THE AGB NEWSLETTER

An electronic publication dedicated to Asymptotic Giant Branch stars and related phenomena

Official publication of the IAU Working Group on Abundances in Red Giants

No. 211 — 4 February 2015

http://www.astro.keele.ac.uk/AGBnews

Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 211th issue of the AGB Newsletter. Some popular stars are being investigated, including three papers featuring IRC +10°216, as well as extra-galactic populations in the Local Group irregular galaxies the Magellanic Clouds and spiral galaxy M 33 and the more distant giant elliptical galaxy Cen A. Perhaps not immediately obvious is the observation of energetic processes surrounding AGB stars and their descendants in the form of UV and X-ray emision, but this is precisely what a couple of projects in this issue have done.

Please pay attention to the Ph.D. position being advertised to work on *Herschel* data, in Denver (USA).

We also hope for good attendance and fruitful discussions at two meetings related to AGB stars later this year – one at the European Week of Astronomy and Space Science in Tenerife (Spain) and another in London.

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

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

Food for Thought

This month's thought-provoking statement is:

Is the Asymptotic Giant Branch really asymptotic?

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)

Dust in brown dwarfs and extra-solar planets IV. Assessing TiO_2 and SiO nucleation for cloud formation modelling

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Clouds form in atmospheres of brown dwarfs and planets. The cloud particle formation processes are similar to the dust formation process studied in circumstellar shells of AGB stars and in Supernovæ. Cloud formation modelling in substellar objects requires gravitational settling and element replenishment in addition to element depletion. All processes depend on the local conditions, and a simultaneous treatment is required. We apply new material data in order to assess our cloud formation model results regarding the treatment of the formation of condensation seeds. We re-address the question of the primary nucleation species in view of new $(TiO_2)_N$-cluster data and new SiO vapour pressure data. We apply the density functional theory using the computational chemistry package GAUSSIAN 09 to derive updated thermodynamical data for $(TiO_2)_N$-clusters as input for our TiO_2 seed formation model. We test different nucleation treatments and their effect on the overall cloud structure by solving a system of dust moment equations and element conservation for a pre-scribed DRIFT-PHOENIX atmosphere structure. Updated Gibbs free energies for the $(TiO_2)_N$-clusters are presented, and a slightly temperature dependent surface tension for $T = 500 \ldots 2000$ K with an average value of $\sigma_\infty = 480.6$ erg cm^{-2}. The TiO_2-seed formation rate changes only slightly with the updated cluster data. A considerably larger effect on the rate of seed formation, and hence on grain size and dust number density, results from a switch to SiO-nucleation. Despite the higher abundance of SiO over TiO_2 in the gas phase, TiO_2 remains considerably more efficient in forming condensation seeds by homogeneous nucleation followed by heterogeneous grain growth. The paper discussed the effect on the cloud structure in more detail.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1410.6610

Examining the infrared variable star population discovered in the Small Magellanic Cloud using the SAGE-SMC survey

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We present our study on the infrared variability of point sources in the Small Magellanic Cloud (SMC). We use the data from the *Spitzer* Space Telescope Legacy Program "Surveying the Agents of Galaxy Evolution in the Tidally Stripped, Low Metallicity Small Magellanic Cloud" (SAGE-SMC) and the "Spitzer Survey of the Small Magellanic Cloud" (S^3MC) survey, over three different epochs, separated by several months to three years. Variability in the thermal infrared is identified using a combination of *Spitzer*'s IRAC 3.6, 4.5, 5.8, and 8.0 μm bands, and the MIPS 24 μm band. An error-weighted flux difference between each pair of three epochs ("variability index") is used to assess the variability of each source. A visual source inspection is used to validate the photometry and image quality. Out of ~ 2 million sources in the SAGE-SMC catalog, 814 meet our variability criteria. We matched the list of variable star candidates to the catalogs of SMC sources classified with other methods, available in the literature. Carbon-rich Asymptotic Giant Branch (AGB) stars make up the majority (61%) of our variable sources, with about a third of all of our sources being classified as extreme AGB stars. We find a small, but significant population of oxygen-rich AGB (8.6%), Red Supergiant (2.8%), and Red Giant Branch (< 1%) stars. Other matches to the literature include Cepheid variable stars (8.6%), early-type stars (2.8%), young-stellar objects (5.8%), and background galaxies (1.2%). We found a candidate OH maser star, SSTISAGE1C J005212.88−730852.8, which is a variable O-rich AGB star, and would be the first OH/IR star in the SMC, if confirmed. We measured the infrared variability of a rare RV Tau variable (a post-AGB star) that has recently left the AGB phase. Fifty nine variable stars from our list remain unclassified.

Accepted for publication in Astronomical Journal
Available from arXiv:1501.01591

New N-bearing species towards OH 231.8+4.2: HNCO, HNCS, HC_3N, and NO

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Circumstellar envelopes (CSEs) around asymptotic giant branch (AGB) are the main sites of molecular formation. OH 231.8+4.2 is a well studied oxygen-rich CSE around an intermediate-mass evolved star that, in dramatic contrast to most AGB CSEs, displays bipolar molecular outflows accelerated up to ~ 400 km s^{-1}. OH 231.8+4.2 also presents an exceptional molecular richness probably due to shock-induced chemical processes. We report the first detection in this source of four nitrogen-bearing species, HNCO, HNCS, HC_3N, and NO, which have been observed with the IRAM 30-m radio telescope in a sensitive mm-wavelength survey towards this target. HNCO and HNCS are also first detections in CSEs. The observed line profiles show that the emission arises in the massive (~ 0.6 M$_\odot$) central component of the envelope, expanding with low velocities of $v_{\rm exp} \sim 15$–30 km s^{-1}, and at the base of the fast lobes. The NO profiles (with FWHM$\sim$ 40–50 km s^{-1}) are broader than those of HNCO, HNCS, and HC_3N and, most importantly, broader than the line profiles of ^{13}CO, which is a good mass tracer. This indicates that the NO abundance is enhanced in the fast lobes relative to the slow, central parts. From LTE and non-LTE excitation analysis, we estimate beam-average rotational temperatures of $T_{\rm rot} \sim 15$–30 K (and, maybe, up to ~ 55 K for HC_3N) and fractional abundances of X(HNCO) $\sim [0.8$–$1] \times 10^{-7}$, X(HNCS) $\sim [0.9$–$1] \times 10^{-8}$, $X(HC_3N) \sim [5$–$7] \times 10^{-9}$, and X(NO) $\sim [1$–$2] \times 10^{-6}$. NO is, therefore, amongst the most abundant N-bearing species in OH 231.8+4.2. We performed thermodynamical chemical equilibrium and chemical kinetics models to investigate the formation of these N-bearing species in OH 231.8+4.2. The model underestimates the observed abundances for HNCO, HNCS, and HC_3N by several orders of magnitude, which indicates that these molecules can hardly be products of standard UV-photon and/or cosmic-ray induced chemistry in OH 231.8+4.2 and that other processes (e.g., shocks) play a major role in their formation. For NO, the model abundance, $\approx 10^{-6}$, is compatible with the observed average value; however, the model fails to reproduce the NO abundance enhancement in the high-velocity lobes (relative to the slow core) inferred from the broad NO profiles. The new detections presented in this work corroborate the particularly rich chemistry of OH 231.8+4.2, which is likely to be profoundly influenced by shock-induced processes, as proposed in earlier works.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1412.2074

The temperature and chronology of heavy-element synthesis in low-mass stars

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Roughly half of the heavy elements (atomic mass greater than that of iron) are believed to be synthesized in the late evolutionary stages of stars with masses between 0.8 and 8 solar masses. Deep inside the star, nuclei (mainly iron) capture neutrons and progressively build up (through the slow-neutron-capture process, or *s*-process) heavier elements that are subsequently brought to the stellar surface by convection. Two neutron sources, activated at distinct temperatures, have been proposed: ^{13}C and ^{22}Ne, each releasing one neutron per α particle captured. To explain the measured stellar abundances, stellar evolution models invoking the ^{13}C neutron source (which operates at temperatures of about one hundred million kelvin) are favoured. Isotopic ratios in primitive meteorites, however, reflecting nucleosynthesis in the previous generations of stars that contributed material to the Solar System, point to higher temperatures (more than three hundred million kelvin), requiring at least a late activation of ^{22}Ne. Here we report a determination of the *s*-process temperature directly in evolved low-mass giant stars, using zirconium and niobium abundances, independently of stellar evolution models. The derived temperature supports ^{13}C as the *s*-process neutron source. The radioactive pair ^{93}Zr–^{93}Nb used to estimate the *s*-process temperature also provides, together with the pair ^{99}Tc–^{99}Ru, chronometric information on the time elapsed since the start of the *s*-process, which we determine to be one million to three million years.

Published in Nature 517, 174 (2015)

Available from http://www.nature.com/nature/journal/v517/n7533/full/nature14050.html

Molecular shells in IRC +10°216: tracing the mass loss history

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Thermally-pulsating AGB stars provide three-fourths of the matter returned to the interstellar medium. The mass and chemical composition of their ejecta largely control the chemical evolution of galaxies. Yet, both the mass loss process and the gas chemical composition remain poorly understood. We present maps of the extended ^{12}CO and ^{13}CO emissions in IRC +10°216, the envelope of CW Leo, the high mass loss star the closest to the Sun. IRC +10°216 is nearly spherical and expands radially with a velocity of 14.5 km s^{-1}. The observations were made On-the-Fly with the IRAM 30-m telescope; their sensibility, calibration, and angular resolution are far higher than all previous studies. The telescope resolution at $\lambda = 1.3$ mm (11″ HPBW) corresponds to an expansion time of 500 yr. The CO emission consists of a centrally peaked pedestal and a series of bright, nearly spherical shells. It peaks on CW Leo and remains relatively strong up to $r_{\rm phot} = 180''$. Further out the emission becomes very weak and vanishes as CO gets photodissociated. As CO is the best tracer of the gas up to $r_{\rm phot}$, the maps show the mass loss history in the last 8000 yr. The bright CO shells denote over-dense regions. They show that the mass loss process is highly variable on timescales of hundreds of years. The new data, however, infirm previous claims of a strong decrease of the average mass loss in the last few thousand years. The over-dense shells are not perfectly concentric and extend farther to the N–NW. The typical shell separation is 800–1000 yr in the middle of the envelope, but seems to increase outwards. The shell-intershell brightness contrast is ≥ 3. All those key features can be accounted for if CW Leo has a companion star with a period of $\simeq 800$ yr that increases the mass loss rate when it comes close to periastron. Higher angular resolution observations are needed to fully resolve the dense shells and measure the density contrast. The latter plays an essential role in our understanding of the envelope chemistry.

Accepted for publication in A&A

Available from arXiv:1412.1948

The UK Infrared Telescope M 33 monitoring project. IV. Variable red giant stars across the galactic disc

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We have conducted a near-infrared monitoring campaign at the UK InfraRed Telescope (UKIRT), of the Local Group spiral galaxy M 33 (Triangulum). The main aim was to identify stars in the very final stage of their evolution, and for which the luminosity is more directly related to the birth mass than the more numerous less-evolved giant stars that continue to increase in luminosity. In this fourth paper of the series, we present a search for variable red giant stars in an almost square degree region comprising most of the galaxy's disc, carried out with the WFCAM instrument in the K band. These data, taken during the period 2005–2007, were complemented by J- and H-band images. Photometry was obtained for 403 734 stars in this region; of these, 4643 stars were found to be variable, most of which are Asymptotic Giant Branch (AGB) stars. The variable stars are concentrated towards the centre of M 33, more so than low-mass, less-evolved red giants. Our data were matched to optical catalogues of variable stars and carbon stars and to mid-infrared photometry from the *Spitzer* Space Telescope. Most dusty AGB stars had not been previously identified in optical variability surveys, and our survey is also more complete for these types of stars than the *Spitzer* survey. The photometric catalogue is made publicly available at the Centre de Données astronomiques de Strasbourg.

Accepted for publication in MNRAS
Available from arXiv:1412.3840

A *Spitzer*/IRAC characterization of Galactic AGB and RSG stars

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We present new *Spitzer*/IRAC observations of 55 dusty Long Period Variables (LPVs, 48 AGB and 6 RSG stars) in the Galaxy that have different chemistry, variability type, and mass-loss rate. O-rich AGB stars (including intrinsic S-type) tend to have redder [3.6]–[8.0] colors than carbon stars for a given [3.6]–[4.5] color due to silicate features increasing the flux in the 8.0-μm IRAC band. For colors including the 5.8-μm band, carbon stars separate into two distinct sequences, likely due to a variable photospheric C_3 feature that is only visible in relatively unobscured, low mass-loss rate sources. Semiregular variables tend to have smaller IR excess in [3.6]–[8.0] color than Miras, consistent with the hypothesis that semi-regular variables lose mass discontinuously. Miras have redder colors for longer periods while semi-regular variables do not. Galactic AGB stars follow the period–luminosity sequences found for the Magellanic Clouds. Mira variables fall along the fundamental pulsation sequence, while semi-regular variables are mostly on overtone sequences. We also derive a relationship between mass-loss rate and [3.6]–[8.0] color. The fits are similar in shape to those found by other authors for AGBs in the LMC, but discrepant in overall normalization, likely due to different assumptions in the models used to derive mass-loss rates. We find that IR colors are not unique discriminators of chemical type, suggesting caution when using color selection techniques to infer the chemical composition of AGB dust returned to the ISM.

Accepted for publication in MNRAS
Available from arXiv:1501.02749

Peculiarities of the atmosphere and envelope of a post-AGB star, the optical counterpart of IRAS 23304+6147

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Based on high-spectral resolution observations performed with the échelle spectrograph NES of the 6-meter telescope, we have studied the peculiarities of the spectrum and the velocity field in the atmosphere and envelope of the optical counterpart of the infrared source IRAS 23304+6147. We have concluded about the absence of significant variations in the radial velocity v_r inferred from atmospheric absorptions and about its coincidence with the systemic velocity deduced from radio data. The envelope expansion velocity $v_\mathrm{exp} = 15.5$ km s^{-1} has been determined from the positions of rotational band lines of the C_2 Swan (0;0) band. A complex emission-absorption profile of the Swan (0; 1) 5635 Å has been recorded. Analysis of the multicomponent Na I D doublet line profile has revealed interstellar components $v(\mathrm{IS}) = -61.6$ and -13.2 km s^{-1} as well as a circumstellar component with $v(\mathrm{CS}) = -41.0$ km s^{-1} whose position corresponds to the velocity inferred from C_2 features. The presence of the interstellar component with $v_\mathrm{r} = -61.6$ km s^{-1} in the spectrum allows $d = 2.5$ kpc to be considered as a lower limit for the distance to the star. A splitting of the profiles for strong absorptions of ionized metals (Y II, Ba II, La II, Si II) attributable to the presence of a short-wavelength component originating in the circumstellar envelope has been detected in the optical spectrum of IRAS 23304+6147 for the first time.

Accepted for publication in Astronomy Letters
Available from arXiv:1501.02548

A 1.3-cm line survey toward IRC +10°216

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IRC +10°216 is the prototypical carbon star exhibiting an extended molecular circumstellar envelope. Its spectral properties are therefore the template for an entire class of objects. The main goal is to systematically study the $\lambda \sim 1.3$-cm spectral line characteristics of IRC +10°216. We carried out a spectral line survey with the Effelsberg-100 m telescope toward IRC +10°216. It covers the frequency range between 17.8 GHz and 26.3 GHz (K-band). In the circumstellar shell of IRC +10°216, we find 78 spectral lines, among which 12 remain unidentified. The identified lines are assigned to 18 different molecules and radicals. A total of 23 lines from species known to exist in this envelope are detected for the first time outside the Solar System and there are additional 20 lines first detected in IRC +10°216. The potential origin of "U" lines is also discussed. Assuming local thermodynamic equilibrium (LTE), we then determine rotational temperatures and column densities of 17 detected molecules. Molecular abundances relative to H_2 are also estimated. A non-LTE analysis of NH_3 shows that the bulk of its emission arises from the inner envelope with a kinetic temperature of 70 ± 20 K. Evidence for NH_3 emitting gas with higher kinetic temperature is also obtained, and potential abundance differences between various ^{13}C-bearing isotopologues of HC_5N are evaluated. Overall, the isotopic $^{12}\mathrm{C}/^{13}\mathrm{C}$ ratio is estimated to be 49 ± 9. Finally, a comparison of detected molecules in the $\lambda \sim 1.3$-cm range with the dark cloud TMC-1 indicates that silicate-bearing molecules are more predominant in IRC +10°216.

Accepted for publication in A&A
Available from arXiv:1412.2394

What causes the large extensions of red-supergiant atmospheres? Comparisons of interferometric observations with 1-D hydrostatic, 3-D convection, and 1-D pulsating model atmospheres

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This research has two main goals. First, we present the atmospheric structure and the fundamental parameters of three red supergiants (RSGs), increasing the sample of RSGs observed by near-infrared spectro-interferometry. Additionally, we test possible mechanisms that may explain the large observed atmospheric extensions of RSGs.
We carried out spectro-interferometric observations of the RSGs V602 Car, HD 95687, and HD 183589 in the near-infrared K-band (1.92–2.47 μm) with the VLTI/AMBER instrument at medium spectral resolution ($R \sim 1500$). To categorize and comprehend the extended atmospheres, we compared our observational results to predictions by available hydrostatic PHOENIX, available 3-D convection, and new 1-D self-excited pulsation models of RSGs.
Our near-infrared flux spectra of V602 Car, HD 95687, and HD 183589 are well reproduced by the PHOENIX model atmospheres. The continuum visibility values are consistent with a limb-darkened disk as predicted by the PHOENIX models, allowing us to determine the angular diameter and the fundamental parameters of our sources. Nonetheless, in the case of V602 Car and HD 95686, the PHOENIX model visibilities do not predict the large observed extensions of molecular layers, most remarkably in the CO bands. Likewise, the 3-D convection models and the 1-D pulsation models with typical parameters of RSGs lead to compact atmospheric structures as well, which are similar to the structure of the hydrostatic PHOENIX models. They can also not explain the observed decreases in the visibilities and thus the large atmospheric molecular extensions. The full sample of our RSGs indicates increasing observed atmospheric extensions with increasing luminosity and decreasing surface gravity, and no correlation with effective temperature or variability amplitude.
The location of our RSG sources in the Hertzsprung–Russell diagram is confirmed to be consistent with the red limits of recent evolutionary tracks. The observed extensions of the atmospheric layers of our sample of RSGs are comparable to those of Mira stars. This phenomenon is not predicted by any of the considered model atmospheres including available 3-D convection and new 1-D pulsation models of RSGs. This confirms that neither convection nor pulsation alone can levitate the molecular atmospheres of RSGs. Our observed correlation of atmospheric extension with luminosity supports a scenario of radiative acceleration on Doppler-shifted molecular lines.

Accepted for publication in A&A
Available from arXiv:1501.01560

First detection of 22 GHz H_2O Masers in TX Camelopadalis

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Simultaneous time monitoring observations of H_2O 6_{16}–5_{23}, SiO $J = 1$–0, 2–1, 3–2, and ^{29}SiO $v = 0$, $J = 1$–0 lines were carried out in the direction of the Mira variable star TX Cam with the Korean VLBI Network single dish radio telescopes. For the first time, the H_2O maser emission from TX Cam was detected near the stellar velocity at five epochs from April 10, 2013 ($\phi = 3.13$) to June 4, 2014 ($\phi = 3.89$) including minimum optical phases. The intensities of H_2O masers are very weak compared to SiO masers. The variation of peak antenna temperature ratios among SiO $v = 1$, $J = 1$–0, $J = 2$–1, and $J = 3$–2 masers is investigated according to their phases. The shift of peak velocities of H_2O and SiO masers with respect to the stellar velocity is also investigated according to observed optical phases. The H_2O maser emission occurs around the stellar velocity during our monitoring interval. On the other hand, the peak velocities of SiO masers show a spread compared to the stellar velocity. The peak velocities of SiO $J = 2$–1, and $J = 3$–2 masers show a smaller spread with respect to the stellar velocity than those of SiO $J = 1$–0 masers. These simultaneous observations of multi-frequencies will provide a good constraint for maser pumping models and a good probe for investigating the stellar atmosphere and envelope according to their different excitation conditions.

Published in Journal of The Korean Astronomical Society
Available from arXiv:1412.8251

Investigating the nature of the Fried Egg nebula: CO mm-line and optical spectroscopy of IRAS 17163−3907

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Through CO mm-line and optical spectroscopy, we investigate the properties of the Fried Egg nebula IRAS 17163−3907, which has recently been proposed to be one of the rare members of the yellow hypergiant class. The CO $J = 2$–1 and $J = 3$–2 emission arises from a region within $20''$ of the star and is clearly associated with the circumstellar material. The CO lines show a multi-component asymmetrical profile, and an unexpected velocity gradient is resolved in the east–west direction, suggesting a bipolar outflow. This is in contrast with the apparent symmetry of the dust envelope as observed in the infrared. The optical spectrum of IRAS 17163−3907 between 5100 and 9000 Å was compared with that of the archetypal yellow hypergiant IRC $+10°420$ and was found to be very similar. These results build on previous evidence that IRAS 17163−3907 is a yellow hypergiant.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1501.03362
and from http://dx.doi.org/10.1051/0004-6361/201321516

A radial velocity survey for post-common-envelope Wolf–Rayet central stars of planetary nebulæ: First results and discovery of the close binary nucleus of NGC 5189

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The formation of Wolf–Rayet central stars of planetary nebulæ ([WR] CSPNe) whose spectroscopic appearance mimics massive WR stars remains poorly understood. Least understood is the nature and frequency of binary companions to [WR] CSPNe that may explain their H-deficiency. We have conducted a systematic radial velocity (RV) study of 6 [WR] CSPNe to search for post-common-envelope (post-CE) [WR] binaries. We used a cross-correlation method to construct the RV time-series as successfully done for massive close binary WR stars. No significant RV variability was detected for the late-[WC] type nuclei of Hen 2-113, Hen 3-1333, PMR 2 and Hen 2-99. Significant, large-amplitude variability was found in the [WC4] nucleus of NGC 5315. In the [WO1] nucleus of NGC 5189 we discovered significant periodic variability that reveals a close binary with $P_{\rm orb} = 4.04 \pm 0.1$ d. We measured a semi-amplitude of 62.3 ± 1.3 km s^{-1} that gives a companion mass of $m_2 \geq 0.5$ M$_\odot$ or $m_2 = 0.84$ M$_\odot$ (assuming $i = 45°$). The most plausible companion type is a massive WD as found in Fleming 1. The spectacular nebular morphology of NGC 5189 fits the pattern of recently discovered post-CE PNe extremely well with its dominant low-ionisation structures (e.g., as in NGC 6326) and collimated outflows (e.g., as in Fleming 1). The anomalously long 4.04 d orbital period is either a once-off (e.g., NGC 2346) or it may indicate there is a sizeable population of [WR] binaries with massive WD companions in relatively wide orbits, perhaps influenced by interactions with the strong [WR] wind.

Accepted for publication in MNRAS
Available from arXiv:1501.03373

Effective collision strengths for excitation and de-excitation of nebular [O III] optical and infrared lines with κ distributed electron energies

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We present effective collision strengths for electron excitation and de-excitation of the ten forbidden transitions between the five lowest energy levels of the astronomically abundant doubly-ionised oxygen ion, O^{2+}. The raw collision strength data were obtained from an R-matrix intermediate coupling calculation using the Breit–Pauli relativistic approximation published previously by the authors. The effective collision strengths were calculated with κ-distributed electron energies and are tabulated as a function of the electron temperature and κ.

Submitted to MNRAS
Available from arXiv:1501.03803

First detection of ultraviolet emission from a detached dust shell: GALaxy Evolution eXplorer observations of the carbon Asymptotic Giant Branch star U Hya

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We present the discovery of an extended ring of ultraviolet (UV) emission surrounding the asymptotic giant branch (AGB) star U Hya in archival observations performed by the GALaxy Evolution eXplorer. This is the third discovery of extended UV emission from a carbon AGB star and the first from an AGB star with a detached shell. From imaging and photometric analysis of the FUV and NUV images, we determined that the UV ring has a radius of $\sim 110''$, thus indicating that the emitting material is likely associated with the detached shell seen in the infrared. We find that scattering of the central point source of NUV and FUV emission by the dust shell is negligible. Moreover, we find that scattering of the interstellar radiation field by the dust shell can contribute at most $\sim 10\%$ of the FUV flux. Morphological and photometric evidence suggests that shocks caused by the star's motion through space and, possibly, shock-excited H_2 molecules are the most likely origins of the UV flux. In contrast to previous examples of extended

UV emission from AGB stars, the extended UV emission from U Hya does not show a bow-shock-like structure, which is consistent with a lower space velocity and lower interstellar medium density. This suggests the detached dust shell is the source of the UV-emitting material and can be used to better understand the formation of detached shells.

Published in Astrophysical Journal Letters
Available from arXiv:1412.7542

Constraints on the surface magnetic fields and age of a cool hypergiant: XMM–*Newton* X-ray observations of VY CMa

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The complex circumstellar ejecta of highly evolved, cool hypergiants are indicative of multiple, asymmetric mass loss events. To explore whether such episodic, non-isotropic mass loss may be driven by surface magnetic activity, we have observed the archetypical cool hypergiant VY CMa with the XMM–*Newton* X-ray satellite observatory. The hypergiant itself is not detected in these observations. From the upper limit on the X-ray flux from VY CMa at the time of our observations ($F_{\rm X,UL} \approx 8 \times 10^{-14}$ erg cm^{-2} s^{-1}, corresponding to $\log L_{\rm X}/L_{\rm bol} \leq -8$), we estimate an average surface magnetic field strength $fB \leq 2 \times 10^{-3}$ G (where f is the filling factor of magnetically active surface regions). These X-ray results for VY CMa represent the most stringent constraints to date on the magnetic field strength near the surface of a hypergiant. VY CMa's mass loss is episodic and may have been in a state of low surface magnetic activity during the XMM observations. The XMM observations also yield detections of more than 100 X-ray sources within $\sim 15'$ of VY CMa, roughly 50 of which have near-infrared counterparts. Analysis of X-ray hardness ratios and IR colors indicates that some of these field sources may be young, late-type stars associated with VY CMa, its adjacent molecular cloud complex, and the young cluster NGC 2362. Further study of the VY CMa field is warranted, given the potential to ascertain the evolutionary timescale of this enigmatic, massive star.

Accepted for publication in Astrophysical Journal
Available from arXiv:1412.5120

The *Chandra* Planetary Nebulæ Survey (ChanPlaNS): III. X-ray emission from the central stars of planetary nebulæ

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We present X-ray spectral analysis of 20 point-like X-ray sources detected in *Chandra* Planetary Nebulæ Survey (ChanPlaNS) observations of 59 planetary nebulæ (PNe) in the solar neighborhood. Most of these 20 detections are associated with luminous central stars within relatively young, compact nebulae. The vast majority of these point-like X-ray-emitting sources at PN cores display relatively "hard" (≥ 0.5 keV) X-ray emission components that are unlikely to be due to photospheric emission from the hot central stars (CSPN). Instead, we demonstrate that these sources are well modeled by optically-thin thermal plasmas. From the plasma properties, we identify two classes of CSPN X-ray emission: (1) high-temperature plasmas with X-ray luminosities, $L_{\rm X}$, that appear uncorrelated with the CSPN bolometric luminosity, $L_{\rm bol}$; and (2) lower-temperature plasmas with $L_{\rm X}/L_{\rm bol} \sim 10^{-7}$. We suggest these two classes correspond to the physical processes of magnetically active binary companions and self-shocking stellar winds, respectively. In many cases this conclusion is supported by corroborative multi-wavelength evidence for the wind and binary properties of the PN central stars. By thus honing in on the origins of X-ray emission from PN central stars,

we enhance the ability of CSPN X-ray sources to constrain models of PN shaping that invoke wind interactions and binarity.

Accepted for publication in Astrophysical Journal
Available from arXiv:1412.2793

The final fate of stars that ignite neon and oxygen off-center: electron capture or iron core-collapse supernova?

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In the ONeMg cores of 8.8–9.5 $M_\odot$ stars, neon and oxygen burning is ignited off-center. Whether or not the neon-oxygen flame propagates to the center is critical for determining whether these stars undergo Fe core collapse or electron-capture-induced ONeMg core collapse. We present more details of stars that ignite neon and oxygen burning off-center. The neon flame is established in a manner similar to the carbon flame of super-AGB stars, albeit with a narrower flame width. The criteria for establishing a flame can be met if the strict Schwarzschild criterion for convective instability is adopted. Mixing across the interface of the convective shell disrupts the conditions for the propagation of the burning front, and instead the shell burns as a series of inward-moving flashes. While this may not directly affect whether or not the burning will reach the center (as in super-AGB stars), the core is allowed to contract between each shell flash. Reduction of the electron fraction in the shell reduces the Chandrasekhar mass and the center reaches the threshold density for the URCA process to activate and steer the remaining evolution of the core. This highlights the importance of a more accurate treatment of mixing in the stellar interior for yet another important question in stellar astrophysics – determining the properties of stellar evolution and supernova progenitors at the boundary between electron capture supernova and iron core-collapse supernova.

Published in The Astrophysical Journal
Available from arXiv:1412.2878
and from http://adsabs.harvard.edu/abs/2014ApJ...797...83J

Classifying the secondary component of the binary star W Aquilæ

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Aims: The object W Aql is an asymptotic giant branch (AGB) star with a faint companion. By determining more carefully the properties of the companion, we hope to better constrain the properties of the AGB star.
Methods: We present new spectral observations of the binary star W Aql at minimum and maximum brightness and new photometric observations of W Aql at minimum brightness.
Results: The composite spectrum near minimum light is predominantly from the companion at wavelengths $\lambda < 6000$ Å. This spectrum can be classified as F8 to G0, and the brightness of the companion is that of a dwarf star. Therefore, it can be concluded that the companion is a main sequence star. From this, we are able to constrain the mass of the AGB component to 1.04–3 $M_\odot$ and the mass of the W Aql system to 2.1–4.1 $M_\odot$. Our photometric results are broadly consistent with this classification and suggest that the main sequence component suffers from approximately 2 mag of extinction in the V band primarily due to the dust surrounding the AGB component.

Published in Astronomy & Astrophysics
Available from arXiv:1501.00863
and from http://www.aanda.org/articles/aa/abs/2015/02/aa23672-14/aa23672-14.html

Emission-line fluxes of Northern planetary nebulæ

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We present long-slit spectrophotometric emission line fluxes of bright and extended ($< 5''$ in diameter) Planetary Nebulæ (PNe) selected from the Acker et al. (1992) catalog with suitable equatorial coordinates for the Northern hemisphere. In total, 17 PNe were chosen and observed in 2008–2010. To measure absolute fluxes, broad slit sizes, ranging from $3''.5$ to $7''.5$ were used and thus equivalent widths of all observable emission line fluxes were also calculated. Among 17 PNe observed, line flux measurements for 12 of them were made for the first time. This work also aims to extend the sky coverage of emission line flux standards in the Northern hemisphere (Dopita & Hua (1997) – 52 PNe in the Southern hemisphere; Wright et al. (2005) – 6 PNe in the Northern hemisphere). Electron temperatures and densities, and chemical abundances of these PNe were also calculated in this work. These data are expected to lead the photometric or spectrometric further work for absolute emission line flux measurements needed for H II regions, supernova remnants etc.

Accepted for publication in Publications of the Astronomical Society of Australia
Available from arXiv:1501.03263

The curious case of ASAS J174600−2321.3: an eclipsing symbiotic nova in outburst?

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The star ASAS J174600−2321.3 was found to exhibit peculiar photometric variability (conspicuous brightening of ~ 4 magnitudes (V), fast luminosity declines, intrinsic pulsations). It was rejected as an RCB candidate in recent investigations on spectroscopic grounds. We have collected and present all available data from public sky surveys, photometric catalogues, and the literature. From an analysis of these data, we have identified ASAS J174600−2321.3 as a long-period eclipsing binary ($P_{\rm orb} = 1011.5$ days). The primary star, which is probably a white dwarf, is currently in outburst and exhibits the spectral characteristics of a reddened, early F-type supergiant; the secondary star is a giant of spectral type late-M. We discuss the possible origin of the observed brightening, which is related to the primary component. ASAS J174600−2321.3 is most certainly an eclipsing symbiotic binary – probably a symbiotic nova of GCVS type NC – that is currently in outburst. However, further photometric and spectroscopic data are needed to confirm this.

Accepted for publication in JAAVSO, Volume 43 (2015)
Available from arXiv:1501.05154
and from http://www.aavso.org/sites/default/files/jaavso/ej295.pdf

Mass loss on the red giant branch: the value and metallicity dependence of Reimers' η in globular clusters

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The impact of metallicity on the mass-loss rate from red giant branch (RGB) stars is studied through its effect on the parameters of horizontal branch (HB) stars. The scaling factors from Reimers (1975) and Schroder & Cuntz (2005) are determined for 56 well-studied Galactic globular clusters (GCs). The median values among clusters are, respectively, $\eta_R = 0.477 \pm 0.070$ ($+0.050/-0.062$) and $\eta_{SC} = 0.172 \pm 0.024$ ($+0.018/-0.023$) (standard deviation and systematic uncertainties, respectively). Mass-loss mechanisms on the RGB have very little metallicity dependence: over a factor of 200 in iron abundance, η varies by $\lesssim$30 per cent, within the current systematic uncertainties on cluster ages and evolution models. Since η incorporates cluster age, the low standard deviation of η among clusters ($\sim$ 14 per cent) suggests that age can almost entirely account for the "second parameter problem". The remaining spread in η correlates with cluster mass and density, suggesting helium enrichment provides the third parameter explaining HB morphology of GCs. The metallicity variation is reduced further if globular clusters are more co-eval than generally thought. This would also better reproduce the observed AGB tip luminosities, which are not well modelled by extrapolating the RGB η to later evolutionary epochs.

Accepted for publication in MNRAS
Available from arXiv:1501.00874

Vibrationally excited C_4H

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Rotational spectra in four new excited vibrational levels of the linear carbon chain radical C_4H radical were observed in the millimeter band between 69 and 364 GHz in a low pressure glow discharge, and two of these were observed in a supersonic molecular beam between 19 and 38 GHz. All have rotational constants within 0.4% of the $X^2\Sigma^+$ ground vibrational state of C_4H and were assigned to new bending vibrational levels, two each with $^2\Sigma$ and $^2\Pi$ vibrational symmetry. The new levels are tentatively assigned to the $1\nu_6$ and $1\nu_5$ bending vibrational modes (both with $^2\Pi$ symmetry), and the $1\nu_6 + 1\nu_7$ and $1\nu_5 + 1\nu_6$ combination levels ($^2\Sigma$ symmetry) on the basis of the derived spectroscopic constants, relative intensities in our discharge source, and published laser spectroscopic and quantum calculations. Prior spectroscopic constants in the $1\nu_7$ and $2\nu_7$ levels were refined. Also presented are interferometric maps of the ground state and the $1\nu_7$ level obtained with the SMA near 257 GHz which show that C_4H is present near the central star in IRC +10°216. We found no evidence with the SMA for the new vibrationally excited levels of C_4H at a peak flux density averaged over a $3''$ synthesized beam of ≥ 0.15 Jy beam^{-1} in the 294–296 and 304–306 GHz range, but it is anticipated that rotational lines in the new levels might be observed in IRC +10°216 when ALMA attains its full design capability.

Accepted for publication in Astrophysical Journal Supplement Series
Available from arXiv:1501.01262

Non-thermal emission from standing relativistic shocks: an application to red giant winds interacting with AGN jets

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Galactic and extragalactic relativistic jets are surrounded by rich environments that are full of moving objects, such as stars and dense medium inhomogeneities. These objects can enter into the jets and generate shocks and non-thermal emission. We characterize the emitting properties of the downstream region of a standing shock formed due to the interaction of a relativistic jet with an obstacle. We focus on the case of red giants interacting with an extragalactic jet. We perform relativistic axi-symmetric hydrodynamical simulations of a relativistic jet meeting an obstacle of very large inertia. The results are interpreted in the framework of a red giant whose dense and slow wind interacts with the jet of an active galactic nucleus. Assuming that particles are accelerated in the standing shock generated in the jet as it impacts the red giant wind, we compute the non-thermal particle distribution, the Doppler boosting enhancement, and the non-thermal luminosity in gamma rays. The available non-thermal energy from jet-obstacle interactions is potentially enhanced by a factor of ~ 100 when accounting for the whole surface of the shock induced by the obstacle, instead of just the obstacle section. The observer γ-ray luminosity, including the flow velocity and Doppler boosting effects, can be $\sim 300(\gamma/10)^2$ times higher than when the emitting flow is assumed at rest and only the obstacle section is considered, where gamma is the jet Lorentz factor. For a whole population of red giants inside the jet of an active galactic nucleus, the predicted persistent gamma-ray luminosities may be potentially detectable for a jet pointing approximately to the observer. Obstacles interacting with relativistic outflows, for instance clouds and populations of stars for extragalactic jets, or stellar wind inhomogeneities in micro-quasar jets and in winds of pulsars in binaries, should be taken into account when investigating the origin of the non-thermal emission from these sources.

Accepted for publication in Astronomy and Astrophysics
Available from arXiv:1501.03118

An imaging and spectroscopic study of the planetary nebulæ in NGC 5128 (Centaurus A): Planetary nebulæ catalogues

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Imaging and spectroscopic observations of planetary nebulæ (PNe) in the nearest large elliptical galaxy NGC 5128 (Centaurus A), were obtained to find more PNe and measure their radial velocities. NTT imaging was obtained in 15 fields in NGC 5128 over an area of about 1 square degree with EMMI using [O III] and off-band filters. Newly detected sources, combined with literature PNe, were used as input for VLT FLAMES multi-fibre spectroscopy in MEDUSA mode. Spectra of the 4600–5100 Å region were analysed and velocities measured based on emission lines of [O III]4959,5007Å— and often Hβ. The chief results are catalogues of 1118 PN candidates and 1267 spectroscopically confirmed PNe in NGC 5128. The catalogue of PN candidates contains 1060 PNe discovered with EMMI imaging and 58 from literature surveys. The spectroscopic PN catalogue has FLAMES radial velocity and emission line measurements for 1135 PNe, of which 486 are new. Another 132 PN radial velocities are available from the literature. For 629 PNe observed with FLAMES, Hβ was measured in addition to [O III]. Nine targets show double-lined or more complex profiles, and their possible origin is discussed. FLAMES spectra of 48 globular clusters were also targetted: 11 had emission lines detected (two with multiple components), but only 3 are PNe likely to belong to the host globular. The total of 1267 confirmed PNe in NGC 5128 with radial velocity measurements (1135 with small velocity errors) is the largest collection of individual kinematic probes in an early-type galaxy. This PN dataset, as well as the catalogue of PN candidates, are valuable resources for detailed investigation of the stellar population of NGC 5128.

Accepted for publication in A&A
Available from arXiv:1501.01853

Using broadband photometry to examine the nature of Long Secondary Periods in red giants

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Long-term JHK light curves have recently become available for large numbers of the more luminous stars in the SMC.

We have used these JHK light curves, along with OGLE V and I light curves, to examine the variability of a sample of luminous red giants in the SMC which show prominent long secondary periods (LSPs). The origin of the LSPs is currently unknown. In oxygen-rich stars, we found that while most broad band colours (e.g., $V-I$) get redder when an oxygen-rich star dims during its LSP cycle, the $J-K$ colour barely changes and sometimes becomes bluer. We interpret the $J-K$ colour changes as being due to increasing water vapour absorption during declining light caused by the development a layer of dense cool gas above the photosphere. This result and previous observations which indicate the development of a chromosphere between minimum to maximum light suggest that the LSP phenomenon is associated with the ejection of matter from the stellar photosphere near the beginning of light decline. We explore the possibility that broadband light variations from the optical to the near-IR regions can be explained by either dust absorption by ejected matter or large spots on a rotating stellar surface. However, neither model is capable of explaining the observed light variations in a variety of colour–magnitude diagrams. We conclude that some other mechanism is responsible for the light variations associated with LSPs in red giants.

Accepted for publication in MNRAS
Available from arXiv:1501.00748

Exploring wind-driving dust species in cool luminous giants III. Wind models for M-type AGB stars: dynamic and photometric properties

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Stellar winds observed in asymptotic giant branch (AGB) stars are usually attributed to a combination of stellar pulsations and radiation pressure on dust. Shock waves triggered by pulsations propagate through the atmosphere, compressing the gas and lifting it to cooler regions, which create favourable conditions for grain growth. If sufficient radiative acceleration is exerted on the newly formed grains through absorption or scattering of stellar photons, an outflow can be triggered. Strong candidates for wind-driving dust species in M-type AGB stars are magnesium silicates (Mg_2SiO_4 and $MgSiO_3$). Such grains can form close to the stellar surface, they consist of abundant materials and, if they grow to sizes comparable to the wavelength of the stellar flux maximum, they experience strong acceleration by photon scattering.
We use a frequency-dependent radiation-hydrodynamics code with a detailed description for the growth of Mg_2SiO_4 grains to calculate the first extensive set of time-dependent wind models for M-type AGB stars. This set includes 139 solar-mass models, with three different luminosities (5000 $L_\odot$, 7000 $L_\odot$, and 10000 $L_\odot$) and effective temperatures ranging from 2600 K to 3200 K. The resulting wind properties, visual and near-IR photometry and mid-IR spectra are compared with observations.
We show that the models can produce outflows for a wide range of stellar parameters. We also demonstrate that they reproduce observed mass-loss rates and wind velocities, as well as visual and near-IR photometry. However, the current models do not show the characteristic silicate features at 10 and 18 μm as a result of the cool temperature of Mg_2SiO_4 grains in the wind. Including a small amount of Fe in the grains further out in the circumstellar envelope will increase the grain temperature and result in pronounced silicate features, without significantly affecting the photometry in the visual and near-IR wavelength regions.
Outflows driven by photon scattering on Mg_2SiO_4 grains are a viable wind scenario for M-type AGB stars, given the success of the current models in reproducing observed mass-loss rates, wind velocities, and photometry. Both synthetic and observed photometry suggest that the dusty envelopes of M-type AGB stars are quite transparent at visual and near-IR wavelengths, otherwise the variations in visual flux would not be dominated by molecular features.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1502.00032

Spectral analysis of BD +30°623, the peculiar binary central star of the planetary nebula NGC 1514

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NGC 1514 is a complex planetary nebula with a peculiar binary central star (BD +30°623) consisting of a cool star and a hot companion. To date, the parameters of the two stars have not been firmly stablished. We present a detailed spectral analysis of BD +30°623 based on intermediate-resolution CAFOS optical spectra and IUE ultraviolet spectra with the goal of deriving the parameters of the two stars. For this purpose, we used an extensive composite grid of Kurucz and Tübingen NLTE Model-Atmosphere spectra. From the fitting procedure, in terms of the minimum χ^2 method, the best models obtained correspond to a Horizontal-Branch A0 star with $T_{\rm eff} = 9850 \pm 150$ K, $\log g = 3.50 \pm 0.25$, and a hot companion with $T_{\rm eff}$ between 80 000 K and 95 000 K and a $\log g \simeq 5.5$. To our knowledge, this is the first time that the parameters of both stars have been determined accurately through a detailed spectroscopic analysis.

Accepted for publication in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1501.07048

Conference Papers

s-Process enrichment in the planetary nebula NGC 3918

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We present deep, high-resolution ($R \sim 40\,000$) UVES at VLT spectrophotometric data of the planetary nebula NGC 3918. This is one of the deepest spectra ever taken of a planetary nebula. We have identified and measured more than 700 emission lines and, in particular, we have detected very faint lines of several neutron-capture elements (*s*-process elements: Kr, Xe and Rb) that enable us to compute their chemical abundances with unprecedented accuracy, thus constraining the efficiency of the *s*-process and convective dredge-up.

Oral contribution, published in "Highlights of Spanish Astrophysics VIII", the XI Scientific Meeting of the Spanish Astronomical Society held on September 8–12, 2014, in Teruel, Spain, eds. A.J. Cenarro, F. Figueras, C. Hernández-Monteagudo, J. Trujillo & L. Valdivielso
Available from arXiv:1412.2071

Dust production from sub-solar to super-solar metallicity in Thermally Pulsing Asymptotic Giant Branch Stars

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We discuss the dust chemistry and growth in the circumstellar envelopes (CSEs) of Thermally Pulsing Asymptotic

Giant Branch (TP-AGB) star models computed with the COLIBRI code, at varying initial mass and metallicity (Z = 0.001, 0.008, 0.02, 0.04, 0.06).
A relevant result of our analysis deals with the silicate production in M-stars. We show that, in order to reproduce the observed trend between terminal velocities and mass-loss rates in Galactic M-giants, one has to significantly reduce the efficiency of chemi-sputtering by H_2 molecules, usually considered as the most effective dust destruction mechanism. This indication is also in agreement with the most recent laboratory results, which show that silicates may condense already at $T_{\rm cond} \sim 1400$ K, instead than at $T_{\rm cond} \sim 1000$ K, as obtained by models that include chemi-sputtering.
From the analysis of the total dust ejecta, we find that the total dust-to-gas ejecta of intermediate-mass stars are much less dependent on metallicity than usually assumed. In a broader context, our results are suitable to study the dust enrichment of the interstellar medium provided by TP-AGB stars in both nearby and high redshift galaxies.

Oral contribution, published in ASP Conference Series
Available from arXiv:1411.3314

Photometric properties of carbon stars in the Small Magellanic Cloud

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The Optical Gravitational Lensing Experiment identified over 1,800 carbon-rich Mira and semi-regular variables in the Small Magellanic Cloud. Multi-epoch infrared photometry reveals that the semi-regulars and Miras follow different sequences in color–color space when using colors sensitive to molecular absorption bands. The dustiest Miras have the strongest pulsation amplitudes and longest periods. Efforts to determine bolometric magnitudes reveal possible systematic errors with published bolometric corrections.

Oral contribution, published in "Why Galaxies Care About AGB Stars III"
Available from arXiv:1412.1845
and from http://isc.astro.cornell.edu/~sloan/library/2015/smcphot

Why Galaxies Care about AGB Stars: Setting the Stage

Alvio Renzini[1]

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In this introduction to the Third Congress of Vienna on AGB stars I first try to highlight why it is so hard to cope with the AGB evolutionary phase. This phase is indeed dominated by three main physical processes concerning bulk motions of matter inside/around stars, namely envelope convection, mixing and mass loss. They are inextricably interlaced with each other in a circular sequence of reactions and counter-reactions which has so far undermined our attempts at calibrating such processes one independent of the other. The second part of this introduction is focused on Globular Clusters, illustrating how they came to be a *new frontier* for the AGB evolution and a new opportunity to understand it.

Opening talk, published in "Why Galaxies Care About AGB Stars", Vienna, July 28 – August 1, 2014
Available from arXiv:1412.6379

Job Advert

University of Denver, USA Ph.D. position

The planetary nebula (PN) phase marks the last throes of stellar evolution for low to intermediate initial mass stars. During this phase, the circumstellar envelope of gas and dust, which is created by mass loss in the preceding asymptotic giant branch (AGB) and post-AGB phases, undergoes a dramatic transformation – ionization, photo-dissociation, and dynamical shaping – caused by the fast wind and the intense radiation from the central star, as well as the interstellar radiation field from the surrounding interstellar space. As a consequence, a multitude of physical conditions are showcased within PNe around the central star. Therefore, PNe provide excellent astrophysical laboratories to investigate theories of stellar evolution and gas-dust dynamical processes within interacting stellar winds and between the circumstellar and interstellar media.

While PN investigations have been traditionally done through diagnostics of optical emission lines, PNe are bright at a wide range of wavelengths from the radio through the UV, and even in the X-ray. Investigations using far-IR radiation are especially critical to comprehend PNe in their entirety, because a large fraction of the cold nebula mass resides beyond the central ionized region. Among these recent far-IR opportunities, those provided by *Herschel* are unique: Herschel allowed simultaneous probing of the multiple components in PNe via far-IR ionic, atomic, and molecular line emission and thermal dust continuum emission.

This Ph.D. project, funded by the NASA Astrophysics Data Analysis Program (ADAP), will involve performing far-IR line diagnostics of the ionized, neutral, and molecular gas components in PNe using spatially resolved far-IR spectroscopic data obtained as part of the *Herschel* Planetary Nebula Survey (HerPlaNS), augmented with ancillary optical slit-scan/IFU data being collected from various observatories. By combining with far-IR thermal continuum emission data that probe the dust component, we can establish a complete empirical picture of PNe without any assumptions. With the ADAP funding, the scope of the project now encompasses the entire *Herschel* Science Archive beyond the original 11 target PNe – there will be additional 30+ sources with which we can perform the far-IR line/continuum diagnostics and assess the statistical significance of the findings.

The student will work with Prof. Toshiya Ueta, who is the PI of the HerPlaNS and its recently funded ADAP extension. Further inquiries about this position should be addressed to him (Toshiya.Ueta@du.edu).
However, the formal application package will have to be submitted through the graduate school on-line application at http://www.du.edu/apply/graduates/applicationrequirements.html. Please note that there is also a Dean's fellowship opportunity, which includes up to 30 quarter-hours of tuition waiver and a 12-month stipend, plus the standard graduate student health insurance provided by the University, in addition to the support from the ADAP funding.
This fellowship application requires a recommendation letter from Prof. Ueta. Therefore, if you are interested, you must send an email to Prof. Ueta with your short CV immediately and submit your on-line application package soon thereafter, as the selection process of the fellowship starts from February 2 on a first come, first served basis. Furthermore, graduate students can also gain teaching experience as the department offers several teaching assistantship positions each year.

The University of Denver is the oldest and largest private university in the Colorado Rocky Mountain region in the US. The Department of Physics and Astronomy has recently undergone a strong expansion with eight faculty members hired since 2006 in the areas of astrophysics, condensed matter, and biophysics. These hires are coupled with a large expansion across the campus in the sciences and engineering, including approximately 22 new faculty in the Natural Sciences and Mathematics division. Our small but energetic department emphasizes hands-on academic preparation in close contact with the faculty. We provide attentive academic instruction and research mentoring up to the Ph.D. level. In the last three years, 67% of the Ph.D. degrees were earned by female students, which places us in the third place nationally among all Physics and Astronomy programs.

See also http://www.physics.du.edu/

Announcements

EWASS 2015 Special Session #5
AGB stars: a key ingredient in the understanding and interpretation of stellar populations

Registration is now open for the 2015 European Week of Astronomy and Space Science (EWASS 2015, 22–26 June 2015; see http://eas.unige.ch/EWASS2015/index.jsp), with a Special Session (#5) foucussed on AGB stars.

"AGB stars: a key ingredient in the understanding and interpretation of stellar populations"
June 26, La Laguna, Tenerife, Spain
http://eas.unige.ch/EWASS2015/session.jsp?id=Sp5

Aims and scope:

Though extremely short in comparison to the core H- and He-burning phases, the AGB evolution of stars not undergoing core collapse proves essential for a number of astrophysical topics, ranging from the interpretation of infrared data of nearby galaxies to the more complex understanding of extinction curves of high-redshift quasars. AGB stars play a fundamental role in the gas and dust pollution of the interstellar medium, a crucial ingredient for many astrophysical contexts, e.g., the self-enrichment of globular clusters or the chemical evolution of the Galaxy.

This special session will be an important occasion to fix the status of the art of AGB modelling, in terms of the internal nucleosynthesis and of the dust formation process in their winds. It will also provide the opportunity of detailed discussions of the role played by AGB stars in the chemical evolution of the Milky Way and of other galaxies, and of the fundamental but still extremely uncertain contribution from AGB stars to the dust budget at high-redshift.

On the observational side, it will be important to discuss the current and future scenarios offered by forthcoming space missions and ground-based facilities for observation of AGB stars in the Milky Way and in nearby galaxies.

Programme:

- AGB stars: internal structure and nucleosynthesis
- The role of AGB stars in the chemical evolution of galaxies
- Dust from AGB stars
- AGB stars from the Local Universe to high-redshift
- Observations of AGB stars in nearby galaxies
- Future perspectives of observations of AGB stars

Invited speakers:

- Martha Boyer (NASA Goddard Space Flight Center, USA)
- Amanda Karakas (Mt. Stromlo Observatory, Australia)
- Raffaella Schneider (INAF, Observatory of Rome, Italy)

Scientific organizers:

- Anibál García-Hernandez (Chair – IAC, Spain)
- Martin Groenewegen (Royal Observatory of Belgium, Belgium)

- Jacco van Loon (Keele University, UK)
- Paolo Ventura (Chair – INAF, Observatory of Rome, Italy)

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Important dates:
- Abstract submission deadline: 10 March 2015
- Early registration deadline: 30 April 2015

We are looking forward to receiving your abstracts!

Best regards,
Anibál García-Hernandez
Paolo Ventura
Jacco van Loon
Martin Groenewegen

See also http://eas.unige.ch/EWASS2015/session.jsp?id=Sp5

Spectroscopy of exoplanets: ExoMol conference at Cumberland Lodge near to London, UK

After four years of the ExoMol project we will be holding a conference 'Spectroscopy of exoplanets' at Cumberland Lodge near to London. The conference will begin in the morning on 24 July and running through to the evening of 26 July 2015 (departing after breakfast the following day).

Cumberland Lodge is a 17^{th} Century house located in Great Windsor Park. It offers easy access to Heathrow and is close to Windsor Castle, which is the oldest and largest occupied castle in the world and the official residence of Her Majesty the Queen. We would aim to visit the castle during the course of the conference. You may like to look at the Cumberland Lodge website: http://www.cumberlandlodge.ac.uk/

The provisional programme includes sessions on: Spectroscopy of exoplanets, Sources of opacity data (theoretical and laboratory), Characterising exoplanetary atmospheres, Observational issues.

We have gaps for 20 minute talks and posters if you want to present work.

You will find further details including: a registration form, details of payments and abstract submissions on the Conference website.

We very much hope that you will be able to attend the conference.

See also http://www.exomol.com/conference/2015/