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Evidence for an internal acceleration of relativistic electrons in the Jovian radiation belts.

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Abstract

Jupiter's inner radiation belts contain ultra-relativistic electrons with magnetic moments above 100 MeV/G, capable of emitting intense synchrotron radiation. Earlier modeling suggested that the origin of these electrons was betatron acceleration associated with inward radial diffusion from the outer magnetosphere. Inward radial diffusion requires a positive radial gradient in electron phase space density. However, measurements of the electron phase space density from JUNO indicate a pronounced peak in electron phase space density in the middle magnetosphere, indicative of an internal acceleration source inside 20-30 RJ. Similar internal peaks in electron phase space density have previously been discovered in the Earth's radiation belts, and attributed to local stochastic acceleration by whistler-mode plasma waves. The precise acceleration process at Jupiter is currently unknown, but the presence of persistent internal peaks in phase space density suggests that a similar internal acceleration process is operative.

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