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Study on beam emittance evolution in a nonlinear plasma wake field accelerator with mobile plasma ions WEIMING AN, CHAN JOSHI, WARREN MORI, UCLA, WEI LU, Tsinghua University, Beijing — We study the electron beam evolution in a nonlinear blowout PWFA when the accelerated beam has a very small matched spot size that can cause the plasma ions collapsing towards the beam. Contrary to the common belief, very small emittance growth of the accelerated electron beam is found when the plasma ion collapsing destroys the perfect linear focusing force in the plasma wake field. The improved quasi-static PIC code QuickPIC also allows us to use very high resolution and to model asymmetric spot sizes. Simulation results show that the accelerated beam will reach a steady state after several cm propagation in the plasma (which is why we can do simulations and not let the drive beam evolve). We find that for round beams the ion density (which is Li+) enhancement is indeed by factors of 100, but that the emittance only grows by around 20 percent. For asymmetric spot sizes, the ion collapse is less and emittance growth is zero in the plane with the largest emittance and about 20 percent in the other plane.

Weiming An
UCLA

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