A Future Formation Flight Mission Using Multiple Compact Satellites for the Terrestrial Ionospheric/Thermospheric Observations

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We are now discussing a future exploration mission by using multiple compact satellites for changeable formation flights in order to elucidate the elementary physical processes and mechanisms causing a variety of polar ionospheric phenomena like auroras. We also consider that this future mission should contribute to the low/mid latitude ionospheric and thermospheric researches through the in-situ observations as well as the prevailing ground-based observations because the electric/magnetic field and electron density/temperature measurements have to be involved in the upper atmospheric explorations both at the polar and the mid/low latitudes. The in-situ observations for the density, wind velocity, and temperature measurements of the upper atomspheric neutral particles would be preferable for these ionospheric/thermospheric observations.

For more detailed definitions of the scientific mission strategy and the specifications of the science instruments in this future mission, we would like to initiate the discussion based on the following preliminary properties. 1: Changeable formation flight function with multiple compact satellites, which are slightly larger/heavier than usual micro satellites, is appropriate for simultaneous multipoint observations of fine-scale auroral phenomena. 2: The precise three axial attitude control system should be applied for realizing the high-quality 2-D imaging of auroral emissions and the simultaneous measurements of the pitch-angle distributions of the auroral particles with top-hat type energy analyzers. 3: It is also preferable to capture the ram direction of the satellite by the accurate attitude control in order to measure the shifted velocity distributions of the core ions and possibly the neutral particles. 4: The three axial electric/magnetic field measurements are quite important for the estimations of the plasma convection, the field-aligned currents, and the poynting energy flux. 5: The sun-synchronous orbit at relatively low altitudes would be desirable both for keeping the observational advantages and meeting the requirements described above.

The discussion and proposal of the future mission are based on successful achievements of the recent exploration mission using the Reimei satellite launched in August, 2005, which is the first genuine microsatellite for the solar-terrestrial physics in Japan, especially the exploration of the fine-scale auroral dynamics. Reimei has been providing the researchers analyzing not only in-situ observational data but ground-based data with the cutting-edge measurement results, and this successful satellite mission should be considered to lead to several interesting proposals for new exploration missions in the world. We are also planning to make a highly plausible proposal on the basis of our own expertizes obtained in the Reimei mission although there are many restrictions in the new exploration missions of STP, e.g., financial budget, available satellite platform system limiting weight/size/power of desired science instruments, the launch method/opportunity. It is, however, undoubtable that highly accurate measurements of magnetic/electric fields and plasma waves should be applied in the future compact satellite missions, as well as the monochromatic auroral imaging camera with high-time/spatial resolutions and the auroral electron/ion energy analyzers with a high-time resolution. Suprathermal ion mass spectrometer and thermal plasma instrument are also necessary in the viewpoints of the observations indicating the preferential acceleration/heating and the outflows of the ionospheric ions. In addition, our instrument team has been developing the neutral particle analyzer called ANA(Atmospheric Neutral Analyzer) which could be carried on the future compact satellites.

In this talk, we present our mission plan and discuss the expected observational subjects in the upper atmosphere at the polar and mid/low latitudes.