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# Luminosity for laser-electron colliders

High intensity laser facilities are expanding their scope from laser and particle-acceleration test beds to user facilities and nuclear physics experiments. A basic goal is to confirm long-standing predictions of strong-field quantum electrodynamics, but with the advent of high-repetition rate laser experiments producing GeV-scale electrons and photons, novel searches for new high-energy particle physics also become possible. The common figure of merit for these facilities is the invariant $\chi \simeq 2\gamma_e|\vec{E}_{\rm laser}|/E_c$ describing the electric field strength in the electron rest frame relative to the "critical" field strength of quantum electrodynamics where the vacuum decays into electron-positron pairs. However, simply achieving large $\chi$ is insufficient; discovery or validation requires statistics to distinguish physics from fluctuations. The number of events delivered by the facility is therefore equally important. In high-energy physics, luminosity quantifies the rate at which colliders provide events and data. We adapt the definition of luminosity to high-intensity laser-electron collisions to quantify and thus optimize the rate at which laser facilities can deliver strong-field QED and potentially new physics events. Modeling the pulsed laser field and electron bunch, we find that luminosity is maximized for laser focal spot size equal or slightly larger than the diameter of the dense core of the electron bunch. Several examples show that luminosity can be maximized for parameters different from those maximizing the peak value of $\chi$ in the collision. The definition of luminosity for electron-laser collisions is straightforwardly extended to photon-laser collisions and lepton beam-beam collisions.

## Working group

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