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Classical and Quantum Description of the Kapitza–Dirac Effect

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In this presentation, we explore the classical and quantum descriptions of the Kapitza-Dirac effect: the scattering of particles, such as electrons or atoms, by a standing wave electromagnetic field. In the classical case we integrate the equation of motion, both in its exact form and using the ponderomotive approximation, for a statistical ensemble of electrons. We present graphical representations of the final momentum distribution as a function of the particles' initial positions. For the quantum description, we integrate the Klein–Gordon equation for a charged particle interacting with the standing wave. Using a method inspired by the work of Gavrila [1], we show that the Klein–Gordon equation reduces to a linear Goursat problem, which we solve numerically. We present a comparison between the classical and quantum results.

[1] M. Gavrila, "Crossed-laser-beam solutions for the Klein-Gordon equation", Phys. Rev. A 99, 012120 (2019)

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