Characteristics of SCR particle fluxes during the enhanced geomagnetic activity in February-March 2023 based on data from the Monitor-1 satellite

G.I. Antonyuk (1,2), V.V. Benghin (2,3), E.E. Antonova (1,2), I.A. Zolotarev (2)

1. Faculty of Physics, Lomonosov Moscow State University, Moscow, Russia
2. Skobeltsyn Institute of Nuclear Physics Lomonosov Moscow State University, Moscow, Russia
3. Institute of Biomedical Problems of the Russian Academy of Sciences, Moscow, Russia

In February-March 2023, a series of M-class flares occurred at the Sun. Afterwards, the NOAA satellite "GOES 16" showed significant increases in particle fluxes. There were 2 sequential increases in SCR fluxes in February, with proton fluxes above 30 MeV reaching a value of $6.8 cm^{-2}s^{-1}sr^{-1}$ on February 25. The following geomagnetic storm on February 27 was characterized by a decrease of the Dst-index value down to -138 nT. The next significant increase of the particle fluxes was registered on March 13, the proton flux above 30 MeV reached the value of 3.5 $cm^{-2} s^{-1} sr^{-1}$. The following decrease in the Dst index on March 15 was as low as -50 nT. Later on March 24, a large geomagnetic storm occurred with the value of the Dst index falling down to -184 nT, however no increase of the SCR fluxes was observed.

During this prolonged disturbance period, between February 20 and March 30, the MSU Monitor-1 spacecraft was in operation. This CubeSat-3U satellite was launched in August 2022 into a low-Earth polar orbit. Its payload, the KODIZ (Combined Radiation Detector) instrument, features a set of detectors to register fluxes of electrons, protons and neutrons. The enhancements described above were also recorded on the "Monitor-1" satellite. In this paper we study the data of a silicon semiconductor detector and a scintillation detector based on CsI crystal.

According to the detector readings of the KODIZ instrument, the increase in the particle count rate in the polar regions was greater than an order of magnitude. On February 26, the semiconductor detector measured a rise from a background level of 3 pulses per second to a peak of 50 pulses per second, while the scintillation detector measured a rise from 7 pulses per second to 130 pulses per second. On March 13, the values reached 10 pulses per second for the semiconductor detector and 70 pulses per second for the scintillation detector.

The study considers measurements of particle fluxes obtained from the MSU satellite "Monitor-1" and their comparison to the data of the NOAA satellite "GOES 16", as well as to the space environment parameters and geomagnetic indices.