

55th IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE
ACTIVITIES (D5)

Prediction, Testing, Measurement and Effects of space environment on space missions (3)

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Kyushu Institute of Technology, JapanCRITICAL PLASMA ENVIRONMENT FOR DEBRIS CAPTURING OPERATION IN AURORAL
OVAL**Abstract**

Japan Aerospace Exploration Agency, JAXA researches the technology for active space debris removal. The anti-charging measure at the moment of capture operation is one of research topics. In order to consider effective countermeasure, we need to know how much potential difference can be possible. As is well known, the charged particles that cause satellite charging depends on the type of orbit. We investigate the potential difference in the polar orbit, which is known as congested orbit populated by many space debris. Through this investigation, we expect to clarify the relationship between plasma environment and potential difference at capture operation. We utilize the past observation results by the DMSP satellites for the plasma environment conditions. We change the ionospheric plasma density from the order of $10^8/m^3$ to $10^{10}/m^3$, and the energy of auroral electron from $1 \times 10^{-4} A/m$ to $1 \times 10^{-6} A/m$. The other environmental parameters are shown in the presentation. We use Multi-Utility Spacecraft Charging Analysis Tool, MUSCAT to obtain the potential difference between the debris and the satellite. MUSCAT is a 3D charging simulation tool. We make the grid models of the satellite and the upper stage of H-II A rocket which is assumed as the removal target in the analysis domain. Whether the potential difference was safe or not was determined based on the Japanese spacecraft charging design guideline. The simulation result shows that if the plasma density is of the order of $10^{10}/m^3$, the potential difference is low enough to ignore the risk of discharge. If the plasma density is lower than $10^{10}/m^3$, the auroral electron current density is the dominant parameter for the potential difference. Since the risk of discharge depends on the plasma density, a device to measure the plasma density is necessary for a debris removal satellite.