Computational Methods for Correlated Quantum Systems in Condensed Matter

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Correlated quantum systems in Condensed Matter confront theoretical physics with big challenges. The inclusion of strong correlations enforces descriptions of the condensed matter systems using many-body representation. This lead to exponential growth on the number basis states and make direct full solution not possible, even for systems with few dozens of electrons using the most powerful classical computing systems. However, accurate understanding of such correlated systems is important for the advancement of fundamental researches as well as high technological applications in condensed matter and material sciences.

Therefore, several numerical methods have been developed to give accurate solutions for correlated systems in condensed matter. These methods allow deeper understanding of physical properties beyond the band theory and mean field approximations. These methods include *dynamical mean field theory (DMFT)*, *quantum Monte Carlo methods (QMC)*, *density matrix renormalization group method (DMRG)*, etc.

For instance, DMRG is a very powerful method to study quasi one dimensional electronic systems with short range interactions. Over the years, it has been established as a variational method within class of states the so called matrix product states. This offer a very interesting link to quantum information theory and allow for very useful advances in problems with real time evolution, two-dimensionl systems, etc.

Therefore, this letter of interest aims to draw the attention on the importance of considering high quality researches and education in computational methods for correlated quantum systems in condensed matter within the *African Strategy for Fundamental and Applied Physics (ASFAP)*. The advancement in this field is not only important for condensed matter physics but can establish resources and infrastructures for other fields and enhance interdisciplinary researches.