SAYAN SPECTROGRAPHIC COSMIC RAY COMPLEX

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The ISTP SB RAS Sayan mountain spectrographic complex was placed into operation in 1971. It consists of three stations of the neutron monitors located at various levels in an atmosphere of the Earth:

IRKUTSK 475 m (IRKT) – 18 NM64

IRKUTSK 2000 m (IRK2) – 12 NM64

IRKUTSK 3000 m (IRK3) – 6 NM64

12 NM64 NEUTRON MONITOR

Altitude 2000 m;

Geographic Coordinates 52.37N 100.55E

Rc(1965)= 3.64 GV; SF= 256;

Pressure Coefficient= -0.713 %/mb

Corrected to 800 mb Standard Pressure mean count per hour - ~ 1500000 c/hour

18 NM64 NEUTRON MONITOR

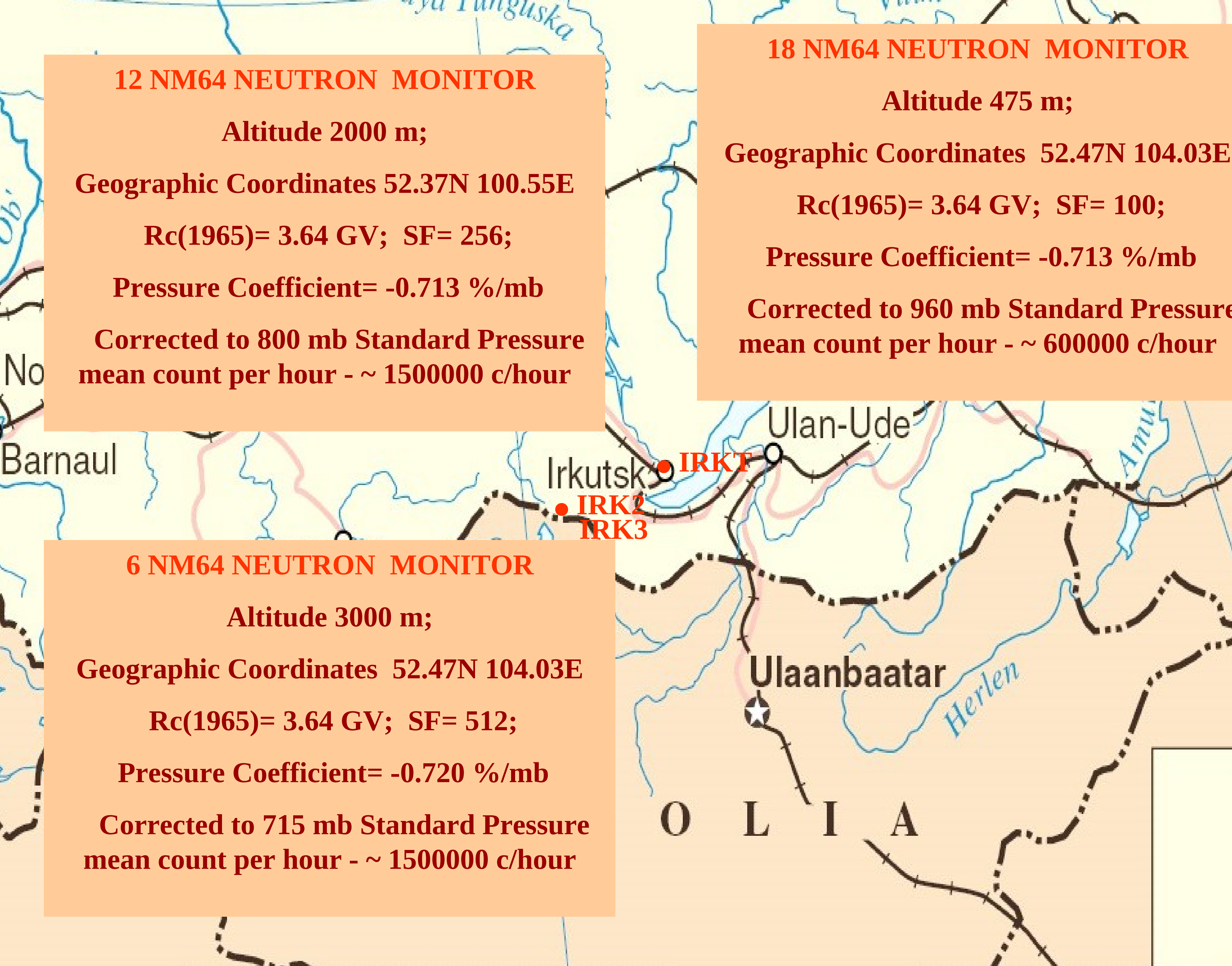
Altitude 475 m;

Geographic Coordinates 52.47N 104.03E

Rc(1965)= 3.64 GV; SF= 100;

Pressure Coefficient= -0.713 %/mb

Corrected to 960 mb Standard Pressure mean count per hour - ~ 600000 c/hour



6 NM64 NEUTRON MONITOR

Altitude 3000 m;

Geographic Coordinates 52.47N 104.03E

Rc(1965)= 3.64 GV; SF= 512;

Pressure Coefficient= -0.720 %/mb

Corrected to 715 mb Standard Pressure mean count per hour - ~ 1500000 c/hour

Data vailable:Real-time

- IRKUTSK 475 m (IRKT) since 1972 (resolution 1hour-1 year)
  since 2001 resolution 1min - 1 year

Quazi-real-time

- IRKUTSK 2000 m (IRK2) since 1981 resolution 1hour-1 year

- IRKUTSK 3000 m (IRK3) since 1981 (resolution 1hour-1 year)
  since 2006 resolution 1min - 1 year

http://cgm.iszf.irk.ru

http://cgm.iszf.irk.ru

IRKUTSK 475 m (IRKT)


18 NM64

Connection between the pavilion and the Institute is implemented using wireless access equipment DWL-2000 and DWL-2100 made by D-LINK.

GPS-2303

New direct current sources GPS-2303 made by INSTEK have been set to supply high-voltage power packs and amplifier-discriminators

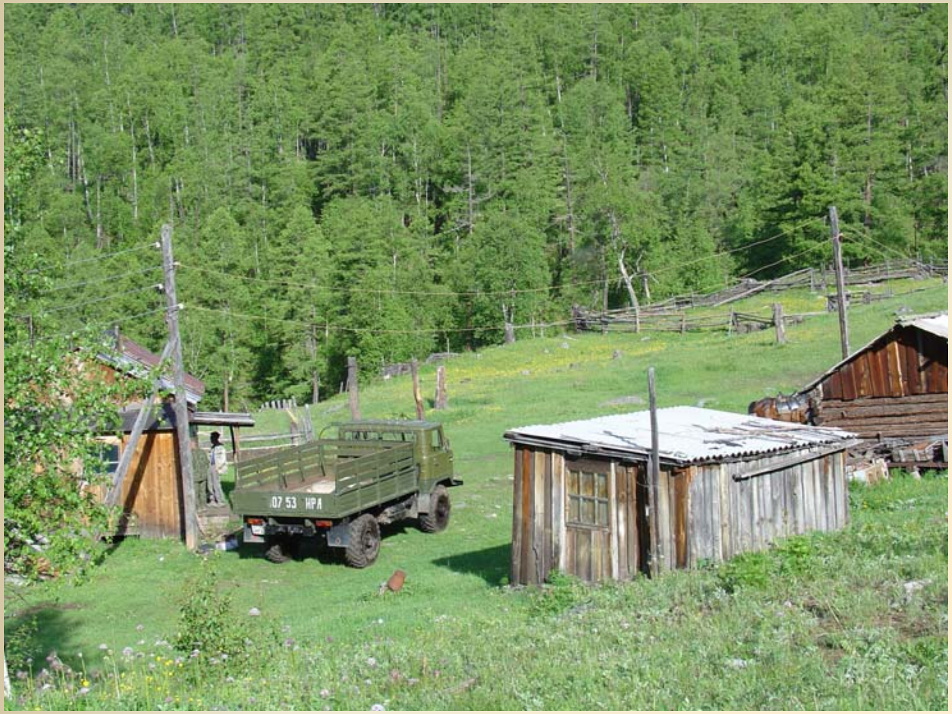
IRKUTSK 2000 m (IRK2)


12 NM64

AirPlusG+ DWL-2000
AP+
AirPremier DWL 2700AP
point of wireless access of
802.11g standard

GRAD 2483M
(amplification 15dBi)
GRAD 492
(amplification 24dB)


View of mountain Khulugaisha



The base is at 1500 м

Rising with the help of horses

Way to station at altitude of 3000 m

3000 m mountain Khulugaisha


6NM64

AirPremier
DWL 2700AP
GRAD 2492

When Sayan mountain spectrographic complex was created It was conceived that rigidity spectrum of CR intensity variations registered at another observation station can be described by the power dependence $$\frac{\Delta D}{D}(R) = BR^{-\gamma}$$

where *R* is the magnetic particle rigidity, and that it is not distorted by the anisotropy in the input-directed particle distribution.

At that time, the spectrograph consisted of three neutron monitors 18HM64, 12HM64 and 6HM64, locating at the level of 435, 2000 and 3000 m. in the Earth atmosphere correspondingly. Besides, a hard μ-meson and a soft electron-photon components were registered at the level of 435 m. Parameters of primary CR spectrum *B* and γ as well as *Rc* geomagnetic cutoff rigidity at this station were determined from the data of these measurements.

The rigidity spectrum parameter γ was revealed to have considerable daily and half-daily variations.

Having compared the obtained geomagnetic cutoff rigidity variations (*Rc*) with Dst during magnetic storms, we found out that the correlation between these magnetosphere characteristics is not so significant as it follows from the theory of CR magnetospheric effect. Correlation was observed between *B* and γ parameters of spectrum variations, and *Rc* parameters characterizing geomagnetic cutoff rigidity variations, which can be calculated from the solution of the system of equations for CR intensity variations.

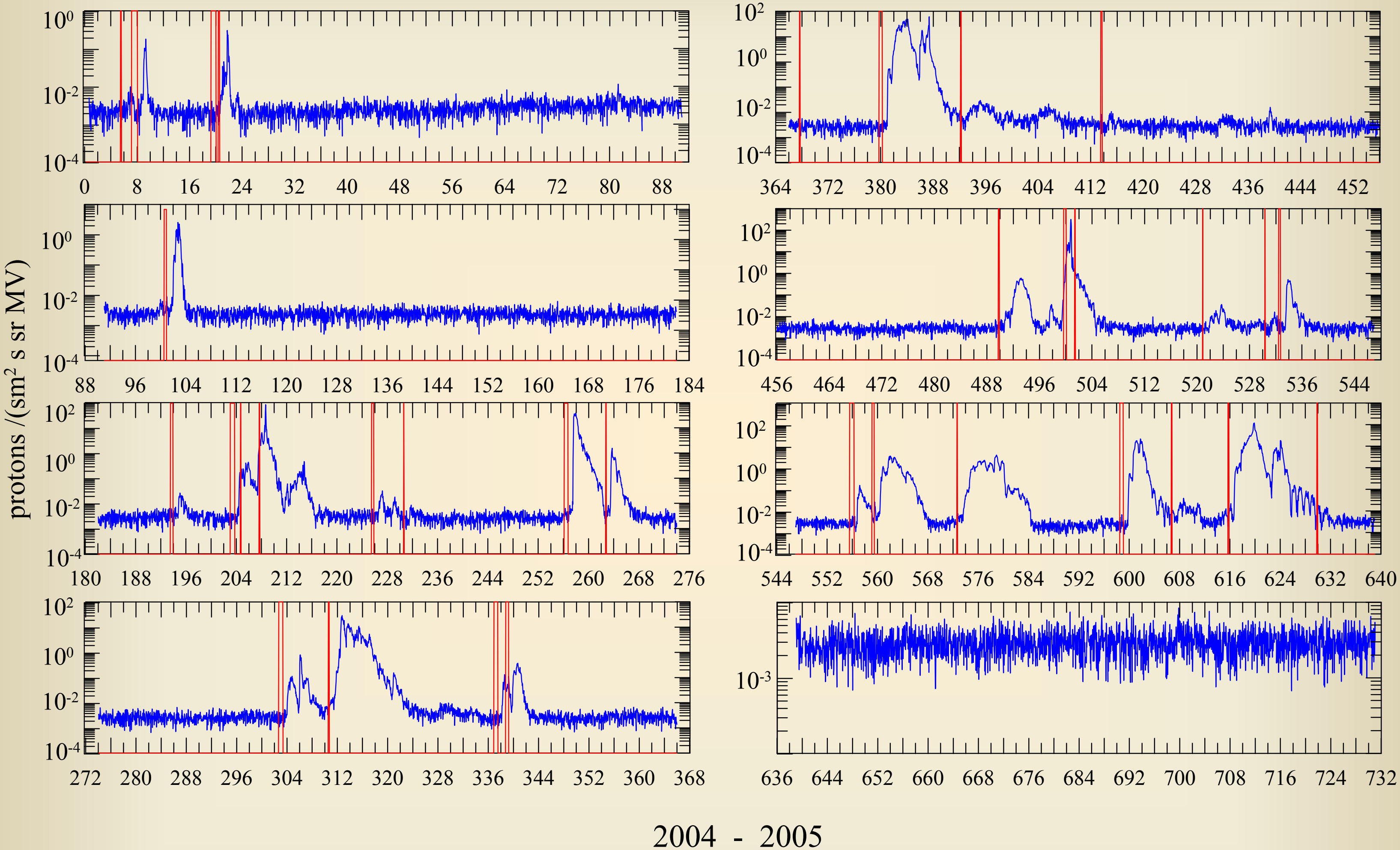
Relaying on these facts, we concluded that there is large-amplitude anisotropy in the input-directed CR distribution during Forbush effects. This anisotropy can be responsible for considerable deviation of rigidity spectrum of particles, which are registered by the spectrographic complex at a station of the world network, from the power law. At the same time, the deviation degree will depend on the local time; it may cause observable periodicity of γ parameter, correlations between the roots of solvable system of equations (B, γ, Rc), and may result in obtaining inadequate information. On the basis of this, we drew a conclusion about relatively weak particle scattering by the solar wind fields; consequently there is another nature of modulation effects in comparison with convective diffusion model.

In this connection, the concept of the CR modulation by the solar wind regular electromagnetic fields was developed *Dvornikov V.M., Matukhin Yu.G. Energy losses of cosmic rays with the solar wind motion in the regular magnetic field. Izv. AS USSR*. Ser. Phys. 1976. V. 39, No 3. P. 624-626 (in Russian). On this basis we worked out a method of spectrographic global survey in order to study rigidity spectrum variations, the CR anisotropy, and variations in the planetary system of geomagnetic cutoff rigidities for every observation hour *Dvornikov V.M., Sdobnov V.E. // J.Geophys.Res. 1997. V. 102, No A11. P. 24209-24219.* using data of the world network of stations and spectrographic complexes.

Hence, now ISTP SB RAN has a model of CR modulation by regular magnetic fields of the heliosphere. The model allows connection of characteristics of these fields with rigidity spectrum parameters and high-energy particle anisotropy; on this basis, it will be possible to monitor and forecast electromagnetic and radiation conditions in the Sun-Earth system using algorithms developed.

It is necessary to fulfill certain requirements of the explotable network of stations in order to realize these algorithms. The network should consist of not less than 30 neutron monitors disposed over the Earth and baric levels in the atmosphere in a certain way. Such network provides information on rigidity spectrum variations, relativistic CR anisotropy beyond the Earth's magnetosphere, and on variations in the planetary system of geomagnetic cutoff rigidities for every observation hour. This information together with satellite-obtained one on energetic particles makes it possible to investigate sporadic phenomena in the heliosphere and their precedent or sequent phenomena, as well as to monitor radiation environment at the earth orbit.

In particular, a method of the solar proton events' forecast was developed within the bounds of this approach *Dvornikov V.M., Kravtsova M.V., Lukovnikova A.A., Sdobnov V.E. Izv. RAS. Ser. Phys. V. 71, No 7. P. 976-978 (in Russian).* We should have necessary real-time information to use this method in practice. The approbation results of this method using the data sampling for 2004-2005 are presented in Fig. 1.


protons /(sm^2 s sr MV)
0 8 16 24 32 40 48 56 64 72 80 88
88 96 104 112 120 128 136 144 152 160 168 176 184
180 188 196 204 212 220 228 236 244 252 260 268 276
272 280 288 296 304 312 320 328 336 344 352 360 368
364 372 380 388 396 404 412 420 428 436 444 452
456 464 472 480 488 496 504 512 520 528 536 544
544 552 560 568 576 584 592 600 608 616 624 632 640
636 644 652 660 668 676 684 692 700 708 716 724 732
2004 - 2005

Conclusion

In order to solve problems of monitoring and space weather forecast using CR effects, it is necessary to have continuous registration of CR intensity at the present world network of neutron monitor stations, satellite measurements outside the magnetosphere, and to use the appropriate modulation model as well as perform special data processing techniques that makes it possible to employ the entire measuring complex as a joint multi-channel device.

At present the ISTP SB RAS Sayan spectrographic complex is ready to operate in real time. When developing automatic data-collection system, it can be used as a part of the limited network of stations to solve practical problems concerning prediction of solar proton events.


THANK YOU!