Coherence effects in the collision of high-energy electron-positron bunches with an intense laser field

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In classical electrodynamics, energy losses due to the emission of electromagnetic radiation can be accounted for by solving the Landau-Lifshitz equation of motion. Analytically, this equation is typically solved while treating each particle independently in an external field; numerically, one often includes a self-consistent mean field, as seen with particle-in-cell (PIC) codes. In both cases, interparticle fields from point-like particles are neglected. By considering the collision of a neutral relativistic electron-positron bunch with an intense laser pulse, we demonstrate that the inclusion of interparticle fields can coherently amplify a broad range of radiated frequencies by orders of magnitude [1]. This corresponds to an amplified energy loss by particles within the bunch, with interparticle fields that feed into the radiation reaction force.

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[1] M. J. Quin, A. Di Piazza, C. H. Keitel, and M. Tamburini, (2023), arXiv:2306.17832.