SEVAN particle-detector network located at Middle-Low latitudes for Solar Physics and Space Weather research

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Multi-particle detectors

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 will give possibility to estimate the energy spectra of the highest energy SCR and distinguish very rare events of direct solar neutron detection.
Second advantage is **distinguishing of proton and neutron initiated GLEs**

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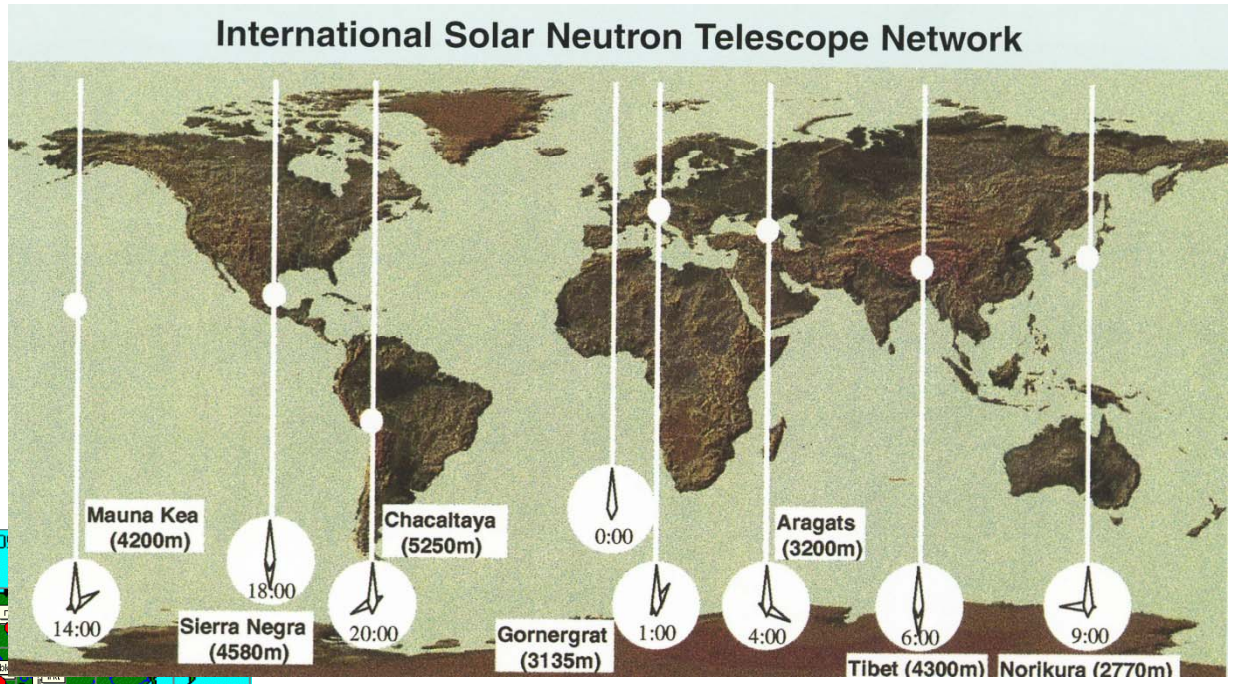
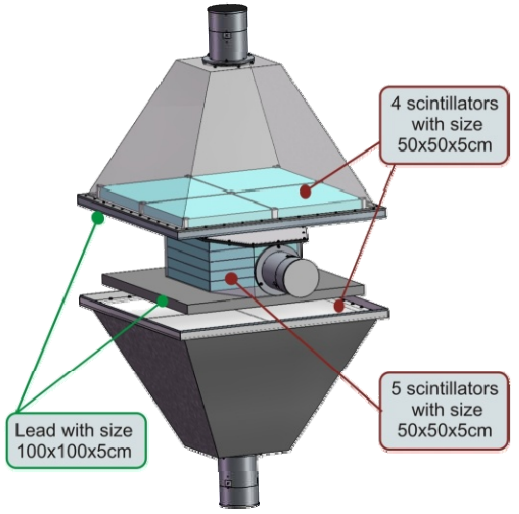
World-wide Particle Detector Networks



Space Environmental Viewing and Analysis Network (SEVAN)

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.



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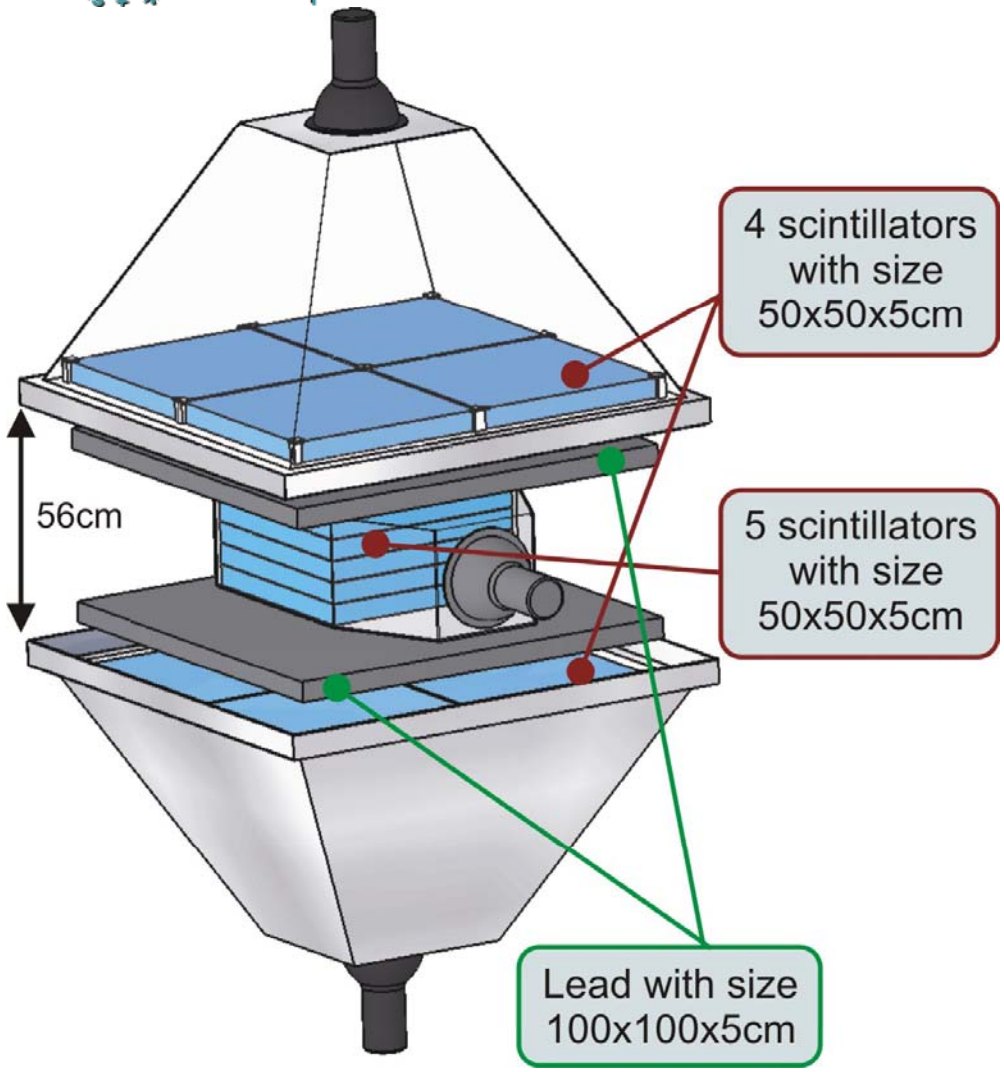
Construction of the SEVAN basic unit



100 – traversal of the low energy charged particle (~<200MeV);

010 – traversal of the neutral particle;

111 & 101 – traversal of the high energy muon (~>250MeV);

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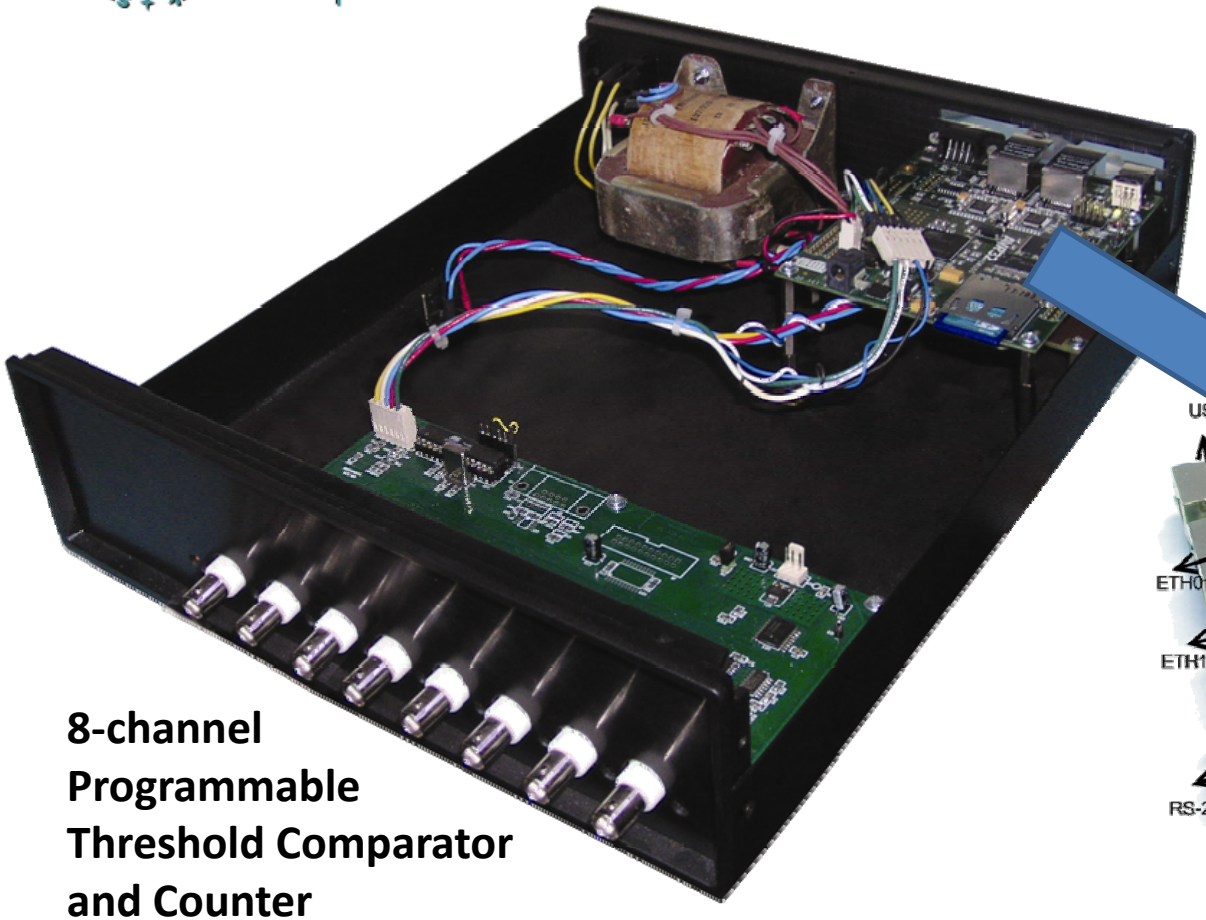
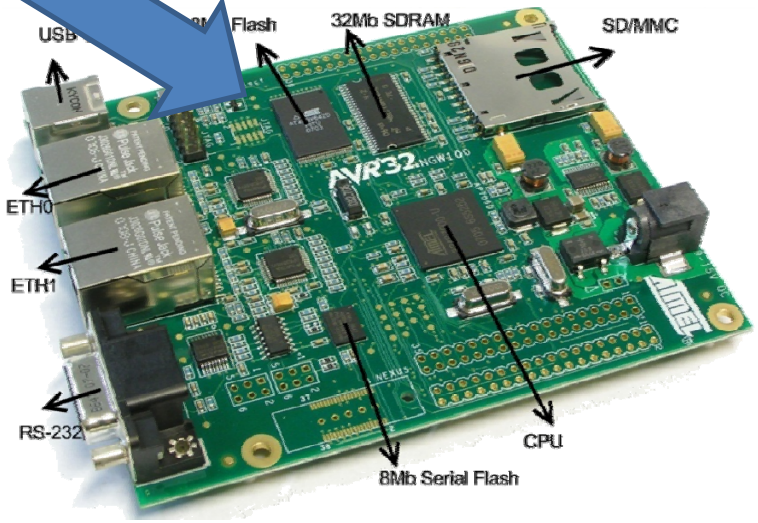
Electronics for the SEVAN



8-channel
Programmable
Threshold Comparator
and Counter

Atmel

Tiny Little AVR32
Board (NGW 100)



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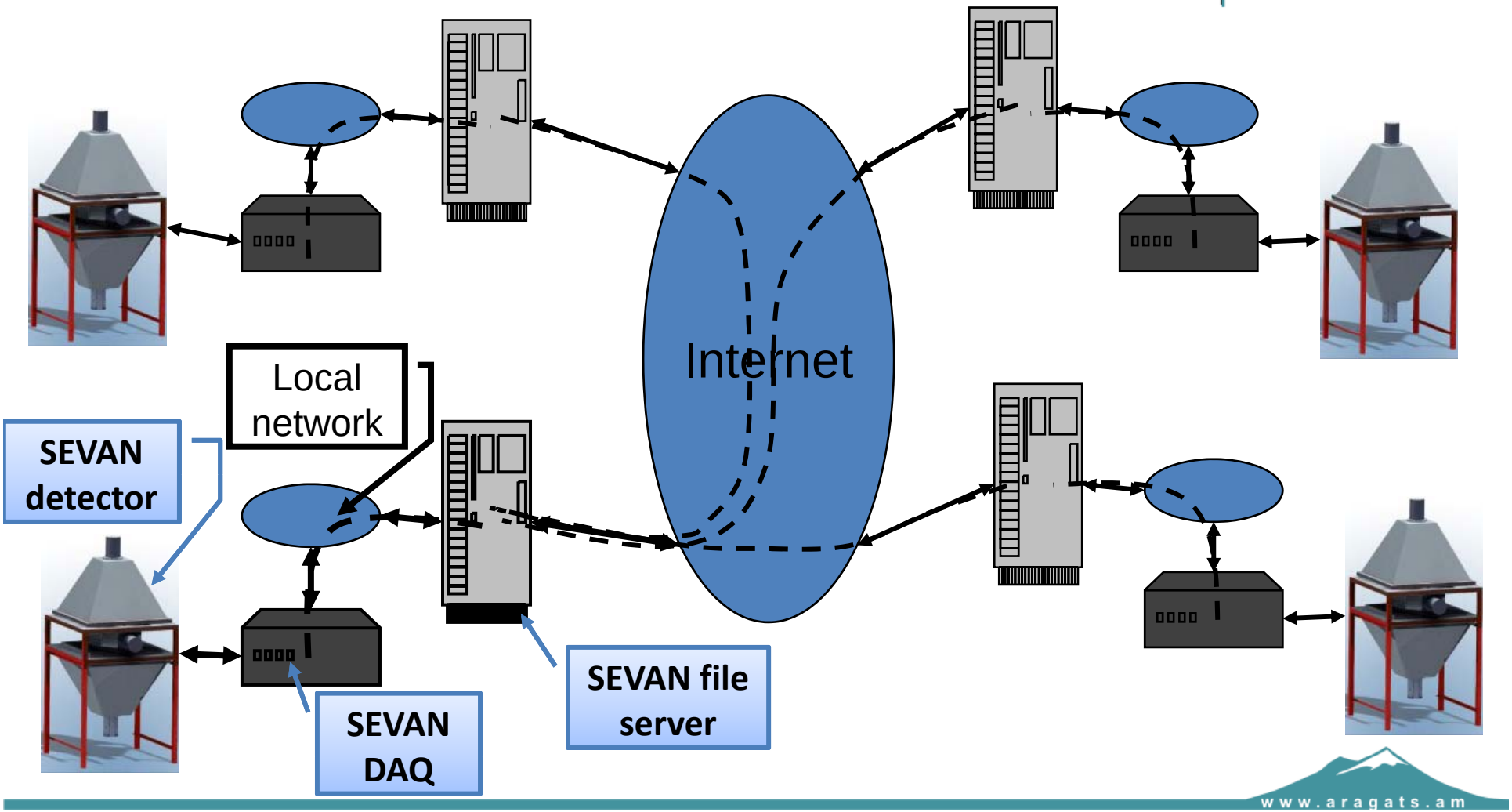
SEVAN network



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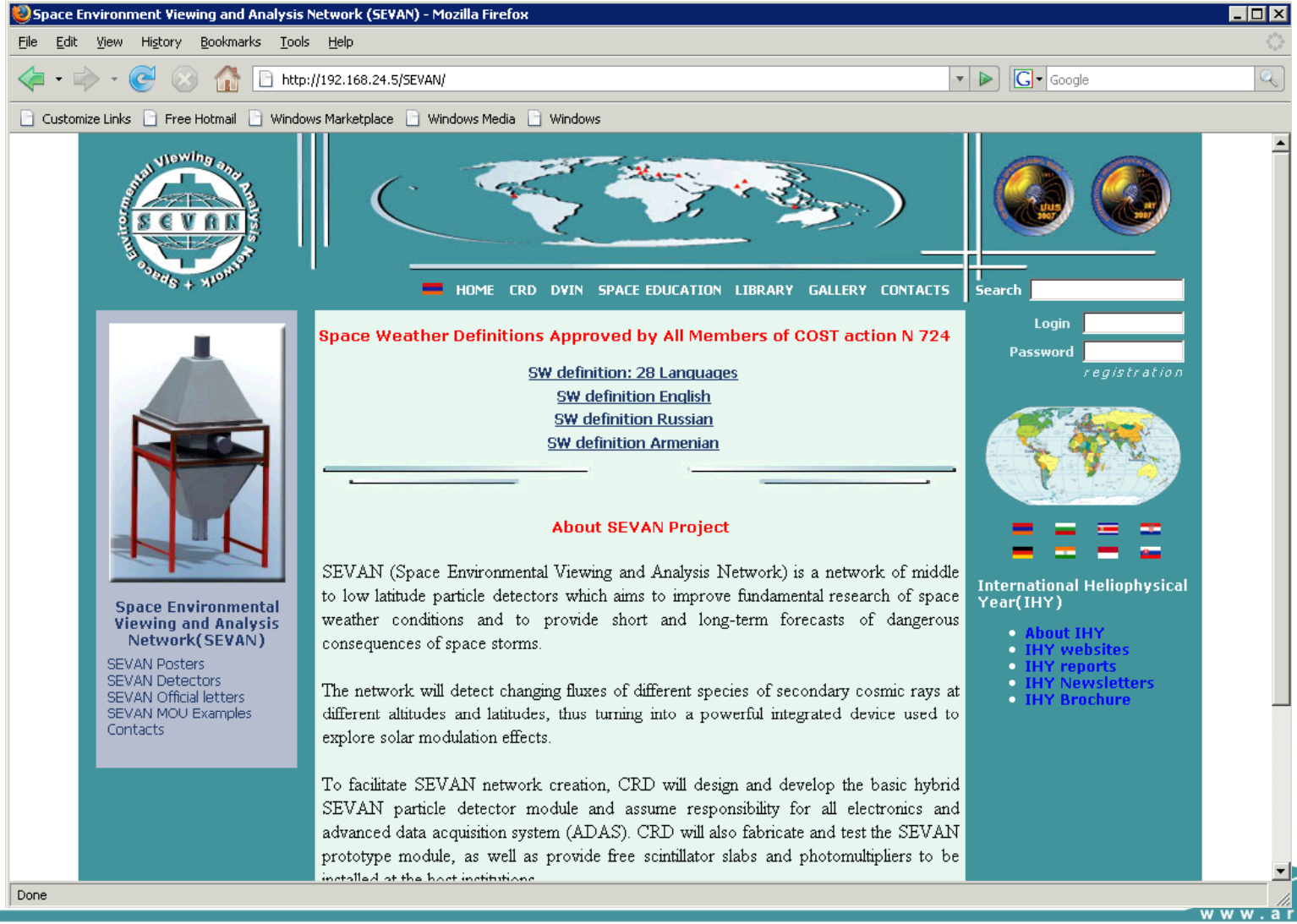
SEVAN home page:
http://sevan.crd.yerphi.am



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SEVAN basic unit located at Yerevan, Burakan and NorAmberd, Armenia.

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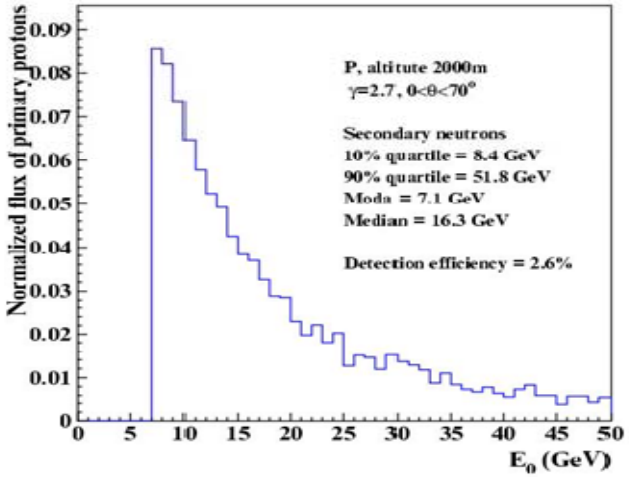
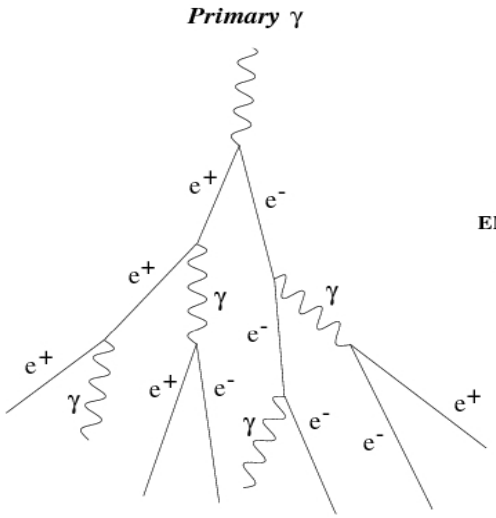
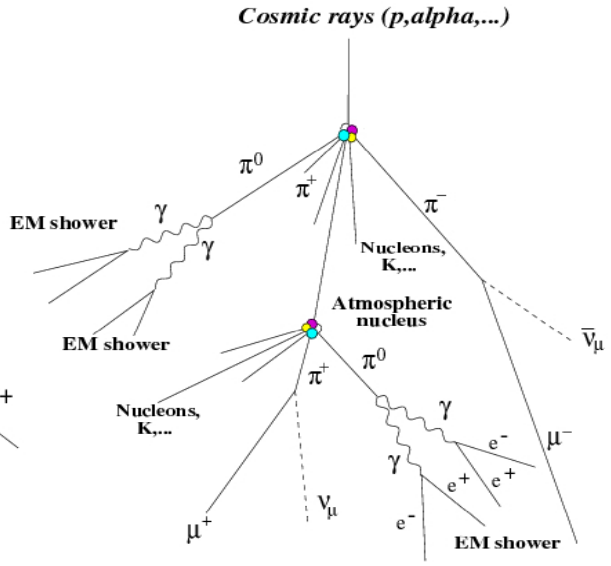
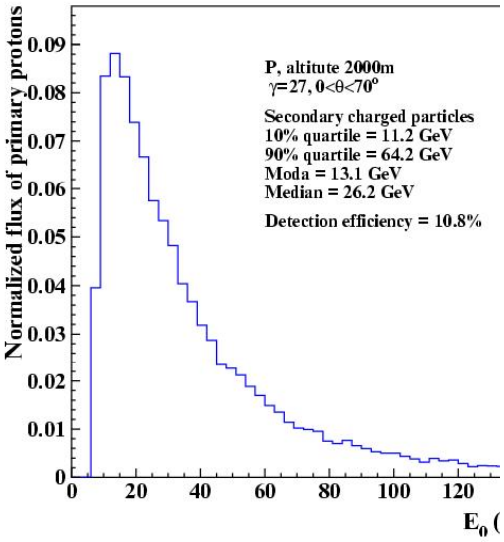
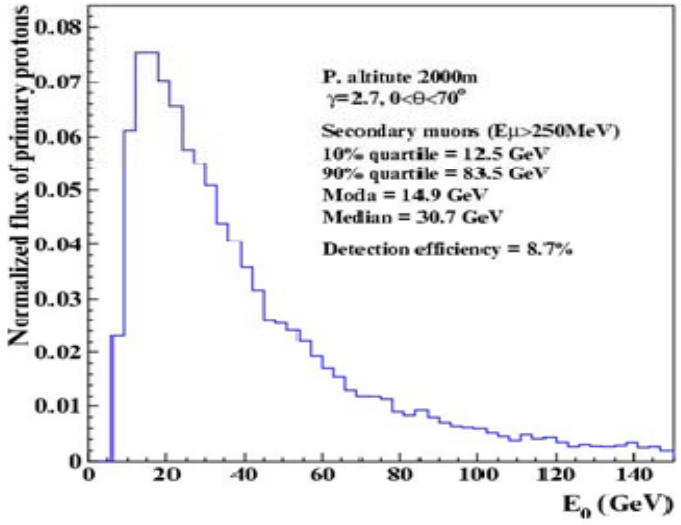
Energies of primary protons initiated various secondary fluxes at Nor Amberd station (2,000 m a.s.l.)

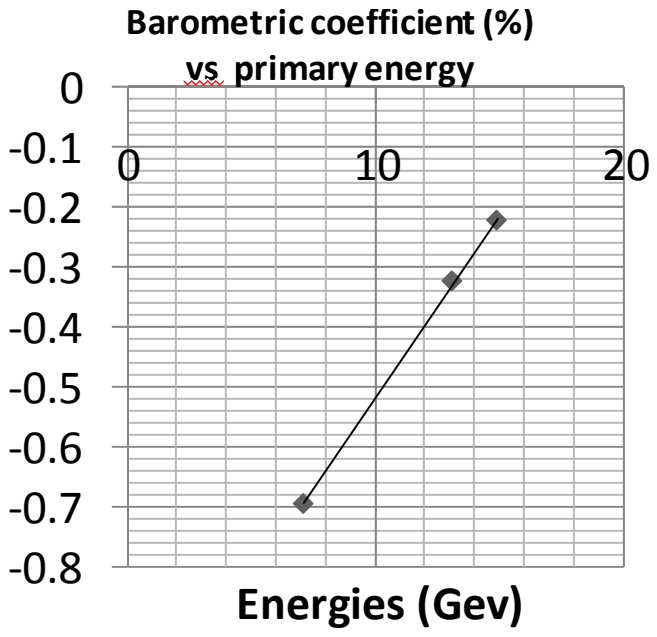












Spectral Knees

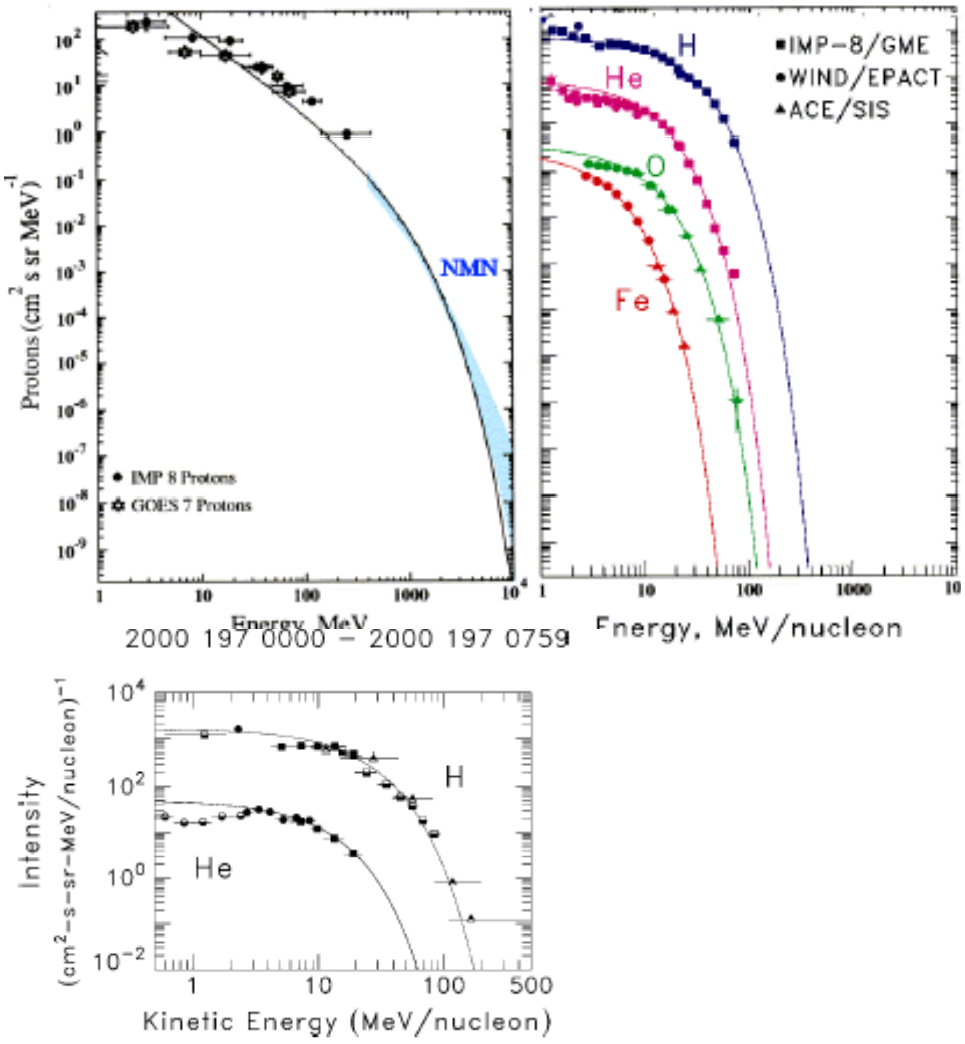
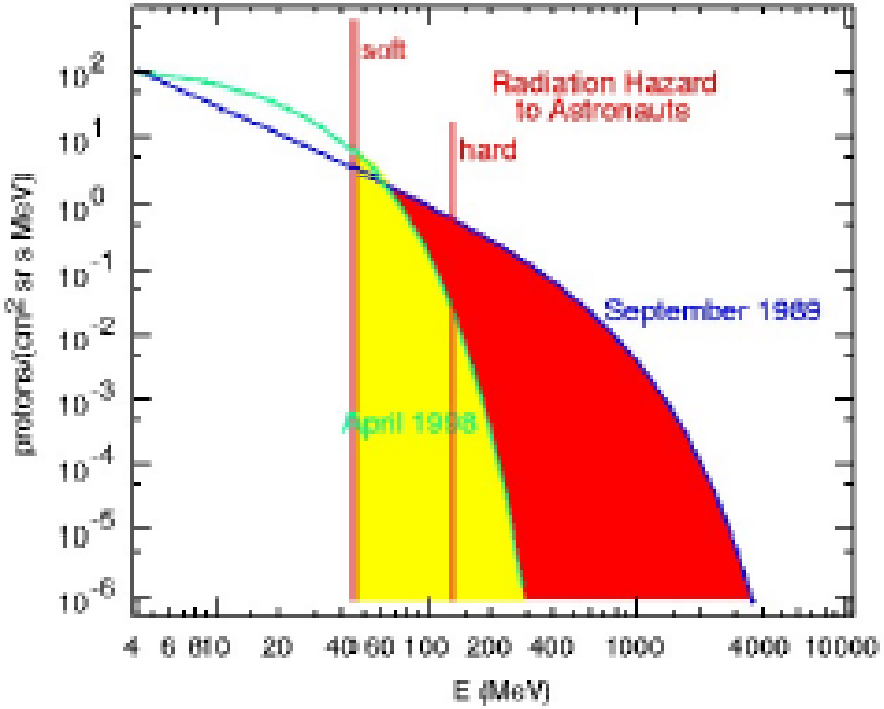
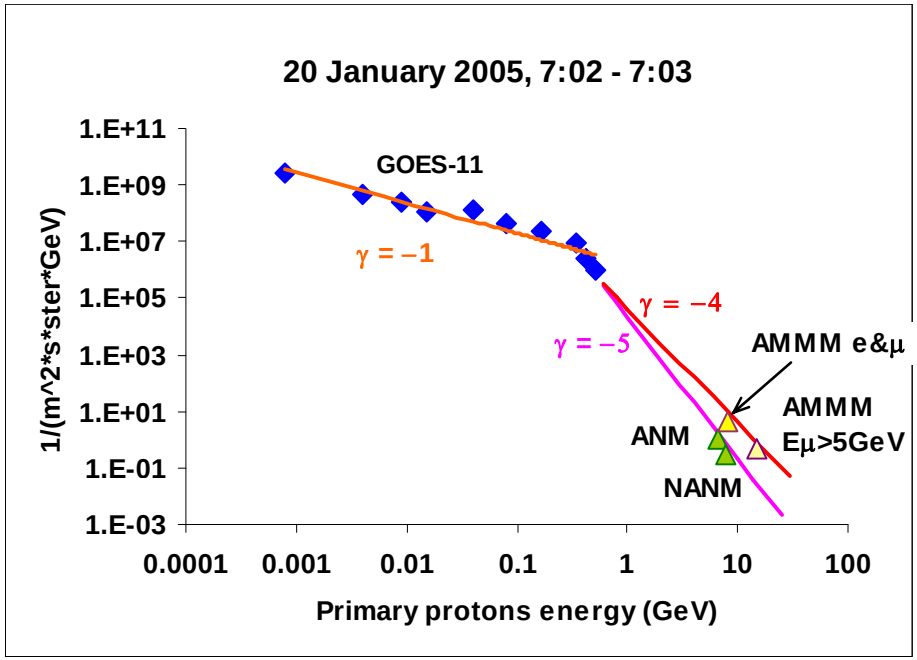
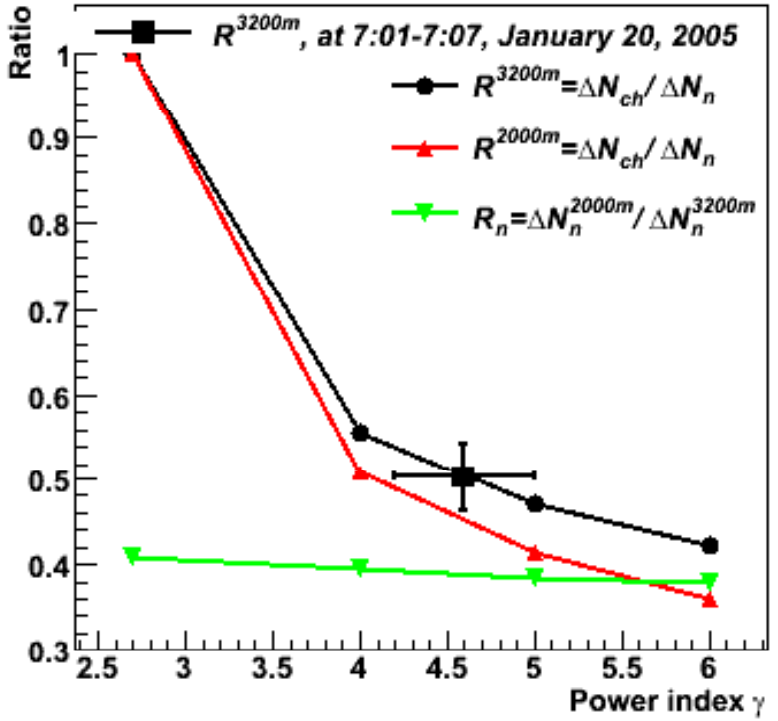


FIG. 5.—H and He spectra in the Bastille Day event, provided by *GOES* (*half-filled triangles*), *Wind*/EPACT/LEMT (*filled circles*), and *IMP8* instruments from NASA/GSFC (*filled squares*) and University of Chicago (*half-filled squares*). *ACE*/EPAM He data (*half-filled circles*) are also shown. Curves are exponentials, normalized to the data and with *e*-folding energies scaled from that of carbon, as described in the text.



Energy Spectrum of the GLE from 20 January 2005





N.Kh. Bostanjyan , A.A. Chilingarian, V.S. Eganov, G.G. Karapetyan, **On the production of highest energy solar protons on 20 January 2005,** Advances in Space Research 39 (2007) 1456–1459

A.A.Chilingarian, A.E.Reimers, **Particle detectors in Solar Physics and Space Weather research**. Astroparticle Physics 27 (2007) 465–472

Simulated enhancements detected by the SEVAN basic unit

5min simulated enhancements in the Upper and Middle layers of the SEVAN basic unit.

Detector Layer	Solar Protons	Solar Neutrons
Upper 5cm scintillator	4.8σ	2.6σ
Middle 25 cm scintillator	1.7σ	6.4σ

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Experimental and simulated count rates of the SEVAN basic unit

Experimental and simulated one-minute count rates in the different layers of the SEVAN basic unit.

Location	Yerevan (1000m)		NorAmberd(2000m)	
	Measured count rate	simulated count rate	Measured count rate	simulated count rate
Upper Detector	13788±134	13109	17109±186	17374
Middle Detector	3116±58	3546	3979±62	4591
Lower Detector	9239±98	9852	9356±132	11755

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Experimental and simulated count rates of the SEVAN basic unit

One Minute Count rates of the secondary fluxes detected by SEVAN module.

	Yerevan (1000m)		NorAmberd(2000m)	
Type of Secondary particle	**Measured count rate**	**simulated count rate**	**Measured count rate**	**simulated count rate**
Low energy charged particles	8862±108	7202	11593±161	10220
Neutral particles	363±19	359	690±27	795
High energy muon	4337±67	5477	4473±99	5548

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Conclusion

Summarizing, the hybrid particle detectors, measuring neutral and charged fluxes provide following advantages upon existing detector networks measuring single species of secondary CR:

- **Enlarged statistical accuracy of measurements;**
- **Probe different populations of primary cosmic rays with rigidities from 7 GV up to 20-30 GV;**
- **Reconstruct SCR spectra and determine position of the spectral "knees";**
- **Classify GLEs in "neutron" or "proton" initiated events;**
- **Estimate and analyze correlation matrices among different fluxes;**
- **Significantly enlarge the reliability of Space Weather alerts due to detection of 3 particle fluxes instead of only one in existing neutron monitor and muon telescope world-wide networks.**

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Post stamp on CRD Participation in International Heliophysical Year

Forecasting of Radiation and Geomagnetic Storms by networks of particle detectors (FORGES-2008)

September 29-October 3, 2008 • Nor Amberd, Armenia

OVERVIEW

The focus of the International Astroparticle Physics Symposium: Forecasting of Radiation and Geomagnetic Storms by Networks of Particle Detectors (FORGES-2008) will be to examine the state and the future possibilities of networks of particle detectors distributed at different latitudes, longitudes and altitudes measuring changing fluxes of neutral and charged particles to forewarn on coming severe radiation and geomagnetic storms.

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- Yerevan Physics Institute (YerPhI)
- International Heliophysical Year (IHY-2007)
- UN Committee on The Peaceful Uses of Outer Space
- European Office of Aerospace Research & Development (EOARD)
- National Foundation on Science and Advanced Technologies (NFSAT)
- Support Committee for Armenia's Cosmic Ray Division (SCACRD)
- Committee on Space Research (COSPAR)

PROGRAM OUTLINE

1. Physics of Interplanetary Coronal Mass Ejections (ICME), their propagation in the interplanetary space and interaction with cosmic rays and magnetosphere; modulation effects posed on the galactic cosmic rays; classification of Geomagnetic Storms (GMSs).

2. Characteristics of ground-based networks of particle detectors; experimental methods of measuring count rates and energies of secondary cosmic rays; efficiency of detecting various species of secondary cosmic rays. Networks monitoring main geophysical parameters.

3. Mathematical methods of the prediction; feature selection; Bayesian and Neural Network models of interpolation and extrapolation; multivariate regression methods.

4. Training of SEVAN (Space Environmental Viewing and Analysis Network) host groups.

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