Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

All-Optical Materials Design of Dissipationless Chiral Edge Modes in Transition-Metal Dichalcogenides MARTIN CLAASSEN, Department of Applied Physics, Stanford University, CHUNJING JIA, BRIAN MORITZ, THOMAS DEVEREAUX, Stanford Institute for Materials and Energy Sciences, SLAC Stanford University — Spurred by the recent progress in transient melting, enhancement and induction of electronic order, a particularly tantalizing prospect concerns the possibility to instead access dynamical steady states with distinct non-equilibrium phase transitions, to affect electronic transport. Here, we show that the interplay of crystal symmetry and optical pumping of monolayer transition-metal dichalcogenides (TMDCs) provides a novel avenue to engineer topologically-protected chiral edge modes, facilitating optically-switchable conduction channels that are insensitive to disorder. Intriguingly, while TMDCs are canonically described as condensed-matter realizations of massive relativistic fermions, here we predict from first principles that circularly-polarized pumping instead accesses the intrinsic three-band nature near the band edges to selectively photo-induce topological band inversions at low pump intensities, while simultaneously limiting absorption for sub-gap pump frequencies. The results presented provide a new strategy to predict and design topological materials out of equilibrium, and should be readily applicable to other classes of semiconductors.

Martin Claassen
Stanford University

Date submitted: 06 Nov 2015

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