Is the neutron flux of the secondary cosmic rays associated with the Earth’s seismic activity

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Abstract. The presented results are obtained during the monitoring of thermal neutrons’ flux in the region of Pamir - one of the most seismic regions on the Earth in 1986-1997. During this period there was detected a number of noticeable increases of the neutron flux during the gravity wave passing across the locality. During the same period about 500 earthquakes with magnitude over 4 happened in the same region. Sometimes the moment of seismic wave passing was known with accuracy less than 1 minute. Nevertheless none of these earthquakes was accompanied with thermal neutrons’ flux increasing. What’s the reason? Mechanical influence of these events on the Earth’s crust seems to be the same, regardless the initial reason of the influence. But the experimental results contradict this assumption. The contribution presents the analysis of the reasons for deficiency and possible reasons for observation of the thermal neutrons’ flux variations during the seismic wave passing across the locality.

Keywords: thermal neutrons, seismic activity

I. INTRODUCTION

For the first time an increase of the neutron intensity during the New and Full Moons was detected in the experiments carried in 1990-1991 in Pamir mountains at the altitude of 4200 above sea level. The following studies have shown that the neutrons’ intensity increases occurs not only during the Moon phases, but also during the passing of tidal gravity wave across the locality, which results from the gravitational interaction between the Earth, the Moon and the Sun, and from the Earth’s revolving round its axis. Sometimes amplitude of these increases dozens times exceeded the neutrons’ background [1,2]. Analysis of the Global Hypocenter Data Base (Version 3.0 CD-ROM), prepared by the National Earthquake Information Center of the US Geological Survey and given to the authors by World Data Center B for Solid Earth Physics, have shown that about 500 earthquakes with magnitude > 4 occurred in the Pamir region during the period of 1986-1997 when the neutron detectors were operated. Nevertheless according to the observations none of the gravitation wave passing across the locality was accompanied with the increasing of the neutrons’ intensity. At the same time the previous studies have shown correlation between large series of the earthquakes and the Moon phases [3]. In the case we could detect neutrons resulted from the earthquakes we could find a neutron method for studies of seismic activity.

II. EXPERIMENTAL RESULTS

Do the neutrons appear near the Earth’s surface during the passing of the seismic wave across the locality? According to the observations of thermal neutrons’ flux in Pamir region (which is one of the most seismically active) during 1986-1997 thermal neutrons’ flux increased noticeably only during the passing of the tidal gravitational wave across the locality. At the same time according to the observations of Tadjik seismologists up to ten earthquakes with different magnitude occur every day in Pamir region (see [4]). Two possible ways of the neutrons’ intensity increases can be offered. In the first case the passing of the tidal wave causes deformation of the crust faults and as a result additional amount of stocked radioactive gases (first of all, Radon) come to the Earth’s surface. Neutrons are produced as a result of nuclear reaction between /alpha-particles, produced by radioactive decay of these gases, and elements of the Earth’s crust and the atmosphere. In the second case the neutrons can occur as a result of mechanic emission, which occurs at high tensions and appearance of micro-cracks in the rocks of the Earth’s crust during the astronomical events and following nuclear reaction "deuteron + deuteron" [5,6,7].

As has been said neutron observations were carried out in Pamir region during 12 years, from 1986 up to 1997, and during this period about 500 earthquakes with magnitude over 4 occurred in the same region. If up to 10 earthquakes with different magnitude happen everyday in Pamir region, than on the average accuracy of time definition of seismic wave passing across the locality is about 2 hours. In 1997 10-days long neutron observations were carried out at seismic station Djerino, which is located 30 km to the North from Dushanbe, at the altitude of 1100 m above the sea level. During this period more than 100 times of seismic waves passing were detected with good time accuracy at the
Fig. 1: Counting rates of the thermal neutrons $N_n$ and electrons $N_e$, measured in Pamir region at the altitude of 1100 m above the sea level. 03:20 UT - Full Moon. Dashed line approximates the maxima values for the day time of July 16 - July 24 observations.

station, but none of them was accompanied with the neutron flux increase, while the tidal wave passing was accompanied with the neutron flux increase everyday. Active role of tidal forces, influenced on the Earth’s crust, in the occurrence of the neutron increases can be illustrated by means of the measurements at the Djerino station [2]. The experimental data on neutrons’ and electrons’ counting rates for the period July 16-26, 1997 is presented at Fig.1. Registration of electrons was necessary in order to monitoring of charged particles. Approximating curve for July 16-24 crosses the maximum neutrons counting rates for each day, which are observed at about noon local time during the tidal wave passing across the locality. Maximum of approximating curve fall to July 20, 05:37 UT. On the same day at 03:20 UT the Full Moon happened. Increase of the neutron counting rates maxima from July 16 to July 20 and the following decrease to July 24 may be associate with correspondent influence of tidal forces of the Moon and the Sun. Their sum achieves the maximum value on the day of Full Moon and decreases during the following days. Probably such behavior of the neutrons’ maxima demonstrate sensitivity of neutron flux to small changes of the tidal force value. The neutrons’ observations were also carried out at midnight (local time) July 21-22. The results are presented at Fig.2. From 17:22 UT till 19:09 UT on July 21, 12 hours after the day increase a multi-impulse splash of the neutron radiation was detected. Its maximum value 100 times exceeded the background level. On July 22 maximum value of the neutrons’ counting rate was detected 12 hours after the night splash. Increases of the neutrons’ counting rates at midday on July 24 and July 25 can be also explained by the increase of the amount of radioactive gases in the Earth’s crust at this time. Night splash of July 21 was accompanied with 1.5 times increase of electrons’ counting rate (see Fig.2). The following sources of additional electrons can be noted. The first source is beta-decay of neutrons [8], the second source is ionization of the air with the protons of 580 keV energy and gamma-rays with energy over 5 MeV, produced as a result of the neutrons’ absorption by the nuclei of the atmospheric nitrogen.

In order to answer the question if the neutrons appear near the Earth’s surface during the passing of seismic waves across the locality it’s necessary to compare physical properties of the tidal gravitational wave and the seismic wave. The tidal waves exist as a result of gravitational interaction of the Moon, the Sun and the Earth, and the revolving of the Earth round its axis. At the Moon and the Sun in zenith or nadir elastic tidal waves always create tension up to 10 Pa. To a good approximation this value can be considered as a constant, because initial physical parameters are also constant to the same approximation (masses of the Sun, the Earth and the Moon, distance between these celestial bodies, speed of the Earth’s revolving round its axis). With this vertical displacements of the Earth’s surface can reach 50 cm. Seismic waves are also elastic waves in the solid Earth’s medium, which spread from the earthquakes’ epicenters through the Earth at a speed from 3 up to 13 km/s, depending on the type of the wave. Compressional and shear seismic waves spread from their sources through the Earth’s body, therefore they are called body waves. Their amplitude for homogeneous and isotropic medium decreases...
Fig. 2: Powerful splash of the thermal neutrons intensity at midnight July 21 - July 22 in Pamir region at the altitude of 1100 m above the sea level.

also increase if the tension in the Earth’s crust is not less than 10 Pa.

REFERENCES