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THE MASSIVE STAR NEWSLETTER

formerly known as the hot star newsletter

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PAPERS

Abstracts of 7 accepted papers

Magnetic massive stars as progenitors of "heavy" stellar-mass black holes

Petit, V. (1), Keszthelyi, Z. (2,3), MacInnis, R. (1), Cohen, D. H. (4), Townsend, R. H. D. (5), Wade, G. A. (2), Thomas, S. L. (1), Owocki, S. P. (6), Puls, J. (7), ud-Doula, A. (8)

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The groundbreaking detection of gravitational waves produced by the inspiralling and coalescence of the black hole (BH) binary GW150914 confirms the existence of "heavy" stellar-mass BHs with masses >25 Msun. Initial modelling of the system by Abbott et al. (2016a) supposes that the formation of black holes with such large masses from the evolution of single massive stars is only feasible if the wind mass-loss rates of the progenitors were greatly reduced relative to the mass-loss rates of massive stars in the Galaxy, concluding that heavy BHs must form in low-metallicity (Z < 0.25-0.5 Zsun) environments. However, strong surface magnetic fields also provide a powerful mechanism for modifying mass loss and rotation of massive stars, independent of environmental metallicity (ud-Doula & Owocki 2002; ud-Doula et al. 2008). In this paper we explore the hypothesis that some heavy BHs, with masses >25 Msun such as those inferred to compose GW150914, could be the natural end-point of evolution of magnetic massive stars in a solar-metallicity environment. Using the MESA code, we developed a new grid of single, non-rotating, solar metallicity evolutionary models for initial ZAMS masses from 40-80 Msun that include, for the first time, the quenching of the mass loss due to a realistic dipolar surface magnetic field. The new models predict TAMS masses that are significantly greater than those from equivalent non-magnetic models, reducing the total mass lost by a strongly magnetized 80 Msun star during its main sequence evolution by 20 Msun. This corresponds approximately to the mass loss reduction expected from an environment with metallicity Z = 1/30 Zsun.

Reference: MNRAS in press
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1611.08964

Comments:

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Spectroscopic evolution of massive stars on the main sequence

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We provide an observational view of evolutionary models in the Hertzsprung--Russell diagram, on the main sequence. For that we computed evolutionary models with the code STAREVOL for 15 < M/Msun < 100. We subsequently calculated atmosphere models at specific points along the evolutionary tracks, using the code CMFGEN. Synthetic spectra obtained in this way were classified as if they were observational data. We tested our spectral classification by comparison to observed spectra of various stars. We also compared our results with empirical data of a large number of OB stars. We obtain spectroscopic sequences along evolutionary tracks. In our computations, the earliest O stars (O2-3.5) appear only above ~50 Msun. For later spectral types, a similar mass limit exists, but is lower. A luminosity class V does not correspond to the entire main sequence. This only holds for the 15 Msun track. As mass increases, a larger portion of the main sequence is spent in luminosity class III. Above 50 Msun, supergiants appear before the end of core-hydrogen burning. Dwarf stars do not occur on the zero-age main sequence above 80 Msun. Consequently, the distribution of luminosity class V in the HR diagram cannot be used to constrain the size of the convective core. The distribution of dwarfs and giants in the HR diagram agrees well with the location of stars analyzed by means of quantitative spectroscopy. For supergiants, there is a slight discrepancy in the sense that luminosity class I is observed slightly earlier than our predictions. This is mainly due to wind densities that affect the luminosity class diagnostic lines. We predict an upper mass limit for dwarf stars (~60 Msun) that is found consistent with the rarity of O2V stars in the Galaxy. Stars with WNh spectral type are not predicted by our models. Stronger winds are required to produce the characteristic emission lines of these objects.

Reference: accepted in Astronomy & Astrophysics
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1612.03044

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B field in OB stars (BOB): The outstandingly strong magnetic field in the evolved He-strong star CPD-62 2124

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The origin and evolution of magnetism in OB stars is far from being well understood. With approximately 70 magnetic OB stars known, any new object with unusual characteristics may turn out to be a key piece of the puzzle. We report the detection of an exceptionally strong magnetic field in the He-strong B2IV star CPD-62 2124. Spectropolarimetric FORS2 and HARPSpol observations were analysed by two independent teams and procedures, concluding on a strong longitudinal magnetic field of approximately 5.2 kG. The quantitative characterisation of the stellar atmosphere yields an effective temperature of 23650±250 K, a surface gravity of 3.95±0.10 dex and a surface helium fraction of 0.35±0.02 by number. The metal composition is in agreement with the cosmic abundance standard, except for Mg, Si and S, which are slightly non-solar. The strong and broad (~300 km/s) disc-like emission displayed by the Hα line suggests a centrifugal magnetosphere supported by the strong magnetic field. Our results imply that CPD-62 2124 is an early B-type star hosting one of the strongest magnetic fields discovered to date, and one of the most evolved He-strong stars known, with a fractional main-sequence lifetime of approximately 0.6.

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Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1612.01537

Comments: Accepted for publication in A&A

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Discovery of rapidly moving partial x-ray absorbers within Gamma Cassiopeiae

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Gamma Cassiopeiae is an enigmatic Be star with unusually strong hard X-ray emission. The Suzaku observatory detected six rapid X-ray spectral hardening events called "softness dips" in a ~100 ksec duration observation in 2011. All the softness dip events show symmetric softness ratio variations, and some of them have flat bottoms apparently due to saturation. The softness dip spectra are best described by either ~40% or ~70% partial covering absorption to kT~12 keV plasma emission by matter with a neutral hydrogen column density of ~2-8e21 cm-2, while the spectrum outside of these dips is almost free of absorption. This result suggests the presence of two distinct X-ray emitting spots in the gamma Cas system, perhaps on a white dwarf companion with dipole mass accretion. The partial covering absorbers may be blobs in the Be stellar wind, the Be disk, or rotating around the white dwarf companion. Weak correlations of the softness ratios to the hard X-ray flux suggest the presence of stable plasmas at kT ~0.9 and 5 keV, which may originate from the Be or white dwarf winds. The formation of a Be star and white dwarf binary system requires mass transfer between two stars; gamma Cas may have experienced such activity in the past.

Reference: Hamaguchi et al. 2016, Astrophysical Journal, 832, 140.
Status: Manuscript has been accepted

Weblink:

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A study of the effect of rotational mixing on massive stars evolution: surface abundances of Galactic O7-8 giant stars

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Massive star evolution remains only partly constrained. In particular, the exact role of rotation has been questioned by puzzling properties of OB stars in the Magellanic Clouds. Our goal is to study the relation between surface chemical composition and rotational velocity, and to test predictions of evolutionary models including rotation. We have performed a spectroscopic analysis of a sample of fifteen Galactic O7-8 giant stars. This sample is homogeneous in terms of mass, metallicity and evolutionary state. It is made of stars with a wide range of projected rotational velocities. We show that the sample stars are located on the second half of the main sequence, in a relatively narrow mass range (25-40 Msun). Almost all stars with projected rotational velocities above 100 km/s have N/C ratios about ten times the initial value. Below 100 km/s a wide range of N/C values is observed. The relation between N/C and surface gravity is well reproduced by various sets of models. Some evolutionary models including rotation are also able to consistently explain slowly rotating, highly enriched stars. This is due to differential rotation which efficiently transports nucleosynthesis products and allows the surface to rotate slower than the core. In addition, angular momentum removal by winds amplifies surface braking on the main sequence. Comparison of the surface composition of O7-8 giant stars with a sample of B stars with initial masses about four times smaller reveal that chemical enrichment scales with initial mass, as expected from theory. Although evolutionary models that include rotation face difficulties in explaining the chemical properties of O- and B-type stars at low metallicity, some of them can consistently account for the properties of main-sequence Galactic O stars in the mass range 25-40 Msun.

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Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1611.05223

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B fields in OB stars (BOB): Concluding the FORS2 observing campaign

M. Schoeller (1), S. Hubrig (2), L. Fossati (3,4), T.A. Carroll (2), M. Briquet (5,2), L.M. Oskinova (6), S. Jarvinen (2), I. Ilyin (2), N. Castro (7,4), T. Morel (5), N. Langer (4), N. Przybilla (8), M.F. Nieva (8), A.F. Kholtygin (9), H. Sana (10), A. Herrero (11,12), R.H. Barba (13), A. de Koter (14), the BOB collaboration

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The "B fields in OB stars" (BOB) collaboration is based on an ESO Large Programme, to study the occurrence rate, properties, and ultimately the origin of magnetic fields in massive stars. In the framework of this programme, we carried out low-resolution spectropolarimetric observations of a large sample of massive stars using FORS2 installed at the ESO VLT 8-m telescope. We determined the magnetic field values with two completely independent reduction and analysis pipelines. Our in-depth study of the magnetic field measurements shows that differences between our two pipelines are usually well within 3sigma errors. From the 32 observations of 28 OB stars, we were able to monitor the magnetic fields in CPD-57 3509 and HD164492C, confirm the magnetic field in HD54879, and detect a magnetic field in CPD-62 2124. We obtain a magnetic field detection rate of 6+-3% for the full sample of 69 OB stars observed with FORS2 within the BOB programme. For the pre-selected objects with a v sin i below 60 km/s, we obtain a magnetic field detection rate of 5+-5%. We also discuss X-ray properties and multiplicity of the objects in our FORS2 sample with respect to the magnetic field detections.

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Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1611.04502

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New ATCA, ALMA and VISIR observations of the candidate LBV SK-67266 (S61): the nebular mass from modelling 3D density distributions

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We present new observations of the nebula around the Magellanic candidate Luminous Blue Variable S61. These comprise high-resolution data acquired with the Australia Telescope Compact Array (ATCA), the Atacama Large Millimetre/Submillimetre Array (ALMA), and VISIR at the Very Large Telescope (VLT). The nebula was detected only in the radio, up to 17 GHz. The 17 GHz ATCA map, with 0.8 arcsec resolution, allowed a morphological comparison with the Hα Hubble Space Telescope image. The radio nebula resembles a spherical shell, as in the optical. The spectral index map indicates that the radio emission is due to free-free transitions in the ionised, optically thin gas, but there are hints of inhomogeneities. We present our new public code RHOCUBE to model 3D density distributions, and determine via Bayesian inference the nebula's geometric parameters. We applied the code to model the electron density distribution in the S61 nebula. We found that different distributions fit the data, but all of them converge to the same ionised mass, ~0.1 $\rm M\odot$, which is an order of magnitude smaller than previous estimates. We show how the nebula models can be used to derive the mass-loss history with high-temporal resolution. The nebula was probably formed through stellar winds, rather than eruptions. From the ALMA and VISIR non-detections, plus the derived extinction map, we deduce that the infrared emission observed by space telescopes must arise from extended, diffuse dust within the ionised region.

Reference:DOI: 10.1093/mnras/stw2986
Status: Manuscript has been accepted

Weblink: https://arxiv.org/abs/1611.05259

Comments:

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Abstracts of 1 submitted papers

LBV's and Statistical Inference

Kris Davidson(1), Roberta M. Humphreys(1), and Kerstin Weis(2)

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Smith & Tomlinson (2015) asserted that statistical tests disprove the standard view of LBVs, and proposed a complex alternative scenario. But Humphreys et al.(2016) showed
that ST's test samples were mixtures of disparate classes of stars, and genuine LBVs statistically agree with with the standard view. Smith(2016) objected at great length to this result. Here we explain why each of his criticisms is incorrect. We also comment on related claims made by Smith & Stassun(2016). This topic illustrates the dangers of uncareful statistical sampling and of unstated assumptions.

Reference: Submitted
Status: Manuscript has been submitted

Weblink: http://adsabs.harvard.edu/abs/2016arXiv160802007D

Comments:

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Abstracts of 2 conference proceedings

Physical characterization of Galactic O-type stars targeted by the IACOB and OWN surveys

G. Holgado (1,2), S. Simón-Díaz (1,2), R. H. Barbá (3)

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3 - Departamento de Física y Astronomía, Univ. de la Serena, Av. Juan Cisternas 1200 Norte, La Serena, Chile

We present first results from the quantitative spectroscopic analysis of ~270 Galactic O-type stars targeted by the IACOB and OWN surveys (implying the largest sample of stars of this type analyzed homogeneously). We also evaluate what is the present situation regarding available information about distances, as provided by the Hipparcos and Gaia missions.

Reference: To appear in Highlights on Spanish Astrophysics IX, Proceedings of the XII Scientific Meeting of the Spanish Astronomical Society held on July 18-22, 2016, in Bilbao, Spain
Status: Conference proceedings

Weblink: https://arxiv.org/abs/1611.02634

Comments:

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New runaway O-type stars in the first Gaia Data Release

J. Maíz Apellániz, R. H. Barbá, S. Simón-Díaz, I. Negueruela, E. Trigueros Páez

CAB, ULS, IAC+ULL, UA, CAB+UCM

We have detected 13 new runaway-star candidates of spectral type O combining the TGAS (Tycho-Gaia Astrometric Solution) proper motions from Gaia Data Release 1 (DR1) and the sample from GOSSS (Galactic O-Star Spectroscopic Survey). We have also combined TGAS and Hipparcos proper motions to check that our technique recovers many of the previously known O-type runaways in the sample.

Reference: To appear in IAUS 239, the lives and death-throes of massive stars
Status: Conference proceedings

Weblink: https://arxiv.org/abs/1612.07923

Comments:

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MEETINGS

Stellar Magnetism: Challenges, Connections, and Prospects. 14th Potsdam Thinkshop

June 12-16, 2017

Telegrafenberg, Potsdam, Germany

The scientific programme will highlight the most recent observational and theoretical work in the field including, but not limited to, the following topics:
- the origin of stellar magnetic fields
- magnetic field geometry and evolution in pre-main-sequence stars
- magnetic fields, rotation, and differential rotation on the main sequence
- the role of small-scale magnetic fields in stellar atmospheres
- global dynamos, activity cycles, and the rotation-activity-age relation in solar-type stars
- magnetic fields in massive stars and magnetically-confined winds
- magnetic star/planet and disk/planet interaction
- magnetism in the late stages of stellar evolution
- future perspectives in theory and observational facilities

Registration and abstract submission will be opened on the 5th of January 2017.

Weblink: https://thinkshop.aip.de/14/

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ANNOUNCEMENTS

Massive Star Newsletter -- short questionnaire

Dear colleagues, the Organizing Committe of the Massive Star Commission and the editors of the Massive Star Newsletter have prepared a short questionnaire to know your opinion about our Newsletter and collect your suggestions for improvements. Please, have a look at it. It is a very short questionnaire and we all can benefit from your answers. Best regards, Artemio Herrero president, on behalf of the Massive Star IAU Commission and the Newsletter editors

Weblink:
https://docs.google.com/forms/d/e/1FAIpQLSfpCu0TV0A4DWQ5h_lP7dpsIG_5ti8e_hcVsltRxTgDt1N8Ow/viewform

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