

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 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 [Flückiger, E. O., R. Bütikofer, Y. Muraki, Y. Matsubara, T. Koi, H. Tsuchiya, T. Hoshida, T. Sako and T. Sakai, A New Solar Neutron Telescope At Gornergrat, Proc. 16th European Cosmic Ray Symposium, rayos cósmicos 98, 219, Universidad de Alcalá, Spain, 1998]. Since 2002 the environmental radiation in the SONTEL lab container at Gornergrat has also been monitored by a conventional GammaTracer unit designed and manufactured by Genitron Instruments GmbH, Frankfurt, Germany.

In 2009 the operation of SONTEL and of the GammaTracer was continued. The solar activity during 2009 was still very low. No solar flare candidates were observed that could have emitted a solar neutron flux observable at ground level.

Figure 1 shows from top to bottom a) the daily averaged values of the radiation dose rate measured by the GammaTracer detector inside the SONTEL detector housing, b) the relative counting rate of the SONTEL proportional counters not corrected and c) corrected for atmospheric pressure variations, and d) the barometric pressure measured close to SONTEL, all for the time interval 1 January – 31 December 2009. The radiation dose rate (panel a), which is not corrected for atmospheric pressure changes, and the uncorrected counting rate of the proportional counters (panel b) show a close correlation. During the first months in 2009 (January – April) the data exhibit a larger fluctuation than in the later months. It seems that the amplitude of the atmospheric pressure variations (panel d) is also larger during the months January – March and again in November – December compared to the variations during the summer months. However, the enhanced fluctuations in the GammaTracer dose rate (panel a) and in the counting rate of the SONTEL proportional counters (panel b) can not be attributed only to the variations in the atmospheric pressure, as the pressure corrected SONTEL count rates (panel c) still show a significant variation, especially during the first four months in 2009. As already reported in the Activity Report for the year 2003, we assume that the sporadic enhancements in the radiation dose rates and in the SONTEL count rates are caused by radon outgassing from the ground. During the season with little or no snow, the radon outgassing from the ground under the detector housing is freighted by wind. But when a thick snow layer surrounds the detector housing, the foundation is sealed and the outgassing radon leaks directly into the lab container through the inlet for cables and then escapes through an opening for the ventilator. A large snow cover was indeed recorded at Gornergrat during the winter 2008/09. MeteoSwiss recorded (by automatic measurements) an increase in the

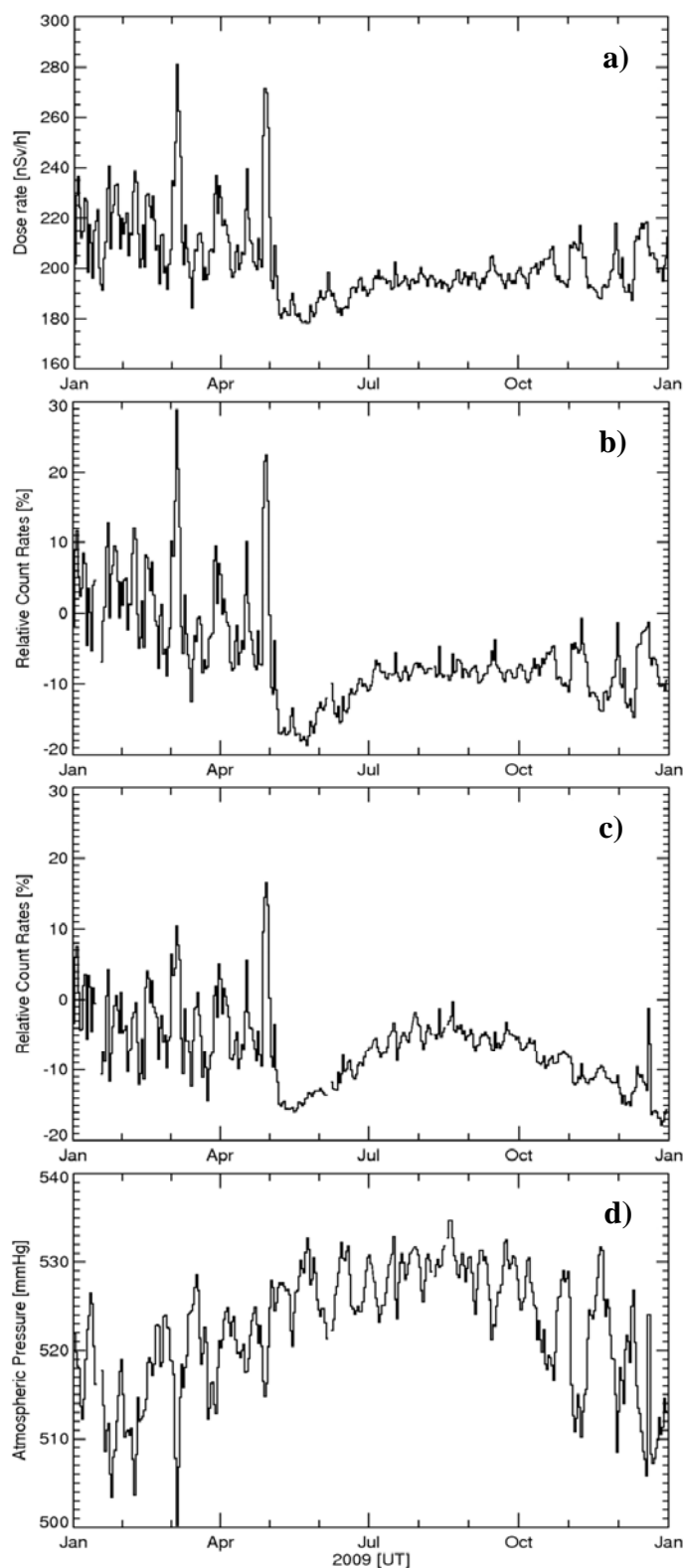


Figure 1: GammaTracer and SONTEL measurements at Gornergrat in the time interval 1 January – 31 December 2009: a) daily averaged values of the radiation dose rate measured by the GammaTracer detector inside the SONTEL lab container, b) relative counting rate of the SONTEL proportional counters not corrected and c) corrected for the atmospheric pressure effect, and d) barometric pressure measured close to the SONTEL detector.

snow depth of almost 50 cm between 4 and 5 March 2009, and a further increase by about 90 cm between 26 and 28 April 2009. Both time intervals correlate with large peaks in the radiation dose rate (panel a) and in the count rates of the SONTEL proportional counters (panels b and c). The highest snow depth at Gornergrat in 2009 was measured on 28 April with 330 cm. After this date the snow cover decreased linearly with time until the beginning of July. These meteo observations support our hypothesis that the observed peaks in the radiation dose rates and in the counting rates of the SONTEL proportional counters were caused by radon entering into the lab container.

Key words:

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Astrophysics, cosmic rays, solar neutrons

Internet data bases:

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Collaborating partners/networks:

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Scientific publications and public outreach 2009:

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**Conference papers**

Matsubara, Y., Y. Muraki, T. Sako, Y. Itow, T. Sakai, S. Shibata, T. Yuda, M. Ohnishi, H. Tsuchiya, Y. Katayose, K. Namikawa, R. Ogasawara, Y. Mizumoto, F. Kakimoto, Y. Tsunsada, K. Watanabe, E. Flückiger, R. Bütikofer, A. Chilingarian, G. Hovsepyan, Y. Tan, J.L. Zhan, R. Ticona, W. Tavera, P. Miranda, J. Valdes-Galicia, L.X. Gonzalez, A. Hurtado, and O. Musalem, Status of the world-wide network of solar neutron telescopes in solar cycle 24, 31<sup>st</sup> International Cosmic Ray Conference, Lodz, Poland, 7-15 July 2009, In Conference Proceedings, 2009.

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