



μFLOW CELL
Scaling Microfluidics to
Industrial Applications

Testimonial ERC-PoC online meeting, FWO, 2-12-25

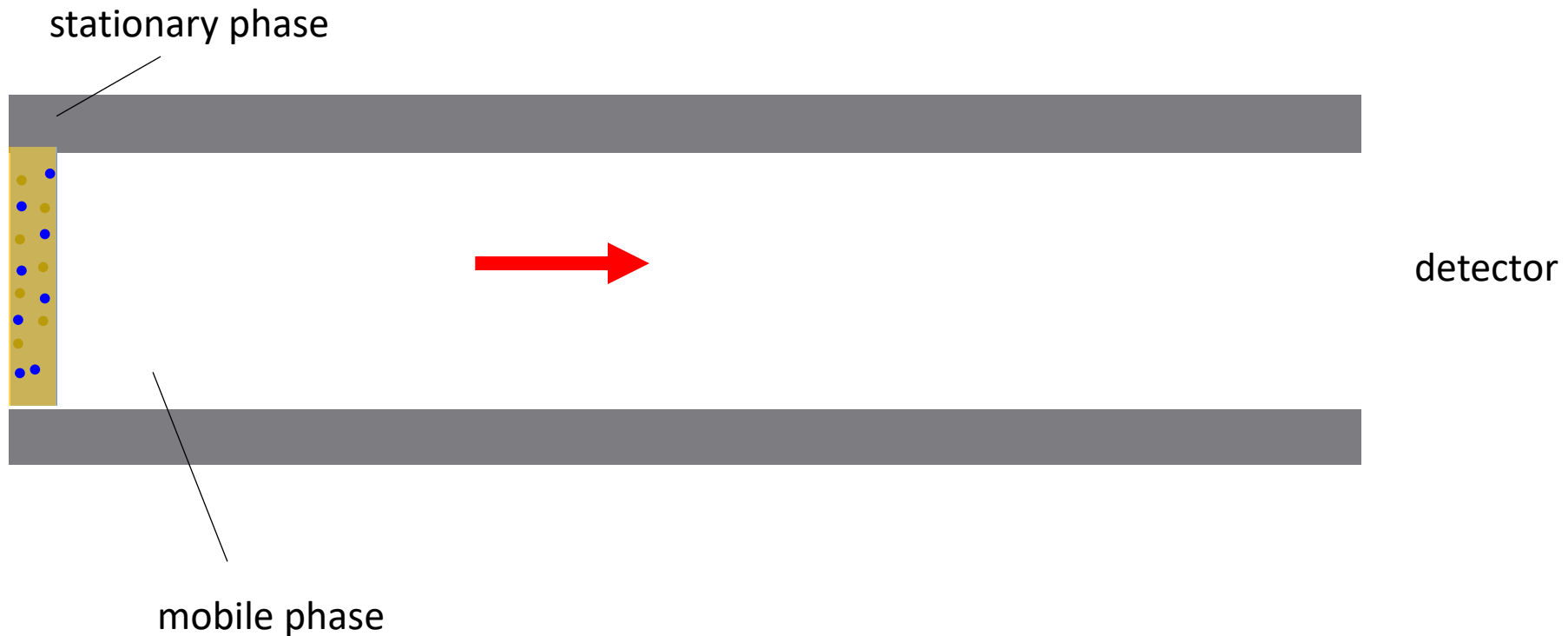
Wim De Malsche

μFlow group, Vrije Universiteit Brussel, Belgium

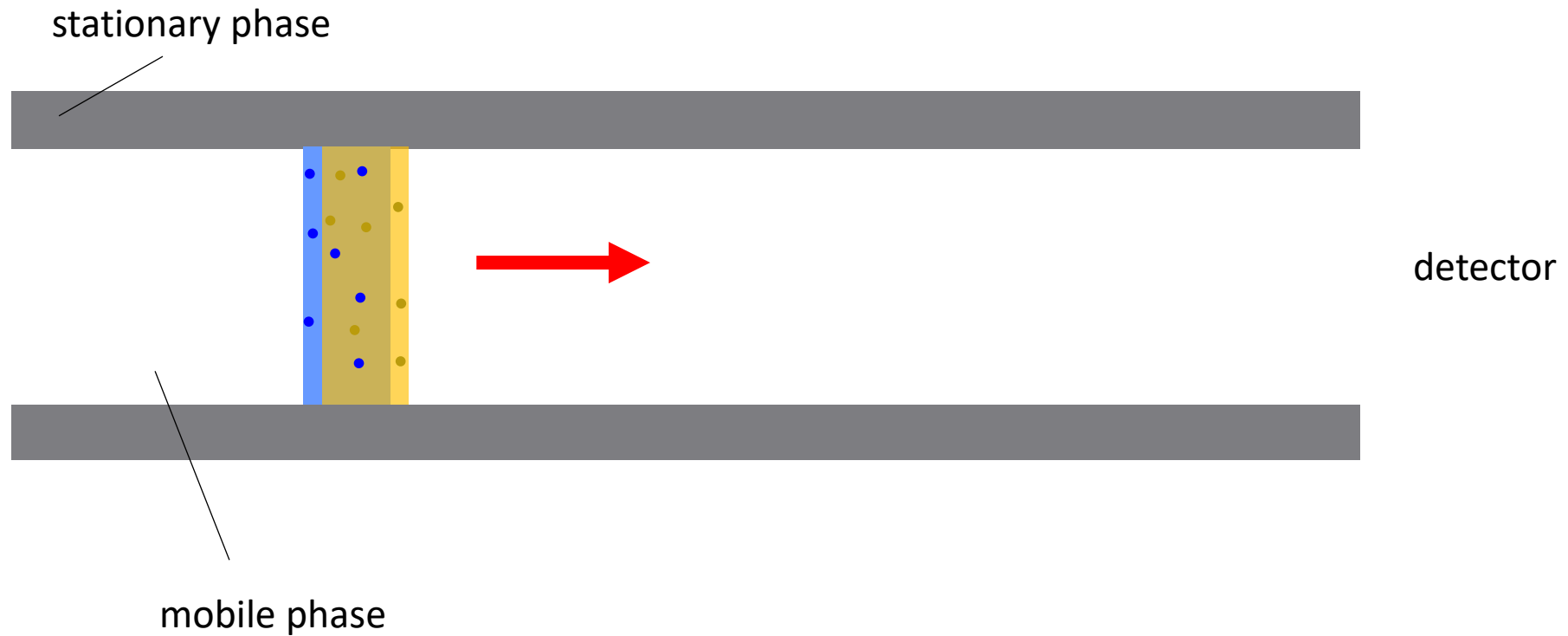


ERC-SG EVODIS ('16-'21)

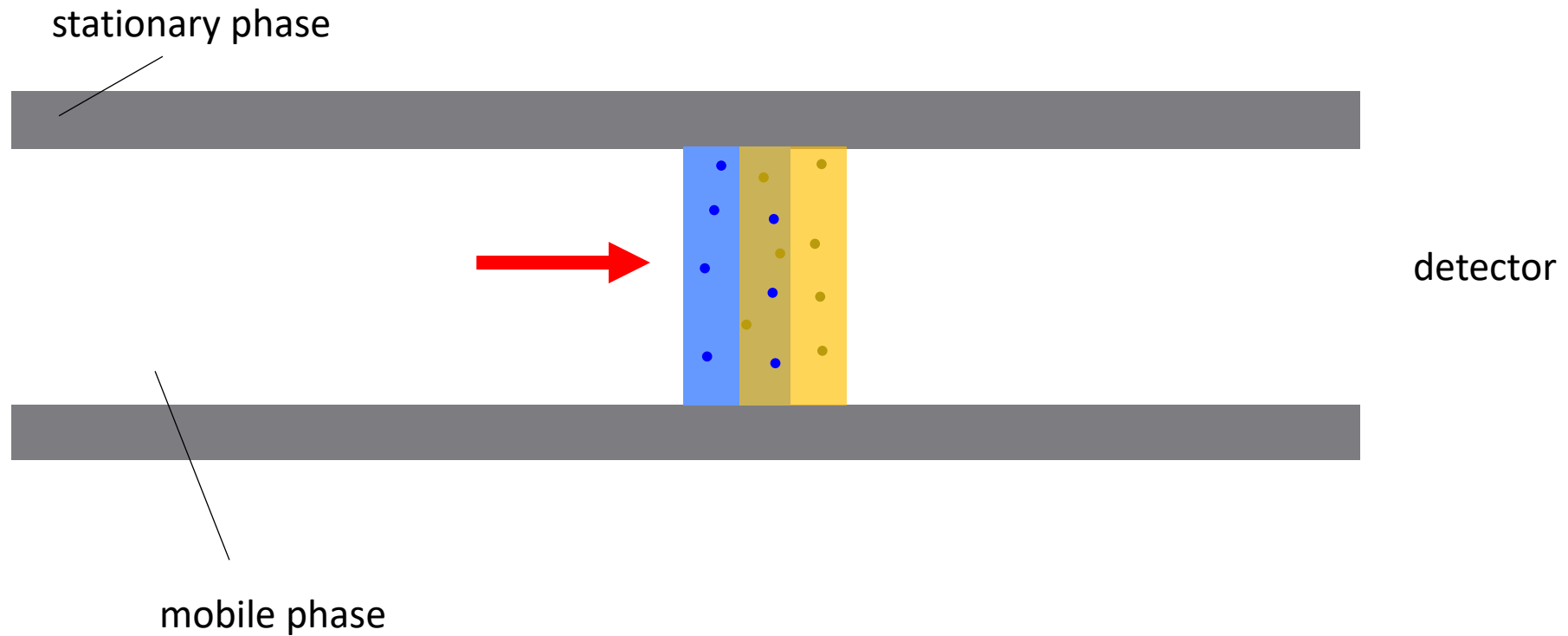
Exploiting vortices to suppress dispersion and reach new separation power boundaries



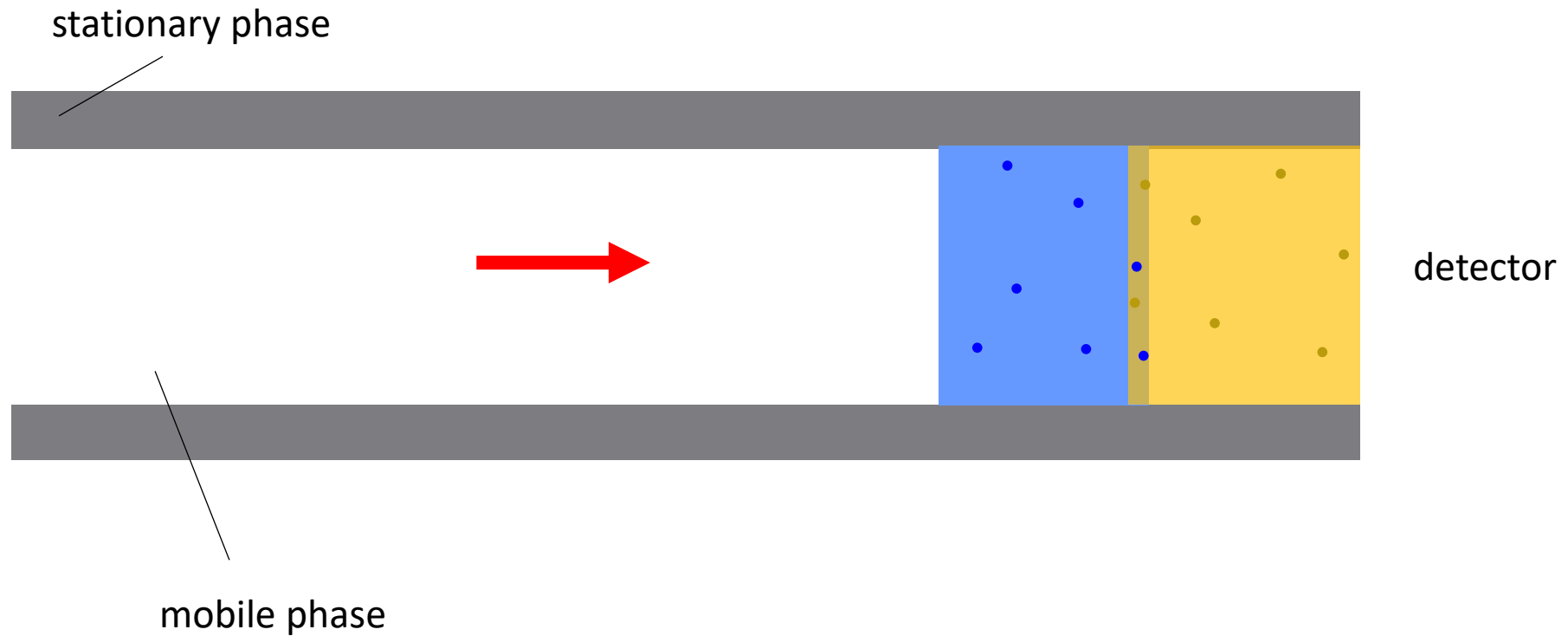
Dispersion in chromatography



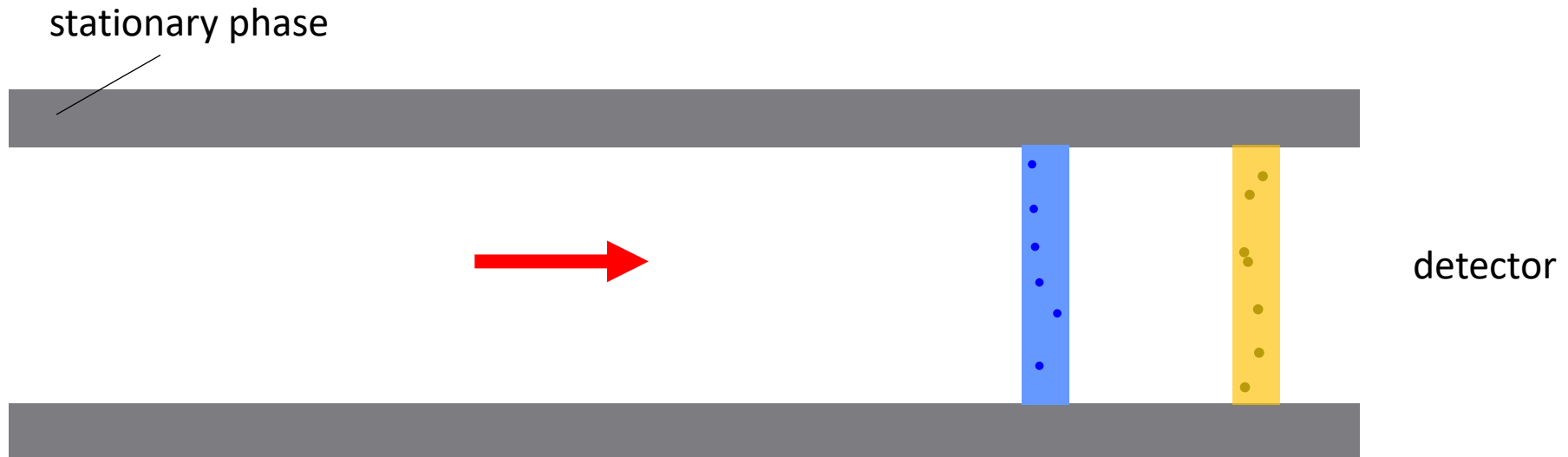
Dispersion in chromatography



Dispersion in chromatography

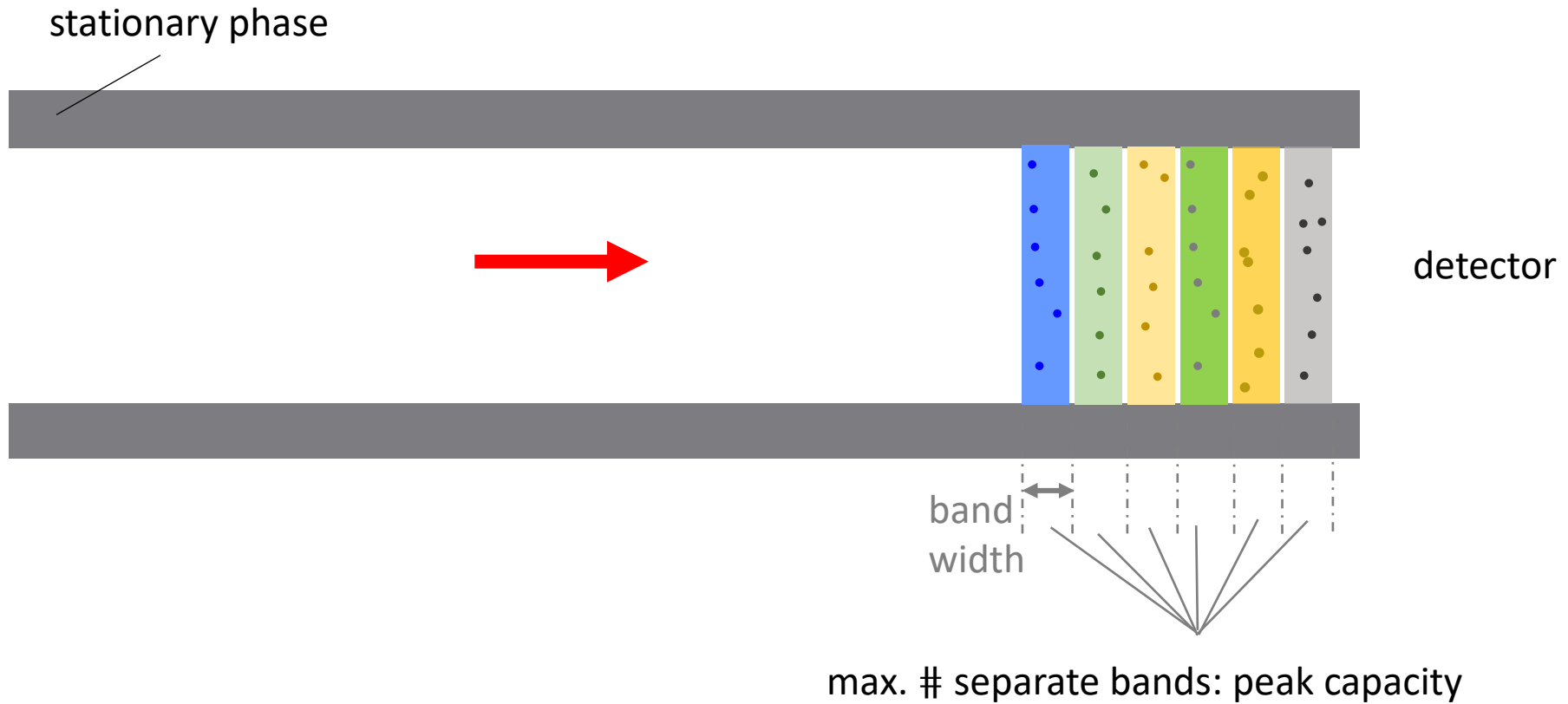


Sense of reducing dispersion

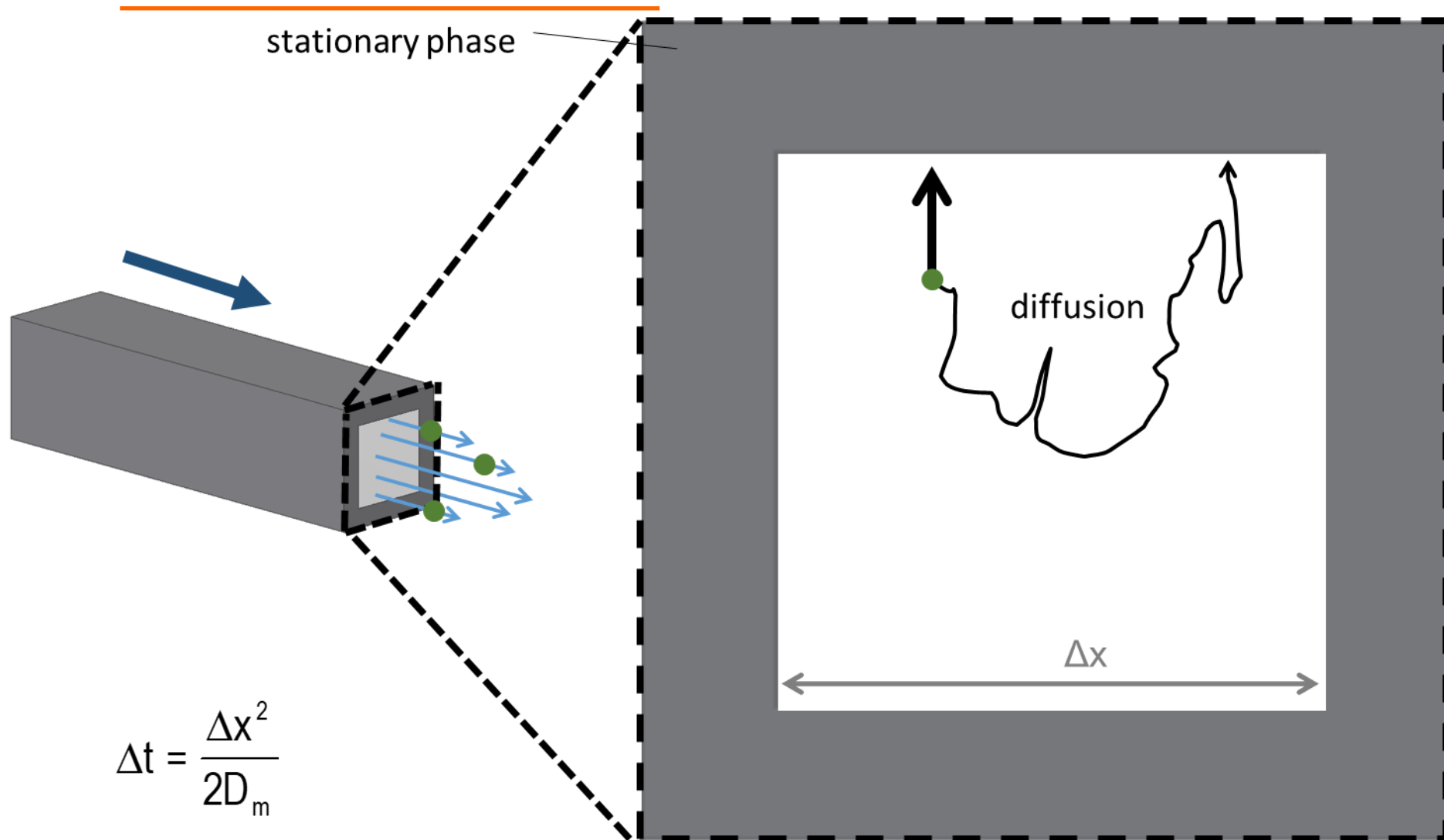


In absence of mobile phase dispersion

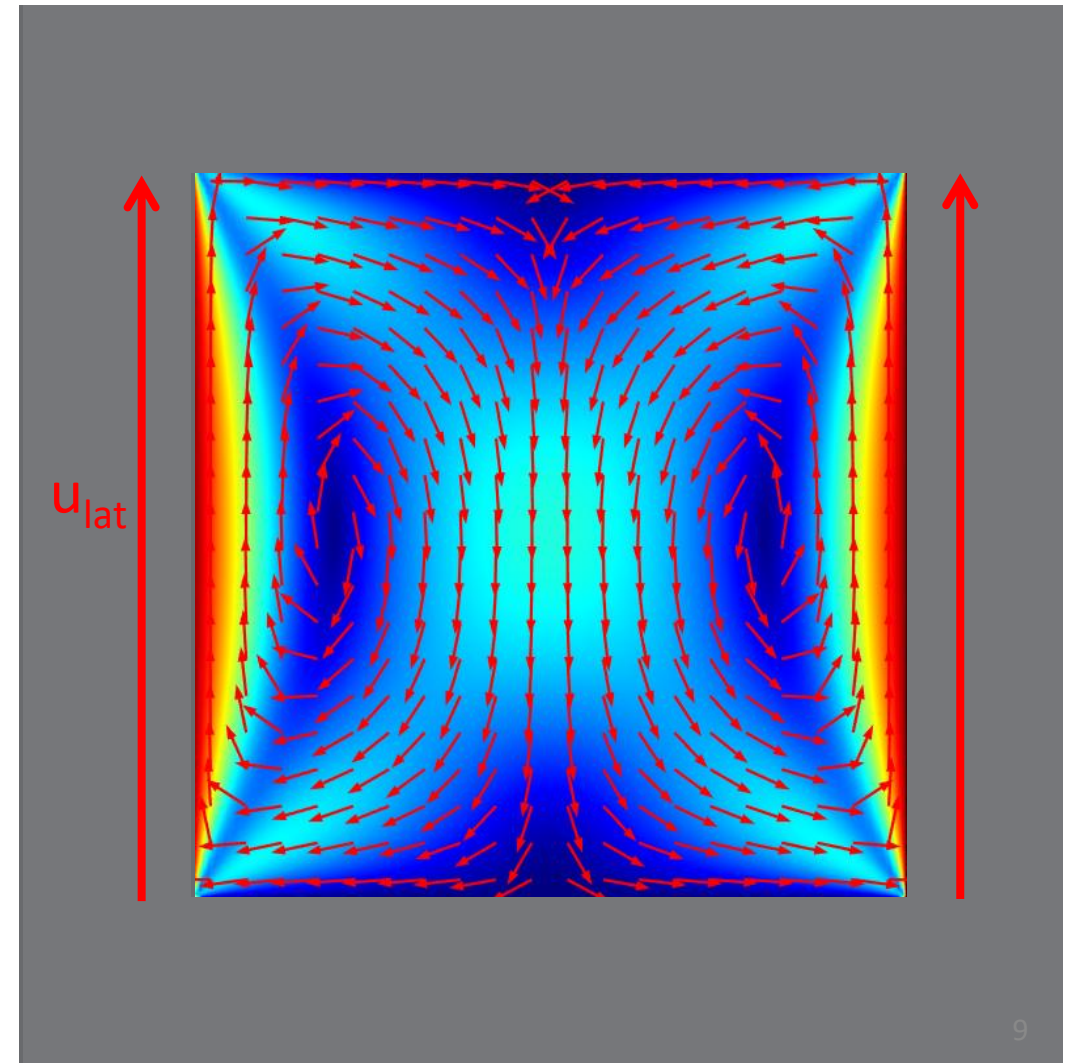
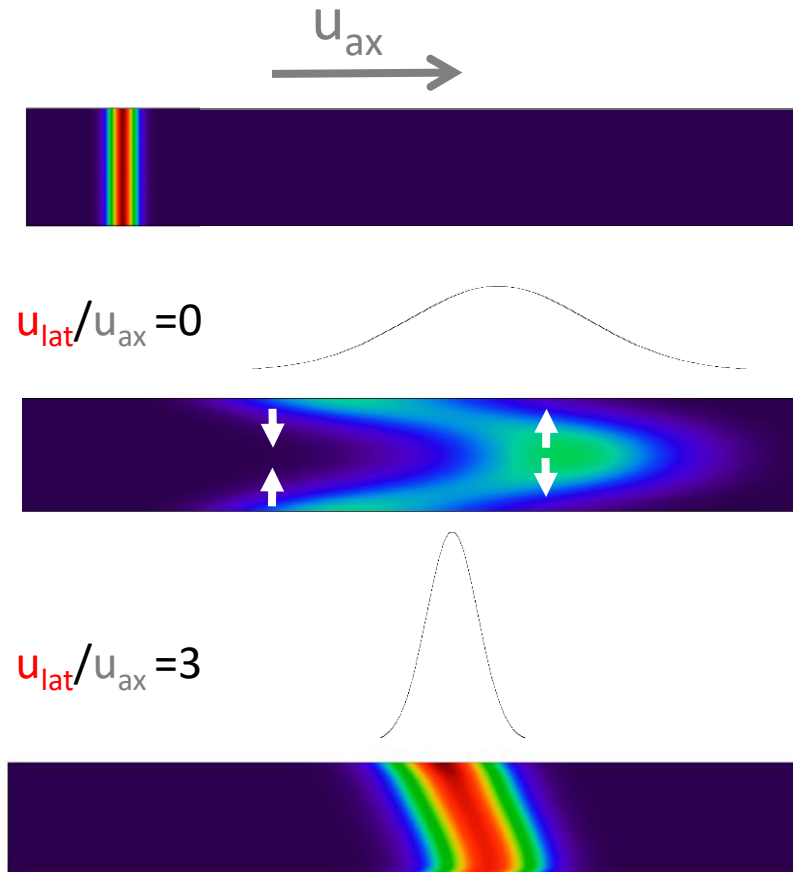
Sense of reducing dispersion



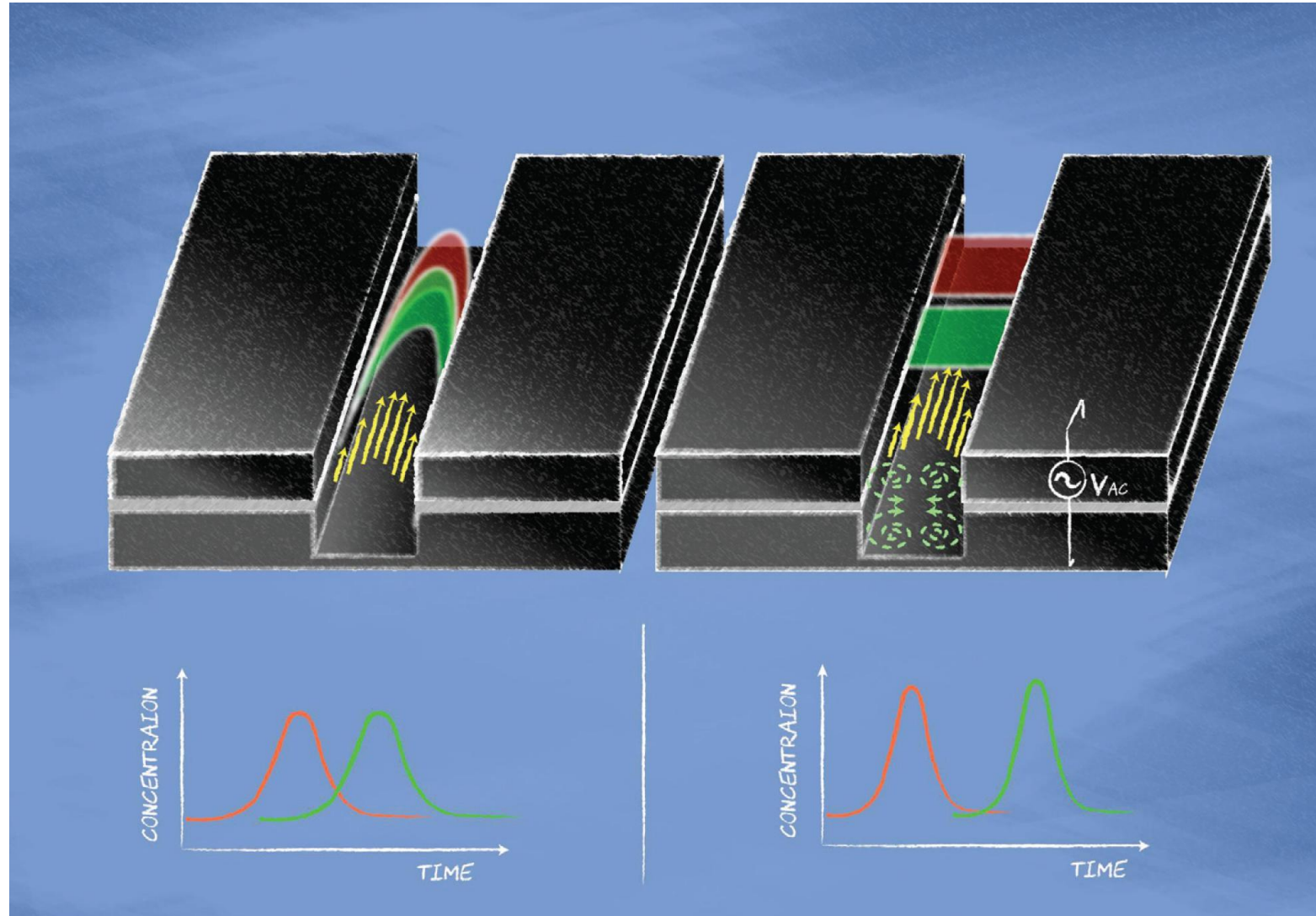
Diffusion limitations in LC



Reducing dispersion by mixing



Mixing with electroosmotic flows



Westerbeek, E., Bomer, J.G., Olthuis, W., Eijkel, J.E., De Malsche, W. (2020), Reduction of Taylor-Aris dispersion by lateral mixing for chromatography applications, Lab-on-a-chip, 20, 3938 – 3947

ERC-PoC '3D-PIV' ('19)

1 company involved (LOI provided)
1 filed patent

- Problem?

Fouling in microfluidic devices

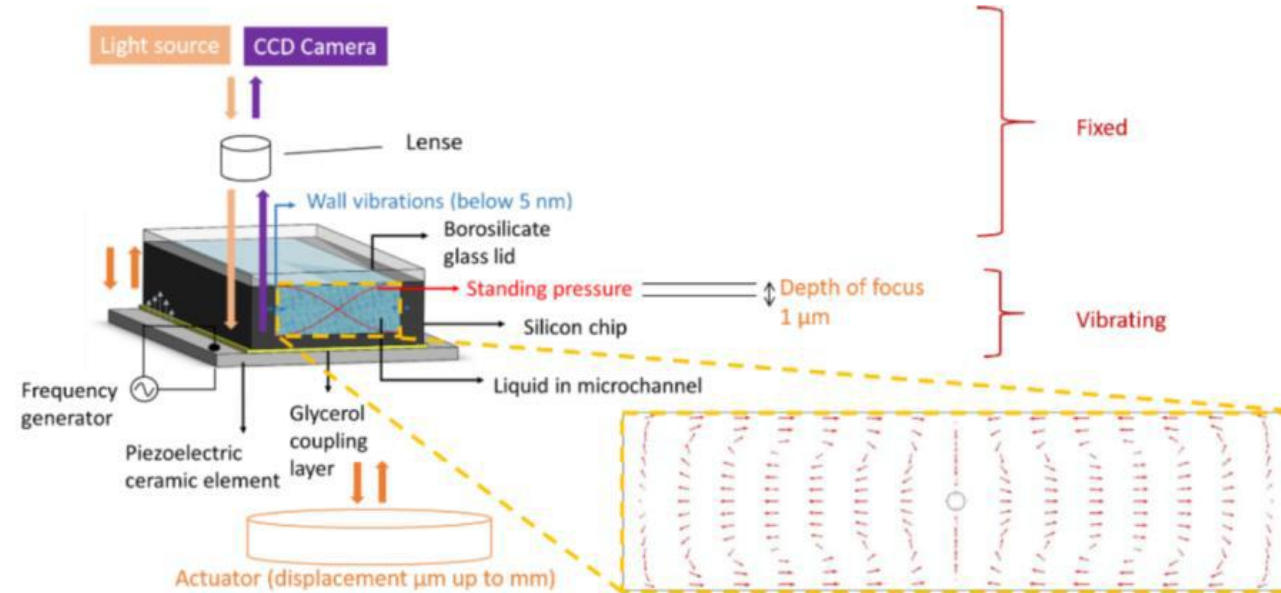
- Solution?

Tailored 3D flows, but imaging difficult

Use oscillating chip in confocal microscope

- Value proposition?

Table-top device able to efficiently analyze the velocimetry of particles in 3D
Avoid fouling, tool to conceive specific functions in microfluidic devices



ERC-PoC 'Evo-LC' ('23)

1 company involved (LOI provided)
1 filed patent

- Problem?

Limited performance, high pressures (and bulky equipment nature) of conventional HPLC systems

- Solution?

Configure channels for practical applications (higher aspect ratios, smaller dimensions) and build dedicated vortex LC instrument

- Value proposition?

Realize an improvement in chromatographic efficiency by factor of 2-3 under relevant chromatographic conditions by using lateral flows (expert lab setting)

Portable instrument (point of care, emergency situation, environmental analysis)

ERC-PoC 'Vortex Sensor' ('22)

1 company involved (LOI provided)

- Problem?

Low sensitivity of flow sensors due to slow transport to sensor surface

- Solution?

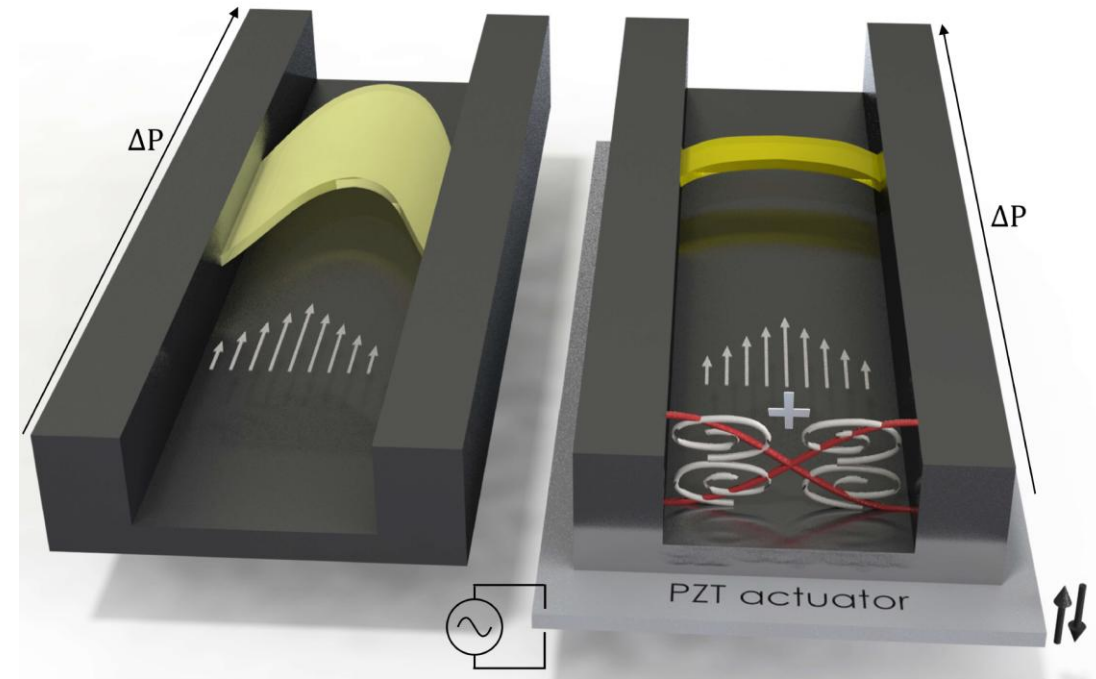
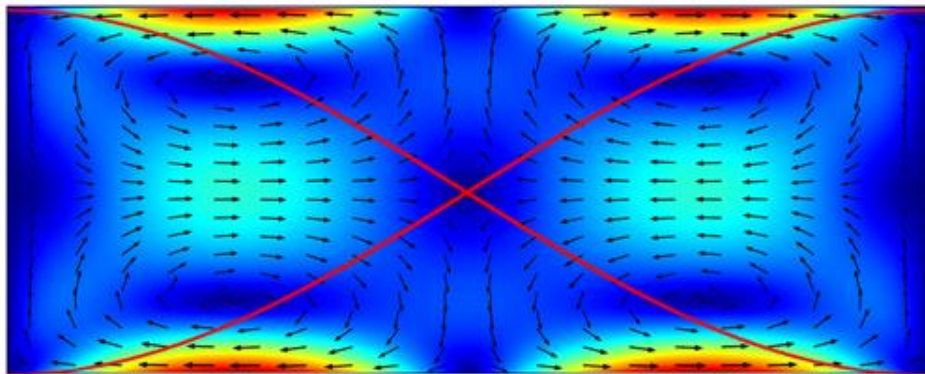
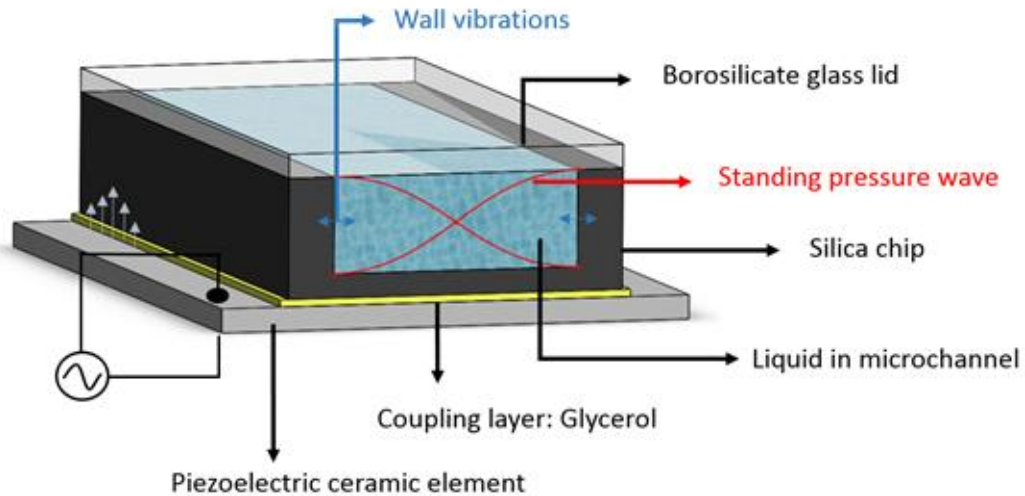
Enhance lateral mass transport (mixing!)

- Value proposition?

Generic method for much faster analysis (higher flow rates), detection at lower concentrations

Point-of-testing analysis, water monitoring, water farms, biotech sensors, (generic technology)

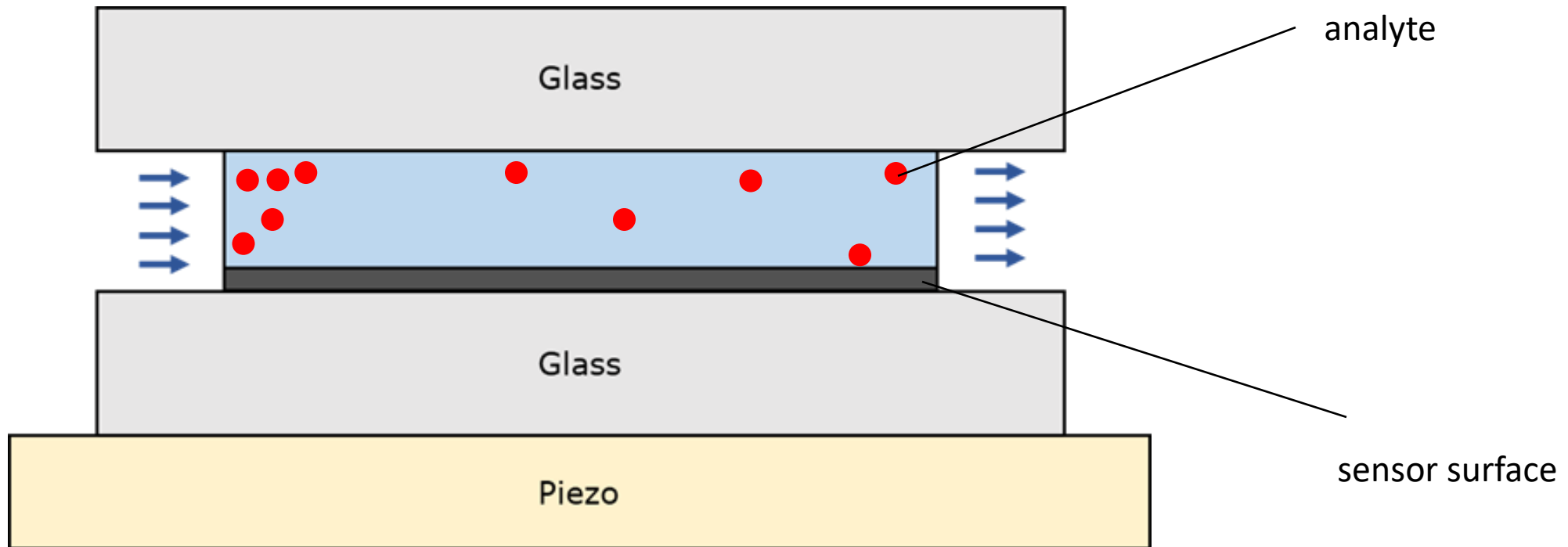
ERC-PoC 'Vortex Sensor' ('22)



Gelin, P., Maes, D., De Malsche, W. (2021), Reducing Taylor-Aris dispersion by exploiting lateral convection associated with acoustic streaming, Chem. Eng. J., 128031

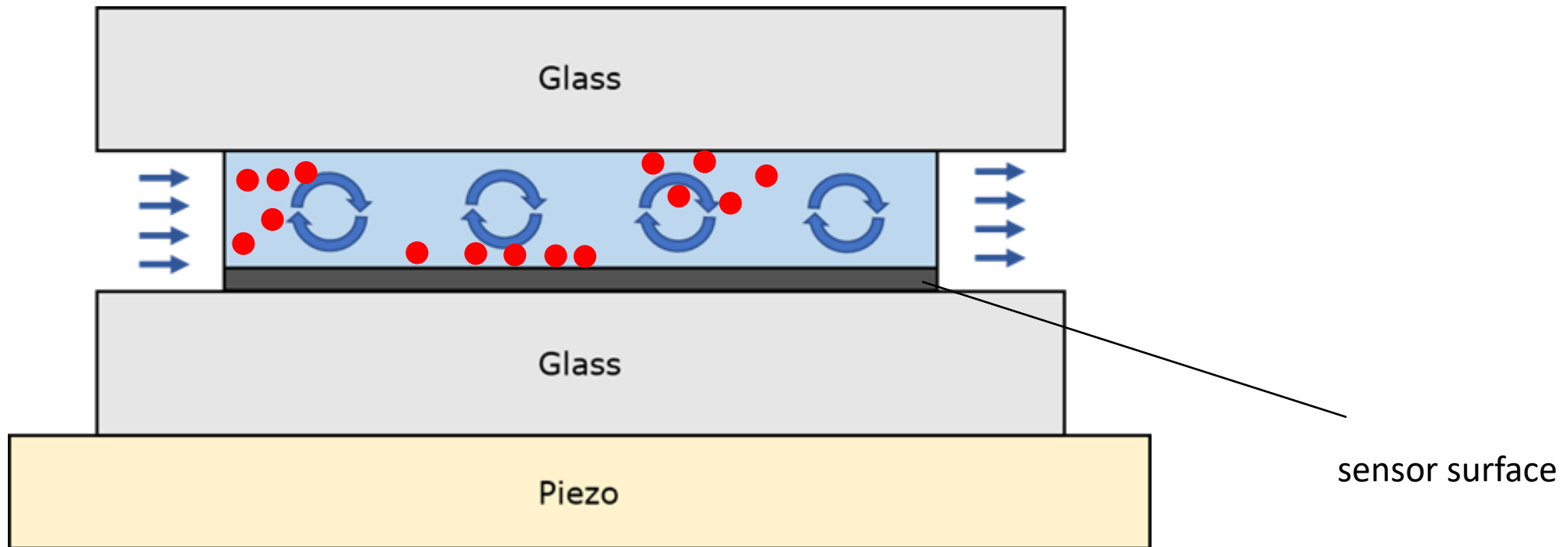
ERC-PoC 'Vortex Sensor' ('22)

Vortex microflow inducer that enables detection of ultra-low concentrations of species in sensors



ERC-PoC 'Vortex Sensor' ('22)

Vortex microflow inducer that enables detection of ultra-low concentrations of species in sensors



Some reflections on my approach

- Technological work should be new and different from main ERC grant
- Try to demonstrate feasibility: add estimation, calculation , simulation
- PoC projects intended towards concrete valorization
 - Business development work (also in budget)
 - Increase TRL from (e.g.) TRL= 1 to TRL=4 (be explicit)
 - Market study, business activities
 - Involve a business developer!
- Language different than for typical fundamental science project
- Formulate impact in a broad sense, but also very specific (instruments or devices that you will make)
- Be concrete about future plans w.r.t. valorization

Acknowledgements



μFLOW CELL
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Industrial Applications



Proof of Concept Grant



Starting Grant

**European
Research
Council**