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Optimization of beam qualities on Plasma Wakefield Acceleration[1] QIANQIAN SU, University of California Los Angeles, JEFFERY LARSON, Argonne National Laboratory, WEIMING AN, FEI LI, YUJIAN ZHAO, LANCE HILDEBRAND, University of California Los Angeles, STEFAN WILD, Argonne National Laboratory, WARREN MORI, University of California Los Angeles
— The plasma wakefield accelerator (PWFA) concept has emerged as a promising candidate for making compact accelerators that can produce high-quality beams. In order for PWFA to produce high-quality beams, the energy spread and emittance must be optimized. This has led to much theoretical analysis and computer simulations on how to choose plasma and beam parameters to inject and accelerate high quality beams. However, such theories and computer simulations have yet aimed at fine tuning the parameters in order to optimize the output beam. In addition, drive beams do not have symmetric Twiss parameters or spot sizes and the shapes are not perfect Gaussians. This makes finding the optimal parameters quite challenging. We have combined the PWFA simulation code QuickPIC with POPAS, a parallel optimization toolbox developed at ANL, to efficiently find the optimal parameters of the beam and plasma that produce the highest-quality beams, and to potentially explore new acceleration regimes. We present preliminary results that show the newly developed optimization tool can find the optimal Twiss parameters for the drive beam in order to preserve the witness beam emittance in a PWFA stage. We also show that the optimization tool can help to minimize the witness beam energy spread.

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