Search for lightning discharge in Venus with Akatsuki/LAC and Pirka telescope

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The existence of lightning discharge in Venus has been controversial for three decades, which might be attributed to the luck of conclusive observational evidence. There had been no satellite payload intentionally designed for the detection of lightning phenomena using radio wave or optical sensor. LAC, lightning and airglow camera, on board Akatsuki spacecraft, is the first sensor optimized for the lightning optical flash measurement in planets other than the Earth. It is expected that LAC could conclude this 30-year discussion on the existence of lightning in Venus. Unique performance of LAC compared to other equipment used in the previous exploration of Venus is the high-speed sampling rate at 20 kHz with 32 pixels of Avalanche Photo Diode (APD) matrix, enabling us to distinguish the natural optical lightning flash from other pulsing noises, including artificial electrical noise and cosmic rays. We selected OI 777 nm line for lightning detection, which is expected to be the most prominent emission in CO2-dominant atmosphere based on the laboratory experiments.

The regular operation of LAC for lightning hunt was started on December 1, 2016. Due to the elongated orbit than that planned originally, we have an umbra for approximately 30 min to observe the lightning flash in the night side of Venus every 10 days, which is almost 1/20 rate of the original plan. The triggering parameter was set so as to optimize for the light curve similar to the normal lightning in the Earth and data obtained totally for about 4 hours were examined. However, we couldn't find any lightning signals. Adding to this triggering parameter set, we added one more parameter set, optimized for sprite type emission with duration of up to 10s of ms. These two sets are in rotation at every 60 sec. Furthermore, in order to investigate fainter emissions, we are now conducting successive force triggering recordings without any threshold, achieving 5 times better sensitivity than the intensity of 1 digital unit at best. Here we report the detailed strategy and the latest status of the LAC observation and discuss the possible explanation for the occurrence rate estimated by all LAC observations.

Also we will make ground observation with a high-speed photometer installed at Pirka telescope, a 1.6-m reflector deployed by Hokkaido University. Here we report the outline of the instrumentation and strategy of the observation.