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Waves, instabilities and turbulence properties in Depolarisation Fronts

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The new mission MMS is currently focusing on the magnetopause but we need to be ready for the study of the tail. An aspect of great importance there are the Dipolarization fronts (DF), formed by reconnection outflows interacting with the pre-existing environment. These regions are host of important energy and wave phenomena [1-3]. Our recent work has investigated these regions via fully kinetic 3D simulations [4-5].
As reported recently on Nature Physics [3], based on 3D fully kinetic simulations started with a well defined x-line, we observe that in the DF reconnection transitions towards a more chaotic regime. In the fronts an instability develops caused by the local gradients of the density and by the unfavourable acceleration and field line curvature. The consequence is the break up of the fronts in a fashion similar to the classical fluid Rayleigh-Taylor instability and the onset of waves and secondary instabilities, transitioning towards a turbulent state.
We investigate here especially the wave signatures that are observed in fully 3D simulations, looking for signatures of interchange-type lower hybrid waves [8], of whistler waves [7]. The end result present a vast array of waves and it is best analysed relying on concepts mutated by the turbulence theory.
The end result of these waves and particle flows [2,6] are energy exchanges. We evaluate the different terms of the energy exchanges (energy deposition, J.E, and energy fluxes) and evaluate their relative improtance. The results presented are contrasted against existing results [1,9] and will provided useful guidance in analysis of future MMS data.

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