THE AGB NEWSLETTER

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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 154$^{\rm th}$ issue of the AGB Newsletter.

If you are looking for a postdoctoral researcher position, why not consider the wonderful Czech Republic in the heart of Europe? Or come to Vienna this Summer for the AGB stars conference or stellar spectroscopy workshop.

The next issue is planned to be distributed on the 1$^{\rm st}$ of June 2010.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

How does one recognise a super-AGB star?

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

Tides and tidal engulfment in post-main sequence binaries: period gaps for planets and brown dwarfs around white dwarfs

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The presence of a close, low-mass companion is thought to play a substantial and perhaps necessary rôle in shaping post-Asymptotic Giant Branch and Planetary Nebula outflows. During post-main-sequence evolution, radial expansion of the primary star, accompanied by intense winds, can significantly alter the binary orbit via tidal dissipation and mass loss. To investigate this, we couple stellar evolution models (from the zero-age main-sequence through the end of the post-main sequence) to a tidal evolution code. The binary's fate is determined by the initial masses of the primary and the companion, the initial orbit (taken to be circular), and the Reimers mass-loss parameter. For a range of these parameters, we determine whether the orbit expands due to mass loss or decays due to tidal torques. Where a common envelope (CE) phase ensues, we estimate the final orbital separation based on the energy required to unbind the envelope. These calculations predict period gaps for planetary and brown dwarf companions to white dwarfs. The upper end of the gap is the shortest period at which a CE phase is avoided. The lower end is the longest period at which companions survive their CE phase. For binary systems with 1 $M_\odot$ progenitors, we predict no Jupiter-mass companions with periods $\lesssim$270 days. Once engulfed, Jupiter-mass companions do not survive a CE phase. For binary systems consisting of a 1 $M_\odot$ progenitor with a companion 10 times the mass of Jupiter, we predict a period gap between $\sim$ 0.1 and $\sim$ 380 days. These results are consistent with both the detection of a $\sim$ 50 M_J brown dwarf in a $\sim$ 0.003 AU ($\sim$ 0.08 day) orbit around the white dwarf WD 0137–349 and the tentative detection of a $\sim$ 2 M_J planet in a $\gtrsim$2.7 AU ($\gtrsim$4 year) orbit around the white dwarf GD 66.

Submitted to MNRAS
Available from arXiv:1002.2216

The nature of G 52.381–0.849 and G 56.240–0.345: young stellar objects associated with extended mid-infrared emission?

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We report the results of visual spectroscopy, mid-infrared (MIR) mapping and photometry, and near-infrared photometry of two candidate symbiotic stars (IPHAS J193108.67+164950.5 and IPHAS J193709.65+202655.7) associated with extended MIR emission. Our analysis of the continua of these sources shows that they are likely to represent Class I-II young stellar objects (YSOs) in which most of the IR emission arises from circumstellar discs, and for which the physical characteristics (stellar temperatures, radii, masses and luminosities) are similar. The extended emission is characterized by a substantial increase in fluxes and dimensions to longer MIR wavelengths. This is likely to arise as a result of emission by polycyclic aromatic hydrocarbons within extended photodissociation regimes, centred upon more compact ionized regions responsible for much of the shorter wave emission. Such dual emission structures are characteristic of those observed in many compact H II regions. Finally, we note that the clouds have asymmetrical structures and wind-swept morphologies, conceivably indicative of shock interaction with external winds. Where this is the case, then it is possible that the YSOs are located in regions of triggered star formation.

Published in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1002.2006

The nature of the compact H II region Sh 2-89 and its stellar content

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We present an analysis of the structure and properties of the compact H II region Sh 2-89, and certain of the young stellar objects (YSOs) within this regime, using mid-infrared (MIR) mapping derived from the Spitzer Space Telescope (SST) and visual slit spectroscopy of the inner regions of the source. We show that the region has a bipolar structure, and contains a variety of Class I and II YSOs. Much of the MIR emission appears to be dominated by PAH emission bands, which cause strong increases in flux in the 5.8 and 8.0 μm photometric channels, whilst the variation of Hα, [N II] at 6583 Å, [S II] at 6716+6731 Å, and MIR emission profiles confirms the presence of complex ionisation fronts, and ionisation stratification. We show however that whilst it contains TiO absorption bands, it shows little evidence for higher excitation He II λ4686 Å or [O III] λ5007 Å emission. Such a result does not rule out the possibility of the source being a symbiotic star, although we note that the detection limits on these lines, and the observed visual/infrared continuum, would make it difficult to fit it into either the D- or S-type symbiotic classifications.

Published in Monthly Notices of the Royal Astronomical Society
Available from arXiv:1003.1539

Spitzer mid-infrared observations of seven bipolar planetary nebulae

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We have investigated the mid-infrared (MIR) and visual structures of seven bipolar planetary nebulae (BPNe), using imaging and spectroscopy acquired using the Spitzer Space Telescope (SST), and the Observatorio Astronómico Nacional in México. The results show that the sources are more extended towards longer MIR wavelengths, as well as having higher levels of surface brightness in the 5.8 and 8.0 μm bands. It is also noted that the 5.8/4.5 and 8.0/4.5 μm flux ratios increase with increasing distance from the nuclei of the sources. All of these latter trends may be attributable to emission by polycyclic aromatic hydrocarbons (PAHs) and/or warm dust continua within circumnebular photo-dissociation regions (PDRs). A corresponding decrease in the flux ratios 8.0/5.8 μm may, by contrast, arise due to changes in the properties of the PAH emitting grains. We note evidence for possible 8.0 μm ring-like structures in the envelope of NGC 2346, located in a region beyond the minor axis limits of the ionized envelope. An analysis of the inner two rings shows that whilst they have higher surface brightnesses at longer MIR wavelengths, they are relatively stronger (compared to underlying emission) at 3.6 and 4.5 μm. There is also evidence for point reflection symmetry along the major axis of the outflow.

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Fast, gusty winds blowing from the core of the pre-planetary nebula M 2-56

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We report optical long-slit spectra and direct imaging (ground-based and with HST) of the pre-planetary nebula (pPN)

M 2-56 obtained at different epochs. The optical nebula is composed by shock-excited material distributed in two pairs of nested lobes with different sizes and surface brightness. The compact, bright inner lobes (ILs) have an angular size of $\sim 1.5'' \times 1''$ each and display closed, bow-shaped ends. The extended, faint outer lobes (OLs), which enclose the inner ones, have an agular size of $\sim 13'' \times 10''$. Within the ILs and the OLs the velocity increases with the distance to the center, however, the ILs show expansion velocities larger than the OLs. Consistent with the large speeds reached by the ILs (of up to ~ 350 km s^{-1} at the tips), we have measured the expansive proper motions of the knots (~ 0.03 arcsec yr^{-1}) by comparing two-epoch HST images. Moreover, we have discovered remarkable changes with time in the continuum and line emission spectrum of M 2-56. In 1998, we detected a burst of Hα emission from the nebula nucleus that is interpreted as an indication of a dense, fast ($\sim$ 350–500 km s^{-1}) bipolar wind from the nebula's core (referred to as "F1-wind"). Such a wind has been recently ejected (after 1989) probably as a short-duration mass-loss event. Our data also reveal an optically thick, compact structure (cocoon?) and a H II region around the central star that result from further post-AGB mass-loss after the F1-wind. Recent brightening of the scattered stellar continuum as well as an increase of scattered Hα emission along the lobes is reported, both results pointing to a decrease of the optical depth of the circumstellar material enshrouding the star. The data presented here unveil the complex post-AGB mass-loss history of this object, whose rapid evolution is driven by multiple episodes of mass outflow, not regularly spaced in time, leading to: (i) acceleration of the molecular envelope that surrounds the optical nebula (kinematical age $t_{\rm k} \sim 1400$ yr — Castro-Carrizo et al. 2002), (ii) the OLs ($t_{\rm k} \sim$ 350–400 yr), (iii) the ILs ($t_{\rm k} \sim 40$ yr), (iv) the F1-wind ($t_{\rm k} \lesssim 10$ yr), and (v) the nuclear cocoon and H sc ii region ($t_{\rm k} < 2$ yr?). The successive multiple post-AGB winds in M 2-56 are characterized by ejection speeds increasing with time. In contrast, the mass-loss rate and linear momentum show a time decreasing trend.

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Available from arXiv:1004.1073
and from http://www.laeff.cab.inta-csic.es/users/csanchez/ms_m256.pdf

Concerning the distance to the center of the Milky Way and its structure

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The distance to the Galactic center inferred from OGLE RR Lyrae variables observed in the direction of the bulge is $R_0 = 8.1 \pm 0.6$ kpc. An accurate determination of R_0 is hindered by countless effects that include an ambiguous extinction law, a bias for smaller values of R_0 because of a preferential sampling of variable stars toward the near side of the bulge owing to extinction, and an uncertainty in characterizing how a mean distance to the group of variable stars relates to R_0. A VI-based period–reddening relation for RR Lyrae variables is derived to map extinction throughout the bulge. The reddening inferred from RR Lyrae variables in the Galactic bulge, LMC, SMC, and IC 1613 match that established from OGLE red clump giants and classical Cepheids. RR Lyrae variables obey a period–colour (VI) relation that is relatively insensitive to metallicity. Edge-on and face-on illustrations of the Milky Way are constructed by mapping the bulge RR Lyrae variables in tandem with cataloged red clump giants, globular clusters, planetary nebulae, classical Cepheids, young open clusters, H II regions, and molecular clouds. The sample of RR Lyrae variables do not trace a prominent Galactic bar or triaxial bulge oriented at $\phi \sim 25°$.

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Available from arXiv:1002.2743
and from http://acta.astrouw.edu.pl/Vol60/n1/a_60_1_4.html

When an old star smolders: On the detection of hydrocarbon emission from S-type AGB stars

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Polycyclic aromatic hydrocarbons (PAHs) produce characteristic infrared emission bands that have been observed in a wide range of astrophysical environments, where carbonaceous material is subjected to ultraviolet (UV) radiation. Although PAHs are expected to form in carbon-rich AGB stars, they have up to now only been observed in binary systems where a hot companion provides a hard radiation field. In this letter, we present low-resolution infrared spectra of four S-type AGB stars, selected from a sample of 90 S-type AGB stars observed with the infrared spectrograph aboard the Spitzer satellite. The spectra of these four stars show the typical infrared features of PAH molecules. We confirm the correlation between the temperature of the central star and the centroid wavelength of the 7.9 μm feature, present in a wide variety of stars spanning a temperature range from 3 000 to 12 000 K. Three of four sources presented in this paper extend this relation towards lower temperatures. We argue that the mixture of hydrocarbons we see in these S-stars has a rich aliphatic component. The fourth star, BZ CMa, deviates from this correlation. Based on the similarity with the evolved binary TU Tau, we predict that BZ CMa has a hot companion as well.

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Available from arXiv:1004.1967

Insight into the OH polarimetric structure of OH 26.5+0.6

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We present the first view of the magnetic field structure in the OH shell of the extreme OH/IR star OH 26.5+0.6. MERLIN interferometric observations of this object were obtained in December 1993 in full polarisation, at 1612, 1665 and 1667 MHz. The maser spots show a spheroidal distribution both at 1612 and 1667 MHz, while at 1665 MHz emission from the blue-shifted maser peak is concentrated on the stellar position, and the red-shifted peak emission exhibits a filamentary structure oriented on a SE–NW axis. The linear polarisation in both main lines is rather faint, ranging from 9 to 20% at 1665 MHz and from 0 to 30% at 1667 MHz. At 1612 MHz most maser spots exhibit a similar range of linear polarisation although those in the outermost parts of the envelope reach values as high as 66%. This is particularly apparent in the southern part of the shell. The detailed distribution of the polarisation vectors could only be obtained at 1612 MHz. The polarisation vectors show a highly structured distribution indicative of a poloidal magnetic field inclined by 40–60° to the line of sight. The velocity distribution of the maser spots with respect to the radial distance is well explained by an isotropic outflow at constant velocity in the case of a prolate shaped spheroid envelope, also tilted about 45–65° to the line of sight.

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Available from arXiv:1004.2659

Abundance analysis for long period variables. Velocity effects studied with O-rich dynamic model atmospheres

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Context: Measuring the surface abundances of AGB stars is an important tool for studying the effects of nucleosynthesis and mixing in the interior of low- to intermediate mass stars during their final evolutionary phases. The atmospheres of AGB stars can be strongly affected by stellar pulsation and the development of a stellar wind, though, and the abundance determination of these objects should therefore be based on dynamic model atmospheres.
Aims: We investigate the effects of stellar pulsation and mass loss on the appearance of selected spectral features (line profiles, line intensities) and on the derived elemental abundances by performing a systematic comparison of hydrostatic and dynamic model atmospheres.
Methods: High-resolution synthetic spectra in the near infrared range were calculated based on two dynamic model atmospheres (at various phases during the pulsation cycle) as well as a grid of hydrostatic COMARCS models with effective temperatures $T_{\rm eff}$ and surface gravities $\log g$ over an adequate range. Equivalent widths of a selection of atomic and molecular lines (Fe, OH, CO) were derived in both cases and compared with each other.
Results: In the case of the dynamic models, the equivalent widths of all investigated features vary over the pulsation cycle. A consistent reproduction of the derived variations with a set of hydrostatic models is not possible, but several individual phases and spectral features can be reproduced well with the help of specific hydrostatic atmospheric models. In addition, we show that the variations in equivalent width that we found on the basis of the adopted state-of-the-art dynamic model atmospheres agree qualitatively with observational results for the Mira R Cas over its light cycle.
Conclusions: The findings of our modelling form a starting point to deal with the problem of abundance determination in strongly dynamic AGB stars (i.e., long-period variables). Our results illustrate that some quantities such as the C/O ratio can probably still be determined to a reasonable accuracy, but the measurement of other quantities will be hampered by the dynamics. The qualitative agreement with observations of R Cas opens promising possibilities for a forthcoming quantitative comparison of our synthetic spectra with observed ones of AGB variables in the globular cluster 47 Tuc.

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Available from arXiv:1004.3481

The San Pedro Mártir planetary nebula kinematic catalogue: Extragalactic planetary nebulae

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We present kinematic data for 211 bright planetary nebulae in eleven Local Group galaxies: M 31 (137 PNe), M 32 (13), M 33 (33), Fornax (1), Sagittarius (3), NGC 147 (2), NGC 185 (5), NGC 205 (9), NGC 6822 (5), Leo A (1), and Sextans A (1). The data were acquired at the Observatorio Astronómico Nacional in the Sierra de San Pedro Mártir using the 2.1m telescope and the Manchester Echelle Spectrometer in the light of [O III] λ5007 at a resolution of 11 km s^{-1}. A few objects were observed in Hα. The internal kinematics of bright planetary nebulae do not depend strongly upon the metallicity or age of their progenitor stellar populations, though small systematic differences exist.

The nebular kinematics and Hβ luminosity require that the nebular shells be accelerated during the early evolution of their central stars. Thus, kinematics provides an additional argument favoring similar stellar progenitors for bright planetary nebulae in all galaxies.

Accepted for publication in Revista Méxicana de Astronomía y Astrofísica
Available from arXiv:1004.3996

Notices to investigation of symbiotic binaries V. Physical parameters derived from UBV magnitudes

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In the optical, the spectrum of symbiotic binaries consists of contributions from the cool giant, symbiotic nebula and the hot star. Strong emission lines are superposed on the continuum. In this paper we introduce a simple method to extract individual components of radiation from photometric UBV magnitudes. We applied the method to classical symbiotic stars AX Per, AG Dra, AG Peg and Z And, the symbiotic novae RR Tel and V1016 Cyg and the classical nova V1974 Cyg during its nebular phase. We estimated the electron temperature and emission measure of the nebula in these systems and the V magnitude of the giant in the symbiotic objects. Our results are in a good agreement with those obtained independently by a precious modelling the UV–IR SED.

Accepted for publication in New Astronomy
Available from arXiv:1004.4106

The evolution of the kinematics of nebular shells in planetary nebulae in the Milky Way Bulge

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We study the line widths in the [O III] λ5007 and Hα lines for two groups of planetary nebulae in the Milky Way Bulge based upon spectroscopy obtained at the Observatorio Astronómico Nacional in the Sierra San Pedro Mártir (OAN-SPM) using the Manchester Echelle Spectrograph. The first sample includes objects early in their evolution, having high Hβ luminosities, but [O sc iii] $\lambda5007/\mathrm{H}\beta < 3$. The second sample comprises objects late in their evolution, with He II $\lambda4686/\mathrm{H}\beta > 0.5$. These planetary nebulae represent evolutionary phases preceeding and following those of the objects studied by Richer et al. (2008). Our sample of planetary nebulae with weak [O III] λ5007 has a line width distribution similar to that of the expansion velocities of the envelopes of AGB stars, and shifted to systematically lower values as compared to the less evolved objects studied by Richer et al. (2008). The sample with strong He II λ4686 has a line width distribution indistinguishable from that of the more evolved objects from Richer et al. (2008), but a distribution in angular size that is systematically larger and so they are clearly more evolved. These data and those of Richer et al. (2008) form a homogeneous sample from a single Galactic population of planetary nebulae, from the earliest evolutionary stages until the cessation of nuclear burning in the central star. They confirm the long-standing predictions of hydrodynamical models of planetary nebulae, where the kinematics of the nebular shell are driven by the evolution of the central star.

Accepted for publication in Astrophysical Journal
Available from arXiv:1004.4971

Job Advert

Post-doctoral position

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

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

The department includes about a dozen active researchers, with a total of about 60 scientists working at the Astronomical Insititute. The department offers excellent computing facilities, running under Linux, and including data reduction programmes such as IRAF. Institute accomodation in Ondrejov can be offered to the successful candidate.

The position is initially for 18 months, with a possible one year extension. The salary will be based on the standard domestic scale. The starting date is expected to be in August 2010. Applicants should send their curriculum vitæ, including a list of publications and research interests and arrange to have two letters of recommendation sent to by mail to Adela Kawka (kawka@sunstel.asu.cas.cz) or send to:

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

The closing date for applications is 14$^{\text{th}}$ May 2010.

See also http://www.asu.cas.cz/news/196_applications-are-invited-for-a-post-doctoral-position/

Announcement

GREAT workshop on comparative modelling of stellar spectra

Vienna, Austria, August 23/24 2010

The idea behind this workshop is to compare various modelling approaches for cool stellar atmospheres by fitting the spectrum of selected cool giants using the corresponding codes. Groups of modellers around the world will participate in a comparison of the various model codes by producing a fit of a small sample (3–4) of given high resolution, high S/N spectra and by deriving basic parameters like $T_{\rm eff}$, $\log g$, [Fe/H], etc. from these data. The results shall be compared and discussed at the workshop in Vienna in order to identify differences between the codes and their impact on the derived quantities. The summary of this discussion shall be published in a paper.

List of invited participants (TBC):
Carlos Abia
Bernhard Aringer
Kjell Eriksson
Bengt Gustafsson
Susanne Höfner
Michael Ireland
Hilding Neilson
Walter Nowotny
Bertrand Plez
Ian Short
Stefan Uttenthaler
Glenn Wahlgren
Markus Wittkowski
Clare Worely

In addition U. Jørgensen und T. Tsuji agreed to provide model fits for our comparison. Almost ten individuals/groups have declared their participation in our model comparison, so we are very excited about the outcome of this workshop.

The workshop is organised by Ulrike Heiter and Thomas Lebzelter and is financially supported by the ESF network initiative GREAT (Gaia Research for European Astronomy Training, http://www.ast.cam.ac.uk/GREAT/index.html) and by the Robert F. Wing support fund at Ohio State University. It is supported by the IAU WG on Abundances in Red Giants.

The total number of participants is limited to 35. We are now announcing an open call for participation. If you are interested, please fill out the application form below and send it by email to GREATgiants.astro@univie.ac.at. Places will be assigned in the order of the arrival of the applications. Please allow for approximately one week for the handling of your application. The call will close officially on June 15 2010.

There is no registration fee for this workshop. A limited number of travel and accommodation grants are available. Please indicate in the form, if you would like to apply for financial support.

It also still possible to participate in our 'experiment' on comparing various model codes by fitting a small set of given spectra. If you are interested to participate, please reply before April 30 2010!

We point out that this workshop will take place immediately after the conference "Why Galaxies Care About AGB Stars II. Shining examples and common inhabitants", August 16–20 2010, in Vienna (http://www.univie.ac.at/galagb). So you may be interested in attending the conference and then append a few more days in Vienna for the workshop!

In case you have any questions, please do not hesitate to contact us: GREATgiants.astro@univie.ac.at

Looking forward to your reply,
Thomas Lebzelter & Ulrike Heiter

— 8< —
Application form
"GREAT workshop on Comparative Modelling of Stellar Spectra"
August 23/24 2010, Department of Astronomy, University of Vienna, Austria

Name:
Email:
Affiliation:
Address:

Do you wish to apply for a travel grant?

Are you interested in participating in the model calculations?

Comments:

Please return to GREATgiants.astro@univie.ac.at