



China's Lunar Exploration Program

The Center of Lunar Exploration
and Space Program of CNSA

July, 2009

Object and Significance of China Lunar Exploration Program

- Embracing the lunar exploration technology;
- Start lunar scientific research and application study;
- Involving in exploration, development and utilization of lunar resources for the future;
- Laying foundation for further exploration into deep space.



China's First Lunar Exploration Program

Project Targets:

- Developing and launching lunar exploration satellite;
- Mastering the basic circumlunar technology;
- Doing lunar science exploration for the first time;
- Constructing the space engineering system of lunar exploration;
- Building up experiences for future lunar exploration.



China's First Lunar Exploration Program

Scientific Targets:

- . Obtaining 3D images of lunar surface;
- . Analyzing elements content and types of substances distribution on lunar surface;
- . Exploring distinguishes of lunar soil;
- . Exploring the environment from earth to moon.



China's First Lunar Exploration Program

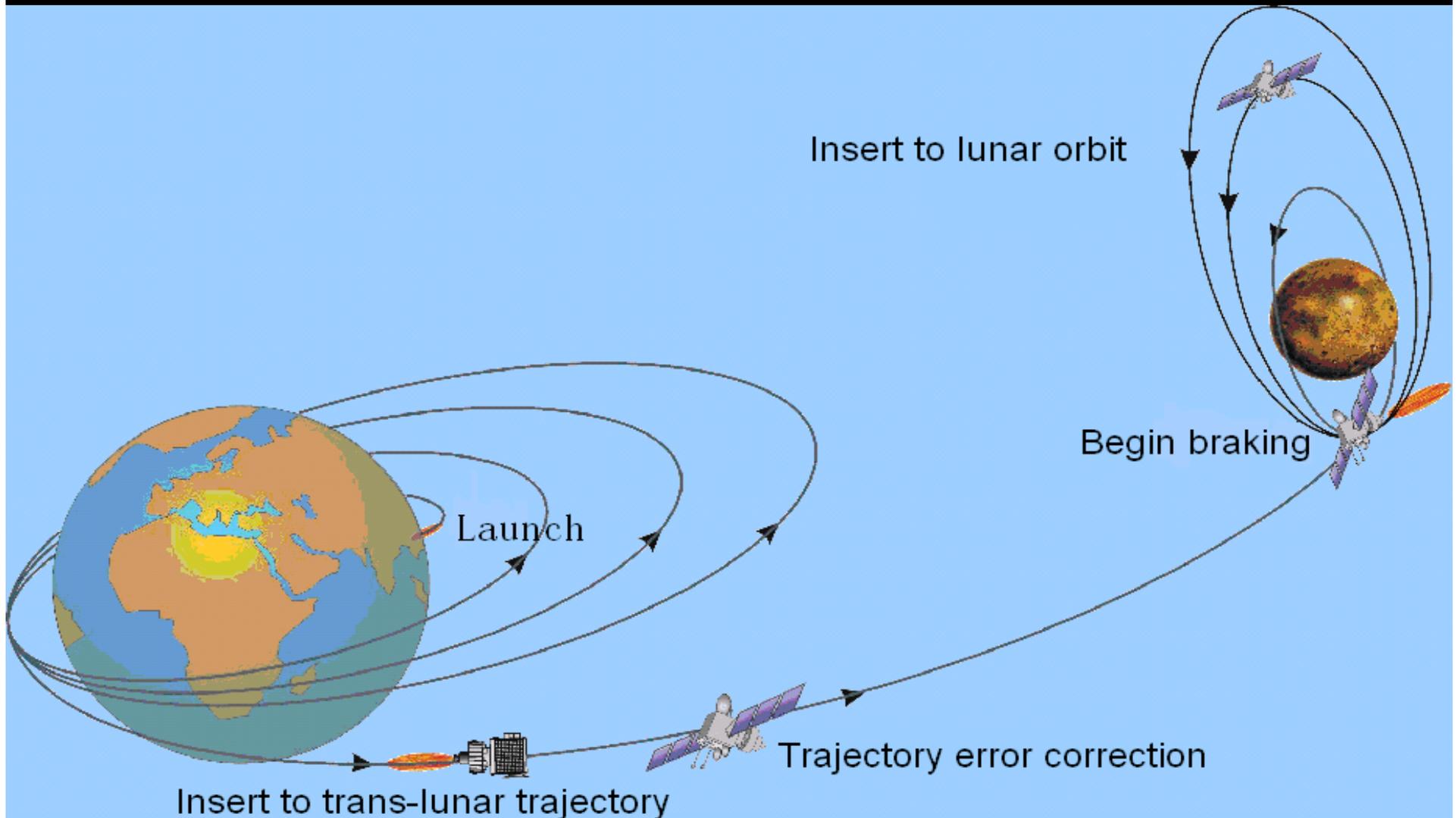
Completely Achieve Project Targets of Lunar Exploration Program

Rocket was launched exactly on time, and entering into the accurate orbit. Through correct controlling and precise orbit-measurement by TT&C system, Chang'e-1 satellite has successfully done it's circumlunar exploration jobs, which leads to complete realization of project targets.



Flight Orbit of Chang'e-1 satellite

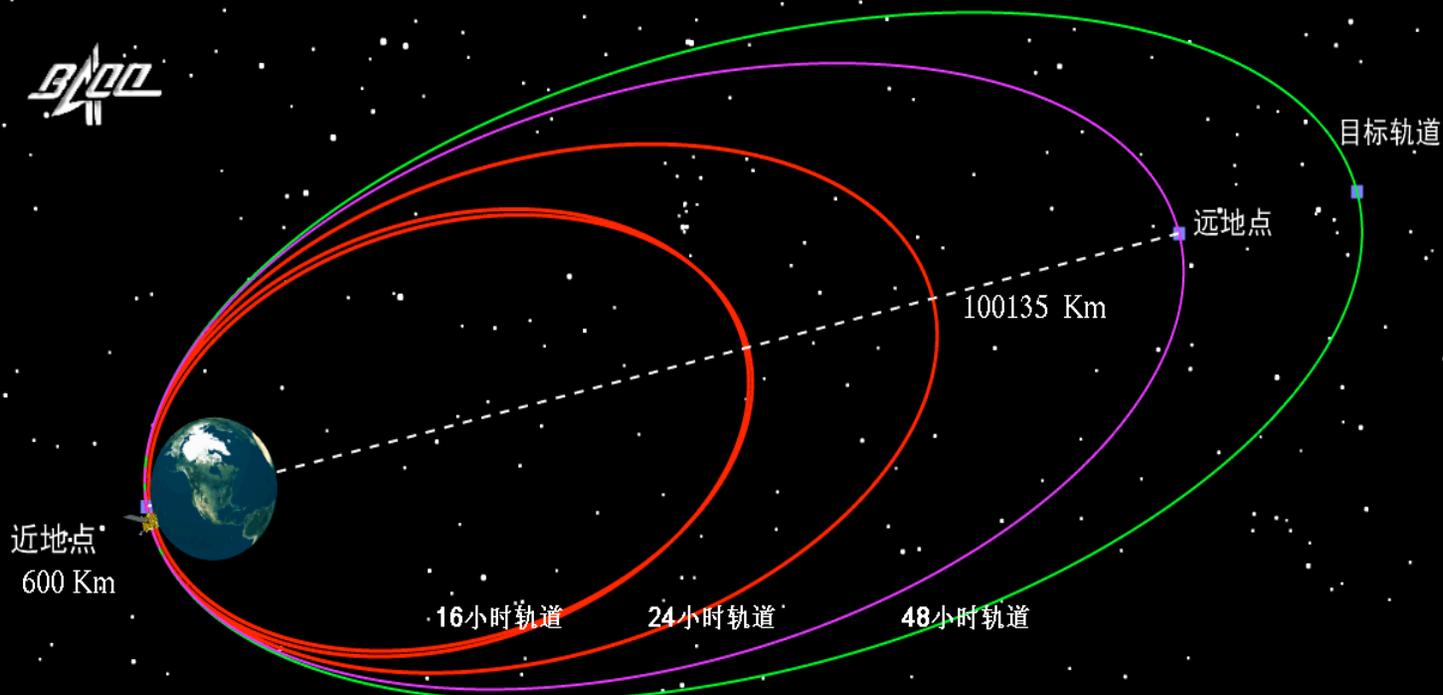
The satellite was launched into elliptical orbit by the rocket. The satellite changes orbit and finally enter the circumlunar working orbit by using its propulsion system through three orbits: Phasing orbit (16h, 24h, 48h), Circumlunar trajectory (114h) and Lunar capture trajectory. The flight lasted for about 10 days.





Flight Progress of Chang'e-1 satellite

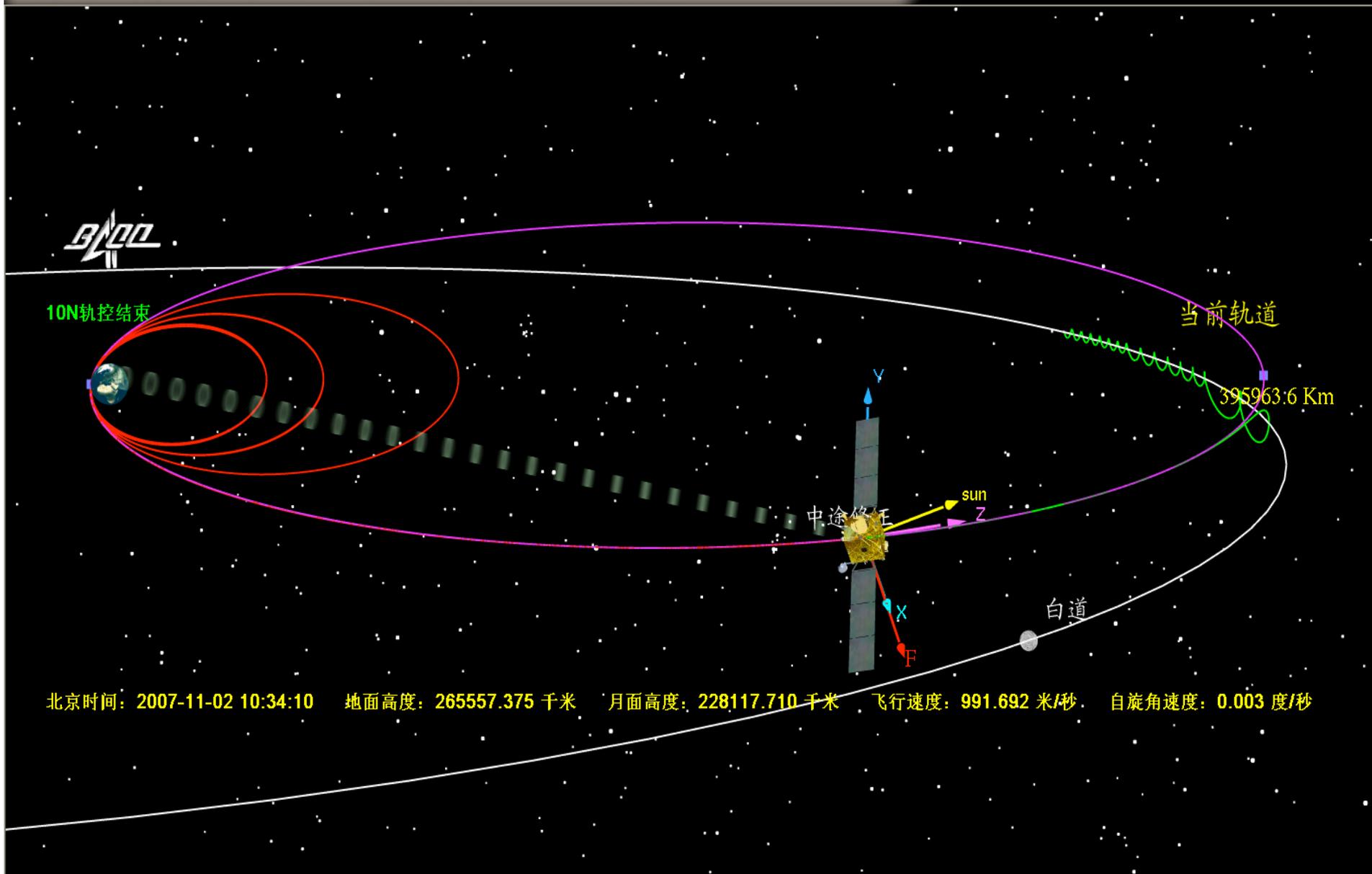
第二次近地点变轨



北京时间: 2007-10-29 17:57:58 地面高度: 694.021 千米 月面高度: 361869.421 千米 飞行速度: 10286.002 米/秒 自旋角速度: -0.003 度/秒

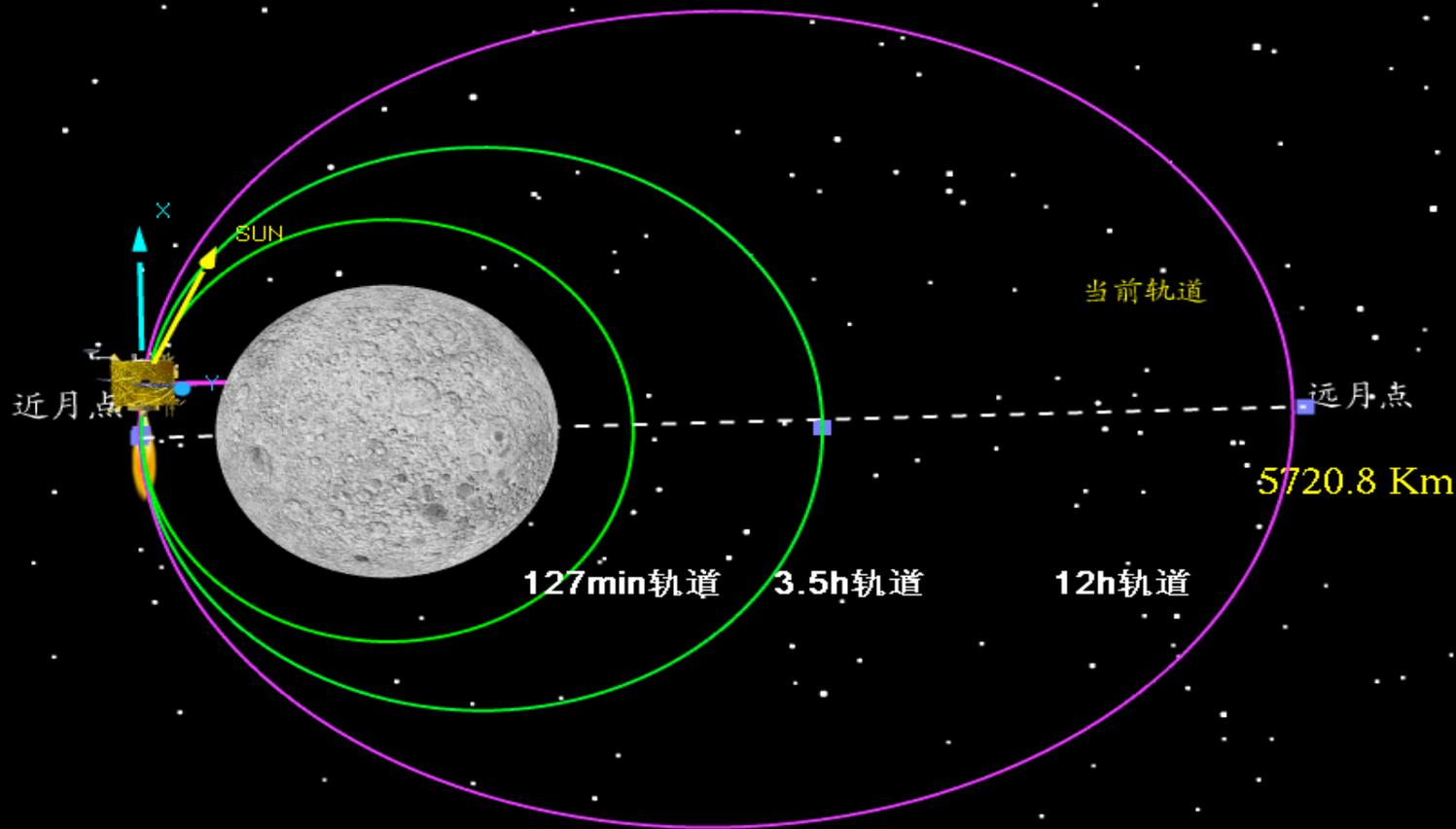


Flight Progress of Chang'e-1 satellite





Flight Progress of Chang'e-1 satellite



北京时间：2007-11-06 11:24:53

飞行速度：1976.583 米/秒

经度：88.238 度

纬度：69.351 度

高度：234.616 千米



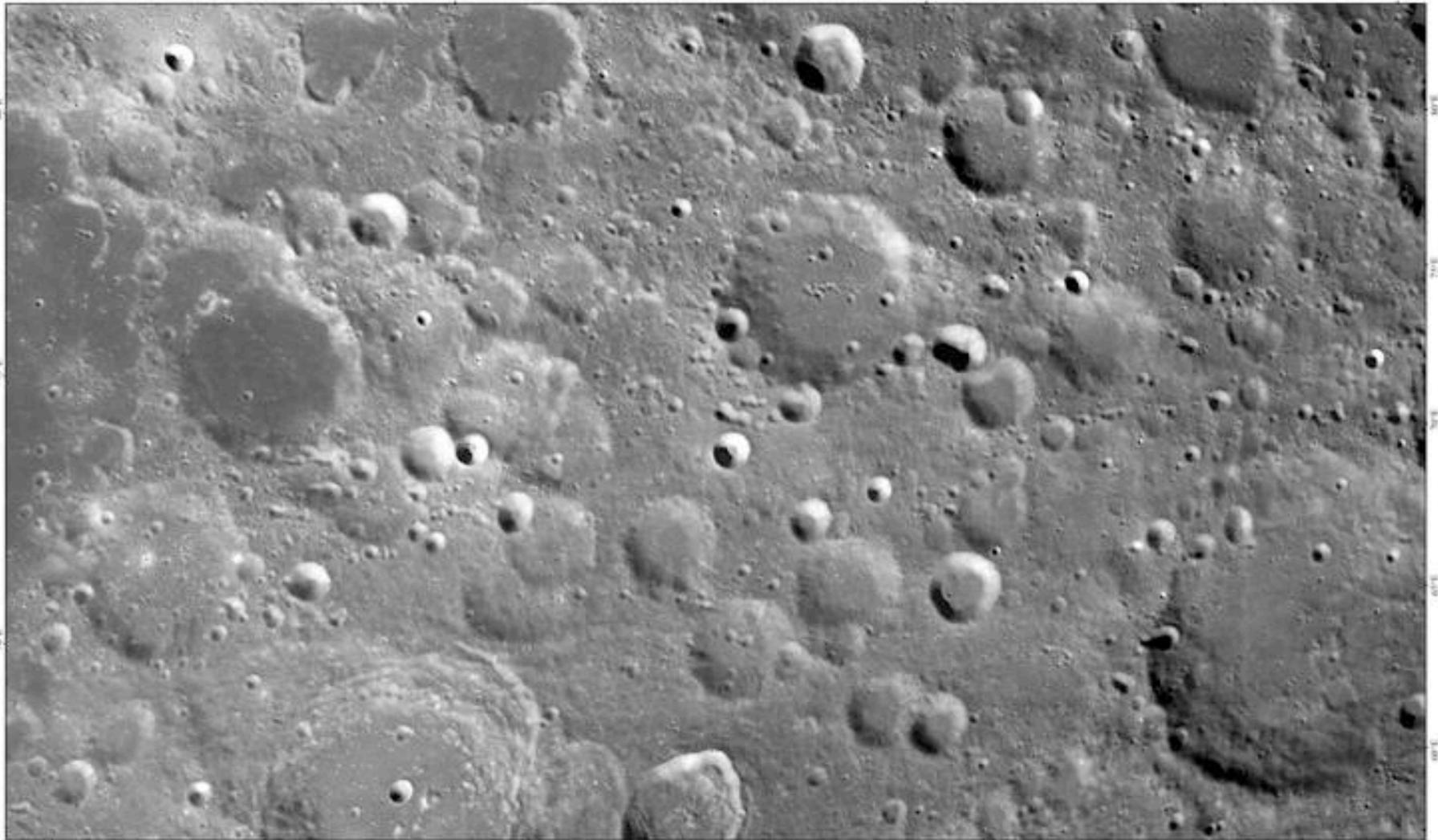
The Chang'e-1 satellite

After a series of orbit experiments, CE-1 satellite has successfully crashed on the Mare Fecunditatis, the preset target area.



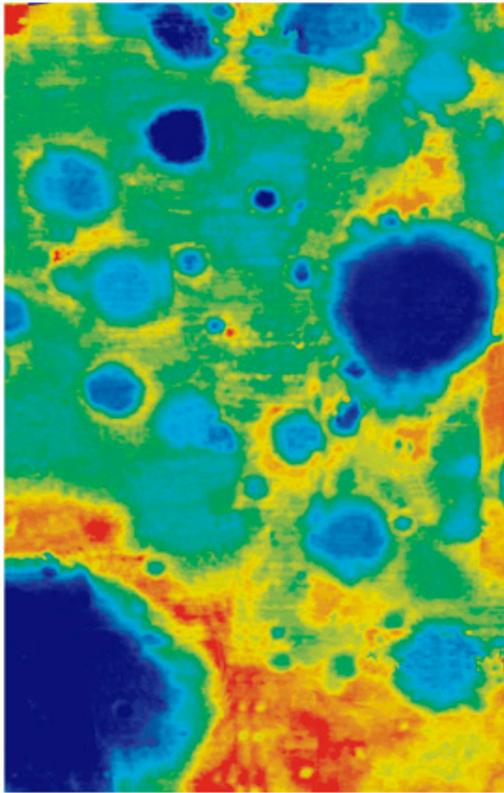
the Scientific Exploration Result of CE-1

The first image of lunar surface by CE-1

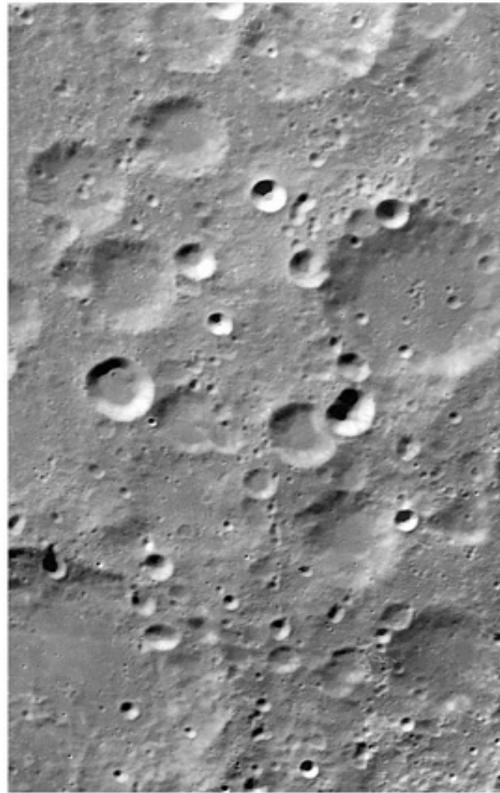




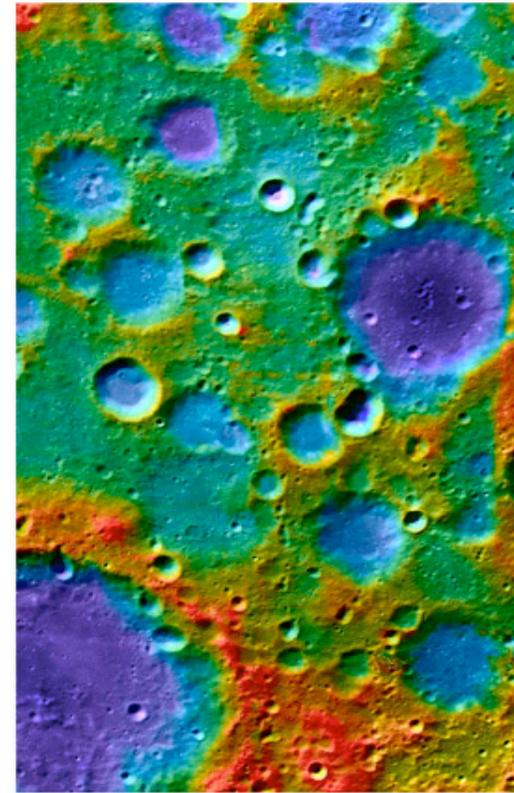
the Scientific Exploration Result of CE-1



三个视角影像处理形成的数字高程模型图

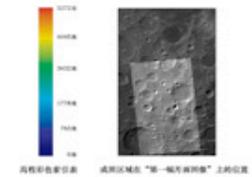


正视影像与数字高程模型处理形成的正射影像图



正射影像与数字高程模型处理形成的数字高程色彩编码地形图

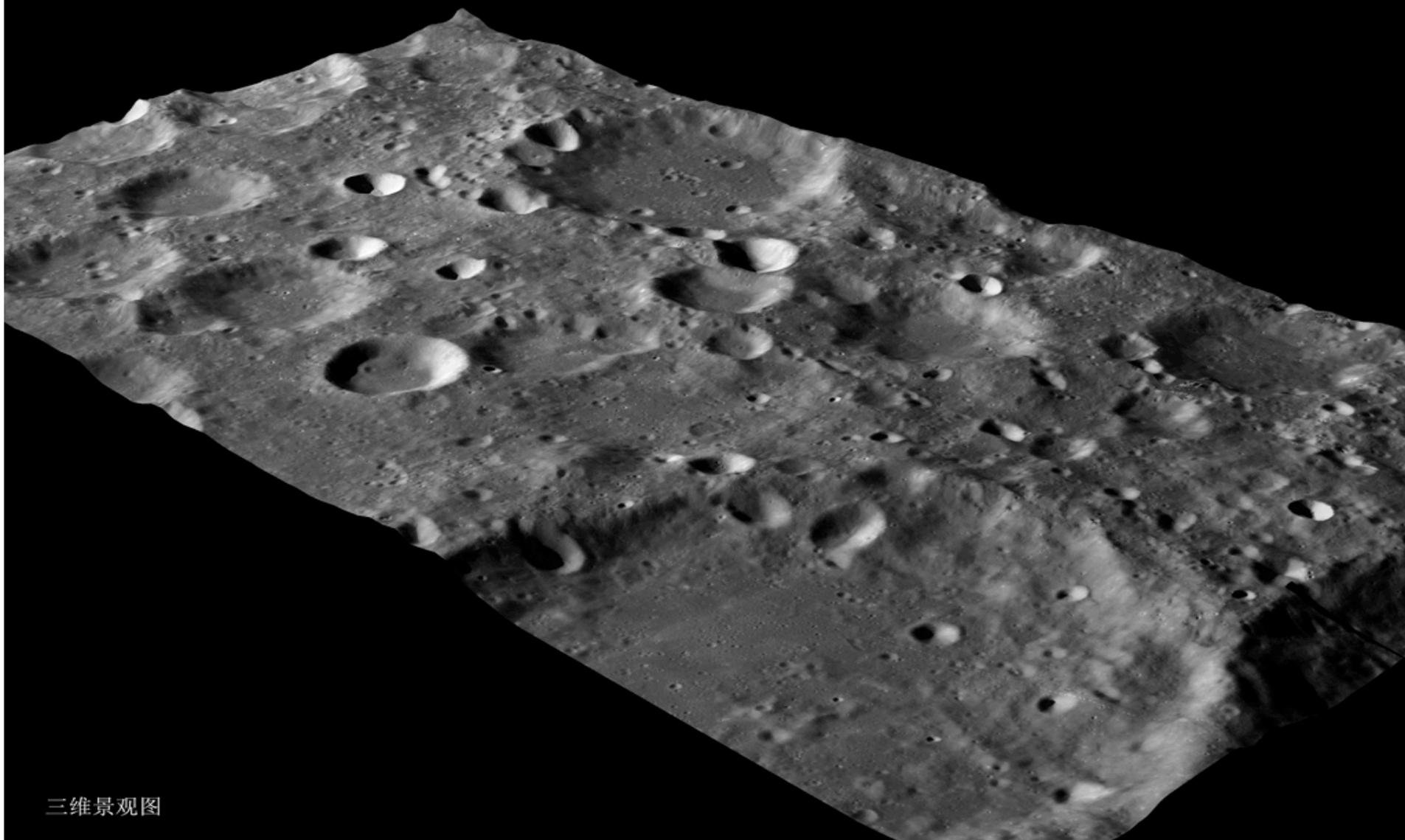
The partial area topographic and geomorphologic map of the first image of moon surface



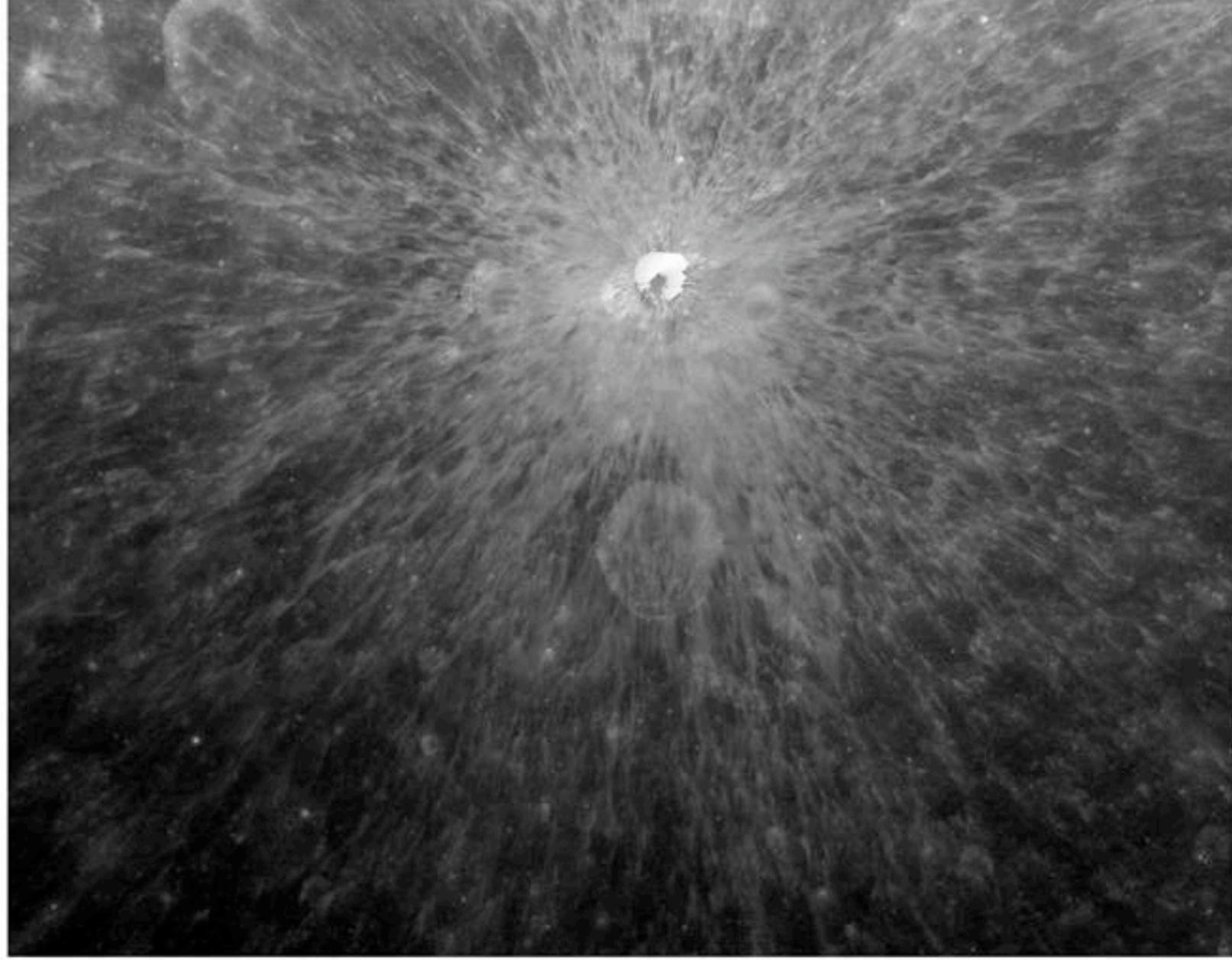
高程色彩编码图 或月区地点“第一幅月球图”上的位置



the Scientific Exploration Result of CE-1



三维景观图



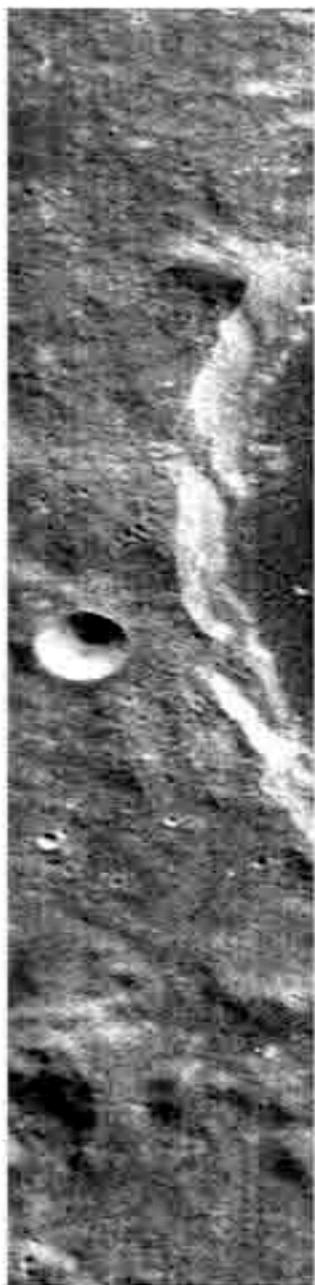
月球背面Lentis撞击坑附近一个典型的辐射线撞击坑形貌，坑缘直径约30km，从撞击坑中心放射状喷射大量高亮物质（根据区域地质背景，应该为基性斜长岩碎屑），该类撞击坑形成年代通常较晚。本图是由5轨CCD正视图影像数据拼接而成的，数据获取时间为2007年12月4日。



月球背面图

月球背面一个典型的辐射线撞击坑

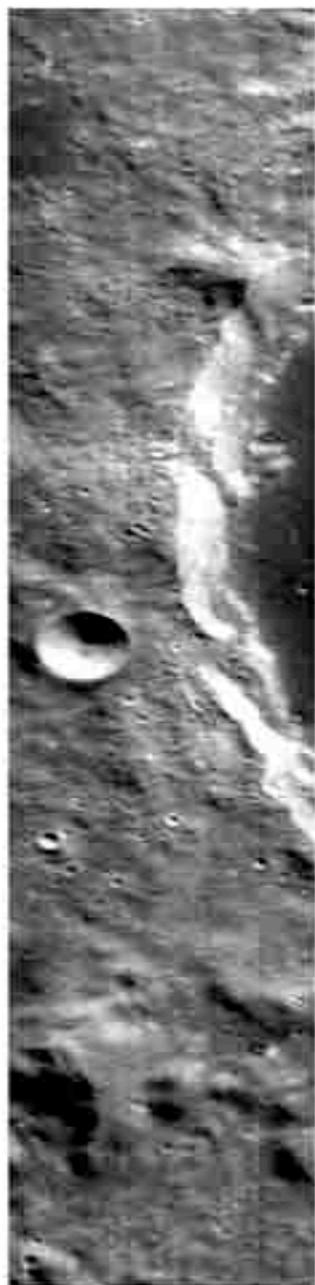
月球背面Lentis撞击坑附近一个典型的辐射线撞击坑形貌，坑缘直径约30km，从撞击坑中心放射状喷射大量高亮物质（根据区域地质背景，应该为基性斜长岩碎屑），该类撞击坑形成年代通常较晚。本图是由5轨CCD正视图影像数据拼接而成的，数据获取时间为2007年12月4日。



第4谱段光谱图
(504.96nm)



第17谱段光谱图
(644.63nm)



第30谱段光谱图
(891.11nm)

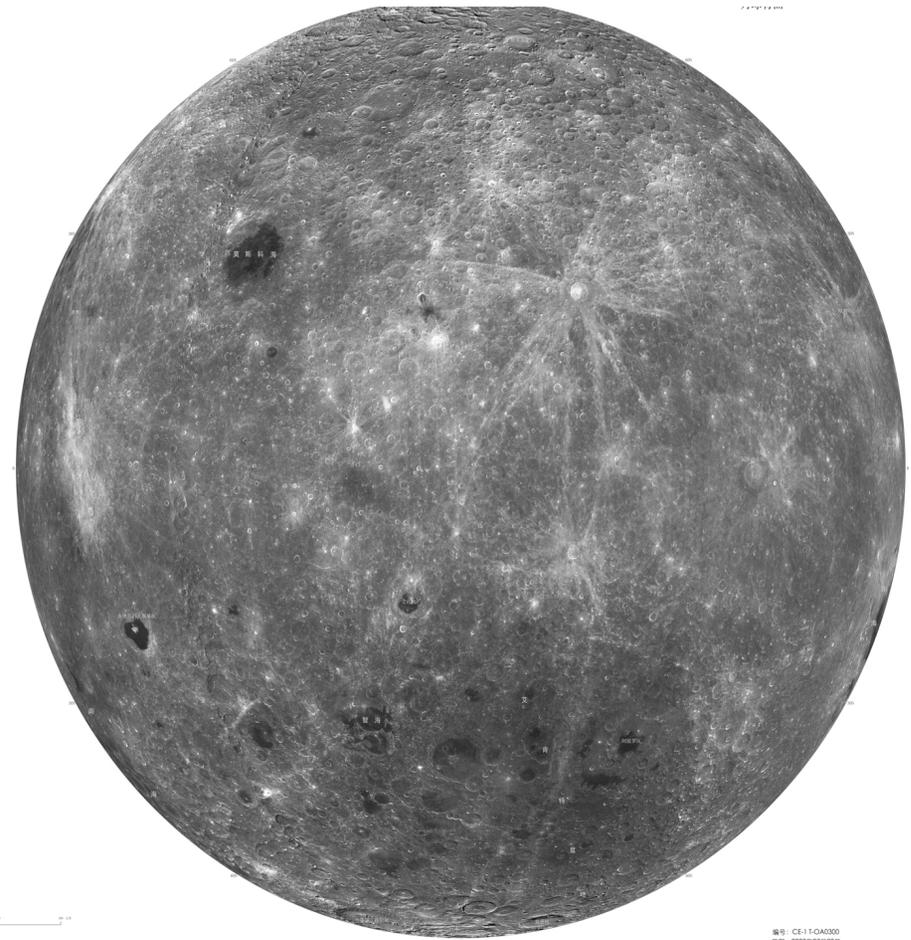


第4、17、30谱段
合成的假彩色图



the Scientific Exploration Result of CE-1

the full image of lunar surface done by CCD camera



中国探月工程嫦娥一号卫星CCD相机拍摄的月球表面图像。图像显示了月球表面的地形特征，包括众多的撞击坑和暗色区域。图像由嫦娥一号卫星搭载的CCD相机拍摄，分辨率为1024x1024像素。图像显示了月球表面的地形特征，包括众多的撞击坑和暗色区域。图像由嫦娥一号卫星搭载的CCD相机拍摄，分辨率为1024x1024像素。

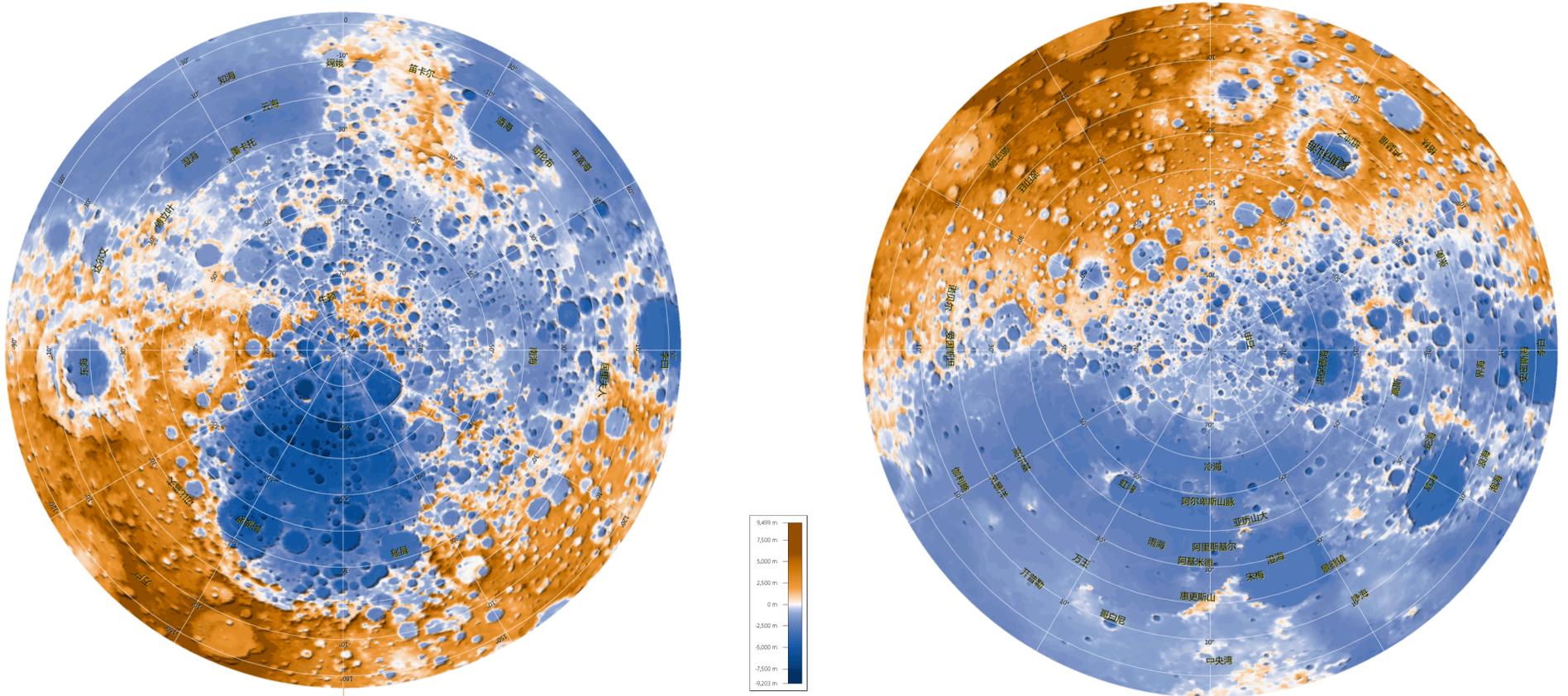
比例尺 1:1000000

编号: CE-1-0A000
日期: 2008年07月20日



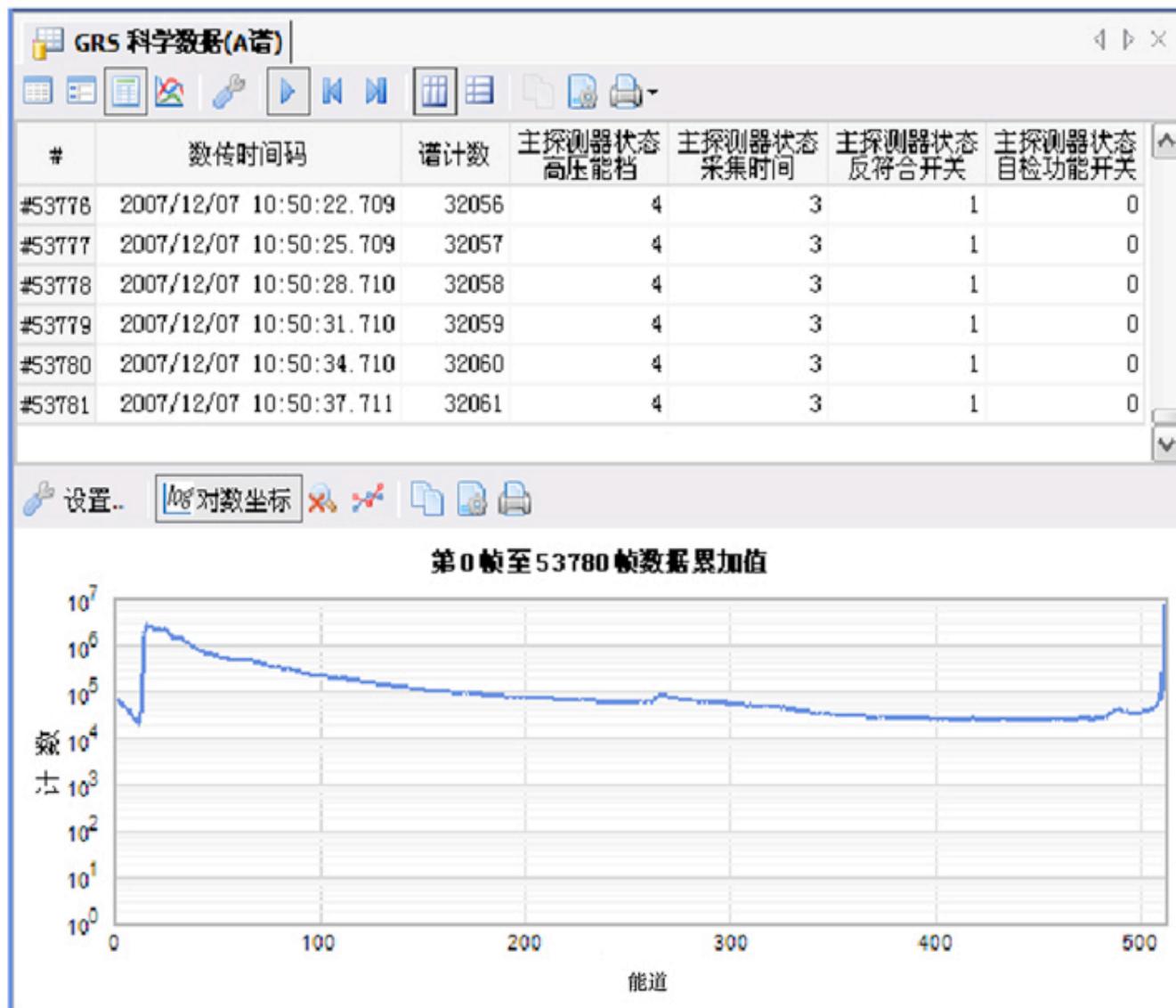
the Scientific Exploration Result of CE-1

the full image of lunar surface done by
Laser Altimeter





the Scientific Exploration Result of CE-1



左图上部为12月7日接收到的伽马谱仪科学数据实时监控情况；下部为能谱曲线。横坐标表示512个能道；纵坐标表示各个能道记录的伽玛光子计数。

伽马射线谱仪每3秒生成一个512道的能谱数据。本快视图显示的是自2007年12月5日14点01分开始，累计了44小时49分的能谱曲线，包含53780帧数据。



the Scientific Exploration Result of CE-1

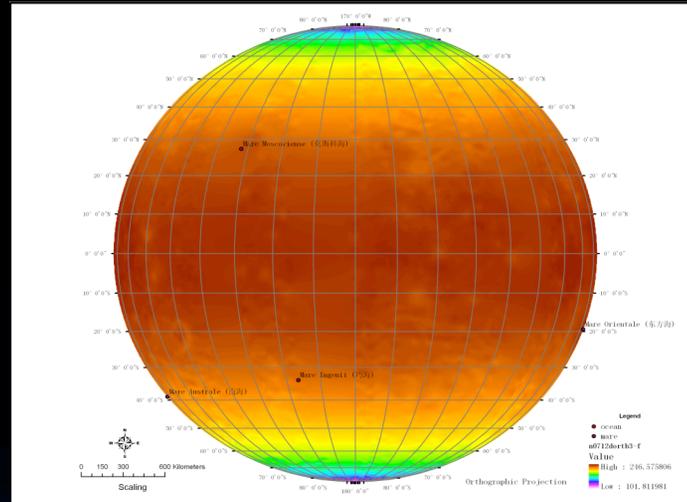
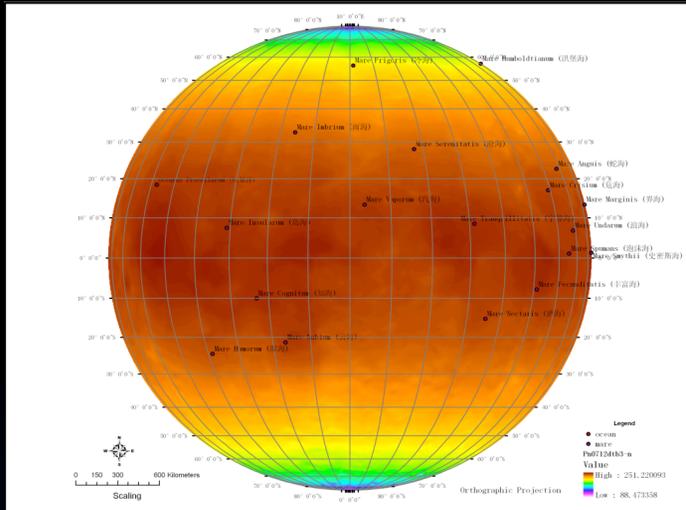


X射线谱仪的科学数据包括4路低能X射线探测器、16路高能X射线探测器、1路太阳监测器能谱和计数等4类科学数据。其中，低能X射线探测器、高能X射线探测器、太阳监测器能谱三类科学数据的表现形式为能谱图，其横坐标为能道，纵坐标为计数；太阳监测器计数的横坐标为时间，纵坐标为计数。

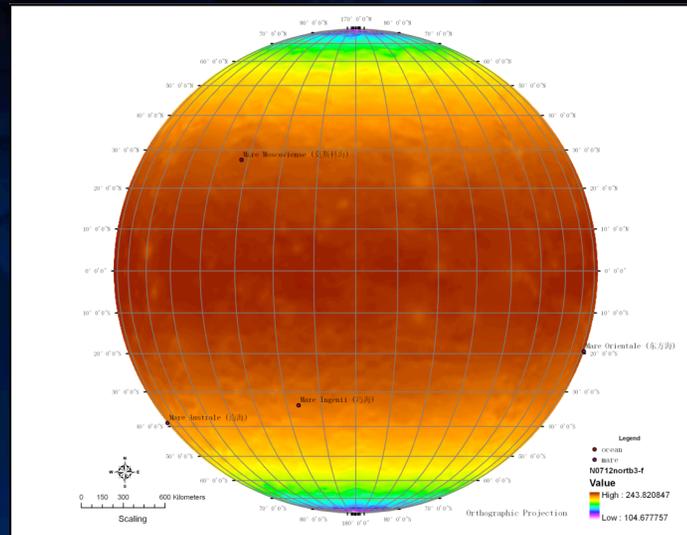
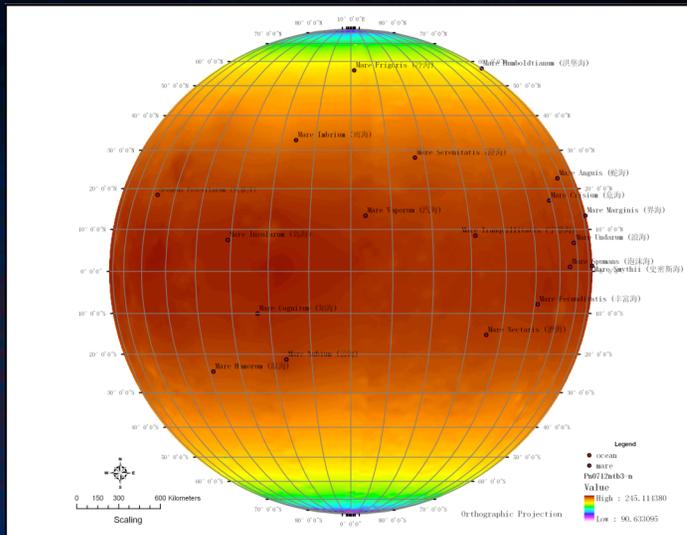
本快视图显示的是自2007年12月5日14点01分开始，累计了44小时49分的能谱数据。



The micro-wave image of lunar in 3GHz



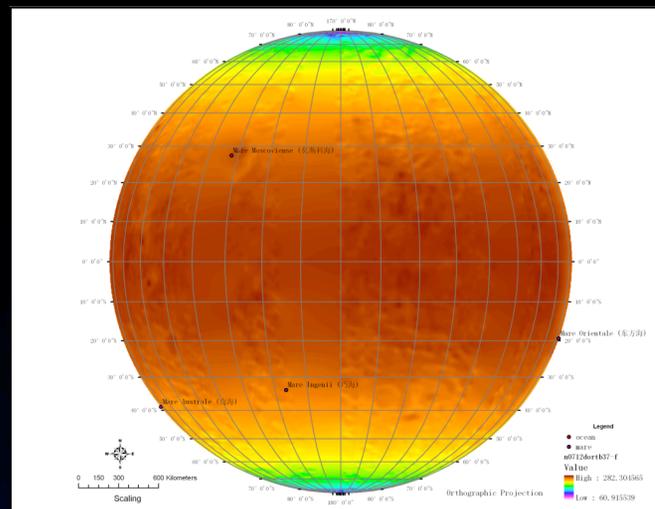
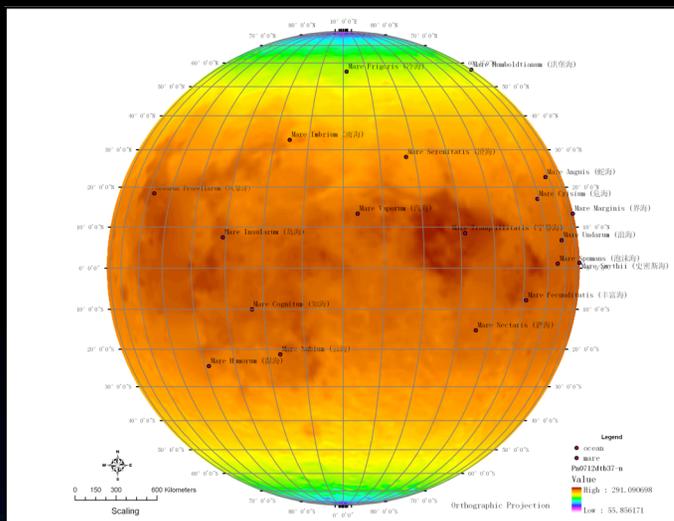
微波月亮 3GHz夜晚正面/背面



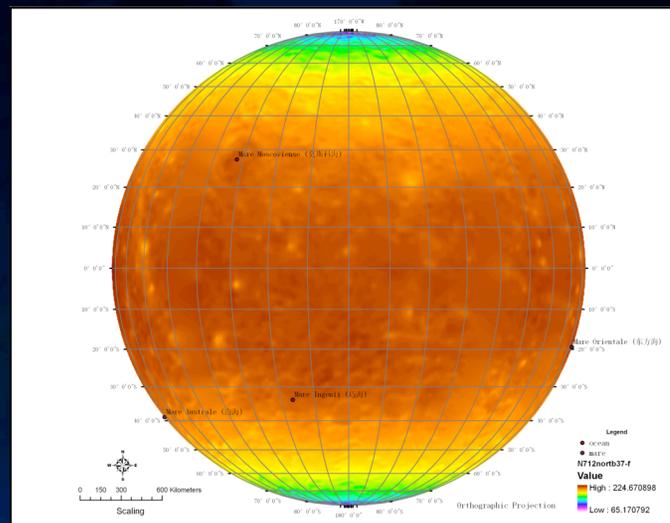
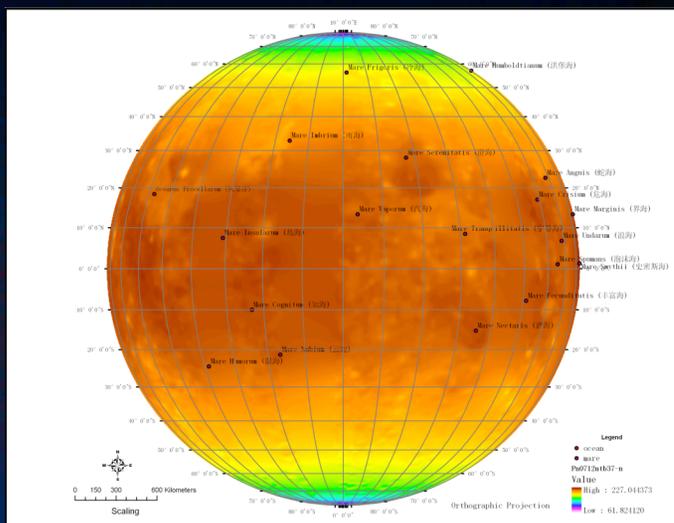


The micro-wave image of lunar in 37GHz

微波月亮 37GHz白天正面/背面



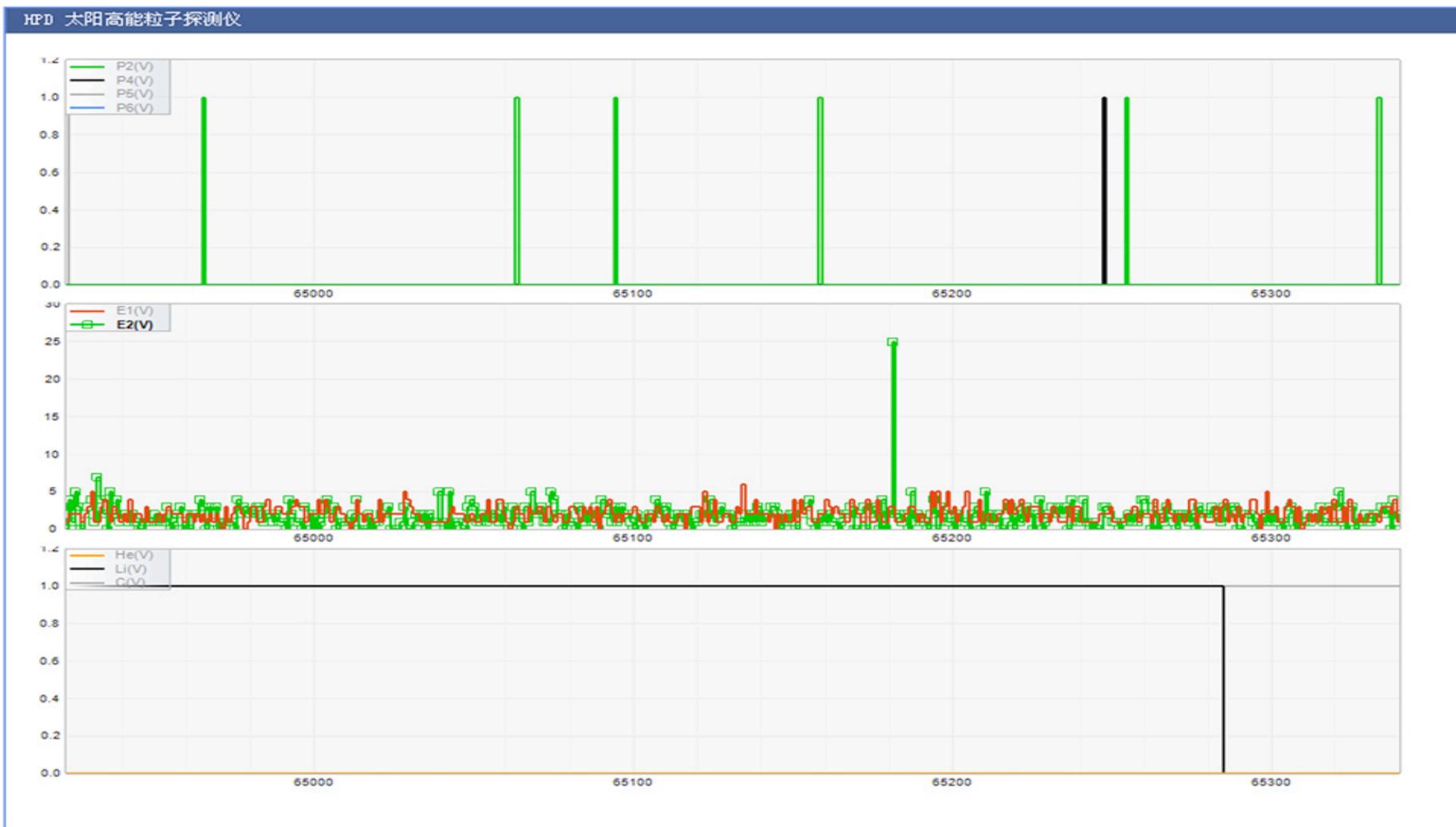
微波月亮 37GHz夜晚正面/背面





the Scientific Exploration Result of CE-1

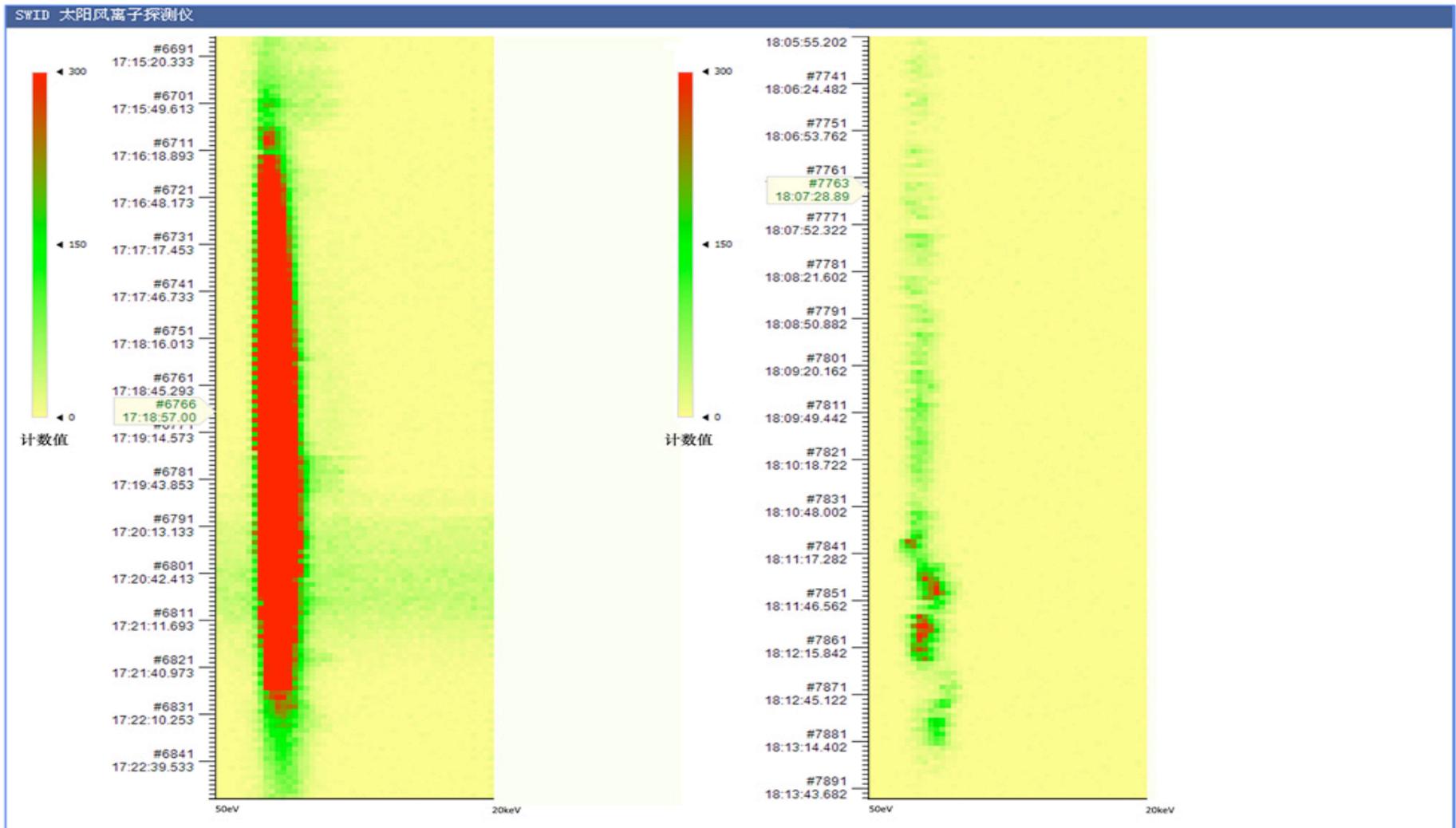
The curve of solar high energy partial





the Scientific Exploration Result of CE-1

The image of solar wind





China's Blueprint for Lunar Exploration

Chang'e Program

- **" Three steps " plan on lunar exploration**

Based on the scientific and technological level, the comprehensive national strength and the entire development strategy of our country, China will concentrate on robotic lunar exploration program before 2020, which falls into 3 stages:

(1) **"orbiting"** 2002-2007 (**the first step**) launching lunar orbit satellite, fulfilling circumlunar exploration.

- (2) **"landing"** 2007-2013 (**the second step**) making first Soft Landing, Roving and Exploring.

- (3) **"returning"** 2013-2020 (**the third step**) making first sampling and returning.

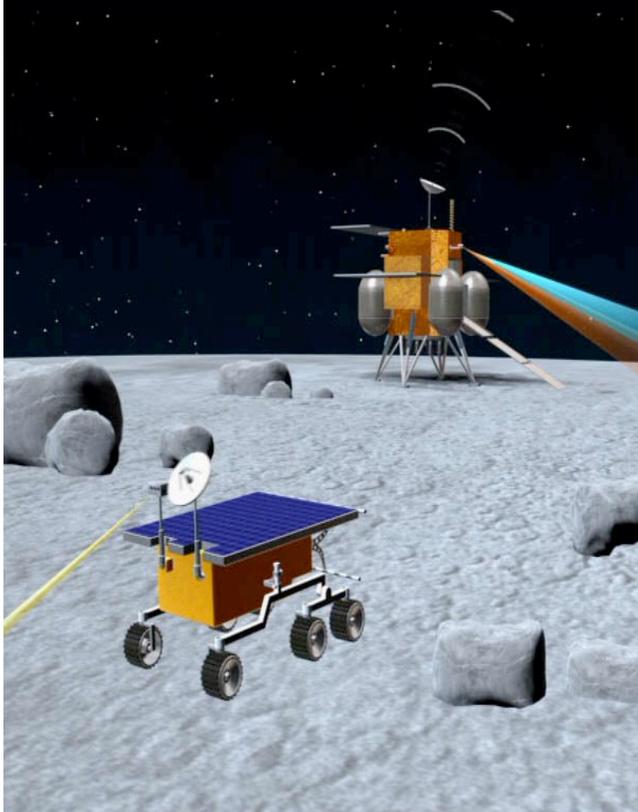


follow-up lunar exploration project

Around 2013

Soft Landing, Roving and Exploring
for the first time

Landing



- Launching lunar soft Lander, testing lunar soft landing technology;
- Developing and launching a Rover;
- Measuring lunar surface environment of landing spot;
- The on site exploration or sampling analyzing of lunar rock.



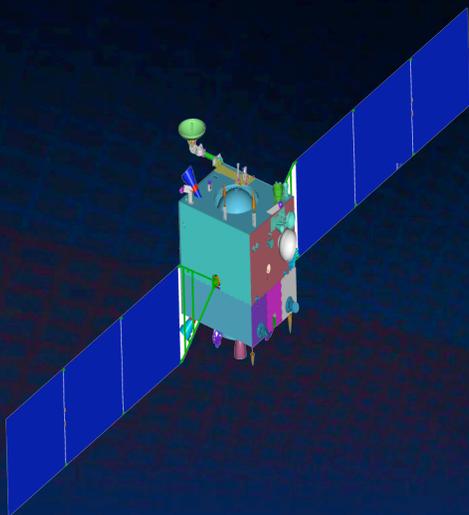
follow-up lunar exploration project

The second stage of Chang'e program: CE-2 satellite

Landing

The CE-2 satellite, taking as the technological test one, was being developed to verify parts of key technologies in the second program stage, and to obtain comparatively precise lunar surface image.

CE-2 will be launched around 2011, which will last 6 months in space.



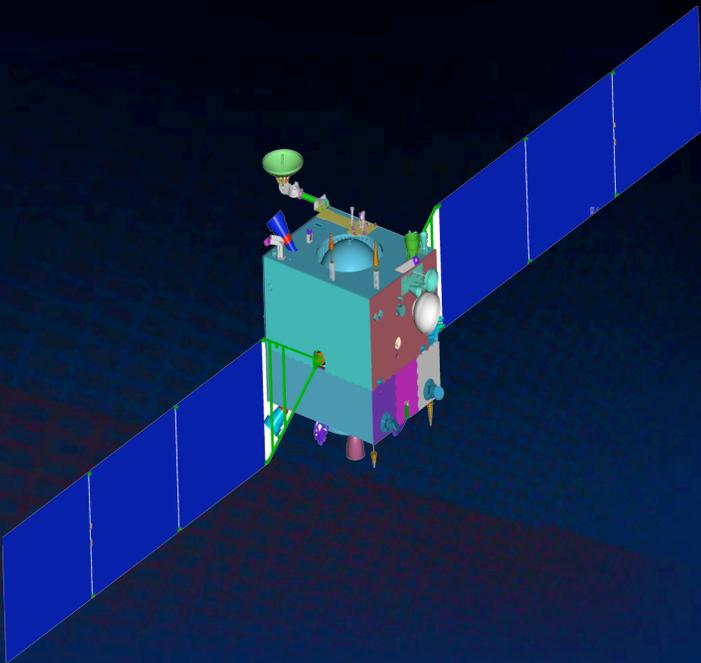


follow-up lunar exploration project

Based on technologies in CE-2 satellite:

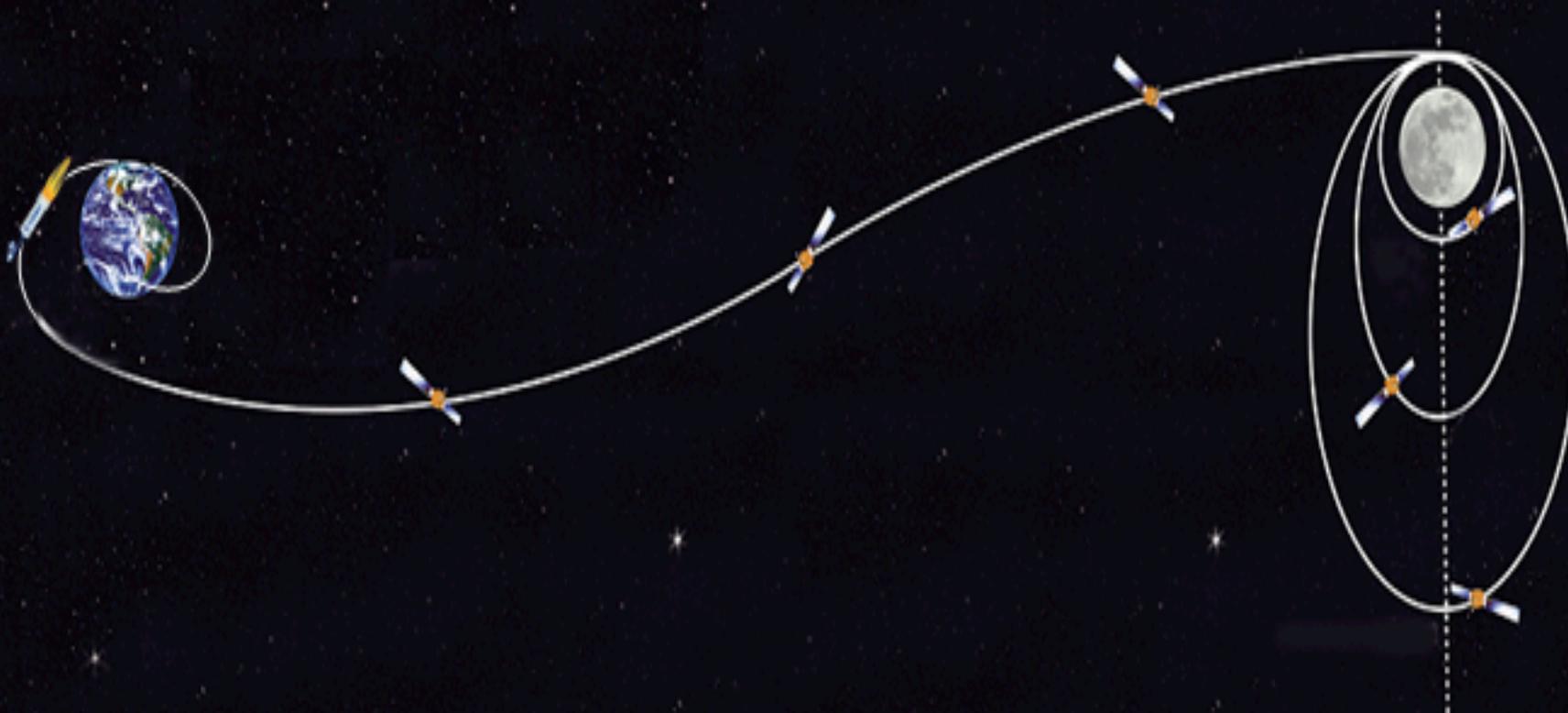
Landing

- Test LTO launching technology;
- Test the circum-lunar technology at 100km orbit;
- Test orbit maneuver technology for landing;
- * To develop high-resolution observation camera.





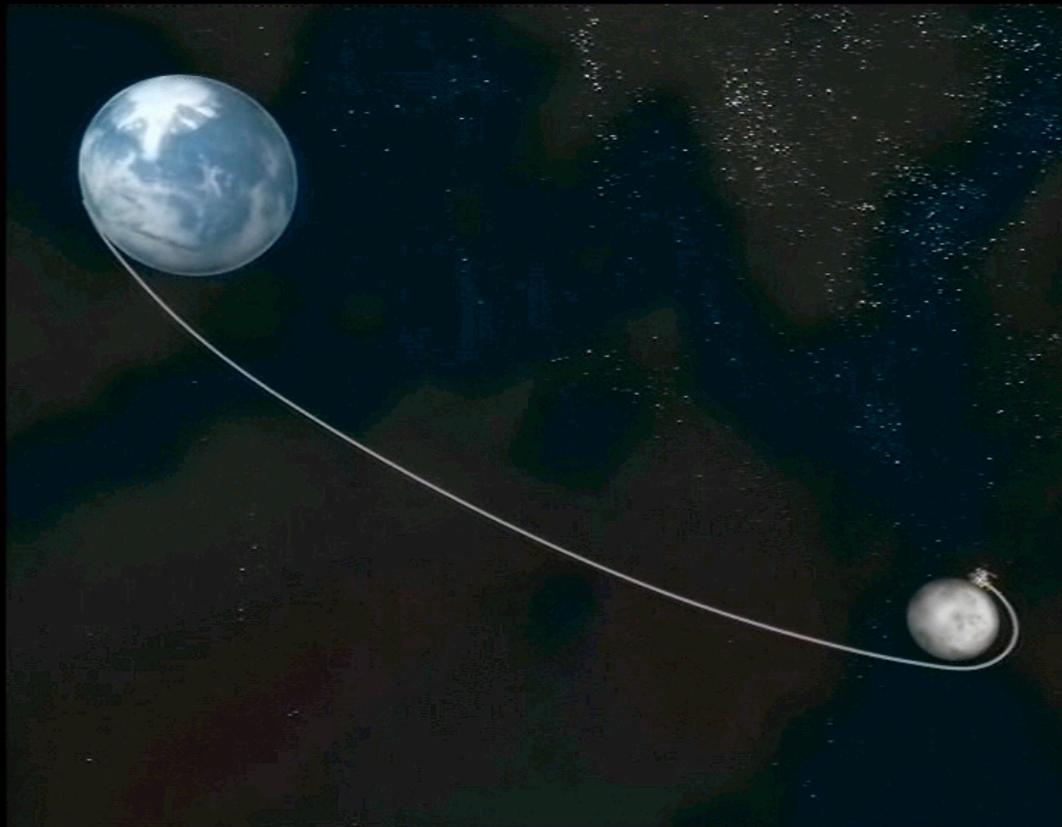
follow-up lunar exploration project





follow-up lunar exploration project

the satellite was directly carried to the earth-moon transfer orbit.





follow-up lunar exploration project

Briefings on the second mission of China's lunar exploration program

Lander and Rover are making scientific exploration on lunar surface.

Landing





follow-up lunar exploration project

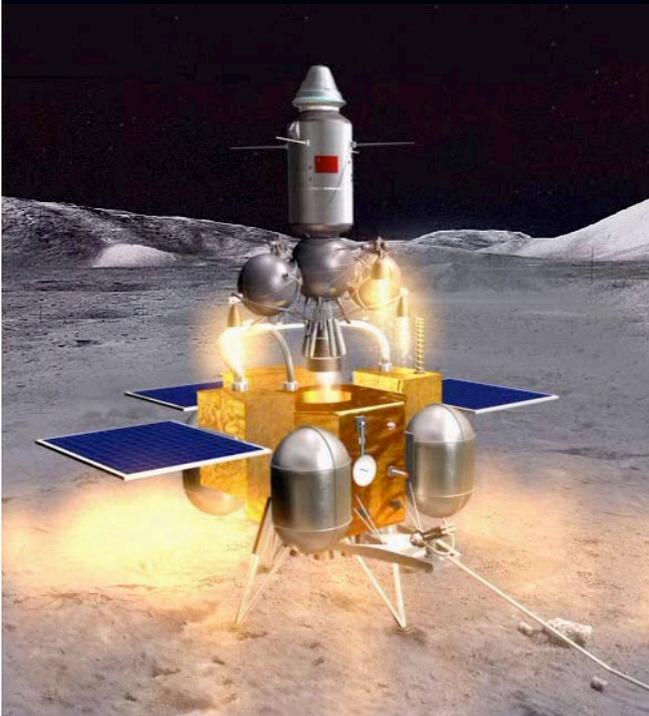
Returning

The third stage: around 2020

Sampling and Returning mission for the first time

Main tasks:

- Develop a small capsule for sampling and returning, a lunar surface drilling machine, a sampler, a robot arm etc.
- Sample and return to the earth based on the on-site analysis
- Investigate into the landing area
- Deepen the understanding of origin and evolution of the moon-earth system





Thanks!