China’s Deep Space Exploration

Lunar Exploration and Space Engineering Center, CNSA
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1. Major Achievements
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3. Open International Cooperation
1. Major Achievements
In the past 20 years, China has successfully completed the three-step goal of “orbiting, landing and sample return”.

China’s Lunar Exploration Programme
“Orbiting, Landing, Sample Return”

<table>
<thead>
<tr>
<th>Mission</th>
<th>Year</th>
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<tbody>
<tr>
<td>Chang’E-1</td>
<td>2007.10</td>
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<tr>
<td>Chang’E-2</td>
<td>2010.10</td>
</tr>
<tr>
<td>Chang’E-3</td>
<td>2013.12</td>
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<td>Chang’E-4</td>
<td>2018.12</td>
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<td>Chang’E-5T</td>
<td>2014.10</td>
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<tr>
<td>Chang’E-5</td>
<td>2020.11</td>
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</tbody>
</table>
1.2 Mars Exploration

Tianwen-1

On May 15, 2021,
Landing

Since May 22, 2021,
Started Mars surface patrol

76m resolution color image of Mars in global scale
1.1 Lunar Exploration

Chang’E-1: Impact remnants rich in carbonaceous chondrites

Chang’E-2: Geologic age of Finsen Crater

Chang’E-3: Mini-magnetosphere

Chang’E-4: Measurements of energetic neutral atoms (ENAs)

Chang’E-5: Music notes
1.3 Capacity Facilities

- Extra-terrestrial s/c test facility
- S/X/Ka deep space network
- Wenchang space launch site
- Sample storage facilities
- Rendezvous docking simulation
- Teleoperation test
2. A Blueprint for The Future
2.1 Lunar Exploration

2024

Queqiao-2
Around 2024

Chang’E-6
Around 2024

Chang’E-7
Around 2026

Chang’E-8
Around 2028

2030

Manned Lunar Landing

International Lunar Research Station

2040

2050

Queqiao Constellation

2024
2030
2040
2050
Chang’E-6

- Launched in the first half of 2024 by CZ-5.
- Sample return from the far side of the Moon.
- The probe now at the launch site.

The whole process takes about 53 days.
Chang’E-7

- Launched around 2026 by the CZ-5.
- To conduct environmental and resource surveys of the lunar south pole.
2.1 Lunar Exploration

- Spacecrafts launched around 2028.
- Laying the Foundation for the long-Term Sustainable Exploration of the Moon.
- Announcement of opportunities for international cooperation.

Intelligent planning of operations

Candidate Landing Zones

- Cabeus Crater
- Leningrad Beta Plateau
- Amundsen Crater
- Shackleton-de Gerlache connecting ridge

Chang’E-8
2.1 Lunar Exploration

International Lunar Research Station

- A comprehensive scientific experiment facility on the lunar surface and lunar orbit that operates autonomously in the long term and manned in the short term.

- With the capabilities of energy supply, central control, round-trip, and lunar surface research, carrying out multidisciplinary, multi-objective and large-scale scientific research activities continuously.

Basic Model of ILRS (2033)  
Expansion Model of ILRS (2045)
2.1 Lunar Exploration

Manned Lunar Landing

- To achieve manned lunar landing around 2030.
2.1 Lunar Exploration

Queqiao Constellation

Phase I
Before 2030
- Pilot type
- Supporting missions such as CLEP Phase IV and the International Lunar Research Station

Phase II
Before 2040
- Basic type
- Regional navigation, support lunar missions, and exploration of Mars and Venus

Phase III
Before 2050
- Expansion type
- Support Mars, Venus, giant planet and solar system edge exploration, etc.

- Speed: 50Mbps, 10Gbps
- Positioning Accuracy: 100m

- Speed: 1~10Gbps
- Positioning Accuracy: 50m

- Speed: >10Gbps
- Positioning Accuracy: excel 10m
2.1 Lunar Exploration

- Queqiao-2
  - Scheduled for launch around 2024, with a working life of 8 years.
  - Service Chang’E-4, 6, 7 and 8 relay communications.
  - Verification and application of Earth-Moon VLBI orbit determination technology.
  - Verification of new communication network protocol technology.

- Tiandu-1
  - Technical validation for laser link, Ka link, etc.

- Tiandu-2

- Tiandu-3
2.2 Planetary Exploration

- Asteroid sampling return
- Mars sampling return
- Jupiter System exploration
- Ice giant, Venus exploration, etc.
- Mars Research Station, etc.
2.2 Planetary Exploration

- Planned launch with CZ-3B around 2025.
- Sample return from near-Earth asteroid 2016HO3 around 2027.
- Exploration of main belt comet 311P around 2034.
### 2.2 Planetary Exploration

**Tianwen-3**

- Two launches by CZ-5 launch vehicle **around 2030.**
- Mars samples return to Earth.

**Orbiter and return modules**

**Landing and assent modules**
Tianwen-4

- Launched by CZ5 around 2030.
- Orbiting Jupiter and its satellites around 2035.
- Reaching Uranus around 2046.
First Asteroid Defence Mission

Mission Objective

- Kinetic impacts on 50m-class asteroids.
- Deepen and expand international exchanges and cooperation, and realise high-precision assessment of defence effects.
- Build a mission support platform to lay the foundation for the construction of subsequent near-Earth asteroid defence systems.
- Enrich the understanding of asteroid orbital evolution and disposal mechanism law.

Timeline:

- **2020**: Start-up mission planning
- **2030**: First kinetic energy impact demonstration of the validation mission
- **2040**: Multi-national cooperation, jointly built basic defence capabilities
- **2050**: Global cooperation and continuous building, improving defence capabilities
Two-stage tandem configuration
(LEO 100t - 150t)

2030

Basic flight verification
One sub-stage reusable fixed point return verification

Basic type
(LTO 35t - 50t)

2040

Two-stage tandem configuration and two-stage fully reusable configuration flight verification

Two-stage tandem configuration
(LEO 100t - 150t)

2050

Establishment of a flight-based round-trip transportation system between sky and earth

Two-stage fully reusable configuration
(LEO 80t)
(100t flighted transport)
2.5 Solar Exploration

Schematic diagram of solar system edge exploration

Flying to the edge of the solar system at 80-100 AU around 2050
3. Open International Cooperation
Principles of International Cooperation

Equality and Mutual Benefit

Peaceful Use

Win-win Cooperation
Lunar Exploration Cooperation

- **Scientific Payloads**
  - CE-4: Sweden, Netherlands, Germany, Saudi Arabia.
  - CE-6: ESA, France, Italy, Pakistan.
  - CE-7, CE-8: under selection.

- **TT&C support**: ESA, Argentina, Chile, Namibia, etc.

- **Lunar sample and science data sharing**
  - Open international cooperation in accordance with the *Rules for the Management of International Cooperation on Lunar Samples and Scientific Data* of the CNSA.

- **Exchange Mars orbiter ephemeris data with NASA.**
CNSA Action Statements

Discussing global governance  Promoting coordination of actions
Deepening project cooperation  Promoting innovative development
Sharing scientific achievements  Encourage diversified participation
Create a platform for cooperation  Maintaining Human Security
THANKS!