Magneto-thermal Reconnection Processes, Related Angular Momentum Transport issues and Formation of High Energy Particle Population*

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A new finding within a two fluid theory of magnetic reconnection [1] is that when the electron thermal conductivity along the magnetic field is relatively large, the perturbed electron temperature tends to become singular [2] in the presence of a reconnected field component and an electron temperature gradient. A transverse thermal diffusion is introduced in order to remove this singularity while a finite (electrical) inductivity is needed to remove the well known singularity of the corresponding transverse plasma displacement [1]. Thus, i) a new "magneto-thermal reconnection" producing mode, driven by the electron temperature gradient, and involving a considerable range of scale distances can be found [3]; ii) the characteristic widths of the layers in which magnetic reconnections takes place remain significant even when the macroscopic distances involved in the process are very large; iii) The phase velocity of the modes that can be found depend mostly on the value of two significant dimensionless quantities. The range of these velocities includes those in the direction of the electron diamagnetic velocity as well as those in the opposite (ion) direction.

The theory of this kind of mode has two features that can lead to a reliable explanation of the fact that high energy particle populations are produced during reconnection events. i) the fact that mode-particle resonances involving the transfer of energy to super-thermal particles can be associated with these (oscillatory) modes [4]; ii) spatial near-singularity of the electron temperature that can enhance the thermal energy of particles in one region while depleting that of particles in a contiguous region [3]. *Sponsored in part by the US DOE.

[1] B. Coppi, *Phys. Fluids* **8**, 2273 (1965).
[2] B. Coppi, B. Basu, P. Montag, *et al. Nucl. Fus*., **55**, 093018 (2015).
[3] B. Coppi, MIT (LNS) Report HEP 15/06 (2015). In print for *Fizika Plazmy.*
[4] B. Coppi, L. Sugiyama, J. Mark and G. Bertin *Ann. Phys*. **119,** 370 (1979).