

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:

---

Prof. Erwin Flückiger, project leader  
Dr. Rolf Bütikofer, Dr. Michael R. Moser

Project description:

---

The solar neutron telescope (SONTEL) at Gornergrat, Switzerland, has been in continuous 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. Since 2002 the environmental radiation at Gornergrat has also been monitored by a conventional GammaTracer unit designed and manufactured by Genitron Instruments GmbH, Frankfurt, Germany.

In 2006 the operation of SONTEL and of the GammaTracer was continued. After the renovation work at the Kulmhotel Gornergrat in 2005 with several interruptions in the operation of SONTEL, the reliability of electric power was much better in 2006. During the reporting year only one interrupt in the operation of SONTEL occurred. SONTEL was in operation during 99.8 % of the time.

As in 2005, the Sun again had a phase with extremely high solar activity although the solar activity cycle 23 is at or near its minimum. In December 2006 several solar bursts occurred. On 13 December 2006 the Sun produced a X3.4 class solar burst at 6°S, 23°W with onset time at 0214 UT and maximum at 0240 UT. The worldwide network of neutron monitor (NM) stations observed a ground level enhancement (GLE) with onset time ~0248 UT. The Jungfrauoch neutron monitors (NM) observed a count rate increase of almost 10% in the one-minute data. In Figure 1 the relative count rates of the different energy channels (neutral + charged particles) and (neutral particles) of SONTEL are plotted. As can be seen from Figure 1 the increase in the count rates of the different channels was only ~3-4%. The reason for this difference is the contribution of muons to the count rate of SONTEL due to galactic cosmic rays (~30% for energies >40 MeV at the neutral channel). During typical GLEs the energy spectrum of the solar cosmic rays is significantly softer compared to the spectrum of galactic cosmic rays. Thus the production rate of muons in reactions of primary solar cosmic ray particles with atomic nuclei of the atmosphere is very low and can be neglected. If the contribution of the muons to the counting rate of SONTEL is subtracted, a similar increase as observed by the Jungfrauoch NMs results in the count rates of the different SONTEL channels. At present a detailed analysis of the SONTEL and the NM data during the GLE on 13 December 2006 is in progress.

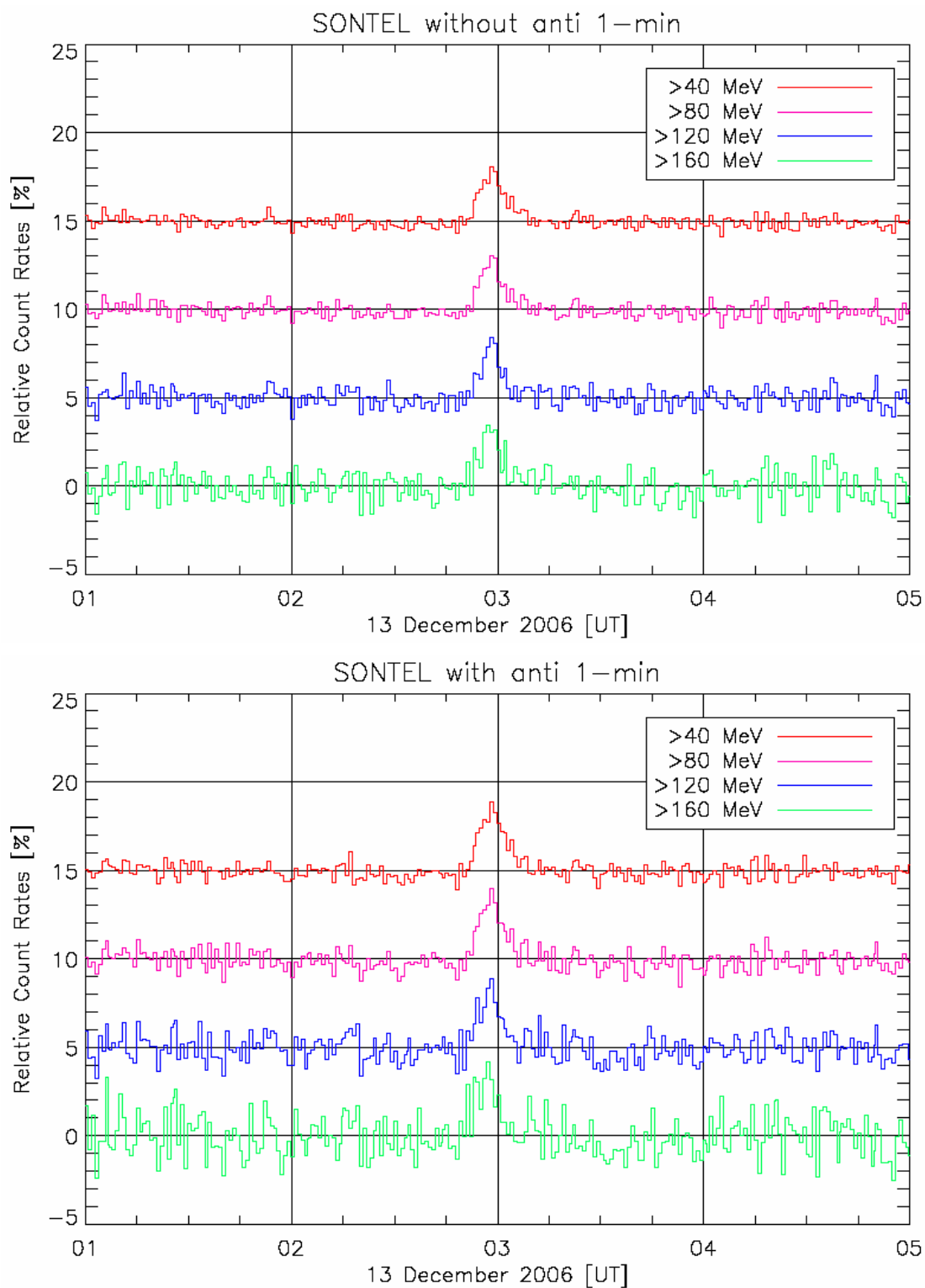


Figure 1: Relative count rates of the energy channels  $>40$ ,  $>80$ ,  $>120$ , and  $>160$  MeV of SONTEL at Gornergrat for the channels (neutral + charged particles) (top) and (neutral particles) (bottom) on 13 December 2006, 0100-0500 UT.

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:

Prof. Y Muraki , Prof. Y. Matsubara, Dr. T. Sako, Dr. H. Tsuchiya, Solar Terrestrial Environment Laboratory, Nagoya University, Nagoya 464-8601, Japan

T. Sakai; Physical Science Lab., College of Industrial Technology, Nihon University, 2-11-1 shin-ei, Narashino-shi, Chiba 275, Japan

Prof. A. Chilingarian, Cosmic Ray Divison, Yerevan Physics Institute, Yerevan, 375036, Armenia

Scientific publications and public outreach 2006:

**Conference papers**

Flückiger, E.O., R. Bütikofer, M.R. Moser, and L. Desorgher, The Extreme Solar Cosmic Ray Particle Event on January 20, 2005, Annual Meeting of the Swiss Physical Society, 2006 in Lausanne, poster presentation.

Flückiger, E.O., R. Bütikofer, M.R. Moser, and L. Desorgher, The Ground Level Enhancement on January 20, 2005, in the Context of Extreme Solar Cosmic Ray Particle Events and Geomagnetic Super Storms, Asia Oceania Geosciences Society 3rd Annual Meeting, 10 - 14 July 2006 in Singapore.

Bütikofer, R., E.O. Flückiger, L. Desorgher, and M.R. Moser, Analysis of the GLE on January 20, 2005: an Update, 20<sup>th</sup> European Cosmic Ray Symposium, Lisbon, Portugal, to be published in the conference proceedings, 2006.

Muraki, Y., An interpretation on high energy solar neutrons and protons, 20<sup>th</sup> European Cosmic Ray Symposium, Lisbon, Portugal, to be published in the conference proceedings, 2006.

Address:

Physikalisches Institut  
Universität Bern  
Sidlerstrasse 5  
CH-3012 Bern

Contacts:

Rolf Bütikofer

Tel.: +41 31 631 4058

Fax: +41 31 631 4405

e-mail: [rolf.buetikofer@space.unibe.ch](mailto:rolf.buetikofer@space.unibe.ch)

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

