

THE THIRD CHINESE SPACE SCIENCE RESEARCH MISSION IN RECENT FIVE YEARS - SPACE DUST AND SPACE ELECTROMAGNETIC BACKGROUND PROBING SATELLITE

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ABSTRACT

China has a development plan, which includes some projects in Space Science Research in recent five years. The Space Dust and Space Electromagnetic Background Probing is the third of them. In this project, Chinese scientists have reviewed the scientific objectives and the purpose of the spacecraft's and the payloads' concept designs, and will begin to manufacture the spacecraft soon.

The main idea of the project is introduced in this paper. The background of space debris and space electromagnetic is focused among the Chinese scientists. Although China has built some ground-based observation capabilities, and has set-up some modelling to research and predict the space debris, like the same as the space electromagnetic, space-based observations are needed.

INTRODUCTION

The background of space debris and space electromagnetic is focused among the Chinese scientist. Although China has built some observations on the ground, and has set-up some modelling to research and predict the space debris, like the same as the space electromagnetic, the space-board observations are needed.

In the concept research on space environment, we find that space debris is one of space environment effect which is harmful to the manned spacecraft. In the past ten years, some suggestions on ground and space detection, model, impacting rate, impacting effect, design standard, protective method are mentioned in China. Some research works have been done on:

- Top layer design of concept research on space debris
- Space debris modeling collection and set up
- Space debris and its effect data collection
- Ground detection

- Space detection plan(space mm Wave Radar and impact detection)
- Design standard of spacecraft to anti space debris
- Predict on space debris flux for Chinese manned spaceship project

China planed to its third space science research mission to detect space debris in space. This is most important to understand the space debris and its effect.

SCIENTIFIC OBJECT

The scientific scope of the Space Duct and Space Electromagnetic Background Probing Mission is below:

Space DUST:

Measurement of the space debris in altitude between 550Km and 2000Km; to rebuild Chinese space debris model and to compare with others; to set-up Chinese spacecraft design standard for protective from Debris;

Space Electromagnetic Background:

To the Electromagnetic pulse which come from the space and the earth; to detect the aurora and the lighting phenomena from the upper atmosphere; to monitor the TIPP through the ionosphere; to set-up the model of space Electromagnetic background; to understand the light-chemical theory of the upper atmosphere and the ionosphere distributing.

SPACECRAFT LINE OUT

The spacecraft is three axis stable to the earth in orbit. The mass is about 650Kg, and the power of the satellite is 1000W. The perigee is 550Km, The apogee is 2000Km and the inclination 98.6°. The designed lifetime is more than 2 years.

PAYLOADS ON SPACE DEBRIS RESEARCH

The space detection is the base work on space debris research. Because of the difference size, velocity and mass of space debris, It is very difficult to detect the space debris in all kinds of characteristic in space. Large space debris (larger than 10cm) can be observed on the ground by Telescope or Radar. Small space debris (smaller than 1mm) can be detect in space by space Radar and impact detector. The question is for the medium space debris (size between 10cm and 1mm), they have large numbers, and the impacting effect of them is more harmful.

For ground detection, there are many methods to observe space debris such as Optical Telescope and Ground Radar.

For space detection, the impact detector, optical monitor, space radar and target returning are generally used.

In Chinese space debris probing mission, there are four kinds of payloads on board the satellite for space dust probing (total mass of them is about 100Kg): to detect the space debris (size larger than 1mm) using millimetre wave radar by remote sensor method; to impact to the space dust(size in 1 to 200 μm) using large area aperture ($>0.16\text{m}^2$) of charge detector or light detector (each type of the instruments has different open windows facing to different directions); a large sensitive array placed on the back of the solar panel to detect the total impact effect, by measuring the change of the resistance; four CCD cameras placed inside the spacecraft to monitor the surface change of the two solar panels in two directions.

- **millimeter wave radar:** it is used to detect the space debris whose size larger than 1mm by remote sensor method. It is good for detecting space debris between 3 to 10 cm in altitude from 600 to 1300Km specially.

Velocity solution: $\leq 50\text{m/s}$

Direction solution: $\pm 1^\circ$

Time solution: $< 1\text{s}$

Noise: $6\sim 9\text{dB}$

Dimension: $400\times 350\times 350\text{mm}$

Weight: 50kg

Power: 120W

□ **Impact detector**

The detector is a target for impacting by the space dust(size in 1 to 200 μm) with a large area aperture($>0.16\text{m}^2$). they collected the signal by detecting charge particle or impacting light. Each type of the instruments has different open windows facing to

different directions.

Charge Detector:

Mass range: 10^{-15} to 10^{-7}g

Size: 0.05 to 50 μm

Velocity: $< 10\text{Km/s}$

Size: $310\times 310\times 360$

Weight: 6Kg

Power: 6W

Light Detector:

Mass range: 10^{-7} to 10^{-3}g

Size: 50 μm to 0.5mm

Velocity: $< 10\text{Km/s}$

Size: $330\times 330\times 260$

Weight: 5Kg

Power: 4W

□ **Large sensitive array**

It placed on the back of the solar panel to detect the total impact effect, by measuring the change of the resistance.

Dimension: $1010\times 1010\times 600$

Weight: 7Kg

Power: 6W

GROUND OPERATION SYSTEM

China is planing to build the ground operation system for the space debris probing mission and the space debris research.

Data process system will place the scientific data in INTERNET. The space debris Coding and Modelling, the space debris predicting and the impact effect research will be done in this system.

Optical monitor

There are four CCD camera placed inside the spacecraft to monitor the surface change of the two solar panels in two directions.

CONCLUSION

China has done some work on space debris and space electromagnetic background research, include basic theory, model and observation. In recently years, the number of space debris rise in near space because of the space activity. It is important for us to research the distributing of the space debris and its effect because of the damage to the spacecraft and space laws. China has a plan to probing space debris in near space in recently years, which focus on measurement of the space debris in altitude between 550Km and 2000Km; to rebuild Chinese space debris model and to compare with others and to setup Chinese spacecraft design standard for protective from Debris. The international cooperation on space debris research both in space and on the ground is welcome on the side of China.