The Density Matrix Renormalization Group and Nuclear Structure

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The Density Matrix Renormalization Group (DMRG) was originally introduced by Steven White in the early 1990s to treat the properties of quantum lattices. It quickly proved to be enormously successful, producing for the ground state energy of the spin-1 Heisenberg chain results that were accurate to 12 significant figures, well beyond what was achievable with any other approximate many-body method. Subsequently, the method was applied with great success to other 1D lattices, including spin chains and t-J and Hubbard models. The model in its original formalism, which worked in terms of real space lattice sites, has also been applied, though with much less success, to some 2D lattices as well.

Subsequently, the DMRG method was reformulated so as not to work solely in terms of real space lattice sites. In this extended version, the method has proven extremely useful in the description of finite Fermi systems, as arise for example in quantum chemistry and in the physics of small metallic grains. The successes achieved in these domains suggests the possible usefulness of the DMRG method in the description of another finite Fermi system, the atomic nucleus. In this presentation I will describe the DMRG method and review the current status of efforts to implement it in the context of large-scale nuclear shell model calculations.