

SPACE DEBRIS SYMPOSIUM (A6)  
Space Debris Removal Issues (5)

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PROPELLANTLESS DEORBITING OF SPACE DEBRIS BY BARE ELECTRODYNAMIC TETHERS

**Abstract**

A 3-year Project started on November 1 - 2010, financed by the European Commission within the FP-7 Space Program, and aimed at developing an efficient de-orbit system that could be carried on board by future spacecraft launched into LEO, will be presented. The operational system will deploy a thin uninsulated tape-tether to collect electrons as a giant Langmuir probe, using no propellant/no power supply, and generating power on board. This project will involve free-fall tests, laboratory hypervelocity-impact and tether-current tests, and design/Manufacturing of subsystems: interface elements, electric control and driving module, electron-ejecting plasma contactor, tether-deployment mechanism/end-mass, and tape samples. Preliminary results to be presented involve: i) devising criteria for sizing the three disparate tape dimensions, affecting mass, resistance, current-collection, magnetic self-field, and survivability against debris itself; ii) assessing the dynamical relevance of tether parameters in implementing control laws to limit oscillations in /off the orbital plane, where passive stability may be marginal; iii) deriving a law for bare-tape current from numerical simulations and chamber tests, taking into account ambient magnetic field, ion ram motion, and adiabatic electron trapping; iv) determining requirements on a year-dormant hollow cathode under long times/broad emission-range operation, and trading-off against use of electron thermal emission; v) determining requirements on magnetic components and power semi-conductors for a control module that faces high voltage/power operation under mass/volume limitations; vi) assessing strategies to passively deploy a wide conductive tape that needs no retrieval, while avoiding jamming and ending at minimum libration; vii) evaluating the tape structure as regards conductive and dielectric materials, both lengthwise and in its cross-section, in particular to prevent arcing in triple-point junctions.