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Existence and Properties of an Equilibrium State with Beam-Beam Collisions*

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Abstract

The equilbrium phase distribution of stored colliding electron beams is studied from the viewpoint of Vlasov-Fokker-Planck (VFP) theory. Numerical integration of the VFP system in one degree of freedom revealed a nearly Gaussian equilibrium with non-diagonal covariance matrix. This result is reproduced approximately in an analytic theory based on linearization of the beam-beam force. Analysis of an integral equation for the equilibrium distribution, without linearization, establishes the existence of a unique equilibrium at sufficiently small current. The role of damping and quantum noise is clarified through a new representation of the propagator of the linear Fokker-Planck equation with harmonic force.

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