Slovak Academy of Sciences

Astronomical Institute

ANNUAL REPORT 2005

Astronomical Institute, Tatranská Lomnica, Slovakia

Contents

1 Foreword

The present form of the report of the activities of the Astronomical Institute of the Slovak Academy of Sciences 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).

Here, we focus almost uniquely on the scientific activities of the Institute and omit a number of important ”non-scientificïssues, like, e.g., financial matters of the institute, teaching commitments at universities, etc.; these can only be found in the Slovak version.

Looking back at the year 2005 let me just briefly summarize major accomplishments. The amount of scientific production is expressed by 66 papers in internationally distinguished refereed journals and 11 articles in referred conference proceedings. A number of interesting results have been obtained, some of them being highlighted in what follows. Our institute plays a very important role in 20 well-established international projects and a number of informal collaborations.

Our institute organized a lecture course given by Prof. Dr. Juergen Staude from the Astrophysical Institute (Potsdam, Germany) on the topic of the Solar Magnetohydrodynamics on Oct 4-7, 2005. PhD as well as undergraduate students have taken part including some staff members of the institute.

The last volume of our journal Contributions of the Astronomical Observatory Skalnate Pleso (number 35) appeared in three regular issues. The journal is covered by the ISI and is electronically available from our web page (http://www.astro.sk) and the ADS database as well.

We have also succeeded in substantially improving our observational facilities. The 0,5-m reflecor for CCD photometry of stars at Stara Lesna was rebuilt for automatical regime.

It was increased throughput of our intranet connection to the Skalnate Pleso and Lomnicky Stit observatories to 11 Mbps. Connection of the local gateway of the SANET academic internet nerwork at Stara Lesna to its backbone in Poprad has been increased to 34 Mbps.

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; 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
- 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,
- a search for meteoroid streams of an asteroidal origin,
- investigation of the meteoroid population in the vicinity of the Earth's orbit,
- interrelations among the populations of small bodies in the Solar System and their evolution,
- description of the distribution of meteoroid particles in the inner Solar System,
- study of the structure of selected meteor showers,
- identification of the meteor sporadic background activity by a forward scatter radio system,
- detection of ozone in the upper mesosphere with ground based radio observations,
- operation of fireball fish-eye cameras within the framework of the European Fireball Network,
- investigation of the light scattering of dust particles in the Solar System and Earth atmosphere,
- search for hyperbolic and interstellar meteoroids using data from IAU Meteor Data Center and other sources,
- 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 and Stará Lesná Observatory - two 60 cm photometric reflectors, a 50 cm reflector with a CCD camera.

Research activities:

- investigation of interacting binary and multiple systems, symbiotic stars, novae and nova-like objects focused on physical processes during phases of their activity, studies of their origin, structure, evolution and physical conditions in the circumstellar environment,
- photometric detection of various manifestations of both regular and semi-regular stellar variability, models' construction explaining the behaviour of the systems,
- use of the IUE as well as HST databases for the spectroscopy of interacting binaries and direct HST images to study expanding envelopes of novae and symbiotic stars,
- spectroscopic investigation of chemically peculiar star phenomena based on spectra from ESO, Mt. Stromlo, Nauchnyj, Ondřejov, 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, J. Svoreň, M. Tirpák (postgraduate student).

3.4 Department of Solar Physics

Head: A. Kučera
Staff: P. Bendík (technician), P. Gömöry, Ľ. Klocok, J. Koza (MC fellowship at the Utrecht University, the Netherlands - since 15/07), R. Mačura (technician), K. Maník (technician), M. Minarovjech, V. Rušin, J. Rybák, M. Saniga, L. Scheirich (technician), J. Sýkora, F. Tomasz (postgraduate student).

3.5 Stellar Department

Head: J. Žižňovský (till 1/12), D. Chochol (since 1/12)
Staff: J. Budaj (currently a post-doctoral scientist at the Penn State University, USA), L. Hric, D. Chochol (till 1/12), R. Komžík, E. Kundra, K. Kuziel (technician), T. Pribulla, P. Schalling (technician), A. Skopal, J. Tremko, M. Vaňko, M. Zboril, J. Zverko, J. Žižňovský (since 1/12).

3.6 Administration and Maintenance

Head: M. Alman
Staff: J. Ambroz, R. Bekeš, F. Buzák, T. Drzewiecka, M. Dufalová, T. Griešová, Ľ. Hanigovský, K. Krempaská, D. Novocký, A. Sanigová, M. Šoltýsová, P. Zimmermann.

4 Guests

In 2005, the following guests visited our institute: J. Tilden (Coastal CRC, Indooroopilly, Australia), I. Iliev (Rozhen Observatory, Bulgarian Academy of Sciences, Sofia, Bulgaria), Z. Mikulášek (Institute of Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic), H. Meszárosová (Astronomical Institute, Ondřejov, Czech Republic), P. Pracna (J. Heyrovský Institute of Physical Chemistry, Prague, Czech Republic), J. Janík (Institute of Theoretical Physics and Astrophysics, Masaryk University, Brno, Czech Republic), L. Leedjärv (Tartu Observatory, Estonia), S. Regnier (ESA, ESTEC, Noordwijk, the Netherlands), M. Jankovič (Central European University, Budapest, Hungary), J. Staude (IAP, Potsdam, Germany), O. Laudal (Matematisk Institutt, Universitetet i Oslo, Blindern, Oslo, Norway), J.I. Romanjuk (SAO RAN, Russia), D. Kudryavtsev (SAO RAN, Russia), S. Shugarov (Sternberg Astronomical Institute, Moscow State University, Moscow, Russia), G. Pupillo (ISAC (FISBAT) CNR, Bologna, Italy), G. Cevolani (ISAC (FISBAT) CNR, Bologna, Italy), A. Ozguc

(Bogazici University, Kandilli Observatory and Earthquake Research Institute, Cengelkoy, Istanbul, Turkey), S.T. Wu (CSPAR, University of Alabama in Huntsville,Huntsville, USA), J. Pap (GEST/University of Maryland, Greenbelt, USA).

5 Results

The main results acquired and published by the research personnel of the Astronomical Institute in the year 2005 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 2005: We applied the method of reconstruction of the composite spectra to 21 symbiotic systems during their quiescent as well as active phases. We determined accurate physical parameters of individual components of radiation. Independently we confirmed the spectral type of cool giants in symbiotic binaries. New distances and quantities of the interstellar redening were refined for some objects. The mass-loss rate for cool components was determined to 10E-7 solar masses per year. We suggested solution for the apparent problem of directly and indirectly determined temperature of the hot objects as a consequence of a disk-like structured accretion material. The effect is extreme during active phases. We revealed the presence of a high-temperature nebula in active systems. On the basis of the properties of individual sources (physical and geometrical parameters) we reconstructed basic structure of the active object in symbiotic binaries, which represents the major result in the field (papers Nos. 57, 59).

2/ The most significant result obtained within frame of international collaboration: The formation and properties of accretion discs and circumstellar material in Algol-type systems is not very well understood. In order to study the underlying physics of these structures, we have calculated synthetic H alpha spectra of TT Hya, which is an Algol-type eclipsing binary with an accretion disc. Both the primary and secondary stars were considered in the calculations as well as a disc surrounding the primary. The Roche model for the secondary star was assumed. The synthetic spectra cover all the phases including primary eclipse and are compared with the observed spectra. The influence of various effects and free parameters of the disc on the emerging spectrum was studied. This enabled us to put some constraints on the geometry, temperature, density and velocity fields within the disc. Differences found between the observed and synthetic spectra unravel the existence of a gas stream as well as a hotter disc-gas interaction region. An additional cooler circumstellar region between the C1 and C2 Roche surfaces is suggested to account for various observed effects. A new computer code called Shellspec was created for this purpose which solves simple radiative transfer along the line of sight in 3D moving media. (paper No. 18).

3/ Prominence archive (database) from the Lomnicky Stit coronal station has been finished in the period 14.9.1962 – 24.12.2003 and its practical using has been shown. Data of this base can be used to study time latitudinal distribution of prominences and their connection with solar surface magnetic fields over solar cycles. Apart of it, study of prominence morfology, their connection with the solar corona flares and CMEs are available as well (paper No. 29).

4/ The response functions for temperature and line-of-sight velocity of the photospheric spectral lines Fe II 523.5 nm, Fe I 543.4 nm and Ni I 543.6 nm are examined. The lines were previously used for determination of the depth dependence of the solar rotation velocity. The positions of local maxima of the response functions to temperature and the calculated optical depths of formation of line cores are confronted. The close coincidence of these quantities is demonstrated and thus verifying the correctness of the optical depth scale of the investigated solar rotation profile (paper No. 71).

5/ Unique observation of a solar flare in all phases of its development with high temporal and spatial resolution was done. Temporal development of the flare shown that the flare started first in the chromosphere, a few minutes earlier than it was pronounced in the X-ray which map the transition region and corona. This is in contrary to classical scenario of the flare evolution, where the primary energy release is supposed in the upper parts of the solar atmosphere (paper No. 72).

6/ Reexamination of the homogeneous coronal data set has been done in the period 1939-1965, using a close correlation between the coronal index of solar activity (CI) and sunspot number (also the 2800 MHz radio flux and the cosmic ray intensity) in the period 1966-2002. New homogeneous coronal data set has been created and a new CI has been recomputed. High correlation between the CI and sunspot number (0.914) has been found. In fact, this method can be used to obtain CI values as far back as reliable sunspot observations exist (1850) (paper No. 50).

7/ Intermittence of the short-term periodicities (25–35 days) of the flare index are investigated using the wavelet transform method for the full-disc and for the northern and the southern hemispheres of the Sun separately over the epoch since 1966 until 2002. Occurence of periodicities of flare index power is highly intermittent in time and flaring activity on the solar hemispheres in several time intervals. Correlations of the period-averaged wavelet power of the flare index for the separate hemispheres and for the full-disc reveal significantly stronger relation between the full-disc and the northern hemisphere than between the full-disc and the southern hemisphere (paper No. 51).

8/ Here we study the 24-day period in the solar flare occurrence for solar cycles 21 and 22 by means of wavelet power spectra together with the solar flare locations in synoptic magnetic maps. We find that the 24-day peak revealed in the power spectra is just the result of a particular statistical clumping of data points, most probably caused by a characteristic longitudinal separation of about +40 degrees to +50 degrees of activity complexes in successive Carrington rotations (paper No. 64).

9/ The short-term periodicities of the flare index are investigated in detail over the epoch of almost 4 cycles (1966-2002). A comparison of the results of the Fourier tra nsform and the time-period wavelet transform of the flare index time series has clari fied the importance of different periodicities, whether they are or are not the har monics of the basic ones, as well as the temporal location of their occurrence. Because we found that the modulation of the flare index due to the 27-day solar rotation is more pronounced during the declining portion of solar cycle than during the rising portion (paper No. 40).

10/ Phenomenology of the coronal manifestations of the solar activity for the last 60 years is described including the north/south asymmetry, zonal deviations (equatorial, middle-latitude and polar zones), presence and persistence of the 'active longitudes' on the Sun, cyclicity and periodicity of the solar activity (paper No. 14).

11/ It was shown that the north/south (N/S) asymmetry (A) of the solar activity presents very adequate index for study of the Quasibiennial oscillations (QBOs) of the solar activity. QBOs are better pronounced in NSA than in the original indices from which the NSA is calculated (number and area of the sunspots, intensity of the magnetic field on the Sun, brightness of the green coronal line emission) (papers Nos. 91 and 102).

12/ A relatively simple exponential relation was found between the coronal green-line emission of the Sun and the solar magnetic field strength. At the same time, during minima of the 11-year solar activity cycles the q-coefficient within the relation in question acquires an opposite sign at the equatorial and polar zones of the Sun. During maxima of the solar cycles the relation of both the above-mentioned parameters is much more complicated (papers Nos. 63 and 67).

13/ Investigation of the Sun's coronal rotation performed throughout six last 11-year solar activity cycles made it possible to interpret the coronal rotation by a co-existence of two regimes of rotation – the fast one with rotational period of 27 days and the slow one manifesting the period of about 30.5 days. Then, the final observed coronal rotation results from overlapping of the two above modes and increases from about 27 days at the solar equator to about 29 days at the latitudes of 40°. Higher, up to the solar poles, more or less rigid regime of coronal rotation is preserved (papers Nos. 15 and 103).

14/ Analysis of space-time distribution of the Fe XIV 530.3 nm coronal emission line brightness over the Sun's surface revealed that during a relatively continuous evolution of this distribution some sudden and expressive discontinuities appear close to the so-called reference points of the 11-year solar activity cycles. Quite long-term (1.5 – 3.0 years) enhancements of solar activity were found within the limited intervals of heliographic longitudes (c.f., active longitudes) and their expressive antipodality and intermittence during particular phases of solar activity cycle are described (paper No. 13).

15/ The analyses of photographic and radar meteor data from the IAU Meteor Data Center and the comparison between these results and the results obtained by cosmic spacecraft detectors and by a high-power radar has shown that the occurence of interstellar meteoriods is different for masses $m > 10^{-10}$ kg, for mass interval $10^{-15} < m < 10^{-10}$ and for masses $m < 10^{-15}$ kg, and that the mass index s of interstellar meteoroids changes continuously along the mass scale. (papers Nos. 79, 80, and 81).

16/ By the analysis of precise photographic orbits, a fine structure of the Perseid stream was found using the method of indices. 560 of 875 Perseids taken into account are sorted out to 17 filaments, which form the higher structures - so-called branches. The stream consists of 1 individual filament, 3 branches of the stream containing 9 filaments together and a central part of the stream. In the central part of the Perseids, 3 branches and 1 individual filament were identified. The structures are dived into a cloud of 315 dispersed orbits (papers Nos. 28 and 89).

17/ It was shown that dust morphology is an important factor responsible for uncertainty in determination of microphysical characteristics of dust particles. For instance, retrieval of a mean size of the particles may be influenced by assumption made about the particle shape. The difference between calculated mean sizes of spherical and non-spherical particles is evident when non-spherical particles are non-randomly oriented in the space (papers Nos. 30 and 31).

18/ The list of the potential meteoroid streams crossing the orbits of all four terrestrial planets was worked out. As comets as meteors were considered to be the potential parent bodies. The number of streams increases, as expected, from the Mercury to Mars. The resultant data for Mars are significantly incomplete, because a large number of the appropriate potential parent bodies has not been discovered, yet (papers Nos. 38, 84).

19/ It was demonstrated that it is possible to obtain information about the cometary cloud from the distribution of the angular elements of new comets (comets coming to the planetary region first time), if these distributions are constructed for a different epoch than the time of their observed perihelion passage (if they are constructed, for example, for the moment of the previous perihelion passage), and new comets are selected from a given set of long-period comets by the criterion newly suggested by P. A. Dybczynski in 2001 (paper No. 95).

20/ The structure of the outer part of the Oort cloud was, for the first time, revealed from the observations. It appeared that the cloud is less concentrated toward its centre (the index of the semi-major-axis power-law distribution is about -0.65) than supposed in the past (index -2 or -2.5). A depletion of the outer cloud caused by the Galactic tide and nearly passing stars was estimated to be about 19 (paper No. 39).

21/ Within the program of the astrometry of selected comets and asteroids, another 54 precise positions of comets and 131 precise positions of asteroids were observed and reduced. The photometry program was focused to enable a modelling of asteroid shapes and to observe the near-Earth objects, asteroids of Hungaria family in an internal region of the main belt, and periodic comets (papers Nos. 37, 73, 74, 76, 133, and 134).

22/ Ground-base support observations of comet 9P/Tempel 1, which we mostly obtained on UH 2.2-m telescope on Mauna Kea, were important contribution for successful NASA cometary space mission Deep Impact. Preliminary analyzes of pre-, during and post-impact observations showed: 1) Impact originated ejection of dust and gas particles from the comet nucleus with a slightly different composition that the original comet material. 2) Impact cause cloud of very small fain dust grains which cover whole impact area. 3) Impact increased cometary activity of the nucleus which last only few hours (paper No. 35).

23/ A global analysis and study of the activity and structure of the Geminid meteor stream based on from forward scatter radio observations in 1996-2003 on the baseline Lecce-Bologna-Modra was made. A half-maximum width of the stream reaches two days and variation of the mass exponent around the shower maximum indicates a relative stabile population of meteoroids with smaller particles distributed predominantely in the ascending branch of activity (paper no. 45).

24/ By separation of the members of the Geminids from the current version of the IAU catalogue of photographic meteor orbits, the mean orbit, the size, form and ephemeris of the Geminid radiant were derived. The radiant area of the central part of the stream is only 2x2 degrees. A study of the orbital evolution of the stream mean orbit and its potential parent the asteroid 3200 Phaethon has confirmed their close genetic relation (paper no. 48).

25/ A complex analysis of the IAU Meteor Data Centre catalogue of photographic meteors, coordinated by our institute, was performed. The analysis consisted of a complex revision of the orbital and geophysical parameters of the catalogued meteor orbits and of adding new additional orbits. The revised version of the catalogue consists of 4581 precise photographic meteor orbits and is available also in an electronic form on the server of the Astronomical Institute, Slovak Academy of Sciences (paper No. 34).

26/ A combination of observations in radio, UV, visible and infrared regions, providing us with information about the complex chemical composition of the cometary nuclei. Combined with the detailed thermal models of the interior of comets will come the ability to separate the primordial differences from the products of aging and evolutionary process. Main sources of knowledge would be an activity in very distant comets, a monitoring the brightness of brigher Centaurs over a range of heliocentric distances and a searching for comas of Kuiper Belt Objects (paper no. 2).

27/ A list of 875 Perseids selected from the newest version of the IAU MDC database of photographic orbits is presented. The selection was made by a method of indices. The list of selected Perseids is available in a digital form as a plain ASCII file from the web address: http://www.astro.sk/caops/Edition/FullTexts/vol35no3/pp199-220dat/ (paper No. 62).

28/ We discovered that spectra of several Am binaries (HD 434, HD 861, HD 108642, HD 178449 a HD 216608) contain spectral lines associated with the fainter secondary component. It was demostrated that high resolution, high S/N CCD observations using 2m class telescopes can discover plenty of new secondary spectra of so far unresolved spectroscopic binary systems (paper No. 93).

29/ We have confirmed the eclipsing model for symbiotic star YY Her. We excluded the possibility to explain the observed light variations by a combination of the ellipsoidal efect and variations of the nebular continuum. The energetic and time scales of the activity of YY Her binary system have been defined (paper No. 24).

30/ The photometric data of the soft X-ray sources of V Sge and QR And have been obtained, analysed and interpreted. During beginning of 2005 the outburst of V Sge was observed. Following the analysis of (O - C) diagram the ephemeris as well as the orbital period were precised (papers. Nos. 82 a 83).

31/ We used the multicolour CCD photometry and spectroscopy of the classical nova V475

Sct to determine its basic parameters and classify the object as a slow Fe II nova. We detected formation of the dust in its expanding envelope accelerated by a stellar wind. The 13-day periodicity of brightness increases was explained either by pulsations of the hot component or by a mass transfer from the red to the white dwarf caused by a third body moving around the binary at eccentric orbit (papers Nos. 25, 26, 27).

32/ Simultaneous analysis of the photometry and spectroscopy of the hot eclipsing binary V1034 Sco in the young open cluster NGC 6231 lead to the improvement of the orbital peri od to 2.4406 days and determination of the parameters of the components. Previously suggested small orbital eccent ricity was found to be only a result of components activity and asymmetry of the radial-velocity curve. Ab solute parameters of the components were used to independently determine the distance modulus of NGC 6231 to be V0-MV = 10.73 +/- 0.02 (paper No. 17).

33/ Analysis of minima times of selected short-period eclipsing binaries revealed cyclic period changes interpreted by the light-time effect. The orbital parameters of the binary aro und the common center of gravity with the third body were determined. Scatter analysis of photoelect ric and CCD times of minima indicated several candidates for short-period triple systems. Other mechanisms responsible for the observed cyclic changes of the orbital period were discussed (paper No. 46).

34/ New photoelectric light curves of contact binaries V344 Lac and V1191 Cyg were presented. Photometric elements for these systems were determined using recently developed code ROCHE. Analysis of orbital period changes was performed using all available minima. Contact binary system V1191 Cygni was found to show a very fast period increase (paper No. 47).

35/ To explain the comlex behaviour of the light curves of symbiotic stars we used their energy distribution in the optical region. The wave-like variation as a function of the orbital motion observed during quiescent phases are produced by the orbitally-related variation of the radiation from the symbiotic nebula. During active phases this type of the light variability disappeares due to creation of the optically thick pseudophotosphere around the active star (paper No. 58).

36/ Based on accuratelly determined physical parameters for quiet symbiotic stars EG And and CQ Dra we revealed that the solely source of the energy for both the binaries is the accretion via the stellar wind from the giant component onto the compact hot companion at accretion rates of 1E-8 solar masses per year (paper No. 60).

37/ We derived approximative formulas for the basic parameters of the Roche lobe, its radius and the position of the inner Lagrange L1-point, for asynchronously rotating component in a binary system. Deviations between numerical solution and that given by our approximation are less than 7 percent. We showed that the gainer star in an interacting binary can rotate more rapidly than the orbital period due to the accretion process. We demostrated this possibility for the binary TX UMa (papers Nos. 19, 61).

38/ For the first time we analysed simultaneously spectroscopic and photom etric data of several chromospherically active (solar type) stars. The data were obtained at foreign observatories. In the case of eclipsing binary AR Lac, the spots on primary were revealed in middle stellar latitudes. Given the season, the spots on SB1 system II Peg are located in low stellar latitudes. These studies are important to derive properties of stellar magnetic activity cycles (papers Nos. 65 and 66).

39/ The Principal Components Analysis method was applied to analyze the multicolour light curves of magnetic CP stars HD 90044 and HD 125248A. The PCA significantly decreases, in comaprison with the Fourier decomposition method, the number of free parameters needed to describe the light curves (paper No. 132).

40/ A distribution of outgoing energy from an A-star atmosfere was calculated for a range of light elements. As an example the role of incerasing silicon abundance was considered. A significant contribution of bound-free transitions to the photometric variability was found (paper No. 131).

41/ We have shown that a Cremonian space-time can then be viewed as an emergent phenomenon when the condition of "homaloidityöf the corresponding web is satisfied (paper No. 53).

42/ It was found out that given a generic Cremonian space-time, its three spatial dimensions are shown to exhibit an intriguing, "two-plus-one-partition with respect to standard observers. We have described a particular kind of six-dimensional Cremonian universe featuring one dimension of space, three dimensions of time and additional two dimensions that are fundamentally different from both time and space (papers Nos. 52 and 54).

43/ We have discovered that a set of mutually unbiased bases (MUBs) in a q-dimensional Hilbert space can be viewed as an analogue of an arc in a (Desarguesian) projective plane of order q. The properties of squeezed quantum states can be described by Galois fields and related algebras (papers Nos. 43 and 55).

44/ An intricate relation has been found between abstract algebra, projective geometry and time-coding of quantum information (paper No. 97).

6 Grants/Projects

6.1 International grants

- 2001-2005, Project DFG - Solar granulation (project No. DFG 436 SLK113/7/0-1) - principal investigators: H. Wöhl, A. Kučera, J. Rybák
- 2003-2005, Project AV ČR-SAV - Research of cataclismic variables - project INTEGRAL - principal investigator: L. Hric
- 2004-2006, Project CNR-SAV - Physical and dynamical aspects of the evolution of short-period Comets - principal investigator: E. Pittich
- 2004-2006, Project CNR-SAV - Interplanetary bodies and atmospheric phenomena - principal investigator: V. Porubčan
- 2004-2006, Project CNR-SAV - Physical processes in active stars and search for their star and planetary companions - principal investigators: D. Chochol, T. Pribulla
- 2002-2005, Project CNR-SAV - Space weather and climatology - principal investigator: J. Sýkora
- 2002-2005, Project 'Processes of interaction in classical novae and symbiotic stars' of AI-SAS with the Astrophysics Research Institute, John Moores University, Liverpool - principal investigator: A. Skopal
- 2002-2006, Project EU HPRN-CT - European solar magnetism network - principal investigators: R. Rutten, A. Kučera
- 2005, OPTICON – Trans-national acces progremme project 7E1404/2005/028+029(6FP EU) - principal investigator: J. Ryák
- 2005-2007, Project FP6-2002-Mobility-5 No. 011379-MULTIDOT - Marie Curie Host Fellowship programme - principal investigator: J. Koza
- 2004-2005, Project HPMT-CT-2001-00245 Marie Curie Host Fellowship programme, The Netherlands Research School for Astronomy (6FP EU) - principal investigator: P. Gömöry
- 2003-2005, Slovak-Chinese project - Study of magnetic fields, corona and prominences in the solar corona over a solar cycle - principal investigator: V. Rušin

- 2003-2005, Slovak-Czech project (project No. MVTS 128/2004-12-20) The variability of cool magnetic stars and its origin - principal investigator: J. Zverko
- 2004-2006, USA-SK NSF project 'Space weather: numerical MHD study of CMEs: inicialization and propagation' - principal investigator: J. Rybák
- 2003-2006, collaborative inter-institute (Slovakia - Croatia) - Solar active phenomena - principal investigator: A. Kučera
- 2005-2006, collaborative inter-government project (Greece - Slovakia) - International Greek-Slovak On-line Network of Selected Astronomical Observatories - principal investigator: L. Hric
- 2005-2007, collaborative inter-institute project (Slovakia - Poland) - Photometric investigation of contact binaries and short-period eclipsing binaries - principal investigator: T. Pribulla
- 2004-2004, institute project ZiF (AG)205-2/2005 (Germany) - Endophysics, time, quantum and the subjective - principal investigator: M. Saniga
- 2003-2005, CNRS project (France) - Squezeed states and uncertainty relations - principal investigator: M. Saniga
- 2005-2007, project of the Project School of Mathemetics and System Engineering (Sweden) - Mathematical modelling in physics, biology, economy and cognitive sciences - principal investigator: M. Saniga

6.2 Grants of the Slovak Grant Agencies VEGA and APVT

- 2003-2005 - Distribution of chemical elements on the surface of chemically peculiar stars - principal investigator: J. Zverko
- 2003-2005 - Dynamical processes and energy transfer in the solar atmosphere - principal investigator: A. Kučera
- 2003-2005 - Cosmic dust, interplanetary and interstellar medium and their effects on the Earth and its atmosphere - principal investigator: A. Hajduk / M. Hajduková
- 2004-2006 - Dynamics and evolution of comets and asteroids from the point of their migration into regions of planetary orbits - principal investigator: E. Pittich
- 2004-2006 - Solar activity in the corona and prominences - principal investigator: V. Rušin
- 2004-2006 - The dynamical evolution and activity of the interplanetary bodies - principal investigator: J. Svoreň
- 2004-2006 - Zonal pecularities in the evolutionary processes on the Sun - principal investigator: J. Sýkora
- 2004-2006 - Study of the activity in the interacting binaries - principal investigator: A. Skopal
- 2004-2006 - The structure of the transmission reagions of the cataclysmic and related binaries - principal investigator: L. Hric
- 2002-2005 - Photometry of interacting binaries - principal investigator: D. Chochol
- 2002-2005 - Slovak photometric telescopes network for studies of selected physical processes in variable stars - principal investigator: L. Hric

- 2005-2007 - Emission corona and prominences: indicators of solar activity and space weather - principal investigator: V. Rušin

6.3 Institute projects

- Radar studies of the faint component of the interplanetary matter - principal investigator: A. Hajduk (till April 2005)
- 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

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2. PITTICH, Eduard: Čas, obloha od januára do decembra. In: Astronomická ročenka 2006, ed. E. Pittich, Slovenská ústredná hvezdáreň, Hurbanovo, 2005, p. 3-89 (in Slovak).
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