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Editors: Jacco van Loon and Albert Zijlstra

## *Editorial*

Dear Colleagues,

It is a pleasure to present you the 188th issue of the AGB Newsletter. There is a lot of extremely interesting new work being presented – read on and find out!

There are several announcements: meetings on stellar rotation, massive stars, and eclipses of giant stars; the recurrent Fizeau exchange programme; and the availability of a high-resolution mid-infrared spectrograph.

The next issue is planned to be distributed around the 1st of April.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

## *Food for Thought*

This month's thought-provoking statement is:

*What happens to the molecular clusters that do not go on to form grains?*

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*

## The expansion proper motions of the extraordinary giant lobes of the planetary nebula KjPn 8 revisited

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The primary aim is to establish a firm value for the distance to the extraordinary planetary nebula KjPn 8. Secondary aims are to measure the ages of the three giant lobes of this object as well as estimate the energy in the eruption, that caused the most energetic outflow, for comparison with that of an intermediate luminosity optical transient (ILOT). For these purposes a mosaic of images in the H$\alpha$+[N II] optical emission lines has been obtained with the new *Aristarchos* telescope in 2011 for comparison with the images of the KjPn 8 giant lobes present on the POSSI-R 1954 and POSSII-R 1991 plates. Expansion proper motions of features over this 57 yr baseline in the outflows are present. Using these, a firm distance to KjPn 8 of $1.8 \pm 0.3$ kpc has been derived for now the angle of the latest outflow to the sky has been established from HST imagery of the nebular core. Previously, the uncertain predictions of a bow-shock model were used for this purpose. The dynamical ages of the three separate outflows that form the giant lobes of KjPn 8 are also directly measured as 3200, 7200 and $\geq 5 \times 10^4$ yr respectively which confirms their sequential ejection. Moreover, the kinetic energy of the youngest and most energetic of these is measured as $\sim 10^{47}$ erg which is compatible with an ILOT origin.

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## The spectral energy distributions of K+A galaxies from the UV to the mid-IR: stellar populations, star formation and hot dust

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We present spectrum synthesis fits to 808 K+A galaxies selected from the Sloan Digital Sky Survey (SDSS) and population synthesis of their spectral energy distributions, extending from the far UV (0.15 $\mu$m) to the mid IR (22 $\mu$m), based on the results of STARLIGHT code fitting to the SDSS spectra. Our modelling shows that K+A galaxies have undergone a large starburst, involving a median 50% of their present stellar masses, superposed over an older stellar population. The metal abundance of the intermediate-age stars shows that star formation did not take place in pristine gas, but was part of a dramatic increase in the star formation rates for originally gas-rich objects. We find no evidence for on-going QSO activity in the UV, which is well modeled by the emission of intermediate-age stars. We use K+A galaxies as local counterparts of high redshift objects to test for the presence of Thermally Pulsing AGB stars in similarly-aged populations and find no excess in the infrared due to emission from such stars, arguing that more distant galaxies are indeed old and massive at their redshift. All of our galaxies show significant excesses in the mid-IR compared to the light from their stars. We fit this *ad hoc* with a 300K blackbody. Possible sources include TP-AGB stars, obscured young star clusters and hidden AGNs, heating a significant dust component.

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# Evolution and the period–luminosity relation for red supergiants in the Magellanic Clouds

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Excitation of radial pulsations in red supergiants of Magellanic Clouds is investigated using the stellar evolution calculations and the self-consistent solution of the equations of radiation hydrodynamics and turbulent convection. The stars with initial masses $6\ M_\odot \le M_{\rm ZAMS} \le 28\ M_\odot$ and the initial chemical composition $X = 0.7$, $0.004 \le Z \le 0.008$ are shown to be unstable against fundamental mode oscillations with periods from 17 to 1200 days as they become helium burning red supergiants. The period–luminosity relation slightly depends on the mass-loss rate varying with a factor of three, whereas its dependence on the metal abundance is $\delta M_{\rm bol} = 0.89\delta \log Z$. In comparison with galactic red supergiants ($Z = 0.02$) the low metal abundances in red supergiants of Magellanic Clouds are responsible for their higher effective temperatures and substantially narrower ranges of evolutionary stellar radius change during helium burning. Therefore on the period–mass diagram the red supergiants of Magellanic Clouds are located within the strip with width of $\delta \log M = 0.09$, so that the uncertainty of mass evaluation of the red supergiant with the known pulsational period is nearly 25%.

**Accepted for publication in Astronomy Letters**
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# Pure rotational spectra of TiO and $TiO_2$ in VY Canis Majoris

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We report the first detection of pure rotational transitions of TiO and $TiO_2$ at (sub-)millimeter wavelengths towards the red supergiant VY CMa. A rotational temperature, $T_{\rm rot}$, of about 250 K was derived for $TiO_2$. Although $T_{\rm rot}$ was not well constrained for TiO, it is likely somewhat higher than that of $TiO_2$. The detection of the Ti oxides confirms that they are formed in the circumstellar envelopes of cool oxygen-rich stars and may be the "seeds" of inorganic-dust formation, but alternative explanations for our observation of TiO and $TiO_2$ in the cooler regions of the envelope cannot be ruled out at this time. The observations suggest that a significant fraction of the oxides is not converted to dust, but instead remains in the gas phase throughout the outflow.

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# Galactic kinematics of planetary nebulæ with [WC] central star

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High resolution spectra are used to analyze the galactic kinematics and distribution of a sample of planetary nebulæ with [WR] and 'wel' central star ([WR]PN and WLPN). The circular and peculiar velocities, ($v_{\rm pec}$), of the objects were derived. The results are: a) [WR]PNe are distributed mainly in the galactic disk and they are more concentrated in a thinner disk than WLPNe and normal PNe, which corresponds to a younger population. b) The sample was separated in Peimbert's types, and it is found that Type I PNe have $v_{\rm pec} > 50$ km s$^{-1}$, indicating young objects. Most of the [WR]PNe are of Type II showing $v_{\rm pec} < 60$ km s$^{-1}$, although a small percentage is of Type III, with larger $v_{\rm pec}$ showing that the Wolf–Rayet phenomenon in central stars can occur at any stellar mass and in old objects. None of our WLPNe is Type I. Thus, [WR]PNe and WLPNe are unrelated objects.

**Accepted for publication in Revista Méxicana de Astronomía y Astrofísica**
*Available from* arXiv:1301.3657

## Absorption efficiencies of forsterite. I: DDA explorations in grain shape and size

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We compute the absorption efficiency ($Q_{\rm abs}$) of forsterite using the discrete dipole approximation (DDA) in order to identify and describe what characteristics of crystal grain shape and size are important to the shape, peak location, and relative strength of spectral features in the 8–40 $\mu$m wavelength range. Using the DDSCAT code, we compute $Q_{\rm abs}$ for non-spherical polyhedral grain shapes with $a_{\rm eff} = 0.1$ $\mu$m. The shape characteristics identified are: 1) elongation/reduction along one of three crystallographic axes; 2) asymmetry, such that all three crystallographic axes are of different lengths; and 3) the presence of crystalline faces that are not parallel to a specific crystallographic axis, e.g., non-rectangular prisms and (di)pyramids. Elongation/reduction dominates the locations and shapes of spectral features near 10, 11, 16, 23.5, 27, and 33.5 $\mu$m, while asymmetry and tips are secondary shape effects. Increasing grain sizes (0.1–1.0 $\mu$m) shifts the 10, 11 $\mu$m features systematically towards longer wavelengths and relative to the 11 $\mu$m feature increases the strengths and slightly broadens the longer wavelength features. Seven spectral shape classes are established for crystallographic *a*-, *b*-, and *c*-axes and include columnar and platelet shapes plus non-elongated or equant grain shapes. The spectral shape classes and the effects of grain size have practical application in identifying or excluding columnar, platelet or equant forsterite grain shapes in astrophysical environs. Identification of the shape characteristics of forsterite from 8–40 $\mu$m spectra provides a potential means to probe the temperatures at which forsterite formed.

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## Planetary nebulæ and H II regions in the spiral galaxy NGC 300. Clues on the evolution of abundance gradients and on AGB nucleosynthesis

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We have obtained deep spectra of 26 planetary nebulæ (PNe) and 9 compact H II regions in the nearby spiral galaxy NGC 300, and analyzed them together with those of the giant H II regions previously observed. We have determined

the physical properties of all these objects and their He, N, O, Ne, S and Ar abundances in a consistent way. We find that, globally, compact H II regions have abundance ratios similar to those of giant H II regions, while PNe have systematically larger N/O ratios and similar Ne/O and Ar/O ratios. We demonstrate that the nitrogen enhancement in PNe cannot be only due to second dredge-up in the progenitor stars, since their initial masses are around 2–2.5 $M_\odot$. An extra mixing process is required, perhaps driven by stellar rotation. Concerning the radial abundance distribution, PNe behave differently from H II regions: in the central part of the galaxy their average O/H abundance ratio is 0.15 dex smaller. Their abundance dispersion at any galactocentric radius is significantly larger than that shown by H II regions and many of them have O/H values higher than H II regions at the same galactocentric distance. This suggests that not only nitrogen, but also oxygen is affected by nucleosynthesis in the PN progenitors, by an amount which depends at least on the stellar rotation velocity and possibly other parameters. The formal O/H, Ne/H and Ar/He abundance gradients from PNe are significantly shallower that from H II regions. We argue that this indicates a steepening of the metallicity gradient in NGC 300 during the last Gyr, rather than an effect of radial stellar motions, although the large observed dispersion makes this conclusion only tentative.

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# Simulations of two-planet systems through all phases of stellar evolution: implications for the instability boundary and white dwarf pollution

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Exoplanets have been observed at many stages of their host star's life, including the main sequence (MS), subgiant and red giant branch stages. Also, polluted white dwarfs (WDs) likely represent dynamically active systems at late times. Here, we perform 3-body simulations which include realistic post-MS stellar mass loss and span the entire lifetime of exosystems with two massive planets, from the endpoint of formation to several Gyr into the WD phase of the host star. We find that both MS and WD systems experience ejections and star–planet collisions (Lagrange instability) even if the planet–planet separation well-exceeds the analytical orbit-crossing (Hill instability) boundary. Consequently, MS-stable planets do not need to be closely-packed to experience instability during the WD phase. This instability may pollute the WD directly through collisions, or, more likely, indirectly through increased scattering of smaller bodies such as asteroids or comets. Our simulations show that this instability occurs predominately between tens of Myr to a few Gyrs of WD cooling.

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# Synthetic photometry for carbon-rich giants. III. Tracing the sequence of mass-losing galactic C-type Miras

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Late-type giant stars in the evolutionary stage of the asymptotic giant branch increasingly lose mass via comparatively slow but dense stellar winds. Not only do these evolved red giants contribute in this way to the enrichment of the surrounding interstellar medium, but the outflows also have a substantial influence on the spectro-photometric appearance of such objects. In the case of carbon-rich atmospheric chemistries, the developing cool circumstellar envelopes contain dust grains mainly composed of amorphous carbon. With increasing mass-loss rates, this leads

to more and more pronounced circumstellar reddening. With the help of model calculations we aim at reproducing the observational photometric findings for a large sample of well-characterised galactic C-type Mira variables losing mass at different rates. We used dynamic model atmospheres, describing the outer layers of C-rich Miras, which are severly affected by dynamic effects. Based on the resulting structures and under the assumptions of chemical equilibrium as well as LTE, we computed synthetic spectra and synthetic broad-band photometry (Johnson–Cousins–Glass BVRIJHKL′M). A set of five representative models with different stellar parameters describes a sequence from less to more evolved objects with steadily increasing mass-loss rates. This allowed us to study the significant influence of circumstellar dust on the spectral energy distributions and the (amplitudes of) lightcurves in different filters. We tested the photometric properties (mean NIR magnitudes, colours, and amplitudes) and other characteristics of the models (mass-loss rates, periods, and bolometric corrections) by comparing these with the corresponding observational data adopted from the literature. Using different kinds of diagrams we illustrate where the models are located in a supposed evolutionary sequence defined by observed C-type Mira samples. Based on comparisons of Galactic targets with empirical relations derived for C stars in the Large Magellanic Cloud we discuss the relevance of metallicity and excess carbon (C–O) for the development of dust-driven winds. Having investigated the dynamic model atmospheres from different (mainly photometric) perspectives, we conclude that our modelling approach (meaning the combination of numerical method and a suitable choice of model parameters) is able to describe C-rich long-period variables over a wide range of mass-loss rates, i.e., from moderately pulsating objects without any dusty wind to highly dust-enshrouded Carbon Miras. Thus, we can trace the observed sequence of C-type Miras, which is mainly determined by the mass loss.

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# The Stagger-grid – a grid of 3D stellar atmosphere models

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We present the Stagger-grid, a comprehensive grid of time-dependent, 3D hydrodynamic model atmospheres for late-type stars with realistic treatment of radiative transfer, covering a wide range in stellar parameters. This grid of 3D models is intended for various applications like stellar spectroscopy, asteroseismology and the study of stellar convection. In this introductory paper, we describe the methods used for the computation of the grid and discuss the general properties of the 3D models as well as their temporal and spatial averages ($\langle 3D \rangle$). All our models were generated with the Stagger-code, using realistic input physics for the equation of state (EOS) and for continuous and line opacities. Our $\sim 220$ grid models range in $T_{\rm eff}$ from 4000 to 7000 K in steps of 500 K, in $\log g$ from 1.5 to 5.0 in steps of 0.5 dex, and [Fe/H] from $-4.0$ to $+0.5$ in steps of 0.5 and 1.0 dex. We find a tight scaling relation between the vertical velocity and the surface entropy jump, which itself correlates with the constant entropy value of the adiabatic convection zone. The range in intensity contrast is enhanced at lower metallicity. The granule size correlates closely with the pressure scale height sampled at the depth of maximum velocity. We compare the $\langle 3D \rangle$ models with widely applied 1D models, as well as with theoretical 1D hydrostatic models generated with the same EOS and opacity tables as the 3D models, in order to isolate the effects of using self-consistent and hydrodynamic modeling of convection, rather than the classical mixing length theory approach. For the first time, we are able to quantify systematically over a broad range of stellar parameters the uncertainties of 1D models arising from the simplified treatment of physics, in particular convective energy transport. In agreement with previous findings, we find that the differences can be significant, especially for metal-poor stars.

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## Testing convective-core overshooting using period spacings of dipole modes in red giants

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Uncertainties on central mixing in main sequence (MS) and core He-burning (He-B) phases affect key predictions of stellar evolution such as late evolutionary phases, chemical enrichment, ages etc. We propose a test of the extension of extra-mixing in two relevant evolutionary phases based on period spacing ($\Delta P$) of solar-like oscillating giants. From stellar models and their corresponding adiabatic frequencies (respectively computed with ATON and LOSC codes) we provide the first predictions of the observable $\Delta P$ for stars in the red giant branch (RGB) and in the red clump (RC). We find: *i)* a clear correlation between $\Delta P$ and the mass of the helium core ($M_{\rm He}$); the latter in intermediate-mass stars depends on the MS overshooting, hence it can be used to set constraints on extra mixing during MS when coupled with chemical composition; *ii)* a linear dependence of the average value of the asymptotic period spacing ($\langle \Delta P \rangle_a$) during the He-B phase on the size of the convective core. A first comparison with the inferred asymptotic period spacing for *Kepler* RC stars suggests the need for extra mixing also during this phase, as evinced from other observational facts.

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## Long-term polarimetric observations of OH127.8+0.0

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OH 1612- and 1667-MHz masers from the well-known object OH 127.8+0.0 were monitored in full polarization mode over a period of 6.5 yr and mapped with MERLIN at one epoch. The OH variability pattern of the star is typical of extremely long-period asymptotic giant branch stars. The distance determined from the 1612-MHz light curve and a new measurement of the angular radius is $3.87 \pm 0.28$ kpc. At both frequencies, the flux of polarized emission tightly follows the total flux variations while, the degrees of circular and linear polarization are constant within measurement accuracy. There is net polarization at both lines. The magnetic field strength estimated from a likely Zeeman pair is $-0.6$ mG at the distance of 5400 au from the star. At the near and far sides of the envelope, the polarization vectors are well aligned implying a regular structure of the magnetic field. The polarization characteristics of the OH maser emission suggest a radial magnetic field which is frozen in the stellar wind.

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## The origin of dust in early-type galaxies and implications for accretion onto supermassive black holes

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We have conducted an archival *Spitzer* study of 38 early-type galaxies (ETGs) in order to determine the origin of the dust in approximately half of this population. Our sample galaxies generally have good wavelength coverage from 3.6um to 160 $\mu$m, as well as visible-wavelength HST images. We use the *Spitzer* data to estimate dust masses, or establish upper limits, and find that all of the ETGs with dust lanes in the HST data are detected in all of the *Spitzer* bands and have dust masses of $\sim 10^{5-6.5}$ $M_{\odot}$, while galaxies without dust lanes are not detected at 70 $\mu$m and 160 $\mu$m and typically have $< 10^5$ $M_{\odot}$ of dust. The apparently dust-free galaxies do have 24 $\mu$m emission that scales with the shorter wavelength flux, yet substantially exceeds the expectations of photospheric emission by approximately a factor of three. We conclude this emission is dominated by hot, circumstellar dust around evolved stars that does not survive to form a substantial interstellar component. The order of magnitude variations in dust masses between galaxies with similar stellar populations rules out a subtantial contribution from continual, internal production in spite of the clear evidence for circumstellar dust. We demonstrate that the interstellar dust is not due to purely external accretion, unless the product of the merger rate of dusty satellites and the dust lifetime is at least an order of magnitude higher than expected. We propose that dust in ETGs is seeded by external accretion, yet the accreted dust is maintained by continued growth in externally-accreted cold gas beyond the nominal lifetime of individual grains. The several Gyr depletion time of the cold gas is long enough to reconcile the fraction of dusty ETGs with the merger rate of gas-rich satellites. As the majority of dusty ETGs are also low-luminosity AGN and likely fueled by this cold gas, their lifetime should similarly be several Gyr.

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## Detection of diffuse X-ray emission from planetary nebulæ with nebular O VI

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The presence of O VI ions can be indicative of plasma temperatures of a few $\times 10^5$ K that is expected in heat conduction layers between the hot shocked stellar wind gas at several $10^6$ K and the cooler ($10^4$ K) nebular gas of planetary nebulæ (PNe). We have used FUSE observations of PNe to search for nebular O VI emission or absorption as a diagnostic of conduction layer to ensure the presence of hot interior gas. Three PNe showing nebular O VI, namely IC 418, NGC 2392, and NGC 6826, have been selected for *Chandra* observations and diffuse X-ray emission is indeed detected in each of these PNe. Among the three, NGC 2392 has peculiarly high diffuse X-ray luminosity and plasma temperature compared with those expected from its stellar wind's mechanical luminosity and terminal velocity. The limited effects of heat conduction on the plasma temperature of a hot bubble at the low terminal velocity of the stellar wind of NGC 2392 may partially account for its high plasma temperature, but the high X-ray luminosity needs to be powered by processes other than the observed stellar wind, probably caused by the presence of an unseen binary companion of the CSPN of NGC 2392. We have compiled relevant information on the X-ray, stellar, and nebular properties of PNe with a bubble morphology and found that the expectations of bubble models including heat conduction compare favorably with the present X-ray observations of hot bubbles around H-rich CSPNe, but have notable discrepancies for those around H-poor [WR] CSPNe. We note that PNe with more massive central stars can produce hotter plasma and higher X-ray surface brightness inside central hot bubbles.

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## Numerical simulations of radiatively-driven dusty winds

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Radiation pressure on dust grains may be an important mechanism in driving winds in a wide variety of astrophysical systems. However, the efficiency of the coupling between the radiation field and the dusty gas is poorly understood in environments characterized by high optical depths like those in ultra-luminous infrared galaxies (ULIRGs) and massive dense star clusters. We present a series of idealized numerical experiments, performed with the radiation-hydrodynamic code ORION, in which we study the dynamics of such winds and quantify their properties. We find that, after wind acceleration begins, radiation Rayleigh–Taylor instability forces the gas into a configuration that reduces the rate of momentum transfer from the radiation field to the gas by a factor $\sim$ 10–100 compared to an estimate based on the optical depth at the base of the atmosphere; instead, the rate of momentum transfer from a driving radiation field of luminosity $L$ to the gas is roughly $L/c$ multiplied by half the optical depth at the dust photosphere, which is far smaller than the optical depth in the deep interior. When we apply our results to conditions appropriate to ULIRGs and star clusters, we find that the asymptotic wind momentum flux from such objects should not significantly exceed that carried by the direct radiation field, $L/c$. This result constrains the expected mass loss rates from systems that exceed the Eddington limit to be of order the so-called "single-scattering" limit, and not significantly higher. We present an approximate fitting formula for the rate of momentum transfer from radiation to dusty gas through which it passes, which is suitable for implementation in sub-grid models of galaxy formation. Finally, we provide a first map of the column density distribution of gas in a radiatively-driven wind as a function of velocity, and velocity dispersion.

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## Polarization morphology of SiO masers in the circumstellar envelope of the AGB star R Cassiopeiæ

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Silicon monoxide maser emission has been detected in the circumstellar envelopes of many evolved stars in various vibrationally-excited rotational transitions. It is considered a good tracer of the wind dynamics close to the photosphere of the star. We have investigated the polarization morphology in the circumstellar envelope of an AGB star, R Cas. We mapped the linear and circular polarization of SiO masers in the $v = 1$, $J = 1$–0 transition. The linear polarization is typically a few tens of percent while the circular polarization is a few percent. The fractional polarization tends to be higher for emission of lower total intensity. We found that, in some isolated features the fractional linear polarization appears to exceed 100%. We found the Faraday rotation is not negligible but is $\sim 15°$, which could produce small scale structure in polarized emission whilst total intensity is smoother and partly resolved out. The polarization angles vary considerably from feature to feature but there is a tendency to favour the directions parallel or perpendicular to the radial direction with respect to the star. In some features, the polarization angle abruptly flips 90°. We found that our data are in the regime where the model of Goldreich et al. (1973) can be applied and the polarization angle flip is caused when the magnetic field is at close to 55° to the line of sight. The polarization angle configuration is consistent with a radial magnetic field although other configurations are not excluded.

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# ATCA survey of $H_2O$ masers in the Large Magellanic Cloud

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We have analysed archival data taken with the Australia Telescope Compact Array (ATCA) during 2001–2003 and detected nine new interstellar and circumstellar $H_2O$ masers in the LMC. This takes the total number of star formation $H_2O$ masers in the LMC to 23, spread over 14 different star forming regions and three evolved stars. Three $H_2O$ maser sources (N 105a/MC 23, N 113/MC 24, N 157a/MC 74) have been detected in all the previous observations that targeted these sites, although all show significant variability on timescales of decades. The total number of independent $H_2O$ maser sources now known in the LMC means that through very long baseline interferometry astrometric measurements it will be possible to construct a more precise model of the galactic rotation of the LMC and its orbital motion around the Milky Way Galaxy.

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# Deep optical imaging of AGB circumstellar envelopes

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We report results of a program to image the extended circumstellar envelopes of asymptotic giant branch (AGB) stars in dust-scattered Galactic light. The goal is to characterize the shapes of the envelopes to probe the mass-loss geometry and the presence of hidden binary companions. THe observations consist of deep optical imaging of 22 AGB stars with high mass loss rates: 16 with the ESO 3.6-m NTT telescope, and the remainder with other telescopes. The circumstellar envelopes are detected in 15 objects, with mass-loss rates $\gtrsim 2 \times 10^{-6}$ $M_\odot$ $yr^{-1}$. The surface brightness of the envelopes shows a strong decrease with Galactic radius, which indicates a steep radial gradient in the interstellar radiation field. The envelopes range from circular to elliptical in shape, and we characterize them by the ellipticity ($E$ = major/minor axis) of iso-intensity contours. We find that $sim$50% of the envelopes are close to circular with $E \lesssim 1.1$, and others are more elliptical with $\sim$ 20% with $E \gtrsim 1.2$. We interpret the shapes in terms of populations of single stars and binaries whose envelopes are flattened by a companion. The distribution of $E$ is qualitatively consistent with expectations based on population synthesis models of binary stars. We also find that $\sim$ 50% of the sample exhibit small-scale, elongated features in the central regions. We interpret these as the escape of light from the central star through polar holes, which are also likely produced by companions. Our observations of envelope flattening and polar holes point to a hidden population of binary companions within the circumstellar envelopes of AGB stars. These companions are expected to play an important role in the transition to post-AGB stars and the formation of planetary nebulæ.

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# Wind Roche-lobe overflow: Application to carbon-enhanced metal-poor stars

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Carbon-enhanced metal-poor stars (CEMP) are observed as a substantial fraction of the very metal-poor stars in the Galactic Halo. Most CEMP stars are also enriched in s-process elements and these are often found in binary systems. This suggests that the carbon enrichment is due to mass transfer in the past from an asymptotic giant branch (AGB) star on to a low-mass companion. Models of binary population synthesis are not able to reproduce the observed fraction of CEMP stars without invoking non-standard nucleosynthesis or a substantial change in the initial mass function. This is interpreted as evidence of missing physical ingredients in the models. Recent hydrodynamical simulations show that efficient wind mass transfer is possible in the case of the slow and dense winds typical of AGB stars through a mechanism called wind Roche-lobe overflow (WRLOF), which lies in between the canonical Bondi–Hoyle–Lyttleton (BHL) accretion and Roche-lobe overflow. WRLOF has an effect on the accretion efficiency of mass transfer and on the angular momentum lost by the binary system. The aim of this work is to understand the overall effect of WRLOF on the population of CEMP stars. To simulate populations of low-metallicity binaries we combined a synthetic nucleosynthesis model with a binary population synthesis code. In this code we implemented the WRLOF mechanism. We used the results of hydrodynamical simulations to model the effect of WRLOF on the accretion efficiency and we took the effect on the angular momentum loss into account by assuming a simple prescription. The combination of these two effects widens the range of systems that become CEMP stars towards longer initial orbital periods and lower mass secondary stars. As a consequence the number of CEMP stars predicted by our model increases by a factor 1.2–1.8 compared to earlier results that consider the BHL prescription. Moreover, higher enrichments of carbon are produced and the final orbital period distribution is shifted towards shorter periods.

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*Available from* arXiv:1302.4441

# Exploring wind-driving dust species in cool luminous giants II. Constraints from photometry of M-type AGB stars

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The heavy mass loss observed in evolved asymptotic giant branch (AGB) stars is usually attributed to a two-stage process: atmospheric levitation by pulsation-induced shock waves, followed by radiative acceleration of newly formed dust grains. The dust transfers momentum to the surrounding gas through collisions and thereby triggers a general outflow. Radiation-hydrodynamical models of M-type AGB stars suggest that these winds can be driven by photon scattering – in contrast to absorption – on Fe-free silicate grains of sizes 0.1–1 $\mu$m. In this paper we study photometric constraints for wind-driving dust species in M-type AGB stars, as part of an ongoing effort to identify likely candidates among the grain materials observed in circumstellar envelopes. To investigate the scenario of stellar winds driven by photon scattering on dust, and to explore how different optical and chemical properties of wind-driving dust species affect photometry we focus on two sets of dynamical models atmospheres: (i) models using a detailed description for the growth of $Mg_2SiO_4$ grains, taking into account both scattering and absorption cross-sections when calculating the radiative acceleration, and (ii) models using a parameterized dust description, constructed to represent different chemical and optical dust properties. By comparing synthetic photometry from these two sets of models to observations of M-type AGB stars we can provide constraints on the properties of wind-driving dust species. Photometry from wind

models with a detailed description for the growth of $Mg_2SiO_4$ grains reproduces well both the values and the time-dependent behavior of observations of M-type AGB stars, providing further support for the scenario of winds driven by photon scattering on dust. The photometry from the models with a parameterized dust description suggests that wind-drivers need to have a low absorption cross-section in the visual and near-IR to reproduce the time-dependent behavior, i.e. small variations in $(J-K)$ and spanning a larger range in $(V-K)$. This places constraints on the optical and chemical properties of the wind-driving dust species. To reproduce the observed photometric variations in $(V-K)$ and $(J-K)$ both detailed and parameterized models suggest that the wind-driving dust materials have to be quite transparent in the visual and near-IR. Consequently, strong candidates for outflows driven by photon scattering on dust grains are $Mg_2SiO_4$, $MgSiO_3$, and potentially $SiO_2$.

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# *Conference Papers*

## Red supergiants in the Local Group

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Galaxies in the Local Group span a factor of 15 in metallicity, ranging from the super-solar M 31 to the Wolf–Lundmark–Melotte (WLM) galaxy, which is the lowest-metallicity (0.1 $Z_\odot$) Local Group galaxy currently forming stars. Studies of massive star populations across this broad range of environments have revealed important metallicity-dependent evolutionary trends, allowing us to test the accuracy of stellar evolutionary tracks at these metallicities for the first time. The RSG population is particularly valuable as a key mass-losing phase of moderately massive stars and a source of core-collapse supernova progenitors. By reviewing recent work on the RSG populations in the Local Group, we are able to quantify limits on these stars' effective temperatures and masses and probe the relationship between RSG mass loss behaviors and host environments. Extragalactic surveys of RSGs have also revealed several unusual RSGs that display signs of unusual spectral variability and dust production, traits that may potentially also correlate with the stars' host environments. I will present some of the latest work that has progressed our understanding of RSGs in the Local Group, and consider the many new questions posed by our ever-evolving picture of these stars.

**Oral contribution, published in Betelgeuse Workshop 2012**
*Available from* arXiv:1302.0822

## A WISE view of novæ

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We present the result of trawling through the WISE archive for data on classical and recurrent novæ. The data show a variety of spectral energy distributions, including stellar photospheres, dust and probable line emission. During the mission WISE also detected some novæ which erupted subsequent to the survey, providing information about the progenitor systems.

**Oral contribution, published in Stella Novæ: Future and Past Decades**
*Available from* arXiv:1302.4334

# *Review Papers*

## The 2013 release of Cloudy

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This is a summary of the 2013 release of the plasma simulation code Cloudy. Cloudy models the ionization, chemical, and thermal state of material that may be exposed to an external radiation field or other source of heating, and predicts observables such as emission and absorption spectra. It works in terms of elementary processes, so is not limited to any particular temperature or density regime. This paper summarizes advances made since the last major review in 1998. Much of the recent development has emphasized dusty molecular environments, improvements to the ionization / chemistry solvers, and how atomic and molecular data are used. We present two types of simulations to demonstrate the capability of the code. We consider a molecular cloud irradiated by an X-ray source such as an Active Nucleus and show how treating EUV recombination lines and the full SED affects the observed spectrum. A second example illustrates the very wide range of particle and radiation density that can be considered.

**Published in Rev. Méx. A&A**
*Available from* arXiv:1302.4485

## Infrared emission from novæ

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We review infrared observations of classical and recurrent novæ, at wavelengths $> 3$ $\mu$m, including both broad-band and spectroscopic observations. In recent years infrared spectroscopy in particular has revolutionised our understanding of the nova phenomenon, by revealing fine-structure and coronal lines, and the mineralogy of nova dust. Infrared spectroscopic facilities that are, or will be, becoming available in the next 10–20 years have the potential for a comprehensive study of nova line emission and dust mineralogy, and for an unbiassed assessment of the extragalactic nova populations.

**Published in Bulletin of the Astronomical Society of India**
*Available from* arXiv:1209.3193

# 400 Years of Stellar Rotation

1st Announcement

Dear colleagues,

We are pleased to announce the workshop 400 Years of Stellar Rotation, to celebrate four centuries of astronomical research after the public announcement of solar rotation by Galileo Galilei. The conference is co-sponsored by the European Southern Observatory and the International Institute of Physics of Natal, and will be held at the Ocean Palace Beach Resort in Natal, Brazil, from Sunday, November 17, to Friday, November 22, 2013.

Main Topics:

- Rotation: From Galileo to CoRoT and Kepler
- Evolutionary models of rotating stars
- The impact of rotation on Solar and Stellar Physics
- The solar rotation profile
- Rotation, winds, magnetic fields and stellar activity
- Observations of rotating stars
- Rotation and chemical abundances
- Rotation, stellar formation and evolution
- Rotation and stellar multiplicity
- Rotation in the final evolutionary stages
- Stellar rotation, activity, and planets

Scientific Organizing Committee:

Adriana Valio, Mackenzie University (São Paulo, Brazil)

André Maeder, Geneva Observatory (Geneva, Switzerland)

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Rolf-Peter Kudritzki, University of Hawai'i (Honolulu, USA)

*See also* http://www.dfte.ufrn.br/400rotation/index.htm

## Fizeau exchange visitors program – call for applications

Dear colleagues!

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff). Applicants are strongly encouraged to seek also partial support from their home or host institutions.

The deadline for applications is March 15. Fellowships can be awarded for missions starting in May 2013. Applications for attending the VLTI school 2013 will be considered but funding will be coordinated with the school organizers.

Further informations and application forms can be found at www.european-interferometry.eu and vltischool.sciencesconf.org

The program is funded by OPTICON/FP7.

Please distribute this message also to potentially interested colleagues outside of the your community!

Looking forward to your applications,
Josef Hron & Laszlo Mosoni
(for the European Interferometry Initiative)

*See also* http://www.european-interferometry.eu
*and* http://vltischool.sciencesconf.org

## Massive Stars: From $\alpha$ to $\Omega$
## June 10–14, 2013, Rhodes, Greece

The "Massive Stars" meetings have enjoyed more than 40 years of startling success since the first meeting in Argentina in 1971. Held every 4 to 5 years, these meetings aim to encapsulate the current state-of-the-art of our understanding of the physics of Massive Stars and their role in the Universe. For this $10^{th}$ meeting in the Massive Stars series the Institute of Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens, with the encouragement of the IAU Working Group on Massive Stars, is hosting the meeting on the island of Rhodes. This beautiful setting was also once home to one of the greatest astronomers of antiquity, Hipparchos, who is generally acknowledged as the founder of trigonometry, discoverer of precession and publisher of the first modern star catalog around 135 BC.

The conference will build on results from ongoing large-scale multi-wavelength surveys of massive stars which are being coupled with new theoretical advances dealing with stellar evolution and the processes which effect that evolution: mass loss, rotation, convection, magnetic fields, multiplicity and environment. It will tackle important problems from birth, through main sequence evolution and until core collapse.

This is an exciting time as observations have revealed large gaps in understanding of the formation and evolution of massive stars. The huge impact that massive stars have on their immediate environment, parent galaxies, and through the Universe, demands better understanding of massive star evolution from $\alpha$ to $\Omega$.

The scientific topics that will be covered are:

- New observational & theoretical results from large-scale surveys (FLAMES, MiMeS, PanSTARRS, PTF), techniques (astrometry) and computation;
- Consequences of zero-age conditions on stellar evolution;
- Massive star environments, massive clusters, dynamical evolution, runaway stars and mergers;
- The importance of binaries for populations of massive stars;
- The upper end of the IMF and the role of mergers;
- Massive-star magnetism and pulsation, evolutionary consequences;
- The role and evolution of stellar rotation across the H–R diagram;
- Mass loss across the H–R diagram and episodic mass-loss from LBVs and other transients;
- Constraints from endpoints;
- Massive stars at very low metallicity.

Looking forward to seeing you in Rhodes!

The LOC co-chairs,
Panos Boumis and Alceste Bonanos

*See also* http://a2omega-conference.net/

## TEXES mid-IR spectrograph on Gemini

We are writing to encourage you to consider proposing to use TEXES, our high resolution mid-IR spectrograph on Gemini. We anticipate that TEXES will be be on Gemini North in 2013B, most likely in October or November, as well as future years, with one run per year likely. It is also available to the community on the IRTF, with 1 or 2 runs each year.

TEXES is most often used in its $R \sim 80,000$ cross-dispersed mode, with an $R \sim 15,000$ long-slit mode also available. Its instantaneous spectral coverage is $\sim 0.5\%$, and it can be used between 5 and 25 $\mu$m. It may also be available at $R \sim 4000$ with 0.25 $\mu$m coverage. The advantages of using TEXES on Gemini are sensitivity to point sources ($\sim 1$ $\sigma$ in 1 sec on 2 Jy) and diffraction-limited spatial resolution on extended sources. Further information is available on the Gemini web site (although the statements about availability may be out of date). Proposals will be due for for semester 2013B near the end of March.

If you are interested in using TEXES on Gemini or the IRTF, please contact one of us.

John Lacy (lacy@astro.as.utexas.edu)
Matt Richter (richter@physics.ucdavis.edu)
Tommy Greathouse (tgreathouse@swri.edu)

*See also* http://www.gemini.edu/sciops/instruments/texes-north

# "Giants of Eclipse"

**Giants of Eclipse** will provide a forum to discuss the physics of cool giant stars, examine new data for those objects, and compare the latest theories. Studies of giants in eclipsing binaries have afforded us a means of deriving precise cool-star physics, and the role of these systems as astrophysical calibrators is central to the meeting. The minute details of the eclipses of $\zeta$ **Aurigæ** systems and other binaries will be examined along with new results from the mysterious two-year eclipse of $\epsilon$ **Aurigæ**. Some of the long-standing and challenging aspects of these systems are now being tackled with new-generation techniques, and novel technologies such as *Kepler*, involving young scientists.

This meeting will feature workshops for discussing the phenomena, data, instrumentation, methods, and models, and will bring together experts in spectroscopy, photometry, imaging, interferometry, spectropolarimetry, stellar magnetic activity, and evolution, including both professionals and amateur astronomers. Moreover, the application of new technologies and perspectives to this unique set of bright objects should lead to exciting advances in our understanding of the physics of cool giant stars and the evolution of stars in general.

This is the first major meeting to feature $\epsilon$ **Aurigæ** since the end of its recent eclipse. That event attracted substantially more observers and more diverse telescopes, methods, and models than ever before. **Giants of Eclipse** will facilitate an assimilation and analysis of the data and models, and simultaneously lead the effort to identify the important observations needed to improve the theoretical models before the next eclipse occurs. Amateur observers will play an essential role in these discussions.

Information about the meeting can be found at http://aas.org/meetings/aastcs3, where you can register, submit an abstract for presentation, and download the meeting's poster. We dearly hope to be able to offer small bursaries to those whose attendendance depends on that support, but have no details as yet.

**Invited Speakers**

Tom Ayres & Graham Harper

Gerard van Belle & Steve Howell

Phil Bennett & John Landstreet

Manfred Cuntz & Hal McAlister

Joel Eaton & Michele Montgomery

Peter Eggleton & Andrej Prsa

Elizabeth Griffin & Mercedes Richards

Ed Guinan & Klaus-Peter Schröder

Wendy Hagen-Bauer & Robert Stencel

Abstracts can be sent **NOW**, until March 31, for early assessment and prior selection.
Late submissions will be accepted until May 1.

Proposals for workshop topics may be sent to the Organizers until July 1.

The future of the fascinating science of eclipsing giants is in your hands ... Come join us!

*See also* http://aas.org/meetings/aastcs3