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Editorial

Dear Colleagues,

It is a pleasure to present you the 253$^{\rm rd}$ issue of the AGB Newsletter. There is a lot to read!

Don't miss the two announcements about infrared facilities – one for a meeting (SPICA) and another for observing opportunities (SOFIA).

Chung Rex responded to last month's Food for Thought, what the merger event would look like of two white dwarves with total mass < 1.4 M$_\odot$. Paraphrasing, and ignoring head-on collisions of unrelated white dwarves: "Giving the limit on the total mass, it is unlikely either of the dwarves is O–Ne rich unless mass had been lost in previous nova explosions. In the case of two helium dwarves, in the absence of significant mass loss from the progenitor the separation is likely large, hence the dwarves will have cooled before any merger happens. Given these dwarves are less compact, tidal distortion may become more important leading to a non-spherical merger product. The surface may not be hot enough for helium fusion to occur and the merger may appear more gentle. If the mass ratio is large then the helium dwarf may be tidally disrupted and/or it may transfer mass onto the more massive dwarf, causing a hot spot and possibly X-ray emission. The helium overlaying the C+O (or O+Ne) may ignite, leading to a different luminosity pattern during the merger."

John Lattanzio offered one more reaction to the previous Food for Thought: "I think Harlow Shapley said: Everyone believes an observation, except the [person] who made it. And no-one believes a theory, except the [person] who created it."

The next issue is planned to be distributed around the 1$^{\rm st}$ of September.

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

Food for Thought

This month's thought-provoking statement is:

Have non-supernova white-dwarf mergers ever been detected?

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

Radiation forces on dust envelopes

Peter H. Jumper[1] *and Christopher D. Matzner*[1]

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We address in detail the radiation forces on spherical dust envelopes around luminous stars, and numerical solutions for these forces, as a first step toward more general dust geometries. Two physical quantities, a normalized force and a force-averaged radius, suffice to capture the overall effects of radiation forces; these combine to yield the radiation term in the virial theorem. In addition to the optically thin and thick regimes, the wavelength dependence of dust opacity allows for an intermediate case in which starlight is easily trapped but infrared radiation readily escapes. Scattering adds a non-negligible force in this intermediate regime. We address all three regimes analytically and provide approximate formulae for the force parameters, for arbitrary optical depth and inner dust temperature. Turning to numerical codes, we examine the convergence properties of the Monte Carlo code HYPERION run in Cartesian geometry. We calibrate both HYPERION and our analytical estimate using the DUSTY code, run in spherical geometry. We find that Monte Carlo codes tend to underestimate the radiation force when the mean free path of starlight is not well resolved, as this causes the inner dust temperature, and therefore the inner Rosseland opacity, to be too low. We briefly discuss implications for more complicated radiation transfer problems.

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Uncertainties in s-process nucleosynthesis in low mass stars determined from Monte Carlo variations

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The main s-process taking place in low mass stars produces about half of the elements heavier than iron. It is therefore very important to determine the importance and impact of nuclear physics uncertainties on this process. We have performed extensive nuclear reaction network calculations using individual and temperature-dependent uncertainties for reactions involving elements heavier than iron, within a Monte Carlo framework. Using this technique, we determined the uncertainty in the main s-process abundance predictions due to nuclear uncertainties link to weak interactions and neutron captures on elements heavier than iron. We also identified the key nuclear reactions dominating these uncertainties. We found that β-decay rate uncertainties affect only a few nuclides near s-process branchings, whereas most of the uncertainty in the final abundances is caused by uncertainties in neutron capture rates, either directly producing or destroying the nuclide of interest. Combined total nuclear uncertainties due to reactions on heavy elements are in general small (less than 50%). Three key reactions, nevertheless, stand out because they significantly affect the uncertainties of a large number of nuclides. These are ^{56}Fe(n,γ), ^{64}Ni(n,γ), and ^{138}Ba(n,γ). We discuss the prospect of reducing uncertainties in the key reactions identified in this study with future experiments.

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Testing tidal theory for evolved stars by using red-giant binaries observed by *Kepler*

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Tidal interaction governs the redistribution of angular momentum in close binary stars and planetary systems and determines the systems evolution towards the possible equilibrium state. Turbulent friction acting on the equilibrium tide in the convective envelope of low-mass stars is known to have a strong impact on this exchange of angular momentum in binaries. Moreover, theoretical modelling in recent literature as well as presented in this paper suggests that the dissipation of the dynamical tide, constituted of tidal inertial waves propagating in the convective envelope, is weak compared to the dissipation of the equilibrium tide during the red-giant phase. This prediction is confirmed when we apply the equilibrium-tide formalism developed by Zahn (1977), Verbunt & Phinney (1995), and Remus, Mathis & Zahn (2012) onto the sample of all known red-giant binaries observed by the NASA *Kepler* mission. Moreover, the observations are adequately explained by only invoking the equilibrium tide dissipation. Such ensemble analysis also benefits from the seismic characterisation of the oscillating components and surface rotation rates. Through asteroseismology, previous claims of the eccentricity as an evolutionary state diagnostic are discarded. This result is important for our understanding of the evolution of multiple star and planetary systems during advanced stages of stellar evolution.

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The Betelgeuse project II: asteroseismology

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We explore the question of whether the interior state of massive red supergiant supernova progenitors can be effectively probed with asteroseismology. We have computed a suite of ten models with ZAMS masses from 15 to 25 $M_\odot$ in intervals of 1 $M_\odot$ including the effects of rotation, with the stellar evolutionary code MESA. We estimate characteristic frequencies and convective luminosities of convective zones at two illustrative stages, core helium burning and off-center convective carbon burning. We also estimate the power that might be delivered to the surface to modulate the luminous output considering various efficiencies and dissipation mechanisms. The inner convective regions should generate waves with characteristic periods of $\sim$ 20 days in core helium burning, $\sim$ 10 days in helium shell burning, and 0.1–1 day in shell carbon burning. Acoustic waves may avoid both shock and diffusive dissipation relatively early in core helium burning throughout most of the structure. In shell carbon burning, years before explosion, the signal generated in the helium shell might in some circumstances be weak enough to avoid shock dissipation, but is subject to strong thermal dissipation in the hydrogen envelope. Signals from a convective carbon-burning shell are very likely to be even more severely damped by within the envelope. In the most optimistic case, early in core helium burning, waves arriving close to the surface could represent luminosity fluctuations of a few millimagnitudes, but the conditions in the very outer reaches of the envelope suggest severe thermal damping there.

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Radio observations of planetary nebulæ: no evidence for strong radial density gradients

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Radio continuum observations trace thermal emission of ionized plasma in planetary nebulæ and bring useful information on nebular geometries. A model of homogeneous sphere or shell cannot fit the nebular spectra and brightness temperatures. Two alternative models have been proposed in the literature: the first one consists of two homogeneous components, while the other one is a model of a shell with a significant radial density gradient. On the other side, prolate ellipsoidal shell model can successfully fit the surface brightness distribution of selected objects. We verify the existing models using data collected in radio surveys covering wide range of frequencies. In about 50% cases, density gradient can be excluded, and none of the remaining objects could be confirmed. None of the observed planetary nebulæ show the spectral index of 0.6 in the optically thick part of the spectrum, which is a value predicted for a shell containing strong radial density gradient. Radio spectra can be fitted with a model of prolate ellipsoidal shell, but also by a shell containing temperature variations in planetary nebulæ. At least eight planetary nebulae show two component spectra, with one compact component showing much higher optical thickness than the other one. Unexpectedly, a group of planetary nebulæ with lowest surface brightness show non-negligible optical thickness. Their emission comes from compact and dense structures, comprising only small part of total nebular mass.

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The Gaia–ESO survey: impact of extra-mixing on C and N abundances of giant stars

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The Gaia–ESO Public Spectroscopic Survey using FLAMES at the VLT has obtained high-resolution UVES spectra for a large number of giant stars, allowing a determination of the abundances of the key chemical elements carbon and nitrogen at their surface. The surface abundances of these chemical species are well-known to change in stars during their evolution on the red giant branch after the first dredge-up episode, as a result of extra-mixing phenomena. We investigate the effects of thermohaline mixing on C and N abundances using the first comparison between the Gaia–ESO survey [C/N] determinations with simulations of the observed fields using a model of stellar population synthesis. We explore the effects of thermohaline mixing on the chemical properties of giants through stellar evolutionary models computed with the stellar evolution code STAREVOL. We include these stellar evolution models in the Besançon Galaxy model to simulate the [C/N] distributions determined from the UVES spectra of the Gaia–ESO survey and compare them with the observations. Theoretical predictions including the effect of thermohaline mixing are in good agreement with the observations. However, the field stars in the Gaia–ESO survey with C and N abundance measurements have a metallicity close to solar, where the efficiency of thermohaline mixing is not very large. The C and N abundances derived by the Gaia–ESO survey in open and globular clusters clearly show the impact of thermohaline mixing at low-metallicity, allowing to explain the [C/N] ratio observed in lower-mass and older giant stars. Using independent observations of carbon isotopic ratio in clump field stars and open clusters, we also confirm that thermohaline mixing should be taken into account to explain the behavior of $^{12}C/^{13}C$ ratio as a function of stellar age. Overall the current model including thermohaline mixing is able to reproduce very well the C and N abundances over the whole metallicity range investigated by the Gaia–ESO survey data.

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Type II supernovæ in low luminosity host galaxies

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We present an analysis of a new sample of type II core-collapse supernovæ (SNe II) occurring within low-luminosity galaxies, comparing these with a sample of events in brighter hosts. Our analysis is performed comparing SN II spectral and photometric parameters and estimating the influence of metallicity (inferred from host luminosity differences) on SN II transient properties. We measure the SN absolute magnitude at maximum, the light-curve plateau duration, the optically thick duration, and the plateau decline rate in the V-band, together with expansion velocities and pseudo-equivalent-widths (pEWs) of several absorption lines in the SN spectra. For the SN host galaxies, we estimate the absolute magnitude and the stellar mass, a proxy for the metallicity of the host galaxy. SNe II exploding in low luminosity galaxies display weaker pEWs of Fe II λ5018, confirming the theoretical prediction that metal lines in SN II spectra should correlate with metallicity. We also find that SNe II in low-luminosity hosts have generally slower declining light curves and display weaker absorption lines. We find no relationship between the plateau duration or the expansion velocities with SN environment, suggesting that the hydrogen envelope mass and the explosion energy are not correlated with the metallicity of the host galaxy. This result supports recent predictions that mass loss for red supergiants is independent of metallicity.

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Capture and escape: the dependence of radiation forces on clumping in dusty envelopes

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Dust barriers effectively capture the photon momentum of a central light source, but low-density channels, along with re-emission at longer wavelengths, enhance its escape. We use Monte Carlo simulations to study the effects of inhomogeneity on radiation forces imparted to a dust envelope around a central star. We survey the strength and scale of an inhomogeneous perturbation field, as well as the optical depth of its spherical reference state, at moderate numerical resolution, relying on our previous resolution study for calibration of the associated error. Inhomogeneities matter most when their scale exceeds the characteristic mean free path. As expected, they tend to reduce the net radiation force and extend its range; however there is significant variance among realizations. Within our models, force integrals correlate with emergent spectral energy distribution. A critical issue is the choice of integral measures of the radiation force. For strong deviations from spherical symmetry the relevant measures assess radial forces relative to the cloud centre of mass. Of these, we find the virial term due to radiation to be the least stochastic of several integral measures in the presence of inhomogeneities.

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Determination of stellar atmospheric parameters for a sample of the post-AGB stars

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We report for the first time the stellar atmospheric parameters for a a set of post-AGB stars classified by Suárez et al. (2006). The stellar spectra were taken from optical region, with low-resolution and have different spectral ranges. We select a sample of 70 objects with A–K spectral types and luminosities I and Ie. The large majority of these objects have been scarcely studied and are located toward the galactic south pole region. We employ a set of empirical relationships that use pseudo-equivalent widths like spectral feature to estimate effective temperature, surface gravity and metallicity. The criteria chosen for selection of absorption are similar to employed by MK classification system.

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On ϵ-mechanism driven pulsations in VV 47

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We report new observations of the central star of the planetary nebula VV 47 carried out to verify earlier assertions that the short-period pulsation modes detected in the star are driven by the ϵ mechanism. In our data, VV 47 was not variable up to a limit of 0.52 mmag in the Fourier amplitude spectrum up to the Nyquist frequency of 21.7 mHz. Given this null result we re-analyzed the data set in which oscillations were claimed. After careful data reduction, photometry, extinction correction, and analysis with a conservative criterion of $S/N \geq 4$ in the Fourier amplitude spectrum, we found that the star was not variable during the original observations. The oscillations reported earlier were due to an over-optimistic detection criterion. We conclude that VV 47 did not pulsate during any measurements

at hand; the observational detection of ϵ-driven pulsations remains arduous.

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The optical properties of dust: the effects of composition, size, and structure

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Dust grains are determinant for setting the chemical, physical, dynamical, and radiative properties of all the media in which they are present. Their influence depends on the grain composition, size, and geometrical structure which vary throughout the lifecycle of dust. In particular, grain growth arises in dense molecular clouds and protoplanetary disks as traced by an enhancement of the dust far-IR emissivity and by the effects of cloudshine and coreshine. Our aim is to investigate the imprint of the grain characteristics on the dust unpolarised optical properties from the visible to the far-IR wavelengths for isolated grains as well as for aggregates. Using optical constants for both carbonaceous and silicate materials, we have derived the absorption and scattering efficiencies, the asymmetry factor of the phase function, the single scattering albedo, and the mass opacity for isolated grains and aggregates, using either the Mie theory or the discrete dipole approximation (DDA). We investigated the effects of the size, porosity and shape of the grains, and of the monomers constituting the aggregates, on the optical properties. Besides this, for aggregates we studied the influence of the number of monomers and of mixing monomer sizes. Grain structure changes result in optical property variations at all wavelengths. Porosity, grain elongation, as well as aggregation all produce an increase in the far-IR opacity. The spectral dependence of this increase depends on the nature of the material composing the grain: it is independent of the wavelength for insulators but not for conductors. In the case of aggregates, the far-IR increase does not depend on the monomer size and saturates for aggregates containing six or more monomers. In the visible and near-IR, the aggregate behaviour is reminiscent of a compact sphere of the same mass whereas at longer wavelengths, it is closer to the effect of porosity. Finally, for silicates, the mid-IR spectral feature at 18 μm is more sensitive to the details of the grain structure than the 10 μm feature. Dust optical properties, from the visible to the far-IR, are highly dependent upon the grain composition, size, and structure. This study provides a basis for understanding the range of variations achievable as a result of varying the grain characteristics. It emphasises the importance of considering the detailed grain structure in determining the dust optical properties and of using exact methods because approximate methods cannot reproduce the entire range of the observed variations at all wavelengths.

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Long-term changes in the variability of pulsating red giants (and one R CrB star)

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We have used many decades of visual observations from the AAVSO International Database, and the AAVSO time-series analysis package VSTAR, to study the long-term changes in period, amplitude, and mean magnitude in about

30 normal pulsating red giants (PRGs) i.e. those without large secular changes in period, as well as a few of the rare PRGs which do have such secular period changes. The periods of the typical PRGs "wander" on time scales of about 40 pulsation periods – significantly longer than the time scales of amplitude variation which are 20–35 with a mean of 27 pulsation periods. We have also studied the range and time scale of the long-term changes in pulsation amplitude and mean magnitude, as well as period, and looked for correlations between these. Changes in mean magnitude are larger in stars with larger mean amplitude, but correlate negatively with changes in amplitude. There is a weak positive correlation between the long-term period changes and amplitude changes. The causes of these three kinds of long-term changes are still not clear. We note, from the presence of harmonics in the Fourier spectra, that the longest-period PRGs have distinctly non-sinusoidal phase curves. For studying PRGs, we demonstrate the advantage of studying stars with minimal seasonal gaps in the observations, such as those near the celestial poles. We studied Z UMi, misclassified as a possible Mira star, but actually an R CrB star. We determined times of onset of 16 fadings. We were not able to determine a coherent pulsation period for this star at maximum, with an amplitude greater than 0.05. We did, however, find that the times of onset of fadings were "locked" to a 41.98-day period – a typical pulsation period for an R CrB star.

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A critical re-evaluation of the Thorne–Żytkow object candidate HV 2112

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It has been argued in the literature that the star HV 2112 in the Small Magellanic Cloud is the first known example of a TŻO, a Red Supergiant with a degenerate neutron core. This claim is based on the star having a high luminosity ($\log(L/\mathrm{L}_\odot)\lesssim 5$), an extremely cool effective temperature, and a surface enriched in in lithium, calcium and various *irp*-process elements. In this paper we re-examine this evidence, and present new measurements of the stellar properties. By compiling archival photometry from blue to mid-IR for HV 2112 and integrating under it's spectral energy distribution we find a bolometric luminosity in the range of $\log(L/\mathrm{L}_\odot) = 4.70$–$4.91$, lower than that found in previous work and comparable to bright asymptotic giant branch (AGB) stars. We compare a VLT+XSHOOTER spectrum of HV 2112 to other late type, luminous SMC stars, finding no evidence for enhancements in Rb, Ca or K, though there does seem to be an enrichment in Li. We therefore conclude that a much more likely explanation for HV 2112 is that it is an intermediate mass (~ 5 $\mathrm{M}_\odot$) AGB star. However, from our sample of comparison stars we identify a new TŻO candidate, HV 11417, which seems to be enriched in Rb but for which we cannot determine a Li abundance.

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The long-term secular mass accretion rate of the recurrent nova T Pyxidis

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We present *Hubble* Space Telescope ultraviolet spectroscopy of the recurrent nova T Pyxidis obtained more than 5 years after its 2011 outburst indicating that the system might not have yet reached its deep quiescent state. The ultraviolet data exhibit a 20 percent decline in the continuum flux from the pre-outburst deep quiescence state to the post-outburst near quiescent state. We suggest that a decline across each recurring nova eruption might help explain the proposed 2 mag steady decline of the system since 1866. Using an improved version of our accretion disk model as well as International Ultraviolet Explorer ultraviolet and optical data, and the 4.8 kpc distance, we corroborate our previous findings that the quiescent mass accretion rate in T Pyx is $\sim 10^{-6}$ M$_\odot$ yr^{-1}. Such a large mass accretion rate would imply that the mass of the white dwarf is increasing with time. However, with the just-released Gaia DR2 distance of 3.3 kpc (after submission of the first version of this manuscript), we find a mass accretion more in line with the estimate of Patterson et al. (2017), of $\sim 10^{-7}$ M$_\odot$ yr^{-1}. Our results predict powerful soft X-ray or extreme ultraviolet emission from the hot inner region of the high accretion rate disk. Using constraining X-ray observations and assuming the accretion disk doesn't depart too much from the standard model, we are left with two possible scenarios. The disk either emits mainly extreme ultraviolet radiation which, at a distance of 4.8 kpc, is completely absorbed by the interstellar medium, or the hot inner disk, emitting soft X-rays, is masked by the bulging disk seen at a higher inclination.

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A search for candidate Li-rich giant stars in SDSS DR10

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We report the results of a search for candidate Li-rich giants among 569,738 stars of the SDSS DR10 dataset. With small variations, our approach is based on that taken in an earlier search for EMP/CEMP stars and uses the same dataset. As part of our investigation, we demonstrate a method for separating post-main sequence and main sequence stars cooler than $T_{\rm eff} \sim 5800$ K using our feature strength measures of the Sr II 4078, Fe I 4072, and Ca I 4227 lines. By taking carefully selected cuts in a multi-dimensional phase space, we isolate a sample of potential Li-rich giant stars. From these, using detailed comparison with dwarf and giant MILES stars, and our own individual spectral classifications, we identify a set of high likelihood candidate Li-rich giant stars. We offer these for further study to promote an understanding of these enigmatic objects.

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Counteracting tidal circularization with the grazing envelope evolution

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We show that substantially enhanced mass loss at periastron passages, as is expected in the grazing envelope evolution (GEE), can compensate for the circularization effect of the tidal interaction in binary systems composed of an asymptotic giant branch (AGB) star and a main sequence secondary star. By numerically integrating the equations of motion we show that under our assumptions the binary system can maintain its high eccentricity as the AGB star evolves toward the post-AGB phase. Our results can explain the high eccentricity of some post-AGB intermediate binaries, i.e. those with an orbital periods in the range of several months to few years. In the framework of the GEE, the extra energy to sustain a high mass loss rate comes from the accretion of mass from the giant envelope or its slow wind onto a more compact secondary star. The secondary star energizes the outflow from the AGB outer envelope by launching jets from the accretion disk.

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Wide-field Infrared Survey Explorer (WISE) catalog of periodic variable stars

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We have compiled the first all-sky mid-infrared variable-star catalog based on Wide-field Infrared Survey Explorer (WISE) five-year survey data. Requiring more than 100 detections for a given object, 50,282 carefully and robustly selected periodic variables are discovered, of which 34,769 (69%) are new. Most are located in the Galactic plane and near the equatorial poles. A method to classify variables based on their mid-infrared light curves is established using known variable types in the General Catalog of Variable Stars. Careful classification of the new variables results in a tally of 21,427 new EW-type eclipsing binaries, 5654 EA-type eclipsing binaries, 1312 Cepheids, and 1231 RR Lyræ. By comparison with known variables available in the literature, we estimate that the misclassification rate is 5% and 10% for short- and long-period variables, respectively. A detailed comparison of the types, periods, and amplitudes with variables in the Catalina catalog shows that the independently obtained classifications parameters are in excellent agreement. This enlarged sample of variable stars will not only be helpful to study Galactic structure and extinction properties, they can also be used to constrain stellar evolution theory and as potential candidates for the *James Webb* Space Telescope.

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On the evolution of ultra-massive white dwarfs

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White dwarfs are nowadays routinely used as reliable cosmochronometers, allowing to date several stellar populations. In particular, ultra-massive white dwarfs are involved in other various applications which include physical processes in the Asymptotic Giant Branch (AGB), the theory of crystallization and type Ia supernova explosions. Despite the interest in these white dwarfs, there are few evolutionary studies in the literature devoted to them. Here, we present new ultra-massive white dwarf evolutionary sequences that constitute an improvement over previous ones. In these new sequences, we take into account for the first time the process of phase separation expected during the crystallization stage of these white dwarfs, by relying on the most up-to-date phase diagram of dense oxygen/neon mixtures. Realistic chemical profiles resulting from the full computation of progenitor evolution during the semi-degenerate carbon burning along the super-AGB phase are also considered in our sequences. Outer boundary conditions for our evolving models are provided by detailed non-gray white dwarf model atmospheres for hydrogen and helium composition. We assessed the impact of all these improvements on the evolutionary properties of ultra-massive white dwarfs, providing up-dated evolutionary sequences for these stars. These white dwarf sequences provide a new theoretical frame to perform astero-seismological studies on the recently detected ultra-massive pulsating white dwarfs.

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HST/WFPC2 imaging analysis and Cloudy modelling of the multiple shell planetary nebulæ NGC 3242, NGC 6826 and NGC 7662

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We performed a detailed photometric analysis and photoionisation modelling on three high excitation multiple shell planetary nebulæ: NGC 3242, NGC 6826 and NGC 7662. Archival HST/WFPC2 narrow band filter images were used to investigate shocked regions by two independent methods: using low excitation ions (via Hα/[N II] vs. Hα/[S II] extended diagnostic diagrams) and by means of high excitation species looking for regions of enhanced [O III]/Hα line ratios. Shocked region analysis via low excitation ions shows that major deviations from the general inside to outside ionisation trend correspond only to regions where FLIERs or LISs are located. The reduction on the SNR at the outskirts of the [O III]/Hα ratio maps, made us unable to unambiguously identified for an enhancement on the [O III]/Hα line ratio as an indicator for shocks. For non-shocked regions we performed a photoionisation modelling using Cloudy. Fittings to the [O III] and Hα observed radial profiles lead us to constrain on the free parameters of the density laws and filling factors together to temperatures and luminosities for the CSPNe. Best fit models show a very well representation of the [O III] and Hα emission. Discrepancies in the model fittings to the [N II] and [S II] profiles at NGC 6826 and NGC 3242, can be attributed in the former case, due to a contamination by the light of the CSPN and, in the latter case, either due to gas inhomogeneities within the clumps or to a leaking of UV radiation.

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The pulsation properties of ultra-massive DA white dwarf stars with ONe cores

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Ultra-massive hydrogen-rich white dwarfs stars are expected to harbour oxygen/neon cores resulting from the progenitor evolution through the super asymptotic giant branch phase. As evolution proceeds during the white dwarf cooling phase, crystallization process resulting from Coulomb interactions in very dense plasmas is expected to occur, leading to the formation of a highly crystallized core. In particular, pulsating ultra-massive white dwarfs offer an unique opportunity to infer and test the occurrence of crystallization in white dwarfs interiors as well as physical processes related with dense plasmas. This paper is aimed to assess the adiabatic pulsation properties of ultra-massive hydrogen-rich white dwarfs with oxygen/neon cores. We study the pulsation properties of ultra-massive hydrogen-rich white dwarf stars with oxygen/neon cores. We employ a new set of ultra-massive white dwarf evolutionary sequences of models with stellar masses in the range $1.10 \leq M_{\star}/M_{\odot} \leq 1.29$ computed taking into account the complete evolution of the progenitor stars and the white dwarf stage. During the white dwarf cooling phase, we consider element diffusion. When crystallization sets on in our models, we take into account latent heat release and also the expected changes in the core chemical composition due to phase separation according to a phase diagram suitable for oxygen and neon plasmas. We compute nonradial pulsationg modes of our sequences of models at the ZZ Ceti phase by taking into account the presence of a solid core. We explore the impact of crystallization on their pulsation properties, in particular the structure of the period spectrum and the distribution of the period spacings. We find that the chemical re-homogeneization due to phase separation during crystallization leaves clear imprints in the pulsation spectrum, particularly strong features in the diagrams of period spacing versus periods. We also find that it is not possible, in principle, to discern whether a white dwarf has a nucleus made of carbon and oxygen or a nucleus of oxygen and neon by simply studying the spacing between periods. The features found in the period-spacing diagrams could be used as a seismological tool to study the processes that occur during crystallization in white dwarfs. In addition, we found that the only way to discern the core composition is, probably, through detailed astero-seismic analysis using the individual periods observed in ZZ Ceti stars.

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Molecular line study of the S-type AGB star W Aquilæ. ALMA observations of CS, SiS, SiO and HCN

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Context: With the outstanding spatial resolution and sensitivity of the Atacama Large Millimeter/sub-millimeter Array (ALMA), molecular gas other than the abundant CO can be observed and resolved in circumstellar envelopes (CSEs) around evolved stars, such as the binary S-type asymptotic giant branch (AGB) star W Aquilæ.
Aims: We aim to constrain the chemical composition of the CSE and determine the radial abundance distribution, the photospheric peak abundance, and isotopic ratios of a selection of chemically important molecular species in the innermost CSE of W Aql. The derived parameters are put into the context of the chemical evolution of AGB stars and are compared with theoretical models. Methods. We employ one-dimensional radiative transfer modeling – with the accelerated lambda iteration (ALI) radiative transfer code – of the radial abundance distribution of a total of five molecular species (CS, SiS, ^{30}SiS, ^{29}SiO and H^{13}CN) and determine the best fitting model parameters based on high-resolution ALMA observations as well as archival single-dish observations. The additional advantage of the spatially resolved ALMA observations is that we can directly constrain the radial profile of the observed line transitions from the observations.
Results: We derive abundances and e-folding radii for CS, SiS, ^{30}SiS, ^{29}SiO and H^{13}CN and compare them to previous studies, which are based only on unresolved single-dish spectra. Our results are in line with previous results and are more accurate due to resolution of the emission regions.

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Sulphur-bearing molecules in AGB stars II: abundances and distributions of CS and SiS

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We surveyed 20 AGB stars of different chemical types using the APEX telescope, and combined this with an IRAM 30 m and APEX survey of CS and SiS emission towards over 30 S-type stars. For those stars with detections, we performed radiative transfer modelling to determine abundances and abundance distributions. We detect CS towards all the surveyed carbon stars, some S-type stars, and the highest mass-loss rate oxygen-rich stars ($> 5 \times 10^{-6}$ M$_\odot$ yr^{-1}). SiS is detected towards the highest mass-loss rate sources of all chemical types ($> 8 \times 10^{-7}$ M$_\odot$ yr^{-1}). We find CS peak fractional abundances ranging from $\sim 4 \times 10^{-7}$ to $\sim 2 \times 10^{-5}$ for the carbon stars, from $\sim 3 \times 10^{-8}$ to $\sim 1 \times 10^{-7}$ for the oxygen-rich stars and from $\sim 1 \times 10^{-7}$ to $\sim 8 \times 10^{-6}$ for the S-type stars. We find SiS peak fractional abundances ranging from $\sim 9 \times 10^{-6}$ to $\sim 2 \times 10^{-5}$ for the carbon stars, from $\sim 5 \times 10^{-7}$ to $\sim 2 \times 10^{-6}$ for the oxygen-rich stars, and from $\sim 2 \times 10^{-7}$ to $\sim 2 \times 10^{-6}$ for the S-type stars. We derived Si^{32}S/Si^{34}S = 11.4 for AI Vol, the only star for which we had a reliable isotopologue detection. Overall, we find that wind density plays an important role in determining the chemical composition of AGB CSEs. It is seen that for oxygen-rich AGB stars both CS and SiS are detected only in the highest density circumstellar envelopes and their abundances are generally lower than for carbon-rich AGB stars by around an order of magnitude. For carbon-rich and S-type stars SiS was also only detected in the highest density circumstellar envelopes, while CS was detected consistently in all surveyed carbon stars and sporadically among the S-type stars.

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Planetary Nebulæ distances in GAIA DR2

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Context: Planetary Nebula distance scales often suffer for model dependent solutions. Model independent trigonometric parallaxes have been rare. Space based trigonometric parallaxes are now available for a larger sample using the second data release of GAIA.
Aims: We aim to derive a high quality approach for selection criteria of trigonometric parallaxes for planetary nebulæ and discuss possible caveats and restrictions in the use of this data release.
Methods: A few hundred sources from previous distance scale surveys were manually cross identified with data from the second GAIA data release (DR2) as coordinate based matching does not work reliable. The data are compared with the results of previous distance scales and to the results of a recent similar study, which was using the first data release GAIA DR1.
Results: While the few available previous ground-based and HST trigonometric parallaxes match perfectly to the new data sets, older statistical distance scales, reaching larger distances, do show small systematic differences. Restricting to those central stars, were photometric colors of GAIA show a negligible contamination by the surrounding nebula, the difference is negligible for radio flux based statistical distances, while those derived from Hα surface brightness still show minor differences. The DR2 study significantly improves the previous recalibration of the statistical distance scales using DR1/TGAS.

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Imprints of white dwarf recoil in the separation distribution of Gaia wide binaries

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We construct from Gaia DR2 an extensive and very pure ($\lesssim 0.2\%$ contamination) catalog of wide binaries containing main-sequence (MS) and white dwarf (WD) components within 200 pc of the Sun. The public catalog contains, after removal of clusters and higher-order multiples, $> 50,000$ MS/MS, $> 3,000$ WD/MS, and nearly 400 WD/WD binaries with projected separations of $50 \lesssim s/\mathrm{au} < 50,000$. Accounting for incompleteness and selection effects, we model the separation distribution of each class of binaries as a broken power-law, revealing marked differences between the three populations. The separation distribution of MS/MS systems is nearly consistent with a single power-law of slope -1.6 over at least $500 < s/\mathrm{au} < 50,000$, with marginal steepening at $s > 10,000$ au. In contrast, the separation distributions of WD/MS and WD/WD binaries show distinct breaks at $\sim 3,000$ au and $\sim 1,500$ au, respectively: they are flatter than the MS/MS distribution at small separations and steeper at large separations. Using binary population synthesis models, we show that these breaks are unlikely to be caused by external factors but can be explained if the WDs incur a kick of ~ 0.75 km s^{-1} during their formation, presumably due to asymmetric mass loss. The data rule out typical kick velocities above 2 km s^{-1}. Our results imply that most wide binaries with separations exceeding a few thousand au become unbound during post-MS evolution.

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When binaries keep track of recent nucleosynthesis : The Zr–Nb pair in extrinsic stars as an s-process diagnostic

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Barium stars are s-process enriched giants. They owe their chemical peculiarities to a past mass transfer phase. During this phase they were polluted by their binary companion, which at the time was an asymptotic giant branch (AGB) star, but is now an extinct white dwarf. Barium stars are thus ideal targets for understanding and constraining the s-process in low- and intermediate-mass AGB stars. We derive the abundances of a large number of heavy elements in order to shed light on the conditions of operation of the neutron source responsible for the production of s-elements in the former companions of the barium stars. Adopting a recently used methodology, we analyse a sample of eighteen highly enriched barium stars observed with the high-resolution HERMES spectrograph mounted on the *Mercator* telescope (La Palma). We determine the stellar parameters and abundances using MARCS model atmospheres. In particular, we derive the Nb-to-Zr ratio which was previously shown to be a sensitive thermometer for the s-process nucleosynthesis. Indeed, in barium stars, ^{93}Zr has fully decayed into mono-isotopic ^{93}Nb, so Nb/Zr is a measure of the temperature-sensitive ^{93}Zr/Zr isotopic ratio. HD 28159, previously classified as K5 III and initially selected to serve as a reference cool K star for our abundance analysis, turns out to be enriched in s-process elements, and as such is a new barium star. Four stars, characterised by high nitrogen abundances, also tend to have high [Nb/Zr] and [hs/ls] ratios. The derived Zr and Nb abundances provide more accurate constraints on the s-process neutron source, identified to be ^{13}C(α, n)^{16}O for barium stars. The comparison with stellar evolution and nucleosynthesis models shows that the investigated barium stars were polluted by a low-mass ($M \sim$ 2–3 M$_\odot$) AGB star. HD 100503 is potentially identified as a high metallicity analogue of carbon-enhanced metal-poor star enriched in both r- and s-process elements (CEMP-rs).

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Confirmation of the link between central star binarity and extreme abundance discrepancy factors in planetary nebulæ

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It has recently been noted that there seems to be a strong correlation between planetary nebulæ with close binary central stars, and highly enhanced recombination line abundances. We present new deep spectra of seven objects known to have close binary central stars, and find that the heavy element abundances derived from recombination lines exceed those from collisionally excited lines by factors of 5–95, placing several of these nebulae among the most extreme known abundance discrepancies. This study nearly doubles the number of nebulae known to have a binary central star and an extreme abundance discrepancy.
A statistical analysis of all nebulæ with measured recombination line abundances reveals no link between central

star surface chemistry and nebular abundance discrepancy, but a clear link between binarity and the abundance discrepancy, as well as an anti-correlation between abundance discrepancies and nebular electron densities: all nebulae with a binary central star with a period of less than 1.15 days have an abundance discrepancy factor exceeding 10, and an electron density less than ~ 1000 cm^{-3}; those with longer period binaries have abundance discrepancy factors less than 10 and much higher electron densities. We find that [O II] density diagnostic lines can be strongly enhanced by recombination excitation, while [S II] lines are not.
These findings give weight to the idea that extreme abundance discrepancies are caused by a nova-like eruption from the central star system, occurring soon after the common-envelope phase, which ejects material depleted in hydrogen, and enhanced in CNONe but not in third-row elements.

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High-temperature dust condensation around an AGB star: evidence from a highly pristine presolar corundum

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Corundum (α-Al_2O_3) and amorphous or metastable Al_2O_3 are common components of circumstellar dust observed around O-rich asymptotic giant branch (AGB) stars and found in primitive meteorites. We report a detailed isotopic and microstructural investigation of a unique presolar corundum grain, QUE060, identified in an acid residue of the Queen Alexandra Range 97008 (LL3.05) meteorite. Based on its O and Mg isotopic compositions, this 1.4-μm diameter grain formed in a low- or intermediate-mass AGB star. It has four developed rhombohedral 011 faces of corundum and a rough, rounded face with cavities. High Mg contents (Mg/Al > 0.004) are due to the decay of radioactive ^{26}Al. No spinel ($MgAl_2O_4$) inclusions that might have exsolved from the corundum are observed, but there are several high-Mg domains with modulated structures. The subhedral shape of grain QUE060 is the first clear evidence that corundum condenses and grows to micrometer sizes in the extended atmospheres around AGB stars. The flat faces indicate that grain QUE060 experienced little modification by gas–grain and grain–grain collisions in the interstellar medium (ISM) and solar nebula. The Mg distribution in its structure indicates that grain QUE060 has not experienced any severe heating events since the exhaustion of ^{26}Al. However, it underwent at least one very transient heating event to form the high-Mg domains. A possible mechanism for producing this transient event, as well as the one rough surface and cavity, is a single grain–grain collision in the ISM. These results indicate that grain QUE060 is the most pristine circumstellar corundum studied to date.

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Available from https://arxiv.org/abs/1807.10077

An atlas of cool supergiants from the Magellanic Clouds and typical interlopers: a guide for the classification of luminous red stars

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We present an atlas composed of more than 1,500 spectra of late-type stars spectral types from G to M) observed simultaneously in the optical and calcium triplet spectral ranges. These spectra were obtained as part of a survey to search for cool supergiants in the Magellanic Clouds and were taken over four epochs. We provide the spectral and luminosity classification for each spectrum (71% are supergiants, 13% are giants or luminous giants, 4% are carbon or S stars, and the remaining 12% are foreground stars of lesser luminosities). We also provide a detailed guide for the spectral classification of luminous late-type stars, the result of the extensive classification work done for the atlas. Although this guide is based on classical criteria, we have put them together and re-elaborated them for modern CCD-spectra as these criteria were scattered among many different works and mainly conceived for use with photographic plate spectra. The result is a systematic, well-tested process for identifying and classifying luminous late-type stars, illustrated with CCD spectra of standard stars and the classifications of our own catalogue.

Accepted for publication in Astronomy & Astrophyisics
Available from https://arxiv.org/abs/1807.07456

De-projection of radio observations of axi-symmetric expanding circumstellar envelopes

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The problem of de-projection of radio line observations of axi-symmetric expanding circumstellar envelopes is studied with the aim of easing their analysis in terms of physics models. The arguments developed rest on the remark that, in principle, when the wind velocity distribution is known, the effective emissivity can be calculated at any point in space. The paper provides a detailed study of how much this is true in practice. The wind velocity distribution assumed to be axi-symmetric and in expansion, is described by four parameters: the angles defining the orientation of the symmetry axis, an overall velocity scale and a parameter measuring the elongation (prolateness) of the distribution. Tools are developed that allow for measuring, or at least constraining, each of the four parameters. The use of effective emissivity as relevant quantity, rather than temperature and density being considered separately, implies important assumptions and simplifications meaning that the approach being considered here is only a preliminary to, and by no means a replacement for, a physics analysis accounting for radiative transfer and hydrodynamics arguments. While most considerations are developed using simulated observations as examples, two case studies (EP Aqr, observed with ALMA, and RS Cnc, with NOEMA) are presented that illustrate their usefulness in practical cases.

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Available from https://arxiv.org/abs/1807.10205

The solar-like "Second Spectrum" and polarized metal lines in the emission of the post-AGB binary 89 Herculis

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We studied the polarized spectrum of the post-AGB binary system 89 Herculis on the basis of data collected with the high-resolution Catania Astrophysical Observatory Spectropolarimeter, HArps-North POlarimeter and Échelle SpectroPolarimetric Device for the Observation of Stars.We find the existence of linear polarization in the strongest metal lines in absorption and with low excitation potentials. Signals are characterized by complex Q and U morphologies

varying with the orbital period. We rule out magnetic fields, continuum depolarization due to pulsations and hot spots as the possible origin of this "Second Solar Spectrum"-like behaviour. The linear polarization we detected in the Ca II 8662-Å line is clear evidence of optical pumping polarization and rules out scattering polarization from free electrons of the circumbinary environment. In the framework of optical pumping due to the secondary star, the observed periodic properties of the spectral line polarization can be justified by two jets, with a flow velocity of a few tens of km s^{-1}, at the basis of that hourglass structure characterizing 89 Herculis. We also discovered linear polarization across the emission profile of metal lines. Numerical simulations show that these polarized profiles could be formed in an undisrupted circumbinary disc rotating at ≤ 10 km s^{-1} and with an orientation in the sky in agreement with optical and radio interferometric results. We conclude that the study of aspherical envelopes, the origin of which is not yet completely understood, of PNe and already present in post-AGBs can benefit from high-resolution spectropolarimetry and that this technique can shape envelopes still too far away for interferometry.

Accepted for publication in Montlhy Notice of the Royal Astronomical Society

Properties of dust in the detached shells around U Ant, DR Ser, and V644 Sco

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Context: Asymptotic giant branch (AGB) stars experience strong mass loss driven by dust particles formed in the upper atmospheres. The dust is released into the interstellar medium, and replenishes galaxies with synthesised material from the star. The dust grains further act as seeds for continued dust growth in the diffuse medium of galaxies. As such, understanding the properties of dust produced during the asymptotic giant branch phase of stellar evolution is important for understanding the evolution of stars and galaxies. Recent observations of the carbon AGB star R Scl have shown an excess emission from the detached shell around the star at submillimetre wavelengths, indicating that the dust in the shell may have so far unknown properties.
Aims: We aim to constrain the properties of the dust observed in the submillimetre in the detached shells around the three carbon AGB stars U Ant, DR Ser, and V644 Sco, and to investigate possible submm-excesses also in these sources.
Methods: We observed the carbon AGB stars U Ant, DR Ser, and V644 Sco at 870 μm using LABOCA on APEX. Combined with observations from the optical to far-infrared, we produced dust radiative transfer models of the spectral energy distributions (SEDs) with contributions from the stars, present-day mass-loss and detached shells. We tested the effect of different total dust masses and grain sizes on the SED, and attempted to consistently reproduce the SEDs from the optical to the submm.
Results: We derive dust masses in the shells of a few 10^{-5} $M_{\odot}$, assuming spherical, solid grains. The best-fit grain radii are comparatively large, and indicate the presence of grains between 0.1 μm – 2 μm. In all cases we detect an excess at 870 μm that cannot be reproduced by simply changing the grain size. We investigate the possibility of the presence of a population of cold grains, a broken emissivity law at far-infrared wavelengths, and the presence of spinning nanoparticles. However, based on the current observational data, it is not possible to draw any firm conclusions.
Conclusions: Together with the observations of R Scl, submm-excess has been observed in four detached-shell sources. The consistent observation of the excess implies that the detached shells contain dust with currently unknown properties. Spatially resolved observations in the submm of a sample of AGB stars without detached shells are required to see whether this is a general phenomena. The results have implications for our understanding of stellar evolution, the chemical evolution of the ISM, and for the evolution of galaxies.

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Available from https://arxiv.org/abs/1807.11305

Astronomical detection of a radioactive molecule ^{26}AlF in a remnant of an ancient explosion

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Decades ago, γ-ray observatories identified diffuse Galactic emission at 1.809 MeV originating from β^+ decays of an isotope of aluminium, ^{26}Al, that has a mean-life time of 1.04 Myr. Objects responsible for the production of this radioactive isotope have never been directly identified, owing to insufficient angular resolutions and sensitivities of the γ-ray observatories. Here, we report observations of millimetre-wave rotational lines of the isotopologue of aluminium monofluoride that contains the radioactive isotope (^{26}AlF). The emission is observed toward CK Vul which is thought to be a remnant of a stellar merger. Our constraints on the production of ^{26}Al combined with the estimates on the merger rate make it unlikely that objects similar to CK Vul are major producers of Galactic ^{26}Al. However, the observation may be a stepping stone for unambiguous identification of other Galactic sources of ^{26}Al. Moreover, a high content of ^{26}Al in the remnant indicates that prior to the merger, the CK Vul system contained at least one solar-mass star that evolved to the red giant branch.

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and from http://dx.doi.org/10.1038/s41550-018-0541-x

A young ultramassive white dwarf in the AB Doradus moving group

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We use Gaia DR2 kinematic data and white dwarf evolutionary models to determine that the young and ultramassive white dwarf GD 50 is a likely member of the AB Doradus moving group. Comparison with the Montréal white dwarf evolutionary models and the MIST main-sequence lifetimes imply a total age of 117 ± 26 (± 13 statistic, ± 22 systematic) Myr, accounting for all possible C/O/Ne core compositions and using the Pleiad white dwarf LB 1497 as a comparison benchmark. This is the first white dwarf cosmochronology age for a nearby young moving group, and allows us to refine the age of the AB Doradus moving group at 133^{+15}_{-20} Myr by combining it with its independent isochronal age. GD 50 is the first white dwarf member of the AB Doradus moving group and is located at only 31 pc from the Sun, making it an important benchmark to better understand the star-formation history of the Solar neighborhood.

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Available from https://arxiv.org/abs/1806.07512
and from http://adsabs.harvard.edu/abs/2018ApJ...861L..13G

The curious case of II Lup: a complex morphology revealed with SAM/NACO and ALMA

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We present the first-ever images of the circumstellar environment of the carbon-rich AGB star II Lup in the infrared and sub-mm wavelengths, and the discovery of the envelope's non-spherical morphology with the use of high-angular resolution imaging techniques with the sparse aperture masking mode on NACO/VLT (that enables diffraction limited resolution from a single telescope) and with ALMA. We have successfully recovered images in K_s (2.18 μm), L' (3.80 μm) and M' (4.78 μm), that revealed the non-spherical morphology of the circumstellar envelope around II Lup. The stellar surface of the AGB star is unresolved (i.e. ≤ 30 mas in K_s however the detected structure extends up to 110 mas from the star in all filters. Clumps have been found in the K_s maps, while at lower emission levels a hook-like structure appears to extend counter-clockwise from the south. At larger spatial scales, the circumstellar envelope extends up to $\approx 23''$, while its shape suggests a spiral at four different molecules, namely CO, SiO, CS and HC_3N, with an average arm spacing of $1\overset{''}{.}7$ which would imply an orbital period of 128 years for a distance of 590pc.

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A white dwarf catalogue from Gaia-DR2 and the Virtual Observatory

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We present a catalogue of 73,221 white dwarf candidates extracted from the astrometric and photometric data of the recently published Gaia DR2 catalogue. White dwarfs were selected from the Gaia Hertzsprung–Russell diagram with the aid of the most updated population synthesis simulator. Our analysis shows that Gaia has virtually identified all white dwarfs within 100 pc from the Sun. Hence, our sub-population of 8,555 white dwarfs within this distance limit and the colour range considered, $-0.52 < (G_{\rm BP} - G_{\rm RP}) < 0.80$, is the largest and most complete volume-limited sample of such objects to date. From this sub-sample we identified 8,343 CO-core and 212 ONe-core white dwarf candidates and derived a white dwarf space density of $4.9 \pm 0.4 \times 10^{-3}$ pc^{-3}. A bifurcation in the Hertzsprung–Russell diagram for these sources, which our models do not predict, is clearly visible. We used the Virtual Observatory tool VOSA to derive effective temperatures and luminosities for our sources by fitting their spectral energy distributions, that we built from the UV to the NIR using publicly available photometry through the Virtual Observatory. From these parameters, we derived the white dwarf radii. Interpolating the radii and effective temperatures in hydrogen-rich white dwarf cooling sequences, we derived the surface gravities and masses. The Gaia 100-pc white dwarf population is clearly dominated by cool ($\sim 8,000$ K) objects and reveals a significant population of massive ($M \sim 0.8$ M$_{\odot}$) white

dwarfs, of which no more than $\sim$ 30–40% can be attributed to hydrogen-deficient atmospheres, and whose origin remains uncertain.

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Available from https://arxiv.org/abs/1807.02559

The double dust envelopes of R Coronæ Borealis stars

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The study of extended, cold dust envelopes surrounding R Coronæ Borealis (RCB) stars began with their discovery by IRAS. RCB stars are carbon-rich supergiants characterized by their extreme hydrogen deficiency and for their irregular and spectacular declines in brightness (up to 9 mags). We have analyzed new and archival *Spitzer* Space Telescope and *Herschel* Space Observatory data of the envelopes of seven RCB stars to examine the morphology and investigate the origin of these dusty shells. *Herschel*, in particular, has revealed the first ever bow shock associated with an RCB star with its observations of SU Tauri. These data have allowed the assembly of the most comprehensive spectral energy distributions (SEDs) of these stars with multi-wavelength data from the ultraviolet to the submillimeter. Radiative transfer modeling of the SEDs implies that the RCB stars in this sample are surrounded by an inner warm (up to 1,200 K) and an outer cold (up to 200 K) envelope. The outer shells are suggested to contain up to 10^{-3} $M_\odot$ of dust and have existed for up to 10^5 yr depending on the expansion rate of the dust. This age limit indicates that these structures have most likely been formed during the RCB phase.

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Available from https://arxiv.org/abs/1808.00618

Conference Papers

Sliding along the Eddington limit — heavy-weight central stars of planetary nebulæ

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Due to thermal pulses, asymptotic giant branch (AGB) stars experience periods of convective mixing that provide ideal conditions for slow neutron-capture nucleosynthesis. These processes are affected by large uncertainties and are still not fully understood. By the lucky coincidence that about a quarter of all post-AGB stars turn hydrogen-deficient

in a final flash of the helium-burning shell, they display nuclear processed material at the surface providing an unique insight to nucleosynthesis and mixing. We present results of non-local thermodynamic equilibrium spectral analyses of the extremely hot, hydrogen-deficient, PG 1159-type central stars of the Skull Nebula NGC 246 and the "Galactic Soccerballs" Abell 43 and NGC 7094.

Oral contribution, published in APN VII
Available from https://arxiv.org/abs/1806.07279
and from http://www.mdpi.com/2075-4434/6/2/65/htm

Recent outburst activity of the symbiotic binary AG Draconis

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The symbiotic binary AG Dra regularly undergoes quiescent and active stages which consist of several outbursts repeating with about 360-d interval. The recent outburst activity of AG Dra started by the minor outburst in the late spring of 2015 and was definitely confirmed by the outbursts in April 2016 and May 2017. In the presented work, the photometric and spectroscopic behaviour of the recent outburst activity of AG Dra is presented in detail. Moreover, the temperature of the white dwarf in AG Dra is studied based on the behaviour of the prominent emission lines. We show that a disentanglement of particular effects in the observed changes of the emission lines is crucial to investigate the intrinsic white dwarf temperature variations related to outburst activity of this strongly interacting binary. We also report the effects of the low excitation lines orbital variations and of the Hβ absorption component on their equivalent widths as well as consequences of the approximations used in our previous works.

Oral contribution, published in "The Golden Age of Cataclysmic Variables and Related Objects IV", 11–16 September 2017, Palermo, Italy
Available from https://arxiv.org/abs/1806.05935
and from https://pos.sissa.it/315/060

Review Papers

Report on the ESO Workshop "Imaging of Stellar Surfaces"

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There have recently been tremendous advances in observational techniques enabling the resolution of the surfaces of stars other than the Sun. Current VLTI instruments, SPHERE on the VLT, and ALMA, as well as other interferometric facilities, have recently succeeded in resolving stellar surfaces. The workshop aimed to bring together observers specialising in different techniques and wavelength regimes, and theoreticians working on stellar atmospheres and stellar structure. We aimed to organise a focused workshop with ample time devoted to the discussion of recent images of stellar surfaces and their extended atmospheres out to a few stellar radii, as well as observational strategies and the relevant underlying physical processes. The workshop was the first to be held in the seminar room of the new ESO Supernova Planetarium & Visitor Centre, and it was also the first workshop for which the new code of conduct for ESO workshops & conferences was in place.

Published in Messenger, 171, 35 (2018)
Available from https://www.eso.org/sci/publications/messenger/archive/no.172-jun18/messenger-no172-35-39.pdf

The importance of binarity in the formation and evolution of planetary nebulæ

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It is now clear that a binary evolutionary pathway is responsible for a significant fraction of all planetary nebulæ, with some authors even going so far as to claim that binarity may be a near requirement for the formation of an observable nebula. In this chapter, we will discuss the theoretical and observational support for the importance of binarity in the formation of planetary nebulæ, initially focussing on common envelope evolution but also covering wider binaries. Furthermore, we will highlight the impact that these results have on our understanding of other astrophysical phenomena, including supernovæ type Ia, chemically peculiar stars and circumbinary exoplanets. Finally, we will present the latest results with regards to the relationship between post-common-envelope central stars and the abundance discrepancy problem in planetary nebulæ, and what further clues this may hold in forwarding our understanding of the common envelope phase itself.

Published in "The Impact of Binaries on Stellar Evolution", Eds. G. Beccari & H.M.J. Boffin, Cambridge University Press (2018)
Available from https://arxiv.org/abs/1806.08244

Announcements

Exploring the Infrared Universe: The Promise of SPICA
Crete (Greece), 20–23 May 2019

The infrared wavelength range is key to understand the origin and evolution of galaxies, stars and planetary systems, which are obscured by dust during a large part of their life cycles. With a large cold mirror and a sensitive suite of instruments, SPICA, recently selected as a candidate for ESA's Cosmic Visions program, stands poised to revolutionize these fields by providing ultra-deep spectroscopy in the 12–230 μm range, as well as imaging (17–37 μm and 100–350 μm) and polarimetry (100–350 μm). With launch planned for 2030, SPICA will complement current and upcoming facilities, filling the spectral gap between JWST and ALMA, while providing a huge leap over previous infrared space missions. We would like to invite the international astronomical community to participate in the conference, Exploring the Infrared Universe: The Promise of SPICA, which will take place on the island of Crete on 20–23 May 2019. At this conference, participants will learn about the capabilities and current design of SPICA, which includes a significant Guest Observer program, while discussing the exciting scientific promise of the mission. Up to date information about the SPICA mission and its instruments can be found at http://www.spica-mission.org, in addition to links to a set of white-papers recently published in the journal PASA, that focus on some of extragalactic science enabled by SPICA.

Topics to be addressed at the meeting include:

- The rise of metals and dust across cosmic time
- Feedback and feeding processes in galaxy evolution
- Star formation and the baryon cycle in galaxies
- Magnetic fields and turbulence in star formation
- Protoplanetary disks and the formation of habitable planets
- Debris disks, planetary systems, and the Solar system

Confirmed invited speakers include: Susanne Aalto, Yuri Aikawa, Françoise Combes, Bill Dent, Edith Falgarone, Davide Fedele, Andrea Ferrara, Javier Goicoechea, Masateru Ishiguro, Patrick Koch, Leon Koopmans, Ilse de Looze, Roberto Maiolino, Thomas Müller, Tohru Nagao, Klaus Pontoppidan, Alexandra Pope, and Peter Roelfsema.

For further information about the conference, please visit http://www.spica2019.org/

Looking forward to seeing you in Crete!

The scientific organizing committee:
Lee Armus, Marc Audard, Vassilis Charmandaris, Yasuo Doi, Eiichi Egami, David Elbaz, Martin Giard, Matt Griffin, Carlotta Gruppioni, Doug Johnstone, Inga Kamp, Hidehiro Kaneda, Ciska Kemper, Kotaro Kohno, Sue Madden, Mikako Matsuura, Stefanie Milam, Paco Najarro, Takashi Onaka, Luigi Spinoglio, Floris van der Tak (chair), Jan Tauber

See also http://www.spica-mission.org

EXES Instrument Encourages SOFIA Cycle 7 Proposals

The Échelon-Cross-Échelle Spectrograph (EXES) team invites proposals to study evolved stars during the current SOFIA Cycle 7 call for proposals, which are due 7 September 2018 21:00 PDT (8 September 2018 04:00 UTC). EXES is a Principal Investigator class instrument on SOFIA capable of providing spectral observations between 4.5 and 28.3 μm. EXES is optimized for very high resolution ($R \sim 100,000$). There are medium ($R \sim 15,000$) and low ($R \sim 4000$) modes available, although there are limitations in these modes that need to be discussed with the instrument team. If there is any interest, please contact the EXES team so that we can work with you on the technical feasibility of your project.

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Relevant Links:
https://www.sofia.usra.edu/science/proposing-and-observing/proposal-calls/cycle-7
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