Advanced Topics in Theoretical Physics

TOPOLOGY AND STRONGLY INTERACTING FERMIONS

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2PM TUESDAY JANUARY 30, 2018

We study a 4d lattice model of massless fermions interacting through a particular four fermion term. Exact symmetries prevent the generation of bilinear fermion mass . Using an auxiliary field representation we generate the one-loop effective action and show that it has non-trivial topological features which manifest in the form of Hopf defects.Fermions propagating in the background of these defects become massive without breaking any symmetries.Furthermore pairs of such defects experience a logarithmic interaction. We argue that a phase transition separates a phase where these defects proliferate from a broken phase where they are bound tightly. We conjecture that by tuning one additional operator the broken phase can be eliminated with a single BKT-like phase transition separating the massless from massive phase.

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