Abstract

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Stability of anyonic superselection sectors

Joint with Matthew Cha and Bruno Nachtergaele

Two states are said to be in the same gapped phase if they are the ground states of a pair of gapped local Hamiltonians that can be connected by a continuous path of local Hamiltonians with a uniform spectral gap. Topologically ordered states have the interesting property that they give rise to excititations with braided statistics, called anyons. Their properties are encoded by a (typically modular) braided tensor category, describing the superselection sector theory of the model. This is believed to be an invariant of the gapped quantum phase. In our work we prove that this is true for an interesting class of quantum spin systems, using only a few physically transparant assumptions. To do this, we generalise earlier results on Doplicher-Haag-Roberts theory for quantum spin systems, to allow for excitations that can only be approximately localised. Two ingredients in our analysis are the (bi-)asymptopias introduced by Buchholz et al., and a Lieb-Robinson bound for quasi-local observables localised in infinite cone-like regions. These bounds allow us to show that the structure remains invariant after applying an automorphism with sufficient decay properties, such as obtained from the spectral flow (also called quasi-adiabatic continuation). With these results we then prove that the sector structure of abelian quantum double models is invariant under sufficiently small perturbations of the dynamics.