Proceedings of ICRC 2001: 4204 © Copernicus Gesellschaft 2001

ICRC 2001

The flows of neutrons of space radiation and from terrestrial crust

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Abstract. The experimental researches at North of Tien Shan were carried out at height 3340 m above a sea level (Zhusalykesen' pass, high-level scientific station of the Physical Institute RAS) in August and December, 1999. The fluxes of neutrons and alfa-particles have been measured. The data of the neutron monitor and the counters of charged particles, that have been locating there too, were attracted also. The data set has allowed to estimate a share of thermal and slow neutrons, caused by processes in terrestrial crust, into a total neutron background. Dynamics of the neutron fluxes, connected with the tide forces in terrestrial crust during the complete solar eclipse in August 11, 1999 and the new moon in December 7, 1999, also have been observed. The contribution of neutrons from terrestrial crust was then not less 10% from a total neutron background. The flux of alfa-particles which form the additional flux of neutrons had the top limit 0.12 ± 0.08 $min^{-1}sm^{-2}$. The experiment has confirmed, that one of the reasons for appearance of the additional neutrons can be the gravitational influence on the Earth of the Moon and the Sun.

1 Introduction

After discovery of the large neutron bursts on Pamirs during a complete solar eclipse of July 22, 1990 (Volodichev et al., 1991) and lunar eclipse of July 26, 1991 (Volodichev et al., 1993), our attention the next years has been attracted to measuring the flows of neutrons in days of new moon, full moon and in days, near to them. The neutron bursts were registered during two tens of new moons and full moons, in times of which measurements were carried out. At some cases the bursts of neutrons took place also in days before and after new moons and full moons. The amplitude of increase of bursts occasionally exceeded a neutron background in tens times. The measurements were performed in various areas of Pamirs at heights from 800 up to 4200 m above sea level. During neutron burst in July 22, 1990, it was ascertained, that the flow of neutrons was directed from the Earth (Volodichev et al., 1997). As for both solar and geophysical condition, the days, in which we have observed the neutron bursts, were quiet**.** It excludes an appearance of the neutron bursts as a result of the known cosmic factors.

On the basis of experimental data the assumption was formulated, according to which the bursts of neutron radiation are born by alfa-particles of radioactive gases of Radon isotopes. The alfa-particles form neutrons by interaction with particles of air and of terrestrial crust. The strong emissions of isotopes Radon should occur mainly in time new moons and full moons and in days, nearest to them, when the tide forces from the Moon and the Sun are maximal and subject the terrestrial crust to the greatest deformations.

The experimental data are received in 1999 on North Tien Shan at station of Physical Institute of Russian Academy of Sciences (the mountain pass Zhusalykesen', height above a sea level 3340m). The data determine also share of neutrons from terrestrial crust in a flow of neutrons of secondary space radiation on the Earth. The data about presence on North Òien Shan of a flow of alfa-particles necessary for formation of neutrons are resulted also.

2 Experimental data

In August and December, 1999 the experimental researches were carried out on North Tien Shan at height 3340m above a sea level (the mountain pass Zhusalykesen', scientific station of Physical Institute of Russian Academy Science). The neutron fluxes (counters SNM-18) and alfa-particles (a

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counter SBT-10) were measured. The data of the neutron particle counters SI5G, located there, were involved also. The received data have allowed to estimate a share of the neutrons caused by processes in terrestrial crust into the total background and to observe the changes of the neutron supermonitor NM64 and of the equipment with the charged flux connected with tide forces in terrestrial crust during a complete solar eclipse in August 11 and new moon in December 7, 1999.

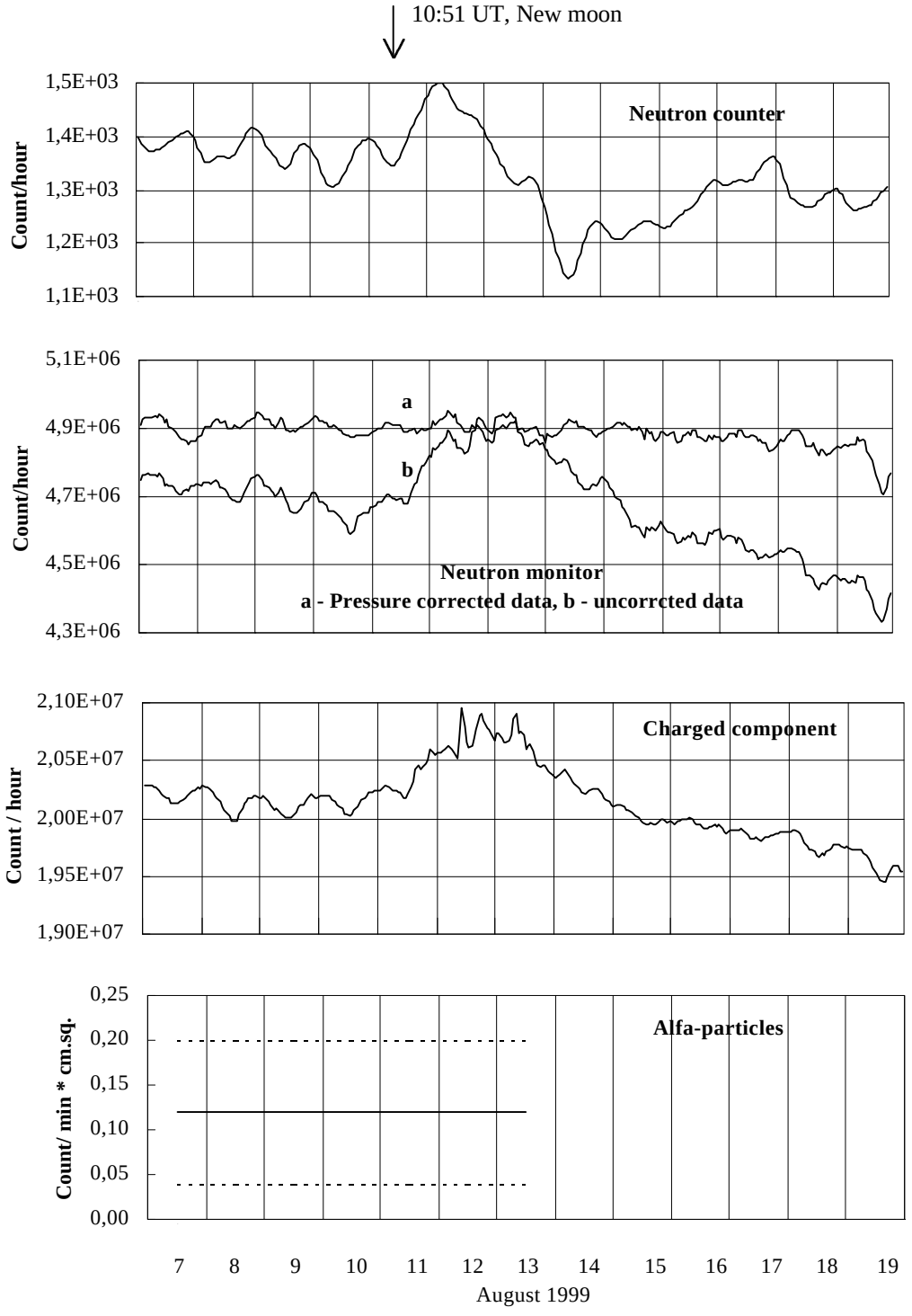

Fig.1. The neutrons and charged particles fluxes at the North Tien Shan in August 1999

August 11 (**Fig.1**.), after a complete solar eclipse (10.51 UT), the flow of neutrons increased on 12%, and was registered by the SNM-18 counter. After this the flow of neutrons has fallen on 25 % for two days and that was restored up for next four days to the level, that has been observed in August 11. For this time the neutron monitor readings, corrected for barometrical pressure, also the meter reading of the charged particle counters have been changed less than into 1-2,5%. The high energy protons of cosmic rays are source of the neutrons for the neutron supermonitor NM64, therefore between the proton fluxes and the reading of the neutron monitor there is a good correlation. For example, in work (Bratolyubova-Tsulukidze et al., 1987) factors of correlation between fluxes of protons of high energy in interplanetary space and the readings of the neutron monitor were determined as 0.928 for the Deep River monitor, and as 0.930 for the Allert monitor. The neutron monitor registers the neutrons of a terrestrial origin with small probability (less than 0.01). On other hand, the sources of the neutrons near to a surface of the Earth are the same protons of high energy cosmic rays, and also neutrons of a terrestrial origin**.** As the SNM-18 neutron counter, placed near earth, registers the total background of neutrons of secondary space radiation and neutrons from a terrestrial crust, the difference between dynamics of the counter data and of the neutron monitor data could be attributed at the expense of the neutrons of a terrestrial origin. In a considered case the flux of neutrons from a terrestrial crust at time of the new moon can be more than 10 % from a general background flow of neutrons.

The flux of alfa-particles average for all time of measurements was $0.12 \pm 0.08 min^{-1} sm^{-2}$ (**Fig.1.**). That is in some times more than the flow of alfa-particles, averaging on all the Earth (Serdukova and Kapitanov, 1975). This is possible to explain with that fact that the northern Tien Shan is rich by stocks of Radon, about that it is possible to say as Radon sources meet there frequently.

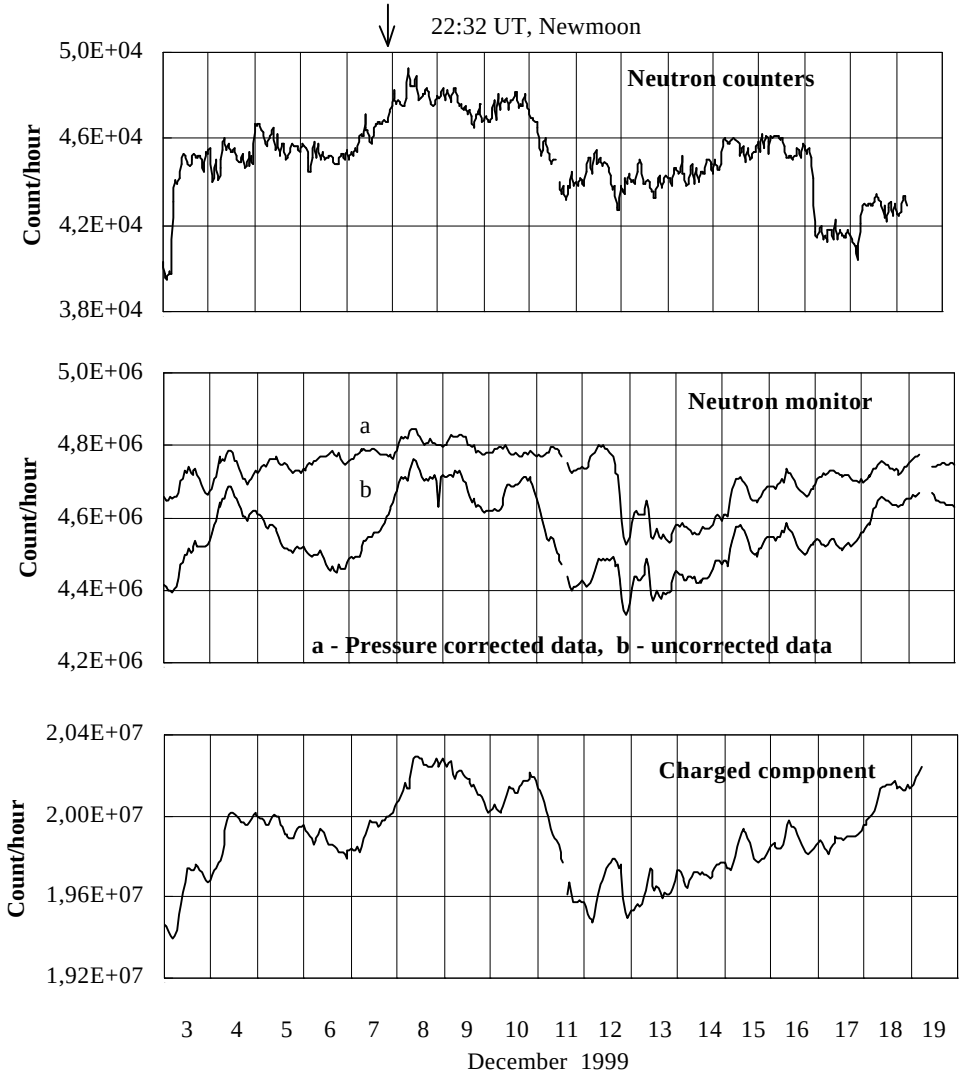

Fig.2. The neutrons and charged particles fluxes at the North Tien Shan in December 1999

The picture similar to that we saw in August, was observed too in December. The increase of the neutrons flux, that has began in December 7 in the day of the new moon (22.32 UT), has grown on 10 % to middle December 8 (**Fig.2**.). In December, the measuring equipment has consisted of 30 neutron counters, instead of one counter as in August. In the next three days there was a fall of the neutron flux, that has decreased on 12 % to December 11. The data of the neutron monitor (corrected on barometrical pressure) and of the charged particle counters have changed on 1-2% per the same days. The increase of the flow of neutrons in time a new moon has made about 10 % from the general background of neutrons.

It is necessary to notice, that the days of August 11 and December 7, 1999 and before them were quiet from the point of view gelio- and geophysical conditions. It was not observed of essential variations of the cosmic rays in the interplanetary space and of the neutrons on the ground monitors. The geomagnetic conditions remained quiet, the large flares on the Sun was not observed. In the period from August 7 till August 11, 1999, the SF and 1F flares have been observed in the west active area 8662 and in the east active areas 8656 and 8657. The K_p-index averaged for three days was changing within 0-4- (Solar-Geophys. Data No.661 and No. 662). The SF and 1F flares have been observed in the period from December 3 till December 7, 1999, also the flare 2N in December 6, but all of them were located in active area 8788 at east part of a solar disk. The K_p-index was changing within 2-5 (Solar-Geophys. Data No.665 and No.666). Data of the NM64 neutron supermonitor, and data of the monitors in other areas of the Earth, were changing at the pointed out days of August and December no more, than on 1-2%, though SC was marked August 8 in 2100UT (Solar-Geophys. Data No.661 and No.662).

These circumstances allow to consider the gravitational influence on the Earth on the part of the Moon and the Sun at these times of new moon as a basic reason of formation of additional neutrons. At the North Tien Shan in August 11 and December 7, 1999 the share of the neutrons from the terrestrial crust into the general background flux of neutrons can be estimated as about 10%.

3 Conclusion

The experiments for definition of the contribution terrestrial crust in a complete flow of thermal and slow neutrons on a surface of the Earth were carried out also on North Tien Shan at height 3340 m above a sea level. The share of the neutrons from the terrestrial crust into the general background flux of neutrons can be estimated as about 10% during the complete solar eclipse in August 11 1999 and the new moon in December 7 1999. These results are corresponding to our point of view that terrestrial crust is an important neutron source that is subjected by variable gravitational influence on the Earth (Volodichev et. al., 2001).

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