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Abstract of recently accepted papers

Pulsating AGB stars in the LMC

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I give a brief review and interpretation of the evolution, mass loss and pulsation of AGB stars in the Large Magellanic Cloud.

Accepted by IAU Colloquium 185 "Radial and Nonradial Pulsations as Probes of Stellar Physics", Leuven July 2001 (invited review)

Preprints can be obtained by contacting jacco@astro.keele.ac.uk

Variations of polarisation properties of OH maser emission from three semiregular variables

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We present an analysis of polarimetric observations of the three semiregular variables RT Vir, R Crt and W Hya obtained in the 1665 and 1667 MHz OH maser lines. Circular polarisation data were taken at intervals over a period of 10−14 years. During the two last years of the monitoring program the targets were observed at intervals of 3−4 weeks in circular and linear polarisation. Circular polarisation was dominant, whereas linear polarisation, if detected, was weak. The degree of circular polarisation varied considerably across the maser profiles. It decreased at velocities where strong OH total flux density was observed, most likely due to blending effects. Individual circularly polarised features exhibited various types of changes; some features were transient or showed significant variations on timescales of few weeks to few months. Other features varied slowly over the period of observations of about 5000 days and polarisation reversal occurred. Net circular polarised emission was detected in the all three stars. Variations of net circular polarisation and the degree of circular polarisation of the maser features of RT Vir, implies a well aligned circumstellar magnetic field. Linearly polarised features preferentially appeared at blue-shifted velocities where they are not suppressed by Faraday rotation. In the blue-shifted 1667 MHz features of RT Vir we observed a systematic increase of degree of linear polarisation associated with a gradual decrease in the degree of circular polarisation. This behaviour was possibly linked

with variations in the electron density or propagation effect in the maser regions. It is suggested that changes in the observational characteristics of the polarised maser emission of the studied stars can be caused by turbulence effects in the circumstellar magnetic field and by global magnetic field reversal.

Accepted by Astronomy and Astrophysics

Preprints can be obtained by contacting msz@astro.uni.torun.pl

Large-scale extended emission around the Helix Nebula: dust, molecules, atoms and ions.

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We present new observations of the ionized gas, molecular gas and cool dust in the Helix nebula (NGC 7293). The ionized gas is observed in the form of a Hα image, which is constructed using images from the Southern H-Alpha Sky Survey Atlas (SHASSA). The molecular emission was mapped using the H_2 $v = 1 \rightarrow 0$ s(1) line at 2.122μm. The far-infrared (FIR) observations were obtained using ISOPHOT on the Infrared Space Observatory (ISO). The Hα observations are more sensitive than previous measurements and show the huge extent of the Helix, confirming it as a density-bounded nebula, and showing previously unseen point-symmetric structures. The H_2 observations show that the molecular gas follows the distribution of molecular material shown in previous work. The molecular emission is confined to that part of the nebula seen in the classic optical image. Furthermore, comparison of the H_2 emission strength with time-dependent models for photo-dissociation regions (PDRs) shows that the emission arises from thermal excitation of the hydrogen molecules in PDRs and not from shocks. The FIR observations, at 90 and 160μm, have contributions mostly from thermal dust emission from cool dust grains, but include a small contribution from ionized atomic lines. Comparison of the FIR emission with the Hα observation shows that the dust and ionized gas are coincident and extend to $\tilde{1}100''$ radius. This equates to a spatial radial extent of more than a parsec (assuming a distance to the Helix of $\tilde{2}00$pc). Assuming that the outer layers of the circumstellar shell have spherical symmetry, radiative transfer modeling of the emission in Hα gives a shell mass of $\tilde{1}.5M_\odot$. However, the modeling does not cover the outer most part of the shell (beyond $\tilde{6}00''$ radius) and therefore this is a lower limit for the shell mass. Moreover, the models suggest the need for very large dust grains, with $\tilde{8}0\%$ of the dust mass in grains larger than 3.5μm. Comparison of these new observations with previous observations shows the large scale stratification of the Helix in terms of ionized gas and dust as well as the co-existence of molecular species inside the ionized zones, where molecules survive in dense condensations and cometary knots.

Accepted by the Astronomical Journal

Preprints can be obtained by contacting akspeck@astro.uiuc.edu
or via WWW on http://www.astro.uiuc.edu/~akspeck/witch-stuff/Research/Publications/

Stellar and circumstellar evolution of long period variable stars.

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In a first paper, HIPPARCOS astrometric and kinematic data were used to calibrate both infrared K and IRAS luminosities at the same time as kinematic parameters of Long Period Variable stars (LPVs). Individual estimated absolute magnitudes and a probabilistic assignation to galactic populations were deduced from these calibrations for each LPV of our sample. Here we propose a scenario of simultaneous stellar and circumstellar evolution according to the galactic populations. The transitory states of S and Tc stars allow us to confirm the

location of the first dredge-up at $M_{bol} = -3.5$. There is also evidence suggesting that a previous enrichment in s-elements from a more evolved companion may accelerate the evolution along the AGB. The possible evolution to OH LPVs is included in this scenario, and any of these stars may have a mass at the limit of the capability for a C enrichment up to $C/O1$. A list of bright massive LPVs with peculiar envelope and luminosity proper ties is proposed as Hot Bottom Burning candidates. The He-shell flash star, R Cen, is found to be exceptionally bright and could become, before leaving the A GB, a C-rich LPV brighter than the usual luminosity limit of carbon stars.

Accepted by A&A

Preprints can be obtained by contacting menes@graal.univ-montp2.fr
or on http://arXiv.org/abs/astro-ph/0110268

Abundances of Planetary Nebula NGC766 and NGC6741

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The ISO and IUE spectra of the elliptical nebulae NGC7662 and NGC6741 are presented. These spectra are combined with the spectra in the visual wavelength region to obtain a complete, extinction corrected, spectrum. The chemical composition of the nebulae is then calculated and compared to previous determinations. The abundances found are compared to determinations made in other nebulae using ISO data. A discussion is given to see if possible evolutionary effects can be found from the abundance differences.

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Preprints can be obtained by contacting pottasch@astro.rug.nl
or via WWW on http://www.astro.rug.nl/Preprints/preprints.html

Nature of OH maser and SiO thermal emission towards carbon star: IRAS 05373−0810 (V1187 Ori)

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We present observational evidence that IRAS 05373−0810 is a genuine carbon star with an ISO SWS spectrum closely resembling that of R Scl. Modelling of the spectral energy distribution of IRAS 05373−0810 suggests that the star has luminosity of order of $8000\,L_\odot$ and loses mass at a rate of about $2–3\,10^{-7}\,M_\odot\,yr^{-1}$. The detected OH maser emission at 1612, 1665 and 1667 MHz and SiO thermal emission at 86.85 GHz towards IRAS 05373−0810 is not associated with this source. The available observations imply that these lines, typical for O–rich sources, come from the molecular cloud L 1641 in the Orion star forming region (OH) and, very likely, from the NGC 2149 molecular complex (SiO).

Accepted by Astronomy and Astrophysics

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

Dissertation abstract

The circumstellar gas evolution from the AGB to the Planetary Nebula phase.

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Thesis work conducted at the Instituto de Astrofísica de Canarias (IAC), Spain

Ph.D dissertation directed by Dr. Arturo Manchado (IAC) and Dr. Guillermo García-Segura (IA-UNAM)

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In this thesis we approach the problem of Planetary Nebulae (PNe) formation in two ways. First, we observe the properties of a large sample (15) of PNe which morphologically show multiple shells, and study the kinematics of the different shells by obtaining and analyzing high resolution, spatially resolved echelle spectra. PNe with attached and detached shells are included in the sample in order to allow a comparison of the kinematic properties of the two subclasses of multiple shell PNe. Second, we follow the evolution of the circumstellar gas from the thermal pulse phase during the AGB to the PNe formation. Our hydrodynamical simulations use realistic winds obtained from stellar evolution calculations. In an attempt to obtain a complete picture for the PNe scenario, we investigate the evolution of the gas ejected for the whole range of stellar masses, that according to stellar evolution gives rise to PNe formation. Six models with masses 1, 1.5, 2, 2.5, 3.5 and 5 $M_{\odot}$ have been used. We also study the effects of different ISM environments.

We investigate the dynamical evolution of the structures generated by the stellar wind during the AGB, the transition time and finally the PNe stages. By comparing the results of our models with the observations at each evolutionary stage, we establish new constraints on the evolutionary history of the star which can be extracted from observations. We find that the circumstellar gas evolution during the AGB phase is highly non-linear because the gas is subject to strong hydrodynamical processes. We show how the variations in the wind which are associated with the thermal pulses, do not remain recorded in the density or velocity structure of the gas, because the wind variations lead to the formation of transient shells with an average lifetime of $\sim 20,000$ yrs. Therefore, it is not possible to use observations to recover information on the later stages of the stellar evolution, such as the number of thermal pulses experienced by the star or the time between consecutive mass-loss events. We emphasize the influence of the ISM on the deceleration and compression of the external shells. Moreover, we find that when the local ISM is taken into account, the mass of the external envelope increases appreciably due to the ISM material swept up by the wind.

We consider for the first time the effects of the AGB-PNe transition phase on the PN gas structure, and find that the transition time evolution determine the size and the dynamical evolution of the PN inner shell. We study the influence of the progenitor mass on the PN observable parameters and we were able to make a logical explanation for the disagreement between the dynamical timescales in PNe and the evolutionary status of their central stars. We also find that according to our models, observations severely underestimate the ionized mass present in PNe.

We also study the interaction of PNe with the ISM assuming that the central star moves relative to its surroundings with a very conservative velocity (20 km s^{-1}). We find that the interaction, in contrast to what has usually been believed, has an enormous influence on the development of the PNe structure since the early stages of the evolution.

Job opportunities

Australia Telescope National Facility, CSIRO
BOLTON POST-DOCTORAL FELLOWSHIP

Applications are invited for the Bolton Fellowship, a three-year post-doctoral appointment tenable at the major Australia Telescope National Facility locations. Bolton Fellows are encouraged to undertake research and/or development in any area relevant to ATNF observational capabilities. The ATNF facilities provide unique opportunities to observe the Southern sky including the Magellanic Clouds and the richest part of our Galaxy.

The ATNF, a Division of CSIRO and Australia's premier radio astronomical facility, has its Sydney Headquarters at the Radiophysics Laboratory, and operates the Parkes 64m telescope, the Narrabri Compact Array and the Mopra 22m telescope near Coonabarabran. The Compact Array has six 22m antennas on a 6km east-west baseline with a 220m north-south spur and operates in six bands between 20cm and 3mm. Among other receivers, the Parkes telescope has a 13-beam focal-plane-array receiver system operating in the 20cm band, primarily for HI and pulsar surveys. With other Australian and overseas antennas, the ATNF telescopes operate as a VLBI array which uses the broad-band S2 recording system. The Headquarters site is shared with CSIRO Telecommunications and Industrial Physics (formerly CSIRO Radiophysics) and the Anglo-Australian Observatory, which operates the 4m Anglo-Australian and Schmidt optical telescopes near Coonabarabran.

The Fellowship is named in honour of John Bolton FRS, a pioneer of radio astronomy who made the first identifications of extragalactic radio sources and who worked at the CSIRO Radiophysics Laboratory between 1947 and 1981.

Applicants must have (or will shortly satisfy the requirements for) a PhD degree in astronomy, astrophysics or related disciplines. The commencement annual salary is in the range $A50K to $A55K plus benefits. A relocation allowance is payable. Bolton Fellows also receive a discretionary research allowance of $A24K over the three-year term.

Applications should include a curriculum vitae, list of publications, statement of proposed research or development ideas, and the names and addresses (preferably email) of three referees, and should be mailed to The Director, ATNF CSIRO, P.O. Box 76, Epping NSW 1710, Australia or emailed to postdoc@atnf.csiro.au. The closing date for applications is December 1, 2001.

For further information on the ATNF and the Fellowship, see the ATNF web pages at http://www.atnf.csiro.au or contact Dr. R. N. Manchester, email: rmanches@atnf.csiro.au, fax: 61-2-9372-4310, or at the above address.

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Post-Doc on 3D numerical simulations

Dear Colleagues,

We are seeking a suitable candidate for a postdoctoral position to work on 3D numerical simulations of mass-transfer in semidetached binaries using and developing the LSU hydrocode (Motl, Tohline & Frank ApJ Supp 2002, or see the web sites
http://www.phys.lsu.edu/astro/movie_captions/motl.binary.html and
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Please bring this job advertisment to the attention of potentially interested candidates.

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Attention: Dr. Sara Seager – Fellowship Application,

Applications are invited for a postdoctoral research associateship at DTM/CIW. The fellow will work with Sara Seager on theoretical and/or observational research on extrasolar planet topics including but not limited to planet atmospheres and planet transit searches. The applicant will also be encouraged to pursue independent research of her/his choice. The appointment is for two years, renewable for a third year contingent upon satisfactory progress and available funding.

The Department of Terrestrial Magnetism has an active group of researchers in the field of extrasolar planets including Alycia Weinberger, Alan Boss, George Wetherill, and Paul Butler. In addition, Conel Alexander and Larry Nittler perform laboratory studies of pre-planetary materials. Other DTM staff members include astronomers John Graham and Vera Rubin, and planetary scientist Sean Solomon. Carnegie is a lead member institution of the NASA Astrobiology Institute. See http://www.ciw.edu/DTM for more information. Facilities available to the successful applicant include the Carnegie telescopes at Las Campanas, Chile: a 1-m, a 2.5-m, and a 50% share of the two 6.5-m Magellan telescopes.

Applications should include a curriculum vitae, a list of publications, and a brief statement of research experience and interests. Completed applications, plus three letters of recommendation to be sent to the above address directly by those familiar with your work, are due 4 January 2002. Women and minority candidates are encouraged to apply. AAE/EOE.