Wannier representation of $Z_2$ topological insulators ALEXEY SOLUYANOV, Rutgers University, DAVID VANDERBILT — We consider the problem of constructing Wannier functions for $Z_2$ topological insulators. For Chern insulators it is well known that there is a topological obstruction to the construction of Wannier functions, and one may wonder whether this is also true in the $Z_2$ case. We consider a model system for the $Z_2$ problem in 2D. In the $Z_2$-even phase the system is an ordinary insulator, and the usual projection-based scheme can be used to build the Wannier representation. In the $Z_2$-odd phase we do find a topological obstruction, but only if one insists on choosing a gauge that respects the time-reversal symmetry, corresponding to Wannier functions that come in time-reversal pairs. If instead we are willing to violate this gauge condition, a Wannier representation becomes possible. We present a scheme for constructing Wannier functions for the $Z_2$-odd phase, showing explicitly that the Wannier functions do not come in Kramers pairs despite the presence of time-reversal symmetry.

Alexey Soluyanov
Rutgers University

Date submitted: 19 Nov 2009

Electronic form version 1.4