

DAY 5: 13:30 – 14:10

## Topological discrete algebra in topological orders

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Algebraic structures in topological orders are discussed. Topological order in two dimensional systems is studied by combining the braid group with a gauge invariant analysis. We show that flux insertions pertinent to the toroidal topology induce automorphisms of the braid group, giving rise to a unified algebraic structure that characterizes the ground-state subspace and fractionalization in topological order. The analysis can be generalized to systems in a higher dimensions or those with non-Abelian gauge symmetries. In latter systems, topological order is found to be closely related to quark (de)confinement phenomena in QCD.

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DAY 5: 14:10 – 14:50

## A Geometric Approach to Magnetization Plateaus

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The problem of magnetization plateaus is reconsidered from the viewpoint of Berry phases. In 1D, it is well-known that a twist argument a la Lieb-Schultz-Mattis (LSM) leads to the so-called quantization condition of Oshikawa, Yamanaka and Affleck. A similar argument has been applied in higher dimensions to obtain a similar condition. However, it is not clear why (i) LSM argument, which tells about existence/inexistence of particle-hole gap, gives the meaningful statement concerning plateaus and (ii) a similar quantization condition holds in higher dimensions as well. We clarify these points with a combined use of Berry phase theory of crystal momentum and effective field theories. (w/ A. Tanaka)