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Why Topology Needs Liquid Crystals

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Liquid crystal physics, which relies on freeze-fracture, X-ray characterization, and optical textures is an especially appropriate venue for the use of mathematics. Where else is the underlying topology and geometry so intimately connected with the observations? The textures themselves are the topological and geometric constructs: from the schlieren patterns under crossed polarizers revealing preimages of the map to $\mathbb{R}P^1$, to the ellipses and hyperbolæ that result from the cusps and focal sets of colliding smectic layers, and to the Bragg reflection of cholesteric layers revealing their periodicity. In this talk I will highlight some of these constructions and show how the world of liquid crystals is the premier place to understand the interplay between physics and topology.

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