

Name of research institute or organization:

Physikalisches Institut, Universität Bern

Title of project:

SONTEL – Solar Neutron Telescope for the identification and the study of high-energy neutrons produced in energetic eruptions at the Sun

Project leader and team

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Project description:

The solar neutron telescope (SONTEL) at Gornergrat, Switzerland, has been in operation since 1998 as the European cornerstone of a worldwide network for the study of high-energy neutrons produced in energetic processes at the Sun.

In 2003 the operation of SONTEL was continued. SONTEL was in operation during 99.3 % of the time. A few interruptions were due to breaks in the power supply longer than the autonomy time of the uninterruptible power supply (UPS) and to hang-ups of the data-taking computer. The reliability performance is expected to improve with a new data-taking computer system that will be developed and put in operation in 2004.

During a large solar eruption on April 15, 2001, when solar particles were observed by cosmic ray detectors on Earth the proportional counters of SONTEL showed a large count rate increase that started several hours before the solar event onset and that had a much longer duration compared to the solar event response as recorded by the other detector channels (see our report on the SONTEL measurements at Gornergrat in the Activity Report 2001 of the International Foundation HFSJG). Simultaneously, an increased level of environmental radioactivity was measured in the detector housing. Since April 2001 further events of enhanced environmental radioactivity have been observed that were not associated with a GLE. For the investigation of these enigmatic increases we made additional measurements of the radon concentration in the detector housing. The measurements, taken from February 27 to March 21, 2003, are summarised in Figure 1. The data show that the radon concentration varied greatly. The counting rate of the proportional counters shows similar variation in the order of a few percent. The variation correlated highly with the radon concentration. The large increases in the radon concentration are also clearly visible in the recordings of the environmental radioactivity. On the other hand the changes in the counting rate of the 40-80 MeV scintillator channel reflect mainly the variations in the primary cosmic ray intensity. A possible explanation is the radon outgassing from the ground. During the season with little or no snow the radon outgassing from the ground under the lab container is well mixed with the surrounding air. However, during times with a thick snow cover the foundation is sealed and the outgassing radon can only leak into the labcontainer through an inlet for cables and escape through an opening for the ventilator (see Figure 2).

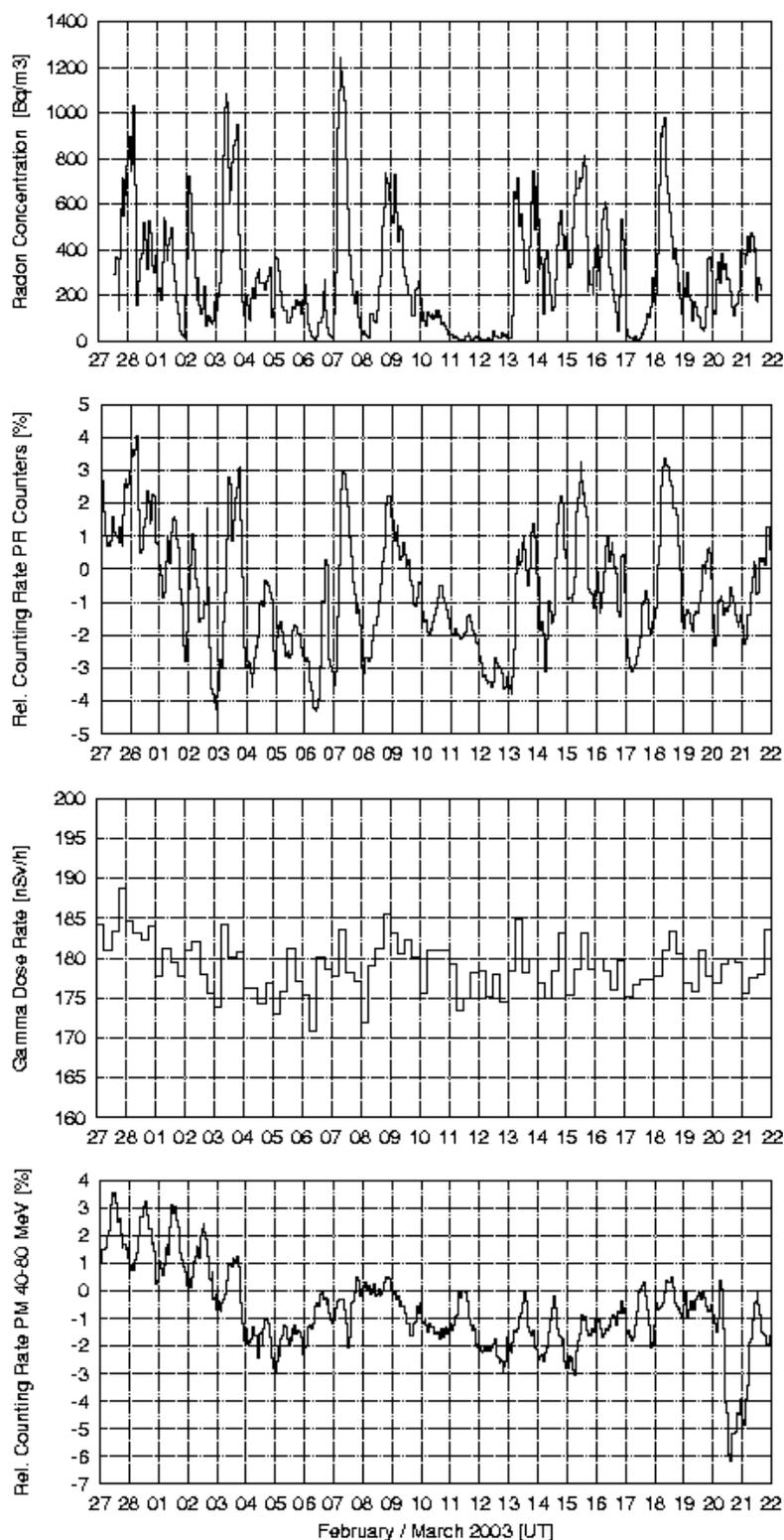


Figure 1: Radioactivity measurements at Gornergrat in the time interval February 27 to March 21, 2003. From top to bottom: Hourly values of radon concentration in the lab container, relative counting rate of the SONTEL proportional counters, 6-hour averages of environmental radioactivity, and relative counting rate of the 40-80 MeV SONTEL neutron channel.

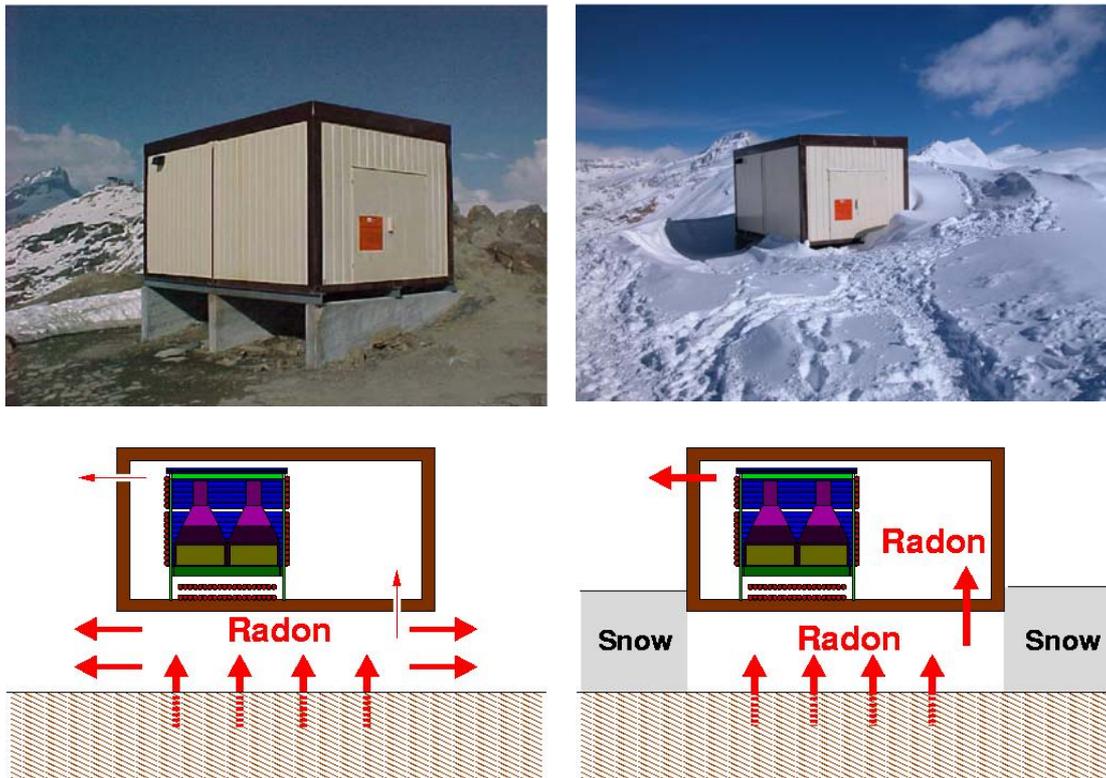


Figure 2: Top: Picture of the lab container at Gornergrat with no snow (left) and with a thick snow cover (right). Bottom: Schematic diagrams of the possible scenario without snow (left) and with a thick snow cover (right).

At the end of October and the beginning of November 2003, a series of energetic solar eruptions occurred. For the solar eruption on October 28, 2003, the time of maximum X-ray flux was 1110 UT (see also our report in this volume on the neutron monitor measurements at Jungfraujoch). Therefore, the most suitable positions to detect solar neutrons by the detectors of the global solar neutron network were at European longitudes. However, due to the large zenith angle at that time of the year the chance to detect solar neutrons at latitudes such as Gornergrat is very small. From the analysis of the data made so far we conclude that SONTEL did not observe any solar neutrons during this event.

Unfortunately, the energetic solar eruptions which followed the October 28, 2003, event occurred during times of day which were not favorable for the Gornergrat station. In particular, the X28 flare on November 4, 2003, the largest solar eruption ever observed, occurred at 1953 UT.

Nevertheless, even in the absence of solar neutrons the SONTEL data during the October/November 2003 time period are of special interest, in particular for the study of solar-terrestrial effects. The comparison of the intensity-time profiles of the photomultiplier channels without anti (charged particles) with the intensity time profiles of the photomultiplier channels with anti (neutral particles) shows interesting but yet unexplained features during the dramatic decrease with onset on October 29, 2003. Further inspection of this phenomenon complementing the analysis of the NM observations at Jungfraujoch and of the global network of ground-based cosmic ray detectors is expected to yield new insight into both the response of the detector and the mechanisms which are responsible for the modulation of galactic cosmic rays in association with coronal mass ejections.

Key words:

Astrophysics, cosmic rays, solar neutrons

Internet data bases:

<http://cosray.unibe.ch/>

<http://stelab.nagoya-u.ac.jp/ste-www1/div3/CR/Neutron/index.html>

Collaborating partners/networks:

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Scientific publications and public outreach 2003:

Conference papers

Moser, M.R., L. Desorgher, and E.O. Flückiger, Solar Neutron Telescope at Gornergrat: Monte Carlo Simulation of Detector Properties, Annual Meeting of the Swiss Physical Society, Basel, 20-21 March, 2003.

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“Auf der Sonne ist einiges los”, Basler Zeitung, November 04, 2003.

“Aurores boréales visibles jusqu'à mardi”, l'agefi, November 04, 2003.

“Was ist mit der Sonne los?”, Blick, November 05, 2003.

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“Die unberechenbare Sonne / Flares, Massenauswürfe und ihr Einfluss auf die Erde”, NZZ Neue Zürcher Zeitung, December 24, 2003.

Radio and television

Interviews with Rolf Bütikofer on local television TeleBärn and Radio Extra Bern about the solar eruptions end of October/beginning of November, November 4, 2003.

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