



Introduction to the Optical Module Bus of China Manned Space Station

Optical Module System of CMS
Oct. 2017



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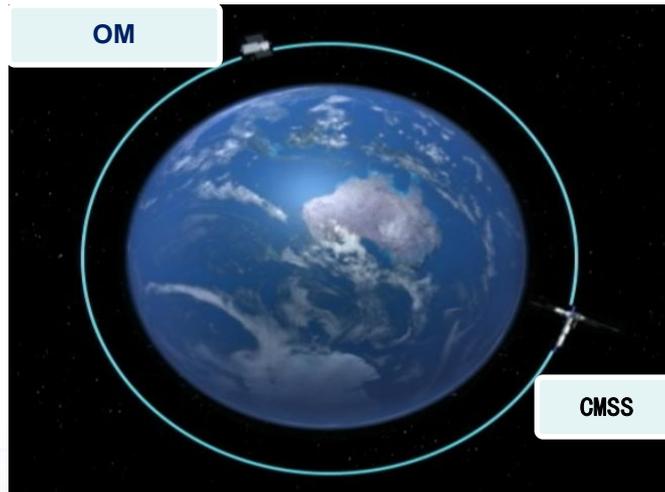


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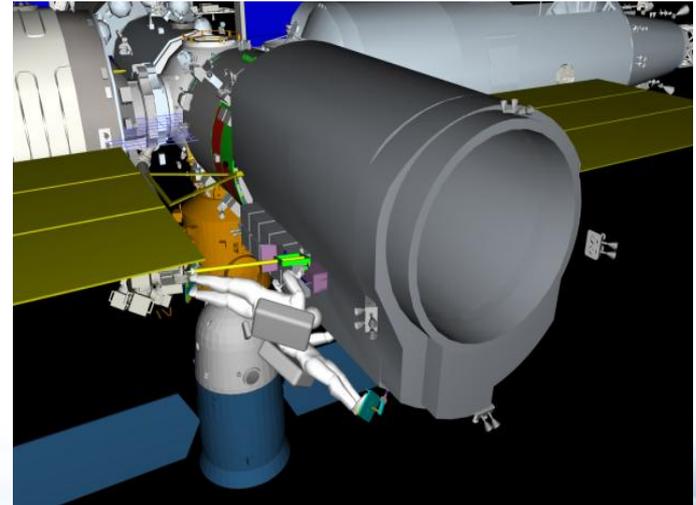
1. Introduction

- **The Optical Module (OM) of China Manned Space Station (CMSS) has been proposed as an independent long-termed spacecraft flying by CMSS, which will achieve more scientific benefits of astronomical observation ,compared with the concept of the optical telescope built in the CMSS.**



1. Introduction

- **The OM bus is being developed to serve the optical telescope payload with the capabilities of independent spaceflight as an individual spacecraft, rendezvous and docking (RVD) with CMSS as a module to accept propellant refueling by the Cargo Ship and maintenance & upgrading by astronaut crew resident in CMSS.**
- **This paper briefly presents the key parameter requirements analysis and the system concept of the OM bus.**

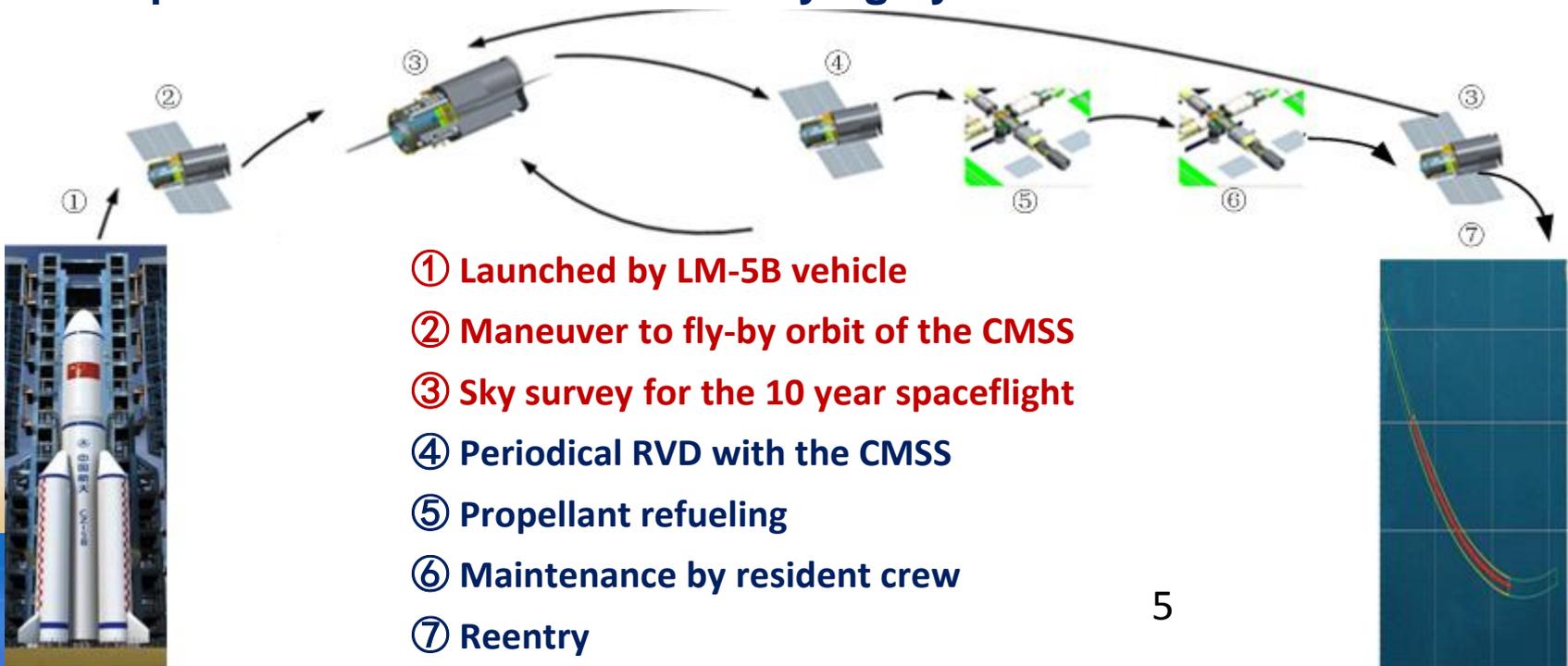


2. Analysis of the Optical Module Mission



(1) Summary of the OM Spaceflight

- The OM will be launched by a LM-5B launch vehicle in Wenchang Satellite Launch Center.
- This module will take several orbit maneuvers independently to the fly-by orbit of CMSS, and then carry out the sky survey mission for 10 years and periodical orbit maintenance flying by CMSS.

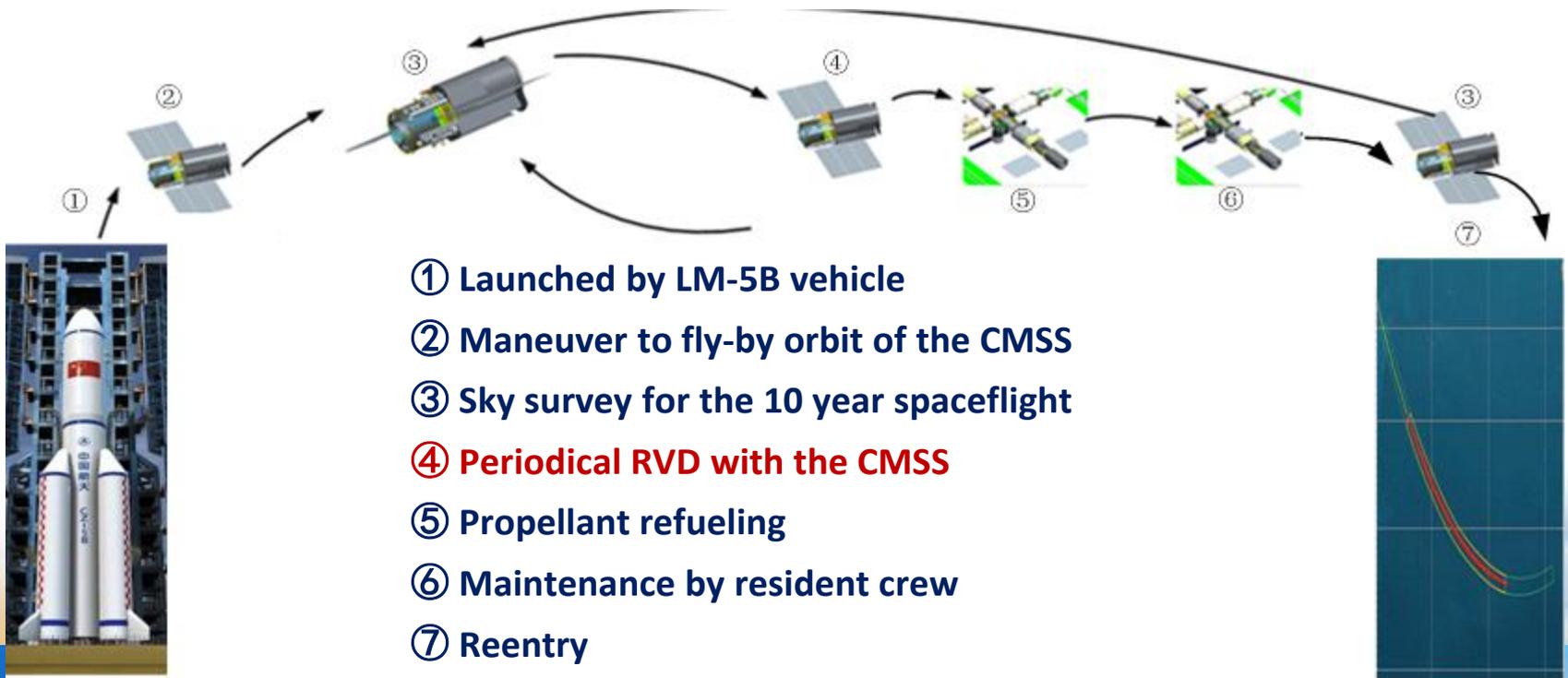


2. Analysis of the Optical Module Mission



(1) Summary of the OM Spaceflight

- With the expenditure of propellant, periodical RVD missions with CMSS are required for propellant refueling by Tianzhou Cargo Ship and system maintenance by resident crew.



2. Analysis of the Optical Module Mission



(1) Summary of the OM Spaceflight

- Meanwhile, urgent RVD mission of maintenance would also be taken due to the system failures of key functions relevant to the sky survey mission.
- The OM will take the reentry mission in the end of life, and be deorbited into the Pacific Ocean.



- ① Launched by LM-5B vehicle
- ② Maneuver to fly-by orbit of CMSS
- ③ Sky survey for the 10 year spaceflight
- ④ Periodical RVD with CMSS
- ⑤ **propellant refueling**
- ⑥ **Maintenance by resident crew**
- ⑦ **Reentry**

2. Analysis of the Optical Module Mission



(2) Sky survey mission

- The sky survey mission requires that the OM has the capabilities of both rapid attitude maneuver and precise and stable control of the telescope's line-of-sight (LOS).
- The rapid attitude maneuver is implemented by the OM bus to change the observation area in order to meet the sky coverage requirement in ten years.

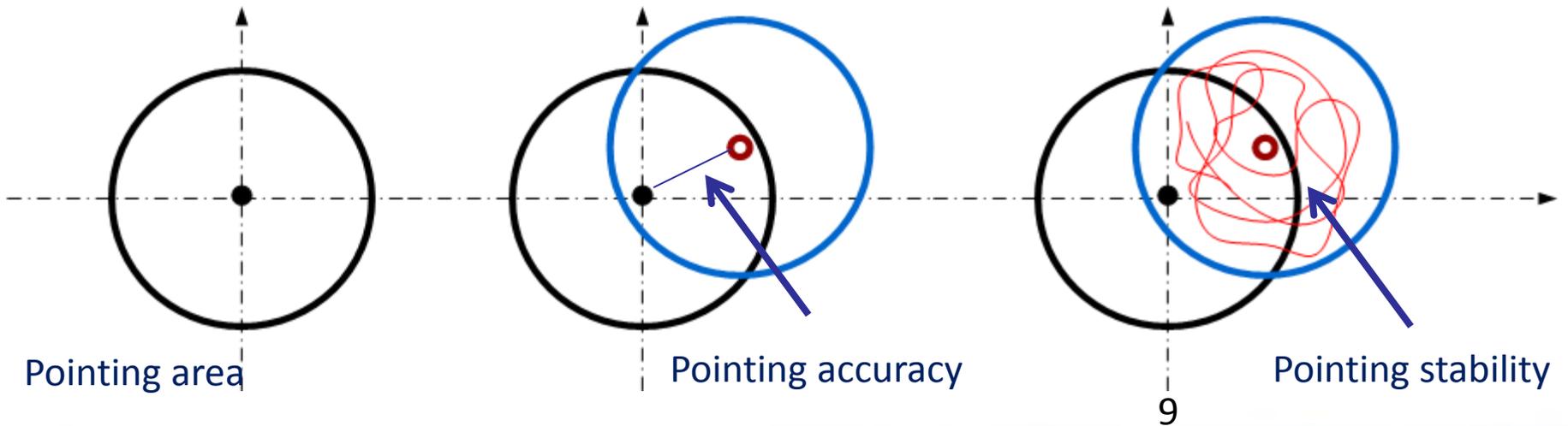


2. Analysis of the Optical Module Mission



(2) Sky survey mission

- The precise and stable control of the telescope LOS is implemented by the OM bus's attitude control subsystem(ACS) and the LOS stabilization system of the telescope payload.



2. Analysis of the Optical Module Mission



(3)RVD mission

- The OM is scheduled to take an active RVD mission with the CMSS every 1~2 year for propellant refueling or maintenance, and then the sky survey mission will be carried on after its separation with the CMSS.

(4)Reentry mission

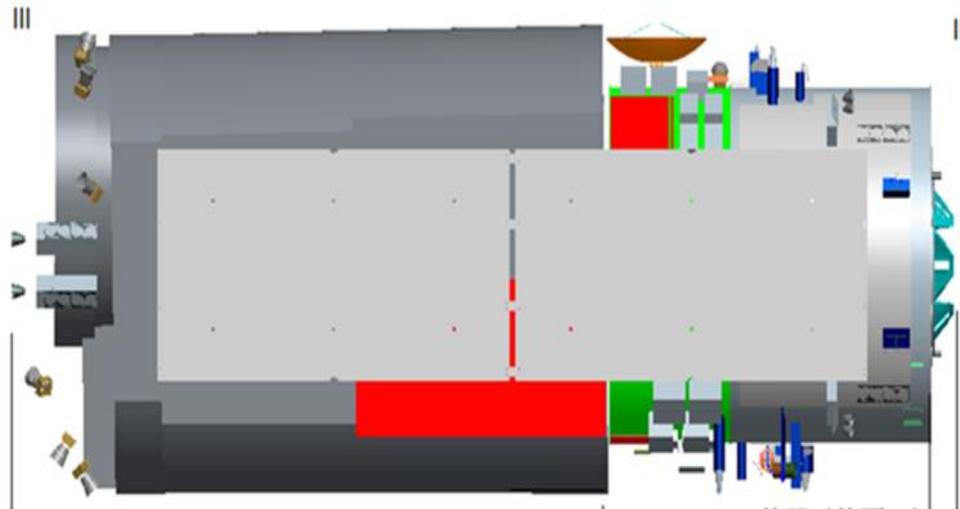
- The OM will take the reentry mission in the end of life, and be deorbited into the Pacific Ocean.



3. System Concept of the Optical Module Bus



The OM is composed of the telescope payload and the OM bus, and the bus is designed to fulfill the need of the telescope for the sky survey.



3. System Concept of the Optical Module Bus



(1) Structure subsystem

- The OM Bus has a cylinder with a inner decagon structure to provide total field of view for resident crew as shown in Fig.1
- Such RVD equipments as laser radar are built in the bottom of the OM.
- A special structure adapter is designed for the telescope payload to reduce the influence of the thermal-structure deformation of the OM bus in orbit.

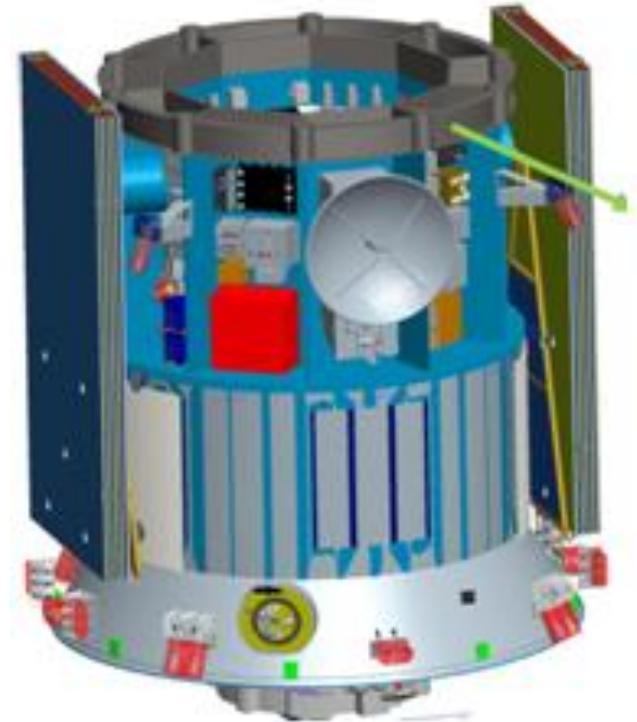


Fig.1 Bus configuration



3. System Concept of the Optical Module Bus



(2) GNC and propulsion subsystem

- The SGCMGs serve as the actuator of GNC to meet the requirement of rapid attitude maneuver, and magnetic torquers are used for moment dumping to reduce consumption of propellant .
- The bus is equipped with 6 tanks of 2100 kg propellant for the flight orbit maintenance and RVD.

(3) Thermal control subsystem

- Loop heat pipes (LHP) are used for the thermal control of the OM bus to meet the equipment temperature requirement of different flight modes with different heat consumption and reduce the power consumption of electrical heating.



3. System Concept of the Optical Module Bus



(4) Power subsystem

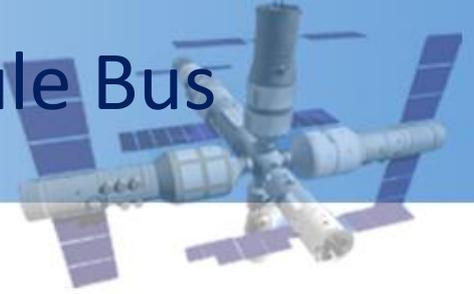
- Developed based on the rigid solar array and lithium battery, and a damper is used to reduce the thermally induced vibrations.

(5) On-board data handling subsystem

- Developed based on the integrated electronics technique.
- Responsible for the data management of the OM bus and the telescope payload.
- Ka space link with TDRS are used for the data transmission of the sky survey.



3. System Concept of the Optical Module Bus



(6) Micro-vibration isolation

- Such disturbance sources as CMG, refrigerator, and solar arrays are systematically distinguished.
- Disturbance characteristics are achieved by tests and numerical simulation.
- Vibration isolation measures are taken for expected disturbance sources, and A numerical simulation tool of Dynamics-Optics-Controls-Structures is developed to verify the line-of-sight requirement \mathfrak{R}_v .



4. Conclusion



With the unremitting efforts for several years, The OM has been determined to develop to fully meet the requirement of the sky survey mission.

The OM bus, a fly-by bus with the space station, is firstly developed for a new mode of long-termed independent spaceflight and periodical docking with the CMSS, and this will evidently decrease the mission risk by the crew's maintenance and extend the OM service life to achieve more scientific observation data by propellant re-fueling. Meanwhile the fly-by bus also serves as a open port of the CMSS to provide a perfect mode for international cooperation.





Thank you for your attention!

