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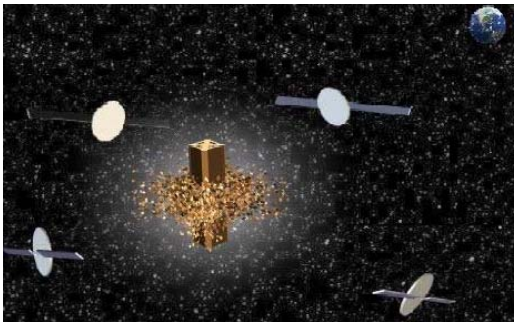
Tailored Force Fields for Space-Based Construction



Conceptual drawing of a large radiation shield being formed using radio waves from pulverized asteroidal material. Earth is shown much larger than it would be seen from the Near-Earth Object region at the Earth-Sun L5.

Potential fields can be used to assemble and construct solid structures over a wide range of size scales. This proposal is to start planning for using such force fields to build large, massive structures in space using extraterrestrial materials. The development of a comprehensive space-based economy is being recognized as the best way to achieve NASA's HEDS goals. A fundamental obstacle to building human settlements in space is the construction of the massive outer radiation shield. Human labor in space is prohibitively dangerous and costly for this mission. A unique set of experiments by our team has shown that by tailoring potential fields, large numbers of objects can be moved into desired positions and desired shapes can be constructed in reduced-gravity environments. This idea holds promise for several types of force fields suitable for automated construction at levels ranging from micrometer-scale discs and fibers to kilometer-scale habitats. Results from microgravity flight experiments at the 10^{-1} m level prove the basic theory. A concept for the 10^{3} m scale using radio waves holds promise at the 50-year horizon. Calculations show that in the 15-30 year time frame, a 2km diameter radiation shield can be built at the Earth-Moon L2 Lagrangian point using lunar materials. The project architecture is aligned with proposals for various other elements of a space-based economy, bringing project cost well within reason. The project will focus on the issue of building the infrastructure of a space-based economy using electromagnetic and acoustic fields. In Phase I, the sample problem of the 1km-radius cylinder will be taken through detailed system and architecture feasibility analysis. The idea of pulverizing carbonaceous asteroids and reconstituting a spaceship structure from pulverized material at the Earth-Sun L5 point will be taken through architecture definition. Phase II will refine the mission plans further.