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Nonstationarity and Reformation of High-Mach Number Quasiperpendicular Shocks: Cluster Observations

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A set of experimental data is presented for a high-Mach-number ($M_f = 5$) quasiperpendicular ($\theta_{Bn} = 81^\circ$) bow shock layer crossed by Cluster spacecraft on 24 January 2001 at 07:05–07:09 UT. The measurements of magnetic field, spectra of electric field fluctuations, and ion distributions reveal that the shock is highly nonstationary. In particular, the magnetic field profiles measured aboard different spacecraft differ considerably from each other. The mean frequency of downshifted waves observed upstream of the shock ramp oscillates with a characteristic time comparable with the proton gyroperiod. In addition, the reflection of ions from the shock is bursty and a characteristic time for this process is also comparable with the ion gyroperiod. All of these features in conjunction are the first convincing experimental evidence in favor of the shock front reformation.