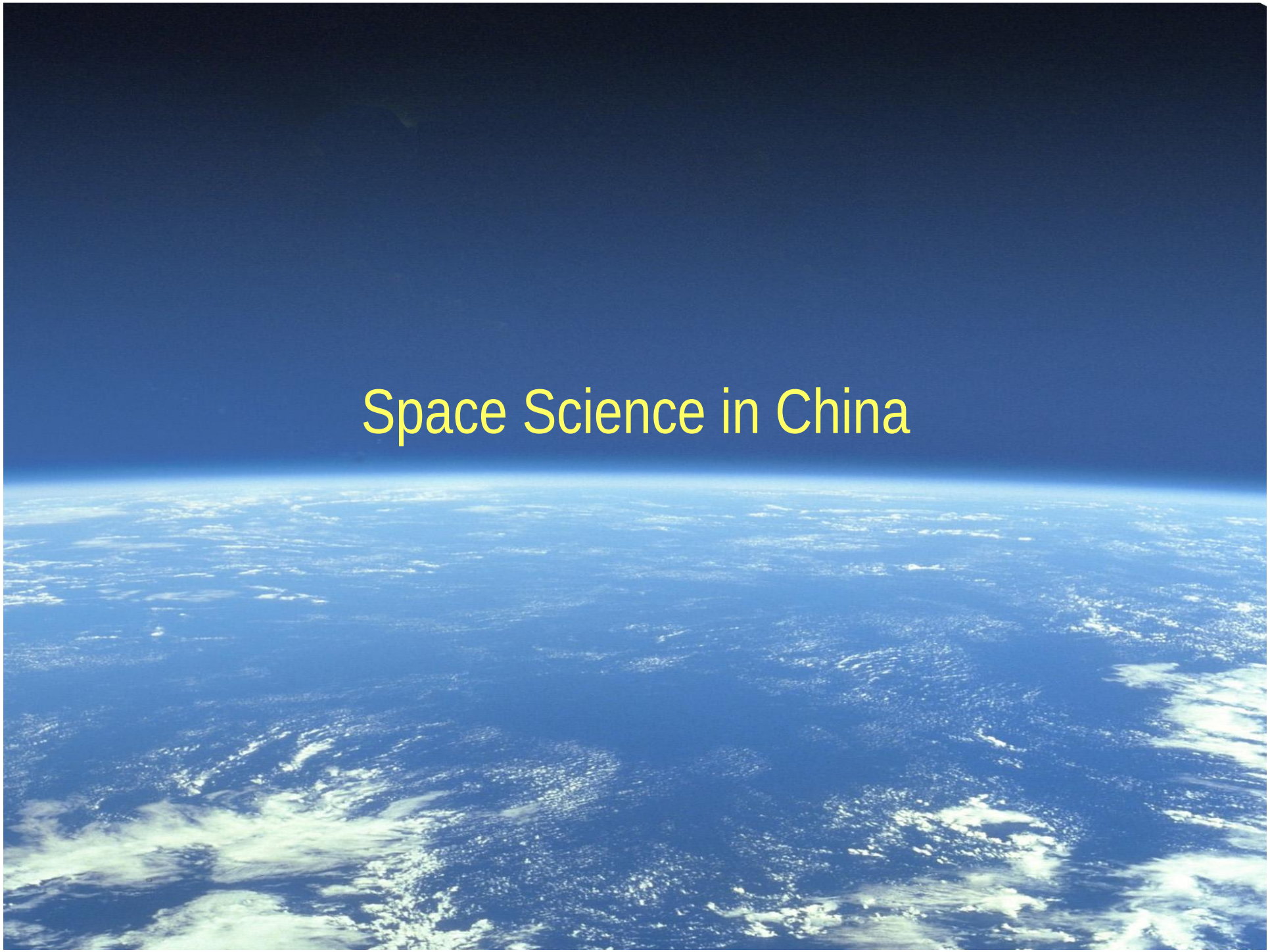
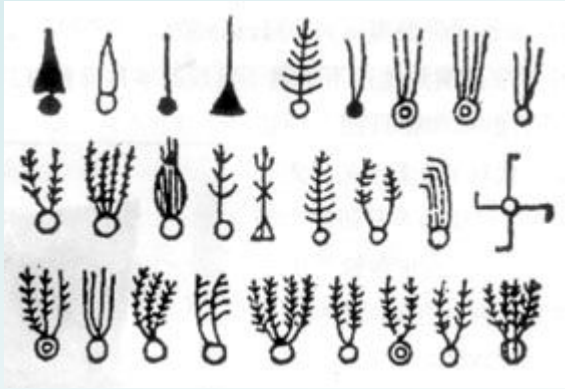

Space Science in China

Contents

- Brief history on space research in China
- Summery of achievements after 1957
- Current Mission and plans
- Foresee the next 20 years
- Remarks

A BRIEF HISTORY ON SPACE RESEARCH IN CHINA

- The earliest record on Haley comet in 613 B.C. and more than 500 (31 for Haley) times comet records afterward
- The earliest record on Sun spots, 28 B.C.
- The earliest application of the earth magnetism --- the compass, ~500 B.C.
- The gun powder was invented in China, and in 14th century Wan Hu tested the ever first rocket and died with his manned rocket flight



A BRIEF HISTORY ON SPACE RESEARCH IN CHINA

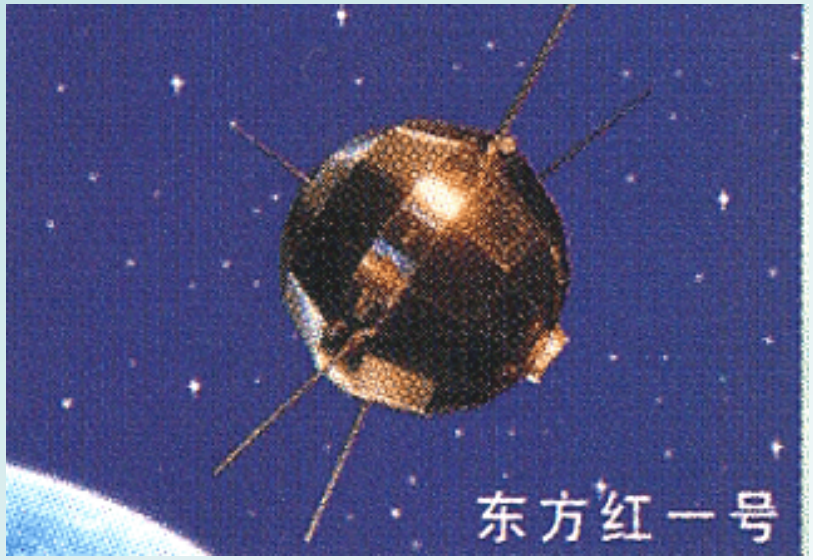
In the modern time:

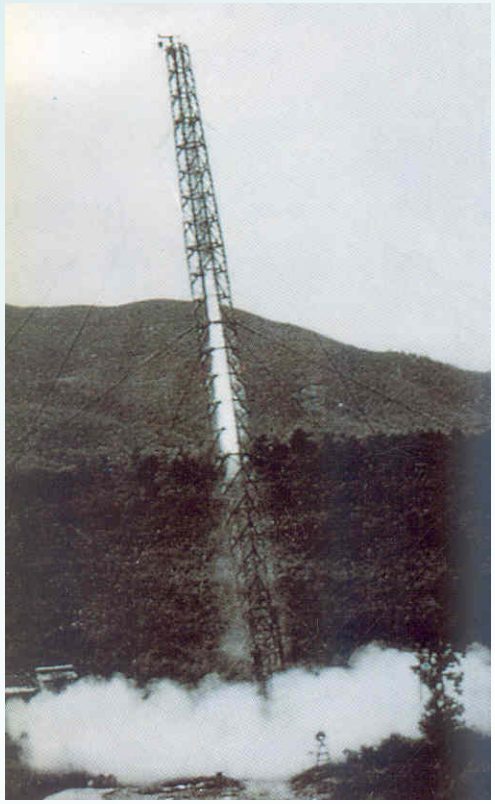
- The first optical astronomical telescope and earth magnetometer observation was installed in Sheshan, Shanghai in 1900
- Ionosphere observation and study since 1930's in the area of Wuhan
- First cosmic ray observation

  for space environment studies installed in Beijing in 1958

Summery of achievements after 1957

- The first sounding rocket was successfully launched in Feb. 1960 with apogee 8km
- The first satellite DFH-1 was successfully launched in 24-04-1970

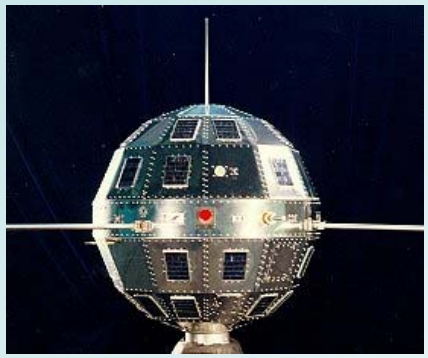


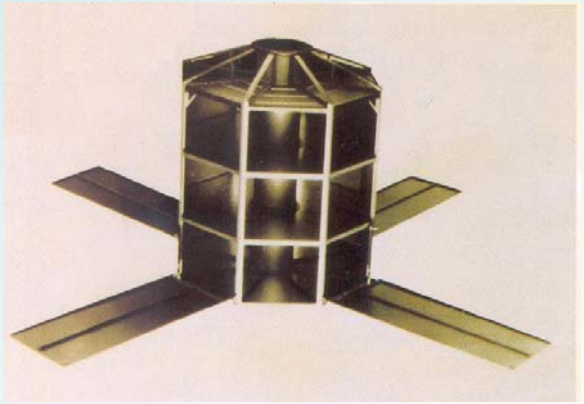


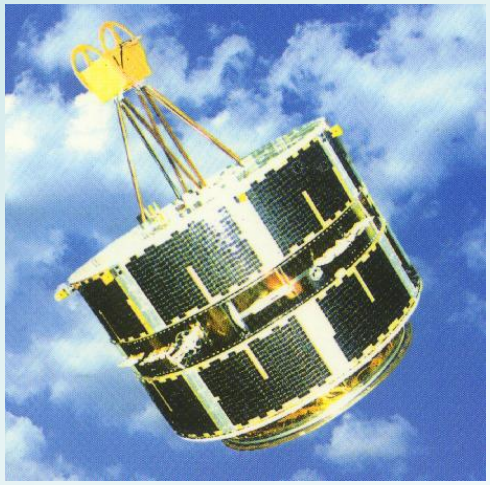
Summery of achievements after 1957

Space environment exploration and space physics studies:

- SJ-1 1971
- SJ-2 1981
- SJ-4 1994
- SJ-5 1999

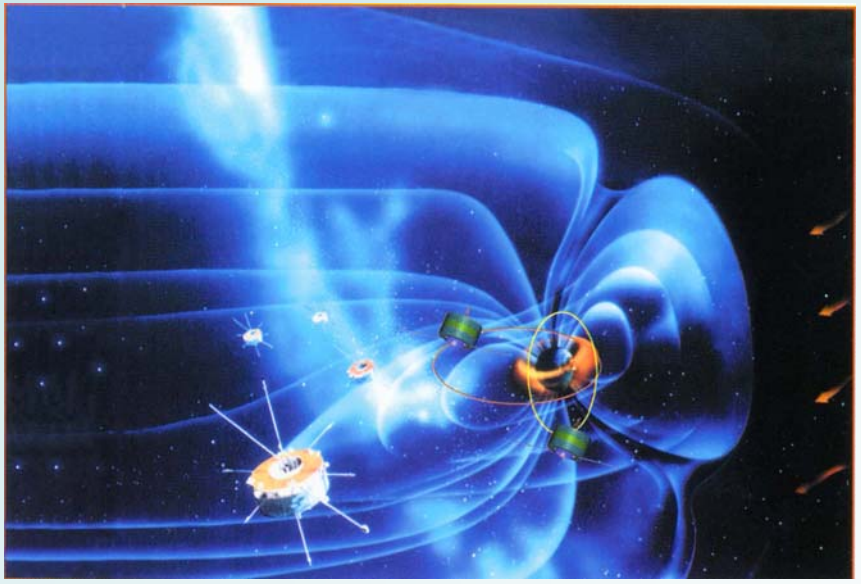






Summery of achievements after 1957

- Double star program was a recent space physics mission with European participations to probe and predict geospace storms. The two stars are an equatorial satellite and a polar satellite used to measure the dynamic processes of the Earth's magnetosphere measurements. TC-1 30.12.2003 TC-2 25.07.2004 .



Current Mission and plans

- In 2000 CNSA published its first white paper and declares that space science is one of its major activities after space technology and space applications
- Recently, CNSA has formulated next 5 years development guidelines in space science

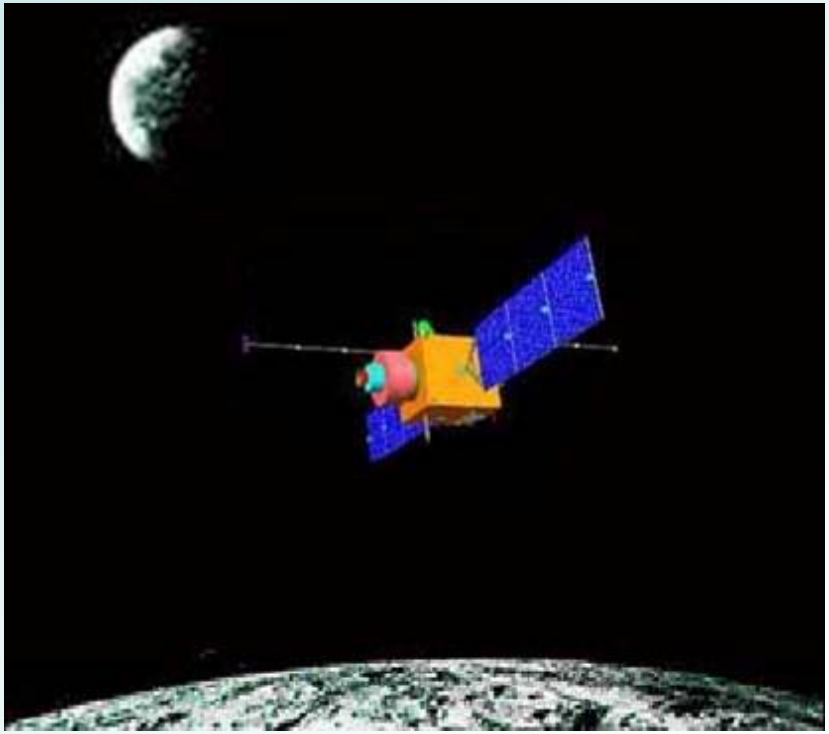
  ----Space exploration towards gain more knowledge in geo-space environment

  ----Initialize more new activities in space astronomy towards universe exploration and other field

  ----Support micro-gravity and space life scientific experiments

Current Mission and plans

- Chang'E –1 represent an important step of Chinese space activities that will go into deep space



Current Mission and plans

- Manned Space Program: Lots of intensive space experiments were carried out on Chinese manned spacecrafts through Shenzhou 1-5

Principles for developing space science in China

- Principle for high priority support: innovative Chinese projects with important scientific objectives
- Fields with strong support: Sun-Earth environment detection, solar system exploration and space astronomy
- Fields with sustained support: space environment utilization, including microgravity, life science and earth-observation from space
- Measures to encourage: public education and outreach, international cooperation in space science

Mid-Long Term Strategic Goals (1)

- Within 15-20 years, build the necessary capacity and facilities for carrying out independent research on the Sun-Earth space environment detection, solar system exploration, and space astronomy observations.
- Build the complete space micorogravity and life science research systems to improve human being's ability to live in space.
- Based upon the current remote sensing satellites, gradually acquire comprehensive capacity for observing the Earth, in order to build the earth science research system focusing on global changes on the earth.

Mid-Long Term Strategic Goals (2)

- Using space facilities and platforms for exploration and research on selected important frontier scientific problems, gradually establish the Chinese space science system characterized by a space science satellite series across multiple science frontiers and disciplines.
- Enhance significantly the research quality and level of space science, make major breakthroughs in some research directions, realize the leap into the international science frontiers, make efforts in achieving the internationally recognized levels in some major research fields, and produce important and original science results and solve important problems for meeting the national strategic needs.

Short-term goals between 2006-2010 (1)

- Launch the Hard X-ray Modulation Telescope satellite in 2010, the first Chinese space astronomy mission, in order to reach the international level in hard X-ray observation and research
  - Discover about 1000 supermassive black holes
  - Detailed studies on pulsars and other compact objects, the dynamical behaviors and high energy radiation processes in the strong gravitational fields around black holes
  - Obtain breakthrough results and play a leading role on black hole research and other related fields.

Short-term goals between 2006-2010 (2)

- Through France-China collaboration, contribute high energy detection instruments to the SMESE (SMall Explorer for Solar Eruptions) mission, to be launched in around 2010 for the next solar maximum, in order to support the space weather and basic solar physics research in China.

These two space astronomy missions, HXMT and SMESE, will enhance the overall research in high energy astrophysics in China, as a solid foundation for China's entry into the era of multi-wavelength astronomy, which is symbolized and represented mostly by space astronomy.

Short-term goals between 2006-2010 (3)

- Continue the support to the development of the key technologies required for the Space Solar Telescope (SST) mission, demonstrate the required 0.1 acrsec angular resolution on the ground, and eventually launch the satellite when it is ready.
- In space physics, based upon the future important scientific results from the “Double-Star” mission, carry-out preliminary research around the “Kua-Fu” mission concept to develop scientific objectives and key techniques, to be selected before 2010, to complete China’s satellite plan for space physics and space environment exploration, in order to layout a solid foundation in China for rapid development in this field.

Short-term goals between 2006-2010 (4)

- In microgravity and life science fields, based on clear tasks and objectives, select space experiments with important scientific meanings and application values through careful evaluations, launch 1-2 satellites with returned payloads, so that the research in the field will develop from the previous piggy-back mode into a steady mission dominated new stage.
- Finally, participations at different levels in international space missions with important and frontier scientific objectives and advanced technologies are encouraged, in order to make China's space science enter into a broad and rapid development phase after the next five-year initial period.

Space Science Development Strategies in China

- Following the principles of space science development, in the fields with strong and sustained supports, missions are selected according to their scientific importance, stimulation to strategic technologies, urgency and technical maturity and feasibility; normally smaller and simpler missions are selected first to minimize risks, but opportunities should also be grasped for missions with great breakthrough potentials.
- Within about 20 years, gradually develop satellite series with different scales, complete China’s transition from a major space technology country into a major space science country in the world.

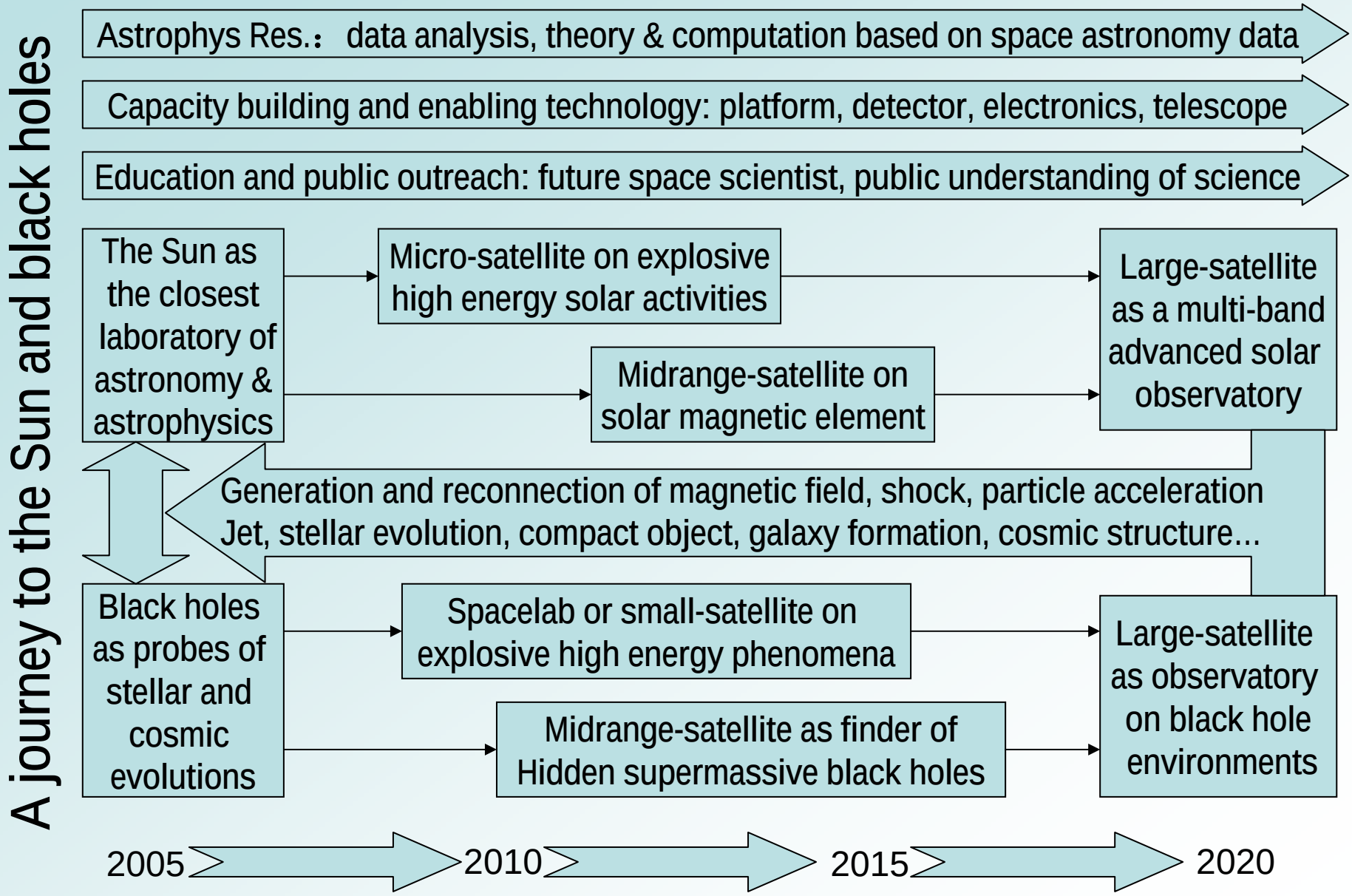
Space science goals before 2010 and road maps

- Space astronomy and solar physics
- Space physics and solar system exploration
- Space earth science
- Microgravity and life sciences in space

Space astronomy and solar physics

- Scientific goals: taking the Sun as the closest astrophysical laboratory and black holes as probes of stellar evolution and cosmic evolution, carry-out multi-wavelength astronomy observations from space to avoid the absorption and disturbance of earth's atmosphere to most electromagnetic radiations from space, in order to study astrophysical objects with different masses and scales.
- Key scientific problems: the early universe, galactic and large scale structures of the universe, formation of first-generation stars and galaxies, dark matter and dark energy, formation of black holes with different masses, formation of stars and their planet systems including giant and earth-like planets, understanding the Sun as a star.

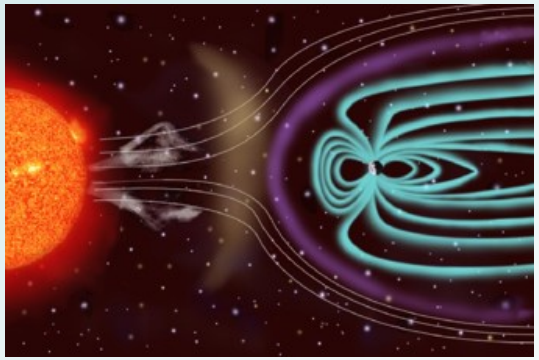
Road Map for China's Space Astronomy and Solar Physics



Space and Solar System Exploration

Roadmap for Space Physics Exploration

Key Exploration Space： Solar – Terrestrial Space



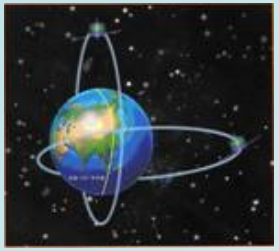
Key Problems:

- ✓ Solar activities' mechanisms and their predictions;
- ✓ Propagation and evolution of interplanetary disturbances;
- ✓ Multi-scale physical processes of the geo-storms；
- ✓ Basic plasma physical processes of the solar terrestrial chain;
- ✓ Physics-based numerical space weather forecast modeling;
- ✓ Affects of solar storms on human activities;
- ✓ Affects of adverse space environment on satellites.

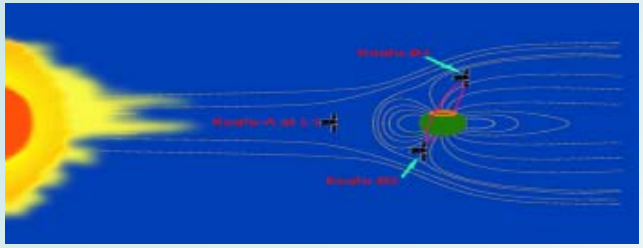
Roadmap for Space Physics Exploration

MIT

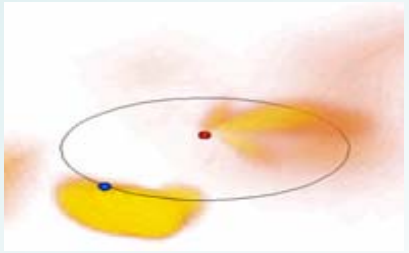
DSP



Kuafu



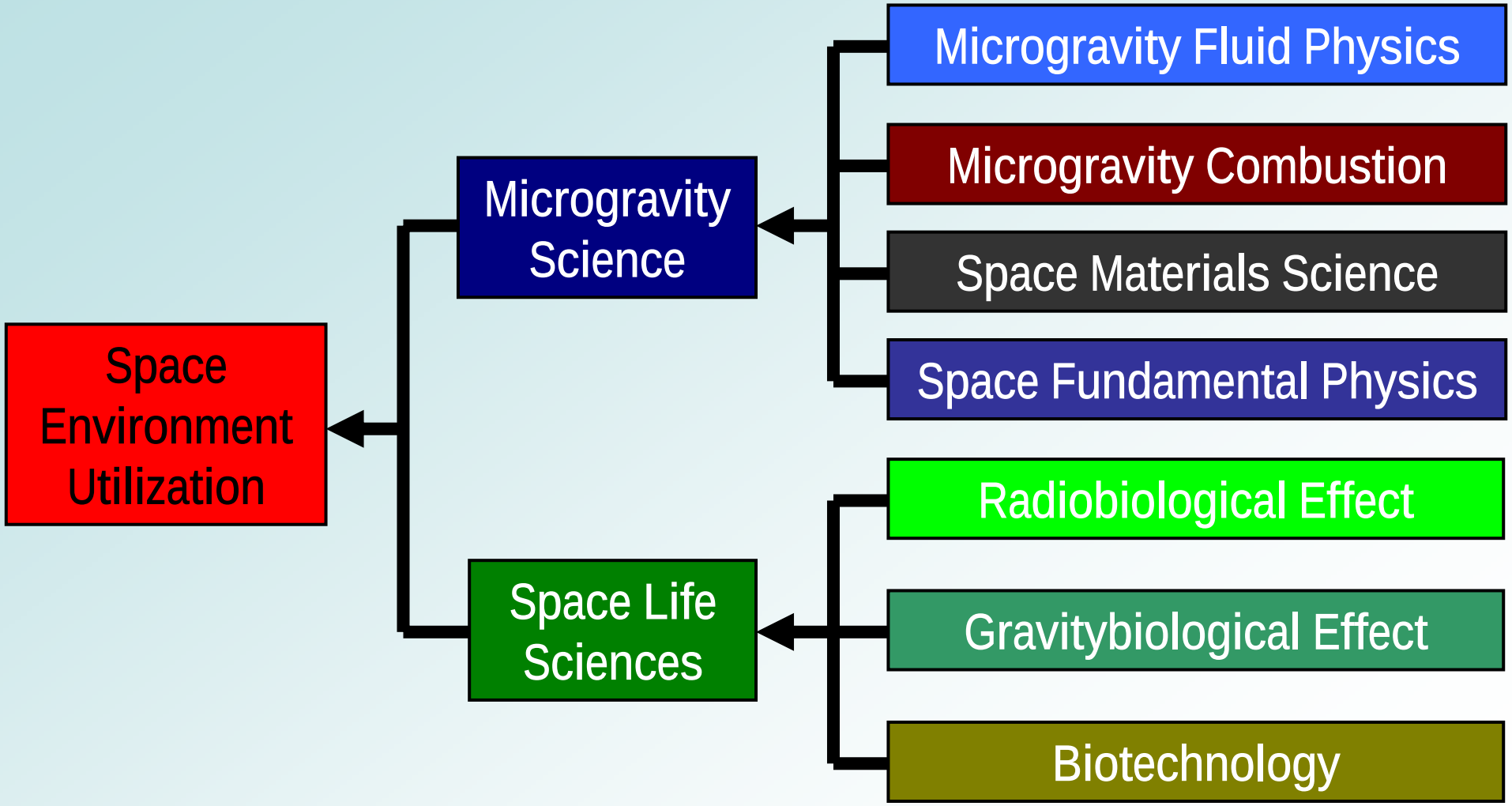
Interplanetary Space



2005 2010 2015 2020 2025

Mars Space Environment Exploration

Primary Subjects to be Studied on the "Eleventh-Five" Recoverable Satellites



2006-2010 Space Science Plan

- Space science missions
- Capacity building
- Research and development for enabling key technologies required by future space missions
- Scientific research for future space missions

2006-2010 Space Science Missions: HXMT

- Launch the Hard X-ray Modulation Telescope satellite in 2010, the first Chinese space astronomy mission: sensitive hard X-ray all-sky survey for discovering highly obscured supermassive black holes
  - 20-250 keV energy range, 5000 cm^2
  - Angular resolution <5 arcmin
  - Location accuracy <1 arcmin

2006-2010 Space Science Missions: SST

- Continue the support to the development of the key technologies required for the Space Solar Telescope (SST) mission, demonstrate the required 0.1 acrsec angular resolution on the ground, and eventually launch the satellite when it is ready.
  - 0.1 arcsec angular resolution
  - sub-gauss magnetic field sensitivity

2006-2010 Space Science Missions

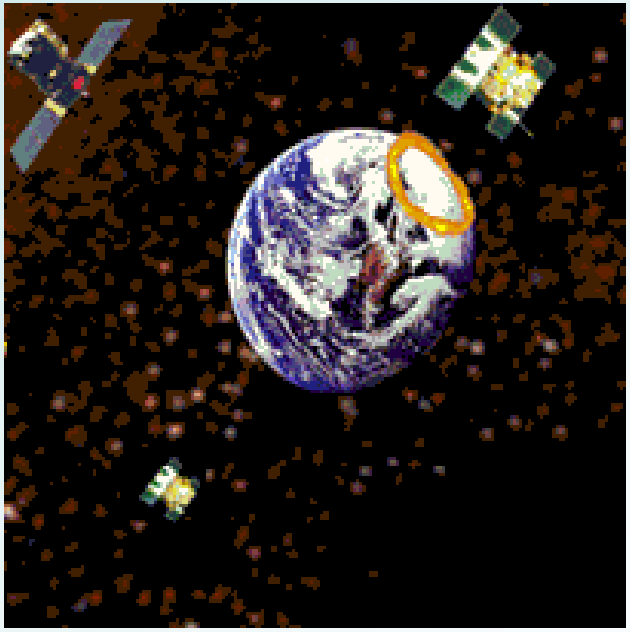
- 1-2 scientific satellites will be launched for obtaining some results about the important applied and fundamental research, with the request of using the re-entry module and orbit module on the retrievable satellite(s) sufficiently .

2006-2010 Space Science Missions: SMESE

- Through France-China collaboration, China contributes high energy detection instruments to the SMESE (SMall Explorer for Solar Eruptions) mission, to be launched in around 2010 for the next solar maximum, in order to support the space weather and basic solar physics research in China.

2006-2010 Space Science Missions: Kua-Fu

- Carry-out preliminary research around the “Kua-Fu” mission concept to develop scientific objectives and key detection techniques, to be selected before 2010, and launched around 2012, to study the Sun-Earth space environment responses to solar activities.
  - Kua-Fu A is located at L1 point for in situ solar wind measurement
  - Kua-Fu B is composed of two satellites located on polar orbit of the earth.

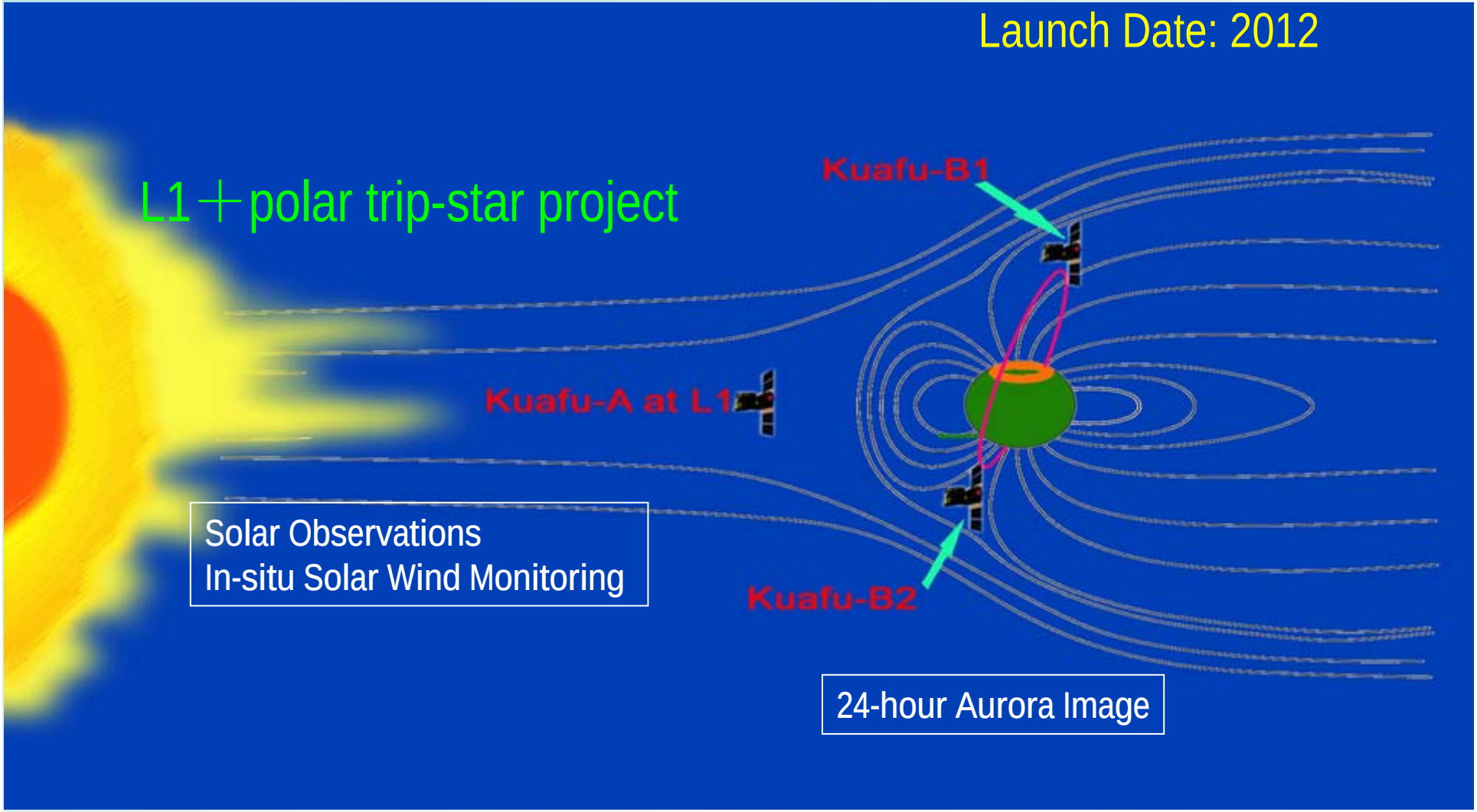


KuaFu

Solar Storm、Aurora and Space Weather Exploration

Launch Date: 2012

L1＋polar trip-star project



Capacity Building

- Research and development for enabling key technologies required by future space missions
  - General purpose and multi-task space science raw data handling platform
  - On-ground and high altitude common experimental platform for space astronomy
  - Space environment basic database and application service platform
  - Research center for microgravity science
  - Research base for space life science and biological technologies

Foresee the next 20 years

In the astronomy area:

- Large aperture optical lens in space (1m)
- High resolution x ray imaging technology
- Extreme high energy cosmic-ray observation
- Space VLBI in mm wave

Foresee the next 20 years

In the space physics and solar system area:

- Comprehensive geo-space exploration missions after DSP
- Interplanetary space solar wind observation
- L1 point in-situ measurement
- Complete monitoring system from the Sun to the ground for space weather

Foresee the next 20 years

In Micro-gravity and space life area:

- An integrated space micro-gravity science system is going to be established primarily aiming at improving human's space-living abilities
- Utilizing the space conditions and platform , advanced exploration and research will be performed on the frontier of some important science problems, followed by the foundation of a Space Science system ,which covers several edging subjects.

Remarks

- China has long history on space exploration but only in recent years it becomes a member of the international space exploration club
- Scientists in China are prepared to deliver good ideas on future programs
- Priorities will be given to the innovative Chinese projects with important scientific objectives
- Strong supports will be given to Sun-Earth environment detection, solar system exploration and space astronomy
- Sustained supports will be given to space environment utilization, including microgravity, life science and earth-observation from space
- Measures will be taken to encourage public education and outreach, international cooperation in space science


Thank You!