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Strain-stiffening in random packings of granular chains HEINRICH JAEGER, ALICE NASTO, DYLAN MURPHY, ERIC BROWN, University of Chicago — We report on triaxial compression experiments performed to characterize the mechanical response of random packings of granular particles. For a wide variety of particle shapes, the packings yield when the shear stress exceeds a value on the order of the confining pressure. In contrast, granular chains consisting of flexibly connected beads exhibit strain stiffening (i.e., the effective modulus increases with strain), sustain stresses far beyond the confining pressure, and do not yield until the chains break. The critical chain length required for significant strain-stiffening to occur corresponds to the minimum circumference of closed loops the chains are able to form during the formation of the packings. This strain-stiffening behavior is similar to that found in polymer materials, and chain packings therefore may serve as a model system to quantify the contribution of pure entanglement effects to the strength of polymer materials in the absence of Brownian motion.

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