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The Cause of Structure in Magnetotail Reconnection

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We have been using a combination of a global magnetohydrodynamic simulation of the interaction between the solar wind, magnetosphere and ionosphere system and a large scale kinetic simulation (iPic3D) to investigate magnetic reconnection in the magnetotail during substorms. Magnetotail reconnection is very dynamic and structured. We find that multiple neutral lines form and the location of reconnection can move across the tail rapidly with multiple simultaneous X-lines. The reconnection is characterized by large (100s km/s) earthward and tailward electron flows and comparable shear flows in the azimuthal (YGSM) direction. The region of shear flow contains structures in which the work done by the electromagnetic fields) on the plasma (J•E') where J is the current density and E 'is electric field in the electron frame alternates between positive and negative. This changes in J•E' mainly come from changes in E '. A number of instabilities have been suggested for the changing field. In our simulation it is consistent with a long wavelength variant on the lower hybrid drift instability. Because of the close correlation with the shear flow an additional instability like the Kelvin-Helmholtz instability may also be occurring. In the talk we will evaluate the possible instabilities.