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From the editors

In our deadline message, it was written that
Back issues and LaTeX forms can also be accessed on WWW throught URL
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As mentionned by several careful readers, whom we warmly thank, this location is wrong. The correct URL is
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Sorry, for this mistake.

Claudine Kahane and Thierry Forveille

Abstract of recently accepted papers

A Spectroscopic Study of HD 179821 (IRAS 19114+0002): Proto-Planetary Nebula or Supergiant?

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A detailed chemical composition analysis of the bright post-AGB candidate HD 179821 (IRAS 19114+0002) is presented. The LTE analysis, based on high-resolution (R $\approx$ 50,000) and high-quality (S/N $\approx$ 300) spectra, yields atmospheric parameters T_{eff} = 6750 K, log g = 0.5, and ξ_t = 5.25 km s^{-1}.

The elemental abundance results of HD 179821 are found to be [Fe/H] = $-$0.1, [C/Fe] = +0.2, [N/Fe] = +1.3, [O/Fe] = +0.2, [α-process/Fe] = +0.5, and [s-process/Fe] = +0.4. These values clearly differ from the elemental abundances of population I F supergiants. The C, N, and O abundances and the total CNO abundance value relative to Fe, [C+N+O/Fe] = +0.5, indicate that the photosphere of HD 179821 is contaminated with both the H- and He-burning products of the AGB phase. The evidence for He-burning through the 3α-process and deep AGB mixing also comes from the observed overabundances of s-process elements. Remarkably, the abundance of the α-process element Na is found to be very large, [Na/Fe] = +0.9.

The ratio O/C = 2.6 indicates that the atmosphere is oxygen-rich. The results of this abundance study support the argument that HD 179821 is a PPN, probably with an intermediate-mass progenitor. However, the strength of the O I triplet lines at 7774 Å and the distance derived from the interstellar Na I D1 & D2 components imply that the star is a luminous object ($M_{bol} \sim -8.9 \pm 1$), and thus a massive supergiant. Thus, while this study contributes important new observational results for this star, an unambiguous determination of its evolutionary status has yet to be achieved.

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Preprints can be obtained by contacting ereddy@kepler.valpo.edu
or via anonnymous ftp on ftp://kepler.valpo.edu/pub/HD179821/paper.ps

A Hubble Space Telescope Survey for Resolved Companions of Planetary-Nebula Nuclei

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We report the results of a *Hubble Space Telescope* "snapshot" survey aimed at finding resolved binary companions of the central stars of Galactic planetary nebulae (PNe). Using the WF/PC and WFPC2, we searched the fields of 113 PNe for stars whose close proximity to the central star suggests a physical association. In all, we find 10 binary nuclei that are very likely to be physically associated, and another six that are possible binary associations. By correcting for interstellar extinction and placing the central stars' companions on the main sequence (or, in one case, on the white-dwarf cooling curve), we derive distances to the objects, and thereby significantly increase the number of PNe with reliable distances.

Comparison of our derived distances with those obtained from various statistical methods shows that all of the latter have systematically overestimated the distances, by factors ranging up to a factor of two or more. We show that this error is most likely due to the fact that the properties of our PNe with binary nuclei are systematically different from those of PNe used heretofore to calibrate statistical methods. Specifically, our PNe tend to have lower surface brightnesses at the same physical radius than the traditional calibration objects. This difference may arise from a selection effect: the PNe in our survey are typically nearby, old nebulae, whereas most of the objects that calibrate statistical techniques are low-latitude, high-surface-brightness, and more distant nebulae. As a result, the statistical methods that seem to work well with samples of distant PNe, e.g., those in the Galactic bulge or external galaxies, may not be applicable to the more diverse population of local PNe.

Our distance determinations could be improved with better knowledge of the metallicities of the individual nebulae and central stars, measurements of proper motions and radial velocities for additional candidate companions, and deeper *HST* images of several of our new binary nuclei.

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H_2O from R Cas: ISO LWS-SWS observations and detailed modelling

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We present 29-197 μm spectra of the oxygen-rich Mira variable star, R Cas, obtained with the Long- and Short-Wavelength Spectrometers (LWS and SWS) on board the Infrared Space Observatory (ISO). The LWS grating observations were made during two pulsational stellar phases, $\phi \approx 0.5$ and 0.2 in August 1996 and June 1997

when the stellar luminosity was near its minimum and mean values, respectively. The infrared flux at the latter epoch was $\approx$ 30–40% stronger than at the former. SWS grating observations were also made in June 1997. The spectrum presents a strong far-infrared (FIR) continuum and is rich in water lines suitable for use as circumstellar diagnostics.

We have constructed a circumstellar model which consistently treats radiative transfer, chemical exchanges, photodissociation, and heating and cooling effects. The overall FIR excitation field was scaled by a factor which varied with the stellar phase. By fitting the model to the observed FIR water line fluxes and continuum while adopting the stellar parameters based on the Hipparcos distance we have found a mass-loss rate of $\dot{M} \approx 3.4 \times 10^{-7} \mathrm{M}_{\odot}\,\mathrm{yr}^{-1}$ and a total *ortho* and *para* water vapour abundance (relative to H_2) of $f \approx 1.1 \times 10^{-5}$. The kinetic temperature and the relative abundances of H_2O, OH, and O in chemical equilibrium have been derived as functions of radial distance r. H_2O excitation is mainly dominated by FIR emitted by dust grains. The deduced model continuum flux at 29–197μm for the $\phi \approx 0.5$ phase was 61% of the flux at $\phi \approx 0.2$. Photodissociation by the FUV interstellar field and CO cooling effects operate farther out than the H_2O excitation region. Our derived mass-loss rate of R Cas is similar to the value 6×10^{-7} $\mathrm{M}_{\odot}\,\mathrm{yr}^{-1}$ previously published for WHya, another oxygen-rich AGB star.

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Preprints can be obtained by contacting tbach@obspm.fr

The peculiar post–AGB supergiant IRAS 04296+3429: optical spectroscopy and its spectral energy distribution

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The optical spectrum of the infrared source IRAS 04296+3429 (optical counterpart – G0 Ia star, V = 14.2) was obtained with the echelle spectrometer PFES at the prime focus of the 6 m telescope. We discover *emission* bands (0,0) and (0,1) of the Swan system of the C_2 molecule in the optical spectrum of IRAS 04296+3429. Comparison with the spectrum of the Hale-Bopp comet leads us to propose that in both cases the same mechanism (resonance fluorescence) is responsible for the emission in the C_2 molecular bands.

Several strong absorption features whose positions coincide with known diffuse interstellar bands (DIBs) are revealed in the spectrum of IRAS 04296+3429.

The infrared spectrum of IRAS 04296+3429 shows the famous 21 μm feature (Kwok et al. 1989), but this object has not been observed by KAO (Omont et al. 1995). However, like IRAS 05113+1347, IRAS 05341+0852 and IRAS 22223+4327 (Kwok et al. 1995, Szczerba et al. 1996), our detailed modelling of its spectral energy distribution suggested that this source also should show the 30 μm band. In fact, *ISO* discovered a broad, relatively strong feature around 30 μm for IRAS 04296+3429 (Szczerba et al. 1999).

The surface chemical composition of the source IRAS 04296+3429 is metal-deficient (the averaged value of the abundances of the iron group elements Ti, V, Cr and Fe relative to the solar values is $[\mathrm{M/H}]_{\odot} = -0.9$) and has been considerably altered during the evolution: carbon, nitrogen and s-process elements are overabundant relative to the metallicity.

The totality of physical and chemical parameters derived for IRAS 04296+3429 confirms a relation between presence of the feature at 21 μm in the spectrum of a carbon rich star and an excess of the s-process elements.

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Preprints can be obtained by contacting szczerba@ncac.torun.pl

IRAS 04296+3429: A 21 μm source with a very strong 30 μm emission band

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We report the detection of the 30 μm emission feature from the C-rich post–Asymptotic Giant Branch (post–AGB) star IRAS 04296+3429 based on ISO SWS observations. ISO data show that there is a clear substructure in the 30 μm feature in the form of a plateau which extends from 26 to 27 μm. This is confirmed by the ISO SWS data for another post-AGB object IRAS 22272+5435, which has the strongest known 30 μm band accounting for about 24% of its total infrared (IR) emission or 12% of the bolometric luminosity. In the case of IRAS 04296+3429 we estimate that about 85% of the total energy is emitted in the infrared of which about 15–22% (depending on the estimated continuum level) is contributed by the 30 μm band. The total energy emitted in the band is at least comparable for both sources, while the energy emitted in the 21 μm band seems to be about 3 times larger in the case of IRAS 04296+3429, if they have the same bolometric luminosity. Grains of pure MgS could be responsible for the observed 30 μm feature provided they have a broad distribution of shapes, but the observed plateau emission is difficult to explain. Small graphite grains with relatively thick MgS coating could be responsible for the observed substructure, but we were not able to definitively solve the question of their contribution to the 30 μm band.

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Bipolar Pre-Planetary Nebulae: Hydrodynamics of dusty winds in binary systems. II. Morphology of the circumstellar envelopes

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We have constructed 3-dimensional Smoothed Particle Hydrodynamics models to examine the influence of a detached binary companion on the dusty winds from red giants and AGB stars and the degree to which this model can reproduce some of the observable characteristics of axisymmetric or bipolar preplanetary nebulae. In this second paper in the series, we focus our attention on the morphology of the circumstellar envelopes. The parameter space of our models includes wind outflow velocities in the range 10 - 26 km s^{-1}, circular orbits with binary separations 3.6 - 50 A.U. and binary companions having masses in the range 0.25 - 2 $M_{\odot}$. By varying these parameters, we find a continuous range of envelope geometries and density contrasts which correspond well to observational classifications of planetary and preplanetary nebulae: bipolar, with density contrasts from 10 to > 200 between the equatorial plane and the polar direction, ellipticals with intermediate contrasts of 5 - 10, and quasi-sphericals, with very low density contrasts. This last category manifests a hitherto unknown type of hydrodynamic solution, in which a spiral shock is formed, covering most of the solid angle around the binary. The cross- sections of these shocks, and to a lesser extent the two-dimensional projections of the quasi-spherical envelopes, appear as a series of rings in the wind. We discuss the observational implications of that type of wind solution. The quasi-spherical geometry is the prevailing type in parameter space. From binary statistics we estimate that ~ 34 - 40 % of detached binaries will give rise to bipolars for a 10 km s^{-1} outflow. We present a classification scheme of the envelope geometries based on a combination of binary and wind parameters. We also find that the mass accretion rates onto the secondary are systematically lower than is predicted by the Bondi-Hoyle theory.

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The Etched Hourglass Nebula MyCn18: I. Hubble Space Telescope Observations

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We have obtained emission-line and continuum images of the young planetary nebula MyCn18 with the Wide-Field Planetary Camera 2 on the Hubble Space Telescope. Although from the ground MyCn18 appeared to have a triple-ring structure similar to SN 1987A, the HST images show that MyCn18 has an overall hourglass shape. A series of arcs appear to be etched on the walls of the hourglass near its rims. In the complex central region of the nebula we find a small, inner hourglass structure and two rings. Ring 1 is a bright elliptical ring and Ring 2 a smaller higher-excitation ring. The outer and inner hourglass, & Ring 1 and Ring 2 all have different centers, and none are coincident with the central star.

The hourglass shape of the main nebula is consistent with the predictions of the generalised interacting winds hypothesis for planetary nebula formation. However, the complex inner nebular structure of MyCn18 and the offset of the central star from the center of the nebula remain a mystery. We discuss several mechanisms for producing the offset of the central star. Although none are found to be completely satisfactory, those involving a binary central star probably offer the best hope of successful explanation.

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