THE AGB NEWSLETTER

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Editors: Jacco van Loon, Ambra Nanni and Albert Zijlstra

Editorial

Dear Colleagues,

It is our pleasure to present you the 210$^{\rm th}$ issue of the AGB Newsletter.

There are several job openings at various levels of junior/seniority, in Australia, Sweden and the UK.

There are also two workshops announced, in France and California.

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

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

Food for Thought

This month's thought-provoking statement is:

Have tidal effects on red giant atmospheres been observed directly?

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

An infrared census of DUST in Nearby Galaxies with *Spitzer* (DUSTiNGS) I. Overview

Martha L. Boyer[1], *K.B.W. McQuinn*[2], *P. Barmby*[3], *A.Z. Bonanos*[4], *R.D. Gehrz*[2], *K.D. Gordon*[5], *M.A.T. Groenewegen*[6], *E. Lagadec*[7], *D. Lennon*[8], *M. Marengo*[9], *M. Meixner*[5], *E. Skillman*[2], *G.C. Sloan*[10], *G. Sonneborn*[1], *J.Th. van Loon*[11] *and A. Zijlstra*[12]

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Nearby resolved dwarf galaxies provide excellent opportunities for studying the dust-producing late stages of stellar evolution over a wide range of metallicity ($2.7 < [Fe/H] < -1.0$). Here, we describe DUSTiNGS (DUST in Nearby Galaxies with *Spitzer*): a 3.6 and 4.5 μm post-cryogen *Spitzer* Space Telescope imaging survey of 50 dwarf galaxies within 1.5 Mpc that is designed to identify dust-producing Asymptotic Giant Branch (AGB) stars and massive stars. The survey includes 37 dwarf spheroidal, 8 dwarf irregular, and 5 transition-type galaxies. This near-complete sample allows for the building of statistics on these rare phases of stellar evolution over the full metallicity range. The photometry is $> 75\%$ complete at the tip of the Red Giant Branch for all targeted galaxies, with the exception of the crowded inner regions of IC 10, NGC 185, and NGC 147. This photometric depth ensures that the majority of the dust-producing stars, including the thermally-pulsing AGB stars, are detected in each galaxy. The images map each galaxy to at least twice the half-light radius to ensure that the entire evolved star population is included and to facilitate the statistical subtraction of background and foreground contamination, which is severe at these wavelengths. In this overview, we describe the survey, the data products, and preliminary results. We show evidence for the presence of dust-producing AGB stars in 8 of the targeted galaxies, with metallicities as low as $[Fe/H] = -1.9$, suggesting that dust production occurs even at low metallicity.

Accepted for publication in ApJS
Available from arXiv:1411.4053

An infrared census of DUST in Nearby Galaxies with *Spitzer* (DUSTiNGS) II. Discovery of metal-poor dusty AGB stars

Martha L. Boyer[1], *K.B.W. McQuinn*[2], *P. Barmby*[3], *A.Z. Bonanos*[4], *R.D. Gehrz*[2], *K.D. Gordon*[5], *M.A.T. Groenewegen*[6], *E. Lagadec*[7], *D. Lennon*[8], *M. Marengo*[9], *I. McDonald*[10], *M. Meixner*[5], *E. Skillman*[2], *G.C. Sloan*[11], *G. Sonneborn*[1], *J.Th. van Loon*[12] *and A. Zijlstra*[10]

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The DUSTiNGS survey (DUST in Nearby Galaxies with *Spitzer*) is a 3.6 and 4.5 μm imaging survey of 50 nearby dwarf galaxies designed to identify dust-producing Asymptotic Giant Branch (AGB) stars and massive stars. Using 2 epochs, spaced approximately 6 months apart, we identify a total of 526 dusty variable AGB stars (sometimes called "extreme" or x-AGB stars; $[3.6]-[4.5]>0.1$ mag). Of these, 111 are in galaxies with [Fe/H] < -1.5 and 12 are in galaxies with [Fe/H] < -2.0, making them the most metal-poor dust-producing AGB stars known. We compare these identifications to those in the literature and find that most are newly discovered large-amplitude variables, with the exception of approximately 30 stars in NGC 185 and NGC 147, one star in IC 1613, and one star in Phoenix. The chemical abundances of the x-AGB variables are unknown, but the low metallicities suggest that they are more likely to be carbon-rich than oxygen-rich and comparisons with existing optical and near-IR photometry confirms that 70 of the x-AGB variables are confirmed or likely carbon stars. We see an increase in the pulsation amplitude with increased dust production, supporting previous studies suggesting that dust production and pulsation are linked. We find no strong evidence linking dust production with metallicity, indicating that dust can form in very metal-poor environments.

Accepted for publication in ApJ
Available from arXiv:1412.0695

Java application for the superposition T-matrix code to study the optical properties of cosmic dust aggregates

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In this paper, we report the development of a java application for the Superposition T-matrix code, JaSTA (Java Superposition T-matrix App), to study the light scattering properties of aggregate structures. It has been developed using Netbeans 7.1.2, which is a java integrated development environment (IDE). The JaSTA uses double precession superposition codes for multi-sphere clusters in random orientation developed by Mackowski and Mischenko (1996). It consists of a graphical user interface (GUI) in the front hand and a database of related data in the back hand. Both the interactive GUI and database package directly enable a user to model by self-monitoring respective input parameters (namely, wavelength, complex refractive indices, grain size, etc.) to study the related optical properties of cosmic dust (namely, extinction, polarization, etc.) instantly, i.e. with zero computational time. This increases the efficiency of the user. The database of JaSTA is now created for a few sets of input parameters with a plan to create a large database in future. This application also has an option where users can compile and run the scattering code

directly for aggregates in GUI environment. The JaSTA aims to provide convenient and quicker data analysis of the optical properties which can be used in different fields like planetary science, atmospheric science, nano science, etc. The current version of this software is developed for the Linux and Windows platform to study the light scattering properties of small aggregates which will be extended for larger aggregates using parallel codes in future.

Published in Computer Physics Communications
Available from arXiv:1405.7306

Departure from centrosymmetry of red giants and supergiants measured with VLTI/AMBER

P. Cruzalèbes[1], *A. Jorissen*[2], *A. Chiavassa*[1], *C. Paladini*[2], *Y. Rabbia*[1] *and A. Spang*[1]

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We study a sample of 16 bright and well-resolved late-type stars (10 O-rich giants, 2 red supergiants, and 4 C-rich giants) using the ESO VLTI/AMBER facility at medium resolution ($R = 1500$) in the K band to detect and measure the deviation from centrosymmetry of their resolved surface brightness distribution. As indicator for departure from centrosymmetry, we use the centrosymmetry parameter (CSP). We observe that CSP increases along the asymptotic giant branch, reaching values as large as 30°. These large CSP values are likely attributable to a few large photospheric convective cells. Carbon stars like W Ori and R Scl, being close to the AGB tip, have the second largest CSP values (17.°6 and 22.°3, respectively), being only surpassed by the M5.5 Ib/II supergiant T Cet (with CSP of 30.°4). For K and early M giants, CSP values are smaller, never exceeding 10°, with a clear tendency to increase with the atmospheric pressure scaleheight. This supports the hypothesis that the observed deviations from centrosymmetry are somehow related to convective cells, whose size depends upon the atmospheric pressure scaleheight.

Published in MNRAS, 446, 3277 (2015)
Available from http://mnras.oxfordjournals.org/cgi/reprint/stu2382?ijkey=Hz0tzpkE9GNzzQz&keytype=ref

The first "water fountain" collimated outflow in a planetary nebula

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"Water fountains" (WFs) are evolved objects showing high-velocity, collimated jets traced by water maser emission. Most of them are in the post-Asymptotic Giant Branch and they may represent one of the first manifestations of collimated mass loss in evolved stars. We present water maser, carbon monoxide, and mid-infrared spectroscopic data (obtained with the Australia Telescope Compact Array, *Herschel* Space Observatory, and the Very Large Telescope, respectively) toward IRAS 15103−5754, a possible planetary nebula (PN) with WF characteristics. Carbon monoxide

observations show that IRAS 15103−5754 is an evolved object, while the mid-IR spectrum displays unambiguous [NeII] emission, indicating that photoionization has started and thus, its nature as a PN is confirmed. Water maser spectra show several components spreading over a large velocity range ($\simeq$ 75 km s^{-1}) and tracing a collimated jet. This indicates that the object is a WF, the first WF known that has already entered the PN phase. However, the spatial and kinematical distribution of the maser emission in this object are significantly different from those in other WFs. Moreover, the velocity distribution of the maser emission shows a "Hubble-like" flow (higher velocities at larger distances from the central star), consistent with a short-lived, explosive mass-loss event. This velocity pattern is not seen in other WFs (presumably in earlier evolutionary stages). We therefore suggest that we are witnessing a fundamental change of mass-loss processes in WFs, with water masers being pumped by steady jets in post-AGB stars, but tracing explosive/ballistic events as the object enters the PN phase.

Accepted for publication in The Astrophysical Journal
Available from arXiv:1412.2327

Mid-infrared variations of R Coronæ Borealis stars

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Mid-infrared photometry of R Coronæ Borealis stars obtained from various satellites from IRAS to WISE has been utilized in studying the variations of the circumstellar dust's contributions to the spectral energy distribution of these stars. The variation of the fractional coverage (R) of dust clouds and their blackbody temperatures ($T_{\rm d}$) have been used in trying to understand the dust cloud evolution over the three decades spanned by the satellite observations. In particular, it is shown that a prediction $R \propto T_{\rm d}^4$ developed in the paper is satisfied, especially by those stars for which a single collection of clouds dominates the IR fluxes. Correlations of R with photospheric abundance and luminosity of the stars are explored.

Accepted for publication in MNRAS
Available from arXiv:1412.7623

Molecular bands in the spectra of M stars

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The profiles of the main molecular bands in the spectral-energy distributions (SEDs) of M stars have been calculated. The calculations of the individual band profiles were performed using the just-overlapping-lines approximation. Information about the oscillator strengths and the sources of the spectroscopic data for specific transitions between electronic levels of molecules is provided. The calculations of theoretical SEDs for M stars were performed using available lists of molecular lines for sources of bound-bound opacity in the atmospheres of oxygen-sequence stars. The observed SEDs of the oxygen-sequence red giant HD 148783 (30 Her) and the M dwarf 2MASS J22424129−2659272 are reproduced. The dependence of the calculated SEDs of the M giant on the adopted metallicity and carbon abundance is studied. The observed SEDs of HD 148783 and 2MASS J22424129−2659272 are described well by theoretical spectra calculated for model atmospheres with $T_{\rm eff}/\log g/[{\rm Fe/H}] = 3250/-0.4/0$ and $3000/5.0/0$, respectively.

Published in Astronomy Reports, Volume 58, Issue 11, p825

Analysis of the spectral energy distribution of the peculiar carbon giant TU Gem

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The TU Gem star has long been known as a peculiar carbon giant of the Galaxy halo, but its classification as a CH star is still debated. We estimated the TU Gem atmosphere parameters through modeling its spectrum and comparison with the spectra of the star observed in two wide spectral ranges (λ = 400–720 nm and λ = 900–2440 nm). The low-dispersion optical TU Gem spectrum obtained by Barnbaum et al. (2006) ($R \sim 600$) and the infrared spectrum presented by Tanaka et al. (2007) ($R \sim 2600$) were used in the analysis. The model atmospheres were calculated using the SAM12 software (Pavlenko 2003). Since the metallicity ([Fe/H]) value could not be determined conclusively based on our spectral data, only the TU Gem effective temperature $T_{\rm eff}$ (that depends weakly on metallicity) was defined with certainty ($T_{\rm eff}$ = 3000 ± 100 K). We determined the C/O, [C/Fe], and [N/Fe] values for the $-2.0 <$ [Fe/H] < 0.0 range with a step of Δ[Fe/H] = 0.5. Our estimate of [C/Fe] (0.63–0.67 at [Fe/H] = −1.0) is higher than the corresponding estimate ([C/Fe] = 0.21 at [Fe/H] = −1.1) given in Kipper et al. (1996), while the estimates for [N/Fe] at the stated metallicities agree with each other: [N/Fe] = +1.0. This brings TU Gem closer to CH stars, but a detailed analysis of the chemical composition of the TU Gem atmosphere is required to reach a definite conclusion.

Published in Kinematics and Physics of Celestial Bodies, Volume 30, Issue 4, p182 (2014)

Conference Papers

Mass loss and variability in evolved stars

Massimo Marengo[1]

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Mass loss and variability are two linked, fundamental properties of evolved stars. In this paper I review our current understanding of these processes, with a particular focus on how observations and models are used to constrain reliable mass loss prescriptions for stellar evolution and population synthesis models.

Oral contribution, published in "Why Galaxies Care about AGB stars III", Vienna, July 28, 2014 (invited review)
Available from arXiv:1412.0803

Orientation of Galactic Bulge Planetary Nebulæ toward the Galactic Center

Ashkbiz Danehkar[1] *and Quentin A. Parker*[1,2]

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[2]Australian Astronomical Observatory, P.O. Box 915, North Ryde, NSW 1670, Australia

We have used the Wide Field Spectrograph on the Australian National University 2.3-m telescope to perform the integral field spectroscopy for a sample of the Galactic planetary nebulæ. The spatially resolved velocity distributions of the Hα emission line were used to determine the kinematic features and nebular orientations. Our findings show that some Bulge planetary nebulæ toward the Galactic Center have a particular orientation.

Poster contribution, published in IAU Symposium 312 "Star Clusters and Black Holes in Galaxies across Cosmic Time", Beijing, China, 2014
Available from arXiv:1412.0012

Review Paper

"Inter-Longitude Astronomy" project: Long Period Variable stars

Ivan L. Andronov[1], *Vladyslava I. Marsakova*[2], *Larysa S. Kudashkina*[1] *and Lidia L. Chinarova*[3]

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This article contains the highlights of complex studies of long-period variable stars such as Miras: semiregular, symbiotic (particularly, pulsating symbiotic), as well as RV Tauri-type stars. In the course of these studies, important characteristics of mean light curves were determined. In the case of multi-component variability, additional periods were found. Correlations between parameters of mean light curves were investigated. The cycle-to-cycle changes of light curve parameters were analyzed using various mathematical methods. Classiffication criteria of variable stars and effects of variability were proposed based on this research. The study of observational parameters and the correlations between them can be used to estimate the age, mass, and other physical characteristics of AGB stars.

Published in Advances in Astronomy and Space Physics, 4, 3 (2014)
Available from http://aasp.kiev.ua/

Job Adverts

Lecturer/Senior Lecturer in Astrophysics

The newly formed School of Physics and Astronomy seeks to appoint an outstanding Lecturer/Senior Lecturer (Level B/C) in astronomy/astrophysics. This is a unique opportunity to join a dynamic, successful and growing School of Physics and Astronomy, which encompasses one of the most diverse astrophysics research groups in Australia. The role demands a commitment to excellence, innovation and creativity in research. Applicants will be considered in any of the school's current research areas in astronomy/astrophysics. However, exceptional applicants in other areas of astronomy and astrophysics are also encouraged to apply.

Job No. 528830

Faculty of Science
School of Physics and Astronomy
Location: Clayton campus
Employment Type: Full-time
Duration: Tenure Track
Remuneration:
$101,051 – $120,001 pa Level B /
$123,787 – $142,735 pa Level C
(includes 17% employer superannuation)

Application close: Feb 1
Enquiries: john.lattanzio@monash.edu or alexander.heger@monash.edu

See also http://jobs.monash.edu.au/jobDetails.asp?sJobIDs=528830&lWorkTypeID=&lLocationID=&sJobNo=astronomy&sKeywords=astronomy&lCategoryID=&lBrandID=&stp=AW&sLanguage=en

5 postdoctoral positions

Applications are invited for up to five postdoctoral positions at the Department of Earth and Space Sciences, Chalmers University of Technology, Sweden, working within the group for Radio Astronomy and Astrophysics located at Onsala, Sweden.

Of the five positions, up to three will be dedicated to the study of evolved stars, magnetic fields, and numerical radiative transfer. (See the full announcement for the other topics) The postdocs will also be able to carry out his/her own research in collaboration with affiliated group members, which includes a number of PhD students. At least one postdoc position (of the five) will be offered within the Nordic ARC node, hosted at the Onsala Swedish National Facility for Radio Astronomy, and will therefore include a fraction of his/her time supporting ALMA observations within the ARC node network.

Interested applicants should have a PhD in astrophysics by the start of the appointment. Applicants should send a CV, description of research interests and a publication list. They should also include the addresses of two references who can be contacted by Chalmers.

The application deadline is 6 February 2015, anticipated starting date will be mid-2015. Further details as well as the electronic submission form can be found following the link below.

For further information contact Wouter Vlemmings (two positions; evolved stars/magnetic fields/radiative transfer/Nordic ARC; wouter.vlemmings@chalmers.se), and Hans Olofsson (one position; evolved stars; hans.olofsson@chalmers.se)

See also http://www.chalmers.se/en/about-chalmers/vacancies/Pages/default.aspx?rmpage=job&rmjob=2690

Postdoctoral Research Associate in Supernova Dust and Molecules

Applications are invited for an STFC-funded PDRA position, available from 1st April 2015, with a duration of up to 3 years, to work with Professor Mike Barlow and Professor Bruce Swinyard on a project to measure the quantities of dust present in supernova ejecta and in supernova remnants, through the analysis of their infrared and optical spectral energy distributions and their emission line spectra. In addition, the molecular content of these objects will be investigated using a variety of techniques, including the exploitation of our discovery of the ArH^+ molecule in the Crab Nebula. Use will be made of *Herschel* archival data, along with existing and future ground-based optical and infrared spectrophotometry of supernovæ and supernova remnants.

Essential requirements: a PhD in Astrophysics, excellent written and verbal communication skills; experience of analysing and modelling infrared and optical photometric and spectroscopic observations of astrophysical sources. Some experience of radiative transfer modelling would be valuable. Applications should be made online via this website: http://www.ucl.ac.uk/hr/jobs/ Please select "Click Here for UCL Current Vacancies", then enter the job reference number 1447979 into "Ref No". Please register and complete the application procedure as directed, also providing a CV and a list of publications, and the names of three referees. Salary: from £33,353 per annum.

Deadline for applications: Feb 1st 2015

Email Address for Informal Inquiries: mjb@star.ucl.ac.uk

See also http://www.ucl.ac.uk/phys/vacancies

Announcements

Exoplanetary Atmospheres and Habitability Workshop in Nice from 12 to 16 October 2015 Inscriptions are open

Dear colleagues,

We are glad to annonce the "Exoplanetary Atmospheres and Habitability – Thermodynamics, Disequilibrium and Evolution focus group's workshop that will be held in Nice at the Observatoire de la Côte d'Azur from 12 to 16 October 2015.

http://exoatmo.sciencesconf.org

SCIENTIFIC RATIONALE

The aim of the workshop is to discuss about chemical disequilibrium and its link to planetary habitability. In particular, the Thermodynamics, Disequilibrium and Evolution focus group seeks to understand how disequilibria are generated in geological / chemical / biological systems, and how these disequilibria can lead to emergent phenomena, such as self-organization and eventually, metabolism.

The prospects for planetary atmosphere characterization are excellent with access to large an amount of data for different kind of stars either with ground- or space-based telescopes supported by accurate modeling of the atmospheric compositions and their corresponding spectra. In particular for many discovered exoplanets (hot and gaseous), a large chemical disequilibrium in the atmosphere has been observed, due to the high vertical temperature gradient. Several new studies are now comparing this of vertical-mixing driven disequilibrium with the chemical disequilibrium characterizing the atmosphere of planet Earth, which is mainly due to the presence of life. However, present research on exoplanet's atmospheric disequilibrium is focused on a very small number of compounds (CH_4, CO, CO_2, H_2O), lacking for a generalized and wider methodology. In this workshop we plan to enlarge these studies to a joint effort between the thermodynamics of habitable conditions to the exoplanetary atmospheres.

Three principal topics will be tackled during the workshop:

- Icy moons, icy planets and the conditions for the emergence of life
- The modeling and observations of exoplanetary atmospheres: chemistry and physics
- The chemical disequilibrium in planetary atmospheres: from hot Jupiters to habitable planets

INVITED SPEAKERS

Icy moons, icy planets and the conditions for the emergence of life	
Laurie Barge	JPL, CalTech, Pasadena (USA)
Athena Coustenis	Observatoire de Meudon, Meudon (France)
Robert Pascal	CNRS and Université de Montpellier (France)
The modeling and observations of exoplanetary atmospheres: chemistry and physics	
Daniel Angerhausen	Goddard Space Flight Center, NASA, Greenbelt (USA)
Renyu Hu	Jet Propulsion Laboratory (USA – to be confirmed)
Franck Selsis	Observatoire de Bordeaux, Bordeaux (France)
The chemical disequilibrium in planetary atmospheres: from hot Jupiters to habitable planets	
Sebastian Danielache	Sophia University, Tokyo (Japan)
Tommaso Grassi	Starplan, University of Copenhagen, (Denemark)
Eugenio Simoncini	Astrophysical Observatory of Arcetri, INAF, Firenze (Italy)

The Thermodynamic, Disequilibrium and Evolution (TDE) Focus Group is a NASA Astrobiology Institute (NAI) sponsored project aimed to make researchers meet and discuss on the thermodynamic requirements of life emergence and planetary habitability. In particular, since its set up in 2011, the TDE helped in bridging the gap between researchers working on the theory and experimental aspects of the Origin of Life and astronomers. It provided a thermodynamic discussion board for planning future space missions and deciding on future targets for the search for habitability. The TDE concentrates on the entropy and energy requirements for life and planets and how they inform our selection of potentially habitable planets and environments in the cosmos.

The TDE page on the NAI website: https://astrobiology.nasa.gov/focus-groups/current/thermodynamics-disequilibrium-and-evolution-tde/

IMPORTANT DATES

December, 2014	:	First announcement and web site
December 1st, 2014	:	Registration and abtract submission open
April 30th, 2015	:	Deadline for financial support request
June 30th, 2015	:	Deadline for registration, fee payment (100 euro) and abstract submission
October 12th, 2015	:	The workshop starts

Looking forward to see you in Nice next year,
Andrea Chiavassa and Eugenio Simoncini on behalf of the SOC

See also http://exoatmo.sciencesconf.org

30 years of photodissociation regions: A symposium to honor David Hollenbach's lifetime in science

Dear colleagues,

We are happy to announce the conference "30 years of photodissociation regions", a symposium to honor David Hollenbach's lifetime in science which will be held June 28th to July 3rd, 2015 at Asilomar, California.

The goal of this meeting is to overview the state of the art in theoretical PDR studies, to review the processes that control the physical and chemical conditions in PDRs and their emission characteristics, to compare and contrast these models with recent observations of PDRs obtained with the *Spitzer* Space Telescope, the *Herschel* Space Observatory, the Stratospheric Observatory For Infrared Astronomy, and the Atacama Large (sub)Millimeter Array, to connect studies of dense PDRs in regions of star formation to the studies of the evolution of the interstellar medium of galaxies over the history of the Universe, and to link and compare and contrast studies of PDRs to those of regions dominated by X-rays, by turbulence, by shocks, and by cosmic rays. In addition, we take this occasion to celebrate the contributions to this field of one of the pioneers, David Hollenbach.

The scientific topics of this meeting include:

- The Physics and Chemistry of PDRs,
- Models of PDRs,
- Observations PDRs in the galactic environment,
- PDRs & star and planet formation,
- PDRs & the ISM of galaxies, and
- PDRs in starburst, (U)LIRG, and high-z environments.

The format of the meeting will consist of invited reviews, invited talks, contributed papers, and poster papers. A list of invited speakers is available on the website.

Venue:

The Asilomar conference center is a California State Park (http://www.visitasilomar.com) beautifully situated on the coast of the Monterey peninsula in a very quiet and serene setting that we hope will be very conducive to a highly interactive meeting.

SOFIA grant:

SOFIA has generously provided support for deserving students to defer their room and board during the meeting. Students who wish to be considered for a SOFIA travel grant have to send a letter of motivation plus a supporting letter from their supervisor. Details can be found on the website.

Registration:

Registration is now open. Early registration is encouraged, as the number of participants will be limited to approximately 150.

Important dates:

Registration and abstract submission deadline: April 2$^{\text{nd}}$, 2015
Student grant requests: February 20$^{\text{th}}$, 2015

See the website for details.

We are looking forward to an exciting meeting and hope to welcome you in Asilomar,

On behalf of the Scientific Organizing Committee,

Margaret Meixner & Xander Tielens

See also http://pdr30.strw.leidenuniv.nl