ZHENGHE-A MISSION TO A NEAR-EARTH ASTEROID AND A MAIN BELT COMETREPL. Xiaojing Zhang[1], Jiangchuan Huang[2], Tong Wang[2] and Zhuoxi Huo[1] Qianxuesen Labortary of Space Technology, China Academy of Space Technology, zhangxiaojing@qxslab.cn [2] China Academy of Space Technology

Introduction: Near-Earth asteroids (NEAs) are leftover building blocks of the solar system formation process, which offer important clues to the chemical mixture from which planets formed about 4.6 billion years ago. NEA sample return missions are considered high priority by a number of leading agencies, as demonstrated by the NASA OSIRIX-Rex mission and JAXA HAYABUSA 1 and 2 missions.

Main belt comets (MBCs) are a recently discovered population that have stable orbits within the main belt but show comet-like activity probably driven by ice sublimation [1]. The presence of water/ice in the asteroid belt is very important for origin of water on earth.

The ZhengHe Mission： Travelling to an NEA and bringing back a sample gives us material to inspect and understand formation and evolution of the solar system. Rendezvous with MBCs and in-situ measurements can provide us key insights into origin of water and life in our earth. Our ZhengHe mission will return a sample from Earth's quasi-satellite 2016HO$_3$ in the first phase and rendezvous with MBC 133P/Elst-Pizarro, map its surface, measure its composition and probe the interior structures in the second phase.

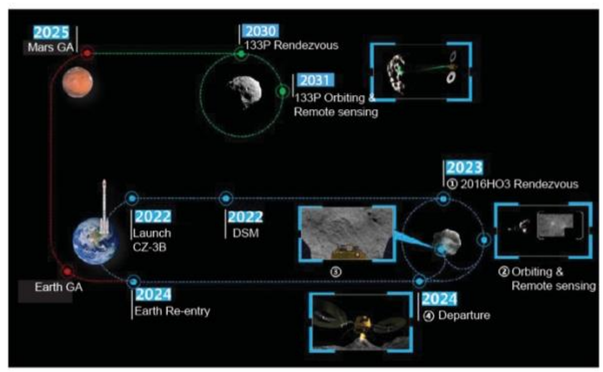
The Mission Objectives. The ZhengHe mission addresses five objectives: (1) to understand the origin and dynamics of Earth's quasi-satellites; (2) to characterize a new Solar System family, the MBCs; (3) to determine presence of water or water ice on MBCs; (4) to test if MBCs are a viable source of Earth's water; (5) to understand the processes occurring in the early solar system and accompanying planet formation;

The Mission Discription. The duration for sample return phase needs to be as short as possible in order to minimize the launch energy. Among all the targets that can satisfy returning samples within 2-3 years, 2016HO3 is of special interest because it is an Earth co-orbital, remaining within 38-100 lunar distance from us. Its spectrum feature suggest 2016HO3 is likely a S, Q or L type asteroid with very primitive composition [2].

ZhengHe flies an over ten-year mission, launching in 2022 to reach the NEA 2016HO$_3$, return 200-1000g sample back to earth within 2-3 years, then continue its journey to rendezvous with the Main Belt comet 133P/Elst-Pizarro just before it reaches perihelion in 2030 and remain there for one year to carry on remote sensing and in-situ measurement.

ZhengHe explores the asteroid and the main belt comet with several instruments, including wide/narrow angle cameras, visible/near-infrared imaging spectrometer, grain impact analyser and dust accumulator, mass spectrometer, γ-ray & Neutron spectrometer, low frequency radar, thermal emission spectrometer, radio science instrument. ZhenHe uses four robotic arms to land on asteroid 2016HO3. Drills on the bottom of robotic arms are used to anchor the main probe to the surface considering 2016HO3 a fast rotator. ZhengHe also flies nano-orbiter and a nano-lander to carry out remote sensing and provide complementary information for sampling. Explosive is used to expose the subsurface of 133P before the nano-lander lands and delivers instruments to detect composition of the subsurface, especially water and volatile.

At the moment, a design study for the ZhengHe mission has been carried out in Chinese Academy of Space Technology.



References:

[1] Hsieh, H.H. and Jewitt, D. (2006). Science, 312, 561-563. [2] Reddy, V. et al. (2017) *AAS*, Abstract #49.