

# The Autonomous Asteroid mapping mission, “Bering”.

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## **Abstract**

The Asteroids is the major group of solar orbiting objects that so far has received the least attention when counting dedicated spacecraft missions for their study. The reason for this is not due to lack of scientific interest, nor due to inaccessibility of individual target Asteroids, but because of the Asteroids are spread out over a huge volume of space, ranging from the inner Solar System to Jupiter. The delta-V requirements to visit more than one, or for selected cases three, is comparable to what is required to go from Earth to the Asteroid belt itself, and because of the huge diversity between the Asteroids themselves, it has been difficult to argue for and design a comprehensive mission.

The science potential from a mission studying the diversity of the Asteroids is vast, with primary science focus areas including Asteroid flux, size and taxonomy distribution holding the promise to give new insight to diverse areas such as the genesis of the solar system, evolution of the planetary surfaces, asteroid-meteorite connections, solar system mass transportation, histology of the terrestrial planets and the source field for Near Earth Objects.

Traditionally the Asteroid as well as the NEO research is performed from large Earth based telescopes searching the skies for objects with unusual proper motions. From such observations information on the target trajectory, surface spectral properties and constraints on the target size are achieved. However, the telescope observations are limited to objects larger than approximately 1km and to certain orbital elements, e.g. telescope observations are relatively difficult for objects inside the Earth orbit.

Space missions obviously have the advantage of getting much closer to the target, but have traditionally faced a number of other problems of which target acquisition and tracking, the shear cost of ground surveillance of the mission, and the delta-V required to go near several pre-selected targets.

Recent developments in spacecraft instrumentation and especially in onboard autonomy have, however made an efficient, cheap and highly performing Asteroid mapping mission possible, potentially giving statistics of flux, type and orbit for NEO and Asteroids covering all sizes from kilometer to a few meters. This paper describes such a mission.

From a discussion of the possible scientific objectives achievable, a suite of instrumentation supporting these goals and providing for a reliable yet highly autonomous mission is discussed.

The possible mission profiles and their merits are discussed and compared to the mission life and delta-V requirements.

The ideal space segment is shown to be two relatively light science crafts, each capable of performing most tasks and observation independently. The two spacecrafts will fly in a loose formation to enable precision orbit characterization of targets, to minimizing the cost mass and delta-V requirements, and to maximize reliability, robustness and the volume of space searched and mapped.