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Editorial

Dear Colleagues,

It is our pleasure to present you the 232nd issue of the AGB Newsletter. Check out the announcement at the back, for a **free** conference in Israel.

Last month's Food for Thought, "How can we overcome the limitations of Gaia for the study of the coolest red giant stars?" provoked two responses: *My gut reaction: We can't. Moreover, it is folly to press an instrument to do something that it was not optimized or designed to do; the uncertainties must rise dramatically (and probably in an uncalculable way) the further we are from the region of optimal performance. (The question may as well ask how to get Gaia to observe the brighter stars). We may try, and get some results, but they will always be cloaked in caveats about the instrument's unsuitability for that task. We need to push, as a group, for an instrument that does specifically what is our top priority, and be prepared to couch the Case in terms that sound slightly glamorous in order to resonate with a broader segment of the community (e.g., "Determining the future properties of the Sun").* Another reader responded: *As far as I know, the limitation is not due to the temperature, but rather due to the extension of these stars. My solution to this limitation would be to build two identical space observatories and launch them in opposite directions to the outer solar system, say to the orbit of Neptune. From their positions, they can simultaneously observe the same field to take a stereoscopic image from which parallaxes can be measured directly. The baseline would thus be increased by a factor of 30, which would allow to measure the parallaxes also of the largest stars. I guess that some minor problems with the downlink rate have to be solved in order to beam down the images. The biggest problem would however be to convince a space agency that this is an important science case!* Is there nothing that can be done with existing/upcoming ground-based and near-Earth observatories, and our clever minds?

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

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

Food for Thought

This month's thought-provoking statement is:

Can a convection cell become as large as the entire star?

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

A search for mass loss on the Cepheid instability strip using H I 21-cm line observations

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We present the results of a search for H I 21-cm line emission from the circumstellar environments of four Galactic Cepheids (RS Pup, X Cyg, ζ Gem, and T Mon) based on observations with the Karl G. Jansky Very Large Array. The observations were aimed at detecting gas associated with previous or ongoing mass loss. Near the long-period Cepheid T Mon, we report the detection of a partial shell-like structure whose properties appear consistent with originating from an earlier epoch of Cepheid mass loss. At the distance of T Mon, the nebula would have a mass (H I+He) of ~ 0.5 $M_\odot$, or $\sim 6\%$ of the stellar mass. Assuming that one-third of the nebular mass comprises swept-up interstellar gas, we estimate an implied mass-loss rate of $\dot{M} \sim (0.6–2) \times 10^{-5}$ $M_\odot$ yr^{-1}. No clear signatures of circumstellar emission were found toward ζ Gem, RS Pup, or X Cyg, although in each case, line-of-sight confusion compromised portions of the spectral band. For the undetected stars, we derive model-dependent 3σ upper limits on the mass-loss rates, averaged over their lifetimes on the instability strip, of $<\sim (0.3–6) \times 10^{-6}$ $M_\odot$ yr^{-1} and estimate the total amount of mass lost to be less than a few per cent of the stellar mass.

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Available from http://arxiv.org/abs/1609.06611

Formation and X-ray emission from hot bubbles in planetary nebulæ. II. Hot bubble X-ray emission

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We present a study of the X-ray emission from numerical simulations of hot bubbles in planetary nebulæ (PNe). High-resolution, two-dimensional, radiation-hydrodynamical simulations of the formation and evolution of hot bubbles in PNe, with and without thermal conduction, are used to calculate the X-ray emission and study its time-dependence and relationship to the changing stellar parameters. Instabilities in the wind-wind interaction zone produce clumps and filaments in the swept-up shell of nebular material. Turbulent mixing and thermal conduction at the corrugated interface can produce quantities of intermediate temperature and density gas between the hot, shocked wind bubble and the swept-up photo-ionized nebular material, which can emit in soft, diffuse X-rays. We use the CHIANTI software to compute synthetic spectra for the models and calculate their luminosities. We find that models both with conduction and those without can produce the X-ray temperatures and luminosities that are in the ranges reported in observations, although the models including thermal conduction are an order of magnitude more luminous than those without. Our results show that at early times the diffuse X-ray emission should be dominated by the contribution from the hot, shocked stellar wind, whereas at later times the nebular gas will dominate the spectrum. We analyse the effect of sampling on the resultant spectra and conclude that a minimum of 200 counts is required to reliably reproduce the spectral shape. Likewise, heavily smoothed surface-brightness profiles obtained from low-count detections of PNe do not provide a reliable description of the spatial distribution of the X-ray emitting gas.

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Available from http://arxiv.org/abs/1609.03197
and from http://mnras.oxfordjournals.org/content/early/2016/09/14/mnras.stw2307.full.pdf

Establishing binarity amongst Galactic RV Tauri stars with a disc

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This study is a contribution in comprehending the role of binarity upon late stages of stellar evolution. We determine the binary status of six Galactic RV Tauri stars, namely DY Ori, EP Lyr, HP Lyr, IRAS 17038−4815, IRAS 09144−4933 and TW Cam, which are surrounded by a dusty disc. We also place them on the HR diagram, thereby establishing their evolutionary nature. All the six Galactic RV Tauri stars included in this study are binaries with orbital periods ranging between $\sim$ 650 and 1700 days and with eccentricities between 0.2 and 0.6. The mass functions range between 0.08 to 0.55 $M_{\odot}$ which points to an unevolved low mass companion. In the photometric time series we detect a long-term variation on the time-scale of the orbital period for IRAS 17038−4815, IRAS 09144−4933 and TW Cam. Our derived stellar luminosities obtained from a calibrated PLC relation indicates that all except DY Ori and EP Lyr, are post-AGB stars. DY Ori and EP Lyr are likely examples of the recently discovered dusty post-RGB stars. The orbital parameters strongly suggest that the evolution of these stars was interrupted by a strong phase of binary interaction during or even prior to the AGB. The observed eccentricities and long orbital periods among these stars provides a challenge to the standard theory of binary evolution.

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ALMA high-spatial resolution observations of the dense molecular region of NGC 6302

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The mechanism behind the shaping of bipolar planetary nebulae is still poorly understood. Accurately tracing the molecule-rich equatorial regions of post-AGB stars can give valuable insight into the ejection mechanisms at work. We investigate the physical conditions, structure and velocity field of the dense molecular region of the planetary nebula NGC 6302 by means of ALMA band 7 interferometric maps. The high spatial resolution of the ^{12}CO and ^{13}CO $J = 3$–2 ALMA data allows for an analysis of the geometry of the ejecta in unprecedented detail. We built a spatio-kinematical model of the molecular region with the software SHAPE and performed detailed non-LTE calculations of excitation and radiative transfer with the SHAPEMOL plug-in. We find that the molecular region consists of a massive ring out of which a system of fragments of lobe walls emerge and enclose the base of the lobes visible in the optical. The general properties of this region are in agreement with previous works, although the much greater spatial resolution of the data allows for a very detailed description. We confirm that the mass of the molecular region is 0.1 $M_{\odot}$. Additionally, we report a previously undetected component at the nebular equator, an inner, younger ring inclined $\sim 60^{\circ}$ with respect to the main ring, showing a characteristic radius of 7.5×10^{16} cm, a mass of 2.7×10^{-3} $M_{\odot}$, and a counterpart in optical images of the nebula. This inner ring has the same kinematical age as the northwest optical lobes, implying it was ejected approximately at the same time, hundreds of years after the ejection of the bulk of the molecular ring-like region. We discuss a sequence of events leading to the formation of the molecular and optical nebulæ, and briefly speculate on the origin of this intriguing inner ring.

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VLTI/AMBER spectro-interferometry of the late-type supergiants V766 Cen (= HR 5171 A), σ Oph, BM Sco, and HD 206859

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Aims: We add four warmer late-type supergiants to our previous spectro-interferometric studies of red giants and supergiants.

Methods: We measure the near-continuum angular diameter, derive fundamental parameters, discuss the evolutionary stage, and study extended atmospheric atomic and molecular layers.

Results: V766 Cen (= HR 5171 A) is found to be a high-luminosity ($\log L/\mathrm{L}_\odot = 5.8 \pm 0.4$) source of effective temperature 4290 ± 760 K and radius 1490 ± 540 $\mathrm{R}_\odot$, located in the Hertzsprung–Russell (HR) diagram close to both the Hayashi limit and Eddington limit; this source is consistent with a 40 $\mathrm{M}_\odot$ evolutionary track without rotation and current mass 27–36 $\mathrm{M}_\odot$. V766 Cen exhibits Na I in emission arising from a shell of radius 1.5 R_Phot and a photocenter displacement of about 0.1 R_Phot. It shows strong extended molecular (CO) layers and a dusty circumstellar background component. The other three sources are found to have lower luminosities of about $\log L/\mathrm{L}_\odot = 3.4$–$3.5$, corresponding to 5–9 $\mathrm{M}_\odot$ evolutionary tracks. They cover effective temperatures of 3900 K to 5300 K and radii of 60–120 $\mathrm{R}_\odot$. They do not show extended molecular layers as observed for higher luminosity red supergiants of our sample. BM Sco shows an unusually strong contribution by an over-resolved circumstellar dust component.

Conclusions: V766 Cen is a red supergiant located close to the Hayashi limit instead of a yellow hypergiant already evolving back toward warmer effective temperatures as discussed in the literature. Our observations of the Na I line and the extended molecular layers suggest an optically thick pseudo-photosphere at about 1.5 R_Phot at the onset of the wind. The stars σ Oph, BM Sco, and HD 206859 are more likely high-mass red giants instead of red supergiants as implied by their luminosity class Ib. This leaves us with an unsampled locus in the HR diagram corresponding to luminosities $\log L/\mathrm{L}_\odot$ of 3.8–4.8 or masses 10–13 $\mathrm{M}_\odot$, possibly corresponding to the mass region where stars explode as (type II-P) supernovæ during the red supergiant stage. With V766 Cen, we now confirm that our previously found relation of increasing strength of extended molecular layers with increasing luminosities extends to double our previous luminosities and up to the Eddington limit. This might further point to steadily increasing radiative winds with increasing luminosity.

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Periodicities of the RV Tau-type pulsating star DF Cygni: A combination of *Kepler* data with ground-based observations

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The RV Tauri stars constitute a small group of classical pulsating stars with some dozen known members in the Milky Way. The light variation is caused predominantly by pulsations, but these alone do not explain the full complexity of light curves. High-quality photometry of RV Tau-type stars is very rare. DF Cygni is the only member of this class of stars in the original *Kepler* field, hence allowing the most accurate photometric investigation of any RV Tauri star to date. The main goal is to analyse the periodicities of the RV Tauri-type star DF Cygni by combining four years of high-quality *Kepler* photometry with almost half a century of visual data collected by the American Association

of Variable Star Observers (AAVSO). *Kepler* quarters of data were stitched together to minimize the systematic effects of space data. The mean levels have been matched with AAVSO visual data. Both datasets were submitted to Fourier and wavelet analyses, while the stability of the main pulsations was studied with the O–C method and analysis of time-dependent amplitudes. DF Cygni shows very rich behaviour on all timescales. The slow variation has a period of 779.606 d and it has been remarkably coherent during the whole time span of the combined data. On top of the long-term cycles, the pulsations appear with a period of 24.925 d, or the double period of 49.85 d if we take the RV Tau-type alternation of the cycles into account. Both types of light variation significantly fluctuate in time, with a constantly changing interplay of amplitude and phase modulations. Long-period change (i.e. the RVb signature) somewhat resembles the long secondary period (LSP) phenomenon of pulsating red giants, whereas short-period pulsations are very similar to those of the Cepheid variables. Comparing the pulsation patterns with the latest models of Type-II Cepheids, we found evidence of strong non-linear effects that are directly observable in the *Kepler* light curve.

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Photometric and spectroscopic study of the supergiant with an infrared excess V1027 Cygni

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We present the results of our UBV and $JHKLM$-photometry for the semiregular pulsating variable V1027 Cyg, a supergiant with an infrared excess, over the period from 1997 to 2015 (UBV) and in 2009–2015 ($JHKLM$). Together with the new data, we analyze the photometric observations of V1027 Cyg that we have obtained and published previously. Our search for a periodicity in the UBV brightness variations has led to several periods from $P = 212^{\rm d}$ to $P = 320^{\rm d}$ in different time intervals. We have found the period $P = 237^{\rm d}$ based on our infrared photometry. The variability amplitude, the light-curve shape, and the magnitude of V1027 Cyg at maximum light change noticeably from cycle to cycle. The deepest minimum was observed in 2011, when the amplitudes of brightness variations in the star reached the following values: $\Delta U = 1.^{\rm m}28$, $\Delta B = 1.^{\rm m}10$, $\Delta V = 1.^{\rm m}05$, $\Delta J = 0.^{\rm m}30$, $\Delta H = 0.^{\rm m}35$, $\Delta K = 0.^{\rm m}32$, $\Delta L = 0.^{\rm m}26$, $\Delta M = 0.^{\rm m}10$. An ambiguous correlation of the $B - V$ and $U - B$ colors with the brightness has been revealed. For example, a noticeable bluing of the star was observed during the deep 1992, 2008, and 2011 minima, while the variations with smaller amplitudes show an increase in $B - V$ at the photometric minima. The spectral energy distribution for V1027 Cyg from our photometry in the range 0.36 (U)–5.0 (M) μm corresponds to spectral types from G8 I to K3 I at different phases of the pulsation cycle. Low-resolution spectra of V1027 Cyg in the range λ4400–9200 Å were taken during 16 nights over the period 1995–2015. At the 1995 and 2011 photometric minima the star's spectrum exhibited molecular TiO bands whose intensity corresponded to spectral types M0–M1, while the photometric data point to a considerably earlier spectral type. We hypothesize that the TiO bands are formed in the upper layers of the extended stellar atmosphere. We have measured the equivalent widths of the strongest absorption lines, in particular, the infrared Ca II triplet in the spectrum of V1027 Cyg. The calcium triplet (Ca T) with $W_\lambda(\mathrm{Ca\,T}) = 20.3 \pm 1.8$ Å as a luminosity indicator for supergiants places V1027 Cyg in the region of the brightest G–K supergiants. V1027 Cyg has been identified with the infrared source IRAS 20004+2955 and is currently believed to be a candidate post-AGB star. The evolutionary status of the star and its difference from other post-AGB objects are discussed.

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The core-degenerate scenario for the progenitors of type Ia supernovæ

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The origin of the progenitors of type Ia supernovæ (SNe Ia) is still uncertain. The core-degenerate (CD) scenario has been proposed as an alternative way for the production of SNe Ia. In this scenario, SNe Ia are formed at the final stage of common-envelope evolution from a merger of a carbon–oxygen white dwarf (CO WD) with the CO core of an asymptotic giant branch companion. However, the birthrates of SNe Ia from this scenario are still not well determined. In this work, we performed a detailed investigation on the CD scenario based on a binary population synthesis approach. The SN Ia delay times from this scenario are basically in the range of 90 Myr – 2500 Myr, mainly contributing to the observed SNe Ia with short and intermediate delay times although this scenario can also produce some old SNe Ia. Meanwhile, our work indicates that the Galactic birthrates of SNe Ia from this scenario are no more than 20% of total SNe Ia due to more careful treatment of mass transfer. Although the SN Ia birthrates in the present work are lower than those in Ilkov & Soker, the CD scenario cannot be ruled out as a viable mechanism for the formation of SNe Ia. Especially, SNe Ia with circumstellar material from this scenario contribute to 0.7–10% of total SNe Ia, which means that the CD scenario can reproduce the observed birthrates of SNe Ia like PTF 11kx. We also found that SNe Ia happen systemically earlier for a high value of metallicity and their birthrates increase with metallicity.

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The ALMA detection of CO rotational line emission in AGB stars in the Large Magellanic Cloud

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Context: Low- and intermediate-mass stars lose most of their stellar mass at the end of their lives on the asymptotic giant branch (AGB). Determining gas and dust mass-loss rates (MLRs) is important in quantifying the contribution of evolved stars to the enrichment of the interstellar medium.
Aims: Attempt to, for the first time, spectrally resolve CO thermal line emission in a small sample of AGB stars in the Large Magellanic Cloud.
Methods: ALMA was used to observe 2 OH/IR stars and 4 carbon stars in the LMC in the CO $J = 2$–1 line.
Results: We present the first measurement of expansion velocities in extragalactic carbon stars. All four C-stars are detected and wind expansion velocities and stellar velocities are directly measured. Mass-loss rates are derived from modelling the spectral energy distribution and *Spitzer*/IRS spectrum with the DUSTY code. Gas-to-dust ratios are derived that make the predicted velocities agree with the observed ones. The expansion velocities and MLRs are compared to a Galactic sample of well-studied relatively low MLRs stars supplemented with "extreme" C-stars that have properties more similar to the LMC targets. Gas MLRs derived from a simple formula are significantly smaller than derived from the dust modelling, indicating an order of magnitude underestimate of the estimated CO abundance, time-variable mass loss, or that the CO intensities in LMC stars are lower than predicted by the formula derived for Galactic objects. This could be related to a stronger interstellar radiation field in the LMC.
Conclusions: Although the LMC sample is small and the comparison to Galactic stars is non-trivial because of uncertainties in their distances (hence luminosities) it appears that for C stars the wind expansion velocities in the LMC are lower than in the solar neighbourhood, while the MLRs appear similar. This is in agreement with dynamical dust-driven wind models.

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High-resolution optical spectroscopy of RS Ophiuchi during 2008–2009

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RS Ophiuchi is a symbiotic variable and a recurrent nova. We have monitored it with the Nordic Optical Telescope and obtained 30 high resolution ($R = 46\,000$) optical spectra over one orbital cycle during quiescence. To our knowledge this is the best-sampled high resolution spectroscopic dataset of RS Oph over one orbital period. We do not detect any direct signatures of an accretion disc such as double peaked emission lines, but many line profiles are complex consisting of superimposed emission and absorption components. We measure the spin of the red giant and conclude that it is tidally locked to the binary orbit. We observe Na I absorption features, probably arising from the circumbinary medium, that has been shaped by previous recurrent nova outbursts. We do not detect any intrinsic polarisation in the optical wavelengths.

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The Cluster AgeS Experiment (CASE). Variable stars in the field of the globular cluster NGC 362

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The field of the globular cluster NGC 362 was monitored between 1997 and 2015 in a search for variable stars. BV light curves were obtained for 151 periodic or likely periodic variables, over a hundred of which are new detections. Twelve newly detected variables are proper motion members of the cluster: two SX Phe and two RR Lyr pulsators, one contact binary, three detached or semi-detached eclipsing binaries, and four spotted variables. The most interesting objects among these are the binary blue straggler V20 with an asymmetric light curve, and the 8.1 d semidetached binary V24 located on the red giant branch of NGC 362, which is a *Chandra* X-ray source. We also provide substantial new data for 24 previously known variables.

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Liberating exomoons in white dwarf planetary systems

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Previous studies indicate that more than a quarter of all white dwarf (WD) atmospheres are polluted by remnant planetary material, with some WDs being observed to accrete the mass of Pluto in 10^6 years. The short sinking timescale for the pollutants indicate that the material must be frequently replenished. Moons may contribute decisively to this pollution process if they are liberated from their parent planets during the post-main-sequence evolution of the planetary systems. Here, we demonstrate that gravitational scattering events amongst planets in WD systems easily triggers moon ejection. Repeated close encounters within tenths of a planetary Hill radii are highly destructive to even the most massive, close-in moons. Consequently, scattering increases both the frequency of perturbing agents in WD systems, as well as the available mass of polluting material in those systems, thereby enhancing opportunities for

collision and fragmentation and providing more dynamical pathways for smaller bodies to reach the WD. Moreover, during intense scattering, planets themselves have pericenters with respect to the WD of only a fraction of an AU, causing extreme Hill-sphere contraction, and the liberation of moons into WD-grazing orbits. Many of our results are directly applicable to exomoons orbiting planets around main sequence stars.

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The fate of exomoons in white dwarf planetary systems

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Roughly 1000 white dwarfs are known to be polluted with planetary material, and the progenitors of this material are typically assumed to be asteroids. The dynamical architectures which perturb asteroids into white dwarfs are still unknown, but may be crucially dependent on moons liberated from parent planets during post-main-sequence gravitational scattering. Here, we trace the fate of these exomoons, and show that they more easily achieve deep radial incursions towards the white dwarf than do scattered planets. Consequently, moons are likely to play a significant role in white dwarf pollution, and in some cases may be the progenitors of the pollution itself.

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Direct measurement of low-energy ^{22}Ne(p,γ)^{23}Na resonances

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The ^{22}Ne(p,γ)^{23}Na reaction is the most uncertain process in the neon–sodium cycle of hydrogen burning. At temperatures relevant for nucleosynthesis in asymptotic giant branch stars and classical novae, its uncertainty is mainly due to a large number of predicted but hitherto unobserved resonances at low energy. A new direct study of low energy ^{22}Ne(p,γ)^{23}Na resonances has been performed at the Laboratory for Underground Nuclear Astrophysics (LUNA),

in the Gran Sasso National Laboratory, Italy. The proton capture on ^{22}Ne was investigated in direct kinematics, delivering an intense proton beam to a ^{22}Ne gas target. γ rays were detected with two high-purity germanium detectors enclosed in a copper and lead shielding suppressing environmental radioactivity. Three resonances at 156.2 keV [$\omega\gamma = (1.48 \pm 0.10) \cdot 10^{-7}$ eV], 189.5 keV [$\omega\gamma = (1.87 \pm 0.06) \cdot 10^{-6}$ eV] and 259.7 keV [$\omega\gamma = (6.89 \pm 0.16) \cdot 10^{-6}$ eV] proton beam energy, respectively, have been observed for the first time. For the levels at E_x = 8943.5, 8975.3, and 9042.4 keV excitation energy corresponding to the new resonances, the γ-decay branching ratios have been precisely measured. Three additional, tentative resonances at 71, 105 and 215 keV proton beam energy, respectively, were not observed here. For the strengths of these resonances, experimental upper limits have been derived that are significantly more stringent than the upper limits reported in the literature. Based on the present experimental data and also previous literature data, an updated thermonuclear reaction rate is provided in tabular and parametric form. The new reaction rate is significantly higher than previous evaluations at temperatures of 0.08–0.3 GK.

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An archive of spectra from the Mayalll Fourier Transform Spectrometer at Kitt Peak

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We describe the SpArc science gateway for spectral data obtained during the period from 1975 through 1995 at the Kitt Peak National Observatory using the Fourier Transform Spectrometer (FTS) in operation at the Mayall 4-m telescope. SpArc is hosted by Indiana University Bloomington and is available for public access. The archive includes nearly 10,000 individual spectra of more than 800 different astronomical sources including stars, nebulae, galaxies, and Solar System objects. We briefly describe the FTS instrument itself, and summarize the conversion of the original interferograms into spectral data and the process for recovering the data into FITS files. The architecture of the archive is discussed, and the process for retrieving data from the archive is introduced. Sample use cases showing typical FTS spectra are presented.

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Radiative shocks create environments for dust formation in classical novæ

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Classical novæ commonly show evidence of rapid dust formation within months of the outburst. However, it is unclear how molecules and grains are able to condense within the ejecta, given the potentially harsh environment created by ionizing radiation from the white dwarf. Motivated by the evidence for powerful radiative shocks within nova outflows, we propose that dust formation occurs within the cool, dense shell behind these shocks. We incorporate a simple molecular chemistry network and classical nucleation theory with a model for the thermodynamic evolution of the post-shock gas, to demonstrate the formation of both carbon and forsterite (Mg_2SiO_4) grains. The high densities due to radiative shock compression ($n \sim 10^{14}$ cm^{-3}) result in CO saturation and rapid dust nucleation. Grains grow efficiently to large sizes $\gtrsim$0.1 μm, in agreement with IR observations of dust-producing novæ, and with total dust masses sufficient to explain massive extinction events such as V705 Cas. As in dense stellar winds, dust formation is CO-regulated, with carbon-rich flows producing carbon-rich grains and oxygen-rich flows primarily forming silicates. CO is destroyed by non-thermal particles accelerated at the shock, allowing additional grain formation at late times, but the efficiency of this process appears to be low. Given observations showing that individual novæ produce both carbonaceous and silicate grains, we concur with previous works attributing this bimodality to chemical heterogeneity of the ejecta. Nova outflows are diverse and inhomogeneous, and the observed variety of dust formation events can be reconciled by different abundances, the range of shock properties, and the observer viewing angle. The latter may govern the magnitude of extinction, with the deepest extinction events occurring for observers within the binary equatorial plane.

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The UK Infrared Telescope M 33 monitoring project. V. The star formation history across the galactic disc

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We have conducted a near-infrared monitoring campaign at the UK InfraRed Telescope (UKIRT), of the Local Group spiral galaxy M 33 (Triangulum). On the basis of their variability, we have identified stars in the very final stage of their evolution, and for which the luminosity is more directly related to the birth mass than the more numerous less-evolved giant stars that continue to increase in luminosity. In this fifth paper of the series, we construct the birth mass function and hence derive the star formation history across the galactic disc of M 33. The star formation rate has varied between $\sim 0.010 \pm 0.001$ ($\sim 0.012 \pm 0.007$) and 0.060 ± 0.005 (0.052 ± 0.009) $M_\odot$ yr^{-1} kpc^{-2} statistically (systematically) in the central square kiloparsec of M 33, comparable with the values derived previously with another camera. The total star formation rate in M 33 within a galactocentric radius of 14 kpc has varied between $\sim 0.110 \pm 0.005$ ($\sim 0.174 \pm 0.060$) and $\sim 0.560 \pm 0.028$ ($\sim 0.503 \pm 0.100$) $M_\odot$ yr^{-1} statistically (systematically). We find evidence of two epochs during which the star formation rate was enhanced by a factor of a few − one that started $\sim$ 6 Gyr ago and lasted $\sim$ 3 Gyr and produced $\geq$ 71% of the total mass in stars, and one $\sim$ 250 Myr ago that lasted $\sim$ 200 Myr and formed $\leq$ 13% of the mass in stars. Radial star formation history profiles suggest that the inner disc of M 33 was formed in an inside–out formation scenario. The outskirts of the disc are dominated by the old population, which may be the result of dynamical effects over many Gyr. We find correspondence to spiral structure for all stars, but enhanced only for stars younger than $\sim$ 100 Myr; this suggests that the spiral arms are transient features and not part of a global density wave potential.

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Determination of pulsation periods and other parameters of 2875 stars classified as MIRA in the All Sky Automated Survey (ASAS)

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We have developed an interactive PYTHON code and derived crucial ephemeris data of 99.4% of all stars classified as

'Mira' in the ASAS data base, referring to pulsation periods, mean maximum magnitudes and, whenever possible, the amplitudes among others. We present a statistical comparison between our results and those given by the AAVSO International Variable Star Index (VSX), as well as those determined with the machine learning automatic procedure of Richards et al. (2012). Our periods are in good agreement with those of the VSX in more than 95% of the stars. However, when comparing our periods with those of Richards et al., the coincidence rate is only 76% and most of the remaining cases refer to aliases. We conclude that automatic codes require still more refinements in order to provide reliable period values. Period distributions of the target stars show three local maxima around 215, 275 and 330 d, apparently of universal validity; their relative strength seems to depend on Galactic longitude. Our visual amplitude distribution turns out to be bimodal, however 1/3 of the targets have rather small amplitudes ($A < 2.5^{\rm m}$) and could refer to semi-regular variables (SR). We estimate that about 20% of our targets belong to the SR class. We also provide a list of 63 candidates for period variations and a sample of 35 multi-periodic stars which seem to confirm the universal validity of typical sequences in the double period and in the Petersen diagrams.

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The effect of porosity of dust particles on polarization and color with special reference to comets

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Cosmic dusts are mostly responsible for polarization of the light that we observe from astrophysical objects. They also lead to color-extinction, thermal re-emission and other scattering related phenomena. Dusts are made of small particles which are characterised by their size (radius), composition (matter), and structure (morphology, including porosity). In the present work, we address the question of the role of the dust particle porosity on light polarization and color, using Discrete Dipole Approximation (DDA) light scattering code. To answer this question, we developed an algorithm to generate solid particles of arbitrary values of porosity. In brief, the model considers a given homogeneous structure made of touching dipoles. The dipoles are randomly removed one by one, such that the remaining structure remains connected. We stop the removal process when the desired porosity is obtained. Then we study the optical properties of the porous particle. That way, we show how the proper value of the porosity affects the polarization and color of the light scattered by these porous particles. In addition to polarization, porosity has important effects on photometric color. Considering an important application, we emphasize the possible role of the porosity of the cometary dust particles on polarization and color of the light scattered by cometary coma.

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Neutron-capture element abundances in Magellanic Cloud planetary nebulæ

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We present near-infrared spectra of ten planetary nebulæ (PNe) in the Large and Small Magellanic Clouds (LMC and SMC), acquired with the FIRE and GNIRS spectrometers on the 6.5-m Baade and 8.1-m Gemini South Telescopes, respectively. We detect Se and/or Kr emission lines in eight of these objects, the first detections of n-capture elements in Magellanic Cloud PNe. Our abundance analysis shows large s-process enrichments of Kr (0.6–1.3 dex) in the six PNe in which it was detected, and Se is enriched by 0.5–0.9 dex in five objects. We also estimate upper limits to Rb and Cd abundances in these objects. Our abundance results for the LMC are consistent with the hypothesis that PNe with 2–3 $M_\odot$ progenitors dominate the bright end of the PN luminosity function in young gas-rich galaxies. We find no significant correlations between s-process enrichments and other elemental abundances, central star temperature, or progenitor mass, though this is likely due to our small sample size. We determine S abundances from our spectra and find that [S/H] agrees with [Ar/H] to within 0.2 dex for most objects, but is lower than [O/H] by 0.2–0.4 dex in some PNe, possibly due to O enrichment via third dredge-up. Our results demonstrate that n-capture elements can be detected in PNe belonging to nearby galaxies with ground-based telescopes, allowing s-process enrichments to be studied in PN populations with well-determined distances.

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Binary star influence on post-main-sequence multi-planet stability

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Nearly every star known to host planets will become a white dwarf, and nearly 100 planet-hosts are now known to be accompanied by binary stellar companions. Here, we determine how a binary companion triggers instability in otherwise unconditionally stable single-star two-planet systems during the giant branch and white dwarf phases of the planet host. We perform about 700 full-lifetime (14 Gyr) simulations with A0 and F0 primary stars and secondary K2 companions, and identify the critical binary distance within which instability is triggered at any point during stellar evolution. We estimate this distance to be about seven times the outer planet separation, for circular binaries. Our results help characterize the fates of planetary systems, and in particular which ones might yield architectures that are conducive to generating observable heavy metal pollution in white dwarf atmospheres.

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The wind speeds, dust content, and mass-loss rates of evolved AGB and RSG stars at varying metallicity

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We present the results of our survey of 1612 MHz circumstellar OH maser emission from asymptotic giant branch

(AGB) stars and red supergiants (RSGs) in the Large Magellanic Cloud. We have discovered four new circumstellar maser sources in the LMC, and increased the number of reliable wind speeds from IR stars in the LMC from 5 to 13. Using our new wind speeds, as well as those from Galactic sources, we have derived an updated relation for dust driven winds: $v_{\rm exp} \propto ZL^{0.4}$. We compare the sub-solar metallicity LMC OH/IR stars with carefully selected samples of more metal-rich OH/IR stars, also at known distances, in the Galactic Centre and Galactic Bulge. For 8 of the Bulge stars we derive pulsation periods for the first time, using near-IR photometry from the VVV survey. We have modeled our LMC OH/IR stars and developed an empirical method of deriving gas-to-dust ratios and mass loss rates by scaling the models to the results from maser profiles. We have done this also for samples in the Galactic Centre and Bulge and derived a new mass loss prescription that includes luminosity, pulsation period, and gas-to-dust ratio $\dot{M} = 1.06^{+3.5}_{-0.8} \cdot 10^{-5}\,(L/10^4\,{\rm L}_{\odot})^{0.9\pm0.1}(P/500\,{\rm d})^{0.75\pm0.3}(r_{\rm gd}/200)^{-0.03\pm0.07}$ ${\rm M}_{\odot}\ {\rm yr}^{-1}$. The tightest correlation is found between mass loss rate and luminosity. We find that the gas-to-dust ratio has little effect on the mass loss of oxygen-rich AGB stars and RSGs within the Galaxy and the LMC. This suggests that mass loss of oxygen-rich AGB stars and RSGs is (nearly) independent of metallicity between a half and twice solar.

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Observations and 3D hydrodynamical models of planetary nebulæ with Wolf–Rayet type central stars

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We present high-resolution, long-slit spectroscopic observations of two planetary nebulæ, M 1-32 and M 3-15, with [WC] central stars located near the Galactic bulge. The observations were obtained with the 2.1-m telescope of the Observatorio Astronomico Nacional, San Pedro Mártir. M 1-32 shows wide wings on the base of its emission lines and M 3-15 has two very faint high-velocity knots. In order to model both planetary nebulae, we built a three-dimensional model consisting of a jet interacting with an equatorially concentrated slow wind, emulating the presence of a dense torus, using the Yguazú hydrodynamical code. From our hydrodynamical models, we obtained position–velocity diagrams in the [N II]6583 line for comparison with the observations. We find that the spectral characteristics of M 1-32 and M 3-15 can be explained with the same physical model – a jet moving inside an asymptotic giant branch wind – using different parameters (physical conditions and position angles of the jet). In agreement with our model and observations, these objects contain a dense torus seeing pole-on and a bipolar jet escaping through the poles. Then, we propose to classify this kind of objects as spectroscopic bipolar nebulæ, although they have been classified morphologically as compact, round, or elliptical nebulae or with "close collimated lobes".

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Does a differentiated, carbonate-rich, rocky object pollute the white dwarf SDSS J104341.53+085558.2?

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We present spectroscopic observations of the dust- and gas-enshrouded, polluted, single white dwarf star SDSS J104341.53+085558.2 (hereafter SDSS J1043+0855). *Hubble* Space Telescope Cosmic Origins Spectrograph far-ultraviolet spectra combined with deep *Keck* HIRES optical spectroscopy reveal the elements C, O, Mg, Al, Si, P, S, Ca, Fe, and

Ni and enable useful limits for Sc, Ti, V, Cr, and Mn in the photosphere of SDSS J1043+0855. From this suite of elements we determine that the parent body being accreted by SDSS J1043+0855 is similar to the silicate Moon or the outer layers of Earth in that it is rocky and iron-poor. Combining this with comparison to other heavily polluted white dwarf stars, we are able to identify the material being accreted by SDSS J1043+0855 as likely to have come from the outermost layers of a differentiated object. Furthermore, we present evidence that some polluted white dwarfs (including SDSS J1043+0855) allow us to examine the structure of differentiated extrasolar rocky bodies. Enhanced levels of carbon in the body polluting SDSS J1043+0855 relative to the Earth–Moon system can be explained with a model where a significant amount of the accreted rocky minerals took the form of carbonates; specifically, through this model the accreted material could be up to 9% calcium-carbonate by mass.

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Nitrogen depletion in field red giants: mixing during the He flash?

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We combine simultaneous constraints on stellar evolutionary status from astero-seismology, and on nitrogen abundances derived from large spectroscopic surveys, to follow nitrogen surface abundances all along the evolution of a low-mass star, comparing model expectations with data. After testing and calibrating the observed yields from the APOGEE survey, we first show that nitrogen surface abundances follow the expected trend after the first dredge-up occurred, i.e. that the more massive is the star the more nitrogen is enhanced. Moreover, the behaviour of nitrogen data along the evolution confirms the existence of non-canonical extra-mixing on the RGB for all low-mass stars in the field. But more surprisingly, the data indicate that nitrogen has been depleted between the RGB tip and the red clump. This may suggest that some nitrogen has been burnt near or at the He flash episode.

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Constraints of the physics of low-mass AGB stars from CH and CEMP stars

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We analyze a set of published elemental abundances from a sample of CH stars which are based on high resolution spectral analysis of ELODIE and Subaru/HDS spectra. All the elemental abundances were derived from local thermodynamic equilibrium analysis using model atmospheres, and thus, they represent the largest homogeneous abundance data available for CH stars up to date. For this reason, we can use the set to constrain the physics and the nucleosynthesis occurring in low mass AGB stars. CH stars have been polluted in the past from an already extinct AGB companion and thus show *s*-process enriched surfaces. We discuss the effects induced on the surface AGB *s*-process distributions by different prescriptions for convection and rotation. Our reference theoretical FRUITY set fits only part of the observations. Moreover, the *s*-process observational spread for a fixed metallicity cannot be reproduced.

At [Fe/H] > -1, a good fit is found when rotation and a different treatment of the inner border of the convective envelope are simultaneously taken into account. In order to increase the statistics at low metallicities, we include in our analysis a selected number of CEMP stars and, therefore, we compute additional AGB models down to [Fe/H] $= -2.85$. Our theoretical models are unable to attain the large $[hs/ls]$ ratios characterizing the surfaces of those objects. We speculate on the reasons for such a discrepancy, discussing the possibility that the observed distribution is a result of a proton mixing episode leading to a very high neutron density (the so-called i-process).

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A collimated wind interpretation for the spectral variability of Z And during its major 2006 eruption

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High-resolution observations in the region, centered at 4400 Å and those of the lines He II 4686, Hβ and He I 6678 of the spectrum of the symbiotic binary Z And were performed during its outburst in 2006. The line Hβ had additional satellite high-velocity emission components situated on either side of its central peak. The lines of neutral helium presented two components, consisting of a nebular emission situated close to the reference wavelength and a highly variable P Cyg absorption. Close to the optical maximum the line He II 4686 was weak emission feature, but with the fading of the light it changed into an intensive emission consisting of a central narrow component and a broad component with a low intensity. The lines of N III and C III were very broadened. We demonstrate that all of these groups of lines with very different profiles can be interpreted in the light of the same model, where a disc-shaped material surrounding the compact object collimates its stellar wind and gives rise to bipolar outflow.

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Mass retention efficiency and i-process nucleosynthesis in He-shell flash evolution of rapidly accreting white dwarfs

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Based on stellar evolution simulations, we demonstrate that rapidly accreting white dwarfs (RAWDs) in close binary systems, like those considered in the single-degenerate progenitor channel of type Ia supernovæ, experience recurrent and very strong He-shell flashes in the stable H-burning accretion regime. The He-shell flashes result in the expansion and, utimately, ejection of the newly-accreted material via super-Eddington luminosity winds or Roche-lobe overflow.

The white dwarf models do not retain any significant amount of the accreted mass, with a He retention efficiency of < 10% depending on mass and convective boundary mixing assumptions. This makes the evolutionary path of such systems to supernova Ia explosion highly unlikely. Instead, we have discovered that such binary systems are an astrophysical site for the intermediate neutron-capture process. In each of the He-shell flashes H-rich material enters the He-shell flash convection zone. 1D stellar evolution simulations of RAWDs show the H-ingestion flash may not cause a split of the convection zone as it was seen in simulations of He-shell flashes in post-AGB and low-Z AGB stars. We estimate that for the production of first-peak heavy elements this site can be of similar importance for galactic chemical evolution as the *s*-process production of low-mass AGB stars.

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NLTE analysis of high resolution H-band spectra. I. Neutral silicon

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We investigated the reliability of our silicon atomic model and the influence of non-local thermodynamical equilibrium (NLTE) on the formation of neutral silicon (Si I) lines in the near-infrared (near-IR) H-band. We derived the differential Si abundances for 13 sample stars with high-resolution H-band spectra from the Apache Point Observatory Galactic Evolution Experiment (APOGEE), as well as from optical spectra, both under local thermodynamical equilibrium (LTE) and NLTE conditions. We found that the differences between the Si abundances derived from the H-band and from optical lines for the same stars are less than 0.1 dex when the NLTE effects included, and that NLTE reduces the line-to-line scatter in the H-band spectra for most sample stars. These results suggest that our Si atomic model is appropriate for studying the formation of H-band Si lines. Our calculations show that the NLTE corrections of the Si I H-band lines are negative, i.e. the final Si abundances will be overestimated in LTE. The corrections for strong lines depend on surface gravity, and tend to be larger for giants, reaching ~ -0.2 dex in our sample, and up to ~ -0.4 dex in extreme cases of APOGEE targets. Thus, the NLTE effects should be included in deriving silicon abundances from H-band Si I lines, especially for the cases where only strong lines are available.

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NLTE analysis of high resolution H-band spectra. II. Neutral magnesium

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Aiming at testing the validity of our magnesium atomic model and investigating the effects of non-local thermodynamical equilibrium (NLTE) on the formation of the H-band neutral magnesium lines, we derive the differential Mg abundances from selected transitions for 13 stars either adopting or relaxing the assumption of local thermodynamical equilibrium (LTE). Our analysis is based on high-resolution and high signal-to-noise ratio H-band spectra from the Apache Point Observatory Galactic Evolution Experiment (APOGEE) and optical spectra from several instruments. The absolute differences between the Mg abundances derived from the two wavelength bands are always less than 0.1 dex in the NLTE analysis, while they are slightly larger for the LTE case. This suggests that our Mg atomic model is appropriate for investigating the NLTE formation of the H-band Mg lines. The NLTE corrections for the Mg I H-band lines are sensitive to the surface gravity, becoming larger for smaller $\log g$ values, and strong lines are more susceptible to departures from LTE. For cool giants, NLTE corrections tend to be negative, and for the strong line at 15765 Å they reach −0.14 dex in our sample, and up to −0.22 dex for other APOGEE stars. Our results suggest that it is important to include NLTE corrections in determining Mg abundances from the H-band Mg I transitions, especially when strong lines are used.

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IR photometry and models for the dust envelopes of two carbon stars

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The results of $JHKLM$ photometry of two carbon stars are presented: the irregular variable NQ Cas and the Mira star BD Vul. Data on the mean fluxes supplemented with mid-IR observations with the IRAS, AKARI, and WISE satellites are used to compute spherically symmetrical model dust envelopes for the stars, consisting of particles of amorphous carbon and silicon carbide. The optical depth in the visible for the comparatively cool dust envelope of BD Vul, with a dust temperature at its inner boundary $T_1 = 610$ K, is fairly low: $\tau_V = 0.13$. The dust envelope of NQ Cas is appreciably hotter ($T_1 = 1550$ K), and has $\tau_V = 0.32$. The estimated mass-loss rates are 1.5×10^{-7} $M_\odot$ yr^{-1} for NQ Cas and 5.9×10^{-7} $M_\odot$ yr^{-1} for BD Vul.

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Conference Papers

The axisymmetric envelopes of RS Cnc and EP Aqr

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We report on observations obtained at IRAM on two semi-regular variable Asymptotic Giant Branch (AGB) stars, RS Cnc and EP Aqr, undergoing mass loss at an intermediate rate of $\sim 10^{-7}$ $M_\odot$ yr^{-1}. Interferometric data obtained with the Plateau-de-Bure interferometer (NOEMA) have been combined with On-The-Fly maps obtained with the 30-m telescope in the CO(1–0) and (2–1) rotational lines. The spectral maps of spatially resolved sources reveal an axisymmetric morphology in which matter is flowing out at a low velocity (~ 2 km s^{-1}) in the equatorial planes, and at a larger velocity (~ 8 km s^{-1}) along the polar axes. There are indications that this kind of morpho-kinematics is relatively frequent among stars at the beginning of their evolution on the Thermally-Pulsing AGB, in particular among those that show composite CO line profiles, and that it might be caused by the presence of a companion. We discuss the progress that could be expected for our understanding of the mass loss mechanisms in this kind of sources

by increasing the spatial resolution of the observations with ALMA or NOEMA.

Oral contribution, published in the 2016 SF2A days
Available from http://arxiv.org/abs/1609.06450

The *s*-process nucleosynthesis in extremely metal-poor stars as the generating mechanism of carbon enhanced metal-poor stars

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The origin of carbon-enhanced metal-poor (CEMP) stars plays a key role in characterising the formation and evolution of the first stars and the Galaxy since the extremely-poor (EMP) stars with [Fe/H] < -2.5 share the common features of carbon enhancement in their surface chemical compositions. The origin of these stars is not yet established due to the controversy of the origin of CEMP stars without the enhancement of *s*-process element abundances, i.e. so called CEMP-no stars. In this paper, we elaborate the *s*-process nucleosynthesis in the EMP AGB stars and explore the origin of CEMP stars. We find that the efficiency of the *s*-process is controlled by O rather than Fe at [Fe/H] < -2. We demonstrate that the relative abundances of Sr, Ba, Pb to C are explained in terms of the wind accretion from AGB stars in binary systems.

Oral contribution, published in "Nuclei in the Cosmos XIV", JPS Conference Proceedings
Available from http://arxiv.org/abs/1609.09317

Li-rich AGB/RGB stars: Lithium abundances and mass loss

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Most metal-rich AGB/RGB stars present strong Li underabundances, since this element is easily destroyed in the high temperatures of the stellar interiors. In spite of this fact, several of these stars are Li-rich, having Li abundances given by $\log(\mathrm{Li}) = \log(\mathrm{Li/H}) + 12 > 1.5$. In a previous work we have shown that high-metallicity Li-rich stars follow the same average Li abundance trend with metallicity as the metal-poor stars, although with a larger dispersion. More recently, we have investigated the existence of correlations of the Li abundances with several physical properties of the stars, such as the effective temperature, mass, radius, and luminosity. In the present work, we extend this investigation to the expected mass loss rates of these stars. Specifically, we look for correlations between the Li abundances and the mass loss rates or related parameters in Li-rich AGB/RGB stars. We have estimated the mass loss rates using a modified form of the Reimers formula and applied it to a large sample of 104 Li-rich giant stars for which reliable stellar data are available. Our proposed method assumes a linear relation between the stellar luminosity and the Li abundance, so that the luminosity can be estimated from the Li abundance. The stellar mass is then obtained from the effective temperature and luminosity using recent evolutionary tracks. The stellar radius can be determined from the stellar gravity, so that the mass loss rate can be calculated using an adequate calibration involving both Li-rich and Li-poor stars in the AGB/RGB branches. The results show that most Li-rich stars have lower mass loss rates compared with C-rich or O-rich giants that do not present Li enhancements.

Poster contribution, published in "The 19^{th} Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun", Ed. G.A. Feiden
Available from http://arxiv.org/abs/1609.06505
and from http://www.astro.iag.usp.br/~maciel/research/articles/art162.pdf

The Planetary Nebulæ Luminosity Function (PNLF): current perspectives

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This paper starts with a brief historical review about the PNLF and its use as a distance indicator. Then the PNLF distances are compared with Surface Brightness Fluctuations (SBF) distances and Tip of the Red Giant Branch (TRGB) distances. A Monte Carlo method to generate simulated PNLFs is described, leading to the last subject: recent progress in reproducing the expected maximum final mass in old stellar populations, a stellar astrophysics enigma that has been challenging us for quite some time.

Oral contribution, published in IAU Symposium 323, "Planetary Nebulæ: Multi-wavelength Probes of Stellar and Galactic Evolution"
Available from http://arxiv.org/abs/1610.08625

(Re)solving mysteries of convection and mass loss of AGB stars: What new models and observations tell us about long-standing problems

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The recent progress in high-spatial-resolution techniques, spanning wavelengths from the visual to the radio regime, is leading to new valuable insights into the complex dynamical atmospheres of Asymptotic Giant Branch (AGB) stars and their wind forming regions. Striking examples are images of asymmetries and inhomogeneities in the photospheric and dust-forming layers which vary on time-scales of months. These features are probably related to large-scale convective flows predicted by 3D star-in-a-box models. Furthermore, high-resolution observations make it possible to measure dust condensation distances, and they give information about the chemical composition and sizes of dust grains in the close vicinity of cool giants. These are essential constraints for building realistic models of wind acceleration and developing a predictive theory of mass loss for AGB stars, which is a crucial ingredient of stellar and galactic chemical evolution models.

Oral contribution, published in "The 19$^{\text{th}}$ Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun"
Available from http://arxiv.org/abs/1610.08937
and from https://zenodo.org/record/154673#.WBMW9lrNWS0

Improving 1D stellar models with 3D atmospheres

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Stellar evolution codes play a major role in present-day astrophysics, yet they share common issues. In this work we seek to remedy some of those by the use of results from realistic and highly detailed 3D hydrodynamical simulations of stellar atmospheres. We have implemented a new temperature stratification extracted directly from the 3D simulations

into the Garching Stellar Evolution Code to replace the simplified atmosphere normally used. Secondly, we have implemented the use of a variable mixing-length parameter, which changes as a function of the stellar surface gravity and temperature – also derived from the 3D simulations. Furthermore, to make our models consistent, we have calculated new opacity tables to match the atmospheric simulations. Here, we present the modified code and initial results on stellar evolution using it.

Poster contribution, published in "Seismology of the Sun and the Distant Stars 2016"
Available from http://arxiv.org/abs/1610.07323

The advanced stages of stellar evolution: impact of mass loss, rotation, and link with B[e] stars

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In this paper, we discuss some consequences of rotation and mass loss on the evolved stages of massive star evolution. The physical reasons of the time evolution of the surface velocity are explained, and then we show how the late-time evolution of massive stars are impacted in combination with the effects of mass loss. The most interesting result is that in some cases, a massive star can have a blue–red–blue evolution, opening the possibility that Blue Supergiants are composed by two distinct populations of stars: one just leaving the main sequence and crossing the HRD for the first time, and the other one evolving back to the blue side of the HRD after a Red Supergiant phase. We discuss a few possible observational tests that can allow to distinguish these two populations, and how supergiant B[e] stars fit in this context.

Oral contribution, published in "The B[e] Phenomenom: Forty Years of Studies", Prague, 2016
Available from http://arxiv.org/abs/1610.07332

Review Paper

Giant star seismology

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The internal properties of stars in the red-giant phase undergo significant changes on relatively short timescales. Long near-interrupted high-precision photometric timeseries observations from dedicated space missions such as CoRoT and *Kepler* have provided seismic inferences of the global and internal properties of a large number of evolved stars, including red giants. These inferences are confronted with predictions from theoretical models to improve our understanding of stellar structure and evolution. Our knowledge and understanding of red giants have indeed increased tremendously using these seismic inferences, and we anticipate that more information is still hidden in the data. Unraveling this will further improve our understanding of stellar evolution. This will also have significant impact on our knowledge of the Milky Way Galaxy as well as on exo-planet host stars. The latter is important for our understanding of the formation and structure of planetary systems.

Published in The Astronomy and Astrophysics Review (Invited, submitted)
Available from http://arxiv.org/abs/1609.07487

Announcement

Planetary Systems Beyond The Main Sequence II

To keep up with the latest developments in the blossoming interdisciplinary field of post-main-sequence exoplanetary science, the second "Planetary Systems Beyond the Main Sequence" conference will be held from 5–10 March, 2017 at the Technion – Israel Institute of Technology.

There is **no registration fee** for the conference, and we welcome participants from all related fields, including exoplanets, stellar evolution, the Solar System, astrochemistry, debris discs and astrobiology. If you are interested in attending and would like to receive future announcements, then please add your email address to the pre-registration list here:

http://planets-beyond-ms.weebly.com/registration.html

We look forward to welcoming you to Technion in March.

SOC:
Hagai Perets (Chair)
Amy Bonsor
John Debes
Jay Farihi
Boris Gänsicke
Roman Rafikov
Sonja Schuh
Dimitri Veras
Alexander Wolszczan
Siyi Xu

See also http://planets-beyond-ms.weebly.com/registration.html