Contributed Talks

- Fakher Assaad, "*Numerical simulations of correlated quantum matter: from models to field theories*", A joint talk of the Saha Institute and ALF Workshop: https://meet.google.com/itk-qigc-vei

  Abstract: The interpretation of phases and quantum phase transitions that are realized in nature and in model calculations very often hinge on field theories. In this talk I will concentrate on various phases of heavy fermions systems – magnetic impurities embedded in metallic environments – and show how they relate to Higgs condensates and de-confined phases. If time allows, I will furthermore touch on exotic phase transitions in Dirac systems.

- Maksim Ulybyshev, "*Heavy tail distributions in fermionic Quantum Monte Carlo: their origins and ways to suppress them*"

  Abstract: If we look at the history of some observable during the Markov process of QMC simulation, we sometimes can observe so-called "spikes": sporadically, the observable acquires the values, which are quite different from mean value, much further away than average fluctuations. If spikes are severe enough, the simulation converges very slowly. It means that in long Markov process for spike-prone model, we can always expect the appearance of a single configuration of auxiliary fields hosting the values of observables, which are so large or so small, that they can substantially shift the resulting mean value. Thus the mean value stabilizes too slowly or even does not stabilize at all.

  We formalize the treatment of these spikes on the basis of heavy-tailed distributions. In-depth analysis of the structure of the path integrals shows that these heavy-tailed distributions are direct consequence of the zeros of fermionic determinant. On the basis of this knowledge, we propose a method to mitigate heavy-tailed distributions ("spikes") in fermion Quantum Monte Carlo. We show that by merely changing the synchronization between local updates and computation of observables, one can reduce the prefactor of the heavy-tailed distribution, thus substantially suppressing statistical fluctuations of observables. The method is especially suitable for local observables similar to e.g. double occupancy, where the resulting speedup can reach two orders of magnitude. For observables, containing spatial correlators, the speedup is more moderate, but still ranges between five and ten. Our results are independent on the nature of the auxiliary field, discrete or continuous, and pave the way to improve measurement strategies for Hybrid Monte Carlo simulations