Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Fully nonlinear waves on quantized vortex rings SCOTT STRONG, KALEIGH RUDGE, LINCOLN CARR, Colorado School of Mines — Vortex filaments are primitive geometric elements in a variety of physical theories, e.g., classical and quantum hydrodynamics, astrophysical plasmas, biological soft matter etc. Our work studies curvature driven binormal flows induced by isolated vortex filaments defining the skeleton upon which free superfluid turbulence must end. Here, the flow of an irrotational inviscid fluid can be mapped onto the evolution of the curvature and torsion of isolated vortices. Dimensional reductions of this type originated in the early 20th-century. The first of which, known as the local induction approximation, asserts that a vortex filament induces an ambient flow, aligned with the local binormal vector, whose speed is proportional to the curvature. This flow is integrable and, as we have found, represents the lowest-order approximation to a fully nonlinear arclength conserving Hamiltonian flow consistent with inviscid fluid dynamics. We briefly discuss how these higher-order corrections allow localized curvature profiles to transport bending along the vortex by leveraging nonlinear gain/loss and dispersion in the vortex medium. In particular, we review the simulations of fully nonlinear waves propagating along simple closed vortex filaments embedded in a three-dimensional superfluid.

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Date submitted: 10 Aug 2020 Electronic form version 1.4