IAF SPACE PROPULSION SYMPOSIUM (C4)
Joint Session on Advanced and Nuclear Power and Propulsion Systems (10-C3.5)

Author: Mr. Marco Capasso
Politecnico di Torino, Italy, s278938@studenti.polito.it

Mr. Fabio De Bortoli
Politecnico di Torino, Italy, s278743@studenti.polito.it
Mr. Fernando Potenza
Politecnico di Torino, Italy, fernandopotenza5@gmail.com

A PHOTONIC SAIL FOR TRANSPORTATION FROM LOW EARTH ORBIT TO MOON ORBIT

Abstract

Fifty years after the first human landing on the Moon, the goal is to come back there, this time to stay. According to the Artemis program, the future lunar missions will be able to rely on a station orbiting the Moon, the Lunar Orbital Platform-Gateway. Among the modules of the LOP-G, there will be an International Habitation Module (I-HAB). The I-HAB will be a docking point for other modules such as the Human Landing System(HLS) that will allow to descend and ascend from Moon surface. The presence of this logistical base will make the Moon metaphorically closer also given the large number of missions expected next years. In this perspective, a modern propulsion method could be useful: the photonic sail, employed in the IKAROS mission, exploits the photon radiation pressure and generates thrust by means of the change in momentum of incident and reflected photons. This system is characterized by some advantages: the sail is light since it is made of aluminized mylar, it can be operated under small amounts of solar energy, and it is reusable, which allow to reduce costs. Taking into consideration these assumptions, the proposal of this paper is to study a low-cost and efficient transportation concept that could move astronauts, resources and equipment between the Earth and the Moon by exploiting an Earth space station (different from the ISS if it will be disposed) and the LOP-G. The concept is a spacecraft equipped with the photonic sail that would be released from the low Earth orbit. Then the spacecraft would be free to move towards the Moon under the solar radiation pressure during the long-range phase. The shape and the orientation of the sail would be changeable, allowing the astronauts on board the spacecraft to control the trim and trajectory. According to this idea, the LOP-G, as well as the low Earth orbit space station, would be equipped with a laser system for the close-range phases, to give the photonic sail a first acceleration at its release and to slow it down for a soft docking when it is nearby. This work is focused on the study of feasibility of this system, which will allow to raise the interest in safe, efficient, reusable and non-polluting alternatives for transportation systems between Earth and Moon. Further studies will analyse and will try to implement this system in longer missions beyond the cislunar space.