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Strange eigenmodes of chaotic granular flow in a tumbler[1] IVAN C. CHRISTOV, JULIO M. OTTINO, RICHARD M. LUEPTOW, Robert R. McCormick School of Engineering and Applied Science, Northwestern University — Through a combined computational–experimental study of monodisperse granular flow in a slowly-rotating quasi-two-dimensional container we show the presence of naturally-persistent mixing patterns, i.e., "strange" eigenmodes of the advection-diffusion operator governing the mixing process in the Eulerian frame. A comparative analysis of the structure of eigenmodes and the corresponding Poincaré section and finite-time Lyapunov exponent field of the flow highlights the relationship between the Eulerian and Lagrangian descriptions of mixing. In addition, we show how the mapping method for scalar transport can be modified to include diffusive effects, which are more significant in a granular flow (in laboratory size equipment) than in a similar fluid flow. This allow us to examine (for the first time in a granular flow) the change in shape, lifespan, and eventual decay of eigenmodes due to diffusive effects at larger numbers of revolutions. Finally, it is shown that segregation patterns in bidisperse mixtures correspond to permanently-excited eigenmodes.

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