THE AGB NEWSLETTER

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Figure 1: Planetary nebula MWP 1 imaged by Don Goldman, suggested by Sakib Rasool. For more details see https://astrodonimaging.com/gallery/mwp1/.

Editorial

Dear Colleagues,

It is a pleasure to present you the 261st issue of the AGB Newsletter. There's lots of work on star clusters and extragalactic red (super)giants, but much else too.

Looking for a job? Consider applying for the postdoctoral fellowships in Oslo, Norway, or Gothenburg, Sweden (not yet got a Ph.D.? They've got an opportunity for you too!), or the position of staff astronomer at ESO in Chile.

Hans Olofsson needs no introduction. He's now provided you with an excuse to spend a few nice days of science and social time in beautiful Smögen, Sweden.

The European Union's Fizeau interferometry initiative is still going strong, thanks to the diligent leadership of Josef Hron and Péter Ábrahám. So do make use of it and get your hands dirty on the power of interferometry.

Last month's Food for Thought "*Do we need an AGB group on Facebook to have more vivid discussion on the field?*" generated a couple of helpful responses. Claudia Paladini pointed us towards an existing (since 2015) Facebook group "Evolved stars" https://www.facebook.com/groups/evolvedstars/ with well over a hundred members, which has been useful for posting advertisements et cetera but hasn't generated much active discussion (yet). Kris Stern suggested SLACK may be more appropriate for vivid discussions, and possibly teleconferences. The latter could be useful when the IAU Working Group on Red Giants and Supergiants starts to define the burning issues in our field and possible strategies forward. More on that later (but volunteers to join the working group remain welcome!).

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

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

Food for Thought

This month's thought-provoking statement is:

What do people think of a SLACK *site for the IAU Working Group on Red Giants and Supergiants? (And who would volunteer to set it up?)*

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

Low state transitions in the nova-like cataclysmic variable HS 0506+7725

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The twelve-year light curve of the nova-like cataclysmic variable HS 0506+7725 between 2006 April and 2018 November is presented. This shows that the star spends most of the time in a normal state at magnitude ~ 14.7, but multiple excursions to a fainter state at magnitude 16.0 to 17.0 were apparent. These normal state/low state transitions of up to 2.3 magnitudes are typical of the VY Scl subclass of CVs. The second of these fading episodes was the best characterised as its return to normal brightness was also observed. The complete transition lasted about 43 days. Further monitoring of this system by amateur astronomers is encouraged to identify and characterise future low states.

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The VLT-FLAMES Tarantula Survey XXXI. Radial velocities and multiplicity constraints of red supergiant stars in 30 Doradus

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The incidence of multiplicity in cool, luminous massive stars is relatively unknown compared to their hotter counterparts.Here we present radial velocity (RV) measurements and investigate the multiplicity properties of red supergiants (RSGs) in the 30 Doradus region of the Large Magellanic Cloud using multi-epoch visible spectroscopy from the VLT-FLAMES Tarantula Survey. Exploiting the high density of absorption features in visible spectra of cool stars, we use a novel slicing technique to estimate RVs of 17 candidate RSGs in 30 Doradus from cross-correlation of the observations with model spectra. We provide absolute RV measurements (precise to better than ± 1 km s^{-1}) for our sample and estimate line-of-sight velocities for the Hodge 301 and SL 639 clusters, which agree well with those of hot stars in the same clusters. By combining results for the RSGs with those for nearby B-type stars, we estimate systemic

velocities and line-of-sight velocity dispersions for the two clusters, obtaining estimates for their dynamical masses of $\log(M_{\rm dyn}/{\rm M}_\odot) = 3.8 \pm 0.3$ for Hodge 301, and an upper limit of $\log(M_{\rm dyn}/{\rm M}_\odot) < 3.1 \pm 0.8$ for SL 639, assuming virial equilibrium. Analysis of the multi-epoch data reveals one RV-variable, potential binary candidate (VFTS 744), which is likely a semi-regular variable asymptotic giant branch star. Calculations of semi-amplitude velocities for a range of RSGs in model binary systems and literature examples of binary RSGs were used to guide our RV variability criteria. We estimate an upper limit on the observed binary fraction for our sample of 0.3, where we are sensitive to maximum periods for individual objects in the range of 1 to 10 000 days and mass-ratios above 0.3 depending on the data quality. From simulations of the RV measurements from binary systems given the current data we conclude that systems within the parameter range $q > 0.3$, $\log P\,[\text{days}] < 3.5$, would be detected by our variability criteria, at the 90% confidence level. The intrinsic binary fraction, accounting for observational biases, is estimated using simulations of binary systems with an empirically defined distribution of parameters where orbital periods are uniformly distributed in the $3.3 < \log P\,[\text{days}] < 4.3$ range. A range of intrinsic binary fractions are considered; a binary fraction of 0.3 is found to best reproduce the observed data. We demonstrate that RSGs are effective extragalactic kinematic tracers by estimating the kinematic properties, including the dynamical masses of two LMC young massive clusters. In the context of binary evolution models, we conclude that the large majority of our sample consists of currently effectively single stars (either single or in long period systems). Further observations at greater spectral resolution and/or over a longer baseline are required to search for such systems.

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Observations of the ultraviolet-bright star Barnard 29 in the globular cluster M 13 (NGC 6205)

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We have analyzed FUSE, COS, GHRS, and *Keck* HIRES spectra of the UV-bright star Barnard 29 in M 13 (NGC 6205). By comparing the photospheric abundances derived from multiple ionization states of C, N, O, Si, and S, we infer an effective temperature $T_{\rm eff} = 21,400 \pm 400$ K. Balmer-line fits yield a surface gravity $\log g = 3.10 \pm 0.03$. We derive photospheric abundances of He, C, N, O, Mg, Al, Si, P, S, Cl, Ar, Ti, Cr, Fe, Ni, and Ge. Barnard 29 exhibits an abundance pattern typical of the first-generation stars in M 13, enhanced in oxygen and depleted in aluminum. An underabundance of C and an overabundance of N suggest that the star experienced nonconvective mixing on the RGB. We see no evidence of significant chemical evolution since the star left the RGB; in particular, it did not undergo third dredge-up. Previous workers found that the star's FUV spectra yield an iron abundance about 0.5 dex lower than its optical spectrum, but the iron abundances derived from all of our spectra are consistent with the cluster value. We attribute this difference to our use of model atmospheres without microturbulence, which is ruled out by careful fits to optical absorption features. We derive a mass $M_\star/{\rm M}_\odot = 0.45$–$0.55$ and luminosity $\log L_\star/{\rm L}_\odot = 3.26$–$3.35$. Comparison with stellar-evolution models suggests that Barnard 29 evolved from a ZAHB star of mass $M_\star/{\rm M}_\odot$ between 0.50 and 0.55, near the boundary between the extreme and blue horizontal branches.

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Residual carbon in oxygen–neon white dwarfs and its implications for accretion-induced collapse

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We explore the effects of the residual ^{12}C present in oxygen–neon white dwarfs (ONe WDs) on their evolution toward accretion-induced collapse (AIC). We produce a set of ONe WD models using Modules for Experiments in Stellar Astrophysics (MESA) and illustrate how the amount and location of the residual carbon depends on the initial mass of the star and assumptions about rotation and convective overshooting. We find a wide range of possible ^{12}C mass fractions roughly ranging from 0.1% to 10%. Convection and thermohaline mixing that occurs as the ONe WDs cool leads to nearly homogeneous interior compositions by the time that AIC would occur. We evolve these ONe WD models and some toy WD models toward AIC and find that regardless of the carbon fraction, the occurrence of Urca-process cooling due to ^{23}Na implies that the models are unlikely to reach carbon ignition before electron captures on ^{24}Mg occur. Difficulties associated with modeling electron-capture-driven convective regions in these ONe WDs prevent us from evolving our MESA models all the way to thermonuclear oxygen ignition and the onset of collapse. Thus, firm conclusions about the effect of carbon on the final fates of these objects await improved modeling. However, it is clear that the inclusion of residual carbon can shift the evolution from that previously described in the literature and should be included in future models.

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The post-common-envelope X-ray binary nucleus of the planetary nebula NGC 2392

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The *Chandra* X-ray Observatory has detected relatively hard X-ray emission from the central stars of several planetary nebulæ (PNe). A subset have no known late-type companions, making it very difficult to isolate which of several competing mechanisms may be producing the X-ray emission. The central star of NGC 2392 is one of the most vexing members, with substantial indirect evidence for a hot white dwarf (WD) companion. Here we report on the results of a radial velocity (RV) monitoring campaign of its central star with the HERMES échelle spectrograph of the Flemish 1.2-m Mercator telescope. We discover a single-lined spectroscopic binary with an orbital period of 1.902208 ± 0.000013 d and a RV semi-amplitude of 9.96 ± 0.13 km s^{-1}. The high degree of nebula ionisation requires a WD companion ($M \gtrsim 0.6$ M$_\odot$), which the mass-function supports at orbital inclinations $\lesssim 7°$, in agreement with the nebula orientation of 9°. The hard component of the X-ray spectrum may be explained by the companion accreting mass from the wind of the Roche lobe filling primary, while the softer component may be due to colliding winds. A companion with a stronger wind than the primary could produce the latter and would be consistent with models of the observed diffuse X-ray emission detected in the nebula. The diffuse X-rays may also be powered by the jets of up to 180 km s^{-1} and active accretion would imply that they could be the first active jets of a post-common-envelope PN, potentially making NGC 2392 an invaluable laboratory to study jet formation physics. The 1.9-d orbital period rules out a double-degenerate merger leading to a Type Ia supernova and the weak wind of the primary likely also precludes a single-degenerate scenario. We suggest that a hard X-ray spectrum, in the absence of a late-type companion, could be a powerful tool to identify accreting WD companions.

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Comparison of Gaia DR2 parallaxes of stars with VLBI astrometry

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We compare the parallaxes of stars from VLBI astrometry in the literature to those in the Gaia DR2 catalog. Our full sample contains young stellar objects, evolved AGB stars, pulsars and other radio stars. Excluding AGB stars, which show significant discrepancies between Gaia and VLBI parallaxes, and stars in binary systems, we obtain an average, systematic, parallax offset of -75 ± 29 μas for Gaia DR2, consistent with their estimate of a parallax zero-point between -100 and 0 μas.

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Constraining the thermally-pulsing asymptotic giant branch phase with resolved stellar populations in the Small Magellanic Cloud

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The thermally-pulsing asymptotic giant branch (TP-AGB) experienced by low-and intermediate-mass stars is one of the most uncertain phases of stellar evolution and the models need to be calibrated with the aid of observations. To this purpose, we couple high-quality observations of resolved stars in the Small Magellanic Cloud (SMC) with detailed stellar population synthesis simulations computed with the TRILEGAL code. The strength of our approach relies on the detailed spatially-resolved star formation history of the SMC, derived from the deep near-infrared photometry of the VISTA survey of the Magellanic Clouds, as well as on the capability to quickly and accurately explore a wide variety of parameters and effects with the COLIBRI code for the TP-AGB evolution. Adopting a well-characterized set of observations – star counts and luminosity functions – we set up a calibration cycle along which we iteratively change a few key parameters of the TP-AGB models until we eventually reach a good fit to the observations. Our work leads to identify two best-fitting models that mainly differ in the efficiencies of the third dredge-up and mass loss in TP-AGB stars with initial masses larger than about 3 $M_\odot$. On the basis of these calibrated models we provide a full characterization of the TP-AGB stellar population in the SMC in terms of stellar parameters (initial masses, C/O ratios, carbon excess, mass-loss rates). Extensive tables of isochrones including these improved models are publicly available.

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30-μm sources in galaxies with different metallicities

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We present an analysis and comparison of the 30μm dust features seen in the *Spitzer* Space Telescope spectra of 207 carbon-rich asymptotic giant branch (AGB) stars, post-AGB objects, and planetary nebulæ located in the Milky Way, the Magellanic Clouds (MCs), or the Sagittarius dwarf spheroidal galaxy (Sgr dSph), which are characterised by different average metallicities. We investigated whether the formation of the 30-μm feature carrier may be a function of the metallicity. Through this study we expect to better understand the late stages of stellar evolution of carbon-rich stars in these galaxies. Our analysis uses the 'Manchester method' as a basis for estimating the temperature of dust for the carbon-rich AGB stars and the planetary nebulae in our sample. We used a black-body function with a single temperature deduced from the Manchester method or its modification to approximate the continuum under the 30-μm feature. The most important conclusion of our work is the fact that the formation of the 30-μm feature is affected by metallicity. Specifically that, as opposed to more metal-poor samples of AGB stars in the MCs, the feature is seen at lower mass-loss rates, higher temperatures, and has seen to be more prominent in Galactic carbon stars. The averaged feature (profile) in the AGB, post-AGB objects, and PNe seems unaffected by metallicity at least between a fifth and solar metallicity, but in the case of PNe it is shifted to significantly longer wavelengths.

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Additional fluorine abundance determinations in evolved stars

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We present new fluorine abundance measurements for a sample of carbon rich asymptotic giant branch (AGB) stars and two other metal-poor evolved stars of Ba/CH types. The abundances are derived from IR, K-band, high-resolution Phoenix@GEMINI-S and Giano-b@TNG obtained spectra. Our sample includes an extragalactic AGB carbon star belonging to the Sagittarius dSph galaxy. The metallicity of our stars ranges from [Fe/H] = 0.0 down to −1.4 dex. The new measurements, together with those previously derived in similar stars, show that normal (N-type) and SC-type AGB carbon stars of near solar metallicity present similar F enhancements, discarding previous hints which suggested that SC-type stars have larger enhancements. These mild F enhancements are compatible with current chemical evolution models pointing out that AGB stars, although relevant, are not the main sources of this element in the solar neighborhood. For lower metallicity stars, larger [F/Fe] ratios are found. This is confirmed by theory. We highlight a tight relation between the [F/⟨s⟩] ratio and the average s-element enhancement [⟨s⟩/Fe] for stars with [Fe/H] > -0.5, which can be explained by the current state-of-the-art low-mass AGB models assuming an extended ^{13}C pocket. For stars with [Fe/H] < -0.5, discrepancies between observations and model predictions still exist. We conclude that the mechanism of F production in AGB stars needs further scrutiny and that simultaneous F and s-element measurements in a larger number of metal-poor AGB stars are needed to better constrain the models.

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Fluorine abundances in the globular cluster M 4

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We present chemical abundances for the elements carbon, sodium, and fluorine in 15 red giants of the globular cluster M 4, as well as six red giants of the globular cluster ω Centauri. The chemical abundances were calculated in LTE via spectral synthesis. The spectra analyzed are high-resolution spectra obtained in the near-infrared region around $\lambda \sim 2.3$ μm with the Phoenix spectrograph on the 8.1-m Gemini South Telescope, the IGRINS spectrograph on the McDonald Observatory 2.7-m Telescope, and the CRIRES spectrograph on the ESO 8.2-m Very Large Telescope. The results indicate a significant reduction in the fluorine abundances when compared to previous values from the literature for M 4 and ω Centauri, due to a downward revision in the excitation potentials of the HF(1–0) R9 line used in the analysis. The fluorine abundances obtained for the M 4 red giants are found to be anti-correlated with those of Na, following the typical pattern of abundance variations seen in globular clusters between distinct stellar populations. In M 4, as the Na abundance increases by $\sim +0.4$ dex, the F abundance decreases by ~ -0.2 dex. A comparison with abundance predictions from two sets of stellar evolution models finds that the models predict somewhat less F depletion (~ -0.1 dex) for the same increase of +0.4 dex in Na.

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Stellar masses from granulation and oscillations of 23 bright red giants observed by BRITE-Constellation

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Context: The study of stellar structure and evolution depends crucially on accurate stellar parameters. The photometry from space telescopes has provided superb data that allowed asteroseismic characterisation of thousands of stars. However, typical targets of space telescopes are rather faint and complementary measurements are difficult to obtain. On the other hand, the brightest, otherwise well-studied stars, are lacking seismic characterization.
Aims: Our goal is to use the granulation and/or oscillation time scales measured from photometric time series of bright red giants ($1.6 \leq V$ [mag] ≤ 5.3) observed with BRITE-Constellation to determine stellar surface gravities and masses.
Methods: We use probabilistic methods to characterize the granulation and/or oscillation signal in the power density spectra and the autocorrelation function of the BRITE-Constellation time series.
Results: We detect a clear granulation and/or oscillation signal in 23 red giant stars and extract the corresponding time scales from the power density spectra as well as the autocorrelation function of the BRITE-Constellation time series. To account for the recently discovered non-linearity of the classical seismic scaling relations, we use parameters from a large sample of *Kepler* stars to re-calibrate the scalings of the high- and low-frequency components of the granulation signal. We develop a method to identify which component is measured if only one granulation component is statistically significant in the data. We then use the new scalings to determine the surface gravity of our sample stars, finding them to be consistent with those determined from the autocorrelation signal of the time series. We further use radius estimates from the literature to determine the stellar masses of our sample stars from the measured surface gravities. We also define a statistical measure for the evolutionary stage of the stars.

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γ Rays from red giant wind bubbles entering the jets of elliptical host blazars

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Blazars in elliptical hosts have a population of red giants surrounding their jet. These stars can carry large wind-blown bubbles into the jets, leading to γ-ray emission through bubble–jet interactions. We study the interaction dynamics and the γ-ray emission produced when the bubbles formed by red giant winds penetrate the jet of a blazar in an elliptical galaxy. First, we characterized the masses and penetration rates of the red giant wind bubbles that enter the jet. Then, the dynamical evolution of these bubbles under the jet impact was analysed analytically and numerically, and the radiation losses of the particles accelerated in the interaction were characterised. Finally, the synchrotron and the inverse Compton contributions above 100 MeV were estimated under different jet magnetic fields, powers, and Lorentz factors. We find that an analytical dynamical model is a reasonable approximation for the red giant wind bubble–jet interaction. The radiation produced by these wind bubbles interacting with a jet can have a duty cycle of up to 1. For realistic magnetic fields, γ rays could be detectable from sources within the local universe, preferentially from those with high Lorentz factors (~ 10), and this could be a relatively common phenomenon for these sources. For magnetic fields in equipartition with the jet power, and high acceleration rates, synchrotron γ rays may be detectable even for modest Lorentz factors (~ 3), but with a much lower duty cycle.

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Exploring circumstellar effects on the lithium and calcium abundances in massive Galactic O-rich AGB stars

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We previously explored the circumstellar effects on the Rb and Zr abundances in massive Galactic O-rich AGB stars. Here we are interested in the role of the extended atmosphere in the case of Li and Ca. Li is an important indicator of HBB while the total Ca in these stars could be affected by neutron captures. The Li abundances were previously studied with hydrostatic models, while the Ca abundances have been determined for the first time. We use a modified version of Turbospectrum and consider the presence of a gaseous circumstellar envelope and radial wind. The new Li abundances derived with the pseudo-dynamical models are very similar to those obtained from hydrostatic models (the average difference is 0.18 dex), with no difference for Ca. The Li and Ca content in these stars is only slightly affected by the presence of a circumstellar envelope. We also found that the Li I and Ca I line profiles are not very sensitive to variations of the model wind parameters. The new Li abundances confirm the Li-rich nature of the sample stars, supporting the activation of HBB in massive Galactic AGB stars. This is in good agreement with the theoretical predictions for solar metallicity AGB models from aton, Monash, and NuGrid/mesa but is at odds with the fruity database, which predicts no HBB leading to the production of Li. Most sample stars display nearly solar Ca abundances that are consistent with the available s-process nucleosynthesis models for solar metallicity massive AGB stars, which predict overproduction of ^{46}Ca relatively to the other Ca isotope and the creation of the radio-active isotope ^{41}Ca but no change in the total Ca abundance. A minority of the stars seem to show a significant Ca depletion (by up to 1.0 dex). Possible explanations are offered to explain their apparent and unexpected Ca depletion.

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Slowing the spins of stellar cores

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The angular momentum (AM) evolution of stellar interiors, along with the resulting rotation rates of stellar remnants, remains poorly understood. Asteroseismic measurements of red giant stars reveal that their cores rotate much faster than their surfaces, but much slower than theoretically predicted, indicating an unidentified source of AM transport operates in their radiative cores. Motivated by this, we investigate the magnetic Tayler instability and argue that it saturates when turbulent dissipation of the perturbed magnetic field energy is equal to magnetic energy generation via winding. This leads to larger magnetic field amplitudes, more efficient AM transport, and smaller shears than predicted by the classic Tayler–Spruit dynamo. We provide prescriptions for the effective AM diffusivity and incorporate them into numerical stellar models, finding they largely reproduce (1) the nearly rigid rotation of the Sun and main sequence stars, (2) the core rotation rates of low-mass red giants during hydrogen shell and helium burning, and (3) the rotation rates of white dwarfs. We discuss implications for stellar rotational evolution, internal rotation profiles, rotational mixing, and the spins of compact objects.

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Interferometric observations of SiO thermal emission in the inner wind of M-type AGB stars IK Tauri and IRC +10°011

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Context: AGB stars go through a process of strong mass-loss that involves pulsations of the atmosphere, which extends to a region where the conditions are adequate for dust grains to form. Radiation pressure acts on these grains which, coupled to the gas, drive a massive outflow. The details of this process are not clear, including which molecules are involved in the condensation of dust grains.
Aims: To study the role of the SiO molecule in the process of dust formation and mass-loss in M-type AGB stars.
Methods: Using the IRAM NOEMA interferometer we observed the ^{28}SiO and ^{29}SiO $J = 3$–2, $v = 0$ emission from the inner circumstellar envelope of the evolved stars IK Tau and IRC +10°011. We computed azimuthally averaged emission profiles to compare the observations to models using a molecular excitation and ray-tracing code for SiO thermal emission.
Results: We observed circular symmetry in the emission distribution. We also found that the source diameter varies only marginally with radial velocity, which is not the expected behavior for envelopes expanding at an almost constant velocity. The adopted density, velocity, and abundance laws, together with the mass-loss rate, which best fit the observations, give us information on the chemical behavior of the SiO molecule and its role in the dust formation process.
Conclusions: The results indicate that there is a strong coupling between the depletion of gas phase SiO and gas acceleration in the inner envelope. This could be explained by the condensation of SiO into dust grains.

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The VLT-FLAMES Tarantula Survey. XXX. Red stragglers in the clusters Hodge 301 and SL 639

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We estimate physical parameters for the late-type massive stars observed as part of the VLT-FLAMES Tarantula Survey (VFTS) in the 30 Doradus region of the Large Magellanic Cloud (LMC). The observational sample comprises 20 candidate red supergiants (RSGs) which are the reddest ($(B-V) > 1$ mag) and brightest ($V < 16$ mag) objects in the VFTS. We use optical and near-IR photometry to estimate their temperatures and luminosities, and introduce the luminosity–age diagram to estimate their ages. We derive physical parameters for our targets, including temperatures from a new calibration of $(J - K_{\rm s})_0$ colour for luminous cool stars in the LMC, luminosities from their J-band magnitudes (thence radii), and ages from comparisons with state-of-the-art evolutionary models. We show that interstellar extinction is a significant factor for our targets, highlighting the need to take it into account in analysis of the physical parameters of RSGs. We find that some of the candidate RSGs could be massive AGB stars. The apparent ages of the RSGs in the Hodge 301 and SL 639 clusters show a significant spread (12–24 Myr). We also apply our approach to the RSG population of the relatively nearby NGC 2100 cluster, finding a similarly large spread. We argue that the effects of mass-transfer in binaries may lead to more massive and luminous RSGs (which we call 'red stragglers') than expected from single-star evolution, and that the true cluster ages correspond to the upper limit of the estimated RSG ages. In this way, the RSGs can serve as a new and potentially reliable age tracer in young star clusters. The corresponding analysis yields ages of 24^{+5}_{-3} Myr for Hodge 301, 22^{+6}_{-5} Myr for SL 639, and 23^{+4}_{-2} Myr for NGC 2100.

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AtomNeb: IDL library for atomic data of ionized nebulæ

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AtomNeb is a database containing atomic data stored in the Flexible Image Transport System (FITS) file format, including the data for collisionally excited and recombination lines typically observed in nebular astrophysics. The AtomNeb interface library is equipped with several application programming interface (API) functions developed in the Interactive Data Language (IDL), which can be also used in the GNU Data Language (GDL). This IDL library relies on the FITS file related IDL procedures from the IDL Astronomy User's library. The AtomNeb IDL library, together with the proEQUIB IDL library, can be used to perform plasma diagnostics and abundance analysis of collisionally excited and recombination lines emitted from ionized nebulæ.

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Investigation of the globular cluster NGC 2808 with the Ultra-Violet Imaging Telescope

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Globular clusters represent stellar laboratories where observations can be used to validate models of stellar evolution. In this study, we put forth new ultraviolet (UV) photometric results of stars in the Galactic globular cluster NGC 2808. NGC 2808 is known to host multiple stellar populations that include at least four distinct groups of horizontal Branch (HB) stars. We have observed this cluster with the AstroSat-UltraViolet Imaging Telescope in two far-UV (FUV) and five near-UV (NUV) filters, respectively. These UV filters enable the identification of HB populations of stars. The results from four NUV filters exhibit bimodal distributions in magnitude histograms. The nature of bimodality has been investigated on the basis of distinct stellar types contributing to those bands. The colour–magnitude diagrams constructed using FUV and NUV filters enable the location of hot stellar populations, viz. stars belonging to Red HB (RHB), Blue HB, Extreme HB, Blue Hook branch and post-Asymptotic Giant Branch. Prominent gaps are observed in the UV colour–magnitude diagrams. We report for the first time, a photometric gap in a NUV colour–magnitude diagram, that segregates the RHB population of this cluster into two groups, that are likely to be associated with distinct generations of stars. We have constructed and examined the Gaia colour–magnitude diagram of the optical counterparts of the hot UV stars. We also investigate the spatial density distributions of various groups of stars in the cluster and comment on the proposed formation models of multiple populations.

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and from https://academic.oup.com/mnras/article/485/2/2877/5365429

Hidden IR structures in NGC 40: signpost of an ancient born-again event

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We present the analysis of infrared (IR) observations of the planetary nebula NGC 40 together with spectral analysis of its [WC]-type central star HD 826. *Spitzer* IRS observations were used to produce spectral maps centred at polycyclic aromatic hydrocarbons (PAH) bands and ionic transitions to compare their spatial distribution. The ionic lines show a clumpy distribution of material around the main cavity of NGC 40, with the emission from [Ar II] being the most extended, whilst the PAHs show a rather smooth spatial distribution. Analysis of ratio maps shows the presence of a toroidal structure mainly seen in PAH emission, but also detected in a *Herschel* PACS 70-μm image. We argue that the toroidal structure absorbs the UV flux from HD 826, preventing the nebula to exhibit lines of high-excitation levels as suggested by previous authors. We discuss the origin of this structure and the results from the spectral analysis of HD 826 under the scenario of a late thermal pulse.

Published in MNRAS
Available from https://arxiv.org/abs/1902.11219
and from http://adsabs.harvard.edu/abs/2019MNRAS.485.3360T

Comprehensive abundance analysis of red giants in the open clusters Stock 2, NGC 2168, 6475, 6991 and 7762

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We have analysed high-dispersion echelle spectra ($R = 60\,000$) of red giant members of five open clusters to derive abundances for many elements from Na to Eu. The [Fe/H] values are -0.06 ± 0.03 for Stock 2, -0.11 ± 0.03 for NGC 2168, -0.01 ± 0.03 for NGC 6475, 0.00 ± 0.03 for NGC 6991 and -0.07 ± 0.03 for NGC 7662. Sodium is enriched in the giants relative to the abundance expected of main sequence stars of the same metallicity. This enrichment of [Na/Fe] by about +0.25 attributed to the first dredge-up is discussed in the light of theoretical predictions and recently published abundance determinations. Abundance ratios [El/Fe] for other elements are with very few exceptions equal to those of field giants and dwarfs, i.e., [El/Fe] $\simeq 0.00$ for [Fe/H] ~ 0.0. An exception is the overabundance of La, Ce, Nd and Sm in NGC 6991 but this is consistent with our previous demonstration that the abundances of these *s*-process products vary by about ± 0.2 among clusters of the same [Fe/H], a variation found also among field giants and dwarfs.

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Conference Paper

Current problems in stellar evolution

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The theory of stellar evolution plays a central role in astrophysics as stellar models are used to infer properties for Galactic and extragalactic stellar populations as well as exoplanetary systems. However, despite decades of experience, stellar models still face major issues linked to transport processes of chemicals and angular momentum. This review will focus on some of the processes responsible for the most sizeable uncertainties in stellar models such as for example convection, rotation and mass loss. The presentation will discuss their implementation, their impact on theoretical predictions and how various observational constraints can help us gain insight on the physics inside stars and face the current challenges of the theory of stellar evolution.

Oral contribution, published in the PHOST conference held in Banyuls, France
Available from https://arxiv.org/abs/1902.10399

Review Paper

What do planetary nebulæ and H II regions reveal about the chemical evolution of nearby dwarf galaxies?

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The Local Group contains a great number of dwarf irregulars and spheroidals, for which the spectroscopy of individual stars can be obtained. Thus, the chemical evolution of these galaxies can be traced, with the only need of finding

populations spanning a large age range and such that we can accurately derive the composition. Planetary nebulæ (PNe) are old- and intermediate-age star remnants and their chemical abundances can be obtained up to 3–4 Mpc. H II regions, which are brighter and much easily detected, represent galaxies young content. PNe and H II regions share similar spectroscopic features and are analysed in the same way. Both are among the best tracers of the chemical evolution allowing to draw the chemical time line of nearby galaxies. The focus in this review are the PN and H II region populations as constraints to the chemical evolution models and the mass–metallicity relation of the local universe.

Published in IAU S344 "Dwarf Galaxies: From the Deep Universe to the Present"
Available from https://arxiv.org/abs/1902.04291

Job Adverts

University of Oslo, Rosseland Centre for Solar Physics (Norway) Postdoctoral Research Fellowship in Solar/Stellar Physics

A position as Postdoctoral Research Fellow is available at the Rosseland Centre for Solar Physics, Institute of Theoretical Astrophysics, University of Oslo. The fellowship period is 3 years. Starting date preferably 01.10.2019 but might be negotiated.

The position is connected to the project "Exploring Millimeter Indicators of Solar-Stellar Activity" (EMISSA), which will use the Atacama Large Millimeter/sub-millimeter Array (ALMA) for a re-evaluation of the activity of stars by means of a comparative solar–stellar study with the Sun serving as a fundamental reference. The EMISSA project will benefit from synergies with the ERC-funded SolarALMA team at Oslo and an ESO-funded ALMA Development Study in co-operation with Onsala Space Observatory, Sweden. The project is part of the Rosseland Centre for Solar Physics (RoCS), which is a centre of excellence funded by the Research Council of Norway and the University of Oslo.

The successful candidate would work on numerical simulations of stellar atmospheres (incl. the Sun) with particular emphasis on radiative transfer calculations but also on the processing and analysis of observations with ALMA in co-operation with the Solar ALMA team at RoCS and with international collaborators.

Salary NOK 515 200 – 597 400 per annum depending on qualifications in position as Postdoctoral Research Fellow (position code 1352).

The full announcement with more information and the online application form can be found at
http://www.jobbnorge.no/en/available-jobs/job/165441/postdoctoral-research-fellowship-in-solar-stellar-physics

Application deadline: April 15. 2019

For further information about this position, please contact Sven Wedemeyer (sven.wedemeyer@astro.uio.no).

See also http://www.jobbnorge.no/en/available-jobs/job/165441/postdoctoral-research-fellowship-in-solar-stellar-physics

European Southern Observatory (Chile) Operations Staff Astronomer

The European Southern Observatory invites applications for a position as Operations Staff Astronomer with duties on the Very Large Telescope (Paranal). Details of the application are given in the job announcement in the URL below. Deadline of the application is May 6$^{\rm th}$.

See also https://recruitment.eso.org

Chalmers University of Technology (Sweden)
Post-doctoral position in evolved stars research

A two-year post-doctoral position is available in the Evolved Stars group of the Department of Space, Earth and Environment at Chalmers University of Technology in Gothenburg, Sweden. The position will be hosted within the Galactic astronomy unit of the Astronomy and Plasma Physics division, in the research group of Dr. Elvire De Beck.

The project will make use of instruments such as ALMA, APEX, OSO 20m, and IRAM 30m in the millimeter/submillimeter, as well as the *Herschel* Space Observatory in the far-infrared. The research will focus on the physical and chemical properties of high- and low-mass stars in the late stages of their evolution, primarily through studies of molecular line observations. The successful applicant will be expected to lead the work in close collaboration with the other members of the group and partner institutes.

The group is active in observational astronomy at all wavelengths, with a focus on millimeter and submillimeter facilities, as well as radiative transfer modelling of molecular line emission and dust, and chemical modelling. The group has close connections to the Onsala Space Observatory, which is the Swedish national facility for Radio Astronomy. The observatory operates telescopes in Sweden, shares in the APEX telescope in Chile, and hosts the Nordic ALMA Regional Center (ARC). The research topics of the division cover a broad range of topics including formation and evolution of galaxies, the birth and death of stars, astrochemistry, and exoplanets.

Application details can be found via the online application submission form.
http://www.chalmers.se/en/about-chalmers/Working-at-Chalmers/Vacancies/Pages/default.aspx?rmpage=job&rmjob=7284&rmlang=UK

Included benefits: a competitive salary and benefits package are offered at Chalmers. Fellows are eligible for social security benefits, including health insurance, paid leave, and retirement benefits. The position also includes travel funds and opportunities for dissemination, networking, and international collaboration will be available.

Application deadline: Wednesday, May 1, 2019

See also http://www.chalmers.se/en/about-chalmers/Working-at-Chalmers/Vacancies/Pages/default.aspx?rmpage=job&rmjob=7284&rmlang=UK

Chalmers University of Technology (Sweden)
PhD position in evolved stars research

Applications are invited for a Ph.D. position in the Evolved Stars group of the Department of Space, Earth and Environment at Chalmers University of Technology in Gothenburg, Sweden. The position will be hosted within the Galactic astronomy unit of the Astronomy and Plasma Physics division, in the research group of Dr. Elvire De Beck.

The project will make use of instruments such as ALMA, APEX, OSO 20m, and IRAM 30m in the millimeter/submillimeter, as well as the *Herschel* Space Observatory in the far-infrared. The position will focus on the physical and chemical properties of low-mass stars appearing as carbon-enriched AGB stars in the late stages of their evolution. The successful applicant will have the opportunity to influence the details of the research project, with the possibility to combine observational work with theoretical modelling. The Ph.D. student will be expected to lead the work in close collaboration with the other members of the group. The research will mainly be done at Onsala Space Observatory, where Chalmers hosts the Swedish National Facility for Radio Astronomy.

The position may also include teaching at Chalmers or performing other duties corresponding up to 20 per cent of working hours, depending on availability. These duties can extend the position to a maximum of five years.

An M.Sc. in astronomy or physics or similar is required. A good understanding of stellar evolution and/or observational techniques would be an asset. The position requires sound verbal and written communication skills in English. Swedish skills are not required. Chalmers offers Swedish courses for those interested.

Application details can be found via the online application submission form.
http://www.chalmers.se/en/about-chalmers/Working-at-Chalmers/Vacancies/Pages/default.aspx?rmpage=job&rmjob=7283&rmlang=UK

Application deadline: Wednesday, May 1, 2019

See also http://www.chalmers.se/en/about-chalmers/Working-at-Chalmers/Vacancies/Pages/default.aspx?rmpage=job&rmjob=7283&rmlang=UK

Announcements

A star has evolved
A conference in the honour of Hans Olofsson

August 27–29, 2019, Smögen, Sweden

For nearly four decades Hans has been a pioneer and driving actor in the field of evolved stars research. He has significantly contributed to our knowledge of the mass loss from AGB stars, the mechanism behind the mass loss, the chemical composition of the stellar winds, the nature behind episodic mass-loss, the maser emission from the envelopes around AGB stars, and the evolution of stars past the AGB stage. In addition, he has been one of the leading scientists to develop the observational methods using molecular line emission at millimetre and submillimetre wavelengths from both single-dish telescopes and interferometers. To celebrate his efforts but also to discuss the advances and prospects of our field we will hold a dedicated conference this year in August.

See also https://sites.google.com/view/astarhasevolved/

Fizeau exchange visitors program – call for applications

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff), with priority given to Ph.D. students and young postdocs. Non-EU based missions will only be funded if considered essential by the Fizeau Committee. Applicants are strongly encouraged to seek also partial support from their home or host institutions.

The deadline for applications is May 15. Fellowships can be awarded for missions to be carried out between mid-July 2019 and December 2019!

Further informations and application forms can be found at http://www.european-interferometry.eu

The program is funded by OPTICON/H2020.

Please distribute this message also to potentially interested colleagues outside of your community!

Looking forward to your applications,
Josef Hron & Péter Ábrahám
(for the European Interferometry Initiative)

See also http://www.european-interferometry.eu