THE AGB NEWSLETTER

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

No. 33 — 01 January 1997

Editors: Thierry Forveille and Claudine Kahane (agbnews@gag.observ-gr.fr)

Abstracts of recently accepted papers

Extended optical nebulae around symbiotic stars

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The observations of *extended* ionized nebulae around symbiotic stars are reviewed. Most of these nebulae are associated with symbiotic Miras, have a bipolar shape, large linear dimensions (0.1 to 2 pc), and high outflow velocities (100–300 km s^{-1}). Collimated jets are also present in some systems. A formation scenario for these nebulae along the lines of the "interacting winds" theory is proposed. New images for some of these objects and the discovery of extended nebulae around CH Cyg and HM Sge are presented. The possible link with planetary nebulae, and in particular with the morphological class of bipolar objects, is then discussed.

Invited review to appear in *Physical Processes in Symbiotic Binaries and Related Systems*, ed. J. Mikolajewska, Publ. Copernicus Foundation for Polish Astronomy, Warsaw, 1997

Preprints can be obtained by contacting rcorradi@iac.es,
or via WWW on http://www.iac.es/proyect/PNgroup/root/iacpn.html,
or via anonymous ftp to iac.es on pub/romano/poland.ps.gz

Self-similarity and scaling behavior of IR emission from radiatively heated dust: I. Theory

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Dust infrared emission possesses scaling properties that yield powerful results with far reaching observational consequences. Scaling was first noticed by Rowan-Robinson for spherical shells and is shown here to be a general property of dust emission in arbitrary geometries. Overall luminosity is never an input parameter of the radiative transfer problem, spectral shape is the only relevant property of the heating radiation when the inner boundary of the dusty region is controlled by dust sublimation. Similarly, the absolute scales of densities and distances are irrelevant; the geometry enters only through angles, relative thicknesses and aspect ratios, and the actual magnitudes of densities and distances enter only through one independent parameter, the overall optical depth. That is, as long as the overall optical depth stays the same, the system dimensions can be scaled up or down by an arbitrary factor without any effect on the radiative transfer problem. Dust properties enter only through dimensionless, normalized distributions that describe the spatial variation of density and the wavelength dependence of scattering and absorption efficiencies.

Scaling enables a systematic approach to modeling and classification of IR spectra. We develop a new, fully scale-free method for solving radiative transfer, present exact numerical results, and derive approximate analytical

solutions for spherical geometry, covering the entire range of parameter space relevant to observations. For a given type of grains, the spectral energy distribution (SED) is primarily controlled by the profile of the spatial dust distribution and the optical depth — each density profile produces a family of solutions, with position within the family determined by optical depth. From the model SEDs presented here, the density distribution and optical depth can be observationally determined for various sources.

Scaling implies tight correlations among the SEDs of various members of the same class of sources such as young stellar objects, late-type stars, etc. In particular, all members of the same class occupy common, well defined regions in color-color diagrams. The observational data corroborate the existence of these correlations.

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

e-mail address : moshe@pa.uky.edu;
also available at http://xxx.lanl.gov/abs/astro-ph/9612164

Time–frequency analysis and pulsation modes of LPV stars. I. *o* Ceti

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The problem of the pulsation modes of the Long Period Variable star *o* Cet is investigated by means of Fourier and wavelet transforms applied to long–term AAVSO visual observations. The results suggest that the variability of this star is mainly due to first–overtone radial pulsation, nonlinearly coupled to at least two other radial modes. This is supported by linear, nonadiabatic modeling, though fundamental–mode or subharmonic pulsation cannot be definitely ruled out. Theoretical estimates of the fundamental parameters of the star are derived from the periods of the modes. The luminosity and the effective temperature are found in agreement with the best recent observational estimates. These results, and the discussion of recent nonlinear calculations, suggest that the linear modes might be basically preserved in the nonlinear pulsation, though with a moderate period shift.

Accepted by Astronomical Journal

Preprints can be obtained by contacting barthes@graal.univ-montp2.fr

Abundance gradients from planetary nebulae in the galactic disk

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Radial abundance gradients are reviewed, with emphasis on the results provided by the analysis of planetary nebula abundances. First, gradients from HII regions in external galaxies are considered and compared with the results for the Milky Way. For the Galaxy, evidences for gradients from stars and supernova remnants are also discussed, especially regarding the discrepancies between the results from relatively young stars and photoionized nebulae. PN gradients are reviewed of the main chemical elements observed in the nebulae, which include the elements that are not produced by the progenitors of the central stars (O, S, Ne, Ar, and Cl) and

those for which some contribution is observed (He, N, and C). Finally, some theoretical aspects regarding the origin of the gradients and their spatial and temporal variations are discussed.

Invited review at IAU Symposium 180, *Planetary Nebulae*, ed. H. J. Habing, H. J. G. L. M. Lamers, Kluwer

Preprints can be obtained by contacting: maciel@orion.iagusp.usp.br
or at the URL: http://www.iagusp.usp.br/~maciel/index.html

Identification of IRAS sources in the outer disk of the Galaxy

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Near infrared imaging and photometric observations at J, H and K (or K′) bands were performed toward 95 IRAS sources in the outer disk of the Galaxy most of which had been searched for SiO maser emission and are candidates for variable late-type stars with cold circumstellar envelopes. Low resolution optical spectroscopic observations were made to 19 stars of them for classifying the spectral types. Thirty-eight of them, for which counterparts were not found at I band brighter than 19mag, were taken near infrared images for identification. All are identified in the near-infrared images brighter than 16 mag at K′ band except two that could be in the faint phase of variation when observed. So most of the IRAS late-type stars perhaps have a near-infrared counterpart although many have no optical counterpart. In the near-infrared color-color diagram, the stars with O-rich and C-rich circumstellar envelopes(CSEs) are separated from each other. The stars with C-rich CSE are redder than those with O-rich CSE in general but there are three very red stars in this sample being SiO maser sources, i.e. with O-rich CSE. By combining the near-infrared colors and IRAS color, the two types of circumstellar envelopes are discriminated. 48 percent are stars with C-rich CSE in the entire sample and the number ratios of C-rich to O-rich stars are 14:43 and 32:6 for the optically identified and unidentified groups respectively. This indicates an increasing proportion of C-rich stars with galacto-centric distance and stellar evolutionary stage. The result is applied to explain the low detection rate of SiO maser emission in a similar and bigger sample in the outer disk of the Galaxy.

AJ. April, 1997 issue in press
Preprints can be obtained by contacting deguchi@nro.nao.ac.jp

Mid-infrared imaging of AGB star envelopes II. Modelling of the observed sources

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Radiative transfer modelling of AGB circumstellar envelopes is applied to a sample of AGB stars previously observed with the mid-IR imaging camera TIRCAM (Busso et al. 1996: Paper I). We present the results of

our simulations, aimed at deriving the physical parameters of the envelope, such as the optical depth and the radial thermal structure, the mass loss and the dust-to-gas mass ratio. The chemical composition of the dust in the observed envelopes is discussed. The ability of different sets of dust opacities to fit the mid-infrared spectra is evaluated. The hypothesis of dust grain aging and annealing in O-rich envelopes is considered in order to explain an apparent inadequacy of the availabe opacities to describe the variety of observed spectra, as previously noted by other authors. Various possible origins of the discrepancies are discussed, together with their consequences on the dust grain formation processes.

Accepted by Astronomy and Astrophysics.

Preprints can be obtained bycontacting marengo@sissa.it
or via WWW on http://www.sissa.it/ marengo/sci/tirpap2/tirpap2.html

NGC 7027: discovery of a Raman line in a planetary nebula

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We report on the discovery of the He II Raman line λ 485.1 nm in the spectrum of the planetary nebula NGC 7027. This line is direct evidence for the presence of atomic hydrogen in the nebula. It is shown that this Raman line can provide reliable pieces of information concerning both the velocity field of the He^{2+} region and the expansion velocity of the surrounding H^0 shell.

Detection of self-Raman scattering of Ly_γ is suspected.

Accepted by Astron & Astrophys. 17/12/96
Preprints can be obtained bycontacting pequignot@obspm.fr,

Barium-rich G stars in the nuclei of the planetary nebulae Abell 35 and LoTr5

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A spectroscopic analysis of the G-star located at the centre of Abell 35 leads to a surface gravity $\log g = 3.7 \pm 0.5$ and an effective temperature $T_{eff} = 5300 \pm 200\,\mathrm{K}$, which are typical of a G8IV spectral type. We estimate a projected rotational velocity of $55 \pm 10\,\mathrm{km\,s^{-1}}$ and deduce a radius $1.5 \leq R_\mathrm{G} \leq 3.5 R_\odot$ in agreement with the subgiant luminosity class: the star is rapidly rotating, near the break-up as for LoTr5 (Jasniewicz et al. 1996a). For both late-type central stars of Abell 35 and LoTr5, we show a photospheric enhancement of the barium element which can be understood as caused by the transfer of s-process-overabundant material from the former AGB star which is now the hot star of the binary. These G-stars could be pre-Barium stars in detached binary systems.

Accepted by Astronomy & Astrophysics
Preprints can be obtained by contacting gjasniew@graal.univ-montp2.fr

Radial velocities of planetary nebulae towards the Galactic bulge

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Accurate radial velocities for a sample of 71 planetary nebulae, mostly located in the direction of the Galactic Centre, are presented. Most of the nebulae discussed in this paper are likely members of the Galactic bulge, based on their radial velocity, longitude and derived distance. The data give a large improvement over existing catalogues, doubling the sample of bulge planetary nebulae with well-determined velocities and suggesting that kinematics of the Galactic Bulge can usefully be studied by planetary nebulae.

Accepted by Astron. Astroph. Suppl. Series

Preprints can be obtained by contacting azijlstr@eso.org
or via WWW on http://www.eso.org/ azijlstr/azijlstr.html

A double dust shell surrounding the carbon star U Ant

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We have investigated the N-type carbon star U Ant in high resolution IRAS images. We find that the star shows two extended dust shell components and that these two shells are also clearly present in the original survey scan data.

We have fitted a double dust shell model with spherical symmetry to the data to obtain the physical quantities of the shells. The inner dust shell component is related directly to the detached gas envelope detected in the mm-wave CO lines in previous studies, while the outer shell has an inner radius of about 3' but has no CO counterpart. The projected separation of the inner edges of the two shells, which is insensitive to any of the model parameters, is derived to be $141''$ - $148''$. Our results together with the CO observations show that the mass loss rate varies by two orders of magnitude along the AGB evolution.

We are able to deduce the distance, interpulse period, core mass, and luminosity of the star selfconsistently, assuming that the two detached shells are related directly to two consecutive thermal pulses along the AGB evolution of this star. They are 324pc,1.0×10^4years, $0.80M_\odot$, and $9.4\times10^3L_\odot$ for the first thermal pulse stage, and 436pc, 1.4×10^4years, $0.77M_\odot$, and $1.7\times10^4L_\odot$ for the full amplitude thermal pulse stage, assuming an expansion velocity of 21 km s^{-1} for both shells. The implied progenitor mass of U Ant is 3-5 $M_\odot$. This method can be applied to other AGB stars with a multiple dust shell to be detected in future observations, which provides a way to determine reliable physical quantities of AGB stars.

Accepted by Astron. Astrophys.
Preprints can be obtained by contacting izumiura@oao.nao.ac.jp

Messages

DUSTY: A New Radiative Transfer Code

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A new code for radiative transfer in dusty envelopes, DUSTY, is now available for public evaluation. The program provides an exact solution for spherically symmetric shells with arbitrary density distribution, grain chemistry and sizes, etc. The code was designed for general public usage and has a flexible, friendly input/output interface.

For a centrally heated shell, DUSTY calculates the radiation field throughout the envelope including dust scattering, absorption and emission. DUSTY has built in optical properties for the most common types of astronomical dust. It supports various analytical forms for the density distribution, and can perform a full dynamical calculation for radiatively driven winds around late-type stars. The spectral energy distribution of the central source can be specified analytically as either Planckian or broken power-law. In addition, arbitrary dust optical properties, density distributions and external radiation can be entered in user supplied files. A single DUSTY run can process an unlimited number of models, with each input set producing a run of optical depths, as specified. The user controls the detail level of the output, which can include both spectral and imaging properties as well as other quantities of interest.

We wish to improve both the program and its manual through user feedback. Persons interested in using DUSTY and providing such feedback should contact us at:

e-mail address : moshe@pa.uky.edu

Faraday Discussion no. 109
Chemistry and Physics of Molecules and Grains in Space

The University of Nottingham, UK
15-17 April 1998

ORGANISING COMMITTEE

Professor P J Sarre (Chairman)	Dr D Field
Dr S Leach	Professor I W M Smith
Professor J Tennyson	Professor D A Williams

The Faraday Discussion will cover the chemistry and physics of molecules and grains in stellar, circumstellar, planetary, cometary, nebular and interstellar media from chemical, physical and astronomical viewpoints. Both established and relatively little explored areas will be represented including the planetary-interstellar chemical connection, star-forming regions in which molecules and grains play both a pivotal role and act as probes of processes, hot chemistry in shocks, the atmospheres of cool stars, chemical and physical modelling of astronomical environments, the assignment of unidentified spectra - signatures in the UV, visible, IR and radio regions, and both current and desired laboratory spectroscopic, kinetic and mechanistic studies. It is intended that results obtained from the Infrared Space Observatory and the Hubble Space Telescope, and observations of comet Hale-Bopp will form part of the meeting.

Contributions are invited for consideration by the Organising Committee. Titles and abstracts of 250 words indicating in general terms the nature of the new results or insight to be presented, should be submitted to Professor P J Sarre (psa@star.le.ac.uk), Department of Chemistry, The University of Nottingham, University Park, Nottingham, NG7 2RD, United Kingdom. The deadline for receipt of abstracts is Friday 14th March 1997. The manuscripts for inclusion in the programme will be required by 31st December 1997.

Your questions answered:

- **What is a Faraday Discussion ?**

  The first Faraday Discussion was held in 1907. It is a unique style of meeting. Apart from an Introductory Lecture to be presented by David Williams, Perren Professor of Astronomy at University College London, there are no formal oral talks. As the name suggests - the emphasis is on discussion.

- **Are there any papers ?**

  Yes. About 20-24 original scientific papers are included. These are "prepublished" and are circulated to the participants 3 weeks before the meeting. The idea is that all Discussion participants read the papers in advance. One of the authors is given 5 minutes to present the key points of the paper at the meeting and it is then discussed. It is common for two or three papers to be taken together when they are in a similar area.

- **Are the discussion comments recorded ?**

  Yes - but not on tape. Each person making a discussion contribution - question, reply, comment etc. writes it down on a numbered 'pro forma'. These can be handed in at the time or submitted within a short time period after the meeting.

- **Is there a publication ?**

  Yes - very much so! A Faraday Discussion volume is published by the Royal Society of Chemistry and includes the Introductory Lecture, the 20-24 research papers, and the discussion comments. It is not uncommon for there to be over 200 discussion comments making this a unique record of the discussion, thoughts, ideas, criticisms etc. of the time. The discussion forum also allows a degree of speculation and forward thinking which would not perhaps readily fit into a formal research publication.

- **How can I participate ?**

  If you wish to submit one of the research papers - which must contain original material - then please submit an abstract to the Organising Committee before 14th March 1997. The abstract should be about 250 words and describe in general terms the nature of the new results or insight to be presented. The Committee then selects those to be included in the meeting. The full papers are then required by 31st December 1997. A poster session is also held.

- **What about preparing for the meeting ?**

  The most successful Faraday Discussions are when the participants are able to make some preparation in advance. For example bringing a few overhead transparencies to illustrate points which you might wish to make in discussion, or to describe work of your own which is related to the paper or subject area under discussion. This is not to say that we aim for a series of mini oral presentations (in any event they are also limited to 5 mins) - but obviously there is much interest in related work, new perspectives etc. and we are keen for this to be included.

- **Has there been a Discussion in this area before ?**

  Yes and No: There was a meeting in 1992 entitled 'Chemistry of the Interstellar Medium'. It was called a 'Symposium' rather than a 'Discussion' but it was similar in style. The papers were published as part of the Journal of the Chemical Society, Faraday Transactions 89, no. 13 (1993)

Peter Sarre (psa@star.le.ac.uk)

ESO IMAGING SURVEY (EIS)

As part of the ongoing effort to conduct a deep, multi-color imaging survey in preparation for the scientific operation of VLT, ESO has established a special program to sponsor the visit of individuals that may want to collaborate in this effort and thereby stimulate the involvement of the community in all phases of the survey. More detailed information on EIS will soon become available on the ESO WEB pages.

ESO is currently seeking people interested to work on EIS software development and data reduction at the ESO Headquarter in Garching for a period of at least several months up to about one year. Financial support for such extended visits will be provided by the EIS project. At the present time we are primarily interested in candidates with experience in one or several of the following areas:

a) design and implementation of software to reduce large quantities of imaging data,

b) programming within astronomical environments such as IRAF, MIDAS and/or IDL (programmer)

c) reduction of astronomical imaging data (data assistant).

The visitors will participate in the design, development and testing of the data reduction pipeline for drift-scan observations; implement modules for on-line data reduction; process and supervise the quality of the data.

We invite those interested to immediately send email to eis@eso.org (subject: EIS visitor) stating their interest and indicating the time period in which they would be available. This should be followed up later with a CV clearly outlining experience and including the names and addresses of at least two references.

Luiz da Costa
Wolfram Freudling