20th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

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CUBESAT-BASED MISSION ARCHITECTURE FOR OUTER PLANET EXPLORATION: URANUS CASE STUDY

Abstract

The key to understanding exoplanets lies in the deeper study of the planets in our Solar System. While the inner solar system planets have been extensively explored during the last decades, the ice giants have not been visited since Voyager 2's flybys more than 30 years ago. With more than three quarters of planet candidates discovered by the Kepler space telescope having Neptunian sizes, a mission to the ice giants would provide deeper insights into the compositions structure of ice giants and consequently, exoplanets.

Among the ice giants, Uranus in particular is mysterious in the questions regarding planet formation and evolution. With its puzzling interior structure, unclear energy balance and internal energy transport mechanisms, and its high obliquity, Uranus represents a prime exploration candidate. A rare celestial alignment between Uranus and Jupiter will occur in the early 2030s, that could advantageously shorten travel time, preserve fuel and lower mission costs. This mission will contribute towards the understanding of the Uranian system and its dynamics.

The proposal presents a technology demonstration mission to maximize scientific return and increase

observation opportunities at Uranus and its moons utilizing a hub system supporting several CubeSats as its payload. CubeSats represent a new paradigm for NewSpace missions that introduces an exciting avenue for planetary science missions. Moreover, the inherent modularity and flexibility of this architecture allows the hub to be equipped with CubeSats of different sizes to accommodate different instrument combinations as well as offering a perfect opportunity for collaboration between agencies, universities and industry. The CubeSats will be integrated with scientific instruments, placed on different orbital regimes and be on active communication with the orbiter during their mission. The hub will be tasked with ridesharing, communications relay and interplanetary propulsion. Trade-off analyses of the CubeSat instrumentation, the "hub", and extended mission opportunities to Uranus' local moons ensure a feasible and reproducible mission architecture to explore other planetary bodies, such as Neptune.

Please note that this work is submitted under the guidance of the Space Exploration Project Group (SEPG) of the Space Generation Advisory Council (SGAC) as part of the ACHIEVED Initiative, which stands for Assembly for Concepts in Human Interplanetary Exploration with Various Extraterrestrial Designations. This initiative aims to enable students and young professionals from diverse technical and cultural backgrounds to work and collaborate on a space mission design project.