An Architecture of Modular Spacecraft with Integrated Structural Electrodynamic Propulsion (ISEP)

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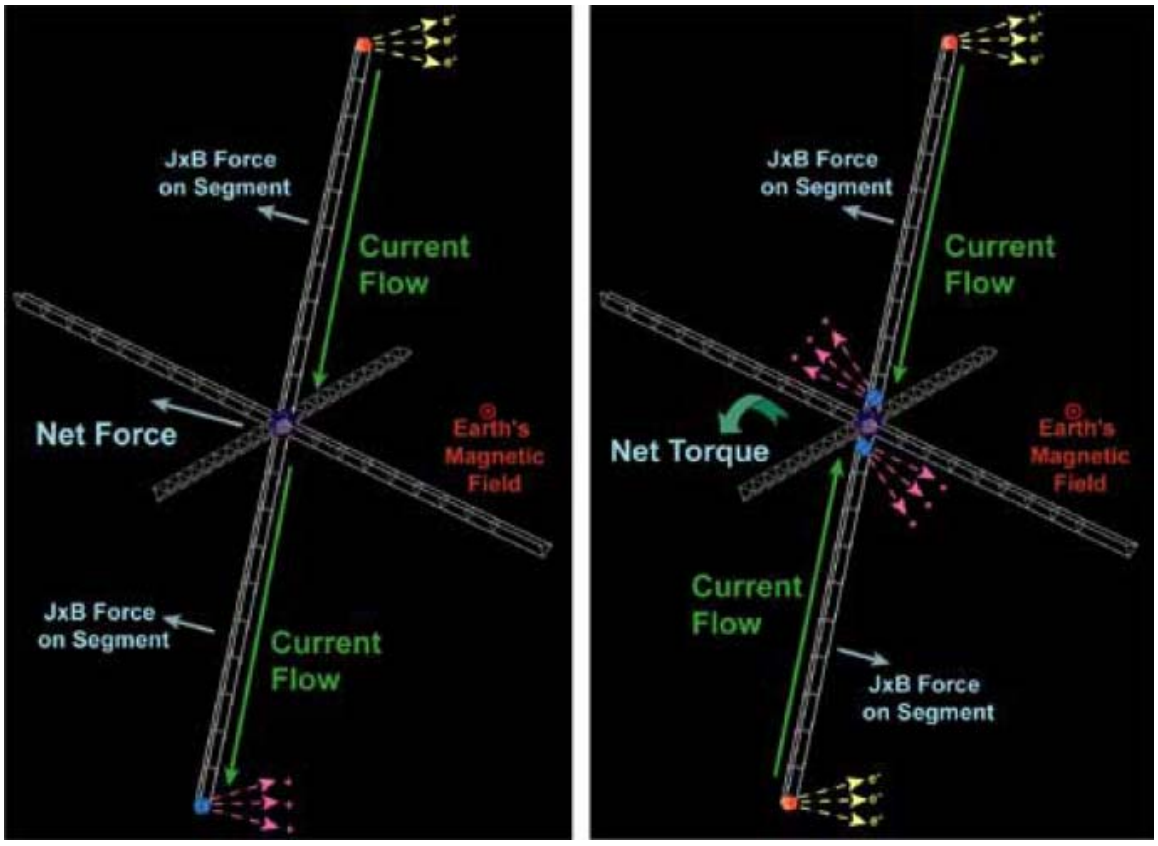

NASA's Vision for Space Exploration (VSE) relies on numerous systems of systems to support a return of robotic and human explorers to the Moon in preparation for human exploration of Mars. Establishing a sustainable and continuous manned presence on the Moon, Mars, and deep space will require a very large total mass of material to be either launched from Earth, or obtained from the moon or asteroids and deliv-ered for use in structural, propulsion, and shielding applications. Moving this material in near-Earth and cislunar space using traditional rocket-based propulsion requires propellant masses that represent a large fraction of the total required launch mass, and thus cost, of the exploration architecture.

The Phase I effort established the feasibility of an innovative multifunctional propulsion-and-structure system concept, called Integrated Structural Electrodynamic Propulsion (ISEP), which uses current-carrying booms deployed from a spacecraft to generate thrust with little propellant expenditure. ISEP utilizes methods conceptually similar to electrodynamic tethers with the added benefit of providing a ca-pability for generating thrust in almost any direction as well as for providing torques for spacecraft atti-tude control. This modular integrated propulsion architecture will facilitate self-assembly of large space systems, and enable propulsion and attitude control of an assembled system during and after such assem-bly. During the Phase II effort, we propose to further refine the ISEP technology, and design an ISEP system for a mission of interest to NASA's VSE. As part of a development and risk mitigation program, TUI will design, build and launch a nanosatellite experiment that will demonstrate both the ISEP concept as well as propellantless current closure using field emissive array cathodes. This simple flight experi-ment

will demonstrate the feasibility of using the ISEP architecture to reduce costs and enhance capabili-ties of NASA’s Exploration Systems, Space Operations and Science Mission directorates.