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Enhanced rate and electron acceleration by the self-generated turbulence of strong guide field reconnection

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It is has been proposed that in astrophysical plasmas reconnection can accelerate particles to high energies. Magnetic reconnection in space and laboratory plasmas typically takes place in turbulence. We concentrated on reconnection in the presence of strong guide fields, typical, e.g. for stellar coronae. In order to understand the role of turbulence in particle acceleration by reconnection in strong external guide fields we first re-investigated the influence of MHD turbulence by describing the turbulence using a sub-grid-scale (SGS) turbulence model of cascading and plasmoid reconnection.

We then considered also the self-generated by reconnection kinetic turbulence in the presence of strong guide fields, typical, e.g. for stellar coronae. For this sake we utilized 3D PIC code simulations. We found that out of the self-generated turbulence of three-dimensional guide field kinetic reconnection grows beyond the linear stage. We found that during the nonlinear stage of reconnection the energy conversion (reconnection-) rate grows beyond that of Petschek's fast rate (Figure 1, 13 inverse ion cyclotron periods after reconnection has started).

We analyzed the consequences of this non-linearly enhanced three-dimensional reconnection for electron acceleration and obtained power-law distributions without any *ad hoc* injection of seed particles even for the spectra of the non-relativistic electrons accelerated by guide-field reconnection.

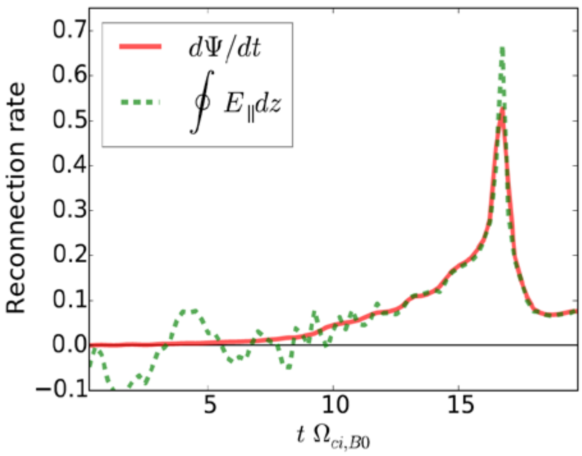

Figure 1: Reconnection rate: from linear and non-linear

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