Recent results on quantum radiation reaction effects in laser plasma interaction

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Radiation reaction (RR) in the interaction of ultra-relativistic electrons with a strong external electromagnetic field is investigated using a kinetic approach in the non-linear moderately quantum regime.

Analyzing the system of kinetic equation for the electron and photon distribution functions, we deduce three complementary descriptions depending on the average quantum parameter of the electron population : a deterministic one relying on the quantum-corrected radiation reaction force in the Landau and Lifschitz (LL) form, a linear Boltzmann equation for the electron distribution function, and a Fokker-Planck (FP) expansion in the limit where the emitted photon energies are small with respect to that of the emitting electrons. [1]

Quantum RR effects can affect significantly the electron distribution function. Our treatment allows us to evidence that both the average quantum parameter and the initial shape of the electron distribution function are important to determine the influence of quantum RR on the system. This has important implications for the experimental observation of quantum RR effect and for the implementation of RR in PIC codes.

The results established for the electron distribution function allow to reinterpret the differences in the radiation spectrum in the three models. In particular, we observe that the features of RR are much more subtil on the radiation spectrum than on the electron distribution function. [2]

References

[1] F. Niel, C. Riconda, F. Amiranoff, R. Duclous and M. Grech, arXiv:1802.02927, (2017)

[2] F. Niel, C. Riconda, F. Amiranoff, M. Lobet, J. Derouillat, F. Pérez, T. Vinci, M. Grech, arXiv:1802.02927 (2018)