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The weirdest martensite: Smectic liquid crystal microstructure and Weyl-Poincaré invariance DANILO LIARTE, MATTHEW BIERBAUM, Cornell University, RICARDO MOSNA, Universidade Estadual de Campinas, RANDALL KAMIEN, University of Pennsylvania, JAMES SETHNA, Cornell University — We propose a generalization of the mathematical theory of martensites to describe the complex assembly of focal conics in smectic liquid crystals. Smectics are remarkable, beautiful examples of materials microstructure, with ordered patterns of geometrically perfect ellipses and hyperbolas. The solution of the complex problem of filling three-dimensional space with domains of focal conics under constraining boundary conditions yields a set of strict rules, which are similar to the compatibility conditions in a martensitic crystal. Here we present the rules giving compatible conditions for the concentric circle domains found at two-dimensional smectic interfaces with planar boundary conditions. Using configurations generated by numerical simulations, we develop a clustering algorithm to decompose the planar boundaries into domains. The interfaces between different domains agree well with the smectic compatibility conditions. We also discuss generalizations of our approach to describe the full three-dimensional smectic domains, where the variant symmetry group is the restricted Weyl-Poincaré group of Lorentz boosts, translations, rotations, and dilatations.

Danilo Liarte
Cornell University

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