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THE MASSIVE STAR NEWSLETTER

formerly known as the hot star newsletter

*

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News

Obituary Dimitri Mihalas

Dear colleagues of the massive star community,

you might have heard already that Dimitri Mihalas has passed away, after serious illness. This is very sad news for us all. According to Ivan Hubeny, just one day before his death Dimitri saw the more or less final manuscript of their new book on Stellar Atmospheres. This and all his other books, as well as our memories, will make him immortal to us.

Please find enclosed the official obituary from Los Alamos, and a more personal obituary by Ivan Hubeny, who was in close contact with Dimitri until his last hours.

Obituary (from Los Alamos)

World-renowned astrophysicist Dimitri Mihalas passed away in his sleep at his home on November 21, 2013 in Santa Fe, New Mexico. Dr. Mihalas retired from the University of Illinois at Urbana-Champaign in 1999 and from the Los Alamos National Laboratory in 2011. Dimitri, to his friends and family, has donated his body to the University of New Mexico Medical School and his library to New Mexico Tech.

Dimitri was born on March 20, 1939 in Los Angeles, California where he grew up. He received his B. A., with Highest Honors, in three majors: Physics, Mathematics, and Astronomy from the University of California at Los Angeles at age 20. Four years later he received his Ph. D in Astronomy and Physics from the California Institute of Technology. He then joined the faculty
of the Department of Astrophysical Sciences at Princeton University. In the following three decades, he was a professor in the Department of Astronomy at the University of Chicago, the University of Colorado at Boulder, and the University of Illinois at Urbana-Champaign. He was also a pioneer in astrophysics and computational physics and remained a world leader in the fields of radiation transport, radiation hydrodynamics, and astrophysical quantitative
spectroscopy for most of his career. His broad knowledge and immense contributions earned him election to the U.S. National Academy of Sciences in 1981 (at age 42, fifteen years earlier than the usual age of

entry) and many other distinguished awards. He was a laboratory fellow at the Los Alamos National Laboratory.

Dimitri had an exceptional record of both quantity and quality of work, and developed new and far-reaching methodologies yielding results of great importance. He made outstanding contributions to the field of Astronomy and Astrophysics. Besides many high-quality papers, he authored or co-authored seven books and co-edited three others. Among them, three of his books have been used as textbooks for both undergraduate and graduate students worldwide and translated into other languages such as Russian and Chinese. His book Foundations of Radiation
Hydrodynamics has become the “bible” of the radiation hydrodynamics community, especially at Los Alamos and Lawrence Livermore National Laboratories and the Naval Research Laboratory.

Dimitri’s colleagues and graduate students held him in high appreciation and expressed their admiration for him at the International Conference in Honor of Dimitri Mihalas for his Lifetime Scientific Contributions on the Occasion of his 70th Birthday held at Boulder in late March 2009.
A symposium was published following the conference.

Throughout his long career, Dimitri gave generously of himself to all with whom he interacted. As an advisor, role model, confidant, and friend, he saw each person as an individual, acknowledging strengths, helping overcome weaknesses, giving encouragement, and enthusiastically praising their success. He touched the lives and careers of many students and colleagues and has left a lasting legacy to be cherished by those who knew him.

Obituary (from Ivan Hubeny)

By now most of us have heard the sad news that Dimitri Mihalas passed away on November 21, 2013.

Dimitri was a leading figure in stellar atmospheres theory over the past more than four decades. He was enormously productive. In his early carrier he worked intensively with Larry Auer, and together they developed several crucial numerical schemes that spurred rapid progress in the computation of model stellar atmospheres. Among them, a momentous achievement was their Complete Linearization Method, which revolutionized the field. Dimitri was author of numerous books, including the classic "Galactic Astronomy" with James Binney, but his famous monograph "Stellar Atmospheres," published in 1970 with a major 2nd edition in 1978, immediately became for most of us the true bible of the field.

In the 1970's and early 1980's Dimitri worked at the High Altitude Observatory of the National Center of Atmospheric Research in Boulder, CO. Surrounded by solar observers there, Dimitri was constantly exposed to detailed pictures of the Sun's atmosphere, graphically showing severe departures from the then computational paradigm of a plane-parallel, horizontally-homogeneous hydrostatic structure. This confrontation led Dimitri to became deeply interested in radiation hydrodynamics, a field which would address these issues. Quite typically of him, in a few years he had produced the classic monograph "Foundations of Radiation Hydrodynamics," in collaboration with his then wife Barbara. Needless to say, this book quickly became a second bible of the field.

These texts are well known to the astronomical community. What is less well known is that Dimitri also published several collections of his poetry and other writings. From an early age, he suffered from bipolar syndrome and transient severe depression. Characteristically for him, he found a way to turn this difficult problem into help for others in a similar situation by writing several books, including "Depression and Spiritual Growth" and "Friendly Primer on Depression." I leaned that people suffering from these conditions have profited from Dimitri's books as much as, if not more than, we have benefited from his professional textbooks and articles.

All this demonstrates that Dimitri not only was a brilliant scientist, but also a truly great and exceptional human being. For many of us he was a teacher, role model, and good friend. He always offered personal, gentle, and yet very strong encouragement to his students and colleagues. He profoundly touched the lives

of all who came in contact with him. This was clearly seen during a conference in Boulder in 2009, to honor Dimitri's lifetime work on the occasion of his 70th birthday. There, his many colleagues expressed their profound gratitude to him and shared many stories about how their work and life had been influenced by him.

As to me personally, I feel very privileged that I could collaborate with him on what sadly turned out to be his last major work: a project that first was conceived as a third edition of "Stellar Atmospheres," but in time grew into a completely new book, with a new title, "Theory of Stellar Atmospheres: An Introduction to Astrophysical Non-equilibrium Quantitative Spectroscopic Analysis." As a sad coincidence, Dimitri passed away just days after the final manuscript was submitted to press.

Dimitri will be missed dearly. But as with all great scientists, great minds, and great human beings, his legacy will continue for a long time to come.

Ivan Hubeny

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VLTI Observatory survey at High Angular resolution of Active OB stars

Dear colleagues,

we would like to announce a public, interferometric survey of the gaseous circumstellar environments of hot stars. The survey is a bad weather/filler program currently carried out by the VLTI group at the Paranal observatory. The targets are selected from three classes: Be stars, supergiants and LBVs, and interacting binaries. The data are taken with the AMBER instrument in high spectral resolution setting (R=12000). The data are available immediately through the ESO archive. Quick-look reductions are published soon after and can be obtained from a dedicated forum:
http://activebstars.iag.usp.br/index.php/forum/ohana

Read more, including the proposal, at http://activebstars.iag.usp.br/index.php/34-ohana

We hope the data will be useful.

Best regards,
Willem-Jan de Wit, Thomas Rivinius, and the Paranal VLTI group

Weblink: http://activebstars.iag.usp.br/index.php/34-ohana

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PAPERS

Abstracts of 18 accepted papers

The IACOB project: I. Rotational velocities in Northern Galactic O and early B-type stars revisited. The impact of other sources of line-broadening

S. Simón-Díaz & A. Herrero

Instituto de Astrofísica de Canarias

Stellar rotation is an important parameter in the evolution of massive stars. Accurate and reliable measurements of projected rotational velocities in large samples of OB stars are crucial to confront the predictions of stellar evolutionary models with observational constraints.

We reassess previous determinations of projected rotational velocities (vsini) in Galactic OB stars using a large, high quality spectroscopic dataset, and a strategy which account for other sources of broadening appart from rotation affecting the diagnostic lines.

We present a versatile and user friendly IDL tool --- based on a combined Fourier Transform (FT) + goodness of fit (GOF) methodology --- for the line-broadening characterization in OB-type stars. We use this tool to (a) investigate the impact of macroturbulent and microturbulent broadenings on vsini measurements, and (b) determine vsini in a sample of ~200 Galactic OB-type stars, also characterizing the amount of macroturbulent broadening (vmacro) affecting the line profiles.

We present observational evidence illustrating the strengths and limitations of the proposed FT+GOF methodology for the case of OB stars. We confirm previous statements (based on indirect arguments or smaller samples) that the macroturbulent broadening is ubiquitous in the massive star domain. We compare the newly derived vsini in the case of O stars and early-B Supergiants and Giants (where the effect of the macroturbulent broadening is found to be larger) with previous determinations not accounting for this extra line-broadening contribution, and show that those cases with vsini < 120 km/s need to be systematically revised downwards by ~25 (+/-20) km/s. We suggest that microturbulence may impose an upper limit below which vsini and vmacro could be incorrectly derived by means of the proposed methodology as presently used, and discuss the implications of this statement on the study of relatively narrow line massive stars.

An investigation of impact of the revised vsini distributions on the predictions by massive star evolutionary models is now warranted. Also, the reliability of vsini measurements in the low vsini regime, using a more precise description of the intrinsic profiles used for the line-broadening analysis, needs to be further investigated.

Reference: A&A
Status: Manuscript has been accepted
Weblink: http://adsabs.harvard.edu/abs/2013arXiv1311.3360S
Comments: Accepted for publication in A&A (19 pages, 15 figures, 6 tables). Tables A1-A5 will be make available in the final edited version of the paper (or under request to SS-D)

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HI Lyman-alpha equivalent widths of stellar populations

Maria A. Peña-Guerrero & Claus Leitherer

Space Telescope Science Institute

We have compiled a library of stellar lya equivalent widths in O and B stars using the model atmosphere codes cgen and tlus, respectively. The equivalent widths range from about 0 to 30 AA in absorption for early-O to mid-B stars. The purpose of this library is the prediction of the underlying stellar lya absorption in stellar populations of star-forming galaxies with nebular lya emission. We implemented the grid of individual equivalent widths into the Starburst99 population synthesis code to generate synthetic lya equivalent widths for representative star-formation histories. A starburst observed after 10 Myr will produce a stellar lya line with an equivalent width of ~ -10pm4 AA in absorption for a Salpeter initial mass function. The lower value (deeper absorption) results for an instantaneous burst, and the higher value (shallower line) for continuous star formation. Depending on the escape fraction of nebular lya photons, the effect of stellar lya on the total profile ranges from negligible to dominant. If the nebular escape fraction is 10%, the stellar absorption and nebular emission equivalent widths become comparable for continuous star formation at ages of 10 to 20 Myr.

Reference: AJ, 146, 158
Status: Manuscript has been accepted

Weblink: http://stacks.iop.org/1538-3881/146/158

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Modeling Tracers of Young Stellar Population Age in Star-Forming Galaxies

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The young stellar population of a star-forming galaxy is the primary engine driving its radiative properties. As a result, the age of a galaxy's youngest generation of stars is critical for a detailed understanding of its star formation history, stellar content, and evolutionary state. Here we present predicted equivalent widths for the H-beta, H-alpha, and Br-gamma recombination lines as a function of stellar population age. The equivalent widths are produced by the latest generations of stellar evolutionary tracks and the Starburst99 stellar population synthesis code, and are the first to fully account for the combined effects of both nebular emission and continuum absorption produced by the synthetic stellar population. Our grid of model stellar populations spans six metallicities (0.001 < Z < 0.04), two treatments of star formation history (a 10^6 Mo instantaneous burst and a continuous star formation rate of 1 Mo per year), and two different treatments of initial rotation rate (v_rot = 0.0v_crit and v_rot = 0.4v_crit). We also investigate the effects of varying the initial mass function. Given constraints on galaxy metallicity, our predicted equivalent widths can be applied to observations of star-forming galaxies to approximate the age of their young stellar populations.

Reference: ApJ, Vol. 779, in press
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1311.1202

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The Dynamics of Ultracompact HII Regions

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Many ultracompact HII regions exhibit a cometary morphology in radio continuum emission. In such regions, a young massive star is probably ablating, through its ultraviolet radiation, the molecular cloud that spawned it. On one side of the star, the radiation drives an ionization front that stalls in dense molecular gas. On the other side, ionized gas streams outward into the more rarefied environment. This wind is underpressured with respect to the neutral gas. The difference in pressure draws in more cloud material, feeding the wind until the densest molecular gas is dissipated.

Recent, time-dependent simulations of massive stars turning on within molecular gas show the system evolving in a direction similar to that just described. Here, we explore a semi-analytic model in which the wind is axisymmetric and has already achieved a steady state. Adoption of this simplified picture allows us to study the dependence of both the wind and its bounding ionization front on the stellar luminosity, the peak molecular density, and the displacement of the star from the center of the clump. For typical parameter values, the wind accelerates transonically to a speed of about 15 km/s, and transports mass outward at a rate of 10^{-4} msun/yr. Stellar radiation pressure acts to steepen the density gradient of the wind.

Reference: MNRAS
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1311.5912

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Optical spectra of 5 new Be/X-ray Binaries in the Small Magellanic Cloud and the link of the supergiant B[e] star LHA 115-S 18 with an X-ray source

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The Small Magellanic Cloud (SMC) is well known to harbor a large number of High-Mass X-ray Binaries (HMXBs). The identification of their optical counterparts provides information on the nature of the donor stars and can help to constrain the parameters of these systems and their evolution. We obtained optical spectra for a number of HMXBs identified in previous textit{Chandra} and textit{XMM-Newton} surveys of the SMC using the AAOmega/2dF fiber-fed spectrograph at the Anglo-Australian Telescope. We find 5 new Be/X-ray binaries (BeXRBs; including a tentative one), by identifying the spectral type of their optical counterparts, and we confirm the spectral classification of an additional 15 known BeXRBs. We compared the spectral types, orbital periods, and eccentricities of the BeXRB populations in the SMC and the Milky Way and we find marginal evidence for difference between the spectral type distributions, but no statistically significant differences for the orbital periods and the eccentricities. Moreover, our search revealed that the well known supergiant B[e] star LHA 115-S 18 (or AzV 154) is associated with the weak X-ray source CXOU J005409.57-724143.5. We provide evidence that the supergiant star LHA 115-S 18 is the optical counterpart of the X-ray source, and we discuss different possibilities of the origin of its low X-ray luminosity (Lx~4x10^33 erg/s).

Reference: MNRAS
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1312.0593

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On the origin of variable structures in the winds of hot luminous stars

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Examination of the temporal variability properties of several strong optical recombination lines in a large sample of Galactic Wolf–Rayet (WR) stars reveals possible trends, especially in the more homogeneous WC than the diverse WN subtypes, of increasing wind variability with cooler subtypes. This could imply that a serious contender for the driver of the variations
is stochastic, magnetic subsurface convection associated with the 170 kK partial-ionization zone of iron, which should occupy a deeper and larger zone of greater mass in cooler WR subtypes. This empirical evidence suggests that the heretofore proposed ubiquitous driver of
wind variability, radiative instabilities, may not be the only mechanism playing a role in the stochastic multiple small-scaled structures seen in the winds of hot luminous stars. In addition to small-scale stochastic behaviour, subsurface convection guided by a global magnetic field with localized emerging loops may also be at the origin of the large-scale corotating interaction
regions as seen frequently in O stars and occasionally in the winds of their descendant WR
stars.

Reference: On the origin of variable structures in the winds of hot luminous stars
Yannick J. L. Michaux; Anthony F. J. Moffat; Andre-Nicolas Chene; Nicole St-Louis

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Weblink:

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Wind collisions in three massive stars of Cyg OB2

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Aims: We wish to study the origin of the X-ray emission of three massive stars in the Cyg OB2 association: Cyg OB2 #5, #8A, #12. Methods: To this aim, dedicated X-ray observations from XMM and Swift are used, as well as archival ROSAT and Suzaku data. Results: Our results on Cyg OB2 #8A improve the phase coverage of the orbit and confirm previous studies: the signature of a wind-wind collision is conspicuous. In addition, signatures of a wind-wind collision are also detected in Cyg OB2 #5, but the X-ray emission appears to be associated with the collision between the inner binary and the tertiary component orbiting it with a 6.7yr period, without a putative collision inside the binary. The X-ray properties strongly constrain the orbital parameters, notably allowing us to discard some proposed orbital solutions. To improve the knowledge of the orbit, we revisit the light curves and radial velocity of the

inner binary, looking for reflex motion induced by the third star. Finally, the X-ray emission of Cyg OB2 #12 is also analyzed. It shows a marked decrease in recent years, compatible with either a wind-wind collision in a wide binary or the aftermath of a recent eruption.

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Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1312.1871

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Discovery of the first B[e] supergiants in M 31

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B[e] supergiants (B[e]SGs) are transitional objects in the post-main sequence evolution of massive stars. The small number of B[e]SGs known so far in the Galaxy and the Magellanic Clouds indicates that this evolutionary phase is short. Nevertheless, the strong aspherical mass loss occurring during this phase, which leads to the formation of rings or disk-like structures, and the similarity to possible progenitors of SN1987A emphasize the importance of B[e]SGs for the dynamics of the interstellar medium as well as stellar and galactic chemical evolution. The number of objects and their mass loss behavior at different metallicities are essential ingredients for accurate predictions from stellar and galactic evolution calculations. However, B[e]SGs are not easily identified, as they share many characteristics with luminous blue variables (LBVs) in their quiescent (hot) phase. We present medium-resolution near-infrared K-band spectra for four stars in M 31, which have been assigned a hot LBV (candidate) status. Applying diagnostics that were recently developed to distinguish B[e]SGs from hot LBVs, we classify two of the objects as bonafide LBVs; one of them currently in outburst. In addition, we firmly classify the two stars 2MASS J00441709+4119273 and 2MASS J00452257+4150346 as the first B[e]SGs in M 31 based on strong CO band emission detected in their spectra, and infrared colors typical for this class of stars.

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Status: Manuscript has been accepted

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Constraints on Massive Star Formation: Cygnus OB2 was always an Association

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2. ETH Zurich
3. University of Sheffield
4. Smithsonian Astrophysical Observatory

We examine substructure and mass segregation in the massive OB association Cygnus OB2 to better understand its initial conditions. Using a well understood Chandra X-ray selected sample of young stars we find that Cyg OB2 exhibits considerable physical substructure and has no evidence for mass segregation, both indications that the association is not dynamically evolved. Combined with previous kinematical studies we conclude that Cyg OB2 is dynamically very young, and what we observe now is very close to its initial conditions: Cyg OB2 formed as a highly substructured, unbound association with a low volume density (< 100 stars/pc^3). This is inconsistent with the idea that all stars form in dense, compact clusters. The massive stars in Cyg OB2 show no evidence for having formed particularly close to one another, nor in regions of higher than average density. Since Cyg OB2 contains stars as massive as ~100 Mo this result suggests that very massive stars can be born in relatively low-density environments. This would imply that the massive stars in Cyg OB2 did not form by competitive accretion, or by mergers.

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Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1311.4537

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The feedback of massive stars on interstellar astrochemical processes

M. De Becker

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Astrochemistry is a discipline that studies physico-chemical processes in astrophysical environments. Such environments are characterized by conditions that are substantially different from those existing in usual chemical laboratories. Models which aim to explain the formation of molecular species in interstellar environments must take into account various factors, including many that are directly, or indirectly related to the populations of massive stars in galaxies. The aim of this paper is to review the influence of massive stars, whatever their evolution stage, on the physico-chemical processes at work in interstellar environments. These influences include the ultraviolet radiation field, the production of high energy particles, the synthesis of radionuclides and the formation of shocks that permeate the interstellar medium.

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Weblink: http://hdl.handle.net/2268/159499

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The VLT-FLAMES Tarantula Survey. XIII: On the nature of O Vz stars in 30 Doradus

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AIMS. We test the hypothesis of O Vz stars (characterized by having HeII4686 stronger in absorption than other He lines in their blue-violet spectra) being at a younger evolutionary stage than are normal O-type dwarfs.
METHODS. We have performed a quantitative spectroscopic analysis of a sample of 38 O Vz and 46 O V stars, identified by the VLT-FLAMES Tarantula Survey in the 30 Doradus region of the Large Magellanic Cloud (LMC). We obtained the stellar and wind parameters of both samples using the FASTWIND stellar atmosphere code and the IACOB-GBAT grid-based automatic tool. In the framework of a differential study, we compared the physical and evolutionary properties of both samples, regarding Teff, logg, logQ and logL. We also investigated the predictions of the FASTWIND code about the O Vz phenomenon.
RESULTS. We find a differential distribution of objects in terms of effective temperature, with O Vz stars dominant at intermediate values. The O Vz stars in 30 Doradus tend to be younger and less luminous, and they have weaker winds than the O V stars, but we also find examples with ages of 2-4 Myr and with luminosities and winds that are similar to those of normal O dwarfs. Moreover, the O Vz stars do not appear to have higher gravities than the O V stars. In addition to effective temperature and wind strength, our FASTWIND predictions indicate how important it is to take other stellar parameters (gravity and projected rotational velocity) into account for correctly interpreting the O Vz phenomenon.
CONCLUSIONS. In general, the O Vz stars appear to be on or very close to the ZAMS, but there are

some examples where the Vz classification does not necessarily imply extreme youth. In particular, the presence of O Vz stars in our sample at more evolved phases than expected is likely a consequence of modest O-star winds owing to the low-metallicity environment of the LMC.

Reference: arXiv:1312.3278
Status: Manuscript has been accepted

Weblink:

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The eccentric massive binary V380 Cyg: revised orbital elements and interpretation of the intrinsic variability of the primary component

A. Tkachenko, P. Degroote, C. Aerts, K. Pavlovski, J. Southworth, P. I. Papics, E. Moravveji, V. Kolbas, V. Tsymbal, J. Debosscher, and K. Clemer

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We present a detailed analysis and interpretation of the high-mass binary V380 Cyg, based on high-precision space photometry gathered with the Kepler space mission as well as high-resolution ground-based spectroscopy obtained with the HERMES spectrograph attached to the 1.2m Mercator telescope. We derive a precise orbital solution and the full physical properties of the system, including dynamical component mass estimates of 11.43+/-0.19 and 7.00+/-0.14 solar masses for the primary and secondary, respectively. Our frequency analysis reveals the rotation frequency of the primary in both the photometric and spectroscopic data and additional low amplitude stochastic variability at low frequency in the space photometry with characteristics that are compatible with recent theoretical predictions for gravity mode oscillations excited either by the convective core or by sub-surface convective layers. Doppler Imaging analysis of the silicon lines of the primary suggests the presence of two high-contrast stellar surface abundance spots which are located either at the same latitude or longitude. Comparison of the observed properties of the binary with present-day single-star evolutionary models shows that the latter are inadequate and lack a serious amount of near-core mixing.

Reference: Monthly Notices of the Royal Astronomical Society (MNRAS)
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1312.3601

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The incidence of stellar mergers and mass gainers among massive stars

S.E. de Mink, H. Sana, N. Langer, R.G. Izzard, F.R.N. Schneider

Carnegie Observatories / Caltech, Space Telescope Science Institute, Argelander Institute Bonn

Because the majority of massive stars are born as members of close binary systems, populations of massive main-sequence stars contain stellar mergers and products of binary mass transfer. We simulate populations of massive stars accounting for all major binary evolution effects based on the most recent binary parameter statistics and extensively evaluate the effect of model uncertainties.

Assuming constant star formation, we find that 8+9−4% of a sample of early type stars to be the product of a merger resulting from a close binary system. In total we find that 30+10−15% of massive main-sequence stars are the product of binary interaction.

We show that the commonly adapted approach to minimize the effects of binaries on an observed sample by excluding systems detected as binaries through radial velocity campaigns can be counterproductive. Systems with significant radial velocity variations are mostly pre-interaction systems. Excluding them substantially enhances the relative incidence of mergers and binary products in the non radial velocity variable sample.

This poses a challenge for testing single stellar evolutionary models. It also raises the question of whether certain peculiar classes of stars, such as magnetic O-stars, are the result of binary interaction and it emphasizes the need to further study the effect of binarity on the diagnostics that are used to derive the fundamental properties (star-formation history, initial mass function, mass to light ratio) of stellar populations nearby and at high redshift.

Reference: Tentatively scheduled for the February 1, 2014, V781 - 2 issue of ApJ.
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1312.3650

Comments: 8 pages, 3 figures, accepted for publ. in ApJ

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The surface nitrogen abundance of a massive star in relation to its oscillations, rotation, and magnetic field

Conny Aerts, Geert Molenberghs, Michael G. Kenward, Coralie Neiner

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B-3500 Hasselt, Belgium;
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B-3000 Leuven, Belgium;

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Tropical Medicine, Keppel Street,
London WC1E7HT, United Kingdom;
LESIA, UMR 8109 du CNRS, Observatoire de Paris, UPMC, Paris
Diderot, 5 Place Jules Janssen 92195 Meudon Cedex, France

We have composed a sample of 68 massive stars in our galaxy whose projected rotational velocity, effective temperature and gravity are available from high-precision spectroscopic measurements. The additional seven observed variables considered here are their surface nitrogen abundance, rotational frequency, magnetic field strength, and the amplitude and frequency of their dominant acoustic and gravity mode of oscillation. Multiple linear regression to estimate the nitrogen abundance combined with principal components analysis, after addressing the incomplete and truncated nature of the data, reveals that the effective temperature and the frequency of the dominant acoustic oscillation mode are the only two significant predictors for the nitrogen abundance, while the projected rotational velocity and the rotational frequency have no predictive power. The dominant gravity mode and the magnetic field strength are correlated with the effective temperature but have no predictive power for the nitrogen abundance.
Our findings are completely based on observations and their proper statistical treatment and call for a new strategy in evaluating the outcome of stellar evolution computations.

Reference: Accepted for publication in The Astrophysical Journal
Status: Manuscript has been accepted

Weblink: http://adsabs.harvard.edu/abs/2013arXiv1312.4144A

Comments: Table 3 in electronic format available upon request.

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The Galactic O-Star Spectroscopic Survey (GOSSS). II. Bright Southern Stars

A. Sota, J. Maíz Apellániz, N. I. Morrell, R. H. Barbá, N. R. Walborn, R. C. Gamen, J. I. Arias, and E. J. Alfaro

IAA-CSIC, LCO, ULS, STScI, IALP

We present the second installment of GOSSS, a massive spectroscopic survey of Galactic O stars, based on new homogeneous, high signal-to-noise ratio, R ~ 2500 digital observations from both hemispheres selected from the Galactic O-Star Catalog (GOSC). In this paper we include bright stars and other objects drawn mostly from the first version of GOSC, all of them south of delta = -20 degrees, for a total number of 258 O stars. We also revise the northern sample of paper I to provide the full list of spectroscopically classified Galactic O stars complete to B = 8, bringing the total number of published GOSSS stars to 448. Extensive sequences of exceptional objects are given, including the early Of/WN, O Iafpe, Ofc, ON/OC, Onfp, Of?p, and Oe types, as well as double/triple-lined spectroscopic binaries. The new spectral subtype O9.2 is
also discussed. The magnitude and spatial distributions of the observed sample are analyzed. We also

present new results from OWN, a multi-epoch high-resolution spectroscopic survey coordinated with GOSSS that is assembling the largest sample of Galactic spectroscopic massive binaries ever attained. The OWN data combined with additional information on spectroscopic and visual binaries from the literature indicate that only a very small fraction (if any) of the stars with masses above 15-20 M_Sol are born as single systems. In the future we will publish the rest of the GOSSS survey, which is expected to include over 1000 Galactic O stars.

Reference: To appear in ApJS
Status: Manuscript has been accepted

Weblink: http://jmaiz.iaa.es/files/Sotaetal14.pdf

Comments:

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Can the magnetic field in the Orion arm inhibit the growth of instabilities in the bow shock of Betelgeuse?

Allard Jan van Marle^1
Leen Decin^1
Zakaria Meliani^2

^{1}Institute of Astronomy, KU Leuven
^{2}Observatoire de Paris, Meudon

Many evolved stars travel through space at supersonic velocities, which leads to the formation of bow shocks ahead of the star where the stellar wind collides with the interstellar medium (ISM). Herschel observations of the bow shock of α-Orionis show that the shock is almost free of instabilities, despite being, at least in theory, subject to both Kelvin-Helmholtz and Rayleigh-Taylor instabilities. A possible explanation for the lack of instabilities lies in the presence of an interstellar magnetic field. We wish to investigate whether the magnetic field of the interstellar medium (ISM) in the Orion arm can inhibit the growth of instabilities in the bow shock of α-Orionis. We used the code MPI-AMRVAC to make magneto-hydrodynamic simulations of a circumstellar bow shock, using the wind parameters derived for α-Orionis and interstellar magnetic field strengths of B=1.4,3.0, and 5.0μG, which fall within the boundaries of the observed magnetic field strength in the Orion arm of the Milky Way. Our results show that even a relatively weak magnetic field in the interstellar medium can suppress the growth of Rayleigh-Taylor and Kelvin-Helmholtz instabilities, which occur along the contact discontinuity between the shocked wind and the shocked ISM. The presence of even a weak magnetic field in the ISM effectively inhibits the growth of instabilities in the bow shock. This may explain the absence of such instabilities in the Herschel observations of α-Orionis.

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

Weblink: http://arxiv.org/abs/1312.5877

Comments:

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A Rare Encounter with Very Massive Stars in NGC 3125-A1

Aida Wofford (1), Claus Leitherer (2), Rupali Chandar (3), and Jean-Claude Bouret (4)

1 -UPMC-CNRS, UMR7095, Institut d'Astrophysique de Paris, F-75014, Paris, France
2- Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
3- University of Toledo, Department of Physics and Astronomy, Toledo, OH 43606, USA
4- Aix Marseille Universite, CNRS, LAM (Laboratoire d'Astrophysique de Marseille) UMR 7326, 13388, Marseille, France

Super star cluster A1 in the nearby starburst galaxy NGC 3125 is characterized by broad He II 1640 emission (full width at half maximum, FWHM∼1200 km s−1) of unprecedented strength (equivalent width, EW=7.1±0.4 AA). Previous attempts to characterize the massive star content in NGC 3125-A1 were hampered by the low resolution of the UV spectrum and the lack of co-spatial panchromatic data. We obtained far-UV to near-IR spectroscopy of the two principal emitting regions in the galaxy with the Space Telescope Imaging Spectrograph (STIS) and the Cosmic Origins Spectrograph (COS) onboard the Hubble Space Telescope (HST). We use these data to study three clusters in the galaxy, A1, B1, and B2. We derive cluster ages of 3-4 Myr, intrinsic reddenings of E(B−V)=0.13, 0.15, and 0.13, and cluster masses of 1.7×10^5, 1.4×10^5, and 1.1×10^5 M⊙, respectively. A1 and B2 show O V 1371 absorption from massive stars, which is rarely seen in star-forming galaxies, and have Wolf-Rayet (WR) to O star ratios of N(WN5−6)/N(O)=0.23 and 0.10, respectively. The high N(WN5−6)/N(O) ratio of A1 cannot be reproduced by models that use a normal IMF and generic WR star line luminosities. We rule out that the extraordinary He II 1640 emission and O V 1371 absorption of A1 are due to an extremely flat upper IMF exponent, and suggest that they originate in the winds of very massive (>120M⊙) stars. In order to reproduce the properties of peculiar clusters such as A1, the present grid of stellar evolution tracks implemented in Starburst99 needs to be extended to masses >120M⊙.

Reference: Tentatively scheduled for the ApJ, February 10, 2014, V782 -
1 issue
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1312.5982

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Spectroscopic and physical parameters of Galactic O-type stars. II. Observational constraints on projected rotational and extra broadening velocities as a function of fundamental parameters and stellar evolution.

N. Markova, J. Puls, S. Simon-Diaz, A. Herrero, H.Markov, N. Langer

Rotation is of key importance for the evolution of massive stars, including their fate as supernovae or Gamma-ray bursts. However, the rotational velocities of OB stars are difficult to determine. Based on our

own data for 31 Galactic O stars and incorporating similar data for 86 OB supergiants from the literature, we investigated the properties of rotational and extra line-broadening as a function of stellar parameters and put constrains on model predictions about the evolution of stellar rotation. Fundamental stellar parameters were determined by means of the
code FASTWIND. Projected rotational and extra broadening velocities, originate from a combined Fourier transform + Goodness-of- fit method. Model calculations published previously were used to estimate the initial evolutionary masses.
Our analysis shows that the sample O stars with initial masses larger than 50~Msun rotate with less that 26% of their break-up velocity, and they also lack slow rotators (vsini < 50~kms). For the more massive stars (Minit > 35 Msun) on the hotter side of the bi-stability jump, the observed and predicted rotational rates agree quite well; for those on the cooler side of the jump, the measured velocities are systematically higher than the predicted ones. In general, the derived extra-broadening velocities decrease toward cooler Teff, whilst for later evolutionary phases they appear, at the same vsini, higher for high-mass stars than for low-mass ones. None of the sample stars shows extra broadening velocities larger than 110~kms. For the majority of the more massive stars, extra broadening either dominates or is in strong competition with rotation. The main implications of our results are at least twofold: i) when appearing at or close to the zero-age main sequence, most of the single and more massive stars may rotate slower than previously thought; (ii) model predictions for the evolution of rotation in hot massive stars may need to be updated.

Reference: A&A

Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/2013arXiv1310.8546M

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Abstracts of 1 conference proceedings

Stellar Spectral Signatures in High-Redshift Galaxies

Claus Leitherer

STScI

Stellar emission and absorption lines are routinely observed in galaxies at redshifts up to 5 with spectrographs on 8-10m class telescopes. While the overall spectra are well understood and have been successfully modeled using empirical and theoretical libraries, some challenges remain. Three issues are discussed: determining abundances using stellar and interstellar spectral lines, understanding the origin of the strong, stellar He II 1640 line, and gauging the influence of stellar Lyman-alpha on the combined stellar+nebular profile. All three issues can be tackled with recently created theoretical stellar libraries for hot stars which take into account the radiation-hydrodynamics of stellar winds.

Reference: International Workshop on Stellar Spectral Libraries, Lyon (France), October 14 - 17, 2013. To be published in ASI Conference Series, 2014, Vol. 10, editors: H. P. Singh & P. Prugniel
Status: Conference proceedings

Weblink: http://arxiv.org/abs/1312.2464

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JOBS

Two Ph.D. positions

Georges Meynet

Astronomical Observatory of Geneva University

The Geneva Observatory invites applications for two PhD positions in the stellar evolution group led by Prof. Georges Meynet.

The themes of the research in the group are stellar physics, non standard mixing processes in stars, massive star evolution, first stars, population of stars in galaxies, nucleosynthesis, progenitors of core-collapse supernovae and Gamma Ray Bursts, and asteroseismology. The group uses stellar evolution codes, population synthesis codes, modeling of stellar spectra, and predictions of asteroseismic observables to address topical questions in the above themes.

The group would like to take the opportunity of these two Ph.D positions to expand its research activities along the two directions below:

1) The modeling of close binary massive stars in order to study the formation of systems containing compact objects such as neutron stars and particularly black holes. The goal of the project is to investigate the origin of compact object spin, and how it is connected to the different physical processes taking place in the evolution of close binary massive stars, progenitors of compact object binaries.

2) The development of new models for the first stellar generations in the Universe, in particular studying the impact of rotation and magnetic fields on the expected nucleosynthesis of these objects and obtaining better diagnostics for identifying the presence of these first stellar generations in high redshift galaxies.

The starting date of both positions is as early as April 1st 2014, but later starting dates are possible. The salary scale is attractive (starting at CHF 50 000) and funding is available for up to 4 years.

The interested candidates are invited to send to Georges Meynet (georges.meynet@unige.ch) the following documents:
1) A motivation letter
2) A brief (1-2 pages) CV
3) At least two recommendation letters (one from the master's thesis advisor)
Deadline : January 31rst 2014.

Attention/Comments:

Weblink: http://obswww.unige.ch/Recherche/evol/?lang=en

Email: georges.meynet@unige.ch

Deadline: January 31st 2014.

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Research Fellow

Alexander Heger

Monash Centre for Astrophysics
School of Mathematical Sciences
Monash University, VIC 3800
Australia

We invite applications for a Research Fellowship in the wider field of stellar evolution and nuclear astrophysics with Prof. Alexander Heger at the Monash Centre for Astrophysics (MoCA) at Monash University, Melbourne, Australia.

The successful candidate should have experience in theoretical or numerical modelling in nuclear astrophysics in one or several of the following fields: formation and evolution of massive or very massive stars, supernovae, binary stars, stellar rotation and magnetic fields, gamma-ray burst and other transients and outbursts, galactic chemical evolution, first stars (formation and evolution), or Type I X-ray burst and superbursts.

MoCA has very active research groups in Stellar Interiors and Nucleosynthesis (SINs - Lattanzio, Lugaro, Heger, Campbell, Mueller), High-energy Astrophysics (Galloway, Levin, Donea, Heger, Price, Mueller, Lazendic-Galloway), Astrophysical Fluid Dynamics and MHD (Monaghan; Price - star formation), Galaxy Evolution (Bown), Numerical General Relativity, and solar physics, amongst others (see http://moca.monash.edu/research). The initial appointment is for two years, with the possibility of extension for a third year contingent upon satisfactory performance, at level A or B depending on experience (A$64.175 - A$108.788 pa including 9.25% employer superannuation). Commencement date should be on or before Oct. 1, 2014

The application needs to be submitted online at by Jan 31, 2013 (AEDT). For the full job ad and application instructions please visit http://jobs.monash.edu.au/jobDetails.asp?sJobIDs=518885

Attention/Comments:

Weblink: http://jobs.monash.edu.au/jobDetails.asp?sJobIDs=518885

Email: alexander.heger@monash.edu

Deadline: Jan 31, 2014 (COB AEDT)

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MEETINGS

NEW WINDOWS ON MASSIVE STARS: Asteroseismology, interferometry, and spectropolarimetry

June 23-27, 2014

Venue: Geneva (Switzerland)

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FIRST ANNOUNCEMENT
IAU symposium 307
"NEW WINDOWS ON MASSIVE STARS:
Asteroseismology, interferometry, and spectropolarimetry"
Geneva (Switzerland)
June 23-27, 2014
==========
* CONTACT:
email: iau307@unige.ch
webpage: http://obswww.unige.ch/Conferences/IAU307/

* IMPORTANT DATES:
Deadline for grant request: January 31, 2014
Deadline for abstract submission: April 30, 2014
Deadline for early fees (250 CHF): May 15, 2014
Conference: June 23-27, 2014

* SCIENTIFIC RATIONALE:
The important outputs of mass, momentum and energy of massive stars strongly modify their environment and make them key agents in the evolution of galaxies during the whole of cosmic history. Their high luminosities make them objects detectable at far distances in the Universe. Massive stars are thus important probes for studying star formation at high redshifts. As the progenitors of core collapse supernovae, of the long soft Gamma Ray Bursts, and of neutron stars and black holes, they are connected with the most intriguing objects in the Universe.
Their physics is, however, not yet very well known and such basic understanding as the origin of the various massive star populations (Be-type stars, red and blue supergiants, Luminous Blue Variables, Wolf- Rayet stars) are still matters of debate, as well as the nature of the progenitors of the various types of core-collapse supernovae (type IIP, IIL, IIb, IIn, Ibc).
Among the great challenges faced nowadays in our understanding of massive star evolution, we can cite the following two points :
• Hydrodynamical processes: turbulent flow, rotation, magnetic fields, as well as mass loss, are all basically fluid dynamics of plasmas. These processes, by governing the quantity of fuel available for a given nuclear burning stage, by modifying the chemical structure of the stars, and by allowing the total mass to strongly decline with time have a dramatic impact on the evolution of massive stars. This also has strong consequences on the chemical evolution of galaxies and on the evolution of their spectral energy distribution.
• Role of multiplicity in massive star evolution : in addition to the complex physics involved in single stars, multiplicity adds new types of interactions through tidal forces, mass transfer and/or stellar mergers, opening the path to a variety of different evolutionary pathways populating various parts of the HR diagram and leading to specific final structures and thus particular supernova events.

Nowadays, asteroseismology, interferometry and spectropolarimetry allow a view into what could have been thought once as unreachable characteristics of stars in general and of massive stars in particular, and thus can provide new clues on how massive stars are evolving:
• Asteroseismology (MOST, CoRoT, Kepler, BRITE) allows to probe what happens into the interior of stars, to identify the zones where steep gradients of chemical composition and of angular velocity occur. This provides essential clues on transport processes inside stars. These transport processes, together with the change of composition due to nuclear reactions and mass loss by stellar winds and/or through mass transfer in close binaries drive the evolution of stars.
• Interferometry (e.g. VLTI, CHARA) explores the shape of stars, the structure and the kinematics of their circumstellar environments. This allows us to probe the deformation of stars resulting from fast rotation and/or tidal forces, to explore the physics of disk formation around early-type stars, to obtain diagnostics of possible anisotropies in the stellar winds and probably in the future to determine if latitudinal differential rotation occurs at the surface of massive stars.
• Spectropolarimetry (Narval, Espadons, HARPSpol) gives information on the amplitudes and topologies of surface magnetic fields. Magnetic fields represent one of the great issues in massive star physics. Fields impact the way angular momentum is distributed in the interior and it may also couple the wind with the surface of the star. These two characteristics probably play a key role in the angular momentum content of the core at the time of the core-collapse event and thus have an important impact on the way stars explode and on the physical properties of the stellar remnants (neutron stars and black holes).
All these three techniques have already obtained fascinating results on massive stars and the time is ripe for organising an international conference focusing on the achievements reached so far. The main aims of the conference will be to:
• allow astronomers interested in massive stars to understand the basics of these three techniques, to what extent the results obtained depend on the theoretical models used for the interpretation of the observed features, to understand the potential of these techniques as well as their present limitations and future developments;
• explore the potential benefits and synergies of these techniques used together and also with more classical approaches such as photometry and spectroscopy to address topical questions in massive star evolution;
• allow observers to learn about the most recent challenges in massive star modeling.

* TOPICS:
The conference will cover the following topics in 6 sessions:

Session 1: CHALLENGES IN MASSIVE STAR EVOLUTION
• Hydrodynamic processes in massive stars and consequences for understanding the main observed characteristics of massive stars
• Massive star populations in galaxies
• Starbursts in distant galaxies
• Chemical evolution of galaxies

Session 2: ASTEROSEISMOLOGY
• How are the interesting astrophysical quantities extracted from the data ? To what extent do these values depend on models ?
• What can be said about the size of the convective core during main sequence evolution ?
• What can be said about the way massive stars rotate internally ? (solid body or not ?)

Session 3: INTERFEROMETRY
• How are the interesting astrophysical quantities extracted from the data ? To what extent do these values depend on models ?
• The shape of stars and testing of the von Zeipel theorem
• Stars with disks.
• Stars with polar winds
• Surfaces of massive stars (differential rotation ?)
• Sizes of the convective cells at the surface of red supergiants ?

Session 4: SPECTROPOLARIMETRY
• How are the interesting astrophysical quantities extracted from the data ? To what extent do these values depend on models ?
• Results of large surveys
• Fossil or dynamo fields ?
• Is there any correlation of the strength of the surface magnetic field with other observed quantities as surface abundances and rotation ?

Session 5: SYNERGY BETWEEN DIFFERENT TECHNIQUES
• Can we see how a star having a strong surface magnetic field rotates internally ?
• Have the slow rotators with strong surface nitrogen enhancement a detectable surface magnetic field ?

Session 6: TOWARDS A SYNTHETIC VIEW OF MASSIVE STAR EVOLUTION
• What are the perspectives for studying stars in stellar clusters with these techniques ?
• What can be expected from future observational facilities ?
• A summary of the conference will be presented by invited speakers.

* LIST OF CONFIRMED INVITED SPEAKERS (provisional):
C. Aerts
D. Arnett
A. Chieffi
J. Grunhut
J. Landstreet
N. Langer
A. Maeder
C. Meakin
A. Meilland
A. Miglio
A. Noels
N. Przybilla
J. Puls
P. Stee
A. Ud Doula
G. van Belle
G. Wade

* SCIENTIFIC ORGANISING COMMITTEE:
Georges Meynet (Switzerland) -- Chair
Philippe Stee (France) -- Co-chair
David Arnett (USA)
Lydia Cidale (Argentina)
Raphael Hirschi (UK)
Emily Levesque (USA)
Marco Limongi (Italy)
André Maeder (Switzerland)
Philip Massey (USA)
Coralie Neiner (France)
Arlette Noels (Belgium)
Stanley Owocki (USA)
Thomas Rivinius (Chile)
Hideyuki Saio (Japan)
Rich Townsend (USA)
Gregg Wade (Canada)

* LOCAL ORGANISING COMMITTEE:

Georges Meynet -- Chair
Patrick Eggenberger
Sylvia Ekström
Anahí Granada
José Groh
Lionel Haemmerlé
Giovanni Privitera
Gilles Simond
Chantal Taçoy

Weblink: http://obswww.unige.ch/Conferences/IAU307/

Email: r.hirschi@keele.ac.uk

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X-ray Astrophysics of Hot Massive Stars

02 Aug - 10 Aug 2014

Venue: Moscow, Russia

New generation of X-ray telescopes allowed important development in the astrophysics of hot massive stars. While some questions about X-ray emission from massive stars have been answered, there are unexpected findings pointing out that our picture of stellar winds is not yet complete. High-resolution spectroscopy, time monitoring, and detailed imaging in X-rays allow to probe stellar atmospheres, magnetospheres, and stellar winds and their impact on interstellar medium and galactic ecology. The most important progress made from the X-ray studies of Wolf-Rayet, O, B, and A-type stars and massive star clusters will be reviewed and the opportunities presented by new facilities will be discussed during this 2 day Scientific event E.3, which will be part of the 40th COSPAR Scientific assembly.

The abstract submission, registration, and visa support is via main COSPAR web-site.
Please contact E3 event organizers in case of questions regarding this event.

Weblink: https://www.cospar-assembly.org/

Email: lida@astro.physik.uni-potsdam.de

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Magnetism and Variability in O stars

17-19 September 2014

Venue: De Rode Hoed, Amsterdam, The Netherlands

For more than 30 years, spectroscopic observations from space have shown that wind variability in massive OB stars is a widespread phenomenon. This variability is not strictly periodic, but cyclic (like sunspots) with a dominant quasi period that scales with the estimated rotation period. The underlying cause or trigger of this variability is not known. The major time-variable wind features likely find their origin close to, or at the surface and have been suggested to be connected to non-radial pulsations or bright magnetic star spots.

The past few years have shown very promising new developments, both observationally and theoretically. High-precision space-based photometry reveals rapid variations, incompatible with pulsations, but consistent with the continuous presence of a multitude of co-rotating bright spots that live at most a few days. These spots are suggested to be of magnetic origin and could trigger large-scale wind variability. Theoretical studies show that magnetic fields can be generated with a short estimated turnover time in sub-surface convective layers in massive stars. These may lead to magnetic spots.

Understanding the role of magnetic fields and variability in O and early B stars is a major challenge in massive star research. This is the focus of a 3-day conference to be held in Amsterdam, organized to mark the formal retirement of Huib Henrichs, who has worked in this field throughout his scientific life.

This conference will be organized in a somewhat different way. Rather than having a skeleton with specific names of invited speakers, the community is invited to come forward on their own accord, thus giving more people a chance to provide their input. From this, a list of speakers and topics will be drawn up, with ample time for discussion. The aim is 25 and 15 min talks (each including discussion) and posters.

Note that an evening welcome reception will preceed the conference, and that the social programme continues on the Saturday afterwards.

Please apply for a talk/poster and pre-register at your earliest convenience on the conference website:
http://www.astro.uva.nl/ostars/
Registration and payment will be open on February 15th, 2014.

First announcement and pre-registration: December 20th, 2013
Second announcement and registration: February 15th, 2014
Early payment fee (275 €): before May 1st, 2014
Regular payment fee (325 €)
Registration closed: June 15th, 2014

SOC:
Huib Henrichs, Ed van den Heuvel, Lex Kaper (chair), Alex de Koter, Tony Moffat (Montreal, Canada), Stan Owocki (Delaware, USA), Gregg Wade (Kingston, Canada)

LOC:
Susan Franzen, Olga Hartoog, Martin Heemskerk, Milena Hoekstra, Lex Kaper (chair), Bertrand Lemasle

Weblink: http://www.astro.uva.nl/ostars/

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