Asteroid Origins Satellite I: An On-orbit Planetary Science Laboratory

Exploration of comets and asteroids can give insight into the origins of the solar system, into the origins of Earth and the origins of the building blocks of life. However surface exploration of asteroids and comets remains a daunting challenge due to their low gravity and unknown surface conditions. This has resulted in loss of several landers or shortened missions. Fundamental studies are required to obtain better readings of the material surface properties and physical models of these small bodies as sending a spacecraft to an asteroid surface mission is fraught with high risk and cost. Our proposed mission, Asteroid Origins Satellite (AOSAT -1) will simulate asteroid surface condition in earth orbit using a CubeSat centrifuge laboratory. Such a capability couldn't be realized on the International Space Station, due to the effects of aerodynamic drag. The CubeSat is a standard 3U platform that will carry crushed meteorite particles (the remnants of asteroid regolith). The spacecraft will operate in two modes, a stationary mode to characterize regolith accretion in the formation of asteroids and in centrifuge mode that will simulate gravity on asteroid surface less than 1 km in diameter. This work provides an overview of the design and development of critical subsystems realized for the mission. The spacecraft has been designed to gather regolith accretion data in the form of high resolution images which are processed on board using a series of smart particle detection algorithms to identify location in three-dimensions and scale of accumulation. The on board processing will enable the missions to be accomplished using a UHF data link, with selective downloading of high-resolution images and video. It is hoped AOSAT 1 will be a model for building a CubeSat laboratory to perform science experiments in orbit. The mission has been selected through NASA's CLI (CubeSat Launch Initiative) and is scheduled for launch in 2017.