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Abstract of recently accepted papers

The planetary nebula K 1-2 and its binary central star VW Pyx

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New data are presented of the post common envelope binary (PCEB) VW Pyx and its associated planetary nebula (PN), K 1-2. The central star is found to be a single-lined (and possible double-lined) spectroscopic binary and is a good candidate for a system in which the main-sequence secondary star is more massive than the subdwarf primary star. The old PN has a high excitation level and a measured electron temperature, $T_O \sim 17000\,K$ for an assumed $log\, n_e = 2.7\,cm^{-3}$. The so-called 'jets' are found to be lower ionisation regions with $T_N \sim 11000\,K$ and $T_O \sim 16000\,K$ with $log\, n_e \sim 2.5\,cm^{-3}$ and with low, but fairly typical PN abundances. We discuss possible histories for K 1-2 and the jets, however there are still many unknowns in the study of accretion and jet-formation for such PN binary central stars.

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Preprints can be obtained from Katrina Exter contacting k.exter@qub.ac.uk or via WWW from star.pst.qub.ac.uk

A census of AGB stars in Local Group galaxies. II. NGC185 and NGC147

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We present results of our ongoing photometric survey of Local Group galaxies, using a four filter technique based on the method of Wing (1971) to identify and characterise the late-type stellar content. Two narrow band filters centred on spectral features of TiO and CN allow us to distinguish between AGB stars of different chemistries [M-type (O-rich) and C-type (C-rich)]. The major parts of two dwarf galaxies of the M 31 subgroup – NGC 185 and NGC 147 – were observed. From photometry in V and i we estimate the tip of the RGB, and derive distance moduli. With additional photometric data in the narrow band filters TiO and CN we identify 154 new AGB carbon stars in NGC 185 and 146 in NGC 147. C/M ratios are derived, as well as mean absolute

magnitudes $\langle M_i \rangle$, bolometric magnitudes M_{bol}, luminosity functions, and the spatial/radial distributions of the C stars in both galaxies.

Accepted by A&A

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On the usefulness of finding charts Or the runaway carbon stars of the Blanco & McCarthy field 37

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We have been recently faced with the problem of cross–identifying stars recorded in historical catalogues with those extracted from recent fully digitized surveys (such as DENIS and 2MASS). Positions mentioned in the old catalogues are frequently of poor precision, but are generally accompanied by finding charts where the interesting objects are flagged. Those finding charts are sometimes our only link with the accumulated knowledge of past literature. While checking the identification of some of these objects in several catalogues, we had the surprise to discover a number of discrepancies in recent works.The main reason for these discrepancies was generally the blind application of the smallest difference in position as the criterion to identify sources from one historical catalogue to those in more recent surveys. In this paper we give examples of such misidentifications, and show how we were able to find and correct them.We present modern procedures to discover and solve cross–identification problems, such as loading digitized images of the sky through the Aladin service at CDS, and overlaying entries from historical catalogues and modern surveys. We conclude that the use of good finding charts still remains the ultimate (though time–consuming) tool to ascertain cross–identifications in difficult cases.

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Preprints can be obtained as astro-ph 302385 or by contacting loup@iap.fr

The envelope of IRC+10216 reflecting the galactic light: UBV surface brightness photometry and interpretation

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We present and analyse new optical images of the dust envelope surrounding the high mass-loss carbon star IRC+10216. This envelope is seen due to external illumination by galactic light. Intensity profiles and colors of the nebula were obtained in the UBV bandpasses. The data are compared with the results of a radiative transfer model calculating multiple scattering of interstellar field photons by dust grains with a single radius. The data show that the observed radial shape of the nebula, especially its half maximum radius, does not depend on wavelength (within experimental errors), suggesting that grains scatter in the grey regime, and this is further supported by the plateau colors being close to those of the ISRF as given by Mattila (1980a). A grain radius of 0.16 μm with envelope parameters as proposed by Groenewegen (1997) can reproduce this

achromatism of shape and color characteristics. However, there remain substantial discrepancies between model and observations concerning the absolute intensity of the nebula and its radial shape. Some of these discrepancies disappear if one adopts a small grain size ($\sim 0.05\,\mu$m), or if one assumes a lower dust mass loss rate for the outer layers ($\theta \geq 20''$, corresponding to 1000 years ago). Within the framework of our simple model, we cannot determine a "dominant" grain size. Future more sophisticated models will have to take into account grain size distribution, and also explore complicated issues like the effects of grain porosity and/or asphericity on scattering, the influence of the envelope small-scale structure on the radiative transfer, and the possibility of a field anisotropy. For the same reasons, it is not presently feasible to establish with confidence whether the interstellar radiation field in the visible is significantly different in strength at the location of IRC+10216 compared to the usually adopted one in the solar neighbourhood.

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Physical Structure of Planetary Nebulae. I. The Owl Nebula

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The Owl Nebula is a triple-shell planetary nebula with the outermost shell being a faint bow-shaped halo. We have obtained deep narrow-band images and high-dispersion echelle spectra in the Hα, [O III], and [N II] emission lines to determine the physical structure of each shell in the nebula. These spatio-kinematic data allow us to rule out hydrodynamic models that can reproduce only the nebular morphology. Our analysis shows that the inner shell of the main nebula is slightly elongated with a bipolar cavity along its major axis, the outer nebula is a filled envelope co-expanding with the inner shell at 40 km s$-$1, and the halo has been braked by the interstellar medium as the Owl Nebula moves through it. To explain the morphology and kinematics of the Owl Nebula, we suggest the following scenario for its formation and evolution. The early mass loss at the TP-AGB phase forms the halo, and the superwind at the end of the AGB phase forms the main nebula. The subsequent fast stellar wind compressed the superwind to form the inner shell and excavated an elongated cavity at the center, but has ceased in the past. At the current old age, the inner shell is backfilling the central cavity.

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Preprints can be obtained
via WWW on http://arXiv.org/abs/astro-ph/0303056
or via anonymous ftp on ftp.astro.uiuc.edu – pub/mar/preprint_owl_nebula.pdf

The circumstellar envelope of HD 56126

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We present a detailed study of the circumstellar envelope of the post-asymptotic giant branch "21 μm object" HD 56126. We build a detailed dust radiative transfer model of the circumstellar envelope in order to derive

the dust composition and mass, and the mass-loss history of the star. To model the emission of the dust we use amorphous carbon, hydrogenated amorphous carbon, magnesium sulfide and titanium carbide. We present a detailed parametrisation of the optical properties of hydrogenated amorphous carbon as a function of H/C content. The mid-infrared imaging and spectroscopy is best reproduced by a single dust shell from 1.2 to 2.6″ radius around the central star. This shell originates from a short period during which the mass-loss rate exceeded 10^{-4} $M_{\odot}$/yr. We find that the strength of the "21" μm feature poses a problem for the TiC identification. The low abundance of Ti requires very high absorption cross-sections in the ultraviolet and visible wavelength range to explain the strength of the feature. Other nano-crystalline metal carbides should be considered as well. We find that hydrogenated amorphous carbon in radiative equilibrium with the local radiation field does not reach a high enough temperature to explain the strength of the 3.3−3.4 and 6−9 μm hydrocarbon features relative to the 11−17 μm hydrocarbon features. We propose that the carriers of these hydrocarbon features are not in radiative equilibrium but are transiently heated to high temperature. We find that 2 per cent of the dust mass is required to explain the strength of the "30" μm feature, which fits well within the measured atmospheric abundance of Mg and S. This further strengthens the MgS identification of the "30" μm feature.

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Preprints can be obtained by contacting shony@rssd.esa.int
or via WWW on http://xxx.lanl.gov/abs/astro-ph/0302448

The high-velocity outflow in the proto-planetary nebula Hen 3−1475

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The proto-planetary nebula Hen 3−1475 shows a remarkable highly collimated optical jet with an S-shaped string of three pairs of knots and extremely high velocities. We present here a detailed analysis of the overall morphology, kinematic structure and the excitation conditions of these knots based on deep ground-based high dispersion spectroscopy complemented with high spatial resolution spectroscopy obtained with STIS onboard HST, and WFPC2 [N II] images. The spectra obtained show double-peaked, extremely wide emission line profiles, and a decrease of the radial velocities with distance to the source in a step-like fashion. We find that the emission line ratios observed in the intermediate knots are consistent with a spectrum arising from the recombination region of a shock wave with shock velocities ranging from 100 to 150 km s^{-1}. We propose that the ejection velocity is varying as a function of time with a quasi-periodic variability (with timescale of the order of 100 years) and the direction of ejection is also varying with a precession period of the order of 1500 years. Some slowing down with distance along the axis of the Hen 3−1475 jet may be due to the entrainment process and/or to the enviromental drag. This scenario is supported by geometric and kinematic evidence: firstly, the decrease of the radial velocities along the Hen 3−1475 jet in a step like fashion; secondly, the kinematic structure observed in the knots; thirdly, the point-symmetric morphology together with the high proper motions shown by several knots; and finally the fact that the shock velocity predicted from the observed spectra of the shocked knots is much slower than the velocities at which these knots move outwards with respect to the central source.

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Multiple Molecular H_2 Outflows in AFGL 618

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We report high spatial (0.5 arcsec) and high spectral (9 km s−1) resolution spectro-imaging of the 2.12 μm H_2 1→0 S(1) line in the proto-planetary nebula AFGL 618 using *BEAR* at the CFHT. The observations reveal the presence of multiple, high-velocity, molecular outflows that align with the remarkable optical jets seen in *HST* images. The structure and kinematics of the outflows show how jets interact with circumstellar gas and shape the environment in which planetary nebulae form.

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Obscured Asymptotic Giant Branch Variables in the Large Magellanic Cloud and the Period-Luminosity Relation

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The characteristics of oxygen-rich and carbon-rich, large amplitude ($\Delta K > 0.4$ mag), asymptotic giant branch variables in the Large Magellanic Clouds are discussed, with an emphasis on those obscured by dust. Near-infrared photometry, obtained over about 8 years, is combined with published mid-infrared observations from IRAS and ISO to determine bolometric magnitudes for 42 stars. Pulsation periods of the O-rich stars are in the range $116 < P < 1393$ days, while those for C-rich stars have $298 < P < 939$ days. In addition to the regular pulsations, one O-rich star and four C-rich stars show large amplitude, $\Delta K > 0.6$ mag, secular or very long period variations which may be associated with changes in their mass-loss rates. We discuss and compare various methods of determining the bolometric magnitudes and show, perhaps surprisingly, that most of the very long period stars seem to follow an extrapolation of the period-luminosity relation determined for stars with shorter periods - although the details do depend on how the bolometric magnitudes are calculated.
Three stars with thin shells, which are clearly more luminous than the obscured AGB stars, are undergoing hot bottom burning, while other stars with similar luminosities have yet to be investigated in sufficient detail to determine their status in this regard. We suggest that an apparent change in slope of the period luminosity relation around 400-420 days is caused by variables with luminosities brighter than the predictions of the core-mass luminosity relation, due to excess flux from hot bottom burning.

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Preprints can be obtained by contacting paw@saao.ac.za
or via WWW on http://arXiv.org/abs/astro-ph/0302246