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Four-Fermion Theories with Exact Chiral Symmetry in Three Dimensions

Wednesday, July 27, 2016 10:00 AM (20 minutes)

We investigate a class of quantum field theories of fermions interacting by a quartic coupling.
This includes well-known models like the Gross-Neveu model and the Thirring model.
In three spacetime dimensions, these models are used to describe properties of solid state systems like high temperature superconductors and graphene.
Additionally, they are interesting as toy models to study chiral symmetry breaking.

The Gross-Neveu model always has a broken and a symmetric phase, while the existence of a broken phase in the Thirring model depends on the number of fermion flavours.
The critical number of fermion flavours for chiral symmetry breaking is still subject of ongoing discussion.
Using SLAC fermions, we are able to simulate the Thirring model with exact chiral symmetry, but the chiral condensate is not obtainable on a finite lattice without explicit breaking.

The talk presents approaches to circumvent this problem.
We use Fierz identities to transform the Thirring model into other four-fermion models, where the chiral condensate does not vanish.
These models show a sign problem, which is not present in the original Thirring model.
We present an algorithm inspired by fermion bags, which may overcome this short coming.
As a second approach, the chiral symmetry breaking of a larger class of four-fermion models is studied.

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