THE AGB NEWSLETTER

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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 245th issue of the AGB Newsletter. We are pleased to also see contributions that may have initially targeted colleagues in a different discipline, but that are of much interest to our community as well.

We would also like to highlight the distance determination to R Sculptoris based on time delay measurements in the circumstellar envelope; coincidentally, Sandra Etoka posted a contribution on a similar technique that has been used for a long time using OH masers.

Looking for a postdoctoral position? There's one on offer in Sweden.

Always wanted to – but never got around to – use CLOUDY? Why not combine it with a holiday to Thailand?

Or why not attend the Dust Cycle conference in Vietnam? Or do both?

The next issue is planned to be distributed around the 3rd of January. We take this opportunity to wish you all a Merry Christmas (or in any case a wonderful December) and a Happy New Year.

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

Food for Thought

This month's thought-provoking statement is:

AGB stars are not round

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

Electron capture supernovæ from close binary systems

Arend Jan Poelarends[1], Scott Wurtz[1], James Tarka[1], Cole Adams[1] and Spencer Hills[1]

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We present the first detailed study of the Electron Capture Supernova Channel (ECSN Channel) for a primary star in a close binary star system. Progenitors of ECSN occupy the lower end of the mass spectrum of supernovæ progenitors and are thought to form the transition between white dwarfs progenitors and core collapse progenitors . The mass range for ECSN from close binary systems is thought to be wider than the range for single stars, because of the effects of mass transfer on the helium core. Using the MESA stellar evolution code we explored the parameter space of initial primary masses between 8 $M_\odot$ and 17 $M_\odot$, using a large grid of models. We find that the initial primary mass and the mass transfer evolution are important factors in the final fate of stars in this mass range. Mass transfer due to Roche Lobe overflow during and after carbon burning causes the core to cool down so that it avoids neon ignition, even in helium-free cores with masses up to 1.52 $M_\odot$, which in single stars would ignite neon. If the core is able to contract to high enough densities for electron captures to commence, we find that, for the adopted Ledoux convection criterion, the initial mass range for the primary to evolve into an ECSN is between 13.5 $M_\odot$ and 17.6 $M_\odot$. The mass ratio, initial period, and mass loss efficiency only marginally affect the predicted ranges.

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Available from https://arxiv.org/abs/1710.11143

An infrared census of DUST in Nearby Galaxies with *Spitzer* (DUSTiNGS). IV. Discovery of high-redshift AGB analogs

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The survey for DUST in Nearby Galaxies with *Spitzer* (DUSTiNGS) identified several candidate Asymptotic Giant Branch (AGB) stars in nearby dwarf galaxies and showed that dust can form even in very metal-poor systems ($Z \sim 0.008\ Z_\odot$). Here, we present a follow-up survey with WFC3/IR on the *Hubble* Space Telescope (HST), using filters that are capable of distinguishing carbon-rich (C-type) stars from oxygen-rich (M-type) stars: F127M, F139M, and F153M. We include six star-forming DUSTiNGS galaxies (NGC 147, IC 10, Pegasus dIrr, Sextans B, Sextans A, and Sag DIG), all more metal-poor than the Magellanic Clouds and spanning 1 dex in metallicity. We double the number of dusty AGB stars known in these galaxies and find that most are carbon rich. We also find 26 dusty M-type stars, mostly in IC 10. Given the large dust excess and tight spatial distribution of these M-type stars, they are most likely on the upper end of the AGB mass range (stars undergoing Hot Bottom Burning). Theoretical models do not predict significant dust production in metal-poor M-type stars, but we see evidence for dust excess around M-type stars even in the most metal-poor galaxies in our sample ($12 + \log(O/H) = 7.26$–7.50). The low metallicities and inferred high stellar masses (up to ~ 10 $M_\odot$) suggest that AGB stars can produce dust very early in the evolution of galaxies (~ 30 Myr after they form), and may contribute significantly to the dust reservoirs seen in high-redshift galaxies.

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Three new barium dwarfs with WD companions: BD +68°1027, RE J0702+129 and BD +80°670

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We report three new barium (Ba) dwarfs lying in Sirius-like systems, which provides direct evidence that Ba dwarfs are companions to white dwarfs (WDs). Atmospheric parameters, stellar masses, and chemical abundances of 25 elements, including light, α, Fe-peak and s-process elements, are derived from high resolution and high S/N spectra. Enhancement of s-process elements with [s/Fe] ratios between 0.4 and 0.6 confirm them as mild barium stars. The estimated metallicities (−0.31, −0.06, 0.13) of BD +68°1027, RE J0702+129 and BD +80°670 are in the range of known Ba dwarfs and giants. As expected, observed indices of [hs/ls], [s/Fe] and [C/Fe] show anticorrelation with metallicity. AGB progenitor masses are estimated for the WD companions of RE J0702+129 (1.47 $M_\odot$) and BD +80°670 (3.59 $M_\odot$), which confirms the predicted range of progenitor AGB masses ($1.5 \sim 4$ $M_\odot$) for unseen WDs around Ba dwarfs. Surface abundances of s-process elements in RE J0702+129 and BD +80°670 are compared with AGB models and they are in close agreement, within predicted accretion efficiencies and pollution factors for Ba stars. These results support that the origin of s-process overabundances in Ba dwarfs is similar to Ba giants via McClure hypothesis in which Ba stars accumulate s-process elements through mass transfer from their host companions during AGB phase.

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Time variations of the radial velocity of H_2O masers in the semi-regular variable R Crt

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H_2O maser emission at 22 GHz in the circumstellar envelope is one of the good tracers of detailed physics and kinematics in the mass loss process of asymptotic giant branch stars. Long-term monitoring of an H_2O maser spectrum with high time resolution enables us to clarify acceleration processes of the expanding shell in the stellar atmosphere. We monitored the H_2O maser emission of the semi-regular variable R Crt with the Kagoshima 6-m telescope, and obtained a large data set of over 180 maser spectra during 1.3 years with an observational span of a few days. Based

on an automatic peak detection method based on a least-squares fitting with a Gaussian basis function model, we exhaustively detected peaks as significant velocity components with the radial velocity on a 0.1 km s^{-1} scale. This analysis result shows that the radial velocity of red-shifted and blue-shifted components exhibits a change between acceleration and deceleration on the time scale of a few hundred days. These velocity variations are likely to correlate with the intensity variations, in particular during flaring state of H_2O masers. It seems reasonable to consider that the velocity variation of the maser source is caused by the shock propagation in the envelope due to stellar pulsation. However, it is difficult to explain the relationship between the velocity variation and the intensity variation only from shock propagation effects.

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THROES: a caTalogue of *HeRschel* Observations of Evolved Stars. I. PACS range spectroscopy

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This is the first of a series of papers presenting the THROES (A caTalogue of *HeRschel* Observations of Evolved Stars) project, intended to provide a comprehensive overview of the spectroscopic results obtained in the far-infrared (55–670 μm) with the *Herschel* space observatory on low-to-intermediate mass evolved stars in our Galaxy. Here we introduce the catalogue of interactively reprocessed PACS (Photoconductor Array Camera and Spectrometer) spectra covering the 55–200 μm range for 114 stars in this category for which PACS range spectroscopic data is available in the *Herschel* Science Archive (HSA). Our sample includes objects spanning a range of evolutionary stages, from the asymptotic giant branch to the planetary nebula phase, displaying a wide variety of chemical and physical properties. The THROES/PACS catalogue is accessible via a dedicated web-based inter- face (this https URL) and includes not only the science-ready *Herschel* spectroscopic data for each source, but also complementary photometric and spectroscopic data from other infrared observatories, namely IRAS (Infrared Astronomical Satellite), ISO (Infrared Space Observatory) or AKARI, at overlapping wavelengths. Our goal is to create a legacy-value *Herschel* dataset that can be used by the scientific community in the future to deepen our knowledge and understanding of these latest stages of the evolution of low-to-intermediate mass stars.

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and from https://throes.cab.inta-csic.es/

Vibrationally excited water emission at 658 GHz from evolved stars

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Several rotational transitions of water have been identified toward evolved stars in the ground vibrational state as well as in the first excited state of the bending mode. In the latter vibrational state of water, the 658 GHz $J = 1_{1,0}–1_{0,1}$ rotational transition is often strong and seems to be widespread in late-type stars. Our main goals are to better characterize the nature of the 658 GHz emission, compare the velocity extent of the 658 GHz emission with SiO maser emission to help locate the water layers and, more generally, investigate the physical conditions prevailing in the excited water layers of evolved stars. Another goal is to identify new 658 GHz emission sources and contribute in showing that this emission is widespread in evolved stars. Eleven evolved stars were extracted from our mini-catalog of

existing and potential 658 GHz sources for observations with the APEX telescope equipped with the SEPIA receiver. The ^{13}CO $J = 6$–5 line was placed in the same receiver sideband for simultaneous observation with the 658 GHz line of water. We have compared the 658 GHz line properties with our H_2O radiative transfer models in stars and we have compared the velocity ranges of the 658 GHz and SiO $J = 2$–1, $v = 1$ maser lines. All stars show 658 GHz emission with a peak flux density in the range 50–70 Jy to 2000–3000 Jy. We have shown that the 658 GHz line is masing and we found that the 658 GHz velocity extent tends to be correlated with that of the SiO maser suggesting that both emission lines are excited in circumstellar layers close to the central star. Broad and stable line profiles are observed at 658 GHz. This could indicate maser saturation although we have tentatively provided first information on time variability at 658 GHz.

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s-Processing from MHD-induced mixing and isotopic abundances in presolar SiC grains

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In the past years the observational evidence that s-process elements from Sr to Pb are produced by stars ascending the so-called Asymptotic Giant Branch (or AGB) could not be explained by self-consistent models, forcing researchers to extensive parameterizations. The crucial point is to understand how protons can be injected from the envelope into the He-rich layers, yielding the formation of ^{13}C and then the activation of the ^{13}C(α,n)^{16}O reaction. Only recently, attempts to solve this problem started to consider quantitatively physically-based mixing mechanisms. Among them, MHD processes in the plasma were suggested to yield mass transport through magnetic buoyancy. In this framework, we compare results of nucleosynthesis models for low-mass AGB stars ($M \lesssim 3$ M$_\odot$), developed from the MHD scenario, with the record of isotopic abundance ratios of s-elements in presolar SiC grains, which were shown to offer precise constraints on the ^{13}C reservoir. We find that n-captures driven by magnetically-induced mixing can indeed account for the SiC data quite well and that this is due to the fact that our ^{13}C distribution fulfils the above constraints rather accurately. We suggest that similar tests should be now performed using different physical models for mixing. Such comparisons would indeed improve decisively our understanding of the formation of the neutron source.

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Ages and heavy element abundances from very metal-poor stars in the Sagittarius dwarf galaxy

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Sagittarius (Sgr) is a massive disrupted dwarf spheroidal galaxy in the Milky Way halo that has undergone several stripping events. Previous chemical studies were restricted mainly to a few, metal-rich ([Fe/H] $\gtrsim -1$) stars that suggested a top-light initial mass function (IMF). Here we present the first high-resolution, very metal-poor ([Fe/H] $= -1$ to -3) sample of 13 giant stars in the main body of Sgr. We derive abundances of 13 elements namely C, Ca, Co, Fe, Sr, Ba, La, Ce, Nd, Eu, Dy, Pb, and Th which challenge the interpretation based on previous studies. Our abundances from Sgr mimic those of the metal-poor halo and our most metal-poor star ([Fe/H] ~ -3) indicates a pure r-process pollution. Abundances of Sr, Pb, and Th are presented for the first time in Sgr, allowing for age determination using nuclear cosmochronology. We calculate ages of 9 ± 2.5 Gyr. Most of the sample stars have been enriched by a range of asymptotic giant branch (AGB) stars with masses between 1.3 and 5 $M_{\odot}$. Sgr J190651.47−320147.23 shows a large overabundance of Pb (2.05 dex) and a peculiar abundance pattern best fit by a 3 $M_{\odot}$ AGB star. Based on star-to-star scatter and observed abundance patterns a mixture of low- and high-mass AGB stars and supernovae (15–25 $M_{\odot}$) are necessary to explain these patterns. The high level (0.29 ± 0.05 dex) of Ca indicates that massive supernovæ must have existed and polluted the early ISM of Sgr before it lost its gas. This result is in contrast with a top-light IMF with no massive stars polluting Sgr.

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The shock-heated atmosphere of an asymptotic giant branch star resolved by ALMA

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Our current understanding of the chemistry and mass-loss processes in solar-like stars at the end of their evolution depends critically on the description of convection, pulsations and shocks in the extended stellar atmosphere. Three-dimensional hydrodynamical stellar atmosphere models provide observational predictions, but so far the resolution to constrain the complex temperature and velocity structures seen in the models has been lacking. Here we present sub-millimeter continuum and line observations that resolve the atmosphere of the asymptotic giant branch star W Hya. We show that hot gas with chromospheric characteristics exists around the star. Its filling factor is shown to be small. The existence of such gas requires shocks with a cooling time larger than commonly assumed. A shocked hot layer will be an important ingredient in the models of stellar convection, pulsation and chemistry that underlie our current understanding of the late stages of stellar evolution.

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Tomography of cool giant and supergiant star atmospheres. I. Validation of the method

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Context: Cool giant and supergiant star atmospheres are characterized by complex velocity fields originating from

convection and pulsation processes which are not fully understood yet. The velocity fields impact the formation of spectral lines, which thus contain information on the dynamics of stellar atmospheres.
Aims: The tomographic method allows to recover the distribution of the component of the velocity field projected on the line of sight at different optical depths in the stellar atmosphere. The computation of the contribution function to the line depression aims at correctly identifying the depth of formation of spectral lines in order to construct numerical masks probing spectral lines forming at different optical depths.
Methods: The tomographic method is applied to 1D model atmospheres and to a realistic 3D radiative hydrodynamics simulation performed with CO5BOLD in order to compare their spectral line formation depths and velocity fields.
Results: In 1D model atmospheres, each spectral line forms in a restricted range of optical depths. On the other hand, in 3D simulations, the line formation depths are spread in the atmosphere mainly because of temperature and density inhomogeneities. Comparison of CCF profiles obtained from 3D synthetic spectra with velocities from the 3D simulation shows that the tomographic method correctly recovers the distribution of the velocity component projected on the line of sight in the atmosphere.

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Planetary nebulæ with UVIT: Far ultra-violet halo around the Bow Tie nebula (NGC 40)

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Context: NGC 40 is a planetary nebula with diffuse X-ray emission, suggesting an interaction of the high-speed wind from WC8 central star (CS) with the nebula. It shows strong C IV 1550 Å emission that cannot be explained by thermal processes alone. We present here the first map of this nebula in C IV emission using broad band filters on the ultra-violet imaging telescope (UVIT).
Aims: We aim to map the hot C IV-emitting gas and its correspondence with soft X-ray (0.3–8 keV) emitting regions in order to study the shock interaction between the nebula and the ISM. We also aim to illustrate the potential of UVIT for nebular studies.
Methods: We carry out a morphological study of images of the nebula obtained at an angular resolution of about 1.″3 in four UVIT filter bands that include C IV 1550 Å and C II] 2326 Å lines as well as UV continuum. We also make comparisons with X-ray, optical, and IR images from the literature.
Results: The C II] 2326 Å images show the core of the nebula with two lobes on either side of CS similar to [N II]. The C IV emission in the core shows similar morphology and extent to that of diffuse X-ray emission concentrated in nebular condensations. A surprising UVIT discovery is the presence of a large faint far UV (FUV) halo in an FUV filter with $\lambda_{\rm eff}$ of 1608 Å. The UV halo is not present in any other UV filter. The FUV halo is most likely due to UV fluorescence emission from the Lyman bands of H_2 molecules. Unlike the optical and IR halo, the FUV halo trails predominantly towards the south–east side of the nebular core, opposite to the CS's proper motion direction.
Conclusions: Morphological similarity of C IV 1550 Å and X-ray emission in the core suggests that it results mostly from the interaction of strong CS wind with the nebula. The FUV halo in NGC 40 highlights the extensive existence of H_2 molecules in the regions even beyond the optical and IR halos. Thus UV studies are important to estimate the amount of H_2, which is probably the most dominant molecule and significant for mass-loss studies.

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Theoretical investigation on the mass loss impact on asteroseismic grid-based estimates of mass , radius, and age for RGB stars

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We aim to perform a theoretical evaluation of the impact of the mass loss indetermination on asteroseismic grid based estimates of masses, radii, and ages of stars in the red giant branch phase (RGB). We adopted the SCEPtER pipeline on a grid spanning the mass range [0.8; 1.8] $M_{\odot}$. As observational constraints, we adopted the star effective temperatures, the metallicity [Fe/H], the average large frequency spacing $\Delta\nu$, and the frequency of maximum oscillation power $\nu_{\rm max}$. The mass loss was modelled following a Reimers parametrization with the two different efficiencies $\eta = 0.4$ and $\eta = 0.8$. In the RGB phase, the average random relative error (owing only to observational uncertainty) on mass and age estimates is about 8% and 30% respectively. The bias in mass and age estimates caused by the adoption of a wrong mass loss parameter in the recovery is minor for the vast majority of the RGB evolution. The biases get larger only after the RGB bump. In the last 2.5% of the RGB lifetime the error on the mass determination reaches 6.5% becoming larger than the random error component in this evolutionary phase. The error on the age estimate amounts to 9%, that is, equal to the random error uncertainty. These results are independent of the stellar metallicity [Fe/H] in the explored range. Asteroseismic-based estimates of stellar mass, radius, and age in the RGB phase can be considered mass loss independent within the range ($\eta \in [0.0, 0.8]$) as long as the target is in an evolutionary phase preceding the RGB bump.

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The temporal evolution of neutron-capture elements in the Galactic discs

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Important insights into the formation and evolution of the Galactic disc(s) are contained in the chemical compositions of stars. We analysed high-resolution and high signal to noise HARPS spectra of 79 solar twin stars in order to obtain precise determinations of their atmospheric parameters, ages ($\sigma \sim 0.4$ Gyr) and chemical abundances ($\sigma < 0.01$ dex) of 12 neutron-capture elements (Sr, Y, Zr, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, and Dy). This valuable dataset allows us to study the [X/Fe]–age relations over a time interval of ~ 10 Gyr and among stars belonging to the thin and thick discs. These relations show that i) the *s*-process has been the main channel of nucleosynthesis of n-capture elements during the evolution of the thin disc; ii) the thick disc is rich in *r*-process elements which suggests that its formation has been rapid and intensive; iii) a chemical continuity between the thin and thick discs is evident in the abundances of Ba. In addition, the heavy (Ba, La, Ce) and light (Sr, Y, Zr) *s*-process elements revealed details on the dependence between the yields of AGB stars and the stellar mass or metallicity. Finally, we confirmed that both [Y/Mg] and [Y/Al] ratios can be employed as stellar clocks, allowing ages of solar twin stars to be estimated with an average precision of ~ 0.5 Gyr.

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An independent distance estimate to the AGB star R Sculptoris

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Context: Distance measurements to astronomical objects are essential for understanding their intrinsic properties. For asymptotic giant branch (AGB) stars it is particularly difficult to derive accurate distance estimates. Period–luminosity relationships rely on the correlation of different physical properties of the stars, while the angular sizes and variability of AGB stars make parallax measurements inherently inaccurate. For the carbon AGB star R Sculptoris, the uncertain distance significantly affects the interpretation of observations regarding the evolution of the stellar mass loss during and after the most recent thermal pulse.
Aims: We aim to provide a new, independent measurement of the distance to R Sculptoris, reducing the absolute uncertainty of the distance estimate to this source.
Methods: R Scl is a semi-regular pulsating star, surrounded by a thin shell of dust and gas created during a thermal pulse ≈ 2000 years ago. The stellar light is scattered by the dust particles in the shell at a radius of $\approx 19''$. The variation in the stellar light affects the amount of dust-scattered light with the same period and amplitude ratio, but with a phase lag that depends on the absolute size of the shell. We measured this phase lag by observing the star R Scl and the dust-scattered stellar light from the shell at five epochs between June – December 2017. By observing in polarised light, we imaged the shell in the plane of the sky, removing any uncertainty due to geometrical effects. The phase lag gives the absolute size of the shell, and together with the angular size of the shell directly gives the absolute distance to R Sculptoris.
Results: We measured a phase lag between the stellar variations and the variation in the shell of 40.0 ± 4.0 days. The angular size of the shell is measured to be $19\farcs1 \pm 0\farcs7$. Combined, this gives an absolute distance to R Sculptoris of 361 ± 44 pc.
Conclusions: We independently determined the absolute distance to R Scl with an uncertainty of 12%. The estimated distance is consistent with previous estimates, but is one of the most accurate distances to the source to date. In the future, using the variations in polarised, dust-scattered stellar light, may offer an independent possibility to measure reliable distances to AGB stars.

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Available from https://arxiv.org/abs/1711.09676

A dearth of small particles in the transiting material around the white dwarf WD 1145+017

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White dwarf WD 1145+017 is orbited by several clouds of dust, possibly emanating from actively disintegrating bodies. These dust clouds reveal themselves through deep, broad, and evolving transits in the star's light curve. Here, we report two epochs of multi-wavelength photometric observations of WD 1145+017, including several filters in the optical, K_s- and 4.5-μm bands in 2016 and 2017. The observed transit depths are different at these wavelengths. However, after correcting for excess dust emission at K_s and 4.5 μm, we find the transit depths for the white dwarf itself are the same at all wavelengths, at least to within the observational uncertainties of $\sim$ 5%–10%. From this surprising result, and under the assumption of low optical depth dust clouds, we conclude that there is a deficit of small particles (with radii < 1.5 μm) in the transiting material. We propose a model wherein only large particles can survive the high equilibrium temperature environment corresponding to 4.5 hr orbital periods around WD 1145+017,

while small particles sublimate rapidly. In addition, we evaluate dust models that are permitted by our measurements of infrared emission.

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Phase plane analysis of the photometrical variations of long-period variables

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Using the phase plane diagrams, the phase light curves of a group of the Mira-type stars and semi-regular variables are analyzed. As generalized coordinates x and $\dot{x}$, we have used m – the brightness of the star and its phase derivative. We have used mean phase light curves using observations of various authors. The data typically span a large time interval (nearly a century). They were compiled from the databases of AAVSO, AFOEV, VSOLJ, ASAS and approximated using a trigonometric polynomial of statistically optimal degree. As the resulting approximation characterizes the auto-oscillation process, which leads to a photometrical variability, the phase diagram corresponds to a limit cycle. For all stars studied, the limit cycles were computed. For a simple sine-like light curve, in e.g., L_2 Pup, the limit cycle is a simple ellipse. In a case of more complicated light curve, in which harmonics are statistically significant, the limit cycle has deviations from the ellipse. In an addition to a classical analysis, we use the error estimates of the smoothing function and its derivative to constrain an "error corridor" in the phase plane.

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Gas-phase spectra of MgO molecules: A possible connection from gas-phase molecules to planet formation

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A more fine-tuned method for probing planet-forming regions, such as protoplanetary discs, could be rovibrational molecular spectroscopy observation of particular premineral molecules instead of more common but ultimately less related volatile organic compounds. Planets are created when grains aggregate, but how molecules form grains is an ongoing topic of discussion in astrophysics and planetary science. Using the spectroscopic data of molecules specifically involved in mineral formation could help to map regions where planet formation is believed to be occurring in order to examine the interplay between gas and dust. Four atoms are frequently associated with planetary formation: Fe, Si, Mg, and O. Magnesium, in particular, has been shown to be in higher relative abundance in planet-hosting stars. Magnesium oxide crystals comprise the mineral periclase making it the chemically simplest magnesium-bearing mineral and a natural choice for analysis. The monomer, dimer, and trimer forms of $(MgO)_n$ with $n = 1$–3 are analyzed in this work using high-level quantum chemical computations known to produce accurate results. Strong vibrational transitions at 12.5 μm, 15.0 μm, and 16.5 μm are indicative of magnesium oxide monomer, dimer, and trimer making these wavelengths of particular interest for the observation of protoplanetary discs and even potentially planet-forming regions around stars. If such transitions are observed in emission from the accretion discs or absorptions from stellar spectra, the beginning stages of mineral and, subsequently, rocky body formation could be indicated.

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and from
https://academic.oup.com/mnras/advance-article-abstract/doi/10.1093/mnras/stx2912/4622974?redirectedFrom=PDF

Discovery of a possible symbiotic binary in the Large Magellanic Cloud

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We report the discovery of a possible symbiotic star, in the Large Magellanic Cloud (LMC). The object under consideration here, designated as RP 870, was detected during the course of a comprehensive Hα survey of the LMC by Reid & Parker (2012). The spectrum of RP 870 showed high ionization emission lines of He I, He II and [O III] and molecular absorption bands of TiO $\lambda\lambda$6180,7100. The collective signatures of a hot component (high excitation/ionization lines) and of a cool component (TiO molecular bands) are seen in RP 870, from which we propose it as a symbiotic star. Since known symbiotic systems are rare in the LMC, possibly less than a dozen are known, we thought the present detection to be interesting enough to be reported.

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The occurrence of planets and other substellar bodies around white dwarfs using K2

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The majority of stars both host planetary systems and evolve into a white dwarf (WD). To understand their post-main-sequence (PMS) planetary system evolution, we present a search for transiting/eclipsing planets and other Substellar Bodies (SBs) around WDs using a sample of 1148 WDs observed by K2. Using transit injections, we estimate the completeness of our search. We place constraints on the occurrence of planets and substellar bodies around white dwarfs as a function of planet radius and orbital period. For short-period ($P < 40$ days) small objects, from asteroid-sized to 1.5 $R_\oplus$, these are the strongest constraints known to date. We further constrain the occurrence of hot Jupiters ($< 1.5\%$), habitable zone Earth-sized planets ($< 28\%$), and disintegrating short-period planets ($\sim 12\%$). We blindly recovered all previously known eclipsing objects, providing confidence in our analysis, and make all light curves publicly available.

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The Gaia–ESO Survey: Lithium enrichment histories of the Galactic thick and thin disc

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Lithium abundance in most of the warm metal-poor main sequence stars shows a constant plateau (A(Li) ~ 2.2 dex) and then the upper

envelope of the lithium vs. metallicity distribution increases as we approach solar metallicity. Meteorites, which carry information about the chemical composition of the interstellar medium at the solar system formation time, show a lithium abundance $A(\mathrm{Li}) \sim 3.26$ dex. This pattern reflects the Li enrichment history of the interstellar medium during the Galaxy lifetime. After the initial Li production in Big Bang Nucleosynthesis, the sources of the enrichment include AGB stars, low-mass red giants, novæ, type II supernovæ, and Galactic cosmic rays. The total amount of enriched Li is sensitive to the relative contribution of these sources. Thus different Li enrichment histories are expected in the Galactic thick and thin disc. We investigate the main sequence stars observed with UVES in Gaia–ESO Survey iDR4 catalogue and find a Li–[α/Fe] anti-correlation independent of [Fe/H], T_{eff}, and $\log g$. Since in stellar evolution different α enhancements at the same metallicity do not lead to a measurable Li abundance change, the anti-correlation indicates that more Li is produced during the Galactic thin disc phase than during the Galactic thick disc phase. We also find a correlation between the abundance of Li and s-process elements Ba and Y, and they both decrease above the solar metallicity, which can be explained in the framework of the adopted Galactic chemical evolution models.

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Available from https://arxiv.org/abs/1711.04829

Conference Papers

Emission line models for the lowest-mass core collapse supernovæ. I: Case study of a 9 $M_{\odot}$ one-dimensional neutrino-driven explosion

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A large fraction of core-collapse supernovæ (CCSNe), 30–50%, are expected to originate from the low-mass end of progenitors with $M_{\mathrm{ZAMS}} = 8$–$12\ \mathrm{M}_{\odot}$. However, degeneracy effects make stellar evolution modelling of such stars challenging, and few predictions for their supernova light curves and spectra have been presented. Here we calculate synthetic nebular spectra of a 9 $\mathrm{M}_{\odot}$ Fe CCSN model exploded with the neutrino mechanism. The model predicts emission lines with FWHM ~ 1000 km s^{-1}, including signatures from each deep layer in the metal core. We compare this model to observations of the three subluminous IIP SNe with published nebular spectra; SN 1997D, SN 2005cs, and SN 2008bk. The prediction of both line profiles and luminosities are in good agreement with SN 1997D and SN 2008bk. The close fit of a model with no tuning parameters provides strong evidence for an association of these objects with low-mass Fe CCSNe. For SN 2005cs, the interpretation is less clear, as the observational coverage ended before key diagnostic lines from the core had emerged. We perform a parameterised study of the amount of explosively made stable nickel, and find that none of these three SNe show the high $^{58}\mathrm{Ni}/^{56}\mathrm{Ni}$ ratio predicted by current models of electron capture SNe (ECSNe) and ECSN-like explosions. Combined with clear detection of lines from O and He shell material, these SNe rather originate from Fe core progenitors. We argue that the outcome of self-consistent explosion simulations of low-mass stars, which gives fits to many key observables, strongly suggests that the class of subluminous Type IIP SNe is the observational counterpart of the lowest mass CCSNe.

Available from https://arxiv.org/abs/1710.04508

Current stage of the ATCA follow-up for SPLASH

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Four ground-state OH transitions were detected in emission, absorption and maser emission in the Southern Parkes Large-Area Survey in Hydroxyl (SPLASH). We re-observed these OH masers with the Australia Telescope Compact Array to obtain positions with high accuracy ($\sim 1''$). According to the positions, we categorised these OH masers into different classes, i.e. star formation, evolved stars, supernova remnants and unknown origin. We found one interesting OH maser source (G336.644−0.695) in the pilot region, which has been studied in detail in Qiao et al. (2016a). In this paper, we present the current stage of the ATCA follow-up for SPLASH and discuss the potential future researches derived from the ATCA data.

Poster contribution, published in IAU336
Available from https://arxiv.org/abs/1711.07604

AGB variables in Local Group dwarf irregular galaxies

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The near and mid-infrared characteristics of large amplitude, Mira, variables in Local Group dwarf irregular galaxies (LMC, NGC 6822, IC 1613, Sgr dIG) are described. Two aspects of these variables are discussed. First, the short period ($P\lesssim$420 days) Miras are potentially powerful distance indicators, provided that they have low circumstellar extinction, or can be corrected for extinction. These are the descendants of relatively low mass stars. Secondly, the longer period stars, many of which undergo hot bottom burning, are poorly understood. These provide new insight into the evolution of intermediate mass stars during the high mass-loss phases, but their use as distance indicators depends on a much firmer understanding of their evolution.
The change in slope of the K period–luminosity relation for O-rich stars that is seen around 400 to 420 days in the LMC is due to the onset of hot bottom burning. It will be sensitive to metallicity and should therefore be expected at different periods in populations with significant differences from the LMC.
The [4.5] period–luminosity relation splits into two approximately parallel sequences. The fainter one fits stars where the mid-infrared flux originates from the stellar photosphere, while the brighter one fits observations dominated by the circumstellar shell.

Oral contribution, published in "Stellar Populations and the Distance Scale", eds. J. Jenkins J., R.M. Rich & R. de Grijs, Peking University (China), September 2017, Astron. Soc. Pac. Conf. Ser.
Available from https://arxiv.org/abs/1711.08932

Atlas of the light curves and phase plane portraits of selected long-period variables

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For a group of the Mira-type stars, semi-regular variables and some RV Tau-type stars the limit cycles were computed and plotted using the phase plane diagrams. As generalized coordinates x and $\dot{x}$, we have used m – the brightness of the star and its phase derivative. We have used mean phase light curves using observations of various authors from the databases of AAVSO, AFOEV, VSOLJ, ASAS and approximated using a trigonometric polynomial of statistically optimal degree. For a simple sine-like light curve, the limit cycle is a simple ellipse. In a case of more complicated light curve, in which harmonics are statistically significant, the limit cycle has deviations from the ellipse. In an addition to a classical analysis, we use the error estimates of the smoothing function and its derivative to constrain an "error corridor" in the phase plane.

Oral contribution, published in Częstochowski Kalendarz Astronomiczny 2018, ed. Bogdan Wszołek
Available from ptma.ajd.czest.pl/publikacje_elektroniczne/cka18.pdf

Distances of stars by means of the phase-lag method

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Variable OH/IR stars are Asymptotic Giant Branch (AGB) stars with an optically thick circumstellar envelope that emit strong OH 1612 MHz emission. They are commonly observed throughout the Galaxy but also in the LMC and SMC. Hence, the precise inference of the distances of these stars will ultimately result in better constraints on their mass range in different metallicity environments. Through a multi-year long-term monitoring program at the Nancay Radio telescope (NRT) and a complementary high-sensitivity mapping campaign at the eMERLIN and JVLA to measure precisely the angular diameter of the envelopes, we have been re-exploring distance determination through the phase-lag method for a sample of stars, in order to refine the poorly-constrained distances of some and infer the currently unknown distances of others. We present here an update of this project.

Oral contribution, published in IAU Symposium No. 336: "Astrophysical Masers: Unlocking the Mysteries of the Universe"
Available from https://arxiv.org/abs/1711.09694

Review Paper

Asteroseismology of red giants & galactic archæology

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Red-giant stars are low- to intermediate-mass ($M \lesssim 10$ M$_\odot$) stars that have exhausted hydrogen in the core. These extended, cool and hence red stars are key targets for stellar evolution studies as well as galactic studies for several reasons: a) many stars go through a red-giant phase; b) red giants are intrinsically bright; c) large stellar internal structure changes as well as changes in surface chemical abundances take place over relatively short time; d) red-giant stars exhibit global intrinsic oscillations.
Due to their large number and intrinsic brightness it is possible to observe many of these stars up to large distances. Furthermore, the global intrinsic oscillations provide a means to discern red-giant stars in the pre-helium core burning from the ones in the helium core burning phase and provide an estimate of stellar ages, a key ingredient for galactic studies.
In this lecture I will first discuss some physical phenomena that play a role in red-giant stars and several phases of red-giant evolution. Then, I will provide some details about asteroseismology – the study of the internal structure of stars through their intrinsic oscillations – of red-giant stars. I will conclude by discussing galactic archæology – the study of the formation and evolution of the Milky Way by reconstructing its past from its current constituents – and the role red-giant stars can play in that.

Published in the IV$^{\text{th}}$ Azores International Advanced School in Space Sciences on "Asteroseismology and Exoplanets: Listening to the Stars and Searching for New Worlds" (arXiv:1709.00645), which took place in Horta, Azores Islands, Portugal in July 2016 (Lecture)
Available from https://arxiv.org/abs/1711.02178

Job Advert

Postdoctoral position in Evolved Stars research

A postdoctoral position is available in the Evolved Stars group of the Chalmers Department of Space, Earth and Environment. The position will be hosted within the Galactic astronomy unit of the Astronomy and Plasma Physics division, as part of the research groups of Professor Hans Olofsson and Wouter Vlemmings. The Galactic astronomy research unit is situated at the Onsala Space Observatory, the Swedish National Facility for Radio Astronomy. The observatory operates telescopes in Sweden, shares in the APEX telescope in Chile, and hosts the Nordic ALMA Regional Center (ARC). The research topics of the Galactic astronomy group cover Galactic star formation to evolved stars; other topics covered at the division include galaxy formation and evolution, and galaxy clusters. Evolved Stars research at the unit is well established and include about 10 members and several associated scientists at collaborating institutes.

A successful applicant is expected to contribute to several ongoing research programs in the Evolved Stars group. Additionally, the successful applicant is encouraged to lead an ambitious, independent research program related to Evolved Stars for a significant fraction of the position. This program should be aligned with the wide range of research at Chalmers, including the Onsala Space Observatory and ALMA ARC Node. The relevant themes include evolved stars from the AGB to post-AGB and Planetary Nebula phases, the circumstellar medium, and astrochemistry, from an observational perspective, primarily through molecular line observations.

The position is offered for a three-year (1+1+1) period at postdoc/researcher level.

Application details can be found in the online application system.

Application deadline: 31 January 2018

For questions, please contact:
Wouter Vlemmings, wouter.vlemmings@chalmers.se, and/or Hans Olofsson, hans.olofsson@chalmers.se

See also http://www.chalmers.se/en/about-chalmers/vacancies/?rmpage=job&rmjob=5635

Announcements

The Cosmic Cycle of Dust and Gas in the Galaxy: from Old to Young Stars

The registration for the conference "The Cosmic Cycle of Dust and Gas in the Galaxy: from Old to Young Stars" is now open. This conference will take place at the International Centre for Interdisciplinary Science and Education (ICISE) located in the beautiful coastal city Quy Nhon in central Vietnam (July 9th to July 13th, 2018).

Organized in the framework of "Rencontres du Vietnam", a conference on the evolution of gas and dust from evolved to young stars will bring astronomers working on the circumstellar environment of evolved stars and star (and planet) forming regions together with planetologists working on the origin of the solar system. In July 2016, in the same cycle of conferences, "Blowing In the Wind" had addressed issues related to the relevant dynamics. In July 2017, another conference of the same cycle, "Star Formation in Different Environments" focused on how stars form. The July 2018 conference will be dedicated to the physico–chemistry and evolution of gas and dust. It will review state-of-the-art knowledge of the molecular and dust components of envelopes and shells surrounding supernovæ, AGB stars and planetary nebulæ as well as diffuse, cold and giant molecular clouds. Special sessions will be dedicated to the origin and evolution of matter in the solar system: meteorites, *Rosetta*, etc. Recent observations, in particular using ALMA, are the source of major progress in the study of the cosmic cycle of the Galaxy, making such a conference very timely.

An updated list of confirmed invited speakers can be found at:
https://cosmiccycle2018.sciencesconf.org/resource/page/id/6

Researchers are invited to submit contributed talks and posters.

Key dates:

- Call for contributed talks: November 20th 2017
- End of early-bird registration May 8th 2018
- Oral contribution submission deadline: May 8th
- Poster contribution submission deadline: June 1st
- Regular registration deadline: June 15th
- Conference starts: July 9th

See also https://cosmiccycle2018.sciencesconf.org/

Cloudy workshop at NARIT in Chiang Mai, Thailand, May 14–25, 2018

The next Cloudy workshop will be at the National Astronomical Research Institute of Thailand (NARIT), in Chiang Mai, Thailand, May 14–25, 2018. The workshop will be patterned after the very successful program at INAOE, Tonantzintla, México, lasting two weeks with three speakers. For more details visit the workshop website at NARIT.

See also http://www.narit.or.th/en/index.php/cloudy