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From granular to Newtonian flow: three-dimensional imaging and rheology of suspensions JOSHUA A. DIJKSMAN, Leiden University, STEVEN SLOTTERBACK, University of Maryland, ELIE WANDERSMAN, Leiden University, CHRIS BERARDI, WILLIAM DEREK UPDEGRAFF, University of Maryland, MARTIN VAN HECKE, Leiden University, WOLFGANG LOSERT, University of Maryland — We show that in sedimenting suspension flows, the microscopic dynamics mimics that of dry granular flows. To probe the dynamics of the suspension, we employ three-dimensional flow imaging and rheological measurements in a split-bottom geometry. We explore the range of flow rates from the rate-independent regime to the onset of rate dependence. In slow flows, we recover "dry granular flow" behavior, well studied in the split-bottom geometry. When the shear rate becomes comparable to the rearrangement timescale of the particles, we observe essentially Newtonian behavior. We show that these observations are consistent with the inertial number theory adapted to suspension flows.

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