THE CHINESE UNIVERSITY OF HONG KONG
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Higher Dimensional Topological Order, Higher Category and a Classification in 3+1D

by

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ALL INTERESTED ARE WELCOME
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Abstract

Topological orders are gapped quantum liquid states without any symmetry. Most of their properties can be captured by investigating topological defects and excitation of various dimensions. Topological defects in n dimensions naturally form a (weak) n-category. In particular, anomalous topological order (boundary theory) is described by fusion n-category and anomaly-free topological order (bulk) is described by non-degenerate braided fusion n-category. Holographic principle works for topological orders: boundary always has a unique bulk. Another important property in 3+1D or higher is that point-like excitations must have trivial statistics; they must carry representations of a certain group. Such a "gauge group" is hidden in every higher dimensional topological order. In 3+1D, condensing point-like excitations leads to a canonical boundary which in turn determines the bulk topological order. By studying such boundary, a rather simple classification is obtained: 3+1D topological orders are classified by the above "gauge group" together with some cocycle twists. These ideas would also play an important role in dimensions higher than 3+1D and in the study of higher categories, topological quantum field theories and other related subjects.

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