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Developing SUNDMRG.jl

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Based on the previous idea of implementing SU(N) symmetries in the density matrix renormalization group (DMRG) [1], we invented a new algorithm, which has been helpful in extending the previous standard-Young-tableaux approach to generic two-dimensional models, for SU(N)-symmetric DMRG [2]. This new algorithm intensively uses the so-called 9ν coefficients of SU(N) irreducible representations, which are the simplest generalization of the 6j/9j-symbols implementation of SU(2).

SUNDMRG.jl [3] is a Julia implementation of our new algorithm. Not only by strictly implementing such a complicated simulation but also by supporting MPI/CUDA high-level parallelization have we achieved the world-record-level DMRG code. More than a million effective bond dimensions can be used in the calculation on the GPU system with two NVIDIA A100s, for example. Parallel GPU simulations are highly suitable for the next-generation DMRG simulation for two-dimensional correlated matters, revealing a hidden side of the quantum correlation in condensed matter systems.
[1] P. Nataf and F. Mila, Phys. Rev. B **97**, 134420 (2018).
[2] M. G. Yamada, K. Penc, and F. Pollmann, to appear.
[3] https://github.com/MGYamada/SUNDMRG.jl

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