abs/1612.06853

Comments: Manuscript revised following the comments by the referee

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Abstracts of 4 conference proceedings

Perspectives for observing hot massive stars with XMM-Newton in the years 2017 - 2027

Gregor Rauw

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XMM-Newton has deeply changed our picture of X-ray emission of hot, massive stars. High-resolution X-ray spectroscopy as well as monitoring of these objects helped us gain a deeper insight into the physics of single massive stars with or without magnetic fields, as well as of massive binary systems, where the stellar winds of both stars interact. These observations also revealed a number of previously unexpected features that challenge our understanding of the dynamics of the stellar winds of massive stars. I briefly summarize the results obtained over the past 15 years and highlight the perspectives for the next decade. It is anticipated that coordinated (X-ray and optical or UV) monitoring and time-critical observations of either single or binary massive stars will become the most important topics in this field over the coming years. Synergies with existing or forthcoming X-ray observatories (NuSTAR, Swift, eROSITA) will also play a major role and will further enhance the importance of XMM-Newton in our quest for understanding the physics of hot, massive stars.

Reference: To appear in a special issue of Astronomical Notes. Proceedings of the workshop "XMM-Newton: The Next Decade", (ESAC, Villafranca del Castillo, Spain, 9-11 May 2016)
Status: Conference proceedings

Weblink: arXiv:1701.04557

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The Red Supergiant Content of the Local Group

Phil Massey (1,), Emily Levesque (2), Kathryn Neugent (1), Kate Evans (1,3), Maria Drout (4), Madeleine Beck (5)

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We summarize here recent work in identifying and characterizing red supergiants (RSGs) in the galaxies of the Local Group.

Reference: To appear in The Lives and Death-throes of Massive Stars, Proceedings IAU Symposium No. 329.
Status: Conference proceedings

Weblink: http://arxiv.org/abs/1702.00221

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The evolution of magnetic hot massive stars: Implementation of the quantitative influence of surface magnetic fields in modern models of stellar evolution

Zsolt Keszthelyi [1,2], Gregg A. Wade [1], Veronique Petit [3,4]

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[3] Florida Institute of Technology
[4] University of Delaware

Large-scale dipolar surface magnetic fields have been detected in a fraction of OB stars, however only few stellar evolution models of massive stars have considered the impact of these fossil fields. We are performing 1D hydrodynamical model calculations taking into account evolutionary consequences of the magnetospheric-wind interactions in a simplified parametric way. Two effects are considered: i) the global mass-loss rates are reduced due to mass-loss quenching, and ii) the surface angular momentum loss is enhanced due to magnetic braking. As a result of the magnetic mass-loss quenching, the mass of magnetic massive stars remains close to their initial masses. Thus magnetic massive stars - even at Galactic metallicity - have the potential to be progenitors of `heavy' stellar mass black holes. Similarly, at Galactic metallicity, the formation of pair instability supernovae is plausible with a magnetic progenitor.

Reference: to appear in Proceedings of IAUS 329
Status: Conference proceedings

Weblink: https://arxiv.org/abs/1702.04460

Comments:

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Recent advances in non-LTE stellar atmosphere models

Andreas A.C. Sander

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In the last decades, stellar atmosphere models have become a key tool in understanding massive stars. Applied for spectroscopic analysis, these models provide quantitative information on stellar wind properties as well as fundamental stellar parameters. The intricate non-LTE conditions in stellar winds dictate the development of adequate sophisticated model atmosphere codes. The increase in both, the computational power and our understanding of physical processes in stellar atmospheres, led to an increasing complexity in the models. As a result, codes emerged that can tackle a wide range of stellar and wind parameters.

After a brief address of the fundamentals of stellar atmosphere modeling, the current stage of clumped and line-blanketed model atmospheres will be discussed. Finally, the path for the next generation of stellar atmosphere models will be outlined. Apart from discussing multidimensional approaches, I will emphasize on the coupling of hydrodynamics with a sophisticated treatment of the radiative transfer. This next generation of models will be able to predict wind parameters from first principles, which could open new doors for our understanding of the various facets of massive star physics, evolution, and death.

Reference: to be published in the Proceedings of the IAU Symposium No. 329 "The lives and death-throes of massive stars"
Status: Conference proceedings

Weblink: https://arxiv.org/abs/1702.04798

Comments: 8 pages, 1 figure

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MEETINGS

Winds from massive stars: What are the real rates?

28 June 2017

Venue: Faculty of Law of the Charles University, Prague, Czech Republic

Massive stars are among the key players that shape our Universe. The massive stars are truly cosmic engines, which power the evolution of matter in the Universe since the formation of first stars. The input of massive star winds into the interstellar matter is mostly given by two parameters: the wind mass-loss rate and the terminal velocity. While the terminal velocity can be directly measured with high precision, the mass-loss rates are strongly debated.

There are several observational tracers of the mass-loss rate across the whole electromagnetic spectrum. In the X-ray domain, the shape of the emission line profiles is affected by the wind density and may therefore be used to determine the wind mass-loss rate. Also the strength of the ultraviolet P Cygni lines depends on the mass-loss rate. The optical region can be reached from the ground, consequently the H alpha emission line is most typically used mass-loss rate indicator. The strength of the infrared recombination lines and radio excess is also closely related to the wind mass-loss rate.

Ideally, all these tracers should give the same mass-loss rate for the same star, which should also agree with theoretical predictions. However, this is not the case for many stars. The differences may amount to one order of magnitude. This is a serious problem for stellar evolutionary models and for the determination of the massive star feedback because even a factor of two difference in the mass-loss rates can have a drastic effect for the predicted (and actual) evolution of massive stars. The differences between the individual discordant determinations may be most likely attributed to the influence of the small scale wind inhomogeneities (clumping) on the diagnostics and on the predictions.

The aim of this special session is to bring together experts on the observational and theoretical studies of the massive star winds to establish the current status of the field of the mass-loss rate determination, discuss the critical uncertainties that are mostly connected with wind inhomogeneities, and propose the best strategies to provide more reliable mass-loss rate determinations to the astrophysical community.

Programme
- Prediction of hot star wind mass-loss rates from theory
- Observational hot star wind mass-loss rates estimation: from X-rays to radio
- Influence of inhomogeneities on the observational mass-loss rate indicators
- Indirect mass-loss rate estimations

Invited speakers

- Ronny Blomme (Royal Observatory of Belgium, Belgium)
- Maurice Leutenegger (NASA/GSFC, USA)
- Francisco Najarro (Centro de Astrobiología, Spain)
- Jon Sundqvist (KU Leuven, Belgium)
- Jorick Vink (Armagh Observatory, UK)

Scientific organisers

- Jiri Krticka (Masaryk University, Czech Republic)
- Nevena Markova (Institute of Astronomy with NAO, BAS, Bulgaria)
- Joachim Puls (Universitäts-Sternwarte, Muenchen, Germany)
- Jorick Vink (Armagh Observatory, UK)

Weblink: http://eas.unige.ch/EWASS/session.jsp?id=SS10

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The physics of evolved stars II: the role of binarity

10 - 13 July 2017

Venue: Nice

This conference aims at gathering researchers working in the domain of evolved stars, be it low mass or high mass, i.e. AGB, LBV, Delta Scuti, WR, sgB[e], etc. This will foster fruitful discussions and exchanges between stellar physicists. The first of this conference series has been organized in 2015 in Nice, and it was dedicated to the memory of Olivier Chesneau, a young stellar physics scientist who was at the origin of many collaborations. To get a sense of the topics discussed during this first conference, you can browse the presentations of the 2015 conference, or take a look at the published proceedings.

Weblink: https://poe2017.sciencesconf.org/

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Eta Carinae, LBVs, and Supernova Impostors

June 19 - 23, 2017

Venue: University of Pittsburgh, Pittsburgh, PA, USA

A five-day workshop which will bring both observational and theoretical researchers together to discuss massive stars, LBVs, and Supernova (SN) Impostors will be held June 19 - 23, 2017 at the University of Pittsburgh.

With the advent of new surveys, many more SN impostors and peculiar SNe are being found. These discoveries are challenging our current understanding of massive star evolution. Some of the questions we intend to address at the workshop are:
What is the relationship between massive stars, LBVs and SN impostors?
What can current observations tell researchers about massive star evolution and instabilities?
Are Type IIn SNe related to classical LBVs or do they arise from another mechanism?
Do LBVs originate from the most massive stars?
Is binarity required for a star to go through the LBV stage?
How important is inflation for massive star outbursts?
How do massive stars influence enrichment leading to molecule and dust formation?

Our tentative schedule, intended to maximize discussion at each stage, will devote the first three to four days to massive stars, LBVs and SN impostors in general. The last one to two days will focus more on Eta Carinae, one of the most enigmatic objects in our local group of galaxies and one of the most massive and luminous stars in our galaxy that is conveniently in the LBV stage. Despite extensive investigations we still have many outstanding questions: Which star underwent the outburst? What caused the outburst? How much material was ejected? What is the enriched ejection telling us about molecules and dust formation? Were there only the 1840s and 1890s events, or were there previous massive ejections in addition to the pre-LBV winds? What is the evolutionary stage of the secondary star?

The workshop will examine how this massive binary fits into our understanding of these questions and discuss the studies, both theoretical and observational, that are needed as the 2020 periastron event approaches. We will also address what other massive stars, LBVs and SN impostors can and should be studied to provide new insights into massive star evolution.

A block of rooms has been reserved at Hilton Garden Inn Pittsburgh in Oakland (Pennsylvania), which is within walking distance of the conference room. Details will be placed on the conference website at http://kookaburra.phyast.pitt.edu/hillier/Eta2017_workshop in the near future. There is no registration fee.

As attendance is limited to approximately 35 participants, all attendees must be approved by the Scientific Organizing Committee. If you are interested in attending the workshop, and in presenting a talk, please send an email to John Hillier at hillier@pitt.edu. Please use the words "Pittsburgh Workshop" in the subject line.

Weblink: http://kookaburra.phyast.pitt.edu/hillier/Eta2017_workshop

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