The Importance of Solar Energetic Ions for the Magnetosphere

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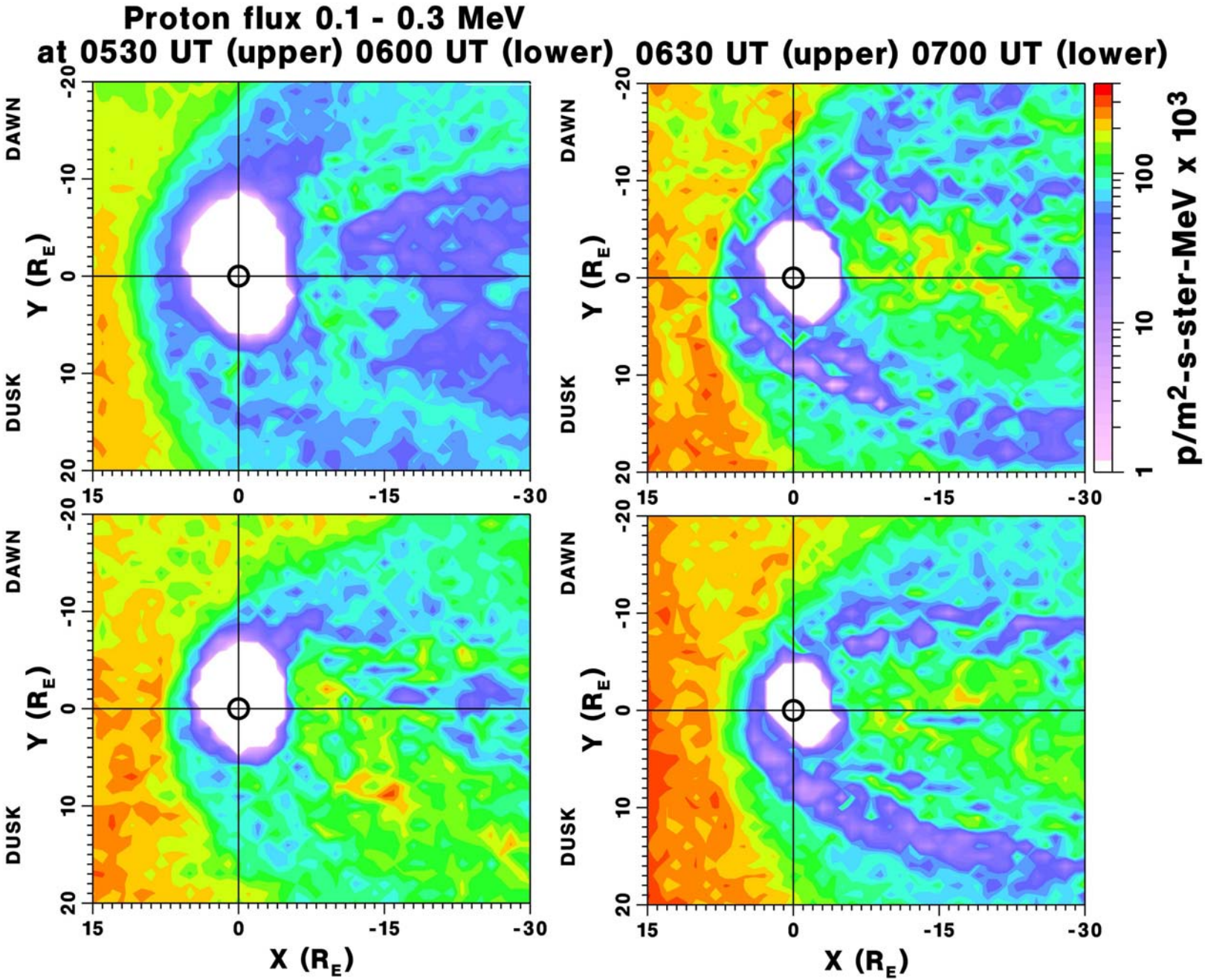


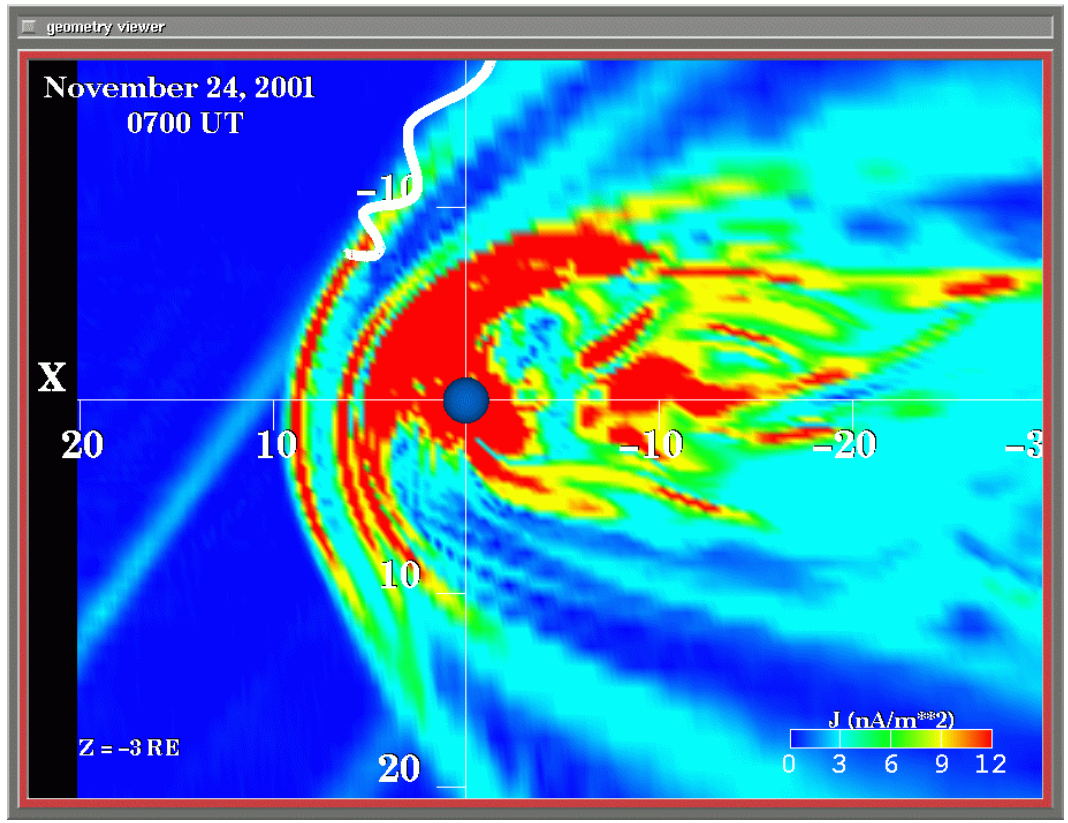
Solar Energetic Particle Trajectory Results

- The magnetic storm of November 24, 2001 was accompanied by a large increase in upstream Solar Energetic Particles (SEP) that were observed by ACE/EPAM.
- The energetic particle distribution versus energy determined from the ACE/EPAM hourly average at 0700 UT was a close fit to a power law with a coefficient of 1.2.
- In this study, SEP trajectories are calculated in fields from global MHD simulations driven by observed solar wind/IMF time series.
- Test particles representing SEPs distributed as a power law (based on ACE/EPAM data) are launched at the simulation boundaries.
- The figure on the previous slide shows calculated proton fluxes from 0.1-0.3 MeV in the z=0 plane at four times on an MHD simulation of the November 24, 2001 storm: 0530 UT (upper left), 0600 UT (lower left); 0630 UT (upper right) and 0700 UT (lower right).
- The proton flux in the inner magnetosphere and the number trapped increases greatly during the event as the dynamic pressure increases and the magnetosphere is compressed.
- Particles were stopped if they reached 2.5 R_E from the Earth.

SEP acceleration at the bow shock

Some SEP particle energies increased by more than 2 MeV as an interplanetary shock interacted with the bow shock near 0700 UT.

- The figure shows contours of current in the z=0 plane with an SEP proton trajectory shown as a white tube.
- Note the impact of an interplanetary shock (current layer upstream of bow shock).



Solar Wind Ion Acceleration

- Solar wind ions were also accelerated near 0700 UT.
- Shown are distributions of protons launched in the solar wind, with solar wind convections speeds and thermal velocities, versus energy as they leave the simulation box or $10R_E$ in the tail – this was done to emphasize dayside acceleration.
- The dotted line shows the final distribution function for a launch at 0430 UT – no protons reach 100 keV.
- The solid line shows the final distribution for a launch at 0700 UT – a high energy tail energy tail extends above 300 keV.