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THE MASSIVE STAR NEWSLETTER

formerly known as the hot star newsletter

*

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

CONTENTS OF THIS NEWSLETTER:

News

Obituary for Olivier Chesneau

Olivier Chesneau, still a budding young astronomer, left us last week at age 42. He was struck a couple of years ago by a rare form of Leukemia, which finally consumed him. This was a great loss, not only because Olivier was simply a great guy and popular collaborator, but also because he was energetic and prolific in his science output. Anyone who writes his last paper on his death bed surrounded by his collaborators must be unusually courageous yet humble. A quick examination with ADS reveals a total of some 240 publications since 1998, ramping rapidly up to the present, of which over 90 (even more if one counts the SPIE papers) were in refereed journals. Many of these papers dealt with massive stars, the latest mentioned above being a first-author paper about interferometrically resolving the famous late-B supergiant Rigel.

Olivier has left a wonderful legacy in his published work of extraordinary quality and quantity. His dream was to reach a happy marriage between interferometry and (spectro-) polarimetry, where the gains would be enormous: what is 0.1% polarization in an unresolved star could suddenly become 1 or 10% or more when resolved. And I think he has advanced the field in that direction already.

I was particularly honoured as one of his three doctoral co-supervisors (that seems to be how many he needed to deal with his abundant energy!), after his masters' studies (DEC in France at the time) in Strasbourg with long-time colleague and friend Agnes Acker, who helped initiate a co-tutelle involving herself, Farokh Vakili (Observatoire de la Côte d`Azur) and myself. This allowed Olivier to obtain a doctorate in France simultaneously with a PhD from North America - not a bad accomplishment. I like to think that this might have helped him reach the level he did, but that may be wishful thinking, since he most likely made it largely on his own laurels, which amply proved themselves in his latest permanent position at Observatoire de la Côte d`Azur.

The last time I saw him in person was in 2011 at the so-called Tonyfest at Lac du Taureau, Quebec Province. He was in fine form in all ways, including scientifically, paddling canoes, at beach-volleyball and in his extraordinary musical talents. As he said in his last email to me: "Yes, music is in my blood and I have really the brain connected to the instrument, and this for a long time." He could play just about any music by ear on the spot on either the piano or the clarinet, the latter being an instrument that I struggled with in my youth. He was truly a gifted musician and I suspect this extended into many areas of his all-too-short life.

In his last weeks, I had some wonderful email correspondence with Olivier. Each time I read them I have to pinch myself in realizing that he is now gone. The pain will linger for quite a while yet. Sincere condolences to Olivier`s wife Martine and the kids from the Massive Star Community.

Tony Moffat

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OC announcement: turning our Working Group into an IAU Commission

Dear Massive Stars Working Group members,

last year, after some discussion our working group took
the decision to transform into an IAU commission.
This idea was hold on standby, as at the same time the IAU
initiated a process to re-organize their divisions and commissions.

Now, the IAU has started the process of Commissions reform.
You can find all details in the IAU announcement:

http://www.iau.org/news/announcements/detail/ann14008/

The Organizing Committee of our working group will submit a Letter of Intent
by October 15th, 2014, proposing a Massive Stars Commission. From that date
and up to January 31st, 2015 IAU members will have the opportunity to indicate
their preferences for the different Commissions in an electronic poll.
These preferences might quite likely play a role in the final Commissions
selection by the IAU Executive Committee (15-17 April 2015).

Becoming an IAU Commission will give us more weight in IAU decisions
(like Symposia and meetings approval) and other advantages,
and will give our community more visibility.

It is thus important that all IAU members of the Massive Stars Working Group
support the Massive Stars Commission proposal by joining this electronic poll
later this year (the OC will issue an announcement when the process starts).
If you are not an IAU member you won't be able to participate in the poll.

Moreover, Commission members have to be IAU members (a requisite that does not
hold for working group members). We will seek a mechanism for non-IAU
members to continue being involved in the possible new Commission,
but nevertheless if you are not an IAU member but fulfill the IAU requisites,
it is recommended that you apply for IAU membership.

If you wish to become IAU member, please contact your IAU national representatives
asap. The admission of new members takes place in the General Assembly
and the previous process needs quite some time. Therefore, if you are not already
IAU member, you won't be able to take part in the poll indicated above, but you
may later become member of the possible new commission, if this is approved.

Artemio Herrero
chair, on behalf of the MSWG-Organizing Committee

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Next Massive Stars Meeting: OC announcement

late 2016 - 2017

Venue: New Zealand

Dear Massive Stars Working Group members,

Recently the Massive Stars Working Group Organizing Committee evaluated the different proposals for the next Massive Stars Meeting and agreed to select the proposal presented by John Eldridge (University of Auckland).

The next Massive Stars Meeting will thus be held in New Zealand, in a date between late 2016 and december 2017 that will be decided later.

The decision was very difficult, as seven different proposals were presented. The OC wishes to thank all proponents for their interest and efforts (in view of the difficult decision, the OC had to ask for additional information that proponents had to prepare).

Participation in the discussions about the next Massive Stars Meetings constituted the last contribution of Joachim Puls to the OC. Joachim Puls has been OC member for six years, chaired the committee in 2011-13 and was member-at-large in 2014. The OC wants to thank him for his dedication to the massive stars community over all these years.

Artemio Herrero
chair, on behalf of the MSWG-Organizing Committee

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PAPERS

Abstracts of 10 accepted papers

B fields in OB stars (BOB): The discovery of a magnetic field in a multiple system in the Trifid Nebula, one of the youngest star forming regions

S. Hubrig (1), L. Fossati (2), T.A. Carroll (1), N. Castro (2), J.F. Gonzalez (3), I. Ilyin (1), N. Przybilla (4), M. Schoeller (5), L.M. Oskinova (6), T. Morel (7), N. Langer (2), R.D. Scholz (1), N.V. Kharchenko (8), M.-F. Nieva (4,9), the BOB collaboration

1 Leibniz-Institut fuer Astrophysik Potsdam
2 Universitaet Bonn
3 ICATE San Juan
4 University of Innsbruck
5 ESO
6 Universitaet Potsdam
7 Universite de Liege
8 Main Astronomical Observatory Kiev
9 University Erlangen-Nuremberg

Recent magnetic field surveys in O- and B-type stars revealed that about
10% of the core-hydrogen-burning massive stars host large-scale magnetic fields.
The physical origin of these fields is highly debated.
To identify and model the physical processes responsible for the generation of magnetic fields in massive stars, it is important to establish whether magnetic massive stars are found in very young star-forming regions or whether they are formed in close interacting binary systems.

In the framework of our ESO Large Program, we carried out low-resolution spectropolarimetric observations with FORS2 in 2013 April of the three most massive
central stars in the Trifid nebula, HD164492A, HD164492C, and HD164492D. These observations indicated a strong longitudinal magnetic field of about 500-600G in the poorly studied component HD164492C. To confirm this detection,
we used HARPS in spectropolarimetric mode on two consecutive nights in 2013 June.

Our HARPS observations confirmed the longitudinal magnetic field in HD164492C.
Furthermore, the HARPS observations revealed that HD164492C cannot be considered as a single star as it possesses one or two companions. The
spectral appearance indicates that the primary is most likely of spectral type B1-B1.5V.
Since in both observing nights most spectral lines appear blended,
it is currently unclear which components are magnetic.
Long-term monitoring using high-resolution
spectropolarimetry is necessary to separate the contribution of each component to the magnetic signal.
Given the location of the system HD164492C in one of the youngest star formation regions,
this system can be considered as a Rosetta Stone for our understanding of the origin of magnetic fields in massive stars.

Reference: A&A
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1403.0491

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Mass loss in main-sequence B stars

Jiri Krticka

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We calculate radiatively driven wind models of main-sequence B stars and provide the wind mass-loss rates and terminal velocities. The main-sequence mass-loss rate strongly depends on the stellar effective temperature. For the hottest B stars the mass-loss rate amounts to 10^{-9} Mo/year, while for the cooler

ones themass-loss rate is lower by more than three orders of magnitude. Main-sequence B stars with solar abundance and effective temperatures lower than about 15 000 K (later than spectral type B5) do not have any homogeneous line-driven wind. We predict the wind mass-loss rates for the solar chemical composition and for the modified abundance of heavier elements to study the winds of chemically peculiar stars. The mass-loss rate may either increase or decrease with increasing abundance, depending on the importance of the induced emergent flux redistribution. Stars with overabundant silicon may have homogeneous winds even below the solar abundance wind limit at 15 000 K. The winds of main-sequence B stars lie below the static limit, that is, a static atmosphere solution is also possible. This points to an important problem regarding the initiation of these winds. We discuss the implications of our models for rotational braking, filling the magnetosphere of Bp stars, and for chemically peculiar stars.

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

Weblink: http://arxiv.org/abs/1401.5511

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The dynamical properties of dense filaments in the infrared dark cloud G035.39–00.33

J. D. Henshaw (1), P. Caselli (1), F. Fontani (2), I. Jimenez-Serra (3), J. C. Tan (4)

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Infrared Dark Clouds (IRDCs) are unique laboratories to study the initial conditions of high-mass star and star cluster formation. We present high-sensitivity and high-angular resolution IRAM PdBI observations of N2H+ (1-0) towards IRDC G035.39-00.33. It is found that G035.39-00.33 is a highly complex environment, consisting of several mildly supersonic filaments (sigma_NT/c_s ~1.5), separated in velocity by <1 km s^-1 . Where multiple spectral components are evident, moment analysis overestimates the non-thermal contribution to the line-width by a factor ~2. Large-scale velocity gradients evident in previous single-dish maps may be explained by the presence of substructure now evident in the interferometric maps. Whilst global velocity gradients are small (<0.7 km s^-1 pc^-1), there is evidence for dynamic processes on local scales (~1.5-2.5 km s^-1 pc^-1). Systematic trends in velocity gradient are observed towards several continuum peaks. This suggests that the kinematics are influenced by dense (and in some cases, starless) cores. These trends are interpreted as either infalling material, with accretion rates ~(7 pm 4)x10^-5 M_sun yr^-1 , or expanding shells with momentum ~24 pm 12 M_sun km s^-1 . These observations highlight the importance of high-sensitivity and high-spectral resolution data in disentangling the complex kinematic and physical structure of massive star forming regions.

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

Weblink: http://arxiv.org/pdf/1403.1444

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Short time scale spectral variability in the A0 supergiant HD92207 and the importance of line profile variations for the interpretation of FORS2 spectropolarimetric observations

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Our recent search for the presence of a magnetic field in the bright early A-type supergiant HD92207 using FORS2 in spectropolarimetric mode indicated the presence of a longitudinal magnetic field of the order of a few hundred Gauss. Assuming the ideal case of a non-variable star, this discovery has recently been questioned in one work trying to demonstrate the importance of non-photon noise in FORS2 observations. The assumption of non-variability of HD92207 can, however, not be held since substantial profile variations of diverse lines on a time scale of minutes or maybe even a fraction of a minute are detected in FORS2 spectra. The presence of short-term spectral variability in blue supergiants, which are considered as type II supernova progenitors, has not been a subject of systematic studies before and is critical for the current theoretical understanding of their physics. Given the detected short term variability, the question of the presence of a magnetic field cannot be answered without proper modeling of the impact of such a variability on the measurements of the magnetic field. Since the short-term periodicity does not fit into the currently known domain of non-radially pulsating supergiants, its confirmation is of great importance for models of stellar evolution.

Reference: MNRAS
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1403.2219

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On the Hα Behaviour of Blue Supergiants: Rise and Fall over the Bi-stability Jump

Blagovest Petrov, Jorick S. Vink, Götz Gräfener

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The evolutionary state of blue supergiants is still unknown. Stellar wind mass loss is one of the dominant processes determining the evolution of massive stars, and it may provide clues on the evolutionary properties of blue supergiants. As the Hα line is the most oft-used mass-loss tracer in the OB-star regime, we provide a detailed analysis of the Hα line for OB supergiant models over an Teff range between 30000 and 12500K. We find a maximum in the Hα equivalent width at 22500 K - at the location of the bi-stability jump. The Hα line behaviour is characterised by two branches of Teff: (i) a "hot" branch between

30000 and 22500 K, where Hα emission becomes stronger with decreasing Teff, and (ii) a "cool" branch between 22500 and 12500 K, where the line becomes weaker. Our models show that this non-monotonic Hα behaviour is related to the optical depth of Lyα, finding that at the "cool" branch the population of the 2nd level of hydrogen is enhanced in comparison to the 3rd level. This is expected to increase line absorption, leading to weaker Hα flux when Teff drops from 22500 K downwards. We also show that for late B supergiants (at Teff below ~15000 K), the differences in the Hα line between homogeneous and clumpy winds becomes insignificant. Moreover, we show that at the bi-stability jump Hα changes its character completely, from an optically thin to an optically thick line, implying that macro-clumping should play an important role at temperatures below the bi-stability jump. This would not only have consequences for the character of observed Hα line profiles, but also for the reported discrepancies between theoretical and empirical mass-loss rates.

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

Weblink: http://arxiv.org/abs/1403.4097

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The Effects of Stellar Rotation. II. A Comprehensive Set of Starburst99 Models

Claus Leitherer(1), Sylvia Ekstrom(2), Georges Meynet(2), Daniel Schaerer(2), Katerina B. Agienko(3), Emily M. Levesque(4)

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We present a new set of synthesis models for stellar populations obtained with Starburst99, which are based on new stellar evolutionary tracks with rotation. We discuss models with zero rotation velocity and with velocities of 40% of the break-up velocity on the zero-age main-sequence. These values are expected to bracket realistic rotation velocity distributions in stellar populations. The new rotating models for massive stars are more luminous and hotter due to a larger convective core and enhanced surface abundances. This results in pronounced changes in the integrated spectral energy distribution of a population containing massive stars. The changes are most significant at the shortest wavelengths where an increase of the ionizing luminosity by up to a factor of 5 is predicted. We also show that high equivalent widths of recombination lines may not necessarily indicate a very young age but can be achieved at ages as late as 10 Myr. Comparison of these two boundary cases (0 and 40% of the break-up velocity) will allow users to evaluate the effects of rotation and provide guidance for calibrating the stellar evolution models. We also introduce a new theoretical ultraviolet spectral library built from the Potsdam Wolf-Rayet (PoWR) atmospheres. Its purpose is to help identify signatures of Wolf-Rayet stars in the ultraviolet whose strength is sensitive to the particulars of the evolution models. The new models are available for solar and 1/7th solar metallicities. A complete suite of models can be generated on the Starburst99 website (www.stsci.edu/science/starburst99/). The updated Starburst99 package can be retrieved from this website as well.

Reference: The Astrophysical Journal Supplement Series, in press (Vol. 212, May 2014)
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1403.5444

Comments: See also v7.0.0 of Starburst99 at http://www.stsci.edu/science/starburst99/

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Massive double compact object mergers: gravitational wave sources and r-process element production sites

N. Mennekens, D. Vanbeveren

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With our galactic evolutionary code that contains a detailed intermediate mass and massive binary population model, we study the temporal evolution of the galactic population of double neutron star binaries, mixed systems with a neutron star and black hole component and double black hole binaries. We compute the merger rates of these relativistic binaries and we translate them into LIGO II detection rates. We demonstrate that accounting for the uncertainties in the relation 'initial mass-final mass' predicted by massive close binary evolution and due to the possible effect of large stellar wind mass loss during the luminous blue variable phase of a star with initial mass larger than 30-40 Mo and during the red supergiant phase of a star with initial mass smaller than 30-40 Mo when such a star is a binary component, the double black hole merger rate may be very small, contrary to predictions made by other groups. Hydrodynamic computations of r-process chemical yields ejected during the relativistic binary merger process have recently become available. With our galactic code that includes binaries it is then straightforward to calculate the temporal galactic evolution of the r-process elements ejected by these mergers. We conclude that except for the earliest evolutionary phase of the Galaxy (~the first 100 Myr) double compact star mergers may be the major production sites of r-process elements and it is probable that the mixed systems dominate this production over double neutron star binary mergers.

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

Weblink: arXiv:1307.0959v2

Comments: 12 pages, 7 figures

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X-rays from Magnetically Confined Wind Shocks: Effect of Cooling-Regulated Shock Retreat

Asif ud-Doula (1), Stanley Owocki (2), Richard Townsend (3), Veronique Petit (2), David Cohen (4)

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We use 2D MHD simulations to examine the effects of radiative cooling and inverse Compton (IC) cooling on X-ray emission from magnetically confined wind shocks (MCWS) in magnetic massive stars with radiatively driven stellar winds. For the standard dependence of mass loss rate on luminosity $Mdot sim L^{1.7} $, the scaling of IC cooling with L and radiative cooling with $Mdot$ means that IC cooling become formally more important for lower luminosity stars. However, because the sense of the trends is similar, we find the overall effect of including IC cooling is quite modest. More significantly, for stars with high enough mass loss to keep the shocks radiative, the MHD simulations indicate a linear scaling of X-ray luminosity with mass loss rate; but for lower luminosity stars with weak winds, X-ray emission is reduced and softened by a {em shock retreat} resulting from the larger post-shock cooling length, which within the fixed length of a closed magnetic loop forces the shock back to lower pre-shock wind speeds. A semi-analytic scaling analysis that accounts both for the wind magnetic confinement and this shock retreat yields X-ray luminosities that have a similar scaling trend, but a factor few higher values, compared to time-averages computed from the MHD simulations. The simulation and scaling results here thus provide a good basis for interpreting available X-ray observations from the growing list of massive stars with confirmed large-scale magnetic fields.

Reference: MNRAS
Status: Manuscript has been accepted

Weblink: https://psu.box.com/s/r5c7phknvklro4naro7w

Comments:

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Winds of low-metallicity OB-type stars: HST-COS spectroscopy in IC1613

Miriam Garcia (1), Artemio Herrero (2,3), Francisco Najarro (1), Daniel J. Lennon (4) and Miguel A. Urbaneja (5,6)

(1) CAB, INTA-CSIC; (2) IAC; (3) ULL; (4) ESA; (5) UIBK; (6) IfA

We present the first quantitative UV spectroscopic analysis of resolved OB stars in IC1613. Because of its alleged very low metallicity (<~1/10 Zo, from HII regions), studies in this Local Group dwarf galaxy could become a significant step forward from the SMC towards the extremely metal-poor massive stars of the early Universe. We present HST-COS data covering the ~1150-1800A wavelength range with resolution R~2500. We find that the targets do exhibit wind features, and these are similar in strength to SMC stars. Wind terminal velocities were derived from the observed PCygni profiles with the SEI method. The vinf-Z relationship has been revisited. The terminal velocity of IC1613 O-stars is clearly lower than Milky Way counterparts, but there is no clear difference between IC1613 and SMC or LMC analogue stars. We find no clear segregation with host galaxy in the terminal velocities of B-supergiants, nor in the vinf/vesc ratio of the whole OB star sample in any of the studied galaxies. Finally, we present

first evidence that the Fe-abundance of IC1613 OB stars is similar to the SMC, in agreement with previous results on red supergiants. With the confirmed ~1/10 solar oxygen abundances of B-supergiants, our results indicate that IC1613's [alpha/Fe] ratio is sub-solar.

Reference: ApJ
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1404.5305

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A Modern Search for Wolf-Rayet Stars in the Magellanic Clouds: First Results

Philip Massey (1), Kathryn F. Neugent (1), Nidia Morrell (2), D. John Hillier (3)

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Over the years, directed surveys and incidental spectroscopy have identified 12 Wolf-Rayet (WR) stars in the SMC and 139 in the LMC, numbers which are often described as "essentially complete." Yet, new WRs are discovered in the LMC almost yearly. We have therefore initiated a new survey of both Magellanic Clouds using the same interference-filter imaging technique previously applied to M31 and M33. We report on our first observing season, in which we have successfully surveyed ~15% of our intended area of the SMC and LMC. Spectroscopy has confirmed 9 newly found WRs in the LMC (a 6% increase), including one of WO-type, only the third known in that galaxy and the second to be discovered recently. The other eight are WN3 stars that include an absorption component. In two, the absorption is likely from an O type companion, but the other six are quite unusual. Five would be classified naively as "WN3+O3 V," but such a pairing is unlikely given the rarity of O3 stars, the short duration of this phase (which is incommensurate with the evolution of a companion to a WN star), and because these stars are considerably fainter than O3 V stars. The sixth star may also fall into this category. CMFGEN modeling suggests these stars are hot, bolometrically luminous, and N-rich like other WN3 stars, but lack the strong winds that characterize WNs. Finally, we discuss two rare Of?p stars and four Of supergiants we found, and propose that the B[e] star HD 38489 may have a WN companion.

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

Weblink: http://arxiv.org/abs/1404.7441

Comments:

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(closed) JOB offer

In this section we list job offers received after the latest previous issue of the newsletter but which are already past the application deadline. If you wish to be alerted immediately of job offers and other annoucements, you are invited to subscribe to the daily notifications by going to this link http://www.astroscu.unam.mx/massive_stars/submission/subscription.php

Full time faculty position astrophysics at the department of physics of the Vrije Universiteit Brussels

Prof. J. D'Hondt, Head of the Dept. of Physics, or Prof. D. Vanbeveren

Dept. of Physics
Astronomy and Astrophysics Research Group
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The Vrije Universiteit Brussel (VUB) in Belgium has an opening for a full time faculty position at the department of physics. The position is aimed at an excellent candidate to take a leading role in the coordination and further development of the research in the astrophysics group. The successful candidate is expected to initiate new projects and acquire the necessary research funding. In addition to this, the ability to teach physics and astrophysics courses at all university levels is required.

Currently the astrophysical research at the VUB revolves around themes related to stellar evolution, binary systems, galaxy kinematics and radio galaxies.

Applications from outstanding candidates working in astrophysics will be considered. Priority will be given to outstanding candidates who have the potential to extend our research in the direction of High-Energy Astrophysics to not only complement the current efforts, but also to strengthen the synergy with our activities in experimental astroparticle physics and explore opportunities for new joint research projects.

The astroparticle physics programme is one of the VUB research lines within the “High-Energy Physics” Strategic Research Programme. Currently it consists of research related to Dark Matter searches as well as studies of Gammy Ray Bursts and Active Galactic Nuclei with the IceCube neutrino observatory at the South Pole.

Profile

* Academic qualification: PhD degree.
* The candidate is expected to endorse the educational vision of the university (full text available on the university website).
* Female candidates are particularly encouraged to apply
* Every first appointment is dependent upon the successful performance of a teaching session.
* Near-native proficiency of English is required. The Vrije Universiteit Brussel provides courses in academic English.
* The administrative and educational language at Vrije Universiteit Brussel is Dutch. If, at your appointment, you do not speak Dutch at all or do not speak it well, we will provide a training offer that must equip you to be able to teach in Dutch within three years. If your teaching assignment is completely in English, then it is expected that you have mastered the Dutch language to a level that will allow you to

participate in the administrative meetings.

Offer

As an employee of the Vrije Universiteit Brussel your days will be spent in a dynamic, diverse and multilingual environment. Both our campuses are set within green oases on the outskirts of the center of the capital of Flanders, Belgium and Europe. This center, with all its opportunities, is within your reach by public transport in under half an hour.

Depending on your experience and academic merits you will receive a salary on one of the pay scales laid down by the government. Hospitalization cover and free use of public transport for travel to and from work are standard conditions of employment. If you would rather cycle to work, compensation is also available for that. Both campuses have extensive sporting facilities which are at your disposal and a nursery is within walking distance.

Recruitment in one of the academic ranks of Senior Academic Staff (senior faculty).

Recruitment in the rank of lecturer is a tenure track appointment which implies an initial appointment as lecturer for a period of 5 years with eligibility for tenure in the rank of senior lecturer by the end of this initial period.

Recruitment in other academic ranks is an initial appointment for 3 years with eligibility for tenure in the same rank by the end of this initial period.

More information is available at www.vub.ac.be under the heading ‘future employees’.

* Planned starting date: 01/09/2014
* Length of contract: Recruitment in the rank of lecturer is a tenure track appointment which implies an initial appointment as lecturer for a period of 5 years with eligibility for tenure in the rank of senior lecturer by the end of this initial period.
* Recruitment in other academic ranks is an initial appointment for 3 years with eligibility for tenure in the same rank by the end of this initial period.
* Deadline for application: 16/04/2014

For more information and how to apply: http://vub.talentfinder.be/en/vacature/10857/we-2014-001--senior-academic-staff--100--physics-astrophysics/

Weblink: http://vub.talentfinder.be/en/vacature/10857/we-2014-001--senior-academic-staff--100--physics-astrophysics/

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Deadline: 16/04/2014

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