Introduction to the formation flying SNIPE mission

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The four 6U CubeSats (~ 10 kg) will be launched into a polar orbit at an altitude of ~500 km by Soyuz-2 at Baikonur Cosmodrome in early 2022. The SNIPE (Small scale magnetospheric and Ionospheric Plasma Experiment) mission is equipped with identical scientific instruments, solid-state telescopes, magnetometers, and Langmuir probes with a high temporal resolution (sampling rates of about 10 Hz). Iridium communication modules provide an opportunity to upload emergency commands to change operational modes when geomagnetic storms occur.

The distances of each satellite will be controlled from 10 km to more than ~ 100 km by the formation flying algorithm. During the 5-day Launch and Early Orbit Phase (LEOP), SNIPE will undergo separation, stabilization, sun acquisition, and on-orbit checkout. The thrusters will be calibrated and the payload checked during the 25-day In-Orbit Testing (IOT) phase. Yonsei University will plan formation flying during the Science Mission Phases (SMP). During SMP-1, the along-track configuration will steadily diminish over three months from an array of spanning ~2000 km to one spanning 10 km. During SMP-2, cross-track separation distances will steadily increase over 3 months until the array spans 400 km. During the extended mission, expected to last at least 6 months, no control will be exercised over the evolving orbits. Science operations will continue until the spacecraft cease to operate.

The SNIPE's scientific goal is to observe spatial and temporal variations of the micro-scale plasma structures on the topside ionosphere. For example, polar cap patches, field-aligned currents (FAC), radiation belt microbursts [1][2], and equatorial and mid-latitude plasma blobs and bubbles are the main observation target of the SNIPE mission. Especially in this presentation, we talk to focus on the electron microburst phenomena, which is electron precipitation having a short duration. We expect the formation flying SNIPE mission to reveal the evidence of wave and particle interactions by observing energy dispersion, spatial scale, and special energy spectra.

Measurements of the dimensions, occurrence rates, amplitudes, and spatiotemporal evolution of such small-scale plasma structures will determine their significance to the solar wind-magnetosphere-ionosphere interaction and quantify their impact on space weather. The data will be released to science community after verification.

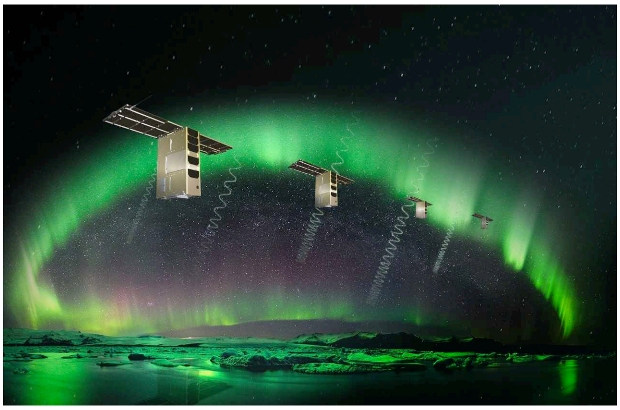

Figure 1. Artistic image of the SNIPE mission observing electron microbursts over the polar region

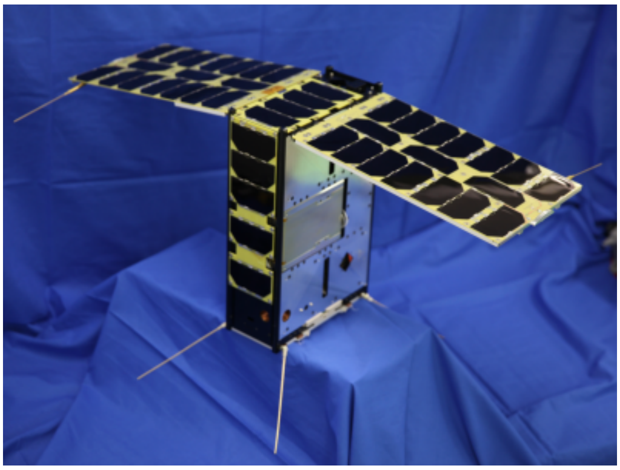

Figure 2. Engineering Model of 6U CubeSat, SNIPE mission

References

[1] Lee et al., (2015) Short-duration Electron Precipitation Studied by Test Particle Simulation, JASS, 32, 317-325
[2] Lee et al., (2012) Anisotropic pitch angle distribution of similar to 100 keV microburst electrons in the loss cone: measurements from STSAT-1, Annales Geophysicae, 30, 1567-1673