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Electron acceleration in cavitated laser produced ion channels
N. NASERI, Tech-X Corporation, Boulder, CO, D. PESME, Ecole Polytechnique, Palaiseau, France, W. ROZMUS, University of Alberta, Edmonton, AB — This paper is concerned with the channeling of a relativistic laser pulse in an underdense plasma and with the subsequent generation of fast electrons in the cavitated ion channel. The laser pulse has a duration of several hundreds femtoseconds and its power P_L exceeds the critical power for laser channeling P_{ch}, with $P_{ch} \approx 1.1P_c$, P_c denoting the critical power for relativistic self-focusing. The laser pulse is focused in a plasma of electron density n_0 such that the ratio n_0/n_c lies in the interval $[10^{-3}, 10^{-1}]$, n_c denoting the critical density. The laser-plasma interaction under such conditions is investigated by means of three dimensional Particle-In-Cell (PIC) simulations. It is observed that the steep laser front gives rise to the excitation of a surface wave which propagates along the sharp radial boundaries of the electron free channel created by the laser pulse. The mechanism responsible for the generation of relativistic electrons observed in the PIC simulations is also analyzed by means of a test particles code. The fast electrons are found to be generated by the combination of a surface wave and of the betatron resonance. The maximum electron energy observed in the simulations is scaled as a function of P_L/P_c.

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