Announcement of Opportunities for Scientific Payloads and Projects onboard Asteroid Exploration Mission

China National Space Administration

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The objectives of asteroid exploration mission in China's deep space exploration program have been defined as achieving a near-Earth asteroid sample return and a main-belt comet orbiting through one launch. In order to promote peaceful exploration and utilization of outer space, scientific and technical innovation, social participation and international cooperation, China National Space Administration publicly solicits for proposals for payload configuration schemes and onboard schemes home and abroad. The announcement is as follows:

1 . MISSION OVERVIEW

The mission will be launched at Xichang Satellite Launch Center by Long March 3B launch vehicle. The probe carrying multiple scientific payloads will orbit and land on the near-Earth asteroid 2016HO3. Samples will be collected and taken back to the proximity of the Earth. A return capsule containing samples will be released by the probe and fly back to Earth. This sample return process will take approximately 3 years. After this process, the probe will continue its journey. With the gravity assist of Earth and Mars, it will arrive in asteroid belt in 7 years. The probe will orbit the

main-belt comet 133P and carry on relevant investigation. The probe will be equipped with multiple scientific payloads for remote sensing, in-situ prospection, and sample return. The specific scientific objectives are as follows:

1.1 Near-Earth Asteroid Exploration

(1) Measure 2016H03 physical parameters, such as the orbit, rotation, shape, size and thermal radiation.

(2) Survey the morphology, surface composition, and internal structure of 2016HO3 and retrieve context information for samples.

(3) Carrying out laboratory analysis on the returned samples. Determine the physical properties, chemical and mineral components, isotope composition and structure. Determine and study the age of asteroid samples. Through comparing with meteorites, establish connections between returned samples and meteorites, as well as connections between ground observations and remote sensing in-situ analysis data.

1.2 Main-belt Comet Exploration

(1) Measuring physical parameters, such as the orbit, rotation, shape, size, and thermal radiation of the main-belt comet 133P.

(2) Detecting morphology, surface composition, internal structure, near-space environment, and possible water and organic material of 133P.

1.3 Scientific Research

Through the obtained data and information, the following scientific research will be conducted:

(1) Reveal characteristics and evolution mechanisms of typical small celestial bodies in the solar system.

Based on the in-situ detection of near-Earth asteroid 2016HO3 and orbiting main-belt comet 133P, and detailed laboratory analysis of the returned samples, comprehensive study of two different types of typical target small objects will be carried out to understand their morphology, composition, internal structure and other characteristics so as to interpret their formation and evolution mechanism.

(2) Explore information of pristine substance and life in the solar system.

Obtain and analyze pristine information of solar system at initial stage. Carry out comprehensive study of comparative planetology. Explore the formation and evolution of the solar system, and conduct

comprehensive study on possible water, various organic substances and minerals in asteroids and comets to provide important evidence for the big question, origin of life.

(3) The interaction between solar wind and small celestial bodies.

Explore the propagation and evolution of solar wind in interplanetary space. Study solar wind weathering effect on asteroids, and formation and evolution of the atmosphere and ionosphere of comets in the main-belt. Understand the spatial distribution characteristics and dynamic variation of dust in small celestial bodies.

2 . Request for Scientific Payloads Schemes

2.1 Objectives

Through scheme proposals, based on engineering design and scientific goals, further optimize the function and performance of payloads, and select the technical solution for the payloads.

2.2 Technical Requirements

The mission will carry eight types of scientific payloads, specifications of which are defined in Annex 1.

2.3 Requirements for Scheme Proposals

(1) Proposed payload schemes should have performances that meet or exceed required specifications by AO. Technical solutions and major scientific objectives shall be specified in particular.

(2) Encourage domestic entities to jointly submit proposals and development of payloads with foreign research institutions .

(3) Encourage engineers and scientists to jointly establish teams to submit proposals with identified science objectives.

(4) Foreign research institutions are welcome to submit payload scheme proposals. The foreign payloads will be carried according to the principle of "free onboard, data sharing, and self-founding". Foreign proposals should be supported by home government/region and comply with relevant laws and international treaties.

(5) In principle, a legal entity can only submit one scheme proposal for one payload. The proposal shall be submitted by legal entities. Those proposals submitted by Chinese institutions shall be seal by the legal entity, and for those submitted by the foreign institutions shall be signed by the institutions legal.

(6) Proposal format and relevant requirements refer to Annex 2.

3 . Onboard Opportunities

3.1 Objectives

In order to promote cooperation in deep space exploration and to encourage public participation, the asteroid exploration mission will provide 200 kg for onboard opportunities. Based on the principle of "self-founding, free onboard, data sharing", the onboard opportunities are open to universities, private companies, and Chinese and foreign research institutes.

3.2 Technical Requirements

Based on the mission scheme, there are two kinds of technical modalities for onboard.

Option one: detectors that are independent from the mission probe carried by launch vehicle. The onboard detectors will separate from the rocket after the main probe enters into orbit, and conduct independent mission.

Option two: The onboard detectors carried by the main probe carried to the proximity of near-earth asteroid or the main-belt comet. The onboard detectors will be released by the main detector in due time. The onboard detectors may conduct detection independently or jointly with the main probe. Meanwhile, the main probe might provide power support according to mission status. The basic requirements are as follows:

(1) Carried by Launch Vehicle

The mass of onboard detectors shall not exceed 200 kg (including mounting bracket).

The rocket will not provide power during launching process and the ground segments does not provide TT&C support.

The onboard detectors shall separate from the rocket after the main probe separates from the launcher, and adapt to the attitude of the rocket.

Requirements of the mechanical interface will be further coordinated after proposed schemes pass the preliminary review.

The rocket parameters refer to the technical manual of Long March 3B (China Great Wall Industry Group Co., Ltd. LM-3B, website: *cn.cgwic.com/launchservice/LM3B.html.*)

(2) Carried by the main probe

a. Mass requirement

If onboard detectors:

- NOT separate from the main probe. Mass shall **not exceed 20kg**
- Separates in the proximity of near-earth asteroid. Mass **shall not exceed 80kg**

- Separates in the proximity of main-belt comet. Mass **shall not exceed 20kg**

b. Power requirement

During the near-Earth asteroid phase, the onboard items power shall not exceed 100 W (including the thermal control power provided by the main probe, etc.).

c. Optional dimension envelopes:

- 400mm×350mm×300mm
- 280mm×260mm×160mm
- 150mm×300mm×300mm

Specific needs can be further coordinated.

d. Temperature range

The temperature in the main detector module is -50°C ~ +70°C, and temperature outside the module is -100°C~+80°C.

e. Data interface

RS422 bus or LVDS interface are available. Adopted interfaces depend on data transmission rate requirements.

f. Power interface

The main probe provides primary power with voltage from 23V to 29V.

g. Mechanical Interface

Mechanical interfaces and separation conditions should be adapted

to the requirements of the main probe and detail configuration shall be further coordinated after final onboard schemes finalized.

h. TT&C

Main probe can provide certain support for the onboard items depending on mission status. The communication protocol and operation process should comply with the main probe.

3.3 Requirements for Proposals

(1) The proposed scheme should have identified engineering and scientific objectives with innovation in scientific purpose and engineering technology. Scientific objectives can be either a complement or an extension to that of the main probe but not a duplication.

(2) Technical requirements to the launch vehicle or the main probe should be clearly specified in the proposal, including but not limited to the modality of onboard, mass, volume, installation, energy, separation, TT&C, etc.

(3) The onboard detectors shall not interfere the main tasks of launch vehicle and detectors, nor change the basic design status of the launch vehicle, launch site, TT&C, ground application system, and be able to complete development within four years after final decision on the onboard is made.

(4) Chinese research entities are encouraged to jointly propose onboard schemes with foreign institutes. Foreign research institutes are

welcome to respond in the way of either independently propose or jointly with Chinese partners, which should be supported by home governments or region and abide by relevant laws and international treaties.

(5) In order to encourage more institutes to participate in the mission and create more cooperation opportunities, priority will be given to schemes with less resource requirements (mass, volume, power consumption, etc.) based on evaluation of innovativeness level in science and technology. Schemes would be optimized or merged according to its engineering feasibility.

(6) Proposals shall be submitted by legal entities. Proposals submitted by Chinese institutions shall be sealed by the legal entity, and those submitted by foreign institutes shall be signed by the institute legal. In principle, a legal entity should lead in submitting one proposal for one onboard scheme.

(7) Elements of the proposal and relevant requirements refer to Annex 3.

4 . Selection Process

4.1 The deadline for submitting the scheme proposals for payloads or onboard projects is **August 31, 2019.**

4.2 China National Space Administration will establish a committee to evaluate the advancement, innovativeness, and social benefits of the

payload schemes, and select three candidates for each type of payload. The selection will be completed by October 31, 2019. Once proposals selected, the proposers shall proceed further scheme design, carry out research and development work planning, and form a detailed development and implementation plan according to the feasibility study report. After the mission kicks off, factors such as product maturity, quality assurance, development progress, and economic feasibility will be reviewed comprehensively. Through competitive and merit-based principle, each type of payload will select one from the three candidates.

4.3 Regarding the onboard project schemes, China National Space Administration will organize a committee of experts to preliminarily review proposals in terms of requirement compliance, scientific objective novelty, technical solutions advancement and social benefits. Candidate scheme proposals will be selected and then reviewed by spacecraft system and rockets system in terms of feasibility and their influence on the safety of the mission.

4.4 The development schedules of payloads and the onboard projects will be further coordinated after the final selection is finished.

4.5 Proposals should be submitted in both hard copy and WORD version.

4.6 The proposers shall ensure that the proposals to China National Space

Administration do not harm benefits of any third party. Meanwhile, proposers shall ensure that the scheme received and reviewed by CNSA do not violate intellectual property rights of any third party. Otherwise, the proposers shall bear the corresponding responsibility.

4.7 The AO will be released on the official website of CNSA. China National Space Administration is responsible for interpretation of any matters not mentioned herein.

Contacts：

China National Space Administration		Lunar Exploration and Space Engineering Center	
Contact	Mr. GAN Yong	Contact	Mr. YANG Ruihong
Tel.	86-10-88581246	Tel.	86-10-68378107
Fax	86-10-88581518	Fax	86-10-68379857
Email	gany@cnsa.gov.cn	Email	yang_ruihong@126.com
Address	8A Fucheng Road, Haidian District, Beijing, China. 100048	Address	China Satellite Communication Mansion, 65 Zhichun Road, Haidian District, Beijing, China. 100190