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Restricted Spin Set Lattice Models: A Route to Topological Order[1] R. ZACHARY LAMBERTY, Cornell University, STEFANOS PAPANIKOLAOU, Yale University, C.L. HENLEY, Cornell University — A typical lattice gauge model configuration consists of elements of a finite symmetry group G placed on directed edges of a two-dimensional lattice. We consider generalized models[2] which are defined by instead only allowing elements from a subset $S \subset G$ consisting of certain classes of group elements. The subset restriction can be regarded as a new (but discrete) tunable model parameter, providing a novel pathway to topologically ordered phases. Taking a small allowed set S, we can realize well understood critical models (e.g. the square lattice ice model or dimer covering); in contrast, for large enough S the configuration ensemble realizes a form of topological order. Using a sequence of sets $S_1 \subset S_2 \subset \ldots$, we can "interpolate" from one kind of state to the other. This is confirmed by Monte Carlo simulations, measuring two characteristic properties: (1) the distribution of separations between two (possibly deconfined) topological defects, and (2) the relative probabilities of different sectors (sub-ensembles with inequivalent products of the group elements around the periodic boundary conditions). We also discuss how to construct quantum-mechanical extensions of these models.

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[2]C. L. Henley, J. Phys. Condens. Matter. 23, 164212 (2011).

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