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Coherent Lagrangian vortices: The black holes of turbulence
GEORGE HALLER, ETH Zurich — We discuss a simple variational principle for coherent material vortices in two-dimensional turbulence. Vortex boundaries are sought as closed stationary curves of the averaged Lagrangian strain. We find that solutions to this problem are mathematically equivalent to photon spheres around black holes in cosmology. The fluidic photon spheres satisfy explicit differential equations whose outermost limit cycles are optimal Lagrangian vortex boundaries. As an application, we uncover super-coherent material eddies in the South Atlantic, which yield specific Lagrangian transport estimates for Agulhas rings. We also describe briefly coherent Lagrangian vortex detection to three-dimensional flows.

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