RENDEZVOUS MISSION PROFILE TO ASTEROID APOPHIS PRIOR TO 2029 EARTH CLOSE APPROACH. Ashton Meginnis (ashton@astroforge.io) AstroForge, Jose Acain (jose@astroforge.io) AstroForge, Colin Helms (colin@astroforge.io) AstroForge, Demyan Lantukh (demyan@astroforge.io) AstroForge

Introduction: The close approach of the asteroid Apophis to Earth in 2029 presents a remarkable scientific and technological opportunity in the domains of planetary geology and planetary defense. The scientific and engineering communities have shown keen interest in deploying a spacecraft to Apophis prior to its encounter with Earth, aiming to showcase humanity's rapid spacecraft deployment capabilities to potentially hazardous asteroids. Additionally, this mission offers a unique chance to observe Apophis before Earth's tidal forces disrupt the distribution of regolith on and beneath its surface. In this paper, AstroForge introduces a spacecraft and mission profile designed to rendezvous with Apophis before the 2029 encounter.

The proposed spacecraft and mission leverage AstroForge's existing deep space exploration space vehicle architecture, ensuring feasibility within the required timelines to reach Apophis before the Earth encounter. The scientific community has specifically expressed interest in a flyby mission to Apophis, however the concept proposed within is capable of either flyby or rendezvous missions. The spacecraft design is a 200kg wet mass vehicle with a total delta-V capability of 5 km/s, allowing for a payload mass allowance of up to 20kg. The solar arrays provide initial power generation of 1,600W, and the power system is tailored to handle instantaneous loads exceeding 800W. With this vehicle, both flyby and rendezvous missions are possible.

AstroForge argues that a rendezvous mission is particularly advantageous for this opportunity due to the extended observation benefits achievable while stationed at Apophis. The spacecraft design remains agnostic to specific payloads; however, AstroForge proposes a potential payload suite based on optical sensors for this mission.

Furthermore, this paper discusses the details of mission trajectory planning, concept of operations, and launch options necessary to achieve the mission's objectives while adhering to stringent schedule and budget constraints. The culmination of these efforts is expected to yield significant scientific and technical achievements, which are summarized in this paper upon successful execution of the mission.