Acceleration of Multi MeV Particles on Open Field Lines as Observed From Juno

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Abstract

The Advanced Stellar Compass (ASC), attitude reference for the MAG investigation onboard Juno, has continuously monitored high energy particles fluxes in Jupiter's magnetosphere since Juno's orbit insertion on July 4, 2016. The particles are measured and characterized in the attitude determination process, requiring removal of signatures from particles with sufficient energy to penetrate the heavily shielded focal plane CCD. Particles with energy >15MeV for electrons, >80MeV for protons, and >~GeV for heavier elements are thus measured at a rate of 4 samples/s. The ASC's highly optimized radiation shield design affords a directional sensitivity, because of the less efficient shielding encountered by particles entering via the optics aperture. This directionality offers preferential detection to electrons with energies between 15 and 25MeV and protons with energies between 80 and 100MeV (i.e operates as a particle telescope), whereas particles with energies above these limits may penetrate from any direction. The part particle flux exhibiting variation with the spin phase of the Juno spacecraft, rotating at 2 RPM, thus have energies in the band mentioned, and velocities pointing to the lens. Juno traverses a section of the north and south polar caps with every periJove, and now, past the midpoint of nominal mission, a detailed mapping of high energetic particles in the aurora regions is obtained. One surprising feature is that very intense beams of particles are regularly measured at field lines reaching well beyond L=50, i.e. on distant closed or open field lines. Such features vary rapidly, signifying either a very limited extent, or, high time variability. In the cases where these beams contain particles with Energies in the directional sensitive range of the ASC, the source of the beam is from the aurora region, suggesting a polar cap mechanism, capable of accelerating a particle directly to 20MeV. We present examples of flux profiles on open field lines, and discuss, using their high variability and directionality, potential source regions.

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