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REVISITING MICROPARTICULATE FLUX IN THE LOW EARTH ORBIT: COMPARISON BETWEEN DIRECT MEASUREMENT OF MICRO-CRATERS ON THE TANPOPO CAPTURE PANELS AND THE TURANDOT FLUX MODEL FOR THE INTERNATIONAL SPACE STATION IN 2015-2016

Abstract

In the recent decades, space debris in the low Earth orbit (LEO) have been increasing due to deliberate explosions and other incidents, according to ground observations and tracking. However, the population of sub-mm sized debris, which is only measurable directly in orbits, has not been systematically measured since 1990‘s. In order to better assess risks paused by hypervelocity impact damages of such small debris and micrometeoroids, feedbacks from direct measurements of current meteoroid and and debris flux in the present epoch are vital.

Here we report the first results of direct measurements of micro-craters formed on the first year samples of the Tanpopo capture panels onboard the JEM(Kibo)-Exposed Facility of the International Space Station in 2015-2016 to reassess the Turandot meteoroid and debris flux model. Exposed to the low Earth orbit in May 2015 and retrieved back in June 2016, eight panels of 100x100x20mm Aluminum-framed aerogel were exposed on three pointing faces, namely the ram(east), north, and space. After safely returned by the Dragon capsule and transferred to the JAXA facilities in September 2016, all the exposed surfaces of these panels were optically surveyed for hypervelocity impact signatures larger than 20 microns for the Al frames and larger than roughly 100 microns for the 10mg/cc hydrophobic, silica aerogels. As the results, 10 hypervelocity impacts on the Al frames and more than 60 on the aerogels are confirmed as of this writing.

As for these micro-craters on the Al frames, impact conditions and origins of each microparticulate have been investigated by measuring crater morphology and elemental analyses with a digital microscope

and SEM/EDX. Whenever possible, impact residues are examined in detail and some are concluded as impacts due to chondritic micrometeoroids or artificial terrestrial contamination.

Combined these flux measurements and origin estimates, the results are compared with the currently available meteoroid and debris flux simulation tool such as Turandot.