Numerical study of the propagation of positron beams in plasmas[1]

XIAOYING LI, PATRIC MUGGLI, University of Southern California — We study the propagation of ultra-relativistic positron bunches in long dense plasmas using numerical simulations. Emittance preservation of the incoming beam is essential for all particle accelerators. In the case of the blowout regime of the plasma wakefield accelerator (PWFA), the electron bunch essentially propagates in a uniform ion column, and its emittance is preserved along the plasma. Such a favorable regime does not exist for positron bunches and the preservation of the bunch emittance is an open question. It was shown experimentally and numerically that single positron bunches suffer halo formation and emittance growth when propagating along a uniform plasma [P. Muggli et al., to appear in Phys. Rev. Lett. 2008]. We therefore investigate the possibility of mitigating these deleterious effects and of preserving the incoming bunch emittance, for example by using a hollow plasma channel. We also investigate emittance preservation in the case of a drive-bunch/witness-bunch PWFA system. Preliminary simulation results will be presented.

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