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Mind the gap: a flow instability controlled by particle-surface distance MICHELLE DRISCOLL, New York Univ NYU, BLAISE DELMOTTE, Courant Institute, New York University, MENA YOUSSEF, STEFANO SACANNA, New York University, Chemistry Department, ALEKSANDAR DONEV, Courant Institute, New York University, PAUL CHAIKIN, New York Univ NYU — Does a rotating particle always spin in place? Not if that particle is near a surface: rolling leads to translational motion, as well as very strong flows around the particle, even quite far away. These large advective flows strongly couple the motion of neighboring particles, giving rise to strong collective effects in groups of rolling particles. Using a model experimental system, weakly magnetic colloids driven by a rotating magnetic field, we observe that driving a compact group of microrollers leads to a new kind of flow instability. First, an initially uniformly-distributed strip of particles evolves into a shock structure, and then it becomes unstable, emitting fingers with a well-defined wavelength. Using 3D large-scale simulations in tandem with our experiments, we find that the instability wavelength is controlled not by the driving torque or the fluid viscosity, but a geometric parameter: the microrollers distance above the container floor. Furthermore, we find that the instability dynamics can be reproduced using only one ingredient: hydrodynamic interactions near a no-slip boundary.

Michelle Driscoll
New York Univ NYU

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