PMQ30 Variational methods for strongly-correlated systems: Can quantum computers boost classical computers?

Thématiques : Quantum Computing, Many-Body Physics, Variational Methods, Numerical methods

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Lien avec GDR ou autres structures : GDR IQFA, GDR NBODY, GDR MEETICC

Nombre de participants : 40

Résumé

Variational methods have been used successfully for decades to study the properties of strongly-correlated systems in condensed-matter physics and quantum chemistry. To deal with the exponential size of the Hilbert space, these methods construct clever families of variational states parameterized by a reduced number of parameters, and then set out to find, analytically or numerically (with a classical computer), the "optimal" set of parameters under some well-chosen criterion, like minimizing the energy. These methods, which include e.g. variational Monte Carlo [1] or tensor network methods [2,3], thus allow to study large systems out of the reach of exact diagonalization, for correlated/frustrated systems for which the notorious "sign problem" forbids the usage of large-scale quantum Monte-Carlo methods [1].
Recently, with the advent of noisy, intermediate-scale quantum computers [4], proposals have been put forth to speed up such variational algorithms by delegating the construction of variational states and the measurement of their energy to quantum computers in their digital [5,6] as well as analog form [7]. These proposals are facing many challenges ranging from finding variational states that can easily be constructed on a given processor, to how to choose ansatz states that are robust to decoherence [8], over how to design classical optimization strategies that work in the presence of stochastic noise. Despite these challenges, these methods are being tested on many small quantum systems [9,10] and can potentially give access to variational states that could otherwise not be represented on classical computers.
The goal of this colloquium is to gather experts in variational methods from both the classical and quantum computing worlds.

Références :

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