

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
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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.

In 2005 the operation of SONTEL and the data transfer to Bern was affected by the construction work at the Kulmhotel Gornergrat. In particular, the electric power was cut several times. As a consequence, there were more interruptions in the operation of SONTEL in 2005 than in the preceding years. Nevertheless SONTEL was in operation during 97.3 % of the time.

Although the sunspot cycle 23 is approaching its end there was a phase of extreme solar activity in January 2005. Between January 15 and 20, 2005, the solar active region NOAA 10720 produced five powerful solar flares. The fifth flare, a X7.1 solar burst, occurred on January 20, 2005, with onset at 0636 UT and peak time at 0952 UT. This flare produced high-energy solar cosmic rays, leading to the second largest ground level enhancement (GLE) observed by the worldwide network of ground based neutron monitors (NMs) in the last fifty years (see the contribution in this publication about the neutron monitors at Jungfraujoch). For this outstanding relativistic solar particle event Figure 1 shows the relative count rates of the NMs at Jungfraujoch (IGY + NM64 combined) and the relative count rate of the neutron channel >40 MeV of the SONTEL at Gornergrat. The two NMs at Jungfraujoch observed a significant pre-increase in the counting rate in the time interval 0647-0649 UT (see Figure 3 in the contribution in this report about the neutron monitors at Jungfraujoch). The neutron channels of the SONTEL detector at Gornergrat, however, did not show an increase at this time, as can be seen from Figure 1. Therefore the possibility that the pre-increase was due to solar neutrons can be excluded, even more so as the zenith angle of the Sun's position at the time of the event (~0800 local time) was too large for solar neutrons to reach the stations at Jungfraujoch and Gornergrat through the atmosphere.

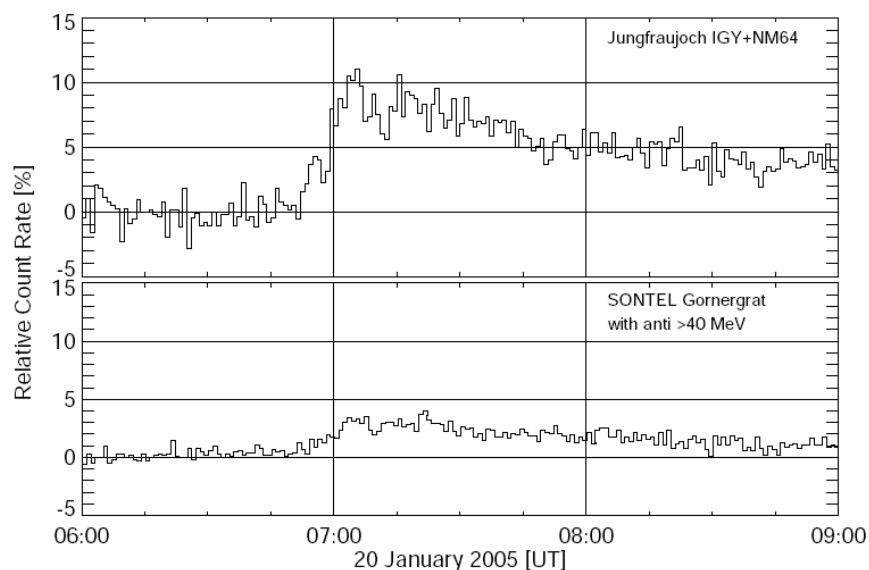


Figure 1: Relative count rates of the neutron monitors at Jungfraujoch (IGY + NM64 combined; above) and relative count rate of the neutron channel >40 MeV of the Solar Neutron Telescope (SONTEL) at Gornergrat, Switzerland, (below) for January 20, 2005, 0600-0900 UT. The data are 1-minute values.

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

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Scientific publications and public outreach 2005:

Refereed journal articles

Flückiger, E. O., R. Bütikofer, L. Desorgher, M. R. Moser, Y. Muraki, Y. Matsubara, T. Sako, H. Tsuchiya and T. Sakai, The giant Forbush decrease in October/November 2003: Data analysis for the solar neutron detector at Gornergrat, *International Journal of Modern Physics A*, **20**(29), 6684-6687, 2005.

Flückiger, E. O., R. Bütikofer, A. Chilingarian, G. Hovsepyan, Y. H. Tan, T. Yuda, H. Tsuchiya, M. Ohnishi, Y. Katayose, Y. Muraki, Y. Matsubara, T. Sako, K. Watanabe, K. Masuda, T. Sakai, S. Shibata, R. Ogasawara, Y. Mizumoto, M. Nakagiri, A. Miyashita, P. H. Stoker, C. Lopate, K. Kudela and M. Gros, Solar neutron events that have been found in solar cycle 23, *International Journal of Modern Physics A*, **20**(29), 6646-6649, 2005.

Book sections

Moser, M. R., L. Desorgher, E. O. Flückiger, R. S. Miller, J. M. Ryan, J. R. Macri and M. L. McConnell, Solar neutron observation at ground-level and from space, Neutrinos and Explosive Events in the Universe, Series: NATO Science Series II: Mathematics, Physics and Chemistry, Proceedings of the NATO Advanced Study Institute on Neutrinos and Explosive Events in the Universe, held in Erice, Italy, 2-13 July 2004, M. M. Shapiro, Stanev, T., Wefel, J.P., eds., 209, 393-397, 2005, Springer-Verlag, ISBN 1-4020-3747-3.

Conference papers

Matsubara, Y., Y. Muraki, T. Sako, K. Watanabe, K. Masuda, T. Sakai, S. Shibata, E. O. Flückiger, R. Bütikofer, A. Chilingarian, G. Hovsepyan, Y. H. Tan, T. Yuda, M. Ohnishi, H. Tsuchiya, Y. Katayose, R. Ogasawara, Y. Mizumoto, M. Nakagiri, A. Miyashita, A. Velarde, R. Ticona and N. Martinic, Search for solar neutrons associated with proton flares in solar cycle 23, 29th International Cosmic Ray Conference, Pune, India, August 03-10, 2005, to be published in the conference proceedings, 2005.

Bütikofer, R., E.O. Flückiger, M.R. Moser, and L. Desorgher, The Extreme Cosmics Ray Ground Level Enhancement on January 20, 2005, Solar Extreme Events 2005 (SEE-2005), International Symposium at Nor Amberd, Armenia, to be published in scientific journal Sun and Geosphere, 2005.

Flückiger, E.O., R. Bütikofer, M.R. Moser, and L. Desorgher, The Cosmic Ray Ground Level Enhancement during the Forbush Decrease in January 2005, 29th International Cosmic Ray Conference, Pune, India, August 03-10, 2005, to be published in the conference proceedings, 2005.

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