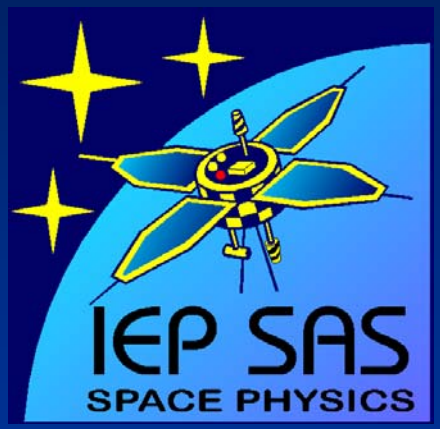
Cosmic Ray measurements at Lomnický štít



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Lomnický Štít (2634 m above sea level in High Tatras mountains, 49.40 N, 20.22 E, geomagnetic vertical cut-off rigidity for cosmic rays ~ 4 GV) comprise cosmic ray and solar observations by Slovak Academy of Sciences and those by Slovak Hydrometeorological Institute.

From the history.

Measurements of ***cosmic rays in High Tatras*** commenced ***50 years ago*** as a part of Czechoslovak scientific program associated with the International Geophysical Year (***IGY***). The experimental device for measurement of muon and nucleon components of cosmic rays was built. Initial data were recorded in bi-hourly intervals.

Experience gained during IGY indicated that shorter recording intervals are necessary for many transient studies. Hourly data were routinely archived from February 1, 1968. The average counting rate of IGY neutron monitor at that time was ~ 9.10^4 per hour. From January 1972 a 4-tube IQSY (International Quiet Sun Year) monitor with an hourly counting rate ~8.10^5 replaced the IGY monitor. This one was subsequently replaced in December 1981 by an 8-tube NM64 installed in the small house on the roof of the main building.

Current status:

8NM64 neutron monitor measures continuously cosmic rays at Lomnický Štít with high statistical acurracy (average count rate ~440 s^{-1}). This allows ***to detect small variations of primary cosmic rays on the ground***

Relations of cosmic rays (CR) to space weather (SW) effects:

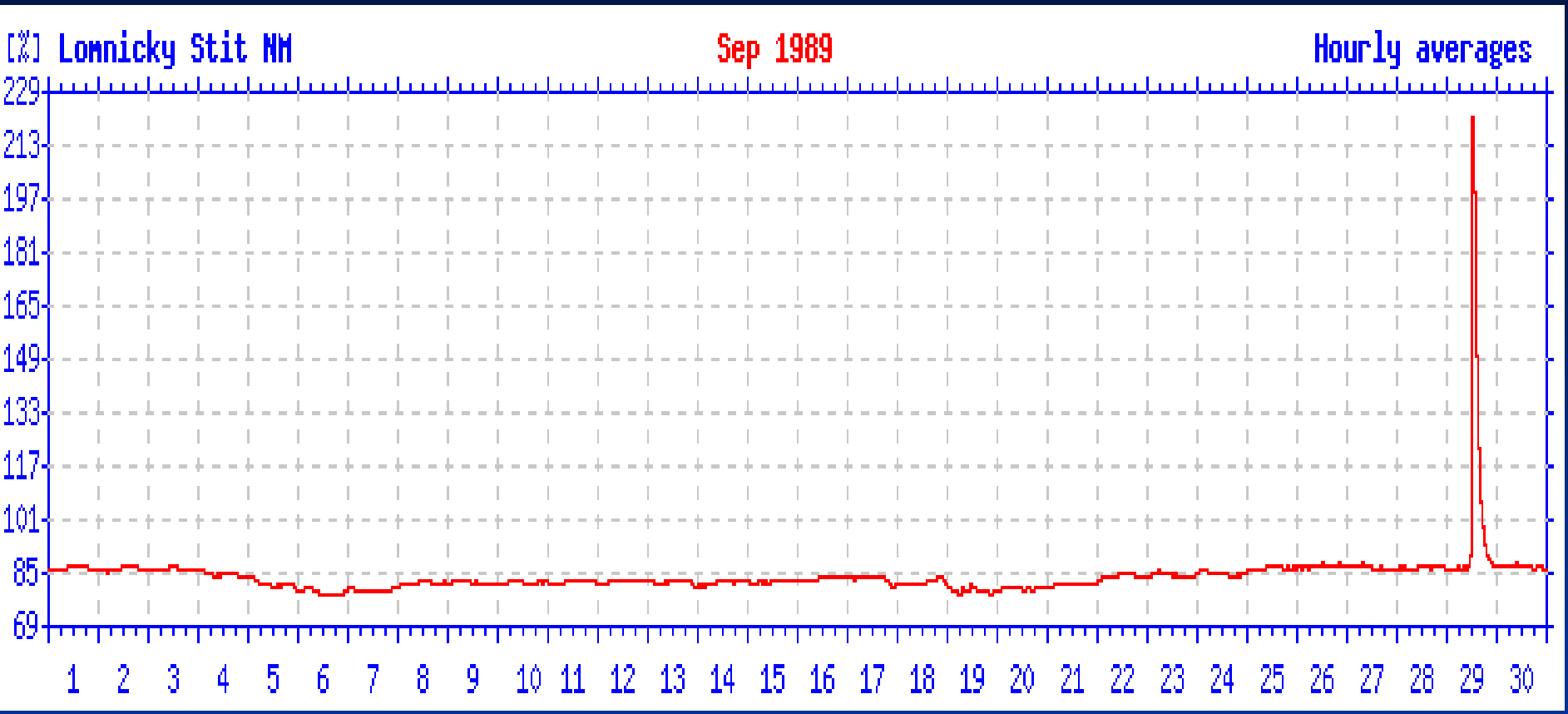
1. Anisotropy of cosmic rays is (in many cases) apparent several hours before CME (coronal mass ejection from the Sun) “arrives” to the vicinity of Earth and initiates a geomagnetic storm with consequences on technological systems at satellites, airplanes and on the ground ***(important for eventual forecasts of SW effects, indirect relations between CR and SW effects).***

2. Monitoring of high energy particle emissions during solar flares or during acceleration in interplanetary space ***(important for description of energetic particle population interacting with materials including the atmosphere, direct relations of CR to SW effects)***.

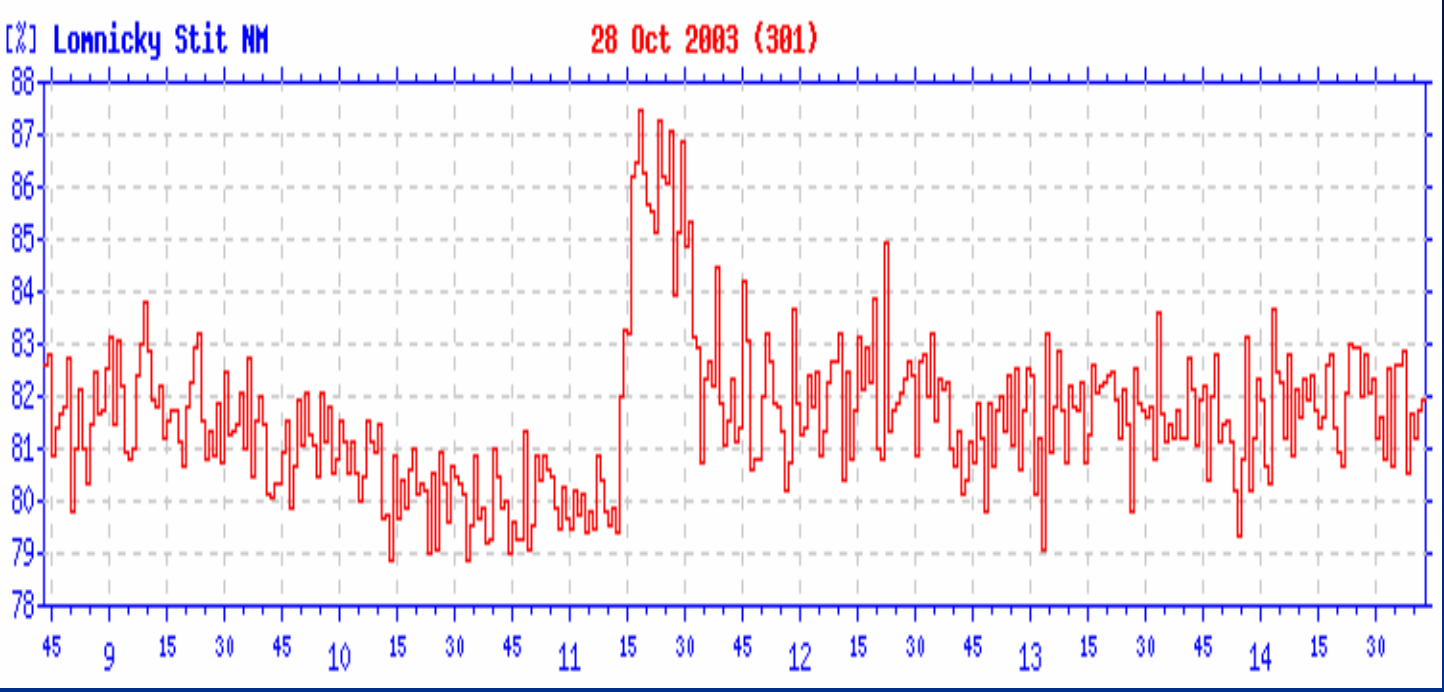
Ground level events.

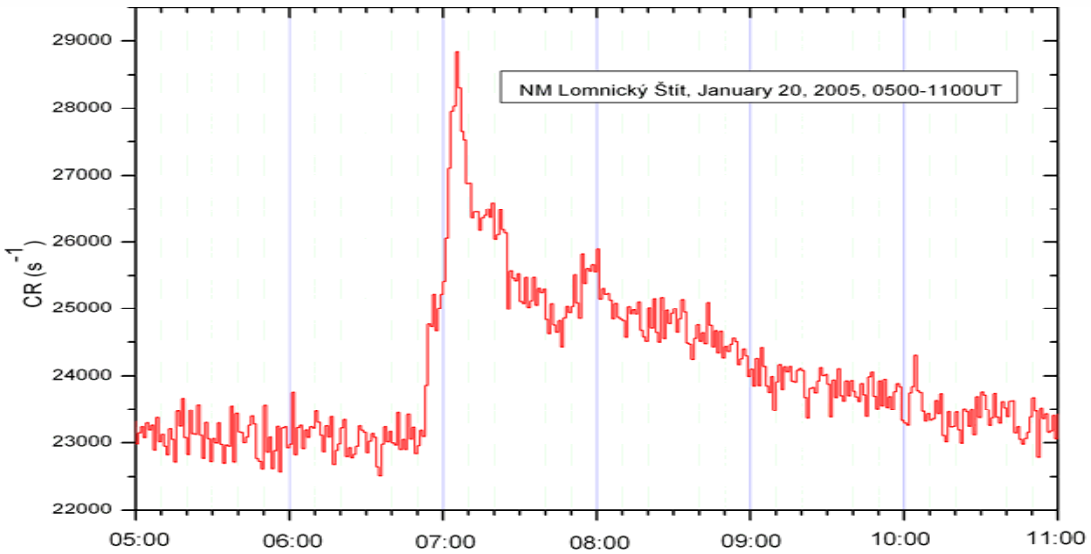
Table 1 Solar acceleration events observed at 4 GV (increases >3 % at LŠ from 1966, numbers from GLE data base).

GLE Nr	YYMMDD	T OF MAX	INCR (%)
17	670128	1000-1015	5.0
29	770924	0940-0955	3.9
30	771122	1035-1040	4.2
31	780507	0340-0345	32.9
36	811012	0755-0810	3.6
38	821207	0000-0005	9.1
39	840216	0910-0915	3.7
42	890929	1240-1245	179.5
45	891024	1915-1920	22.2
47	900521	2310-2315	5.3
48	900524	2115-2120	6.5
49	900528	1040-1045	3.8
52	910615	0925-0930	4.1
60	010415	1418-1419	13.5
65	**031028**	**1117-1118**	**8.8**
69	**050120**	**0705-0706**	**23.9**
70	**061203**	**0300-0310**	**12.0**



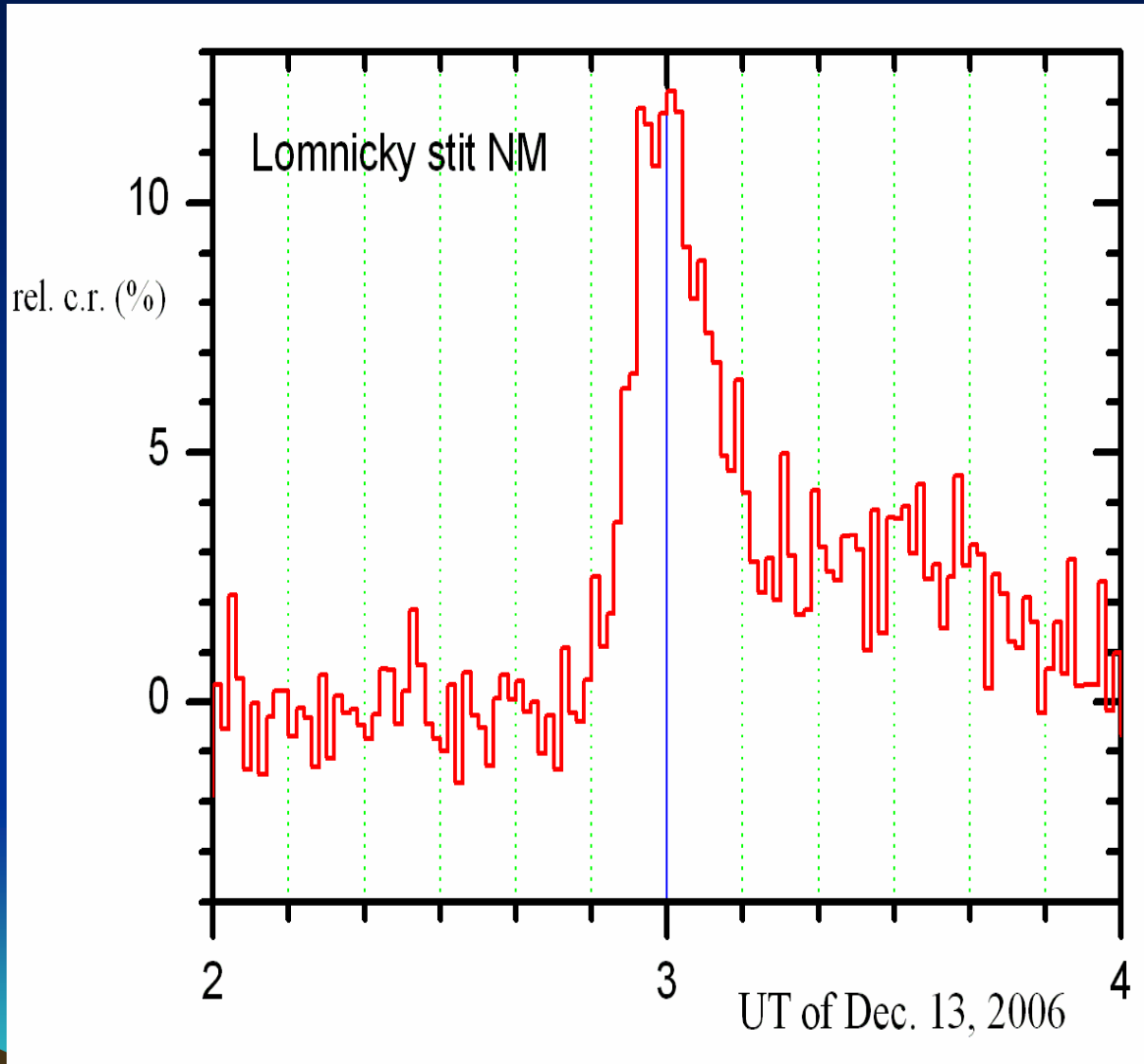
The largest increase observed at Lomnický Štít NM was that on September 29, 1989, due to solar particles. High energy particles may affect the materials, electronics at high altitudes and cause the changes in the atmosphere

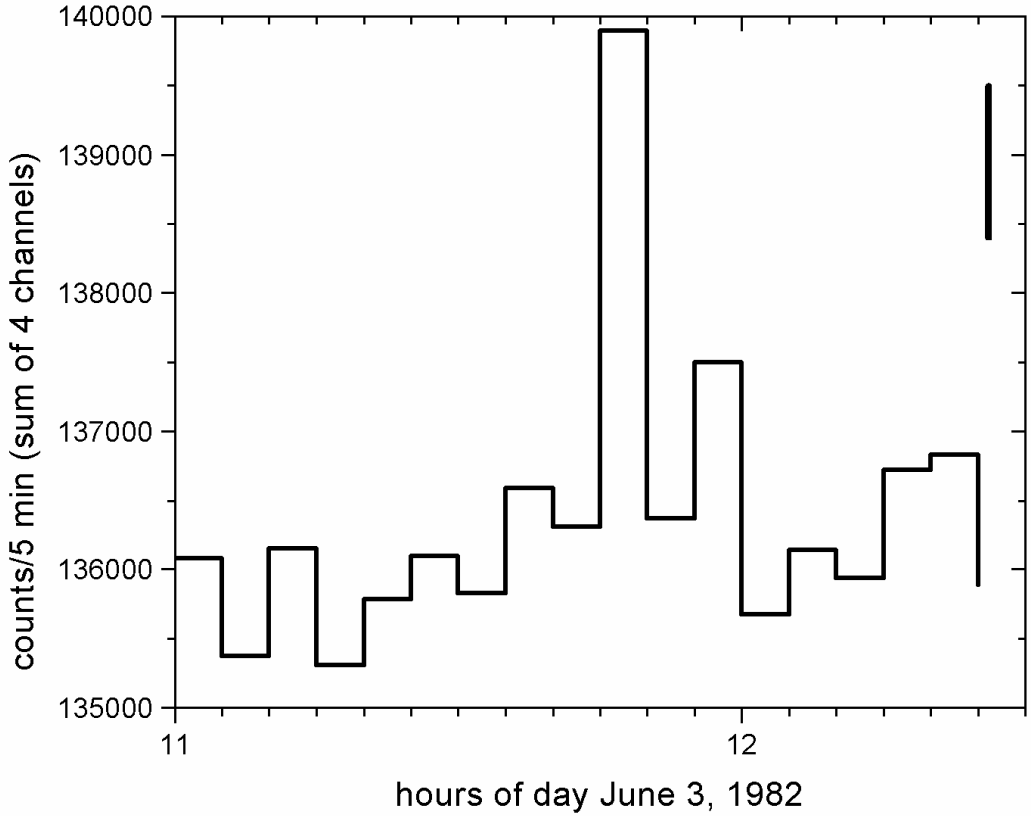




Two GLEs observed at Lomnický štít indicating acceleration to > 4 GV.

Recently (unexpected during solar activity minimum) particles of very high energy were produced during a solar flare on December 13, 2006. Measurements at Lomnický Štít confirmed the acceleration to at least 4 GV. 1min data indicate 12 % increase above the background.





Lomnický Štít solar neutron response during the first ground level event observed as a consequence of solar neutron emissions observable on Earth's orbit. High statistical accuracy confirmed other observations during that event on Jungfraujoch, Switzerland . 3 sigma bar is shown.

Continuous cosmic ray observations at Lomnický Štít (in addition to satellite measurements and other ground based observations of CR) is potentially useful both for ***monitoring of primary CR variability*** and for ***eventual forecasting of space weather effects***.

EXISTING INFRASTRUCTURE OF IEP SAS AT LOMNICKÝ ŠTÍT, PERMANENT STAFF THERE (R.Langer, V.Kollár, S.Štefánik) AND ITS EXPERIENCE CAN BE USED FOR OTHER TYPES OF HIGH MOUNTAIN STUDIES (e.g. ATMOSPHERIC, DOSIMETRIC)

Data NM available in real time at http://neutronmonitor.ta3.sk ,

more about energetic particle experiments with IEP SAS participation at http://space.saske.sk

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