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Comparing energetic particle loss processes in the magnetospheres of Jupiter and Saturn using Energetic Neutral Atom (ENA) remote sensing

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The dedicated Energetic Neutral Atom (ENA) imager on the Cassini spacecraft provided indispensable measurements of magnetospheric processes at Saturn. At Jupiter, Cassini provided only a few serendipitous ENA images as the spacecraft flew by Jupiter at large radial distances. The Juno spacecraft, now in a polar orbit around Jupiter, carries no ENA camera, but the energetic particle JEDI instrument is sensitive to ENA's with energies > 50 keV, provided there are few charged particles in the environment to mask their presence. Even with limited ENA capabilities, the Juno mission has revealed important differences between Saturn and Jupiter with regard to how charged ions are lost from these magnetospheric systems. Specifically, a major contribution to ENA emissions at Jupiter come from Jupiter's polar atmosphere. These ENAs likely arise from energetic ions that nearly precipitate in the auroral zone, only to mirror magnetically within the atmosphere where they charge exchange with atoms in Jupiter's upper atmosphere. Cassini did not observe this precipitating component at Saturn despite the abundance of quality ENA measurements obtained there. We conclude that ion precipitation into Jupiter's atmosphere is competitive with other loss processes. In contrast, in the Saturn system, it is likely that losses associated with the dense neutral gas populations near the equator dominate the loss of energetic particles.