Development of the Sensor and Optics of the Lightning and Airglow Camera onboard PLANET-C

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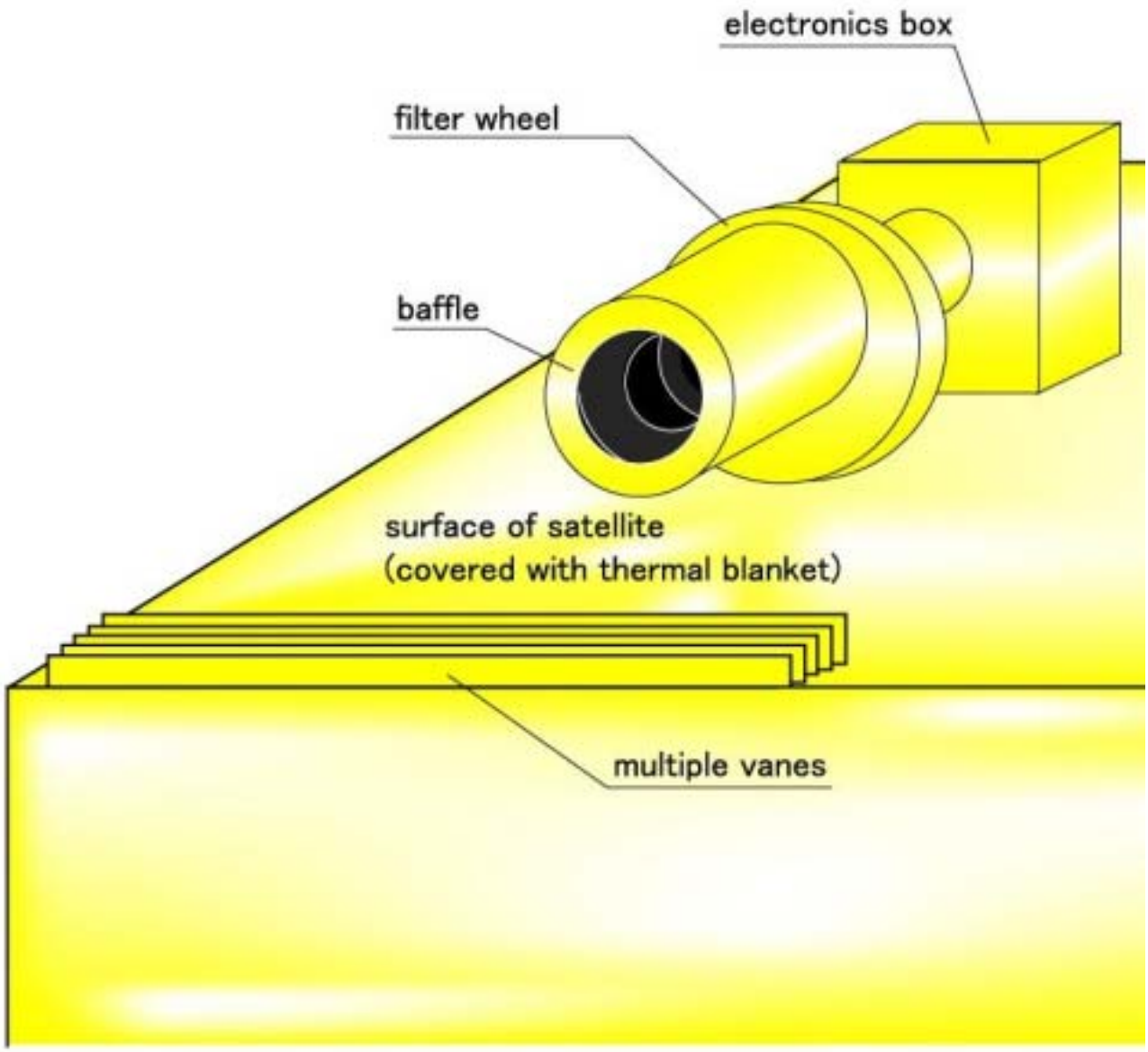
We are developing a lightning and airglow camera (LAC) onboard the Japanese Venus mission PLANET-C. The LAC is a high-speed imaging sensor and measures lightning flashes and airglow emissions on the Venus nightside disk. One of the major targets of LAC is to settle controversy on the lightning of Venus. Further, the LAC observations provide us information for the charging mechanism, charge separation mechanism, physics of sulfuric acid clouds, mesoscale planetary meteorology and impacts on atmospheric chemical processes. If lightning discharges occur in the upwelling cloud layers such as the Earth and Jupiter, LAC enables us to monitor vertical convections in the atmosphere of Venus. Continuous observations of nightglow provide us information on the global circulation in the Venus lower thermosphere. The LAC enables us to measure wave-like structures produced by a dynamical coupling between the lower and upper atmosphere of Venus. Furthermore, we are planning to measure the 558 nm [OI] emission which was recently discovered by a ground-based telescope, but its origin is mysterious.

The LAC has a field of view (FOV) of 12ºin the full angle. A multi-anode photo-multiplier tube (PMT) or an avalanche photo-diode (APD) is adopted as a detector of LAC. Both sensors have 8 by 8 matrix of 2-mm square pixels, out of which 44 pixels converting the circular FOV of LAC. An optics with one lens is adopted for LAC. Interference filters are used for selecting a wavelength of 777 nm [OI] for lightning flash measurement and wavelength of 551 nm [O2] and 558 nm [OI] for nightglow measurement. The bandwidth of the interference filter (FWHM) is 4 nm. Individual lightning flash events are recorded with a 50-kHz pre-trigger sampling, while airglow image is recorded continuously at intervals of 10 seconds. The LAC has a spatial resolution of about 10 km for measurement at 1000 km altitude and 500 km at 3 Rv altitude (Rv: Venus radius).

The goal of the LAC is to measure lightning events with the intensity of 1/100 of standard lightning events on the Earth from 1000 km altitude and to measure 100-R (Rayleigh) airglow with signal to noise ratio (S/N) more than 10.

To realize this goal, we are working on the following three items: (1) selection and examination of sensors which are detectable for weak optical emission, (2) design and development of a high-contrast optics of which reduces stray-light by an order of 1e-10, and (3) design of data acquisition for high-speed pre-trigger sampling. We report the present situation of these.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filter wheel
baffle
surface of satellite
(covered with thermal blanket)
multiple vanes