SEE 2007 Symposium Invitation

On behalf of the National and Kapodistrian University of Athens, in co-operation with Democritus University of Thrace, University of Ioannina, National Observatory of Athens, it is our pleasure to invite you to attend and participate to the SEE 2007 Symposium. This has been recognized as a Committee on Space Research (COSPAR) Colloquium, and is going to be held on September 24-27, 2007 at the Titania Hotel of Athens. We wish to thank the following for their contribution to the success of this conference: National & Kapodistrian University of Athens (http://www.uoa.gr), Hellenic Ministry of Education (http://www.ypepth.gr), European Office of Aerospace Research and Development, Air Force Office of Scientific Research, United States Air Force Research Laboratory (http://www.london.af.mil), Committee on Space Research (COSPAR) (http://cosparhq.cnes.fr) , European Space Agency (ESA) (http://www.esa.int), Hellenic Physicists Association (http://www.eef.gr).

The scientific topics that will be covered are:

- **A:** Solar Extreme Events of December 2006
- **B:** Energetic processes on the Sun during extreme events, solar events at solar minimum.
- **C:** The chain of physical processes in the solar-terrestrial system (Sun-Heliosphere-Magnetosphere-Ionosphere-Upper Atmosphere-Ground).
- **D:** World-wide particle detector networks for space weather research.
- **E:** Integrated Systems of forecasting and alerting on the dangerous consequences of violent solar storms.
- **F:** International Heliospheric Year 2007

All presented – oral & poster – papers, will be considered for publishing under standart reffering procedures at a special issue of *Advances on Space Research*

A conference reception Welcome cocktail at the roof garden of Titania Hotel will be held on Sunday 23rd at 19:00. As for the Traditional Greek Evening this will take place on day Tuesday 25th, at the picturesque Plaka, under the Acropolis.

A conference such as the SEE 2007 is a unique opportunity for students to get involved in the community, to expand their horizon, and to enhance their knowledge. The SEE 2007 is fortunate to have a team of enthusiastic and dedicated students assisting and participating in the event. During the conference, they will do their best to help you, inside and outside the conference facilities.

Athens is rich in historical sites. A striking example is the Parthenon temple at Acropolis. The tours that are being offered will enable convenient visits to Acropolis as well as to many other famous sites. In September, the arid climate on the Aegean coast is suitable for beach-going with plenty of sun, and an average air temperature of 80F (27°C).

We would like to welcome you at the SEE2007 Symposium in Athens.

Helen Mavromichalaki
Chair

Xenophon Moussas
Co-Chair

Panagiota Preke – Papadhma
Vice-Chair

Scientific Rationale

The Solar Extreme Events 2007 (SEE 2007) International Symposium will be focused on a series of comprehensive discussions on solar, heliospheric and magnetospheric aspects related to the solar extreme events of 2005 and 2006. The SEE 2007 will bring together scientists from different fields covering disciplines of the Sun, Earth and Heliopsheric Sciences as well as Cosmic Ray Physics and Space Weather. Analysis of satellite and ground-based data will be presented, discussed and interpreted both from experimental and theoretical point of view. Moreover, a special session on the International Heliospheric Year (IHY) is organized.

During the declining phase of the 23rd cycle of solar activity, the solar atmosphere and the solar magnetic field experienced numerous extremely strong energy releases manifested by the events of July 2005, August-September 2005 and most recently December 2006, highlighted by powerful solar flares and magnificent coronal mass ejections. As a result of this unexpected intense solar activity, the heliospheric plasma, the electromagnetic fields and energetic particle populations as well as cosmic rays were strongly influenced. The magnetosphere responded to these perturbations with strong magnetic storms, broad aurora, radiation belt, and ionosphere variations. As a consequence significant upper atmosphere and ground disturbances were recorded. The extreme solar-terrestrial events of 2005 and 2006 were recorded by many space-borne and ground-based instruments. The importance of these disturbances lies both at their impact on technological systems, as well as at the framework of the scientific investigations of the near-Earth environment. The aim of this International Symposium is to provide a world forum for the discussion of recent interesting events in the coupled solar-terrestrial system, which attracted the attention of scientists, engineers and the public, as they are important for our better understanding of the World we are living in and the knowledge of the impacts on technological and biological systems. Special attention will be paid to recent well documented phenomena in the 23-rd solar cycle as well as archives. SEE 2007 Symposium aims to create opportunities for new scientific contacts and collaborations.

With the occasion of the completion of 50 years of Space exploration, an additional topic regarding the International Heliospheric Year (IHY) will be included to Athens SEE 2007 Symposium. On the top of which for first time, a Workshop on Neutron Monitors entitled 'The present and the future of the NMs' will be held on the last day, where principal investigators of more than 25 NMs of the Worldwide Neutron Monitor Network will present their activities and their future plans.

The SEE 2007 Organizing Committee cordially welcomes you in Greece!

Scientific Program

The Solar Extreme Events 2007 (SEE2007) Symposium Program consist of contributed oral and poster papers and a number of Invited Talks. All Invited Talks will be 20 minutes in length with an additional 5 minutes for questions and answers. All other contributed talks will be 10 minutes in length with an additional 5 minutes for questions and answers.

The **Topics** that will be covered are:

- **A:** Solar Extreme Events of December 2006
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- **C:** The chain of physical processes in the solar-terrestrial system (Sun-Heliosphere-Magnetosphere-Ionosphere-Upper Atmosphere-Ground).
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- **E:** Integrated Systems of forecasting and alerting on the dangerous consequences of violent solar storms.
- **F:** International Heliospheric Year 2007

Oral presentations will be held in the Niki room of the Titania hotel.

Poster papers can be viewed from 9:00 Monday, September 24 through 14:30 Thursday, September 27 in the Niki room of the Titania Hotel.

Program - Sunday, 23 September 2007

17:00-19:00 Registration Desk Open at TITANIA Hotel

19:00-21:00 Welcome cocktail at the roof garden of Titania Hotel

Program - Monday, 24 September 2007

9:00-9:30 Welcome addresses and general information – Opening

Session A: Solar Extreme Events of December 2006

Chairs: M. I. Panasyuk, K. Kudela

9:30-9:55 **'Characteristics of the cosmic ray ground level enhancement on January 20, 2005 and December 13, 2006 as obtained from worldwide neutron monitor data'**
E. Flueckiger

9:55-10:20 **'Two acceleration mechanisms for Ground Level Enhancements'**
H. Moraal and K.G. McCracken

10:20-10:45 **'Characteristics of relativistic solar cosmic rays in large ground level events'**
E. V. Vashenyuk, Y. V. Balabin, B. B. Gvozdevsky

10:45-11:10 **'Solar extreme events in the past: What do we know about them?'**
I. Usoskin

11:10-12:00 Coffee break

Chairs: E. V. Vashenyuk, R. Buetikofer

12:00-12:25 **'Properties of solar flares and proton event forecasting'**
A. Belov

12:25-12:40 **'Dynamics of relativistic solar cosmic rays during December 13, 2006 GLE'**
A. B. Gvozdevsky, E. V. Vashenyuk, Y. V. Balabin

12:40-12:55 '**Modeling the solar cosmic ray event of 13 December 2006 using ground level neutron monitor data'**PP
A. Plainaki, H. Mavromichalaki, A. Belov, E. Eroshenko, V. Yanke

12:55-13:10 **'Spectral-temporal features of solar radio emission at the stage of halo type CMEs: Formation and initial propagation during the solar extreme events of December 2006'**
O. Sheiner, V. Fridman, Y. Tikhomirov

13:10-13:25 **'Observations of Energetic Solar Particles 13-16 December 2006'**
J. B. Blake, T. Mulligan, J. E. Mazur

13:25-13:40 **'Solar events seen in the 10-20 GeV energy range by a muon telescope located in Karlsruhe, Germany'**
I. Braun , J. R. Horandel, J. Engler and J. Milke

13:40-13:55 **'Solar Extreme Events in December 2006 and their influence on near-Earth environment: 'Universitetskiy-Tatiana' satellite observations'**
I .N. Myagkova, M. I. Panasyuk, L. L. Lazutin, E. A. Muravieva, L. I. Starostin, T. A. Ivanova, N. N. Pavlov, I. A. Rubinshtein, N. N. Vedenkin, N. A. Vlasova

14:00 – 16:00 *Lunch break*

Session A: Posters

Chairs: E. Eroshenko

PA-1 **'Study of the 13 December 2006 Halo CME and its interplanetarY Signature'**
A. Mitsakou, G. Bampasidis, X. Moussas

PA-2 **'Prehistory and history of the December 2006 GLE'**
M. Storini, P. Diego, M. Laurenza

PA-3 **'The cosmic ray ground level enhancement on 13 December 2006'**
R. Buetikofer, E.O. Flueckiger, L. Desorgher, M.R. Moser, and B. Pirard

PA-4 **'Forbush Decrease after the GLE on 13 December 2006 detected by the muon-telescope at BEO, Moussala**
I. Angelov, E. Malamova, J. Stamenov

PA-5 **'Variations of the rigidity spectrum and cosmic ray anisotropy in December 2006'**
V. M. Dvornikov, V. E. Sdobnov

PA-6 **'Solar Extreme Events at the Middle Latitudes: Identification of Ground Level Enhancements'**
U. Beisembaev, V.I. Drobzhev, E. A. Dryn, O. N. Kryakunova, N. F. Nikolaevskiy

PA-7 **'Estimation of the solar proton spectrum in the GLE70 event'**
V. G. Grigoryev, S. A. Starodubtsev, V. M. Dvornikov, V. E. Sdobnov

PA-8 **'Neutron Monitor asymptotic directions of viewing during the event of 13 December 2006'**
C. Plainaki, H. Mavromichalaki, A. Belov, E. Eroshenko, V. Yanke

PA-9 **'Geomagnetic variations of solar origin in relation to human physiological parameters during December 2006'**
M. Papailiou, H. Mavromichalaki, A. Vassilaki, Kelesidis, G. Mertzanos, B. Petropoulos

PA-10 **'Neutron monitor multiplicity measurements during the 13.12.2006 GLE'**
B. B. Gvozdevsky, Yu. V. Balabin, E. V. Vashenyuk, L. I. Schur

PA-11 **Solar Protons and outer radiation belt during Solar Extreme Events of December 2006: Glonass and express data**
N. N. Vedenkin, S. V. Balashov, V. V. Ivanov, T. A. Ivanova, D. S. Karpenko, I. A. Maksimov, N. N. Pavlov, I. A. Rubinstein, L. V. Tverskaya, D. A. Trofimchuk, V. I. Tulupov

Session B: Energetic Processes on the Sun during extreme events, solar events at solar minimum

Chairs: N. Gopalswamy, N. Crosby

16:00-16:25 **'Geoeffectivity of solar radio flares near solar minimum: Analysis of metric and decimetric flares detected by the Trieste solar radio system (TSRS) in 2005 and 2006'**
M. Messerotti

16:25-16:50 **'Strong perturbations on the Sun and in the heliosphere: scaling of similar and individual characteristics'**
I. Veselovsky

16:50-17:15 **'On the early phase of solar energetic particle events: Are these signatures of acceleration mechamism?'**
G. Bazilevskaya

17:15-18:00 **Coffee break**

Chairs: J. Valdes-Galicia, A. Chilingarian

18:00-18:25 **'High-energy gamma-ray emissions, energetic electrons and solar proton events'**
V. Kurt

18:25-18:40 **'Thin structure of temporal profiles of solar flares January 15, 17 and 20, 2005 by data of AVS-F apparatus onboard CORONAS-F satellite'**
I. V. Arkhangelskaja, A. I. Arkhangelskij, A. S. Glyanenko, Yu. D. Kotov

18:40-18:55 **'Study of the 28 October 2003 and 20 January 2005 solar flares by means of 2.223 MeV gamma-emissions of them'**
E. V. Troitskaya, L. I. Miroshnichenko

18:55-19:10 **'Solar extreme events: questions of definition of the phenomena and their forecast'**
V. Ishkov

19:10-19:25 **'Solar and magnetospheric particle dynamics during the magnetic storm of July 23-27, 2004'**
L. Lazutin, S. N. Kuznetsov

19:30 International Heliospheric Year 2007 (IHY 2007)

Chairs: K-L. Klein, H. Moraal

19:30-19:50 **'IHY Science'**
N. Gopalswamy

19:50-20:10 '**The role of the electronic geophysical year (eGY) in exploiting multi-instrument, multi-band data via virtual observatories (VO) for solar extreme events analysis**'
M. Messerotti

20:10-20:30 **'The Heliosphere'**
X. Moussas

Program - Tuesday, 25 September 2007

Chairs: M. Messerotti, L. Lazutin

9:00- 9:25 **'Solar Extreme Events 2005-2006: Effects on near-Earth space systems and Interplanetary missions'**
N. Crosby

9:25-9:50 **'Solar neutrons as an indicator of particle acceleration at the Sun'**
J. Valdes-Galicia, L. X. Gonzalez, A. Hurtado, O. Musalem, Y. Matsubara, Y. Muraki, T. Sako, K. Watanabe, T. Sakai, S. Shibata

9:50-10:15 **'Astrophysical aspects in the studies of solar cosmic rays'**
L.I. Miroshnichenko, J. Perez-Peraza

10:15-10:30 **'Solar Extreme Events in minimum of the solar activity'**
R. A. Nymmik

10:30-10:45 **'On the source of 10 hours periodic electron/ion observations and waves in the heliosphere related with CME and CIRs during the time period October 2003-March 2004'**
G. C. Anagnostopoulos, I. Louri, E. Vassiliadis, P. Marhavilas, E. T. Sarris

10:45-11:00 **'The rare exclusion of the July 2005 cosmic ray variations resulted from western and behind the limb solar activity'**
A. Papaioannou, A. Belov, H. Mavromichalaki, E. Eroshenko, V. Oleneva

Session B: Posters

Chairs: G. Maris

PB-1 **'Interplanetary and solar aspects of two – component concept for ground level enhancements of solar cosmic rays'**
L.I. Miroshnichenko, E.V. Vashenyuk, J. Perez-Peraza, Yu.V. Balabin, A. Gallegos-Cruz

PB-2 **'Two-component features of the two largest GLEs: 23 February 1956 and 20 January 2005'**
E.V. Vashenyuk, L.I. Miroshnichenko, J. Perez-Peraza, Yu.V. Balabin, A. Gallegos-Cruz

PB-3 **'The largest in history GLEs: January 20, 2005 and February 23, 1956: Comparative modeling study'**
E. V. Vashenyuk, Yu. V. Balabin, B. D. Gvozdevsky,
L. I. Miroshnichenko

PB-4 **'Special type of the magnetic and auroral activity produced by sudden commencement of the extreme magnetic storms'**
L. L. Lazutin, S. N. Kuznetsov

PB-5 **'Solar sources of the rapid solar wind during the descendant and minimum phases of solar cycles'**
G. Maris , O. Maris

PB-6 **'Observations of high-energy gamma radiation onboard the CORONAS-F satellite as an indicator of proton acceleration during solar flares'**
S.N. Kuznetsov, V.G. Kurt, Yu. Yushkov, K. Kudela

PB-7 **'An Interpretation of Rapid Changes in the Magnetic Field Associated with Solar Flares'**
I. V. Oreshina, B. V. Somov

PB-8 **'A comparison of Solar Energetic Events of 2005 and 2006 and their differing Geoeffectiveness'**
A. Radharani, G. Rajaram, J. B. Ankush, J. Rathod, D. S. Misra,
C. G. Patil, M. Y. S. Prasad

PB-9 **'Transformation and transport of sub-photospheric energy into the corona during solar extreme events in December 2006'**
V. I. Sidorov, M. Yu. Savinkin, S. A. Yazev

PB-10 **'The observation of gamma-ray emission during January 20 2005 solar flare'**
A. I. Arkhangelskij, I. V. Arkhangelskaja, A. S. Glyanenko, Yu. D. Kotov

PB-11 **'The role of new gamma-ray observations in investigation of powerful solar flares'**
I. V. Arkhangelskaja, A. I. Arkhangelsky, E. V. Troitskaya,
L. I. Miroshnichenko

PB-12 **Space storm measurements of the July 2005 solar extreme events from the Low Corona to the Earth**
C. Caroubalos, P. Preka-Papadima, H. Mavromichalaki, X. Moussas,
A. Papaioannou, E. Mitsakou, A. Hilaris

PB-13 **'The biggest Forbush effect in 2003 according to observations on Mt. Hermon Neutron total component and different multiplicities'**
L. I. Dorman, L. A. Pustil'nik, A. Sternlieb, I. G. Zukerman

PB-14 **'Evolution and flare productivity of SEE active regions in the last solar physical cycle (solar cycles number 22 & 23)'**
V.N. Ishkov

PB-15 **'An MHD-turbulence model for solar corona'**
Z. Romeou, M. Velli, G. Einaudi

10:45-12:00 **Poster session**

12:00-12:30 **Light snack**

12:30-16:00 **Exhibition to Ancient Solar Observatory and Clock**

Session C: The chain of physical processes in the solar- terrestrial system (Sun-Heliosphere-Magnetosphere-Ionosphere-Upper Atmosphere-Ground)

Chairs: E. Flueckiger, M. Gehmeyr

16:00-16:25 **'Magnetosphere response to the 2005 and 2006 extreme solar events as observed by the Cluster and Double Star spacecraft'**
I. Dandouras, H. Reme, J. Cao, P. Escoubet

16:25-16:50 **'Balloon measurements of the cosmic ray fluxes in the atmosphere and the role of these particles in the atmospheric processes'**
Y. Stozhkov, V. Ermakov, N. Svirzhevsky

16:50-17:05 **'Dynamics of the plasma sheet in the magnetotail: Interrelation of turbulent flows and thin current sheet structures'**
A. Kropotkin

17:05-17:20 **'Some peculiarities of the decay of extreme solar energetic particle events'**
E.I. Daibog, K. Kecskemety, Yu.I. Logachev

17:20-17:35 **'Forecasting the solar wind in the inner heliosphere'**
M. Gehmeyr, N Arge, L. Mayer, D. Odstrcil

17:35-18:00 **Coffee break**

18:00-18:15 **'Topology of high latitude magnetosphere during large magnetic storms and the main mechanisms of relativistic electron acceleration'**
A. Antonova

18:15-18:30 **'Statistical properties of the most powerful perturbations on the Sun and in the heliosphere'**
O. Yakovchouk, I. S. Veselovsky

18:30-18:45 **'Possible influence of solar extreme events and related geomagnetic disturbances on human physiological state: results of collaborative Bulgarian-Azerbaijan studies'**
S. Dimitrova, F. R. Mustafa, I. Stoilova, E. S. Babayev, E. Kazimov

18:45-19:00 **'Thermal neutrons response to the GLEs'**
E. A. Sigaeva, O. Yu. Nechaev, M. I. Panasyuk, A. V. Bruns, O. A. Troshichev

19:00-19:15 **'Creation of a quasi-trapped proton fluxes model below Earth's radiation belt'**
A. N. Petrov, O. R. Grigoryan, S. N. Kuznetsov

19:15-19:30 **'CORONAS-F measurements of high-energy solar proton spectra'**
B. Yushkov, S. N. Kuznetsov ,K. Kudela , R. Bucek

21:30 **Traditional Greek Evening**

Program - Wednesday, 26 September 2007

Chairs: R. Hippler, L. Miroshnichenko

9:00- 9:25 **'Radiation Environment of the Inner Magnetosphere: Ouiet and Storm Periods**
M. Panasyuk

9:25-9:50 **'Coronal mass ejections during solar cycle 23'**
N. Gopalswamy

9:50-10:15 **'The effect of intense geomagnetic storms from the 23rd solar cycle on the radiation belt electrons: satellite data analysis and physical simulations'**
A. Varotsou

10:15-10:40 **'Influence of magnetic clouds on the cosmic rays and the near-Earth space environment'**
Dr. Badruddin

10:40-11:00 Coffee break

Chairs: I. Dandouras, I. Veselovsky

11:00-11:25 **'Ozon destruction by solar electrons in relation to Solar Variability and the terrestrial latitude'**
V. Tritakis, G. Korbakis, P. Nastos, A. Paliatsos, Yu. Pisanko

11:25-11:50 **'Response of Venus induced magnetosphere under extreme solar conditions'**
K. Kudela, T. L. Zhang

11:50-12:15 **'Ionospheric monitoring and short term forecasting at middle latitudes during solar extreme events'**
A. Belehaki

Session C: Posters

Chairs: P. Preka-Papadima

PC-1 **'Solar Cosmic Rays and Solar-Terrestrial Relations: Observational Evidence and Mechanisms (Review)'**
L. I. Miroshnichenko

PC-2 **'Solar protons effect on middle atmosphere during SEEs 28.10.2003 and 13.12.2006'**
A. S. Kirillov, E. V. Vashenyuk, B. B. Gvozdevsky, Kh. Fadel

PC-3 **'Interplanetary manifestation of solar extreme events occurred during the post solar maximum of cycle 23'**
S. Dasso, M. S. Nakwacki, P. Demoulin, C. H. Mandrini

PC-4 **'The solar wind charge exchange process as seen in X-rays and plans for a space based telescope'**
J. A. Carter, S. Sembay

PC-5 **'Variations of the Relativistic Electron Flux of the Outer Radiation Belts during Extreme Geomagnetic Time Intervals'**
S. N. Kuznetsov, I. N. Myagkova, M. I. Panasyuk, E. A. Muravieva, B. Yu. Yushkov

PC-6 **'Solar Energetic Particles Variations and Their Penetration in the Earth's Magnetosphere during Extreme Geomagnetic Storms (2001-2005 years)'**
S. N. Kuznetsov, L. L. Lazutin, I. N. Myagkova, M. I. Panasyuk, A. N. Podorolsky, K. Kudela

PC-7 **'Solar cosmic rays as a factor of Space Weather and their effect on the atmosphere processes in auroral and subauroral zones'**
V. E. Timofeev, N. G. Skryabin

PC-8 **'The relation of the energy magnetic solar field indices with the long-term cosmic rays modulation'**
R. T. Gushchina, A. V. Belov, V. N. Obridko, B. D. Shelting

PC-9 **'Some Remarks to January 17 - 22, 2005 Event in Space Weather'**
K. Kudela, I. Dorotovic, M. Lorenc, M. Rybansky

PC-10 **'Variations of aerosol optical properties during an extreme solar event of 20.01.2005'**
I. Mironova, L. Desorgher

PC-11 **'Interplanetary medium conditions and state of the magnetosphere associated with the global Pc5 oscillations'**
A. S. Potapov, T. N. Polyushkina

PC-12 **'Large solar flares and related proton events in December 2006'**
I. V. Zimovets, A. B. Struminsky

PC-13 **'Solar proton enhancements and coronal mass ejections during the last solar cycle'**
M. Gerontidou, H. Mavromichalaki, A. Belov, V. Kurt

PC-14 **'Variation of the trapped proton fluxes measured on board low-orbital satellites'**
N. I. Nikolaeva, N. V. Kuznetsov

PC-15 **'A new statistical index for the coronal mass ejections'**
E. Paouris

12:15 - 13:30 **Poster session**

13:30 - 15:30 **Lunch break**

15:30 Excursion to Mycenae-Naples and dinner

Program - Thursday, 27 September 2007

Session D: World-wide particle detector networks for space weather research

Chairs: I. Usoskin, G. Basilevskaya

9:00-9:25 **'Hybrid particle-detector networks located at Middle-Low latitudes for Solar Physics and Space Weather research'**
A. Chilligarian

9:25-9:40 **'Interactive database on the Cosmic Ray Anisotropy'**
A. Eroshenko, A. S. Asipenka, A. V. Belov, E. G. Klepach, V. G. Yanke

9:40- 9:55 **'Real-time database for high resolution Neutron Monitor measurements'**
C. T. Steigies, O. M. Rother, R. F. Wimmer-Schweingruber, B. Heber

9:55-10:10 **'Advanced date acquisition system for the SEVAN (Space Enviromental Viewing and Analysis Network)'**
S. Chilligarian, A. Chilingaryan, V. Danielyan, A. Yeghikyan

Session D: Posters

Chairs: O. Kryakunova

PD-1 **'Thorough phenomenological study of major Forbush decreases: Does the recovery depend on energy?'**
I. G. Usoskin, G. A. Kovaltsov, O. G. Gladysheva, T. Jamsen

PD-2 **'Multiplicity and Coupling Function of the neutron αnd muon components'**
E. V. Pletnikov, V. G. Kartyshov, V. G. Yanke, Ch. Sarlanis, G. Souvatzoglou

PD-3 **'On the Possibility to modernize existent network of Neutron Monitors'**
A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian, V. Danielyan, K. Avakyan, A. Reymers, S. Tseruny

PD-4 **'A new detector added to the Antarctic laboratory for cosmic rays'**
M. Storini, F. Signoretti, P. Diego, M. Laurenza, E. G. Cordaro
E. F. Olivares

PD-5 **'Data Visualization Interactive Network 3-rd for ASEC'**
A. Yeghikya, A. Chilingarian

PD-6 **'Characteristics of the Space Environmental Viewing and Analysis Network (SEVAN)'**
A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian, V. Danielyan, K. Avakyan, A. Reymers, S. Tserunyan

PD-7 **'Electronics for the Space Environmental Viewing and Analysis Network (SEVAN)'**
K. Arakelyan, A. Avetisyan, A. Chilingarian, S. Chilingarian, V. Danielyan

PD-8 **'Cosmic ray research at Spitsbergen'**
E. V. Vashenuyk, B. B. Gvozdevsky, Yu. V. Balabin

PD-9 **'On the possibility to modernize existent network of Neutron Monitors'**
A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian, V. Danielyan, K. Avakyan, A. Reymers, S. Tserunyan

Session E: Integrated systems of forecasting and alerting on the dangerous consequences of violent solar storms

Chairs: M. Parisi, A. Belehaki

10:10-10:25 '**Cosmic rays and space weather effects: methods of forecasting'**
L. Dorman

10:25-10:40 **'Real Time GLE ALERT for December 2006 at the ANMODAP center'**
H. Mavromichalaki, G. Souvatzoglou, C Sarlanis, G. Mariatos, A. Belov, E. Eroshenko, V. Yanke

10:40-10:55 **'MuSTAnG – Muon Space weather Telescope for Anisotropies at Greifswald'**
R. Hippler, A. Mengel, F. Jansen, G. Bartling, W. Guoehler, K. Kudela

10:55-11:30 **Coffee break**

11:30-12:00 **Poster session**

Session E: Posters

Chair: S. Dimitrova

PE-1 **'Generation of ALERT signal for solar cosmic ray ground level enhancements (GLEs)'**
A. V. Belov, E. A. Eroshenko, E. G. Klepach, V. G. Yanke, G. Souvatzoglou, C. Sarlanis, H. Mavromichalaki, E. Dryn, O. Kryakunova, N. Nikolaevsky

PE-2 **'The method of forecast of solar proton events'**
V. M. Dvornikov, M. V. Kravtsova, A. A. Lukovnikova, V. E. Sdobnov

PE-3 **'Detailed Prediction of 24th-25th Solar Cycles Shape'**
V. Tritakis G. Giouvanellis, H. Mavromichalaki

Workshop on Neutron Monitors

'The present and the future of NMs'

Chairs: X. Moussas, A. Belov

12:00-12:10 **'High mountain Alma-Ata cosmic ray station: current state of cosmic ray research by means of Neutron Monitors'**
O. N. Kryakunova

12:10-12:20 **'The activities in the Athens Neutron Monitor Station '**
H. Mavromichalaki

12:20-12:30 **'Neutron Monitors operated at Aragats Space –Environmental Center (ASEC)'**
A. Chilingarian

12:30-12:40 **'Israel Cosmic Ray and Space Weather Center: Past, Present and Future'**
L. Dorman

12:40-12:50 **'Sayan mountain spectrographic complex of Neutron Monitors of ISTP SB RAS'**
V. M. Aleshkov, V. M. Dvornikov, A. A. Lukovnikova, V. E. Sdobnov

12:50-13:00 **'The world wide neutron monitor network: at present and in future'**
E. Eroshenko

13:00-13:10 **'The Swiss Neutron Monitors'**
E. Flueckiger

13:10-13:20 **'The neutrons at Kerguelen Island and Terre Adelie and related activities at Paris Observatory'**
K.-L. Klein and N. Fuller

13:20-13:30 **'The Neutron Monitor of Kiel'**
C. Steigies

13:30-13:40 **'Cosmic Ray Measurements at Lomnický Štít '**
K. Kudela, V. Kollár, R. Langer, I. Strhárský

13:40-13:50 **'Virtual Earth-Sun Observatory (veso) at Universidad Nacional Autonoma de Mexico'**
J. Valdes-Galicia

13:50-14:00 **'The OULU neutron monitor: 43-years of measurements'**
I. Usoskin

14:00-14:10 **'The new Plateau de Bure Neutron Monitor and the Altitude Test Single-Event Effects Test European Platform (ASTEP)'**
J.-L. Autran

14:10-14:20 **'An intercalibration of the world's neutron monitors'**
H. Moraal

14:20-14:30 **'The SVIRCO Observatory (INAF/UNIROMA3 Collaboration): Present status'**
M. Parisi, M. Storini, F. Signoretti

14:30-16:30 **Lunch break**

16:30-17:00 **'The mechanism of Antikythera, the oldest known astronomical computer'**
X. Moussas

17:00-18:00 **General Discussion- Summary and Conclusions:**
M. Panasyuk

18:00-18:30 **CLOSING AND END OF THE SYMPOSIUM**

Solar Extreme Events 2007

Abstracts

Session A

Solar Extreme Events of December 2006

AI-1: Characteristics of the cosmic ray ground level enhancement on January 20, 2005 and December 13, 2006 as obtained from world-wide neutron monitor data

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Abstract

The Ground Level Enhancements (GLEs) observed on January 20, 2005, and December 13, 2006, are both large events by historical standards. The January 20, 2005 event is ranked the second largest in fifty years with a peak count rate increase at the south polar NM stations exceeding several thousand percent (McMurdo: ~3000%, Terre Adelie: 4500%), and South Pole: >5000%). The December 13, 2006, GLE had a maximum increase of the order of 100% at Oulu and 80% at Apatity. The paper first summarizes the main characteristics of the two events as derived by various authors from the data of the worldwide network of neutron monitors. Secondly, the unusual time of occurrence near solar minimum is addressed. Finally, the relevance of the January 20, 2005, and December 13, 2006, GLEs is discussed in the context of Solar Extreme Events.

AI-2: Two Acceleration Mechanisms for Ground Level Enhancements

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Abstract

The SANAE NM observed three distinct intensity peaks during the cosmic-ray ground level enhancement (GLE) of 20 January 2005. Using these observations, together with those of 10 other NMs, it is shown in this contribution that there were two distinctly different cosmic ray populations in this GLE, and that these were accelerated in two different regions of the solar corona, namely the flare associated with the sunpot group and the CME associated with this event.

AI-3: Characteristics of relativistic solar cosmic rays in large ground level events

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Abstract

The modeling analysis of 14 large GLEs occurred in the period 1956-2006 on the data of the worldwide neutron monitors has been performed. The special attention is given to SEE on decline phase of the current, 23 solar cycles. The modelling consists of the next steps: 1. Definition of asymptotic viewing cones of the NM stations under study by the particle trajectory computations in a model magnetosphere. 2. Calculation of the NM responses at variable primary solar proton flux parameters. 3. Application of a least square procedure for determining primary solar proton parameters: rigidity spectrum, anisotropy axis direction, pitch-angle distribution outside the magnetosphere by comparison of computed ground based detector responses with observations. In all studied cases two distinct RSP populations (components) were revealed: the early impulse-like intensity increase with exponential energy spectrum (prompt component), and the late gradual increase with a softer energy spectrum of the power law form (delayed component). The possible physical reasons of formation of two populations of relativistic SCR with various spectra are discussed.

AI-4: Solar extreme events in the past: What do we know about them?

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Abstract

Solar extreme events accompanied by enhanced irradiation of Earth by solar energetic particles are known since mid-20th century by means of direct measurements of cosmic radiation by ground-based and space-borne detectors. However, the period since 1940's is characterized by the high level solar activity, which is unprecedented for the last few millennia. Therefore, it is of great interest to study such extreme solar event in the past when the Sun was quieter than nowadays. Here a brief review is presented of indirect methods to study solar extreme events in the past, before the instrumental era. The primary method is based on measurements of nitrates/nitrites in polar ice that is sensitive to enhanced flux of solar energetic particles (> 30 MeV). Cosmogenic isotopes 10Be and 14C are less sensitive to solar particles but also can provide additional information on solar extreme events. The results for cosmogenic isotopes are consistent with the nitrate method. The results show that indeed extreme solar events did occur in the past. Moreover, the results suggest that extreme events are more

probable during periods when the solar activity is moderate, while very high activity produces a large number of medium-to-strong events but only seldom leads to occurrence of an extreme solar event. Constraints on the rate of extreme events are discussed and some speculations on the possible mechanism are presented.

AI-5: Properties of solar flares and proton event forecasting

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Abstract

X-ray flares and acceleration processes are in the one complex of sporadic solar events (together with CME generation, radio bursts, magnetic field dissipation and reconnection). This supposes the connection (if not physical, but at least statistical) between characteristics of the proton events and flares. The statistical analysis indicates that the probability and magnitude of the near-Earth proton enhancement depends critically on the flare's importance and its heliolongitude. The flare heliolongitude frequently determines the character of the proton event time profile. There are also other relations exist between proton events and X-ray flare characteristics. Such relations may be used for elaboration of the forecasting models, which allow us to calculate a probability of the proton event, its delay and expected proton flux on the basis of the X-ray observations. However, we should herewith remember on the limitation of accumulated statistics. X-ray flare and proton enhancement are observed yet so short time that any new burst of solar activity is able to change our mind concerning a relation ?solar flare-proton enhancement?. That occurred directly in the last bursts of 23-rd cycle, in 2005-2006. The special features of proton forecasting by the solar X-ray observations are discussed. Special attention is concentrated around prognostic models for the most extreme of proton enhancements - ground level enhancements (GLE).

A-1: Dynamics of relativistic solar cosmic rays during December 13, 2006 GLE

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Abstract

The dynamics of relativistic solar cosmic rays on data of ground level observations during the GLE of 13.12.2006 have been studied. The data of 32 neutron monitors of the worldwide network were used in the analysis. By least square (optimization) methods parameters of relativistic solar protons: rigidity (energetic) spectra, anisotropy directions and pitch-angular distributions were obtained and their dynamical changes studied during the event. It is shown, that in the beginning of the event solar protons arrived at the Earth along the IMF as a narrow collimated beam. These particles caused short-lived peak increase on a number of neutron monitor stations. On later phase a reverse flux (to the Sun) has appeared and the spectrum became appreciably softer. The rigidity spectral exponent changed from 4 to 6 in course of the event.

A-2: Modeling the solar cosmic ray event of 13 December 2006 using ground level neutron monitor data

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Abstract

In order to understand the physics taking place under extreme solar conditions such as those producing ground level enhancements of solar cosmic rays, it is important to use accurate and reliable models. The NM-BANGLE model is a new cosmic ray model which couples primary solar cosmic rays at the top of the Earth's atmosphere with the secondary ones detected at ground level by neutron monitors during GLEs. This model calculates the evolution of several GLE parameters such as the solar cosmic ray spectrum and anisotropy as well as the particle flux distribution, revealing crucial information on the energetic particle propagation and distribution. The total output of the NM-BANGLE model is a multi-dimensional GLE picture that gives an important contribution to revealing the characteristics of solar energetic particle events recorded at ground level. In this work, the results of the NM-BANGLE model application to the recent GLE of 13 December 2006 are presented and discussed. Moreover, a comparison with the extreme event of 20 January 2005 (GLE69) has been realized.

A-3: Spectral-temporal Features of Solar Radio Emission at the Stage of Halo Type CMEs: Formation and Initial Propagation (during Solar Extreme Events of December 2006)

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Abstract

It was established earlier that the majority of the large CMEs events are preceded by phenomena in solar radio emission within a time interval of about 60 min. These phenomena are developed in the form of the sporadic component of radio emission over a wide range of frequencies. This work presents the spectral-temporal special features of radio-events in the centimeter (cm) and decimeter (dm) ranges of the radio waves, preceded Halo CMEs in the two-hour interval of their registration. For studying of these precursors of CMEs the data of the worldwide network of solar observatories in the radio-frequency band are used. Information about the phenomena and the characteristics of CMEs were undertaken from http://sdaw.jsfc.nasa.gov./CME_list. Examined set of the Halo type CMEs consists of "isolated" CMEs events, i.e., when the preceding CMEs event is recorded not less than for 8 hours, and following not less than 6 hours, prior to the event in question. Basic observed CMEs parameters are used for studying: angular width, the initial velocity of propagation, and also the phenomenological type of phenomenon. Such characteristics of the sporadic component of radio emission, as intensity and the duration of sporadic component at different frequencies of cm and dm wavelength range are analyzed taking into account observed type of bursts. It is established the stability of the spectral-temporal structure of CMEs precursors in the radio-frequency band and its dependence on CMEs parameters.

A-4: Observations of Energetic Solar Particles: 13-16 December 2006

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Abstract

We observed the extraordinary energetic solar particle events of 13-16 December with several spacecraft including Polar, two HEO satellites, and SAMPEX. Our observations were supported by observations by ACE, STEREO and GOES satellites as well as neutron monitors. A large, prompt ESP event began around 02:50 UT on 13th December 2006. The event included a GLE, unusual for this time in the solar cycle. Prior to the onset the two HEO satellites showed an electron precursor several

minutes before the onset of the energetic protons. The electron spectrum was relatively soft with detectable electrons only of a few hundred keV and less, suggestive of electrons resulting from solar neutron decay. The energetic proton fluxes decayed away smoothly until midday on 14th December around the time of shock arrival at 13:55 UT. The temporal profile of the energetic protons differed substantially at GOES in geostationary orbit from the profiles observed upstream of the Earth at L1, and at Polar, near the Earth at 9RE, but on open field lines over the southern polar cap. We will show these detailed comparisons and comment on their significance in such a late solar-cycle event.

A-5: Solar events seen in the 10-20 GeV energy range by a muon telescope located in Karlsruhe, Germany

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Abstract

Since 1993, a muon telescope located at the Forschungszentrum Karlsruhe has been recording the flux of single muons originating from primary cosmic ray protons with energies in the 10-20 GeV range. Several significant structures are detected. These non-periodic events coincide with Forbush decreases seen at lower energies by neutron-monitors. Further the development of the muon rate is compatible with the neutron-monitor rate. A selection of recent events will be presented and compared to data from the Jungfraujoch neutron monitor.

A-6: Solar Extreme Events in December 2006 and their influence on near-Earth environment: "Universitetskiy-Tatiana" satellite observations

I .N. Myagkova, M. I. Panasyuk, L. L. Lazutin, E. A. Muravieva, L. I. Starostin, T. A. Ivanova, N. N. Pavlov, I. A. Rubinshtein, N. N. Vedenkin, N. A. Vlasova

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Abstract

Four solar flares of X-class in SXR-emission in agreement with GOES classification were observed during the first half of December 2006 (X9.0 -05.12.06, X6.5 - 06.12.06, X3.4 - 13.12.06 and X1.5 - 14.12.06). We should notice that these powerful flares took place near the minimum of the current

solar cycle. Solar energetic particle (SEP) produced in these flares after the propagation or/and acceleration in the interplanetary medium were observed in near-Earth space by different scientific missions. In particular, at the altitudes near 950 km SEP were detected by instruments on board Russian polar low-altitude "Universitetskiy-Tatiana". The main goal of this space project of Lomonosov Moscow State University was scientific and educational activity on the basis of experimental data obtained from the small spacecrafts. We observed that these four flares have led to only three SEP events. It is possible connected with the location of the two first flares near the east limb (E68 and E64) or/and that only flare 06.12.2007 was accompanied by Halo Coronal Mass Ejection (CME). After flares 5 and 6 December there were no observed significant magnetic storms and the deep penetration of SEP in the Earth magnetosphere. Also there were no significant variations in the Outer Radiation belts of the Earth both of the flux of electrons with the energies 700-900 keV and > 3.5 MeV. The influence of the flares 13 and 14 December on the near-Earth environment was more impressive. Such effects were due to both their central and west position (W23 and W46) and two Halo CME (12 December with the initial linear speed 1774 km/s and 13 December, 1042 km/s) appearance. The location of SEP penetration boundary in the Earth's magnetosphere during the main phase of the magnetic storm was about 55 degrees in the evening MLT sector and about 57 degrees in the morning one. The strong variations of the relativistic and sub-relativistic electrons in the outer ERB after the geomagnetic storm on 15 December were measured by "Universitetskiy-Tatiana". Instead of the weak belt with the boundaries 4-5 L, since 16 December and up to the end 2006 year we could observed the strong belt of relativistic electrons from L=3 to L-5.5-6. The presented experimental results demonstrate an opportunity of successful application of small educational spacecrafts in the important scientific programs (e.g. Space Weather).

PA-1: Study of the 13 December 2006 Halo CME and its interplanetary signature

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Abstract

During the descending phase of the 23rd solar cycle, extreme solar events in the years 2005 and 2006 have occurred. In particular, on the 13th of December 2006, a Halo CME was observed by the LASCO/SOHO C2 and C3 coronographs. Using WIND and OMNI data, we have identified the interplanetary signature of this event in the near Earth environment indicating that it was indeed Earth-directed. We have studied the geometrical and the dynamical characteristics of the ICME from the in situ observations and have compared them to the statistical characteristics of ICMEs in general. A detailed analysis of this interplanetary coronal mass ejection as well as its driven shock is presented.

PA-2: Prehistory and history of the December 2006 GLE

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Abstract

GLEs (Ground Level Enhancements) constitute an important subset of Solar Energetic Particle (SEP) events registered in the terrestrial environment. Being the GLE particles of relativistic energy, they are able to affect ground-based records of cosmic ray detectors. From 1942 to present seventy GLEs were identified by the world-wide cosmic-ray community. They often occur during active periods of solar activity, but there exist several exceptions during low solar activity levels. The 13 December 2006 GLE is one of them. Several papers on the topic were presented at the 30th ICRC 2007. This paper mainly focuses on the possible solar-terrestrial phenomena tied to the event occurrence, by analyzing the solar/interplanetary prehistory and history. We describe various features collected for December 2006 and discuss the identified peculiar signatures useful for the comprehension of the particle generation, acceleration, and propagation of the December 13 event. The individuation of key solar conditions, producing such kind of energetic events, is a relevant topic to build up a scenario for a GLE forecast code, which is still missing.

PA-3: The cosmic ray ground level enhancement on 13 December 2006

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Abstract

Close to the current solar activity minimum, two large solar cosmic ray ground level enhancements (GLE) were recorded by the worldwide network of neutron monitors (NM). The GLE on 20 January 2005 is ranked among the largest in years with gigantic count rate increases at the south polar NM stations McMurdo (almost 3000%), Terre Adelie (4500%) and South Pole (more than 5000%). The GLE recorded on 13 December 2006 is among the largest in solar cycle 23, with count rate increases up to 90% (Oulu, Apatity). From the recordings of the NMs we determined the characteristics of the solar particle flux near Earth for the 13th December 2006 event. For the analysis a new parameterized yield function developed by our group was utilized. The results of the analysis are presented and compared with the results obtained by using the specific yield function by Debrunner et al. that has been the basis for the analysis of many GLEs. Furthermore the results are compared with the characteristics of the GLE on 20 January 2005 that has been determined in former investigations by several authors.

PA-4: Forbush Decrease after the GLE on 13 December 2006 detected by the muon-telescope at BEO, Moussala

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Abstract

The Basic Environmental Observatory is located at peak Moussala, 2925m a.s.l. ($25^{o}35^{o}$ E , $42^{o}11^{o}$ N), Rila Mountain, Bulgaria. A muon telescope with effective area 1 square meter, using 8 water cherenkov detectors, is in operation since August 2006 at the observatory. A Forbush decrease with amplitude ~4% in the intensity of the muon component of cosmic rays was detected after the GLE on 13^{th} December 2006. Brief description of the instrument and the experimental results are presented.

PA-5: Variations of the rigidity spectrum and cosmic ray anisotropy in December 2006

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Abstract

According to ground-based measurements of cosmic ray (CR) intensity on a worldwide network of stations the method of spectrographic global survey investigates variations of the rigidity spectrum and anisotropy CR during December 2006. It is shown that at 4.00 UT CR flare (December, 13) highest degree of anisotropy (up to ~150%) with the maximal intensity of particles with rigidity 4 GV in anti-solar direction (asymptotic direction ~-25, ~160 degrees) was observed. At joint analysis of ground and satellite measurements of protons in an energy range from units MeV up to tens Gev parameters rigidity spectrum CR, reflecting electromagnetic characteristics of fields of heliosphere for the investigated period are certain. On the basis of analysis the explanation of observable anisotropy and variation CR in a wide energy range is given.

PA-6: Solar Extreme Events at the Middle Latitudes: Identification of Ground Level Enhancements

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Abstract

This work is directed toward the experimental and theoretical investigation of the ground level solar cosmic ray enhancements (GLE). Relativistic protons (>1 GeV) are generated in powerful flares more often than they are observed at the Earth. Especially it concerns to observation at the middle latitudes. Although recorded magnitudes of ground level enhancements are usually very small at these geomagnetic latitudes the high statistical accuracy of the 18-tube NM-64 Alma-Ata neutron monitor, located at 3340 m altitude, make possible detection of these events. The possible solar proton contribution into general flux of galactic cosmic rays registered by means of Alma-Ata high altitude neutron monitor has been investigated in those events when it is difficult to notice visually GLE events. GLE were investigated using Student's criterion. Some last GLE on November 1997, on August 1998 and on December 2006 were analyzed. It is shown that using of Student's criterion allows to reveal effectively GLE at the middle latitudes and to defined upper limit energy spectra of particles.

PA-7: Estimation of the solar proton spectrum in the GLE70 event

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Abstract

The GLE event on December 13, 2006 as observed by network station neutron monitor data is investigated. The GLE power spectrum suggested for this event is estimated taking into account the primary differential spectrum of galactic cosmic rays, coupling coefficients and integral multiplicities of concrete detectors at different latitudes and observation levels. It is noted that the additional increase of solar protons is also manifested in the ionization chamber ASK-1 data at the Yakutsk station.

PA-8: Neutron Monitor asymptotic directions of viewing during the event of 13 December 2006

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Abstract

During the recent ground level enhancement of 13 December 2006, also known as GLE70, solar cosmic ray particles of energy bigger that ~500 MeV/nucleon propagated inside the Earth's magnetosphere and finally accessed low-altitude satellites and ground level neutron monitors. The magnitude and the characteristics of this event registered at different neutron monitor stations of the worldwide network can be interpreted adequately on the basis of an estimation of the solar particle trajectories in the near Earth interplanetary space. In this work, an extended representation of the Earth's magnetic field was realized applying the Tsyganenko 1989 model. Using a numerical back-tracing technique the solar proton trajectories inside the magnetospheric field of the Earth were calculated for a variety of particles, initializing their travel at different locations, covering a wide range of energies. In this way, the asymptotic directions of viewing were calculated for a significant number of neutron monitor stations, providing crucial information on the Earth's "magnetospheric optics" for primary solar cosmic rays, on the top of the atmosphere, during the big solar event of December 2006. The neutron monitor network has been treated, therefore, as a multidimensional tool that gives insights into the arrival directions of solar cosmic ray particles as well as their spatial and energy distributions during extreme solar events.

PA-9: Geomagnetic variations of solar origin in relation to human physiological parameters during December 2006

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Abstract

There is an increasing amount of evidence linking biological effects to solar and geomagnetic conditions. A series of studies is published referring to the changes in normal human physical responses at different levels of daily and monthly geomagnetic activity. In this study the possible relation between the daily variations of cosmic ray intensity, measured by the Neutron Monitor of the University of Athens (http://cosray.phys.uoa.gr) and the average daily and hourly heart rate frequency of persons, with no symptoms or hospital admission, monitored by Holter electrocardiogram, is considered. This work refers to a group of persons admitted to the cardiological clinic of the KAT hospital in Athens during the time interval from 4th to 22nd December 2006, characterized by extreme solar and geomagnetic activity. Intense cosmic ray events were recorded during this period, such as a series of Forbush decreases started on 6th December and lasted until the end of the month and a solar proton event causing a Ground Level Enhancement (GLE) of the cosmic ray intensity on 13th December. A sudden decrease of the cosmic ray intensity on 15th December resulted in a magnetic storm, which was recorded in Athens station (cut-off rigidity 8.53 GV) with amplitude of 5%. It is noticed that during quiet geomagnetically days the heart rate frequency and the cosmic ray intensity variations are positively correlated, while both these parameters under study present maximum and minimum values at around the same hours. When intense cosmic ray variations, like Forbush decreases and relativistic proton events, produced by strong solar phenomena, occur, cosmic ray intensity and heart rate frequency get minimum values and their variations, also, coincide. During these events the correlation coefficient of these two parameters changes and follows the behaviour of the cosmic ray intensity variations. This is only a part of an investigation, which has begun using data from the year 2002 and is still in progress.

PA-10: Neutron monitor multiplicity measurements during the 13.12.2006 GLE

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Abstract

Neutron monitor multiplicity can give the information on a spectrum of primary solar protons and its variations during ground level enhancements (GLE) related to relativistic solar cosmic rays. Recently we designed and installed a new data acquisition system on the neutron monitor (NM) in Barentsburg, Spitsbergen archipelago. It is able to register a multiplicity. The system is based on ordinary PC, equipped with an extension card ADLINK PCI-7233H, which is a high-speed 32-channel digital input card. Via this card the specially written collecting program continuously registers pulses from all 18 channels of the NM and intervals between pulses. Elapsed time between pulses is measured with a precision of 1 microsecond. Each pulse is processed during 6 microseconds, which is a dead time of the registering system. The GLE of December 13, 2006 was recorded by the Barentsburg NM. We have derived multiplicities 2-10 and studied their behaviour during this event and subsequent Forbush decrease. Count rates of multiplicities 2-3 show a significant increase during the GLE, while the Forbush decrease is seen in multiplicities up to 5. The multiplicity spectrum changes are comparable with the solar proton spectrum dynamics during the GLE. The spectra of relativistic solar protons were derived from the worldwide NM network by modelling technique.

PA-11: Solar protons and outer radiation belt during solar extreme events of December 2006: Glonass and express data

N. N. Vedenkin, S. V. Balashov, V. V. Ivanov, T. A. Ivanova, D. S. Karpenko, I. A. Maksimov, N. N. Pavlov, I. A. Rubinstein, L. V. Tverskaya, D. A. Trofimchuk, V. I. Tulupov

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Abstract

We study the behavior of the trapped radiation (electrons and protons) and solar protons in the magnetosphere in December 2006, as seen from GLONASS (circle orbit h~20000 km, inclination ~65^{o}) and geostationary Express-A3 satellites. Particles were observed in the energy ranges: 0.04 - 1 MeV electrons and 3 - 70 MeV protons. Prior to a strong (|Dst|max~150 nT) storm of 15 December, outer belt of 0.7 MeV electrons peaked at L~4.5; after the storm, the flux increased as high as one order of magnitude, and its peak shifted to L<4 (GLONASS does not traverse L<4). The flux of 0.8-1 MeV electrons on Express-A3 increased only twice of the pre-storm level. In quiet conditions, solar protons of >3 MeV energy are seen exclusively in the high-latitude parts of the GLONASS orbit. During the storm 15 December, solar protons flooded all parts of the orbit including the equatorial one where previously we saw only a peak of the proton radiation belt. Intensity of the trapped protons decreased during the main phase of the storm and returned back to the pre-storm level at the end of the recovery phase.

Session B

Energetic processes on the Sun during extreme events, solar events at solar minimum

BI-1: Geoeffectivity of solar radio flares near solar minimum: Analysis of metric and decimetric flares detected by the Trieste solar radio system (TSRS) in 2005 and 2006

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Abstract

The Sun is a non-directional, broad-band radio noise source whose background level increases with the emission frequency. Radio outbursts, characterized by gradual and/or impulsive evolution at different time scales, can exhibit a level increase of orders of magnitude with respect to the quiet Sun values, in association with non-thermal plasma processes in perturbed chromospheric and coronal layers. In recent years, various authors considered the potential direct effect of enhanced solar radio noise on mobile radio communications and on Global Positioning Systems (GPSs).In this work, we will review such effects and, in this framework, we will consider a selection of relevant solar radio flares observed by the Trieste Solar System (TSRS) in 2005 and 2006, i.e., in the proximity of the solar activity minimum, expected in 2007.

BI-2: Strong perturbations on the Sun and in the heliosphere: scaling of similar and individual characteristics

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Abstract

Strong perturbations in the solar atmosphere and in the heliosphere produced by the solar activity are considered using available observational data and theoretical models. Dimensionless scaling approach allows the quantitative delimitation and classification schemes of similar and individual physical properties. Examples of flare-like and CME-like events are characterized by the "Velocity-emission ratio". Turbulent and laminar regimes, quasi-steady and transient phenomena are described in the solar wind plasma in the inner and in the distant heliosphere. Solar wind ion composition variations are discussed using multi-fluid mixing and separation model description. Finally, the coupling between global long-term evolution processes and in situ local plasma dynamics is considered.

BI-3: On the Early Phase of Solar Energetic Particle Events: Are these signatures of acceleration mechanism?

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Abstract

Many physical processes precede and accompany the Solar Energetic Particles (SEP) occurrence on the Earth's orbit. Explosive energy release on the Sun gives rise to a flare and a coronal mass ejection (CME). X-ray and gamma emissions are believed to be connected with flares. Radio emission is signature of disturbances traveling through the corona and interplanetary space. Particles can gain energy both in the flare and the accompanying wave processes. The beginning of the SEP events has the advantage of being the phase most close to the time of acceleration. Influence of interplanetary transport is minimal in the case of first arriving relativistic solar protons recorded by ground based neutron monitors (in so called Ground-level events, GLE). The early phase of the SEP events attracts attention of many researches searching for the understanding of particle acceleration. However, they come to the opposite conclusions. While some authors find arguments for coronal mass ejections as a sole accelerator of SEPs others prove a flare to be the SEP origin. Here, the circumstances of SEP generation for several GLEs of the 23rd solar cycle are considered. Timing of X-ray, CME, and radio emissions shows a great variety from event to event. However, positions of CMEs at the time of relativistic protons ejection from the Sun and this time relation to hard X-ray emission argue against CMEs as a source of first arriving relativistic solar protons.

BI-4: Solar flares high energy gamma-ray emission and protons and electrons events measured at 1a.u.

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Abstract

This report is a short overview of our experimental knowledge of high energy gamma-ray emission and solar proton and electron events near the Earth.
1.Gamma-rays above 50 MeV are mainly due to the decay of pions produced by accelerated ions of energies greater than several hundreds MeV/nucl. Thus, this emission indicates the appearance of high energy nuclei in the corona. The available measurements of temporal behavior of high-energy gamma-

ray emission from solar flares are discussed. These very few observations of the gamma-ray emission with the characteristic spectrum of pion-decay process gave us an unique opportunity to compare the acceleration time of protons with Ep>300 - 400 MeV to the release time of high-energy protons measured at ground level by the neutron monitor (NM) network. Proton arrival time to the Earth is consistent with the time of pion decay high-energy gamma-ray emission appearance at the Sun.
2. There is a brief consideration of accelerated electrons characteristics which produce the primary electron bremsstrahlung. Energy spectra of 0.0 4-100 MeV interplanetary electrons originating from solar flare compared with the electron bremsstrahlung.
3. The main result of the comparison of SPEs and Soft X-ray (SXR)flare properties are also discussed. Energetic proton measurements obtained from the GOES and IMP-8 satellites as well as from ground based neutron monitors are compared with the GOES soft X-ray measurements of the associated solar flares for the period 1975-2003. A broad range of phenomenology relating proton events to flares was found. The time frequency and size distributions of the peak intensities of the SPEs have been obtained over the entire mentioned period. The statistical analysis indicates that the probability and magnitude of the near-Earth proton enhancement depends critically on the flare's importance and its heliolongitude. It was also found that the heliolongitude frequently determines the character of the proton event time profile. In addition to intensity, duration and timing proton events were found to be related to the other flare properties such as longer loop lengths.

B-1: Thin structure of temporal profiles of solar flares January 15, 17 and 20 2005 by data of AVS-F apparatus onboard CORONAS-F satellite

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Abstract

The temporal profiles and energy spectra of the solar flares January 15, 17, 20 2005 by data of AVS-F apparatus onboard CORONAS-F satellite are discussed. The energy spectra of these solar flares contain positron line and neutrons capture line. Solar flares January 17 and 20 spectra also contain some nuclear lines. Thin structure with characteristic timescales 33-92 sec is presented on flares temporal profiles in energy bands corresponding observed spectral features which confirmed by periodogram analysis (confidence level is 99%).

B-2: Study of the 28 October 2003 and 20 January 2005 solar flares by means of 2.223 MeV gamma-emissions from them

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Abstract

We have studied some characteristics of solar flares and surrounding medium (solar plasma) by means of 2.223 MeV line time profile of gamma-emission from neutron captures by hydrogen nuclei. It was composed the code with making allowance for the main processes of neutron interactions and deceleration in the solar atmosphere, character of neutron source, losses of neutrons and density model of the solar atmosphere. The comparing of modeled time profiles of 2.223 MeV gamma-line with observed ones allowed us to reveal the density enhancements in the sub-flare regions of the extreme flares of 28th October 2003 and 20th January 2005. Besides, the same analysis let us to detect the values of spectral indexes of charged particles and their evolution with the time during gamma-emission of the flares. The hardening of charged particles spectrum with the time is found. We use the data of INTEGRAL and CORONAS-F for analysis. The main parameters affected the gamma-line 2.223 MeV time profiles are discussed. Two possible mechanisms of density enhancement appearance in the period of solar flare and two possible directions of energy flows correspondingly are discussed too.

B-3: Solar extreme events: Questions of definition of the phenomena and their forecast

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Abstract

In the light of sharp splash in interest to solar extreme events (SEE) there is a question on definition of the investigated phenomenon. In opinion one definition SEE completely and entirely depends on those disturbances (significant deviations from background values) in a Earth's environment space or in any point of a heliosphere which make the solar active phenomena. Now influences of the solar active phenomena on environment can be estimated in a five-point scale on three positions:

-Electromagnetic impact - influence of electromagnetic radiation during development of powerful solar flash basically on an ionosphere (SIDs), breaking a radio communication on a time interval till several o'clock (R1 - 5).
- Solar proton events - arrival to a environment of the solar charged particles, influence basically radiating conditions in a vicinity of the Earth, cause growth of electronic concentration above polar caps absorption, breaking radio communication on polar lines (S1 - 5).
- Disturbances of a geomagnetic field - magnetic storms – consequence of arrival to environment of solar plasma streams with the raised density, speed of particles, temperatures, and with the strengthened magnetic field (G1 - 5).
In this case, it would be natural to define solar extreme events as greater powerful the flare phenomena which consequence in a environment is realization of the maximal disturbances in all three positions, i.e. R5, S5, G5. However, the phenomena (S) and (G) essentially depend on localization solar flare events on a visible disk of the Sun and, for example, from the most powerful flares near to western limb the Sun of a geomagnetic field disturbance (phenomenon G) will be minimal, as all energy of coronal mass ejection from this flares will pass by the Earth (flare event 4.11.2003). The most powerful flares on east limb will not be shown, except for phenomenon G, and in high energy particles (S) as also solar protons and coronal mass ejection will be directed aside from the Earth (1.06.1991, 6.03.1989). Other approach in my opinion more natural, conducts to definition SEE as solar flare superevents with a x-ray class not less X15, accompanied powerful coronal mass ejection with V?1500 km/s. Such flares are accompanied by intensive dynamic radio splashes II and IV type, and frequent ejection of solar filaments. Similar events undoubtedly affect all heliosphere, and Earth's environment space is simply a special case only.

The method for utilizing solar observational data to predict of the powerful solar flare events, that a large solar flare and solar filament ejection, is presented. Both phenomena are result of the new emergent flux distinct powerful and rate of emergence. The process of new magnetic flux emergence, its evolution and its interaction with already existing magnetic flux is sufficiently determined that allows us to predict as a period of flare energy release (PFER) so an importance of most solar flare in the flare set of this period. All large solar flares are always accompanied by a series of weaker events.
They formed together the PFER confined within the time intervals about 55±20 hours, when the bulk of the middle and large solar flare are accomplished. The method of the large solar flare event prediction has been put to successful test on Russian scientific satellites such as GRANAT, GAMMA, CORONAS-I. Computer version this forecast techniques has been developed on the base of real-time solar data. The forecasts are accessible via http://www.izmiran.rssi.ru/space/solar/forecast - Russian version and http://titan.wdcb.ru/virbo_rus/viewlast.do?section=RBBulletin – English version.
This research supported by the grant of Russian Foundation for Basic Research 07-02-00246-a and RAS Program No.16 "Solar activity and physical processes in the Solar-Terrestrial system.

B-4: Solar and magnetospheric particle dynamics during magnetic storms of July 23 – 27, 2004

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Abstract

It is a case study of a chain of three magnetic storms with a special attention to the particle dynamics based on CORONAS F low altitude satellite measurements. Particle acceleration during SC, solar proton penetration inside the polar cap, quasi trapping region and inner magnetosphere and relation of the penetration boundary to the magnetosphere configuration and solar wind parameters were studied. We found that solar protons were captured to the inner radiation belt at the recovery phase of the last magnetic storm and remain visible during satellite orbits above Brazilian magnetic anomaly for 30 days until the next magnetic storm. Then in 20-30 hours we registered strong precipitation of these protons and enhanced proton flux disappeared.

B-5: Solar Extreme Events 2005-2006: Effects on Near-Earth Space Systems and Interplanetary Missions

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Abstract

"Solar extreme events" have taken on a whole new meaning with the advent of unique solar observatories offering breath-taking images of these phenomena. In parallel the effects that these events can have on technological systems both in space and on ground are becoming more and more evident. Human space travel initiatives have come to include interplanetary space exploration and currently the uncertainties for assuring the crew's safety is being looked at with new eyes. Each solar cycle has its own famous solar extreme events. This talk with give an overview of the space weather induced effects that were encountered on technological and biological systems at the time of solar extreme events occurring during solar cycle 23. Examples from near-Earth space, where one for example finds spacecraft in geostationary orbit and humans onboard the International Space Station, will be presented. Thereafter the implications of solar extreme events on interplanetary space travel will be discussed. What would have happened if the solar cycle 23 events had occurred during a human mission to Mars? Would a vulnerable spacecraft from Earth been able to mitigate against such a scenario? Future interplanetary space weather forecasting procedures as well as innovative shielding techniques will be discussed.

B-6: Solar neutrons as an indicator of particle acceleration at the Sun

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Abstract

The Sun is the nearest cosmic accelerator we have, this provides unique opportunities for studying particle acceleration mechanisms using instrumentation in or near the Earth. Particles may be accelerated to high energies by several mechanisms. Differentiating between these possibilities is a fundamental problem of cosmic ray physics. In this talk, a summary of past solar neutron events observed by the international network of solar neutron telescopes that occurred during solar cycle 23 will be presented, together with the X-ray and gamma-ray emissions available. The discussion will pursue the aim to find clues to discriminate between different acceleration possibilities. New results on proton spectra of GLE events will also be presented.

B-7: Astrophysical aspects in the studies of solar cosmic rays

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Abstract

This review comprises main concepts, available observational data and recent theoretical results related to astrophysical aspects of particle acceleration at/near the Sun and extreme capacities of the solar accelerator(s). We summarize underground and ground-based observations of solar cosmic rays (SCR) accumulated since 1942, direct spacecraft measurements of solar energetic particles (SEP) near the Earth's orbit, indirect information on the SCR variations in the past, and other relevant astrophysical, solar and geophysical data. The list of the problems under discussion includes: upper limit spectrum (ULS) for solar cosmic rays; maximum energy (rigidity), Em (Rm), of particles accelerated at/near the Sun; production of the flare neutrinos; energetics of SCR and solar flares; production of flare neutrons and gamma rays; charge states and elemental abundances of accelerated solar ions; coronal mass ejections (CMEs) and extended coronal structures in acceleration models;

magnetic reconnection in acceleration scenarios; size (frequency) distributions of solar proton events (SPE) and stellar flares; occurrence probability of giant flares; archaeology of solar cosmic rays. The discussion allows outlining a series of interesting conceptual and physical associations of SCR generation with the high-energy processes at other stars. The most reliable estimates of various parameters are given in each of research fields mentioned above; a set of promising lines of future studies is highlighted. It is emphasized a great importance of SCR data for resolving some general astrophysical problems.

B-8: Solar extreme events in minimum of the solar activity

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Abstract

The probability of occurrence of extremely large SEP events is determined by both the general properties of the distribution function, and the character of this function in the region of large fluxes (fluences and peak fluxes) of particles. The analysis of experimental data has shown that the distribution function describing a set of events, divided by the sum of Wolf numbers during the measurement of this set, is identical for any period (phase) of solar activity. This means that the probability of occurrence of SEP events for the identical sum of Wolf numbers is the same for any phase (maximum or minimum, ascending or declining) of solar activity.

B-9: On the source of 10 hours periodic electron/ ion observations and waves in the heliosphere related with a CME and CIRs during the time period October 2003- March 2004

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Abstract

Low energy ion flux/spectral modulation and magnetic field directional variations with the Jupiter rotation period (~10 hours) were observed by Ulysses during its Distant Jupiter Encounter, as long as Ulysses moved from north to south heliolatitudes, between days 290/2003 - 90/2004. In general this ~10 hour ion modulation was found to be more evident around times of passage of CIRs and was observed by Ulysses after the detection of Jovian bKOM and nKOM ~10 hours emissions. In addition, characteristic ~ 40 min periodic variations were often seen superimposed on the ~ 10 hour flux

increases (for example days 348-352/03). However, a more surprising ion phenomenon could be seen observed in the heliosphere between days ~320-332/03. Previous studies have already shown that Ulysses observed the passage of a coronal mass ejection (CME) between d. ~320-324 / 03 (Koning et al. [2005]) and that Jovian >~3 MeV electrons were ejected within the CME (McKibben et al, 2005). On days 329-331 / 03 (25-27, November 2003), a series of ~10h separated short (~1-3 hours) duration low energy (~0.05 - ~2.00 MeV) ion bursts were observed by the spacecraft ACE, which were accompanied by ~10 hour spectral variation of low energy(~40 - ~100 keV) electrons and ~ 10/5 hour quasi-periodic IMF directional variations. At those times, ACE was at a distance of ~240 RE from Earth and located near IMF lines connecting Sun with Jupiter. The analysis of energetic ion pitch angle distributions suggest that a large scale particle layer was "near" ACE for a long time(~2.5 days) and approached / removed quasi-periodically (~10 hours) from the ACE spacecraft. During the main phase of ACE ion bursts, field aligned flows from the antisunward direction were observed, but a comparison of simultaneous observations at ACE, Goetail, IMP-8 and geostationary spacecrafts (LANL-01A, LANL-02A, LANL-97A, 1994-084, 1991-080, 1990-095) rather suggest that the Earth's magnetosphere/ bow shock was not the source of the ~10 / 5 quasi-periodic ion flows. We believe that the Jovian magnetosphere triggered by the impact of the CIRS (CME) was most probably the source of the ~10 quasi-periodicities in low energy ion observations in the outer (inner) heliosphere during the time period examined in this study.

B-10: The rare exclusion of the July 2005 cosmic ray variations resulted from western and behind the limb solar activity

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Abstract

One of the most interesting and unusual periods of the recent solar activity was July 2005. Despite the fact that this month was at the end of the 23rd solar cycle it was a period of extreme activity. In a total 80 Coronal Mass Ejections (CMEs) – out of which 17 Halo and 11 Partial Halo- as well as 214 Solar Flares (SF), highlighted by 19 M class and 2 X class SF most of which situated at the western limb of the Sun or even behind it, resulted important disturbances at the interplanetary medium. The main events of this period occurred at the invisible side of the Sun and did not reveal significantly in Earth and near Earth consequences. However, cosmic ray variations testify high power of these events. Rather unusual Forbush effect was observed starting from July 16. A deep decrease of the cosmic ray (CR) density (about 8% for 10 GV particles) of a complicated shape with an intermediate increase occurred during the non significant disturbance of the solar wind. The association of these CR variations to the processes in the central part of the solar disk was not successful. Such a behavior of the CR seems to be related to the events on the western limb or behind it where several large releases

of solar matter were observed, during these days. The events are also characterized by a very large CR anisotropy, the magnitude of which, and especially direction, are in accordance with a suggestion on the western source. Usually in such a case (the main interplanetary disturbance is far on the west) the FE is absent or, is very small and short lasted. In July 2005 we observed a rare exclusion, which may testifies that giant (quite possible >=30%) decrease of CR density to the west from Sun-Earth line. An over all description of the July 2005 situation as well as the results of the convection- diffusion treatment with space CR gradients are presented in this work. Also some general remarks concerning extreme western solar events and their impact on cosmic rays are also discussed.

PB-1: Interplanetary and solar aspects of two – component concept for ground level enhancements of solar cosmic rays

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Abstract

We summarize our results obtained earlier for a number of Ground Level Enhancements (GLEs) of solar cosmic rays (SCR) that have demonstrated distinctly two-component structure of relativistic solar proton (RSP) populations, namely, Prompt and Delayed ones (PC and DC). Observationally, PC and DC differ from each other by the form of time profiles (pulse-like and gradual ones), pitch-angle distributions (PAD) (anisotropic and isotropic ones) and spectrum rigidity, namely, by hard (flat) and soft (steep) spectra, respectively. In particular, at the GLE onset the PC is extremely anisotropic. The particles of PC are presumably accelerated in the processes of magnetic reconnection in the low corona, in close association with H-alpha eruption, onset of CME and type II radio emission. Theoretically, in terms of the SCR propagation theory, the DC may be treated as a result of transformation of the PC in the process of interplanetary propagation (SCR scattering at the irregularities of IMF). On the other hand, particles of DC may be accelerated in the low corona and then carried out to the outer corona by an expanding CME. In general, the underlying physical circumstances leading to the initial spikes and two-peak structures in some GLEs are not presently well understood. Taking into account our modeling results, we do not believe, however, that above hypothesis of "an interplanetary origin" of the features mentioned can resolve alone the problem of relativistic proton events. There are some grounds to accept a two-source model of SCR generation itself at/near the Sun, in the frame of the concept of multiple acceleration processes in the solar atmosphere.

PB-2: Two-component features of the two largest GLEs: 23 February 1956 and 20 January 2005

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Abstract

The comparative analysis of the characteristics of relativistic solar cosmic rays (SCR) in the two largest Ground Level Enhancements (GLEs), of 23rd February 1956 and 20th January 2005, has been performed. The parameters of relativistic solar protons (RSP) were obtained from ground-based observations on neutron monitors and muon detectors by a modeling technique. It included: a) calculation of asymptotic cones of ground-based detectors; b) modeling of cosmic ray detector responses at variable parameters of solar proton flux; c) determination by a least square procedure of primary solar proton parameters by comparison of computed responses with the observations. The two particle populations (components), the prompt (PC) with high anisotropy and exponential energetic spectrum and delayed one (DC) with moderate anisotropy and power law energetic spectrum, were shown to exist in both cases. The prompt component was a cause of a giant impulse increase at a limited number of NM stations; the DC formed a gradual increase with moderate amplitude at the most NM stations over the globe. It is argued that only exponential energetic spectrum (not power-law) in aggregate with specific yield function energetic dependence could cause such great increase effect (~5000%) in both cases. Selected two GLEs provide a bright demonstration of existence of two separate RSP sources at/near the Sun. The interplanetary propagation, in itself, is not capable to create such different properties of two populations of relativistic solar particles.

PB-3: The largest in history GLEs January 20, 2005 and February 23, 1956. Comparative modeling study

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Abstract

Comparative analysis of the characteristics of relativistic solar cosmic rays (SCR) in the two largest GLEs of February, 23 1956 and January 20, 2005 has been performed. Both events have taken place near to a solar minimum: GLE 23.02.1956 on a rise and the GLE 20.01.2006 on a decay phases of solar cycle respectively. Using a modeling technique, the parameters of relativistic solar protons (RSP) were obtained from ground-based observations by neutron monitors (NM) and muon detectors. The two particle populations (components), prompt (PC) with high anisotropy and exponential energy spectrum and delayed one (DC) with moderate anisotropy and power-law spectrum, were shown to exist in both cases. The prompt component was a cause of a giant pulse-like increase at a limited number of NM stations, and the DC caused a gradual increase with moderate amplitude at the most NM stations over the globe. It is argued that only exponential energy spectrum (but not power-law one), in combination with energy dependence of the NM specific yield functions, could cause such great increase effect (~5000%) in both events.

PB-4: Special type of the magnetic and auroral activity produced by sudden commencement of the extreme magnetic storms

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Abstract

Sudden Commencements of several strong magnetic storms were accompanied by unusual magnetic and auroral activity. Magnetic bays grow in several minutes to 400-2000nT simultaneously in a wide longitudinal sector from midnight to early morning. Although such events were usually identified as a special type of the magnetosperic substorm, a supersubstorm, there are strong reasons to state that it is not a substorm at all. Isolated substorms or complicated substorm activity include two basical processes: gradual accumulation of the energy inside the magnetosphere (growth phase) and explosive

instabilities releasing the energy during localized auroral breakup and following activations during expansion phase. During analyzed events which we named as a sudden auroral activations (SA), growth phase was absent, energy are not accumulated but supplied by solar wind SC pulse instantly. Also there are simultaneous activation in a wide area instead of the localized activation. We analyzed 5 SA events and come to the conclusion that the main process which accelerates auroral particles with following precipitation into the ionosphere was a ExB radial injection, the process which is rather common in the magnetosphere but usually more gradual and less powerful.

PB-5: Solar sources of the rapid solar wind during the descendant and minimum phases of solar cycles

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Abstract

During each solar cycle, just after its maximum, the polar magnetic reversal takes place; this process might take some months or even 1-2 years. After it has been finished, a new magnetic dipol is born under the solar surface, belonging to the next solar cycle. This is why, during the descendant phase of a solar cycle, some complex interactions between the old and new dipols could occur and, consequently, extreme solar events are registered. The paper analyses the dynamics of the High-Speed Streams (HSSs) in solar wind during the descendant and minimum phases of the solar cycles nos. 20-23 taking into account the stream parameters: the duration, maximum velocity, velocity gradient and importance. We use the well-known HSS catalogs (Lindblad and Lundstedt: 1981, 1983, 1989; Mavromichalaki et al.: 1988, 1998) for solar cycles 20-22 (1964-1996) as well as a new catalog for solar cycle 23 (1996-2006, Maris & Maris, 2007). Obvious differences in the HSS dynamics in respect to their solar origin (flares or coronal holes) have been established. A special analysis of the extreme solar events of 2005 and 2006 and their consequences in solar wind dynamics is made. The HSSs registered in 2005 and 2006 are analysed in comparison with the HSS registered during the corresponding phases of the previous solar cycles.

PB – 6: Observations of high-energy gamma radiation onboard the CORONAS-F satellite as an indicator of proton acceleration during solar flares

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Abstract

Solar flare gamma radiation with energies > 0.5 MeV is the direct indicator of accelerated proton appearance in the corona. Protons with energies 10-30 MeV generate gamma-line radiation of excited nuclei as well as the neutron capture line 2.2 MeV. Protons accelerated up to at least 300 MeV generate the high-energy gamma radiation as a result of neutral pion decay. This radiation is characterized by wide spectral maximum about 70 MeV and is originated in density matter of the flare volume. The SONG instrument onboard the CORONAS-F detected high-energy gamma radiation produced by several major solar flares at 2001-2005. In flares of 28 October 2003 and 20 January 2005 we determined exact moments of the pion decay radiation and hence of high-energy proton appearance at the Sun. Comparison of the proton acceleration time in the flare with the onset time of following GLE permits to make a conclusion that any delay between the proton acceleration and their escaping is absent.

PB-7: An Interpretation of Rapid Changes in the Magnetic Field Associated with Solar Flares

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Abstract

A topological model of the magnetic field is used here for interpreting the recently discovered drastic changes in magnetic field associated with solar flares. The following observational results are self-consistently explained: (1) the transverse field strength decreases at outer part of active regions and increases significantly in their centres; (2) the center-of-mass positions of opposite magnetic polarities converge towards the magnetic neutral line just after flares onset; (3) the magnetic flux of active regions decreases steadily during the course of flares. For X-class flares, almost 50% events show such changes.

PB-8: A comparison of Solar Energetic Events of 2005 and 2006 and their differing Geoeffectiveness

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Abstract

Years 2005 and 2006 lie on the declining phase of solar cycle 23. The next solar cycle will begin somewhere between March and September 2007. As part of our work we have studied the Solar Energetic Events (SEE) and associated Space weather changes at the dayside Lagrangian point (L1), Geostationary orbit (GSO) and at Earth for these two years. In this paper we highlight the differences between solar wind velocity (Vsw), solar wind density (Nsw), solar wind dynamic pressure (Psw), the interplanetary B and its components, 2 MeV electron flux (Ne) at GSO, geomagnetic index Kp, Cosmic ray neutron monitor (CRNM) count monitored at Earth. All Space Weather show a marked difference between 2005 and 2006. The year 2005 is seems to be far more active than 2006, with 8-10 Solar Energetic Proton (SEP). Events having occurred; in contrast there is only 1 major SEP event in 2006. Comparative values of Vsw between 2005 and 2006 are: above 700 km/s in 2005 and with around 600 km/s in 2006. The peak Psw touches 100 nPa in 2005 but does not even crosses 20 nPa in 2006. Similar differences are seen in the IMF (Bavg and its components), the 2Mev Ne flux at GSO, Kp index and the CRNM count at Earth.

PB-9: Transformation and transport of sub-photospheric energy into the corona during solar extreme events in December 2006

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Abstract

SOHO magnetograms have been used to analyze the evolution of the magnetic field (MF) in a unique complex of activity (CA) that included the long-lived (at least 4 solar rotations) central sunspot and opposite-polarity elements surrounding it. The analysis revealed an annular zone of emergence of a nonpotential MF into the corona which surrounded the sunspot umbra. The “annihilation” effect of opposite-polarity magnetic elements at the photospheric level has been interpreted as a change in the cross-section of emergent helical magnetic loops accelerated at the inner and outer boundary of the annular zone. We reconstructed the topology of the subphotospheric MF consisting of the central

quasi-radial "trunk" of like polarity with weak spiral twisting of MF lines of the quasi-cylindrical envelope surrounding the "trunk" and consisting of different-scale loops with complicated structure ("crown"). We examined the mechanism of sequential transformation of energy: energy of kinematic motion of plasma inside the quasi-cylindrical envelope; non potential energy of the MF inside it; emergence of non potential energy into the corona in the annular zone; accumulation of this energy in the corona; release of accumulated energy in a series of extreme solar events. In this scheme, the emergent MF is an "elevator" for the energy trapped during its movement. The MF of such a CA may be thought of as being a natural "probe" for diagnostics of deep-seated regions of the Sun, as deep as the "bottom" of the convection zone.

PB-10: The observation of gamma-ray emission during January 20, 2005 solar flare

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Abstract

The solar flare of 20.01.2005 (class X7.1) was the biggest one in January 2005 series. It was started at 06:36 UT, ended at 07:26 UT and the maximum of X-ray emission was at 07:01 UT by GOES data. AVS-F apparatus onboard CORONAS-F registered gamma-emission during rising phase of this flare in two energy bands: 0.1-20 MeV and 2-140 MeV. The highest gamma-ray energy was registered during this flare was ~140 MeV. Nuclear lines, positron line, neutrons capture line and spectral feature caused by neutral pions decay were observed in this flare energy spectrum. Also some spectral peculiarities were observed in the region of 15-21 MeV in time interval of 06:44:52-06:51:16 UT. The possibilities of this feature treatment are discussed.

PB-11: The role of new gamma-ray observations in investigation of powerful solar flares

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Abstract

Gamma-ray emission from solar flares gives information about the nature of the accelerated particles and the physical conditions in the area in which flare occurs and surrounding media. Nuclear lines present the abundance of elements, density, and temperature of the ambient solar atmosphere and data concerned with the parameters of the accelerated ions. The possible interpretation of spectra and spectral peculiarities observed during some January 2005 solar flares are discussed.

PB-12: Space storm measurements of the July 2005 solar extreme events from the Low Corona to the Earth

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Abstract

A combined recording from the Athens Neutron Monitor Station and the ARTEMIS-IV radio spectrograph of the solar extreme events of July 2005 is being presented. The use of a number of earthbound receivers, space experiments and data archives (the ARTEMIS-IV radio spectrograph, the Athens Neutron Monitor Data Processing Center and the WIND experiment) provided new insight for this rather unusual period of July 2005, as all important solar events and the resulted cosmic ray variations are traced from the Low Corona to the Earth. The observed time sequence of events of this time period indicates that the initiation of CMEs is closely related to the appearance of type II and IV radio bursts and strong solar flares. Their effects extend from the base of the solar corona to the near Earth vicinity. As a result, the worldwide neutron monitor network recorded an unusual Forbush decrease. In specific, a sharp enhancement of cosmic ray intensity occurred right after the main phase of the FD on July 16, was followed by a second decrease within less than 12 hours. The peculiarity of this event owes to the fact that it does not comprise a ground level enhancement of solar cosmic rays neither a geomagnetic effect in cosmic rays. This event appear to be caused by some special structure of interplanetary disturbances in the inner heliosphere at that time period when the Earth crossed a periphery of a giant Forbush effect started in the western part of the heliosphere after the flare on July 14. An analysis of all available space born and ground level detectors regarding this irregular event is being performed.

PB-13: The biggest Forbush effect in 2003 according to observations on Mt. Hermon in neutron total component and in different multiplicities

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Abstract

We investigate the biggest in 2003 Forbush effect observed by NM of Emilio Segre' Observatory on Mt. Hermon in neutron total component (more than 15%) and in different multiplicities. On the basis of these data we determine rigidity spectrum of cosmic ray intensity decrease, effect of pre-increase, and estimate properties of interplanetary shock wave and moving magnetic trap caused observed giant Forbush effect in cosmic rays. We compare obtained data with results of observations on other sites on the Earth and on satellites.

PB-14: Evolution and flare productivity of SEE active regions in the last solar physical cycle (solar cycles number 22 & 23)

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Abstract

Last "physical" cycle of solar activity uniting solar cycles 22 and 23, has brought a lot of new in our understanding of solar active events, especially extreme. It is enough to notice, that practically all the most powerful events 22 solar cycles were carried out in a phase of a maximum, and in a solar cycle 23 extreme solar events were carried out at the latest stage of a phase of a minimum. In cycle 22 similar flare event occurred on March, 1989 (~ max.), June 1991 (~2.5 y). For 10 years of development of 23 solar cycle it is registered only five flares with a x-ray importance (X >=10) (for example, for interval 1 - 15 June, 1991 only, its was 5 too, and there are more solar extreme events, than for all 21 solar cycle) and three of them were the main one during the concerned of flare activity period 19.10 - 04.11.2003 (~ 3.5 y.) Research of active regions with extreme flare events has allowed to reveal general characteristics of these areas and conditions of generation of such events. Attention is drawn to necessity to distinguish actually solar extreme events and extreme displays of disturbances of a Earth's environment space. The last depend on geometrical factors of occurrence and propagation of disturbances from greater flare events more. The last are frequent not extreme. The opportunity of forecasting extreme flare events as result of interaction of new emerging magnetic fluxes and with already existing magnetic structures is considered.

PB-15: An MHD-turbulence model for Solar Corona

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Abstract

The disposition of energy in the solar corona has always been a problem of great interest. It is still an open question how the low temperature photosphere supports the existence of solar extreme phenomena. A turbulent heating mechanism for the solar corona through the framework of Reduced Magnetohydrodynamics (RMHD) is proposed. Two-dimensional incompressible long time simulations of the average energy dissipation have been carried out with the aim to reveal the characteristics of the long time statistical behavior of a two-dimensional cross section of a coronal loop. It was found that a slow photospheric magnetic field driving self-organizes at large scales via an inverse MHD cascade. Scaling laws are being proposed in order to quantify the nonlinearity of the system response. Finally, the importance of the photospheric time scales for the coronal heating problem is analyzed and discussed.

Session C

The chain of physical processes in the solar – terrestrial system

(Sun – Magnetosphere – Ionosphere – Upper Atmosphere – Ground)

CI-1: Magnetosphere response to the 2005 and 2006 extreme solar events as observed by the Cluster and Double Star spacecraft

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Abstract

The four identical Cluster spacecraft, launched in 2000, orbit the Earth in a tetrahedral configuration and on a highly eccentric polar orbit (4 - 19.6 RE). This allows the crossing of critical layers that develop as a result of the interaction between the solar wind and the Earth's magnetosphere. During the northern hemisphere winter their apogee is in the solar wind, allowing to study the magnetopause and bow shock structure and response to solar wind conditions, whereas during the remaining part of the year they analyze the magnetotail dynamics during storms and substorms. The 4 RE perigee permits them to sample the ring current, the outer radiation belt and the outer plasmasphere from south to north, almost following the same magnetic field line (latitudinal profile). Since 2004 the Chinese Double Star TC 1 and TC2 spacecraft, whose payload comprise also backup models of instruments developed by European scientists for Cluster, provide two additional points of measurement, on a larger scale: the Cluster and Double Star orbits are such that the spacecraft are almost in the same meridian, allowing conjugate studies. The Cluster and Double Star observations during the 2005 and 2006 extreme solar events will be presented, showing uncommon plasma parameters values in the near-Earth solar wind and in the magnetosheath, unusual dayside magnetosphere compression, detection of high-energy particle populations, and ring current development.

CI-2: Balloon measurements of cosmic ray fluxes in the atmosphere and role of these particles in the atmospheric processes

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Abstract

The experimental data on cosmic ray fluxes in the atmosphere obtained in the balloon experiments from 1957 till present time are analyzed. The following questions are discussed: long-term modulation of cosmic rays and negative trend of cosmic ray flux; ion production in the atmosphere; cosmic rays, electric characteristics of the atmosphere and global electric circuit; thundercloud formation and lightning production; global changes of climate in the nearest future.

C-1: Dynamics of the plasma sheet in the magnetotail: interrelation of turbulent flows and thin current sheet structures

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Abstract

Dynamics of the magnetotail features two different time scales. A short time scale T1 is associated with disturbances propagating in the tail lobes, with their relatively strong magnetic field and low plasma density. A longer time scale T2 is associated with plasma motions in the plasma sheet, with its small normal component of the magnetic field and a greater density. A disturbance appearing in the magnetotail on the time scale T1 produces a weak loss of equilibrium on medium spatial scales (a few RE) in the plasma sheet. It is shown by means of theoretical argument and numerical simulation that the relaxation process which follows on the time scale T2, produces extremely thin embedded current sheets, along with generation of fast plasma flows. The process provides an effective mechanism for transformation of magnetic energy accumulated in the magnetotail, into energy of plasma flows. The fast flows may drive turbulence on shorter spatial scales. In their turn, these motions may serve as an origin for neutral line generation, and reconnection. The latter generates signals in MHD modes, propagating in the magnetotail lobes, and thus new fast disturbances on the time scale T1 are produced. Application to substorm phenomenology is discussed.

C-2: Some peculiarities of the decay of extreme solar energetic particle events

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Abstract

The majority of few-MeV solar energetic particle (SEP) events exhibit exponential-law decays. The comparison of experimental values of characteristic decay times, tobs, with those obtained in theoretical models considering convection transport and adiabatic deceleration shows that theoretically expected t values, Ttheor = 3r/4V (1 + v ή γ), V is the solar speed, v ή γ spectral exponent, r distance from the Sun, depending on environmental plasma parameters, are reasonably close (within about 25 %) to the fitted slopes in nearly 50% of all cases where solar wind speed stays approximately constant. These results were obtained for 1-25 MeV protons on the basis of large statistics of IMP 8 data. On the basis of SOHO COSTEP and ACE EPAM data on proton and electron intensities correlations between their shapes and characteristic decay times in the framework of the above theoretical model are

considered. It is shown that in extreme events this correlation deviates from the predicted one. The decay of the event of 23 Sep.1978 is discussed which can be considered as extreme from the point of view of theoretical interpretations. The same peculiarities may be considered as confirmations of CME-associated shock acceleration, particle reservoir and convection transport and adiabatic deceleration models.

C-3: Forecasting the Solar Wind in the Inner Heliosphere

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Abstract

One main effort of the Center for integrated Space Weather Modeling (CISM) is to develop space weather models for the Sun-Earth chain. Among them is the Solar Wind model that gives a 3 dimensional description of the solar wind structures in the inner heliosphere. It is driven by daily NSO/SOLIS synoptic maps. We employ the Wang-Sheeley-Arge (WSA) algorithm to compute potential field solutions of the solar corona and derive inner boundary conditions for the ideal MHD code ENLIL. It in turn propagates the solar wind structures out to Earth and beyond. With this model we can describe the ambient solar wind at the three locations of the ACE and STEREO space crafts. We predict the plasma parameters for lead times of 1 to 5 days in 8 hour cadences and describe the space environment in the inner heliosphere. This model is implemented at the NOAA Space Environment Center in Boulder, Colorado. We report on validation efforts and prediction performances, and demonstrate how our model supports the activities at the forecast center.

C-4: Topology of high latitude magnetosphere during large magnetic storms and the main mechanisms of relativistic electron acceleration

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Abstract

One of the main goals of the solution of Space Weather problem is the prediction of the appearance of very large fluxes of relativistic electrons as large fluxes of electrons with energies larger than 1 MeV pose a serious potential hazard to satellites missions. Large fluxes of relativistic electrons are formed in the outer radiation belt during the recovery phase of some storms. The formation of large fluxes is connected with the competition of acceleration and loss processes. Two-step acceleration process is ordinarily analyzed. “Seed” population with energies ~hundreds of KeV is appeared during expansion

phase of magnetospheric substorm. “Seed” population is additionally accelerated obtaining relativistic energies by some other process. The mysterious properties of relativistic electrons are the great level of their variability and low level of correlation with the strength of geomagnetic storm. Several acceleration mechanisms have been proposed for the explanation of electron acceleration, including radial diffusion and internal acceleration by wave-particle interactions. Such mechanisms do not take into account great changes of magnetospheric topology during magnetic storm. Such changes are mainly connected with asymmetric and symmetric ring current development. The formation of “seed” population of electrons during magnetospheric substorms also is a problem now as it was found that substorm expansion phase onset take place on the quasidipolar magnetic field lines. Latest findings on the changes of magnetospheric topology during magnetic storms are summarized. The processes leading to such changes are discussed. The acceleration of relativistic electrons is analyzed.

C-5: Statistical properties of the most powerful perturbations on the Sun and in the heliosphere

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Abstract

Strongest perturbations on the Sun (flares and coronal mass ejections) and their transient manifestations in the heliosphere (solar wind plasma, radiation and electromagnetic fields) are of great practical interest from the point of view of the space weather evaluation and forecast. Several difficulties exist in their study: 1) the statistics of such events is rare by definition of extreme events; 2) the reliable theoretical models are still not available. We discuss some common and specific properties of extreme events: a) the broad diversity of their parameters, which makes all such events unique and not similar in some sense; b) the absence of universality even under similar manifestations of biggest solar flares and coronal mass ejections; c) the global and multiple character of the most powerful perturbations on the Sun and in the heliosphere; d) the relation of such events to the longitudinal asymmetry of the Sun and to the longer-duration variations in the solar atmosphere. At present time, the conditions of space weather in the near-Earth space can be estimated sometimes using a five-point scale (www.sec.noaa.gov/NOAAscales/): extreme (5), severe (4), strong (3), moderate (2), minor (1). The scales describe the environmental disturbances for three event types: 1) radio blackouts (R1-R5), solar proton radiation storms (S1-S5), geomagnetic storms (G1-G5). The database was compiled, which contains 85 strongest events for the period since 1859 to 2007. The statistical analysis of strongest events on theses three positions R, S, G, and also on some other indexes of solar activity will be presented and discussed. The tendency confirmed of extreme events to be strong in all parameters (“syndrome of big flares”). The work is supported by the INTAS grant 03-51-6206, the Russian Foundation for Basic Research grants 07-02-07012, 06-05-64500, Russian Academy of Sciences Programs P30 and OFN 16 and Interdisciplinary MSU Program.

C-6: Possible influence of solar extreme events and related geomagnetic disturbances on human physiological state: Results of collaborative Bulgarian – Azerbaijani studies

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Abstract

This study is based on the analysis and comparison of similar investigations performed in Bulgaria and Azerbaijan about possible influence of solar extreme events and related geomagnetic variations on human physiological state. Arterial blood pressure and heart rate of 86 healthy volunteers were measured on working days during a period of comparatively high solar and geomagnetic activity (autumn 2001 and spring 2002) in Sofia. Altogether 2799 measurements for each of the physiological parameters were gathered and analyzed. Heart rate and electrocardiograms (ECGs) were registered in 7 healthy volunteers on working days (including Saturdays), in the Medical Center INAM in Baku, from 15.07.2006 till 21.04.2007. Obtained 1038 digital recordings were subjected to the analysis. Special attention was paid to solar extreme events of December 2006. Analysis of variance (ANOVA) was employed to check the significance of the influence of geomagnetic activity, estimated by averaged diurnal value of Dst-index on the physiological parameters under consideration. Results revealed a statistically significant increment for systolic and diastolic blood pressures with geomagnetic activity increase. Arterial blood pressure values started increasing two days prior to geomagnetic storms and had higher values up to two days after them. Probably the dynamic of arterial blood pressure reveals a compensatory reaction of human organism as adequate reaction to environmental changes. Heart rate did not react statistically significantly for both groups under geomagnetic changes. It should be noted that persons examined were healthy. It seems that heart rate is probably more stable physiological parameter for healthy persons under these conditions.

C-7: Thermal neutrons response to the GLEs

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Abstract

Long-term observations near the Earth's crust have shown that thermal neutrons are very sensitive regarding different processes and phenomena both in the near-Earth space and in the Earth's crust itself. The reason of it is the dual nature of the thermal neutron flux observed near the Earth's surface. Its first source is bound up with the high-energy particles of cosmic rays penetrating into the Earth's atmosphere and interacting with its elements. The second source originates from the radioactive gases contained in the Earth's crust. While the contribution of the second source is strongly depends on the Earth's crust conditions and reflects its movements, the contribution of the space-originated source must respond to any variations of high-energy particles flux near the Earth. Ground level enhancement (GLE) recorded on January 20, 2005 by the neutron monitors world-wide network may be comparable to the greatest GLEs over the whole period of observations in spite of that it occurred at a time period close to the minimum of the 23d solar cycle. At polar stations the peak of the cosmic ray variations reached several thousands of percentages. At the same time the flux of thermal neutrons in Antarctica increased up to several hundreds of percentage. Both for the stations of neutron monitors, and thermal neutrons monitors located at high and middle latitudes the recorded effect from this GLE was considerably less or even absent at all. The results of comparative analysis of the latest GLEs and thermal neutrons response to them are discussed.

C-8: Creation of model of quasi-trapped proton fluxes below Earth's radiation belt

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Abstract

The object of investigation is the phenomenon of proton (ten's keV, several MeV) flux enhancement in near-equatorial region (L<1.15) at altitude up to ~1000 km (the storm-time equatorial belt). These fluxes are quite small but the problem of their origin is more interesting than the possible damage they can produce. The well known sources of these protons are radiation belt and ring current. The mechanism of transport is first charge-exchange on neutral hydrogen of exosphere and second charge-exchange on oxygen of upper atmosphere. Therefore this belt is something like the ring current

projection to low altitudes. Using ACTIVE (Intercosmos-24), MIR station (SPRUT-VI experiment), NOAA POES series, SAMPEX and other satellites data we obtain the average energy spectrum, the approximation of spectrum using kappa-function, the flux dependence on L, B geomagnetic parameters. On the basis of more than 30 years of experimental observations we made the empiric model that extends model of proton fluxes AP8 below 100 keV and to the small L-values (L<1.15). The model was realized as the package of programs integrated into COSRAD system available via Internet (http://cosrad.sinp.msu.ru). The model can be used for revision of estimation of dose that obtains low-orbital space devices.

C-9: CORONAS-F measurements of high-energy solar proton spectra

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Abstract

Fluxes of protons at the energy range of 0.8 - 4 GeV accelerated during solar flares of October-November 2003 were detected onboard the CORONAS-F satellite having polar circular orbit with an altitude ~450 km. The SONG instrument consisted of a CsI(Tl) crystal of size Ø20 cm ×10 cm and had sufficient geometric factor (~1500 $cm^2 \cdot sr$) to detect directly solar protons as a count rate exceeding above a background level in a wide range of geomagnetic cut-off rigidities calculated in the geomagnetic field described by IGRF and Tsyganenko models. Using the geomagnetic cut-off effect we determined solar proton spectra on 28 October (GLE65) and 29 October (GLE66). Measured spectra are in a good agreement with combined spectra obtained with GOES data and calculated from neutron monitor network data.

CI-3: Radiation Environment of the inner magnetosphere: Quiet and storm Periods

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Abstract

The radiation environment near the Earth is characterized by the permanent presence of particles of radiation belts, ring current, galactic cosmic rays,secondary and albedo radiation produced as a result of the interaction between the atmosphere and the particles that precipitated from the belts and penetrated deep into the magnetic field generated by cosmic rays. Solar storms are accompanied by ejections of plasma and energetic particles into the interplanetary medium. Part of the solar material penetrates into the geomagnetic field and changes the spatial and energy distributions of charged

particles, which are stationary during quiet periods, but dependent on colar cycle.Solar energetic particles (SEPs) can reach low altitudes and fill both polar caps and outer region of trapping zone during solar and geomagnetic storms, thus resulting in additional radiation effects in the near-Earth environment. On the other hand, geomagnetic disturbances—substorms and storms—arising during solar storms result in an intense transport and acceleration of particles in Earth's environment both inside and outside the region of trapped radiation. In total, these processes lead to complex variations of fluxes of charged particles named radiation storms.The effects of "near -Earth" radiation storms are discussing in this talk.

CI-4: Coronal Mass Ejections of Solar Cycle 23

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Abstract

Coronal mass ejections (CMEs) were first observed in white light in the early 1970s, but their key role in space weather has been established only after the advent of the Solar and Heliospheric Observatory (SOHO) mission. CMEs have been observed over the entire solar cycle by a single coronagraph for the first time, thus yielding a uniform and extended data set. SOHO also observed two CMEs of historical significance with their shocks arriving at Earth in less than 20 hours. Halo CMEs, although known before, have become the most important subset of CMEs for space weather purposes. In addition, SOHO observed the CMEs corresponding to all but one of the ground level enhancement events (GLEs) showing that they belonged to a group of CMEs with highest average energy. I discuss the properties of various subsets of CMEs associated with geomagnetic storms, solar energetic particles (SEPs), magnetic clouds, and interplanetary radio-bursts. I will show that only 10% of all CMEs have significant consequences in the heliosphere.

CI-5: The effect of intense geomagnetic storms from the 23rd solar cycle on the radiation belt electrons: satellite data analysis and physical simulations

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Abstract

The close relationship between the Earth's radiation belt dynamics and solar activity has been well established. At Los Alamos National Laboratory (LANL) a very large database of satellite measurements in the Earth's radiation environment exists. Particle and plasma detectors on board the LANL geosynchronous satellites at around 6.6 Earth radii provide continuous measurements of the trapped electron population's outer boundary, while particle detectors on board the Global Positioning System (GPS) satellites at 4 Earth radii measure the heart of the electron outer radiation belt, a highly dynamic place. During the 23rd solar cycle, data was collected from 7 detectors in operation on geosynchronous satellites and 8 detectors in operation on GPS satellites creating a database which offers a great opportunity to study the Earth's radiation belt dynamics on different timescales. The dynamics are studied on the solar cycle scale as well as on the scale of a single geomagnetic storm and results are presented here. For a better understanding of the radiation belt dynamics and the physical processes involved one has to combine satellite observations with physical simulations. The Salammbo 3D physical model has been extensively used for theoretical physical studies. Here it is used to simulate a real geomagnetic storm from the 23rd solar cycle. The conclusions obtained from the comparison of the simulation results with satellite data are a measure of how good our current understanding of the radiation belt dynamics is.

C-10: Influence of magnetic clouds on the cosmic rays and the near-Earth space environment

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Abstract

We discuss the effects of magnetic clouds on cosmic rays as observed by neutron monitors. We also discuss their impact on the geo-magnetosphere by utilizing the indices of geomagnetic activity. Other structure/features associated with magnetic clouds e.g. shock/sheath, interaction region and high speed stream are also considered and their effectiveness in modulating the cosmic ray intensity and geomagnetic activity are synthesized. The use and importance of interplanetary plasma and field parameters during the passage of structures of distinct properties, and physical mechanisms playing important role are also discussed.

CI-6: Ozon destruction by solar electrons in relation to Solar Variability and the terrestrial latitude

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Abstract

The goal of this study is to determine the contribution of the solar corposcular radiation in the stratospheric ozone destruction in relation to the solar variability and the terrestrial latitude of the observational point. For this reason, we have analysed relativistic electron fluxes 150Kev-5Mev collected by the Russian, low altitude (1000 Km), polar trajectory, Satellite METEOR in relation to ground based observations of ozone concentration. Separate analysis to each year of the solar cycle and various 10deg wide latitude zones of the North Hemisphere have shown that ozon destruction by solar electrons is highly affected by indivitual solar cycle phases and terrestrial latitude.

CI-7: Responses of Venus induced magnetosphere under extreme solar conditions

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Abstract

The aim of a planetary mission is usually to study the planet itself. It often emphasizes on the surface geological mapping, atmospheric remote sensing and space plasma environment of the planet. However, when properly equipped, an inner planets (Mercury and Venus) mission can be easily used by the space weather community as a sentinel upstream of Earth in the solar wind. Venus Express, the first European planetary mission to Venus, was launched on November 9, 2005 and placed into orbit about Venus on April 11, 2006. Onboard VEX, there are magnetometer and plasma analyzer. Since VEX will spend most of its 24 hour orbit period in solar wind, it will provide us useful data for space weather study. In this paper, we examine the responses of Venus induced magnetosphere under extreme solar conditions in 2006 at solar minimum. The induced magnetosphere behaves much different under these extreme solar conditions: the ionopause increases its altitude to a level seen only at solar maximum; we can identify all the ICME events by magnetic field data although Venus was separated by a great longitudinal angle with Earth; we observed distant bow shock located at a distance about 10 Re which is equivalent to find Earth bow shock at 100 Re by a simple scaling. In all, Venus Express provides us a good opportunity to study the solar extreme events.

CI-8: Ionospheric monitoring and short term forecasting at middle latitudes during solar extreme events consequences of violent solar storms

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Abstract

Ionospheric storms represent an extreme form of space weather with important effects on ground- and space-based technological systems, including radio wave communications, navigation and surveillance systems. At middle latitudes the ionospheric response lead to either positive or negative storm effects. Daytime positive storms are attributed to travelling atmospheric-ionospheric disturbances and subsequent changes in the global wind circulation. Negative storm effects are attributed to neutral gas composition changes which are propagated toward middle latitudes during night and which subsequently rotate into the day sector. These phenomena are driven by highly variable solar and magnetospheric energy inputs to the Earth's upper atmosphere, which continue to provide a major difficulty for attempts now being made to simulate the detailed storm response of the coupled neutral and ionized upper atmospheric constituents. The requirement for quasi-real-time products based upon current ionospheric specification has led to an increased importance of so-called real-time ionospheric models. Ionospheric specification tools comprise terrestrial sounding systems, including real-time networks of ionospheric sounders. The European Digital Upper Atmosphere Server (DIAS) is an advanced real-time network of European digisondes. DIAS delivers products and services for near real-time specification of ionospheric parameters and short term ionospheric forecast up to 24 hours ahead based on empirical and data driven autoregression modelling techniques. The paper reports on the success of near real-time ionospheric specification over large geographic areas, given the advanced capabilities of modern ionosondes, and on the performance of ionospheric prediction models especially during solar extreme events.

PC-1: Solar Cosmic Rays and Solar-Terrestrial Relations: Observational Evidence and Mechanisms

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Abstract

A number of geophysical effects of solar energetic particles (SEPs), or solar cosmic rays (SCR), are reviewed. We concentrate mainly on the observational evidence and mechanisms of some expected effects and/or poor-studied phenomena discovered within 2-3 last decades: depletion of the ozone layer; perturbations in the global electric current; change of the atmospheric transparency; and production of nitrates. Some "archaeological" data on SCR fluxes in the past and upper limit of total energy induced by solar flare protons are also discussed. Due attention is paid to the periodicities in the solar particle fluxes. Actually, many solar, heliospheric and terrestrial parameters changing generally in phase with the solar activity are subjected to a temporary depression close to the solar maximum (Gnevyshev Gap). Similar gap has been found recently in the yearly numbers of the >10 MeV proton events. All above mentioned findings are evidently of great importance in the studies of general proton emissions of the Sun and long-term trends in the behavior of solar magnetic fields. In addition, those data can be very helpful for elaboration the methods for prediction the radiation conditions in space and estimation of the SEPs contribution into solar effects on the geosphere, their relative role in the formation of terrestrial weather and climate.

PC-2: Solar protons effect on middle atmosphere during SEEs 28.10.2003 and 13.12.2006

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Abstract

The effect of energetic solar protons on the middle atmosphere (20-80 km) chemical composition during the SEEs October 28-29, 2003 and December 13, 2006 has been studied. The solar proton spectra were obtained from the neutron monitors, balloons and spacecraft data. One-dimensional time-dependent model (Fadel et al., 2006, Adv. Space Res.) has been used to calculate the production and loss of minor atmospheric components during the GLE. For SEE 13.12.2006 the derived depletions of ozone content is in good agreement with experimental data obtained by the Microwave Limb Sounder (MLS) instrument on the AURA spacecraft.

PC-3: Interplanetary manifestation of solar extreme events occurred during the past solar maximum of cycle 23

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Abstract

We study the fast and huge magnetic clouds associated with the strongest solar eruptions, occurred during the post solar maximum of the solar cycle 23. Magnetic clouds are believed to be closed twisted flux tubes traveling from the Sun to the outer heliosphere. However, their evolution in spatial scales of the order of the Sun-Earth distance is still not fully known. Even the identification of their boundaries is an open question in some cases. We applied a new method to analyze magnetic clouds, which is based on the conservation of the azimuthal flux between the in- and out-bound branches of the cloud, and it is valid for finite distances between the spacecraft trajectory and the cloud axis. The direct method is useful to improve the determination of boundaries and/or orientation when one of these two is known. From this analysis we find that the flux ropes are followed by a large coherent region and we interpret it as the existence of a previous larger flux rope, which partially reconnected with the surrounding environment in its front. Thus, the original flux rope is progressively peeled by reconnection and transformed to the observed interplanetary mass ejection. Our results are put within the frame of the solar measurements obtained from the probably source regions.

PC-4: The solar wind charge exchange process as seen in X-rays and plans for a space based telescope

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Abstract

The solar wind charge exchange (SWCX) process has proved to be a significant source of background for space based X-ray telescopes such as XMM-Newton and Suzaku, dependent on specific alignment and observing conditions. SWCX produces emission lines within the soft X-ray band from the interaction of solar ions, including oxygen VII, oxygen VIII, carbon V and magnesium, with neutrals such as geocoronals in the Earth's magnetosheath. It can be used as an indicator of the conditions in the solar wind and the dynamical interaction between the solar wind and the Earth's magnetic field. We present the observational evidence of this effect and discuss the importance for future space missions. We also discuss plans for a lunar based telescope dedicated to observing this phenomenon.

PC-5: Variations of the Relativistic Electron Flux of the Outer Radiation Belts during Extreme Geomagnetic Time Intervals

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Abstract

The results of the relativistic (Ee>1.5 MeV) electron experimental studies in the outer Earth's radiation belt (RB) obtained during CORONAS-F mission are presented. Variations of the relativistic electron in the outer RB were measured during four years, from August 2001 until June 2005. Several of the extremely strong magnetic storms took place during this period, the strongest of them were observed during November 6, 2001 (Dst=-257 nT), November 24, 2001 (Dst=-221 nT), October 29-30, 2003 (Dst=-400 nT), November 20, 2003 (Dst=-465 nT). Besides, tens of moderate (Dst:-150 nT) and weak (Dst:-100 nT) storms were observed. Characteristics of relativistic electrons variations in the outer part of trapping region can be described as a following matter.

1. During the main phase of any geomagnetic storm, without obvious dependence from its amplitude or some of "external" factors, i.e. CME bow shock or high-speed solar wind parameters, the relativistic electron flux decreases in the wide range of outer belt. We associate the decrease in the electron flux with a global change of the magnetic field in the region of outer belt - the abrupt decrease of the size of the trapping region during the main phase of the geomagnetic storms.
2. During recovery phase rather fast (within several days) restoration of relativistic electron belt occurs, but it is usually observed much closer to Earth, near the boundary of the penetration of solar electrons during the main phase of the magnetic storm.
3. Then the electron intensity increase on the order and more. Such increasing lasts during some weeks, sometimes up to a following magnetic storm, which leads to a new decreasing of the electron intensity. We should note that some of the strong relativistic electron intensity increases have observed (up to 10-50 times, in comparison with the condition before the storm) after not only the strong but after moderate and even weak geomagnetic indignations (Dst- variation module can be less
100 nT and even 70 nT. As one of the possible explanation of such extreme enhancements of relativistic electron fluxes is their interaction with the high-speed streams of solar wind have been considered. We have found the tendency of increase of relativistic electrons enhancement 7-10 days after arrival flux high-speed streams of solar wind takes place (with various time shift, depending on L and electron energy). Other possible mechanisms, i.e. wave-particles interactions will be also discussed.

PC-6: Solar Energetic Particles Variations and Their Penetration in the Earth's Magnetosphere during Extreme Geomagnetic Storms (2001-2005 years)

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Abstract

More then 50 solar particle events affecting the near-Earth's environment were observed from August, 2001 till June, 2005 in the experiments on board CORONAS-F. Set of instruments developed by SINP MSU on board this satellite permited to measure charged solar particles fluxes - protons with the energies 1-90 MeV and electrons 0.03-12 MeV, nuclei 2-20 MeV/n and from C to Si 4-40 MeV/n. Penetration of solar energetic particles in the polar caps during the main phase of magnetic storms is one of the important sources of radiation danger in the near-Earth space, especially for low-altitude satellites. The size of the energetic particle penetration area depends both on proton rigidity and on geomagnetic conditions. The most intensive SEP were measured during several solar extreme events periods from 2001 till 2005 years. Some of these SEP event were accompanied by the powerful geomagnetic storms (e.g. November 6, 2001 (Dst=-257 nT), November 24, 2001 (Dst=-221 nT), October 29-30, 2003 (Dst=-400 nT), November 2004, 2004 (Dst=-374 nT)). During the main phase on these storms energetic solar particles have penetrate extremely deep in the Earth's magnetosphere lower than 50 degrees of invariant latitude. It should be noted that even moderate magnetic storms with Dst about 150-250 nT observed during September 2001, April 2002, July 2004, May 2005 caused the SEP penetration rather deep in the Earth's magnetosphere up to invariant latitudes about 55-57 degrees. Obtained results show that the dependence of the SEP boundary on Dst variation value could not be approximated by the simple linear function and one should take into account the influence of even moderate geomagnetic storms on the process of SEP penetration inside the magnetosphere.

PC-7: Solar cosmic rays as a factor of Space Weather and their effect on the atmosphere processes in auroral and subauroral zones

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Abstract

Solar cosmic rays as one of the main factors of influence space weather of on processes in the atmosphere are investigated. The data of high-energy solar cosmic rays (SCRs) are used and the processes initiated by them in the atmosphere at auroral and subauroral latitudes are studied. The formation of SCK intensity distribution in latitude and longitude and its dynamics during proton events are considered using data of neutron monitors at two meridional station networks separated in longitude: Tixie Bay, Yakutsk, Irkutsk in the Eastern Siberia and Barentsburg, Apatity, Oulu, Moscow in Europe. The association between changes of dynamic characteristics of solar wind and their manifestations in SCRs and in some atmospheric parameters is also investigated. The differences in geocosmophysical effects depending on the difference of geomagnetic and geographical latitudes along the auroral zone have been obtained.

PC-8: The relation of the energy magnetic solar field indices with the long-term cosmic rays modulation

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Abstract

The previously-proposed model of CR modulation in the heliosphere, which considers the relation of the observed long-term CR variations with the cyclic changes of heliospheric parameters, has been used to estimate CR variations for 1976-2006. In order to describe the whole investigated period by using the united model and more deep reflection of the solar cycle as complex interaction of two field systems (large scale and local) by CR variations it has been proposed to introduce the next parameters of the solar magnetic field: polarity, the total integral and partial energetic indexes, the tilt of the current sheet and the flare indexes. The role of each index in the CR modulation is determined. For the multi-parameter description of long-term CR variations by using the integral index or one of four partial indexes during the period of 1.1977-12.1999 the best fit is obtained for the total energetic index

and the sector-odd index SO. The sector-odd index characterizes an inclined dipole and reflects an influence of the SA at low and middle latitudes. It is proposed that a phenomenon of CR decreasing in minima of SA cycles (from cycle to cycle) discussed now in space physics could be described by corresponding decreasing of the zone-odd index. The period of 2000-2006 is the most complex for the considered model, because the discrepancy between the model and observations increases beginning from the middle of 2000. The problematic features of CR behavior and its modeling during the current 23rd solar cycle are discussed.

PC-9: Some Remarks to January 17 - 22, 2005 Event In Space Weather

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Abstract

This contribution can be regarded as a continuation of paper Kuznetsov et al. (2006) on GLE from January 20, 2005 whereas we focused mainly on a study of FD from January 17-18 and 21-22, 2005. As an input for investigation are data from the neutron monitor at Lomnick Peak (1 minute counts) and from the Geomagnetic Observatory in Hurbanovo (1 minute data), both in Slovakia. Data on magnetic field and solar wind from satellites GOES 10 and 12, SOHO-CELIAS, ACE and WIND have been used for understanding of global evolution of the event. Magnetic field is transformed to the RTN system whereas only disturbed part of the field is compared. i.e. daily variation and constant part is subtracted. Field reduction method is described in the contribution. Our results are temporal vector diagrams of variation of all parameters at all positions from where we used data. Amplitudes |B| exceed 100 nT and variations during arrival of wavefront of CME take place in the same minute at ground-based station and at GOES satellites. Variations have such character as if in the CME would be regions with dominant electric charge of opposite sign, eventually electric currents with different orientation. Based on values v_{p} a n_{p} and using certain assumptions we determined mass of CME on 17 and 21 January, respectively, of 10^{12} kg. Decrease of cosmic ray level run suddenly (during 10 minutes) but starting at about 2 hours after a sudden change of magnetic field.

PC-10: Variations of aerosol optical properties during an extreme solar event of 20.01.2005

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Abstract

A detailed investigation of an extreme solar event of 20.01.2005 from atmospheric point of view is presented. Cosmic rays of galactic origin are the main source of ionization in the Earth's stratosphere and troposphere. An additional flux of solar cosmic protons can significantly increase the effect of ionization of the Earth atmosphere. During the solar event of 20.01.2005 the world network of neutron monitors registered a narrow beam of solar cosmic ray particles leading to a severe Ground Level Enhancement (GLE). The effect of ionization of the Earth's atmosphere due to this GLE --- was calculated using models --- of University of Oulu and University of Bern. Here an analysis of daily variations of the aerosol optical depth is presented for January -- 2005. The results of the investigation show a strong increase of the concentration of sulfate aerosol on the second day after the GLE observed in the south magnetic pole region where the maximum penetration of anisotropic solar cosmic rays took place. This suggests that the enhanced flux of solar energetic particles can lead to essential changes in the chemical and physical properties of the polar troposphere.

PC-11: Interplanetary medium conditions and state of the magnetosphere associated with the global Pc5 oscillations

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Abstract

The most intense geomagnetic pulsations in the Pc5 range occurring during the powerful magnetospheric storms are studied by using data from a wide network of the ground-based stations. Distributions of the main parameters characterizing state of the interplanetary plasma during intervals of global Pc5 have been calculated. Examination of conditions in the solar wind and variations of the interplanetary magnetic field show that there are some prerequisites to global Pc5 occurrence in the magnetosphere. The most favorable conditions arise when the super fast streams of the solar wind flow around the magnetosphere. Being generated global Pc5 activity influences the magnetosphere dynamics contributing to the total level of disturbance. This has been shown by comparing AE index

variations with those of the interplanetary electric field defined as a product of the IMF vertical component by the solar wind velocity with negative sign. As a whole, the analysis reveals a complicated picture of the ULF waves participation in the processes of energy entry and drain in the magnetosphere. The work was supported by RFBR grants 06-05-64143 and 07-05-00696 and INTAS grant 06-1000013-8823.

PC-12: Large solar flares and related proton events in December 2006

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Abstract

The Sun has revealed a surprising activity in December 2006. There were four X-class flares and four corresponding proton events near the Earth. In this work for these energetic events we investigate relations between time properties and an amount of neutral emission in particular hard X-ray emission (ACS SPI INTEGRAL) and proton fluxes in the interplanetary medium. We think that different time phases of the flare hard X-ray time profiles correspond to different physical mechanisms of charge particles acceleration and/or injection into the interplanetary medium.

PC-13: Solar proton enhancements in relation to the coronal mass ejections in the solar cycle 23

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Abstract

The main properties of 11416 coronal mass ejections (CMEs) observed by the Solar and heliospheric Observatory (SOHO) mission's Large Angle and Spectrometric Coronagraph (LASCO) C2 from January 1997 through December 2006 are studied. A comparison of these data to the solar proton enhancements (SPEs) taken from the extended database of solar proton events with energy >10MeV and peak flux >1pfu measured at the earth's orbit (Belov et al., Solar Phys. 2005) gives new results

concerning their sources and acceleration mechanisms. Till now it is believed that the soft x-ray flares with importance >M5 may provide a reasonable proxy index for SPE production rate. A statistical analysis carried out in this work indicates that the production of SPEs is well connected also to the fast and wide coronal mass ejections. This is an important result from the space weather point of view.

PC-14: Variation of the trapped proton fluxes measured on board low-orbital satellites

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Abstract

Fluxes of the solar and geomagnetically trapped protons measured on Russian low-orbital satellites Coronas-F (500km) and Universitetskiy (970 km) in 2001-2005 in comparison with NPOES-15, 17 (800 km) and GOES-11 (geosynchronous orbit) are presented in the report. Variation of the fluxes of the trapped protons with the solar cycle was analyzed and comprehensive analysis of the measurements onboard different satellites was made. Good agreement for measurements onboard low-orbital satellites and GOES-11 data was found for an isotropic fluxes of the solar protons with energies 1-100 MeV, that were observed in big solar events. For the fluxes of geomagnetically trapped protons on L=1.15-1.8 measured on different low-orbital satellites some divergences, corresponding to a different orientation of the detectors and their field of view, were found. Measured fluxes of the trapped protons were compared with AP8 model; the model underestimates measured fluxes especially for protons with energy less then 10 MeV.

PC-15: A new statistical index for the coronal mass ejections

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Abstract

Our neighborhood star, the Sun, is a star which characterized from a lot of physical phenomena strongly related with nuclear reactions in his core, mass motions in convection zone or interactions between magnetic fields and plasmas in his atmosphere. Especially the solar activity characterized from the number of sunspots. Some events such as solar flares and coronal mass ejections sometimes are extremely violent and may reach Earth with catastrophic results on satellites, communications and posing a very serious threat to any unprotected astronauts. As a result the better understanding of these

solar extreme events seems to be today something more of just science. In this work we are trying to understand statistically the coronal mass ejections trough the time and produce an index –P_i– which is a monthly parameter defined from the equation: $P_i = 0.65\ N_c + 0.35\ V_p$, where N_c is the total number of CMEs per month and V_p is the mean plasma velocity of CMEs per month. The factors 0.65 and 0.35 are the best values as results from the cross correlation coefficients. The plot of the P_i index for the years 1996-2007 seems to be very good in relative with the sunspot number or the cosmic rays as they measured in the Neutron Monitors on the surface. As we now some of these events are related with magnetospheric events on Earth's atmosphere. The fluctuations of P_i index seems to be strongly related with the fluctuations of cosmic rays intensity, especially in periods of violent phenomena. This index is very interesting as can explain the high solar activity even when the sunspot number is in the minimum, in the declining phase of the 11 year solar cycle, as it is happens in the 23rd solar cycle.

Session D

World – wide particle detector networks for Space weather research

DI-1: Hybrid particle-detector networks located at Middle-Low latitudes for Solar Physics and Space Weather research

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Abstract

A network of middle to low latitude particle detectors called SEVAN (Space Environmental Viewing and Analysis Network) is planned in the framework of the International Heliophysical Year (IHY), to improve fundamental research of the solar accelerators and space weather conditions. The network will detect changing fluxes of the most of species secondary cosmic rays at different altitudes, latitudes and altitudes those constituting powerful integrated device in exploring solar modulation effects. Surface detectors measure time series of secondary particles born in cascades originated in the atmosphere by nuclear interactions of protons and nuclei accelerated in galaxy. During violent solar explosions sometimes additional secondary particles are added to this "background" flux. Studies of changing time series of secondary particles shed light on the high-energy particle acceleration mechanisms by flares and Coronal Mass Ejection driven shocks. Time series of intensities of high energy particles can also provide highly cost-effective information on the key characteristics of the interplanetary disturbances. Recent results on of the detection of the extreme solar events (2003, 2005) by the monitors of the Aragats Space-Environmental Center (ASEC) illustrate wide possibilities opening with introduction of new particle detectors measuring neutron, electron and muon fluxes with inherent correlations.

DI-2: Interactive database on the cosmic ray anisotropy

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Abstract

Data on the hourly means of cosmic ray density and anisotropy derived by the GSM method over the 1957-2006 are introduced in to MySQL database. This format allowed an access to data both in local and in the Internet. Using the realized combination of script-language Php and My SQL database the Internet project was created on the access for user's data on the CR anisotropy in different formats (http://cr20.izmiran.rssi.ru/AnisotropyCR/Index.php). Usage the sheaf Php and MySQL provides fast receiving data even in the Internet since a request and following process of data are accomplished on

the project server. Usage of MySQL basis for the storing data on cosmic ray variations give a possibility to construct requests of different structures, extends the variety of data reflection, makes it possible the conformity data to other systems and usage them in other projects.

DI-3: Real-time database for high resolution Neutron Monitor measurements

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Abstract

The worldwide network of standardized neutron monitors is, after 50 years, still the state-of-the-art instrumentation to measure spectral variations of the primary cosmic ray component. These measurements are an ideal complement to space based cosmic ray measurements. Data from the approximately 50 IGY and NM64 neutron monitors is stored locally but also available through data collections sites like the World Data Center (WDC) or the IZMIRAN ftp server. The data from the WDC is in a standard format, but only hourly values are available. IZMIRAN collects the data in the best available time resolution, but the data arrives on the ftp server only hours, sometimes days, after the measurements. Also, the high time-resolution measurements of the different stations do not have a common format, a conversion routine for each station is needed before they can be used for scientific analysis. We propose to setup a real-time database where high resolution cosmic ray measurements can be store and accessed immediately after the measurement. Stations that do not have 1-minute resolution measurements should be upgraded to 1-minute or better resolution with an affordable standard registration system, that will submit the measurements to the database via the internet in real-time. This resolves the problem of different data formats and for the first time allows using real-time cosmic ray measurements for space weather predictions.

D-1: Advanced Data Acquisition System for the Space Environmental Viewing and Analysis Network

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Abstract

For the reliable and timely forecasts of dangerous conditions of Space Weather world-wide networks of particle detectors operate at different latitudes, longitudes and altitudes. Based on new type of

hybrid particle detectors developed at ASEC (Aragats Space Environmental Center) in the context of the International Heliophysical Year (IHY 2007) we start to prepare hardware and software for the first sites of SEVAN (Space Environmental Viewing and Analysis Network) particle detectors network. In the paper presented the architecture of the newly developed DAS (Data Acquisition System) for the SEVAN. We plan to run SEVAN network under one-and-the same DAS, enabling fast integration of data for on-line analysis of Solar Energetic Events in progress. The ADAS (Advanced Data Acquisition System) is designed as a distributed network of the uniform components connected by means of web service interfaces. Its main component is URCS (Unified Readout and Control Server) server which controls the underlying electronics by means of the detector specific drivers and makes a preliminary analysis of the on-line data. The lower level components of URCS servers are implemented in pure C and the fast binary representation is used for the data exchange with electronics. However, after preprocessing the data is converted to the self-describing hybrid XML/Binary format and from that point the system components are implemented on a high level of abstraction and the web service interfaces are used for the data interchange. To achieve better reliability all URCS servers are running on embedded minicomputers without moving mechanical parts. The data storage is carried out by means of two high performance servers working in parallel which are periodically inquiring the data from all URCS servers and storing it in MySQL database. The implementation of control interface is based on the high level web standards and, therefore, all properties of the system can be remotely managed and monitored by the operators from internet browsers. The ADAS at ASEC in Armenia is in operation from November 2006. The reliability of the multi-client service was proved by continuous monitoring of neutral and charged components of incident cosmic ray flux with 7 particle monitors located at 2000 and 3200 meters above sea level on the distance of 40 and 60 km. from the main data server.

PD-1: Thorough phenomenological study of major Forbush decreases: Does the recovery depend on energy?

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Abstract

We present a thorough statistical study of major Forbush decreases during the last decades, using cosmic ray data from ground based detectors – neutron monitors and muon telescopes. We show that many events depict features that are unexpected from the standard theory and earlier considerations, based on poorer statistical studies: (1) the recovery time of a Forbush decrease strongly depends on the mean response energy of the detector; (2) an over-recovery is observed in the most energetic cosmic ray data (muon detector). Such a behavior is not expected from the standard theory of a Forbush decrease and implies a need for a more detailed model. Here we suggest a simple qualitative scenario for the observed phenomenon.

PD-2: Multiplicity and Coupling Function of the neutron αnd muon components

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[2]*Nuclear and Particle Physics Section, Physics Department, Athens University, Athens, Greece*

Abstract

At present universally recognized software packages appeared on the calculation of cascade processes in different medium and energy ranges. The most fitted for our tasks version is the package of ATMOCOSMOS. Using this software the integral multiplicities for neutron, muon and electron-photon components of cosmic ray were obtained for different depths in the atmosphere and for 1-100 GeV energy range for the primary particles. Taking into account the sensitivity function the response functions have been calculated for some detectors and their approximation for a practical usage. Special attention was paid to a region of small.

PD-3: On the possibility to modernize existent network of Neutron Monitors

A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian, V. Danielyan, K. Avakyan, A. Reymers, S. Tserunyan

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Abstract

Despite decades of tradition, neutron monitors remain the state-of-the-art instrumentation for measuring spectral variations in the energy range from about 500 MeV to 20 GeV of the primary cosmic ray component (above the Earth's atmosphere). The worldwide network presently consists of about 50 standardized IGY and NM64 neutron monitors. We propose an update of this network by introducing new detectors and new electronics to be added to existing detectors, significantly enlarging its performance for solar physics and space weather research. We propose to locate scintillation detectors above and below (if construction of AM allows) the standard sections of NM. New scintillator detectors of size 1 x 1 x 0.01 m3 produced by the Institute of High Energy Physics, Protvino, Russia are compact and provide uniformity light collection. Measuring both neutral and charged flux of the secondary cosmic rays will allow to:

- Significantly enlarge the count rate of detector; note that flux of low energy charged particles is ~10 times higher than neutron flux;

- Explore more energetic population of the primary cosmic rays, giving possibility to estimate spectra of the solar cosmic rays;
- Distinguish Ground level Enhancements originated by solar neutrons;
- Estimate the incident direction of the additional flux of solar cosmic rays.

New Data Acquisition (DAQ) electronics will provide also possibility to count total number of the evaporated neutrons originated in lead by hadrons entering NM. Number of neutrons is good proxy of the incident hadron energy.

PD-4: A new detector added to the Antarctic laboratory for cosmic rays

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Abstract

The Antarctic Laboratory for Cosmic Rays (LARC, acronym for Laboratorio Antartico per i Raggi Cosmici) is a joint venture presently between the Italian National Institute for Astrophysics (INAF) and the University of Chile (UChile). From January 1991 a 6-NM64 detector is operating on King George Island (South Shetlands). It is supported by the Departamento de F?sica (UChile/FCFM), the Istituto di Fisica dello Spazio Interplanetario (IFSI-Roma), the Instituto Ant?rtico Chileno (INACH) and the Piano Nazionale di Ricerche in Antartide (PNRA - Italia). In this work we describe the different phases performed in Italy for the realization of a 3He-NM unit, which started working during the XXII Antarctic Summer Campaign. Recorded data during solar activity cycle 24 will furnish a useful research tool for the next Solar Extreme Events.

PD-5: PD-Data Visualization Interactive Network 3-rd for ASEC

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Abstract

Data Visualization Interactive Network 3-rd version was developed to give the following services:
- Gathering and storing data in database
- Online presentation of data

- Online processing of data
- Data exchange between users of DVIN
- Managing online collaborations between users

The system is highly interactive and exceptional information is easily accessible online. Data can be monitored and analyzed for desired time spans in a fast and reliable manner by the remote users world-wide.

Data from particle detectors from space and earth surface is automatically downloaded and stored in DVIN for joint analysis with ASEC monitors.

DVIN provides wide possibilities for sharing data and sending warnings and alerts to scientists and world-wide, which have fundamental and practical interest in knowing the space weather conditions. DVIN gives opportunity to remote groups to share the process of analyzing, exchange data analysis methods, prepare joint publications and maintain networks of particle detectors. DVIN gives users set of online features for physical interface from the time series of changing secondary particle fluxes.

PD-6: Characteristics of the Space Environmental Viewing and Analysis Network (SEVAN)

A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian,
V. Danielyan, K. Avakyan, A. Reymers, S. Tserunyan

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Abstract

One of the major advantages of multi-particle detectors is probing of the different populations of the primary cosmic rays, initiated particle cascades in terrestrial atmosphere. With basic detector of SEVAN network we are measuring fluxes of neutrons and gammas, of low energy charged component and high energy muons. This diversity of information obtained from SEVAN network located mostly at low and middle latitudes will give possibility to estimate the energy spectra of the highest energy Solar Cosmic Rays (SCR). SEVAN network will be sensitive to very weak fluxes of SCR above 10 GeV, very poorly explored till now. To understand sensitivity of new type of particle detectors to highest energy solar ions we investigate the response of SEVAN basic units to galactic and solar particles. New physical inference methods are proposed and tested for:

- estimation of the index of power spectra of solar cosmic rays incident on the terrestrial atmosphere
- distinguishing of the ground level enhancements initiated by solar neutrons.

PD-7: Electronics for the Space Environmental Viewing and Analysis Network (SEVAN)

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Abstract

A network of middle to low latitude particle detectors called SEVAN (Space Environmental Viewing and Analysis Network) is planned in the framework of the International Heliophysical Year (IHY), to improve fundamental research of the solar accelerators and space weather conditions. The functionality of the Data Acquisition (DAQ) unit for the SEVAN is very flexible and strongly depends on the software. It has 8 analog inputs, receiving the pulses from the scintillator detectors buffer amplifiers. The pulse amplitudes are converted to a standard TTL/CMOS pulses sequences, about 23 for the order of magnitude. These pulses then are counted by the CPLD module and send to the microcontroller, which can collect the data and perform preprocessing, according to the experiment requirements, i.e. a total count of events for the each channel, coincidences, anticoincidence, etc. For the program selectable condition, the unit generates a pulse in the TRIGGER output. All analog data is stored and for the each channel the amplitude spectrum is connected. The spectrum output for the chosen channel can be observed using any standard digital oscilloscope, connected to the SPECTRUM output on the front panel. Besides the main DAQ function, the unit also acts as the master for the detector control Local Area Network (LAN) which is used for programming and monitoring high voltage values and programming the ADC thresholds. The threshold of the each channel is program selectable in the range about 2 – 500 mV in 2mV steps. The host Mini-PC is connected to the CRD intranet by the Ethernet interface. All experimental data is thus available on the net. Additionally it is possible remote reprogramming of the C32USB module microcontroller, according to the desired physical experiment.

PD-8: Cosmic ray research at Spitsbergen

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Abstract

By spring of 2003 the neutron monitor in Barentsburg (78.06N, 14.22E) at Spitsbergen archipelago has been installed and put into operation. It became the northernmost instrument of such kind among more than 40 neutron monitors of the worldwide network. The installation of the neutron monitor at

Spitsbergen allowed filling in a gap in observations of cosmic rays coming from the northern areas of heliosphere and magnetosphere. With the help of the neutron monitor in Barentsburg 5 events with relativistic solar cosmic rays have been already registered: October 28 and 29, November 2, 2003, January 20, 2005 and December 13, 2006. In first 4 of these events the steady South-North anisotropy of solar cosmic rays was observed. The solar cosmic ray flux from the South considerably exceeded a flux from the North that can testify to global asymmetry in the heliomagnetosphere in a current phase of the solar heliomagnetic cycle. The asymmetry disappeared by the end of 2006 as it was not observed during the GLE on 13.12.2006. The possible role of the neutron monitor at Spitsbergen in revealing connections of cosmic rays with local weather and climate changes is discussed also.

PD-9: On the possibility to modernize existent network of Neutron Monitors

A. Chilingarian, G. Hovsepyan, K. Arakelyan, A. Avetisyan, S. Chilingarian,
V. Danielyan, K. Avakyan, A. Reymers, S. Tserunyan

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Abstract

Despite decades of tradition, neutron monitors remain the state-of-the-art instrumentation for measuring spectral variations in the energy range from about 500 MeV to 20 GeV of the primary cosmic ray component (above the Earth's atmosphere). The worldwide network presently consists of about 50 standardized IGY and NM64 neutron monitors. We propose an update of this network by introducing new detectors and new electronics to be added to existing detectors, significantly enlarging its performance for solar physics and space weather research. We propose to locate scintillation detectors above and below (if construction of AM allows) the standard sections of NM. New scintillator detectors of size 1 x 1 x 0.01 m3 produced by the Institute of High Energy Physics, Protvino, Russia are compact and provide uniformity light collection. Measuring both neutral and charged flux of the secondary cosmic rays will allow to:
* Significantly enlarge the count rate of detector; note that flux of low energy
charged particles is ~10 times higher than neutron flux;
* Explore more energetic population of the primary cosmic rays, giving possibility
to estimate spectra of the solar cosmic rays;
* Distinguish Ground level Enhancements originated by solar neutrons;
* Estimate the incident direction of the additional flux of solar cosmic rays.
New Data Asquisition (DAQ) electronics will provide also possibility to count total
number of the evaporated neutrons originated in lead by hadrons entering NM. Number of neutrons is good proxy of the incident hadron energy.

Session E

Integrated systems of forecasting and alerting on the dangerous consequences of violent solar storms

EI-1: Cosmic rays and space weather effects: methods of forecasting

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Abstract

This report based on many original papers of author and his colleagues on the using of cosmic rays (CR) for continue monitoring and forecasting of great natural hazards for people and technologies from space weather effects. It consists from 5 parts.
Part 1. Cosmic rays and space weather influence on global climate change (determining of the part of global climate change caused by the long-term change of CR intensity through influence on air ionization and planetary clouds formation; examples from the past; method of forecasting of the part of global climate change caused by space weather effects).
Part 2. Global natural disaster from great magnetic storms connected with big CR Forbush-decreases and their assessment by using world-wide network of CR stations (great geomagnetic storms affect adversely global technology systems, high frequency radio communications are disrupted, electric power distribution grids are blacked out when induced currents causes safety devices to trip, and atmospheric warming causes increased drag on satellites and anomalies in their operation, increasing of frequency of infarct myocardial, brain strokes, car and train accidents; examples of electric power and long oil tubes catastrophes in the past in Canada and other countries; we show that by using on-line one hour CR data from world-wide network of stations is possible to made exact assessment of this natural hazard for 15-20 hours before of the storm sudden commencement).
Part 3. Global natural disaster from great intense radiation hazards for astronauts, crew and passengers on regular airline flights (on the standard altitude about 10 km), and some time for people on the ground due to great solar flare CR events (statistical distribution, examples from the past; we show that this advertisement, with high occurrence probability, can be given 30-60 minutes before the arrival of the more dangerous particle flux). This method is based on the well known fact that the main part of radiation hazard in space and in atmosphere is caused by particles with small energy (few hundreds MeV) that reach the Earth 1-2 hours after their acceleration on the Sun; on the contrary the relatively small flux of high-energy ($\geq$ 2 GeV) particles, which can be detected by super neutron monitors and practically are not involved in the radiation hazard, reach the Earth much more quickly. Several minutes of observation of the first-coming solar high-energy particles can give enough information on intensity, energy spectrum, transport parameters, and source function to make it possible to predict the time-space distribution of radiation hazard in interplanetary space (for astronauts and space-probe technology) and in the Earth atmosphere as a function of latitude (geomagnetic cut-off rigidity) and altitude.
Part 4. Prediction of the interaction of a dust-molecular cloud with the solar system by measurements of changes in the galactic CR distribution function. From the past we know that the dust from clouds between the Sun and the Earth leads to decrease of solar irradiation flux with sufficient decreasing of global planetary temperature (on 5-7° in comparison with 0.8° from green effect). The plasma in a moving molecular dust cloud contains a frozen-in magnetic field; this field could modify the stationary

galactic CR distribution outside the Heliosphere. The change in the distribution function can be significant, and it should be possible to identify these changes when the distance between the cloud and the Sun becomes comparable with the dimension of the cloud. The continuous observation of a time variation of the CR distribution function for many years should provide the possibility of determining the direction and the speed of the cloud relative to the Sun, as well as its geometry. Therefore one could predict its evolution in space and determine whether it will catch the Sun or not. In the case of high probability of capture, we could predict the time of the capture and how long the solar system will be inside the cloud.

Part 5. Prediction of the radiation hazard produced by CR particles generated in a nearby Supernova explosion (SE). From the energetic balance of CR in the Galaxy it was estimated that the full power for CR production is $W_{CR} \sim 3\times10^{40}$ erg/s. Now it is common accepted that the Supernova explosions are the main source of galactic CR. At each explosion the average energy transferred to CR is $E_{SE} \sim 10^{50} - 10^{51}$ erg. From this we can determine the expected frequency of SE in our Galaxy and in vicinity of the Sun. We estimate the probability of Supernova explosions inside different distances from the Sun and expected radiation hazard, and its variation with time. We show that in some cases the level of radiation may increases about 1000 times in comparison with present level, and it will be very dangerous for the Earth's civilization and biosphere. But we show that by high energy CR measurements by ground and underground muon telescopes and low-latitude neutron monitors on the Earth will be obtain information on the source function and diffusion coefficient for many years before when real radiation hazard will be formatted on the Earth. We show how on the basis of this information we can made exact forecasting on developing in time of the radiation hazard in space and in the atmosphere on different altitudes and cutoff rigidities (different geomagnetic latitudes) by using method of coupling functions, and experts must to decide how to prevent the Earth's civilization (in some cases it will be necessary for people to live underground or in special protected buildings for several hundred years, and go out only for very short time). It is important that on the basis of obtained forecast the Earth's civilization will have time at least several tens years to prepare the life underground and in special protected buildings.

EI-2: Real time GLE alert for December 2006 in the ANMODAP center

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Abstract

Within the last years, a real-time system to monitor high energy cosmic rays for space weather use has been operated at Athens neutron monitor station. Neutron monitor and satellite high resolution data in real time are used, making it possible to observe cosmic rays in dual energy range observations. In large solar energetic particle (SEP) events, ground level enhancement (GLE) can provide the earliest

alert for the onset of the SEP event. This system watches for count rate increases recorded in real time by twenty-three neutron monitors, which triggers an alarm if a ground level enhancement (GLE) is detected. Our effort is to determine optimal strategies for detecting the GLE event at a very early stage, while still keeping the false alarm rate at a very low level. We have studied past events to optimize appropriate intensity threshold values and a baseline to determine the intensity increase. We define three levels of alarm (watch, warning, and alert) on the basis of the number of stations that record a significant intensity increase. For every downloader there is a program named [station]_GLE_alert.exe. This program every minute calculates in real time the mean value of the last 60 minutely measurements and Compares this value with a threshold that is N*Sigma (N<3). If we have 5 pre-alert points in succession we define a Station Alert. If we see at least three stations in station alert mode another program provides a General GLE Alert A statistical analysis on the last ten GLEs recorded from 2000 till 2006 using 1-minute data from our database, produced GLE alarms for nine events in our system. Alarm times for these nine events are compared with satellite proton and geomagnetic data separating if the event is GLE or magnetospheric one.The GLE alert precedes the earliest alert from GOES (100 MeV or 10 MeV protons) by 10-30 min. When the alert is final then an automated e-mail is sent to all the interested users. On December 13, 2006 at 2:55UT the last GLE of the 23rd solar cycle was occurred. This event, also known as GLE70, started at ~ 2:48 UT, whereas the neutron monitor flux in most stations reached its maximum in ~3:00-3:10 UT. In northern Europe the event was registered with big amplitudes that in some cases reached ~ 70-90%, rendering this recent enhancement in one of the greatest GLEs of the 23rd solar cycle. An Alert signal was established by the ANMODAP Center and for the first time was sent out by our system. A detailed analysis of this alert is discussed.

E-1: MuSTAnG --- Muon Space weather Telescope for Anisotropies at Greifswald

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Abstract

The Muon Spaceweather Telescope for Anisotropies at Greifswald (MuSTAnG) MuSTAnG became operational during November 2007. MuSTAnG is dedicated to space weather forecasting. First space weather observations were made during the 13 December 2007 event. Results in comparison with those of other muon telescopes will be presented at the conference.

PE-1: Generation of ALERT signal for solar cosmic ray ground level enhancements (GLEs)

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[3]*Institute of Ionosphere, Kazakhstan*

Abstract

The system of elaboration of ALERT signal by real time data on ground level enhancements recorded by neutron monitor network is described and discussed in this work. On the retrospective experimental data (solar X-ray radiation, solar protons of >100 MeV, ground level enhancements) starting from 1986 the strategy was studied for elaborating the earliest signal of the ground enhancement onset. Only in two cases of 30 observed enhancements (GLE 040-069) the system could not generate a true ALERT signal because of very low amplitude of enhancement; in all other cases output ALERT signal is ahead of analogous signal generated by the data of GOES channel (p>100MeV) in average on 20 min. This time is enough to perform the estimation of the solar proton spectra from data of ground level monitoring and make a prognosis of time profile for solar protons >100 MeV practically at the initial phase of enhancement. The basic points of a program solution for output ALERT signal generation are outlined and possibilities to improve the proposed method are considered. A complete description of this system and its developing are presented at http://cr0.izmiran.ru/Alert/AlertGLE.htm.

PE-2: The method of forecast of solar proton events

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Abstract

According to the temporal variations of CR rigidity spectrum parameters the dynamic processes are researched in the interplanetary space and it is found that the variation of electromagnetic characteristics of heliosphere begins up to the sporadic phenomena on the Sun. In particular, it is shown that before the sporadic phenomena the generation of local polarization electric fields, magnetic

fields intensity decrease in the small-scale heliosphere structures and also the increase of potentials difference between the pole and the surface of ecliptics take place. Use of the given features combination allows carrying out the forecast of solar proton events with the advance term from several hours up to several tens of hours with a high degree of defense.

PE-3: Detailed Prediction of the 24th-25th Solar Cycles Shape

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Abstract

A primary attempt to approach in shape the forthcoming 24th-25th pair of solar cycles have been made. We apply a well-tested empirical method which is based on the solar surface area index, that is an index which takes in mind both sunspots and faculae. Six-month and three-month averages of the area index have been predicted which give a good general overview of the forhcoming 22-year solar cycle. Prehistory of our method and recent accuracy tests give us the impression that our prediction coincides to the expected observed values by 80-90%.

Session F

International Heliospheric Year 2007

FI-1: IHY Science

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Abstract

One of the key aspects of the International Heliophysical Year (IHY) Program is to address scientific questions that need international collaboration in the form of scientific campaigns. This effort is termed as the Coordinated Investigation Program (CIP). There are more than 60 CIPs proposed so far and each has a unique objective in understanding some aspect of the physical processes taking place in heliospace. This talk provides an overview of the IHY program with a special emphasis on the CIPS. Selected examples will be discussed in more detail especially those CIPs that are relevant to Sun-Earth connection.

FI-2: The role of the electronic geophysical year (eGY) in exploiting multi instrument, multi-band data via virtual observatories (VO) for solar extreme events analysis

M. Messerotti[1,2], B. Ritschel[3] and the eGY Team

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Abstract

A varied set of ground- and space-based instruments produces, on a routinary and/or on a targeted basis, large volumes of remote and in-situ data relevant to the Sun, to the heliospheric environment and to the geospace. A comprehensive analysis of solar extreme events and their effects on geospace needs the capability to observe the relevant solar phenomena, to track the associated perturbations propagating in the interplanetary space and to identify the response of the terrestrial/planetary magnetosphere, atmosphere and ionosphere. Such an analysis can be carried out by accessing and retrieving non-homogeneous data sets from different providers relevant to multi-instrument, multi-band observations. An effective tool for carrying out this task is the Virtual Observatory (VO), which provides advanced means for data searching, retrival, visualization and analysis from geographically distributed, non-homogeneous data repositories, in a unified operating framework via a common Graphical User Interface (GUI). With reference to that, the electronic Geophysical Year (eGY; http://www.egy.org) is an international initiative aimed at promoting easy and effective data access

and standardization in the Geosciences, at the provider side, whenever possible, or via the VO intrinsic features, when unfeasible. Scheduled from July 2007 to July 2008 under the auspices of the International Union of Geodesy and Geophysics (IUGG), eGY has been setting the bases for achieving this goal by various actions in synergy with the other I*Y initiatives like the International Heliophysical Year (IHY), the International Polar Year (IPY), and the International Year of Planet Earth (IYPE). In this framework, we will outline the organization of eGY activities relevant to facilitating the analysis of heliospheric data via VOs and we will stress the synergetic role of eGY-Europe (http://egy-europe.oats.inaf.it), the European section of eGY.

FI-3: The heliosphere

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Abstract

The heliosphere is a huge region in the Galaxy dominated by the solar wind, rarefied plasma that is continuously emitted by the Sun and expands till its pressure is balanced by the pressure of the interstellar medium that surrounds all stars. The heliosphere is an important chapter of space physics. It changes continuously from the variations of velocity, density, magnetic field and structure of the solar wind. The heliosphere is the large scale environment of humans, and as such it greatly affects our lives on Earth (even more in space), mainly through the modulation of cosmic rays. A brief presentation of the heliosphere is given, fast and slow streams in the heliosphere are described, the heliospheric current sheet, the termination shock, the heliosheath and the heliopause are presented and its influence to the galactic cosmic rays and energetic particles. A quick reference is also given concerning education and research on the heliosphere and more generally Space Physics in Greece.

FI-4: The Antikythera Mechanism, the oldest known astronomical computer

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Abstract

The Antikythera Mechanism is the oldest scientific instrument and the oldest known astronomical computer we have in hands. It dates from the 2nd century BC. This extraordinary mechanism was found by sponge divers in an ancient shipwreck off the island of Antikythera, Greece in 1900. This peculiar device is much more complex than any known astrolabe. It is an exact astronomical instrument which works with gears and has several complicated exact scales, circular and spiral. It is relatively small; the size of a laptop, and it was definitely a portable instrument. This computer comes with an embedded user's manual, written in Greek with fonts of the 2nd CBC. The instrument has been studied by Rediadis, 1902, Theofanidis, 1932, Price, 1959, 1975, Wright, 1995, 2002 and it was known to be a complex astronomical calculator. We have performed a new study of this miraculous Mechanism using modern non-linear high resolution computer tomography of X-tek Systems and Polynomial Texture Map (PTM) 3D surface photography by HP. These techniques enabled us to have very detailed representations of the interior of the Mechanism, to read the computer manual, which has been hidden for over 21 centuries in the rust, to reconstruct and understand better the Antikythera Mechanism. The manual has a mechanical section, an astronomical, some geographical notes (the name ISPANIA in these texts is the oldest reference to this country) several references to the motion of planets. The term "stationary point" of a planet appears several times. There are several dials and scales, two of them spiral, one for the Saros and Exeligmos cycle (18 year plus 8 hours and 54 years and one day for the eclipses of the Sun and the Moon, with inscriptions of the eclipses on the scale, a second spiral scale for the Meton's cycle (19 years) and Callippic cycle (76 years) for an accurate calendar. The Moon mechanism shows the position and phase of the Moon during the month. The velocity of the Moon is variable following the theory of Hipparchus, which is an approximation Kepler's second law for the angular velocity, i.e. the Moon goes faster near the perigee and slower at the apogee. The study continues and we have new results almost continuously.


Solar Extreme Events 2007
Fundamental Science and Applied Aspects
COSPAR Colloquium
Monday 24 September– Thursday 27 September 2007
Workshop on Neutron Monitors
The Present and the Future of Neutron Monitors
Properties and utilization of neutron monitors:
The worldwide network as a tool for space weather studies
Thursday 27 September 2007
Titania Hotel, Athens, Greece
http://cosray.phys.uoa.gr/SEE2007/workshop_on_neutron_monitors.htm
Local Organizing Committee
C. Alissandrakis, D. Assimakopoulos, A. Belov, J. Bieber, C. Caroubalos, A. Chilingarian, N. Crosby, L. Dorman, E. Fluckiger, S. Krimigis, K. Kudela, H. Mavromichalaki,X. Moussas, M. Panasyuk, P. Preka-Papadema, M. Sarris, E. Stassinopoulos, M. Storini, K. Tsinganos, I. Veselovsky, V. Yanke, C. Zerefos
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High mountain Alma-Ata cosmic ray station: current state of cosmic ray research by means of Neutron Monitors

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Abstract

The Alma-Ata high mountain (3340 m above see level) neutron monitor has a counting rate of 1200 c/s and can detect solar flare particles with energy higher than 6.7 GV. The station has been operated since 1973 providing 1-hourly 5-minute and 1-minute data. All data are accessible in the electronic database, and real time data are presented in on-line regime at Web sites: http://tien-shan.org/ionos/index.htm, and http://213.211.74.116/CosRay/index.htm and http://213.211.74.116/CosRay/prod05.htm (data bank). Now the systems of presentation of 1-minute NM data in real time and counting rate of each canal are created.

The activities in the Athens Neutron Monitor Station

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Abstract

Cosmic ray measurements at Athens (37.58˚N, 23.47˚E) initiated in November 2000 with a standard 6NM-64 neutron monitor. Athens station was the sixth one to present both graphical and digital data in real time (http://cosray.phys.uoa.gr). Thanks to its high cut-off rigidity (8.53 GV), the Athens neutron monitor station records secondary cosmic ray data that correspond to the high energy part of the primary spectrum. Within the last years an effort in collaboration with IZMIRAN Cosmic Ray group has been made in order to construct an effective database of both NM and satellite data in real time, regarding the necessities of space weather monitoring (Athens Neutron Monitor Data Processing Center – ANMODAP Center). This Center, using the onset algorithm produces real time alert signals for GLEs and magnetospheric events sending them out by email notices. Apart from the alert signals, GLE treatment is realized with the application of the Neutron Monitor-Basic Anisotropic Ground Level Enhancement (NM-BANGLE) model, using data from many neutron monitor stations widely distributed around the globe and determining the time evolution of several GLE-parameters. Additionally, radiation doses during important radiation effects due to the very energetic particles reaching the vicinity of the Earth, are calculated. A simulation on space radiation using the Space Environment Information System (SPENVIS) tool is also being considered. Also, correlation of the cosmic ray variations with physiological parameters that play important role for human health, is calculated. Therefore, the ANMODAP Center provides the scientific community with an extremely useful tool for space weather monitor or/and prognosis operating in real time.

Neutron Monitors operated at Aragats Space –Environmental Center (ASEC)

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Abstract

The Aragats Space Environmental Center (ASEC) provides monitoring of different species of secondary cosmic rays and consists of two high altitude research stations on Mt. Aragats in Armenia. Geographic coordinates: 40°30'N, 44°10'E, cutoff rigidity: ~7.1 GV. Among various particle detectors In 1996 we restarted our first detector - the Nor Amberd Neutron Monitor 18NM64 type Neutron Monitors (NM) are operating at Nor Amberd research station (2000m above sea level) and at the Aragats research station (3200m above sea level). Recently modernized electronics of both monitors allows simultaneously registration of 3 time series according to 3 prefixed dead times. New installed "slow control" system allows control and automatic tuning of high voltage for each proportional camber of NM. Advanced Data Analysis system provides data storage on file servers, data transfer to computer center and various possibilities of control and visualization. Very interesting features of ASEC NMs consist in possibility of measuring simultaneously neutral and charged fluxes of cosmic rays. System of scintillator detectors build around NM allows estimation of the arrival direction of the primary cosmic rays. Correlated information on neutral and charged fluxes is very useful for alerting on dangerous conditions of the Space Weather and for fundamental research in Solar Physics.

Israel Cosmic Ray and Space Weather Center: Past, Present, and Future

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Sayan mountain spectrographic complex of Neutron Monotors of ISTP SB RAS

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Abstract

The conception of developing the Sayan mountain spectrographic complex of cosmic rays (CR) as well as its realization history is presented. Characteristics of stations forming the complex and the corresponding results of analysis of variations of rigid spectrum parameters and geomagnetic cutoff rigidities are given. As concluded, there is no possibility for obtaining reliable information of CR intensity variations and geomagnetic cutoff rigidities from only spectrographic complex data. Means for operating the Sayan complex within the world network of stations are discussed, and the results are shown under given approach.

The world wide neutron monitor network: at present and in future

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Abstract

Neutron Monitor, 60 years ago invented, till now remains as one of the main cosmic ray detector. The world wide neutron monitor network entering its second part of century continues its extension and improving. At present the main problems of NMN Network are an operative collection of data and their processing in real time regime.

The Swiss Neutron Monitors

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Abstract

The Cosmic Ray Group of the Physikalisches Institut of the University of Bern has been operating an 18 IGY neutron monitor (NM) since 1958 and a 3 NM64 since 1986, both at Jungfraujoch (geographic latitude: 46.55° N; geographic longitude: 7.98° E; effective vertical cutoff rigidity, Epoch 2000.0: Pc = 4.50 GV; altitude: IGY 3570 m asl, NM64 3475m asl). These NMs, together with the NM at Lomnický Štít, fill the latitude gap between the Rome station (Pc = 6.19 GV) and the Kiel station (Pc = 2.20 GV). The 3500 m altitude of Jungfraujoch provides good response to galactic and solar primary cosmic ray protons and ions near the geomagnetic cutoff rigidity of ~4.5 GV, and to solar neutrons with energies as low as ~250 MeV. The mid-latitude location entails an enhanced sensitivity to geomagnetic effects and therefore permits the study of magnetospheric perturbations. The records of a special neutron monitor in Bern (46.95° N, 7.45° E; 570 m asl) allow a rapid qualitative analysis of the spectral variations of the primary nucleonic cosmic radiation, and they complement the measurements of the Jungfraujoch neutron monitors (e.g. attenuation length of solar cosmic ray events). The paper gives an overview of the NM sites, the technical and operational aspects of the detectors, and their observational characteristics. In addition, examples of the most relevant observations in the past are presented to illustrate the significance of the Swiss NMs in the European and global NM network.

The neutrons at Kerguelen Island and Terre Adelie and related activities at Paris Observatory

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Abstract

The two French neutron monitors at Kerguelen Island and at Terre Adelie are operated by the French Polar Institute (IPEV). Paris Observatory is responsible for he scientific use of the data. Simultaneously the Meudon solar physics group is active in research on solar coronal dynamics, using ground-based and spaceborne instruments in the whole electromagnetic spectrum. We'll give a brief description of the neutron monitors and of our related activities: the investigation of the origin of solar energetic particles and provision of input for the monitoring of radiation doses of aircraft crews.

‘The Neutron Monitor of Kiel’

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Cosmic Ray Measurements at Lomnický Štít

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Abstract

During IGY in 1957 the cosmic ray measurement started also in High Tatra mountains. Neutron monitor data from Lomnický Štít (2634 m above sea level, 49.40 N, 20.22 E, vertical geomagnetic cut-off rigidity ~4 GV) are available since 1958. The experimental device was several times reconstructed. Average counting rate was increased and time resolution was improved. From 1982 the neutron monitor with 8 tubes in 4 sections is in operation with 5 min resolution and from 1984 with 1 min resolution. High statistical accuracy (average counting rate ~ 440 s^{-1}) allows to study the details of the variability of primary cosmic ray flux. The detailed description of 8 NM 64 at LS can be found in [1]. Preliminary data in real time are available at http://neutronmonitor.ta3.sk. In addition, neutron multiplicity measurements are running for the past three years. Selected results based on these measurements are described briefly with references in [2].

This work is supported by Slovak Grant Agency APVV, project no. 51-053805.

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Virtual Earth-Sun Observatory (VESO) at Universidad Nacional Autonoma de Mexico

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Abstract

The study of solar perturbations traveling to Earth, have reached great importance and the term "Space Weather" has been coined to describe the state of perturbation on the interplanetary medium and the magnetic behavior around Earth. As part of these studies running by the international community, the *Instituto de Geofisica* of the *Universidad Nacional Autónoma de México* (UNAM) undertake the endeavor to join four separate observatories to shape a Virtual Observatory to monitor the Earth-Sun environment. These four instruments participate actively, in collaboration with other observatories and spacecrafts with similar objectives; they are:
1.The Solar Radio Interferometer (SRI) is a Sun observing telescope in the 4 centimeter wavelength recording microwave solar emissions during eight hours every day, this emission is approximately constant except when a Solar flare takes place. Flares are the first indicators of solar activity and usually are followed by a Coronal Mass Ejection.
2. The MEXican Array RadioTelescope (MEXART)of Coeneo (Michoacán) tracks high scale transitory perturbations in its course from the Sun to the Earth using the Interplanetary Scintillation technique. The MEXART is a radiotelescope configured to detect cosmic sources of radio affected by solar activity (interplanetary scintillation). The antenna is composed by a 4096 (64X64) array dipole-kind antennas reaching a total physical area of 9,500 square meters. Length East-West of this array is 140 meters, and North-South is 80meters.
3. The lowest energy cosmic ray flux ($E< 10^{11}$eV) is controlled by the Heliosphere. Cosmic Rays should go through the solar wind pushing them outward of the Solar System. Changes in the solar wind conditions induce variations in cosmic ray intensity, this variability contain important information of solar activity and Heliosphere conditions. The Neutron Monitor at the *Universidad Nacional Autónoma de México* campus in Mexico City tracks cosmic rays with energies from $8.2x10^{9}$eV.
4. The Geomagnetic Observatory in Teoloyucan measures geomagnetic field variations from internal and external sources. The Worldwide Geomagnetic Observatories Network (INTERMAGNET) detects diverse external features, such as solar perturbations that reach Earth producing Geomagnetic Storms after going through interplanetary medium. Solar activity also has influence over the electric currents in Ionosphere and in Earth's magnetic field resulting as a diurnal variation in every single station of the network.

The Teoloyucan Geomagnetic Observatory is part of this international network, it measures on the Earth's surface the last stage of disturbed or steady solar wind conditions (among other related phenomena) closing a physical circuit of VESO's measurements tracked in the first instance, in the Sun. The VESO main objective is to analyze, study and spread information along with the interconnected observatories; this will permit to perform an interdisciplinary research of Heliospheric phenomena.

The OULU neutron monitor: 43-years measurements

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The new Plateau de Bure Neutron Monitor and the Altitude Test Single-Event Effects Test European Platform (ASTEP)

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Abstract

This talk will present the construction of the Plateau de Bure Neutron Monitor (PdBNM) and the preliminary results obtained during the verification/calibration step performed in Marseille at sea level. This new monitor neutron (type 3NM64 with high pressure He3 detectors) will be definitively installed at the altitude of 2252m on the ASTEP platform, the Altitude Single-Event Effects Test European Platform. The first motivation for the PdBNM is to provide an experimental characterization of the neutron flux on ASTEP, in order to correlate flux variations (an possible GLE) with Single-Event Effects (SEE) electrically detected in the microelectronics components and circuits under test in the same location. Real-time data from PdBNM should be also collected and online published in the framework of national and European initiatives concerning the compilation of neutron monitor databases.

An intercalibration of the world's neutron monitors

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Abstract

The status of a project to intercalibrate the worldwide network of neutron monitors with a mobile neutron monitor will be reported. The purpose of this intercalibration is to derive intensity spectra of secondary cosmic rays, so that continuous spectral information about cosmic-ray modulation, to at least one decade higher in energy than is typically available from spacecraft, can be determined.

However, to be useful, this intercalibration must be accurate to within ± 0.2%. Results will be presented of the stability, energy response, temperature sensitivity and environmental effects of the calibration neutron monitor, how successful we are likely to be to achieve this ± 0.2% limit, and our current status with the calibration project.

The SVIRCO Observatory (INAF/UNIROMA3 Collaboration): Present status

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Abstract

The Rome/SVIRCO (Studio Variazioni Intensità Raggi Cosmici) station (now Observatory) performs uninterrupted cosmic ray measurements since July 1957. In May 1997 the neutron monitor was moved from the Physics Department of "La Sapienza" University of Rome (41.90 N, 12.52 E, 60 m a.s.l.) to the Physics Department of Roma Tre University (41.86 N, 12.47 E, sea level). In this short summary we describe the present status of the neutron monitor operation, the data acquisition systems and the recent upgrade of the detector from 17 to 20 NM-64. This enhancement improved the overall counting rate and then the statistical quality of the recorded data. The increased reliability of the short-time data acquisition allows to analyse with more accuracy cosmic ray events.

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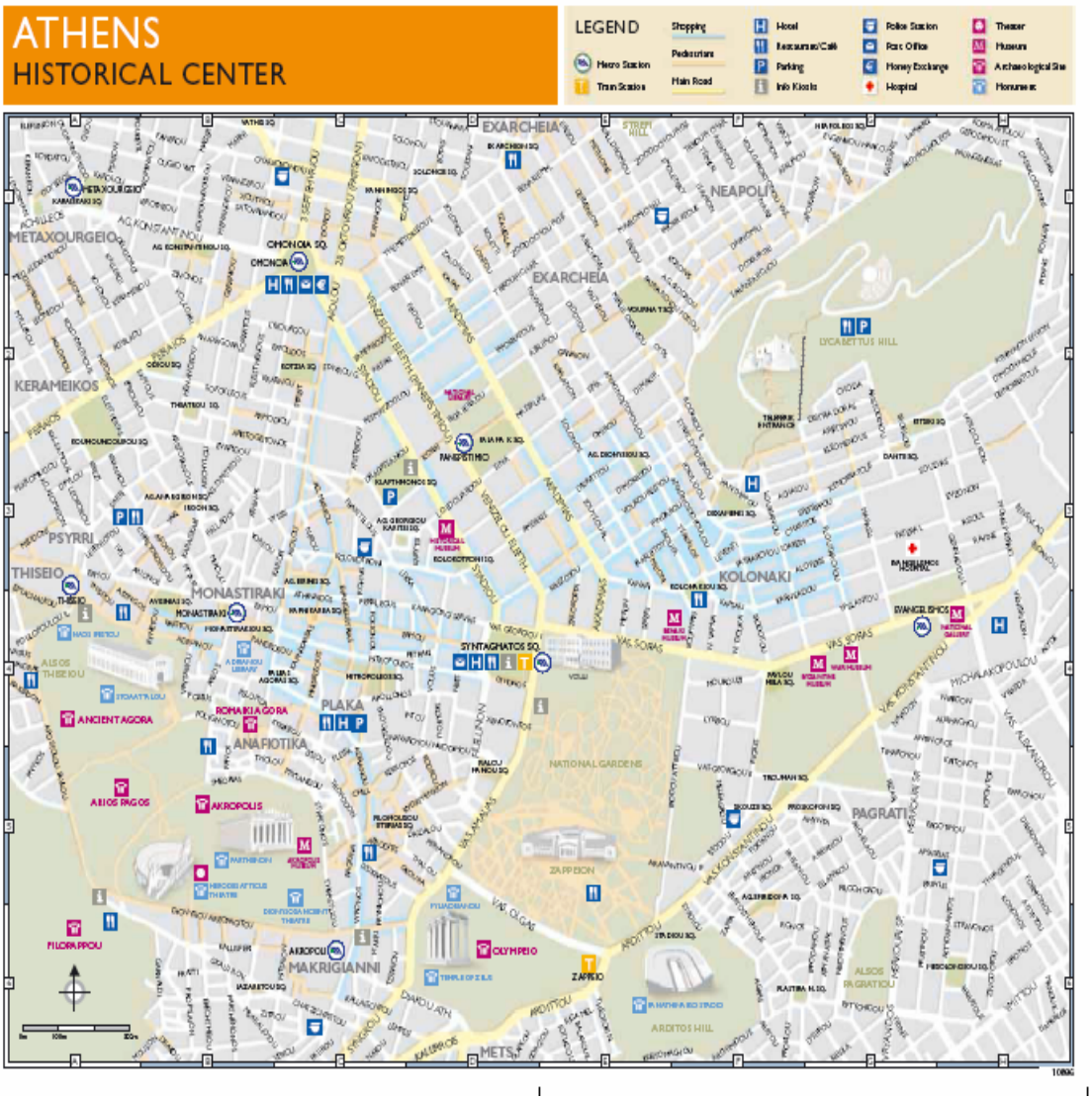
Athens Map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Parking
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Police Station
Post Office
Money Exchange
Hospital
Theater
Museum
Archaeological Site
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