Random waves in a vibrated 2D granular medium with magnetic dipolar interactions.

MSC: Laboratoire Matière et Systèmes Complexes
UMR 7057 CNRS / Université Paris Diderot

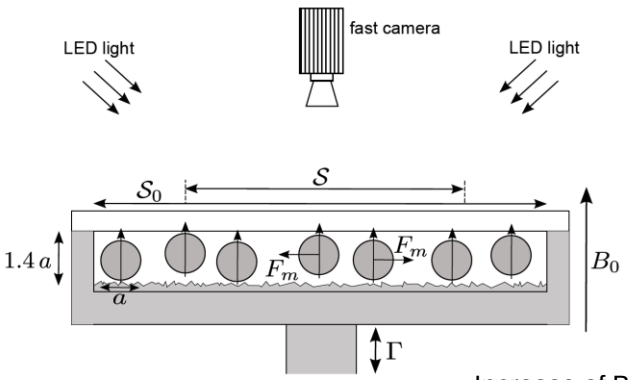
Département Physique Paris Diderot

Michael Berhanu (CR CNRS, MSC), with

Simon Merminod (Phd defended at MSC /10/2016, now post-doc at Brandeis University, USA)

Eric Falcon (DR CNRS, MSC)

Gustavo Castillo (Assistant Professor, Univ. O'Higgins, Chile)



Increase of B_0 at
a given shaking strength

Dissipative granular gas
$\varepsilon=E_m/E_c \approx 0$

Quasi-elastic collisionles gas
$\varepsilon=E_m/E_c=16.2$

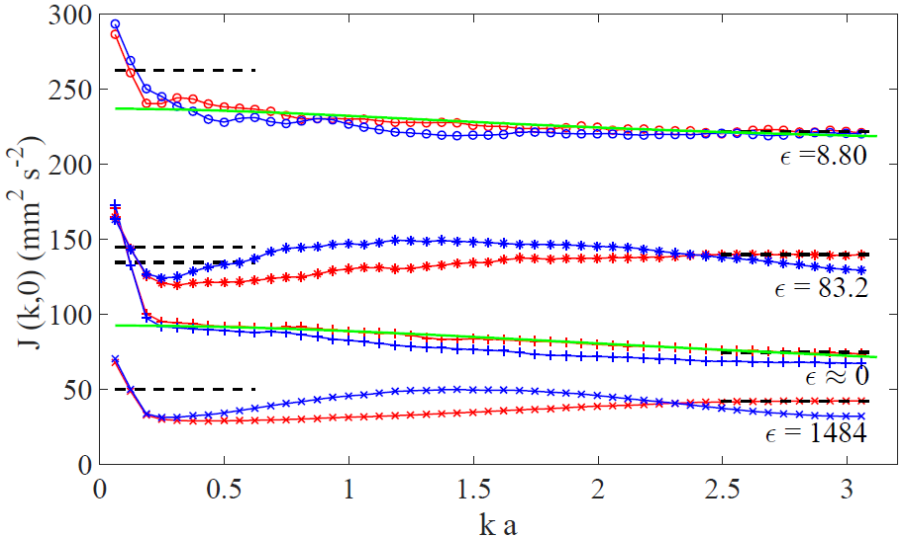
Hexagonal crystal
$\varepsilon=E_m/E_c=283$

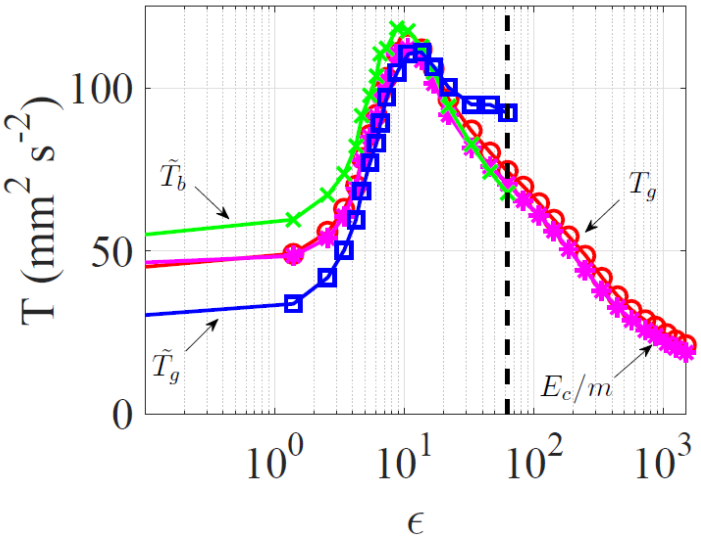
Acknowledgements :
Thierry Hocquet (MSC) & Martin Devaud (MSC)

Spatial velocity correlations studied in Fourier space

- Computation of longitudinal and transverse current correlation function: $J_L(k,t)$ and $J_T(k,t)$. Granular temperature T, Ec/m.

Deviation from kinetic energy equipartition to quantify the distance to thermal equilibrium.





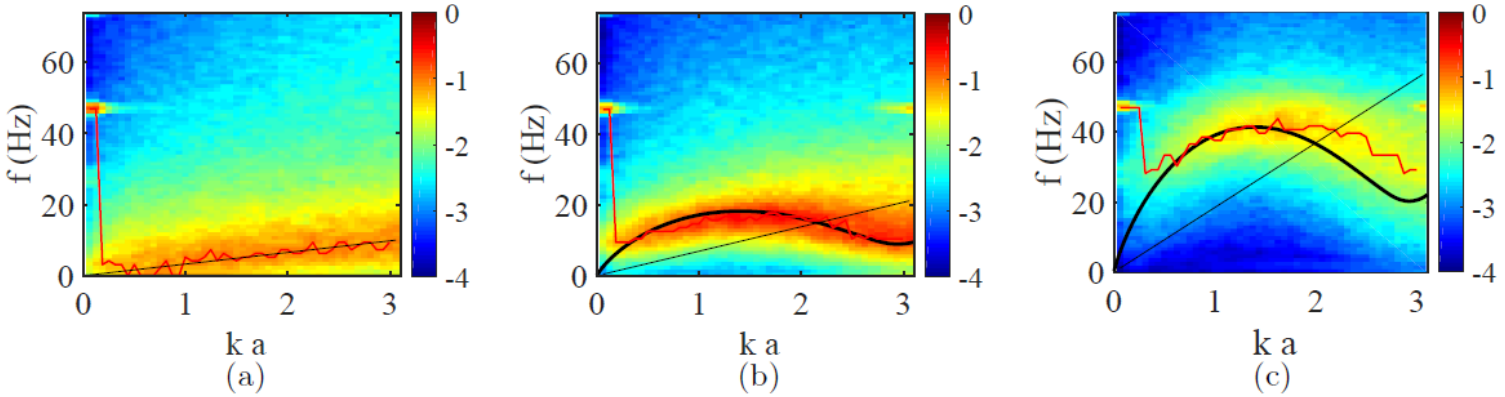
- According to fluctuating hydrodynamics theory (Puglisi et al. J. Chem Phys. 2012), for a granular, granular temperature at the grain scale is smaller than the large scale temperature (bath temperature).

In our experiment, $T_b > T_g$ in the dissipative granular phase and $T_b = T_g$ in the quasi-elastic regime, maximum of the curve T vs ε.

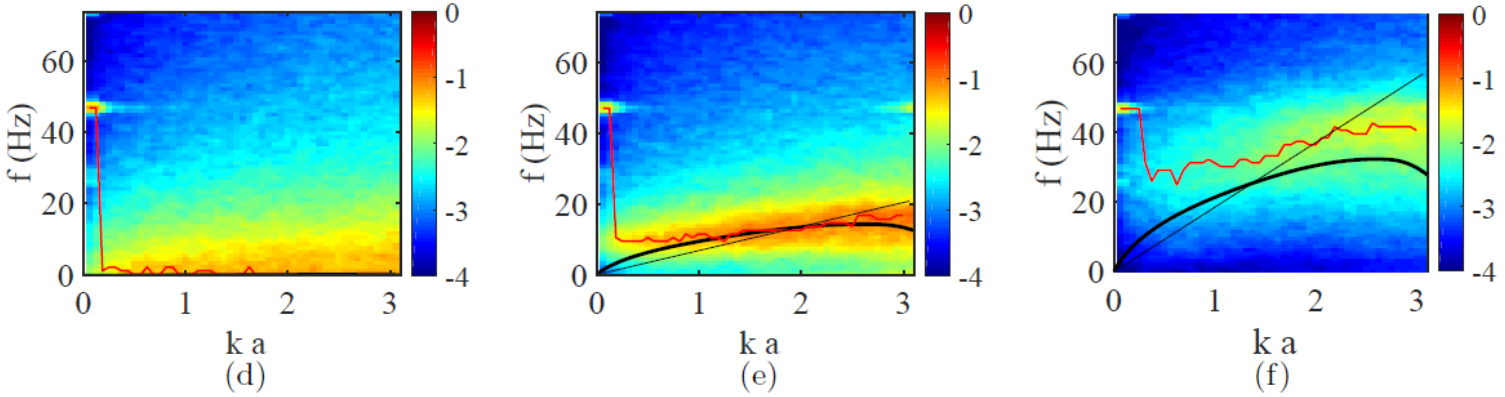
Space-time spectra: dispersion relation of random waves

- Computation of space-time velocity spectra Sv (k,f) for longitunal and transverse fluctuations.

Longitudinal
$S_{v\,L}$ (k,f)



Transverse
$S_{v\,T}$ (k,f)



ε=0 Granular Gas

ε=83.2

ε=1484 Hexagonal crystal

- No transverse waves in the granular gas phase.

In the hexagonal crystal phase, dispersion relations are well reproduced by points dipole model with harmonic approximation (Golden et al. PRE 2010).