Radiation signatures of the Weibel/current filamentation instability

J.L. Martins, S.F. Martins, R.A. Fonseca and L.O. Silva

GoLP/Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Av. Rovisco Pais 1049-001 Lisboa, Portugal, jlmartins@ist.utl.pt

The Weibel/current filamentation instability is common in both astrophysical and laboratory scenarios. Radiation signatures associated with the electrons dynamics in such scenarios are relevant for the interpretation of astrophysical observations and of future experiments.

Using the OSIRIS 2.0 framework we explore scenarios where plasma turbulence arising from the crossing of plasma flows leads to the occurrence of the Weibel/current filamentation instability. We perform 2D and 3D PIC simulations and focus our study on the electron time scale and on the radiation mechanisms associated with the dynamics of the electrons in the fields, particularly in the small-scale magnetic fields. The features of these radiation processes are explored using a post-processing radiation diagnostic that determines the power spectrum of the radiation using the particle's trajectory in phasespace.

Time resolved study of radiation spectrum establishes the correlation of its evolution with that of the instability. A steepening of the lower energy part of the spectrum is observed as the instability grows. This will be discussed in connection with the evolution of the fields (strength and characteristic scales). Plasma dispersion effects (Razin effect) and their influence on the features of the lower energy part of the spectrum will also be addressed.

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