

# Thermodiffusion of latex beads studied with a microfluidic cell

Dzmitry Afanasekau, Simone Wiegand

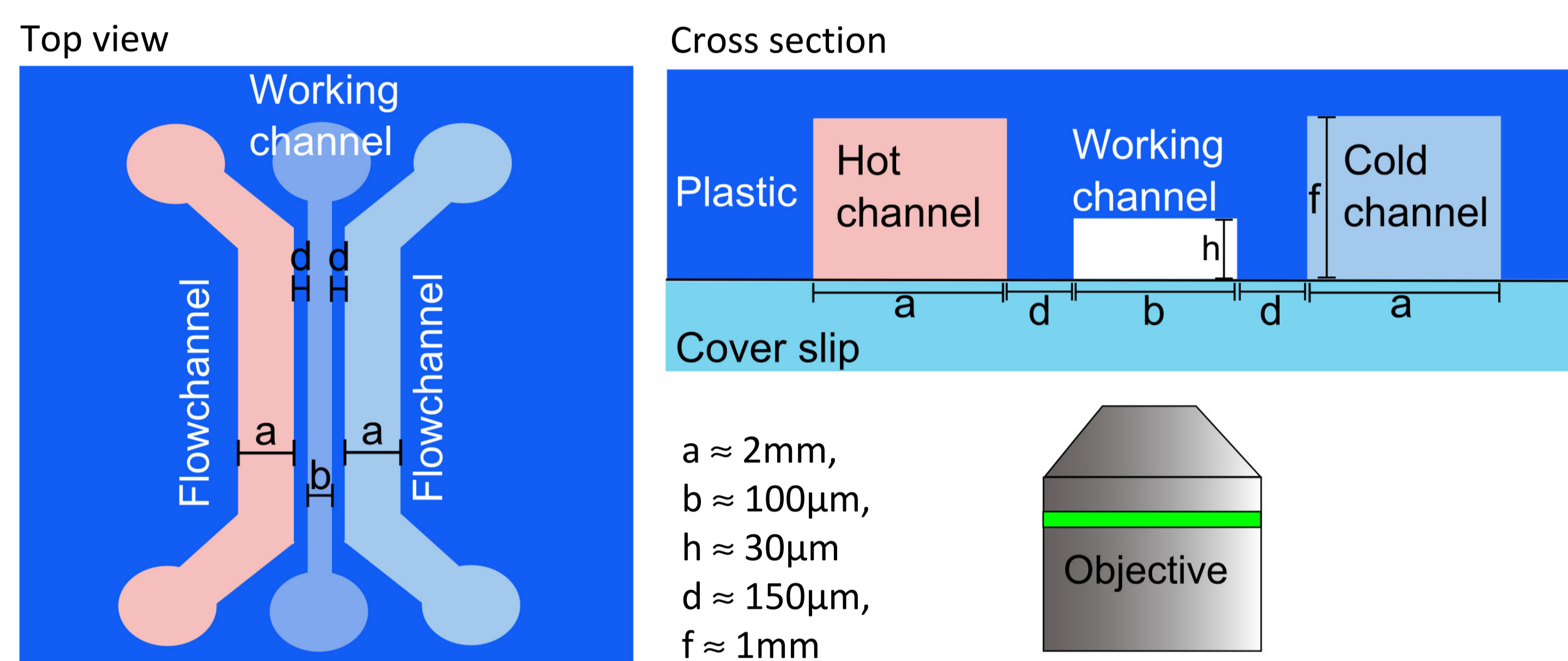
## Introduction

### Challenges in thermophoresis

- Current understanding of thermophoresis in liquids is not complete.
- Both theory and experiments are required.
- Most of currently used methods (optical, based on beam deflection or diffraction) are not suitable for studying thermophoresis of big colloidal particles ( $d > 100\text{nm}$ ) as well as for complex mixtures
- Application of thermophoresis for biosensors

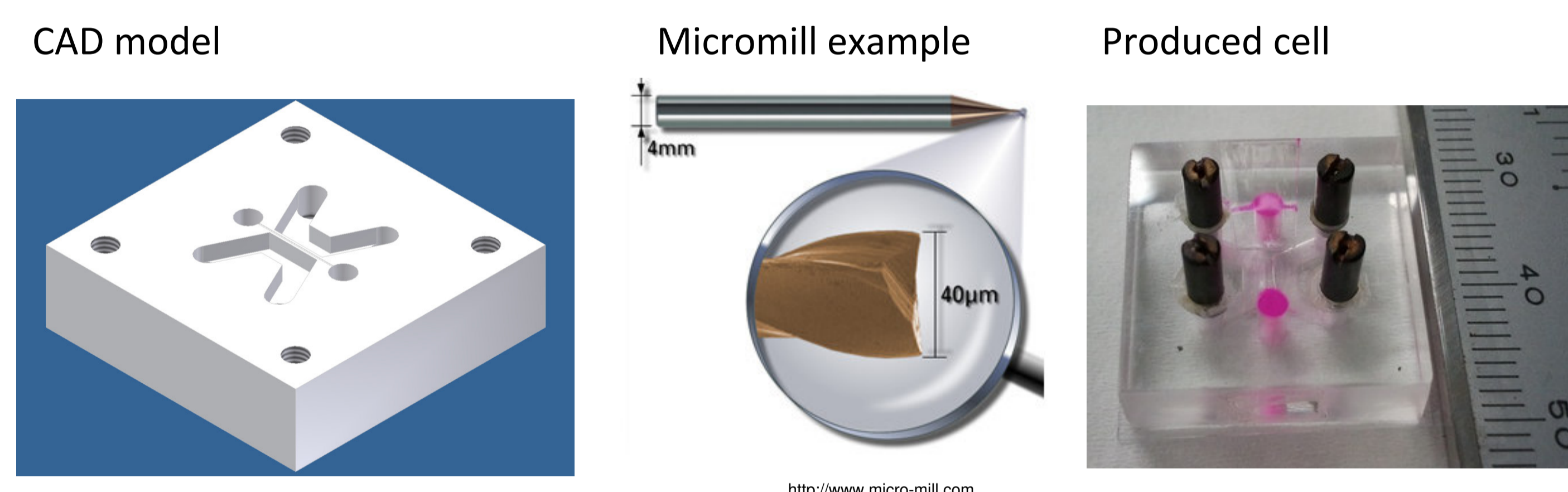
## Microfluidic cell

### Design



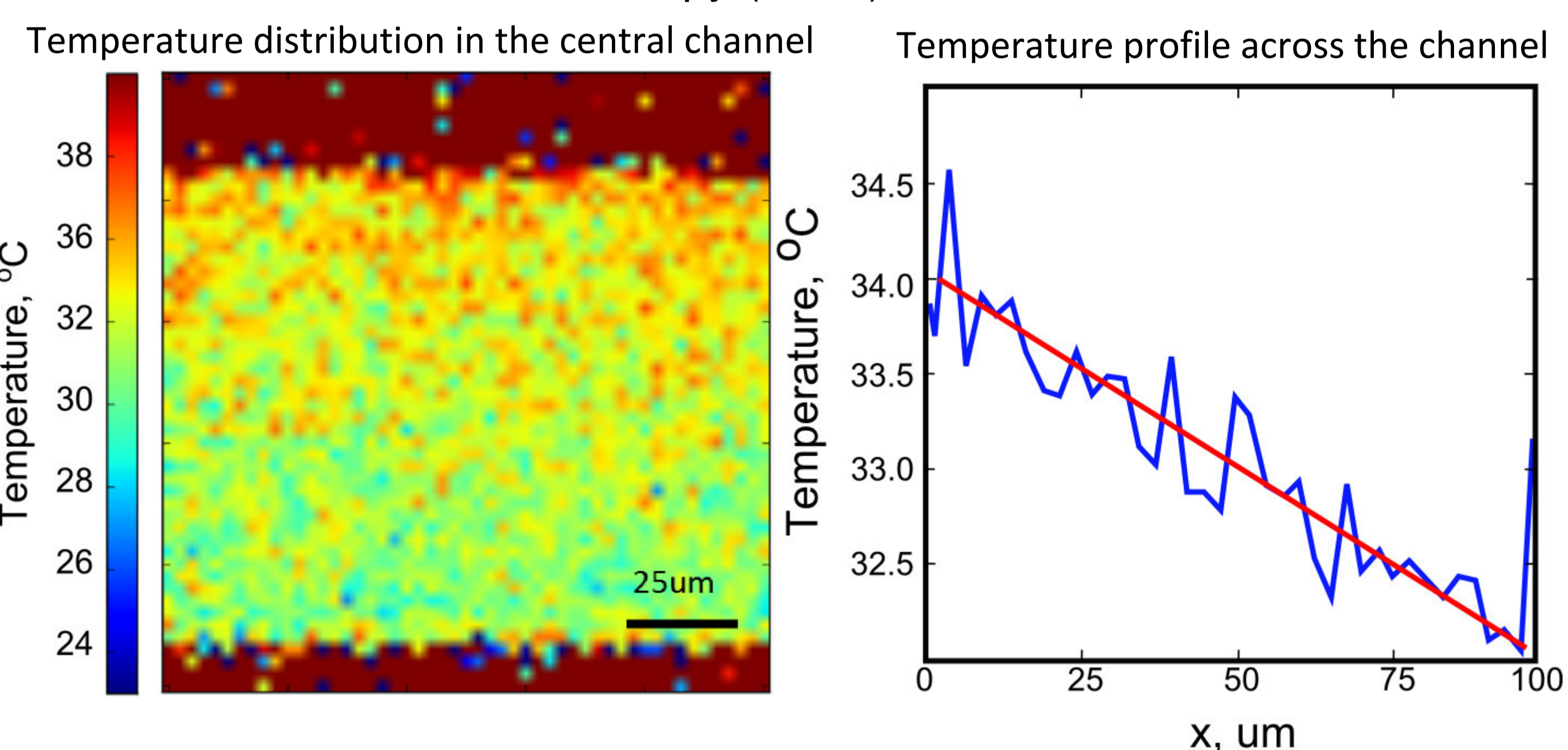
### Production

Made of Plexiglas by micromilling



### Characterization

Fluorescence life time microscopy (FLIM) with Rhodamine B



### Advantages

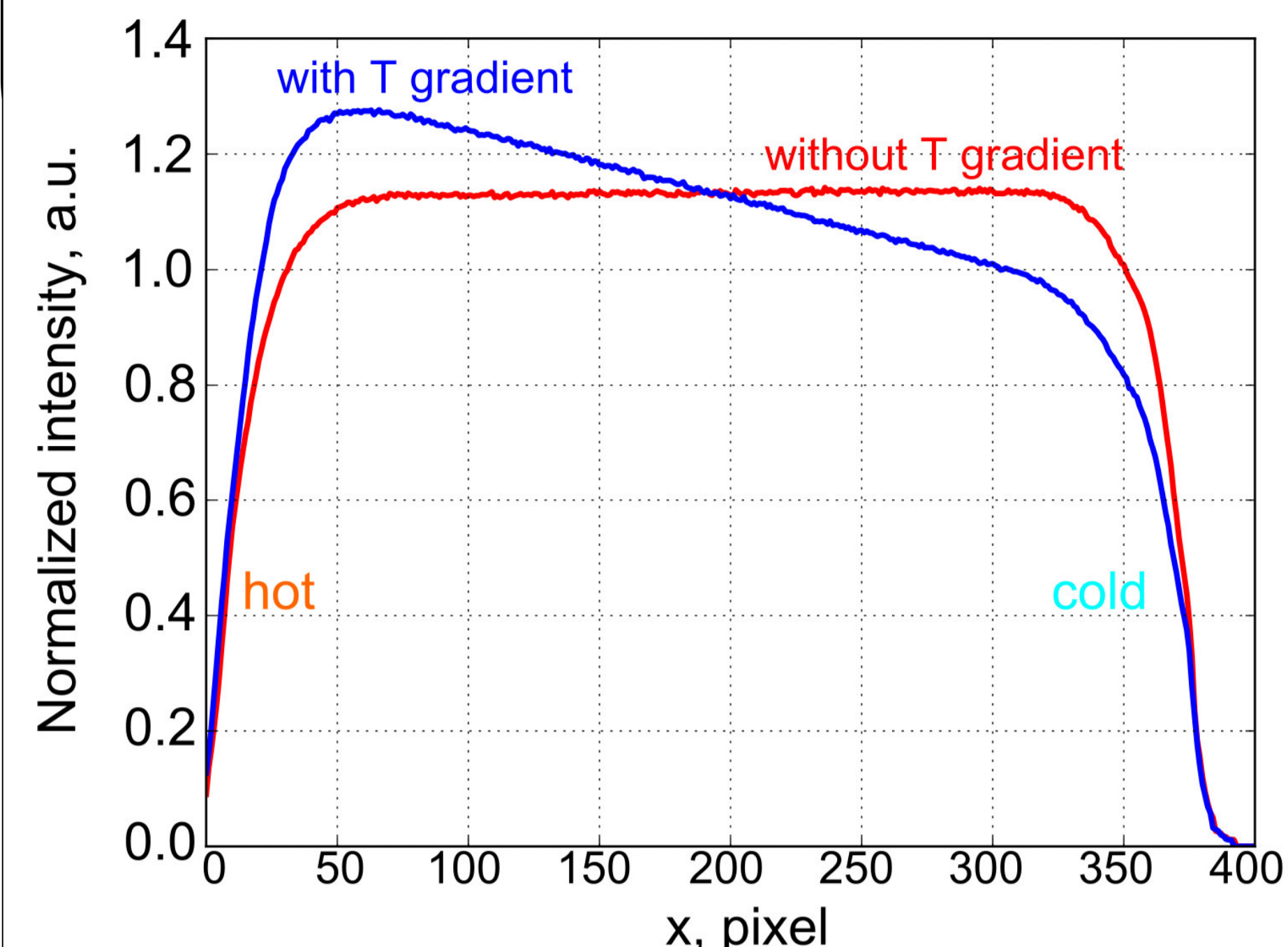
- Investigation in buffer solutions is possible
- Large colloids can be studied ( $> 100\text{nm}$ )
- Complex mixtures can be investigated
- Large temperature gradient  $10^4\text{ K/m}$
- Single particles can be tracked (studied)

## Small particles

Latex nanobeads (25 nm) 1% in water

Thermo Scientific™ Fluoro-Max green fluorescent internally dyed polystyrene particles in water.

Particles cannot be distinguished in the microscope. Fluorescence intensity is taken as a measure of concentration



At the equilibrium when  $c \ll 1$ :

$$\vec{j} = -D\vec{\nabla}c - cD_T\vec{\nabla}T = 0$$

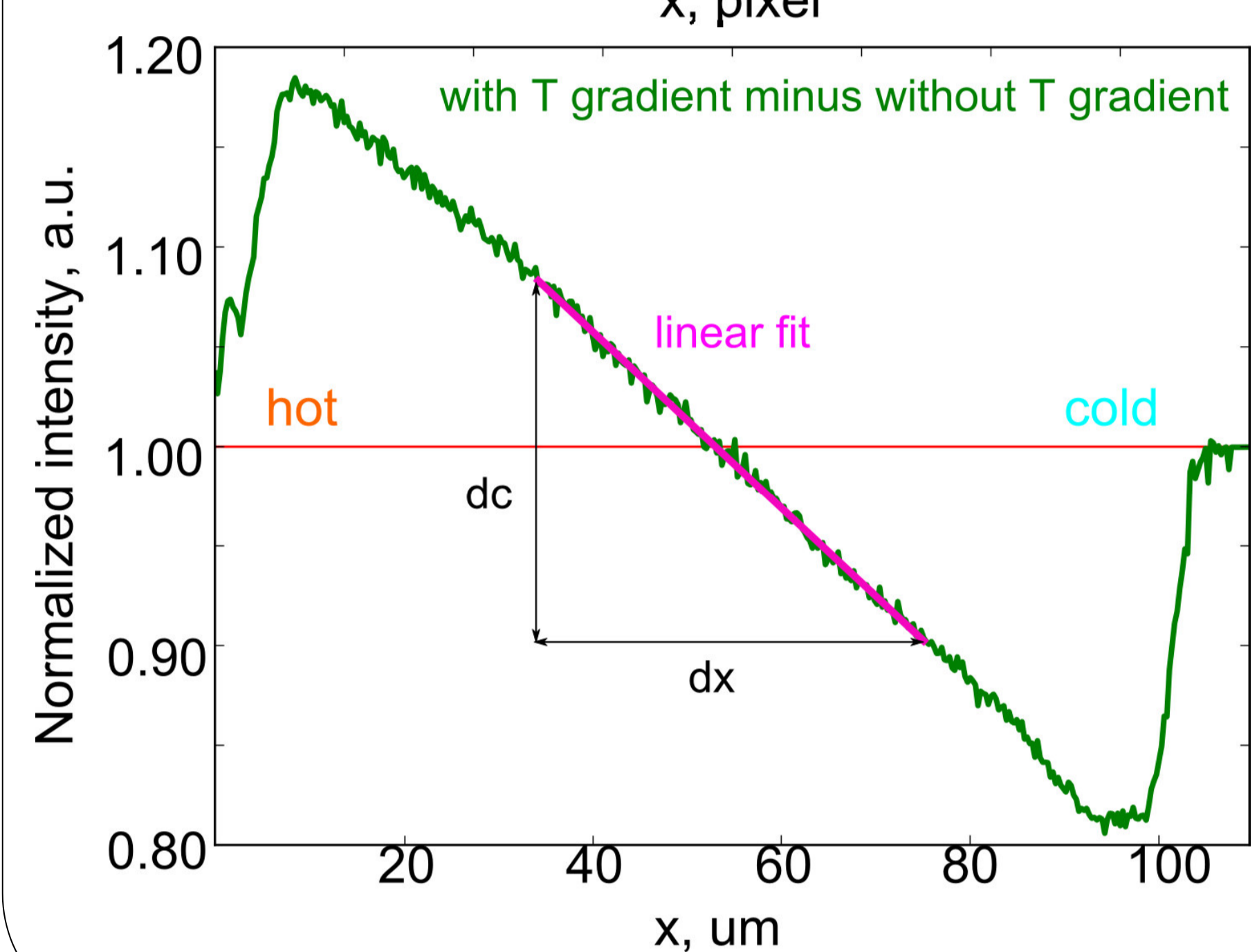


$$S_T = -\frac{D_T}{D} = -\frac{1}{c} \frac{|\vec{\nabla}c|}{|\vec{\nabla}T|} = -\frac{dc/dx}{c dT/dx}$$

$$S_T \approx -0.18\text{ K}^{-1}$$

for  $T = 25^\circ\text{C}$

Validation against TDFRS measurements is planned

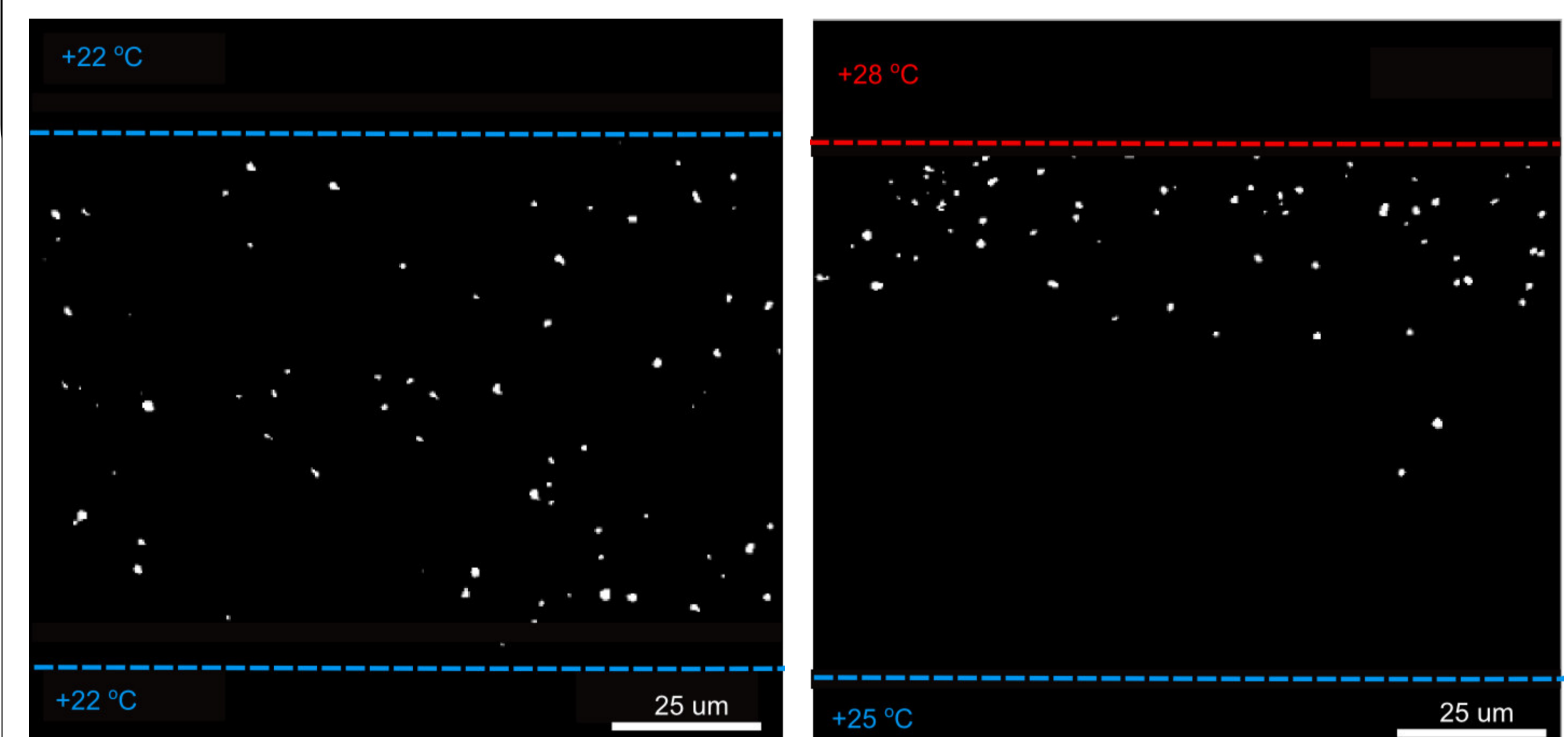


## Large particles

Latex microbeads (0.5µm) 0.01% in water

Thermo Scientific™ Fluoro-Max green fluorescent internally dyed polystyrene particles in water.

Single particles can be distinguished in the microscope and counted



At the equilibrium when  $c \ll 1$ :

$$\vec{j} = -D\vec{\nabla}c - cD_T\vec{\nabla}T = 0$$

$$c = c_0 \exp\left(\frac{S_T \Delta T}{L} x\right)$$

fitting

$$S_T \approx -3.0\text{ K}^{-1}$$

