

Cosmic Rays in Space Weather research

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Map of Armenia



Aragats Space-Environmental Center

- Measure as much as possible secondary CR fluxes with different energy thresholds;
- Measure the histogram of energy releases on minute-by-minute basis;
- Monitor correlations between changing CR fluxes;
- Measure particle arrival directions;
- Use same detectors for SW and high energy CR;
- Perform simulation of the time-series registered by the ASEC monitors;
- Correlate surface and space-born detectors data assessable from the Internet;
- Be part of world-wide networks and create new networks;
- Provide forecasting and alerts on severe conditions of the SW.

List of ASEC Particle Detectors

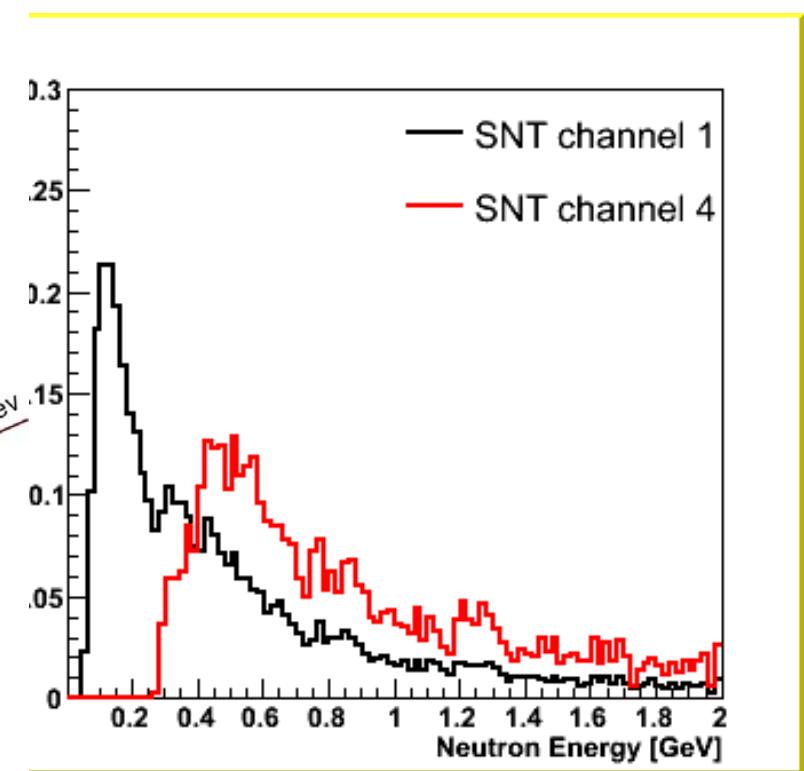
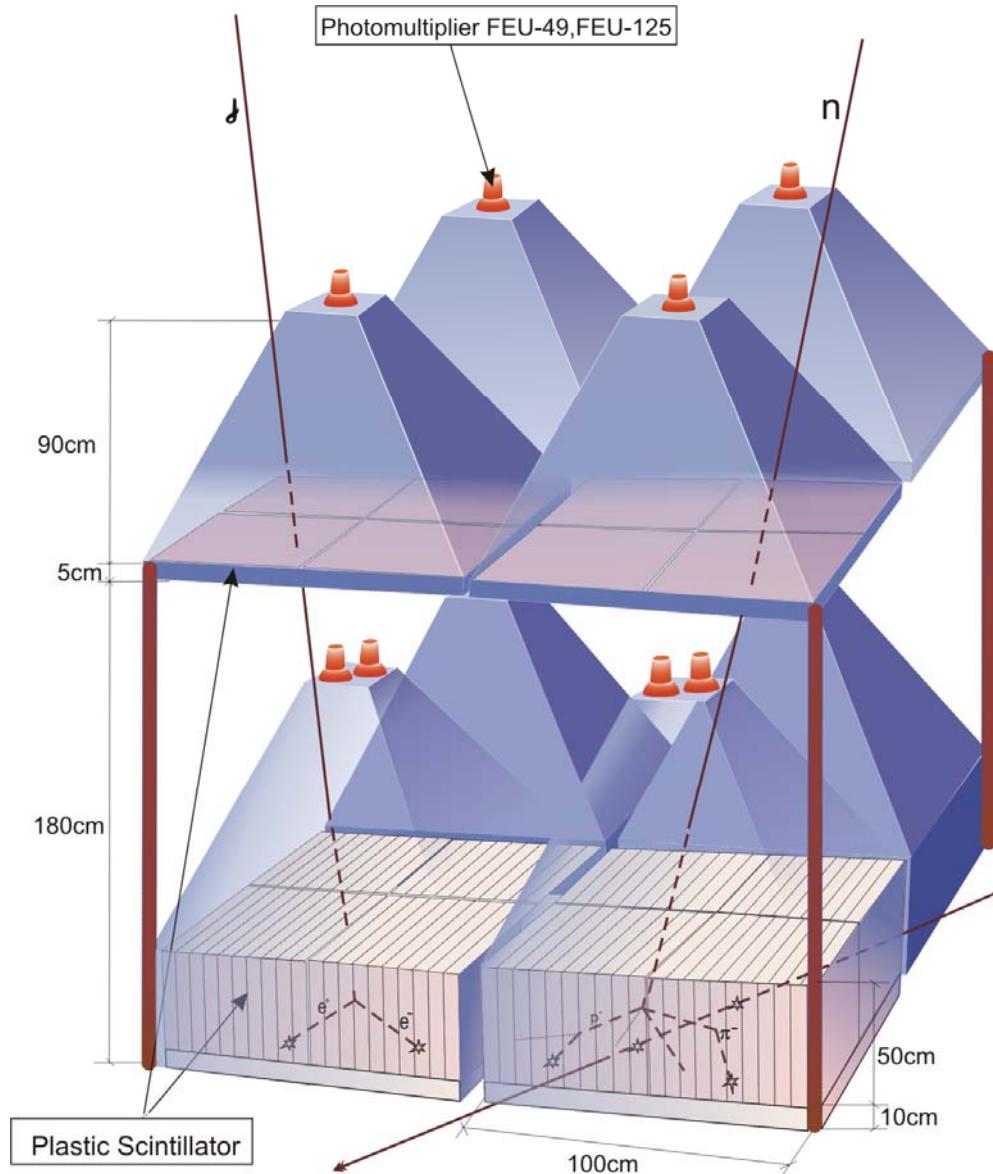
| Detector | Altitude <i>m</i> | Surface <i>m</i> ² | Threshold(s) <i>MeV</i> | Operation | Count (<i>min</i> ⁻¹) | rate |
|-------------------------|----------------------|---------------------------------|-------------------------|-----------|--|------|
| NANM (18NM64) | 2000 | 18 | 50 | 1996 | 2.7×10^4 | |
| ANM (18NM64) | 3200 | 18 | 50 | 2000 | 6.1×10^4 | |
| SNT-4channels + veto | 3200 | 4 (60cm thick) 4 (5cm thick) | 120, 200, 300, 500 7 | 1998 | 5.2×10^4 1.2×10^5 | |
| NAMMM | 2000 | 5 + 5 | 7 ; 350*** | 2002 | 7.0×10^4 | |
| AMMM | 3200 | 45 | 5000 | 2002 | 1.3×10^5 ** | |
| MAKET-ANI | 3200 | 6 | 7 | 1996 | 1.5×10^5 | |

*Count rate for the first threshold; near vertical charged particles are excluded

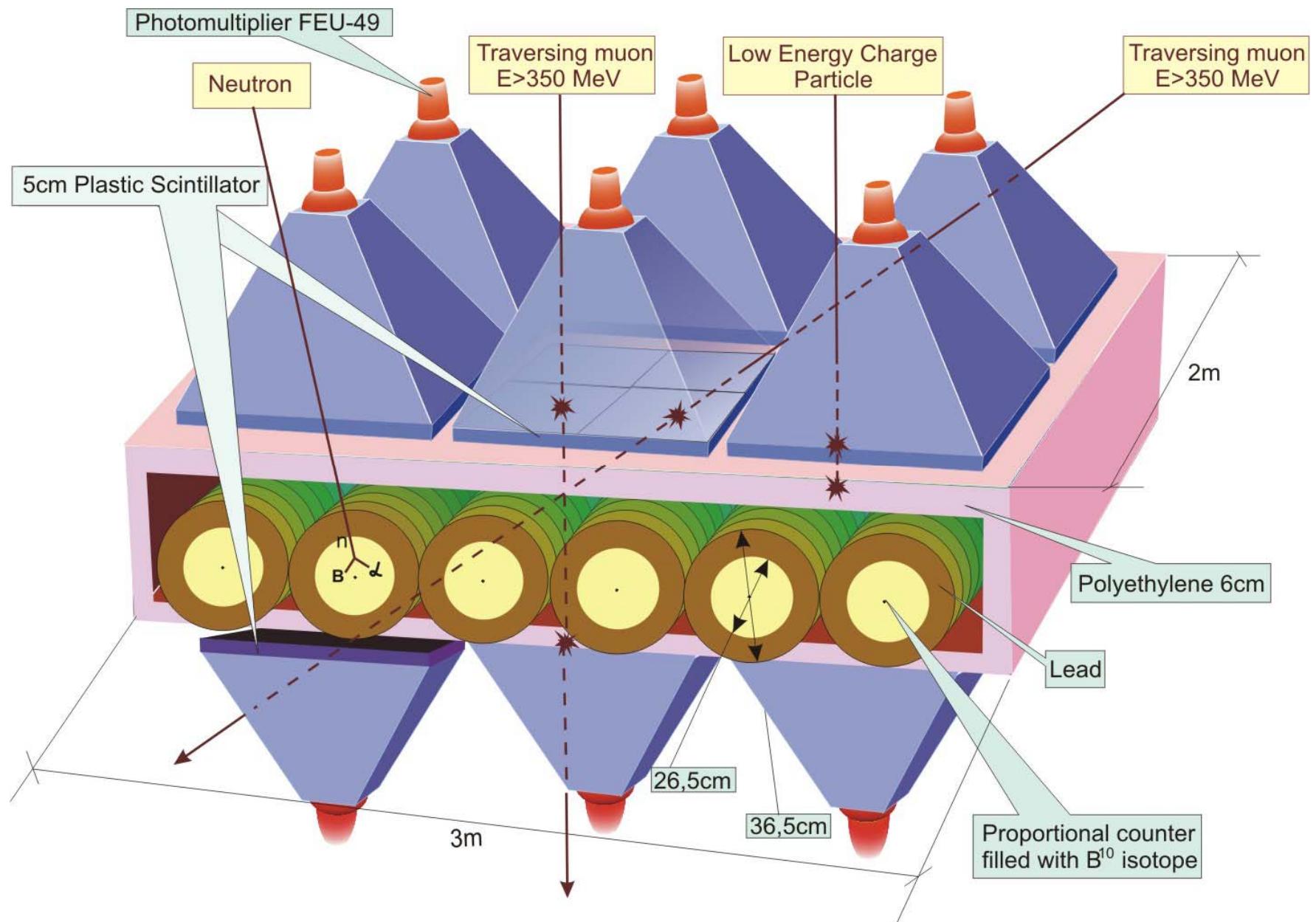
**Total count rate of 45 muon detectors from 150 (100 to be put in operation in 2006)

*** First number – energy threshold for the upper detector, second number – bottom detector.

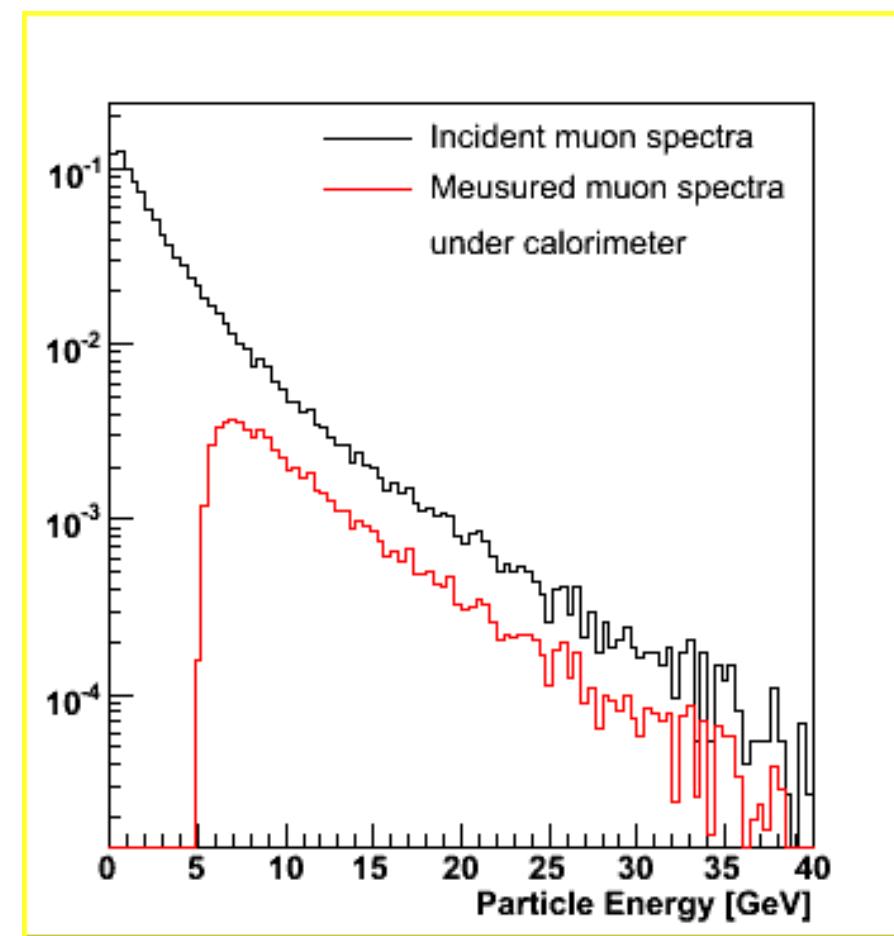
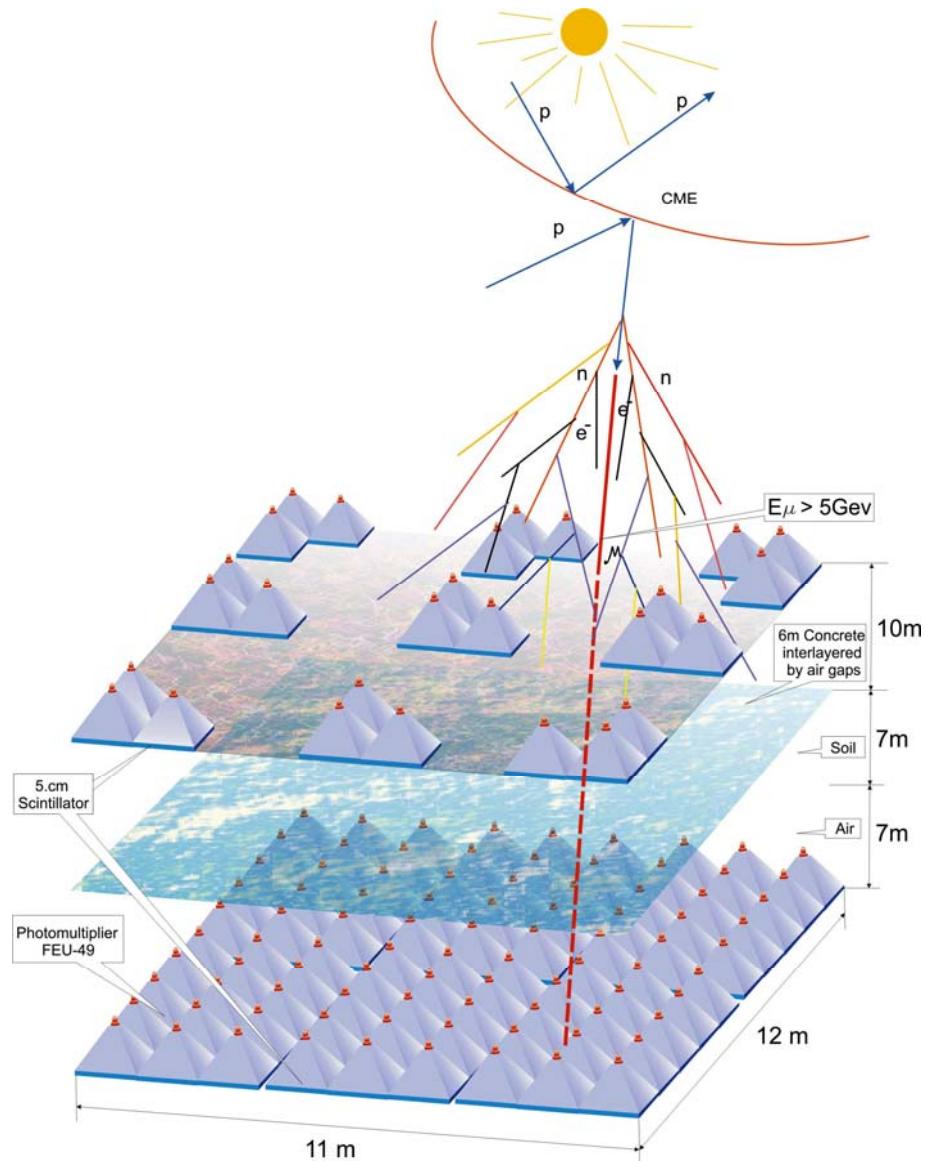
Solar Neutron Telescope



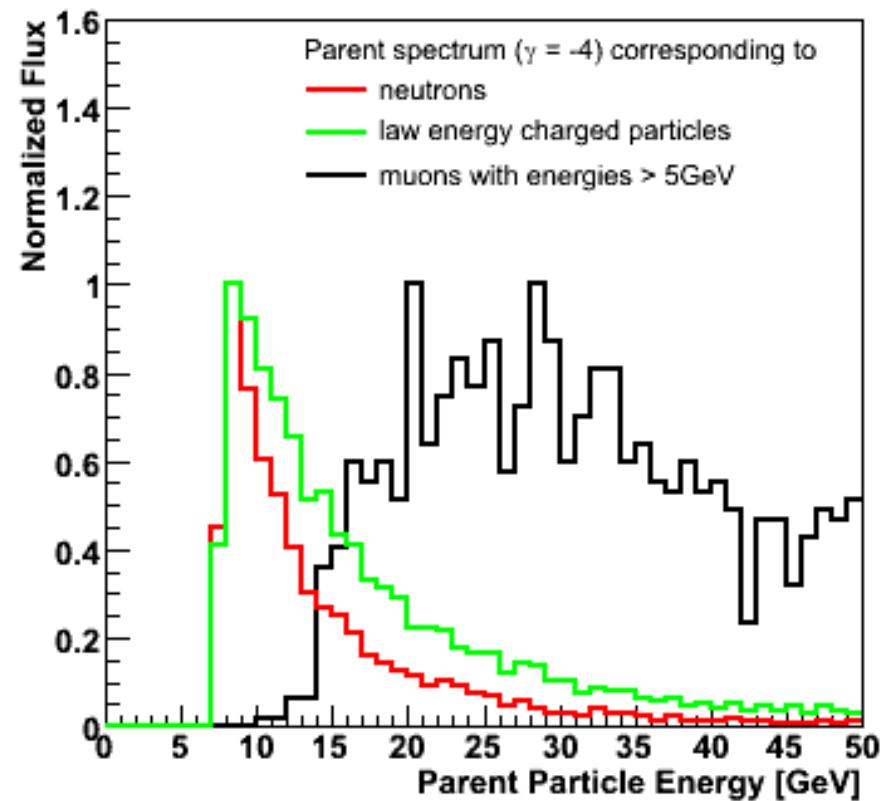
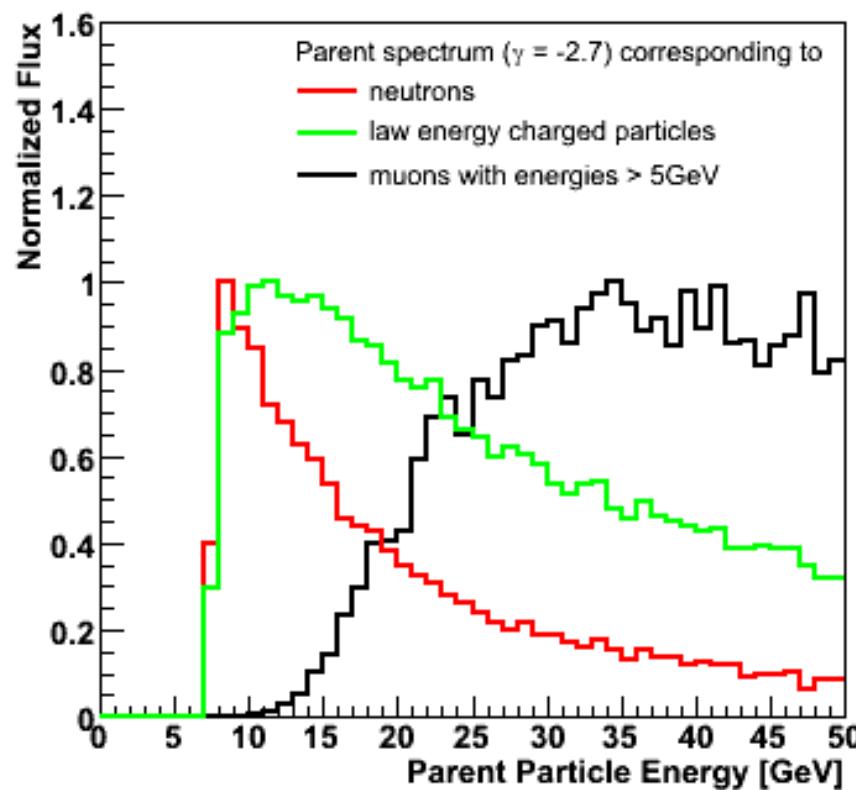
Nor Amberd Multidirectional Muon Monitor



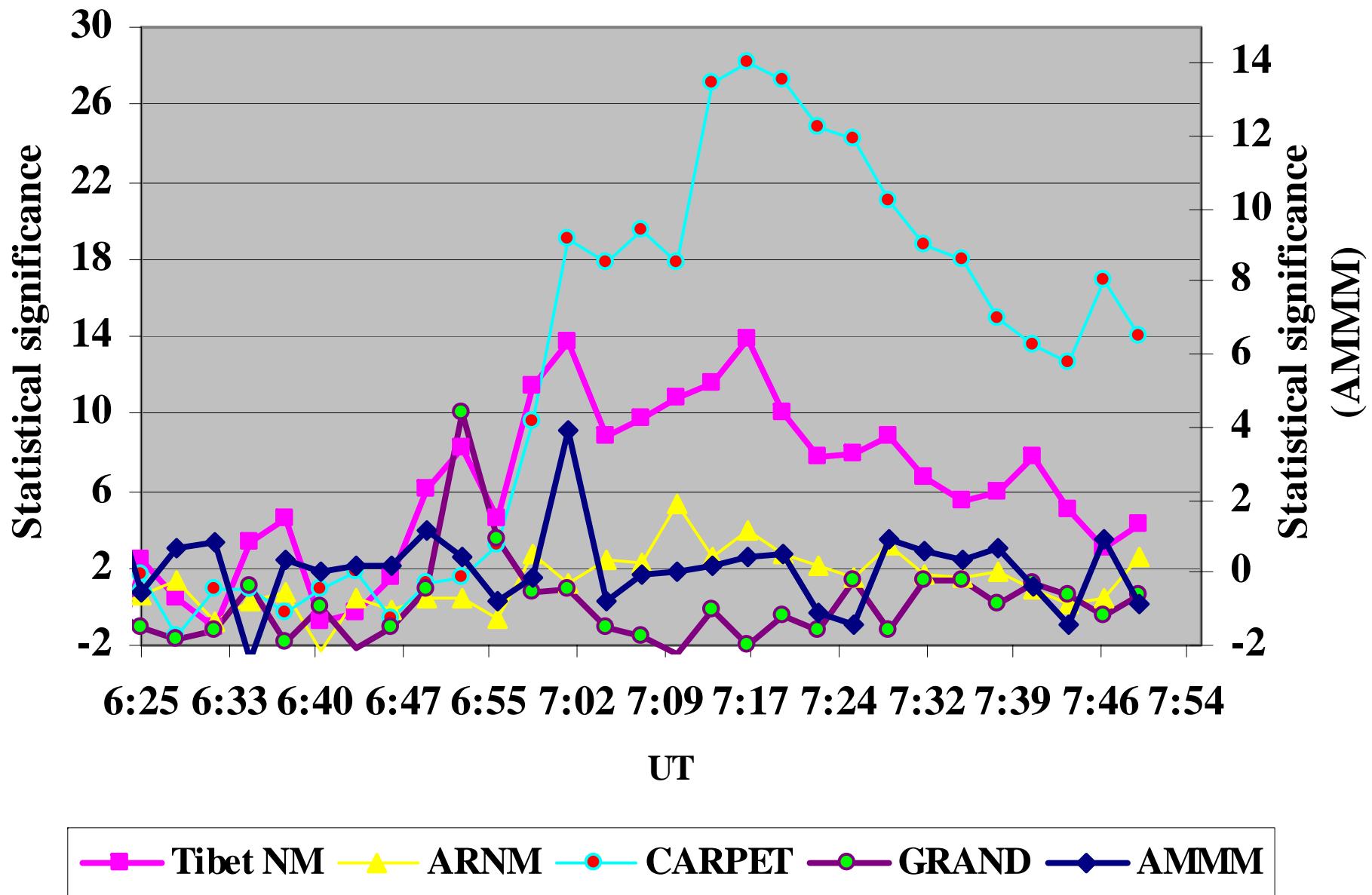
Aragats Multidirectional Muon Monitor (AMMM)



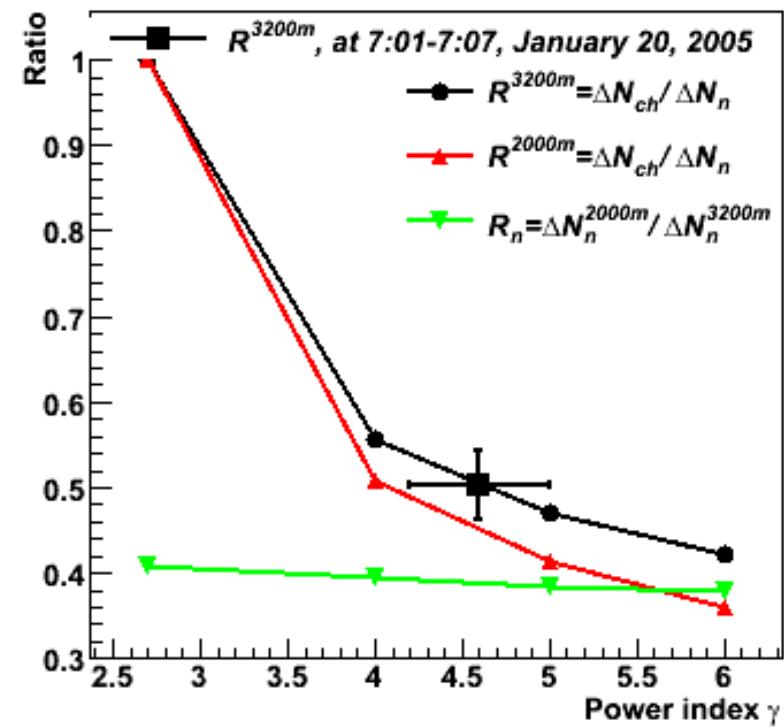
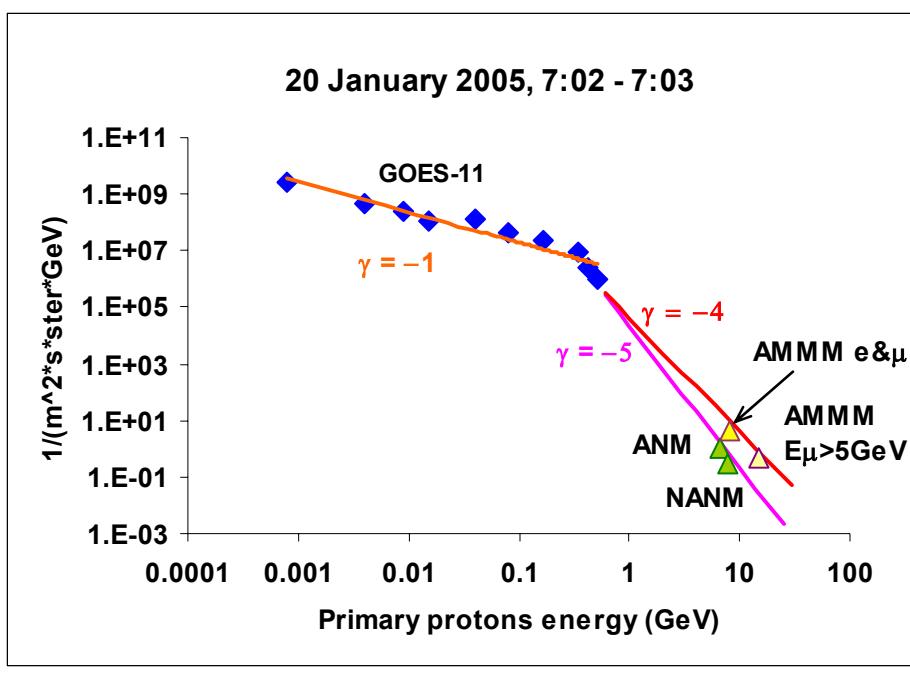
ASEC monitor are “selecting” different energy populations of GCR and SCR



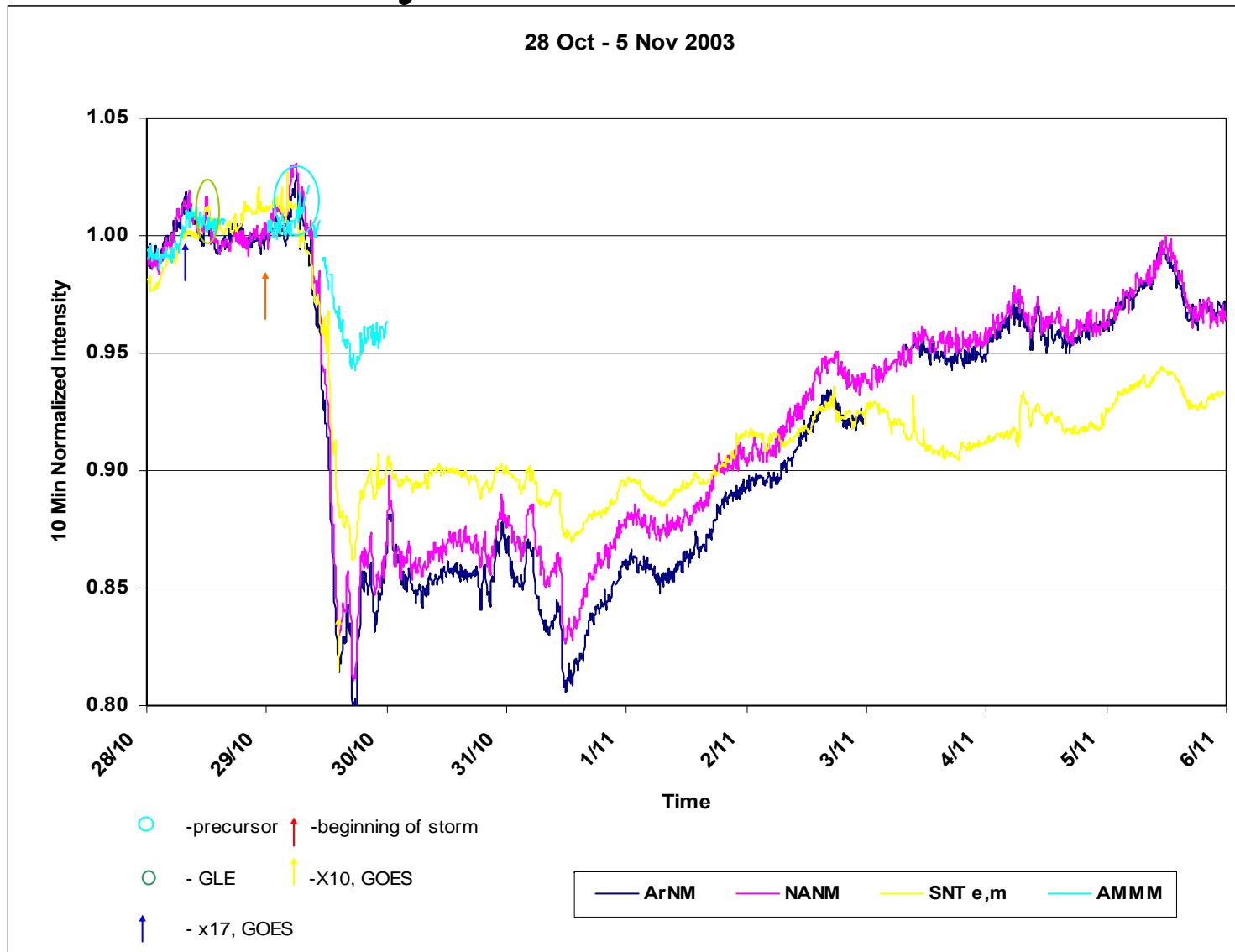
20.01.2005 (3min)



Energy Spectrum of the GLE from 20 January 2005



Famous ‘‘Halloween’’ events of 2003, detected in electron & muon and neutron fluxes by ASEC monitors



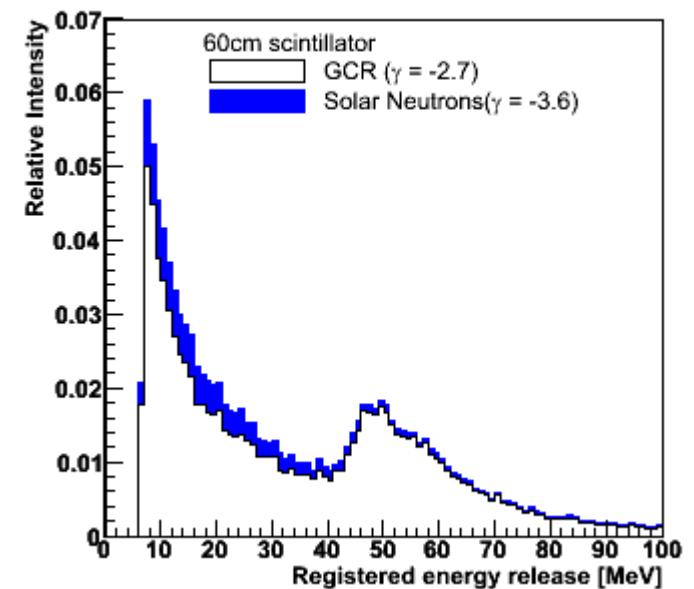
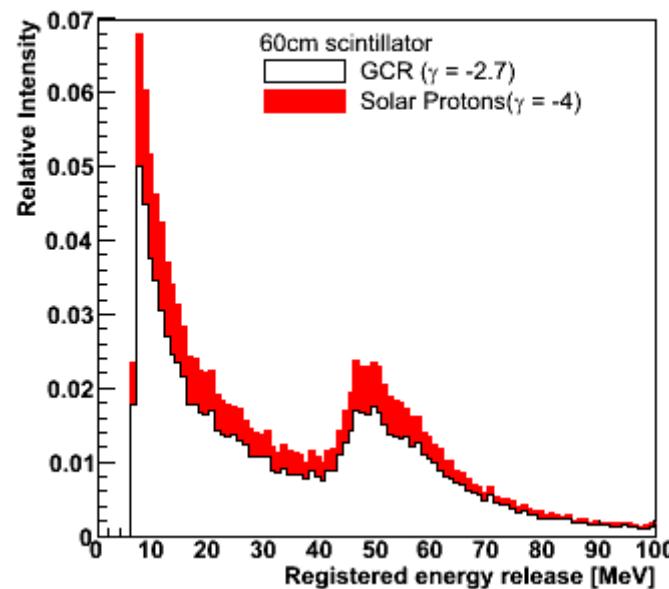
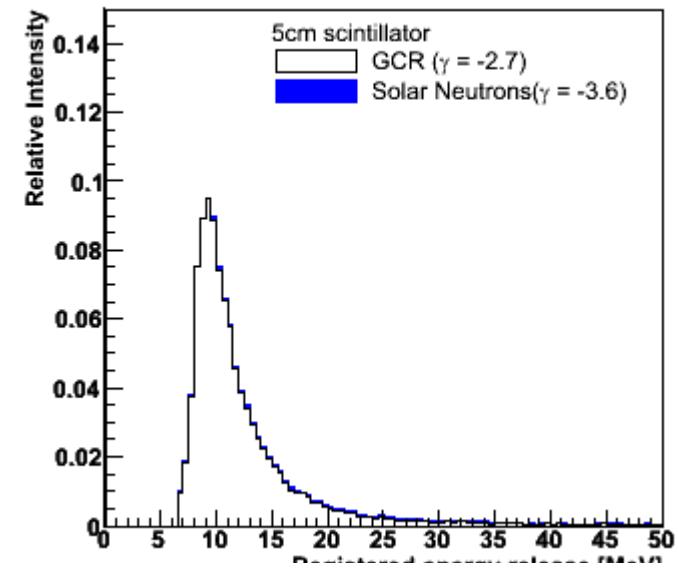
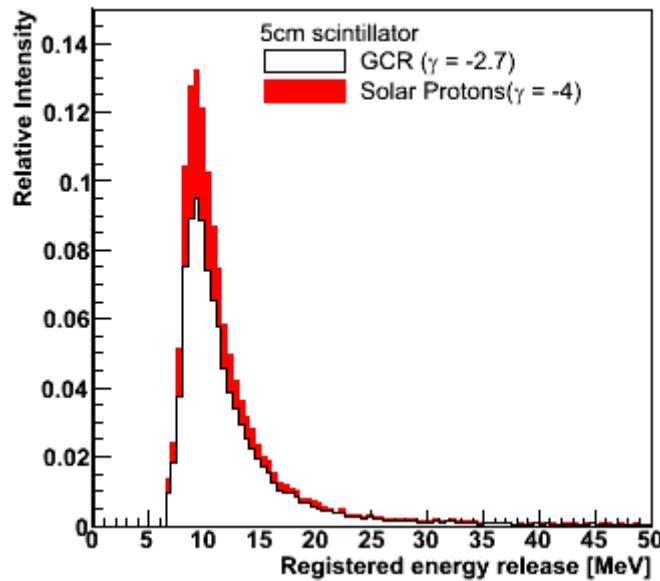
Correlation Matrix of ASEC monitors for 29 October 2003 (6:09 – 14:39), Fd

| | ANM | NANM | AMMM | SNTe,μ | SNT thr1 | SNT thr2 | SNT thr 3 | SNT thr4 |
|-----------------|-------------|-------------|-------------|---------------|-----------------|-----------------|------------------|-----------------|
| ANM | 1 | 1,00 | 0,97 | 0,99 | 0,99 | 0,97 | 0,95 | 0,98 |
| NANM | 1,00 | 1 | 0,97 | 0,99 | 0,99 | 0,97 | 0,95 | 0,98 |
| AMMM | 0,97 | 0,97 | 1 | 0,97 | 0,97 | 0,95 | 0,93 | 0,95 |
| SNTe,μ | 0,99 | 0,99 | 0,97 | 1 | 1,00 | 0,99 | 0,97 | 0,99 |
| SNT thr1 | 0,99 | 0,99 | 0,97 | 1,00 | 1 | 0,99 | 0,96 | 0,99 |
| SNT thr2 | 0,97 | 0,97 | 0,95 | 0,99 | 0,99 | 1 | 0,99 | 0,99 |
| SNT thr3 | 0,95 | 0,95 | 0,93 | 0,97 | 0,96 | 0,99 | 1 | 0,97 |
| SNT thr4 | 0,98 | 0,98 | 0,95 | 0,99 | 0,99 | 0,99 | 0,97 | 1 |

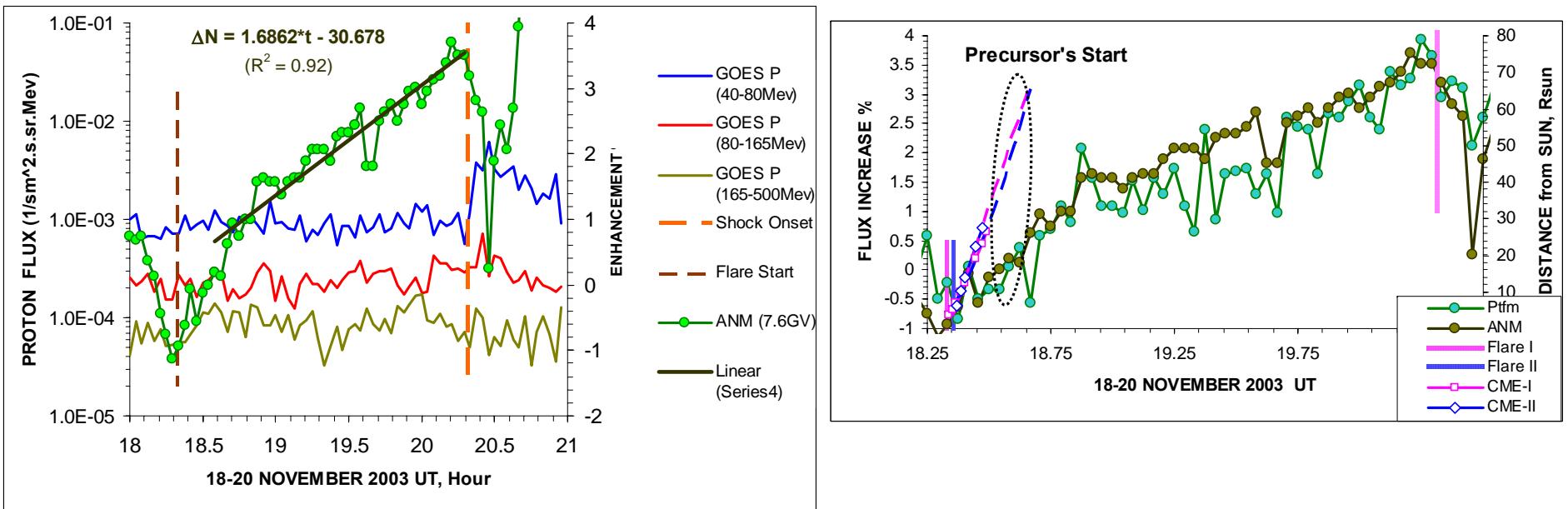
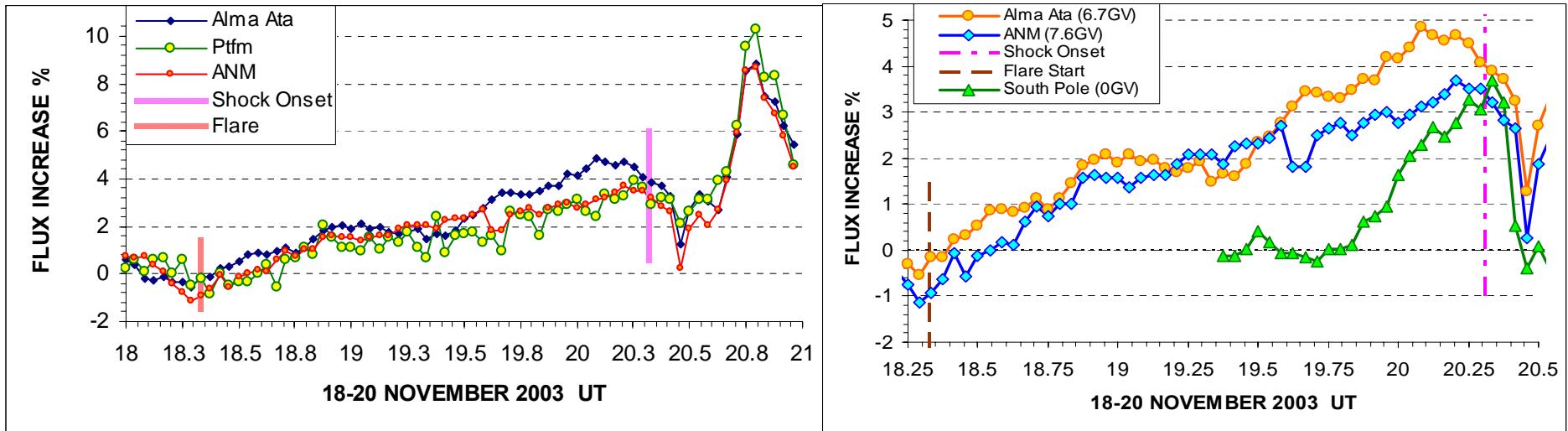
ASEC Monitors Correlation Matrix 25 Jan 2003, (quiet time)

| | ArNM | NANM | AMMM | SNT_{e,μ} | SNT thr1 | SNT thr2 | SNT thr3 | SNT thr4 |
|--------------------------|-------------|-------------|-------------|--------------------------|-----------------|-----------------|-----------------|-----------------|
| ArNM | 1 | | | | | | | |
| NANM | 0,01 | 1 | | | | | | |
| AMMM | 0,03 | 0,02 | 1 | | | | | |
| SNT_{e,μ} | 0,02 | -0,01 | 0,12 | 1 | | | | |
| SNT thr1 | 0,05 | 0,03 | 0,08 | 0,06 | 1 | | | |
| SNT thr2 | 0,04 | -0,04 | -0,04 | -0,05 | 0,43 | 1 | | |
| SNT thr3 | 0,03 | 0,03 | 0,00 | -0,01 | 0,31 | 0,42 | 1 | |
| SNT thr4 | 0,01 | -0,02 | -0,04 | 0,03 | 0,15 | 0,33 | 0,46 | 1 |

Neutron and Proton GLEs as seen by the SNT



Precursor of largest GMS from 20 November 2003



Correlation Matrix of ASEC monitors for 20-21 November 2003 г. (14:40 – 6:00), Geomagnetic Storm

| | ArNM | NANM | AMMM | SNT_{e,μ} | SNT thr1 | SNT thr2 | SNT thr3 | SNT thr4 |
|--------------------------|--------------|--------------|-------------|--------------------------|-----------------|-----------------|-----------------|-----------------|
| ArNM | 1 | 0.89 | -0.01 | 0.47 | 0.81 | 0.85 | 0.67 | 0.38 |
| NANM | 0.89 | 1 | -0.04 | 0.44 | 0.79 | 0.83 | 0.65 | 0.35 |
| AMMM | -0.01 | -0.04 | 1 | 0.53 | 0.14 | -0.04 | 0.13 | 0.13 |
| SNT_{e,μ} | 0.47 | 0.44 | 0.53 | 1 | 0.62 | 0.36 | 0.50 | 0.36 |
| SNT thr1 | 0.81 | 0.79 | 0.14 | 0.62 | 1 | 0.87 | 0.72 | 0.43 |
| SNT thr2 | 0.85 | 0.83 | -0.04 | 0.36 | 0.87 | 1 | 0.81 | 0.48 |
| SNT thr3 | 0.67 | 0.65 | 0.13 | 0.50 | 0.72 | 0.81 | 1 | 0.68 |
| SNT thr4 | 0.38 | 0.35 | 0.13 | 0.36 | 0.43 | 0.48 | 0.68 | 1 |

ADAS Server - SeaMonkey

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ADAS

Aragats Data Acquisition Server

Version: 3.0.8 Status: Ok

Submit

Channel 1 (Layer: 1, Sensor: 1)

High Voltage (V):
1398

Threshold (V):
2.2300

SoftThreshold :
1

High Voltage: 1400
Cur. Counter: 691

Channel 5 (Layer: 2, Sensor: 1)

High Voltage (V):
1349

Threshold (V):
2.1500

SoftThreshold :
1

High Voltage: 1347
Cur. Counter: 400

Channel 2 (Layer: 1, Sensor: 2)

High Voltage (V):
1580

Threshold (V):
2.3000

SoftThreshold :
1

High Voltage: 1580
Cur. Counter: 715

Channel 6 (Layer: 2, Sensor: 2)

High Voltage (V):
1309

Threshold (V):
2.0500

SoftThreshold :
1

High Voltage: 1310
Cur. Counter: 402

Server Info Documentation Configuration Error Log Real Time Data Current Data Today Data Stored Data

DarkSoft News DarkSoft Projects

Restart Server Stop Server Download Config Upload Config Configure USB NTP Status

Shutdown PC

ADAS Server - SeaMonkey

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ADAS

Aragats Data Acquisition Server

Version: 3.0.8
Status: Ok

Server Info
Documentation
Configuration
Error Log
Real Time Data
Current Data
Today Data
Stored Data

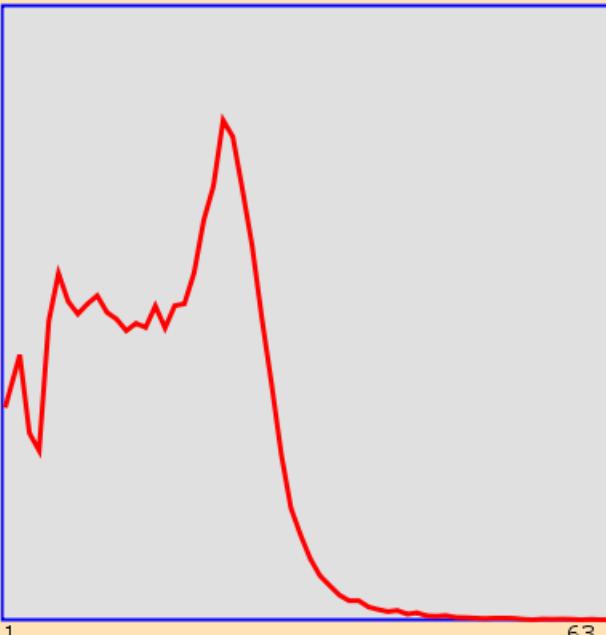
DarkSoft News
DarkSoft Projects

Restart Server
Stop Server
Download Config
Upload Config
Configure USB
NTP Status

Detector 1 Spectrum

Center: 23

Total Events:
41364
Events (>20):
16355
Events (>26):
5081
Events (>28):
2769
Events (>34):
614



Sensor: 1)
Voltage: 1350
threshold: 2.1500

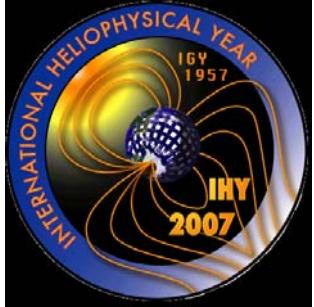


Spectrum

Sensor: 2)
Voltage: 1309
threshold: 2.0500

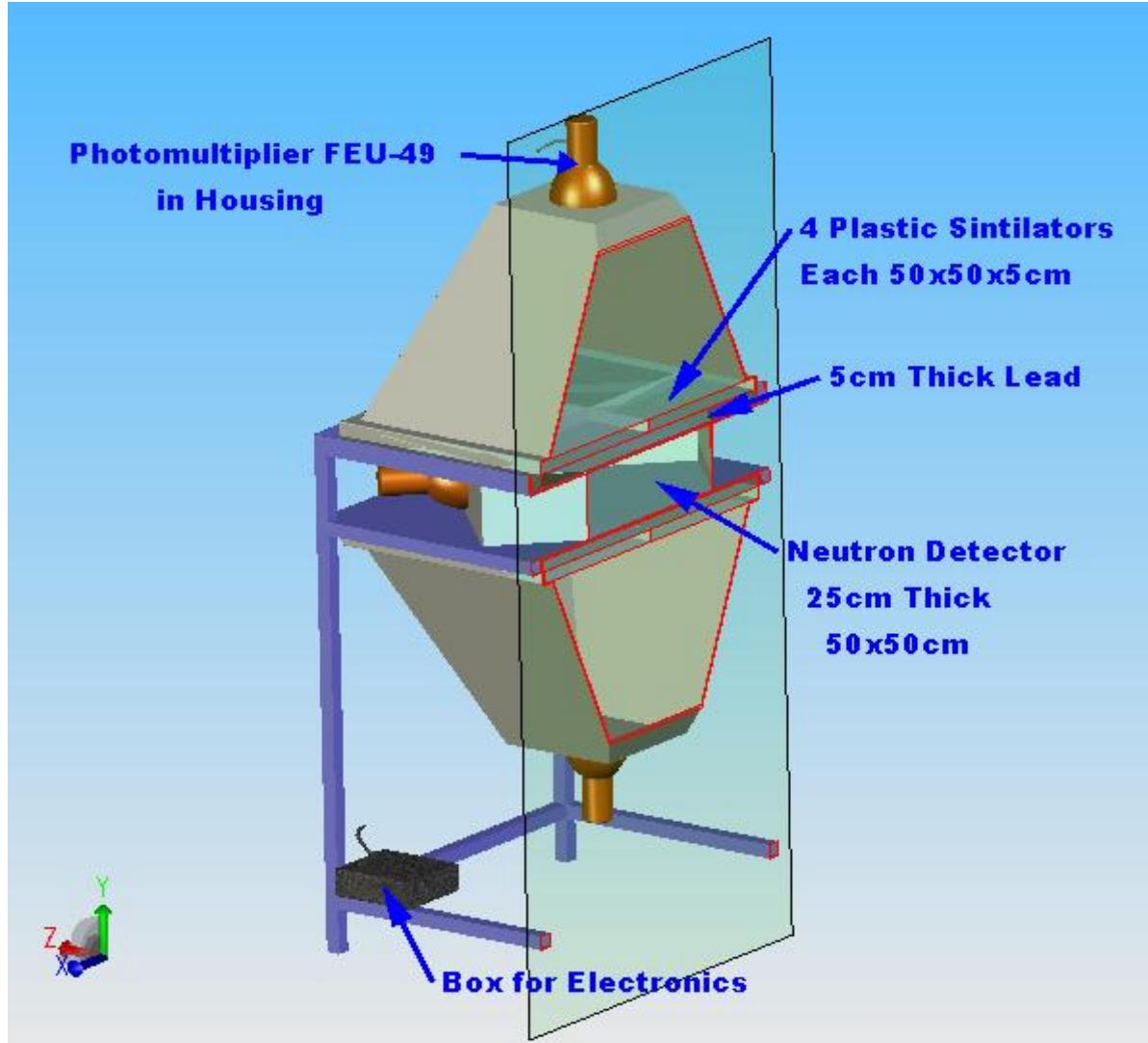


Spectrum



Sevan Detector

Space Environmental Viewing and Analysis Network



Software Trigger
(Microcontroller based)

111 – Charged particle-
high; 300 MeV muon

010 – Neutral particle

100 – Low energy charged
particle

011 – High energy neutral
particle

001 – horizontal muon

101 – 2 horizontal muons

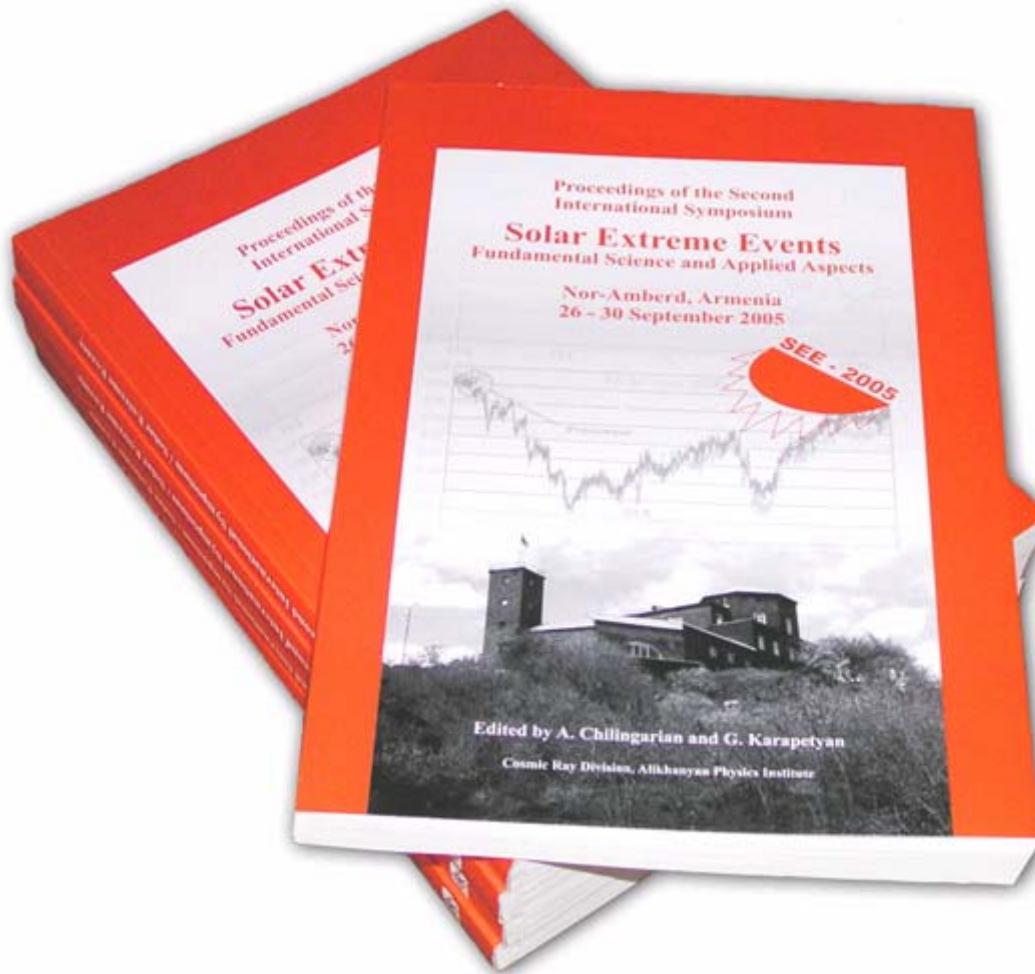
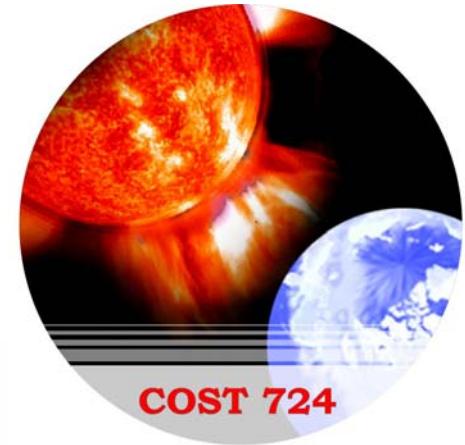
MMM – Extensive Air
Shower

Space Environment Viewing and Analysis Network (SEVAN)





Proceedings of the International Conference Solar Extreme Events - 2005



http://crdlx5.yerphi.am/index.php?Page=/Online_News/CRDSEE/Proceedings/&Title=0