THE AGB NEWSLETTER

An electronic publication dedicated to Asymptotic Giant Branch stars and related phenomena

No. 121 — 1 June 2007

http://www.astro.keele.ac.uk/AGBnews

Editors: Jacco van Loon and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 121st issue of the AGB Newsletter. Topics range from symbiotic binaries and the origin of R-type carbon stars to circumstellar chemistry and grain physics. Note also the paper by Jasonjot Kalirai et al., who find that at super-solar metallicity, mass loss on the RGB prevents many stars from undergoing the helium flash, forcing them to end up as an undermassive helium white dwarf.

The editorial office is going on holidays (indeed!), and we will therefore issue only two issues over the coming three months. The next issue will thus be distributed on the 13th of July; the deadline for contributions is the 12th of July.

Editorially Yours,
Jacco van Loon and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Does the galactic Bulge harbour undermassive but warm, bright white dwarfs?

Reactions to this statement or suggestions for next month's statement can be e-mailed to agbnews@astro.keele.ac.uk (please state whether you wish to remain anonymous)

Refereed Journal Papers

Integral-field spectroscopy of Planetary Nebulae with VLT FLAMES

Y. G. Tsamis[1], *J. R. Walsh*[2], *D. Péquignot*[3], *M. J. Barlow*[1], *X.-W. Liu*[4] *and I. J. Danziger*[5]

[1]Dept. of Physics and Astronomy, University College London, UK
[2]ST-ECF, ESO, Germany
[3]Observatoire de Paris, Meudon, France
[4]Dept. of Astronomy, Beijing, China
[5]Observatory of Trieste, Italy

Results from the first dedicated observations of three Galactic planetary nebulae (NGC 5882, 6153 and 7009) made with VLT FLAMES and the Giraffe/Argus integral field unit are discussed. The unique capabilities of the Giraffe/Argus spectrograph allowed construction of two dimensional spectral maps of one nebula and of large portions of the other two, and to record in exquisite detail the weak optical recombination lines emitted from carbon, oxygen and nitrogen ions.

Published in The Messenger, 2007, vol. 127, p. 53
Available from http://www.eso.org/gen-fac/pubs/messenger/

Optically Thick Radio Cores of Narrow-Waist Bipolar Nebulae

Ting-Hui Lee[1,4], *Jeremy Lim*[2] *and Sun Kwok*[3,4]

[1]National Optical Astronomy Observatory, Tucson, AZ 85719, USA
[2]Institute of Astronomy and Astrophysics, Academia Sinica, Taipei 106, Taiwan
[3]Department of Physics, Faculty of Science, University of Hong Kong, Hong Kong
[4]Departemnt of Physics and Astronomy, University of Calgary, Calgary, AB T2N 1N4, Canada

We report our search for optically thick radio cores in sixteen narrow-waist bipolar nebulae. Optically thick cores are a characteristic signature of collimated ionized winds. Eleven northern nebulae were observed with the Very Large Array (VLA) at 1.3 cm and 0.7 cm, and five southern nebulae were observed with the Australia Telescope Compact Array (ATCA) at 6 cm and 3.6 cm. Two northern objects, 19W32 and M 1-91, and three southern objects, He 2-25, He 2-84 and Mz 3, were found to exhibit a compact radio core with a rising spectrum consistent with an ionized jet. Such jets have been seen in M 2-9 and may be responsible for shaping bipolar structure in planetary nebulae.

Accepted for publication in ApJ
Available from arXiv:0705.0512

Origin of the early-type R stars: a binary-merger solution to a century-old problem?

Robert Izzard[1,3], *C. Simon Jeffery*[2] *and John Lattanzio*[3]

[1]University of Utrecht, The Netherlands
[2]Armagh Observatory, Northern Ireland
[3]Monash University, Melbourne, Australia

The early-R stars are carbon-rich K-type giants. They are enhanced in ^{12}C, ^{13}C and ^{14}N, have approximately solar oxygen, magnesium isotopes, s-process and iron abundances, have the luminosity of core-helium burning stars, are not

rapid rotators, are members of the Galactic thick disk and, most peculiarly of all, are all single stars. Conventional single-star stellar evolutionary models cannot explain such stars, but mergers in binary systems have been proposed to explain their origin.
We have synthesized binary star populations to calculate the number of merged stars with helium cores which could be early-R stars. We find many possible evolutionary channels. The most common of which is the merger of a helium white dwarf with a hydrogen-burning red giant branch star during a common envelope phase followed by a helium flash in a rotating core which mixes carbon to the surface. All the channels together give ten times more early-R stars than we require to match recent Hipparcos observations - we discuss which channels are likely to be the true early-R stars and which are not. For the first time we have constructed a viable model of the early-R stars with which we can test some of our ideas regarding common envelope evolution in giants, stellar mergers, rotation, the helium flash and the origin of the early-R stars.

Accepted for publication in A&A
Available from arXiv:0705.0894

CH Cyg X-ray Jet Activity and Multi-component Structures

Margarita Karovska[1], *Christopher L. Carilli*[2], *John C. Raymond*[1] *and Janet A. Mattei*[3]

[1]Smithsonian Astrophysical Observatory, USA

[2]National Radio Astronomy Observatory, USA

[3]American Association of Variable Star Observers, USA

In this paper we report detection of multiple component structures in a Chandra X-ray image obtained in March 2001 of the nearby symbiotic interacting binary system CH Cyg. These components include a compact central source, an arc-like structure or a loop extending to 1.5″ (400 AU) from the central source associated with the 1997 jet activity, and possibly a newly formed jet extending to $\sim$ 150 AU from the central source. The structures are also visible in VLA and HST images obtained close in time to the Chandra observations. The emission from the loop is consistent with optically thin thermal X-ray emission originating from a shock resulting from interaction of the jet ejecta with the dense circumbinary material. The emission from the central source originates within $<$ 50 AU region, and is likely associated with the accretion disk around the white dwarf. CH Cyg is only the second symbiotic system with jet activity detected at X-ray wavelengths, and the Chandra high-angular resolution image, combined with the VLA and HST images, provides the closest view of the region of jet formation and interaction with the circumbinary material in a symbiotic binary.

Accepted for publication in Astrophysical Journal

Iron abundances of B-type post-Asymptotic Giant Branch stars in globular clusters: Barnard 29 in M 13 and ROA 5701 in ω Cen

H. M. A. Thompson[1], *F. P. Keenan*[1], *P. L. Dufton*[1], *R. S. I. Ryans*[1], *J. V. Smoker*[1], *D. L. Lambert*[2] *and A. A. Zijlstra*[3]

[1]Astrophysics Research Centre, School of Mathematics and Physics, Queen's University, Belfast BT7 1NN, Northern Ireland

[2]University of Texas at Austin, Austin, TX 78712–1083, USA

[3]School of Physics and Astronomy, University of Manchester, P.O. Box 88, Manchester M60 1QD, UK

High resolution optical and ultraviolet spectra of two B-type post-Asymptotic Giant Branch (post-AGB) stars in globular clusters, Barnard 29 in M 13 and ROA 5701 in ω Cen, have been analysed using model atmosphere techniques. The optical spectra have been obtained with FEROS on the ESO 2.2-m telescope and the 2d-Coudé spectrograph on the 2.7-m McDonald telescope, while the ultraviolet observations are from the GHRS on the HST. Abundances of light elements (C, N, O, Mg, Al and S) plus Fe have been determined from the optical spectra, while the ultraviolet

data provide additional Fe abundance estimates from Fe III absorption lines in the 1875–1900 Å wavelength region. A general metal underabundance relative to young B-type stars is found for both Barnard 29 and ROA 5701. These results are consistent with the metallicities of the respective clusters, as well as with previous studies of the objects. The derived abundance patterns suggest that the stars have not undergone a gas-dust separation, contrary to previous suggestions, although they may have evolved from the AGB before the onset of the third dredge-up. However, the Fe abundances derived from the HST spectra are lower than those expected from the metallicities of the respective clusters, by 0.5 dex for Barnard 29 and 0.8 dex for ROA 5701. A similar systematic underabundance is also found for other B-type stars in environments of known metallicity, such as the Magellanic Clouds. These results indicate that the Fe III ultraviolet lines may yield abundance values which are systematically too low by typically 0.6 dex and hence such estimates should be treated with caution.

Accepted for publication in MNRAS
Available from arXiv:0705.2196

Mass Loss Evolution and the Formation of Detached Shells around TP-AGB Stars

Lars Mattsson[1], *Susanne Höfner*[1] *and Falk Herwig*[2]

[1]Department of Astronomy and Space Physics, Uppsala University, Box 515, SE-751 20 Uppsala, Sweden
[2]Keele Astrophysics Group, School of Physical and Geographical Sciences, Keele University, Staffordshire ST5 5BG, UK

Context. The origin of the so called "detached shells" around AGB stars is not fully understood, but two common hypotheses state that these shells form either through the interaction of distinct wind phases or an eruptive mass loss associated with a He-shell flash. We present a model of the formation of detached shells around thermal pulse asymptotic giant branch (TP-AGB) stars, based on detailed modelling of mass loss and stellar evolution, leading to a combination of eruptive mass loss and wind interaction.
Aims. The purpose of this paper is first of all to connect stellar evolution with wind and mass loss evolution and demonstrate its consistency with observations, but also to show how thin detached shells around TP-AGB stars can be formed. Previous attempts to link mass loss evolution with the formation of detached shells were based on approximate prescriptions for the mass loss and have not included detailed modelling of the wind formation as we do here.
Methods. Using stellar parameters sampled from an evolutionary track for a 2 $M_\odot$ star, we have computed the time evolution of the atmospheric layers and wind acceleration region during a typical thermal pulse with detailed radiation hydrodynamical models including dust formation. Based on these results, we simulate the subsequent circumstellar envelope (CSE) evolution using a spherical hydrodynamic model.
Results. We find that existing simple mass loss prescriptions all suggest different mass loss evolutions and that they differ from our detailed wind modelling. The most important factor for the formation of a detached shell is the wind velocity evolution which has a strong impact on the wind interaction and the resulting pile-up of matter. Our CSE model shows that a thin shell structure may be formed as a consequence of a rather short phase of intense mass loss in combination with a significant variation in the wind velocity, as obtained by our wind models. This situation can only be obtained for a limited range of amplitudes for the piston boundary used in the dynamic atmosphere models.
Conclusions. The combined mass loss eruption and wind interaction scenario for the formation of detached shells around AGB stars (suggested by previous work) is confirmed by the present modelling. Changes in mass loss rate and wind velocity due to a He-shell flash are adequate for creating distinct wind phases and a "snow plow effect" that is necessary to form a geometrically thin detached shell. The derived properties of the shell (i.e. radius, thickness and density) are more or less consistent with existing observational constraints.

Accepted for publication in Astronomy & Astrophysics
Available from arXiv:0705.2232

The unusual hydrocarbon emission from the early carbon star HD 100764: The connection between aromatics and aliphatics

G.C. Sloan[1], *M. Jura*[2], *W.W. Duley*[3], *K.E. Kraemer*[4], *J. Bernard-Salas*[1], *W.J. Forrest*[5], *B. Sargent*[5], *A. Li*[6], *D.J. Barry*[1], *C.J. Bohac*[5], *D.M. Watson*[5] *and J.R. Houck*[1]

[1]Cornell University, Astronomy Department, Ithaca, NY, USA

[2]Department of Physics and Astronomy and Center for Astrobiology, University of California, Los Angeles, USA

[3]Department of Physics and Astronomy, University of Waterloo, Canada

[4]Air Force Research Laboratory, Space Vehicles Directorate, MA, USA

[5]Department of Physics and Astronomy, University of Rochester, USA

[6]Department of Physics and Astronomy, University of Missouri, USA

We have used the Infrared Spectrograph (IRS) on the *Spitzer Space Telescope* to obtain spectra of HD 100764, an apparently single carbon star with a circumstellar disk. The spectrum shows emission features from polycyclic aromatic hydrocarbons (PAHs) that are shifted to longer wavelengths than normally seen, as characteristic of "class C" systems in the classification scheme of Peeters et al. All seven of the known class C PAH sources are illuminated by radiation fields that are cooler than those which typically excite PAH emission features. The observed wavelength shifts are consistent with hydrocarbon mixtures containing both aromatic and aliphatic bonds. We propose that the class C PAH spectra are distinctive because the carbonaceous material has not been subjected to a strong ultraviolet radiation field, allowing relatively fragile aliphatic materials to survive.

Accepted for publication in ApJ
Available from arXiv:0705.0905

Grain Physics and Rosseland Mean Opacities

Jason W. Ferguson[1,2], *Amanda Heffner-Wong*[3], *Jonathan J. Penley*[1], *Travis S. Barman*[4] *and David R. Alexander*[5]

[1]Wichita State University, USA

[2]visiting Max-Planck-Institut für Astrophysik, Germany

[3]now at Project Zero, Harvard Graduate School of Education, USA

[4]Lowell Observatory, USA

[5]now at Idaho State University, USA

Tables of mean opacities are often used to compute the transfer of radiation in a variety of astrophysical simulations from stellar evolution models to proto-planetary disks. Often tables, such as Ferguson et al. (2005), are computed with a predetermined set of physical assumptions that may or may not be valid for a specific application. This paper explores the effects of several assumptions of grain physics on the Rosseland mean opacity in an oxygen rich environment. We find that changing the distribution of grain sizes, either the power-law exponent or the shape of the distribution, has a marginal effect on the total mean opacity. We also explore the difference in the mean opacity between solid homogenous grains and grains that are porous or conglomorations of several species. Changing the amount of grain opacity included in the mean by assuming a grain-to-gas ratio significantly affects the mean opacity, but in a predictable way.

Accepted for publication in Astrophysical Journal
Available from arXiv:0705.1478
and from http://webs.wichita.edu/physics/opacity/

Stellar Evolution in NGC 6791: Mass Loss on the Red Giant Branch and the Formation of Low Mass White Dwarfs

Jasonjot S. Kalirai[1,2], *P. Bergeron*[3], *Brad M. S. Hansen*[4], *Daniel D. Kelson*[5], *David B. Reitzel*[4], *R. Michael Rich*[4] *and Harvey B. Richer*[6]

[1]University of California at Santa Cruz, USA

[2]Hubble Fellow

[3]Université de Montreal, Canada

[4]University of California at Los Angeles, USA

[5]Carnegie Observatories, USA

[6]University of British Columbia, Canada

We present the first detailed study of the properties (temperatures, gravities, and masses) of the NGC 6791 white dwarf population. This unique stellar system is both one of the oldest (8 Gyr) and most metal-rich ([Fe/H] $\sim +0.4$) open clusters in our Galaxy, and has a color-magnitude diagram (CMD) that exhibits both a red giant clump and a much hotter extreme horizontal branch. Fitting the Balmer lines of the white dwarfs in the cluster, using Keck/LRIS spectra, suggests that most of these stars are undermassive, $\langle M \rangle = 0.43 \pm 0.06$ M$_\odot$, and therefore could not have formed from canonical stellar evolution involving the helium flash at the tip of the red giant branch. We show that at least 40% of NGC 6791's evolved stars must have lost enough mass on the red giant branch to avoid the flash, and therefore did not convert helium into carbon-oxygen in their core. Such increased mass loss in the evolution of the progenitors of these stars is consistent with the presence of the extreme horizontal branch in the CMD. This unique stellar evolutionary channel also naturally explains the recent finding of a very young age (2.4 Gyr) for NGC 6791 from white dwarf cooling theory; helium core white dwarfs in this cluster will cool ~ 3 times slower than carbon-oxygen core stars and therefore the corrected white dwarf cooling age is in fact > 7 Gyr, consistent with the well measured main-sequence turnoff age. These results provide direct empirical evidence that mass loss is much more efficient in high metallicity environments and therefore may be critical in interpreting the ultraviolet upturn in elliptical galaxies.

Submitted to Astrophysical Journal
Available from arXiv:0705.0977

Hydrocarbon anions in interstellar clouds and circumstellar envelopes

T.J. Millar[1], *C. Walsh*[1], *M.A. Cordiner*[1], *R. Ní Chuimín*[2] *and E. Herbst*[3]

[1]School of Mathematics and Physics, Queen's University Belfast, Northern Ireland

[2]School of Physics and Astronomy, University of Manchester, England

[3]Departments of Physics, Chemistry and Astronomy, Ohio State University, USA

The recent detection of the hydrocarbon anion C_6H^- in the interstellar medium has led us to investigate the synthesis of hydrocarbon anions in a variety of interstellar and circumstellar environments. We find that the anion/neutral abundance ratio can be quite large, on the order of at least a few percent, once the neutral has more than five carbon atoms. Detailed modeling shows that the column densities of C_6H^- observed in IRC+10216 and TMC-1 can be reproduced. Our calculations also predict that other hydrocarbon anions, such as C_4H^- and C_8H^-, are viable candidates for detection in IRC+10216, TMC-1 and photon-dominated regions such as the Horsehead Nebula.

Accepted for publication in Astrophysical Journal Letters
Available from arXiv:0705.0639

Abell 43: Longest Period Planetary Nebula Nucleus Variable

J.-E. Solheim[1], *G. Vauclair*[2], *A. Mukadam*[3], *R. Janulis*[4] *and V. Dobrovolskas*[5]

[1]Institute of Theoretical Astrophysics, University of Oslo, Norway

[2]Université Paul Sabatier, Observatoire Midi-Pyrenees, France

[3]Department of Astronomy, University of Washington, Seattle, U.S.A

[4]Institute of Theoretical Physics and Astronomy of Vilnius University, Lithuania

[5]Observatory of Vilnius University, Lithuania

Based on 24h high speed photometry of the hybrid PG 1159 star Abell 43, we have detected 6 sighificant pulsations with periods between 2380 s and 6075 s. A short (4h) run on the almost spectroscopic twin NGC 7094 central star resulted in detection of 3 low amplitude pulsations with periods between 2000 s and 5000 s. The results are close to predictions for g-mode pulsations driven by the κ-mechanism induced by the partial ionization of carbon and oxygen.

Accepted for publication in Astronomy and Astrophysics
Available from arXiv:0705.2115

The symbiotic star H 1-36. A composite model of line and continuum spectra from radio to ultraviolet

R. Angeloni[1,2], *M. Contini*[2,1], *S. Ciroi*[1] *and P. Rafanelli*[1]

[1]Dept. of Astronomy, University of Padova, Italy

[2]School of Physics and Astronomy, Tel Aviv University, Israel

In this paper we analyse the spectra of D-type SS H 1-36 within a colliding-wind scenario. We aim to analyse the properties of this object taking into account the observational data along the whole electromagnetic spectrum, in order to derive a self-consistent picture able to interpret the nature of the system as a whole. After constraining the relative physical conditions by modelling more than 40 emission lines from radio to UV, we are able to explain the continuum spectral energy distribution by taking into account all the emitting contributions arising from both the stars, the dust shells and the gaseous nebulae. A comprehensive model of the radio spectra allows to reproduce the different slopes of the radio profile and the turnover frequency, as well as the different size of the observed shocked envelope at different frequencies in the light of the different contributions from the expanding and reverse nebulae. The IR continuum unveils the presence of two dust shells with different radii and temperatures, which might be a distinctive feature of D-type symbiotic systems as a class of objects. The broad profiles of IR lines direct us to investigate whether an X-ray jet may be present. This insight leads us to indicate H 1-36 as a promising X-ray target and to encourage observations and studies which consistently take into account the complex nature of symbiotic stars throughout the whole electromagnetic spectrum.

Accepted for publication in A&A
Available from arXiv:0705.2808

Gas and dust spectra of the D′ type symbiotic star HD 330036

R. Angeloni[1,2], *M. Contini*[2,1], *S. Ciroi*[1] *and P. Rafanelli*[1]

[1]Dept. of Astronomy, University of Padova, Italy

[2]School of Physics and Astronomy, Tel Aviv University, Israel

We present a comprehensive and self-consistent modelling of the D′ type symbiotic star (SS) HD 330036 from radio to UV. Within a colliding-wind scenario, we analyse the continuum, line and dust spectra by means of SUMA, a code that simulates the physical conditions of an emitting gaseous cloud under the coupled effect of ionization from an external radiation source and shocks. We find that the UV lines are emitted from high density gas between the stars downstream of the reverse shock, while the optical lines are emitted downstream of the shock propagating outwards the system. As regards with the continuum SED, three shells are identified in the IR, at 850 K, 320 K and 200 K with

radii $r = 2.8\ 10^{13}$ cm, $4\ 10^{14}$ cm, and 10^{15} cm, respectively, adopting a distance to Earth $d = 2.3$ kpc: interestingly, all these shells appear to be circumbinary. The analysis of the unexploited ISO-SWS spectrum reveals that both PAHs and crystalline silicates coexist in HD 330036, with PAHs associated to the internal shell at 850 K, and crystalline silicates stored into the cool shells at 320 K and 200 K. Strong evidence that crystalline silicates are shaped in a disk-like structure is derived on the basis of the relative band strengths. Finally, we suggest that shocks can be a reliable mechanism in activating the annealing and the consequent crystallization processes. We show that a consistent interpretation of gas and dust spectra emitted by SS can be obtained by models which accounts for the coupled effect of the photoionizing flux and of shocks. The VLTI/MIDI proposal recently accepted by ESO aims to verify and better constrain some of our results by means of IR interferometric observations.

Accepted for publication in A&A
Available from arXiv:0705.2804

Discovery of Phosphaethyne (HCP) in Space: Phosphorus Chemistry in Circumstellar Envelopes

Marcelino Agúndez[1], *José Cernicharo*[1] *and Michel Guélin*[2]

[1]DAMIR, Instituto de Estructura de la Materia, CSIC, 28006, Madrid, Spain
[2]IRAM, 300 Rue de la Piscine, 38406, St. Martin d'Héres, France

We present the first detection in space of phosphaethyne, the phosphorus analogue of HCN. We have observed with the IRAM 30-m telescope four successive rotational transitions of HCP in the AGB star envelope IRC+10216. After PN and CP, HCP is the third phosphorus-bearing molecule identified in the interstellar medium. HCP forms under thermochemical equilibrium in the surroundings of the stellar photosphere, from which it is expelled into space. It locks 3 % of the phosphorus present in the expanding envelope, the remaining most likely being condensed on grains. We further discuss the chemistry of phosphorus in circumstellar envelopes in the light of our findings and speculate on other phosphorus compounds that may be detectable.

Accepted for publication in Astrophysical Journal Letters

Direct diameter measurement of a star filling its Roche Lobe: The semi-detached binary SS Leporis spatially resolved with VINCI/VLTI

Tijl Verhoelst[1], *Els van Aarle*[1] *and Bram Acke*[1]

[1]Instituut voor Sterrenkunde, KULeuven, Belgium

Stellar evolution in close binary systems is strongly influenced by mass transfer from one star to the other when one component fills its zero-velocity surface or Roche Lobe. SS Lep is a fairly nearby close binary showing the Algol paradox and a shell spectrum, both indicative of (past) mass transfer. To study the process of mass transfer and its evolutionary consequences, we aim at a direct characterisation of the spatial dimensions of the different components of SS Lep with IR interferometry. We use VINCI/VLTI interferometric observations in the K band and photometric observations from the UV to the far-IR. The visibilities are interpreted with simple geometrical models and the Spectral Energy Distribution (SED) is decomposed into the three main components: A star, M star and dust shell/disk. From the SED, we find that the main emitters in the K band are the M star and the circumstellar environment. Both are spatially resolved with the VINCI observations, showing the excess to be circumbinary and showing the M star to have a size equal to its Roche Lobe. We conclude that we have, for the first time, directly resolved a star filling its Roche Lobe. The resulting mass transfer is probably the cause of (1) the circumbinary dust disk of which we see the hot inner region spatially resolved in our observations, (2) the unusually high luminosity of the A star and (3) the shell spectrum seen in the UV and optical spectra.

Accepted for publication in A&A Letters
Available from arXiv:0705.4410

The Mira variable S Ori: Relationships between the photosphere, molecular layer, dust shell, and SiO maser shell at 4 epochs

M. Wittkowski[1], *D. A. Boboltz*[2], *K. Ohnaka*[3], *T. Driebe*[3] *and M. Scholz*[4,5]

[1]ESO, Garching, Germany

[2]U. S. Naval Observatory, Washington, DC, USA

[3]Max-Planck-Institut für Radioastronomie, Bonn, Germany

[4]University of Heidelberg, Heidelberg, Germany

[5]University of Sydney, Sydney, Australia

We present the first multi-epoch study that includes concurrent mid-infrared and radio interferometry of an oxygen-rich Mira star. We obtained mid-infrared interferometry of S Ori with VLTI/MIDI at four epochs in December 2004, February/March 2005, November 2005, and December 2005. We concurrently observed v=1, J=1-0 (43.1 GHz), and v=2, J=1-0 (42.8 GHz) SiO maser emission toward S Ori with the VLBA in January, February, and November 2005. The MIDI data are analyzed using self-excited dynamic model atmospheres including molecular layers, complemented by a radiative transfer model of the circumstellar dust shell. The VLBA data are reduced to the spatial structure and kinematics of the maser spots. The modeling of our MIDI data results in phase-dependent continuum photospheric angular diameters of 9.0 ± 0.3 mas (phase 0.42), 7.9 ± 0.1 mas (0.55), 9.7 ± 0.1 mas (1.16), and 9.5 ± 0.4 mas (1.27). The dust shell can best be modeled with Al_2O_3 grains using phase-dependent inner boundary radii between 1.8 and 2.4 photospheric radii. The dust shell appears to be more compact with greater optical depth near visual minimum ($\tau_V \sim 2.5$), and more extended with lower optical depth after visual maximum ($\tau_V \sim 1.5$). The ratios of the 43.1 GHz/42.8 GHz SiO maser ring radii to the photospheric radii are $2.2 \pm 0.3/2.1 \pm 0.2$ (phase 0.44), $2.4 \pm 0.3/2.3 \pm 0.4$ (0.55), and $2.1 \pm 0.3/1.9 \pm 0.2$ (1.15). The maser spots mark the region of the molecular atmospheric layers just beyond the steepest decrease in the mid-infrared model intensity profile. Their velocity structure indicates a radial gas expansion. S Ori shows significant phase-dependences of photospheric radii and dust shell parameters. Al_2O_3 dust grains and SiO maser spots form at relatively small radii of $\sim 1.8 - 2.4$ photospheric radii. Our results suggest increased mass loss and dust formation close to the surface near the minimum visual phase, when Al_2O_3 dust grains are co-located with the molecular gas and the SiO maser shells, and a more expanded dust shell after visual maximum. Silicon does not appear to be bound in dust, as our data show no sign of silicate grains.

Accepted for publication in A&A

Available from arXiv:0705.4614

and from ESO press release 25/07 at http://www.eso.org/public/outreach/press-rel/pr-2007/pr-25-07.html

Conference Paper

On the Connection between Mass Loss and Evolution of C-rich AGB stars

Lars Mattsson[1], *Susanne Höfner*[1], *Rurik Wahlin*[1] *and Falk Herwig*[2]

[1]Department of Astronomy and Space Physics, Uppsala University, Box 515, SE-751 20 Uppsala, Sweden

[2]Keele Astrophysics Group, School of Physical and Geographical Sciences, Keele University, Staffordshire ST5 5BG, UK

The mass loss properties of carbon AGB stars are not very well constrained at present. A variety of empirical or theoretical formulae with different parameterisations are available in the literature and the agreement between them is anything but good. These simple mass loss prescriptions are nontheless used in many models of stellar evolution without much consideration of their applicability in various cases. We present here an on-going project aiming at a better description of the mass loss, that could be used to improve stellar evolution models — especially the evolution during the TP-AGB phase. As a first step, we have considered the mass loss evolution during a He-shell flash. Using stellar parameters sampled from a stellar evolutionary track, we have computed the time evolution of the atmospheric layers and wind acceleration region during a flash event with detailed frequency-dependent radiation-hydrodynamical

models including dust formation. Based on these results, we have also simulated the subsequent long-term dynamical evolution of the circumstellar envelope (CSE), including the formation of a detached shell. We find that existing simple mass loss prescriptions imply different mass loss evolutions compared with our model. The second step of the project deals with the dependence of mass loss on the basic stellar parameters. At the moment we are computing a large grid of wind models for C-rich AGB stars. Preliminary results show that simple parameterisations are difficult to obtain in certain regions of the parameter space considered, due to strong non-linearities in the wind mechanism.

Oral contribution, published in "Why Galaxies Care about AGB Stars", held in Vienna, August 7-11, 2006; eds. F. Kerschbaum, C. Charbonnel & B. Wing, ASP Conf.Ser.
Available from arXiv:0705.2315

Announcements

IAU symposium 251: Organic Matter in Space

Hong Kong, China
February 18-22, 2008

Recent infrared spectroscopic observations have found evidence of complex carbonaceous compounds with aromatic and aliphatic structures in circumstellar and interstellar media. Laboratory isotopic analysis of meteorites and interplanetary dust collected in the upper atmosphere have revealed the presence of pre-solar grains similar to those formed in evolved stars. Primitive meteorites and interplanetary dust particles also contain complex organics, at least some of which show isotopic evidence that they have an interstellar heritage. Spectroscopic studies of comets and asteroids also show spectral signatures of organics. In fact, the molecular composition of comets has been found to closely resemble that of dense interstellar clouds. The direct link between star dust and the solar system therefore suggests that the early solar system was chemically enriched by both stellar ejecta and the products of interstellar processing. Millimeter and submm observations have detected rotational transitions of over 140 molecules, including hydrocarbons, alcohols, acids, aldehydes, ketones, amines, ethers, and other organic molecules. Organic molecules and compounds are also believed to be the carriers of the diffuse interstellar bands, the 2175 Å extinction feature, and the extended red emission. More precise identifications of the organic materials found in space and the processing they have undergone will depend on close working relationships between astronomers and laboratory spectroscopists.

The Cassini mission and the Huygens probe have returned new results on the chemical composition of planetary and satellite atmospheres. There is an increasing recognition that organic compounds are major constituents of the atmosphere and surface of Titan. In addition, the Stardust mission has recently returned samples from the Comet 81P/Wild 2 and is currently providing us with a great opportunity to examine the content of stellar and interstellar material in the solar system. This, in conjunction with recent progress in laboratory simulations of stardust, will open up a new area of research tying together astronomy, chemistry, geology, and even biology.

In this symposium, we intend to assemble observational astronomers, laboratory spectroscopists, and solar system scientists to share their expertise in order to come up with new ideas for the solution to the many unsolved mysteries associated with the origin, evolution, and distribution of organic matter in space.

Conference location

The conference will be held at the University of Hong Kong, Hong Kong, China. The city of Hong Kong has a very strong international character with a mixed culture of east and west. It is a major air hub in Asia with extensive air connections to major cities in all five continents.

Scientific Organizing Committee:

Peter Bernath	U.K.
Thomas Geballe	U.S.A.
Thomas Henning	Germany
William Irvine	U.S.A.
Sun Kwok	China (co-chair)
Karl Menten	Germany
Tom Millar	U.K.
Yvonne Pendleton	U.S.A.
Scott Sandford	U.S.A. (co-chair)
Setsuko Wada	Japan
Ernst Zinner	U.S.A.

Local organizing committee:

Kwing Chan (HKUST), K.S. Cheng (HKU), Albert C. Cheung (City U), Allan Cheung (HKU), Sun Kwok (HKU, chair), Chun Ming Leung (HK Open U), Junichi Nakashima (HKU), Steve Pointing (HKU), Jason Pun (HKU, chair)

Important dates:

Deadline for application of IAU travel grant: September 15, 2007

Deadline for submission of abstracts: October 15, 2007

Deadline for early registration: November 30, 2007

Deadline for submission of manuscript: March 31, 2008 (IAU deadline for the edited manuscript to reach CUP is end of May, 2008 and the publication date is end of August 2008).

We would like to invite you to join us in the symposium. Details and current information can be found at the conference web site www.hku.hk/science/iau251.

See also www.hku.hk/science/iau251

Explosive and Quiescent Stellar Mass Loss, and The Origins of Dust in the Universe

Electronic versions are available of most of the talks and posters presented at the following two sessions at the UK National Astronomy Meeting in Preston, on 17 April 2007:

"Explosive and Quiescent Stellar Mass Loss" - http://www.astro.keele.ac.uk/e-stars/nam2007/session12.html

"The Origins of Dust in the Universe" - http://www.astro.keele.ac.uk/e-stars/nam2007/session33.html

These sessions were organised by the UK Working Group on Evolved Stars, and cover a range of topics including AGB stars and their descendants

Jacco van Loon & Albert Zijlstra
contact: jacco@astro.keele.ac.uk

See also http://www.astro.keele.ac.uk/e-stars