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The role of electrons in the formation of the double peak in the cross-tail current density by using a three-dimensional hybrid code

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In this work we present a stationary three-dimensional hybrid code with ions represented by particles and electrons by a massless fluid. We use this code to study how electrons influence the ion dynamics in the magnetotail current sheet in several physical processes as, for example, the formation of a double peak in the cross-tail current density, which is observed very often by CLUSTER crossing of the neutral sheet. We try to compare the simulation results with the more recent observations.
We solve the ion equations of motion in assigned electric and magnetic fields typical of the magnetotail sheet, and ion distribution function moments are obtained. Plasma is assumed quasi-neutral and we determine the electron bulk velocity perpendicular to the magnetic field from the electron momentum equation with $m_e \rightarrow 0$, without collisions and using a simple adiabatic or isothermal equation of state. The parallel component of the electron bulk velocity is derived from the electron continuity equation.
We find that the the main electron contribution to the total cross-tail current density derives from the finite Larmor term of electron gradient pressure; further, this electron term is responsible for the formation of a double peak in the total current density even in those case where the ion current density does not display any double layer structure.