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Figure 1: The planetary nebula NGC 6852 in Aquila was captured by the CHART32 team at Cerro Tololo in Chile, using an 80-cm f/7 instrument and a combination of Hα, [O III] and RGB filters with a total integration time of 19 hours. See http://www.chart32.de/index.php/component/k2/item/225

Editorial

Dear Colleagues,

It is a pleasure to present you the 234th issue of the AGB Newsletter.

Are you looking for a postdoctoral research position? There are advertisements for work on radioactivity in Hungary and high resolution studies in Chile.

Thanks as always to Sakib Rasool for suggesting yet another beautiful picture of a planetary nebula for the cover. Please feel free to suggest pictures related to the topic of this newsletter – in particular images, spectra or diagrams from your recent work are most welcome.

The next issue is planned to be distributed around the 1st of February. Happy New Year!

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

Food for Thought

This month's thought-provoking statement is:

Circumstellar grain formation is not 100% efficient

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

On the possible triple central star system of PN SuWt 2: No ménage à trois at the heart of the Wedding Ring

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SuWt 2 is a planetary nebula consisting of a bright ring-like waist from which protrude faint extended lobes – a morphology believed to be typical of progenitors which have experienced a close-binary evolution. Previous observations of NSV 19992, the star at the projected centre of SuWt 2, have found it to comprise two A-type stars in a 4.9 day eclipsing orbit, neither of which could be the nebular progenitor. Radial velocity studies provided a hint that the systemic velocity of this double A-type binary might be varying over time, suggesting the presence of a third component hypothesised to be the nebular progenitor. Here, we present an extensive radial velocity monitoring study of NSV 19992, performed with the high-resolution échelle spectrograph UVES mounted on ESO's VLT, in order to constrain the possible variation in the systemic velocity of the A-type binary and its relation to the progenitor of SuWt 2. The observations, acquired over a period of approximately one year, show no evidence of variability in the systemic velocity of NSV 19992. Combining these new observations with previous high-resolution spectroscopy demonstrates that the systemic velocity is also stable over much longer periods and, moreover, is distinct from that of SuWt 2, strongly indicating that the two are not associated. We conclude that NSV 19992 is merely a field star system, by chance lying in the same line of sight as the nebular centre, and that it bares no relation to SuWt 2 or its, as yet unidentified, central star(s).

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Available from http://arxiv.org/abs/1611.01819

A revised planetary nebula luminosity function distance to NGC 628 using MUSE

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Distance uncertainties plague our understanding of the physical scales relevant to the physics of star formation in extragalactic studies. The planetary nebulæ luminosity function (PNLF) is one of very few techniques that can provide distance estimates to within $\sim 10\%$, however it requires a planetary nebula (PN) sample that is uncontaminated by other ionizing sources. We employ optical IFU spectroscopy using MUSE on the VLT to measure [O III] line fluxes for sources unresolved on 50 pc scales within the central star-forming galaxy disk of NGC 628. We use diagnostic line ratios to identify 62 PNe, 30 supernova remnants and 87 H II regions within our fields. Using the 36 brightest PNe we determine a new PNLF distance modulus of $29.91^{+0.08}_{-0.13}$ mag ($9.59^{+0.35}_{-0.57}$ Mpc), in good agreement with literature values but significantly larger than the previously reported PNLF distance. We are able to explain the discrepancy and recover the previous result when we reintroduce SNR contaminants to our sample. This demonstrates the power

of full spectral information over narrowband imaging in isolating PNe. Given our limited spatial coverage within the galaxy, we show that this technique can be used to refine distance estimates even when IFU observations cover only a fraction of a galaxy disk.

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On the silicate crystallinities of oxygen-rich evolved stars and their mass loss rates

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For decades ever since the early detection in the 1990s of the emission spectral features of crystalline silicates in oxygen-rich evolved stars, there is a long-standing debate on whether the crystallinity of the silicate dust correlates with the stellar mass loss rate. To investigate the relation between the silicate crystallinities and the mass loss rates of evolved stars, we carry out a detailed analysis of 28 nearby oxygen-rich stars. We derive the mass loss rates of these sources by modeling their spectral energy distributions from the optical to the far infrared. Unlike previous studies in which the silicate crystallinity was often measured in terms of the crystalline-to-amorphous silicate mass ratio, we characterize the silicate crystallinities of these sources with the flux ratios of the emission features of crystalline silicates to that of amorphous silicates. This does not require the knowledge of the silicate dust temperatures which are the major source of uncertainties in estimating the crystalline-to-amorphous silicate mass ratio. With a Pearson correlation coefficient of ~ 0.24, we find that the silicate crystallinities and the mass loss rates of these sources are not correlated. This supports the earlier findings that the dust shells of low mass-loss rate stars can contain a significant fraction of crystalline silicates without showing the characteristic features in their emission spectra.

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Long period variable stars in NGC 147 and NGC 185. I. Their star formation histories

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NGC 147 and NGC 185 are two of the most massive satellites of the Andromeda galaxy (M 31). Close together in the sky, of similar mass and morphological type dE, they possess different amounts of interstellar gas and tidal distortion. The question therefore is, how do their histories compare? Here we present the first reconstruction of the star formation histories of NGC 147 and NGC 185 using long-period variable stars. These represent the final phase of evolution of low- and intermediate-mass stars at the asymptotic giant branch, when their luminosity is related to their birth mass. Combining near-infrared photometry with stellar evolution models, we construct the mass function and hence the star formation history. For NGC 185 we found that the main epoch of star formation occurred 8.3 Gyr ago, followed by a much lower, but relatively constant star formation rate. In the case of NGC 147, the star formation rate peaked only 7 Gyr ago, staying intense until ~ 3 Gyr ago, but no star formation has occurred for at least 300 Myr. Despite their similar masses, NGC 147 has evolved more slowly than NGC 185 initially, but more dramatically in more recent times. This is corroborated by the strong tidal distortions of NGC 147 and the presence of gas in the centre of NGC 185.

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Dust formation and mass loss around intermediate-mass AGB stars with initial metallicity $Z_{\rm ini} \leq 10^{-4}$ in the early Universe I: Effect of surface opacity on the stellar evolution and dust-driven wind

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Dust formation and resulting mass loss around Asymptotic Giant Branch (AGB) stars with initial metallicity in the range of $0 \leq Z_{\rm ini} \leq 10^{-4}$ and initial mass $2 \leq M_{\rm ini}/{\rm M}_\odot \leq 5$ are explored by the hydrodynamical calculations of dust-driven wind (DDW) along the AGB evolutionary tracks. We employ the MESA code to simulate the evolution of stars, assuming an empirical mass-loss rate in the post-main sequence phase, and considering the three types of low-temperature opacities (scaled-solar, CO-enhanced, and CNO-enhanced opacities) to elucidate the effect on the stellar evolution and the DDW. We find that the treatment of low-temperature opacity strongly affects the dust formation and resulting DDW; in the carbon-rich AGB phase, the maximum $\dot{M}$ of $M_{\rm ini} \geq 3$ M$_\odot$ star with the CO-enhanced opacity is at least one order of magnitude smaller than that with the CNO-enhanced opacity. A wide range of stellar parameters being covered, a necessary condition for driving efficient DDW with $\dot{M} \geq 10^{-6}$ M$_\odot$ yr^{-1} is expressed as the effective temperature $T_{\rm eff} \lesssim 3850$ K and $\log(\delta_{\rm C} L/\kappa_{\rm R} M) \gtrsim 10.43 \log T_{\rm eff} - 32.33$ with the carbon excess $\delta_{\rm C}$ defined as $\epsilon_{\rm C} - \epsilon_{\rm O}$ and the Rosseland mean opacity $\kappa_{\rm R}$ in units of cm^2 g^{-1} in the surface layer, and the stellar mass (luminosity) M (L) in solar units. The derived fitting formulæ of gas and dust mass-loss rates in terms of input stellar parameters could be useful for investigating the dust yield from AGB stars in the early Universe being consistent with the stellar evolution calculations.

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Turbulent chemical diffusion in convectively bounded carbon flames

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It has been proposed that mixing induced by convective overshoot can disrupt the inward propagation of carbon deflagrations in super-asymptotic giant branch stars. To test this theory, we study an idealized model of convectively bounded carbon flames with 3D hydrodynamic simulations of the Boussinesq equations using the pseudospectral code DEDALUS. Because the flame propagation timescale is much longer than the convection timescale, we approximate the flame as fixed in space, and only consider its effects on the buoyancy of the fluid. By evolving a passive scalar field, we derive a *turbulent* chemical diffusivity produced by the convection as a function of height, $D_{\rm t}(z)$. Convection can stall a flame if the chemical mixing timescale, set by the turbulent chemical diffusivity, $D_{\rm t}$, is shorter than the flame propagation timescale, set by the thermal diffusivity, κ, i.e., when $D_{\rm t} > \kappa$. However, we find $D_{\rm t} < \kappa$ for most of the flame because convective plumes are not dense enough to penetrate into the flame. Extrapolating to realistic stellar conditions, this implies that convective mixing cannot stall a carbon flame and that "hybrid carbon–oxygen–neon" white dwarfs are not a typical product of stellar evolution.

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History of the mass ejection in K 4-37: from the AGB to the evolved planetary nebula phase

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We present narrow-, broad-band, and WISE archive images, and high- and intermediate-resolution long-slit spectra of K 4-37, a planetary nebula that has never been analyzed in detail. Although K 4-37 appears bipolar, the morphokinematical analysis discloses the existence of three distinct axes and additional particular directions in the object, indicating that K 4-37 is a multi-axis planetary nebula that has probably been shaped by several bipolar outflows at different directions. A 4–6 $M_\odot$ main-sequence progenitor is estimated from the derived high nebular He and N abundances, and very high N/O abundance ratio (~ 2.32). The general properties are compatible with K 4-37 being a highly evolved planetary nebula located at ~ 14 kpc. The WISE image at 22 μm reveals K 4-37 to be surrounded by a large ($\sim 13 \times 8$ pc^2) elliptical detached shell probably related to material ejected from the AGB progenitor. The observed elliptical morphology suggests deformation of an originally spherical AGB shell by the ISM magnetic field or by the influence of a companion. We compare K 4-37 and NGC 6309 and found remarkable similarities in their physical structure but noticeably different chemical abundances that indicate very different progenitor mass. This strongly suggests that, irrespective of the initial mass, their (presumably binary) central stars have shared a very similar mass ejection history.

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Magnetic field structure in single late-type giants: The weak G-band giant 37 Comæ from 2008 to 2011

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Aims: This work studies the magnetic activity of the late-type giant 37 Com. This star belongs to the group of weak G-band stars that present very strong carbon deficiency in their photospheres. The paper is a part of a global investigation into the properties and origin of magnetic fields in cool giants.
Methods: We use spectropolarimetric data, which allows the simultaneous measurement of the longitudinal magnetic field B_l, line activity indicators (Hα, Ca II IRT, S-index) and radial velocity of the star, and consequently perform a direct comparison of their time variability. Mean Stokes V profiles are extracted using the least squares deconvolution (LSD) method. One map of the surface magnetic field of the star is reconstructed via the Zeeman Doppler imaging (ZDI) inversion technique.
Results: A periodogram analysis is performed on our dataset and it reveals a rotation period of 111 days. We interpret this period to be the rotation period of 37 Com. The reconstructed magnetic map reveals that the structure of the surface magnetic field is complex and features a significant toroidal component. The time variability of the line activity indicators, radial velocity and magnetic field B_l indicates a possible evolution of the surface magnetic structures in the period from 2008 to 2011. For completeness of our study, we use customized stellar evolutionary models suited to a weak G-band star. Synthetic spectra are also calculated to confirm the peculiar abundance of 37 Com.

Conclusions: We deduce that 37 Com is a 6.5 $M_\odot$ weak G-band star located in the Hertzsprung gap, whose magnetic activity is probably due to dynamo action.

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Characterizing the population of bright infrared sources in the Small Magellanic Cloud

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We used *Spitzer*'s Infrared Spectrograph (IRS) to observe stars in the Small Magellanic Cloud (SMC) selected from the Midcourse Space Experiment (MSX) Point Source Catalog. We concentrate on the dust properties of oxygen-rich evolved stars, which show less alumina than Galactic stars. This difference may arise from the SMC's lower metallicity, but it could be a selection effect: the SMC sample includes more stars which are brighter and thus more massive. The distribution of SMC stars along the silicate sequence looks more like that of Galactic red supergiants than asymptotic giant branch stars (AGBs). While many are definitively AGB stars, several SMC stars show evidence of hot bottom burning. Other sources show mixed chemistry (oxygen-rich and carbon-rich features), including supergiants with PAH emission. MSX SMC 134 may be the first confirmed silicate/carbon star in the SMC, and MSX SMC 049 is a post-AGB candidate. MSX SMC 145, previously a candidate OH/IR star, is actually an AGB star with a background galaxy at $z = 0.16$ along the same line-of-sight. We consider the overall characteristics of all the MSX sources, the most infrared-bright objects in the SMC, in light of *Spitzer*'s higher sensitivity and resolution, and compare them with the object types expected from the original selection criteria. This population represents what will be seen in more distant galaxies by the James Webb Space Telescope (JWST). Color–color diagrams using the IRS spectra and JWST mid-infrared filters show how one can separate evolved stars from young stellar objects (YSOs) and distinguish among different YSO classes.

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High-resolution spectroscopy of the extremely iron-poor post-AGB star CC Lyr

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High-resolution optical spectroscopy was conducted for the metal-poor post-AGB star CC Lyr to determine its chemical abundances and spectral line profiles. Our standard abundance analysis confirms its extremely low metallicity ([Fe/H] < -3.5) and a clear correlation between abundance ratios and the condensation temperature for 11 elements, indicating that dust depletion is the cause of the abundance anomaly of this object. The very low abundances of Sr and Ba, which are detected for the first time for this object, suggest that heavy neutron-capture elements are not significantly enhanced in this object by the *s*-process during its evolution through AGB phase. Radial velocity of this object and

profiles of some atomic absorption lines show variations depending on pulsation phases, which could be formed by dynamics of the atmosphere rather than by binarity or contributions of circumstellar absorption. On the other hand, the Hα emission with double peaks shows no evident velocity shift, suggesting that the emission is originating from the circumstellar matter, presumably the rotating disk around the object.

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The discovery of a planetary candidate around the evolved low-mass *Kepler* giant star HD 175370

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We report on the discovery of a planetary companion candidate with a minimum mass $M \sin i = 4.6 \pm 1.0$ $M_{\rm Jupiter}$ orbiting the K2 III giant star HD 175370 (KIC 007940959). This star was a target in our program to search for planets around a sample of 95 giant stars observed with *Kepler*. This detection was made possible using precise stellar radial velocity measurements of HD 175370 taken over five years and four months using the coudé échelle spectrograph of the 2-m *Alfred Jensch* Telescope and the fibre-fed échelle spectrograph *HERMES* of the 1.2-m *Mercator* Telescope. Our radial velocity measurements reveal a periodic (349.5 ± 4.5 days) variation with a semi-amplitude $K = 133 \pm 25$ m s^{-1}, superimposed on a long-term trend. A low-mass stellar companion with an orbital period of ~ 88 years in a highly eccentric orbit and a planet in a Keplerian orbit with an eccentricity $e = 0.22$ are the most plausible explanation of the radial velocity variations. However, we cannot exclude the existence of stellar envelope pulsations as a cause for the low-amplitude radial velocity variations and only future continued monitoring of this system may answer this uncertainty. From *Kepler* photometry we find that HD 175370 is most likely a low-mass red-giant branch or asymptotic-giant branch star.

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The abundance of C_2H_4 in the circumstellar envelope of IRC +10°216

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High spectral resolution mid-IR observations of ethylene (C_2H_4) towards the AGB star IRC +10°216 were obtained using the Texas Echelon Cross Échelle Spectrograph (TEXES) at the NASA Infrared Telescope Facility (IRTF). Eighty

ro-vibrational lines from the 10.5-μm vibrational mode ν_7 with $J < 30$ were detected in absorption. The observed lines are divided into two groups with rotational temperatures of 105 and 400 K (warm and hot lines). The warm lines peak at ≈ -14 km s^{-1} with respect to the systemic velocity, suggesting that they are mostly formed outwards from $\approx 20\ R_\star$. The hot lines are centered at -10 km s^{-1} indicating that they come from a shell between 10 and 20 $R_\star$. 35% of the observed lines are unblended and can be fitted with a code developed to model the emission of a spherically symmetric circumstellar envelope. The analysis of several scenarios reveal that the C_2H_4 abundance relative to H_2 in the range 5–20 $R_\star$ is 6.9×10^{-8} in average and it could be as high as 1.1×10^{-7}. Beyond 20 $R_\star$, it is 8.2×10^{-8}. The total column density is $6.5(3.0) \times 10^{15}$ cm^{-2}. C_2H_4 is found to be rotationally under local thermodynamical equilibrium (LTE) and vibrationally out of LTE. One of the scenarios that best reproduce the observations suggests that up to 25% of the C_2H_4 molecules at 20 $R_\star$ could condense onto dust grains. This possible depletion would not influence significantly the gas acceleration although it could play a role in the surface chemistry on the dust grains.

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Conference Papers

Probing seismic solar analogues through observations with the NASA *Kepler* space telescope and *Hermes* high-resolution spectroscopy

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Stars similar to the Sun, known as solar analogues, provide an excellent opportunity to study the preceding and following evolutionary phases of our host star. The unprecedented quality of photometric data collected by the *Kepler* NASA mission allows us to characterise solar-like stars through asteroseismology and study diagnostics of stellar evolution, such as variation of magnetic activity, rotation and the surface lithium abundance. In this project, presented in a series of papers by Salabert et al. (2016a,b) and Beck et al. (2016a,b), we investigate the link between stellar activity, rotation, lithium abundance and oscillations in a group of 18 solar-analogue stars through space photometry, obtained with the NASA *Kepler* space telescope and from currently 50+ hours of ground-based, high-resolution spectroscopy with the *Hermes* instrument. In these proceedings, we first discuss the selection of the stars in the sample, observations and calibrations and then summarise the main results of the project. By investigating the chromospheric and photospheric activity of the solar analogues in this sample, it was shown that for a large fraction of these stars the measured activity levels are compatible to levels of the 11-year solar activity cycle 23. A clear

correlation between the lithium abundance and surface rotation was found for rotation periods shorter than the solar value. Comparing the lithium abundance measured in the solar analogues to evolutionary models with the Toulouse–Geneva Evolutionary Code (TGEC), we found that the solar models calibrated to the Sun also correctly describe the set of solar/stellar analogs showing that they share the same internal mixing physics. Finally, the stars KIC 3241581 and KIC 10644353 are discussed in more detail.

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Gaseous abundances in planetary nebulæ: What have we learned in the past five years?

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Nearly 50 years ago, in the proceedings of the first IAU symposium on planetary nebulæ (PNe), Lawrence H. Aller and Stanley J. Czyzak said that the problem of determination of the chemical compositions of planetary and other gaseous nebulæ constitutes one of the most exasperating problems in astrophysics". Although the situation has greatly improved over the years, many important problems are still open and new questions have arrived to the field, which still is an active field of study. Here I will review some of the main aspects related to the determination of gaseous abundances in PNe and some relevant results derived in the last five year, since the last IAU symposium on PNe.

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New models for the evolution of central stars of planetary nebulæ: Faster and Brighter

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The post-asymptotic giant branch (AGB) phase is arguably one of the least understood phases of the evolution of low- and intermediate- mass stars. The recent post-AGB evolutionary sequences computed by Miller Bertolami (2016) are at least three to ten times faster than those previously published by Vassiliadis & Wood (1994) and Blöcker (1995) which have been used in a large number of studies. This is true for the whole mass and metallicity range. The new models are also ~ 0.1–0.3 dex brighter than the previous models with similar remnant masses. In this short article we comment on the main reasons behind these differences, and discuss possible implications for other studies of post-AGB stars or planetary nebulæ.

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Abundances and gradients in M 31 – a chemical study of planetary nebulæ in the substructures

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We present deep optical spectroscopy of seven planetary nebulæ (PNe) in the substructures of M 31, three in the Northern Spur and four associated with the Giant Stream. The spectra were obtained with the OSIRIS spectrograph on the 10.4m GTC. The detection of the [O III] 4363Å auroral line in all PNe of our sample enables reliable abundance determinations. Our targets have low N/O (< 0.5) and He/H ratios, indicating that they are probably Type II PNe. The PNe in our sample have rather homogeneous oxygen abundances, with an average value of 8.56 ± 0.10. Based on the abundances as well as the spatial and kinematical information of our targets, we speculate that the Northern Spur and the Giant Stream might have the same origin. We raise a hypothesis that the dwarf satellite M 32 might be responsible for these two substructures. New observations have recently been made to assess this hypothesis.

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The kinematical behavior of ORLs and CELs in PNe with [WR] central star

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In Planetary Nebulæ (PNe) ionic abundances can be derived by using collisionally excited lines (CELs) or recombination lines (ORLs). However such abundances do not coincide for the same ion and usually the abundances from ORLs are larger than those from CELs by factors of 2 or larger. This occurs in H II regions as well. The origin of the discrepancy, known as the Abundance Discrepancy Factor (ADF) is, so far, an open problem in astrophysics of gaseous nebulæ. It has been attributed to temperature fluctuations, tiny metal-rich inclusions embedded in the H-rich plasma, gas inhomogeneities or other processes. In this work we analyze the kinematical behavior of CELs and ORLs in two PNe ionized by [WC] stars, finding that in general kinematics of ORLs do not follow the behavior of CELs. In particular the expansion velocities from CELs and ORLs for the same ion are different indicating that ORLs seem to be produced in zones nearer the central stars than CELs. This is in agreement with results found by other authors,for individual PNe.

Oral contribution, published in "IAU Symp. 323 – Planetary Nebulæ: Multi-Wavelength Probes of Stellar and Galactic Evolution"
Available from http://arxiv.org/abs/1611.06198

AGB and post-AGB objects in the outer Galaxy

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We present the results of our search for low- and intermediate mass evolved stars in the outer Galaxy using AllWISE catalogue photometry. We show that the [3.4]–[12] versus [4.6]–[22] colour–colour diagram is most suitable for separating C-rich/O-rich AGB and post- AGB star candidates. We are able to select 2,510 AGB and 24,821 post-AGB star candidates. However, the latter are severely mixed with the known young stellar objects in this diagram.

Poster contribution, published in "IAU Symposium No. 323, Planetary Nebulæ: Multi-Wavelength Probes of Stellar and Galactic Evolution"
Available from http://arxiv.org/abs/1612.09118

Job Adverts

RADIOSTAR post-doc positions

We invite applications for postdoctoral positions at Konkoly Observatory in Budapest (Hungary) to work with Dr. Maria Lugaro and collaborators on the ERC-funded project RADIOSTAR, "Radioactivities from Stars to Solar Systems". The project will exploit radioactive nuclei produced by nuclear reactions inside stars and supernovæ to understand the origin of our Solar System. Three positions will be available from the beginning of September 2017, initially for two years, and renewable for one or two more years.

Potential applicants with interest and proven experience in:

- Nuclear Astrophysics/Nuclear networks
- Stellar and Supernova nucleosynthesis
- Galactic chemical evolution

are encouraged to apply.

The RADIOSTAR project involves close collaboration with Amanda Karakas (Monash), Alexander Heger (Monash), Marco Pignatari (Hull), Brad Gibson (Hull), and Brad Meyer (Clemson). Generous travel funds will be provided for visit to collaborators and to attend major meetings in the field.

To apply, please send a cover letter with a curriculum vitæ, a publication list and a brief statements of research accomplishments and interests (not exceeding 2 pages each) via email to maria.lugaro@csfk.mta.hu in pdf format by February 28th, 2017. Applicants should also indicate the names and email addresses of three (minimum two) professors who agree to provide reference letters.

Konkoly Observatory (www.konkoly.hu) is a thriving research environment with roughly 50 staff astronomers working on topics from variable stars, asteroseismology, exoplanets, stellar (and solar) activity, Solar System objects, star formation, the interstellar medium and proto-planetary disks (ERC funded), to nucleosynthesis, transients, and supernovæ.

Postdoctoral position in high angular resolution astronomy

Applications are invited for a postdoctoral position in high angular resolution astronomy in the Instituto de Astronomía at the Universidad Católica del Norte, Chile, funded by the Joint Committee of ESO and Government of Chile.

The successful applicant will work with Prof. Keiichi Ohnaka on high angular resolution observations of cool evolved stars with optical/infrared interferometric techniques as well as adaptive optics. The work will include the analysis and interpretation of high angular resolution data, for example, radiative transfer modeling and aperture-synthesis imaging of the stellar atmosphere and circumstellar environment to clarify the long-standing problem of the mass loss from stars in late evolutionary stages.

The successful applicant will have access to the 10% of the telescope time on all existing facilities in Chile, such as VLT, ALMA, Gemini-South, and Magellan.

The appointment will be for two years. Experience in optical/infrared interferometry and/or research on cool evolved stars would be an asset.

Interested applicants should submit a CV, publication list, description of research interests and arrange three letters of reference directly sent to Prof. Keiichi Ohnaka (k1.ohnaka@gmail.com). Applications submitted by February 28, 2017 will receive full consideration, but late applications may be considered until the position is filled. For further information, please contact Prof. Keiichi Ohnaka (k1.ohnaka@gmail.com).