Paper ID: 50446
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17th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Impact-Induced Mission Effects and Risk Assessments (3)

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# EXAMINATION OF THE IMPLICATIONS OF LARGER DEBRISAT FRAGMENT CHARACTERISTICS

**Abstract**

Understanding the characteristics of debris from on-orbit hypervelocity collisions is of increasing importance as the space environment becomes more congested and issues of debris lethality and lifetime become more relevant to space operators. Limited information can be derived from the existing debris from historical on-orbit events, restricted by observable size and detail of characterization. Ground testing is necessary to provide detailed debris characteristics and extend data to smaller-sized fragments. DebriSat is a joint project involving the US. Air Force Space and Missile Systems Center (SMC), NASA, The Aerospace Corporation, and University of Florida (UF). The experiment involved impacting a high-fidelity satellite mock-up and a lower fidelity upper stage mock-up in a test chamber with 600 g projectiles at approximately 7 km/s. The resulting debris from each test was collected and is currently being characterized at UF.

While the initial DebriSat characterization focused on small fragments, several millimeters in size, recent work has included many fragments larger than 1 cm. These larger DebriSat fragments overlap the size range of orbital fragments trackable by the U.S. Space Surveillance Network and include fragments that would likely be mission-ending to a satellite if it were impacted on orbit. Comparison of the characteristics of trackable-sized ground-test fragments and similar on-orbit fragments enhances understanding of the similarities and differences between on-orbit and ground-test generated debris and enables better prediction of the debris characteristics from future on-orbit events. This range of larger fragments also covers debris too small to track but large enough to result in satellite mission failure, providing valuable information to support on-orbit fragmentation models and associated risk assessments for some of the most hazardous debris. One such fragmentation model is The Aerospace Corporation's IMPACT, which simulates debris from explosions and hypervelocity collisions. The model generates debris properties including numbers, masses, spreading speeds, and physical characteristics such as size and area-to-mass ratio.

This paper discusses observed properties of the larger DebriSat fragments in comparison to the smaller particles, on-orbit fragmentation debris, and the IMPACT model. It explores various methods of determination of area-to-mass ratio as compared to estimates of area-to-mass of on-orbit fragments based on observation. It also discusses the implications of the similarities and differences between these classes of fragments and explores how models such as IMPACT may be improved to reflect this new understanding.