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Summary status report of the electric solar wind sail: Principles and applications

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The electric solar wind sail is a way of using the momentum flux of the solar wind for spacecraft propulsion. The physical idea was conceived in 2004 [1] and a feasible-looking technical implementation scheme based on centrifugal stretching of separate tethers was found in 2006 [2]. Two-dimensional particle-in-cell (PIC) plasma simulations were used to evaluate the obtainable solar wind thrust [3] and trajectory calculations for concrete space missions have been recently performed [4]. They confirm that the electric sail method would compare favourably with ion engines and solar sails in terms of launch mass and traveltime characteristics in many cases. Ideas how to implement the concept technically have during 2007 progressed to a rather detailed level, for example, clear plans how to implement thrust vector direction and magnitude control are already existing. We estimate that a typical electric sail hardware in its totality would weigh only 50-100 kg, thus the system is cheap to launch into orbit.

If successfully built and demonstrated in space, the electric sail could provide a practical and cheap way of sending probes to the outer solar system with unprecedentedly short traveltimes. For 200 kg total probe mass the outward speed could be 3-6 times faster than today's fastest spacecraft (50-100 km/s, 10-20 AU/year). The electric sail could also be used to make travel in the inner solar system cheaper than at present: because the electric sail needs no fuel, its launch mass is smaller than in chemical or ion propulsion, for example. The latter property might be used also for asteroid resource utilisation, for example, for ferrying water ice mined from near-Earth asteroids to Earth orbit where it is used to produce rocket fuel. This kind of exploitation of extraterrestrial resources could significantly benefit other large-scale space applications

like solar power satellites.

References

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