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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 175$^{\rm th}$ issue of the AGB Newsletter, with lots to enjoy.

Congratulations to Elvire De Beck for a beautiful Ph.D. thesis on circumstellar envelopes. We wish her all the best.

Those who do not yet have a Ph.D. may find the opportunities in Switzerland attractive, and those who do have a Ph.D. may be interested in the job opening in the Czech Republic – both great places and projects.

It is not yet too late to register for the workshop on mass return from stars to galaxies, at STScI in March, but abstracts need to be in by 3 February (!): http://www.stsci.edu/institute/conference/mass-loss-return

Following suggestions how to make the newsletter a more efficient discussion forum without invoking social network media, we would like to encourage the community to exploit the newsletter's "announcement" type of submission which can be (almost) anything from announcing a new result, asking for supporting observations, suggesting an idea for discussion, reacting to results or ideas published elsewhere, et cetera.

Some reactions were received to the question whether there is a place for spirituality in science. It was argued that "spirituality", and "soul", are based on belief not scientific methods, though allowance should be made for human emotions such as passion (and presumably also "suspicion"?). On the other hand, if human perception and thought are based on the laws of physics then our imagination should perhaps be granted some degree of "reality"?

The next issue is planned to be distributed around the 1$^{\rm st}$ of March

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Are dust estimates consistent with gas abundances?

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

Refereed Journal Papers

Solid-phase C_{60} in the peculiar binary XX Ophiuchi?

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We present infrared spectra of the binary XX Ophiuchi obtained with the Infrared Spectrograph on the *Spitzer* Space Telescope. The data show some evidence for the presence of solid C_{60} – the first detection of C_{60} in the solid phase – together with the well-known "Unidentified Infrared" emission features. We suggest that, in the case of XX Oph, the C_{60} is located close to the hot component, and that in general it is preferentially excited by stars having effective temperatures in the range 15 000–30 000 K. C_{60} may be common in circumstellar environments, but un-noticed in the absence of a suitable exciting source.

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Habitability of super-Earth planets around main-sequence stars including red giant branch evolution: Models based on the integrated system approach

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In a previous study published in Astrobiology, we focused on the evolution of habitability of a 10 M_E super-Earth planet orbiting a star akin to the Sun. This study was based on a concept of planetary habitability in accordance to the integrated system approach that describes the photosynthetic biomass production taking into account a variety of climatological, biogeochemical, and geodynamical processes. In the present study, we pursue a significant augmentation of our previous work by considering stars with zero-age main-sequence masses between 0.5 and 2.0 $M_\odot$ with special emphasis on models of 0.8, 0.9, 1.2 and 1.5 $M_\odot$. Our models of habitability consider again geodynamical processes during the main-sequence stage of these stars as well as during their red giant branch evolution. Pertaining to the different types of stars, we identify so-called photosynthesis-sustaining habitable zones (pHZ) determined by the limits of biological productivity on the planetary surface. We obtain various sets of solutions consistent with the principal possibility of life. Considering that stars of relatively high masses depart from the main-sequence much earlier than low-mass stars, it is found that the biospheric life-span of super-Earth planets of stars with masses above approximately 1.5 $M_\odot$ is always limited by the increase in stellar luminosity. However, for stars with masses below 0.9 $M_\odot$, the life-span of super-Earths is solely determined by the geodynamic time-scale. For central star masses between 0.9 and 1.5 $M_\odot$, the possibility of life in the framework of our models depends on the relative continental area of the super-Earth planet.

Published in International Journal of Astrobiology
Available from arXiv:1107.5714

New evidence supporting cluster membership for the keystone calibrator δ Cephei

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New and existing $UBVJHK_s$, spectroscopic, NOMAD, HST, and revised HIP observations are employed to determine properties for δ Cep and its host star cluster. The multi-faceted approach ensured that uncertainties were mitigated ($\sim$ 2%). The following fundamental parameters were inferred for δ Cep: $E(B-V) = 0.073 \pm 0.018$ mag, $\log(t) = 7.9 \pm 0.1$, and $d = 272 \pm 3$(se)± 5(sd) pc. The cluster exhibits a turnoff near B6 ($M_\star/M_\odot \sim 5$), and the brightest host cluster members are the supergiants ζ Cep (K1.5Ib) and δ Cep. To within the uncertainties, the two stars share common astrometric parameters (π, $\mu_{\rm ra}$, $\mu_{\rm dec}$, $RV \sim -17$ km s^{-1}) and are tied to bluer members via the evolutionary track implied by the cluster's $UBVJHK_s$ color–color and color–magnitude diagrams. The cluster's existence is bolstered by the absence of an early-type sequence in color-magnitude diagrams for comparison fields. NOMAD data provided a means to identify potential cluster members ($n \sim 30$) and double the existing sample. That number could increase with forthcoming precise proper motions (DASCH) for fainter main-sequence stars associated with classical Cepheids (e.g., δ Cep), which may invariably foster efforts to strengthen the Galactic Cepheid calibration and reduce uncertainties tied to H_0.

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The period change of the Cepheid Polaris suggests enhanced mass loss

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Polaris is one of the most observed stars in the night sky, with recorded observations spanning more than 200 years. From these observations, one can study the real-time evolution of Polaris via the secular rate of change of the pulsation period. However, the measurements of the rate of period change do not agree with predictions from state-of-the-art stellar evolution models. We show that this may imply that Polaris is currently losing mass at a rate of $\dot{M} \approx 10^{-6}$ $M_\odot$ yr^{-1} based on the difference between modeled and observed rates of period change, consistent with pulsation-enhanced Cepheid mass loss. A relation between the rate of period change and mass loss has important implications for understanding stellar evolution and pulsation, and provides insight into the current Cepheid mass discrepancy.

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Eccentric ellipsoidal red giant binaries in the LMC: Complete orbital solutions and comments on Interaction at periastron

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Modelling ellipsoidal variables with known distances can lead to exact determination of the masses of both components, even in the absence of eclipses. We present such modelling using light and radial velocity curves of ellipsoidal red giant binaries in the LMC, where they are also known as sequence E stars. Stars were selected as likely eccentric systems on

the basis of light curve shape alone. We have confirmed their eccentric nature and obtained system parameters using the Wilson–Devinney code. Most stars in our sample exhibit unequal light maxima as well as minima, a phenomenon not observed in sequence E variables with circular orbits. We find evidence that the shape of the red giant changes throughout the orbit due to the high eccentricity and the varying influence of the companion. Brief intervals of pulsation are apparent in two of the red giants. We determine pulsation modes and comment on their placement in the period–luminosity plane. Defining the parameters of these systems paves the way for modelling to determine by what mechanism eccentricity is maintained in evolved binaries.

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On the physical structure of IRC +10 216. Ground-based and *Herschel* observations of CO and C_2H

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Context: The carbon-rich asymptotic giant branch star IRC +10 216 undergoes strong mass loss, and quasi-periodic enhancements of the density of the circumstellar matter have previously been reported. The star's circumstellar environment is a well-studied, and complex astrochemical laboratory, with many molecular species proved to be present. CO is ubiquitous in the circumstellar envelope, while emission from the ethynyl (C_2H) radical is detected in a spatially confined shell around IRC +10 216. As reported in this article, we recently detected unexpectedly strong emission from the N = 4–3, 6–5, 7–6, 8–7, and 9–8 transitions of C_2H with the IRAM 30-m telescope and with *Herschel*/HIFI, challenging the available chemical and physical models.
Aims: We aim to constrain the physical properties of the circumstellar envelope of IRC +10 216, including the effect of episodic mass loss on the observed emission lines. In particular, we aim to determine the excitation region and conditions of C_2H, in order to explain the recent detections, and to reconcile these with interferometric maps of the N = 1–0 transition of C_2H.
Methods: Using radiative-transfer modelling, we provide a physical description of the circumstellar envelope of IRC +10 216, constrained by the spectral-energy distribution and a sample of 20 high-resolution and 29 low-resolution CO lines – to date, the largest modelled range of CO lines towards an evolved star. We further present the most detailed radiative-transfer analysis of C_2H that has been done so far.
Results: Assuming a distance of 150 pc to IRC +10 216, the spectral-energy distribution is modelled with a stellar luminosity of 11300 $L_\odot$ and a dust-mass-loss rate of 4.0×10^{-8} $M_\odot$ yr^{-1}. Based on the analysis of the 20 high-frequency-resolution CO observations, an average gas-mass-loss rate for the last 1000 years of 1.5×10^{-5} $M_\odot$ yr^{-1} is derived. This results in a gas-to-dust-mass ratio of 375, typical for this type of star. The kinetic temperature

throughout the circumstellar envelope is characterised by three powerlaws: $T_{\rm kin}(r) \propto r^{-0.58}$ for radii $r \leq 9$ stellar radii, $T_{\rm kin}(r) \propto r^{-0.40}$ for radii $9 \leq r \leq 65$ stellar radii, and $T_{\rm kin}(r) \propto r^{-1.20}$ for radii $r \geq 65$ stellar radii. This model successfully describes all 49 observed CO lines. We also show the effect of density enhancements in the wind of IRC +10 216 on the C_2H-abundance profile, and the close agreement we find of the model predictions with interferometric maps of the C_2H $N = 1$–0 transition and with the rotational lines observed with the IRAM 30 m telescope and *Herschel*/HIFI. We report on the importance of radiative pumping to the vibrationally excited levels of C_2H and the significant effect this pumping mechanism has on the excitation of all levels of the C_2H-molecule.

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The link between planetary systems, dusty white dwarfs, and polluted white dwarfs

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It has long been suspected that metal-polluted white dwarfs (types DAZ, DBZ, and DZ) and white dwarfs with dusty disks possess planetary systems, but a specific physical mechanism by which planetesimals are perturbed close to a white dwarf has not yet been fully posited. In this paper we demonstrate that mass loss from a central star during post main sequence evolution can sweep planetesimals into interior mean motion resonances with a single giant planet. These planetesimals are slowly removed through chaotic excursions of eccentricity that in time create radial orbits capable of tidally disrupting the planetesimal. Numerical N-body simulations of the Solar System show that a sufficient number of planetesimals are perturbed to explain white dwarfs with both dust and metal pollution, provided other white dwarfs have more massive relic asteroid belts. Our scenario requires only one Jupiter-sized planet and a sufficient number of asteroids near its 2:1 interior mean motion resonance. Finally, we show that once a planetesimal is perturbed into a tidal crossing orbit, it will become disrupted after the first pass of the white dwarf, where a highly eccentric stream of debris forms the main reservoir for dust producing collisions. These simulations, in concert with observations of white dwarfs, place interesting limits on the frequency of planetary systems around main sequence stars, the frequency of planetesimal belts, and the probability that dust may obscure future terrestrial planet finding missions.

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The Galactic R Coronae Borealis stars: the C_2 Swan bands, the carbon problem, and the $^{12}C/^{13}C$ ratio

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Observed spectra of R Coronae Borealis (RCB) and hydrogen-deficient carbon (HdC) stars are analysed by synthesizing the C_2 Swan bands (1,0), (0,0), and (0,1) using our detailed line list and the Uppsala model atmospheres. The (0,1) and (0,0) C_2 bands are used to derive the ^{12}C abundance, and the (1,0) $^{12}C^{13}C$ band to determine the $^{12}C/^{13}C$ ratios. The carbon abundance derived from the C_2 Swan bands is about the same for the adopted models constructed with different carbon abundances over the range: 8.5 (C/He = 0.1%), to 10.5 (C/He = 10%). Carbon abundances derived from C I lines are about a factor of 4 lower than the carbon abundance of the adopted model atmosphere over the

same C/He interval, as reported by Asplund et al. (2000), who dubbed the mismatch between adopted and derived C abundance the "carbon problem". In principle, the carbon abundances obtained from C_2 Swan bands and that assumed for the model atmosphere can be equated for a particular choice of C/He that varies from star to star. Then, the carbon problem for C_2 bands is eliminated. However, such C/He ratios are in general less than those of the EHe stars, the seemingly natural relatives to the RCB and HdC stars. A more likely solution to the C_2 carbon problem may lie in a modification of the model atmosphere's temperature structure. The derived carbon abundances and the $^{12}C/^{13}C$ ratios are discussed in light of the double degenerate (DD) and the final flash (FF) scenarios.

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A trio of metal-rich dust and gas disks found orbiting candidate white dwarfs with K-band excess

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This paper reports follow-up photometric and spectroscopic observations, including warm *Spitzer* IRAC photometry of seven white dwarfs from the SDSS with apparent excess flux in UKIDSS K-band observations. Six of the science targets were selected from 16,785 DA star candidates identified either spectroscopically or photometrically within SDSS DR7, spatially cross-correlated with HK detections in UKIDSS DR8. Thus the selection criteria are completely independent of stellar mass, effective temperature above 8000 K, and the presence (or absence) of atmospheric metals. The infrared fluxes of one target are compatible with a spatially-unresolved late M or early L-type companion, while three stars exhibit excess emissions consistent with warm circumstellar dust. These latter targets have spectral energy distributions similar to known dusty white dwarfs with high fractional infrared luminosities (thus the K-band excesses). Optical spectroscopy reveals the stars with disk-like excesses are polluted with heavy elements, denoting the ongoing accretion of circumstellar material. One of the disks exhibits a gaseous component − the fourth reported to date − and orbits a relatively cool star, indicating the gas is produced via collisions as opposed to sublimation, supporting the picture of a recent event. The resulting statistics yield a lower limit of 0.8% for the fraction dust disks at DA-type white dwarfs with cooling ages less than 1 Gyr. Two overall results are noteworthy: all stars whose excess infrared emission is consistent with dust are metal-rich; and no stars warmer than 25,000 K are found to have this type of excess, despite sufficient sensitivity.

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The Solar System's post-main sequence escape boundary

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The Sun will eventually lose about half of its current mass nonlinearly over several phases of post-main sequence evolution. This mass loss will cause any surviving orbiting body to increase its semimajor axis and perhaps vary its eccentricity. Here, we use a range of Solar models spanning plausible evolutionary sequences and assume isotropic mass loss to assess the possibility of escape from the Solar System. We find that the critical semimajor axis in the Solar System within which an orbiting body is guaranteed to remain bound to the dying Sun due to perturbations from stellar mass loss alone is approximately 1,000 AU − 10,000 AU. The fate of objects near or beyond this critical semimajor axis, such as the Oort Cloud, outer scattered disc and specific bodies such as Sedna, will significantly

depend on their locations along their orbits when the Sun turns off of the main sequence. These results are applicable to any exoplanetary system containing a single star with a mass, metallicity and age which are approximately equal to the Sun's, and suggest that few extrasolar Oort Clouds could survive post-main sequence evolution intact.

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Two-component Galactic Bulge probed with renewed galactic chemical evolution model

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Results of recent observations of the Galactic Bulge demand that we discard a simple picture of its formation, suggesting the presence of two stellar populations represented by two peaks of stellar metallicity distribution (MDF) in the bulge. To assess this issue, we construct Galactic chemical evolution models that have been updated in two respects: First, the delay time distribution (DTD) of type Ia supernovae (SNe Ia) recently revealed by extensive SN Ia surveys is incorporated into the models. Second, the nucleosynthesis clock, the s-processing in asymptotic giant branch (AGB) stars, is carefully considered in this study. This novel model first shows that the Galaxy feature tagged by the key elements, Mg, Fe, Ba for the Bulge as well as thin and thick disks is compatible with a short-delay SN Ia. We present a successful modeling of a two-component Bulge including the MDF and the evolutions of [Mg/Fe] and [Ba/Mg], and reveal its origin as follows. A metal-poor component ($\langle [Fe/H] \rangle \sim -0.5$) is formed with a relatively short timescale of ~ 1 Gyr. These properties are identical to the thick disk's characteristics in the solar vicinity. Subsequently from its remaining gas mixed with a gas flow from the disk outside the Bulge, a metal-rich component ($\langle [Fe/H] \rangle \sim +0.3$) is formed with a longer timescale (~ 4 Gyr) together with a top-heavy initial mass function that might be identified with the thin disk component within the Bulge.

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Rotten Egg Nebula: The magnetic field of a binary evolved star

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Most of PNe are not spherical. The loss of spherical symmetry occurs somewhere between the AGB and PN phase. The cause of this change of morphology is not yet well known, but magnetic fields are one of the possible agents. Its origin remains to be determined, and potentially requires the presence of a massive companion to the AGB star. Therefore, further detections of the magnetic field around evolved stars (in particular those thought to be part of a binary system) are crucial to improve our understanding of the origin and role of magnetism on evolved stars. One such binaries is the pre-PN OH 231.8, around which a magnetic field was detected in the OH maser region of the outer circumstellar envelope. We aim to detect and infer the properties of the magnetic field of this source in the water maser region. We observed the $6_{1,6}$–$5_{2,3}$ water maser rotational transition to determine its linear and circular

polarization. These emissions are located within the inner regions of OH 231.8 (at few tens of AU). We detected 30 water maser features, which occur in two distinct regions that are moving apart with a velocity on the sky of 2.3 mas yr^{-1}. Taking into account the inclination angle of the source, this corresponds to an average separation velocity of 15 km s^{-1}. Based on the velocity gradient of the maser emission, the masers appear to be dragged along the direction of the nebula jet. Linear polarization is present in 3 of the features, and circular polarization was detected in the 2 brightest ones. We found that the strength of the magnetic field is $|B_{||}| \sim 45$ mG which, when assuming a toroidal magnetic field, implies $B \sim 1.5$–2.0 G on the stellar surface. The morphology of the field is not yet determined, but the high scatter found on the directions of the linear polarization vectors could indicate that the masers occur near the tangent points of a toroidal field.

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Chemical composition of AY Ceti: A flaring, spotted star with a white dwarf companion

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The detailed chemical composition of the atmosphere AY Cet (HD 7672) is determined from a high-resolution spectrum in the optical region. The main atmospheric parameters and the abundances of 22 chemical elements, including key species such as ^{12}C, ^{13}C, N, and O, are determined. A differential line analysis gives $T_{\rm eff} = 5080$ K, $\log g = 3.0$, [Fe/H] $= -0.33$, [C/Fe] $= -0.17$, [N/Fe] $= 0.17$, [O/Fe] $= 0.05$, C/N $= 1.58$, and $^{12}C/^{13}C = 21$. Despite the high chromospheric activity, the optical spectrum of AY Cet provides a chemical composition typical for first ascent giants after the first dredge-up.

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NGC 6778: a disrupted planetary nebula around a binary central star

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The planetary nebula (PN) NGC 6778 harbors a binary central star with a short orbital period and displays two systems of fast collimated outflows. To assess the influence of the evolution through a common-envelope phase of the binary system of NGC 6778 on its formation and shaping, we have used narrow-band images and high-dispersion long-slit spectra of the nebula to investigate its detailed morphology and kinematics. We find that the overall structure of NGC 6778 can be described as a bipolar PN. The equatorial ring is highly disrupted and many radial features (filamentary wisps and cometary knots) also show strong dynamical effects. There are clear connections between the bipolar lobes and the fast collimated outflows: the collimated outflows seem to arise from bright knots at the tips of the bipolar lobes, whereas the kinematics of the bipolar lobes is distorted. We suggest that the interaction of the fast collimated outflows of NGC 6778 with its nebular envelope has resulted in the disruption of the nebular shell and equatorial ring.

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The dust budget of the SMC: Are AGB stars the primary dust source at low metallicity?

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We estimate the total dust input from the cool evolved stars in the Small Magellanic Cloud (SMC), using the 8 μm excess emission as a proxy for the dust-production rate. We find that Asymptotic Giant Branch (AGB) and red supergiant (RSG) stars produce (8.6–9.5)$\times 10^7$ $M_\odot$ yr^{-1} of dust, depending on the fraction of far-infrared sources that belong to the evolved star population (with 10%–50% uncertainty in individual dust-production rates). RSGs contribute the least ($<$ 4%), while carbon-rich AGB stars (especially the so-called "extreme" AGB stars) account for 87%–89% of the total dust input from cool evolved stars. We also estimate the dust input from hot stars and supernovae (SNe), and find that if SNe produce 10^{-3} $M_\odot$ of dust each, then the total SN dust input and AGB input are roughly equivalent. We consider several scenarios of SNe dust production and destruction and find that the interstellar medium (ISM) dust can be accounted for solely by stellar sources if all SNe produce dust in the quantities seen around the dustiest examples and if most SNe explode in dense regions where much of the ISM dust is shielded from the shocks. We find that AGB stars contribute only 2.1% of the ISM dust. Without a net positive contribution from SNe to the dust budget, this suggests that dust must grow in the ISM or be formed by another unknown mechanism.

Accepted for publication in ApJ
Available from arXiv:1201.5384

Conference Papers

Constructing a Cepheid period p-factor relation from static model stellar atmospheres

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One of the largest uncertainties for using the Baade–Wesselink method to measure Cepheid distances is the value of the projection factor (p-factor). However, p-factors measured using the IRSB technique and from hydrodynamic models disagree. In this work, we compute spherically-symmetric static model stellar atmospheres and predict a period p-factor relation.

Poster contribution, published in "20$^{\text{th}}$ Stellar Pulsation Conference Series: Impact of new instrumentation and new insights in stellar pulsations"
Available from arXiv:1201.0802

High-temperature optical constants of dust analogues for the Solar Nebula

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The dust in protoplanetary disks is influenced by a lot of different processes. Besides others, heating processes are the most important ones: they change not only the physical and chemical properties of dust particles, but also their emission spectra. In order to compare observed infrared spectra of young stellar systems with laboratory data of hot (up to 700° C) circumstellar dust analogues, we investigate materials, which are important constituents of dust in protoplanetary disks. We calculated the optical constants by means of a simple Lorentzian oscillator fit and apply them to simulations of small-particle emission spectra in order to compare our results with real astronomical spectra of AGB-stars and protoplanetary disks.

Poster contribution, published in "ECLA 2011" (European Conference on Laboratory Astrophysics), EAS publication series
Available from arXiv:1201.1801

The central PNe populations of external galaxies with SAURON

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Thanks to SAURON integral-field observations we uncovered the Planetary Nebulae (PNe) populations inhabiting the central and nuclear regions of our galactic neighbours M 32 and M 31, respectively, and discuss the significant differences between their corresponding PNe luminosity functions in light of the properties of their parent stellar populations. In particular, we conclude that the lack of bright PNe in the nuclear regions of M 31 is likely linked to the nearly Solar value for the stellar metallicity, consistent with previous suggestions that a larger metallicity would bias the Horizontal-Branch (HB) populations toward bluer colors, with fewer red HB stars capable of producing PNe and more blue HB stars that instead could contribute to the far-UV flux that is observed in metal-rich early-type galaxies and, incidentally, also in the nucleus of M 31.

Oral contribution, published in IAU Symposium 283, "Planetary Nebulae, an Eye to the Future"
Available from arXiv:1112.3875

Review Paper

Planetary nebula populations and kinematics

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The brightest planetary nebulae achieve similar maximum luminosities, have similar ratios of chemcial abundances, and apparently share similar kinematics in all galaxies. These similarities, however, are not necessarily expected theoretically and appear to hide important evolutionary differences. As predicted theoretically, metallicity appears to affect nebular kinematics, if subtly, and there is a clear variation with evolutionary stage. To the extent that it can be investigated, the internal kinematics for galactic and extragalactic planetary nebulae are similar. The extragalactic planetary nebulae for which kinematic data exist, though, probably pertain to a small range of progenitor masses, so there may still be much left to learn, particularly concerning the kinematics of planetary nebulae that descend from the more massive progenitors.

Published in IAU Symp. 283, "Planetary Nebulae: An Eye to the Future"
Available from arXiv:1201.5192

Thesis

Molecular diagnostics of the circumstellar envelopes of Asymptotic Giant Branch stars – mass loss and chemistry

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The asymptotic giant branch (AGB) is part of the late evolution of stars with initial masses of 0.8–9 $M_{\odot}$. It is characterised by a steady wind carrying mass from the stellar surface into the interstellar medium (ISM), creating an extended circumstellar envelope (CSE) of gas and dust around the star. This matter will ultimately enrich the ISM with new chemical elements produced in the stellar interior.

The work presented in this thesis is dedicated to the study of molecular gas in the CSEs of AGB stars, by means of detailed radiative-transfer analysis. This is essential in order to constrain and understand the physical and chemical characteristics of the CSEs. The launch of the *Herschel Space Observatory* (*Herschel*) on 14 May 2009 has given astronomers access to a wavelength range which is extremely difficult to observe from ground-based observatories due to atmospheric interference. A substantial part of the work presented in this thesis is based on high-quality data obtained with the HIFI instrument, a high-resolution spectrometer on board *Herschel*.

The study of carbon monoxide (CO) provides strong constraints on basic physical parameters of a star and its CSE. I show the strength in analysing CO data and apply it to a large sample of evolved stars, thereby determining the rates at which they lose mass. The star's mass-loss rate is an essential parameter in any study of late stellar evolution on the AGB. I further perform detailed radiative-transfer modelling of other molecules, such as e.g. SiO, HCN, and C_2H, leading to a better understanding of the prevalent physical conditions and chemical reactions. The chemical characteristics of the CSE of an AGB star are largely determined by the composition of the central star. Hence, this work contributes new and unique insights into the structure and evolution of stars on the AGB.

Thesis defended 8 November, 2011

Job Adverts

Astronomical Institute, Academy of Sciences of the Czech Republic Post-doctoral position

Applications are invited for a post-doctoral position in the Stellar Department. The successful applicant will work with Dr. Adela Kawka and Dr. Stephane Vennes on the spectral energy distribution of white dwarf and hot subdwarf stars. The applicant should have experience with observations, data reduction and data analysis of infrared, optical and/or ultraviolet data and have good programming skills.

The Stellar Department of the Astronomical Institute is located on the observatory site in Ondrejov, which is situated approximately 30 km south-east of Prague. The stellar department operates a 2m telescope with a coudé spectrograph, which is suitable for studies of bright objects (B stars, hot subdwarfs). Czech Republic is a member state of both ESO and ESA, and have access to ESO facilities. Members of the department have been successful in obtaining time on 2, 4 and 8m class telescopes at ESO.

The department includes about a dozen active researchers, with a total of 70 scientists working at the Astronomical Insititute. The department offers excellent computing facilitities, running under Linux, and including data reduction programmes such as IRAF. Institute accomodation in Ondrejov will be offered to the successful candidate.

The position is for 10 months. The salary will be based on the standard domestic scale. The starting date is expected to be early March 2012. Applicants should send their curriculum vitae, including a list of publications and research interests and arrange to have two letters of support sent by email to Adela Kawka (kawka@sunstel.asu.cas.cz) with a copy to Petr Heinzel (pheinzel@asu.cas.cz) or send to:

Adela Kawka
Astronomical Institute of the Academy of Sciences of the Czech Republic
Fricova 298
251 65 Ondrejov
Czech Republic

The closing date for applications is 27th February 2012.

See also http://www.asu.cas.cz/news/357_post-doctoral-position-in-the-stellar-department/

Istituto Ricerche Solari Locarno, Switzerland / Geneva University PhD position – Topic: Planet engulfing scenarios

A Swiss–NSF-funded PhD position is open at the solar physics research institute Istituto Ricerche Solari Locarno, IRSOL, located in Locarno in the Southern part of Switzerland. The project will be carried out in collaboration with the University of Geneva, and Kiepenheuer Institut in Freiburg, Germany. The PhD student will be enrolled as a PhD student at the University of Geneva.

The PhD student will have the opportunity to work in a lively small group on a challenging and cutting-edge topic. The work will address on planet engulfing scenarios considering both theoretical and observational aspects. The goal will be to study the consequences on the star involved in the process of planet engulfing, through numerical modeling, and to find corresponding observational signatures. The PhD student is expected to get familiar with the instrumentation and the observational techniques at the IRSOL observatory, where it will be possible to carry out spectroscopy observations of bright stars and to perform calibration observations on the Sun. Fainter stars will be observed at the Gregor telescope in Tenerife or at other large telescopes.

We are seeking an outstanding and highly motivated candidate with a MSc or equivalent degree in astrophysics, astronomy or physics with interests in observational techniques and numerical modeling. The candidates should send a letter of motivation, a CV, academic transcripts and contact details of three potential referees by post or by email to the address below. Electronic material should be sent in a single PDF-file.

IRSOL
via Patocchi
CH-6605 Locarno Monti
Switzerland
Email: info@irsol.ch with CC: mbianda@irsol.ch
Links: www.irsol.ch

Workplace location: the PhD student is expected to spend about 2 years at the University of Geneva to work on the theoretical modeling. For the remaining period the main workplace will be at IRSOL in Locarno.

Gross annual salary: $\sim$ 40 000 CHF (ca. 34 000 EUR)
Applications will be considered until the position is filled.
Start date: as soon as possible, in any case not later than summer 2012.

For more information please contact:
Dr. Michele Bianda (IRSOL): mbianda@irsol.ch, +41 91 743 42 26
Prof. Georges Meynet (University of Geneva): Georges.Meynet@unige.ch
Prof. Svetlana Berdjugina (KIS): sveta@kis.uni-freiburg.de

See also http://www.irsol.ch/Concorso_dottorando.pdf

Announcement

The origin of dust in galaxies in the *Herschel* and ALMA era

Royal Astronomical Society, A Specialist Discussion
Friday, 9th March 2012, 10:30–15:30
The Geological Society, Burlington House, London, W1J 0BG, UK

Dust grains are ubiquitous in the interstellar medium of galaxies. They are responsible for the formation of molecular hydrogen and for absorbing and re-emitting up to 90% of the energy from galaxies, as well as providing an effective coolant for star formation. Although important in a number of astrophysical processes, the origin and consequently the chemical make-up and emission properties of dust grains is largely unknown. Since the launch of the *Herschel* Space Observatory and *Planck* Satellite in 2009, we are beginning to understand far more about the origin and composition of dust. This has consequences for understanding the physical properties of dust grains, which in turn is crucial to correctly interpret results from studies of galaxy evolution and star formation with *Herschel*, and ultimately ALMA.

Invited speakers include:
A.G.G.M. Tielens, A.C. Andersen, C. Carilli

You can find more information, including a preliminary program on
http://www.astro.cardiff.ac.uk/newsandevents/conferences/RAS-2012-03/
http://www.ras.org.uk/component/gem/?id=164

A Specialist Discussion Meeting organised by: Haley Gomez (Cardiff), Mikako Matsuura (UCL) and Robert Kennicutt (Cambridge)

See also http://www.ras.org.uk/component/gem/?id=164