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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 184$^{\rm th}$ issue of the AGB Newsletter. This month's edition is particularly voluminous and appears to be dominated by the phenomenon of binarity and its associated phenomena such as symbiosis, novæ and mergers/engulfment. Let that not make you miss the other interesting contributions, for example on circumstellar grains (solid SiO!) and molecules (fullerenes and the like).

To carry on the binarity theme, please join us in congratulating Joseph Roche with his Ph.D. thesis on EG Andromedæ.

And if that is not enough, why not spend a warm week in Cape Town immersing yourself in the topic of Stella Novæ? (Or the ocean.) See the announcement at the back of the newsletter.

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

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Would it not be great if publicly available evolutionary tracks incorporated the effects of binarity?

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

A new method of determining the characteristics of evolved binary systems revealed in the observed circumstellar patterns: Application to AFGL 3068

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The binary characteristics of asymptotic giant branch (AGB) stars are imprinted in the asymmetric patterns of their circumstellar envelopes. We develop a simple method for constraining the orbital parameters of such binary stars from the characteristics of a spiral-like pattern observed at large distances from the central stars. We place constraints on the properties of AFGL 3068 (i.e. the masses of binary components, the viewing inclination of the orbital plane, as well as the orbital period, velocity, and separation). In particular, the mass of the companion star of AFGL 3068 is estimated to be greater than 2.6 $M_{\odot}$. This method is applicable to other AGB stars, providing a step toward understanding the role binary stars can play in explaining the diverse patterns in observed circumstellar envelopes.

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An infrared study of fullerene planetary nebulae

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We present a study of sixteen Planetary Nebulae (PNe) where fullerenes have been detected in their *Spitzer* Space Telescope spectra. This large sample of objects offers an unique opportunity to test conditions of fullerene formation and survival under different metallicity environments as we are analyzing five sources in our own Galaxy, four in the Large Magellanic Cloud, and seven in the Small Magellanic Cloud. Among the sixteen PNe under study, we present the first detection of C_{60} (possibly also C_{70}) fullerenes in the PN M 1-60 as well as of the unusual $\sim$ 6.6, 9.8, and 20 μm features (attributed to possible planar C_{24}) in the PN K 3-54. Although selection effects in the original samples of PNe observed with *Spitzer* may play a potentially significant role in the statistics, we find that the detection rate of fullerenes in C-rich PNe increases with decreasing metallicity ($\sim$ 5% in the Galaxy, $\sim$ 20% in the LMC, and $\sim$ 44% in the SMC) and we interpret this as a possible consequence of the limited dust processing occuring in Magellanic Cloud (MC) PNe. CLOUDY photoionization modeling matches the observed IR fluxes with central stars that display a rather narrow range in effective temperature ($\sim 30,000$–45,000 K), suggesting a common evolutionary status of the objects and similar fullerene formation conditions. Furthermore, the data suggest that fullerene PNe likely evolve from low-mass progenitors and are usually of low-excitation. We do not find a metallicity dependence on the estimated fullerene abundances. The observed C_{60} intensity ratios in the Galactic sources confirm our previous finding in the MCs that the fullerene emission is not excited by the UV radiation from the central star. CLOUDY models also show that line- and wind-blanketed model atmospheres can explain many of the observed [Ne III]/[Ne II] ratios by photoionization suggesting that possibly the UV radiation from the central star, and not shocks, are triggering the decomposition of

the circumstellar dust grains. With the data at hand, we suggest that the most likely explanation for the formation of fullerenes and graphene precursors in PNe is that these molecular species are built from the photo-chemical processing of a carbonaceous compound with a mixture of aromatic and aliphatic structures similar to that of HAC dust.

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and from http://rialto.ll.iac.es/folleto/research/preprints/?c=view&pre_id=12043

Foretellings of Ragnarök: World-engulfing asymptotic giants and the inheritance of white dwarfs

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The search for planets around white dwarf stars, and evidence for dynamical instability around them in the form of atmospheric pollution and circumstellar discs, raises questions about the nature of planetary systems that can survive the vicissitudes of the Asymptotic Giant Branch (AGB). We study the competing effects, on planets at several AU from the star, of strong tidal forces arising from the star's large convective envelope, and of the planets' orbital expansion due to stellar mass-loss. We, for the first time, study the evolution of planets while following each thermal pulse on the AGB. For Jovian planets, tidal forces are strong, and can pull into the envelope planets initially at ~ 3 AU for a 1 $M_\odot$ star and ~ 5 AU for a 5 $M_\odot$ star. Lower-mass planets feel weaker tidal forces, and Terrestrial planets initially within 1.5–3 AU enter the stellar envelope. Thus, low-mass planets that begin inside the maximum stellar radius can survive, as their orbits expand due to mass-loss. The inclusion of a moderate planetary eccentricity slightly strengthens the tidal forces experienced by Jovian planets. Eccentric Terrestrial planets are more at risk, since their eccentricity does not decay and their small pericentre takes them inside the stellar envelope. We also find the closest radii at which planets will be found around white dwarfs, assuming that any planet entering the stellar envelope is destroyed. Planets are in that case unlikely to be found inside ~ 1.5 AU of a white dwarf with a 1 $M_\odot$ progenitor and ~ 10 AU of a white dwarf with a 5 $M_\odot$ progenitor.

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Maser observations of Westerlund 1 and comprehensive considerations on maser properties of red supergiants associated with massive clusters

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We report the results of Australia Telescope Compact Array (ATCA) observations of the Westerlund 1 (Wd1) region in the SiO $v = 1$, $J = 1$–0 and H_2O 6_{16}–5_{23} maser lines, and we also report the analysis of maser properties of red supergiants (RSGs) associated with 6 massive clusters including Wd 1. The primary purpose of this research is to explore possibilities of using maser emission for investigating the nature of massive clusters and associated RSGs. The SiO $v = 1$, $J = 1$–0 and H_2O 6_{16}–5_{23} maser lines are detected toward 2 of 4 known RSGs in Wd 1. The large velocity ranges of maser emission are consistent with the RSG status. RSGs with maser emission tend to exhibit redder $\log(F_{21}/F_{12})$ and [K–12.13] colors compared to RSGs with no maser emission. The mass-loss rates derived from dust radiative transfer modeling suggest that RSGs with maser emission tend to exhibit larger mass-loss rates compared to RSGs with no maser emission. In an extended sample of 57 RSGs in 6 massive clusters, detections in the SiO line tend to homogeneously distribute in absolute luminosity L, whereas those in the H_2O line tend to distribute in a region with large L values.

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A carbon-rich Mira variable in a globular cluster: A stellar merger

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The membership of Matsunaga's variable 1, a carbon-rich, mass-losing, Mira variable, in the globular cluster Lyngå 7 is discussed on the basis of radial velocities. We conclude that it is a member, the first known C-Mira in a globular cluster. Since such a variable is expected to have an age of $\sim$ 1–2 Gyr and an initial mass of $\sim$ 1.5 $M_{\odot}$, we conclude that this star must be the product of a stellar merger.

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Multi-dimensional models of circumstellar shells around evolved massive stars

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Massive stars shape their surrounding medium through the force of their stellar winds, which collide with the circumstellar medium. Since the characteristics of these stellar winds vary over the course of the evolution of the star, the circumstellar matter becomes a reflection of the stellar evolution and can be used to determine the characteristics of the progenitor star. In particular, whenever a fast wind phase follows a slow wind phase, the fast wind sweeps up its predecessor in a shell, which is observed as a circumstellar nebula. We make 2-D and 3-D numerical simulations of fast stellar winds sweeping up their slow predecessors to investigate whether numerical models of these shells have to be 3-D, or whether 2-D models are sufficient to reproduce the shells correctly. We use the MPI-AMRVAC code, using hydrodynamics with optically thin radiative losses included, to make numerical models of circumstellar shells around massive stars in 2-D and 3-D and compare the results. We focus on those situations where a fast Wolf–Rayet star wind sweeps up the slower wind emitted by its predecessor, being either a red supergiant or a luminous blue variable. As the fast Wolf–Rayet wind expands, it creates a dense shell of swept up material that expands outward, driven by the high pressure of the shocked Wolf–Rayet wind. These shells are subject to a fair variety of hydrodynamic-radiative instabilities. If the Wolf–Rayet wind is expanding into the wind of a luminous blue variable phase, the instabilities will tend to form a fairly small-scale, regular filamentary lattice with thin filaments connecting knotty features. If the Wolf–Rayet wind is sweeping up a red supergiant wind, the instabilities will form larger interconnected structures with less regularity. The numerical resolution must be high enough to resolve the compressed, swept-up shell and the evolving instabilities, which otherwise may not even form. Our results show that 3-D models, when translated to observed morphologies, give realistic results that can be compared directly to observations. The 3-D structure of the nebula will help to distinguish different progenitor scenarios.

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WD 0837+185: the formation and evolution of an extreme mass ratio white dwarf-brown dwarf binary in Præsepe

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There is a striking and unexplained dearth of brown dwarf companions in close orbits ($<$ 3 AU) around stars more

massive than the Sun, in stark contrast to the frequency of stellar and planetary companions. Although rare and relatively short-lived, these systems leave detectable evolutionary end points in the form of white dwarf–brown dwarf binaries and these remnants can offer unique insights into the births and deaths of their parent systems. We present the discovery of a close (orbital separation ~ 0.006 AU) substellar companion to a massive white dwarf member of the Præsepe star cluster. Using the cluster age and the mass of the white dwarf we constrain the mass of the white dwarf progenitor star to lie in the range 3.5–3.7 $M_{\odot}$ (B9). The high mass of the white dwarf means the substellar companion must have been engulfed by the B star's envelope while it was on the late asymptotic giant branch (AGB). Hence, the initial separation of the system was ~ 2 AU, with common envelope evolution reducing the separation to its current value. The initial and final orbital separations allow us to constrain the combination of the common envelope efficiency (α) and binding energy parameters (λ) for the AGB star to $\alpha\lambda \sim 3$. We examine the various formation scenarios and conclude that the substellar object was most likely to have been captured by the white dwarf progenitor early in the life of the cluster, rather than forming *in situ*.

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The binary fraction of planetary nebula central stars I. A high-precision, I-band excess search

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We still do not know what causes aspherical planetary nebula morphologies. A plausible hypothesis is that they are due to the presence of a close stellar or substellar companion. So far, only ~ 40 binary central stars of planetary nebula have been detected, almost all of them with such short periods that their binarity is revealed by photometric variability. Here we have endeavoured to discover binary central stars at any separation, thus determining the unbiased binary fraction of central stars of planetary nebula. This number, when compared to the binary fraction of the presumed parent population can give a first handle on the origin of planetary nebulae. By detecting the central stars in the I band we have searched for cool companions. We have found that 30% of our sample have an I band excess detected between one and a few sigma, possibly denoting companions brighter than M3–4V and with separations smaller than ~ 1000 AU. By accounting for the undetectable companions, we determine a de-biased binary fraction of 67–78% for all companions at all separations. We compare this number to a main sequence binary fraction of (50 ± 4)% determined for spectral types F6V–G2V, appropriate if the progenitors of today's PN central star population is indeed the F6V–G2V stars. The error on our estimate cannot be constrained tightly, but we determine it to be between 10 and 30%. We conclude that the central star binary fraction may be larger than expected from the putative parent population. However, this result is based on a sample of 27 *bona fide* central stars and should be considered preliminary. The success of the I band method rests critically on high precision photometry and a reasonably large sample. From a similar analysis, using the more sensitive J band of a subset of 11 central stars, the binary fraction is 54% for companions brighter than $\sim$ M5–6V and with separations smaller than about 900 AU. De-biassing this number in the same way as was done for the I band we obtain a binary fraction of 100–107%. The two numbers should be the same and the discrepancy is likely due to small number statistics. Finally, we note how the previously-derived short period PN binary fraction of 15–20% is far larger than expected based on the main sequence binary fraction and period distribution.
As a byproduct of our analysis we present an accurately vetted compilation of observed main sequence star magnitudes, colours and masses, which can serve as a reference for future studies. We also present synthetic colours of hot stars as a function of temperature (20–170 kK) and gravity ($\log g = 6$–8) for Solar and PG 1159 compositions.

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On the survival of brown dwarfs and planets engulfed by their giant host star

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The recent discovery of two Earth-mass planets in close orbits around an evolved star has raised questions as to whether substellar companions can survive encounters with their host stars. We consider whether these companions could have been stripped of significant amounts of mass during the phase when they orbited through the dense inner envelopes of the giant. We apply the criterion derived by Murray et al. for disruption of gravitationally bound objects by ram pressure, to determine whether mass loss may have played a role in the histories of these and other recently discovered low-mass companions to evolved stars. We find that the brown dwarf and Jovian mass objects circling WD 0137−349, SDSS J08205+0008, and HIP 13044 are most unlikely to have lost significant mass during the common envelope phase. However, the Earth-mass planets found around KIC 05807616 could well be the remnant of one or two Jovian mass planets that lost extensive mass during the common envelope phase.

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Investigation of the triple-α reaction in a full three-body approach

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Background: The triple-α reaction is the key to our understanding about the nucleosynthesis and the observed abundance of ^{12}C in stars. The theory of this process is well established at high temperatures but rather ambiguous in the low temperature regime where measurements are impossible.
Purpose: Develop a new three-body method, which tackles properly the scattering boundary condition for three charged particles and takes into account both the resonant and the non-resonant reaction mechanisms on the same footing, to compute the triple-alpha reaction rate at low temperatures.
Methods: We combine the R-matrix expansion, the R-matrix propagation method, and the screening technique in the hyperspherical harmonics basis.
Results: Both the 2^+_1 bound state and the 0^+_2 resonant state in ^{12}C are well reproduced. We also study the cluster structure of these states. We calculate the triple-α reaction rate for $T = 0.01$–0.1 GK.
Conclusions: We obtain the same rate as NACRE for temperatures above 0.07 GK, but the new rate is largely enhanced at lower temperatures ($\approx 10^{12}$ at 0.02 GK). The differences are caused by the direct capture contribution to the reaction when three α particles can not reach the resonant energies.

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A 3D radiative transfer framework IX. Time dependence

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Context: Time-dependent, 3D radiation transfer calculations are important for the modeling of a variety of objects,

from supernovae and novae to simulations of stellar variability and activity. Furthermore, time-dependent calculations can be used to obtain a 3D radiative equilibrium model structure via relaxation in time.
Aims: We extend our 3D radiative transfer framework to include direct time dependence of the radiation field; i.e. the dI/dt terms are fully considered in the solution of radiative transfer problems.
Methods: We build on the framework that we have described in previous papers in this series and develop a subvoxel method for the dI/dt terms.
Results: We test the implementation by comparing the 3D results to our well tested 1D time dependent radiative transfer code in spherical symmetry. A simple 3D test model is also presented.
Conclusions: The 3D time dependent radiative transfer method is now included in our 3D RT framework and in PHOENIX/3D.

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High-resolution optical spectroscopy of DY Cen: diffuse interstellar bands in a proto-fullerene circumstellar environment?

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We search high-resolution and high-quality VLT/UVES optical spectra of the hot R Coronae Borealis (RCB) star DY Cen for electronic transitions of the C_{60} molecule and diffuse interstellar bands (DIBs). We report the non-detection of the strongest C_{60} electronic transitions (e.g., those at $\sim$ 3760, 3980, and 4024 Å). Absence of C_{60} absorption bands may support recent laboratory results, which show that the $\sim$ 7.0, 8.5, 17.4, and 18.8 μm emission features seen in DY Cen – and other similar objects with PAH-like dominated IR spectra – are attributable to proto-fullerenes or fullerene precursors rather than to C_{60}. DIBs towards DY Cen are normal for its reddening; the only exception is the DIB at 6284 Å (possibly also the 7223 Å DIB) that is found to be unusually strong. We also report the detection of a new broad (FWHM $\sim$ 2 Å) and unidentified feature centered at $\sim$ 4000 Å. We suggest that this new band may be related to the circumstellar proto-fullerenes seen at infrared wavelengths.

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Looking deep into the Cat's Eye: Structure and rotation in the fast wind of the PN central star of NGC 6543

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We present HST/STIS time-series spectroscopy of the central star of the 'Cat's Eye' planetary nebula NGC 6543. Intensive monitoring of the UV lines over a 5.8 hour period reveals well defined details of large-scale structure in the fast wind, which are exploited to provide new constraints on the rotation rate of the central star. We derive characteristics of the line profile variability that support a physical origin due to co-rotating interaction regions

(CIRs) that are rooted at the stellar surface. The recurrence time of the observed spectral signatures of the CIRs is used to estimate the rotation period of the central star and, adopting a radius between 0.3 and 0.6 $R_{\odot}$ constrains the rotational velocity to the range $54 \leq v_{\rm rot} \leq 108$ km s^{-1}. The implications of these results for single star evolution are discussed based on models calculated here for low-mass stars. Our models predict a sub-surface convective layer in NGC 6543 which we argue to be causally connected to the occurrence of structure in the fast wind.

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The WIRED Survey III: An infrared excess around the eclipsing post-common envelope binary SDSS J030308.35+005443.7

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We present the discovery with WISE of a significant infrared excess associated with the eclipsing post-common envelope binary SDSS J030308.35+005443.7, the first excess discovered around a non-interacting white dwarf+main sequence M dwarf binary. The spectral energy distribution of the white dwarf+M dwarf companion shows significant excess longwards of 3 μm. A $T_{\rm eff}$ of 8940 K for the white dwarf is consistent with a cooling age > 2 Gyr, implying that the excess may be due to a recently formed circumbinary dust disk of material that extends from the tidal truncation radius of the binary at 1.96 $R_{\odot}$ out to < 0.8 AU, with a total mass of $\sim 10^{20}$ g. We also construct WISE and follow-up ground-based near-infrared light curves of the system, and find variability in the K band that appears to be in phase with ellipsoidal variations observed in the visible. The presence of dust might be due to a) material being generated by the destruction of small rocky bodies that are being perturbed by an unseen planetary system or b) dust condensing from the companion's wind. The high inclination of this system, and the presence of dust, make it an attractive target for M dwarf transit surveys and long term photometric monitoring.

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A carbon dwarf wearing a necklace: first proof of accretion in a post-common-envelope binary central star of a planetary nebula with jets

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The formation of collimated outflows or jets in planetary nebulae (PNe) is not well understood. There is no evidence for active accretion disks in PNe making it difficult to decide which of several proposed jet formation scenarios may be correct. A handful of wide binary central stars of PNe are known to have accreted carbon and slow neutron capture (s-process) enhanced material, the immediate progenitors of barium stars, however no close binary analogues

are known to have passed through a common-envelope (CE) phase. Here we present spectroscopy of The Necklace taken near lightcurve minimum that for the first time reveals a carbon-rich (C/O > 1) companion, a carbon dwarf, in a post-CE central star. As unevolved stars do not produce carbon, the chemical enhancement of the secondary can only be explained by accretion from the primary. Accretion most likely happened prior to the CE phase via wind accretion as not enough material can be accreted during the short CE phase. The pair of jets in The Necklace, which are observed to be older than the PN, are therefore likely to have been launched from an accretion disk around the companion during this early accretion phase. This discovery adds significant weight to the emerging scenario that jets in post-CE PNe are primarily launched by an accretion disk around a main-sequence companion before the CE phase.

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Dust driven mass loss from carbon stars as a function of stellar parameters – I. A grid of solar-metallicity wind models (Corrigendum)

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Aims: The purpose of this corrigendum is to point out that a handful of models in the original paper were computed with faulty initial structures.
Methods: Using exactly the same modelling methods we have recomputed the faulty models with new initial structures.
Results: The new results slightly changes some of the trends in the wind properties with stellar parameters, but the overall effects are small. The conclusions are not affected

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A detailed spatiokinematic model of the conical outflow of the multipolar planetary nebula, NGC 7026

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We present an extensive, long-slit, high-resolution coverage of the complex planetary nebula (PN), NGC 7026. We acquired ten spectra using the Manchester Échelle Spectrometer at San Pedro Martír Observatory in Baja California, México, and each shows exquisite detail, revealing the intricate structure of this object. Incorporating these spectra into the 3-dimensional visualization and kinematic program, SHAPE, and using HST images of NGC 7026, we have produced a detailed structural and kinematic model of this PN. NGC 7026 exhibits remarkable symmetry consisting of three lobe-pairs and four sets of knots, all symmetrical about the nucleus and displaying a conical outflow. Comparing the 3-D structure of this nebula to recent, XMM–*Newton* X-ray observations, we investigate the extended X-ray emission in relation to the nebular structure. We find that the X-ray emission, while confined to the closed, northern lobes of this PN, shows an abrupt termination in the middle of the SE lobe, which our long slit data shows to be open. This is where the shocked, fast wind seems to be escaping the interior of the nebula and the X-ray emission rapidly cools in this region.

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The hot R Coronae Borealis star DY Centauri is a binary

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The remarkable hot R Coronae Borealis star DY Cen is revealed to be the first and only binary system to be found among the R Coronae Borealis (RCB) stars and their likely relatives, including the Extreme Helium stars and the hydrogen-deficient carbon stars. Radial velocity determinations from 1982–2010 have shown DY Cen is a single-lined spectroscopic binary in an eccentric orbit with a period of 39.67 days. It is also one of the hottest and most H-rich member of the class of RCB stars. The system may have evolved from a common-envelope to its current form.

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AKARI Infrared Camera Survey of the Large Magellanic Cloud. I. Point Source Catalog

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We present a near- to mid-infrared point source catalog of 5 photometric bands at 3.2, 7, 11, 15 and 24 μm for a 10 deg^2 area of the Large Magellanic Cloud (LMC) obtained with the Infrared Camera (IRC) onboard the AKARI satellite. To cover the survey area the observations were carried out at 3 separate seasons from 2006 May to June, 2006 October to December, and 2007 March to July.

The 10-σ limiting magnitudes of the present survey are 17.9, 13.8, 12.4, 9.9, and 8.6 mag at 3.2, 7, 11, 15 and 24 μm, respectively. The photometric accuracy is estimated to be about 0.1 mag at 3.2 μm and 0.06–0.07 mag in the other bands. The position accuracy is $0\farcs3$ at 3.2, 7 and 11 μm and $1\farcs0$ at 15 and 24 μm. The sensitivities at 3.2, 7, and 24 μm are roughly comparable to those of the *Spitzer* SAGE LMC point source catalog, while the AKARI catalog provides the data at 11 and 15 μm, covering the mid-infrared spectral range contiguously. Two types of catalog are provided: a Catalog and an Archive. The Archive contains all the detected sources, while the Catalog only includes the sources that have a counterpart in the *Spitzer* SAGE point source catalog. The Archive contains about 650,000, 140,000, 97,000, 43,000, and 52,000 sources at 3.2, 7, 11, 15, and 24 μm, respectively. Based on the catalog, we discuss the luminosity functions at each band, the color–color diagram, and the color–magnitude diagram using the 3.2, 7, and 11 μm band data. Stars without circumstellar envelopes, dusty C-rich and O-rich stars, young stellar objects, and background galaxies are located at distinct regions in the diagrams, suggesting that the present catalog is useful for the classification of objects towards the LMC.

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Laboratory measurement of optical constants of solid SiO and application to circumstellar dust

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Silicate minerals belong to the most abundant solids in space. Their formation becomes difficult at the transition from the oxygen rich chemistry of M-stars to the carbon rich chemistry of C-stars. In the intermediate type S-stars oxygen and carbon are consumed by CO and SiO molecule formation, and left-over oxygen to build the SiO_4-tetrahedra of silicates becomes scarce. Then SiO molecules may directly condense into solid SiO. The IR absorption spectrum of solid SiO differs from that of silicates by the absence of Si–O–Si bending modes at 18 μm while the absorption by Si–O bond stretching modes at 10 μm is present. Such characteristics are observed in a number of S-star spectra. We suggest that this observation may be explained by formation of solid SiO as a major dust component at C/O abundance ratios close to unity. We determine the IR absorption properties of solid SiO by laboratory transmission measurements of thin SiO films produced by vapour deposition on a Si(111) wafer. From the measured spectra the dielectric function of SiO is derived. The results are used in model calculations of radiative transfer in circumstellar dust shells with solid SiO dust. Comparison of synthetic and observed spectra shows that reasonable agreement is obtained between the main spectral characteristics of emission bands due to solid SiO and an emission band centred on 10 μm, but without accompanying 18 μm band, observed in some S-stars. We propose that solid SiO is the carrier material of this 10 μm spectral feature.

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The Local Group galaxy NGC 6822 and its asymptotic giant branch stars

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JHK_s photometry is presented from a 3.5 year survey of the central regions of the irregular galaxy NGC 6822. The morphology of the colour–magnitude and colour–colour diagrams is discussed with particular reference to M, S and C-type AGB stars and to M-supergiants. Mean JHK_s magnitudes and periods are given for 11 O-rich and 50 presumed C-rich Miras. Data are also listed for 27 large amplitude AGB stars without periods and for 69 small amplitude AGB variables. The slope of the bolometric period–luminosity relation for the C-rich Miras is in good agreement with that in the LMC. Distance moduli derived from the C- and O-rich Miras are in agreement with other estimates. The period distribution of C-rich Miras in NGC 6822 is similar to that in the Magellanic Clouds, but differs from that in the dwarf spheroidals in the Local Group. In the latter there is a significant proportion of large amplitude, short period variables indicating a population producing old carbon-rich AGB stars.

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Early-stage young stellar objects in the Small Magellanic Cloud – and the first D-type symbiotic system in the SMC

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We present new observations of 34 Young Stellar Object (YSO) candidates in the Small Magellanic Cloud (SMC). The photometric selection required sources to be bright at 24 and 70 μm (to exclude evolved stars and galaxies). The anchor of the analysis is a set of *Spitzer*-IRS spectra, supplemented by groundbased 3–5 μm spectra, *Spitzer* IRAC and MIPS photometry, near-IR imaging and photometry, optical spectroscopy and radio data. The sources' spectral energy distributions (SEDs) and spectral indices are consistent with embedded YSOs; prominent silicate absorption is observed in the spectra of at least ten sources, silicate emission is observed towards four sources. Polycyclic Aromatic Hydrocarbon (PAH) emission is detected towards all but two sources. Based on band ratios (in particular the strength of the 11.3-μm and the weakness of the 8.6-μm bands) PAH emission towards SMC YSOs is dominated by predominantly small neutral grains. Ice absorption is observed towards fourteen sources in the SMC. The comparison of H_2O and CO_2 ice column densities for SMC, Large Magellanic Cloud (LMC) and Galactic samples suggests that there is a significant H_2O column density threshold for the detection of CO_2 ice. This supports the scenario proposed by Oliveira et al. (2011), where the reduced shielding in metal-poor environments depletes the H_2O column density in the outer regions of the YSO envelopes. No CO ice is detected towards the SMC sources. Emission due to pure-rotational 0–0 transitions of molecular hydrogen is detected towards the majority of SMC sources, allowing us to estimate rotational temperatures and H_2 column densities. All but one source are spectroscopically confirmed as SMC YSOs. Based on the presence of ice absorption, silicate emission or absorption, and PAH emission, the sources are classified and placed in an evolutionary sequence. Of the 33 YSOs identified in the SMC, 30 sources populate different stages of massive stellar evolution. The presence of ice- and/or silicate-absorption features indicates sources in the early embedded stages; as a source evolves, a compact H II region starts to emerge, and at the later stages the source's IR spectrum is completely dominated by PAH and fine-structure emission. The remaining three sources are classified as intermediate-mass YSOs with a thick dusty disc and a tenuous envelope still present. We propose one of the SMC sources is a D-type symbiotic system, based on the presence of Raman, H and He emission lines in the optical spectrum, and silicate emission in the IRS-spectrum. This would be the first dust-rich symbiotic system identified in the SMC.

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Unexpectedly large mass loss during the thermal pulse cycle of the red giant star R Sculptoris!

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The asymptotic-giant-branch star R Sculptoris is surrounded by a detached shell of dust and gas. The shell originates from a thermal pulse during which the star underwent a brief period of increased mass loss. It has hitherto been impossible to constrain observationally the timescales and mass-loss properties during and after a thermal pulse – parameters that determine the lifetime of the asymptotic giant branch and the amount of elements returned by the star. Here we report observations of CO emission from the circumstellar envelope and shell around R Sculptoris with an angular resolution of $1\farcs30$. What was previously thought to be only a thin, spherical shell with a clumpy structure is revealed to also contain a spiral structure. Spiral structures associated with circumstellar envelopes have been previously seen, leading to the conclusion that the systems must be binaries. Combining the observational data with hydrodynamic simulations, we conclude that R Sculptoris is a binary system that underwent a thermal pulse $\sim 1,800$ years ago, lasting ≈ 200 years. About 3×10^{-3} $M_\odot$ of material were ejected at a velocity of 14.3 km s^{-1} and at a rate ~ 30 times higher than the pre-pulse mass-loss rate. This shows that about three times more mass was returned to the interstellar medium during and immediately after the pulse than previously thought.

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Chromospheric thermal continuum millimetre emission from non-dusty K and M red giants

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We examine the thermal free–free millimetre fluxes expected from non-dusty and non-pulsating K through mid-M giant stars based on our limited understanding of their inhomogeneous chromospheres. We present a semi-analytic model that provides estimates of the radio fluxes for the mm wavelengths (e.g., CARMA, ALMA, JVLA Q-band) based on knowledge of the effective temperatures, angular diameters and chromospheric Mg II h & k emission fluxes. At 250 GHz, the chromospheric optical depths are expected to be significantly less than unity, which means that fluxes across the mm and sub-mm range will have a contribution from the chromospheric material that gives rise to the ultraviolet emission spectrum, as well as the cool molecular material known to exist above the photosphere. We predict a lower bound to the inferred brightness temperature of red giants based on heating at the basal flux limit if the upper chromospheres have filling factor ~ 1. Multi-frequency mm observations should provide important new information on the structuring of the inhomogeneous chromospheres, including the boundary layer, and allow tests of competing theoretical models for atmospheric heating. We comment on the suitability of these stars as mm flux calibrators.

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Measuring the orbital inclination of Z Andromedæ from Rayleigh scattering

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The orbital inclination of the symbiotic prototype Z And has not been established yet. At present, two very different values are considered, $i \sim 44°$ and $i \gtrsim 73°$. The correct value of i is a key parameter in, for example, modeling the highly-collimated jets of Z And. The aim of this paper is to measure the orbital inclination of Z And. First, we derive the hydrogen column density ($N_{\rm H}$), which causes the Rayleigh scattering of the far-UV spectrum at the orbital phase $\phi = 0.961 \pm 0.018$. Second, we calculate $N_{\rm H}$ as a function of i and ϕ for the ionization structure during the quiescent phase. Third, we compare the $N_{\rm H}(i, \phi)$ models with the observed value. The most probable shaping of the H I/H II boundaries and the uncertainties in the orbital phase limit i of Z And to 59^{+3}_{-2} degrees. Systematic errors given by using different wind velocity laws can increase i up to $\sim 74°$. A high value of i is supported independently by the orbitally related variation in the far-UV continuum and the obscuration of the O I] 1641 Å emission line around the inferior conjunction of the giant. The derived value of the inclination of the Z And orbital plane allows treating satellite components of Hα and Hβ emission lines as highly-collimated jets.

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Electron optical depths and temperatures of symbiotic nebulæ from Thomson scattering

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Symbiotic binaries are comprised of nebulæ, whose densest portions have electron concentrations of 10^8–10^{12} cm^{-3} and extend to a few AU. They are optically thick enough to cause a measurable effect of the scattering of photons on free electrons. In this paper we introduce modelling the extended wings of strong emission lines by the electron scattering with the aim to determine the electron optical depth, τ(e) and temperature, T(e), of symbiotic nebulæ. We applied our profile-fitting analysis to the broad wings of the O VI 1032, 1038 Å doublet and He II 1640 Å emission line, measured in the spectra of symbiotic stars AG Dra, Z And and V1016 Cyg. Synthetic profiles fit well the observed wings. By this way we determined τ(e) and T(e) of the layer of electrons, throughout which the line photons are transferred. During quiescent phases, the mean τ(e) $= 0.056 \pm 0.006$ and T(e) $= 19\,200 \pm 2\,300$ K, while during active phases, mean quantities of both parameters increased to τ(e) $= 0.64 \pm 0.11$ and T(e) $= 32\,300 \pm 2\,000$ K. During quiescent phases, the faint electron-scattering wings are caused mainly by free electrons from/around the accretion disk and the ionized wind from the hot star with the total column density, N(e)$\lesssim 10^{23}$ cm^{-2}. During active phases, the large values of τ(e) are caused by a supplement of free electrons into the binary environment as a result of the enhanced wind from the hot star, which increases N(e) to $\sim 10^{24}$ cm^{-2}.

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Ionization structure of hot components in symbiotic binaries during active phases

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During active phases of symbiotic binaries, an optically thick medium in the form of a flared disk develops around their

hot stars. During quiescent phases, this structure is not evident. We propose the formation of a flared neutral disk-like structure around the rotating white dwarf (WD) in symbiotic binaries. We applied the wind compression model and calculated the ionization boundaries in the compressed wind from the WD using the equation of photoionization equilibrium. During active phases, the compression of the enhanced wind from the rotating WD can form a neutral disk-like zone at the equatorial plane, while the remainder of the sphere above/below the disk is ionized. Calculated hydrogen column density throughout the neutral zone and the emission measure of the ionized fraction of the wind, calculated for the mass-loss rate from the WD, $\dot{M} = 2 \times 10^{-6}$ M$_\odot$ yr^{-1} with $v_\infty = 2\,000$ km s^{-1}, are consistent with those derived from observations. During quiescent phases, the neutral disk-like structure cannot be created because of insufficient mass-loss rate. Formation of the neutral disk-like zone at the equatorial plane is connected with the enhanced wind from the rotating WD, observed during active phases of symbiotic binaries. This probably represents a common origin of warm pseudophotospheres, indicated in the spectrum of active symbiotic binaries with a high orbital inclination.

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A 3D view of the remnant of Nova Persei 1901 (GK Per)

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We present a kinematical study of the optical ejecta of GK Per. It is based on proper motions measurements of 282 knots from ~ 20 images spanning 25 years. Doppler-shifts are also computed for 217 knots. The combination of proper motions and radial velocities allows a unique 3-D view of the ejecta to be obtained. The main results are: (1) the outflow is a thick shell in which knots expand with a significant range of velocities, mostly between 600 and 1000 km s^{-1}; (2) kinematical ages indicate that knots have suffered only a modest deceleration since their ejection a century ago; (3) no evidence for anisotropy in the expansion rate is found; (4) velocity vectors are generally aligned along the radial direction but a symmetric pattern of non-radial velocities is also observed at specific directions; (5) the total Hα+[N II] flux has been linearly decreasing at a rate of 2.6% per year in the last decade. The Eastern nebular side is fading at a slower rate than the Western one. Some of the knots displayed a rapid change of brightness during the 2004–2011 period. Over a longer timescale, a progressive circularization and homogenization of the nebula is taking place; (6) a kinematic distance of 400 ± 30 pc is determined. These results raise some problems to the previous interpretations of the evolution of GK Per. In particular, the idea of a strong interaction of the outflow with the surrounding medium in the Southwest quadrant is not supported by our data.

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Spin down of the core rotation in red giants

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The space mission *Kepler* provides us with long and uninterrupted photometric time series of red giants. We are now able to probe the rotational behaviour in their deep interiors using the observations of mixed modes.
We aim to measure the rotational splittings in red giants and to derive scaling relations for rotation related to seismic and fundamental stellar parameters.
We have developed a dedicated method for automated measurements of the rotational splittings in a large number of red giants. Ensemble asteroseismology, namely the examination of a large number of red giants at different stages of their evolution, allows us to derive global information on stellar evolution.
We have measured rotational splittings in a sample of about 300 red giants. We have also shown that these splittings are dominated by the core rotation. Under the assumption that a linear analysis can provide the rotational splitting, we observe a small increase of the core rotation of stars ascending the red giant branch. Alternatively, an important slow down is observed for red-clump stars compared to the red giant branch. We also show that, at fixed stellar radius, the specific angular momentum increases with increasing stellar mass.
Ensemble asteroseismology indicates what has been indirectly suspected for a while: our interpretation of the observed rotational splittings leads to the conclusion that the mean core rotation significantly slows down during the red giant phase. The slow-down occurs in the last stages of the red giant branch. This spinning down explains, for instance, the long rotation periods measured in white dwarfs.

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Classical Cepheids require enhanced mass loss

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Measurements of rates of period change of Classical Cepheids probe stellar physics and evolution. Additionally, better understanding of Cepheid structure and evolution provides greater insight into their use as standard candles and tools for measuring the *Hubble* constant. Our recent study of the period change of the nearest Cepheid, Polaris, suggested that it is undergoing enhanced mass loss when compared to canonical stellar evolution model predictions. In this work, we expand the analysis to rates of period change measured for about 200 Galactic Cepheids and compare them to population synthesis models of Cepheids including convective core overshooting and enhanced mass loss. Rates of period change predicted from stellar evolution models without mass loss do not agree with observed rates whereas including enhanced mass loss yields predicted rates in better agreement with observations. This is the first evidence that enhanced mass loss as suggested previously for Polaris and δ Cephei must be a ubiquitous property of Classical Cepheids.

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The radio light curve of the γ-ray nova in V407 Cyg: Thermal emission from the ionized symbiotic envelope, devoured from within by the nova blast

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We present multi-frequency radio observations of the 2010 nova event in the symbiotic binary V407 Cygni, obtained with the Karl G. Jansky Very Large Array and spanning 1–45 GHz and 17–770 days following discovery. This nova – the first ever detected in γ rays – shows a radio light curve dominated by the wind of the Mira giant companion, rather than the nova ejecta themselves. The radio luminosity grew as the wind became increasingly ionized by the nova outburst, and faded as the wind was violently heated from within by the nova shock. This study marks the first time that this physical mechanism has been shown to dominate the radio light curve of an astrophysical transient. We do not observe a thermal signature from the nova ejecta or synchrotron emission from the shock, due to the fact that these components were hidden behind the absorbing screen of the Mira wind.
We estimate a mass-loss rate for the Mira wind of $\dot{M}_{\rm w} \approx 10^{-6}$ M$_\odot$ yr^{-1}. We also present the only radio detection of V407 Cyg before the 2010 nova, gleaned from unpublished 1993 archival VLA data, which shows that the radio luminosity of the Mira wind varies by a factor of $\gtrsim$20 even in quiescence. Although V407 Cyg likely hosts a massive accreting white dwarf, making it a candidate progenitor system for a Type Ia supernova, the dense and radially continuous circumbinary material surrounding V407 Cyg is inconsistent with observational constraints on the environments of most Type Ia supernovæ.

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On the impossible NGC 4372 V1 and V2: an extended AGB to the [Fe/H] = −2.2 cluster

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The asymptotic giant branch (AGB) of the globular cluster NGC 4372 appears to extend to unexpectedly high luminosities. We show, on the basis of proper motions and spatial distribution, that the extended AGB is indeed a likely part of the cluster. We also present the first spectra of the very cool (2600 K), very luminous (8000 L$_\odot$), very dusty, oxygen-rich, purported long-period variable stars V1 and V2 that define the AGB tip. In particular, on the basis of their radial velocities, we conclude that V1 and V2 are probably members. We find that V1 and V2 are likely

undergoing the superwind phase that terminates their nuclear-burning evolution. We hypothesise that the mass-loss processes that terminate the AGB are inhibited in NGC 4372 due to a lack of atmospheric pulsation and the high gas-to-dust ratio in the ejecta, leading to a delay in the associated enhanced mass loss and dust production. Previously predicted, but never observed, this explains the high mass of the white dwarf in Pease 1 in M 15 without the need to invoke a stellar merger. If commonplace, this phenomenon has implications for the mass return from stars, the production of carbon stars and supernovæ through the Universe's history, and the AGB contribution to light from unresolved metal-poor populations.

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Conference Papers

Synthetic light curves for Born Again events: preliminary results

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The development of surveys which will be able to cover a large region of the sky several times per year will allow the massive detection of transient events taking place in timescales of years. In addition, the projected full digitalization of the Harvard plate collection will open a new window to identify slow transients taking place in timescales of centuries. In particular, these projects will allow the detection of stars undergoing slow eruptions as those expected during late helium flashes in the post-AGB evolution. In order to identify those transients which correspond with late helium flashes the development of synthetic light curves of those events is mandatory. In this connection we present preliminary results of a project aimed at computing grids of theoretical light curves of born again stars.

Poster contribution, published in "The 18th European White Dwarf Workshop", Krakow, Poland
Available from arXiv:1210.0264

IC 4663: the first unambiguous [WN] Wolf–Rayet central star of a planetary nebula

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Several [WC]-type central stars of planetary nebulae (PNe) are known to mimic the spectroscopic appearance of massive carbon-rich or WC-type Wolf–Rayet stars. In stark contrast, no [WN]-type central stars have yet been identified as

clear-cut analogues of the common nitrogen-rich or WN-type Wolf–Rayet stars. We have identified the [WN3] central star of IC 4663 to be the first unambiguous example in PNe. The low luminosity nucleus and an asymptotic giant branch (AGB) halo surrounding the main nebula prove the bona-fide PN nature of IC 4663. Model atmosphere analysis reveals the [WN3] star to have an exotic chemical composition of helium (95%), hydrogen (< 2%), nitrogen (0.8%), neon (0.2%) and oxygen (0.05%) by mass. Such an extreme helium-dominated composition cannot be predicted by current evolutionary scenarios for hydrogen deficient [WC]-type central stars. Only with the discovery of IC 4663 and its unusual composition can we now connect [WN] central stars to the O(He) central stars in a second H-deficient and He-rich evolutionary sequence, [WN]→O(He), that exists in parallel to the carbon-rich [WC]→PG 1159 sequence. This suggests a simpler mechanism, perhaps a binary merger, can better explain H-deficiency in PNe and potentially other H-deficient/He-rich stars. In this respect IC 4663 is the best supported case for a possible merged binary central star of a PN.

Oral contribution, published in "The 18th European White Dwarf Workshop", Krakow, Poland, 2012
Available from arXiv:1210.0562

Inverting the white dwarf luminosity function: the star formation history of the Solar neighbourhood

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I present an algorithm for inverting the luminosity function for white dwarfs to obtain a maximum likelihood estimate of the star formation rate of the host stellar population. The algorithm is of the general class of Expectation Maximization, and involves iteratively improving an initial guess of the star formation rate. Tests show that the inversion results are quite sensitive to the assumed metallicity and initial mass function, but relatively insensitive to the initial–final mass relation and ratio of H/He atmosphere white dwarfs. Application to two independent determinations of the Solar neighbourhood white dwarf luminosity function gives similar results: the star formation rate is characterised by an early burst, and more recent peak at 2–3 Gyr in the past.

Oral contribution, published in "The 18th European White Dwarf Workshop"
Available from arXiv:1209.5593

Can Li-rich K giants eject shells? Assembling the lithium puzzle in K giants

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The existence of K giant stars with high Li abundance continues to challenge the standard theory of stellar evolution. All recent extensive surveys in the Galaxy show the same result: about 1% of the mainly normal slow rotating K giants are Li rich. We explore here a model with two scenarios based on the important relation of Li-rich and Li-poor K giants with IR excesses. In this model, all K giant stars suffer a rapid enrichment and depletion of Li inducing the formation and ejection of circumstellar shells. The observational detection of these shells will not only validate this model, but also will give important hints on the mechanism of Li enrichment of these stars.

Oral contribution, published in ESO workshop "Circumstellar Dynamics at High Resolution", ASP Conf. Ser.
Available from arXiv:1209.5338

Metal abundances in hot DO white dwarfs

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The relatively high abundance of carbon in the hot DO white dwarf RE 0503−289 indicates that it is a descendant of a PG 1159 star. This is corroborated by the recent detection of the extremely high abundances of trans-Fe elements which stem from s-process nucleosynthesis in the precursor AGB star, dredged up by a late He-shell flash and possibly amplified by radiative levitation. On the other hand, the hottest known DO white dwarf, KPD 0005+5106, cannot have evolved from a PG 1159 star but represents a distinct He-rich evolutionary sequence that possibly originates from a binary white dwarf merger.

Oral contribution, published in "The 18th European White Dwarf Workshop", Krakow, Poland, 13–17 August 2012
Available from arXiv:1209.4977

Open science project in white dwarf research

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I will propose a new way of advancing white dwarf research. Open science is a method of doing research that lets everyone who has something to say about the subject take part in the problem solving process.
Already now, the amount of information we gather from observations, theory and modelling is too vast for any one individual to comprehend and turn into knowledge. And the amount of information just keeps growing in the future. A platform that promotes sharing of thoughts and ideas allows us to pool our collective knowledge of white dwarfs and get a clear picture of our research field. It will also make it possible for researchers in fields closely related to ours (AGB stars, planetary nebulae etc.) to join the scientific discourse.
In the first stage this project would allow us to summarize what we know and what we don't, and what we should search for next. Later, it could grow into a large collaboration that would have the impact to, for example, suggest instrument requirements for future telescopes to satisfy the needs of the white dwarf community, or propose large surveys.
A simple implementation would be a wiki page for collecting knowledge combined with a forum for more extensive discussions. These would be simple and cheap to maintain. A large community effort on the whole would be needed for the project to succeed, but individual workload should stay at a low level.

Oral contribution, published in "The 18th European White Dwarf Workshop"
Available from arXiv:1210.0713

Fullerenes in circumstellar and interstellar environments

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In recent years, the fullerene species C_{60} (and to a lesser extent also C_{70}) has been reported in the mid-IR spectra of various astronomical objects. Cosmic fullerenes form in the circumstellar material of evolved stars, and survive in the interstellar medium (ISM). It is not entirely clear how they form or what their excitation mechanism is.

Oral contribution, published in "Unexplained spectral phenomena in the interstellar medium", Special Session 16 at the General Assembly of the IAU, August 27–28, 2012, Beijing, China

Maser emission during post-AGB evolution

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This contribution reviews recent observational results concerning astronomical masers toward post-AGB objects with a special attention to water fountain sources and the prototypical source OH 231.8+4.2. These sources represent a short transition phase in the evolution between circumstellar envelopes around symptotic giant branch stars and planetary nebulae. The main masing species are considered and key results are summarized.

Oral contribution, published in IAU Symposium 287: "Cosmic Masers: from OH to H_0", eds. R.S. Booth, E.M.L. Humphreys and W.H.T. Vlemmings
Available from arXiv:1210.4373

Preliminary results on SiO $v = 3$ $J = 1$–0 maser emission from AGB stars

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We present the results of SiO maser observations at 43 GHz toward two AGB stars using the VLBA. Our preliminary results on the relative positions of the different $J = 1$–0 SiO masers ($v = 1$, 2 and 3) indicate that the current ideas on SiO maser pumping could be wrong at some fundamental level. A deep revision of the SiO pumping models could be necessary.

Poster contribution, published in IAU Symposium 287: "Cosmic Masers: from OH to H_0", eds. R.S. Booth, E.M.L. Humphreys and W.H.T. Vlemmings
Available from arXiv:1210.4389

An abundance study of the red giants in the seismology fields of the CoRoT satellite

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[5]Astronomical Institute 'Anton Pannekoek', University of Amsterdam, The Netherlands
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[7]LESIA, CNRS, Observatoire de Paris, Meudon, France
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A precise characterisation of the red giants in the seismology fields of the CoRoT satellite is a prerequisite for further in-depth seismic modelling. The optical spectra obtained for 19 targets have been used to accurately estimate their fundamental parameters and chemical composition. The extent of internal mixing is also investigated through the abundances of Li, CNO and Na (as well as $^{12}C/^{13}C$ in a few cases).

Poster contribution, published in the 40^{th} Liège International Astrophysical Colloquium "Ageing low-mass stars: from red giants to white dwarfs"
Available from arXiv:1210.2982
and from http://www.ster.kuleuven.be/∼thierry/articles/LIAC40_morel.pdf

A review on carbon-rich molecules in space

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[5]CSIC, Spain

We present and discuss carbon-rich compounds of astrochemical interest such as polyynes, acetylenic carbon chains and the related derivative known as monocyanopolyynes and dicyanopolyynes. Fullerenes are now known to be abundant in space, while fulleranes – the hydrogenated fullerenes – and other carbon-rich compounds such as very large polycyclic aromatic hydrocarbons (VLPAHs) and heavy petroleum fractions are suspected to be present in space. We review the synthesis, the infrared spectra as well as the electronic absorption spectra of these four classes of carbon-rich molecules. The existence or possible existence in space of the latter molecules is reported and discussed.

Oral contribution, published in IAU General Assembly, Special Session 16 "Unexplained Spectral Phenomena in the ISM" (Invited Review)
Available from arXiv:1210.5593

Testing the binary hypothesis for the formation and shaping of planetary nebulæ

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There is no quantitative theory to explain why a high 80% of all planetary nebulae are non-spherical. The *binary hypothesis* states that a companion to the progenitor of a central star of planetary nebula is required to shape the nebula and even for a planetary nebula to be formed at all. A way to test this hypothesis is to estimate the binary fraction of central stars of planetary nebulæ and to compare it with that of the main sequence population. Preliminary results from photometric variability and the infrared excess techniques indicate that the binary fraction of central stars of planetary nebulæ is higher than that of the main sequence, implying that PNe could preferentially form via a binary channel. This article briefly reviews these results and current studies aiming to refine the binary fraction.

Oral contribution, published in "EUROWD 12"
Available from arXiv:1210.6226

Red giant oscillations: Stellar models and mode frequency calculations

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We present preliminary results on modelling KIC 7693833, the so far most metal-poor red giant star observed by

Kepler. From time series spanning several months, global oscillation parameters and individual frequencies were obtained and compared to theoretical calculations. Evolution models are calculated taking into account spectroscopic and asteroseismic constraints. The oscillation frequencies of the models were computed and compared to the *Kepler* data. In the range of mass computed, there is no preferred model, giving an uncertainty of ~ 30 K in $T_{\rm eff}$, 0.02 dex in $\log g$, 0.7 $R/R_{\odot}$ in radius and of abouxt 2.5 Gyrs in age.

Poster contribution, published in ESF Conference "The Modern Era of Helio- and Asteroseismology"
Available from arXiv:1210.6495

Review Paper

Circumstellar masers in the Magellanic Clouds

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The nearby dwarf irregular galaxies the Large and Small Magellanic Clouds have metallicities of about half and a fifth solar, respectively, which offers the unique opportunity to study astrophysical processes as a function of metallicity. Masers in the outflows from evolved stars allow to measure the wind speed, vital to derive mass-loss rates and test wind driving mechanisms. The metallicity dependence of the wind speed in particular allows us to make inferences about dust formation and mass loss in the early Universe. I will review past surveys for circumstellar OH, water, and SiO masers in the Magellanic Clouds (and provide a literature review of interstellar masers). I will then discuss the way these measurements have influenced our understanding of mass loss, and end with outlining the prospects for future surveys for OH masers in the Magellanic Clouds.

Published in "Science with Parkes @ 50 Years Young", Ed. Robert Braun (2012)
Available from arXiv:1210.0983
and from http://www.atnf.csiro.au/research/conferences/Parkes50th/ProcPapers/vanLoon.pdf

Thesis

EG Andromedæ: A symbiotic system as an insight into red giant chromospheres

Joseph Roche[1]

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Symbiotic systems are interacting binary stars consisting of both hot and cool components. This results in a complex environment that is ideal for studying the latter stages of stellar evolution along with interactions within binary systems. As a star approaches the end of its life, in particular the red giant phase, it exhausts its supply of core hydrogen and begins burning its way through successively heavier elements. Red giants lose mass in the form of a dense wind that will replenish the interstellar medium with chemical elements that are formed through nuclear processes deep in the stellar interior. When these elements reach the interstellar medium they play a central role in both stellar and planetary evolution, as well as providing the essential constituents needed for life. The undoubted significance of these cool giants means the study of their atmospheres is necessary to help understand our place in the Universe. This thesis presents *Hubble* Space Telescope observations of the symbiotic system EG Andromedæ as an insight into red giant stars. EG And is one of the brightest and closest symbiotic systems and consists of a red giant primary along with a white dwarf. The presence of the white dwarf in the system allows spatially resolved examination of the red giant primary. The benefits of using such a system to better understand the base of red giant chromospheres is shown. Along with the observations of EG And, new HST observations of an isolated red giant spectral standard HD 148349 are described. The similarity between the isolated spectral standard and the red giant primary of EG And

is demonstrated, showing that much of the information gleaned from a symbiotic system can be applied to the general red giant population. Using both ultraviolet and optical spectroscopy, the atmosphere of EG And and HD 148349 are investigated and contrasted.

PhD Thesis, Trinity College Dublin
Available from arXiv:1210.7699
and from http://www.tcd.ie/Physics/Astrophysics/

Announcement

Stella Novæ: Past and Future Decades

2nd Announcement
Stella Novæ: Past and Future Decades
4–8 February 2013, Cape Town
www.ast.uct.ac.za/stellanovae2013

- Full Registration is OPEN
- The number of participants will be limited to 120
- The deadline for early registration and submitting abstracts (Oral contribution/Poster) is 15th of November 2012
- Limited funding is available for reduced registration for students
- The deadline for late registration is 15th of December 2012
- Contact stellanovae2013@ast.uct.ac.za

Scientific Rationale:
This conference will bring together experts and young scientists in the research field of novæ. Since the last conference on novae in 2002 new developments in nova research have emerged. Here we will explore the latest developments in the nova field from both theoretical and observational points of view, throughout the whole of the electromagnetic spectrum. Furthermore, with the advent of all-sky surveys of the transient sky, global networks of robotic telescopes and large future telescope facilities, new windows into the study of classical and recurrent novæ will emerge.

Invited speakers:
Laura Chomiuk
Matt Darnley
Jeremy Drake (TBC)
Robert Gehrz
Margarita Hernanz
Joachim Krautter
Jordi José
Mario Livio (TBC)
Joanna Mikołajewska
Ulisse Munari
Peter Nugent (TBC)
Tim O'Brien
Greg Schwarz
Allen Shafter
Michael Shara
Sumner Starrfield
Brian Warner

Registration and abstract:
The formal registration is now open, and the deadline for submitting abstracts for contributed talks and posters is 15th November 2012. If you have pre-registered before, we kindly request that you now complete the full registration form. We strongly encourage young participants to apply for a contributed talk. The registration fee will be 3400 Rands ($\sim$ 400 US dollars); this fee includes a welcome reception on the preceding Sunday in the Cape Town aquarium, tea and coffee breaks, lunch (except Wednesday) and the conference proceedings (ASP Conference Series). Attendance at the conference will be limited to 120 participants.

To register and submit an abstract, please access the web form available at: http://www.ast.uct.ac.za/stellanovae2013/registration.html

We will organise a 1 minute oral presentation for all posters during the different sessions, before the morning tea break to allow participants to introduce their contributions.

Student grants:
We have limited funding to support students therefore we would like to decrease the registration fee for those students who will be contributing with an oral presentation and/or poster. We require a letter of motivation from the supervisor to be sent to the e-mail above if you would like to be considered for a student reduction in the registration fee.

Venue and Hotels:
The conference will be held at the Pavilion Clock Tower at the V&A Waterfront. A list of associated hotels is given on the conference website; these hotels are all within walking distance of the conference venue.

We look forward to seeing you in Cape Town in February.

Best regards,
Patrick Woudt and Valerio Ribeiro
On behalf of the SOC

SOC:
M. Bode (UK)
L. Bildsten (USA)
A. Evans (UK)
R. Gehrz (USA)
M. Hernanz (Spain)
J. Mikołajewska (Poland)
T. O'Brien (UK)
V. Ribeiro (South Africa)
J. Sokoloski (USA)
S. Starrfield (USA)
B. Warner (South Africa)
R. Williams (USA)
P. Woudt (South Africa, Chair)

LOC:
R. Armstrong
R. Daniels
C. Marsh
V. Ribeiro (Co-Chair)
M. Schurch
P. Woudt (Co-Chair)

See also http://www.ast.uct.ac.za/stellanovae2013/