

Panoramic imaging mass-spectrometer for planetary studies

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Plasma diagnostics can provide extremely useful information for solar system studies. Neutral and ion sputtering from the surface leads to the formation of neutral and ion exospheres with compositions that reflect the surface composition modified by ionization and transport processes around the body. Measurements of ion composition and velocity distributions provide important information about surface composition and its recycling. Plasma measurements from low altitude spacecraft and landers on planetary bodies without atmospheres can be used to map the surface composition, while spectrometers onboard spacecraft orbiting planets with atmosphere are used for study of planetary losses, mass-exchange with the solar wind, and the long-term evolution of their environment.

To perform reliable measurements of planetary plasmas a complete 3-dimensional velocity distributions of various ion species is necessary. In addition, if fast measurements of the major ion species are the main goal of plasma physics studies, precise measurements of the minor ion composition are often essential to unveil important properties of the atmosphere or the surface. Therefore ion mass spectrometers for solar system missions require both the capability of making fast measurements of the 3D-velocity distribution of ions and high mass resolution for detailed composition studies.

We describe a novel type of miniature panoramic ion mass-spectrometer suitable for making such 3-dimensional measurements of ion components with high mass resolution. The feeding electron optics of our plasma analyzer (CAMERA) allows for fast measurements within an instantaneous 2π field of view, which has no gaps and can be accomplished on either stabilized or rotating spacecraft, or landers. It is followed by a time-of-flight mass-spectrometer that retains imaging capabilities of the feeding optics and provides mass-resolution $M/\Delta M$ in excess of 100. Our spectrometer also provides flexible control of the energy bandwidth, mass and angular resolution, as well as high

temporal resolution and UV rejection. This type of instrument is under development for BepiColombo and Phobos-Grunt missions.

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