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EUV spectroscopic observation of Io plasma torus using UVIS onboard Cassini spacecraft

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Almost all stars and planets emit lights in various wavelengths through resonance scattering, electron impacted excitation, charge exchange reaction, black body radiation, and so on. These emissions bring us various types of information about these celestial objects. For example, the temperature of the star, and the composition of a planetary atmosphere can be deduced.
Among these lights, the EUV (Extreme Ultra Violet: 50 - 150 nm) lights are particularly useful for planetary science. The greatest strength of EUV is the existence of vast amounts of emission lines from atoms and ions. These lights are emitted through the resonance scattering of solar lights or collisional excitation between the ambient electrons. The brightness depends not only on the density of those atoms or ions, but also on the conditions of the excitation sources, electrons. In other words, by analyzing the EUV spectra from the targets, the condition of solar light or ambient electrons can be deduced. This method is so called, spectral diagnosis.
In this study, the spectral diagnosis method is used for the observation of the Io plasma torus where the sulfur and oxygen ions are emitting EUV lights mainly through electron impacted excitation. The Io torus is located in the inner magnetosphere of Jupiter (5.91 Jovian radii; RJ = 71 500 km) where the strong planetary magnetic field is dominant. The torus emissions are able to be used as probes of the plasma parameters around there.
The EUV spectra acquired by Cassini spacecraft during its flyby of Jupiter on the way to Saturn are analyzed. Through the spectral diagnosis method, the electron density (NE), core electron temperature (TC), hot (350 eV) electron fraction (FH), and ion composition ratios are derived as follows; NE ~2500 cm-3, TC ~4 eV, FH ~3 %, [O+]/[S2+] ~1.2, [S+]/[S2+] ~0.35, and [S3+]/[S2+] ~0.15. These results are consistent with that of in situ measurements of Voyager-1 and Galileo spacecraft.
The generation processes of the hot electron component are discussed. According to the relationship between Io phase angle and the derived torus parameters, the acceleration along the field line from Io to Jupiter found to be not the main source process. The response to the variability of Jovian aurora which is related to the plasmas around the middle magnetosphere (10 - 40 RJ) are also analyzed, and are found to have no clear relationship. These results suggest that there is another dominant source process of the hot electrons or a response faster than 10 hours, which is the accumulation time of the analyzed spectra.

Keywords: Jupiter, Io torus, EUV, Spectral, Cassini, Inner magnetosphere