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Large Scale Spheromak for Magnetic Shielding of Spacecraft
JOHN SLOUGH, MSNW LLC — Exposure to the energetic particles associated with solar energetic particle events and galactic cosmic rays are known radiation hazards for human exploration. Material shielding would add substantial mass to the spacecraft and provide shielding over very limited areas. The concept that will be explored here is the prospect of providing the shielding by making use of ambient low density plasma that supports the large scale currents needed to provide sufficient magnetic flux to deflect the energetic particles. Such a closed magnetic configuration can be produced by force-free currents (i.e. a spheromak). These plasmas have been created in several laboratories at high magnetic field, but small scale (meter scale vs the low field, 100 meter scale envisioned here). Unlike the fusion application all that is needed is a very low energy density structure that can be maintained with minimal power. The low power is possible if the expected confinement scaling with increasing radius observed in most experiments is obtained. The lack of a material vacuum boundary in space should considerably simplify the maintenance of the configuration. We aim to address several critical issues with the spheromak plasma shroud. Questions to be addressed are (1) How does cosmic ray deflection scale with plasma parameters, (2) Can the sustainment mechanisms presently known be scaled for the durations associated with space flight, and (3) What is the best path for development and validation of the concept. *This work was funded under a grant from the NASA Institute for Advanced Concepts.

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