IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

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A TECHNICAL GUIDE TO THE ARCANUM MISSION: A MULTIROLE NEPTUNIAN MISSION.

Abstract

An ongoing revolution in next-generation super heavy-lift launch vehicle development, fuelled by both commercial and government programmes, offers a window of opportunity for large scientific missions to be commissioned in the near future. The additional promise of low cost-per-kilogram to orbit also has the potential to further widen participation in space science in the coming decades.

Development of the Arcanum Mission has led to a large number of constituent quantitive studies, all of which have examined some aspect of this new market and all of which have been based around the specific case of a large outer Solar System spacecraft destined for the Neptunian System. Throughout the course of this study, the limits of specific launch vehicles such as SpaceX Starship and the value of refuelling capabilities on such vehicles have been translated into a large holistic mission design study, conducted by the multinational research group Conex Research. This has allowed for detailed launch vehicle analysis to propagate across astrodynamics, to systems engineering, and then down to component- and instrument-level design, showing what can be expected from these new spacecraft by the scientific community.

Completing a series of papers on the Arcanum Mission, this paper will connect the work of various teams and present in detail viable deep space trajectories, supporting spacecraft structure and propulsion design, communications considerations and multiple other mission components, linking this with near-future enabling technologies; something important to help encourage similar work across the space community. The mission itself also answers a long-made call for an outer planets mission; something which is the topic of numerous working groups across the world. A large multirole orbiter-lander spacecraft, Arcanum has primary science goals surrounding Neptune, Triton, and Kuiper Belt Objects. When in the destined high-eccentricity high-inclination Neptunian orbit, the spacecraft will use a specially designed off-axis three-mirror anastigmatic telescope to make deep space observations at its apoapsis, and a suite of planetary science instruments to analyse the planet around which it orbits during periapsis. The orbiter,

augmented by a lander and surface penetrators for Triton will answer questions on Triton's weak atmosphere, geological structure and dynamics, Neptune's magnetosphere and atmosphere, and interactions between bodies in the system.

Conex Research, a portmanteau of Conceptual and Exploration, was founded during the first COVID-19 lockdown as a platform for early-career professionals - mainly current undergraduate and recently graduated students - to develop skills in research and space mission proposal writing.