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LUCIANUS: A LUNAR CUBESAT MISSION FOR MOON AND DEEP SPACE EXPLORATION

Abstract

The LUnar Cubesat Initiative Aimed to Novel and Unique Science (LUCIANUS) is a CubeSat mission proposed in the framework of ESA's Lunar CUbesat for Exploration (LUCE) program. In last years, increasing miniaturization and energetic efficiency in payload design has made CubeSat systems attractive for scientific missions and in orbit demonstrations, not only in the vicinity of the Earth, but also in deep space environment. LUCIANUS is going to demonstrate these new capabilities in a cis-lunar scientific mission, made up of two different but harmonized sub-missions: ARDAN and BARBICANE.

ARDAN consists in two identical 8U CubeSats, aimed at lunar resource prospecting and environment analysis, each one equipped with an IR camera, a thermogravimetric sensor, and a neutral atoms detector. The observation of subtle thermal gradients on the lunar surface will be exploited to map the location and the size of lunar lava tubes, while the other two sensors will measure the distribution of suspended dust and neutral atoms, allowing to study their interactions with light magnetic fields and solar radiations.

BARBICANE is a single 12U CubeSat, whose main goal is astronomical observation from a deep space location with a miniaturized Gamma Ray Bursts (GRB) detector. The spacecraft will perform also an exploration and technology demonstration working on a Near Rectilinear Orbits (NRO) in the Moon-Earth Three-Body System, interesting location to support surface vehicles to cis-lunar outpost continuous transfer back and forth. Plus, during the raising of the spacecraft, a thermogravimetric sensor will measure the dust distribution at high altitudes, providing complementary measures to the ones taken by ARDAN.

The dynamics of all the CubeSats will be tracked through the use of Corner Cube Reflectors. The objective of LUCIANUS mission are focused in supporting and complementing the lunar exploration

goals currently identified by the scientific community, involving a fleet of CubeSats: the use of such small satellites allows to increase the coverage with multiple spacecraft acting together. Scientific objectives and technological challenges are presented in the paper, together with the mission timeline and phases. The design solutions identified to address the scientific and technological goals are discussed at system and subsystem levels. Miniaturized solutions are proposed for all subsystems and in particular for propulsion and ADCS. Details on the design are provided for all subsystems and the budgets are eventually presented.