ESPCI
Laboratoire PMMH
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Séminaire PMMH

Salle de réunion du PMMH, Campus Jussieu, Bâtiment Cassan A, 1 er étage

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Experimental validation of nonextensive scaling law in confined granular media : emergence of shear bands

The statistics of grain displacements probability distribution function (pdf) during the shear of a granular medium displays an unusual dependence with the shear increment upscaling as recently evinced [Phys. Rev. Lett. 115 238301 2015]. Basically, the pdf of grain displacements has clear nonextensive (q-Gaussian) features at small scales but approaches to Gaussian characteristics at large shear window scales - the granulence effect. We experimentally validate a particular case of the so-called Tsallis-Bukman scaling law, by fitting the pdf of the measured fluctuations with a q-Gaussian distribution, and the diffusion exponent is measured independently during the experiment. Applying an original technique, we were able to evince a transition from an anomalous diffusion regime to a Brownian behavior as a function of the length of the strain-window used to calculate the displacements of grains in experiments. Recently, we have extended this analysis studying a larger system which exhibits a severe shear band fault during the macroscopic straining. This analysis have shown a singular behavior of q at large scales, displaying a non-monotonic dependence with the shear increment. By means of an independent image treatment, we demonstrate that this singular non-monotonicity can be associated with the emergence of the shear band within the confined system. We believe that this original approach using Statistical Mechanics tools to identify shear bands can be a very useful piece to solve the complex puzzle of the rheology of dense granular systems and be used to explore the origins of the macroscopic friction in confined granular materials.