
THE AGB NEWSLETTER

*An electronic publication dedicated to stellar evolution
on the asymptotic giant branch and beyond*

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Abstract of recently accepted papers

Spatially resolved spectroscopy of the outflow from the symbiotic Mira RX Pup

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We present and discuss long slit echelle spectra taken at various position angles in the nebula surrounding the symbiotic Mira RX Pup. The spectra were taken in the H α spectral region and are spatially resolved. The fact that the nebula shows up only in the [NII] lines has enabled us to subtract the underlying point source spectrum, showing clearly the spatio-kinematic structure of the nebula. We confirm the presence of the elongated feature found by Paresce (1990) at PA=15°, but not its high H α /[NII] ratio. We also find no evidence for a jet, but a velocity decreasing with distance from the central object. A new nebular structure is found at ~90° to the main feature. The split lines indicate a nebula expanding with velocities ≥ 80 km s⁻¹, probably with a bipolar shape. Both nebulae are some 100s of times larger than the binary separation of RX Pup.

Accepted by Astronomy & Astrophysics

Preprints can be obtained by contacting rcorradi@ing.iac.es

or via WWW on <http://www.ing.iac.es/Astronomy/science/ingpub/index2000.html>

Circumstellar dust shells around long-period variables IX. Molecular layers resulting from shocked carbon-rich atmospheres

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The existence of warm zones of an enhanced molecular content surrounding the photospheres of AGB stars has been postulated to explain observed molecular absorption/emission components which are in excess of the results obtained from classical hydrostatic model atmospheres. We have analyzed the chemical equilibrium molecular composition of time-dependent models of carbon-rich circumstellar envelopes for various combinations of the stellar parameters and found that groups of molecules appear to be present in different zones with temporally varying temperature and density. The regions of enhanced molecular abundances are situated between the stellar photosphere and the circumstellar dust shell. In the models, these zones are produced by the levitation

of the atmospheric gas due to the dissipation of shock waves and/or due to radiation pressure on molecules and dust.

Accepted by A& A.

Preprints can be obtained by contacting chris@astro.physik.tu-berlin.de
or via WWW on <http://export.physik.tu-berlin.de/Publikationen/Publ00/index.html>

NGC 6543: The Rings Around the Cat's Eye

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Hubble archival images of NGC 6543 reveal a series of at least nine regularly spaced, circular, concentric rings that surround the famous nebular core, known as the “Cat’s Eye Nebula”. The rings are almost certainly spherical “bubbles” of periodic isotropic nuclear mass pulsations which preceded the formation of the core. The bubbles are detected solely in the lines of H α , [O III], and [N II]. The core and the bubbles around it appear to have very similar temperature, ionization and chemical properties.

Assuming a distance of 1 kpc and an outflow velocity of 10 km s⁻¹, a good fit to the H α surface brightness distribution suggests that the bubbles were ejected with constant mass, ($\sim 0.01 M_{\odot}$), and thickness (~ 1000 AU) approximately every 1500 years. The combined mass of the visible bubbles, $\sim 0.1 M_{\odot}$, is comparable to that of the present mass of the core ($\sim 0.05 M_{\odot}$).

Since the bubbles are evenly spaced and there is no sign of bubble–bubble collisions, then the bubble ejection mechanism regulates the outflow speed to better than 10%. The line widths of the bubbles, ~ 30 km s⁻¹, argues that the bubbles are in the process of thickening and merging on time scales $\leq 10^3$ y. Their ejection period is consistent with a suggestion that quasi-periodic shells are launched every few hundred years in dust-forming AGB winds (Simis *et al.* 2000 but not consonant with the predictions of extant models of core thermal pulses ($\sim 10^5$ y) and surface pulsations (~ 10 y).

It appears that regular isotropic AGB mass pulses can precede the formation of brighter, denser and more complex PN cores that are formed when an abrupt change of mode of mass loss occurs. Disruptive binary companion mergers or the sudden emergence of a magnetic field might account for the mode change.

Accepted by Astronomical Journal

Preprints can be obtained via anonymous ftp on
<ftp://ftp.astro.washington.edu/pub/users/balick/6543paper/rings.pdf>

Modeling of C stars with core/mantle grains: Amorphous carbon + SiC

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A set of 45 dust envelopes of carbon stars has been modeled. Among them, 34 were selected according to their dust envelope class (as suggested by Sloan, Little-Marenin & Price, 1998) and 11 are extreme carbon stars. The models were performed using a code that describes the radiative transfer in dust envelopes considering core/mantle grains composed by an α -SiC core and an amorphous carbon (A.C.) mantle. In addition, we have also computed models with a code that considers two kinds of grains - α -SiC and A.C. - simultaneously. Core-mantle grains seem to fit dust envelopes of evolved carbon stars, while two homogeneous grains are more able to reproduce thinner dust envelopes. Our results suggest that there exists an evolution of dust grains in the

carbon star sequence. In the beginning of the sequence, grains are mainly composed of SiC and amorphous carbon; with dust envelope evolution, carbon grains are coated in SiC. This phenomena could perhaps explain the small quantity of SiC grains observed in the interstellar medium. However, in this work we consider only α -SiC grains, and the inclusion of β -SiC grains can perhaps change some of these results.

Accepted by A&A

Preprints can be obtained by contacting lorenz@sun1.ov.ufrj.br

HD 172481: a super lithium-rich metal-deficient post-AGB binary with a red AGB companion

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We present in this paper a study on the peculiar supergiant HD 172481. Its spectral type (F2Ia), high galactic latitude ($b = -10.^\circ 37$), circumstellar dust, high radial velocity and moderate metal deficiency ($[\text{Fe}/\text{H}] = -0.55$) confirm the post-AGB character of this object. A detailed chemical analysis shows slight but real s-process overabundances, however no CNO-enhancement was detected. Furthermore, the spectral energy distribution and the TiO bands in the red part of the spectrum reveal a red luminous companion. The luminosity ratio of the hot F type component and this cool M type companion L_F/L_M is derived for a reddening of $E(\text{B}-\text{V}) = 0.44$ ($L_F/L_M \sim 1.8$) and indicates that the companion must also be strongly evolved and probably evolving along the AGB. Neither our photometric data-set, nor our radial velocity monitoring show evidence for orbital variability which may indicate that the period is too large for direct binary interaction. Most interestingly, a strong lithium resonance line is detected, which yields an abundance of $\log \epsilon(\text{Li}) = 3.6$. Several explanations for this large lithium content are explored.

Accepted by Astronomy & Astrophysics Main Journal.

Preprints can be obtained by contacting maarten.reyniers@ster.kuleuven.ac.be
or via WWW on <http://www.ster.kuleuven.ac.be/homepage/publications.html>
or on <http://xxx.lanl.gov/abs/astro-ph/0010486>
or via anonymous ftp on <ftp://ftp.ster.kuleuven.ac.be/dist/maarten/hd172481.ps.gz>

Discovery of a disk-collimated bipolar outflow in the proto-planetary nebula IRAS 17106–3046

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We report the discovery of a collimated bipolar outflow emerging from a visible disk around the proto-planetary nebula IRAS 17106–3046. The radius of the disk, estimated to be 2500 AU at a distance of 4 kpc, is too large for it to be a Keplerian disk created by accretion. The radial intensity profile of the disk suggests that it is consistent with an expanding torus. In contrast to the open-end, butterfly-like lobes commonly seen in bipolar planetary nebulae, the lobes of IRAS 17106–3046 have pointed ends, suggesting a recently-formed jet breaking out of the lobes. IRAS 17106-3046 therefore could represent the earliest stage of the bipolar shaping process during the transition from an asymptotic giant branch star to a planetary nebula.

Accepted by ApJ Letters

Preprints can be obtained via WWW on <http://www.iras.ucalgary.ca/kwok/reprints.html>

ISO LWS observations of planetary nebula fine-structure lines

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We have obtained 43–198 μm far-IR spectra for a sample of 51 Galactic planetary nebulae (PN) and proto-planetary nebulae (PPN), using the Long Wavelength Spectrometer (LWS) on board the Infrared Space Observatory (ISO). Spectra were also obtained of the former PN candidate Lo 14. The spectra yield fluxes for the fine-structure lines [N II] 122- μm , [N III] 57- μm and [O III] 52- and 88- μm emitted in the ionized regions and the [O I] 63- and 146- μm and [C II] 158- μm lines from the photodissociation regions (PDRs), which have been used to determine electron densities and ionic abundances for the ionized regions and densities, temperatures and gas masses for the PDRs. The strong [N III] and [O III] emission lines detected in the LWS spectrum taken centred on Lo 14 could be associated with the nearby strong radio and infrared source G 331.5–0.1.

We find that the electron densities yielded by the [O III] 88 μm /52 μm doublet ratio are systematically lower than those derived from the optical [Ar IV] $\lambda 4740/\lambda 4711$ and [Cl III] $\lambda 5537/\lambda 5517$ doublet ratios, which have much higher critical densities than the 52- and 88- μm lines, suggesting the presence of density inhomogeneities in the nebulae. Ionic abundances, N^+/H^+ , N^{2+}/H^+ and O^{2+}/H^+ , as well as the $\text{N}^{2+}/\text{O}^{2+}$ abundance ratio, which provides a good approximation to the N/O elemental abundance ratio, are derived. Although ionic abundances relative to H^+ deduced from the far-IR fine-structure lines are sensitive to the adopted electron density and the presence of density inhomogeneities, the strong dependence on the nebular physical conditions is largely cancelled out when $\text{N}^{2+}/\text{O}^{2+}$ is calculated from the 57 $\mu\text{m}/(52\mu\text{m} + 88\mu\text{m})$ flux ratio, owing to the similarity of the critical densities of the lines involved.

The temperatures and densities of the PDRs around 24 PN have been determined from the observed [O I] and [C II] line intensity ratios. Except for a few objects, the deduced temperatures fall between 200 and 500 K, peaking around 250 K. The densities of the PDRs vary from 10^4 – 10^5 cm^{-3} , reaching $3 \times 10^5 \text{ cm}^{-3}$ in some young compact PN. With a derived temperature of 1600 K and a density of 10^5 cm^{-3} , the PDR of NGC 7027 is one of the warmest and at the same time one of the densest amongst the nebulae studied. For most of the PN studied, the [C II]-emitting regions contain only modest amounts of material, with gas masses $\leq 0.1 M_\odot$. Exceptional large PDR masses are found for a few nebulae, including NGC 7027, the bipolar nebulae M 2-9 and NGC 6302, the young dense planetary nebulae BD+30°3639, IC 418 and NGC 5315, and the old, probably recombining, nebulae IC 4406 and NGC 6072.

Accepted by MNRAS

*Preprints can be retrieved from <ftp://ftp.star.ucl.ac.uk/pub/xwl/>
or by contacting X.-W.Liu at xwl@star.ucl.ac.uk*

IRAS09425–6040: A carbon star surrounded by highly crystalline silicate dust

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We present infrared spectroscopy and millimeter photometry and spectroscopy of the peculiar carbon star IRAS09425–6040. The 2–15 μm spectrum, as well as the CO millimeter line observations are typical for a (J-type) carbon star with moderate mass-loss rate. The 15–45 μm spectrum is dominated by strong emission bands from Mg-rich and Fe-poor crystalline silicates. IRAS09425–6040 has the highest abundance of crystalline silicates (75 per cent) observed in any source so far. The ISO data, combined with IRAS and millimeter wavelength photometry indicate the presence of large cold grains. The observations indicate that the carbon star IRAS09425–6040 is surrounded by a stationary, massive, highly crystalline oxygen-rich dust disk which is depleted of gas. These properties are very similar to those of the disk seen in the Red Rectangle. We propose that IRAS09425–6040 is the evolutionary progenitor of the central binary of the Red Rectangle nebula.

Accepted by A&A

Preprints can be obtained by contacting fjmolster@mvainc.com
or via WWW on <http://www.astro.uva.nl/frankm/papers.html>

On winds from giants in binary systems

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We explore the influence of a companion on the wind from a giant in a binary system. We have developed a simple method for estimating the enhancement and intrinsic non-sphericity of the outflow in this case. Assuming the Roche model (modified to account for the reduced effective gravity of the giant), local stellar parameters (T_{eff} , g) are calculated. This, according to our approach, allows to derive the local mass loss rate. The influence of varying the model parameters on the results is studied. A relation between the ratio of the stellar radius to the Roche lobe radius and the overall wind enhancement is obtained both numerically and in an analytical approximation. A similar relation is derived for the equatorial-to-polar wind intensity contrast.

Accepted by Astronomy & Astrophysics

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

Arizona Prize Postdoctoral Fellowship in Theoretical Astrophysics

The University of Arizona has recently established the Arizona Prize Postdoctoral Fellowship as part of its Program in Theoretical Astrophysics. Awarded to a single individual for a period of three years, the post-doctoral fellowship recognizes outstanding potential in original scientific research in the area of Theoretical Astrophysics. This is broadly construed to include forefront problems in cosmological, galactic, stellar, and planetary astrophysics.

The Fellow will collaborate with faculty members in the Arizona Theoretical Astrophysics Program (TAP), which currently includes over 15 faculty members drawn from the departments of Astronomy, Physics, and Planetary Sciences. The Fellow is expected to interact significantly with faculty in more than one department, and will also have the opportunity to tie into a broad range of ground- and space-based projects underway at Arizona. An annual stipend of \$45 K plus \$5 K for research expenditures will be paid to the Fellow.

The application review process will start December 1, 2000 and will continue until the position is filled.

Applicant is asked to submit a cover letter (making specific reference to the Prize Fellowship), a curriculum vitae, a bibliography, a description of the anticipated research program and how the applicant might work productively in more than one of the TAP departments, and any preprints deemed important.

The applicant must also arrange for three letters of recommendation to be sent, preferably for arrival before December 1.

Please send all material to Prof. J. I. Lunine, Chair, Arizona Theoretical Astrophysics Program, LPL/UA, P.O. Box 210092, 1629 E. University Blvd. Tucson AZ 85721-0092, USA.

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Post doctoral position

Institut d'Astronomie et d'Astrophysique, Université Libre de Bruxelles

Applications are invited for a post-doctoral position to work on the exploitation of the Hipparcos *Intermediate Astrometric Data* and *Transit Data*, with special emphasis on late-type giants (carbon and Mira stars).

The duration is 2 years, with the possibility to extend it to 3 years, starting immediately.

Candidates should have a PhD and some experience with Hipparcos data. Applications (which should be accompanied by a CV and a statement of research interest) or informal enquiries about the research program should be directed to Dr. A. Jorissen (Institut d'Astronomie et d'Astrophysique, Université Libre de Bruxelles, CP 226, Boulevard du Triomphe, B-1050 Bruxelles, Belgium; email: ajorisse@astro.ulb.ac.be).

Research interests and publications of the group at IAA-ULB may be found at <http://www-astro.ulb.ac.be>

Astronomy and Astrophysics Tenure-track Assistant Professor
Department of Physics and Astronomy
Vanderbilt University

The Department of Physics and Astronomy invites applications and nominations for a tenure-track assistant professor position in astronomy and astrophysics beginning in the 2001-2002 academic year. An exceptionally qualified person at a more senior level may also be considered. The successful candidate will be expected to establish a vigorous research program and to be highly effective in teaching at the undergraduate and graduate levels. Candidates with specialties in any area of astronomy and astrophysics are invited to apply. Related research areas within the department include star and planetary system formation, atmospheres and interior physics of low-mass stars and white and brown dwarfs, planetary and protoplanetary nebulae, binary and variable stars, space physics, particle astrophysics and cosmology.

Potential applicants are invited to request more information regarding faculty research activities from the Search Committee and to visit our web site, at <http://www.physics.vanderbilt.edu/>.

Applicants should send a curriculum vitae, a letter describing current and planned research activities and teaching experience, and a list of three references who may be contacted for letters of recommendation. Candidates are especially encouraged to describe how they plan to develop their research programs at Vanderbilt.

Applications and requests for further information should be sent to:

David A. Weintraub, Chair,
Astrophysics Search Committee, Vanderbilt University, Department of Physics & Astronomy,
P.O. Box 1807 Station B, Nashville, TN 37235-1807.
EMAIL: david.weintraub@vanderbilt.edu,
FAX: 615-343-7263.

Review of applications will begin January 31, 2001, and will continue until the position is filled.

Vanderbilt University is an Equal Opportunity, Affirmative Action Employer. Women and minority candidates are particularly encouraged to apply.

Announcements

ASTRID DATABASE

Substantial evolutions have been made about the server capabilities and the data of ASTRID database that is dedicated to stars in advanced evolutive stages

NEWS about the WEB server

We made the web services as close as possible to the telnet ones. So several menus are now available. Among them:

- "Simple Search" gives access to all included data for a source searched from one of the numerous identifiers recognized by the base.
↳ From here a DIRECT ACCESS TO SIMBAD (CDS) is available that can provide complementary data, and a LINK TO AAVSO predicted maxima and minima dates of LPVs.
- "Astrid Query" allows users to build a sample fulfilling some criteria,
- "Table Maker" makes a table of selected data. The user can get it either in text or in html format

Instructions with examples are available on-line.

NEWS about data

Among the new data we would like to specifically draw your attention to:

- Qualified data of NIR-Survey DeNIS sources associated to ASTRID objects are progressively added as soon as they are available,
- Variable star candidates in the Galactic Bulge from DeNIS and ISOGAL properties are put into the base.
- CO spectroscopic data are now in the base.

Work is in progress for giving access to more data, as example:

- OH spectra, available as graph or table,
- TYCHO2 astrometric and photometric data of sources associated to ASTRID objects,
- past observed maxima and minima dates of LPVs.

Let us remind that we can add into ASTRID any data that you think to be useful

ASTRID address: <http://astrid.graal.univ-montp2.fr>

ASTRID e-mail: astrid@graal.univ-montp2.fr

Marie-Odile MENNESSIER and Michel BELMAS, GRAAL, CNRS and Univ. Montpellier II, F34095 Montpellier Cedex5 (France)

First Announcement IAU SYMPOSIUM 209

Planetary Nebulae: Their Evolution and Role in the Universe

November 19-23, 2001,
Canberra, Australia

Dear Colleagues,

We are very pleased to announce IAU Symposium 209, "Planetary Nebulae: Their Evolution and Role in the Universe" to be held at Canberra, Australia in November 19-23, 2001.

Following the previous IAU symposia on Planetary Nebulae (PN), in Czechoslovakia (1967), USA (1976), UK (1982), Mexico (1987), Austria (1992) and The Netherlands (1996), the 2001 PN symposium will be held in Australia's capital Canberra. Research on PN has undergone a renaissance in recent years. Observations from space (IUE, IRAS, ROSAT, HST, ISO, etc.) have revealed these objects to be more complex and physically interesting than had previously been suspected. Since the last symposium, infrared spectroscopic observations by ISO have identified new molecular and solid state species with significant implications on our understanding of the fields of interstellar chemistry and grain formation mechanisms. High resolution optical observations with the HST have revealed many new kinds of structures and jets. By the date of the symposium, new data from FUSE and AXAF will have become available to shed new light on the nature of such structures.

The conference will cover the following major topics:

- PN surveys and their distribution in the galaxies
- PN in the scheme of stellar evolution
- Central stars and their atmospheres
- Nebular Properties of PN
- PN as galaxy probes

This email has been widely distributed, but please make sure your colleagues are aware of IAU Symposium 209. The conference will be held in the Dome of the Academy of Sciences, surrounded by gardens, adjacent to the ANU campus, and overlooking Lake Burley Griffin in the heart of Australia's "bush capital" (see <http://www.act.gov.au>).

Early summer is very pleasant in Canberra (15-28 C) and it is an excellent time to get a flavor of this spacious planned city and visit its many interesting institutions. The traditional symposium dinner and the always successful Australian wine-tasting evening will be organized, as well as a tour of Tidbinbilla Nature Reserve.

At this time you are invited to pre-register on our web page:

http://www.mso.anu.edu.au/pn_symp

The deadline for pre-registration is March 1, 2001 and the deadline for application for (very limited !) travel support is May 1, 2001.

The list of invited speakers, contributed talks etc. will be finalized following the deadline for pre-registration.

With best regards,

Sun Kwok and Mike Dopita (Co-chairs, SOC)

....on behalf of the Scientific Organizing Committee:

A. Acker (France), M. Arnaboldi (Italy), B. Balick (U.S.A.), M. Barlow (U.K.), M. Dopita (Australia, co-chair), S. Deguchi (Japan), G. Jacoby (U.S.A.), S. Kwok (Canada, co-chair), W.J. Maciel (Brazil), A. Manchado (Spain), M. Perinotto (Italy), S.R. Pottasch (The Netherlands), D. Schoenberner (Germany), Y. Terzian (U.S.A.), S. Torres-Peimbert (Mexico), R. Tylanda (Poland), P.R. Wood (Australia)

....and the Local Organising Committee:

M. Dopita, M. Sevenster, C. Jackson, P. McGregor, R. Sutherland & P. Wood (all at RSAA)