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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

Happy New Year! It is a pleasure to present you the 198$^{\rm th}$ issue of the AGB Newsletter.

Congratulations to Paul Beck who obtained his Ph.D. at Leuven University on the topic of asteroseismology of red giant stars. We wish him all the best in his future endeavours.

There are some terrific jobs and Ph.D. places working with fantastic people: in Onsala and in Melbourne, for instance.

Please see the Food for Thought below; contributions are welcome on the point of recent developments in our field, until the end of this month for the 199$^{\rm th}$ issue, and about research priorities by the end of February for the 200$^{\rm th}$ issue.

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

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

What have been the most significant developments in our field since 2005?
What are the most pressing issues to resolve in the next hundred months?

Reactions to this statement or suggestions for next month's statement can be e-mailed to agbnews@astro.keele.ac.uk (please state whether you wish to remain anonymous)

Refereed Journal Papers

Submillimeter polarisation and magnetic field properties in the envelopes of proto-planetary nebulæ CRL 618 and OH 231.8+4.2

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We have carried out continuum and line polarisation observations of two Proto-Planetary Nebulæ (PPNe), CRL 618 and OH 231.8+4.2, using the Submillimeter Array (SMA) in its compact configuration. The frequency range of observations, 330–345 GHz, includes the CO($J = 3 \rightarrow 2$) line emission. CRL 618 and OH 231.8+4.2 show quadrupolar and bipolar optical lobes, respectively, surrounded by a dusty envelope reminiscent of their AGB phase. We report a detection of dust continuum polarised emission in both PPNe above 4-σ but no molecular line polarisation detection above a 3-σ limit. OH 231.8+4.2 is slightly more polarised on average than CRL 618 with a mean fractional polarisation of 4.3 and 0.3 per cent, respectively. This agrees with the previous finding that silicate dust shows higher polarisation than carbonaceous dust. In both objects, an anti-correlation between the fractional polarisation and the intensity is observed. Neither PPNe show a well defined toroidal equatorial field, rather the field is generally well aligned and organised along the polar direction. This is clearly seen in CRL 618 while in the case of OH 231.8+4.2, the geometry indicates an X-shaped structure coinciding overall with a dipole/polar configuration. However in the later case, the presence of a fragmented and weak toroidal field should not be discarded. Finally, in both PPNe, we observed that the well organised magnetic field is parallel with the major axis of the ^{12}CO outflow. This alignment could indicate the presence of a magnetic outflow launching mechanism. Based on our new high resolution data we propose two scenarios to explain the evolution of the magnetic field in evolved stars.

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Available from arXiv:1312.0272

Investigating potential planetary nebula/cluster pairs

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Fundamental parameters characterizing the end-state of intermediate-mass stars may be constrained by discovering planetary nebulæ (PNe) in open clusters (OCs). Cluster membership may be exploited to establish the distance,

luminosity, age, and physical size for PNe, and the intrinsic luminosity and mass of its central star. Four potential PN–OC associations were investigated to assess the cluster membership for the PNe. Radial velocities were measured from intermediate-resolution optical spectra, complemented with previous estimates in the literature. When the radial velocity study supported the PN/OC association, we analyzed whether other parameters (e.g., age, distance, reddening, central star brightness) were consistent with this conclusion. Our measurements imply that the PNe VBe 3 and HeFa 1 are not members of the OCs NGC 5999 and NGC 6067, respectively, and that they very likely belong to the background Bulge population. Conversely, consistent radial velocities indicate that NGC 2452/NGC 2453 could be associated, but our results are not conclusive so additional observations are warranted. Finally, we demonstrate that all the available information point to He 2-86 being a young, highly internally obscured PN member of NGC 4463. New near-infrared photometry acquired via the Vista Variables in the Via Lactea ESO public survey was used in tandem with existing UBV photometry to measure the distance, reddening, and age of NGC 4463, finding $d = 1.55 \pm 0.10$ kpc, $E(B-V) = 0.41 \pm 0.02$ mag, and $\tau = 65 \pm 10$ Myr, respectively. The same values should be adopted for the PN if the proposed cluster membership is confirmed.

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New light on the multiple jets of CRL 618

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Context: Proto-planetary nebulæ (pPN) are thought to represent the transitory phase of the late stages of low- to intermediate-mass stars. Most pPNe show a bipolar or multipolar geometry. The process(es) that transforms the spherical asymptotic giant branch (AGB) ejecta into a bipolar/multipolar geometry is not known in detail. Interactions between stars in a binary system are suspected to cause the departure from spherical symmetry.
Aims: We aim to determine wether the existence of a binary source that ejects a wind (from the primary) and a bipolar precessing jet with a time-dependent ejection velocity (from the orbiting companion) could produce the morphology and kinematics of the well-known multipolar pPN CRL 618.
Methods: We applied an anisotropic wavelet analysis to the [S II] *Hubble* Space Telescope (HST) images of CRL 618 to determine the charateristic sizes of various small-scale structures across and along the optical jets of CRL 618. From the archival [S II] HST images of CRL 618 with a 10.7 yr time base, we carried out proper-motion measurements of the emission structures observed in the lobes of CRL 618. We computed six 3D numerical simulations of a precessing, time-dependent ejection velocity jet launched from a hypothetical companion star of a binary system.
Results: We found the proper motions to be well aligned with the jet axis with tangential velocities ranging from 60 to 430 km s^{-1}. The tangential velocity is a monotonically increasing function of the distance to the central source. We found that our numerical simulations reproduce the morphology and proper-motion measurements of CRL 618 when we considered a trend of decreasing jet velocity with time to reproduce the tangential velocity vs. distance dependence.
Conclusions: From the comparison we made between the structure and proper motions observed in CRL 618 and predictions from 3D jet simulations, we found that the size and morphology of the lobes and the proper motion behavior of CRL 618 can be explained in terms of a well-collimated bipolar ejection, a precession of the outflow axis, an approximately periodic time-variability of the outflow velocity (with a period of ~ 15 yr), and a long-term trend of decreasing outflow velocities from dynamical timescales of 50 yr towards more recent times.

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VLA survey of 22 GHz H_2O masers toward ten silicate carbon stars

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Despite their carbon-rich photospheres, silicate carbon stars show evidence of oxygen-rich circumstellar material, which is thought to exist in disks. Silicate carbon stars represent interesting cases that allow us to study the possible effects of binarity on stellar evolution and the mass loss accompanied by the formation of disks. We present a small survey of 22 GHz H_2O masers toward ten silicate carbon stars with much better sensitivity than is the case for previous observations. We observed our sample with the Karl G. Jansky Very Large Array (VLA) using the most expanded configuration (A-configuration) with a maximum baseline of 36 km. For some of our program stars with noisy Infrared Astronomical Satellite (IRAS) Low Resolution Spectra (LRS), we present new mid-IR spectra obtained with the Very Large Telescope Interferometer and the *Spitzer* Space Telescope. We detected the H_2O masers toward five out of ten silicate carbon stars (EU And, V778 Cyg, IRAS 06017+1011, V1415 Cyg, and NC 83 = V1945 Cyg), with NC 83 being a new detection. No H_2O masers were detected toward BM Gem, IRAS 07221−0431, IRAS 08002−3803, IRAS 18006−3213, and HD 189605. The velocity separation between the most blue- and red-shifted maser features is 10–14 km s^{-1}. If we assume that the masers originate in circum-companion disks, the measured velocity separations translate into a lower limit of the rotational velocity of 5–7 km s^{-1}, and the upper limit of the radius of the maser emitting region is estimated to be 10–68 au for a companion mass of 0.5–1.7 $M_\odot$. The new mid-IR spectra of NC 83, IRAS 06017+1011, and HD 189605 confirm the 10-μm silicate emission. The latter two stars show a bump at $\sim$ 11.5 μm, which is presumably due to SiC originating in the ongoing mass loss from the carbon-rich primary star, not due to crystalline silicate. We also report on the detection of the UV flux at 2271 Å toward HD 189605.

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High spectral resolution spectroscopy of the SiO fundamental lines in red giants and red supergiants with VLT/VISIR

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The mass-loss mechanism in red giants and red supergiants is not yet understood well. The SiO fundamental lines near 8 μm are potentially useful for probing the outer atmosphere, which is essential for clarifying the mass-loss mechanism. However, these lines have been little explored until now. We present high spectral resolution spectroscopic observations of the SiO fundamental lines near 8.1 μm in 16 bright red giants and red supergiants. Our sample consists of seven normal (i.e., non-Mira) K–M giants (from K1.5 to M6.5), three Mira stars, three optically bright red supergiants, two dusty red supergiants, and the enigmatic object GC IRS3 near the Galactic center. Our program stars were observed between 8.088 μm and 8.112 μm with a spectral resolving power of 30 000 using VLT/VISIR. We detected SiO fundamental lines in all of our program stars except for GC IRS3. The SiO lines in normal K and M giants as well as optically bright (i.e., not dusty) red supergiants do not show P-Cygni profiles or blueshifts, which means the absence of systematic outflows in the SiO line forming region. We detected P-Cygni profiles in the SiO lines in the dusty red supergiants VY CMa and VX Sgr, with the latter object being a new detection. These SiO lines originate in the outflowing gas with the thermal dust continuum emission seen as the background. The outflow velocities of the SiO line forming region in VY CMa and VX Sgr are estimated to be 27 km s^{-1} and 17 km s^{-1}, respectively. We derived basic stellar parameters (effective temperature, surface gravity, luminosity, and mass) for the normal K–M giants and optically bright red supergiants in our sample and compared the observed VISIR spectra with synthetic spectra predicted from MARCS photospheric models. Most of the SiO lines observed in the program stars warmer than $\sim$ 3400 K are reasonably reproduced by the MARCS models, which allowed us to estimate the silicon abundance as well as the $^{28}Si/^{29}Si$ and $^{28}Si/^{30}Si$ ratios. However, we detected possible absorption excess in some SiO lines. Moreover,

the SiO lines in the cooler red giants and red supergiant cannot be explained by the MARCS models at all, even if the dust emission is taken into account. This disagreement may be a signature of the dense, extended molecular outer atmosphere.

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Near-infrared imaging of white dwarfs with candidate debris disks

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We have carried out $JHK_{\rm s}$ imaging of 12 white dwarf debris disk candidates from the WIRED SDSS DR7 catalog, aiming to confirm or rule out disks among these sources. On the basis of positional identification and the flux density spectra, we find that seven white dwarfs have excess infrared emission, but mostly at WISE W1 and W2 bands, four are due to nearby red objects consistent with background galaxies or very low mass dwarfs, and one exhibits excess emission at $JHK_{\rm s}$ consistent with an unresolved L0 companion at the correct distance. While our photometry is not inconsistent with all seven excesses arising from disks, the stellar properties are distinct from the known population of debris disk white dwarfs, making the possibility questionable. In order to further investigate the nature of these infrared sources, warm *Spitzer* imaging is needed, which may help resolve galaxies from the white dwarfs and provide more accurate flux measurements.

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The core mass growth and stellar lifetime of thermally pulsing asymptotic giant branch stars

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We establish new constraints on the intermediate-mass range of the initial–final mass relation by studying white dwarfs in four young star clusters, and apply the results to study the evolution of stars on the thermally pulsing asymptotic giant branch (TP-AGB). We show that the stellar core mass on the AGB grows rapidly from 10% to 30% for stars with $M_{\rm initial} = 1.6$ to 2.0 $M_{\odot}$. At larger masses, the core-mass growth decreases steadily to $\sim 10\%$ at $M_{\rm initial} = 3.4$ $M_{\odot}$. These observations are in excellent agreement with predictions from the latest TP-AGB evolutionary models in Marigo et al. (2013). We also compare to models with varying efficiencies of the third dredge-up and mass loss, and demonstrate that the process governing the growth of the core is largely the stellar wind, while the third dredge-up plays a secondary, but non-negligible role. Based on the new white dwarf measurements, we perform an exploratory calibration of the most popular mass-loss prescriptions in the literature. Finally, we estimate the lifetime and the integrated luminosity of stars on the TP-AGB to peak at $t \sim 3$ Myr and $E = 1.2 \times 10^{10}$ $L_{\odot}$ yr for $M_{\rm initial} \sim 2$ $M_{\odot}$ ($t \sim 2$ Myr for luminosities brighter than the RGB tip at $\log(L/L_{\odot}) > 3.4$), decreasing to $t = 0.4$ Myr and $E = 6.1 \times 10^{9}$ $L_{\odot}$ yr for stars with $M_{\rm initial} \sim 3.5$ $M_{\odot}$. The implications of these results are discussed with respect to general population synthesis studies that require correct modeling of the TP-AGB phase of stellar evolution.

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The eclipsing post-common envelope binary CSS 21055: a white dwarf with a probable brown-dwarf companion

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We report photometric observations of the eclipsing close binary CSS 21055 (SDSS J141126+200911) that strongly suggest that the companion to the carbon–oxygen white dwarf is a brown dwarf with a mass between 0.030 and 0.074 $M_\odot$. The measured orbital period is 121.73 min and the totality of the eclipse lasts 125 s. If confirmed, CSS 21055 would be the first detached eclipsing WD+BD binary. Spectroscopy in the eclipse could provide information about the companion's evolutionary state and atmospheric structure.

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Opacity of fluffy aggregates

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Context: Dust grains coagulate in protoplanetary disks to form fluffy aggregates. Theoretical and experimental studies have shown that the internal density of dust aggregates is expected to be as small as 10^{-4} g cm^{-3}. Disk observations, on the other hand, are interpreted as the emission from compact grains. The emission may come from fluffy aggregates. However, optical properties of such fluffy aggregates have been poorly understood.
Aims: We aim to reveal the mass opacity of fluffy aggregates at from infrared to millimeter wavelengths with the filling factor ranging from 1 down to 10^{-4}.
Methods: We use Mie calculations with an effective medium theory. The monomers are assumed to be 0.1 μm-sized grains, which is much shorter than the wavelengths which we focus on.
Results: We find that the absorption mass opacity of fluffy aggregates are well characterized by the product $a \times f$, where a is the dust radius and f is the filling factor, except for the interference structure. The scattering mass opacity is also well characterized by $a \times f$ at short wavelengths while it is higher in more fluffy aggregates at long wavelengths. We also derive the analytic formula of the mass opacity and find that it well reproduces the Mie calculations. We also calculate the expected difference of the emission between compact and fluffy aggregates in protoplanetary disks with a simple dust growth and drift model. We find that the compact and fluffy aggregates can be distinguished by the radial distribution of the opacity index β. The previous observation of the radial distribution of β is consistent with the fluffy case, but more observations are required to distinguish fluffy or compact. In addition, we find that the scattered light would be another clue to distinguish the compact and fluffy aggregates.

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Submillimeter H_2O masers in water-fountain nebulæ

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We report the first detection of submillimeter water maser emission toward water-fountain nebulæ, which are post-AGB stars that exhibit high-velocity water masers. Using APEX we found emission of the ortho-H_2O ($10_{29} \rightarrow 9_{36}$) transition at 321.226 GHz toward three sources: IRAS 15445−5449, IRAS 18043−2116 and IRAS 18286−0959. Similarly to the 22 GHz masers, the submillimeter water masers are expanding with a velocity larger than that of the OH masers, suggesting that these masers also originate in fast bipolar outflows. While in IRAS 18043−2116 and IRAS 18286−0959, which figure among the sources with the fastest water masers, the velocity range of the 321 GHz masers coincides with that of the 22 GHz masers, the submillimeter masers of IRAS 15445−5449 appear in a different velocity range. This indicates that the 321 GHz and 22 GHz masers could be coexisting in the first two sources, but they are tracing different regions in the later one. The intensity of the submillimeter masers is comparable to that of the 22 GHz masers, implying that the kinetic temperature of the region where the masers originate should be $T_k > 1000$ K. We propose that the passage of two shocks through the same gas can create the conditions necessary to explain the presence of strong high-velocity 321 GHz masers coexisting with the 22 GHz masers in the same region.

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Chemical composition of the atmospheres of red giants with high space velocities

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The results of a comparative analysis of the elemental abundances in the atmospheres of 14 red giants with high Galactic space velocities are presented. For almost all of the chemical elements considered, the their abundance trends with metallicity correspond to those constructed for thick-disk dwarfs. In the case of sodium, the main factor affecting the [Na/Fe] abundance in the stellar atmosphere for red giants is the surface gravity that characterizes the degree of development of the convective envelope. The difference between the [Na/Fe] abundances in the atmospheres of thin-and thick-disk red giants has been confirmed.

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Sodium in the atmospheres of thick-disk red giants

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The parameters and elemental abundances of atmospheres for ten thick-disk red giants was determined from high-resolution spectra by the method of model stellar atmospheres. The results of a comparative analysis of the [Na/Fe]

abundances in the atmospheres of the investigated stars and thin-disk red giants are presented. Sodium in the atmospheres of thick-disk red giants is shown to have no overabundances typical of thin-disk red giants.

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Light curves of symbiotic stars in massive photomeric surveys II: S and D′-type systems

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We present results of period analysis of ASAS, MACHO and OGLE light curves of 79 symbiotic stars classified as S and D′-type. The light curves of 58 objects show variations with the orbital period. In case of 34 objects, orbital periods are estimated for the first time, what increases the number of symbiotic stars with known orbital periods by about 64%. The light curves of 46 objects show, in addition to the long-term or/and orbital variations, short-term variations with time scales of 50–200 days most likely due to stellar pulsations of the cool giant component. We also report eclipse-like minima and outbursts present in many of the light curves.

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Can the magnetic field in the Orion arm inhibit the growth of instabilities in the bow shock of Betelgeuse?

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Many evolved stars travel through space at supersonic velocities, which leads to the formation of bow shocks ahead of the star where the stellar wind collides with the interstellar medium (ISM). *Herschel* observations of the bow shock of α Orionis show that the shock is almost free of instabilities, despite being, at least in theory, subject to both Kelvin–Helmholtz and Rayleigh–Taylor instabilities. A possible explanation for the lack of instabilities lies in the presence of an interstellar magnetic field. We wish to investigate whether the magnetic field of the ISM in the Orion arm can inhibit the growth of instabilities in the bow shock of α Orionis. We used the code MPI-AMRVAC to make magneto-hydrodynamic simulations of a circumstellar bow shock, using the wind parameters derived for α Orionis and interstellar magnetic field strengths of B = 1.4, 3.0, and 5.0 μG, which fall within the boundaries of the observed magnetic field strength in the Orion arm of the Milky Way. Our results show that even a relatively weak magnetic field in the interstellar medium can suppress the growth of Rayleigh–Taylor and Kelvin–Helmholtz instabilities, which occur along the contact discontinuity between the shocked wind and the shocked ISM. The presence of even a weak magnetic field in the ISM effectively inhibits the growth of instabilities in the bow shock. This may explain the absence of such instabilities in the *Herschel* observations of α Orionis.

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Pulsating red giant stars in eccentric binary systems discovered from *Kepler* space-based photometry

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The unparalleled photometric data obtained by NASA's *Kepler* space telescope led to an improved understanding of red giant stars and binary stars. Seismology allows us to constrain the properties of red giants. In addition to eclipsing binaries, eccentric non-eclipsing binaries, exhibiting ellipsoidal modulations, have been detected with *Kepler*.
We aim to study the properties of eccentric binary systems containing a red giant star and derive the parameters of the primary giant component.
We apply asteroseismic techniques to determine masses and radii of the primary component of each system. For a selected target, light and radial velocity curve modelling techniques are applied to extract the parameters of the system and its primary component. Stellar evolution and its effects on the evolution of the binary system are studied from theoretical models.
The paper presents the asteroseismic analysis of 18 pulsating red giants in eccentric binary systems, for which masses and radii were constrained. The orbital periods of these systems range from 20 to 440 days. The results of our ongoing radial velocity monitoring program with the HERMES spectrograph reveal an eccentricity range of $e = 0.2$ to 0.76. As a case study we present a detailed analysis of KIC 5006817, whose rich oscillation spectrum allows for a detailed seismic analysis. From seismology we constrain the rotational period of the envelope to be at least 165 d, which is roughly twice the orbital period. The stellar core rotates 13 times faster than the surface. From the spectrum and radial velocities we expect that the Doppler beaming signal should have a maximum amplitude of 300 ppm in the light curve. Fixing the mass and radius to the asteroseismically determined values, from our binary modelling we find a value of the gravity darkening exponent that is significantly larger than expected. Through binary modelling, we determine the mass of the secondary component to be 0.29 ± 0.03 $M_{\odot}$.
For KIC 5006817 we exclude pseudo-synchronous rotation of the red giant with the orbit. The comparison of the results from seismology and modelling of the light curve shows a possible alignment of the rotational and orbital axis at the 2σ level. Red giant eccentric systems could be progenitors of cataclysmic variables and hot subdwarf B stars.

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Using kinematic properties of pre-planetary nebulæ to constrain engine paradigms

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Some combination of binary interactions and accretion plausibly conspire to produce the ubiquitous collimated outflows from planetary nebulæ (PN) and their presumed pre-planetary nebulæ (PPN) precursors. But which accretion engines are viable? The difficulty in observationally resolving the engines warrants the pursuit of indirect constraints. We show how kinematic outflow data for 19 PPN can be used to determine the minimum required accretion rates. We consider main sequence (MS) and white dwarf (WD) accretors and five example accretion rates inferred from published models to compare with the minima derived from outflow momentum conservation. While our primary goal is to show the method in anticipation of more data and better theoretical constraints, taking the present results at face value already rule out modes of accretion: Bondi–Hoyle–Lyttleton (BHL) wind accretion and wind Roche lobe overflow (M-WRLOF, based on Mira parameters) are too feeble for all 19/19 objects for a MS accretor. For a WD accretor, BHL is ruled out for 18/19 objects and M-WRLOF for 15/19 objects. Roche lobe overflow from the primary can seemingly accommodate 7/19 objects but only accretion modes operating from within common envelope evolution seem to be able to accommodate all 19 objects. Sub-Eddington rates for a MS accretor are acceptable but 8/19 would require super-Eddington rates for a WD.

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Evolution of thermally pulsing asymptotic giant branch stars III. Dust production at supersolar metallicities

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We extend the formalism presented in our recent calculations of dust ejecta from the Thermally Pulsing Asymptotic Giant Branch (TP-AGB) phase, to the case of super-solar metallicity stars. The TP-AGB evolutionary models are computed with the COLIBRI code. We adopt our preferred scheme for dust growth. For M-giants, we neglect chemisputtering by H_2 molecules and, for C-stars we assume a homogeneous growth scheme which is primarily controlled by the carbon over oxygen excess. At super-solar metallicities, dust forms more efficiently and silicates tend to condense significantly closer to the photosphere ($r \sim 1.5R_\star$) – and thus at higher temperatures and densities – than at solar and sub-solar metallicities ($r \sim 2$–$3\ R_\star$). In such conditions, the hypothesis of thermal decoupling between gas and dust becomes questionable, while dust heating due to collisions plays an important role. The heating mechanism delays dust condensation to slightly outer regions in the circumstellar envelope. We find that the same mechanism is not significant at solar and sub-solar metallicities. The main dust products at super-solar metallicities are silicates. We calculate the total dust ejecta and dust-to-gas ejecta, for various values of the stellar initial masses and initial metallicities $Z = 0.04$, 0.06. Merging these new calculations with those for lower metallicities it turns out that, contrary to what often assumed, the total dust-to-gas ejecta of intermediate-mass stars exhibit only a weak dependence on the initial metal content.

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Observed relationship between CO(2–1) and dust emission during post-AGB phase

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A CO(2–1) line survey is performed toward a sample of 58 high Galactic latitude post-AGB (pAGB) stars. To complement the observations, a compilation of literature CO(2–1) line data of known pAGB stars is done. After combining the datasets, CO(2–1) line data are available for 133 pAGB stars (about 34 per cent of known pAGB stars) among which 44 are detections. The CO line strengths are compared with infrared dust emission for these pAGB stars by defining a ratio between the integrated CO(2–1) line flux and IRAS 25-μm flux density (CO–IR ratio). The relationship between the CO-IR ratio and the IRAS color C23 (defined with the 25- and 60-μm flux densities) is called here the CO–IR diagram. The pAGB objects are found to be located between AGB stars and planetary nebulæ (PNe), and segregate into three distinctive groups (I, II and III) on the CO–IR diagram. By analyzing their various properties such as chemical types, spectral types, binarity, circumstellar envelope expansion velocities, and pAGB sub-types on the CO–IR diagram, it is argued that the group-I objects are mainly intermediate mass C-rich pAGB stars in early pAGB stage (almost all of the considered carbon rich "21-μm" stars belong to this group); the group-II objects are massive or intermediate mass pAGB stars which already follow the profound trend of PNe; and the group-III objects are mainly low mass binary pAGB stars with very weak CO(2–1) line emission (almost all of the considered RV Tau variables belong to this group). The CO–IR diagram is proven to be a powerful tool to investigate the co-evolution of circumstellar gas and dust during the short pAGB stage of stellar evolution.

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Constraining the age of the NGC 4565 H I disk warp: determining the origin of gas warps

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We have mapped the distribution of young and old stars in the gaseous H I warp of NGC 4565. We find a clear correlation of young stars (< 600 Myr) with the warp, but no coincident old stars (> 1 Gyr), which places an upper limit on the age of the structure. The formation rate of the young stars, which increased ~ 300 Myr ago relative to the surrounding regions, is $(6.3^{+2.5}_{-1.5}) \times 10^{-5}$ M$_\odot$ yr^{-1} kpc^{-2}. This implies a $\sim 60 \pm 20$ Gyr depletion time of the H I warp, similar to the timescales calculated for the outer H I disks of nearby spiral galaxies. While some stars associated with the warp fall into the asymptotic giant branch (AGB) region of the color magnitude diagram, where stars could be as old as 1 Gyr, further investigation suggests that they may be interlopers rather than real AGB stars. We discuss the implications of these age constraints for the formation of H I warps, and the gas fueling of disk galaxies.

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Thesis

Asteroseismology of red-giant stars: mixed modes, differential rotation, and eccentric binaries

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Astronomers are aware of rotation in stars since Galileo Galilei attributed the movement of sunspots to rotation of the Sun in 1613. In contrast to the Sun, whose surface can be resolved by small telescopes or even the (protected) eye, we detect stars as point sources with no spatial information. Numerous techniques have been developed to derive information about stellar rotation. Unfortunately, most observational data allow only for the surface rotational rate to be inferred. The internal rotational profile, which has a great effect on the stellar structure and evolution, remains hidden below the top layers of the star – the essential is hidden to the eyes.

Asteroseismology allows us to "sense" indirectly deep below the stellar surface. Oscillations that propagate through the star provide information about the deep stellar interiors while they also distort the stellar surface in characteristic patterns leading to detectable brightness or velocity variations. Also, certain oscillation modes are sensitive to internal rotation and carry information on how the star is spinning deep inside. Thanks to the unprecedented quality of NASA's space telescope *Kepler*, numerous detailed observations of stars in various evolutionary stages are available. Such high quality data allow that for many stars, rotation can not only be constrained from surface rotation, but also investigated through seismic studies.

The work presented in this thesis focuses on the oscillations and internal rotational gradient of evolved single and binary stars. It is shown that the seismic analysis can reach the cores of oscillating red-giant stars and that these cores are rapidly rotating, while nested in a slowly rotating convective envelope.

Leuven University, Belgium
Available from http://fys.kuleuven.be/ster/pub/phd-thesis-paul-beck/phd-thesis-paul-beck

Job Adverts

Chalmers University of Technology, Onsala Space Observatory, Sweden PhD and postdoc position: Evolved stellar outflows and magnetic fields

Applications are invited for a postdoctoral and PhD position in the study of evolved stars at the Department of Earth and Space Science, Chalmers University of technology, Sweden. The starting date of the positions is anticipated before June 2014.

The ERC funded research will focus on radio/sub-mm observations of evolved stars with instruments as ALMA, JVLA, eMERLIN and APEX. The PhD position will be focused on observations and modeling of evolved star magnetic fields. The postdoc will work on related topics and will also be able to carry out their own research in collaboration with affiliated group members.

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Interested postdoc applicants should have a PhD in astrophysics by the start of the appointment. For the PhD student position a MSc in astronomy or physics is required. Experience with stellar evolution, magnetic fields or interferometry would be an asset. Applicants should send CV, description of research interests and a publication list, and arrange for two letters of reference to be sent directly to Dr. Wouter Vlemmings at wouter.vlemmings@chalmers.se

Note that the application deadline is already at January 15th 2014!
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See also http://jobregister.aas.org/node/46734

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The Monash Centre for Astrophysics has very active research groups in Stellar Interiors and Nucleosynthesis (SINs – Professor John Lattanzio, Dr. Maria Lugaro, Professor Alexander Heger, Dr. Simon Campbell, Dr. Bernhard Müller), High-energy Astrophysics (Dr. Duncan Galloway, Dr. Yuri Levin, Dr. Alina Donea, Professor Alexander Heger, Dr. Daniel Price, Dr. Bernhard Müller, Dr. Jasmina Lazendić-Galloway), Astrophysical Fluid Dynamics and MHD (including the inventor of SPH, Professor Joe Monaghan; and Dr. Daniel Price – star formation), Galaxy Evolution (Dr. Michael Bown), Numerical General Relativity, and Australia's leading research group on Solar Physics, amongst others. (see http://moca.monash.edu/research)

MoCA spans both the School of Mathematical Sciences and the School of Physics and holds weekly seminars throughout the year attracting a number of visitors from around the world. It has a weekly journal club, and an active visitor program including a special program for longer stays of distinguished visitors.

See also http://jobs.monash.edu.au/jobDetails.asp?sJobIDs=518885&lWorkTypeID=&

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Currently the school supports an array of major instrumentation, which includes condensed matter physics laboratories for investigating 2D materials, laser trapping and cooling (BEC) laboratories, atom optics laboratories; advanced X-ray facilities (e.g., SAXS/WAXS, rotating anode X-ray system). The school has access to advanced electron microscopy and microanalysis facilities (via the Monash Centre for Electron Microscopy) and is also a large user of overseas synchrotron radiation facilities (e.g., SPring-8, Photon Factory, ESRF and the APS); researchers in the school are actively involved with beamline development at the Australian Synchrotron, which is adjacent to Monash University.

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For more information about the School of Physics visit http://monash.edu/science/about/schools/physics/

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