

# Packing fraction and compaction dynamics of magnetic powders



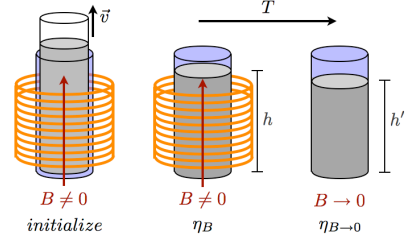
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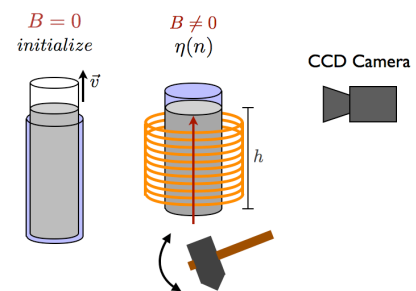
## Abstract

We have investigated experimentally the influence of magnetic interactions between the grains (i) on the packing fraction and (ii) on the compaction dynamics of a granular pile. The granular material used to perform these studies is made of ferromagnetic grains submitted to an external magnetic field  $B$ . The evolution of the packing fraction as a function of the Bond number  $Bo$  which is the ratio between the cohesive force  $F_c$  and the grain weight  $mg$  has been measured. Moreover, we present an experimental protocol that allows one to tune the packing fraction  $\eta$  of a random pile of ferromagnetic spheres from a value close to the lower limit of random loose packing  $\eta_{RLP}$  to the upper limit of random close packing  $\eta_{RCP}$ . Concerning the compaction dynamics, the influence of the magnetic interaction on the compaction characteristic time  $\tau$  has been measured.

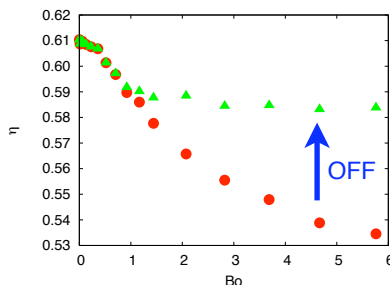
## Packing fraction of a magnetized powder



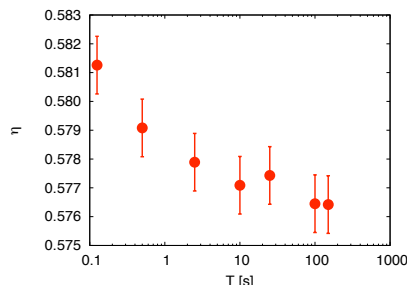
## Compaction dynamics of a magnetized powder



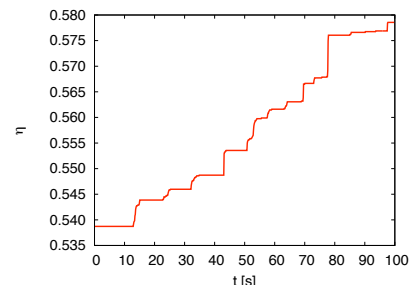
## Packing fraction of a magnetized powder



(circles) Packing fraction  $\eta$  as a function of the Bond number  $Bo$ . (triangles) Packing fraction  $\eta_{B \rightarrow 0}$  after switching off the magnetic field.



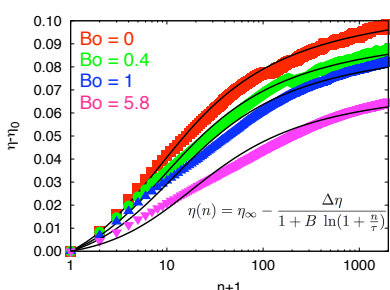
Final packing fraction  $\eta$  after a decreasing of the magnetic field along a ramp during  $T$  seconds.



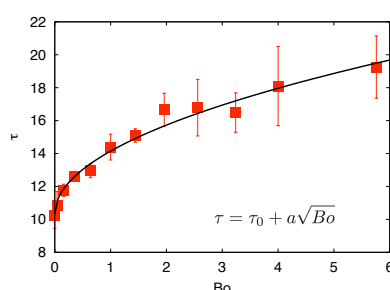
Typical temporal staircase evolution of the packing fraction  $\eta$  during the collapse.

G. Lumay and N. Vandewalle, *New J. of Phys.* **9**, 406 (2007)

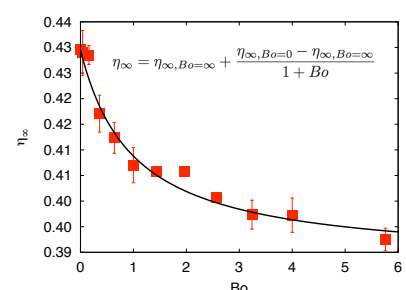
## Compaction dynamics of a magnetized powder



Typical compaction curves corresponding to different Bond numbers  $Bo$ .



Evolution of the characteristic time  $\tau$  as a function of the Bond number  $Bo$ .



Decrease of the asymptotic packing fraction  $\eta_\infty$  with the Bond number  $Bo$ .

G. Lumay, S. Dorbolo, N. Vandewalle, arXiv:0907.0646