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Segregation in a quasi-stationary avalanche on an inclined conveyor-belt

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We have carried out laboratory experiments to determine the internal structure of segregating dense granular avalanches and test the recent theoretical predictions of the existence of breaking size-segregation waves [Thornton & Gray, 2008]. Measurements were performed on a quasi-stationary avalanche that flows down an inclined upward-moving conveyor-belt. In this configuration the bottom layers of the flow are dragged upslope while upper layers are avalanching downslope due to gravity; effectively, as if the observer were moving along with an avalanche. We show that a breaking size-segregation wave is located in the flow, recirculating the particles, and causing large particles to accumulate downslope and fines upslope. The large particles at the downslope end, after being deposited and overrun, are carried upslope through the lower layers, segregate to the free-surface, and avalanche down again. Small particles segregate downwards and are dragged upslope when reaching the lower layers. Imaging of a cross-section of the bulk flow, far from the side-wall, is made possible by combining a laser light sheet and an interstitial liquid that has a matched refractive index with the particles.

Thornton, A. R. & Gray, J. M. N. T. 2008 Breaking size-segregation waves and particle recirculation in granular avalanches. J. Fluid Mech. 596, 261–284.