THE AGB NEWSLETTER

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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Figure 1: Planetary nebula Fr 2-25 (David Frew, 2008) or Alv–Kn 1 (Filipe Alves & Matthias Kronberger, 2012) is a large (20′), old nebula in Monoceros, interacting with the surrounding interstellar medium. For more details see http://www.chart32.de/index.php/component/k2/item/155.

Editorial

Dear Colleagues,

It is a pleasure to present you the 260$^{\text{th}}$ issue of the AGB Newsletter. There are some very interesting papers on the effect of mass loss on planetary system architecture and on the origin of interstellar asteroids. Gaia data are also being put to good use.

If you like dust or other stuff in space, take your pick from three conferences (or go to them all).

If you don't yet have a Ph.D. then why not consider working towards one in Leuven?

Efrat Sabach and Noam Soker responded to the Food for Thought statements of the previous two issues ("How large will the Sun really become?" and "What fraction of stars evolve as single stars all the way to the PN phase?"):

"We start by what we find to be the relevant term: A Jsolated star. We think that the important question is whether a companion enhances the mass loss rate during the very late giant phases of the star (upper RGB or upper AGB phase). A stellar companion at a large orbital separation will do nothing, while a close Jupiter-like planet and more massive sub-stellar objects will enhance the mass loss rate, e.g., by depositing angular momentum to the envelope.
We term the stars that are isolated from angular momentum (J) deposition by a companion J-isolated stars, or Jsolated stars. We think that Jsolated stars suffer from a lower mass loss rate on the AGB than non-Jsolated stars, and hence reach larger radii and luminosities on the upper AGB.
The sun is a Jsolated star because it will not swallow Jupiter, hence we predict the mass loss rate on the AGB will be lower than most estimates. Our calculations show that under this assumption the Sun will reach a maximum radius of up to 300 $R_\odot$ and more (Sabach and Soker 2018b, http://adsabs.harvard.edu/abs/2018MNRAS.479.2249S), twice as much as predicted by traditional estimates.
These larger radii allow AGB stars to swallow far away planets and hence turn into non-Jsolated stars. Combining with the results of De Marco and Soker (2011, http://adsabs.harvard.edu/abs/2011PASP..123..402D) we now estimate that about half of 1–8 $M_\odot$ stars reach the AGB as Jsolated stars and the mass loss rate will be too low to form a detectable PN. We further estimate that about fifth of all PNe are faint and circular and have resulted from Jsolated stars afterall, and about fifth of PNe were shaped by sub-stellar objects."

Tomasz Kamiński (Tomek) suggested this month's Food for Thought (see below) and he has very kindly volunteered to set it up if there is sufficient demand for it.

The next issue is planned to be distributed around the 1$^{\text{st}}$ of April.

Editorially Yours,
Jacco van Loon, Ambra Nanni and Albert Zijlstra

Food for Thought

This month's thought-provoking statement is:

Do we need an AGB group on Facebook to have more vivid discussion on the field?

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

Refereed Journal Papers

IFU spectroscopy of Southern PNe: VII Photo-ionization modelling of intermediate excitation class objects

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We present integral field unit spectroscopic observations of southern Galactic planetary nebulæ (PNe), IC 2501, Hen 2-7, and PB 4. The goal of studying these objects together is that, although they have roughly similar intermediate excitation and evolution of central stars (CSs), they display very different evolution in their nebular structure which needs to be understood. The morphologies and ionisation structures of the objects are investigated using a set of emission-line maps representative of the different ionisation zones. We use those in order to construct two-zone self-consistent photo-ionization models for each nebula to determine new model-dependent distances, progenitor luminosities, effective temperatures and CS masses. The physical conditions, chemical compositions, and expansion velocities and ages of these nebulæ are derived. In Hen 2-7 we discover a strong poleward-directed jet from the presumed binary CS. Oxygen and nitrogen abundances derived from both collisionally excited and recombination lines reveal that PB 4 displays an extreme abundance discrepancy factor, and we present evidence that this is caused by fluorescent pumping of the O II ion by the EUV continuum of an interacting binary CS, rather than by recombination of the O III ion. Both IC 2501 and PB 4 were classified by others as Weak Emission Line Stars (WELS). However, our emission line maps show that their recombination lines are spatially extended in both objects, and are therefore of nebular rather than CS origin. Given that we have found this result in a number of other PNe, this result casts further doubt on the reliability, or even the reality, of the WELS classification.

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Available from https://arxiv.org/abs/1902.00742
and from http://adsabs.harvard.edu/doi/10.1093/mnras/stz201

The central star of planetary nebula PHR 1315−6555 and its host Galactic open cluster AL 1

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PHR 1315−6555 is a rare case of a Galactic Planetary Nebula that is a proven member of the Open Cluster AL 1. This allows its distance to be defined with precision and thus the accurate measurement of its physical characteristics along with the parameters of its Central Star (CS). In this work we use HST to detect this unique CS and constrain the cluster's physical parameters. Our results suggest that the cluster rests at a distance of ~ 12 kpc, is highly reddened, and has an age of around 0.66 Gyrs and a turn-off mass of ~ 2.2 $M_\odot$. Our deep Colour–Magnitude Diagram (CMD) suggests that the metallicity of the cluster is subsolar ($Z = 0.006$). Our photometric measurements indicate that the PN's core is a faint blue star close to the nebular apparent centre, with an observed dereddened visual VEGA magnitude of 21.82 ± 0.60. A significant contribution from any possible binary companion is unlikely but possible. Our results show that the CS has an effective Zanstra temperature of around 113 kK and a mass of 0.58 $M_\odot$ providing a unique additional point to the fundamental White Dwarf Initial-to-Final-Mass Relation.

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Available from https://arxiv.org/abs/1901.04174

The role of internal photons on the chemistry of the circumstellar envelopes of AGB stars

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Recent high spatial resolution observations of gas and dust in the circumstellar envelopes (CSEs) of AGB stars indicate morphologies much more complex than the smooth density distributions generated by spherically symmetric, constant mass loss rates. In particular, the observation of spiral arcs and disks indicate the likely presence of a binary companion which in some cases give rise to the UV photons detected by GALEX. In this article, we extend our recent model of the chemistry in a clumpy, porous CSE around an AGB star to include the influence of stellar blackbody photons on the CSE chemistry. Our results indicate that internal photons, in a clumpy, porous CSE, can alter chemistry within a few stellar radii and, for some molecules, alter abundances out to several hundred stellar radii. They further suggest that harder radiation from companion stars or accretion disks will have a substantial impact on chemistry in the dust formation zones and inner CSEs of AGB stars.

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A census of symbiotic stars in the 2MASS, WISE, and Gaia surveys

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We present a new census of Galactic and extragalactic symbiotic stars (SySts). This compilation contains 323 known and 87 candidate SySts. Of the confirmed SySts, 257 are Galactic and 66 extragalactic. The spectral energy distributions (SEDs) of 348 sources have been constructed using 2MASS and AllWISE data. Regarding the Galactic SySts, 74% are S types, 13% D, and 3.5% D′. S types show an SED peak between 0.8 and 1.7 μm,whereas D types show a peak at longer wavelengths between 2 and 4 μm. D′ types, on the other hand, display a nearly flat profile. Gaia distances and effective temperatures are also presented. According to their Gaia distances, S types are found to be members of both thin and thick Galactic disk populations, while S+IR and D types are mainly thin disk sources. Gaia temperatures show a reasonable agreement with the temperatures derived from SEDs within their uncertainties. A new census of the O˙VI λ6830 Raman-scattered line in SySts is also presented. From a sample of 298 SySts with available optical spectra, 55% are found to emit the line. No significant preference is found among the different types. The report of the O VI λ6830 Raman-scattered line in non-SySts is also discussed as well as the correlation between the Raman-scattered O VI line and X-ray emission. We conclude that the presence of the O VI Raman-scattered line still provides a strong criterion for identifying a source as a SySt.

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The puzzling high velocity G5 supergiant star HD 179821: new insight from Gaia DR2 data

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HD 179821 is classified as G5 Ia star. From the IRAS colors and spectral energy distributions it was classified as a post-AGB star. But some studies classify it as a massive (30 to 19 $M_\odot$) post-red supergiant evolving to become a Type II supernova. Its mass and evolutionary status remained a hotly debated question even after several detailed spectroscopic studies as the distance was not known. We use the parallax of HD 179821 from the second Gaia data release, and deduce its distance 2959 ± 409 pc and its absolute magnitude $M_V = -5.7 \pm 0.3$. Using the absolute magnitude determined in this paper, we show that HD 179821 fits very well with post-AGB tracks in the H–R diagram. Our results clearly confirm that HD 179821 is a post-AGB star of mass ~ 0.8 $M_\odot$. It is not a 30 $M_\odot$ red supergiant. The progenitor mass of this post-AGB star may be ~ 4 $M_\odot$ but may be a bit more.

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Abundances and kinematics of carbon-enhanced metal-poor stars in the Galactic halo; A new classification scheme based on Sr and Ba

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Carbon-enhanced metal-poor (CEMP) stars span a wide range of stellar populations, from bona fide second-generation stars to later-forming stars that provide excellent probes of binary mass transfer and stellar evolution. Here we analyse 11 metal-poor stars (8 of which are new to the literature), and demonstrate that 10 are CEMP stars. Based on high signal-to-noise ratio (S/N) X-Shooter spectra, we derive abundances of 20 elements (C, N, O, Na, Mg, Ca, Sc, Ti, Cr, Mn, Fe, Ni, Sr, Y, Ba, La, Ce, Pr, Nd, and Eu). From the high-S/N spectra, we were able to trace the chemical contribution of the rare earth elements (REE) from various possible production sites, finding a preference for metal-poor low-mass asymptotic giant branch (AGB) stars of 1.5 $M_\odot$ in CEMP-s stars, while CEMP-r/s stars may indicate a more massive AGB contribution (2–5 $M_\odot$). A contribution from the r-process – possibly from neutron star–neutron star mergers (NSM) – is also detectable in the REE stellar abundances, especially in the CEMP-r/s sub-group rich in both slow(s) and rapid(r) neutron-capture elements. Combining spectroscopic data with Gaia DR2 astrometric data provides a powerful chemo-dynamical tool for placing CEMP stars in the various Galactic components, and classifying CEMP stars into the four major elemental-abundance sub-groups, which are dictated by their neutron-capture element content. The derived orbital parameters indicate that all but one star in our sample (and the majority of the selected literature stars) belong to the Galactic halo. These stars exhibit a median orbital eccentricity of 0.7, and are found on both prograde and retrograde orbits. We find that the orbital parameters of CEMP-no and CEMP-s stars are remarkably similar in the 98 stars we study. A special case is the CEMP-no star HE 0020−1741, with very low Sr and Ba content, which possesses the most eccentric orbit among the stars in our sample, passing close to the Galactic centre. Finally, we propose an improved scheme to sub-classify the CEMP stars, making use of the Sr/Ba ratio, which can also be used to separate very metal-poor stars from CEMP stars. We explore the use of [Sr/Ba] versus [Ba/Fe] in 93 stars in the metallicity range $-4.2 \lesssim$ [Fe/H] < -2. We show that the Sr/Ba ratio can also be successfully used

for distinguishing CEMP-s, CEMP-r/s, and CEMP-no stars. Additionally, the Sr/Ba ratio is found to be a powerful astro-nuclear indicator, since the metal-poor AGB stars exhibit very different Sr/Ba ratios compared to fast-rotating massive stars and NSM, and is also reasonably unbiased by NLTE and 3D corrections.

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Ca line formation in late-type stellar atmospheres: I. The model atom

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Context: Departures from local thermodynamic equilibrium (LTE) distort the calcium abundance derived from stellar spectra in various ways, depending on the lines used and the stellar atmospheric parameters. The collection of atomic data adopted in non-LTE (NLTE) calculations must be sufficiently complete and accurate.
Aims: We derive NLTE abundances from high-quality observations and reliable stellar parameters using a model atom built afresh for this work, and check the consistency of our results over a wide wavelength range with transitions of atomic and singly ionised calcium.
Methods: We built and tested Ca I and Ca II model atoms with state-of-the-art radiative and collisional data, and tested their performance deriving the Ca abundance in three benchmark stars: Procyon, the Sun, and Arcturus. We have excellent-quality observations and accurate stellar parameters for these stars. Two methods to derive the LTE / NLTE abundances were used and compared. The LTE / NLTE centre-to-limb variation (CLV) of Ca lines in the Sun was also investigated.
Results: The two methods used give similar results in all three stars. Several discrepancies found in LTE do not appear in our NLTE results; in particular the agreement between abundances in the visual and infra-red (IR) and the Ca I and Ca II ionisation balance is improved overall, although substantial line-to-line scatter remains. The CLV of the calcium lines around 6165 Å can be partially reproduced. We suspect differences between our modelling and CLV results are due to inhomogeneities in the atmosphere that require 3D modelling.

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Hubble Space Telescope photometry of multiple stellar populations in the inner parts of NGC 2419

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We present new deep imaging of the central regions of the remote globular cluster NGC 2419, obtained with the F343N and F336W filters of HST/WFC3. The new data are combined with archival imaging to constrain nitrogen and helium abundance variations within the cluster. We find a clearly bimodal distribution of the nitrogen-sensitive F336W–F343N colours of red giants, from which we estimate that about 55% of the giants belong to a population

with about normal (field-like) nitrogen abundances (P1), while the remaining 45% belong to a nitrogen-rich population (P2). On average, the P2 stars are more He-rich than the P1 stars, with an estimated mean difference of $\Delta Y \simeq 0.05$, but the P2 stars exhibit a significant spread in He content and some may reach $\Delta Y \simeq 0.13$. A smaller He spread may be present also for the P1 stars. Additionally, stars with spectroscopically determined low [Mg/Fe] ratios ([Mg/Fe] < 0) are generally associated with P2. We find the P2 stars to be slightly more centrally concentrated in NGC 2419 with a projected half-number radius of about 10% less than for the P1 stars, but the difference is not highly significant ($p = 0.05$). We find evidence of rotation for the P1 stars, whereas the results are inconclusive for the P2 stars, which are consistent with no rotation as well as the same average rotation found for the P1 stars. Because of the long relaxation time scale of NGC 2419, the radial trends and kinematic properties of the populations are expected to be relatively unaffected by dynamical evolution. Hence, they provide constraints on formation scenarios for multiple populations, which must account not only for the presence of He spreads within sub-populations identified via CNO variations, but also for the relatively modest differences in the spatial distributions and kinematics of the populations.

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The temperature and density from permitted O II lines in the planetary nebula NGC 7009

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We present spatial- and velocity-resolved spectroscopy of NGC 7009 acquired with the UVES spectrograph at the VLT UT2/Kueyen. We use these data to determine the structure of the electron temperature and electron density based upon O II permitted (recombination) lines. We find a strong gradient in the O II-based electron temperature. It agrees with the electron temperature determined by forbidden (collisionally excited) lines in part of the nebular volume, but also differs by more than 6000 K in other parts of the nebular volume. This result supports the hypothesis that NGC 7009 contains two plasma components, one of which emits both forbidden and permitted lines and the other that emits only permitted lines. For the component that emits only permitted lines, we find a lower limit to the electron density of 10^4 cm^{-3} from the O II permitted lines, which is higher than derived from forbidden lines. We are unable to determine whether the two plasma components are in pressure equilibrium from our data, but there exist temperature and density combinations that allow this equilibrium for temperatures between 600 and 6000 K. For most of the temperature and density conditions allowed for the component that emits only permitted lines, its mass of O^{2+} is less than that of the plasma component that emits forbidden lines.

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The fate of AGB winds in massive galaxies and the ICM

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Asymptotic Giant Branch (AGB) winds from evolved stars not only provide a non-trivial amount of mass and energy return, but also produce dust grains in massive elliptical galaxies. Due to the fast stellar velocity and the high ambient temperature, the wind is thought to form a comet-like tail, similar to Mira in the Local Bubble. Many massive elliptical galaxies and cluster central galaxies host extended dusty cold filaments. The fate of the cold dusty stellar wind and its relation to cold filaments are not well understood. In this work, we carry out both analytical and numerical studies of the interaction between an AGB wind and the surrounding hot gas. We find that the cooling time of the tail is inversely proportional to the ambient pressure. In the absence of cooling, or in low pressure environments (e.g., the outskirts of elliptical galaxies), AGB winds are quickly mixed into the hot gas, and all the AGB winds have similar appearance and head-to-tail ratio. In high pressure environments, such as the Local Bubble and the central regions of massive elliptical galaxies, some of the gas in the mixing layer between the stellar wind and the surrounding hot gas can cool efficiently and cause the tail to become longer. Our simulated tail of Mira itself has similar length and velocity to that observed, and appears similar to the simulated AGB tail in the central regions of massive galaxies. We speculate that instead of thermal instability, the induced condensation at the mixing layer of AGB winds may be the origin of cold filaments in massive galaxies and galaxy clusters. This naturally explains the existence of dust and PAH in the filaments.

Submitted to ApJ

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HD 101584: circumstellar characteristics and evolutionary status

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There is growing evidence that red giant evolution is often affected by an interplay with a nearby companion, in some cases taking the form of a common-envelope evolution. We have performed a study of the characteristics of the circumstellar environment of the binary object HD 101584, that provides information on a likely evolutionary scenario. We have obtained and analysed ALMA observations, complemented with observations using APEX, of a large number of molecular lines. An analysis of the spectral energy distribution has also been performed. Emissions from 12 molecular species (not counting isotopologues) have been observed, and most of them mapped with angular resolutions in the range $0''.1$ to $0''.6$. Four circumstellar components are identified: i) a central compact source of size $\approx 0''.15$, ii) an expanding equatorial density enhancement (a flattened density distribution in the plane of the orbit) of size $\approx 3''$, iii) a bipolar high-velocity outflow (≈ 150 km s^{-1}), and iv) an hourglass structure. The outflow is directed almost along the line of sight. There is evidence of a second bipolar outflow. The mass of the circumstellar gas is $\approx 0.5\,[D/1\,\mathrm{kpc}]^2$ M$_\odot$, about half of it lies in the equatorial density enhancement. The dust mass is $\approx 0.01\,[D/1\,\mathrm{kpc}]^2$ M$_\odot$, and a substantial fraction of this is in the form of large-sized, up to 1-mm, grains. The estimated kinetic age of the outflow is $\approx 770\,[D/1\,\mathrm{kpc}]$ yr. The kinetic energy and the scalar momentum of the accelerated gas are estimated to be $7 \times 10^{45}\,[D/1\,\mathrm{kpc}]^2$ erg and $10^{39}\,[D/1\,\mathrm{kpc}]^2$ g cm s^{-1}, respectively. We provide good evidence that the binary system HD 101584 is in a post-common-envelope-evolution phase, that ended before a stellar merger. Isotope ratios combined with stellar mass estimates suggest that the primary star's evolution was terminated already on the first red giant branch (RGB). Most of the energy required to drive the outflowing gas was probably released when material fell towards the companion.

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Enrichment of the Galactic disc with neutron capture elements: Sr

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The enrichment history of heavy neutron-capture elements in the Milky Way disc provides fundamental information about the chemical evolution of our Galaxy and about the stellar sources that made those elements. In this work we give new observational data for Sr, the element at the first neutron-shell closure beyond iron, $N = 50$, based on the analysis of the high resolution spectra of 276 Galactic disc stars. The Sr abundance was derived by comparing the observed and synthetic spectra in the region of the Sr I 4607 Å line, making use of the LTE approximation. NLTE corrections lead to an increase of the abundance estimates obtained under LTE, but for these lines they are minor near solar metallicity. The average correction that we find is 0.151 dex. The star that is mostly affected is HD 6582, with a 0.244 dex correction. The behaviour of the Sr abundance as a function of metallicity is discussed within a stellar nucleosynthesis context, in comparison with the abundance of the heavy neutron-capture elements Ba ($Z = 56$) and Eu ($Z = 63$). The comparison of the observational data with the current GCE models confirm that the *s*-process contributions from Asymptotic Giant Branch stars and from massive stars are the main sources of Sr in the Galactic disc and in the Sun, while different nucleosynthesis sources can explain the high [Sr/Ba] and [Sr/Eu] ratios observed in the early Galaxy.

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Discovery of kilogauss magnetic fields on the nearby white dwarfs WD 1105−340 and WD 2150+591

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Magnetic fields are present in roughly 10% of white dwarfs. These fields affect the structure and evolution of such stars, and may provide clues about their earlier evolution history. Particularly important for statistical studies is the collection of high-precision spectro-polarimetric observations of (1) complete magnitude-limited samples and (2) complete volume-limited samples of white dwarfs. In the course of one of our surveys we have discovered previously unknown kG-level magnetic fields on two nearby white dwarfs, WD 1105−340 and WD 2150+591. Both stars are brighter than $m_V = 15$ mag. WD 2150+591 is within the 20-pc volume around the Sun, while WD 1105−340 is just beyond 25 pc in distance. These discoveries increase the small sample of such weak-field white dwarfs from 21 to 23 stars. Our data appear consistent with roughly dipolar field topology, but it also appears that the surface field structure may be more complex on the older star than on the younger one, a result similar to one found earlier in our study of the weak-field stars WD 2034+372 and WD 2359−434. This encourages further efforts to uncover a clear link between magnetic morphology and stellar evolution.

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A submillimeter polarization analysis of Frosty Leo

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We present a polarimetric investigation of the protoplanetary nebula Frosty Leo performed with the Submillimeter Array. We were able to detect, in the low continuum level (peak at 14.4 mJy beam^{-1}), a marginal polarization at $\sim 2.6\sigma$. The molecular line investigation based on the CO $J = 3 \rightarrow 2$ emission shows a peak emission of 68.1 Jy beam^{-1} km s^{-1} and the polarization detection in this CO line is also marginal, with a peak at $\sim 3.8\sigma$. In both cases, it was therefore not possible to use the electric vector maps (E-field) to accurately trace the magnetic field (B-field) within the PPN. The spatio-kinematic modelling realised with the different velocity channel maps indicates three main structures: a distorted torus accompanied by a bipolar outflow or jet aligned with its axis and a flattened spherical "cap". The comparison of the CO polarization segments with our model suggests that the polarized emission probably arises in the first two components.

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Carbon ^{12}C/^{13}C isotope ratio of α Aurigæ revised

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Capella (α Aur) is one of the few binaries in the sky with two cool giant stars. With spectral types of G8 III and G0 III, the two components appear at different but distinct stages in their evolution. The G0 secondary star is a Hertzsprung-gap giant, and the G8 primary star is thought to be a clump giant.
We present a new measure of the carbon ^{12}C/^{13}C isotope ratio of the primary component of Capella using high-resolution $R \approx 250\,000$ spectra obtained with the Potsdam Échelle Polarimetric and Spectroscopic Instrument (PEPSI) with both the Vatican Advanced Technology Telescope (VATT) and the Large Binocular Telescope (LBT).
Signal-to-noise ratios of up to 2 700 were obtained by averaging nightly spectra. These average spectra were used to disentangle the two binary components. The isotope ratio was derived with the use of spectrum synthesis from the CN lines at 8004 Å.
We found that the ^{12}C/^{13}C ratio of the primary component of Capella is 17.8 ± 1.9. Our measurement precision is now primarily limited by the spectral-line data and by the grid-step size of the model atmospheres rather than the data. The separated spectrum of the secondary component does not show distinguishable ^{12}CN and ^{13}CN lines because of its $v \sin i$ and higher temperature.
Our new ^{12}C/^{13}C value is significantly lower than the previous value of 27 ± 4 but now agrees better with the recent model prediction of 18.8–20.7.

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Abundance–age ratios in the HARPS-GTO sample with Gaia DR2: chemical clocks for a range of [Fe/H]

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The purpose of this work is to evaluate how several elements produced by different nucleosynthesis processes behave with stellar age and provide empirical relations to derive stellar ages from chemical abundances. We derive different sets of ages using Padova and Yonsei–Yale isochrones and *Hipparcos* and Gaia parallaxes for a sample of more than 1000 FGK dwarf stars for which he have high-resolution ($R \sim 115\,000$) and high-quality spectra from the HARPS-GTO program. We analyze the temporal evolution of different abundance ratios to find the best chemical clocks. We apply multi-variable linear regressions to our sample of stars with a small uncertainty on age to obtain empirical relations of age as a function of stellar parameters and different chemical clocks. We find that [α/Fe] ratio (average of Mg, Si and Ti), [O/Fe] and [Zn/Fe] are good age proxies with a lower dispersion than the age–metallicity dispersion. Several abundance ratios present a significant correlation with age for chemically separated thin disk stars (i.e. low-α) but in the case of the chemically defined thick disk stars (i.e. high-α) only the elements Mg, Si, Ca and Ti II show a clear correlation with age. We find that the thick disk stars are more enriched in light-s elements than thin disk stars of similar age. The maximum enrichment of s-process elements in the thin disk occurs in the youngest stars which in turn have solar metallicity. The slopes of the [X/Fe]–age relations are quite constant for O, Mg, Si, Ti, Zn, Sr and Eu regardless of the metallicity. However, this is not the case for Al, Ca, Cu and most of the s-process elements, which display very different trends depending on the metallicity. This demonstrates the limitations of using simple linear relations based on certain abundance ratios to obtain ages for stars of different metallicities. Finally, we show that by using 3D relations with a chemical clock and two stellar parameters (either $T_{\rm eff}$, [Fe/H] or stellar mass) we can explain up to 89% of age variance in a star. A similar result is obtained when using 2D relations with a chemical clock and one stellar parameter, being up to a 87% of the variance explained. The complete understanding of how the chemical elements were produced and evolved in the Galaxy requires the knowledge of stellar ages and precise chemical abundances. We show how the temporal evolution of some chemical species change with metallicity, with remarkable variations at super-solar metallicities, that will help to better constrain the yields of different nucleosynthesis processes along the history of the Galaxy.

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Speeding past planets? Asteroids radiatively propelled by giant branch Yarkovsky effects

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Understanding the fate of planetary systems through white dwarfs which accrete debris crucially relies on tracing the orbital and physical properties of exo-asteroids during the giant branch phase of stellar evolution. Giant branch luminosities exceed the Sun's by over three orders of magnitude, leading to significantly enhanced Yarkovsky and YORP effects on minor planets. Here, we place bounds on Yarkovsky-induced differential migration between asteroids and planets during giant branch mass loss by modelling one exo-Neptune with inner and outer exo-Kuiper belts. In our bounding models, the asteroids move too quickly past the planet to be diverted from their eventual fate, which can range from: (i) populating the outer regions of systems out to 10^4–10^5 au, (ii) being engulfed within the host star, or (iii) experiencing Yarkovsky-induced orbital inclination flipping without any Yarkovsky-induced semimajor axis drift. In these violent limiting cases, temporary resonant trapping of asteroids with radii of under about 10 km by the planet is insignificant, and capture within the planet's Hill sphere requires fine tuned dissipation. The wide variety of outcomes presented here demonstrates the need to employ sophisticated structure and radiative exo-asteroid models in future studies. Determining where metal-polluting asteroids reside around a white dwarf depends on understanding extreme Yarkovsky physics.

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Gas infall and possible circumstellar rotation in R Leo

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We present new interferometer molecular observations of R Leo taken at 1.2 mm with the Atacama Large Millimeter Array with an angular resolution up to $\simeq 0\farcs026$. These observations permitted us to resolve the innermost envelope of this star revealing the existence of a complex structure that involves extended continuum emission and molecular emission showing a non-radial gas velocity distribution. This molecular emission displays prominent red-shifted absorptions located right in front to the star typical of material infall and lateral gas motions compatible with the presence of a torus-like structure.

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Carbon star wind models at solar and sub-solar metallicities: a comparative study. I. Mass loss and the properties of dust-driven winds

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The heavy mass loss observed in evolved stars on the asymptotic giant branch (AGB) is usually attributed to dust-driven winds, but it is still an open question how much AGB stars contribute to the dust production in the interstellar medium, especially at lower metallicities. In the case of C-type AGB stars, where the wind is thought to be driven by radiation pressure on amorphous carbon grains, there should be significant dust production even in metal-poor environments. Carbon stars can manufacture the building blocks needed to form the wind-driving dust species themselves, irrespective of the chemical composition they have, by dredging up carbon from the stellar interior during thermal pulses.

The atmospheres and winds of C-type AGB stars are modeled with the 1D spherically symmetric radiation-hydrodynamical code Dynamic Atmosphere and Radiation-driven Wind models based on Implicit Numerics (DARWIN). The models include a time-dependent description for nucleation, growth, and evaporation of amorphous carbon grains directly out of the gas phase. To explore the metallicity-dependence of mass loss we calculate model grids at three different chemical abundances (solar, LMC, and SMC). Since carbon may be dredged up during the thermal pulses as AGB stars evolve, we keep the carbon abundance as a free parameter. The models in these three different grids all have a current mass of one solar mass; effective temperatures of 2600 K, 2800 K, 3000 K, or 3200 K; and stellar luminosities equal to $\log(L_\star/\mathrm{L}_\odot) = 3.70$, 3.85, or 4.00.

The DARWIN models show that mass loss in carbon stars is facilitated by high luminosities, low effective temperatures, and a high carbon excess (C–O) at both solar and subsolar metallicities. Similar combinations of effective temperature, luminosity, and carbon excess produce outflows at both solar and subsolar metallicities. There are no large systematic differences in the mass-loss rates and wind velocities produced by these wind models with respect to metallicity, nor any systematic difference concerning the distribution of grain sizes or how much carbon is condensed into dust. DARWIN models at subsolar metallicity have approximately 15% lower mass-loss rates compared to DARWIN models at solar metallicity with the same stellar parameters and carbon excess. For both solar and subsolar environments typical grain sizes range between 0.1 and 0.5 μm, the degree of condensed carbon varies between 5% and 40%, and the gas-to-dust ratios between 500 and 10 000.
C-type AGB stars can contribute to the dust production at subsolar metallicities (down to at least [Fe/H] = -1) as long as they dredge up sufficient amounts of carbon from the stellar interior. Furthermore, stellar evolution models can use the mass-loss rates calculated from DARWIN models at solar metallicity when modeling the AGB phase at subsolar metallicities if carbon excess is used as the critical abundance parameter instead of the C/O ratio.

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Origin of 1I/‘Oumuamua. II. An ejected exo-Oort cloud object?

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1I/‘Oumuamua is the first detected interstellar interloper. We test the hypothesis that it is representative of a background population of exo-Oort cloud objects ejected under the effect of post-main sequence mass loss and stellar encounters. We do this by comparing the cumulative number density of interstellar objects inferred from the detection of 1I/‘Oumuamua to that expected from these two clearing processes. We consider the 0.08–8 $M_\odot$ mass range, take into account the dependencies with stellar mass, Galactocentric distance, and evolutionary state, and consider a wide range of size distributions for the ejected objects. Our conclusion is that 1I/‘Oumuamua is likely not representative of this background population, even though there are large uncertainties in the masses and size distributions of the exo-Oort Clouds. We discuss whether the number density of free-floating, planetary-mass objects derived from gravitational microlensing surveys could be used as a discriminating measurement regarding 1I/‘Oumuamua’s origin (given their potential common origin). We conclude that this is challenged by the mass limitation of the surveys and the resulting uncertainty of the mass distribution of the free floaters. The detection of interlopers may be one of the few observational constraints of the small end of this population, with the caveat that, as we conclude here and in Moro-Martín (2018), in the case of 1I/‘Oumuamua, it might not be appropriate to assume this object is representative of an isotropic background population, which makes the derivation of a number density very challenging.

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Distance, luminosity and evolutionary status of ϵ Aurigæ (F0 Iaep) from Gaia DR2 parallax

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From Gaia DR2 parallax of ϵ Aurigæ the distance, M_V, $M_{\rm bol}$, and $\log(L_\star/{\rm L}_\odot)$ are found to be 445 parsecs, -6.5 mag, -6.5 mag and 4.5 respectively. These results clearly indicate that ϵ Aurigæ (F0 Iae) is a post-AGB star. The progenitor of ϵ Aurigæ is most likely an intermediate mass star of 4–5 $M_\odot$ or the progenitor may be a star which is lower mass limit of a super-AGB star.

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Exploring the origin of clumpy dust clouds around cool giants. A global 3D RHD model of a dust-forming M-type AGB star

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Dust grains forming in the extended atmospheres of AGB stars are critical for the heavy mass loss of these cool luminous giants, as they provide radiative acceleration for the stellar winds. Characteristic mid-IR spectral features indicate that the grains consist mainly of silicates and corundum. The latter species seems to form in a narrow zone within about 2 stellar radii, preceding the condensation of silicate dust, which triggers the outflow. Recent high-angular-resolution observations show clumpy, variable dust clouds at these distances. We explore possible causes for the formation of inhomogeneous dust layers, using 3D dynamical simulations. We modeled the outer convective envelope and the dust-forming atmosphere of an M-type AGB star with the CO5BOLD radiation-hydrodynamics code. The simulations account for frequency-dependent gas opacities, and include a time-dependent description of grain growth and evaporation for corundum (Al_2O_3) and olivine-type silicates (Mg_2SiO_4). In the inner, gravitationally bound, and corundum-dominated layers of the circumstellar envelope, a patchy distribution of the dust emerges naturally, due to atmospheric shock waves that are generated by large-scale convective flows and pulsations. The formation of silicate dust at somewhat larger distances probably indicates the outer limit of the gravitationally bound layers. The current models do not describe wind acceleration, but the cloud formation mechanism should also work for stars with outflows. Timescales of atmospheric dynamics and grain growth are similar to observed values. In spherical averages of dust densities, more easily comparable to unresolved observations and 1D models, the variable 3D morphology manifests itself as cycle-to-cycle variations. We conclude that grain growth in the wake of large-scale non-spherical shock waves, generated by convection and pulsations, is a likely mechanism for producing the observed clumpy dust clouds, and for explaining their physical and dynamical properties.

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An infrared census of dust in nearby galaxies with *Spitzer* (DUSTiNGS): V. The period–luminosity relation for dusty metal-poor AGB stars

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The survey for DUST In Nearby Galaxies with *Spitzer* (DUSTiNGS) has identified hundreds of candidate dust-producing Asymptotic Giant Branch (AGB) stars in several nearby metal-poor galaxies. We have obtained multi-epoch follow-up observations for these candidates with the *Spitzer* Space Telescope and measured their infrared (IR) lightcurves. This has allowed us to confirm their AGB nature and investigate pulsation behavior at very low metallicity. We have obtained high-confidence pulsation periods for 88 sources in seven galaxies. We have confirmed DUSTiNGS variable star candidates with a 20% success rate, and determined the pulsation properties of 19 sources already identified as Thermally-Pulsing AGB (TP-AGB) stars. We find that the AGB pulsation properties are similar in all galaxies surveyed here, with no discernible difference between the DUSTiNGS galaxies (down to 1.4% solar metallicity; [Fe/H] = −1.85) and the far more metal-rich Magellanic Clouds (up to 50% solar metallicity; [Fe/H] = −0.38). These results strengthen the link between dust production and pulsation in AGB stars and establish the IR Period–Luminosity (P–L) relation as a reliable tool (±4%) for determining distances to galaxies, regardless of metallicity.

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A young multipolar planetary nebula in the making – IRAS 21282+5050

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We present high-angular-resolution *Hubble* Space Telescope (HST) optical and near-infrared imaging of the compact planetary nebula (PN) IRAS 21282+5050. Optical images of this object reveal several complex morphological structures including three pairs of bipolar lobes and an elliptical shell lying close to the plane of the sky. From near infrared observations, we found a dust torus oriented nearly perpendicular to the major axis of elliptical shell. The results suggest that IRAS 21282+5050 is a multipolar PN, and these structures developed early during the post asymptotic-giantbranch (AGB) evolution. From a three-dimensional (3-D) model, we derived the physical dimensions of these apparent structures. When the 3-D model is viewed from different orientations, IRAS 21282+5050 shows similar apparent structures as other multipolar PNs. Analysis of the spectral energy distribution and optical spectroscopic observations of the nebula suggests the presence of a cool companion to the hot central star responsible for the ionization of the nebula. Whether the binary nature of the central star has any relations with the multipolar structure of the nebula needs to be further investigated.

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Reduced maximum mass-loss rate of OH/IR stars due to unnoticed binary interaction

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In 1981, the idea of a superwind that ends the life of cool giant stars was proposed. Extreme OH/IR-stars develop

superwinds with the highest mass-loss rates known so far, up to a few 10^{-4} $M_\odot$ yr^{-1}, hence informing our understanding of the maximum mass-loss rate achieved during the Asymptotic Giant Branch (AGB) phase. A condundrum arises whereby the observationally determined duration of the superwind phase is too short for these stars to become white dwarfs. Here, we report on the detection of spiral structures around two cornerstone extreme OH/IR-stars, OH 26.5+0.6 and OH 30.1−0.7, identifying them as wide binary systems. Hydrodynamical simulations show that the companion's gravitational attraction creates an equatorial density enhancement mimicking a short extreme superwind phase, thereby solving the decades-old conundrum. This discovery restricts the maximum mass-loss rate of AGB stars around the single-scattering radiation-pressure limit of a few 10^{-5} $M_\odot$ yr^{-1}. This brings about crucial implications for nucleosynthetic yields, planet survival, and the wind-driving mechanism.

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Detection of highly excited OH towards AGB stars: a new probe of shocked gas in the extended atmospheres

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We report the detection and investigate the properties of high-excitation λ-doubling line emission of hydroxyl (OH) detected towards three asymptotic giant branch (AGB) stars (W Hya, R Dor, and IK Tau) using ALMA. The OH lines are produced very close to the central stars and seem optically thin and with no maser effect. We analyse the molecular excitation using a population diagram and find rotational temperatures of ~ 2500 K and column densities of $\sim 10^{19}$ cm^{-2} for both W Hya and R Dor. For W Hya, we observe emission from vibrationally excited H_2O arising from the same region as the OH emission. Moreover, CO $v = 1$; $J = 3$–2 emission also shows a brightness peak in the same region. Considering optically thin emission and the rotational temperature derived for OH, we find a CO column density ~ 15 times higher than that of OH, within an area of (92×84) mas^2 centred on the OH emission peak. These results should be considered tentative because of the simple methods employed. The observed OH line frequencies differ significantly from the predicted transition frequencies in the literature, and provide the possibility of using OH lines observed in AGB stars to improve the accuracy of the Hamiltonian used for the OH molecule. We predict stronger OH λ-doubling lines at millimetre wavelengths than those we detected. These lines will be a good probe of shocked gas in the extended atmosphere and are possibly even suitable as probes of the magnetic field in the atmospheres of close-by AGB stars through the Zeeman effect.

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Conference Papers

Spectral analysis of the binary nucleus of the planetary nebula Hen 2-428 – first results

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Identifying progenitor systems for the double-degenerate scenario is crucial to check the reliability of type Ia supernovæ

as cosmological standard candles. Santander-García et al. (2015) claimed that Hen 2-428 has a double degenerate core whose combined mass significantly exceeds the Chandrasekhar limit. Together with the short orbital period (4.2 hours), the authors concluded that the system should merge within a Hubble time triggering a type Ia supernova event. García-Berro et al. (2016) explored alternative scenarios to explain the observational evidence, as the high mass conclusion is highly unlikely within predictions from stellar evolution theory. They conclude that the evidence supporting the supernova progenitor status of the system is premature. Here we present the first quantitative spectral analysis of Hen 2-428 which allows us to derive the effective temperatures, surface gravities and helium abundance of the two CSPNe based on state-of-the-art, non-LTE model atmospheres. These results provide constrains for further studies of this particularly interesting system.

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On possibility of detection of emission from nanodiamonds in vicinity of stellar objects: laboratory spectroscopy and observational data

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[3]SAO RAS, N.Arkhyz, Russia
[4]Instituto de Astronomía, Univ. Católica del Norte, Antofagasta, Chile

Based on extensive laboratory characterization of presolar nanodiamonds extracted from meteorites, we have proposed a novel approach to detect nanodiamonds at astrophysical objects using the 7370 Å emission band arising from lattice defects. Details of laboratory spectroscopic studies and preliminary results of observations are presented.

Oral contribution, published in "Modern stellar astronomy 2018", Volume 1, eds. O.Yu. Malkov, V.N. Obridko, A.S. Rastorguev & N.N. Samus, pp.311–314
Available from https://arxiv.org/abs/1901.10360

Job Advert

Ph.D. position:
second generation protoplanetary discs around evolved binaries

The Institute of Astrophysics of the K.U. Leuven (Belgium) seeks a highly-motivated excellent Ph.D. candidate ready to complement our team in our project to investigate binary interaction physics in low- to intermediate mass stars using high angular resolution techniques.

The impact of binarity on the evolution of low- to intermediate mass stars is an important yet poorly understood domain of stellar astrophysics. This project focuses on those interacting systems where one of the components has gone through a giant star phase. At the end of their life some binary stars form Keplerian discs of gas and dust with similar properties to the planet-forming discs around young stars (also called protoplanetary discs). Around evolved binaries, these scaled-up versions of protoplanetary discs form as the result of an unconstrained binary interaction process taking place at the end of the asymptotic giant branch evolution of the initially most massive star. Dynamical interactions between the binary and its circumbinary disc strongly influence the evolution of these objects. However, these interactions are poorly constrained and the discs structure, dispersal and evolution remain elusive.

With this project we focus on the very inner structure and aim at spatially resolving all building blocks of these systems and their interactions. We will use a combination of very specific observational data as well as state-of-the art radiative transfer modelling tools. This Ph.D. project is embedded into a larger research project for which we recently obtained a large programme of observations, called "Inspiring", at the Very Large Telescope Interferometer of the European Southern Observatory. This large programme aims to image at an astronomical unit scale the disc-binary interactions in post-AGB binary systems. This research will open new windows to study, in space and time, dust sublimation physics, disc-binary interactions, and circumstellar disc evolution.

The student will be involved in writing observing proposals, data reduction and analysis, detailed modelling and astrophysical interpretation of the results. Prior knowledge in high angular resolution astrophysics, radiative transfer modeling and/or stellar evolution would be an asset.

Additional information can be obtained by contacting Prof. Hans Van Winckel (Hans.VanWinckel@kuleuven.be) or Dr. Jacques Kluska (Jacques.Kluska@kuleuven.be)

See also https://fys.kuleuven.be/ster/vacancies/vacancies

Announcements

Celebrating the first 40 years of Alexander Tielens' contribution to Science: The Physics and Chemistry of the ISM

Dates and venue

The symposium will be held 2–6 September 2019 in the historical Congres du Palais des Papes, Avignon, France (http://www.avignon-congres.com/).

Rationale

Xander Tielens has been driving research in the fields of interstellar physics and chemistry and the cosmic cycle of matter with outstanding contributions for 40 years. With this meeting, we wish to celebrate his scientific achievements and discuss future research directions opened up by his contributions.

The meeting will focus on the fields strongly influenced by Xander involving the physical and chemical processes that control the interstellar medium and its life cycle: PDRs, interstellar and circumstellar dust, PAHs, ices and astrochemistry. We will especially emphasize future opportunities offered by the powerful telescopes at our disposal such as, for example, ALMA, SOFIA, and JWST.

The meeting will consist of invited reviews, invited and contributed talks, and posters.

Key dates

- February 11: Opening of the registration and abstract submission on the symposium website
- June 1: Deadline of Abstract submission for oral contributions
- June 15: Announcement of the selected oral contributions
- June 20: Deadline of registration

Please note that the symposium participation is restricted to 120 persons, based on first-signed first-selected, so do not delay your registration!

Confirmed invited speakers

L. Allamandola, N. Balucani, A. Boogert, F. Boulanger, S. Cazaux, J. Cernicharo, L. d'Hendecourt, T. de Graauw, J. Goicoechea, H. Habing, D. Hollenbach, C. Joblin, B. Lefloch, M. Kaufman, C. Kemper, M. Meixner, T. Millar, T. Onaka, M.-E. Palumbo, E. Roueff, K. Schuster, E. van Dishoeck, R. Waters

Scientific Organizing Committee

C. Ceccarelli (chair), A. Candian (co-chair), J. Cami, C. Dominik, L. Hornekær, K. Justtanont, E. Peeters, M. Wolfire

Local Organizing Committee

B. Lefloch (chair), E. Bianchi, C. Borye, M. Bouvier, M. De Simone, M.-H. Sztefek

Contacts

loc-XT2019@univ-grenoble-alpes.fr

See also https://tielens2019.sciencesconf.org/

Cosmic Dust

Venue:

Chiba Institute of Technology
Tsudanuma 2-17-1
Narashino
Chiba 275-0016
Japan

Date:

Monday, August 12 – Friday, August 16, 2019

Objectives:

This series of Cosmic Dust meetings aims at finding a consensus among experts on the formation and evolution of cosmic dust: where it comes from and where it goes. The meeting is organized by dust freaks who are very enthusiastic not only to make the goal achievable but also to establish a dust community across every scientifically relevant discipline for the development of cosmic dust research. For this reason, the primary objective of the meeting is to bring together professionals who deal with cosmic dust as well as provide an opportunity for participants to develop interpersonal relationships and scientific interactions among themselves.

Scope:

All kinds of cosmic dust such as

- intergalactic dust
- circumnuclear dust

- interstellar dust
- protoplanetary disk dust
- debris disk dust
- cometary dust
- interplanetary dust
- circumplanetary dust
- stellar nebular condensates
- presolar grains
- micrometeorites
- meteoroids
- meteors
- regolith particles
- planetary ærosols

are the subject of discussion. The meeting is open for any aspects of dust research by means of different methods of studies (in-situ and laboratory measurements, astronomical observations, laboratory and numerical simulations, theoretical modeling, data analyses, etc.). Also welcome are papers on dust-related topics, for example:

- the formation of molecules and their reactions on and their desorption from the surface of a solid substance
- light scattering by non-spherical particles and particulate surfaces
- space missions and instrumentation for measurements of particulates

Admissions application:

Please complete online meeting application at the CPS website in order to attend the meeting. The deadline for the application is May 8, 2019, 11:59 p.m. Japan Standard Time (UTC+09:00). Because the number of participants is limited to a maximum of 50, the online application does not guarantee admission to the meeting. Participants will be determined at the discretion of the SOC and all applicants will be notified of the admissions decision by May 31, 2019. Priority will be given to those who contribute oral or poster sessions and retain enthusiasm for discussions throughout the meeting. For further details, please visit the Cosmic Dust website. https://www.cps-jp.org/ dust/Application.html

Registration fee:

The early bird rate of 10,000 JPY (ca. $100) is available for those who complete both admissions application and abstract submission by April 24, 2019. The registration fee for those who complete admissions application on and after May 25, 2019 is 15,000 JPY (ca. $150). While no payment is required at the time of admissions application and abstract submission, the registration fee should be paid once admittance is guaranteed. No matter what circumstances are specified, the registration fee will not be waived. The payment of the registration fee permits free admission to all scientific sessions, daily coffee breaks, a banquet, and an excursion.

Best poster award:

The best poster award will be given to the most excellent content and presentation of a poster at the Cosmic Dust meeting, although higher priorities are given to posters by students and junior scientists. The award winner will be announced in the closing minutes of the meeting.

Proceedings:

The proceedings of the meeting is planned to be published as a special issue of original papers (or in exceptional cases, review articles from invited speakers) in a peer-reviewed journal. All participants are strongly encouraged to publish a paper in this special issue of the journal, although paper submission to the proceedings is not obligatory. In recent years, the proceedings were published in Planetary and Space Science:
http://www.sciencedirect.com/science/journal/00320633/100
http://www.sciencedirect.com/science/journal/00320633/116
http://www.sciencedirect.com/science/journal/00320633/133

Important dates:

- 24 April 2019, Deadline for Early-Bird Application
- 8 May 2019, Deadline for Admissions Application
- 31 May 2019, Notification of Admissions Decision
- 12–16 August 2019, Cosmic Dust

Scientific organizing committee (SOC):

- Jean-Charles Augereau (IPAG, France)
- Takayuki Hirai (Chitec/PERC)
- Cornelia Jäger (Max Planck Institute for Astronomy, Germany)
- Hidehiro Kaneda (Nagoya University, Japan)
- Hiroshi Kimura (Chitec/PERC, Japan) [Chair]
- Ludmilla Kolokolova (University of Maryland, USA)
- Aigen Li (University of Missouri–Columbia, USA)

Local organizing committee (LOC):

- Hiroki Chihara (Osaka Sangyo University)
- Takayuki Hirai (Chitec/PERC) [Chair]
- Hidehiro Kaneda (Nagoya University)
- Hiroshi Kimura (Chitec/PERC)
- Hiroshi Kobayashi (Nagoya University)
- Takaya Nozawa (National Astronomical Observatory of Japan)
- Takaya Okamoto (ISAS/JAXA)
- Tomomi Omura (Kobe University)
- Takafumi Ootsubo (ISAS/JAXA)
- Hiroki Senshu (Chitec/PERC)
- Takashi Shimonishi (Tohoku University)
- Ryo Tazaki (Tohoku University)
- Koji Wada (Chitec/PERC)

Contact information:

Hiroshi Kimura – mailto:dust-inquiries@cps-jp.org
Please mind that any email attachment will be blocked.

Brief history:

The Cosmic Dust meeting started in 2006 as a session called "Cosmic Dust" of the 3rd AOGS (Asia–Oceania Geoscience Society) annual meeting in Singapore. Dust freaks have kept on organizing the session at subsequent AOGS meetings in Korea (2008), India (2010), and Taiwan (2011). The Cosmic Dust series has been recognized as the most successful session of the AOGS Planetary Sciences Section. In 2012, the time was ripe to be free from organizing restrictions on the AOGS meeting. From that time on, the Cosmic Dust meeting is totally independent of any international conferences and professional associations. The past meetings on Cosmic Dust have been held in a relaxed and joyful atmosphere. So will be the coming one!

See also https://www.cps-jp.org/∼dust/

International Workshop "Cosmic Lab"

Venue:

Chiba Institute of Technology, Narashino, Chiba, Japan

Dates:

Monday, March 25 – Tuesday, March 26, 2019

Keynote:

The international workshop "Cosmic Lab" aims at sharing know-how, experience, and ideas to perform advanced research on extraterrestrial materials in space. Knowledge sharing is set for the goal, because it helps us to improve currently available methods and find novel approaches to test a hypothesis. A workshop-style engagement with experts in their respective fields is anticipated to provide not only great opportunities for young researchers to learn lessons and newcomers to begin with but also a step to better brainstorming. Therefore, the "Cosmic Lab" workshop offers an ideal platform for knowledge sharing and better brainstorming over various types of research in so-called cosmic environments (i.e., an extremely ultra-high vacuum, microgravity, and/or harsh radiation). More specifically, in "Cosmic Lab", knowledge sharing and better brainstorming are targeted to:

- space-borne in-situ measurements
- balloon-, rocket-, and satellite-borne experiments
- space-telescopic observations

including, but not limited to, ground-based experiments for preparation, development, and calibration of instruments onboard spacecraft, and detailed analyses of data achieved in the outer space. Numerical simulations and theoretical predictions for the detection of extraterrestrial materials are also welcome. In this regard, "Cosmic Lab" is open to and takes an interdisciplinary approach to any research activities beyond ground-based observatories and laboratories.

Invitees (confirmed):

- Jun Aoki (Osaka Univ., Japan) – Development of multi-turn mass spectrometry system on board space explorer OKEANOS

- Yuki Kimura (Hokkaido Uni., Japan) – Sounding rocket: a tool for understanding dust formation under microgravity environment
- Harald Krüger (MPS, Germany) – Galileo, Ulysses, Cassini in-situ dust measurements
- Shuji Matsuura (Kwansei Gakuin Univ., Japan) – Cosmic infrared background experiments by sounding-rockets and interplanetary missions
- Itsuki Sakon (Univ. of Tokyo, Japan) – Understanding the properties of dust and organics synthesized in classical novæ based on observations and experiments
- Sho Sasaki (Osaka Univ., Japan) – Development of TOF (time-of-flight) dust analyzer
- Xiaoping Zhang (MUST, China) – New view on lunar dust and a dust detector concept for comet mission

Admissions: 20 participants

Admissions decisions are in principle made on a first come, first served basis, but priority is in practice given to an energetic registrant.

Online registration: https://goo.gl/forms/Bzc5PzavI1NnLbMq1
Accepted registrants will receive the latest information on the workshop, provided that the registration form is submitted by Monday, March 11, 2019, 10:00 a.m. JST (UTC+9).

Registration fee: 500 JPY (ca. $5)

While no payment is required at the time of online registration, the registration fee should be paid by cash on arrival at the venue. No matter what circumstances are specified, the registration fee will not be waived.

Igniters:

Hiroshi Kimura, Takayuki Hirai, Hiroki Senshu, Koji Wada (PERC)

Contact: Hiroshi Kimura – inquiries4labo@perc.it-chiba.ac.jp

See also http://www.perc.it-chiba.ac.jp/meetings/labo/