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Topological chaos and mixing in rectangular ducts JIE CHEN, MARK STREMLER, Virginia Polytechnic Institute and State University, VISHWANATH SOMASHEKAR, MICHAEL OLSEN, Iowa State University — Chaos and rapid mixing can be achieved in laminar duct flow when a strong secondary flow is induced at the duct boundary. This approach has been used previously for pressure-driven flow in microchannels with surface grooves and electro-osmotic flow in microchannels with variations in surface potential. For the proper choice of parameters, there exist streamtubes that 'braid' the surrounding fluid as it moves through the duct. The ensuing mixing can be evaluated using the Thurston-Nielsen classification theorem, which predicts a lower bound on the stretching rate in the flow. This braiding motion suggests an approach for mixing fluid in rectangular ducts with very high aspect ratio. The discussion will include numerical modeling of 'lid-driven' duct flows, analysis of topological chaos in these flows, and experimental characterization of mixing in pressure-driven flow through a high-aspect-ratio microchannel with surface grooves.

Jie Chen
Virginia Polytechnic Institute and State University

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