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Agitated granular rod monolayers: Tetratic or uniaxial nematic?[1]
THOMAS MUELLER, Experimentalphysik V, University of Bayreuth, DANIEL DE LAS HERAS, Theoreticalphysik II, University of Bayreuth, INGO REHBERG, KAI HUANG, Experimentalphysik V, University of Bayreuth — The ordering of granular rod monolayers under vertical agitations against gravity is investigated experimentally and compared quantitatively with equilibrium Monte Carlo simulations and density functional theory. At sufficiently high number density, short rods form a tetratic state and long rods form a uniaxial nematic state. The ordering transitions are found to be independent of the agitation frequency and strength, suggesting that the detailed nature of energy injection into such a nonequilibrium system does not play a crucial role. Interestingly, the length-to-width ratio at which the order changes from tetratic to uniaxial is around 7.3 in both experiments and simulations. This quantitative agreement indicates that, despite of driven far from thermodynamic equilibrium, agitated granular systems may share similar features with corresponding equilibrium systems. Finally, we summarize the universal and non-universal aspects between nonequilibrium granular rod and equilibrium liquid crystal systems in a state diagram.

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Kai Huang
Experimentalphysik V, University of Bayreuth

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