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1 Foreword

The present form of the report of the activities of the Astronomical Institute of the Slovak Academy of Sciences (AI SAS) does not differ significantly from the last year report. Its structure and layout are, however, considerably different from those in the corresponding Slovak version (also available at our web page). The English version is focused almost uniquely on the scientific activities of the AI SAS and it omits a number of important non-scientific issues, like, e.g., financial matters of the institute, teaching commitments at universities, etc.; these can only be found in the Slovak version. The report for 2007 is the fifth in the English language that I have the pleasure to present, and I hope you will find it of interest.

Our staff in High Tatras and Bratislava was unchanged in 2007 except Matej Sekeráš started his PhD study in the Stellar Department.

It is useless to attempt to summarize content of the following many pages in a few rows here. Nevertheless, some important issues should be pointed out. The amount of scientific production is expressed by 59 papers in internationally distinguished refereed journals. A number of interesting results have been obtained, some of them being highlighted in what follows. Our institute plays a very important role in 16 well-established international projects and a number of informal collaborations.

In the first half of 2007, the assessment of the Astronomical Institute for the years 2003-2006 was done. On the base of a drawn up questionnaire, reports of assessors and recommendations of the Accreditation Commission, Astronomical Institute of SAS received the evaluation A* of the Presidium of the Slovak Academy of Sciences, which means in a verbal assessment rating as an outstanding organization in which most of the research meets international standards.

AI SAS organized in 2007 three scientific meetings. 26th European Symposium on Occulatation Projects held at Stará Lesná on August 24-26, 2007 - 66 participants from 10 countries. Conference on Achievments of Stellar Astronomy held at Bezovec on May 25-27, 2007 - 30 participants from 3 countries. An Intensive Mini-Workshop on Finite Projective Geometries in Quantum Theory held at Stará Lesná on August 1-4, 2007 - 9 participants from 5 countries.

In 2007, AI SAS has been again very successful at applying for observational time at the worldclass solar telescopes, located at the Canary Islands, through the Opticon Trans-national Access Program of the 6FP EU. All financial expenses related to the operation of these telescopes during our campaigns have been covered by this program (totally 81 000 Euros).

Institute staff has been offered, with a priority, an observing time on the most modern solar satellite Hinode. The project Ënergy and transport dynamics in the above-solar network and coronal heating mechanisms"took place on 12/04 and 04/14 2007 and included instruments: Hinode / EIS, SOT, XRT, SoHO / SUMER, CDS, EIT, TRACE.

The significant contribution to the knowledge of distribution of the small meteorid particles in the Earth vicinity, resulting from long-term cooperation with the Astronomical Institute of the Academy of Sciences of the Czech Republic was the installation of automatic bolide camera at Lomnický peak in October 2007. Camera worth of 1.8 million Sk was constructed by the Czech side, operation and maintenance is provided by our Institute and the results will be interpreted and published together.

The last volume of our journal Contributions of the Astronomical Observatory Skalnate Pleso (number 37) appeared in three regular issues. The journal is covered by the ISI and is electronically available from our web page (http://www.ta3.sk) and the ADS database as well.

We have also succeeded to improve substantially our observational facilities and infrastructure. In 2007, equipment for coating mirrors with diameter up to 0.65 meters was put into operation. Coating, of the first primary and secondary mirror of 0.6-m telescope in Stará Lesná, by aluminum and silicon protective layer means the implementation of long-term task that will gradually save considerable funds of the Astronomical Institute at maintenance of another optical systems in telescopes in Stará Lesná and Skalnaté Pleso. T. Pribulla has the main credit

for the acquisition of the necessary procedures and technologies.

The first, substantial part of the exchange of 65-year old water supply connection to Skalnaté Pleso Observatory was realised in 2007. This project will be completed in the first half of 2008.

In 2007, the video conferencing equipment was purchased for headquarters in Stará Lesná. Then, a few video connections, including participation in a meeting of directors of the first Division of SAS, were realised.

The head of the Stellar Department D. Chochol has acted as a single point of contact (national coordinator in the Slovak Republic) for the activities of the International Year of Astronomy 2009.

Ján Svoreň
director of AI SAS

2 Research

2.1 Interplanetary matter

Observational facilities:
Skalnaté Pleso Observatory - a 61 cm reflector with a CCD camera, an all sky fireball fish-eye camera; Lomnický štít Observatory – automatic bolide camera (expositions started on October 25), Modra Observatory - a receiver of a forward scatter meteor radar.

Research activities:

- theoretical investigation of transfer orbits among different populations of small bodies in the Solar System regarding near-Earth objects
- interrelations among the populations of small bodies in the Solar System and their evolution, a search for binary asteroids
- photometry and astrometry of asteroids and comets
- investigation of the activity of selected cometary nuclei and its influence on the physical and dynamical evolution of these bodies
- evolution of Oort cloud comets
- study of the structure of selected meteor showers
- operation of fireball fish-eye cameras within the framework of the European Fireball Network
- search for hyperbolic and interstellar meteoroids using data from IAU Meteor Data Center Catalogue
- investigation of a structure of daily meteor showers with ground based radio observations,
- study of meteorite properties.

2.2 Solar physics

Observational facilities:
Stará Lesná Observatory - a horizontal solar telescope with spectrograph, Lomnický Peak Coronal Station - a double 20 cm coronagraph with a spectrograph.

Research activities:

- study of rotational characteristics of sunspots and surrounding photospheric plasma based on own measurements,
- spectral analysis of the quiet and active solar photosphere and chromosphere using spectra from Tenerife VTT observations,
- study of the dynamics and energy transfer in the quiet upper solar atmosphere from SOHO (SUMER, CDS, EIT) and TRACE satellites data,
- investigation of the coupling of a cosmic ray modulation and solar LDE flares and also coronal mass ejections,
- derivation of magnetic fields in specific coronal structures using own eclipse observations,

- analysis of coronal holes and their relation to the background and local magnetic fields and a relationship between polarization and intensity of the green line in different coronal structures,
- study of a time-latitudinal distribution and large-scale development of solar prominences,
- observations of both the 530.3 nm and 637.4 nm emission coronal lines as well as the white-light corona to study solar cycles,
- preparation of the homogeneous coronal data set for the 530.3 nm coronal line,
- computation of the coronal index of solar activity.

2.3 Stellar astrophysics

Observational facilities:
Skalnaté Pleso Observatory 60 cm reflector for photoelectric photometry, Stará Lesná Observatory 60 cm reflector for photoelectric photometry, 50 cm reflector for CCD photometry.

Research activities:

- modeling of the photometric and spectroscopic observations of interacting binaries aimed at the determination of basic parameters of the components, distribution of circumstellar matter and study of physical processes in the systems,
- spectroscopic observations in Canada (DDO), Hawai (CFHT), Chile (LCO) and adaptive optic observations at the CFHT focused on the detection of multiple stellar systems, studies and simulations of the spectra, lightcurves and atmosphere models of the extrasolar planets and brown dwarfs,
- investigation of symbiotic stars, novae and nova-like objects focused on physical processes during the stages of their activity, studies of their origin, structure, evolution and physical conditions in the circumstellar environment,
- modeling the composite spectra of symbiotic stars using own method of disentangling of their continua and reconstruction of the structure of active components to understand better the extreme conditions during their outbursts,
- multifrequency study of symbiotic stars and cataclysmic variables using the XMM, FUSE, HST and ISO satellites,
- photometric detection and explanation of various manifestations of both regular and semi-regular stellar variability,
- photometric and spectroscopic investigation of chemically peculiar stars using the spectra taken at the ESO, Crimea, Ondrejov, Rozhen and Zelenchuk observatories,
- study of the chemical composition and properties of the atmospheres of CP stars, and the role of radiative diffusion of some species,
- search for possible relations between the orbital parameters of binaries with Am components.

3 Personnel

3.1 Executives

Director : J. Svoreň, deputy director : J. Žižňovský, scientific secretary : J. Rybák

3.2 Scientific Council

A. Bobák, E. Dzifčáková, K. Kudela, A. Kučera (chairman), L. Neslušan, E. Pittich, V. Porubčan, T. Pribulla (vice-chairman), V. Rušin, J. Rybák, A. Skopal, J. Žižňovský.

3.3 Department of Interplanetary Matter

Head: J. Svoreň
Staff in Bratislava: J. Farkašová, M. Hajduková, Jr., I. Kapišinský, M. Kocifaj, J. Pittichová (currently a post-doctoral scientist at the Institute for Astronomy, University of Hawaii, USA), E. Pittich, T. Paulech, V. Porubčan, N.A. Solovaya
Staff in the High Tatras: G. Červák (technician), M. Husárik (postgraduate student), M. Jakubík, Z. Kaňuchová (postgraduate student), L. Neslušan, M. Pikler (technician), J. Svoreň, M. Tirpák (postgraduate student).

3.4 Department of Solar Physics

Head: A. Kučera
Staff: P. Bendík (technician), P. Gömöry, P. Havrilla (technician), Ľ. Klocok, J. Koza, R. Mačura (technician), K. Maník (technician), M. Minarovjech, V. Rušin, J. Rybák, M. Saniga, J. Sýkora.

3.5 Stellar Department

Head: D. Chochol
Staff: D. Božík (technician), J. Budaj, Ľubomír Hambálek (postgraduate student), L. Hric, V. Kollár, R. Komžík, E. Kundra (postgraduate student), K. Kuziel (technician), T. Pribulla, P. Schalling (technician), A. Skopal, J. Tremko, M. Vaňko, M. Zboril, J. Zverko, J. Žižňovský.

3.6 Administration and Maintenance

Head: M. Alman
Staff: J. Ambróz, R. Bekeš, F. Budzák, T. Drzewiecka, M. Dufalová, T. Griešová, Ľ. Hanigovský, J. Krempaský, K. Krempaská, J. Krasula, V. Mačáková, D. Novocký, A. Sanigová, M. Šoltýsová, M. Zajíčková, P. Zimmermann.

4 Guests

In 2007, the following guests visited our institute: R. Brajsa (Hvar Obsevatory, University of Zagreb, Croatia), G. Cevolani (ISAC (FISBAT) CNR, Bologna, Italy), J. Drahorad, M. A. Hanna (National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt), A. A. Haroon (National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt), H. Havlicek (Institut fur Diskrete Mathematik und Geometrie, TU Vienna, Austria), I. Iliev (Astronomical Institute, Sofia, Bulgaria), J. Janik (Institute of Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic), M. Kibler (CNRS/IN2P3, Institute

de Physique Nucleaire, Lyon, France), Z. Mikulášek (Institute of Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic), M. Planat (FEMTO-ST, LPMO/CNRS, Besancon, France), P. Pracna (Heyrovský Institute of Physical Chemistry, Prague, Czech Republic), K. Radziszewski (Astronomical Institute, University of Wroclaw, Poland) J.I. Romanjuk (SAO RAN, Russia), P. Rudawy Astronomical Institute, University of Wroclaw, Poland) S. Shugarov (Sternberg Astronomical Institute, Moscow State University, Moscow, Russia), S. Stoiser (Institute of physics/IGAM, University of Graz, Graz, Austria), W. Stuckey (Department of Physics, Elizabethtown College, Elizabethtown, USA), A. Veronig (Institute of physics/IGAM, University of Graz, Graz, Austria), M. Temmer (Institute of physics/IGAM, University of Graz, Graz, Austria), M. Zejda (Institute of Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic).

5 Results

The main results acquired and published by the research personnel of the Astronomical Institute in the year 2007 are briefly described below. Information about the reference to the published paper in the list of publications is given in brackets.

1/ The most significant result of the year 2007: Periodic light variability is a general feature observed in magnetic chemically peculiar (mCP) stars.

We simulate light curves of the helium-strong chemically peculiar star HD 37776 assuming that the observed periodic light variations originate as a result of inhomogeneous horizontal distribution of chemical elements on the surface of a rotating star. We show that chemical peculiarity influences the monochromatic radiative flux, mainly due to bound-free processes. Using a model of the distribution of silicon and helium on HD 37776 surface, derived from spectroscopy, we calculate a photometric map of the surface and consequently the uvby light curves of this star. Basically, the predicted light curves agree in shape and amplitude with the observed ones. We conclude that the basic properties of variability of this helium strong chemically peculiar star can be understood in terms of the model of spots with peculiar chemical composition (Paper No. 29).

2/ The most significant results for applications and public relations: Slovak astronomical seminar for teacher.

Staff of the AISAS in frame of the project APVV LPP-0146 "Meetings with the Universeöf the Slovak research and development agency prepared for days October 4-6, 2007 a seminar for teacher of the basic and grammar schools. The seminar was prepared within the international heliophysical year 2007 when we have celebrated 50th anniversary of the Sputnik-1 fly. This satellite was launched in date of the first day of the seminar but 50 years ago. Lectures were given on the Sun, on solar activity effects on the Earth, on global climatic changes on the Earth, on meteoroids, on extrasolar planets and on other astronomical subjects - on Slovak solar astrophysics 101 years ago, on amateur construction of a simple refractor in school for each pupil. All participant have received a CD with text of the lectures as well as a paper copy of the almanac with the lectures. The main aim of the seminar was to provide teachers with news on the latest research results on the universe which could be used for teaching of astronomy and physics at schools. (Project APVV LPP-146, web page of the seminar: `www.astro.sk/~choc/open/07_casu/str`.

3/ The most significant results obtained within frame of international collaboration: The very nearby M/T dwarf binary SCR 1845-6357.

The recently discovered star SCR 1845-6357 (hereafter SCR 1845) is the first late M/T dwarf binary discovered. SCR 1845 is a particular object due to its tight orbit (currently around 4 AU) and its proximity to the Sun (3.85 pc). We present spatially resolved VLT/NACO images and low resolution spectra of SCR 1845 in the J, H and K near-infrared bands. Since the T dwarf companion, SCR 1845B, is so close to the primary SCR 1845A, orbital motion is evident even within a year. Following the orbital motion, the binary mass can be measured accurately within a decade, making SCR 1845B a key T-dwarf mass-luminosity calibrator. The NIR spectra allow for accurate determination of spectral type and also for rough estimates of the object physical parameters. The spectral type of SCR 1845B is determined by direct comparison of the flux calibrated JHK spectra with T dwarf standard template spectra and also by NIR spectral indices obtained from synthetic photometry. Constrained values for surface gravity, effective temperature and metallicity are derived by comparison with model spectra. Our data prove that SCR 1845B is a brown dwarf of spectral type T6 that is co-moving with and therefore gravitationally bound to the M8.5 primary. Fitting the NIR spectrum of SCR 1845B to model spectra yields an effective temperature of about 950 K and a surface gravity logg=5.1 (cgs) assuming solar metallicity. Mass and age of SCR 1845B are in the range 40 to 50 Jupiter masses and 1.8 to 3.1 Gyr (paper No. 25).

4/ A complex method to study the accretion disks in interacting binaries was developed. It combines the synthetic spectra calculations and Doppler tomography. It was applied to TT Hya. New orbital elements of the binary were determined. Gas stream and an elliptical accretion disk was detected. UV spectra were used to determine temperature of the accretion disk. Mass transfer rate was estimated from the Halpha (paper No. 33).

5/ Evolution and radii of all 14 currently known transiting exoplanets were calculated and compared to the observations. Small radii of some planets were explained with rock cores. Bigger planets were explained with higher than solar atmospheric opacities which slow down the cooling of the planets (paper No. 18).

6/ Latest infrared observations of the HD209458b obtained by Spitzer were interpreted. Planet has a temperature inversion -stratosphere on its day side. This is caused by absorption of the stellar light in the high altitudes and in the optical region by some unknown absorber (paper No. 19).

7/ The multicolour CCD photometry and spectroscopy of the classical nova V475 Scuti led to the determination of its basic parameters, classification of the object as a Fe II nova and detection of a dust formation in the expanding envelope accelerated by a stellar wind (paper No. 22).

8/ Infrared observations with the 3.6m CFHT telescope were aimed at the detection of low-mass companions. A new method to detect additional components in the diffraction pattern of a star at the separations of only 0.07-1" has been developed. Detection of companion objects to HV Aqr, OO Aql, CK Boo, XY Leo, BE Scl, and RZ Tau supports the hypothesis that close binaries mostly originate in multiple stellar systems where the third component can drain angular momentum from the close pair (paper No. 41).

9/ Radial velocity measurements and corresponding spectroscopic elements were presented for 10 close binaries. The radial velocities were determined by improved technique of rotational profile fitting to the extracted broadening functions. Observations of XY UMa clearly showed presence of cool photospheric spots on the hotter component. Spectroscopy of the multiple system XY Leo supported hypothesis that the system hosts another binary with orbital period of 0.805 days (paper No. 40).

10/ Photometric observations performed with the MOST satellite lead to discovery of a close binary (HD313926) with orbital period of only 2.27 days and relatively high eccentricity (e=0.2) at the same time. The system consists of componenents of B3-7 spectral types. HD313926 is

the system with the most eccentric orbit among early-type binaries with orbital period shorter than 3.5 days. In spite of the large size of the components and the short period the orbit of the binary has not been circularized yet. This means that the system is very young (paper No. 42).

11/ We determined the mass loss rate via the stellar wind from the symbiotic prototype Z And by modeling the broad H-alpha emission wings during its major outburst. At the optical maximum the system was losing mass at rates of 2.3×10−6 solar masses per year, whereas at the end of the outburst, in 2003 November, only at 1.6×10−6 solar masses per year. Possibility of the Raman scattering as a responsible process for the broad wings was discussed (paper No. 73).

12/ We elaborated a method to correct the UBVR photometric measurements for the effect of emission lines with the main aim to calibrate spectroscopic observations. We determined Dm corrections from the ratio of fluxes with and without emission lines, transmitted from the object through the photometric filter. An exact and a simplified approach for operative use were applied. The largest effect was found for novae in U, B and R domains, where up to 70% of the light is radiated through emission lines (paper No. 46).

13/ We presented results of an international campaign of symbiotic stars observations during 2003.9 to 2007.2. Our observations revealed new outbursts of symbiotic stars Z And, AE Ara, BF Cyg, CI Cyg and AG Dra. During 2006 June – December, the light curve of CH Cyg showed a 2 mag decline in all colours, caused probably by a dust condensation in the system (paper No. 47).

14/ We analyzed periodic variations in the light curve of the anomalous object in the center of the planetary nebula Sh 2-71. We refined the previous ephemeris of these variations in the UBVRI colours and identified a non-periodic, long-term variability. Spectroscopic observations suggested the presence of a super-dense nebula surrounding the central object, what supported our proposal about its binary nature (paper No. 66).

15/ Within the framework of monitoring the active late type stars we obtained the photometry of long rotational period objects 29 Dra and 12 Cam and very active star II Peg. With the effort to study and understand their magnetic cycle and properties of magnetic dynamo we analysed the light curves and estimated spot properties on stellar surface (paper No. 75).

16/ We compiled a database of published photometric observations of magnetic chemically peculiar (mCP) stars which now contains more than 107 000 photometric measurements of 102 mCP stars and will be continually supplemented with published or new photometric data on these and about 150 additional mCP stars. For all the included data we estimated the error of measurements and the effective amplitudes of light curves in the spectral regions of the Strömgren‘s uvby, Johnson‘s UBV and the Hipparcos Hp systems (paper No. 32).

17/ We evaluated a radial velocity determination method using a cross-corelation of the observed spectrum with the theoretic one computed for the corresponding spectral type, chemical composition and the rotation of the star. The method was used for detection of the by now unresolved components in the spectra of SB1 and SB2 binary stars (paper No. 50).

18/ We measured variations in orientation of fourteen dynamic fibrils as a function of time in a small solar plage. We found motions with average angular velocities of the order of 1 deg/min suggesting systematic turning from one limit position to another, particularly apparent in the case of fibrils with lifetimes of a few minutes. Shorter fibrils tend to turn faster than longer ones, which we interpret as due to vortex flows at footpoints of magnetic fluxtubes (paper No. 60).

19/ We derived correlation coefficients between temperature and line-of-sight velocity as a function of optical depth throughout the non-magnetic and magnetic solar photosphere. The maximum anticorrelation of about -0.6 between temperature and line-of-sight velocity in the non-magnetic photosphere occurs at optical depth -0.4. It turned out that magnetic field is another significant decorrelating factor along with 5-min oscillations and seeing (paper No. 58).

20) By inversion of spectrograms we derived temperature fluctuations in non-magnetic and

magnetic solar photosphere. While the observed low photosphere shows small temperature fluctuations (about 50 K), the sub-photospheric layers and the upper photosphere show larger fluctuations, with similar gradients as in 3D hydrodynamics simulations. However, the observed temperature fluctuations are lower than in the simulations at all depths, which we attribute to smearing by atmospheric seeing (paper No. 59).

21/ For 3 selected solar flares analysis of the long-period variations of thier radio and X-ray emission was peformed using the statistical methods of the period analysis. Based on the rerived results on existence of long-period emission vatiations in these flares the mechanism generating these oscillations was determined (paper No. 31).

22/ An analysis of the time-latitude distribution of the coronal green line 530.3 nm local intensity maxima and of the solar magnetic fields in the period 1976 – 2005 by using a new, modified method show that the local coronal intensity maxima are localised on the border of the opposite polarities of large-scale magnetic fields (paper No. 36).

23/ Following the analysis of the daily values of total solar irradiance (TSI) and of the green line coronal index we have shown, that the course of both the indexes are interchangeable, except for the days when the big sunspot groups occurs on the solar surface. The course of TSI has been extrapolated by using a regression curve for the period 1947-1977 (paper No. 35).

24/ Data analysis of the time-latitude of the green coronal line 530.3 nm intensity and of the photospheric magnetic fields show that the latitude migration consist both the poleward and equatorward components. The green coronal and magnetic fields s ynoptic maps for the high heliographic latitudes were investigated for the first time. Consequently, the increased coronal line intensities are correlated with a boundaries of the increased magnetic fields with opposite polarities (paper No. 36).

25/ The solar corona as observed during the total solar eclipse of March 29, 2006, was compared with space-borne observations from the SOHO and TRACE satellites. Based on this comparison, it was found that fine structures (1 – 2 arcsec) of the white-light corona are almost identical with those observed within the X-ray and EUV coronas. This was the first analysis of this kind and some of the ground-based observations were found to be of a better quality than the corresponding space-borne ones (paper No. 38).

26/ Comparisons of the Fe XIV 530.3 nm coronal emission line brightness with the summary area of sunspots and the magnetic field strength revealed diffrent relation of the coronal emission line brightness on strength and topology of the global magnetic fileds in different phases of the solar activity cycle. Results of this paper could be helpful when testifying various models of the solar corona heating from 6000 K in the solar photosphere to more than 1 million K in the corona (paper No. 17).

27/ It was found that degree of polarization in the polar plumes of the solar corona is 10% higher than between them. Current interpretation of the brightness and polarization leads to the conclusion that for teprerature at about 1 MK density of the individual plumes reaches 2.7×10^8 cm^{-3} and decreases to 2.0×10^8 cm^{-3} in the interplume regions. This result is promising for study of the geo-effectiveness of the polar areas on the Sun (paper No. 83).

28/ We revealed that typical values of the vertical current densities vary in the range $\pm$ 40 mA/m^2 inside the sunspot under study. Moreover, we found an extended area of enhanced vertical current densities in the umbra (values up to $80mA/^2$). Our analysis also showed that the vertical component of the magnetic field strength decreases by 0.6-1.6 G/km and 0.5-0.8 G/km in the umbra and inner penumbra, respectively. On the other hand, we found an increase of the vertical component of the magnetic field in the outer penumbra (typical values vary between 0.1-0.5 G/km) (paper No. 54).

29/ We have shown that the surface charge may influence optical properties of very small particles (size of which is much smaller than the wavelength of incident electromagnetic radiation). Specifically, the numerical calculations were performed for i) charged spherical particles present in the interplanetary space, and ii) charged water droplets and ice grains in the Earth

atmosphere. Slightly absorbing charged particles may attenuate the electromagnetic radiation more than 10 times efficiently than equivalent non-charged particles. The well-known efficiency factors for extinction, absorption, and radiation pressure increase with decreasing grain temperature (paper No. 26).

30/ Activity and structure of the daytime meteor streams, the Dzeta Perseids and Beta Taurids, observed by the forward scatter system operating along the baseline Bologna-Modra in 1997-2004 and for meteor radar data obtained from Ondrejov in 2003-2005, were analysed and studied. The forward-scatter data were corrected for a new response function derived for the system. In the both streams independent filaments of meteoroids are observed. The filaments are the most probably result of individual ejections of meteoroids from the parent body (paper No. 39).

31/ The microstructure of the Fermo meteorite (chondrite, fall observed on September 25, 1996, Fermo, Italy) was studied by electron microscopy methods. A detailed analysis of minerals as kamacite, taenite, troilite, enstatite, olivine and pyroxene was performed. These micro- and nanostructural constituents enable to contribute to the reconstruction of the event related to the cosmic history of meteorite (paper No. 23).

32/ It was demonstrated that the efficiency of the discovery of dynamically old comets is considerably lower than that of dynamically new comets due to a decline of comet brightness at their repeating approaches to the Sun (so-called fading effect). Consequently, the flux of new comets through the zone of visibility has been overestimated about an order of magnitude. As well, the size of the outer-Oort-cloud population has correspondingly been overestimated (paper No. 37).

33/ We developed a new improved model of stellar passages through the Solar-System neighbourhood to describe an influence of their perturbations on the Oort Cloud (paper No. 30).

34/ The analysis of the hyperbolic meteor orbits included in the photographic and radar catalogues of the IAU MDC showed that the hyperbolicity of the vast majority of the orbits is not real and has been caused by the dispersion of determined velocities as well as by the erroneous determination of the right ascension and declination, which influences the value of the elongation of the radiant position of a meteor from the apex of the Earth and thus the resulting values of heliocentric velocity. From the 970 hyperbolic orbits in the Harvard radar catalogues, only about 5% can be recognized as interstellar (papers Nos. 20 a 76),

35/ An important result of international cooperation with colleagues from Ondrejov (Czech Republic), Modra (Slovak Republic), USA, Australia and Ukraine was the discovery of binary asteroid (8116) Jeanperrin at the Skalnate Pleso Observatory and three discovery by-products of (2486) Metsahovi, (16635) 1993 QO, and (32039) 2000 JO23 (papers Nos. 96, 99, 100 a 101).

36/ The simulation of the evolution of the orbits of comet 96P/Machholz, asteroid 2003 EH1 and their theoretical meteoroid streams is done. By the comparison of the results of this simulation and the parameters distributions of the observed Quadrantids it is proved that at least one of 96P and 2003 EH1 is the parent body of Quadrantids.Due to an uncertainty in the orbit determination and unknown non-gravitational effects, it is impossible to decide which one of these two bodies is the dominant parent. We demonstrated that 96P and 2003 EH1 could originate in one progenitor (paper no. 24).

37/ The conditions for Lyapunov stability in the general three-body problem, in which the distance between the star components is much greater than that between the orbiting star and the planet, were derived. The result was applied on the extra-solar planet gamma Cephei. Computations from the initial orbital elements showed that the planet has stable orbit if values of the longitude of ascending node of the secondary star lie between 31 and 120 degree and the mutual inclination between the planet and the primary star orbits is from the interval 113-124 degree (paper No. 48).

38/ In the photometric survey of interplanetary matter at the Skalnate Pleso Observatory has been acquired the photometric data on 31 asteroids. The photometric program was focused

for the 3D shape modeling of asteroids mainly and for the Near-Earth asteroids. There were obtained 143 astrometric positions of 10 comets (papers Nos. 71, 74, 77, and 81),

39/ The very first classification of projective lines over finite rings up to order 31 was made. Based on this classification, a series of important theoretical discoveries was made about the geometry of finite-dimensional quantum systems; in particular, an intriguing link was found between quantum entanglement within two-qubit systems and the geometry of the projective line over the quotient ring GF(2)[x]/(x^3-x) (papers Nos. 43, 44, and 45).

40/ An important relation was found between the properties of two-qubit systems and the geometry of a Veldkamp space, the structure of multi-qubit configurations and the geometry of symplectic polar spaces of order two and, finally, a complete geometrical theory of the commutation algebra of the generalized single-qudit Pauli groups was created (papers Nos. 21, 79 and 80).

6 Grants/Projects

6.1 International grants

- 2005-2007, Project FP6-2002-Mobility-5 No. 011379-MULTIDOT - Marie Curie Host Fellowship programme - principal investigator: J. Koza
- 2007, OPTICON – Trans-national access programme project (6FP EU): Spectroscopy and imaging tomography of the solar fibrils: photospheric drivers and coronal consequences – Swedish Solar Telescope - principal investigator: A. Kučera
- 2007, OPTICON – Trans-national access programme project (6FP EU): Spectroscopy and imaging tomography of the solar fibrils: photospheric drivers and coronal consequences – Dutch Open Telescope - principal investigator: A. Kučera
- 2007-2008, Project FP6-2007-MERG-CT-2007-046475 (6FP EU) – Solar network dynamics - principal investigator: A. Kučera
- 2007-2010, Project FP7-2007-MIRG-CT-2007-200297 (7FP EU) – Brown dwarfs and extrasolar planets - principal investigator: J. Zverko
- 2004-2008, USA-SK NSF project - Space weather: numerical MHD study of CMEs: inicialization and propagation - principal investigator: J. Rybák
- 2005-2006, collaborative inter-government project (Greece - Slovakia) - International Greek-Slovak On-line Network of Selected Astronomical Observatories - principal investigator: L. Hric
- 2006-2007, collaborative inter-government project (Austria - Slovakia) - Solar flares: trigerring mechanism and consequences for space weather - principal investigator: J. Rybák
- 2006-2007, collaborative inter-government project (Slovakia - Czech republic - project No. 01506) - The variability of chemically peculiar stars of the Main Sequence - principal investigator: J. Zverko
- 2006-2009, Project DFG - temporal evolution of the photosphere and chromosphere in a quiet and active regions (project No. DFG 436 SLK113/7/0-1) - principal investigators: H. Wöhl, A. Kučera, J. Rybák
- 2007-2008, Project Slovakia-France (CNRS) – Projective and related geometries for quantum information - principal investigator: M. Saniga

- 2007-2009, Project CNR-SAV - Meteoroids and space debris: an important component of the near-Earth space environment - principal investigator: V. Porubčan
- 2007-2009, collaborative inter-institute (Slovakia - Croatia) - Time evolution of active processes in the solar atmosphere - principal investigator: A. Kučera
- 2006-2007, collaborative inter-government project (France - Slovakia) ECO-NET No. 12651 NJ - Geometries over finite rings and the properties of mutually unbiased bases - principal investigator: M. Saniga
- 2007, Action Austria-Slovakia: Project No. 57s02 (SAIA) – Adaptation of astrophysical light scattering techniques for environmental aerosol research - principal investigator: M. Kocifaj
- 2008, Action Austria-Slovakia: Project No. 58s2 (SAIA) – Finite geometries behind Hilbert spaces - principal investigator: M. Saniga

6.2 Grants of the Slovak Grant Agencies VEGA and APVT

- 2005-2007 - APVT-51-012704 – Emission corona and prominences: indicators of solar activity and space weather - principal investigator: V. Rušin
- 2007-2009 - APVT-0066-06 – Heating of the solar corona: observational verification of the physical mechanisms - principal investigator: J. Rybák
- 2007-2009 - APVV-LPP-0068 – Astronomy – science for teachers and pupils - principal investigator: A. Kučera
- 2007-2009 - APVV-LPP-0146 – Meetings with Universe - principal investigator: V. Rušin
- 2006-2010 - APVV-LPP-0172 – Olympiad for astronomy for scholars - principal investigator: L. Hric
- 2006-2009 - Complexes of small bodies of the Solar System - principal investigator: M. Hajduková
- 2006-2009 - Dynamics of small bodies in cosmic space, physico-chemical properties of the bodies - principal investigator: M. Kocifaj
- 2006-2008 - Investigation of properties of chemically peculiar (CP) stars - principal investigator: J. Zverko
- 2006-2008 - Quantum theory of information for multiparticle systems - investigator: M. Saniga
- 2006-2008 - Multispectral analysis and modeling of development of active and quiet solar atmosphere atmosphere - principal investigator: A. Kučera
- 2007-2009 - The structure and characteristics of meteoroid streams and their parent bodies - principal investigator: J. Svoreň
- 2007-2009 - Structural studies of interacting binaries and multiple systems - principal investigator: A. Skopal
- 2007-2009 - Activity as a consequence of physical processes connected with mass transfer and accretion of matter in selected interacting binaries - principal investigator: L. Hric
- 2007-2009 - Research of magnetic fields in the solar corona and their reply in heliosphere - principal investigator: M. Minarovjech

- 2007-2009 - Role of non-gravitational forces in evolution of orbits of asteroids and comets - principal investigator: E. Pittich
- 2007-2009 - Influence of interstellar molecular clouds on dynamics of bodies in the Oort cloud and Kuiper belt - principal investigator: L. Neslušan

6.3 Institute projects

- Structure of meteor streams - principal investigator: V. Porubčan
- Cosmic dust - principal investigator: I. Kapišinský
- Dynamics of comets and asteroids and investigation of cometary dust - principal investigator: E. Pittich
- The astrometry of asteroids and the mutual interaction of interplanetary matter - principal investigator: L. Neslušan
- Photometry of comets and asteroids and cometary astrometry - principal investigator: J. Svoreň
- Study of variable phenomena of early spectral type stars and automatization of their observations - principal investigator: J. Žižňovský
- Chemically peculiar stars - principal investigator: J. Zverko
- Close binaries - principal investigator: D. Chochol
- Cataclismic variable stars - principal investigator: L. Hric
- Symbiotic stars - principal investigator: A. Skopal
- Solar eclipses - principal investigator: V. Rušin
- Solar protuberances and automatization of solar observations - principal investigator: M. Minarovjech
- Dynamics of solar photosphere and chromosphere - principal investigator: A. Kučera
- Solar cycle and Solar-terrestrial relations - principal investigator: J. Sýkora
- Outer layers of the solar atmosphere - principal investigator: J. Rybák

7 List of publications

7.1 Books and book chapters published in Slovakia

1. PITTICH, Eduard M.: Astronomická ročenka 2008, Slovenská ústredná hvezdáreň, Hurbanovo, 2007, ISBN 978-80-85221-56-5. p. 1-200 (in Slovak).

2. RYBÁK, Ján, SVOREŇ, Ján: Celoslovenský astronomický seminár pre učiteľov – 2007, Zborník prednášok. Tatranská Lomnica: Astronomický ústav SAV. ISBN 978-80-969842-1-3. p. 1-80 (in Slovak).

7.2 Book chapters published abroad

3. KLAČKA, J. - KOCIFAJ, Miroslav: Effect of electromagnetic radiation on dynamics of cosmic dust particles In: Maravell, N.S. Space Science: New Research. New York: Nova Science Publishers, 2006, ISBN 1-60021-005-8. p. 245-285.

7.3 Book chapters published in Slovakia

4. HRIC, Ladislav: Premenné hviezdy. In: Astronomická ročenka 2008, ed. E. Pittich, Slovenská ústredná hvezdáreň, Hurbanovo, 2007, ISBN 978-80-85221-56-5. p. 157–175 (in Slovak).

5. KUČERA, Aleš: Dynamické Slnko a slnečno-zemské vzťahy. In: Rybák, J., Svoreň, J., Celoslovenský astronomický seminár pre učiteľov – 2007 Tatranská Lomnica, Astronomický ústav SAV, Tatranská Lomnica, 2007, ISBN 978-80-969842-1-3. p. 7–16 (in Slovak).

6. PITTICH, Eduard: Čas, obloha od januára do decembra. In: Astronomická ročenka 2007, ed. E. Pittich, Slovenská ústredná hvezdáreň, Hurbanovo, 2006, p. 3-89 (in Slovak).

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7.4 Papers in journals indexed in Current Contents

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18. BURROWS, A. – HUBENY, I. – BUDAJ, Ján – HUBBARD, W.B.: Possible solutions to the radius anomalies of transiting giant planets. In: The Astrophysical Journal, Vol. 661, no. 1, 2007, p. 502-514.

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