

Comprehensive Mapping and Statistical Analysis of Energetic Ion Distributions in Jupiter's Magnetosphere Using Juno/JEDI Data

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Jupiter's magnetosphere is the largest and most energetic planetary magnetosphere in our solar system. Although charged particles reaching MeV energies are observed in other magnetospheres as well, Jupiter is distinguished by the presence of ion populations that are accelerated to tens of keV up to several MeV and even higher energies throughout its vast magnetosphere. In this study, we present a comprehensive investigation of Jupiter's multispecies energetic ion environment using data from Juno's Jupiter Energetic particle Detector Instrument (JEDI). Specifically, we use data from the JEDI-090 and JEDI-270 sensors, which provide measurements of the energy, angular, and compositional ion distributions of hydrogen (~ 50 keV to ~ 1 MeV), oxygen (~ 170 keV to ~ 2 MeV) and sulfur (~ 170 keV to ~ 4 MeV). In this survey, we present comprehensive ion maps derived from the entire Juno prime mission (orbits 1 to 34) and spanning all available energy channels from when the spacecraft explored the dawn to pre-midnight sector of Jupiter's magnetosphere. These maps reveal the spatial and energetic distributions of hydrogen, oxygen, and sulfur ions, providing insights into the global magnetodisk structure, and ion distributions in both equatorial and off-equatorial regions. We also calculate the H/O and H/S ion composition ratios, as well as assess ion flux spectral characteristics using spectral indices and intensity factors derived from analytical fits. These provide new insights into the Jovian plasma environment, the ion spectral characteristics and the relationships between these populations. Characterizing the energetic ion distributions both near the Galilean moons and at higher magnetic latitudes will also provide useful context for the particle environment encountered by the upcoming JUICE mission.