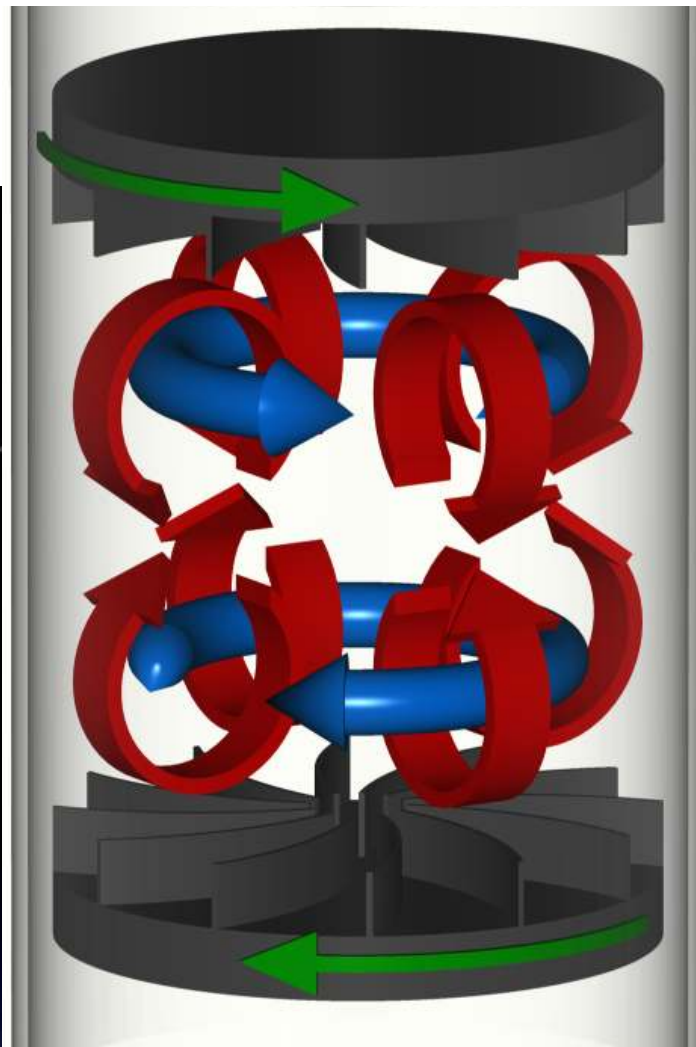


L'énergie cinétique normalisée $\delta(t)$:

une quantité globale en turbulence
inhomogène et anisotrope

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Groupe Instabilités et Turbulence
Service de Physique de l'Etat Condensé
Direction des Sciences de la Matière
CEA Saclay - CNRS URA 2464



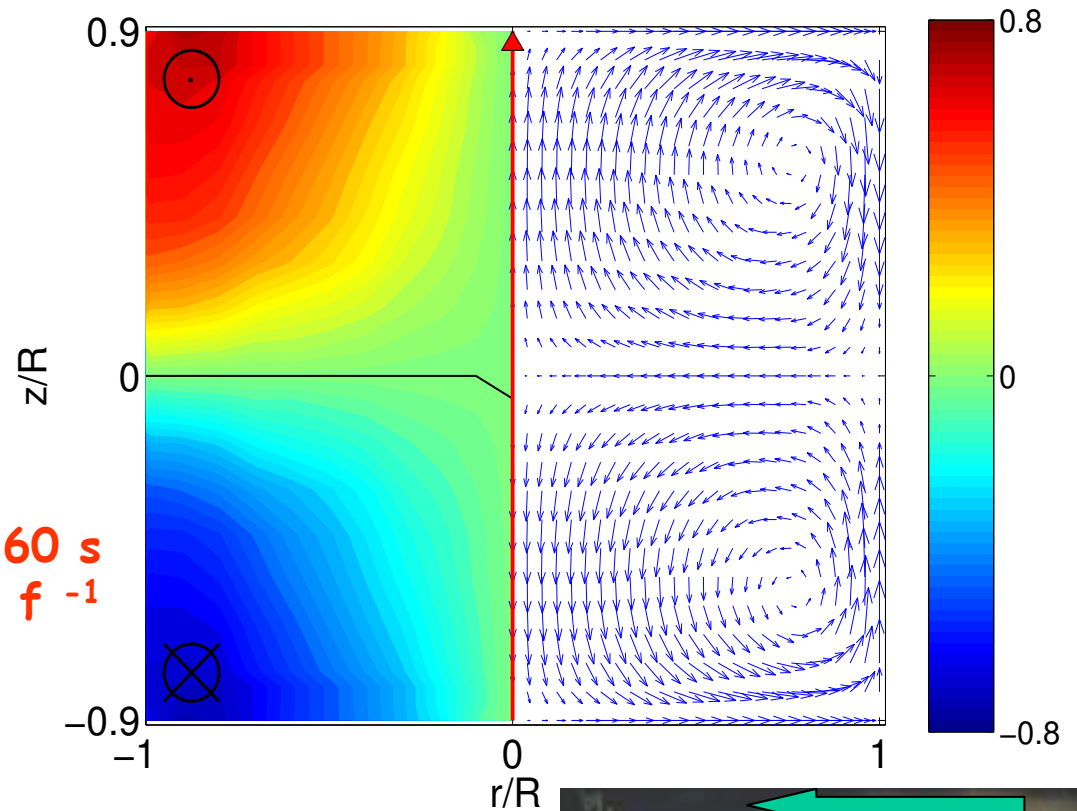
**Ecoulement
de
von Kármán**



L'écoulement de von Kármán turbulent et ses **trois** échelles

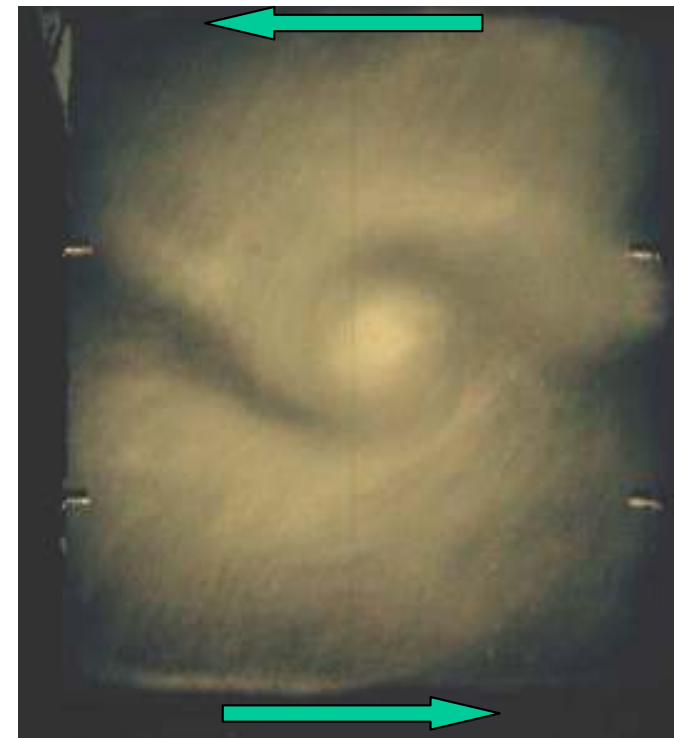
Temps de moyennage : 60 s
 $500 f^{-1}$

$$Re \simeq 10^6$$



Temps de moyennage : 1/20 s
 $1/2 f^{-1}$

Temps de moyennage : 1/500 s
 $1/50 f^{-1}$

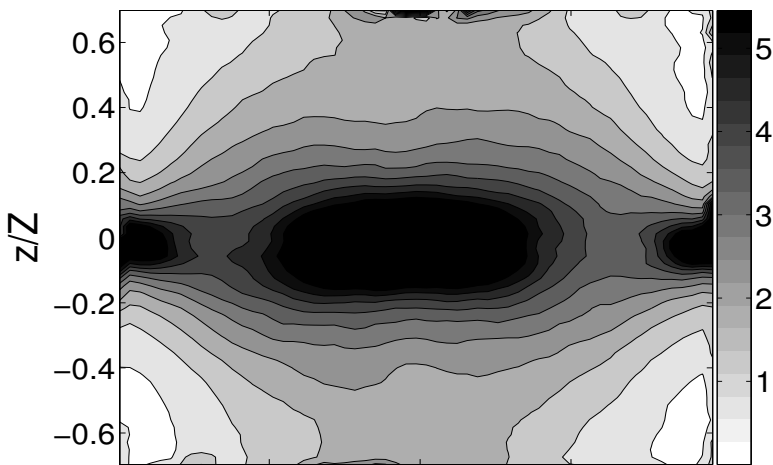


- 1 -

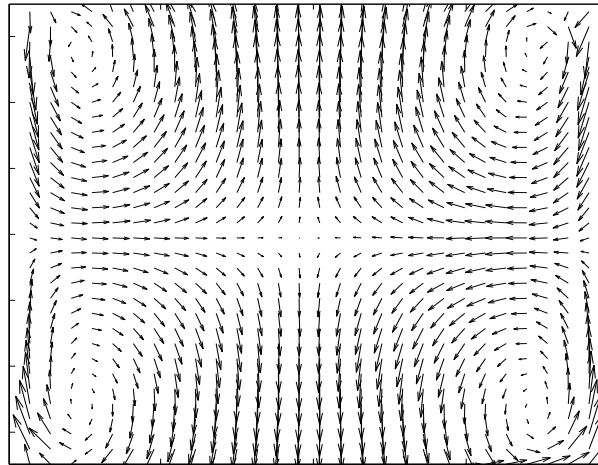
Comment **quantifier**
les **fluctuations turbulentes**
autour d'un **écoulement moyen** ?

L'énergie cinétique normalisée $\delta(t)$

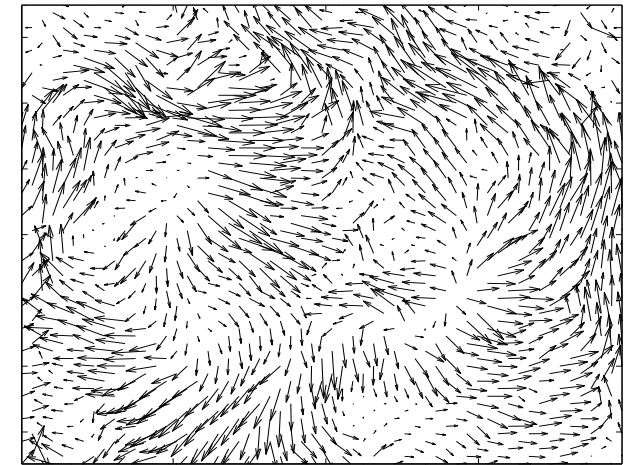
Generalization of turbulence intensity inhomogeneous & anisotropic flows $i = \sqrt{\frac{V^2 - \bar{V}^2}{\bar{V}^2}}$ for



Turbulence intensity



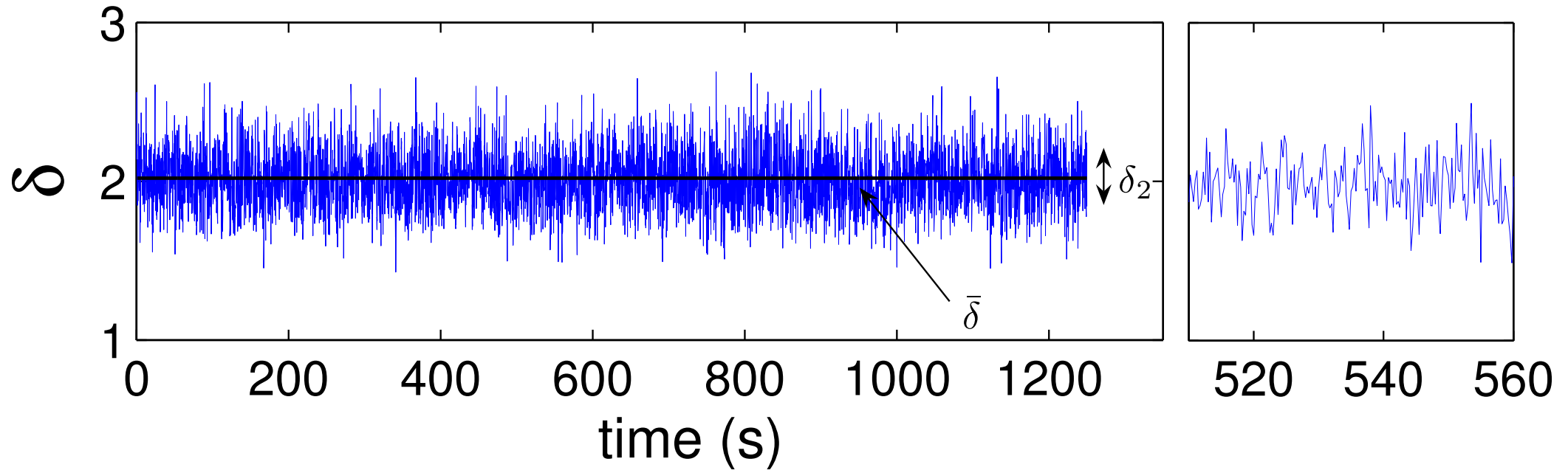
Time averaged \mathbf{v} field



Instantaneous \mathbf{v} field

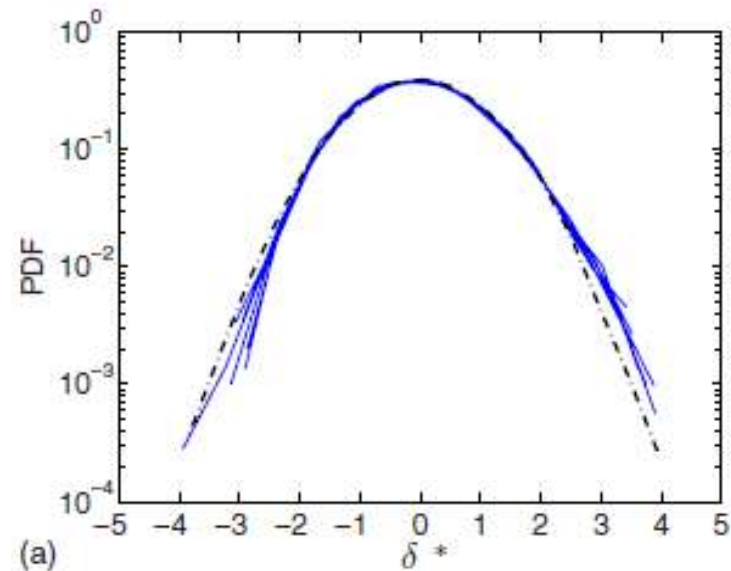
$$\delta(t) = \frac{E(t)}{\bar{E}} = \frac{\langle V^2(t) \rangle}{\langle \bar{V}^2 \rangle}$$

Dynamique et statistique de $\delta(t)$



statistique gaussienne :

$\delta(t) \longrightarrow \bar{\delta} \text{ \& \ } \delta_2$



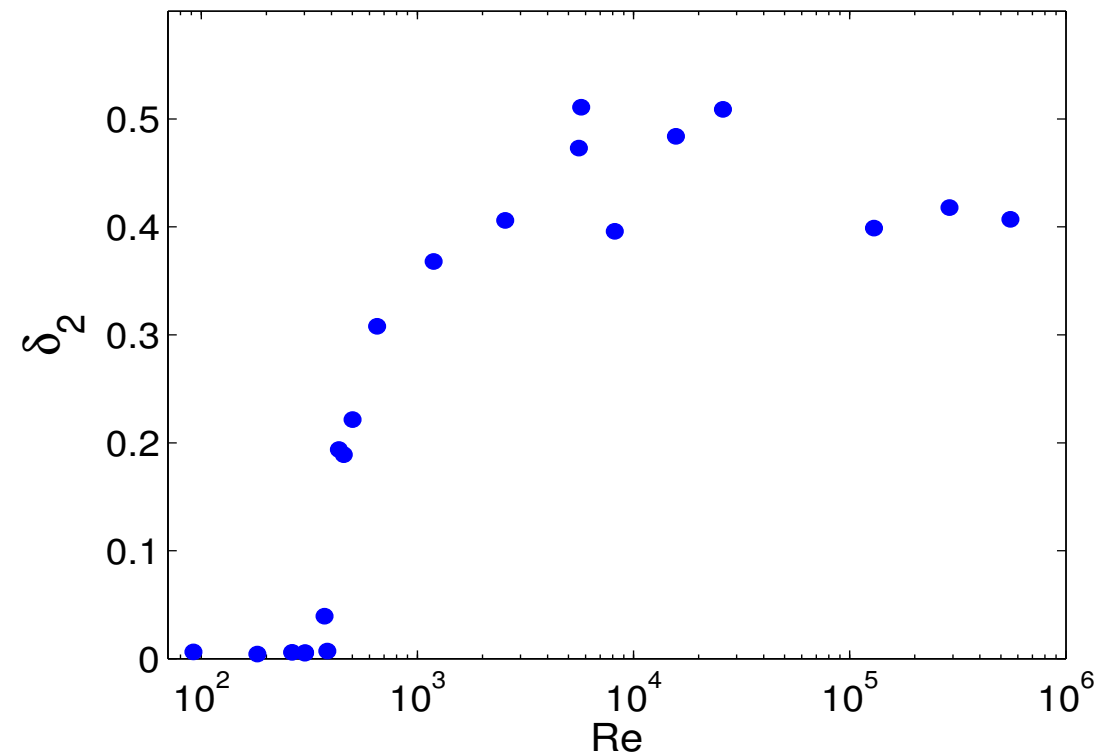
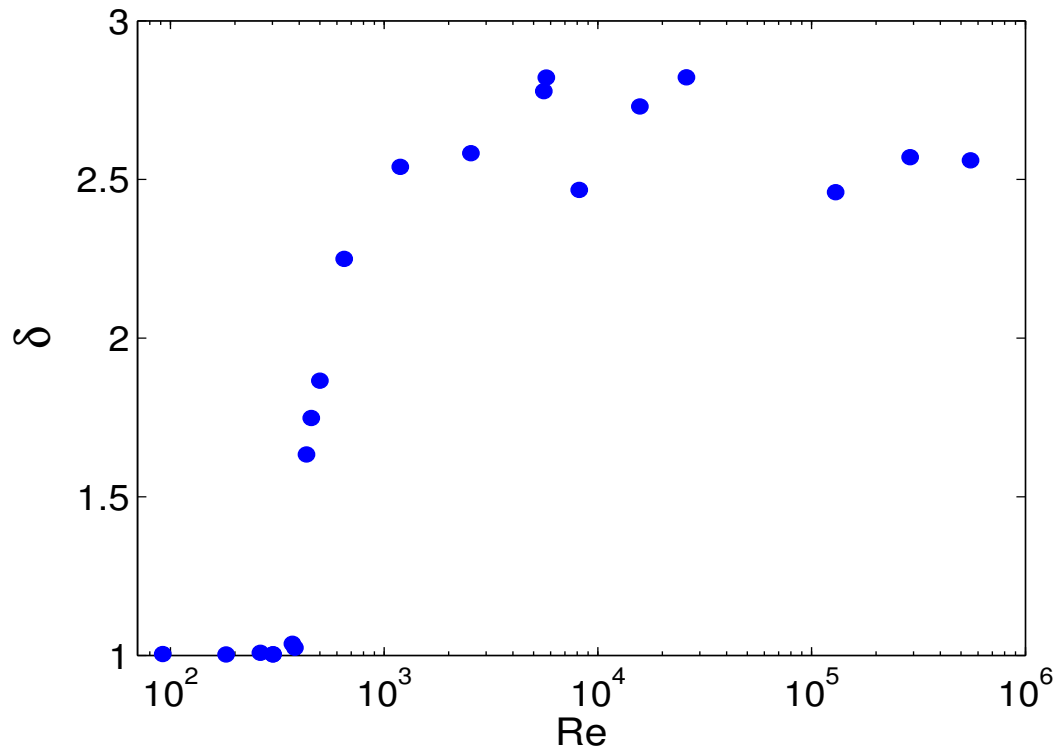
Evolution de $\bar{\delta}$ & δ_2 avec le nb de Reynolds

$$\bar{\delta} = \frac{\overline{\langle V^2(t) \rangle}}{\langle \bar{V}^2 \rangle}$$

$$\delta_2 = \sqrt{\overline{\delta(t)^2} - \overline{\delta(t)}^2} = \frac{E_{rms}}{\bar{E}} \propto \frac{1}{\sqrt{N}}$$

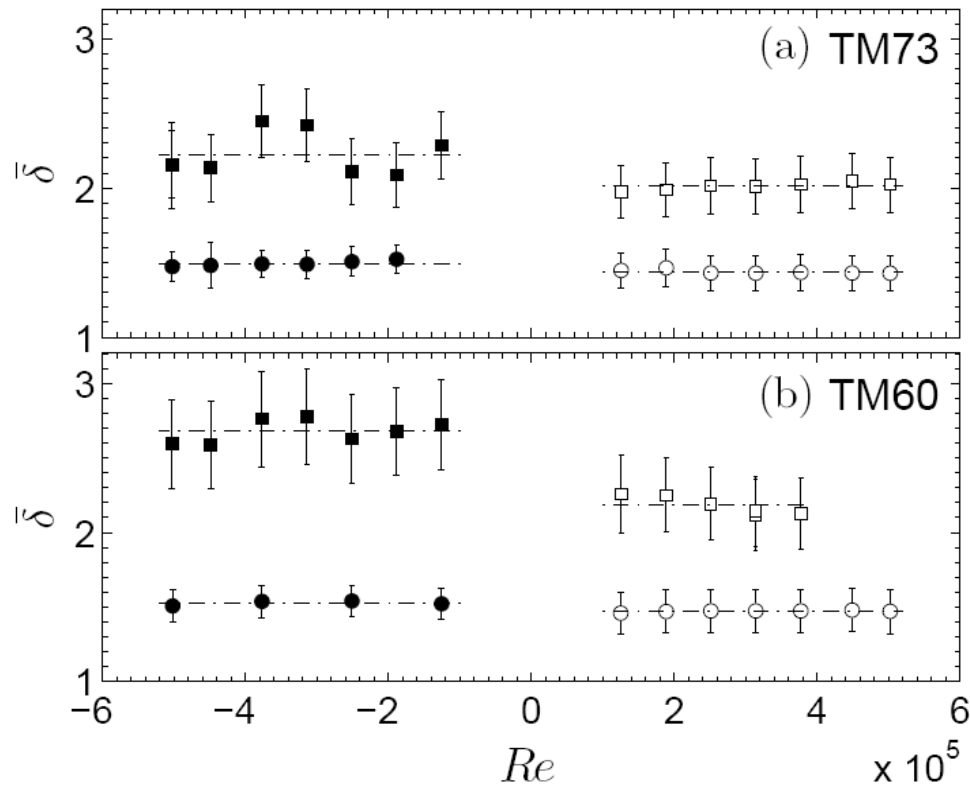
distance to mean flow

N = degrees of freedom

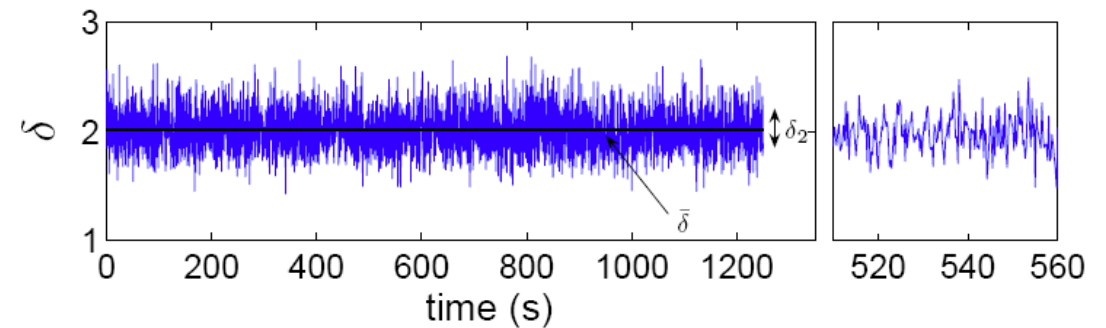


cf. Aumaître et al. EPJB (2004 & 2006)

Caractérisation d'écoulements différents

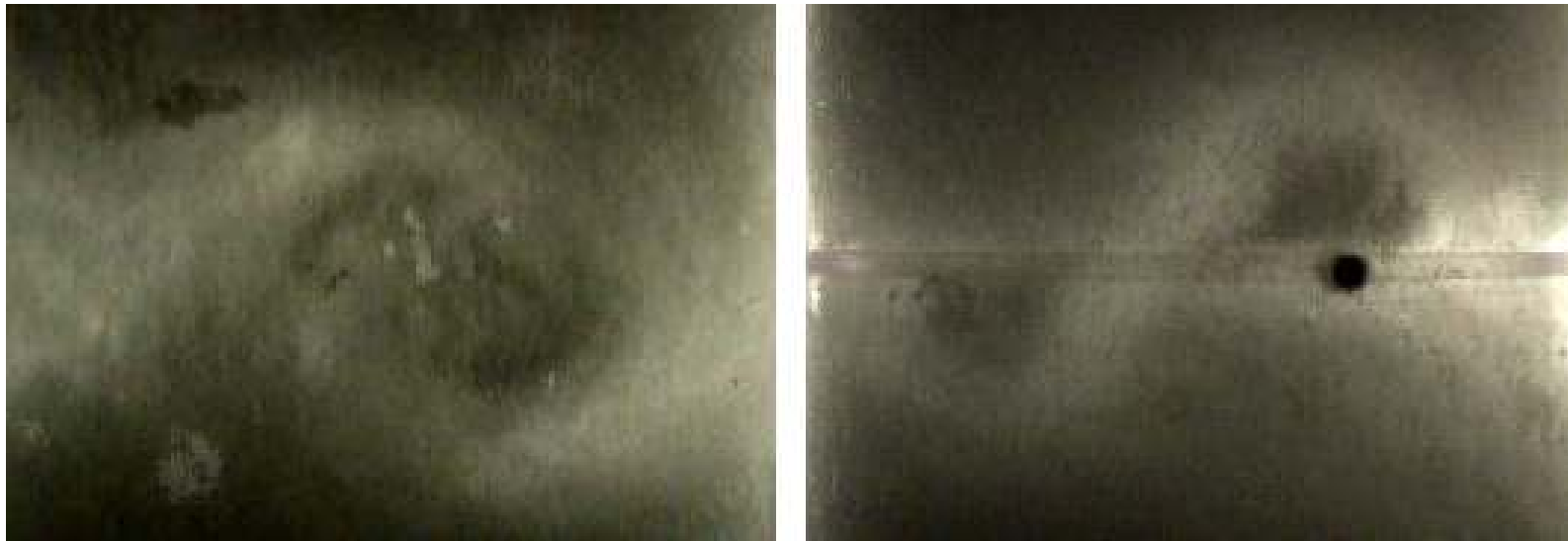


$$\delta(t) = \frac{\langle V^2(t) \rangle}{\langle \bar{V}^2 \rangle}$$



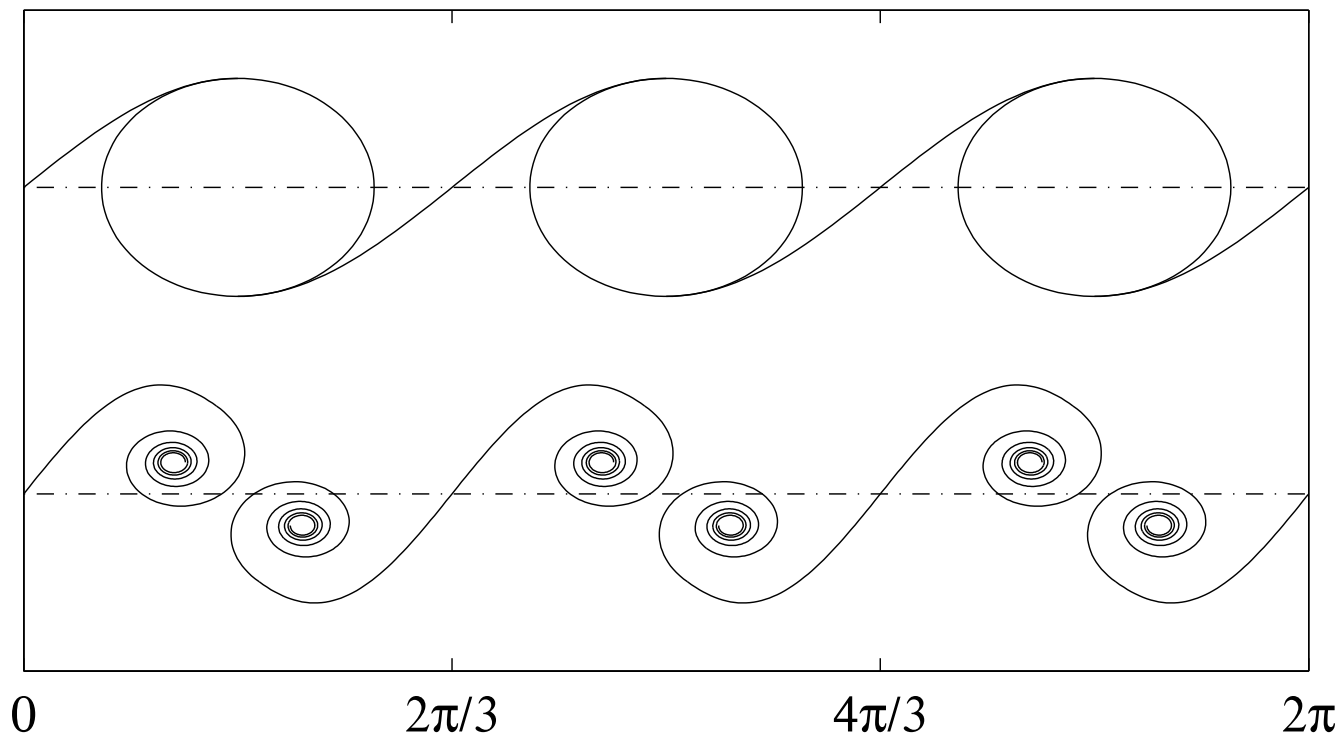
Impellers	$\bar{\delta}$				δ_2			
	TM60		TM73		TM60		TM73	
Sense	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)
Without annulus	2.64	2.18	2.22	2.02	0.30	0.24	0.24	0.18
With annulus	1.52	1.47	1.50	1.48	0.11	0.15	0.11	0.12

La couche de cisaillement



libre

contrainte

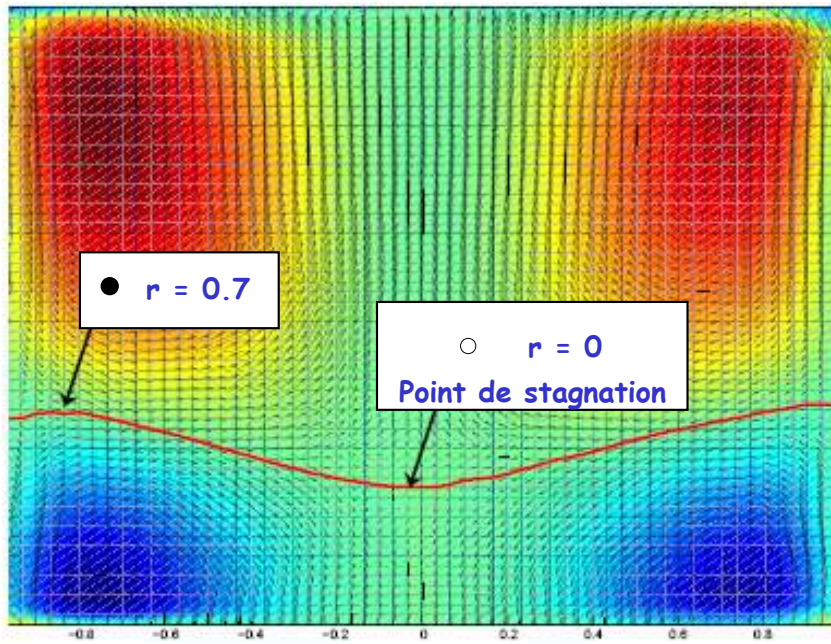


- 2 -

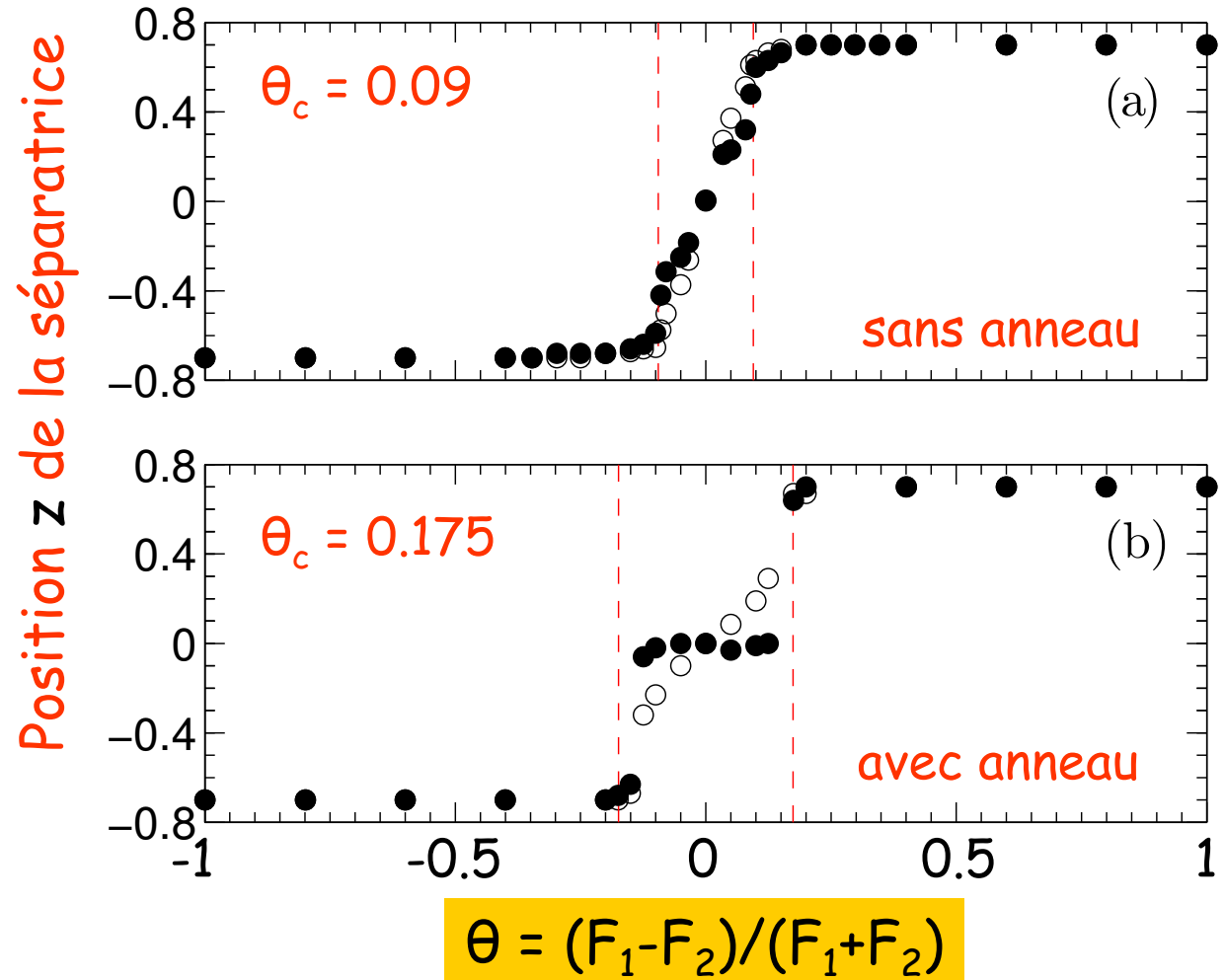
Changeons maintenant
la **symétrie** ou la **topologie**
de l'écoulement **moyen**

Position de la couche de cisaillement en fonction de θ

Forme de la séparatrice par SPIV
(zéro de la fonction courant)

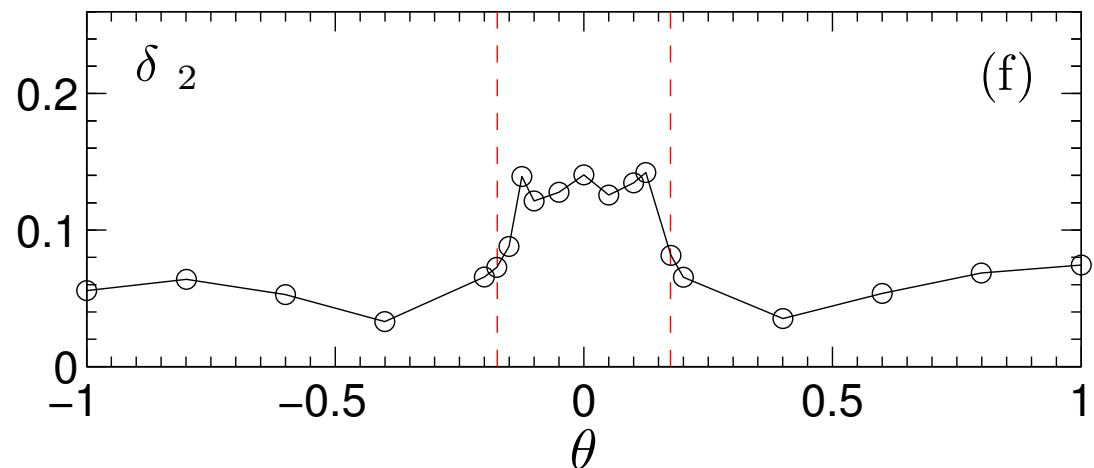
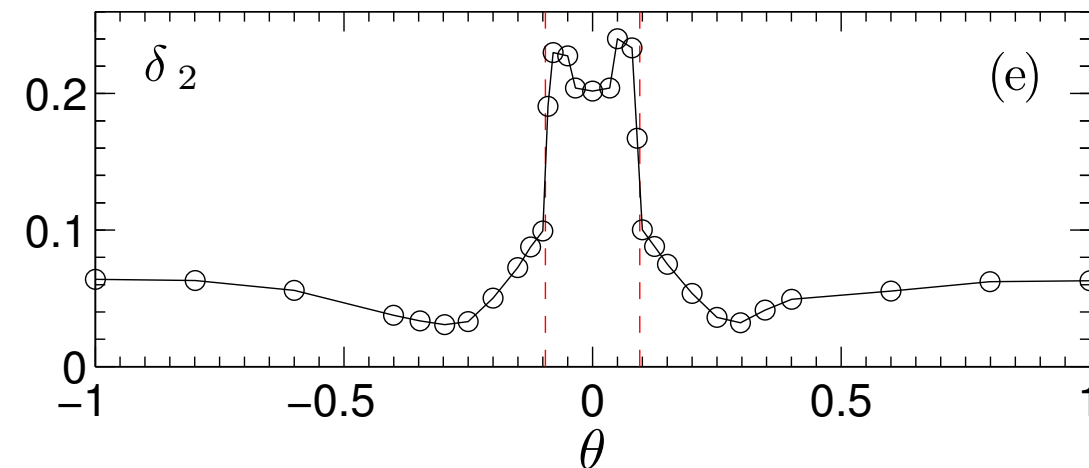
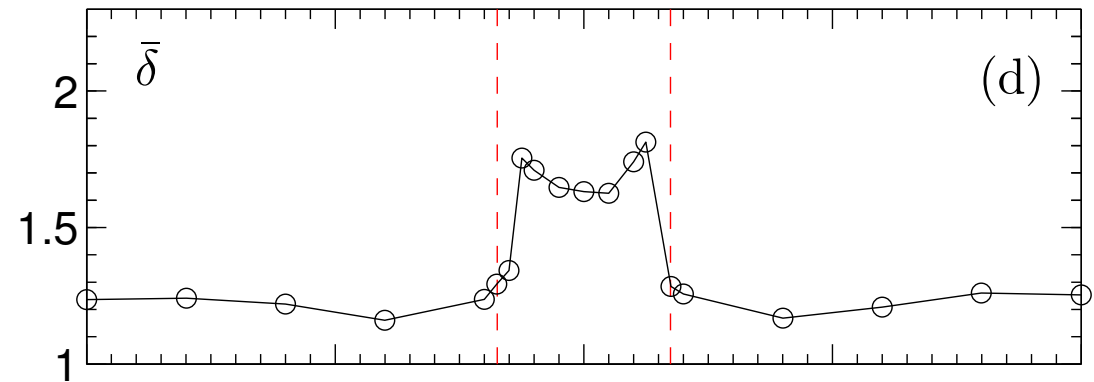
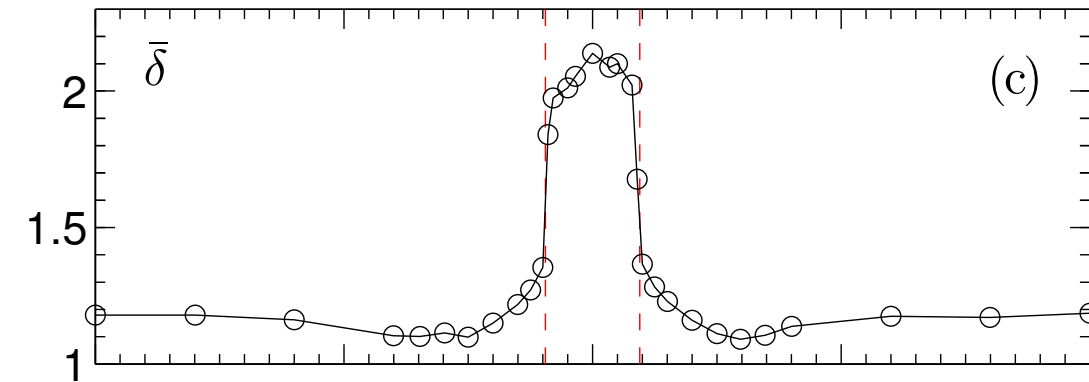
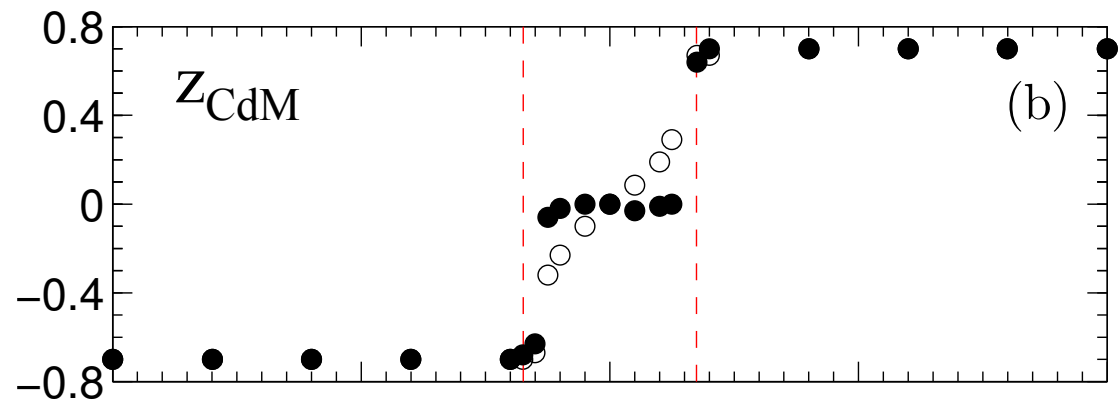
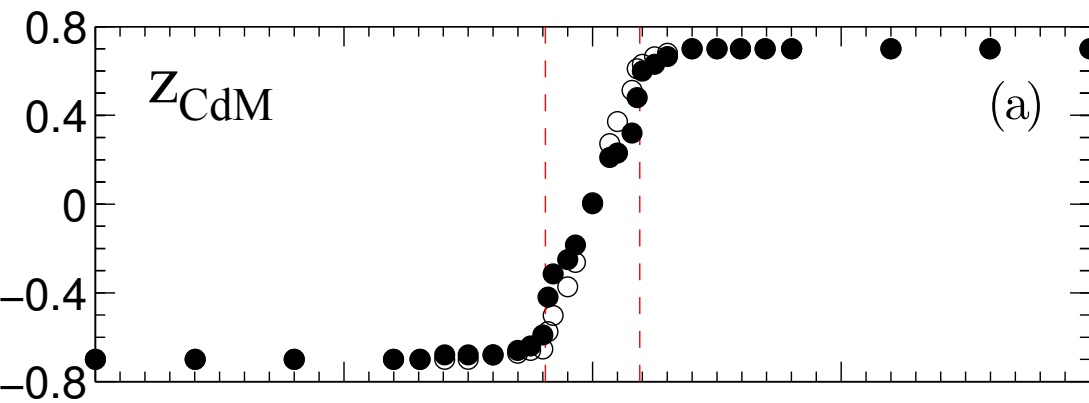


$\theta = 0.05$, sans anneau



L'anneau stabilise et retient la séparatrice

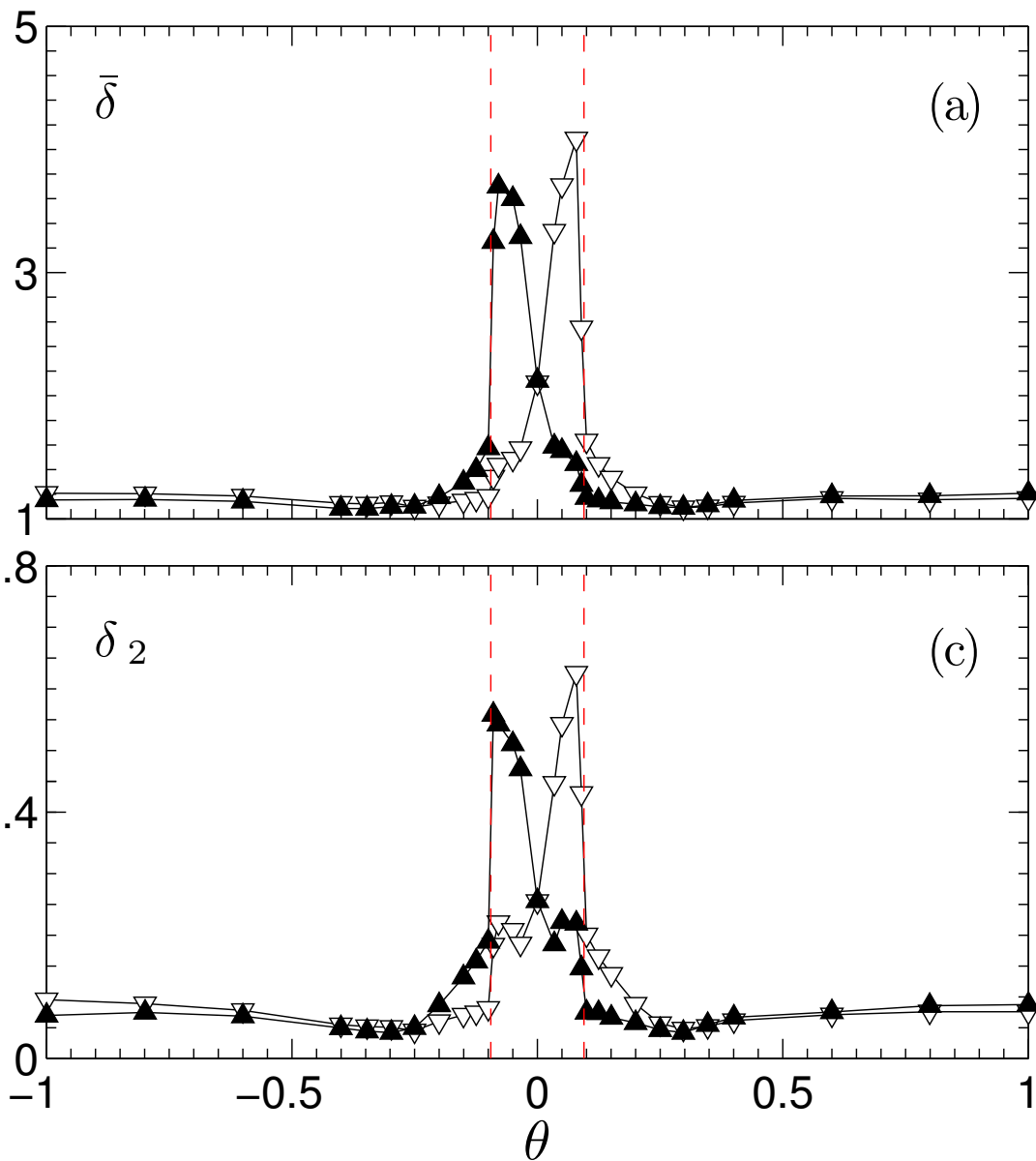
δ : paramètre d'ordre pour la transition 1 cellule / 2 cellules ?



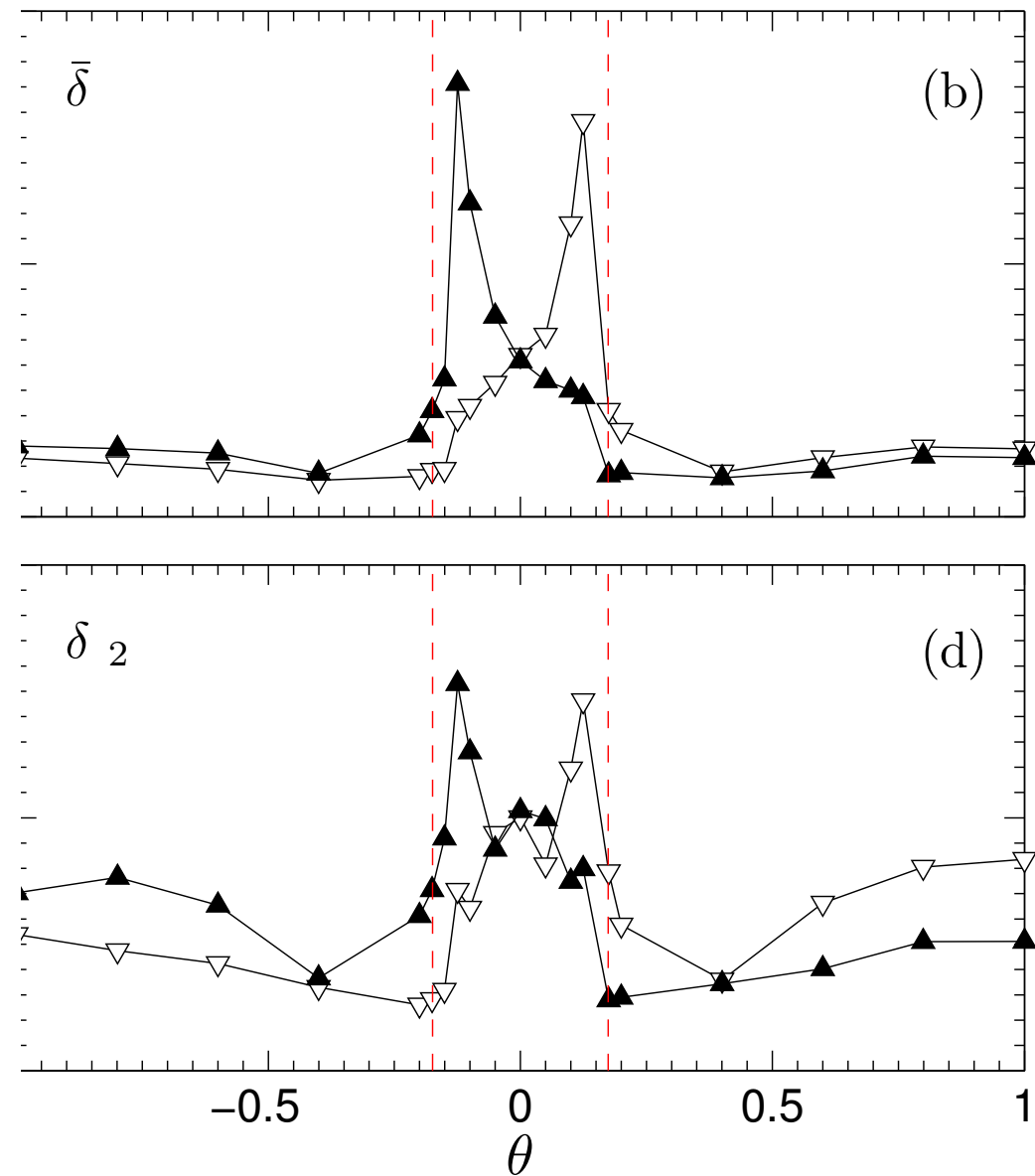
TM73 sans anneau

TM73 avec anneau

δ mesuré sur deux demi-cellules : divergences au seuils ?



TM73 sans anneau



TM73 avec anneau