Use of Superconducting Magnet Technology for Astronaut Radiation Protection

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Left unshielded, astronauts on long, interplanetary voyages will be exposed to lethal doses of radiation from cosmic rays. The proposed superconducting magnetic radiation shielding system could reduce the mass of shielding required for interplanetary travel by an order of magnitude compared to traditional absorption technologies. Since mass directly drives the cost of space systems, magnetic shielding can make space exploration more affordable and hence more sustainable, a prime requirement of the new Space Exploration Vision. The concept of magnetic shielding is not new; the Earth has been doing it for billions of years! However, the ability to produce strong enough magnetic fields to enable magnetic shielding around spacecraft requires superconducting magnet technology that is only just becoming available. Many of the technical developments referred to in this proposal were made as part of the AMS experiment currently scheduled to spend several years attached to the International Space Station. However, as revolutionary as these developments have been to date, they will not yet permit the construction of a sufficiently strong, large-volume, long-lasting magnetic field suitable for long-duration human space flight. We propose to begin studying the issues specifically related to integrating a large magnetic shield into an interplanetary spacecraft. In Phase I, we will study the shielding efficiency of the baseline design and begin a conceptual systems design. In Phase II, we plan to extend the shielding studies to a detailed comparison with passive absorption and address specific details of integrating the magnetic shield into a spacecraft.

Important Note: The work proposed for this NIAC research is not primarily to develop new technology for superconducting magnets in space (although some new technology will definitely be required) but to study how to expand the size of space-qualified superconducting magnets, how to best configure such magnets to shield radiation in a habitable volume, and how to incorporate the systems into a reasonable, safe design for an interplanetary vehicle.

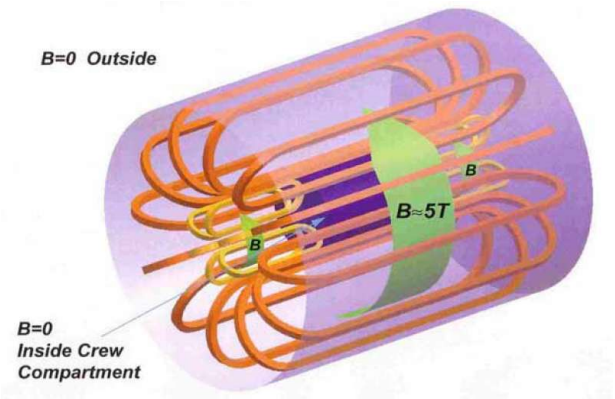

Figure 1 – Conceptual design for a magnetic shield surrounding a crew compartment
Scale: The diameter of the crew compartment is 2.5 m