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Tensor Network Algorithms for Braiding Anyons BABATUNDE AYENI, SUKHWINDER SINGH, Centre for Engineered Quantum Systems, Macquarie University, ROBERT PFEIFER, Dept. of Physics Astronomy, GAVIN BRENNEN, Centre for Engineered Quantum Systems, Macquarie University — Anyons are point-like (quasi)particles which exist only in two-dimensional systems and have exchange statistics that are neither bosonic nor fermionic. These particles were first proposed as a mere theoretical curiosity, but it was later shown that they arise in topological states of matter and that certain species of non-Abelian anyons can be used for low error quantum computation. Despite the importance of anyons, fundamentally and technologically, comparatively little is understood about their many body behaviour especially when the non local effects of braiding are taken into account. This largely due to the lack of efficient numerical methods to study them. In order to circumvent this problem, and to broaden our understanding of the physics of anyons, the authors have developed several numerical methods based on tensor network algorithms including: anyonic Matrix Product States (MPS), anyonic Time Evolving Block Decimation (TEBD), anyonic Density Matrix Renormalization Group (DMRG), and Anyonic U(1) MPS. These can be used to simulate static interacting and itinerant braiding anyons on a finite or infinite lattice. We have used our methods to study the phase diagrams of some species, such as Abelian Z3 anyons and non-Abelian Fibonacci and Ising.

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