National Aeronautics and Space Administration

INVESTIGATION OF THE JOVIAN RADIATION BELTS USING JADE'S BACKGROUND NOISE

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OBJECTIVE

The objective is (1)to utilize the background anode data from the Jovian Auroral Distributions Experiment (JADE) on Juno to study the dynamics of energetic electrons in the polar regions of the Jovian magnetosphere and (2) update the JPL standard Jovian radiation model, GIRE3.

SCOPE

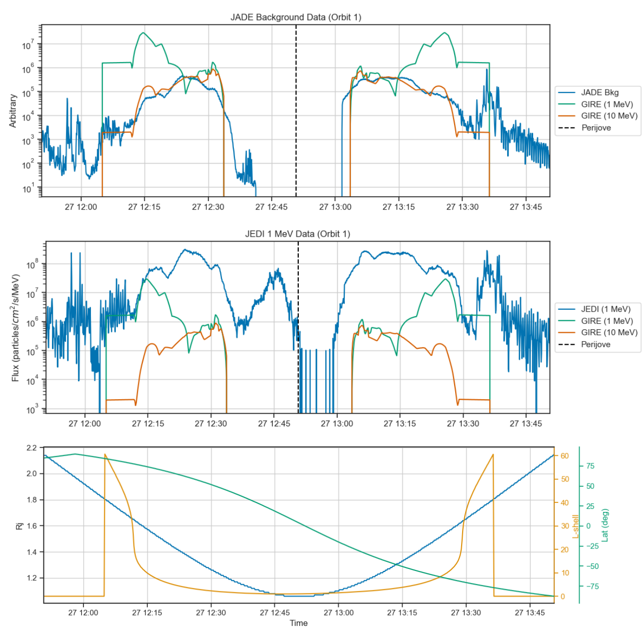
- Analyze JADE instrument and background noise signal over multiple orbits
- Analyze JEDI's data to estimate Jupiter's radiation spectra
- Compare JEDI data and JADE background with Jupiter radiation model output
- Identify orbits for additional study

Galileo Interim Radiation Electron (GIRE3) Model

- JPL standard radiation model at Jupiter being used for mission planning and radiation design for all Jovian missions.
- Based mainly on Galileo Energetic Particle Detector (EPD) augmented by the data from Pioneer and Voyager flybys at Jupiter

Juno Orbit 1 Results

- We compared the results of the JADE background data, JEDI 1 MeV data, and the GIRE model for the first orbit of Juno.
- The JADE background data are counts per second normalized to the 10 MeV GIRE3 flux.
- The agreement between JEDI is good until about 12:20 when Juno flies inward of Io, where it is postulated that electrons are deficient and ions are dominant.



MODEL EQUATION (POWER-LAW SPECTRUM)

$$CPS|_{BGN} = \int_0^\infty A_{eff}\, J(E) G(E) dE = \int_0^\infty A_{eff}\, J_0 \left(\frac{E}{E_0}\right)^m G(E)\, dE$$

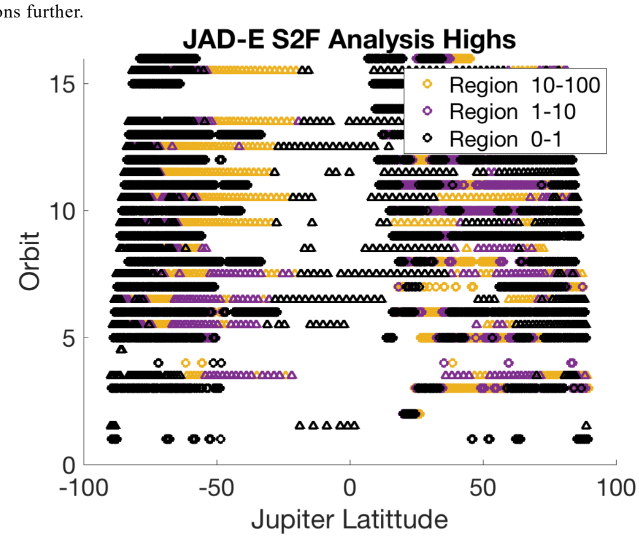
$$\approx \sum_{i=1}^{n} A_{eff}\, J_0 \left(\frac{E_i}{E_0}\right)^m G(E_i)\, \Delta E_i$$

Also, assuming the power-law spectrum, we used the slope (*m*), from the JEDI measurements and estimated the 1 MeV electron differential flux (J_o) using the above equation with E_o=1 MeV. G(E) is geometric factor.

Then, these JADE 1 MeV fluxes are compared to the JEDI 1 MeV flux measurements. The ratios between them are shown below.

Studying Other Orbits

We studied other orbits to identify the orbits with the largest difference between JADE and JEDI data. High ratio regions are scientifically interesting and we will investigate these regions further.



SIGNIFICANT RESULTS AND NEXT STEP

We successfully demonstrated that the JADE-E background noise data can be used to estimate the high-energy electron flux (>~10 MeV). This is significant because Juno is not equipped with any high energy particle detector and the data from JADE noise data analysis can provide high energy electron data which are not available otherwise. We also compared the trend of JADE background with GIRE3 10 MeV electron flux estimates, which shows a rather good agreement.. This new data set from JADE will be very valuable to validate the models, improve their coverage, and reduce their uncertainty. Furthermore, the result of this study can enable a study of energetic electron dynamics and structure as a function of latitude and L-shell (the L-shell parameter is the distance from the center of the planet to the dipole field line measured in Jupiter radii at the magnetic equator). We will investigate the different theories for loss and acceleration mechanisms of energetic electrons in high latitude region where particle trapping is not strong as in the equatorial region.

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