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Recent advances in quasi-static Particle-in-Cell simulations for modeling plasma accelerators

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Modeling plasma-based accelerators is a computationally challenging task.

To resolve the full kinetic behavior of the beams and the plasma, particle-in-cell (PIC) codes are the method of choice. In the quasi-static approximation it is assumed that the beams evolve on a different time scale than the plasma, allowing for a separate treatment of the beams. Consequently, quasi-static PIC enables large time steps in comparison to conventional electromagnetic PIC codes.

In the last years, the quasi-static PIC method has been significantly improved. Here, the latest advances are presented, including novel algorithmic and numeric implementations, as well as porting the quasi-static PIC algorithm to the latest high-performance computing architectures. The impact of these developments on established experiments like AWAKE is evaluated. Finally, future needs and development plans are discussed.

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