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Topological index for fermion systems in disordered media

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A considerable number of mathematical results regarding gapped Hamiltonians of fermions were achieved in recent years. Among the most important are topological protection under small perturbations and the persistence of the spectral gap for interacting fermions. However, information on the classification of the underlying systems in terms of topological indices is lacking. We show the first step towards the relation between a sort of topological index σ, introduced at the 80's by Araki and Evans for gapped Hamiltonians of interacting fermion systems on the lattice. Our mathematical framework are Self–dual CAR Algebras (sCAR), whose structure contains the information on the symmetries of free fermions embedded in disordered systems, and are also useful to study interacting fermion systems even with supperconductors terms. Last but not least, sCAR are closely related to the Shale–Stinespring Theorem. The latter plays an important role in the study of Fredholm modules in the context of Clifford and CAR algebras. In this way a new approach encompassing examples of both topological as well as more traditional types of phase transitions of simple models, and which is close in spirit to noncommutative geometry, is proposed. Finally, I will comment how to tackle the problem of classification of Gapped Hamiltonians in terms of σ for the interparticle case.