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Classical Theory of Compton Scattering FREDERIC HARTEMANN, DAVID GIBSON, LLNL, ARTHUR KERMAN, MIT — The Dirac-Lorentz equation describes the dynamics of a classical point charge in an electromagnetic field, accounting for radiative effects in a manifestly covariant and gauge invariant manner. The validity of this equation is assessed by direct comparison between the Dirac-Lorentz dynamics of an electron subjected to a plane wave in vacuum and the well-known recoil associated with Compton scattering. In the small recoil limit, the classical Dirac-Lorentz is shown to yield the correct momentum transfer. For larger values of the recoil, the quantum scale appears explicitly, and the classical Dirac-Lorentz equation does not properly model this situation, as shown by deriving an exact analytical solution for a monochromatic plane wave of wavenumber k to any order in kr, where r is the classical electron radius. This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

Frederic Hartemann
LLNL

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