Development of a balloon-borne telescope for remote sensing of planets (2)

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A balloon-borne telescope system for remote sensing of planetary atmospheres and plasmas has been developed. A telescope floating in the polar stratosphere can continuously monitor planets for more than 24 hours. Thin air of the stratosphere makes it possible to observe planets in a condition free from bad weather with fine seeing and atmospheric transmittance. Moreover, a balloon-borne telescope system is less expensive compared with a ground-based huge telescope or a planetary mission with an orbiter. This project is also a step for a planetary satellite telescope.

In 2004 key components of the system have been designed, manufactured and tested. A sun sensor which will detect attitude of the gondola is simply composed of a position sensitive photodiode and a pinhole. A performance test of the sun sensor by detecting direct sun light on the ground showed that the sensor has a sufficient signal-to-noise ratio enough to determine the attitude of gondola with an accuracy of 0.0075 degree. A control moment gyro (CMG) is adopted for a torquer of attitude control. A small proto-type CMG has been manufactured and its torque was tested in various conditions. The CMG generated torque equivalent to the designed value, but the generated torque had excess noise due to unbalance of the wheel. It is expected that the noise will be significantly reduced by careful balancing of the wheel. A tip/tilt mirror mount is used as the final stage of star tracking. Frequency response of the tip/tilt mirror mount has been measured. The mount when operated in a closed loop feedback responded to a sinusoidal signal with frequency of more than 50 Hz without serious delay of phase. A star sensor was assembled with a multi-anode photomultiplier tube. It has been confirmed by an experiment with a laser that sensitivity of star position detection changes with defocusing of a star image on the photocathode of the photomultiplier tube. Finally, a commercial black and white video camera has been evaluated by a vacuum test and a thermal test. The video camera functioned normally in the cold and low pressure environment severer than that in the stratosphere.

We will step forward to a production stage of a flight model in 2005, and the first experimental flight is scheduled in 2006.