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Entanglement entropy for arbitrary quantum lattice models from quantum Monte Carlo TOMMASO ROSCILDE, Ecole Normale Supérieure de Lyon (France), STEPHAN HUMENIUK, Ecole Normale Supérieure de Lyon (France) and Ludwig-Maximilians-Universitaet, Munich (Germany) — We present a general scheme to numerically calculate the Renyi entropy for the reduced density matrix of a subsystem in a quantum lattice model at finite and (physically) zero temperature. This scheme is based on an extended-ensemble formulation of quantum Monte Carlo, which can be applied in principle to any quantum Monte Carlo algorithm. It improves on the existing approach of R. G. Melko et al., Phys. Rev. B 82, 100409(R) (2010) and of M. B. Hastings et al., Phys. Rev. Lett. 104, 157201 (2010) in that it allows to probe the ground-state properties of lattice models regardless of their symmetry - as long as they admit an efficient quantum Monte Carlo algorithm. We test the entanglement entropy scaling of fundamental quantum spin models, showing e.g. that the two-dimensional XX model, describing lattice hardcore bosons, exhibits an area law despite lacking an intrinsic length scale for the decay of correlations.

Tommaso Roscilde
Ecole Normale Supérieure de Lyon (France)

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