Astronomical Institute
Academy of Sciences of the Czech Republic

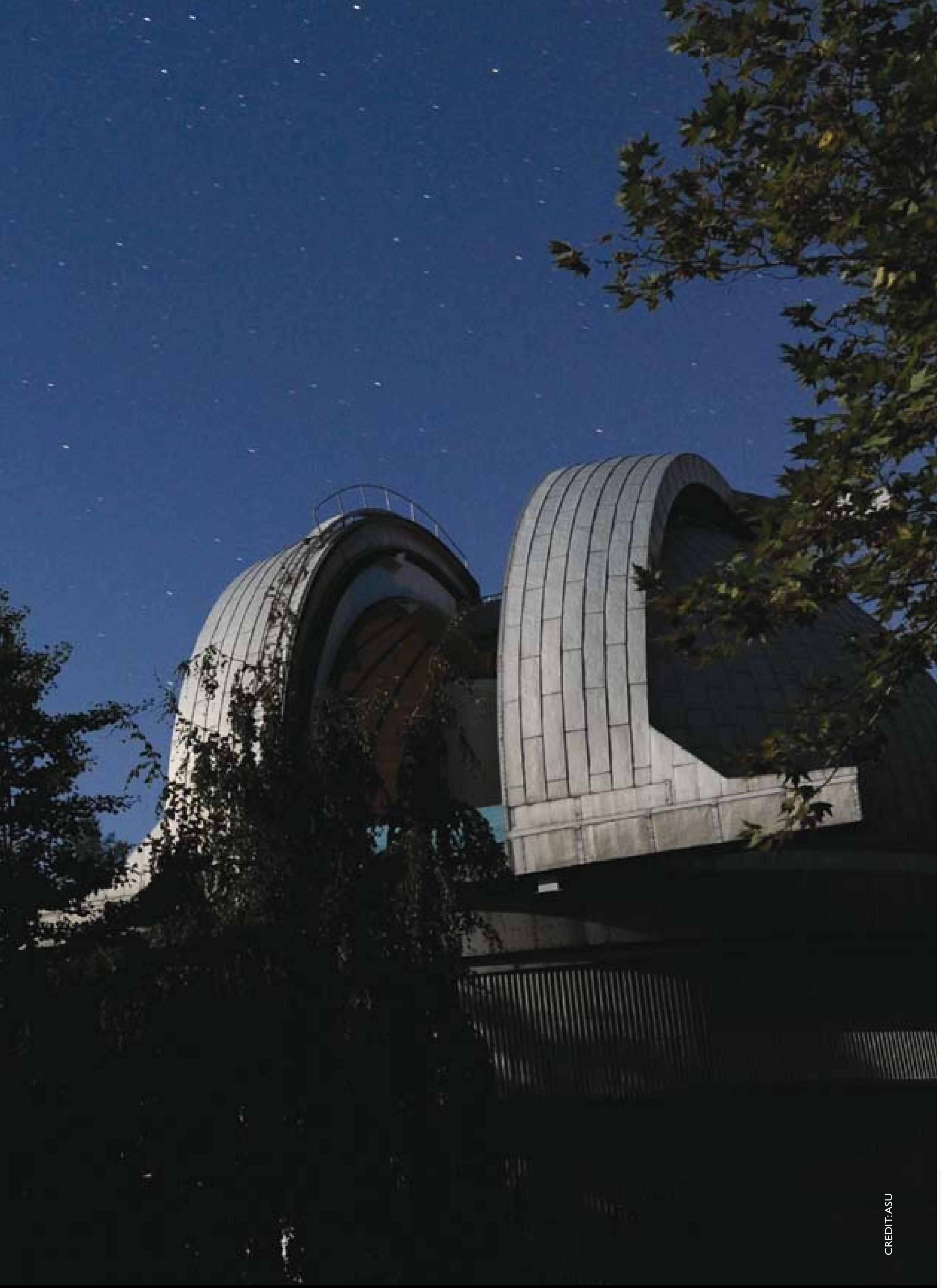
ACTIVITY REPORT

2011–2012

Astronomický ústav AV ČR

Perek 2m Telescope in Ondřejov.

CONTENTS



CREDIT: ASU

The dome of Perek Telescope.

FOREWORD

Vladimír Karas, the Director of the Astronomical Institute.

A long time ago, astronomy became the earliest classical science to develop an observational basis to prove or disprove theories about the processes shaping cosmic bodies and the Universe as a whole. To this end the development of highly sophisticated instrumentation has been crucial, allowing astronomers to carry out precise observations and quantify and record results. In addition to this empirical approach, another equally important aspect of this field has been the tight relationship with mathematics, which provides the basis for deeper understanding of the origin and evolution of cosmic systems. Astronomy was the first to develop and employ procedures that are now routinely accepted by other branches of science.

Presently, astronomers are highly trained in mathematical methods, physics, and computing, as well as in modern technology. These skills are quite necessary as scientific discoveries are not well planned, but rather occur as coincidences or opportunities to define future directions of research for those who are prepared to recognize newly emerging ideas. The discovery of the cosmic microwave background radiation is a clear example of an incidental finding that shaped our view of cosmic history by supporting the hypothesis of the Big Bang.

Understanding how the Universe functions and evolves, what our role is in it, what will be the future of stars, of our Sun, and of the Solar System are clearly the main motivations for the endless efforts of astronomers. These questions also motivate new generations to learn and create an enormous interest in the general public. But does basic research in astronomy provide also some kind of direct benefit to society? In this context the issue of technical innovations and corporate spin-offs has become a fashionable topic of discussions.

Indeed, numerous practical applications of "blue-sky" astronomy research do exist and are well known: current communication methods of today owe a lot to radio astronomy research beginning several decades ago and helping to develop techniques of transmitting, compressing, detecting, and decoding weak signals. This laid the basis for modern wire-less technology.

Construction of ever bigger telescopes and ever more sensitive detectors is motivated by an unending hunt for photons from the most distant galaxies, quasars and other faint objects. Clearly this is useful and relevant in numerous other areas of technology development aside from astronomy. Astronomers realized the importance of charge-coupled devices (CCD) for imaging, and these detectors are now present in all digital cameras. Likewise, active optics has been greatly improved in recent years to achieve amazingly sharp images and remove the degrading effects of the atmosphere; the same technique is now employed in other areas of image processing.

X-ray astronomy studies reveal dense compact stars and black holes, as gas becomes enormously accelerated and heated due to overwhelming gravitational attraction of these bodies. This gas radiates much of its energy in the form of high-energy radiation, i.e. X-rays and gamma-rays. However, the wavelength of this radiation is so short that it cannot be focused by ordinary telescopes, which are suitable for much longer wavelengths of optical light. Astronomers have mastered techniques of X-ray imaging as well as high-dispersion studies of grating spectra. This knowledge is useful in many types of application ranging from medicine to security. One could continue endlessly discussing various everyday applications of astronomical research. However, the few examples given above should be ample to understand that, indeed, basic research – in astronomy but not only in this field – has brought people a vast amount of valuable knowledge and experience.

Motivated by curiosity, fundamental knowledge is equally useful as a search for solutions to specific problems: not only that basic science has provided foundations for electronics including computers, transportation including rockets and satellites, communication technology including the Internet, and so on and so forth, but even more importantly it creates deep cultural connections and provides a broad perspective about the Cosmos which surrounds us. Indeed, Heinrich Hertz did not discover electromagnetic waves with the aim of constructing a radio, instead, he was captivated by the beauty of theoretical physics, which describes electromagnetism in terms of Maxwell's equations.

Firm observational evidence from data acquired by ground based telescopes and detectors on-board satellites are essential for astronomical research, as well as the whole of science, as without them research would quickly lose direction and lead to useless speculations.

At the Astronomical Institute, we participate in the effort to reveal fundamental facts about our Universe and its diverse constituents, including our Sun and billions of other suns, planets and asteroids, as well as enigmatic black holes and neutron stars. We do it because we recognize these topics as immensely important and also because we are confident that our research, like any other high-quality basic research, is equally useful for our society as the search for direct solutions to practical tasks of everyday life.

Curiosity often helps us to find new views on old problems.

II EVENTS OF THE LAST TWO YEARS (2011–2012)

International evaluation of the Institute took place in 2011 within the frame of periodic assessment of all the academic institutes in the country. The elaborate procedure has considered the scientific output (excellence), international collaboration, education and PR activities, and the infrastructure of the organization. Our Institute was rated as excellent in context of the whole Academy of Sciences. This then had a direct impact on our budget in 2012.

In 2012, a new five-year term of the Institute Council commenced and new council members were elected. The acting Chair of the Council is Jiří Borovička who continues successfully in this position from the previous period. Director of the Institute Petr Heinzel has finished his second term and the new director, Vladimír Karas, was appointed by the Academy of Sciences of the Czech Republic. His first term started in May 2012.

A new building – the Astronomical Pavilion – was built for the Prague section of the Institute, where mainly the Department of Galaxies and Planetary Systems is situated. The official opening took place on July 19, 2011 with the participation of the President of the Academy of Sciences, vice-President and other guests.

In Ondřejov, the ALMA (Atacama Large Millimeter/submillimeter Array) regional node continues its activities and it participates in preparations of solar observations. In this way the Institute takes an active role in the largest ground-based astronomy project of the decade that represents a major new facility for observations in new windows of the radio spectrum with unprecedented sensitivity and resolution. Our node supports the community in the Eastern European area, and also welcomes visitors from other regions. In February 2012, the ALMA winter school was organized in Prague in the new premises of the Institute.

Astronomical pavilion – the new building of the Institute in Prague.

The Institute has signed an agreement between the Niels Bohr Institute in Copenhagen and ESO regarding the participation in observations at La Silla Observatory using the Danish 1.54m telescope. With substantial financial help from the Academy of Sciences, the modernization of the telescope's control system has been achieved, and currently observations of small solar-system bodies, as well as stars, are carried out remotely from the Czech Republic.

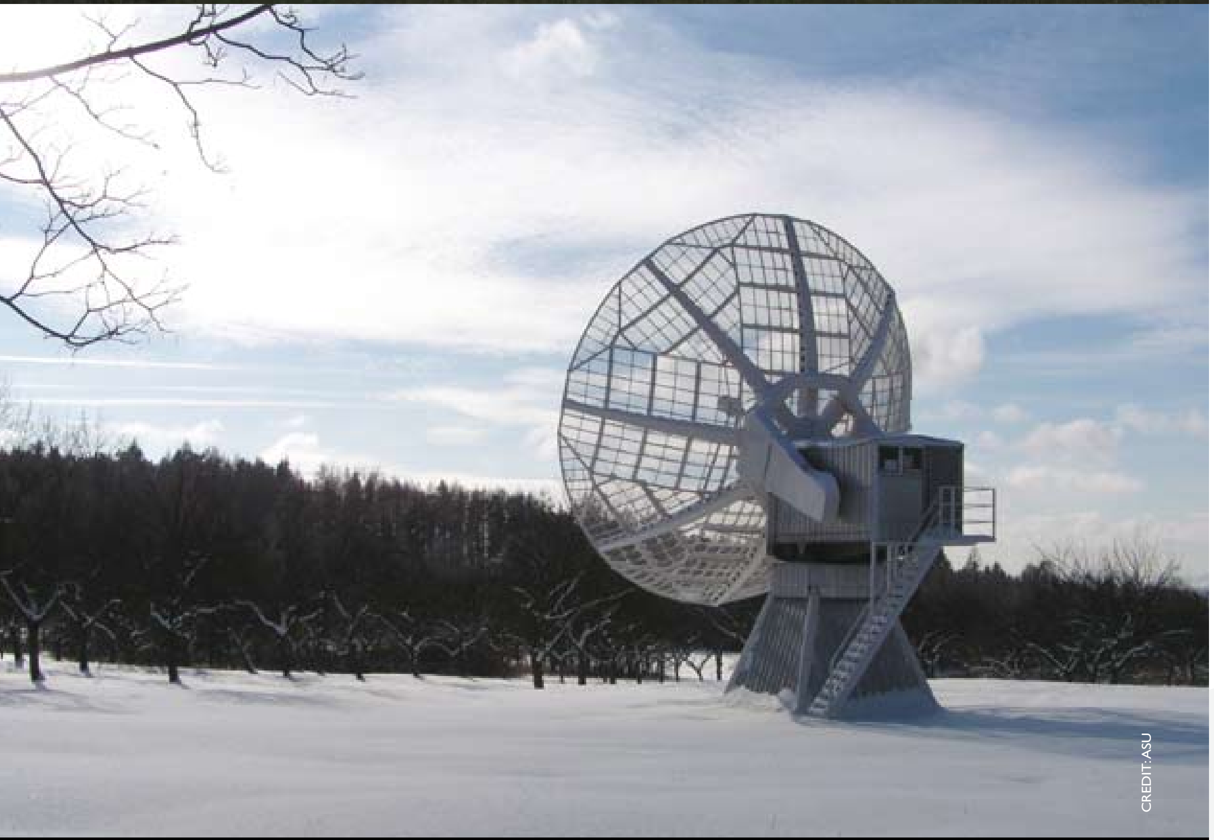
The Institute has been involved in the European Association for Solar Observations (EAST), the organization that is going to build the European Solar Telescope equipped with a 4-meter mirror. The design phase was finished in 2011 with active participation from the Institute and supported by the FP7 program of the European Union. We have also been involved in the development and construction of currently the largest European solar telescope GREGOR (diameter 1.5 m), which was inaugurated at Teide Solar Observatory (Tenerife) in May 2012.

The Institute has continued its involvement in various space projects, namely those related to European Space Agency (ESA). In October 2011, ESA approved the Solar Orbiter

Astronaut Andrew Feustel with the "Czech astronaut" Krtek. Educational project "To the Space with Krtek".

CREDIT: P. HORÁLEK

Noctilucent mezospheric clouds of water ice crystals seen in Ondřejov on a summer night in 2012.



CREDIT: ASU

Solar radar watches the Sun day by day from sunrise to sunset.

The dome with the 1.54m telescope at La Silla ESO Observatory in Chile.

(the M2 category mission) and the work on phases C/D of the satellite construction started. We have participated in three international consortia to build the scientific payload instruments METIS (UV coronagraph), STIX (hard X-ray telescope) and RPW (in situ radio plasma-wave detector). The launch is expected in 2017. Also the formation flight project Proba-3, with a large externally occulted coronagraph, is on track, now entering the production phase. The Institute closely collaborates with VZLU in Prague, TOPTEC in Turnov and Max-Planck Institut für Sonnesystemforschung in Germany. We also continue our involvement in Gaia, GOCE, XMM and other ongoing projects of ESA. Recently the CLASP polarimetric mission of JAXA and NASA space agencies was approved, with the Institute's participation.

Celebrating the 45th anniversary of 2m Perek Telescope.

The Institute was extensively involved in PR activities related to the STS-134 space-shuttle mission of NASA to International Space Station, with the astronaut Andrew Feustel on board. A delegation led by the President of the Academy of Sciences was invited to participate in launch activities at Kennedy Space Center in Florida. After the successful mission the astronaut and his family visited our country by invitation of the Academy of Sciences, and Andrew Feustel received the prestigious Academy medal "De scientia et humanitate optime meritis".

In an August 2012 celebration, the Ondřejov 2-metre stellar telescope was named

Perek Telescope, in honour of Professor Luboš Perek, the former Institute's director. L. Perek managed the construction of 2-meter telescope in Ondřejov Observatory in the 1960s, and the telescope was inaugurated in 1967 during the General Assembly of the International Astronomical Union held that year in Prague.

In 2012, the new FP7 Space program on Strong Gravity was evaluated and accepted by the European Commision. Starting from 2013 our Institute will act as an Coordinating Institution and will lead this highly competitive project of the European Union, where our scientists will work jointly with their colleagues in University of Cambridge (UK), Nicolaus Copernicus Astronomical Centre in Warsaw (Poland), University of Cologne (Germany), Third University of Rome (Italy), Spanish National Research Council in Madrid (Spain), and Strasbourg University (France).

Our Institute played a significant role in two large-scale grant projects of the Czech Ministry of Education, Youth and Sport: the Center for Theoretical Astrophysics, which was proposed and lead by the Institute, and the Center of Earth's Dynamics Research, where we took part in the consortium. These projects helped to support a number of PhD students and young scientists at the Institute. Although both were finished with the end of year 2011, the effort to ensure adequate funding for our research, teaching and public outreach continues.

III STRUCTURE OF THE INSTITUTE

The Astronomical Institute of the Academy of Sciences of the country is the foremost astronomy organization in the country. Its major part is located in the village Ondřejov southeast from Prague, where it operates the largest Czech optical telescope and a number of other instruments. The second part of the Institute is located in Prague.

3.1 Scientific Profile and Research Activities

The research conducted at the Institute covers a wide range of topics; from the immediate environs of the Earth to distant galaxies and black holes in their cores. The research activities are carried out in four scientific departments divided into smaller working groups.

Department of Solar Physics

(i) Physics of Solar Flares and Prominences (numerical simulations of plasma processes and radiation transfer in flares and prominences, optical and UV spectral diagnostics, X-ray and radio observations)

(ii) Structure and Dynamics of the Solar Atmosphere (quiet and active regions, sunspots, granules and supergranules, interactions between plasma motions and magnetic field)

(iii) Heliosphere and Space Weather (magnetohydrodynamic numerical simulations of propagation and evolution of coronal mass ejections and other transient disturbances, solar activity monitoring and forecasting; image processing)

Department of Stellar Physics

(i) Physics of Hot Stars (theoretical and observational studies of binaries, early-type stars, Be and B[e] stars, white dwarfs, stellar winds, moving envelopes in general, and stellar pulsations)

(ii) Two-meter telescope group (operation, maintenance and the development of the largest telescope in Czech Republic)

(iii) High Energy Astrophysics (celestial X-ray and gamma-ray sources, cataclysmic variable stars, analyses of ground-based and satellite data, X-ray optics)

Department of Interplanetary Matter

(i) Meteor Physics (physical properties, chemical composition and spatial distribution of meteoroids, physical processes during meteoroid penetration of the atmosphere, meteor observations in optical region)

(ii) Asteroids (rotations, shapes, surface and bulk properties of near-Earth objects, binary asteroids, photometry and astrometry of asteroids)

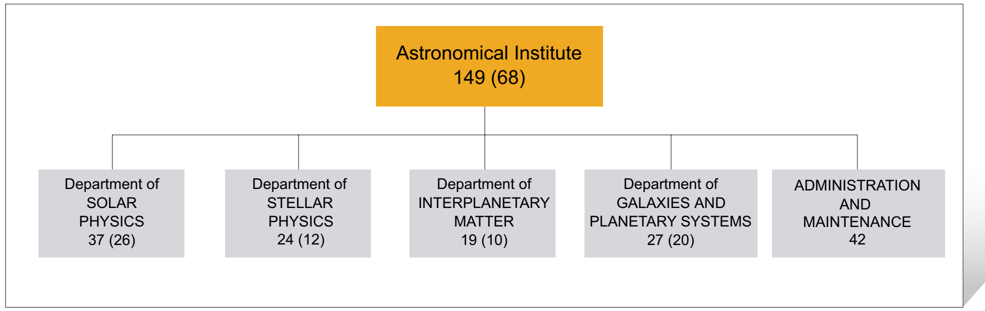
Department of Galaxies and Planetary Systems

(i) Astrophysics of Galaxies (formation of star clusters and evolution of galaxies; comparison of radio, infrared, optical, and X-ray observations with analytical models and computer simulations of gravitational and hydrodynamic processes, kinematics and physical properties of AGN host galaxies)

(ii) Relativistic Astrophysics (active galactic nuclei and Galactic black hole candidates; analysis, within the framework of general relativity, of high-energy X-rays; comparison with observations)

(iii) Planetary Systems (Earth rotation; Earth gravity field; gravity field of the Moon and the planets; resonances and dynamics of the asteroids, Kuiper belt and exoplanetary systems; creation of an astrometric star catalogue, motion of artificial satellites under the influence of gravitational and non-gravitational forces)

More details about activities and recent results of working groups are given in following chapters.



The structure of the Astronomical Institute of the Academy of Sciences of the Czech Republic. The total numbers of staff members in the Institute and in the departments are shown. Numbers of scientists are given in parentheses.

3.2 Executive Staff, Contact Addresses

Director:
Doc. RNDr. Vladimír Karas, DrSc. / phone: (+420) 323 620 113, (+420) 226 258 410 / e-mail: director@asu.cas.cz

Secretary:
Daniela Pivová / phone: (+420) 323 620 116 / fax: (+420) 323 620 117 / e-mail: daniela.pivova@asu.cas.cz

Deputy Directors:
RNDr. Jiří Borovička, CSc. / phone: (+420) 323 620 153 / fax: (+420) 323 620 263 / e-mail: jiri.borovicka@asu.cas.cz

Doc. RNDr. Petr Heinzel, DrSc. / phone: (+420) 323 620 233 / fax: (+420) 323 620 210 / e-mail: petr.heinzel@asu.cas.cz

Mail address of the Institute:
Astronomical Institute, Fričova 298, 251 65 Ondřejov, Czech Republic

Internet:
http://asu.cas.cz

Executive Board of the Institute

Vladimír Karas, the Director of the Institute.

Jiří Borovička, Deputy for Research Activities.

Petr Heinzel, Deputy for Foreign Relations.

Richard Plaček, Head of Administration and Maintenance Staff.

Jiří Kubát, Head of Stellar Department.

Jan Palouš, Head of Department of Galaxies and Planetary Systems.

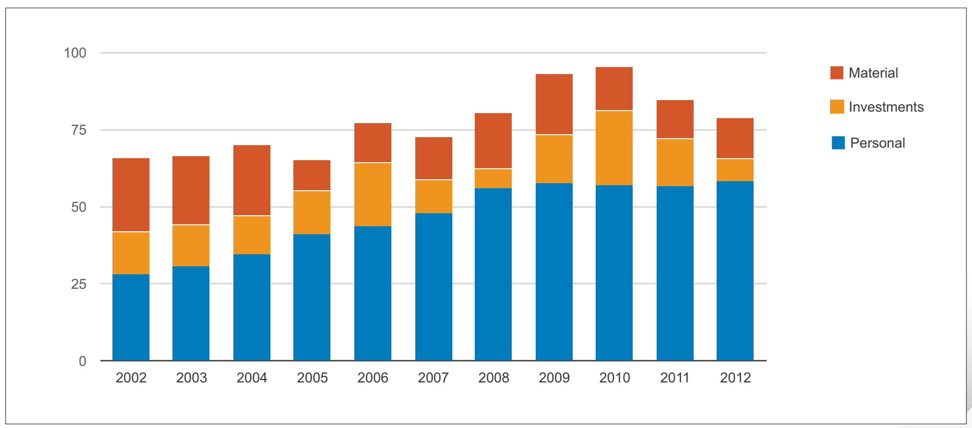
Michal Sobotka, Head of Solar Department.

Pavel Spurný, Head of Department of Interplanetary Matter.

3.3 Council of the Institute

J. Borovička – Chairman, M. Bárta, M. Bursa, P. Heinzel, D. Heyrovský (Charles University, Prague), B. Jungwiert, V. Karas, M. Karlický, E. Marková (Czech Astronomical Society), M. Prouza (Institute of Physics ASCR), L. Šubr (Charles University, Prague), P. Suchan – secretary.

In 2007, the Institute, like the other institutes of the Academy of Sciences, gained new legal status of the so called public research institution. According to the law, the Council of the Institute, consisting of 7 internal and 4 external members, was elected at the beginning of 2012 for a period of 5 years. The Council organized a competition for the position of director of the Institute. Other tasks of the Council include the determination of the main directions of research, approval of the budget of the institute, definition of internal rules, and approval of agreements between the Institute and other organizations.



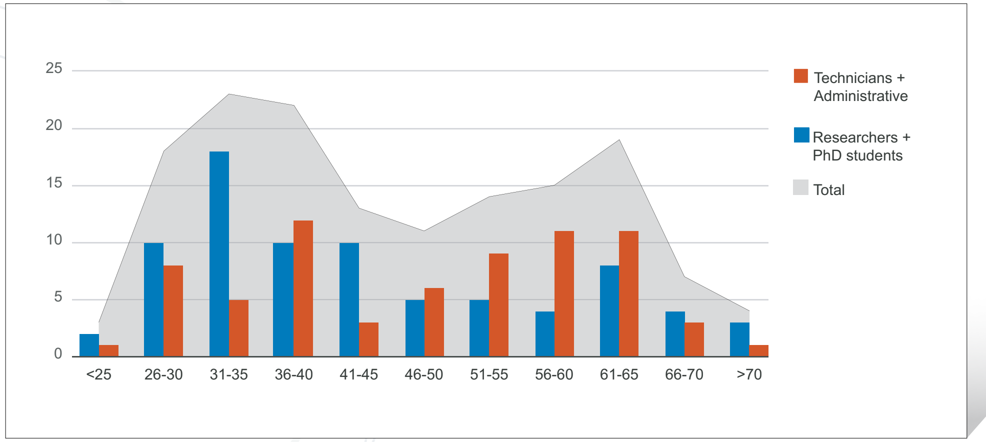
Expenditures of the Institute since 2002 (in millions of Czech Crowns). Foreign grants are not included.

Administration and maintenance staff. From left to right, front line: V. Pácová, J. Bečková, P. Ešner, M. Chytrová, H. Kalibová, Z. Ambrožová, M. Procházková, V. Zámyslická, P. Vodrhánková; second line: J. Nováková, M. Horáková, S. Hauzar, J. Voláková, H. Hanušková, J. Štichová, R. Plaček, V. Kocourek, Z. Pácová; third line: M. Slezák, L. Navrátil.

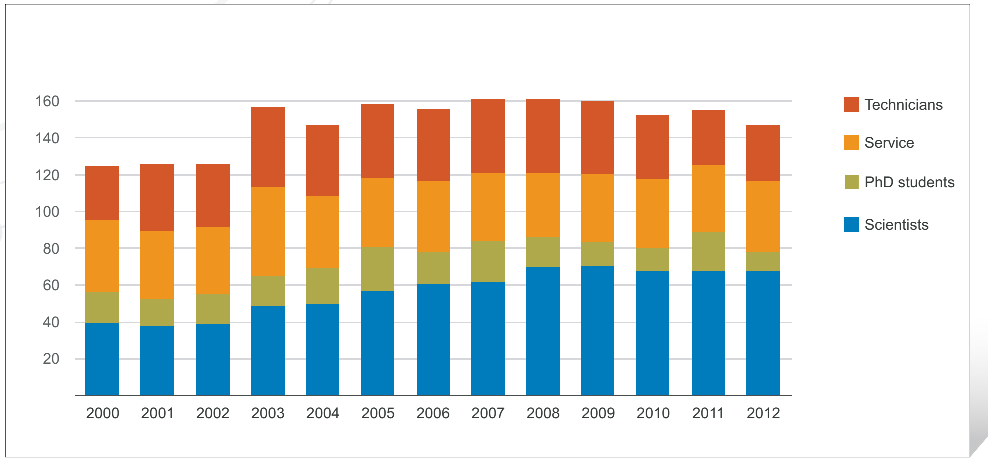
Director's secretariat. From left to right: A. Lišková, N. Karlická, P. Spurný, J. Borovička, R. Plaček, J. Kubát, P. Suchan, V. Karas, D. Pivová, R. Svašková, K. Soldánová. The photograph is taken in front of the portrait of Josef Frič, the founder of the Institute.

3.4 Personnel and Infrastructure

The total number of employees at the end of 2012 was 149, 49 of which were part-time employees. The number of scientists was 68 and there were 11 PhD students. The PhD students are part-time employees. The decrease in recent years is due to the budget cut by



Age distribution of all the employees and of those engaged in astronomical research (2012).



Number of employees at the Institute since 2000.

the Czech government for the whole Academy of Sciences.

Ondřejov Observatory represents a research campus with its own facilities such as a cafeteria, apartment houses etc. Accommodation for visitors is also available. The Prague part resides in a new building (since 2011) which is a part of the campus of the Institute of Geophysics. A major part of the Department of Galaxies and Planetary Systems resides in Prague.

The work of the scientific departments is supported by the library (head R. Svašková), computer-system and network managers (M. Jandová, P. Ryšavý), mechanical workshop (head J. Zeman), and administration and maintenance (head R. Plaček). The administration and maintenance includes a finance section (Z. Ambrožová), personal section (J. Štichová), accounting section (head M. Chytrová), operations and supplies (H. Kalibová), maintenance (head M. Slezák) and cafeteria (head V. Zámyslická).

3.5 Library and Publishing

Head Librarian: R. Svašková; Staff: N. Karlická, K. Soldánová.

The main function of the library is to provide access to sources of informations to all employees of the Institute. The library also serves as the centre of information about astronomical and astrophysical literature for the whole country.

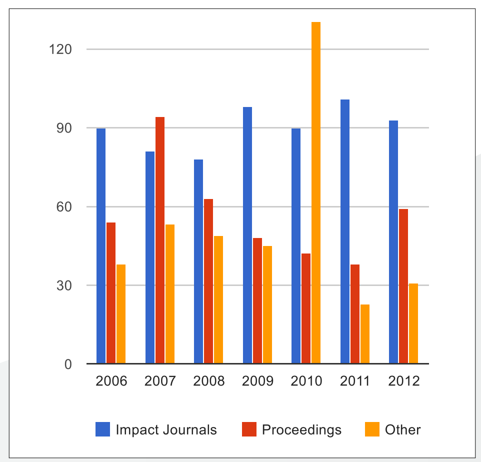
The history of the library goes back to the 18th century. Books from this period are stored separately and tended with special care. The historical section contains 253 titles which are described in detail in a catalogue published in Scripta Astronomica No. 1

Library staff. From left to right: N. Karlická, Head Librarian R. Svašková, K. Soldánová.

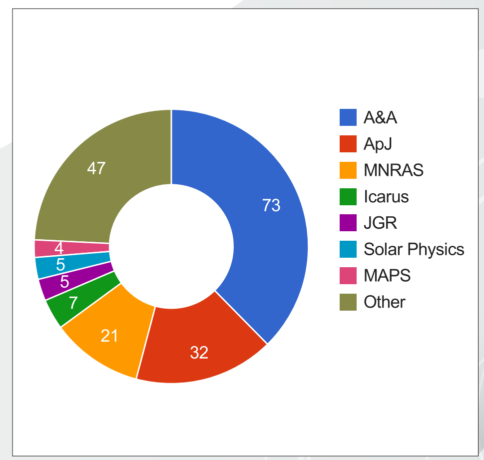
(1986) and No. 6 (1994). Twenty two most damaged books from this section were completely restored.

Scientific literature is nowadays mostly represented by periodicals. The library has complete series of many fundamental astronomical journals. Many of these journals are available online thanks to the membership of the Institute in the National Consortium of Springer and Elsevier publishing houses. Monographs in the library are located in a separate building, which was partly renovated in 2006 and which offers modern equipment and a calm and comfortable place for studying. All catalogued books can be accessed electronically using the widely known software Aleph, which is used in the whole Academy of Sciences. The library accepts request from its clients and obtains requested articles and documents.

The most important product of the Institute's research and development activities are its publications. Our researches frequently publish in high impact scientific journals. About two thirds of all our impact papers are published in the most renowned astronomical journals like Astronomy & Astrophysics, The Astrophysical Journal and Monthly Notices, and the remaining one third in other more specialized journals. Over the past years, the Institute had over 90 papers published in impact journals per year, few more dozens in conference proceedings, and about the same amount of other publications in bulletins and other astronomical periodicals. Examples of our most valuable recent results are given in Chapter 5.



Number of Institute's publications over past years.



Number of scientific papers published in different journals over past two years.

IV SCIENTIFIC DEPARTMENTS AND WORKING GROUPS

This chapter contains detailed information about staff, scientific activities and additional results of individual research departments and groups. The described structure and staff information reflects the situation at the end of 2012 unless otherwise noted.

4.1. Department of Solar Physics

Department Head: M. Sobotka.
Deputy: M. Bárta.

Secretary: A. Chytrová,
phone: (+420) 323 620 146,
e-mail: alice.chytrova@asu.cas.cz

The Solar Physics Department studies our nearest star, the Sun, and, in particular, active phenomena in the solar atmosphere. This includes solar flares as well as accompanying heliospheric effects. Evolution of solar active regions, helioseismology, structure and evolution of sunspots, physics of prominences and filaments, flare-energy storage, release and transport are all studied. The research of the Solar Department can be characterized as a combination of computer-controlled solar observations in optical, radio and X-ray wavebands, analysis and interpretation of adata, and theoretical research with extensive numerical modelling of the processes under study. All these activities are based on a close cooperation with many institutes in Austria, Brazil, France, Germany, Italy, Japan, the Netherlands, Poland, Portugal, Russia, Slovakia, Spain, UK and the USA. This cooperation includes exchange of various data and their theoretical interpretation, as well as our participation in some ground-based and space projects.

4.1.1 Physics of Solar Flares and Prominences

Head scientist: M. Karlický.
Scientists: M. Bárta, A. Berlicki, B. P. Dabrowski, E. Dzifčáková, F. Fárník, S. Gunár, P. Heinzel, K. Jiřička, J. Kašparová, P. Kotrč, A. Kulinová-Zemanová, H. Mészárosová, D. Nickeler, P. Schwartz, J. Štěpán, M. Varady.
PhD students: J. Skála.
Assistants: V. Kavka, J. Leško, V. Snížek.

The principal goal of this group is to understand the energetics and dynamics of complex plasma processes in flares and prominences, occurring on various spatial and temporal scales. However, small-scale processes observed with a high spatial resolution and on sub-second time scales are critical in evaluating the global physical behaviour of these phenomena, this being the current trend in solar physics. Two complementary tools are used: (i) optical and UV spectral diagnostics to derive the basic structural and dynamical plasma parameters, and (ii) numerical simulations of plasma processes and radiation transfer. This work is further supplemented by X-ray and radio observations which provide information on hot flare plasmas.

A large horizontal telescope with spectrograph (HSFA2) has been modernized and put into a standard mode of operation. It is fully computer-controlled and takes spectra simultaneously in H-alpha, He D3, H-beta, Ca II 8542 A, CaII K. Observed spectra and images can be found at http://helios.asu.cas.cz/spectra/. Most of the HSFA2 observations are concentrated on high temporal resolution of fast processes in solar flares. HSFA2 takes part in collaborative campaigns with observatories in France (Meudon, Pic-du-Midi), Poland (Wroclaw), the Canary Islands and elsewhere. Simultaneous observations with high temporal resolution have been performed with the large coronograph in Bialkow (Poland) and common periods of prominence oscillations have been revealed. The experimental horizontal telescope with spectrograph continued observations of prominences in H-alpha and D3 lines and in H-alpha slit-jaw images. Catalogues of the observed flares and prominences together with other useful data be found at http://www.asu.cas.cz/~sos/. A new experiment for measurement changes of Balmer continuum in solar flares is prepared at the experimental spectrograph.

Solar radio emission is monitored by three radio telescopes. The 0.8-2.0 GHz radio spectrograph with 512 frequency channels was reconstructed in 2006 and it is now used for measuring dynamic spectra with 10 ms time resolution. The 2.0-4.5 GHz radio spectrograph with 512 frequency channels is used with 100 ms time resolution. The 3.0 GHz single frequency radiometer with 10 ms time resolution is used for monitoring solar radio activity and studying short-duration phenomena. All instruments are fully automatic, monitoring the solar activity daily, from sunrise to sunset. The goal is study of fast dynamic phenomena, especially fine structures of solar radio bursts. The list of observed events, as well as pictures of observed radio bursts, is available to interested parties at http://www.asu.cas.cz/~radio/. Information about observed events is also regularly sent to Boulder, Colorado, USA, where it appears monthly in "Solar Geophysical Data".

Membership of the Czech Republic in European Space Agency (ESA) enabled our Institute to participate in the prestigious Solar Orbiter project − a solar observatory which will be launched into a close solar orbit in 2017. Solar Department guarantees Czech contribution to three scientific instruments on board the mission: STIX (X-ray Spectrometer/Telescope), METIS (Solar Coronograph) and RPW (Radio and Plasma Waves Analyser). At its closest point, the spacecraft will be closer to the Sun than any previous spacecraft, braving the fierce heat and will carry its telescopes to almost one-quarter of Earth's distance from our nearest star. It will provide unique data and imagery of the Sun.

EUV and X-ray bands represent a fundamental source of information on the state of solar plasma and physical processes taking place in the upper layers of the solar atmosphere – the transition region and corona. In these bands, we use top-quality satellite data obtained in broad international cooperation (missions YOHKOH, SOHO, TRACE, RHESSI, etc.).

The optical and UV spectral data are used for quantitative plasma diagnostics, which are performed by means of sophisticated non-LTE techniques. Non-LTE codes have been developed in close cooperation with the Institut d'Astrophysique Spatiale in Orsay (France) and with the Max-Planck-Institut für

Department of Solar Physics. From left to right: A. Chytrová, D. Nickeler, S. Šimberová, J. Leško, J. Kavka, J. Štěpán, M. Karlický, S. Gunár, M. Sobotka, B. Dabrowski, A. Heinzelová, P. Kotrč, Š. Mackovjak, E. Dzifčáková, P. Heinzel, P. Ambrož, M. Bárta, J. Kuprjakov, M. Klvaňa, V. Snížek. Heliosphere and Space Weather Group, resident in Prague, is on a separate photograph (see p. 22).

Astrophysik in Garching (Germany). Recently, they have been extended to time-dependent and 2D versions. As a result, we obtain information on the thermodynamic structure of the flaring atmosphere or prominence structures, as well as on dynamical processes (velocity fields). Numerical simulations of plasma processes also predict the X-ray and radio emissivity of flares. A so-called hybrid code which consists of three parts have been further developed: a test-particle part simulates propagation of particle beams, a hydrodynamic part solves equations of 1D hydrodynamics, and radiation is treated in non-LTE using time-dependent equations of statistical equilibrium and accelerated lambda iterations. The code includes several modes of particle beams (electron, proton, neutral) and new models of secondary acceleration were implemented. Numerical simulations of flare processes extended into interplanetary space, e.g., flare-shock propagation, are also carried out.

Soft X-ray images and spectra are used to understand the physics of solar flares: events preceding flares, evolution of hot post-flare loops, triggering of CMEs, etc. From these measurements not only the electron temperature and emission measure of hot coronal plasma can be estimated, but also deviations from the Maxwellian distributions (like n-distributions) can be determined.

Physics of Solar Flares and Prominences Group. From left to right: Sitting: H. Meszárosová, E. Dzifčáková, M. Bárta. Standing: D. Nickeler, J. Leško, J. Kavka, J. Štěpán, S. Gunár, M. Karlický, B. Dabrowski, P. Kotrč, Š. Mackovjak, P. Heinzel, V. Snížek.

Hard, mostly non-thermal, X-ray emission gives information on high-energy particle beams in the solar corona. Observations of this kind can identify regions of acceleration and thermalization of these beams and could also provide some clue to the still poorly understood physical mechanisms which produce these high-energy particle beams responsible for solar flares. The effects of non-thermal distributions on the observed EUV and X-ray line spectra are analysed. The synthetic spectral lines and continua are calculated using modified software and extended database of CHIANTI. New diagnostic methods on the electron distribution functions are developed and used for the interpretation of observations of the transition region, solar corona and flares.

In 2005, the computer cluster OCAS (Ondřejov Cluster for Astrophysical Simulations, see http://wave.asu.cas.cz/ocas) was built at the Institute. The cluster is used mainly for the numerical modelling of basic processes in solar flares (magnetic reconnection, plasmoid ejecta) and prominences (relaxation to the MHS equilibria, radiative transfer) using MPI-parallelised MHD and PIC codes (both 2D and 3D). The codes are extended to calculations of the modeled emission in X-rays, radio and H this providing a connection with our observing facilities. The numerical investigations are accompanied by analytical investigations, concerning flows around plasmoids, and fragmentation of current sheets in MHS equilibria by shear flows, using non-canonical transformations of Clebsch potentials also known as Euler potentials.

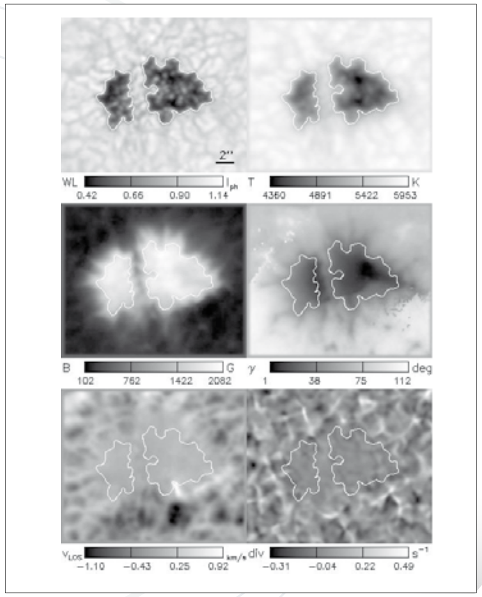
In 2012, the section Solar Activity Monitoring and Forecasting was moved to our group from the Heliosphere and Space Weather Group. This section observes the Sun in white light and in the Hα line. The observations are used in scientific research and contribute to the world net ISES (as a station No. 31516) and to SIDC in Brussels. Besides solar observations, the section collects all the accessible data on the actual state of solar activity. The section compiles and publishes a weekly solar-activity forecast (for approximately 90 Czech and international users) and a daily solar-activity forecast (for the Czech Television). The forecasts have been published weekly at Ondřejov since 1978. Two small refractors are used for monitoring observations of the whole solar disc (in white light – refractor 150/750 mm, in H – refractor 50/320 mm with the filter Coronado 0.7 Å). For detailed observations of the solar photosphere and chromosphere, two refractors are used (205/2830 mm [A. Clark, 1858] and 210/3410 mm + Hα filter DayStar 0.6 Å), with CCD-cameras and digitization. A small refractor (63/840 mm) is used for drawings of the whole solar disk in white light. The latest data can be found on http://www.asu.cas.cz/~sunwatch/.

4.1.2 Structure and Dynamics of the Solar Atmosphere

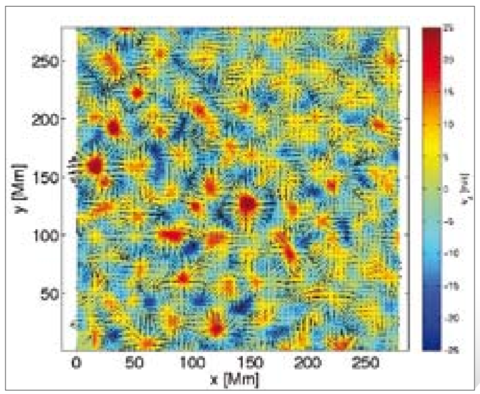
Head scientist: M. Sobotka.
Scientists: P. Ambrož, V. Bumba, J. Jurčák, M. Klvaňa, M. Švanda.

The group studies physical conditions in the solar atmosphere, in the near-surface layers of the convection zone, in active regions, and in sunspots in order to understand interactions between plasma motions and magnetic field. High spatial-resolution observations in the optical region are used for this purpose. Global and large-scale dynamic properties of the Sun are studied and transport velocities of

Structure and Dynamics of the Solar Atmosphere Group. From left to right: P. Ambrož, J. Jurčák, M. Klvaňa, M. Sobotka. Sitting: M. Švanda.



Time-averaged grey-scale maps of (left to right, top to bottom) continuum, temperature, magnetic field strength, magnetic field inclination, line-of-sight velocity, and divergence of horizontal velocity in a large solar pore and its surroundings.



An example of the near-subsurface flow field map obtained by the MC-SOLA inversion code. The horizontal flow components are displayed by arrows, the vertical component by colours. The scale arrow indicates the horizontal flow of 250 m/s. Dominant structures seen in the map are supergranules (diverging-flow cells with a typical size of 30 Mm), where divergence regions in the horizontal flow nicely correspond with the upflow regions in the vertical flow.

plasma in the solar atmosphere are analysed.

Observational data come from large solar telescopes located in the Canary Islands observatories and from solar satellites SOHO and HINODE. The group is collaborating with leading German astrophysical institutes on the project GREGOR, a large solar telescope with a diameter of 1.5 m. In 2011 we took part in alignment and testing of postfocal instruments. The telescope was inaugurated on 21 May 2012 at Observatorio del Teide, Tenerife, Canary Islands. Participation in the project, financed by the Czech Ministry of Education, Youth and Sports, allows us to share observing time on this unique instrument. The group collaborates with the Astronomical Observatory of the Coimbra University, Portugal, in the operation of the full-disc spectroheliograph, maintaining the software for data acquisition and processing. This software was implemented in the period 2008–2010. The daily observed spectroheliograms and Dopplergrams are available in the French solar data base BASS 2000.

Since 2008, the group has been involved in the development of the large European Solar Telescope (EST), promoted by the European Association for Solar Telescopes (EAST) and financed by EU in the FP 7 programme. EST will be a 4-meter class solar telescope located in the Canary Islands. It will be optimised for studies of the magnetic coupling between the deep photosphere and upper chromosphere. EST will specialize in high spatial and temporal resolution using instruments that can efficiently produce two-dimensional spectral information. The conceptual design phase was finished in 2011. The members of the group participated in the formulation of scientific requirements and were responsible for the complete design of the 15cm Auxiliary Full-Disc Telescope for EST, including the concepts of the optical, mechanical and control systems.

Sunspots' fine structures (penumbral filaments and grains, umbral dots and light bridges) that result from the complex behaviour of partially ionized dense gas moving in a strong magnetic field are studied. Sunspot umbrae and penumbrae are associated with complex patterns of magnetic fields and velocities. Using high-resolution images and 2D spectra, physical parameters, dynamics, evolution and mutual relations of various types of sunspot fine structures as well as organized flows around sunspots and pores are analysed. Inversion codes are used to derive stratifications of plasma parameters in sunspots and photosphere from spectropolarimetric observations.

Plasma flows in the near-surface layers of the convection zone are studied with a goal to estimate the empirical constraints on solar convection in these layers, which is barely exploited by numerical simulations. The method of local helioseismology, in particular the code implementing Multichannel Subtractive Optimally Localised Averaging (MC-SOLA; developed in collaboration with the Max-Planck-Institut für Sonnensystemforschung) is used. The new validated code allows to minimize various terms in the cost function of the inverse problem including the cross-talk term. The cross-talk contributions are known to preclude independent inversions for weak vertical component of the flow. With cross-talk minimised, nothing else prevents us from studying the vertical flow. For example, it turned out that in some supergranules – cells connected with large-scale convection – there might exist large-magnitude vertical flows at depths around 1.5 Mm. Such flows are not predicted by numerical simulations. It indicates that the depth structure of supergranules might be much more complex than previously thought.

Horizontal velocity fields in the photosphere are likely to have a major impact on the formation of structures and objects in the solar chromosphere, particularly those in the vicinity of the polarity inversion line (PIL). There are serious reasons to believe that the origin of solar filaments and fibril orientation in the chromosphere is due to the magnetic field influenced by specific horizontal velocity fields in the photosphere. For testing models of solar prominences it was necessary to verify the presence of convergent flow toward the filament or a shear flow around the filament axis. An extensive observational mterial from ground-based measurements was used for this purpose. We found that horizontal velocity fields exhibit, mainly around PIL, a specific mean shear flow. The magnetic field indicates a large-scale transport at larger distances on both sides of the PIL and the convergence of the magnetic field of opposite polarity to the axis of the filament.

4.1.3 Heliosphere and Space Weather

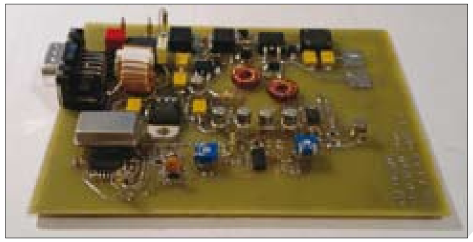
Head scientist: M. Vandas.
Scientists: P. Hellinger, S. Šimberová, Š. Štverák, P. Trávníček.
PhD students: D. Herčík, M. Jílek, J. Laifr,
Assistants: O. Šebek, R. Pavelka.

Space weather research and forecasting involves a complex chain of various dynamic phenomena. Improved understanding of heliospheric disturbances is needed to enhance capabilities to associate, and eventually forecast, solar eruptive phenomena with geomagnetic storms. Essential to this effort are magnetohydrodynamic (MHD) numerical simulations of propagation, evolution, and interaction of transient disturbances on their way to Earth. The group performs these simulations with a special emphasis on coronal mass ejections (CMEs) and their most geoeffective subset, magnetic clouds, which are in fact the interplanetary flux ropes. Apart from MHD simulations, structure and evolution of magnetic clouds are studied theoretically and compared to in situ spacecraft measurements. Magnetic clouds are modelled as oblate or curved magnetic force-free flux ropes. Electron acceleration at nearly perpendicular collisionless shocks is investigated theoretically, mainly how the acceleration is modified by various shock front shapes.

The group also focuses on kinetic simulations of the interaction of collisionless solar wind plasma with planets and moons using semi-kinetic code (kinetic ions, fluid electrons). We have developed a global model of a planetary magnetosphere based on the kinetic theory of plasma and applied it to the study of a planet with a magnetosphere comparable to the planet Mercury and Moon. This model is used by NASA within the MESSENGER project and for studies of the lunar wake. The model is also used for studies of the interaction of the water plume near Enceladus with plasma of Saturn, and the plasma environment of the Jovian moons Io and Ganymede.

Data observed in situ by ESA and NASA spacecraft missions are investigated using advanced techniques, e.g., particle (electron, ion) velocity distribution functions are analysed and their radial trends are determined. Theoretical and numerical approaches are used to study relevant physical processes responsible for the observed evolution of the particle distribution functions and their moments. For instance, the radial trends of electron and ion parallel and perpendicular temperatures (with respect to the ambient magnetic field) are determined and necessary heating rates are inferred. Our research is supported by two contracts within the 7th Framework Programme for Research (FP7) of the European Commission.

An important complement to the theoretical modelling is participation in the hardware development for the acquisition of data in situ. Our team has developed Dual Segmented Langmuir Probe (DSLP) experiment flown on ESA's Proba 2 spacecraft, it participates in the development of Radio Plasma Waves (RPW) experiment for Solar Orbiter (ESA), and Radio and Plasma Wave Instrument (RPWI) for JUICE (ESA). Our group also participated in the study of the plasma payload for the first Lunar Lander of ESA.



Bread-board Model (BBM) design of the Low Voltage Power Supply (LPVS) for Radio Plasma Wave Instrument (RPWI) on JUICE spacecraft of the European Space Agency (ESA) developed by our team at ASI.

The group is also involved in image information processing. The art of image processing is a topic with boundaries well beyond astronomy. Astronomical image processing applies a variety of numerical methods extract scientifically valuable information from the observed data. Applied sciences in this subject cover broad area including pre-processing (data acquisition from the space and ground-based observation, standard data reduction, removing of noise components and random disturbances, raw and processed data archiving), modelling of image degradation, image fusion and reconstruction, statistical analysis of dynamical events, and pattern recognition. New mathematical methods and algorithms are developed in cooperation with the Institute of Information Theory and Automation.

Heliosphere and Space Weather Group; members involved in projects of the European Space Agency (ESA) and FP7. From left to right: R. Pavelka, O. Šebek, D. Herčík, J. Laifr, M. Jílek, P. Hellinger, M. Vandas, P. Trávníček, Š. Štverák.

4.2. Department of Stellar Physics

Department Head: J. Kubát.
Deputy: M. Šlechta
(until June 2012, A. Kawka).

Secretary: E. Kortusová (until December 2011 E. Hajduová), phone: (+420) 323 620 226, e-mail: eva.kortusova@asu.cas.cz

The Department of Stellar Physics has three working groups: one is involved in the care of the 2m optical telescope (Perek telescope group); the second group (Physics of Hot Stars) studies early-type stars, Be and B[e] stars, white dwarfs, subdwarfs, stellar winds, moving envelopes in general, and binaries; the third group (High Energy Astrophysics) concentrates on multispectral analyses, evolution, and emission mechanisms of celestial X-ray and gamma-ray sources.

4.2.1 Physics of Hot Stars

Head scientist: J. Kubát.
Scientists: A. Aret, A. Kawka, P. Koubský, M. Kraus, P. Németh, M. E. Oksala, P. Škoda, S. Štefl, S. Vennes, V. Votruba.
PhD students: E. Arazimová-Hiczová, K. Šejnová, B. Šurlan, A. Tichý, J. Vážný.

The research of the group is focused on the theoretical and observational studies of early-type stars, Be and B[e] stars, white dwarfs, subdwarfs, stellar winds, moving envelopes in general, and binaries. The observational programs are based on spectroscopic data from the Perek 2m telescope in Ondřejov, on data obtained at the European Southern Observatory (ESO) in Chile, and on data from other facilities abroad – Dominion Astrophysical Observatory (Canada), Observatoire de Haute Provence (France), Rozhen Observatory (Bulgaria), Cerro Tololo Inter-American Observatory (Chile), Kitt Peak National Observatory (KPNO – USA), Apache Point Observatory (USA), and Siding Springs Observatory (Australia). The spectroscopic data are supplemented by photometric measurements obtained at Hvar Observatory (Croatia), Perth Observatory (Australia), and Białkow Observatory (Poland). Surveys like SDSS, Galaxy Evolution Explorer (GALEX), Guide Star Catalogue (GSC), and Two Micron All Sky Survey (2MASS) are also extensively used. The extensive international collaboration in the framework of ESA Gaia concentrates on the automated stellar classification procedure for Be and other variable stars.

Physics of Hot Stars Group and Perek Telescope Group: P. Koubský, M. Kraus, M. E. Oksala, E. Kortusová, L. Řezba, J. Honsa, V. Pácová, V. Votruba, R. Veselý, M. Šlechta, J. Fuchs, J. Kubát.

We initiated a systematic survey of Be stars with the coudé spectrograph of the Perek 2m Telescope. Based on this survey, we discovered a 28.9-day binary, omicron Puppis, which is the fourth object belonging to the class of Be/sdO binaries. This may impose a constraint on possible evolutionary scenarios for Be stars and close binaries in general. During a spectroscopic survey of a blue supergiant star HD 202850, we discovered variability in its photospheric lines with a period of only 1.6 hours. Such a short period has not been predicted for stars in this evolutionary phase so far, and might represent a milestone for future asteroseismological studies. We have discovered the sudden appearance of molecular emission in another supergiant star, namely LHA 115-S 65, meaning that the circumstellar material accumulated recently in a cool, dense ring. Furthermore, we found a set of singly ionized calcium lines in spectroscopic data of a large sample of supergiants. These lines turned out to be excellent tracers for high-density atomic disk regions close to the star. This diagnostic provides us with an ideal tool for our future studies. From high-resolution optical spectra of LHA 115-S 18 taken between 2000 and 2008, the appearance and strengthening of two emission features at wavelengths 6825 and 7082 Å was discovered, which was identified as Raman-scattered lines. This is the first time that these lines have been detected in the spectrum of a massive, luminous B[e] star.

We have observed several white dwarfs using the Very Large Telescope (VLT) of the ESO. The spectra showed minute traces of calcium and iron in the atmosphere of five objects. Our observations prove the existence of an external supply of material, most probably debris from an ancient planetary system, with an infalling rate of at least one tonne per second. We also detected a weak magnetic field in one of our objects: magneto-hydrodynamic models show that past interaction between the envelope of the progenitor of the compact object and a putative rocky planet may have generated the observed field.

While working on our extensive all-sky survey of ultraviolet-excess survey conducted at Kitt Peak National Observatory and at ESO, we encountered a most unusual white dwarf. At 0.17 solar mass, the newly identified object GALEX J171708.5+675712 became one of the least massive degenerate objects known. These unusual properties are the result of past interaction with another compact object that was found in a close six-hour orbit with GALEX J171708.5+675712. This pair of stars acquired great astrophysical importance when we discovered shallow eclipses that will allow us to determine the actual size of these objects and provide deeper understanding of the internal structure, and observed a rare combination of relativistic beaming and gravitational lensing effects.

We conducted a spectropolarimetric survey of 58 high proper-motion hydrogen-rich white dwarfs. The survey aimed at detecting low magnetic fields (less than about 100 kG) and helped identify the new magnetic white dwarfs NLTT 2219 and NLTT 10480. A series of observations of the white dwarf NLTT 12758 revealed changes in polarity occurring within an hour possibly associated with an inclined, fast rotating dipole, and possibly the effect of a field concentration ('spot') or the presence of a non-magnetic white dwarf companion. Similar observations of NLTT 13015 also showed possible polarity variations. The survey data proved useful in constraining the chemical composition, age and kinematics of a sample of cool white dwarfs as well as in constraining the incidence of double degenerates.

A model atmosphere analysis of cool hydrogen-rich white dwarfs observed at the Very Large Telescope (at ESO) with the X-shooter spectrograph was done. The spectra of three objects (NLTT 1675, 6390, and 11393) show heavy elements (Mg, Al, Ca, or Fe). The abundance analysis revealed a relatively high iron-to-calcium ratio in NLTT 1675 and NLTT 6390.

An update of the low-resolution spectroscopic follow-up and model atmosphere analysis of hot subdwarf stars from the GALEX survey was done. Targets were selected on the basis of colour indexes calculated from the GALEX GR6 NUV, GSC V and the 2MASS J and H photometry. High signal-to-noise ratio spectra were obtained at ESO and KPNO over the course of three years. Detailed H, He and CNO abundance analysis helped to improve the effective temperature, gravity, and He abundance determination, and to constrain CNO abundances. In total, 191 observations of 180 targets were processed and 124 sdB and 42 sdO stars were found in this sample. An extended set of spherically symmetric hydrogen-helium NLTE model atmospheres of first stars was calculated, which enabled determination of the ionizing radiation flux from these stars as a function of their age.

Detailed NLTE models of the Vela X-1 envelope were calculated. The effect of the X-rays, which photoionize the wind and destroy the ions responsible for wind acceleration, was studied. The resulting decrease of the radiative force explains the observed reduction of the wind terminal velocity in the direction of the neutron star. The X-rays create a distinct photoionized region around the neutron star filled with a stagnating flow. The existence of such photoionized bubbles is a general property of High Mass X-ray Binaries (HMXBs).

The influence of XUV radiation on the PV ionization fraction in hot star winds was studied. Using a detailed solution of the hydrodynamical radiative transfer and statistical equilibrium equations, we confirm that a sufficiently strong XUV radiation source might decrease the PV ionization fraction, however, the XUV radiation also influences the ionization fraction of heavier ions that drive the wind, leading to a decrease of the wind terminal velocity. The consequence is that XUV radiation alone cannot bring theory and observations into agreement.

For the first time, the full problem of resonance line formation with 3-D radiative transfer in the inhomogeneous (clumped) wind is treated. By synthesizing resonance line profiles using newly developed 3-D Monte Carlo Radiative Transfer code, this work investigated how different properties of clumps may influence the formation of resonance lines (mostly UV lines), and how it can affect mass-loss rate determination. Our model demonstrates that to obtain empirically correct mass-loss rates from UV resonance lines, wind clumping and its 3-D nature must be taken into account.

4.2.2 Perek Telescope Group

Head scientist: M. Šlechta.
Technicians and assistants: J. Fuchs, J. Honsa, L. Kotková, L. Řezba, J. Sloup, M. Tlamicha, F. Žďárský.

The principal instrument of the stellar department is the reflecting telescope with a 2 meter diameter mirror, which is in operation since 1967. In the past three decades, three major upgrades of the telescope control system (1982–87, 1996–98, 2007) were made. In August 2012, the telescope was named after its principal founder, Luboš Perek. The telescope is primarily used for medium dispersion spectroscopy.

The main camera of the coudé spectrograph is the 700 mm camera equipped with a LN2-cooled CCD chip – SITe ST005A thinned UV-enhanced back illuminated chip (2000 x 800) 15μm pixels. Its outstanding performance and low readout noise of less than 7 electrons allows us to obtain high S/N spectra (resolution 10 000–20 000) of objects up to 12^{th} magnitude in less than two hours of exposure. Another CCD detector (custom manufactured ITL chip STA0520A based on LORAL wafer, thinned, (2688 x 512) 15μm pixels, cooled by Cryotiger) is installed in the coudé 400mm camera. Another CCD – EEV thinned back illuminated chip (2048 x 2048) 13.5 μm pixels is operating at the focus of the Ondřejov echelle spectrograph (OES).

A new interface that controls the CCD cameras is at the final stage of development. PESO (Python Exposure Script for Ondřejov) is a multi-threaded Python script providing GUI interface for operating the CCD cameras attached to the Ondřejov 2m telescope spectrographs. It can setup the spectrograph configuration, the exposure time and ensures the CCD is read out following an exposure. It also writes the correct FITS header information and saves the FITS frame. It is written in Python, calling C wrappers and custom libraries.

The 2007 upgrade of the control system offers a precise and stable performance of the telescope. It also enables remote control of the telescope. The autoguiding system OPSO (OpenGL Pointing System for Ondřejov) was shown to be fully functional and enables automatic control of the telescope position, which is based on movements of the stellar image with respect to the slit.

In 2010, the electronics of the spectrographs were upgraded. The standard commercial components replaced the old and unique (and hence irreplaceable) components. Moreover, the electronics driving the telescope and the spectrographs were unified. The current setup allows remote control of the telescope and the spectrographs.

During the summer of 2012, the driving system of the dome shutter was reconstructed.

4.2.3 High Energy Astrophysics

Head scientist: R. Hudec.
Scientists: C. Polášek, V. Šimon.
Technicians: M. Nekola, J. Štrobl.
Assistants: M. Blažek, V. Hudcová, M. Kocka, M. Skulinová.

The group concentrates on multispectral analyses, evolution, and emission mechanisms of celestial X-ray and gamma-ray sources (extragalactic – gamma-ray bursts, blazars; galactic X-ray binary sources and other types of X-ray sources). It participates in satellite projects, with emphasis on INTEGRAL, Gaia, and LOFT. The INTEGRAL satellite continues its smooth operation in space, and the group is involved in related scientific analyses. We participate in the ESA Gaia project in the work package on supplementary ground-based observations within Gaia CU7 unit and applications of ultra-low dispersion spectra delivered by Gaia RP/BP photometers in astrophysics. The ESA LOFT is a new project now in the assessment phase.

We investigate the properties of optical afterglows (OAs) of GRBs and their time evolution, including the supernova-GRB relation and the resolution between the synchrotron component and the contribution of the supernova.

High Energy Astrophysics Group. From left to right, back raw: C. Polášek, J. Štrobl; middle raw: V. Šimon, M. Polák, M. Blažek, V. Hudcová, P. Skála; front raw: M. Jakubec, R. Hudec.

Analyses of the long-term X-ray activity of galactic sources are focused on the investigation of transient events like outbursts and high/low state transitions in systems with a mass-accreting compact object (e.g., neutron star), like the Rapid Burster (MXB 1730-335), KS 1731-460, 4U 1608-52, XTE J1701-462. Among others, these analyses make use of the data from the telescopes ASM and BAT on board RXTE and Swift satellites, respectively. The long-term processes operating in the accretion disc of these systems are the main purpose of these studies. We have also investigated the behaviour of the unique source GRB 070610/SWIFT J195509+261406 during its 2007 outburst.

The group also provides ground-based data and analyses for various satellite projects. The ground-based segment includes several robotic CCD-based detecting systems/telescopes (D50 cm, D25 cm/BART, and three D30 cm telescopes (BOOTES), fully robotic, in collaboration with Spain) with RTS2 control software. They provide rapid observations of optical counterparts of GRBs, and monitoring of other objects of high-energy astrophysics. D50 has successfully detected numerous OAs of GRBs down to magnitude 20; it also observed optical counterparts of various X-ray sources. The BOOTES collaboration, supported by the AS CR – CSIC project, resulted in numerous scientific publications. More recently, both Ondřejov as well as the BOOTES robotic telescopes became part of EU FP7 project GLORIA. The GRB analyses are also supported by investigations of GRBs by SID ionospheric monitors and optical all-sky monitors (in collaboration).

We also participate in efforts to scientifically use the valuable information recorded on archival astronomical plates. Selected known extragalactic (blazars) and galactic (cataclysmic variables and other high-energy sources) sources have been studied using these unique plates. We also evaluate methods for automated analyses of low-dispersion spectral images recorded on plates related to ESA Gaia with emphasis on studies of spectral type variability.

Studies of astronomical X-ray optics and the design and development of novel wide-field Lobster-Eye optics for astrophysical applications are also continuing. We organized international workshops AXRO (Astronomical X-Ray Optics) in Prague in 2011 and 2012.

4.3 Department of Interplanetary Matter

Department Head: P. Spurný.
Deputy: P. Pravec.

Secretary: H. Zichová, phone: (+420) 323 620 160, e-mail: hana.zichova@asu.cas.cz

The Department of Interplanetary Matter studies minor bodies of the Solar System, in particular meteoroids and asteroids. Attention is devoted to the study of the interactions of interplanetary bodies of different sizes with the Earth's atmosphere. Photometric studies of Near-Earth Asteroids are also performed. The Department consists of two working groups.

4.3.1 Meteor Physics

Head scientist: J. Borovička.
Scientists: D. Čapek, P. Koten, P. Pecina, L. Shrbený, P. Spurný, R. Štork.
PhD student: V. Vojáček.
Assistants: J. Boček, J. Keclíková, P. Horálek, L. Smolíková, J. Starý, L. Kopřivová.

The group observes meteors in the optical region and performs theoretical interpretations of the observations. The basic observational system is the European Fireball Network (EN) established in former Czechoslovakia in 1963 and now consisting of 10 stations in Czech Republic, where the centre of the EN is located, and 13 stations in Germany, 2 in Slovakia and Austria and 1 each in the Netherlands, France, Luxembourg and Switzerland. During the last decade all Czech stations have been equipped with the sophisticated instrument for opti-

Department of Interplanetary Matter. From left to right: R. Štork, P. Pecina, P. Koten, P. Pravec, H. Zichová, D. Čapek, L. Smolíková, P. Kušnirák, V. Vojáček, K. Hornoch, J. Keclíková, J. Boček, J. Starý, J. Borovička, P. Spurný, L. Shrbený.

Meteor Physics Group. From left to right: D. Čapek, J. Boček, P. Koten, J. Borovička, P. Pecina, H. Zichová, L. Smolíková, J. Starý, P. Spurný, V. Vojáček, R. Štork, J. Keclíková, L. Shrbený.

cal observation of fireballs, the Autonomous Fireball Observatory (AFO). The efficiency of observations, complexity and quality of recorded data significantly increased after this modernization of the Czech part of EN which was finished in 2007. Fireballs brighter than magnitude –4 are recorded, including detailed light curves provided by second generation photoelectric sensors (5000 samples/s) of the AFOs (this modernization was finished in 2010). In last two years we started to develop new instrument for fireball photography, the Digital Autonomous Fireball Observatory, which is now intensively tested and which should secure our leading position in precise fireball observations. Additional data on fireballs are obtained from long-focus horizontal cameras placed at Ondřejov Observatory. Also, fireball spectra are simultaneously photographed at the Ondřejov Observatory. Sensitive television cameras are used in the double station video observation program for observation of faint meteors and their spectra during the activity of interesting meteor showers. In the period 2011 to 2012 we were also working on the development of new automatic video instruments for continuous observations of meteors down +6 magnitude. Two MAIA (Meteor Automatic Imager and Analyzer) systems were successfully tested and are ready for deployment and regular work on the stations (Ondřejov and Kunžak).

The observational data are used to study physical processes during the penetration of meteoroids into planetary atmospheres, including ablation, deceleration, radiation, and meteoroid fragmentation. The physical properties and chemical composition of different types of meteoroids, their origin and distribution in the solar system and their relation to comets, asteroids and meteorites are being determined. Due to high efficiency of observations in two reported years we recorded and analysed more than 100 multi-station fireballs in Central Europe and about 40 fireballs in the second observational project where we substantially participate, the Desert Fireball Network in SW Australia.

The main scientific goals of the working group of Meteor Physics in last two years were connected with analyses of several instrumentally observed meteorite falls in Central Europe and SW Australia and with successful observation of the predicted outburst of the Draconid meteor shower. In addition, we theoretically studied the destruction of meteoroids by the thermal stress caused by the solar heating.

An exceptionally bright fireball appeared over Slovakia on February 28, 2010. Since the weather was cloudy at all stations of the European Network, we used casual videos from Hungary to determine the fireball trajectory and orbit. On the basis of our prediction, several dozens of meteorites were recovered in the vicinity of the city of Košice. Using the fireball light curve recorded by our AFO radiometers, we modelled atmospheric fragmentation of the meteoroid and compared the model predictions with the actual meteorite strewn field.

Another case of this category, but significantly smaller, was observed by the Desert Fireball Network in the Nullarbor Plains in SW Australia on April 13, 2010. Based on two photographic records of moderately bright fireball (–9 mag) we predicted the impact location of a possible fall of small meteorites. One 25g meteorite classified as H5 ordinary chondrite and named Mason Gully was found close (150m) to the predicted position for given mass. This is the second case of such successful prediction and recovery after Bunburra Rockhole, the major milestone of this ambitious project in SW Australia.

Motivated by our better understanding and successful prediction of several recent instrumentally observed meteorite falls, in spring 2011 we completely reanalysed one of the best documented case of superbolide category, the historical bolide Benešov, which was recorded by our cameras on May 7, 1991. We predicted a slightly different impact location and suggested a new searching strategy. Four small highly weathered fragments were found exactly in the predicted impact area for corresponding masses. This result is in many aspects pioneering. We proved that in some special cases it is still possible to predict and find meteorites long time after the fall. However the most important result is in heterogeneity of the recovered meteorites. We discovered that the Benešov meteoroid consisted of at least three different types of material which highly support the idea that larger meteoroids can be compositionally very complicated bodies.

We studied also one interesting artificial fireball caused by the re-entry of the HAYABUSA interplanetary spacecraft occurred over Australia on June 13, 2010. It was observed by Japanese temporary cameras as well as the cameras of the Desert Fireball Network. We used these data to reconstruct the re-entry trajectory, velocity and luminosity, and compared them with the prediction made before the re-entry.

The most important event in video observations of regular meteor showers occurred on 8th October 2011 when the outburst of the Draconid shower was predicted. Therefore we organized two observation campaigns. The ground based experiment was set up in the Northern Italy. We also co-organized the aircraft mission above the Northern Europe, which consisted from two small planes carrying set of different instruments. Both experiments successfully observed the peak of the activity, which occurred within predicted time. Detailed examination of the data suggests mass separation of the incoming particles, with the bigger meteoroids arriving earlier then than smaller ones. A study of meteor deceleration and spectra revealed differences in the structure of Draconid meteoroids.

4.3.2 Asteroids

Head scientist: P. Pravec.
Scientists: P. Scheirich, A. Galád.
PhD student: T. Henych.
Assistants: P. Kušnirák, K. Hornoch.

The group focuses on physical studies of asteroids in the Solar system. We study non-gravitational processes in small asteroids, binary systems and paired asteroids, and asteroids in excited (non-principal) rotation states. We also observe so called Near-Earth Asteroids (NEAs; also NEOs – Near Earth Objects) and their source regions. NEAs are a part of the asteroid population, which represents an impact hazard for the Earth. Precise astrometry allows a determination of the orbits of NEOs and therefore to calculate their potential risk for the Earth. There is a number of observatories across the world which collaborate with us on the project (see references available on http://www.asu.cas.cz/~ppravec/).

Our two main observational instruments are the 1.54m Danish telescope at the European Southern Observatory, La Silla, Chile (since 2012) and the 0.65m telescope at Ondřejov. The observations on the 1.5m telescope at La Silla are run within our collaboration project with the Danish colleagues at the Niels Bohr Institute, Copenhagen University. The collaboration with the other observatories across the world provides us with data from a number of their instruments that allow us to get a substantially more thorough understanding of the studied objects.

Asteroids Group. From left to right: P. Scheirich, T. Henych, K. Hornoch, P. Pravec, P. Kušnirák, A. Galád.

We studied the distribution of orbit poles of small binary asteroids and found out that they are not distributed randomly, but that they concentrated around the poles of the ecliptic. We proposed that the anisotropic distribution is due to the tilt of spin axes of their parent bodies or primary components caused by the YORP effect.

A large astrometric ESA satellite, Gaia, should be launched in 2013. We investigated its capability to detect binary asteroids through their photocenter oscillation. We found out that Gaia will cover a range of the binary parameter space largely unexplored so far, promising to bring new important results on the binary asteroid population.

We used asteroid photometry data that we collected over many years with the Ondřejov 0.65m and the Table Mountain Observatory 0.6m telescopes and we derived accurate absolute magnitudes for a sample of asteroids. We found that catalogued absolute magnitude data are biased. With our data, we derived the bias and corrected the asteroid albedo estimates obtained by Mainzer et al. (2011) and Masiero et al. (2011) from WISE thermal observations.

4.4 Galaxies and Planetary Systems

Department Head: J. Palouš.
Deputy: C. Ron.

Secretary: M. Bečvářová
(until July 2012 S. Přádná),
phone: (+420) 226 258 400,
e-mail: marcela.becvarova@asu.cas.cz

The department of Galaxies and Planetary Systems is involved in three areas of research: the evolution of galaxies in groups and clusters, and the formation of stars and stellar clusters; the kinematics and physical properties in central parts of active galaxies; the Earth's rotation and its gravity field, dynamics of asteroids, Earth satellites and Trans Neptunian Objects, and a compilation of an astrometric star catalogue.

Several scientists from the department are also interested in the history of astronomy. The topics include the role of astronomy in culture, Mesoamerican archeoastronomy, and the study of Jesuit and other astronomical heritage. Members of the department are involved in the care of the Astronomical clock of Prague and historical sundials as well as in editions, translations and interpre-

Department of Galaxies and Planetary Systems. From left to right: J. Horák, D. Kunneriath, R. Wünsch, P. Jáchym, E. Olson, V. Karas, A. Růžička, J. Palouš, M. Dovčiak, Z. Šíma, M. Horký, S. Ehlerová, M. Bečvářová, J. Hamerský, J. Vondrák, V. Sochora, V. Sidorin.

tation of medieval and early modern astronomical texts.

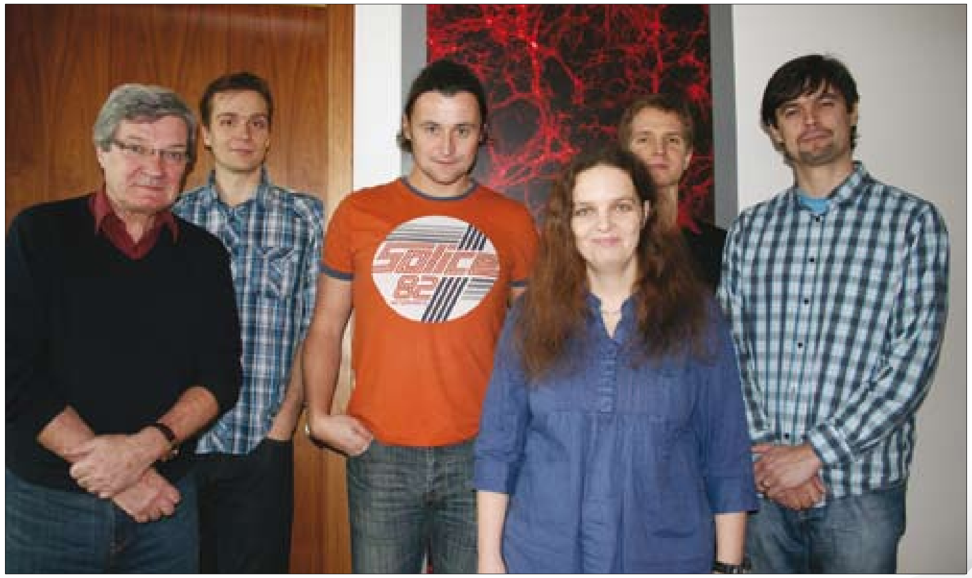
4.4.1 Astrophysics of Galaxies

Head scientist: J. Palouš.
Scientists: S. Ehlerová, F. Hueyotl-Zahuantitla, P. Jáchym, B. Jungwiert, I. Orlitová, L. Perek, A. Růžička, R. Wünsch.
PhD students: K. Bartošková, I. Ebrová, M. Křížek, V. Sidorin.

The working group Astrophysics of Galaxies studies the evolution of galaxies in groups and clusters, and the formation of stars and starclusters. Radio, infrared, optical, and X-ray observations are compared with analytical models and computer simulations of gravitational and MHD processes. Description of main topics which were studied during the last two years follows.

Young stars eject energy, mass and metals into the interstellar medium. Star formation drives supersonic turbulence and triggers subsequent star formation at other places. Structures – shells, supershells, filaments and sheets – are formed by the mass and energy feedback of young stars. We created a catalogue of shells and supershells in the outer Milky Way using an automatic routine for searching in 3D HI data cubes. Discovered structures are also identified in galactic surveys in other wave-bands. The gravitational fragmentation of expanding shells is studied using the SPH and AMR techniques, which are found to agree very well. Fragmentation is discovered to be strongly influenced by the environment which the shell expands in, with a low-pressure environment leading to suppression of low-mass fragments and potentially a top-heavy stellar or cluster mass function.

Hydrodynamical processes occurring during the formation of super star clusters (SSC) are studied with analytical and numerical models and compared to optical and X-ray observations of SSCs. We make numerical models of winds driven by SSCs taking into account radiative cooling. The importance of the cooling for the wind dynamics depends on the properties of the central clusters: the wind of low stellar density clusters behaves almost adiabatically and can be described by the well known semi-analytical solution. As the stellar cluster density grows the cooling of the wind starts to be important and the wind enters the so-called radiative regime in which the wind temperature quickly drops at a certain distance from the cluster. In the case of the densest clusters, a thermal instability occurs inside the cluster and no stationary wind solution exists. We follow the evolution of the clusters in such a super-critical regime using the hydrodynamic codes ZEUS and FLASH for which the cooling routine was modified to make it suitable for the modelling of extremely rapidly cooling regions. We found that the wind evolves in a bimodal regime in which the densest inner region undergoes strong radiative cooling which results in the accumulation of matter there, while the outer region still sustains a quasi-stationary wind. Hydrodynamical simulations show that cold dense clumps are formed in the inner cluster region, which may support the secondary star formation. However, a fraction of the clumps is accelerated by the surrounding hot wind and ejected from the cluster.



Astrophysics of Galaxies Group. From left to right: J. Palouš, P. Jáchym, A. Růžička, S. Ehlerová, V. Sidorin, R. Wünsch.

The evolution of galaxies in groups and clusters is analysed with restricted N-body codes using genetic algorithms. A model of the evolution of the galaxy group including the Milky Way, LMC and SMC was proposed. The high-speed motion of galaxies in the hot and diluted medium in galaxy clusters creates a ram pressure on the interstellar medium, which is stripped away from parent galaxies. The code GADGET using the SPH approach with a gravity tree is used to describe how the ISM gas is removed from spirals, quenching the star formation in galactic discs while triggering it in the tidal arms and at the leading edge of gaseous discs. The above projects are conducted in collaboration with the University of Cardiff, UK; Instituto Nacional de Astrofísica Optica y Electronica in Mexico; Observatoire de Paris, France; and Institut fuer Astronomie der Universitaet Wien, Austria.

We have been participating in the Calar Alto Legacy Integral Field spectroscopy Area survey (CALIFA, a wide-field optical 3D spectroscopy survey of 600 nearby (z ~ 0.005-0.03) galaxies. The CALIFA international collaboration has delivered the first of the foreseen data releases to the astronomical community in November 2012. This DR1 comprises 200 science-grade datacubes corresponding do 100 CALIFA galaxies observed in two spectroscopic setups. The data can be accessed on the CALIFA DR1 webpage.

We have simulated the kinematic imprint of minor mergers in shell galaxies, predicting a quadruple-peaked line-of-sight velocity distribution (LOSVD) of the shells. Subsequently, we have linked the observables (positions of LOSVD peaks) to the characteristics of the gravitational potential, thus proposing a new method to constrain the distribution of dark matter in galactic halos.

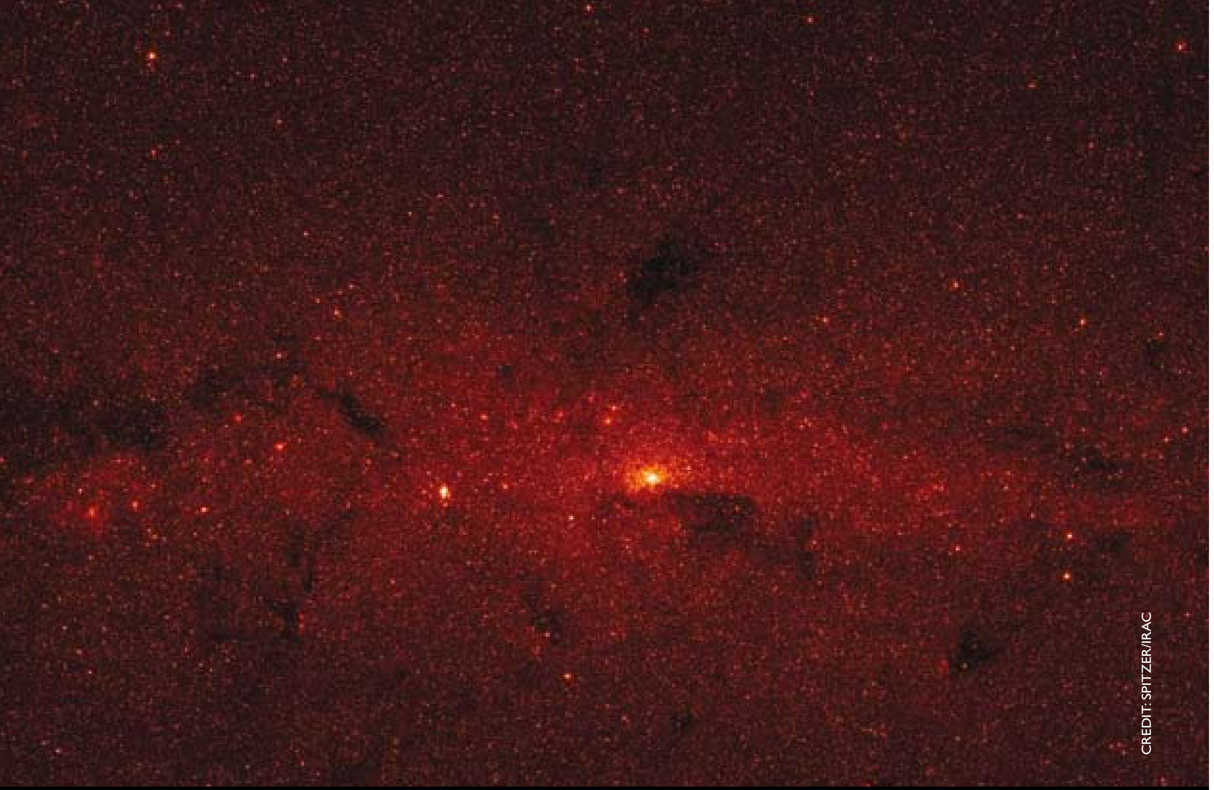
We have participated, in a collaboration lead by our colleagues from the European Southern Observatory and from the Masaryk University in Brno, in modelling the orbits of stellar clusters in our Galaxy, with the aim to evaluate their possible migration over large galactocentric distances due to a recently discovered migration mechanism, the resonance overlap scattering under the simultaneous presence of a bar and spiral arms rotating at different angular speeds.

4.4.2 Relativistic Astrophysics

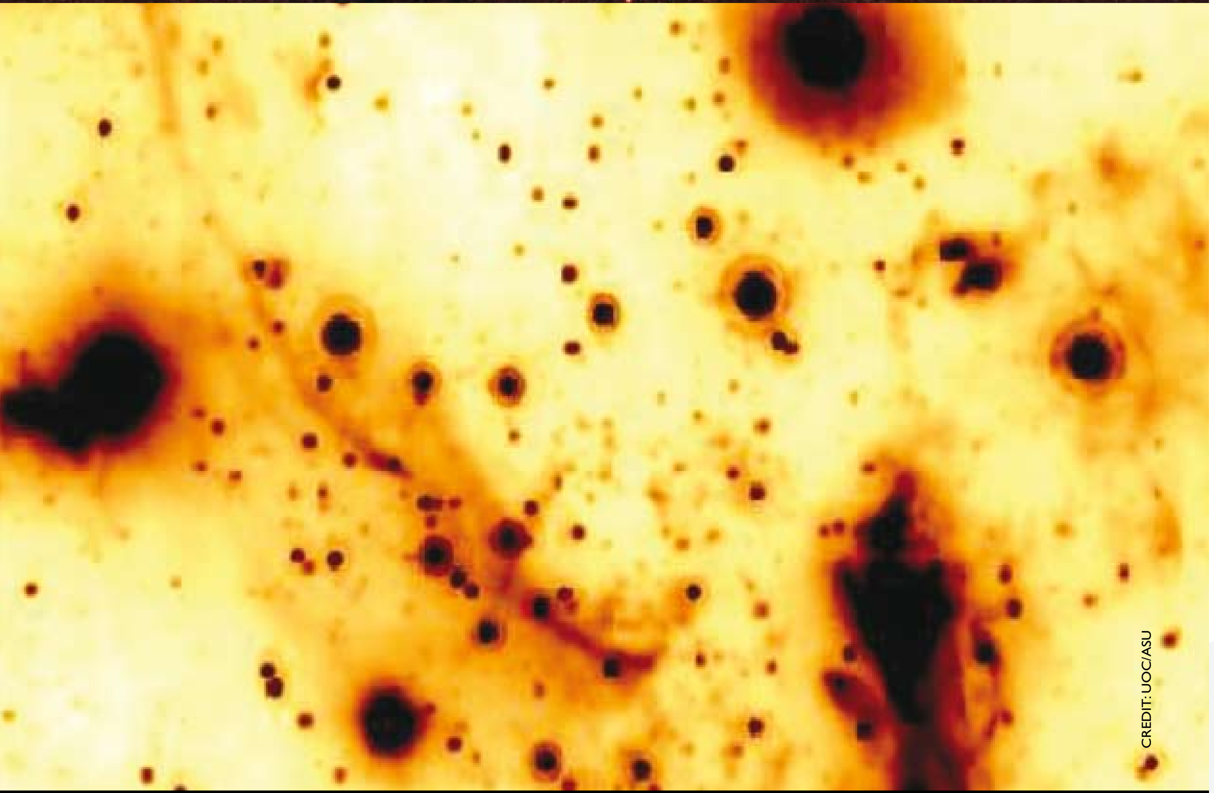
Head scientist: V. Karas.
Scientists: M. Bursa, M. Dovčiak, P. Hadrava, J. Horák, D. Kunneriath, T. Pecháček, J. Svoboda.
PhD students: J. Čechura, O. Kopáček, V. Sochora, J. Hamerský.

Members of the group of Relativistic Astrophysics deal with theoretical aspects of strong gravitational fields in cosmic bodies, including the data modelling and interpretation. Additional research funding has been attracted from national granting agencies and through various projects at European Space Agency and European Southern Observatory. The group is part of the Centre for Theoretical Astrophysics and is involved in teaching and supervising students at undergraduate and graduate levels. Research and teaching are carried out in fruitful collaboration with collaborators at Charles University in Prague, Silesian University in Opava, and at various institutions abroad.

Research topics and scientific results of the group members include the following:



Mid-infrared survey of the central 2×1.5 degree part of the Milky Way.



The mini-spiral, stars and dust around the supermassive black hole in the centre of the Milky Way.

X-ray spectroscopy of active galaxies and stellar mass black holes (Bursa, Dovčiak, Hadrava, Horák, Svoboda, and students): The X-ray reflection features of irradiated accretion discs around black holes enable us to probe the effects of strong gravity and determinate the black-hole properties. We investigate the reflection signs, i.e. the iron K-line and the Comptonized hump, which arise by reprocessing of radiation on the surface of an accretion disc, and how they are affected by the spin of a rotating black hole. We develop models for the polarization signature of the radiation coming from the vicinity of accreting black holes. In the optical/UV range, polarimetry observations and modelling have already proven to be a useful tool to investigate active galaxies by tracing geometrical and dynamical properties of structures surrounding their nuclei. Recently we have concentrated our attention on the study of variations in the primary and reprocessed radiation from an orbiting spot around a black hole.

Stochastical variability and oscillations of accretion discs (Dovčiak, Horák, Karas, Pecháček): Accreting black holes in binary systems often exhibit quasi-periodic oscillations of the observed X-rays. In some cases the frequency of these oscillations is very high (kilohertz) and they occur at two distinct peaks. Oscillation properties differ between sources, however, it appears that they keep a fixed frequency ratio of small rational numbers. The origin of this phenomenon is yet unknown. We have focused on the resonance scenario of accretion disc oscillations. Furthermore, the short-term variability of active galactic nuclei is often being linked with a presence of hot spots residing on the surface of an accretion disc. We apply the theory of stochastic processes to model the observed signal.

Relativistic Astrophysics Group. From left to right: V. Karas, M. Dovčiak, O. Kopáček, J. Hamerský, P. Hadrava, M. Bursa, T. Pecháček, D. Kunneriath.

Acceleration mechanisms and flares from Galactic Centre (Sagittarius A*) supermassive black hole (Bursa, Karas, Kopáček, Kunneriath): Do extremely rotating black holes power relativistic jets? A compelling answer may be beyond our reach for some time. To be sure, magnetic fields play an important role in astrophysics. Near rotating compact objects, neutron stars and black holes, the field lines are wildly deformed by rapidly moving plasma and strong gravitational fields. Recently we have studied the frame-dragging effects as the origin of magnetic reconnection and particle acceleration in close vicinity of a rotating black hole. We work on the modelling of flares to explain the Galactic Centre variability that has been reported in various wavelengths ranging from X-rays to near infrared and sub-millimeter domains.

4.4.3 Planetary Systems

Head scientist: C. Ron.
Scientists: A. Bezděk, M. Burša, J. Klokočník, R. Peřestý, L. Sehnal, Z. Šíma, V. Štefka, J. Vondrák.
PhD student: J. Sebera.

The Zeiss Photographic Zenith Tube (PZT) used at the Ondřejov Observatory to monitor changes of the Earth's orientation in space since 1973 has been renovated radically in 2005–2006. The photographic plate has been replaced by a CCD chip and all the system can be now controlled remotely through the internet. The PZT is used mostly for monitoring of non-polar and non-tidal deflection of the local vertical and also for determining the positions and proper motions of stars.

We worked on the problem of creating a new, more precise astrometric star catalogue with improved proper motions and quasi-periodic terms reflecting orbital motions of stars in multiple systems by combining space mission results (Hipparcos and Tycho Catalogues) with ground-based optical observations of latitude/universal time variations.

We derived the series for the various precessional parameters, that allow precession to be computed with an accuracy comparable to IAU 2006 around the central epoch J2000.0, a few arcseconds throughout the historical period, and a few tenths of a degree at the ends of the ± 200 millennia time span.

In recent years, the activity has been concentrated on geophysical excitation of nutation, namely the atmospheric and oceanic excitation of free core nutation. Also the solar excitation of the Earth rotation has been studied.

The satellite altimetry data, namely single and dual satellite crossover altimetry for the Earth's gravity field determination and accuracy assessment has been studied and applied.

Planetary Systems Group, the Ondřejov part. From left to right: J. Klokočník, A. Bezděk.

Planetary Systems Group, the Prague part. From left to right: C. Ron, J. Vondrák.

A new method for the Earth's gravity field models accuracy assessment, based on the single satellite cross-over residuals and latitude-lumped coefficients has been developed and applied for various gravity models. The satellite altimetry data are also used for monitoring the temporal variation in the geopotential W0 and time variability of the Earth's inertia ellipsoid.

The satellite gradiometry mission GOCE (Gravity and Ocean Circular Experiment) has been launched in March 2009 and is equipped with a gradiometer to directly measure the second derivatives of the geopotential. Our group participated in planning of its orbit (fine orbit tuning) and data processing for gravity field determination and testing. We have had the grant ESA PECS C 98056 (2007–2011) for this purpose.

We study relationship between density of ground tracks and accuracy of gravity field parameters (namely of monthly solutions for variations of gravity) and we applied the results for the missions GRACE and GOCE and we are extending this study for planetary orbiters. We were invited to cooperate in a frame of a special study group of IAG on the evaluation of the new gravitational model EGM 08 (which has been issued by US NIMA). Our testing concerns comparison with detailed terrestrial data and verification of known impact craters on the Earth; the accuracy and resolution of EGM 08 is a few miligals on majority of locations on the Earth and about 9 km at the equator. So we are able to confirm the well known (geologically proved) impact structures on the Earth with diameter higher than about 30 km. At this opportunity we identified several new candidates for the impact craters.

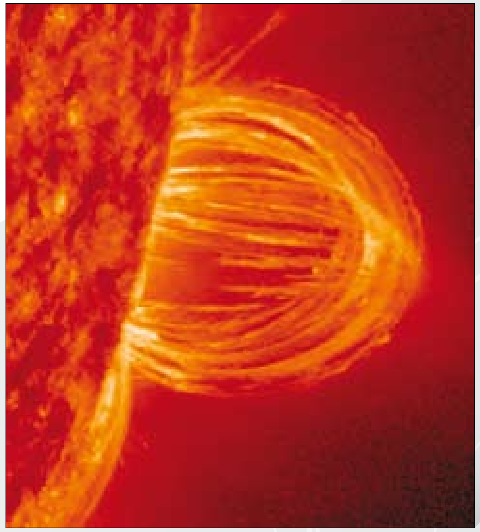
We have developed an original inversion method to compute the long-wave part of the Earth gravitational field from precise GPS positions of geodetic satellites (CHAMP, GRACE, GOCE). In addition to the static component, also the time-variable part of Earth gravitational field can be estimated, including the motion of the geocenter.

V PRINCIPAL RESULTS

5.1 Energy cascades in solar magnetic field reconnection

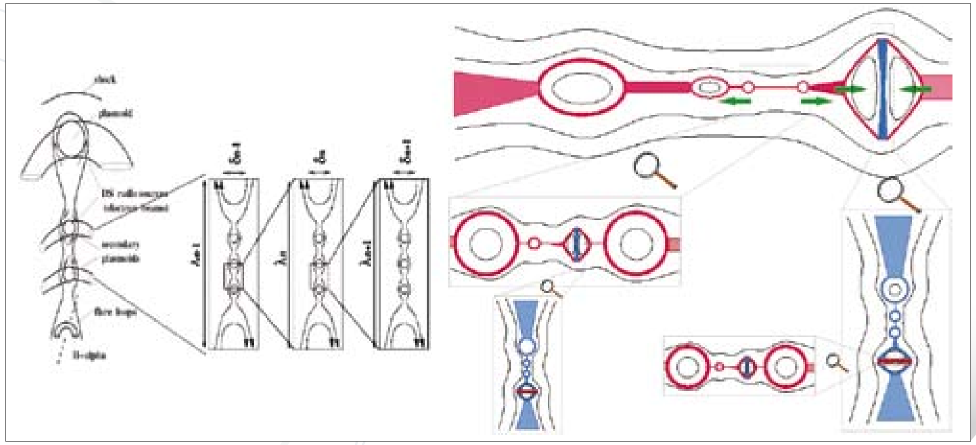
M. BÁRTA, J. BÜCHNER, M. KARLICKÝ, J. SKÁLA: Spontaneous Current-Layer Fragmentation and Cascading Reconnection in Solar Flares I: Model and Analysis (2011), ApJ 737, id. 24.
M. BÁRTA, J. BÜCHNER, M. KARLICKÝ, P. KOTRČ: Spontaneous Current-Layer Fragmentation and Cascading Reconnection in Solar Flares II: Relation to Observations (2011), ApJ 730, id. 47.
M. KARLICKÝ, M. BÁRTA: Successive Merging of Plasmoids and Fragmentation in a Flare Current Sheet and their X-ray and Radio Signatures (2011), ApJ 733, id. 107.

Magnetic field reconnection is accepted as the key mechanism for energy release in solar flares and other eruptive events in space plasmas. However, direct application of magnetic-reconnection theory to the physics of



CREDIT: NASA/ROYAL OBSERVATORY BELGIUM/SIDC

Solar flare seen by NASA's Solar Dynamics Observatory.



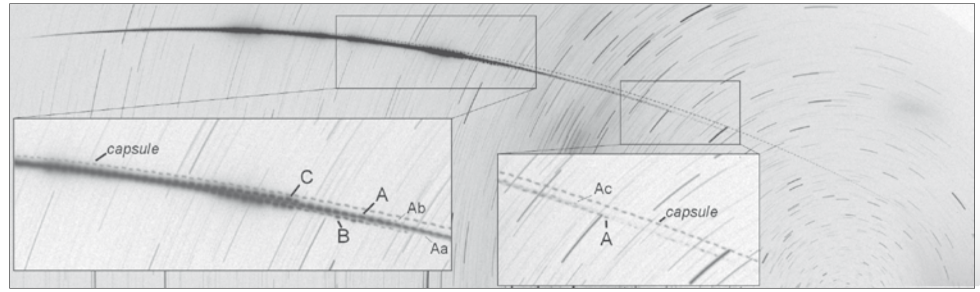
Left: Schematic idea of fractal reconnection (Shibata and Tanuma: Earth, Planet, Space 53, 2001) inserted into the interpretation of radio Drifting Pulsating Structures (DPS) by Karlický (Astronomy & Astrophysics 417, 2004). Right: The schematic view of cascading processes in magnetic reconnection as they were actually observed in our high-resolution numerical experiment. The simulation proved for the first time relevance of the Shibata's idea. Moreover, it newly revealed the significance of the plasmoid coalescence for current-layer fragmentation. The plasmoids – magnetic helical fluxtubes – play in the cascade towards the smaller scales in magnetic reconnection role similar to that played by the vortex tubes in the turbulent cascade found in sheared fluid flows.

solar flares (and other large-scale phenomena) faced a crucial issue for a long time: All known micro-physical processes leading to the change of magnetic field topology (i.e. the reconnection) require thin current sheets (~1m in the solar corona). On the other hand, the typical flare current-layer width estimated from observations is about six orders of magnitude larger. In order to overcome this scale gap Shibata and Tanuma (2001) suggested schematic conception of fractal reconnection. We focused at the research of this anticipated tearing-mode cascade in a fully non-linear regime using numerical simulations. We disclosed that earlier numerical experiments did not see the process because of their limited resolution. Extended range of scales covered by our simulations for the first time proved the role of the tearing-mode cascade for the energy transfer. Above all it revealed the significance of the opposite process – the plasmoid coalescence – for further fragmentation of the current structures. Although plasmoid coalescence eventually leads to the formation of a single larger structure from the two smaller, this process is inherently connected with further fragmentation in the current sheet between the merging plasmoids. Consequently, also this process unexpectedly contributes to the energy transport towards small scales (direct cascade). Using kinetic Particle-In-Cell simulations we proved that this process (fragmenting coalescence) applies down to the dissipation scale. The results extend the scope of solar physics and contribute to the development of magnetic-reconnection theory and the theory of plasma turbulence in general.

5.2 The passage of the Japanese HAYABUSA spacecraft through the atmosphere during the re-entry – analysis of an artificial fireball

J. BOROVIČKA, S. ABE, L. SHRBENÝ, P. SPURNÝ, P. A. BLAND: Photographic and radiometric observations of the HAYABUSA re-entry (2011), PASJ, Vol. 63, No. 5, p. 1003.

Japanese interplanetary spacecraft HAYABUSA investigated asteroid Itokawa and brought samples back to the Earth. The re-entry occurred over southern Australia on June 13, 2010. Due to the failure of the main engine, not only the



Photograph of the fireball caused by the re-entry of the HAYABUSA spacecraft taken by the Japanese expedition near Coober Pedy. The exposure was interrupted by rotating shutter 10 times per second. Individual fragments are marked.

re-entry capsule, which separated from the spacecraft shortly before the arrival to the Earth, but also the spacecraft itself entered the atmosphere. The spacecraft of mass of about 400 kg followed the capsule with one second delay. It completely disintegrated and evaporated in the atmosphere, creating a bright fireball. The capsule of mass of 20 kg was protected by a thermal shield, survived therefore the atmospheric passage and did not radiate so much.

Japanese scientists observed the re-entry from several sites with the aim to localize the capsule after its impact and to investigate the artificial fireball. The fireball was also recorded by the cameras of the Desert Fireball Network operated by our Institute in collaboration with colleagues from UK and Australia in southwestern Australia. In the paper we analyzed the trajectory, velocity, deceleration and radiation of the capsule, the spacecraft and its main fragments. We also determined the heights of spacecraft fragmentations. The trajectory of the capsule deviated from the prediction by mere 300 meters. Some fragments gained a side velocity of 250 m/s during the break-ups. The luminous efficiency of the spacecraft fireball, i.e. the part of its kinetic energy radiated out, was determined to 1.3%. The observation of this fireball represented a rare opportunity to study the interaction of a body of known mass, structure and composition with terrestrial atmosphere at a speed of 12 km/s and gain data for the study of natural meteoroids.

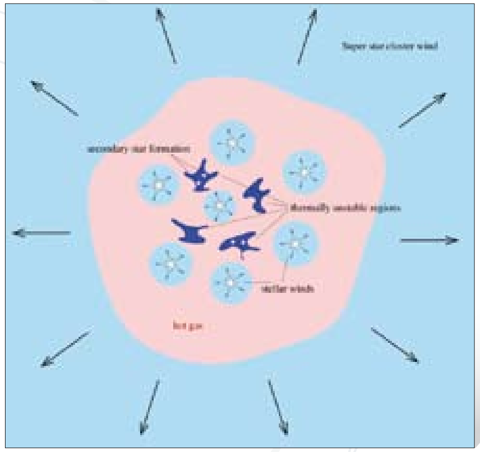
5.3 Cooling winds of super star clusters

R. WÜNSCH, S. SILICH, J. PALOUŠ, G. TENORIO-TAGLE, C. MUÑOZ-TUÑÓN: Evolution of Super Star Cluster Winds with Strong Cooling (2011), ApJ 740, id. 75.

We studied evolution of winds of young stars in massive stellar clusters (Super Star Clusters)

CREDIT: NASA AMES RESEARCH CENTER / ED SCHILLING

HAYABUSA re-entry and its breakdown.



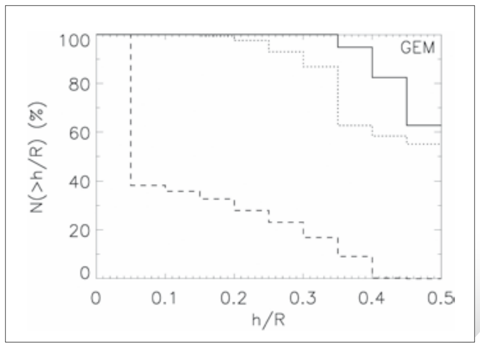
Schematic sketch of a Super Star Cluster.

observed for instance in colliding galaxies as Antennae (NGC 4038/NGC 4039). Results describing the so called bimodal regime in those clusters, obtained in previous works (Wünsch et al. 2007, 2008), are connected to results of stellar population synthesis code Starburst99 used to calculate total energy and mass deposition rates of young massive stars in the cluster. This mass and energy leads to the formation of the star cluster wind reaching a substantial distance in galactic or intergalactic space. Under certain circumstances given by the mass and the radius of the super star cluster, the wind becomes thermally unstable in the central region of the cluster. The work estimates the period and the extent of the thermal instability which may be source of mass for the central black hole or induced secondary star formation. The works builds on two previous papers and for the first time quantitatively formulates implications of the thermal instability for the evolution of Super Star Clusters.

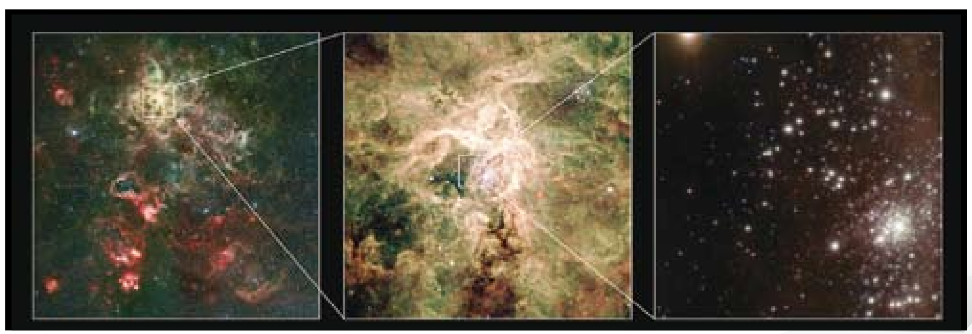
5.4 Thermal stress in small meteoroids: II. Effects of an insulating layer

D. ČAPEK, D. VOKROUHLICKÝ: Thermal stress in small meteoroids II. Effects of an insulating layer (2012), A&A 539, A25.

Čapek & Vokrouhlický (2010) studied the destruction of spherical and homogeneous meteoroids by the thermal stress caused by the solar heating. The real process of the destruction of the meteoroids is more complicated. As the meteoroid approaches the Sun, thermal stresses first exceed the material strength near the surface. One may then consider two possible end-state situations: (i) the fractured material at the surface is immediately removed by the transformation of elastic energy into kinetic energy during the crack formation, or owing to centrifugal forces. In this case, the thermal stress results in erosion of the meteoroid, reducing its size. (ii) The fractured material remains at the surface, possibly owing to either molecular sticking or an insufficiently interconnected system of fractures. We focused on the second possibility and developed an appropriate analytical model. Our results show that in one or a few revolutions about the Sun, a particulate surface layer develops and is able to thermally shield the core, preventing any further damage by thermal stresses. We found that the depth of fractured surface layer increases with increasing body size, it increases with decreasing angle between the spin axis and the orbital plane, and decreases with the degree of the cracking. We also estimate the distribution of the final depths of the surface layer for major meteoroid showers with perihelion distances smaller than 1 AU. Our results show that the thermal stress weathering affects not only the surface of the Earth's dry deserts, Mercury, or NEAs. The thermal stresses are also able to damage the surface of small meteoroids at sufficiently small perihelion distances. The most affected meteoroid streams seem to be δ −Aquariids, Geminids, and Monocerotids.



Cumulative number of Geminid meteoroids (ordinate) with fractured surface layer depth equal to or greater than h/R (abscissa), where R is the radius of the body. Three sizes of meteoroids were used: 10 cm (solid line), 1 cm (dotted line), and 1 mm (dashed line).



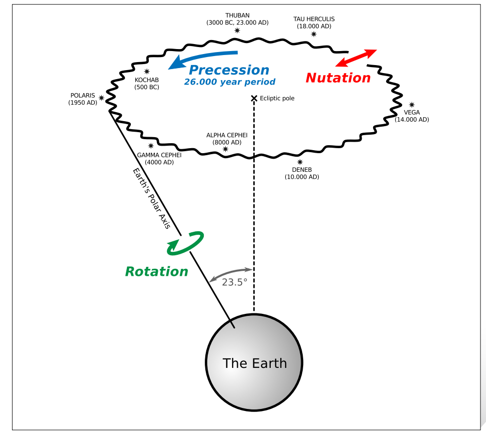
CREDIT: ESO/P. CROWTHER/C. J. EVANS.

The Tarantula Nebula with the embedded supercluster R136.

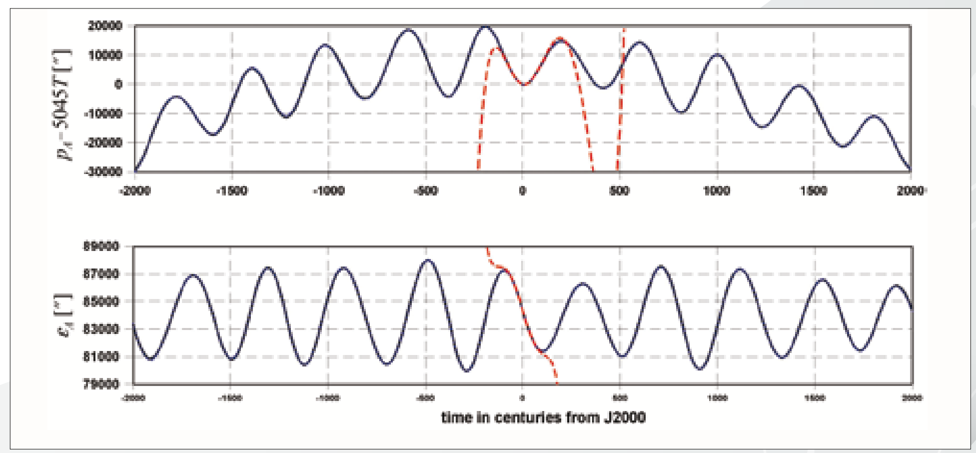
5.5 New model of Earth's precession

J. VONDRÁK, N. CAPITAINE, P. WALLACE: New precession expressions valid for long time intervals (2011), A&A 524, A22.

Precession is a very long-periodic motion of Earth's axis of rotation in space, around the pole of the ecliptic. All precession models used in astronomy (including the present one, IAU 2006) are given as an expansion into power series of time. We demonstrated that these models are

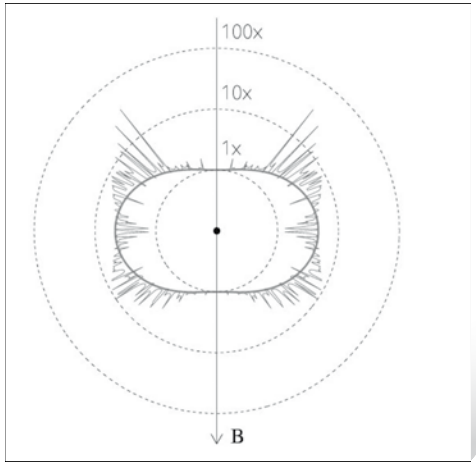


The Earth's rotation axis now happens to be pointing close to Polaris, but due to its precession it will point to Vega in 13,000 years, while after the period of 26,000 years Polaris will once again be the Pole Star.



Comparison of the new model (full line) with the numerical integration (dotted line) and the model IAU 2006 (dashed line), for the general precession in longitude p_A and obliquity of the ecliptic ε_A. First two curves are graphically indistinguishable.

extremely accurate in a close vicinity of the basic epoch J2000.0 (several centuries), but, for more distant epochs, they rapidly diverge from reality. To derive the new model, valid in the interval of hundreds thousand years, we used numerical integration of the Earth's motion in the solar system and its rotation, and thence we obtained analytical expressions in the form of trigonometric series for a number of precession angles. Typical periods of the individual terms are hundreds centuries. By choosing appropriate weights when estimated individual amplitudes we achieved the accuracy of the new model to be equivalent to the model IAU 2006 for epochs distant up to 1000 years from the basic epoch, and gradually decreasing to a few minutes of arc for the epochs 200 thousand years away. This is a substantial improvement since the errors of the model IAU 2006 at these epochs are reaching tens degrees. We expect that the new model can be used, e.g., in historical studies.



Intensity of accelerated electrons depending on angles from the direction of the magnetic field B. The intensity is relative with respect to the initial intensity (shown by the smallest dashed circle). The thick line shows the intensity for a plane shock (e.g., without waviness).

5.6 Electron acceleration in a wavy shock front

M. VANDAS, M. KARLICKÝ: Electron acceleration in a wavy shock front (2011), A&A 531, A55.

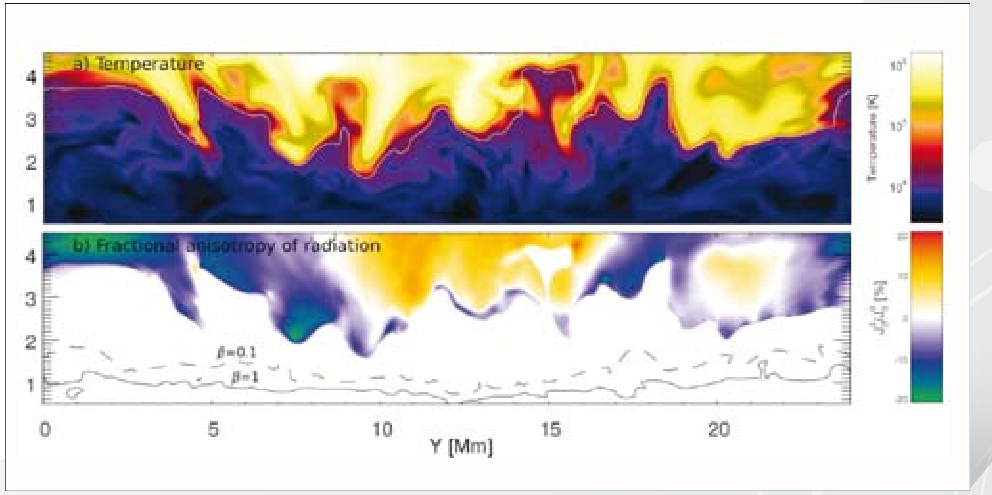
It is well known that electrons are accelerated by shock waves in space (e.g., in the solar corona or interplanetary space). To study this process theoretically, the shape of shock waves is usually taken as a plane. We investigated a more general case, when a shock wave has a wavy form, which is probably more close to reality. An unexpected result was found that angular distribution of accelerated electrons is very anisotropic, with many spikes. Such a distribution is prone to invoke various plasma instabilities which may intensify electron acceleration and associated radio emission. The shock wave model was based on a regular wavy shock (sinusoidal shape). But our detailed investigation shows that this type of distribution will be also present for irregular wavy shock, that is, for a form more probable in nature.

5.7 The Hanle effect of Ly-alpha in magnetohydrodynamic model of the solar transition region

J. ŠTĚPÁN, J. TRUJILLO BUENO, M. CARLSSON, J. LEENAARTS: The Hanle Effect of Lyalpha in a Magnetohydrodynamic Model of the Solar Transition Region (2012), ApJL 758, p. 43.

In order to understand the mechanism of solar coronal heating, it is crucial to obtain quantitative information on magnetic field at its lower boundary, the transition region (TR). Within this layer, just few kilometres thick, the temperature rises from few thousands to millions of Kelvins and the density of plasma rapidly decreases. Magnetic field in this layer modulates propagation of plasma waves and the whole mechanism of energy transfer from the lower layers of the atmosphere to the corona. In order to measure magnetic fields, we can use observations of linear polarization of spectral lines which is sensitive to magnetic fields via the Hanle effect. TR predominantly emits ultraviolet radiation in which the strongest line is the hydrogen Lyman-alpha at 122 nanometres. Measurement of its polarization will be performed by the international (USA, Japan, Spain, Norway, France, Czech Republic) project CLASP (Chromospheric Lyman-Alpha SpectroPolarimeter). The goal of our work, done in collaboration with scientists from Spain and Norway, is to show the effect of complicated spatial structuring of the TR on the line polarization. This effect needs to be distinguished from the action of magnetic fields. We have used a detailed 3D magnetohydrodynamic (MHD) model of the solar atmosphere and we have applied our tools for calculation of radiation transfer. We have found that the scattering processes in Lyman-alpha do produce measurable linear polarization of the line. Moreover, this polarization is sensitive to the magnetic fields present in the model. A comparison of our results with the experimental results of CLASP shall soon enable us to decipher magnetic structure of the solar transition region.

Aurora Borealis, resulting from the interaction of high-speed charged particles with the Earth magnetosphere, seen from the ISS.



Upper panel: Slice of the MHD model showing temperature in a vertical slice of the atmosphere. The transition region is indicated by red colour, the corona is yellow. Lower panel: Anisotropy of the Lyman-alpha line radiation in the same slice. Line polarization originates in regions with non-zero anisotropy, i.e., at the lower boundary of the corona.

5.8 The Bunburra Rockhole meteorite fall in SW Australia: Fireball trajectory, luminosity, dynamics, orbit, and impact position from photographic and photoelectric records

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This work describes detailed analysis of the first instrumentally observed meteorite fall in Australia which was recorded photographically and photoelectrically by 2 stations of the Desert Fireball Network (DFN) on July 20, 2007.

This event was caused by a small meteoroid with an initial mass of 22 kg which entered the atmosphere with a low speed of 13.4 km/s and began a luminous trajectory at an altitude of 63 km. In maximum it reached –9.6 magnitude and terminated after 5.7 s and a 65 km long flight at an altitude of 30 km. On the basis of evaluation of photographic records a possible fall of small meteorites and their impact location was predicted. The first organized search took place in October 2008 and the first meteorite (150 g) was found 97 m southward from the predicted central line at the end of the first searching day. The second stone (174 g) was found 39 m northward from the central line, both exactly in the predicted mass limits. During the second expedition in February 2009, a third fragment of 14.9 g was found again very close (~100 m) from the predicted position. The meteorite was designated Bunburra Rockhole (BR) after a nearby landscape structure.

This result is from many aspects unique. It is the fifth predicted meteorite fall in history, the first instrumentally observed meteorite fall in the southern hemisphere and the first one based only on data from dedicated instruments. There was no other observation, and without our unique experiment the fall would be completely unknown. BR is the first documented meteorite fall from a relatively small meteoroid, which produced not so bright fireball with a terminal height of 30 km. All previous observed meteorite falls were caused by much larger bodies penetrating much deeper in the atmosphere. Recovered meteorites are also exceptional. This first DFN sample is classified as a new type of anomalous achondrite (Bland, Spurný et al. 2009 in Science). BR is the first known meteorite from an unusual Aten type orbit (a < 1 AU). BR is the first achondrite with a known orbit and it is one of the most precise orbits ever calculated for a meteorite dropping fireball.

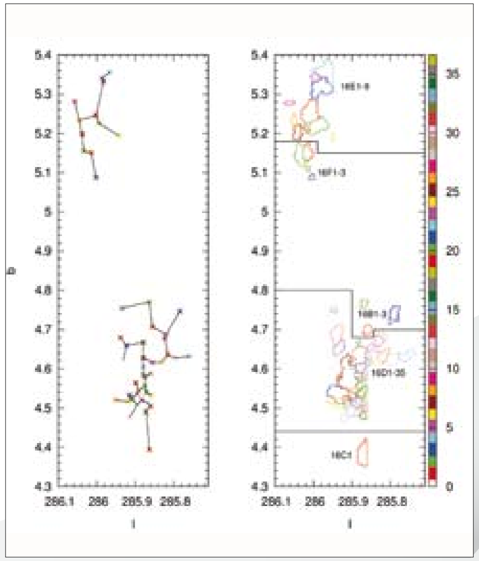
Bunburra Rockhole meteorites recovered by the first expedition in October 2008. The meteorites are classified as anomalous achondrites and they are the first achondrites with known heliocentric orbit. The first meteorite (right on the image) with mass of 150 g was found on October 3. The second meteorite with mass of 174 g was found on October 11, 2008.

5.9 The Carina Flare: What can fragments in the wall tell us

R. WÜNSCH, P. JÁCHYM, V. SIDORIN, S. EHLEROVÁ, J. PALOUŠ, J. DALE, J. R. DAWSON, Y. FUKUI: The Carina Flare: What can fragments in the wall tell us? (2012), A&A 539, A116.

The purpose of this work is threefold: (i) we present our original observations of CO molecular lines emitted by a part of the Carina Flare supershell taken by the ESO APEX telescope; (ii) we describe a new object finding algorithm DENDROFIND and use it for identification of dense fragments in the observed region; (iii) we compare the fragment properties to the prediction of the Pressure Assisted Gravitational Instability (PAGI) – the theory of the thick shell fragmentation. At a distance only 2.6 kpc, Carina Flare (GSH287+04-17) is one of the nearest supershells in our Galaxy. Since it extends hundreds of pc above the galactic disc, the probability of other non-related objects being projected to the same region of the sky is low, and this makes Carina Flare ideal for a study of the shell fragmentation process. The observations were taken by the APEX telescope under the ESO programme 086.c-0187 during the 86th period: October 2010 – March 2011. Using the DENDROFIND algorithm developed in our group, we identify dense fragments. We determine fragment masses and their mean separation by constructing the minimum spanning tree (by the method suggested by O. Borůvka in 1926). We compare the obtained masses and separations to the PAGI theory (Wünsch et al., 2010; Dale et al., 2009, 2011). We conclude that the observed combination of fragment masses and separations is well explained by their origin due to the gravitational instability. Moreover, these fragment properties enable us to determine the shell surface density and the pressure extended to the shell, and these values are in a good agreement with HI and CO observations of the Carina Flare supershell found in the literature.

APEX (the Atacama Pathfinder Experiment) is a millimetre/submillimetre telescope standing on Chajnantor Plateau in Chile.

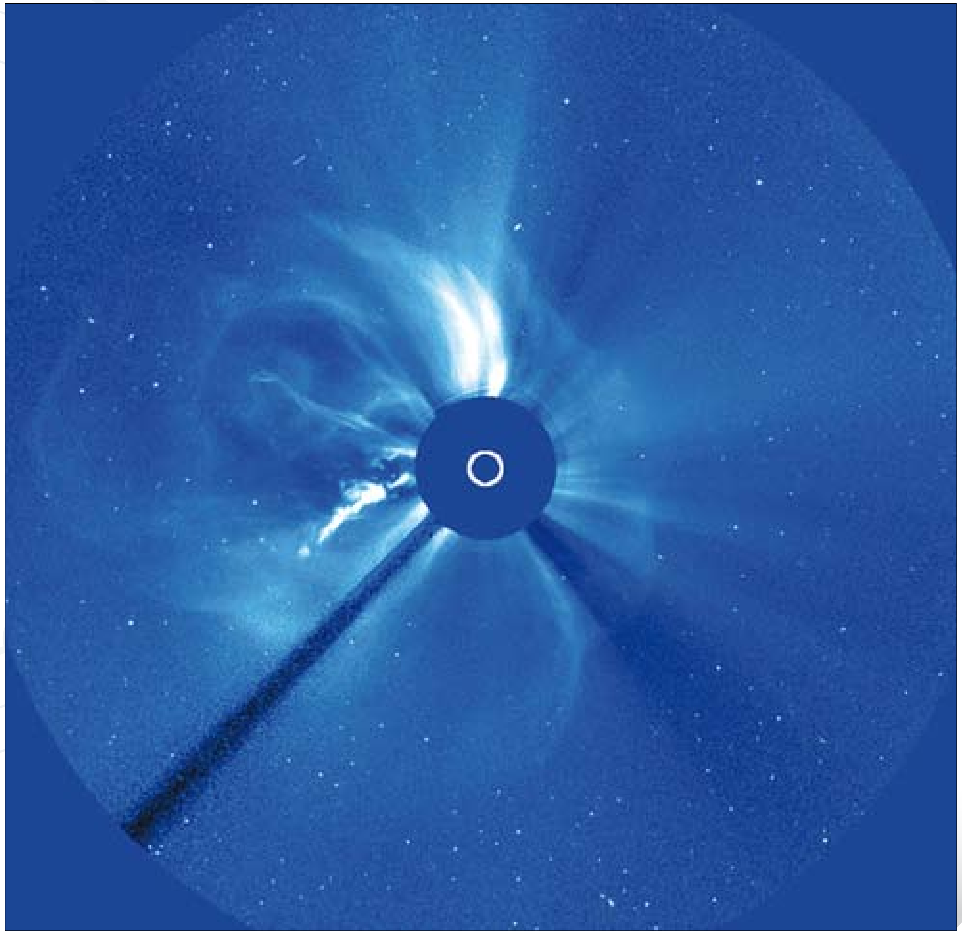


Left: Minimum spanning tree connecting positions of fragments found in our observations. Right: The identified fragments shown as contours of colour denoting the fragment number.

5.10 The electron n-distribution and double layers in solar flares

J. DUDÍK, J. KAŠPAROVÁ, E. DZIFČÁKOVÁ, M. KARLICKÝ, Š. MACKOVJAK: The non-Maxwellian continuum in the X-ray, UV and radio range (2012), A&A 539, A107.

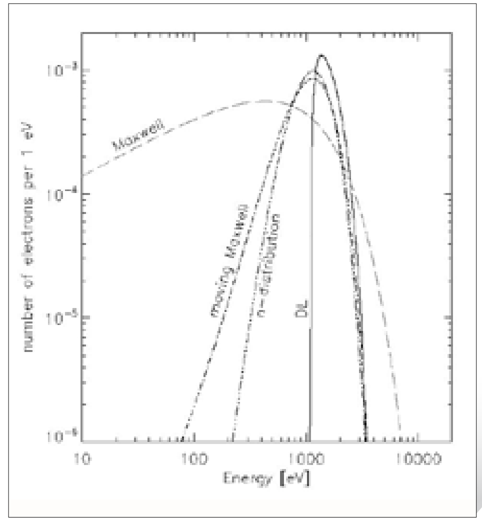
By analysing X-ray spectra we detected n-distributions of electron energies in the impulsive phases of solar flares (Kulinová et al. 2011).


CREDIT: ESA/NASA

A solar flare seen by the LASCO imager on board the ESA/NASA SOHO spacecraft.

We found that the n-distribution and moving Maxwellian one are nearly the same at their high-energy parts (Karlický et al. 2012). Based on their mutual fitting at these parts we derived a simple relation between parameters of these distributions as: $v_0/v_T \sim (3/4\ n)^{1/2}$, where v_0 is the drift velocity and v_T is the thermal one.

However, we find that observed values of the parameter n of the n-distribution correspond to very high values of the parameter v_0/v_T for which the moving Maxwellian distribution is unstable. Thus to generate the distribution similar to the n-distribution, some stabilization process is necessary. Therefore, we investigate processes in the electron beam-return current system in the impulsive phase of solar flares using a 3-D electromagnetic particle-in-cell model. We find that in such a system the strong double layer (DL) can be formed and in its electric field the electrons are strongly accelerated. The high-energy part of their distribution resembles that of the n-distribution (see Figure) and remains stable (Karlický 2012). Thus, a detection of the n-distributions indicates a presence of double layers in solar flares. A similarity of processes in solar flares and those in the terrestrial aurora, where the double layers were observed by FAST satellite, support this idea. Finally, we study the influence of the n-distribution on the X-ray continua observed by X-ray spectrometers (Dudík et al. 2012).



Comparison of the electron distribution functions with the same mean energy in solar flares: n-distribution, the moving Maxwell distribution and DL distribution, which is generated in the double layer, are nearly the same at their high-energy part. They decrease towards higher energies much faster than the Maxwell one.

5.11 Binary asteroid population: Anisotropic distribution of orbit poles of small, inner main-belt binaries

P. PRAVEC, P. SCHEIRICH, D. VOKROUHLICKÝ, A. W. HARRIS, P. KUŠNIRÁK, K. HORNOCH, D. P. PRAY, D. HIGGINS, A. GALÁD, ET AL.: Binary asteroid populatio II. Anisotropic distribution of orbit poles of small, inner main-belt binaries (2012), Icarus 218, p. 125.

Asteroids in the main belt between Mars and Jupiter are a source of near-Earth objects. Some of them are actually binary, i.e., they are bound systems of two bodies. We study their properties and evolutionary processes, that can improve an analysis of the impact hazard to Earth.

Asteroids are weak structures, they split when spun up to the critical rotation frequency and form binaries, i.e., systems of two bodies orbiting around their common centre of mass. In our work, we studied parameters of these binary asteroids. We found that their orbits are not oriented randomly, but they concentrate in two specific directions. The concentration appears to be a result of the thermal YORP effect that spins up asteroids, leading to their splitting and formation of binaries.

We studied 18 binary asteroids that we discovered during 2005 to 2011. We used the technique of temporally resolved photometry. The measurements were done with the 65cm telescope from the Ondřejov Observatory and from collaborating stations in Europe, North and South America and Australia. From the data, we derive parameters of the binary asteroids. The most interesting finding is that the binary orbits are not oriented randomly in space. We analyse the data including simulations of observational selection effects and we find that the binary orbital poles concentrate within 30 degrees from the north and south poles of the ecliptic. We propose two plausible explanations for the concentration, both being due to an action of the thermal YORP effect on asteroids. The effect is a result of the torque of infrared photons emitted from asteroid's irregular surface. This effect, besides spinning up the asteroid up to the critical frequency, also moves its pole to the upright or downright position.

The new findings extend our knowledge about how the thermal YORP effect acts to asteroids. This non-catastrophic evolutionary mechanism is an important process that reshapes the whole asteroid population.

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Photograph of night Prague taken from International Space Station.


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Winter night at the Institute.

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Physics of bright photographic meteors, measurements of all-sky images.

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(petr.scheirich@asu.cas.cz)
postdoctoral scientist
Modeling of binary and tumbling asteroids from photometric data.

Pavol Schwartz
(pavol.schwartz@asu.cas.cz)
research associate
Non-LTE study of the solar filaments and prominences, EUV spectroscopy of small-scale chromospheric structures, reduction of the data from SoHO/CDS and SoHO/SUMER spectrographs and from instruments of Hinode satelite.

Vojtěch Sidorin
(vojtech.sidorin@gmail.com)
PhD student
Interstellar matter, star formation, shells, supershells and filaments, gravitational instability, triggered star formation, the initial mass function.

Jan Skála
(jskala@physics.ujep.cz)
PhD student
Modelling magnetic field reconnection in the solar flares.

Michal Sobotka
(michal.sobotka@asu.cas.cz)
senior research scientist
Sunspots, fine structure and velocity fields in solar photosphere, high spatial resolution photometry and spectroscopy, image processing, time-series analysis, instrumentation.

Vjačeslav Sochora
(vjaceslav.sochora@asu.cas.cz)
PhD student
Radiation processes in strong gravity and their applications to active galactic nuclei and Galactic black holes.

Pavel Spurný
(pavel.spurny@asu.cas.cz)
senior research scientist
Physics of meteor flight in the atmosphere, computations of meteor orbits and trajectories, prediction of meteorites impact positions, radiation of meteors at very high altitudes, reduction methods for determination of meteor trajectories, high resolution light curves of fireballs from AFO radiometers, double station television observations of meteors.

Jiří Svoboda
(jiri.svoboda@asu.cas.cz)
postdoctoral scientist
Effects of strong gravitational field acting on radiation near compact objects, X-ray spectroscopy.

Klára Šejnová
(klara.sejnarova@asu.cas.cz)
PhD student
Be stars, modelling of Be stars.

Zdislav Šíma
(zdenek.sima@asu.cas.cz)
research scientist
Scientific interest first focused on binary stars, later more on problems of gravitational fields of planets in the solar system, namely the combination of satellite altimetric measurements and primary constants of the Earth and other planets.

Stanislava Šimberová
(stanislava.simberova@asu.cas.cz)
research scientist
Digital image processing in astronomy and astrophysics; pattern recognition – image fusion, contextual classification, feature selection, classifier performance, filtration. Image enhancement and restoration – multispectral image analysis and reconstruction, texture synthesis, geometric transformation, probabilistic relaxation, multichannel blind deconvolution.

Vojtěch Šimon
(vojtech.simon@asu.cas.cz)
research scientist
High energy astrophysics. Long-term activity and eruptive processes of accreting compact objects; relations of the character of orbital modulation to the long-term activity. Afterglows of gamma-ray bursts (GRBs), supernova - GRB connections, implications for the environment in the host galaxies of GRBs. CCD photometry, data analysis and evaluation.

Petr Škoda
(petr.skoda@asu.cas.cz)
research scientist
CCD spectroscopy, data acquisition and reduction, telescope instrumentation, computational astrophysics, astronomical databases and archives and the Virtual Observatory.

Miroslav Šlechta
(miroslav.slechta@asu.cas.cz)
research associate
Observational and computational astronomy, CCD data acquisition and reduction. History of natural sciences and astronomy.

Vojtěch Štefka
(vojtech.stefka@asu.cas.cz)
post-doctoral scientist
Earth orientation in space and its determination by modern space techniques and ground observations.

Stanislav Štefl
stanislav.stefl@asu.cas.cz)
senior research scientist
Active early-type stars, stellar oscillations, structure and density oscillations of circumstellar disks, interacting binaries, stellar magnetic fields; echelle spectroscopy, near-IR and visual interferometry, mm/sub-mm astronomy.

Jiří Štěpán
(jiri.stepan@asu.cas.cz)
research scientist
Non-LTE polarized radiative transfer, atomic processes, chromospheric magnetic fields, solar flares, software development.

Rostislav Štork
(rostislav.stork@asu.cas.cz)
research associate
TV observation of faint meteors. Planning observing campaigns, operating stations, inspecting recorded video files, searching for meteors and cataloguing them, maintaining TV meteor database.

Štěpán Štverák
(stverak@asu.cas.cz)
postdoctoral scientist
Non-thermal properties of particle distributions in space plasmas, H/W development of plasma diagnostic tools (Langmuir probes), numerical modelling and data analysis, simulations of collisionless plasmas.

Brankica Šurlan
(brankica.surlan@asu.cas.cz)
PhD student
Winds of hot stars, radiative transfer in inhomogeneous (clumped) medium.

Michal Švanda
(michal.svanda@asu.cas.cz)
research scientist
Inversion methods for local helioseismology, travel-time measurements, velocity and magnetic fields in solar photosphere, large-volume data processing.

Adam Tichý
(adam.tichy@asu.cas.cz)
PhD student
Stellar atmosphere modelling, especially radiation in stellar winds. Statistical thermodynamics used in stellar atmospheres.

Pavel Trávníček
(pavel@asu.cas.cz)
research scientist
Kinetic simulations (hybrid/Vlasov codes) of collisionless plasmas, kinetic processes in the interaction between plasma flows and planets and moons, temperature anisotropy driven instabilities in the solar wind and Earth's magnetosheath, shocks in collisionless plasmas.

Marek Vandas
(marek.vandas@asu.cas.cz)
senior research scientist
Magnetohydrodynamic simulations of interplanetary disturbances, acceleration of electrons by shock waves, magnetic clouds in the solar wind.

Michal Varady
(michal.varady@asu.cas.cz)
research associate
Solar flares and coronal loops. Numerical modelling of their hydrodynamics, electromagnetic emission, transfer and dissipation of energy of high energy particle beams in solar atmosphere, modelling of solar flares combined with radiative transfer. EUV and soft X-ray observations and diagnostics of high energy particle beams.

Jaroslav Vážný
(jaroslav.vazny@asu.cas.cz)
PhD student
Astroinformatics, machine learning and data mining, virtual observatory, big data, automatic spectral analysis.

Stephane Vennes
(vennes@sunstel.asu.cas.cz)
senior research scientist
Stellar evolution, white dwarfs, evolved binaries; Computational astrophysics, radiative transfer and convective transport in stellar atmospheres, diffusion, stellar opacities; Data analysis, spectroscopic and photometric surveys and databases, stellar parameters.

Vlastimil Vojáček
(vlastimil.vojacek@asu.cas.cz)
PhD student
Photometry, light curves, physical structure, trajectory computation and image processing of faint video meteors. Spectroscopy and physics of meteor flight in atmosphere.

Jan Vondrák
(jan.vondrak@asu.cas.cz)
research scientist emeritus
Reference frames, Earth rotation and its interaction with geophysical excitations, polar motion, precession-nutation, astrometry, ephemeris astronomy.

Viktor Votruba
(viktor.votruba@asu.cas.cz)
research scientist
Radiation hydrodynamics, theory of radiatively driven stellar winds from hot stars, multicomponent stellar wind, numerical simulations, various type of instabilities in stellar wind, nonlinear dynamics.

Richard Wünsch
(richard.wunsch@asu.cas.cz)
research scientist
Radiation-hydrodynamic simulations, self-gravity, grid-based codes; interstellar matter, star formation, expanding shells and supershells; planet formation, protoplanetary discs, layered discs; super star clusters, thermal instability.

Alena Zemanová
(alena.zemanova@asu.cas.cz)
research associate
Solar flares, spectroscopic diagnostics - soft X-ray spectra, diagnostics of the non-thermal distributions in the corona and the transition region, data processing (satellite and ground-based), participating on the developemnent of Solar Optical Robotic Telescope.

6.2 Personal Awards

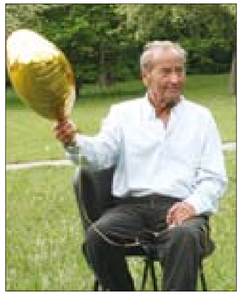
Following employees of the Institute received individual awards in 2011 and 2012:

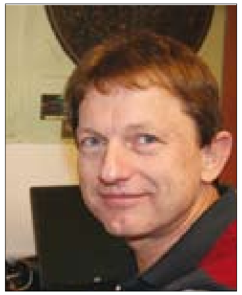

Stanislav Gunár was awarded the Premium of Otto Wichterle by the Academy of Sciences of the Czech Republic for a set of papers on solar prominences.


Petr Hadrava received the Kopal lecture granted by the Czech Astronomical Society for the significant results in the field of double stars and multiple stars.


Jan Jurčák was awarded the Premium of Otto Wichterle from Academy of Sciences of the Czech Republic for studying sunspots.


Adéla Kawka received the Academy of Sciences Award for young researchers for research of white dwarfs in our galaxy.


Josip Kleczek received the Littera Astronomica award granted by the Czech Astronomical Society for the book "Life with the Sun and in the Universe".


Pavel Spurný was awarded the Academy of Sciences Praemium Academiae for research of meteoroids and meteors.


Pavel Suchan received the Medal of Vojtěch Náprstek by Academy of Sciences for the popularisation of science.


Petr Sobotka was awarded the Zdeněk Kvíz award granted by the Czech Astronomical Society for the popularisation of science.


Michal Švanda received Jan Frič Award from the Institute for a set of papers on helioseismology.


Jan Vondrák received honorary degree by Paris Observatory.


Richard Wünsch received Jan Frič Award from the Institute for the research of induced star formation.

6.3 Supervision of PhD and Masters Theses

On the basis of an agreement with the Faculty of Mathematics and Physics of Charles University, Prague, the Institute participates in the undergraduate study programs of Astronomy and Astrophysics and in Plasma Physics. The Institute, along with the Faculty, is also responsible for PhD study program in Theoretical Physics, Astronomy and Astrophysics. Students of some other universities in the Czech and Slovak Republics are also supervised by researchers from the Institute.

PhD Theses supervised by researchers of the Astronomical Institute

Bartošková K. (Masaryk University, Brno), supervisor B. Jungwiert.

Bílek M. (Charles University, Prague), supervisor B. Jungwiert.

Ceniga M. (Masaryk University, Brno), supervisor J. Kubát.

Čechura J. (Charles University, Prague), supervisor P. Hadrava.

Dinnbier F. (Charles University, Prague), supervisor R. Wünsch.

Ebrová I. (Charles University, Prague), supervisor B. Jungwiert.

Hamerský J. (Charles University, Prague), supervisor V. Karas.

Henych T. (Masaryk University, Brno), supervisor P. Pravec.

Herčík D. (Czech Technical University, Prague), supervisor P. Trávníček.

Jílek M. (Czech Technical University, Prague), supervisor P. Trávníček.

Kopáček O. (Charles University, Prague), supervisor V. Karas.

Křížek M. (Charles University, Prague), supervisor B. Jungwiert.

Laifr J. (Czech Technical University, Prague), supervisor P. Trávníček.

Lynnyk A. (Charles University, Prague), supervisor M. Vandas.

Mackovjak Š. (Comenius University, Bratislava, Slovakia), supervisor E. Dzifčáková.

Muratore M.F. (University of La Plata, Argentina), supervisor M. Kraus.

Prosecký T. (Charles University, Prague), supervisor P. Heinzel.

Skála J. (J.E. Purkyně University, Ústí nad Labem), supervisor M. Bárta.

Skalická T. (Masaryk University, Brno), supervisor B. Jungwiert.

Sidorin V. (Charles University, Prague), supervisor J. Palouš.

Sochora V. (Charles University, Prague), supervisor V. Karas.

Šebek O. (Czech Technical University, Prague), supervisor P. Trávníček.

Šurlan B. (Charles University, Prague), supervisor J. Kubát.

Tichý A. (Masaryk University, Brno), supervisor J. Kubát.

Vážný J. (Masaryk University, Brno), supervisor P. Škoda.

Vojáček V. (Charles University, Prague), supervisor J. Borovička.

Zychová L. (Masaryk University, Brno), supervisor S. Ehlerová.

PhD Theses successfully defended under the scientific supervision by researchers of the Astronomical Institute

Ceniga M.: Stellar wind of hot stars
(2011, Masaryk University Brno, supervisor J. Kubát)

Abstract: The radiation driven winds of rotating hot stars were studied in this PhD thesis. The radiation driven wind is well described by the CAK theory, which assumes the Sobolev approximation in calculation of the line-radiative force. The rotation was included by assuming the conservation of angular momentum. The code, developed in this thesis, stems from the Krtička's code and calculates the solution of the 1D stationary isothermal axisymmetric rotating line-driven wind. The oblateness of the star, the gravity darkening effects, and the non-radial components of forces were neglected. The results of modelling confirm that there is a new solution of hydrodynamic equations for rapidly rotating stars. This new wind solution, connected with a new critical point located far from the star, is much denser and slower than the CAK solution for slowly rotating stars. The wind density ratio between the equator and the pole ($\Omega_{rov}/\Omega_{pol}$) reaches at least two orders of magnitude in the region closest to the stellar surface and one order of magnitude in the outer part of the wind. The calculations show the existence of a high density disk close to the stellar surface. Disk formation close to the star is influenced mainly by the gas pressure gradient and by the continuum radiative force, and significantly depends on the wind density at the stellar surface. The switch from the fast solution to the slow solution occurs for a certain value of rotation speed called the "switch"" rotation speed. The switch rotation rate (Ω_{switch}) depends on the set of the force multiplier parameters; the lower value of the Ω parameter, the lower value of the "switch" rotation rate. Higher value of the Ω parameter causes the same effect. At the rotation rate $\Omega=\Omega_{switch}$ there are two critical points, but the slow solution is obtained only for the new one. For rotation rates close to the "switch" value, $\Omega \rightarrow \Omega_{switch}$, there are strongly oscillating unstable solutions. The effect of the fast rotation alone cannot explain the high wind-density ratio for the stars with B[e] phenomenon. To explain it, wind models assuming the bi-stability effect were calculated. This effect was represented by two sets of line force parameters to describe different temperatures at the pole and in the equatorial region, the effect caused by the fast rotation. The calculations confirm the high density ratio in the whole wind, $\Omega_{rov}/\Omega_{pol}\approx 100$, which satisfies the lower value predicted for the B[e] stars disk.

Kopáček O.: Transition from regular to chaotic motion in black hole magnetospheres
(2011, Charles University Prague, supervisor V. Karas)

Abstract: Cosmic black holes can act as agents of particle acceleration. We study properties of a system consisting of a rotating black hole immersed in a large scale organized magnetic field. Electrically charged particles in the immediate neighbourhood of the horizon are influenced by strong gravity acting together with magnetic and induced electric components. We relax several constraints which were often imposed in previous works: the magnetic field does not have to share a common symmetry axis with the spin of the black hole but they can be inclined with respect to each other, thus violating the axial symmetry. Also, the black hole does not have to remain at rest but it can instead perform fast translational motion together with rotation. We demonstrate that the generalization brings new effects. Starting from uniform electro-vacuum fields in the curved spacetime, we find separatrices and identify magnetic neutral points forming in certain circumstances. We suggest that these structures can represent signatures of magnetic reconnection triggered by frame-dragging effects in the ergosphere. We further investigate the motion of charged particles in these black hole magnetospheres. We concentrate on the transition from the regular motion to chaos, and in this context we explore the characteristics of chaos in relativity. For the first time, we apply recurrence plots as a suitable technique to quantify the degree of chaos near a black hole.

Lynnyk A.: Evolution of Interplanetary Coronal Mass Ejections
(2011, Charles University Prague, supervisor M. Vandas)

Abstract: This thesis deals with deformation of the Interplanetary Coronal Mass Ejections (ICMEs) and their sub-class Magnetic Clouds (MCs) during their propagation in the Solar Wind (SW). The statistical study of the expanded MCs has shown that expansion greatly affects the MC internal magnetic field. We had shown that this influence is more clear for the MCs observed close to their axes. The study of the stand-off shock distance in front of the supersonic ICME confirms a smooth deformation of the ICMEs along their path from the Sun into interplanetary space. We observed that this deformation is increasing with the velocity of the ICME. This study also confirmed the difference in sheaths that are created in front of expanding and non-expanding ICMEs. We found that velocity distribution inside the MC is not uniform and it has large fluctuations. We found that the MC cross-section is usually strongly deformed.

Šurlan B.: Radiation in stellar winds. Resonance line formation in inhomogeneous hot star winds
(2012, Charles University Prague, supervisor J. Kubát)

Abstract: To incorporate the three-dimensional nature of stellar wind clumping into radiative transfer calculations, in this thesis a newly developed full 3D Monte Carlo radiative transfer code for inhomogeneous expanding stellar winds is presented and used to investigate how different model parameters influence formation of resonance lines. Those are computed using realistic 3D models that describe the dense as well as the rarefied wind components with non-monotonic velocity fields. It is shown that the density and velocity wind inhomogeneities have very strong impact on the resonance line formation. The models show that the line opacity is lower for a larger clump separation and shallower velocity gradients within the clumps. They also demonstrate that to obtain empirically correct mass-loss rates from UV resonance lines, wind clumping and its 3-D nature must be taken into account.

Masters Theses supervised by researchers of the Astronomical Institute

Andrássy R. (P. J. Šafárik University, Košice, Slovakia), supervisor R. Hudec. He defended his thesis Gamma ray bursts and their precursors in September 2011.

Bílek M. (Charles University, Prague), supervisor B. Jungwiert. He defended his thesis Shell galaxies and modified Newtonian dynamics in May 2011.

Dinnbier F. (Charles University, Prague), supervisor B. Jungwiert. He defended his thesis The influence of stellar mass-loss and the dynamic star clusters in May 2011.

Doležalová B. (Masaryk University, Brno), supervisor J. Kubát.

Dyčková Š. (Masaryk University, Brno), supervisor P. Heinzel

Hamerský J. (Charles University, Prague), supervisor V. Karas. He defended his theses Magnetic field in the Galactic centre. In May 2011.

Janeková L. (Masaryk University, Brno), supervisor B. Jungwiert

Krejčová K. (Charles University, Prague), supervisor A. Kawka. She defended her thesis Spectroscopic Studies of white dwarf stars in September 2011.

Pavelka R. (Czech Technical University, Prague), supervisor P. Trávníček.

Poledniková J. (Masaryk University, Brno), supervisor R. Hudec. She defended her thesis Cosmic gamma ray bursts, their parameters and correlations in May 2011.

Pék J. (University of West Bohemia, Pilsen), supervisor C. Ron.

Poledníková J. (Masaryk University, Brno), supervisor R. Hudec. She defended her thesis Cosmic gamma ray bursts, their parameters and correlations in May 2011.

Tomić S. (University of Belgrade, Serbia), supervisor M. Kraus. She defended her thesis Line profile variability in Galactic B supergiants in August 2012.

6.4 Participation in Editorial Boards

V. Bumba: Honorary member of the Editorial Board of Solar Physics

M. Burša: member of Editorial Board of Earth, Moon, and Planets

P. Heinzel: member of the Editorial Board of Solar Physics and Serbian Astronomical Journal

M. Karlický: member of the Editorial Board of Solar Physics and Contributions of the Astronomical Observatory Skalnaté Pleso

P. Koubský: member of the Editorial Board of the Central European Astrophysical Bulletin

J. Kleczek: Honorary member of the Editorial Board of Solar Physics

P. Kotrč: member of the Editorial Board of the Central European Astrophysical Bulletin

J. Palouš: member of Editorial Board of Romanian Astronomical Journal

L. Perek: member of Editorial Board of Space Policy

C. Ron: member of Editorial Board of Romanian Astronomical Journal

J. Vondrák: member of Editorial Board of Serbian Astronomical Journal and Contributions of the Astronomical Observatory Skalnaté Pleso

6.5 Involvement in International Scientific Organizations

European Southern Observatory (ESO) and European Space Agency (ESA)

The Institute is actively involved in several ESO observing programs and number of our scientists are successful in turning their proposals into observations. Main themes are star formation, massive stars and white dwarfs. We modernized the Danish 1.54m telescope at La Silla ESO site and started a testing observation campaign of small solar system bodies. In Ondřejov, our ALMA Regional Centre is actively involved in preparation of solar observations with the world's largest astronomical instrument. J. Palouš is a member of ESO Council; J. Kubát (2011, 2012), P. Hadrava (2011) and P. Pravec (2012) served as advisors of ESO Observing Program Committee; S. Štefl works directly at VLT telescope.

Institute's scientists are also members of international teams involved in ESA projects. Petr Heinzel is a member, as an associated scientist, of the scientific team of SUMER (Solar Ultraviolet Measurements of Emitted Radiation) experiment on SOHO (Solar & Heliospheric Observatory) satellite. René Hudec is a member of the OMC (Optical Monitoring Camera) experiment consortium as well as a member of ISDC consortium of INTEGRAL satellite, a member of CU7 Unit of ESA Gaia, a consortium member and co-investigator of ESA LOFT and a member of ESA Telescope working group of IXO/Athena. František Fárník is a member of the international consortium for development and manufacture of Solar Orbiter/STIX instrument (X-ray telescope and spectrometer) as the Czech Co-I. Pavel Koubský and René Hudec are leaders of workpackages within section CU7 of future ESA Gaia satellite. Pavel Trávníček is a co-investigator of Radio and Plasma Wave Instrument (RPWI) of JUICE mission, Co-I in PEACE experiment, the satellite Double Star, Principal Investigator in DualSegmented Langmuir Probe (DSLP) experiment of Proba 2 satellite, a member of scientific teams of MPPE and SERENA-PICAM experiments on Bepi-Colombo probe. He is also a leading Co-I in the Radio Plasma Waves (RPW) consortium of Solar Orbiter mission. Petr Heinzel and Stanislav Gunár are members of the consortium for development of the solar corona-graph ASPIICS for PROBA-3 mission. Arkadiusz Berlicki is a Co-I member in the international consortium of METIS corona-graph onboard Solar Orbiter ESA mission, while P. Heinzel is in the Advisory Board. J. Štěpán is a member of science team of JAXA-NASA polarization experiment CLASP. M. Švanda is the CFO for the ground segment of PLATO ESA mission. Vladimir Karas and Michal Dovčiak are members of the Management Committee for COST action MP1104 "Polarization as a tool to study the Solar System and beyond" for the Czech Republic.

The following scientists employed at the Institute are members of the International Astronomical Union:

P. Ambrož, M. Bárta, J. Borovička, V. Bumba, M. Bursa, M. Burša, D. Čapek, J. Dale, M. Dovčiak, E. Dzifčáková, S. Ehlerová, F. Fárník, A. Galád, S. Gunár, P. Hadrava, P. Harmanec, P. Heinzel, J. Horák, R. Hudec, P. Jáchym, B. Jungwiert, J. Jurčák, V. Karas, M. Karlický, J. Kašparová, A. Kawka, J. Kleczek, J. Klokočník, M. Klvaňa, P. Koten, P. Kotrč, P. Koubský, M. Kraus, J. Kubát, H. Mészárosová, D. Nickeler, J. Palouš, P. Pecina, L. Perek, P. Pravec, C. Ron, A. Růžička, P. Scheirich, P. Schwartz, L. Shrbený, M. Sobotka, P. Spurný, Z. Šíma, V. Šimon, P. Škoda, M. Šlechta, S. Štefl, J. Štěpán, M. Švanda, M. Vandas, S. Vennes, J. Vondrák, V. Votruba, and R. Wünsch.

The official representative of the Czech Republic to the IAU is the Czech National Committee for Astronomy (CNCA). The following scientists from the Institute were members of the CNCA:

J. Borovička, P. Hadrava (chairman), P. Heinzel, M. Karlický, J. Palouš, P. Pravec, C. Ron (secretary), J. Vondrák.


CREDIT: ALMA/HST

Combined optical and sub-millimetre image of the pair of colliding Antennae Galaxies.

Examples of approved ESO observing programs for 2012 in which scientists of our Institute took part.		
Project name	**Telescope/Instrument**	**Scientist**
Triggered Star Formation in the Carina Flare supershell	APEX/SHFI	J. Palouš, P. Jáchym, V. Sidorin, R. Wünsch
Star formation in the assembling cluster complex RXJ1347-11 at z=0.45	UT1/FORS2	I. Orlitová-- Stoklasová
Abundances analysis of new DAZ white dwarfs	UT2/X-Shooter	A. Kawka, S. Vennes
Hot subdwarf binaries in the GALEX survey	NTT/EFOSC2	S. Vennes, A. Kawka
The magnetic field structure of white dwarfs	UT1/FORS2	A. Kawka, S. Vennes
Properties of rare double degenerates: A new class of nitrogen-polluted DQ white dwarfs?	UT2/X-Shooter	S. Vennes, A. Kawka
Photospheric signature of accreted material onto cool, old white dwarfs	UT2/X-Shooter	A. Kawka, S. Vennes
Resolving the inner dusty disk structure in the core of the evolved object Hen 2-90	VLT/MIDI	M. Kraus
Probing the mass-loss history and the evolutionary phase of massive evolved stars	UT4/SINFONI	M. Kraus
CO observation of ram pressure stripped galaxies ESO137-001 and ESO137-002 in A3627	APEX/SHFI	P. Jáchym
The study of the characteristics of the dusty disk around CPD-52 9243	VLT/MIDI	M. Kraus
Study of non-gravitational asteroid evolution processes via photometric observations	DK154	P. Pravec, P. Scheirich, A. Galád
Systematic observations of fields near the South Ecliptic Pole for calibrations of Gaia satellite measurements	DK154	P. Koubský, V. Votruba, P. Škoda

The following IAU members are currently active in the committees of the IAU bodies:

J. Borovička: vice-president of Commission 22 (Meteors, Meteorites and Interplanetary Dust) P. Heinzel: member of the organizing committee of Commission 12 (Solar Radiation and Structure) J. Palouš: IAU vice-president, member of the IAU Executive Committee C. Ron: member of Finance Sub-Committee J. Vondrák: member of the organizing committees of Division I (Fundamental Astronomy) and Commission 4 (Ephemerides) (until August 2012)

The official representative of the Czech Republic to the IUGG (International Union of Geodesy and Geophysics) is the Czech National Committee of IUGG.

The following scientist from the Institute is member of the CNC of IUGG: Z. Šíma.

Involvement of scientists from the Institute in other important international organizations:

Committee on Space Research (COSPAR), European Astronomical Society (EAS), American Astronomical Society (AAS), Royal Astronomical Society (RAS), European Geophysical Union (EGU), American Geophysical Union

Combined multi-wavelength image of star forming galaxy M82.

The list of the ESA projects at the Institute, till the end of 2012		
Project name	**PI**	**Period**
Czech participation on GAIA project / PECS	P. Koubský	2007–2011
EJSM-JGO scientific and payload assessment study / PRODEX	P. Hellinger	2011–2013
Solar Orbiter: Low-Voltage Power Supply for ESA Cosmic Visions / PRODEX	P. Hellinger	2011–2013
Lunar Dust, Plasma, Waves and Fields Package for Lunar Exploration / EMITS	P. Hellinger	2011–2013
Czech participation on INTEGRAL	R. Hudec	2005–2011
GOCE – specific tasks on fine gravity field structure of the Earth	J. Klokočník	2007–2011
X-ray Observation XMM: Active galactic nuclei and black holes	V. Karas	2007–2012
DSLP Operations on Board Proba 2 – raw Data Processing and Archiving / TaskForce	Š. Štverák	2012–2013
BepiColombo: Kinetic processes in the solar wind, Mercury's magnetosheath and magnetosphere / PECS	P. Trávníček	2008–2014

(AGU), International Association of Geodesy (IAG) and the International Union of Geodesy and Geophysics (IUGG), European Association for Solar Telescopes (EAST), Joint Organization for Solar Observations (JOSO), Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) etc. The involvement in these and other organizations is given in the following list:

P. Ambrož: member of the National Commisson of SCOSTEP

M. Bárta: member of the National Commission of SCOSTEP

J. Borovička: member of EAS

V. Bumba: member of EAS

F. Fárník: member of of Czech National Committee COSPAR, adviser of the Czech delegate to ESA/SPC

P. Hadrava: member of CHAMA (Commission for History of Ancient and Medieval Astronomy IUHPS), Comisssion C19 Astrophysics IUPAP)

P. Heinzel: member of EAS

R. Hudec: member of AAAS and SPIE

K. Jiřička: member of the Committee on Radio Astronomy Frequencies (CRAF) of the European Science Foundation (ESF); member of the International Union of Radio Science (URSI), commission J (Radio Astronomy)

B. Jungwiert: member of AAS and EAS

A. Kawka: member (representing the Czech Republic) of the European Southern Observatory Users Committee (for a 3 year term 2011–2013); member of the Astronomical Society of Australia (MASA)

V. Karas: member of RAS, the International Society on General Relativity and Gravitation, American Astronomical Society

M. Karlický: member of the Executive committee of WISER (World Institute for Space Environment Research, University of Adelaide); Co-leader of WISER Research Working Group on Sun/Heliosphere; Representative of the Czech ESO-ALMA node in the ALMA project

J. Klokočník: member of COSPAR, IAG/IUGG, EGU, AGU

P. Kotrč: member of the Board of the JOSO and JOSO National Representative

M. Kraus: member of the German Physical Society (DPG); member of the German Astronomical Society (AG)

H. Mészárosová: member of the European Physics Society (EPS); member of the European Solar Physics Division (ESPD)

D. Nickeler: member of the German Astronomical Society (AG)

J. Palouš: member of RAS; member of Royal Society of Edinburgh; member of Editorial Board of Romanian Astronomical Journal

L. Perek: associate member of the Royal Astronomical Society since 1970; member of the Deutsche Akademie der Naturforscher Leopoldina since 1975; member of the International Institute of Space Law since 1977, member of its Board of Directors 1996–2006; member of the International Academy of Astronautics since 1977, Advisor to its President 2002–2006; Honorary member of the Academie Nationale de l'Air et de l'Espace, Toulouse, since 1994; member of EAS

P. Pravec: member of the Division of Planetary Sciences of the AAS; member of the Spaceguard Foundation

M. Sobotka: national representative in the European Association for Solar Telescopes (EAST) since 2006

Z. Šíma: since 1995 member of the International Geoid Service, Special Working Group of the GSFC/DMA; since 1995 member of Special Commission SC3 – Fundamental Astrogeodetic Constants of the IAG/IUGG; Inter-Commission Committee on Planetary Geodesy of IAG/IUGG; member of Scientific Instrument Society; member of Società Astronomica Italiana

S. Šimberová: representative of the Czech and Slovak Republics of TC13 Pattern Recognition in Astronomy and Astrophysics of the International Association for Pattern Recognition (IAPR)

Trávníček: member of AGU

M. Vandas: since 2000 COSPAR Scientific Commission D (Space Plasmas in the Solar System, including Planetary Magnetospheres) to IAU Liaison, since 2002 member and since 2008 secretary of the National Committee of SCOSTEP

S. Vennes: member (representing the Czech Republic) of the ESO Scientific Technical Committee; fellow of the Astronomical Society of Australia (FASA)

Participation in the ERA-NET ASTRONET2

ASTRONET2 is a collaboration network for coordination of European Astronomy building on the earlier ERA-NET ASTRONET 1. The objectives for ASTRONET 2 is to establish a long term mechanism for planning and coordination of European Astronomy, to follow up on the Science Vision and Roadmap for infrastructures developed under the first ASTRONET, to narrow the scientific and technology gaps between European countries and to establish data on human and financial resources in the European countries. The Astronomical Institute is a partner in ASTRONET2, and is the work package leader for the ASTRONET workpackage 3 (WP3) "Integration of new Member States in the future of European Astronomy" WP3 aims to analyse the obstacles impeding the full participation of new Member States in the European main stream astronomy, and propose suitable actions at the institutional and agency level that may accelerated the integration. The target countries have been identified, and a list of contacts in these countries has been established. A request for information additional to ASTRONET 1 "Report on the management of the European Astronomy: Eastern European countries" has been sent out. A working group of ASTRONET partners and associates has been formed and a new questionnaire concerning the research areas in which the astronomical community in each country is active has been developed. In parallel to questionnaires, web searches for information and publication data analyses will be used to serve as complementary avenues to retrieve requested information.

Summer night sky in Ondřejov with Fireworks galaxy NGC6946 and open cluster NGC6939.

6.6 Visitors of the Institute

Each year, we host number of scholars, postdocs and students from all over the world who come to spend their time working with colleagues at our Institute. Here we present the list of scientists who visited us in 2011–2012:

Name	Country	Days
Abramowicz M.	Poland	38
Anzer U.	Germany	27
Aret A.	Estonia	15
Asif ud-Doula	USA	6
Badescu O.	Rumania	6
Berezhnoy A.	Russia	117
Biermacki P.	Poland	21
Bisbas T.	England	8
Bodnarova M.	Slovakia	3
Brown P.	Canada	25
Bucha B.	Slovakia	39
Cader B.	Poland	4
Campbell-Brown M.	Canada	25
Cidale L.	Argentina	17
Cremaschini C.	Italy	8
Csatáryová M.	Slovakia	5
Curé M.	Chille	6
Czerny B.	Poland	14
Čadež A.	Slovenia	15
Dale J.	Germany	56
Dudík J.	Slovakia	65
Ecolane B.	Germany	3
Feldmeier A.	Germany	3
Fernandes M.B.	Brazil	6
Förste Ch.	Germany	9
Gális R.	Slovakia	5
Giovannelli F.	Italy	5
Gömöry P.	Slovakia	4
Goosman R.	France	14
Gorosabel J.	Spain	7
Granda A.	Swiss	8
Guainazzi M.	Spain	12
Guzyi S.	Spain	7
Hamann W.R.	Germany	3
Herlender M.	Poland	10
Husárik M.	Slovakia	6
Chapanov Y.	Bulgaria	21
Chmielewska E.	Poland	5
I. De la Calle	Spain	8
Iliev L.	Bulgaria	59
Jejčič S.	Slovenia	19
Jelínek M.	Spain	5
Johnson D.	USA	7
Kai T.	China	5
Kalinovič I.	Serbia	20
Kashapova L.	Russia	30
Kenney J.	USA	24
Klimushkin D.	Russia	15
Kojima Y.	Japan	22
Kolomanski S.	Poland	4
Köppen J.	Germany	30
Kovačevič M.	Serbia	20
Krišandová Z.	Slovakia	6
Kromer M.	Germany	11
Kunneriath D.	Germany	71
Kuprjakov J.A.	Russia	256
Kylafis N.	Greece	4
Lara Gil O.	Spain	7
Leedjärv L.	Estonia	3
Lemmerer B.	Austria	10
Mackovjak Š.	Slovakia	20
Marčeta D.	Serbia	5
Marin F.	France	23
Marino R.A.	Spain	4
Mason H.	England	4
Matt G.	Italy	12
Mazur G.	Poland	6
Mennkikent R.	Chille	13
Miller J.	England	2
Miloševič M.	Serbia	20
Mitrasinovič A.	Serbia	20
Moser L.	Germany	9
Mrozek T.	Poland	4
Muratore M .F.	Argentina	78
Murphy K.	USA	6
Nishizuka N.	Japan	60
Olsson E.	Sweeden	16
Oskinova L.	Germany	3
Papadakis I.	Greece	8
Paraschiu P.	Rumania	6
Pauritsch J.	Austria	21
Petit V.	USA	6
Petkovič D.	Serbia	20
Piantschitsch I.	Austria	25
Psaltis D.	USA	14
Radovič V.	Serbia	13
Radziszewski K.	Poland	5
Rezzolla L.	Germany	4
Rompolt B.	Poland	4
Rosales Ortega F. F.	Spain	7
Rozanska A.	Poland	18
Ruben S.R.	Spain	9
Rudawska R.	France	4
Rybák J.	Slovakia	5
Samardžija B.	Serbia	6
Savič D.	Serbia	20
Schmieder B.	France	7
Silich S.	Mexico	56
Sillanpaa A.	Finland	5
Slošier R.	Slovakia	5
Smole M.	Serbia	20
Stojanovič I.	Serbia	6
Straub O.	Swiss	11
Svoreň J.	Slovakia	6
Sylwester B.	Poland	5
Tapas D.	India	8
Tenorio-Tagle G.	Mexico	8
Thirouin A.	Spain	69
Thonnofer S.	Austria	27
Tomič S.	Serbia	50
Torres A.	Argentina	17
Utz D.	Austria	10
Vacaro T.	USA	28
Valencia M.	Germany	23
Veltonen M.	Finland	5
Vincent F.	Poland	8
Vollner B.	France	5
Walch S.	England	14
Wenchi Y.	Poland	11
Wielgos M.	Poland	7
Witzel G	Germany	6
Yu Wenfei	China	5
Zahuantitla F.	Mexico	90
Zapior M.	Poland	11
Zwaan M.	Germany	3

Winter 2011's Comet Lovejoy photographed near Earth's horizon from onboard ISS.

Activity Report 2011−2012: Astronomical Institute of the Academy of Sciences of the Czech Republic

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