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Active mixing and self-consistent chaos in a vortex chain[1]
AMANDA KINNEY[2], TOM SOLOMON, Bucknell University — We present results of experimental studies of the destabilization of a chain of alternating vortices due to mixing in the flow of an active impurity, i.e., an impurity whose mixing can change the flow itself. The flow is driven by magnetohydrodynamic forcing – an electrical current passing through a layer of salt water interacts with a spatially-periodic magnetic field produced by permanent magnets below the fluid. The active impurity is a salt-water solution with larger salt concentration; consequently, regions with higher impurity concentration have higher electrical conductivity and a higher current density, resulting in a change in the local forcing of the flow. Instabilities are found in which blobs of higher and lower salt concentration form and advect around the vortices, bumping the vortex boundaries periodically and causing chaotic mixing between adjacent vortices. An instability is also found in which the vortices breath in the lateral direction, as well as an instability to aperiodic time dependence. The various instabilities are mapped out in parameter space as a function of driving current and concentration difference.

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