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Elastic Turbulence is Spatially Patchy in 3-D Porous Media CHRISTOPHER BROWNE, SUJIT DATTA, Princeton University — Polymer additives can produce unstable flow fluctuations, often known as elastic turbulence. This unstable flow can be harnessed to aid the mobilization of trapped immiscible fluids from porous media for applications like enhanced oil recovery (EOR) and groundwater remediation. However, it remains unknown how elastic turbulence manifests in a disordered porous medium. Here, we provide the first direct visualization of elastic turbulence in a 3-D porous medium. Surprisingly, this unstable flow is not spatially homogenous, as is commonly assumed: instead, we observe discrete pore-scale pockets of unstable flow, giving rise to spatially patchy elastic turbulence throughout the medium. We demonstrate that the formation of these unstable pockets is determined by variations in the pore-scale geometry, as quantified by a dimensionless parameter that characterizes the persistence of elastic stresses in the flow. Guided by this finding, we directly link the energy dissipated by these pore-scale fluctuations to the flow resistance through the entire medium, enabling us to develop a general model by which macroscopic transport properties can be predicted. Our work thus provides a general framework by which elastic turbulence in porous media can be predicted and controlled.

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