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Forbush Decrease and Geomagnetic Storm Effects on Cosmic Rays: CARPET Observations from Riyadh

The CARPET cosmic ray detector, installed at King Abdulaziz City for Science and Technology (KACST), Riyadh, Saudi Arabia (24.67°N, 46.74°E, altitude 613 m, Rc=14.4 GV), represents a collaborative effort between KACST and the P.N. Lebedev Physical Institute (LPI), Moscow, Russia. This instrument, operational since 2017, is designed to measure low-energy secondary cosmic rays and investigate their relationships with solar activity and atmospheric phenomena.

In March 2024, the detector recorded significant cosmic ray variations associated with a major space weather event characterized by multiple coronal mass ejections (CMEs) and a subsequent strong geomagnetic storm (Kp=8). Analysis of CARPET measurements revealed a pronounced Forbush decrease with a maximum amplitude of ˜5%. The high temporal resolution of the detector enabled detailed tracking of cosmic ray flux evolution throughout the event sequence.

Comparative analysis incorporating data from four additional cosmic ray stations, along with solar wind parameters and geomagnetic indices, provided comprehensive characterization of the event. The observations demonstrate the CARPET detector's effectiveness in monitoring space weather phenomena and validate its role in complementing space-based measurements. These findings contribute to our understanding of cosmic ray modulation during solar-terrestrial events while highlighting the significance of ground-based cosmic ray monitoring networks.

Keywords: CARPET Detector; Forbush Decrease; Space Weather, Cosmic Ray Variations

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