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Photo-induced Tomonaga-Luttinger liquid in a one-dimensional Mott insulator

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We theoretically study the metallic state induced by strong electric fields applied to a one-dimensional Mott insulator. The time-dependent density matrix renormalization group method is used to calculate the nonlinear optical conductivity where we have found an emergence of metallic states with linear dispersions within the energy gap. The charge velocity is renormalized by interaction which indicates that the photo-doped carriers behave collectively as in the equilibrium Tomonaga-Luttinger liquid. A non-equilibrium phase diagram for the photo-induced insulator-to-metal transition is then proposed. The mechanism of photo-doping is further studied by an effective Dirac model, where the Floquet method is employed to incorporate the effect of strong electric fields.