

Nonlinear Kinetic Instabilities in Relativistic Plasmas

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Abstract: Plasma instabilities that generate aperiodic fluctuations are of outstanding importance in the astrophysical context. Two prominent examples are the electromagnetic Weibel instability and the electrostatic Harris instability, which operate in initially non-magnetized and magnetized plasmas, respectively. It can be shown that only for gyrotropic particle distribution functions (where the gyrotropy is perpendicular to the wave direction) can one have decoupled longitudinal and transverse linear Weibel modes that exist over a continuum of wavenumbers. For any asymmetry, no matter how small, the longitudinal and transverse linear modes are coupled and the continuum of wavenumbers collapses to isolated wavenumbers allowing Weibel modes as is determined both analytically and also with numerical simulations. In the talk, basic features as well as recent developments of kinetic instabilities are presented. Furthermore, the emitted radiation of charged particles is discussed that are constrained by non-linear Weibel modes.