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Emergent Ultra-Long-Range Interactions Between Active Particles in Hybrid Active-Inactive Systems JOSHUA STEIMEL, JUAN ARAGONES, HELEN HU, MIT, NASER QURESHI, UNAM, ALFREDO ALEXANDER-KATZ, MIT — Particle-particle interactions determine the state of a system. Control over the range and magnitude of such interactions has been an active area of research for decades due to the fundamental challenges it poses in science and technology. Effective interactions between active particles have gathered much attention as they can lead to out-of-equilibrium cooperative states such as flocking. Inspired by nature, where active living cells coexist with lifeless, immobile objects and structures, here we study the effective interactions that appear in systems composed of active and passive mixtures of colloids. Our system is a two dimensional colloidal monolayer composed primarily of passive (inactive) colloids and a very small fraction of active (sinning) ferromagnetic colloids. We find an emergent ultra-long-range attractive interaction between active particles induced by the activity of the spinning particles and mediated by the elasticity of the passive medium. Interestingly, the appearance of such interaction depends on the spinning protocol and has a minimum actuation time scale below which no attraction is observed. Overall, these results clearly show that in the presence of elastic components, active particles can interact across very long distances without any chemical modification of the environment. Such a mechanism might potentially be important for some biological systems and can be harnessed for newer developments in synthetic active soft materials.

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