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

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DEVELOPMENT OF A MINIATURE OSCILLOSCOPE AND CURRENT PROBE FOR MEASUREMENT OF ARC CURRENT ON-BOARD HORYU-3

Abstract

The World's largest-scale space system today is the International Space Station (ISS). The ISS generates 160V and operates in the 100kW class. For next-generation space systems, larger power spacecraft are necessary. When operating high voltage solar arrays it is especially advantageous to decrease transmission loss and improve efficiency. In the 1990s, spacecraft bus voltages doubled from 50V to 100V. At this time, however, many arcing incidents occurred on spacecraft solar arrays. The frequency of arcing depends on the interaction between ambient plasma and high-energy electrons and the spacecraft. The scale of arcing is directly proportional to the spacecraft generation voltage. Therefore, arcing on spacecraft that generate high voltage is likely to damage the solar array. The power generation efficiency of damaged solar arrays decreases, and finally, the spacecraft cannot operate. The 160V power generation of the ISS is a set value that reduces the likelihood of arcing. For solving the above problems, we are studying the arc phenomenon and arc mitigation technology through ground-based tests at Kyutech. However, several experiments were also carried out in space on-orbit. In May 2011, PASCAL (Primary Arc effects Solar Cell At LEO), which was carried in MISSE-8 (Materials International Space Station Experiment-8), was launched by STS-134. PASCAL has several solar arrays. PASCAL carried out an arcing test on orbit to observe degradation phenomenon of solar arrays caused by arcing. PASCAL also tried to measure arcing current, but failed. The failure cause is regarded as low sampling rate (100kSamples/sec). HORYU-3 is a 3U cubesat currently under development by a satellite project team in Kyutech. HORYU-3 will attempt to measure arcing current in orbit. Therefore, a miniature oscilloscope of high sampling rate (40MSamples/sec) and current probe is under development. We will discuss the following content: 1,Development of BBM of the miniature oscilloscope of high sampling rate (40MSamples/sec). 2,Design and testing of the prototype current probe. 3,Ground-based arcing tests at Kyutech. 4,Evaluation of the system. This mission will be the first measurement of arcing current in orbit. It will evaluate the validity of ground-based test systems by comparing the result of ground-based tests with experiments conducted in space. It also may help explain the arcing phenomenon that occurs in orbit.