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From the editors

Dear colleagues,

We wish you a happy and productive New Year. We are sorry for the delay of this issue but the beginning of a year is always a very busy time of the year, specially when you have to celebrate it at the telescope, as it happened to both of us this time.

We remind you that uou can submit material for the following sections: *Abstracts of recently accepted papers* (for papers sent to refereed journals and invited review papers only), *Dissertation abstracts*, *Meetings*, *New books*, *New Jobs*, and *Messages* (for instance to request preprints when preparing a review).

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Yours comments are welcome.

Thierry Forveille and Claudine Kahane

Abstracts of recently accepted papers

A search for water and mainline masers in OH / IR star mimics with strong silicate emission features

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IRAS sources with a strong $9.7\,\mu$m silicate emission feature have a low resolution spectral type of 28 or 29, and appear to be associated with oxygen-rich circumstellar shells. Yet $\approx 40\,\%$ of those searched at Arecibo for 1612 MHz emission have none, despite red IR colours, $(25\text{-}12)\,\mu\text{m} > -0.55$, that point to a thick shell. We report on a water and mainline OH maser search of a complete sample of these OH / IR star colour mimics, where we find 7 new water and 5 new mainline masers. In aggregate just 10 / 60 (17 %) of our whole sample of LRS 28-9 sources are without any kind of detected maser. The frequency of water and mainline masers in

our mimics is about half that in OH / IR stars with the same colour, a result that independently confirms that the shells of mimics are in some way different from those of OH / IR stars. Combining these results with other work on the incidence of masers in O-rich shells suggests that the percentage of maserless shells increases from $\approx 11\,\%$ to $\approx 25\,\%$ at (25-12) μm = -0.5.

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Nucleosynthesis and mixing on the AGB II. Carbon and Barium stars in the Galactic Disk

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We study the role played by nucleosynthesis processes in thermal pulses and by mixing episodes (the third dredge-up) in determining the abundances of intrinsic and extrinsic Asymptotic Giant Branch (AGB) stars. This is done by comparing results from AGB models with observations of s-process and CNO nuclei in C stars (N-type) and in various classes of Ba stars (Ba dwarfs, CH subgiants, Ba II giants) with metallicities typical of the disc population. The complementary information coming from abundances of Li and Mg isotopes is also discussed. According to a generally accepted scenario, the main neutron source at the origin of s-process nucleosynthesis is assumed to be the reaction ^{13}C(α,n)^{16}O; a minor contribution derives also from the marginal activation of the reaction ^{22}Ne(α,n)^{25}Mg at the end of each flash. Making use of the latest neutron-capture cross sections and parameterizing the amount of ^{13}C burnt per pulse, we compute the nucleosynthesis occurring in the He shell and the dredge-up of material to the surface according to recent AGB models. Using envelope abundances after the first dredge-up derived from observations of first-ascent red giants and adopting standard prescriptions for mass loss, we succeed in fitting the photospheric compositions of C and Ba stars within their uncertainties. Our results confirm that C stars (N-type) are evolutionary descendants of normal (Tc-rich) S stars and are characterized by the same spread in mean neutron exposures (0.2 – 0.4 mbarn^{-1}). As for the binary Ba stars, their abundances are compatible with the hypothesis of mass transfer from an AGB primary component to a dwarf or giant secondary. We show that several constraints, including the Mg isotope ratios and the neutron density derived from the Rb/Sr ratio, require that s-processing occurs in low mass AGB stars but exclude the possibility that Barium stars derive from primaries of intermediate mass ($3 \leq M/M_{\odot} \leq 8$) efficiently burning the neutron source ^{22}Ne. The s-process enriched binary Ba giants show mean neutron exposures covering a wider range, reaching higher values (up to 1.0 mbarn^{-1}) than for normal (single) C stars. An inverse correlation of the mean neutron exposure with metallicity is also present. Hence, the higher efficiency in s-processing shown by several Ba stars is interpreted as an indication that the metallicity range they cover is larger than for intrinsic AGB stars commonly observed. In fact, if the amount of primary ^{13}C burnt is roughly constant for the studied stars, their effectiveness in producing neutron rich nuclei must increase (non-linearly) toward lower metal contents. In this scenario the exponential distributions of neutron exposures provided by low mass AGB stars can account well for the s-process abundances observed in Population I AGB stars, with no need to invoke strong single neutron exposures, as sometimes suggested in the past.

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Radiative ^{13}C burning in AGB stars
and s-processing

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We present new evolutionary calculations for a 3 $M_\odot$ star of population I starting from the zero age main sequence and followed up to the 25th thermal pulse of the asymptotic giant branch. The third dredge-up is found to occur in a self-consistent way from the 14th pulse on. We show that any amount of ^{13}C possibly synthesized at the H/He interface during the interpulse period is completely burnt through (α, n) reactions before the next pulse develops. As a consequence, *s*-elements are produced in a radiative environment, at a neutron density of at most a few 10^7 n/cm^{-3}. They are then engulfed and diluted into the next convective pulse, where a second (minor) neutron burst occurs, driven by the ^{22}Ne(α,n)^{25}Mg reaction marginally activated near the end of the He-shell instability. Despite the differences of the present model with respect to past calculations, we predict *s*-process distributions very close to those computed by allowing ^{13}C to burn in convective pulses: ^{13}C burning and the ensuing *s*-processing are confirmed to account for the main observational and experimental constraints. The reasons for this are briefly discussed. Since no ^{13}C survives the interpulse phase, we conclude that no modifications of the pulse shape due to the energy feedback from the ^{13}C(α,n)^{16}O reaction occur.

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A CO(3–2) Survey of Nearby Mira Variables

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A survey of CO(3–2) emission from optically visible oxygen–rich Mira variable stars within 500 pc of the sun was conducted. A molecular envelope was detected surrounding 36 of the 66 stars examined. Some of these stars have lower outflow velocities than any Miras previously detected in CO. The average terminal velocity of the ejected material was 7.0 km s^{-1}, about half the value found in Miras selected by infrared criteria. None of the stars with spectral types earlier than M 5.5 were detected. The terminal velocity increases as the temperature of the stellar photosphere decreases, as would be expected for a radiation driven wind. Mass loss rates for the detected objects were calculated, and it was found that there is no correlation between the infrared color of a Mira variable, and its mass loss rate. The mass loss rate is correlated with the far infrared luminosity, although a few stars appear to have extensive dust envelopes without any detectable molecular wind. A power–law relationship is found to hold between the mass loss rate and the terminal velocity of the ejected material. This relationship indicates that the dust envelope should be optically thick in the near infrared and visible regions of the spectrum when the outflow velocity is $\gtrsim 17$ km s^{-1}. At the low end of the range of outflow velocities seen, the dust drift velocity may be high enough to lead to the destruction of the grains via sputtering. Half of the stars which were detected were re–observed in the CO(4–3) transition. A comparison of the outflow velocities obtained from these observations with those obtained by other investigators at lower frequencies shows no evidence for gradual acceleration of the outer molecular envelope.

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Circumstellar Dust Shells around Long-period Variables III. Instability due to an exterior κ–mechanism caused by dust formation

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Dynamical models of circumstellar dust shells (CDS) around very luminous carbon–rich long-period variables are presented which include time-dependent hydrodynamics and a detailed treatment of the processes of formation, growth and evaporation of the dust grains. In contrast to our previous calculations, where we assumed that the sinusoidally moving inner boundary simulates the interior pulsation of the star, we now present model calculations, where the velocity of the inner boundary is equal to zero.

A new nonlinear effect arises because of the dust opacity: By the backwarming due to the formation of a discrete dust layer, small–amplitude waves are initiated in the innermost region which provide a density enhancement necessary for a new dust formation and growth cycle. It is shown how this mechanism starts in an initially hydrostatic atmosphere and how it is self-maintaining due to the induced waves. Hence, the circumstellar shell mimics a pulsating atmosphere, although this effect is caused by an instability due to the dust formation process.

Furthermore, it is shown that this modeling approach yields stationary dust–driven wind models as a limiting case. However, this is only achieved if the dust opacity is neglected in the determination of the temperature in radiative equilibrium or if dust formation is so ineffective that no relevant backwarming occurs.

Since very high luminosities and low temperatures are needed for the exterior κ–mechanism to occur by itself, the pure effect as described in this paper probably will not show up in general but only for objects at the very end of their AGB evolution. However, as AGB stars are usually pulsating objects, a complex interaction between the pulsation and the exterior κ–mechanism is likely to occur in a broader range of parameters.

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Mainline OH detection rates from blue circumstellar shells

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We identified 240 accessible circumstellar shells with water and / or SiO masers, and used the Arecibo and Nançay radio telescopes to search for mainline OH emission from them. Our targets are often mira variables without previously known mainline masers. This search results in 89 detections, of which 77 are new. The probability of detecting a maser is larger once a water maser is known, and becomes progressively larger the thicker and redder the shell. Nevertheless, almost all of our examples of solitary 1665 MHz masers, rather than the joint occurrence of both 1665 and 1667 MHz masers, are in the bluest shells.

The IRAS low resolution spectral type is the strongest factor correlating with the mainline detection rate. We find that 67 % of objects with a silicate emission feature exhibit masers, whereas only 27 % of objects with a comparatively featureless 1n type do. These rates are colour insensitive. We ascribe this clearcut difference to differing UV extinction properties of the two grain types, which is likely to result from differing grain-size distributions. The IR colour sensitivity of the overall mainline detection rate is thus almost entirely an incidental artifact of the changing proportion of the two grain types with colour. Inferentially, since 90 % of the sample exhibit water masers, and the proportion of blue sources with silicate features is substantially larger than an unbiased selection from the IRAS Point Source Catalog would give, the incidence of water masers is similarly sensitive to spectral type.

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Messages

Les comptes-rendus de l'atelier "PLANETARY NEBULAE" , tenu au Col de Steige les 3, 4, 5 juin 1994 , peuvent etre obtenus sur demande aupres de :

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