Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Selective scattering between Floquet-Bloch and Volkov states in a topological insulator FAHAD MAHMOOD, CHING-KIT CHAN, ZHANYBEK ALPICHSHEV, DILLON GARDNER, YOUNG LEE, PATRICK LEE, NUH GEDIK, Massachusetts Inst of Tech-MIT — The coherent optical manipulation of solids is emerging as a promising way to engineer novel quantum states of matter. The strong time periodic potential of intense laser light can be used to generate hybrid photon-electron states. Interaction of light with Bloch states leads to Floquet-Bloch states which are essential in realizing new photo-induced quantum phases. Similarly, dressing of free electron states near the surface of a solid generates Volkov states which are used to study non-linear optics in atoms and semiconductors. The interaction of these two dynamic states with each other remains an open experimental problem. Here we use Time and Angle Resolved Photoemission Spectroscopy (Tr-ARPES) to selectively study the transition between these two states on the surface of the topological insulator Bi_2Se_3. We find that the coupling between the two strongly depends on the electron momentum, providing a route to enhance or inhibit it. Moreover, by controlling the light polarization we can negate Volkov states in order to generate pure Floquet-Bloch states. This work establishes a systematic path for the coherent manipulation of solids via light-matter interaction.

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Date submitted: 06 Nov 2015 Electronic form version 1.4