
Strong-field QED features in the leptonic beam collision

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The quantum electrodynamic (QED) phenomena, i.e., photon emission and pair production, from the collision of dense and ultra-relativistic leptonic beams are studied in the strong-QED and low-disruption regimes [1]. Analytical solutions to the yield of photons and pairs from a single particle are obtained. The low- and high-energy photons present distinctive features which are described by different analytical solutions. The high-energy photons dominate the photon energy spectrum in the strong QED regime. A sharp peak, close to the beam energy, appears in the high-energy photon spectrum, in contrast to the low-energy photon population with a broad distribution. The impacts of the QED-strength parameter and bunch length are revealed by our analytical solutions. Our study suggests the collective photon spectrum from the colliding beams preserve the distinct features stated above. It also indicates that beam collision in the strong QED regime is capable of producing ultra-relativistic, collimated, and mono-chromatic photon beams. We also show that our results hold even when a small misalignment is present, which relaxes the requirement of experiments with such leptonic beams. 3-Dimensional (3D) particle-in-cell (PIC) simulations with OSIRIS are performed to verify our study.

References

- [1] W. L. Zhang, T. Grismayer, L. O. Silva, In preparation, 2022.