# Magnetic Field Generation in Collisionless Shocks

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Collisionless shocks, which are frequently driven associated with astrophysical phenomena, are considered to be sites of magnetic fields generation, especially for relativistic shocks or high Mach number shocks. For example, recent observations indicate that magnetic fields are amplified in the downstream of the shocks associated with afterglows of gamma-ray bursts (GRBs) and those at the shell of supernova remnants (SNRs).

These collisionless shocks generally dissipate the bulk kinetic energy of the upstream particles through the interaction with strong electromagnetic fluctuations generated by various plasma instabilities in the shock transition region. Therefore, one of the possibilities is that the amplified magnetic fields in the downstream are remnant of them. The Weibel instability, which is driven in anisotropic collisionless plasmas, is considered to play an essential role in generating the magnetic fields, especially for shocks in weakly magnetized plasmas.

In my talk, I will review this topic briefly and show the result of direct numerical simulations of collisionless shocks in electron-positron plasmas using particle-in-cell method. I will also mention a saturation model of the Weibel instability based on the Alfven current argument and its application to shocks in SNRs.