PARM: Initial result of the auroral camera on the G-CHASER (RockSat-XN) rocket and status of the development of auroral cameras for the LAMP rocket experiment

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We developed an Aurora Imaging Camera (AIC) for NASA’ s G-CHASER (RockSat-XN) sounding rocket launched on 13th January, 2019. In addition, LAMP sounding rocket scheduled to be launched from December 2019 to February 2020 to reveal the spatio-temporal relationship between PsA and relativistic electrons, namely microbursts. In this presentation, we report the development of AIC, the result f the G-CHASER (RockSat-XN) rocket, as well as the current status of LAMP rocket project.

On the G-CHASER rocket experiment, 7 scientific and educational instruments were provided from Japan, U.S., Norway and Puerto Rico. Japanese instrument, called PARM, consists of an intermediate energy (20 - 100 keV) electron detector MED, high energy (several hundred keV - 2 MeV) electron detector HEP, fluxgate magnetometer AFG, and auroral camera AIC. Concerning development of AIC, we carried out sensitivity calibration experiment, electrical function test, fabrications, focus adjustment and environmental (vibration, vacuum and thermal) tests from January to July 2018. AIC consists of detector unit AIC-S and power/data processing electric unit AIC-E. AIC-S consists of a CCD camera (Watec 910 HX), wide-angle lens (F-number: 1.6, focal length: 3.5 mm, field of view: 96.4˚x75˚) and a glass filter (RG665) that transmits light with a wavelength longer than 665 nm.

NASA decided to launch the G-CHASER rocket at 9:00UT on 13rd January 2019 from Andoya Space Center, Norway (69.3˚N, 16.0˚E in the geographic coordinate). At this time, the solar elevation was -4˚, hence twilight had been already started and the region above 15km was sunlit. AIC detected leak light from the rocket skirt until the separation of skirt at an altitude of 82.9km. From time variation of AIC data, rocket spin frequencies were estimated to be ~5Hz at ~20km altitude and ~1Hz at ~80km altitude. This is consistent with the modulation period of magnetic field data observed by AFG. Because AIC was designed to measure weak pulsating aurora with hundreds Rayleigh, the AIC data was saturated above 82.9km after separation of rocket in the sunlit region, and no aurora was observed.

We are also conducting the LAMP sounding rocket project whose PI is Dr. Sarah Jones in NASA/GSFC. This is scheduled to be launched at Poker Flat Research Range in Alaska in 2019 winter. Japanese PARM2 team will provide high energy (several hundred keV - 2 MeV) electron detector HEP, fluxgate magnetometer MIM, and auroral cameras AIC2. We concern AIC2 that consists of two cameras AIC2-S1/AIC2-S2 and power/data processing electric unit AIC2-E. AIC2-S1/S2 and AIC2-E will be installed on a despun platform to derotate rocket spin. AIC2-S1 measures N2 1stPG emission with a narrow FOV lens (F value: 0.95, focal length:17mm, field of view 27x27deg), and AIC-S2 measures OI 844.6nm emission with a wide-angle lens (F value:1.6, focal length:3.5 mm, diagonal field of view:120x120˚). AIC2-S1 will take fine structure of PsA in the region more than 100 x 100 km area around the magnetic footprint with a few kilometer resolution, while AIC2-S2 will obtain an altitude distribution of

PsA in the F-region as well as wide-range distribution of PsA. The characteristic energy of precipitating electron can be estimated from the ration of OI844.6 and N2 1stPG. The cameras are conducted by a single board computer NanoPi M4 via USB3.0 high speed interface. We confirmed to get frame sampling rate with approximately 10Hz with this system. Region-of-interest (ROI) of 3660 x 3660 pixel area is binned with 61x61pixels, and finally image data with 60 x 60 bin (16 bit/bin) is recorded at 10 Hz. The precise imaging and altitude distribution of PsA are obtained with AIC2 at two wavelengths with 10Hz sampling. The imaging data combined with precipitating electron data in the wide energy range enable us to investigate the relativistic electron precipitation in microbursts that is probably caused by chorus waves in the magnetosphere.

Keywords: auroral camera, rocket experiment

