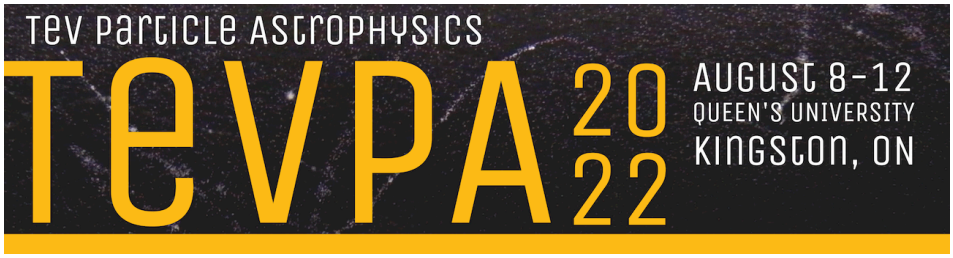

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Electron pre-acceleration through Stochastic Shock Drift Acceleration at shocks in merging galaxy clusters

Tuesday 9 August 2022 14:00 (20 minutes)

Particle pre-acceleration remains an important unresolved problem in the diffusive shock acceleration (DSA) theory. This mechanism acting at merger shocks in galaxy clusters is thought to produce relativistic electrons that form the so-called radio relics detected in radio and X-ray. DSA at merger shocks may also generate high- and ultra-high-energy cosmic rays and associated gamma-ray emission and neutrinos. We report on our recent studies of electron pre-acceleration in nonrelativistic shocks with low Mach numbers propagating in hot intracluster medium. We use large-scale fully kinetic 2D and hybrid-kinetic 2D and 3D numerical simulations that allow us to investigate the effects of the ion-scale rippling of the shock front and the multi-scale turbulence in the shock transition and downstream. We demonstrate that electron injection to DSA can be provided through stochastic shock-drift acceleration (SSDA) process, in which electrons are confined in the shock transition by pitch-angle scattering off turbulence and gain energy from the motional electric field. Through analysis of multi-scale turbulence in the shock at different pre-shock conditions we demonstrate a crucial role of the shock rippling in electron acceleration via SSDA.

Collaboration name

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