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The physics of electron flow stagnation in collisionless magnetic reconnection

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In addition to the in-plane null point of the magnetic field, the general in- and outflow geometry of magnetic reconnection requires the existence of stagnation points of the flow in the reconnection plane. This applies to any ion species, as well as to the electrons. In symmetric reconnection, the in-plane magnetic null closely coincides with the location of the flow stagnation point, so that physical processes at both critical points are identical or very nearly so. This is different in asymmetric reconnection, where even in MHD these locations do not coincide. In kinetic plasmas, it has been shown that electric field contributions at the flow stagnation point results from thermal inertia effects, i.e. from the divergence of the electron pressure tensor. The electric field at the magnetic null (the "X-point") involves contributions from bulk inertial effects, which increase by the degree of overall asymmetry. In order to understand the overall physical foundation of magnetic reconnection, the flow stagnation point is therefore of particular importance. In this presentation, we will show that population mixing, which is associated with nongyrotropic pressures, is a fundamental feature of the electron dynamics at the electron flow stagnation point. This result has implications for the role mixing and nongyrotropies play in facilitating collisionless magnetic