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Author: Prof.Dr. Gustavo Medina Tanco
Universidad Nacional Autónoma de México (UNAM), Mexico, gmtanco@nucleares.unam.mx

COLMENA MICRO-ROVERS FOR LUNAR EXPLORATION: A PROOF OF CONCEPT

Abstract

The COLMENA mission is a lunar payload with a total mass of 608 grams, consisting of 5 small rovers, each with a diameter of 12 cm, a high of 4 cm and 57 g of mass, a container for launch cislunar transportation and Moon landing, a deployment mechanism, telecommunications relay station and data pre-processing unit. COLMENA was built and tested at LINX in Mexico, and has been already successfully integrated in Pittsburgh, USA, to the deck of the Peregrine lander from Astrobotic, responsible for its transportation up to the lunar surface. At this time, launch is foreseen by the mid 2022 with a Moon landing in August/September. The COLMENA mission has several objectives. It will test the survivability of such small units to the thermal and radiation stresses of deep space and lunar surface, since due to their low mass constraints, there is no active thermal control and only minimal radiation shielding. It will also analyze the impact of mechanical abrasion and electrostatic effects of the lunar regolith, which is critical since all the electronics and mechanics of the rovers lay at only 18 mm from the surface and, therefore, their operation takes place inside one Debye length of the limit layer of the dusty plasma which combines sub-micrometer regolith particles in levitation together with solar wind ions and electrons. If this goes well, the rovers will cooperatively generate a common reference system and cluster at a point of their own choice. Furthermore, each rover has a suite of sensors which, in conjunction with the relay telecoms module on the lander, will be used to characterize dielectric properties of the dusty plasma near the lunar surface. The whole COLMENA mission on the Moon will last for as many as 8 terrestrial days. This first mission will probe the concept of using small robots working in cooperation for autonomous science exploration, prospection or eventual economic exploitation operations over large areas of exposed surfaces covered with regolith.