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Extended Granular Temperature

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We consider the role of elastic energy in the context of granular materials undergoing shear flow. Depending on the ratio of pressure to Young's modulus of the material from which grains are made and the typical velocity of shearing, there is a transition from a regime in which the fluctuations of kinetic energy are dominant to the regime where the fluctuations of elastic energy are dominant. This regime has likely been reached in recent experiments. We then consider a generalization of the granular temperature that includes both types of energy fluctuations and that changes smoothly from one regime to the other. We conclude by discussing related energy distributions and the degree to which the zeroth law of thermodynamics is satisfied by this new generalized temperature.

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