Abstract Submitted for the MAR13 Meeting of The American Physical Society

Direct Measurement of the Zak phase in Topological Bloch Bands MARCOS ATALA, MONIKA AIDELSBURGER, Ludwig-Maximilians Universitat, JULIO BARREIRO, Ludwig-Maximilians Universitat and Max-Planck Institute of Quantum Optics, DMITRY ABANIN, TAKUYA KITAGAWA, EUGENE DEM-LER, Harvard University, IMMANUEL BLOCH, Ludwig-Maximilians Universitat and Max-Planck Institute of Quantum Optics — Geometric phases that characterize the topological properties of Bloch bands play a fundamental role in the modern band theory of solids. Here we report on the direct measurement of the geometric phase acquired by cold atoms moving in one-dimensional optical lattices. Using a combination of Bloch oscillations and Ramsey interferometry, we extract the Zak phase – the Berry phase acquired during an adiabatic motion of a particle across the Brillouin zone – which can be viewed as an invariant characterizing the topological properties of the band. For a dimerized optical lattice, which models polyacetylene, we measure a difference of the Zak phase equal to π for the two possible polyacetylene phases with different dimerization. This indicates that the two dimerized phases belong to different topological classes, such that for a filled band, domain walls have fractional quantum numbers. Our work establishes a new general approach for probing the topological structure of Bloch bands in optical lattices.

> Dmitry Abanin Harvard University

Date submitted: 09 Nov 2012

Electronic form version 1.4