THE AGB NEWSLETTER

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

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

From the Editors

Rapid dissemination of information nowadays depends on preprints as much as on journals, yet few libraries (if any) receive a complete set of preprints. Following the very successfull example of the Star Formation Newsletter (edited by Bo Reipurth, reipurth@eso.org), we are thus starting an electronic newsletter on mass losing AGB stars, as a vehicle for preprint announcement. It draws heavily on the Star Formation (with permission from Bo). It also uses the same general rules, the main one being that the newsletter only contains the abstracts of accepted papers, which keeps the extra work to a minimum for both contributors and the newsletter editors. There will also be separate sections for dissertation abstracts and conference announcements. We plan to have roughly monthly installments. This initial issue was generated from some of the abstracts of preprints available in our library, but we obviously don't intend to keep typing abstracts forever. The usefulness of the newsletter will thus depend on your sending abstracts to agbnews@gag.observ-gr.fr as your papers get accepted. We would apreciate if you could prepare your abstracts in LaTeX following the examples presented here and check that they are self contained (please no fancy style files and no includes!). Since we cannot be sure of success, this is started as an experience which will be reviewed in about one year.

We intend the newsletter to cover stellar evolution from the early AGB to dispersal of the planetary nebulae, with an emphasis on mass loss and circumstellar matter. Theoretical and observational papers (any wavelength) are both welcome. More massive objects such as Wolf Rayet stars and supernovae are excluded since the two communities have relatively little overlap.

The initial distribution list for this newsletter was obtained by cross-correlating the list of participants of two recent conferences (at la Serena and Cambridge) with the computer readable E-mail directory maintained by Chris Benn (email@ast-star.cam.ac.uk). It was then complemented by the addresses of a few people we personally knew, who either didn't attend one of these conferences or more frequently didn't have an address in the edition of the E-mail directory available on our computer. We hope it is a reasonably fair sampling of the target community, but we do realize it is an incomplete one, and more so for recent graduate students. We would thus apreciate if you could suggest additions, preferably with a valid E-mail address. Please also tell us if you receive this mail at an obsolete address which is likely to become invalid, or of course if you want to stop receiving the newsletter for any reason.

We take this opportunity to wish you a happy and productive new year.

Thierry Forveille and Claudine Kahane

Abstracts of recently accepted papers

Abundance gradients from disk planetary nebulae : O, Ne, S and Ar

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A new determination of the radial abundance gradients O/H, Ne/H, S/H, and Ar/H is made for disk planetary nebulae, that is, those object of Peimbert types I, II and III. On the basis of a sample containing 200 nebulae, it can be concluded that these gradients are generally similar, and of the same order of magnitude as the O/H gradient displayed by galactic HII regions. Some distance-independent correlations confirm the accuracy of the abundances and support the interpretation of the gradients in terms of chemical evolution models. The time evolution of the abundance gradients in the Milky Way is investigated, and their variation with the types of PN are compared with predictions of chemical evolution models.

Accepted by Astron. Astrophys. *For preprints, contact* maciel@iag.usp.ansp.br

Grids of stellar models. IV. From 0.8 to 120 $M_\odot$ at Z = 0.040

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The present grid of evolutionary sequences at metallicity Z=0.040, completes the sets of grids computed for Z=0.020 and 0.001 by Schaller et al. (1992), Z=0.008 by Schaerer et al. (1992) and Z=0.004 by Charbonnel et al. (1993). The models with mass loss and moderate core overshooting have been computed for 0.8 to 120 $M_\odot$ using up-to-date input physics and the new radiative opacities from Iglesias et al. (1992) and Kurucz (1991).

Accepted by Astron. Astrophys. *For preprints, contact* schaerer@obs.unige.ch

On the pre-decline and decline phases of FG Sge, the post-AGB star and central star of the planetary nebula PK 60 - 7°.1

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We present and discuss VBLUW photometry of the variable star FG Sge, made between 1987 and 1991, which is the central star of a planetary nebula. The pulsational history, the long-term brightness and colour variation and the spectral evolution (B5 I-K1 I) of the star during its passage accross the HR diagram during the interval 1955-1992 are analyzed. The slope and timescale of this passage are roughly similar to the theoretical track for a low mass star after its final He shell flash. It appears that there exists an inconsistency between the trend of the temperature based on most of the spectral type determinations and other temperature determinations. Adopting the temperature scale based on the spectra and a distance of 2500 pc, the star crossed the population I Cepheid strip between 1972 and 1983, but the period of pulsation of FG Sge was about five times longer than that of Cepheids of the same luminosity. A comparison with recent calculations on the characteristics of post-AGB stars, suggests a possible mass of ~ 0.65 $M_\odot$. The phase of the steep decline by $\sim 3.^m5$ in the visual brightness can be interpreted by a combination of a short evolution to the blue and an obscuration by a circumstellar dust cloud.

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Calculations of the outflow velocity of envelopes of cool giants

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We study the transfer of momentum from photons to dust grains to (molecular) gas in the outflow around cool giants (carbon-stars, Mira variables and OH/IR stars) beyond the radius where the dust grains condense. The problem is circular : radiation pressure determines the outflow velocity of the dust and thus also the dust density; on the other hand, the dust density determine, via radiative transfer effects, the spectrum of the photons and thus the effective radiation pressure. This circular problem is solved by a rapidly converging iterative procedure.

The gas outflow velocity at large distances, v_{out}, is a function of the stellar luminosity, L_*, of the dust-to-gas ratio, δ, of the mass loss rate, $\dot{M}$, and of the radius of the dust grain, a : $v_{out} \propto L_*^{0.3}\delta^{0.5}f$, where $f \propto (\dot{M}/a)^{1.0}$ for $\dot{M} < 10^{-7}$ $M_\odot$/yr and $f \propto (\dot{M}/a)^{0.04}$ for $\dot{M} > 10^{-5}$ $M_\odot$/yr : for stars with large mass loss rates, such as OH/IR stars, V_{out} does not depend on $\dot{M}$ or on the dust grain radius a. The fact that v_{out} – a quantity that can be measured accurately and easily – depends rather strongly on δ opens the possibility to measure the dust-to-gas ratio; in O-rich stars, such as OH/IR stars, this ratio is probably indicative of the primordial stellar abundance of silicium. The largest outflow velocities are predicted for carbon stars, and this is caused by the slower decrease in photon absorption cross section towards longer wavelengths.

We compare our predictions with observed properties of a large sample of OH/IR stars and of Miras and find a good qualitative and quantitative agreement. We confirm a conclusion by Wood et al. (1993) that very luminous OH/IR stars in the Large Magellanic Cloud owe their low outflow velocity to the low dust-to-gas ratio, a consequence of the low metallicity of the LMC. Similarly we consider a sample of about 100 OH/IR stars within 200 pc from the galactic center that has an average AGB luminosity and an uncommonly high value of v_{out}; we conclude that these stars are probably very metal rich, perhaps even more than the stars in the Baade windows studied by Rich (1990).

Accepted by Astron. Astrophys. *For preprints, contact* habing@RULHL1.LEIDENUNIV.NL

The discrimination between O- and C- rich circumstellar envelopes from molecular observations

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We have observed a wide sample of circumstellar envelopes around evolved stars in 10 radio lines of the molecules HCN, HNC, SiS, HC_3N, CS, SiO, SO and ^{13}CO. The species form two groups : O-like molecules (SiO and SO; that are relatively stronger in O-rich stars) and C-like molecules (HCN, HNC, SiS, HC_3N and CS; stronger in C-rich sources). We find statistically significant criteria that, from the line intensity ratios of O-/C-like molecules, allow to classify evolved stars as O-rich or C-rich. Such criteria are also useful to establish a meaningful comparison between peculiar chemistry objects and the main chemical classes. For line pairs including ^{12}CO and ^{13}CO the criteria can also be settled but the discrimination is less significant. Some observations of the S-type stars show that these objects present line intensity properties that are almost exactly equidistant between those of C- and O-rich sources.

Accepted by Astrophys.J. Letters *For preprints, contact* bujarrabal@cay.es

Neutral Carbon in the Circumstellar Envelope of α Ori

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We report the detection of emission in the 609 μm $^3P_1 \rightarrow {}^3P_0$ fine structure line of neutral atomic carbon in the circumstellar envelope of α Ori, using the 10.4 m telescope of the Caltech Submillimeter Observatory. The C I line is centered at a radial velocity of +3 km s^{-1} , with an intensity of 200 mK, and a width of 30 km s^{-1}, characteristic of the expanding circumstellar envelope. The observations show that C I is an important component of the circumstellar gas. The number of C I atoms in the envelope exceeds the number of CO molecules by a factor of ≈ 5, and the C I column density is large enough that significant absorption of the stellar and chromospheric spectrum can be expected at wavelengths shorter than the C I ionization edge at 1100 Å. The mass loss rate determined from our observations using the photospheric carbon abundance and assuming full recombination of carbon in the transition region is 2 10^{-6} $M_\odot$ yr^{-1}. This is in good agreement with the value determined from H I 21 cm observations and confirms that C I is a major carrier of carbon between the chromosphere and the outer envelope.

Accepted by Astron. Astrophys. *For preprints, contact* huggins@acf.nyu.edu

Dissertation Abstracts

We are waiting for your contributions !

Meetings

08 Aug - 11 Aug "Asymmetrical Planetary Nebulae",
Haifa, Israel.
Contact; Amos Harpaz (phconf@vmsa.technion.ac.il).

29 Aug - 02 Sep "Circumstellar Matter",
Heriot-Watt University Conference Centre, Edinburgh, Scotland.
Contact: Graeme Watt (ROE); Tel: (031) 668 8310. Fax: (031) 662 1668.
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Postdocs, permanent or temporary positions,...announcements welcome !

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