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Abstracts of recently accepted papers

Images of Low Excitation HC_3N Emission from IRC+10^o216

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Spatially and kinematically resolved images of emission in the ground state J=1→0 F=2→1 line of HC_3N at λ = 3.3cm are presented which illustrate the structure of the molecular shell surrounding the evolved carbon star IRC+10^o216. This ground state line, which traces cool material, should provide a good probe of outlying material. The emission appears ringlike, peaking at a radial distance of 12 arcsec, but with substantial contributions from the entire envelope, extending to a radial distance of about 30 arcsec from the star. The J=1→0 F=2→1 line emission in the vibrationally excited $2\nu_7^2$ state has not been detected. A model is developed which reproduces both the images shown here, and also other images from lines in the millimeter wavelength region. The results show that the ringlike appearance of HC_3N emission occurs because of the shell form of HC_3N abundance distribution, with a peak at radius 15 arcsec falling off more slowly exterior to the peak than interior to it. A second model produces a better fit to the observations, but requires an interior region of unrealistically high HC_3N abundance and a low mass loss rate.

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A CCD survey for faint high-latitude carbon stars

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We describe a wide area CCD survey to search for faint high latitude carbon (FHLC) stars. Carbon giants provide excellent probes of the structure and kinematics of the outer Galactic halo. We use two color photometric selection with large format CCDs to cover 52 deg^2 of sky to a depth of about $V = 18$. Of 94 faint C star candidates from our own CCD survey, one highly ranked $V = 17$ candidate was found to have strong carbon and CN bands. We estimate that to a depth of $V = 18$, the surface density of FHLC stars is 0.02 deg^{-2}. An updated FHLC sample is used to constrain halo kinematic and structural parameters. Although larger samples are needed, the effective radius of FHLC giants, assuming a deVaucouleurs law distribution, is larger than that for Galactic globular clusters.

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Elemental Abundances for a Sample of Southern Galactic Planetary Nebulae

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We present spectrophotometric observations of a sample of 81 southern galactic planetary nebulae (PN), and derive elemental abundances for 68 objects, supplementing the optical observations with UV data in 25 cases. We define Type I PN as those objects which have experienced envelope-burning conversion to nitrogen of dredged-up primary carbon. Such nebulae are recognised by their having nitrogen abundances which exceed the total (C+N) abundance of H II regions in the same galaxy. In our own galaxy, this criterion corresponds to N/O>0.8. In the current sample, 11 nebulae having N/O>0.8 are thereby classified as Type I. For these Type I PN, no evidence is found for oxygen depletion, compared to non-Type I PN. No trend is found between the N/O and O/H ratios for the entire sample, and the mean O/H ratios for the non-Type I and Type I PN are the same within the errors; O/H= $(4.93\pm2.22)\times10^{-4}$ by number for 42 non-Type I PN and O/H=$(4.42\pm1.44)\times10^{-4}$ for 11 Type I PN. Also, no difference is found between the oxygen abundances in the PN in this sample and the oxygen abundances in galactic H II regions. Hence we find no evidence for the ON-cycle (which is predicted to operate during the 2nd dredge-up) to have significantly altered the surface abundances of the progenitor stars, even for the Type I PN. The helium abundances derived for the non-Type I PN are in accord with those predicted by Becker & Iben for the 1st and 3rd dredge-up phases. A comparison between the nitrogen abundances in the PN and the carbon+nitrogen abundances in galactic H II regions indicates that roughly 36% of the initial carbon is converted into nitrogen in the case of the non-Type I PN, consistent with predictions for the first dredge-up by Becker & Iben. However, in order to explain the high nitrogen abundances derived for the Type I PN, envelope-burning of dredged-up carbon into nitrogen, following the 3rd dredge-up, is definitely required. Total C+N+O abundances are found to be correlated with C/H for the combined non-Type I and Type I sample; the carbon has been enhanced by He-burning processed material brought up by the 3rd dredge-up.

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Circumstellar Dust Shells around Long-period Variables II. Theoretical lightcurves of C-stars

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Theoretical lightcurves of long–period and Mira variables are presented.

Based on dynamical models of circumstellar dust shells (CDS), which include time–dependent hydrodynamics and a detailed treatment of the processes of formation, growth and evaporation of carbon grains, frequency–dependent radiative transfer calculations have been carried out which yield the synthetic infrared lightcurves of these dust shell models.

It turns out that the discrete structure of the CDS due to the periodic formation of new dust layers decisively influences the shape of the lightcurves by producing e.g. intermediate extrema. This is demonstrated in detail for one model. Furthermore, dust shell models are presented whose lightcurves exhibit the superposition of two different oscillations: The oscillation with the period of the interior pulsation is superposed by an oscillation with a longer period which is produced by the dynamical structure of the CDS. Similar features are present in observed lightcurves, which indicates that our, nevertheless preliminary, modelling approach shows promise for interpreting the optical appearance of Miras and long–period variables.

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The radial distribution of HC_3N molecules in IRC+10216

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We present sensitive, high resolution maps of HC_3N emission in the circumstellar envelope of IRC+10216. We have mapped the $J = 16 - 15$, $J = 18 - 17$ and $J = 24 - 23$ transitions at 1mm and 2mm wavelength. Contrary to previous maps of lower transitions, they show centrally peaked intensity distributions. We resolve this discrepancy by modelling the vibrational and rotational excitation of HC_3N, showing that it largely results from radiative and collisional excitation in the envelope inner layers. The HC_3N abundance is changed by this result in the sense that HC_3N is more abundant than previously thought. Our new results are compared with chemical models.

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The gasdynamic evolution of spherical planetary nebulae: Radiation-Gasdynamics of Planetary Nebulae III

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Using a radiation-gasdynamics code the evolution of spherical planetary nebulae is followed, while taking into account the evolution of central star and the fast wind. These models show the importance of ionization fronts for the structure of planetary nebulae, especially for the so called multiple shell nebulae (MSPN). It is shown that the outer shell is formed by the ionization front while the inner shell is swept-up by the fast wind. These models explain the emission profiles of the outer shells as well as their various kinematic properties. Because they are shaped by the ionization front these outer shells only give indirect information on the AGB mass loss history. The models indicate that typical MSPN structures point to mass loss variations during the AGB phase. The ionization also leads to a stalling of the expansion of the nebula, leading to nebulae with expansion ages lower than their evolutionary age. Values for ionized mass and Zanstra temperatures are derived from the models.

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Circumstellar CO emission in S stars. I. Mass-loss with little or no dust

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47 S stars have been searched for circumstellar CO (J=1–0 and/or 2–1) emission, and 29 have been detected, including 4 which show no evidence of dust in their *IRAS* LRS spectra, and one with possibly no Tc (and therefore not an AGB star). Six stars show anomalous features in their profiles, showing the presence of more than one kinematic component in the expanding outflow. Two stars may have detached-shell envelopes. The mean expansion velocity distribution for S star envelopes is different than that for C-rich stars, with the former having a slightly lower mean expansion velocity, and a significantly higher fraction of objects with

very low expansion velocities (5.5 $\mathrm{km\,s^{-1}}$). In most S stars, the mass-loss rates are $> 2 \times 10^{-7}\,\mathrm{M_{\odot}\,yr^{-1}}$ and the gas-to-dust ratios are > 1000. Our detection of CO in S stars with little or no detectable dust implies substantial mass-loss in these objects. The expansion velocities and mass-loss rates of the relatively dust-free stars show a much steeper dependence on the the far-infrared excess ($\Delta \mathrm{IR_e}$), as compared to the more dusty stars. This suggests that when the amount of dust becomes small, mass-loss may be partially driven by a different mechanism than radiation pressure on grains, which probably dominates in the dusty envelopes.

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Book Review

Lecture Notes in Physics Vol. 428

Molecules in the Stellar Environment

U.G. Jorgensen, University of Copenhagen, Denmark (Ed.)

(Comments from Alain OMONT)

This volume gives an excellent survey of our present knowledge of molecular processes in stellar and protostellar objects. It reviews molecular physics in stellar environments and is intended to bridge the gap between astrophysicists and chemists. The topics range from the theoretical to the computational and include observational data. Among the topics treated are questions of stellar evolution, the determination of physical properties and structures, and the chemical composition of stellar protospheres. Opacity is studied in the context of various types of stellar and protostellar objects.

Proceedings of IAU Colloquium No. 146 Held in Copenhagen, Denmark, May 24 29, 1993 1994. IV, 432 pp. Hardcover. Springer–Verlag

Messages

To all participants in the ESO/CTIO workshop on Mass Loss on the AGB and Beyond held in La Serena,January 1992.

I have noticed that some of you did not receive the proceedings of the workshop. ALL participants have the right to get a copy free of charge and those of you who have not received one, please let me know and I'll send you one.

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