THE   AGB   NEWSLETTER

An electronic publication dedicated to Asymptotic Giant Branch stars and related phenomena

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Editorial

Dear Colleagues,

It is our pleasure to present you the 299$^{\text{th}}$ issue of the AGB Newsletter. This means next issue is the 300$^{\text{th}}$ – time for a little celebration or an excuse for something a little different. Suggestions are still welcome, especially contributions (stories, pictures, links to animations, art...). Just e-mail them to us (astro.agbnews@keele.ac.uk) or post via the website choosing the catch-all "announcement" category.

Jobs in France! A Ph.D. position in the Côte d'Azur and a postdoc position in Toulouse.

Meetings: in Cambridge to celebrate Peter Eggleton, and an ERASMUS School on the Spanish island of La Palma.

Last month's *Food for Thought* ("How can we prove (close) binarity of red (super) giants in the presence of pulsation and convection") provoked the briefest of reactions: "jets!" (we'll announce the first among you who told us the correct name of the respondent – except for the respondent themselves of course!) and a more elaborate one from Lee Patrick (IAC, Spain):

"This is an important question [ed.: we agree]. There are, of course, multiple ways to detect binarity among cool stars.

The May 2022 issue of the AGB newsletter included our article on the identification of RSG binary systems in the SMC (Patrick et al. 2022). In this study we directly detected the hot companions of RSGs using space-based UV photometry.

Probably the most secure method to detect close companions (because, from photometry, there is very little constraints on orbital periods) is to detect characteristic radial velocity variations in the cool star. The problem with such an approach is two-fold:

1. The orbital periods are very large because of the physical size of the cool stars (minimum orbital periods on the order of a few years).

2. The presence of pulsations and convection.

The presence of pulsations and convection in RSGs gives rise to radial velocity variations on the order of 10 km s^{-1}, and hence orbital configurations, that can be detected."

We ask: could UV light come from chromospheres? What if the companion is cool, too? Do we know of eclipsing (or rather transiting) red giant or supergiant binaries? Reactions are welcome!

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

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

Food for Thought

This month's thought-provoking statement is:

If there was one thing we should change in our research culture, what would it be?

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)

Characterisation of Galactic carbon stars and related stars from Gaia EDR3

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The third early Gaia data release (EDR3) has improved the accuracy of the astrometric parameters of numerous long-period variable (LPV) stars. Many of these stars are on the asymptotic giant branch (AGB), showing either a C-rich or O-rich envelope and are characterised by high luminosity, changing surface composition, and intense mass loss. This make them very useful for stellar studies. In a previous investigation, we used Gaia DR2 astrometry to derive the luminosity function, kinematic properties, and stellar population membership of a flux-limited sample of carbon stars in the solar neighbourhood of different spectral types. Here, we extend this initial study to more recent surveys with a greater number of Galactic carbon stars and related stars by adopting the more accurate EDR3 astrometry measurements. Based on a much larger statistics, we confirm that N- and SC-type carbon stars share a very similar luminosity function, while the luminosities of J-type stars (M_{bol}) are fainter by half a magnitude on average. R-hot type carbon stars have luminosities throughout the RGB, which favours the hypothesis of an external origin for their carbon enhancement. Moreover, the kinematic properties of a significant fraction of the R-hot stars are compatible with the thick-disc population, in contrast with that of N- and SC-type stars, which would belong mostly to the thin disk. We also derive the luminosity function of a large number of Galactic extrinsic and intrinsic (O-rich) S stars and show that the luminosities of the latter are typically higher than the predicted onset of the third dredge-up during the AGB for solar metallicity. This result is consistent with these stars being genuine thermally pulsing AGB stars. On the other hand, using the so-called Gaia–2MASS diagram, we show that the overwhelming majority of the carbon stars identified in the LAMOST survey as AGB stars are probably R-hot and/or CH-type stars. Finally, we report the identification of about 2,660 new carbon stars candidates that we identified through their 2MASS photometry, their Gaia astrometry, and their location in the Gaia–2MASS diagram.

Locating red supergiants in the Galaxy NGC 6822

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Using archival near-IR photometry, we identify 51 of the K-band brightest red supergiants (RSGs) in NGC 6822 and compare their physical properties with stellar evolutionary model predictions. We first use Gaia parallax and proper motion values to filter out foreground Galactic red dwarfs before constructing a J–K versus K color–magnitude diagram to eliminate lower-mass asymptotic giant branch star contaminants in NGC 6822. We then cross match our results to previously spectroscopically confirmed RSGs and other NGC 6822 content studies and discuss our overall completeness, concluding that radial velocity alone is an insufficient method of determining membership in NGC 6822.

After transforming the J and K magnitudes to effective temperatures and luminosities, we compare these physical properties with predictions from both the Geneva single-star and Binary Population and Spectral Synthesis (BPASS) single and binary-star evolution tracks. We find that our derived temperatures and luminosities match the evolutionary model predictions well, however, the BPASS model, which includes the effects of binary evolution, provides the best overall fit. This revealed the presence of a group of cool RSGs in NGC 6822, suggesting a history of binary interaction. We hope this work will lead to further comparative RSG studies in other Local Group galaxies, opportunities for direct spectroscopic follow-up, and a better understanding of evolutionary model predictions.

Observed extra mixing trends in red giants are reproduced by the reduced density ratio in thermohaline zones

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Observations show an almost ubiquitous presence of extra mixing in low-mass upper giant branch stars. The most commonly invoked explanation for this is the thermohaline instability. One dimensional stellar evolution models include prescriptions for thermohaline mixing, but our ability to make direct comparisons between models and observations has thus far been limited. Here, we propose a new framework to facilitate direct comparison: Using carbon to nitrogen measurements from the SDSS-IV APOGEE survey as a probe of mixing and a fluid parameter known as the reduced density ratio from one dimensional stellar evolution programs, we compare the observed amount of extra mixing on the upper giant branch to predicted trends from three-dimensional fluid dynamics simulations. By applying this method, we are able to place empirical constraints on the efficiency of mixing across a range of masses and metallicities. We find that the observed amount of extra mixing is strongly correlated with the reduced density ratio and that trends between reduced density ratio and fundamental stellar parameters are robust across choices for modeling prescription. We show that stars with available mixing data tend to have relatively low density ratios, which should inform the regimes selected for future simulation efforts. Finally, we show that there is increased mixing at low values of the reduced density ratio, which is consistent with current hydrodynamical models of the thermohaline instability. The introduction of this framework sets a new standard for theoretical modeling efforts, as validation for not only the amount of extra mixing, but trends between the degree of extra mixing and fundamental stellar parameters is now possible.

Exploring the s-process history in the Galactic disk: cerium abundances and gradients in open clusters from the OCCAM/APOGEE sample

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The APOGEE Open Cluster Chemical Abundances and Mapping survey is used to probe the chemical evolution of the s-process element cerium in the Galactic disk. Cerium abundances were derived from measurements of Ce II lines in the APOGEE spectra using the Brussels Automatic Code for Characterizing High Accuracy Spectra in 218 stars belonging to 42 open clusters. Our results indicate that, in general, for ages < 4 Gyr, younger open clusters have higher [Ce/Fe] and [Ce/α-element] ratios than older clusters. In addition, metallicity segregates open clusters in the [Ce/X]–age plane (where X can be H, Fe, or the α-elements O, Mg, Si, or Ca). These metallicity-dependent relations result in [Ce/Fe] and [Ce/α] ratios with ages that are not universal clocks. Radial gradients of [Ce/H] and [Ce/Fe] ratios in open clusters, binned by age, were derived for the first time, with d[Ce/H]/dR$_{GC}$ being negative, while d[Ce/Fe]/dR$_{GC}$ is positive. [Ce/H] and [Ce/Fe] gradients are approximately constant over time, with the [Ce/Fe] gradient becoming slightly steeper, changing by $\sim$ +0.009 dex kpc^{-1} Gyr^{-1}. Both the [Ce/H] and [Ce/Fe] gradients are shifted to lower values of [Ce/H] and [Ce/Fe] for older open clusters. The chemical pattern of Ce in open clusters across the Galactic disk is discussed within the context of s-process yields from asymptotic giant branch (AGB) stars, gigayear time delays in Ce enrichment of the interstellar medium, and the strong dependence of Ce nucleosynthesis on the metallicity of its AGB stellar sources.

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APOGEE detection of N-rich stars in the tidal tails of Palomar 5

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Recent results from chemical tagging studies using APOGEE data suggest a strong link between the chemical abundance patterns of stars found within globular clusters, and chemically peculiar populations in the Galactic halo field. In this paper we analyse the chemical compositions of stars within the cluster body and tidal streams of Palomar 5, a globular cluster that is being tidally disrupted by interaction with the Galactic gravitational potential. We report the identification of nitrogen-rich (N-rich) stars both within and beyond the tidal radius of Palomar 5, with the latter being clearly aligned with the cluster tidal streams; this acts as confirmation that N-rich stars are lost to the Galactic halo from globular clusters, and provides support to the hypothesis that field N-rich stars identified by various groups have a globular cluster origin.

Dynamic role of dust in formation of molecular clouds

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Dust is the usual minor component of the interstellar medium. Its dynamic role in the contraction of the diffuse gas into molecular clouds is commonly assumed to be negligible because of the small mass fraction, $f \simeq 0.01$. However, as shown in this study, the collective motion of dust grains with respect to the gas may considerably contribute to the destabilisation of the medium on scales $\lambda \lesssim \lambda_J$, where λ_J is the Jeans length-scale. The linear perturbations of the uniform self-gravitating gas at rest are marginally stable at $\lambda \simeq \lambda_J$, but as soon as the drift of grains is taken into account, they begin growing at a rate approximately equal to $(f\tau)^{1/3} t_{\rm ff}^{-1}$, where τ is the stopping time of grains expressed in units of the free fall time of the cloud, $t_{\rm ff}$. The physical mechanism responsible for such a weak dependence of the growth rate on f is the resonance of heavy sound waves stopped by the self-gravity of gas with weak gravitational attraction caused by perturbations of the dust fraction. Once there is stationary subsonic bulk drift of the dust, the growing gas–dust perturbations at $\lambda < \lambda_J$ become waves propagating with the drift velocity projected

onto the wavevector. Their growth has a resonant nature as well and the growth rate is substantially larger than that of the recently discovered resonant instability of gas–dust mixture in the absence of self-gravity. The new instabilities can facilitate gravitational contraction of cold interstellar gas into clouds and additionally produce dusty domains of sub-Jeans size at different stages of molecular cloud formation and evolution.

Does the streaming instability exist within the terminal velocity approximation?

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Terminal velocity approximation is appropriate to study the dynamics of gas–dust mixture with solids tightly coupled to the gas. This work reconsiders its compatibility with physical processes giving rise to the resonant streaming instability in the low dust density limit. It is shown that the linearised equations have been commonly used to study the streaming instability within the terminal velocity approximation actually exceed the accuracy of this approximation. The refined equations for gas–dust dynamics in the terminal velocity approximation do not lead to the streaming instability. Physical processes giving rise to this instability are also discussed.

Probing red supergiant dynamics through photo-center displacements measured by Gaia

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Red supergiant (RSGs) are cool massive stars in a late phase of their evolution when the stellar envelope becomes fully convective. They are the brightest stars in the universe at infrared light and can be detected in galaxies far beyond the Local Group, allowing for accurate determination of chemical composition of galaxies. The study of their physical properties is extremely important for various phenomena including the final fate of massive stars as type II supernovæ and gravitational wave progenitors. We explore the well-studied nearby young stellar cluster χ Per. Using Gaia EDR3 data, we find the distance of the cluster ($d = 2.260 \pm 0.020$ kpc). We then investigate the variability of the convection-related surface structure as a source for parallax measurement uncertainty. We use state-of-the-art 3D radiative hydrodynamics simulations with CO5BOLD and the post-processing radiative transfer code OPTIM3D to compute intensity maps in the Gaia G photometric system. We calculate the variabiltiy, as a function of time, of the intensity-weighted mean from the synthetic maps. We then select the RSG stars in the cluster and compare their uncertainty on parallaxes to the predictions of photocentre displacements. The synthetic maps of RSG show extremely irregular and temporal variable surfaces due to convection-related dynamics. Consequentially, the position of the

photo-center varies during Gaia measurements between 0.033 and 0.130 au (up to 5% of the corresponding simulation stellar radius). We argue that the variability of the convection-related surface structures accounts for a substantial part of the Gaia EDR3 parallax error of the RSG sample. We suggest that the variation of the uncertainty on Gaia parallax could be exploited quantitatively using appropriate 3D simulations to extract, in a unique way, important information about the stellar dynamics and parameters of RSG stars.

Gaia EDR3 data of post-AGB stars with overabundance of s-process elements: evolutionary status and binarity

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Kamath et al. analyzed Gaia EDR3 data of 18 post-asymptotic giant branch (AGB) supergiants having overabundance of s-process elements, some of which exhibit unusually low luminosities in disagreement with expectations of s-process nucleosynthesis. I have examined the Gaia RUWE statistics of these stars, and find that 13 have RUWE $\gg$ 1.4, suggesting they are most likely unresolved binaries that contain low-mass companions. The remaining five stars have RUWE < 1.4 and I find that their luminosities are in agreement with post-AGB evolutionary tracks.

Dynamics in a stellar convective layer and at its boundary: comparison of five 3D hydrodynamics codes

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Our ability to predict the structure and evolution of stars is in part limited by complex, 3D hydrodynamic processes such as convective boundary mixing. Hydrodynamic simulations help us understand the dynamics of stellar convection and convective boundaries. However, the codes used to compute such simulations are usually tested on extremely simple

problems and the reliability and reproducibility of their predictions for turbulent flows is unclear. We define a test problem involving turbulent convection in a plane-parallel box, which leads to mass entrainment from, and internal-wave generation in, a stably stratified layer. We compare the outputs from the codes FLASH, MUSIC, PPMSTAR, PROMPI, and SLH, which have been widely employed to study hydrodynamic problems in stellar interiors. The convection is dominated by the largest scales that fit into the simulation box. All time-averaged profiles of velocity components, fluctuation amplitudes, and fluxes of enthalpy and kinetic energy are within $\lesssim 3\sigma$ of the mean of all simulations on a given grid (128^3 and 256^3 grid cells), where σ describes the statistical variation due to the flow's time dependence. They also agree well with a 512^3 reference run. The 128^3 and 256^3 simulations agree within 9% and 4%, respectively, on the total mass entrained into the convective layer. The entrainment rate appears to be set by the amount of energy that can be converted to work in our setup and details of the small-scale flows in the boundary layer seem to be largely irrelevant. Our results lend credence to hydrodynamic simulations of flows in stellar interiors. We provide in electronic form all outputs of our simulations as well as all information needed to reproduce or extend our study.

Catching a grown-up starfish planetary nebula – II. Plasma analysis and central star properties of PC 22

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After performing the morpho-kinematic analysis of the planetary nebula (PN) PC 22, we now present its nebular and stellar analysis. The plasma investigation relies on the novel use of a Monte Carlo analysis associated with the PyNeb code for the uncertainty propagation. The innermost region of the nebula shows electronic temperatures $T_e \approx 10,800$ K using [N II] and $\approx 13,000$ K using [O III] and electronic densities $n_e \approx 600$ cm^{-3}. We also used for the first time a machine learning algorithm to calculate Ionisation Correction Factors (ICFs) specifically adapted to PC 22. This has allowed us to have pioneer ICFs for $(S^+ + S^{++})/O^{++}$, Cl^{++}/O^{++}, and $Ar^{3+}+Ar^{4+}$, as well as a possible new determination for the total abundance of neon. The study of the stellar spectrum revealed the presence of broad emission lines consistent with a Wolf–Rayet-type [WR] classification and more precisely a [WO1]-subtype based on different qualitative and quantitative criteria. This classification is also coherent with the high stellar temperature derived from the reproduction of the ionization state of the gas with the Mexican Million Models database (3MdB) and the best fit model obtained with the NLTE model atmosphere code PoWR. PC 22 is therefore a new addition to the [WO1]-subtype PNe.

Red variable stars in three M 81 group dwarf galaxies

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Archival [3.6] and [4.5] images are used to identify and characterize variable stars in the Magellanic-type galaxies Holmberg II, NGC 2366, and IC 2574. Using parametric and nonparametric detection methods, 74 confirmed or suspected long-period variables (LPVs) are found. The period distributions of the LPVs in NGC 2366 and IC 2574 are

similar. While the period distribution of LPVs in Ho II is uncertain due to small number statistics, there appears to be a deficiency of LPVs with periods between 550 and 650 days when compared with NGC 2366 and IC 2574. The LPVs are diffusely distributed on the sky, and do not follow the underlying light from unresolved stars, as expected if episodes of star formation within the past few hundred megayears have occurred throughout the galaxies, including their outer regions. Distances computed for Ho II and NGC 2366 from the period–luminosity relations (PLRs) agree to within ~ 0.1 mag with those based on the tip of the red giant branch (RGB). Efforts to estimate an LPV-based distance modulus for IC 2574 are complicated by the presence of first overtone pulsators among LPVs with periods < 600 days, although the PLR at the long-period end is consistent with the distance estimated from the RGB-tip. In addition to the LPVs, 10 candidate sgB[e] or luminous blue variables and two candidate red supergiant variables are also identified. Nine candidate sgB[e] stars that do not show evidence of variability are also identified based on their locations in the color–magnitude diagram.

Grain alignment in the circumstellar shell of IRC +10°216

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Dust-induced polarization in the interstellar medium (ISM) is due to asymmetric grains aligned with an external reference direction, usually the magnetic field. For both the leading alignment theories, the alignment of the grain's angular momentum with one of its principal axes and the coupling with the magnetic field requires the grain to be paramagnetic. Of the two main components of interstellar dust, silicates are paramagnetic, while carbon dust is diamagnetic. Hence, carbon grains are not expected to align in the ISM. To probe the physics of carbon grain alignment, we have acquired Stratospheric Observatory for Infrared Astronomy/High-resolution Airborne Wideband Camera-plus far-infrared photometry and polarimetry of the carbon-rich circumstellar envelope (CSE) of the asymptotic giant branch star IRC +10°216. The dust in such CSEs are fully carbonaceous and thus provide unique laboratories for probing carbon grain alignment. We find a centrosymmetric, radial, polarization pattern, where the polarization fraction is well correlated with the dust temperature. Together with estimates of a low fractional polarization from optical polarization of background stars, we interpret these results to be due to a second-order, direct radiative external alignment of grains without internal alignment. Our results indicate that (pure) carbon dust does not contribute significantly to the observed ISM polarization, consistent with the nondetection of polarization in the 3.4-μm feature due to aliphatic CH bonds on the grain surface.

Thermonuclear and electron-capture supernovæ from stripped-envelope stars

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(abridged) When stripped from their hydrogen-rich envelopes, stars with initial masses between ~ 7 and 11 $M_\odot$ develop massive degenerate cores and collapse. Depending on the final structure and composition, the outcome can range from a thermonuclear explosion, to the formation of a neutron star in an electron-capture supernova (ECSN). It has been recently demonstrated that stars in this mass range may initiate explosive oxygen burning when their central densities are still below $\rho_c \lesssim 10^{9.6}$ g cm^{-3}. This makes them interesting candidates for Type Ia Supernovæ – which we call (C)ONe SNe Ia – and might have broader implications for the formation of neutron stars via ECSNe. Here, we model the evolution of 252 helium-stars with initial masses in the 0.8–3.5 $M_\odot$ range, and metallicities between $Z = 10^{-4}$ and 0.02. We use these models to constrain the central densities, compositions and envelope masses at the time of explosive oxygen ignition. We further investigate the sensitivity of these properties to mass-loss rate assumptions using additional models with varying wind efficiencies. We find that helium-stars with masses between ~ 1.8 and 2.7 $M_\odot$ evolve onto 1.35–1.37 $M_\odot$ (C)ONe cores that initiate explosive burning at central densities between $\log_{10}(\rho_c/\text{g cm}^{-3}) \sim 9.3$ and 9.6. We constrain the amount of residual carbon retained after core carbon burning, and conclude that it plays a critical role in determining the final outcome: Cores with residual carbon mass fractions of $X_{\min}(^{12}C) \gtrsim 0.004$ result in (C)ONe SNe Ia, while those with lower carbon mass fractions become ECSNe. We find that (C)ONe SNe Ia are more likely to occur at high metallicities, whereas at low metallicities ECSNe dominate.

Stellar populations of the globular cluster NGC 5053 investigated using AstroSat – Ultra Violet Imaging Telescope

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Globular clusters being old and densely packed serve as ideal laboratories to test stellar evolution theories. Although there is enormous literature on globular clusters in optical bands, studies in the ultraviolet (UV) regime are sparse. In this work, we study the stellar populations of a metal poor and a rather dispersed globular cluster, NGC 5053, using the UV instrument of AstroSat, namely the Ultra Violet Imaging Telescope in three far-UV (F154W, F169M, F172M) and three near-UV (N219M, N245M, N263M) filters. Photometry was carried out on these images to construct a catalogue of UV stars, of which the cluster members were identified using Gaia EDR3 catalogue. UV and optical CMDs help us locate known stellar populations such as BHB stars, RR Lyræ stars, RHB stars, BSSs, SX Phoenicis, RGB and AGB stars. Based on their locations in the CMDs, we have identified 8 new BSS candidates, 6 probable eBSSs, and an EHB candidate. Their nature has been confirmed by fitting their spectral energy distributions with stellar atmospheric models. We believe the BSS population of this cluster is likely to have a collisional origin based on our analyses of their radial distribution and SEDs. BaSTI-IAC isochrones were generated to characterize the cluster properties, and we find that the observed brightness and colours of cluster members are best-fit with a model that is α-enhanced with a helium fraction of 0.247, metallicity of -1.9 dex and age within a range of 10.5–14.5 Gyr.

Chemo-dynamics and asteroseismic ages of seven metal-poor red giants from the *Kepler* field

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In this work we combine information from solar-like oscillations, high-resolution spectroscopy and Gaia astrometry to derive stellar ages, chemical abundances and kinematics for a group of seven metal-poor Red Giants and characterise them in a multidimensional chrono-chemo-dynamical space. Chemical abundance ratios were derived through classical spectroscopic analysis employing 1D LTE atmospheres on *Keck*/HIRES spectra. Stellar ages, masses and radii were calculated with grid-based modelling, taking advantage of availability of asteroseismic information from *Kepler*. The dynamical properties were determined with GALPY using Gaia EDR3 astrometric solutions. Our results suggest that underestimated parallax errors make the effect of Gaia parallaxes more important than different choices of model grid or – in the case of stars ascending the RGB – mass-loss prescription. Two of the stars in this study are identified as potentially evolved halo blue stragglers. Four objects are likely members of the accreted Milky Way halo, and their possible relationship with known accretion events is discussed.

Physical conditions and chemical abundances of the variable planetary nebula IC 4997

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The planetary nebula (PN) IC 4997 is one of a few rapidly evolving objects with variable brightness and nebular emission around a hydrogen-deficient star. In this study, we have determined the physical conditions and chemical abundances of this object using the collisionally excited lines (CELs) and optical recombination lines (ORLs) measured from the medium-resolution spectra taken in July 2014 with the FIbre-fed Échelle Spectrograph on the Nordic Optical Telescope at La Palma Observatory. We derived electron densities of $\gtrsim 3 \times 10^4$ cm^{-3} and electron temperatures of $\gtrsim 14,000$ K from CELs, whereas cooler temperatures of $\sim 11,000$ and $\sim 7,000$ K were obtained from helium and heavy element ORLs, respectively. The elemental abundances deduced from CELs point to a metal-poor progenitor with [O/H] $\lesssim -0.75$, whereas the ORL abundances are slightly above the solar metallicity, [O/H] ≈ 0.15. Our abundance analysis indicates that the abundance discrepancy factors (ADFs $\equiv$ ORLs/CELs) of this PN are relatively large: ADF(O^{2+}) $\gtrsim 8$ and ADF(N^{2+}) $\gtrsim 7$. Further research is needed to find out how the ADFs and variable emissions are formed in this object and whether they are associated with a binary companion or a very late thermal pulse.

The curious case of Betelgeuse

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Betelgeuse is the nearest red supergiant, one of the brightest stars in our sky, and statistically speaking it would be expected to be "typical". Yet it exhibits many features that seem "curious", to say the least. For instance it has a high proper motion. It rotates fast. It has little dust. It dimmed unexpectedly. Is any of these, and other, phenomena atypical, and taken together does it make Betelgeuse atypical? This is important to know, because we need to know whether Betelgeuse might be a prototype of red supergiants in general, or certain subclasses of red supergiants, since we can study it in such great detail. It is also important to know as it may be a link to understanding other, apparently atypical cases such as supernova 1987A, and maybe even such exotica as Thorne-Żytkov objects. Studying this question in itself helps us understand how we deal with rarity and coincidence in understanding the Universe we live in.

Oral contribution, published in 16th **Marcel Grossmann meeting**
Available from https://arxiv.org/abs/2112.06076

Université Côte d'Azur, Nice, France
Ph.D. in magnetic field and convection in evolved stars

Dear colleagues,

We announce a financed Ph.D. job in framework of PEPPER (https://lagrange.oca.eu/fr/welcome-to-anr-pepper). The deadline for applying the 30/6, if the position is not filled before.

For any information and to apply please contact me: andrea.chiavassa@oca.eu

Best wishes,
Andrea Chiavassa

See also https://lagrange.oca.eu/images/LAGRANGE/pages_perso/chiavassa/PEPPER/PEPPER_PHD.pdf

Observatoire Midi-Pyrenees – IRAP (France)
Postdoctoral position

A postdoctoral position in stellar astrophysics is proposed in the framework of the funded ANR project PEPPER (https://lagrange.oca.eu/fr/welcome-to-anr-pepper)

The post-doctoral researcher will work at the Observatoire Midi-Pyrenees (IRAP, Toulouse, France) together with Arturo Lopez Ariste, Torsten Böhm, Pascal Petit and Philippe Mathias, members of the Toulouse node of the PEPPER

Collaboration.

The main research topic concerns the interpretation of spectropolarimetric data (both linear and circular) issued from different instruments, and compare the results with outputs of 3D simulations. Among the goals we intend to better constrain the velocity fields that exist on different timescales, and mainly linked to convection.

By 2022, October 1st, candidates should send:

1. a CV including a publication list (4 pages max),

2. a statement of research interests (2 pages max),

3. arrange for three letters of reference to be provided separately to Philippe.Mathias@irap.omp.eu using "PEPPER postdoc" in the email header.

See also https://lagrange.oca.eu/images/LAGRANGE/pages_perso/chiavassa/PEPPER/PostDoc_Toulouse.pdf

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$$\boxed{\textit{Announcements}}$$

2022 ERASMUS+ School
"Eclipsing Binaries and Asteroseismology: Precise fundamental stellar parameters in the golden age of time-domain astronomy"

We are pleased to announce the 2022 ERASMUS+ School "Eclipsing Binaries and Asteroseismology: Precise fundamental stellar parameters in the golden age of time-domain astronomy" to be held on the Spanish island of La Palma from September 26th to September 30th 2022.

The school will operate in a hybrid format with no registration fee. The school is targeted at Masters and Ph.D. students, but all applicants will be considered. In-person attendance is limited and will be selected based on the registration materials, remote participants will be invited to attend via zoom. The deadline for in-person registration is June 15th 2022. Please see the school webpage – https://iacerasmus.github.io/ERASMUS2022/ – for full details.

With numerous active or recently completed public, space-based missions and ground-based follow-up surveys, never before has such a wealth of high-quality and homogeneous multi-epoch photometry and spectroscopy been available – making this truly the golden age of time-domain astronomy. These data offer the opportunity to derive fundamental stellar parameters with a precision that was previously impossible. In particular, time-resolved light and radial velocity curves of eclipsing binary stars are critical tools with which to derive model-independent masses and radii, while asteroseismology of pulsating stars can be used derive their hitherto hidden internal structure.

In this school, we will outline the fundamentals of the determination of stellar parameters, as well as providing an introduction to both the publicly available data, and the cutting-edge tools and software used in their exploitation. The school itself will be divided into more traditional lectures and hands-on sessions/tutorials demonstrating, for example, the access to survey data and its modelling with state-of-the-art tools.

See also https://iacerasmus.github.io/ERASMUS2022/

Stars, to mark the 80th birthday of Peter Eggleton

The Stars 2020 conference to celebrate the 80th birthday of Peter Eggleton will take place Sunday 14th August to Saturday 20th August, in person at the Institute of Astronomy in Cambridge. Registration is now open through the conference website. Abstract submission is also open, with the deadline for consideration for talks 14th June, and for posters 14th July.

Topics to be covered:

- Asteroseismology

- Accurate luminosities (Gaia)

- Nucleosynthesis including spectra and meteoritic abundances

- Spectroscopy (Gaia-ESO, LAMOST)

- Stellar winds

- Rotation, differential rotation and magnetic fields

- Extra mixing processes

- Detailed physics including reaction rates, equation of state and opacities

- Binary and Multiple Stars

Hoping to see you in Cambridge in August,
Avishai Gilkis on behalf the organizing committee

See also https://www.ast.cam.ac.uk/meetings/2022/stars.mark.80th.birthday.peter.eggleton