Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Vertical vorticity at a free surface.[1] PAUL W. FONTANA, Seattle University — The concept of surface vorticity is developed as a necessary consequence of the discontinuity of flow at the fluid surface. The construct provides the proper boundary conditions for a vortex-dynamical description of surface waves. It is shown that the perturbed free surface in general possesses vertical vorticity, even when the underlying flow is irrotational and the fluid is ideal. This resolves a paradox pointed out by Umeki, who discovered irrotational surface waves with surface rotation in the horizontal plane [Phys. Fluids A **4**, 1968 (1992)]. A dynamical equation for vertical vorticity at the free surface is derived and interpreted physically. The traditional idea that vortex lines terminate at fluid boundaries is shown to be unphysical and is amended to include surface vorticity. The extension of vertical surface vorticity into the bulk is connected with particular topological structures, such as plughole vortices, breaking waves, and Klein's Kaffeelöffel. This analysis generalizes boundary-layer vorticity theory to the free surface in the ideal limit. The analogy between surface vorticity on an ideal liquid and sheet currents at the surface of a superconductor is described.

[1]Work done as a Visiting Fellow at the Australian National University.

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Date submitted: 31 Jul 2016 Electronic form version 1.4