

Separating Particles Using Tangential Flow Filtration and Inertial Microfluidics

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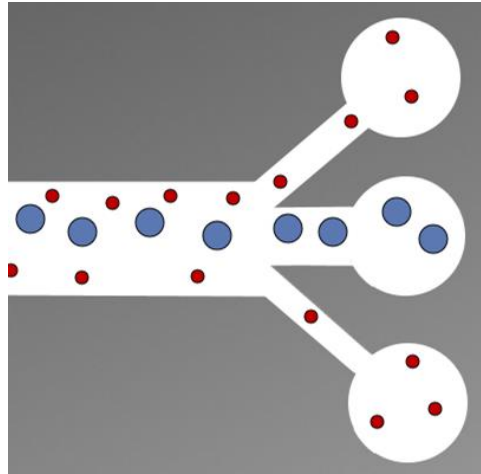
Department: Mechanical Engineering

University of California, Santa Barbara

A Better Way to Process Cells

Diagnosing diseases:

Microfluidics offers efficiency, automation, and use of small sample sizes



Finding a Balance Between Viscous and Inertial Forces

Reynolds number (Re)

$$Re = \frac{\rho U H}{\mu}$$

where

ρ = density

U = velocity

H = characteristic length

μ = viscosity

$Re \ll 1$, viscous forces dominate

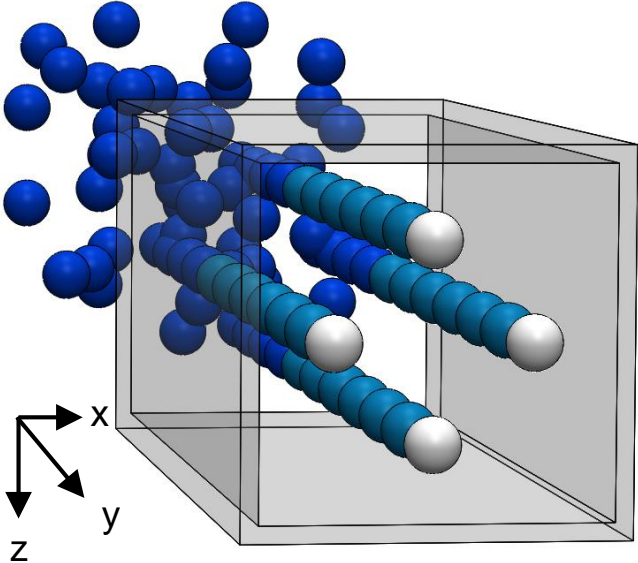
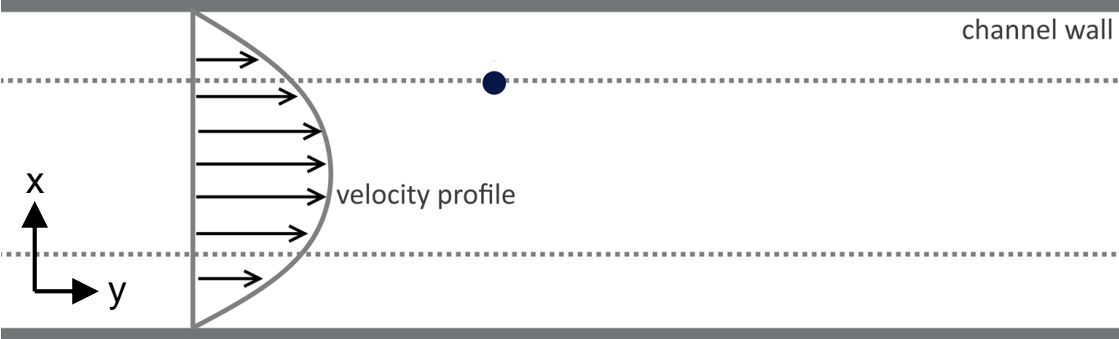
$Re \gg 100$, inertial forces dominate

We are in the regime

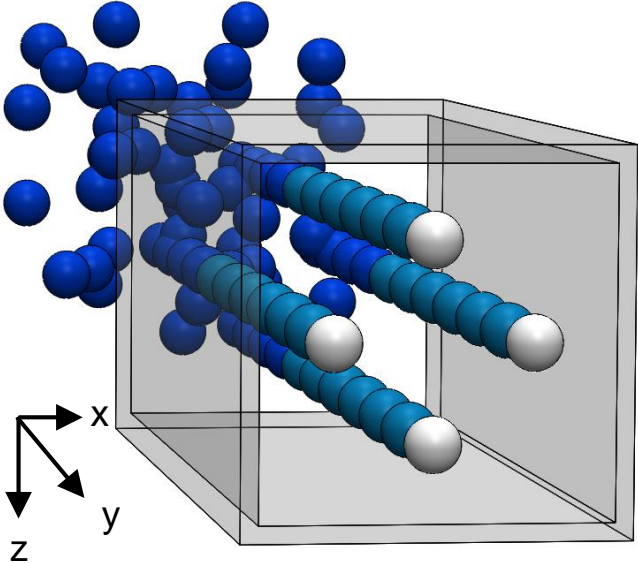
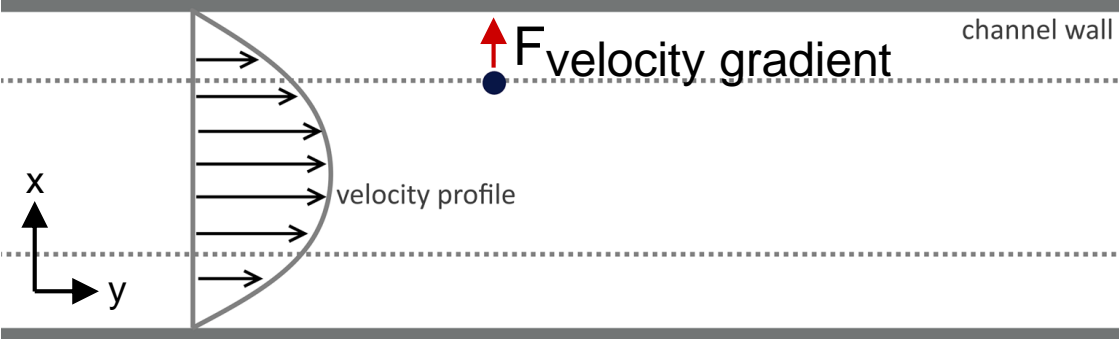
$1 < Re < 100$

where inertial focusing occurs

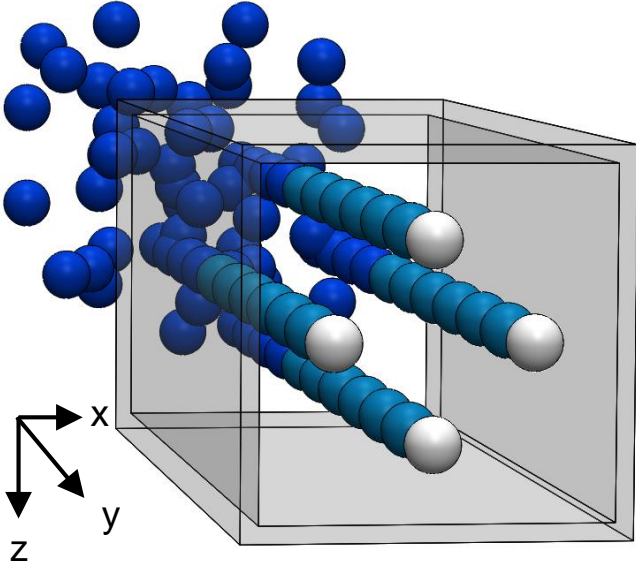
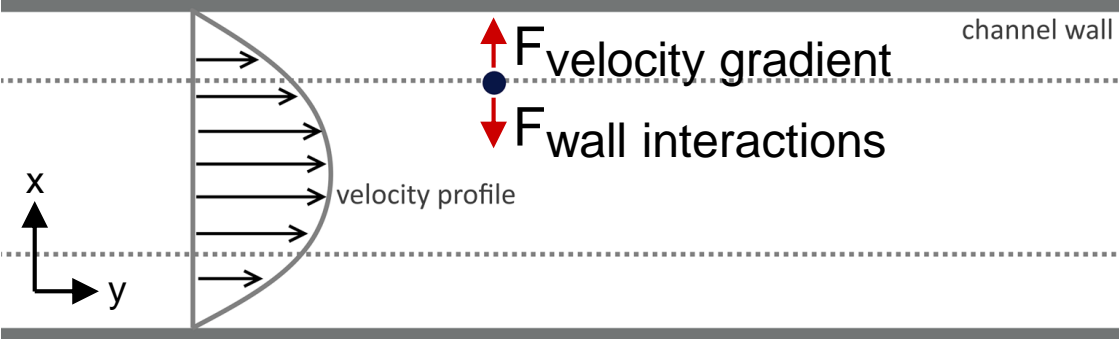
Particles Equilibrate Due to Two Main Forces



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Tangential Flow Filtration Channels Allow Flow Manipulation



Straight Channel

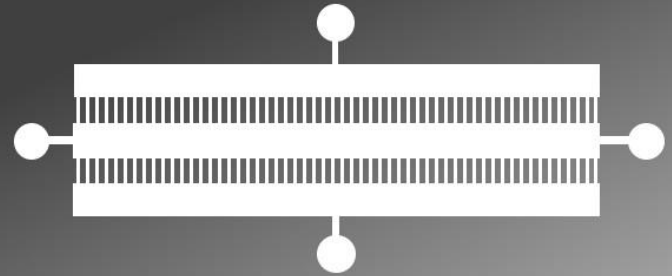
1cm

Tangential Flow Filtration Channels Allow Flow Manipulation



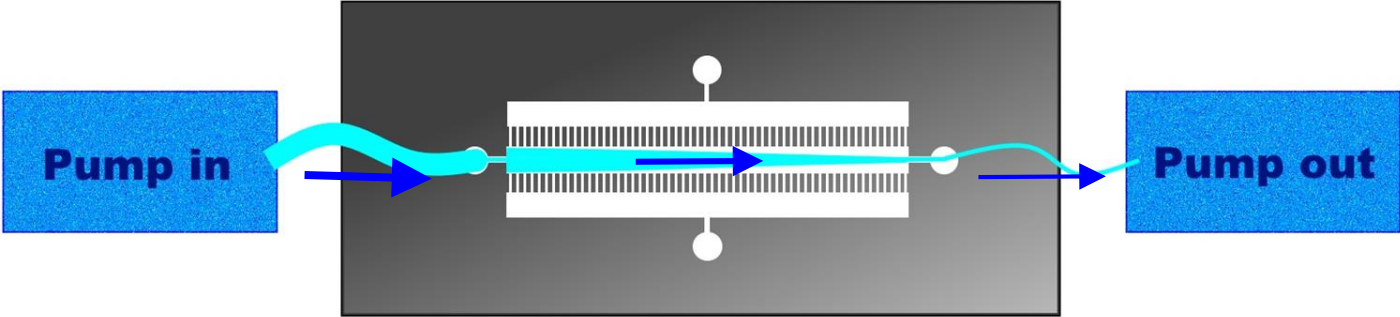
Straight Channel

1cm

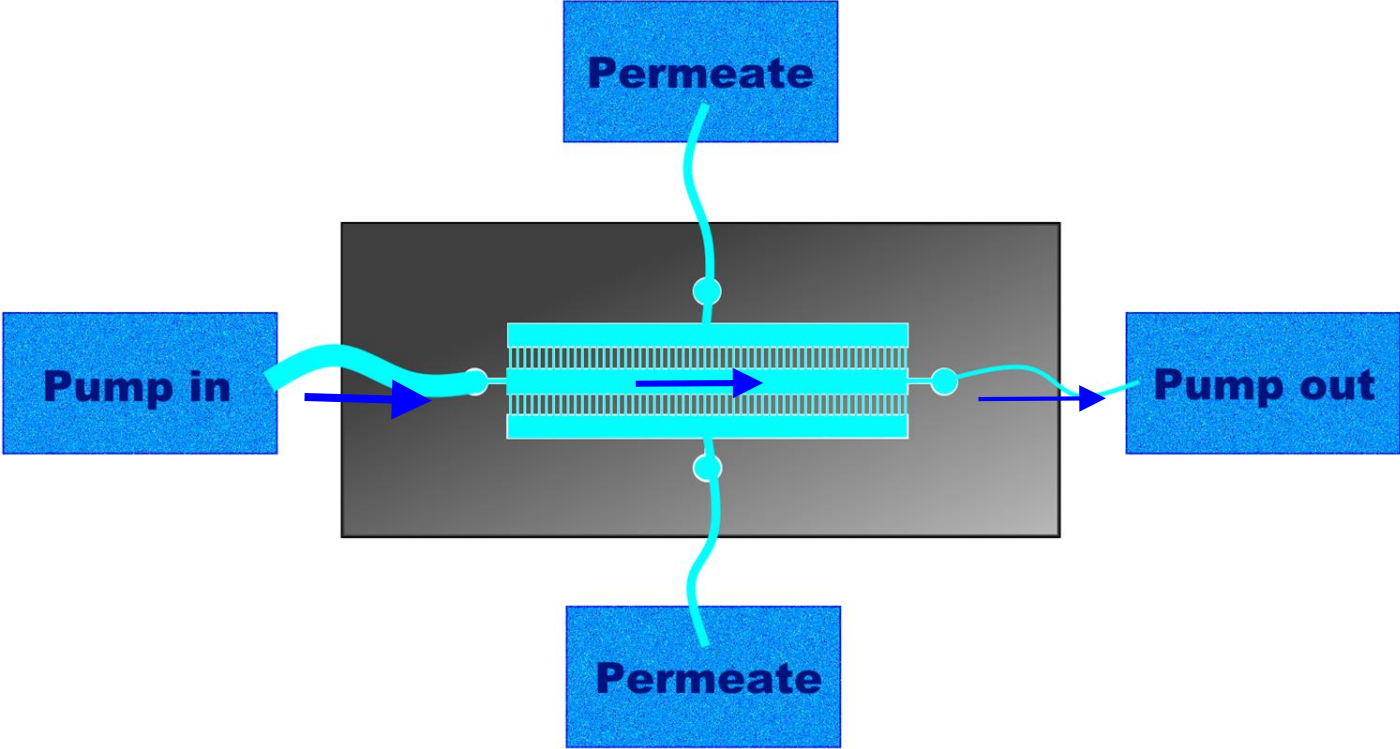


Tangential Flow Filtration (TFF) Channel

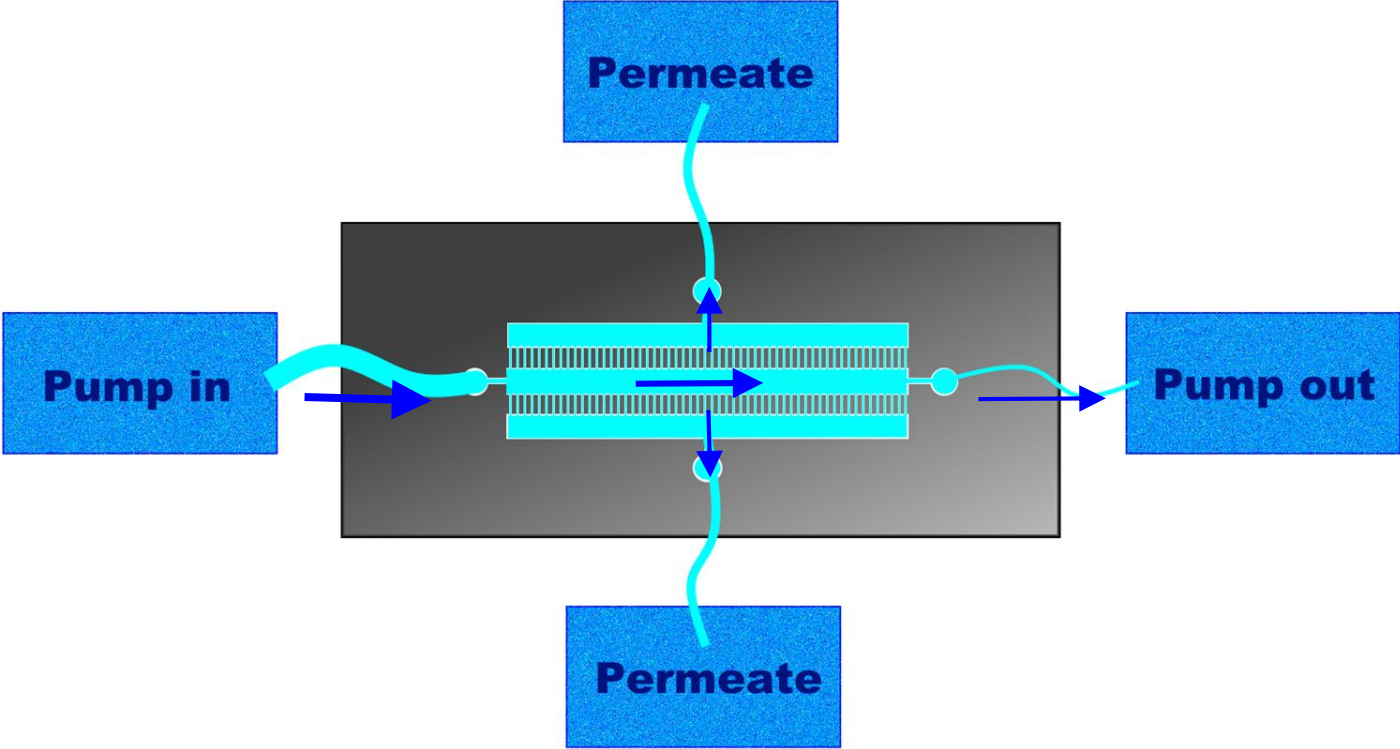
Permeate Flow in a TFF Device



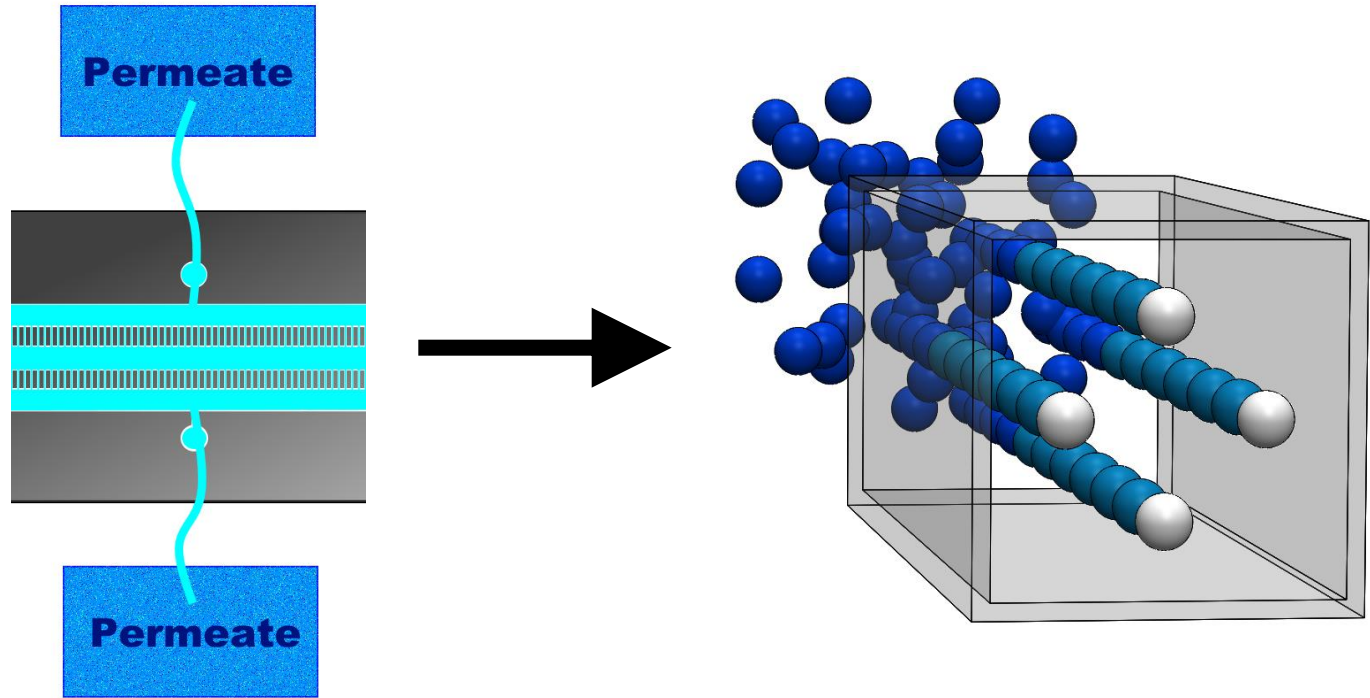
Permeate Flow in a TFF Device

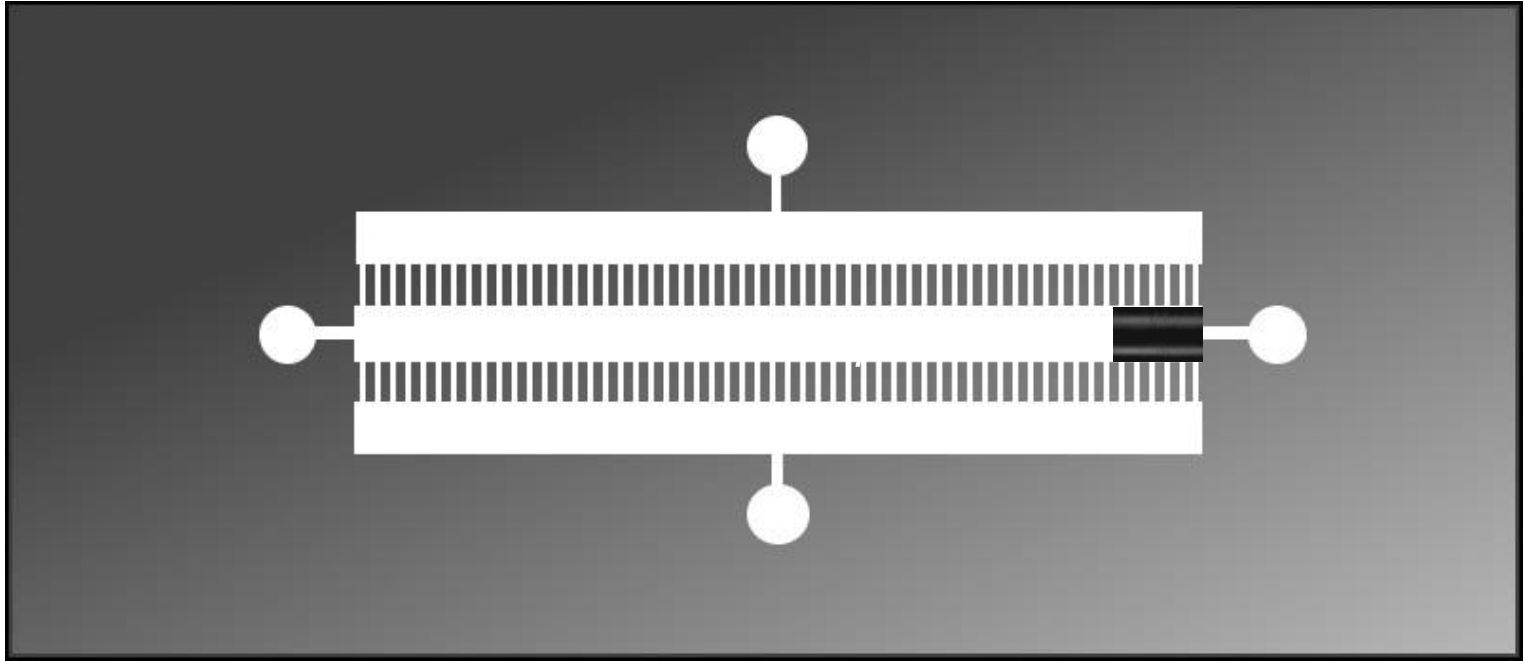


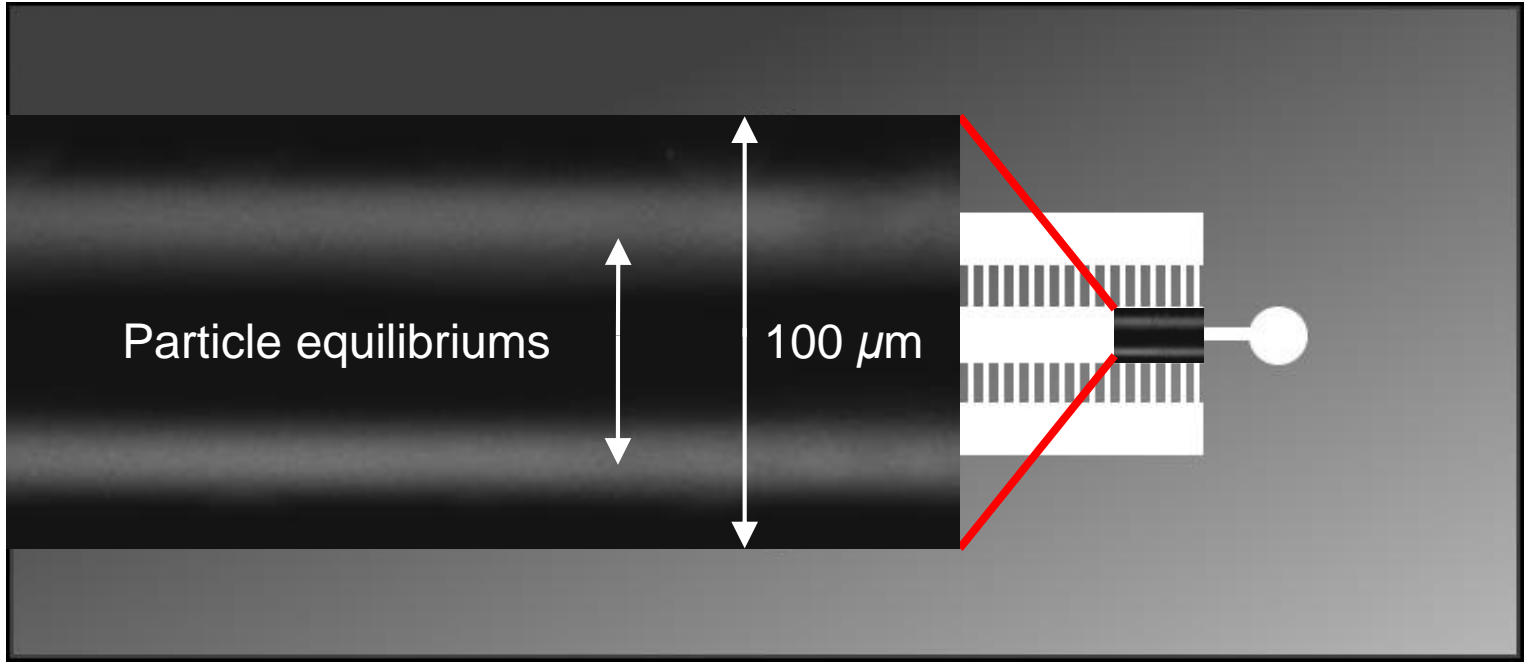
Permeate Flow in a TFF Device

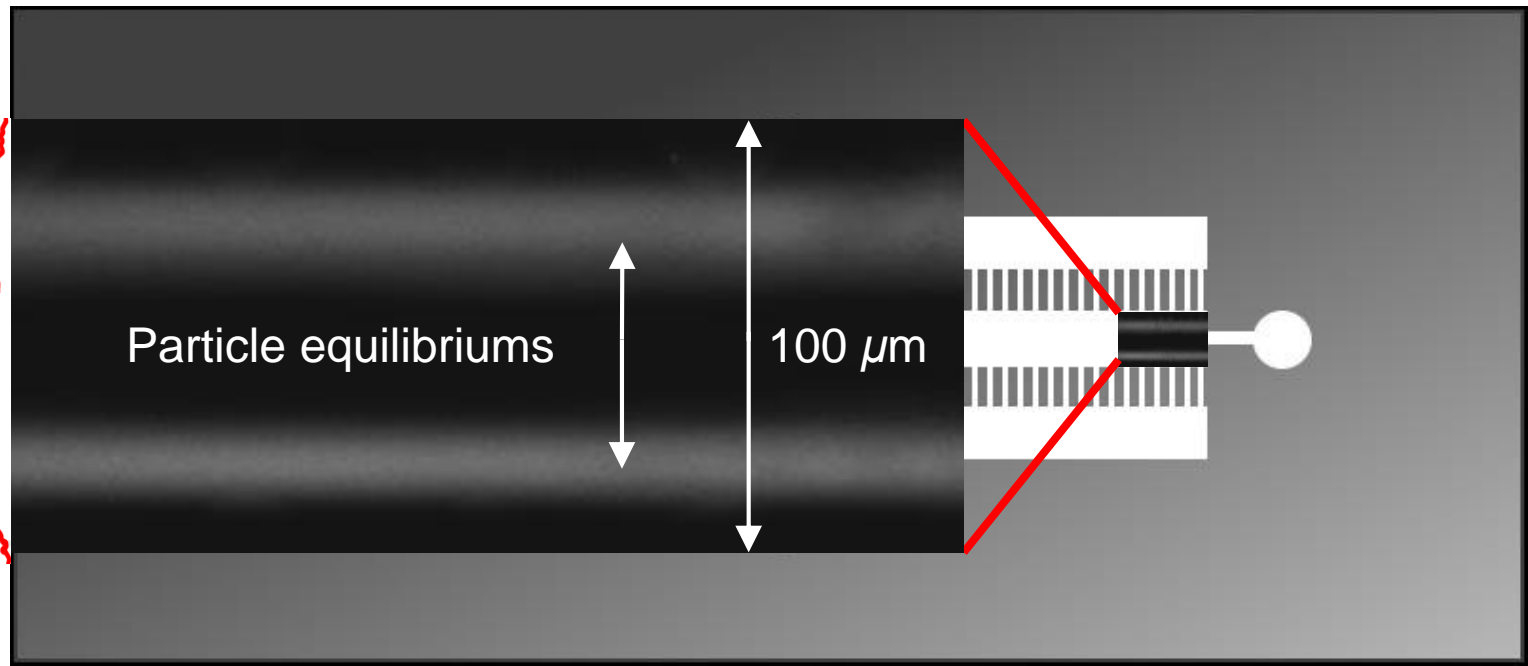


The Effect of Permeate Flow on Equilibrium Position

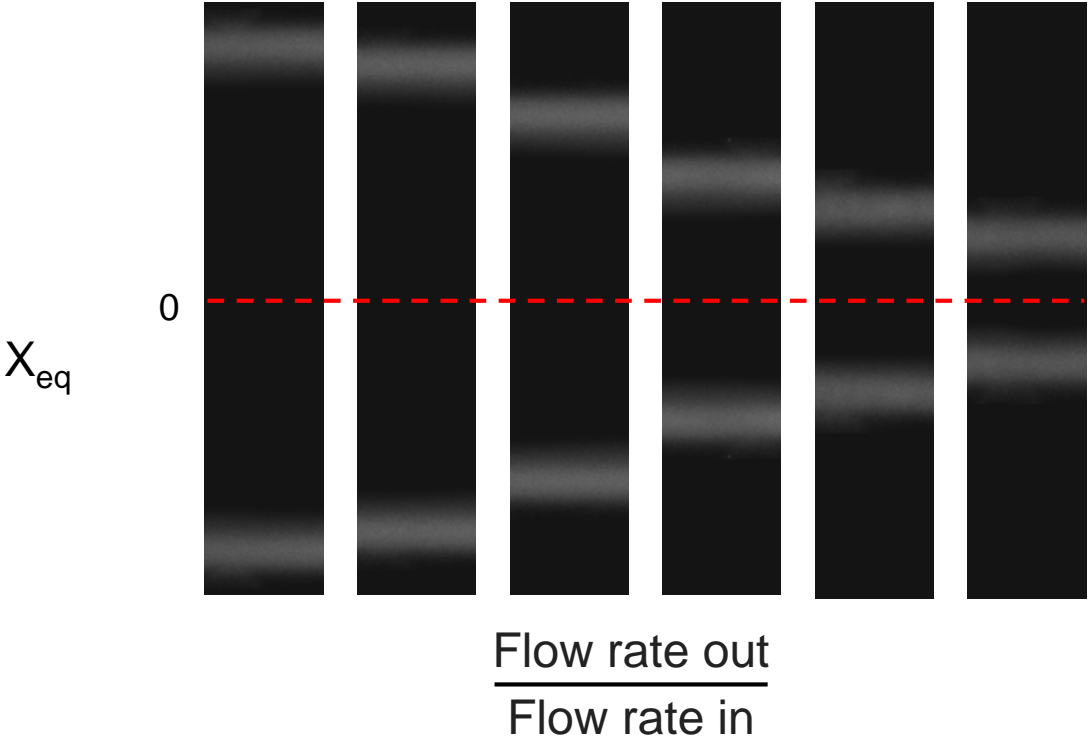




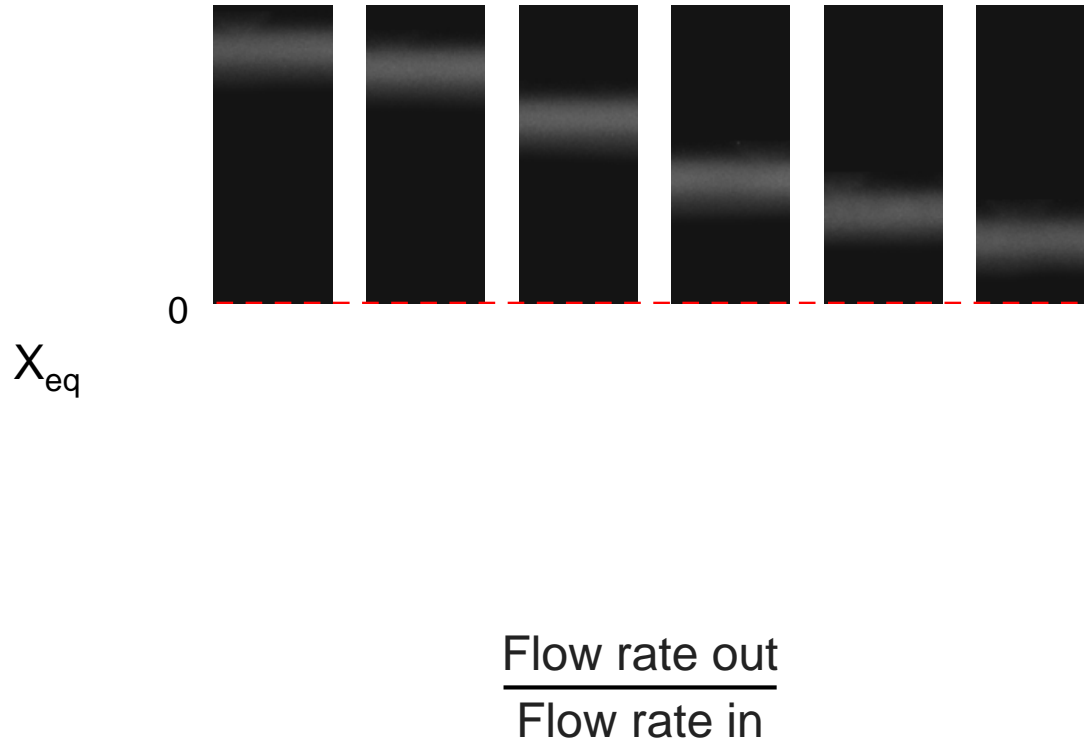




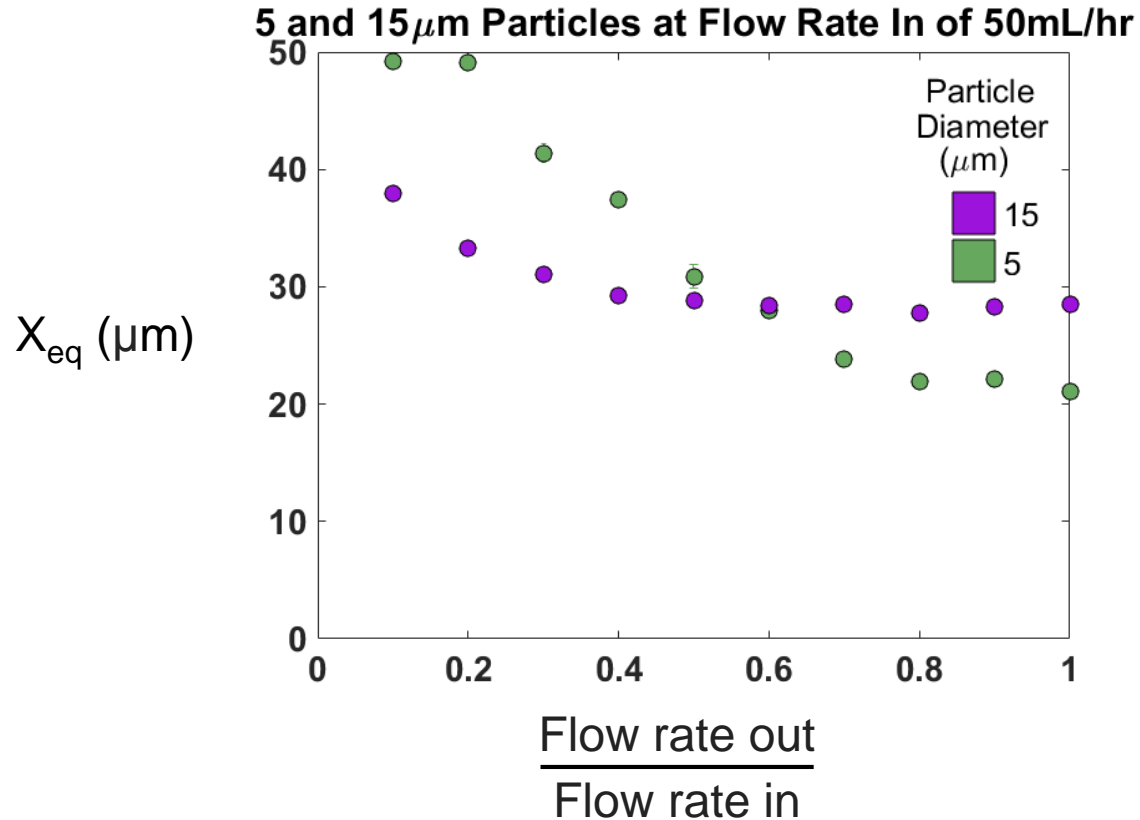
Variations in Permeate Flow Changes Equilibrium Positions



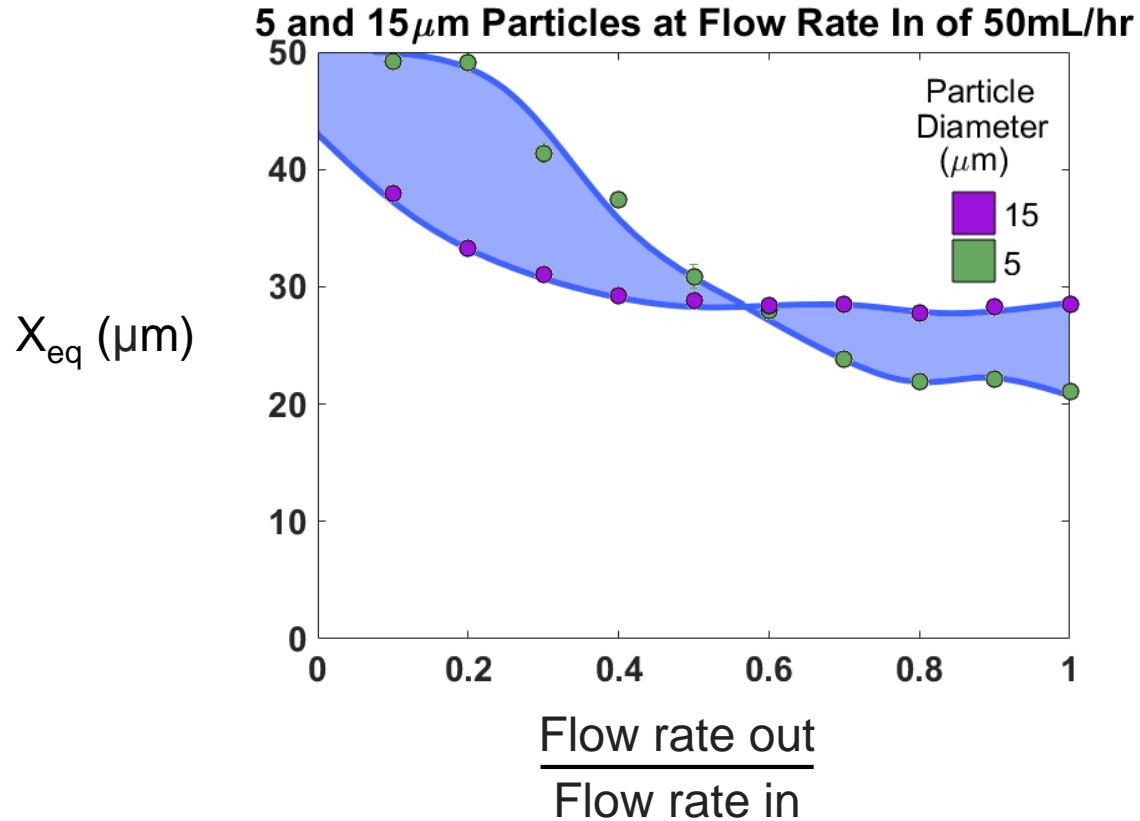
Variations in Permeate Flow Changes Equilibrium Positions



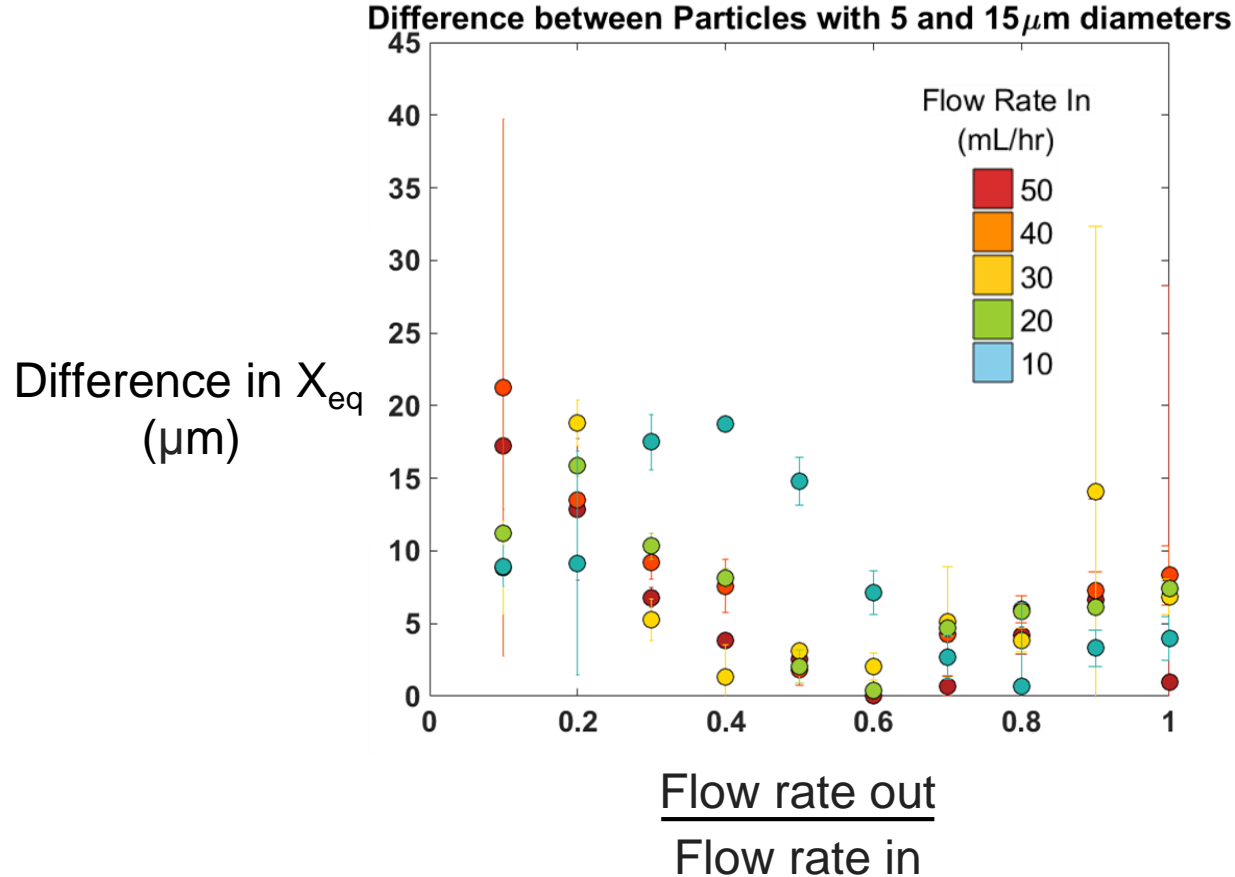
Separation is Possible!



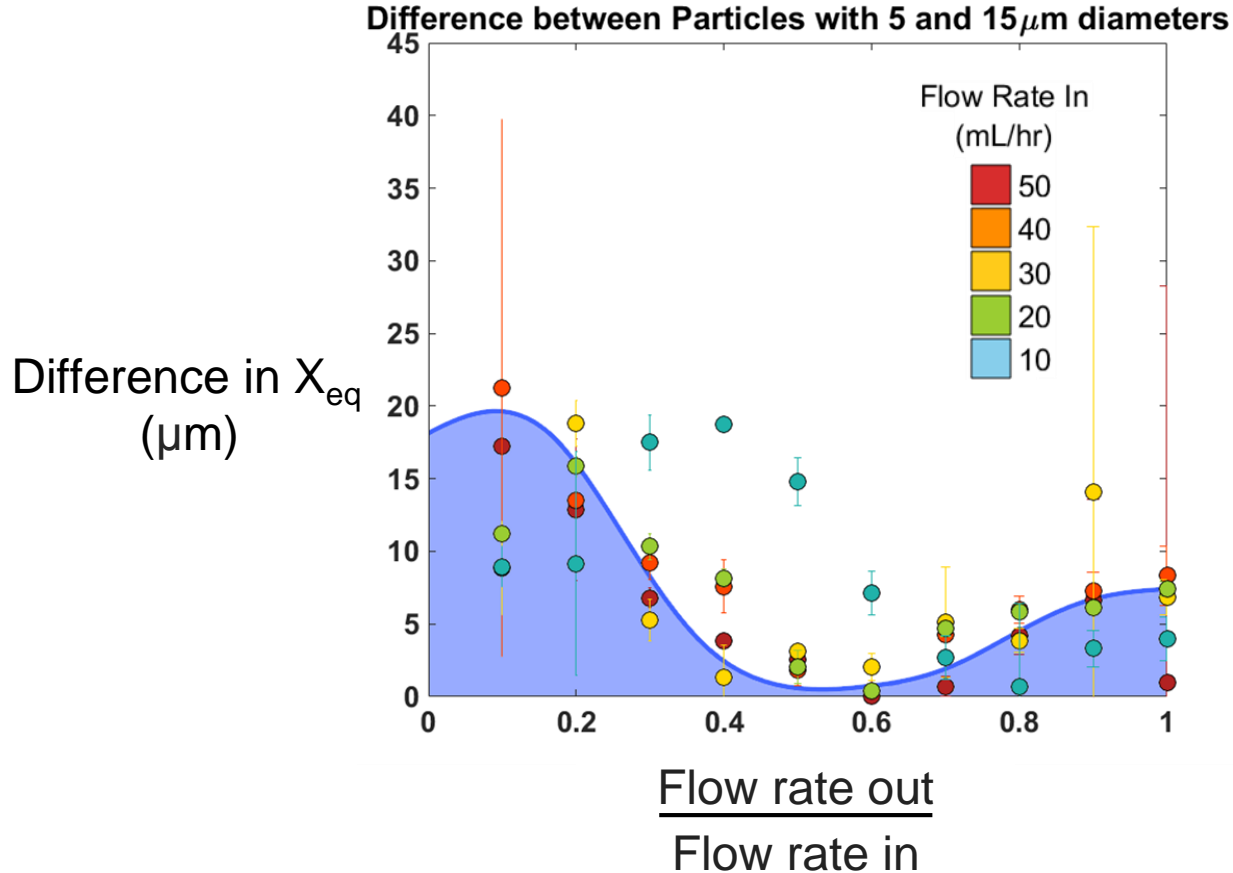
Separation is Possible!



Difference is Maximized at Flow Out/In Values of 0.2 and 0.9

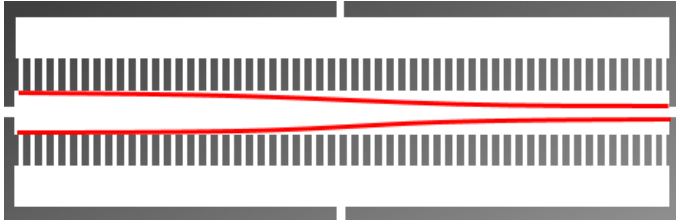


Difference is Maximized at Flow Out/In Values of 0.2 and 0.9



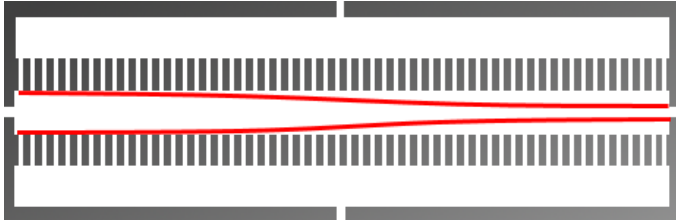
Future Work

Determine X_{eq} as a function of channel location (trajectories)

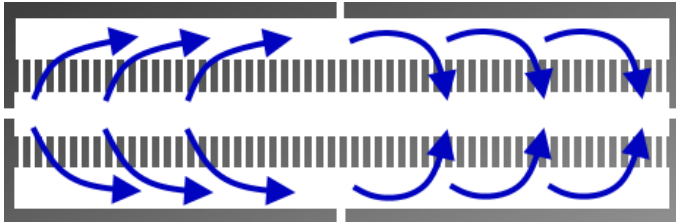


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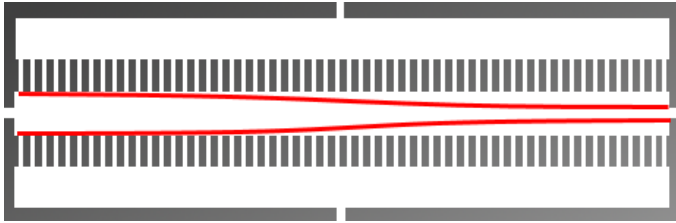


Design a device for constant permeate flow

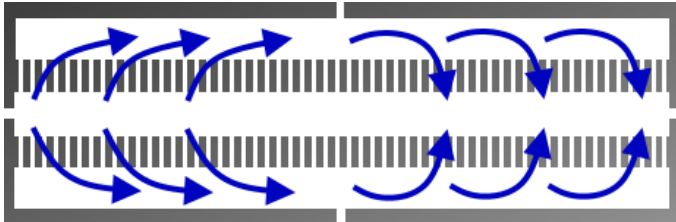


Future Work

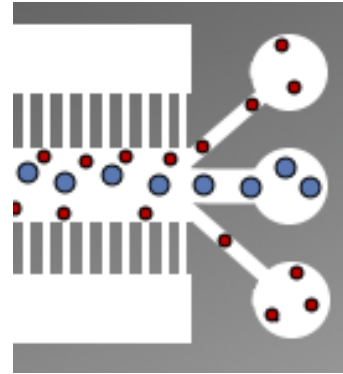
Determine X_{eq} as a function of channel location (trajectories)



Design a device for constant permeate flow



Add exit channels to verify separation



Acknowledgements



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The Office of the Dean, Math, Life & Physical Sciences