Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

3D Vortex Solitons in Hyperbolic Self-Defocusing Nonlinear Media using unitary qubit lattice algorithms suitable for quantum computing LINDA VAHALA, Old Dominion University, GEORGE VAHALA, William Mary, MIN SOE, Rogers State University, ABHAY RAM, MIT — The nonlinear Schrodinger equation (NLS) - a ubiquitous equation of nonlinear physics - models Langmuir waves in hot plasmas. A stable bright or a stable dark soliton/vortex arises from the swign on the nonlinear term. in 3D NLS there are no stable structures. Efremidis [1] found quasi-stationary vortices provided the standard elliptic operator is transformed to hyperbolic. Now the transverse dark soliton is stabilized by the longitudinal bright soliton. We present here a qubit unitary lattice algorithm, with 2 qubits for the scalar field at each lattice site. These two qubits are then locally entangled by unitary collision operators and then that entanglement is propagated throughout the lattice by unitary streaming operators. The resulting mesoscopic algorithm is ideally parallelized and can be readily encoded onto a quantum computer. It is seen that while there is a quasi-stable m = 1 vortex, the m = 2 vortex is unstable: from quantum vortex theory the energy of a m = 2 quantum vortex is greater than twice that of an m = 1 vortex. This leads to a rapid transition to two m = 1 vortices. [1] N. K. Efremidis et. al. Phys. Rev. Lett. **98**, 113901 (2007) [2] L. Vahala et. al. Commun Nonlinear Sci Numer Simul **75**, 152-159 (2019)

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Date submitted: 03 Jul 2019 Electronic form version 1.4