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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 239th issue of the AGB Newsletter.

There are several Ph.D. and postdoctoral researcher positions on offer in Leuven (Belgium) and Leeds (UK).

Michael Feast has turned 90 (years young), congratulations! To celebrate this, an event is organised in Cape Town. Please see Shazrene Mohamed's invitation.

Another meeting is organised in Massachusetts, USA, on "radio stars".

Please also consider the request from Elvire De Beck, to help coordinate a case for evolved stars science for the future Origins Space Telescope.

The Fizeau programme continues to provide opportunities for researchers to visit centres of expertise on interferometry.

The next issue is planned to be distributed around the 1st of July.

Editorially Yours,
Jacco van Loon, Ambra Nanni and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

LBVs and red supergiants are mutually exclusive phases through which a massive star can evolve

Reactions to this statement or suggestions for next month's statement can be e-mailed to astro.agbnews@keele.ac.uk (please state whether you wish to remain anonymous)

Refereed Journal Papers

On the deuterium abundance and the importance of stellar mass loss in the interstellar and intergalactic medium

Freeke van de Voort[1,2], *Eliot Quataert*[3], *Claude-André Faucher-Giguère*[4], *Dušan Kereš*[5], *Philip F. Hopkins*[6], *T.K. Chan*[5], *Robert Feldmann*[7] *and Zachary Hafen*[4]

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We quantify the gas-phase abundance of deuterium in cosmological zoom-in simulations from the Feedback In Realistic Environments project. The cosmic deuterium fraction decreases with time, because mass lost from stars is deuterium-free. At low metallicity, our simulations confirm that the deuterium abundance is very close to the primordial value. The deuterium abundance decreases towards higher metallicity, with very small scatter between the deuterium and oxygen abundance. We compare our simulations to existing high-redshift observations in order to determine a primordial deuterium fraction of $(2.549 \pm 0.033) \times 10^{-5}$ and stress that future observations at higher metallicity can also be used to constrain this value. At fixed metallicity, the deuterium fraction decreases slightly with decreasing redshift, due to the increased importance of mass loss from intermediate-mass stars. We find that the evolution of the average deuterium fraction in a galaxy correlates with its star formation history. Our simulations are consistent with observations of the Milky Way's interstellar medium: the deuterium fraction at the solar circle is 83–92 per cent of the primordial deuterium fraction. We use our simulations to make predictions for future observations. In particular, the deuterium abundance is lower at smaller galactocentric radii and in higher mass galaxies, showing that stellar mass loss is more important for fuelling star formation in these regimes (and can even dominate). Gas accreting onto galaxies has a deuterium fraction above that of the galaxies' interstellar medium, but below the primordial fraction, because it is a mix of gas accreting from the intergalactic medium and gas previously ejected or stripped from galaxies.

Submitted to MNRAS
Available from https://arxiv.org/abs/1704.08254

Throwing icebergs at white dwarfs

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The atmospheres of white dwarfs, the last life stage of most stars (≤ 8 M$_\odot$), are expected to consist nearly entirely of hydrogen and helium. However, observations have revealed pollution by heavier elements in about a quarter to a half of all white dwarfs. While asteroids and dwarf planets have been identified as the typical sources of pollution, surprisingly, some observations have shown that pollution by larger planetary bodies (e.g., Mars-like or larger) or by icy material from Kuiper belt analog objects orbiting at great distances from the white dwarf can also occur. Here we report on a mechanism that utilizes the observed high binary fraction of stars, and naturally leads to the emergence of both of these observed features. We find that this mechanism readily explains and is consistent with observations.

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Pre-supernova outbursts via wave heating in massive stars I: Red supergiants

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Early observations of supernovæ (SNe) indicate that enhanced mass loss and pre-SN outbursts occur in progenitors of many types of SNe. We investigate the role of energy transport via waves driven by vigorous convection during late-stage nuclear burning of otherwise typical 15 $M_{\odot}$ red supergiant SNe progenitors. Using MESA stellar evolution models including 1D hydrodynamics, we find that waves carry $\sim 10^7$ $L_{\odot}$ of power from the core to the envelope during core neon/oxygen burning in the final years before core collapse. The waves damp via shocks and radiative diffusion at the base of the hydrogen envelope, which heats up fast enough to launch a pressure wave into the overlying envelope that steepens into a weak shock near the stellar surface, causing a mild stellar outburst and ejecting a modest ($\lesssim$1 $M_{\odot}$) amount of mass at low speed ($\lesssim$50 km s^{-1}) roughly one year before the SN. The wave heating inflates the stellar envelope but does not completely unbind it, producing a non-hydrostatic pre-SN envelope density structure different from prior expectations. In our models, wave heating is unlikely to lead to luminous type IIn SNe, but it may account for flash-ionized SNe and some of the diversity seen in II-P/II-L SNe.

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Probing the dusty stellar populations of the Local Volume galaxies with JWST/MIRI

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The Mid-Infrared Instrument (MIRI) for the *James Webb* Space Telescope (JWST) will revolutionize our understanding of infrared stellar populations in the Local Volume. Using the rich *Spitzer*-IRS spectroscopic data-set and spectral classifications from the Surveying the Agents of Galaxy Evolution (SAGE)-Spectroscopic survey of over a thousand objects in the Magellanic Clouds, the Grid of Red supergiant and Asymptotic giant branch star ModelS (GRAMS), and the grid of YSO models by Robitaille et al. (2006), we calculate the expected flux-densities and colors in the MIRI broadband filters for prominent infrared stellar populations. We use these fluxes to explore the *JWST*/MIRI colours and magnitudes for composite stellar population studies of Local Volume galaxies. MIRI color classification schemes are presented; these diagrams provide a powerful means of identifying young stellar objects, evolved stars and extragalactic background galaxies in Local Volume galaxies with a high degree of confidence. Finally, we examine which filter combinations are best for selecting populations of sources based on their JWST colours.

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An outburst powered by the merging of two stars inside the envelope of a giant

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We conduct three-dimensional hydrodynamical simulations of energy deposition into the envelope of a red giant star as a result of the merger of two close main sequence stars or brown dwarfs, and show that the outcome is a highly non-spherical outflow. Such a violent interaction of a triple stellar system can explain the formation of ”messy”, i.e., lacking any kind of symmetry, planetary nebulæ (PNe) and similar nebulæ around evolved stars. We do not simulate the merging process, but simply assume that after the tight binary system enters the envelope of the giant star the interaction with the envelope causes the two components, stars or brown dwarfs, to merge and liberate gravitational energy. We deposit the energy over a time period of about nine hours, which is about one per cent of the orbital period of the merger product around the center of the giant star. The ejection of the fast hot gas and its collision with previously ejected mass are very likely to lead to a transient event, i.e., an intermediate luminosity optical transient (ILOT).

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Extreme radio-wave scattering associated with hot stars

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We use data on extreme radio scintillation to demonstrate that this phenomenon is associated with hot stars in the solar neighbourhood. The ionized gas responsible for the scattering is found at distances up to 1.75 pc from the host star, and on average must comprise 10^5 distinct structures per star. We detect azimuthal velocities of the plasma, relative to the host star, up to 9.7 km s^{-1}, consistent with warm gas expanding at the sound speed. The circumstellar plasma structures that we infer are similar in several respects to the cometary knots seen in the Helix, and in other planetary nebulæ. There the ionized gas appears as a skin around tiny molecular clumps. Our analysis suggests that molecular clumps are ubiquitous circumstellar features, unrelated to the evolutionary state of the star. The total mass in such clumps is comparable to the stellar mass.

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and from www.manlyastrophysics.org

Orbital evolution in binary systems with giant stars

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Using 3D radiation-hydrodynamic simulations and analytic theory, we analyze the orbital evolution of asymptotic-giant-branch (AGB) binary systems for various initial orbital separations and mass ratios, and thus different initial accretion modes. We present a convenient analytic framework to calculate the rate of orbital period change using input from simulations. We find that the angular momentum carried away by the L2 Lagrange point mass loss can effectively shrink the orbit when accretion occurs via wind-Roche-lobe overflow. This is in contrast to the large mass loss in Bondi–Hoyle accretion systems which acts to enlarge the orbit. We find that orbital period decay in AGB binary systems is faster when one accounts for the nonlinear evolution of the accretion mode as the binary starts to tighten. This can increase the fraction of binaries that result in common envelope, luminous red novæ, Type Ia supernovæ and planetary nebulæ with tight central binaries. The results have implications for the probability and properties of planets orbiting closely around white dwarfs.

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Search for hydrogenated C_{60} (fulleranes) in circumstellar envelopes

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The recent detection of fullerene (C_{60}) in space and the positive assignment of five diffuse interstellar bands to C_{60}^+ reinforce the notion that fullerene-related compounds can be efficiently formed in circumstellar envelopes and be present in significant quantities in the interstellar medium. Experimental studies have shown that C_{60} can be readily hydrogenated, raising the possibility that hydrogenated fullerenes (or fulleranes, $C_{60}H_m$, m = 1–60) may be abundant in space. In this paper, we present theoretical studies of the vibrational modes of isomers of $C_{60}H_m$. Our results show that the four mid-infrared bands from the C_{60} skeletal vibrations remain prominent in slightly hydrogenated C_{60}, but their strengths diminish in different degrees with increasing hydrogenation. It is therefore possible that the observed infrared bands assigned to C_{60} could be due to a mixture of fullerenes and fulleranes. This provides a potential explanation for the observed scatter of the C_{60} band ratios. Our calculations suggest that a feature around 15 μm due to the breathing mode of heavily hydrogenated C_{60} may be detectable astronomically. A preliminary search for this feature in 35 C_{60} sources is reported.

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Evidence for compact binary systems around *Kepler* red giants

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We present an analysis of 168 oscillating red giants from NASA's *Kepler* mission that exhibit anomalous peaks in their Fourier amplitude spectra. These peaks result from ellipsoidal variations which are indicative of binary star systems, at frequencies such that the orbit of any stellar companion would be within the convective envelope of the red giant. Alternatively, the observed phenomenon may be due to a close binary orbiting a red giant in a triple system, or chance alignments of foreground or background binary systems contaminating the target pixel aperture. We identify 87 stars in the sample as chance alignments using a combination of pixel Fourier analysis and difference imaging. We find that

in the remaining 81 cases the anomalous peaks are indistinguishable from the target star to within 4″, suggesting a physical association. We examine a Galaxia model of the *Kepler* field of view to estimate background star counts and find that it is highly unlikely that all targets can be explained by chance alignments. From this, we conclude that these stars may comprise a population of physically associated systems.

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Magnetic field in IRC +10°216 and other C-rich evolved stars

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Context: During the transition from the Asymptotic Giant Branch (AGB) to planetary nebulæ (PN), the circumstellar geometry and morphology change dramatically. Another characteristic of this transition is the high mass-loss rate, that can be partially explained by radiation pressure and a combination of various factors, such as the stellar pulsation, the dust grain condensation, and opacity in the upper atmosphere. The magnetic field can also be one of the main ingredients that shapes the stellar upper atmosphere and envelope.
Aims: Our main goal is to investigate for the first time the spatial distribution of the magnetic field in the envelope of IRC +10°216. More generally we intend to determine the magnetic field strength in the circumstellar envelope (CSE) of C-rich evolved stars, compare this field with previous studies for O-rich stars, and constrain the variation of the magnetic field with r the distance to the star's centre.
Methods: We use spectropolarimetric observations of the Stokes V parameter, collected with Xpol on the IRAM-30m radiotelescope, observing the Zeeman effect in seven hyperfine components of the CN J = 1–0 line. We use the Crutcher et al. (1996) method to estimate the magnetic field. For the first time, the instrumental contamination is investigated, through dedicated studies of the power patterns in Stokes V and I in detail.
Results: For C-rich evolved stars, we derive a magnetic field strength (B) between 1.6 and 14.2 mG while B is estimated to be 6 mG for the proto-PN (PPN) AFGL 618, and an upper value of 8 mG is found for the PN NGC 7027. These results are consistent with a decrease of B as $1/r$ in the environment of AGB objects, that is, with the presence of a toroidal field. But this is not the case for PPN and PN stars. Our map of IRC +10°216 suggests that the magnetic field is not homogeneously strong throughout or aligned with the envelope and that the morphology of the CN emission might have changed with time.

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Discovery of carbon-rich Miras in the Galactic bulge

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Only one carbon-rich (C-rich, hereinafter) Mira variable has so far been suggested as a member of the Galactic bulge

and this is in a symbiotic system. Here we describe a method for selecting C-rich candidates from an infrared colour–colour diagram, $(J - K_s)$ vs. $([9] - [18])$. Follow-up low-resolution spectroscopy resulted in the detection of 8 C-rich Mira variables from a sample of 36 candidates towards the Galactic bulge. Our near-infrared photometry indicates that two of these, including the known symbiotic, are closer than the main body of the bulge while a third is a known foreground object. Of the 5 bulge members, one shows He I and [O II] emission and is possibly another symbiotic star. Our method is useful for identifying rare C-rich stars in the Galactic bulge and elsewhere. The age of these C-rich stars and the evolutionary process which produced them remain uncertain. They could be old and the products of either binary mass transfer or mergers, i.e. the descendants of blue stragglers, but we cannot rule out the possibility that they belong to a small in-situ population of metal-poor intermediate age (< 5 Gyr) stars in the bulge or that they have been accreted from a dwarf galaxy.

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An infrared photometric and spectroscopic study of post-AGB stars

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We present here *Spitzer* mid-infrared (IR) spectra and modeling of the spectral energy distribution (SED) of a selection of post-Asymptotic Giant Branch (PAGB) stars. The mid-IR spectra of majority of these sources showed spectral features such as polycyclic aromatic hydrocarbons (PAHs) and silicates in emission. Our results from SED modeling showed interesting trends of dependency between the photospheric and circumstellar parameters. A trend of dependency is also noticed between the ratios of equivalent widths (EWs) of various vibrational modes of PAHs and the photospheric temperature $T_\star$ and model-derived stellar parameters for the sample stars. The PAGB mass loss rates derived from the SED models are found to be higher than those for the AGB stars. In a few objects, low and high excitation fine structure emission lines were identified, indicating their advanced stage of evolution. Further, IR vibration modes of fullerene (C_{60}) were detected for the first time in the PAGB star IRAS 21546+4721.

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The evolution of CNO isotopes: a new window on cosmic star-formation history and the stellar IMF in the age of ALMA

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We use state-of-the-art chemical models to track the cosmic evolution of the CNO isotopes in the interstellar medium (ISM) of galaxies, yielding powerful constraints on their stellar initial mass function (IMF).We re-assess the relative roles of massive stars, asymptotic giant branch (AGB) stars and novæ in the production of rare isotopes such as ^{13}C, ^{15}N, ^{17}O and ^{18}O, along with ^{12}C, ^{14}N and ^{16}O. The CNO isotope yields of super-AGB stars, novæ and fast-rotating massive stars are included. Having reproduced the available isotope enrichment data in the solar neighbourhood, and across the Galaxy, and having assessed the sensitivity of our models to the remaining uncertainties, e.g., nova yields and star-formation history, we show that we can meaningfully constrain the stellar IMF in galaxies using C, O and N isotope abundance ratios. In starburst galaxies, where data for multiple isotopologue lines are available, we find compelling new evidence for a top-heavy stellar IMF, with profound implications for their star-formation rates

and efficiencies, perhaps also their stellar masses. Neither chemical fractionation nor selective photodissociation can significantly perturb globally-averaged isotopologue abundance ratios away from the corresponding isotope ones, as both these processes will typically affect only small mass fractions of molecular clouds in galaxies. Thus the Atacama Large Millimetre Array now stands ready to probe the stellar IMF, and even the ages of specific starburst events in star-forming galaxies across cosmic time unaffected by the dust obscuration effects that plague optical/near-infrared studies.

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A phenomenological modification of thermohaline mixing in globular cluster red giants

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Thermohaline mixing is a favoured mechanism for the so-called "extra mixing" on the red giant branch of low-mass stars. The mixing is triggered by the molecular weight inversion created above the hydrogen shell during first dredge-up when helium-3 burns via ^{3}He(^{3}He,2p)^{4}He. The standard 1D diffusive mixing scheme cannot simultaneously match carbon and lithium abundances to NGC 6397 red giants. We investigate two modifications to the standard scheme: (1) an advective two stream mixing algorithm, and (2) modifications to the standard 1D thermohaline mixing formalism. We cannot simultaneously match carbon and lithium abundances using our two stream mixing approach. However we develop a modified diffusive scheme with an explicit temperature dependence that can simultaneously fit carbon and lithium abundances to NGC 6397 stars. Our modified diffusive scheme induces mixing that is faster than the standard theory predicts in the hotter part of the thermohaline region and mixing that is slower in the cooler part. Our results infer that the extra mixing mechanism needs further investigation and more observations are required, particularly for stars in different clusters spanning a range in metallicity.

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Episodic mass ejections from common-envelope objects

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After the initial fast spiral-in phase experienced by a common-envelope binary, the system may enter a slow, self-regulated phase, possibly lasting 100s of years, in which all the energy released by orbital decay can be efficiently transported to the surface, where it is radiated away. If the remaining envelope is to be removed during this phase, this removal must occur through some as-yet-undetermined mechanism. We carried out 1-d hydrodynamic simulations of a low-mass red giant undergoing a synthetic common-envelope event in such a slow spiral-in phase, using the stellar evolutionary code MESA. We simulated the heating of the envelope due to frictional dissipation from a binary companion's orbit in multiple configurations and investigated the response of the giant's envelope. We find that our model envelopes become dynamically unstable and develop large-amplitude pulsations, with periods in the range 3–20 years and very short growth time-scales of similar order. The shocks and associated rebounds that emerge as these pulsations grow are in some cases strong enough to dynamically eject shells of matter of up to 0.1 $M_{\odot}$, $\sim 10\%$ of the mass of the envelope, from the stellar surface at above escape velocity. These ejections are seen to repeat within a

few decades, leading to a time-averaged mass-loss rate of order 10^{-3} $M_\odot$ yr^{-1} which is sufficiently high to represent a candidate mechanism for removing the entire envelope over the duration of the slow spiral-in phase.

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Chemical abundances of 1111 FGK stars from the HARPS GTO planet search program II: Cu, Zn, Sr, Y, Zr, Ba, Ce, Nd and Eu

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Aims: To understand the formation and evolution of the different stellar populations within our Galaxy it is essential to combine detailed kinematical and chemical information for large samples of stars. The aim of this work is to explore the chemical abundances of neutron capture elements which are a product of different nucleosynthesis processes taking place at diverse objects in the Galaxy, such as massive stars, asymptotic giant branch (AGB) stars and supernovæ (SNe) explosions.
Methods: We derive chemical abundances of Cu, Zn, Sr, Y, Zr, Ba, Ce, Nd and Eu for a large sample of more than 1000 FGK dwarf stars with high-resolution ($R \sim 115\,000$) and high-quality spectra from the HARPS-GTO program. The abundances are derived by a standard Local Thermodynamic Equilibrium (LTE) analysis using measured Equivalent Widths (EWs) injected to the code MOOG and a grid of Kurucz ATLAS9 atmospheres.
Results: We find that thick disk stars are chemically disjunct for Zn and Eu and also show on average higher Zr but lower Ba and Y when compared to the thin disk stars. We also discovered that the previously identified high-metal-rich population is also enhanced in Cu, Zn, Nd and Eu with respect to the thin disk but presents Ba and Y abundances lower on average, following the trend of thick disk stars towards higher metallities and further supporting the different chemical composition of this population. By making a qualitative comparison of O (pure α), Mg, Eu (pure r-process) and s-process elements we can distinguish between the contribution of the more massive stars (SNe II for α and r-process elements) and the lower mass stars (AGBs) whose contribution to the enrichment of the Galaxy is delayed due to their longer lifetimes. The ratio of heavy-s to light-s elements of thin disk stars presents the expected behaviour (increasing towards lower metallicities) and can be explained by a major contribution of low-mass AGB stars for s-process production at disk metallicities. However, the opposite trend found for thick disk stars suggests that intermediate-mass AGB stars played an important role in the enrichment of the gas from where these stars formed. Previous works in the literature also point to a possible primary production of light-s elements at low metallicities to explain this trend. Finally, we also find an enhancement of light-s elements in the thin disk at super solar metallicities which could be caused by the contribution of metal-rich AGB stars.

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Globular cluster formation with multiple stellar populations from hierarchical star cluster complexes

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Most old globular clusters (GCs) in the Galaxy are observed to have internal chemical abundance spreads in light

elements. We discuss a new GC formation scenario based on hierarchical star formation within fractal molecular clouds. In the new scenario, a cluster of bound and unbound star clusters ('star cluster complex', SCC) that have a power-law cluster mass function with a slope (β) of 2 is first formed from a massive gas clump developed in a dwarf galaxy. Such cluster complexes and $\beta = 2$ are observed and expected from hierarchical star formation. The most massive star cluster ('main cluster'), which is the progenitor of a GC, can accrete gas ejected from asymptotic giant branch (AGB) stars initially in the cluster and other low-mass clusters before the clusters are tidally stripped or destroyed to become field stars in the dwarf. The SCC is initially embedded in a giant gas hole created by numerous supernovæ of the SCC so that cold gas outside the hole can be accreted on to the main cluster later. New stars formed from the accreted gas have chemical abundances that are different from those of the original SCC. Using hydrodynamical simulations of GC formation based on this scenario, we show that the main cluster with the initial mass as large as [2–5] $\times 10^5$ $M_\odot$ can accrete more than 10^5 $M_\odot$ gas from AGB stars of the SCC. We suggest that merging of hierarchical SSCs can play key roles in stellar halo formation around GCs and self-enrichment processes in the early phase of GC formation.

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Magnetically aligned dust and SiO maser polarization in the envelope of the red supergiant VY CMa

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We use Atacama Large Millimeter/submillimeter Array (ALMA) Band 5 science verification observations of the red supergiant VY CMa to study the polarization of SiO thermal/masers lines and dust continuum at ~ 1.7 mm wavelength. We analyse both linear and circular polarization and derive the magnetic field strength and structure, assuming the polarization of the lines originates from the Zeeman effect, and that of the dust originates from aligned dust grains. We also discuss other effects that could give rise to the observed polarization. We detect, for the first time, significant polarization ($\sim 3\%$) of the circumstellar dust emission at millimeter wavelengths. The polarization is uniform with an electric vector position angle of $\sim 8°$. Varying levels of linear polarization are detected for the $J = 4$–3 ^{28}SiO $v = 0$, 1, 2, and ^{29}SiO $v = 0$, 1 lines, with the strongest polarization fraction of $\sim 30\%$ found for the ^{29}SiO $v = 1$ maser. The linear polarization vectors rotate with velocity, consistent with earlier observations. We also find significant (up to $\sim 1\%$) circular polarization in several lines, consistent with previous measurements. We conclude that the detection is robust against calibration and regular instrumental errors, although we cannot yet fully rule out non-standard instrumental effects. Emission from magnetically aligned grains is the most likely origin of the observed continuum polarization. This implies that the dust is embedded in a magnetic field > 13 mG. The maser line polarization traces the magnetic field structure. The magnetic field in the gas and dust is consistent with an approximately toroidal field configuration, but only higher angular resolution observations will be able to reveal more detailed field structure. If the circular polarization is due to Zeeman splitting, it indicates a magnetic field strength of ~ 1–3 Gauss, consistent with previous maser observations.

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Available from https://arxiv.org/abs/1703.02084

The coldest place in the Universe: probing the ultra-cold outflow and dusty disk in the Boomerang Nebula

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Our Cycle 0 ALMA observations confirmed that the Boomerang Nebula is the coldest known object in the Universe, with a massive high-speed outflow that has cooled significantly below the cosmic background temperature. Our new CO 1–0 data reveal heretofore unseen distant regions of this ultra-cold outflow, out to $\gtrsim$120,000 au. We find that in the ultra-cold outflow, the mass-loss rate ($\dot{M}$) increases with radius, similar to its expansion velocity (v) − taking $v \propto r$, we find $\dot{M} \propto r^{0.9-2.2}$. The mass in the ultra-cold outflow is $\gtrsim$3.3 $M_\odot$, and the Boomerang's main-sequence progenitor mass is $\gtrsim$4 $M_\odot$. Our high angular resolution ($\sim 0\overset{''}{.}3$) CO $J = 3$–2 map shows the inner bipolar nebula's precise, highly-collimated shape, and a dense central waist of size (FWHM) $\sim$ 1740 au $\times$275 au. The molecular gas and the dust as seen in scattered light via optical HST imaging show a detailed correspondence. The waist shows a compact core in thermal dust emission at 0.87–3.3 mm, which harbors $(4–7) \times 10^{-4}$ $M_\odot$ of very large ($\sim$mm-to-cm sized), cold ($\sim$ 20–30 K) grains. The central waist (assuming its outer regions to be expanding) and fast bipolar outflow have expansion ages of $\lesssim$1925 yr and $\leq$ 1050 yr: the "jet-lag" (i.e., torus age minus the fast-outflow age) in the Boomerang supports models in which the primary star interacts directly with a binary companion. We argue that this interaction resulted in a common-envelope configuration while the Boomerang's primary was an RGB or early-AGB star, with the companion finally merging into the primary's core, and ejecting the primary's envelope that now forms the ultra-cold outflow.

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Available from https://arxiv.org/abs/1703.06929

New outburst of the symbiotic nova AG Peg after 165 years

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AG Peg is known as the slowest symbiotic nova, which experienced its nova-like outburst around 1850. After 165 years, during June of 2015, it erupted again showing characteristics of the Z And-type outburst. The primary objective is to determine basic characteristics, the nature and type of the 2015 outburst of AG Peg. We achieved this aim by modelling the spectral energy distribution using low-resolution spectroscopy (330–750 nm), medium-resolution spectroscopy (420–720 nm; $R = 11\,000$), and $UBVR_\mathrm{C}I_\mathrm{C}$ photometry covering the 2015 outburst with a high cadence. Optical observations were complemented with the archival HST and FUSE spectra from the preceding quiescence.

During the outburst, the luminosity of the hot component was in the range of 2–11 $\times 10^{37}(d/0.8\text{kpc})^2$ erg s^{-1}. To generate the maximum luminosity the white dwarf (WD) had to accrete at $\sim 3 \times 10^{-7}$ M$_\odot$ yr^{-1}, which exceeds the stable-burning limit and thus led to blowing optically thick wind from the WD. We determined its mass-loss rate to a few $\times 10^{-6}$ M$_\odot$ yr^{-1}. At the high temperature of the ionising source, 1.5–2.3 $\times 10^5$ K, the wind converted a fraction of the WD's photospheric radiation into the nebular emission that dominated the optical. A one order of magnitude increase of the emission measure, from a few $\times 10^{59}(d/0.8\text{kpc})^2$ cm^{-3} during quiescence, to a few $\times 10^{60}(d/0.8\,\text{kpc})^2$ cm^{-3} during the outburst, caused a 2 mag brightening in the LC, which is classified as the Z And-type of the outburst. The very high nebular emission and the presence of a disk-like H I region encompassing the WD, as indicated by a significant broadening and high flux of the Raman-scattered O VI 6825Å line during the outburst, is consistent with the ionisation structure of hot components in symbiotic stars during active phases.

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Mitigating the mass dependence in the $\Delta\nu$ scaling relation of red-giant stars

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The masses and radii of solar-like oscillators can be estimated through the asteroseismic scaling relations. These relations provide a direct link between observables, i.e. effective temperature and characteristics of the oscillation spectra, and stellar properties, i.e. mean density and surface gravity (thus mass and radius). These scaling relations are commonly used to characterize large samples of stars. Usually, the Sun is used as a reference from which the structure is scaled. However, for stars that do not have a similar structure as the Sun, using the Sun as a reference introduces systematic errors as large as 10% in mass and 5% in radius. Several alternatives for the reference of the scaling relation involving the large frequency separation (typical frequency difference between modes of the same degree and consecutive radial order) have been suggested in the literature. In a previous paper, we presented a reference function with a dependence on both effective temperature and metallicity. The accuracy of predicted masses and radii improved considerably when using reference values calculated from our reference function. However, the residuals indicated that stars on the red-giant branch possess a mass dependence that was not accounted for. Here, we present a reference function for the scaling relation involving the large frequency separation that includes the mass dependence. This new reference function improves the derived masses and radii significantly by removing the systematic differences and mitigates the trend with $\nu_{\max}$ (frequency of maximum oscillation power) that exists when using the solar value as a reference.

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Available from https://arxiv.org/abs/1705.07886

Conference Papers

Time-series surveys and pulsating stars: the near-infrared perspective

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The purpose of this review is to discuss the advantages and problems of near-infrared surveys in observing pulsating stars in the Milky Way. One of the advantages of near-infrared surveys, when compared to optical counterparts, is that the interstellar extinction is significantly smaller. As we see in this review, a significant volume of the Galactic disk can be reached by infrared surveys but not by optical ones. Towards highly obscured regions in the Galactic mid-plane, however, the interstellar extinction causes serious problems even with near-infrared data in understanding the observational results. After a review on previous and current near-infrared surveys, we discuss the effects of the interstellar extinction in optical (including Gaia) to near-infrared broad bands based on a simple calculation using synthetic spectral energy distribution. We then review the recent results on classical Cepheids towards the Galactic center and the bulge, as a case study, to see the impact of the uncertainty in the extinction law. The extinction law, i.e. the wavelength dependency of the extinction, is not fully characterized, and its uncertainty makes it hard to make the correction. Its characterization is an urgent task in order to exploit the outcomes of ongoing large-scale surveys of pulsating stars, e.g., for drawing a map of pulsating stars across the Galactic disk.

Oral contribution, published in 22$^{\text{nd}}$ Los Alamos Stellar Pulsation Conference Series. "Wide field variability surveys: a 21$^{\text{st}}$-century perspective"
Available from https://arxiv.org/abs/1705.02547

Evolutionary states of red-giant stars from grid-based modelling

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From its surface properties it can be difficult to determine whether a red-giant star is in its helium-core-burning phase or only burning hydrogen in a shell around an inert helium core. Stars in either of these stages can have similar effective temperatures, radii and hence luminosities, i.e. they can be located at the same position in the Hertzsprung–Russell diagram. Asteroseismology – the study of the internal structure of stars through their global oscillations – can provide the necessary additional constraints to determine the evolutionary states of red-giant stars. Here, we present a method that uses grid-based modelling based on global asteroseismic properties ($\nu_{\max}$, frequency of maximum oscillation power; and $\Delta\nu$, frequency spacing between modes of the same degree and consecutive radial orders) as well as effective temperature and metallicity to determine the evolutionary phases. This method is applicable even to timeseries data of limited length, although with a small fraction of miss-classifications.

Poster contribution, published in joint TASC2/KASC9 workshop – SPACEINN & HELAS8 conference
Available from https://arxiv.org/abs/1705.05879

Variable stars in the northern Galactic plane from KISOGP

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[1]The University of Tokyo, Japan
[2]on behalf of KISOGP team

We have conducted a large-scale survey of the northern plane using Kiso Wide Field Camera attached to Schmidt telescope at Kiso observatory. The KISOGP (KWFC Intensive Survey of the Galactic Plane) project have made 40–70 epoch observations in I band of about 320 sq. degrees for 5 years starting in 2012. The limiting magnitude is around 16.5 in I. In the data analysis so far, we detected a couple of thousands of variable stars including approximately 100 Cepheids and more than 700 Miras. Roughly 90 percent of them were not previously reported as variable stars, indicating that there are still many relatively bright variables to be found in the Galactic plane.

Poster contribution, published in "Wide field variability surveys: a 21^{st}-century perspective"
Available from https://arxiv.org/abs/1705.08567

Review Papers

Binary stars as the key to understanding planetary nebulæ

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Planetary nebulæ are traditionally considered to represent the final evolutionary stage of all intermediate-mass stars ($\sim$ 0.7–8 $M_\odot$). Recent evidence seems to contradict this picture. In particular, since the launch of the *Hubble* Space Telescope it has become clear that planetary nebulæ display a wide range of striking morphologies which cannot be understood in a single star scenario, instead pointing towards a binary evolution in a majority of systems. Here, we summarise our current understanding of the importance of binarity in the formation and shaping of planetary nebulæ, as well as the surprises that recent observational studies have revealed with respect to our understanding of binary evolution in general. These advances have critical implications, including for the understanding of mass transfer processes in binary stars – particularly the all-important but ever-so poorly understood 'common envelope phase' – as well as the formation of cosmologically important type Ia supernovæ.

Published in Nature Astronomy
Available from https://arxiv.org/abs/1705.00283

Nebular spectroscopy: a guide on H II regions and planetary nebulæ

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We present a tutorial on the determination of the physical conditions and chemical abundances in gaseous nebulæ. We also include a brief review of recent results on the study of gaseous nebulae, their relevance for the study of stellar evolution, galactic chemical evolution, and the evolution of the universe. One of the most important problems in abundance determinations is the existence of a discrepancy between the abundances determined with collisionally excited lines and those determined by recombination lines, this is called the ADF (abundance discrepancy factor) problem; we review results related to this problem. Finally, we discuss possible reasons for the large t^2 values observed in gaseous nebulæ.

Published in PASP (invited tutorial)
Available from https://arxiv.org/abs/1705.06323

Institute of Astronomy, University of Leuven, Belgium

1 Postdoc and 2 Ph.D. positions
Observational and theoretical stellar astrophysics
The winds of hot and cool massive stars

The MAESTRO Project

Throughout the Universe, the dynamics and chemical evolution of spiral galaxies like our Milky Way are largely controlled by the lives and deaths of stars with masses many times that of the Sun. But the evolution of these massive stars, in turn, is highly regulated by the huge amounts of mass expelled from their surfaces, by means of powerful starlight-driven wind outflows. These stellar winds critically determine how such massive stars evolve through their lives, how they finally die in giant supernova explosions, and how they after their violent deaths leave behind exotic remnants such as neutron stars and black holes. However, large uncertainties concerning such mass loss remain, affecting present-day predictions for massive-star evolution, including even massive-star progenitor models of gravitational wave sources. In this context, the MAESTRO project aims to fundamentally improve our understanding of the driving mechanism of massive-star winds. We will use novel theoretical and observational methods to probe the winds ofhot and cool massive stars, throughout their entire evolution and across a large range of metallicity environments.Financed by the K.U. Leuven University in Belgium, the MAESTRO project will bridge the theoretical, computational, and observational expertise of 4 academic members of the Institute of Astronomy at K.U. Leuven, to build an interdisciplinary team tackling the above critical stellar physics questions, and to enhance the predictive power of contemporary stellar evolution models of massive stars.

The Vacancies
The Institute of Astronomy of the K.U. Leuven (Belgium) seeks highly motivated and excellent applicants to take on important roles in the MAESTRO project. Applications are invited for 1 postdoc and 2 Ph.D. positions financed through a prestigious research grant (C1) from the K.U. Leuven university. The selected candidates will join the MAESTRO team, closely under the supervision of with Profs. Leen Decin, Hugues Sana, Jon Sunqvist and Alex de Koter, and as part of an international network of collaborators, to obtain crucial observational constraints and to develop new theoretical methods needed to advance our understanding of hot and cool massive-star winds.

The MAESTRO project will open 6 positions in the next 3 years. Here, we specifically advertise de following 1 postdoc and 2 Ph.D. positions (with preferred starting date around 1 October 2017):

- Ph.D. position: Theory of Wolf–Rayet winds – The Ph.D. student will aim to develop a theoretical framework for the radiative acceleration driving the winds of Wolf–Rayet (WR) stars; using this framework then,fulldynamical wind models will be constructedtoobtain theoretical predictions for global wind properties (e.g.,mass-loss rate)and their scaling with fundamental stellar parameters.

- Ph.D. position: Observations and Diagnostics of Red Supergiant winds – The Ph.D. student will aim to derive the geometrical and dynamical wind structure of Red Supergiants (RSGs) using existing retrieval methods and will study the current morphology and mass-loss evolution during the RSG life time, as well as the mass-loss signatures at low metallicities.

- Postdoc position: Observations of hot and cool massive stars – The postdoc will be responsible for the observational aspects of the MAESTRO project. Tasks involve, e.g.: collect, reduce and/or organize a multi-wavelength data-set covering hot (OB, WR) and cool (RSGs) massive stars across a wide metallicity range, develop and/or adapt the necessary techniques to analyse crowded regions and unresolved small clusters. Lead the analysis of these data, including part of the daily supervision of students in the MAESTRO project.

The Host Institute
The Institute of Astronomy (IoA) of Leuven University in Belgium consists of a young and vibrant research group of some 50 scientists, engineers, and administrative staff (fys.kuleuven.be/ster), including 6 full-time and 3 part-time professors. The institute is an expertise centre in stellar physics and is active in several international consortia and collaborations, involving telescopes at observatories worldwide and in space. Members of IoA have access to parallel computing facilities at Leuven University. The IoA is responsible for the organisation of the 2-year Master in Astronomy & Astrophysics of the Faculty of Science and owns the 1.2m Mercator telescope at Roque de los Muchachos, La Palma Observatory, Canary Islands. The institute has a long tradition in instrumental, observational, and theoretical studies of stellar evolution.

The Ph.D. Contract
The selected Ph.D. students will be offered a 4-year contract, including a mid-term evaluation after 2 years. The salary will be commensurate to the standard scale for Ph.D. students in Belgium; it includes social and medical insurance as well as pension rights. The preferred starting date is October 1st 2017 but can be negotiated. The successful Ph.D. applicants(will) have to register at and comply with the regulations of the Arenberg Doctoral School of the Leuven University. Good command of the English language is a requirement to be approved by the doctoral school. The successful Ph.D. applicants will follow a doctoral programme including personal training in management, science communication, and teaching. As part of the doctoral program, the students will have to take up a teaching task of at maximally 4 hours per week in one of the Bachelor (in Dutch) or Master (in English) programmes. Ph.D. students at IoA are also required to perform at least one Mercator observing run of 10 nights per year for the pooled IoA long-term monitoring programmes.

The Postdoc Contract
The selected post-doc will be offered a 2-year contract with a possible extension of maximum 1 year. The salary will be commensurate to the standard scale for post-doc researcher in Belgium and will depend on the number of years of experience after Ph.D. It includes social and medical insurance as well as pension rights. The preferred starting date shall be between October 1st 2017 and January 1st 2018 but can be negotiated. The postdoc will also be encouraged to take up training in science and people management, science communication and grant application writing with the aim to develop a personal independent career track.

Requirements and Instructions to Apply
Ph.D. applicants must hold a M.Sc. degree in physics, astrophysics or mathematics or else own an equivalent diploma. The degree must be dated at the latest one month before the position can be taken up. Expertise in astrophysics is an asset but not a requirement.
Post-doc applicants must hold a Ph.D. in astrophysics or an equivalent diploma. The ideal candidates will have a strong observational and data analysis background, including expertise relevant for the atmosphere analysis of hot and/or cool massive stars. Prior-experience with UV, optical, IR and/or sub-mm observations and facilities such as the HST, ESO/VLT (XShooter, UVES, SPHERE, MUSE, KMOS), ALMA and JWST, or similar facilities, will be viewed positively by the selection committee. Similarly, preference will be given to applicants who demonstrate expertise with low-metallicity environments, crowded regions, IFU spectroscopy and/or future JWST observations.
PhD and postdoc applicants: Proficiency in English is assumed/required. The application package should be sent as one single PDF containing (i) a curriculum vitæ with a full publication list, (ii) a statement of interest (max. one page for Ph.D. applicants and 2 pages for postdocs) and (iii) a summary of the research experience (e.g., master thesis; also max. one page for Ph.D. applicants and 3 pages for postdocs). Exclusively for Ph.D. applicants, (iv) a list of all master courses with their number of study points and the scores obtained. Applicants must also provide the names and contact details of two reference persons who would be prepared to send confidential recommendation letters should they be requested to do so. The selection committee will send out requests for such letters for those applicants on the short-list after an initial ranking. The short-listed applicants will be invited for an interview (live or via Skype).

The application material should be sent by e-mail to Leen.Decin@kuleuven.be with subject "MAESTRO-⟨applicant_name⟩" at the latest by 1 July 15, 2017.

Interviews will be held during the summer and selected candidates will be contacted at the latest by August 31, 2017.

Only complete applications received by July 15^{th} 2017 will be considered. Information on the positions and on the MAESTRO project may be obtained by contacting the co-promotors of the project:
Prof. Leen Decin: email (Leen.Decin@kuleuven.be) or phone (+32-16-32.70.41)
Prof. Hugues Sana: email (Hugues.Sana@kuleuven.be) or phone (+32-16-37.43.61)
Prof. Jon Sundqvist: email (Jon.Sundqvist@kuleuven.be) or phone (+32-487-36.31.20)
Prof. Alex de Koter: email (A.deKoter@uva.nl) or phone (+31-20-525.74.91)
or at the website https://fys.kuleuven.be/ster/Projects/maestro

See also http://fys.kuleuven.be/ster/vacancies/maestro-vacancies

Leeds University, UK and University of Leuven, Belgium 3 yr Ph.D. position in the field of astrochemistry

Interdisciplinary project on the stellar winds around evolved stars at Leuven University (Belgium) and the Leeds University (UK) funded by the ERC-CoG_2014 grant AEROSOL (PI. L. Decin, University of Leuven).

Application deadline 30^{th} June 2017.

The project and the position

We seek an excellent candidate for a Ph.D. research position ready to play a key role in the interdisciplinary ERC Consolidator Grant AEROSOL (2016–2020, PI. Prof. Leen Decin). The aim of the project is to boost our understanding of the physics and chemistry characterizing the stellar winds around evolved stars. The project builds upon novel observations, detailed theoretical wind models, and targeted laboratory experiments (see http://fys.kuleuven.be/ster/Projects /aerosol/aerosol). The candidate will interact closely with a team consisting of astrophysicists, chemists, and computational mathematicians.

Specifically, we seek a candidate with interest both in laboratory chemistry and in chemical modelling. In a first part of the project, the candidate will perform laboratory experiments aiming to understand the reactivity of Ni and Al in environments mimicking the winds of evolved stars. In a second phase, the student will study silicate dust formation using ab-initio quantum theory to establish likely reaction pathways occurring in stellar outflows. The candidate will perform his/her study at the University of Leeds supervised by Prof. John Plane (University of Leeds) and Prof. Leen Decin (University of Leuven, University of Leeds), working in collaboration with Dr. David Gobrecht (University of Leuven).

Candidates should have an interest in astrophysics, astrochemistry and/or physical chemistry. The experimental work will be carried out in the modern and fully-equipped research laboratories at the Universities of Leeds. The (quantum) chemical computations will use the HPC facilities of the University of Leuven. The Ph.D. student will interact closely with other team members at the Universities of Leuven and Leeds.

Institute of Astronomy – University of Leuven
The Institute of Astronomy (IoA) of the Leuven University in Belgium is a young and vibrant research group of some 50 scientists, engineers and administrative staff (fys.kuleuven.be/ster), including 6 full-time and 3 part-time professors. The institute is an expertise centre in stellar physics and is active in several international consortia and collaborations, involving telescopes at observatories worldwide and in space. Members of IoA have access to parallel computing facilities at Leuven University. The IoA is responsible for the organisation of the 2-year Master in Astronomy & Astrophysics of the Faculty of Science and owns the 1.2m Mercator telescope at Roque de los Muchachos, La Palma Observatory, Canary Islands. The institute has a long tradition in instrumental, observational, and theoretical studies of the late stages of evolution of low and intermediate mass stars.

School of Chemistry – University of Leeds
The Atmospheric and Planetary Chemistry (APC) Research Group within the School of Chemistry http://www.chem.leeds.ac.uk/research/groups/atmospheric-and-planetary-chemistry.html consists of ∼ 40 scientists (3 Professors, academic staff, postdoctoral fellows and Ph.D. students). Research into the Earth's at-mosphere focuses on field measurements of key species in the atmosphere, laboratory studies of chemical oxidation of volatile organic compounds and the chemistry of meteor-ablated metals in the upper atmosphere, and detailed modelling using the Master Chemical Mechanism and the Whole Atmosphere Community Climate Model. The Planetary Chemistry research uses a combination of laboratory work, observations and modelling with an enhanced focus on chemistry at low temperatures using a pulsed Laval expansion, specialised flow tubes and theoretical models. The experience in combustion and high temperature pyrolysis chemistry is relevant for the conditions of 'super Earth' and 'hot Jupiter' exoplanets. The Group has extensive collaborations within Leeds (Physics and Astronomy, Institute for Climate and Atmospheric Science), nationally (National Centre for Atmospheric Science) and internationally (NASA, JPL and many university departments worldwide).

Conditions
The successful applicant will perform research in the context of AEROSOL. The Ph.D. student will be able to take up personal training in science and people management, science communication, and grant application writing with the aim to develop a personal independent career track. The selected candidate will be offered a 3-year studentship, with a starting date between 1 July 2017 and 1 January 2018. In their application, candidates are requested to indicate their preferred starting date.

Requirements and instructions to apply
Applicants must possess a Master's degree in (astro)physics, chemistry or mathematics, or an equivalent diploma. High proficiency in English is assumed. Applications must include:

- a Curriculum Vitæ;
- a statement of research interests (maximum 2 pages);
- a letter detailing your specific qualifications for the position and your career/educational goals (max. 1 page);
- two letters of recommendation from people well acquainted with your academic achievements. The letters are to be submitted separately to the address mentioned below.

Applications should be made using the University On-line Application System, where you can upload your supporting documents directly onto the system: http://www.leeds.ac.uk/info/130206/applying/91/applying_for_research_degrees
Please note: this opportunity is only available to those eligible for the UK/Non-UK EU fees rate.
http://www.leeds.ac.uk/info/102040/fees_and_costs/104/research_degrees_fees

The short-listed applicants will be invited for an interview (live or via skype).

More information can be obtained by contacting:

Prof. L. Decin Institute for Astronomy
Department of Physics and Astronomy, K.U. Leuven
Celestijnenlaan 200D, 3001 Heverlee, Belgium
Leen.Decin@kuleuven.be
++32-16-32 70 41

Prof. J. Plane
Professor of Atmospheric Chemistry
School of Chemistry
University of Leeds, Leeds
LS2 9JT, UK
J.M.C.Plane@leeds.ac.uk
++44-113-343-8044

See also http://fys.kuleuven.be/ster/vacancies/vacancies

Leeds University, UK and University of Leuven, Belgium
Vacancy for a 2 yr (+1 yr) post-doctoral position in the field of laboratory experiments for astrochemical research

Interdisciplinary project on the stellar winds around evolved stars at Leuven University (Belgium) and Leeds University (UK) funded by the ERC-CoG_2014 grant AEROSOL (PI. L. Decin, University of Leuven).

The project and the position
We seek an excellent candidate for a post-doctoral research position ready to play a key role in the interdisciplinary ERC Consolidator Grant AEROSOL (2016–2020, PI. Prof. Leen Decin). The aim of the project is to boost our understanding of the physics and chemistry characterizing the stellar winds around evolved stars. The project builds upon novel observations, detailed theoretical wind models, and targeted laboratory experiments (see http://fys.kuleuven.be/ster/Projects/aerosol/aerosol). The candidate will interact closely with a team consisting of astrophysicists, chemists, and computational mathematicians.

Specifically, we seek a post-doctoral researcher with expertise in gas-phase reaction kinetics. The experimental research concerns the determination of rate coefficients and product distributions of elementary gas-phase reactions involving key reactive species (OH, C_2H, HCHO, etc.) in stellar winds for which data are currently lacking. Specifically, several advanced laser-spectroscopic and chemiluminescence techniques will be employed to follow photolytically-generated reactive species in real time in a state-of-the-art low-temperature de Laval-nozzle apparatus with the aim to obtain the rates of gas-phase reactions at temperatures below 200 K. The candidate will (1) perform the laboratory experiments at the University of Leeds in collaboration with Prof. Dwayne Heard. In addition, there is an opportunity for the candidate (2) to design a new de Laval nozzle apparatus at the University of Leuven, in collaboration with Prof. Leen Decin and Prof. Jeremy Harvey.

Candidates should have an interest in physical chemistry, high-resolution laser spectroscopy, chemical kinetics, and experimental research. The experimental work will be carried out in the modern and fully equipped research laboratories at the Universities of Leeds and Leuven. Both groups enjoy and encourage further close collaboration with researchers in the departments employing high-level quantum chemical calculations on species related to this project.

Institute of Astronomy – University of Leuven
The Institute of Astronomy (IoA) of the Leuven University in Belgium is a young and vibrant research group of some 50 scientists, engineers and administrative staff (fys.kuleuven.be/ster), including 6 full-time and 3 part-time professors. The institute is an expertise centre in stellar physics and is active in several international consortia and collaborations, involving telescopes at observatories worldwide and in space. Members of IoA have access to parallel computing facilities at Leuven University. The IoA is responsible for the organisation of the 2-year Master in Astronomy & Astrophysics of the Faculty of Science and owns the 1.2m Mercator telescope at Roque de los Muchachos, La Palma Observatory, Canary Islands. The institute has a long tradition in instrumental, observational, and theoretical studies of the late stages of evolution of low and intermediate mass stars.

School of Chemistry – University of Leeds
The Atmospheric and Planetary Chemistry (APC) Research Group within the School of Chemistry http://www.chem.leeds.ac.uk/research/groups/atmospheric-and-planetary-chemistry.html consists of $\sim$ 40 scientists (3 Professors, academic staff, postdoctoral fellows and Ph.D. students). Research into the Earth's atmosphere focuses on field measurements of key species in the atmosphere, laboratory studies of chemical oxidation of volatile organic compounds and the chemistry of meteor-ablated metals in the upper atmosphere, and detailed modelling using the Master Chemical Mechanism and the Whole Atmosphere Community Climate Model. The Planetary Chemistry research uses a combination of laboratory work, observations and modelling with an enhanced focus on chemistry at low temperatures (< 100 K) using a pulsed Laval expansion, specialised flow tubes and theoretical models. The experience in combustion and high temperature pyrolysis chemistry is relevant for the conditions of "super Earth" and "hot Jupiter" exoplanets. The Group has extensive collaborations within Leeds (Physics and Astronomy, Institute for Climate and Atmospheric Science), nationally (National Centre for Atmospheric Science) and internationally (NASA, JPL and many university departments worldwide).

Contract
The successful applicant will perform research in the context of AEROSOL. The postdoc will be able to take up personal training in science and people management, science communication, and grant application writing with the aim to develop a personal independent career track. The selected candidate will be offered a 2-year contract. There is also a potential opportunity for the Research Fellow to be employed and funded by Leuven University, Belgium, for a subsequent one year period following the two year appointment at Leeds. During the first two years of the contract, the candidate will be mainly situated in Leeds; during the third year (if offered) the candidate gets the exciting possibility to construct a new de Laval nozzle apparatus at the University of Leuven. The salary will be commensurate to the standard scale for postdoctoral researchers; it includes social and medical insurance as well as pension rights. The starting date shall be between 1 July 2017 and 1 January 2018. In their application, candidates are requested to indicate their preferred starting date.

Requirements and instructions to apply
Applicants must possess a Ph.D. degree in astrophysics or physical chemistry or own an equivalent diploma; the degree must be dated at the latest one month before the position can be taken up. High proficiency in English is assumed. The application package should be sent as a single PDF including

- a Curriculum Vitæ;
- a full publication list;
- a statement of research interests and future plans (maximum 3 pages);
- a letter detailing your specific qualifications for the position and your career/educational goals (maximum 1 page);
- two letters of recommendation from professors well acquainted with your academic achievements.

The letters are to be submitted separately to the address mentioned below.

The short-listed applicants will be invited for an interview (live or via skype). The application material should be sent by e-mail to Leen.Decin@kuleuven.be and D.E.Heard@leeds.ac.uk at the latest by 30 June 2017.

Only complete applications received by that date will be considered.

More information can be obtained by contacting

Prof. L. Decin
Institute for Astronomy
Department of Physics and Astronomy, K.U. Leuven
Celestijnenlaan 200D, 3001 Heverlee, Belgium
Leen.Decin@kuleuven.be
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Prof. D. Heard
Professor of Atmospheric Chemistry
School of Chemistry
University of Leeds
Leeds
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++44-113-343-6471

See also http://fys.kuleuven.be/ster/vacancies/vacancies

Announcements

Radio Stars: from kHz to THz

The Massachusetts Institute of Technology Haystack Observatory is pleased to announce a three-day workshop "Radio Stars: from kHz to THz", to be held in Westford, Massachusetts, USA from November 1–3, 2017.

The goal of the workshop is to provide a forum for the presentation and discussion of new developments in solar and stellar astrophysics enabled by the latest generation of radio observatories operating from meter to submillimeter wavelengths. We seek to bring together both observers and theorists to stimulate a lively exchange of ideas on how radio wavelength observations provide new and unique insights into the workings of stars.

The workshop will focus on radio emission from both hot and cool stars spanning the main sequence through post-main sequence evolutionary phases. One underlying theme will be how the new technologies that are opening increasing swaths of the electromagnetic spectrum to the studies of stars ("from kHz to THz") are revolutionizing our understanding of stellar astrophysics in the process. We will also look toward the future to identify the needs and wishes of the stellar community for new radio facilities that are planned or underway.

Invited speakers will include: Bin Chen (New Jersey Institute of Technology), Deanne Coppejans (Northwestern University), Ken Gayley (University of Iowa), Gregg Hallinan (Caltech), Jeffrey Linsky (University of Colorado Boulder; tentative), Amy Mioduszewski (NRAO), Hans Olofsson (Chalmers University), Rachel Osten (Space Telescope Science Institute), Ylva Pihlstrom (University of New Mexico), Luis Rodríguez (UNAM), Ian Stevens (University of Birmingham; tentative), and Albert Zijlstra (University of Manchester).

For additional information, or to register, please visit our web site: http://www.haystack.mit.edu/workshop/Radio-Stars2017/. For questions, email: haystars@haystack.mit.edu.

The deadline for abstract submission for contributed talks is July 14. Registration closes on October 2.

We hope to see you at Haystack Observatory in November 2017!

See also http://www.haystack.mit.edu/workshop/Radio-Stars2017/

Fizeau exchange visitors program – call for applications

Dear colleagues!

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff), with priority given to Ph.D. students and young postdocs. Non-EU based missions will only be funded if considered essential by the Fizeau Committee. Applicants are strongly encouraged to seek also partial support from their home or host institutions.

The deadline for applications is June 15. Fellowships can be awarded for missions to be carried out between August and November 2017!

Further informations and application forms can be found at www.european-interferometry.eu

The program is funded by OPTICON/H2020.

Please distribute this message also to potentially interested colleagues outside of your community!

Looking forward to your applications,
Josef Hron & Peter Abraham
(for the European Interferometry Initiative)

See also www.european-interferometry.eu

Feast Fest 2017: Trends in Astronomy

We would like to invite you to attend a one day workshop in honour of Prof. Michael Feast's 90th birthday (celebrated this past December), organized by the South African Astronomical Observatory (SAAO), the University of Cape Town (UCT), and the University of the Western Cape (UWC).

Title: Feast Fest 2017: Trends in Astronomy
Website: http://feastfest.saao.ac.za/
Venue: SAAO
Date: 31 July 2017
Registration deadline: 16 June 2017

The main focus of the meeting is new astronomy with talks covering theory, observation and instrumentation (see http://feastfest.saao.ac.za/programme/ for a draft of the programme). Due to limited funding, the speakers are primarily local researchers from the Western Cape and a few international speakers. The talks will be aimed at Ph.D. students, so please do pass this on to your students and encourage them to register.

Lunch and dinner will be provided and there are no registration fees, however, for logistical and catering purposes, we ask that all attendees register at http://feastfest.saao.ac.za/registration/

We hope that you will all be able to join us!

Kind regards,
Shazrene

See also http://feastfest.saao.ac.za/

Evolved stars with the future Origins Space Telescope

Dear evolved-stars researchers,

Below is an invitation to those of you interested in helping to further develop the evolved-stars science case for the future far-infrared Origins Space Telescope (OST). Your participation would entail helping to clearly define the science goals and, e.g., helping to write white papers showing the relevance of OST to the advancement of our research field.

About OST
The current design study defines a 9m filled-aperture far-infrared telescope, with an expected fly-time in the early-to-mid 2030s. See
https://asd.gsfc.nasa.gov/firs/,
http://origins.ipac.caltech.edu/ and
http://newsletter.stsci.edu/the-origins-space-telescope-mission-study
for some information on this future NASA-led mission. Currently, the mission is planned to carry five instruments:

- a medium-resolution survey spectrometer, operating at 30–800 μm,
- a FIR high-resolution direct detection spectrometer, operating at 25–160 μm,

- a heterodyne receiver, operating at 0.5–2.7 THz (continuously) and some extra narrow windows up to ~ 5 THz,
- a FIR imager/polarimeter, operating in a number of well-defined windows, and
- a MIR imager spectrometer coronagraph. (Caution: All numbers are of course preliminary.)

Evolved-stars science with OST
The evolved-stars science case that we have thus far presented is built around the fundamentals of dust formation in the circumstellar environments of evolved stars. In summary, we wish to observe a (local) sample of circumstellar environments in the far-infrared and sub-millimeter in order to understand the transformation from the gas phase to the solid phase, sampling different chemical types (M, S, C) and a range of densities. There are (at least) two clearly distinguishable facets to this science case:

The gas
The gas in and just above the atmospheres of AGB stars and red supergiants is subject to depletion when seed nuclei form and the dust condenses and grows. Observations of the highly excited gas in these dynamically complex environments need high sensitivity and high spectral resolution, which can easily be attained with a heterodyne receiver. A large instantaneous bandwidth will help to mitigate time-variability in single-epoch observations and monitoring stars over several epochs would give the opportunity to try to understand the time-variability in line excitation and chemistry. We have successfully argued within the core science team for the heterodyne instrument that these environments offer a unique chance to unravel dust formation and that the next-generation heterodyne instrument on OST could play a vital role in achieving our goals.

The dust
Alongside the depletion signatures in the gas, we need to trace the dust particles as they grow. With a spectral reach down to about 25 μm with the high-resolution spectrometer, OST will be able to search for the signatures of the smallest dust clusters. At the same time, it will be able to sample the long-wavelength signatures as, e.g., seen with PACS at higher sensitivity, and higher spectral and spatial resolution.

Combining the above two facets will answer many of the currently open questions around the dust formation and growth and outflow dynamics in the circumstellar environments of evolved stars.

Future of the case
We have already successfully argued the importance of this science case within the OST framework. During a recent workshop, aimed at defining the requirements for the heterodyne instrument, it was quickly concluded by the entire team that the evolved-stars science case is a high-profile case that helps drive the instrument requirements for the heterodyne instrument. Furthermore, the American leads of the OST "Milky Way, ISM and Nearby Galaxies" science-working group (Cara Battersby and Karin Sandstrom; one of a total of six science working groups) have expressed strong interest in and support for our science case. This means that our case has made it onto the list of science cases that will be ranked by the NASA-leads and hopefully taken into the interim report to be submitted to NASA later this year for future approval and rating of the overall OST mission.

I now wish to invite you to be part of and contribute to this science case. For now, this mainly means to help further develop the case based on your observational and theoretical expertise. If you wish to join this effort, I would contact you to write up a white paper on this science case, in your particular field of interest and expertise. The white papers will be requested by NASA, some time later this year, to be included in the 2020 decadal survey, where OST will be presented as future mission.

Please let me know per email (elvire.debeck [at] chalmers.se) if you are interested in joining efforts to unravel the dust puzzle using OST. I will gather all expressions of interest and will communicate and coordinate any further developments of the science case with those of you who wish to join the team.

Best regards,
Elvire De Beck,
as member of the core science team of the OST heterodyne receiver
and coordinator of the evolved-stars science case for OST