Observation plan of pulsating aurora by the multi-spectral auroral camera on the LAMP rocket

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We are developing the multi-spectral auroral imager (AIC2) installed on the LAMP rocket. We report the current status of development and future plan of AIC2. Chorus waves generated in the magnetospheric equatorial region are thought to cause the pitch angle scattering of electrons in a wide energy range (several keV –1 MeV or more). Therefore, a correlation between pulsating aurora and microbursts is expected. However, there is no simultaneous observation between them. The LAMP rocket aims to carry out simultaneous observation of pulsating aurora and microbursts with comprehensive instrument of plasma particles, magnetic fields, and optical imaging to reveal the mechanism. This rocket is scheduled to be launched at Poker Flat Research Range in December 2020. The project PI is Dr. Sarah L, Jones of NASA/GSFC, and instruments measuring thermal electrons, low energy electrons, intermediate energy electrons and magnetic field are provided from institutes in US, and the instrumental package called PARM2 (Pulsating AuRora and Microburst 2) is proved by the Japanese team.
AIC2 consists of two CMOS detectors AIC-S1 and S2 and an electrics AIC-E, and will perform simultaneous auroral imaging at two wavelengths. We adopted the consumer CMOS camera ZWO ASI183MM for detector. Compared with the detector of AIC on the Rocksat-XN rocket launched last year, we improved 5 times lower noise (3.6 e-RMS) and 16 times wider dynamic range (12 bit A/D) in sampling at the detector. AIC-S1 targets the E region N2 aurora with an interference filter (Andover, CW 670 nm, FWHM 20 nm) and an objective lens (SpaceCom JF17095M, f = 17 mm, F/0.95, field of view 29 deg x 29 deg). AIC-S2 is designed for F-regin O 844.6 nm aurora with an interference filter (Andover, CW 846.1 nm, FWHM 4.4 nm) and an objective lens (SpaceCom HF3.5M-2, f = 3.5mm, F/1.6, field of view 106 deg x 106 deg). To gain S/N and reduce data size, binning is performed for original 3660 pix x 3600 pix image, and a 60 bin x 60 bin image is produced for each frame. AIC2 is mounted on a despun platform to cancel a rocket spin. Combining the despun platform with rocket attitude control, AIC-S1 will point to the magnetic footprint to perform simultaneous observation between fine structure of pulsating aurora and precipitating electrons. AIC-S2 will point west and cover the wide area from the rim of the earth to nadir, and obtain the height profile of O 844.6 nm emission as well as the pulsating auroral distribution in the wide range. The time resolution is 10 frame/s. At the apex altitude (˜ 450km), the spatial resolution at nadir is 3.0 km x 3.0 km for AIC-S1 (E-region), and 6.3 km x 6.3 km for AIC-S2 (F-region). The AIC-E consists of two NanoPi M4 board computers, custom FPGA, power supply, and signal processing electronics to handle a large amount of image data generated from two cameras. We also newly developed a heat pipe to cool the heat generated at two CPUs of NanoPi M4.
On the development of AIC2, we carried out the electrical interface test between AIC-S1, S2 and AIC-E from September 2019 to this February, and confirmed the data acquisition with 10 frame/s, image binning and data communication. We also made the calibration test with the integrated sphere in NIPR in June and August 2019, and estimated the dynamic ranges of AIC-S1 and S2 to be 0.27-3100 kR and 2.2-27000 kR, with the resolutions of 48 R/bit and 410 R/bit, respectively, in the case with a gain of 450. In addition, we conducted a data communication test using a despun table with slip ling connector that is almost similar to the flight model in March 2019. We confirmed that that the data communication via the

slip ring works as expected if we use a differential signal interface, and shielded and twist-pair cables. By July 2020, we will perform environmental tests, such as vacuum, temperature and vibration tests, in Japan, and interface test with the flight model despun table is planned at the University of New Hampshire.

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