

## Spaceborne multi-turn time-of-flight mass spectrometer for isotope analysis

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In situ low-energy ion measurement in terrestrial or planetary plasma environment has been done with a variety of ion analyzers. Detailed studies of plasma characteristics demand not only energy analysis but also mass analysis. When measuring a variety of ions originating from planetary atmospheres, we need to be able to measure the ion composition with high mass resolution. As we achieve the measurements of the ion composition by mass analyzers around planetary environment, higher mass resolution is needed in order to distinguish heavy species and isotopes. For the future isotope measurements around moons, planets and asteroids, we are developing a high-mass-resolution mass analyzer. One of our scientific objects is to measure the Martian atmospheric escape and evolution. Although mass resolution ( $m/dm$ ) of 100 is generally needed for the isotope analysis of planetary particles, the Martian atmospheric escape and evolution science requires  $m/dm > 3,000$  to discriminate  $N_2$  from  $CO$ .

ISAS particle measurement group has developed a time-of-flight(TOF) ion mass analyzer with mass resolution of about 20 for KAGUYA, which succeeded in measuring ions originating from the lunar exosphere and surface. It is also preparing a TOF mass analyzer with mass resolution of 40 for the BepiColombo mission. Multi-turn TOF mass spectrometers(MULTUM), where ions are stored in a fixed orbit within electrostatic sectors and allowed to propagate the same orbit numerous times, have been developed by Osaka Univ. mass spectrometry group. One of the MULTUM series achieves the mass resolution over 30000 with the size of 20cm x 20cm. Our isotope analyzer in development for the future planetary mission employs the MULTUM system. We will show the spaceborne MULTUM analyzer and report the development schedule.

Keywords: mass analysis, isotope analysis, MULTUM