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Second order nonlinear QED processes in ultra-strong laser fields
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— In the interaction of ultra-intense laser fields with matter the ever increasing peak laser intensities render nonlinear QED effects ever more important. For long, ultra-intense laser pulses scattering large systems, like a macroscopic plasma, the interaction time can be longer than the scattering time, leading to multiple scatterings. These are usually approximated as incoherent cascades of single-vertex processes. Under certain conditions, however, this common cascade approximation may be insufficient, as it disregards several effects such as coherent processes, quantum interferences or pulse shape effects. Quantifying deviations of the full amplitude of multiple scatterings from the commonly employed cascade approximations is a formidable, yet unaccomplished task. In this talk we are going to discuss how to compute second order nonlinear QED amplitudes and relate them to the conventional cascade approximation. We present examples for typical second order processes and benchmark the full result against common approximations. We demonstrate that the approximation of multiple nonlinear QED scatterings as a cascade of single interactions has certain limitations and discuss these limits in light of upcoming experimental tests.

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