

CARINA: a near-Earth D-type asteroid sample return mission

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Abstract-

**D-type asteroids are among the most primitive small bodies of the solar system. Believed to be formed in the outer solar system, a minor fraction of these faint objects can be found in the near-Earth region. Some were suspected to be extinct comets disguised as asteroids. If D-type near-Earth asteroids could represent extinct comets, they would offer us a unique opportunity to investigate the relationship between two classes of minor bodies in our solar system. To provide new insights into D-type asteroids’ composition and dynamical evolution and the possible relation with comets, we introduce the mission concept CARINA (Comet Asteroid Relation INvestigation and Analysis). CARINA will visit and collect a sample from the asteroid 2002 AT4 and address key scientific questions related to our understanding of the early solar system evolution, and the origins of water and life on the early Earth. This paper outlines the scientific motivation and the means for the sample return. The spacecraft is equipped with a sampling ring to perform in-situ analysis and to collect, in a “touch and go” manner, samples from the surface and subsurface of the asteroid. A capsule is expected to return the samples to Earth in **

Index Terms- D-type asteroids; Comets; Near-earth objects; Sample return; Asteroid–comet continuum; Solar system evolution; Astrobiology

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