THE AGB NEWSLETTER

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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 152$^{\rm nd}$ issue of the AGB Newsletter.

Congratulations to Matthias Maercker for having received his Philosopher's Degree, well done! One of the topics of his research concerned the shells around carbon stars — see also the paper by him and Hans Olofsson, as well as two papers on that oddest (or should we say "prototypical"?) of carbon stars, IRC+10 216.

Further of note are papers dealing with extra-galactic AGB populations, some at high redshift indeed, as well as several papers related to planetary systems that may or may not survive the AGB phase.

Those looking for employment may wish to consider job openings in Granada (Spain) and Brussels (Belgium). Also don't miss the announcements at the end of the newsletter.

Advanced notice: Massimo Marengo has set up a Google forum, to discuss the Food for Thought topics or anything else related to AGB stars. If you receive an invitation to join this Google group, you know it is (well, may be) genuine.

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

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Can SNe 1.5 from massive zero-metallicity AGB stars produce (iron?) dust explaining high-redshift long-λ emission?

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

Rocky planetesimals as the origin of metals in DZ stars

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(Abridged) An analysis of the calcium and hydrogen abundances, Galactic positions and kinematics of 146 DZ stars from the Sloan Digital Sky Survey demonstrates that interaction with the interstellar medium cannot account for their externally polluted atmospheres. The calcium-to-hydrogen ratios for the 37 DZA stars are dominated by super-solar values, as are the lower limits for the remaining 109 DZ stars. All together their metal-contaminated convective envelopes contain $10^{20\pm2}$ g of calcium, commensurate with the masses of calcium inferred for large asteroids. It is probable that these stars are contaminated by circumstellar matter; the rocky remains of terrestrial planetary systems. In this picture, two predictions emerge: 1) at least 3.5% of all main sequence A- and F-type stars build terrestrial planets; and 2) the DZA stars are externally polluted by both metals and hydrogen, and hence constrain the frequency and mass of water-rich, extrasolar planetesimals.

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A near-infrared study of AGB and red giant stars in the Leo I dSph galaxy

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A near-infrared imaging study of the evolved stellar populations in the dwarf spheroidal galaxy Leo I is presented. Based on JHK observations obtained with the WFCAM wide-field array at the UKIRT telescope, we build a near-infrared photometric catalogue of red giant branch (RGB) and asymptotic giant branch (AGB) stars in Leo I over a 13.5 arcmin square area. The V–K colours of RGB stars, obtained by combining the new data with existing optical observations, allow us to derive a distribution of global metallicity [M/H] with average [M/H]$= -1.51$ (uncorrected) or [M/H]$= -1.24 \pm 0.05$ (int) ± 0.15 (syst) after correction for the mean age of Leo I stars. This is consistent with the results from spectroscopy once stellar ages are taken into account. Using a near-infrared two-colour diagram, we discriminate between carbon- and oxygen-rich AGB stars and obtain a clean separation from Milky Way foreground stars. We reveal a concentration of C-type AGB stars relative to the red giant stars in the inner region of the galaxy, which implies a radial gradient in the intermediate-age (1–3 Gyr) stellar populations. The numbers and luminosities of the observed carbon- and oxygen-rich AGB stars are compared with those predicted by evolutionary models including the thermally-pulsing AGB phase, to provide new constraints to the models for low-metallicity stars. We find an excess in the predicted number of C stars fainter than the RGB tip, associated to a paucity of brighter ones. The number of O-rich AGB stars is roughly consistent with the models, yet their predicted luminosity function is extended to brighter luminosity. It appears likely that the adopted evolutionary models overestimate the C star lifetime and underestimate their K-band luminosity.

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Chemical abundances in the externally polluted white dwarf GD 40: Evidence of a rocky extrasolar minor planet

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We present Keck/High Resolution Échelle Spectrometer data with model atmosphere analysis of the helium- dominated polluted white dwarf GD 40, in which we measure atmospheric abundances relative to helium of nine elements: H, O, Mg, Si, Ca, Ti, Cr, Mn, and Fe. Apart from hydrogen, whose association with the other contaminants is uncertain, this material most likely accreted from GD 40's circumstellar dust disk whose existence is demonstrated by excess infrared emission. The data are best explained by accretion of rocky planetary material, in which heavy elements are largely contained within oxides, derived from a tidally disrupted minor planet at least the mass of Juno, and probably as massive as Vesta. The relatively low hydrogen abundance sets an upper limit of 10% water by mass in the inferred parent body, and the relatively high abundances of refractory elements, Ca and Ti, may indicate high-temperature processing. While the overall constitution of the parent body is similar to the bulk Earth being over 85% by mass composed of oxygen, magnesium, silicon, and iron, we find $n(\mathrm{Si})/n(\mathrm{Mg}) = 0.30 \pm 0.11$, significantly smaller than the ratio near unity for the bulk Earth, chondrites, the Sun, and nearby stars. This result suggests that differentiation occurred within the parent body.

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Planetary Nebulae: Observational properties, mimics, and diagnostics

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The total number of true, likely and possible planetary nebulae (PN) now known in the Milky Way is nearly 3000, double the number known a decade ago. The new discoveries are a legacy of the recent availability of wide field, narrowband imaging surveys, primarily in the light of Hα. In this paper, we summarise the various PN discovery techniques, and give an overview of the many types of objects which mimic PN and which appear as contaminants in both Galactic and extragalactic samples. Much improved discrimination of classical PN from their mimics is now possible based on the wide variety of high-quality multiwavelength data sets that are now available. We offer improved taxonomic and observational definitions for the PN phenomenon based on evaluation of these better diagnostic capabilities. However, we note that evidence is increasing that the PN phenomenon is heterogeneous, and PN are likely to be formed from multiple evolutionary scenarios. In particular, the relationships between some collimated symbiotic outflows and bipolar PN remain uncertain.

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Evolution of Low- and Intermediate-Mass Stars with [Fe/H]≤ -2.5

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We present extensive sets of stellar models for 0.8–9.0 $\mathrm{M}_\odot$ in mass and $-5 \leq [\mathrm{Fe/H}] \leq -2$ and $Z = 0$ in metallicity.

The present work focuses on the evolutionary characteristics of hydrogen mixing into the He-flash convective zones during the core and shell He flashes which occurs for the models with [Fe/H]$\lesssim -2.5$. Evolution is followed from the zero age MS to the TPAGB phase including the hydrogen engulfment by the He-flash convection during the RGB or AGB phase. There exist various types of mixing episodes of how the H mixing sets in and how it affects the final abundances at the surface. In particular, we find H ingestion events without dredge-ups that enables repeated neutron-capture nucleosynthesis in the He flash convective zones with ^{13}C(a,n)^{16}O as neutron source. For $Z = 0$, the mixing and dredge-up processes vary with the initial mass, which results in different final abundances in the surface. We investigate the occurrence of these events for various initial mass and metallicity to find the metallicity dependence for the He-flash driven deep mixing (He–FDDM) and also for the third dredge-up (TDU) events. In our models, we find He–FDDM for $M \leq 3$ M$_\odot$ for $Z = 0$ and for $M\lesssim 2$ M$_\odot$ for $-5\lesssim$[Fe/H]$\lesssim -3$. On the other hand, the occurrence of the TDU is limited to the mass range of ~ 1.5 M$_\odot$ to ~ 5 M$_\odot$ for [Fe/H]$= -3$, which narrows with decreasing metallicity. The paper also discusses the implications of the results of model computations for observations. We compared the abundance pattern of CNO abundances with observed metal-poor stars. The origins of most iron-deficient stars are discussed by assuming that these stars are affected by binary mass transfer. We also point out the existence of a blue horizontal branch for $-4\lesssim$[Fe/H]$\lesssim -2.5$.

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Line formation in AGB atmospheres including velocity effects. Molecular line profile variations of long period variables

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The atmospheres of evolved red giants are considerably influenced by pulsations of the stellar interiors and developing stellar winds. The resulting complex velocity fields severely affect molecular line profiles observable in NIR spectra. With the help of model calculations the complex line formation process in AGB atmospheres was explored with the focus on velocity effects. Furthermore, we aimed for atmospheric models which are able to quantitatively reproduce line profile variations found in observed spectra of pulsating late-type giants. Models describing pulsation-enhanced dust-driven winds were used to compute synthetic spectra under the assumptions of chemical equilibrium and LTE and by solving the radiative transfer in spherical geometry including velocity effects. Radial velocities derived from Doppler-shifted synthetic line profiles provide information on the gas velocities in the line-forming region of the spectral features. On the basis of dynamic models we investigated in detail the finding that various molecular features in AGB spectra originate at different geometrical depths of the very extended atmospheres. We show that the models are able to quantitatively reproduce the characteristic line profile variations of lines sampling the deep photosphere. The global velocity fields of typical LPVs are also realistically reproduced. Possible reasons for discrepancies concerning other modelling results are outlined. In addition, we present a model showing variations of CO $\Delta v = 3$ line profiles comparable to observed spectra of SRVs and discuss that the non-occurence of line doubling in these objects may be due to a density effect. The results of our line profile modelling are another indication that the dynamic models studied here are approaching a realistic representation of the outer layers of AGB stars with or without mass loss.

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Is dust forming on the Red Giant Branch in 47 Tuc?

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Using *Spitzer* IRAC observations from the SAGE–SMC Legacy program and archived *Spitzer* IRAC data, we investigate dust production in 47 Tuc, a nearby massive Galactic globular cluster. A previous study detected infrared excess, indicative of circumstellar dust, in a large population of stars in 47 Tuc, spanning the entire Red Giant Branch (RGB). We show that those results suffered from effects caused by stellar blending and imaging artifacts and that it is likely that no stars below about 1 mag from the tip of the RGB are producing dust. The only stars that appear to harbor dust are variable stars, which are also the coolest and most luminous stars in the cluster.

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The astrosphere of the asymptotic Giant Branch star IRC+10 216

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We have discovered a very extended shock structure (i.e., with a diameter of about 24′) surrounding the well-known carbon star IRC+10 216 in ultraviolet images taken with the GALEX satellite. We conclude that this structure results from the interaction of IRC+10 216's molecular wind with the interstellar medium (ISM), as it moves through the latter. All important structural features expected from theoretical models of such interactions are identified: the termination shock, the astrosheath, the astropause, the bowshock, and an astrotail (with vortices). The extent of the astropause provides new lower limits to the envelope age (69,000 years) and mass (1.4 $M_\odot$, for a mass-loss rate of 2×10^{-5} $M_\odot$ yr^{-1}). From the termination-shock standoff distance, we find that IRC+10 216 is moving at a speed of about $\gtrsim$91 km s^{-1} (1 $cm^{-3}/n_{ISM})^{1/2}$ through the local ISM.

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Observational study of the multistructured Planetary Nebula NGC 7354

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We present an observational study of the planetary nebula (PN) NGC 7354 consisting of narrow band Hα and

[N II]λ6584 imaging as well as low and high dispersion long-slit spectroscopy and VLA-D radio continuum. According to our imaging and spectroscopic data, NGC 7354 has four main structures: a quite round outer shell and an elliptical inner shell, a collection of low-excitation bright knots roughly concentrated on the equatorial region of the nebula and two asymmetrical jet-like features, not aligned neither with the shells axes, nor with each other. We have obtained physical parameters like electron temperature and electron density as well as ionic and elemental abundances for these different structures. Electron temperature and electron density slightly vary throughout the nebula going from $\simeq 11,000$ to $\simeq 14,000$ K, and from $\simeq 1000$ to $\simeq 3000$ cm^{-3}, respectively. The local extinction coefficient $c_{H\beta}$ shows an increasing gradient from South to North and a decreasing gradient from East to West consistent with the number of equatorial bright knots present in each direction. Abundance values show slight internal variations but most of them are within the estimated uncertainties. In general, abundance values are in good agreement with the ones expected for PNe. Radio continuum data are consistent with optically thin thermal emission. Mean physical parameters derived from the radio emission are electron density $n_e = 710$ cm^{-3} and M(H II)$= 0.22$ M$_\odot$.
We have used the interactive three-dimensional modeling tool SHAPE to reproduce the observed morphokinematic structures in NGC 7354 with different geometrical components. Our observations and model show evidence that the outer shell is moving faster ($\simeq 35$ km s^{-1}) than the inner one $\simeq 30$ km s^{-1}. Our SHAPE model includes several small spheres placed on the outer shell wall to reproduce to equatorial bright knots. Observed and modeled velocity for these spheres lies between the inner and outer shells velocity values. The two jet-like features were modeled as two thin cylinders moving at a radial velocity of $\simeq 60$ km s^{-1}. In general, our SHAPE model is in very good agreement with our imaging and spectroscopic observations. Finally, after modeling NGC 7354 with SHAPE, we suggest a possible scenario for the formation of the nebula.

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Three carbon-enhanced metal-poor dwarf stars from the SDSS — Chemical abundances from CO5BOLD 3D hydrodynamical model atmospheres

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The origin of carbon-enhanced metal-poor stars enriched with both s and r elements is highly debated. Detailed abundances of these types of stars are crucial to understand the nature of their progenitors. The aim of this investigation is to study in detail the abundances of SDSS J1349−0229, SDSS J0912+0216 and SDSS J1036+1212, three dwarf CEMP stars, selected from the Sloan Digital Sky Survey. Using high resolution VLT/UVES spectra ($R \sim 30\,000$) we determine abundances for Li, C, N, O, Na, Mg, Al, Ca, Sc, Ti, Cr, Mn, Fe, Co, Ni and 21 neutron-capture elements. We made use of CO5BOLD 3D hydrodynamical model atmospheres in the analysis of the carbon, nitrogen and oxygen abundances. NLTE corrections for C I and O I lines were computed using the Kiel code. We classify SDSS J1349−0229 and SDSS J0912+0216 as CEMP-r+s stars. SDSS J1036+1212 belongs to the class CEMP-no/s, with enhanced Ba, but deficient Sr, of which it is the third member discovered to date. Radial-velocity variations have been observed in SDSS J1349−0229, providing evidence that it is a member of a binary system. The chemical composition of the three stars is generally compatible with mass transfer from an AGB companion. However, many details remain difficult to explain. Most notably of those are the abundance of Li at the level of the Spite plateau in SDSS J1036+1212 and the large over-abundance of the pure r-process element Eu in all three stars.

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The heavily polluted atmosphere of the DAZ white dwarf GALEX J193156.8+011745

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We report on the discovery of a new heavily polluted white dwarf. The DAZ white dwarf GALEX J193156.8+011745 was identified in a joint *GALEX*/GSC survey of ultraviolet-excess objects. Optical spectra obtained at ESO NTT show strong absorption lines of magnesium and silicon and a detailed abundance analysis based on VLT-Kueyen UVES spectra reveal super-solar abundances of silicon and magnesium, and near-solar abundances of oxygen, calcium, and iron. The overall abundance pattern bears the signature of ongoing accretion onto the white dwarf atmosphere. The infrared spectral energy distribution shows an excess in the H and K bands likely associated with the accretion source.

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Bolometric correction and spectral energy distribution of cool stars in Galactic clusters

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In this work we have investigated the relevant trend of the bolometric correction (BC) at the cool-temperature regime of red giant stars and its possible dependence on stellar metallicity. Our analysis relies on a wide sample of optical-infrared spectroscopic observations, along the 3500 Å $\Rightarrow$ 2.5 μm wavelength range, for a grid of 92 red giant stars in five (3 globular + 2 open) Galactic clusters, along the full metallicity range covered by the bulk of the stars, $-2.2 \leq$ [Fe/H] $\leq +0.4$.

Synthetic BVR_cI_cJHK photometry from the derived spectral energy distributions allowed us to obtain robust temperature (T_{eff}) estimates for each star, within $\pm$100 K or less. According to the appropriate temperature estimate, black-body extrapolation of the observed spectral energy distribution (SED) allowed us to assess the unsampled flux beyond the wavelength limits of our survey. For the bulk of our red giants, this fraction amounted to 15% of the total bolometric luminosity, a figure that raises up to 30% for the coolest targets ($T_{eff} \lesssim 3500$ K). Allover, we trust to infer stellar M_{bol} values with an internal accuracy of a few percent. Even neglecting any correction for lost luminosity etc. we would be overestimating M_{bol} by $\lesssim$0.3 mag, in the worst cases. Making use of our new database, we provide a set of fitting functions for the V and K BC vs. T_{eff} and vs. $(B-V)$ and $(V-K)$ broad-band colors, valid over the interval $3300 \leq T_{eff} \leq 5000$ K, especially suited for Red Giants.

The analysis of the BC_V and BC_K estimates along the wide range of metallicity spanned by our stellar sample show no evident drift with [Fe/H]. Things may be different for the B-band correction, where the blanketing effects are more and more severe. A drift of $\Delta(B-V)$ vs. [Fe/H] is in fact clearly evident from our data, with metal-poor stars displaying a "bluer" $(B-V)$ with respect to the metal-rich sample, for fixed T_{eff}.

Our empirical bolometric corrections are in good overall agreement with most of the existing theoretical and observational determinations, supporting the conclusion that (a) BC_K from the most recent studies are reliable within $\lesssim \pm 0.1$ over the whole color/temperature range considered in this paper, and (b) the same conclusion apply to BC_V only for stars warmer than $\simeq$ 3800 K. At cooler temperatures the agreement is less general, and MARCS models are the only ones providing a satisfactory match to observations, in particular in the BC_V vs. $(B-V)$ plane.

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Does GD 356 have a Terrestrial Planetary Companion?

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GD 356 is unique among magnetic white dwarfs because it shows Zeeman-split Balmer lines in pure emission. The lines originate from a region of nearly uniform field strength ($\delta B/B \approx 0.1$) that covers 10 per cent of the stellar surface in which there is a temperature inversion. The energy source that heats the photosphere remains a mystery but it is likely to be associated with the presence of a companion. Based on current models we use archival *Spitzer* IRAC observations to place a new and stringent upper limit of 12 $M_{jupiter}$ for the mass of such a companion. In the light of this result and the recent discovery of a 115 min photometric period for GD 356, we exclude previous models that invoke accretion and revisit the unipolar inductor model that has been proposed for this system. In this model a highly conducting planet with a metallic core orbits the magnetic white dwarf and, as it cuts through field lines, a current is set flowing between the two bodies. This current dissipates in the photosphere of the white dwarf and causes a temperature inversion. Such a planet is unlikely to have survived the RGB/AGB phases of evolution so we argue that it may have formed from the circumstellar disc of a disrupted He or CO core during a rare merger of two white dwarfs. GD 356 would then be a white dwarf counterpart of the millisecond binary pulsar PSR 1257+12 which is known to host a planetary system.

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Rapid dust production in submillimeter galaxies at $z > 4$?

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The existence of submillimeter-selected galaxies (SMGs) at redshifts $z > 4$ has recently been confirmed. Using simultaneously all the available data from UV to radio we have modelled the spectral energy distributions of the six known spectroscopically confirmed SMGs at $z > 4$. We find that their star formation rates (average ~ 2500 $M_\odot$ yr^{-1}), stellar ($\sim 3.6 \times 10^{11}$ $M_\odot$) and dust ($\sim 6.7 \times 10^8$ $M_\odot$) masses, extinction ($A_V \sim 2.2$ mag) and gas-to-dust ratios (~ 60) are within the ranges for $1.7 < z < 3.6$ SMGs. Our analysis suggests that infrared-to-radio luminosity ratios of SMGs do not change up to redshift ~ 5 and are lower by a factor of ~ 2.1 than the value corresponding to the local IR-radio correlation. However, we also find dissimilarities between $z > 4$ and lower-redshift SMGs. Those at $z > 4$ tend to be among the most star-forming, least massive and hottest (~ 60 K) SMGs and exhibit the highest fraction of stellar mass formed in the ongoing starburst ($\sim 45\%$). This indicates that at $z > 4$ we see earlier stages of evolution of submillimeter-bright galaxies. Using the derived properties for $z > 4$ SMGs we investigate the origin of dust at epochs less than 1.5 Gyr after the Big Bang. This is significant to our understanding of the evolution of the early Universe. For three $z > 4$ SMGs asymptotic giant branch stars could be the dominant dust producers. However, for the remaining three only supernovae are efficient and fast enough to be responsible for dust production, though requiring a very high dust yield per supernova (0.15–0.65 $M_\odot$). The required dust yields are lower if a top-heavy initial mass function or significant dust growth in the interstellar medium are assumed. We estimate lower limits of the contribution of SMGs to the cosmic star formation and stellar mass densities at $z \sim 4$–5 to be $\sim 4\%$ and $\sim 1\%$, respectively.

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α Element abundances in a large sample of Galactic Planetary Nebulae

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In this paper, we present emission line strengths, abundances, and element ratios (X/O for Ne, S, Cl, and Ar) for a sample of 38 Galactic disk planetary nebulae (PNe) consisting primarily of Peimbert classification Type I. Spectrophotometry for these PNe incorporates an extended optical/near-IR range of $\lambda\lambda$3600–9600 Å including the [S III] lines at 9069 Å and 9532 Å, setting this relatively large sample apart from typical spectral coverage. We have utilized Emission Line Spectrum Analyzer, a five-level atom abundance routine, to determine T_e, N_e, ionization correction factors, and total element abundances, thereby continuing our work toward a uniformly processed set of data. With a compilation of data from $>$ 120 Milky Way PNe, we present results from our most recent analysis of abundance patterns in Galactic disk PNe. With a wide range of metallicities, galactocentric distances, and both Type I and non-Type I objects, we have examined the α elements against H II regions and blue compact galaxies (H2BCGs) to discern signatures of depletion or enhancement in PNe progenitor stars, particularly the destruction or production of O and Ne. We present evidence that many PNe have higher Ne/O and lower Ar/Ne ratios compared to H2BCGs within the range of 8.5–9.0 for $12 + \log(O/H)$. This suggests that Ne is being synthesized in the low- and intermediate-mass progenitors. Sulfur abundances in PNe continue to show great scatter and are systematically lower than those found in H2BCG at a given metallicity. Although we find that PNe do show some distinction in α elements when compared to H2BCG, within the Peimbert classification types studied, PNe do not show significant differences in α elements amongst themselves, at least to an extent that would distinguish in situ nucleosynthesis from the observed dispersion in abundance ratios.

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Infrared photometry and evolution of mass-losing AGB stars. III. Mass-loss rates of MS and S stars

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Context. The asymptotic giant branch (AGB) phase marks the end of the evolution for low- and intermediate-mass stars, which are fundamental contributors to the mass return to the interstellar medium and to the chemical evolution of galaxies. The detailed understanding of mass-loss processes is hampered by the poor knowledge of the luminosities and distances of AGB stars. Aims. In a series of papers we are trying to establish criteria permitting a more quantitative determination of luminosities for the various types of AGB stars, using the infrared (IR) fluxes as a basis. An updated compilation of the mass loss rates is also required, as it is crucial in our studies of the evolutionary properties of these stars. In this paper we concentrate our analysis on the study of the mass-loss rates for a sample of galactic S stars.
Methods. We reanalyze the properties of the stellar winds for a sample of galactic MS, S, SC stars with reliable estimates of the distance on the basis of criteria previously determined. We then compare the resulting mass loss rates with those previously obtained for a sample of C-rich AGB stars.
Results. Stellar winds in S stars are on average less efficient than those of C-rich AGB stars of the same luminosity. Near-to-mid infrared colors appear to be crucial in our analysis. They show a good correlation with mass loss rates in particular for the Mira stars. We suggest that the relations between the rates of the stellar winds and both the near-to-mid infrared colors and the periods of variability improve the understanding of the late evolutionary stages of low mass stars and could be the origin of the relation between the rates of the stellar winds and the bolometric magnitudes.

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Gas phase atomic metals in the circumstellar envelope of IRC+10 216

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We report the results of a search for gas phase atomic metals in the circumstellar envelope of the asymptotic giant branch carbon star IRC+10 216. The search was made using high resolution ($\lambda/\Delta\lambda = 50\,000$) optical absorption spectroscopy of a background star that probes the envelope on a line of sight 35″ from the center. The metal species that we detect in the envelope include Na I, K I, Ca I, Ca II, Cr I, and Fe I, with upper limits for Al I, Mn I, Ti I, Ti II, and Sr II. The observations are used to determine the metal abundances in the gas phase and the condensation onto grains. The metal depletions in the envelope range from a factor of 5 for Na to 300 for Ca, with some similarity to the depletion pattern in interstellar clouds. Our results directly constrain the condensation efficiency of metals in a carbon-rich circumstellar envelope and the mix of solid and gas phase metals returned by the star to the interstellar medium. The abundances of the uncondensed metal atoms that we observe are typically larger than the abundances of the metal-bearing molecules detected in the envelope. The metal atoms are therefore the major metal species in the gas phase and likely play a key role in the metal chemistry.

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Available from arXiv:1002.3554

P3D: a general data-reduction tool for fiber-fed integral-field spectrographs

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The reduction of integral-field spectrograph (IFS) data is demanding work. Many repetitive operations are required in order to convert raw data into, typically a large number of, spectra. This effort can be markedly simplified through the use of a tool or pipeline, which is designed to complete many of the repetitive operations without human interaction. Here we present our semi-automatic data-reduction tool P3D that is designed to be used with fiber-fed IFSs. Important components of P3D include a novel algorithm for automatic finding and tracing of spectra on the detector, and two methods of optimal spectrum extraction in addition to standard aperture extraction. P3D also provides tools to combine several images, perform wavelength calibration and flat field data. P3D is at the moment configured for four IFSs. In order to evaluate its performance we have tested the different components of the tool. For these tests we used both simulated and observational data. We demonstrate that for three of the IFSs a correction for so-called cross-talk due to overlapping spectra on the detector is required. Without such a correction spectra will be inaccurate, in particular if there is a significant intensity gradient across the object. Our tests showed that P3D is able to produce accurate results. P3D is a highly general and freely available tool. It is easily extended to include improved algorithms, new visualization tools and support for additional instruments. The program code can be downloaded from the P3D-project web site http://p3d.sourceforge.net.

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Available from arXiv:1002.4406
and from http://p3d.sourceforge.net

High-resolution HST/ACS images of detached shells around carbon stars

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Context: Overall spherically symmetric, geometrically thin gas and dust shells have been found around a handful of AGB carbon stars. Their dynamical ages lie in the range 10^3 to 10^4 years. A tentative explanation for their existence is that they have formed as a consequence of mass-loss-rate modulations during a He-shell flash.
Aims: The detached shells carry information on their formation process, as well as on the small-scale structure of the circumstellar medium around AGB stars due to the absence of significant line-of-sight confusion.
Methods: The youngest detached shells, those around the carbon stars R Scl and U Cam, are here studied in great detail in scattered stellar light using the Advanced Survey Camera on the *Hubble Space Telescope*. Quantitative results are derived assuming optically thin dust scattering.
Results: The detached dust shells around R Scl and U Cam are found to be consistent with an overall spherical symmetry. They have radii of 19.2″ (corresponding to a linear size of 8×10^{16} cm) and 7.7″ ($5{\times}10^{16}$ cm), widths of 1.2″ ($5{\times}10^{15}$ cm) and 0.6″ ($4{\times}10^{15}$ cm), and dust masses of 3×10^{-6} and 3×10^{-7} $M_\odot$, respectively. The dynamical ages of the R Scl and U Cam shells are estimated to be 1700 and 700 yr, respectively, and the shell widths correspond to time scales of 100 and 50 yr, respectively. Small-scale structure in the form of less than arcsec-sized clumps is clearly seen in the images of the R Scl shell. Average clump dust masses are estimated to be about 2×10^{-9} $M_\odot$. Comparisons with CO line interferometer data show that the dust and gas shells coincide spatially, within the errors ($\leq 1''$ for U Cam and $\approx 2''$ for R Scl).
Conclusions: The results are consistent with the interpretation of geometrically thin gas and dust shells formed by a mass-loss eruption during a He-shell flash, and where interaction with a previous wind also plays a role. The mass loss responsible for the shells must have been remarkably isotropic, and, if wind interaction plays a role, this applies also to the mass loss prior to the eruption. Clumpy structure is present in the R Scl shell, possibly as a consequence of the mass loss itself, but more likely as a consequence of instabilities in the expanding shell.

Accepted for publication in Astronomy and Astrophysics

Galactic bulge giants: probing stellar and galactic evolution I. Catalogue of *Spitzer* IRAC and MIPS sources

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Aims: We aim at measuring mass-loss rates and the luminosities of a statistically large sample of Galactic bulge stars at several galactocentric radii. The sensitivity of previous infrared surveys of the bulge has been rather limited, thus fundamental questions for late stellar evolution, such as the stage at which substantial mass-loss begins on the red giant branch and its dependence on fundamental stellar properties, remain unanswered. We aim at providing evidence and answers to these questions.
Methods: To this end, we observed seven 15×15 arcmin^2 fields in the nuclear bulge and its vicinity with unprecedented sensitivity using the IRAC and MIPS imaging instruments on-board the *Spitzer Space Telescope*. In each of the fields, tens of thousands of point sources were detected.

Results: In the first paper based on this data set, we present the observations, data reduction, the final catalogue of sources, and a detailed comparison to previous mid-IR surveys of the Galactic bulge, as well as to theoretical isochrones. We find in general good agreement with other surveys and the isochrones, supporting the high quality of our catalogue.

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Available from arXiv:1002.5015
and from ftp://ftp.ster.kuleuven.be/dist/stefan/Spitzer/

Conference Paper

Sub-arcsecond morphology of Planetary Nebulae

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[3]Instituto de Astronomía y Meteorología, Guadalajara, México

Planetary nebulae (PNe) can be roughly categorized into several broad morphological classes. The high quality images of PNe acquired in recent years, however, have revealed a wealth of fine structures that preclude simplistic models for their formation. Here we present narrow-band, sub-arcsecond images of a sample of relatively large PNe that illustrate the complexity and variety of small-scale structures. This is especially true for bipolar PNe, for which the images reveal multi-polar ejections and, in some cases, suggest turbulent gas motions. Our images also reveal the presence or signs of jet-like outflows in several objects in which this kind of component has not been previously reported.

Oral contribution, published in "Legacies of the Macquarie/AAO/Strasbourg Hα Planetary Nebula Project", PASA (refereed)
Available from arXiv:1002.3249

Thesis

Asymptotic Giant Branch stars viewed up-close and far-off: The physics, chemistry, and evolution of their circumstellar envelopes

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The asymptotic giant branch (AGB) is the last stage of stellar evolution for stars with masses between ≈ 0.8–8 $M_\odot$. This phase is characterised by an intense mass loss, which builds up a circumstellar envelope (CSE) of dust and gas. It is through this process that the AGB stars contribute to the chemical evolution of galaxies. In addition, a rich and varied chemistry is active within the CSEs.

Observations of circumstellar H_2O are of particular interest, as it is expected to be one of the most abundant molecules in the inner envelopes of M-type AGB stars (with C/O < 1). The first part of this thesis concerns the modelling of water vapour emission lines from CSEs around M-type AGB stars. Using satellite observations and detailed radiative transfer models, H_2O abundances in these stars are determined and compared with theoretical chemical models. The importance of resolved H_2O line profiles and excitation through different vibrationally excited states are also demonstrated.

The second part of the thesis has its focus on the detached shells of dust and gas observed around a handful of carbon AGB stars (with C/O > 1), believed to be an effect of highly time-variable mass loss during a thermal pulse. The detached shells around three sources were observed in stellar light scattered by dust and gas in the shells using ground-based and spaceborne telescopes. The observations allow a separation of the scattering agents, and reveal information on the detached shells in unprecedented detail.

Defended and passed in Stockholm on January 18, 2010

Job Adverts

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5 year "Senior" Postdoctoral Positions in Spain: "Ramon y Cajal" programme

These are 5-year tenure-track contracts that, after an evaluation at the 4^{th} year, are open as permanent positions.

The selection is based on the merits of the candidates who are expected to bring her/his own research projects. Financial support for the research project is also offered. Last year successful candidates had a minimum of 20 publications in the best refereed journals in the field.

ELIGIBILITY:
PhD degree obtained after March 2, 2000.

HOW TO APPLY:
Click here (deadline March 2, 2010):

http://www.micinn.es/portal/site/MICINN/menuitem.791459a43fdf738d70fd325001432ea0/?vgnextoid=
b60f242046c26210VgnVCM1000001d04140aRCRD&vgnextchannel=48a9282978ea0210VgnVCM1000001034e20aRCRD
&vgnextfmt=formato2&id3=1cbf980767d26210VgnVCM1000001d04140a____

Our "Stellar Evolution and Nucleosynthesis Group" at the University of Granada is seeking for candidates !!

http://www.ugr.es/%7Efteorica/festelar/estelar.html

In case you are interested in applying for the "Ramon y Cajal" contracts, contact us as soon as possible, the University has to applied for a number of positions specifying research areas and deadline is February 22.

All the Best and Good Luck !!

Inma y Carlos

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Inma Domínguez: inma@ugr.es + 34 958 249062

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Facultad de Ciencias
Universidad de Granada
18071 Granada

See also http://www.micinn.es/portal/site/MICINN/menuitem.791459a43fdf738d70fd325001432ea0/?vgnextoid=
b60f242046c26210VgnVCM1000001d04140aRCRD&vgnextchannel=48a9282978ea0210VgnVCM1000001034e20aRCRD
&vgnextfmt=formato2&id3=1cbf980767d26210VgnVCM1000001d04140a____

3 year postdoc contracts

We offer a 3 year "junior" postdoctoral contract (Juan de la Cierva) within the Project "TWO CHALLENGES IN MODERN STELLAR PHYSICS: SUPERNOVA PROGENITORS AND AGB STARS" (AYA2008-04211-C02-02).

The selected candidate will be part of our research team at the "Departamento de Física Teórica y del Cosmos", Universidad de Granada, Granada, Spain.

ELIGIBILITY:
PhD obtained after September 1st, 2006.

HOW TO APPLY:
Click here (deadline March 4th 2010):

http://www.micinn.es/portal/site/MICINN/menuitem.791459a43fdf738d70fd325001432ea0/?vgnextoid=f900759903236210VgnVCM1000001d04140aRCRD&vgnextchannel=76c9282978ea0210VgnVCM1000001034e20aRCRD&vgnextfmt=formato2&id3=39a5759903236210VgnVCM1000001d04140a____&lang_choosen=en

Documents needed:

1. Passport copy
2. CV of our team and of the PI
3. CV of the candidate
4. Project to be developed
5. Copy of PhD certificate of the candidate

Interested candidates, please contact as soon as possible:

Carlos Abia: cabia@ugr.es + 34 958 249061
Inma Domínguez: inma@ugr.es + 34 958 249062

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See also http://www.micinn.es/portal/site/MICINN/menuitem.791459a43fdf738d70fd325001432ea0/?vgnextoid=f900759903236210VgnVCM1000001d04140aRCRD&vgnextchannel=76c9282978ea0210VgnVCM1000001034e20aRCRD&vgnextfmt=formato2&id3=39a5759903236210VgnVCM1000001d04140a____&lang_choosen=en

Postdoctoral position in single and binary star evolution

The Institute of Astronomy and Astrophysics (IAA — ULB, Brussels) is opening a postdoctoral position for a period up to 36 months within the Coordinated Research Action project entitled: "Heavy elements in the universe: stellar evolution, nucleosynthesis and abundance determinations" (http://www.astro.ulb.ac.be/ARC/)

ELIGIBILITY:
At the time of engagement, the applicant must have obtained his/her PhD no more than 8 years ago. The net salary will be in the range 2000–2300 euros/month depending on the age and experience of the applicant.

PROFILE:
Preference will be given to candidates with expertise in stellar evolution, binary evolution, modelling of binary interactions and/or hydrodynamical simulations.

THE INSTITUTE:
The successful candidate will be working in a stimulating environment with local experts in stellar evolution, nucleosynthesis, spectroscopy, hydrodynamics, nuclear physics and binary stars (http://www-astro.ulb.ac.be/).

HOW TO APPLY:
Interested candidates should send a CV, publication list, description of research interest, and two letters of recommendation to Prof. Alain Jorissen (ajorisse@astro.ulb.ac.be). The position can start as early as April 1st 2010 and will remain open until it is filled.

See also http://www-astro.ulb.ac.be/

Announcements

Fizeau exchange visitors program in optical interferometry: Deadline March 15

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff).

The deadline for applications is the 15th March for visits starting 1st of May.

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

The program is funded by OPTICON/FP7.

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

See also www.european-interferometry.eu

UK ALMA Regional Centre (Manchester) Forthcoming events

ALMA Science in Galaxies 29 – 30 March 2010
http://www.alma.ac.uk/events/galactic-science-2010

The first call for ALMA proposals is expected within a year, for mm/sub-mm interferometry observations in 2011 with a subset of the full capabilities. This two-day meeting will discuss ALMA's potential for research in the local Universe. Invited speakers including van Loon (Stellar winds), Harper (Evolved stars), Richer (Star formation), Forgan (Simulations), Caselli (Chemistry), Greaves (Discs and planets), Aalto (Galaxies) and Eckart (Galactic Centre).

CASA workshop 31 March – 01 April 2010
http://www.alma.ac.uk/events/manchester-casa-2010

A hands-on introduction to the software package developed for ALMA and the EVLA, useful for any radio interferometry data.

See also http://www.alma.ac.uk/events/galactic-science-2010
http://www.alma.ac.uk/events/manchester-casa-2010