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Experimental observation of radiation reaction due to hard photon emission in the collision of a high-intensity laser with a laser-wakefield accelerated electron beam

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The dynamics of energetic particles in strong electromagnetic fields can be strongly influenced by radiation reaction, and today's lasers are sufficiently intense to explore the transition between the classical and quantum radiation reaction regimes. Here, we report on the observation of radiation reaction in the collision of an ultra-relativistic electron beam generated by laser wakefield acceleration ($E > 500$ MeV) with an intense laser pulse ($a_0 > 10$). We measure an energy loss in the post-collision electron spectrum that is correlated with the detected signal of hard photons (gamma-rays), consistent with a quantum (stochastic) description of radiation reaction. The generated gamma-rays have the highest energies yet reported from an all-optical inverse Compton scattering scheme, with characteristic energy > 30 MeV.

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