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ENVIRONMENTAL RADIATION MEASURED IN TUNGUSKA (SIBERIA) AND DURING THE FLIGHTS FROM FORLI -KRASNOYARSK -FORLI

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1 Introduction

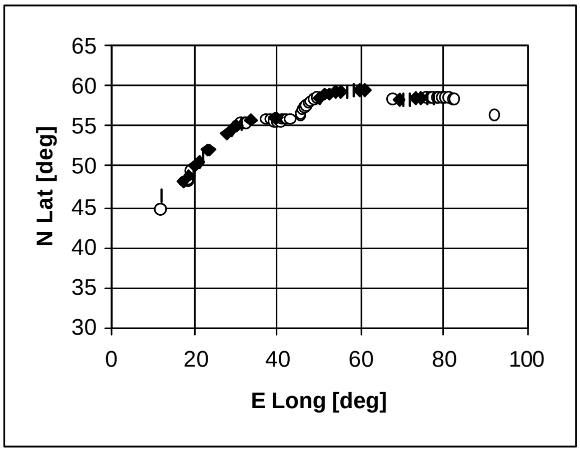
In July 1999, during the TUNGUSKA99 expedition in the Vanavara region (Siberia), one detector for the monitoring of the Environmental Radiation (ER)[1] {cosmic radiation plus radioactivity with E > 50 keV} was operated on board of the aeroplane that took the expedition from Forli (Italy) to Krasnoyarsk (Siberia) and back, and while at the base camp of the expedition close to Cheko Lake [2]. The main purpose was to measure the cut-off and altitude variations of the secondary cosmic radiation with energies in the range 3-10 MeV and to monitor the presence of radionuclides either of local or airborne origin.

2 The detector

The detector was an improved version but with minor changes with respect to the one described in [2]. It is based on a NaI(Tl) mono-crystal having the dimensions (10cm x 20∅ cm) and 2 cm of Pb, 0.1 cm of Cu and 0.3 cm of Al shaped around the crystal and the PMT. No KOH source is present in order to have continuous adjustment of PMT gain as the HV supplied by the new ACQ card coupled to a PC was found to be very stable. We accumulated 2048-channel spectra every 10-15 minutes with 3 keV/ch resolution. An online program allowed a quick-look analysis and graphical inspection of data collected in different pre-set energy bands. Pressure data were available at different times sporadically.

3 Observations during the flight

The detector was located in the aeroplane main cabin that was pressurised at 940mbar. The total thickness of the body was estimated of 3 mm of Al. The data concerning altitude and position of the aeroplane were made available by the crew. The flight started from Forli the 14/07/1999 at 10:35 UGT and landed in Moscow at 16:15 UGT the same day. It departed at 20:30 UGT and arrived in Krasnoyarsk (Siberia) the 15/07/1999 at



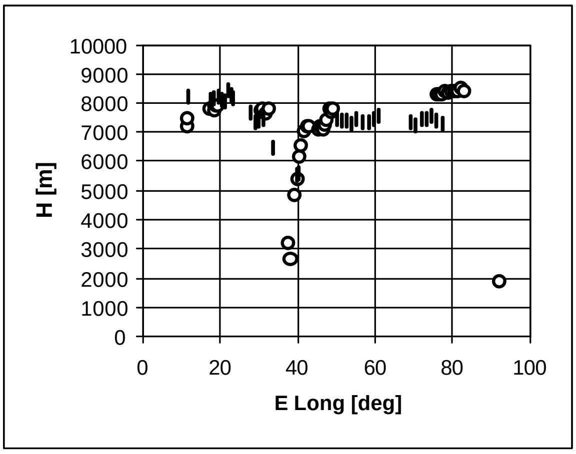


Figure 1- (left) Position in geographic coordinates of the aeroplane and (right) altitude during the flight from Forli- Moscow- Krasnoyarsk-Moscow- Forli. Open circles: Forli-Krasnoyarsk; dots: return.

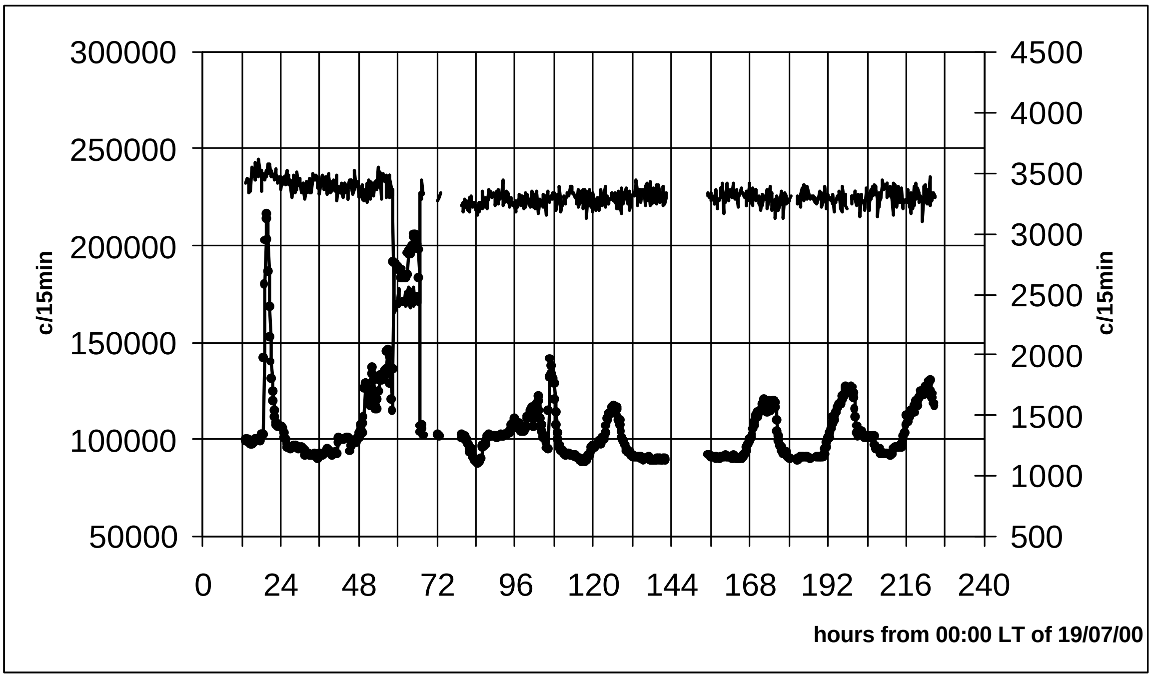


Figure 2.- Time series of counting rate in the band 20 keV-3 MeV [airborne and local origin radionuclides] (lower curve, left scale) and for energies > 3 MeV [ultrasoft cosmic rays] (upper curve, right scale). In the former one can notice sporadic radon storms and daily variations. In the latter a big decrease when the detector was turned upside down.

about 4:00 UGT. The return started the 29/07/99 at 13:00 UGT with a stop in Moscow [29/07 20:00 - 30/07 15:00] and arrival in Forli the 30/07/99 at 20:10 UGT. As stated above our main interest was on the variation of secondary cosmic ray flux as function of altitude and geographical position. The first one varied between ground level and 8400 m. a.s.l, the latter one from Lat 44° 35' N and Long 11° 47' E up to 59° 31' N and 92° 09' N respectively. In figure 1 we report the flight journey (geographical coordinates and altitude). We calculated the attenuation length by using the data at 8400 and 7200 m a.s.l for the same vertical rigidity cut-off (1.95 GV) and results =(200±10) g/cm^2 in agreement with observations up to 5050 m a.s.l. [3].

4 Observations at Cheko Lake

The figure 2 shows the time history of the observations for the radioactivity band [50keV-3 MeV]. As already measured by us in other places [3-5] sporadic increments lasting few hours and daily variations are present [see e.g. 19/07/99 and the last few days 25-28/07/99]. The origin of the former variations are to be found in the airborne radionuclides presence; in fact the inspection of the spectral features in the difference between the spectrum before and after the peak [fig. 3] reveals the presence of peaks typical of radon daughters. We notice that a rainstorms was recorded during that same hours. The detector was also turned upside down and this is the cause of the episodic increase in the radioactivity band during 21/07/99. The spectrum does not show any peculiarity with respect to the spectrum when the detector was looking upward. The increment is due to the fact that the source of radioactivity is in the ground.

During the last days of the data taking one can observe diurnal variations. This are probably due to increased release of radon from ground during the warmest hours of the days [3].

The hourly counting rate of the cosmic ray component with energy in the range 3 – 10 MeV is shown in figure 4. Our data seem to agree with Moscow neutron monitor station for the same period. Unfortunately the Forbush decrease observed by that station in day 19/07/99 occurs at the time of an interruption in our data taking. However the jump of 5% in the counting rate recorded before and after the interruption can be explained by the occurrence of such an event.

5 Conclusions

Our detector for airborne radioactivity and ultrasoft cosmic ray component has been operated with good continuity on board of an aeroplane and in a remote region of Siberia. With our observation we were able to confirm the existence of sporadic radonic storms in connection with rain washout. With observations at high altitude it will be possible, by means of a very small and portable detector, to have significant measurements of cosmic ray flux variations as a consequence of solar activity

Acknowledgments

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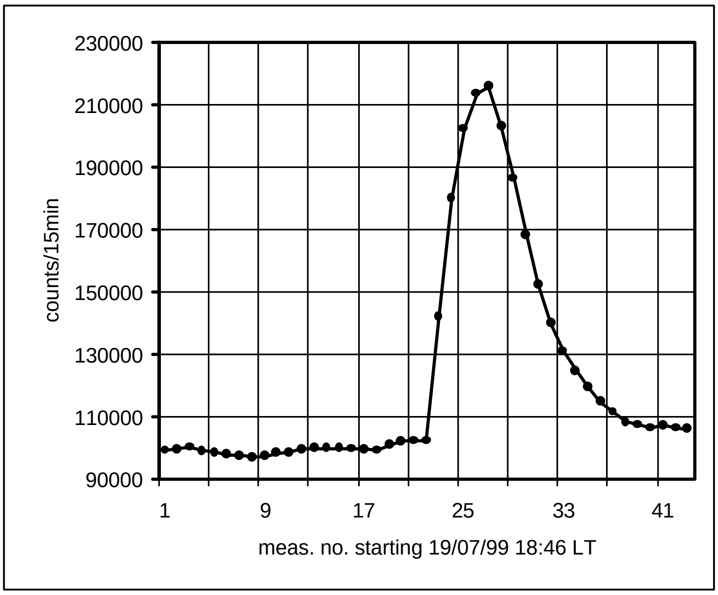

Figure 3- Radonic storm registered at the base camp of Cheko Lake during a rain storm.

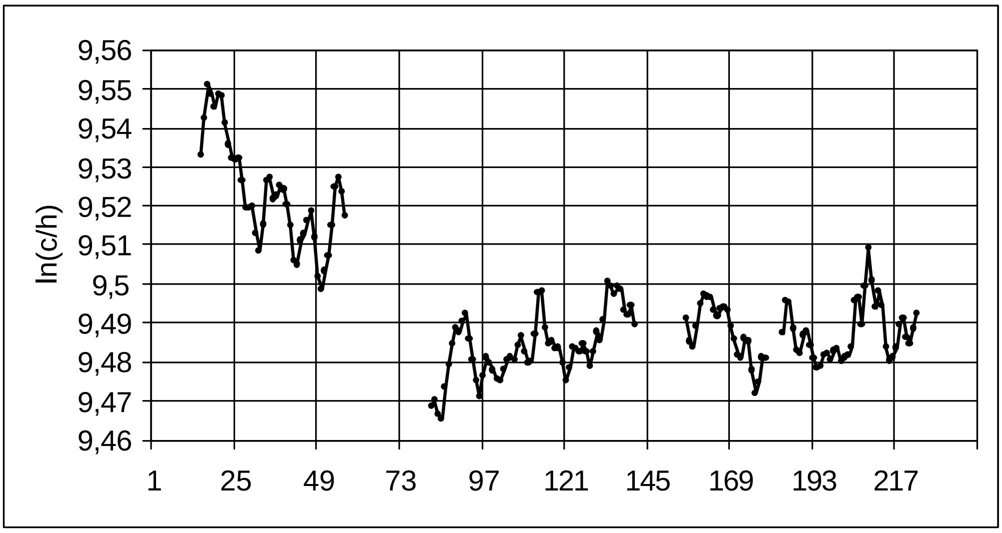

Figure 4- Hourly counting rate of cosmic rays component with energy [3-10 MeV](logarithmic scale) starting from 00:00LT of day 19/07/1999