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Effect of Inflow Density on Magnetic Reconnection: Particle-in-Cell Simulations PIN WU, University of Delaware — We perform a systematic study of the effect of inflow density on reconnection diffusion regions using a 2.5-D particle-in-cell (PIC) code. The diffusion region structures are analyzed at times when all simulations have reconnected the same amount of magnetic flux. We find that reducing the inflow density from 1 to 1/100th of the current sheet density dramatically increases the diffusion region physical size and the reconnection rate. The width of the diffusion region scales with the upstream ion inertial length systematically. Consistent with the presence of counter-streaming inflowing ion beams near the x-line, the ion meandering width in the diffusion region also scales with the ion inertial length. The aspect ratio of the ion diffusion region remains a constant, independent of the inflow density. The quadrupole Hall magnetic field is reduced. The upstream magnetic field deviates from its asymptotic value by $\sim 50\%$ at the lowest simulated inflow density. The downstream ion outflow velocity scales linearly with the upstream Alfvén speed with a multiplication factor $\sim 0.4 < 1$. When applied to magnetic reconnection in the Earth's magnetotail, this factor of 0.4 is a possible explanation as to why bulk flow velocities in the magnetotail are typically on the order of 500 km/s, while the Alfvén speeds of inflowing plasmas can exceed 2000 km/s.

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