Preferential sampling of elastic chains in turbulence

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## Clustering in turbulent flows

bubbles
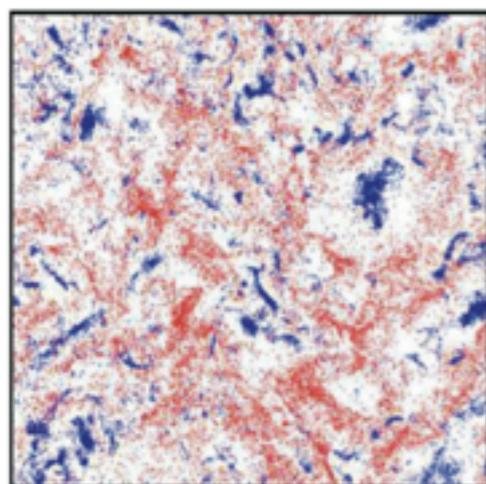
Calzavarini et al. *JFM* (2008)

heavy particles
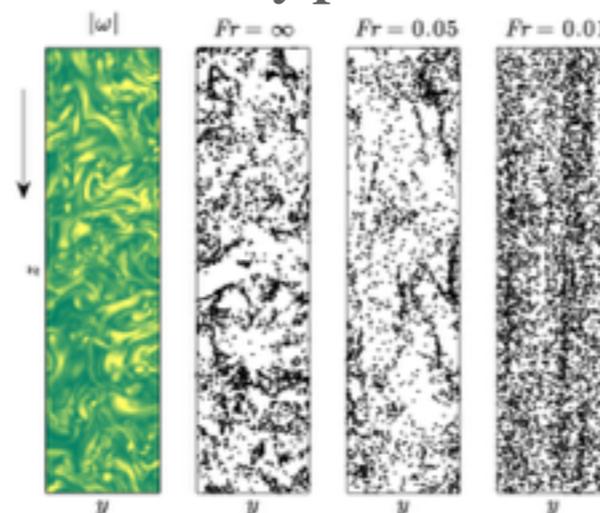

Bec et al. *PRL* (2014)

gyrotactic swimmers
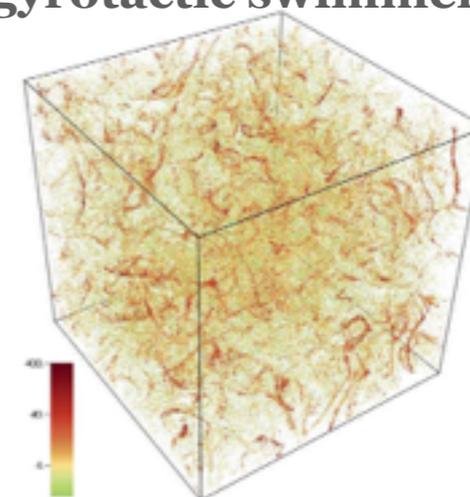
Cencini et al. *EPJE* (2019)

Elastic chains in 2D turbulence

N_{b} inertialess beads joined by $N_{\mathrm{L}} = N_{\mathrm{b}} - 1$ springs with maximum length L_{m} an relaxation time τ
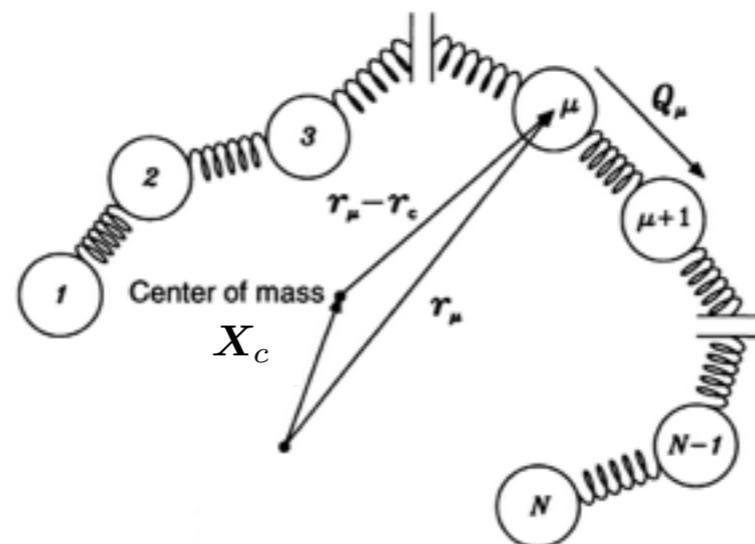
$\ell_{\mathrm{eq}} \ll \ell_{\mathrm{forcing}} \ll N_{\mathrm{L}} L_{\mathrm{m}}$

Weissenberg number $\mathrm{Wi} = \tau / T_{\mathrm{eddy}}$

Deformability parameter $\Phi = L_{\mathrm{m}} / N_{\mathrm{L}} \ell_f$

Selection of vortical regions

Wi = 0.04   Wi = 0.9   Wi = 0.9

(a)   (b)   (c)
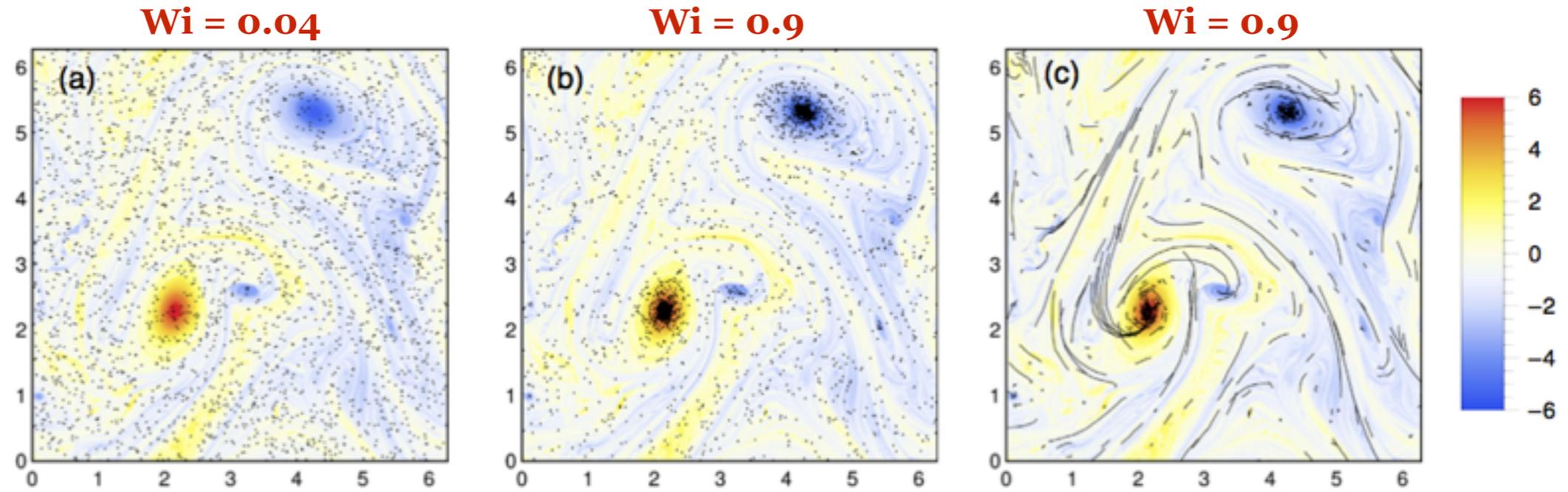
2D Navier–Stokes on $[0,2\pi]^2$, grid resolution 1024^2, forcing $f = -F_0 \, k_f \cos(k_f \, x)$

PDF of the Okubo-Weiss parameter Λ

Wi

— 0
— 0.12
— 0.49
— 1.22
— 2.44
— 7.31

Wi
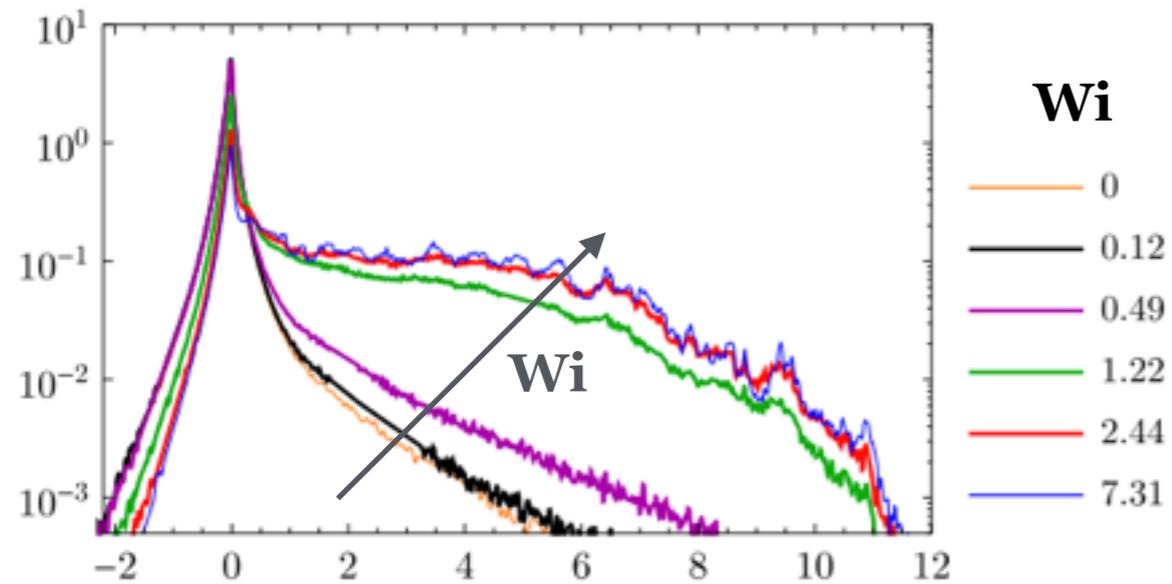
$\Lambda = (\omega^2 - \sigma^2)/4\langle\omega^2\rangle$

ω vorticity; σ strain rate

Effect of chain deformability

$\langle\Lambda\rangle$

$\dfrac{L_m}{N_L \ell_f}$

○ 0.33
■ 0.75
◇ 1.50
△ 3.00

Φ

Wi

Picardo, DV, Pal & Ray, *Phys. Rev. Lett.* **121**, 244501 (2018)