PARTICLE ACCELERATION AND RADIATION PRODUCTION AT WEIBEL-MEDIATED PLASMA SHOCKS

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Strong, e.g., relativistic, shocks propagating through a non-magnetized or a weakly magnetized plasma are mediated by the Weibel instability. This seems to be unambiguously shown in theoretical analysis and in numerical simulations (see other talks on this conference). Since such shocks are thought to be produced in astrophysical sources, e.g., gamma-ray bursts (GRBs), a question of diagnostic or remote sensing readily arises. As any astrophysical source, a GRB can only be observed by telescopes, hence to understand how the properties of the emitted radiation are related to the internal structure of the shock is of paramount importance. The Weibel instability generates magnetic fields on a very small spatial scale, of the order of a plasma skin depth. An energetic electron propagating through such fields will emit photons in the jitter regime. The spectrum of the jitter radiation is markedly different from the conventional synchrotron radiation and can serve as a benchmark of the Weibel turbulence. As the Weibel instability develops in the nonlinear stage, it energizes (accelerates) the electrons up to the near equipartition with the protons, thus leading to the high radiative efficiency of the shock. In this talk, we will discuss the physical principles of the jitter radiation, its anisotropic radiation pattern, as well as the possible (non-Fermi) mechanisms of the electron acceleration.