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GRANULAR AND MULTIPHASE FLOWS

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Separation and Charge Amplification in Granular Flows

In 1867, Lord Kelvin described an ingeniously simple experiment in which two adjacent streams of water droplets could be cross-connected in such a way that each stream amplifies the charge on the second stream . In his system, a small charge on one initial droplet becomes amplified to generate large stored charges. We show here that a counterpart effect in a stream of falling grains can be engineered, with no clever electrical connections, to generate spontaneous charging and separation of an initially well-mixed blend of similar granular materials. We find that this effect causes profound segregation in common pharmaceutical grains, resulting in sample concentrations of active ingredients in an initially mixed blend that vary after charging between 5% and 90% depending on location. Our findings also provide insights into the mechanisms by which charges can be amplified in identical materials.

Dr. Shinbrot received his PhD in Physics from the University of Maryland in 1992, after which he held a postdoctoral research position at Northwestern University. He began his career at Rutgers University in 1995, where he is now a professor in the Biomedical Engineering Department at Rutgers University. Dr. Shinbrot's is internationally recognized for his research contributions in the field of granular flows and chaotic mixing. His work has been the subject of feature articles in *Science*, *Nature*, *Scientific American*, *Discover*, *Science News*, *New Scientist*, *The Scientist, Reuters, BBC, NY Times, Washington Post, Albuquerque Journal,* and the *Chicago Tribune.*

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