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The non-resonant streaming instability: from theory to experiments

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The non-resonant streaming instability leads to the generation of large amplitude magnetic field fluctuations, and may play an essential role in the acceleration of cosmic rays. We present a study of the non-resonant streaming instability in non-ideal plasma environments with finite temperature and collisionality. We have extended the existing kinetic theory to the case of large plasma temperature, and shown that the instability may be strongly modified if the ions Larmor radius becomes comparable or larger than the unstable wavelengths. Using multi-dimensional hybrid-Particle-In-Cell simulations including a Monte Carlo module for Coulomb and neutral collisions, we study the non-linear evolution of the instability and show that Coulomb collisions can promote the growth of the instability. In contrast neutral collisions yield an important damping, in agreement with existing theoretical predictions. These results are then used to design future experiments aiming at observing the instability for the first time in laboratory conditions.

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