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# An analysis of surface waves and compressibility observed at a quasi perpendicular terrestrial bow shock

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The observation concerns a series of high beta, high mach, quasi perpendicular bow shock crossings on 2003-12-19 by CLUSTER (in burst telemetry mode) for which magnetic field and density oscillations were seen in the shock transition region. We take advantage of exceptionally slow crossings with four spacecraft moving together from the solar wind to the magnetosheath and back again. High resolution density and magnetic field time-series (sampled at 5 Hz) are conveniently and convincingly split into three contiguous frequency ranges that allow for a straightforward separation as background, "suface wave" and higher frequency turbulence. The shock conditions are carefully derived; the normal estimated via 4 point timing and model. Timing is also used to characterize the density and magnetic field fluctuations in terms of wave vectors and velocity. The most likely explanation is that the large and strongly correlated density and magnetic field oscillations observed at low frequency (near the ion cyclotron frequency) are surface waves. Less coherent waves at higher frequency (whistler frequency range) in the ramp and magnetosheath as well as upstream waves are also present and briefly studied in the minimum variance frame and for compressibility. All waves are looked at in the shock normal frame. Observations are compared with results from two-dimensional hybrid simulations. We also construct a simple pragmatical model to describe the surface wave, in particular its amplitude and speed relative to the shock interface, in order to make the bridge between observation and simulation.