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MRI Study of Granular Flow in a Split-Bottomed Couette Cell
XIANG CHENG, ANTONIO BARBERO, MATTHIAS MOBIUS, HEINRICH JAEGER, SIDNEY NAGEL, The James Franck Institute, The University of Chicago — Recent studies of dense granular flow in a split-bottomed Couette geometry have brought new insights into the concept of shear bands in granular systems [1]. However, to date experimental results have primarily focused on the flow at the top surface of the system. Here we present a study of the 3- dimensional structure of shear band formed in such a geometry using magnetic resonance imaging (MRI). We show that the angular velocity profiles in horizontal plane follow an error function as observed at the top surface. By measuring the center and the width of the shear band at the different heights in the bulk, we map out the 3-D shape of the shear band and investigate the behavior of the shear band as a function of the total filling height. We find that when the top of the shear band detaches from the surface of the bulk, its shape changes dramatically, similar to a first order transition as has been proposed by theory [2]. [1] D. Fenistein, J. W. van de Meent, and M. van Hecke, PRL 92, 094301 (2004). [2] T. Unger, J. Torok, J. Kertesz, D. E. Wolf, PRL 92, 214301 (2004).

Xiang Cheng
The James Franck Institute, The University of Chicago

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