Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Topological phases of parafermions: a model with exactly-solvable ground states CHRISTOPHE MORA, Laboratoire Pierre Aigrain Ecole Normale Suprieure , FERNANDO IEMINI, ICTP Trieste and Scuola Normale Superiore, Pisa, LEONARDO MAZZA, Dpartement de Physique, Ecole Normale Suprieure — Parafermions are the simplest generalization of Majorana fermions: they show non-Abelian fractional statistics and can realize topological order. We present a non-trivial and quasi-exactly-solvable model for a chain of parafermions in a symmetry-protected topological phase. We characterize analytically the ground-state wavefunctions, which are matrix-product states and have a particularly elegant interpretation in terms of Fock parafermions, reflecting the factorized nature of the ground states. Using these wavefunctions, we demonstrate analytically several signatures of topological order such as non-local edge-edge correlations, the presence of edge zero modes and the threefold degeneracy of the entanglement spectrum. Our model also provides a typical example of weak edge modes which are not commuting with the full Hamiltonian.

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Date submitted: 10 Nov 2016 Electronic form version 1.4