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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 215$^{\rm th}$ issue of the AGB Newsletter. We hope you enjoy its contents as much as we do.

It's not a bad time to be looking for a job: whether it's a Ph.D. or postdoc position, in Madrid or Belgium, or more permanent positions in Dublin (Eire).

Consider also the interesting workshop on silicates in space, in Heidelberg. And to remind you of further upcoming meetings: AGB stars session at EWASS (Tenerife, end of June); AGB and red supergiant mass loss in Garching bei München (early July) and various sessions of interest at the IAU General Assembly in Hawai'i in August as well as the Magellanic Clouds meeting in Baltimore early October. We hope to see you somewhere this Summer!

The next issue is planned to be distributed around the 29$^{\rm nd}$ of June.
(Note the early date, due to holidays – yes! – of the editor-in-chief.)

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

Food for Thought

This month's thought-provoking statement is:

Population III AGB stars do not differ from next generation AGB stars

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

Molecular phonons and their absorption/emission spectra from the far IR to microwaves

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Together with fingerprint modes, molecules also carry coherent vibrations of all their atoms (phonons). Phonon spectra extend from about 20 to beyond 10^4 μm, depending on molecular size. These spectra are discrete but large assemblies of molecules of the same family, differing only by minor structural details, will produce continua. As such assemblies are expected to exist in regions where dust accumulates, they are bound to contribute to the observed continua underlying the Unidentified Infrared Bands and the 21-μm band of planetary nebulæ as well as to the diffuse galactic emission surveyed by the *Planck* astronomical satellite and other means. The purpose of this work is to determine the intensity of such continua and their extent into the millimetric range, and to evaluate their detectability in this range. The rules governing the spectral distributions of phonons are derived and shown to differ from those which obtain in the solid state. Their application allow the extinction cross-section per H atom, and its maximum wavelength, to be determined as a function of molecular size and dimensionality. Chemical modeling of more than 15 large molecules illustrate these results. It is found that the maximum phonon wavelength of a 2D structure increases roughly as the square of its larger dimension. Spectral energy distributions were computed as far as 4000 μm, for molecules up to 50 Å in length.

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A double power-law fit to the computed stellar $\log(\tau/\mathrm{y})$–$\log(m/m_\odot)$ relation

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The computed $\log(\tau/\mathrm{y})$–$\log(m/m_\odot)$ relation for the stellar initial mass range, 0.6–120.0, and the stellar initial metallicity range, 0.0004–0.0500, tabulated in an earlier attempt (Portinari et al. 1998) is fitted to a good extent by a four-parameter curve, expressed by a double power-law, for assigned stellar initial metallicity, which can be reduced to a three-parameter curve, expressed by a single power-law, for the whole set of stellar initial metallicities. The relative errors do not exceed about 2% and 4%, respectively. The extent to which the interpolation curve, expressed by a single power-law, can be extrapolated towards both high-mass and low-mass stars, is also investigated. High-mass star lifetimes are understimated by a factor less than 2 up to $m/m_\odot = 1000$ and by a fiducial factor less than 4 up to infinite. Low-mass star lifetimes are overestimated by a factor of about 3 down to $m/m_\odot = 0.25$ and by an unacceptably large factor down to $m/m_\odot = 0.08$. The interpolation curve, expressed by a single power-law, is related (in differential form) to a generalization of the equation of the exponential decay, which could be the starting point for a theoretical interpretation. As a simple application, the star mass fraction of a single star generation with stellar initial mass function defined by a power-law, is plotted vs. the logarithmic stellar lifetime. The star mass fraction declines in time at a decreasing rate for mild stellar initial mass function and at an increasing rate for steep stellar initial mass function, where a linear trend is exhibited for a value of the exponent close to the Salpeter's value, equal to -2.35.

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Simplified models of stellar wind anatomy to interpret high-resolution data. Analytical approach to embedded spiral geometries

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Context: Recent high-resolution observations have shown stellar winds to harbour complexities which strongly deviate from spherical symmetry, generally assumed as standard wind model. One such morphology is the Archimedean spiral, generally believed to be formed by binary interactions, as has been directly observed in multiple sources.
Aims: We seek to investigate the manifestation in the observables of spiral structures embedded in the spherical outflows of cool stars. We aim to provide an intuitive bedrock with which upcoming ALMA data can be compared and interpreted.
Methods: By means of an extended parameter study, we modelled rotational CO emission from the stellar outflow of asymptotic giant branch stars. To this end, we developed a simplified analytical parametrised description of a 3D spiral structure. This model is embedded into a spherical wind and fed into the 3D radiative transfer code LIME, which produces 3D intensity maps throughout velocity space. Subsequently, we investigate the spectral signature of rotational transitions of CO in the models, as well as the spatial aspect of this emission by means of wide-slit position–velocity (PV) diagrams. Additionally, we quantified the potential for misinterpretation of the 3D data in a 1D context. Finally, we simulated ALMA observations to explore the effect of interferometric noise and artefacts on the emission signatures.
Results: The spectral signatures of the CO rotational transition $v = 0$ $J = 3$–2 are very efficient at concealing the dual nature of the outflow. Only a select few parameter combinations allow for the spectral lines to disclose the presence of the spiral structure. The inability to disentangle the spiral from the spherical signal can result in an incorrect interpretation in a 1D context. Consequently, erroneous mass-loss rates would be calculated. The magnitude of these errors is mainly confined to a factor of a few, but in extreme cases can exceed an order of magnitude. CO transitions of different rotationally excited levels show a characteristic evolution in their line shape that can be brought about by an embedded spiral structure. However, if spatial information on the source is also available, the use of wide-slit PV diagrams systematically expose the embedded spiral. The PV diagrams also readily provide most of the geometrical and physical properties of the spiral-harbouring wind. Simulations of ALMA observations prove that the choice of antenna configuration is strongly dependent on the geometrical properties of the spiral. We conclude that exploratory endeavours should observe the object of interest with a range of different maximum-baseline configurations.

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New binaries among UV-selected, hot subdwarf stars and population properties

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We have measured the orbital parameters of seven close binaries, including six new objects, in a radial velocity survey of 38 objects comprising a hot subdwarf star with orbital periods ranging from ~ 0.17 to 3 d. One new system, GALEX J2205−3141, shows reflection on a M dwarf companion. Three other objects show significant short-period variations, but their orbital parameters could not be constrained. Two systems comprising a hot subdwarf paired with a bright main-sequence/giant companion display short-period photometric variations possibly due to irradiation

or stellar activity and are also short-period candidates. All except two candidates were drawn from a selection of subluminous stars in the *Galaxy Evolution Explorer* ultraviolet sky survey. Our new identifications also include a low-mass subdwarf B star and likely progenitor of a low mass white dwarf (GALEX J0805−1058) paired with an unseen, possibly substellar, companion. The mass functions of the newly identified binaries imply minimum secondary masses ranging from 0.03 to 0.39 $M_\odot$. Photometric time series suggest that, apart from GALEX J0805−1058 and J2205−3141, the companions are most likely white dwarfs. We update the binary population statistics: Close to 40 per cent of hot subdwarfs have a companion. Also, we found that the secondary mass distribution shows a low-mass peak attributed to late-type dwarfs, and a higher-mass peak and tail distribution attributed to white dwarfs and a few spectroscopic composites. Also, we found that the population kinematics imply an old age and include a few likely halo population members.

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The abundances of light neutron-capture elements in planetary nebulæ – III. The impact of new atomic data on nebular selenium and krypton abundance determinations

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The detection of neutron(n)-capture elements in several planetary nebulæ (PNe) has provided a new means of investigating s-process nucleosynthesis in low-mass stars. However, a lack of atomic data has inhibited accurate trans-iron element abundance determinations in astrophysical nebulae. Recently, photoionization and recombination data were determined for Se and Kr, the two most widely detected n-capture elements in nebular spectra. We have incorporated these new data into the photoionization code Cloudy. To test the atomic data, numerical models were computed for 15 PNe that exhibit emission lines from multiple Kr ions. We found systematic discrepancies between the predicted and observed emission lines that are most likely caused by inaccurate photoionization and recombination data. These discrepancies were removed by adjusting the Kr^{+}–Kr^{3+} photoionization cross sections within their cited uncertainties and the dielectronic recombination rate coefficients by slightly larger amounts. From grids of models spanning the physical conditions encountered in PNe, we derive new, broadly applicable ionization correction factor (ICF) formulae for calculating Se and Kr elemental abundances. The ICFs were applied to our previous survey of near-infrared [Kr III] and [Se IV] emission lines in 120 PNe. The revised Se and Kr abundances are 0.1–0.3 dex lower than former estimates, with average values of $[\mathrm{Se/(O,Ar)}] = 0.12 \pm 0.27$ and $[\mathrm{Kr/(O,Ar)}] = 0.82 \pm 0.29$, but correlations previously found between their abundances and other nebular and stellar properties are unaffected. We also find a tendency for high-velocity PNe that can be associated with the Galactic thick disk to exhibit larger s-process enrichments than low-velocity PNe belonging to the thin disk population.

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A luminous red Nova in M 31 and its progenitor system

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We present observations of M 31 LRN 2015 (MASTER OT J004207.99+405501.1), discovered in M 31 in 2015 January, and identified as a rare and enigmatic luminous red nova (LRN). Spectroscopic and photometric observations obtained by the Liverpool Telescope showed the LRN becoming extremely red as it faded from its $M_V = -9.4 \pm 0.2$ peak. Early spectra showed strong Hα emission that weakened over time as a number of absorption features appeared, including Na I D and Ba II. At later times strong TiO absorption bands were also seen. A search of archival *Hubble* Space

Telescope data revealed a luminous red source to be the likely progenitor system, with pre-outburst Hα emission also detected in ground-based data. The outburst of M 31 LRN 2015 shows many similarities, both spectroscopically and photometrically, with that of V838 Mon, the best studied LRN. We finally discuss the possible progenitor scenarios.

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The orbital evolution of asteroids, pebbles and planets from giant branch stellar radiation and winds

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The discovery of over 50 planets around evolved stars and more than 35 debris discs orbiting white dwarfs highlight the increasing need to understand small body evolution around both early and asymptotic giant branch (GB) stars. Pebbles and asteroids are susceptible to strong accelerations from the intense luminosity and winds of GB stars. Here, we establish equations that can model time-varying GB stellar radiation, wind drag and mass loss. We derive the complete three-dimensional equations of motion in orbital elements due to (1) the Epstein and Stokes regimes of stellar wind drag, (2) Poynting–Robertson drag, and (3) the Yarkovsky drift with seasonal and diurnal components. We prove through averaging that the potential secular eccentricity and inclination excitation due to Yarkovsky drift can exceed that from Poynting–Robertson drag and radiation pressure by at least three orders of magnitude, possibly flinging asteroids which survive YORP spin-up into a widely dispersed cloud around the resulting white dwarf. The GB Yarkovsky effect alone may change an asteroid's orbital eccentricity by ten per cent in just one Myr. Damping perturbations from stellar wind drag can be just as extreme, but are strongly dependent on the highly uncertain local gas density and mean free path length. We conclude that GB radiative and wind effects must be considered when modelling the post-main-sequence evolution of bodies smaller than about 1000 km.

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Insights into internal effects of common-envelope evolution using the extended *Kepler* mission

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We present an analysis of the binary and physical parameters of a unique pulsating white dwarf with a main-sequence companion, SDSS J1136+0409, observed for more than 77 d during the first pointing of the extended *Kepler* mission: K2 Campaign 1. Using new ground-based spectroscopy, we show that this post-common-envelope binary has an orbital period of 6.89760103(60) hr, which is also seen in the photometry as a result of Doppler beaming and ellipsoidal variations of the secondary. We spectroscopically refine the temperature of the white dwarf to 12330(260) K and its

mass to 0.601(36) $M_\odot$. We detect seven independent pulsation modes in the K2 light curve. A preliminary asteroseismic solution is in reasonable agreement with the spectroscopic atmospheric parameters. Three of the pulsation modes are clearly rotationally split multiplets, which we use to demonstrate that the white dwarf is not synchronously rotating with the orbital period but has a rotation period of 2.49(53) hr. This is faster than any known isolated white dwarf, but slower than almost all white dwarfs measured in non-magnetic cataclysmic variables, the likely future state of this binary.

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The dust mass in $z > 6$ normal star forming galaxies

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We interpret recent ALMA observations of $z > 6$ normal star forming galaxies by means of a semi-numerical method, which couples the output of a cosmological hydrodynamical simulation with a chemical evolution model which accounts for the contribution to dust enrichment from supernovæ, asymptotic giant branch stars and grain growth in the interstellar medium. We find that while stellar sources dominate the dust mass of small galaxies, the higher level of metal enrichment experienced by galaxies with $M_\star > 10^9$ $M_\odot$ allows efficient grain growth, which provides the dominant contribution to the dust mass. Even assuming maximally efficient supernova dust production, the observed dust mass of the $z = 7.5$ galaxy A 1689-zD1 requires very efficient grain growth. This, in turn, implies that in this galaxy the average density of the cold and dense gas, where grain growth occurs, is comparable to that inferred from observations of QSO host galaxies at similar redshifts. Although plausible, the upper limits on the dust continuum emission of galaxies at $6.5 < z < 7.5$ show that these conditions must not apply to the bulk of the high redshift galaxy population.

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A young white dwarf with an infrared excess

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Using observations of *Spitzer*/IRAC, we report the serendipitous discovery of excess infrared emission from a single white dwarf PG 0010+280. At a temperature of 27,220 K and a cooling age of 16 Myr, it is the hottest and youngest white dwarf to display an excess at 3–8 μm. The infrared excess can be fit by either an opaque dust disk within the tidal radius of the white dwarf or a 1300 K blackbody, possibly from an irradiated substellar object or a re-heated giant planet. PG 0010+280 has two unique properties that are different from white dwarfs with a dust disk: (i) relatively low emission at 8 μm and (ii) non-detection of heavy elements in its atmosphere from high-resolution spectroscopic observations with *Keck*/HIRES. The origin of the infrared excess remains unclear.

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The central star candidate of the planetary nebula Sh 2-71: Photometric and spectroscopic variability

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We present the analysis of several newly obtained and archived photometric and spectroscopic datasets of the intriguing and yet poorly understood 13.5-mag central star candidate of the bipolar planetary nebula Sh 2-71. Photometric observations confirmed the previously determined quasi-sinusoidal lightcurve with a period of 68 days and also indicated periodic sharp brightness dips, possibly eclipses, with a period of 17.2 days. In addition, the comparison between U and V lightcurves revealed that the 68-day brightness variations are accompanied by a variable reddening effect of $\Delta E(U-V) = 0.38$. Spectroscopic datasets demonstrated pronounced variations in spectral profiles of Balmer, helium and singly ionised metal lines and indicated that these variations occur on a time-scale of a few days. The most accurate verification to date revealed that spectral variability is not correlated with the 68-day brightness variations. The mean radial velocity of the observed star was measured to be ~ 26 km s^{-1} with an amplitude of ± 40 km s^{-1}. The spectral type was determined to be B8 V through spectral comparison with synthetic and standard spectra. The newly proposed model for the central star candidate is a Be binary with a misaligned precessing disc.

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Discovery of SiCSi in IRC +10°216: A missing link between gas and dust carriers of SiC bonds

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We report the discovery in space of a disilicon species, SiCSi, from observations between 80 and 350 GHz with the IRAM 30m radio telescope. Owing to the close coordination between laboratory experiments and astrophysics, 112 lines have now been detected in the carbon-rich star CW Leo. The derived frequencies yield improved rotational and centrifugal distortion constants up to sixth order. From the line profiles and interferometric maps with the Submillimeter Array, the bulk of the SiCSi emission arises from a region of $6''$ in radius. The derived abundance is comparable to that of SiC_2. As expected from chemical equilibrium calculations, SiCSi and SiC_2 are the most abundant species harboring a SiC bond in the dust formation zone and certainly both play a key role in the formation of SiC dust grains.

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Understanding AGB evolution in Galactic Bulge stars from high-resolution infrared spectroscopy

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An analysis of high-resolution near-infrared spectra of a sample of 45 asymptotic giant branch (AGB) stars towards the Galactic Bulge is presented. The sample consists of two subsamples, a larger one in the inner and intermediate Bulge, and a smaller one in the outer Bulge. The data are analysed with the help of hydrostatic model atmospheres and spectral synthesis. We derive the radial velocity of all stars, and the atmospheric chemical mix ([Fe/H], C/O, $^{12}C/^{13}C$, Al, Si, Ti, and Y) where possible. Our ability to model the spectra is mainly limited by the (in)completeness of atomic and molecular line lists, at least for temperatures down to $T_{\rm eff} \approx 3100$ K. We find that the subsample in the inner and intermediate bulge is quite homogeneous, with a slightly sub-solar mean metallicity and only few stars with super-solar metallicity, in agreement with previous studies of non-variable M-type giants in the Bulge. All sample stars are oxygen-rich, C/O$<$ 1.0. The C/O and carbon isotopic ratios suggest that third dredge-up (3DUP) is absent among the sample stars, except for two stars in the outer Bulge that are known to contain technetium. These stars are also more metal-poor than the stars in the intermediate or inner Bulge. Current stellar masses are determined from linear pulsation models. The masses, metallicities and 3DUP behaviour are compared to AGB evolutionary models. We conclude that these models are partly in conflict with our observations. Furthermore, we conclude that the stars in the inner and intermediate bulge belong to a more metal-rich population that follows bar-like kinematics, whereas the stars in the outer bulge belong to the metal-poor, spheroidal bulge population.

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SAGE-Var: An infrared survey of variability in the Magellanic Clouds

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We present the first results from the SAGE-Var program, a follow on to the *Spitzer* legacy program "Surveying the Agents of Galaxy Evolution" (SAGE; Meixner et al. 2006). We obtained 4 epochs of photometry at 3.6 & 4.5 μm covering the bar of the Large Magellanic Cloud (LMC) and the central region of the Small Magellanic Cloud (SMC) in order to probe the variability of extremely red sources missed by variability surveys conducted at shorter wavelengths, and to provide additional epochs of observation for known variables. Our 6 total epochs of observations allow us to probe infrared variability on 15 different timescales ranging from $\sim$ 20 days to $\sim$ 5 years. Out of a full catalog of

1,717,554 (LMC) and 457,760 (SMC) objects, we find 10 (LMC) and 6 (SMC) large amplitude AGB variables without optically measured variability owing to circumstellar dust obscuration. The catalog also contains multiple observations of known AGB variables, type I and II Cepheids, eclipsing variables, R CrB stars and young stellar objects which will be discussed in following papers. Here we present infrared Period–Luminosity (PL) relations for classical Cepheids in the Magellanic Clouds, as well as improved PL relationships for AGB stars pulsating in the fundamental mode using mean magnitudes constructed from 6 epochs of observations.

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IRAS 19135+3937: An SRd variable as interacting binary surrounded by a circumbinary disc

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Semi-regular (SR) variables are not a homogeneous class and their variability is often explained due to pulsations and/or binarity. This study focuses on IRAS 19135+3937 (IRAS 19135), an SRd variable with an infra-red excess indicative of a dusty disc.
A time-series of high-resolution spectra, UBV-photometry as well as a very accurate light curve obtained by the *Kepler* satellite, allowed us to study the object in unprecedented detail. We discovered it to be a binary with a period of 127 days. The primary has a low surface gravity and an atmosphere depleted in refractory elements. This combination of properties unambiguously places IRAS 19135, in the subclass of post-Asymptotic Giant Branch stars with dusty discs. We show that the light variations in this object can not be due to pulsations, but are likely caused by the obscuration of the primary by the circumbinary disc during orbital motion. Furthermore, we argue that the double-peaked Fe emission lines provide evidence for the existence of a gaseous circumbinary Keplerian disc inside the dusty disc. A secondary set of absorption lines has been detected near light minimum, which we attribute to the reflected spectrum of the primary on the disc wall, which segregates due to the different Doppler shift. This corroborates the recent finding that reflection in the optical by this type of discs is very efficient. The system also shows a variable Hα profile indicating a collimated outflow originating around the companion. IRAS 19135 thus encompasses all the major emergent trends about evolved disc systems, that will eventually help to place these objects in the evolutionary context.

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Determining the nature of faint X-ray sources from the ASCA Galactic Center Survey

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We present the results of the the identification of six objects from the ASCA Galactic Center and Galactic Plane Surveys: AX J173548−3207, AX J173628−3141, AX J1739.5−2910, AX J1740.4−2856, AX J1740.5−2937, and AX J1743.9 −2846. *Chandra*, XMM–*Newton*, and XRT/Swift X-ray data have been used to improve the positions of the optical counterparts to these sources. Thereafter, we have carried out a series of spectroscopic observations of the established optical counterparts at the RTT-150 telescope. Analysis of X-ray and optical spectra as well as photometric measurements in a wide wavelength range based on optical and infrared catalogs has allowed the nature of the program sources to be determined. Two X-ray objects have been detected in the error circle of AX J173628−3141: one is a coronally active G star and the other may be a symbiotic star, a red giant with an accreting white dwarf. Three sources (AX J1739.5−2910, AX J1740.5−2937, AX J1743.9−2846) have turned out to be active G–K stars, presumably RS CVn objects, one (AX J1740.4−2856) is an M dwarf, and another one (AX J173548−3207) most likely a low-mass X-ray binary in its low state. The distances and corresponding luminosities of the sources in the soft X-ray band (0.5–10 keV) have been estimated; analysis of deep INTEGRAL Galactic Center observations has not revealed a statistically significant flux at energies > 20 keV from any of them.

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Herschel observations of extreme OH/IR stars – the isotopic ratios of oxygen as a sign-post for the stellar mass

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Aims: The late stages of stellar evolution are mainly governed by the mass of the stars. Low- and intermediate-mass stars lose copious amounts of mass during the asymptotic giant branch (AGB) which obscure the central star making it difficult to study the stellar spectra and determine the stellar mass. In this study, we present observational data that can be used to determine lower limits to the stellar mass.
Methods: Spectra of nine heavily reddened AGB stars taken by the *Herschel* Space Observatory display numerous molecular emission lines. The strongest emission lines are due to H_2O. We search for the presence of isotopologues of H_2O in these objects.
Results: We detected the ^{16}O and ^{17}O isotopologues of water in these stars, but lines due to $H_2^{18}O$ are absent. The lack of ^{18}O is predicted by a scenario where the star has undergone hot-bottom burning which preferentially destroys ^{18}O relative to ^{16}O and ^{17}O. From stellar evolution calculations, this process is thought to occur when the stellar mass is above 5 $M_\odot$ for solar metallicity. Hence, observations of different isotopologues of H_2O can be used to help determine the lower limit to the initial stellar mass.
Conclusions: From our observations, we deduce that these extreme OH/IR stars are intermediate-mass stars with masses of ≥ 5 $M_\odot$. Their high mass-loss rates of $\sim 10^{-4}$ $M_\odot$ yr^{-1} may affect the enrichment of the interstellar medium and the overall chemical evolution of our Galaxy.

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A new survey of cool supergiants in the Magellanic Clouds

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In this study we conduct a pilot program aimed at the red supergiant population of the Magellanic Clouds. We intend to extend the current known sample to the unexplored low end of the brightness distribution of these stars, aiming at the frontier between supergiants and AGB stars, so to build a more representative dataset with which to extrapolate their behaviour to other Galactic and extra-galactic environments.

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and from http://www.aanda.org/articles/aa/abs/2015/06/aa25362-14/aa25362-14.html

Formation of planetary debris discs around white dwarfs II: Shrinking extremely eccentric collisionless rings

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The formation channel of the tens of compact debris discs which orbit white dwarfs (WDs) at a distance of one Solar radius remains unknown. Asteroids that survive the giant branch stellar phases beyond a few au are assumed to be dynamically thrust towards the WD and tidally disrupted within its Roche radius, generating extremely eccentric ($e > 0.98$) rings. Here, we establish that WD radiation compresses and circularizes the orbits of super-μm to cm-sized ring constituents to entirely within the WD's Roche radius. We derive a closed algebraic formula which well-approximates the shrinking time as a function of WD cooling age, the physical properties of the star and the physical and orbital properties of the ring particles. The shrinking timescale increases with both particle size and cooling age, yielding age-dependent WD debris disc size distributions.

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What is the shell around R Coronæ Borealis?

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The hydrogen-deficient, carbon-rich R Coronæ Borealis (RCB) stars are known for being prolific producers of dust which causes their large iconic declines in brightness. Several RCB stars, including R CrB, itself, have large extended dust shells seen in the far-infrared. The origin of these shells is uncertain but they may give us clues to the evolution of the RCB stars. The shells could form in three possible ways. 1) they are fossil Planetary Nebula (PN) shells, which would exist if RCB stars are the result of a final, helium-shell flash, 2) they are material left over from a white-dwarf merger event which formed the RCB stars, or 3) they are material lost from the star during the RCB phase. Arecibo 21-cm observations establish an upper limit on the column density of H I in the R CrB shell implying a maximum shell mass of $\lesssim$0.3 $M_\odot$. A low-mass fossil PN shell is still a possible source of the shell although it may not contain enough dust. The mass of gas lost during a white-dwarf merger event will not condense enough dust to produce the observed shell, assuming a reasonable gas-to-dust ratio. The third scenario where the shell around R CrB has been produced during the star's RCB phase seems most likely to produce the observed mass of dust and the observed size of the shell. But this means that R CrB has been in its RCB phase for $\sim 10^4$ yr.

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Probing hypergiant mass loss with adaptive optics imaging & polarimetry in the infrared: MMT-Pol and LMIRCAM observations of IRC +10°420 & VY Canis Majoris

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We present 2–5 μm adaptive optics (AO) imaging and polarimetry of the famous hypergiant stars IRC +10°420 and VY Canis Majoris. The imaging polarimetry of IRC +10°420 with MMT-Pol at 2.2 μm resolves nebular emission with intrinsic polarization of 30%, with a high surface brightness indicating optically thick scattering. The relatively uniform distribution of this polarized emission both radially and azimuthally around the star confirms previous studies that place the scattering dust largely in the plane of the sky. Using constraints on scattered light consistent with the polarimetry at 2.2 μm, extrapolation to wavelengths in the 3–5-μm band predicts a scattered light component significantly below the nebular flux that is observed in our LBT/LMIRCam 3–5-μm AO imaging. Under the assumption this excess emission is thermal, we find a color temperature of $\sim$ 500 K is required, well in excess of the emissivity-modified equilibrium temperature for typical astrophysical dust. The nebular features of VY CMa are found to be highly polarized (up to 60%) at 1.3 μm, again with optically thick scattering required to reproduce the observed surface brightness. This star's peculiar nebular feature dubbed the "Southwest Clump" is clearly detected in the 3.1 μm polarimetry as well, which, unlike IRC +10°420, is consistent with scattered light alone. The high intrinsic polarizations of both hypergiants' nebulæ are compatible with optically thick scattering for typical dust around evolved dusty stars, where the depolarizing effect of multiple scatters is mitigated by the grains' low albedos.

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Spitzer Infrared Spectrograph point source classification in the Small Magellanic Cloud

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The Magellanic clouds are uniquely placed to study the stellar contribution to dust emission. Individual stars can be resolved in these systems even in the mid-infrared, and they are close enough to allow detection of infrared excess caused by dust. We have searched the *Spitzer* Space Telescope data archive for all Infrared Spectrograph (IRS) staring-mode observations of the Small Magellanic Cloud (SMC) and found that 209 Infrared Array Camera (IRAC) point sources within the footprint of the Surveying the Agents of Galaxy Evolution in the Small Magellanic Cloud (SAGE-SMC) *Spitzer* Legacy programme were targeted, within a total of 311 staring mode observations. We classify these point sources using a decision tree method of object classification, based on infrared spectral features, continuum and spectral energy distribution shape, bolometric luminosity, cluster membership and variability information. We find 58 asymptotic giant branch (AGB) stars, 51 young stellar objects (YSOs), 4 post-AGB objects, 22 Red Supergiants (RSGs), 27 stars (of which 23 are dusty OB stars), 24 planetary nebulæ (PNe), 10 Wolf–Rayet (WR) stars, 3 H II regions, 3 R Coronæ Borealis (R CrB) stars, 1 Blue Supergiant and 6 other objects, including 2 foreground AGB stars. We use these classifications to evaluate the success of photometric classification methods reported in the literature.

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Conference Paper

Wind acceleration in AGB stars: Solid ground & loose ends

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The winds of cool luminous AGB stars are commonly assumed to be driven by radiative acceleration of dust grains which form in the extended atmospheres produced by pulsation-induced shock waves. The dust particles gain momentum by absorption or scattering of stellar photons, and they drag along the surrounding gas particles through collisions, triggering an outflow. This scenario, here referred to as Pulsation-Enhanced Dust-DRiven Outflow (PEDDRO), has passed a range of critical observational tests as models have developed from empirical and qualitative to increasingly self-consistent and quantitative. A reliable theory of mass loss is an essential piece in the bigger picture of stellar and galactic chemical evolution, and central for determining the contribution of AGB stars to the dust budget of galaxies. In this review, I discuss the current understanding of wind acceleration and indicate areas where further efforts by theorists and observers are needed.

Oral contribution, published in "Why Galaxies Care About AGB Stars III", eds. F. Kerschbaum, J. Hron & R. Wing, ASP Conference Series (Invited Review)
Available from arXiv:1505.07425

Job Adverts

Universidad Autónoma de Madrid 1 Ph.D. and a postdoc position

Applications are invited for a 2-year postdoctoral position (1+1yr after positive evaluation) and a 4-year Ph.D. position at the Department of Theoretical Physics from the Universidad Autónoma de Madrid (UAM). The successful candidates will be hired under the project "From stones to planets and back to rocks: understanding planet formation and destruction" (AYA2014-55840-P), lead by Eva Villaver and Gwendolyn Meeus and funded by the Spanish National Plan of R&D. The research will depend on the experience of the candidate, but should focus on either:

- How the structure of protoplanetary and debris discs depends on the presence of planets.
- How stellar evolution affects the architecture of planetary systems.

The methods can either be observational or theoretical. We are seeking a highly motivated researcher with experience in some of the following areas: protoplanetary or debris disc modelling, stellar evolution, detection of planets, or high spatial/spectral resolution disc observations (e.g., with ALMA).

Postdoctoral applicants must have obtained their Ph.D. in Astrophysics or Physics and have a doctoral certificate at the moment of appointment, while the doctoral candidate must have a Master in Astrophysics or Physics at that time. Ideally the position will start in fall of 2015, but a later start is also possible. Applicants should send their CV with publication list, along with a cover letter briefly describing research interests and achievements, and arrange for two recommendation letters to be sent to eva.villaver@uam.es and gwendolyn.meeus@uam.es by July 20$^{\text{th}}$, 2015.

The contracts include medical insurance under the Spanish National Health Service which also cover your accompanying partner and children, if relevant.

Our group is also a host for Marie S. Curie fellowships, and can provide administrative support for those wishing to apply.

Located in Madrid, Spain, the Department of Theoretical Physics at UAM offers a rich atmosphere in front-line physics research, ranging from Particle Physics (both theoretical and experimental), Nuclear Physics, Neuroscience, Experimental High-Energy Physics, to Astrophysics. The Astrophysics group at the department carries out research on Cosmology, Galactic and Extra-galactic Astrophysics, and runs a Master Ph.D. program in Astrophysics. Further information about UAM's Department of Theoretical Physics is available via the Internet on the UAM Web page (www.ft.uam.es). Close collaboration with the Centre for Astrobiology (CAB) and the ESA European Space Astronomy Centre (ESAC), also located in Madrid, is ongoing.

See also www.ft.uam.es

Université libre de Bruxelles & Katholieke Universiteit Leuven & Royal Observatory of Belgium
3 (co-supervised) Ph.D. positions (Reminder)

Three Ph.D. positions are open in the framework of the STARLAB project (see website below for a short description) involving the Institut d'Astronomie of the Université libre de Bruxelles, the Royal Observatory of Belgium, and the Instituut voor Sterrenkunde of the Katholieke Universiteit Leuven, all located within 25 kms of each other in central Belgium.

The goal of the STARLAB project is to improve our understanding of key physical and chemical processes at work in single and binary low- and intermediate-mass stars. A first Ph.D. project is focused on abundance determinations in late-type stars as tracers for nucleosynthesis and mixing processes, another on binary-star interaction physics, and the third one on the study of the circumstellar environment of late-type mass-losing stars as tracers for the mass loss processes.

See also http://www.astro.ulb.ac.be/pmwiki/BRAIN/PhD

Institut d'Astronomie et d'Astrophysique, Université libre de Bruxelles
Post-doc position (Reminder)

Applications are invited for a Postdoctoral Research Position at the Institute of Astronomy and Astrophysics of the Université libre de Bruxelles, Belgium (http://www.astro.ulb.ac.be), in the framework of the project "Extrinsic stars in the Gaia era". Gaia–ESO (GES) is a public spectroscopic survey, targeting more than 105 stars, systematically covering all major components of the Milky Way, from Halo to star-forming regions, providing a homogeneous overview of the distributions of kinematics and elemental abundances, thus complementing the Gaia data. It uses the Very Large Telescope FLAMES instrument.

The main scientific interests of the IAA group are detailed abundances in late-type stars, stellar evolution, binary star evolution and nucleosynthesis. The group is strongly involved in the Gaia–ESO Survey and moreover has a privileged access to the HERMES high-resolution spectrograph. The successful applicant will participate in a research project entitled "Extrinsic stars in the Gaia era" and will work in the GES consortium, in particular in WG14 in charge of non-standard objects. He/she will be involved in spectroscopic binary detection as well as detection and analysis of non-standard objects within the GES and possibly HERMES.

See also http://www.astro.ulb.ac.be//pmwiki/pub/Post-doc-GES.pdf

Trinity College Dublin, Ireland
Up to Two Assistant Professorships in Solar or Stellar Astrophysics

Trinity College Dublin seeks applications for one and potentially two Assistant Professorships in Solar or Stellar Astrophysics. The successful candidate(s) will have a Ph.D. and a proven post-doctoral track record in areas that complement and extend existing research in the School of Physics' solar and stellar physics research groups (http://www.physics.tcd.ie/astrophysics). Areas of potential interest include space weather, solar-terrestrial physics and evolved stars, including theoretical modelling of solar and stellar atmospheres, but candidates with expertise in other areas of numerical modelling are also encouraged to apply.

One permanent appointment will be made and a second position may be filled subject to the successful candidate having secured funding from an external funding agency. The second appointment will be a fixed-term contract of up to five years (depending on the funding available).

The deadline for applications is 12 noon on Thursday, 25 June 2015.

The School of Physics has been awarded Institute of Physics Juno Practitioner status for taking action to address gender inequities across its student and staff body. It is committed to promoting better working practices for men and women. The School welcomes applications from all qualified applicants, and applications are particularly encouraged from traditionally under-represented groups in Physics.

Further details can be found at https://jobs.tcd.ie (search under keyword "Astrophysics").

See also https://jobs.tcd.ie

Announcement

Silicates in Space

A workshop held at Heidelberg University, Sept. 28 – Oct. 1, 2015

Silicates are one of the most abundant dust components in circum- and interstellar environments. Diverse evidences and facts on silicate dust in space have been provided by observations, particularly by infrared spectroscopy and the comparison of astronomical with simulated and experimentally measured spectra. Condensation experiments as well as model calculations have been carried out in order to study the formation and processing of silicate dust grains. This workshop aims for exchanging, gaining, and enlarging knowledge and information from participants working in different fields (experimental, observational, theoretical) in order to deepen our understanding with regards to silicate dust grains.

The meeting is organized by: A. Tamanai, R. Dohmen, H.-P. Gail, H. Mutschke, M. Trieloff. The workshop will be held at the Kirchhoff Institute for Physics at University of Heidelberg, Germany.

The registration is now open.

See also http://www.kip.uni-heidelberg.de/spp1385/