2. SPACE PHYSICS, GEOPHYSICS AND ASTRONOMY.

The institutes of the Slovak Republic are continuing the space research activities in the directions of space solar physics and X-ray astronomy, interplanetary matter and explorations of the comets, solar wind and its interactions with the Earth's magnetosphere, energetic particles in the magnetosphere and in interplanetary space, atmosphere and ionosphere of the Earth. The following short survey presents selected activities of the abovementioned directions and the obtained results.

The dynamics of cosmic particles with the energies well below those of cosmic rays and well above those of solar wind (from few tens of keV up to several MeV) have been studied by the ***Institute of Experimental Physics, SAS, Košice*** (its Department of Space Physics) in the co-operation with the laboratories in abroad. In addition, the measurements of secondary cosmic rays observed by ground based method have been analysed. The analysis of the data obtained both from the low altitude and high apogee satellites, as well as development and construction of new instruments for the future studies continued in the period 2000-2001.

Both case and statistical studies of energetic particle dynamics within the magnetosphere, near its boundary regions, in the geomagnetic tail and in the foreshock were studied with using measurements by DOK-2 and DOK-S in the Interball project [13,20,24,25,28,29,30,32-36,43,44]. Figure 3 shows the results of extensive statistical study by DOK-2 experiment (tail probe) and Figure 4 illustrates the fine energy spectra and their temporal evolution observed on auroral probe. Comparison with the wave, magnetic field and plasma experiments on the same satellite as well as with the energetic particle measurements on POLAR and SOHO were done. Comparison of spectra obtained by DOK-1 on Prognoz-10 with the spectra of ions in another positions was done in [46].

Measurements by SONG instrument on CORONAS-I satellite were used for the comparison of low energy part of the cosmic ray spectra with the ground based neutron observations during a Forbush decrease. The detailed distribution of gamma ray flux at altitude 500 km was obtained. The spatial distribution of gamma rays associated with trapped particles was analysed. Comparison of SONG measurements on CORONAS-I with SAMPEX observations started

recently. The results from CORONAS-I can be found in [10-12,27]. Preliminary analysis of LET spectra observations on MIR are presented in [16].

New experiments for measurements of energetic particles in future missions are in progress in the collaboration with several institutes in abroad e.g. with STIL Maynooth, Ireland [45]. Figure 5 illustrates the energetic particle spectrometer MEP-1. A photostimulation method for evaluation of pile-up effects was developed [6,7].

Cosmic ray measurements by neutron monitor at Lomnický Štít became available in real time (http://neutronmonitor.ta3.sk). The modulation of cosmic rays in the heliosphere and sensitivity of neutron monitor to galactic cosmic rays was studied in [41,42]. Connections between cosmic rays, solar variability and space weather effects, as well as temporal evolution of various quasiperiodicities in cosmic ray records were examined in the series of papers [1-5,14,15,21,22,26,31,37]. The geomagnetic effects on cosmic rays have been checked by methods of trajectory computations in model geomagnetic field [8-10,23,38-40].

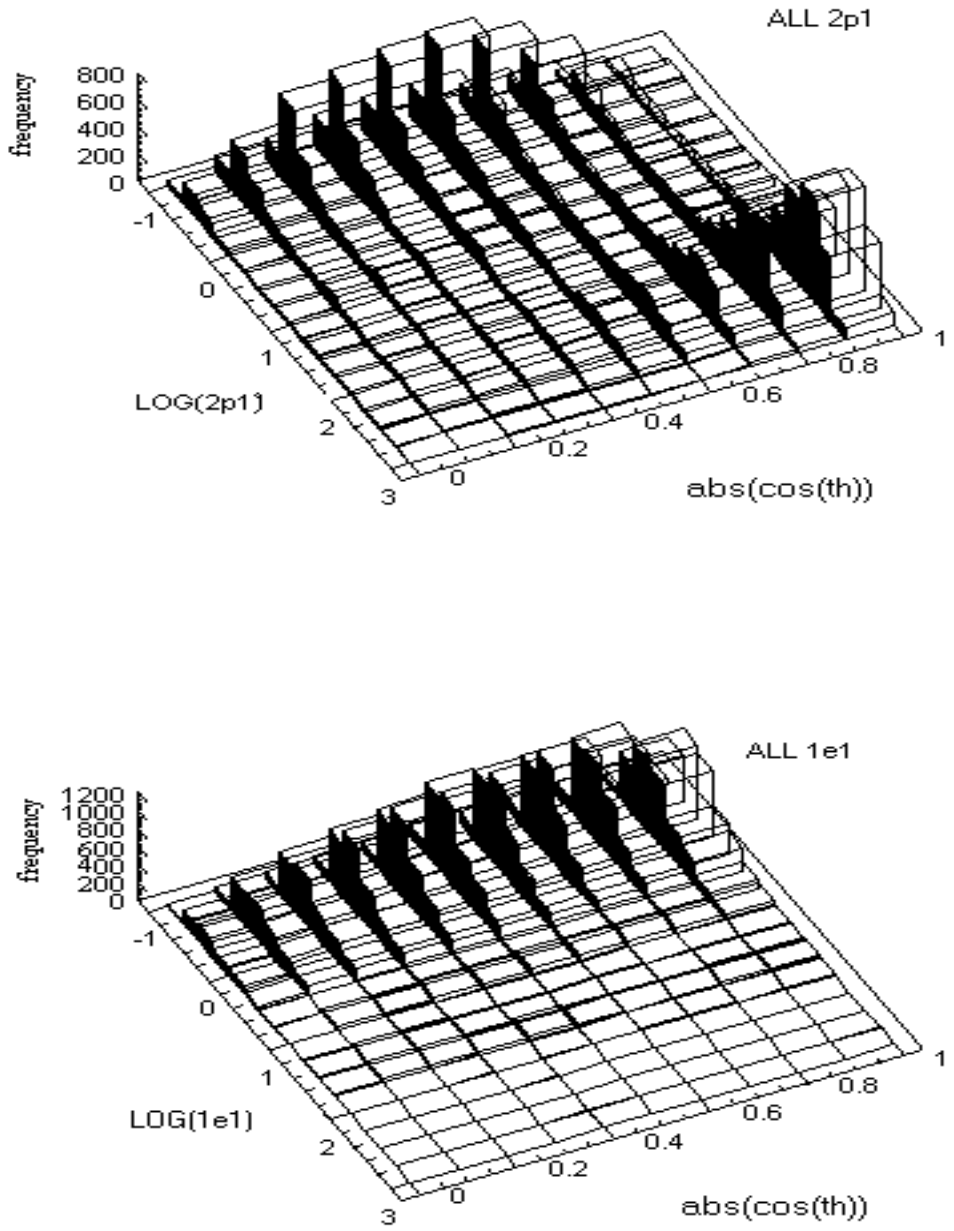

Fig. 3. Distribution of the 2 minute averages of logarithm of ion and electron fluxes observed in the region upstream of the Earth's bow shock by DOK-2 instrument on Interball-1 (tail probe) during 4 years. The upper and lower panels display the ions (20.6 to 26.7 keV) and electrons (21.2 to 25.7 keV) respectively. It is apparent that high ion fluxes are more frequently observed for quasi-parallel geometry than for quasi-perpendicular one. Th is the angle between the magnetic field line vector and the normal to the bow shock at the model connection point. The electrons do not indicate such type of dependence. Altogether ~25000 measurements are reviewed.

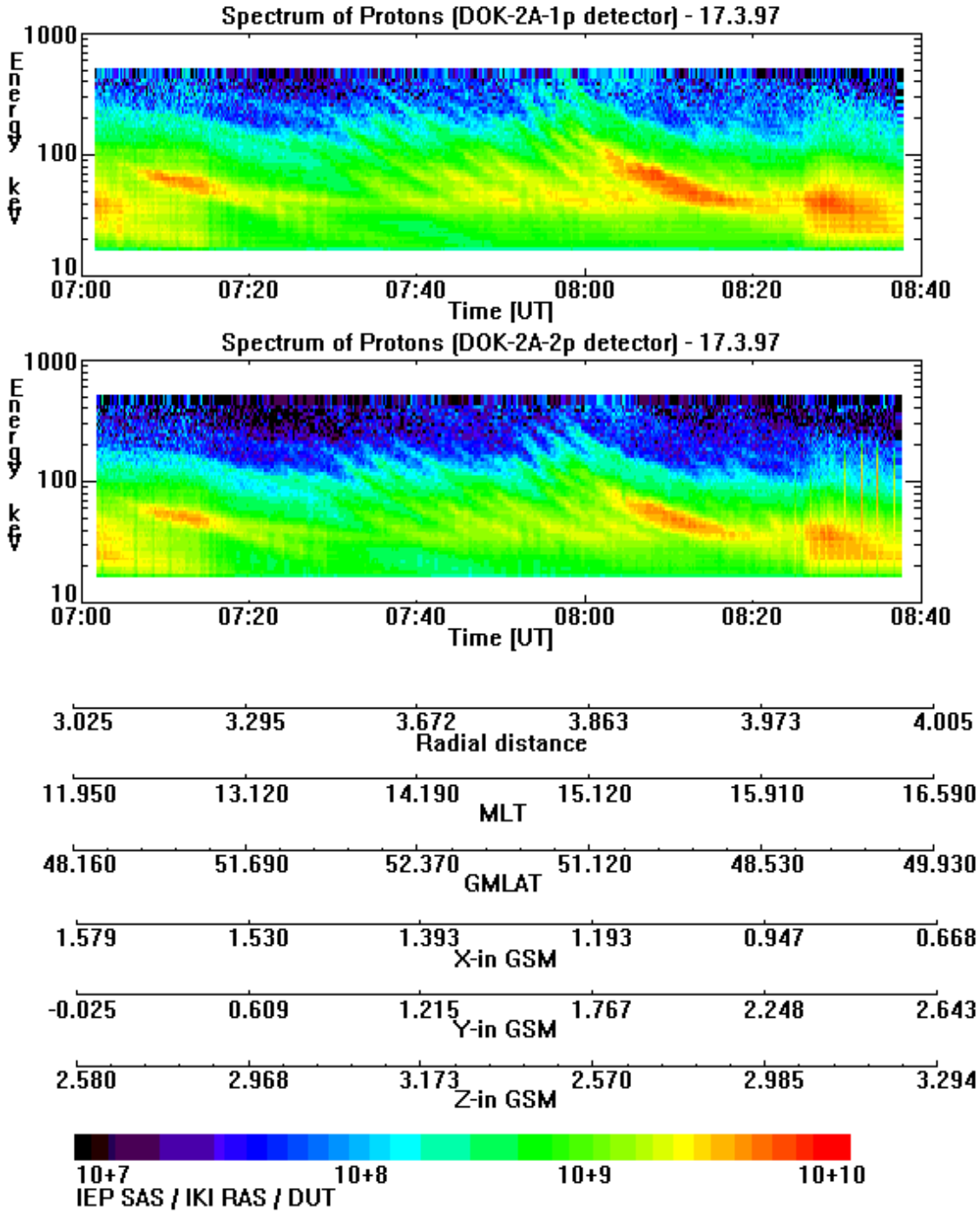

Fig. 4. Example of sequence of dispersive events of ions observed in the outer magnetosphere by DOK-2 on Interball-2 (auroral probe) in the postnoon sector of magnetic local time. The values correspond to $J(E)*E^3$, where J(E) is differential intensity (#/cm^2.s.ster.keV) and E is in keV.

Fig. 5. Spectrometer of electrons and protons (MEP-1) developed, constructed and tested at IEP SAS Košice in the collaboration with scientists in abroad. The device was originally scheduled for the satellite of the project COMPASS. It is a relatively simple monitoring type of instrument for measurements of energetic electrons and ions (tens of keV up to several MeV) with high flexibility of the measurement modes. It can be used e.g. for the microsatellites or for another missions (scientific and well as commercial satellites) for monitoring of flux and energy spectra of energetic particles with relevance to space weather effects.

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The activities of the ***Faculty of Mathematics, Physics and Informatics of the Comenius University, Bratislava*** **(*Department of Nuclear Physics*)** have been oriented in the field of interaction of cosmic rays with material objects on the study of four major problems:

- Study of chemical elemental composition of 433 Eros asteroid.
- Study of preatmospheric sizes of parent bodies of meteoritic showers
- Study of geomagnetic field intensity variations using in situ produced cosmogenic nuclides
- Study of possible link between cosmic ray intensity and some environmental factors.

Result of these studies were published in 9 reviewed papers and in about dozen of contributions to conferences.

Last year, were obtained experimental data from NEAR mission. We participated in this data analysis. Using the measured fluxes of gamma rays and our model calculations we were able to convert obtained fluxes in elemental maps of NEAR surface and determine the type of the investigated asteroid.

During the last few years a lot of meteorites belonging to meteoritic showers were found. One of the basic questions related to history of these objects is the size of the parent body. Ratios of various cosmogenic nuclides extracted both from metal and stone phase of meteorites can be used as shielding depth and preatmospheric size indicators. We analyzed a few meteorites and used our model for simulation of production rates. Based on this work we were able to put some limits on the sizes of investigated parent bodies, their exposure and terrestrial age.

A few years ago there was suggested idea that there exists inverse correlation between cosmic ray flux and cloud coverage. Using the codes developed for simulation of cosmic ray interactions with matter we were able to simulate the number of secondary particles produced in these interactions. There is proportional relation between these secondaries and condensation nuclei. Having calculated their density we concluded that cosmic rays couldn’t be main trigger of cloudiness formation.

The production rates of in situ produced cosmogenic nuclides depends on primary cosmic ray particle flux, they modulation because the solar activity and geomagnetic field intensity. As most of cosmic ray particles are charged the interaction of geomagnetic field with them leads to their deflection. This leads to the dependence of cosmogenic nuclide production rates on geomagnetic field intensities. Having long records of geomagnetic field intensity we can calculate calibration curve for particular nuclide production. On opposite side having long

records for cosmogenic nuclides and model for their production rates we can reconstruct the paleomagnetic intensity in the past. Some progress in broth approaches was reached last years as is demonstrated in listed publication [7] and [8].

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A number of aspects of magnetospheric physics was studied at the ***Geophysical Institute of the Slovak Academy of Sciences in Bratislava*** (GPI SAS).

From the viewpoint of variability of space weather the long-term modulation features in climate evolution were studied. The oscillatory character in dynamics of main meteorological parameters has been reported, which seems to be related to solar forcing [1, 2, 3].

The influence of the Sun on the near-Earth environment was manifested in terms of an eclipse-induced effects in the ionosphere and magnetosphere. The pronounced signatures of these effects can be followed mainly in the Y component of the geomagnetic field [4, 5].

The accumulated local geomagnetic signal energy content on time scale of substorms and storms has been introduced and its scaling properties have been studied. It was demonstrated that in case of geomagnetic field (GMF) fluctuations there exists a multifractal counterpart of the previously reported spectral break which separates higher and lower frequency parts of the spectrum. It appears that different types of multifractal spectra describe the fluctuations in direct dissipation or loading-unloading regimes of the solar wind-magnetosphere interaction. The loading-unloading mode fluctuations seem to be analogous to the simple multiplicative p-model commonly used in turbulence studies [6, 7, 8].

Wavelet-based filtering has been used to study the higher-order statistical properties of geomagnetic energetic events [9] and solar wind minute-mean magnetic fluctuations from the WIND satellite [10]. It was found that the statistical distributions of energies of intermittent events and waiting times between intermittencies are very similar for both geomagnetic and solar wind data. Near SOC (Self-Organized Criticality), chaotic turbulence or shell-models were proposed as candidates for explaining the observed statistical features [9, 10].

A nonlinear neural network model was proposed for modeling and prediction of the magnetic storms (Dst index) using 1 [h] means of solar wind parameters from the ACE satellite. A set of orthogonal linear coordinates from solar wind parameters was introduced for neural network input and a feed-forward multilayer network was used to learn input-output relations and to recognize patterns from the ACE database. It was found that the main phase of storms is better reproduced when only the solar wind parameters are used in input which

can be explained by the thorough influence of solar wind forcing during the initial phase of storms. The recovery phase becomes determined better, however, when multilayer network is used with feedback and the nonlinear dynamics of the magnetosphere is also considered [11, 12, 13].
Singularity properties of magnetic field time series of ground-based and solar wind data arising due to the intermittence of fluctuations were studied. Multifractal spectra computed from AE index, Thule and Narssarssuaq observatory data and from the ACE and WIND IMF B magnitude and Bz component data available with time resolution of 16 [s] and 3 [s] were compared. The geoeffectiveness of singular solar wind fluctuations was studied in such a way. It was found that patchy reconnection at the magnetopause can be influenced by the level of intermittence of solar wind fluctuations [14, 15].
Local scaling and singularity properties of solar wind and geomagnetic time series were analysed using the so-called Hölder exponents. It has been shown that due to multifractality of fluctuations the exponent changes from point to point [16].
The existence of a peculiar interplay between singularity and amplitude characteristics was demonstrated in analysed events for Dst index and ACE satellite data. Superior neural network performance was achieved when the extra information on local singularity exponents was added to the input layer of a backpropagation neural network model [16].
One of the important goals in the field of solar-terrestrial studies is to measure properly the GMF fluctuations induced by a variable space weather. In June 2000 the GPI SAS has been an organizer of the regular international meeting which contributes to sophistification of the GMF measurements. During the meeting the comparative measurements were carried out at the Hurbanovo geomagnetic observatory which celebrated its 100-year anniversary in 2000. The invited papers and contributions from scientific sessions of the mentioned above IX-th IAGA Workshop on ”Geomagnetic Observatory Instruments, Data Acquisition and Processing” are available for the international scientific community due to the publication of the processings of the meeting [17]. In the issue various aspects of the space and ground-based geomagnetic measurements and their applications in magnetospheric and space physics are discussed. The Hurbanovo geomagnetic observatory as a unit of the IMO (INTERMAGNET observatory) network supplies the international database with its high time resolution data on the GMP fluctuations on a regular basis, which contributes to the solar-terrestrial studies, especially space weather dynamics.
In the ***Department of Geophysics, Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava***, numerical simulations of the response of the middle atmosphere were used to investigate the situation after the very strong Solar Proton Event (SPE) of October 19, 1989. The 1-D photochemical models were considered. Ionization rates calculated using the solar proton fluxes measured aboard the Russian polar satellite system ”Meteor”

were used for the calculations. It is shown that not only ion pairs, but also NO_x and HO_x are produced and thus SPE affects both ionized and neutral (long living) constituents. A large increase of precipitating particles in high latitudes during SPE results in a very substantial increase of electron density in lower ionosphere. Consequently, the absorption of radio waves considerably increases [18, 19].

In the ***Astronomical Institute, Faculty of Mathematics, Physics and Informatics Comenius University, Bratislava***, data from EIT (SOHO), SXT (YOHKOH), GOES were used for the analysis of the solar flares in H-alfa, ultraviolet region (EIT on SOHO) and X-ray (SXT on YOHKOH). From the observational point of view the topology of the flaring active region was studied. The basic topological features were found and compared with theorethical models in order to explain the most probable trigger mechanism of analysed flares [20, 21].

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The activities of the ***Astronomical Institute of the Slovak Academy of Sciences, Tatranska Lomnica*** (www.astro.sk), related to the program COSPAR, were devoted to the research in solar and stellar physics using satellite measurements, mainly in the UV, XUV and X spectral regions. Additionally data of in-situ measurements of the solar planetary system environment have been exploited. It concerns mainly solar data of YOHKOH, SOHO, TRACE satellites and from previous ones of the NOAA and GOES series. Stellar data of the IUE satellite, Hipparcos satellite and Hubble Space Telescope were used as well for the research of various variable stars.

Investigation of the space-time distribution of the solar corona brightness revealed a number of regularities in the cyclic and evolutionary processes on the Sun over more than five solar cycles [16,17,18]. It was shown that the above distribution is strongly moderated by the solar magnetic field intensity and topology [3]. A pronounced north/south asymmetry of the solar corona was identified and discussed [1] and a method for the prediction of solar activity one 11-year solar cycle ahead was proposed [2].
Ten total solar eclipses observed during 1973-1999 period were analyzed

[14,15] and a clear anti-correlation between polarization and intensity (brightness) of the so-called green-line corona was reported as a priority discovery [4].
The IUE archive low dispersion spectra of the symbiotic star AX Persei were used to reconstruct its spectral energy distribution. By this way we determined basic parameters of individual components of radiation in the combined spectrum. [12]
The original HST imaging of the symbiotic star CH Cygni was obtained during its recent 1998-2000 outburst. The HST image shows the central stars are embedded in a nebula extended to 620+/-150 A.U. The nebula is a product of the outburst and reflects the expansion velocity of about 1200 km/s. [13]
The IUE archive spectra of the symbiotic nova V1329 Cygni were used for explanation of the mechanism causing its brightness variations. [5]
Similar IUE data together with the photometric data of the Hipparcos satellite provided physical information for the study of the early binary star V1329 Cygni with a disk. [9]
The idea "A mission to long-period comets" was elaborated for the European Planetary Exploration Programme by Dr. E.M. Pittich (http://spaceflight.esa.int/future/exploration). Its submission has provided valuable input to the Exploration Scientific Experts Group in the preparation of the Scientific background for the programme proposal.
The cosmic dust particle L2009 P9 from the NASA Johnson Space Center Cosmic Dust Collection was studied. Its analysis was the first step to gaining the more reliable input data for theoretical and modelling research in the field of the dust dynamics.[7]
Previously obtained (JOP 078) observations onboard SOHO and TRACE satellites were used for searching of the solar transition region structures and dynamical processes taking place therein [10,11].
Relation of the cosmic rays variability periodicities with the interplanetary magnetic field strength was studied in the range of the intermediate periods over the epoch 1969-2000 and similarities for the period of 1.3 year were found for the decreasing phases of the cycles 20 and 22 [8].
The solar X-ray emission background and the cosmic rays intensity in the epoch 1968-1987 were analyzed also [6].
Other papers relevant for COSPAR are listed in [19-32].

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