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Landau Damping I

Tuesday, November 15, 2022 8:30 AM (1 hour)

Charged particle beams naturally exhibit self-enhanced oscillations, or coherent instabilities, driven by the interaction between the particles in the beam through collective forces such as electromagnetic wake fields, space-charge, beam-beam, ions or electron clouds. Highlighting the fundamental difference between the collective motion and the one of individual particles, we discuss how a spread in velocities or oscillation frequencies in an ensemble of particles leads to a damping of collective oscillations through the mechanism of Landau damping. We then illustrate the Liouville theorem from which we derive the strength of Landau damping in a simplified configuration using the Van Kampen approach. Based on this model we define the concept of stability diagrams.

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