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Spin-Hamiltonian for the Quantum Hall State in a Ladder Geometry ELIOT KAPIT, PRASHANT LUITEL, DARRELL SCHROETER, Reed College — The first calculation of the true ground state of the parent-Hamiltonian proposed by Laughlin [R. B. Laughlin, Ann. Phys. **191**, 163 (1989)] for the $m = 2$ Fractional Quantum Hall state on a torus is presented. Laughlin's model is generalized to the case of a system in a ladder geometry and rewritten in terms of familiar spin-spin interactions, demonstrating that the model corresponds to a long-range Heisenberg Hamiltonian with an additional four-site interaction. The exact diagonalization of the Hamiltonian is performed to extract the energy, correlation functions, sub-lattice magnetization, and overlap with the Quantum Hall state. Our results confirm the recent work showing that the model is not exact [D. F. Schroeter, Ann. Phys. **310**, 155 (2004)] and also show it to be not without merit: the overlap between the QH state and exact ground state approaches the significant value of 0.83 in the limit that the ladder becomes infinitely long.

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