



# IMAGE-Activated Cell Sorting

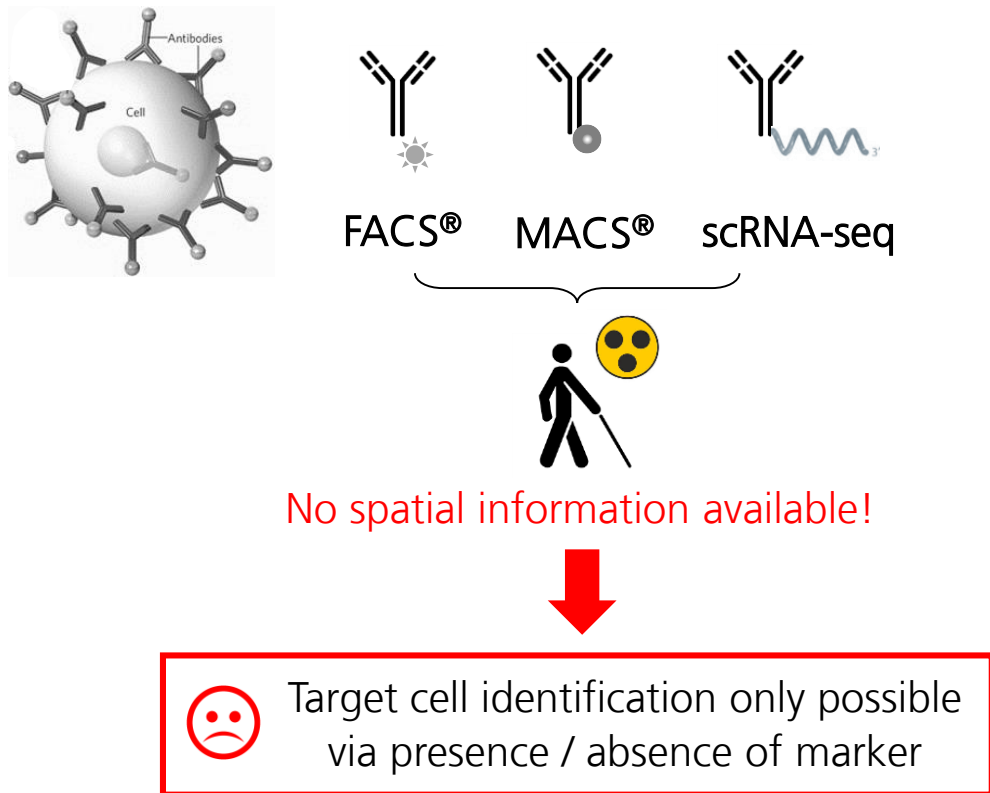
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Overcoming limitations of classical cell sorting methods







# Challenge

Classical sorting methods are blind for spatial features in cells

## Spatial blindness limits target cell identification



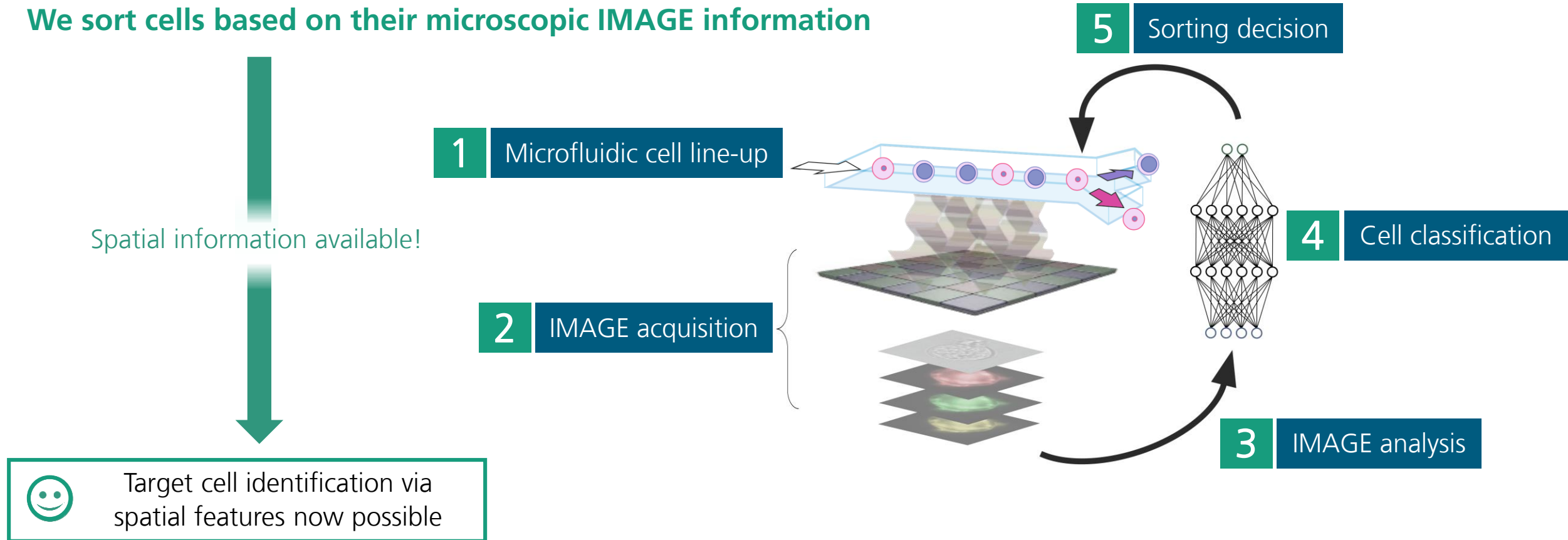
## Important use cases are not addressable

Spatial feature	Application
 Nucleus-to-cytoplasm ratio	Cancer diagnostics, liquid biopsy
 Cell shape	Biotechnology, food industry
 Protein (co-)localization	Immune response, Immunology research
 Cell aggregation	Platelet function Anti-tumor cell therapy
 Chromosome count	Cancer research, CTC biology
 Immunological synapse	CAR T cell therapy and research

# Solution

## IMAGE-Activated Cell Sorting

We sort cells based on their microscopic IMAGE information



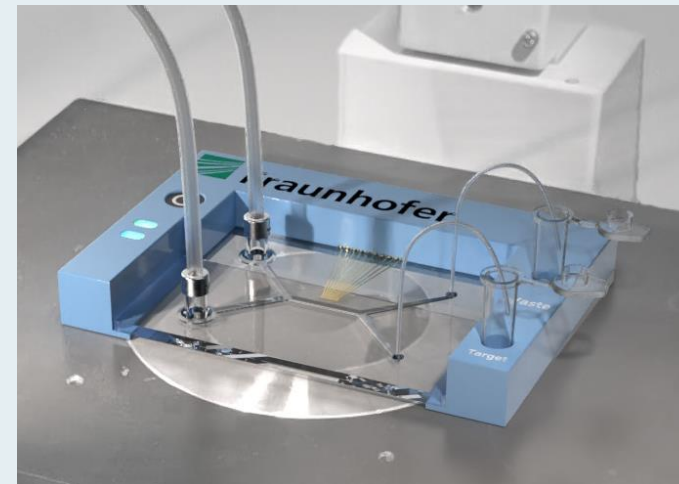
# Fraunhofer IMAGE-Activated Cell Sorting Technology

## Fast Facts

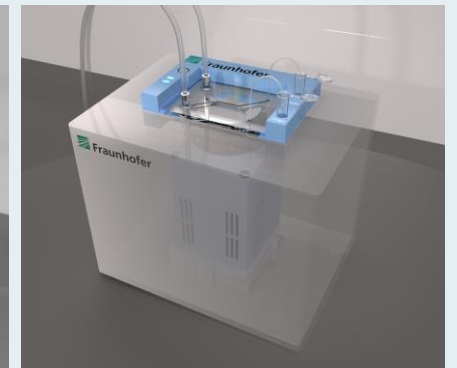
- 2-way sorting
- High resolution, high quality imaging data
  - 3-4 colors + bright field
- AI-supported cell classification
  - »Train by example« using cell images
- Lossless processing of low cell numbers ( $10^4 - 10^6$  cells)
  - High yield, high purity
- Wide spectrum of cell sizes
  - 3...100  $\mu\text{m}$  in diameter
- High biocompatibility
  - Low pressure (<4 psi), low shear stress, physiological media, aerosol-free cell deposition
- Single-cell deposition (under development)
  - Cell deposition in tubes or plates (or any other vessel)

## Possible product designs

A) Microscope add-on



B) Stand-alone device

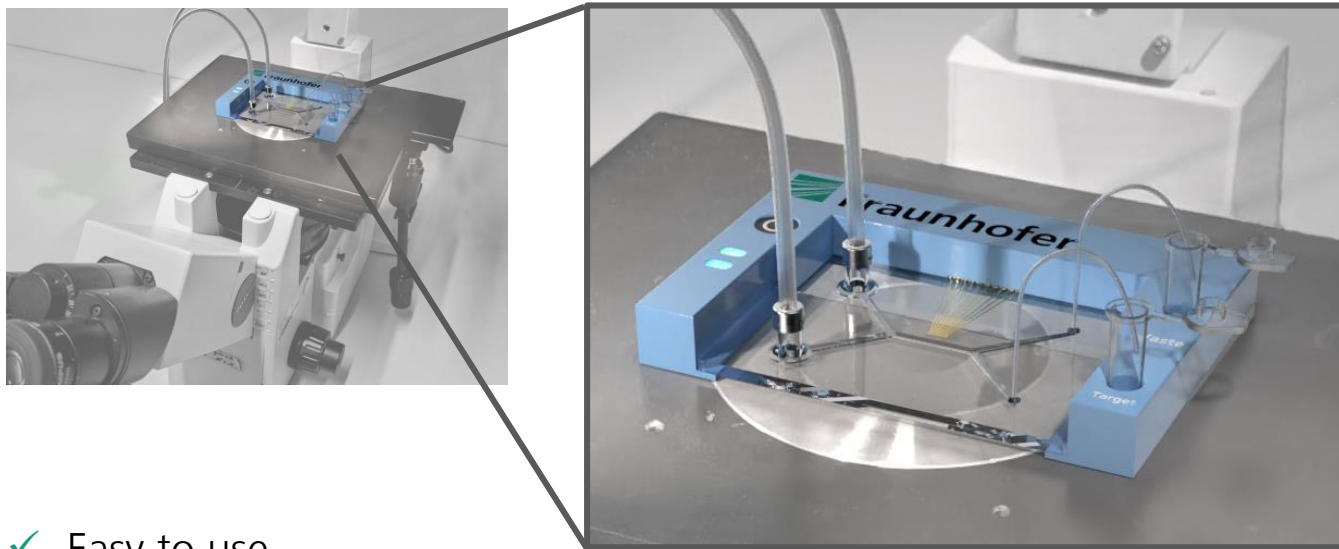


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# What makes us special

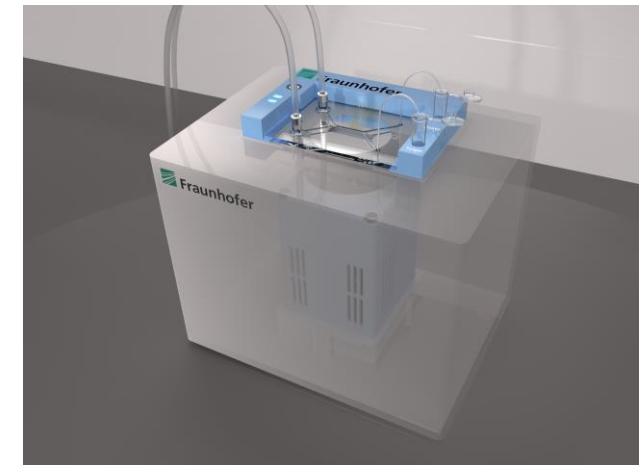
Our microfluidic sorting technology offers high flexibility

## A) Microscope add-on



- ✓ Easy to use
- ✓ Easy to adopt
- ✓ Highest flexibility in image acquisition

## B) Stand-alone device



- ✓ Small foot print
- ✓ Cost efficient, parallelizable
- ✓ Easy to integrate into existing sorting processes



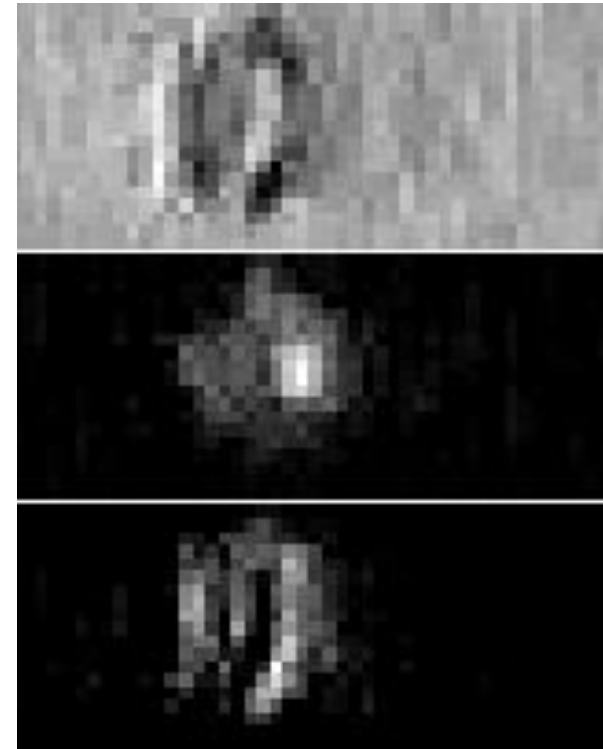
# What makes us special

High image quality

## High optical resolution and image quality

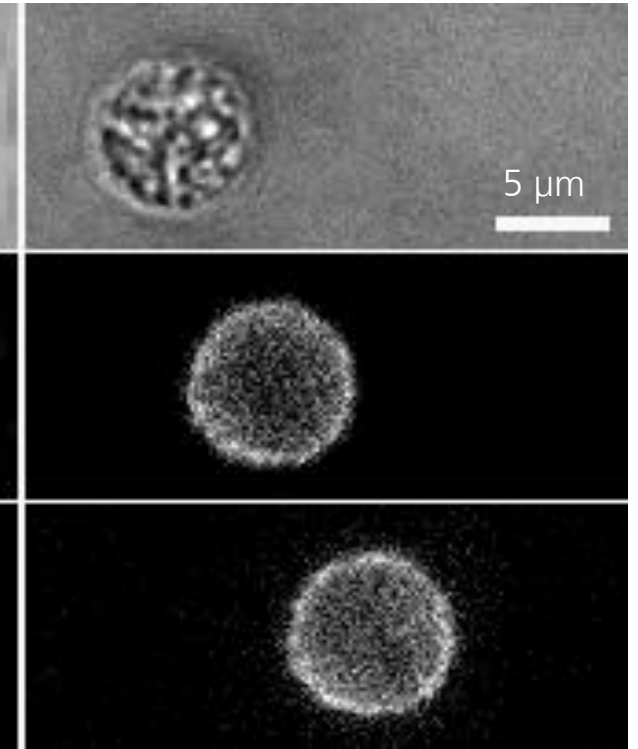
- ✓ High-resolution imaging (e.g., 40X, NA1.42)
- ✓ 3-4 fluorescence colors + 1 brightfield image
- ✓ Multiple images per cell over time

Other



Sampling = 572 nm / px  
10X, NA 0,3

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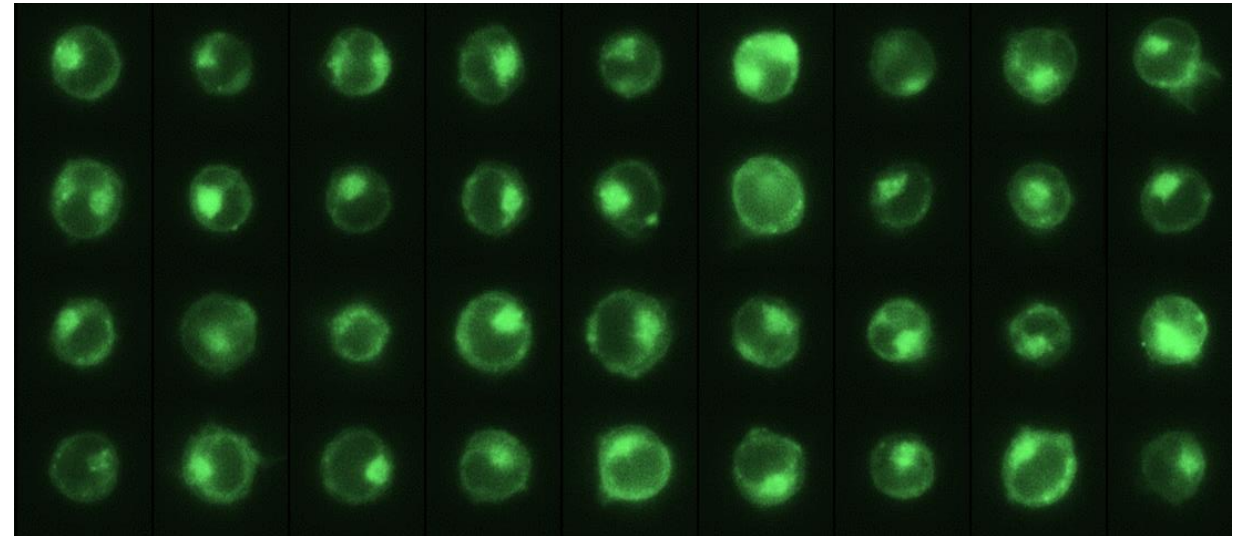
Sampling = 160 nm / px  
40X, NA 1,42  
120 μs exposure time

# What makes us special

Adaptability to many imaging techniques

## Highly flexible imaging

- ✓ Transmitted light microscopy  
(e.g., bright field, phase contrast, interference contrast etc...)
- ✓ Fluorescence imaging  
(e.g., multi-color excitation; variety of emission wavelengths)
- ✓ Other imaging techniques  
(e.g., RAMAN, quantitative phase imaging, polarized light microscopy etc...)
- ✓ Spectroscopic methods  
(e.g., impedance spectroscopy, UV/VIS/NIR spectroscopy etc...)



*Images of membrane-stained T cells flowing through the microchannel  
(imaged at 60X, NA1.42)*

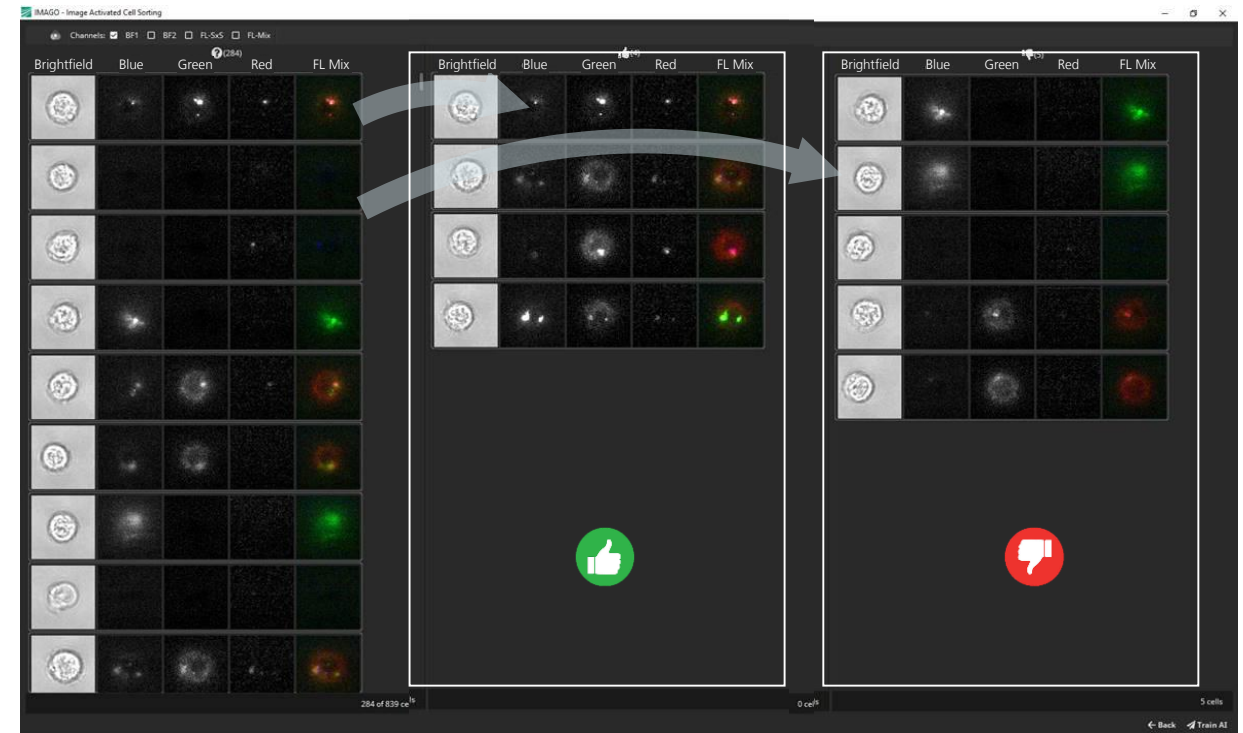
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# What makes us special

Easy definition of the sorting criteria

## AI-based cell classification

- ✓ Intelligent image analysis and sorting decision generation
- ✓ »Train by example« using cell images replaces tedious gating
- ✓ Training with low number of example images via drag-and-drop
- ✓ Feed-back on sorted and unsorted cells



Target definition: Co-localization of membrane proteins

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# What makes us special

Low system complexity

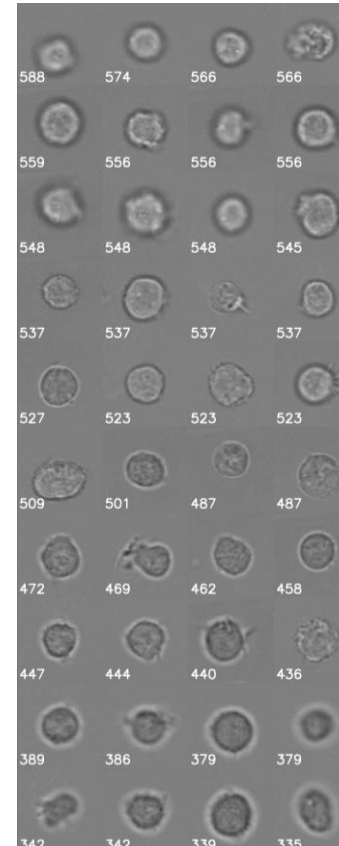
## Cell focusing and cell alignment via electrokinetic forces

- ✓ No sheath flows for cell focusing necessary
- ✓ Low flow velocity possible
- ✓ Low shear forces
- ✓ Low system complexity

### Plain channel

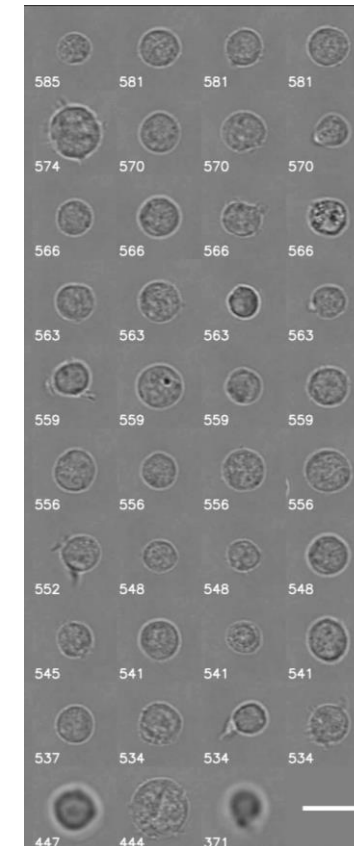
w/o sheath flow focusing:

Random cell distribution



### Our channel:

Focally aligned cells



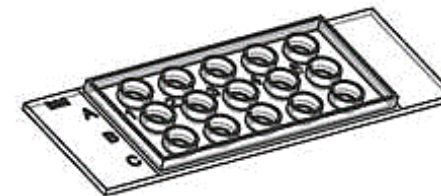
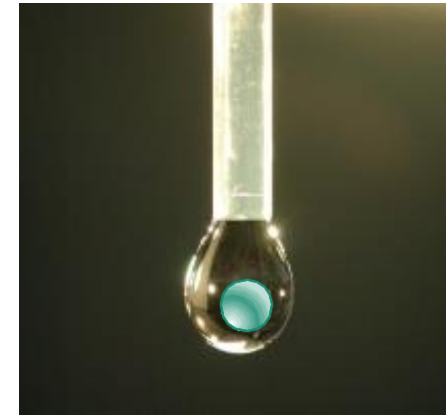
*Gerling et al., LabChip 2023,  
DOI: 10.1039/D3LC00242J*

# What makes us special

High biocompatibility

## Cell recovery via microfluidic droplet collection

- ✓ Low pressure ( $< 4$  psi,  $< 300$  mbar)
- ✓ No aerosol, no voltage, no pressure drop
- ✓ Low shear forces
- ✓ Physiological medium compositions
- ✓ Recovery of target cells into any vessel type (e.g., micro titer plates)



# Fraunhofer Image-Activated Cell Sorting Technology

Possible starting points for you

## Research and Development

*Tell us your  
needs*

- We adapt our technology to your requirements

## Licensee

- Technology or product licensing:
  - Microfluidic sorting technology
  - AI-based image data analysis
  - Optical system design
  - Microfluidic chips
  - Suitable for Table-top device or microscope upgrade kit

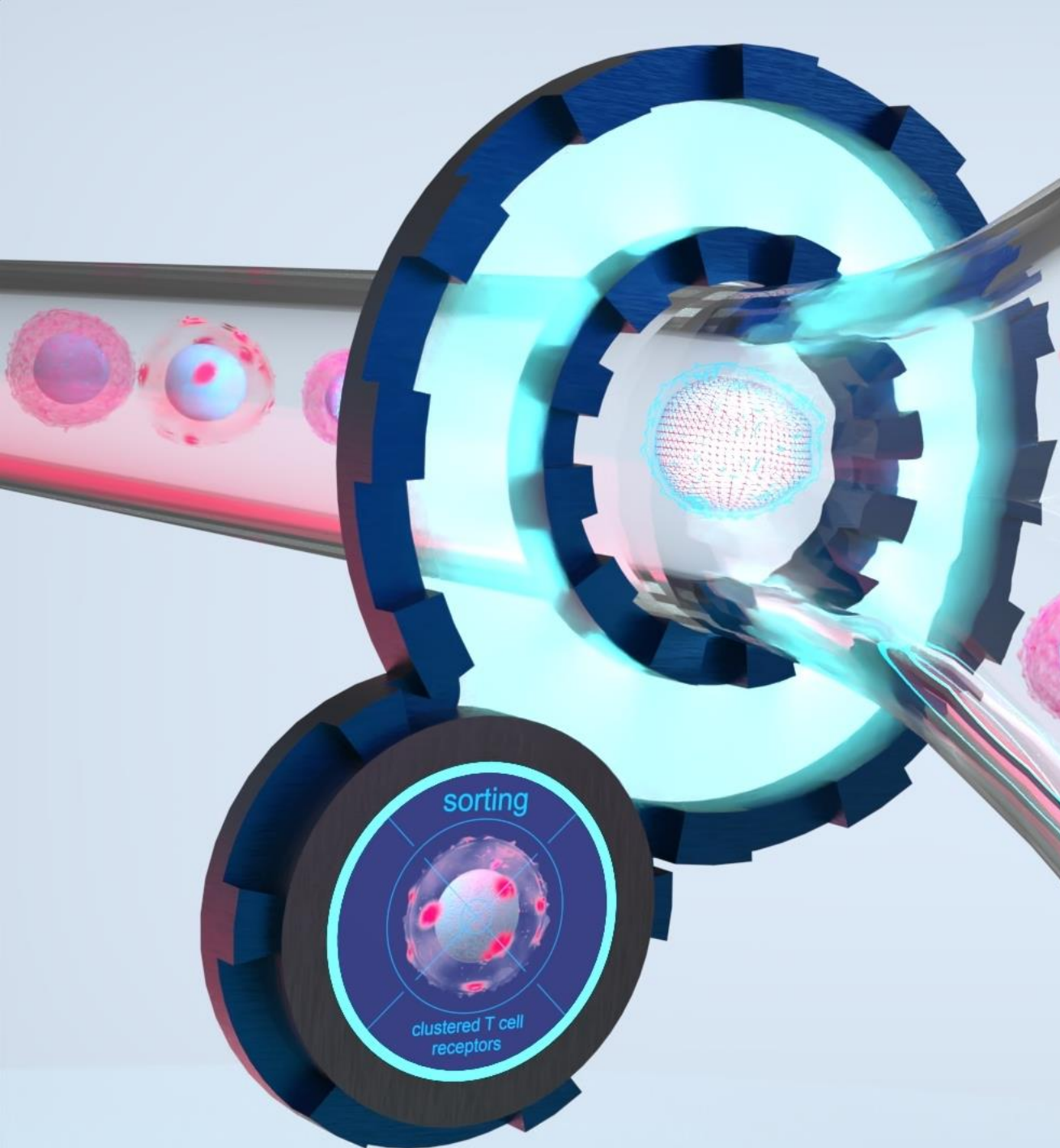
## Sorting as a service

*Send us  
your sample*

- We sort your valuable cell samples on the basis of high-content features



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For more information visit  
our website

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[www.cellsorting.fraunhofer.de](http://www.cellsorting.fraunhofer.de)







## Contact

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## Partners

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