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*Abstracts of recently accepted papers*

## Pulsation modes of Mira stars and questioning of linear modelling: indications from HIPPARCOS and the LMC

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Thorough discussion of the previous theoretical works on the pulsation of Long Period Variables leads us to the conclusion that the mode periods predicted by linear models must significantly differ from the reality, and that, if one nevertheless relies upon such a modelling, it is at least necessary to change the mixing length. The hypothesis that the so–derived mode periods be reasonably reliable is supported by confrontation between a model grid based on these grounds and the luminosities of LPVs in the Large Magellanic Cloud and in LMC clusters, as well as the luminosities and effective temperatures of Miras in the solar neighbourhood. A wide majority of the Miras appear probably pulsating on the first overtone, and the sample Semi–Regulars on the second. However, a significant proportion of Miras seem to be fundamental pulsators. Individual masses are derived. A few stars are probably undergoing hot bottom burning, while two seem to have a peculiar dust envelope.

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## Insights into the formation of barium and Tc-poor S stars from an extended sample of orbital elements

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The set of orbital elements available for chemically-peculiar red giant (PRG) stars has been considerably enlarged thanks to a decade-long CORAVEL radial-velocity monitoring of about 70 barium stars and 50 S stars.

When account is made for the detection biases, the observed binary frequency among strong barium stars, mild barium stars and Tc-poor S stars (respectively 35/37, 34/40 and 24/28) is compatible with the hypothesis that they are all members of binary systems.

This paper presents a detailed analysis of the complete set of orbital parameters available for PRG stars; the individual data are given in three companion papers. The main results are as follows: (i) The similarity between the orbital-period, eccentricity and mass-function distributions of Tc-poor S stars and barium stars confirms that Tc-poor S stars are the cooler analogs of barium stars; (ii) The eccentricity – period diagram of PRG stars clearly bears the signature of dissipative processes associated with mass transfer, since the maximum eccentricity observed at a given orbital period is much smaller than in a comparison sample of normal giants; (iii) The mass function distribution is compatible with the unseen companion being a white dwarf (WD); (iv) Assuming that the WD companion has a mass in the range $0.60 \pm 0.04$ $M_\odot$, the masses of mild and strong barium stars amount to $1.9 \pm 0.2$ and $1.5 \pm 0.2$ $M_\odot$, respectively; (v) Mild barium stars are not restricted to long-period systems; the difference between mild and strong barium stars is mainly one of galactic population rather than of orbital separation, in agreement with their respective kinematical properties; (vi) Binarity is probably not a sufficient condition to produce a PRG star, and a metallicity lower than solar seems to be required as well.

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*Preprints can be obtained by contacting* ajorisse@astro.ulb.ac.be
*or via WWW on* http://astro.ulb.ac.be/Htm/ps.htm
*Orbital elements are available on WWW at: http://obswww.unige.ch/~udry/cine/barium/barium.html*

# A CORAVEL radial-velocity monitoring of giant Ba and S stars: spectroscopic orbits and intrinsic variations

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This paper provides orbital parameters for 38 barium stars and 10 extrinsic S stars derived from a decade-long CORAVEL monitoring. Lower bounds on the orbital period (generally exceeding 10 y) have been obtained for 10 more systems.

Mira S, SC and (Tc-poor) C stars have also been monitored and show intrinsic radial-velocity variations due to atmospheric phenomena. Tentative orbital solutions have been proposed for 3 stars (S UMa, X Cnc, BD-08:1900) where the velocity and photometric periods are different. Three stars (RZ Peg, SS Vir and R CMi) exhibit radial-velocity variations synchronous with the light variations. *Pseudo*-orbital solutions have been derived for those stars. In the case of RZ Peg, a line-doubling phenomenon is observed near maximum light, and probably reflects the shock wave propagating through the photosphere.

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*Individual data are available on WWW at: http://obswww.unige.ch/~udry/cine/barium/barium.html*

# A CORAVEL radial-velocity monitoring of S stars: symbiotic activity vs. orbital separation

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Orbital elements are presented for the Tc-poor S stars HR 363 (= HD 7351) and HD 191226. With an orbital period of 4592 d (=12.6 y), HR 363 has the longest period known among S stars, and yet it is a strong X-ray source. Its X-ray flux is similar to that of HD 35155, an S star with one of the shortest orbital periods (640 d). This surprising result is put in perspective with other diagnostics of binary interaction observed in binary S stars. They reveal that there is no correlation between the level of binary interaction and the orbital period. This situation may be accounted for if the wind mass-loss rate from the giant is the principal factor controlling the activity level in these (detached) systems, via a stream of matter funneled through the inner Lagragian point.

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*Preprints can be obtained by contacting* ajorisse@astro.ulb.ac.be
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*Individual data are available on WWW at: http://obswww.unige.ch/~udry/cine/barium/barium.html*

# The chemical structure of bipolar planetary nebulae. II. 13 objects

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Long slit spectrophotometry of 13 bipolar planetary nebulae has been used to study their physical and chemical properties. In each nebula, one to seven different spatial regions have been considered in order to search for possible abundance variations through the nebulae.
We obtained the following main results:

– within the errors, the He, O, and N abundances are constant through all the nebulae.

– the Ne, Ar, and S abundances are also constant, within the errors, but their face values have systematic increases toward the outer regions of the nebulae. These trends may be attributed to inaccuracies in the ionization correction factors, as predicted by Alexander & Balick (1997) for long-slit observations of extended PNe. The corresponding increase of the N abundance predicted by those authors is, however, generally not observed (with one exception).

– The present sample contains some of the Galactic PNe with the highest He and N/O abundances known to date (M 3–2, He 2–111, NGC 6537). The highest He overabundances cannot by reproduced by any current model of AGB evolution.

– Oxygen depletion is suggested for the nebulae with the highest N/O abundances, indicating that efficient ON cycle process has occurred in their progenitors

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*Preprints can be obtained by contacting* rcorradi@ll.iac.es
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# CARBON STARS

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In this review we first describe basic information for carbon stars starting with the most recent spectral classification system of P.C. Keenan and luminosities derived from data in the Hipparcos Catalogue. For the SRb and Lb variables $M_K = -6.8 \pm 1.2$ (21 stars). Only two R stars (non-variables) have measured K magnitudes and show $M_K = -5.2$. The four N stars show $M_V = +0.76 \pm 1.06$. Using the Magellanic Clouds, in which the stars are selected by apparent magnitude, carbon stars as bright as $M_K = -9.2$ are found. The distribution of carbon stars perpendicular to the Galactic plane is best understood by two exponentials of scale height about 65 and 300 parsecs. The CH stars, however, are a true halo population of low metalicity. Effective temperatures of C-N stars derived from lunar occultations and near-IR interferometry range from 2000 to 3300 K with little correlation with spectral subtype. Stellar radii derived from angular diameter measurements of C-N stars with Hipparcos parallaxes fall within the limits of 2.4 to 4.7 A.U. Separate short sections describe special carbon stars such as the carbon dwarfs, R stars, and CH stars. The chemical composition of the C-N stars derived by Lambert and collaborators shows that their C/H and N/H ratios are actually very near to being solar. In addition, their $^{12}C/^{13}C$ ratios (excluding the so-called J stars with $^{12}C/^{13}C$ below about 10) are similar to the present interstellar ratios. This indicates that much of the C and N in our Galaxy came from mass-losing carbon stars.

Carbon stars are surrounded by cool dusty molecular envelopes produced by mass loss, whose composition follows that of the photosphere. Mass loss rates up to several $\times 10^{-5}$ $M_\odot$ $yr^{-1}$ are observed. Carbon stars appear to contribute about half of the total mass return to the local interstellar medium, at a rate which can replace it in about a Hubble time. Infrared colors and CO observations show that all N stars lose mass but the R stars do not; although the data are far from conclusive, these may be carbon-rich red giant branch stars. The mass loss rate distributions for semiregular and irregular variables are very similar, as are the luminosities, suggesting that these stars belong to the same population. The Mira variables, however, have mass loss rates higher by about a factor of 10. The peak in the mass loss rate distribution for all carbon stars is $\sim 10^{-7}$ $M_\odot$ $yr^{-1}$, interestingly close to the rate of growth of the core mass, and demonstrating the close relationship between mass loss and the evolution of the star.

Observations of the silicate and SiC dust features in the infrared spectra of carbon stars suggest that dust mixtures can occur in the envelope: this could be due to temperature inhomogeneities across the stellar atmosphere.

The review discusses recent developments in observations of detached shells, which appear to form on the timescale of helium shell flashes. The statistics of the occurrence of these shells, and the properties of the stars with detached shells, suggest that they are a normal occurrence in the evolution of carbon stars. A discussion of the complex circumstellar chemistry of carbon stars is followed by a description of recent observations which show marked deviations from spherical symmetry in many carbon stars, and the presence of very fast molecular winds which appear to accompany the final burst of mass ejection and the beginning of evolution to the planetary nebula stage.

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*For preprints (paper only at the present time), contact* wall@orca.astro.washington.edu or gk@astro.princeton.edu

## Orientation of planetary nebulae within the Galaxy

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Narrow-band CCD images of 209 axially symmetrical PNe have been examined in order to determine the orientation of their axes within the disc of the Galaxy. The nebulae have been divided into the bipolar ($B$) and elliptical ($E$) PNe morphological types, according to the scheme of Corradi & Schwarz (1995).

In both classes, contrary to the results of Melnick & Harwit (1975) and Phillips (1997) we do not find any strong evidence for non-random orientations of the nebulae in the Galaxy. Compared to previous work in this field, the present study takes advantage of the use of larger and morphologically more homogeneous samples and offers a more rigorous statistical analysis.

**Accepted by M.N.R.A.S.**

*Preprints can be obtained by contacting* rcorradi@ll.iac.es
*or via WWW on* http://www.iac.es/publicaciones/preprints.html

## A circumbinary reservoir around BM Gem ?

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We report detection of both (J = 1–0) and (J = 2–1) CO emission from the oxygen-rich circumstellar envelope around the carbon star with an oxygen rich circumstellar envelope BM Gem; the line has two distinct components. Unique among mass-losing carbon stars, there is a feature which is much narrower (FWHM $\sim$ 1 km s$^{-1}$) than the "normal" CO emission detected from winds. This narrow feature sits on top of a broader (FWHM = 15 km s$^{-1}$) line which is probably the emission from the "normal" wind. The most plausible interpretation of the narrow feature is that we are observing emission from a circumbinary reservoir of material, probably in the form of a distorted or puffed-up disk. We propose that this circumbinary reservoir is composed of oxygen-rich material left over from a previous phase of mass-loss that was trapped in the system by the action of an as-yet undetected companion.

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# FARADAY DISCUSSION 109 15th -17th April 1998
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The Final Programme, Application Form, Bursary and Registration details for this meeting are now available and can be obtained by

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Chemistry and Physics of Molecules and Grains in Space, FD 109.
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