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Nonstationarity of quasi-perpendicular shock front: comparative approach from CLUSTER data with numerical simulation results

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Both numerical simulations and experimental observations (CLUSTER) have evidenced that the front of quasi perpendicular shocks may be strongly stationary or nonstationary. Simulations have evidenced several different mechanisms responsible for this nonstationarity both on macro- (ion) and micro- scales. The fact that several mechanisms can coexist together make a clear diagnosis quite difficult. On the other hand, multi-satellites CLUSTER mission reveals to be helpful for clarifying the situation. The present work focuses on experimental CLUSTER data where macroscale nonstationarity is evidenced and identified as being due to the shock front self reformation driven by the accumulation of reflected ions. Detailed analysis is performed based on many criteria accumulated from a collection of previous 1D and 2D PIC simulation (changes both in ramp-foot scales and typical changes in the local ion distribution function). In particular, it accounts the surprising experimental results where the shock ramp can be very thin and access to a few inertial electron lengths only. Present detailed results are also completed by an additional statistical analysis. These experimental data confirm that the shock front can be nonstationary and that the identified responsible process can strongly compete with another self reformation process

driven by nonlinear dispersive waves activity.