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Lightning and thundercloud observation in Jupiter by spacecraft and telescopes

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Lightning discharge is an excellent tool to explore the planetary atmosphere as well as Earth based on the knowledge of the relationship between the atmospheric dynamics, especially the vertical convection, and electrical charge. It has been suggested for a decade that thunderstorms in Jovian atmosphere take important roles not only in the investigation of meteorology, which determines the large scale structures such as belt/zone and big ovals, but also in probing the water abundance of the deep atmosphere, which is crucial to constrain the behavior of volatiles in early solar system. We plan to make observation of thunderstorm activity based on lightning flash detection and cloud imagery using spacecraft and ground-based telescope. We would propose a very simple high-speed imaging unit onboard Jovian orbiter of EJSM, Optical Lightning Detector, OLD, optimized for detecting optical emissions from lightning discharge in Jupiter. OLD consists of radiation-tolerant CMOS sensors and two H Balmer Alpha line (656.3nm) filters. The different bandwidths of the filters enable us to estimate the depth of discharge. On the other hand, we also consider detecting the optical flashes using a ground-based 1.6 m reflector dedicated to planetary observation, which was installed at Nayoro, Hokkaido, this year by Hokkaido University. Here we introduce strategies to observe lightning optical emissions by this telescope with narrow-band high speed imaging unit. Continuous monitoring with such a ground-based facilities make it possible to compare lightning activity with variations of large-scale motions, leading to the understanding of the dynamics of Jovian atmosphere.

Keywords: Jupiter, thunderstorm, lightning, spacecraft, telescope