CC
R

Scientific report on the activities of the Associated European Laboratory « Astronomy Poland-France »

2008

This document reports on the scientific activities of the LEA Astro-PF during 2008 and complements the general LEA report for 2004-2007.

The report is divided in the following topics:
A Galaxies and Cosmology
B High Energy Astrophysics
C Stellar structure
D Advanced stages of stellar evolution and interstellar medium
E Dense matter, compact stars and gravitational radiation
F Heliosphere and astrospheres, planets

The collaboration resulted in 31 joint publications in 2008. Many others are in preparation.

Two international meetings were co-organized by French and Polish LEA Astro-PF members and co-sponsored by the LEA. They are described at the end of this document.

Grazyna Stasinska and Pawel Haensel
January 2009

A Galaxies and Cosmology

Interacting galaxies in Virgo cluster - observations and modeling

LEA participants from the Polish side: Marian Soida, Katarzyna Otmianowska-Mazur, K.; Urbanik
LEA participants from the French side: Bernd Vollmer

Hydrodynamical and magnetohyrodynamical models of selected Virgo spiral galaxies have been constructed. The models are focused on interactions between galaxies and/or galaxies and intergalactic medium. The results are directly comaparable with observations carried by larger groups with our participation:
a/ kinematic properties have been confronted (mainly) with HI spectral observations; b/ from MHD models synthetic maps of synchrotron emission we are directly comparing with real (mostly VLA) data at higher frequencies. A number of succesfull models, and our observations were already published.

Publications:

Vollmer, B.; Soida, M.; Chung, A.; van Gorkom, J. H.; Otmianowska-Mazur, K.; Beck, R.; Urbanik, M.; Kenney, J. D. P. *Pre-peak ram pressure stripping in the Virgo cluster spiral galaxy NGC 4501* Astronomy and Astrophysics, Volume 483, Issue 1, 2008, pp.89-106

Giant radio galaxies

LEA participants from the Polish side: Dorota Koziel-Wierzbowska
LEA participants from the French side: Grazyna Stasinaka

Giant radio-galaxies are the largest connect structures in the Universe. It is not understood yet whether their gigantic size is related to some of their own physical property or if it is due to the properties of the intergalactic medium. Dorota Koziel-Wierzbowska has constituted a sample of giant radio-galaxies by analyzing several catalogs of radio maps, as well as a comparison sample of normal size radio galaxies. The optical counterpars

of these radio galaxies have been looked for in the Sloan Digital Sky Survey, the spectra extracted from the SDSS data base and analyzed with the brazilian code STARLIGHT. The optical properties are being analyzed to see if they reveal any physical difference between the two classes of radio galaxies. The collaboration within the LEA started at the end of 2008. The present results were included in the PhD thesis of Dorota Koziel-Wierzbowska (december 2008). A joint paper is to be submitted at the beginning of 2008.

Radio galaxies

LEA participants from the Polish side: Marek Sikora
LEA participants from the French side: Jean-Pierre Lasota

Publications

Sikora, Marek; Stawarz, Łukasz; Lasota, Jean-Pierre (2008) *Radio-loudness of active galaxies and the black hole evolution* New Astronomy Reviews, Volume 51, Issue 10-12, p. 891-897.

Stawarz, L.; Sikora, M.; Lasota, J.-P. *Radio Loudness of AGNs: Host Galaxy Morphology and the Spin Paradigm* in: Extragalactic Jets: Theory and Observation from Radio to Gamma Ray ASP Conference Series, Vol. 386, proceedings of the conference held 21-24 May, 2007 in Girdwood, Alaska, USA. Edited by Travis A. Rector and David S. De Young. San Francisco: Astronomical Society of the Pacific, 2008., p.169

Mass modeling of spherical systems

LEA participants from the Polish side: Ewa LOKAS, Radoslaw WOJTAK, Jaroslaw KLIMENTOWSKI
LEA participants from the French side: Gary MAMON

1) Submitted paper Klimentowski et al. on tidal evolution of tidally stripped spiral galaxy and the formation of a dwarf spheroidal. In this paper, we show that the tidal tails of the small simulated spiral galaxy orbiting around the Milky Way are almost always aligned with the central regions of the Milky Way. We show how the tidal is flipped during the final pericentric passage, which destroys the bar and pumps sufficient energy into the system to make it appear as a dwarf spheroidal.

2) Hosted 3-month visit of R. Wojtak, with intense discussions on a) Mass modeling of projected systems with distribution functions fit from LCDM halos; b) maximum entropy systems; c) building of systems in 6D phase space.

Publications:

Wojtak, Lokas, Mamon, Gottloeber, Klypin & Hoffman 2008, MNRAS 388, 815, The distribution function of dark matter in massive haloes

Klimentowski, Lokas, Kazantzidis, Prada, Mayer & Mamon 2008, IAUS 244, 321, Mass Modelling of dwarf Spheroidal Galaxies

Klimentowski, Lokas, Kazantzidis, Mayer, Mamon, & Prada 2008, MNRAS submitted arXiv:0803.2464, Tidal evolution of a disky dwarf galaxy in the Milky Way potential: the formation of a dwarf spheroidal

The Cosmic Velocity Field

LEA participants from the Polish side: Chodorowski, Bilicki
LEA participants from the French side: Colombi, Lavaux

One of major problems with the cosmological velocity-gravity comparisons is that in 3-D galaxy surveys, the third coordinate of a galaxy is not its distance but redshift. Colombi, Chodorowski & Teyssier (2007) invented a novel method, based on an analysis of the velocity-gravity relation directly in redshift space. Therefore, there is no need of (problematic) reconstruction of the density field in real space. We derived the relation in the linear

regime and tested it successfully using controlled numerical experiments based on a cosmological N-body simulation (with N = 10^7 particles!).

During 2008, we have produced realistic mock catalogs with observational features (incompleteness, zone of avoidance, outer edge effects, cosmic variance, error in distance measurements, mass-to-light assignment) to check the robustness of the algorithm of comparison in extreme conditions. So far, the velocity-gravity relation is holding quite well provided the M/L relation for galaxies and/or clusters is known sufficiently well to prevent any bias. We have now begun testing the relation on real data, provided by prof. Brent Tully (Univ. of Hawaii), with some positive preliminary results.

The best estimate of the gravitational acceleration acting on the LG can be obtained by measuring the flux dipole of the 2 Micron All Sky Survey (2MASS). For this estimate to be optimal, it is necessary to optimize the survey window through which the flux dipole is measured. Chodorowski, Jean-Baptiste Coiffard, Bilicki, Colombi and Ciecielag (2008) have explicitly constructed such a window for the 2MASS survey. With a graduate student of Chodorowski, Maciej Bilicki, we have estimated the LG gravity from the 2MASS survey, employing our optimal window. We have also done a successful effort to compute analytically one of the two major systematic errors, that is the shot noise (the underlying density field is sparsely sampled by the galaxy distribution).

With Guilhem Lavaux, a graduate student of Colombi, we have done a significant effort to improve the Zeldovich reconstruction of the velocity field in his MAK reconstruction of galaxy initial positions. However, the resulting correction turned out to be small.

Publications:

Chodorowski, Michał J.; Coiffard, Jean-Baptiste; Bilicki, Maciej; Colombi, Stéphane; Ciecielag, Paweł
Towards the optimal window for the 2MASS dipole Monthly Notices of the Royal Astronomical Society, Volume 389, Issue 2, pp. 717-730

B High Energy Astrophysics

Time variability in X-ray emitting accretion disks

LEA participants from the Polish side: Wlodek Kluzniak
LEA participants from the French side: Didier Barret

A systematic investigation into the properties of kHz QPOs in certain accreting neutron star sources has revealed that the QPO properties such as the amplitude and quality factor as a function of the frequency reveal a functional dependence which may be indicative of an underlying physical mechanism, such as a resonance or signatures of strong gravity.

Binary systems at TeV energies

LEA participants from the Polish side: Andrzej A. Zdziarski
LEA participants from the French side: Guillaume Dubus, Julien Malzac

A study of an INTEGRAL observation of Cyg X-1 during a flare simultaneous with a detection of the system in the TeV range by MAGIC (JM, AAZ). A model of the above TeV flare with electron acceleration and photon propagation via a spatially extended pair cascade (JM, AAZ).

Publications : 12 joint multiauthor papers (GD, AAZ) on results on observations of various cosmic sources in the TeV range with the HESS observatory.

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *HESS upper limits for Kepler's supernova remnant* Astronomy and Astrophysics, Volume 488, Issue 1, 2008, pp.219-223

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *Chandra and HESS observations of the supernova remnant CTB 37B* Astronomy and Astrophysics, Volume 486, Issue 3, 2008, pp.829-836

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *Exploring a SNR/molecular cloud association within HESS J1745-303* Astronomy and Astrophysics, Volume 483, Issue 2, 2008, pp.509-517

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *Discovery of VHE γ-rays from the high-frequency-peaked BL Lacertae object RGB J0152+017* Astronomy and Astrophysics, Volume 481, Issue 3, 2008, pp.L103-L107

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *Discovery of very high energy gamma-ray emission coincident with molecular clouds in the W 28 (G6.4-0.1) field* Astronomy and Astrophysics, Volume 481, Issue 2, 2008, pp.401-410

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *Upper limits from HESS active galactic nuclei observations in 2005-2007* Astronomy and Astrophysics, Volume 478, Issue 2, February I 2008, pp.387-393

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *HESS observations and VLT spectroscopy of PG 1553+113* Astronomy and Astrophysics, Volume 477, Issue 2, 2008, pp.481-489

Aharahonian F et al. (authors include Boisson,C., Bulik,T., Dubus, G., Katarzynski K., Moderski R., Ostrowski M., Zdziarski A.A.) *HESS very-high-energy gamma-ray sources without identified counterparts* Astronomy and Astrophysics, Volume 477, Issue 1, January I 2008, pp.353-363

Modeling X-ray spectra and variability of Active Galactic Nuclei

LEA participants on the Polish side: Bozena Czerny, Agata Rozanska, Marek Nikolajuk
LEA participants on the French side: Rene Goosmann, Martine Mouchet, Anabela Goncalves

Our common research focuses on two aspects of the physics of the accretion flow onto black holes in active galactic nuclei: the intrinsic variability of emission and the effects of reprocessing of the primary emission through the warm absorber medium.

1. We continued the relativistic multi-flare modeling for AGN by reproducing XMM data of the Seyfert galaxy MCG-6-30-15. We considered lightcurves, rms variaiblity and power spectra. A paper summarizing the results obtained is in preparation. Furthermore, we test the magnetic flare model as a mechanism of the intrinsic variability. In 2008 we prepared a computer code to simulate the flare distribution across the disk surface which includes the effect of avalanches, i.e. the spontaneous flares considered by us before in a few papers are now supplemented with secondary flares and the signal propagates inwards. With this new model we aim at explanation of both the fractional variability amplitude AND the X-ray power spectra in a broad frequency range. The code is basically ready but still needs final tests.

2. We completed a project of analyzing the warm absorber effect in case of an intrinsic spectrum dominated in optical/UV by a very strong Big Blue Bump which is characteristic for bright quasars. In this case the absorption spectra are sensitive not just to the ionization parameter of an absorbing medium but also to the local density. This gives an unprecedented opportunity to determine the distance of the absorbing medium from the nucleus. The outline of the method was already published and the application to an exemplary quasar is in preparation (preliminary results are being prepared for publication as a conference paper). We also tested the treatment of the thermal instability within the warm absorber by the TITAN code used for warm absorber application - the results were submitted for publication.

Publications

Różańska, A.; Kowalska, I.; Gonçalves, A. C. *How to estimate the distance to the warm absorber in AGN from photoionized models* Astronomy and Astrophysics, Volume 487, Issue 3, 2008, pp.895-900

C Stellar structure

Massive photometry of variable stars: Time series analysis

LEA participants on the Polish side: Alex Schwarzenberg-Czerny, Krzysztof Kaminski, Mariusz Wisniewski
LEA participants on the French side: Jean-Baptiste Marquette, J.P. Beaulieu

We continued our long term collboration on large scale photometric surveys of nearby laxies (LMC/SMC & M33). Our recent results yielded large scale survey of variable stars in M33, most complete to date. In previous years we demonstrated that study of bi-modal cepheids discovered by our survey (with LEA joint contribution) enabled determination of the metallicity gradient across M33. Presently we published exhaustive description of the M33 variable star catalogue assembled in the course of past ollaboration. Our analysis of EROS photometry of SMC/LMC yielded large number of new cepheid variables (catalogue of bi-modal Cepheids in the Magellanic Clouds in publication stage in A&A) and also some peculiar objects. In particular we demonstrated recently, that EROS2 J005135-714459 could be a peculiar cepheid. Its brightness and amplitude seem to evolve on time scale short compared to the mode excitation one.
Our analysis excludes star blending as explanation, hence properties of this star remain puzzle for the theory. On the technical side our collaboration within LEA concentrates on joint development of the time series analysis software, suitable for our studies of variable stars.

Publications

Marquette, J.-B. , et al. (including Beaulieu, J.-P, Schwarzenberg-Czerny, A.) "Light curve of EROS2 J005135-714459 ", VizieR Online Data Catalog, http://adsabs.harvard.edu/abs/2008yCat..34860891M

Bersier, D. et al. (including Schwarzenberg-Czerny, A.) "A large-scale survey for variable stars in M33" **http://adsabs.harvard.edu/abs/2008arXiv0803.2010B**

Marquette, J. B.; Tisserand, P.; François, P.; Beaulieu, J. P.; Doublier, V.; Lesquoy, É.; Milsztajn, A.; Pritchard, J.; Schwarzenberg-Czerny, A.; Afonso, C.; and 30 coauthors *Discovery of a peculiar Cepheid-like star towards the northern edge of the Small Magellanic Cloud* Astronomy and Astrophysics, Volume 486, Issue 3, 2008, pp.891-898

Massive photometry of variable stars: Time series analysis

LEA participants on the Polish side: Maria-Kurpinski Winiarska
LEA participants on the French side: Edouard Oblak

Our studies focus on some applications of our own photometric and spectroscopic observations of eclipsing binaries made in the observatory of Krakow and the Observatoire de Haute-Provence. One of the scientific objectives was to study the evolution of stars of sub-solar mass. In late 2007, at the request of the publisher of "Astronomy and Astrophysics, "we started to expand our submitted publication, including the curves light for six eclipsing binaries, in addition radial velocity for thirty systems, already included in the submitted paper. The simultaneous reduction of two curves with the Wilson-Devinney code requested more time than expected, given the required accuracy for masses and radii determinations. A collaboration was established with G. Milone, of University of Canada, and revealed the existend of a third star (presented at the 213th meeting of the AAS, Long Beech, which was held on 4-8 January 2008).

The determination of temperatures and chemical abundances using ELODIE spectra of the system system V2154 Cyg delayed for reasons beyond our will. We will seek to establish a new collaboration with Spain on this subject in order to obtain the parameters. The theoretical work is completed and ready to be applied by J. Fernandes, from the University of Coimbra, Portugal. We do not apply for further funding from the LEA and will seek to complete in 2009 the started studies.

We wish to thank the organizers of the program LEA Astro-PF for the financial assistance which alllowed to bring together researchers from different countries around an international observing campaign.

D Advanced stages of stellar evolution and interstellar medium

Planetary Nebulae

LEA participants from the Polish side: Ryszard Szczerba, Slawomir Gorny
LEA participants from the French side: Grazyna Stasinska

We have continued a long-term international collaboration on the most oxygen-poor planetary nebula, which involves over 10 researchers from 6 countries. We have gathered our multiwavelengths observations obtained over 4 years. We have constructed a series of photoionization models reproducing observed line intensities in the UV, optical and infrared: the aim is to derive the chemical composition of this nebula. We plan submission of the paper in 2009.

We have performed a thorough analysis of the chemical abundances and central star properties of planetary nebulae in the Galactic bulge, after gathering the largest sample of high quality data, with literature data supplementing our own observations. We have been able to separate planetary nebulae belonging physically to the galactic bulge from those seen in the direction of the bulge but belonging to the Galactic disk population. We have shown that those population of planetary nebulae have different abundances.

Publications

Chiappini, C.; Gorny, S.; Stasinska, G.; Barbuy, B. , 2008arXiv0812.0558C Abundances in the Galactic bulge: results from planetary nebulae and giant stars (MNRAS in press)

Gorny, S.; Chiappini, C.; Stasinska, G., Cuisinier,F, 2009, Planetary nebulae in the direction of the Galactic bulge: On nebulae with emission-line central stars" (MNRAS in press)

Post-AGB Objects

LEA participants from the Polish side: Szczerba, Gorny, Schmidt, Siodmak
LEA participants from the French side: Stasinska

We are preparing an update of tour Torun catalogue of post-AGB and related objects, including a full description of „possible post-AGB objects". This update will be submitted in 2009.

Carbon chemistry in interstellar clouds

LEA participants from the Polish side: Szczerba, Schmidt, Kazmierczak, Jastrzebska
LEA participants from the French side: Gerin

This collaboration started recently. Absorption line data obtained at the IRAM 30m telescope have been analysed, and a poster has been presented at the "Molecular Universe" conference in may 2008 in Arcachon. The analysis shows that the radicals CCH and c-C3H2 are as well correlated in the studied sources than in the diffuse, high latitute clouds, previously studied by Liszt and Lucas. This work extends the range of physical conditions where the orrelation is valid to transluscent clouds. A joint paper is in preparation.

E Dense matter, compact stars and gravitational radiation

Compact stars as sources of gravitational waves

LEA participants on the Polish side: Rosinska (Gondek) Dorota, Bulik Tomasz, Bejger Michal, Izabela Kowalska
LEA participants on the French side: Villain Loic, Gourgoulhon Eric

We have studied properties of binary neutron stars and strange quark stars in the framework of Isenberg-Wilson-Mathews approximation of general relativity. We have studied the impact of the equation of state (EOS) of dense matter and the total mass of the system on the last orbits of inspiral. We have shown that the frequency of gravitational waves at the marginally stable orbit, one of potentially observable parameters by gravitational wave detectors strongly depends on EOS. We have found a formulae describing the dependence of the frequency of gravitational waves at the marginally stable orbit on the compactness parameter for the equal mass binaries for broad ranges of masses.

We have developed the highly accurate relativistic code for differentially rotating neutron stars. We have studied the structure of differentially rotating relativistic stars with a polytropic equation of state. The new spectral code enabled us to strongly improve previous studies done with other codes that suffered from numerical limitations. An important result was the discovery of a parametric transition showing that the structure of the solution space is much more complicated than previously thought (Ansorg, Gondek-Rosinska, Villain 2008)

Publications

Ansorg M., Gondek-Rosi{\'n}ska D., Villain L., The Continuous Parametric Transition of Spheroidal to Toroidal Differentially Rotating Stars in General Relativity, 2008, arXiv, arXiv:0812.3347

Ansorg M., Gondek-Rosi{\'n}ska D., Villain L., Bejger M., The maximum mass of differentially rotating neutron stars, 2008, EAS, 30, 373

Physics of compact stars and black holes

LEA participants on the Polish side: Michal Bejger, Dorota Gondek-Rosinska, Pawel Haensel, Odele Straub, Lulian Zdunik
LEA participants on the French side: Silvano Bonazzola, Brandon Carter, Jean-Louis Cornou, Eric Gourgoulhon, Philippe Grandclément, Micaela Oertel, Jerome Novak, Nicolas Vasset, Loïc Villain, Frédéric Vincent

We analyzed potentially observable phenomena during spin evolution of isolated pulsars, such as back bending and corequakes resulting from instabilities, which could result from phase transitions in neutron star cores. We studied these aspects of spin evolution of isolated compact stars by means of analytical models of equations of state, for both constant-pressure phase transitions and the transitions through the mixed-phase region We studied the fate of rotating stars entering the region of instability calculating the change in radius, energy release, and spin-up associated with the corequake in rotating neutron star, triggered by the instability. The energy release was found to be very weakly dependent on the angular momentum of collapsing star. We developed a model for gamma-radiation outflow from newly-born magnetized quark stars, which can explain some of the cosmological long gamma-ray bursts. Using precise 2-D code we calculated the maximal masses of differentially rotating neutron stars. We calculated the inspiral stage for coalescing neutron-star – neutron-star binary and the associated grawitatonial wave burst. The dependence on the dense matter equation of state was studied. The case of quark-star – quark-star binary was studied and the corresponding observable quantities were evaluated.

We studied the softening effect of hyperons in the core of neutron stars and have done a systematic analysis of the effects of phase transitions in rotating neutron stars, focusing on potentially observable phenomenon of speed up of rotation of pulsars. We also calculated the energy released by this process. Comparing our results with observations could help determine whether, at very high density (between 3 and 6 times the nuclear density), a phase transition occurs, transforming the standard hadronic matter states exotic meson condensate (pions or kaons) or even a plasma of deconfined quarks. Furthermore, we calculated the gamma-ray emission of a hot newborn quark star, rotating differentially, and winding up the magnetic field.

Publications

M. Bejger, J.L. Zdunik, P. Haensel & E. Gourgoulhon : "The energy release--stellar angular momentum independence in rotating compact stars undergoing first-order phase transitions", in "Exotic States of Nuclear Matter", edited by M. Baldo, F. Burgio, H.-J. Schulze & U. Lombardo, World Scientific (2008).

Gondek-Rosinska D., Limousin F., The final phase of inspiral of strange quark star binaries, 2008, arXiv, arXiv:0801.4829

Heyvaerts, J.; Bonazzola, S.; Bejger, M.; Haensel, P. Luminosity of a quark-star undergoing torsional oscillations and the problem of gamma ray bursts, submitted to Astronomy and Astrophysics 2008arXiv0811.1090H (2008)

J.L. Zdunik, P. Haensel, M. Bejger & E. Gourgoulhon : "EOS of dense matter and fast rotation of neutron stars", in "Exotic States of Nuclear Matter", edited by M. Baldo, F. Burgio, H.-J. Schulze & U. Lombardo, World Scientific (2008).

Zdunik, J. L.;Bejger, M.;Haensel, P.;Gourgoulhon, E. Phase transitions in rotating neutron stars cores: back bending, stability, corequakes, and pulsar timing
Astronomy and Astrophysics, Volume 450, Issue 2, 2006, pp.747-758

J.L. Zdunik, M. Bejger, P. Haensel, & E. Gourgoulhon : "Strong first-order phase transition in a rotating neutron star core and the associated energy release", Astronomy and Astrophysics 479, 515-522 (2008).

F Heliosphere and astrospheres, planets

LEA participants from the Polish side: Ratkiewicz, Grygorczuk
LEA participants from the French side: Ben Jaffel

In order to continue our work published in Astronum 2008 we have calculated several models of the heliosphere using our MHD model with the boundaryconditions as in the paper by Baranov and Malama, 1993, 1995 and Wood etal., 2008. Using plasma data obtained from our simulations we have integrated them in the regions between the heliopause and the bow shock in the upwind direction hemisphere. We use those results to interpret the data from Voyagers observations and be able to predict the interstellar magnetic field. We continue the work on the Chombo model of the neutral hydrogen distribution function interacting with the solar wind and interstellar plasma via charge exchange.

Publications

Ratkiewicz, R., L. Ben-Jaffel, and J. Grygorczuk (2008), What do we know about the orientation of the local interstellar magnetic field?, ASPCS (Astronum), 385, 189-194

Ratkiewicz, R., and J. Grygorczuk (2008), Orientation of the Local Interstellar Magnetic Field Inferred from Voyagers Positions, GRL 35, L23105, doi:10.1029/2008GL036117

Conferences and workshops co-sponsored by the LEA Astro-PF in 2008

1)

Workshop organized by Grazyna Stasinska (LUTH, Observatoire de Paris) and Ryszard Szczerba (CAMK, Torun)

"Planetary nebulae near and far"
Sasek Maly (Poland) Sunday 24 August – Thursday 4 September 2004

This 11-day workshop gathered 15 participants with the aim of advancing on existing collaborations and fostering new ones in fields related to planetary nebulae research. Mornings were devoted to seminars and then outdoor activities. Afternoons and evenings to work in small groups .
A public conference was organized on one of the evenings for the habitants of the village and tourists.

Schedule of Seminars

* Monday 25
9-9h40: Christophe Morisset: A full (stellar and nebular) model for the PN IC418
9h40-10h20: Agata Karska: infrared photometry of Milky Way PNe
10h20-11h: Grazyna Stasinska: Extragalactic planetary nebulae and HII regions: the case of the galaxy NGC 3109

* Tuesday 26
9-9h40: Sergio Simon-Diaz: Steps towards probing the ionizing fluxes of massive stars using HII regions
9h40-10h20: Natasza Siodmak: HST observations of proto-planetary nebulae
10h20-11h: Valentina Luridiana: The role of Lyman continuum pumping in ionized nebulae

* Wednesday 27
9-9h40: Marcin Hajduk: The planetary nebula M 2-29: an occultation event in the nucleus
9h40-10h20: Krzysztof Gesicki: The planetary nebula M 2-29: unusual structure and kinematics
10h20-11h: Natalia Vale Asari: The SEAGAL Project (Semi-Empirical Analysis of Galaxies)

* Thursday 28
9-9h40: Mirek Schmidt: Circumstellar shells around carbon stars: an introduction
9h40-10h20: Marta Pulecka: Thermal structure of circumstellar shells around carbon stars
10h20-11h: Matthias Steffen: Modeling the evolution of Planetary Nebulae (I)

20-...: public talk by Grazyna Stasinska on "Why are stars important to us?" (in Polish)
followed by observation of the night sky (weather permitting)

* Friday 29
9-9h40: Sergio Simon-Diaz:The chemical composition of the Orion star forming region: stars, gas, and dust
9h40-10h20: Ralf Napiwotzki: SBS 1150+599A and Nova Vul: Two weired close binary central stars
10h20-11h: Matthias Steffen: Modeling the evolution of Planetary Nebulae (II)

* Monday 1
9-9h40: Grazyna Stasinska: Can retired galaxies mimic active galaxies?
(or when planetary nebulae meet the physics of galaxies)
9h40-10h20: Natalia Vale Asari: The mass-metalicity relation in the SDSS revisited
10h20-11h: Christophe Morisset: 3MdB, the Mexican Million Models Database:

* Tuesday 2

9-9h40: Ryszard Szczerba: PAHs in the envelopes of evolved stars and in the ISM
9h40-10h20: Ralf Napiwotzki: Galactic populations of white dwarfs and post-AGB stars
10h20-11h: Miguel Cervino: Probabilistic paradigm in the interpetation of the integrated light of stellar systems

* Wednesday 3
9-12: informal presentations of work achieved during the workshop

Reports by the participants

Wanda Cacha

During the Sasek Workshop I worked mainly with Mirek Schmidt and Marta Pułecka, who introduced me to their code, which models rotational lines for molecules present in circumstellar envelopes of carbon stars. They told me about problems they encountered during the modelling, and some possible ways of solving them (adding vibrational transitions to the model). We also found out, that the photoionization code, CLOUDY, is able to compute the radiation transfer for PDR regions with the usage of chemical reactions occuring therein, so we asked Christophe Morisset to give us a small introduction to the code.

Miguel Cerviño

During my stay in Sasek I have meet Valentina Luridiana and Sergio Simón, and we have been working in a paper about fluorescence by Luridiana et al. We have also make a preliminary draft for related issues, like the inclusion of current model atmospheres that produce different ionizing fluxes in evolutionary synthesis codes.

Also I have meet Chirstophe Morriset and Valentina Luridiana and we have stablish preliminary ideas about possible explotation of the Mexican photoionization database and it application to galaxies as a composition of individual Hii regions.

Finally, the aspect related with planetary nebulae has been vey iseful to me, since I have not several ideas for the inclusion of planetary nebulae evolution in my synthesis code.

Marcin Hajduk

During our stay in Sasek we presented our recent results on the central star (me) and planetary nebula (Krzysztof) M2-29. We revised our article (A&A Letters) on M2-29 central star, which was re-submitted to the referee. We made corrections in the text and in the figures, and added one new figure, requested by the referee, of the optical spectrum of M2-29. Me and Krzysztof Gesicki worked on the text of the article. We discussed with Ralf Napiwotzki possible related objects. Hot white dwarf EGB 6 shows some similarities to M2-29. We also discussed relationship between M2-29 and iron deficient Post-AGB stars. This may be important in constraiting the origin and nature of the complex structure of M2-29: its unresolved, inner nebula and probably dusty, circumbinary disk.

Valentina Ludidiana

The workshop has been an opportunity to discuss with M. Cerviño and S. Simón-Díaz the last details of our work on "Fluorescent excitation of Balmer lines in gaseous nebulae". A discussion with R. Szczerba has also been very useful to clarify the role of dust in the context of the mechanism being studied.
The paper has just been submitted.

M. Cerviño, S. Simón-Días and me also planned future collaboration on two related issues:
a) the inclusion of massive star atmospheres with shocked stellar winds in synthesis models, with the aim of providing a new generation of synthesis models for the study of stellar populations and photoionized regions, and
b) the study of fluorescent excitation of helium lines in gaseous nebulae, with the aim of estimating the impact of fluorescent excitation on primordial helium determinations.

M. Cerviño, C. Morisset and I also discussed on Dr. Morisset's 3Mdb project, focusing on two issues:
a) how to resolve the bias in the 3Mdb predictions which appears as the result of a non-uniform distribution of models in the parameter space of the database, a feature which is intrinsic to the genetic algorithm followed.

b) how to apply the 3Mdb results to the study of the emission of ensembles of HII regions, a topic that is currently being studied by my and Dr. Cerviño's PhD student M. Villaverde.

Christophe Morisset

1) Decontamination of the M43 images due to the emission of M42: in a collaboration with Sergio Simon-Diaz, I'm involved in the use and development of the pseudo-3D photoionization code Cloudy_3D. We aim to use this code to perform a detailled 3D model for the HII region M43. This region is very close to the bright M43 Orion nebula and part of the radiation measured in the M43 images actually comes from M43. We discuss a strategy to take this contamination into account.
2) Work on the 3MdB: I'm developping a photoionization model database (3MdB: the Mexican Million Models database) and we started in working with this new unique tool with Grazyna Stasinska and Natalia.We identify a source of bias i nthe use of the database and began to work on its resolution. I also had fruitable discussions on the use of the 3MdB with Miguel Cervino and Valentina
3) I recently did (with Leonid Georgiev, UNAM) a very detailed stellar and nebular model of the PN IC418. The model reproduce all the observations. The IR dust emission is not swell fitted because the purpose of the published models was not the study of the dust. I started in Sasek a collaboration with Ryszard Szczerba to use the unique model I obtained to put strong constraints on the dust composition and abundance and to see how this composition is in agreement with what we learned for the star and the nebula.
4) I also interacted with Matthias Steffen on the dynamical evolution of the PN IC418, with Ralk Napiwoski on the star of the halo nebula and help Mirek, Wanda and Marta in the installation and use of the photoinization code Cloudy.

Ralf Napiwotzki

Napiwotzki with Szczerba/Schmidt:

The main project during the workshop was comparing results of my population synthesis programme with the Torun catalogue of post-AGB objects. The synthesis programme was developed to describe the Galactic populations of white dwarfs (thin disk, thick disk, halo) and is calibrated using white dwarf observations. This synthesis programme
was extended to include a detailed treatment of post-AGB stars and central stars of planetary nebulae. The comparison of observed and simulated samples revealed agreement and disagreement. An observed dip in the spectral distribution around spectral type A is well reproduced by the models. However, the simulations predict a large number of post-AGB stars of the thick disk and halo populations, which is *not seen* in the observed catalogue. The most likely reason for this discrepancy are selection effects. Most post-AGB objects in the catalogue are selected due to their infrared properties not included in the simulations so far. We started to implement a realistic treatment of the infrared emission from circumstellar material. Test runs showed that this will allow a more realistic simulation of the observed sample. Work on this will continue after the workshop.

Involvement in other projects reported by others :
- Hajduk/Gesicki: Interpretation of the M 2-29 system and comparison with potential counterparts
- Stasinska/Morisset SBS1150

Mirek Schmidt

During the workshop we discussed on the ongoing project entittled "Profile variation of CO rotational lines during AGB evolution"(Szczerba, Steffen, Schmidt).
We plan to use existing time-dependent hydrodynamical models of the dust shell for the computation of profile variation of CO rotational lines.The purpose of consultations was the choice of proper numerical tools, i.e. radiative transfer method for the efficient solution of the problem. Particularly, we expect interesting results in two phases of the AGB evolution: short period after thermal pulse and transition phase to post-AGBphase.

Second project is also connected with the PPN phase of evolution and is entittled "Convective models of post-AGB supergiants" in collaboration with Arunas Kucinskas, Matthias Steffen, Ryszard Szczerba and Miroslaw

Schmidt. The aim of the project is computation of the 3D hydrodynamical models of supergiant's atmosphere. We expect that application od these models to the observed spectra will allow more precise estimation of the surface gravities – necessary condition for the precise estimation of stellar masses in the PPN phase.

With Marta Pulecka and Wanda Cacha we practised running the code for thermal structure computation of circumstellar shells of AGB stars. From Christophe Morisset we learned about the code CLOUDY and about his pseudo-3D CLOUDY approach to the computation of photoionization structure of the Planetary Nebula.

Sergio Simon-Diaz

In collaboration with G. Stasinska, C. Morisset, R. Szczerba

H1013: A suposedly metal rich HII region in M101
H1013 is an HII region located in the inner part of the spiral galaxy M101.The optical spectrum of this ionized nebula was studied by Bresolin (2007), who derived an oxygen abundance log(O/H)+12=8.57 dex. However, this HII region was expected to be metal rich.
In view of this result, H1013 could be a candidate of metal rich HII region in which the abundance derived using optical lines is affected by the biases commented in Stasinska (2005). To corfirm or discriminate this hypothesis we obtained a IRS@Spitzer spectrum of this ionized nebula. A proper combined analysis of the IR and optical spectra require a photoionization model of the nebula.
During this workshop we have been working in this photoionization model, using the information given the optical and IR spectrum, along with narrow band filter imagery of the nebula. For this study we use the photoionization code CLOUDY (Ferland et al. 1998) and the IDL tools CLOUDY-3D developed by C. Morisset.

Grazyna Stasinska

-with Agata Karska: plans for her future phd
-preparation of open public conference “dlaczego gwiazdy sa dla nas wazne?”
- with Sergio and Christophe: the case of a supposedly metal-rich HII region
- with Natalia: SDSS/SEAGAL issues
- with Christophe and Natalia: work on 3MdB (the Mexican Million Models database): identification and fixing of biases
- with Christophe, Ralf, Ryszard and Mathias Steffen:
The chemical composition of SBS 1150+599A /PNG 135.9+55.9, the most-oxygen poor planetary nebula
We have continued our long work of photoionization modelling for this object, in order to determine its chemical composition. We have started writing the paper.
We have also interacted with Mathias Steffen (a member of a « rival » team, working on dynamical aspects of this object.

Ryszard Szczerba

I worked on two projects (plus 3 just started projects that are described by C. Morisset and M. Schmidt).

The first project, in collaboration with C. Joblin, O. Bernie and C. Szyszka, is devoted to investigation of PAH features in the envelopes of evolved stars and in the interstellar medium. During workshop, we were able to introduce necessary changes and sent the proof for publication in Astronomy and Astrophysics. Title of this paper is: "The carriers of the mid-IR emission bands in planetary nebulae reanalysed. Evidence for a link between circumstellar and interstellar aromatic dust."

The second project is related to the further development of Torun catalogue of post-AGB objects. We were able to include into our catalogue the optical spectra form PhD thesis of Olga Suarez and add data for more than 100 candidate post-AGB objects. The full paper describing this version of the catalogue is in the final stage of preparation and should be sent to Astronomy and Astrophysics in September/October.

Natalia Vale Asari

During this workshop, Grazyna Stasinska and I continued our work on the SEAGal project (Semi-Empirical Analysis of Galaxies).

Project 1: Introduction to the computation of photoionization models.
Drs. Grazyna Stasinska and Christophe Morrisset helped me install, compile and test the photoionization code CLOUDY. This will be very helpful for future works, e.g, estimating average abudances of star-forming galaxies.

Project 2: Investigation of weak emission lines in the Sloan Digital Sky Survey.
The quality of SDSS spectra is good enough for statistical studies and averages over many objects, but may be less than ideal to study features in individual objects. For instance, the investigation of weak emission lines for individual galaxies requires very high signal-to-noise observations, much higher than the obtained in most SDSS observations. However, when we sum over many spectra of objects of similar physical properties, the result can be quite revealing, in that weak emission lines can be seen where none could be easily distinguished in individual spectra.

We have obtained summed spectra of star-forming galaxies, grouping them by their mass and nebular metallicity. We have checked their emission-line spectra and searched for weak emission lines. We found [Ne III]3869 and [Fe VII]4893,4989 lines, but not much more information that has not been already published by other groups. Therefore, we decided to abandon this project for now and we may use co-added spectra in the future in other works.

Project 3: The mass-metallicity relation in the SDSS.
There have been some studies on the mass-metallicity relation (MZR) in the SDSS, and they have reached very different conclusions regarding which physical processes influence this relation. For instance, Tremonti et al. (2004) conclude that outflows and galactic winds are the most probable drivers of the shape of the MZR, whereas Ellison et al. (2008) claim that star formation efficiency alone explains the MZR. Other possible explanations are infall of pristine matter into galaxies (e.g., Finlator & Davé 2008) and variable integrated galactic initial mass function (e.g., Köppen, Weidner & Kroupa 2007)

With our population synthesis code STARLIGHT, we can recover the time-dependent star formation history and chemical evolution of a galaxy. So, we can look at the evolution of the MZR with time, and we may be able to distingish among those various scenerios. In this workshop, we started to look at the MZR for different ages in a very quick way, and we already found some evidence that the MZR relation was steeper in the past and offset to smaller metallicities with respect to the present MZR.

2)
International conference organized by Krzysztof Gozdziewski (Torun University) and Jean Schneider (LUTH, Observatoire de Paris)

Extrasolar planets in multi-body systems: Theory and Observations
August 25-29, Toruń, Poland

This 4-day conference gathered about 50 participants from various countries.

Programme – Monday, August 25
09:00 – 09:30 Conference Opening

— Session I — Chair: Matthew J. Holman — observations (RV) —
09:30 – 10:15 Jason T. Wright A Survey of Multiple Planet Systems
10:15 – 10:40 Hugh R. A. Jones The Anglo-Australian Planet Search
10:40 – 11:05 Nader Haghighipour The Long-Term Stability and Prospects of the Detection of Terrestrial and Habitable Planets in Multiplanet and Multiple Star Extrasolar Planetary Systems
11:05 – 11:30 Coffee break & Poster Session

— Session II — Chair: Jason T. Wright — observations (RV) —
11:30 – 12:15 Stéphane Udry Systems with Neptune-mass planets and super-Earths
12:15 – 12:40 Roman V. Baluev Optimal planning of radial velocity observations for multi-planet extrasolar systems
12:40 – 13:05 Wesley A. Traub Earth detection by SIM-Lite and RV in multi-planet systems
13:05 – 15:00 Lunch

— Session III — Chair: Yann Alibert — planet formation —
15:00 – 15:45 John C. B. Papaloizou Orbital Migration and the formation of systems of super earths
15:45 – 16:10 Paweł Artymowicz Corotational flows and migration type III in binary environment
16:10 – 16:35 Ewa Szuszkiewicz Dynamical architectures of planetary systems induced by the orbital migration
16:35 – 17:00 Coffee break & Poster Session

— Session IV — Chair: Gregory Laughlin — dynamics —
17:00 – 17:45 Jacques Laskar Chaotic diffusion in planetary systems
17:45 – 18:10 Vacheslav V. Emel'yanenko Migration of the outermost objects in planetary systems
18:10 – 18:35 Daniel Malmberg Is our sun a Singleton?

Programme – Tuesday, August 26

— Session V — Chair: John C. B. Papaloizou — planet formation —
08:45 – 09:30 Yann Alibert Testing planet formation models against observations
09:30 – 09:55 Edyta Podlewska Do we expect to find Super-Earths close to gas giants?
09:55 – 10:20 Artur Gawryszczak Wengen test #4 - comparision of grid and SPH codes on self-gravitating protoplanetary discs
10:20 – 10:45 Coffee break & Poster Session

— Session VI — Chair: Eugene Serabyn — observations (transits) —
10:45 – 11:30 Matthew J. Holman Transits in Multiple-Planet Systems
11:30 – 11:55 Juan Cabrera Search for Super-Earths by timing of transits with CoRot
11:55 – 12:20 Jean Schneider Detecting companions to extrasolar planets using mutual events
12:20 – 12:30 Photo session with Copernicus
12:30 – 15:00 Lunch

— Session VII — Chair: Alessandro Sozzetti — obs. (imaging, RV) —
15:00 – 15:45 Eugene Serabyn High-contrast interferometry and coronagraphy
15:45 – 16:10 Antonio S. Hales Observing Planetary Systems with ALMA
16:10 – 16:35 Nuno Cardoso Santos Planets or stellar spots: diagnostics and tests to single and multi-planet systems
16:35 – 17:00 Coffee break & Poster Session

— Session VIII — Chair: Jacques Laskar — dynamics —
17:00 – 17:45 Gregory Laughlin Dynamics of Multi-Planet Systems
17:45 – 18:10 Alexandre C. M. Correia Stellar wobble caused by di□erent gravitational sources
18:10 – 18:35 Hans Scholl Dynamical stability of an alleged planet at 1 AU in the 55 Cancri system

Programme – Wednesday, August 27

— Session IX — Chair: St ´ephane Udry — obs. (binary stars, RV) —
08:45 – 09:30 Anne Eggenberger Detection and characterization of planets in binary and multiple star systems
09:30 – 09:55 Silvano Desidera The SARG Planet Search
09:55 – 10:20 Maciej Konacki Precision radial velocities of double-lined binary stars and the search for circumbinary planets
10:20 – 10:45 Coffee break & Poster Session

— Session X — Chair: Ji-Lin Zhou — planet formation —

10:45 – 11:30 Wilhelm Kley The formation of massive planets in binary stars
11:30 – 11:55 Matthew J. Payne Formation of the Planets and Debris Disk of HD 69830
11:55 – 12:20 Wladimir Lyra Planet formation bursts in the edges of the dead zone
12:20 – 14:15 Lunch

— Session XI — Chair: Anne Eggenberger — obs. (astrometry) —
14:15 – 15:00 Alessandro Sozzetti Multi-Planet Systems Characterization with Micro-Arcsecond Astrometry
15:00 – 15:25 Tristan R¨ oll Astrometric search for extrasolar planets in stellar multiple systems.
15:25 – 15:50 Krzysztof G. Hełminiak Astrometry of visual binaries with Adaptive Optics
15:50 – 16:15 Coffre break & Poster Session

— Session XII — Chair: Tatiana A. Michtchenko — dynamics —
16:15 – 17:00 Eric B. Ford The origin of multi-planet systems
17:00 – 17:25 Jocelyn Couetdic Dynamical constrains for the orbital elements of radial velocity planetary systems
17:25 – 17:50 Dimitri Veras Planet Scattering and Extrasolar Planets on Very Wide Orbits
19:00 Conference dinner (''Pod Arsenałem'')

Programme – Thursday, August 28

— Session XIII — Chair: Francesco Marzari — obs. (microlensing) —
08:45 – 09:30 Andrzej Udalski Planetary microlensing - exciting results and prospects
09:30 – 09:55 Elke Pilat-Lohinger On the stability of planets in the habitable zone in inclined multi-planet systems
09:55 – 10:20 Andrzej Niedzielski Multiplicity among evolved planetary systems.
10:20 – 10:45 Coffee break & Poster Session

— Session XIV — Chair: Andrzej Udalski — dynamics —
10:45 – 11:30 Tatiana A. Michtchenko Dynamics of resonant and non-resonant planetary systems
11:30 – 11:55 Gwenaël Boué Spin axis evolution of interacting bodies
11:55 – 12:20 Cezary Migaszewski The secular dynamics of generalized coplanar, non-resonant planetary system
12:20 – 14:15 Lunch

— Session XV — Chair: Wilhelm Kley — planet formation —
14:15 – 15:00 Francesco Marzari From planetesimals to planets in binary star systems
15:00 – 15:25 Philippe Th´ebault Planetesimal accretion in Alpha Centauri
15:25 – 15:50 Jens Rodmann Dynamics of dust particles in binary systems
15:50 – 16:15 Coffee break & Poster Session

— Session XVI — Chair: Eric B. Ford — dynamics —
16:15 – 17:00 Ji-Lin Zhou Formation and tidal evolution of hot super-Earths in multiple exoplanet systems
17:00 – 17:25 Jade Bond Chemical and Dynamical Modelling of Terrestrial Planet Formation.
17:25 – 17:50 Adri ´an Rodr´ıguez Colucci Hot Jupiter and Super-Earth Tidal Evolution
17:50 – 18:15 Conference summary
19:00 Excursion to the Piwnice Observatory

Excerpts of the report on the conference (to be published in the quarterly of Polish Astronomical Society *Postepy Astronomii*)

The event was devoted to one of the most current, popular and contemporary themes intensively developed in Astronomical research – the search for extrasolar planets. It was the first big scientific conference on this topic in Poland.
The idea for the conference was actually from Jean Schneider of the Paris-Meudon Observatory, where the undersigned had the pleasure to have a working visit in the winter of 2006 and 2007. Jean Schneider is a passionate researcher of extrasolar planets. One of the tangible signs of his passion is the Encyclopaedia of Exoplanets (http://exoplanet.eu). […]. When working in Meudon, we talked about a

workshop among dozens of people who would be dedicated to a special class of planetary systems, consisting of many objects. […]The problem, is the extraordinary diversity of these multiple systems. Jean argued that the conference on multiple systems is needed as a summary of existing knowledge and a scientific discussion forum. Since we expected interest of astronomers from France and Poland, we informed of the idea Prof. Grazyna Stasinska from Meudon and Prof. Pawel Haensel from CAMK, who are the coordinators of the French-Polish cooperation in the field of Astrophysics (the so-called AstroPF-LEA). Both were very receptive from the beginning to the idea of the workshop, and offered financial support. Especially the mental support of Prof. Grazyna Stasińskiej was essential for the project to see the light. Eventually, Jean suggested that the conference was held in Torun, so that the event may become a part of the promotion of our city. Taking also into account the fact that Copernicus, the discoverer of the architecture of the Solar multi planetary system was born in Torun, it would be difficult to think of a better location for this scientific meeting.
[…]
One of the most important stages of the conference is the setting up of a Scientific Committee, whose task is to care about the high level of scientific lectures and conferece materials. The Scientific Committee meetings of our conference were true astronomical figures: the pioneers of the field, Geoffrey Marcy (University of Berkeley, USA), Michel Mayor (University of Geneva), Alexander Wolszczan (Penn-State University, USA) - discoverer of the first planet outside the Solar System; John Papaloizou (University of Cambridge, United Kingdom), creator of the modern theory of the formation of planetary systems and Sylvio Ferraz - Mello (Brazil), who is one of the best specialists in the field Of ceslestial mechanics.
[…]
The material of the conference can be accessed at www: / / exoplanets.astri.umk.pl). The proceedings will be published by the EAS

Krzysztof Goździewski