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QED-PIC Simulations: from the Breakdown of Classical Physics to the Schwinger Limit[1]

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We intend to show three types of QED effects that can be simulated in OSIRIS-QED:

- QED-Radiation Reaction: we have incorporate a module which allows photons emission from nonlinear Compton scattering. The typical electron energy sufficient to diagnose weak QED effects is around few GeV and such beams can be generated from an all-optical source. Simulations can show the influence of quantum emission on the energy spread of an electron beam colliding head-on with an intense laser.

- Pair cascades in counter-propagating lasers: in this configuration, the stimulated pair production is due to the Breit-Wheeler process. We have developed an algorithm that allows particle merging (while conserving particle distributions) to avoid memory overflow. 2D/3D simulations and analytical predictions for the growth rates will be presented.

- Vacuum polarisation: the process of photon-photon scattering leads to a set of corrected Maxwell's equations, effectively creating a non linear polarization and magnetization of the vacuum. To study this interaction, we incorporated a robust solver in the OSIRIS. Our work also shows vacuum birefringence and high harmonics generation.

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