THE AGB NEWSLETTER

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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 181st issue of the AGB Newsletter. Among the posted items, several concern nucleosynthesis, mining the WISE data, or interferometry. An intriguing result is the analysis of dust in Kepler's supernova remnant and its possible origin in an AGB-star (+ white dwarf) progenitor system.

Congratulations to the Journal of the American Association of Variable Star Observers on its centennial! Please have a look at the two reviews in their celebratory issue, on Miras and R Corona Borealis stars.

We also would like to draw your attention to the two announcements, one of a newsletter on dust particles and another of a workshop in Paris on Betelgeuse and red supergiants.

The next issue is planned to be distributed on the 10th of September.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Where are the R Corona Borealis stars?

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

Refereed Journal Papers

Germanium, arsenic, and selenium abundances in metal-poor stars

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The elements germanium (Ge, $Z = 32$), arsenic (As, $Z = 33$), and selenium (Se, $Z = 34$) span the transition from charged-particle or explosive synthesis of the iron-group elements to neutron-capture synthesis of heavier elements. Among these three elements, only the chemical evolution of germanium has been studied previously. Here we use archive observations made with the Space Telescope Imaging Spectrograph on board the *Hubble* Space Telescope and observations from several ground-based facilities to study the chemical enrichment histories of seven stars with metallicities $-2.6 < [\mathrm{Fe/H}] < -0.4$. We perform a standard abundance analysis of germanium, arsenic, selenium, and several other elements produced by neutron-capture reactions. When combined with previous derivations of germanium abundances in metal-poor stars, our sample reveals an increase in the [Ge/Fe] ratios at higher metallicities. This could mark the onset of the weak s-process contribution to germanium. In contrast, the [As/Fe] and [Se/Fe] ratios remain roughly constant. These data do not directly indicate the origin of germanium, arsenic, and selenium at low metallicity, but they suggest that the weak and main components of the s-process are not likely sources.

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Available from arXiv:1207.0518

Formalism for inclusion of measured reaction cross sections in stellar rates including uncertainties and its application to neutron capture in the s-process

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A general formalism to include experimental reaction cross sections into calculations of stellar rates is presented. It also allows to assess the maximally possible reduction of uncertainties in the stellar rates by experiments. As an example for the application of the procedure, stellar neutron capture reactivities from KADoNiS v0.3 are revised and the remaining uncertainties shown. Many of the uncertainties in the stellar rates are larger than those obtained experimentally. This has important consequences for s-process models and the interpretation of meteoritic data because it allows the rates of some reactions to vary within a larger range than previously assumed.

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Available from arXiv:1207.1664
and from http://nucastro.org/tables.html#exp2stellar

Modeling the physical and excitation conditions of the molecular envelope of NGC 7027

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The link between the shaping of bipolar planetary nebulae and the mass ejection activity of their central stars is still poorly understood. Appropriately characterizing the evolution of the shells ejected during the late stages of stellar evolution and the interaction between these shells is fundamental to gain insight into the mechanism of nebular

shaping. This must include the study of the molecular emission, which tracks the mass-loss history during the late AGB and post-AGB stages, when the nebula is being actively shaped.
Herschel/HIFI provides an invaluable tool by opening a new window (most of the sub-mm and far infrared range is only acces- sible from space) from which to probe warm molecular gas ($\sim$ 50–1000 K). This paper presents a radiative-transfer, spatio-kinematic modeling of the molecular envelope of the young planetary nebula NGC 7027 in several high- and low-J ^{12}CO and ^{13}CO transitions observed by *Herschel*/HIFI and the IRAM 30-m radio-telescope, and discusses the structure and dynamics of the molecular envelope.
We have developed a code which, used along with the existing SHAPE software (Steffen et al. 2011), implements spatio-kinematic modeling with accurate non-LTE calculations of line excitation and radiative transfer in molecular species. We have used this code to build a relatively simple "russian doll" model to account for the physical and excitation conditions of the molecular envelope of NGC 7027.
The model nebula consists of four nested, mildly bipolar shells plus a pair of high-velocity blobs. The innermost shell is the thinnest and shows a significant jump in physical conditions (temperature, density, abundance and velocity) with respect to the adjacent shell. This is a clear indication of a shock front in the system, which may have played a role in the shaping of the nebula. Each of the high-velocity blobs is divided into two sections with considerably different physical conditions. The striking presence of H_2O in NGC 7027, a C-rich nebula, is likely due to photo-induced chemistry from the hot central star, although formation of water by shocks cannot be ruled out. The computed molecular mass of the nebula is 1.3 $M_\odot$, compatible with that derived from previous works.

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Oxygen and sodium abundances in M 13 (NGC 6205) giants: Linking globular cluster formation scenarios, deep mixing, and post-RGB evolution

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We present O, Na, and Fe abundances, as well as radial velocities, for 113 red giant branch (RGB) and asymptotic giant branch (AGB) stars in the globular cluster M 13. The abundances and velocities are based on spectra obtained with the WIYN–Hydra spectrograph, and the observations range in luminosity from the horizontal branch (HB) to RGB-tip. The results are examined in the context of recent globular cluster formation scenarios. We find that M 13 exhibits many key characteristics that suggest its formation and chemical enrichment are well-described by current models. Some of these observations include: the central concentration of O-poor stars, the notable decrease in [O/Fe] (but small increase in [Na/Fe]) with increasing luminosity that affects primarily the "extreme" population, the small fraction of stars with halo-like composition, and the paucity of O-poor AGB stars. In agreement with recent work, we conclude that the most O-poor M 13 giants are likely He-enriched and that most (all?) O-poor RGB stars evolve to become extreme HB and AGB-manqué stars. In contrast, the "primordial" and "intermediate" population stars appear to experience standard HB and AGB evolution.

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Polarization of light scattered by large aggregates

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Study of cosmic dust and planetary aerosols indicate that some of them contain a large number of aggregates of the

size that significantly exceeds the wavelengths of the visible light. In some cases such large aggregates may dominate in formation of the light scattering characteristics of the dust. In this paper we present the results of computer modeling of light scattering by aggregates that contain more than 1000 monomers of submicron size and study how their light scattering characteristics, specifically polarization, change with phase angle and wavelength. Such a modeling became possible due to development of a new version of Multi Sphere T-Matrix (MSTM) code for parallel computing. The results of the modeling are applied to the results of comet polarimetric observations to check if large aggregates dominate in formation of light scattering by comet dust. We compare aggregates of different structure and porosity. We show that large aggregates of more than 98% porosity (e.g., ballistic cluster–cluster aggregates) have angular dependence of polarization almost identical to the Rayleigh one. Large compact aggregates (less than 80% porosity) demonstrate the curves typical for solid particles. This rules out too porous and too compact aggregates as typical comet dust particles. We show that large aggregates not only can explain phase angle dependence of comet polarization in the near infrared but also may be responsible for the wavelength dependence of polarization, which can be related to their porosity.

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Available from arXiv:1206:6509
and from http://www.sciencedirect.com/science/article/pii/S0022407312000465

Classification study of WISE infrared sources: identification of candidate Asymptotic Giant Branch stars

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In the WISE all-sky source catalogue there are 76 million mid-infrared (MIR) point sources that were detected at the first three WISE bands and have association with only one 2MASS near-IR source within $3''$. We search for their identifications in the SIMBAD database and find 3.2 million identified sources. Based on these known sources, we establish three criteria for selecting candidate AGB stars in the Galaxy, which are three defined occupation zones in a color–color diagram, Galactic latitude $|g_{\rm b}| < 20°$, and "corrected" WISE third-band $W3_{\rm c} < 11$. Applying these criteria to the WISE+2MASS sources, 1.37 million of them are selected. We analyze the WISE third-band W3 distribution of the selected sources, and further establish that $W3 < 8$ is required in order to exclude a large fraction of normal stars in them. We therefore find 0.47 million candidate AGB stars in our Galaxy from the WISE source catalogue. Using $W3_{\rm c}$, we estimate their distances and derive their Galactic distributions. The candidates are generally located around the Galactic center uniformly, with 68% (1-σ) of them within approximately 8 kpc. We discuss that optical spectroscopy can be used to verify the C-rich AGB stars in our candidates, and they will be good targets for the LAMOST survey that is planned to start from fall of 2012.

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The distance and size of the red hypergiant NML Cyg from VLBA and VLA astrometry

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We have measured the annual parallax and proper motion of NML Cyg from multiple epoch VLBA observations of

the circumstellar H_2O and SiO masers. The measured parallax of NML Cyg is 0.620 ± 0.047 mas, corresponding to a distance of 1.61 ± 0.12 kpc. The measured proper motion of NML Cyg is $\mu_x = -1.55 \pm 0.42$ mas yr^{-1} eastward and $\mu_y = -4.59 \pm 0.41$ mas yr^{-1} northward. Both the distance and proper motion are consistent with that of Cyg OB2, within their joint uncertainty, confirming their association. Taking into consideration molecular absorption signatures seen toward NML Cyg, we suggest that NML Cyg lies on the far side of the Cyg OB2 association. The stellar luminosity revised with our distance brings NML Cyg significantly below the empirical luminosity limit for a red supergiant. Using the VLA observation the radio photosphere and the SiO maser as a phase reference, we partially resolve the radio photosphere of NML Cyg at 43 GHz and find its diameter is about 44 mas, suggesting an optical stellar diameter of 22 mas, if the size of radio photosphere is 2 times the optical photosphere. Based on the position of circumstellar SiO masers relative to the radio photosphere, we estimate the absolute position of NML Cyg at epoch 2008.868 to be $R.A. = 20^h46^m25\overset{s}{.}5382 \pm 0\overset{s}{.}0010$, $Decl. = 40°06'59\overset{''}{.}379 \pm 0\overset{''}{.}015$. The peculiar motions of NML Cyg, the average of stars in Cyg OB2, and four other star-forming regions rules out that an expanding "Strömgren sphere" centered on Cyg OB2 is responsible for the kinematics of the Cygnus X region.

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Evolved star water maser cloud size determined by star size

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Cool, evolved stars undergo copious mass loss but the details of how the matter is returned to the ISM are still under debate. We investigated the structure and evolution of the wind at 5 to 50 stellar radii from Asymptotic Giant Branch (AGB) and red supergiant stars (RSGs). 22-GHz water masers around seven evolved stars were imaged using MERLIN, at sub-AU resolution. Each source was observed at between 2 and 7 epochs (several stellar periods). We compared our results with long-term Pushchino single dish monitoring. The 22-GHz emission is located in approximately spherical, thick, unevenly filled shells. The outflow velocity doubles between the inner and outer shell limits. Water maser clumps could be matched at successive epochs separated by < 2 years for AGB stars, or at least 5 years for RSG. This is much shorter than the decades taken for the wind to cross the maser shell, and comparison with spectral monitoring shows that some features fade and reappear. In 5 sources, most of the matched features brighten or dim in concert from one epoch to the next. One cloud in W Hya was caught in the act of passing in front of a background cloud leading to 50-fold, transient amplification. The masing clouds are 1–2 orders of magnitude denser than the wind average and contain a substantial fraction of the mass loss in this region, with a filling factor $< 1\%$. The RSG clouds are $\sim 10\times$ bigger than those round the AGB stars. Proper motions are dominated by expansion, with no systematic rotation. The maser clouds survive for decades (the shell crossing time) but the masers are not always beamed in our direction. Radiative effects cause changes in flux density throughout the maser shells on short timescales. Cloud size is proportional to parent star size; clouds have a similar radius to the star in the 22-GHz maser shell. Stellar properties such as convection cells must determine the clumping scale.

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Dust and molecular shells in asymptotic giant branch stars – Mid-infrared interferometric observations of R Aql, R Aqr, R Hya, W Hya and V Hya

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Mid-IR (8–13 μm) interferometric data of four oxygen-rich AGB stars (R Aql, R Aqr, R Hya, and W Hya) and one carbon-rich AGB star (V Hya) were obtained with MIDI/VLTI between April 2007 and September 2009. The spectrally dispersed visibility data are analyzed by fitting a circular fully limb-darkened disk (FDD). The FDD diameter as function of wavelength is similar for all oxygen-rich stars. The apparent size is almost constant between 8 and 10 μm and gradually increases at wavelengths longer than 10 μm. The apparent FDD diameter in the carbon-rich star V Hya essentially decreases from 8 to 12 μm. The FDD diameters are about 2.2 times larger than the photospheric diameters estimated from K-band observations found in the literature. The silicate dust shells of R Aql, R Hya and W Hya are located fairly far away from the star, while the silicate dust shell of R Aqr and the amorphous carbon (AMC) and SiC dust shell of V Hya are found to be closer to the star at around 8 photospheric radii. Phase-to-phase variations of the diameters of the oxygen-rich stars could be measured and are on the order of 15% but with large uncertainties. From a comparison of the diameter trend with the trends in RR Sco and S Ori it can be concluded that in oxygen-rich stars the overall larger diameter originates from a warm molecular layer of H_2O, and the gradual increase longward of 10 μm can be most likely attributed to the contribution of a close Al_2O_3 dust shell. The chromatic trend of the Gaussian FWHM in V Hya can be explained with the presence of AMC and SiC dust. The observations suggest that the formation of amorphous Al_2O_3 in oxygen-rich stars occurs mainly around or after visual minimum. However, no firm conclusions can be drawn concerning the mass-loss mechanism.

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GASKAP – The Galactic ASKAP Survey

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A survey of the Milky Way disk and the Magellanic System at the wavelengths of the 21-cm atomic hydrogen (H I) line and three 18-cm lines of the OH molecule will be carried out with the Australian Square Kilometre Array Pathfinder telescope. The survey will study the distribution of H I emission and absorption with unprecedented angular and velocity resolution, as well as molecular line thermal emission, absorption, and maser lines. The area to be covered includes the Galactic plane ($|b| < 10°$) at all declinations south of $\delta = +40°$, spanning longitudes 167° through 360° to 79° at $b = 0°$, plus the entire area of the Magellanic Stream and Clouds, a total of 13,020 square degrees. The brightness temperature sensitivity will be very good, typically $\sigma_T \simeq 1$ K at resolution 30″ and 1 km s^{-1}. The survey has a wide spectrum of scientific goals, from studies of galaxy evolution to star formation, with particular contributions

to understanding stellar wind kinematics, the thermal phases of the interstellar medium, the interaction between gas in the disk and halo, and the dynamical and thermal states of gas at various positions along the Magellanic Stream.

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Substellar companions to seven evolved intermediate-mass stars

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We report the detections of substellar companions orbiting around seven evolved intermediate-mass stars from precise Doppler measurements at Okayama Astrophysical Observatory. o UMa (G4 II–III) is a giant with a mass of 3.1 $M_\odot$ and hosts a planet with minimum mass of $m_2 \sin i = 4.1$ M_J in an orbit with a period $P = 1630$ d and an eccentricity $e = 0.13$. This is the first planet candidate (< 13 M_J) ever discovered around stars more massive than 3 $M_\odot$. o CrB (K0 III) is a 2.1 $M_\odot$ giant and has a planet of $m_2 \sin i = 1.5$ M_J in a 187.8 d orbit with $e = 0.19$. This is one of the least massive planets ever discovered around ~ 2 $M_\odot$ stars. HD 5608 (K0 IV) is an 1.6 $M_\odot$ subgiant hosting a planet of $m_2 \sin i = 1.4$ M_J in a 793 d orbit with $e = 0.19$. The star also exhibits a linear velocity trend suggesting the existence of an outer, more massive companion. 75 Cet (G3 III:) is a 2.5 $M_\odot$ giant hosting a planet of $m_2 \sin i = 3.0$ M_J in a 692 d orbit with $e = 0.12$. The star also shows possible additional periodicity of about 200 d and 1880 d with velocity amplitude of ~ 7–10 m s^{-1}, although these are not significant at this stage. ν Oph (K0 III) is a 3.0 $M_\odot$ giant and has two brown-dwarf companions of $m_2 \sin i = 24$ M_J and 27 M_J, in orbits with $P = 530.3$ d and 3190 d, and $e = 0.126$ and 0.17, respectively, which were independently announced by Quirrenbach et al. (2011). The ratio of the periods is close to 1:6, suggesting that the companions are in mean motion resonance. We also independently confirmed planets around κ CrB (K0 III–IV) and HD 210702 (K1 IV), which had been announced by Johnson et al. (2008) and Johnson et al. (2007a), respectively. All of the orbital parameters we obtained are consistent with the previous results.

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Models for the lithium abundances of multiple populations in globular clusters and the possible role of the Big Bang lithium

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Globular cluster stars show chemical abundance patterns typical of hot-CNO processing. Lithium is easily destroyed by proton capture in stellar environments, so its abundance may be crucial to discriminate among different models proposed to account for multiple populations. In order to reproduce the observed O–Na anticorrelation and other patterns typical of multiple populations, the formation of second generation stars must occur from the nuclearly processed stellar ejecta, responsible of the chemical anomalies, diluted with pristine gas having the composition of first generation stars. The lithium abundance in the unprocessed gas – which is very likely to be equal to the lithium abundance emerging from the Big Bang – affects the lithium chemical patterns among the cluster stars. This paper

focuses on a scenario in which processed gas is provided by asymptotic giant branch (AGB) stars. We examine the predictions of this scenario for the lithium abundances of multiple populations. We study the role of the non-negligible lithium abundance in the ejecta of massive AGB (A(Li) $\sim$ 2), and, at the same time, we explore how our models can constrain the extremely large – and very model dependent – lithium yields predicted by recent super-AGB models. We show that the super-AGB yields may be tested by examining the lithium abundances in a large set of blue main sequence stars in ω Cen and/or NGC 2808. In addition, we examine the different model results obtained by assuming for the pristine gas either the Big Bang abundance predicted by the standard models (A(Li) = 2.6–2.7), or the abundance detected at the surface of population II stars (A(Li) = 2.2–2.3). Once a chemical model is well constrained, the O–Li distribution could perhaps be used to shed light on the primordial lithium abundance.

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Swift/UVOT photometry of the planetary nebula WeBo 1: Unmasking a faint hot companion star

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We present an analysis of over 150 ks of data on the planetary nebula WeBo 1 (PN G 135.6+01.0) obtained with the Swift/Ultraviolet Optical Telescope (UVOT). The central object of this nebula has previously been described as a late-type K giant barium star with a possible hot companion, most likely a young pre-white dwarf. UVOT photometry shows that while the optical photometry is consistent with a large cool object, the near-ultraviolet (UV) photometry shows far more UV flux than could be produced by any late-type object. Using model stellar atmospheres and a comparison to UVOT photometry for the pre-white dwarf PG 1159−035, we find that the companion has a temperature of at least 40,000 K and a radius of, at most, 0.056 $R_\odot$. While the temperature and radius are consistent with a hot compact stellar remnant, they are lower and larger, respectively, than expected for a typical young pre-white dwarf. This likely indicates a deficiency in the assumed UV extinction curve. We find that higher temperatures more consistent with expectations for a pre-white dwarf can be derived if the foreground dust has a strong "blue bump" at 2175 Å and a lower R_V. Our results demonstrate the ability of Swift to both uncover and characterize hot hidden companion stars and to constrain the UV extinction properties of foreground dust based solely on UVOT photometry.

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Dust shell model of the water fountain source IRAS 16342−3814

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We investigate the circumstellar dust shell of the water fountain source IRAS 16342−3814. We performed two-dimensional radiative transfer modeling of the dust shell, taking into account previously observed spectral energy distributions (SEDs) and our new J-band imaging and H- and K_s-band imaging polarimetry obtained using the VLT/NACO instrument. Previous observations expect an optically thick torus in the equatorial plane because of a striking bipolar appearance and a large viewing angle of 30–40°. However, models with such a torus as well as a bipolar lobe and an AGB shell cannot fit the SED and the images simultaneously. We find that an additional optically and geometrically thick disk located inside a massive torus solves this problem. The masses of the disk and

the torus are estimated to be 0.01 $M_\odot$ at the $a_{max} = 100$ μm dust and 1 $M_\odot$ at $a_{max} = 10$ μm dust, respectively. We discuss a possible formation scenario for the disk and torus based on a similar mechanism to the equatorial back flow. IRAS 16342−3814 is expected to undergo mass loss at a high rate. The radiation from the central star is shielded by the dust that was ejected in the subsequent mass loss event. As a result, the radiation pressure on dust particles cannot govern the motion of the particles anymore. The mass loss flow can be concentrated in the equatorial plane by help of an interaction, which might be the gravitational attraction by the companion, if it exists in IRAS 16342−3814. A fraction of the ejecta is captured in a circum-companion or circum-binary disk and the remains are escaping from the central star(s) and form the massive torus.

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Discovery of a halo around the Helix Nebula NGC 7293 in the WISE all-sky survey

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We report the discovery of an extended halo (40′ in diameter) around the planetary nebula NGC 7293 (the Helix Nebula) observed in the 12 μm band from the Wide-field Infrared Survey Explorer all-sky survey (WISE). The mid-infrared halo has an axisymmetric structure with a sharp boundary to the northeast and a more diffuse boundary to the southwest, suggesting an interaction between the stellar wind and the interstellar medium (ISM). The symmetry axis of the halo is well aligned with that of a northeast arc, suggesting that the two structures are physically associated. We have attempted to fit the observed geometry with a model of a moving steady-state stellar wind interacting with the ISM. Possible combinations of the ISM density and the stellar velocity are derived from these fittings. The discrepancies between the model and the observations suggest that the stellar mass loss has a more complicated history, including possible time and angle dependences.

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Dust in a type Ia supernova progenitor: *Spitzer* spectroscopy of Kepler's supernova remnant

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Characterization of the relatively poorly-understood progenitor systems of type Ia supernovae is of great importance in astrophysics, particularly given the important cosmological role that these supernovae play. Kepler's supernova remnant, the result of a type Ia supernova, shows evidence for an interaction with a dense circumstellar medium (CSM), suggesting a single-degenerate progenitor system. We present 7.5–38 μm infrared (IR) spectra of the remnant, obtained with the *Spitzer* Space Telescope, dominated by emission from warm dust. Broad spectral features at 10 and 18 μm, consistent with various silicate particles, are seen throughout. These silicates were likely formed in the stellar outflow from the progenitor system during the AGB stage of evolution, and imply an oxygen-rich chemistry. In addition

to silicate dust, a second component, possibly carbonaceous dust, is necessary to account for the short-wavelength IRS and IRAC data. This could imply a mixed chemistry in the atmosphere of the progenitor system. However, non-spherical metallic iron inclusions within silicate grains provide an alternative solution. Models of collisionally-heated dust emission from fast shocks (> 1000 km s^{-1}) propagating into the CSM can reproduce the majority of the emission associated with non-radiative filaments, where dust temperatures are ~ 80–100 K, but fail to account for the highest temperatures detected, in excess of 150 K. We find that slower shocks (a few hundred km s^{-1}) into moderate density material ($n_0 \sim 50$–250 cm^{-3}) are the only viable source of heating for this hottest dust. We confirm the finding of an overall density gradient, with densities in the north being an order of magnitude greater than those in the south.

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A CH star in the globular cluster NGC 6426

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We report on the serendipitous discovery of a carbon star near the centre of the low-metallicity globular cluster NGC 6426. We determined its membership and chemical properties using medium-resolution spectra. The radial velocity of -159 km s^{-1} makes it a member of the cluster. We used photometric data from the literature and the COMARCS stellar atmospheric models to derive its luminosity, effective temperature, surface gravity, metallicity, and approximate C, N, and O abundance ratios. According to these properties, we suggest that this star is a genuine carbon rich low-metallicity AGB star.

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Detection of an asymmetry in the envelope of the carbon Mira R Fornacis using VLTI/MIDI

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Aims: We present a study of the envelope morphology of the carbon Mira R For with VLTI/MIDI. This object is one of the few asymptotic giant branch (AGB) stars that underwent a dust-obscuration event. The cause of such events is still a matter of discussion. Several symmetric and asymmetric scenarios have been suggested in the literature.
Methods: Mid-infrared interferometric observations were obtained separated by two years. The observations probe different depths of the atmosphere and cover different pulsation phases. The visibilities and the differential phases were interpreted using GEM-FIND, a tool for fitting spectrally dispersed interferometric observations with the help of wavelength-dependent geometric models.
Results: We report the detection of an asymmetric structure revealed through the MIDI differential phase. This asymmetry is observed at the same baseline and position angle two years later. The observations are best simulated with a model that includes a uniform-disc plus a Gaussian envelope plus a point-source. The geometric model can

reproduce both the visibilities and the differential phase signatures.
Conclusions: Our MIDI data favour explanations of the R For obscuration event that are based on an asymmetric geometry. We clearly detect a photocentre shift between the star and the strongly resolved dust component. This might be caused by a dust clump or a substellar companion. However, the available observations do not allow us to distinguish between the two options. The finding has strong implications for future studies of the geometry of the envelope of AGB stars: if this is a binary, are all AGB stars that show an obscuration event binaries as well? Or are we looking at asymmetric mass-loss processes (i.e. dusty clumps) in the inner part of a carbon-rich Mira?

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On the excitation and formation of circumstellar fullerenes

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We compare and analyze the *Spitzer* mid-infrared spectrum of three fullerene-rich planetary nebulae in the Milky Way and the Magellanic Clouds; Tc 1, SMP SMC 16, and SMP LMC 56. The three planetary nebulae share many spectroscopic similarities. The strongest circumstellar emission bands correspond to the infrared active vibrational modes of the fullerene species C_{60} and little or no emission is present from Polycyclic Aromatic Hydrocarbons (PAHs). The strength of the fullerene bands in the three planetary nebulae is very similar, while the ratio of the [Ne III]15.5μm/[Ne II]12.8μm fine structure lines, an indicator of the strength of the radiation field, is markedly different. This raises questions about their excitation mechanism and we compare the fullerene emission to fluorescent and thermal models. In addition, the spectra show other interesting and common features, most notably in the 6–9 μm region, where a broad plateau with substructure dominates the emission. These features have previously been associated with mixtures of aromatic/aliphatic hydrocarbon solids. We hypothesize on the origin of this band, which is likely related to the fullerene formation mechanism, and compare it with modeled Hydrogenated Amorphous Carbon that present emission in this region.

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Review Papers

Miras

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Mira variables share essential characteristics: High visual amplitude, periods of hundreds of days, red colors (spectral types M, S, and C), and the presence of emission lines at some phases. They are fundamental mode pulsators, with progenitor masses ranging from > 1 to several solar masses. In this review, we summarize what is known from modeling and observational studies, including recent measurements from optical and IR interferometry, and studies involving large samples of stars particularly in the Magellanic Clouds. While we have a good idea of how these stars fit into the big picture of stellar evolution, many important details remain to be settled by a combination of more ambitious models and new observational techniques. Carrying on observations of bright Mira variables will be essential

for interpreting observations of large numbers of fainter sources as well as for assessing the completeness and accuracy of the models.

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What are the R Coronae Borealis stars?

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The R Coronae Borealis (RCB) stars are rare hydrogen-deficient, carbon-rich, supergiants, best known for their spectacular declines in brightness at irregular intervals. Efforts to discover more RCB stars have more than doubled the number known in the last few years and they appear to be members of an old, bulge population. Two evolutionary scenarios have been suggested for producing an RCB star, a double degenerate merger of two white dwarfs, or a final helium shell flash in a planetary nebula central star. The evidence pointing toward one or the other is somewhat contradictory, but the discovery that RCB stars have large amounts of ^{18}O has tilted the scales towards the merger scenario. If the RCB stars are the product of white dwarf mergers, this would be a very exciting result since RCB stars would then be low-mass analogs of type Ia supernovae. The predicted number of RCB stars in the Galaxy is consistent with the predicted number of He/CO WD mergers. But, so far, only about 65 of the predicted 5000 RCB stars in the Galaxy have been discovered. The mystery has yet to be solved.

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Announcements

ELSnews: online newsletter that covers remote sensing of cosmic dust and planetary aerosols and surfaces

See our online newsletter at http://www.astro.umd.edu/∼elsnews to learn about new developments in theory, modeling, experiments, and observations that use electromagnetic and light-scattering techniques to study dust particles and surfaces. The newsletter also informs about meetings, papers, awards, and other issues related to this topic. Subscribe to ELSnews or submit your information to the newsletter at elsnews@astro.umd.edu.

See also http://www.astro.umd.edu/∼elsnews/

Betelgeuse Workshop, Paris, Nov. 26–29, 2012

We are organizing a workshop in Paris on the physics of red supergiants, with a special focus on the emblematic object of this class: Betelgeuse.

The goal of this meeting is to assemble a comprehensive description of the different regions constitutive of Betelgeuse, to understand how the different regions interact with each other, and eventually how red supergiants are functioning.

We foresee a genuine workshop format with many opportunities for exchanges among 50 participants who actively carry out research on Betelgeuse, and/or on similar objects. Please refer to the web site for further details.

See also http://betelgeuse.sciencesconf.org/