

SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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MULTI-LAYER INSULATION MODEL FOR MASTER-2009

Abstract

In 1999, optical surveys of the GEO transfer orbit region using ESA's 1 m Ritchey-Chrétien Space Debris telescope located in Tenerife were initiated. During these surveys an unexpected debris population was discovered. The objects exhibited mean motions similar to GEO but had high excentricities and quickly changing orbit parameters and brightness levels. Since the beginning of these surveys the source has been confirmed by other observations. An initial idea had been that objects with very high area-to-mass ratios released from GEO satellites could be forced into orbits similar to those seen during the surveys by solar radiation pressure. One candidate for these objects is multi-layer insulation foil which is used for thermal insulation purposes on almost all satellites. For one, this material has very high area-to-mass ratios of up to $100\text{ m}^2/\text{kg}$. In addition, the multi-layer insulation is coated with thin metallic films which makes them highly reflective and thus easily visible with optical telescopes. To investigate whether this material qualified as a possible candidate for this source, two independent models were created which simulate the creation of multi-layer insulation debris through fragmentation events and aging related delamination. Subsequent comparisons of the simulated objects to the measurement data from observation campaigns showed adequate correlation. This prompted the decision to include an upgrade of the multi-layer insulation models into MASTER. The current paper gives a complete overview of these models as implemented into MASTER-2009. Initially, the data underlying the models is presented. Next, the two MLI models are developed and the most important model parameters and assumptions are discussed. Finally, the simulated population is presented. The paper concludes by comparing the simulation results of the population to the observations performed with ESA's space debris telescope.