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Non-affine deformations in biological gels QI WEN, ANINDITA BASU, JESSAMINE WINER, ARJUN YODH, PAUL JANMEY, University of Pennsylvania — Compared to flexible polymer gels, filamentous biopolymer networks generally have larger elastic moduli, a striking increase in elastic modulus with increasing strain, and a pronounced negative normal stress when deformed under simple shear. Different theoretical models based on either entropic elasticity of semiflexible filaments or enthalpic bending and stretching of rods can under some conditions account for all three of these unusual features. An essential difference between theories that relate microscopic structural parameters such as persistence length and mesh size of biopolymer gels to their macroscopic rheology are predictions about whether deformation of these materials is affine. We test the validity of this affine assumption by embedding micron-sized fluorescent beads within the networks and quantifying their displacements under shear deformation. Measures of non-affine deformation are small for networks of thin relatively flexible filaments and get smaller as strain increases. The small non-affine measures are consistent with the entropic model for non-linear elasticity of semiflexible polymer networks. However, as filament stiffness and mesh size increases the deformations become more non-affine, these results are possible more consistent with enthalpic bending and stretching models.

Qi Wen
Department of Physics, University of Pennsylvania

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