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A physical mechanism for enhanced orientational order of self propelled hard rods APARNA BASKARAN, CRISTINA MARCHETTI, Syracuse University — We consider a model of 2D hard rods on a substrate. The rods interact through energy and momentum conserving binary collisions. Self propulsion is implemented as a center of mass force acting along the long axis of each rod. The nonequilibrium statistical mechanics for this microscopic model is systematically developed. In the overdamped regime, the dynamics is described by a modified Smoluchowski equation that includes new momentum transfer contributions that arise from self propulsion. Hydrodynamic equations for the density, polarization and nematic order parameter are derived by coarse graining the Smoluchowski equation. The homogeneous equations yield an isotropic-nematic transition at lower densities than the Onsager density corresponding to an equilibrium system of hard rods. This enhanced ordering arises from the additional momentum transfer associated with self propulsion and is expected to be a generic feature of a broad class of active systems.

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