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 136$^{\rm th}$ issue of the AGB Newsletter. There are very exciting results obtained on the PNe surrounding the products of a common-envelope phase of binary evolution (see the contributions by the IPHASS team and by Afşar & İbanoğlu). No less exotic is the inference of AGB dust within elliptical galaxies in the Pavo galaxy group (Marie Machacek). A lot of work is presented, too, on the properties of circumstellar dust. And perhaps Susanne (Höfner) has found yet another solution for driving the winds of oxygen-rich AGB stars!

Our warm congratulations go to Krispian Lowe, for having obtained his Philosopher's Degree on the basis of a very detailed investigation of a post-AGB object.

For those of you who also have got their PhD, and who wish to continue postdoctoral research in astronomy, there are two positions open, one in Nice (France) and one in Bonn (Germany) — where the latter place also offers PhD positions.

If you have been stunned by the amazing results from the Japanaese infrared satellite *AKARI*, why not attend the conference dedicated to this continuing mission, in Tokyo (Japan) next year?

The next issue will be distributed on the 1$^{\rm st}$ of December; the deadline for contributions is the 30$^{\rm th}$ of November.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Somehow, AGB stars **always** *seem to find a way to drive a strong wind*

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)

A planetary nebula around nova V458 Vul undergoing flash ionization

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Nova V458 Vul erupted on 2007 August 8$^{\rm th}$ and reached a visual magnitude of 8.1 a few days later. Hα images obtained six weeks before the outburst as part of the IPHAS galactic plane survey reveal an 18$^{\rm th}$ magnitude progenitor surrounded by an extended nebula. Subsequent images and spectroscopy of the nebula reveal an inner nebular knot increasing rapidly in brightness due to flash ionization by the nova event. We derive a distance of 13 kpc based on light travel time considerations, which is supported by two other distance estimation methods. The nebula has an ionized mass of 0.2 $M_{\odot}$ and a low expansion velocity: this rules it out as ejecta from a previous nova eruption, and is consistent with it being a ∼14,000 year old planetary nebula, probably the product of a prior common envelope (CE) phase of evolution of the binary system. The large derived distance means that the mass of the erupting WD component of the binary is high. We identify two possible evolutionary scenarios, in at least one of which the system is massive enough to produce a Type Ia supernova on merging.

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Dynamical Opacity-Sampling Models of Mira Variables. I: Modelling Description and Analysis of Approximations

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We describe the Cool Opacity-sampling Dynamic EXtended (`CODEX`) atmosphere models of Mira variable stars, and examine in detail the physical and numerical approximations that go in to the model creation. The CODEX atmospheric models are obtained by computing the temperature and the chemical and radiative states of the atmospheric layers, assuming gas pressure and velocity profiles from Mira pulsation models, which extend from near the H-burning shell to the outer layers of the atmosphere. Although the code uses the approximation of Local Thermodynamic Equilibrium (LTE) and a grey approximation in the dynamical atmosphere code, many key observable quantities, such as infrared diameters and low-resolution spectra, are predicted robustly in spite of these approximations. We show that in visible light, radiation from Mira variables is dominated by fluorescence scattering processes, and that the LTE approximation likely under-predicts visible-band fluxes by a factor of two.

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Two-colour photometry of the binary planetary nebula nuclei UU Sagittae and V477 Lyrae: oversized secondaries in post-common-envelope binaries

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We present new V and R-passband CCD photometry of UU Sge and V477 Lyr, the eclipsing binary nuclei of the planetary nebulae Abell 63 and Abell 46, respectively. We have performed a simultaneous analysis of VR light-curves and estimated the effective temperatures for the primary and secondary stars to be 78 000 ± 3000 and 6136 ± 240 K for UU Sge, 49 500 ± 4500 and 3874 ± 350 K for V477 Lyr. We have also reanalysed the previously measured radial velocities and combined the results with those obtained from the analysis of the light curves to derive absolute parameters of the components. The secondary stars have larger radii than expected from their main-sequence counterparts at the same masses. We have determined the post-common envelope ages and the thermal time scales of the systems and examined the possible reasons of expanded radius of the secondary components, together with some selected post-common envelope binaries. We conclude that the secondary components of the nuclei of the planetary nebulae are still out of thermal equilibrium along with two post-common envelope systems: HS 1136+6646 and RE 1016−053. For other systems, magnetic activity has been suggested as the more plausible reason for their expanded radii. We have also estimated the common-envelope efficiency parameters of UU Sge and V477 Lyr.

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The Antares emission nebula and mass loss of α Sco A

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The Antares nebula is a peculiar emission nebula seen in numerous Fe II lines and in radio free-free emission, probably

associated with the H II region caused by α Sco B in the wind of α Sco A. High-resolution spectra with spatial resolution were used to study the emission line spectrum, the physical nature of the nebula and to determine the mass-loss rate of the M supergiant α Sco A.
The Antares nebula was mapped with long-slit (10″) and high-resolution ($R = 80\,000$) spectra using UVES at the VLT. The resulting 2-D images were used to reconstruct a 3-D picture of the H II region and its absolute location in space relative to α Sco A.
We found that the Antares nebula shows, in addition to numerous Fe II lines, the Balmer line recombination spectrum H_α, H_β up to H_{10}, and N II 6583/6548 Å, H_α and N II with the same extent as seen in cm radio free-free emission. Combining velocity information from optical and GHRS/HST spectra with H_α velocities, the H II region is found to be located ~ 215 AU behind the plane of the sky of α Sco A. From the H_α/N II intensity ratio and the non-visibility of the O sc ii 3726/3729 Å lines we estimate a low mean electron temperature of $\overline{T}_e = 4900$ K and an N abundance enhanced by a factor of ~ 3 due to the CNO cycle in α Sco A. The shape and size of the H II region yield a mean mass-loss rate of $(1.05 \pm 0.3) \times 10^{-6}$ $M_\odot$ yr^{-1}. The Fe II lines originate predominantly at the edges (rear and front) of the H II region. UV continuum pumping as well as collisional excitation seem to be responsible for the observed iron lines.

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Silicon carbide absorption features: dust formation in the outflows of extreme carbon stars

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Infrared carbon stars without visible counterparts are generally known as extreme carbon stars. We have selected a subset of these stars with absorption features in the 10–13 μm range, which has been tentatively attributed to silicon carbide (SiC). We add three new objects meeting these criterion to the seven previously known, bringing our total sample to ten sources. We also present the result of radiative transfer modeling for these stars, comparing these results to those of previous studies. In order to constrain model parameters, we use published mass-loss rates, expansion velocities and theoretical dust condensation models to determine the dust condensation temperature. These show that the inner dust temperatures of the dust shells for these sources are significantly higher than previously assumed. This also implies that the dominant dust species should be graphite instead of amorphous carbon. In combination with the higher condensation temperature we show that this results in a much higher acceleration of the dust grains than would be expected from previous work.
Our model results suggest that the very optically thick stage of evolution does not coincide with the timescales for the superwind, but rather, that this is a very short-lived phase.
Additionally, we compare model and observational parameters in an attempt to find any correlations. Finally, we show that the spectrum of one source, IRAS 17534−3030, strongly implies that the 10–13 μm feature is due to a solid state rather than a molecular species.

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Detection of C_5N^- and vibrationally excited C_6H in IRC +10216

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We report the detection in the envelope of the C-rich star IRC +10216 of four series of lines with harmonically related frequencies: B1389, B1390, B1394 and B1401. The four series must arise from linear molecules with mass and size

close to those of C_6H and C_5N. Three of the series have half-integer rotational quantum numbers; we assign them to the $^2\Delta$ and $^2\Sigma$- vibronic states of C_6H in its lowest (ν_{11}) bending mode. The fourth series, B1389, has integer J with no evidence of fine or hyperfine structure; it has a rotational constant of 1388.860(2) MHz and a centrifugal distortion constant of 33(1) Hz; it is almost certainly the C_5N^- anion.

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High-resolution X-ray spectroscopy of the evolving shock in the 2006 outburst of RS Ophiuchi

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The evolution of the 2006 outburst of the recurrent nova RS Ophiuchi was followed with 12 X-ray grating observations with *Chandra* and *XMM-Newton*. We present detailed spectral analyses using two independent approaches. From the best dataset, taken on day 13.8 after outburst, we reconstruct the temperature distribution and derive elemental abundances. We find evidence for at least two distinct temperature components on day 13.8 and a reduction of temperature with time. The X-ray flux decreases as a power-law, and the power-law index changes from $-5/3$ to $-8/3$ around day 70 after outburst. This can be explained by different decay mechanisms for the hot and cool components. The decay of the hot component and the decrease in temperature are consistent with radiative cooling, while the decay of the cool component can be explained by the expansion of the ejecta. We find overabundances of N and of α elements, which could either represent the composition of the secondary that provides the accreted material or that of the ejecta. The N overabundance indicates CNO-cycled material. From comparisons to abundances for the secondary taken from the literature, we conclude that 20–40% of the observed nitrogen could originate from the outburst. The overabundance of the α elements is not typical for stars of the spectral type of the secondary in the RS Oph system, and white dwarf material might have been mixed into the ejecta. However, no direct measurements of the α elements in the secondary are available, and the continuous accretion may have changed the observable surface composition.

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Angular Diameters of the Hyades Giants Measured with the CHARA Array

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We present angular diameters of the Hyades giants, γ, δ^1, ϵ, and θ^1 Tau from interferometric measurements with

the CHARA Array. Our errors in the limb-darkened angular diameters for these stars are all less than 2%, and in combination with additional observable quantities, we determine the effective temperatures, linear radii and absolute luminosities for each of these stars. Additionally, stellar masses are inferred from model isochrones to determine the surface gravities. These data show that a new calibration of effective temperatures with errors well under 100 K is now possible from interferometric angular diameters of stars.

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Morpho-Kinematic Properties of the 21 μm Source IRAS 07134+1005

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We report the results of a Submillimeter Array (SMA) interferometric observation of 21-μm source IRAS 07134+1005 in the CO $J = 3$–2 line. In order to determine the morpho-kinematic properties of the molecular envelope of the object, we constructed a model using the *Shape* software to model the observed CO map. We find that the molecular gas component of the envelopes can be interpreted as a geometrically thick expanding torus with an expanding velocity of 8 km s^{-1}. The inner and outer radii of the torus determined by fitting *Shape* models are 1.2″ and 3.0″, respectively. The inner radius is consistent with the previous values determined by radiative transfer modeling of the spectral energy distribution and mid-infrared imaging of the dust component. The radii and expansion velocity of the torus suggest that the central star has left the asymptotic giant branch about 1140–1710 years ago, and that the duration of the equatorial enhanced mass loss is about 2560–3130 years. From the absence of an observed jet, we suggest that the formation of a bipolar outflow may lack behind in time from the creation of the equatorial torus.

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Element enhancements along the entire AGB phase

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The results of a study of the AGB phase of stellar evolution are presented. Abundances have been determined for Fe, C, O, the light s-process elements, Y and Zr, the heavy s-process elements, La and Nd, and the r-process element, Eu. The expected relationship between enhanced C, increasing C/O ratio and enhanced s-process elements has been quantified. Results are presented to provide observational data with which to compare theoretical predictions. The results in this paper confirm previously suggested relationships between C, C/O and s-process element enhancements. It is seen that AGB stars show C/O ratios from C/O≈ 0.4 to 1.0, while C enhancements lie between [C/Fe]=0.1 to 0.9 dex. Enhancements of s-process elements are as much as [s/Fe]≈ 1.0 dex for the stars in which C is also greatly enhanced.

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Far-infrared spectra of hydrous silicates at low temperatures — Providing laboratory data for Herschel and ALMA

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Hydrous silicates occur in various cosmic environments, and are among the minerals with the most pronounced bands in the far infrared (FIR) spectral region. Given that Herschel and ALMA will open up new possibilities for astronomical FIR and sub-mm spectroscopy, data characterizing the dielectric properties of these materials at long wavelengths are desirable. We aimed at examining the FIR spectra of talc, picrolite, montmorillonite, and chamosite, which belong to four different groups of phyllosilicates. We tabulated positions and band widths of the FIR bands of these minerals depending on the dust temperature. By means of powder transmission spectroscopy, spectra of the examined materials were measured in the wavelength range 25–500 μm at temperatures of 300, 200, 100, and 10 K. Room-temperature measurements yield the following results. For talc, a previously unknown band, centered at 98.5 μm, was found, in addition to bands at 56.5 and 59.5 μm. For montmorillonite, several bands at wavelengths < 110 μm were detected, including a band at 105 μm with an FWHM of about 10 μm. Picrolite shows a sharp 77 μm FIR band. Chamosite is characterized by bands in the 72–92 μm range, and a prominent band at 277 μm. At decreasing temperature, most of the bands shift to shorter wavelengths. Examining a potential counterpart of the 105-μm band in the spectra of HD 142527 and HD 100546, we find that the broad band in the spectra of these young stars — extending from 85 to 125 μm — cannot be due to montmorillonite or any of the hydrous silicates we studied, since these materials have sharper bands in the FIR wavelength range than previously assumed, especially at low temperatures.

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Sakurai's Object: characterising the near-infrared CO ejecta between 2003 and 2007

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We present observations of Sakurai's Object obtained at 1–5 μm between 2003 and 2007. By fitting a radiative transfer model to an echelle spectrum of CO fundamental absorption features around 4.7 μm, we determine the excitation conditions in the line-forming region. We find $^{12}C/^{13}C \sim 3.5$, consistent with CO originating in ejecta processed by the very late thermal pulse, rather than in the pre-existing planetary nebula. We demonstrate the existence of $2.2 \times 10^{-6} < M < 2.7 \times 10^{-6}$ M$_\odot$ of CO ejecta outside the dust, forming a high-velocity wind of 500 ± 80 km s^{-1}. We find evidence for significant weakening of the CO band and cooling of the dust around the central star between 2003 and 2005. The gas and dust temperatures are implausibly high for stellar radiation to be the sole contributor.

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Winds of M-type AGB stars driven by μm-sized grains

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In view of the recent problem regarding the dynamical modelling of winds of M-type AGB stars (insufficient radiation

pressure on silicate grains), some of the basic assumptions of these models need to be re-evaluated critically. Accepting the conclusion that non-grey effects will force silicate grains to be virtually Fe-free, the viability of driving winds with μm-sized Fe-free silicates, instead of small particles, is examined. Using both simple estimates and detailed dynamical atmosphere and wind models, it is demonstrated that radiation pressure on Fe-free silicate grains is sufficient to drive outflows if the restriction to the small particle limit is relaxed, and prevailing thermodynamic conditions allow grains to grow to sizes in the μm range. The predicted wind properties, such as mass-loss rates and outflow velocities, are in good agreement with observations of M-type AGB stars. Due to a self-regulating feedback between dust condensation and wind acceleration, grain growth naturally comes to a halt at particle diameters of about 1 μm. The most efficient grain sizes to drive winds are in a rather narrow interval around 1 μm. These values are set by the wavelength range corresponding to the flux maximum in typical AGB stars, and are very similar to interstellar grains.

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A Multiwavelength View of Star Formation in Interacting Galaxies in the Pavo Group

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We combine *Spitzer* IRAC mid-infrared (MIR) and *Chandra* X-ray observations of the dominant galaxies NGC 6872 and NGC 6876 in the Pavo group with archival optical and H I data to study interaction-induced star formation. In the spiral galaxy NGC 6872, 8.0 μm and 5.8 μm nonstellar emission having colors consistent with polycyclic aromatic hydrocarbons (PAHs) is concentrated in clumps in three regions: in a 5 kpc radius outer ring about the center of the spiral galaxy, in a bridge of emission connecting NGC 6872's northern spiral arm to IC 4970, and along the full extent of both NGC 6872's tidal arms. PAH emission is correlated with young star clusters and dense H I regions. We find no strong differences in the MIR colors of the star-forming regions in the spiral galaxy NGC 6872 as a function of position relative to the tidally interacting companion galaxy IC 4970. We find 11 very luminous X-ray sources ($\gtrsim(0.5-5)\times10^{39}$ erg s^{-1}) clustered to the southwest in NGC 6872, near bright star-forming regions. In NGC 6872's tidal features, young star clusters form at the boundaries of diffuse X-ray gas, suggesting that stars form as gas stripped by the interactions cools. The nucleus of NGC 6872 is a weak X-ray point source with $0.5-8$ keV luminosity of 8.5×10^{39} erg s^{-1}, but there is little evidence in the inner 1 kpc of NGC 6872 for PAH emission from recent star formation or nuclear activity. However, a 4 kpc 'stream', leading from the outer ring of NGC 6872 to the nucleus, may signal the transport of interstellar matter into NGC 6872's nuclear region. Nonstellar emission, consistent with PAH emission, is also found in the central region of elliptical galaxy NGC 6877, companion to the dominant Pavo group elliptical galaxy NGC 6876. However, in the central region of NGC 6876, the dust emission is more likely due to silicate emission from old AGB stars.

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Low temperature Rosseland opacities with varied abundances of carbon and nitrogen

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The radiative energy transport can under certain assumptions be treated in the diffusion approximation. If so, the

Rosseland mean opacity coefficient characterises the interaction between radiation and matter. The opacity data are usually available in pre-tabulated form, and in the generation of the data one assumes a distinct heavy element mixture which is usually a scaled solar one. It is thus that the presently available data cannot cover the full parameter range of some astrophysical problems where the chemical composition of the medium under consideration changes. We want to provide low temperature opacity data that incorporate varied abundances of the elements carbon and nitrogen. In the temperature range that we focus at, molecules are the dominant opacity source. Our dataset spans a large metallicity range and shall deliver the necessary input data for stellar evolution models as well as other applications. We conduct chemical equilibrium calculations in order to evaluate the partial pressures of neutral atoms, ions and molecules. Based on a large dataset containing atomic line and continuum data, and, most importantly, a plethora of molecular lines, we subsequently calculate Rosseland mean opacity coefficients. This is done not only for a number of different metallicities, but also for varied abundances of the isotopes ^{12}C and ^{14}N at each metallicity. The molecular data comprise the main opacity sources at either an oxygen-rich or carbon-rich chemistry. We tabulate the opacity coefficients as a function of temperature and, basically, density. Already within a certain chemistry regime an alteration in the carbon abundance causes, due to the special role of the CO molecule, considerable changes in the Rosseland opacity. The transition from a scaled solar (i.e. oxygen-rich) mixture to the carbon-rich regime results in opacities that can, at low temperatures, be orders of magnitude different compared to the initial situation. The reason is that different molecular absorbers make up the mean opacity in either case. A varying abundance of nitrogen has less pronounced effects but, nevertheless, cannot be neglected. In typical astrophysical applications, it is indispensable to take into account opacity variations due to chemistry changes. The new data is, in this respect, superior to previous compilations, but is, however, still subject to uncertainties.

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Conference Papers

Coordinated AMBER and MIDI observations of the Mira variable RR Aql

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We have used near- and mid-infrared interferometry to investigate the pulsating atmosphere and the circumstellar environment of the Mira variable RR Aql. Observations were taken with the VLTI/AMBER (near infrared) and the VLTI/MIDI (mid infrared) instruments. We have obtained a total of 15 MIDI epochs between Apr 9, 2004 and Jul 28, 2007 covering 4 pulsation cycles and one AMBER epoch on Sep 9, 2006 at phase 2.82. This work is also part of an ongoing project of joint VLTI and VLBA observations to study the connection between stellar pulsation and the mass loss process. Here we present a comparison of the AMBER visibility data to a simple uniform disk model as well as to predictions by recent self-excited dynamic model atmospheres. The best fitting photospheric angular diameter of the model atmosphere at phase 2.82 is $\Theta_{\rm Phot} = 9.9 \pm 2.4$ mas.

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Spectral modeling of gaseous metal disks around DAZ white dwarfs

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We report on our attempt for the first non-LTE modeling of gaseous metal disks around single DAZ white dwarfs recently discovered by Gänsicke et al. and thought to originate from a disrupted asteroid. We assume a Keplerian rotating viscous disk ring composed of calcium and hydrogen and compute the detailed vertical structure and emergent spectrum. We find that the observed infrared Ca II emission triplet can be modeled with a hydrogen-deficient gas ring located at $R = 1.2$ R$_\odot$, inside of the tidal disruption radius, with $T_{\rm eff} \approx 6000$ K and a low surface mass density of ≈ 0.3 g cm^{-2}. A disk having this density and reaching from the central white dwarf out to $R = 1.2$ R$_\odot$ would have a total mass of $7 \cdot 10^{21}$ g, corresponding to an asteroid with ≈ 160 km diameter.

Oral contribution, published in 16th **European White Dwarf Workshop, Barcelona, 2008**
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Revisiting the theoretical DBV (V777 Her) instability strip: the MLT theory of convection

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We reexamine the theoretical instability domain of pulsating DB white dwarfs (DBV or V777 Her variables). We performed an extensive g-mode nonadiabatic pulsation analysis of DB evolutionary models considering a wide range of stellar masses, for which the complete evolutionary stages of their progenitors from the ZAMS, through the thermally pulsing AGB and born-again phases, the domain of the PG 1159 stars, the hot phase of DO white dwarfs, and then the DB white dwarf stage have been considered. We explicitly account for the evolution of the chemical abundance distribution due to time-dependent chemical diffusion processes. We examine the impact of the different prescriptions of the MLT theory of convection and the effects of small amounts of H in the almost He-pure atmospheres of DB stars on the precise location of the theoretical blue edge of the DBV instability strip.

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MARCS model atmospheres

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In this review presented at the Symposium A stellar journey in Uppsala, June 2008, I give my account of the historical development of the MARCS code from the first version published in 1975 and its premises to the 2008 grid. It is shown that the primary driver for the development team is the science that can be done with the models, and that they constantly strive to include the best possible physical data. A few preliminary comparisons of M star model spectra to spectrophotometric observations are presented. Particular results related to opacity effects are discussed. The size of errors in the spectral energy distribution (SED) and model thermal stratification are estimated for different densities of the wavelength sampling. The number of points used in the MARCS 2008 grid (108000) is large enough to ensure errors of only a few K in all models of the grid, except the optically very thin layers of metal-poor stars.

Errors in SEDs may reach about 10% locally in the UV. The published sampled SEDs are thus appropriate to compute synthetic broad-band photometry, but higher resolution spectra will be computed in the near future and published as well on the MARCS site (marcs.astro.uu.se). Test model calculations with TiO line opacity accounted for in scattering show an important cooling of the upper atmospheric layers of red giants. Rough estimates of radiative and collisional time scales for electronic transitions of TiO indicate that scattering may well be the dominant mechanism in these lines. However models constructed with this hypothesis are incompatible with optical observations of TiO (Arcturus) or IR observations of OH (Betelgeuse), although they may succeed in explaining H_2O line observations. More work is needed in that direction.

Oral contribution, published in A Stellar Journey, 2008, Physica Scripta, Eds. P. Barklem, A. Korn & B. Plez
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Prospects for Studies of Stellar Evolution and Stellar Death in the JWST Era

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I review the prospects for studies of the advanced evolutionary stages of low-, intermediate- and high-mass stars by the JWST and concurrent facilities, with particular emphasis on how they may help elucidate the dominant contributors to the interstellar dust component of galaxies. Observations extending from the mid-infrared to the submillimeter can help quantify the heavy element and dust species inputs to galaxies from AGB stars. JWST's MIRI mid-infrared instrument will be so sensitive that observations of the dust emission from individual intergalactic AGB stars and planetary nebulae in the Virgo Cluster will be feasible. The Herschel Space Observatory will enable the last largely unexplored spectral region, from the far-IR to the submm, to be surveyed for new lines and dust features, while SOFIA will cover the wavelength gap between JWST and Herschel, a spectral region containing important fine structure lines, together with key water-ice and crystalline silicate bands. Spitzer has significantly increased the number of Type II supernovae that have been surveyed for early-epoch dust formation but reliable quantification of the dust contributions from massive star supernovae of Type II, Type Ib and Type Ic to low- and high-redshift galaxies should come from JWST MIRI observations, which will be able to probe a volume over 1000 times larger than Spitzer.

Oral contribution, published in 'Astrophysics in the Next Decade: JWST and Concurrent Facilities' (Conference held in Tucson, Arizona, Sept 24–27, 2007), edited by H.A. Thronson, M. Stiavelli & A.G.G.M. Tielens; Springer Series: Astrophysics and Space Science Proceedings
Available from arXiv:0810.2984

Modeling He-rich subdwarfs through the hot-flasher scenario

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We present 1D numerical simulations aimed at studying the hot-flasher scenario for the formation of He-rich subdwarf stars. Sequences were calculated for a wide range of metallicities and with the He core flash at different points of the post-RGB evolution (i.e. different remnant masses). We followed the complete evolution from the ZAMS, through the hot-flasher event, and to the subdwarf stage for all kinds of hot-flashers. This allows us to present a homogeneous set of abundances for different metallicities and all flavors of hot-flashers. We extend the scope of our work by analyzing

the effects in the predicted surface abundances of some standard assumptions in convective mixing and the effects of element diffusion.
We find that the hot-flasher scenario is a viable explanation for the formation of He-sdO stars. Our results also show that element diffusion may produce the transformation of (post hot-flasher) He-rich atmospheres into He-deficient ones. If this is so, then the hot-flasher scenario is able to reproduce both the observed properties and distribution of He-sdO stars.

Poster contribution, published in 16^{th} **European White Dwarf Workshop**
Available from arXiv:0810.4828

Polarization from the Structured Envelopes of Cool Evolved Stars

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We present preliminary calculations of electron scattering polarizations from models of structured cool star envelopes. We note that net polarizations from unresolved sources can result from non-spherical scattering envelopes and/or anisotropic illumination from a photosphere that has brightness variations. The resultant polarizations are quite small (hundreths of a percent); however, Rayleigh scattering from molecular opacity and/or dust scattering from the more extended envelope under similar considerations may produce higher polarizations.

Poster contribution, published in The Biggest, Baddest, Coolest Stars
Available from arXiv:0810.4287

Review Paper

Wonderful Mira

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Since being named "wonderful" in the seventeenth century for its peculiar brightness variability, Mira A has been the subject of extensive research and become the prototype for a whole class of "Mira" variable stars. The primary star in a binary system, Mira A is reaching the end of its life and currently undergoing an extended period of enhanced mass loss. Recent observations have revealed a surrounding arc-like structure and a stream of material stretching 12 light years away in opposition to the arc. In this article, I review recent modelling of this cometary appearance as a bow shock with an accompanying tail of material ram pressure stripped from the head of the bow shock, place Mira in an evolutionary context, predict its future with reference to the similar star R Hya and planetary nebula Sh 2-188, and speculate some avenues of research both on Mira itself and on other "Mira-like" stars with bow shocks and tails. I also discuss the implications of this discovery for our own star, the Sun.

Published in Philosophical Transactions of the Royal Society A, vol. 366, triennial issue 'Astronomy' (doi:10.1098/rsta.2008.0167)
Available from http://journals.royalsociety.org/content/k7q030325k5gv81m/?p=2004fe40a44e4434846b7c2b5d4a8f2b&pi=6

Thesis

Infrared Polarimetry and Integral Field Spectroscopy of Post-Asymptotic Giant Branch Stars

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In this thesis, I present the properties of IRAS 19306+1407 central source and its surrounding circumstellar envelope (CSE), from the analysis of near-infrared (near-IR) polarimetry and integral field spectroscopy (IFS), with supporting archived HST images and sub-millimetre (sub-mm) photometry. This is supported by axi-symmetric light scattering (ALS), axi-symmetric radiative transfer (DART) and molecular hydrogen (H_2) shock models.

The polarimetric images show that IRAS 19306+1407 has a dusty torus, which deviates from axisymmetry and exhibits a "twist" feature. The DART and ALS modelling shows that the CSE consists of Oxygen-rich sub-micrometre dust grains, with a range in temperature from 130 ± 30 to 40 ± 20 K at the inner and outer radius, respectively, with inner and outer radii of 1.9 ± 0.1×10^{14} and 2.7 ± 0.1×10^{15} m. The CSE detached 400 ± 10 years ago and the mass loss lasted 5700 ± 160 years, assuming a constant asymptotic giant branch (AGB) outflow speed of 15 km s^{-1}. The dust mass and total mass of the CSE is 8.9±5×10^{-4} and 1.8±1.0×10^{-1} $M_\odot$, assuming a gas-to-dust ratio of 200. The mass loss rate was 3.4±2.1×10^{-5} $M_\odot$ year. The central source is consistent with a B1 I-type star with a radius of 3.8 ± 0.6 $R_\odot$, luminosity of 4500 ± 340 $L_\odot$ at a distance of 2.7 ± 0.1 kpc.

A purpose built idl package (FUS) was developed and used in the SINFONI IFS data critical final reduction steps. It also produced emission line, kinematic and line ratio images. The IFS observations show that H_2 is detected throughout the CSE, located in bright arcs and in the bipolar lobes. The velocity of the H_2 is greatest at the end of the lobes. Brγ emission originates from, or close, to the central source — produced by a fast jump (J) shock or photo-ionised atomic gas. The 1–0 S(1)/2–1 S(1) and 1–0 S(1)/3–2 S(3) ratios were used as a diagnostic and determined that H_2 was excited by bow shaped shocks; however, these shock models could not wholly explain the observed rotational and vibrational temperatures. The CDR values were fitted by combining continuous (C) or J-bow shock and fluorescence models, with a contribution from the latter, observed throughout the CSE (5–77 per cent). The majority of shock can be described by a C-bow shock model with B = 0.02 to 1.28 mG. Shocks are predominately seen in the equatorial regions. Polarimetry and IFS highlight a "twist" feature, which could be due to an episodic jet undergoing a recent change in the outflow direction.

The sub-arcsecond IFS observations reveal a flocculent structure in the south-east bright arc, consisting of several clumps interpreted as a fast-wind eroding an equatorial torus, possibly forming H_2 knots seen in (some) evolved planetary nebulae (PNe).

My analysis has effectively constrained the following: spectral type, stellar radius, luminosity and distance, chemistry, dust grain properties, geometry, age, mass loss, excitation mechanism and evolutionary state of the post-AGB star and its surrounding CSE. I conclude that IRAS 19306+1407 is a post-AGB object on the verge becoming a PN.

274 pages, accepted and hard back bound
Available from http://hdl.handle.net/2299/2449

The Observatory of the Côte d'Azur, Nice, France Post-doctoral position in automatic stellar classification

The Observatory of the Côte d'Azur (Nice, France) calls for applications to a postdoctoral position to work on the automatic classification of the stellar spectra collected by ESO instruments.

The successful applicant will work in close collaboration with P. de Laverny, A. Recio-Blanco, V. Hill and A. Bijaoui, members of the Gaia group of the Côte d'Azur Observatory. Their main scientific interests are stellar evolution and chemical abundances, stellar populations, galactic archeology, automatic classification and the preparation of the ESA/Gaia mission. In this group, a specific algorithm is developed (MATISSE, Recio-Blanco et al., 2006, MNRAS, 370, 461) in order to automatically derive the stellar atmospheric parameters and chemical abundances from spectra collected with current instruments or future ones, such as the Gaia/RVS. In the framework of a collaborative work with ESO, this algorithm will be applied to the ESO stellar spectra in order to provide to the whole astronomical community the stellar parameters together with the reduced spectra directly from the ESO archives.

We are particularly interested by applicants with previous experiences in the field of observational stellar astrophysics, stellar atmospheres, spectroscopic reduction/analysis and/or chemical analysis, but all applicants with experience in related areas will also be considered. Preference will also be given to candidates with strong independent research programs in these areas, as the applicant is expected to carry on his own research in parallel.

The position is for one year renewable, subject to performance and (very likely) extended funding. The starting date has some flexibility within the first term of 2009. Funds for travel and research will be available, as well as easy access to computing facilities.

Applicants are requested to send a CV, a list of publications, and a brief (3 pages) description of past/future research, accomplishments and relevant technical experiences. This material together with three letters of reference should be sent to Patrick de Laverny. The deadline to apply is 10 December 2008, and further information can be directly requested from:

Patrick de Laverny
email : laverny@oca.eu
Observatoire de la Côte d'Azur
BP4229
F-06304 Nice cedex 4
France

Argelander Institute for Astronomy (AIfA), University of Bonn Postdoctoral and PhD Positions in computational astrophysics for ALMA

Applications are invited for a postdoctoral position and at least one PhD position at the Argelander Institute for Astronomy (AIfA). Here the successful candidates will join the local ALMA Regional Center (ARC) node's growing submillimeter-interferometry research group, which has scientific interests ranging from galaxy evolution to star formation and evolved stars.

The candidates will work on radiative transfer modeling as part of the ASTRONET project 'Adaptable Radiative Transfer Innovations for Submillimeter Telescopes' (ARTIST). The ARTIST collaboration between the University of Bonn, Leiden University (Netherlands) and CSIC-IEEC (Spain) aims to develop the next generation model suite for

comprehensive multi-dimensional radiative transfer calculation of the dust and line emission as well as their polarization. Prior experience in computational astrophysics and/or radiative transfer is highly desirable.

The postdoctoral and PhD positions are for three years, and will include a number of working visits to the partner institutes.

Applicants for the postdoctoral position should send a CV, description of research interests, a publication list and arrange for the submission of three letters of recommendation. For the PhD position a CV and two letters of recommendation are requested. Applications should be sent to:

Attention: Christina Stein-Schmitz, Institute Secretary
Argelander Institute for Astronomy
Auf dem Hügel 71
Bonn, D 53121
Germany

Tel: +49 228 736789
FAX: +49 228 731775
Email Submission Address: chstein@astro.uni-bonn.de

Applications received before 15 December 2008 will receive full consideration. Women and minorities are particularly encouraged to apply.

For further information about the position, please contact ARTIST coordinator Jes Jörgensen (jes@astro.uni-bonn.de) or team members Wouter Vlemmings (wouter@astro.uni-bonn.de) or Frank Bertoldi (bertoldi@astro.uni-bonn.de).

See also http://www.astro.uni-bonn.de/ARC/artist/ (ARTIST homepage)
http://www.astro.uni-bonn.de/english/index.php (AIfA)
http://www.astro.uni-bonn.de/ARC/ (Bonn-Cologne-Bochum ARC Node)

Announcement

AKARI, a light to illuminate the misty Universe

to be held from February 16–19, 2009 at Fukutake Hall, The University of Tokyo, Tokyo, Japan

Objectives:
The goal of this meeting is to present latest results based on observations of AKARI together with related topics to the wide international community. AKARI is the Japanese satellite mission fully dedicated to infrared astronomy. It is a JAXA mission with the participation of ESA. AKARI was launched in February 2006 and completed an all-sky survey observation in 6 infrared bands from 9 to 160 μm in about 1.5 years. It also made staring observations in imaging and spectroscopic modes in the 2–180 μm wavelength range until 2007 August. It is now continuing near-infrared observations in the 2–5 μm range. The meeting covers a wide range of astronomical fields where AKARI made significant contributions, from solar system objects to cosmology.

Main topics:
Solar system objects and zodiacal light Planetary and star formation Stellar evolution and mass loss Interstellar medium Nearby galaxies Active galactic nuclei and ultra-luminous infrared galaxies Deep survey of remote galaxies Infrared cosmic background

Scientific Organizing Committee:
Takashi Onaka (UoT)
Yoshikazu Nakada (UoT)

Hiroshi Murakami (ISAS/JAXA)
Hideo Matsuhara (ISAS/JAXA)
Motohide Tamura (NAOJ)
Nobuo Arimoto (NAOJ)
Hidehiro Kaneda (Nagoya U)
Hyung Mok Lee (SNU)
Seungsoo Hong (SNU)
Michael Rowan-Robinson (IC)
Glenn White (Open U)
Martin Kessler (ESA)
Peter Barthel (RUG)
George Helou (IPAC)

Location:
This conference will be held in Fukutake Hall of the University of Tokyo (http://fukutake.iii.u-tokyo.ac.jp/english/index.html) located right in the center of Tokyo, Japan.

It is a brand new conference hall of the Interfaculty Initiative in Information Studies and equipped with the latest conference facilities. Since the University of Tokyo is located in the center of Tokyo, you can easily find out hotels and restaurants in close distances as well as places for entertainment.

WEB-site and registration: Additional information on the conference can be found at http://akari2009.com/

There will be room for contributed talks and posters.

If you are interested in the conference and would like to receive further information, please fill in the following preregistration form and send it to akari2009@ir.isas.jaxa.jp.

The conference web page will provide accommodation information soon.

We hope to see you in Tokyo in February.

On behalf of the SOC and LOC

Takashi Onaka

— Preregistration Form —

AKARI, a light to illuminate the misty Universe
February 16–19, 2009, at Fukutake Hall, The University of Tokyo, Tokyo, Japan

Name
Institute
e-mail address
Plan to make presentation Yes/No

— Send back to akari2009@ir.isas.jaxa.jp —

See also http://akari2009.com/