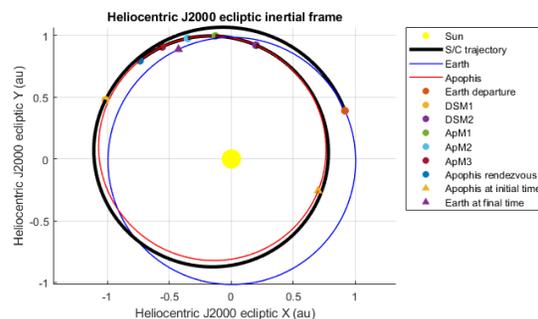


Rendezvous Mission to Apophis: Prospect for the Korea Astronomy and Space Science Institute. Young-Jun Choi^{1,2} on behalf of RMA team, ¹Korea Astronomy and Space Science Institute, Daedukdaero 776, Daejeon, South Korea, yjchoi@kasi.re.kr, ²University of Science and Technology, Daejeon, South Korea

Overview: 99942 Apophis is a silicate, Potentially Hazardous Asteroid (PHA) with an estimated size of 370 m. Apophis will approach the Earth to come within the geostationary orbit during the encounter in 2029. It is expected to offer a unique chance to study 1) global properties (shape, surface topography, internal structure, and spin states), 2) the surface arrangements (regolith and boulder distributions, distributions of space weathered and newly exposed un-weathered regolith on the surface), or 3) their detectable changes expected to happen on the body during the approach. The Rendezvous Mission to Apophis (RMA) proposed by Korea Astronomy and Space Science Institute (KASI) will make rendezvous with Apophis by a few months before the Earth encounter.

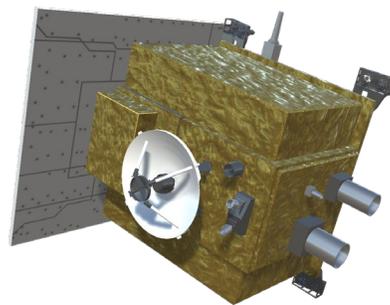
Science goal: The science goal of the RMA mission is to global-map the asteroid before and after the Earth's approach. It is expected to detect changes in the changes in rotational properties, surface topography and regolith distribution of Apophis through comparison before and after Earth's approach. It would further expand our knowledge on the physical and dynamical processes which are expected to occur due to the gravitational tidal forces when an asteroid encounter with a planet. It will also provide an opportunity to promote great knowledge of the science of planetary defense.

Mission profile: Based on the domestic launch capability, we designed a preliminary trajectory that the spacecraft will be launched in October 2027 and begins rendezvous with the asteroid in December 2028 after cruising for 14 months. The spacecraft flies at a distance of 10 km from the asteroid for around eight months to obtain a global map. We expect to record with high spatial and temporal resolution, the very specific event of surface change, such as a mass-sliding during the Earth's encounter of the asteroid, by closely approaching as possible as we can.



Instruments: The primary candidate instruments are multi-band polarimetry camera (PolACam), Wide-angle Camera (WECam), and laser altimeter. The polarimetry map can be obtained maneuvering the spacecraft in a hyperbolic orbit with respect to the Apophis, in combination with changes in phase angle and spin status. The difference in small-scale structure during the Earth's encounter of the asteroid occurs the change in polarimetric properties on the surface. PolACam has the similar design of the Wide-angle Polarimetry Camera (PolCam) onboarded Korea Pathfinder Lunar Orbiter (KPLO) which will be launched in August, 2022. PolACam will obtain the surface images with seven bandpass and polarization filters, which effective wavelengths of bandpass filters are 320, 430, 545, 705, 860, 955, 1055 nm. And its spatial resolution at 10 km operation orbit is 25 cm. WECam will be useful not only for optical navigation but also for detecting particles orbiting the asteroid-like those reported around Bennu [1]. The field of view of WECam is $44^\circ \times 32^\circ$. Thus, the detecting area is larger than 360 times of the asteroid. The laser altimeter will measure the distance between the asteroid and spacecraft during the mission operation. The measuring accuracy of the distance is 2.5 m. Thus, digital elevation model with 2.5 m accuracy will be obtained.

Spacecraft: The preliminary design of the RMA spacecraft uses chemical propulsion system with no ion-engine.



References [1] Lauretta D. S. et al. (2019) *Science*, Vol.366, Issue 6470.