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. 224 — 2 March 2016

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 224$^{\rm th}$ issue of the AGB Newsletter.

Sadly we must open with the shocking news that Mike Jura has passed away. Many of you will know Mike from his work, as a collaborator, or as a friend. Mike made huge contributions to our knowledge of the mass loss and dust production from cool evolved stars in the Milky Way, both in terms of the individual sources and as a population. Over the past decade or so Mike established the new field of white dwarf pollution, which gives us an entirely new view on what happened on the preceding AGB. We expect to be publishing an obituary in next month's issue; given the suddenness of Mike's departure one can imagine that to require a little bit of time. He will be missed, but remembered and consciously or unconsciously he will remain an inspiration for much of our work.

Changing to a more pleasant occasion, we wish to congratulate Emilio Lapenna with obtaining his Ph.D. – well done!

And if jobs are what one is looking for, there is an advertisement for a faculty position in Chile and one for a post-doctoral position in Leuven.

The Fizeau programme to support work visits to transfer knowledge of interferometry is still continuing, so consider this if you want to engage with that exciting and fast-developping observational technique. We also encourage you to have a look at the reasons why attending this year's "Cool Stars" conference may be particularly interesting.

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

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

Food for Thought

This month's thought-provoking statement is:

Interaction between convection and pulsation can explain sequence D in the Wood Diagram

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

Refereed Journal Papers

Sulphur molecules in the circumstellar envelopes of M-type AGB stars

Taissa Danilovich[1], E. De Beck[1], J.H. Black[1], H. Olofsson[1] and K. Justtanont[1]

[1]Onsala Space Observatory, Department of Earth and Space Sciences, Chalmers University of Technology, 439 92 Onsala, Sweden

The sulphur compounds SO and SO_2 have not been widely studied in the circumstellar envelopes of asymptotic giant branch (AGB) stars. By presenting and modelling a large number of SO and SO_2 lines in the low mass-loss rate M-type AGB star R Dor, and modelling the available lines of those molecules in a further four M-type AGB stars, we aim to determine their circumstellar abundances and distributions. We use a detailed radiative transfer analysis based on the accelerated lambda iteration method to model circumstellar SO and SO_2 line emission and molecular data files for both SO and SO_2 that are more extensive than those previously available. Using 17 SO lines and 98 SO_2 lines to constrain our models for R Dor, we find an SO abundance of 6.7×10^{-6} and an SO_2 abundance of 5×10^{-6} with both species having high abundances close to the star. We also modelled ^{34}SO and found an abundance of 3.1×10^{-7}, giving an $^{32}SO/^{34}SO$ ratio of 21.6. We derive similar results for the circumstellar SO and SO_2 abundances and their distributions for the low mass-loss rate object W Hya. For these stars, the circumstellar SO and SO_2 abundances are much higher than predicted by chemical models and these two species may account for all available sulphur. For the higher mass-loss rate stars, we find shell-like SO distributions with peak abundances that decrease and peak abundance radii that increase with increasing mass-loss rate. The positions of the peak SO abundance agree very well with the photodissociation radii of H_2O. We find evidence that SO is most likely through the photodissociation of H_2O and the subsequent reaction between S and OH. The S-bearing parent molecule appears not to be H_2S. The SO_2 models suggest an origin close to the star for this species, also disagreeing with current chemical models.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1602.00517

Three new low-energy resonances in the ^{22}Ne(p,γ)^{23}Na reaction

F. Cavanna[1], R. Depalo[2], M. Aliotta[3], M. Anders[4,5], D. Bemmerer[5], A. Best[6], A. Boeltzig[7], C. Broggini[8], C.G. Bruno[3], A. Caciolli[2], P. Corvisiero[1], T. Davinson[3], A. di Leva[9], Z. Elekes[10], F. Ferraro[1], A. Formicola[6], Zs. Fülöp[10], G. Gervino[11], A. Guglielmetti[12], C. Gustavino[13], Gy. Gyürky[10], G. Imbriani[9], M. Junker[6], R. Menegazzo[8], V. Mossa[14], F.R. Pantaleo[14], P. Prati[1], D.A. Scott[3], E. Somorjai[10], O. Straniero[15], F. Strieder[16], T. Szücs[5], M.P. Takács[4,5] and D. Trezzi[12]

[1]Università degli Studi di Genova and INFN, Sezione di Genova, Via Dodecaneso 33, 16146 Genova, Italy
[2]Università degli Studi di Padova and INFN, Sezione di Padova, Via F. Marzolo 8, 35131 Padova, Italy
[3]SUPA, School of Physics and Astronomy, University of Edinburgh, EH9 3FD Edinburgh, United Kingdom
[4]Technische Universität Dresden, Institut für Kern- und Teilchenphysik, Zellescher Weg 19, 01069 Dresden, Germany
[5]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstr. 400, 01328 Dresden, Germany
[6]Laboratori Nazionali del Gran Sasso (LNGS), 67100 Assergi (AQ), Italy
[7]Gran Sasso Science Institute, 67100 L'Aquila, Italy
[8]INFN, Sezione di Padova, Via F. Marzolo 8, 35131 Padova, Italy
[9]Università di Napoli Federico II and INFN, Sezione di Napoli, 80126 Napoli, Italy
[10]Institute for Nuclear Research (MTA ATOMKI), P.O. Box 51, HU-4001 Debrecen, Hungary
[11]Università degli Studi di Torino and INFN, Sezione di Torino, Via P. Giuria 1, 10125 Torino, Italy
[12]Università degli Studi di Milano and INFN, Sezione di Milano, Via G. Celoria 16, 20133 Milano, Italy
[13]INFN, Sezione di Roma La Sapienza, Piazzale A. Moro 2, 00185 Roma, Italy
[14]Università degli Studi di Bari and INFN, Sezione di Bari, 70125 Bari, Italy
[15]Osservatorio Astronomico di Collurania, Teramo, and INFN, Sezione di Napoli, Napoli, Italy
[16]Institut für Experimentalphysik III, Ruhr-Universität Bochum, 44780 Bochum, Germany

The ^{22}Ne(p,γ)^{23}Na reaction takes part in the neon–sodium cycle of hydrogen burning. This cycle affects the synthesis

of the elements between ^{20}Ne and ^{27}Al in asymptotic giant branch stars and novæ. The ^{22}Ne(p,γ)^{23}Na reaction rate is very uncertain because of a large number of unobserved resonances lying in the Gamow window. At proton energies below 400 keV, only upper limits exist in the literature for the resonance strengths. Previous reaction rate evaluations differ by large factors. In the present work, the first direct observations of the ^{22}Ne(p,γ)^{23}Na resonances at 156.2, 189.5, and 259.7 keV are reported. Their resonance strengths are derived with 2–7% uncertainty. In addition, upper limits for three other resonances are greatly reduced. Data are taken using a windowless ^{22}Ne gas target and high-purity germanium detectors at the Laboratory for Underground Nuclear Astrophysics in the Gran Sasso laboratory of the National Institute for Nuclear Physics, Italy, taking advantage of the ultra-low background observed deep underground. The new reaction rate is a factor of 20 higher than the recent evaluation at a temperature of 0.1 GK, relevant to nucleosynthesis in asymptotic giant branch stars.

Published in Physical Review Letters
Available from arXiv:1511.05329
and from http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.115.252501

Carbon stars in the X-shooter Spectral Library

A. Gonneau[1,2], A. Lançon[1], S.C. Trager[2], B. Aringer[3,4], M. Lyubenova[2], W. Nowotny[3], R.F. Peletier[2], P. Prugniel[5], Y.-P. Chen[6], M. Dries[2], O.S. Choudhury[7], J. Falcón-Barroso[8,9], M. Koleva[10], S. Meneses-Goytia[2], P. Sánchez-Blázquez[11] and A. Vazdekis[8,9]

[1]Observatoire Astronomique de Strasbourg, Université de Strasbourg, CNRS, UMR 7550, 11 rue de l'Université, F-67000 Strasbourg, France
[2]Kapteyn Astronomical Institute, University of Groningen, Postbus 800, 9700 AV, Groningen, The Netherlands
[3]University of Vienna, Department of Astrophysics, Türkenschanzstraße 17, 1180 Wien, Austria
[4]Dipartimento di Fisica e Astronomia Galileo Galilei, Università di Padova, Vicolo dell'Osservatorio 3, I-35122 Padova, Italy
[5]CRAL–Observatoire de Lyon, Université de Lyon, Lyon I, CNRS, UMR5574, France
[6]New York University Abu Dhabi, Abu Dhabi, P.O. Box 129188, Abu Dhabi, United Arab Emirates
[7]Leibniz-Institut für Astrophysik Potsdam (AIP), An der Sternwarte 16, 14482 Potsdam, Germany
[8]Instituto de Astrofísica de Canarias, Vía Láctea s/n, La Laguna, Tenerife, Spain
[9]Departamento de Astrofísica, Universidad de La Laguna, E-38205 La Laguna, Tenerife, Spain
[10]Sterrenkundig Observatorium, Universiteit Gent, Krijgslaan 281, 9000 Gent, Belgium
[11]Universidad Autónoma de Madrid, Departamento de Física Teórica, E-28049 Cantoblanco, Madrid, Spain

We provide a new collection of spectra of 35 carbon stars obtained with the ESO/VLT X-shooter instrument as part of the X-shooter Spectral Library project. The spectra extend from 0.3 μm to 2.4 μm with a resolving power above $\sim$ 8000. The sample contains stars with a broad range of $(J-K)$ color and pulsation properties located in the Milky Way and the Magellanic Clouds.
We show that the distribution of spectral properties of carbon stars at a given $(J-K)$ color becomes bimodal (in our sample) when $(J-K)$ is larger than about 1.5. We describe the two families of spectra that emerge, characterized by the presence or absence of the absorption feature at 1.53 μm, generally associated with HCN and C_2H_2. This feature appears essentially only in large-amplitude variables, though not in all observations. Associated spectral signatures that we interpret as the result of veiling by circumstellar matter, indicate that the 1.53 μm feature might point to episodes of dust production in carbon-rich Miras.

Accepted for publication in A&A
Available from arXiv:1602.00887

Spitzer mid-infrared point sources in the fields of nearby galaxies

Stephen J. Williams[1,2] and Alceste Z. Bonanos[2]

[1]Department of Physics, University of Crete, GR-71003, Heraklion, Greece
[2]IAASARS, National Observatory of Athens, GR-15236, Penteli, Greece

We present *Spitzer* IRAC mid-infrared point source catalogs for mosaics covering the fields of the nearby ($\leq$ 4 Mpc)

galaxies NGC 55, NGC 253, NGC 2366, NGC 4214, and NGC 5253. We detect a total of 20159 sources in these five fields. Point spread function photometry was performed on sources detected in both *Spitzer* IRAC 3.6-μm and 4.5-μm bands at greater than 3σ above background. These data were then supplemented by aperture photometry in the IRAC 5.8-μm and 8.0-μm bands conducted at the positions of the shorter wavelength sources. For sources with no detected object in the longer wavelengths, we estimated magnitude limits based on the local sky background. The individual galaxy point source breakdown is the following: NGC 55, 8746 sources; NGC 253, 9001 sources; NGC 2366, 505 sources; NGC 4214, 1185 sources; NGC 5253, 722 sources. The completeness limits of the full catalog vary with bandpass and were found to be $m_{3.6} = 18.0$, $m_{4.5} = 17.5$, $m_{5.8} = 17.0$, and $m_{8.0} = 16.5$ mag. For all galaxies, this corresponds to detection of point sources brighter than $M_{3.6} = -10$ mag. These catalogs can be used as a reference for stellar population investigations, individual stellar object studies, and in planning future mid-infrared observations with the *James Webb* Space Telescope.

Accepted for publication in Astronomy and Astrophysics
Available from arXiv:1601.06970

Searching for new yellow symbiotic stars: positive identification of StHα 63

N.O. Baella[1,2], C.B. Pereira[3], L.F. Miranda[4] and A. Alvarez-Candal[3]

[1]Unidad de Astronomía, Instituto Geofísico del Perú, Lima, Perú

[2]Departamento de Ciencias, Sección Física, Pontificia Universidad Católica del Perú, Apartado 1761, Lima, Perú

[3]Observatório Nacional/MCTI, Rua Gen. José Cristino, 77, 20921-400, Rio de Janeiro, Brazil

[4]Instituto de Astrofísica de Andalucía–CSIC, C/ Glorieta de la Astronomías/n, E-18008 Granada, Spain

Yellow symbiotic stars are useful targets to probe whether mass transfer has happened in these binary systems. However, the number of known yellow symbiotic stars is very scarce. We report spectroscopic observations of five candidate yellow symbiotic stars selected by their position in the 2MASS (J−H) versus (H−K_s) diagram and included in some emission-line catalogs. Among the five candidates, only StHα 63 is identified as a new yellow symbiotic star because of its spectrum and its position in the $[TiO]_1$–$[TiO]_2$ that indicates a K4–K6 spectral type. In addition, the derived electron density ($\sim 10^{8.4}$ cm^{-3}) and several emission line intensity ratios provide further support for that classification. The other four candidates are rejected as symbiotic stars because three of them actually do not show emission lines and the fourth one shows only Balmer emission lines. We also found that the WISE W3–W4 index clearly separates normal K-giants from yellow symbiotic stars and, therefore, can be used as an additional tool to select candidate yellow symbiotic stars.

Accepted for publication in The Astronomical Journal

Hydrodynamic simulations of the interaction between giant stars and planets

Jan E. Staff[1,2,3], Orsola De Marco[1,2], Peter Wood[4], Pablo Galaviz[1,2] and Jean-Claude Passy[5]

[1]Department of Physics and Astronomy, Macquarie University NSW 2109, Australia

[2]Astronomy, Astrophysics and Astrophotonics Research Centre, Macquarie University, Sydney, NSW 2109, Australia

[3]Currently at the University of Florida, dept. Astronomy, USA

[4]Research School of Astronomy and Astrophysics, Australian National University, Cotter Road, Weston Creek, ACT 2611, Australia

[5]Argelander Institut für Astronomie, 53121 Bonn, Germany

We present the results of hydrodynamic simulations of the interaction between a 10 Jupiter mass planet and a red or asymptotic giant branch stars, both with a zero-age main sequence mass of 3.5 $M_\odot$. Dynamic in-spiral timescales are of the order of few years and a few decades for the red and asymptotic giant branch stars, respectively. The planets will eventually be destroyed at a separation from the core of the giants smaller than the resolution of our simulations, either through evaporation or tidal disruption. As the planets in-spiral, the giant stars' envelopes are

somewhat puffed up. Based on relatively long timescales and even considering the fact that further in-spiral should take place before the planets are destroyed, we predict that the merger would be difficult to observe, with only a relatively small, slow brightening. Very little mass is unbound in the process. These conclusions may change if the planet's orbit enhances the star's main pulsation modes. Based on the angular momentum transfer, we also suspect that this star-planet interaction may be unable to lead to large scale outflows via the rotation-mediated dynamo effect of Nordhaus and Blackman. Detectable pollution from the destroyed planets would only result for the lightest, lowest metallicity stars. We furthermore find that in both simulations the planets move through the outer stellar envelopes at Mach-3 to Mach-5, reaching Mach-1 towards the end of the simulations. The gravitational drag force decreases and the in-spiral slows down at the sonic transition, as predicted analytically.

Accepted for publication in MNRAS
Available from arXiv:1602.03130

Drifting asteroid fragments around WD 1145+017

S. Rappaport[1], B. Gary[2], T.G. Kaye[3], A. Vanderburg[4], B. Croll[5], P.B. Benni[6] and J.L. Foote[7]

[1]MIT, USA
[2]Hereford Arizona Observatory, USA
[3]Raemor Vista Observatory, USA
[4]Harvard–Smithsonian Center for Astrophysics, USA
[5]Institute for Astrophysical Research, Boston University, USA
[6]Acton Sky Portal, USA
[7]Vermillion Cliffs Observatory, USA

We have obtained extensive photometric observations of the polluted white dwarf WD 1145+017 which has been reported to be transited by at least one, and perhaps several, large asteroids (or, planetesimals) with dust emission. We have carried out 53 observation sessions on 37 nights, totaling 192 hours, of this 17$^{\rm th}$ magnitude star with small to modest size telescopes covering the interval 2015 November 1 to 2016 January 21. In all, we have detected some 237 significant dips in flux. Periodograms of the data reveal a significant periodicity of 4.5004 hours that is consistent with the dominant ("A") period detected with K2. The folded light curve at this period shows there is an hour-long depression in flux with a mean depth of nearly 10%. This depression is comprised of a series of shorter and sometimes deeper dips that do not always occur at exactly the same orbital phase, and which would be unresolvable with K2. In fact, we also find numerous dips in flux at other orbital phases. Nearly all of the dips associated with this activity appear to drift systematically in phase with respect to the "A" period by about 2.5 minutes per day with a dispersion of ~ 0.5 min/d, corresponding to a mean drift period of 4.4928 hours. In all, we can track approximately 15 of these drifting features. There is no detection of the "B"–"F" periods found with K2, but if they remain at the K2 levels we would not expect to have seen them. We explain the drifting motion as that of smaller bodies ('fragments') that break off from the asteroid and go into a slightly smaller orbit than that of the asteroid. If our interpretation is correct, we can use the drift rate to determine the mass of the asteroid. Under that scenario, we find that the mass of the asteroid is $M_{\rm a} \simeq 10^{23}$ grams, or about 1/10$^{\rm th}$ the mass of Ceres, with an uncertainty of about a factor of 2.

Submitted to MNRAS
Available from arXiv:1602.00740

Discovery of rubidium, cadmium, and germanium emission lines in the near-infrared spectra of planetary nebulæ

N.C. Sterling[1], Harriet L. Dinerstein[2], Kyle F. Kaplan[2] and Manuel Bautista[3]

[1]University of West Georgia, USA
[2]University of Texas at Austin, USA
[3]Western Michigan University, USA

We identify [Rb IV] 1.5973 and [Cd IV] 1.7204 μm emission lines in high-resolution ($R = 40,000$) near-infrared spectra of the planetary nebulæ (PNe) NGC 7027 and IC 5117, obtained with the IGRINS spectrometer on the 2.7-m telescope

at McDonald Observatory. We also identify [Ge VI] 2.1930 μm in NGC 7027. Alternate identifications for these features are ruled out based on the absence of other multiplet members and/or transitions with the same upper levels. Ge, Rb, and Cd can be enriched in PNe by *s*-process nucleosynthesis during the asymptotic giant branch (AGB) stage of evolution. To determine ionic abundances, we calculate [Rb IV] collision strengths and use approximations for those of [Cd IV] and [Ge VI]. Our identification of [Rb IV] 1.5973 μm is supported by the agreement between Rb^{3+}/H^{+} abundances found from this line and the 5759.55-Å feature in NGC 7027. Elemental Rb, Cd, and Ge abundances are derived with ionization corrections based on similarities in ionization potential ranges between the detected ions and O and Ne ionization states. Our analysis indicates abundances 2–4 times solar for Rb and Cd in both nebulæ. Ge is subsolar in NGC 7027, but its abundance is uncertain due to the large and uncertain ionization correction. The general consistency of the measured relative *s*-process enrichments with predictions from models appropriate for these PNe (2.0–2.5 $M_{\odot}$, [Fe/H] = −0.37) demonstrates the potential of using PN compositions to test *s*-process nucleosynthesis models.

Accepted for publication in ApJ Letters
Available from arXiv:1602.03188

MUSE crowded field 3D spectroscopy of over 12,000 stars in the globular cluster NGC 6397 – I. The first comprehensive spectroscopic HRD of a globular cluster

Tim-Oliver Husser[1], *Sebastian Kamann*[1], *Stefan Dreizler*[1], *Martin Wendt*[2,3], *Nina Wulff*[1], *Roland Bacon*[4], *Lutz Wisotzki*[2], *Jarle Brinchmann*[5], *Peter M. Weilbacher*[2], *Martin M. Roth*[2] *and Ana Monreal-Ibero*[6]

[1]Institut für Astrophysik, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany
[2]Leibniz-Institut für Astrophysik Potsdam (AIP), An der Sternwarte 16, D-14482 Potsdam, Germany
[3]Institut für Physik und Astronomie, Universität Potsdam, 14476 Potsdam, Germany
[4]CRAL, Observatoire de Lyon, CNRS, Université Lyon 1, 9 avenue Ch. André, 69561 Saint Genis-Laval Cedex, France
[5]Leiden Observatory, Leiden University, P.O. Box 9513, 2300 RA Leiden, The Netherlands
[6]GEPI, Observatoire de Paris, CNRS, Université Paris-Diderot, Place Jules Janssen, 92190 Meudon, France

Aims: We demonstrate the high multiplex advantage of crowded field 3D spectroscopy using the new integral field spectrograph MUSE by means of a spectroscopic analysis of more than 12,000 individual stars in the globular cluster NGC 6397.
Methods: The stars are deblended with a PSF fitting technique, using a photometric reference catalogue from HST as prior, including relative positions and brightnesses. This catalogue is also used for a first analysis of the extracted spectra, followed by an automatic in-depth analysis using a full-spectrum fitting method based on a large grid of PHOENIX spectra.
Results: With 18,932 spectra from 12,307 stars in NGC 6397 we have analysed the largest sample so far available for a single globular cluster. We derived a mean radial velocity of $v_{\rm rad} = 17.84 \pm 0.07$ km s^{-1} and a mean metallicity of [Fe/H] = -2.120 ± 0.002, with the latter seemingly varying with temperature for stars on the RGB. We determine $T_{\rm eff}$ and [Fe/H] from the spectra, and log g from HST photometry. This is the first very comprehensive HRD for a globular cluster based on the analysis of several thousands of stellar spectra, ranging from the main sequence to the tip of the RGB. Furthermore, two interesting objects were identified with one being a post-AGB star and the other a possible millisecond-pulsar companion.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:1602.01649

A search for hydrogenated fullerenes in fullerene-containing planetary nebulæ

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

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

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

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

[4]INAF – Osservatorio Astrofisico di Catania, Italy

[5]Actinium Chemical Research srl, Italy

Detections of C_{60} and C_{70} fullerenes in planetary nebulæ (PNe) of the Magellanic Clouds and of our own Galaxy have raised the idea that other forms of carbon such as hydrogenated fullerenes (fulleranes like $C_{60}H_{36}$ and C_60H_{18}), buckyonions, and carbon nanotubes, may be widespread in the Universe. Here we present VLT/ISAAC spectra ($R \sim 600$) in the 2.9–4.1 μm spectral region for the Galactic PNe Tc 1 and M 1-20, which have been used to search for fullerene-based molecules in their fullerene-rich circumstellar environments. We report the non-detection of the most intense infrared bands of several fulleranes around $\sim$ 3.4–3.6 μm in both PNe. We conclude that if fulleranes are present in the fullerene-containing circumstellar environments of these PNe, then they seem to be by far less abundant than C_{60} and C_{70}. Our non-detections together with the (tentative) fulleranes detection in the proto-PN IRAS 01005+7910 suggest that fulleranes may be formed in the short transition phase between AGB stars and PNe but they are quickly destroyed by the UV radiation field from the central star.

Accepted for publication in A&A
Available from arXiv:1602.07481
and from http://www.iac.es/preprints/?c=view&pre_id=16015

Radio planetary nebulæ in the Small Magellanic Cloud

Howard Leverenz[1], *Miroslav D. Filipović*[2], *I.S. Bojičić*[3], *E.J. Crawford*[2], *J.D. Collier*[2], *K. Grieve*[2], *D. Drašković*[4] *and W.A. Reid*[4]

[1]University of Southern Queensland, Toowoomba, Qld 4350, Australia

[2]University of Western Sydney, Locked Bag 1797, Penrith, NSW 2751, Australia

[3]Department of Physics, The University of Hong Kong, Pokfulam Road, Hong Kong, China

[4]Department of Physics and Astronomy, Macquarie University, Sydney, NSW 2109, Australia

We present ten new radio continuum (RC) detections at catalogued planetary nebula (PN) positions in the Small Magellanic Cloud (SMC): SMP S6, LIN 41, LIN 142, SMP S13, SMP S14, SMP S16, J 18, SMP S18, SMP S19 and SMP S22. Additionally, six SMC radio PNe previously detected, LIN 45, SMP S11, SMP S17, LIN 321, LIN 339 and SMP S24 are also investigated (re-observed) here making up a population of 16 radio detections of catalogued PNe in the SMC. These 16 radio detections represent $\sim$ 15% of the total catalogued PN population in the SMC. We show that six of these objects have characteristics that suggest that they are PN mimics: LIN 41, LIN 45, SMP S11, LIN 142, LIN 321 and LIN 339. We also present our results for the surface brightness – PN radius relation (Σ–D) of the SMC radio PN population. These are consistent with previous SMC and LMC PN measurements of the (Σ–D) relation.

Published in Astrophysics and Space Science
Available from arXiv:1602.03911

Probing O-enrichment in C-rich dust planetary nebulæ

D.A. García-Hernández[1], *P. Ventura*[2], *G. Delgado-Inglada*[3], *F. Dell'Agli*[2], *M. Di Criscienzo*[2] *and A. Yagüe*[2,1]

[1]IAC–ULL, spain

[2]OAR, Italy

[3]IAUNAM, México

The abundance of O in planetary nebulæ (PNe) has been historically used as a metallicity indicator of the interstellar

medium (ISM) where they originated; e.g., it has been widely used to study metallicity gradients in our Galaxy and beyond. However, clear observational evidence for O self enrichment in low-metallicity Galactic PNe with C-rich dust has been recently reported. Here we report asymptotic giant branch (AGB) nucleosynthesis predictions for the abundances of the CNO elements and helium in the metallicity range $Z_{\odot}/4 < Z < 2\ Z_{\odot}$. Our AGB models, with diffusive overshooting from all the convective borders, predict that O is overproduced in low-Z low-mass ($\sim$ 1–3 $M_{\odot}$) AGB stars and nicely reproduce the recent O overabundances observed in C-rich dust PNe. This confirms that O is not always a good proxy of the original ISM metallicity and another chemical elements such as Cl or Ar should be used instead. The production of oxygen by low-mass stars should be thus considered in galactic-evolution models.

Accepted for publication in MNRAS Letters
Available from arXiv:1602.05346
and from http://www.iac.es/folleto/research/preprints/?c=view&pre_id=16014

Full-lifetime simulations of multiple unequal-mass planets across all phases of stellar evolution

Dimitri Veras[1], *Alexander J. Mustill*[2], *Boris T. Gänsicke*[1], *Seth Redfield*[3], *Nikolaos Georgakarakos*[4], *Alex B. Bowler*[1] *and Maximillian J.S. Lloyd*[1]

[1]University of Warwick, UK
[2]Lund Observatory, Sweden
[3]Wesleyan University, USA
[4]New York University Abu Dhabi, UAE

We know that planetary systems are just as common around white dwarfs as around main sequence stars. However, self-consistently linking a planetary system across these two phases of stellar evolution through the violent giant branch poses computational challenges, and previous studies restricted architectures to equal-mass planets. Here, we remove this constraint and perform over 450 numerical integrations over a Hubble time (14 Gyr) of packed planetary systems with unequal-mass planets. We characterize the resulting trends as a function of planet order and mass. We find that intrusive radial incursions in the vicinity of the white dwarf become less likely as the dispersion amongst planet masses increases. The orbital meandering which may sustain a sufficiently dynamic environment around a white dwarf to explain observations is more dependent on the presence of terrestrial-mass planets than any variation in planetary mass. Triggering unpacking or instability during the white dwarf phase is comparably easy for systems of unequal-mass planets and systems of equal-mass planets; instabilities during the giant branch phase remain rare and require fine-tuning of initial conditions. We list the key dynamical features of each simulation individually as a potential guide for upcoming discoveries.

Accepted for publication in MNRAS
Available from arXiv:1603.00025

A population of eruptive variable protostars in VVV

Carlos Contreras Peña[1,4,2], *P.W. Lucas*[2], *D. Minniti*[1,7], *R. Kurtev*[3,4], *W. Stimson*[2], *C. Navarro Molina*[4,3], *J. Borissova*[3,4], *N. Kumar*[2], *M.A. Thompson*[2], *T. Gledhill*[2], *R. Terzi*[2], *D. Froebrich*[5] *and A. Caratti o Garatti*[6]

[1]Departamento de Ciencias Fisicas, Universidad Andres Bello, Republica 220, Santiago, Chile
[2]Centre for Astrophysics Research, University of Hertfordshire, Hatfield, AL10 9AB, UK
[3]Instituto de Física y Astronomía, Universidad de Valparaíso, ave. Gran Bretaña, 1111, Casilla 5030, Valparaíso, Chile
[4]Millennium Institute of Astrophysics, Av. Vicuña Mackenna 4860, 782-0436, Macul, Santiago, Chile
[5]Centre for Astrophysics and Planetary Science, University of Kent, Canterbury CT2 7NH, UK
[6]Dublin Institute for Advanced Studies, School of Cosmic Physics, Astronomy & Astrophysics Section, 31 Fitzwilliam Place, Dublin 2, Ireland
[7]Vatican Observatory, V00120 Vatican City State

We present the results of a search for high amplitude infrared variable stars in 119 deg^2 of the Galactic midplane covered by the Vista Variables in the Via Lactea (VVV) survey. We find 816 variables with $\Delta K_{\rm s} > 1$ mag in the 2010–2012

data, almost all of which are new discoveries. The sample is strongly concentrated toward areas of star formation. Stars found in these areas show characteristics that support classification as young stellar objects (YSOs), these comprising about 50% of the sample. This provides further evidence that YSOs are the commonest high amplitude infrared variable stars. Analysis of the 2010–2014 time series of objects in SFRs shows that the overall amplitude of variability increases towards younger evolutionary classes (class I and flat-spectrum sources). The earlier evolutionary classes show higher r.m.s. variability on all timescales longer than 25 days but the reverse trend is seen at shorter timescales, where class II YSOs are more variable. We divide our likely YSOs into different types according to their light curve morphology. We find 106 objects with eruptive light curves, 45 dippers, 39 faders, 24 eclipsing binaries, 65 long-term periodic variables ($P > 100$ days) and 162 short-term variables. Eruptive YSOs and faders tend to have the highest amplitudes and eruptive systems have the reddest SEDs. The 2 epochs of VVV JHK_s multicolour-data indicate that extinction is not the main cause of variability in these systems and follow up spectroscopy in a companion paper (Paper 2) verifies high accretion rates in the eruptive systems. These discoveries increase the number of eruptive variable YSOs by a factor of at least 5. The majority are optically obscured systems at earlier stages of evolution than the known FUor and EXor types of eruptive YSO. We find that eruptive variability is at least an order of magnitude more common in class I YSOs than class II YSOs. The typical 1 to 4 year duration of the outbursts is between those of EXors and FUors.

Submitted to MNRAS
Available from arXiv:1602.06267

Infrared spectroscopy of eruptive variable protostars from VVV

Carlos Contreras Peña[1,4,2], P.W. Lucas[2], R. Kurtev[3,4], D. Minniti[1,7], A. Caratti o Garatti[6], F. Marocco[2], M.A. Thompson[2], D. Froebrich[5], N. Kumar[2], W. Stimson[2], C. Navarro Molina[4,3], J. Borissova[3,4], T. Gledhill[2] and R. Terzi[2]

[1]Departamento de Ciencias Fisicas, Universidad Andres Bello, Republica 220, Santiago, Chile

[2]Centre for Astrophysics Research, University of Hertfordshire, Hatfield, AL10 9AB, UK

[3]Instituto de Física y Astronomía, Universidad de Valparaíso, ave. Gran Bretaña, 1111, Casilla 5030, Valparaíso, Chile

[4]Millennium Institute of Astrophysics, Av. Vicuña Mackenna 4860, 782-0436, Macul, Santiago, Chile

[5]Centre for Astrophysics and Planetary Science, University of Kent, Canterbury CT2 7NH, UK

[6]Dublin Institute for Advanced Studies, School of Cosmic Physics, Astronomy & Astrophysics Section, 31 Fitzwilliam Place, Dublin 2, Ireland

[7]Vatican Observatory, V00120 Vatican City State

In the first part of this study (Paper I) we detected a large population of highly variable Young Stellar Objects (YSOs) in the Vista Variables in the Via Lactea (VVV) survey, typically with Class I or flat spectrum SEDs and a variety of light curve types. Here we present infrared spectra of 37 of these variables, many of which were observed while in a bright state. The spectra confirm that 15/18 sources with eruptive light curves have the signatures of a high accretion rate, either showing emission features associated with EXors ($\Delta v = 2$ CO, Brγ, H_2) and/or features associated with FUors ($\Delta v = 2$ CO and H_2O strongly in absorption). Similar signatures of high accretion rates were seen in 3/5 sources classified as long term periodic YSOs and in 1/2 faders. As expected, these signatures were not seen in the dippers or short term variable YSOs. Most sources with smooth Mira-like light curves are confirmed as dusty Mira variables and the sample also contains 2 CVs and a carbon star. In total we have added 19 new objects to the broad class of eruptive variable YSOs with episodic accretion but we find that most of them do not fit the established subclasses (FUors, EXors). Instead, the sample shows outburst durations between those of EXors and FUors and a mixture of the spectroscopic characteristics of both subclasses. This is in line with a small number of other recent discoveries that have already begun to blur the distinction. Since these previously atypical objects are now the majority amongst embedded members of the class, we propose a new classification for them as "MNors". This term (pronounced "emnor") follows V1647 Ori, the illuminating star of McNeil's Nebula.

Submitted to MNRAS
Available from arXiv:1602.06269

Conference Paper

The discovery and characterisation of binary central stars in planetary nebulæ

David Jones[1,2]

[1]IAC, Spain
[2]ULL, Spain

Close binary central stars of planetary nebulæ are key in constraining the poorly-understood common-envelope phase of evolution, which in turn is critical in understanding the formation of a wide-range of astrophysical phenomena (including cataclysmic variables, low-mass X-ray binaries and supernovæ type Ia). Here, I present the results of our on-going, targeted search for close-binaries in planetary nebulæ which has led to the discovery of more than 10 new central binaries in just the last few years (almost the same as the total discovered during the 1980s and 1990s together). This success has been rooted in the targeted selection of objects for study, based on morphological features deemed typical of binarity, as well as novel observing strategies (including the employment of narrow-band filters for photometry to minimise nebular contamination), both of which are discussed. These new discoveries, coupled with the painstaking characterisation of both newly discovered systems and those from the literature, mean that we are now in a position to begin to probe the physics of the common-envelope phase.

Oral contribution, published in "11$^{\text{th}}$ Pacific Rim Conference on Stellar Astrophysics"
Available from arXiv:1602.00846

Review Paper

Interaction between convection and pulsation

Günter Houdek[1] *and Marc-Antoine Dupret*[2]

[1]Stellar Astrophysics Centre, Århus University, 8000 Århus C, Denmark
[2]Institut d'Astrophysique et de Géophysique, Université de Liège, 4000 Liège, Belgium

This article reviews our current understanding of modelling convection dynamics in stars. Several semi-analytical time-dependent convection models have been proposed for pulsating one-dimensional stellar structures with different formulations for how the convective turbulent velocity field couples with the global stellar oscillations. In this review we put emphasis on two, widely used, time-dependent convection formulations for estimating pulsation properties in one-dimensional stellar models. Applications to pulsating stars are presented with results for oscillation properties, such as the effects of convection dynamics on the oscillation frequencies, or the stability of pulsation modes, in classical pulsators and in stars supporting solar-type oscillations.

Published in Living Rev. Solar Phys., 12 , 8 (2015)
Available from arXiv:1601.03913
and from http://solarphysics.livingreviews.org/Articles/lrsp-2015-8/

Thesis

COSMIC-LAB: Unexpected results from high-resolution spectra of AGB stars in globular clusters

Emilio Lapenna[1,2]

[1]Dipartimento di Fisica e Astronomia, Università degli Studi di Bologna, v.le Berti Pichat 6/2, I-40127 Bologna, Italy
[2]INAF–Osservatorio Astronomico di Bologna, via Ranzani 1, I-40127, Bologna, Italy

This thesis is aimed at clarifying one of the least studied phases of stellar evolution: the asymptotic giant branch (AGB). Recent results obtained for Galactic globular clusters (GCs) suggest that the AGB stage may contain crucial information about the evolutionary history of exotic stars (Beccari et al. 2006) and multiple-populations (Campbell et al. 2013) in the parent cluster. The thesis presents the analysis of a large sample of high-resolution spectra of AGB stars in four Galactic GCs, acquired at the Very Large Telescope (ESO) and the 2.2 meter telescope (MPG). The obtained results provide evidence of a previously unknown physical mechanism affecting the neutral species of some chemical elements in the atmosphere of most AGB stars: because of it, the abundances derived from neutral lines are systematically underestimated, while those measured from ionized lines remain unaffected. Such a behaviour exactly corresponds to what expected in the case of non-local thermodynamic equilibrium (NLTE) conditions in the star atmosphere. For this reason, in this work we refer to it as "NLTE effect", with the caveat that this could be not the case. In fact, the current NLTE models are unable to account for the observed effect, thus demonstrating that either our comprehension of NLTE is not adequate enough, or that some more complex physical phenomena are occurring in AGB atmospheres. This effect has been found in all the investigated GCs. It affects most (but not all) AGB stars and, in some cases, also some RGB stars. It is particularly evident for iron and titanium lines (i.e. the elements providing the largest number of both neutral and ionized lines). The deep understanding of the detected phenomenon is of paramount importance since it has a huge impact on the proper determination of GC chemistry and enrichment history (for instance, it can mimic spurious iron spreads).

PhD thesis
Available from arXiv:1601.04346

Job Adverts

Faculty Positions in Astrophysics at Instituto de Astrofísica de Atacama

Dear Colleagues,
I'd like to call your attention to the following ad : Faculty Positions in Astrophysics at Instituto de Astrofísica de Atacama, Copiapó (Chile), http://eas.unige.ch/jobs.jsp?id=671

The Instituto de Astrofísica de Atacama (IAA) at the Universidad De Atacama (UDA) in Copiapó (Chile) invites applications for two faculty positions to join the IAA team. The successful candidates will join a group of five faculty working on a broad range of research topics and will have access to the Chilean Time in a broad array of facilities, including ALMA, VLT, Gemini, Magellan, LSST, GMT and the E-ELT.

We are particularly interested in candidates with strong experience in one or more of these fields:

- Origin, structure and evolution of planets, satellites, and minor bodies in the Solar System;
- Extrasolar Planets;
- Formation, structure and evolution of stars;

- Milky Way: stellar populations, star clusters, variable stars, galactic structure;
- Terrestrial Mars analogs;
- Astrobiology.

The positions carry teaching duties in astronomy at the undergraduate level, with a load of 6h per week. The working language is English. While knowledge of Spanish is not required (teaching can be done in English), the successful candidates are expected to teach in Spanish within two years. The appointment at UDA will be for three years, with a first probation year, and the position is further extendable subject to performance.

Applicants should have a Ph.D. in astronomy or physics or related sciences completed at least 3 years prior to the starting day of the contract.

To receive full consideration, applications must be sent by Friday 18 of March 2016, although the position will remain open until filled. Start date is expected to be October 2016.

Applications must be submitted by e-mail to Mauro Barbieri (mauro.barbieri@uda.cl), and they should include:

1) Cover letter,
2) Curriculum Vitæ,
3) List of publications,
4) Statement of recent research achievements (max. 2 pages),
5) An outline of future research (min. 2 pages, max. 10 pages),
6) The contact details of three referees (one needs to be the last employer, the others needs to be aware of the recent work of the candidate).

Questions may be addressed to the previous e-mail address.

Relevant links:

Universidad de Atacama
http://www.uda.cl

Instituto de Astrofísica de Atacama
https://sites.google.com/site/grupoastrouda

Convocatoria Programa de Inserción de Investigadores en la UDA
http://www.vrip.uda.cl/frontend/noticia_completa/104

Best regards,
Mauro Barbieri

See also http://eas.unige.ch/jobs.jsp?id=671

Job opening for a post-doctoral position 2 yr (+2 yr) at the Leuven University in the field of theoretical models for evolved stars

Interdisciplinary project on the stellar winds around evolved stars at the Leuven University in Belgium funded by the ERC-CoG 2014 grant AEROSOL (PI. L. Decin).

The project

At the Leuven University (Belgium), we seek an excellent candidate for a post-doctoral research position, ready to play a key role in a new interdisciplinary project focusing on stellar winds around evolved (low-mass) stars. The candidate will interact closely with a team consisting of astrophysicists, chemists, and computational mathematicians, as the goal of the project is to boost our understanding of the physics and chemistry characterizing these stellar winds. The project builds upon novel data (including ALMA, *Herschel*, etc.), detailed theoretical wind models, and targeted laboratory experiments (see http://fys.kuleuven.be/ster/Projects/aerosol/aerosol).

Specifically, we now seek a post-doctoral researcher with expertise in theoretical and numerical modelling, if possible within an astrophysical context. The goal of the project is to develop a dynamical forward chemistry model for stellar winds coupling the effects of hydrodynamics, thermodynamics, chemistry, and radiative transfer. Different numerical modules are already available. The post-doc will be part of a very active and highly performing team, which guarantees an environment in which the post-doc has access to ample support and which will train the post-doc towards his/her own career path.

Institute of Astronomy

The Institute of Astronomy (IoA) of the Leuven University is a young and active research group of some 50 scientists, engineers and administrative staff (http://fys.kuleuven.be/ster). The institute is involved in several international networks and research projects, involving telescopes at international observatories and space missions. The organisation of the Master in Astronomy & Astrophysics of the Faculty of Science at the Leuven University is in the hands of the IoA. The IoA has a long tradition in the observational and theoretical studies of the late stages of evolution of low and intermediate mass stars.

The position

At the Leuven University, the candidates will join the Institute of Astronomy (Prof. L. Decin). The interdisciplinary project is carried out in collaboration with Dr. J. Yates (UCL, London; director DiRAC facilities), Prof. T. Millar (Belfast University) and Prof. J. Nuth (NASA, Greenbelt). The candidate will interact closely with the other team members at the IoA and within the departments of mathematics and chemistry. At the Leuven University, we have access to parallel computing facilities, to be exploited extensively in this project.

Contract

The postdoc candidate will be employed at the Institute of Astronomy. The initial contract runs over 2 years and could be prolonged with another 2 years after positive evaluation. The salary will be commensurate to the standard scale for post-doctoral researchers at the Leuven University. The preferred starting date is between 1 October 2016 and 1 December 2016, but will be adapted to the selected candidate's availability. Candidates are thus requested to indicate their preferred starting date in the application.

Interested?

The successful post-doc candidate must have a Ph.D. degree in astrophysics, (theoretical) physics or (applied) mathematics. The application must be sent as single pdf document including

- A Curriculum Vitæ (including publication list).
- A statement of research interests and future plans (maximum 3 pages).

- A letter detailing your specific qualifications for the position and your career/educational goals (maximum 1 page).
- Two letters of recommendation from professors well acquainted with your academic achievements.

The letters are to be submitted separately to the address mentioned below. The application should be sent by email to Prof. L. Decin (Leen.Decin@ster.kuleuven.be) and Dr. K. Clemer (Katrijn.Clemer@ster.kuleuven.be).

DEADLINE for the application: 1 May 2016

More information can be obtained by contacting

Prof. L. Decin
Institute for Astronomy
Department of Physics and Astronomy, KU Leuven
Celestijnenlaan 200D, 3001 Heverlee, Belgium
Leen.Decin@ster.kuleuven.be
++32-16-32 70 41
http://fys.kuleuven.be/ster/staff/senior-staff/leen
See also: http://fys.kuleuven.be/ster/

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

Announcements

Fizeau exchange visitors program: call for applications

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative.

The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff), non-EU based missions will only be funded if considered essential by the Fizeau Committee. Applicants are strongly encouraged to seek also partial support from their home or host institutions.

The deadline for applications is March 15. Fellowships can be awarded for missions starting in May.

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

The program is funded by OPTICON/FP7.

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

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

See also www.european-interferometry.eu

AGB Stars at the Cambridge Workshop on Cool Stars, Stellar Systems and the Sun

The 2016 *Cambridge Workshop on Cool Stars, Stellar Systems and the Sun*, will include AGB stars as a major feature.

To be held in Uppsala Sweden from 6–10 June 2016, the themes are:

(1) (sub)Stellar Interiors & Fundamental Properties

(2) Physics of (sub)Stellar Atmospheres & Cool Star Abundances

(3) Stellar Winds, Mass Loss and Rotation from pre-MS through the AGB

(4) Solar/Stellar Magnetic Activity and the impact on Planetary Environments

(5) Cool Stars in the Galactic Context

There will also be two splinter sessions devoted to Mass-losing AGB stars and Supergiants (http://coolstars19.com/splinters/agb/)

Invited speakers include: Susanne Höfner, Amanda Karakas, Elizabeth Humphreys, Eric Lagadec, Shazrene Mohamed and Claudia Paladini.

See also http://coolstars19.com/index.html