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

Project description:

The solar neutron telescope (SONTEL) at Gornergrat, Switzerland, has been in continous 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 2007 the operation of SONTEL and of the GammaTRACER was continued. The radioactivity detector GammaTRACER had to be sent to the manufacturer in Germany for exchange of battery and re-calibration in June 2007. In the first half of 2007 several problems arose with the data-taking computers of SONTEL. Therefore it was decided to exchange the data-taking system. The new data archiving system consists now of only one personal computer based on the operating system Linux instead of two personal computers as before. With this new system the probability of a breakdown of the data-taking system could be reduced significantly. In the beginning of August 2007 lightning struck near the lab container at Gornergrat, causing total damage to some parts of the SONTEL electronics. It was not easy to find out which parts of the electronic were broken. After receipt of some spare parts from our Japanese colleagues it turned out that other parts had also been destroyed by the lightning. All in all SONTEL was not in operation for one month due to this incident. At the beginning of November 2007 we had problems with the internet connection to the data-taking computer. Due to this problem, SONTEL was again down for several days.

The solar activity during 2007 was very low, and no solar flare candidates were observed that could have emitted a solar neutron flux observable at ground. We therefore present in this activity report an overview of the measurements by the GammaTRACER unit at Gornergrat. Figure 1 shows the daily averaged relative not pressure corrected count rate of the SONTEL proportional counters, the dose rate, and the atmospheric pressure at Gornergrat for 2007. The gaps in the data series are, as already mentioned above, due to a longer break in the operation of SONTEL in August 2007 and during seven days in November 2007, as well as to the revision of the GammaTRACER unit from 25 May to 20 July 2007. As some sections of the proportional counters show a clear temperature dependence, the data of these units were not included in this analysis, i.e. sections A-1, A-2, E-1, and E-2. The developing with time of the dose rate as well as the count rate of the SONTEL proportional counters are in anti-correlation with the atmospheric pressure. As expected from the difference in the volumes of the detectors, the count rates of the

SONTEL proportional counters has better statistics than the dose rate measured by the GammaTRACER unit. In Figure 2 the count rates of the SONTEL proportional counters are plotted versus the dose rate measured by the GammaTRACER unit in 2007. The time series are divided into two time intervals: 1 January – 25 May 2007 (before exchange of battery and recalibration of GammaTRACER, symbol +) and 10 September – 31 December 2007 (after exchange of battery and recalibration of GammaTRACER, symbol *). During both time intervals in 2007 the data points can be approximated by a linear regression fit. From Figure 1 and 2 it follows that after the recalibration, the GammaTRACER unit most likely gives a dose rate that is about 3.8 nSv/h or 2% higher than before the exchange of the battery at the mean dose rate of 189 nSv/h. This discrepancy is within the uncertainty of calibration of +/-6% given by the manufacturer. The analysis of the GammaTRACER data yields an average dose rate at Gornergrat of ~190 nSv/h, with a dependence on atmospheric pressure of ~1 nSv/h/mmHg.

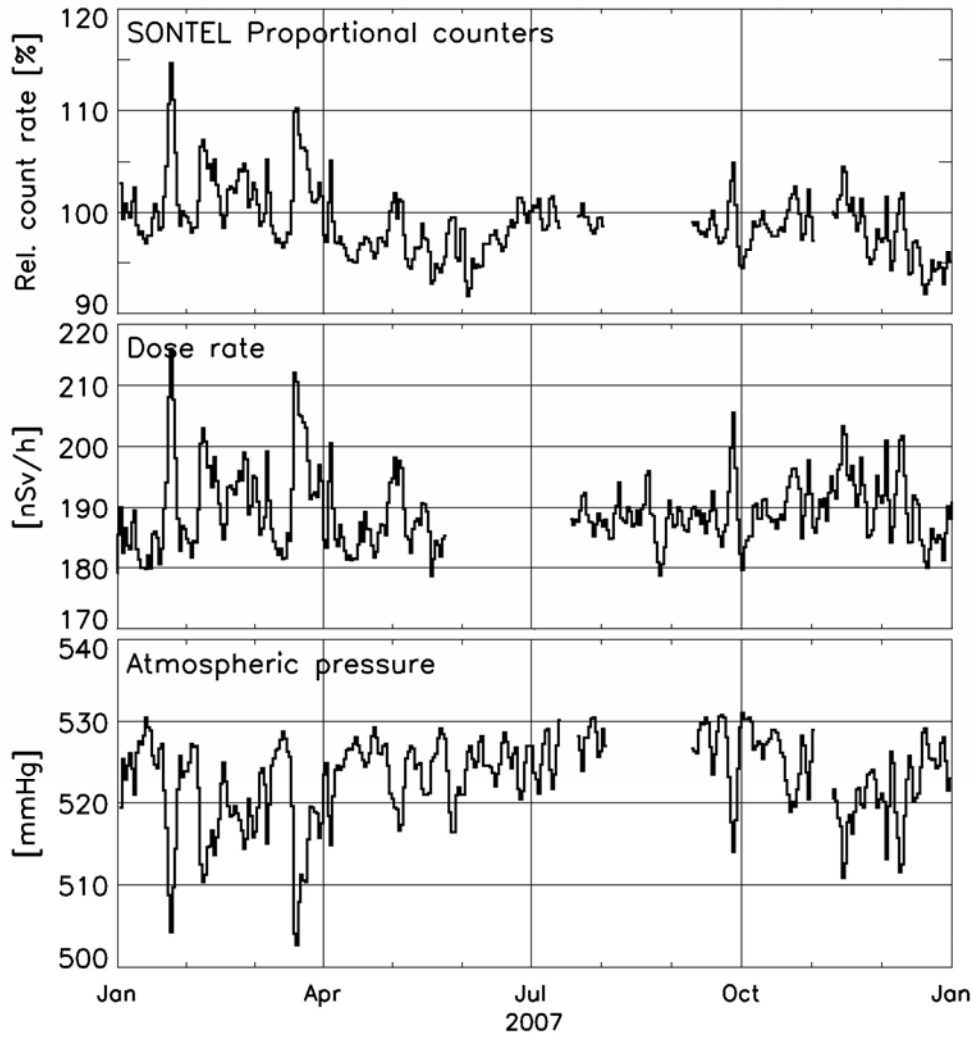
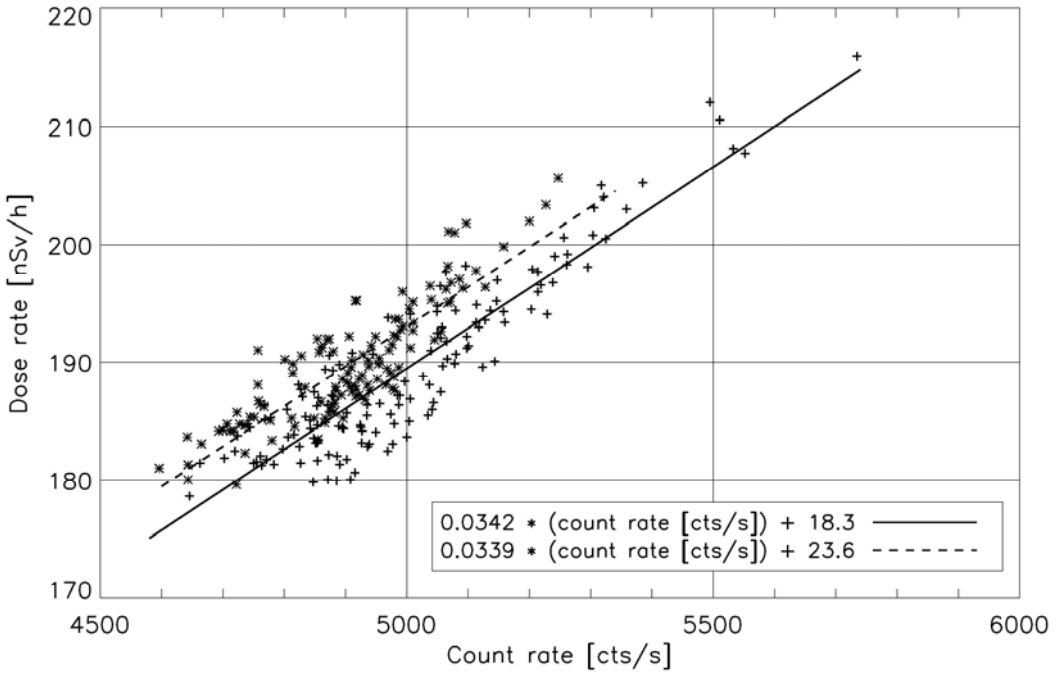


Figure 1: Daily average values of the dose rate, of the relative not pressure corrected count rate of the proportional counters of SONTEL, and of the atmospheric pressure at Gornergrat for the time interval January - December 2007.



Figue 2: Daily average dose rates measured by GammaTRACER versus daily average counting rates of SONTEL proportional counters in 2007. +: 1 January – 25 May 2007, *: 10 September – 31 December 2007.

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:

Refereed journal articles

Muraki, Y., Y. Matsubara, S. Masuda, S. Sakakibara, T. Sako, K. Watanabe, R. Bütikofer, E.O. Flückiger, A. Chilingarian, G. Hovsepyan, F. Kakimoto, T. Terasawa, Y. Tsunesada, A. Velarde, P. Evenson, J. Poirier, T. Sakai, Detection of High-Energy Solar Neutrons and Protons by Ground Level Detectors, accepted for publication in Astroparticle Physics, 2007.

Conference papers

Matsubara, Y., Y. Muraki, T. Yuda, M.Ohnishi, H. Tsuchiya, Y. Katayose, R. Ogasawara, Y. Mizumoto, F. Kakimoto, Y. Tsunesada, A. Velarde, R. Ticona, T. Sako, N. Martinic, P. Miranda, J. Valdes-Galicia, L.X. Gonzalez, A. Hurtado, O. Musalem, K. Watanabe, T. Sakai, S. Shibata, E. Flueckiger, R. Buetikofer, A. Chilingarian, Y. Tan, Search for solar neutron associated with series of X-class flares during the declining period of solar cycle 23, 30th International Cosmic Ray Conference, 03 11 July 2007 in Mérida, México.

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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
URL: http://cosray.unibe.ch