Optical ground-based observation of Venusian lightning in 2015

Masataka Imai[1]; Yukihiro Takahashi[1]; Mitsuteru SATO[2]
[1] Cosmosciences, Hokkaido Univ.; [2] Hokkaido Univ.

Lightning is one of the fundamental atmospheric phenomena and it was produced by strong convective clouds on the Earth. We have known that lightning also exists on the giant planets such as Jupiter and Saturn, and these planets are well known having intense atmospheric convection. Besides with their impacts on chemical reaction, lightning can be an important implications for the atmospheric dynamics.

On Venus, lightning explorations were started in 1970s from several spacecraft such as Venera series and Pioneer Venus Orbiter [e.g. Ksanfomaliti et al., 1979; Taylor et al., 1979], and also previous ground-based observations challenged to detect the lightning flash [e.g. Hansell et al., 1995]. It has been known that this planet has severe environment with high pressure and temperature and fast zonal atmospheric winds named Superrotation. Recently, Japanese Venus exploration AKATUSKI and one of its camera IR2 firstly success to reveal the strong convective cloud formation in the middle layer of Venus. However, Venusian lightning activity has been a mystery over a half century, and we still do not get over the ambiguity of evidential measurements of previous studies.

In these surroundings, a new type of lightning detector, LAC (Lightning and Airglow Camera) onboard AKATSUKI [Takahashi et al., 2008] are ready to start its lightning exploration. We expect that LAC success to detect the lightning flash, and we began to support the LAC observation from ground. 1.6-m optical telescope named Pirka was operated to observe night side of Venus on July, 2015 around the season of inferior conjunction. Using the liquid crystal tunable filter (LCTF: FWHM ˜10 nm) and 777.4 nm strong emission line wavelength, which laboratory experiments suggest, total ˜2 hours sequent images were obtained. Exposure time of each image is 0.035 s and after biasing (subtracting) with the two previous and the two following images are investigated. Considering the point spread function and point fluctuation caused by seeing effect, 3x3 and 5x5 pixels window was adopted to search the strong emission region on Venus night side disk.

As a results, we did not success to find the significant emission region larger than 3 times of background noise standard deviation. Our detection limit is an order of 10^7 J at observation wavelength and it is two or three times better than [Hansel et al., 1995]. Previous observations detected six or seven 10^8–10^9 J magnitude lightning flushes in ˜3 hours, therefore our result shows negative possibility of the existence of lightning. However, it can be considered that the convective activity on Venus has strong temporal variation, and final conclusion will be provided from the LAC observations.