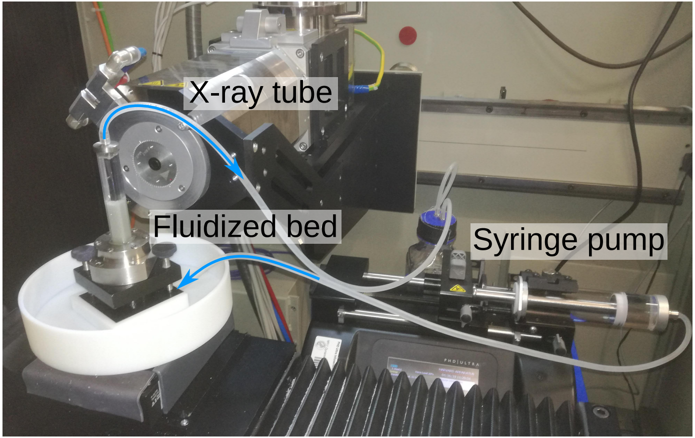
Experimental validation of X-DFA: A suspension of sedimenting particles



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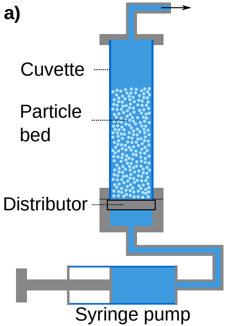
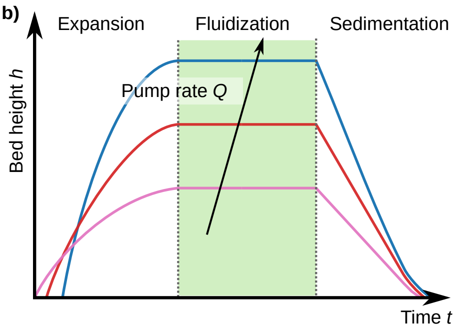
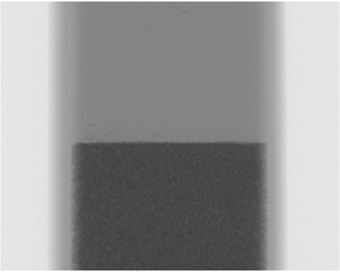
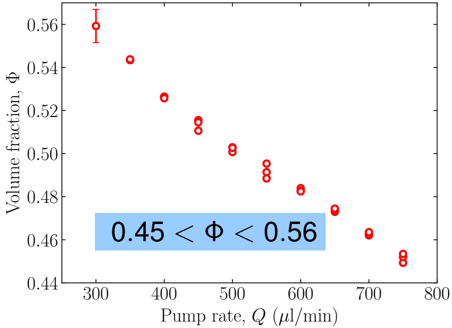




X-ray radiography





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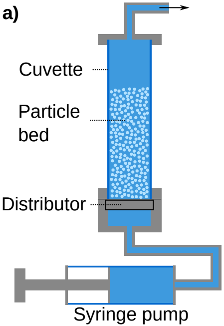
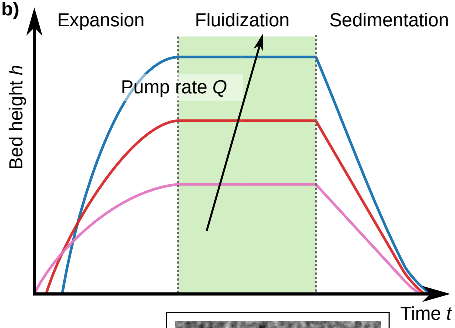
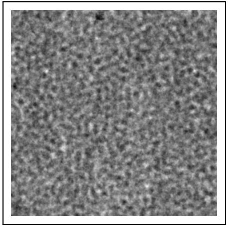
a)



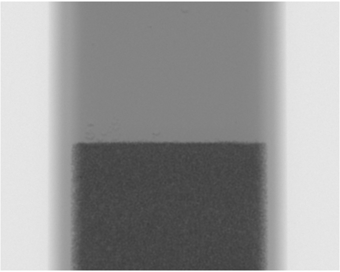
b)

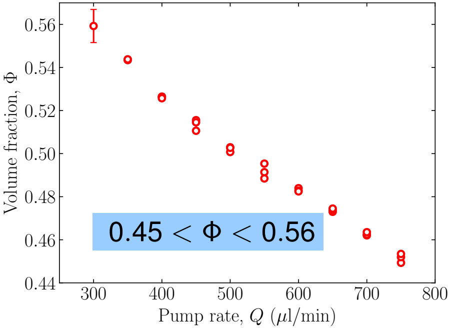


No reliable reference velocity!



X-ray radiography





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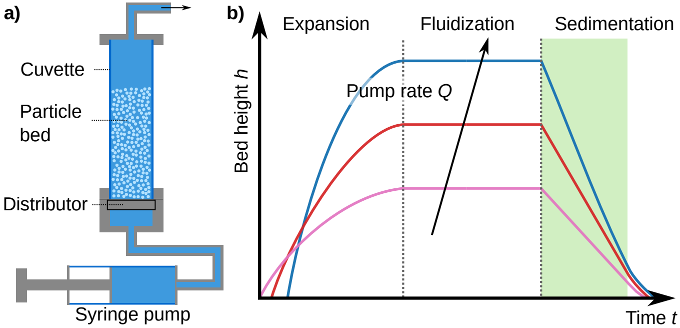
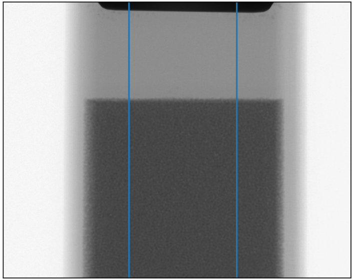
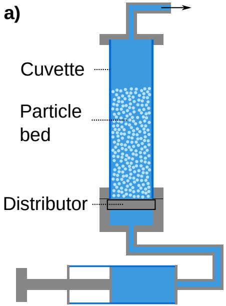
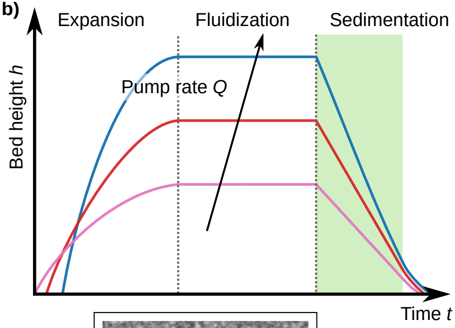


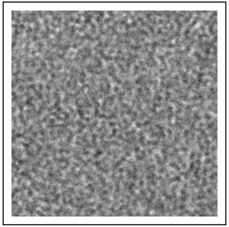
X-ray radiography



Experimental validation of X-DFA: A suspension of sedimenting particles

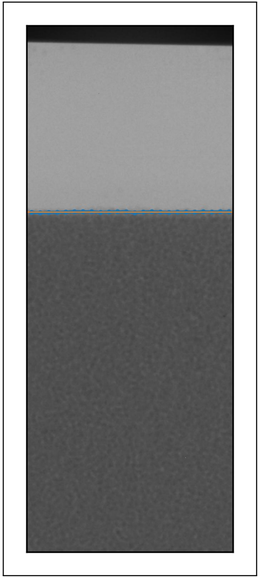




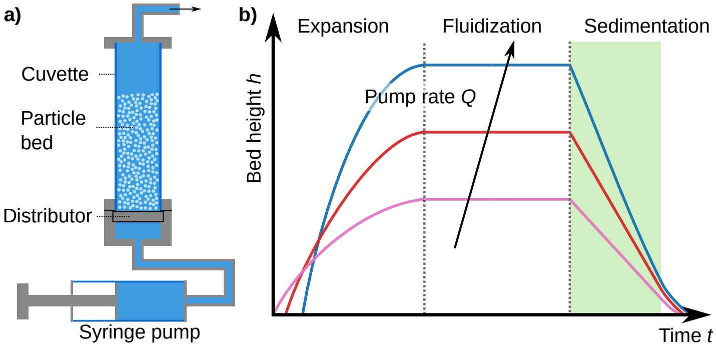


Comparison of
$\langle v \rangle_{\mathrm{xdfa}}$ and $\langle v \rangle_{\mathrm{front}}$

X-ray radiography

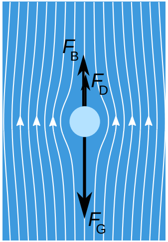


Liquid fluidized bed: Richardson-Zaki law



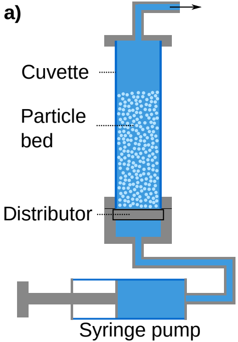
Gravitation Buoyancy Drag

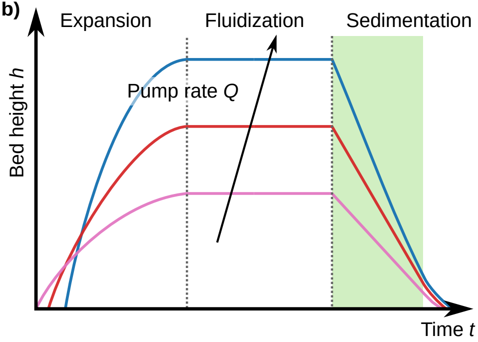
$$F_G = F_B + F_D$$



$$\frac{\langle v \rangle_{\text{fluid}}}{v_{\text{Stokes}}} = (1 - \Phi)^n$$

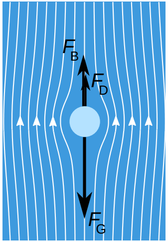
Liquid fluidized bed: Richardson-Zaki law



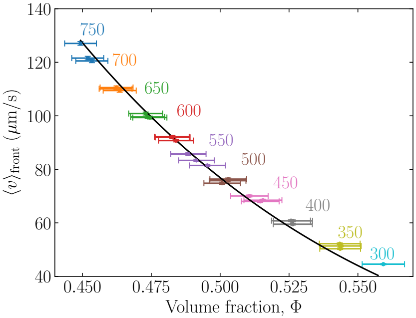


Gravitation Buoyancy Drag

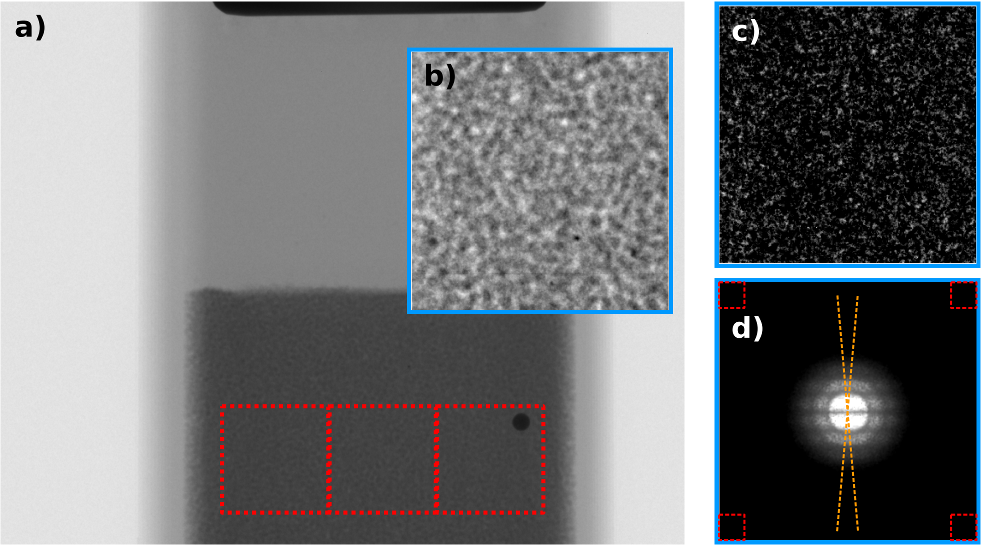
$$F_G = F_B + F_D$$



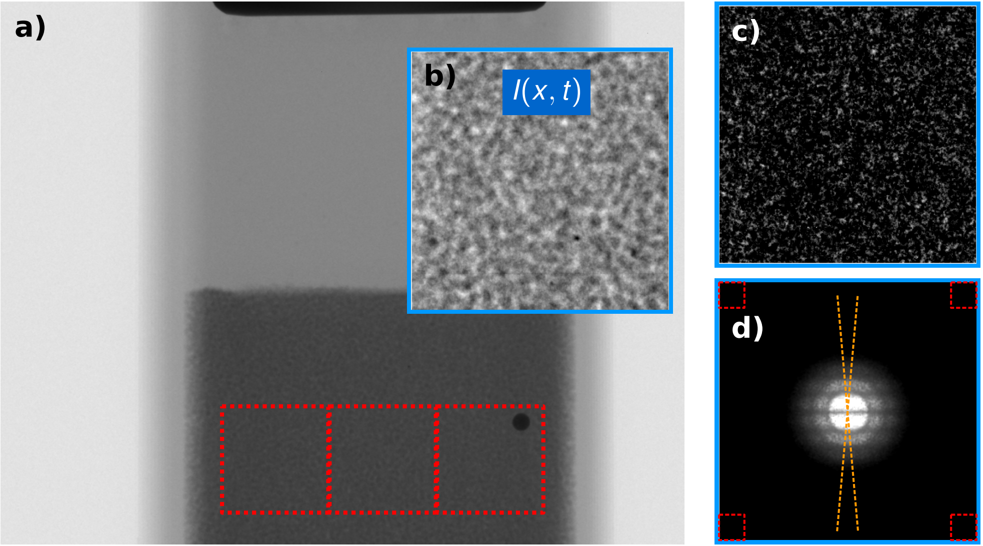
$$\frac{\langle v \rangle_{\text{front}}}{v_{\text{Stokes}}} = (1 - \Phi)^n$$



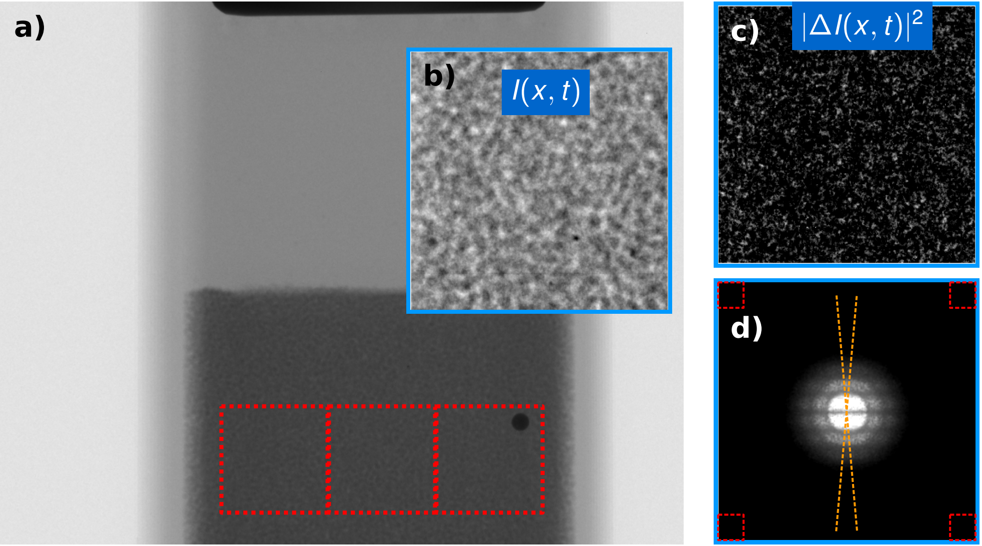
X-DFA for a suspension of sedimenting particles



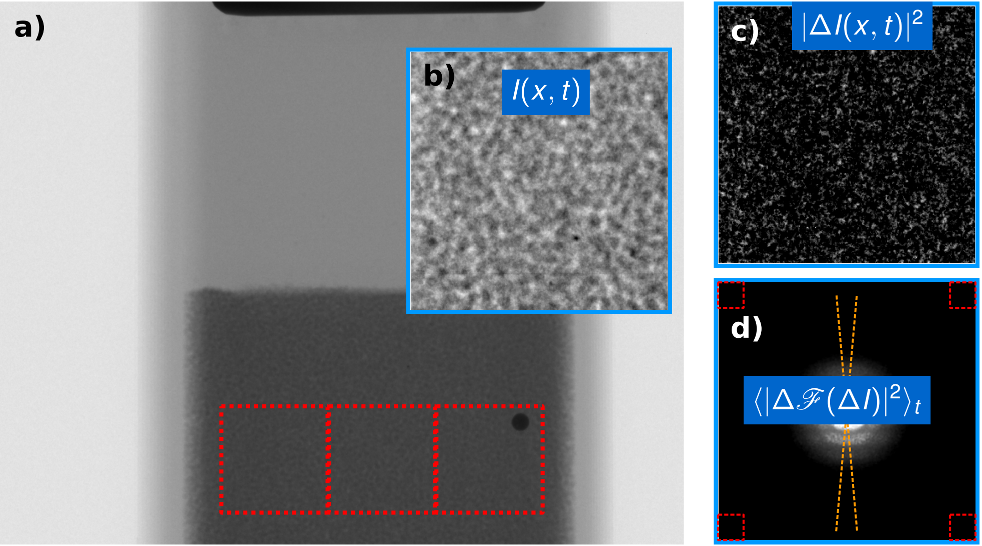
X-DFA for a suspension of sedimenting particles



X-DFA for a suspension of sedimenting particles



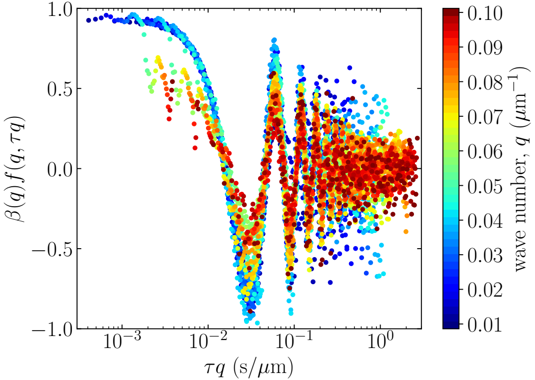
X-DFA for a suspension of sedimenting particles

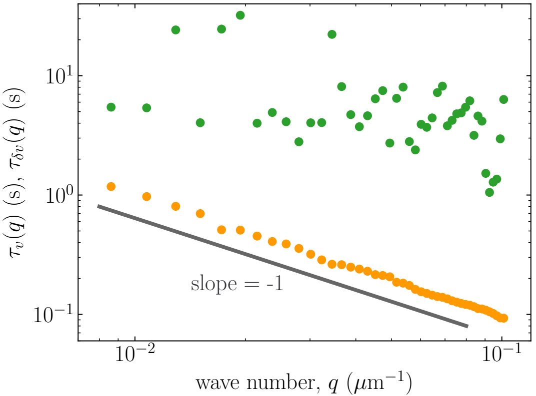


X-DFA for a sedimenting particle suspension

$$f(q,\tau) = \cos(q\langle v_s\rangle\tau)\exp\left(-\frac{1}{2}q^2\delta v^2\tau^2\right)$$

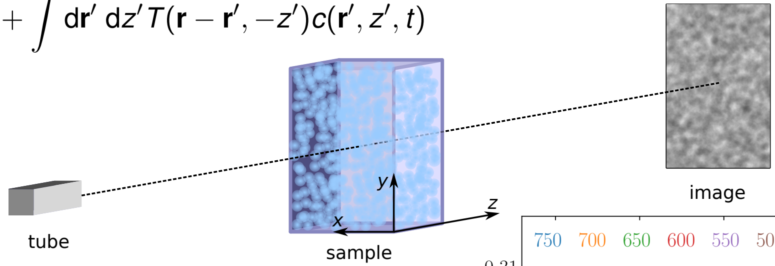
$$\langle v_s\rangle = \langle\Delta r\rangle/\tau_\nu, \langle\delta v\rangle = \langle\delta r\rangle/\tau_{\delta\nu}$$

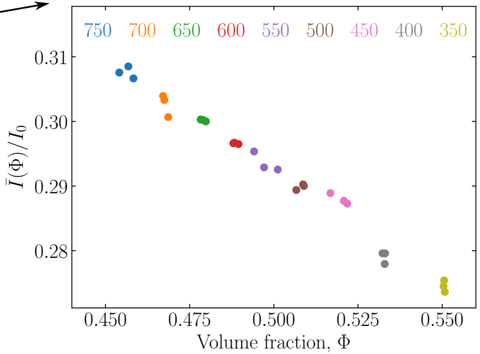




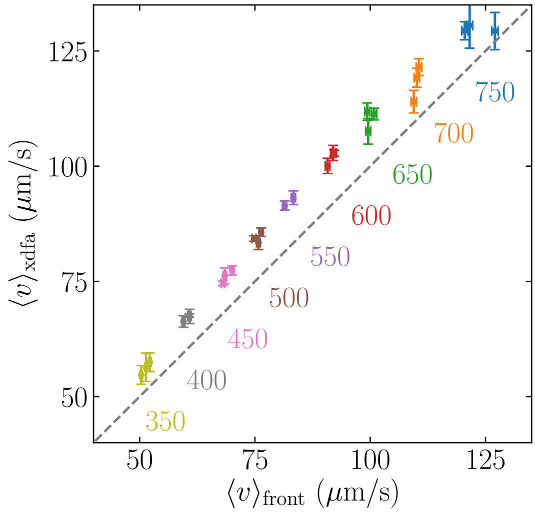
X-DFA: Requirement of linear space invariant imaging

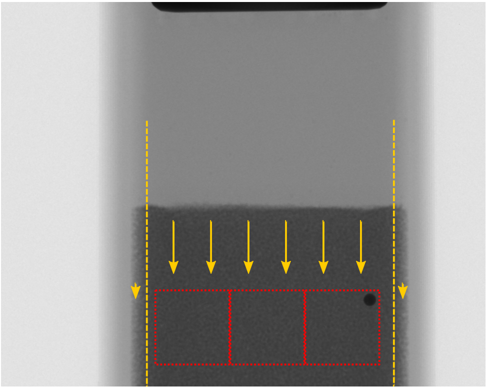
$$I(\mathbf{r}, t) = I_0 + \int \mathrm{d}\mathbf{r}'\, \mathrm{d}z'\, T(\mathbf{r}-\mathbf{r}', -z')\, c(\mathbf{r}', z', t)$$





Front tracking vs. X-DFA

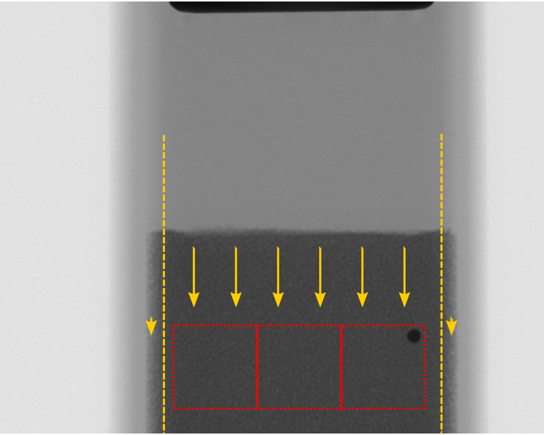




sample video

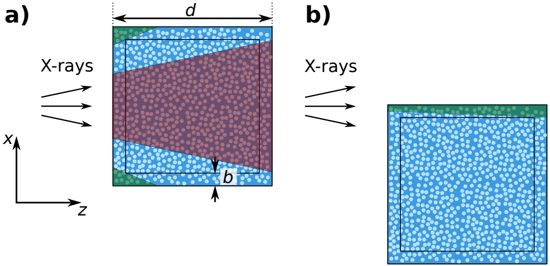
$\langle v \rangle_{\mathrm{xdfa}} > \langle v \rangle_{\mathrm{front}}$ by 9.4%

Estimate width of boundary layer



$\langle v \rangle_{\mathrm{xdfa}} > \langle v \rangle_{\mathrm{front}}$ by 9.4%

$\langle v \rangle_{\mathrm{xdfa}}$ takes two layers into account
$\langle v \rangle_{\mathrm{front}}$ takes four layers into account



Estimation:
Boundary velocity = 0
Else = const.
$\rightarrow b \approx 3$ particle diameters

Thank you for your attention!