# GAPPED BOUNDARIES AND DEFECTS IN LEVIN-WEN MODELS

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Topological order has become an important subject of study in condensed matter physics after the discovery of fractional quantum Hall effect. It also has potential applications in topological quantum computing. Levin-Wen models describe a large class of non-chiral topological orders at RG fixed points. It can be viewed as a Hamiltonian version of Turaev-Viro TQFTs.

In this talk, we will show how to use the representation theory of unitary finite fusion categories to enrich the Levin-Wen models with boundaries and defects of codimension 1,2,3. The physical phase of these models are characterized by the properties of excitations (or quasi-particles, or anyons). We will show that excitations in the bulk and on the boundary and defects can be classified by the superselection sectors of local operator algebras which are naturally determined by the lattice configurations in the neighborhood of the excitations. For the simplest configurations, these local operator algebras can be enhanced to weak $C^*$-Hopf algebras.

We will move one step further by showing that these superselection sectors are equivalent to the simple (bi-)module functors between (bi-)module categories over a unitary finite fusion category. As a consequence, we obtain the boundary-bulk duality, which says that a boundary theory determines the bulk theory uniquely, but a bulk theory only determines the Morita class of its boundary theories. We will also show a precise correspondence between bulk dualities and invertible defect lines.

In the end, we will discuss the connection between our theory and extended Turaev-Viro TQFTs. This is a joint work with Alexei Kitaev.

*Keywords*: topological order, weak Hopf algrebra, excitations, defects, module categories, module functors, extended TQFTs

[1] Alexei Kitaev, Liang Kong, Models for gapped boundaries and domain walls, [arXiv:1104.5047].