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Reconnected Astrophysical Plasma results from PIC code simulations

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Non-thermal acceleration is one of the most challenging problems in theoretical plasma astrophysics. There is an enormous number of astrophysical objects that emits powerful outbursts of high-energy radiation with non-thermal spectrum like Pulsar Wind Nebulae (PWNe), and Blazars. There is a strict relation between the emitting particle's energy and the resulting photon energy. The ideal Magnetic Hydrodynamics is not always able to explain recent observations on Crab Nebula and Blazars. Magnetic Reconnection (MR) is one of the candidates to explain the most explosive phenomena seen in our Universe, from the topological point of view, MR mechanism is a change in the plasma magnetic fields lines which causes the conversion on site of magnetic energy into kinetic energy. The most energetic flares can be caused by the so-called "fast reconnection", which implies that plasma is very diluted and collisionless. I will present some results from simulations obtained from PIC model code (Zeltron) to explain some transient phenomena such as those observed in the Crab Nebula and Blazars. Zeltron code is based on PIC (Particle-in-Cells) models, in which the Vlasov equation is solved indirectly. Zeltron code does not integrate on single particles but on their trajectories. PIC type models allow to overcome limits of the MHD codes by identifying the Magnetic Reconnection process as the cause of the observation of synchrotron radiation above the Burn-off limit. I will present simulations using different initial conditions by using Zeltron code, for example, results from 2-antiparallel current sheets for the magnetic field with periodic conditions.

Collaboration

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