THE AGB NEWSLETTER

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

No. 39 — 01 July 1997

Editors: Thierry Forveille and Claudine Kahane (agbnews@obs.ujf-grenoble.fr)

Abstracts of recently accepted papers

Chemical Abundances of Planetary Nebulae in the Sagittarius Dwarf Elliptical Galaxy

J. R. Walsh[1], *G. Dudziak*[1], *D. Minniti*[2] *& A. A. Zijlstra*[1]

[1] European Southern Observatory, Karl-Schwarzschild Strasse 2, D-85748 Garching bei München, Germany

[2] Lawrence Livermore National Laboratory, MS L-413, P.O Box 808, Livermore, CA 94550

Spectrophotometry and imaging of the two planetary nebulae He 2-436 and Wray 16-423, recently discovered to be in the Sagittarius dwarf elliptical galaxy, are presented. Wray 16-423 is a high excitation planetary nebula (PN) with a hot central star. In contrast He 2-436 is a high density nebula with a cooler central star and evidence of local dust, the extinction exceeding that for Wray 16-423 by $E_{B-V} = 0.28$. The extinction to Wray 16-423, (E_{B-V}=0.14) is consistent with the line of sight extinction to the Sagittarius Dwarf. Both PN show Wolf-Rayet features in their spectra, although the lines are weak in Wray 16-423. Images in [O III] and Hα+[N II], although affected by poor seeing, yield a diameter of 1.2″ for Wray 16-423 after deconvolution, whilst He 2-436 was unresolved. He 2-436 has a luminosity about twice that of Wray 16-423 and its size and high density suggest a younger nebula. In order to reconcile the differing luminosity and nebular properties of the two nebulae with similar age progenitor stars, it is suggested that they are on He burning tracks

An abundance analysis is presented for both PN using empirical abundance determinations. The abundance pattern is very similar in both nebulae and both show an oxygen depletion of -0.4 dex with respect to the mean oxygen abundance of Galactic planetary nebulae and [O/H] = -0.6 . The Sagittarius PN progenitor stars are representative of the higher metallicity tail of the Sagittarius population. The pattern of abundance depletion is similar to that in the only other planetary nebula in a dwarf galaxy companion of the Milky Way, that in Fornax, for which new spectra are presented. However the abundances are larger than for Galactic halo PN suggesting a later formation age. The oxygen abundance of the Sagittarius galaxy deduced from its PN, shows similarities with that of dwarf ellipticals around M 31, advancing the notion that this galaxy was a dwarf elliptical before its interaction with the Milky Way.

Accepted by The Astrophysical Journal *Preprints can be obtained by: contacting* jwalsh@eso.org
It appeared in the astrophysics preprint server as astro-ph/9705030

Dust Envelope Modelling of the Red Rectangle Nebula

Bruno Lopez[1], *Eric Tessier*[2], *Pierre Cruzalèbes*[3], *Jean Lefèvre*[1] *and Thibaut Le Bertre*[4]

[1] Observatoire de la Côte d'Azur, Département Fresnel UMR 6528, BP 4229, F-06034 Nice Cedex 4, France

[2] Groupe d'Astrophysique, Observatoire de Grenoble, Université Joseph-Fourier, BP 53X, F-38041 Grenoble Cedex, France

[3] Observatoire de la Côte d'Azur, Département Fresnel UMR 6528, Av. Copernic, F-06130 Grasse, France

[4] DEMIRM, Observatoire de Paris, 61 av. de l'Observatoire, F-75014 Paris, France

Radiative transfer modelling of the dust shell of the post-AGB Red Rectangle nebula is proposed in non-spherical geometry. The present work follows a previous study by Yusef-Zadeh et al. (1984) in which the dust density law smoothly decreases with latitude above and below the midplane of the disc shaped envelope.

Our aim is to take account of new observational constraints in addition to those already imposed by the image of the nebula at visible wavelengths. The broad band spectrum is fitted. The infrared map at 2.2μm is also taken into account for our model. As a result of our study, we find that the best compromise in the choice of the model parameters leads to a dust density law which differs from the one proposed previously. The temperature of the hottest grains is about 1000 K. Large dust particles are present in the circumstellar environment, the largest of these being probably confined to the plane of the disc.

We estimate the dust shell mass to be about $3.8 \times 10^{-4} M_{\odot}$ assuming a distance of 330 pc for the Red Rectangle (Cohen et al. 1975).

Accepted by Astronomy and Astrophysics *Preprints can be obtained by contacting* lopez@obs-nice.fr

A multiwavelength study of LS II+34^{0}26: a hot post-AGB star in the process of becoming a planetary nebula

P. García-Lario[1,2], *M.Parthasarathy*[3,4], *D. de Martino*[5], *L. Sanz Fernández de Córdoba*[2], *R. Monier* [4], *A. Manchado*[6] *and S.R. Pottasch*[7]

[1] Leiden Observatory. PO Box 9513, NL-2300 RA Leiden (The Netherlands)

[2] Laboratorio de Astrofísica Espacial y Física Fundamental. INTA . Apartado de Correos 50727. E-28080 Madrid, Spain

[3] Indian Institute of Astrophysics. I-560034 Bangalore, India

[4] CDS, Observatoire de Strasbourg, 11 rue de l'Universite, F-67000 Strasbourg, France

[5] Osservatorio Astronomico di Capodimonte. Via Moiariello, 16. I-80131 Naples, Italy

[6] Instituto de Astrofísica de Canarias, E-38200 La Laguna, Tenerife (Spain)

[7] Kapteyn Laboratorium, PO Box 800. NL-9700, AV Groningen (The Netherlands)

We present the results from a multiwavelength analysis of LS II+34^{0}26, recently identified as a low mass post-AGB star and not a massive population I B-type star, as previously thought. We confirm that the central star is a carbon-poor post-AGB star surrounded by a very low excitation and compact nebula.

Spectroscopic monitoring carried out since 1991 reveals variations which suggest that this star has had a mass loss episode in the period 1993–1995. The asymmetric profiles in a few absorption lines in high resolution optical spectra indicate the presence of complex motions in the outer layers of the atmosphere. The radial velocity variations (several tens of km s^{-1}) observed in spectra taken in a single epoch can be attributed to stellar pulsation. For a few lines stronger variations over the years (up to 70 km s^{-1}) can be explained if these lines are formed in the outflow.

The anomalous extinction observed in the UV suggests that part of the reddening is of circumstellar origin and that the standard interstellar extinction law is not applicable. On the other hand, the absence of a significant near infrared excess in LS II+34^{0}26 suggests that the mass loss enhancement corresponds to a short-lived episode of modest intensity.

Although non-LTE effects prevent the accurate determination of the atmospheric parameters and abundances of LS II+34^{0}26, a comparative analysis with LS IV$-$12^{0}111 indicates that both stars are very similar. Both are

identified as low mass carbon-poor hot post-AGB stars belonging to the halo population of our Galaxy.

Accepted by Astronomy and Astrophysics *Preprints can be obtained by contacting* pgarcia@iso.vilspa.esa.es

The rich molecular content of OH231.8+4.2

C. Sánchez Contreras[1,2], *V. Bujarrabal*[1], *J. Alcolea*[1]

[1] Observatorio Astronómico Nacional (IGN), Apartado 1143, E-28800 Alcalá de Henares, Spain

[1] Departamento de Astrofísica, Facultad C. Físicas, Universidad Complutense, E-28040 Madrid, Spain

We have carried out maps of microwave lines of 8 different molecules (^{12}CO(2-1 and 1-0), ^{13}CO(2-1 and 1-0), SiO(5-4), HCO$^+$(1-0), $SO_2(10_{0,10}$-$9_{1,9})$, CS(5-4), HCN(1-0) and HNC(1-0)) in OH231.8+4.2, a protoplanetary nebula that shows a particularly rich molecular emission. Confirming previous observations, the total molecular extent is comparable to the optical image and the lines show a total velocity range $\sim$ [$-$80:+250] km s^{-1} (LSR), due to a high-velocity flow in the axial direction. The observed transitions show a practically constant velocity gradient, $\sim$ 6 km s^{-1} per arcsec, in the direction of the polar axis. All the observed molecular lines (except for HCO$^+$) show similar emission features: an intense component in the velocity range [+10:+55] that comes from the nebula center, and weaker wing emission originating in the lobes, that appear fragmented in several gas components flowing at high velocity in the axial direction. HCO$^+$, remarkably, does not show a dominant central feature, its emission being dominated by the contribution of the fast clumps. ¿From the intensity ratio of the ^{13}CO transitions, we have estimated that the CO excitation remains practically constant in the whole nebula, the rotational temperature showing a low value, $\sim$ 10 K. We have also calculated the mass, momentum and molecular abundances in the different components of the nebula. We estimate a total molecular mass in the envelope of 0.5$-$1 $M_\odot$, and at least 0.2 $M_\odot$ are axially flowing at velocities (with respect to the systemic one) larger than 40 km s^{-1}. It is argued that this material corresponds to a large fraction of the envelope ejected in the previous AGB phase, after being accelerated by interaction with the fast post-AGB jets. We stress that the high value of the measured axial momentum cannot be explained by radiation pressure, a different mechanism for the release of kinetic momentum by the star must be at work. The abundances of CS, HNC and HCN are found to be practically constant across the nebula. SO_2 is more abundant in the south lobe, while SiO shows the opposite behavior, confirming the asymmetry of the source with respect to the equatorial plane. The HCO$^+$ abundance is found to be much higher in the axial flow than in the central component of the nebula, as expected in view of its intensity distribution. We suggest that this molecule (and probably SiO) is efficiently formed in the lobes of OH231.8+4.2 by shock-induced reactions.

Accepted by Astron. Astrophys. *Preprints can be obtained by contacting* sanchez@oan.es

OH/IR objects: modelling of circumstellar dust envelopes by a Monte Carlo method

S. Lorenz-Martins [1] *and F.X. de Araújo* [1]

[1] Observatório Nacional, R.J., Brazil

OH/IR star dust envelopes have been modelled, using a Monte Carlo type numerical method. Some characteristics of the circumstellar shell (such as extinction opacity at a given wavelength, its size and the exponent of the power law density distribution $\rho \propto r^{-m}$) have been estimated by fitting the spectral energy distribution. IRAS LRS data were used for the silicate feature at 9.7μm. Near infrared and IRAS fluxes at 12μm, 25μm, 60μm and 100μm have been considered as well. A tendency of increasing optical thickness with the colour index [K-L'], suggested by previous works, is confirmed. The silicate feature change from emission to absorption when the optical thickness at this band ($\tau_{9.7}$) is somewhere around 3 $\sim$ 6. In addition, the density exponent found for absorption feature stars is m = 2.5. This result is compatible with two possible scenarios: a mass

loss increasing in time (if the outflow velocity is constant) or a more or less constant mass loss rate and an accelerated expansion.

Accepted by MNRAS *Preprints can be obtained by contacting S.Lorenz-Martins - silvia@on.br*

Oxygen-rich Mira variables: near-infrared luminosity calibrations. Populations and period–luminosity relations *

R. Alvarez[1], *M-O. Mennessier*[1], *D. Barthès*[1], *X. Luri*[2,3] *and J.A. Mattei*[4]

[1] GRAAL, Université Montpellier II, UPRESA 5024/CNRS, F–34095 Montpellier Cedex 05, France

[2] Departament d'Astronomia i Meteorologia, Universitat de Barcelona, Avda. Diagonal 647, E–08028 Barcelona, Spain

[3] DASGAL, Observatoire de Paris-Meudon, F–92195 Meudon Cedex, France

[4] AAVSO, 25 Birch Street, Cambridge, Massachusetts 02138–1205, USA

HIPPARCOS astrometric and kinematical data of oxygen-rich Mira variables are used to calibrate absolute near-infrared magnitudes and kinematic parameters. Two sets of near-infrared magnitudes compiled from different authors are used: broad-band K and narrow-band photometric measurements at 1.04 μm (104 filter). Three distinct classes of stars with different kinematics and scale height have been identified. The two most significant groups present characteristics close to the ones usually assigned to extended/thick disk–halo population and old disk population respectively, and thus they might differ by their metallicity abundance. They exhibit different period distributions, as expected if these two groups actually correspond to populations of distinct initial masses, ages and metallicities. Two parallel period–luminosity relations are found in K as well as in 104, one for each significant population. The shift between these relations is interpreted as the consequence of the effects of metallicity abundance on the luminosity.

* Based on data from the ESA HIPPARCOS astrometry satellite

Accepted by Astron. Astrophys. *For preprints, contact* alvarez@graal.univ-montp2.fr

Optical spectrum of the IR-source IRC+10420 in 1992-1996

Klochkova V.G., Chentsov E.L., Panchuk V.E.

Special Astrophysical Observatory, Nizhnij Arkhyz, 357147 RUSSIA

To understand the evolutionary stage of the peculiar supergiant IRC+10420, we have been taking spectra for several years at the 6 m telescope. The optical spectrum of IRC+10420 of the years from 1992 through 1996 points to the increase in the temperature: spectral class A5 instead of the former F8, as was pointed out by Humpreys et al., (1973). Now it resembles the spectra of late-type B[e] stars. The spectrum contains absorptions (mainly of ions) formed in the photosphere, apparently stationary with respect to the star center of mass, and emissions too, which can be formed in the fossil expanding envelope as well as partly in its compressing region.

Using our spectra and spectral data obtained by Oudmaijer (1995) we estimated the atmospheric parameters $T_{\rm eff}$ = 8500 K, log g=1.0, $\xi_{\rm t}$ = 12 km/s and concluded that metallicity of IRC+10420 is solar: the average value $[({\rm V, Cr, Fe})/{\rm H}]_{\odot} = -0.03$.

Combination of results allows us to consider IRC+10420 as a massive supergiant evolving to the WR-stage.

Accepted by MNRAS *Preprints can be obtained by contacting* valenta@alba.sao.ru

The classification of helium-rich hot subdwarfs

C.S.Jeffery[1], *J.S.Drilling*[2], *P.M.Harrison*[3], *U.Heber*[4] *and S.Moehler*[5,4]

[1] Armagh Observatory, Armagh, N.Ireland

[2] Dept of Physics and Astronomy, Louisiana State University, Baton Rouge, USA

[3] Dept of Physics and Astronomy, St Andrews University, St Andrews, Scotland

[4] Dr. Remeis-Sternwarte, Bamberg, Germany

[5] Space Telescope Science Institute, Baltimore, USA

Spectroscopy has been obtained of 23 subluminous stars, twenty of which had been classified as "helium-rich subdwarf B stars" from 10Å resolution spectra. From inspection of the HeII, HeI and Balmer lines, the sample clearly shows a wider range in HeII/HeI and He/H ratios than hitherto supposed for the class. We introduce a classification scheme for helium-rich hot subdwarfs based on 1.5Å spectra of high S/N, which can be extended to include all hot subdwarfs with spectra dominated by H, HeI or HeII. The aim of this classification scheme is to establish reference standards which would be suitable for subsequent fine analysis.

Accepted by Astronomy and Astrophysics Supplement Series

Preprints can be obtained by contacting csj@star.arm.ac.uk *or via WWW on* http://star.arm.ac.uk/~ambn/preprints.html *(Preprint No. 264),*
or http://star.arm.ac.uk/~ambn/264csj.ps (1.4Mb)

New Jobs

The University of Calgary has an opening for a postdoctoral fellow/research associate in the field of infrared/submllimetre astronomy. The candidate should have a background in infrared or millimetre wave astronomy, and is expected to participate in our observing and related data analysis programs. The University of Calgary has active observing programs at various ground-based infrared and millimetre telescopes, as well as on the Infrared Space Observatory. The successful candidate will have the opportunity to join the observing programs of the Odin satellite, which is a submillimetre-wave satellite supported by the Canadian Space Agency to be launched in 1998.

Further information can be obtained from Dr. Sun Kwok, Department of Physics and Astronomy, University of Calgary, Calgary, Alberta Canada T2N 1N4 (Tel:403-220-5414, email:kwok@iras.ucalgary.ca, www: http://www.iras.ucalgary.ca). Position will remain open until a suitable candidate is found.