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Anisotropic Radiation Spectra from Strong Weibel Turbulence[1]

MIKHAIL MEDVEDEV, University of Kansas — We refer the end state of the nonlinear Weibel instability to as the "Weibel turbulence". This state is observed in a wide variety of plasma environments, ranging from laser-plasma interaction systems and Fast Ignitor to collisionless unmagnetized shocks in space driven by cosmic explosions — supernovae and gamma-ray bursts. Strong Weibel turbulence is characterized by quasi-steady-state, high-amplitude magnetic field inhomogeneities residing on a plasma skin depth scale. The dynamics and evolution of these fields is governed by strong nonlinear interactions of the associated current filaments, and is accompanied by efficient anisotropic heating of the electrons. We study the radiation emitted by these electrons and present a fully analytical calculation of the radiation spectrum. The anisotropy of the electron PDF and the magnetic filament orientation are taken into account. We obtained that the power spectrum $P(\omega)$ varies from $\propto \omega^1$ to $\propto \omega^0$ as the viewing angle Θ (with respect to the mean direction of the current filaments) varies from 0 to $\pi/2$. We stress that the spectral analysis will provide accurate diagnostics of the plasma conditions in Fast Ignitor, astrophysical shocks and other systems.

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