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The Hubbard model in the canonical formulation

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We formulate the many-body system of non-relativistic fermions (Hubbard model) in the canonical formulation using transfer matrices in fixed fermion number sectors. By analytically integrating out the auxiliary Hubbard-Stratanovich field due to the four-fermion interaction, we express the system in terms of discrete, local fermion occupation numbers which are the only remaining degrees of freedom. We show the close relation to the fermion loop and the fermion bag formulation. Then we demonstrate and prove that in 1+1 dimension the fermion sign problem is absent. Finally, we construct improved estimators for fermionic correlation functions and for the chemical potential, and present results for arbitrary densities, spin-polarizations and mass-imbalances.

Authors: Mr WENGER, Urs (University of Bern); Mr BURRI, Sebastian (University of Bern)

Presenter: Mr WENGER, Urs (University of Bern)

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