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Weak symmetry breaking in two dimensional topological insulators[1] CHENJIE WANG, MICHAEL LEVIN, Univ of Chicago — We show that there exist 2D time reversal invariant fractionalized insulators with the property that both their boundary with the vacuum and their boundary with a topological insulator can be fully gapped without breaking any symmetries. This result leads us to an apparent paradox: we consider a geometry in which a disk-like region made up of a topological insulator is surrounded by an annular strip of a fractionalized insulator, which is in turn surrounded by the vacuum. If we gap both boundaries of the strip, we naively obtain an example of a gapped interface between a topological insulator and the vacuum that does not break any symmetries – an impossibility. The resolution of this paradox is that this system spontaneously breaks time reversal symmetry in an unusual way, which we call weak symmetry breaking. In particular, we find that the only order parameters that are sensitive to the symmetry breaking are nonlocal operators that describe quasiparticle tunneling processes between the two edges of the strip; expectation values of local order parameters vanish exponentially in the limit of a wide strip. Also, we find that the symmetry breaking comes with a ground state degeneracy, but the degeneracy is topologically protected, rather than symmetry protected.

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Chenjie Wang
Univ of Chicago

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