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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 230th issue of the AGB Newsletter.

Don't forget to get your Letter of Intent in by the mid-September deadline, for an IAU Symposium or Focus Meeting during the General Assembly (in Vienna) year of 2018. The IAU Commission G3 "Stellar Evolution" would be happy to endorse well-thought-through proposals for meetings (IAU or otherwise) related to stellar evolution.

The next issue is planned to be distributed around the 1st of October.

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

Food for Thought

This month's thought-provoking statement is:

What do long secondary periods really measure?

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

Refereed Journal Papers

M 31N 2008-12a – The remarkable recurrent nova in M 31: pan-chromatic observations of the 2015 eruption

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The Andromeda Galaxy recurrent nova M 31N 2008-12a had been observed in eruption ten times, including yearly eruptions from 2008–2014. With a measured recurrence period of $P_{\rm rec} = 351 \pm 13$ d (we believe the true value to be half of this) and a white dwarf very close to the Chandrasekhar limit, M 31N 2008-12a has become the leading pre-explosion supernova type Ia progenitor candidate. Following multi-wavelength follow-up observations of the 2013 and 2014 eruptions, we initiated a campaign to ensure early detection of the predicted 2015 eruption, which triggered ambitious ground and space-based follow-up programs. In this paper we present the 2015 detection; visible to near-infrared photometry and visible spectroscopy; and ultraviolet and X-ray observations from the Swift observatory. The LCOGT 2m (Hawaii) discovered the 2015 eruption, estimated to have commenced at Aug. 28.28 ± 0.12 UT. The 2013–2015 eruptions are remarkably similar at all wavelengths. New early spectroscopic observations reveal short-lived emission from material with velocities $\sim 13\,000$ km s^{-1}, possibly collimated outflows. Photometric and spectroscopic observations of the eruption provide strong evidence supporting a red giant donor. An apparently stochastic variability during the early super-soft X-ray phase was comparable in amplitude and duration to past eruptions, but the 2013 and 2015 eruptions show evidence of a brief flux dip during this phase. The multi-eruption Swift/XRT spectra show tentative evidence of high-ionization emission lines above a high-temperature continuum. Following Henze et al. (2015), the updated recurrence period based on all known eruptions is $P_{\rm rec} = 174 \pm 10$ d, and we expect the next eruption of M 31N 2008-12a to occur around mid-Sep. 2016.

Submitted to ApJS
Available from http://arxiv.org/abs/1607.08082

Observations of the planetary nebula RWT 152 with OSIRIS/GTC

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RWT 152 is one of the few known planetary nebulæ with an sdO central star. We present subarcsecond red tunable filter Hα imaging and intermediate-resolution, long-slit spectroscopy of RWT 152 obtained with OSIRIS/GTC with the goal of analyzing its properties. The Hα image reveals a bipolar nebula with a bright equatorial region and multiple bubbles in the main lobes. A faint circular halo surrounds the main nebula. The nebular spectra reveal a very low-excitation nebula with weak emission lines from H^+, He^+, and double-ionized metals, and absence of emission lines from neutral and single-ionized metals, except for an extremely faint [N II] 6584 emission line. These spectra may be explained if RWT 152 is a density-bounded planetary nebula. Low nebular chemical abundances of S, O, Ar, N, and Ne are obtained in RWT 152, which, together with the derived high peculiar velocity ($\sim$ 92–131 km s^{-1}), indicate that this object is a Halo planetary nebula. The available data are consistent with RWT 152 evolving from a low-mass progenitor ($\sim$ 1 M$_\odot$) formed in a metal-poor environment.

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Post main sequence evolution of icy minor planets: implications for water retention and white dwarf pollution

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Most observations of polluted white dwarf atmospheres are consistent with accretion of water depleted planetary material. Among tens of known cases, merely two cases involve accretion of objects that contain a considerable mass fraction of water. The purpose of this study is to investigate the relative scarcity of these detections. Based on a new and highly detailed model, we evaluate the retention of water inside icy minor planets during the high luminosity stellar evolution that follows the main sequence. Our model fully considers the thermal, physical, and chemical evolution of icy bodies, following their internal differentiation as well as water depletion, from the moment of their birth and through all stellar evolution phases preceding the formation of the white dwarf. We also account for different initial compositions and formation times. Our results show that previous studies have either underestimated or overestimated water retention. We also reaffirm that water can survive in a variety of circumstances and in great quantities, and therefore other possibilities are discussed in order to explain the infrequency of water detections. We find that the most likely explanation is that water does not survive the dissociation of tidally disrupted minor planets, and instead a direct impact onto the white dwarf is required. We show that this possibility is statistically plausible, and predict that if this hypothesis is correct, future observations of extremely water rich atmospheres will involve only helium dominated DB white dwarfs.

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The abundance of lithium in an AGB star in the globular cluster M 3 (NGC 5272)

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A survey of red giants in the globular cluster M 3 with the Hydra multi-object spectrograph on the WIYN 3.5-m telescope indicated a prominent Li I 6707 Å feature in the red giant vZ 1050. Follow-up spectroscopy with the ARC 3.5-m telescope confirmed this observation and yielded a derived abundance of $A(\mathrm{Li})_{\mathrm{NLTE}} = 1.6 \pm 0.05$. In addition, the high oxygen and low sodium abundances measured from the same spectrum suggest that vZ 1050 is a first generation cluster star. The location vZ 1050 above the horizontal branch and blueward of the red giant branch in the cluster's color–magnitude diagram places vZ 1050 on M 3's asymptotic giant branch. The likely source for the enhanced lithium abundance is the Cameron–Fowler mechanism operating in vZ 1050 itself.

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The far-ultraviolet spectra of two hot PG 1159 stars

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PG 1159 stars are hot, hydrogen-deficient (pre-) white dwarfs with atmospheres mainly composed of helium, carbon, and oxygen. The unusual surface chemistry is the result of a late helium-shell flash. Observed element abundances enable us to test stellar evolution models quantitatively with respect to their nucleosynthesis products formed near the helium-burning shell of the progenitor asymptotic giant branch stars. Because of the high effective temperatures (T_{eff}), abundance determinations require ultraviolet spectroscopy and non-local thermodynamic equilibrium model atmosphere analyses. Up to now, we have presented results for the prototype of this spectral class and two cooler members (T_{eff} in the range 85 000–140 000 K). Here we report on the results for two even hotter stars (PG 1520+525 and PG 1144+005, both with $T_{\mathrm{eff}} = 150\,000$ K) which are the only two objects in this temperature–gravity region for which useful far-ultraviolet spectra are available, and revisit the prototype star. Previous results on the abundances of some species are confirmed, while results on others (Si, P, S) are revised. In particular, a solar abundance of sulphur is measured in contrast to earlier claims of a strong S deficiency that contradicted stellar evolution models. For the first time, we assess the abundances of Na, Al, and Cl with newly constructed non-LTE model atoms. Besides the main constituents (He, C, O), we determine the abundances (or upper limits) of N, F, Ne, Na, Al, Si, P, S, Cl, Ar, and Fe. Generally, good agreement with stellar models is found.

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Hubble Space Telescope constraints on the winds and astrospheres of red giant stars

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We report on an ultraviolet spectroscopic survey of red giants observed by the *Hubble* Space Telescope, focusing on spectra of the Mg II h & k lines near 2800 Å in order to study stellar chromospheric emission, winds, and astrospheric absorption. We focus on spectral types between K2 III and M5 III, a spectral type range with stars that are noncoronal, but possessing strong, chromospheric winds. We find a very tight relation between Mg II surface flux and photospheric temperature, supporting the notion that all K2–M5 III stars are emitting at a basal flux level. Wind velocities ($V_{\rm w}$) are generally found to decrease with spectral type, with $V_{\rm w}$ decreasing from ~ 40 km s^{-1} at K2 III to ~ 20 km s^{-1} at M5 III. We find two new detections of astrospheric absorption, for σ Pup (K5 III) and γ Eri (M1 III). This absorption signature had previously only been detected for α Tau (K5 III). For the three astrospheric detections the temperature of the wind after the termination shock correlates with $V_{\rm w}$, but is lower than predicted by the Rankine–Hugoniot shock jump conditions, consistent with the idea that red giant termination shocks are radiative shocks rather than simple hydrodynamic shocks. A full hydrodynamic simulation of the γ Eri astrosphere is provided to explore this further.

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Spectral identification of the u-band variable sources in two LAMOST fields

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We selected 82 u-band variable objects based on the u-band photometry data from SCUSS and SDSS, in the field of LAMOST Complete Spectroscopic Survey of Pointing Area at Southern Galactic Cap. The magnitude variation of the targets is restricted to larger than 0.2 mag and limiting magnitude down to 19.0 mag in u-band. According to the spectra from LAMOST, there are 11 quasars with red-shift between 0.4 and 1.8, 60 variable stars and 11 unidentified targets. The variable stars include one active M-dwarf with a series of Balmer emission lines, seven Horizontal Branch stars containing six RR Lyræ stars matching with SIMBAD, and one giant, one AGB star and two RR Lyræ candidates by different colour selections. All these variable stars mainly locate near the main sequence in the g–r verse u–g diagram. The quasars are well distinguished from stars by both u–g colour and variation in u-band.

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Composite circumstellar dust grains

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We calculate the absorption efficiencies of composite silicate grains with inclusions of graphite and silicon carbide in the spectral range 5–25 μm. We study the variation in absorption profiles with volume fractions of inclusions. In particular we study the variation in the wavelength of peak absorption at 10 and 18 μm. We also study the variation of the absorption of porous silicate grains. We use the absorption efficiencies to calculate the infrared flux at various dust temperatures and compare with the observed infrared emission flux from the circumstellar dust around some M-Type & AGB stars obtained from IRAS and a few stars from *Spitzer* satellite. We interpret the observed data in terms of the circumstellar dust grain sizes; shape; composition and dust temperature.

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Accretion of pristine gas and dilution during the formation of multiple-population globular clusters

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We study the interaction of the early spherical GC wind powered by Type II supernovæ (SNe II) with the surrounding ambient medium consisting of the gaseous disk of a star forming galaxy at redshift $z \gtrsim 2$. The bubble formed by the wind eventually breaks out of the disk, and most of the wind moves directly out of the galaxy and is definitively lost. The fraction of the wind moving nearly parallel to the galactic plane carves a hole in the disk which will contract after the end of the SN activity. During the interval of time between the end of the SN explosions and the "closure" of the hole, very O-poor stars (the Extreme population) can form out of the super-AGB (asymptotic giant branch) ejecta collected in the GC center. Once the hole contracts, the AGB ejecta mix with the pristine gas, allowing the formation of stars with an oxygen abundance intermediate between that of the very O-poor stars and that of the pristine gas. We show that this mechanism may explain why Extreme populations are present only in massive clusters, and can also produce a correlation between the spread in helium and the cluster mass.
Finally, we also explore the possibility that our proposed mechanism can be extended to the case of multiple populations showing bimodality in the iron content, with the presence of two populations characterized by a small difference in [Fe/H]. Such a result can be obtained taking into account the contribution of delayed SN II.

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Long Period Variables: questioning the pulsation paradigm

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Long period variables, among them Miras, are thought to be pulsating. Under this approach the whole star inflates and deflates along a period that can vary from 100 to 900 days; that pulsation is assumed to produce shock waves on the outer layers of the star that propagate into the atmosphere and could account for the increase in luminosity and the presence of emission lines in the spectra of these stars. However, this paradigm can seriously be questioned from a theoretical point of view. First, in order to maintain a radial pulsation, the spherical symmetry of the star must be preserved: how can it be reconciled with the large convective cells present in these stars? or when close companions are detected? Secondly, how different radial and non-radial pulsation modes of a sphere could be all damped except one radial mode? These problems have no solution and significantly weigh on the pulsation paradigm. Acknowledging this inconsistency, we show that a close companion around these stars could account for the star variability. To support this assertion we study the observed light curves, their shapes at different wavelengths and their changes over time.

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Compact planetary nebulæ in the Galactic Disk: analysis of the central stars

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We have obtained multi-wavelength observations of compact Galactic planetary nebulæ (PNe) to probe post-Asymptotic

Giant Branch (AGB) evolution from the onset of nebular ejection. We analyze new observations from HST to derive the masses and evolutionary status of their central stars (CSs) in order to better understand the relationship between the CS properties and those of the surrounding nebulæ. We also compare this sample with others we obtained using the same technique in different metallicity environments: the Large and Small Magellanic Clouds. We work with HST/WFC3 images of 51 targets obtained in a snapshot survey (GO-11657). The high spatial resolution of HST allows us to resolve these compact PNe and distinguish the CS emission from that of their surrounding PNe. The targets were imaged through the filters F200LP, F350LP, and F814W from which we derive Johnson V and I magnitudes. We derive CS bolometric luminosities and effective temperatures using the Zanstra technique, from a combination of HST photometry and ground-based spectroscopic data. We present new unique photometric measurements of 50 CSs, and derived effective temperatures and luminosities for most of them. Central star masses for 23 targets were derived by placing the stars on a temperature–luminosity diagram and compare their location with the best available single star post-AGB evolutionary tracks; the remaining masses were indeterminate most likely because of underestimates of the stellar temperature, or because of substantial errors in the adopted statistical distances to these objects. The distribution of CS masses in the sample of compact PNe is different than sample in the LMC and SMC, but with a median mass of 0.59 $M_\odot$ it is similar to other Galactic samples. We conclude that the compact nature of many of the PNe is a result of their large distance, rather than their physical dimension.

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The mass-loss rates of red supergiants at low metallicity: Detection of rotational CO emission from two red supergiants in the Large Magellanic Cloud

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Using the PACS and SPIRE spectrometers on-board the *Herschel* Space Observatory, we obtained spectra of two red supergiants (RSGs) in the Large Magellanic Cloud (LMC). Multiple rotational CO emission lines ($J = 6$–5 to 15–14) and 15 H_2O lines were detected from IRAS 05280−6910, and one CO line was detected from WOH G64. This is the first time CO rotational lines have been detected from evolved stars in the LMC. Their CO line intensities are as strong as those of the Galactic RSG, VY CMa. Modelling the CO lines and the spectral energy distribution results in an estimated mass-loss rate for IRAS 05280−6910 of 3×10^{-4} $M_\odot$ yr^{-1}. The model assumes a gas-to-dust ratio and a CO-to-H_2 abundance ratio is estimated from the Galactic values scaled by the LMC metallicity ([Fe/H] ~ -0.3), i.e., that the CO-to-dust ratio is constant for Galactic and LMC metallicities within the uncertainties of the model. The key factor determining the CO line intensities and the mass-loss rate found to be the stellar luminosity.

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Studies of the long secondary periods in pulsating red giants

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We have used systematic, sustained visual observations from the AAVSO International Database, and the AAVSO time-series analysis package VSTAR to study the unexplained "long secondary periods" (LSPs) in 27 pulsating red giants. In our sample, the LSPs range from 479 to 2967 days, and are on average 8.1 ± 1.3 times the pulsation period. There is no evidence for more than one LSP in each star. In stars with both the fundamental and first overtone radial period present, the LSP is more often about 10 times the latter. The visual amplitudes of the LSPs are typically 0.1 magnitude, and do not correlate with the LSP. The phase curves tend to be sinusoidal, but at least two are sawtooth. The LSPs are stable, within their errors, over the timespan of our data, which is typically 25 000 days. The amplitudes, however, vary by up to a factor of two or more on a time scale of roughly 20–30 LSPs. There is no obvious difference between the behaviour of the carbon (C) stars and the normal oxygen (M) stars. Previous multicolour photoelectric observations showed that the LSP colour variations are similar to those of the pulsation period, and of the LSPs in the Magellanic Clouds, and not like those of eclipsing stars. We note that the LSPs are similar to the estimated rotation periods of the stars, though the latter have large uncertainties. This suggests that the LSP phenomenon may be a form of modulated rotational variability.

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ALMA observations of the vibrationally-excited rotational CO transition $v = 1$, $J = 3$–2 towards five AGB stars

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We report the serendipitous detection with ALMA of the vibrationally-excited pure-rotational CO transition $v = 1$, $J = 3$–2 towards five asymptotic giant branch (AGB) stars, o Cet, R Aqr, R Scl, W Aql, and π^1 Gru. The observed lines are formed in the poorly-understood region located between the stellar surface and the region where the wind starts, the so-called warm molecular layer. We successfully reproduce the observed lines profiles using a simple model. We constrain the extents, densities, and kinematics of the region where the lines are produced. R Aqr and R Scl show inverse P-Cygni line profiles which indicate infall of material onto the stars. The line profiles of o Cet and R Scl show variability. The serendipitous detection towards these five sources shows that vibrationally-excited rotational lines can be observed towards a large number of nearby AGB stars using ALMA. This opens a new possibility for the study of the innermost regions of AGB circumstellar envelopes.

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AG Pegasi – now a classical symbiotic star in outburst?

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Optical spectroscopy study of the recent AG Peg outburst observed during the second half of 2015 is presented.

Considerable variations of the intensity and the shape of the spectral features as well as the changes of the hot component parameters, caused by the outburst, are discussed and certain similarities between the outburst of AG Peg and the outburst of a classical symbiotic stars are shown. It seems that after the end of the symbiotic nova phase, AG Peg became a member of the classical symbiotic stars group.

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The chemical compositions of solar twins in the open cluster M 67

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Stars in open clusters are expected to share an identical abundance pattern. Establishing the level of chemical homogeneity in a given open cluster deserves further study as it is the basis of the concept of chemical tagging to unravel the history of the Milky Way. M 67 is particularly interesting given its solar metallicity and age as well as being a dense cluster environment. We conducted a strictly line-by-line differential chemical abundance analysis of two solar twins in M 67: M 67-1194 and M 67-1315. Stellar atmospheric parameters and elemental abundances were obtained with high precision using *Keck*/HIRES spectra. M 67-1194 is essentially identical to the Sun in terms of its stellar parameters. M 67-1315 is warmer than M 67-1194 by $\approx$ 150 K as well as slightly more metal-poor than M 67-1194 by $\approx$ 0.05 dex. M 67-1194 is also found to have identical chemical composition to the Sun, confirming its solar twin nature. The abundance ratios [X/Fe] of M 67-1315 are similar to the solar abundances for elements with atomic number $Z \leq 30$, while most neutron-capture elements are enriched by $\approx$ 0.05 dex, which might be attributed to enrichment from a mixture of AGB ejecta and r-process material. The distinct chemical abundances for the neutron-capture elements in M 67-1315 and the lower metallicity of this star compared to M 67-1194, indicate that the stars in M 67 are likely not chemically homogeneous. This poses a challenge for the concept of chemical tagging since it is based on the assumption of stars forming in the same star-forming aggregate.

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Rings and arcs around evolved stars – I. Fingerprints of the last gasps in the formation process of planetary nebulæ

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Evolved stars such as asymptotic giant branch stars (AGB), post-AGB stars, proto-planetary nebulæ (proto-PNe), and planetary nebulæ (PNe) show rings and arcs around them and their nebular shells. We have searched for these morphological features in optical *Hubble* Space Telescope and mid-infrared *Spitzer* Space Telescope images of $\sim$ 650 proto-PNe and PNe and discovered them in 29 new sources. Adding those to previous detections, we derive a frequency of occurrence $\sim$ 8 per cent. All images have been processed to remove the underlying envelope emission and enhance

outer faint structures to investigate the spacing between rings and arcs and their number. The averaged time lapse between consecutive rings and arcs is estimated to be in the range 500–1200 yr. The spacing between them is found to be basically constant for each source, suggesting that the mechanism responsible for the formation of these structures in the final stages of evolved stars is stable during time periods of the order of the total duration of the ejection. In our sample, this period of time spans ≤ 4500 yr.

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Historic light curve of V890 Cas

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The variability of V890 Cas is studied with 87 I-band plates of the Asiago 67/90cm Schmidt telescope. The star shows variations of about 5 mag with an average magnitude $I = 13$ and a period of about 493 days. From our data it seems unlikely that this star undergoes amplitude variations, like e.g. R Cyg. An $R - I \sim 5.0$ color index is derived near the maximum luminosity. This is in fair agreement with the result $r' - i' = 5.46$ mag reported by Wright et al. (2009 MNRAS 400, 1413) measured when the star was in a fainter ($i' = 14.7$ mag) and probably cooler state. Overall, the 17 years time span of the Asiago archive plates fully support the Mira-type variability of V890 Cas indicated by the VSNET database.

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The evolution of red supergiants to supernova in the LMC cluster NGC 2100

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The mass loss rates of red supergiants (RSGs) govern their evolution towards supernova and dictate the appearance of the resulting explosion. To study how mass-loss rates change with evolution we measure the mass-loss rates ($\dot{M}$) and extinctions of 19 red supergiants in the young massive cluster NGC 2100 in the Large Magellanic Cloud. By targeting stars in a coeval cluster we can study the mass-loss rate evolution whilst keeping the variables of mass and metallicity fixed. Mass-loss rates were determined by fitting DUSTY models to mid-IR photometry from WISE and *Spitzer*/IRAC. We find that the $\dot{M}$ in red supergiants increases as the star evolves, and is well described by $\dot{M}$ prescription of de Jager, used widely in stellar evolution calculations. We find the extinction caused by the warm dust is negligible, meaning the warm circumstellar material of the inner wind cannot explain the higher levels of extinction found in the RSGs compared to other cluster stars. We discuss the implications of this work in terms of supernova progenitors and stellar evolution theory. We argue there is little justification for substantially increasing the $\dot{M}$ during the RSG phase, as has been suggested recently in order to explain the absence of high mass Type II-P supernova progenitors. We also argue that an increase in reddening towards the end of the RSG phase, as observed for the two most evolved cluster stars, may provide a solution to the red supergiant problem.

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Planetary engulfment as a trigger for white dwarf pollution

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The presence of a planetary system can shield a planetesimal disk from the secular gravitational perturbations due to distant outer massive objects (planets or stellar companions). As the host star evolves off the main sequence to become a white dwarf, these planets can be engulfed, triggering secular instabilities and leading to the tidal disruptions of small rocky bodies. These disrupted bodies can feed the white dwarfs with rocky material and possibly explain the high-metallicity material in their atmospheres. We illustrate how this mechanism can operate when the gravitational perturbations are due to the Kozai–Lidov mechanism from a stellar binary companion. We show that this mechanism can explain the observed levels of accretion if: (1) the planetary engulfment happens fast compared to the secular timescale, which is generally the case for wide binaries (> 100 au) and planetary engulfment during the Asymptotic Giant Branch; (2) the planetesimal disk has a total mass of $\sim 10^{-4}$–10^{-2} $M_\oplus$. We show that this new mechanism can provide a steady supply of material throughout the entire life of the white dwarfs for all cooling ages and can account for a large fraction (up to nearly half) of the observed polluted WDs.

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Abundance analysis of s-process enhanced barium stars

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Detailed chemical composition studies of stars with enhanced abundances of neutron-capture elements can provide observational constraints for neutron-capture nucleosynthesis studies and clues for understanding their contribution to the Galactic chemical enrichment. We present abundance results from high-resolution spectral analyses of a sample of four chemically peculiar stars characterized by s-process enhancement. High-Resolution spectra ($R \sim 42\,000$) of these objects spanning a wavelength range from 4000 to 6800 Å, are taken from the ELODIE archive. We have estimated the stellar atmospheric parameters, the effective temperature $T_{\rm eff}$, the surface gravity $\log g$, and metallicity [Fe/H] from local thermodynamic equilibrium analysis using model atmospheres. We report estimates of elemental abundances for several neutron-capture elements, Sr, Y, Zr, Ba, La, Ce, Pr, Nd, Sm, Eu and Dy. While HD 49641 and HD 58368 show [Ba/Fe] ≥ 1.16 the other two objects HD 119650 and HD 191010 are found to be mild barium stars with [Ba/Fe] ~ 0.4. The derived abundances of the elements are interpreted on the basis of existing theories for understanding their origin and evolution.

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Identifying the chemistry of the dust around AGB stars in nearby galaxies

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Asymptotic giant branch (AGB) stars are significant contributors to the chemical enrichment of the interstellar medium (ISM) of galaxies. It is therefore essential to constrain the AGB contribution to the dust budget in galaxies. Recent estimates of the total dust injection rate to the Large and Small Magellanic Clouds (LMC and SMC; Riebel et al. (2012), Boyer et al. (2012), Srinivasan et al. in prep) have used data from the *Spitzer* Space Telescope SAGE (Surveying the Agents of Galaxy Evolution; Meixner et al. 2006) and SAGE-SMC (Gordon et al. 2011) surveys. When sorted by dust chemistry, the data allow for a comparison of O-rich and carbonaceous dust-production rates. In the LMC, for instance, the rate of dust production from carbon stars is about two and a half times that from oxygen-rich AGBs. A reliable determination of the fractional contributions of the two types of dust would serve as input to models of chemical evolution. However, the *Spitzer* IRAC photometric bands do not sufficiently probe the characteristic mid-infrared spectral features that can distinguish O-rich AGBs from carbon stars – namely, the 9.7-μm silicate feature and the 11.3-μm silicon carbide feature. With the continuous spectral coverage in the 4–30 μm range, SPICA has the potential to distinguish these two types of chemistries. In this contribution, synthetic photometry from the model grid of AGB stars, GRAMS (Sargent et al. 2011; Srinivasan et al. 2011) will be used to discuss the science possibilities that SPICA might offer this study.

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