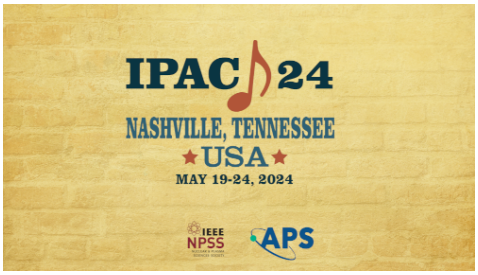

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Comparison of WarpX and GUINEA-PIG for electron positron collisions

Sunday, 19 May 2024 14:00 (4 hours)

As part of the Snowmass'21 planning exercise, the Advanced Accelerator Concepts community proposed developing multi-TeV linear colliders and considered beam-beam effects for these machines [1]. Such colliders operate under a high disruption regime with an enormous number of electron-positron pairs produced from QED effects. Thus, it requires a self-consistent treatment of the fields produced by the pairs, which is not implemented in state-of-the-art beam-beam codes such as GUINEA-PIG. WarpX is a parallel, open-source, and portable particle-in-cell code with an active developer community that models QED processes with photon and pair generation in relativistic laser-beam interactions [2]. However, its application to beam-beam collisions has yet to be fully explored. In this work, we benchmark the luminosity spectra, photon spectra, and the recently implemented pair production processes from WarpX against GUINEA-PIG in ultra-tight collisions, and ILC scenarios. This is followed by a run-time comparison to demonstrate the speed-up advantage of WarpX. Ultimately, this work ensures a more robust modeling approach to electron-positron collisions, with the goal of scaling up to 15 TeV.

Footnotes

[1] T. Barklow et al. Journal of Instrumentation 18, P09022 (2023).
[2] L. Fedeli et al. 2022 SC22: International Conference for High Performance Computing, Networking, Storage and Analysis (SC). IEEE Computer Society 2022.

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