Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

Dirac dynamics of stationary light in 1D: Klein tunneling and Zitterbewegung JOHANNES OTTERBACH, RAZMIK UNANYAN, MICHAEL FLEISCHHAUER, University of Kaiserslautern — In order to create nonlinear interactions between single photons in an atomic ensemble it is necessary to have long interaction times and high electric fields per photon. One possibility to achieve this is to use stationary light in setups exhibiting electromagnetically induced transparency (EIT). We analyze the ultimate limit of compression of stationary photonic excitations and show that at pulse lengths as small as the absorption length the probe pulses have to be described by an effective Dirac equation for a two-component spinor. The effective speed of light and the effective mass entering this equation can be controlled externally and can be made many orders of magnitude smaller than the corresponding quantities for graphene, fermionic atoms and electrons. Consequently relativistic behavior can be observed at much larger length scales and much lower energies. As a result of this the compression limit, given by the corresponding Compton length, can be macroscopic. We discuss certain predictions of the Dirac theory as e.g. Klein tunneling and the Zitterbewegung.

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Date submitted: 22 Jan 2009 Electronic form version 1.4