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Structure of electron diffusion region of collisionless magnetic reconnection: theory and simulations.

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Collisionless electron-scale physics in the vicinity of the magnetic reconnection neutral point is studied in this presentation. Simple estimates of electron diffusion region (EDR) parameters are presented based on the closure for electron pressure non-gyrotropy [Divin, 2010] within the demagnetization region. Typical spatial scales (electron inertial length) and velocity estimates (electron Alfven velocity) appear naturally in the model. Two-dimensional implicit Particle-in-Cell (PIC) simulations of antiparallel reconnection confirm the basic tenets of the EDR model for a wide range of mass ratios, including realistic proton-to-electron mass ratio. Open boundary conditions are used in order to observe the full multiscale structure of collisionless reconnection and prevent the magnetic flux pile-up in the outflow region. In addition, the results of the PIC simulations reported before [Karimabadi, 2007], [Shay, 2007], [Klimas, 2008] are compared to our model and good agreement is found. The effect of EDR elongation first found in [Daughton, 2006] is somewhat out of the scopes of the current presentation as reconnection ejecta does not contribute to the collisionless electron dissipation near the X-point and could be neglected in our discussion.