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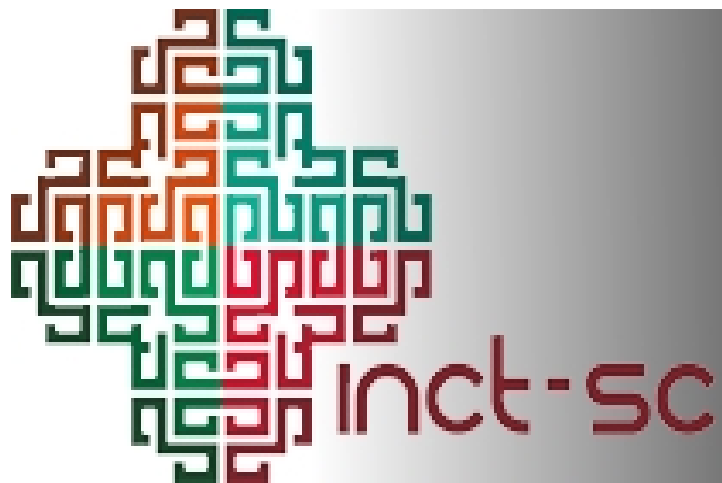
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Simulações em Sistemas Complexos:

Allbens Atman Picardi Faria

Departamento de Física e Matemática
Instituto Nacional de Ciência e Tecnologia – Sistemas Complexos
A. P. F. Atman – Bolsista de Produtividade CNPq – nível II

- **Distribuição de velocidades em sistemas granulares confinados**
- **Modelo comportamental para o mercado de ações**
- **Modelo para propagação da Leishmaniose**



INSTITUTO NACIONAL DE CIÊNCIA E TECNOLOGIA DE SISTEMAS COMPLEXOS

Colaboradores:

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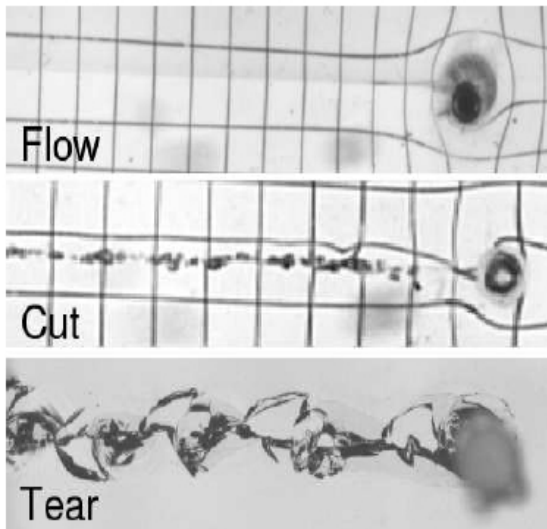
Incipientes (?):

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Objetivos

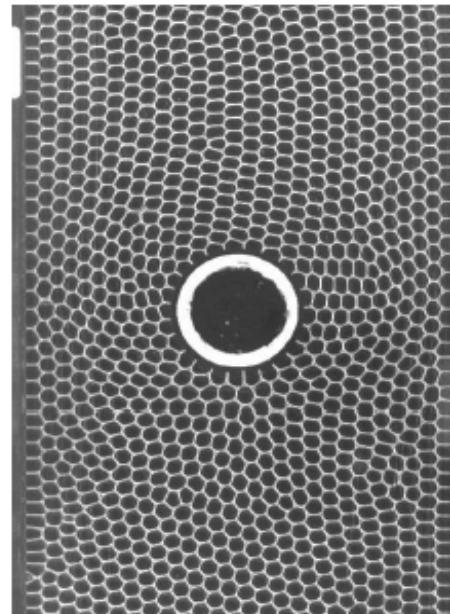
- Estudar a distribuição de velocidades de um meio granular confinado, sujeito a um escoamento forçado em torno de um intruso;
- Verificar o comportamento da distribuição em função da densidade; estudar a aproximação do estado engarrafado;
- Associar a distribuição de velocidades à reologia local do sistema;

Fluido micelar visco-elástico



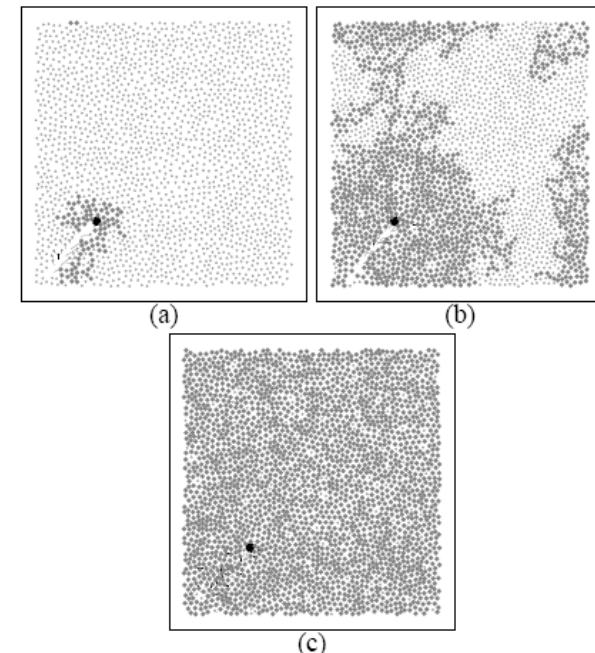
Gladden, Belmonte, 2006

Mousses



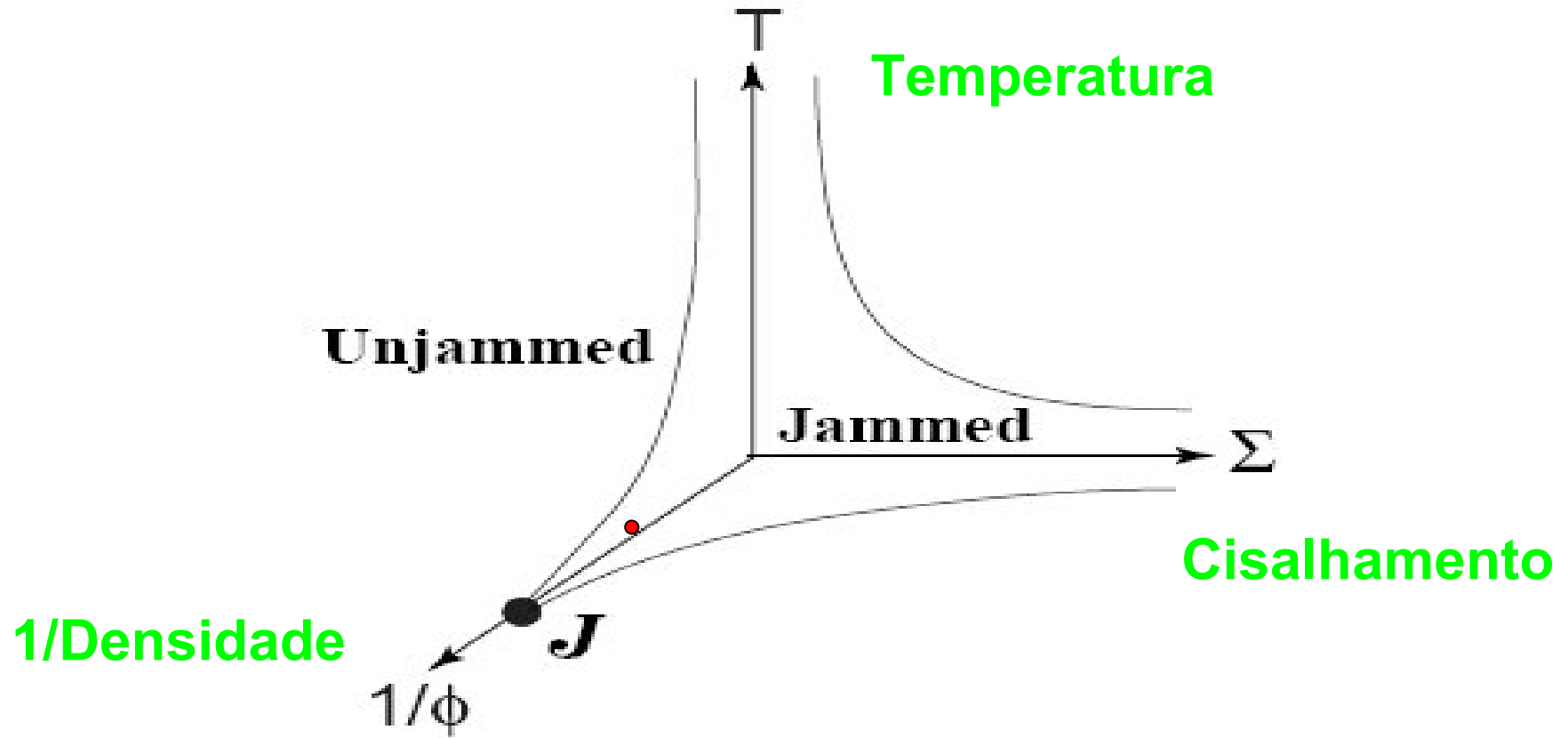
Raufaste et al., 2007

Simulações de grãos

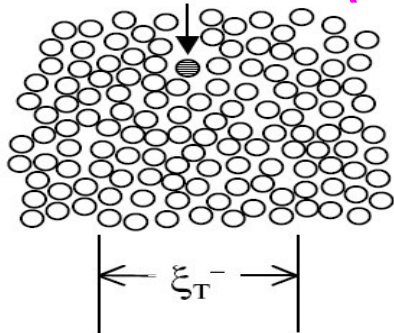


Reichhardt et al, 2005

Transição de Engarrafamento



O'Hern et al. (2003)



Para sistema de partículas sem atrito com repulsão de curto alcance:

$$3D \quad \phi_J \sim 64 \% \quad \sim RCP$$

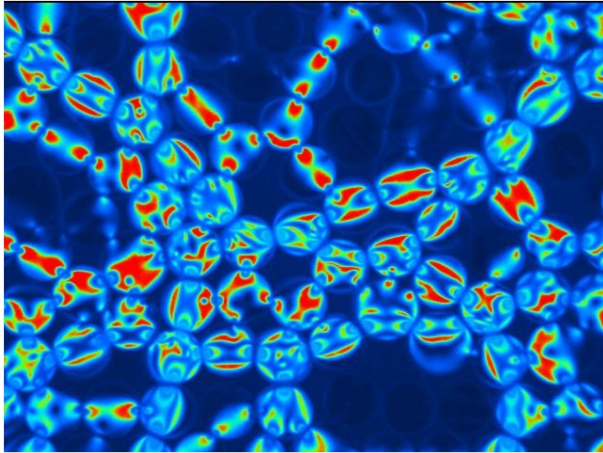
$$2D \quad \phi_J \sim 84\%$$

(sistemas de tamanho finito)

Meios granulares reais

→ Cadeias de força

→ Correlações de longo alcance ?



*Page perso Bob Behringer,
Duke University*

→ Anisotropia induzida

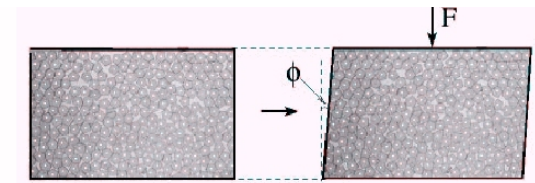
*Atman et al., J. Geng, B. Behringer
Eur.Phys.J. E 2005*

→ Papel crucial do atrito e sua « mobilização »

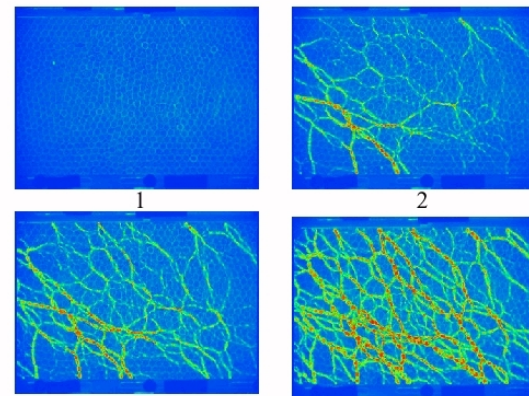
→ Cadeias de força

- Fortes : $F > \langle F \rangle$
(anisotrópica
// Esqueleto:
- Fracas : $F < \langle F \rangle$

Radjaï et al., PRL , 1996

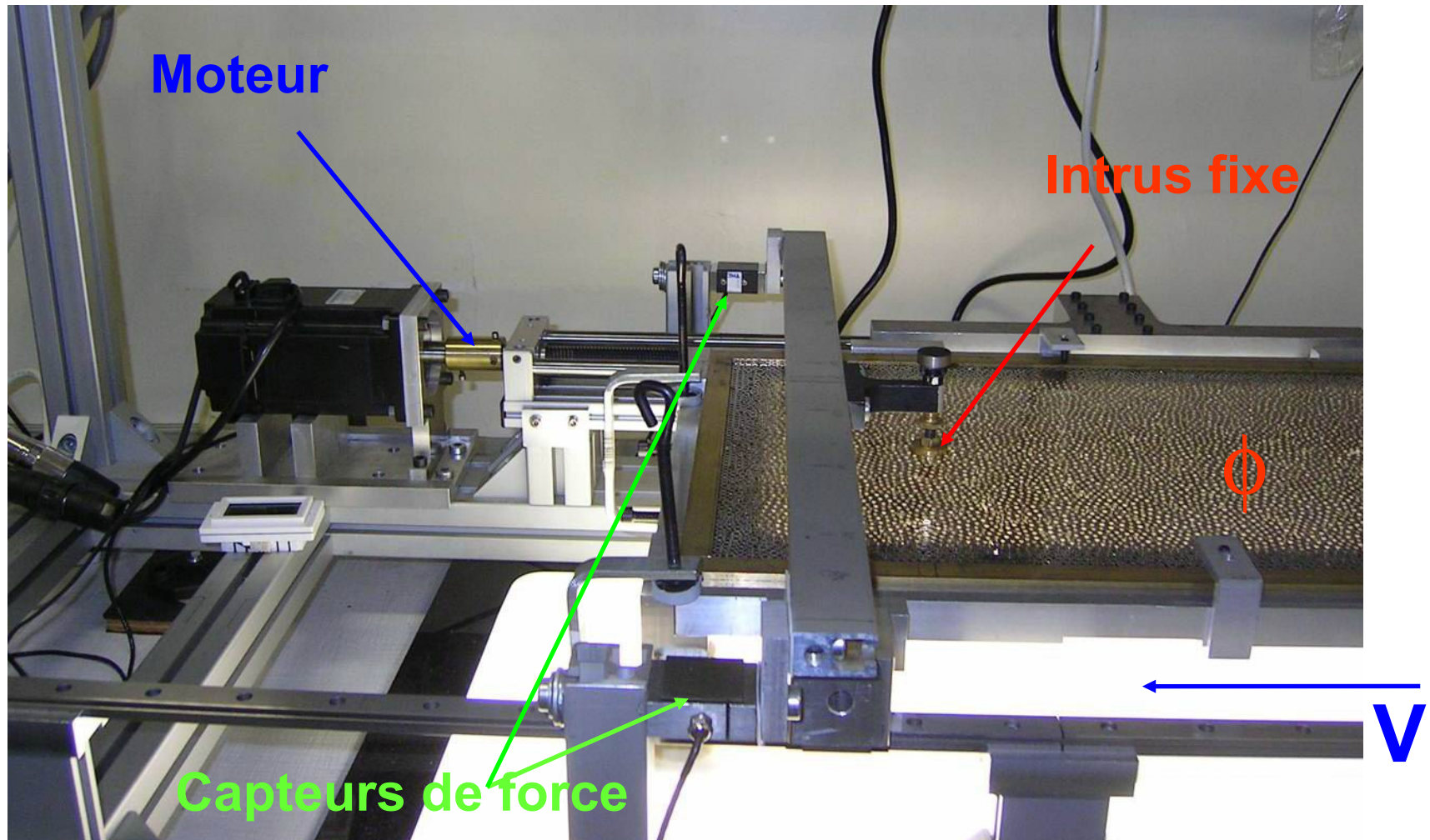


(a)



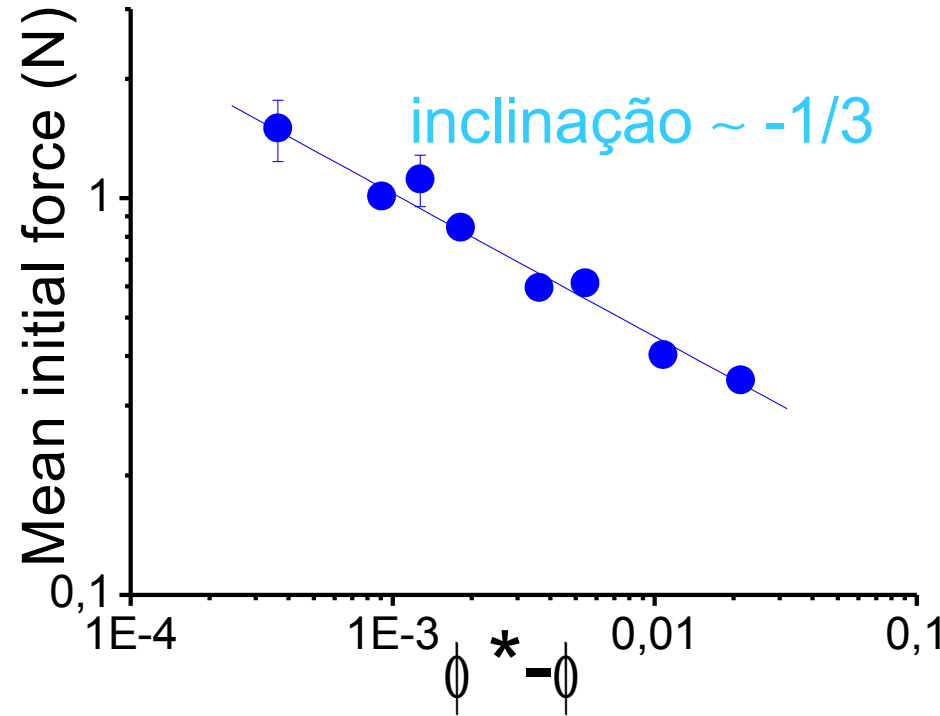
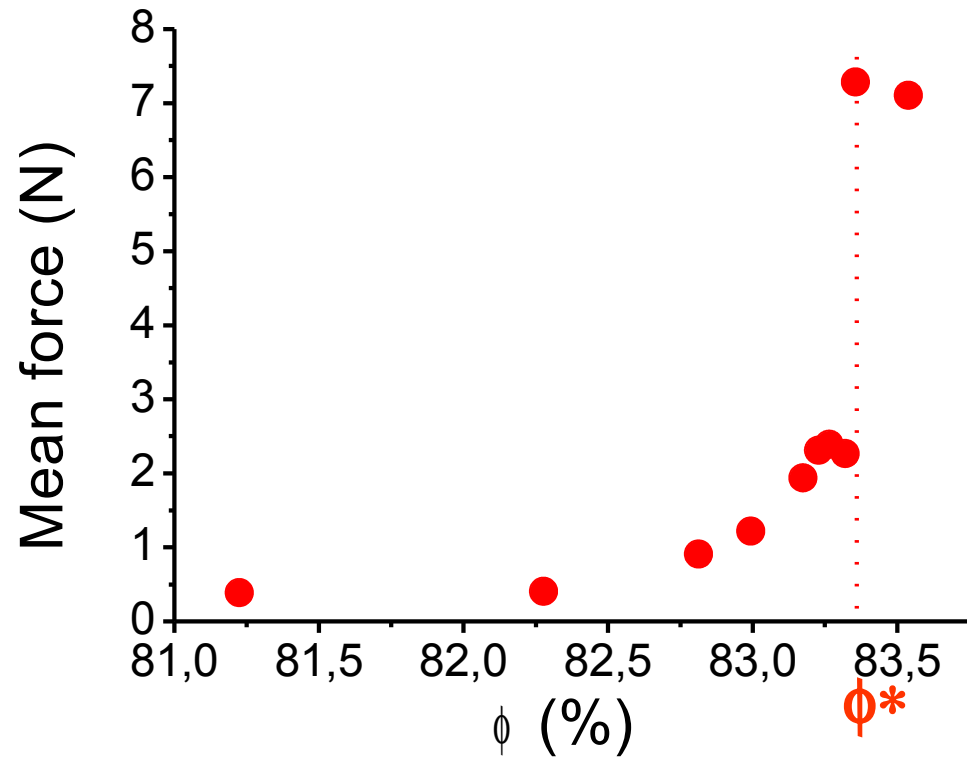
(b)

Dispositif expérimental



Milieu granulaire 2D dans une cellule rectangulaire de longueur ajustable
largeur = $W = 269.5 \text{ mm}$ ($54 d_2$)
longueur = $L = 456.5 \text{ à } 470.5 \text{ mm}$ ($91 d_2 \text{ à } 94 d_2$)

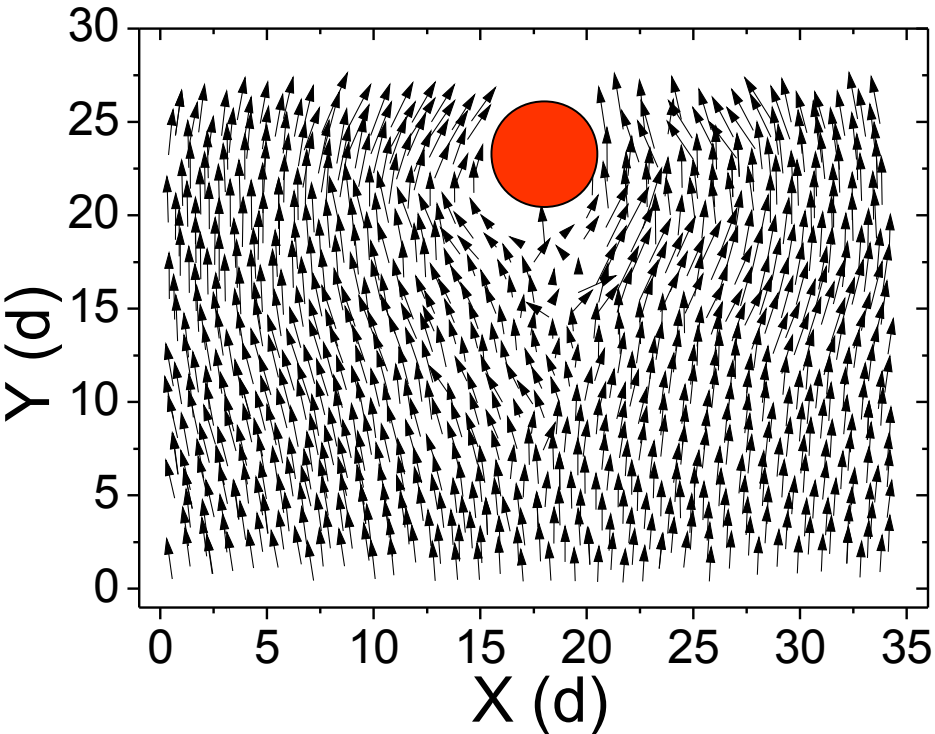
Evolução da força média com a densidade ϕ



Aumento rápido (divergência?) da intensidade da força inicial para uma densidade crítica de $\phi^* \sim 83,35$ %

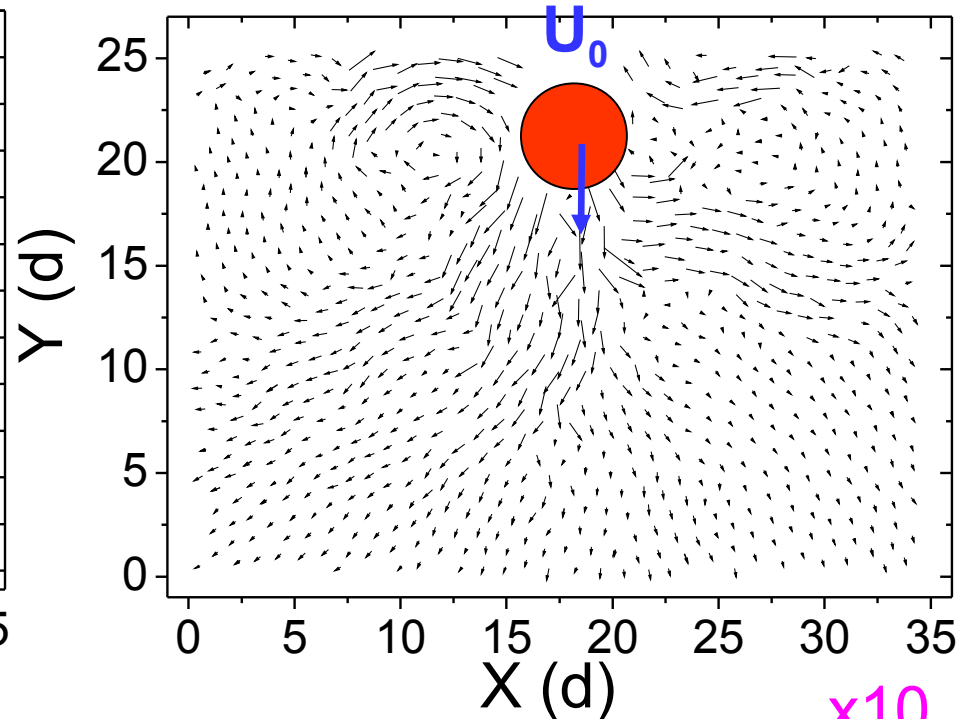
Champ de déplacement

Entre 2 images successives (Déplacement du plateau = $U_0 = d_2/5 = D/20$)



Dans le référentiel du labo

$U_0 \uparrow$

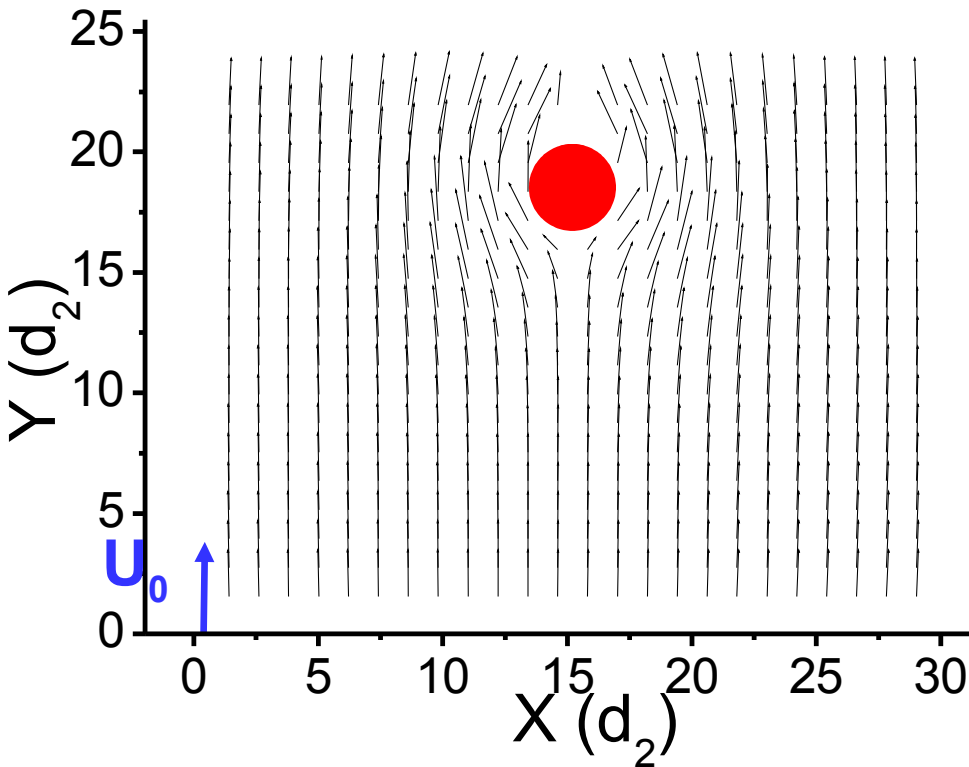


Dans le référentiel du plateau $\times 10$

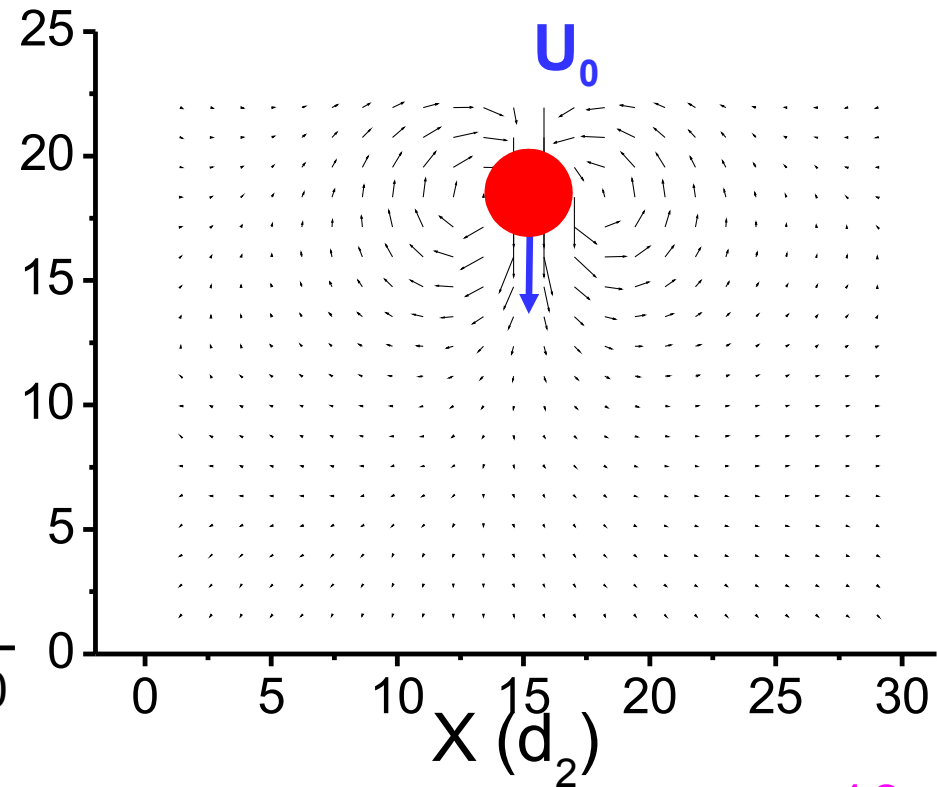
- effet à longue portée de la perturbation produite par l'intrus
- 2 rouleaux de recirculation

Campo de deslocamento médio

Labo Ref.



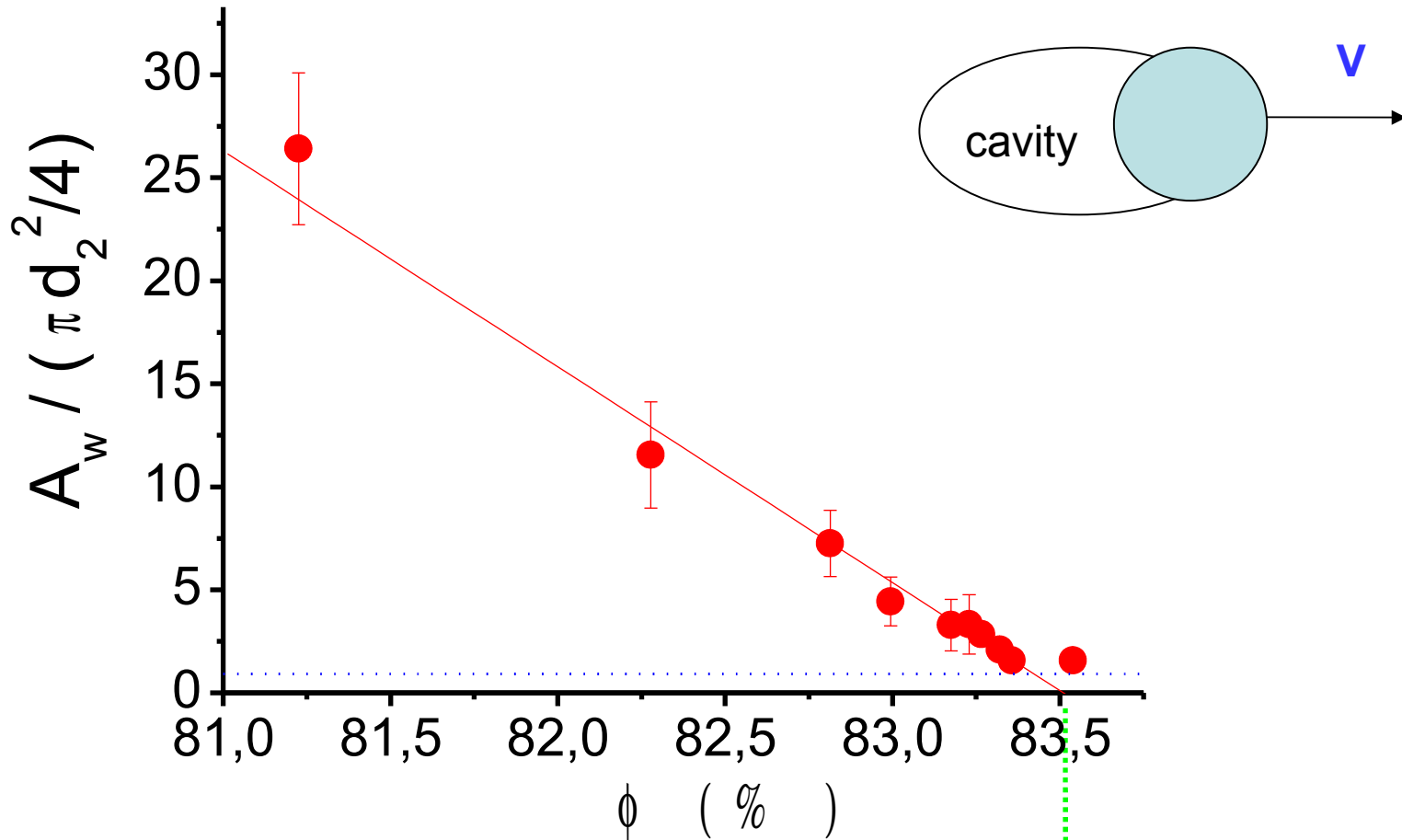
Plateau Ref.



x10

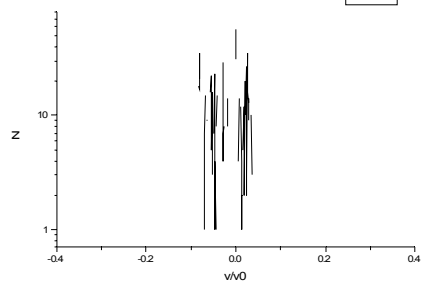
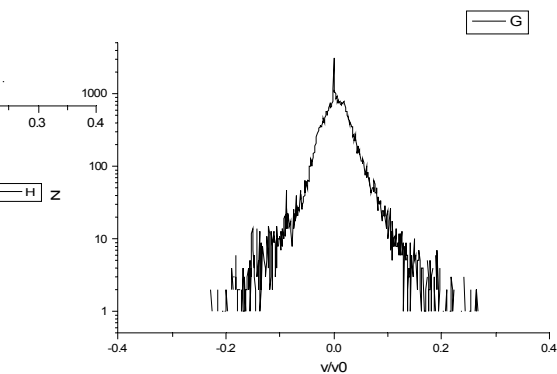
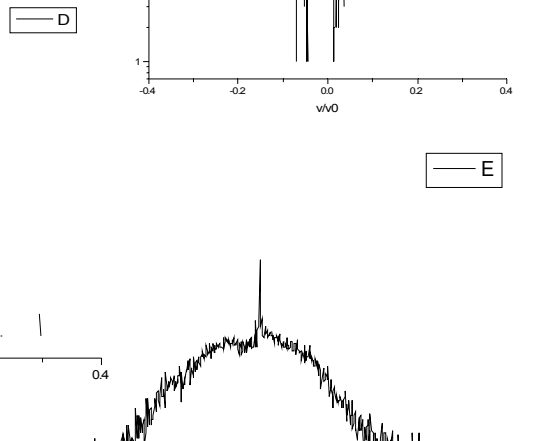
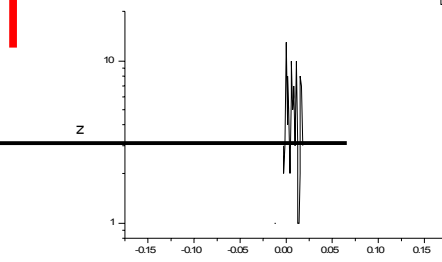
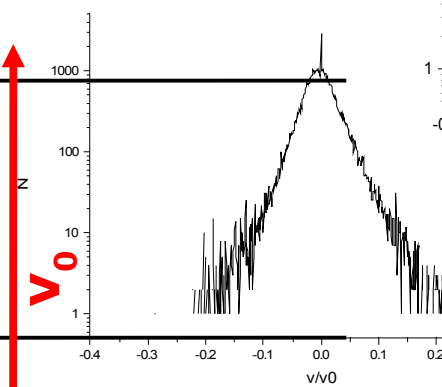
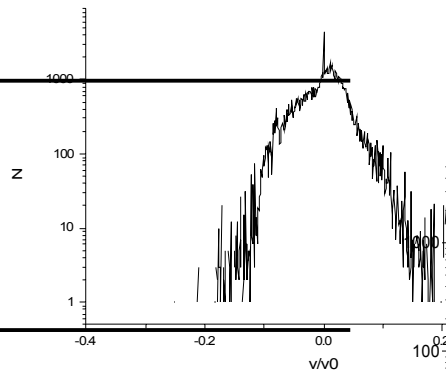
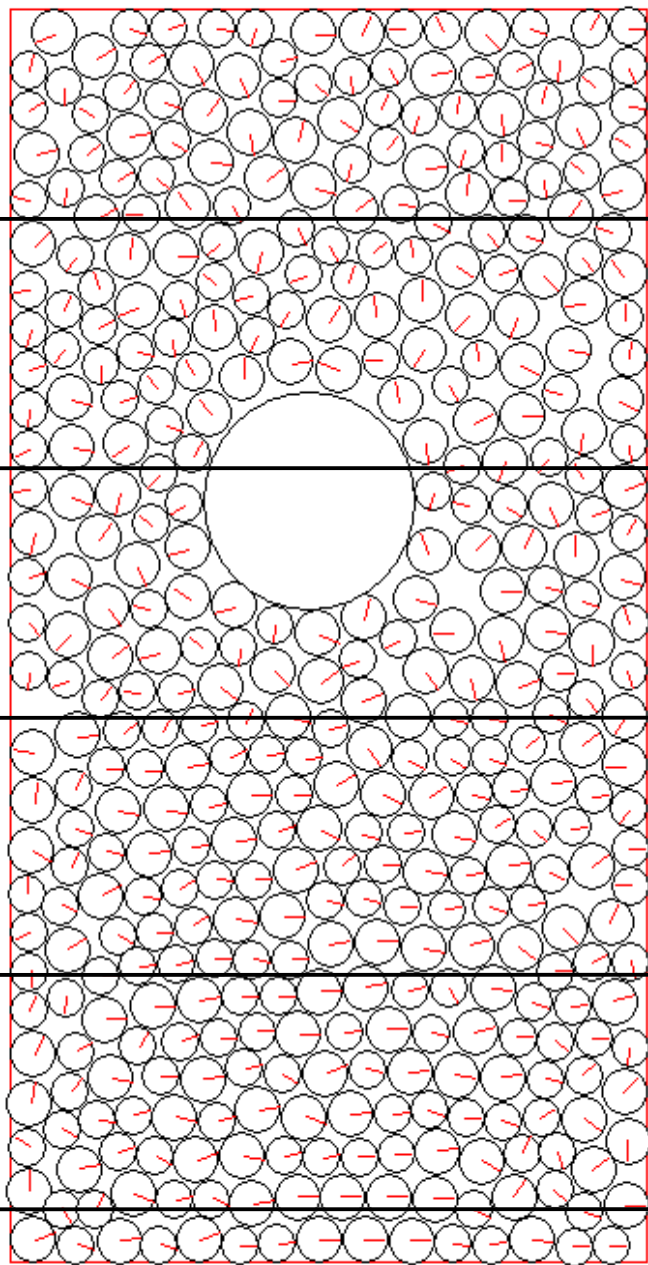
- Média amostral e temporal com células de tamanho $1.2 d_2$
- Simetria direita/esquerda
- Recircução em torno do intruso

Tamanho médio da cavidade



- Fit para $A_w = a(\phi^* - \phi)$
- $A_w \rightarrow 0$ quando F diverge

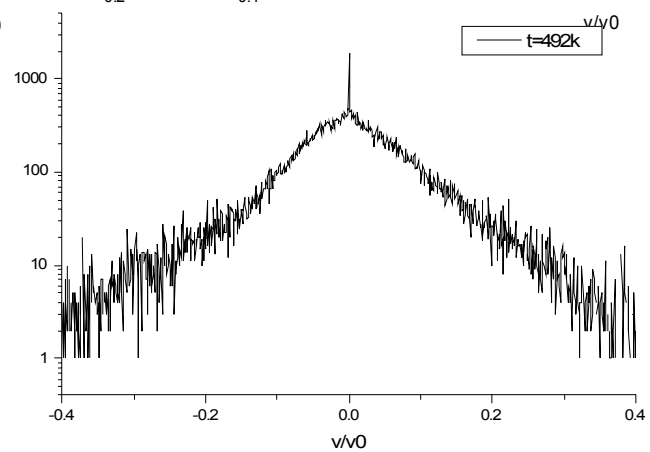
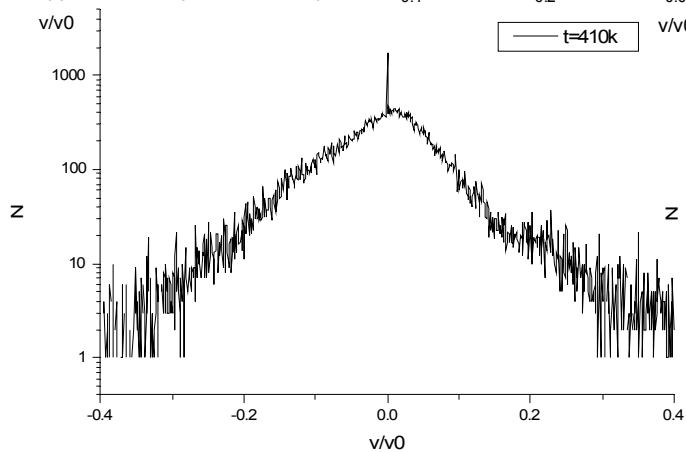
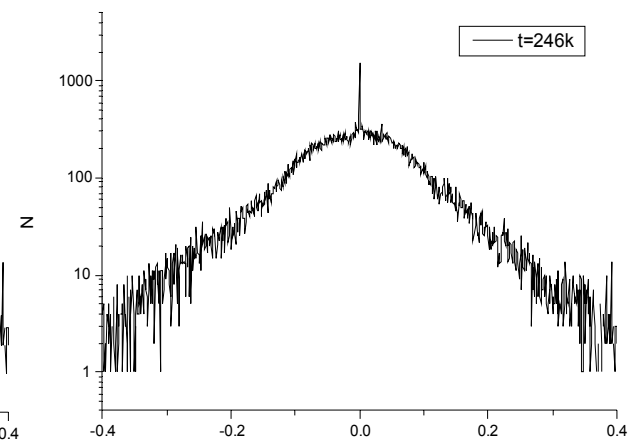
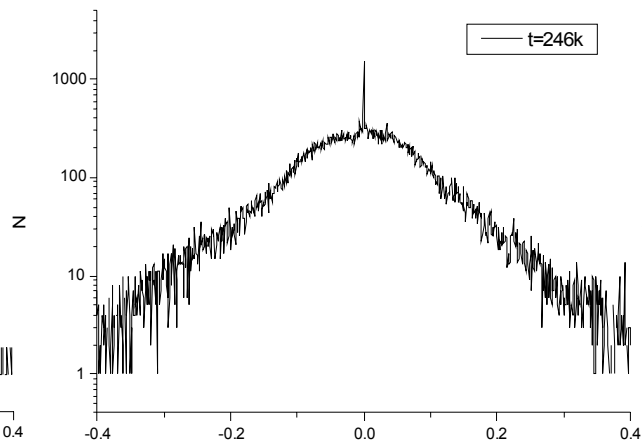
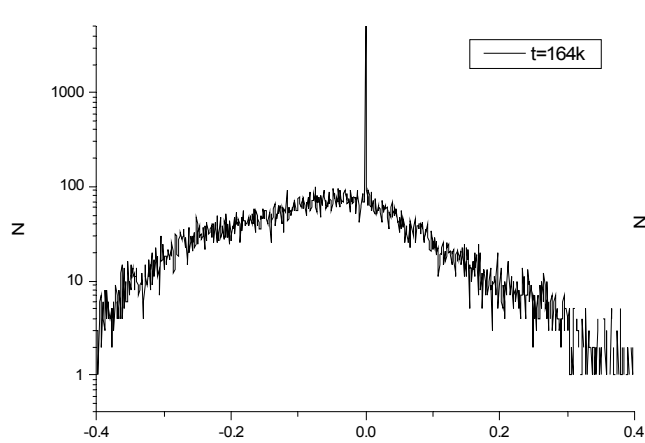
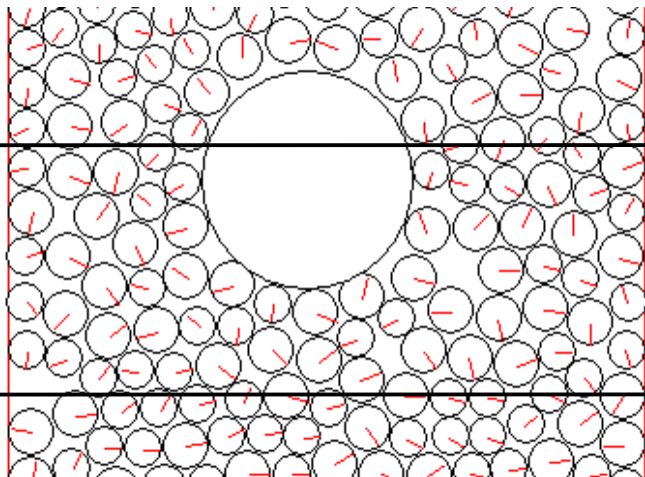
$\phi^* = 83.51\%$

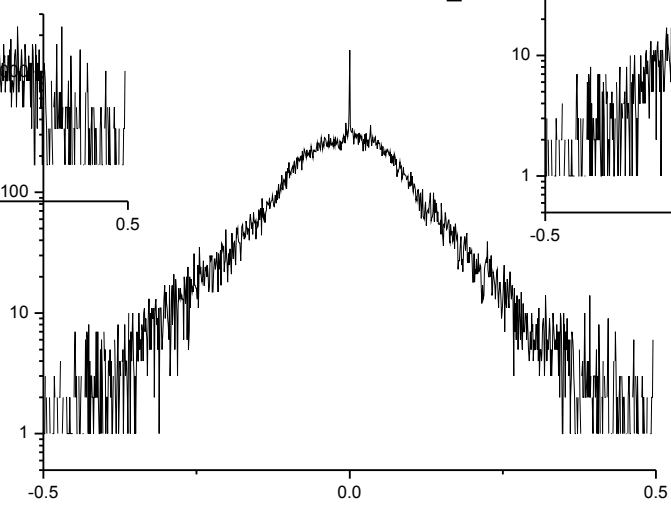
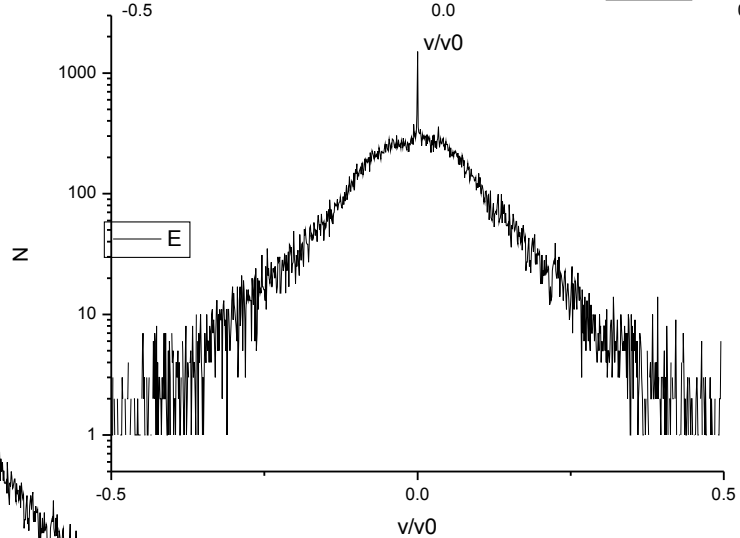
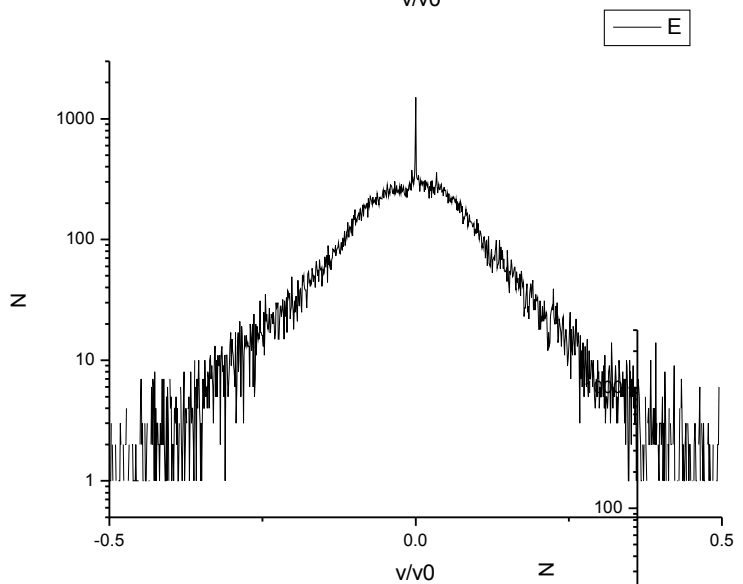
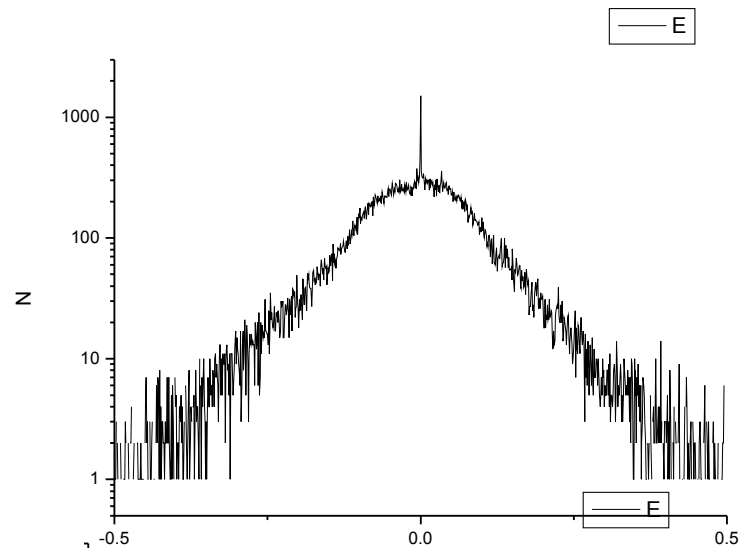
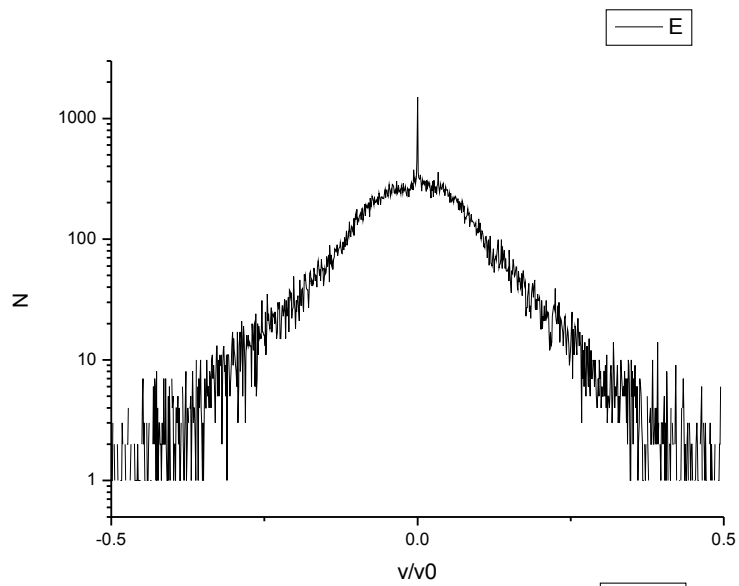
B**C****D****E****F****G****H**

Temporal Evolution:

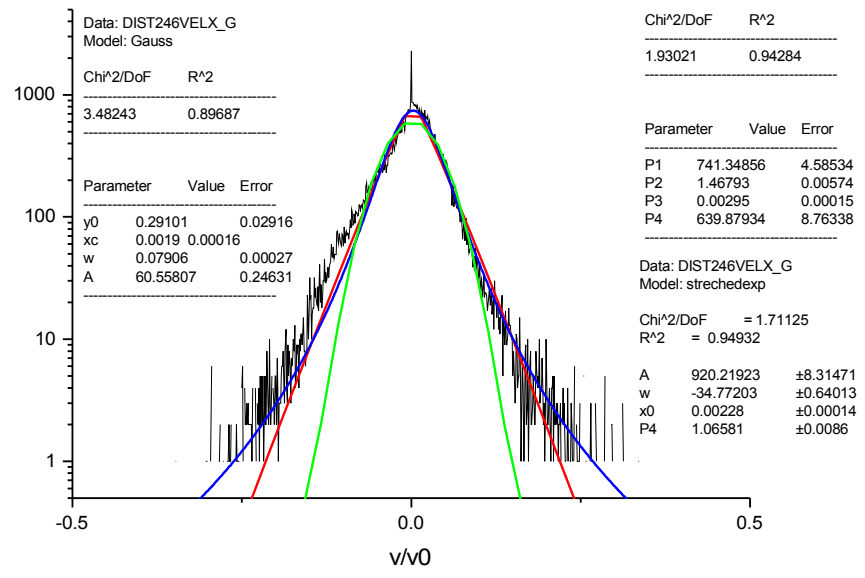
$$\rho = 0.84$$

E

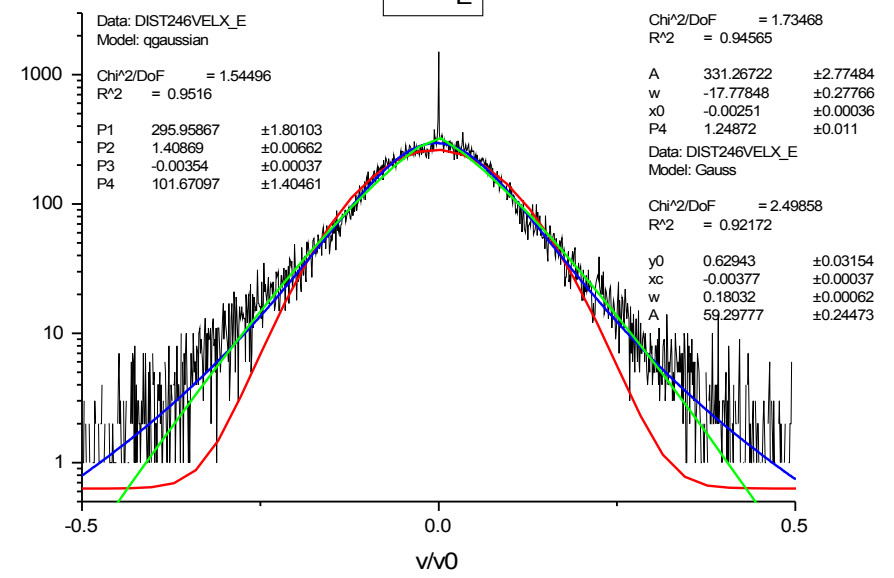




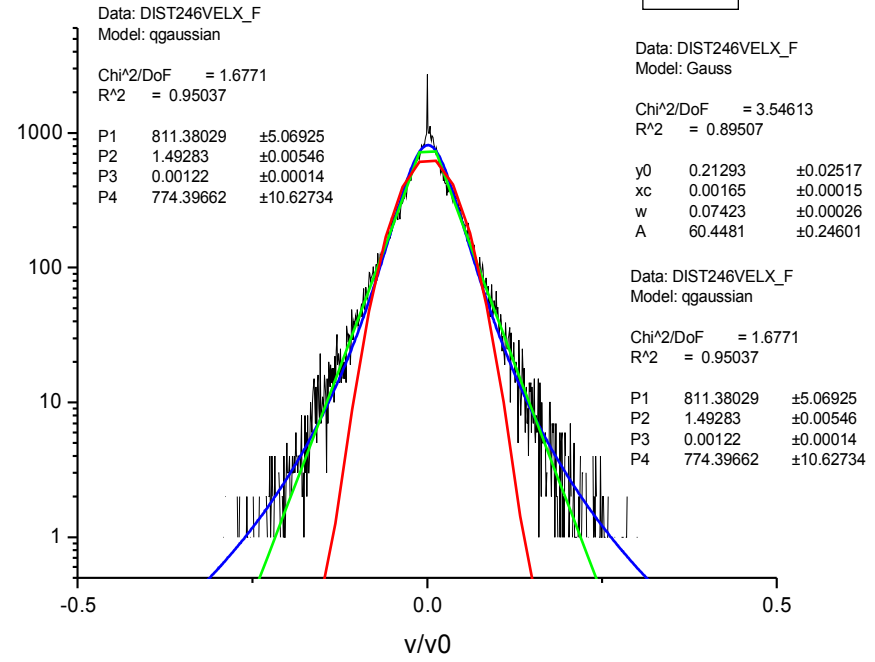
G



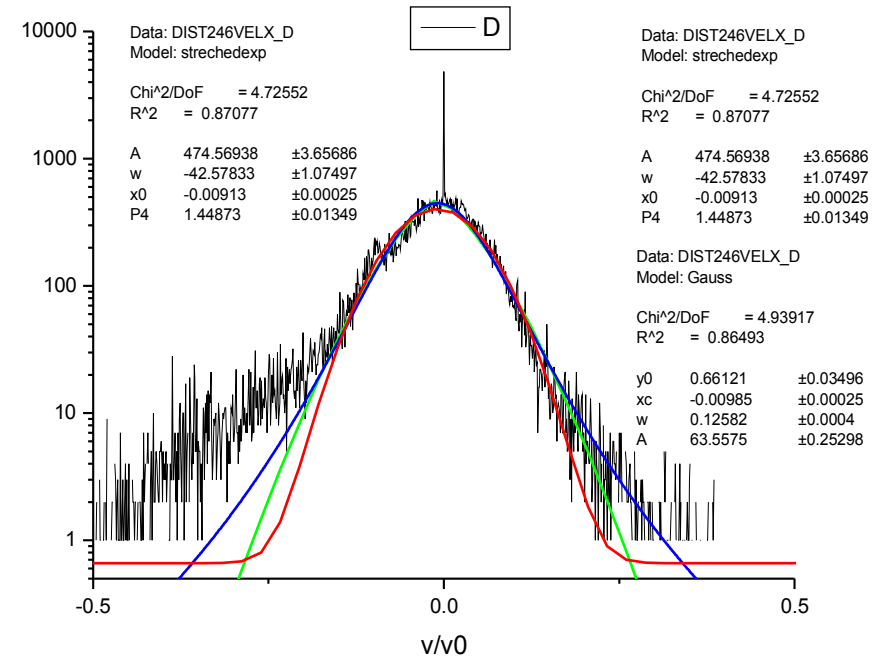
E

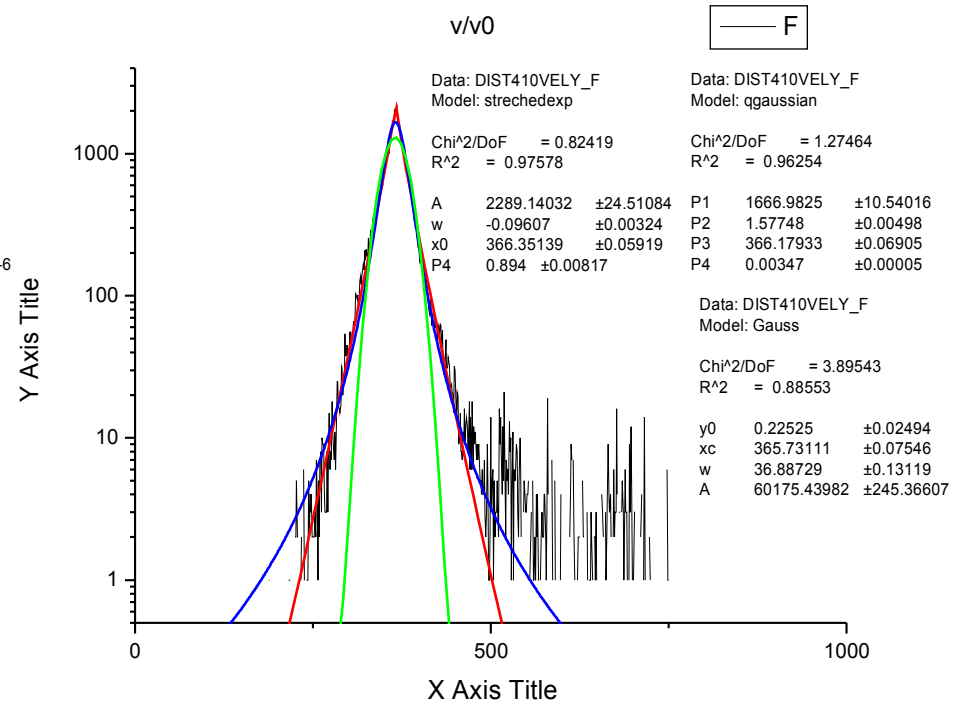
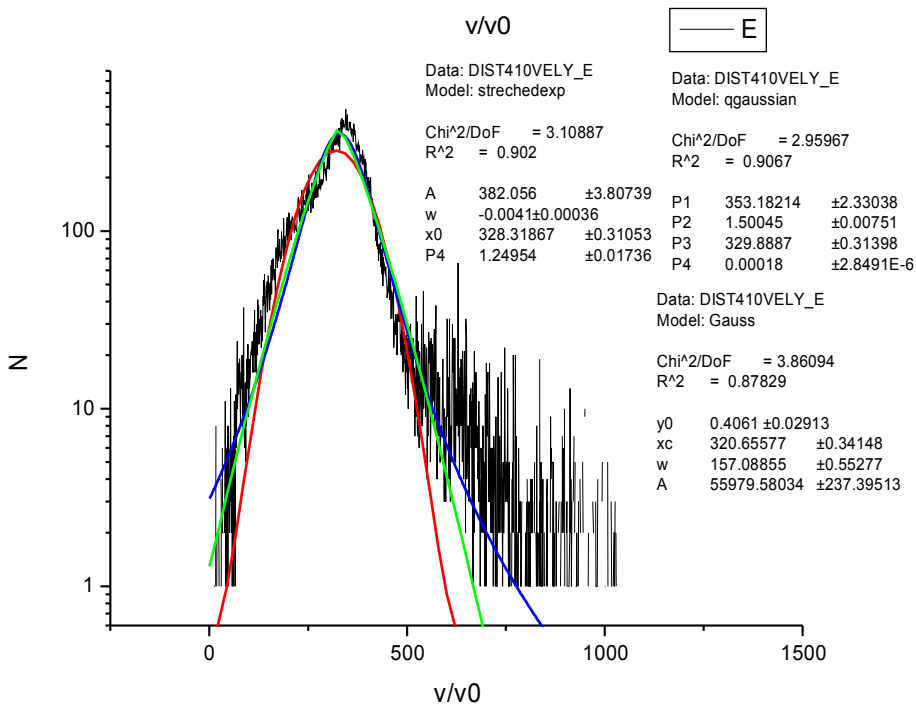
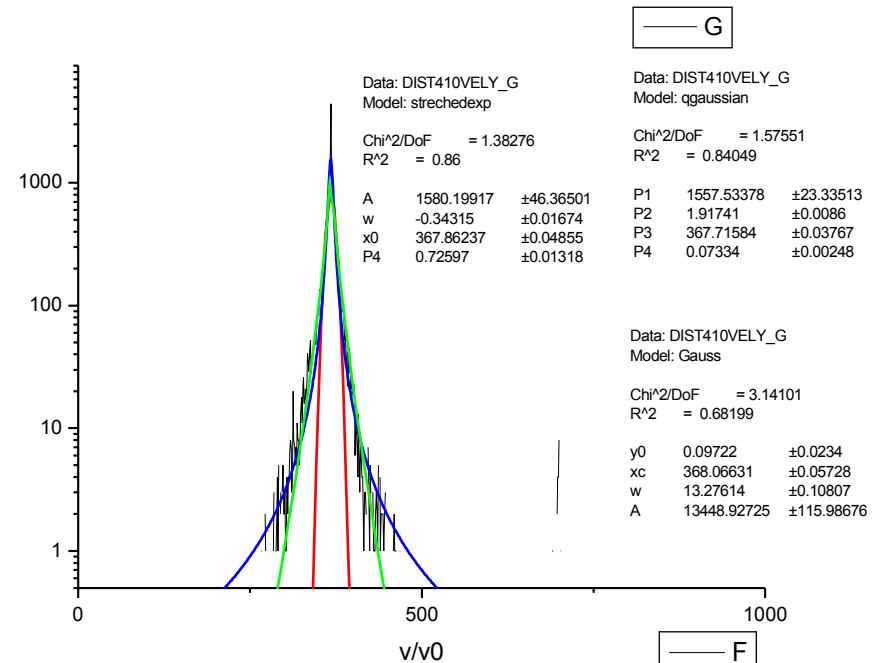
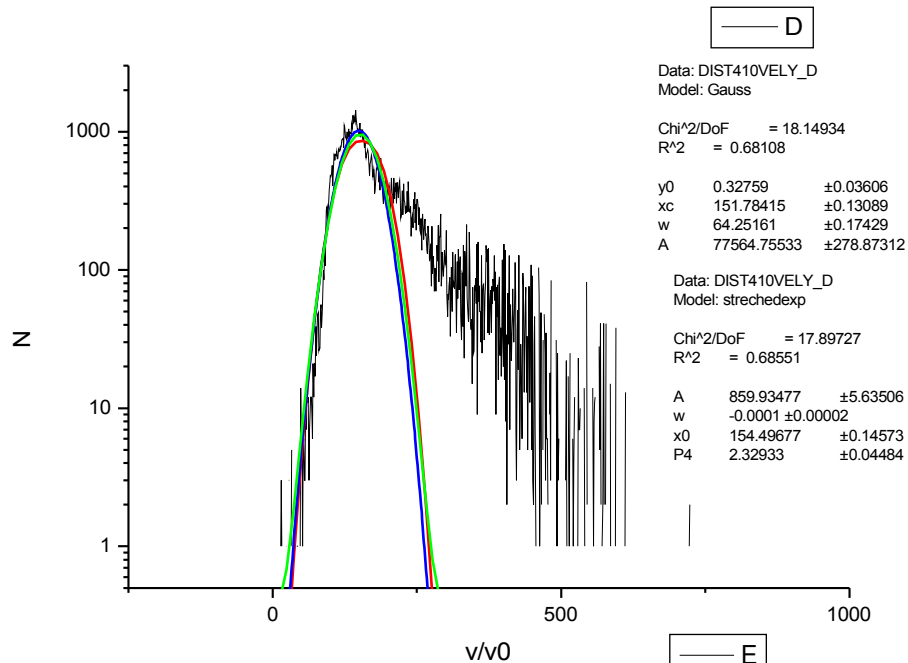


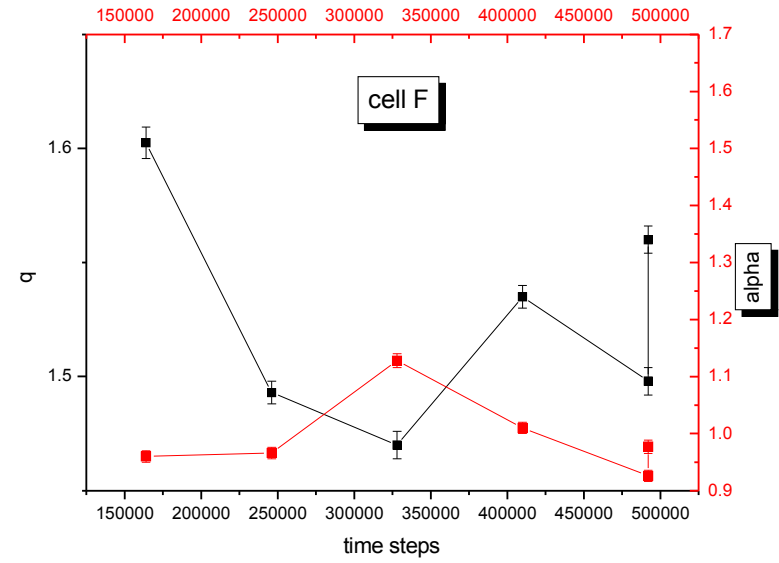
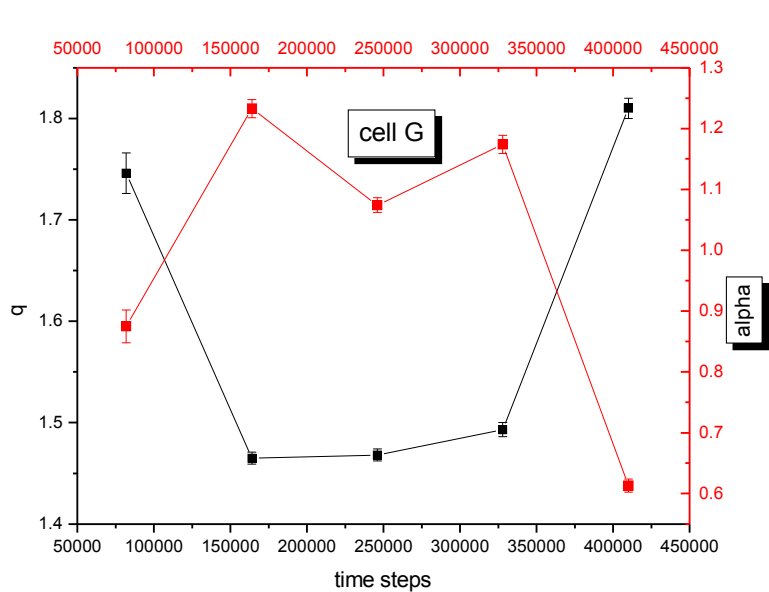
F



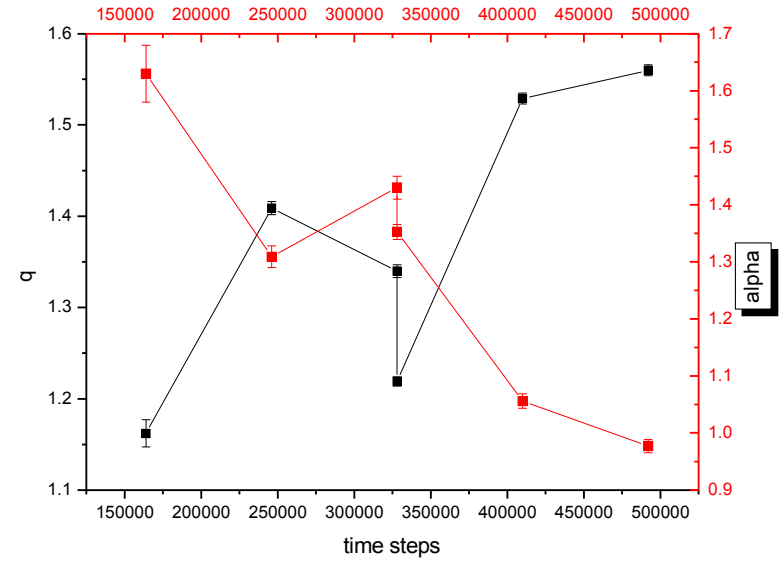
D

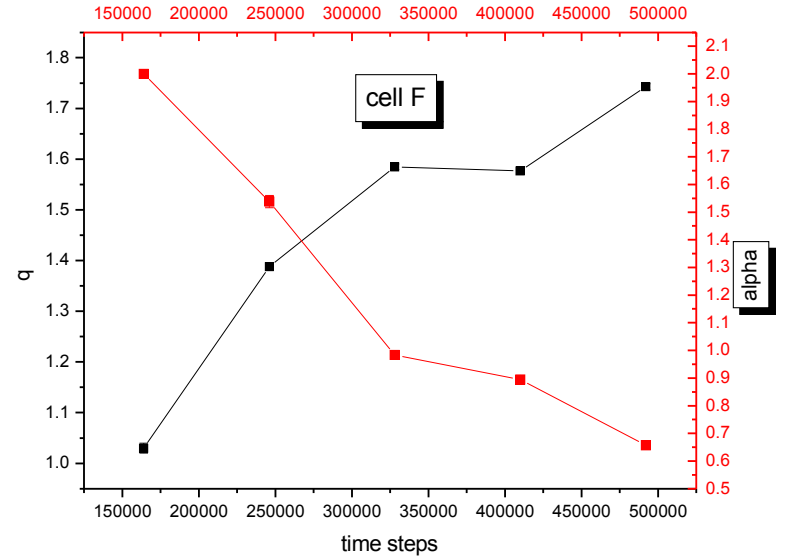
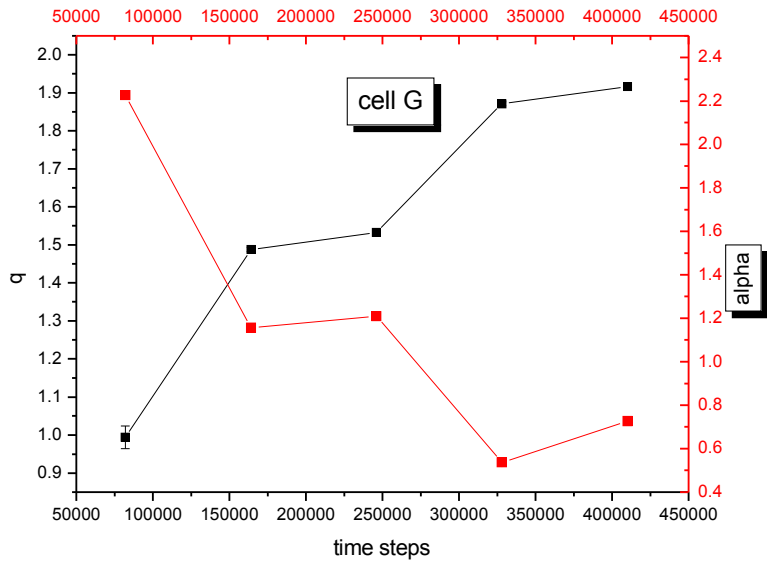




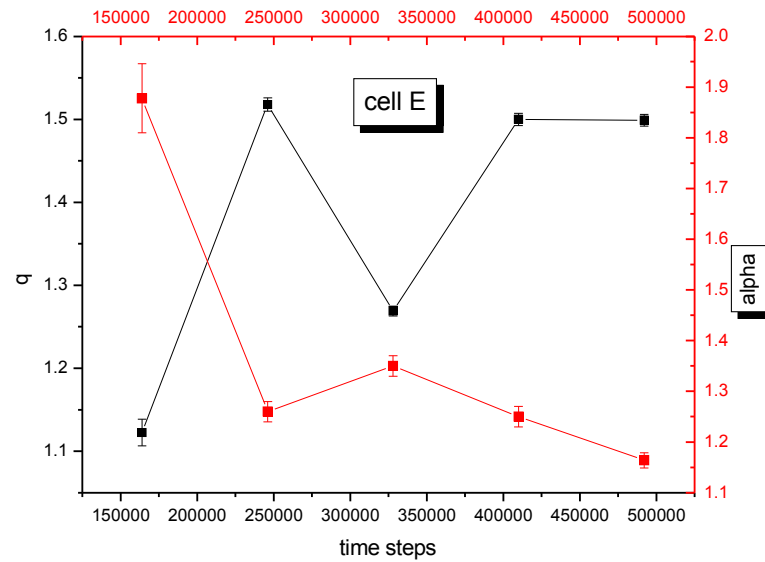


V_x distribution



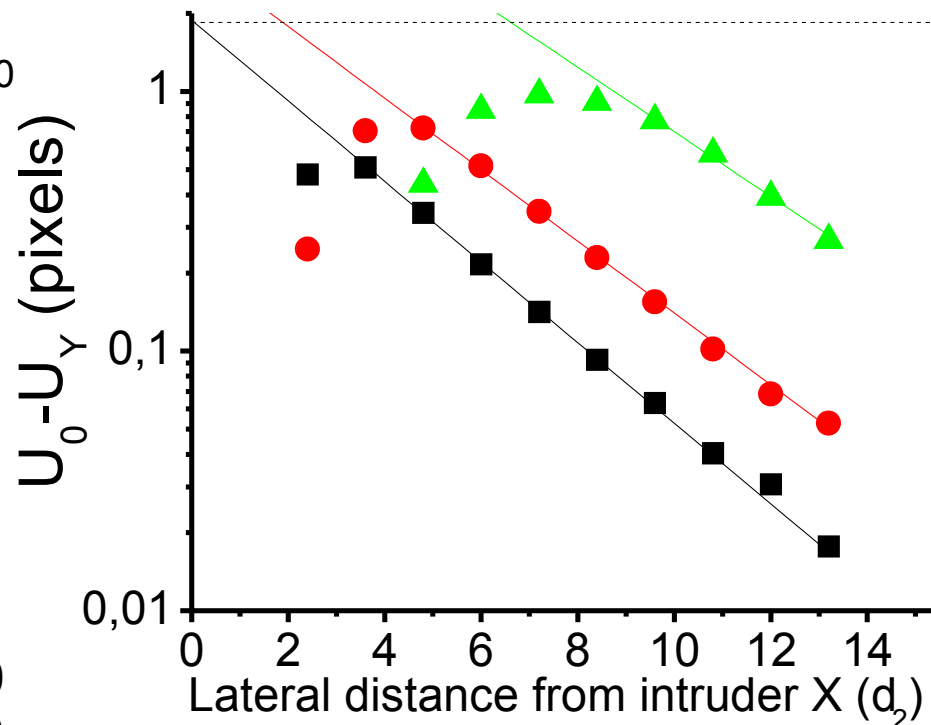
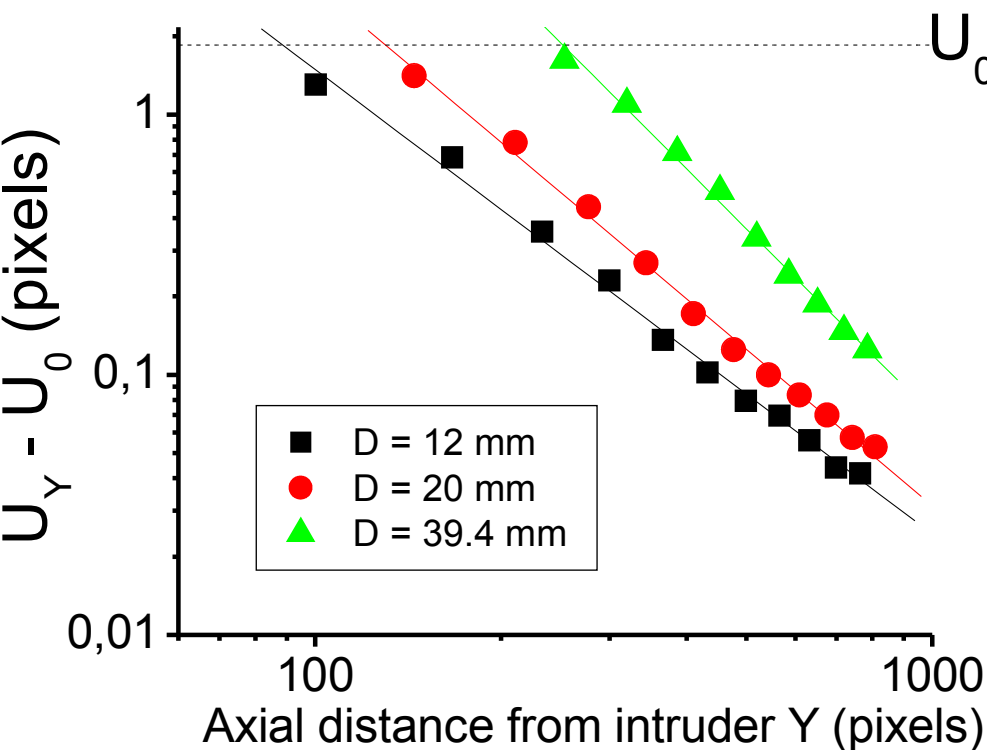


V_y distribution



Decroissance axiale et latérale

Plateau Ref.



→ Décroissance axiale en loi de puissance

$$|U_0 - U_Y| \approx \frac{1}{Y^\alpha}$$

→ Décroissance latérale exponentielle

$$|U_0 - U_Y| \approx e^{-\frac{X}{d_c}}$$

Discharge Avalanches of Sandpiles

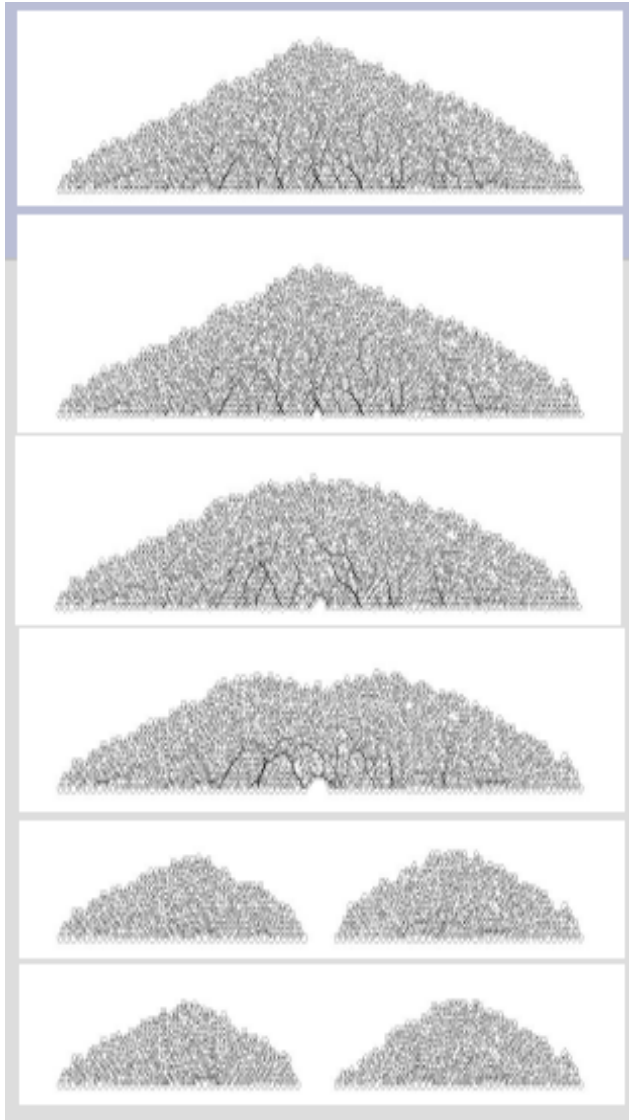
A.P.F. Atman

J.G. Moreira

Caio F. M. Magalhães

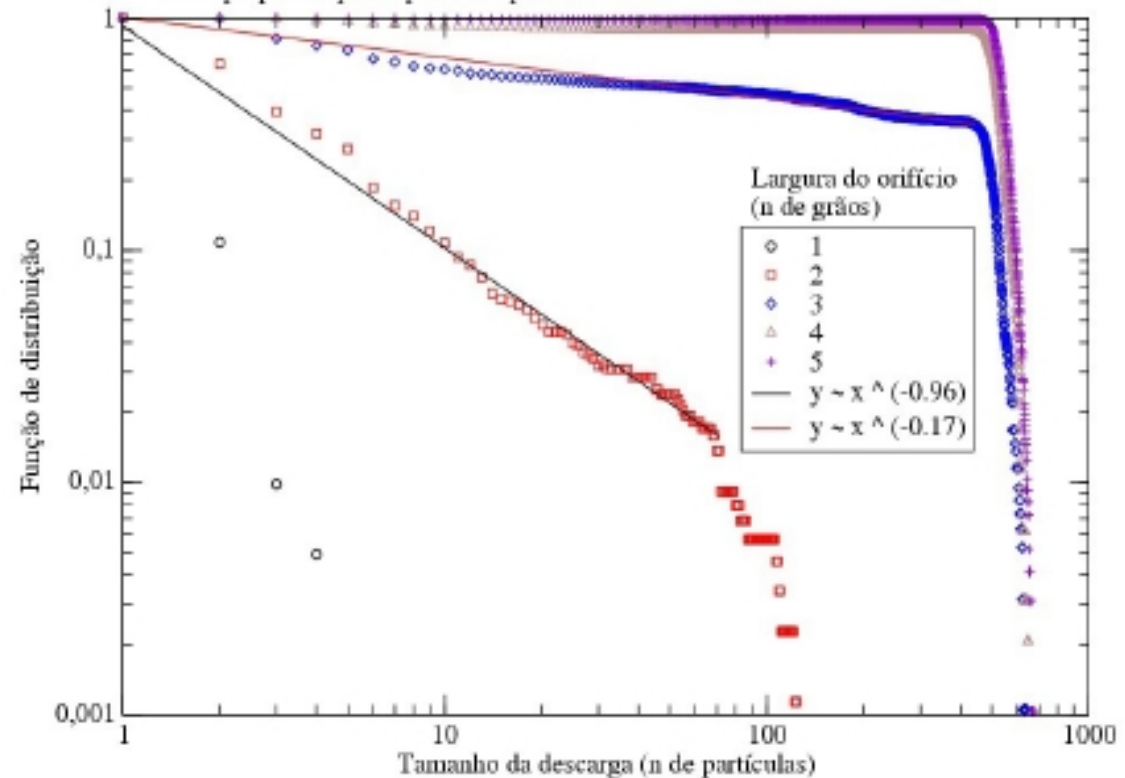


UFMG



Distribuição do tamanho de descargas

Pilha preparada por deposição tipo chuva

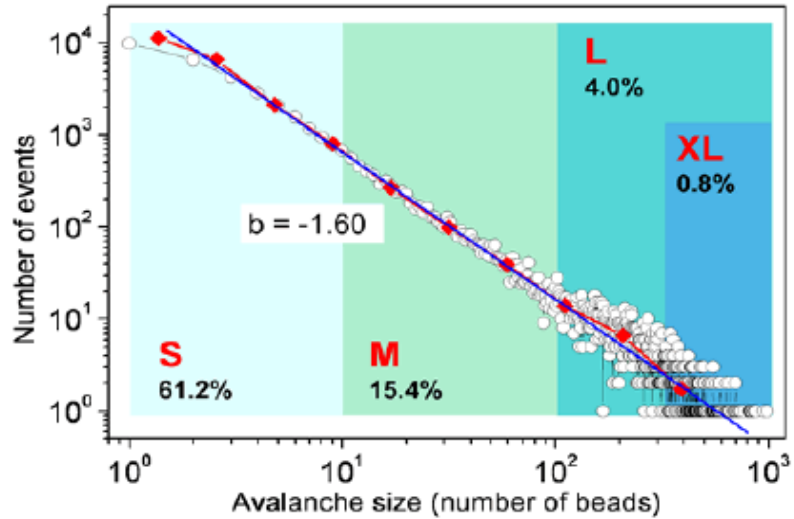


Avalanches em empilhamentos granular

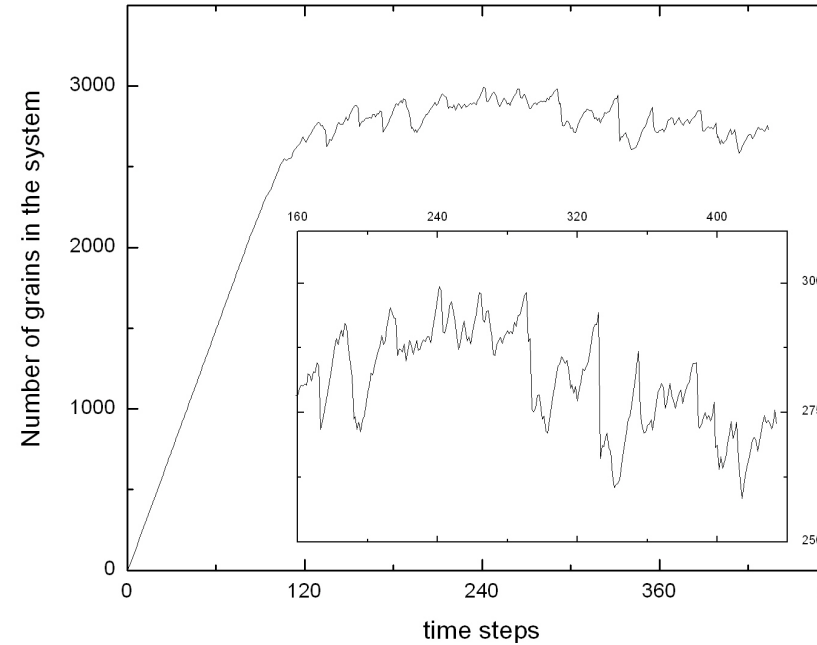
José Guilherme Moreira – UFPA

Ana Cristina de Oliveira PIBIC – CNPq - U





O. Ramos, E. Altshuler and K. J. Maloy, *Avalanche prediction in Self-organized systems*, Preprint cond-mat/0808.0623v1, (2008).



Discharge of grains in a granular pile: a molecular dynamics study – in preparation
 C. F. M. Magalhães, J. G. Moreira
 A. P. F. Atman

