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**Velocity Fluctuations and Granular Fluidity: An Experimental Exploration**[1] REBECCA N. POON, AMALIA L. THOMAS, NATHALIE M. VRIEND, University of Cambridge — To construct non-local constitutive equations for granular flow, Kamrin and Koval (Phys. Rev. Lett. 108 (2012)) defined a granular fluidity, $g = \dot{\gamma}/\mu$, relating two macroscopic quantities: the shear rate $\dot{\gamma}$, and the stress ratio $\mu$. Zhang and Kamrin (ZK: Phys. Rev. Lett. 118 (2017)) subsequently proposed that microscopically, $g = \frac{\delta v}{d} F(\Phi)$, where $\delta v$ is the average magnitude of single-particle velocity fluctuations around the spatial mean, $F(\Phi)$ is some function of the local volume fraction $\Phi$ (which may depend on e.g. flow geometry) and $d$ is the particle diameter. ZK validated their proposal by numerical simulations in three different 3D geometries. Here we present the first experimental validation of the relation between these microscopic and macroscopic fluidities, in a fourth geometry: an avalanche down a 2D chute. We access $\delta v$ and $\Phi$ by particle tracking, and use photoelasticity to obtain $\mu$. We observe that, indeed, $g = \frac{\delta v}{d} F(\Phi)$ in our system, indicating the robustness of the ZK definition to changes of dimension and geometry. We discuss our form of $F(\Phi)$, which is similar to that found by ZK, and interpret its shape in terms of the jamming transition in dense granular flows.

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