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From the Editors

With more than 400 subscribers to the AGB Newsletter, it happens regularly that some subscribers change their e-mail addresses, either because they have moved, or due to changes of machine names. Many send us their new address, but some do not. Every month a dozen of newsletters bounce back due to machines being down, poor connections or addresses that no longer exist. We try to keep track of which mails are returned, and if the same address fails three times in a row, and we are unable to locate a new address, we delete it from the mailing list. It is quite an effort to do this, and we therefore ask you to kindly let us know whenever your e-mail address changes. About two dozen subscribers have been removed this way so far, and should you be among them, you are welcome to contact us and get back on the mailing list.

Abstracts of recently accepted papers

A study on the nature of the peculiar supergiant HD101584

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We present a study of low- and high-resolution ultraviolet, high-resolution optical CAT/CES spectra and ultraviolet, optical and infrared photometry of the peculiar supergiant HD 101584. From the photometry we learn that the ultraviolet and optical energy distribution cannot be fitted in a consistent way and we need a model in which the UV and optical energy distribution are formed by different gas. The Geneva photometry is best fitted to a B9II Kurucz model, $T_{eff} = 12000 \pm 1000$ K and $\log g = 3.0 \pm 1.0$, with an extinction of $E(B-V) = 0.49 \pm 0.05$.

The observed spectral features in the spectrum of HD 101584 are classified in eight different categories based on the velocity, shape of profile and the identification. The high-excitation HeI ($\chi = 20.87$ eV), NII ($\chi = 18.40$ eV), CII ($\chi = 14.39$ eV) and NI ($\chi = 10.29$ eV) optical absorption lines are formed in the photosphere of a late B-star (e.g. B8-9I-II). These absorption lines show radial velocity variations which are attributed to binary motion, with the secondary being a white dwarf or a low-mass main sequence object. The low-excitation P-Cygni lines in the optical and UV are formed in the wind. The number density of absorption lines in the UV is so large

that the wind spectrum acts as an iron curtain in front of the B-star. The terminal velocity of the wind of $v_\infty = 100 \pm 30$ km s^{-1} is consistent with the star being a low-mass post-AGB star and the low effective gravity is attributed to the presence of a nearby, unseen, secondary. We estimate a mass-loss rate of $\dot{M} \approx 10^{-8}$ M$_\odot$ yr^{-1}. Narrow absorption and emission lines are observed which are formed in a circumsystem disk with a typical radius of $10^2 R_*$.

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Optical identification of IRAS sources in outer Galaxy

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The optical identifications at both V and I bands are given of 102 color-selected IRAS PSC sources in the outer disk of our Galaxy. The positions were obtained from CCD images using stars in the same frame and listed in the GSC catalogue (Guide Star Catalogue for Hubble Space Telescope) as references. The identification was judged from the consistency with IRAS parameters in three aspects: the position, color and light variation. We identified 47 sources as variable stars, 2 as non-variable stars. There are 1 star that has not been checked light variation and 9 sources associated with nebulosity in the sample. We did not find optical counterparts for 43 sources until as faint as 20mag at V band and 19mag at I band. About 50% of these sources are found to have optical counterpart. The data suggest that whether or not an IRAS PSC source can be optically identified results from not only the IRAS colors but also the C/O abundance in such a way that an oxygen-rich source maybe more likely to be identified.

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Spectroscopic Flickering in the WC8 Nucleus of the Planetary Nebula NGC 40

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The flat-topped profile of the nuclear C IIIλ5696Å line in the WC8 nucleus of NGC 40 shows profile shape variations on time scales of hours. Relatively narrow intensity peaks and/or valleys (i.e. "features") appear first near the center of the 1400 km s^{-1}-wide C III line. Over the next $\sim$3 hours the features slide toward either the red or blue line edge with a Doppler Shift that increases linearly with time. The apparent acceleration is apparently the same for all features. The size of the acceleration zone is at least 5 Rsun. At least one feature is visible at any time and the timing of the formation of features appears to be random. The fluxes of C III and many other nuclear lines are also variable on time scales of days and months.

The optical attributes of the C IIIλ5696Å line from the nucleus of NGC 40 are very similar to line profile variations reported in some "normal" late-type WC stars by Robert, Moffat, and their collaborators. This suggests that the same wind acceleration mechanism (which they believe to be radiative acceleration of "blobs" forming in an unstable outflowing wind) is an inherent property of local conditions in WR atmospheres.

We were unable to detect any variability in the uv spectrum of NGC 40 using the IUE at low dispersion on two consecutive days.

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M 1-46: a case study on multiple-shell planetary nebula formation

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We discuss in detail the evolutionary path of the multiple-shell planetary nebula M 1-46, on the light of our new observations. The velocities of the halo and main nebula correspond to a dynamical time-lap between the shells of about 6.8×10^4 years. By means of an NLTE analysis of the central star's spectrum we derived a stellar temperature of T_{eff}=45 000 K, which, coupled to the visual magnitude and an appropriate bolometric correction, gives a stellar luminosity of 5 370 $L_\odot$. The mass of the central star has been evaluated to be 0.6 $M_\odot$, and its interpulse time on the Asymptotic Giant Branch is 7.6×10^4 years. The agreement between the observed intershell time-lap and the evolutionary interpulse time-lap points to the fact that the formation of this planetary nebula could be ascribed to the gasping mass loss associated with the thermal pulses at the Thermally-Pulsating Asymptotic Giant Branch.

The high-resolution spatially resolved observations reveal the presence of different kinematical components in the main nebula which cannot be understood in a homogeneous expanding shell scenario.

As regards the chemical abundances, M 1-46 has the typical abundances of a type II PN. No definite abundance gradient between the shells is found.

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New abundances of southern planetary nebulae

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As a continuation of a long-term observational program with the purpose of deriving the chemical abundances of southern planetary nebulae (PN), we present here the line fluxes, colour excesses, electron temperatures and densities, and abundances of He, O, N, S, Ar and Ne for 15 PN. These objects were classified according to the Peimbert classification scheme, taking into account the chemical and kinematical properties as well as distance-independent correlations.

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He2-104 Revisited

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We report new spectroscopic observations of He 2-104 (the southern crab). The Balmer decrement indicates a reddening corresponding to a colour excess E(B-V)=1.2 mag. The main body of the ionized region has an important density stratification with values ranging from 10^3 cm^{-3} up to 6-7 $\times$ 10^6 cm^{-3}, shown by a robust correlation between density and the ionization potential of the preceding ion. The average electron temperature through that region is about 13 000 K. Our data suggests only a modest enhancement of He and N. The Stoy temperature of the hot star is of the order of 30 000 K, suggesting an early evolutionary stage for the planetary.

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Limits on Ionized Gas in Globular Clusters

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Globular clusters are expected to accumulate interstellar gas due to mass loss from their stars. A sensitive search of six clusters for free-free emission from ionized gas at 8.4 GHz using the VLA failed to detect any gas, with limits well below the expected accumulation from mass loss if the gas remains in the cluster. However, simple models of the equilibrium distribution of photoionized gas show that the velocity dispersion of the gas is greater than that of the stars, and beyond a critical radius the gas flows out of the cluster as a wind. The expected amounts of accumulated gas are then below the detection threshold of the observations.

Fifteen radio point sources were detected in the six globular cluster fields. The majority are likely to be background sources, but five are associated with objects which are known cluster members – four probable low-mass X-ray binaries in Pal 2, NGC 6440, NGC 6624 and NGC 7078 and the planetary nebula K 648 in NGC 7078. Two other radio sources in the field of NGC 7078 may also belong to this cluster.

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The chemical composition of post-AGB star, proto-planetary nebulae candidate IRAS 22272 + 5435 = SAO 34504

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The new high-resolution, high signal-to-noise spectrum has been gathered for proto-planetary nebulae candidate IRAS 22272+5435 using the 6-m telescope. The spectroscopic indicators provided the atmospheric parameters T_{eff} = 5600 K and $logg$ = 0.5, approximately equal to those for G2-supergiants. We find that IRAS 22272+5435 is iron poor: $[Fe/H] = -0.49$ dex, however, other elements of iron-peak are overabundant. The standard LTE analysis by the model atmospheres method shows that Li is overabundant in the atmosphere of IRAS 22272+5435. The carbon abundance based on three CI lines and oxygen abundance computed from the forbidden line at 6300.32 $\AA$ gives the $C/O \approx 12$. The elements of α – process are found to be overabundant relative to the solar ones, excluding Ca, which has a normal abundance. Heavy neutron-capture elements are

overabundant (+2.0 *dex* on the average). The radial velocity derived from roughly 40 absorption lines is found to be -39.7 km/s, probably, suggesting that IRAS 22272+5435 does not belong to the halo. The observed asymmetry of strong absorption lines may be the result of velocity gradients, likely mass outflow, in the atmosphere of this object. The radial velocity, low iron abundance, overabundance of carbon and s–process elements, and detached circumstellar shell suggest that IRAS 22272+5435 is an evolved low mass star of the old (thick) disk population.

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The Kinematics and Morphology of the Planetary Nebula Fleming 1

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High resolution, spatially resolved measurements of the Hα and [NII] 6584 $\AA$ emission lines of the core of the PN Fleming 1 (taken with the Manchester Echelle Spectrometer on the Anglo-Australian telescope) reveal it to be a butterfly type nebula with an unusual toroidal structure around its waist expanding radially outwards at a velocity of 36 km s^{-1} . The strings of knots of gas to the north and south of the core are confirmed to be generated by globules of gas ejected at a velocity of about 85 km s^{-1} from the core by an episodic, bipolar, rotating source. The lifetime of the globules is considered and the line emission from the knots is shown to be most likely dominated by bow shocked ambient gas. A jet-like feature visible close to the edge of the nebular core is shown to have a different nature to that of the knots.

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A kinematical investigation of the bipolar planetary nebula NGC 650–1

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High spatial and spectral resolution observations of the Hα, [N II]6584 Å and [O III]5007 Å emission line profiles from the planetary nebula NGC 650–1 have been obtained with the Isaac Newton and William Herschel Telescopes using the Manchester echelle spectrometer.

These observations, and additional narrow–band images obtained using the San Pedro Màrtir telescope, are compared with synthesised images and spectra based on the generalised interacting stellar winds (GISW) models (involving a slow wind strongly concentrated towards the equatorial plane) and a good correspondence is found, confirming NGC 650–1 to be a bipolar wind–driven bubble orientated at an inclination of $\sim 75°$ with the NW lobe pointing towards the observer.

There is a bright central ring with two attached (inner) lobes, which show typical expansion velocities of ~ 43 km s^{-1} and ~ 60 km s^{-1} respectively. Outside the inner lobes are the fainter outer lobes which are observed to

have a very low expansion velocity ($\sim$ 5 km s^{-1}), and which have on one side (SE) a polar cap which shows higher velocities again ($\sim$ 20 km s^{-1}). The nature of these outer lobes remains unclear. The origin of discrepancies between the observations and models are discussed in some detail.

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The bright core and double halo of the planetary nebula NGC 40

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Deep, narrow-band CCD images in the visible, nebular emission lines of the planetary nebula NGC 40, obtained with the San Pedro Martir telescope, have revealed the presence of two haloes to the barrel-shaped nebular core and a jet-like feature projecting from it. A faint, diffuse inner halo is $\approx 90''$ diameter whereas the outer halo has prominent filaments embedded in patchy emission within a region $\approx 4'$ diameter.

Spatially resolved longslit spectra of the Hα and [N II]6584Å emission lines have been obtained, using the Manchester echelle spectrometer combined with the Isaac Newton telescope, from the bright core of NGC 40, its two haloes and the jet-like phenomenon. Hundreds of times fainter C II 6578Å profiles were obtained only from the bright core.

The outer filamentary halo is shown to be relatively inert, emitting narrow, single lines on the systemic heliocentric radial velocity of -31 km s^{-1}. Its internal turbulent motions are shown to be ≈ 7 km s^{-1} and its electron temperature $T_e = 7\,400 \pm 160$ K. The nebular emisison lines from the inner, diffuse, spherical halo are split in places by ≤ 50 km s^{-1} which is approximately the splitting found over the bright nebular core.

The jet-like feature is kinematically associated with the receding end of the barrel shaped core and does not have any of the kinematical characteristics expected of a true jet.

The creation of all of these phenomena are discussed within current evolutionary models of planetary nebulae.

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A Butterfly in the Making: Revealing the Near-Infrared Structure of Hubble 12

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We present deep narrowband near-IR images and moderate resolution spectra of the young planetary nebula Hubble 12. These data are the first to show clearly the complex structure for this important planetary nebula. Images were obtained at λ = 2.12, 2.16, and 2.26 μm. The λ = 2.12 μm image reveals the bipolar nature of the nebula, as well as complex structure near the central star in the equatorial region. The images show an elliptical region of emission which may indicate a ring or a cylindrical source structure. This structure is possibly related to the mechanism which is producing the bipolar flow. The spectra show the nature of several distinct components. The central object is dominated by recombination lines of H I and He I. The core is not a significant source of molecular hydrogen emission. The east position in the equatorial region is rich in lines of ultraviolet–excited fluorescent H_2. A spectrum of part of the central region shows strong [Fe II] emission which might indicate the presence of shocks.

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The Discovery of a Bipolar, Rotating, Episodic Jet (BRET) in the Planetary Nebula KjPn 8

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A spectacular ($\simeq 14' \times 4'$) bipolar nebula, with a symmetric and rotating, high-velocity collimated outflow, with episodic outburst properties, has been discovered in the Cassiopeia-Cepheus region. A compact object classified as the planetary nebula KjPn 8 is located at the center of symmetry of this extraordinary nebula. The angular extent of this bipolar structure is now the largest one known associated with a planetary nebula (PN). A mosaic of Hα images covering the full extent of the nebula is presented, as well as [NII] λ 6584, [SII] λ 6724, [OII] λ 3729 and [OIII] λ 5007 Å images of the central ($\simeq 5' \times 5'$) region. These images reveal symmetric pairs of bow shocks which are located at different position angles, in a way expected from a rotating, episodic jet. Low dispersion spectroscopy of regions of the bipolar lobes confirms their shock excited nature. The core is of low excitation class and seems nitro gen-enriched. Our 3.5 cm VLA observations yields a first radio detection of the core of KjPn8.

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Dissertation Abstracts

Evolved stars with circumstellar shells

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This thesis consists of two related topics. The first part concerns the study of post-Asymptotic Giant Branch objects. The second part of the thesis involves IRC +10420, an object that was originally proposed to be a post-AGB star, but is nowadays thought to be a post-Red Supergiant Branch object. The thesis starts with an introduction in the field of evolved stars in *Chapter 1.*

A selection of post-AGB stars in the IRAS Point Source Catalog is presented in *Chapter 2* and yielded a catalog of more than 450 objects, containing many post-AGB candidates and a large sample of other sources like Be stars, proto-planetary systems and pre-main sequence stars.

Chapter 3 describes a spectroscopic survey of post-AGB candidate stars in the near-infrared. One of the main results was the discovery of variable CO first-overtone emission at 2.3 μm. It is speculated that the emission may be due to post-AGB mass loss.

In *Chapter 4*, the short-term variability in the Hα line of the post-AGB star HD 56126 is investigated. A careful examination of high quality data shows, contrary to previous suggestions, that no variability is present on timescales of minutes. The Hα is variable on a time scale of months, which may be due to pulsation.

Chapter 5 concerns a search for hotter post-AGB objects than found so far in infrared searches. To this end, the criterion that an object should be detected by IRAS at 12 μm was abandoned. Three candidates were found. The circumstellar shells appear to have been ejected longer ago than found for most objects studied so far in the literature.

In *Chapter 6* an abundance study has been carried out for one of the objects discovered in Chapter 5 (SAO 225457 = HD 133656). The abundances, combined with spectral features and the location above the Galactic plane are similar to the known post-AGB stars, suggest that SAO 225457 is indeed a post-AGB object.

In *Chapter 7* we investigate the spectral evolution of post-AGB stars using the photo-ionization model CLOUDY and the latest evolutionary predictions from Blöcker (1995a+b). The emphasis is laid on the evolution of the infrared colours during the post-AGB phase. We find that the effect of the evolving star, that increases in temperature, can not be neglected.

Chapter 8 concerns a comparative study of the 21 μm emission band that has been observed in the IRAS LRS spectra of post-AGB stars and HII regions. It is concluded that the 21 μm feature in HII regions may well be explained as an artefact of LRS, because the HII regions are resolved by the IRAS LRS-spectrometer, while this instrument was designed for point sources.

Chapter 9 presents a study of the spectral energy distribution and mass loss history of IRC +10420 . The main conclusions from this work are that the photometric changes over the last 20 years indicate that the temperature of IRC +10420 increased more than 1000 K and that the spectral energy distribution can not be fitted with a single shell model, but that a hot component has to be invoked.

Finally, in *Chapter 10*, the entire optical spectrum of IRC +10420 , is studied. The change in surface temperature discussed in the previous chapter is confirmed using the new optical spectra. The spectral type is A-type which is a significant change from the F8 determination in the seventies. We find that the bi-polar flow scenario that was proposed by us some years ago is not compatible with the new data. Instead, we suggest, based on the consistently red-shifted absorption line profiles that IRC +10420 probably undergoes *infall* of material.

Copies of the thesis are freely available upon request by contacting the author at the above address.