

Hunt for optical lightning flash in Venus using LAC onboard Akatsuki and ground telescope

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There are not a few extensive investigations using data obtained with spacecraft and ground-based telescopes have been carried out in order to get a firm evidence of lightning discharge in Venus, we don't reach consensus on its existence. Indeed there exist some strong indications of electrical discharge both in optical and radio wave measurements. But these "evidences" are sometimes not accepted in the majority of researcher community. LAC on board Akatsuki spacecraft, Venus climate orbiter, is the first sensor optimized for the lightning flash detection in planets other than the Earth so that it can identify the optical flash caused by electrical discharge in the atmosphere of Venus. Unique performance of LAC compared to other equipments used in the previous studies of Venus lightning is the high-speed sampling rate at 30 kHz for all 32 pixels of APD matrix, enabling us to distinguish the optical lightning flash from other pulsing noises. 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 second attempt of the insertion of Akatsuki into the orbit around Venus on December 7, 2015 was quite successful. After checking the sound condition of high-voltage system for the APD detector, the regular operation of LAC at nominal high-voltage of 300 V for lightning hunt was started on December 1, 2016. Due to the elongated orbit than that planned originally, we have an umbra for about 30 min to observe the lightning flash in the night side of Venus every 10 days.

Up to now (February 16, 2017), we have examined 10 times observations with total observation time period of 2h 48m, but couldn't find any lightning signals, though we confirmed the health condition of the sensor looking at the scattered sun light near the limb and pulses caused by cosmic rays. If the spacecraft is located at a distance of 5,500 km from Venus surface, the threshold of triggering is 1/20 of the average of the Earth lightning flash and the instant field-of-view is 1/500 of the whole globe. We plan to continue this regular observation, that is, 30-min waiting every 10 days for several years.

Also we have been trying to detect lightning flash in the night side disk of Venus with ground-based 1.6-m telescope of Hokkaido University. The high sampling rate up to 200 frames/sec with EM-CCD camera realizes the better sensitivity for optical flash than previous study carried out by University of Arizona (Hansell et al., 1995), which reported several lightning flashes.

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