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On foreshock dynamics in shock-shock interaction

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On August 10, 1998, an interplanetary (IP) shock hit the bow shock of the Earth. The quasi-radial interplanetary magnetic field configuration and the advantageously located spacecraft made it possible to analyze in detail the dynamics of different plasma regions as the shocks approached each other.

The spacecraft formed a magentic connection to the IP shock 6–7 hours before it crossed the near-Earth space. ACE near the L1 point was magnetically connected to the oblique IP shock only. Wind, located at $X \sim 78\,R_{\mathrm{E}}$, magnetically scanned the quasi-perpendicular flank of the bow shock. Closer to the Earth, Geotail was moving in and out of the ion foreshock of the bow shock, while Interball was deeper inside it.

In the present study we analyze the magnetic fluctuations, the different particle populations and the IP shock front structure in these locations. The observations show that the IP shock had a turbulent foreshock as well, with the power in the magnetic fluctuations increasing as the shock approached. However, the energy density of the energetic particles was higher still. In addition, we find that the increase in the energetic particles due to acceleration in the shock-shock interaction resulted in a significant decrease of the magnetic field strenght in the foreshock of the Earth. We suggest that modification of the IP shock front in the Earth's foreshock was also caused by the increased levels of suprathermal and energetic particles.