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Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is a pleasure to present you the 183$^{\rm rd}$ issue of the AGB Newsletter. Models, masers and metal-poor stars, novæ and white dwarfs, and some tools; surely there is something of your interest.

The Fizeau programme of exchange of staff related to interferometry still exists – see the announcement at the back of the newsletter.

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

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

White dwarf population synthesis helps improve AGB models

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

Two short mass-loss events that unveil the binary heart of Minkowski's Butterfly Nebula

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Studying the appearance and properties of bipolar winds is critical to understand the stellar evolution from the AGB to the planetary nebula (PN) phase. Many uncertainties exist regarding the presence and role of binary stellar systems, mainly due to the deficit of conclusive observational evidences. We investigate the extended equatorial distribution around the early bipolar planetary nebula M 2-9 "Minkowski's Butterfly Nebula") to gather new information on the mechanism of the axial ejections. Interferometric millimeter observations of molecular emission provide the most comprehensive view of the equatorial mass distribution and kinematics in early PNe. Here we present subarcsecond angular-resolution observations of the ^{12}CO 2–1 line and continuum emission with the Plateau de Bure interferometer. The data reveal two ring-shaped and eccentric structures at the equatorial basis of the two coaxial optical lobes. The two rings were formed during short mass-loss episodes ($\sim$ 40 yr), separated by $\sim$ 500 yr. Their positional and dynamical imprints provide evidence of the presence of a binary stellar system at the center, which yields critical information on its orbital characteristics, including a mass estimate for the secondary of $\lesssim$0.2 M$_\odot$. The presence of a stellar system with a modest-mass companion at the center of such an elongated bipolar PN strongly supports the binary-based models, because these are more easily able to explain the frequent axisymmetric ejections in PNe.

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A catalog of planetary nebula candidates in the Sculptor spiral galaxy NGC 300

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[O III] 5007Å on-band and off-band images, obtained with the Very Large Telescope (VLT) and FORS2 spectrograph in two zones (center and outskirts) of the spiral galaxy NGC 300, are analyzed searching for emission line objects. In particular we search for planetary nebula (PN) candidates to analyze their distribution and luminosity properties, to perform follow-up spectroscopy, and to study the planetary nebula luminosity function, PNLF. In the continuum-subtracted images, a large number of emission line objects were detected. From this sample we selected those objects with stellar appearance and no detectable central star as PN candidates. [O III]5007 instrumental magnitudes were measured and calibrated by using spectrophotometric data from the follow-up spectroscopy. We have identified more than a hundred PN candidates and many compact H II regions. The PN sample is the largest one reported for this galaxy so far. For all the objects we present coordinates, instrumental [O III]5007 magnitudes, and apparent nebular [O III]5007 fluxes and magnitudes. The [O III]5007 observed luminosity function for PNe (PNLF) was calculated for the whole sample and for the central and outskirts samples. The three PNLF are similar within uncertainties. We fit the empirical PNLF to the observed PNLF for all the samples. From our best fit for the whole sample, we derived a maximum value for the apparent magnitudes of $m^\star_{5007} = 22.019 \pm 0.022$ and obtained a tentative estimate of the distance modulus $m(5007) - M(5007) = 26.29^{+0.12}_{-0.22}$ mag, which agrees well with the recent value derived from Cepheid stars.

Accepted for publication in Astronomy and Astrophysics

Available from arXiv:1208.5541

The expanding dusty bipolar nebula around the nova V1280 Sco

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The fast temporal evolution of the ejecta morphology of novae can be considered as an important test bench for studying the shaping of many kinds of nebulae. V1280 Sco is one of the slowest dust-forming nova ever historically observed that has experienced a particularly long common-envelope phase. We performed multi-epoch high-spatial resolution observations of the circumstellar dusty environment of V1280 Sco to investigate the level of asymmetry of the ejecta. We observed V1280 Sco in 2009, 2010 and 2011 (from $t = 877$ days after discovery until $t = 1664$ d) using unprecedented high angular resolution techniques. We used the NACO/VLT adaptive optics system in the J, H and K bands, together with contemporaneous VISIR/VLT mid-IR imaging that resolved the dust envelope of V1280 Sco, and SINFONI/VLT observations secured in 2011. We report the discovery of a dusty hourglass-shaped bipolar nebula. The apparent size of the nebula increased from $0\farcs30 \times 0\farcs17$ in July 2009 to $0\farcs64 \times 0\farcs42$ in July 2011. The aspect ratio suggests that the source is seen at high inclination. The central source shines efficiently in the K band and represents more than $56 \pm 5\%$ of the total flux in 2009, and $87 \pm 6\%$ in 2011. A mean expansion rate of 0.39 ± 0.03 milliarcsec per day is inferred from the VISIR observations in the direction of the major axis, which represents a projected upper limit. Assuming that the dust shell expands in that direction as fast as the low-excitation slow ejecta detected in spectroscopy, this yields a lower limit distance to V1280 Sco of ~ 1 kpc; however, the systematic errors remain large due to the complex shape and velocity field of the dusty ejecta. The dust seems to reside essentially in the polar caps and no infrared flux is detected in the equatorial regions in the latest dataset. This may imply that the mass loss was dominantly polar.

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The most metal-poor stars. II. Chemical abundances of 190 metal-poor stars Including 10 new stars with [Fe/H] < -3.5

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We present a homogeneous chemical abundance analysis of 16 elements in 190 metal-poor Galactic halo stars (38 program and 152 literature objects). The sample includes 171 stars with [Fe/H] ≤ -2.5, of which 86 are extremely metal poor, [Fe/H] ≤ -3.0. Our program stars include ten new objects with [Fe/H] ≤ -3.5. We identify a sample

of "normal" metal-poor stars and measure the trends between [X/Fe] and [Fe/H], as well as the dispersion about the mean trend for this sample. Using this mean trend, we identify objects that are chemically peculiar relative to "normal" stars at the same metallicity. These chemically unusual stars include CEMP-no objects, one star with high [Si/Fe], another with high [Ba/Sr], and one with unusually low [X/Fe] for all elements heavier than Na. The Sr and Ba abundances indicate that there may be two nucleosynthetic processes at lowest metallicity that are distinct from the main r-process. Finally, for many elements, we find a significant trend between [X/Fe] versus $T_{\rm eff}$ which likely reflects non-LTE and/or 3D effects. Such trends demonstrate that care must be exercised when using abundance measurements in metal-poor stars to constrain chemical evolution and/or nucleosynthesis predictions.

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The most metal-poor stars. III. The metallicity distribution function and CEMP fraction

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We examine the metallicity distribution function (MDF) and fraction of carbon-enhanced metal-poor (CEMP) stars in a sample that includes 86 stars with [Fe/H] < -3.0, based on high-resolution, high-S/N spectroscopy, of which some 32 objects lie below [Fe/H] $= -3.5$. After accounting for the completeness function, the "corrected" MDF does not exhibit the sudden drop at [Fe/H] $= -3.6$ that was found in recent samples of dwarfs and giants from the Hamburg/ESO survey. Rather, the MDF decreases smoothly down to [Fe/H] $= -4.1$. Similar results are obtained from the "raw" MDF. We find the fraction of CEMP objects below [Fe/H] $= -3.0$ is $23 \pm 6\%$ and $32 \pm 8\%$ when adopting the Beers et al. and Aoki et al. CEMP definitions, respectively. The former value is in fair agreement with some previous measurements, which adopt the Beers et al. criterion.

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Oxygen-rich dust production in IC 10

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We report the detection of oxygen-rich circumstellar envelopes in stars of the nearby (700 kpc) starburst galaxy

IC 10. The star-formation history and the chemical environment of this galaxy make it an ideal target to observe dust production by massive stars in a metal-poor environment.
The goal of this study is to identify oxygen-rich stars in IC 10 and to constrain their nature between asymptotic giant branch stars (AGBs), red supergiants (RSGs), and other bright infrared sources. We examine the mass-loss rates of the stars and compare to results obtained for the Magellanic Clouds. Our objectives are to (1) assess whether RSGs can be significant dust producers in IC 10, and (2), solve the discrepancy between the star-formation history of IC 10 and the relatively low number of RSGs detected in the optical.
We search for silicate dust in emission by using the spectral map observed with the Infrared Spectrograph on board the *Spitzer* Space Telescope. The optical ($UBVRI$) and infrared (JHK, *Spitzer*/IRAC and *Spitzer*/MIPS) photometry are used to assert the membership of the stars to IC 10 and distinguish between AGBs and RSGs. Radiative models are used to infer mass-loss rates and stellar luminosities.
The luminosity and colors of at least 9 silicate emission sources are consistent with stars within IC 10. Furthermore, the photometry of 2 of these sources is consistent with RSGs. We derive dust mass-loss rates similar to the values found in the Magellanic Clouds. Accounting for the sample completeness, RSGs are not important contributors to the dust mass budget in IC 10.

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PARSEC: stellar tracks and isochrones with the PAdova & TRieste Stellar Evolution Code

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We present the updated version of the code used to compute stellar evolutionary tracks in Padova. It is the result of a thorough revision of the major input physics, together with the inclusion of the pre-main sequence phase, not present in our previous releases of stellar models. Another innovative aspect is the possibility of promptly generating accurate opacity tables fully consistent with any selected initial chemical composition, by coupling the OPAL opacity data at high temperatures to the molecular opacities computed with our AESOPUS code (Marigo & Aringer 2009). In this work we present extended sets of stellar evolutionary models for various initial chemical compositions, while other sets with different metallicities and/or different distributions of heavy elements are being computed. For the present release of models we adopt the solar distribution of heavy elements from the recent revision by Caffau et al. (2011), corresponding to a Sun's metallicity $Z = 0.0152$. From all computed sets of stellar tracks, we also derive isochrones in several photometric systems. The aim is to provide the community with the basic tools to model star clusters and galaxies by means of population synthesis techniques.

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Wide binary effects on asymmetries in asymptotic giant branch circumstellar envelopes

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Observations of increasingly higher spatial resolution reveal the existence of asymmetries in the circumstellar envelopes of a small fraction of asymptotic giant branch (AGB) stars. Although there is no general consensus for their origin, a

binary companion star may be responsible. Within this framework, we investigate the gravitational effects associated with a sufficiently wide binary system, where Roche lobe overflow is unimportant, on the outflowing envelopes of AGB stars using three dimensional hydrodynamic simulations. The effects due to individual binary components are separately studied, enabling investigation of the stellar and circumstellar characteristics in detail. The reflex motion of the AGB star alters the wind velocity distribution, thereby, determining the overall shape of the outflowing envelope. On the other hand, the interaction of the companion with the envelope produces a gravitational wake, which exhibits a vertically thinner shape. The two patterns overlap and form clumpy structures. To illustrate the diversity of shapes, we present the numerical results as a function of inclination angle. Not only is spiral structure produced by the binary interaction, but arc patterns are also found that represent the former structure when viewed at different inclinations. The arcs reveal a systematic shift of their centers of curvature for cases when the orbital speed of the AGB star is comparable to its wind speed. They take on the shape of a peanut for inclinations nearly edge-on. In the limit of slow orbital motion of the AGB star relative to the wind speed, the arc pattern becomes nearly spherically symmetric. We find that the aspect ratio of the overall oblate shape of the pattern is an important diagnostic probe of the binary as it can be used to constrain the orbital velocity of the AGB star, and moreover the binary mass ratio.

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Annual parallax distance to the K-type star system IRAS 22480+6002 measured with VERA

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We present the astrometric VLBI observations of H_2O masers associated with IRAS 22480+6002 (= IRC +60°370, hereafter I22480) with the VLBI Exploration of Radio Astrometry (VERA). The stellar type of I22480 looks unusual as a stellar maser source and has been debated since the 1970s. We successfully determined the annual parallax of a group of the H_2O maser spots, $\pi = 0.400 \pm 0.025$ mas, corresponding to a distance to I22480 of $D = 2.50^{+0.17}_{-0.15}$ kpc. This suggests that the estimated bolometric luminosity of I22480 should be revised to 35 000 $L_\odot$, favoring a K-type supergiant rather than an RV Tau-type variable star previously suggested. Although the spectral type is unusual as a stellar maser source, the internal motions of the H_2O maser features suggest that the H_2O masers are associated with the circumstellar envelope of this star. Taking into account a possible stellar motion with respect to the maser feature motions, we derived a secular proper motion of I22480, $(\mu_\alpha, \mu_\delta) = (-2.58 \pm 0.33, -1.91 \pm 0.17)$ mas yr^{-1}. The derived motion of I22480 in the Milky Way has a deviation by ~ -30 km s^{-1} in the Galactic azimuthal direction from a circular motion estimated from the Galactocentric distance to I22480 and assumption of a flat Galactic rotation curve. This peculiar motion is still comparable to those typically seen in the H_2O maser sources located in the Perseus spiral arm. Taking into account the peculiar motion and the proximity to the Galactic midplane ($z \simeq 60$ pc), I22480 may be a member of the Galactic thin disk.

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OPACOS: OVRO post-AGB CO(1–0) emission survey. I. Data and derived nebular parameters

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We have performed interferometric observations of the ^{12}CO(J = 1–0) emission in a sample of 27 objects spanning

different evolutionary stages from the late Asymptotic Giant Branch (late-AGB), through the post-AGB (pAGB) phase, and to the Planetary Nebula (PN) stage, but dominated by pAGB objects and young PNs ($\geq 81\%$). In this paper (first in a series) we present our maps and main nebular properties derived for the whole sample. Observations were performed with the millimeter wavelength array of the Owens Valley Radio Observatory (OVRO). The angular resolution obtained in our survey ranges between $2\farcs3$ and $10\farcs7$. The ^{13}CO and C^{18}O ($J = 1$–0) transitions as well as the 2.6-mm continuum emission have been also observed in several objects. The detection statistics in the ^{12}CO, ^{13}CO, C^{18}O transitions and 2.6-mm continuum is 89%, 83%, 0%, and 37%, respectively. We report first detections of ^{12}CO($J = 1$–0) emission in 13 targets and confirm emission from several previous marginal detections. The molecular envelope probed by ^{12}CO($J = 1$–0) emission is extended for 18 (out of 24) sources; envelope asymmetries and/or velocity gradients are found in most extended objects. Our data have been used to derive accurate target coordinates, systemic velocities and to characterize the envelope size, morphology, and kinematics. We also provide an estimate of the total molecular mass and the fraction of it contained in fast flows, lower limits to the linear momentum and to the isotopic ^{12}C/^{13}C ratio, as well as the AGB mass-loss rate and time-scale for sources with extended CO emission.

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Available from http://www.cab.inta-csic.es/users/csanchez/OPACOS/

A hydrodynamic study of the circumstellar envelope of α Scorpii

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Context: Both the absolute mass-loss rates and the mechanisms that drive the mass loss of late-type supergiants are still not well known. Binaries such as α Sco provide the most detailed empirical information about the winds of these stars.
Aims: The goal was to improve the binary technique for the determination of the mass-loss rate of α Sco A by including a realistic density distribution and velocity field from hydrodynamic and plasma simulations.
Methods: We performed 3D hydrodynamic simulations of the circumstellar envelope of α Sco in combination with plasma simulations accounting for the heating, ionization, and excitation of the wind by the radiation of α Sco B. These simulations served as the basis for an examination of circumstellar absorption lines in the spectrum of α Sco B as well as of emission lines from the Antares nebula.
Results: The present model of the extended envelope of α Sco reproduces some of the structures that were observed in the circumstellar absorption lines in the spectrum of α Sco B. Our theoretical density and velocity distributions of the outflow deviate considerably from a spherically expanding model, which was used in previous studies. This results in a higher mass-loss rate of $(2 \pm 0.5) \times 10^{-6}$ $M_\odot$ yr^{-1}. The hot H II region around the secondary star induces an additional acceleration of the wind at large distances from the primary, which is seen in absorption lines of Ti II and Cr II at -30 km s^{-1}.

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Common proper motion wide white dwarf binaries selected from the Sloan Digital Sky Survey

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Wide binaries made up of two white dwarfs (WDs) receive far less attention than their tight counterparts. However, our

tests using the binary population synthesis code StarTrack indicate that, for any set of reasonable initial conditions, there exists a significant observable population of double white dwarfs (WDWDs) with orbital separations of 10^2 to 10^5 AU. We adapt the technique of Dhital et al. to search for candidate common proper motion WD companions separated by $< 10'$ around the $> 12,000$ spectroscopically confirmed hydrogen-atmosphere WDs recently identified in the Sloan Digital Sky Survey. Using two techniques to separate random alignments from high-confidence pairs, we find nine new high-probability wide WDWDs and confirm three previously identified candidate wide WDWDs. This brings the number of known wide WDWDs to 45; our new pairs are a significant addition to the sample, especially at small proper motions (< 200 mas yr^{-1}) and large angular separations ($> 10''$). Spectroscopic follow-up and an extension of this method to a larger, photometrically selected set of SDSS WDs may eventually produce a large enough dataset for WDWDs to realize their full potential as testbeds for theories of stellar evolution.

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The 1.17-day orbit of the double-degenerate (DA+DQ) NLTT 16249

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New spectroscopic observations show that the double degenerate system NLTT 16249 is in a close orbit ($a = 5.6 \pm 0.3$ $R_\odot$) with a period of 1.17 d. The total mass of the system is estimated between 1.47 and 2.04 $M_\odot$ but it is not expected to merge within a Hubble time-scale ($t_{\rm merge} \approx 10^{11}$ yr). Vennes & Kawka (2012, ApJ, 745, L12) originally identified the system because of the peculiar composite hydrogen (DA class) and molecular (C_2 – DQ class – and CN) spectra and the new observations establish this system as the first DA plus DQ close double degenerate. Also, the DQ component was the first of its class to show nitrogen dredged-up from the core in its atmosphere. The star may be viewed as the first known DQ descendant of the born-again PG 1159 stars. Alternatively, the presence of nitrogen may be the result of past interactions and truncated evolution in a close binary system.

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MESAFace, a graphical interface to analyze the MESA output

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MESA (Modules for Experiments in Stellar Astrophysics) has become very popular among astrophysicists as a powerful and reliable code to simulate stellar evolution. Analyzing the output data thoroughly may, however, present some challenges and be rather time-consuming. Here we describe MESAFace, a graphical and dynamical interface which provides an intuitive, efficient and quick way to analyze the MESA output.

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and from http://www.mgiannotti.com/mesaface.php

Can Galactic chemical evolution explain the oxygen isotopic variations in the Solar System?

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A number of objects in primitive meteorites have oxygen isotopic compositions that place them on a distinct, mass-independent fractionation line with a slope of one on a three- isotope plot. The most popular model for describing how this fractionation arose assumes that CO self-shielding produced ^{16}O-rich CO and ^{16}O-poor H_2O, where the H_2O subsequently combined with interstellar dust to form relatively ^{16}O-poor solids within the Solar Nebula. Another model for creating the different reservoirs of ^{16}O-rich gas and ^{16}O-poor solids suggests that these reservoirs were produced by Galactic chemical evolution (GCE) if the Solar System dust component was somewhat younger than the gas component and both components were lying on the line of slope one in the O three-isotope plot. We argue that GCE is not the cause of mass-independent fractionation of the oxygen isotopes in the Solar System. The GCE scenario is in contradiction with observations of the $^{18}O/^{17}O$ ratios in nearby molecular clouds and young stellar objects. It is very unlikely for GCE to produce a line of slope one when considering the effect of incomplete mixing of stellar ejecta in the interstellar medium. Furthermore, the assumption that the Solar System dust was younger than the gas requires unusual timescales or the existence of an important stardust component that is not theoretically expected to occur nor has been identified to date.

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Exploring wind-driving dust species in cool luminous giants I. Basic criteria and dynamical models of M-type AGB stars

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The heavy mass loss observed in evolved AGB stars is usually attributed to a two-stage process: atmospheric levitation by pulsation-induced shock waves followed by radiative acceleration of dust grains, which transfer momentum to the surrounding gas through collisions. In order for an outflow to occur the two stages of the mass-loss scheme have to connect, i.e. the radiative acceleration can only be initiated if the levitated gas reaches a distance from the stellar photosphere where dust particles can condense. This levitation distance is limited by the kinetic energy transferred to the gas by the shock waves, which imposes strict constraints on potential wind-driving dust species. This work is part of an ongoing effort aiming at identifying the actual wind-drivers among the dust species observed in circumstellar envelopes. In particular, we focus on the interplay between a strong stellar radiation field and the dust formation process. To identify critical properties of potential wind-driving dust species we use detailed radiation-hydrodynamical models which include a parameterized dust description, complemented by simple analytical estimates to help with the physical interpretation of the numerical results. The adopted dust description is constructed to mimic different chemical and optical dust properties in order to systematically study the effects of a realistic radiation field on the second stage of the mass loss mechanism. We see distinct trends in which combinations of optical and chemical dust properties are needed to trigger an outflow. Dust species with a low condensation temperature and a NIR absorption coefficient that decreases strongly with wavelength will not condense close enough to the stellar surface to be considered as potential wind-drivers. Our models confirm that metallic iron and Fe-bearing silicates are not viable as wind-drivers due to their near-infrared optical properties and resulting large condensation distances. TiO_2 is also excluded as a wind-driver due to the low abundance of Ti. Other species, such a SiO_2 and Al_2O_3, are less clear-cut cases due to uncertainties in the optical and chemical data and further work is needed. A strong candidate is Mg_2SiO_4 with grain sizes of 0.1–1 μm, where scattering contributes significantly to the radiative acceleration, as suggested by earlier theoretical work and supported by recent observations.

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The brightest pure-H ultracool white dwarf

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We report the identification of LSR J0745+2627 in the United Kingdom InfraRed Telescope Infrared Deep Sky Survey (UKIDSS) Large Area Survey (LAS) as a cool white dwarf with kinematics and age compatible with the thick-disk/halo population. LSR J0745+2627 has a high proper motion (890 mas yr^{-1}) and a high reduced proper motion value in the J band ($H_{\rm J} = 21.87$). We show how the infrared-reduced proper motion diagram is useful for selecting a sample of cool white dwarfs with low contamination. LSR J0745+2627 is also detected in the Sloan Digital Sky Survey (SDSS) and the Wide-field Infrared Survey Explorer (WISE). We have spectroscopically confirmed this object as a cool white dwarf using X-Shooter on the Very Large Telescope. A detailed analysis of its spectral energy distribution reveals that its atmosphere is compatible with a pure-H composition model with an effective temperature of 3880 ± 90 K. This object is the brightest pure-H ultracool white dwarf ($T_{\rm eff} < 4000$ K) ever identified. We have constrained the distance (24–45 pc), space velocities and age considering different surface gravities. The results obtained suggest that LSR J0745+2627 belongs to the thick-disk/halo population and is also one of the closest ultracool white dwarfs.

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An H I shell-like structure associated with nova V458 Vulpeculae?

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We report the radio detection of a shell-like H I structure in proximity to, and probably associated with, the nova V458 Vul. High spectral resolution observation with the Giant Metrewave Radio Telescope has made it possible to study the detailed kinematics of this broken and expanding shell. Unlike the diffuse Galactic H I emission, this is a single velocity component emission with significant clumping at $\sim 0\farcm5$ scales. The observed narrow line width of ~ 5 km s^{-1} suggests that the shell consists of mostly cold gas. Assuming a distance of 13 kpc to the system, as quoted in the literature, the estimated H I mass of the nebula is about 25 $M_\odot$. However, there are some indications that the system is closer than 13 kpc. If there is a physical association of the H I structure and the nova system, the asymmetric morphology and the off-centred stellar system indicates past strong interaction of the mass loss in the asymptotic giant branch phase with the surrounding interstellar medium. So far, this is the second example, after GK Per, of a large H I structure associated with a classical nova.

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CO structure of the 21-μm source IRAS 22272+5435: A sign of a jet launch?

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We report the results of radio interferometric observations of the 21-μm source IRAS 22272+5435 in the CO $J = 2$–1

line. 21-μm sources are carbon-rich objects in the post-AGB phase of evolution which show an unidentified emission feature at 21 μm. Since 21-μm sources usually also have circumstellar molecular envelopes, the mapping of CO emission from the envelope will be useful in tracing the nebular structure. From observations made with the Combined Array for Research in Millimeter-wave Astronomy (CARMA), we find that a torus and spherical wind model can explain only part of the CO structure. An additional axisymmetric region created by the interaction between an invisible jet and ambient material is suggested.

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The bizarre chemical inventory of NGC 2419, an extreme outer Halo globular cluster

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We present new Keck/HIRES observations of six red giants in the globular cluster NGC 2419. Although the cluster is among the most distant and most luminous in the Milky Way, it was considered chemically ordinary until very recently. Our previous work showed that the near-infrared Ca II triplet line strength varied more than expected for a chemically homogeneous cluster, and that at least one star had unusual abundances of Mg and K. Here, we confirm that NGC 2419 harbors a population of stars, comprising about one third of its mass, that is depleted in Mg by a factor of 8 and enhanced in K by a factor of 6 with respect to the Mg-normal population. Although the majority, Mg-normal population appears to have a chemical abundance pattern indistinguishable from ordinary, inner halo globular clusters, the Mg-poor population exhibits dispersions of several elements. The abundances of K and Sc are strongly anti-correlated with Mg, and some other elements (Si and Ca among others) are weakly anti-correlated with Mg. These abundance patterns suggest that the different populations of NGC 2419 sample the ejecta of diverse supernovae in addition to AGB ejecta. However, the abundances of Fe-peak elements except Sc show no star-to-star variation. We find no nucleosynthetic source that satisfactorily explains all of the abundance variations in this cluster. Because NGC 2419 appears like no other globular cluster, we reiterate our previous suggestion that it is not a globular cluster at all, but rather the core of an accreted dwarf galaxy.

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Pilot VLBI survey of SiO $v = 3$ $J = 1 \rightarrow 0$ maser emission around evolved stars

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In this Letter, we report detections of SiO $v = 3$ $J = 1 \rightarrow 0$ maser emission in very long baseline interferometric (VLBI) observations towards 4 out of 12 long-period variable stars: WX Psc, R Leo, W Hya, and T Cep. The detections towards WX Psc and T Cep are new ones. We also present successful astrometric observations of SiO $v = 2$ and $v =3$ $J = 1 \rightarrow 0$ maser emissions associated with two stars: WX Psc and W Hya and their position-reference continuum sources: J010746.0+131205 and J135146.8−291218 with the VLBI Exploration of Radio Astrometry (VERA). The relative coordinates of the position-reference continuum source and SiO $v = 3$ maser spots were measured with respect

to those of an SiO $v = 2$ maser spot adopted as fringe-phase reference. Thus the faint continuum sources were *inversely* phase-referenced to the bright maser sources. It implies possible registration of multiple SiO maser line maps onto a common coordinate system with 10 microarcsecond-level accuracy.

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Comparative modelling of the spectra of cool giants

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Context: Our ability to extract information from the spectra of stars depends on reliable models of stellar atmospheres and appropriate techniques for spectral synthesis. Various model codes and strategies for the analysis of stellar spectra are available today.
Aims: We aim to compare the results of deriving stellar parameters using different atmosphere models and different analysis strategies. The focus is set on high-resolution spectroscopy of cool giant stars.
Methods: Spectra representing four cool giant stars were made available to various groups and individuals working in the area of spectral synthesis, asking them to derive stellar parameters from the data provided. The results were discussed at a workshop in Vienna in 2010. Most of the major codes currently used in the astronomical community for analyses of stellar spectra were included in this experiment.
Results: We present the results from the different groups, as well as an additional experiment comparing the synthetic spectra produced by various codes for a given set of stellar parameters. Similarities and differences of the results are discussed.
Conclusions: Several valid approaches to analyze a given spectrum of a star result in quite a wide range of solutions. The main causes for the differences in parameters derived by different groups seem to lie in the physical input data and in the details of the analysis method. This clearly shows how far from a definitive abundance analysis we still are.

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Carbon enrichment of the evolved stars in the Sagittarius dwarf spheroidal

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We present spectra of 1142 colour-selected stars in the direction of the Sagittarius Dwarf Spheroidal (Sgr dSph) galaxy, of which 1058 were taken with VLT/FLAMES multi-object spectrograph and 84 were taken with the SAAO Radcliffe

1.9-m telescope grating spectrograph. Spectroscopic membership is confirmed (at $> 99\%$ confidence) for 592 stars on the basis of their radial velocity, and spectral types are given. Very slow rotation is marginally detected around the galaxy's major axis. We identify five S stars and 23 carbon stars, of which all but four carbon stars are newly-determined and all but one (PQ Sgr) are likely Sgr dSph members. We examine the onset of carbon-richness in this metal-poor galaxy in the context of stellar models. We compare the stellar death rate (one star per 1000–1700 years) to known planetary nebula dynamical ages and find that the bulk population produce the observed (carbon-rich) planetary nebulæ. We compute average lifetimes of S and carbon stars as 60–250 and 130–500 kyr, compared to a total thermal-pulsing asymptotic giant branch lifetime of 530–1330 kyr. We conclude by discussing the return of carbon-rich material to the ISM.

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An updated catalog of OH-maser-emitting planetary nebulæ

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Aims: We studied the characteristics of planetary nebulæ (PNe) that show both OH maser and radio continuum emission (hereafter OHPNe). These have been proposed to be very young PNe, and therefore, they could be key objects for understanding the formation and evolution of PNe.
Methods: We consulted the literature searching for interferometric observations of radio continuum and OH masers toward evolved stars, including the information from several surveys. We also processed radio continuum and OH maser observations toward PNe in the Very Large Array data archive. The high positional accuracy provided by interferometric observations allow us to confirm or reject the association between OH maser and radio continuum emission.
Results: We found a total of six PNe that present both OH maser and radio continuum emissions, as confirmed with radio interferometric observations. These are bona fide OHPNe. The confirmed OHPNe present a bipolar morphology in resolved images of their ionized emission at different wavelengths, suggesting that the OH maser emission in PNe is related to nonspherical mass-loss phenomena. The OH maser spectra in PNe present a clear asymmetry, tending to show blueshifted emission with respect to the systemic velocity. Their infrared colors suggest that most of these objects are very young PNe. OHPNe do not form a homogeneous group, and seem to represent a variety of different evolutionary stages. We suggest that OH masers pumped in the AGB phase may disappear during the post-AGB phase, but reappear once the source becomes a PN and its radio continuum emission is amplified by the OH molecules. Therefore, OH maser emission could last significantly longer than the previously assumed 1000 yr after the end of the AGB phase. This maser lifetime may be longer in PNe with more massive central stars, which ionize a larger amount of gas in the envelope.

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Carbon and oxygen isotopic ratios in Arcturus and Aldebaran: Constraining the parameters for non convective mixing on the RGB

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Context: We re-analysed the carbon and oxygen isotopic ratios in the atmospheres of the two bright K giants Arcturus

(α Boo) and Aldebaran (α Tau).
Aims: These stars are in the evolutionary stage following the first dredge-up (FDU). Previous determinations (dating more than 20 years ago) of their $^{16}O/^{18}O$ ratios showed a rough agreement with FDU expectations; however, the estimated $^{16}O/^{17}O$ and $^{12}C/^{13}C$ ratios were lower than in the canonical predictions for red giants. Today these anomalies are interpreted as signs of the occurrence of non-convective mixing episodes. We therefore re-investigated this issue in order to verify whether the observed data can be reproduced in this hypothesis and if the rather well determined properties of the two stars can help us in fixing the uncertain parameters characterizing non-convective mixing and in constraining its physical nature.
Methods: We used high-resolution infrared spectra from the literature to derive the $^{12}C/^{13}C$ and $^{16}O/^{17}O/^{18}O$ ratios from CO molecular lines near 5 μm, using the LTE spectral synthesis method. We made use of the recently published ACE-FTS atlas of the infrared solar spectrum for constructing an updated atomic and molecular line lists in this spectral range. We also reconsidered the determination of the stellar parameters to build the proper atmospheric and evolutionary models.
Results: We found that both the C and the O isotopic ratios for the two stars considered actually disagree with pure FDU predictions. This reinforces the idea that non-convective transport episodes occurred in them. By reproducing the observed elemental and isotopic abundances with the help of parametric models for the coupled occurrence of nucleosynthesis and mass circulation, we derived constraints on the properties of non convective mixing, providing information on the so far elusive physics of such phenomena. We find that very slow mixing, like that associated to diffusive processes, is incapable of explaining the observed data, which require a rather fast transport. Circulation mechanisms with speeds intermediate between those typical of diffusive and of convective mixing should be at play. We however conclude with a word of caution on the conclusions possible at this stage, as the parameters for the mass transport are rather sensitive to the stellar mass and initial composition. At least for α Boo, reducing the uncertainty still remaining on such data would be highly desirable.

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Infra-red reflectance and emissivity spectra of nanodiamonds

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Reflectance and emissivity spectra of nanodiamonds powder were measured in a dedicated setup at temperatures up to 873 K. The spectra are characterised by presence of sharp bands due to surface-bound functional groups. Thermal desorption of oxygen-containing groups leads to corresponding spectral changes. The maximal emissivity of nanodiamond powder reaches 0.985.

Submitted to Journal of Physics: Condensed Matter
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Announcement

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 October 15. Fellowships can be awarded for missions starting in January 2013, pending contractual procedures in FP7.

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

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 www.european-interferometry.eu