

# China's Deep-space Exploration to 2030

ZOU Yongliao LI Wei OUYANG Ziyuan

(Key Laboratory of Lunar and Deep Space Exploration, National Astronomical Observatories,  
Chinese Academy of Sciences, Beijing 100012)

**Abstract** Focusing on the key scientific questions of deep space exploration which include the origin and evolution of the solar system and its planets, disastrous impact on the Earth by the solar activities and small bodies, extraterrestrial life, this paper put forward a propose about the roadmap and scientific objectives of China's Deep-space Exploration before 2030.

**Key words** China's Deep-space Exploration, Scientific objectives, Solar system and its planets

**Classified index** V4

During the past 50 years, great strides of China's aerospace industry, especially the great success of China's Lunar Exploration Program have laid a solid basis of technology, facilities and human resources for future China's Deep-space Exploration. Recently, Chinese scientists discussed and proposed a roadmap and scientific objectives of China's Deep-space Exploration before 2030.

China's Deep-space Exploration will focus on the key scientific questions of deep space, with an overall planning to explore asteroids, the Sun, Venus, Jupiter *etc.*, which starts from Mars. It aims at important research findings in the origin and evolution of the solar system and its planets, disastrous impact on the Earth by the solar activities and small bodies, extraterrestrial life *etc.*, and promoting astronomy, space science and technology applications.

In about 15 years before 2030, 9 or 10 times deep-space exploration missions would be implemented, according to China's existing scientific, aerospace technology and economic basis and development capabilities. All these missions will be executed by three stages. The first stage plans to explore Mars, whose

natural environment is close to the Earth's, as well as some asteroids and the Sun which may have disastrous effects on the Earth. This stage includes the Mars Global Remote Sensing orbiter and a small rover, near-Earth asteroid multi-target detection, Sun fixed-point observation. The second stage, called the further promotion, will continue to explore Mars, solar activity and main-belt asteroid, which includes Venus exploration orbiter, Mars lander and rover, the solar polar orbit observations and the main-belt asteroid (Ceres) sample return. The third stage is called sustainable development, on the basis of the first two stages, including Jupiter orbiter, Mars sample return and solar storms panoramic observation.

The general scientific objectives of future Mars exploration are: (i) to research the Mars water and soil characteristics, the life information; (ii) to explore Martian atmospheric structure and meteorological characteristics, the Martian magnetic and gravity fields, atmosphere and climate change and its evolutionary history, and to do comparative studies on Earth's magnetic field, atmosphere and climate evolution trend; (iii) to explain the roles of the wind,

water/ice, volcanoes, impact and tectonic activities *etc.* played in the Martian surface topography transformation, to reveal the evolution history of Mars geological features and to conduct comparative planetary studies.

The main scientific objectives of the asteroid missions include: (i) to precisely monitor the orbit of asteroids which have potential threat to Earth, to assess the probability of impact on the Earth, and to detect its topography, structure, compositions; (ii) to acquire and analyze the matter from the early solar system; to research the origin and evolution of the asteroids; (iii) to detect the asteroids weathering layer, and study the interaction of the solar wind with the asteroid; (iv) to detect the possible organic life, and study the origin and evolution of life.

In terms of solar observations, the missions intend to detect the solar vector magnetic field, velocity field and radiation field, monitor the solar activity, study the origin and evolution of the solar magnetic field and solar activity, explain the physical mechanism of solar flares and coronal mass ejections, explore the solar activity disastrous impact on near-Earth space environment, improve solar storm forecast and warning capabilities.

In the term of Venus exploration, the planed missions aim at detecting the atmosphere, ionosphere

and magnetosphere; doing researches on the composition and structure of the atmosphere, lightning and airglow, the greenhouse effect, atmospheric circulation, such as the formation mechanism and the overall evolution; studying interactions of the atmosphere, the ionosphere with the solar wind, exploring the mechanism of water escape; detecting the topography, geological structure and surface compositions; researching the geological forces and evolution and transformation of the surface of Venus; detecting the Venus gravity field and magnetic field, exploring the internal structure of Venus.

The general scientific objectives of Jupiter exploration are: (i) to explore the structure of Jupiter's magnetosphere, solar wind interactions with Jupiter's magnetic field; (ii) to research the Jupiter's atmosphere and its changes, and its atmospheric circulation patterns and dynamic mechanisms; (iii) to detect the interplanetary transport of the solar wind from Venus to the Earth, to Jupiter; (iv) to explore the space environment and ice surface topography of Europa, to study the characteristics of atmosphere and ice thickness profiles; (v) to implement spacecraft experiment of biological cabin, and to research the survival characteristics of terrestrial life in extraterrestrial environment.