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The ISS-CREAM Silicon Charge Detector for identification of the charge of cosmic rays up to Z = 26

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The Cosmic Ray Energetics And Mass experiment for the International Space Station (ISS-CREAM) is a space-borne mission designed for the precision measurement of energy and elemental composition of cosmic rays. It was launched and installed on the ISS in August 2017. The Silicon Charge Detector (SCD), placed at the top of the ISS-CREAM payload, consists of 4 layers. Each layer has 2688 silicon pixels and associated electronics arranged in such a fashion that its active detection area of 78 x 74 cm2 is free of any dead area. The 4-layer configuration was chosen to achieve the best precision in measuring the charge of cosmic rays within the constraints on the mass, volume and power allotted to it. The amount of material used for its support structure was minimized as well to reduce the chance of interactions of the cosmic ray within the structure. Given the placement of the SCD, its 4-layer configuration and the minimal amount of material in the cosmic-ray trajectory, the SCD is capable of measuring the charge of cosmic rays ranging from protons to iron nuclei with excellent detection efficiency and charge resolution. We present the design and fabrication of the SCD, and its performance during various ground tests before launch including a heavy-ion beam test. We also present the operation and performance of the SCD on the ISS.

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