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. 186 — 3 January 2013

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

Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

Happy New Year! It is a pleasure to present you the 186$^{\rm th}$ issue of the AGB Newsletter.

There's a job for someone, in Leuven. And a conference for many of us, in Chile.

Last month's Food for Thought ("AGB stars are supernova progenitors") provoked a response from loyal newsletter-reader John Eldridge: "The first important question is 'which type of supernova?' – thermonuclear or core-collapse. I think AGB stars will only in rare situations produce either type of SNe. For such a low mass star that goes through 2$^{\rm nd}$ dredge-up there will only be a supernova if it is in a binary which will typically prevent second dredge-up so the star will never reach the AGB. It has been suggested by many however that at low metallicities AGB stars are viable single-star progenitors to type Ia thermonuclear supernovæ. When the hydrogen envelope is removed at the same time the core reaches $M_{\rm ch}$.While more massive AGB stars that experience core carbon burning are very likely to produce electron-capture core-collapse supernovæ at lower metallicities for the same reason but the hydrogen envelope is not required to be removed at this time. I finally note that no such progenitors have yet been observed in pre-explosion images and would have a distinctive appearance. Most progenitors for II-P SNe appear to be normal red supergiants. However there are some supernovæ such as SN 2008S are possible candidates for explosions of AGB stars." Reactions to this, or to the original statement, are welcomed.

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

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

A fullerene revolution?

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

Star hoppers: planet instability and capture in evolving binary systems

Katilin M. Kratter[1] *and Hagai B. Perets*[1]

[1]Harvard-Smithsonian Center for Astrophysics, USA

Many planets are observed in stellar binary systems, and their frequency may be comparable to that of planetary systems around single stars. Binary stellar evolution in such systems influences the dynamical evolution of the resident planets. Here, we study the evolution of a single planet orbiting one star in an evolving binary system. We find that stellar evolution can trigger dynamical instabilities that drive planets into chaotic orbits. This instability leads to planet–star collisions, exchange of the planet between the binary stars ("star hoppers"), and ejection of the planet from the system. The means by which planets can be recaptured is similar to the pull-down capture mechanism for irregular solar system satellites. Because planets often suffer close encounters with the primary on the asymptotic giant branch, captures during a collision with the stellar envelope are also possible for more massive planets. Such capture could populate the habitable zone around white dwarfs.

Published in The Astrophysical Journal, Volume 753, Issue 1, article id. 91
Available from arXiv:1204.2014

Very deep spectroscopy of the bright Saturn Nebula NGC 7009 – II. Analysis of the rich optical recombination spectrum

Xuan Fang[1] *and Xiao-Wei Liu*[1,2]

[1]Department of Astronomy, School of Physics, Peking University, Beijing, P.R. China
[2]The Kavli Institute for Astronomy and Astrophysics, Peking University, Beijing, P.R. China

In Paper I (Fang & Liu 2011), we presented deep, long-slit spectrum of the bright Saturn nebula NGC 7009. Numerous permitted lines emitted by the C^+, N^+, O^+ and Ne^+ ions were detected. Gaussian profile fitting to the spectrum yielded more than 1000 lines, the majority of which are optical recombination lines (ORLs) of heavy element ions. In the current paper, we present a critical analysis of the rich optical recombination spectrum of NGC 7009, in the context of the bi-abundance nebular model proposed by Liu et al. (2000). Transitions from individual multiplets are checked carefully for potential blended lines. The observed relative intensities are compared with the theoretical predictions based on high quality effective recombination coefficients, now available for the recombination line spectrum of a number of heavy element ions.

The possibility of plasma diagnostics using the ORLs of various heavy element ions is discussed in detail. The line ratios that can be used to determine electron temperature are presented for each ion, although there is still a lack of adequate atomic data and some of the lines are still not detected in the spectrum of NGC 7009 due to weakness and/or line blending. Plasma diagnostics based on the N II and O II recombination spectra both yield electron temperatures close to 1000 K, which is lower than those derived from the collisionally excited line (CEL) ratios (e.g., the [O III] and [N II] nebular-to-auroral line ratios; see Paper I for details) by nearly one order of magnitude. The very low temperatures yielded by the O II and N II ORLs indicate that they originate from very cold regions. The C^{2+}/H^+, N^{2+}/H^+, O^{2+}/H^+ and Ne^{2+}/H^+ ionic abundance ratios derived from ORLs are consistently higher, by about a factor of 5, than the corresponding values derived from CELs. In calculating the ORL ionic abundance ratios, we have used the newly available high quality effective recombination coefficients, and adopted an electron temperature of ~ 1000 K, as given by the ORL diagnostics and as a consequence presumably representing the physical conditions prevailing in the regions where the heavy element ORLs arise. Measurements of the ultraviolet (UV) and infrared (IR) CELs from the literature are used to calculate CEL ionic abundance ratios when optical data are not available for the ionic species. A comparison of results of plasma diagnostics and abundance determinations for NGC 7009 points to the existence of "cold", metal-rich (i.e., H-deficient) inclusions embedded in the hot, diffuse ionized gas, first postulated

by Liu et al. (2000).
At electron temperatures yielded by the N II and O II ORLs, the predicted relative intensities of ORLs agree well with the observed values, indicating that the current quantum calculations of the recombination spectra of those two ionic species well represent the recombination processes under nebular conditions. Deviations from the LS coupling, noticed in an earlier quantitative spectroscopy by Liu et al. for the same object, are again confirmed, especially for recombination lines of the 4f–3d transition array. For N II, as well as for O II, the ionic abundances derived from different J-resolved transitions within a multiplet, or from the transitions belonging to different multiplets, agree with each other. This is another evidence that the new effective recombination coefficients are reliable. New calculations of the effective recombination coefficients for the Ne II lines at nebular temperatures and densities are needed.

Accepted for publication in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1212.0005

The Galactic R Coronæ Borealis stars and the final He-shell flash object V4334 Sgr (Sakurai's Object): a comparison

B.P. Hema[1]*, Gajendra Pandey*[1] *and David L. Lambert*[2]

[1]Indian Institute of Astrophysics, II Block Koramangala, Bangalore 560034, India
[2]The W.J. McDonald Observatory, University of Texas at Austin, TX78712, USA

The high resolution optical spectra of H-deficient stars, R Coronæ Borealis stars and H-deficient carbon stars are analyzed by synthesizing the C_2 Swan bands (0,1), (0,0), and (1,0) using our detailed line-list and Uppsala model atmosphere, to determine the C-abundances and the $^{12}C/^{13}C$ ratios which are potential clues to the formation process of these stars. The C-abundances derived from C_2 bands are 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%). The carbon abundances derived from C I lines are a factor of four lower than that adopted for the model atmosphere over the same C/He interval, as reported by Asplund et al.: "the carbon problem". In principle, the carbon abundances obtained from C_2 Swan bands and that adopted for the model atmosphere can be equated for a particular choice of C/He that varies from star to star (unlike C I lines). Then, the carbon problem for C_2 bands is eliminated. However, such C/He ratios are in general less than those of the extreme helium stars, the seemingly natural relatives to the RCB and HdC stars. 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. The carbon abundance and the $^{12}C/^{13}C$ ratios for the FF product, Sakurai's Object is derived. The carbon abundance in the Sakurai's object is 10 times higher than in the RCB star VZ Sgr. On an average, the carbon abundance in the Sakurai's Object is about 10 to 100 times higher than in RCB stars. The $^{12}C/^{13}C$ ratio in Sakurai's Object is 3.4, the equilibrium value, as expected for FF products.

Accepted for publication in Proceedings of Science
Available from arXiv:1211.6219

Impact of a revised $^{25}Mg(p,\gamma)^{26}Al$ reaction rate on the operation of the Mg–Al cycle

Oscar Straniero[1,2] *and LUNA collaboration*

[1]INAF–Osservatorio di Teramo, Italy
[2]INFN, Napoli, Italy

Proton captures on Mg isotopes play an important role in the Mg–Al cycle active in stellar H-burning regions. In particular, low-energy nuclear resonances in the $^{25}Mg(p,\gamma)^{26}Al$ reaction affect the production of radioactive $^{26}Al^{gs}$ as well as the resulting Mg/Al abundance ratio. Reliable estimations of these quantities require precise measurements of the strengths of low-energy resonances. Based on a new experimental study performed at LUNA, we provide revised

rates of the ^{25}Mg(p,γ)^{26}Al^{gs} and the ^{25}Mg(p,γ)^{26}Al^{m} reactions with corresponding uncertainties. In the temperature range 50 to 150 MK, the new recommended rate of the ^{26}Al^{m} production is up to 5 times higher than previously assumed. In addition, at $T = 100$ MK, the revised total reaction rate is a factor of 2 higher. Note that this is the range of temperature at which the Mg–Al cycle operates in an H-burning zone. The effects of this revision are discussed. Due to the significantly larger ^{25}Mg(p,γ)^{26}Al^{m} rate, the estimated production of ^{26}Al^{gs} in H-burning regions is less efficient than previously obtained. As a result, the new rates should imply a smaller contribution from Wolf–Rayet stars to the galactic ^{26}Al budget. Similarly, we show that the AGB extra-mixing scenario does not appear able to explain the most extreme values of ^{26}Al/^{27}Al, i.e. $> 10^{-2}$, found in some O-rich presolar grains. Finally, the substantial increase of the total reaction rate makes the hypothesis of a self-pollution by massive AGBs a more robust explanation for the Mg–Al anticorrelation observed in globular-cluster stars.

Accepted for publication in ApJ
Available from arXiv:1211.6661

An X-ray and optical light curve model of the eclipsing symbiotic binary SMC 3

Mariko Kato[1] *and Izumi Hachisu*[2]

[1]Keio University, Japan
[2]University of Tokyo, Japan

Some binary evolution scenarios to Type Ia supernovæ include long-period binaries that evolve to symbiotic supersoft X-ray sources in their late stage of evolution. However, symbiotic stars with steady hydrogen burning on the white dwarf's (WD) surface are very rare, and the X-ray characteristics are not well known. SMC 3 is one such rare example and a key object for understanding the evolution of symbiotic stars to Type Ia supernovæ. SMC 3 is an eclipsing symbiotic binary, consisting of a massive WD and red giant (RG), with an orbital period of 4.5 years in the Small Magellanic Cloud. The long-term V light curve variations are reproduced as orbital variations in the irradiated RG, whose atmosphere fills its Roche lobe, thus supporting the idea that the RG supplies matter to the WD at rates high enough to maintain steady hydrogen burning on the WD. We also present an eclipse model in which an X-ray emitting region around the WD is almost totally occulted by the RG swelling over the Roche lobe on the trailing side, although it is always partly obscured by a long spiral tail of neutral hydrogen surrounding the binary in the orbital plane.

Accepted for publication in Astrophys. J. (2013)
Available from arXiv:1211.5728

Far- and mid-infrared spectroscopy of complex organic matter of astrochemical interest: coal, heavy petroleum fractions, and asphaltenes

F. Cataldo[1,2]*, D.A. García-Hernández*[3,4] *and A. Manchado*[3,4,5]

[1]INAF – Osservatorio Astrofisico di Catania, Italy
[2]Actinium Chemical Research srl, Italy
[3]Instituto de Astrofísica de Canarias (IAC), Spain
[4]Universidad de La Laguna (ULL), Spain
[5]CSIC, Spain

The coexistence of a large variety of molecular species (i.e. aromatic, cycloaliphatic and aliphatic) in several astrophysical environments suggests that unidentified infrared emission (UIE) occurs from small solid particles containing a mix of aromatic and aliphatic structures (e.g., coal, petroleum, etc.), renewing the astronomical interest on this type of materials. A series of heavy petroleum fractions namely "Distillate Aromatic Extract" (DAE), "Residual Aromatic Extract" (RAE), heavy aromatic fraction (BQ-1) and asphaltenes derived from BQ-1 were used together

with anthracite coal and bitumen as model compounds in matching the band pattern of the emission features of proto-planetary nebulae (PPNe). All the model materials were examined in the mid-infrared (2.5–16.66 μm) and for the first time in the far-infrared (16.66–200 μm), and the infrared bands were compared with the UIE from PPNe. The best match of the PPNe band pattern is offered by the BQ-1 heavy aromatic oil fraction and by its asphaltenes fraction. Particularly interesting is the ability of BQ-1 to match the band pattern of the aromatic-aliphatic C–H stretching bands of certain PPNe, a result which is not achieved neither by the coal model nor by the other petroleum fractions considered here. This study shows that a new interesting molecular model of the emission features of PPNe are asphaltene molecules which are composed by an aromatic core containing 3–4 condensed aromatic rings surrounded by cycloaliphatic (naphtenic) and aliphatic alkyl chains. It is instead shown the weakness of the model involving a mixture of polycyclic aromatic hydrocarbons (PAHs) for modeling the aromatic infrared emission bands (AIBs). The laboratory spectra of these complex organic compounds represent a unique data set of high value for the astronomical community; e.g., they may be compared with the *Herschel* Space Observatory spectra ($\sim$ 51–220 μm) of several astrophysical environments such as (proto-) Planetary Nebulae, H II regions, reflection nebulae, star forming galaxies, and young stellar objects.

Accepted for publication in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1212.0971
and from http://rialto.ll.iac.es/folleto/research/preprints/?c=view&pre_id=12063

The Infrared Telescope Facility (IRTF) spectral library: spectral diagnostics for cool stars

Mary Cesetti[1,2]*, Alessandro Pizzella*[1,2]*, Valentin D. Ivanov*[3]*, Lorenzo Morelli*[1,2]*, Enrico M. Corsini*[1,2] *and Elena Dalla Bontà*[1,2]

[1]Dipartimento di Fisica e Astronomia "G. Galilei", Università di Padova, vicolo dell'Osservatorio 3, I-35122 Padova, Italy
[2]INAF–Osservatorio Astronomico di Padova, vicolo dell'Osservatorio 5, I-35122 Padova, Italy
[3]European Southern Observatory, Ave. Alonso de Córdova 3107, Casilla 19, Santiago 19001, Chile

Context: The near-infrared (NIR) wavelength range offers some unique spectral features, and it is less prone to the extinction than the optical one. Recently, the first flux calibrated NIR library of cool stars from the NASA Infrared Telescope Facility (IRTF) have become available, and it has not been fully exploited yet.
Aims: We want to develop spectroscopic diagnostics for stellar physical parameters based on features in the wavelength range 1–5 μm. In this work we test the technique in the I and K bands. The study of the Y, J, H, and L bands will be presented in the following paper.
Methods: An objective method for semi-empirical definition of spectral features sensitive to various physical parameters is applied to the spectra. It is based on *sensitivity map* – i.e. derivative of the flux in the spectra with respect to the stellar parameters at a fixed wavelength. New optimized indices are defined and their equivalent widths (EWs) are measured.
Results: The method is applied in the I- and K-band windows of the IRTF stellar spectra to verify the new technique by comparing the results with the known behavior of well-studied spectral features. A number of sensitive features to the effective temperature and surface gravity are re-identified or newly identified clearly showing the reliability of the *sensitivity map* analysis.
Conclusions: The *sensitivity map* allows to identify the best bandpass limits for the line and nearby continuum. It reliably predicts the trends of spectral features with respect to a given physical parameter but not their absolute strengths. Line blends are easy to recognize when blended features have different behavior with respect to some physical stellar parameter. The use of sensitivity map is therefore complementary to the use of indices. We give the EWs of the new indices measured for the IRTF star sample. This new and homogeneous set of EWs will be useful for stellar population synthesis models and can be used to get element-by-element abundances for unresolved stellar population studies in galaxies.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1211.5572

VISIR–VLT high resolution study of the extended emission of four obscured post-AGB candidates

M.W. Blanco[1], *M.A. Guerrero*[1], *G. Ramos-Larios*[2], *L.F. Miranda*[3,4], *E. Lagadec*[5], *O. Suárez*[6] *and J.F. Gómez*[1]

[1]Instituto de Astrofísica de Andalucía (IAA–CSIC), Glorieta de la Astronomía S/N, 18008 Spain

[2]Instituto de Astronomía y Meteorología, Av. Vallarta No. 2602, Col. Arcos Vallarta, 44130 Guadalajara, Jalisco, México

[3]Universidad de Vigo, Departamento de Física aplicada, Facultad de Ciencias, Campus Lagoas-Marcosende s/n, 36310 Vigo, Spain

[4]Consejo Superior de Investigaciones Científicas (CSIC), Madrid, Spain

[5]European Southern Observatory (ESO), Karl Schwarschild Str. 2, Garching bei München, Germany

[6]Laboratoire Lagrange, UMR7293, Université de Nice Sophia-Antipolis, CNRS, Observatoire de la Côte d'Azur, 06300 Nice, France

Context: The onset of the asymmetry of planetary nebulæ (PNe) is expected to occur during the late Asymptotic Giant Branch (AGB) and early post-AGB phases of low- and intermediate-mass stars. Among all post-AGB objects, the most heavily obscured ones might have escaped the selection criteria of previous studies detecting extreme axisymmetric structures in young PNe.
Aims: Since the most heavily obscured post-AGB sources can be expected to descend from the most massive PN progenitors, these should exhibit clear asymmetric morphologies. High-resolution observations of these sources should reveal marked bipolar morphologies, confirming the link between progenitor mass and nebular morphology.
Methods: We have obtained VISIR–VLT mid-IR images of a sample of four heavily obscured post-AGB objects barely resolved in previous *Spitzer* IRAC observations in order to analyze their morphology and physical conditions across the mid-IR. The images obtained in four different mid-IR filters have been deconvolved, flux calibrated, and used to construct RGB composite pictures as well as color (temperature) and optical depth maps that allow us to study the morphology and physical properties of the extended emission of the sources in our sample.
Results: We have detected extended emission from the four objects in our sample and resolved it into several structural components that are greatly enhanced in the temperature and optical depth maps. The morphologies of the sample, as well as their physical conditions, reveal the presence of asymmetry in three young PNe (IRAS 15534−5422, IRAS 17009−4154, and IRAS 18454+0001), where the asymmetries can be associated with dusty tori and slightly bipolar outflows. The fourth source (IRAS 18229−1127), a possible post-AGB star, is better described as a rhomboidal detached shell.
Conclusions: The heavily obscured sources in our sample do not show extreme axisymmetric morphologies. This is at odds with the expectation of highly asymmetrical morphologies in post-AGB sources descending from massive PN progenitors, which is otherwise supported by observations of bright mid-IR unobscured sources. The sources presented in this paper may be sampling critical early phases in the evolution of massive PN progenitors, before extreme asymmetries develop.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1212.1057

Annual parallax distance and secular motion of the water fountain source IRAS 18286−0959

Hiroshi Imai[1,2], *Tomoharu Kurayama*[3], *Mareki Honma*[4] *and Takeshi Miyaji*[4]

[1]Graduate School of Science and Engineering, Kagoshima University, Japan

[2]International Centre for Radio Astronomy Research, The University of Western Australia, Australia

[3]Center for Fundamental Education, Teikyo University of Science, Japan

[4]Mizusawa VLBI Observatory, National Astronomical Observatory of Japan, Japan

We report on results of astrometric observations of H_2O masers in the "water fountain" source IRAS 18286−0959 (I 18286) with the VLBI Exploration of Radio Astrometry (VERA). These observations yielded an annual parallax of I 18286, $\pi = 0.277 \pm 0.041$ mas, corresponding to a heliocentric distance of $D = 3.61^{+0.63}_{-0.47}$ kpc. The maser feature, whose annual parallax was measured, showed the absolute proper motion of $(\mu_\alpha, \mu_\delta) = (-3.2 \pm 0.3, -7.2 \pm 0.2)$ mas yr^{-1}. The intrinsic motion of the maser feature in the internal motions of the cluster of features in I 18286 does not seem to trace the motion of the bipolar jet of I 18286. Taking into account this intrinsic motion, the derived

motion of the maser feature is roughly equal to that of the maser source I 18286 itself. The proximity of I 18286 to the Galactic midplane ($z \approx 10$ pc) suggests that the parental star of the water fountain source in I 18286 should be intermediate-mass AGB/post-AGB star, but the origin of a large deviation of the systemic source motion from that expected from the Galactic rotation curve is still unclear.

Accepted for publication in Publications of the Astronomical Society of Japan
Available from arXiv:1211.6207

Measurement of the -3 keV resonance in the reaction ^{13}C(α,n)^{16}O of importance in the s-process

M. La Cognata[1], *C. Spitaleri*[1,2], *O. Trippella*[1,3], *G.G. Kiss*[1,4], *G.V. Rogachev*[5], *A.M. Mukhamedzhanov*[6], *M. Avila*[5], *G.L. Guardo*[1,2], *E. Koshchiy*[5], *A. Kuchera*[5], *L. Lamia*[2], *S.M.R. Puglia*[1,2], *S. Romano*[1,2], *D. Santiago*[5] *and R. Spartà*[1,2]

[1]Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali del Sud, 95123 Catania, Italy

[2]Dipartimento di Fisica e Astronomia, Università di Catania, 95123 Catania, Italy

[3]Istituto Nazionale di Fisica Nucleare, Sezione di Perugia, Perugia, Italy and Dipartimento di Fisica, Università di Perugia, 06123 Perugia, Italy

[4]Institute of Nuclear Research (ATOMKI), 4026 Debrecen, Hungary

[5]Department of Physics, Florida State University, Tallahassee, Florida 32306, USA

[6]Cyclotron Institute, Texas A&M University, College Station, Texas 77843, USA

The ^{13}C(α,n)^{16}O reaction is the neutron source for the main component of the s-process, responsible for the production of most nuclei in the mass range $90 < A < 204$. It is active inside the helium-burning shell in asymptotic giant branch stars, at temperatures $< 10^8$ K, corresponding to an energy interval where the ^{13}C(α,n)^{16}O is effective from 140 to 230 keV. In this region, the astrophysical S(E)-factor is dominated by the -3 keV subthreshold resonance due to the 6.356 MeV level in ^{17}O, giving rise to a steep increase of the S(E)-factor. Notwithstanding that it plays a crucial role in astrophysics, no direct measurements exist inside the s-process energy window. The magnitude of its contribution is still controversial as extrapolations, e.g., through the R matrix and indirect techniques, such as the asymptotic normalization coefficient (ANC), yield inconsistent results. The discrepancy amounts to a factor of 3 or more right at astrophysical energies. Therefore, we have applied the Trojan horse method to the ^{13}C(^{6}Li,n^{16}O)^{4}He quasifree reaction to achieve an experimental estimate of such contribution. For the first time, the ANC for the 6.356 MeV level has been deduced through the Trojan horse method as well as the n-partial width, allowing to attain an unprecedented accuracy in the ^{13}C(α,n)^{16}O study. Though a larger ANC for the 6.356 MeV level is measured, our experimental S(E)-factor agrees with the most recent extrapolation in the literature in the 140–230 keV energy interval, the accuracy being greatly enhanced thanks to this innovative approach.

Published in Physical Review Letters
Available from http://prl.aps.org/abstract/PRL/v109/i23/e232701

The global gas and dust budget of the Small Magellanic Cloud

M. Matsuura[1], *Paul M. Woods*[1] *and P.J. Owen*[1]

[1]UCL, UK

In order to understand the evolution of the interstellar medium (ISM) of a galaxy, we have analysed the gas and dust budget of the Small Magellanic Cloud (SMC). Using the *Spitzer* Space Telescope, we measured the integrated gas mass-loss rate across asymptotic giant branch (AGB) stars and red supergiants (RSGs) in the SMC, and obtained a rate of 1.4×10^{-3} M$_\odot$ yr^{-1}. This is much smaller than the estimated gas ejection rate from type II supernovæ (SNe) (2–4×10^{-2} M$_\odot$ yr^{-1}). The SMC underwent a an increase in star-formation rate in the last 12 Myrs, and consequently

the galaxy has a relatively high SN rate at present. Thus, SNe are more important gas sources than AGB stars in the SMC. The total gas input from stellar sources into the ISM is 2–4 $\times 10^{-2}$ $M_\odot$ yr^{-1}. This is slightly smaller than the ISM gas consumed by star formation ($\sim 8 \times 10^{-2}$ $M_\odot$ yr^{-1}). Star formation in the SMC relies on a gas reservoir in the ISM, but eventually the star-formation rate will decline in this galaxy, unless gas infalls into the ISM from an external source. The dust injection rate from AGB and RSG candidates is 1×10^{-5} $M_\odot$ yr^{-1}. Dust injection from SNe is in the range of 0.2–11 $\times 10^{-4}$ $M_\odot$ yr^{-1}, although the SN contribution is rather uncertain. Stellar sources could be important for ISM dust (3×10^{-5} $M_\odot$ yr^{-1}) in the SMC, if the dust lifetime is about 1.4 Gyrs. We found that the presence of poly-aromatic hydrocarbons (PAHs) in the ISM cannot be explained entirely by carbon-rich AGB stars. Carbon-rich AGB stars could inject only 7×10^{-9} $M_\odot$ yr^{-1} of PAHs at most, which could contribute up to 100 $M_\odot$ of PAHs in the lifetime of a PAH. The estimated PAH mass of 1800 $M_\odot$ in the SMC can not be explained. Additional PAH sources, or ISM reprocessing should be needed.

Accepted for publication in MNRAS
Available from arXiv:1212.1468

The contribution of thermally-pulsing Asymptotic Giant Branch and red supergiant stars to the luminosities of the Magellanic Clouds at 1–24 μm

J. Melbourne[1] *and Martha L. Boyer*[2]

[1]Caltech, USA
[2]NASA GSFC, USA

We present the near- through mid-infrared flux contribution of thermally-pulsing asymptotic giant branch (TP-AGB) and massive red supergiant (RSG) stars to the luminosities of the Large and Small Magellanic Clouds (LMC and SMC, respectively). Combined, the peak contribution from these cool evolved stars occurs at $\sim$ 3–4 μm, where they produce 32% of the SMC light, and 25% of the LMC flux. The TP-AGB star contribution also peaks at $\sim$ 3–4 μm and amounts to 21% in both galaxies. The contribution from RSG stars peaks at shorter wavelengths, 2.2 μm, where they provide 11% of the SMC flux, and 7% for the LMC. Both TP-AGB and RSG stars are short lived, and thus potentially impose a large stochastic scatter on the near-IR derived mass-to-light ratios of galaxies at rest-frame 1–4 μm. To minimize their impact on stellar mass estimates, one can use the M/L ratio at shorter wavelengths (e.g., at 0.8–1 μm). At longer wavelengths ($\geq$ 8 μm), emission from dust in the interstellar medium dominates the flux. In the LMC, which shows strong PAH emission at 8 μm, TP-AGB and RSG contribute less than 4% of the 8-μm flux. However, 19% of the SMC 8-μm flux is from evolved stars, nearly half of which is produced by the rarest, dustiest, carbon-rich TP-AGB stars. Thus, star formation rates of galaxies, based on an 8-μm flux (e.g., observed-frame 24 μm at $z = 2$), may be biased modestly high, especially for galaxies with little PAH emission.

Accepted for publication in ApJ
Available from arXiv:1212.4169

Extension of the C star rotation curve of the Milky Way to 24 kpc

P. Battinelli[1]*, S. Demers*[2]*, C. Rossi*[3] *and K.S. Gigoyan*[4]

[1]Osservatorio Astronomico di Roma, Viale del Parco Mellini 84, 00136 Roma, Italy
[2]Département de Physique, Université de Montréal, CP 6128, Succursale Centre-Ville, Montréal, Qc, H3C3J7, Canada
[3]Dipartimento di Fisica, Universita "La Sapienza", Piazzale a. Moro 2, 00185 Roma, Italy
[4]V.A. Ambartsumian Byurakan Astrophysical Observatory, 0213, Aragatsotn Marz, Armenia

Demers & Battinelli published, in 2007 the rotation curve of the Milky Way based on the radial velocity of carbon (C) stars outside the Solar circle. Since then we have established a new list of candidates for spectroscopy. The goal

of this paper is to determine the rotation curve of the Galaxy, as far as possible from the Galactic Center, using N-type C stars. The stars were selected from their dereddened 2MASS colours, then the spectra were obtained with the Dominion Astrophysical Observatory and Asiago 1.8-m telescopes. This publication adds radial velocities and Galacto-centric distances of 36 C stars, from which 20 are new confirmed. The new results for stars up to 25 kpc from the Galactic Center, suggest that the rotation curve shows a slight decline beyond the Solar circle.

Accepted for publication in Astrophysics
Available from arXiv:1212.1116

A new model for mixing by double-diffusive convection (semi-convection). II. The transport of heat and composition through layers

Toby S. Wood[1], *Pascale Garaud*[1] *and Stephan Stellmach*[2]

[1]University of California Santa Cruz, USA

[2]Institut für Geophysik, Westfälische Wilhelms-Universität Münster, Germany

Regions of stellar and planetary interiors that are unstable according to the Schwarzschild criterion, but stable according to the Ledoux criterion, are subject to a form of oscillatory double-diffusive (ODD) convection often called "semi-convection". In this series of papers, we use an extensive suite of three-dimensional (3D) numerical simulations to quantify the transport of heat and composition by ODD convection, and ultimately propose a new 1D prescription that can be used in stellar and planetary structure and evolution models. The first paper in this series demonstrated that under certain conditions ODD convection spontaneously transitions from an initially homogeneously turbulent state into a staircase of convective layers, which results in a substantial increase in the transport of heat and composition. Here, we present simulations of ODD convection in this layered regime, we describe the dynamical behavior of the layers, and we derive empirical scaling laws for the transport through layered convection.

Submitted to The Astrophysical Journal
Available from arXiv:1212.1218

An aluminium tool for multiple stellar generations in the globular clusters 47 Tuc and M 4

Eugenio Carretta[1], *Raffaele G. Gratton*[2], *Angela Bragaglia*[1], *Valentina D'Orazi*[3,4] *and Sara Lucatello*[2]

[1]INAF–Osservatorio Astronomico di Bologna, Italy

[2]INAF–Osservatorio Astronomico di Padova, Italy

[3]Dept. of Physics and Astronomy, Macquarie University, Australia

[4]Monash Centre for Astrophysics, Australia

We present aluminium abundances for a sample of about 100 red giant stars in each of the Galactic globular clusters 47 Tuc (NGC 104) and M 4 (NGC 6121). We have derived homogeneous abundances from intermediate-resolution FLAMES/GIRAFFE spectra. Aluminium abundances are from the strong doublet Al I at 8772–8773 Å as in previous works done for giants in NGC 6752 and NGC 1851, and nitrogen abundances are extracted from a large number of features of the CN molecules, by assuming a suitable carbon abundance. We added previous homogeneous abundances of O and Na and newly derived abundances of Mg and Si for our samples of 83 stars in M 4 and 116 stars in 47 Tuc to obtain the full set of elements from proton-capture reactions produced by different stellar generations in these clusters. By simultaneously studying the Ne–Na and Mg–Al cycles of H-burning at high temperature our main aims are to understand the nature of the polluters at work in the first generation and to ascertain whether the second generation of cluster stars was formed in one or, rather, several episodes of star formation. Our data confirm that in M 4 only two stellar populations are visible. On the other hand, for 47 Tuc a cluster analysis performed on our full dataset suggests

that at least three distinct groups of stars are present on the giant branch. The abundances of O, Na, Mg and Al in the intermediate group can be produced within a pollution scenario; results for N are ambiguous, depending on the C abundance we adopt for the three groups.

Accepted for publication in Astronomy and Astrophysics
Available from arXiv:1212.1169

Polarimetric studies of carbon stars at high Galactic latitude

Aruna Goswami[1] *and Drisya Karinkuzhi*[1]

[1]Indian Institute of Astrophysics, Bangalore, India

Very little is known about the polarimetric properties of CH stars and carbon-enhanced metal-poor (CEMP) stars, although many of these objects have been studied in detail both photometrically and spectroscopically. We aim to derive polarimetric properties for a large sample of CEMP stars and CH stars to fill this gap. Multiband polarimetric observations were conducted in the first run for a sample of twenty-nine objects that include twenty-two CEMP and CH stars and seven polarization standards. Estimates of polarization were obtained using standard procedures of polarization calculation. Five objects in our sample do not show any significant polarization over the different colours of $BVRI$. For the rest of the objects the derived percentage polarization estimates are $\leq 1\%$, and they are found to exhibit random behaviour with respect to the inverse of the effective wavelength of observations. Polarization also does not seem to have any correlation with the effective temperatures of the stars. Our polarimetric estimates indicate there are circumstellar envelopes around these stars that are spherically symmetric or envelopes with little or no dust. In the plane of differential polarization, defined as the difference between the maximum and the minimum polarizations within the $BVRI$-bands, versus their visual magnitude, the stars appear to be confined to a narrow band. The implication of this trend for understanding the nature of the circumstellar environment remains to be determined and requires detailed modelling.

Accepted for publication in Astronomy and Astrophysics
Available from arXiv:1212.4276

Large-scale environments of binary AGB stars probed by *Herschel* – I. Morphology statistics and case studies of R Aquarii and W Aquilæ

A. Mayer[1], *A. Jorissen*[2], *F. Kerschbaum*[1], *R. Ottensamer*[1,6], *W. Nowotny*[1], *N.J.L. Cox*[3], *B. Aringer*[1], *J.A.D.L. Blommaert*[3,7], *L. Decin*[3], *S. van Eck*[2], *H.-P. Gail*[4], *M.A.T. Groenewegen*[5], *K. Kornfeld*[1], *M. Mecina*[1], *Th. Posch*[1], *B. Vandenbussche*[3] *and C. Waelkens*[3]

[1]University of Vienna, Department of Astrophysics, Türkenschanzstraße 17, 1180 Wien, Austria

[2]Institut d'Astronomie et d'Astrophysique, Université Libre de Bruxelles, CP. 226, Boulevard du Triomphe, 1050 Brussels, Belgium

[3]Instituut voor Sterrenkunde, KU Leuven, Celestijnenlaan, 200D, 3001 Leuven, Belgium

[4]Institut für Theoretische Astrophysik, Zentrum für Astronomie, Universität Heidelberg, Albert-Überle-Str. 2, 69120 Heidelberg, Germany

[5]Koninklijke Sterrenwacht van België, Ringlaan 3, 1180 Brussels, Belgium

[6]Institute of Computer Vision and Graphics, TU Graz, Infeldgaße 16/II, 8010 Graz, Austria

[7]Department of Physics and Astrophysics, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

The Mass loss of Evolved StarS (MESS) sample offers a selection of 78 asymptotic giant branch (AGB) stars and red supergiants (RSGs) observed with the PACS photometer on-board *Herschel* at 70 μm and 160 μm. For most of these objects, the dusty AGB wind is not spherically symmetric and the wind shape can be subdivided into four classes. In the present paper we concentrate on the influence of a companion on the morphology of the stellar wind. Literature was searched to find binaries in the MESS sample, which were subsequently linked to their wind-morphology class to assert that the binaries are not distributed equally among the classes. In the second part of the paper we concentrate

on the circumstellar environment of the two prominent objects R Aqr and W Aql. Each shows a characteristic signature of a companion interaction with the stellar wind. For the symbiotic star R Aqr, PACS revealed two perfectly opposing arms that in part reflect the previously observed ring-shaped nebula in the optical. However, from the far-IR there is evidence that the emitting region is elliptical rather than circular. The outline of the wind of W Aql seems to follow a large Archimedean spiral formed by the orbit of the companion but also shows strong indications of an interaction with the interstellar medium. We investigated the nature of the companion of W Aql and found that the magnitude of the orbital period supports the size of the spiral outline.

Published in A&A 549, A69 (2013)
Available from arXiv:1211.3595

Probing the '30-μm' feature: lessons from extreme C stars

Stephen J. Messenger[1]*, Angela Speck*[2] *and Kevin Volk*[3]

[1]Massachusetts Institute of Technology, USA
[2]University of Missouri, USA
[3]Space Telescope Science Institute, USA

Some carbon-rich evolved stars exhibit a very prominent spectral feature at $\sim$ 30 μm. The C-rich nature of these objects suggests that the carrier is a sulfide, carbide, or other substance apt to form in a reducing environment. However, the carrier of this spectral feature remains disputed, with magnesium sulfide (MgS) as the most favored candidate. In order to investigate the carrier of the '30-μm' feature further, we have taken a dual approach, studying both laboratory and observational data. In order to obtain a homogeneous sample, we studied the '30-μm' feature observed in the spectra of Galactic extreme carbon stars that exhibit the 11-μm SiC absorption feature. Thus, we avoid potential differences in the target objects that could contribute to the observed differences in the shape, position, and strength of the '30-μm' feature. In addition, we analyzed the shape and position of the '30-μm' features for a range of sulfide minerals for which laboratory data exists. Our study of observed astronomical features shows a range of shapes and positions for the '30-μm' feature despite similarities in the source objects. The nature of our sample argues against grain processing or temperature differences due to hardening of the stellar radiation field with evolution. While there are very few correlations between spectral parameters for our sample, the peak positions of the $\sim$ 11-μm absorption and 30-μm emission features do correlate, and these peak positions correlate with the modeled optical depth. These correlations suggest the carriers of the observable spectral features are closely related to one another and to the density/pressure in the dust formation zone. Furthermore, we suggest that the blue-broadening of the 11-μm feature cannot be attributed to SiS_2 based on existing laboratory spectra, but further lab work is needed to investigate the effect of increasing oxidation.

Accepted for publication in Astrophysical Journal

Variable stars and the Asymptotic Giant Branch: stellar pulsations, dust production, and mass loss

Angela K. Speck[1]

[1]University of Missouri, USA

Low- and intermediate-mass stars (1–8 $M_\odot$; LIMS) are very important contributors of material to the interstellar medium (ISM), and yet the mechanisms by which this matter is expelled remain a mystery. In this paper we discuss how interferometry plays a role in studying the interplay between pulsation, mass loss, dust formation and evolution of these LIMS.

Published in Journal of the American Association of Variable Star Observers
Available from http://www.aavso.org/ejaavso401244

Geometry and velocity structure of HD 44179's bipolar jet

Joshua D. Thomas[1], *Adolf N. Witt*[1], *Jason P. Aufdenberg*[2], *Jon E. Bjorkman*[1], *Julie A. Dahlstrom*[3], *L.M. Hobbs*[4] *and Donald G. York*[5]

[1]Ritter Astrophysical Research Center, The University of Toledo, Toledo, OH 43606, USA

[2]Physical Sciences Department, Embry–Riddle Aeronautical University, Daytona Beach, FL 32114, USA

[3]Department of Physics and Astronomy, Carthage College, Kenosha, WI 53140, USA

[4]Yerkes Observatory, The University of Chicago, Williams Bay, WI 53191, USA

[5]Department of Astronomy & Astrophysics and The Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA

In this paper we analyse a set of 33 optical spectra, which were acquired with the ARCES echelle spectrograph ($R = 38,000$) on the 3.5-m telescope at the Apache Point Observatory. We examine the Hα profile in each of these observations in order to determine the geometry and velocity structure of the previously discovered bipolar jet, which originates from the secondary star of HD 44179 located at the centre of the Red Rectangle nebula. Using a 3D geometric model we are able to determine the orbital coverage during which the jet occults the primary star. During the occultation, part of the Hα line profile appears in absorption. The velocity structure of the jet was determined by modelling the absorption line profile using the Sobolev approximation for each orbital phase during which we have observations. The results indicate the presence of a wide angle jet, likely responsible for observed biconical structure of the outer nebula. Furthermore, we were able to determine a likely velocity structure and rule out several others. We find that the jet is comprised of low-density, high-velocity, central region and a higher-density, lower-velocity, conical shell.

Accepted for publication in The Monthly Notices of the Royal Astronomical Society
Available from arXiv:1212.5735

Electron temperatures and free-electron energy distributions of nebulæ from C II dielectronic recombination lines

Peter Storey[1] *and Taha Sochi*[1]

[1]University College London, UK

A recently generated theoretical line list of C II dielectronic recombination lines together with observational data gathered from the literature is used to investigate the electron temperature in a range of astronomical objects, mainly planetary nebulæ. The electron temperature is obtained by a least-squares optimisation using all the reliable observed lines in each object. In addition, the subset of lines arising directly from autoionising states is used to directly determine the free-electron energy distribution which is then compared with various theoretical possibilities. The method described here can potentially determine whether there are departures from Maxwell–Boltzmann distributions in some nebulæ, as has been recently proposed. Using published observations of the three planetary nebulæ where the relevant lines are recorded, we find that the data are best matched by Maxwell–Boltzmann distributions but that the uncertainties are sufficiently large at present that κ-distributions or two-component nebular models are not excluded.

Accepted for publication in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1212.4513

Water ice in high mass-loss rate OH/IR stars

Kyung-Won Suh[1] *and Young-Joo Kwon*[1]

[1]Dept. of Astronomy and Space Science, Chungbuk National University, South Korea

We investigate water-ice features in spectral energy distributions (SEDs) of high mass-loss rate OH/IR stars. We use a radiative transfer code which can consider multiple components of dust shells to make model calculations for various

dust species including water ice in the OH/IR stars. We find that the model SEDs are sensitively dependent on the location of the water-ice dust shell. For two sample stars (OH 127.8+0.0 and OH 26.5+0.6), we compare the detailed model results with the infrared observational data including the spectral data from the Infrared Space Observatory (ISO). For the two sample stars, we reproduce the crystalline water-ice features (absorption at 3.1 μm and 11.5 μm; emission at 44 and 62 μm) observed by ISO using a separate component of the water-ice dust shell that condensed at about 84–87 K ($r \sim 1500$–1800 au) as well as the silicate dust shell that condensed at about 1000 K ($r \sim 19$–25 au). For a sample of 1533 OH/IR stars, we present infrared two-color diagrams (2CDs) using the Infrared Astronomical Satellite and AKARI data compared with theoretical model results. We find that the theoretical models clearly show the effects of the crystalline water-ice features (absorption at 11.5 μm and emission at 62 μm) on the 2CDs.

Accepted for publication in Astrophysical Journal

Properties of OH, SiO, and H_2O maser emission in O-rich AGB stars

Young-Joo Kwon[1] *and Kyung-Won Suh*[1]

[1]Dept. of Astronomy and Space Science, Chungbuk National University, South Korea

We investigate the properties of OH, SiO, and H_2O maser emission in O-rich AGB stars. We use a sample of 3373 objects, which is an updated version of the list of O-rich AGB stars presented in Suh & Kwon (2011). We divide the 3373 O-rich AGB stars into four different groups based on the maser emission: OH maser sources (1533), SiO sources (1627), H_2O sources (452), and sources with no maser (610). To understand the nature of the maser sources, we present various infrared two-color diagrams (2CDs) using IRAS, 2MASS, and AKARI data. For each group, we compare the positions on various infrared 2CDs with theoretical models. We find that the OH maser sources generally show larger color indices and larger dust optical depths than SiO or H_2O sources. We suggest that the differences of the color indices for different maser sources are due to different mass-loss rates and dust formation processes.

Accepted for publication in Journal of the Korean Astronomical Society

Thermonuclear reaction rate of $^{18}O(p,\gamma)^{19}F$

M.Q. Buckner[1,2]*, C. Iliadis*[1,2]*, J.M. Cesaratto*[1,2]*, C. Howard*[1,2]*, T.B. Clegg*[1,2]*, A.E. Champagne*[1,2] *and S. Daigle*[1,2]

[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, 27599, USA

[2]Triangle Universities Nuclear Laboratory, Durham, NC 27708, USA

For stars with $0.8\ M_\odot \leq M \leq 8.0\ M_\odot$, nucleosynthesis enters its final phase during the asymptotic giant branch (AGB) stage. During this evolutionary period, grain condensation occurs in the stellar atmosphere, and the star experiences significant mass loss. The production of presolar grains can often be attributed to this unique stellar environment. A subset of presolar oxide grains features dramatic ^{18}O depletion that cannot be explained by the standard AGB star burning stages and dredge-up models. An extra mixing process, referred to as *cool bottom processing* (CBP), was proposed for low-mass AGB stars. The ^{18}O depletion observed within certain stellar environments and within presolar grain samples may result from the ^{18}O + p processes during CBP. We report here on a study of the $^{18}O(p,\gamma)^{19}F$ reaction at low energies. Based on our new results, we found that the resonance at $E_R^{lab} = 95$ keV has a negligible affect on the reaction rate at the temperatures associated with CBP. We also determined that the direct capture S-factor is almost a factor of 2 lower than the previously recommended value at low energies. An improved thermonuclear reaction rate for $^{18}O(p,\gamma)^{19}F$ is presented.

Published in Phys. Rev. C 86, 065804 (2012)
Available from arXiv:1212.1126
and from http://prc.aps.org/abstract/PRC/v86/i6/e065804

Diffuse interstellar bands in fullerene planetary nebulæ: the fullerenes – diffuse interstellar bands connection

D.A. García-Hernández[1,2] *and J.J. Díaz-Luis*[1,2]

[1]Instituto de Astrofísica de Canarias (IAC), Spain

[2]Universidad de La Laguna (ULL), Spain

We present high-resolution ($R \sim 15\,000$) VLT/UVES optical spectra of two planetary nebulæ (PNe; Tc 1 and M 1-20) where C_{60} (and C_{70}) fullerenes have already been found. These spectra are of high quality ($S/N > 300$) for PN Tc 1, which permits us to search for the expected electronic transitions of neutral C_{60} and diffuse interstellar bands (DIBs). Surprisingly, we report the non-detection of the most intense optical bands of C_{60} in Tc 1, although this could be explained by the low C_{60} column density estimated from the C_{60} infrared bands if the C_{60} emission peaks far away from the central star. The strongest and most common DIBs in both fullerene PNe are normal for their reddening. Interestingly, the very broad 4428-Å DIB and the weaker 6309-Å DIB are found to be unusually intense in Tc 1. We also report the detection of a new broad ($FWHM \sim 5$ Å) unidentified band at ~ 6525 Å. We propose that the 4428-Å DIB (probably also the 6309-Å DIB and the new 6525-Å band) may be related to the presence of larger fullerenes (e.g., C_{80}, C_{240}, C_{320}, and C_{540}) and buckyonions (multishell fullerenes such as $C_{60}@C_{240}$ and $C_{60}@C_{240}@C_{540}$) in the circumstellar envelope of Tc 1.

Accepted for publication in Astronomy & Astrophysics Letters
Available from arXiv:1301.0242
and from http://rialto.ll.iac.es/folleto/research/preprints/?c=view&pre_id=13002

Conference Paper

Hydrodynamic studies of the evolution of Recurrent, Symbiotic, and Dwarf Novæ: the White Dwarf components are growing in mass

Sumner Starrfield[1]*, F.X. Timmes*[1]*, C. Iliadis*[2]*, W.R. Hix*[3]*, W.D. Arnett*[4]*, C. Meakin*[5] *and W.M Sparks*[5]

[1]School of Earth and Space Exploration, ASU, Tempe, AZ 85287-1404, USA

[2]Dept. of Physics and Astronomy, UNC, Chapel Hill, NC, 27599-3255, USA

[3]Dept. of Physics and Astronomy, UT, Knoxville, TN 37996-1200, USA

[4]Dept. of Astronomy, UA, Tucson, AZ 85721, USA

[5]Los Alamos National Laboratory, Los Alamos, NM 87545, USA

Symbiotic binaries are systems with white dwarfs (WDs) and red giant companions. Symbiotic novæ are those systems in which thermonuclear eruptions occur on the WD components. These are to be distinguished from events driven by accretion disk instabilities analogous to Dwarf Novæ eruptions in Cataclysmic Variable outbursts. Another class of Symbiotic systems are those in which the WD is extremely luminous and it seems likely that quiescent nuclear burning is ongoing on the accreting WD. A fundamental question is the secular evolution of the WD. Do the repeated outbursts or quiescent burning in these accreting systems cause the WD to gain or lose mass? If it is gaining mass, can it eventually reach the Chandrasekhar Limit and become a supernova (a SN Ia if it can hide the hydrogen and helium in the system)? In order to better understand these systems, we have begun a new study of the evolution of Thermonuclear Runaways (TNRs) in the accreted envelopes of WDs using a variety of initial WD masses, luminosities, and mass accretion rates. We use our 1-D hydro code, NOVA, which includes the new convective algorithm of Arnett, Meakin & Young, the Hix & Thielemann nuclear reaction solver, the lliadis reaction rate library, the Timmes equation of state, and the OPAL opacities. We assume a solar composition (Lodders abundance distribution) and do *not* allow any mixing of accreted material with core material. This assumption strongly influences our results. We report here (1) that the WD grows in mass for all simulations so that "steady burning" does not occur, and (2) that only a small fraction of the accreted matter is ejected in some (but not all) simulations. We also find that the accreting systems, before thermonuclear runaway, are too cool to be seen in X-ray searches for SN Ia progenitors.

Oral contribution, published in Asiago Workshop on Symbiotic Binary Systems, July 2011
Available from arXiv:1211.6145

Job Advert

Post-AGB stars in the Small and Large Magellanic Clouds as unique tracers of stellar evolution

With this vacancy, we are looking for a highly motivated young post-doctoral researcher to join the Insitute of Astronomy (Instituut voor Sterrenkunde or IvS) to exploit the scientific potential of the newly found and characterised large sample of post-AGB stars in the Large and Small Magellanic clouds (LMC, SMC respectively). The successful candidate will use high-quality data of individual objects, (partly already obtained on the Very Large Telescope of the European Southern Observatory) to decipher the chemical content of their photospheres. Detailed comparison with tailored, state-of-the-art chemical evolutionary models, will allow him/her to put stringent constraints on the nucleosynthesis and mixing processes active in stars. The goal is to obtain a better quantified understanding of the yields and role of solar-like stars in the chemical evolution of galaxies. The project is embedded in a larger theoretical and observational collaborative effort at the IvS, to study in detail the final evolution of stars of low-and intermediate-initial mass.

Who are we?

The IvS of the KU Leuven University is a young and active research group of some 50 scientists, engineers and administrative staff (http://www.ster.kuleuven.be). The institute is involved in several international networks and research projects which rely on data gathered with telescopes at international observatories and with space missions. The institute's key areas of expertise are stellar structure and evolution (asteroseismology, evolved stellar evolution and circumstellar astrophysics) and astronomical instrumentation (both ground-based as well as space-borne). The IvS also operates the 1.2-m Mercator Telescope at Roque de los Muchachos observatory. The IvS is responsible for the organisation of the Master in Astronomy & Astrophysics of the Faculty of Science.

Profile:

We are looking for a highly motivated candidate (m/f) who:

- recently obtained a PhD in Astrophysics;
- has an excellent track record of peer-reviewed publications on themes related to final stages of stellar evolution;
- has good knowledge of tools to interpret stellar data;
- has a proven expertise on observational or theoretical stellar astrophysics;
- has good knowledge of Scientific English;
- is well familiar with at least one computer language. Knowledge of Python is a bonus.

Tasks:

The successful candidate will spend most of the time on research in the context of the program and will:

- assist the project leader in the writing of and reporting for research grants (5% of the time);
- perform at least one observing run of two weeks per year for the pooled IvS programmes at the observatories of La Palma (Spain);
- take up a teaching task and/or research classes in Bachelor of Physics or the Master in Astronomy and Astrophysics with a maximum of 4 hours/week.

The successful candidate shall have the opportunity to act as thesis supervisor for master thesis students.

Contract:

Following the usual procedure at KU Leuven University, the contract runs over two years, but may extended, depending on the funding. The position is to be taken up as soon as possible. Applicants are requested to indicate their availability in their application (not later than May 2013).

Salary is according to the university regulations for postdoctoral researchers and depends on age and work experience.

Applications:

Send a full curriculum vitæ and a 1-page motivation letter to:

Prof. Dr. Hans Van Winckel
Hans.VanWinckel@ster.kuleuven.be

The candidates also must arrange for three letters of recommendation to be sent electronically to the same email address.

The application and recommendation letter deadline is 1 February 2013. Only complete applications will be considered.

Contact Information:

Prof. H. Van Winckel
Instituut voor Sterrenkunde
Celestijnenlaan 200D
B-3001 Leuven
Belgium
Email: Hans.VanWinckel@ster.kuleuven.be
Website: www.ster.kuleuven.be

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

Announcement

The Deaths of Stars and the Lives of Galaxies
Santiago, Chile, 8–12 April 2013

We are pleased to announce the workshop "The deaths of stars and the lives of galaxies", to be held in Santiago, Chile, 8–12 April 2013.

The meeting will cover topics related to the final stages of stellar evolution and the many important aspects of astronomy that depend on understanding how stars die and what happens to their remnants. The meeting will bring together researchers in quite diverse areas of stellar astrophysics, but which actually have strong connections.

The broad themes to be covered by the meeting will be

1. Channels of stellar death: how well do we understand what happens to stars in all mass ranges at the end of their lives? Do all massive stars explode as supernovæ? Do all low to intermediate mass stars become planetary nebulæ? What are the SN 2008S-type luminous transients?

2. Products of stellar death: what are the sources of the abundant dust in the high redshift universe? Which stars produce carbon? Do we understand the chemical evolution of galaxies?

3. Stellar death in an extragalactic context: Type Ia supernovæ as stellar candles in cosmology, the planetary nebula luminosity function, planetary nebulæ in between galaxies, planetary nebulæ as probes of galactic kinematics, evolved star research in the E-ELT era.

The deadline for submission of abstracts is 31 January, and the deadline for registration is 28 February. The conference can accommodate up to 120 people.

Conference e-mail: dslg2013@eso.org

See also http://www.eso.org/dslg2013/