HORIZON 2061
Planetary Exploration 2061
STEP 3 : Synthesis Workshop
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Exploration technologies for advanced small platforms reaching to extreme environments

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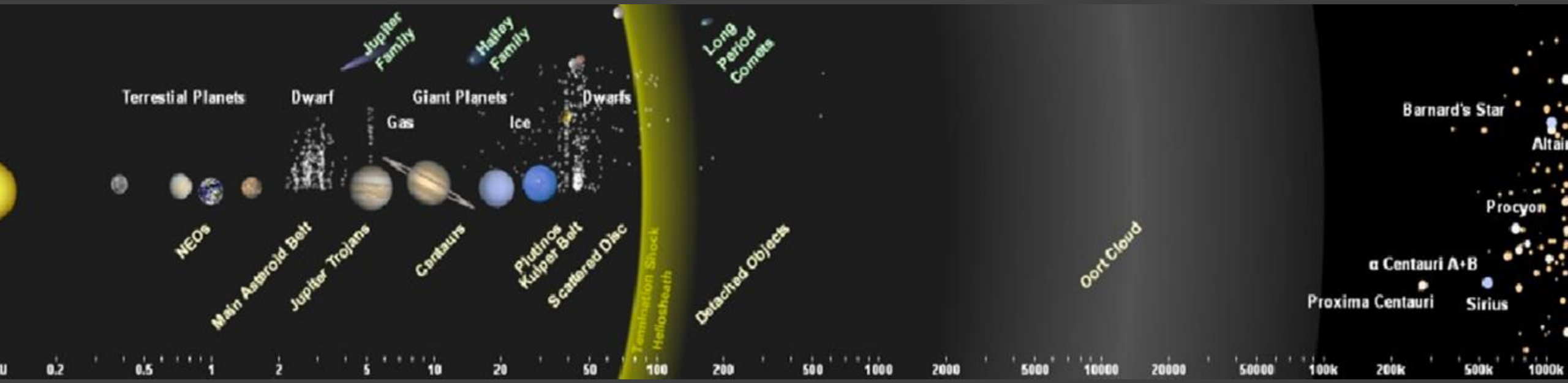
Why we need advanced small platforms?



n the future, more opportunities to deep space

- Need more affordable probes;
- Need multi-measurement;
- Need dynamic image ;
- Ned detailed exploration and mapping of planetary resources…

About small satellite in China

- Small satellite: mass 100~1000kg;
- Micro satellite: mass 10~100kg；
- Nanosatellite: mass 1~10kg；
- Picosatellite: mass：<1kg

About small platform

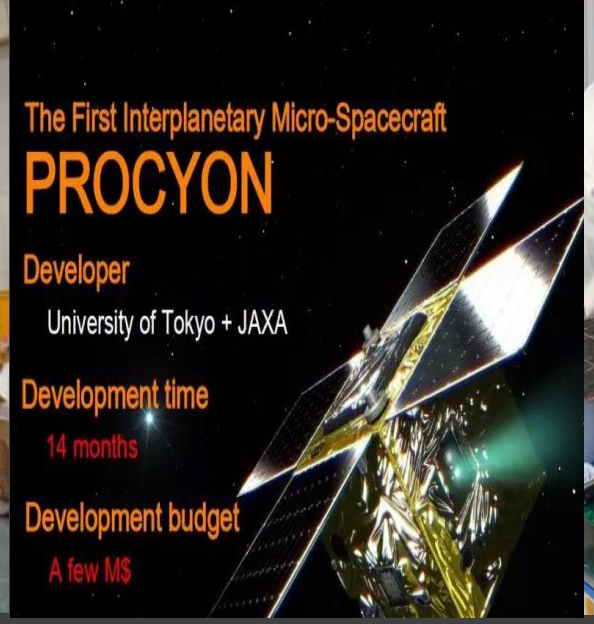
- Orbiter, Lander;
- Rover; Entry probes;
- spacestation，Airplane；
- Submarine….

Voyager 1&2
815kg

Pluto/New Horizons
478.3kg

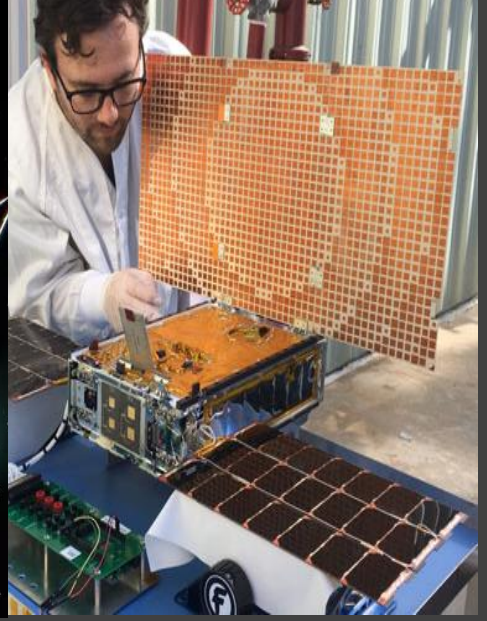
Image credit: NASA

Pioneer 10
251.8 kg



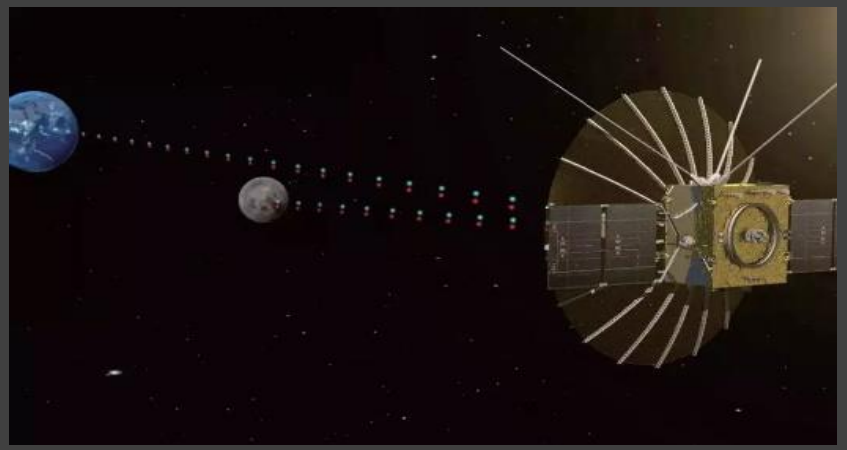
PROCYON
65kg

Image credit: JAXA/TOKYO



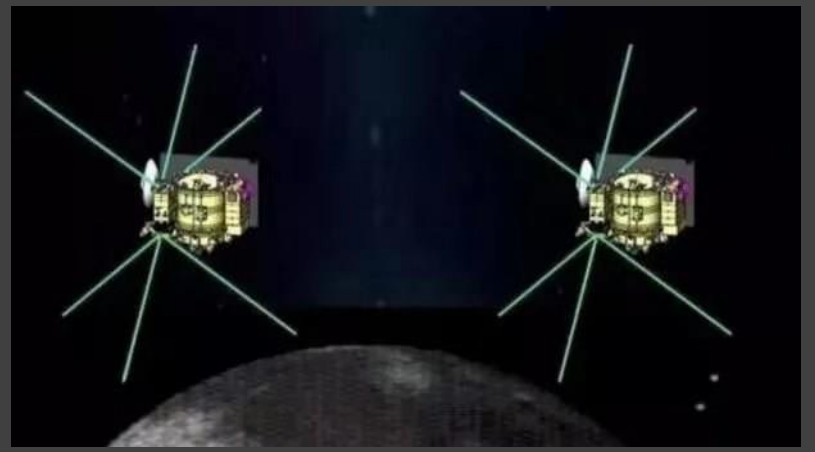
6U Cubesat :Marco A/B
<10 kg

Image credit:NASA/JPL



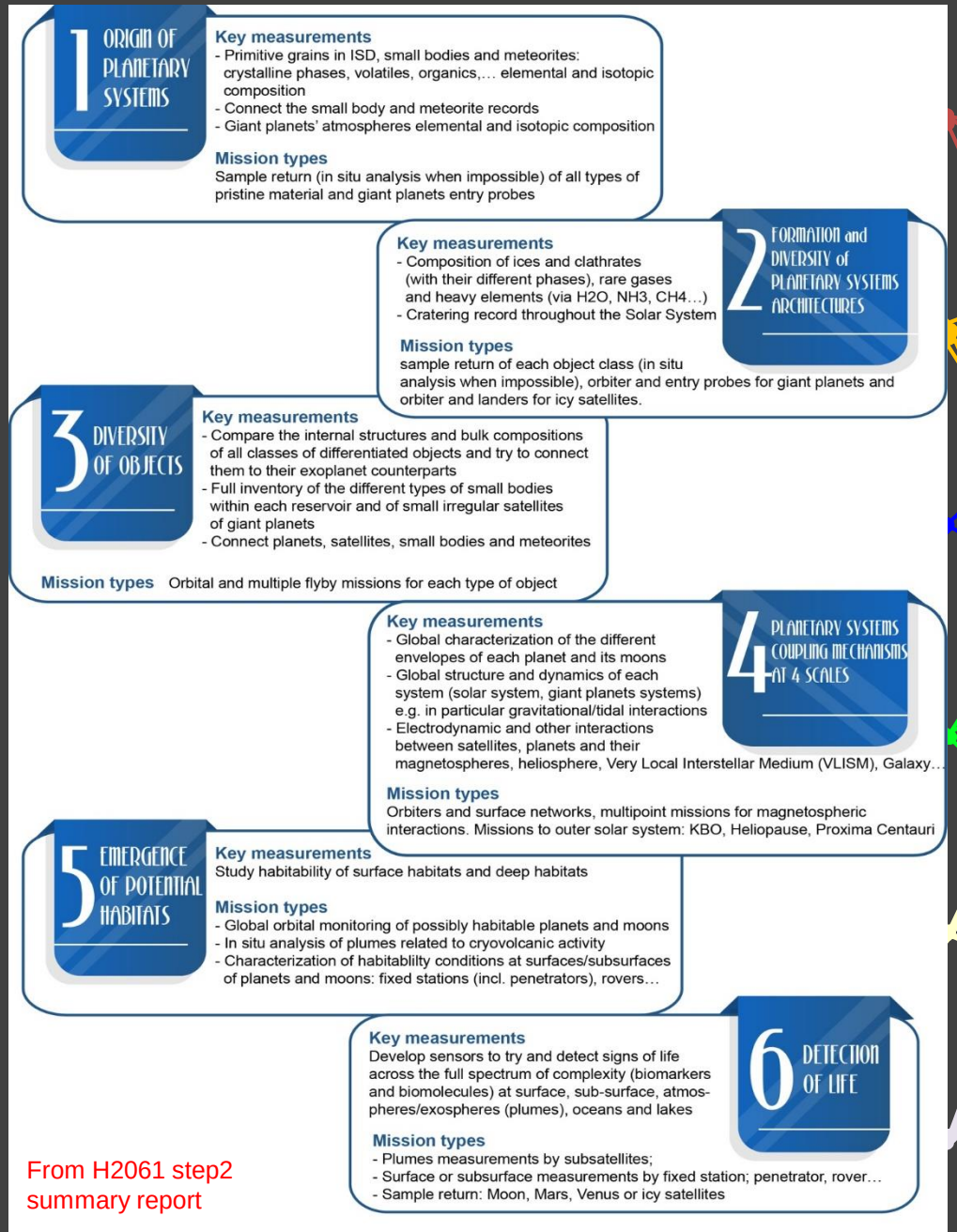
Small satellite China CE-4
relay satellite
425kg

This is China's first attempt to use small and micro-satellite on a deep-space mission.



Microsatellite :Longjiang-1/2
47 kg

1 Advanced Small Platforms Faced to Extreme Environments in the Future Missions



From H2061 step2 summary report

1) High and low temperature extremes

2) Complex wind field and atmospheric movement

3) High pressure and low pressure operations

4) High levels of radiation

5) High corrosive environment

6) The ocean environment

2 Advanded technologies for advanced small platforms

1) Science Instrumentation

- Remote sensing, In situ measurements, Seismometers:,better spectra, better resolution remote sensing instrument;
- New tools and methods used in Life detection:
- In situ operations: sample retrieval and handling, such as tools, systems, encapsulation and return, scooping and digging, sampling on slopes ， melting subsurface ice；
- Advanced sample handling systems，Contamination control and Planetary protection;
- Miniaturization, Printable instruments and electronics, Autonomy (IA...) for operations；
- Sustainability in extreme environment, Long life time

2 Advanded technologies for advanced small platforms

2) ASPs system design

- Mother-daughter spacecraft, Networking and formation flying technologies of ASPs or swarm spacecraft systems

Mother-daughter architectures at single targets

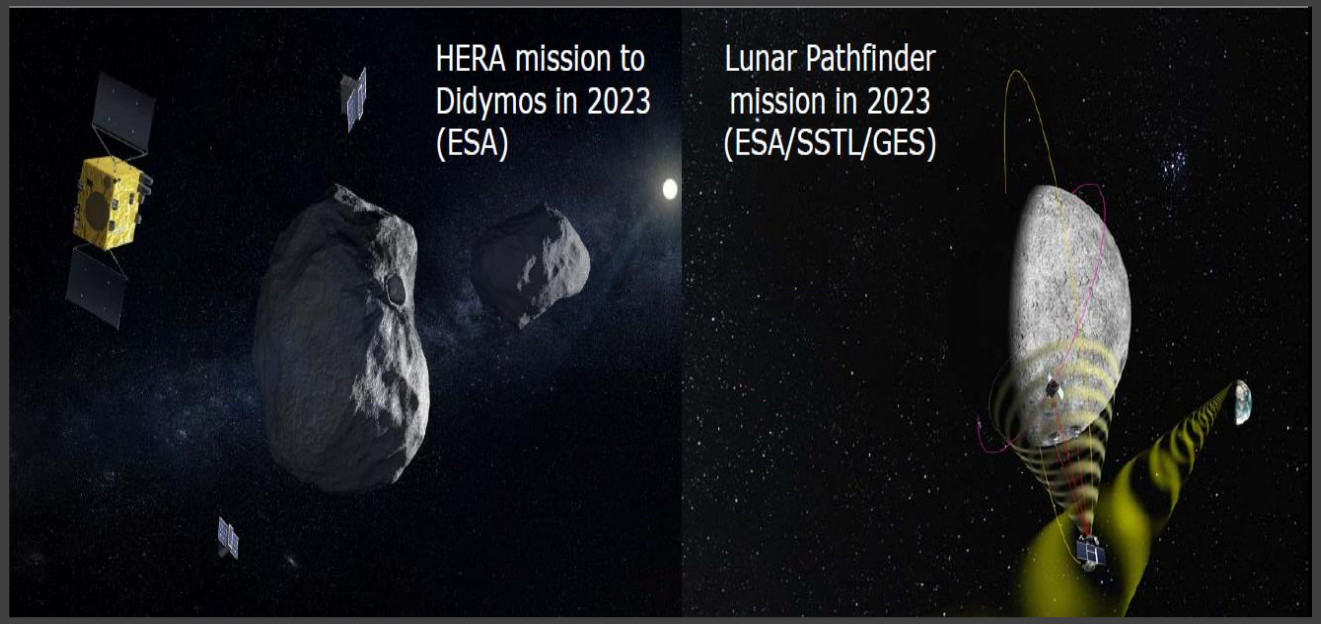


Image credit: ESA, From Roger Walker, the 8th iCubesat，2019

Transportation & data relay provided by larger mothercraft Deep investigation of a single target body with multi-point measurements

ASPs carrying Swarm spacecraft systems

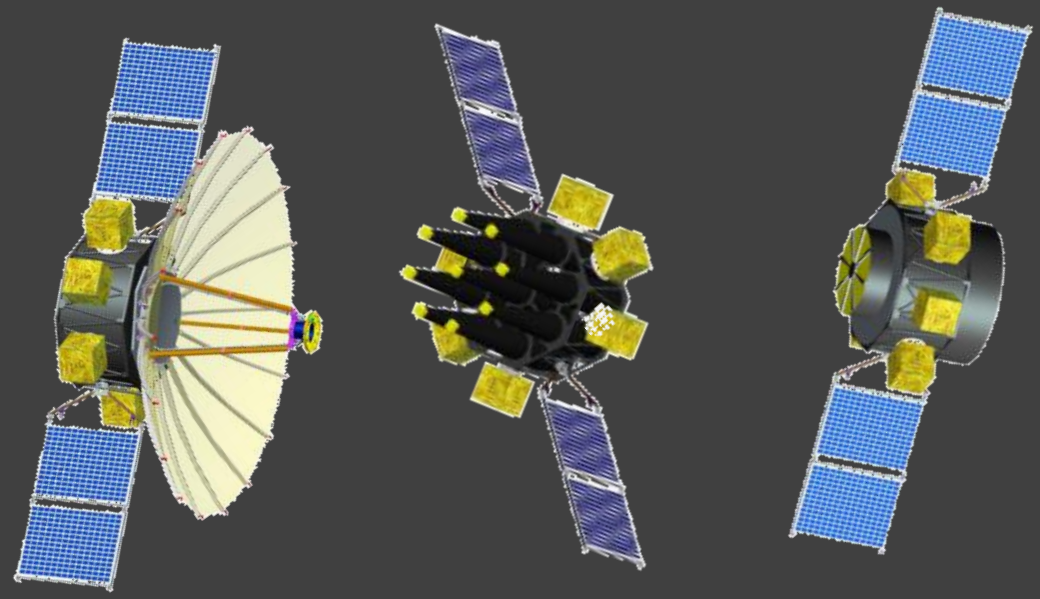


Image credit: DFH, CAST, China

Characteristics of ASPs:

The truss structure is flexible and adaptable to different load shapes; Structural and functional integration composite material, lightweight material, cable-free design, plug and play…

2 Advanded technologies for advanced small platforms

2) ASPs system design

Flexible, Smart, Autonomy, Low cost(FSAL)

- Networking and assembly modes of ASPs with other exploration platforms;
- Multi-target mission architectures, such as carrying ASP probes to be dropped off at various locations;
- SmallSats，CubeSats, distributed sensors, multi-point measurements, Increase of efficiency.
- Modular/standard spacecraft with standard interfaces/volumes for customized instruments , in order to lower costs.

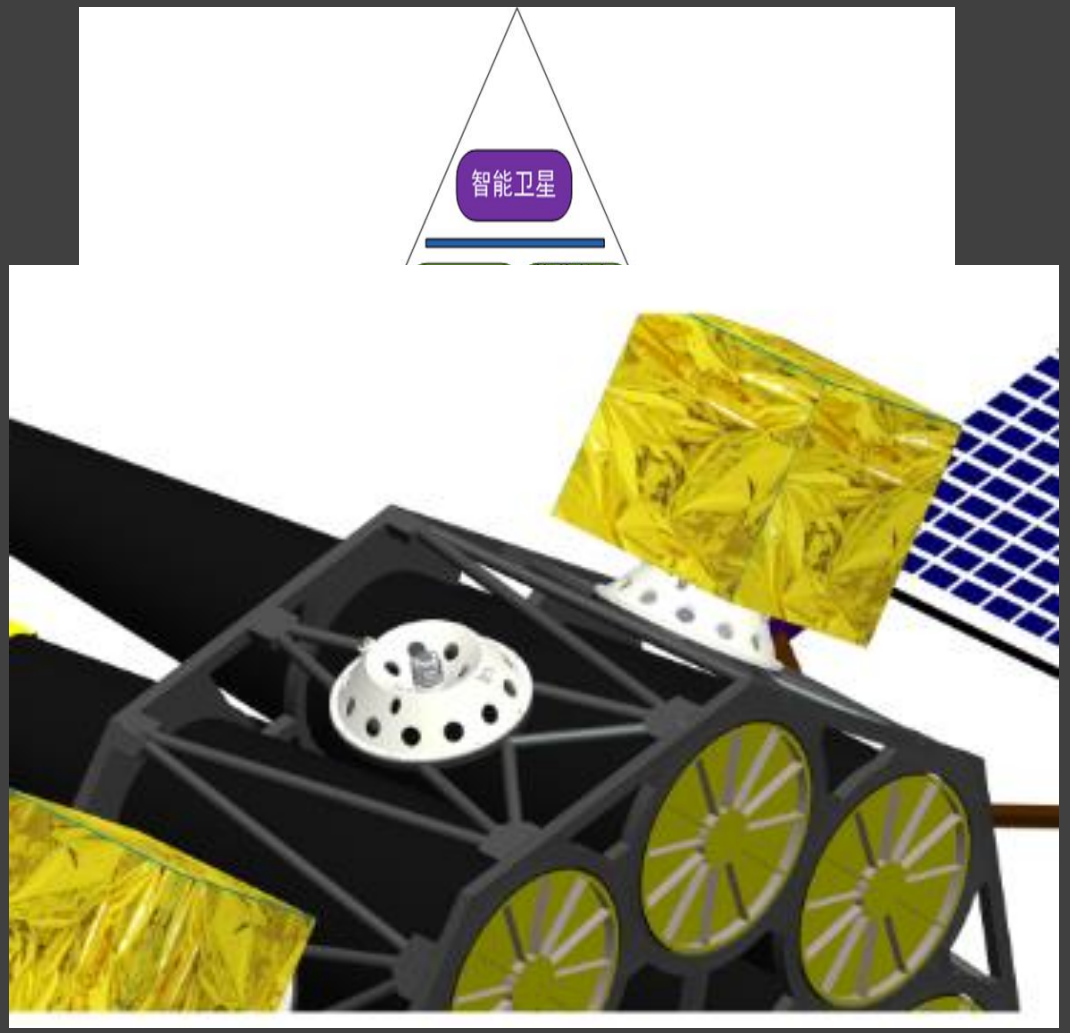
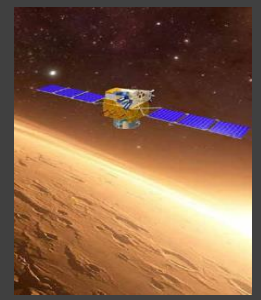
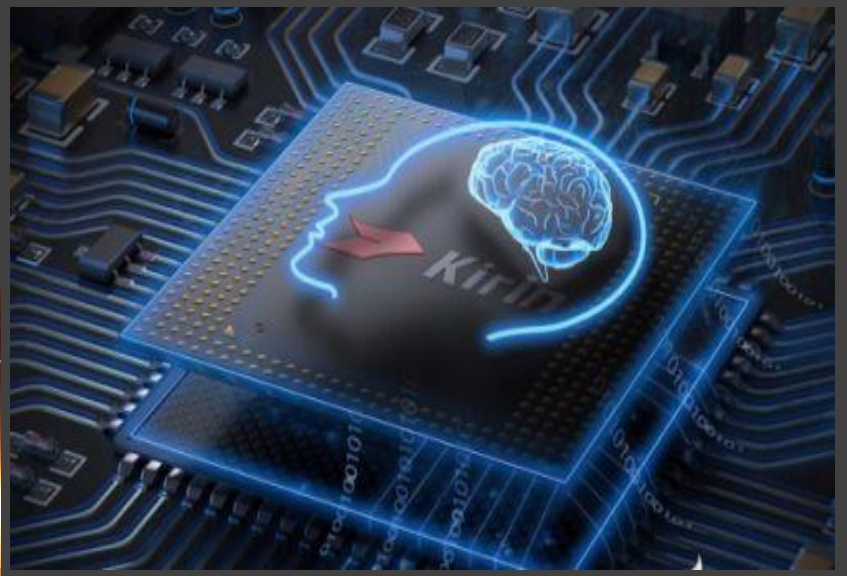


Image credit: DFH, CAST, China

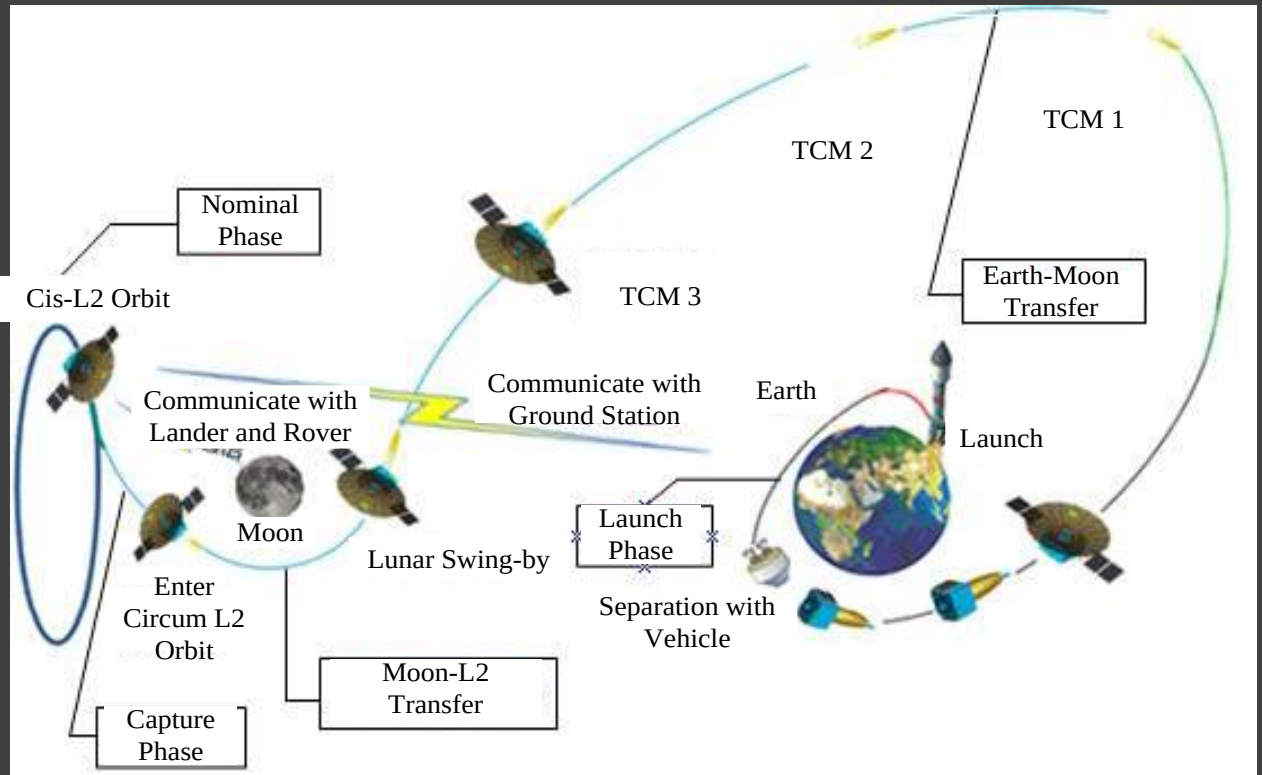
2 Advanded technologies for advanced small platforms

3) Task planning technology of autonomous deep space



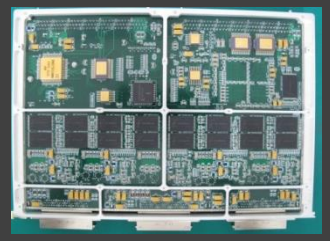


- Leveraging flying technology;
- Quantum computer;
- Big data processing;
- Advanced online signal processing technology;
- Intelligence in machines/Systems (IA,…);
- Adaptation to unknown events, if one lost, another can replace it……
- Flight software can be redefined.

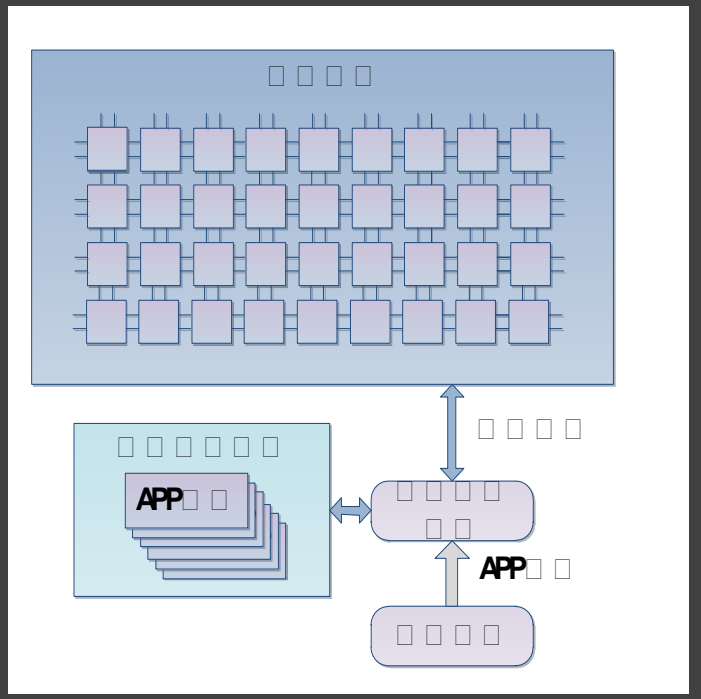


2 Advanded technologies for advanced small platforms

4) Autonomous Navigation and control technology



- Ubiquitous intelligence in machines
- Autonomous network detection and formation flying technology
- Optimize science collection via autonomy
- Mass storage device，Intelligent retrieval, Support real-time information fusion processing



5) intelligent health management technology

- Fault diagnosis and health management technology for energy propulsion and thermal management systems;
- Support expert database

2 Advanded technologies for advanced small platforms

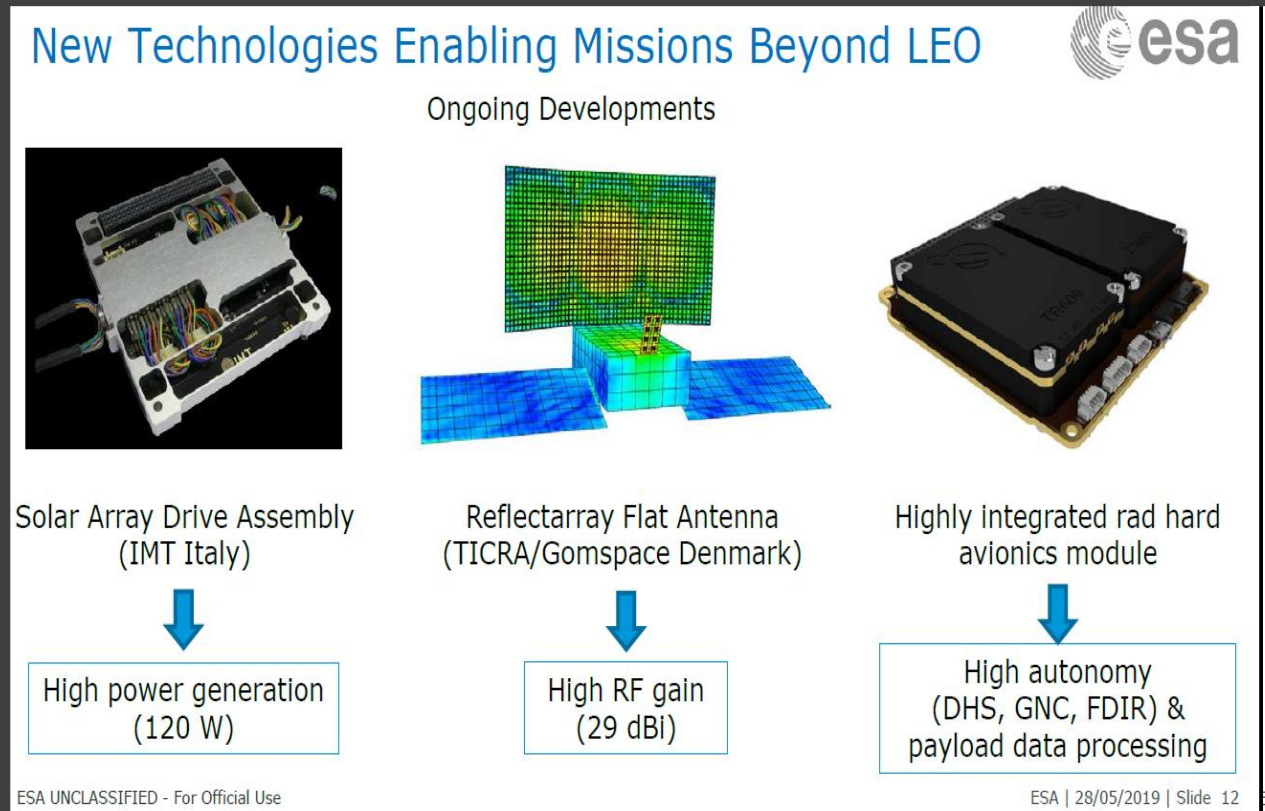
6) Advanced propulsion and energy technology

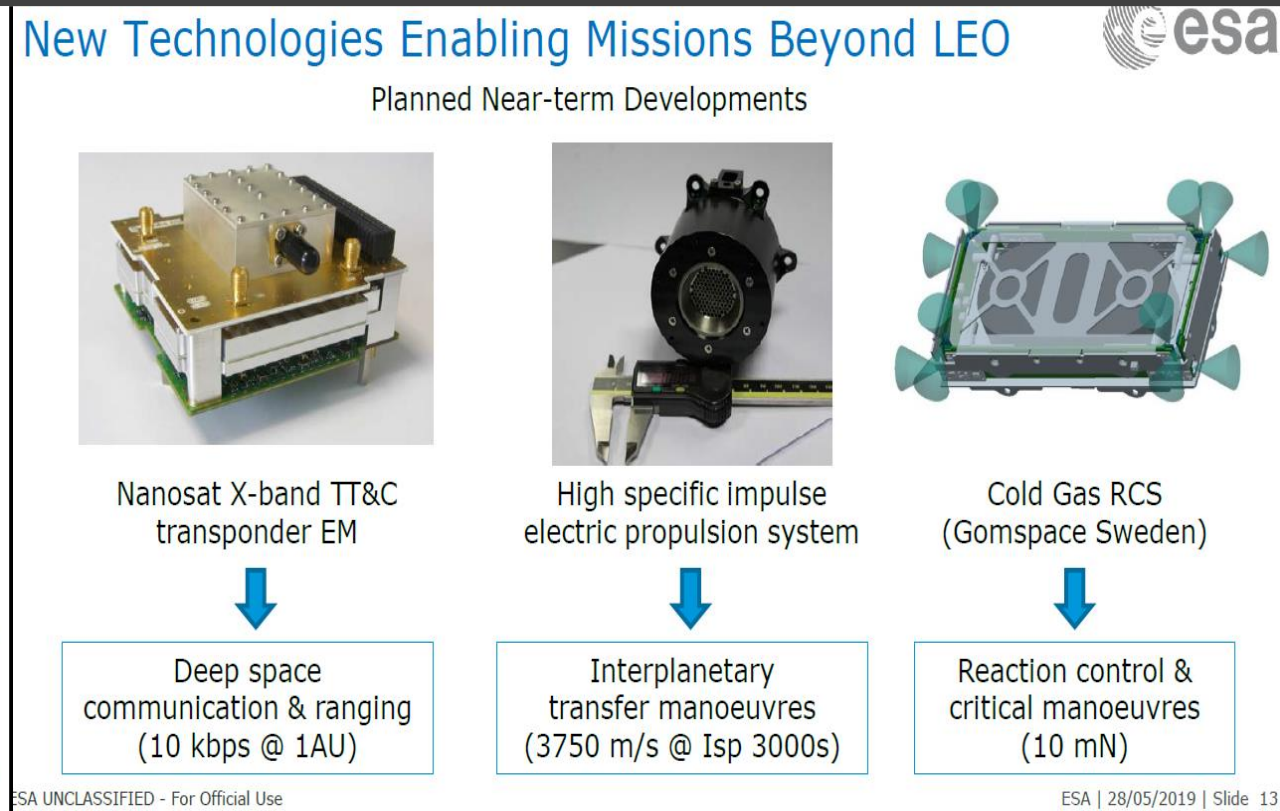
- Propulsion technology for faster access to the outer planets, heliospheric boundaries and beyond,

  Electric propulsion, Nuclear propulsion，laser propulsion…

- Energy storage (all-temperature), Surface power systems

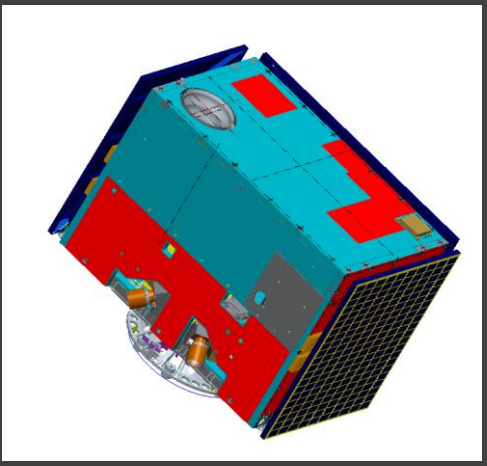
Image credit: ESA, From Roger Walker, the 8th iCubesat，201

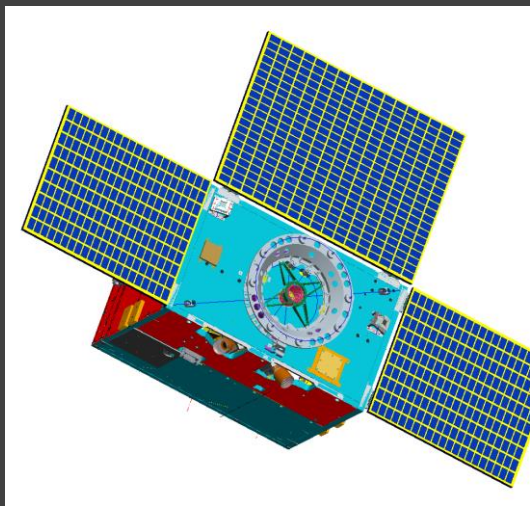




3 Another research for advanced small platforms

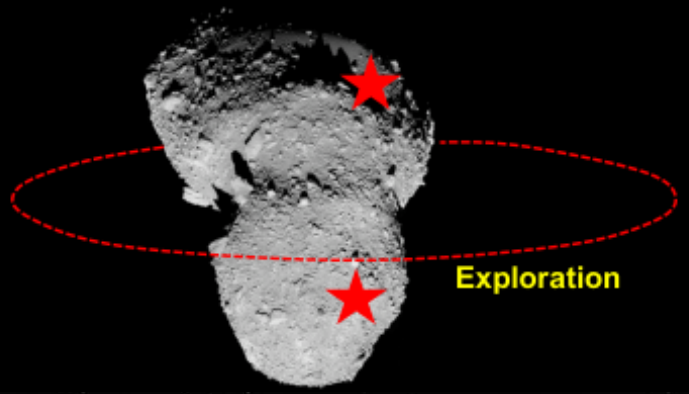
- The use of international cooperation opportunities to fly deep space missions;
- Special opportunities of small satellite launch verification technologies, the potentialities of using new launch or deployment opportunites;
- Long-term environment monitoring, understanding and characterizing pristine to evolved environmental conditions in planetary worlds;
- Advanced manufacturing technology;
- Modeling and simulation system;
- Ground Launch Measurement and Control System;
- Scientific data processing and analysis.





Next Engineer Project in China: Asteroid exploration

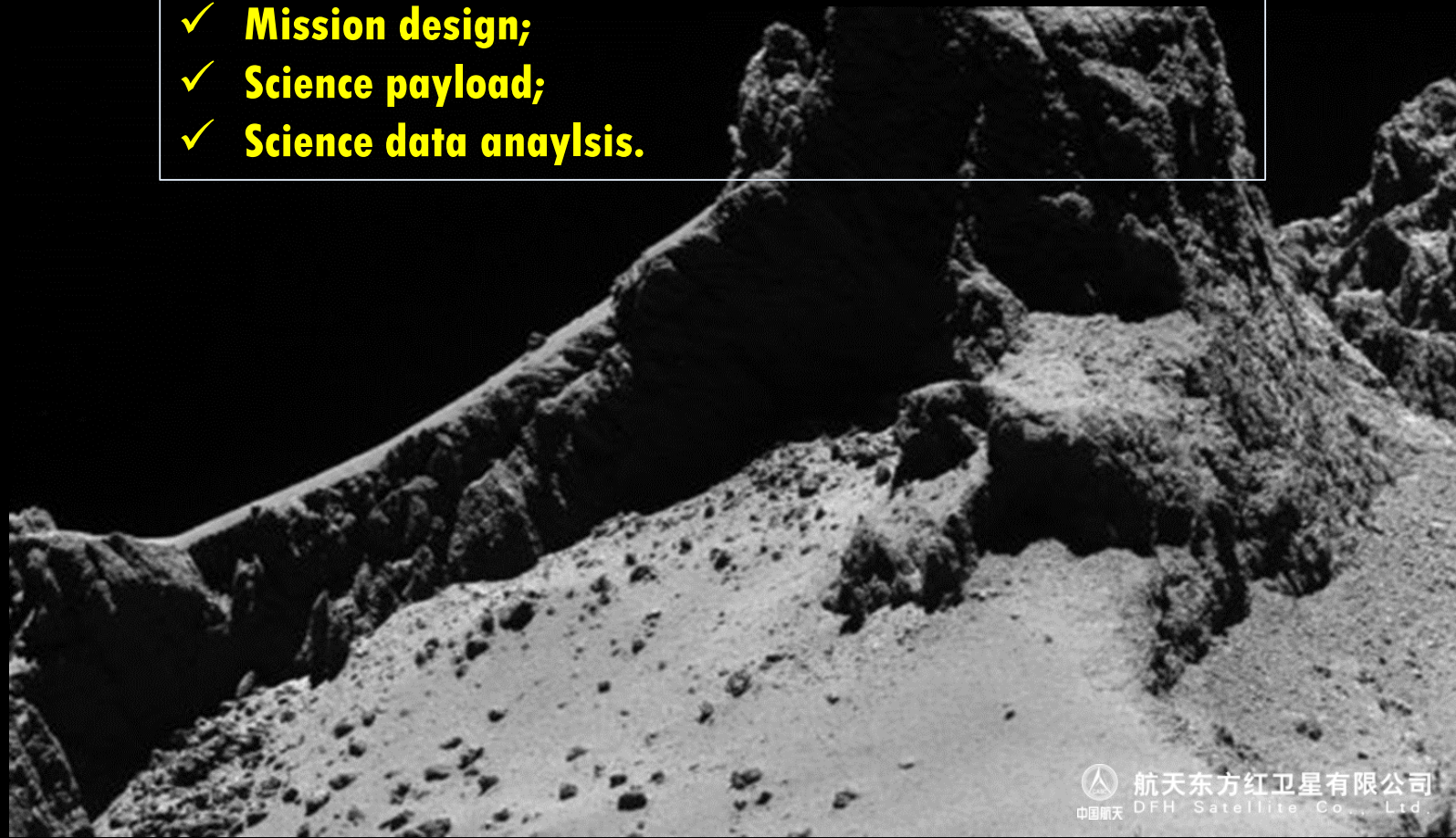
- Exploration from orbit
- Multi-site sampling



Cooperation with you:

- ✓ Science question;
- ✓ select asteroid target and land site;
- ✓ Mission design;
- ✓ Science payload;
- ✓ Science data anaylsis.

4D Evolution of the solar system in the 1st 10 Ma



THANK YOU FOR YOUR ATTENTION!

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