

Gram-scale Nano-spacecraft Entry into Star Systems

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Abstract

Breakthrough Starshot is a study to consider the concept of ultra-fast Nano- spacecraft probes towards the stellar system Alpha Centuari. These probes leave the solar system at .2 the speed of light. The beginning of the journey and the intermediate interstellar trajectory has been the subject of preliminary studies [1], [2]. Considered here is arrival at destination. In Starshot it is proposed that a bundle of spacecraft be directed towards the target with the intent that some fraction of the interceptors would make close enough flybys to take physical measurements. If active guidance, navigation and control can be realized for Nano- spacecraft it may be possible to intercept the Astrosphere of one or more stars of the Alpha Centuari system. Of interest here is interaction of an interceptor with the Astrosphere of a target star, of particular consideration is the interaction of a Nano- spacecraft with radiation pressure, Poynting-Robertson drag, Lorentz forces, stellar wind drag and Coulomb drag [3],[4]. How do these forces perturb the trajectories of spacecraft at destination? The dynamics of Nano-spacecraft under the influence of these forces is followed by numerical integration of the equations of motion. This paper is submitted for the day 2 session Sails and Beams.

Keywords: Nano-ship Trajectories, Astrosphere Forces, Project Starshot

References:

- [1] P. Lubin, "A Roadmap to Interstellar Flight", JBIS, 69, pp.40-72, 2016.
- [2] Hoang, T., Lazarian, A., Burkhart, B., & Loeb, A., "The Interaction of Relativistic Spacecrafts with the Interstellar Medium", The Astrophysical Journal, Volume 837, Number 1, 2016.
- [3] Burns; Lamy; Soter, "Radiation Forces on Small Particles in the Solar System". Icarus. 40 (1): 1–48, 1979.
- [4] Belyaev, Mikhail A.; Rafikov, Roman R. , "The Dynamics of Dust Grains in the Outer Solar System", The Astrophysical Journal, Volume 723, Issue 2, pp. 1718-1735 (2010)