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Qubit lattice representation of the Kelvin Helmholtz instability[1]

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A qubit unitary lattice algorithm, which scales almost perfectly to the full number of cores available (e.g., 216 000 cores on a CRAY XT5), is used to examine the Kelvin Helmholtz (KH) instability for a mean shear layer between two fluids whose dynamics satisfy the nonlinear Schrodinger (NLS) equation. The ground state wavefunction of weakly interacting Bose-Einstein gas condensates satisfies the NLS. In the nonlinear stage, simulations of Takeuchi et. al. have indicated there are 2 basic instability mechanisms: the standard classical mechanism as well as a quantum mechanism dealing with the excitation of interface modes with negative energies. Singly quantized vortices are emitted from the regions of the sawtooth modes and propagate into each fluid. Our unitary qubit algorithm permits very detailed spatial resolution, much higher than that possible by standard algorithms. We compare and contrast our results to those of Takeuchi [Phys. Rev. B81, 094517 (2010)].

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