New Laboratory-Based Satellite Impact Experiments for Breakup Fragment Characterization

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A consortium consisting of the NASA Orbital Debris Program Office, U.S. Air Force's Space and Missile Systems Center, the Aerospace Corporation, and University of Florida is planning a series of hypervelocity impact experiments on mockup targets at the U.S. Air Force's Arnold Engineering Development Complex (AEDC) in early 2014. The target for the first experiment resembles a rocket upper stage whereas the target for the second experiment represents a typical 60-cm/50-kg class payload that incorporates modern spacecraft materials and components as well as exterior wrap of multi-layer insulation and three solar panels. The projectile is designed with the maximum mass that AEDC's Range G two-stage light gas gun can accelerate to an impact speed of 7 km/sec. The impact energy is expected to be close to 15 MJ to ensure catastrophic destruction of the target after the impact. Low density foam panels are installed inside the target chamber to slow down and soft-catch the fragments for post-impact processing. Diagnostic instruments, such as x-ray and high speed optical cameras, will also be used to record the breakup process.

The main goal of this "DebriSat" project is to characterize the physical properties, including size, mass, shape, and density distributions, of orbital debris that would be generated by a hypervelocity collision involving an upper stage or a modern satellite in the low Earth orbit environment. In addition, representative fragments will be selected for laboratory optical and radar measurements to allow for better interpretation of data obtained by telescope and radar observations. This paper will provide a preliminary report of the impact results and the plans to process, measure, and analyze the fragments.