"Disordered Topological Insulators: Exact Characterizations using Non-Commutative Geometry"

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The classification and characterization of perfectly periodic Topological Insulators can be reduced to exercises in topology over the classical Brillouin torus. A generic statement about these systems, which now can be found quite often in the recent literature in a form or another, goes like this: the formula $X$ defines a topological number for the system $Y$ which remains quantized and invariant as long as the spectral energy gap remains open. For disordered systems, one would like to generalize this statement by replacing the spectral energy gap with the mobility gap. The most important physical consequence of such generalized statement is the presence of mobility edges harboring extended bulk states in Topological Insulators. Experimentally these extended states can be access by gating the topological films or by doping in the bulk, and can be put to work in various applications.

Non-commutative Geometry (NCG) seems to provide the natural framework for the analysis of disordered Topological Insulators. It enables a natural generalization of the classical Brillouin torus, to what is now known as the Non-Commutative Brillouin torus, and statements like the one mentioned above can be generated via Index theorems. In this talk I will exemplify how this machinery works, through a discussion of the non-commutative electric polarization, of the non-commutative higher Chern and spin-Chern numbers, of the non-commutative magneto-electric response. Explicit computer calculations will be presented, including phase diagram mappings via NCG, and analyses of the quantum critical regime at the topological-to-trivial transition via the non-commutative Kubo-formula.

Time and date: 10:30 AM, Friday, Sept. 20, 2013 (+coffee beforehand)
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