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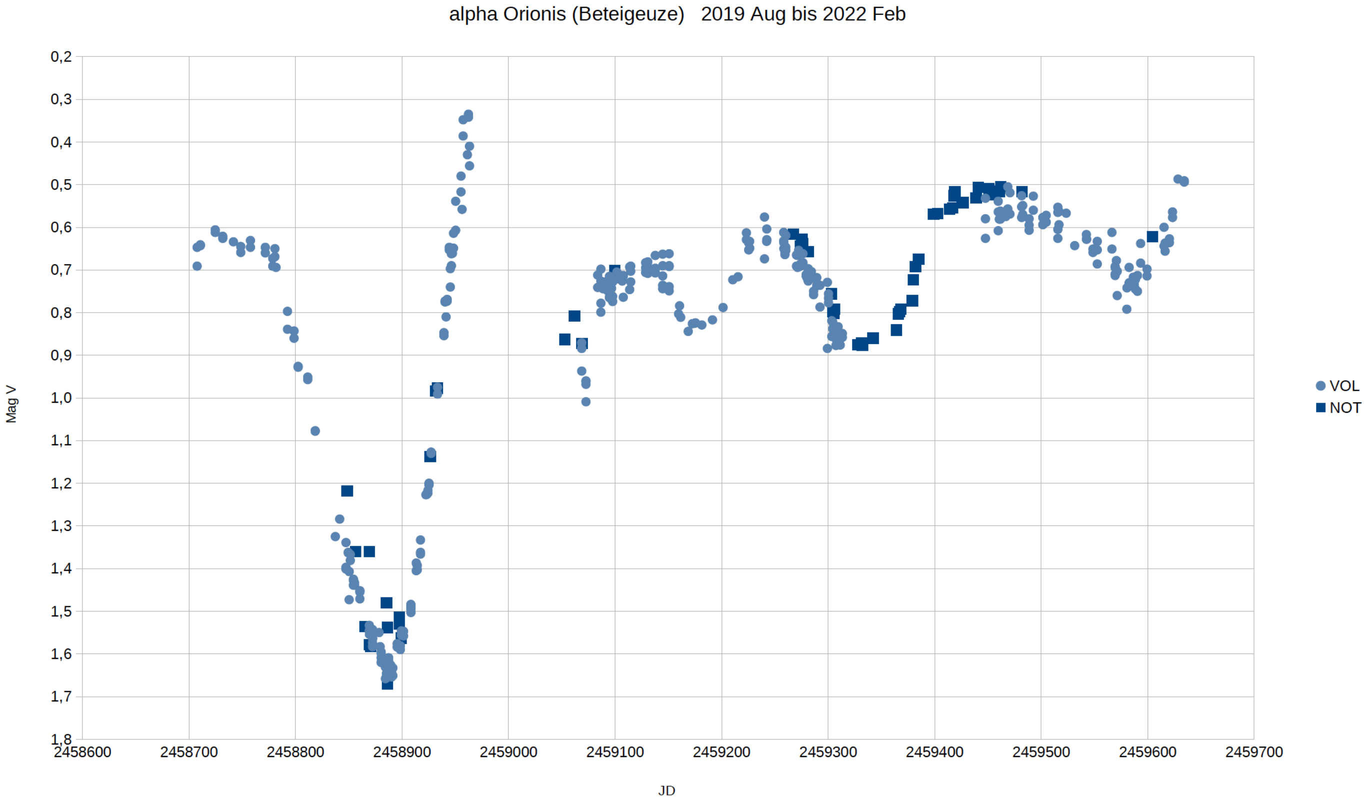

Figure 1: Recent light curve of Betelgeuse, during and since the Great Dimming (from July 2019 till February 2022). See https://www.astronomerstelegram.org/?read=15240 – comments are welcome to astro.agbnews@keele.ac.uk

Editorial

Dear Colleagues,

It is our pleasure to present you the 297^{th} issue of the AGB Newsletter.

We hope you find the cover picture intriguing, brought to us by Costantino Sigismondi. The shape of the linear ingress and linear – albeit slightly faster – recovery during the Great Dimming, the "overshoot" in brightness and the subsequent U-shaped variations all need quantitative explanation by a model that has *predictive* power. The challenge is on!

Last month's *Food for Thought* ("Planetary or stellar companions only complicate the circumstellar envelopes of red giants or supergiants through their gravity") provoked a few responses.

Ana Escorza writes:
"It is certainly true that companions, through their gravity, complicate things concerning the study of red giants or supergiants, but I would not say they 'only' complicate things. Through their gravity, companions give us access to precious information that is difficult to obtain without them, like, for example, estimates or limits on stellar masses. Additionally, when these companions interact with the giant stars or with their circumstellar environments, they produce a wide variety of peculiar objects that can be used as additional constraints to study the more complex red giants. My very biased example: barium stars as tracers of AGB nucleosynthesis and as important constraints for binary interaction and evolution models. I would say instead that companions can be the cause and the solution to most of our problems."

Noam Soker writes:
"This statement is not well defined. So I will break it.
1. 'Only'. The interaction includes several aspects, so 'only' does not describe the entire interaction. For example, a companion can lead to the formation of a circumbinary disk, that in turn can change the orbital properties of the binary. In the case of massive stars, the circumstellar matter (CSM) can play a role in the post-explosion properties. Namely, the collision of the supernova ejecta with the CSM, now shaped by the companion, can change the light curve, depending on the morphology of the CSM. The companion can also enhance the mass loss rate from the giant.
2. 'Complicate'. It depends what one considers as complicated. Forming an axial-symmetric structure is not complicating. Maybe it is making it simpler.
3. 'Their gravity'. Consider symbiotic novæ. There is a thermonuclear outburst on the surface of a mass-accreting white dwarf. It ejects mass that shapes the CSM. So now the nuclear energy, not only gravity, affects the CSM. There are more extreme, although rare, cases, like if the WD experiences a peculiar type Ia supernova."

Marie Van de Sande and Tom Millar write:
"Our answer to this question is a resounding NO! Stellar companions have radiation fields that, depending on stellar temperature, can have a large impact on chemical processes throughout the outflow. The detection of molecules such as CH_3CN in the inner envelope of IRC +10°216 (Agúndez et al. 2015) and SiN in the envelopes of IRC +10°216 (Turner 1992) and W Aql (De Beck & Olofsson 2020) give some support to this model since their presence is hard to understand otherwise.
In https://ui.adsabs.harvard.edu/abs/2022MNRAS.510.1204V/abstract we find that the impact of a stellar companion depends on the intensity of the stellar UV radiation, which depends on its stellar classification, and on the extinction it experiences as it radiates outward through the envelope. Photodissociation can now occur in the dense, inner regions of the outflow, altering the nature and products of chemical reactions which affect the entire circumstellar envelope. The outcome of the chemistry depends on the balance between two-body reactions, which build up complexity, and photoreactions, which destroy this. We find that there are chemical effects that can be used to differentiate between a stellar or a planetary companion."

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

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

Food for Thought

This month's thought-provoking statement is:

What is Betelgeuse going to do next?

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)

Spatio-kinematic models of five nova remnants: correlations between nova shell axial ratio, expansion velocity and speed class

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We present long-slit intermediate-dispersion spectroscopic observations and narrow-band direct imaging of four classical nova shells, namely T Aur, HR Del, DQ Her and QU Vul, and the nova-like source CK Vul. These are used to construct models of their nebular remnants using the morpho-kinematic modelling tool Shape to reveal their 3D shape. All these nova remnants but CK Vul can be described by prolate ellipsoidal shells with different eccentricity degree, from the spherical QU Vul to the highly elongated shell with an equatorial component HR Del. On the other hand, CK Vul shows a more complex structure, with two pairs of nested bipolar lobes. The spatio-kinematic properties of the ellipsoidal nova shells derived from our models include their true axial ratios. This parameter is expected to correlate with the expansion velocity and decline time t_3 (i.e. their speed class) of a nova as the result the interaction of the ejecta with the circumstellar material and rotation speed and magnetic field of the white dwarf. We have compared these three parameters including data available in the literature for another two nova shells, V533 Her and FH Ser. There is an anti-correlation between the expansion velocity and the axial ratio and decline time t_3 for nova remnants with ellipsoidal morphology, and a correlation between their axial ratios and decline times t_3, confirming theoretical expectations that the fastest expanding novæ have the smallest axial ratios. We note that the high expansion velocity of the nova shell HR Del of 615 km s^{-1} is inconsistent with its long decline time t_3 of 250 days.

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Rings and arcs around evolved stars – III. Physical conditions of the ring-like structures in the planetary nebula IC 4406 revealed by MUSE

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We present the analysis of Very Large Telescope (VLT) Multi Unit Spectroscopic Explorer (MUSE) observations of the planetary nebula (PN) IC 4406. MUSE images in key emission lines are used to unveil the presence of at least 5 ring-like structures North and South of the main nebula of IC 4406. MUSE spectra are extracted from the rings to unambiguously assess for the first time in a PN their physical conditions, electron density (n_e) and temperature (T_e). The rings are found to have similar T_e than the rim of the main nebula, but smaller n_e. Ratios between different ionic species suggest that the rings of IC 4406 have a lower ionization state than the main cavity, in contrast to what was suggested for the rings in NGC 6543, the Cat's Eye Nebula.

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The NuGrid AGB evolution and nucleosynthesis data set

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Asymptotic Giant Branch (AGB) stars play a key role in the chemical evolution of galaxies. These stars are the fundamental stellar site for the production of light elements such as C, N and F, and half of the elements heavier than Fe via the slow neutron capture process (s-process). Hence, detailed computational models of AGB stars' evolution and nucleosynthesis are essential for galactic chemical evolution. In this work, we discuss the progress in updating the NuGrid data set of AGB stellar models and abundance yields. All stellar models have been computed using the MESA stellar evolution code, coupled with the post-processing MPPNP code to calculate the full nucleosynthesis.The final data set will include the initial masses $M_{\rm ini}/{\rm M}_\odot = 1$, 1.65, 2, 3, 4, 5, 6 and 7 for initial metallicities $Z = 0.0001$, 0.001, 0.006, 0.01, 0.02 and 0.03. Observed s-process abundances on the surfaces of evolved stars as well as the typical light elements in the composition of H-deficient post-AGB stars are reproduced. A key short-term goal is to complete and expand the AGB stars dataset for the full metallicity range. Chemical yield tables are provided for the available models.

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Detection of the S(1) rotational Line of H_2 toward IRC +10°216: a simultaneous measurement of mass-loss rate and CO abundance

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We report the first detection of the S(1) pure rotational line of ortho-H_2 at 17.04 μm in an asymptotic giant branch star, using observations of IRC +10°216 with the Echelon-cross-Echelle Spectrograph (EXES) mounted on the Stratospheric Observatory for Infrared Astronomy (SOFIA). This line, which was observed in a very high sensitivity spectrum (RMS noise $\simeq 0.04\%$ of the continuum), was detected in the wing of a strong telluric line and displayed a P Cygni profile. The spectral ranges around the frequencies of the S(5) and S(7) ortho-H_2 transitions were observed as well but no feature was detected in spectra with sensitivities of 0.12% and 0.09% regarding the continuum emission, respectively. We used a radiation transfer code to model these three lines and derived a mass-loss rate of $(2.43 \pm 0.21) \times 10^{-5}$ ${\rm M}_\odot$ yr^{-1} without using the CO abundance. The comparison of this rate with previous estimates derived from CO observations suggests that the CO abundance relative to H_2 is $(6.7 \pm 1.4) \times 10^{-4}$. From this quantity and previously reported molecular abundances, we estimate the O/H and C/H ratios to be $(3.3 \pm 0.7) \times 10^{-4}$ and $> (5.2 \pm 0.9) \times 10^{-4}$, respectively. The C/O ratio is $> 1.5 \pm 0.4$. The absence of the S(5) and S(7) lines of ortho-H_2 in our observations can be explained by the opacity of hot dust within 5 $R_\star$ from the center of the star. We estimate the intensity of the S(0) and S(2) lines of para-H_2 to be $\simeq 0.1\%$ and 0.2% of the continuum, respectively, which are below the detection limit of EXES.

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Fluorine abundances in the Galactic nuclear star cluster

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Abundances of fluorine (^{19}F), as well as isotopic ratios of ^{16}O/^{17}O, are derived in a sample of luminous young ($\sim 10^7$–10^8 yr) red giants in the Galactic center (with Galactocentric distances ranging from 0.6–30 pc), using high-resolution infrared spectra and vibration-rotation lines of H^{19}F near $\lambda \approx 2.3$ μm. Five of the six red giants are members of the Nuclear star cluster that orbits the central supermassive black hole. Previous investigations of the chemical evolution of ^{19}F in Galactic thin and thick disk stars have revealed that the nucleosynthetic origins of ^{19}F may be rather complex, resulting from two, or more, astrophysical sites; fluorine abundances behave as a primary element with respect to Fe abundances for thick disk stars and as a secondary element in thin disk stars. The Galactic center red giants analyzed fall within the thin disk relation of F with Fe, having near-solar, to slightly larger, abundances of Fe ($\langle$[Fe/H]$\rangle = +0.08 \pm 0.04$), with a slight enhancement of the F/Fe abundance ratio ($\langle$[F/Fe]$\rangle = +0.28 \pm 0.17$). In terms of their F and Fe abundances, the Galactic center stars follow the thin disk population, which requires an efficient source of ^{19}F that could be the winds from core-He burning Wolf–Rayet stars, or thermally-pulsing AGB stars, or a combination of both. The observed increase of [F/Fe] with increasing [Fe/H] found in thin disk and Galactic center stars is not predicted by any published chemical evolution models that are discussed, thus a quantitative understanding of yields from the various possible sources of ^{19}F remains unknown.

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Spectroscopic analysis tool for intEgraL fieLd unIt daTacubEs (SATELLITE): case studies of NGC 7009 and NGC 6778 with MUSE

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Integral field spectroscopy (IFS) provides a unique capability to spectroscopically study extended sources over a 2D field of view, but it also requires new techniques and tools. In this paper, we present an automatic code, Spectroscopic Analysis Tool for intEgraL fieLd unIt daTacubEs, SATELLITE, designed to fully explore such capability in the characterization of extended objects, such as planetary nebulæ, H II regions, galaxies, etc. SATELLITE carries out 1D and 2D spectroscopic analysis through a number of pseudo-slits that simulate slit spectrometry, as well as emission line

imaging. The 1D analysis permits direct comparison of the integral field unit (IFU) data with previous studies based on long-slit spectroscopy, while the 2D analysis allows the exploration of physical properties in both spatial directions. Interstellar extinction, electron temperatures and densities, ionic abundances from collisionally excited lines, total elemental abundances, and ionization correction factors are computed employing the PYNEB package. A Monte Carlo approach is implemented in the code to compute the uncertainties for all the physical parameters. SATELLITE provides a powerful tool to extract physical information from IFS observations in an automatic and user configurable way. The capabilities and performance of SATELLITE are demonstrated by means of a comparison between the results obtained from the Multi Unit Spectroscopic Explorer (MUSE) data of the planetary nebula NGC 7009 with the results obtained from long-slit and IFU data available in the literature. The SATELLITE characterization of NGC 6778 based on MUSE data is also presented.

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Multi-epoch optical spectroscopy of the post-AGB star HD 161796

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The evolutionary rate of the pulsating post-asymptotic giant branch (post-AGB) star HD 161796 was suspected to be high. Spectra of HD 161796 acquired during a time span of 18 yr are analyzed with the main goal of determining the evolutionary increase in temperature and comparing it with the latest post-AGB star evolutionary models. Inspection of the spectra reveals splitting and significant temporal variation in strong absorption lines, suggesting the presence of shock waves in the atmosphere of the pulsating star. The Hα profiles point to variable incipient mass loss. Most medium-strength lines have variable blue wings, while the red wings remain stationary, presumably due to variations in the warm outflow from the stellar surface. The modeling of the spectra suggests the average value for the effective temperature to be 7275 K, and for surface gravity, a value of $\log g = 0.7$. Different iron abundances are found for different spectra, probably due to the inability to model the pulsating photosphere with stationary atmospheric models. On average, we arrive at [Fe/H] $= -0.06$. The observed underabundance in neutron capture and some other elements is inferred to be a consequence of dust–gas separation. It is confirmed that, during pulsation, the stellar surface is hotter when the star is smaller in size. The spectra show a 420 K range in effective temperature – a smaller variation than can be found from pulsation-related changes in color. No significant rate of evolution is seen, contrary to earlier suggestions. The initial mass of the star is evaluated to be $\lesssim 2\ M_\odot$.

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Structure, stability and optical photoabsorption properties of small Ti_nC_x clusters

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Titanium–carbide molecular clusters are thought to form in the circumstellar envelopes (CSEs) of carbon-rich Asymptotic Giant Branch stars (AGBs) but, to date, their detection has remained elusive. To facilitate the astrophysical identification of those clusters in AGBs and post-AGBs environments, the molecular structures and optical absorption spectra of small Ti_nC_x clusters, with $n = 1$–4 and $x = 1$–4, and some selected larger clusters, Ti_3C_8, Ti_4C_8, Ti_6C_{13}, Ti_7C_{13}, Ti_8C_{12}, Ti_9C_{15}, and $Ti_{13}C_{22}$, have been calculated. The density functional formalism, within the B3LYP approximation for electronic exchange and correlation, was used to find the lowest energy structures. Except the clusters having a single Ti atom, the rest exhibit three-dimensional structures. Those are formed by a Ti fragment surrounded in general by carbon dimers. The optical spectra of Ti_nC_x, computed by time-dependent density functional theory, using the corrected CAM-B3LYP functional, show absorption features in the visible and near infrared regions which may help in the identification of these clusters in space. In addition, most of the clusters have sizable electric dipole moments, allowing their detection by radio-astronomical observations.

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Statistical tests of young radio pulsars with/without supernova remnants: implying two origins of neutron stars

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The properties of young pulsars and their relations to supernova remnants (SNRs) have been a topic of interest. At present, 383 SNRs in the Milky Way galaxy have been published, which are associated with 64 radio pulsars and 46 pulsars with high-energy emissions. However, we noticed that for 630 young radio pulsars with spin periods of less than half a second no SNRs surrounding or nearby them have yet been observed, which raises the question whether the two types of young radio pulsars with/without SNRs could hold distinctive characteristics. Here, we employ statistical tests on two groups of young radio pulsars with (52) and without (630) SNRs to reveal whether they share different origins. Kolmogorov–Smirnov (K–S) and Mann–Whitney–Wilcoxon (M–W–W) tests indicate that the two samples have different distributions with parameters of spin period (P), derivative of spin period ($\dot{P}$), surface magnetic field strength (B), and energy loss rate ($\dot{E}$). Meanwhile, the cumulative number ratio between pulsars with and without SNRs at different spindown ages decreases significantly after 10–20 kyr. So we propose the existence of two types of supernovæ (SNe), corresponding to their SNR lifetimes, which can be roughly ascribed to low-energy and high-energy SNe. Furthermore, the low-energy SNe may be formed from 8–12 $M_\odot$ progenitors, e.g., possibly experiencing electron capture, while main sequence stars of 12–25 $M_\odot$ may produce the high-energy SNe probably by iron core collapse.

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The BAyesian STellar Algorithm (BASTA): a fitting tool for stellar studies, asteroseismology, exoplanets, and Galactic archæology

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We introduce the public version of the BAyesian STellar Algorithm (BASTA), an open-source code written in Python to determine stellar properties based on a set of astrophysical observables. BASTA has been specifically designed to robustly combine large data sets that include asteroseismology, spectroscopy, photometry, and astrometry. We describe the large number of asteroseismic observations that can be fit by the code and how these can be combined with atmospheric properties (as well as parallaxes and apparent magnitudes), making it the most complete analysis pipeline available for oscillating main-sequence, subgiant, and red giant stars. BASTA relies on a set of pre-built stellar isochrones or a custom-designed library of stellar tracks, which can be further refined using our interpolation method (both along and across stellar tracks or isochrones). We perform recovery tests with simulated data that reveal levels of accuracy at the few percent level for radii, masses, and ages when individual oscillation frequencies are considered, and show that asteroseismic ages with statistical uncertainties below 10 per cent are within reach if our stellar models are reliable representations of stars. BASTA is extensively documented and includes a suite of examples to support easy adoption and further development by new users.

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On the most luminous planetary nebulæ of M 31

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The planetary nebula luminosity function (PNLF) is a standard candle that comprises a key rung on the extragalactic distance ladder. The method is based on the empirical evidence that the luminosity function of planetary nebulæ (PNe)

in the [O III] λ5007 nebular emission line reaches a maximum value that is approximately invariant with population age, metallicity, or host galaxy type. However, the presence of bright PNe in old stellar populations is not easily explained by single-star evolutionary models.
To gain information about the progenitors of PNe at the tip of the PNLF, we obtained the deepest existing spectra of a sample of PNe in the galaxy M 31 to determine their physico-chemical properties and infer the post-asymptotic giant branch (AGB) masses of their central stars (CSs). Precise chemical abundances allow us to confront the theoretical yields for AGB stellar masses and metallicities expected at the bright end of the PNLF. Central star masses of the sampled PNe provide direct information on the controversial origin of the universal cutoff of the PNLF.
Using the OSIRIS instrument at the 10.4m Gran Telescopio Canarias (GTC), optical spectra of nine bright M 31 PNe were obtained: four of them at the tip of the PNLF, and the other five some 0.5 magnitudes fainter. A control sample of 21 PNe with previous GTC spectra from the literature is also included. We analyze their physical properties and chemical abundances (He, N, O, Ar, Ne, and S), searching for relevant differences between bright PNe and the control samples. The CS masses are estimated with Cloudy modeling using the most recent evolutionary tracks.
The studied PNe show a remarkable uniformity in all their nebular properties, and the brightest PNe show relatively large electron densities. Stellar characteristics also span a narrow range: $\langle L_*/\mathrm{L}_\odot\rangle = 4\,300 \pm 310$, $\langle T_\mathrm{eff}\rangle = 122\,000 \pm 10\,600$ K for the CSs of the four brightest PNe, and $\langle L_*/\mathrm{L}_\odot\rangle = 3\,300 \pm 370$, $\langle T_\mathrm{eff}\rangle = 135\,000 \pm 26\,000$ K for those in the control set. This groups all the brightest PNe at the location of maximum temperature in the post-AGB tracks for stars with initial masses $M_\mathrm{i} = 1.5$ M$_\odot$.
These figures provide robust observational constraints for the stellar progenitors that produce the PNLF cutoff in a star-forming galaxy such as M 31, where a large range of initial masses is in principle available. Inconsistency is found, however, in the computed N/O abundance ratios of five nebulæ, which are 1.5 to 3 times larger than predicted by the existing nucleosynthesis models for stars of these masses.

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First models of the s-process in AGB stars of solar metallicity for the stellar evolutionary code Aton with a novel stable explicit numerical solver

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Aims: We describe the first s-process post-processing models for asymptotic giant branch (AGB) stars of masses 3, 4, and 5 M$_\odot$ at solar metallicity ($Z = 0.018$) computed using the input from the stellar evolutionary code Aton.
Methods: The models are computed with the new code Snuppat (S-process NUcleosynthesis Post-Processing code for Aton), which includes an advective scheme for the convective overshoot that leads to the formation of the main neutron source, ^{13}C. Each model is post-processed with three different values of the free overshoot parameter. Included in the code Snuppat is the novel Patankar–Euler–Deflhard explicit numerical solver, which we use to solve the nuclear network system of differential equations.
Results: The results are compared to those from other s-process nucleosynthesis codes (Monash, Fruity, and NuGrid), as well as observations of s-process enhancement in AGB stars, planetary nebulæ, and barium stars. This comparison shows that the relatively high abundance of ^{12}C in the He-rich intershell in Aton results in an s-process abundance pattern that favours the second over the first s-process peak for all the masses explored. Also, our choice of an advective

as opposed to a diffusive numerical scheme for the convective overshoot results in significant s-process nucleosynthesis for the 5 $M_\odot$ models as well, which may be in contradiction with observations.

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Numerical simulations of convective 3-dimensional red supergiant envelopes

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We explore the three-dimensional properties of convective, luminous ($L \approx 10^{4.5}$–10^5 $L_\odot$), Hydrogen-rich envelopes of Red Supergiants (RSGs) based on radiation hydrodynamic simulations in spherical geometry using Athena. These computations comprise ≈ 30% of the stellar volume, include gas and radiation pressure, and self-consistently track the gravitational potential for the outer ≈ 3 $M_\odot$ of the simulated $M \approx 15$ $M_\odot$ stars. This work reveals a radius, $R_{\rm corr}$, around which the nature of the convection changes. For $r > R_{\rm corr}$, though still optically thick, diffusion of photons dominates the energy transport. Such a regime is well-studied in less luminous stars, but in RSGs, the near- (or above-) Eddington luminosity (due to opacity enhancements at ionization transitions) leads to the unusual outcome of denser regions moving outwards rather than inward. This region of the star also has a large amount of turbulent pressure, yielding a density structure much more extended than 1D stellar evolution predicts. This "halo" of material will impact predictions for both shock breakout and early lightcurves of Type II-P supernovæ. Inside of $R_{\rm corr}$, we find a nearly flat entropy profile as expected in the efficient regime of mixing-length-theory (MLT). Radiation pressure provides ≈ 1/3 of the support against gravity in this region. Our comparisons to MLT suggest a mixing length of $\alpha = 3$–4, consistent with the sizes of convective plumes seen in the simulations. The temporal variability of these 3D models is mostly on the timescale of the convective plume lifetimes (≈ 300 days), with amplitudes consistent with those observed photometrically.

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2021 Census of interstellar, circumstellar, extragalactic, protoplanetary disk, and exoplanetary molecules

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To date, 241 individual molecular species, comprised of 19 different elements, have been detected in the interstellar and circumstellar medium by astronomical observations. These molecules range in size from two atoms to seventy, and have been detected across the electromagnetic spectrum from cm-wavelengths to the ultraviolet. This census presents a summary of the first detection of each molecular species, including the observational facility, wavelength range, transitions, and enabling laboratory spectroscopic work, as well as listing tentative and disputed detections. Tables of molecules detected in interstellar ices, external galaxies, protoplanetary disks, and exoplanetary atmospheres are provided. A number of visual representations of this aggregate data are presented and briefly discussed in context.

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Mira Ceti, atypical archetype

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With the aim of unraveling the complexity of the morpho-kinematics of the circumstellar envelope (CSE) of Mira Ceti, we review, extend and in some cases revisit ALMA millimeter observations of the emission of the SiO(5–4) and CO(3–2) molecular lines. In addition, we present a detailed analysis of the optically thin ^{13}CO(3–2) emission, which provides several important new results. In agreement with observations at infrared and visible wavelengths, we give evidence for confinement and probably rotation of a dense gas volume within $\sim$ 50 au from the star and for a large SiO line-width within $\sim$ 15 au. We show that the mass-loss process is episodic and takes the form of clumps having a very low SiO/CO abundance ratio compared with similar oxygen-rich long period variables, probably a result of depletion on dust grains and photo-dissociation. We evaluate the mass loss rate associated with the main clumps and compare it with values obtained from single dish observations. We argue that the SiO emission observed in the south-western quadrant is not related to the mechanism of generation of the nascent wind but to a mass ejection that occurred eleven years before the observations. We remark that Mira Ceti is not a good archetype in terms of its wind: models aiming at describing the very complex gas-dust chemistry in action in the CSE of oxygen-rich AGB stars may find it difficult to account for its peculiar features, small variations in the parameters deciding when and where mass loss can proceed significantly.

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Thermonuclear ^{17}O(n,γ)^{18}O reaction rate and its astrophysical implications

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A new thermonuclear ^{17}O(n,γ)^{18}O rate is derived based on a complete calculation of the direct-capture (DC) and resonant-capture contributions, for a temperature region up to 2 GK of astrophysical interest. We have first calculated the DC and subthreshold contributions in the energy region up to 1 MeV, and estimated the associated uncertainties by a Monte Carlo approach. It shows that the present rate is remarkably larger than that adopted in the JINA REACLIB in the temperature region of 0.01 $\sim$ 2 GK, by up to a factor of $\sim$ 80. The astrophysical impacts of our rate have been examined in both s-process and r-process models. In our main s-process model, which simulates flash-driven convective mixing in metal-deficient asymptotic giant branch stars, both ^{18}O and ^{19}F abundances in interpulse phases are enhanced dramatically by factors of $\sim$ 20–40 due to the new larger ^{17}O(n,γ)^{18}O rate. It shows, however, that this reaction hardly affects the weak s-process in massive stars since the ^{17}O abundance never becomes significantly large in the massive stars. For the r-process nucleosynthesis, we have studied impacts of our rate in both the collapsar and neutron burst models, and found that the effect can be neglected, although an interesting loophole effect is found owing to the enhanced new rate, which significantly changes the final nuclear abundances if fission recycling is not involved in the model; however, these significant differences are almost completely eliminated if the fission recycling is considered.

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Sakurai's Object revisited: new laboratory data for carbonates and melilites suggest the carrier of 6.9-μm excess absorption is a carbonate

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We present new room-temperature 1100–1800 cm^{-1} spectra of melilite silicates and 600–2000 cm^{-1} spectra of three randomly orientated fine-grained carbonates to determine the possible carrier(s) of a 6.9-μm absorption feature observed in a variety of dense astronomical environments including young stellar objects and molecular clouds. We focus on the low-mass post-AGB star Sakurai's Object which has been forming substantial quantities of carbonaceous dust since an eruptive event in the 1990s. Large melilite grains cannot be responsible for the 6.9-μm absorption feature because the similarly-shaped feature in the laboratory spectrum was produced by very low (0.1 per cent by mass) carbonate contamination which was not detected at other wavelengths. Due to the high bandstrength of the 6.9-μm feature in carbonates, we conclude that carbonates carry the astronomical 6.9-μm feature. Replacement of melilite with carbonates in models of Sakurai's object improves fits to the 6–7-μm *Spitzer* spectra without significantly altering other conclusions of Bowey's previous models except that there is no link between the feature and the abundance of melilite in meteorites. With magnesite ($MgCO_3$), the abundance of 25-μm-sized SiC grains is increased by 10–50 per cent and better constrained. The mass of carbonate dust is similar to the mass of PAH dust. Existing experiments suggest carbonates are stable below 700 K, however it is difficult to ascertain the applicability of these experiments to astronomical environments and more studies are required.

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Hα spectroscopy of the recurrent nova RS Oph during the 2021 outburst

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We report spectroscopic observations of the Hα emission line of the recurrent nova RS Oph obtained between 12 and 23 August 2021 during the recent outburst. On the basis of the sharp P Cyg profile superimposed onto the strong $H\alpha$ emission, we estimate that the outflowing velocity of the material surrounding RS Oph is in the range 32 km s^{-1} $< V_{out} <$ 68 km s^{-1}.
The new Gaia distance indicates that the red giant should be probably classified in between II and III luminosity class.
The spectra are available upon request from the authors and on Zenodo.
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Announcement

The 13^{th} Torino workshop on AGB stars and related topics

The 13^{th} Torino Workshop will take place (in person) June 19–24, 2022 in Perugia, Italy. The conference is the thirteenth in the Torino Workshop series. The focus of the workshop will be the physics and nucleosynthesis of asymptotic giant branch (AGB) stars and many related topics. The current major advances in stellar evolution, astronomical observations, modeling of stellar winds and dust formation, meteoritic stardust measurements, galactic chemical evolution, theoretical and experimental nuclear astrophysics will be explored. The workshop will bring together researchers from a variety of research fields to address the current issues and discuss the future directions by interdisciplinary approaches.

This meeting edition will celebrate Prof. Maurizio M. Busso on the occasion of his 70^{th} birthday. Maurizio is among the founders of the Torino Workshop and during his career he has given important contributions to the study of AGB stars and related fields covered in the workshop.

All interested colleagues are kindly invited to connect to the conference webpage
https://agenda.infn.it/e/TorinoWorkshop2022
to find more information, submit their abstracts and register for the workshop.

Important dates of the 13^{th} Torino Workshop are:

- Call for abstract deadline: April 15^{th}, 2022
- Abstract notification and preliminary program: April 30^{th}, 2022
- Registration deadline: May 10^{th}, 2022
- Welcome reception: June 19^{th}, 2022
- Workshop beginning: June 20^{th}, 2022

Hoping to see you in Perugia
Sara Palmerini on behalf the organizing committee

See also https://agenda.infn.it/e/TorinoWorkshop2022