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Emergent collective dynamics in ensembles of magnetic colloidal rollers ALEXEY SNEZHKO, Argonne National Laboratory — Strongly interacting colloids driven out-of-equilibrium by an external periodic forcing often develop non-trivial collective dynamics. Ferromagnetic micro-particles immersed in water and sediment on the bottom surface of the flat cell are energized by a single-axis homogeneous alternating magnetic field applied perpendicular to the surface supporting the particles. Upon application of the alternating magnetic field the magnetic torque on each particle is transferred to the mechanical torque giving rise to a rolling motion of the particle. Experiments reveal a rich collective dynamics of magnetic rollers in a certain range of excitation parameters. Flocking and spontaneous formation of steady vortex motion have been observed. The effects are fine-tuned and controlled by the parameters of the driving magnetic field. Formation of the self-organized collective states spontaneously breaking the symmetry of the underlying interactions has been attributed to the interplay of inelastic inter-particle collisions and self-induced hydrodynamic flows in the system. The research was supported by the U.S. DOE, Office of Basic Energy Sciences, Division of Materials Science and Engineering.

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