衛星搭載機器開発に向けた較正設備のための粒子ビームモニタリングシステムの開発

大川 裕貴 [1]; 武井 智美 [2]; 平原 聖文 [3]
[1] 名大・理・素粒子宇宙; [2] 名大・理・素粒子宇宙; [3] 名大・宇地研

Monitoring systems for characterizing charged-particle beams in the calibration facilities for space-borne instruments

Yutaka Ohkawa[1]; Tomomi Takei[2]; Masafumi Hirahara[3]
[1] Particle and Astrophysical Science, Naioya Univ.; [2] Division of Particle and Astrophysics,Nagoya Univ.; [3] ISEE, Nagoya Univ.

For the space explorations, particularly the in-situ observations of the planetary space and upper atmospheres of the Earth and planets, technologies related to particle instruments are very important in order to carry out quantitative in-situ measurements of space plasmas and atmospheric neutral particles. As one of the experimental facilities necessary for the developments of these particle instruments, advanced beamline calibration facilities are crucial for performing the calibrations of the particle instruments by emitting electron or ion beams simulating the space and upper atmospheric particles in vacuum chambers. The characteristics of the beamline facilities largely affect the calibration results of the particle instruments so that the homogeneities of the two-dimensional (2D) distributions of cross sections and the energy and angular dispersions of the beam fluxes are very important in the developments of the particle instruments. However, these characteristics of the beamlines have not been investigated in quantitatively and routinely so far.

Since we are constructing the beamline calibration facilities in our institute of Nagoya University, we should also develop a beamline monitoring system as an important component of our facilities in order to systematically obtain various types of data regarding the beamline characteristics. Our beamline monitoring system consists of two subsystems: one is for monitoring the 2D cross sections of the beam fluxes and another for measuring the energy and angular dispersions according to horizontal displacement. The subsystem 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 have already developed a C#-language program package that controls the instruments, obtains count data from the MCP, compensates time variations of the beam fluxes, and finally displays contour maps of the 2D cross sections of the beam fluxes. In addition, this subsystem can carry out the 2D monitoring measurements in response to various circumstances for calibrating particle instruments.

On the other hand, the subsystem monitoring the energy and angular dispersions is now under development, which can measure spatial dependences of energy and angular dispersions on the horizontal displacement. This monitoring system consists of two axial turntables, a linear motion stage, a compact cylindrical electrostatic analyzer with a pin hole and a single-anode MCP. We have almost built a program using LabVIEW, which controls the turntables and the linear stage, sweeps the voltages applied to the electrostatic analyzer, adjusts the parameters of the beamline, and obtains count data from the MCP. The comparisons between SIMION∗1 simulation results on the electrostatic analyzer and experimental results using the energetic ion beams with energies of 3 to 6keV have verified the properties of the energy and angular dispersions of the beams.

In this presentation, we will give the overview of our beamline monitoring systems and discuss the data showing the beamline characteristics in order to consider the application toward future developments of the particle instruments.

∗1 : Ion and Electron Optics Simulator program