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Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond (4)

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CHARACTERIZATION OF A NON-STATIONARY SPHERICAL INFLATED LIGHT SAIL FOR
ULTRA-FAST INTERSTELLAR TRAVEL BY USING COMMERCIAL 3D CODES

Abstract

Spherical inflated light sails have been considered to push ultra-light nanocrafts at a significant fraction of light speed. The light sail, which is essentially an extremely thin shell, would be subjected to extremely high accelerations and deformations. The purpose of this research is to perform a non-stationary 3D numerical analysis to study the deformed shape of a spherical inflated light sail riding on a laser beam. Common commercial codes are not specifically designed to deal with this phenomenon. A similar physical context can be found in crash events, which can be analyzed by using commercial codes. Since the development of a dedicated numerical code would require a remarkable effort, an attempt of using such commercial codes has been conducted. Attention has been paid on the simulation of the dynamics of the inflating gas and its effect on sail deformation. Moreover, the effect of changing the features of the sail shell, such as the material and the thickness, as well as the inflating pressure have been considered. The results of this investigation can be used as useful guideline for sail design, as well as an input for further analysis on sail stability.