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Abstracts of recently accepted papers

Semiregular variables of types SRa and SRb. Circumstellar CO emission of an oxygen-rich sample

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O-rich Semiregular Variables (SRVs) of types SRa and SRb have been observed in the ^{12}CO (J=1–0) and (J=2–1) lines using the SEST, La Silla, Chile, and the 20-m telescope at Onsala, Sweden. In total 22 detections (13 are new ones) and 1 tentative detection can be reported among the 48 stars observed. In 7 cases detections are precluded because of strong interference from interstellar CO emission. The majority of the detected objects, covering both small and longer periods, are weak in CO, i.e. they are low mass-loss rate objects ($\leq 10^{-7}\,solarmass/\mathrm{yr}$), and have, with only a few exceptions, envelopes with small expansion velocities (the mean value is $\approx$8 km/s). However, in this respect their properties are very similar to those of bright O–rich Mira variables, whose pulsational periods are on the average 2–3 times higher.

A comparison between stellar and circumstellar properties shows that the gas expansion velocity does not depend on the stellar effective temperature, nor on the period. Likewise, we find no correlation between mass-loss rate and period, but there might be a weak dependence of the former on the stellar effective temperature.

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Irregular variables of type Lb. New JHKL′M-photometry for 160 stars

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This paper presents new near infrared observations of 160 Irregular variables of type Lb in the JHKL′M filter bands. These measurements are supplemented by data for additional 56 stars taken from the literature. In total 220 datasets are available because of some multiple observations. From our sample, 216 stars have near infrared (NIR) photometry now.

Our sample of visually bright Lb-variables displays very similar infrared properties when compared with SRa- and SRb-variables. Derived from NIR-two colour diagrams the oxygen-rich Lbs seem to have intermediate

atmospheric conditions between Miras and normal giants. There may be a sligthly larger "contamination" with non AGB-giants than in the case of the semiregulars. Using only our IR-colours the S- and the Carbon-stars among the Lbs again are undistinguishable from SR-variables of the same chemistry.

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Abundances in the symbiotic star AG Draconis: the barium-symbiotic connection

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An abundance analysis of the yellow symbiotic system AG Draconis reveals it to be a metal-poor K-giant ([Fe/H] = -1.3) which is enriched in the heavy s-process elements. This star thus provides a link between the symbiotic stars and the binary barium and CH stars which are also s-process enriched. These binary systems, which exhibit overabundances of the heavy elements, owe their abundance peculiarities to mass transfer from thermally-pulsing asymptotic giant branch stars, which have since evolved to become white-dwarf companions of the cool stars we now view as the chemically peculiar primaries. A comparison of the heavy-element abundance distribution in AG Dra with theoretical nucleosynthesis calculations shows that the s-process is defined by a relatively large neutron exposure (τ=1.3 mb^{-1}), while an analysis of the rubidium abundance suggests that the s-process occurred at a neutron density of about 2 x 10^8 cm^{-3}. The derived spectroscopic orbit of AG Dra is similar to the orbits of barium and CH stars. Because the luminosity function of low-metallicity K giants is skewed towards higher luminosities by about 2 magnitudes relative to solar-metallicity giants, it is argued that the lower metallicity K giants have larger mass-loss rates. It is this larger mass-loss rate that drives the symbiotic phenomena in AG Dra and we suggest that the other yellow symbiotic stars are probably low-metallicity objects as well.

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Fluorine production in intermediate-mass stars

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The ^{19}F production during the first dozen thermal pulses of AGB stars with masses M and metallicities Z ($M = 3\,M_\odot$, $Z = 0.02$), ($M = 6\,M_\odot$, $Z = 0.02$) and ($M = 3\,M_\odot$, $Z = 0.001$) is investigated on grounds of detailed stellar models and of revised rates for $^{15}N\,(\alpha\,,\gamma)\,^{19}F$ and $^{18}O(\alpha,\gamma)^{22}Ne$. These calculations confirm an early expectation that ^{19}F *is* produced in AGB thermal pulses. They also enlarge substantially these previous results by showing that the variations of the level of ^{19}F production during the evolution is very sensitive to the maximum temperature reached at the base of the pulse. These variations are analyzed in detail, and are shown to result from a subtle balance between different nuclear effects (mainly ^{19}F production or destruction in a pulse, and ^{15}N synthesis during the interpulse), possibly superimposed on dilution effects in more or less extended pulse convective tongues.

Our calculations, as most others, do not predict the third dredge-up self-consistently. When parametrized, it appears that our models of intermediate-mass AGB stars are able to account only for the lowest ^{19}F overabundances observed in solar-metallicity MS, S and C stars. That conclusion is expected to hold true for low-mass stars when fluorine production results from secondary ^{13}C only. Massive AGB stars, on the other hand, are not expected to build up large surface F abundances. Therefore, the large fluorine overabundance reported for the super Li-rich star WZ Cas (where hot bottom burning is supposed to be operating) remains unexplained so far. Our results for the ($3\,M_\odot$, $Z = 0.001$) star indicate that fluorine surface overabundances can also be expected in low-metallicity stars provided that third dredge-ups occur after the early cool pulses. The relative increase in the surface $^{19}F/^{12}C$ ratio is, however, lower in the low-metallicity than in the solar-metallicity star. No observations are reported yet for these stars, and are urgently called for.

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or via anonnymous ftp through ftp obsftp.unige.ch, cd /pub/mowlavi, get fluor.ps.gz
or on ftp://obsftp.unige.ch/pub/mowlavi, *file* fluor.ps.gz

Thermodynamical properties of stellar matter: I. Equation of state for stellar interiors

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Considering the Helmholtz free energy which provides detailed knowledge of the charged many-particle physics we present an analytical formulation of the equation of state (EOS) for fully ionized matter.

The nonideal effects due to exchange and correlation interactions of charged particles are described by Padé approximants, which cover a wide range of densities and temperatures. The formulae are valid at any electron degeneracy, for a broad region of Coulomb coupling and are applicable to any chemical mixture. Relativistic generalizations are taken into account for the most predominant astrophysical conditions.

Finally, we present results for H, He, C and O plasmas and give comparisons with other EOS approaches.

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Interferometric observations of 43 and 86 GHz SiO masers in R Cassiopeiae

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We have undertaken interferometric studies of the SiO maser emission from the nearby Mira-type star R Cassiopeiae. The $v = 1, J = 1 \rightarrow 0$ SiO transition at 43 GHz was observed with a European very long baseline (VLB) interferometer, and the $v = 1, J = 2 \rightarrow 1$ SiO transition at 86 GHz with the IRAM connected interferometer

on Plateau de Bure. These observations show a complex spatial/velocity SiO emission pattern, and reveal the presence of both compact and extended SiO emission. The similarities found in our 43 and 86 GHz maps may indicate that both emissions originate from the same volume of gas. Confirmation of such result would provide some constraint on the SiO pumping mechanisms.

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Circumstellar Envelopes of J-type Carbon Stars

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The modelling of "normal" J-type carbon stars (without silicate features) has been performed, considering two kind of grains simultaneously: amorphous carbon (A.C.) and silicon carbide (SiC). The temperature of central stars and some characteristics of circumstellar shell as extinction opacities and its extension were determined by fitting the flux curves. The SiC/A.C. ratio as well as the energy distributions and temperature law have been studied. The results show that these J-type carbon stars have thin envelopes (with extinction opacities about 0.02) and intermediate SiC/A.C. ratios. Based on these results two alternative scenarios are discussed: (1) Normal J-type carbon stars would be in an intermediate group between Groups I and II introduced by Lorenz-Martins & Lefèvre (1994). (2) J-type stars (normal and peculiar) could form an alternative evolutive sequence, which differs from that proposed for ordinary carbon stars.

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The asymmetric bipolar flow in OH231.8+4.2

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We present ^{12}CO and ^{13}CO microwave line observations of the protoplanetary nebula OH231.8+4.2. The extent of the emission is comparable to the optical nebula, the CO lines showing a large total range of observed velocity that exceeds 300 kms^{-1}. The velocity of the molecular gas shows a very strong and well defined gradient along the nebular axis. In the south lobe, coincident with the bow-shaped structure identified in optical images, we detect an extension of the CO nebula which has no counterpart in the north. In this region, the CO emitting gas is flowing in the axial direction with (deprojected) velocities up to 330 kms^{-1}. The total mass probed by CO is large, $\sim 0.5 - 1\ M_{\odot}$, probably being the dominat component of the nebular material. A mass of at least 0.1 $M_{\odot}$ is found to be in axial expansion at more than 30 kms^{-1}. It is argued that this massive fast wind is the remnant of the past AGB mass loss process, accelerated by the presently active bipolar ejections. Mass and momentum (in the axial direction) are calculated for the different spectral features. We estimate that the kinematic time needed to shape the present nebula (from the AGB precursor) is $\sim$ 900 yr.

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Detection of HC_9N (J=39-38) from CRL2688 and CRL618 and of NH_3(5,4) toward CRL618

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Our previous discovery of the HC_9N molecule in CRL2688 via the $J = 43 - 42$ transition has prompted us to search for other transitions. We report here our detection of the HC_9N $J = 39 - 38$ emission from the CRL2688 and CRL618 nebulae, using the 100-m Effelsberg telescope. Toward CRL2688, the line is double peaked like the stronger $J = 43 - 42$ one. Toward CRL618, the line is tentatively detected; and a reversal ammonia line, non-metastable transition (5,4), appears in the spectrum. This absorption line is due to the ammonia emission in the west side of the fast wind which is absorbed by the cooler outer H II region emitting the radio continuum. We define the hot clump region extending from -30 to the systemic velocity -21 km/s and which emits non-metastable and metastable lines. Our previously described envelope model of CRL2688 was applied to both HC_9N $J = 39 - 38$ and $J = 43 - 42$ observed line profiles to derive the HC_9N abundance and other physical parameters of the envelope.

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Methanol in the circumstellar envelope of IRC+10°216

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Millimeter-wave observations of the extremely carbon-rich circumstellar envelope of IRC+10°216 show several emission lines that we identify with rotational transitions of methanol. We describe our observations and the reasoning leading to this identification. We argue that shock chemistry, ion-molecule reactions, and grain surface reactions might all be potential sources of circumstellar methanol. Each of these pathways either require or produce H_2O in the envelope of IRC+10°216.

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HD 133656 : a new high-latitude supergiant

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In the course of our study of post-Asymptotic Giant Branch objects, we discovered that the seventh magnitude A supergiant HD 133656 has an infrared excess emission due to cool circumstellar dust, and that its photospheric abundance pattern is population II like. We present a detailed abundance study of the object, and discuss its nature in terms of post-AGB evolution : its galactic latitude, cold IR-excess, luminosity, abundances and photometric behaviour indicate HD 133656 to be a descendant of the F-type high-latitude supergiants. The deficiencies of the s-process elements are more difficult to understand in a post-AGB evolutinary scenario.

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