Calibration experiment of an ion mass spectrometer & transmission properties of ions through ultra-thin carbon foil

Shoichiro Yokata[1], Yoshifumi Saito[1], Kazushi Asamura[1], Yoichi Kazama[1], Toshifumi Mukai[1]

[1] ISAS

We will report the calibration experiment of the ion mass spectrometer for lunar plasma observation. The ion mass spectrometer employs the LEF TOF method in order to achieve the considerably high mass resolution because there are various and heavy ions around the Moon. We used specific electric field (LEF) which increases linearly with respect to the distance along an axis. We experimentally calibrated the characteristics of the analyzer. The TOF profiles of various ion species were obtained and were compared with the calculated TOF profiles. We used two kinds of the ultra-thin carbon foil which are 1.2 ug/cm2 and 0.5 ug/cm2. We also report the transmission properties of ions through the ultra-thin carbon foil.

Combined with the ion energy spectrometer, the newly developed ion mass spectrometer on board the SELENE satellite which will be launched in 2004 and will be put into the lunar orbit, will measure the 3-D distribution function of mass-discriminated ions around the Moon. The observation objectives are the investigation of the desorption and transport mechanism of the lunar atmosphere, the examination of the interaction between the solar wind and the lunar surface, and so on. We will report the calibration experiment of the ion mass spectrometer.

The ion mass spectrometer employs the Linear Electric Field(LEF) Time-Of-Flight(TOF) method in order to achieve the considerably high mass resolution because there are various and heavy ions around the Moon. The mass resolution of the TOF method is limited by the energy degradation and the angular scattering caused by the passage of the incident ions through the ultra-thin carbon foil. We resolved this problem by using specific electric field (LEF) which increases linearly with respect to the distance along an axis. Since the equation of motion for charged particles in LEF is an equation of a simple harmonic oscillator, the bounce time of the particles from entering to exiting the LEF region is one half of the oscillation period. This bounce time is independent of the dispersion of energy and angle caused by the passage of the incident ions through the carbon foil. Therefore, high mass resolution can be expected.

We fabricated a test-model of the ion mass spectrometer and experimentally calibrated its characteristics. The TOF profiles of various ion species were obtained and were compared with the calculated TOF profiles. We used two kinds of the ultra-thin carbon foil which are 1.2 ug/cm2 and 0.5 ug/cm2. We also report the transmission properties of ions through the ultra-thin carbon foil obtained from the TOF profiles of neutrals.