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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present the 109$^{\rm th}$ issue of the AGB Newsletter. As you will soon notice, amongst the 55 (!) contributions a large number are from the Planetary Nebulae conference and from the Torino workshop. We hope this will be a nice reminder for those of you who attended these conferences, and an inspiration for those of you who could not be there.

Don't miss Rebecca Soria-Ruiz's thesis, Falk Herwig's Annual Review of A&A, the advertisements for PhD scholarships at Monash University Melbourne, a postdoctoral position at University College London, proceedings of the 2004 polarimetry conference and an upcoming workshop on symbiotic binaries in Poland.

The next issue will be distributed on the 1$^{\rm st}$ of July; the deadline for contributions is the 30$^{\rm th}$ of June.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

AGB stars do not contribute to the pre-enrichment of globular cluster stars and extremely metal-poor halo stars

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)

Swift observations of the 2006 outburst of the recurrent nova RS Ophiuchi : I. Early X-ray emission from the shocked ejecta and red giant wind

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RS Ophiuchi is a recurrent nova which began its latest outburst on 2006 February 12. Previous outbursts have shown that high velocity ejecta interact with a pre-existing red giant wind, setting up shock systems analogous to those seen in Supernova Remnants. However, in the previous outburst in 1985, X-ray observations with EXOSAT did not commence until 55 days after the initial explosion. Here we report on *Swift* observations covering the first month of the 2006 outburst with both the Burst Alert (BAT) and X-ray Telescope (XRT) instruments. With the BAT it was possible to trace the evolution of the hard X-ray flux from the earliest phases, with a clear detection in a band 14-25 keV from $t = 0$ to $t \sim 6$ days, and a less strong detection at 25-50 keV during the first few days. It was also observed with XRT from 0.3-10 keV, starting at 3.17 days after outburst. The XRT spectra clearly show the presence of both line and continuum emission. These rapidly evolving spectra can be fitted by thermal emission from hot gas whose characteristic temperature, overlying absorbing column and resulting unabsorbed total flux decline monotonically after the first few days. Shock velocities derived from the fitted plasma temperatures are in good agreement with those found from observations at other wavelengths. Similarly, the derived circumstellar column density is in accord with that expected from the red giant wind ahead of the forward shock. These observations confirm the basic models of the 1985 outburst and lead us to conclude that Phase I of remnant evolution (where the ejecta are important in supplying energy to the shocked ambient medium) terminated by $t \sim 10$ days and the remnant then rapidly evolved to display behaviour characteristic of Phase III (where the shocked material is well cooled). Around $t = 26$ days however, a new, luminous and highly variable soft X-ray source appeared in the spectra whose origin will be explored more fully in a subsequent paper.

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The Low Excitation Planetary Nebulae HuDo 1 and HuBi 1 and their [WC10] Central Stars

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Low- and high-resolution spectra of the planetary nebulae HuDo 1 and HuBi 1, around [WC-late] stars, are analyzed. The objects belong to the galactic disk, with heliocentric radial velocities of -12 km s^{-1} (HuDo 1) and 57 km s^{-1} (HuBi 1). C(Hβ) reddening values are of 2.04 for HuDo 1 and 1.22 for HuBi 1. Plasma line ratios are used to estimate physical conditions and abundances. We find log (O/H)+12 = 8.43 and 8.57, and N/O = 0.2 and 0.1 for HuDo 1 and HuBi 1 respectively. HuBi 1 is the only PN excited by a very late [WC] star showing intense nebular He I recombination lines. From the stellar lines we derive a [WC 10] type for both stars, although HuBi 1 central star should be slightly hotter for providing a large amount of He^0 ionizing photons. Nebular and stellar parameters of HuDo 1 and HuBi 1 are compared with those of other [WC 10] objects, concluding that the stars of HuDo 1 and HuBi 1 should be intrinsically fainter. In particular HuBi 1 seems a low-density evolved nebula around a low-mass slowly-evolving star.

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Shock excitation of the knots of Hen 3-1475

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We present new optical STIS HST spectroscopic observations of the jets of the proto-planetary nebula Hen 3-1475. The excitation conditions of the knots of Hen 3-1475 are derived from the observed optical spectra, confirming that the knots are shock excited. The shocked spectra are qualitatively reproduced by simple "3/2"D bow shock models. We present a set of bow shock models devoted to planetary nebulae, and discuss the effects of the pre-ionization conditions, the bow shock velocity, the bow shock shape and the chemical abundances on the predicted spectra. To explore the reliability of the "3/2"D bow shock models, we also compare the observed spectra of other three proto-planetary nebulae (M 1-92, M 2-56 and CRL 618) to the predicted spectra.

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IR-source IRAS20508+2011: spectral variability of the optical component.

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Based on high-resolution spectra we revealed variability of the optical spectrum of the cool star identified with the IR source IRAS 20508+2011. Over the four years of our observations, the radial velocity derived from photospheric absorption lines varied in the interval $V_r = 15 - 30$ km/s. In the same time, the Hα profile varied from an intense bell-shaped emission line with a small absorption to 2-peaked emission with a central absorption feature below the continuum level. At al but one epoch, the positions of the metallic photospheric lines were systematically shifted relative to the Hα emission: $\Delta V_r = V_r(met) - V_r(H, emis) \approx -23$ km/s. The Na D doublet lines shown a complex profile with broad (half-width ≈ 120 km/s) emission and photospheric absorption, as well as an interstellar component. We used model atmospheres to determine the physical parameters and chemical composition of the star's atmosphere: T_{eff}=4800 K, log g=1.5, ξ_t=4.0 km/s and metallicity [Fe/H]= -0.36. We detected overabundances of oxygen [O/Fe] =+1.79 (with the ratio [C/O]≈ -0.9), and α-process elements, as well as a deficit of heavy metals. The totality of the parameters suggests that the optical component of IRAS 20508+2011 is an "O-rich" AGB star with luminosity

$M_v \approx -3^m$ that is close to its evolution transition to the post-AGB stage.

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A non-LTE abundance analysis of the post-AGB star ROA 5701

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An analysis of high-resolution Anglo-Australian Telescope (AAT)/ University College London Échelle Spectrograph (UCLÉS) optical spectra for the ultraviolet (UV)-bright star ROA 5701 in the globular cluster ω Cen (NGC 5139) is performed, using non-local thermodynamic equilibrium (non-LTE) model atmospheres to estimate stellar atmospheric parameters and chemical composition. Abundances are derived for C, N, O, Mg, Si and S, and compared with those found previously by Moehler et al. We find a general metal underabundance relative to young B-type stars, consistent with the average metallicity of the cluster. Our results indicate that ROA 5701 has not undergone a gas–dust separation scenario as previously suggested. However, its abundance pattern does imply that ROA 5701 has evolved off the AGB prior to the onset of the third dredge-up.

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Neutron-capture elements in the s- and r-process-rich stars: Constraints on neutron-capture nucleosynthesis processes

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The chemical abundances of the very metal-poor double-enhanced stars are excellent information for setting new constraints on models of neutron-capture processes at low metallicity. These stars are known as s+r stars, since they show enhancements of both s-process and r-process elements. The observed abundance ratios for the double-enhanced stars can be explained by those of stars that were polluted by an AGB star and subsequently accreted very significant amounts of r-process material out of an AIC (accretion-induced collapse) or Type 1.5 supernova. In this paper we present for the first time an attempt to fit the elemental abundances observed in the s- and r-rich, very metal-poor stars using a parametric model and suggest a new concept of component coefficients to describe the contributions of the individual neutron-capture processes to double-enhanced stars. We find that the abundance ratios of these stars are best fitted by enrichments of s- and r-process material. The overlap factor in the AGB stars where the observed s-process elements were produced lies between 0.1 and 0.81. Taking into account the dependence of the initial-final mass relations on metallicity, this wide range of values could possibly be explained by a wide range of core-mass values of AGB stars at low metallicity. The component coefficient of the r-process is strongly correlated with the component coefficient of the s-process for the double-enhanced stars. This is significant evidence that the r-process material in double-enhanced stars comes from an AIC or Type 1.5 supernova.

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Diagnostics for specific PAHs in the far-IR: searching neutral naphthalene and anthracene in the Red Rectangle

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Context: In the framework of the interstellar polycyclic aromatic hydrocarbons (PAHs) hypothesis, far-IR skeletal bands are expected to be a fingerprint of single species in this class.

Aims: We address the question of detectability of low energy PAH vibrational bands, with respect to spectral contrast and intensity ratio with "classical" Aromatic Infrared Bands (AIBs).

Methods: We extend our extablished Monte-Carlo model of the photophysics of specific PAHs in astronomical environments, to include rotational and anharmonic band structure. The required molecular parameters were calculated in the framework of the Density Functional Theory.

Results: We calculate the detailed spectral profiles of three low-energy vibrational bands of neutral naphthalene, and four low-energy vibrational bands of neutral anthracene. They are used to establish detectability constraints based on intensity ratios with "classical" AIBs. A general procedure is suggested to select promising diagnostics, and tested on available Infrared Space Observatory data for the Red Rectangle nebula.

Conclusions: The search for single, specific PAHs in the far-IR is a challenging, but promising task, especially in view of the forthcoming launch of the Herschel Space Observatory.

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The distribution of SiO in the circumstellar envelope around IRC+10216

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New interferometric observations of SiO $J = 5 \rightarrow 4$ circumstellar line emission around the carbon star IRC+10216, using the Submillimeter Array, are presented. Complemented by multi-transition single-dish observations, including infrared observations of ro-vibrational transitions, detailed radiative transfer modelling suggests that the fractional abundance of SiO in the inner part of the envelope, between $\approx$3–8 stellar radii, is as high as $\approx 1.5 \times 10^{-6}$. This is more than an order of magnitude higher than predicted by equilibrium stellar atmosphere chemistry in a carbon-rich environment and indicative of the importance of non-LTE chemical processes. In addition to the compact component, a spatially more extended ($r_{\rm e} \approx 2.4 \times 10^{16}$ cm) low-fractional-abundance ($f_0 \approx 1.7 \times 10^{-7}$) region is required to fit the observations. This suggests that the majority of the SiO molecules are effectively accreted onto dust grains in the inner wind while the remaining gas-phase molecules are eventually photodissociated at larger distances. Evidence of departure from a smooth wind is found in the observed visibilities, indicative of density variations of a factor 2 to 5 on an angular scale corresponding to a time scale of about 200 years. Additionally, constraints on the velocity structure of the wind are obtained.

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R Coronae Borealis at the 2003 Light Minimum

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High-resolution optical spectra of R CrB obtained in 2003 March is discussed. The 2003 spectra are compared with the extensive collection of spectra from the 1995-1996 minimum. Spectroscopic features common to the two minima include sharp emission lines of neutral and singly-ionized atoms, broad emission lines including He I, [N II] 6583 Å, Na D, and Ca II H & K lines, and blueshifted aborption lines of Na D, and K I resonance lines. Prominent differences between the 2003 and 1995-96 spectra are seen. The 2003 profiles of Na D, Ca II H & K are fit by a single Gaussian but in 1995-1996 two Gaussians separated by about 200 km s^{-1} were required. However, the He I broad emission lines are fit by a single Gaussian at all times; the emitting He and Na-Ca atoms are probably not colocated. The C_2 Phillips 2-0 lines are detected as sharp absorption lines in 2003 indicating presence of gas at 1300 K.The 2003 spectra show C I sharp emission lines at minimum light with a velocity changing in five days by about 20 km s^{-1} when the velocity of 'metal' sharp lines is unchanged; the C I emission may arise from shock-heated gas. Spectra at maximum shows extended blue wings to strong lines with the extension dependent on a line's lower excitation potential a signature of stellar wind. Changes in the cores of the resonance lines of Al I and Na D and the Ca II IR lines suggest complex flow patterns near the photosphere. The spectroscopic differences at the two mimima show the importance of continued scrutiny of the declines of R CrB.

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First stars IX -Mixing in extremely metal-poor giants. Variation of the $^{12}C/^{13}C$, [Na/Mg] and [Al/Mg] ratios

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-Context : Extremely metal-poor (EMP) stars preserve a fossil record of the composition of the ISM when the Galaxy formed. It is crucial, however, to verify whether internal mixing has modified their surface composition, especially in the giants where most elements can be studied.

-Aims : We aim to understand the CNO abundance variations found in some, but not all EMP field giants analysed earlier. Mixing beyond the first dredge-up of standard models is required, and its origin needs clarification.

-Methods : The $^{12}C/^{13}C$ ratio is the most robust diagnostic of deep mixing, because it is insensitive to the adopted stellar parameters and should be uniformly high in near-primordial gas. We have measured ^{12}C and ^{13}C abundances in 35 EMP giants (including 22 with [Fe/H]< -3.0) from high-quality VLT/UVES spectra analysed with LTE model atmospheres. Correlations with other abundance data are used to study the depth of mixing.

-Results : The $^{12}C/^{13}C$ ratio is found to correlate with [C/Fe] (and Li/H), and clearly anti-correlate with [N/Fe], as expected if the surface abundances are modified by CNO processed material from the interior. Evidence for such deep mixing is observed in giants above $\log L/L_\odot = 2.6$, brighter than in less metal-poor stars, but matching the bump

in the luminosity function in both cases. Three of the mixed stars are also Na-and Al-rich, another signature of deep mixing, but signatures of the ON cycle are not clearly seen in these stars.

-Conclusions : Extra mixing processes clearly occur in luminous RGB stars. They cannot be explained by standard convection, nor in a simple way by rotating models. The Na-and Al-rich giants could be AGB stars themselves, but an inhomogeneous early ISM or pollution from a binary companion remain possible alternatives.

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Spitzer Observations of V838 Monocerotis: Detection of a Rare Infrared Light Echo

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We present *Spitzer* observations of the unusual variable V838 Monocerotis. Extended emission is detected around the object at 24, 70 and 160 μm. The extended infrared emission is strongly correlated spatially with the *HST* optical light echo images taken at a similar epoch. We attribute this diffuse nebulosity to be from an infrared light echo caused by reprocessed thermal emission from dust heated by the outward-propagating radiation from the 2002 eruption. The detection of an IR light echo provides an opportunity to estimate the mass in dust of the echo material and hence constrain its origin. We estimate the dust mass of the light echo to be on the order of a solar mass - thereby implying the total gas plus dust mass to be considerably more - too massive for the echo material to be the ejecta from previous outburst/mass-losing events. This is therefore suggestive that a significant fraction of the matter seen through the light echo is interstellar in origin. Unresolved emission at 24 and 70 μm is also seen at the position of the central star possibly indicating the presence of hot dust freshly condensed in the outburst ejecta.

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SiO Maser Survey of the Inner Bar of the Galactic Bulge

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We surveyed 291 MSX/2MASS infrared objects in the $7^\circ \times 2^\circ$ area of the galactic center in the 43 GHz SiO J=1-0 v=1 and 2 maser lines, obtaining accurate radial velocities of 163 detected objects. The surveyed area is the region where the IRAS catalog is incomplete due to contamination by high source density. The objects in the present MSX/2MASS sample were chosen to have similar infrared characteristics to those of the previous SiO-maser-survey samples based on the color selected IRAS sources. The sampling based on the 2MASS catalog causes a bias to the foreside objects of the bulge due to heavy obscuration by interstellar dust;the detections are considerably leaned on the $V_{\rm lsr} < 0$ side.The $l-v$ diagram reveals two conspicuous features, which were not present or tenuous in the previous studies: one feature indicating a linear velocity increase with longitude with $|l| < 1.5^\circ$, which is likely associated with the inner bar, and

the other feature having considerably eccentric velocities more than those of the normal x_1-orbit family feature.The extinction-corrected K magnitudes (if used as a distance modulus) tend to show a sequential deposition of these objects along the line of sight toward the Galactic center depending on their radial velocities. The tendency that appeared in the distance measures is consistent with the bulge-bar dynamical model utilizing the periodic orbit families in the bar potential.

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Distance determination to NGC 55 from the planetary nebula luminosity function

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We analysed [O III], H-alpha, and continuum images of the Sculptor group spiral galaxy NGC 55 obtained with the WFI instrument at the 2.2-m telescope of ESO. We identified 21 new planetary nebula candidates. We constructed the [O III]5007 Planetary Nebula Luminosity Function (PNLF) and determined a most likely distance of 2.30 ± 0.35 Mpc. The distance to NGC 55 is a bit larger than previously determined distances, which means that the Sculptor group is further away from the Local group than previously thought. The PNLF distance to NGC 55 is comparable to the PNLF distance of NGC 300 (Soffner et al. 1996), adding support to the suggestion that these galaxies from a bound pair. There doesn't seem to be a shortage of planetary nebula candidates in this metal poor galaxy.

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The planets capture model of V838 Monocerotis: conclusions for the penetration depth of the planet/s

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V838 Mon is the prototype of a new class of objects. Understanding the nature of its multi-stage outburst and similar systems is challenging. So far, several scenarios have been invoked to explain this group of stars. In this work, the planets-swallowing model for V838 Mon is further investigated, taking into account the findings that the progenitor is most likely a massive B type star. We find that the super-Eddington luminosity during the eruption can explain the fast rising times of the three peaks in the optical light curve. We used two different methods to estimate the location where the planets were consumed. There is a nice agreement between the values obtained from the luminosities of the peaks and from their rising time scale. We estimate that the planets were stopped at a typical distance of one solar radius from the center of the host giant star. The planets-devouring model seems to give a satisfying explanation to the differences in the luminosities and rising times of the three peaks in the optical light curve of V838 Mon. The peaks may be explained by the consumption of three planets or alternatively by three steps in the terminal falling process of a single planet. We argue that only the binary merger and the planets-swallowing models are consistent

with the observations of the new type of stars defined by V838 Mon.

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Spectral analyses of eighteen hot H-deficient (pre-) white dwarfs from the Sloan Digital Sky Survey Data Release 4

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Context: The Sloan Digital Sky Survey Data Release 4 has provided spectra of several new PG 1159 stars and DO white dwarfs. This increase in known hot H-deficient compact objects significantly improves the statistics and helps to investigate late stages of stellar evolution.

Aims: From the optical SDSS spectra, effective temperatures and surface gravities are derived in order to place the observed objects in an evolutionary context. Especially the connection between PG 1159 stars and DO white dwarfs shall be investigated.

Method: Using our non-LTE model atmospheres and applying χ^2-fitting techniques, we determine stellar parameters and their errors. We derive total stellar masses for the DO white dwarfs using model evolutionary tracks.

Results We confirm three PG 1159 stars, with one showing ultra-high excitation ion features, and one sdO which we originally classified as a PG 1159 star. Additionally, we re-analysed the known PG 1159 star, PG 1424+535, with our new models. Furthermore, we present the first spectral analyses of thirteen DO white dwarfs, three of which show M-star features in their spectra, while two display ultra-high excitation ion features.

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Heavy Element Abundances in Giant Stars of 47 Tuc

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This research forms part of an investigation into heavy element abundances in Asymptotic Giant Branch (AGB) stars in various stellar environments. Seven giant stars in the southern globular cluster 47 Tuc have been observed using the Anglo-Australian Telescope. Abundances for five s- and r- process elements have been determined: the light s-process elements, Y and Zr; the heavy s-process elements, La and Nd; and the r-process element Eu. Mean enhancements in the light s-process, [ls/Fe], of $\sim$+0.6 dex and heavy s-process elements, [hs/Fe], of $\sim$+0.3 dex were determined for all the giant stars. There was no statistically significant difference between the abundances determined for the Red Giant Branch (RGB) and AGB stars in this study. The results for the RGB stars differ from those obtained by a number of previous studies. However, because of the similar abundance results obtained for the AGB and RGB stars in this study we believe this provides evidence for previous enrichment of the material from which these stars formed.

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A warped m=2 water maser disc in V778 Cyg?

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The silicate carbon star V778 Cyg is a source of 22 GHz water maser emission which was recently resolved by MERLIN. Observations revealed an elongated S-like structure along which the velocities of the maser features show a linear dependence on the impact parameter. This is consistent with a doubly-warped m=2 disc observed edge-on. Water masers and silicate dust emission (detected by IRAS and ISO) have a common origin in O-rich material and are likely to be co-located in the disc. We propose a detailed self-consistent model of a masing gas-dust disc around a companion to the carbon star in a binary system, which allows us to estimate the companion mass of 1.7 ± 0.1 $M_\odot$, the disc radius of 40 ± 3 AU and the distance between companions of about 80 AU. Using a dust-gas coupling model for water masing, we calculate the maser power self-consistently, accounting for both the gas and the dust energy balances. Comparing the simulation results with the observational data, we deduce the main physical parameters of the masing disc, such as the gas and dust temperatures and their densities. We also present an analysis of the stability of the disc.

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Probing the mass-loss history of AGB and red supergiant stars from CO rotational line profiles. I. Theoretical model - Mass-loss history unravelled in VY CMa

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Context. Mass loss plays a dominant role in the evolution of low mass stars while they are on the Asymptotic Giant Branch (AGB). The gas and dust ejected during this phase are a major source in the mass budget of the interstellar medium. Recent studies have pointed towards the importance of variations in the mass-loss history of such objects.
Aims. By modelling the full line profile of low excitation CO lines emitted in the circumstellar envelope, we can study the mass-loss *history* of AGB stars.
Methods. We have developed a non-LTE radiative transfer code, which calculates the velocity structure and gas kinetic temperature of the envelope in a self-consistent way. The resulting structure of the envelope provides the input for the molecular line radiative calculations which are evaluated in the comoving frame. The code allows for the implementation of modulations in the mass-loss rate. This code has been benchmarked against other radiative transfer codes and is shown to perform well and efficiently.
Results. We illustrate the effects of varying mass-loss rates in case of a superwind phase. The model is applied to the well-studied case of VY CMa. We show that both the observed integrated line strengths as the spectral structure present in the observed line profiles, unambiguously demonstrate that this source underwent a phase of high mass loss ($\sim 3.2 \times 10^{-4}\,M_\odot$/yr) some 1000 yr ago. This phase took place for some 100 yr, and was preceded by a low mass-loss phase ($\sim 1 \times 10^{-6}\,M_\odot$/yr) taking some 800 yr. The current mass-loss rate is estimated to be in the order of $8 \times 10^{-5}\,M_\odot$/yr.
Conclusions In this paper, we demonstrate that both the relative strength of the CO rotational line profiles and the (non)-occurrence of spectral structure in the profile offer strong diagnostics to pinpoint the mass-loss history.

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Does simultaneous solution matter for stellar evolution codes?

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A version of the STARS stellar evolution code has been developed that uses a non-simultaneous solution of the equations of stellar structure and evolution. In all other respects it is identical to the normal, fully simultaneous version. It is therefore possible to test the dependence of the solution on how the equations are solved. Two cases are investigated: a $5M_{\odot}$ and a $3M_{\odot}$ star, both of metallicity Z=0.02. Prior to the asymptotic giant branch, the models are almost identical. However once thermal pulses start, the two methods of solution yield diverging results with the non-simultaneous technique predicting longer interpulse periods. This is traced to difficulties associated with hydrogen burning caused by the use of a moving mesh. It is shown that, with careful control of the temporal resolution, the results of the simultaneous technique can be recovered.

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Oxygen Chemistry in the Circumstellar Envelope of the Carbon-Rich Star IRC+10216

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In this paper we study the oxygen chemistry in the C-rich circumstellar shells of IRC+10216. The recent discoveries of oxygen bearing species (water, hydroxyl radical and formaldehyde) toward this source challenge our current understanding of the chemistry in C-rich circumstellar envelopes. The presence of icy comets surrounding the star or catalysis on iron grain surfaces have been invoked to explain the presence of such unexpected species. This detailed study aims at evaluating the chances of producing O-bearing species in the C-rich circumstellar envelope only by gas phase chemical reactions. For the inner hot envelope, it is shown that although most of the oxygen is locked in CO near the photosphere (as expected for a C/O ratio greater than 1), some stellar radii far away species such as H_2O and CO_2 have large abundances under the assumption of thermochemical equilibrium. It is also shown how non-LTE chemistry makes very difficult the CO→H_2O,CO_2 transformation predicted in LTE. Concerning the chemistry in the outer and colder envelope, we show that formaldehyde can be formed through gas phase reactions. However, in order to form water vapor it is necessary to include a radiative association between atomic oxygen and molecular hydrogen with a quite high rate constant. The chemical models explain the presence of HCO^+ and predict the existence of SO and H_2CS (which has been detected in a 3 mm line survey to be published). We have modeled the line profiles of H_2CO, H_2O, HCO^+, SO and H_2CS using a non-local radiative transfer model and the abundance profiles predicted by our chemical model. The results have been compared to the observations and discussed.

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Elemental abundances in the atmosphere of clump giants.

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The aim of this paper is to provide the fundamental parameters and abundances for a large sample of local clump giants with a high accuracy. This study is a part of a big project, where the vertical distribution of the stars in the Galactic disc and the chemical and dymamical evolution of the Galaxy are being investigated. The selection of clump stars for the sample group was made applying a color - absolute magnitude window to nearby Hipparcos stars. The effective temperatures were estimated by the line depth ratio method. The surface gravities ($\log g$) were determined by two methods (the first one was the method based on the ionization balance of iron and the second one was the method based on fitting of the wings of Ca I 6162.17 Å line). The abundances of carbon and nitrogen were obtained from molecular synthetic spectrum, the Mg and Na abundances were derived using the non-LTE approximation. The "classical" models of stellar evolution without atomic diffusion and rotation-induced mixing were employed. The atmospheric parameters ($T_{\rm eff}$, $\log g$, [Fe/H], $V_{\rm t}$) and Li, C, N, O, Na, Mg, Si, Ca and Ni abundances in 177 clump giants of the Galactic disc were determined. The underabundance of carbon, overabundance of nitrogen and "normal" abundance of oxygen were detected. A small sodium overabundance was found. A possibility of a selection of the clump giants based on their chemical composition and the evolutionary tracks was explored. The theoretical predictions based on the classical stellar evolution models are in good agreement with the observed surface variations of the carbon and nitrogen just after the first dredge-up episode. The giants show the same behavior of the dependencies of O, Mg, Ca, Si (α-elements) and Ni (iron-peak element) abundances vs. [Fe/H] as dwarfs do. This allows one to use such abundance ratios to study the chemical and dynamical evolution of the Galaxy.

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Nuclear reaction rate uncertainties and astrophysical modeling: Carbon yields from low-mass giants

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Calculations that demonstrate the influence of three key nuclear reaction rates on the evolution of asymptotic giant branch stars have been carried out. We study the case of a star with an initial mass of 2 $M_\odot$ and a metallicity of Z=0.01, somewhat less than the solar metallicity. The dredge-up of nuclear processed material from the interior of the star and the yield predictions for carbon are sensitive to the rate of the ^{14}N(p,g)^{15}O and triple- reactions. These reactions dominate the H- and He-burning shells of stars in this late evolutionary phase. Published uncertainty estimates for each of these two rates propagated through stellar evolution calculations cause uncertainties in carbon enrichment and yield predictions of about a factor of 2. The other important He-burning reaction, ^{12}C(a,g)^{16}O, although associated with the largest uncertainty in our study, does not have a significant influence on the abundance evolution compared with other modeling uncertainties. This finding remains valid when the entire evolution from the main sequence to the tip of the asymptotic giant branch is considered. We discuss the experimental sources of the rate uncertainties addressed here and give some outlooks for future work.

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Hydrodynamic simulations of He-shell flash convection

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We present the first hydrodynamic, multi-dimensional simulations of He-shell flash convection. Specifically, we investigate the properties of shell convection at a time immediately before the He-luminosity peak during the $15^{\rm th}$ thermal pulse of a stellar evolution track with initially two solar masses and metallicity Z = 0.01. This choice is a representative example of a low-mass asymptotic giant branch thermal pulse. We construct the initial vertical stratification with a set of polytropes to resemble the stellar evolution structure. Convection is driven by a constant volume heating in a thin layer at the bottom of the unstable layer. We calculate a grid of 2D simulations with different resolutions and heating rates. Our set of simulations includes one low-resolution 3D run. The computational domain includes 11.4 pressure scale heights. He-shell flash convection is dominated by large convective cells that are centered in the lower half of the convection zone. Convective rolls have an almost circular appearance because focusing mechanisms exist in the form of the density stratification for downdrafts and the heating of localized eddies that generate upflows. Nevertheless, downdrafts appear to be somewhat more focused. The He-shell flash convection generates a rich spectrum of gravity waves in both stable layers above and beneath the convective shell. The magnitude of the convective velocities from our 1D mixing- length theory model and the rms-averaged vertical velocities from the hydrodynamic model are consistent within a factor of a few. However, the velocity profile in the hydrodynamic simulation is more asymmetric, and decays exponentially inside the convection zone. An analysis of the oscillation modes shows that both g-modes and convective motions cross the formal convective boundaries, which leads to mixing across the boundaries. Our resolution study shows consistent flow structures among the higher resolution runs, and we see indications for convergence of the vertical velocity profile inside the convection zone for the highest resolution simulations. Many of the convective properties, in particular the exponential decay of the velocities, depend only weakly on the heating rate. However, the amplitudes of the gravity waves increase with both the heating rate and the resolution.

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Conference Papers

The Abundances of Light Neutron-Capture Elements in Planetary Nebulae

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We present preliminary results from a large-scale survey of the neutron(n)-capture elements Se and Kr in Galactic planetary nebulae (PNe). These elements may be produced in PN progenitors by s-process nucleosynthesis, and brought to the stellar envelope by third dredge-up (TDU). We have searched for [Kr III] 2.199 and [Se IV] 2.287 μm in 120 PNe, and detected one or both lines in 79 objects, for a detection rate of 66%. In order to determine abundances of Se and Kr, we have added these elements to the atomic database of the photoionization code CLOUDY, and constructed a large grid of models to derive corrections for unobserved ionization stages. Se and Kr are enriched in ∼73% of the PNe in which they have been detected, and exhibit a wide range of abundances, from roughly solar to enriched by a factor of 10 or more. These enrichments are interpreted as evidence for the operation of the s-process and TDU in the progenitor stars. In line with theoretical expectations, Kr is more strongly enhanced than Se, and the abundances of both elements are correlated with the carbon abundance. Kr and Se are strongly enhanced in Type I PNe, which may be evidence for the operation of the ^{22}Ne neutron source in intermediate-mass AGB stars. These results constitute the first broad characterization of s-process enrichments in PNe as a population, and reveal the impact of low- and intermediate-mass stars on the chemical evolution of trans-iron elements in the Galaxy.

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Optical recombination lines as probes of conditions in planetary nebulae

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Since the last IAU symposium on planetary nebulae (PNe), several deep spectroscopic surveys of the relatively faint optical recombination lines (ORLs) emitted by heavy element ions in PNe and H II regions have been completed. New diagnostic tools have been developed thanks to progress in the calculations of basic atomic data. Together, they have led to a better understanding of the physical conditions under which the various types of emission lines arise. The studies have strengthened the previous conjecture that nebulae contain another component of cold, high metallicity gas, which is too cool to excite any significant optical or UV CELs and is thus invisible via such lines. The existence of such a plasma component in PNe and possibly also in H II regions provides a natural solution to the long-standing problem in nebular astrophysics, i.e. the dichotomy of nebular plasma diagnostics and abundance determinations using ORLs and continua on the one hand and collisionally excited lines (CELs) on the other.

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Planetary nebulae as probes for galactic chemical evolution

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The role of planetary nebulae as probes for the galactic chemical evolution is reviewed. Their abundances throughout the Galaxy are discussed for key elements, in particular oxygen and other alpha elements. The abundance distribution derived from planetary nebulae leads to the establishment of radial abundance gradients in the galactic disk that are important constraints to model the chemical evolution of the Galaxy. The radial gradient, well determined for the solar neighborhood, is examined for distinct regions. For the galactic anticenter in particular, the observational data confirm results from galactic evolution models that point to a decreasing in the gradient slope at large galactocentric distances. The possible time evolution of the radial gradient is also examined comparing samples of planetary nebulae of different ages, and the results indicate that a flattening in the gradient occurred, which is confirmed by some galactic evolution models. The galactic bulge is another important region whose modeling can be constrained by observational results obtained from planetary nebulae. Results derived in the last few years indicate that bulge nebulae have an abundance distribution similar to that of disk objects, however with a larger dispersion.

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New results on the time variation of the radial abundance gradients from planetary nebulae

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New results on the time variation of the radial abundance gradients in the galactic disk are presented on the basis of four different samples of planetary nebulae. These comprise both smaller, homogeneous sets of data, and larger but non-homogeneous samples. Four different chemical elements are considered, namely, O, S, Ar, and Ne. Other objects such as open clusters, cepheids and HII regions are also taken into account. Our analysis support our earlier conclusions in the sense that, on the average, the radial abundance gradients have flattened out during the last 6 to 8 Gyr, with important consequences for models of the chemical evolution of the Galaxy.

Poster contribution, published in IAU Symposium 234: Planetary Nebulae in Our Galaxy and Beyond,

ed. M. J. Barlow, R. H. Méndez
Available from astro-ph/0605074
and from http://www.astro.iag.usp.br/∼maciel

Disklike Structure in the Semiregular Pulsating Star X Her

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The author presents the results of Berkeley-Illinois-Maryland (BIMA) array interferometric observations in the CO $J = 1$–0 line toward X Her and EP Aqr, the semiregular pulsating stars with a composite CO line profile, and also reports finding of a disklike structure in X Her. In the CO spectrum both of X Her and EP Aqr, a composite profile including narrow and broad components is seen as reported by the previous single-dish observations. The spatial structure of the broad component region of X Her shows a bipolar shape, and that of the narrow component shows an elliptical/spherical shape. The blue- and red-shifted parts of the X Her narrow component show a systematic difference in the velocity integrated intensity map. The spatio-kinetic properties of the X Her narrow component are reminiscent of a Keplerian rotating disk with a central mass of 0.9 $M_{\odot}$. The spatial distributions of both the narrow and the broad components of EP Aqr appear to be roughly round with the same peak positions; no significant velocity gradient is seen. The spatio-kinetic properties of EP Aqr are reminiscent of a multiple-shell structure model rather than of a bipolar flow and disk model.

Poster contribution, published in The $234^{\rm th}$ Symposium of the International Astronomical Union held at Kona, Hawai'i 3-7 April, 2006
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The Sulfur Abundance Anomaly in Planetary Nebulae

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The failure of S and O abundances in most planetary nebulae to display the same strong direct correlation that is observed in extragalactic H II regions represents one of the most perplexing problems in the area of PN abundances today. Galactic chemical evolution models as well as large amounts of observational evidence from H II region studies support the contention that cosmic abundances of alpha elements such as O, Ne, S, Cl, and Ar increase together in lockstep. Yet abundance results from the Henry, Kwitter, & Balick (2004) database show a strong tendency for most PNe to have S abundances that are significantly less than expected from the observed level of O. The most likely explanation for the sulfur anomaly is the past failure to properly measure the abundances of unseen ionization stages above S^{2+}. Future observations with Spitzer will allow us to test this hypothesis.

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Gallery of Planetary Nebulae Spectra

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In the course of our abundance studies over the past decade we have accumulated more than 120 high-quality, medium resolution spectra of planetary nebulae (PNe) from 3600-9600 Å using the KPNO 2.1m Goldcam CCD spectrograph and the CTIO 1.5m RC spectrograph. Results have been published in, *e.g.*, Kwitter & Henry (1998); Henry, Kwitter & Balick (2004); and Milingo et al. (2006). We have created this website as a place where the spectra are available for graphical display, and where PN atlas information and image links are tabulated.

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Available from astro-ph/0605040
and from http://oit.williams.edu/nebulae

ELSA: An Integrated, Semi-Automated Nebular Abundance Package

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We present ELSA, a new modular software package, written in C, to analyze and manage spectroscopic data from emission-line objects. In addition to calculating plasma diagnostics and abundances from nebular emission lines, the software provides a number of convenient features including the ability to ingest logs produced by IRAF's splot task, to semi-automatically merge spectra in different wavelength ranges, and to automatically generate various data tables in machine-readable or LaTeX format. ELSA features a highly sophisticated interstellar reddening correction scheme that takes into account temperature and density effects as well as He II contamination of the hydrogen Balmer lines. Abundance calculations are performed using a 5-level atom approximation with recent atomic data, based on R. Henry's ABUN program. Improvements planned in the near future include use of a three-region ionization model, similar to IRAF's nebular package, error propagation, and the addition of ultraviolet and infrared line analysis capability. Detailed documentation for all aspects of ELSA are available at the ELSA website at http://www.williams.edu/Astronomy/research/PN/ .

Poster contribution, published in IAU Symp 234
Available from astro-ph/0605099
and from http://www.williams.edu/Astronomy/research/PN/

New Planetary Nebulae towards the Galactic bulge

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New Planetary Nebulae (PNe) were discovered through an [O III] 5007 Å emission line survey in the Galactic bulge region with $l > 0$ deg. We detected 240 objects, including 44 new PNe. Deep Hα+[N II] CCD images as well as low resolution spectra were obtained for the new PNe in order to study them in detail. Preliminary photo-ionization models of the new PNe with Cloudy resulted in first estimates of the physical parameters and abundances. They are compared to the abundances of Galactic PNe.

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Available from astro-ph/0605083

New advances in nebular photoionisation modelling

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The study of photoionised gas in planetary nebulae (PNe) has played a major role achieving, over the years, a better understanding of a number of physical processes pertinent to a broader range of fields than just PNe studies, ranging from atomic physics to stellar evolution. Whilst empirical techniques are routinely employed for the analysis of the emission line spectra of such objects, the accurate interpretation of the observational data often requires the solution of the radiative transfer (RT) problem in the nebula, via the application of a photoionisation code. A number of large-scale codes have been developed since the late sixties, using various analytical or statistical techniques mainly under the assumption of spherical symmetry and a few in 3D. These codes have been proved to be powerful and in many cases essential tools, but a clear idea of the underlying physical processes and assumptions is necessary in order to avoid reaching misleading conclusions.

The development of the codes has been driven by the observational constraints available, but also compromised by the available computer power. Modern codes are faster and more flexible, with the ultimate goal being the achievement of a description of the observations relying on the smallest number of parameters possible. In this light, recent developments have been focused on the inclusion of new atomic data, the inclusion of a realistic treatment for dust grains mixed in the ionised and photon dominated regions (PDRs) and the expansion of some codes to PDRs with the inclusion of chemical reaction networks. Furthermore the last few years have seen the development of fully 3D photoionisation codes based on the Monte Carlo method.

A brief review of the photoionisation codes currently in use is given here, with emphasis on recent developments, including the expansion of the models to the 3D domain, the identification of new observational constraints and how these can be used to extract useful information from realistic models.

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Three-Dimensional Ionisation, Dust RT and Chemical Modelling of Planetary Nebulae

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The assumption of spherical symmetry is not justified for the vast majority of PNe. The interpretation of spatially-resolved observations cannot rely solely on the application of 1D codes, which may yield incorrect abundances determinations resulting in misleading conclusions. The 3D photoionisation code MOCASSIN (Monte CAarlo SimulationS of ionised Nebulae) is designed to remedy these shortcomings. The 3D transfer of both primary and secondary radiation is treated self-consistently without the need of approximations. The code was benchmarked and has been applied to the study of several PNe. The current version includes a fully self-consistent radiative transfer treatment for dust grains mixed within the gas, taking into account the microphysics of dust-gas interactions within the geometry-independent Monte Carlo transfer. The new code provides an excellent tool for the self-consistent analysis of dusty ionised regions showing asymmetries and/or density and chemical inhomogeneities. Work is currently in progress to incorporate the processes that dominate the thermal balance of photo-dissociation regions (PDRs), as well as the formation and destruction processes for all the main molecular species.

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Infrared Imaging of Planetary Nebulae from the Ground Up

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New ground-based telescopes and instruments, the return of the NICMOS instrument on the Hubble Space Telescope (HST), and the recent launch of the Spitzer Space Telescope have provided new tools that are being utilized in the study of planetary nebulae (PNe). Multiwavelength, high spatial resolution ground-based and HST imaging have been used to probe the inner regions of young PNe to determine their structure and evaluate formation mechanisms. Spitzer/IRAC and MIPS have been used to image more evolved PNe to determine the spatial distribution of molecular hydrogen, ionized gas, and dust in the nebulae and halos.

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Unravelling the chemical inhomogeneity of PNe with VLT FLAMES integral-field unit spectroscopy

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Recent weak emission-line long-slit surveys and modelling studies of PNe have convincingly argued in favour of the existence of an unknown component in the planetary nebula plasma consisting of cold, hydrogen-deficient gas, as an explanation for the long-standing recombination-line versus forbidden-line temperature and abundance discrepancy problems. Here we describe the rationale and initial results from a detailed spectroscopic study of three Galactic PNe undertaken with the VLT FLAMES integral-field unit spectrograph, which advances our knowledge about the small-scale physical properties, chemical abundances and velocity structure of these objects across a two-dimensional field of view, and opens up for exploration an uncharted territory in the study and modelling of PNe and photoionized nebulae in general.

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Carbon stars in local group dwarf galaxies: C and O abundances

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We present abundances of carbon and oxygen as well as abundance ratios $^{12}C/^{13}C$ for a sample of carbon stars in the LMC, SMC, Carina, Sculptor and Fornax dwarf galaxies. The overall metallicities in these dwarf galaxies are lower than in the galactic disc. The observations cover most of the AGB and we discuss the abundance patterns in different regions along the AGB. The abundances are determined from infrared spectra obtained with the ISAAC spectrometer

on VLT (R=1500) and the Phoenix Spectrometer on Gemini South (R=50000). The synthetic spectra used in the analysis were computed with MARCS model atmospheres. We find that the oxygen abundance is decreasing with decreasing overall metallicity of the system while the C/O ratio at a given evolutionary phase is increasing with decreasing oxygen abundance.

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The formation of globules in planetary nebulae

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We discuss the formation of globules in planetary nebulae, typified by those observed in the Helix Nebula. We show that the properties of the globules, their number, mass, separation, and overall geometry strongly support a scenario in which globules are formed by the fragmentation of a swept-up shell as opposed to models in which the knots form in the AGB wind. We show that the RT or other instabilities which lead to the break-up of shells formed in the nebulae by fast winds or ionization fronts can produce arrays of globules with the overall geometry and within the mass range observed. We also show that the presence of a magnetic field in the circumstellar gas may play an important role in controlling the fragmentation process. Using field strengths measured in the precursor AGB envelopes, we find that close to the central star where the fields are relatively strong, the wavelengths of unstable MRT modes are larger than the shell dimensions, and the fragmentation of the shell is suppressed. The wavelength of the most unstable MRT mode decreases with increasing distance from the star, and when it becomes comparable to the shell thickness, it can lead to the sudden, rapid break-up of an accelerating shell. For typical nebula parameters, the model results in numerous fragments with a mass scale and a separation scale similar to those observed. Our results provide a link between global models of PN shaping in which shells form via winds and ionization fronts, and the formation of small scale structures in the nebulae.

Oral contribution, published in Planetary Nebulae in Our Galaxy and Beyond, IAU Symposium 234, eds. M. J. Barlow, R. H. Méndez
Available from astro-ph/0605307

The Spectroscopic Properties of Bright Extragalactic Planetary Nebulae

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The properties of bright extragalactic planetary nebulae are reviewed based upon the results of low and high resolution spectroscopy. It is argued that bright extragalactic planetary nebulae from galaxies (or subsystems) with and without star formation have different distributions of central star temperature and ionization structure. As regards the chemical compositions, oxygen and neon are generally found to be unchanged as a result of the evolution of the stellar progenitors. Nitrogen enrichment may occur as a result of the evolution of the progenitors of bright planetary nebulae in all stellar populations, though this enrichment may be (more) random in old stellar populations. Helium abundances appear to be influenced by the chemical evolution of the host galaxy, with planetary nebulae in dwarf spheroidals having systematically elevated abundances. Neither the age nor the metallicity of the progenitor stellar population has a strong effect upon the kinematics observed for nebular shells. Both the range of expansion velocites, 8-28 km/s, and the typical expansion velocity, ∼18 km/s, are found to be relatively constant in all galaxies. On the other hand, bright planetary nebulae in the bulge of M31 have systematically higher expansion velocities than their

counterparts in M31's disk. The expansion velocities show no trend with nebular Hβ luminosity, apart from a lack of large expansion velocities at the highest luminosities (the youngest objects), but appear to correlate with the 5007/Hβ ratio, at least until this ratio saturates. These results suggest a link between the evolution of the nebular shells and central stars of bright extragalactic planetary nebulae.

Oral contribution, published in IAU Symp. 234: Planetary Nebulae in Our Galaxy and Beyond, M. J. Barlow and R. H. Méndez, eds.
Available from astro-ph/0605348

bHROS high spectral resolution observations of PN forbidden and recombination line profiles

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We have acquired high spectral resolution observations (R=150,000) of the planetary nebulae NGC 7009 and NGC 6153, using bHROS on Gemini South. Observations of this type may provide a key to understanding why optical recombination lines (ORLs) yield systematically higher heavy element abundances for photoionized nebulae than do the classical forbidden collisionally excited lines (CELs) emitted by the same ions; NGC 7009 and NGC 6153 have notably high ORL/CEL abundance discrepancy factors (ADFs) of 5 and 10, respectively. Due to the opposite temperature dependences of ORLs and CELs, ORLs should be preferentially emitted by colder plasma. Our bHROS observations of NGC 7009 reveal that the [O III] 4363 Å CEL has a FWHM linewidth that is 1.5 times larger than that shown by O II ORLs in the same spectrum, despite the fact that all of these lines are emitted by the O^{2+} ion. The bHROS spectra of NGC 6153 also show that its O II ORLs have significantly narrower linewidths than do the [O III] 4363 Å and 5007 Å lines but, in addition, the [O III] 4363 Å and 5007 Å lines show very different velocity profiles, implying the presence of large temperature variations in the nebula.

Poster contribution, published in IAU Symposium No. 234, 'Planetary Nebulae in our Galaxy and Beyond', M. J. Barlow & R. H. Méndez, eds.
Available from astro-ph/0605235

Planetary nebulae as mass tracers in galaxies

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Planetary nebula are useful kinematic tracers of the stars in all galaxy types. I review recent observationally-driven developments in the study of galaxy mass profiles. These have yielded surprising results on spiral galaxy disk masses and elliptical galaxy halo masses. A key remaining question is the coupling between PNe and the underlying stellar populations.

Oral contribution, published in Proc. IAU Symp. 234, Planetary Nebulae in Our Galaxy and Beyond (3-7 April 2006), eds. M.J. Barlow & R.H. Méndez (Cambridge Univ. Press)
Available from astro-ph/0605275

Missing Galactic PNe: [S III] Imaging Survey

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The total number of Galactic planetary nebulae is highly uncertain; the most inclusive current catalog contains only ∼1,500. We will use the PRISM wide-field imager on the 1.83 m Perkins Telescope to conduct a pilot survey of the Galactic plane in search of [S III] emission from planetary nebulae obscured by dust and missed by surveys of Hα. We are employing the method of Jacoby & Van de Steene, who surveyed the bulge for 9532 Å [S III] emission. In addition to seeing through more of the extinction, use of the [S III] emission line will a priori reject the most troublesome catalog contaminants: ultracompact H II regions.

Poster contribution, published in IAU Symp. 234: Planetary Nebulae in our Galaxy and Beyond
Available from astro-ph/0605545

Helium enhancements in globular cluster stars from Asymptotic Giant Branch star pollution

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Using a chemical evolution model we investigate the intriguing suggestion that there are populations of stars in some globular clusters (e.g. NGC 2808, omega Centauri) with enhanced levels of helium (Y from about 0.28 to 0.40) compared to the majority of the population that presumably have a primordial helium abundance. We assume that a previous generation of massive low-metallicity Asymptotic Giant Branch (AGB) stars has polluted the cluster gas via a slow stellar wind. We use two independent sets of AGB yields computed from detailed models to follow the evolution of helium, carbon, nitrogen and oxygen in the cluster gas using a Salpeter initial mass function (IMF) and a number of top-heavy IMFs. In no case were we able to fit the observational constraints, Y > 0.30 and C+N+O approximately constant. Depending on the shape of the IMF and the yields, we either obtained Y approximately greater than 0.30 and large increases in C+N+O or Y < 0.30 and C+N+O approximately constant. These results suggest that either AGB stars alone are not responsible for the large helium enrichment or that any dredge-up from this generation of stars was less than predicted by standard models.

Oral contribution, published in The VIII Torino Workshop on Nucleosynthesis in AGB stars: Constraints on AGB Nucleosynthesis from Observations
Available from astro-ph/0605540

Temperature Variations and Chemical Abundances in Planetary Nebulae

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In this review we present a brief discussion on the observational evidence in favor of the presence of temperature variations, and conclude that many planetary nebulae show spatial temperature variations that are larger than those predicted by 1D static chemically homogeneous photoionization models. To determine accurate chemical abundances it is necessary to know the cause of these temperature variations and several possibilities are discussed. The importance of this problem is paramount to test the models of stellar evolution of low and intermediate mass stars and of the chemical evolution of galaxies. We conclude that the proper abundances for chemically homogeneous PNe are those derived from recombination lines, while for the two-abundance nebular model the proper heavy element abundances relative to hydrogen are those derived from visual and UV collisionally excited lines adopting the t2 values derived from T_e([O III]) and T_e(Balmer).

Oral contribution, published in IAU Symp., 234, Planetary Nebulae in our Galaxy and Beyond
Available from astro-ph/0605595

Galactic Abundance Patterns via Peimbert Types I & II PNe

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We present total element abundances based upon newly acquired spectrophotometry of a sample of >120 Galactic PNe. We continue the use of the near-IR [S III] features to determine S^{+2} abundances and to improve total extrapolated sulfur - a useful metallicity tracer. With this compilation we explore abundance patterns in PNe that reveal signatures of stellar evolution and nucleosynthesis as well as larger-scale galactic chemical evolution.

Poster contribution, published in Planetary Nebulae in our Galaxy and Beyond, IAU Symposium No. 234, 2006
Available from astro-ph/0605066

Review Papers

Mass loss on the Asymptotic Giant Branch

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Mass loss on the Asymptotic Giant Branch provides the origin of planetary nebulae. This paper reviews several relevant aspects of AGB evolution: pulsation properties, mass loss formalisms and time variable mass loss, evidence for asymmetries on the AGB, binarity, ISM interaction, and mass loss at low metallicity. There is growing evidence that mass loss on the AGB is already asymmetric, but with spherically symmetric velocity fields. The origin of the rings may be in pulsational instabilities causing mass-loss variations on time scales of centuries.

Published in IAU Symp. 234, Planetary Nebulae in Our Galaxy and Beyond (Invited Review)
Available from astro-ph/0605097

Local Group surveys for Planetary Nebulae

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The Local Group (LG) represents the best environment to study in detail the PN population in a large number of morphological types of galaxies. The closeness of the LG galaxies allows to investigate the faintest side of the PN luminosity function and to detect PNe also in the less luminous galaxies, the dwarf galaxies, where a small number of them is expected.

A review of the results of the most recent imaging surveys in the LG is presented. Some applications of the surveys for PNe to the study of the star formation history of the host galaxies are analyzed. In addition, these new observational data are an invaluable resource for follow-up spectroscopy to derive the chemical properties of not only PNe, but also other important emission-line sources like HII regions. These are fundamental tools for the discussion of the chemical evolution of the host galaxies, mapping the history of their chemical enrichment at different epochs. The latest results on this subject are presented.

Published in Proceeding of the IAU Symp. 234, Planetary Nebulae in Our Galaxy and Beyond,M. J. Barlow & R. H. Méndez, eds.
Available from astro-ph/0605222

Properties of Post-AGB Stars

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A review is presented of the most relevant results obtained in the last few years on this rare class of astronomical sources. Multi-wavelength analysis of an increasing number of post-AGB stars reveal that they constitute a more inhomogeneous population of stars than previously thought. The new data available allow us to study these sources with unprecedent spatial resolution and to extend our spectroscopic knowledge in a systematic way to the infrared for the first time, where crucial information is contained on the chemical composition of the gas and dust in their circumstellar shells. The overall infrared properties derived from ISO and Spitzer data can be used to trace the mass loss history and the chemical evolution of the ejected material. The new results impose severe observational constraints to the current nucleosynthesis models and suggest that the evolution is mainly determined not only by the initial mass but also by the metallicity of the progenitor star. Post-AGB samples are likely to grow in the near future with the advent of new data from space facilities like Spitzer or Akari. Studies of post-AGB stars in the galactic halo, the Magellanic Clouds and other galaxies of the Local Group will certainly improve our knowledge on the evolutionary connections between AGB stars and PNe.

Published in IAU Symp. 234 Planetary Nebulae in Our Galaxy and Beyond (3-7 April 2006), eds. M.J. Barlow & R.H. Méndez (Cambridge Univ. Press)
Available from astro-ph/0605458

Evolution of Asymptotic Giant Branch Stars

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The current status of modeling the evolution and nucleosynthesis of asymptotic giant branch (AGB) stars is reviewed. The principles of AGB evolution have been investigated in recent years leading to improved and refined models, for example with regard to hot-bottom burning or the third dredge-up. The post processing s-process model yields quantitative results that reproduce many observations. However, these and most other processes in AGB stars are intimately related to the physics of stellar mixing. Mixing in AGB stars is currently not well-enough understood for accurate yield predictions. Several constraints and methods are available to improve the models. Some regimes of AGB evolution have not yet been studied in sufficient detail. These include the super-AGB stars and AGB stars at extremely low or ultra low metallicity.

Published in Annu. Rev. Astron. Astrophys. 2005. 43. 435.
Available from ftp://astroftp.phys.uvic.ca/pub/herwig/PUBLICATIONS/ARAA05-AGB-herwig.pdf

The Elemental Abundances in Bare Planetary Nebula Central Stars and the Shell Burning in AGB Stars

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We review the obser ved properties of extremely hot, hydrogen-deficient postasymptotic giant branch (AGB) stars of spectral type [WC] and PG1159. Their H deficiency is probably caused by a (very) late helium-shell flash or an AGB final thermal pulse, laying bare interior stellar regions that are usually kept hidden below the hydrogen envelope. Thus, the photospheric elemental abundances of these stars allow us to draw conclusions about details of nuclear burning

and mixing processes in the precursor AGB stars. We summarize the state of the art of stellar evolution models that simulate AGB evolution and the occurrence of a late He-shell flash. We compare predicted elemental abundances to those determined by quantitative spectral analyses performed with advanced non-LTE model atmospheres. Good qualitative and quantitative agreement is fcan contribute to an even more complete picture of the nuclear processes in AGB stars.

Published in PASP, 118:183204, 2006 February
Available from astro-ph/0512320
and from ftp://astroftp.phys.uvic.ca/pub/herwig/PUBLICATIONS/werner06_pasp_review.pdf

Thesis

High resolution studies of SiO circumstellar masers in AGB stars

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We present high-spatial and high-spectral resolution studies of SiO masers in the circumstellar envelopes of late-type stars. These masers occur in the inner layers of the CSEs, in a region dominated by the stellar pulsation, thus being good (if not the only) probes available to understand the physics in these regions. Using the NRAO Very Long Baseline Array, we have produced maps of the ^{28}SiO v=1 and v=2 J=1-0 and J=2-1 transitions towards several AGB stars: two Mira-type (TXCam and RLeo), one OH/IR (IRC+10011) and one S-type (χ Cyg) stars. The ^{29}SiO v=0 J=1-0 and J=2-1 emission has also been studied. The spatial distributions retrieved, some of them for the first time, are in clear contradiction with the predictions of the models developed to date. We suggest that spectral line overlaps strongly affect the excitation of SiO and may explain the results obtained.

ftp://ftp.oan.es/pub/users/r.soria/TESIS-RSoria.pdf

Job Adverts

PhD Scholarships

The Centre for Stellar and Planetary Astrophysics is able to support studies toward a PhD degree. The next round of applications closes June 20. Scholarships cover all fees and a living allowance. Here is your chance to join a vibrant research group in one of the world's best cities.

Further enquiries to Prof John Lattanzio john.lattanzio@sci.monash.edu.au

See also http://www.cspa.monash.edu.au/

Postdoctoral Research Fellowship in studies of dust around supernovae and evolved stars

Applications are invited for a Postdoctoral Research Fellowship funded by the Particle Physics and Astronomy Research Council (PPARC), for research into dust around supernovae and evolved stars, to commence by 1 October 2006.

Applications are sought from candidates with observational or theoretical research interests in dust, supernovae or evolved stars. The research will focus on the contributions made by supernovae and by evolved stars to the dust enrichment of the Universe and will include the analysis of Spitzer and Gemini infrared data, as well as involvement in Herschel-SPIRE far-infrared and submillimeter Guaranteed Time programs.

The Department of Physics and Astronomy at UCL hosts one of the largest Astrophysics groups in the United Kingdom. Current research areas include cosmology, extragalactic astrophysics, star formation, circumstellar matter, massive stars, astrochemistry, planetary atmospheres and instrumentation; see www.star.ucl.ac.uk and www.star.ucl.ac.uk/groups/cie/

The position is for up to three years, with a salary from 24,886 pounds per annum, depending on age and experience, plus 2,400 pounds London Allowance. Applicants should post or email a UCL application form (http://www.ucl.ac.uk/hr/docs/down a CV, a list of publications and a statement of research interests to Prof. M. J. Barlow, Department of Physics and Astronomy, University College London, Gower St. London WC1E 6BT, UK (mjb@star.ucl.ac.uk). Applicants should also ask at least two referees to write or email Prof. Barlow by the closing date of July 14th 2006. Please quote reference CJNW/06.

Announcements

Astronomical Polarimetry - Current Status and Future Directions

Edited by Andy Adamson, Colin Aspen, Chris J. Davis & Takuya Fujiyoshi

These are the proceedings of a workshop held in Waikoloa, Hawai'i on 15-19 March 2004. The book provides an overview of polarimetric techniques, observations and the interpretation of polarimetry data at optical, infrared and millimeter wavelengths. Although encompassing many areas of astronomy, it includes a number of articles on circumstellar matter and evolved stars. Relevant reviews include:

Polarimetry Techniques at Optical and Infrared Wavelengths – J. Hough
Techniques in the Millimetre to Far-Infared – J. Greaves
Ejecta and the Late Stages of Stellar Evolution — T. Gledhill
H band AO Imaging-Polarimetry of IRC+10216 — K. Murakawa et al.
Imaging Polarimetry of Proto-planetary Nebulae — T. Ueta et al.
Dust and Infrared Polarization Signatures — D. Aitken
Mid-Infrared Spectropolarimetry: Dust and Magnetic Fields — C. Wright et al.
Searching for Links Between B-Fields and Stellar Evolution — S. Bagnulo

Astronomical Society of the Pacific Conference Series Volume 343 ISBN 1-58381-210-5, hardbound, 530 pages, 2005 US$77.00 Astronomical Society of the Pacific 390 Ashton Avenue, San Francisco, CA 94112-1722, USA

See also http://www.aspbooks.org/

Evolution and chemistry of symbiotic stars, binary post-AGB and related objects

28-30 August 2006 in Wierzba (Mazury Lakes) Poland.

Dear Colleagues,

We would like to invite you to participate in the conference "Evolution and chemistry of symbiotic stars, binary post-AGB and related objects" to be held in Wierzba, Poland from August 28-30, 2006.

The topics would be related to chemical composition determination; influence of chemical composition on evolution and evolution on chemical composition. In particular, the topics we would like to cover are:

- Effect of metallicity on mass loss and activity of symbiotic stars and related systems (including hot component outbursts, jet formation, etc.)
- Relationship between symbiotic stars and other binaries involving post-AGB stars
- Effect of rotation (including binary interactions) on nucleosynthesis
- Formation of s-process elements in various chemical and physical (e.g. binary systems, post-AGB stars) environments
- Binary post-AGB evolution
- Mixed chemistry and binarity

SOC: R. Corradi, A. Jorissen, J. Mikolajewska co-chair, J. Sokoloski, R. Szczerba co-chair, H. van Winckel, P. A. Whitelock, A. Zijlstra

The main reason(s) to organize the conference is the 25^{th} anniversary of the first IAU colloquium on symbiotic stars (the infamous meeting in Haute Provance) and also to celebrate Michael Friedjung (who organized jointly with Roberto Viotti this meeting as well as co-organized - with myself - the second IAU Coll on symbiotic stars in Torun) 65 birthday. The workshop will be held in a resort of the Polish Academy of Science in the Mazury Lakes region. The dates suggested (28-30 August) are just after the General Assembly of the IAU assembly in Prague. We will have some financial support from the Polish-French collaboration programme to organize this workshop.

Please visit our web page http://www.camk.edu.pl/conferences/wierzba/ to find registration form (note that the deadline for registration, and hotel reservation is June 30, as well as information about the preliminary program of the workshop, 2006), the conference site and travel.

With best regards,

Joanna Mikolajewska and Ryszard Szczerba

See also http://www.camk.edu.pl/conferences/wierzba/