High Energy Particle Populations and Momentum Transport Associated with Collisionless Reconnection Processes

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In the two-fluid description [1] of reconnection processes in collisionless plasmas a new type of "magneto-thermal" mode producing reconnection is found [2,3] when the longitudinal electron thermal conductivity is relatively large. The mode is driven by the electron temperature gradient and can have a phase velocity in the direction of the electron diamagnetic velocity or in the opposite (ion) direction. A sequence of processes is analyzed to point out that high-energy particle populations can be produced during reconnection events through mode-particle resonances [4] that transfer the energy of the reconnecting mode to super-thermal particle populations. The spatial near-singularity of the perturbed electron temperature, that can enhance the thermal energy of particles in one region while depleting that of particles in the adjacent region, may be an additional contributing factor in this context. The modes can extract momentum from the plasma sheet and in an axisymmetric toroidal confinement configuration could sustain a "spontaneous rotation" [5] of the plasma column by extracting angular momentum of the opposite sign from it. Sponsored in part by the U.S. DOE.

[1] B. Coppi, *Phys. Fluids* **8,** 2273, 1965.
[2] B. Coppi, *Plasma Physics Reports* (Fizika Plazmy) **42**, 5, 383, 2016.
[3] B. Coppi, B. Basu and A. Fletcher, *Nuclear Fusion*, to appear, 2017.
[4] B. Coppi, L. Sugiyama, *et al., Ann. Phys*., **119**, 370, 1979.
[5] B. Coppi, *Nucl. Fusion* **42**, 1, 2002.