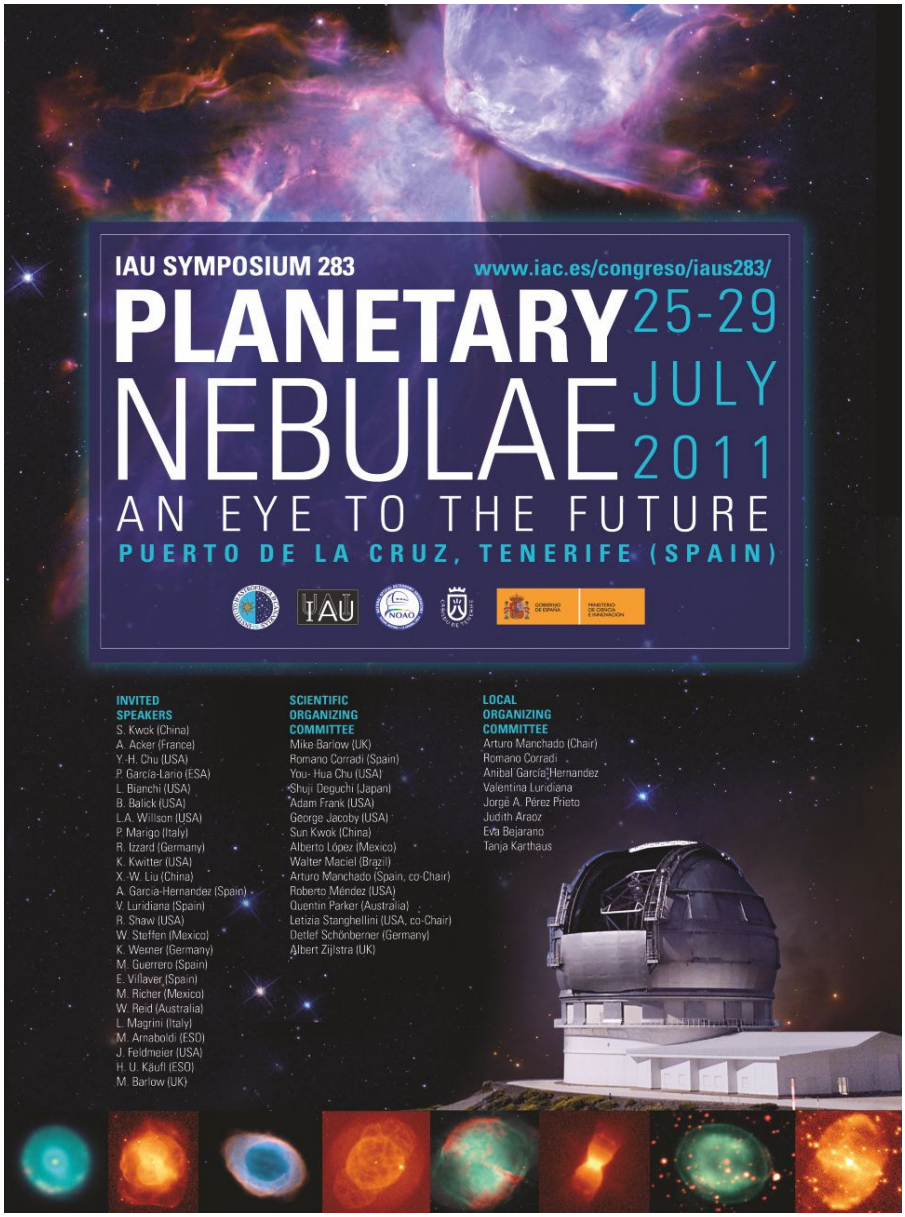
IAUS283 Planetary Nebulae: An Eye to the Future



PROGRAMME & ABSTRACTS

25-29 July, 2011
Puerto de La Cruz Conference Centre
Tenerife, Canary Islands, Spain

Organized by

INSTITUTO DE ASTROFÍSICA DE CANARIAS

SPONSORS

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- M. Arnaboldi (ESO)
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- L. Bianchi (USA)
- Y.-H. Chu (USA)
- A. García-Hernandez (Spain)
- P. García-Lario (ESA)
- M. Guerrero (Spain)
- R. Izzard (Germany)
- H. U. Kaufl (ESO)
- K. Kwitter (USA)
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- X.-W. Liu (China)
- V. Luridiana (Spain)
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- Q. Parker (Australia)
- W. Reid (Australia)
- M. Richer (Mexico)
- R. Shaw (USA)
- W. Steffen (Mexico)
- E. Villaver (Spain)
- K. Werner (Germany)
- L. A. Willson (USA)

Scientific Organizing Committee (SOC)

- Mike Barlow (UK)
- Romano Corradi (Spain)
- You- Hua Chu (USA)
- Shuji Deguchi (Japan)
- Adam Frank (USA)
- George Jacoby (USA)
- Sun Kwok (China)
- Alberto López (Mexico)
- Walter Maciel (Brazil)
- Arturo Manchado (Spain, co-Chair)
- Roberto Méndez (USA)
- Quentin Parker (Australia)
- Letizia Stanghellini (USA, co-Chair)
- Detlef Schönberner (Germany)
- Albert Zijlstra (UK)

Local Organizing Committee (LOC, IAC)

- Judith Araoz
- Eva Bejarano
- Romano Corradi
- Anibal García-Hernandez
- Valentina Luridiana
- Arturo Manchado (Chair)
- Eva Villaver

SOCIAL PROGRAMME INFORMATION

Sunday, 24

17:00-21:00 Registration at Conference Centre
18:00-20:30 Welcome reception at Conference Centre

Monday, 25

08:00-09:00 Registration.

09:00-09:15 Conference Opening.

Wednesday, 27

12:45-19:00 Dolphin watching trip

We will leave the Conference Centre by bus at 12:45 (after last session) to the port of Los Gigantes. The boat tour will take 3 hours, from 14:30-17:30, and we hope to see dolphins or whales. We will see the spectacular cliffs of Los Gigantes. Lunch and drinks will be served (paella with chicken, soft drinks, beer, wine and water). Buses will bring you back to the hotel for a 19:00 arrival.

Participants attending the dolphins and whales excursion are encouraged to bring sunscreen, swimsuit and towel.

15:00-20:00 Excursion to the Teide National Park

We have organised a tour of the spectacular National Park, recently accepted as UNESCO world heritage site. Buses will leave the Conference Centre at 15:00h and take us to the Boca del Tauce region, within the Teide National Park (altitude some 2.200 m). We will be met by tourist guides of the Park Service, who will lead us on a 2-hour tour. Afterwards we will visit the Park's Visitors Centre where we will see a film about the origin of Tenerife's volcanoes, and visit the botanical garden. Buses will bring you back to the hotel for a 20:00 arrival.

We strongly recommend that you bring sunscreen, hat and warm clothes.

Thursday, 28

13:00-13:15 **Group photograph** will be taken in the gardens (after the morning last session).

20:00-23:00 **Closing dinner** at *La Finca Zamora*

Buses will leave the hotels at 19:30 to take us to *Finca Zamora* and will return before midnight.

SCIENTIFIC PROGRAMME

(R) Invited Reviews:	**30+5 min**
(C) Contributed Talks:	**20+5 min**

Sunday, 24th			
18:00 - 20:30	***Welcome Cocktail***		
17:00 - 21:00	Registration		
Monday, 25th			
08:00 - 09:00	Registration		
09:00 - 09:15	Welcome address (Arturo Manchado)		
Session 1: New Results from Observations **Chair: Silvia Torres-Peimbert**			
09:15 - 09:50	R	**S Kwok**	Historical overview of Planetary Nebulae Research.
09:50 - 10:25	R	**Q Parker**	The Past, Present and Future of Planetary Nebulae Surveys in our Galaxy.
10:25 - 10:50	C	**R L M Corradi**	A wealth of new planetary nebulae from the IPHAS survey.
10:50 - 11:25	**Coffee-break & poster viewing**		
11:25 - 12:00	R	**Y-H Chu**	Spitzer Observations of Planetary Nebulae.
12:00 - 12:25	C	**L Stanghellini**	Spitzer IRS spectra of compact Galactic planetary nebulae: the link between dust, early evolution, and metallicity.
12:25 - 13:00	R	**P García-Lario**	Early Herschel results.
13:00 - 15:00	**Lunch break & poster viewing**		
Chair: Ronald Weinberger			
15:00 - 15:25	C	**P van Hoof**	Herschel observations of PNe in the MESS key program.
15:25 - 16:00	R	**L Bianchi**	New results from the UV.
16:00 - 16:30	**Coffee-break & poster viewing**		
16:30 - 17:05	R	**B. Balick**	How Hubble Changed Research in Planetary Nebulae.
17:05 - 17:30	C	**E Lagadec**	A mid-infrared imaging survey of post-AGB stars.
17:30 - 17:55	C	**A López**	The SPM Kinematic Catalogue of Planetary Nebulae.
17:55 - 18:20	C	**R. Rubin**	SOFIA Observations of the Planetary Nebula NGC 7009.
Tuesday, 26th			
Session 2: The Stellar Evolution Connection			
2a: *Through the AGB and Beyond* **Chair: Katrina Exter**			
09:00 - 09:35	R	**L Willson**	Mass loss on the AGB and Beyond.
09:35 - 10:00	C	**M Matsuura**	Observational study of mass loss from AGB stars and beyond.
10:00 - 10:25	C	**A Manchado**	Morphological classification of post-AGB stars.
10:25 - 10:55	**Coffee-break & poster viewing**		
10:55 - 11:30	R	**P Marigo**	AGB evolution: new theoretical results.
11:30 - 12:05	R	**R Izzard**	Common envelopes: the binary route to Planetary

			Nebulae?.
12:05 - 12:30	C	**A Riera**	Shaping proto-Planetary Nebulae by binary systems.
12:30 - 12:55	C	**B Miszalski**	Ongoing surveys for close binary central stars and wider implications.
12:55 - 14:55	**Lunch break & poster viewing**		
14:55 - 15:20	C	**M Moe**	Population Synthesis of Galactic PN from Binaries.
15:20 - 15:45	C	**S Bright**	Observing compact disks inside PPNe with the VLTI.
15:45 - 16:15	**Coffee-break & poster viewing**		
2b: *Aspects of the PN Phase* Chair: Richard Henry			
16:15 - 16:50	R	**K B Kwitter**	Cosmic recycling.
16:50 - 17:15	C	**A Karakas**	Heavy elements in planetary nebulae: A theorist's gold mine.
17:15 - 17:50	R	**X. Liu**	Atomic processes in photoionized gaseous nebulae.
17:50 - 18:05	R	**V Luridiana**	Report on the workshop "Uncertainties in Atomic Data and How they Propagate in Chemical Abundances.
18:05 - 18:30	C	**D Gonçalves**	When Shape Matters: correcting the ICFs to derive the chemical abundances of bipolar and elliptical PNe.
Wednesday, 27th			
Session 2: The Stellar Evolution Connection (cont.)			
2b: *Aspects of the PN Phase* (cont.) Chair: Detlef Schönberner			
09:00 - 09:35	R	**A García-Hernández**	Molecular processes from the AGB to the PN stage.
09:35 - 10:10	R	**R Shaw**	Shape, Structure, and Morphology in Planetary Nebulae.
10:10 - 10:35	C	**A Frank**	Wind Capture Accretion Disks and Magnetic Towers in pPN.
10:35 - 10:55	**Coffee-break & poster viewing**		
10:55 - 11:30	R	**W Steffen**	Dynamical modeling and the interactions with the ISM.
11:30 - 11:55	C	**A Amiri**	Magnetic Fields and Developing Asymmetries in Circumstellar Masers of evolved stars.
11:55 - 12:20	C	**W Vlemmings**	Magnetic fields during the evolution towards Planetary Nebulae.
12:20 - 12:45	C	**R Sahai**	Understanding the Immediate Progenitors of Planetary Nebulae.
12:45 - 19:00	***Dolphin watching trip***		
15:00 - 20:00	***Excursion to the Teide National Park***		
Thursday, 28th			
Session 2: The Stellar Evolution Connection (cont.)			
2c: *Aspects of the Central Stars* (cont.) Chair: Albert Zijlstra			
09:00 - 09:25	C	**S-N Chong**	Multipolar Planetary Nebulae: Not as Geometrically Diversified as Thought.
09:25 - 09:50	C	**P Huggins**	Jet Power in Planetary Nebulae: Theory vs. Observation.
09:50 - 10:15	C	**D Frew**	Are planetary nebulae derived from multiple evolutionary scenarios?.

10:15 - 10:45	R	**M Peimbert**	Poster Summary.
10:45 - 11:15	**Coffee-break & poster viewing**		
11:15 - 11:50	R	**K Werner**	The white dwarf connection.
11:50 - 12:25	R	**M Guerrero**	Observations of central stars and their winds from X-ray observations.
12:25 - 12:50	C	**M Ziegler**	(F)UV Spectroscopy of 15 Extremely Hot Central Stars of Planetary Nebulae.
12:50 - 13:10	***Group Photograph***		
13:10 - 15:10	**Lunch break & poster viewing**		
15:10 - 15:35	C	**M Steffen**	Modeling the diffuse X-ray emission of Planetary Nebulae with different chemical composition.
15:35 - 16:10	R	**E Villaver**	Planets, Evolved Stars, and How they might influence each other.
16:10 - 16:40	R	**G van de Steene**	Poster Summary.
16:40 - 16:55	**Coffee-break & poster viewing**		
Session 3: The Cosmic Population of Galactic and Extragalactic PNe Chair: Walter Maciel			
16:55 - 17:30	R	**W Reid**	PNe in the Magellanic Clouds and other Local Group galaxies.
17:30 - 17:55	C	**H van Winckel**	Post-AGB stars of the LMC and SMC.
17:55 - 18:20	C	**G Stasinska**	Ionization of galaxies by their planetary nebulae.
20:00 - 23:00	***Closing Dinner at "La Finca Zamora"***		
Friday, 29th			
Session 3: The Cosmic Population of Galactic and Extragalactic PNe (cont.) Chair: Roberto Méndez			
09:00 - 09:35	R	**M Richer**	PN populations and kinematics.
09:35 - 10:10	R	**L Magrini**	Constraining the chemical evolution of the Local Group Galaxies.
10:10 - 10:35	C	**L Guzmán-Ramírez**	Carbon chemistry in Galactic Bulge Planetary Nebulae.
10:35 - 11:00	C	**M Peña**	Planetary nebulae in NGC300: their chemical abundances and the abundance gradient in this galaxy.
11:00 - 11:20	**Coffee-break & poster viewing**		
11:20 - 11:55	R	**M Arnaboldi**	PN populations in external galaxies.
11:55 - 12:20	C	**L Girardi**	M31 planetary nebulae as seen by PHAT.
12:20 - 12:45	C	**J R Walsh**	NGC 5128 - a nearby laboratory for PNe in a giant early-type galaxy.
12:45 - 13:10	C	**M Sarzi**	The Planetary Nebulae Population in the Central Regions of M32: the SAURON view.
13:10 - 15:00	**Lunch break & poster viewing**		
Session 4: Future Endeavours in the Filed Chair: Letizia Stanghellini			
15:00 - 15:35	R	**H Käufl**	The Frontier of Ground-Based Observations.
15:35 - 16:10	R	**M Barlow**	The impact of future space observatories on PN research.
16:10 - 17:00	**General discussion**		
END OF CONFERENCE			

INVITED REVIEWS & CONTRIBUTED TALKS

Topics:

Session 1: New Results from Observations

Session 2: The Stellar Evolution Connection

2a: Through the AGB and Beyond

2b: Aspects of the PN Phase

2c: Aspects of the Central Stars

Session 3: The Cosmic Population of Galactic and Extragalactic PNe

Session 4: Future Endeavours in the Field

SESSION 1: New Results from Observations
Chair: Silvia Torres-Peimbert

® Historical overview of Planetary Nebulae Research

S. Kwok

Planetary nebulae (PN) were first discovered over 200 years ago and our understanding of these objects has undergone significant evolution over the years. Developments in astronomical optical spectroscopy and atomic physics have shown that PN are gaseous objects photoionized by UV radiation from a hot central star. Studies of the kinematics of the nebulae coupled with progress in theories of stellar evolution have led to the identification that PN are evolved stars and progenitors of white dwarfs. Development of infrared and millimeter-wave technology in the 1970s made us realize that there are significant amount of neutral matter (molecules and dust) in PN. The link of PN to the stellar winds from their progenitor AGB stars and subsequent dynamical interactions are now believed to be the underlying causes of the morphological structures of PN. The role of PN as prolific molecular factories producing complex molecules and organic solids has significant implications on the chemical enrichment of the Galaxy.

In this talk, we will emphasize the misconceptions and errors that we have encountered in our journey of understanding the nature of PN. The various detours and dead ends that had happened during our quest to pin down the evolutionary status and causes of nebulae ejection will be discussed. As there are still many unsolved problems in PN research, these lessons of history have much to offer for future progress in this field.

® The Past, Present and Future of Planetary Nebulae Surveys in our Galaxy

Q*. Parker,* *A. Acker, D. Frew, B. Miszalski*

I will briefly provide some historical perspectives of the heterogeneous compilations of planetary nebulae (PNe) accrued up until the 21st century before presenting some of the key results from the recent major growth in the known population of PNe in our Galaxy. This has been made possible thanks to high-sensitivity, high-resolution, narrow-band surveys of the Milky Way. Furthermore, the ability to more effectively combine multi-wavelength imaging data via the proliferation of online databases enables us to both recognize new PNe and help eliminate the many PN mimics that have biased previous catalogues. I will then spend some time summarising the status of current and future PN surveys in our Galaxy and beyond, before addressing the prospects for further astrophysical exploitation of this fascinating, albeit brief, period in the late-stage evolution of low to intermediate mass stars.

© A wealth of new planetary nebulae from the IPHAS survey

***R.L.M. Corradi**, L. Sabin, Q. Parker, A. Mampaso, R. Morris, R. Greimel, J.E. Drew, and the IPHAS collaboration*

A systematic search for discrete nebulae from IPHAS, the 1800 square degree Hα survey of the Northern Galactic Plane carried out at La Palma Observatory, is currently underway. Here we present the first major instalment of the "IPHAS Catalogue of Extended Nebulae". This includes a complete census of emission-line nebulae in 320 square degrees toward the inner regions of the Galaxy. In this area, five hundred emission nebulae have been catalogued including 100 known planetary nebulae (PNe), and 150 new IPHAS candidate PNe. A vigorous programme of spectroscopic confirmation of IPHAS candidate PNe over the entire survey area is underway using a number of telescopes worldwide. So far, around one hundred new PNe have been spectroscopically confirmed (Viironen et al. 2008, 2009, 2011, Corradi et al. 2011, Sabin et al. 2011, Ramirez et al. 2011). Their main properties, some outstanding examples, as well as the relevance of the IPHAS survey to determine the total PN population in the Galactic disc and its chemical gradient will be discussed.

® Spitzer Observations of Planetary Nebulae

Y.-H. Chu

The Spitzer Space Observatory has made targeted IRAC and/or MIPS observations of ~100 PNe, and the Spitzer survey of the Galactic plane (GLIMPSE) has detected many more PNe serendipitously. The IR images can be compared with optical images to diagnose the nature of the IR emission, whether it consists of nebular lines or dust continuum. The IRS spectra of the nebulae can be further used to confirm the nature of the IR emission, study chemical compositions, and discover exotic molecules. Spitzer observations of the central stars of PNe (CSPNs) have revealed IR excesses indicative of circumstellar dust. These circumstellar dust disks have been suggested to be produced by collisions among sub-planetary bodies in their planetary systems. Dust production through binary interactions cannot be ruled out, but the presence of binary companions is not known for most CSPNs showing mid-IR excesses.

© Spitzer IRS spectra of compact Galactic planetary nebulae: the link between dust, early evolution, and metallicity

L. Stanghellini, *D.A. García-Hernández, P. García-Lario, J.E. Davies, R.A. Shaw, E. Villaver, A. Manchado, J.V. Perea-Calderon*

We acquired IRS/Spitzer 5-38 um spectra of ~150 compact Galactic planetary nebulae (PN) in Cycle 5 to study the early dust properties. Misclassified PNe are about 5% of the sample. The PN spectra typically present a dust continuum, dust emission features, and nebular emission lines. The sample is complete, flux-limited for those PNe with optical diameters smaller than about 4 arcsec. We found that PNe characterized by carbon-rich dust have progenitors within a narrow mass range, as opposed to the oxygen-rich and the mixed-chemistry dust PNe. We also found differences in the Galactic distribution of the different dust types. Dust temperature and infrared luminosity has been derived for all PNe, and trends among these quantities, compared to those of Magellanic Cloud PNe, disclose the early dust evolution in relation to the metallicity of the progenitors. Within the studied sample we found four PNe presenting the characteristic fullerene emission features.

® Early Herschel results

P. García-Lario

Herschel, an ESA space observatory equipped with science instruments provided by European-led Principal Investigator consortia with important participation from NASA, was launched on 14 May 2009. With its 3.5m diameter primary mirror, Herschel is the largest space telescope ever launched into space, and carries onboard three science instruments, whose focal plane units are cryogenically cooled inside a superfluid helium cryostat. The PACS and SPIRE instruments provide broadband imaging photometry in six bands centred on 75, 100, 160, 250, 350, and 500 microns and imaging spectroscopy over the range 55-672 microns. The HIFI instrument provides very high-resolution heterodyne spectroscopy over the ranges 157-212 and 240-625 microns.

The results obtained already in the first year and a half of routine science operations demonstrate that Herschel will have strong impact on all research fields, from Solar System studies to the area of Cosmology, from the analysis of star formation to the mysteries of galaxy formation.

In this talk I will review the Herschel highlights in the area of evolved stars in general and of planetary nebulae more in particular, resulting from observations performed with the three instruments onboard Herschel since launch. This will be exemplified by a few observational results, just the tip of the iceberg of what is yet to come in the remaining year and a half of science operations.

SESSION 1: New Results from Observations (cont.)
Chair: Ronald Weinberger

© Herschel observations of PNe in the MESS key program

P.A.M. van Hoof*, M.J. Barlow, G.C. Van de Steene, K.M. Exter, R. Wesson, M. Matsuura, and the MESS consortium*

The Royal Observatory of Belgium is leading the Herschel Guaranteed Time Key Project "MESS" (Mass loss of Evolved StarS). This project has observed a wide variety of evolved stellar objects in spectroscopic and photometric mode using both the PACS and SPIRE instruments on board the Herschel satellite. The aims of the project are to study the mass loss history of the central star, the hydrodynamical interactions in the outflows and the properties of the dust that was formed in the ejecta. The project studies a wide variety of evolved objects, including planetary nebulae (PNe). In my talk I will give an overview of the most recent results that we obtained on PNe. This will include new imaging data of NGC 650 and NGC 6853, as well as recent spectroscopic results.

® New results from the UV

L. Bianchi

The UV (below about 3000 Å) and far-UV (shortwards of Ly-α) domains hold unique clues to unravel the physical parameters of Central Stars of Planetary Nebulae (CSPNe) and the paths for this elusive final stage of stellar evolution, thanks to a wealth of diagnostic transitions from ionic species not observable at other wavelengths.
Intermediate mass stars are the major providers of important elements: understanding how they shed most of their initial mass is critical also for understanding the chemical enrichment of the ISM. Mass-loss diagnostic lines abound in the far-UV and UV, and when the CSPN reaches the hottest T_{eff} before turning on the WD-cooling sequence, and the wind fades, the last wind lines to disappear are in the far-UV. New diagnostic spectral lines for elements such as neon were discovered in the far-UV range. This domain offers also a host of molecular hydrogen diagnostics, tracing the circum-stellar material expelled in previous phases.

® How Hubble Changed Research in Planetary Nebulae

B. Balick

The superior, stable, narrowband imaging capabilities of the Hubble Space Telescope have made it a stunning nebular microscope and, more recently, a movie camera, that provide new insights into the evolution pathways of planetary nebulae. I will present a broad perspective of 20 years of fascinating and often very puzzling results that show that the ends of stellar lives are far more exciting than we might have imagined, and (accordingly) pose an array of challenging questions. The presentation ends with a review the array of new opportunities that will unfold in the next decade, from new observational tools (ALMA, JWST, and IR interferometry) to focussed theoretical questions well suited for a new era of new modeling tools with integrated 3-D magnetohydrodynamic hydrodynamics with radiation transfer and shock cooling. In short, Hubble observations and synergistic IR and molecular studies have vitalized the field of late stellar astrophysics.

© A mid-infrared imaging survey of post-AGB stars

E. Lagadec, *T. Verhoelst, D. Mekarnia, O. Suárez, A. Zijlstra, P. Bendjoya, R. Szczerba, O. Chesneau, H. van Winckel, M. Barlow, M. Matsuura, J. Bowey, S. Lorenz-Martins, T. Gledhill*

Post-AGB stars are key objects for the study of the dramatic morphological changes of low- to intermediate-mass stars on their evolution from the Asymptotic Giant Branch (AGB) towards the Planetary Nebula stage. There is growing evidences that binary interaction processes may very well have a determining role in the shaping process of many objects, but so far direct evidence is still weak. We aim at a systematic study of the dust distribution around a large sample of Post-AGB stars as a probe of the symmetry breaking in the nebulae around these systems. We conducted the first 8m-class telescopes imaging survey in the mid-infrared to study the inner part of these evolved stars to probe direct emission from dusty structures in the core of Post-AGB stars in order to better understand their shaping mechanisms. We imaged a sample of 93 evolved stars and nebulae in the mid-infrared using VISIR/VLT, T-Recs/Gemini South and Michelle/Gemini North. We found that all the Proto-Planetary Nebulae we resolved show a clear departure from spherical symmetry. 59 out of the 93 observed targets appear to be none resolved. The resolved targets can be divided in two categories. The nebulae with a dense central core, that is either bipolar or multipolar. The nebulae with no central core have an elliptical morphology. The dense central torus observed likely host binary systems which triggered fast outflows that shaped the nebulae. We will present the results of that survey and ongoing follow-up projects aiming at understanding the ejection of material by those stars.

© The SPM Kinematic Catalogue of Planetary Nebulae

***J.A. López**, M. Richer, M.T. García-Díaz, D.M. Clark, J. Meaburn, H. Riesgo, M. Lloyd, W. Steffen*

The San Pedro Mártir Kinematic Catalogue of Planetary Nebulae provides spatially resolved, long-slit, echelle spectra for about 600 PNe, representing 56 observing runs and about 4000 individual integrations to date. The data is presented wavelength calibrated and corrected for heliocentric motion. PDF files of each spectra are ready to download from the web database with full spatial and spectral information. This is the most extensive single source of data relative to the internal kinematics of the nebular shell in PNe. Data can be retrieved for individual objects or groups, such as by morphology, galactic population, binary cores, fast outflows, etc. The multiple functionality of the web database will be demonstrated during this talk.

© SOFIA Observations of the Planetary Nebula NGC 7009

***R. Rubin**, S. Colgan, R. Corradi, R. Sankrit, A. Tielens, Y. Tsamis*

We report spectrophotometric observations made with SOFIA/FORCAST currently scheduled for 1 June 2011. Optical measurements have shown that the abundance discrepancy factor (adf) varies with position in several high-adf PNe and is highest close to the central star. The very low electron temperature inclusions, postulated to explain the abundance discrepancy, must be cooled predominantly by fine structure IR lines. These SOFIA data will map mid-IR FS lines (and our related Herschel program will add several far-IR FS lines) in the bright, well-characterized, high-adf PN NGC 7009. We will compare these IR results with FS optical line measurements in order to correlate ratios of IR to optical fluxes with position, and thus correlate with where the adf peaks.

SESSION 2: The stellar evolution connection

2a: Through the AGB and beyond
Chair: Katrina Exter

® Mass loss on the AGB and Beyond

L.A. Willson

The problem of pre-PN mass loss may be separated into three parts, each requiring somewhat different modeling and observations to resolve. These three parts are: (a) At what luminosity does the mass loss end the AGB evolution, and how does this vary with M and Z? (b) What are dM/dt and $v_\infty(t)$ once the star reaches this luminosity, until the envelope is almost entirely gone and the star leaves the AGB? (c) What produces the rich asymmetries of the final outflows? This review will focus on the first two questions, but the third affects our understanding of the first two if most PNe are shaped by processes that can also modulate dM/dt.

© Observational study of mass loss from AGB stars and beyond

M. Matsuura et al.

It is important to properly describe the mass-loss rate of AGB stars, in order to understand their evolution from the AGB to PN phase. The primary goal of this study is to understand the relation between the stellar luminosity and mass-loss rate. The secondary goal is to investigate the influence of metallicity on the mass-loss rate. The luminosity of the star is a crucial parameter for the radiative driven stellar wind. Many efforts have been invested to constrain the AGB mass-loss rate, but most of the previous studies use Galactic objects, which have poorly known distances, thus their luminosities. To overcome this problem, we have studied mass loss from AGB stars in the Galaxies of the Local Group. The distance to the stars have been independently measured, thus AGB stars in these galaxies are ideal for understanding the mass-loss rate. Moreover, these galaxies have a lower metallicity than the Milky Way, providing an ideal target to study the influence of metallicity on the mass-loss rate. We report our analysis of mass loss, using the Spitzer Space Telescope, the Herschel Space Observatory and the Atacama Pathfinder Experiment (APEX). We will discuss the influence of AGB mass-loss on stellar evolution, and explore AGB and PN contribution to the lifecycle of matter in galaxies.

© Morphological classification of post-AGB stars

***A. Manchado**, D.A. García-Hernández, E. Villaver, J. Guironnet de Massa*

We present a complete study of the morphology of post-Asymptotic Giant Branch (post-AGB) stars. The post-AGB stage is a very short evolutionary phase between the end of the AGB and the beginning of the Planetary Nebula (PN) stage (between 100 and 10,000 yrs). Post-AGB stars do not show variability and are not hot enough to fully ionize the hydrogen envelope. We have defined the end of the post-AGB phase and the beginning of the PN phase when the star has a temperature of 30,000 K. Post-AGB stars have a circumstellar shell that is illuminated by the central stars or partially ionized. However, this circumstellar shell is too small to be resolved by ground-based observations. Thus, we have used data from the Hubble Space Telescope (HST) database to resolve these shells. 140 post-AGBs were found in this database. Here we present the preliminary results on their morphological classification and the correlation with several parameters such as galactic latitude and 2MASS and IRAS fluxes. Our preliminary results show that 40% of the sample are stellar-like (S), 33% bipolar (B), 12% multipolar (M) and 15% elliptical (E).

® AGB evolution: new theoretical results

P. Marigo

Key properties of Planetary Nebulae (mass of the central star, chemical abundances, and dynamics) depend critically on the evolution of the progenitor star during the Asymptotic Giant Branch (AGB) phase.
At present the modeling of this phase is still affected by severe uncertainties due to our poor knowledge of processes like mass loss and convection.
On the other hand, strong constraints to AGB models are set by observations, e.g. Galactic initial-final mass relation, luminosity functions of C and M type stars in the Magellanic Clouds and other nearby galaxies, number counts of AGB stars in star clusters, chemical abundances in PNe, near- and mid-infrared photometric surveys of AGB star populations.
In this framework, I will review the most recent results of AGB modeling, highlighting the improvements and pointing out the weak points that still deserve major effort.

® Common envelopes: the binary route to Planetary Nebulae?

R. Izzard

I shall review recent progress on understanding common-envelope evolution with emphasis on its end result, a (possibly bipolar) planetary nebula. Which stars will go into the common-envelope phase? How is it modelled? What is the outcome and will it lead to a planetary nebula? I will review both the detailed modelling approach, e.g. through hydrodynamical simulations, and the population/statistical comparison technique. Future prospects will be considered briefly, e.g. CE/PN research including calibration of models to observations through chemical yield comparisons and improved modelling of progenitors and lifetimes.

© Shaping proto-Planetary Nebulae by binary systems

***A. Riera**, P. Velázquez, W. Steffen, A. Raga, J. Cantó*

We present the results of 3D hydrodynamic simulations aimed to explore the binary scenario for shaping bipolar, point- and mirror-symmetric proto-Planetary Nebulae. We consider a jet launched by the secondary star of a binary system, located at the center of the PPN, which propagates within a circumstellar medium swept previously up by the wind of the giant companion. As a result of the presence of the companion star, the accretion disk around the jet source is likely to process. We apply the combination of an orbital motion plus a precession to the well-known proto-PNe Red Rectangle and CRL 618.

© Ongoing surveys for close binary central stars and wider implications

B. Miszalski

Binary central stars have long been invoked to explain the vexing shapes of planetary nebulae (PNe) despite there being scant direct evidence to support this hypothesis. Modern large-scale surveys and improved observing strategies have allowed us to significantly boost the number of known close binary central stars and estimate at least 20% of PNe have close binary nuclei that passed through a common-envelope (CE) phase. The larger sample of post-CE nebulae appears to have a high proportion of bipolar nebulae, low-ionisation structures (especially in SN1987A-like rings) and polar outflows or jets. These trends are guiding our target selection in ongoing multi-epoch spectroscopic and photometric surveys for new binaries. Multiple new discoveries are being uncovered that further strengthen the connection between post-CE trends and close binaries. I will review these ongoing surveys and discuss the wider implications of our new discoveries on common-envelope evolution, microstructure and jet formation, dust obscuration events and the spectral classification of central stars.

© Population Synthesis of Galactic PN from Binaries

***M. Moe**, O. de Marco*

There is at present no viable theory whereby a *single* star with M_{MS} <2.4 ± 0.3 $M_{\odot}$ can initiate and sustain a "superwind" dM/dt>$10^{-5\ -\ -4}$ $M_{\odot}$ yr^{-1} at the tip of the AGB, which is necessary for PN formation. However, we propose that a binary companion can not only shape the morphology of a PN, but more importantly provide the required mass loss rate enhancement to generate the superwind. We give an overview of our recently submitted binary population synthesis paper where we calculate PN formation rates from binary common envelopes (CE), mergers, tidally synchronized systems that avoid CE, gravitationally focused winds, and double degenerate systems. The predicted number of Galactic PN with radii < 0.9 pc shaped *and ejected* by a binary companion is 7,600 ± 2,200, which is (65±20)% of the observationally-estimated number of Galactic PN. We demonstrate that the observed *close* CSPN binary fraction of 15-20% is consistent with our overall binary fraction considering we predict *two* peaks at log P(days)~0 and 4 in the CSPN period distribution. Finally, we discuss the impact of binarity on the PN luminosity function, CS mass distribution, chemical abundances, etc., and why these distributions predicted in the binary scenario are close to observations while the single star paradigm produces distributions which are measurably discrepant.

© Observing compact disks inside PPNe with the VLTI

***S.N. Bright**, O. De Marco, O. Chesneau, E. Lagadec*

AGB stars appear to lose mass spherically, but many PNe that result from the mass-loss have non-spherical morphologies, often with highly collimated sub-structures. Compact disks have been found in some bipolar PNe but their role in the axis-symmetrical shaping process remains unknown. At the cooler end of the AGB-PN transition, compact Keplerian disks are found to be common in post-AGB binaries. However, generally no resolved nebulae are found in these systems, so these objects may never develop into PNe. Another group of post-AGB stars, pre-PNe, actually have collimated nebulae shining by reflected light or shock ionisation. It is unknown why some, otherwise similar, post-AGB stars have resolved nebulae while others do not. The nebulae in pre-PNe are very similar to young PNe and are extremely likely to be their immediate predecessors. We are observing the inner circumstellar regions of pre-PNe at very high angular resolutions with the Very Large Telescope Interferometer (VLTI). We seek to determine whether pre-PNe have disks similar to PNe. We wish to understand the potential link between disks observed in young PNe, the asymmetries observed in PNe, and the disks around binary post-AGB stars with no nebulae.

SESSION 2: The stellar evolution connection

2b: Aspects of the PN phase
Chair: Richard Henry

® Cosmic recycling

K.B. Kwitter, *R. Henry*

We review gas-phase abundances in PNe, and describe their dual utility as archives of original progenitor metallicity via the α elements, as well as sources of processed material from nucleosynthesis during the star¹s evolution, i.e., C, N, and s-process elements. Observational methods, including analysis tools and computer modeling, are discussed, along with the status of recombination-line vs. forbidden-line abundance determinations. We also summarize results from a recent collaborative comparison with several abundances research groups. Finally, we suggest areas where more work is needed to improve our abilities to determine abundances in PNe.

© Heavy elements in planetary nebulae: A theorist's gold mine

A. Karakas*, M. Lugaro*

Observations of planetary nebulae have revealed a gold mine of information about the composition of heavy elements synthesized by the slow neutron capture process (the s-process). In some of these nebulae the abundances of s-process elements are enriched by factors of 10 to 30 times the solar value, indicating that these elements were produced in the progenitor star while it was on the asymptotic giant branch (AGB). In this talk I summarize results of our recent full s-process network predictions covering a wide range of progenitor masses and metallicities. I will provide a comparison to observations and show how this can provide important insights into nucleosynthesis processes occurring deep within AGB stars.

® Atomic processes in photoionized gaseous nebulae

X. Liu

In this review, I will highlight some major progresses on the study of atomic processes in photoionized gaseous nebulae since the last PN symposium.

® Report on the workshop "Uncertainties in Atomic Data and How they Propagate in Chemical Abundances"

V. Luridiana, *J. García-Rojas*

The workshop "Uncertainties in Atomic Data and How they Propagate in Chemical Abundances", held on 20-22 October, 2010, at the Instituto de Astrofísica de Canarias in Tenerife (Spain) has brought together scientists concerned with the completeness and accuracy of atomic data for astrophysical applications, such as atomic physicists, theoretical astrophysicists and observers. The topics covered in the workshop include the evaluation of uncertainties in atomic data, the propagation of such uncertainties in chemical abundances, and the feedback between observations and theoretical calculations.
Communication issues were also discussed, such as how to ensure that atomic data are correctly understood and used and which forum is best for a fluid interaction between the communities involved in the production and use of atomic data. Here, I will briefly report on the discussions held during the workshop and on the initiatives that followed.

© When Shape Matters: Correcting the ICFs to derive the chemical abundances of bipolar and elliptical PNe

***D.R. Gonçalves**, R. Wesson, C. Morisset, M. Barlow, B. Ercolano*

The extraction of chemical abundances of ionised nebulae from a limited spectral range is usually hampered by the lack of emission lines corresponding to certain ionic stages. So far, the missing emission lines have been accounted for by the ionisation correction factors (ICFs), constructed under simplistic assumptions like spherical geometry by using 1-D photoionisation modelling. In this talk I will discuss the first results of our ongoing project to find a new set of ICFs to determine total abundances of N, O, Ne, Ar, and S, with optical spectra, in the case of non-spherical PNe. These results are based on a grid of 3-D photoionisation modelling of round, elliptical and bipolar shaped PNe, spanning the typical PNe luminosities, effective temperatures and densities. We show that the additional corrections -to the largely used Kingsburgh and Barlow (1994) ICFs- are always higher for bipolars than for ellipticals. Moreover, these additional corrections are, for bipolars, up to: 15% for oxygen, 30% for nitrogen, 20% for neon, 25% for argon and 50% for sulphur. Finally, on top of the fact that corrections change greatly with shape, they vary as greatly with the central star temperature.

SESSION 2: The stellar evolution connection (cont.)

2b: Aspects of the PN phase
Chair: Detlef Schönberner

® Molecular processes from the AGB to the PN stage

D.A. García-Hernández

A large variety of complex organic molecules and inorganic solid-state compounds have been observed to emerge in the circumstellar environment of stars (both C-rich and O-rich) in the transition phase between Asymptotic Giant Branch (AGB) stars and Planetary Nebulae (PNe), following the formation of gas-phase molecules and inorganic solid-state compounds in the previous AGB phase. The ~100-10,000 years of evolution following the end of the AGB phase represents a most fascinating laboratory for astrochemistry and provides severe constraints on any model of gas-phase and solid-state chemistry. One of the major challenges of present day astrophysics and astrochemistry is to understand the formation pathways of these complex organic molecules and inorganic solid-state compounds (e.g., polycyclic aromatic hydrocarbon (PAHs) and fullerenes in the case of a C-rich chemistry and oxides and crystalline silicates in O-rich environments) in space. In this talk, I will present an observational review of the molecular processes in the late stages of stellar evolution with a special emphasis on the formation of PAHs and fullerenes as well as the possible carrier candidates of the unidentified 21, 26, and 30 micron features usually observed in post-AGB stars and young PNe.

® Shape, Structure, and Morphology in Planetary Nebulae

R. Shaw

Since their recognition as a distinct astrophysical phenomenon more than two centuries ago, the role of morphology in planetary nebula (PN) research has evolved from mere description to a key tool in understanding their origins, structure, and evolution. Over the last century the study of morphology has revealed many profound insights into the PN phenomenon. For instance, we learned that PNe are associated with the late stages of stellar evolution; that they have complex, three-dimensional structures; that their shapes evolve continuously from the moment of formation to their dispersal into the ISM; that their macroscopic symmetries are well correlated with their chemical properties and the masses of their central stars; that the structures on all spatial scales result from a variety of causes, and so on. A revival over the past two decades in PNe morphological studies springs from a combination of factors, including the advent of wide-area, high dynamic range detectors; the growing archive of high resolution images from the X-ray to the mid-IR; and the advent of numerical simulations of the co-evolution of PNe and their central stars. Yet the story of PN formation from their immediate precursors, the AGB stars, is not yet fully written. In this area PN morphology continues to inspire, provide context, or serve as an ultimate standard of comparison for many investigations in this area of astrophysics. After a brief review of the remarkable successes of PN morphology, I will summarize how this tool has been employed in more than 150 papers over the last half-decade to advance our understanding of PNe.

© Wind Capture Accretion Disks and Magnetic Towers in pPN

A. Frank, *M. Haurte-Espinosa, J. Carroll, E. Blackman, J. Nordhaus*

We present new results of 3-D AMR MHD simulations focusing on two distinct aspects of pPN evolution. We first report the results of a campaign of simulations to explore the development of accretion disks formed via wind capture. Our result focus on the limits of disk formation and the range of disk properties. We also present new simulations of collimated outflows driven entirely by magnetic fields. These Poynting flux dominated "magnetic towers" hold promise for explaining key properties of pPN flows. Our simulations address magnetic tower evolution and stability.

® Dynamical modeling and the interactions with the ISM

W. Steffen

In this review I will present recent theoretical work on the dynamics of planetary nebulae and their interaction with their environment. This includes progress on the shaping mechanisms, the observable kinematics that results from the dynamical evolution as well as the changes of structure due to motion through the local interstellar medium.

© Magnetic Fields and Developing Asymmetries in Circumstellar Masers of evolved stars

N. Amiri, *W. Vlemmings, H. van Langevelde, A. Kemball*

Maser emission occurs in different regions of the circumstellar envelopes (CSEs) of evolved stars and can be studied at high angular resolution using radio interferometers. These masers are useful probes of the dynamics and kinematics of the outflow from AGB stars. Moreover, masers can be important tracers of the magnetic field strength and morphology at various distances from the central stars. It is expected that the magnetic field plays an important role in transforming spherically symmetric asymptotic giant branch (AGB) stars into a-spherical planetary nebulae (PNe). Theoretical modeling indicated that magnetically collimated jets may be responsible for the formation of the a-spherical PNe. Water fountain sources are a class of post-AGB objects in which H_2O masers indicate high velocity collimated jets. Our radio interferometric observations indicate that asymmetries are also present in the OH maser region of the envelope. We performed kinematical reconstruction in order to understand the distribution of OH masers in the CSEs of these stars. Our results show that the OH masers could have either equatorial or bi-conical distribution. Additionally, the observations reveal significant field strength for the OH maser region of these objects, which show the possible role of the magnetic field in collimating the CSEs. At distances close to the central stars, between the photosphere and the dust formation zone, SiO masers occur. SiO maser polarimetry has been performed for Mira variables and supergiants and seems to indicate dynamically significant and ordered magnetic fields. We extended these studies and performed VLBA SiO maser polarization observations of objects with more extreme mass-loss, in order to understand the origin of the transition between the AGB and PNe. These observations will enable us to understand the SiO emission mechanisms and possibly distinguish between competing models on the origin of the SiO maser polarization.

© Magnetic fields during the evolution towards Planetary Nebulae

W. Vlemmings

While strong magnetic fields are shown to be ubiquitous in the envelopes of AGB and post-AGB stars, their origin and role in PNe formation is still unclear. I will present the currently available observations of circumstellar envelope magnetic fields. I will also discuss the possibilities that will be offered by the next generation of telescopes, in particular ALMA, in determining the origin and the effect of magnetic fields on the mass-loss process and on the shaping of PNe.

© Understanding the Immediate Progenitors of Planetary Nebulae

R. Sahai, *M. Morris, C. Sanchez-Contreras, M. Claussen*

Pre-Planetary Nebulae (PPNe) represent a relatively short, but all important, intermediate evolutionary phase in the evolution of AGB stars to Planetary Nebulae (PNe). Our unbiased, high-resolution imaging surveys with HST of young PNe and PPNe show very strong morphological similarities between these classes. Thus, our morphological scheme for PPN classification is easily extended to young PNe, preserving virtually all of the primary and secondary descriptors, and adding a few new secondary ones. The primary shaping of PNe likely begins before the PN phase. We have therefore been searching for clues to PNe formation and shaping mechanisms in PPNe. Amongst the clues which we have uncovered in our multiwavelength (covering optical, mm-wave and radio wavelengths) studies of PPNe, we will discuss the following: (a) Hα emission with P-Cygni profiles and very broad wings (b) massive collimated outflows (c) equatorial waists and disks with very large (millimeter-sized) dust grains.

SESSION 2: The stellar evolution connection

2c: Aspects of the Central Stars
Chair: Albert Zijlstra

© Multipolar Planetary Nebulae: Not as Geometrically Diversified as Thought

***S.-N. Chong**, S. Kwok, H. Imai et al.*

We present a general three-dimensional model of multipolar planetary nebulae (PNe). By rotating to different viewing angles and adjusting the angles between the multiple lobes, we demonstrate that the model is able to produce HST H_α images of 20 multipolar young PNe, e.g. NGC 6881. Though this model only considers the geometrical projection effects, it significantly unifies the selected PNe and can be considered as a first-order fundamental model of the "multipolar" morphological class. This kind of model reduces complexity and is essential to pursuing of the shaping mechanism. Further discussions based on the model parameters include the spectral energy distributions (SEDs) and the chemical compositions which reflect the evolutionary status of the PNe. In addition, we illustrate that under some special conditions, i.e. in certain viewing angles, it will be hard to imagine that the projected image originates from a multipolar model. More evolved cases such as NGC 6072 will also be compared.

© Jet Power in Planetary Nebulae: Theory vs. Observation

P. Huggins

High velocity jets are among the most prominent features of a wide class of planetary nebulae, but their origins are not understood. Several different types of physical model have been suggested to power the jets, but there is no consensus or preferred scenario. We confront current theoretical ideas on jet formation with observations, using the best studied pre-planetary nebulae in millimeter CO, where the dynamical properties are best defined. In addition to the mass, velocity, momentum, and energy of the jets, the mass and energetics of the equatorial mass-loss that typically accompanies jet formation prove to be important diagnostics. Our integrated approach provides estimates for some key physical quantities - such as the binding energy of the envelope when the jets are launched - and allows testing of model features using correlations between parameters. Even with a relatively small sample of well-observed objects, we find that some specific scenarios for powering jets can be ruled out or rendered implausible, and others are promising at a quantitative level.

© Are planetary nebulae derived from multiple evolutionary scenarios?

D. Frew, *Q. Parker*

Our understanding of the diversity of planetary nebulae (PNe) has been significantly enhanced as a result of several recent large PN surveys, particularly MASH and IPHAS. These new surveys have uncovered substantial numbers of evolved, obscured, and/or unusual PNe that are providing important clues to the origin, evolution and nature of these fascinating sources. These discoveries suggest that the `PN phenomenon' is in fact more heterogeneous than previously envisaged. Even after the careful elimination of nebular mimics from volume-limited samples of PNe using our newly developed multi-wavelength discriminators, there remains a surprising diversity in the population of Galactic disk PNe and their central stars. Indeed, several evolutionary scenarios are implicated in the formation of objects presently catalogued as PNe. I will summarise these evolutionary pathways, before presenting data on the relative frequencies of different types of PNe in volume-limited 1.0 kpc and 2.0 kpc samples centred on the Sun. Our data provide an important new benchmark for confrontation with stellar evolution theory and population synthesis models.

® Poster Summary

M. Peimbert

® The white dwarf connection

K. Werner

We summarize results of recent quantitative spectral analyses of hot central stars that mark the immediate transition phase from the post-AGB to the white dwarf evolutionary stage.

® Observations of central stars and their winds from X-ray observations

M. Guerrero

The photospheric emission from the hottest central stars of planetary nebulae (CSPNe) is capable to extend into the X-ray domain, with emission peaking at 0.1-0.2 keV and vanishing above 0.4 keV. Unexpected, intriguing hard X-ray emission with energies greater than 0.5 keV has been reported for several CSPNe and for a number of white-dwarfs (WDs). Different mechanisms may be responsible for the hard X-ray emission from CSPNe and WDs: coronal emission from a late-type companion or the CSPN itself, shocks in fast winds as in OB stars, leakage from underneath the star photosphere, or accretion of material from a disk or a companion star. Therefore, the hard X-ray emission associated with CSPNe may have significant implications for our understanding of the formation of PNe: binary companions, disks, and magnetic fields are thought to play a major role in the shaping of PNe, whereas clumping in the stellar wind may have notable effects in the PN evolution by modifying the stellar mechanical energy output. Here I present the results of different observational efforts to search for hard X-ray emission from CSPNe and discuss the different production mechanisms.

© (F)UV Spectroscopy of 15 Extremely Hot Central Stars of Planetary Nebulae

***M. Ziegler**, T. Rauch, K. Werner, J.W. Kruk.*

We present results of (F)UV spectral analyses of 15 CSPNe of DAO-type (A 7, A 31, A 35, A 39, NGC 3587, NGC 6720, NGC 6853, NGC 7293, PuWe 1, Sh 2-174) and O(H)-type (A 36, Lo 1, LSS 1362, NGC 1360, NGC 4361) CSPNe, based on NLTE model atmospheres. We aim especially at a precise determination of T_{eff} by evaluation of ionization equilibria of many species and ionization stages. This is the prerequisite for log g and abundance determinations. The derived parameters are crucial constraints for predictions of AGB nucleosynthesis as well as stellar evolution calculations. Additional modeling of the ISM line-absorption enables to unambiguously identify nearly all observed lines and to improve both, the photospheric as well as the ISM model.

© Modeling the diffuse X-ray emission of Planetary Nebulae with different chemical composition

M. Steffen, *D. Schoenberner, C. Sandin, R. Jacob*

Based on time-dependent radiation-hydrodynamics simulations of the evolution of Planetary Nebulae (PNe), we have carried out a systematic parameter study to address the non-trivial question of how the diffuse X-ray emission of PNe with closed central cavities depends on the evolutionary state of the nebula, the mass of the central star, and the chemical composition of the stellar wind and circumstellar matter. Given the radial temperature/density structure of the spherically symmetric hydrodynamical model, we use the Chianti code to compute the emergent X-ray spectrum, the X-ray luminosity, and the wavelength-dependent surface brightness distribution of the hot central cavity. For hydrogen-rich composition, the models predict the highest X-ray luminosity for metal-rich nebulae with massive and hot central stars. Preliminary test calculations indicate that Planetary Nebula with a Wolf-Rayet type central star can reach even higher X-ray luminosities. In general, the model predictions depend critically on whether or not thermal conduction at the interface between the central "hot bubble" and the inner nebula is taken into account. Quantitative comparison of the model results with available X-ray observations indicates that thermal conduction plays an important role in controlling the temperature structure and X-ray emission of the central cavity. Our grid of models may be used to interpret observed correlations (e.g.,between X-ray temperature and bubble radius), and to estimate whether or not a given PN is detectable by present-day/future X-ray observatories.

® Planets, Evolved Stars, and How they might influence each other

E. Villaver

Over the last 20 years planetary searches have revealed a wealth of systems orbiting stars on the Main Sequence. Most of these low-mass stars eventually will evolve into the Giant phases before entering the Planetary Nebulae (PNe) stage. In the last years, the presence of planets has also been discovered around more massive evolved stars, mostly, along the Red Giant Branch, but also along the Horizontal Branch. Moreover, disks have been found around White Dwarfs presumably formed by tidally disrupted asteroids. In all, there is evidence that an evolved (or evolving) star might influence the survival of planets. In this review I will try to summarize such evidence, but furthermore, I will present the other side of the story, that is, how the presence of a planet might alter the evolution of stars and with that, the PN formation.

® Poster Summary

G. van de Steene

SESSION 3: The cosmic population of galactic and extragalactic PNe

Chair: Walter Maciel

® PNe in the Magellanic Clouds and other Local Group galaxies

W. Reid

A review of searches and research into planetary nebulae (PNe) within the Magellanic Clouds (MCs) and Local Group (LG) galaxies (within 1.3 Mpc of the Milky Way) over the past 5 years. Topics covered include surveys, imaging, population sizes, magnitude limits, a brief review of the science being conducted, results, instruments and telescopes being used.

We begin with the MCs, which provide an excellent laboratory in which to study extragalactic PNe. With known distances and low extinction, most PNe are bright enough to provide good spatial resolution and access to their central stars using today's modern telescopes. The astrophysical advantages of MC PNe include: a good sample size for statistical and kinematic studies, low to intermediate metallicity environments, PNe can be individually analysed and directly compared for size, shape, mass, metallicity, local environment and galactic location. With average diameters <4 arcsec on the sky, spectroscopy is able to cover the majority of the ionised shell, providing very accurate emission-line luminosities.

Turning our attention to the local group in general, advances over the last 5 years have seen increased research using HST imaging, SAGE-Spitzer multi-channel imaging and high-resolution ground-based spectroscopy using MOS and IFU instruments to measure an unprecedented number of parameters, including central stars, for nebula photoionisation models. Significantly, improved sensitivity on the Australia Telescope Compact Array (ATCA) has allowed the detection of radio emission from a number of bright PNe in the MCs. PNe in the MCs and M31 galaxies have become established as excellent distance calibrators for the PNLF, thanks to the consistent bright OIII λ5007 cut-off.

© Post-AGB stars of the LMC and SMC

H. van Winckel*, E. van Aarle, P.R. Wood, T. Lloyd Evans, D. Kamath, T. Ueta*

Post-AGB stars evolve on a fast track and systematic searches of the rare objects in external galaxies only became possible after the release of deep infrared surveys. We exploited the release of the infrared LMC and SMC SAGE-Spitzer surveys and we searched for luminous, optically bright stars with infrared colours indicative of a past history of heavy dusty mass loss. Additionally, we executed a complete low-resolution spectral survey at Siding Spring, Australia, and at SAAO (South-Africa). Our final result consists of some 1400 good candidate post-AGB stars in the LMC alone. This full LMC catalogue was recently accepted for publication (van Aarle et al., 2011, A&A in press). We studied several objects already in detail using both high-resolution optical spectra (which allow us to determine the abundances of a wide range of elements, from CNO up to the heaviest s-process elements) and low resolution IR spectra (to study the circumstellar dust properties). The abundances are modeled using state-of-the-art chemical stellar evolution AGB models. The unique spectral characteristics of post-AGB stars, together with the newly defined large sample, covering a wide range in luminosities and metallicities, with well constrained distances, make that these objects provide unprecedented direct tests for the poorly understood final structure and chemical evolution of solar-like stars. The ultimate goal is to use these unique properties of post-AGB stars, to gain insight in the badly understood AGB nucleosynthesis and its dependency on metallicity and initial mass as well as to learn more on the connection between post-AGB stars and the PNe samples of both Magellanic clouds. We propose here a contributed talk to give a status report of our ongoing research.

© Ionization of galaxies by their planetary nebulae

G. Stasinska

We show that the population of hot low-mass evolved stars (HOLMES) in galaxies, i.e. nuclei of planetary nebulae and their remnants can easily explain two long-standing problems of extragalactic astronomy: the ionization and heating of the diffuse interstellar medium in spirals and the observed emission-line spectra of ellipticals. We present quantitative models for both types of galaxies and confront them to observations.

SESSION 3: The cosmic population of galactic and extragalactic PNe (cont.)

Chair: Roberto Méndez

® PN populations and kinematics

M. Richer

The brightest planetary nebulae achieve similar maximum luminosities, have similar ratios of chemical abundances, and apparently share similar kinematics in all galaxies. These similarities, however, are not necessarily expected theoretically and appear to hide important evolutionary differences. As predicted theoretically, metallicity appears to affect nebular kinematics, if subtly. There are also clear differences in the evolution of planetary nebulae from galaxies with and without ongoing star formation, but it is not yet clear whether the cause is the difference in metallicity or small differences in the initial masses of the progenitor stars.

® Constraining the chemical evolution of the Local Group Galaxies.

L. Magrini

Planetary nebulae (PNe) are fundamental tools to investigate the chemical evolution of nearby galaxies. PN progenitors do not modify, at least at zeroth approximation, the composition of α-elements such as oxygen, neon, argon, and sulphur, and thus are optimal tracers of the composition of the interstellar medium at the epoch of their formation. The spectroscopy of PNe, combined with that of HII regions, is a powerful method which allows us to analyse the chemical enrichment history of galaxies and in particular the time evolution of the distribution of metals.
I will review the recent results obtained in the study of the chemical abundances of extragalactic PNe (and H II regions), in particular dealing in the problem of the time variation of radial metallicity gradients in disk galaxies.
Chemical evolution models indeed predict different temporal behaviours of the metallicity gradient depending on assumptions such as gas inflow and outflow rate, and star and cloud formation efficiencies. Observations are needed to constrain these theoretical scenarios, but so far they have been insufficient, especially for the old populations. I will show how PNe (and H II regions) are helping to constrain such models and to understand the chemical evolution of nearby spiral galaxies, such as M33 and M81, and of Local Group dwarfs.

© Carbon chemistry in Galactic Bulge Planetary Nebulae

L. Guzmán-Ramírez, *A. Zijlstra, R.N Chuimn, K. Gesicki, E. Lagadec, T.J. Millar, P.M. Woods*

Galactic Bulge Planetary Nebulae show evidence of mixed chemistry with emission from both silicate dust and PAHs. This mixed chemistry is unlikely to be related to carbon dredge up, as third dredge-up is not expected to occur in the low mass Bulge stars. We show that the phenomenon is widespread, and is seen in 30 nebulae out of 40 of our sample, selected on the basis of their infrared flux. HST images and UVES spectra show that the mixed chemistry is not related to the presence of emission-line stars, as it is in the Galactic disk population. We also rule out interaction with the ISM as origin of the PAHs. Instead, a strong correlation is found with morphology, and the presence of a dense torus. A chemical model is presented which shows that hydrocarbon chains can form within oxygen-rich gas through gas-phase chemical reactions. The model predicts two layers, one at A_V~1.5 where small hydrocarbons form from reactions with C^+, and one at A_V~4, where larger chains (and by implication, PAHs) form from reactions with neutral, atomic carbon. These reactions take place in a mini-PDR. We conclude that the mixed chemistry phenomenon occurring in the Galactic Bulge Planetary Nebulae is best explained through hydrocarbon chemistry in an UV-irradiated, dense torus.

© Planetary nebulae in NGC 300: their chemical abundances and the abundance gradient in this galaxy

***M. Peña**, G. Stasinska, F. Bresolin, Y. Tsamis*

A spectrophotometric analysis of a significant sample of PNe and compact HII regions in two zones (center and outskirts) of NGC300 is presented. Data were obtained with FORS2 at the VLT-ESO. A wide wavelength coverage allows us to obtain several temperature and density sensitive diagnostic ratios. Abundances of He, N, O, Ar and S were derived for 18 PNe and 9 compact H II regions were the [O III] electron temperature was measured. Results: H II regions and PNe show similar O/H abundance range, although some PNe, mainly in the center, present low O abundance. PNe are N-richer than H II regions and three of them are Type I. Our PNe are located in a range of galactocentric distances allowing us to analyze the O, Ne, and Ar abundance gradients in the disk in comparison with the gradients derived from H II regions. The PNe gradients are flatter than the H II gradients and show larger dispersion.. Some phenomena like ON-cycle, hot- bottom burning and stellar migration that could be causing these flatter gradients are discussed. An additional result, derived from H II regions, show that N/O is much lower in the external zone of NGC300 (possible the disk is less evolved in the periphery). Also a less-steep gradient is observed for the Ar/O abundance ratio.

® PN populations in external galaxies

M. Arnaboldi

I will present the results from the current surveys of planetary nebulae in elliptical galaxies using the planetary nebulae spectrograph (PNS) and in the diffuse light in the nearby clusters. I illustrate the properties of the luminosity specific PN numbers (α parameter for short) in these systems and their relations with the properties of the parent stellar populations, i.e. its age and metallicity.

© M31 planetary nebulae as seen by PHAT

L. Girardi, *C. Johnson, J. Dalcanton, L. Bianchi, N. Caldwell, K. Gordon, P. Rosenfield, B. Williams (for the PHAT Team)*

The Panchromatic Hubble Andromeda Treasury (PHAT) is a Hubble Space Telescope Multi-cycle program to map roughly a third of M31's star forming disk, using 6 filters covering from the ultraviolet through the near infrared. We have cross-matched the Merrett et al. (2006) catalog of M31 PNe with the first PHAT data obtained in cycle 18. The most interesting results so far regard the UV-optical photometry of PNe in the M31 bulge and inner disk. For all objects with F475W<22, we find a very close relationship between the [O III]5007 and F475W magnitudes. The PNe stand out clearly in well-defined regions of color-color plots, especially those involving the F275W, F336W and F475W filters. A substantial fraction of the objects with a blue F475W-F814W color in PHAT catalogs are PNe. We discuss the observed trends in the light of synthetic models for the evolution of PNe (Marigo et al. 2001), and considering the properties of the underlying stellar populations as derived from PHAT data.

© NGC 5128 - a nearby laboratory for PNe in a giant early-type galaxy

J.R. Walsh, *H. Kuntschner, G.H. Jacoby, R.F. Peletier, M. Rejkuba, N.A. Walton, K.A. Woodley*

NGC 5128 at 3.8 Mpc is the nearest large elliptical galaxy and is ideally suited to a detailed study of its planetary nebular population. About 1100 PNe are known in NGC 5128 and accurate radial velocities of 1050 have been measured with the VLT FLAMES spectrometer, enabling detailed studies of the galaxy kinematic signature. Evidence for PN kinematic sub-groups, perhaps presenting the relics of infalling dwarf galaxies, can be searched, for example. VLT FORS emission line spectrophotometry and comparison with photoionization models provide light element abundances for the some 40 PNe. A spread in O abundance of about 0.8 dex is found but no obvious radial gradient out to 19 kpc; the mean [O/H] is -0.2. Comparison of the O abundance from the PN with the derived metallicity for the underlying stellar population allows the [O/Fe] ratio, a diagnostic for the enrichment history of the galaxy, to be investigated.

© The Planetary Nebulae Population in the Central Regions of M32: the SAURON view

M. Sarzi, *G. Mamon, E. Emsellem, M. Cappellari, R. Bacon, R. Davies, T. de Zeeuw*

Extragalactic Planetary Nebulae (PNe) are not only useful as distance signposts or as tracers of the dark-matter content of their host galaxies, but constitute also good indicators of the main properties of their parent stellar populations. Yet, so far, the properties of PNe in the optical regions of galaxies where stellar population gradients can be more extreme have remained largely unexplored, mainly because the detection of PNe with narrow-band imaging or slit-less spectroscopy is considerably hampered by a strong stellar background. Integral-field spectroscopy (IFS) can overcome this limitation, and here we present a study of the PN population in the nearby compact elliptical M32. Using SAURON data taken with just two 10-minutes-long pointings we have doubled the number of known PNe within the effective radius of M32, detecting PNe five times fainter than previously found in narrow-band images that collected nearly the same number of photons. Furthermore, by carefully accounting for the incompleteness of our survey we could conclude, despite having only 15 sources that the central PNe population of M32 is consistent with the generally adopted shape for the PNe Luminosity Function and its typical normalization observed in early-type galaxies. Finally, owing to the proximity of M32 and to UV images taken with HST, we could identify the most likely candidates for the central star of a subset of our detected PNe and conclude that these stars are affected by substantial amounts of circumstellar dust extinction, a finding that could reconcile the intriguing discrepancy previously reported in M32 between model predictions and observations for the later stages of stellar evolution. Considering the modest time investment on a 4m-class telescope that delivered these results, this work illustrates the potential of future IFS studies for the central PNe population of early-type galaxies.

SESSION 4: Future endeavours in the field

Chair: Letizia Stanghellini

® The Frontier of Ground-Based Observations

U Käufl

The ESO VLT on Paranal is presently in transition from its first generation instrumentation to second generation instruments or at least to substantially upgraded instrumentation. The focus for new instrumentation is largely to gain multipicity, high image definition or integral field imaging spectroscopy.
Starting from recent observational highlights the status and trends for groundbased instrumentation will be reviewed. Particularly the context with the field of PNs in all evolutionary phases will be established.
Particular focus of the review will be spectroscopy and scientific cases where groundbased observations offer a particular advantage.
To the extent possible today, a projection will be given as to the potential of the extremely large telescopes on the horizon, which will work best in the (near-)infrared.

® The impact of Future Space Observatories on PN research

M. Barlow

Orbiting Space Observatories have played an important role in planetary nebulae research, providing data from otherwise inaccessible regions of the electromagnetic spectrum and, particularly in the case of the Hubble Space Telescope, angular resolutions that have been unobtainable from the ground. But during the next few years the HST and Herschel observatories are expected to cease operations, while the XMM-Newton and Chandra X-ray observatories, both launched in 1999, have already exceeded their design lifetimes by large margins.

Two new large astronomy missions are planned for the coming decade: ESA's GAIA, which is scheduled to be launched in 2013 for a 5-year mission, will determine positions, parallaxes and proper motions for a vast number of stars out to several tens of kpc; and the NASA/ESA 6.5m James Webb Space Telescope, an infrared observatory with many capabilities, now unfortunately delayed towards the end of the decade. In addition, the JAXA ASTRO-H X-ray mission, with key spectroscopic capabilities, is scheduled for launch in 2014.

These missions can potentially have a significant impact on research on planetary nebulae and related objects - I will attempt to describe some of the opportunities that they will provide.

POSTERS

Morphological and kinematical analysis of the planetary nebula Hu 1-2 and its irradiated bow-shocks

***L.F. Miranda**, M. Blanco, M.A. Guerrero, A. Riera*

Hu 1-2 is an elliptical/bipolar high-excitation planetary nebula with [N II]-enhanced microstructures and two bipolar knots. We present optical and near-IR narrow band images, and high-resolution long-slit spectra of Hu 1-2 that allow us to make a detailed description of its unusual morphology and internal kinematics. The data also reveal that the bipolar knots probably represent bow-shocks associated to high-velocity outflows that are irradiated from the central star.

Rule or exception? planetary nebulae around hot subdwarf stars

***A. Aller**, L.F. Miranda, A. Ulla, R. Oreiro, M. Manteiga, E. Pérez, C. Rodríguez-López*

Hot subdwarf O stars (sdOs) are blue low-mass stars evolving towards the white dwarf phase, although their origin is still unknown. Investigating the association of sdOs with planetary nebulae (PNe) is essential to confirm a post-AGB origin or to favour other progenitors. To date, only four sdOs associated with a PN are known, but are they the rule or the exception? In this work, we present deep images and intermediate-resolution long-slit spectra of RWT 152, the only known PN+sdO system in the northern hemisphere. These data allow us, for the first time, to analyze the morphology of the nebula as well as the absorption spectrum of the central star. We also show preliminary results for other sdO+PN candidate, in the context of an ongoing survey of PNe around sdOs.

Using photoionization modeling to determine accurate distances for planetary nebulae

***A. Danehkar,** D.J. Frew, Q.A. Parker, O. De Marco*

Accurate distance determinations of planetary nebulae (PNe) are crucial in unraveling the connection between the evolution and physical characteristics of the expanding nebula shells and the properties of the central stars. Using reliable distances, we can accurately estimate fundamental parameters of PNe such as core mass, luminosity, and nebular mass. In this work, we aim to provide accurate determinations of these parameters through photoionization modeling. As a first part of this work, we will generate accurate distances to the PNe A 39, PFP 1, NGC 7027, NGC 2440, and NGC 1514, carefully selected to sample a representative range of central star properties, ionization, and morphology. Their physical parameters such as electron temperature, density and ionic abundances are estimated from an empirical analysis. For each PN, the distance is determined by interpolating from a wide grid of photoionization models by using either 1-D (CLOUDY; Ferland et al. 1998) or 3-D (MOCASSIN; Ercolano et al. 2003) codes based on PN morphology.

Magnetic field of two Water Fountains
A.F. Pérez-Sánchez, *W.H.T. Vlemmings, J.M. Chapman*

We present the morphology and linear polarization of the 22GHz H_2O masers in the high-velocity outflow of two water fountain sources, IRAS 15445-5449 and IRAS 18043-2116. Different levels of saturated maser emission have been detected for both sources. The fractional polarization levels measured for the maser features of IRAS 15445-5449 indicate that the polarization vectors are tracing the poloidal component of the magnetic field in the emitting region. For IRAS 18043-2116 we have measured low levels of fractional linear polarization. The magnetic field in the H_2O maser region of this source is thus likely the toroidal or poloidal component.

Evolution and Nucleosynthesis of AGB stars in Magellanic Cloud clusters
D. Kamath, ***A. Karakas****, P. Wood*

In this poster we present new evolutionary sequences for the observed AGB stars in the three Magellanic cloud clusters: NGC 1978, NGC 1846, and NGC 419. Using the observed abundances, pulsation masses, effective temperatures, and luminosities we compute new stellar models for AGB stars in these clusters. The stellar evolutionary code has updated opacities as well as an updated mass-loss formula to reflect the new observations. We compare the HR diagrams from the stellar models to the observed colour magnitude diagrams. The stellar structure models are used as input to calculate the detailed nucleosynthesis. For NGC 1978 and NGC 1846 we compare our model results to the observationally derived abundances of carbon, oxygen, and fluorine. For NGC 419 we provide abundance predictions, although there are currently no published abundances. The models will eventually be used for s-process nucleosynthesis studies of post-AGB stars in the Magellanic Clouds.

He I temperatures in Planetary Nebulae
A. Peimbert, *M. Peimbert*

It is well established that PNe are not thermally homogeneous, beyond what chemically homogeneous photoionization models predict. To discriminate between the different scenarios proposed in the literature, we have determined the temperature and density based on He I lines for a dozen PNe. We compare these determinations with those derived from collisionally excited lines, CELs, and from the Balmer continua. We find high Balmer temperatures for very high ionization PNe (higher than those derived from He I and CELs): this is due to the higher temperature in the He^{++} region. For PNe where He^{+} is the dominant helium species we find that the He I temperatures agree with the Balmer temperatures and that both are lower than those derived from CELs; suggesting that most PNe are chemically homogeneous.

Excitation conditions of the jets of the pPN CRL 618 as seen by the STIS (HST)
***A. Riera**, A.C. Raga, P.F. Velazquez, S.A.R. Haro-Corzo, P. Kajdic*

We present the results of the optical spectroscopic observations (both medium and low spectral resolution) of the lobes of the proto-Planetary Nebula CRL 618 obtained with the Space Telescope Imaging Spectrograph on board of the *Hubble Space Telescope*. We have obtained de-reddened emission line ratios of several features which are reproduced by planar shocks moving through a dense medium $\sim 10^4$ cm^{-3} with shock velocities from 30 to 40 km s^{-1}.

A study into the kinematics and binary-induced shaping of the bipolar PN HaTr 4
***A.A. Tyndall**, D. Jones, M. Lloyd, T.J. O'Brien, D. Pollacco*

HaTr 4 is a compact bipolar planetary nebula with a binary central star. We present data analysis from VLT-UVES longslit echelle spectra, focusing on [OIII]5006.84 Å emission emanating from the central star system. By combining narrowband imagery with high spectral and spatial resolution position-velocity arrays, it was possible to create a spatio-kinematical model of HaTr 4 and hence further constrain its morphology, expansion velocity, kinematical age, and nebular inclination in relation to that of the binary.

New kinematical distance scale for the Galactic PNe
***A.F. Kholtygin**, I.I. Nikiforov, V.V. Akimkin*

We analyze the kinematics of disk planetary nebulae (PNe) to derive the formal Galactic center distance, R0, for the catalogues of PNe distances by Acker (1978), Cahn et al. (1992), Phillips (2004), and Stanghellini et al. (2008). These distance scales are renormalized to obtain the correct value of R0 =7.9 kpc evaluated from many original estimates (Nikiforov 2004). A new catalogue of distances for PNe was created by averaging all individual renormalized distances.

A nature of a bulge of the Galaxy: a view from planetary nebulae and disk globular clusters
A.F. Kholtygin*, Yu.V. Milanova, I.I. Nikiforov, O.V.Vasyakina*

We study the element abundance evolution for bulge objects. We show that abundances are similar for planetary nebulae (PNe) in the bulge and in the thin disk. It is also found that the metal rich disk subsystem of globular clusters looks in spatial metallicity maps as a bar-like structure which parameters are close to those for the Galactic bar.

Distribution of dust grains in circumstellar shells
A.J. van Marle*, Z. Meliani, R. Keppens, L. Decin*

We present numerical simulations of the hydrodynamical interactions that produce circumstellar shells. These simulations include several scenarios, such as wind-wind interaction and wind-ISM collisions. In our calculations we have taken into account the presence of dust in the stellar wind. Our results show that, while small dust grains tend to be strongly coupled to the gas, large dust grains are only weakly coupled. As a result, the distribution of the large dust grains is not representative of the gas distribution. This may complicate the interpretation of infrared observations of circumstellar nebulae, since dust is the primary source of infrared radiation.

Luminosity and Abundance Correlations in a Carefully-Studied Sample of PNe
J. McKeever, ***B. Balick****, K. Kwitter, K. Braxton, T. Gomez, J. Green, R.B.C. Henry*

We report the results of empirical correlation studies of a homogeneously observed and analyzed set of 120 Galactic PNe spanning a wide range of distances, abundances, excitation, densities, and both major Peimbert types. Our goal is to continue the analysis of these data begun in Milingo et al 2010 and Henry et al 2010 who primarily examined correlations of abundances and with galactocentric radius R_{gal}. We find that a subsample of PNe chosen for their large [O III] luminosities, L[O III], generally show tighter abundance correlations as a function of log(O/H) than does the full sample. In addition to He/H and N/H, the abundances of Cl and Ar correlate with Peimbert types I and II. These results are not sensitive to the derived values of ionization correction factors, ICF. Finally, we show that L[O III] rises and then falls when plotted against the physical radius R_{neb} of PNe, the latter a likely proxy for nebular age. This result nicely complements the studies of Frew 2008 (PhD thesis) who found a tight correlation of Hβ and [OIII] surface brightness with R_{neb}. [N II]/H_α and He II 4686/H_β ratios also correlate with R_{neb}, but the trends are scattered.

A radiative transfer model of dust structures in CRL 2688
D. Vinkovic, ***B. Balick***

Hubble Space Telescope images of CRL 2688 (Egg Nebula) show a symmetric pair of bright lobes extending to a radius of 7" on both sides of a opaque dusty ellipsoid, all of which is surrounded by concentric circular arc segments extending to ~40". New Hubble images from 0.6 to 1.7 μm reveal significant variations color and opacity in the distribution of scattered starlight. We have constructed a detailed radiation-transfer model consisting principally of an optically thick equatorial disk-like structure; bipolar lobes with density enhancements along the polar axis and at the base of lobes; an optically thin extended envelope containing spherical density-enhanced shells to mimic the outer rings of CRL 2688; and a pair of near-stellar caps that collimate and redden the dispersing starlight near its source. We used the code LELUYA (www.leluya.org) that calculates dust scattering, absorption and thermal emission on a highly unstructured triangular self-adaptive grid that simultaneously traces the density and optical depth and their gradients. Our model nicely reproduces all of the basic features detected in the four-color HST images, including the famous searchlights and arcs, as well as the measured spectral energy distribution ("SED") of CRL 2688. Assuming a distance of 420 pc we estimate the light originates in a giant star with a temperature T_* ~7000 K and a luminosity as 5500±1100 $L_\odot$.

Planetary Nebulae in the VISTA Magellanic Cloud Survey
B. Miszalski*, R. Napiwotzki, M.-R. Cioni*

The VISTA Magellanic Cloud (VMC) survey is assembling a deep, multi-epoch atlas of YJK_s photometry across the Magellanic Clouds. Prior to the VMC only the brightest Magellanic Cloud PNe (MCPNe) were accessible at near-infrared (NIR) wavelengths. It is now possible for the first time to assemble the NIR properties of MCPNe and to identify contaminating non-PNe that mimic PNe which are best revealed at NIR wavelengths (e.g. H II regions and symbiotic stars). We present the first VMC results for a sample of 102 objects previously classified as LMC PNe. A large proportion of the sample is found to be non-PNe based on an assessment of multi-wavelength and multi-epoch photometry. At least six periodic variables were identified from OGLE-III photometry of the sample but curiously none of these are associated with bona-fide PNe. Our reclassifications and OGLE-III photometry strongly suggest misclassified field stars, instead of bona-fide PNe, are responsible for previous claims of a large population of giant central star companions in the LMC. The VMC survey will also allow for the identification of underrepresented Magellanic PNe which we demonstrate with the detection of a new VMC-selected PN with a [WC9]-[WC11] central star.

A Consolidated Online Database of Galactic Planetary Nebulae
B. Miszalski*, A. Acker, F. Ochsenbein, Q. Parker*

Since the unifying Strasbourg-ESO Catalogue of Galactic Planetary Nebulae (SECGPN) a large number of new discoveries have been made thanks to improved surveys and discovery techniques. The increasingly heterogeneous population of Galactic PNe is approaching 3000 objects and becoming more difficult to study on the whole without a centralised repository. We introduce a consolidated and interactive online database with object classifications that reflect the latest multi-wavelength data and the most recent results. The extensible database, hosted by the Centre de Donnees astronomique de Strasbourg (CDS), will contain a wealth of observed data for large, well-defined samples of PNe including coordinates, multi-wavelength images, spectroscopy, line intensities, radial velocities and binary status.

The Σ-D relation for Galactic planetary nebulae: application of orthogonal fitting procedure

B. Vukotic*, D. Urosevic*

We estimate the parameters of the radio surface brightness to diameter (Σ-D) relation for the sample of Galactic planetary nebulae (PNe). The bootstrap re-sampling and orthogonal offsets fitting procedure are applied. The orthogonal fitting procedure provides that the parameter values of D-Σ and Σ-D fits are invariant within the estimated uncertainties. We discuss the probability statistics of the fitted ($\log \Sigma = \log A - \beta \log D$) relation and the resulting fit parameters which is indicative for PN distance determination.

Maser Kinematics and Infrared Properties of the Water Fountain IRAS 18286-0959

B. Yung, *J.-I. Nakashima, H. Imai, S. Deguchi, P.J. Diamond, S. Kwok*

A "Water fountain" is a transitional object between an AGB star and a PNe. The VLBA observations of 22.2GHz water maser emission reveal a "double-helix" outflow pattern from one of the water fountains, IRAS 18286-0959. The pattern is reasonably fit by a model consisting of two precessing jets. We propose that the appearance of two jets observed are the result of a single driving source with a significant proper motion. We also exam the infrared properties of water fountains and found that they might have their own IR color characteristics which are not suggested in previous color classifications (e.g., van der Veen & Habing 1988). The IR color of water fountains could serve as a new criteria for searching this type of rare objects.

NGC 6826 and NGC 7009: A Unified study of the Planetary Nebulae and their central stars

C. Fierro, ***A. Peimbert,*** *L. Georgiev, C. Morisset, A. Arrieta*

We develop self-consistent stellar-nebular models of NGC 6826 and NGC 7009. The models reproduce the available observations in the optical and UV, showing that additional constrains obtained with this combined approach to the lead to more trustworthy results. The UV and optical spectra (920-2000 Å and 3650-6800 Å) of the central star are modeled with the atmospheres code CMFGEN. The synthetic spectra is used as input for the photoionization code CLOUDY, which is then used to reproduce the optical nebular spectra. The parameters obtained through models are supplemented with those obtained from the semi-analytical study of each nebula. The stellar-nebular model allow us to obtain 16 parameters (T_{eff}, log g, L, distance, age, nebular size, etc.) of each nebula and its central star. We obtained the chemical composition of the star and the nebula independently. This allows us to develop a comparative study of the chemical composition in the nebula and the central star. The analysis of different regions in the nebulae indicates homogeneous chemical composition. Abundances determined for the stars agree with those of the nebulae assuming temperature fluctuations ($t^2 \neq 0.00$) in the nebular gas.

Carbonaceous molecules in the O-rich circumstellar environment of post-AGB binaries
***C. Gielen**, J. Cami, J. Bouwman, M. Min*

We report on the detection of PAH and C_{60} carbonaceous molecules in the infrared spectra of binary post-AGB stars. These binary post-AGB sources are characterised by the presence of a stable oxygen-rich dust disc, with strong features of amorphous and crystalline silicates. Emission of PAHs is already observed in a few post-AGB sources, but it is the first time fullerenes are detected in these sources. There is evidence that the central stars are oxygen rich, which would make the detection of carbonaceous molecules even more surprising.

Dust in IC 418
***C. Morisset**, R. Szczerba, A. García-Hernández*

We construct a detailed model for the IR dust emission in the PN IC 418. We succeed to reproduce the emission from 2 to 200 microns. We can determine the amount of emitting dust as well as its composition, and compare to the depletion of elements observed in the photoionized region.

High-ionization recombination lines in NGC 6302
*D. Pequignot, C**. Morisset,** S. Casassus*

A preliminary VLT UVES spectrum of NGC 6302 (Casassus et al. 2002) has been recently analysed by means of X-SSN, a spectrum synthesis code for nebulae (Morisset and Pequignot). A wealth of permitted optical recombination lines from highly-ionized species are detected/identified for the first time in a PN, and some of them probably for the first time in (Astro)Physics.

Combined modelling of the He-131 planetary nebula and its central star
*A. Arrieta, L. Georgiev, G. Stasinska, **C. Morisset***

We present the preliminary results of an auto-consistent model of He 2-131 planetary nebula and its central star. We model the star using the CMFGEN code and then we use its spectral energy distribution as input to the CLOUDY-3D photoionization code to compute the intensities of the nebular emission lines and their profiles. We iterate between the two codes until we are able to reproduce the characteristics of stellar spectrum and of the nebular lines. One of the important outcomes of our study is the comparison of the chemical composition of the stellar atmosphere and that of the nebula.

Optical and infrared study of enigmatic post-AGB primary and disk shaped secondary in ε Aurigae

***C. Muthumariappan**, M. Parthasarathy*

ε Aurigae is a spectroscopic binary with a period of 27 years which is punctuated by flat bottomed eclipse of 2 year duration. The system has three components: a F0Ia post-AGB primary star of mass 2.2$M_{\odot}$, a B5 type main sequence secondary that is surrounded by a disk of gas and dust. The disk eclipses the primary. The nature of the transiting disk and its origin were not known. From the archival data spanning from UV to far-IR we constructed SED of this binary star. To constrain the physical and chemical properties of the disk, we modelled the disk shaped secondary from the SED using a 2D Monte-Carlo radiative transfer code SRCDUST. We investigate that the grains in the disk are basically silicates and hence the disk was originated from a mass transfer from the F0Ia post-AGB star to its companion. The disk is geometrically thin which is seen nearly edge-on. The grains are mostly forward scattering with size larger than 10\mu. It is suggested that the disk has a mass smaller than 0.00005$M_{\odot}$, a diameter of 4AU and a scale height of 0.01 and it doest exhibit a central hole. We also carried out high resolution (~70,000) spectroscopic monitoring of K I, Na, and H_{α} profiles during the totality phase of the present eclipse of ε Aurigae using VBT Echelle spectrograph. Results from these observations will be presented.

Radiative Transfer models of 21 and 30micron features in five C-rich PPNe

***C. Muthumariappan**, B.E. Reddy*

The 21 μm and 30 μm emission features are the strongest dust emission features detected in the C-rich PPNs which together account more than 20% of the total IR flux. The required atomic abundances in the carriers to account for the total power emitted by the spectral features should be consistent with their stellar photospheric values. Using DUSTY, we have made 1D radiative transfer models for five C rich PPNs which show strong emission features at 21 and 30 micron; namely IRAS 07134+1005, IRAS 16594-4656, IRAS 19500-1709, IRAS 22272+5435, and IRAS 23304+6147. Taking FeO and MgS respectively are the carriers of the 21μm and 30 μm features, we derived the atomic abundances of Fe, Mg and S locked up in the circumstellar grains. The required atomic abundances in the circumstellar envelope are smaller than their stellar photospheric values available in the literature. Dust shell mass, temperature and the mass-loss rate were derived for these five PPNs and were compared with the values published .

The role of heat conduction to the physical properties of the Planetary Nebula BD+30º 3639

C. Sandin, *D. Schönberner, M. Steffen, R. Jacob, U. Rühling, W.-R. Hamann, H. Todt*

X-ray observations of the bright and young planetary nebula BD+30º 3639 have revealed diffuse emission in an extended region around the H-deficient central star. In order to reproduce the physical properties of this diffuse emission, we have, at first, extended our time-dependent photoionization models with heat conduction for such H-deficient conditions. We have then calculated an extensive set of models to match observed properties of both the wind-blown bubble and the surrounding nebula. In this study we have had to consider the slow AGB wind, the fast hot-CSPN wind, as well as detailed properties of the stellar evolution. I will present the outcome of our study, showing how delicate physical interactions have formed this object. Precise estimates are, for example, required of poorly known properties such as the stellar mass, the AGB wind, and the stellar evolution. Empirically, the results are most sensitive to properties of the fast CSPN wind; we need to adopt an expansion velocity of at least 1000km/s to form a bubble. The H-deficient heat conduction efficiency is also lower than in more H-rich objects, the electron temperature in the bubble still comes out right, at a few million Kelvin. A main conclusion of our work is that heat conduction is needed to explain X-ray properties of wind-blown bubbles also in these H-deficient objects.

Kinematics study of three bulge planetary nebulae.

C. Szyszka*, C. Morisset, A. A. Zijlstra, J. R. Walsh, D. Pequignot*

With the availability of high-spectral-resolution integral-field-unit spectrographs, kinematic observations of resolved planetary nebulae became possible. Data were obtained with the VLT FLAMES Giraffe spectrograph. We used Cloudy 3D which is an IDL library to compute pseudo-3D photoionization models by interpolating between several 1D Cloudy models. The Shape tool was used to facilitate the search for the best morphology. We present a kinematic study which bases on a range of ionization from neutral to 54 eV.Three bulge planetary nebulae (M 2-4, M 2-8 and Fg 2) in using these techniques.

HST expansion proper motions in NGC 6302

C. Szyszka, *A.A. Zijlstra, J.R. Walsh*

The expansion proper motions in NGC 6302 have been measured from two epochs of HST imaging, separated by 9.43 years in the [N II] 6583Å filter from HST WF/PC2 and WFC3. The proper motions of a set of 200 individual tiles within 90" of the central star were found. The velocity field shows a characteristic linear increase of velocity with radial distance (a so-called Hubble flow). It agrees well with a previous ground-based determination by Meaburn et al. (2008) in a lobe further from the star. The pattern of proper motion vectors is mostly radial and the origin is close to the position of the central star directly detected by Szyszka et al. (2009). The results show that the lobes of NGC 6302 were ejected during a brief event 2250±35 yr ago. In the inner regions there is evidence for a subsequent acceleration of the gas by an additional 9.2 km/s, possibly related to the onset of ionization.

Two (X) shoots at two planetary nebulae
***C. Szyszka**, A. A. Zijlstra, J. R. Walsh, D. Pequignot*

The VLT spectrograph X-shooter is currently the only one capable of observing the range from 330 nm up to 2.5 μm in a single pointing. Its medium resolution R ~10000 makes it very suitable for PN research providing uniform flux scale for high fidelity emission line studies. The large instantaneous wavelength range enables many diagnostic line ratios for multiple ions to be investigated. We present two exploratory spectra of contrasting PNe - NGC 6302 as an example of very high ionization and M 2-9 as a high density dusty PN symbiotic star.

A Sample of New Planetary Nebulae in the IPHAS and DSH Catalogue
***Ch.-H. Hsia,** S. Kwok*

We report the optical and infrared study of a sample of five new planetary nebulae (PNe) in the IPHAS and DSH catalogue. The PN status of our sample was first confirmed based on optical narrow-band images and low resolution spectra. According to their locations of these objects in the emission-line-ratio diagram, the sources are low excitation PNe but high dynamic ages. They are always fainter than other known ones and easily hidden in the Galactic plane. We found an extended bipolar PN (IPHASX J195248.8+255359) with two faint lobes in H_α wavelength and a bright core seen in [OIII]. A spectral energy distribution (SED) with various components of this object is made and the implication on circumstellar dust is discussed. We also find that three IPHAS PNe are located in the GLIMPSE area, all of which have obvious MIR counterparts. In these MIR images, some PNe display prominent emissions in the central dust torus regions and extend structures. The shapes and relative strength of the IR emission reveal the locations of dust with different temperatures.

A Systematic Study of Young Multipolar Planetary Nebulae
***Ch.-H. Hsia**, S. Kwok*

Morphological shaping of planetary nebulae is believed to occur during the evolutionary transition from the ending of AGB to the PN phase. To understand the natures and characteristics of these objects in the transient stage, we have investigated the high-resolution Hubble Space Telescope imaging of young PNe with multiple collimated lobes in different orientations and their IR features. In this present report, we describe our results showing that out of eleven young multipolar PNe observed in our sample, five reveal broad silicate features (9.7 and 18 μm) which are commonly seen in oxygen-rich PNe and two display ring/arc structures. According to their adopted distances and expansion velocities, the sources are indeed young PNe with kinematic ages of ~10^3 yrs. We suggest that our sample may have similar intrinsic structures as other multipolar nebulae based on 3D morpho-kinematic modeling.

A Detailed Spatiokinematic Model of the Multipolar Planetary Nebula, NGC 7026
***D.M. Clark**, J.A. López, M.G. Richer, H. Riesgo*

We present the most extensive, long-slit, high-resolution coverage of the complex planetary nebula (PN), NGC 7026. Ten spectra we acquired using the Manchester Echelle Spectrometer at San Pedro Mártir Observatory in Baja California, Mexico, and each shows exquisite detail, revealing the intricate structure of this object. Incorporating these spectra into the 3-dimensional visualization and kinematic program, Shape, and using HST images of NGC 7026, we have produced a detailed structural and kinematic model of this PN. Knowledge of the 3-D structure of this nebula is relevant to understand the physics behind the extended X-ray emission in this object.

The hunt for the PN binary fraction
***D. Douchin**, O. De Marco, D. Frew, J.-C. Passy, G. Jacoby, M. Moe, T. Hillwig, Q. Parker*

The hunt for the PN binary fraction during the past 20 years, the idea that non-spherical PN might need a binary or planetary interaction to be shaped was discussed by various authors. It is now generally agreed that the different shapes and structures of PN cannot be fully explained by single stars evolution. Observationally, more and more PN have been discovered in the middle of PN, opening the binary central star of PN hunt that is today of a major interest in PN observing and understanding (see DeMarco 2009, Miszalski et al. 2009). Thanks to these efforts, approximately 45 binary central star of PN have been detected. All of these are close binaries detected via flux and radial velocity variability. However, a more comprehensive idea of the binary fraction is needed to support of disprove the binary hypothesis. In this talk, we will present the results of the last observations led by our team concentrating on IR excess observations aimed at detecting wider binaries.

Searching for binary CSPN with Kepler
***D. Douchin**, S. Howell, G. Jacoby, O. De Marco, M. Kronberger, T. Hillwig*

The Kepler Observatory offers unprecedented photometric precision (<1 mmag) and cadence for monitoring the central stars of planetary nebulae, allowing the detection of tiny periodic light curve variations, a signature of binarity. With these precisions free from the observational gaps dictated by weather and lunar cycles, we are able to detect companions at much larger separations and with much smaller radii than ever before. We have been awarded targeted observing time to obtain light-curves of the four known CSPN, plus one possible PN, plus one newly discovered PN (Kronberger et al, this conference) in the Kepler field at cadences of both 30 min and one min for each of these CSPN. Of these six objects, we have already determined that three are periodic variables, likely to be close binaries. Two others are variable but no periodicity could be found in the initial data set. And, there is no Kepler data yet for the newly discovered PN.

Morphology origin of asymmetric planetary nebulae: hydrodynamical simulations and photoionization maps
***D. Falceta-Gonçalves**, H. Monteiro*

In the past few years, the origin of the myriad of morphologies presented by planetary nebulae has been extensively studied, based on observations and both analytical and numerical models. In the theoretical domain magnetic fields, jets and interacting winds have been proposed. However, these models have not been confronted with the observations except for density or column density maps. In order to perform a full analysis, comparing the models to the observations, the inclusion of ionization from a central source is mandatory. In this work we study the formation of asymmetric nebulae based on wind interaction + light jets, and perform a full 3D radiative transfer calculation to obtain a self-consistent distribution of ions. The emission maps for the main emission lines are obtained. Combining the emissivities with the simulated velocity distributions, we obtain position-velocity maps that may be directly compared to the observations.

Newly discovered haloes and outer features around southern planetary nebulae from the SuperCOSMOS Hα Survey.
***D. Frew**, I. Bojicic, Q. Parker*

We have used the SuperCOSMOS H_α Survey (SHS; Parker et al. 2005) to look for faint outer structures such as haloes, jets, ansae and knots around known planetary nebulae across 4000 sq. degrees of the southern Milky Way. The SHS covers a strip ~20 degrees wide along the Galactic equator south of declination +2 deg. The fine resolution (~1 arcsec) and deep sensitivity (2-5 Rayleighs at Hα) of the SHS make it ideally suited for this purpose. Quotient images (H_α / broadband red) were generated for each PN in the survey area of sufficient size to ensure that faint outer structures could be found with some extending more than 10~arcminutes away from the central nebula. In this poster we will present some of the more interesting discoveries, and give some preliminary statistics on the prevalence of outer structures in PNe of different morphological classes and surface brightnesses.

Examining the influence of central star binarity on the morpho-kinematics of PNe
***D. Jones**, M. Lloyd, M. Santander-García, A.A. Tyndall*

The role of central star binarity in the shaping of planetary nebulae has been the subject of much debate, with single stars believed to be incapable of producing the most highly collimated morphologies. However, observational support for binary-induced shaping has been sadly lacking. Here, I will present the most recent results of a continuing programme to spatio-kinematically model the morphologies of all PNe known to contain a close binary central star. Spatio-kinematical modelling is imperative for these objects, as it circumvents the degeneracy between morphology and orientation which can adversely affect determinations of morphology based on imaging alone. Furthermore, spatio-kinematical modelling accurately determines the orientation of the nebular shell, allowing the theoretically predicted perpendicular alignment, between nebular symmetry axis and binary orbital plane, to be tested. To date, every PN subjected to this investigation has displayed the predicted alignment, indicating that central star binarity has played an important role in the formation and evolution of these nebulae (e.g., Mitchell et al. 2007; Jones et al. 2010; Tyndall et al. 2011; Jones et al. 2011). The further results from this programme will be key, not only in determining whether binary interaction is responsible for shaping the studied PNe, but also the importance of binary-induced shaping in the formation and evolution of PNe in general.

PNe spectroscopy in the dwarf spheroidal NGC 185: how to fake a Seyfert galaxy
***D.R. Gonçalves**, L. Martins, L. Magrini, A. Teodorescu, G. Lanfranchi, C. Quireza*

Elemental abundance ratios and their variation due to star formation are among the most important constraints of chemical evolution models. Due to the intrinsic faintness of dwarf galaxies, observational constraints to their evolution, such as the chemical abundances of stellar populations of different ages, can be obtained only for nearby galaxies. In this contribution we discuss properties based on the Gemini Multi-Object spectroscopy of the PNe in the dwarf spheroidal galaxy NGC 185, one of the three dwarf companions of M31. These properties will be interpreted in terms of the chemical evolution of NGC 185 itself, and, combined with the chemistry of other M31 dwarf satellites, in terms of the chemical evolution of the Andromeda group as a whole. A very interesting and peculiar characteristic of NGC 185 is the fact it is a dwarf spheroidal galaxy whose Seyfert-like line ratios may be produced by stellar processes. It is so because its AGN status was never confirmed since its nucleus was not detected at 6 cm and 20 cm radio continuum VLA surveys. So, although the weak emission lines in this galaxy formally place it in the category of Seyfert, it is probable that NGC 185 does not contain a genuine active nucleus. It was previously suggested that the line emission of its central region come from its Post-AGB (PNe) population. For the first time this will be tested, together with other possible ionisation mechanisms with stellar origin. Stellar population synthesis and chemical evolution models based on the data we recently obtained will be used to support our conclusions.

PN as tracers of the kinematic structure of the starburst galaxy IC 10
***D.R. Gonçalves**, A. Alves-Brito, R.H. Méndez, A.M. Teodorescu, L. Magrini*

We present radial velocities of about 30 emission-line nebulae (~20 of them being known PNe) in the nearest (0.8Mpc) starburst galaxy IC 10 by taking advantage of the deep spectroscopic capabilities provided by FOCAS on the 8.2m Subaru telescope. The slitless spectroscopy used in this project is a known efficient and effective way of discovering new PNe and exploring the kinematics of galaxies. In this contribution we discuss the kinematic pattern of IC 10 using PNe out to ~12 arcmin from the galaxy centre. The results are key to understand the dynamics of the underlying stellar population of IC 10 that could represent the trace of past tidal interactions in the Local Group. Furthermore, this study might reveal the possible connection of PNe with the H I
envelope located around IC 10, thus ruling out or confirming the existence of a stellar population coincident with the extended gas, and enlightening its formation and evolutionary history.

The kinematics of highly evolved planetary nebulae
***E.M. Pereyra**, M.G. Richer, J. A. López*

We present a kinematic study for a sample of 74 highly evolved planetary nebulae based on spatially resolved, long-slit echelle spectroscopy. The data have been drawn from the San Pedro Mártir Kinematic Catalogue of PNe. The aim is to characterize in detail the global kinematics of PNe at advanced stages of evolution with the largest sample of homogenous data used to date for this purpose. The results reveal groups that share kinematic and photo-ionizing characteristics of the nebular shell at the different late stages under study. The expansion velocities are typically larger than seen in earlier evolutionary stages, with the largest velocities occurring in objects with very weak or absent [N II] emission. These results shall serve to be compared to predictions of hydrodynamic models.

Molar Extinction Coefficient and integrated molar absorptivity of the infrared absorption spectra of C_{60} and C_{70} fullerenes and related hydrogenated derivatives "Fulleranes"

***F. Cataldo**, S. Iglesias-Groth, A. Manchado*

The molar extinction coefficients known also as molar absorptivity ε of infrared absorption bands of C_{60} and C_{70} fullerenes and related hydrogenated derivatives known as "fulleranes" were determined in the temperature range comprised between 80 K and 523 K. Furthermore, also the integrated molar absorptivity Ψ of each infrared absorption band either of C_{60} and of C_{70} were measured and reported together with the Ψ values of the related hydrogenated derivatives "fulleranes". These results can be useful in the quantitative determination of C_{60} and C_{70} fullerenes and "fulleranes" in space after the recent discovery that these molecules are present around the young planetary nebula Tc1 and in other astrophysical objects. Additional data reported regard the radical cation and radical anion absorption bands of C_{60} and C_{70} fullerenes generated in laboratory which can be useful as well for the qualitative and quantitative search of these molecules in space

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C/O Abundance Ratios and Dust Features in Galactic Planetary Nebulae

***G. Delgado Inglada,** M. Rodríguez*

The nature of the dust grains formed in the stellar envelopes of asymptotic giant branch (AGB) stars is controlled by the gas chemistry, in particular by the value of the C/O abundance ratio. We expect silicates and oxides to form in O-rich environments (C/O<1) and carbonaceous material such as amorphous carbon or SiC grains in C-rich environments (C/O >1). Since planetary nebulae (PNe) are the descendants of AGB stars, the value of C/O in the ionized gas is likely to be related to the type of grains present in the nebulae, which can be inferred from infrared spectroscopy. However, the calculation of C/O in PNe is not an easy task, requiring the combination of ultraviolet and optical lines and uncertain corrections for the unobserved ions. We present here a homogeneous analysis of the C/O abundance ratio in a sample of Galactic PNe with available optical and ultraviolet spectra of good quality. Some of these PNe also have infrared spectra from Spitzer, which we use to identify dust features such as SiC, PAHs, the 30 μm feature, and silicates. We compare the values of C/O obtained with different methods, including the ones that involve recombination lines, and we explore the relation between the C/O abundance ratios and the infrared dust features observed in the nebulae.

Weak and Extended Molecular Hydrogen in PN NGC 6369

***G. Ramos-Larios**, J.P. Phillips, M. Guerrero, R. Vázquez*

NGC 6369 is an elliptical planetary nebula with a filamentary halo and faint bipolar lobes. We present visual imaging and spectroscopy of the source taken with the Nordic Optical Telescope (NOT) and the Observatorio Astronómico Nacional at San Pedro Mártir, Mexico (OAN-SPM). This is supplemented with imaging of the ν = (1-0) S(1) λ2.121μm transition of H_2 taken with the 4.2 m William Herschel Telescope (WHT), and mid-infrared imaging and spectroscopy acquired using the Infrared Space Observatory (ISO) and Spitzer Space Telescope (Spitzer). It is shown that there is evidence for H_2 emission in the near and mid-infrared, and that the ν = (1-0) S(1) transition is weakly detected over an extended region. We also note that there is evidence for emission by polycyclic aromatic hydrocarbons (PAHs). Echelle spectroscopy confirms the presence of a bipolar outflow structure to the east and west of the central star.

Herschel PACS Imaging of Planetary Nebulae
G.C. Van de Steene*, K. Exeter, P.A.M. van Hoof, and MESS consortium*

We will present the images of Planetary Nebulae that were obtained with PACS and SPIRE instruments on board the Herschel satellite in the framework of the MESS key program and discuss the results obtained.

High resolution spectroscopic monitoring of post-AGB stars
G.C. Van de Steene *and HERMES consortium*

We will present the first results of the monitoring of post-AGB stars with the high resolution Hermes Spectrograph on the Mercator telescope at La Palma.

Grids of Synthetic Spectra for H-poor Central Stars of Planetary Nebulae (CSPNe)
G.R. Keller*, L. Bianchi, J.E. Herlad, W.J. Maciel*

We present comprehensive grids of model spectra from far-UV to IR, covering the parameter space of [WC]-type CSPNe (Keller et al. 2011, MNRAS, submitted) and PG1159 stars. Models are calculated with CMFGEN accounting for non-LTE, line blanketing, winds, and clumping, and including ions previously neglected. Our uniform model set enables systematic analysis of observed spectra to constrain stellar parameters, facilitates line identification, and illustrates spectral line changes across the CSPN evolutionary phase. The grids are available at http://dolomiti.pha.jhu.edu/planetarynebulae.html. We used them to analyze UV and far-UV spectra of the hot Central Stars of NGC 6905 and NGC 5189. We also explore additional parameters, such as less abundant ions not included in the wider grids and the iron abundance. GK acknowledges support from CAPES-0370-09-6 and Fapesp-06/58240-3 grants.

Abell 70 as a Rosetta stone linking post-AGB binaries and PNe
H.M.J. Boffin*, B. Miszalski*

More than 40 close binary central stars are known that have passed through a common-envelope stage, but we know essentially nothing about orbital periods in the intermediate range (P=100-1500 days). Such binaries are most likely the long sought-after progeny of post-AGB binaries and chemically peculiar stars whose composition was modified by binary evolution. We have recently discovered the binary nature of the central star of Abell 70 (A 70; PN G038.1-25.4) which belongs to the small class of Barium-enhanced central stars (A 35, Lo Tr5, and We Bo1). A 70 shows only a cool subgiant with strong Barium lines in the optical, while GALEX UV imaging confirms the presence of a hot white dwarf. This rules out a `born-again' scenario and provides impetus for further discoveries to be made. An s-process rich cool star in a nebula ejected by the polluting star is a very transient stage that constitutes a formidable Rosetta stone for advancing multiple poorly understood aspects of stellar evolution. These include the s-process mechanism due to thermal pulses on the AGB, the thermohaline mixing, the mass transfer process in binaries, and the ejection mechanism of the PN envelope.

A fresh look at the prototypical point-symmetric planetary nebula Fleming 1
H.M.J. Boffin, *B. Miszalski*

Fleming 1 is the prototype for a whole class of planetary nebulae which exhibit S-shaped or point-symmetric polar outflows, known as bipolar, rotating episodic jets (BRETs). Here we present deep narrow-band VLT FORS2 images of Fleming 1 which reveal for the first time a SN1987A-like ring of low-ionisation structures. These fragmented rings are only seen in other post-CE nebulae and strongly suggest Fleming 1 went through a common-envelope phase. A giant bipolar shell enveloping the jets and a complex filamentary structure of the inner nebula are also seen for the first time.

Trigonometric parallax measurements of post-AGB stars with VERA
H. Imai, *D. Tafoya*

Some of water vapour maser sources are associated with post-AGB stars such as planetary and pre-planetary nebulae and "water fountain" sources. They provide a great opportunity to directly determine distances to these objects via trigonometric parallax measurement; leading us to directly determine their physical parameters and to understand the properties of the central stellar objects. At the same time, their secular motions should tell us their orbits in the Milky Way; leading us to estimate the origins and masses of their progenitor stars. Here we show the results of trigonometric parallax measurements towards K 3-35, IRAS 19312+1950, and IRAS 18286-0959; they are a planetary nebula, a pre-planetary nebula, and a water fountain source, respectively.

A 3D View of Planetary nebula NGC 40
H. Monteiro, *D. Falceta-Gonçcalves*

We present the results of a study of the planetary nebula NGC 40 with the use of the 3-D photoionization code Mocassin constrained by observational data of different types. The modeling process allows us to derive the three-dimensional nebular structure, physical and chemical characteristics and ionizing star parameters of the object by simultaneously fitting the integrated line intensities, the temperature map, density map, and the observed morphologies in different emission lines. For this particular case we combined hydrodynamical simulations with the photoionization scheme in order to obtain a self-consistent distribution of density and velocity of the nebular material. Finally, using theoretical evolutionary tracks of intermediate and low mass stars, we derive the mass and age of the central star of NGC 40 as 0.567 $M_{\odot}$ and 5810 yrs, respectively. The distance obtained from the fitting procedure was 1150 ± 170 pc.

Mapping the physical and chemical properties of the planetary nebula NGC 3242
H. Monteiro, *D.R. Gonçalves, M. Leal-Ferreira*

We present optical integral field spectroscopy analysis of the main components, with the exception of the halo, as well as of the detected small-scale structures of the planetary nebulae NGC 3242. The observations were obtained with the VIMOS instrument attached to VLT-UT3. Spatially resolved maps of the electronic density (Ne), temperatures (Te) and chemical abundances, i.e., in a pixel to pixel fashion of the small and large-scales structures of this planetary nebula are determined in this work. These diagnostic and abundance maps represent important constraints for future detailed three dimensional photoionization modeling of the nebula, as well as providing important information on biases introduced by traditional slit observations.

Weak emission line central stars of planetary nebulae
H. Todt, *M. Peña*

To understand the evolution and morphology of planetary nebulae, a detailed knowledge of their central stars is required. Among the most interesting objects are central stars that exhibit emission lines in their spectra, indicating stellar mass-loss and thus allowing to study the evolution of planetary nebulae in action. Emission line central stars constitute about 10% of all central stars. Half of them are practically hydrogen-free Wolf-Rayet type central stars of the carbon sequence, so-called [WC] stars, that show strong emission lines of carbon and oxygen in their spectra. Large attention has already been devoted to studies of [WC] stars and various scenarios of their formation have been proposed. In this contribution we address the much less studied *weak* emission line central stars (WELS). These stars are poorly analyzed and their hydrogen content is mostly unknown. To clarify this situation we obtained optical spectra that include the important Balmer lines of hydrogen, for four weak emission line central stars. We present the results of our analysis, provide spectral classification and discuss possible explanations for their formation and evolution.

V605 Aquilae: a born-again star, a nova or both?
H.H.B. Lau, *O. De Marco, X.-W. Liu*

V605 Aquilae is widely assumed to have been the result of a final helium shell flash occurring on a single-post-asymptotic giant branch star. However, recent observations show the hydrogen-deficient knot is neon-rich while the central star is carbon rich. This cannot be explained by the final flash scenario alone. We find two binary scenarios that have the potential to explain the observations. The first scenario invokes the merger of a MS star and a massive ONe white dwarf. The second invokes an ONe classical nova that takes place shortly after a final helium shell flash. We will discuss the main drawback of the two scenarios. While the second scenario is based on better-understood physics, but, through a population synthesis technique, we determine that its frequency of occurrence should be very low. There are already two final flash stars that are found to have hydrogen-deficient ejecta with abnormally high neon abundances. This begs for better explanation rather than the final flash scenario.

MASH Planetary Nebulae detected with the Australia Telescope Compact Array
I. Bojicic, *Q. Parker, D. Frew*

We present multifrequency radio-continuum observations of 235 Galactic PNe from the MASH catalogue made with the Australian Telescope Compact Array (ATCA). A subset of 123 PNe (52%) was clearly detected, and our new, accurate radio flux densities are among the lowest ever measured for Galactic PNe. Using a compiled data-set of previously known and our newly detected PNe, the radio brightness temperature distributions in three discrete samples were studied. These concern the Solar neighbourhood, distant Galactic disk, and Galactic bulge PN populations. We compare the detection rates and flux densities against the spatial properties of PNe in each sample. A clear selection effect is found at lower Galactic latitudes due to severe extinction. In addition, we are developing new, robust techniques of PN detection, classification and diagnostics based on mid-IR to radio flux ratios to help refine searches for Galactic PNe in obscured regions. In this talk I will present our new results as well as prospects for further research.

A catalogue of planetary nebula H_α fluxes derived from the SHASSA and VTSS surveys.
***I. Bojicic**, D. Frew, Q. Parker*

We present a new set of integrated Hα fluxes derived from the Southern H_α Sky Survey Atlas (SHASSA) and the Virginia Tech Spectral-line Survey (VTSS) for over 1000 Galactic planetary nebulae (PNe). Aperture photometry on the digital images was performed to extract H_α+ N II fluxes. The N II contribution was then deconvolved using literature data and new spectrophotometric data. This is the largest compilation of homogenously derived H_α fluxes yet measured. Comparison with previous work shows that the flux scale has no significant zero-point error. Our new H_α fluxes will be used to determine new Zanstra temperatures for those PNe with accurate central star photometry, to calculate surface-brightness distances for each PN, and determine new absolute PN magnitudes for delineating the faint end of the PN luminosity function.

Plasma Diagnostics for Planetary Nebulae and H II Regions using N II and O II Optical Recombination Lines
***I. McNabb**, X. Fang, X.-W. Liu, P.J. Storey*

We carry out plasma diagnostic analysis for a number of planetary nebulae (PNe) and H II regions. We use N II and O II optical recombination lines (ORLs) with new effective recombination coefficients calculated under the intermediate coupling scheme, for a range of electron temperatures (T_e) and densities (N_e) and fitted against the most reliable measurements. Comparing T_e derived from ORLs, collisionally excited lines (CELs), the hydrogen Balmer Jump, and/or He I if available, we find the relation T_e (ORLs) < T_e (He I) < T_e (H I BJ) < T_e (CELs), confirming the physical conditions in the two-abundance model postulated by Liu et al. (2000), i.e. the nebula contains another cold, metal-rich and probably H-deficient component.

IR excesses of Central Stars of Planetary Nebulae
***J. Bilikova**, Y.-H. Chu, K.e Su, R. Gruendl, T. Rauch, et al.*

In our Spitzer 24 μm survey of hot white dwarfs (WDs) we found 9 WDs with IR excesses, 7 of them are still central stars of planetary nebulae (CSPNs). We have also carried out a Spitzer archival study of CSPNs, and found additional objects with IR excesses. To date, a total of ~15 CSPNs show IR excesses from Spitzer observations. These mid-IR excesses are indicative of the presence of circumstellar dust, which could be produced by collisions or disruption of sub-planetary objects. To further assess the nature of these IR-excesses, we have obtained Spitzer IRS, Gemini NIRI and Michelle, and KPNO 4m echelle spectra of these objects. In this poster, we present the analysis of these spectroscopic observations and discuss the nature of these IR excesses.

Could some meteoritic stardust have originated from post-AGB and PNN winds?
J. Buntain, *M. Lugaro, A. Karakas*

After very dense and slow winds erode the outer layer of an asymptotic giant branch (AGB) star down to a thin H-rich layer ($\sim 10^{-3}$ $M_{\odot}$) the star becomes a post-AGB star and evolves at constant luminosity towards hotter temperatures. It may then become a planetary nebula (PN) with a planetary nebula nucleus (PNN) at its centre. During these phases, the thin H-rich surface layer of the star is eroded by winds. In particular, very fast and low density winds occur from the PNN which cause dramatic effects by dynamically interaction with the material that exists around the central stars from previous wind episodes. Stardust oxide and silicate grains that formed around AGB stars are recovered from meteorites. The origin of the "Group II grains" which show enrichments in ^{17}O and depletions in ^{18}O, is currently explained by invoking the occurrence of some kind of extra-mixing process in AGB stars who physical mechanism is a matter of debate. We propose an alternative explanation for their origin by suggesting that these grains may have originated from the winds of post-AGB stars and PNNs. By comparing our stellar model predictions to the composition observed in Group II grains we try to assess this hypothesis. We predict that these winds show the signature of H-burning and that their composition is close to that of Group II grains. However, could dust grains actually form in these winds, and in large enough quantities? A possible site were dust formation may occur could be identified in the post-shock regions produced when fast winds from a PNN collide with the material surrounding the star, however, to our knowledge there are no theoretical or observational studies confirming or ruling out our hypothesis.

Polarized radiative transfer equation in some nontrivial coordinate systems
J. Freimanis

AGB stars, post-AGB objects, protoplanetary nebulae and young planetary nebulae often have gas-dust shells of complex morphology and nontrivial geometry. Conical, toroidal, maybe ellipsoidal and other structures are often observed. Radiation coming from these objects is usually highly polarized. While modeling such objects it is desirable to solve the corresponding equations of mathematical physics in such a coordinate system which reflects the symmetry of the astronomical object. A general method to derive polarized radiative transfer equation in different coordinate systems was developed recently (Freimanis 2011). In this contribution, the general method is applied to several coordinate systems of type mentioned above, and clear expressions for polarized RTE are obtained.

Green's functions for polarized radiative transfer equation in different geometries
J. Freimanis

AGB stars, post-AGB objects and young planetary nebulae often have shells of complex morphology and nontrivial geometry. Radiation coming from these objects occurs to be highly polarized. Green's functions for vector radiative transfer equation in homogeneous isotropic infinite medium in case of plane-parallel, spherically symmetric and cylindrically symmetric problems are reviewed in this contribution. One and the same set of basis functions involved into different integral representations is used to construct the solution of RTE in all the geometries mentioned.

Abundances and ADFs in PNe with [WC] central stars
***J. García Rojas**, M. Peña, M.T. Ruiz*

PNe around [WR] central stars constitute a particular photoionized nebula class, representing about 10% of the PNe with known progenitor. They seem suitable for analyzing the abundance discrepancy found when abundances are derived from collisional excited lines in contrast with those from recombination lines, due to it is plausible to expect that some H-deficient material in small knots could be contaminating the hot plasma, which is one of the explanation proposed to explain large abundance discrepancy factors (ADFs). In this talk we present results obtained from the analysis of very deep echelle spectra of a dozen of planetary nebulae with central stars classified as weak emission lines stars (wels) or [WC] type stars.

Further Exploration of Galactic Disk Abundance Gradients
***J.B. Milingo**, R.B.C. Henry, K.B. Kwitter, B. Balick*

With a compiled set of homogeneously determined abundances for 124 Galactic planetary nebulae (PNe), we examine the abundance gradient in the Milky Way disk. We present recent results from a detailed regression analysis of the oxygen gradient. With O, Ne, S, Cl, and Ar available for both Peimbert Types I and II PNe, and a range of galactocentric distance from 0.9 to 21 kpc, we present additional exploration of the disk abundance gradient by statistically analyzing a series of short segments of increasing average galactocentric distance. Finally, we further analyze the scatter observed in PNe abundances within these segments.

Morphokinematic Properties of the 21 μm Source IRAS 22272+5435
***J. Nakashima**, N. Koning, S. Kwok, N. Volgenau, H.K.B. Yung, Y. Zhang*

In this poster, we report the preliminary results of a CARMA observation of the 21 μm source IRAS 22272+5435 in the CO J=2-1 line. The target is a proto-typical 21 μm source: i.e., a carbon-rich proto-planetary nebula with strong emission at 21 μm. The 21 μm sources are a fascinating sample to investigate the metamorphosis of intermediate-mass evolved stars, because they are lying within a particular narrow evolutionary range (i.e., early post-AGB). A recent SMA CO observation of IRAS 07134+1005, another typical 21 μm source, revealed an expanding torus corresponding to the emission region of the 21 μm feature, but did not find a jet, which is often detected together with a torus. We have suggested that this phenomenon might be a common characteristic of 21 μm sources, but of course we need to investigate more 21 μm sources to compare the morpho-kinematic properties. However, since the angular size of the circumstellar envelopes of 21 μm sources is generally too small, only the biggest object IRAS 07134+1005 has been able to be resolved by conventional interferometers until the advent of CARMA. In this project, we have obtained high-resolution CO map of IRAS 22272+5435, which has a second biggest size of the circumstellar envelope among known 21 μm sources. In the preliminary results, we found that the CO properties of IRAS 22272+5435 are clearly different from that of IRAS 07134+1005. For example, elongations seen the mid-infrared and CO images are extended in mutually perpendicular directions, although in the case of IRAS 07134+1005 the CO map matches up with the mid-infrared image.

The kinematical behaviour of the planetary nebulae with [WC] central star.
J. Rechy-García, ***M. Peña***

High resolution spectroscopic data of a large sample of galactic planetary nebulae with [WC] central stars ([WC]PNe), obtained with the spectrographs "echelle" of OAN-SPM, Mexico, and MIKE at Clay 6.5-m telescope, Las Campanas Observatory, are analyzed to determine their kinematical behaviour. Their heliocentric and LSR velocities are determined with a precision better than a few km/s. Distances obtained from the literature are used to derive the peculiar velocities of the objects, V(pec)= V(LRS)-V(circ). Our preliminary results are: - The [WC]PNe are distributed in the galactic disk and they appear more concentrated than the normal PNe. - Separating the sample in Peimbert types, we find that Type I PNe show in general low peculiar velocities (< 50 km/s) except for a couple of objects apparently belonging to the galactic bulge. For the other [WC]PNe, most of them belong to Type II (defined as having V(pec) < 60 km/s). However there is an important fraction (17%) showing V(pec) larger than 60 km/s therefore they are classified as Type III. Our results are being analyzed.

A complete survey of millimeter line emission from CO and ^{13}CO in water fountain stars
J.R. Rizzo*, J.F. Gómez, M. Osorio, L.F. Miranda, O. Suárez*

Water fountain stars represent a transitional stage between the AGB and planetary nebulae, when the mass loss changes from spherical to bipolar. This group is characterized by water maser emission at 22 GHz spread over more than 100 km s^{-1} (even 500 km s^{-1} at the most extreme case), and a clear bipolar morphology. The objective of this work is to detect and further study the circumstellar envelope where the bipolar outflows are currently emerging. We have used the 30m IRAM radio telescope at Pico Veleta to search for CO and ^{13}CO J=1$\rightarrow$0 and 2$\rightarrow$1 line emission associated to all the water fountain stars visible from the telescope. We have detected CO and ^{13}CO emission in eight sources over a total of ten. Most of this emission, however, comes from foreground/background galactic clouds. Just in two cases we detect clear signposts of emission arising from the circumstellar envelopes; a third case is considered as tentative. Using the observational line parameters we have modelled the line emission in the two positive detections, and for the first time some global physical parameters of the circumstellar envelope corresponding to a water fountain star were provided. These results encourage new searches using more sensitive observations and higher angular resolutions. Another natural follow up to these results is also to start a study of other chemical compounds, as well as the search for other, undiscovered water fountain stars.

Radial Density Profiles of PNe Halos From Numerical Models of Mass-loss Histories
***J.L. Verbena**, K.P. Schröder*

We review the stellar mass loss of red giants and tip-AGB objects analyzing the variation in the expansion velocity for different mass models (Wachter 2002). We approach the superwind problem and see the evolution of tip-AGB stars via previously made mass-loss histories that are consistent with the Weidemann (1987) initial-final mass relationship (for carbon-rich stars). Finally density profiles are made from this mass-loss histories, and the corresponding LOS integration is compared with recent data published (Phillips et al. 2009). We note the resemblance between the results obtained with our models and the observational data. So we are able to reproduce the general trends of the emission from simple models, without need of complex physics.

NGC 7027 observed with Herschel
***K. Exter** et al.*

NGC 7027 has been observed with Herschel-PACS (spectroscopy and photometry) and Herschel-SPIRE (spectroscopy). We present here the data and our modelling of this PN.

Abundances of PNe in the Disk of M31 and the Radial Oxygen Gradient
***K.B. Kwitter**, E. M. M. Lehman, B. Balick, R.B.C. Henry*

We report on 16 planetary nebulae (PNe) in the disk of M31, observed spectroscopically at APO and Gemini-N. These PNe, taken from Merrett et al. (2006) are located between 15 and 50 arcminutes from the major axis, and are not associated with any known satellites or star streams. We detected [O III] λ4363 in all of the objects, allowing for direct temperature determination. We find O/H ranging from half to slightly above solar, comparable to Milky Way disk PNe (Henry et al. 2010). We also find N/O from solar to several times solar. Finally, we use the oxygen abundances to derive a radial gradient, which we find to be shallower than the one in the Milky Way, even after accounting for M31's larger disk scale length.

UV Emission Line Imaging of Planetary Nebulae
***L. Bianchi**, K. Forster, J. Herald, A. Manchado*

GALEX (the Galaxy Evolution Explorer) has provided far-UV(1344-1786 Å) and near-UV(1771-2831 Å) imaging of several Planetary Nebulae (e.g., Bianchi et al. 2008). Such data are sensitive to detect low flux levels (of the order of 27 mag/sq.arcsec), fainter than any spectroscopic capability can reach, however the broad-band filters may include both several nebular emission lines and continuum emission, in the direct imaging mode. We used the GALEX grism mode to obtain slitless spectral imaging of a sample of PNe with diameters larger than 1 arcminute, in the near-UV range. The grism data produce 2D images of the prominent UV nebular emission lines, when such lines dominate the flux. Combined with diagnostic lines in the optical domain, such measurements help constrain physical parameters, including some abundances. This program is an experimental use of the grism for emission line objects, and as such may suggest potential expansions with other instrumentation.

Identification of three new proto-Planetary Nebulae exhibiting the unidentified feature at 21 μm

L. Cerrigone*, J.L. Hora, G. Umana, C. Trigilio, A.H. Hart, G. Fazio*

Among its great findings, the IRAS mission showed the existence of an unidentified mid-IR feature around 21 μm. Since its discovery, this feature has been detected in all C-rich proto-PNe of intermediate spectral type (A-G) and - weakly - in a few PNe and AGB stars, but the nature of its carriers remains unknown. In this contribution, we show the detection of this feature in the spectra of three new stars transiting from the AGB to the PN stage obtained with the Spitzer Space Telescope. Following a recent suggestion, we try to model the SEDs of our targets with amorphous carbon and FeO, which might be responsible for the unidentified feature. The fit thus obtained is not completely satisfactory, since the shape of the feature is not well matched. In the attempt to relate the unidentified feature to other dust features, we noticed a correlation between the flux emitted in the 21 μm feature and that emitted at 7 and 11 μm (PAH bands and HAC broad emission). Such a correlation may point to a common nature of the carriers.

PNe as observational constraints in chemical evolution models for NGC 6822

L. Hernández-Martínez, L. Carigi, ***M. Peña****, M. Peimbert*

We present chemical evolution models for the dwarf irregular galaxy NGC 6822 using chemical abundances of Planetary Nebulae (PNe) and H II regions as observational constraints, past and present component of the ISM respectively. Two sets of chemical abundances, one derived from collisionally excited lines (CELs) and one, from recombination lines (RLs), are used. We try to use our models as a tool to discriminate between both procedures for abundance determinations. We also discuss the predicted ΔY/ΔO values for NGC 6822. In our chemical evolution code, the chemical contribution of low and intermediate mass stars is time delayed, while for the massive stars the chemical contribution follows the instantaneous recycling approximation. Our models have two main free parameters: the upper mass limit, M_{up}, of the initial mass function (IMF) and the mass of a well-mixed outflow. In order to reproduce the gaseous mass and O/H abundance of our observational constraints (PNe and H II regions) we need to vary M_{up} and the outflow rate. Some models will be present in this work.

Low dispersion spectroscopy of small point-symmetric Planetary Nebulae

L. Olguin, *R. Vázquez, M.E. Contreras, L. Sabin*

We present an observational study of a sample of three Point-Symmetric Planetary Nebulae (PNe): PC 19, He 2-429, and He 1-1, whose kinematics has been previously reported in the literature. The study includes an analysis of physical conditions, chemical abundances, and nature of the emission in specific regions of interest. A description of each object, taking into account morphological and kinematical data obtained from literature, is presented. We found that the abundances of He 2-429 and He 1-1 correspond to a Peimbert' Type I PNe while those of PC 19 abundances are in good agreement with a Type IV PN. Kinematic evidence derived from proper motion measurement combined with the amount of ionized mass support PC 19 classification and suggest that its progenitor star was a low-mass low-metallicity star member of the galactic halo population.

The Multipolar Planetary Nebula NGC 5189
***L. Sabin**, R. Vázquez, J.A. López and T. García-Díaz*

NGC 5189 is a planetary nebula (PN) which morphology, described in the literature as "highly chaotic", has been poorly studied over the years. The asymmetrical PN is indeed complex with its multiple outflows, cometary knots, low ionization structures and twisted torus. Interestingly NGC 5189 presents three main outflows which are the morphological signatures of episodic mass loss events, most likely emerging from a precessing source. The same pattern is also found in point symmetric PNe. In order to study this phenomenon with more details we present optical imaging from Las Campanas Observatory as well as high resolution spectra taken at the Anglo Australian Telescope with the Manchester Echelle Spectrograph (MES). The kinematical information combined with the morpho-kinematic modelling and reconstruction tool *SHAPE* are giving new insights not only into NGC 5189 itself but also into the class of multipolar PNe.

New Planetary Nebulae with ISM interaction discovered with IPHAS
***L. Sabin**, R.L.M. Corradi, Q. Parker, A. Mampaso, A. Zijlstra*

The low surface brightness usually associated with nebulae mixing with the ISM has for a long time been a substantial obstacle in the observation and statistical study of these interactions. Thanks to the detection capability of new northern survey IPHAS (INT Photometric Hα Survey), in terms of depth and imaging resolution, we were able to visually detect/select tens of good candidate Planetary Nebulae interacting with the interstellar medium (PNe-ISM) at different stages of interaction following Wareing et al. (2007) classification. A spectroscopic investigation was conducted with the San Pedro Martir 2.1m telescope (SPM) and we present the first results involving a proper classification (as the main difficulty is to visually separate PNe-ISM from other faint systems such as old HII regions, Supernovae SNRs or diffuse Hα structures) and analysis (density, line ratios...etc). The kinematical results obtained for the "brightest" PNe, using the high resolution spectrograph MEZCAL at SPM, are also presented in order to show a full picture of the various morphologies encountered. This investigation is a first step in a more comprehensive study of PNe-ISM as more candidates are yet to be found in the IPHAS framework.

Signatures of pulsations and mass-loss in the spectra of post-AGB stars
***L. Zacs**, J. Sperauskas, A. Laure, O. Smirnova*

The results of radial velocity monitoring and high-resolution spectroscopy are presented for selected post-AGB stars. High-resolution optical spectra are analyzed in details for three cool R CrB candidate stars to clarify the evolutionary status of these rare objects. Long-term observations are performed for three proto-planetary nebulae (PPN) with the main goal to understand better the pulsation properties and dynamical phenomena in the extended atmospheres. The time series of high-resolution optical spectra are discussed for IRAS22272+5435. The spectrum of IRAS22272+5435 originates in the circumstellar envelope (CSE) and throughout different layers in the atmosphere of HD235858. A large number of narrow molecular lines originated in the CSE are present in the optical spectrum of IRAS22272+5435, blueshifted relative to the photospheric lines. Time series of high resolution spectra shows splitting of low-excitation atomic absorption lines and significant changes in the intensity of C_2 and CN features originated in the extended atmosphere significantly affected by pulsations.

VISIR-VLT mid-infrared images of the water emitting planetary nebula K3-35
M. Blanco, *M.A. Guerrero, L.F. Miranda, E. Lagadec, O. Suárez*

K 3-35 is an extremely young bipolar planetary nebula that contains a precessing bipolar jet and a small (radius 80 AU) water maser equatorial ring. We have obtained VISIR-VLT images in the SiC, PAH1, and [SIV] filters to analyze the morphology of K 3-35 at mid-IR wavelengths and to investigate the temperature structure of its dust emission. The images show the innermost nebular regions (undetected at optical wavelengths) and the bipolar jets. The temperature map shows two distinct regions in the nebula: a low temperature region associated to the equatorial zone, and two high temperature regions associated to the bipolar lobes.

IRAS 19071+0857, a Bipolar Planetary Nebula with a Dusty Torus
G. Niccolini, ***M. Blanco****, O. Suárez, P. Bendjoya, J.F. Gómez, M.A. Guerrero, L.F. Miranda, R. Rizzo*

We present mid-IR observations toward the planetary nebula (PN) IRAS 19071+0857 taken with VISIR at the Very Large Telescope (VLT), as well as continuum observations at 22 GHz obtained with the Expanded Very Large Array (EVLA). The mid-IR images reveal a dusty torus perpendicular to the bipolar structure traced by the radio continuum emission. The emission from the torus observed in mid-IR has been modeled using a radiative transfer code.

GLMP160 - first [WR] star in binary
M. Hajduk, *P.A.M. van Hoof, A.A. Zijlstra, K. Gesicki*

We discuss the result of the search for [WR] central stars in binary systems. GLMP160 is the first [WR] central star in a binary system known. We analyze photometry, spectroscopy and imaging of this system.

ATCA radio observations of compact PNe
M. Hajduk, *A. Zijlstra*

We present new observations in the radio continuum of 31 planetary nebulae at 5 and 8 GHz with the Australian Telescope Compact Array. The observations are used to investigate properties of the interstellar extinction toward Galactic Bulge.

New faint planetary nebulae from the DSS and SDSS
M. Kronberger, *G.H. Jacoby, O. De Marco, D. Douchin, D. Frew, D. Harmer, S. Howell, Q. Parker, D. Patchick, D. Riddle*

Recent Hα surveys such as SHS [1] and IPHAS [2] have almost doubled the number of known planetary nebulae (PNe) in our Galaxy. However, both surveys are restricted to Milky Way regions close to the Galactic plane. Thus, it is likely that a population of unknown PNe exists also at higher Galactic latitudes that is still awaiting discovery. The lack of high-resolution Hα imagery requires the use of other methods in order to search for new PNe in these regions. Possibilities are the visual inspection of multicolour Digitized Sky Survey (DSS) and Sloan Digitized Sky Survey (SDSS) images, and the survey for narrowband emitters on combined [OIII], Hα and [SII] images. The application of these two methods in fields mostly complementary to those covered by SHS and IPHAS has lead so far to the discovery of more than 100 PN candidates. In a first observing campaign, 76 of the candidates were imaged with the WIYN 3.5m and the OHP 1.2m telescopes, of which 60 were found to be possible or probable PNe [3]. Spectroscopic studies of 51 of the targets, including two previously unobserved candidates, confirmed 44 as PNe. Of the remaining 11 targets without spectra, 10 have a high probability of being PNe based on their morphology alone. This work presents narrowband images of about 15 candidates that were not included in the previous campaign. We note that one of the candidates (Kn 61) is located within the target field of the Kepler satellite mission. [1] Parker, Q. A. et al., MNRAS 362, 689 (2005) [2] Drew, J. et al., MNRAS 362, 753 (2005) [3] Jacoby, G. et al., Pub. Ast. Soc. Aus. 27, 156 (2010)

Spectral Analysis of PG 1034+001, the Exciting Star of Hewett 1
M. Mahsereci, *T. Rauch, E. Ringat, K. Werner, J.W. Kruk*

PG 1034+001 is an extremely hot, helium-rich DO-type star that excites the nebula Hewett 1 and large parts of the surrounding interstellar medium.

We present preliminary results of an ongoing spectral analysis of PG 1034+001 by means of non-LTE model atmospheres that consider all elements from hydrogen to nickel. The analysis is based on high-resolution ultraviolet (FUSE, IUE) and optical (VLT/UVES, KECK) data. The results are compared with those of PG 1034+001's spectroscopic twin, the DO star PG 0038+199.

Spectral Analysis with the Virtual Observatory Tool TheoSSA
E. Ringat, T. Rauch, ***M. Mahsereci***

In the framework of a German Astrophysical Virtual Observatory (GAVO) project spectral energy distributions for the analysis of hot objects like central stars of planetary nebulae were made accessible by the service TheoSSA. By now this service is based on the Tübingen NLTE Model-Atmosphere Package TMAP, a code developed and tested over the last 25 years. We present the possibilities of TheoSSA comparing the service results with "classical" spectral analyses of the DO white dwarf and central star of a planetary nebula PG1034+001.

Gaia future contribution to the study of Planetary Nebulae
M. Manteiga, *B. Arcay, A. Ulla, A. Aller, L.F. Miranda, Y. Isasi*

Gaia, the forthcoming astrometric ESA survey, is expected to contribute significantly to our knowledge on the distance to galactic PNe. Beside providing information about parallax and proper motions of the sources, Gaia will be equiped with two spectrophotometers that will allow to obtain the SEDs in the spectral region 0.4 to 1.1 microns, and a radial velocity spectrograph in the IR CaII triplet region. We present our simulations on Gaia observations obtained by the use of GOG (Gaia Object Generator) for a catalogue of proto-PNe and PNe (Suárez et al. 2009) and discuss the potentiality of these data to classify and infer some physical properties of the sources.

Filling factor and temperature variations in Planetary Nebulae
M. Peimbert*, A. Peimbert*

We have found a strong correlation between small filling factors and large t^2 values in planetary nebulae. We have also found that in general the filling factor for Type I PNe is smaller than for Type II PNe. These results imply that the abundance correction due to temperature inhomogeneities in general is larger for Type I PNe than for Type II PNe. This difference helps to reproduce the expected abundance difference between PNe of Type I and II predicted by Galactic chemical evolution models.

Chemical Abundances in H II Regions and Planetary Nebulae of the Solar Neighborhood
M. Rodríguez*, G. Delgado-Inglada*

Recently, we derived in a homogeneous way the oxygen abundances for five H II regions and eight PNe of the solar neighborhood (at distances lower than 2 kpc), with observed spectra of high quality. We used collisionally excited lines and recombination lines, finding that in both cases the abundances derived for the PNe are 0.2 dex above those calculated for the H II regions. We compared the resulting abundances with those found for the Sun, B stars, and the diffuse ISM. A good agreement can be reached for the results implied by collisionally excited lines if the H II regions have about a quarter of their oxygen atoms deposited onto an organic refractory dust component. This dust component was previously proposed to explain the pattern of oxygen depletion in the diffuse and dense ISM. Oxygen is the element for which the derived abundances are more reliable, but results for the other elements could provide further evidence on this issue. However, this requires studying the bias introduced by ionization correction factors, which is likely to be different in H I regions and PNe. Here we present preliminary results of this analysis.

NGC 7027: Probing the kinematics and excitation conditions of the warm molecular gas
***M. Santander-García**, V. Bujarrabal, J. Alcolea et al.*

The sub-mm range -most of which is only accessible from space- allows us to probe warm molecular gas (~50-1000 K), opening a new window from which to study the physics and chemistry of astrophysical objects, particularly of planetary nebulae. NGC 7027 is a young PN essentially constituted by molecular gas (85% of the total measured mass of the nebula), despite the T_{eff} of its central star being ~1.9 x 10^5 K. We present Herschel/HIFI observations of several high-J lines of CO and H_2O in this object probing the different components of its warm molecular gas. We have developed a code which, used along the existing SHAPE software, implements spatiokinematical modeling with accurate non-LTE calculations of line excitation and radiative transfer in molecular species. The high quality of the data, together with this code, have allowed us to study, for the first time, the kinematics and excitation conditions of the warm gas of such a high-excitation PN.

Herschel/HIFI observations of molecular lines from young planetary nebulae
*V. Bujarrabal, J. Alcolea, **M. Santander-García** et al.*

We present Herschel/HIFI observations of intermediate-excitation molecular lines in the far-infrared/sub-mm ranges in several young planetary nebulae. The high spectral resolution provided by the heterodyne receiver HIFI allows accurate measurements of the line profiles, whose structure corresponds to the kinematics of the various nebular components, notably fast bipolar outflows and slow shells. We have detected lines of several molecules in our sources, including in particular ^{12}CO, ^{13}CO, and H_2O, as well as other species like NH_3, OH, $H_2{}^{18}O$, HCN, SiO, etc. Wide profiles often showing spectacular line wings have been found. The observed lines are particularly useful to study warm gas, which is not probed by the low-J lines observable from the ground. In particular, we have studied the excitation properties of the high-velocity emission coming from fast bipolar outflows, in which we detect the presence of gas with temperatures over 100-200 K.

Kn 26: a Textbook Case Bipolar Planetary Nebula with a Twist
***M.A. Guerrero**, R. Vázquez, L.F. Miranda, G. Ramos-Larios*

New surveys for planetary nebulae (PNe) are incessantly increasing the number of known PNe in our Galaxy. Using existing digital sky surveys, Jacoby et al. (2010) presented Kn 26, a bipolar PN candidate known for a long time as the emission line source Lan 384. Here we present high spatial-resolution optical and near-IR narrow-band images of this nebula, high-dispersion long-slit echelle spectra, and low-resolution spectroscopy. The new data confirm the PN nature of Kn 26 and reveal features typical of bipolar PNe: butterfly morphology, H2 emission, and nitrogen enrichment. A detailed analysis of the morphology and kinematics, however, suggests the possible presence of two pairs of bipolar lobes that would make Kn 26 a new member of the class of quadrupolar PN.

X-ray Emission from Central Regions of the Born-Again Planetary Nebula A 30
***M.A. Guerrero**, W.-R. Hamann, Y.-H. Chu, L. Oskinova, H. Todt, D. Schonberner, M. Steffen, N. Ruiz, R.A. Gruendl, W. Blair*

The planetary nebula (PN) A 30 is one of the few cases of a born-again PN, where hydrogen-deficient knots are located at a close range of the central star. The cometary appearance of these knots, with bow-shock structures pointing towards the central star and fanning tails radiating away, suggests that they have been ablated. XMM-Newton and Chandra observations of A 30 have been obtained. We find diffuse X-ray emission associated with the petal-like structures interior to the round exterior shell. We also find an unexpectedly bright, unresolved point-source at the position of the central star. However, the X-ray emission expected from its photosphere is negligible. Wind-intrinsic shocks or the termination shock of a hot bubble are alternative mechanisms capable of producing the observed X-ray flux, given the available kinetic energy in the stellar wind.

Detection of Diffuse X-ray Emission from Planetary Nebulae with Nebular O VI Emission or Absorption
***M.A. Guerrero**, R.A. Gruendl, Y.-H. Chu, D. Schonberner, M. Steffen, N. Ruiz*

Shocked stellar winds confined in the central cavities of planetary nebulae (PNe) are sources of diffuse soft X-ray emission. Chandra and XMM-Newton observations of PNe have started to reveal several trends in the occurrence of X-ray emission, X-ray luminosity and temperature of the hot plasma. Here we present Chandra X-ray observations of IC 418, NGC 2392, and NGC 6826, three PNe with indications of the presence of collisionally ionized O VI at the interface layer between the hot interior and the cool nebular shell. X-ray emission is detected in all of these three PNe, thus indicating that nebular O VI emission or absorption is an excellent diagnostic for the presence of hot gas from shocked fast winds.

Radio-continuum search for the extragalactic PNe
***M.D. Filipovic**, I.S. Bojicic, E.J. Crawford, M. Coen, J.L. Payne, A. De Horta*

I would present recent discovery of a new radio-continuum population of extragalactic PNe in the Magellanic Clouds together with their extra ordinary multi-frequency properties. Also, I will present our early results on the Luminosity Function and other statistical analysis on these sources. Finally, the upcoming SKA is one of the greatest opportunities that we may have in the coming decade to further understand complete population of PNe in nearby external galaxies.

On the Magnetic Field of the Rotten Egg Nebula
***M.L. Leal-Ferreira**, W.H.T. Vlemmings, J.-F. Desmurs, H.J. van Langevelde, P.J. Diamond, A. Kemball, N. Amiri*

During the transition from an AGB star to a Planetary Nebula, the majority of the low/intermediate initial mass star loses its spherical symmetry. The process responsible for that change of morphology is, so far, not well understood. The candidates responsible for shaping these objects are (i) a companion to the star (binary/heavy planet) and its tidal forces, (ii) disk interaction and (iii) magnetic fields - or a combination of these. In this work, we focus on the third candidate. We investigated the polarization of the H_2O maser emissions of the pre-Planetary Nebula OH231.8+4.2 (Rotten Egg Nebula), to infer the properties of its magnetic field. Our preliminary results show that a magnetic field $B_{||}$ of ~46 mG is present in the H_2O maser region of this pPN.

A view of the Eskimo from Saturn
M.T. García-Díaz, *J.A. López, W. Steffen, M.G. Richer, H. Riesgo*

The 3D and kinematic structure of the Eskimo nebula, NGC 2392, has been notoriously difficult to interpret given its complex morphology, multiple kinematic components and its nearly pole-on orientation along the sightline. Here we present the most comprehensive high resolution spectroscopic mapping of the Eskimo planetary nebula to date. The data consist of 21 spatially resolved, long-slit echelle spectra tightly spaced over the Eskimo and along its bipolar jets. This data set allow us to construct a velocity-resolved [N~II] channel map of the nebula with a resolution of 10 km s^{-1} that disentangles the different kinematic components of the nebula and reveals clearly for the first time the kinematic expansion pattern for each of the components. The spectroscopic information is combined with HST images to construct the first detailed three dimensional model of the Eskimo with the code SHAPE. With this model we demonstrate that the Eskimo is nearly a twin to the Saturn nebula, but rotated 90 degrees to the line of sight.

Nebula around R Coronae Borealis
N. Kameswara Rao*, D.L. Lambert*

The star R Coronae Borealis shows forbidden lines of O II, N II, and S II during the deep minimum when the star is fainter by about 8 to 9 magnitudes from normal brightness, suggesting the presence of nebular material around it. We present low and high spectral resolution observations of these lines during the on-going deep minimum of R CrB, which started in July 2007. These emission lines show double peaks with a separation of about 100 km s^{-1}. The line ratios of S II and O I I suggest an electron density of about 100 cm^{-3}. We discuss the physical conditions and possible origins of this low density gas. These forbidden lines have also been seen in other RCB stars during their deep light minima and thus a general characteristic of these stars which might have some relevance to their origins.

Morphology of the Red Rectangle Proto-Planetary Nebula
N. Koning*, S. Kwok, W. Steffen*

The morphology of the Red Rectangle (RR) proto-planetary nebula (PPN) exhibits several singular attributes. Most prominent are a series of linear features perpendicular to the symmetry axis which appear as "ladder rungs" across the nebula. At the edge of each "rung" gas seemingly flows in a parabolic shape towards the center of the nebula. We present a new model of the RR which explains these features as a projection e□ect of the more common spherically-symmetric outflows seen in other PPN (e.g. Egg Nebula). Using the 3D morpho-kinematic modeling software SHAPE, we have created a model of the RR that consists of spherical shells evacuated by a biconal outflow. When the symmetry axis is oriented perpendicular to the line of sight, the spherical shells become linear thereby reproducing the "rungs" seen in the RR. When oriented at di□erent inclinations, the linear features become spherical as observed in the Egg Nebula.

Spectral Analysis of the O(He)-type Central Stars of the Planetary Nebulae K 1-27 and Lo Tr4

N. Reindl, *T. Rauch, E. Ringat, K. Werner, J.W. Kruk*

The five known O(He)-type stars are post-AGB stars that exhibit almost pure helium absorption-line spectra. Thus, their evolution deviates from the hydrogen-deficient post-AGB evolutionary sequence of carbon-dominated stars like e.g. PG 1159 stars. The origin of O(He) stars is still not explained. They might be either post-early AGB stars or the progeny of R Coronae Borealis stars. The central stars of the planetary nebulae K1-27 and LoTr4 belong to the O(He) spectral type. Both have spectroscopic twins without a surrounding nebula, namely HS,2209+8229 and HS,1522+6615, respectively. We present preliminary results of an ongoing non-LTE spectral analysis of all five O(He) stars, based on FUSE and HST/COS observations.

Advances in Atomic Data for Neutron-Capture Elements

N.C. Sterling, *M.C. Witthoeft, A. Aguilar, D.A. Esteves, P.C. Stancil, A.L.D. Kilcoyne, R.C. Bilodeau*

Neutron n-capture elements (atomic number Z>30), which can be produced in planetary nebulae (PNe) progenitor stars via s-process nucleosynthesis, have been detected in nearly 100 PNe. This demonstrates that nebular spectroscopy is a potentially powerful tool for studying the production and chemical evolution of trans-iron elements. However, significant challenges must be addressed before this goal can be achieved. One of the most substantial hurdles is the lack of atomic data for n-capture elements, particularly that needed to solve for their ionization equilibrium (and hence to convert ionic abundances to elemental abundances). To address this need, we have computed multi-configuration distorted-wave photoionization (PI) cross sections and radiative recombination (RR) and dielectronic recombination (DR) rate coefficients for the first six ions of Se and Kr (similar calculations are ongoing for Xe). The calculations were benchmarked against experimental PI cross section measurements conducted at the Advanced Light Source synchrotron radiation facility. We estimate the internal uncertainties to be 30-50% for PI cross sections,≤10% for RR, and from 20% to two orders of magnitude for DR rate coefficients. In addition, we computed charge transfer (CT) rate coefficients for ions of six n-capture elements using multi-channel Landau Zener and Demkov codes. We are incorporating these data into the photoionization code Cloudy to derive ionization correction factors for Se and Kr, and will test the sensitivity of abundance determinations to atomic data uncertainties via Monte Carlo simulations. These efforts will enable the accurate determination of nebular Se, Kr, and Xe abundances, allowing robust investigations of s-process enrichments in PNe.

Planetary nebulae and the chemical evolution of the galactic bulge: new abundances of older objects

***O. Cavichia**, R.D.D. Costa, M. Molla, W.J. Maciel*

In our previous work, we have derived accurate chemical abundances of a sample of planetary nebulae (PNe) located near the interface of the galactic bulge and disk. In view of their nature, planetary nebulae have very short lifetimes, and the chemical abundances derived so far have a natural bias favoring younger objects. In this work, we report the results for the physical parameters and abundances for a sample of old PNe located in the galactic bulge, based on low dispersion spectroscopy secured at the SOAR telescope using the Goodman spectrograph. The new data allow us to extend our database including older, weaker objects that are at the faint end of the planetary nebula luminosity function (PNLF). The results show that the abundances of our sample are similar to those from other regions of the bulge. Nevertheless, the average abundances of the galactic bulge do not follow the observed trend of the radial abundance gradient in the disk. These results are in agreement with a chemical evolution model for the Galaxy recently developed by our group.

The evolution of the radio continuum from planetary nebulae

O.I. Sharova

The radio continuum variations from galactic planetary nebulae in the process of the central star evolution without helium flashes are considered. On the base of our distance scale we obtained empirical evolutionary dependences for the ionized mass and the hydrogen atoms concentration. The parameters of theoretical model of the interacting stellar winds (ISW, Kwok 1982) are determined to reach an agreement between empirical and theoretical dependences. In this model the time dependences are obtained for the critical frequency and the intrinsic flux density at several frequencies. The critical frequency is strongly depends on the mass of star nucleus. For the nucleus mass 0.546 $M_{\odot}$ it is always lower than 1 GHz. But planetary nebula remains optically thick at 15 GHz up to kinematical age of 100 years if the central star mass is 0.836 $M_{\odot}$. The intrinsic flux density changes in a wide interval of values in some orders of power. Radio flux at 15 GHz continues to increase up to age of 10^3 years in model with 0.640 $M_{\odot}$, up to 10^4 years in the model with 0.565 $M_{\odot}$. The maximum rate of the flux density 8% yr^{-1} increase is obtained for the model with 0.640 $M_{\odot}$ in the interval from 200 to 1100 years. Further the flux density decrease with rate 0.8% yr^{-1}. We have obtained the sequences of instantaneous spectra at 0.960-21.7 GHz for a group of planetary nebulae (IC 418, NGC 6369 et al.) by using of RATAN-600. They were compared to theoretical conclusions.

The MASH PN surveys: current legacy and future resource

***Q. Parker** and the MASH team*

Over the past 10 years the MASH surveys have effectively doubled Galactic PN and have had a major impact in the field. The scientific exploitation of this major legacy resource is well underway and many interesting results have already been reported. MASH PN are more evolved, extincted and of lower surface brightness than previous compilations. Simple PN confirmation is now being replaced by more detailed spectroscopic and multi-wavelength study of the large-numbers of bona-fide discoveries and exotic mimics while the underpinning Hα survey itself continues to reveal additional objects. In this talk I will briefly summarise the most important results to come out of the MASH programme so far but will concentrate on the fresh projects and studies now underway at Macquarie by our group that promise to deliver significant additional insights into the PN phenomena.

Planetary nebulae and their mimics: the MASH Miscellaneous Emission Nebula project
***R. Boissay**, Q.A. Parker, D.J. Frew, I. Bojicic*

The total number of true, likely and possible planetary nebulae (PN) now known in the Milky Way are about 3000, approximately twice the number known a decade ago. The new discoveries are a legacy of the recent availability of wide-field, narrowband imaging surveys, primarily in the light of Hα. The two most important are the AAO/UKST SuperCOSMOS Hα survey – SHS and the Isaac Newton photometric Hα survey - IPHAS, which are responsible for most of the new discoveries. A serious problem with previous PN catalogues is that several different kinds of astrophysical objects are able to mimic PN in some of their observed properties leading to significant contamination. These objects include H~II regions and Strömgren zones around young O/B stars, reflection nebulae, Wolf-Rayet ejecta, supernova remnants, Herbig-Haro objects, young stellar objects, B[e] stars, symbiotic stars and outflows, late-type stars, cataclysmic variables, low redshift emission-line galaxies, and even image/detector flaws. PN catalogues such as the Macquarie/AAO/Strasbourg Hα Planetary Nebula catalogue (MASH) have been carefully vetted to remove these mimics using the wealth of new wide-field multi-wavelength data and our 100% follow-up spectroscopy to produce a compilation of new PN discoveries of high purity. During this process significant numbers of PN mimics have been identified. The aim of this project is to compile these MASH rejects into a catalogue of Miscellaneous Emission Nebulae (MEN) and to study and highlight the most unusual and interesting examples. A new global analysis of these MEN objects is underway before publishing the MEN catalogue online categorizing objects by type together with their spectra and multi-wavelength images.

3D Ionization Structure & Kinematics of NGC 2392
***R. Dufour,** J. Sick*

We discuss the three dimensional morphology, ionization structure, and kinematics of NGC 2392, the "Eskimo," based on new and archival HST imagery and new long-slit echelle and integral field spectroscopy. High spatial resolution 2D ionization maps of the nebula were made from the HST WFPC2 imagery and compared with maps of the emission-line structure in weaker diagnostic lines from the VIRUS-P IFS observations obtained at McDonald Observatory. Then high velocity resolution long-slit spectroscopy with the KPNO 4m echelle spectroscopy was used to map the kinematics and evaluate the 3D ionization structure of the nebula in several important ions, including C^{++} for the first time.

PN abundance determinations - A view from 1D-RHD simulations
***R. Jacob,** C. Sandin, D. Schönberner, M. Steffen*

During the last years radiation-hydrodynamics simulations have become a powerful tool for understanding formation and evolution of planetary nebulae in terms of simple morphologies and kinematics. Contrary to photo-ionisation models (with their ad-hoc assumptions of their structure and physics) the RHD models are fully internally consistent with respect to their density distribution, velocity field, and chemical composition. Thus, we use our models as simple proxies for real objects and test the reliability of several aspects of abundance determinations that are based on either plasma diagnostics or static photo-ionisation codes. We discuss effects of non-compliance to thermal and/or ionisation equilibrium, and test the accuracy of various ionisation-correction-factor schemes. This allows us to argue inter alia the sulphur anomaly not to be genuine, despite its recent "confirmation" by infrared observations.

On the internal kinematics of planetary nebulae
***R. Jacob**, D. Schönberner, H. Lehmann, M. Steffen*

We report on our detailed study of the internal kinematics of round/elliptical double-shell planetary nebulae (PNe). Our new, quite enlarged sample of PNe covers all evolutionary phases across the Hertzsprung-Russell diagram. By means of high-resolution and high S/N spectrograms we determined bulk matter velocities of the wind-driven rims and the maximum (= post-shock) gas velocities of the thermally expanding shells. Our study confirms previously found results which were based on a much smaller sample of PNe: Both rim and shell accelerates with time, or evolution, but such that their difference velocities ($V_{postshock}$ - V_{rim}) remain roughly constant. This finding is at variance with the commonly used assumption that PNe expand homologously (or uniformly), but in agreement with the prediction of radiation-hydrodynamics simulations if realistic initial conditions and time-evolution of stellar winds and radiation fields are considered. We conclude that a typical PN is a dynamically active system throughout its entire life, controlled first by photo-ionisation and later also by wind interaction.

X-ray spectra from hot wind-driven bubbles with chemical gradients
***R. Jacob,** C. Sandin, D. Schönberner, M. Steffen*

The first high-resolution X-ray spectroscopy of a planetary nebula BD +30° 3639 (Yu et al. 2009), opens the possibility to study plasma conditions and chemical compositions of X-ray emitting regions of PNe in much greater detail than before. This prompted us to develop a model for typical wind-blown bubbles with realistic temperature and density profiles according to thermal conduction theory. The X-ray emission of these bubble models is computed by means of the well-documented CHIANTI code and allows to quickly perform detailed parameter studies without the need for dedicated hydrodynamical simulations. We report first results on how the X-ray spectra depend on chemical composition (hydrogen-rich vs. hydrogen-poor) and how temperature and abundance determinations reflect temperature gradients as well as chemical gradients and mixtures within the bubbles.

Peculiar CNO photospheric abundances in the central star of NGC 2392
***R.H. Méndez**, M.A. Urbaneja, R.P. Kudritzki, R.K. Prinja*

The Eskimo and its central star have long been known to have some remarkable peculiarities: high nebular expansion velocity, slow stellar wind, low mass loss rate, too high He II Zanstra temperature, and, in particular, great strength of N lines and weakness of C lines in the central star spectrum (Mendez 1991, IAU Symp 145, 375). Using new, high signal-to-noise CFHT ESPaDOnS visual spectrograms, and archive IUE and FUSE UV spectrograms, together with state-of-the-art non-LTE hydrodynamical model atmospheres, we will present quantitatively accurate He, C, N, O photospheric abundance determinations in the central star of NGC 2392, and compare them with the corresponding abundances in two "more normal" central stars (IC 4593, NGC 6826), which bracket NGC 2392 in surface temperature. We will explore the evolutionary implications of these abundances.

Individual extinctions and metallicity limits from deep PN spectra in M60 and M82
R.H. Méndez, *A.M. Teodorescu, T. Hattori, L. Magrini, L.C. Johnson*

Using the Subaru telescope and its FOCAS spectrograph in multi-object mode, we have obtained deep spectra of a selection of bright PNs in two galaxies, the Virgo elliptical M 60 and the starburst spiral M 82. We will present individual reddenings from the Balmer decrement, and limits on metallicities from the ratio of [O III] 4959, 5007 to H_β, as done in Méndez et al. 2005, ApJ 627, 767. We will explore consequences for metallicity and PNLF distance determinations.

Early Results from ChanPLaNS: Mystery of Hard X-ray Emitting CSPNe
R. Montez Jr., *J.H. Kastner, B. Balick, E. Behar, E. Blackman, V. Bujarrabal, Y.-H. Chu, R. Corradi, O. De Marco, A. Frank, D. Frew, M. Guerrero, S. Kwok, B. Miszalski, J. Nordhaus, Q. Parker, R. Sahai, C. Sandin, D. Schoenberner, N. Soker, J. Sokoloski, W. Steffen, T. Ueta, E. Villaver, A. Zijlstra*

We are presently using the Chandra X-ray Observatory to conduct the first systematic X-ray survey of planetary nebulae (PNe) in the solar neighborhood. The Chandra Planetary Nebula Survey (ChanPlaNS) is a 570 ks Chandra Cycle 12 Large Program targeting 21 high-excitation PNe within ~1.5 kpc of Earth. When complete, this survey will provide a suite of new X-ray diagnostics that will inform the study of late stellar evolution, binary star astrophysics, and wind interactions. Among the early results of ChanPlaNS (when combined with archival Chandra data) is a surprisingly high detection rate of relatively hard X-ray emission from CSPNe. Specifically, X-ray point sources are clearly detected in roughly half of all 28 PNe observed thus far by Chandra, and all but one of these X-ray-emitting CSPNe display evidence for a hard (few MK) component in their Chandra spectra. Only the central star of the Dumbbell appears to display "pure" hot blackbody emission from a ~200 kK hot white dwarf photosphere in the X-ray band. Potential explanations for the "excess" hard X-ray emission detected from the other CSPNe include late-type companions (heretofore undetected, in most cases) whose coronae have been rejuvenated by recent interactions with the mass-losing WD progenitor, non-LTE effects in hot white dwarf photospheres, and slow (re-)accretion of previously ejected red giant envelope mass. We discuss these and other potential constraints on the origin and evolution of PNe and their central stars imposed by the early ChanPlaNS results.

Processing of Polycyclic Aromatic Hydrocarbons in Evolved Planetary Nebulae
R. Ohsawa, *T. Onaka, I. Sakon, I. Yamamura, M. Matsuura, H. Kaneda*

We investigate the infrared emission bands from Polycyclic Aromatic Hydrocarbons (PAHs) in galactic planetary nebulae (PNe). Several studies have pointed out that the PAH band profiles vary with the object types, especially from interstellar to circumstellar environments. PAHs in PNe are assumed to be in transition from circumstellar PAHs to interstellar PAHs. Thus, investigation of PAHs in PNe is interesting for understanding of physical and chemical processes on PAHs. We obtain 84 near-infrared spectra of galactic PNe with the AKARI/IRC. For 31 of them, we retrieve mid-infrared spectra with the Spitzer/IRS from the Spitzer Heritage Archive. Evolved PNe are selected taking account of the temperature of their central stars, and the evolutionary phase is estimated by the emission line ratio $[SIV]_{10.51}/[NeII]_{12.81}$. As a result, we find that the strength of the PAH bands around 3 μm relative to other mid-infrared PAH bands are significantly enhanced along with the PN evolution. In addition, we find that the band ratio of 3.4 to 3.3 μm is also enhanced with evolution. Since these 3 μm bands are believed to be attributed to C-H bonds in relatively small PAHs. For a consistent explanation, we propose that the increases indicate an unusual PAH processing, such as hydrogenation, on PAHs in evolved PNe.

A new statistical distance scale based on MSX data
R. Ortiz*, M.V.F. Copetti, S. Lorenz-Martins*

Statistical distance scales, when correctly evaluated, constitute a robust alternative if they are based on a large sample with accurate observational parameters. Nevertheless many methods available in the literature make use of visual data that are severely affected by reddening. In this work we propose a statistical method based on a relationship between the age and the specific intensity of the radiation emitted in the MSX bands. An analysis of some theoretical evolutionary models shows that, during the first 2×10^3 years, the nebular radius seems to increase at a nearly constant rate. This effect occurs because even though the various gas shells expand at different velocities, they might be observed as a single shell in radio images, for example. Distances are evaluated for a hundred objects in various directions of the Galactic disc. The present method is especially suited for young, compact planetary nebulae in the Galactic disc, severely affected by interstellar extinction.

A Statistical Sample of Planetary Nebulae in the Galactic Bulge: Measuring Masses and Mass−Loss Rates
R. Sahai, *Q. Parker, B. Miszalski, A. Kovacevic, K. Exter, G. van de Steene, N. Sterling, H. Dinerstein, D. Frew, D. R. Goncalves, A. Zijlstra, L. Sabin, R. Costa et al.*

We describe a Herschel OT1 program to obtain 100-500 micron photometry for a statistical, flux-limited (in the IRAS 60 micron band) sample of Galactic bulge planetary nebulae (GBPNe), using PACS and SPIRE. The Galactic Bulge volume, offers a unique, nearby environment where a statistical population of PNe, all at roughly the same well-established distance, can be studied in order to understand these objects, test theoretical models for their formation and evolution, and address the mystery of the constancy of the PN luminosity function (an important cosmological distance indicator). Much of the mass ejected during the preceding AGB phase is expected to lie outside the ionised shells in these objects, and can only be detected via the thermal emission from cold dust. The proposed observations are a critical component of a broader study comprising existing and future ground- and space-based observations that will produce a combination of nebular masses, mass-loss rates, luminosities, physical sizes, morphologies, radial velocities, ages, and chemical abundances for a statistical sample of planetary nebulae, resulting in a unique dataset describing the final stages of stellar evolution in unprecedented detail. Data have just begun to be obtained, and we will describe our efforts to build and model the full SEDs of observed GBPNe, and derive nebular masses and mass-loss rates.

Studies of Planetary Nebulae with SOFIA: Current and Future Prospects
R. Sankrit

The Stratospheric Observatory for Infrared Astronomy (SOFIA), a joint project of NASA and the Deutsches Zentrum für Luft- und Raumfahrt (DLR), is a 2.5m telescope on board a Boeing 747-SP airplane. SOFIA will operate above 99% of the water vapour in the Earth's atmosphere, and provide access to a broad wavelength range, including the mid- and far-infrared. SOFIA is highly relevant for PNe studies. High angular-resolution imaging in broad and narrow mid-infrared bands, spectroscopy yielding measurements of important diagnostic lines (e.g. of multiple ionization stages of O, Ne, S), and high resolution spectroscopy of emission lines such as [CII] 158 μm can be used to study the molecular content, elemental abundances and kinematics of PNe. I will discuss in detail the relevance of SOFIA to PNe studies. (If available at the time of the meeting, I will present images from some early observations.) I will also give an overview of the observing program and describe how the international astronomy community can propose to use SOFIA.

The second release of the Torun catalogue of Galactic post-AGB objects. Morphological and spectral classifications
R. Szczerba, *N. Siodmiak, G. Stasinska, J. Borkowski, P. García-Lario, O. Suárez, A. García-Hernández*

The Torun catalogue of Galactic post-AGB and related objects was created to facilitate the research on the late evolution of low- and intermediate-mass stars. The main reason for this upgrade of the catalogue was introducing a new classification scheme of post-AGB objects. We have also classified the spectral energy distributions of the post-AGB stars and their HST images. We have given on-line access to optical spectra for 124 likely and possible objects, to all the available HST images of post-AGB objects (about 100), as well as to long-term photometric data for 12 carbon-rich post-AGB objects. The second edition of the catalogue contains more than 300 likely (including 112 RV Tau stars), and more than 80 possible post-AGB objects. During the talk I will review present features of the catalogue.

Uncertainties in measurements of chemical abundances in planetary nebulae
R. Wesson, *D. Stock*

We have written a code which calculates temperatures, densities, and chemical abundances from both forbidden and permitted transitions in photoionized nebulae, and which quickly and robustly calculates the associated statistical uncertainties using a Monte Carlo technique. We apply this code to a number of objects. For spectra with low signal to noise, typical assumptions of Gaussian uncertainty distributions break down, and uncertainty distributions are significantly non-symmetrical. We also use the code to estimate the significance of systematic uncertainties such as those introduced by the choice of atomic data. We find that these uncertainties can be comparable with the statistical uncertainties.

The evolution of the nebula surrounding V458 Vulpeculae, a post double common-envelope nova
R. Wesson, *M.J. Barlow, R.L.M. Corradi, J.E. Drew, P.J. Groot, C. Knigge, D. Steeghs, R. Napiwotzki, P. Rodriguez-Gil, A.A. Zijlstra*

The nova V458 Vulpeculae underwent an outburst in August 2007. Pre-explosion images revealed a nebula surrounding the nova; follow-up imaging and spectroscopy showed that this was a planetary nebula. The characteristics of the system suggest a combined mass exceeding the Chandrasekhar limit, making the system a potential Type Ia supernova progenitor. Since the outburst we have obtained images and spectra of the nebula on numerous occasions. Observing the progress of the ionisation front from the nova flash at several epochs allowed an accurate distance to be determined, and spectra reveal the rapidly changing physical conditions. Our observations included spatially-resolved spectra of a bright nebular knot obtained with X-Shooter on the VLT. We present our observations of the system over the almost four years since its outburst.

Herschel imaging of the Helix Nebula
R. Wesson, *M.J. Barlow, P.A.M. van Hoof, M. Matsuura, K. Exter, and MESS consortium*

We present Herschel PACS + SPIRE images of the planetary nebula NGC 7293, the Helix Nebula. One of the closest planetary nebulae to Earth. Herschel has permitted this nebula to be studied at unprecedented spatial resolution in the far infrared. By comparing PACS + SPIRE images which trace the location of dust in the nebula with ground-based images tracing molecular H_2 emission, we can place constraints on the origin of molecular hydrogen in the nebula. We present photoionisation models which we have used to determine the physical conditions of the dust and investigate formation scenarios for the H_2.

A Detailed Look at Chemical Abundances in Magellanic Cloud Planetary Nebulae
R.A. Shaw, *T.-H. Lee, L. Stanghellini, J.E. Davies, D.A. García-Hernández, P. García-Lario, J.V. Perea-Calderón, E. Villaver, A. Manchado, S. Palen, B. Balick*

We present an analysis of elemental abundances of He, N, O, Ne, S, and Ar in Magellanic Cloud planetary nebulae (PNe). We derived the abundances from a combination of deep, high dispersion optical spectra, space-based slitless optical spectra, as well as mid-IR spectra from the Spitzer Space Telescope and UV spectra from IUE and HST/STIS. Through the use of wider wavelength coverage, higher dispersion, and more accurate flux calibration, we have been able to derive elemental abundances which are among the most accurate available, and allow us to examine elemental yields in these low metalicity environments with greater precision than most studies have been able to achieve.
We used ionic abundances derived from IR emission lines, including those from ionization stages not observable in the optical, to examine the accuracy of some commonly used recipes for ionization correction factors (ICFs). We find that most of these ICFs work very well even in the limit of substantially sub-Solar metallicities, except for PNe with very high ionization. Our abundance analysis shows enhancements of He and N that are predicted from prior dredge-up processes of the progenitors on the AGB, and which agree well with expectations from nebular morphology. The derived elemental abundances for Ne, S, and Ar, which are not expected to change significantly from nucleosynthesis in the prior AGB phase, show significant dispersion with respect to the O abundance. In addition, the S and Ar abundances are systematically low compared to H II regions in each galaxy, while the Ne abundance is on average elevated.
Finally, we identified MG 8 as an interesting limiting case of a PN central star with a ~3.5 $M_{\odot}$ progenitor in which hot-bottom burning did not occur in its prior AGB evolution.

The Curious Conundrum Regarding Sulfur and Oxygen Abundances in Planetary Nebulae
R.B.C. Henry*, A. Speck, A.I. Karakas, G.J. Ferland*

The chemical evolution of interstellar sulfur and oxygen is widely believed to proceed in lockstep. As such, S and O abundance trends in both PNe and H II regions should mimic each other. Yet PN abundance studies in the MWG and other galaxies consistently show that PN S abundances are systematically below the corresponding level in H II regions for the same O abundance by a factor of 2 on average. In this paper we report on fresh attempts to identify causal parameters through numerous correlation tests of PN properties, an investigation of S depletion onto dust and molecules, consideration of S destruction via stellar nucleosynthesis, and tests for shortcomings of the current S ionization correction factor due to dielectronic recombination.

Modeling bipolar Planetary Nebulae
D.M. Faes, ***R.D.D. Costa****, C. Morisset*

This study aims to map spatially the physical properties of a set of planetary nebulae with bipolar morphology, and then build their models. For this, observations were performed using long slit and IFU techniques. Modeling was performed with the *Cloudy* code. Our results show that the simulations are able to reproduce the major features of observations, even taking simplifying assumptions for the astrophysical environment. A significant fraction of PNe appears to be limited by density. Sub-structures could be identified as deviations in the symmetry of the emerging fluxes. Changes in the reddening from H_{α}/H_{β} ratio indicate differential extinction in the nebulae. Plasma diagnostic diagrams show some features reproduced by the models, and can be use to evaluate their accuracy.

Sh 2-71 and its possible binary central star
***R.L.M. Corradi**, Q.A. Parker, P. Sorensen, D. Frew*

We present new observations of the remarkable planetary nebula SH 2-71. Deep H_α+[NII] images allow the detection of faint extensions of the radial structures observed in the inner regions of the nebula. The properties of the two candidate central stars of the nebula are also discussed by means of time-series spectroscopy and new photometry.

The 3D structure of BD +30 3639: A planetary nebula with a non-homologous expansion
***S. Akras**, S. Wolfgang*

BD +30° 3639 is a member of the rare group of PN with Wolf-Rayet type central star and expansion velocities higher in [O III] than in [N II]. Observation images and high resolution spectra from literature are used to produce a 3-D model of the nebula using the code SHAPE. We find that two different velocity laws are needed. Hence, the internal velocity field of BD +30° 3639 decreases with the distance from the central star in agreement with the radiation-hydrodynamic models. Furthermore, the high-speed bipolar collimated outflows jets are described with a cylindrical velocity component in agreement with the magneto-hydrodynamic models. In addition, the distance of BD +30° 3639 is estimated between 1.3 and 1.7 kpc. Moreover, the criss-cross mapping technique shows that the kinematic center of nebula is located 0.5 arcsec from the central star. Finally, we find indications of possible interaction between the east part of nebula and the H_2 molecule.

A 3-D morpho-kinematic study of M 1-32
***S. Akras**, A. López, S. Wolfgang*

M1-32 is a member of the rare group of planetary nebula with Wolf-Rayet central star and expansion velocities higher in [O III] and He I than in [N II] and H_β (Medina et al. 2006). High resolution spectra from SPM are presented showing high-speed bipolar collimated outflows with expansion velocities of up to 150-170 km/s in H_α+[N II] lines. In addition, an equatorial ring is also found with expansion velocities of up to 20-30 km/s. This information is used in order to produce a 3-D model using the morpho-kinematic code SHAPE. The preliminary results show that M1-32 is seen almost pole-on with inclination angle between 5 and 10 degrees with respect to the line of sight. We also conclude that the outflows jets can only be described with a cylindrical velocity component in agreement with magneto-hydrodynamic models.

The Ionization State of the Halo PN NGC 2438
S. Dalnodar

NGC 2438 is a classical multiple shell or halo planetary nebula. Its central star and the main nebula are well studied. Also it was target of hydrodynamic simulations. This initiated a discussion whether the haloes are mainly containing recombined gas, or if they are still ionized. We analyzed narrow-band images and long slit spectra at multiple positions to obtain a deeper look on morphological details and the properties of the outer shell and the halo. Using temperature measurements from emission lines we got an electron temperature which clearly indicates a fully ionized stage. Additionally measurements of the electron density suggest a variation of the filling factor. Based on those results, we conclude that there is no major fraction of recombination in this phase.

On the production of multicharge ions in planetary nebulae
S. Ibadov

Production of multicharge ions due to generation of hot expanding plasma blobs, short living "compound particles", at high-velocity collisions between dust grains of a planetary nebula with dust particles of the interstellar medium is analytically considered. Dependences of the multiplicity of produced ions on the velocity of the planetary nebula are determined.

Investigation of the recombination of the retarded shell of "born-again" CSPNe by time-Dependent radiative transfer models
A. Koskela, S. Dalnodar, R. Kissmann, A. Reimer, A. Ostermann, ***S. Kimeswenger***

A normal planetary nebula stays more then 10\,000 years in the state of a photoionized nebula. As long as the timescales of the most important ionizing processes are much smaller, the ionization state can be characterized by a static photoionization model and simulated with codes like, e.g., CLOUDY. When the star exhibits a late Helium flash, however, the ionizing flux stops within a very short timescale. The star then re-appears from it's opaque shell after a few years (or centuries) as a cold giant star without any hard ionizing photons. Describing the physics of such behavior requires a fully time-dependent radiative transfer model. Past investigations used data of the old nebulae around V605 Aql and V4334 Sgr to derive a model of the pre-outburst state of the CSPN in a static model. With regard to these models Schönberner (2008, ASPC, 391, 139) critically raised the question whether a significant change in the ionization state (and thus the spectrum) has to be expected after a time of 80 years, and whether static models are applicable at all.
Here we directly address this problem/question and present the results of a time-dependent radiative transfer recombination model to derive parameters for the state of this dynamical phase of such a nebula.

Expansion velocities of planetary nebulae
S. Torres-Peimbert*, A. Arrieta, L. Georgiev*

In order to clarify the observed relation between the expansion velocity measured from lines of different ions and their ionization potential, we present kinematical data for several objects. We have collected spectroscopic data from high dispersion spectra from public databases, and from it we are comparing expansion velocities for a set of planetary nebulae of different morphologies, sizes and ages.

Distance determination of PNe using the extinction-distance method
S.G. Navarro*, R.L.M. Corradi, A. Mampaso*

We present individual distances to some PNe determined by the extinction-distance method. In order to apply this method, and to obtain distances with enough accuracy, we need to determine the spectral type of 40 to 60 stars in the line of sight of each PNe. This implies the necessity of classify few thousands of stellar spectra with S:N ratio between 10 and 60. To solve such need we developed an ANN system to perform automatic spectral classification which could classify spectra with S:N ratio as low as 20 with an accuracy better than 2 spectral subtypes.

New observations of southern Galactic planetary nebulae
S.K. Gorny

We present new spectroscopic observations of almost 50 planetary nebulae located between Vela and Norma constellations. We analyse the chemical composition of these objects and discuss their properties from the viewpoint of their Galactic structure membership.

A relation between nebular morphology and infrared properties
***S.K. Gorny**, N.Siodmiak*

The relation between the planetary nebulae morphology and their global infrared properties is presented. We discuss its possible origin as related to the last stages of AGB evolution.

The growth of outflows from evolved stars: a live video
***T. Liimets**, R.L.M. Corradi, B. Balick, M. Santander-García*

The image quality achievable with modern telescopes (from the space but also from the ground) allows the apparent growth of relatively close/fast stellar outflows to be revealed and measured in timescales of few years. The information about the tangential component of the gas and shocks motions, coupled with line-of-sight velocities from Doppler shifts, allows a detailed view of the dynamical evolution of the outflows to be obtained, a privileged information for theoretical modelling. In this "live" poster, animations that we have obtained by combining multi-epoch images of several outflows from evolved stars will be displayed on a computer screen. They include the lighthouse rotation of the "symbiotic" planetary nebula M 2-9, the ballistic expansion of the classical nova remnant (surrounded by an old PN) in GK Per, the equatorial-and-polar fast outflows from the symbiotic stars R Aqr, Hen 2-147 and Hen 2-104, and the shaping at work in the proto-PNe CRL 618 and CRL 2688 and in more mature PNe such as NGC 6543.

Kinematic age determinations of Planetary Nebula central stars
***T.S. Rodrigues**, W. J. Maciel*

Central stars of planetary nebulae (CSPN) have a relatively large mass interval, so that it is expected that these stars also have different ages, typically above 1 Gyr. Apart from the properties of the CSPN themselves, the problem of age determination is also important in the context of the chemical evolution of the Galaxy, for instance in the understanding of the time variation of chemical abundance gradients. However, the accurate determination of CSPN ages is a complex problem, and there are no unique and reliable methods. In this work, we estimate the ages of a sample of CSPN on the basis of some correlations between their kinematic properties and the expected ages. According to these correlations, the observed dispersions in the U, V, W velocities are uniquely defined by the stellar ages. Two samples were chosen, containing approximately 200 and 800 nebulae, respectively, for which accurate radial velocities are available in the literature. The adopted correlations were derived from the recent Geneva-Copenhagen survey of galactic stars. Preliminary results suggest the most CSPN in the galactic disk have ages under 3 Gyr. These results are also compared with some recent age distributions based on independent correlations involving the nebular chemical abundances. (FAPESP/CNPq)

Excitation of emission lines by fluorescence and recombination in IC418
V. Escalante, *C. Morisset, L. Georgiev*

We predict intensities of lines of C II, N I, N II, O I and OII and compare them with a deep spectroscopic survey of IC 418 to test the effect of excitation of nebular emission lines by continuum fluorescence of starlight. Our calculations use a nebular model and a synthetic spectrum of its central star to take into account excitation of the lines by continuum fluorescence and recombination. The N II spectrum is mostly produced by fluorescence due to the low excitation conditions of the nebula, but many C II and O II lines have more excitation by fluorescence than recombination. In the neutral envelope, the N I permitted lines are excited by fluorescence, and almost all the O I lines are excited by recombination. Electron excitation produces the forbidden optical lines of O I, but continuum fluorescence excites most of the N I forbidden line intensities. Lines excited by fluorescence of light below the Lyman limit thus suggest a new diagnostic to explore the photodissociation region of a nebula.

From nebular to pynebular: a new package for the analysis of emission lines
V. Luridiana*, C. Morisset, R.A. Shaw, D. Díaz-González*

The **nebular** package is a widely used set of IRAF applications for the analysis of emission lines. It can be used in several ways to compute physical quantities and abundances given observed emission line intensities. For example, it can compute electron temperature (T_e) and density (N_e), predict volume emissivities given T_e and N_e, and ionic abundances given T_e, and N_e, and one or more emission lines. In this contribution we describe an ongoing project to migrate {nebular} from IRAF to a more modern programming environment where it can be used as a stand-alone program, as a software library, or as a set of web applications. Python, an interpreted, high-level programming language which enjoys wide use in the astronomical community, was selected as the target language. The current functionality of **nebular** will be preserved in the new environment, and the supporting atomic data will be reviewed and updated. Additionally, the current functionalities will be extended and new ones will be added. The following are a few examples: for a selected subsample of ions, the user will be given the option to switch among different data sets; atomic parameters for additional ions will be included, particularly those elements produced via s-process in AGB stars; a tool for the simultaneous determination of N_e and T_e from pairs of line ratios will be added; the automated tasks such as 'zones' and 'abund', which can process observations of a long list of targets, will be extended to include infrared lines. Additional, basic functionalities are planned, such as computing ionic abundances for He and some other elements from recombination lines; recipes for computing total elemental abundances from ionic abundances will be added, using common or user-defined ICF formulae; and a tool for the error analysis of T_e, N_e, and abundances will be developed.

A complete spectroscopic survey of LMC PNe candidates from MCELS
W. Reid, *Q.A. Parker*

In 2006 Reid & Parker added 460 planetary nebulae (PNe) to the 169 previously known across the central 25 deg^2 of the LMC. The resulting large number of PNe now known in the central LMC have yielded significant advances in our knowledge of the central LMC's kinematical sub-structure (rotation, inclinations, transverse velocity) and raised interesting questions regarding the kinematical structure of the outer regions. Our access to the MCELS survey provides the opportunity to achieve equivalent results across the whole ~95 deg^2 of the LMC, critical for a complete determination of kinematics and abundance gradients. We have already used AAOmega to spectroscopically verify 92 new PNe to add to the 101 previously known in the outer LMC. New PN radial velocities are being compared to other tracers and the HI gas disk. These are being added to existing kinematic data to create gradients and verify models. With a near complete LMC PNe census to V=22, an unbiased LMC PNLF is being built in order to identify any population sub-trends or `dips' while providing an accurate bright-end cutoff which is used as a standard candle.

Radial abundance gradients from planetary nebulae and young objects: age effects
W.J. Maciel, *T.S. Rodrigues, R.D.D. Costa*

Radial abundance gradients are extremely important constraints for evolution models of the Milky Way and other galaxies. They can be obtained by combining data from young objects (HII regions, OB stars), with the corresponding data from older objects (open clusters, planetary nebulae). There is presently some controversy regarding both the magnitude and the time evolution of the gradients, and progress in the area depends critically on the age determinations of these objects. We have developed several methods to estimate the ages of planetary nebula central stars (CSPN). In this work we discuss the effects on the time variation of the gradients resulting from our new determinations of kinematic ages of CSPN. The main conclusion is that most objects in the PN sample with accurate radial velocities have ages under 3 Gyr approximately. This affects the time evolution of the gradients, in the sense that the expected differences between the gradients of older and younger objects are smaller than usually assumed. (FAPESP/CNPq).

Very deep spectroscopy of the bright Saturn nebula NGC7009 - Optical recombination spectrum and new effective recombination coefficients
***X. Fang**, X. Liu, P. Storey*

We have carried out new *ab initio* calculations of the effective recombination coefficients for the N II recombination spectrum. The new calculations are valid for temperatures down to an unprecedentedly low level (approximately 100 K). We present very deep CCD spectrum of the bright, medium-excitation planetary nebula NGC 7009, with a wavelength coverage from 3040 to 11,000 Å. Emission line identification is carried out to identify all the emission features in the spectra, based on the available laboratory atomic transition data. Since the spectra are of medium resolution, we use multi-Gaussian line profile fitting to deblend faint blended lines, most of which are optical recombination lines (ORLs) emitted by singly ionized ions of abundant second-row elements such as C, N, O and Ne. In total about 1200 emission features are identified, with the faintest ones down to fluxes 10^{-4} of Hβ. Plasma diagnostics using optical forbidden line ratios are carried out. Also derived are electron temperatures and densities from the H I, He I and He II recombination spectrum. The most significant multiplets in optical emitted by C II, N II, O II and Ne II are analyzed against theoretical predictions. General agreement is found between observations and theoretical calculations. Ionic and elemental abundances are derived for C, N, O and Ne from both ORLs and collisionally excited lines (CELs). Elemental abundances of C, N, O and Ne from ORLs are higher than those from CELs by a factor of 5-7.

Radio Continuum and Radio Recombination Line Imaging toward Selected Planetary Nebulae
***Y. Gómez,** L.F. Rodríguez*

H66α recombination line and 1.3 cm continuum observations have been carried out with the Very Large Array (angular resolution about 4") toward a sample of four planetary nebulae: NGC 7009, NGC 6369, NGC 3242 and NGC 6572. The $H66_{\alpha}$ line has been detected for all nebulae, around its geometric center. We analyze the kinematics of the line toward the center where in some cases there are clear velocity gradients. In all nebulae the line and the continuum emission have a very similar spatial distribution, suggesting that at this wavelength the dominant continuum process is the optically thin free-free, since both recombination line and free-free emissions originate mostly from electron-proton interactions, and that there is no significant contribution from spinning dust.

Planetary Nebulae Detected in the Spitzer Space Telescope GLIMPSE 3D Legacy Survey
***Y. Zhang,** S. Kwok, Ch.-H. Hsia, J.-I. Nakashima, N. Koning*

Due to interstellar extinction, optical census of Galactic planetary nebulae (PNs) is highly incomplete, and some compact H II regions might have been miss-classified as PNs. The problem is particularly severe in the Galactic plane where the extinction in the optical is significant and hampers the detections of PNs. Unlike optical observations, infrared (IR) observations are hardly affected by interstellar extinction, and provide a good opportunity to study highly obscured PNs. In this study, we use the data from the Spitzer Legacy Infrared Mid-Plane Survey Extraordinaire 3D (GLIMPSE 3D) to investigate the mid-infrared (MIR) properties of PNs and PN candidates.

A Study of the Effect of Ionization and Illumination on Morphologies of Planetary Nebulae

Y. Zhang, *S. Kwok*

We carry out a modelling study of the effect of ionization and illumination on the morphologies of Planetary Nebulae (PNs), aiming to investigate the hypothesis of Kwok (2010, PASA, 27, 174) that the bipolar and multipolar lobes of PNs can be produced by leakage of UV photons into those directions. Using the photoionization code CLOUDY, we construct a nebular model consisting of a dense envelope and cones of low density. The results show that the visible morphologies of PNs might fundamentally differ from their intrinsic structure.

[Fe III] lines in the planetary nebula NGC 2392

Y. Zhang, *X. Fang, X.-W. Liu, S. Kwok*

Eskimo Nebula, NGC 2392, is a young double-shell planetary nebula (PN). Its intrinsic structure and shaping mechanism are still not fully understood. We present new optical spectroscopy of NGC 2392. The slit was placed at two different locations to obtain the spectra of the inner and outer shells. Several [Fe III] lines are clearly detected. We find that these [Fe III] lines mostly originate from the inner shell. Therefore, we suggest that NGC 2392 might have an intrinsic structure similar to Ant nebula Mz 3, which exhibits a number of [Fe III] lines from the central dense regions. In this scenario, the inner and outer shells correspond to the central emission core and the outer lobes of Mz 3, respectively.

Trigonometric Parallax of the Protoplanetary Nebula OH 231.8+4.2

Y.K. Choi, *A. Brunthaler, K. M. Menten, M.J. Reid*

We report measurements of the trigonometric parallx of H2O masers around the protoplanetary nebula OH 231.8+4.2 carried out with the Very Long Baseline Array. Based on astrometric monitoring for 1 year, we measured a trigonometric parallax of 0.89 ± 0.02 mass, corresponding to a distance of 1.12 +0.04/-0.03 kpc. This is most accurate distance to OH 231.8+4.2, and the first one based on an annual parallax measurement. Combining the distance and proper motions with observed radial velocities gives the full space motion of OH231.8+4.2. The distribution and internal motions of the H2O masers are consistent with the bipolar outflow in literatures. We also present our observations of SiO masers, which trace the disk of OH 231.8+4.2.

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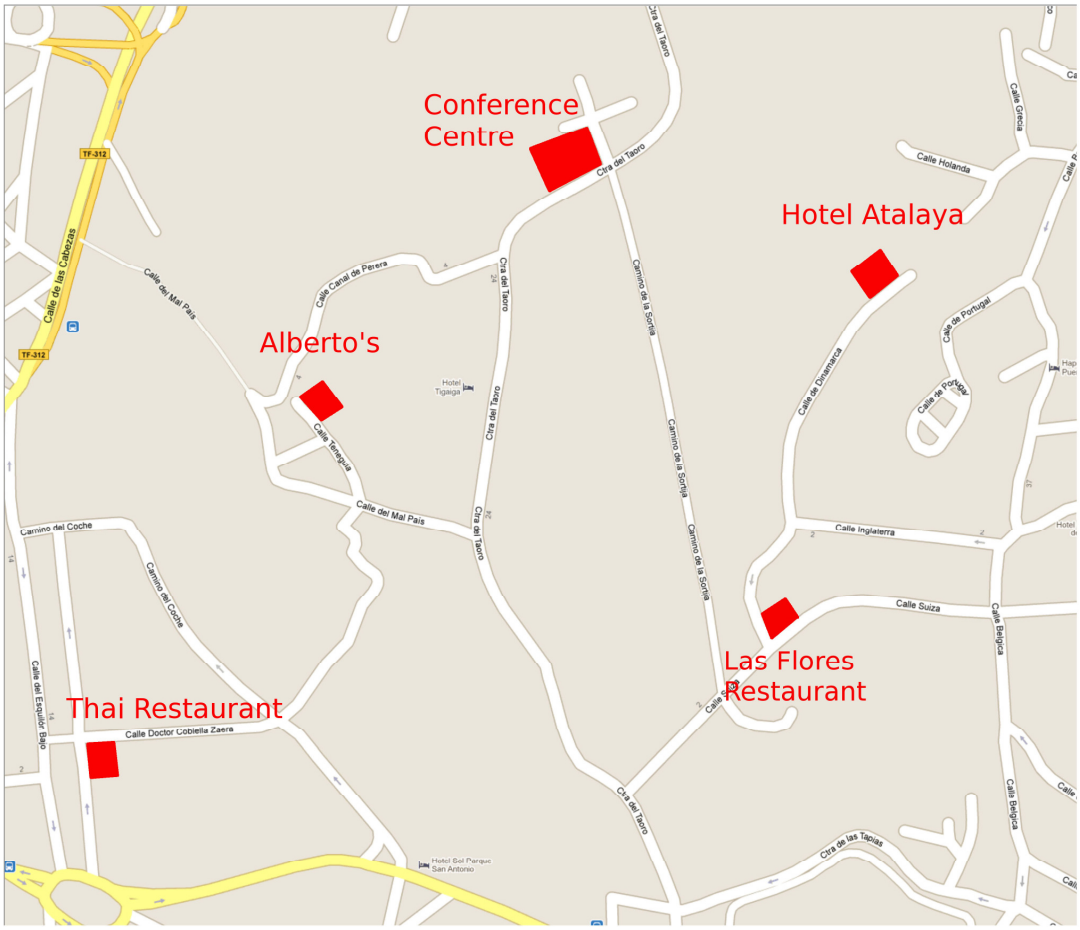

Restaurant: **Hotel Atalaya**, *CalleDinamarca 3, Parque Taoro, 38400 Puerto de la Cruz*
Walking distance: 5 minutes
Food: Buffet; Price: 10 Euros
http://www.trhhoteles.com/es/nuestros-hoteles/vacacionales/hotel-trh-atalaya-tenerife/hotel-atalaya.html
Cafe/bar **Albertos´s**, *Calle Malpais 5 Parque Taoro, 38400 Puerto de la Cruz*
Walking distance: 5 minutes
Food: just snacks, sandwiches & pizzas
http://www.trivago.es/puerto-de-la-cruz-42693/barpub/bar-alberto-s-1705829
Restaurant **Las Flores**, *Calle Suiza 5, Parque Taoro,* 38400 Puerto de la Cruz
Walking distance: 5 minutes
Food: International; Price: 15-20 Euros
http://www.las-flores.es/uk.html
Restaurant **Ruen Thai**
Address: Calle Dr. Celestino Cobiella Zaera, below Puerto Palace Hotel 39400 Puerto de la Cruz, Tel 922 376946 ruenthai@live.com
Walking distance: 10-15 minutes
Food: Thai; Price: 15- 20 Euros
http://www.tenerife-holiday-home-insider.com/restaurant-ruen-thai.html

Restaurants in Puerto de la Cruz

Puerto de la Cruz is full of restaurants, most of which are rather tourist orientated. There are some very good restaurants though but you'll have to shop around. Those given below are examples of what you could find around El Puerto and beyond. Usual opening hours: 13:00 - 15:00 and 19:30 - 23:00h.

RESTAURANT	ADDRESS / PHONE	SPECIALITY
A Casa Gallega	Puerto Viejo, 18 (922 374 516)	Galician food
Café París	Avda Cristobal Colón 2. (922 384000)	Enjoy a good coffee and cakes
Casa Antigua	San Felipe, 95 (922 380 078)	Canarian specialities
Casa Lala	Camino del Durazno. (922 381794)	Fresh fish.
Casa Miranda	Santo Domingo, 13 (922 373 871)	Canarian food
Casa Régulo	Pérez Zamora 16 (922 38 45 06)	Fresh fish and Canarian food
China II	Avda Generalísimo 13. (922 38 19 08)	Chinese food.
El Abuelo	Avda. Generalísimo, 25 (922 385 489)	Castilian food.
El Bistro	Avda Generalísimo, 9	Italian cuisine.
El Duende	La Higuerita, 41. (922 374517)	Canarian food.
El Limón	Esquivel, 4 (922 381 619)	Vegetarian food.
El Sultán	C/ Perú (Avda. Colón), 8 (922 386 537)	Lebanese food.
Estambul	Canino, 23 (922 38 63 71)	Turkish food.
Hannen Barril	Plaza del Charco (922 371 383)	German specialities.
Il Papagayo	Avda Richard J Yeoward, 1 (922 381400)	Mediterranen specialities.
La Casona	Plaza del Charco, 13 (922 373 422)	International food
La Cazuela	Avda. colón, 12 (922 388 923)	Live shellfish from Galicia.
La Cuadra	Blanco, 9 (922 380 271)	International food.
La Gañanía	Camino del Durazno, 71. (922 371000)	Canarian food.
La Rosa di Bari	El Lomo. (922 382386)	Good Italian food.
La Tasca de al Lado	Las Lonjas. Plaza de Europa (922 368360)	Canarian specialities.
Los Faroles	Avda Francisco Afonso (922 38 46 16)	Rice & meat specialities.
Magnolia	Avda Marqués Villanueva del Prado. (922 385614).	Catalan specialities
Mi Vaca y Yo	Cruz Verde 3. (922 385247)	Fresh fish.
Orquídea	Aceviño, 12 "La Paz" (922 370330)	French specialities.
Palatino	El Lomo, 28 (922 382374)	Fresh seafood.
Patio Canario	El Lomo 8. (922 380451)	Canarian specialities and fresh fish
Poco Loco	Paseo Los Dragos, 7	Mexican cuisine.
Rancho Grande	Paseo San Telmo. (922 383799)	Best steak in town.
Peruano	El Pozo. (922 382253)	Peruvian specialities.
Rancho Grande	Paseo San Telmo, 8 (922 383 757)	International food.
Rincón Canario	Cruz Verde, 2 (922 381 283)	Canarian specialities.
Tic Tac	Avda. Generalísimo, 26 (922 38 42 20)	Fresh seafood.
The Oriental	Hotel Botánico (922 38 14 00)	Thailand's/oriental food
Zebra Maria	Avda. Marqués de Villanueva (carretera El Botánico) s/n (922 38 18 55)	Pizzeria

MAP OF TENERIFE

USEFUL TELEPHONE NUMBERS

Emergency (Fire — Police — Ambulance):	112
Health Emergencies:	061
Hospital Universitario de Canarias:	922 678 000
Hospital Nuestra Señora de la Candelaria:	922 602 000
Local Police (Puerto de la Cruz):	922 378 448 / 922 378 449
National Police (Puerto de la Cruz):	922 376 820
Guardia Civil Puerto de la Cruz:	922 383 258
Missing children:	116000
Radio taxi Puerto de la Cruz:	922 374 194
Buses Titsa:	922 531 300
Reina Sofía South Airport:	922 759 200 / 922 759 510
Los Rodeos North Airport:	922 635 800 / 922 635 635
Iberia:	902 400 500 / 922 759 285
Air Europa:	902 401 501 / 922 759 244
Spanair:	902 131 415 / 922 759 150
IAC's Headquarter:	922 605 200

BUS MAP

A Bus will leave from a point opposite the Hotel Beatriz Atlantis every morning at 08:40h. In the afternoons, a bus will leave from the Conference Center, 15 minutes after the end of the last Session, except on Wednesday.

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