MAR15-2014-002581

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Lars Onsager Prize Talk: Flow Equations for Hamiltonians

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The equation $dH(l) = GH(l)$ can describe the renormalization group equation for the Hamiltonian/Lagrangian $H(l)$ and the generator G of the group. But it can also describe a Hamiltonian flow for bosons/fermions, which eliminates the off-diagonal matrix elements or (quasi)-particle violating terms by means of unitary transformations $dH(l)/dl = [\eta(l), H(l)]$. Typically off-diagonal matrix elements are eliminated for $\Delta E > l^{-1/2}$. The flow equation has been applied to numerous systems (F. Wegner, J. Phys. A: Math. Gen. 39 (2006) 8221, arXiv: cond-mat/0511660; S. Kehrein, The Flow Equation Approach to Many-Particle Systems, Springer 2006), among them to the two-dimensional Hubbard-model, spin-boson models, the Anderson impurity model, QED and QCD. A simple and surprising result (as compared to that by Frohlich) is obtained for the elimination of the electron-phonon interaction yielding an attractive interaction for all energies. (P. Lenz and F. Wegner, Nucl. Phys. B482 (1996) 693; arXiv: cond-mat/9604087).