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Particle acceleration in reconnection regions

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Magnetic reconnection is a way to convert energy of magnetic field into other types of energy, in particular, accelerate energetic particles. To be important in astrophysical circumstances magnetic reconnection should be fast, i.e. should not depend on fluid resistivity (or depend logarithmically). A new mechanism of fast magnetic reconnection that we proposed and successfully tested is able to convert a substantial part of energy stored in magnetic field into energetic particles. We discuss how the mechanism induces fast reconnection in the presence of weak turbulence, which is omnipresent in astrophysical environments. As reconnected magnetic field lines contract, this induces first order Fermi acceleration of particles. Numerical simulations confirm the efficiency of the acceleration process and demonstrate that the processes of acceleration (similar to the processes of reconnection) should be described in 3D. The proposed acceleration mechanism was applied to explain anomalous cosmic rays measured by Voyagers as well as the anisotropy of cosmic rays measured by the MILAGRO and ICECUBE collaborations. The relative role of the new reconnection acceleration and the traditional shock acceleration mechanisms is an interesting issue that still should be addressed.