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Channeling of relativistic laser pulses in underdense plasmas and electron acceleration NEDA NASERI, University of Alberta, DENIS PESME, Ecole Polytechnique, WOJCIECH ROZMUS, University of Alberta, KONSTANTIN POPOV, University of Ottawa — We present results of 3D PIC simulations and the corresponding theoretical analysis of relativistic self-focusing, laser pulse channeling, surface wave generation and electron acceleration. For laser pulse powers above the threshold for channeling, we have observed the stability of the laser pulse propagation as a single mode in an electron free channel. These results apply to sub-picosecond laser pulses, and a very good agreement has been observed between the stationary analytical theory predictions and our PIC simulations. The sharp front of the laser pulse excites surface wakes in the channels. These surface waves play a fundamental role in electron acceleration. The nonlinear longitudinal fields of the surface waves first trap and accelerate the electrons located on the channel walls. These fast particles can be further accelerated by the laser field through a betatron-like mechanism involving the transverse fields of the surface wave. This two- stage process is necessary to explain the large number of high energy electrons observed in the simulations. This acceleration mechanism ultimately results in the channel destruction.

Wojciech Rozmus
University of Alberta

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