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Fermion Mass Generation without a chiral condensate

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Massless fermions can become massive due to interactions through the mechanism of Spontaneous Symmetry Breaking (SSB). This mode of mass generation is popular and has been used in the Standard Model. Here, we explore
the possibility of fermions acquiring a mass through interactions, but without SSB.\\
We consider a fermion system on a cubical lattice and introduce an on-site four-fermion interaction with coupling constant U. Using the symmetries of the system on the lattice, we can predict
the existence of massless fermions for small U. For very large values of U, we can argue that the fermions become massive without the formation of a fermion bilinear condensate.
Monte Carlo results suggest that chiral condensate is zero for all values of the coupling constant. We show that the phase transition from the massless to the massive phase is second order. We also calculate
the critical exponents of the theory. The existence of a second order phase transition implies that one can take the continuum limit of the lattice model and obtain an interesting Quantum Field Theory with a new mechanism for fermion mass generation.

Summary

We seem to have a lattice model where fermions acquire a mass, but the chiral condensate remains zero. The phase transition from massless to massive phase seems to be second-order.

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