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Scar lines and topological singularities in the orientation field of fibers advected in fluid flows GREG VOTH, BARDIA HEJAZI, Wesleyan University — We examine the orientation fields of slender fibers advected by chaotic and turbulent fluid flows. The fibers show fascinating structures called scar lines, where their orientations rotate by π over very short distances. When brownian motion is important, for example in liquid crystals, there are topological singularities, or disclinations in 3D, that are the dominant structures in the orientation field. Consideration of the fluid stretching using Cauchy-Green strain tensors in a 2D chaotic flow allows us to identify similar topological singularities in the non-Brownian orientation field as well. We identify the mechanisms for formation of scar lines and topological singularities. The scar lines screen the topological singularities so that the dominant structures in the orientation field become asymptotically independent of the existence of the topological singularities. The rheology of fiber suspensions and the dynamics of turbulent flows are both strongly dependent on the orientation of the recent stretching, allowing these insights into the geometry of fiber orientation to provide insights into the mechanics of the fluid flow.

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