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Topological phases in 1d and 2d SU(N) models

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Alkaline-earth and ytterbium cold atomic gases make it possible to simulate SU(N)-symmetric fermionic systems in a very controlled fashion. Such a high symmetry is expected to give rise to several exotic phases, for instance molecular Luttinger liquids or symmetry-protected topological (SPT) phases in one dimension [1]. Using a bichromatic optical lattice to realize a one-dimensional ladder, it is possible to stabilize SU(N) chiral Haldane phases that also break reflection symmetry [2], which can be understood from an effective two-leg ladder model where all possible N SPT phases have been found using analytical and numerical approaches [3].

In two dimensions, topological phases known as chiral spin liquids, which are the analogous of quantum Hall phases for spin systems, can also be realized in SU(N) models. We have proposed a family of generic time-reversal symmetry breaking SU(N)-symmetric models, of arbitrary $N \geq 2$, in the fundamental representation, that stabilize Abelian chiral spin phases as found by using a combination of complementary numerical methods such as exact diagonalizations, infinite density matrix renormalization group and infinite Projected Entangled Pair State.

We will discuss possible observation of such topological phases in ultracold atom setups.

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