Deterministic and Stochastic Radiation Reaction in Focused Laser-Electron Scattering

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The energy losses of electrons arising from the emission of radiation will be a standard feature in upcoming experiments using PW optical lasers. While several studies have addressed this issue in an idealized setting of scattering of electrons with a Plane Wave, few analytical models have been developed for the collision with focused laser pulses. In this case, not all electrons will interact with the same peak laser field due to spatio-temporal synchronization effects. However, it is possible to estimate the effective laser intensity of interaction for each fraction of electron ensemble. This allows the generalization of scaling laws previously derived in the context of a Plane Wave setup to more realistic geometries including 3D effects.

Recently, we have shown that the positron yield in focused laser-electron scattering can indeed be estimated by adapting a scaling law derived for Plane-Wave scattering [1].

In this work, we develop a semi-analytical model to predict the final electron distribution function using both Classical and Quantum Radiation Reaction description, including several non-ideal features such as offsets from the laser focus, interaction at an angle, non-monoenergetic beams, and focusing.

This model may be used to support experiments in the future, namely when searching for specific signatures of Quantum Radiation Reaction.

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References

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