Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Effective hydrodynamic field theory and condensation picture of topological insulators ATMA CHAN, University of Illinois at Urbana-Champaign, THOMAS KVORNING, Stockholm University, SHINSEI RYU, EDUARDO FRADKIN, University of Illinois at Urbana-Champaign — While many features of topological band insulators are commonly discussed at the level of singleparticle electron wave functions, such as the gapless Dirac spectrum at their boundary, it remains elusive to develop a hydrodynamic or collective description of fermionic topological band insulators in 3+1 dimensions. As the Chern-Simons theory for the 2+1-dimensional quantum Hall effect, such a hydrodynamic effective field theory provides a universal description of topological band insulators, even in the presence of interactions, and that of putative fractional topological insulators. In this paper, we undertake this task by using the functional bosonization. The effective field theory in the functional bosonization is written in terms of a two-form gauge field, which couples to a U(1) gauge field that arises by gauging the continuous symmetry of the target system (the U(1) particle number conservation). Integrating over the U(1) gauge field by using the electromagnetic duality, the resulting theory describes topological band insulators as a condensation phase of the U(1) gauge theory (or as a monopole condensation phase of the dual gauge field). The hydrodynamic description, and the implication of its duality, of the surface of topological insulators are also discussed.

Shinsei Ryu
University of Illinois at Urbana-Champaign

Date submitted: 04 Nov 2015 Electronic form version 1.4