Development of filter photometers aboard the TARANIS satellite for the sprite and TGF observations

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In the past 20 years, various new phenomena associated with lightning discharges were discovered. One of these phenomena is transient luminous events (TLEs), such as sprites, elves and blue jets. These transient optical flashes are generate by the strong cloud-to-ground discharges whose charge moment or peak current is extremely large. The other is terrestrial gamma-ray flashes (TLFs), which are first discovered by BATSE aboard the CGRO satellite in 1994. The most likely models for the generation of TGFs involve the production of runaway electron beams accelerated in an avalanche process by thundercloud associated with strong electric fields. However, fundamental issues regarding the association of TLEs or lightning with TGFs and the nature of the source of penetrating radiation itself remain a mystery.

In order to study the generation region and mechanism of TGFs and to identify the relationship between TLEs and TGFs, simultaneous space measurements of lightning, TLEs and TGFs are essential. For these purposes a micro satellite mission named TARANIS (Tool for the Analysis of RAdiations from lightNIngs and Sprites) is under way. The scientific payload consists of two cameras, three photometers, one hard X-ray/gamma-ray detector, one energetic electron detector, and electric/magnetic field sensors. The orbit of the satellite will be polar sun-synchronous with an altitude of 700 km, and the local time of ascending node is required to be 22 LT with a slow drift of the order of 2 LT/year. Our group has joined the TARANIS mission as co-investigators, and started development of the photometers. The photometers consist of four channels: one wide-FOV (42.7 deg.) photometer with wideband filter (150-280 nm) named as PH1, two wide-FOV (42.7 deg.) photometers with narrowband filter (337+/-5 nm, 762.5+/-5 nm) named as PH2 and PH3, and one wide-FOV (86.8 deg.) with wideband filter (600-800 nm) named as PH4. As the optical detector of these photometers, metal-package photomultiplier tubes (PMTs) will be used for PH1-PH3. For PH4 a photodiode with 10x10 mm^2 size will be used. As the optics of the photometers, telecentric dioptrics system is adopted.

The dimension (LxDxH) and mass of the photometers is 12x19x14 cm and 1 kg, respectively. We have developed breadboard model last year and started various tests for the performance check. Based on these results, we started designing of the engineering model (EM) of the photometers. At the presentation, we will discuss the results derived from the performance check tests and will present the detailed EM design of the photometers more in detail.