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A 4D Model of the Io Plasma Torus using Diffusive Equilibrium
PARKER HINTON, Univ of Colorado - Boulder, FRAN BAGENAL, KALEB BODISCH, LASP — Jupiter's moon Io volcanically outgasses roughly 1000kg/s of neutral atoms that, through various physical mechanisms, end up as plasma in Jupiter's magnetosphere. This plasma then becomes distributed along magnetic field lines according to diffusive equilibrium and assumes an overall toroidal structure with a few distinct sections. These sections include the cold inner torus (disk), a portion between the disk and the orbit of Io (duct or sometimes called the ribbon), and the remaining warmer outer torus (donut). The disk exists from approximately 4-5.6 RJ, the duct exists from 5.6-6 RJ, and the donut portion extends from 6-10 RJ, where RJ is the radius of Jupiter (1 RJ = 71,492 km). We seek to reproduce these three features in our 4D model, adding time (duration) as the last dimension. Current modeling efforts involve using a simple tilted dipole magnetic field model. This simple model effectively reproduces the bulk of the toroid – the warmer outer donut. We experiment with other magnetic field models such as VIP4 in order to best match observations and improve the accuracy of our model. We further apply techniques of physical chemistry and ground based observations to develop understanding of the cold inner torus and to aid our modeling efforts. Our model includes various parameters that can be adjusted in order to gain further insight into the plasma torus. Such parameters include ion and electron temperatures, densities, and distributions, as well as the magnetic field model.

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