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Jitter radiation mechanism — a diagnostic tool of Weibel turbulence and Gamma-Ray Bursts[1]

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The Weibel instability is common in laser-produced plasmas and, as one has recently realized, it plays a major role in the formation and dynamics of astrophysical shocks of gamma-ray bursts (GRBs) and, perhaps, supernovae. Thanks to technological advances in the recent years, experimental studies of the Weibel instability are now possible at Petawatt- scale laser plasma facilities (such as NIF, Omega, etc) and in direct particle-in-cell (PIC) numerical simulations. We, thus, have a unique opportunity to model and study astrophysical conditions in numerical and laboratory experiments. At this stage, accurate diagnostic techniques are of great demand. In this presentation, we will discuss the physics of radiation, referred to as the *Jitter Radiation*, emitted by relativistic electrons (e.g., an electron beam or a thermal distribution) moving through the Weibel-generated magnetic fields, to which we refer as the *Weibel turbulence*. The similarity of Jitter radiation and the newly introduced "diffusive synchrotron radiation" is stressed. We'll show that the Jitter radiation field is anisotropic with respect to the direction of the Weibel current filaments and that its spectral and polarization characteristics are determined by microphysical plasma parameters. With the present computing capabilities, it is feasible to obtain radiation from plasma with Weibel-generated fields directly from PIC simulations, for the conditions relevant to laboratory laser- plasma experiments and relativistic astrophysical shocks of GRBs. Synergy of computer modeling, laboratory experiments and astrophysical observations will provide unique possibilities to diagnose plasma conditions in wide range of systems, thus putting *Plasma High-Energy Astrophysics* on the firm quantitative basis.

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