THE AGB NEWSLETTER

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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

Many of you will have heard by now of the tragic loss of our colleague Hugo Schwarz, so totally unexpected and devastating. Hugo has not only contributed significantly to our understanding of planetary nebulae, but also inspired people around him with his unique life philosophy. Our thoughts are with his family and friends in these difficult times, who can be assured that he lives on in the fond memories of many.

We here present the 115$^{\rm th}$ issue of the AGB Newsletter, with no less than 41 contributions ranging from stellar interiors, elemental abundances, molecules, dust, planetary nebula shapes, high-resolution measurements, interacting binaries, and variability, to globular cluster giants and dust production in extra-galactic systems. Two of these papers are published in *Science*, presenting new insight into the interiors of red giants: models that describe how mixing can resolve the ^{3}He problem (Eggleton et al.), and measurements that identify the long-sought neutron source responsible for neutron-rich elements such as rubidium (García-Hernández et al.).

Don't miss the announcements of two conferences in June 2007: "RS Ophiuchi (2006) and the Recurrent Nova Phenomenon", in Keele (UK), and a few days later "Asymmetrical Planetary Nebulae IV", in La Palma (Spain).

The next issue will be distributed on the 3$^{\rm rd}$ of January; the deadline for contributions is the 2$^{\rm nd}$ of January. We wish you pleasant holidays and a Happy New Year.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

We are at the brink of fully understanding the interiors of red giant 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)

Refereed Journal Papers

Adaptive Optics Imaging of IRAS 18276−1431: a bipolar pre-planetary nebula with circumstellar "searchlight beams" and "arcs"

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We present high-angular resolution images of the post-AGB nebula IRAS18276−1431 (also known as OH17.7−2.0) obtained with the Keck II Adaptive Optics (AO) system in its Natural Guide Star (NGS) mode in the $K_{\rm p}$, $L_{\rm p}$, and $M_{\rm s}$ near-infrared bands. We also present supporting optical F606W and F814W HST images as well as interferometric observations of the ^{12}CO(J=1-0), ^{13}CO(J=1-0), and 2.6 mm continuum emission with OVRO. The envelope of IRAS18276−1431 displays a clear bipolar morphology in our optical and NIR images with two lobes separated by a dark waist and surrounded by a faint $4.5'' \times 3.4''$ halo. Our $K_{\rm p}$-band image reveals two pairs of radial "searchlight beams" emerging from the nebula center and several intersecting, arc-like features. From our CO data we derive a mass of $M > 0.38[D/3{\rm kpc}]^2$ M$_\odot$ and an expansion velocity $v_{\rm exp} = 17$ km s^{-1} for the molecular envelope. The density in the halo follows a radial power-law proportional to r^{-3}, which is consistent with a mass-loss rate increasing with time. Analysis of the NIR colors indicates the presence of a compact central source of ∼300-500 K dust illuminating the nebula in addition to the central star. Modeling of the thermal IR suggests a two-shell structure in the dust envelope: 1) an outer shell with inner and outer radius $R_{\rm in} \sim 1.6 \times 10^{16}$ cm and $R_{\rm out} \gtrsim 1.25 \times 10^{17}$ cm, dust temperature $T_{\rm dust}$ ∼105-50 K, and a mean mass-loss rate of $\dot{M} \sim 1 \times 10^{-3}$ M$_\odot$ yr^{-1}; and 2) an inner shell with $R_{\rm in} \sim 6.3 \times 10^{14}$ cm, $T_{\rm dust}$ ∼500-105 K, and $\dot{M} \sim 3 \times 10^{-5}$ M$_\odot$ yr^{-1}. An additional population of big dust grains (radius $a \gtrsim 0.4$ mm) with $T_{\rm dust}$ =150-20 K and mass $M_{\rm dust} = (0.16 - 1.6) \times 10^{-3}$ $[D/3{\rm kpc}]^2$ M$_\odot$ can account for the observed sub-mm and mm flux excess. The mass of the envelope enclosed within $R_{\rm out} = 1.25 \times 10^{17}$ cm derived from SED modeling is ∼1 $[D/3{\rm kpc}]^2$ M$_\odot$.

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Available from astro-ph/0610891

Observations of the 6 Centimeter Lines of OH in Evolved (OH/IR) Stars

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Recent observational and theoretical advances have called into question traditional OH maser pumping models in evolved (OH/IR) stars. The detection of excited-state OH lines would provide additional constraints to discriminate amongst these theoretical models. In this Letter, we report on VLA observations of the 4750 MHz and 4765 MHz lines of OH toward 45 sources, mostly evolved stars. We detect 4765 MHz emission in the star forming regions Mon R2 and LDN 1084, but we do not detect excited-state emission in any evolved stars. The flux density and velocity of the 4765 MHz detection in Mon R2 suggests that a new flaring event has begun.

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A Post-AGB Star in the Small Magellanic Cloud Observed with the Spitzer Infrared Spectrograph

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We have observed an evolved star with a rare combination of spectral features, MSX SMC 029, in the Small Magellanic Cloud (SMC) using the low-resolution modules of the Infrared Spectrograph on the Spitzer Space Telescope. A cool dust continuum dominates the spectrum of MSX SMC 029. The spectrum also shows both emission from polycyclic aromatic hydrocarbons (PAHs) and absorption at 13.7 μm from C_2H_2, a juxtaposition seen in only two other sources, AFGL 2688 and IRAS 13416−6243, both post-asymptotic giant branch (AGB) objects. As in these sources, the PAH spectrum has the unusual trait that the peak emission in the 7-9 μm complex lies beyond 8.0 μm. In addition, the 8.6 μm feature has an intensity as strong as the C-C modes which normally peak between 7.7 and 7.9 μm. The relative flux of the feature at 11.3 μm to that at 8 μm suggests that the PAHs in MSX SMC 029 either have a low ionization fraction or are largely unprocessed. The 13-16 μm wavelength region shows strong absorption features similar to those observed in the post-AGB objects AFGL 618 and SMP LMC 11. This broad absorption may arise from the same molecules which have been identified in those sources: C_2H_2, C_4H_2, HC_3N, and C_6H_6. The similarities between MSX SMC 029, AFGL 2688, and AFGL 618 lead us to conclude that MSX SMC 029 has evolved off the AGB in only the past few hundred years, making it the third post-AGB object identified in the SMC.

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Deep Mixing of He-3: Reconciling Big Bang and Stellar Nucleosynthesis

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Low-mass stars, ∼1-2 solar masses, near the Main Sequence are efficient at producing He-3, which they mix into the convective envelope on the giant branch and should distribute into the Galaxy by way of envelope loss. This process is so efficient that it is difficult to reconcile the low observed cosmic abundance of He-3 with the predictions of both stellar and Big Bang nucleosynthesis. In this paper we find, by modeling a red giant with a fully three-dimensional hydrodynamic code and a full nucleosynthetic network, that mixing arises in the supposedly stable and radiative zone between the hydrogen-burning shell and the base of the convective envelope. This mixing is due to Rayleigh-Taylor instability within a zone just above the hydrogen-burning shell, where a nuclear reaction lowers the mean molecular weight slightly. Thus we are able to remove the threat that He-3 production in low-mass stars poses to the Big Bang nucleosynthesis of He-3.

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and from http://www.maths.monash.edu.au/∼johnl/helium/

A Spitzer/IRAC Census of the Asymptotic Giant Branch Populations in Local Group Dwarfs. I. WLM

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We present Spitzer/IRAC observations at 3.6 and 4.5 μm along with optical data from the Local Group Galaxies Survey

to investigate the evolved stellar population of the Local Group dwarf irregular galaxy WLM. These observations provide a nearly complete census of the asymptotic giant branch (AGB) stars. We find 39% of the infrared-detected AGB stars are not detected in the optical data, even though our 50% completeness limit is three magnitudes fainter than the red giant branch tip. An additional 4% of the infrared-detected AGBs are misidentified in the optical, presumably due to reddening by circumstellar dust. We also compare our results with those of a narrow-band optical carbon star survey of WLM, and find the latter study sensitive to only 18% of the total AGB population. We detect objects with infrared fluxes consistent with them being mass-losing AGB stars, and derive a present day total mass-loss rate from the AGB stars of $0.7 - 2.4 \times 10^{-3}$ $M_{\odot}$ yr^{-1}. The distribution of mass-loss rates and bolometric luminosities of AGBs and red supergiants are very similar to those in the LMC and SMC and the empirical maximum mass-loss rate observed in the LMC and SMC is in excellent agreement with our WLM data.

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Tracing the development of dust around evolved stars: The case of 47 Tuc

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We observed mid-infrared (7.5-22 μm) spectra of AGB stars in the globular cluster 47 Tuc with the Spitzer telescope and find significant dust features of various types. Comparison of the characteristics of the dust spectra with the location of the stars in a $\log P - K$-diagram shows that dust mineralogy and position on the AGB are related. A 13 μm feature is seen in spectra of low luminosity AGB stars. More luminous AGB stars show a broad feature at 11.5 μm. The spectra of the most luminous stars are dominated by the amorphous silicate bending vibration centered at 9.7 μm. For 47 Tuc AGB stars, we conclude that early on the AGB dust consisting primarily of Mg-, Al- and Fe oxides is formed. With further AGB evolution amorphous silicates become the dominant species.

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The Abundance of Interstellar Fluorine and Its Implications

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We report results from a survey of neutral fluorine (F I) in the interstellar medium. Data from the *Far Ultraviolet Spectroscopic Explorer* (*FUSE*) were used to analyze 26 lines of sight lying both in the galactic disk and halo, including lines to Wolf-Rayet stars and through known supernova remnants. The equivalent widths of fluorine resonance lines at 951.871 Å and 954.827 Å were measured or assigned upper limits and combined with a nitrogen curve of growth to obtain F I column densities. These column densities were then used to calculate fluorine depletions. Comparisons are made to the previous study of F I by Federman et al. (2005) and implications for F I formation and depletion are discussed.

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Calibrating Type Ia Supernovae using the Planetary Nebula Luminosity Function I. Initial Results

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We report the results of an [O III] λ5007 survey for planetary nebulae (PN) in five galaxies that were hosts of well-observed Type Ia supernovae: NGC 524, NGC 1316, NGC 1380, NGC 1448 and NGC 4526. The goals of this survey are to better quantify the zero-point of the maximum magnitude versus decline rate relation for supernovae Type Ia and to validate the insensitivity of Type Ia luminosity to parent stellar population using the host galaxy Hubble type as a surrogate. We detected a total of 45 planetary nebulae candidates in NGC 1316, 44 candidates in NGC 1380, and 94 candidates in NGC 4526. From these data, and the empirical planetary nebula luminosity function (PNLF), we derive distances of $17.9^{+0.8}_{-0.9}$ Mpc, $16.1^{+0.8}_{-1.1}$ Mpc, and $13.6^{+1.3}_{-1.2}$ Mpc respectively. Our derived distance to NGC 4526 has a lower precision due to the likely presence of Virgo intracluster planetary nebulae in the foreground of this galaxy. In NGC 524 and NGC 1448 we detected no planetary nebulae candidates down to the limiting magnitudes of our observations. We present a formalism for setting realistic distance limits in these two cases, and derive robust lower limits of 20.9 Mpc and 15.8 Mpc, respectively.

After combining these results with other distances from the PNLF, Cepheid, and Surface Brightness Fluctuations distance indicators, we calibrate the optical and near-infrared relations for supernovae Type Ia and we find that the Hubble constants derived from each of the three methods are broadly consistent, implying that the properties of supernovae Type Ia do not vary drastically as a function of stellar population. We determine a preliminary Hubble constant of $H_0 = 77 \pm 3$ (random) $\pm$ 5 (systematic) km s^{-1} Mpc^{-1} for the PNLF, though more nearby galaxies with high-quality observations are clearly needed.

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Proof of polar ejection from the close-binary core of the planetary nebula Abell 63

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We present the first detailed kinematical analysis of the planetary nebula Abell 63, which is known to contain the eclipsing close-binary nucleus UU Sge. Abell 63 provides an important test case in investigating the role of close-binary central stars on the evolution of planetary nebulae.

Longslit observations were obtained using the Manchester echelle spectrometer combined with the 2.1-m San Pedro Martir Telescope. The spectra reveal that the central bright rim of Abell 63 has a tube-like structure. A deep image shows collimated lobes extending from the nebula, which are shown to be high-velocity outflows. The kinematic ages of the nebular rim and the extended lobes are calculated to be 8400$\pm$500 years and 12900$\pm$2800 years, respectively, which suggests that the lobes were formed at an earlier stage than the nebular rim. This is consistent with expectations that disk-generated jets form immediately after the common envelope phase.

A morphological-kinematical model of the central nebula is presented and the best-fit model is found to have the same inclination as the orbital plane of the central binary system; this is the first proof that a close-binary system directly affects the shaping of its nebula. A Hubble-type flow is well-established in the morphological-kinematical modelling of the observed line profiles and imagery.

Two possible formation models for the elongated lobes of Abell 63 are considered (1) a low-density, pressure-driven jet

excavates a cavity in the remnant AGB envelope; (2) high-density bullets form the lobes in a single ballistic ejection event.

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A near-infrared shock wave in the 2006 outburst of recurrent nova RS Oph

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Near-infrared spectra are presented for the recent 2006 outburst of the recurrent nova RS Ophiuchi (RS Oph).We report the rare detection of an infrared shock wave as the nova ejecta plows into the pre-existing wind of the secondary in the RS Oph system consisting of a white dwarf (WD) primary and a red giant secondary. The evolution of the shock is traced through a free expansion stage to a decelerative phase. The behavior of the shock velocity with time is found to be broadly consistent with current shock models. The present observations also imply that the WD in the RS Oph system has a high mass indicating that it could be a potential SNIa candidate. We also discuss the results from a recent study showing that the near-IR continuum from the recent RS Oph eruption does not originate in an expanding fireball. However, the present work shows that the IR line emission does have an origin in an expanding shock wave.

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High Resolution Spectra of Bright Central Stars of Bipolar Planetary Nebulae, and the Question of Magnetic Shaping

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We present ESO NTT high resolution echelle spectroscopy of the central stars (CSs) of eight southern bipolar planetary nebulae (PNe) selected for their asymmetry. Our aim was to determine or place limits on the magnetic fields of the CSs of these nebulae, and hence to explore the role played by magnetic fields in nebular morphology and PN shaping. If magnetic fields do play a role, we expect these CSs to have fields in the range $10^2 - 10^7$ G from magnetic flux conservation on the reasonable assumption that they must evolve into the high field magnetic white dwarfs. We were able to place an upper limit of $\approx 20,000$ G to the magnetic fields of the central stars of He 2-64 and MyCn 18. The spectrum of He 2-64 also shows a P-Cygni profile in He I λ5876 and λ6678, corresponding to an expanding photosphere with velocity ~ 100 km s^{-1}. The detection of helium absorption lines in the spectrum of He 2-36 confirms the existence of a hot stellar component. We did not reach the necessary line detection for magnetic field analysis in the remaining objects. Overall, our results indicate that if magnetic fields are responsible for shaping bipolar planetary nebulae, these are not required to be greater than a few tens of kilogauss.

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A Robust Test of Evolution near the Tip of the Red Giant Branch and Missing Giants in NGC 2808

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We describe a new method for robustly testing theoretical predictions of red giant evolution near the tip of the giant branch. When theoretical cumulative luminosity functions are shifted to align the tip in I-band and normalized at a luminosity level slightly brighter than the red giant bump, virtually all dependence on age and composition (heavy elements and helium abundance) is eliminated. While significant comparisons with observations require large samples of giant stars, such samples are available for some of the most massive Milky Way globular clusters. We present comparisons with the clusters NGC 2808 and M5, and find that NGC 2808 has a deficiency of bright giants (with a probability of less than about 3% that a more extreme distribution of giant stars would have happened by chance). We discuss the possibilities that underestimated neutrino losses or strong mass loss could be responsible for the deficit of giants. While we cannot rule out the neutrino hypothesis, it cannot explain the apparent agreement between the M5 observations and models. On the other hand, strong mass loss provides a potential link between the giant star observations and NGC 2808's unusually blue horizontal branch. If the mass loss hypothesis is true, there is likely a significant population of He white dwarfs that could be uncovered with slightly deeper UV observations of the cluster.

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Chemical compositions and plasma parameters of planetary nebulae with Wolf-Rayet and *wels* central stars

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Aims: Chemical compositions and other properties of planetary nebulae around central stars of spectral types [WC], [WO], and *wels* are compared with those of 'normal' central stars, in order to clarify the evolutionary status of each type and their interrelation.
Methods: We use plasma diagnostics to derive from optical spectra the plasma parameters and chemical compositions of 48 planetary nebulae. We also reanalyze the published spectra of a sample of 167 non-WR PN. The results as well as the observational data are compared in detail with those from other studies of the objects in common.
Results: We confirm that [WC], [WO] and *wels* nebulae are very similar to those 'normal' PN: the relation between [N II] and [O III] electron temperatures, abundances of He, N, O, Ne, S and Ar, and the number of ionizing photons show no significant differences. However, some differences are observed in their infrared (IRAS) properties. *wels* nebulae appear bluer than [WR] PN.The central star's spectral type is clearly correlated with electron density, temperature and excitation class of the nebula, [WC] nebulae tend to be smaller than the other types. All this corroborates the view of an evolutionary sequence from cool [WC 11] central stars inside dense, low excitation nebulae towards hot [WO 1] stars with low density, high excitation nebulae. The *wels* PN, however,appear to be a separate class of objects, not linked to WRPN by evolution: nebular excitation, electron temperature and density, and the number of ionizing photons all cover the whole range found in the other types. Their lower mean N/O ratio and slightly lower He/H suggest progenitor stars less massive than for the other PN types. Furthermore, the differences between results of different works are dominated by the differences in observational data rather than differences in the analysis methods.

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Sir James Jeans and the Stability of Gaseous Stars

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In 1925 Sir James Jeans calculated that a star made up of an ideal gas, generating energy as a moderately positive function of temperature and density, could not exist. Such stars would be unstable to radial oscillations of increasing size. It appears that the flaw in his calculation has never been clearly explained, especially the physical basis for it. I conclude it lies in an almost offhand assumption made about the form of the temperature perturbation. The episode provides a number of lessons about complicated calculations and their interpretation.

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Rubidium-Rich Asymptotic Giant Branch Stars

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A long debated issue concerning the nucleosynthesis of neutron-rich elements in Asymptotic Giant Branch (AGB) stars is the identification of the neutron source. We report intermediate-mass (4 to 8 solar masses) AGB stars in our Galaxy that are rubidium-rich owing to overproduction of the long-lived radioactive isotope ^{87}Rb, as predicted theoretically 40 years ago. This represents a direct observational evidence that the ^{22}Ne(α,n)^{25}Mg reaction must be the dominant neutron source in these stars. These stars then challenge our understanding of the late stages of the evolution of intermediate-mass stars and would promote a highly variable Rb/Sr environment in the early solar nebula.

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The shape and composition of interstellar silicate grains

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We investigate the composition and shape distribution of silicate dust grains in the interstellar medium. The effects of the amount of magnesium and iron in the silicate lattice are studied in detail. We fit the spectral shape of the interstellar 10 μm extinction feature as observed towards the galactic center using various particle shapes and dust materials. We use very irregularly shaped coated and non-coated porous Gaussian Random Field particles as well as a statistical approach to model shape effects. For the dust materials we use amorphous and crystalline silicates with various composition as well as silicon carbide (SiC). The results of our analysis of the 10 μm feature are used to compute the shape of the 20 micron silicate feature and to compare this with observations of this feature towards the galactic center. By using realistic particle shapes to fit the interstellar extinction spectrum we are, for the first time, able to derive the magnesium fraction in interstellar silicates. We find that the interstellar silicates are highly magnesium

rich (Mg/(Fe+Mg)>0.9) and that the stoichiometry lies between pyroxene and olivine type silicates (O/Si=3.5). This composition is not consistent with that of the glassy material found in GEMS in interplanetary dust particles indicating that the amorphous silicates found in the Solar system are, in general, not unprocessed remnants from the interstellar medium. Also, we find that a significant fraction of silicon carbide (∼3%) is present in the interstellar dust grains. We discuss the implications of our results for the formation and evolutionary history of cometary and circumstellar dust. We argue that the fact that crystalline silicates in cometary and circumstellar grains are almost purely magnesium silicates is a natural consequence of our findings that the amorphous silicates from which they were formed were already magnesium rich.

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Stellar and Molecular Radii of a Mira Star: First Observations with the Keck Interferometer Grism

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Using a new grism at the Keck Interferometer, we obtained spectrally dispersed ($R \sim 230$) interferometric measurements of the Mira star R Vir. These data show that the measured radius of the emission varies substantially from 2.0-2.4 μm. Simple models can reproduce these wavelength-dependent variations using extended molecular layers, which absorb stellar radiation and re-emit it at longer wavelengths. Because we observe spectral regions with and without substantial molecular opacity, we determine the stellar photospheric radius, uncontaminated by molecular emission. We infer that most of the molecular opacity arises at approximately twice the radius of the stellar photosphere.

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X–ray broad-band study of the symbiotic X–ray binary 4U 1954+31

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We present results of several pointed X–ray broad band observations of the 'symbiotic X–ray binary' 4U 1954+31 performed with the satellites *BeppoSAX*, *EXOSAT*, *ROSAT*, *RXTE* and *Swift* between October 1983 and April 2006. We also studied the *RXTE* ASM data over a period of more than 10 years, from January 1996 to October 2006. Light curves of all pointed observations show an erratic behaviour with sudden increases in the source emission on timescales variable from hundreds to thousands of seconds. There are no indications of changes in the source spectral hardness, with the possible exception of the *RXTE* pointed observation. Timing analysis does not reveal the presence of coherent pulsations or periodicities either in the pointed observations in the range from 2 ms to 2000 s or in the long-term *RXTE* ASM light curve on timescales from days to years. The 0.2–150 keV spectrum, afforded with *BeppoSAX*, is the widest for this source available up to now in terms of spectral coverage and is well described by a model consisting of a lower-energy thermal component (hot diffuse gas) plus a higher-energy (Comptonization) emission, with the latter modified

by a partially-covering cold absorber plus a warm (ionized) absorber. A blackbody modelization of our *BeppoSAX* low-energy data is instead ruled out. The presence of a complex absorber local to the source is also supported by the 0.1–2 keV *ROSAT* spectrum. *RXTE*, *EXOSAT* and *Swift* X–ray spectroscopy is consistent with the above results, but indicates variations in the density and the ionization of the local absorber. A 6.5 keV iron emission line is possibly detected in the *BeppoSAX* and *RXTE* spectra. All this information suggests that the scenario which better describes 4U 1954+31 consists of a binary system in which a neutron star orbits in a highly inhomogeneus medium, accreting matter from a stellar wind coming from its optical companion, an M-type giant star.

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The Abundances of Light Neutron-Capture Elements in Planetary Nebulae – I. Photoionization Modeling and Ionization Corrections

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We have conducted a large-scale survey of 120 planetary nebulae (PNe) to search for the near-infrared emission lines [Kr III] 2.199 and [Se IV] 2.287 μm. The neutron(n)-capture elements Se and Kr may be enriched in a PN if its progenitor star experienced s-process nucleosynthesis and third dredge-up. In order to determine Se and Kr abundances, we have added these elements to the atomic databases of the photoionization codes Cloudy and XSTAR, which we use to derive ionization correction factors (ICFs) to account for the abundances of unobserved Se and Kr ions. However, much of the atomic data governing the ionization balance of these two elements are unknown, and have been approximated from general principles. We find that uncertainties in the atomic data can lead to errors approaching 0.3 dex in the derived Se abundances, and up to 0.2–0.25 dex for Kr. To reduce the uncertainties in the Kr ionization balance stemming from the approximate atomic data, we have modeled ten bright PNe in our sample, selected because they exhibit emission lines from multiple Kr ions in their optical and near-infrared spectra. We have empirically adjusted the uncertain Kr atomic data until the observed line intensities of the various Kr ions are adequately reproduced by our models. Using the adjusted Kr atomic data, we have computed a grid of models over a wide range of physical parameters (central star temperature, nebular density, and ionization parameter), and derived formulae that can be used to compute Se and Kr ICFs. In the second paper of this series, we will apply these ICFs to our full sample of 120 PNe, which comprises the first large-scale survey of n-capture elements in PNe.

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Properties of dust in early-type galaxies

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We report optical extinction properties of dust for a sample of 26 early-type galaxies based on the analysis of their multicolour CCD observations. The wavelength dependence of dust extinction for these galaxies is determined and the extinction curves are found to run parallel to the Galactic extinction curve, which implies that the properties of dust in the extragalactic environment are quite similar to those of the Milky Way. For the sample galaxies, value of the parameter R_V, the ratio of total extinction in V band to selective extinction in B & V bands, lies in the range 2.03 - 3.46 with an average of 3.02, compared to its canonical value of 3.1 for the Milky Way. A dependence of R_V on dust morphology of the host galaxy is also noticed in the sense that galaxies with a well defined dust lane show tendency to

have smaller R_V values compared to the galaxies with disturbed dust morphology. The dust content of these galaxies estimated using total optical extinction is found to lie in the range 10^4 to 10^6 $M_\odot$, an order of magnitude smaller than those derived from IRAS flux densities, indicating that a significant fraction of dust intermixed with stars remains undetected by the optical method. We examine the relationship between dust mass derived from IRAS flux and the X-ray luminosity of the host galaxies.The issue of the origin of dust in early-type galaxies is also discussed.

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The extra-mixing efficiency in very low metallicity RGB stars

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AIMS: After the first dredge-up, low-mass Red Giant Branch (RGB) stars experience an extra-mixing episode that strongly affects the chemical abundances on their surface. This mixing occurs at the bump in the luminosity function. In this Letter we describe the efficiency of the extra-mixing in RGB stars found in very metal-poor globular clusters (GC). METHODS: The VLT/ISAAC spectra of twenty stars located between the bump and the tip of the RGB in four GCs with metallicities between [Fe/H]=−1.2 and −2.5 dex were collected. The carbon isotopic ratios on their surface were derived from the second overtone (Δv=2) bands of the CO molecule at 2.3 μm with the spectral synthesis method. RESULTS: It is found that the carbon isotopic ratios of very metal-poor GC stars always reach the equilibrium value of the CNO cycle almost immediately above the bump in the luminosity function. No additional mixing episode at brighter luminosities and no variations with the clusters' metallicity were detected. The extra-mixing is therefore found to be very efficient in metal-poor low-mass RGB stars, in very good agreement with theoretical expectations.

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Spitzer spectroscopy of carbon stars in the Small Magellanic Cloud

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We present Spitzer Space telescope spectroscopic observations of 14 carbon-rich AGB stars in the Small Magellanic Cloud. SiC dust is seen in most of the carbon-rich stars but it is weak compared to LMC stars. The SiC feature is strong only for stars with significant dust excess, opposite to what is observed for Galactic stars. We argue that in the SMC, SiC forms at lower temperature than graphite dust, whereas the reverse situation occurs in the Galaxy where SiC condenses at higher temperatures and forms first. Dust input into the interstellar medium by AGB stars consists mostly of carbonaceous dust, with little SiC or silicate dust. Only the two coolest stars show a 30-μm band due to MgS

dust. We suggest that this is due to the fact that, in the SMC, mass-losing AGB stars generally have low circumstellar (dust) optical depth and therefore effective heating of dust by the central star does not allow temperatures below the 650 K necessary for MgS to exist as a solid. Gas phase C_2H_2 bands are stronger in the SMC than in the LMC or Galaxy. This is attributed to an increasing C/O ratio at low metallicity. We present a colour-colour diagram based on Spitzer IRAC and MIPS colours to discriminate between O- and C-rich stars. We show that AGB stars in the SMC become carbon stars early in the thermal-pulsing AGB evolution, and remain optically visible for $\sim 6 \times 10^5$ yr. For the LMC, this lifetime is $\sim 3 \times 10^5$ yr. The superwind phase traced with Spitzer lasts for $\sim 10^4$ yr. Spitzer spectra of a K supergiant and a compact H II region are also given.

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The molecular envelope around the red supergiant VY CMa

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We present millimeter interferometric observations of the molecular envelope around the red supergiant VY CMa with the SubMillimeter Array (SMA). The high angular resolution ($< 2''$) allows us to derive the structure of the envelope as observed in the 1.3 mm continuum, ^{12}CO(2-1), ^{13}CO(2-1) and SO(6,5-5,4) lines emission. The circumstellar envelope is resolved into three components: a dense, compact and dusty central component, embedded in a more diffuse and extended envelope plus a high velocity component. We construct a simple model, consisting of a spherically symmetric slowly expanding envelope and bipolar outflows with a wide opening angle ($\sim 120°$) viewed close to the line of sight ($i = 15°$). Our model can explain the main features of the SMA data and previous single-dish CO multi-line observations. An episode of enhanced mass loss along the bipolar direction is inferred from our modelling. The SMA data provide a better understanding of the complicated morphology seen in the optical/IR high resolution observations.

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Near-infrared variability of a sample of galactic carbon Miras

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Aims. In this paper we aim to determine the longest pulsation period of infrared carbon stars. Methods. Forty-seven infrared carbon stars were selected based on (1) IRAS colours and spectral classification from the IRAS LRS atlas, and (2) known carbon stars with large CO expansion velocities. Multi-epoch JHKL photometry was obtained. Results.Reliable periods could be derived for 31 stars. The two longest periods are 840 and 870 days, only slightly longer than the previously longest known period for a galactic carbon star of 783 days. This is considerably shorter than the periods of some OH/IR stars. As the present survey targeted carbon stars that are likely to be among those with the longest periods expected, this difference appears real. To try to understand the longest observed period, the synthetic AGB code of Wagenhuber & Groenewegen (1998) was fine-tuned to reproduce the models of Vassiliadis & Wood (1993). For several initial masses the fundamental mode period distribution was calculated for stars inside observed instability strip. Depending on details of the adopted mass loss rate, it is found that the mass limit where a carbon star has a probability of less than 1% of being in the observed instability strip with a period longer than 900 days is between 2.6 and 3.1 $M_\odot$. Conclusions. Synthetic AGB calculations suggest that the observed upper limit

in period can be interpreted as an upper mass limit of carbon star formation, with a value of between 2.6 and 3.1 $M_\odot$, depending on the adopted AGB mass loss rate. Such a mass limit is predicted by stellar evolution through the occurence of Hot Bottom Burning where (dredged-up) carbon is converted into nitrogen; this is predicted to occur at higher masses (4 $M_\odot$), although this depends on convection and core overshoot.

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Surface pollution of main-sequence stars through encounters with AGB ejecta in ω Centauri

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The origin of a double main-sequence (MS) in ω Centauri is explored. We have shown from theoretical calculations on the stellar evolution that the colors of MS stars are shifted to those of the observed blue MS if the surface layers are polluted by He-rich materials with the mass of $\sim$0.1 $M_\odot$. Stars are supposed to be polluted through numerous encounters with the ejecta descended from massive asymptotic giant-branch (AGB) stars. Two populations of stars with different kinematics exceptionally observed in ω Cen indicate that kinematically cooler stars are more polluted through encounters with AGB ejecta than kinematically hotter ones because the accretion rate is inversely proportional to the cube of the relative velocity. We propose that both of these factors split the MS in ω Cen. This theoretical scheme explains why only ω Cen exhibit a double MS and matches the amount of He necessary to produce the blue MS with that supplied from massive AGB stars. Furthermore, we predict that even if globular clusters (GCs) possess only one generation of stars, the velocity dispersion of stars broaden the MS in the color-magnitude diagram as long as the GCs are massive enough to keep the AGB ejecta after the burst of star formation. This view explains the broad MS recently found in the GC NGC 2808 which exhibits no scatter in [Fe/H] and thus is likely to consist of a single generation of stars unlike the case of ω Cen.

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VLTI/AMBER interferometric observations of the recurrent Nova RS Oph 5.5 days after outburst

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We report on spectrally dispersed interferometric AMBER/VLTI observations of the recurrent nova RS Oph five days after the discovery of its outburst on 2006 Feb 12. Using three baselines ranging from 44 to 86 m, and a spectral resolution of $\lambda/\delta\lambda$=1500, we measured the extension of the milliarcsecond-scale emission in the K band continuum and in the Brγ and He I 2.06 μm lines, allowing us to get an insight into the kinematics of the line forming regions.

The continuum visibilities were interpreted by fitting simple geometric models consisting of uniform and Gaussian ellipses, ring and binary models. The visibilities and differential phases in the Brγ line were interpreted using skewed ring models aiming to perform a limited parametric reconstruction of the extension and kinematics of the line forming region. The limited *uv* coverage does not allow discrimination between filled models (uniform or Gaussian ellipses) and rings. Binary models are discarded because the measured closure phase in the continuum is close to zero. The visibilities in the lines are at a low level compared to their nearby continuum, consistent with a more extended line forming region for He I 2.06 μm than Brγ. The ellipse models for the continuum and for the lines are highly flattened (b/a$\sim$0.6) and share the same position angle (PA$\sim$140°). Their typical Gaussian extensions are 3.1×1.9 mas, 4.9×2.9 mas and 6.3×3.6 mas for the continuum, Brγ and He I 2.06 μm lines, respectively. Two radial velocity fields are apparent in the Brγ line: a 'slow' expanding ring-like structure (v_{rad} $\leq$1800 km s^{-1}), and a 'fast' structure extended in the E-W direction (v_{rad} $\sim$2500-3000 km s^{-1}), a direction that coincides with the jet-like structure seen in the radio. These results confirm the basic fireball model, contrary to the conclusions of other interferometric observations conducted by Monnier et al. (2006).

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The chemical content of nearby galaxies from planetary nebulae: NGC 147

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We report the results of spectroscopic observations, obtained with the GEMINI Multi-Object Spectrograph, of 8 planetary nebulae (PNe) in the dwarf spheroidal (dSph) galaxy NGC 147, a companion of M 31. The physico-chemical properties of the six brightest PNe (Corradi et al. 2005) were derived using both the empirical ICF method and photoionization modelling with CLOUDY. Different aspects of the evolution of low and intermediate mass stars in a low-metallicity environment are analysed using relationships between chemical abundances. In addition, certain features of the chemical evolution of NGC 147 were examined. In particular, the mean metallicity of PNe, O/H=8.06 (corresponding to [Fe/H](PNe)~ -0.97), is close to the metallicity of the old stellar population, [Fe/H]=-1.0 (Butler & Martínez-Delgado 2005), suggesting a negligible chemical enrichment during a substantial amount of time. Finally, the luminosity-metallicity relationship for the dwarf galaxies of the Local Group is discussed. The location in the luminosity-metallicity diagram of dSphs does not exclude their formation from old dwarf irregular (dIrs) galaxies, but it does exclude their formation from the present time dIrs, since the differences between their metallicities are already present in their older populations. The offset in the luminosity-metallicity relationship indicates a faster enrichment of dSphs, and together with the different average abundance ratio [O/Fe] demonstrates the different star formation histories for these two types of galaxies.

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On the nature of the cool component of MWC 560

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MWC 560 (V694 Mon) is one of the most enigmatic symbiotic system with a very active accretion-powered hot component. Such activity can be supported only by a luminous asymptotic giant branch star, i.e. a Mira or SR variable,

with a high mass-loss rate. It is also a very unusual jet source because the jet axis lies practically parallel to the line of sight. The aims of our study are the determination of the evolutionary status of the cool component of MWC 560. Our methods involve analysis of near-IR JHKL and optical light curves. The cool component of MWC 560 pulsates with a period of ∼340 days, and it is probably a red SR variable on the thermally pulsing AGB. The high mass-loss rate expected for such a star is sufficient to power the observed activity of the hot companion.

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Proper Motions of the Ansae in the Planetary Nebula NGC 7009

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For the planetary nebula NGC 7009, we present a comparison of two unpublished Very Large Array archive data sets taken with a time separation of 8.09 years to confirm the proper motions of its ansae observed in the optical. We determine values of 23±6 and 34±10 mas yr^{-1} for the eastern and western ansae, respectively. There is marginal evidence suggesting that the flux densities of the jets that connect the ansae with the main body of the nebula diminished in about 30% over the period between the two observations. We also set an upper limit to the expansion of the main body of the planetary nebula, setting a lower limit of ∼700 pc for its distance.

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The Progenitors of Planetary Nebulae in Dwarf Irregular Galaxies

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We present chemical abundances for planetary nebulae and H II regions in the Local Group dwarf irregular galaxy NGC 6822 based upon spectroscopy obtained at the Canada-France-Hawaii Telescope using the Multi-Object Spectrograph. From these and similar data compiled from the literature for planetary nebulae in the Magellanic Clouds, Sextans A, Sextans B, and Leo A, we consider the origin and evolution of the stellar progenitors of bright planetary nebulae in dwarf irregular galaxies. On average, the oxygen abundance observed in the bright planetary nebulae in these galaxies coincides with that measured in the interstellar medium, indicating that, in general, the bright planetary nebulae in dwarf irregulars descend primarily, though not exclusively, from stars formed in the relatively recent past. We also find that the ratio of neon to oxygen abundances in these bright planetary nebulae is identical to that measured in the interstellar medium, indicating that neither abundance is significantly altered as a result of the evolution of their stellar progenitors. We do find two planetary nebulae, that in Sextans A and S33 in NGC 6822, where oxygen appears to have been dredged up, but these are the exception rather than the rule. In fact, we find that even nitrogen is not always dredged up, so it appears that the dredge-up of oxygen is uncommon for the abundance range of the sample.

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Non-adiabatic Oscillations of Red Giants

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Using our non-local time-dependent theory of convection, the linear non-adiabatic oscillations of 10 evolutionary model series with masses of 1–3$M_\odot$ are calculated. The results show that there is a red giant instability strip in the lower temperature side of the Hertzsprung-Russel (HR) diagram which goes along the sequences of the red giant branch (RGB) and the asymptotic giant branch (AGB). For red giants of lower luminosities, pulsation instability are found at high order overtones, the lower order modes from the fundamental to the second overtone are stable. Towards higher luminosity and lower effective temperature, instability moves to lower order modes, and the amplitude growth rate of oscillations also grows. At the high luminosity end of the strip, the fundamental and the first overtone become unstable, while all the modes above the $4^{\rm th}$ order become stable. The excitation mechanism have been sdudied in detail. It is found that turbulent pressure plays a key role for excitating of red variables. The frozen convection approximation is unavailaable for the low temperature stars with extended convective envelopes. In any case, this approximation can explain neither the red edge of the Cepheid instability strip, nor the blue edge of the pulsating red giant instability strip. An analytic expression of a pulsation constant as a function of stellar mass, luminosity and effective temperature is presented from this work.

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Diffraction-limited 3μm Spectroscopy of IRAS 04296+3429 and IRAS 05341+0852: Spatial Extent of Hydrocarbon Dust Emission and Dust Evolutionary Sequence

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We present 3 μm spectroscopy of the carbon-rich proto-planetary nebulae IRAS 04296+3429 and IRAS 05341+0852 conducted with the adaptive optics system at the Subaru Telescope. We utilize the nearly diffraction-limited spectroscopy to probe the spatial extent of the hydrocarbon dust emitting zone. We find a hydrocarbon emission core extending up to 100–160 mas from the center of IRAS 04296+3429, corresponding to a physical diameter of 400–640 AU, assuming a distance of 4 kpc. On the other hand, we find that IRAS 05341+0852 is not spatially resolved with this instrumentation. The physical extent of these proto-planetary nebulae, along with the reanalyzed data of IRAS 22272+5435 published previously, suggests a correlation between the physical extent of the hydrocarbon dust emission and the spectral evolution of the aliphatic to aromatic features in these post-AGB stars. These measurements represent the first direct test of the proposed chemical synthesis route of carbonaceous dust in the circumstellar environment of evolved stars.

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PAHs in Galaxies: their Properties and Evolution

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I summarize the results of two recent studies, based on ISO and Spitzer mid-IR spectra of galaxies and Galactic regions, aimed at understanding the origins of the variations of the aromatic features among and inside galaxies. I show that the ratios between the most intense bands (6.2, 7.7, 8.6 and 11.3 μm) are principally sensitive to the charge of the molecules, and therefore represent a powerful diagnostic tool of the physical conditions inside the region where the emission is originating. Then, I show that the weakness of the aromatic bands, in low-metallicity environments, is a consequence of the delayed injection of their carriers, the Polycyclic Aromatic Hydrocarbons (PAHs), into the interstellar medium (ISM) of galaxies. Indeed, PAHs are believed to form in the envelopes of post-AGB stars, several hundreds of million years after the beginning of the star formation, when the system is already chemically evolved.

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The period-luminosity relation of Mira variables in NGC 6388 and NGC 6441

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We report a result of our near-infrared repeated observations of Mira variables in the globular clusters NGC 6388 and 6441. These two clusters are known as peculiar clusters with blue horizontal branch stars and RR Lyr variables which are unexpected for their relatively high metallicities. We derive their distance moduli by fitting the Mira variables in the period-luminosity relation. They are the first distance estimates, for these clusters, which were observationally obtained in an independent way from the horizontal branch stars. The obtained distances revealed that the absolute magnitudes of the peculiar RR Lyr variables are similar to the metal-poor ones of [Fe/H]=-2 dex. It is suggested that the constraint we found should be reproduced by any theories to explain the horizontal morphology of these peculiar clusters.

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Spitzer/IRAC Characterization of Galactic AGB Stars

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The Spitzer Space Telescope and in particular its InfraRed Array Camera (IRAC) is an ideal facility to study the distribution of AGB stars in our own and other galaxies because of its efficiency in surveying vast areas of the sky and its ability to detect sources with infrared excess. The IRAC colors of AGB stars, however, are not well known because cool stars have numerous molecular absorption features in the spectral region covered by the IRAC photometric system. The presence and strength of these features depends on the chemistry of the stellar atmosphere and the mass loss rate

and can change with time due to the star's variability. To characterize the IRAC colors of AGB stars, we are carrying out a Spitzer Guaranteed Time Observation program to observe a sample of AGB stars with IRAC. The results will be made available to the community in the form of template magnitudes and colors for each target with the goal of aiding the identification of AGB stars in already available and future IRAC surveys. We present here the first results of this project.

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A study of the mass loss rates of symbiotic star systems

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The amount of mass loss in symbiotic systems is investigated, specifically mass loss via the formation of jets in R Aquarii (R Aqr). The jets in R Aqr have been observed in the X-ray by Chandra over a four year time period. The jet changes on times scales of a year and new outflows have been observed. Understanding the amount of mass and the frequency of ejection further constrain the ability of the white dwarf in the system to accrete enough mass to become a Type 1a supernova progenitor. The details of multi-wavelength studies, such as speed, density and spatial extent of the jets will be discussed in order to understand the mass balance in the binary system. We examine other symbiotic systems to determine trends in mass loss in this class of objects.

Poster contribution, published in "The Multicoloured Landscape of Compact Objects and their Explosive Origins"
Available from astro-ph/0611401

Estimation of the dust mass-loss rates from AGB stars in the Fornax and Sagittarius dwarf Spheroidal galaxies

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To study the effect of metallicity on the mass-loss of AGB stars, we have conducted mid-infrared photometric measurements of AGB stars in the Sagittarius and Fornax Dwarf Spheroidal Galaxies ([Fe/H]=−1.1 and −1.3) with the 10-micron camera of VISIR at the VLT. These observations combined with previous near-infrared photometric measurements allow us to estimate mass-loss rates in these galaxies. We show here that the observed AGB display dust-driven mass-loss. Dust mass-loss rate are found to be in the range $0.2\times10^{-10} - 1.3 \times 10^{-8}$ $M_{\odot}yr^{-1}$ for the observed AGB stars in SgrD and around 5×10^{-11} $M_{\odot}yr^{-1}$ for the observed star in Fornax.

Oral contribution, published in ASP conf Ser, "Why Galaxies Care About AGB Stars"
Available from astro-ph/0611073

The Destruction of ^{3}He by Rayleigh-Taylor Instability on the First Giant Branch

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Low-mass stars, ∼1-2 $M_\odot$, near the Main Sequence are efficient at producing ^{3}He, which they mix into the convective envelope on the giant branch and distribute into the Galaxy by way of envelope loss. This process is so efficient that it is difficult to reconcile the observed cosmic abundance of ^{3}He with the predictions of Big Bang nucleosynthesis. In this paper we find, by modeling a red giant with a fully three-dimensional hydrodynamic code and a full nucleosynthetic network, that mixing arises in the supposedly stable and radiative zone between the hydrogen-burning shell and the base of the convective envelope. This mixing is due to Rayleigh-Taylor instability within a zone just above the hydrogen-burning shell. In this zone the burning of the ^{3}He left behind by the retreating convective envelope is predominantly by the reaction $^3\mathrm{He} + {}^3\mathrm{He} \rightarrow {}^4\mathrm{He} + \mathrm{p} + \mathrm{p}$, a reaction which, untypically for stellar nuclear reactions, lowers the mean molecular weight, leading to a local minimum. This local minimum leads to Rayleigh-Taylor instability, and turbulent motion is generated which will continue ultimately up into the normal convective envelope. Consequently material from the envelope is dragged down sufficiently close to the burning shell that the ^{3}He in it is progressively destroyed. Thus we are able to remove the threat that ^{3}He production in low-mass stars poses to the Big Bang nucleosynthesis of ^{3}He. Some slow mixing mechanism has long been suspected, that connects the convective envelope of a red giant to the burning shell. It appears to be necessary to account for progressive changes in the $^{12}\mathrm{C}/^{13}\mathrm{C}$ and $^{14}\mathrm{N}/^{12}\mathrm{C}$ ratios on the First Giant Branch. We suggest that these phenomena are also due to the Rayleigh-Taylor-unstable character of the ^{3}He-burning region.

Oral contribution, published in Proc. of IAU Symposium 239
Available from astro-ph/0611609

Review Paper

AGB stars in extragalactic systems

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I will be reviewing three methods to identify late-type giants in extragalactic systems, based on the main characteristics of AGB stars (they are infrared bright, variable, and have spectral peculiarities).

Published in Conference: "Why Galaxies Care About AGB Stars"
Available from astro-ph/0611163

RS Ophiuchi (2006) and the Recurrent Nova Phenomenon

On 2006 February 12$^{\rm th}$, the recurrent nova RS Ophiuchi erupted for the first time since 1985. This event triggered off an intensive multi-wavelength observational campaign, from the radio to x-rays. Theoreticians have been busy as well! Following the 1985 eruption a successful workshop was held in Manchester, UK; the proceedings were published in RS Ophiuchi (1985) and the Recurrent Nova Phenomenon, ed. M.F. Bode. Utrecht: VNU Science Press, 1987.

Following the 2006 eruption, we are hosting a follow-up meeting at Keele University from 12-14 June 2007. The conference will be wide ranging, taking in the enviroments of red giants, supernova progenitors and supernova remnants, accretion and thermonuclear processes in close binary systems, shocks, as well as recurrent novae.

Nye Evans (LOC Chair) and Mike Bode (SOC Chair)

email: rsoph@astro.keele.ac.uk

See also http://cadcwww.dao.nrc.ca/cadcbin/get_meetings?meeting_no=2060

"Asymmetrical Planetary Nebulae IV" conference

FIRST ANNOUNCEMENT AND CALL FOR REGISTRATION

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International Conference
ASYMMETRICAL PLANETARY NEBULAE IV
La Palma, Canary Islands, 18-22 June 2007
http://www.iac.es/proyect/apn4

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After more than two decades of intensive work, understanding the complex shapes of planetary nebulae and their implication on stellar evolution in general, is still a challenging and exciting goal. We are glad to announce the fourth conference of the "Asymmetrical Planetary Nebulae" series devoted to this astrophysical problem. It will be held on La Palma in the Canary Islands (Spain) from June 18 to 22, 2007. The conference will have a format similar to the previous ones of the series, including invited reviews on specific subjects, invited contributed talks (selected among those proposed by participants), and posters. Ample opportunity will be given to participants - and in particular to young researchers - to present new relevant results, both in form of talks and during the extensive discussion times that are foreseen during the conference.

The topics to be discussed during the conference are: multiwavelength observations of aspherical geometries from the asymptotic giant branch to the late planetary nebula phase (including collimated outflows, jets, microstructures, spherical haloes around aspherical nebulae, etc.); the correlation of morphology with the basic properties of their stellar progenitors; the processes at work during the AGB (thermal pulses and magnetic fields spinning up the envelope, surface rotation, pulsations or other types of instabilities, winds and the processes that drive them); shaping models, and the role of magnetic fields and discs (observations, theory, HD and MHD modeling, accretion discs formation theories); the role of binary evolution (observations, theory for common-envelope systems and detached interacting binaries, population synthesis models for binary stars, progenitors and progeny of planetary nebulae with central binary stars); related objects (symbiotic stars, supersoft X-ray systems, YSO with slow jets, aspherical nebulae around massive stars, post-AGB binary stars).

Please visit the conference web page

http://www.iac.es/proyect/apn4

where you will find more detailed information about the meeting. In particular, in the section Topics and Sessions you will find the scientific rationale of the conference, with highlights of some questions that the SOC has identified as the critical issues to be addressed. Please think how your work might contribute to any of them: we invite everybody not only to propose a talk on a specific subject, but also to prepare one-slide contributions to be presented in the discussion sessions.

APN4 is organized by the Isaac Newton Group of Telescopes and the Instituto de Astrofisica de Canarias, and will be held in the Hotel H10 Taburiente Playa in Los Cancajos, a quiet beach resort located between the airport and the capital Santa Cruz de La Palma. The hotel offers attractive prices for participants, and even cheaper accommodation is available in the attached H10 Costa Salinas Apartments that belong to the same hotel chain.

We are applying to various funding agencies. If these applications are successful, financial help might be available for applicants who are short of funding, especially if young researchers and/or coming from less favoured regions.

The SOC of the conference is composed of:

Bruce Balick	USA
Romano L.M. Corradi	UK/Spain (co-chair)
Orsola De Marco	USA
Martin A. Guerrero	Spain
Joel H. Kastner	USA
Arturo Manchado	Spain (co-chair)
Raghvendra Sahai	USA
Noam Soker	Israel
Letizia Stanghellini	USA

The main deadlines are:

31 Jan, 2007 Deadline for Conference Registration and Abstract Submission
15 Apr, 2007 Deadline for Hotel Booking
15 Aug, 2007 Deadline for submission of papers for the Proceedings

To register for the APN4 conference you have to fill in the on-line Registration Form in the conference web page. Once registered, you can log in your personal account, add talks or posters abstracts, and modify all your personal data at any moment (until deadline).

Looking forward to seeing you next year on La Palma, our best regards,

Romano Corradi & Arturo Manchado

on behalf of the SOC of the conference

Contact e-mail: apn4@ing.iac.es

APN4 WILL BE DEDICATED TO THE MEMORY OF OUR FRIEND AND COLLEAGUE HUGO SCHWARZ, WHO RECENTLY DIED IN A MOTOR ACCIDENT IN CHILE.

See also http://www.iac.es/proyect/apn4