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The elasticity of smectic liquid crystal elastomers JAMES ADAMS, MARK WARNER, Theory of Condensed Matter, Cavendish Laboratory, Cambridge University — The elasticity of smectic elastomers is remarkable: response is solid-like along the layer normal and rubbery in the plane. These 2-D elastomers have extreme Poisson ratios and a reversible threshold above which the elastic modulus is drastically reduced. This behavior can be understood from a microscopic model based on the anisotropic chain shape of liquid crystalline polymers that couple to the smectic layers through the crosslinks. This coupling constrains the layer normal to deform affinely with the rubber matrix. Additionally chain shape distribution anisotropy colors the complex shears occurring after the mechanical instability occurs. Results fit well with experimental elastic and X-ray scattering data.
Smectic C elastomers are predicted to display soft elasticity, accompanied by an intricate microstructure to accommodate the strains required for softness. They are anticipated to be of great technological importance because their symmetry permits piezoelectricity, ferroelectricity and second harmonic generation.

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