High Frequency Incoherent and Coherent Radiation in SMILEI: application to XUV emission from electrons accelerated in surface waves

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Relativistic high-charge electron bunches can be produced by surface plasma waves (SPW) excited by ultra-high intensity fs lasers impinging on a solid-density target which strongly enhances the laser-plasma coupling. There is good evidence that SPW excitation survives in the ultra relativistic regime [1] and that the produced electron bunches experience strong acceleration, therefore emitting large amounts of electromagnetic radiation [2] with interesting characteristics (such as directionality, brightness, spectral range etc.).

In most numerical works performed with Particle-in-cell (PIC) codes, the treatment of radiation is either directly captured on the simulation grid (coherent radiation), or approximated by synchrotron emission or non-linear inverse Compton scattering (depending on the importance of quantum effects) for very high frequencies that can not be resolved on the simulation grid. In the later case, emission is usually assumed to be incoherent.

In this work, we propose the implementation of a diagnostic, based on the Lienard Wiechert potentials following the method of [3], complementing the pre-existing radiation modules in the open-source PIC code SMILEI [4, 5]. The implementation of this radiation treatment in SMILEI is not only interesting for the study of SPW excitation and electron acceleration in the ultra relativistic regime, but also for the investigation of betatron radiation and high harmonic generation among many others.

References

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