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Spontaneous Bifurcation of Single Peaked Current Sheets by Chaotic Electron Scattering

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It is shown that single-peaked collisionless current sheets in a Harris-type equilibrium spontaneously bifurcate as a result of chaotic scattering of electrons at fluctuating magnetic fields near the center of the sheet, as demonstrated by a 2D kinetic particle-in-cell simulation. For this effect to be simulated explicit particle advancing is necessary, since the details of the electron motion have to be resolved. Unlike previous investigations of triggering bifurcated current sheet (BCS) where initial perturbations or external pressure was applied the bifurcation is spontaneous if thermal noise is taken into account. A spontaneous current sheet bifurcation develops quicker than a tearing mode or other plasma instabilities. It is shown that in the course of the current sheet bifurcation the Helmholtz free energy decreases while the entropy increases, i.e. the new, bifurcated current sheet is in a more propable state than the single-peaked one.

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