18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space Debris Detection, Tracking and Characterization (1)

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DIRECT MEASUREMENTS OF HYPERVELOCITY IMPACT FLUXES ON THE TANPOPO AL FRAMES IN 2015-2018 DEMAND CURRENT MICROPARTICULATE ENVIRONMENT MODELS IN LEO

Abstract

Space debris and micrometeoroids are moving at hypervelocity in low-Earth orbit (LEO). Even a microparticle smaller than 1 mm can cause serious damages to the satellite operations. Thus it is necessary to continuously predict the microparticulate environment. At present, no means has been established for observing microparticle from the ground, and in each country, in-orbit measurements have been performed to predict the microparticulate environment such as LDEF, EURECA, SFU. NASA and ESA have constructed LEO microparticulate environment models based on past in-orbit measurement data (MASTER, ORDEM). JAXA and MUSCAT Space Engineering Co., Ltd. have built a simulation software called Turandot (Tactical Utility for Rapid ANalysis of Debris on Orbit Terrestrial) that uses these models to predict impact frequency. It is important to continue in-orbit measurements to predict the impact risks with high accuracy. In the “Tanpopo Project” by JAXA, microparticulate collection experiment have been conducted onboard the Kibo Exposure Facility of the International Space Station for five years each year from 2015. There is a period difference of several decades between this project and the orbital measurements performed in the 1980s and 1990s. By comparing the two, it is possible to capture the long-term changes in the particulate environment taking into account the solar cycle. In the Tanpopo project, the impact fluxes were derived from the number of impact crater, exposure period, and exposure area for the two-year space experiment samples from 2015 to 2017. In addition, this study derives the impact flux from the space experiment sample from 2017 to 2018 and captures short-term changes in the microparticulate environment over several years by comparing the measured values for three years. The difference between the Tanpopo project and past in-orbit measurement projects is that many of the past projects are long-term or one-time only. The model constructed from these data is suitable for predicting

long-term fluctuations of the microparticulate environment. On the other hand, since the Tanpopo project is short-term and continuous, adding these data to the model leads to accurate prediction of changes in the microparticulate environment. From the above, this study contributes to the verification of the model and the improvement of the prediction accuracy by comparing the measured values from the space experiment results from 2015 to 2018 with the predicted values from the microparticulate environment model.