Controlling radiation losses by quantum quenching

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Continual advances in achievable laser power has spurred renewed interest in using intense light to study fundamental predictions of classical and quantum electrodynamics (QED) [1–5]. One cornerstone of such experiments is the collision of laser beams with particle bunches [6, 7]. Particle motion in intense fields is inherently non-linear, in particular due to radiation reaction (RR) which is the impact of energy loss on particle motion. RR can reduce collision energies [8], hinder particle acceleration schemes [2, 9, 10], and is seemingly unavoidable. Much work has gone into demonstrating that RR, long thought negligible, must now be accounted for in order to accurately model state-of-the-art high intensity laser- matter interactions [2, 11, 12]. Here, we will show on a different facet of the quantum nature of radiation reaction. Using analytical results, as well as both single particle and particle-in-cell simulations, we demonstrate that one can control, and effectively turn off, RR by tuning the laser pulse length. We will also present a realisable experimental setup (see Fig. 1), requiring only modest parameters, with which to observe the effect and so demonstrate a possibility to control quantum processes in intense light-matter interactions [13].

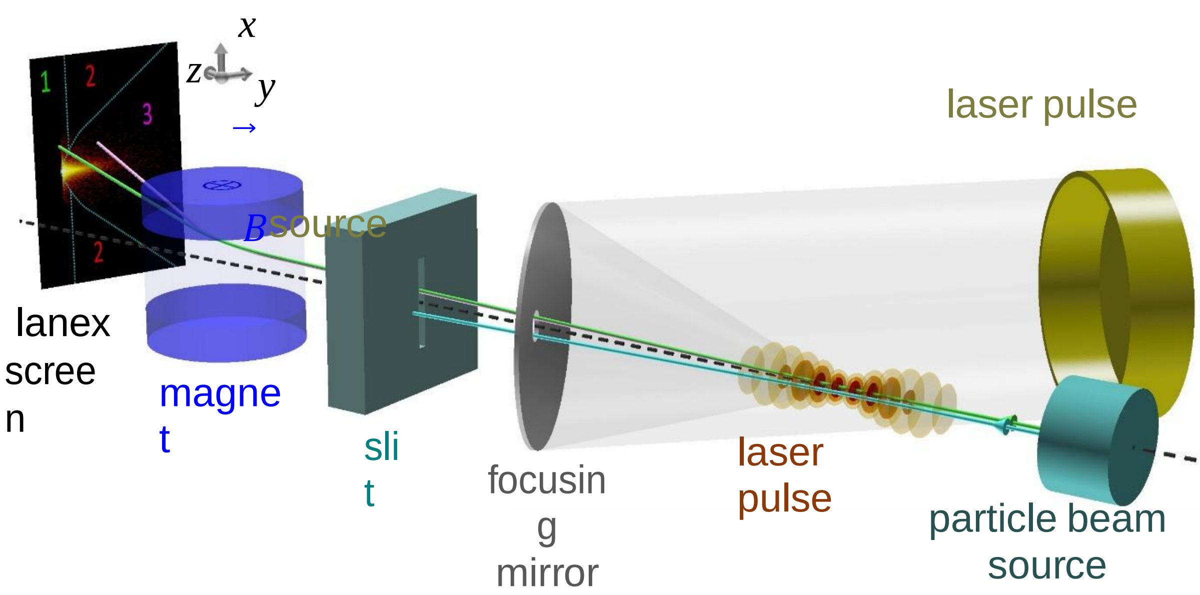

Figure 1. Proposed experimental setup for testing quantum quenching.

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