R009-27
B 会場 ：11/7　PM1 （13:45-15:30）
13:45～14:00

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Two-band simultaneous observation for planetary lightning by using the photomultiplier tubes mounted on a ground-based telescope

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The activity and distribution of lightning can be used to understand the mechanism of atmospheric dynamics on the other planets. The moist convection is a source of generating lightning, which is important to transfer the energy in the atmosphere. The spacecraft has detected lightning on Jupiter through night-side optical imaging and radio wave observation. From the existence of cumulonimbus near the observed lightning region, moist convection is expected to be correlated with the jovian lightning distribution, like on Earth. Previous studies (Gierash et al., 2000; Ingersoll et al., 2000) suggested that the many small-scale eddies, receiving their energy from the moist convection, drive the zonal jet. We can obtain information about the convection by monitoring jovian lightning. About Venus, LAC onboard AKATSUKI recorded a possible optical signal from Venusian lightning on March 1, 2020 (Takahashi et al., 2020). If the lightning discharge originates the signal, the occurrence rate is equal to 2.7×10^{-12} $s^{-1}km^{-2}$ estimated by Hansell et al., 1995. If we can monitor global Venusian lightning activity and distribution, it could be helpful to understand the Venusian atmospheric dynamics.

We have developed the Planetary lightning Detector (PLD) to observe the optical Jovian and Venusian lightning flashes and be mounted on a 1.6-m Pirka ground-based telescope. The PLD is a high-speed photon-counting sensor using the photomultiplier tube to obtain the light curve of lightning optical flashes. PLD observes the background level simultaneously with a second photomultiplier tube with a broadband filter to ensure the light detected at the lightning emission line is well over the noise level and background variation. We use a beamsplitter to separate the incident light from the telescope into two photomultiplier tubes. The first photomultiplier tube observes the wavelength of Jovian or Venusian lightning. The PLD has narrowband filters of 777 nm (FWHM = 1nm) for Venusian lightning and 656 nm (FWHM = 1nm) for Jovian lightning (Borucki et al., 1996). The second photomultiplier tube observes the background variation with the broadband filter, 700 nm (FWHM = 10 nm). We have observed Venus and Jupiter since 2021. We analyze the data with wavelet denoising to remove the pulses caused by cosmic rays and shot noise. We compare the light curve obtained by the first PMT and the background variation observed by the second PMT. Suppose the first PMT recorded the waveform showing an increase in value, unlike the second PMT, and the pulses have a larger count value above the trigger level estimated by the background noise amplitude. In that case, the candidate pulses are considered to have been detected. Several possible pulses are found in the case of Venus. We can't rule out the possibility that all recorded light curves originate from noise. We discuss statistically and precisely to conclude the lightning detection.