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Prediction and measurement of space weather conditions and impacts on space missions (3)

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A NANO-PAYLOAD FOR COSMIC RAY MONITORING AND SPACE WEATHER ANALYSIS

Abstract

The prediction of impending space weather remains an area of active scientific research, and growing government and private industry concern. Carleton University has a long history of world class excellence in the design, implementation, and characterization of particle detectors for high energy physics experiments, and has more recently applied that expertise to the tracking of secondary cosmic rays for broader applications. Carleton's primary role in the design and construction of a large-scale experiment to use cosmic rays for 3D tomographic imaging of cargo containers and trucks (CRIPT) led to the implementation of a cosmic ray telescope for space weather studies (FOREWARN). Working on these projects as a research assistant, in turn, led to my involvement with a cubesat project (IAC-11,E2,3,9,x9405) for the Canadian Satellite Design Challenge (CSDC), where the payload I proposed was intended to extend our knowledge of the modulation of primary cosmic rays by coronal mass ejections (CMEs), and to make continuous observations to help differentiate those from non CME-related fluctuations. The team did not win the challenge; however, work has continued on the detector with a low-cost proof-of-concept completed in November 2013. If the performance of the proof-of-concept is deemed to meet the requirements of the proposed scientific mission, a full version of the detector will be built with the intent of launching it on a cubesat to prove its capabilities in orbit. Because of its small size ($<600 cm^3$), power (<1W), weight (<1kg), modest and scalable data requirements (was designed for a single ground station with a 9600bps link), and a symmetric architecture that allows it to be operated in arbitrary orbits and orientations (including rotation-stabilized or even non-stabilized platforms), the hope is it will become an option routinely considered for inclusion as a hosted payload and eventually provide an ad hoc array in various orbits. Such an array could provide real-time in-orbit measurement of cosmic ray flux and anisotropy to assist in predicting space weather, and invaluable data on the dynamic high-energy radiation environment around Earth in general. An overview of the design and capabilities of both the proposed and proof-of-concept detectors will be presented, along with an overview of the technologies and analysis techniques employed by Carleton for ground-based observations. The testing of the proof-of-concept is scheduled to be completed over the summer of 2014, and preliminary findings will also be presented.