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Unitary Computational Algorithm for a 3D Hamiltonian System: twisting of filamentary vortex solitons demarcated by fast Poincare recurrence time JEFFREY YEPEZ, Air Force Research Labs, Hanscom AFB, GEORGE VAHALA, William & Mary, LINDA VAHALA, Old Dominion University — A mesoscopic lattice representation for the 3D Gross-Pitaevskii (GP) equation is considered using two qubits/spatial node. These qubits are locally entangled by unitary collision operators and the post collision probabilities are then streamed to neighboring nodes by unitary operators. Vortex reconnection occurs without viscosity or resistivity, with Kelvin waves emitted and propagated along the vortex tubes. If the internal energy of this Hamiltonian system is sufficiently low, fast Poincare recurrence time is found – a result very unexpected for a 3D system. Strong vortex entanglement is found at intermediate times – not unlike the Arnold Cat map. In this parameter regime there is not a turbulent steady state. However, as the internal energy of the system is increased, twisting of the line vortices is found as the system approaches the zero internal energy Poincare recurrent time. For long times turbulence ensues with the Poincare recurrence time now becoming astronomical.

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