Atmospheric neutral analyzer for mass and velocity measurements: design and laboratory test of mass analyzer

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In order to understand the variability of the ionosphere-thermosphere system, in-situ measurements of the composition and density of the neutral atmosphere and the detailed velocity distribution of individual species are required. However, most conventional types of instruments for neutral atmosphere lack the simultaneous capability of measuring neutral atmospheric velocity and resolving neutral mass.

We are developing the Atmospheric Neutral Analyzer (ANA) instrument to measure neutral composition and velocity distribution simultaneously in the thermosphere. It is designed to measure the detailed, mass-resolved two-dimensional velocity distribution of thermospheric neutral species, and to derive the corresponding density, mass composition, velocity and temperature from the measured distribution. ANA consists of an entrance collimator with an electron gun, which ionizes neutral particles, a Radio-Frequency (RF) ion mass analyzer, and a two-dimensional position sensitive MCP detector. The detailed design of ANA was determined by numerical calculations and the performance was estimated. The dimension of ANA without electronics is expected to be 100 x 120 x 170 mm. The mass resolution is 10%, and the measurement range and error of temperature are 500+/-35 K to 2000+/-100 K. The measurement error of wind velocity is found to be +/-35 m/s when the temperature is 500 K and +/-150 m/s when that is 2000 K. As the next step, we have made a prototype of the RF ion mass analyzer and started laboratory experiments using a suprathermal-energy ion beam line, which is currently under development in our laboratory. The detailed information on the beam line will be presented by Ito et al.

In this presentation, we will show preliminary results of laboratory experiments as well as the detailed design of the instrument. A future exploration mission and scientific targets regarding ANA will be mentioned in the talk presented by Hirahara et al. in this meeting.