SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FAR FUTURE (D4)
Novel Concepts and Technologies (1)

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SOLAR QUANTUM PROPULSION

Abstract

We use the term solar quantum propulsion to characterize a systems concept we are exploring. The goal is transforming solar energy to optical quantum states in space. We seek, in particular, energy levels useful for propulsion requirements typical of general activities in space. A price is paid, e.g., as compared to solar thermal propulsion, in the form of the extra step of transforming sunlight to coherent light. There is also a further price paid in that transmission of the optical states of interest in the atmosphere of Earth must typically be avoided. The energetic quantum states required for typical propulsion applications in space will be degraded to an unacceptable degree by nonlinear optical, and other, interactions with the atmosphere of Earth. Advantages gained using this systems concept are: (1) The required energy is accessed in space, from other locations in space, as opposed to requiring transport from Earth; (2) Energy can be distributed in space on short notice, when and where needed, using optics of dimensions comparable to existing resources in space; (3) Concentration of optical energy in both space and time is achieved to a degree that addresses current critical needs. An example is efficient ablative propulsion generated by optical energy delivered at multi-kilometer distance. This offers means of enabling safe efficient deorbiting of a majority of small orbital debris currently in near Earth space; and (4) Functions in space become achievable at reduced cost. Possible examples are more economical change of orbit and novel means of supporting horizontal lift to orbit. In the very long term this strategy may offer yet more adventurous capabilities. Examples are: optically enabled fusion engines, direct generation of matter and anti-matter using intense focused coherent light, energy beaming to spacecraft traveling to other planets, defense of Earth against asteroids, and possibly even support for interstellar travel. The absence of atmospheric distortion and optical loss in space as well as access to continuous solar illumination appear advantageous to implementing this capability. Current terrestrial work in solar pumped lasers has already demonstrated efficiencies adequate to recommend this effort. Focused efforts in space can be reasonably expected to yield yet higher efficiencies and larger average and larger peak energies. Our group at UAH has worked with personnel at NASA Marshall and NASA GRC on related topics, published papers, and given talks identifying a suite of related applications at the 2009, 2010, and 2011 IAC meetings.