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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 137$^{\rm th}$ issue of the AGB Newsletter. There is a lot of work presented on circumstellar molecules, extra-galactic planetary nebulae, and symbiotic stars, but also new results on the initial-final mass relationship around the crucial boundary between AGB stars and red supergiants. And if you always wondered what will a Blue Straggler look like, when evolving up the giant branch, then here's just the paper for you.

Whether you want to gain a Ph.D. or continue postdoctoral research, Bonn is offering you the opportunity to study magnetic fields in evolved stars.

The next issue will be distributed on the 4$^{\rm th}$ of January 2009; the deadline for contributions is the 3$^{\rm rd}$ of January. With our best wishes for the New Year,

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Extra-galactic planetary nebulae are generally used to learn more about their host galaxy — we ought to be able to use these to our advantage, to learn more from them about the late stages of stellar evolution too!

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

High-resolution spectroscopic observations of four yellow-type symbiotic stars: CD-43°14304, Hen 3-1213, Hen 3-863 and StHα 176

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We report on the analysis of high resolution optical spectra of four symbiotic stars CD-43°14304, Hen 3-863, Hen 3-1213 & StHα 176. The chemical composition of the atmosphere of the investigated stars show that they are all metal-poor K giants with metallicities around [Fe/H] ≈ -1.0. All stars show an enrichment of the elements created by slow neutron-capture reactions. The luminosities obtained of the symbiotic star CD-43°14304 and probably for Hen 3-1213 are below those of the asymptotic giant branch (AGB) stars that started helium burning (via thermal pulses) and become self-enriched in the neutron-capture elements. Therefore, their abundance peculiarities are due to mass tranfer from the previous thermally pulsing AGB star (now the white dwarf) overabundant in s-process elements. For the stars Hen 3-863 and StHα 176 the uncertainties due to the distance (and interstellar absorption as well) prevent a safe determination of the lumonosity. The heavy-element abundance distrubution of these four symbiotics analyzed is similar to the three symbiotics previously analyzed (AG Dra, BD-21°3873 and Hen 2-467). Finally, their general abundance pattern follows the halo standard abundance.

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The peculiar molecular envelope around the post-AGB star IRAS 08544−4431

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Circumbinary disks have been hypothesized to exist around a number of binary post-AGB stars. Although most of the circumbinary disks have been inferred through the near IR excess, a few of them are strong emitters of molecular emission. Here we present high angular resolution observations of the emission of ^{12}CO and its isotopomer ^{13}CO $J = 2$–1 line from the circumstellar envelope around the binary post-AGB star IRAS 08544−4431, which is one of the most prominent members of this class of objects. We find that the envelope is resolved in our observations and two separate components can be identified: (a) a central extended and strong component with very narrow linewidth between 2–6 km s^{-1}; (b) a weak bipolar outflow with expansion velocity up to 8 km s^{-1}. The central compact component possesses low and variable ^{12}CO/^{13}CO $J = 2$–1 line ratio, indicating optically thick emission of the main isotope. We estimate a molecular gas mass of 0.0047 M$_\odot$ for this component based on the optically thinner ^{13}CO $J = 2$–1 line. We discuss the relation of the molecular envelope and the circumbinary disk inferred from near IR excess and compare with other known cases where the distribution of molecular gas has been imaged at high angular resolution.

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VLT/FORS1 spectrophotometry of the first planetary nebula discovered in the Phoenix dwarf galaxy

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Context: A planetary nebula (PN) candidate was discovered during FORS imaging of the Local Group dwarf galaxy Phoenix. Aims: Use this PN to complement abundances from red-giant stars. Methods: FORS spectroscopy was used to confirm the PN classification. Empirical methods and photoionization modeling were used to derive elemental abundances from the emission line fluxes and to characterize the central star. Results: For the elements deemed most reliable for measuring the metallicity of the interstellar medium (ISM) from which the PN formed, [O/H]~ -0.46 and [Ar/H]~ -1.03. [O/H] has lower measurement errors but greater uncertainties due to the unresolved issue of oxygen enrichment in the PN precursor star. Conclusions: Earlier than 2 Gyr ago (the lower limit of the derived age for the central star) the ISM had $Z = 0.002$–0.008, a range slightly more metal-rich than the one provided by stars. Comparing our PN-to-stellar values to surveys for other dwarf Local Group galaxies, Phoenix appears as an outlier.

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Diagnostics of the Early Explosion Phase of a Classical Nova Using Its X-ray Emission: A Model for the X-ray Outburst of CI Camelopardalis in 1998

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We have computed a spherically symmetric model for the interaction of matter ejected during the outburst of a classical nova with the stellar wind from its optical component. This model is used to describe the intense X-ray outburst (the peak 3–20 keV flux was ~ 2 Crab) of the binary system CI Camelopardalis in 1998. According to our model, the stellar wind from the optical component heated by a strong shock wave produced when matter is ejected from the white dwarf as the result of a thermonuclear explosion on its surface is the emission source in the standard X-ray band. Comparison of the calculated and observed time dependences of the mean radiation temperature and luminosity of the binary system during its outburst has yielded very important characteristics of the explosion. We have been able to measure the velocity of the ejected matter immediately after the onset of the explosion for the first time: it follows from our model that the ejected matter had a velocity of ~ 2700 km s^{-1} even on 0.1–0.5 day after the outburst onset and it flew with such a velocity for the first 1–1.5 day under an external force, possibly, the radiation pressure from the white dwarf. Subsequently, the matter probably became transparent and began to decelerate. The time dependence of the mean radiation temperature at late expansion phases has allowed us to estimate the mass of the ejected matter, $\sim 10^{-7}$–10^{-6} M$_\odot$. The mass loss rate in the stellar wind required to explain the observed peak luminosity of the binary system during its outburst has been estimated to be $\dot{M} \sim (1-2) \times 10^{-6}$ M$_\odot$ yr^{-1}.

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Submillimeter narrow emission lines from the inner envelope of IRC +10216

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A spectral-line survey of IRC +10216 in the 345 GHz band has been undertaken with the Submillimeter Array. Although not yet completed, it has already yielded a fairly large sample of narrow molecular emission lines with line-widths indicating expansion velocities of ~ 4 km s^{-1}, less than 3 times the well-known value of the terminal expansion velocity (14.5 km s^{-1}) of the outer envelope. Five of these narrow lines have now been identified as rotational transitions in vibrationally excited states of previously detected molecules: the $v = 1$, $J = 17$–16 and $J = 19$–18 lines of Si^{34}S and ^{29}SiS and the $v = 2$, $J = 7$–6 line of CS. Maps of these lines show that the emission is confined to a region within ~ 60 AU of the star, indicating that the narrow-line emission is probing the region of dust-formation where the stellar wind is still being accelerated.

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Six White Dwarfs with Circumstellar Silicates

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Spitzer Space Telescope spectra reveal 10 μm silicate emission from circumstellar dust orbiting six externally-polluted white dwarfs. Micron-size glasses with an olivine stoichiometry can account for the distinctively broad wings that extend to 12 μm; these particles likely are produced by tidal-disruption of asteroids. The absence of infrared PAH features is consistent with a scenario where extrasolar rocky planets are assembled from carbon-poor solids.

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The Keck Aperture Masking Experiment: spectro-interferometry of 3 Mira Variables from 1.1 to 3.8 μm

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We present results from a spectro-interferometric study of the Miras o Cet, R Leo and W Hya obtained with the Keck Aperture Masking Experiment from 1998 Sep to 2002 Jul. The spectrally dispersed visibility data permit fitting with circularly symmetric brightness profiles such as a simple uniform disk. The stellar angular diameter obtained over up to ~ 450 spectral channels spaning the region 1.1–3.8 μm is presented. Use of a simple uniform disk

brightness model facilitates comparison between epochs and with existing data and theoretical models. Strong size variations with wavelength were recorded for all stars, probing zones of H_2O, CO, OH, and dust formation. Comparison with contemporaneous spectra extracted from our data show a strong anti-correlation between the observed angular diameter and flux. These variations consolidate the notion of a complex stellar atmosphere consisting of molecular shells with time-dependent densities and temperatures. Our findings are compared with existing data and pulsation models. The models were found to reproduce the functional form of the wavelength vs. angular diameter curve well, although some departures are noted in the 2.8–3.5 μm range.

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Discovery of photospheric CaX emission lines in the far-UV spectrum of the hottest known white dwarf (KPD 0005+5106)

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For the first time, we have identified photospheric emission lines in the far-UV spectrum of a white dwarf. They were discovered in the Far Ultraviolet Spectroscopic Explorer spectrum of the hot ($T_{\rm eff} \sim 200,000$ K) DO white dwarf KPD 0005+5106 and they stem from extremely highly ionized calcium (CaX 1137, 1159 Å). Their photospheric origin is confirmed by non-LTE line-formation calculations. This is the highest ionisation stage of any element ever observed in a stellar photosphere. Calcium has never been detected before in any hot white dwarf or central star of planetary nebula. The calcium abundance determination for KPD 0005+5106 (1–10 times solar) is difficult, because the line strengths are rather sensitive to current uncertainties in the knowledge of effective temperature and surface gravity. We discuss the possibility that the calcium abundance is much lower than expected from diffusion/levitation equilibrium theory. The same emission lines are exhibited by the [WCE]-type central star NGC 2371. Another CaX line pair (1461, 1504 Å) is probably present in a Hubble Space Telescope spectrum of the PG 1159-type central star NGC 246.

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Probing The Lower Mass Limit for Supernova Progenitors and the High-Mass End of the Initial–Final Mass Relation from White Dwarfs in the Open Cluster M 35 (NGC 2168)

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We present a photometric and spectroscopic study of the white dwarf population of the populous, intermediate-age open cluster M 35 (NGC 2168); this study expands upon our previous study of the white dwarfs in this cluster. We spectroscopically confirm 14 white dwarfs in the field of the cluster: 12 DAs, 1 hot DQ, and 1 DB star. For each DA, we determine the white dwarf mass and cooling age, from which we derive the each star's progenitor mass. These data are then added to the empirical initial–final mass relation (IFMR), where the M 35 WDs contribute significantly to the high-mass end of the relation. The resulting points are consistent with previously-published linear fits to the IFMR, modulo moderate systematics introduced by the uncertainty in the star cluster age. Based on this cluster alone, the observational lower limit on the maximum mass of white dwarf progenitors is found to be ~ 5.1–5.2 $M_\odot$ at the 95%

confidence level; including data from other young open clusters raises this limit as high as 7.1 $M_\odot$, depending on the cluster membership of three massive WDs and the core-composition of the most massive WDs. We find that the apparent distance modulus and extinction derived solely from the cluster white dwarfs ($(m-M)_V = 10.45 \pm 0.08$ and $E(B-V) = 0.185 \pm 0.010$, respectively) is fully consistent with that derived from main-sequence fitting techniques. Four M 35 WDs may be massive enough to have oxygen-neon cores; the assumed core composition does not significantly affect the empirical IFMR. Finally, the two non-DA WDs in M 35 are photometrically consistent with cluster membership; further analysis is required to determine their memberships.

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Variable Evolved Stars and YSOs Discovered in the Large Magellanic Cloud using the SAGE Survey

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We present initial results and source lists of variable sources in the Large Magellanic Cloud (LMC) for which we detect thermal infrared variability from the SAGE (Surveying the Agents of a Galaxy's Evolution) survey, which had 2 epochs of photometry separated by three months. The SAGE survey mapped a $7^\circ \times 7^\circ$ region of the LMC using the IRAC and the MIPS instruments on board Spitzer. Variable sources are identified using a combination of the IRAC 3.6, 4.5, 5.8, 8.0 μm bands and the MIPS 24 μm bands. An error-weighted flux difference between the two epochs is used to assess the variability. Of the ~ 3 million sources detected at both epochs we find $\sim 2,000$ variable sources for which we provide electronic catalogs. Most of the variable sources can be classified as asymptotic giant branch (AGB) stars. A large fraction ($> 66\%$) of the extreme AGB stars are variable and only smaller fractions of carbon-rich (6.1%) and oxygen-rich (2.0%) stars are detected as variable. We also detect a population of variable young stellar object candidates.

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Emission line objects in NGC 6822. New Planetary Nebula candidates

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Images obtained with the CTIO 4-m telescope and the MOSAIC-2 wide field camera in [O III] 5007 and Hα on-band and off-band filters are analyzed to search for emission lines objects in the irregular galaxy NGC 6822. In particular we search for PN candidates. In addition, spectrophotometric data of a sub-sample of objects obtained with ESO VLT-FORS2 are used to calibrate the MOSAIC imaging. A large number of line emission regions were detected, for which we measured instrumental magnitudes in all the filters. Based on some criteria to distinguish between PNe and compact H II regions, we found 26 PN candidates, increasing the known sample in 8 objects. Also we detected a number of compact H II regions and 20 stellar objects emitting in Hα. For all the objects we present coordinates, instrumental

magnitudes and nebular [O III] and Hα+[N II] fluxes. The observed PNLF for the PN [O III] 5007 magnitudes and the cumulative PNLF were calculated. We confirm that the PNLF presents a dip, similar to the one detected for the SMC, at 2.5 mag down the maximum. The cumulative PNLF returns a value $M^{\star}_{5007} = -3.71^{+0.21}_{-0.42}$ for the peak absolute magnitude of the PNLF which is faint compared to the value expected for galaxies with metallicity similar to the one of NGC 6822 although similar within uncertainties. From our best fit to the observed PNLF we obtained a rough distance modulus $m - M = 23.64^{+0.23}_{-0.43}$ mag, which agrees within uncertainties with recent values reported in the literature. The number of PN in the brightest 0.5 mag normalized to the galactic bolometric luminosity, $\alpha_{0.5}$ was estimated to be $(3.8^{+0.90}_{-0.71}) \times 10^{-9}$, which is similar to the values derived for galaxies with recent star formation and for small galaxies (M_B fainter than -18 mag).

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Infrared Spectroscopy of Symbiotic Stars. VII. Binary Orbit and Long Secondary Period Variability of CH Cygni

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High-dispersion spectroscopic observations are used to refine orbital elements for the symbiotic binary CH Cyg. The current radial velocities, added to a previously published 13 year time series of infrared velocities for the M giant in the CH Cyg symbiotic system, more than double the length of the time series to 29 years. The two previously identified velocity periods are confirmed. The long period, revised to 15.6 ± 0.1 yr, is shown to result from a binary orbit with a 0.7 $M_\odot$ white dwarf and 2 $M_\odot$ M giant. Mass transfer to the white dwarf is responsible for the symbiotic classification. CH Cyg is the longest period S-type symbiotic known. Similarities with the longer period D-type systems are noted. The 2.1 year period is shown to be on Wood's sequence D, which contains stars identified as having long secondary periods (LSP). The cause of the LSP variation in CH Cyg and other stars is unknown. From our review of possible causes, we identify g-mode non-radial pulsation as the leading mechanism for LSP variation in CH Cyg. If g-mode pulsation is the cause of the LSPs a radiative region is required near the photosphere of pulsating AGB stars.

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A dense disk of dust around the born-again Sakurai's object

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In 1996, Sakurai's object (V4334 Sgr) suddenly brightened in the centre of a faint Planetary Nebula (PN). This very rare event was interpreted as the reignition of a hot white dwarf that caused a rapid evolution back to the cool giant phase. From 1998 on, a copious amount of dust has formed continuously, screening out the star which has remained embedded in this expanding high optical depth envelope. The new observations, reported here, are used to study the morphology of the circumstellar dust in order to investigate the hypothesis that Sakurai's Object is surrounded by

a thick spherical envelope of dust. We have obtained unprecedented, high-angular resolution spectro-interferometric observations, taken with the mid-IR interferometer MIDI/VLTI, which resolve the dust envelope of Sakurai's object. We report the discovery of a unexpectedly compact (30×40 milliarcsec, 105×140 AU assuming a distance of 3.5 kpc), highly inclined, dust disk. We used Monte Carlo radiative-transfer simulations of a stratified disk to constrain its geometric and physical parameters, although such a model is only a rough approximation of the rapidly evolving dust structure. Even though the fits are not fully satisfactory, some useful and robust constraints can be inferred. The disk inclination is estimated to be 75±3 degree with a large scale height of 47±7 AU. The dust mass of the disk is estimated to be 6×10^{-5} $M_{\odot}$. The major axis of the disk (132±3 degree) is aligned with an asymmetry seen in the old PN that was re-investigated as part of this study. This implies that the mechanism responsible for shaping the dust envelope surrounding Sakurai's object was already at work when the old PN formed.

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Interstellar Extinction and Long-Period Variables in the Galactic Center

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We derive a new map of the interstellar extinction near the Galactic Center (GC) extending to much higher values of A_V than previously available. We use the results obtained to better characterise the long-period variable star population of the region.
We take the Spitzer IRAC catalogue of GC point sources (Ramírez et al. 2008) and combine it with new isochrones (Marigo et al. 2008) to derive extinctions based on photometry of red giants and asymptotic giant branch (AGB) stars. We apply it to deredden the LPVs found by Glass et al. (2001) (Glass-LPVs) near the GC. We make period–magnitude diagrams and compare them to those from other regions of different metallicity.
Our new extinction map of the GC region covers $2.0^\circ \times 1.4^\circ$ (280×200 pc at a distance of 8 kpc). The Glass-LPVs follow well-defined period–luminosity relations (PL) in the IRAC filter bands at 3.6, 4.5, 5.8, and 8.0 μm. The period–luminosity relations are similar to those in the Large Magellanic Cloud, suggesting that the PL relation in the IRAC bands is universal. We use ISOGAL data to derive mass-loss rates and find for the Glass-LPV sample some correlation between mass-loss and pulsation period, as expected theoretically. Theoretical isochrones for a grid of different metallicities and ages are able to reproduce this relation. The GC has an excess of high luminosity and long period LPVs compared to the Bulge, which supports previous suggestions that it contains a younger stellar population.

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The core helium flash revisited: II. Two and three-dimensional hydrodynamic simulations

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We study turbulent convection during the core helium flash close to its peak by comparing the results of two and

three-dimensional hydrodynamic simulations. In a previous study we found that the temporal evolution and the properties of the convection inferred from two-dimensional hydrodynamic studies are similar to those predicted by quasi-hydrostatic stellar evolutionary calculations. However, as vorticity is conserved in axisymmetric flows, two-dimensional simulations of convection are characterized by incorrect dominant spatial scales and exaggerated velocities. Here, we present three-dimensional simulations that eliminate the restrictions and flaws of two-dimensional models, and that provide a geometrically unbiased insight into the hydrodynamics of the core helium flash. In particular, we study whether the assumptions and predictions of stellar evolutionary calculations based on the mixing-length theory can be confirmed by hydrodynamic simulations. We use a multidimensional Eulerian hydrodynamics code based on state-of-the-art numerical techniques to simulate the evolution of the helium core of a 1.25 $M_\odot$ Pop I star. Our three-dimensional hydrodynamic simulations of the evolution of a star during the peak of the core helium flash do not show any explosive behavior. The convective flow patterns developing in the three-dimensional models are structurally different from those of the corresponding two-dimensional models, and the typical convective velocities are smaller than those found in their two-dimensional counterparts. Three-dimensional models also tend to agree better with the predictions of mixing length theory. Our hydrodynamic simulations show the presence of turbulent entrainment that results in a growth of the convection zone on a dynamic time scale. Contrary to mixing length theory, the outer part of the convection zone is characterized by a sub-adiabatic temperature gradient.

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Red supergiants as potential Type IIn supernova progenitors: Spatially resolved 4.6 μm CO emission around VY CMa and Betelgeuse

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We present high-resolution 4.6 μm CO spectra of the circumstellar environments of two red supergiants (RSGs) that are potential supernova (SN) progenitors: Betelgeuse and VY Canis Majoris. Around Betelgeuse, ^{12}CO emission within $\pm 3''$ (± 12 km s^{-1}) follows a mildly clumpy but otherwise spherical shell, smaller than its $\sim 55''$ shell in K I λ7699. In stark contrast, 4.6 μm CO emission around VY CMa is coincident with bright K I in its clumpy asymmetric reflection nebula, within $\pm 5''$ (± 40 km s^{-1}) of the star. Our CO data reveal redshifted features not seen in K I spectra of VY CMa, indicating a more isotropic distribution of gas punctuated by randomly distributed asymmetric clumps. The relative CO and K I distribution in Betelgeuse arises from ionization effects within a steady wind, whereas in VY CMa, K I is emitted from skins of CO cloudlets resulting from episodic mass ejections 500–1000 yr ago. In both cases, CO and K I trace potential pre-SN circumstellar matter: we conclude that an extreme RSG like VY CMa might produce a Type IIn event like SN 1988Z if it were to explode in its current state, but Betelgeuse will not. VY CMa demonstrates that luminous blue variables (LBVs) are not necessarily the *only* progenitors of SNe IIn, but it underscores the requirement that SNe IIn suffer enhanced episodic mass loss shortly before exploding.

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Blue Stragglers After the Main Sequence

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We study the post-main sequence evolution of products of collisions between main sequence stars (blue stragglers),

with particular interest paid to the horizontal branch and asymptotic giant branch phases. We found that the blue straggler progeny populate the colour–magnitude diagram slightly blueward of the red giant branch and between 0.2 and 1 magnitudes brighter than the horizontal branch. We also found that the lifetimes of collision products on the horizontal branch is consistent with the numbers of so-called "evolved blue straggler stars" (E-BSS) identified by various authors in a number of globular clusters, and is almost independent of mass or initial composition profile. The observed ratio of the number of E-BSS to blue stragglers points to a main sequence lifetime for blue stragglers of approximately 1–2 Gyr on average.

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On the origin of white dwarfs with carbon-dominated atmospheres: the case of H 1504+65

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We explore different evolutionary scenarios to explain the helium deficiency observed in H 1504+65, the most massive known PG 1159 star. We concentrate mainly on the possibility that this star could be the result of mass loss shortly after the born-again and during the subsequent evolution through the [WCL] stage. This possibility is sustained by recent observational evidence of extensive mass-loss events in Sakurai's object and is in line with the recent finding that such mass losses give rise to PG 1159 models with thin helium-rich envelopes and large rates of period change, as demanded by the pulsating star PG 1159−035. We compute the post born again evolution of massive sequences by taking into account different mass-loss rate histories. Our results show that stationary winds during the post-born-again evolution fail to remove completely the helium-rich envelope so as to explain the helium deficiency observed in H 1504+65. Stationary winds during the Sakurai and [WCL] stages only remove at most half of the envelope surviving the violent hydrogen burning during the born-again phase. In view of our results, the recently suggested evolutionary connection born-again stars → H 1504+65 → white dwarfs with carbon-rich atmospheres is difficult to sustain unless the whole helium-rich envelope could be ejected by non-stationary mass-loss episodes during the Sakurai stage.

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Relative Astrometry of the $J = 1$–0, $v = 1$ and $v = 2$ SiO Masers towards R Leonis Minoris using VERA

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Oxygen-rich Asymptotic Giant Branch (AGB) stars are intense emitters of SiO and H_2O maser lines at 43 ($J = 1$–0, $v = 1$ and 2) and 22 GHz, respectively. VLBI observations of the maser emission provides a unique tool to sample the innermost layers of the circumstellar envelopes in AGB stars. Nevertheless, the difficulties in achieving astrometrically aligned $v = 1$ and $v = 2$ SiO maser maps have traditionally prevented a unique interpretation of the observations in

terms of physical underlying conditions, which depend on the nature of the SiO pumping mechanism.
We have carried out observations of the SiO and H_2O maser emission towards R LMi, using the astrometric capabilities of VERA. Due to the too-weak emission of the reference calibrator we had to develop a special method to accurately relate the coordinates for both transitions. We present relative astrometrically aligned $v = 1$ and $v = 2$ $J = 1$–0 SiO maser maps, at multiple epochs, and discuss the astrophysical results. The incorporation of astrometric information into the maps of SiO masers challenges the weak points in the current theoretical models, which will need further refinements to address the observations results.

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Carbon and Nitrogen Abundances in Early-Type Galaxies

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For the first time, we undertake a systematic examination of the nitrogen abundances using the NH 3360 feature for a sample of 35 early-type galaxies spanning a range of masses and local environment. The nitrogen-sensitive molecular feature at 3360 Å has been employed in conjunction with a suite of atomic- and molecular-sensitive indices to provide unique and definitive constraints on the chemical content of these systems. By employing NH 3360, we are now able to break the carbon, nitrogen, and oxygen degeneracies inherent to the use of the CN-index. We demonstrate that the NH 3360 feature shows little dependency upon the velocity dispersion (our proxy for mass) of the galaxies, contrary to what is seen for carbon- and magnesium-sensitive indices. At face value, these results are at odds with conclusions drawn previously using indices sensitive to both carbon and nitrogen, such as cyanogen (CN). With the aid of stellar population models, we find that the N/Fe ratios in these galaxies are consistent with being mildly-enhanced with respect to the solar ratio. We also explore the dependence of these findings upon environment, by analyzing the co-added spectra of galaxies in the field and the Coma cluster. We confirm the previously found differences in carbon abundances between galaxies in low- and high-density environments, while showing that these differences do not seem to exist for nitrogen. We discuss the implications of these findings for the derivation of the star formation histories in early-type galaxies, and for the origin of carbon and nitrogen, themselves.

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Detection of Vibrationally Excited CO in IRC +10216

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Using the Submillimeter Array we have detected the $J = 3$–2 and 2–1 rotational transitions from within the first vibrationally excited state of CO toward the extreme carbon star IRC +10216 (CW Leo). The emission remains spatially unresolved with an angular resolution of $\sim 2''$ and, given that the lines originate from energy levels that are ~ 3100 K above the ground state, almost certainly originates from a much smaller ($\sim 10^{14}$ cm) sized region close to the stellar photosphere. Thermal excitation of the lines requires a gas density of $\sim 10^9$ cm^{-3}, about an order of magnitude higher than the expected gas density based previous infrared observations and models of the inner dust shell of IRC +10216.

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SiO Maser Emission in Miras

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We describe a combined dynamic atmosphere and maser propagation model of SiO maser emission in Mira variables. This model rectifies many of the defects of an earlier model of this type, particularly in relation to the infra-red (IR) radiation field generated by dust and various wavelength-dependent, optically thick layers. Modelled masers form in rings with radii consistent with those found in VLBI observations and with earlier models. This agreement requires the adoption of a radio photosphere of radius approximately twice that of the stellar photosphere, in agreement with observations. A radio photosphere of this size renders invisible certain maser sites with high amplification at low radii, and conceals high-velocity shocks, which are absent in radio continuum observations. The SiO masers are brightest at an optical phase of 0.1 to 0.25, which is consistent with observed phase-lags. Dust can have both mild and profound effects on the maser emission. Maser rings, a shock and the optically thick layer in the SiO pumping band at 8.13 μm appear to be closely associated in three out of four phase samples.

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Transient jets in the symbiotic prototype Z Andromedae

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We present the development of the collimated bipolar jets from the symbiotic prototype Z And that appeared and disappeared during its 2006 outburst. We monitored the outburst with the optical high-resolution spectroscopy and multicolor $UBVR_{\rm C}$ photometry. In 2006 July Z And reached its historical maximum at $U \sim 8.0$. After $\sim$1 mag decline in mid-August, it kept its brightness at a high level of $U \sim 9$ up to 2007 January. During this period, rapid photometric variations with $\Delta m \sim 0.06$ mag on the timescale of hours developed. Simultaneously, high-velocity satellite components appeared on both sides of the Hα and Hβ emission line profiles. Their presence was transient, being detected to the end of 2006. They were launched asymmetrically with the red/blue velocity ratio of 1.2–1.3. From about mid-August onward they became symmetric at $\sim \pm 1200$ km s^{-1}, reducing the velocity to $\sim \pm 1100$ km s^{-1} at their disappearance. Spectral properties of these satellite emissions indicated the ejection of bipolar jets collimated within an average opening angle of 6.°1. If the jets were expelled at the escape velocity then the mass of the accreting white dwarf is $M_{\rm WD} \sim 0.64$ M$_\odot$. We estimated the average outflow rate via jets to $\dot{M}_{\rm jet} \sim 2 \times 10^{-6} (R_{\rm jet}/1\,{\rm AU})^{1/2}$ M$_\odot$ yr^{-1}, during their August–September maximum, which corresponds to the emitting mass in jets, $M_{\rm jet}^{\rm em} \sim 6 \times 10^{-10} (R_{\rm jet}/1\,{\rm AU})^{3/2}$ M$_\odot$. During their lifetime, the jets released the total mass of $M_{\rm jet}^{\rm total} \approx 7.4 \times 10^{-7}$ M$_\odot$. Evolution in the rapid photometric variability and asymmetric ejection of jets around the optical maximum can be explained by a disruption of the inner parts of the disk caused by radiation-induced warping of the disk.

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Variation of fluxes of RR Tel emission lines measured in 2000 with respect to 1996

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The aim of this work is to make available unpublished non-Fe^+ emission line fluxes from optical spectra of the symbiotic nova RR Tel which were taken in 2000, and to compare them with fluxes of the same lines from spectra taken in 1996. After leaving out blends and misidentifications, as well as the unreliable far-red and violet lines, we present the $\log(F_{2000}/F_{1996})$ flux ratios for identified non-Fe^+ lines. Mean values of $\log(F_{2000}/F_{1996})$ for different ionization potential ranges of the ions producing the lines are shown separately for the permitted and forbidden lines. All means show fading, which is larger in the lowest range of ionization potential. Provisional interpretations are suggested. We also measured the values of FWHM in 2000; the previously known decrease with time of FWHM of lines due to the same ion has continued.

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Supergiant Temperatures and Linear Radii from Near-Infrared Interferometry

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We present angular diameters for 42 luminosity class I stars and 32 luminosity class II stars that have been interferometrically determined with the Palomar Testbed Interferometer. Derived values of radius and effective temperature are established for these objects, and an empirical calibration of these parameters for supergiants will be presented as a functions of spectral type and colors. For the effective temperature versus $(V-K)_0$ color, we find an empirical calibration with a median deviation of $\Delta T = 70$ K in the range of $0.7 < (V-K)_0 < 5.1$ for LC I stars; for LC II, the median deviation is $\Delta T = 120$ K from $0.4 < (V-K)_0 < 4.3$. Effective temperature as a function of spectral type is also calibrated from these data, but shows significantly more scatter than the $T_{\rm eff}$ versus $(V-K)_0$ relationship. No deviation of $T_{\rm eff}$ versus spectral type is seen for these high luminosity objects relative to luminosity class II giants. Directly determined diameters range up to 400 $R_\odot$, though are limited by poor distance determinations, which dominate the error estimates. These temperature and radii measures reflect a direct calibration of these parameters for supergiants from empirical means.

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Postdoctoral Position in the study of Magnetic Fields during the Late Stages of Stellar Evolution

Applications are invited for a postdoctoral position in the newly established Emmy Noether research group led by Dr. Wouter Vlemmings on the topic of 'Magnetic fields during the birth and death of stars' at the Argelander Institute for Astronomy (AIfA). The appointment will be for two years, with possible renewal, on a E13 TV-L contract with full social benefits.

The postdoctoral project will focus on millimeter and sub-millimeter wavelength polarization observations of evolved stars with instruments such as the SMA, IRAM PdB and eventually ALMA. He/she will also carry out his/her own research in collaboration with the other group members, which will include a number of PhD students.

The successful candidate will join the new Emmy Noether research group, which has close ties to the local ALMA Regional Center (ARC) node and its growing submillimeter-interferometry research group. He/she will also have access to advanced modeling tools that will be developed through the ASTRONET collaboration 'Adaptable Radiative Transfer Innovations for Submillimeter Telescopes' (ARTIST).

Interested applicants should have a PhD in astrophysics by the start of the appointment. They should send a CV, description of research interests, a publication list and arrange for the submission of three letters of recommendation to (PDF email submissions preferred):

Attention: Wouter Vlemmings, Dr.
Argelander Institute for Astronomy
Auf dem Hügel 71
Bonn, D 53121
Germany

Tel: +49 228 733670
FAX: +49 228 731775
Email Submission Address: wouter@astro.uni-bonn.de
Email Inquiries: wouter@astro.uni-bonn.de

Applications received before 15 January 2009 will receive full consideration, but applications will be accepted until the position is filled. Women and minorities are particularly encouraged to apply.

More information can be found at:
http://www.astro.uni-bonn.de/∼wouter/EN/ (EN group homepage)
http://www.astro.uni-bonn.de/english/index.php (AIfA)
http://www.astro.uni-bonn.de/ARC/ (Bonn-Cologne-Bochum ARC Node)

PhD Position in the study of Magnetic Fields of Evolved Stars

Applications are invited for a three-year PhD position in the newly established Emmy Noether research group led by Dr. Wouter Vlemmings on the topic of 'Magnetic fields during the birth and death of stars' at the Argelander Institute for Astronomy (AIfA).

The PhD project focus on radio-interferometric maser polarization observations, measuring the magnetic field around a large number of stars that will evolve into planetary nebulae. These observations will be followed up by further observations with among others the SMA and IRAM PdB to further clarify the origin of the magnetic fields.

The successful candidate will join the new Emmy Noether research group consisting of 2–3 additional PhD students and postdoctoral researchers. The group also has close ties to the local ALMA Regional Center (ARC) node and its growing submillimeter-interferometry research group. The successful candidate will benefit from strong collaborations with researchers at a number of foreign institutes.

Interested candidates should hold the equivalent of a Masters degree, including a substantial thesis, in Astronomy or Physics by the start of the appointment. Previous experience with interferometric data analysis is not required but would be an asset.

Interested candidates should send a CV, education history with transcripts of study record, and a brief description of research interests, and arrange for the submission of two letters of recommendation to (PDF email submissions preferred):

Attention: Wouter Vlemmings, Dr.
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Applications received before 15 January 2009 will receive full consideration, but applications will be accepted until the position is filled. Women and minorities are particularly encouraged to apply.

More information can be found at:
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http://www.astro.uni-bonn.de/english/index.php (AIfA)
http://www.astro.uni-bonn.de/ARC/ (Bonn-Cologne-Bochum ARC Node)