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P4.2020 Identifying quantum radiation reaction by using colliding ultra-intense lasers in gases

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In the past year, huge progresses have been made to detect radiation reaction effect in the collision of an ultraintense laser and a high-energy electron beam.
However, there still remain large uncertainties on the quantum effect of radiation reaction.
Here, we propose a scheme for identifying the quantum radiation reaction effect on relativistic electron motion in strong electromagnetic fields, where two ultraintense lasers are used to collide with each other in a tenuous gas.
Different from the previous method by laser-beam collisions, in which the radiation reaction effect is evidenced by the energy loss in the electron energy spectrum, here the transition between the classical and quantum radiation reaction regimes is distinguished from the angular distribution of the total electron radiations. With no need of additional relativistic electron beams, the
scheme is more robust and easily achievable in experiments. Both theory and 2D particle-in-cell simulations show that the classical radiation dominates in the transverse direction perpendicular to laser axis, forming a dipole-like pattern, while that in the quantum regime dominates at four diagonal directions, constituting a butterfly-like structure.

References

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