# THE AGB NEWSLETTER

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## *Editorial*

Dear Colleagues,

It is a pleasure to present you the 257$^{\rm th}$ issue of the AGB Newsletter.

Apart from the exciting new results, do pay attention to the conference on supernova type Ia progenitors, in Armenia. The jury are still out as to the role of red giants in the progenitor channel(s)!

As you may know, the IAU Working Group on Abundances of Red Giants has regrouped under the new, broader remit of "Red Giants and Supergiants". The AGB Newsletter has always advocated that we keep a broad and open mind towards what concerns the physics of cool luminous stars, and it will continue to act as a forum for its community. The Working Group has set itself two tasks: one is to identify the major problems in our field that need solving, and potential avenues to solving them; the other is to develop the role the AGB Newsletter can play to stimulate interaction and debate within our community. In the previous issue we asked for suggestions who "should" join our committee – this should be read as an invitation for anyone to step forward. A message to us, astro.agbnews@keele.ac.uk would be forwarded to the Working Group chair.

The next issue is planned to be distributed around the 3$^{\rm rd}$ of January 2019.

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

## *Food for Thought*

This month's thought-provoking statement is:

*What should be the topic for the next IAU symposium related to our field?*

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*

## 3D hydrodynamical models of point-symmetric planetary nebulæ: the special case of H 1-67

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We present 3D hydrodynamical simulations of a precessing jet with a time-dependent ejection velocity (or a time-dependent ejection density), interacting with a circumstellar medium given by a dense, anisotropic, and slow AGB wind, forming a torus. We explore a set of configurations with different values for the precession angle and number of ejections. The temporal evolution of these models is analysed at times up to 1500 or 1800 yr. From our hydrodynamical models, we obtain position–velocity diagrams (PV diagrams) in the [N II] $\lambda$6583 line to be compared with high resolution observations of the planetary nebula H 1-67. From spectral data this object shows high-velocity jets and a point-symmetric morphology. With our synthetic PV diagrams we show that a precessing jet with a time-dependent ejection velocity (or a time-dependent ejection density) reproduce the point-symmetric morphological structure for this nebula if the precession cone angle is larger than 30°. Our synthetic PV diagrams can be used to understand how the S-like morphology, also presented by other planetary nebulæ, is formed. For H 1-67 we found a heliocentric velocity of $-8.05$ km s$^{-1}$ and height below the Galactic plane of $-451.6$ pc.

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## Binarity among CEMP-no stars: an indication of multiple formation pathways?

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Carbon-enhanced metal-poor (CEMP) stars comprise a high percentage of stars at the lowest metallicities. The stars in the CEMP-no subcategory do not show any s-process enhancement and therefore cannot easily be explained by transfer of carbon and s-process elements from a binary AGB companion. We have performed radial velocity monitoring of a sample of 22 CEMP-no stars to further study the role that binarity plays in this type of CEMP star. We find four new binary CEMP-no stars based on their radial velocity variations; this significantly enlarges the population of known binaries to a total of 11. One of the new stars found to be in a binary system is HE 0107−5240, which is one of the most iron-poor stars known. This supports the binary transfer model for the origin of the abundance pattern of this star.We find a difference in binary fraction in our sample that depends on the absolute carbon abundance, with a binary fraction of $47^{+15}_{-14}$% for stars with a higher absolute carbon abundance and $18^{+14}_{-9}$% for stars with a lower absolute carbon abundance. This might imply a relation between a high carbon abundance and the binarity of a metal-poor star. Although binarity does not equate to mass transfer, there is a possibility that a CEMP-no star in a binary system has been polluted, and care has to be taken in the interpretation of their abundance patterns. We furthermore demonstrate the potential of Gaia of discovering additional binary candidates.

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# Measuring the expansion and age of the nova shell IPHASX J210204.7+471015

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The parallax expansion and kinematics of a nova shell can be used to assess its age and distance, and to investigate the interaction of the ejecta with the circumstellar medium. These are key to understand the expansion and dispersal of the nova ejecta in the Galaxy. Multi-epoch images and high-dispersion spectroscopic observations of the recently discovered classical nova shell IPHASX J210204.7+471015 around a nova-like system have been used to derive a present day expansion rate of $0\farcs100$ yr$^{-1}$ and an expansion velocity of 285 km s$^{-1}$. These data are combined to obtain a distance of 600 pc to the nova. The secular expansion of the nova shell place the event sometime between 1850 and 1890, yet it seems to have been missed at that time. Despite its young age, 130–170 yr, we found indications that the ejecta has already experienced a noticeable deceleration, indicating the interaction of this young nova shell with the surrounding medium.

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# Gaia Data Release 2: All-sky classification of high-amplitude pulsating stars

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Out of the 1.69 billion sources in the Gaia Data Release 2 (DR2), more than half a million are published with photometric time series that exhibit light variations during 22 months of observation. An all-sky classification of

common high-amplitude pulsators (Cepheids, long-period variables, $\delta$ Scuti / SX Phoenicis, and RR Lyræ stars) is provided for stars with brightness variations greater than 0.1 mag in the G band. A semi-supervised classification approach was employed, firstly training multi-stage Random Forest classifiers with sources of known types in the literature, followed by a preliminary classification of the Gaia data and a second training phase that included a selection of the first classification results to improve the representation of some classes, before the application of the improved classifiers to the Gaia data. Dedicated validation classifiers were used to reduce the level of contamination in the published results. A relevant fraction of objects were not yet sufficiently sampled for reliable Fourier series decomposition, so classifiers were based on features derived from statistics of photometric time series in the G, BP, and RP bands, as well as from some astrometric parameters. The published classification results include 195,780 RR Lyræ stars, 150,757 long-period variables, 8550 Cepheids, and 8882 $\delta$ Scuti / SX Phoenicis stars. All of these results represent candidates, whose completeness and contamination are described as a function of variability type and classification reliability. Results are expressed in terms of class labels and classification scores, which are available in the vari_classifier_result table of the Gaia archive.

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## Evidence of enhanced magnetism in cool, polluted white dwarfs

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We report the discovery of a new, polluted, magnetic white dwarf in the Luyten survey of high-proper motion stars. High-dispersion spectra of NLTT 7547 reveal a complex heavy element line spectrum showing the effect of a magnetic field of 240 kG in a cool ($\approx$ 5 200 K) hydrogen-dominated atmosphere. The abundance pattern shows the effect of accreted material with a distinct magnesium-rich flavour. Combined with earlier identifications, this discovery supports a correlation between the incidence of magnetism in cool white dwarfs and their contamination by heavy elements.

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## R Coronæ Borealis: radial-velocity and other observations, 1950–2007

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Radial-velocity observations made on more than a thousand nights are presented for the type star of the R Coronæ Borealis (RCB) class. There are four principal sources: the Lick Observatory (1950–1953), the original Cambridge radial-velocity spectrometer (1968–1991), and the Haute-Provence and Cambridge Coravels (1986–1998 and 1997–2007, respectively). In the case of the last set the size (equivalent width) and width (expressed as if $v \sin i$) of the Coravel cross-correlation ('dip') profiles are also given, and the variation and complexity of those profiles are discussed. Although there is often evidence of cyclical behaviour in radial velocity, no coherent periodicity is found in any of the series. From time to time, and especially over 100 days before the great decline of 2007, the atmosphere was highly disturbed, with evidence of high-velocity components. We suggest that those are associated with large turbulent

elements and result in mass ejection to sufficient distances for the formation of soot and other solids and thus the initiation of RCB-type declines. We associate the changes in light and radial velocity near maximum light primarily with the combined effect of such turbulent elements, and not with coherent pulsation. There is some evidence for a variation in the mean radial velocity on a time scale of about ten thousand days.

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## The orbital period–mass ratio relation of wide sdB+MS binaries and its application to the stability of RLOF

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Wide binaries with hot subdwarf-B (sdB) primaries and main sequence companions are thought to form only through stable Roche lobe overflow (RLOF) of the sdB progenitor near the tip of the red giant branch (RGB). We present the orbital parameters of eleven new long period composite sdB binaries based on spectroscopic observations obtained with the UVES, FEROS and CHIRON spectrographs. Using all wide sdB binaries with known orbital parameters, 23 systems, the observed period distribution is found to match very well with theoretical predictions. A second result is the strong correlation between the orbital period ($P$) and the mass ratio ($q$) in the observed wide sdB binaries. In the $P$–$q$ plane two distinct groups emerge, with the main group (18 systems) showing a strong correlation of lower mass ratios at longer orbital periods. The second group are systems that are thought to be formed from higher mass progenitors. Based on theoretical models, a correlation between the initial mass ratio at the start of RLOF and core mass of the sdB progenitor is found, which defines a mass-ratio range at which RLOF is stable on the RGB.

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## Optical properties of amorphous carbon dust around C-stars: new constraints from 2MASS and Gaia observations

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In this work the optical properties of amorphous carbon (amC) dust condensed around carbon(C)-stars are constrained by comparing the observations for the Large Magellanic Cloud C-stars from the Two Micron All Sky Survey (2MASS) and from the Gaia data release 2 (DR2) with the synthetic photometry obtained by computing dust growth and radiative transfer in their circumstellar envelopes. The set of optical constants of amC dust considered have been pre-selected according to their ability to reproduce the infrared colour–colour diagrams in the Small Magellanic Cloud.

Only two combinations of the o ptical data set and grain size are able to reproduce the infrared photometry and the Gaia observations simultaneously. The analysis presented provides information about the properties of amC dust grains that might be characterized by a diamond-like structure, rather than a graphite-like one, at least around the most dust-enshrouded C-stars, or be composed of "small" grains of size less than 0.04 $\mu$m. The selected data sets will be adopted to compute grids of spectra as a function of the stellar parameters that will be employed to estimate the dust return and mass-loss rates of C-stars by fitting their spectral energy distribution, and to study the resolved stellar populations of nearby objects.

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## High-resolution observations of gas and dust around Mira using ALMA and SPHERE/ZIMPOL

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The outflows of oxygen-rich asymptotic giant branch (AGB) stars are thought to be driven by radiation pressure by photon scattering on grains with sizes of tenths of microns. The details of the formation of dust in the extended atmospheres of these stars and the mass-loss process is still not well understood. We obtained quasi-simultaneous observations of the AGB star Mira using ALMA and ZIMPOL to probe the distribution of gas and large dust grains, respectively. The polarized light images show dust around Mira A, the companion (Mira B) and in a trail that connects the two sources. ALMA reveals that dust around Mira A is contained in a high-gas-density region with a significant fraction of the polarized light arising from its edge. We constrained the gas density, temperature, and velocity within a few stellar radii from the star by modelling the CO $v = 1$, $J = 3$–2 line. We find a mass ($\sim 3.8 \pm 1.3$)$^{-4}$ M$_\odot$ to be contained between the stellar millimetre photosphere and 4 stellar radii. Our best-fit models with lower masses also reproduce the $^{13}$CO $v = 0$, $J = 3$–2 line emission from this region. We find $TiO_2$ and AlO abundances corresponding to 4.5% and $< 0.1$% of the total titanium and aluminium expected for a solar-composition gas. The low abundance of AlO allows for efficient Al depletion into dust already very close to the star, as expected from thermal dust emission observations and theoretical calculations of Mira variables. We constrain the presence of aluminium oxide grains based on the scattered light observations and our gas-phase model. We find that aluminium oxide grains can account for a significant fraction of the total aluminium atoms in this region only if the grains have sizes $\lesssim 0.02$ $\mu$m. This is an order of magnitude smaller than the maximum sizes predicted by dust-formation and wind-driving models.

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## High-velocity bullets from V Hydræ, and AGB star in transition: ejection history and spatio-kinematic modeling

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The carbon star V Hydræ (V Hya) provides new insight into the nature of the launching mechanism of jet-like outflows that are believed to be the cause of the poorly understood transition phase of AGB stars into aspherical planetary nebulæ. V Hya has been shown to periodically eject collimated gas blobs at high velocities ("bullets"). By analyzing

data from HST/STIS 2-D spectra, obtained at six epochs spaced over a decade that show 4 successively ejected bullets with a spacing of $\sim 8.5$ years, we have created kinematic models of the dynamical evolution of a specific bullet (#1) for the first three observed epochs (2002, 2003, 2004) using a 3D spatio-kinematic code, SHAPE. Using these models, we fit the observed morphology, line-of-sight velocity, proper motion and intensity for the extended, gaseous bullet as a function of time over a period of 2 years, in order to constrain its 3D movement and the evolution of its physical properties over this period. Our results suggest that although bullet #1's motion is predominantly ballistic, there are small but significant changes in the position angle and inclination angle of the long (symmetry) axis of the bullet that tilt it progressively towards the symmetry axis of the bipolar molecular nebula around V Hya. In contrast, bullet #3 shows strong acceleration soon after ejection. We discuss the possibilities that bullet acceleration is caused by either a non-radial magnetic field and/or by hydrodynamic interaction with the ambient gas through which the bullet is traveling.

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## Progenitor constraints on the Type Ia supernova SN 2014J from *Hubble* Space Telescope H$\beta$ and [O III] observations

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Type Ia supernovæ are understood to arise from the thermonuclear explosion of a carbon-oxygen white dwarf, yet the evolutionary mechanisms leading to such events remain unknown. Many proposed channels, including the classical single-degenerate scenario, invoke a hot, luminous evolutionary phase for the progenitor, in which it is a prodigious source of photo-ionizing emission. Here, we examine the environment of SN 2014J for evidence of a photo-ionized nebula in pre- and post-explosion [O III] 5007Å and H$\beta$ images taken with the *Hubble* Space Telescope. From the absence of any extended emission, we exclude a stable nuclear-burning white dwarf at the location of SN 2014J in the last $\sim 100,000$ years, assuming a typical warm interstellar medium (ISM) particle density of 1 cm$^{-3}$. These limits greatly exceed existing X-ray constraints at temperatures typical of known supersoft sources. Significant extreme-UV/soft X-ray emission prior to explosion remains plausible for lower ISM densities (e.g., $n \sim 0.1$ cm$^{-3}$). In this case, however, any putative nebula would be even more extended, allowing deeper follow-up observations to resolve this ambiguity in the near future.

**Submitted to MNRAS Letters**
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## A power-law decay evolution scenario for polluted single white dwarfs

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Planetary systems can survive the stellar evolution, as evidenced by the atmospheric metal pollution and circumstellar dusty disks of single white dwarfs. Recent observations show that 1%–4% of single white dwarfs are accompanied by dusty disks, while the occurrence rate of metal pollution is about 25%–50%. The dusty disks and metal pollution have been associated with accretion of remannt planetary systems around white dwarfs, yet the relation between these two phenomena is still unclear. Here we suggest an evolutionary scenario to link the two observational phenomena. By

analyzing a sample of metal polluted white dwarfs, we find that the mass accretion rate onto the white dwarf generally follows a broken power law decay, which matches well with the theoretical prediction, if assuming dust accretion is primarily driven by Poynting–Robertson drag and the dust source is primarily delivered via dynamically falling asteroids perturbed by a Jovian planet. The presence of disks is mainly at the early stage ($t_{\rm cool} \sim 0.1$–$0.7$ Gyr) of the whole process of metal pollution, which is detectable until $\sim 8$ Gyr, naturally explaining the fraction ($\sim 2\%$–$16\%$) of metal-polluted white dwarfs having dusty disks. The success of this scenario also implies that the configuration of an asteroid belt with an outer gas giant might be common around stars of several solar masses.

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*and from* https://www.nature.com/articles/s41550-018-0609-7

## Role of supergiants in the formation of globular clusters

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Multiple stellar populations are observed in almost all globular clusters, but the origin of this phenomenon is still debated. We investigate the role cool supergiants may have played. To do this, we combine two investigative methods: state-of-the-art massive stellar evolution and calculations of the hydrodynamic structure of the cluster gas. This approach allows us to study how star formation in young massive clusters depends on the energy and mass input of the first generation of stars, while predicting the chemical composition of the second generation. We find that the presence of massive (9–500 $M_\odot$) metal-poor supergiants in the young cluster leads to a star-formation episode within the first 4 Myr of the cluster's lifetime, that is, before the first core-collapse supernovæ explode or the gas is expelled. The stellar winds accumulate in the cluster center, forming the second generation there. Its composition is predicted to show variations in O & Na abundances, consistently with observations. The abundance of helium is, similarly to other scenarios involving massive stars, higher than what is referred from observations. Supposing dynamical removal of stars from the outskirts of the cluster, or applying a top-heavy initial mass function, we can predict a number ratio of the second-generation as high as 20–80%. The effect of metallicity is shown to be important, as the most luminous supergiants are only predicted at low metallicity, thus limiting – but not excluding – the extent of a polluted second generation at high metallicity. These massive stars becoming black holes suggests globular clusters hosting gravitational wave progenitors. Our scenario predicts a correlation between the mass of the cluster and the extent of the multiple population phenomenon.

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## HST/GHRS observations of cool, low-gravity stars – VI. Mass-loss rates and wind parameters for M giants

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The photon-scattering winds of M-giants absorb parts of the chromospheric emission lines and produce self-reversed spectral features in high resolution HST/GHRS spectra. These spectra provide an opportunity to assess fundamental parameters of the wind, including flow and turbulent velocities, the optical depth of the wind above the region of photon creation, and the star's mass-loss rate. This paper is the last paper in the series "GHRS Observations of Cool, Low-Gravity Stars"; the last several have compared empirical measurements of spectral emission lines with models

of the winds and mass-loss of K-giant and supergiants. We have used the Sobolev with Exact Integration (SEI) radiative transfer code, along with simple models of the outer atmosphere and wind, to determine and compare the wind characteristics of the two M-giant stars, $\gamma$ Cru (M3.5 III) and $\mu$ Gem (M3 IIIab), with previously derived values for low-gravity K-stars. The analysis specifies the wind parameters and calculates line profiles for the Mg II resonance lines, in addition to a range of unblended Fe II lines. Our line sample covers a large range of wind opacities and, therefore, probes a range of heights in the atmosphere.
Our results show that $\mu$ Gem has a slower and more turbulent wind then $\gamma$ Cru. Also, $\mu$ Gem has a weaker chromosphere, in terms of surface flux, with respect to $\gamma$ Cru. This suggests that $\mu$ Gem is more evolved than $\gamma$ Cru. Comparing the two M-giants in this work with previously studied K-giant and supergiant stars ($\alpha$ Tau, $\gamma$ Dra, $\lambda$ Vel) reveals that the M-giants have slower winds than the earlier giants, but exhibit higher mass-loss rates. Our results are interpreted in the context of the winds being driven by Alfvén waves.

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## Positional offsets between SiO masers in evolved stars and their cross-matched counterparts

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Observations of dust-enshrouded evolved stars selected from infrared catalogs requiring high positional accuracy, like infrared spectroscopy or long baseline radio interferometric observations, often require preparational observational steps determining a position with an accuracy much better than 1″. Using phase-referencing observations with the Very Large Array at its highest resolution, we have compared the positions of SiO 43 GHz masers in evolved stars, assumed to originate in their infrared detected circumstellar shells, with the positions listed in the MSX, WISE, 2MASS, and Gaia catalogs. Starting from an MSX position it is, in general, simple to match 2MASS and WISE counterparts. However, in order to obtain a Gaia match to the MSX source it is required to use a two-step approach due to the large number of nearby candidates and low initial positional accuracy of the MSX data. We show that the closest comparable position to the SiO maser in our limited sample never is the MSX position. When a plausible source with a characteristic signature of an evolved star with a circumstellar shell can be found in the area, the best indicator of the maser position is provided by the Gaia position, with the 2MASS position being second best. Typical positional offsets from all catalogs to the SiO masers are reported.

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## Spatially resolving the atmosphere of the non-Mira-type AGB star SW Vir in near-infrared molecular and atomic lines with VLTI/AMBER

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We present a near-infrared spectro-interferometric observation of the non-Mira-type, semiregular asymptotic giant branch star SW Vir. Our aim is to probe the physical properties of the outer atmosphere with spatially resolved data in individual molecular and atomic lines. We observed SW Vir in the spectral window between 2.28 and 2.31 $\mu$m with the near-infrared interferometric instrument AMBER at ESO's Very Large Telescope Interferometer (VLTI). Thanks

to AMBER's high spatial resolution and high spectral resolution of 12 000, the atmosphere of SW Vir has been spatially resolved not only in strong CO first overtone lines but also in weak molecular and atomic lines of $H_2O$, CN, HF, Ti, Fe, Mg, and Ca. Comparison with the MARCS photospheric models reveals that the star appears larger than predicted by the hydrostatic models not only in the CO lines but also even in the weak molecular and atomic lines. We found that this is primarily due to the $H_2O$ lines (but also possibly due to the HF and Ti lines) originating in the extended outer atmosphere. Although the $H_2O$ lines manifest themselves very little in the spatially unresolved spectrum, the individual rovibrational $H_2O$ lines from the outer atmosphere can be identified in the spectro-interferometric data. Our modeling suggests an $H_2O$ column density of $10^{19}$–$10^{20}$ cm$^{-2}$ in the outer atmosphere extending out to $\sim 2\ R_\star$. Our study has revealed that the effects of the non-photospheric outer atmosphere are present in the spectro-interferometric data not only in the strong CO first overtone lines but also in the weak molecular and atomic lines. Therefore, analyses of spatially unresolved spectra, such as for example analyses of the chemical composition, should be carried out with care even if the lines appear to be weak.

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## Past and future of the central double-degenerate core of Henize 2-428

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It has been suggested that SNe Ia could be produced in the condition of the violent merger scenario of the double-degenerate model, in which a thermonuclear explosion could be produced when the merging of double carbon–oxygen white dwarfs (CO WDs) is still ongoing. It has been recently found that the nucleus of the bipolar planetary nebula Henize 2-428 consists of double CO WDs that have a total mass of $\sim 1.76$ M$_\odot$, a mass ratio of $\sim 1$ and an orbital period of $\sim 4.2$ hours, which is the first and only discovered progenitor candidate of SNe Ia predicted by the violent merger scenario. In this work, we aim to reproduce the evolutionary history of the central double CO WDs of Henize 2-428. We find that the planetary nebula Henize 2-428 may originate from a primordial binary that have a $\sim 5.4$ M$_\odot$ primary and a $\sim 2.7$ M$_\odot$ secondary with an initial orbital period of $\sim 15.9$ days. The double CO WDs are formed after the primordial binary experiencing two Roche-lobe overflows and two common-envelope ejection processes. According to our calculations, it takes about 840 Myr for the double CO WDs to merge and form an SN Ia driven by the gravitational wave radiation after their birth. To produce the current status of Henize 2-428, a large common-envelope parameter is needed. We also estimate that the rate of SNe Ia from the violent merger scenario is at most $2.9 \times 10^{-4}$ yr$^{-1}$, and that the delay time is in the range of 90 Myr to the Hubble time.

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## The Advanced Spectral Library (ASTRAL): reference spectra for evolved M-stars

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The HST Treasury Program "Advanced Spectral Library Project: Cool Stars" was designed to collect representative, high quality ultraviolet spectra of eight evolved F–M type cool stars. The Space Telescope Imaging Spectrograph (STIS) échelle spectra of these objects enable investigations of a broad range of topics including stellar and interstellar astrophysics. This paper provides a guide to the spectra of the two evolved M-stars, the M2 Iab supergiant $\alpha$ Ori

and the M3.4 giant $\gamma$ Cru, with comparisons to the prototypical K1.5 giant $\alpha$ Boo. It includes identifications of the significant atomic and molecular emission and absorption features and discusses the character of the photospheric and chromospheric continua and line spectra. The fluorescent processes responsible for a large portion of the emission line spectrum, the characteristics of the stellar winds, and the available diagnostics for hot and cool plasmas are also summarized. This analysis will facilitate the future study of the spectra, outer atmospheres, and winds, not only of these objects, but for numerous other cool, low-gravity stars for years to come.

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# *Conference Papers*

## Oxygen-rich long period variables in the X-Shooter Spectral Library

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The X-Shooter Spectral Library (XSL) contains more than 800 spectra of stars across the color-magnitude diagram, that extend from near-UV to near-IR wavelengths (320–2450 nm). We summarize properties of the spectra of O-rich long period variables in XSL, such as phase-related features, and we confront the data with synthetic spectra based on static and dynamical stellar atmosphere models. We discuss successes and remaining discrepancies, keeping in mind the applications to population synthesis modeling that XSL is designed for.

**Oral contribution, published in IAU Symp 343, "Why Galaxies Care about AGB stars", eds. F. Kerschbaum, M. Groenewegen & H. Olofsson**
*Available from* https://arxiv.org/abs/1811.02841

## Nano dust in space and astrophysics

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We summarize the Focus Meeting (FM10) "Nano Dust in Space and Astrophysics" held in Vienna, Austria on 28–29 August 2018 during the 30$^{\rm th}$ General Assembly of the International Astronomical Union (IAU). The theme of this focus meeting is related to the detection, characterization and modeling of nano particles – cosmic dust of sizes of

roughly 1 to 100 nm – in space environments like the interstellar medium, planetary debris disks, the heliosphere, the vicinity of the Sun and planetary atmospheres, and the space near Earth. Discussions focus on nano dust that forms from condensations and collisions and from planetary objects, as well as its interactions with space plasmas like the solar and stellar winds, atmospheres and magnetospheres. A particular goal is to bring together space scientists, astronomers, astrophysicists, and laboratory experimentalists and combine their knowledge to reach cross fertilization of different disciplines.

**Oral contribution, published in "Astronomy in Focus", XXX$^{\text{th}}$ IAU General Assembly, ed. Maria Teresa V.T. Lago**
*Available from* https://arxiv.org/abs/1810.12502

## Graphene and carbon nanotubes in space

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As the fourth most abundant element in the universe, carbon plays an important role in the physical and chemical evolution of the interstellar medium. Due to its unique property to form three different types of chemical bonds through $sp^1$, $sp^2$, and $sp^3$ hybridizations, carbon can be stabilized in various allotropes, including amorphous carbon, graphite, diamond, polycyclic aromatic hydrocarbon, fullerenes, graphene, and carbon nanotubes.

**Oral contribution, published in "Astronomy in Focus" for the Focus Meeting (FM10) "Nano Dust in Space and Astrophysics" organised by Ingrid Mann, Aigen Li & Kyoko K. Tanaka at the 30$^{\text{th}}$ General Assembly of the IAU (2018)**
*Available from* https://arxiv.org/abs/1810.06786

## Are the silicate crystallinities of oxygen-rich evolved stars related to their mass loss rates?

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A sample of 28 oxygen-rich evolved stars is selected based on the presence of crystalline silicate emission features in their ISO/SWS spectra. The crystallinity of silicate dust, measured as the flux fraction of crystalline silicate features, is found not related to the mass loss rate that is derived from fitting the spectral energy distribution.

**Poster contribution, published in IAU Symp. 343, "Why Galaxies Care About AGB Stars: A Continuing Challenge through Cosmic Time" (2018)**
*Available from* https://arxiv.org/abs/1809.10293

# The extended Planetary Nebula Spectrograph (ePN.S) early type galaxy survey: the kinematic diversity of stellar halos

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In this contribution we report on a kinematic study for 33 early type galaxies (ETGs) into their outer halos (average 6 effective radii, $R_e$). We use planetary nebulæ (PNe) as tracers of the main stellar population at large radii, where absorption line spectroscopy is no longer feasible. The ePN.S survey is the largest survey to-date of ETG kinematics with PNe, based on data from the Planetary Nebula Spectrograph (PN.S), counter-dispersed imaging, and high-resolution PN spectroscopy. We find that ETGs typically show a kinematic transition between inner regions and halos. Slow rotators have increased rotational support at large radii. Most of the ePN.S fast rotators show a decrease in rotation, due to the fading of the stellar disk in the outer, more slowly rotating spheroid. 30% of these fast rotators are dominated by rotation also at large radii, 40% show kinematic twists or misalignments, indicating a transition from oblate to triaxial in the halo. Despite this variety of kinematic behaviors, the ePN.S ETG halos have similar angular momentum content, independently of fast/slow rotation of the central regions. Estimated kinematic transition radii in units of $R_e$ are $\sim$ 1–3 $R_e$ and anti-correlate with stellar mass. These results are consistent with cosmological simulations and support a two-phase formation scenario for ETGs.

**Oral contribution, published in XXX IAU General Assembly, Focus Meeting 6 "Galactic Angular Momentum" (2018)**
*Available from* https://arxiv.org/abs/1811.02354
*and from* http://doi.org/10.5281/zenodo.1481552

# The missing mass conundrum of post-common-envelope planetary nebulæ

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Most planetary nebulæ (PNe) show beautiful, axisymmetric morphologies despite their progenitor stars being essentially spherical. Angular momentum provided by a close binary companion is widely invoked as the main agent that would help eject an axisymmetric nebula, after a brief phase of engulfment of the secondary within the envelope of the Asymptotic Giant Branch (AGB) star, known as a common envelope (CE). The evolution of the AGB would be thus interrupted abruptly, its (still quite) massive envelope fully ejected to form the PN, which should be more massive than a PN coming from the same star were it single. We test this hypothesis by deriving the ionised+molecular masses of a pilot sample of post-CE PNe and comparing them to a regular PNe sample. We find the mass of post-CE PNe to be actually lower, on average, than their regular counterparts, raising some doubts on our understanding of these intriguing objects.

**Oral contribution, published in IAU Symposium 343, "Why Galaxies Care About AGB Stars: A Continuing Challenge through Cosmic Time"**
*Available from* https://arxiv.org/abs/1810.09296

# Detection of optical flickering from the symbiotic Mira-type binary star EF Aquilæ

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We performed photometry with a 1 minute time resolution of the symbiotic stars EF Aquilæ, AG Pegasi and SU Lyncis in Johnson $B$ and $V$ band. Our observations of the symbiotic Mira-type star EF Aql demonstrate the presence of stochastic light variations with an amplitude of about 0.25 magnitudes on a time scale of 5 minutes. The observations prove the white dwarf nature of the hot component in the binary system. It is the $11^{\rm th}$ symbiotic star (among more than 200 symbiotic stars known in our Galaxy) which displays optical flickering. For SU Lyn we do not detect flickering with an amplitude above 0.03 mag in $B$ band. For AG Peg, the amplitude of variability in $B$ and $V$ band is smaller than 0.05 mag and 0.04 mag respectively.

**Poster contribution, published in the XI Bulgarian–Serbian Astronomical Conference (XI BSAC) Belogradchik, Bulgaria (2018), Publ. Astron. Soc. "Rudjer Bošković" No. 18, 2019**
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# The loss of large amplitude pulsations at the end of AGB evolution

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Since 2013 we are performing with the Nancay Radio Telescope (NRT) a monitoring program of $> 100$ Galactic disk OH/IR stars, having bright 1612-MHz OH maser emission. The variations of the maser emission are used to probe the underlying stellar variability. We wish to understand how the large-amplitude variations are lost during the AGB–post-AGB transition. The fading out of pulsations with steadily declining amplitudes seems to be a viable process.

**Poster contribution, published in IAUS 343, "Why Galaxies Care about AGB Stars", Eds. F. Kerschbaum, M. Groenewegen & H. Olofsson**
*Available from* https://arxiv.org/abs/1811.06906
*and from* https://www.hs.uni-hamburg.de/nrt-monitoring

# *Review Paper*

## Science with an ngVLA – stellar activity on red giant and supergiant stars: mass loss and the evolution of the stellar dynamo

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In this Chapter we examine the role of the ngVLA to further our understanding of the different manifestations of convective or turbulence-driven stellar activity on red giant and supergiant stars. The combination of high spatial resolution and high sensitivity will enable the ngVLA to significantly improve our understanding of the processes that dissipate energy in the extended atmospheres of cool evolved stars, and drive ubiquitous stellar outflows. The high spatial resolution will enable us to image the surfaces of nearby red supergiants, and to measure the atmospheric extent of red giants. Multi-frequency observations will permit thermal continuum tomography on the largest angular diameter stars, providing key empirical data to test theoretical models. The complementary frequencies and similar spatial resolutions of the ngVLA and ALMA will be a powerful synergy.

**Published in "Science with a Next-Generation VLA", ed. E.J. Murphy, ASP Monograph Series**
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# *Announcement*

## Compact white dwarf binaries from SN Ia progenitors to gravitational wave sources

We have a pleasure to announce that the

Compact white dwarf binaries – from SN Ia progenitors to gravitational wave sources

will be held from September 15 to September 21 2019, in Yerevan, Armenia.

Compact white dwarf binaries are formed when the more massive component in a stellar binary expands towards the end of its stellar life and engulfs its companion. This brief and dynamically violent common envelope phase shrinks the orbital separation, and results in a radically different evolution compared to single star evolution. Compact white dwarf binaries become interactive and lead to a variety of astrophysically important outcomes, including supernovæ type Ia and low-frequency gravitational wave sources.

The goal of this conference is to bring together experts working across all areas related to compact white dwarf binaries, and to address the key issues. For more information and to express your interest please visit http://cwdb2019.com

*See also* http://cwdb2019.com