

Development of the beamline monitoring system for calibration of particle analyzers in the future space explorations

*Ohkawa Yutaka¹, Masafumi Hirahara¹

1. Institute for Space-Earth Environmental Research, Nagoya University

In the space explorations, particularly observations of the upper atmosphere of the Earth, technologies related to particle analyzers are very important in order to carry out quantitative in-situ observations of space plasmas and neutral particles. As one of the systems necessary for the developments of those particle analyzers, a beamline calibration system is crucial for performing the calibrations of the particle analyzers by emitting electron or ion beams simulating the space and upper atmospheric particles in the vacuum chamber. The characteristics of the beamline system affect the calibration results of the particle analyzers so that the homogeneities of the two-dimensional (2D) cross sections and energy/angular distributions of the beam fluxes are very important in the developments of the particle analyzers.

Since we are constructing the beamline calibration systems in our institute of Nagoya University, we should also develop a beamline monitoring system as an important subsystem in the beamline calibration system in order to obtain the various data of the beamline characteristics. Our beamline monitoring system consists of two components: one is for monitoring the 2D cross sections and another for monitoring the energy/angular distributions.

The component monitoring the 2D cross sections of the beam fluxes is almost completed by combining horizontal and vertical linear motion stages and a multi-anode Micro Channel Plate assembly (MCP), and we also have been developing a C#-language program package that controls two linear stages, obtains count data from MCP, compensates time variations of the beam fluxes, and finally displays contour maps of the 2D cross sections of the beam fluxes. The component monitoring the energy/angular distributions consists of azimuthal/elevational turntables and a compact cylindrical electrostatic analyzer with a pin hole and a single-anode MCP, and we have nearly built a program using LabVIEW, which controls the turntables and the voltages applied to the electrostatic analyzer, adjusts the parameters of the beamline, and obtains count data from MCP. The comparisons between SIMION simulation results on the electrostatic analyzer and experimental results using the energetic ion beams with energies of 3 to 10keV have verified the validity of the energy/angular distribution monitoring system. The control of these devices and data processing could be done by a single laptop Windows computer. In this presentation, we will give the overview of our beamline monitoring system and discuss the data showing the beamline characteristics in order to consider the application toward future developments of the particle analyzers.

Keywords: Beamline, Particle analyzer, Space explorations