Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Granular mixing in quasi-two-dimensional tumblers with a vanishing flowing layer IVAN CHRISTOV, JULIO M. OTTINO, RICHARD M. LUEPTOW, Northwestern University — We study, numerically and analytically, a singular limit of granular tumbled flows in quasi-two-dimensional rotating drums. Focusing on two versions of the kinematic continuum model of such flows, we examine the transition to the limiting dynamics as the shear layer vanishes. The limiting behavior is shown to be the same for both versions of the continuum model. Moreover, we demonstrate that, just as in a three-dimensional spherical tumbler, the limiting no-shear-layer dynamical system belongs to a class of discrete discontinuous mappings called piecewise isometries. In doing so, we identify a new mechanism of mixing, in the absence of the usual streamline crossing mediated by the flowing layer, termed streamline jumping. This leads to complex, if not technically chaotic, dynamics as long as the tumbler and fill fraction are such that the free surface of the flow moves vertically and horizontally in time.

Ivan Christov
Northwestern University

Date submitted: 24 Jul 2009 Electronic form version 1.4