Rigidity of Non-thermal Solids

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Many soft solids exhibit structural and mechanical features that emerge from ``frozen-in'' stresses, or prestress. These can arise from a variety of sources. Jammed solids gain their rigidity from external forces, and the resulting prestress is essential to defining their solidity. Colloidal gels often form in processes in which thermal fluctuations of the constituents are frozen and the internal stresses that are generated can be partially redistributed at best. The rigidity and flow of biological tissues is defined by active forces at cell junctions. What all of these solids have in common is the absence of a unique, stress-free reference state: prestress determines the mechanical response, which in turn influences the assembly of the stress-bearing network. A question that was raised in the mid 90's but remained unanswered and dormant for decades is what principles define the mechanical response of such solids. Over the last decade, U(1) tensor gauge theories with fractonic charges have been mapped on to a stress-only framework of continuum elasticity. In this talk, I will discuss this theoretical approach, its successes and open questions.