The First Experiment of Balloon-Borne Telescope System for Optical Remote Sensing of Planetary Atmospheres and Plasmas

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A balloon-borne telescope system has been developed for remote sensing of planetary atmospheres and plasmas from the polar stratosphere. In this system, a Schmidt–Cassegrain telescope with a 300-mm clear aperture is mounted on a gondola whose attitude is controlled by control moment gyros, an active decoupling motor, and a Sun sensor. The gondola can float in the stratosphere for periods in excess of 1 week. A pointing stability of 0.1 arcsec(rms) will be achieved by the cooperative operation of the following three-stage pointing devices: a gondola-attitude control system, two-axis telescope gimbals for coarse guiding, and a tip/tilt mirror mount for guiding error correction. The first target for the system is Venus. Wind vectors in the Venusian upper atmosphere will be derived from the tracking of cloud patterns observed in the ultraviolet and near-infrared regions.

The first experiment of the balloon-borne telescope system was conducted on June 3, 2009 in Taikicho, Hokkaido. The balloon was launched at 4:10 JST and ascended up to an altitude of 13.7 km where the balloon was in a level flight at 5:10. It started rising again at 6:40 and reached an altitude of 32.0 km at 8:05. After a second level flight for three hours the gondola was separated from the balloon and recovered on the sea. The system has been operating perfectly for two hours after launch. During the first level flight attitude control was inactive except for a short period while we tried to capture the Sun. After activation of attitude control oscillation of the azimuthal angle of the Sun was damped at an expected rate and the gondola was stabilized within an rms error of one degree for a several minutes. At two hours after launch telemetry was lost. Presumably hang-up of the onboard CPU occurred. We tried to restart the CPU by commands but it failed. Unfortunately capture of Venus images by the telescope was aborted. After recovery of the gondola the onboard CPU was inspected and a failure of file system was found. The CPU can restart after repair of the crashed file. Though the first experiment was far from success, we have got HK data for two hours and video data throughout the flight. The video data include video signals from the Sun sensor and the star sensor. The former contains information on gondola attitude. Detailed analysis of these experimental data is proceeding.