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Generalized Ginsparg-Wilson relations: Fermionic anomalies and topological phases on the lattice

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A lattice formulation of non-Abelian chiral gauge theories has long been an open problem. One of the most important developments motivated by this question is the Ginsparg-Wilson (GW) relation, which encodes how the anomalous chiral symmetry "optimally" manifests on the lattice. Developments in condensed-matter physics have uncovered a deep connection between anomalies and topological insulators/superconductors. Domain-wall fermions used in lattice QCD simulations can be understood as a special case of this. Since domain-wall fermions are also a solution to the GW relation, we may ask: can the GW relation be generalized to other topological phases? We show that it is possible to write down such generalized GW relations, as well as corresponding overlap operators. Interestingly, perturbative and even some global anomalies (à la Witten) show up in this formalism in an elementary fashion from the Jacobian of the fermionic measure.

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