Hall-MHD simulation of collisionless reconnection at the magnetopause with a density gradient

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It has been suggested that the Hall term is important in collisionless reconnection and Hall-MHD might be a better basis in simulations and for theory than resistive MHD (e.g., Shay et al., JGR, 106, 3759, 2001). Some experimental evidence for this has been found at the magnetopause (MP) from

GEOTAIL (Deng and Matsumoto, Nature, 410, 557, 2001; Oieroset et al.,Nature, 412, 414, 2001).

It is our great wish to check and see with CLUSTER data if there is really a Hall current close to the reconnection line by looking at the 'out-of-plane' magnetic field. CLUSTER consists of four identical subsatellites and they fly together. Each of them has magnetic and electric fields, particles and plasma waves instruments onboard. When comparing our data with expectations that come from the published simulations, there are a few difficulties, for example:

1) there is a density gradient across the MP, but all simulations have been so far done with a homogeneous background. The density gradient must make things less symmetric. For example, on which side would one expect the stronger Hall current, the magnetosheath or magnetosphere side?

2) What should 4 satellites see when flying through a specific reconnection scenario? For the first step to understand the collisionless reconnection process occurring around MP, we try to study a simple reconnection scenario with the 2-D Hall-MHD code that we previously applied to a magnetosphere-ionosphere coupling process associated with an auroral arc but in the present study we set the ion-neutral collision frequency to zero and modify the boundary conditions and background parameters accordingly. We present in this paper how the simulation can address specifically the MP scenarios as observed

with satellites such as GEOTAIL and CLUSTER.