Contribution ID: **24** Type: **Invited Talk**

From Few to Many: Recent Advances in Ab Initio Nuclear Structure Calculations

Wednesday, 2 August 2023 12:25 (35 minutes)

A first-principle description of atomic nuclei requires the use of two- and three-nucleon interactions combined with an efficient many-body solution for the nuclear state. In particular the treatment of chiral three-body operators provides a significant computational challenge due to high memory requirements. In the first part of my talk, I will discuss two complementary ways to cope with that challenge by approximating chiral three-nucleon forces, either from low-rank matrix factorizations [1] or normal-ordering techniques [2]. The two frameworks are benchmarked in atomic nuclei, from triton up to lead.
In the second part, I will introduce the density matrix renormalization group (DMRG) approach and show how the DMRG outperforms traditional diagonalization-based approaches by using a factorized matrix-product-state representation of the many-body wave function. I will further discuss the use of entanglement entropies as a proxy for nuclear shell effects along medium-mass isotopic chains [3].
Eventually, the combination of accurate nuclear interactions with scalable many-body approaches will pave the way for further high-precision calculations in exotic nuclei.

[1] A. Tichai, P. Arthuis, M. Heinz, K. Hebeler, J. Hoppe, T. Miyagi and A. Schwenk (in preparation, 2023)
[2] K. Hebeler, V. Durant, J. Hoppe, M. Heinz, A. Schwenk, J. Simonis and A. Tichai, Phys. Rev. C 107, 024310 (2023)
[3] A. Tichai, S. Knecht, A.T. Kruppa, Ö. Legeza, C.P. Moca, A. Schwenk, M.A. Werner and G. Zarand, arXiv:2207.01438 (2022)

Primary author: Dr TICHAI, Alexander (TU Darmstadt)

Presenter: Dr TICHAI, Alexander (TU Darmstadt)

Session Classification: Wednesday Plenary Session (AudiMax)