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LENA Observations on March 31, 2001: Magnetosheath Remote Sensing

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We discuss observations from the IMAGE Low Energy Neutral Atom (LENA) imager on March 31, 2001 when the solar wind flux, as measured by ACE/SWEPAM, was over a factor of ten higher than typical solar wind conditions. Observations from LANL-94 on this day indicate that over the time period of interest, about 0330-0600 UT, the magnetopause was inside of geosynchronous orbit. The flux of neutrals resulting from solar wind charge exchange with the Earth's geocorona scales with the product of: (1) solar wind flux, (2) geocoronal density, (3) line of sight integration length, and (4) the reciprocal of the square of the source distance. Because all of these factors increase dramatically with high solar wind flux, LENA observes significant brightening between the direction of the Sun and the Earth on this day. These emissions are a continuous non-linear function of solar wind flux, varying as the solar wind flux to about the 3.7 power.

They cannot be explained by a LENA response to energetic charged particles. The LENA data have been compared to results of global MHD simulations performed at the Community Coordinated Modeling Center (CCMC) using the BATSRUS global MHD code developed at the University of Michigan for this day. The comparison shows that solar wind charge exchange with the Earth's geocorona will produce the signal observed by LENA. Furthermore, structure in the LENA observations can be mapped to features appearing in the CCMC simulations, suggesting that plasma structure in the magnetosheath may be imaged using low energy neutral atom line-of-sight profiles.