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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleague,

It is our pleasure to present you the 119th issue of the AGB Newsletter. It features some extremely intriguing contributions, such as: the Earth will not survive the Sun's PN phase (Villaver & Livio), the detection of a Born-Again protoplanetary disk around Mira B (Ireland et al.), more on dusty white dwarves (von Hippel et al.), the detection of CN from carbon stars in Active Galactic Nuclei (Riffel et al.), the detection of water masers in two PNe (Suárez. Gómez & Morata), hydrodynamical model results producing vortices in the wakes of AGB stars (Wareing, Zijlstra & O'Brien), and various articles on AGB evolution and nucleosynthesis, exotic objects, et cetera.

If you are looking for a PhD position, you must check out the advertisement for up to nine (9!) such positions in Vienna, an institute with a strong research tradition in AGB stars and their pulsation and extended atmospheres, situated in the heart of Europe.

If you haven't already done so, please consider attending the conference "Unsolved Problems in Stellar Physics" in beautiful Cambridge, 2-6 July this year. Links to more information can be found in the announcement at the end of the newsletter.

The next issue will be distributed on the 1st of May; the deadline for contributions is the 30th of April.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Which are the evaporating planets in images of Planetary Nebulae?

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)

Can Planets survive Stellar Evolution?

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We study the survival of gas planets around stars with masses in the range 1-5 $M_{\odot}$, as these stars evolve off the Main Sequence. We show that planets with masses smaller than one Jupiter mass do not survive the Planetary Nebula phase if located initially at orbital distances smaller than (3-5) AU. Planets more massive than two Jupiter masses around low mass (1 $M_{\odot}$ on the Main Sequence) stars survive the Planetary Nebula stage down to orbital distances of 3 AU. As the star evolves through the Planetary Nebula phase, an evaporation outflow will be established at the planet's surface. Evaporating planets may be detected using spectroscopic observations. Planets around white dwarfs with masses $M_{\rm WD} > 0.7$ $M_{\odot}$ are generally expected to be found at orbital radii $r > 15$ AU. If planets are found at smaller orbital radii around massive white dwarfs, they had to form as the result of the merger of two white dwarfs.

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Central Stars of Planetary Nebulae in the Galactic Bulge

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Context: Optical high-resolution spectra of five central stars of planetary nebulae (CSPN) in the Galactic Bulge have been obtained with Keck/HIRES in order to derive their parameters. Since the distance of the objects is quite well known, such a method has the advantage that stellar luminosities and masses can in principle be determined without relying on theoretical relations between both quantities.
Aims: By alternatively combining the results of our spectroscopic investigation with evolutionary tracks, we obtain so-called spectroscopic distances, which can be compared with the known (average) distance of the Bulge-CSPN. This offers the possibility to test the validity of model atmospheres and present date post-AGB evolution.
Methods: We analyze optical H/He profiles of five Galactic Bulge CSPN (plus one comparison object) by means of profile fitting based on state of the art non-LTE modeling tools, to constrain their basic atmospheric parameters ($T_{\rm eff}$, log g, helium abundance and wind strength). Masses and other stellar radius dependent quantities are obtained from both the known distances and from evolutionary tracks, and the results from both approaches are compared.
Results: The major result of the present investigation is that the derived spectroscopic distances depend crucially on the applied reddening law. Assuming either standard reddening or values based on radio-Hβ extinctions, we find a mean distance of 9.0 ± 1.6 kpc and 12.2 ± 2.1 kpc, respectively. An "average extinction law" leads to a distance of 10.7 ± 1.2 kpc, which is still considerably larger than the Galactic Center distance of 8 kpc. In all cases, however, we find a remarkable *internal agreement* of the individual spectroscopic distances of our sample objects, within $\pm 10\%$ to $\pm 15\%$ for the different reddening laws.
Conclusions: Due to the uncertain reddening correction, the analysis presented here cannot yet be regarded as a consistency check for our method, and a rigorous test of the CSPN evolution theory becomes only possible if this problem has been solved.

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Available from astro-ph/0702755
and from http://www.usm.uni-muenchen.de/people/puls/papers/cspn.pdf

Reaction rate uncertainties and the operation of the NeNa and MgAl chains during HBB in intermediate-mass AGB stars

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We test the effect of proton-capture reaction rate uncertainties on the abundances of the Ne, Na, Mg and Al isotopes processed by the NeNa and MgAl chains during hot bottom burning (HBB) in asymptotic giant branch (AGB) stars of intermediate mass between 4 and 6 solar masses and metallicities between $Z = 0.0001$ and 0.02. We provide uncertainty ranges for the AGB stellar yields, for inclusion in galactic chemical evolution models, and indicate which reaction rates are most important and should be better determined. We use a fast synthetic algorithm based on detailed AGB models. We run a large number of stellar models, varying one reaction per time for a very fine grid of values, as well as all reactions simultaneously. We show that there are uncertainties in the yields of all the Ne, Na, Mg and Al isotopes due to uncertain proton-capture reaction rates. The most uncertain yields are those of ^{26}Al and ^{23}Na (variations of two orders of magnitude), ^{24}Mg and ^{27}Al (variations of more than one order of magnitude), ^{20}Ne and ^{22}Ne (variations between factors 2 and 7). In order to obtain more reliable Ne, Na, Mg and Al yields from IM-AGB stars the rates that require more accurate determination are: ^{22}Ne(p,g)^{23}Na, ^{23}Na(p,g)^{24}Mg, ^{25}Mg(p,g)^{26}Al, ^{26}Mg(p,g)^{27}Al and ^{26}Al(p,g)^{27}Si. Detailed galactic chemical evolution models should be constructed to address the impact of our uncertainty ranges on the observational constraints related to HBB nucleosynthesis, such as globular cluster chemical anomalies.

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The s-process in stellar population synthesis: a new approach to understanding AGB stars

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Thermally pulsating asymptotic giant branch (AGB) stars are the main producers of slow neutron capture (s-) process elements, but there are still large uncertainties associated with the formation of the main neutron source, ^{13}C, and with the physics of these stars in general. Observations of s-process element enhancements in stars can be used as constraints on theoretical models. For the first time we apply stellar population synthesis to the problem of s-process nucleosynthesis in AGB stars, in order to derive constraints on free parameters describing the physics behind the third dredge-up and the properties of the neutron source. We utilize a rapid evolution and nucleosynthesis code to synthesize different populations of s-enhanced stars, and compare them to their observational counterparts to find out for which values of the free parameters in the code the synthetic populations fit best to the observed populations. These free parameters are the amount of third dredge-up, the minimum core mass for third dredge-up, the effectiveness of ^{13}C as a source of neutrons and the size in mass of the ^{13}C pocket. We find that galactic disk objects are reproduced by a spread of a factor of two in the effectiveness of the ^{13}C neutron source. Lower metallicity objects can be reproduced only by lowering by at least a factor of 3 the average value of the effectiveness of the ^{13}C neutron source needed for the galactic disk objects. Using observations of s-process elements in post-AGB stars as constraints we find that dredge-up has to start at a lower core mass than predicted by current theoretical models, that it has to be substantial ($\lambda \gtrsim 0.2$) in stars with mass $M \lesssim 1.5$ M$_\odot$ and that the mass of the ^{13}C pocket must be about 1/40 that of the intershell region.

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Evolution of asymptotic giant branch stars I. Updated synthetic TP-AGB models and their basic calibration

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We present new synthetic models of the TP-AGB evolution. They are computed for 7 values of initial metal content (Z from 0.0001 to 0.03) and for initial masses between 0.5 and 5.0 $M_\odot$, thus extending the low- and intermediate-mass tracks of Girardi et al. (2000) until the beginning of the post-AGB phase. The calculations are performed by means of a synthetic code that incorporates many recent improvements, among which we mention: (1) the use of detailed and revised analytical relations to describe the evolution of quiescent luminosity, inter-pulse period, third dredge-up, hot bottom burning, pulse cycle luminosity variations, etc.; (2) the use of variable molecular opacities — i.e. opacities consistent with the changing photospheric chemical composition — in the integration of a complete envelope model, instead of the standard choice of scaled-solar opacities; (3) the use of formalisms for the mass-loss rates derived from pulsating dust-driven wind models of C- and O-rich AGB stars; and (4) the switching of pulsation modes between the first overtone and the fundamental one along the evolution, which has consequences in terms of the history of mass loss. It follows that, in addition to the time evolution on the HR diagram, the new models predict in a consistent fashion also variations in surface chemical compositions, pulsation modes and periods, and mass-loss rates. The onset and efficiency of the third dredge-up process are calibrated in order to reproduce basic observables like the carbon star luminosity functions in the Magellanic Clouds, and TP-AGB lifetimes (star counts) in Magellanic Cloud clusters. In this paper, we describe in detail the model ingredients, basic properties, and calibration. Particular emphasis is put in illustrating the effects of using variable molecular opacities. Forthcoming papers will present the theoretical isochrones and chemical yields derived from these tracks, and additional tests performed with the aid of a complete population synthesis code.

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The circumbinary disc around the J-type C-star IRAS 18006−3213

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In the generally accepted, but poorly documented model, silicate J-type C-stars are binary objects for which the silicate emission originates from a circumbinary or a circumcompanion disc. We aim at testing this hypothesis by a thorough spectral and spatial observational study of one object: IRAS 18006−3213. We obtained, analysed and modeled high spatial resolution interferometric VLTI/MIDI observations on multiple baselines ranging from 45 m to 100 m. All observations resolved the object and show the very compact nature of the N-band emission ($\sim$ 30 mas). In addition, the highest spatial resolution data show a significant differential phase jump around 8.3 μm. This demonstrates the asymmetric nature of the N-band emission. Moreover, the single telescope N-band spectrum shows the signature of highly processed silicate grains. These data are used to confirm the model on silicate J-type C-stars for IRAS 18006−3213. We show that the most favourable model of the dust geometry is a stable circumbinary disc around the system, seen under an intermediate inclination. The data presented on the silicate J-type C-star IRAS 18006−3213 provide evidence that the oxygen rich dust is trapped in a circumbinary disc. The formation of this disc is probably linked to the binary nature of the central star.

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The Spitzer/IRS Infrared Spectrum and Abundances of the Planetary Nebula IC 2448

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We present the mid-infrared spectrum of the planetary nebula IC 2448. In order to determine the chemical composition of the nebula, we use the infrared line fluxes from the Spitzer spectrum along with optical line fluxes from the literature and ultraviolet line fluxes from archival IUE spectra. We determine an extinction of C(Hβ) = 0.27 from hydrogen recombination lines and the radio to Hβ ratio. Forbidden line ratios give an electron density of 1860 cm^{-3} and an average electron temperature of 12700 K. The use of infrared lines allows us to determine more accurate abundances than previously possible because abundances derived from infrared lines do not vary greatly with the adopted electron temperature and extinction, and additional ionization stages are observed. Elements left mostly unchanged by stellar evolution (Ar, Ne, S, and O) all have subsolar values in IC 2448, indicating that the progenitor star formed out of moderately metal deficient material. Evidence from the Spitzer spectrum of IC 2448 supports previous claims that IC 2448 is an old nebula formed from a low mass progenitor star.

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New detections of H_2O masers in planetary nebulae and post-AGB stars using the Robledo-70m antenna

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Aims: We investigated the possible relationship between the evolutionary stage of post-AGB stars and planetary nebulae (PNe) and the presence of water masers in their envelopes.
Methods: We have used NASA's 70-m antenna in Robledo de Chavela (Spain) to search for the water maser transition at 22 235.08 MHz, towards a sample of 105 sources with IRAS colour characteristic of post-AGB stars and PNe at declination $> -32°$. 83% of the sources in the sample are post-AGB stars, 15% PNe or PN candidates, while only 2% seem to be H II regions.
Results: We have detected five water masers, of which four are reported for the first time: two in PNe (IRAS 17443−2949 and IRAS 18061−2505), a "water fountain" in a post-AGB star (IRAS 16552−3050), and one in a source previously catalogued as a PN, but whose classification is uncertain (IRAS 17580−3111).
Conclusions: The unexpected detections of water masers in two objects among the small subset of PNe led us to suggest that the PNe harbouring water masers are a special type of massive, rapidly evolving PNe.

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Jets and Tori in Proto-Planetary Nebulae

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We investigate the time sequence for the appearance of jets and molecular tori in the transition of stars from the Asymptotic Giant Branch to the planetary nebula phase. Jets and tori are prominent features of this evolution, but their origins are uncertain. Using optical and millimeter line kinematics, we determine the ejection history in a sample

of well-observed cases. We find that jets and tori develop nearly simultaneously. We also find evidence that jets typically appear slightly later than tori, with a lag time of a few hundred years. These characteristics provide strong evidence that jets and tori are physically related, and they set new constraints on theories of jet formation. The ejection of a discrete torus followed by jets on a short time scale favors the class of models in which a companion interacts with the central star. Models with long time scales, or with jets followed by a torus, are ruled out.

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Very Large Excesses of ^{18}O in Hydrogen-Deficient Carbon and R Coronae Borealis Stars: Evidence for White Dwarf Mergers

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We have found that at least seven hydrogen-deficient carbon (HdC) and R Coronae Borealis (RCB) stars, have ^{16}O/^{18}O ratios close to and in some cases less than unity, values that are orders of magnitude lower than measured in other stars (the Solar value is 500). Greatly enhanced ^{18}O is evident in every HdC and RCB we have measured that is cool enough to have detectable CO bands. The three HdC stars measured have $^{16}\mathrm{O}/^{18}\mathrm{O} < 1$, lower values than any of the RCB stars. These discoveries are important clues in determining the evolutionary pathways of HdC and RCB stars, for which two models have been proposed: the double degenerate (white dwarf (WD) merger), and the final helium-shell flash (FF). No overproduction of ^{18}O is expected in the FF scenario. We have quantitatively explored the idea that HdC and RCB stars originate in the mergers of CO- and He-WDs. The merger process is estimated to take only a few days, with accretion rates of 150 $M_\odot$ yr^{-1} producing temperatures at the base of the accreted envelope of $1.2-1.9\times10^8$ K. Analysis of a simplified one-zone calculation shows that nucleosynthesis in the dynamically accreting material may provide a suitable environment for a significant production of ^{18}O, leading to very low values of ^{16}O/^{18}O, similar to those observed. We also find qualitative agreement with observed values of ^{12}C/^{13}C and with the CNO elemental ratios. H-admixture during the accretion process from the small H-rich C/O WD envelope may play an important role in producing the observed abundances. Overall our analysis shows that WD mergers may very well be the progenitors of O^{18}-rich RCB and HdC stars, and that more detailed simulations and modeling are justified.

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The first detection of near-infrared CN bands in active galactic nuclei: signature of star formation

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We present the first detection of the near-infrared CN absorption band in the nuclear spectra of active galactic nuclei (AGN). This feature is a recent star formation tracer, being particularly strong in carbon stars. The equivalent width of the CN line correlates with that of the CO at 2.3 μm, as expected in stellar populations (SP) with ages between ~0.2 and ~2 Gyr. The presence of the 1.1 μm CN band in the spectra of the sources is taken as an unambiguous evidence of the presence of young/intermediate SP close to the central source of the AGN. Near-infrared bands can

be powerful age indicators for star formation connected to AGN, the understanding of which is crucial in the context of galaxy formation and AGN feedback.

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Supersoft X-ray Light Curve of RS Ophiuchi (2006)

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One of the candidates for Type Ia supernova progenitors, the recurrent nova RS Ophiuchi underwent the sixth recorded outburst in February 2006, and for the first time a complete light curve of supersoft X-ray has been obtained. It shows the much earlier emergence and longer duration of a supersoft X-ray phase than expected before. These characteristics can be naturally understood when a significant amount of helium layer piles up beneath the hydrogen burning zone during the outburst, suggesting that the white dwarf (WD) is effectively growing up in mass. We have estimated the WD mass in RS Oph to be 1.35 ± 0.01 $M_\odot$ and the growth rate of the WD mass to be at an average rate of about 1×10^{-7} $M_\odot$ yr^{-1}. The white dwarf will probably reach the critical mass for Type Ia explosion if the present accretion continues further for a few to several times 10^5 years.

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Low-mass, helium-enriched PG1159 stars: a possible evolutionary origin and the implications for their pulsational stability properties

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We examine a recently-proposed evolutionary scenario that could explain the existence of the low-mass, helium-enriched PG1159 stars. We assess the overstability of pulsation g-modes of stellar models as evolution proceeds along the PG1159 domain. Stellar models are extracted from the full evolution of a 1 $M_\odot$ model star that experiences its first thermal pulse as a late thermal pulse (LTP) after leaving the AGB. The evolutionary stages corresponding to the born-again episode and the subsequent helium sub-flashes are taken into account in detail. Under reasonable mass-loss rate assumptions, the evolutionary scenario reproduces the high helium abundances observed in some PG1159 stars. We find that, despite the high helium abundance in the driving layers, there exists a narrow region in the $\log g - \log T_{\rm eff}$ diagram for which the helium-enriched PG1159 sequence exhibits unstable pulsation modes with periods in the range 500 to 1600 s. In particular, the nonpulsating helium-enriched PG1159 star, MCT 0130−1937, is located outside the theoretical instability domain. Our results suggest that MCT 0130−1937 is a real non-pulsating star and that the lack of pulsations should not be attributed to unfavorable geometry. Our study hints at a consistent picture between the evolutionary scenario that could explain the existence of helium-enriched PG1159 stars and the nonvariable nature of MCT 0130−1937. We also present theoretical support for the unusually high helium abundance observed in the nonpulsating PG1159 star HS 1517+7403. We suggest that HS 1517+7403 could be a transition object linking the low-mass helium-rich O(He) stars with the helium-enriched PG1159 stars via the evolutionary connection K1-27 → HS 1517+7403 → MCT 0130−1937.

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Are the models for Type Ia supernova progenitors consistent with the properties of supernova remnants?

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We explore the relationship between the models for progenitor systems of Type Ia supernovae and the properties of the supernova remnants that evolve after the explosion. Most models for Type Ia progenitors in the single degenerate scenario predict substantial outflows during the presupernova evolution. Expanding on previous work, we estimate the imprint of these outflows on the structure of the circumstellar medium at the time of the supernova explosion, and the effect that this modified circumstellar medium has on the evolution of the ensuing supernova remnant. We compare our simulations with the observational properties of known Type Ia supernova remnants in the Galaxy (Kepler, Tycho, SN 1006), the Large Magellanic Cloud (0509−67.5, 0519−69.0, N103B), and M31 (SN 1885). We find that optically thick outflows from the white dwarf surface (sometimes known as 'accretion winds') with velocities above 200 km s^{-1} excavate large low-density cavities around the progenitors. Such large cavities are incompatible with the dynamics of the forward shock and the X-ray emission from the shocked ejecta in all the Type Ia remnants that we have examined.

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The New Class of Dusty DAZ White Dwarfs

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Our mid-infrared survey of 124 white dwarfs with the Spitzer Space Telescope and the IRAC imager has revealed an infrared excess associated with the white dwarf WD 2115−560 naturally explained by circumstellar dust. This object is the fourth white dwarf observed to have circumstellar dust. All four are DAZ white dwarfs, i.e., they have both photospheric Balmer lines and photospheric metal lines.
We discuss these four objects as a class, which we abbreviate "DAZd", where the "d" stands for "dust". Using an optically-thick, geometrically-thin disk model analogous to Saturn's rings, we find that the inner disk edges are at $\gtrsim$0.1 to 0.2 R$_\odot$ and that the outer disk edges are ~ 0.3 to 0.6 R$_\odot$. This model naturally explains the accretion rates and lifetimes of the detected WD disks and the accretion rates inferred from photospheric metal abundances.

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Envelope density pattern around wide binary AGB stars: A dynamical model

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Context. Various morphologies such as multi-concentric shells and spiral-like patterns have been observed around Proto-Planetary Nebulae and AGB stars. It is widely argued that the regular density patterns are produced by binary systems.
Aims. The goal is to build up a simple dynamical model for the out-flowing circumstellar envelope around AGB stars in a wide binary system to explore the parameter dependence of the geometrical characteristics of column density patterns.
Methods. For an AGB star in a wide binary system, the orbital motion of the star can be approximated as a series of pistons that simultaneously push out dust and gas along radial directions, but work in different oscillation phases. The piston model can fast produce column density patterns with high enough spatial resolutions for parameter dependence exploration. Results. The formation of 3-D quasi-spherical density structure is induced by orbital motion of the AGB star. The column density pattern only depends on two parameters: eccentricity of the orbit e and the terminal outflow velocity to mean orbital velocity ratio gamma. When viewed perpendicular to the orbital plane, spiral, broken spiral, and incomplete concentric shell patterns can be seen, while when viewed along the orbital plane, alternative concentric half-shell, egg-shell, and half-shell half-gap patterns will develop. Nonzero eccentricity causes asymmetry, while larger gamma makes a weaker pattern and helps bring out asymmetry. A spiral pattern may becomes broken when $e > 0.4$. The spiral center is always less than 12% of spiral pitch away from the orbit center. One should have more chances (∼80%) seeing spiral-like patterns than seeing concentric shells (∼20%) in the circumstellar envelope of wide binary AGB stars.

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High-quality Spectrophotometry of the Planetary Nebula in the Fornax dSph

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We present results of NTT spectroscopy of the one known planetary nebula (PN) in the dwarf spheroidal galaxy Fornax, a gas-deficient Local Group galaxy that stopped its star formation activity a few hundred million years ago. We detected the [O III] $\lambda 4363$ line with a signal-to-noise ratio of ∼22. For the first time we detected the weak [S II] $\lambda\lambda 6717,6731$ lines ($I(6717+6731) \approx 0.01 I(\mathrm{H}\beta)$), determined the electron number density ($N_\mathrm{e}(\mathrm{S\,II}) = 750$ cm^{-3}), and calculated O, N, Ne, Ar, S, Cl, Fe, He and C abundances. The abundance analysis presented here is based on the direct calculation of the electron temperature T_e and yields an oxygen abundance of 12+log(O/H) = 8.28±0.02. The analysis of the O, Ne, Ar and S abundances shows that the original ISM oxygen abundance was 0.27±0.10 dex lower and that third-dredge-up self-pollution in oxygen took place. The blue spectrum shows weak Wolf-Rayet features, and the progenitor star is classified as a weak emission-line star. Four of the five PNe in dwarf spheroidal galaxies are now known to show WR wind features. Overall, the metallicity of the progenitor of the PN fits in well with stellar spectroscopic abundances derived in previous studies as well as with the stellar age-metallicity relation of Fornax.

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Born-Again Protoplanetary Disk Around Mira B

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The Mira AB system is a nearby ($\sim$107 pc) example of a wind accreting binary star system. In this class of system, the wind from a mass-losing red giant star (Mira A) is accreted onto a companion (Mira B), as indicated by an accretion shock signature in spectra at ultraviolet and X-ray wavelengths. Using novel imaging techniques, we report the detection of emission at mid-infrared wavelengths between 9.7 and 18.3 μm from the vicinity of Mira B but with a peak at a radial position about 10 AU closer to the primary Mira A. We interpret the mid-infrared emission as the edge of an optically-thick accretion disk heated by Mira A. The discovery of this new class of accretion disk fed by M-giant mass loss implies a potential population of young planetary systems in white-dwarf binaries which has been little explored, despite being relatively common in the solar neighborhood.

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Infrared spectroscopy of carbon monoxide in V838 Mon

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We report spectra of the overtone and fundamental bands of CO in the eruptive variable V838 Mon, which trace the recent evolution of the star and allow its ejecta to be characterized. The data were obtained at the United Kingdom Infrared Telescope on fourteen nights from 2002 January, shortly after the first outburst of the star, to 2006 April. Although the near-infrared stellar spectrum superficially resembled a cool supergiant after both the first and third of its outbursts in 2002, its infrared "photosphere" at that time consisted of highly blueshifted gas that was moving outward from the original stellar surface. A spectrum obtained during the third outburst reveals a remarkable combination of emission and absorption in the CO first overtone bands. The most recent observations show a composite spectrum that includes a stellar-like photosphere at a temperature similar to that seen just after the initial outburst, but at a radial velocity redshifted by 15 km s^{-1} relative to the stellar velocity determined from SiO maser emission, suggesting that the atmosphere is now contracting. Three shell components, corresponding to expansion velocities of 15, 85, and 145 km s^{-1}, also are present, but absorption is seen at all expansion velocities out to 200 km s^{-1}. Weak absorption features of fundamental band lines of ^{13}CO have been detected. However, the large uncertainty in the value of $^{12}C/^{13}C$ does not constrain the evolutionary status of the progenitor.

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An evolutionary catalogue of galactic post-AGB and related objects

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With the ongoing AKARI infrared sky survey, of much greater sensitivity than IRAS, a wealth of post-AGB objects may be discovered. It is thus time to organize our present knowledge of known post-AGB stars in the galaxy with a view to using it to search for new post-AGB objects among AKARI sources.We searched the literature available on the NASA Astrophysics Data System up to 1 October 2006, and defined criteria for classifying sources into three categories: *very likely*, *possible* and *disqualified* post-AGB objects. The category of *very likely* post-AGB objects is made up of several classes.We have created an evolutionary, on-line catalogue of Galactic post-AGB objects, to be referred to as *the Toruń catalogue of Galactic post-AGB and related objects*. The present version of the catalogue contains 326 *very likely*, 107 *possible* and 64 *disqualified* objects. For the very likely post-AGB objects, the catalogue gives the available optical and infrared photometry, infrared spectroscopy and spectral types, and links to finding charts and bibliography.

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The nebula around the post-AGB star 89 Her

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We aim to study the structure of the nebula around the post-AGB, binary star 89 Her. The presence of a rotating disk around this star had been proposed but not been yet confirmed by observations. We present high-resolution PdBI maps of CO J=2–1 and 1–0. Properties of the nebula are directly derived from the data and model fitting. We also present N-band interferometric data on the extent of the hot dust emission, obtained with the VLTI. Two nebular components are found: (a) an extended hour-glass-like structure, with expansion velocities of about 7 km s^{-1} and a total mass $\sim$ 3 10^{-3} M$_\odot$, and (b) an unresolved very compact component, smaller than $\sim 0.4''$ and with a low total velocity dispersion of $\sim$ 5 km s^{-1}. We cannot determine the velocity field in the compact component, but we argue that it can hardly be in expansion, since his would require too recent and too sudden an ejection of mass. On the other hand, assuming that this component is a keplerian disk, we derive disk properties that are compatible with expectations for such a structure; in particular, the size of the rotating gas disk should be very similar to the extent of the hot dust component from our VLTI data. Assuming that the equator of the extended nebula coincides with the binary orbital plane, we provide new results on the companion star mass and orbit.

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Vortices in the wakes of AGB stars

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Vortices have been postulated at a range of size scales in the universe including at the stellar size-scale. Whilst hydrodynamically simulating the wind from an asymptotic giant branch (AGB) star moving through and sweeping up

its surrounding interstellar medium (ISM), we have found vortices on the size scale of 10^{-1} pc to 10^{1} pc in the wake of the star. These vortices appear to be the result of instabilities at the head of the bow shock formed upstream of the AGB star. The instabilities peel off downstream and form vortices in the tail of AGB material behind the bow shock, mixing with the surrounding ISM. We suggest such structures are visible in the planetary nebula Sh 2-188.

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Carbon Rich Extremely Metal Poor Stars: Signatures of Population-III AGB stars in Binary Systems

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We use the Cambridge stellar evolution code STARS to model the evolution and nucleosynthesis of zero-metallicity intermediate-mass stars. We investigate the effect of duplicity on the nucleosynthesis output of these systems and the potential abundances of the secondaries. The surfaces of zero-metallicity stars are enriched in CNO elements after second dredge up. During binary interaction, such as Roche lobe overflow or wind accretion, metals can be released from these stars and the secondaries enriched in CNO isotopes. We investigate the formation of the two most metal poor stars known, HE 0107−5240 and HE 1327−2326. The observed carbon and nitrogen abundances of HE 0107−5240 can be reproduced by accretion of material from the companion-enhanced wind of a 7 $M_{\odot}$ star after second dredge-up, though oxygen and sodium are underproduced. We speculate that HE 1327−2326, which is richer in nitrogen and strontium, may similarly be formed by wind accretion in a later AGB phase after third dredge-up.

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Three-Dimensional Hydrodynamical Simulations of Surface Convection in Red Giant Stars. Impact on spectral line formation and abundance analysis

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We investigate the impact of 3D hydrodynamical model atmospheres of red giant stars at different metallicities on the formation of spectral lines of a number of ions and molecules. We carry out realistic 3D simulations of surface convection in red giant stars with varying effective temperatures and metallicities. We use the simulations as time-dependent hydrodynamical model stellar atmospheres to compute atomic (Li I, O I, Na I, Mg I, Ca I, Fe I and Fe II) and molecular (CH, NH, OH) spectral lines under the assumption of local thermodynamic equilibrium (LTE). We compare the line strengths computed in 3D with the results of analogous line formation calculations for 1D, hydrostatic, plane-parallel MARCS model atmospheres in order to estimate the impact of 3D models on the derivation of elemental abundances. The temperature and density inhomogeneities and correlated velocity fields in 3D models, as well as the differences between the 1D and mean 3D structures significantly affect the predicted line strengths. Under the assumption of LTE, the low atmospheric temperatures of very metal-poor 3D model atmospheres cause the lines from neutral species and molecules to appear stronger than in 1D. Therefore, elemental abundances derived from these lines using 3D models are significantly lower than according to 1D analyses. Differences between 3D and 1D abundances of C, N, and O derived from CH, NH, and OH weak low-excitation lines are found to be in the range −0.5 dex to −1.0 dex for the the red giant stars at [Fe/H]=−3 considered here. At this metallicity, large negative corrections (about

−0.8 dex) are also found for weak low-excitation Fe I lines. We caution, however, that departures from LTE might be significant for these and other elements and comparable to the effects due to stellar granulation.

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A Search for Radio Continuum Emission Towards Long-period Variable Stars

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We hereby report on a sensitive search for radio continuum observations from a sample of 34 Mira and semi-regular variable stars. The main aim of this survey was to search for thermal free-free emission from post-shock ionised gas. Thirty-four stars were observed at 3- and 6-cm using the Australia Telescope Compact Array. Radio continuum emission was detected from one source only, the symbiotic Mira R Aqr. No continuum emission was detected from the other sources, with three-sigma upper limits of typically 0.3 mJy. From the upper limits to the radio flux densities, we have found upper limits to the gas brightness temperatures near two stellar radii at a characteristic size of 5×10^{13} cm. Upper limits to shock velocities have been estimated using a shock model. For the 11 nearest sources in our sample we obtain brightness temperatures below 6 000 K and shock velocities below 13 km s^{-1}. For 11 out of 14 sources with previously published detections, the radio brightness temperatures are below 4 000 K. For an upper limit of 4 000 K, we estimate that the shock velocities at two stellar radii are below 10 km s^{-1}.

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Silicates in D-type symbiotic stars: an ISO overview

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We investigate the IR spectral features of a sample of D-type symbiotic stars in order to constrain the emitting properties of coupled dust-gas particles across the whole system. In particular, analyzing unexploited ISO-SWS data, deriving the basic observational parameters of dust bands, and comparing them with respect to those observed in other astronomical sources, we try to highlight the effect of environment on grain chemistry and physics. We find strong amorphous silicate emission bands at ∼10 μm and ∼18 μm in a large fraction of the sample. The analysis of the ∼10 μm band, along with a direct comparison with several astronomical sources, reveals that silicate dust in symbiotic stars shows features between the characteristic circumstellar environments and the interstellar medium. This indicates an increasing reprocessing of grains in relation to specific symbiotic behavior of the objects. A correlation between the central wavelength of the ∼10 and ∼18 μm dust bands is found. By the modeling of IR spectral lines we investigate also dust grains conditions within the shocked nebulae. Both the unusual depletion values and the high sputtering efficiency might be explained by the formation of SiO moleculae, which are known to be a very reliable shock tracer. We conclude that the signature of dust chemical disturbance due to symbiotic activity should be looked for in the outer, circumbinary, expanding shells where the environmental conditions for grain processing might be achieved. Symbiotic stars are thus attractive targets for new mid-infrared and mm observations.

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Conference Paper

On TP-AGB stars and the mass of galaxies

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Recent calculations of evolutionary tracks of TP-AGB stars of different mass and metallicity by Marigo et al. (2007) have been incorporated in the Bruzual & Charlot evolutionary population synthesis models. The mass of the stellar population in HUDF galaxies at z from 1 to 3 determined from fits to the spectro-photometric data of these galaxies are 5 to 15% of the mass determined from the BC03 models. The ages inferred for these populations are 20 to 50% of the BC03 estimates.

Oral contribution, published in IAU Symposium No. 241 "Stellar populations as building blocks of galaxies", eds. A. Vazdekis and R. Peletier, Cambridge: Cambridge University Press
Available from astro-ph/0703052

Job Advert

Institute of Astronomy, University of Vienna, Austria
Doctoral positions in the International Graduate School on "The Cosmic Matter Circuit"

The international graduate school (Initiativkolleg: IK) on "The Cosmic Matter Circuit" awards up to nine doctoral positions to highly qualified and motivated students starting October 1st, 2007. The PhD program focuses on one of the big challenges of modern Astrophysics, the various proc-esses of matter cycles. Research topics range from the small-scale matter cycle (stellar mass loss, chemical yields, interstellar medium) via the galactic-scale matter cycle (propagation of Cosmic Rays, galactic disk-halo connection, galactic winds and gas infall) to the global extragalactic scales (e.g., gas removal from galaxies by galaxy-galaxy interactions and ram-pressure stripping, evolution of galaxy groups and clusters, and galaxy formation).

The positions are funded for 3 years. The successful applicants are employed half time (20 hours/ week) at the University of Vienna, including up to 10 hours/week in teaching and research tasks to be agreed individually. The total annual stipend amounts to 14,321 Euros, including health insurance, university tuition fees are waived. Very good skill of the English language is mandatory. The students are expected to hold a degree equivalent to the Austrian Diploma or Masters Degree in Astronomy/Astrophysics or a related area.

Applicants are invited to submit documents by e-mail or first class mail to the Spokesperson of the College that have to arrive **before May 31st, 2007** and to include: cover letter stating the reasons for applying; curriculum vitae; documentation of previous studies and certified copies of all university degrees received; expose of research interests and/or proposed dissertation projects (max. 3 pages). In addition, two letters of recommendation of persons familiar with the applicant's work and studies should be sent separately by the deadline to the Spokesperson. The University of Vienna is an equal opportunity employer and particularly encourages applications from women and disabled persons. Applications within the deadline will be fully considered, but reviewing will continue until the positions are filled.

Supervisors and Lecturers responsible for the training program: Dieter Breitschwerdt, Gerhard Hensler, Thomas Lebzelter, Christian Theis and Werner Zeilinger.

Contact: Spokesperson of the Initiative Kolleg: Prof. Dr. Gerhard Hensler
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See also http://www.univie.ac.at/IK-CosmicMatterCircuit

Announcement

Unsolved Problems in Stellar Physics

The conference "Unsolved Problems in Stellar Physics" in honour of Prof. Douglas Gough that will be held from 2 to 6 July 2007 in Cambridge, England.

The conference will cover the areas:
1) Convection and semi-convection in stars.
2) Stellar abundances and stellar ages.
3) Extra-mixing processes.
4) Rotation and magnetic fields.
5) Mass loss from stars.

Each topic will be covered from the point of view of asteroseismology and stellar evolution.

You can register at the conference website: http://www.ast.cam.ac.uk/meetings/stars07/ The website also contains further information about the conference as well as arrangements for accomodation and travel information.

We look forward to seeing you in July!

Best wishes,
Chris Tout
Guenter Houdek
Richard Stancliffe

See also http://www.ast.cam.ac.uk/meetings/stars07/