Contribution ID: **4** Type: **Poster Presentation**

INFLUENCE OF THE SOLAR ACTIVITY ON THE BACKGROUND OF A HIGH-RESOLUTION GAMMA-RAY SPECTROMETER

Thursday, 5 May 2022 12:50 (20 minutes)

Galactic cosmic rays produce neutrons when they interact with the Earth's atmosphere. In gamma-ray spectrometers these neutrons can be scattered and captured in the materials of the shield and the detector, producing signals in the spectrometer's background. By the end of the eighties, at JSI, a new spectrometer was built, housing a germanium detector with a relative efficiency of 36% in a lead shield with the mass of about 4 tons. To reduce the intensity of the signals due to the neutrons in the spectrometer background about 100 kg of paraffin and plates with boron acid were placed in the shield's cavity. As a consequence of that, the only signatures due to the neutrons and recognized in the spectrometer background were the peak at 2223 keV due to their capture on hydrogen and the Doppler broadened peak at 477 keV due to their capture in 10B. The count rate in the peak at 2223 keV amounted about 11 counts per hour.
Since the flux density of neutrons depends on the intensity of primary cosmic rays striking the atmosphere, it is expected that the variability of this intensity due to its moderation by the solar wind causes a variability of the count rate in the peak at 2223 keV. The intensity of solar wind depends on the number of sunspots, which changes with the solar cycle, having a period of 11 years. Therefore the count rate in the peak at 2223 keV exhibits a time dependence, correlated with the number of sunspots. As a consequence of that a negative correlation is expected to occur between the number of sunspots and the count rate.
Since the year 1996 measurements of the background of this spectrometer exist, therefore it is possible to correlate the count rate in the peak at 2223 keV with the number of sunspots over a time interval lasting more than two solar cycles. Because the solar wind takes a few days to reach the Earth, the correlation was investigated as a function of the shift in time between the start of the background measurement with respect to the date of sunspot number.
The dependence of the correlation coefficient on the shift in time has shown a long-term correlation corresponding to the 11-year solar cycle and a short-term correlation corresponding to sunspots. From the position and the width of the minimum of the correlation coefficient corresponding to sunspots it was possible to assess the speed of the solar wind to (870 ± 590) km/s and the mean duration of the phenomena on the Sun driving the solar wind to 6.8 days. The irregular depression in the dependence of the correlation coefficient preceding the drop corresponding to sunspots indicates that the magnetic fields on the photosphere, causing the solar wind, exist before they reveal their presence by cooling the photosphere and causing sunspots.

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Session Classification: Low Level γ-ray Spectrometry

Track Classification: Low level γ-ray spectrometry