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**Shawn X Cui\*** (xingshan@stanford.edu). *Four Dimensional Topological Quantum Field Theories.*

We give an introduction to topological quantum field theories (TQFTs), which have wide applications in low dimensional topology, representation theory, and topological quantum computing. In particular, TQFTs provide invariants of smooth manifolds. We give an explicit construction of a family of four dimensional TQFTs. The input to the construction is a class of tensor categories called  $G$ -crossed braided fusion categories where  $G$  is any finite group. We show that our TQFTs generalize most known examples such as Yetter's TQFT and the Crane-Yetter TQFT. It remains to check if the resulting invariant of 4-manifolds is sensitive to smooth structures. It is expected that the most general four dimensional TQFTs should arise from spherical fusion 2-categories, the proper definition of which has not been universally agreed upon. Indeed, we prove that a  $G$ -crossed braided fusion category corresponds to a 2-category which does not satisfy the criteria to be a spherical fusion 2-category as defined by Mackaay. Thus the question of what axioms properly define a spherical fusion 2-category is open. (Received February 12, 2018)