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Hamiltonian models for topological phases of matter in three spatial dimensions

We present commuting projector Hamiltonian realizations of a large class of (3+1)D topological models based on unitary G-crossed braided fusion categories. This construction comes with a wealth of examples from the physics literature on symmetry-enriched topological phases. The spacetime counterparts to our Hamiltonians are a family of unitary state sum topological quantum fields theories (TQFTs), recently defined by Cui, that appear to capture all known constructions in the literature, including the Crane-Yetter-Walker-Wang and 2-Group gauge theory models. We also present Hamiltonian realizations of another state sum TQFT family, recently constructed by Kashaev, whose relation to existing models was previously unknown. We argue that these TQFTs are captured as a special case of the Crane-Yetter-Walker-Wang model, with a premodular input category in some instances.