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Study of Non-Abelian Quantum Turbulence using Qubit Unitary Lattice Simulations GEORGE VAHALA, William Mary, LINDA VAHALA, Old Dominion University, MIN SOE, Rogers State University — In 3D classical incompressible turbulence, one obtains the $k^{-5/3}$ Kolmogorov energy cascade. In quantum turbulence one has vortex reconnection without viscosity. The topological properties of the order parameter manifold restrict the collision dynamics of vortex-vortex interaction. For scalar quantum turbulence [1], with only Abelian vortices, a triple total energy cascade region is seen on a 5760^3 grid, while the incompressible part of the energy shows a single cascade of k^{-3}. Non-Abelian turbulence [2] requires 5 coupled NLS equations (c.f., spin-2 BEC). We perform unitary qubit analysis for vortex reconnection of non-Abelian equivalence classes. Following these studies we are in a position to perform high resolution non-Abelian quantum turbulence simulations. Previous CFD studies [2] required the addition of numerically stabilizing dissipation and compensating energy influx. Our qubit unitary lattice algorithm requires no such numerical artifacts and is immediately transferable to a quantum computer.
[1] J. Yepez, G. Vahala, L. Vahala and M. Soe, Phys Rev. Lett **103**, 084501 (2009)
[2] M. Kobayashi et. al. Phys. Rev. Lett. **103**, 115301 (2009), arXiv 1606.07190 (2016)

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