Charging wave assisted electron bunch guiding along a laser irradiated wire

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It is known from the experiments on interaction of short intense laser pulses with a metal wire that it can be used to guide for a long distance an electron bunch (beam) formed from the particles expelling from the irradiated spot. In this report electron bunch guiding along a wire observed in the experiments is explained by excitation of the pulse type charging (polarization) surface wave and polarization current. This is achieved using 3D PIC simulations at the sub-mm distance and test particle approach at the macro distance along a wire. Based on the presented physical model of laser-wire interaction, estimates are provided of the emerging surface fields caused by the loss of quasi-neutrality of the target due to the escape of the most energetic electrons heated by the laser pulse. The ability of these fields to guide electrons along the wire is discussed. The presented numerical PIC modeling confirms this physical model. The calculation results demonstrate how electrons, initially oscillating in the Debye sheath, begin to be deflected along the wire under the influence of fields maintained by a positive surface current flowing along the wire. As a result, some time after the end of the laser pulse, two symmetrical electron beams form, traveling along the metal wire (plasma cylinder) away from the focus of the laser pulse on the target.