# Toolkit for efficient modelling of realistic laser scattering experiments

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The new generation of peta-watt optical laser facilities will finally allow tests of Strong Field QED, with new experiments being planned for the near-future. The setups used will usually consist of scattering of intense focused laser pulses with either relativistic electron beams or high-energy photon sources.

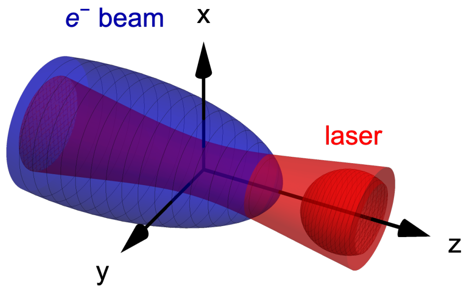


Figure 1: Schematic of the scattering of an intense focused laser with an electron beam.

Most analytical models of the observables in scattering events (electron-positron and photon yields, spectra and angular distributions) have been developed in the framework of a plane wave laser pulse with a temporal envelope. In realistic scenarios, the probe beam will have non-negligible dimensions in relation to the laser characteristic scales (spotsize, Rayleigh range and duration) and to possible fluctuations in alignment (either temporal synchronization or transverse offsets due to Poynting instability of the laser).

It has proved challenging to incorporate all of these effects in a fully analytical model. However, we have recently shown that it is possible to map observables from 1D, plane wave models to realistic 3D scenarios through a distribution of probe particles in effective intensity at collision [1], in particular, for the positron yield in electron-laser scattering.

In this work, we develop a toolkit to obtain approximations of the relevant observables (distributions) including several non-ideal features such as offset from the laser focus, interaction at an angle (in particular at 90º), non-monoenergetic beams, beam divergence, and tight-focusing. This model may be used to support large-data high-repetition rate experiments in the future, leveraging on its speed for optimization or reconstruction of experimental parameters, namely when searching for specific signatures of Quantum Radiation Reaction and nonlinear Breit-Wheeler pair production.

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## References

[1] Óscar Amaro and Marija Vranic 2021 New J. Phys. **23** 115001