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Abstract of recently accepted papers

On the nature of the pulsation of the post-AGB star HD 56126

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Spectroscopic and photometric observations of the variable carbon-rich post-AGB star HD 56126 are analysed in order to improve the knowledge of its pulsation and of its fundamental parameters. New high resolution spectra (R=42 000), taken as regularly as possible (every 7–9 days) from October 1995 to April 1996 at the Haute-Provence Observatory, are presented. Important profile variations of the Hα line are confirmed, and variations of Hβ are also shown for the first time. These variations can be significant over time intervals as short as $\sim$7 days.

Photospheric radial velocities were derived and merged with other data from different sources to form a set of 89 values spanning $\sim$8 years. We also considered a completely independent set of 87 V-band Geneva photometric measurements made over 7 years and covering approximatively the same epoch. The results of the Fourier analysis of the radial velocity and photometric series agree remarkably well : a strong main period of $P = 36.8 \pm 0.2$ days is found in both data sets. This period supersedes the value of 27 days previously found by us with much fewer data points. Weaker secondary oscillations, probably related to the irregularity of the pulsation, are also detected. There is no prominent Fourier component at $\sim 2P$ and the pulsation of HD 56126 is certainly quite different from that of RV Tauri variables.

Linear nonadiabatic analysis has been applied. It is found that the only linear radial mode that can fit the main period is the first overtone. This, together with the requirement of some driving of the pulsation and with the core mass–luminosity relation, favours the following range of fundamental parameters : log(g) = 0.38–0.49, M = 0.57–0.63 $M_\odot$, T_{eff} = 5700–6100 K and L = 5250–8160 $L_\odot$.
Owing to its higher temperature, the star seems more evolved than post-AGB RV Tauri's.

Hydrodynamical models are also discussed. The spectroscopic and photometric variations of the star appear to be consistent with a radial pulsation yielding shockwaves which propagate through the atmosphere, probably contribute both to the driving and to the limitation of the pulsation, and generate the complex, asynchronous motion of the outer hydrogen layers.

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Multiple shells in IRC+10216: shell properties

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We report on the properties of the multiple shells in the circumstellar envelope of IRC+10216, using deep optical imaging, including data from the Hubble Space Telescope. The intensity profiles confirm the presence of thin ($\sim 0.5''$–$3''$), limb-brightened shells in the envelope, seen in stellar and ambient Galactic light scattered by dust. The shells are spaced at irregular intervals of $\sim 5''$–$20''$, corresponding to time scales of 200–800 yr, although intervals as short as $\sim 1''$ (40 yr) are seen close to the star. The location of the main shells shows a good correlation with high-resolution, molecular line maps of the inner envelope, indicating that the dust and gas are well coupled. The shell/intershell density contrast is typically ~ 3, and we find that the shells form the dominant mass component of the circumstellar envelope. The shells exhibit important evolutionary effects: the thickness increases with increasing radius, with an effective dispersion velocity of 0.7 km s^{-1}, and there is evidence for shell interactions. Despite the presence of bipolar structure close to the star, the global shell pattern favors a roughly isotropic, episodic mass loss mechanism, with a range of time scales.

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Expansion velocities and dynamical ages of planetary nebulae

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The [OIII] expansion velocities are presented for planetary nebulae in the Galactic Bulge and Halo, and in the Sagittarius Dwarf spheroidal galaxy. The velocities are shown to increase with the distance from the star, in agreement with hydrodynamical models. Dynamical ages are derived from these velocities and are corrected for the effects of post-AGB acceleration and non-uniform velocities. Masses for the central stars are obtained from relations between dynamical ages and stellar temperatures. The stellar core mass distribution is narrow, peaking at 0.61 $M_{\odot}$. This is higher than predicted for the Bulge by initial-final mass relations, but consistent with the local white dwarf mass distribution.

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Preprints can be obtained by contacting gesicki@astri.uni.torun.pl
or via WWW on http://www.astri.uni.torun.pl/~gesicki/GesZij2000.ps.gz

On ^{7}Li Enrichment by Low Mass Metal Poor Red Giant Branch Stars

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[3] Observatório do Valongo - UFRJ - Rio de Janeiro - Brazil First-ascent red giants with strong and very strong Li lines have just been discovered in globular clusters. Using the stellar internal prompt ^{7}Li enrichment - mass loss scenario, we explore the possibility of ^{7}Li enrichment in the interstellar matter of the globular cluster M3 produced by these Li rich giants. We found that enrichment as large as 70% or more compared to the initial ^{7}Li content of M3 can be obtained during the entire life of this cluster. However, due to the several crossings of M3 into the Galactic plane, the new ^{7}Li will be very probably removed by ram pressure into the disk. Globular clusters appear then as possible new sources of ^{7}Li in the galactic disk. It is also suggested that the known Na/Al variations in stars of globular clusters could be somehow related to the ^{7}Li variations and that the cool bottom mixing mechanism acting in the case of ^{7}Li could also play a role in the case of Na and Al surface enrichments.

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Preprints can be obtained by contacting drake@on.br *or via WWW on* http://xxx.lanl.gov/abs/astro-ph/0004345

The Optical Spectrum of the Planetary Nebula NGC 6543

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With the Hamilton Echelle spectrograph at Lick Observatory, rich emission spectral lines of the planetary nebula NGC 6543 were secured in the wavelength range from 3550 Å to 10 100 Å. We chose two bright regions, $\sim 8''$ east and $\sim 13''$ north of the central star of which physical conditions and chemical abundances may differ due to the different physical characteristics involving the mass ejection of different epoch. By combining Hamilton Echelle observations with archive UV data secured with the *International Ultraviolet Explorer* (IUE), we obtain improved diagnostics and chemical composition for the two observed regions. The diagnostic diagram gives the average value of $T_e = 8000 \sim 8300$ K, and the electron number density near $N_e \sim 5000$ cm^{-3} for most ions, while some low excitation lines indicate much higher temperature, i.e. $T_e \sim 10\,000$ K. With construction of a photoionization model, we try to fit the observed spectra in a self consistent way: thus, for most elements, we employ the same chemical abundances in the nebular shell; and we adopt an improved Sobolev approximation (ISA) model atmosphere for the hydrogen deficient Wolf Rayet type central star. Within the observational errors, the chemical abundances do not seem to show any positional variation except for helium. The chemical abundances of NGC 6543 appear to be the same as in average planetary nebulae. The progenitor star may have been an object of one solar mass, of which most heavier elements were less plentiful than in the Sun.

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Preprints can be obtained by via WWW on http://www.boao.re.kr/~hyung/paper/ngc6543.tar.gz *or by contacting* hyung@hanul.kao.re.kr

Circumstellar dust shells around long-period variables VIII. CO infrared line profiles from dynamical models for C-stars

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We present simplified non-LTE radiative transfer calculations for CO (v 0-1) fundamental and (v 0-2) overtone lines, using the structure of dynamical models for dust shells around carbon-rich long-period variables, which result from a consistent treatment of hydro- and thermodynamics, radiative transfer, chemistry and carbon grain formation.

Owing to the saturation of the fundamental band absorption cores the most useful information is provided by the P-Cygni emission component, which can be used to constrain the dust optical depth in the $5\,\mu$m region. The first overtone lines clearly reflect the shocked, layered structure of the inner shell region by showing a multi-component structure of the profiles. At least the lines of higher rotational excitation ($J_l > 10$) are not saturated even for mass loss rates of the order of $10^{-5} M_\odot \mathrm{yr}^{-1}$ and thus can be used to constrain the mass loss rate. Furthermore, the dynamics of the dust formation process is reflected in the temporal evolution of the synthetic CO first overtone line profiles resulting from the models. The formation of a new dust layer in the inner shell region leads to a secondary (low velocity) absorption component which evolves on the time scale of a dust formation event, usually longer than the pulsation period of the star.

The synthetic overtone line profiles calculated on the basis of one dust shell model resemble the time variations of corresponding lines in the observed high resolution CO line spectra of the carbon-Mira IRC +10216, which thereby are interpreted as result of a dust formation event taking place on a time scale of $\approx 10\,$yr corresponding to 6 pulsation periods of the star. However, the calculated fundamental line absorption cores are broader than observed and the first overtone line strengths are too high, indicating that the density and thus probably the mass loss rate of the model is too high by a factor of about 3 and should be closer to the value of $1\,10^{-5}\,M_\odot \mathrm{yr}^{-1}$ given for IRC +10216 in the literature.

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