Sticking transition in a minimal model for the collisions of active particles in quantum fluids

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Abstract

Particles of low velocity, traveling without dissipation in a superfluid, can interact and emit sound when they collide. We propose a minimal model in which the equations of motion of the particles, including a short-range repulsive force, are self-consistently coupled with the Gross-Pitaevskii equation. We show that this model generates naturally an effective superfluid-mediated attractive interaction between the particles; and we study numerically the collisional dynamics of particles as a function of their incident kinetic energy and the length scale of the repulsive force. We find a transition from almost elastic to completely inelastic (sticking) collisions as the parameters are tuned. We find that aggregation and clustering result from this sticking transition in multiparticle systems.

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