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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 208$^{\rm th}$ issue of the AGB Newsletter. The variety of topics is, as usual, enormous, though post-AGB phases feature prominently, as does R Scuti this time.

Don't miss the announcements of the Olivier Chesneau Prize, and of three workshops to keep you busy and entertained over the course of May–July next year.

We look forward to receiving your reactions to this month's *Food for Thought* (see below)!

The next issue is planned to be distributed around the 1$^{\rm st}$ of December.

Editorially Yours,
Jacco van Loon, Ambra Nanni and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

What is your favourite AGB star, RSG, post-AGB object, post-RSG or PN? And why?

Reactions to this statement or suggestions for next month's statement can be e-mailed to astro.agbnews@keele.ac.uk (please state whether you wish to remain anonymous)

Refereed Journal Papers

Evolutionary status of the active star PZ Mon

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We use original spectra and available photometric data to recover parameters of the stellar atmosphere of PZ Mon, formerly referred as an active red dwarf. The derived effective temperature $T_{\rm eff} = 4700$ K and gravity $\log g = 2.8$ suggest that PZ Mon is a K2 III giant. Stellar atmosphere parameters ($T_{\rm eff}$ and $\log g$) alongside with the evolutionary tracks are used to estimate the stellar mass of ≈ 1.5 $M_\odot$ and the radius of ≈ 7.7 $R_\odot$. The angular radius derived by the infrared flux method when combined with the linear radius suggests the distance of 250 ± 70 pc, a factor 2.5 smaller than that suggested by the *Hipparcos* parallax. The red giant status of PZ Mon is confirmed by the carbon and nitrogen abundance. The spectrum reveals pronounced He I 5876 Å absorption and Hα emission indicating the robust chromosphere. The IUE spectrum is found to contain transition layer emission line of C IV 1550 Å. The C IV and X-ray luminosities turn out typical of RS CVn stars. The extended set of available photometric data confirms the period of 34.14 days presumably related to the stellar rotation. We found variations of the radial velocity with the amplitude of ≈ 8 km s^{-1} which could be caused by the orbital motion.

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Line lists for the $A^2\Pi$-$X^2\Sigma^+$ (red) and $B^2\Sigma^+$-$X^2\Sigma^+$ (violet) systems of CN, $^{13}C^{14}N$, and $^{12}C^{15}N$, and application to astronomical spectra

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New red and violet system line lists for the CN isotopologues $^{13}C^{14}N$ and $^{12}C^{15}N$ have been generated. These new transition data are combined with those previously derived for $^{12}C^{14}N$, and applied to the determination of CNO abundances in the solar photosphere and in four red giant stars: Arcturus, the bright very low-metallicity star HD 122563, and carbon-enhanced metal-poor stars HD 196944 and HD 201626. When lines of both red and violet system lines are detectable in a star, their derived N abundances are in good agreement. The mean N abundances determined in this work generally are also in accord with published values.

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Available from arXiv:1408.3828
and from http://stacks.iop.org/0067-0049/214/26

On the asymptotic acoustic-mode phase in red-giant stars and its dependence on evolutionary state

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Asteroseismic investigations based on the wealth of data now available, in particular from the CoRoT and *Kepler* missions, require a good understanding of the relation between the observed quantities and the properties of the underlying stellar structure. Kallinger et al. (2012) found a relation between their determination of the asymptotic phase of radial oscillations in evolved stars and the evolutionary state, separating ascending-branch red giants from helium-burning stars in the 'red clump'. Here we provide a detailed analysis of this relation, which is found to derive from differences between these two classes of stars in the thermodynamic state of the convective envelope. There is potential for distinguishing red giants and clump stars based on the phase determined from observations that are too short to allow distinction based on determination of the period spacing for mixed modes. The analysis of the phase may also point to a better understanding of the potential for using the helium-ionization-induced acoustic glitch to determine the helium abundance in the envelopes of these stars.

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Properties of the CO and H_2O MOLsphere of the red supergiant Betelgeuse from VLTI/AMBER observations

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Context: Betelgeuse is the closest red supergiant (RSG); therefore, it is well suited for studying the complex processes in its atmosphere that lead to the chemical enrichment of the interstellar medium.
Aims: We intend to investigate the shape and composition of the close molecular layer (also known as the MOLsphere) that surrounds the star. This analysis is part of a wider program that aims at understanding the dynamics of the circumstellar envelope of Betelgeuse.
Methods: On January and February 2011, Betelgeuse was observed using the Astronomical Multi-BEam combineR (AMBER) instrument of the Very Large Telescope Interferometer (VLTI) in the H and K bands. Using the medium spectral resolution of the instrument ($R \sim 1500$), we were able to investigate the carbon monoxide band heads and the water-vapor bands. We used two different approaches to analyse our data: a model fit in both the continuum and absorption lines and then a fit with a Radiative HydroDynamics (RHD) simulation.
Results: Using the continuum data, we derive a uniform disk diameter of 41.01 ± 0.41 mas, a power law type limb-darkened disk diameter of 42.28 ± 0.43 mas and a limb-darkening exponent of 0.155 ± 0.009. Within the absorption lines, using a single layer model, we obtain parameters of the MOLsphere. Using a RHD simulation, we unveil the convection pattern in the visibilities.
Conclusions: We derived a new value of the angular diameter of Betelgeuse in the K band continuum. Our observations in the absorption lines are well reproduced by a molecular layer at 1.2 stellar radii containing both CO and H_2O. The visibilities at higher spatial frequencies are matching a convection pattern in a RHD simulation.

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The physical structure of planetary nebulae around sdO stars: Abell 36, DeHt 2, and RWT 152

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We present narrow-band Hα and [O III] images, and high-resolution, long-slit spectra of the planetary nebulæ (PNe) Abell 36, DeHt 2, and RWT 152 aimed at studying their morphology and internal kinematics. These data are complemented with intermediate-resolution, long-slit spectra to describe the spectral properties of the central stars and nebulae. The morphokinematical analysis shows that Abell 36 consists of an inner spheroid and two bright point-symmetric arcs; DeHt 2 is elliptical with protruding polar regions and a bright non-equatorial ring; and RWT 152 is bipolar. The formation of Abell 36 and DeHt 2 requires several ejection events including collimated bipolar outflows that probably are younger than and have disrupted the main shell. The nebular spectra of the three PNe show a high excitation and also suggest a possible deficiency in heavy elements in DeHt 2 and RWT 152. The spectra of the central stars strongly suggest an sdO nature and their association with PNe points out that they have most probably evolved through the asymptotic giant branch. We analyze general properties of the few known sdOs associated to PNe and find that most of them are relatively or very evolved PNe, show complex morphologies, host binary central stars, and are located at relatively high Galactic latitudes.

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Expansion of hydrogen-poor knots in the born-again planetary nebulæ A 30 and A 78

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We analyze the expansion of hydrogen-poor knots and filaments in the born-again planetary nebulæ A 30 and A 78 based on *Hubble* Space Telescope (HST) images obtained almost 20 yr apart. The proper motion of these features generally increases with distance to the central star, but the fractional expansion decreases, i.e., the expansion is not homologous. As a result, there is not a unique expansion age, which is estimated to be 610–950 yr for A 30 and 600–1140 yr for A 78. The knots and filaments have experienced complex dynamical processes: the current fast stellar wind is mass loaded by the material ablated from the inner knots; the ablated material is then swept up until it shocks the inner edges of the outer, hydrogen-rich nebula. The angular expansion of the outer filaments shows a clear dependence on position angle, indicating that the interaction of the stellar wind with the innermost knots channels the wind along preferred directions. The apparent angular expansion of the innermost knots seems to be dominated by the rocket effect of evaporating gas and by the propagation of the ionization front inside them. Radiation-hydrodynamical simulations show that a single ejection of material followed by a rapid onset of the stellar wind and ionizing flux can reproduce the variety of clumps and filaments at different distances from the central star found in A 30 and A 78.

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Systematic trend of water vapour absorption in red giant atmospheres revealed by high resolution TEXES 12-μm spectra

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The structures of the outer atmospheres of red giants are very complex. The notion of large optically thick molecular spheres around the stars (MOLspheres) has been invoked in order to explain e.g. spectro-interferometric observations. However, high-resolution spectra in the mid-IR do not easily fit into this picture. They rule out any large sphere of water vapour in LTE surrounding red giants. Our aim here is to investigate high-resolution, mid-infrared spectra for a range of red giants, from early-K to mid M. We have recorded 12-μm spectra of 10 well-studied bright red giants, with TEXES on the IRTF. We find that all giants in our study cooler than 4300 K, spanning a range of effective temperatures, show water absorption lines stronger than expected. The strengths of the lines vary smoothly with spectral type. We identify several spectral features in the wavelength region that undoubtedly are formed in the photosphere. From a study of water-line ratios of the stars, we find that the excitation temperatures, in the line-forming regions, are several hundred Kelvin lower than expected from a classical photospheric model. This could either be due to an actually lower temperature structure in the outer regions of the photospheres caused by, for example, extra cooling, or due to non-LTE level populations, affecting the source function and line opacities. We have demonstrated that these diagnostically interesting water lines are a general feature of red giants across spectral types, and we argue for a general explanation of their formation rather than explanations requiring specific properties. Since the water lines are neither weak (filled in by emission) nor appear in emission, as predicted by LTE MOLsphere models in their simplest forms, the evidence for the existence of such large optically-thick, molecular spheres enshrouding the stars is weakened. (abbreviated)

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On the missing second generation AGB stars in NGC 6752

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In recent years the view of Galactic globular clusters as simple stellar populations has changed dramatically, as it is now thought that basically all globular clusters host multiple stellar populations, each with its own chemical abundance pattern and colour–magnitude diagram sequence. Recent spectroscopic observations of asymptotic giant branch stars in the globular cluster NGC 6752 have disclosed a low [Na/Fe] abundance for the whole sample, suggesting that they are all first generation stars, and that all second generation stars fail to reach the AGB in this cluster. A scenario proposed to explain these observations invokes strong mass loss in second-generation horizontal branch stars – all located at the hot side of the blue and extended horizontal branch of this cluster – possibly induced by the metal enhancement associated to radiative levitation. This enhanced mass loss would prevent second generation stars from reaching the asymptotic giant branch phase, thus explaining at the same time the low value of the ratio between horizontal branch and asymptotic giant branch stars (the R_2 parameter) observed in NGC 6752. We have critically discussed this mass-loss scenario, finding that the required mass-loss rates are of the order of 10^{-9} $M_\odot$ yr^{-1}, significantly higher than current theoretical and empirical constraints. By making use of synthetic horizontal branch simulations, we demonstrate that our modelling predicts correctly the R_2 parameter for NGC 6752, without the need to invoke very efficient mass loss during the core He-burning stage. As a test of our stellar models we show that we can reproduce the observed value of R_2 for both M 3, a cluster of approximately the same metallicity and with a redder horizontal branch

morphology, and M 13, a cluster with a horizontal branch very similar to NGC 6752. Our simulations for NGC 6752 horizontal branch predict however the presence of a significant fraction – at the level of $\sim 50\%$ – second generation stars along the cluster asymptotic giant branch. We conclude that there is no simple explanation for the lack of second generation stars in the spectroscopically surveyed sample, although the interplay between mass loss (with low rates) and radiative levitation may play a role in explaining this puzzle.

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The wind of W Hya as seen by *Herschel*. II. The molecular envelope of W Hya

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The evolution of low- and intermediate-mass stars on the asymptotic giant branch (AGB) is mainly controlled by the rate at which these stars lose mass in a stellar wind. Understanding the driving mechanism and strength of the stellar winds of AGB stars and the processes enriching their surfaces with products of nucleosynthesis are paramount to constraining AGB evolution and predicting the chemical evolution of galaxies.
In a previous paper we have constrained the structure of the outflowing envelope of W Hya using spectral lines of the ^{12}CO molecule. Here we broaden this study by including an extensive set of H_2O and ^{28}SiO lines. It is the first time such a comprehensive study is performed for this source. The oxygen isotopic ratios and the ^{28}SiO abundance profile can be connected to the initial stellar mass and to crucial aspects of dust formation at the base of the stellar wind, respectively.
We model the molecular emission observed by the three instruments on board *Herschel* Space Observatory using a state-of-the-art molecular excitation and radiative transfer code. We also account for the dust radiation field in our calculations.
We find an H_2O ortho-to-para ratio of $2.5^{+2.5}_{-1.0}$, consistent with what is expected for an AGB wind. The O^{16}/O^{17} ratio indicates that W Hya has an initial mass of about 1.5 $M_\odot$. Although the ortho- and para-H_2O lines observed by HIFI appear to trace gas of slightly different physical properties, we find that a turbulence velocity of 0.7 ± 0.1 km s^{-1} fits the HIFI lines of both spin isomers and those of ^{28}SiO well.
The modelling of H_2O and ^{28}SiO confirms the properties of the envelope model of W Hya, as derived from ^{12}CO lines, and allows us to constrain the turbulence velocity. The ortho- and para-$H_2^{16}O$ and ^{28}SiO abundances relative to H_2 are $(6^{+3}_{-2}) \times 10^{-4}$, $(3^{+2}_{-1}) \times 10^{-4}$, and $(3.3 \pm 0.8) \times 10^{-5}$, respectively, in agreement with expectations for oxygen-rich AGB outflows. Assuming a solar silicon-to-carbon ratio, the ^{28}SiO line emission model is consistent with about one-third of the silicon atoms being locked up in dust particles.

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Constraining the shaping mechanism of the Red Rectangle through spectro-polarimetry of its central star

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We carried out high-sensitivity spectropolarimetric observations of the central star of the Red Rectangle proto-planetary nebula with the aim of constraining the mechanism that gives its biconical shape. The stellar light of the central binary system is linearly polarised since it is scattered on the dust particles of the nebula. Surprisingly, the linear polarisation in the continuum is aligned with one of the spikes of the biconical outflow. Also, the observed Balmer lines as well as the Ca II K lines are polarised. These observational constraints are used to confirm or reject current theoretical models for the shaping mechanism of the Red Rectangle. We propose that the observed polarisation is very unlikely generated by a uniform biconical stellar wind.
Also, the hypothesis of a precessing jet does not completely match the observations since it will require a jet aperture larger than that of the nebula.

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On the distances of planetary nebulæ

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Past calibrations of statistical distance scales for planetary nebulæ have been problematic, especially with regard to "short" vs. "long" scales. Reconsidering the calibration process naturally involves examining the precision and especially the systematic errors of various distance methods. Here we present a different calibration strategy, new for planetaries, that is anchored by precise trigonometric parallaxes for sixteen central stars published by Harris et al. (2007) of USNO, with four improved by Benedict et al. using the *Hubble* Space Telescope. We show how an internally consistent system of distances might be constructed by testing other methods against those and each other. In such a way systematic errors can be minimized. Several of the older statistical scales have systematic errors that can account for the short-long dichotomy. In addition to scale-factor errors all show signs of radius dependence, i.e. the distance ratio [scale/true] is some function of nebular radius. These systematic errors were introduced by choices of data sets for calibration, by the methodologies used, and by assumptions made about nebular evolution. The statistical scale of Frew and collaborators (2008, 2014) is largely free of these errors, although there may be a radius dependence for the largest objects. One set of spectroscopic parallaxes was found to be consistent with the trigonometric ones while another set underestimates distance consistently by a factor of two, probably because of a calibration difference. "Gravity" distances seem to be overestimated for nearby objects but may be underestimated for distant objects, i.e. distance-dependent. Angular expansion distances appear to be suitable for calibration after correction for astrophysical effects (e.g. Mellema 2004). We find extinction distances to be often unreliable individually though sometimes approximately correct overall (total sample). Comparison of the *Hipparcos* parallaxes (van Leeuwen 2007) for large planetaries with our "best estimate" distances confirms that those parallaxes are overestimated by a factor 2.5, as suggested by Harris et al.'s result for PHL 932. There may be negative implications for *Gaia* parallaxes for these objects. We suggest a possible connection with the much smaller overestimation recently shown for the *Hipparcos* Pleiades parallaxes by Melis et al. (2014).

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First detection of surface magnetic fields in Post-AGB stars: the cases of U Monocerotis and R Scuti

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While several observational investigations have revealed the presence of magnetic fields in the circumstellar envelopes, jets and outflows of post-Asymptotic Giant Branch stars (PAGBs) and planetary nebulæ (PNe), none has clearly demonstrated their presence at the stellar surface. The lack of information on the strength of the surface magnetic fields prevents us from performing any thorough assessment of their dynamic capability (i.e. material mixing, envelope shaping, etc.). We present new high resolution spectropolarimetric (Stokes V) observations of a sample of PAGB stars, realised with the instruments ESPaDOnS and Narval, where we searched for the presence of photospheric magnetic fields. Out of the seven targets investigated the RV Tauri stars U Mon and R Sct display a clear Zeeman signature and return a definite detection after performing a least squares deconvolution (LSD) analysis. The remaining five PAGBs show no significant detection. We derived longitudinal magnetic fields of 10.2 ± 1.7 G for U Mon and 0.6 ± 0.6 G for R Sct. In both cases the Stokes profiles point towards an interaction of the magnetic field with the atmosphere dynamics. This first discovery of weak magnetic fields (e.g., ~ 10 G level) at the stellar surface of PAGB stars opens the door to a better understanding of magnetism in evolved stars.

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Super and massive AGB stars – IV. Final fates – Initial to final mass relation

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We explore the final fates of massive intermediate-mass stars by computing detailed stellar models from the zero age main sequence until near the end of the thermally pulsing phase. These super-AGB and massive AGB star models are in the mass range between 5.0 and 10.0 $M_{\odot}$ for metallicities spanning the range $Z = 0.02$–0.0001. We probe the mass limits M_{up}, M_{n} and M_{mass}, the minimum masses for the onset of carbon burning, the formation of a neutron star, and the iron core-collapse supernovæ respectively, to constrain the white dwarf/electron-capture supernova boundary. We provide a theoretical initial to final mass relation for the massive and ultra-massive white dwarfs and specify the mass range for the occurrence of hybrid CO(Ne) white dwarfs. We predict electron-capture supernova (EC-SN) rates for lower metallicities which are significantly lower than existing values from parametric studies in the literature. We conclude the EC-SN channel (for single stars and with the critical assumption being the choice of mass-loss rate) is very narrow in initial mass, at most approximately 0.2 $M_{\odot}$. This implies that between ~ 2–5 per cent of all gravitational collapse supernovæ are EC-SNe in the metallicity range $Z = 0.02$ to 0.0001. With our choice for mass-loss prescription and computed core growth rates we find, within our metallicity range, that CO cores cannot grow sufficiently massive to undergo a Type 1.5 SN explosion.

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XMM–*Newton* RGS observations of the Cat's Eye Nebula

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We present an analysis of XMM–*Newton* Reflection Grating Spectrometer (RGS) observations of the planetary nebula (PN) NGC 6543, rendering it the second PN with high resolution X-ray spectroscopic observations besides BD +30°3639. The observations consist of 26 pointings, of which 14 included RGS observations for a total integration time of 435 ks. Many of these observations, however, were severely affected by high-background levels, and the net useful exposure time is drastically reduced to 25 ks. Only the O VII triplet at 22 Å is unambiguously detected in the RGS spectrum of NGC 6543. We find this spectrum consistent with an optically thin plasma at 0.147 keV (1.7 MK) and nebular abundances. Unlike the case of BD +30°3639, the X-ray emission from NGC 6543 does not reveal overabundances of C and Ne. The results suggest the N/O ratio of the hot plasma is consistent with that of the stellar wind, i.e., lower than the nebular N/O ratio, but this result is not conclusive.

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NGC 6309, a planetary nebula that shifted from round to multipolar

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We present new narrow-band Hα, [N II], and [O III] high-resolution images of the quadrupolar planetary nebula (PN) NGC 6309 that show in great detail its bipolar lobes and reveal new morphological features. New high- and low-dispersion long-slit spectra have been obtained to help in the investigation of the new nebular components. The images and spectra unveil two diffuse blobs, one of them located at 55″ from the central star along the NE direction ($PA = +71°$) and the other at 78″ in the SW direction ($PA = -151°$). Therefore, these structures do not share the symmetry axes of the inner bipolar outflows. Their radial velocities relative to the system are quite low: +3 and −4 km s^{-1}, respectively. Spectroscopic data confirm a high [O III] to Hα ratio, indicating that the blobs are being excited by the UV flux from the central star. Our images convincingly show a spherical halo 60″ in diameter encircling the quadrupolar nebula. The expansion velocity of this shell is low, < 66 km s^{-1}. To study the formation history of NGC 6309, we have used our new images and spectra, as well as available échelle spectra of the innermost regions, to estimate the kinematical age of each structural component: the software SHAPE has been used to construct a morpho-kinematic model for the ring and the bipolar flows that implies an age of 4,000 yr, the expansion of the halo sets a lower limit for its age $> 46,000$ yr, and the very low expansion of the blobs suggests they are part of a large structure corresponding to a mass ejection that took place 150,000 yr ago. In NGC 6309 we have direct evidence of a change in the geometry of mass loss, from spherical in the halo to axially-symmetric in the two pairs of bipolar lobes.

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Ejection of globular cluster interstellar media through ionization by white dwarfs

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UV radiation from white dwarfs can efficiently clear Galactic globular clusters (GCs) of their intra-cluster medium (ICM). This solves the problem of the missing ICM in clusters, which is otherwise expected to build up to easily observable quantities. To show this, we recreate the ionizing flux in 47 Tuc, following randomly generated stars through their AGB, post-AGB and white dwarf evolution. Each white dwarf can ionize all the material injected into the cluster by stellar winds for ~ 3 Myr of its evolution: ~ 40 such white dwarfs exist at any point. Every GC's ICM should be ionized. The neutral cloud in M 15 should be caused by a temporary overdensity. A pressure-supported ICM will expand over the cluster's tidal radius, where it will be truncated, allowing Jeans escape. The modelled Jeans mass-loss rate approximates the total stellar mass-loss rate, allowing efficient clearing of ICM. Any cluster's ICM mass should equal the mass injected by its stars over the sound-travel time between the cluster core and tidal radius. We predict ~ 11.3 $M_\odot$ of ICM within 47 Tuc, cleared over ~ 4 Myr, compared to a dynamical timescale of 4.3 Myr. We present a new mass hierarchy, discussing the transition between globular clusters dwarf galaxies.

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The wonderful complexity of the Mira AB system

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We have mapped the ^{12}CO(3–2) line emission around the Mira AB system at $0\farcs5$ resolution using the Atacama Large Millimeter/submillimeter Array (ALMA). The CO map shows amazing complexity. The circumstellar gas has been shaped by different dynamical actors during the evolution of the system and several morphological components can be identified. The companion is marginally resolved in continuum emission and is currently at $0\farcs487 \pm 0\farcs006$ separation. In the main line component, centered on the stellar velocity, spiral arcs around Mira A are found. The spiral appears to be relatively flat and oriented in the orbital plane. An accretion wake behind the companion is clearly visible and the projected arc separation is of order $5''$. In the blue wing of the line emission, offset from the main line, several large (~ 5–$10''$), opposing arcs are found. We tentatively suggest that this structure is created by the wind of Mira B blowing a bubble in the expanding envelope of Mira A.

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Spectroscopic observations of the bright RV Tauri variable R Scuti

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A series of spectra of the RV Tauri star R Scuti taken as it rose from a deep minimum to a bright maximum during 2013 October and November reveals major changes taking place in the photosphere and outer atmosphere of the star. This may be the first such series of spectra and demonstrates the capability of amateur spectroscopy for studying these complex stars.

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and from http://www.britastro.org/jbaa/pdf_cut/jbaa_5749.pdf

Wind mass transfer in S-type symbiotic binaries I. Focusing by the wind compression model

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Luminosities of hot components in symbiotic binaries require accretion rates that are higher than those that can be achieved via a standard Bondi–Hoyle accretion. This implies that the wind mass transfer in symbiotic binaries has to be more efficient. We suggest that the accretion rate onto the white dwarfs (WDs) in S-type symbiotic binaries can be enhanced sufficiently by focusing the wind from their slowly rotating normal giants towards the binary orbital plane. We achieved this aim by applying the wind compression model to the stellar wind of slowly rotating red giants in S-type symbiotic binaries. Our analysis reveals that for typical terminal velocities of the giant wind, 20 to 50 km s^{-1}, and measured rotational velocities between 6 and 10 km s^{-1}, the densities of the compressed wind at a typical distance of the accretor from its donor correspond to the mass-loss rate, which can be a factor of ~ 10 higher than for the spherically symmetric wind. This allows the WD to accrete at rates of 10^{-8}–10^{-7} $M_\odot$ yr^{-1}, and thus to power its luminosity. In this way we show that the high wind-mass-transfer efficiency in S-type symbiotic stars can be caused by compression of the wind from their slowly rotating normal giants, whereas in D-type symbiotic stars, the high mass transfer ratio can be achieved via the gravitational focusing, which has recently been suggested for very slow winds in Mira-type binaries.

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Study of the extended radio emission of two supernova remnants and four planetary nebulæ associated to MIPSGAL bubbles

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We present radio observations of two supernova remnants and four planetary nebulæ with the Very Large Array and the Green Bank Telescope. These objects are part of a larger sample of radio sources, discussed in a previous paper, counterpart of the MIPSGAL 24-μm compact bubbles. For the two supernova remnants we combined the

interferometric observations with single-dish data to obtain both a high resolution and a good sensitivity to extended structures. We discuss in detail the entire combination procedure adopted and the reliability of the resulting maps. For one supernova remnant we pose a more stringent upper limit for the flux density of its undetected pulsar, and we also show prominent spectral index spatial variations, probably due to inhomogeneities in the magnetic field and in its ejecta or to an interaction between the supernova shock and molecular clouds. We eventually use the 5-GHz maps of the four planetary nebulæ to estimate their distance and their ionized mass.

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ALMA data suggest the presence of a spiral structure in the inner wind of CW Leo

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Context: Evolved low-mass stars lose a significant fraction of their mass through a stellar wind. While the overall morphology of the stellar wind structure during the Asymptotic Giant Branch (AGB) phase is thought to be roughly spherically symmetric, the morphology changes dramatically during the post-AGB and planetary nebula phase during which often bipolar and multi-polar structures are observed.
Aims: We aim to study the inner wind of the well-known AGB star CW Leo. Different diagnostics probing different geometrical scales have pointed toward a non-homogeneous mass-loss process: dust clumps are observed at milli-arcsec scale, a bipolar structure is seen at arcsecond-scale and multi-concentric shells are detected beyond $1''$.
Methods: We present the first ALMA Cycle 0 band 9 data around 650 GHz. The full-resolution data have a spatial resolution of $0\farcs42 \times 0\farcs24$, allowing us to study the morpho-kinematical structure within $\sim 6''$.
Results: We have detected 25 molecular lines. The emission of all but one line is spatially resolved. The dust and molecular lines are centered around the continuum peak position. The dust emission has an asymmetric distribution with a central peak flux density of ~ 2 Jy. The molecular emission lines trace different regions in the wind acceleration region and suggest that the wind velocity increases rapidly from about 5 $R_\star$ almost reaching the terminal velocity at ~ 11 $R_\star$. The channel maps for the brighter lines show a complex structure; specifically for the ^{13}CO $J = 6$–5 line different arcs are detected within the first few arcseconds. The curved structure present in the PV map of the ^{13}CO $J = 6$–5 line can be explained by a spiral structure in the inner wind, probably induced by a binary companion. From modeling the ALMA data, we deduce that the potential orbital axis for the binary system lies at a position angle of ~ 10–$20°$ to the North–East and that the spiral structure is seen almost edge-on. We infer an orbital period of 55 yr and a binary separation of 25 au (or ~ 8.2 $R_\star$). We tentatively estimate that the companion is an unevolved low-mass main-sequence star.
Conclusions: A scenario of a binary-induced spiral shell can explain the correlated structure seen in the ALMA PV images of CW Leo. Moreover, this scenario can also explain many other observational signatures seen at different spatial scales and in different wavelength regions, such as the bipolar structure and the almost-concentric shells. The ALMA data hence provide us for the first time with the crucial kinematical link between the dust clumps seen at milli-arcsecond scale and the almost concentric arcs seen at arcsecond scale.

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Conference Papers

The very fast evolution of the VLTP object V4334 Sgr

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V4334 Sgr (Sakurai's object) is an enigmatic evolved star that underwent a very late thermal pulse a few years before its discovery in 1996. It ejected a new, hydrogen-deficient nebula in the process. Emission lines from the newly ejected gas were first discovered in 1998 (He I 10830 Å) and 2001 (optical). We have monitored the optical emission spectrum since. From 2001 through 2007 the optical spectrum showed an exponential decline in flux, consistent with a shock that occurred around 1998 and started cooling soon after that. In this paper we show that since 2008 the line fluxes have been continuously rising again. Our preliminary interpretation is that this emission comes from a region close to the central star, and is excited by a second shock. This shock may have been induced by an increase in the stellar mass loss and wind velocity associated with a rise in the stellar temperature.

Oral contribution, published in "19th European White Dwarf Workshop", Montréal, Canada
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Post-asymptotic giant branch evolution of low- and intermediate-mass stars. Preliminary results

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Preliminary results from an ongoing project to compute a grid of post-AGB models are presented. Our preliminary results show that stellar evolution computations that include an updated treatment of the microphysics predict post-AGB timescales that are several times shorter that predicted by older models. Also the mass-luminosity relation of post-AGB models deviates from that of older grids. In addition, our results suggest only a slight metallicity dependence of the post-AGB timescales. We expect these results to have significant consequences for models of the formation of planetary nebulæ and their luminosity function.

Oral contribution, published in "19th European Workshop on White Dwarfs"
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Observations of binaries in AGB, post-AGB stars and planetary nebulæ

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During the last years, many observational studies have revealed that binaries play an active rôle in the shaping of non spherical planetary nebulæ. We review the different works that lead to the direct or indirect evidence for the presence

of binary companions during the Asymptotic Giant Branch, proto-planetary nebula and planetary nebula phases. We also discuss how these binaries can influence the stellar evolution and possible future directions in the field.

Oral contribution, published in "Why Galaxies Care about AGB stars III" (invited review)
Available from arXiv:1410.3692

Announcements

Cloudy Workshop, 2015 May 4–8
Copernicus Astronomical Center, Warsaw, Poland

Registration is now open for the 2015 May Cloudy workshop. It will be held May 4–8 at Nicolaus Copernicus Astronomical Center, Warsaw Poland.

Cloudy is a code that simulates diffuse gaseous environments. It calculates the plasma, chemistry, radiation transport, and dynamics problems simultaneously and self consistently, building from the foundation of individual atomic and molecular processes. The result is a prediction of the conditions in the material and its observed spectrum.

This workshop will cover observation, theory, and application of Cloudy to a wide variety of astronomical environments. This includes the theory of diffuse non-LTE matter and quantitative spectroscopy (the science of using spectra to make physical measurements). We will use Cloudy to simulate such objects as AGB stars, Active Galactic Nuclei, Starburst galaxies, and the intergalactic medium.

The sessions will consist of a mix of textbook study, using Osterbrock & Ferland, Astrophysics of Gaseous Nebulæ and Active Galactic Nuclei, application of the spectral-simulation code Cloudy to a variety of astrophysical problems, and projects organized by the participants. No prior experience with Cloudy is assumed. There is no registration fee and financial support is not available.

See also http://cloud9.pa.uky.edu/∼gary/cloudy/CloudySummerSchool/

Call for nominations for the Olivier Chesneau Prize

In May 2014 Olivier Chesneau, one of the most active and prolific members of the optical interferometry community, passed away at the age of 41. To honour his work in this field, his home institute, the Laboratoire J.-L. Lagrange at the Observatoire de la Cpte d'Azur in France and ESO have established a prize in his memory.

The prize will be awarded every two years, for the first time in 2015, for the best thesis completed by a PhD student in the past two calendar years in the field of high angular resolution optical astronomy at a European institution. This includes adaptive optics, optical interferometry and similar techniques.

More information about the prize can be found here:

https://olivier-chesneau.oca.eu
http://www.eso.org/public/announcements/ann14078/

See also https://olivier-chesneau.oca.eu

The physics of evolved stars: A conference dedicated to the memory of Olivier Chesneau

Nice, June 8–12, 2015

https://olivier-chesneau.oca.eu

First announcement

As a talented scientist, animated with a constant passion for astronomy, Olivier Chesneau led pioneering works using visible and infrared long-baseline interferometry. Olivier used this technique to study disk formation around varied astrophysical objects, such as evolved massive stars, planetary nebulae, and novae. His foremost results include the study of the close environment of η Carinæ and other massive stars, the first direct detection of disks in planetary nebulæ, finding evidences of dust bipolar ejections by novæ shortly after eruption, and the discovery of the largest yellow hypergiant star in the Milky Way. His results were often widely publicized through press releases from ESO and CNRS–INSU. The 2012 Michelson Prize of the International Astronomical Union and of Mount Wilson Institute was awarded to Olivier Chesneau for major contributions in stellar astrophysics made with long-baseline interferometry.

After his untimely departure several months ago, his friends and colleagues in Nice have decided to organize a conference that brings together experts in different fields to study the physics of evolved stars: this was Olivier's approach to tackle outstanding questions about these stars. The conference will concentrate on four different processes in evolved stars: mass loss, binarity, rotation, and astrochemistry (dust formation). Contributions are invited along these themes, from theory and numerical simulations to all observational approaches. Only two invited talks are planned to leave as much room as possible to individual contributions (oral and posters) and discussions.

The conference will be held on June 8–12, 2015, in Nice, France. Pre-registration is open (see instructions at olivier-chesneau.oca.eu) and please submit an abstract (even tentative) during registration. We expect the registration fee to be around 150 euros, and it could be waived for some students. Based on the proposed contributions received by 2014 December 15, a preliminary program will be established by the SOC and announced in early January 2015 with detailed information for registration.

See also https://olivier-chesneau.oca.eu

Stellar End Products: The Low Mass – High Mass Connection

ESO Garching, 6–10 July, 2015

In this workshop, we intend to bring together observers and theorists from the low mass and high mass stellar communities with the goals of:

- understanding the evolved star mass loss process and the injection of energy and matter (enriched in molecules and dust) into the ISM
- comparing Asymptotic Giant Branch and Red Supergiant stars – why are they observationally similar in many ways yet apparently have very different interior stellar structures and their mass loss evolves differently
- determining the roles of magnetic fields, binarity, jets and collimated mass loss, metallicity, initial mass etc. upon stellar evolution and end products – how can almost spherically symmetric stars produce broadly bipolar morphologies over such a large mass loss range?

The meeting will be spread over five days, starting on Monday afternoon and ending on Friday at lunchtime. It will consist of invited and contributed talks, posters and discussion sessions.

See also http://www.eso.org/sci/meetings/2015/STEPS2015.html