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Many-Body Quantum Physics with Tensor Networks[1] PAWAN KHATIWADA, IMRAN MIRZA, Miami University, MACKLIN QUANTUM INFORMATION SCIENCES TEAM — The accurate prediction of the ground state and interesting exciting states in many-body quantum systems is a daunting task due to an exponential problem size growth with the number of interacting atoms. To deal with this problem, in condensed matter physics either approximate mean-field theories are proposed, or fast numerical algorithms are developed which consume a lot of computational resources. In the 1990s with the advent of quantum computing, entanglement has been recognized as one of the main resources in quantum information sciences. In the early 2000s, the physicists introduced the Tensor Network (TN) theory (and the notion of matrix product states) [*] as a novel way to study interesting states of many-body quantum systems. TN theory makes use of the structure of entanglement of the many-body systems to make predictions about the energy configuration of the system. In this work, we present a brief overview of TN theory accessible to a graduate-level or an advanced undergraduate-level audience.
[*] Román Orús. "A practical introduction to tensor networks: Matrix product states and projected entangled pair states." Annals of Physics 349 (2014): 117-158.

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