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## *Abstracts of recently accepted papers*

### Abundances in type I planetary nebulae: is the galactic disk presently oxygen deficient?


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We report new spectroscopic observations for a sample of "bona fidae" type I planetary nebulae, which satisfy kinematical, distance to the galactic plane and morphological criteria. Special care was taken to estimate physical parameters as electron temperature and density. The mean sample oxygen abundance $\varepsilon(O) = 8.64\pm0.23$ confirms our earlier results: a deficiency of about 0.25 dex with respect to the solar value. We emphasize that the present result is entirely compatible with new stellar (Cunha & Lambert 1994) and diffuse gas data (Meyer et al. 1994) recently obtained in the Orion complex.



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### V Hydrae : the missing link between spherical red giants and bipolar planetary nebulae ?


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We have performed fully sampled mapping of CO (J=1−0) and (J=2−1) emission around the red giant carbon star V Hya, with the IRAM 30m telescope. The velocity structure of the lines reveals two symmetric high velocity wings that we interpret as arising from a bipolar flow. Exactly between the red and the blue cones lies a low velocity component showing the same symmetry axis. We suggest that this component is a moderately oblate spheroid with biconical holes centered on the minor axis, or a thick torus with the same symmetry axis as the bipolar flow. The high signal-to-noise ratio and spectral resolution of the data allow a detailed comparison of the observed lines with a model of the envelope. Using this model, we derive the geometrical and kinematical parameters of the bipolar flow : it appears to have a wide opening angle (65°) and shows a radially decreasing

velocity law, starting at a velocity of at least 50 km $s^{-1}$ at the flow inner radius. We suggest that this behaviour is due to an increase with time of the flow ejection velocity close to the star. In contrast, the low-velocity component expands at a constant velocity of 7.5 km $s^{-1}$. From our model we also derive the total mass loss rate of V Hya ($\sim 1.5 \times 10^{-6}$ $M_{\odot}$ $yr^{-1}$), with about 90 % of the molecular gas expelled in the high-velocity jet. The circumstellar envelope around V Hya contains $\sim 2.1 \times 10^{-3}$ $M_{\odot}$, with about four times more gas in the bipolar flow than the low-velocity component. We compare our observations with other evidence for asymmetric mass loss from V Hya. Considering also the star's fast rotation revealed by the photospheric lines, we conclude that V Hya is probably experiencing the short binary common envelope evolution phase between the AGB and the planetary nebula stage, where highly asymmetric mass loss develops.

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## Unveiling low–ionization microstructures in planetary nebulae

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(H$\alpha$+[NII])/[OIII] ratio images have been used to search for low–ionization small–scale structures in a sample of 258 planetary nebulae.

Radially symmetrical knots or jet–like structures, which are enhanced in the ratio images compared to the neighbouring regions of the nebulae, have been identified in 23 objects. Some of these features are barely detected or invisible in the H$\alpha$+[NII] and [OIII] images. Empirical evidence, as well as some simple modelling, demonstrate that the selected features are characterized by having a lower ionization that the surrounding gas. For the above properties, most of them resemble the low–ionization microstructures discussed recently by Balick et al. (1993, 1994), and named FLIERs (Fast Low–Ionization Emission Regions).

The present work shows that the image–division technique is a very useful tool to look for ionization structures in planetary nebulae and other HII regions. Its main advantage is that the division removes the morphological components which are pure density enhancements, so that the output image remains mostly sensitive to excitation and abundance variations through the nebulae.

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## Bright Giants in the Sagittarius Dwarf Galaxy

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Near-infrared photometry is presented of 75 late-type giants in the direction of the Sagittarius dwarf galaxy. 71 of these are thought to be members of the galaxy; the other four are late-type M stars in the Bulge. The carbon stars and possible carbon stars have a wide range of properties. The reddest ones are similar to carbon stars in Fornax, while the bluest are more like those in Sculptor, Draco and Ursa Minor. A clearly defined giant branch indicates a metallicity slightly weaker than that of 47 Tuc and a value of [Fe/H] $\leq -0.8$ is estimated. The most luminous star which is a confirmed member of the dwarf galaxy is a carbon star with $M_{bol} \sim -4.5$. Four variable stars have been discovered; these are probably of the semi-regular and/or Mira type with periods of the order of 150 to 300 days.

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## Non-spherical dust driven winds of slowly rotating AGB stars

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We propose a new mechanism to explain an asymmetric mass loss for C-rich asymptotic giant branch (AGB)-stars based on the effect how rotation modifies dust driven winds. Even small deviations from spherical symmetry introduced by slow rotations are amplified in the zone of dust condensation due to the non-linear behaviour and the strong temperature and density dependence of the dust formation process. This mechanism leads to a preferential mass loss with higher velocities in the equatorial plane. Depending on the rotation rate we calculate for typical AGB stars stationary dust driven winds and present the rotation modulated solutions as a function of the polar angle. The mass loss rate can differ by large factors comparing the polar to the equatorial region. This mechanism provides also a simple explanation for the widely observed asymmetries found in the shapes of planetary nebulae.

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## The molecular envelopes of planetary nebulae

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We report the results of a survey of millimeter CO emission in 91 planetary nebulae using the IRAM 30 m and SEST 15 m telescopes. The observations provide new detections or improved data for 23 nebulae in the CO(2−1) and/or CO(1−0) line, and sensitive limits for those not seen in CO. Analysis of the results together with previous observations confirms the existence of an important class of planetary nebulae with massive ($10^{-2}$– a few $M_\odot$) envelopes of molecular gas. These nebulae typically have abundance ratios of N/O $> 0.3$ and bipolar morphologies indicative of a young disk population. The column density through the envelopes and their mass relative to the mass of ionized gas show dramatic decreases with increasing nebular size, documenting the expansion of the envelopes and the growth of the optical nebulae at the expense of the molecular gas. The molecular envelopes remain a major mass component in these objects until the nebulae reach a radius of $R \approx 0.1$ pc. The nebulae not detected in CO have little or no molecular gas ($< 10^{-2}$–$10^{-3}\,M_\odot$), and their envelopes must be rapidly photo-dissociated before or during the compact phase. The large differences in the molecular gas content of the nebulae highlight the different evolutionary paths for planetary nebula formation which result from the range in mass of the progenitors and the structure of their circumstellar envelopes.

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## A revised period-luminosity relation for carbon Miras

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The period-luminosity and period-K relations of carbon Miras in the Galaxy are derived. The procedure is a two step process. First, the P-L and P-K relations of carbon Miras in the Large Magellanic Cloud are derived from 54 spectroscopically confirmed carbon Miras with periods between 150 and 520 days. The slopes of these relations are assumed to hold for Miras in the Galaxy; an assumption which has proved valid for oxygen-rich Miras. Secondly, the zero points of the Galactic P-L and P-K relations are determined by shifting the relations for the LMC Miras, assuming a distance modulus of 18.5 mag, and no correction for metallicity difference.

An (uncertain) estimate for the zero point of the P-L relation is derived by combining the observed peak of the period distribution of Galactic carbon-Miras with the theoretically predicted peak of the carbon-star luminosity-function. A direct estimate is also made of the luminosity of the only carbon Mira known to have a normal binary companion. The zero points derived by these two methods are consistent with that of shifting the LMC relation. The finally adopted period-luminosity and period-K relations of Galactic carbon-Miras are $M_{bol} = -2.59 \log P + 2.02$ and $M_{\rm K} = -3.56 \log P + 1.14$.

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# Dynamical models of LPV atmospheres: a comparative study

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Numerical models for atmospheres of carbon–rich long-period variables (LPVs) obtained by two different codes are compared with regard to the radial structure of the circumstellar shell, its dynamics and the propagation of shock waves, the dust formation and its effects on the dynamics and thermodynamics of the atmosphere as well as the mass loss rates and the outflow velocities. The general features of the models such as the formation of discrete dust layers, the occurrence of multiperiodicity or the dust-induced $\kappa$-mechanism in purely dust-driven winds are the same in both cases while a detailed quantitative comparison of special model calculations demonstrates certain effects caused by the different numerical schemes. Nevertheless we find that the two modelling methods give remarkably similar results with respect to the complex physical system under consideration.

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