A New Solar Neutron Telescope at Mt. Aragats

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Abstract

Since the autumn of 1997, a solar neutron detector (SNT1) has been operated at Mt. Aragats (3,250m) in Armenia. In the present solar cycle 23, several interesting solar neutron events have been detected by the SNT1 and from the fall of 2002, an upgraded neutron detector (SNT2) has been constructed. In this paper, we describe recent activities concerning the detection of solar neutrons at Mt. Aragats cosmic ray observatory.

1. Introduction

In the autumn of 1997, a solar neutron detector was added to the array of Mt. Aragats cosmic ray detectors, which already included a traditional neutron monitor. Since 1990, the Japanese group has developed a new type of solar neutron detector which can measure the energy of neutrons. In order to realize continuous observation of solar flares and the production of neutrons, it is necessary to install neutron detectors at every 90 degrees of longitude surrounding the globe. Armenia, located in the mid-longitude between the Swiss Alps and the Tibet highlands, is a suitable place to place such a neutron detector. Furthermore there is a traditional cosmic ray observatory (Chilingarian et al, 2003), electricity is available, and there are numerous experts on cosmic rays. These are the reasons why the Japanese group decided to collaborate with Armenian scientists on this project. The first solar neutron detector (SNT1) has a detection area of 4m^2 and began its observation in the autumn of 1997. A photo of the SNT1 is shown in Fig. 1.

In solar cycle 23, several interesting events were detected by SNT1. In the solar flare event (X1.9) of 12th July 2000, the SNT1 observed a 3.5 σ enhancement of neutrons. Then in the solar flare events of 2nd (X1.4) and 10th (X2.3) April 2001, the SNT1 observed 4.7 σ and 4.5 σ level enhancements at 9:57 UT and 5:06UT respectively. These events are shown in Fig. 2. The signal of 10th April was also observed by the Tibet solar neutron telescope. In the solar flare of 12th

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Fig. 1. The Solar neutron Telescope SNT1 at Mt. Aragats (3250m). The detector consists of two layers of plastic scintillators for anti-coincidence (to reject charged particles) and thick (60cm) plastic scintillator to convert neutrons into protons and measure the energy of those protons. At present the SNT1 can measure the direction of protons in 9 directions.

April 2001, the SNT1 detected 3.4 σ level signals at 9:45 and 10:16 UT. The signal was also detected by the Swiss neutron telescope and a preliminary report has been given at the previous conference (Flueckiger et al., 2001). Two more candidate events have been detected on 24th Sep. 2001 and 11th Dec. 2001. Since then no event has been detected. During the 24th Sep. 2001 event, the Tibet neutron monitor detected a strong neutron signal from the solar flare (See the report by Sako et al. at this conference).

2. New Solar Neutron Detector — SNT2

Since the SNT1 has a wide gap between the scintillator and the anti-counter, a new system has been proposed by the Armenian group. To remove the gap, the scintillator has been set in the opposite way, i.e., light from the scintillator is observed from the bottom side by the photomultipliers and the anti-counters are set in contact with the surface of the plastic scintillator (Fig. 3). The anti-counter is provided by the use of 25 proportional counters. Each proportional counter has dimension 9 cm $\times$ 18 cm $\times$ 280 cm length. 50 cm thick plastic scintillator is used in the case of SNT2. The SNT2 is inclined with 24 degrees to the horizontal in

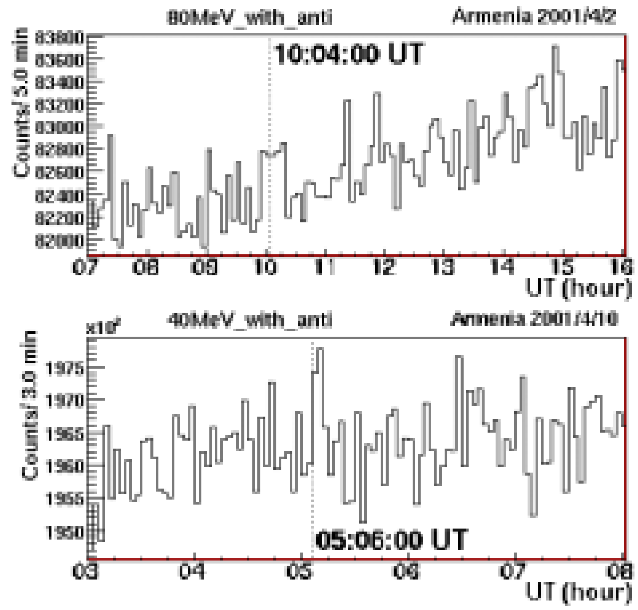
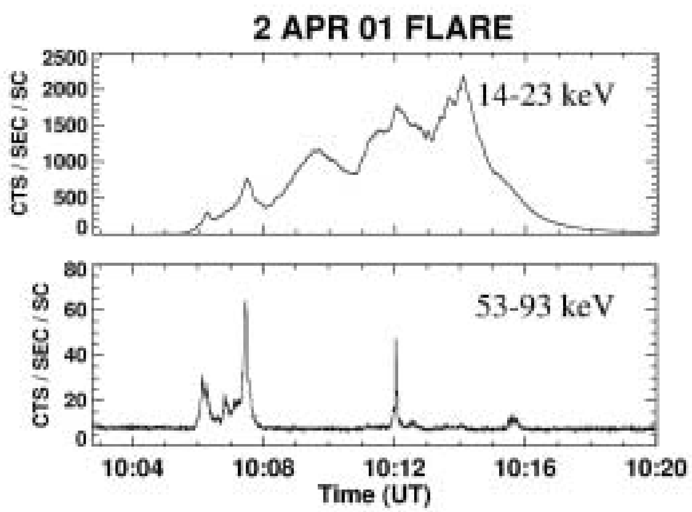


Fig. 2. The time profile of SNT1 for the events of 2^{nd} April 2001 (upper panel) and 10^{th} April 2001 (lower panel). From the data of Yokoh and GOES satellites, the 2^{nd} April flare started at 10:04 UT (X=1.4) , while the 10^{th} April flare started at 5:06 UT(X=2.3). In the lower panel, the time profile of hard X-rays detected by the Yokoh satellite is shown for the flare of 2^{nd} April 2001.



order to view the Sun directly. The new system is shown in Fig. 4. It will be in operation from the summer of 2003. It is expected that the background, which is composed by the charged particles such as muons, electron and positrons and protons will be very effectively reduced.

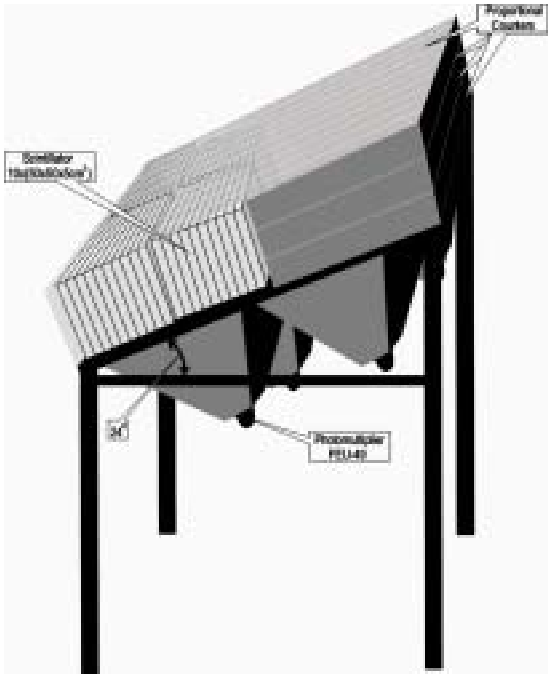


Fig. 3. A sketch of new solar neutron telescope SNT2. In this drawing, (not shown), 25 proportional counters will be attached above 50cm thick plastic scintillator to remove charged particles.

Fig. 4. Photograph of SNT2 at Mt. Aragats (3250m).

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References

E. Fleuckiger et al., Proceed. 27^{th} ICRC (Hamburg), 8 (2001) 3044.
T. Sako et al., Proceed., Proceed. 28^{th} ICRC (Tsukuba), (2003).
A. Chilingarian et al. , J. of Phys. G, 29 (2003)1.