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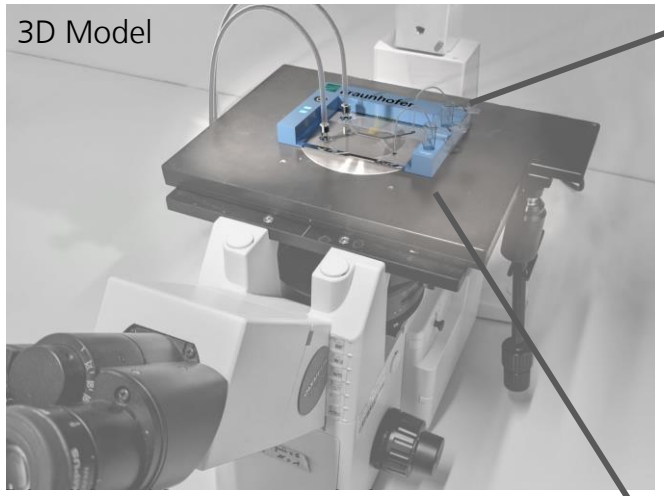
IMAGE-Activated Cell Sorting

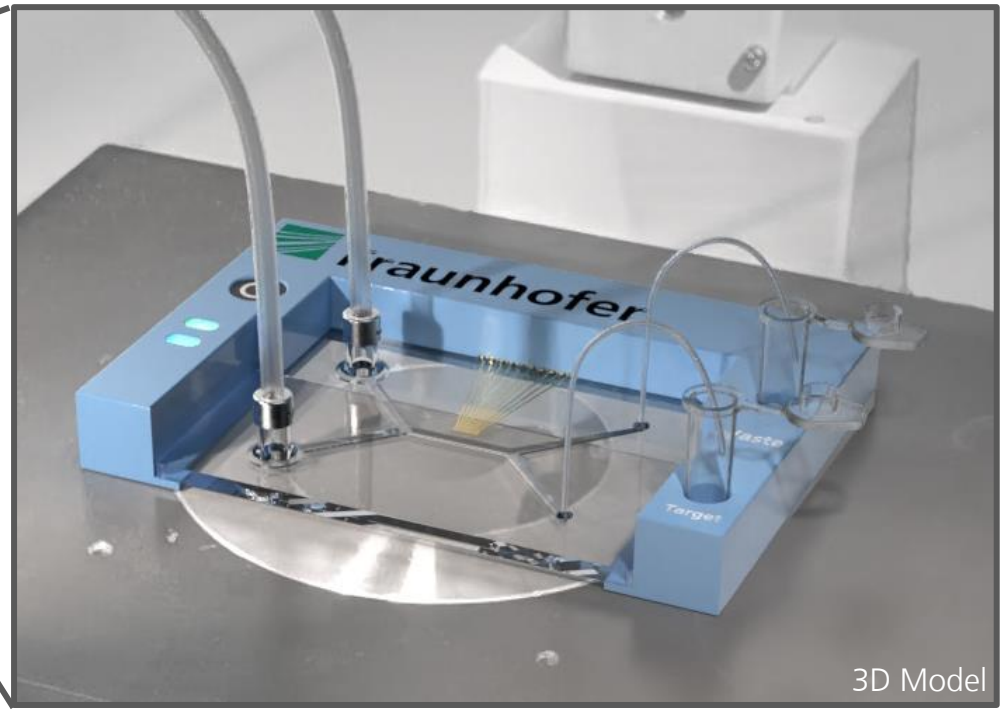
Turn your microscope into a cell sorter and overcome limitations of classical cell sorting

IMAGE-Activated Cell Sorting

General implementation

Microfluidic microscope add-on compatible with almost any type of microscope!





- ✓ Easy to use
- ✓ Easy to adopt
- ✓ Highest flexibility in image acquisition
- ✓ Low-loss cell processing – well suited for small and valuable cell samples
- ✓ Better defined cell populations

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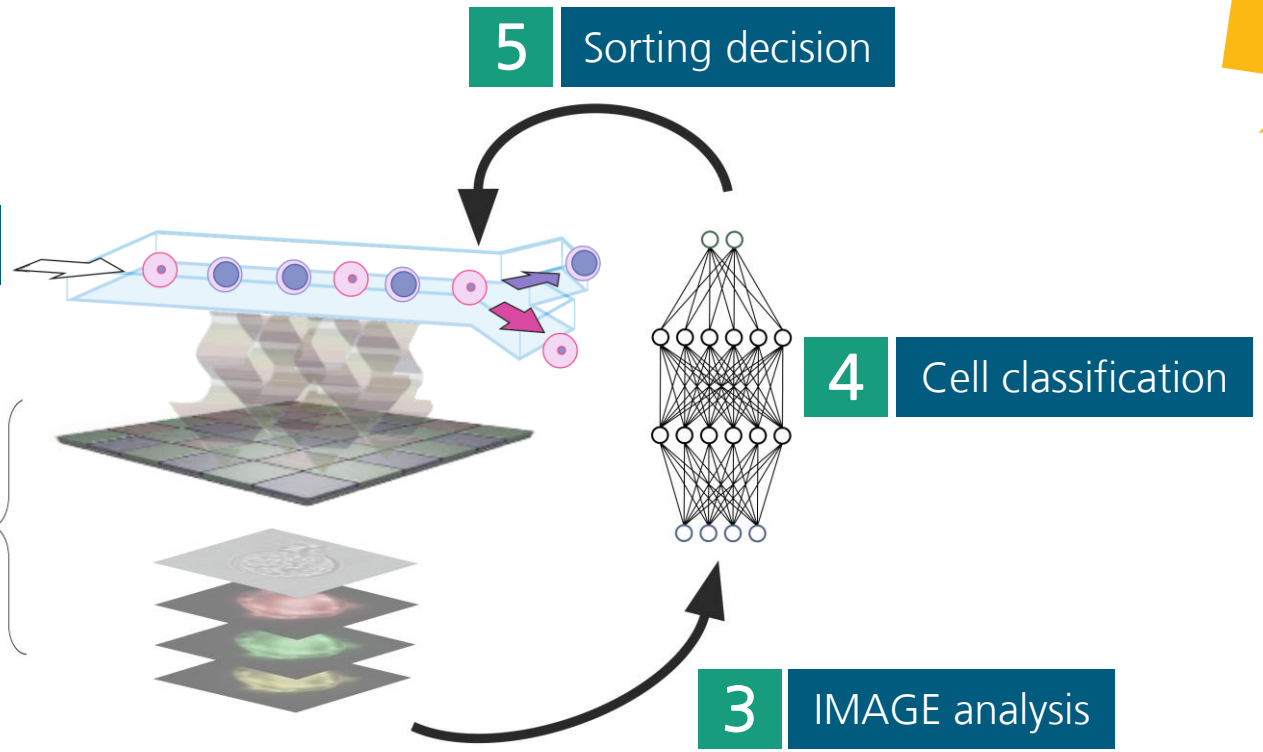
IMAGE-Activated Cell Sorting

Basic concept



Target cell identification via spatial features and/or surface markers!

Label-free or fluorescence-based detection!

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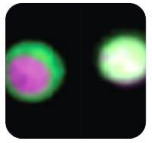
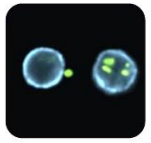
Sorting cells based on their microscopic IMAGE information….

…allows addressing previously inaccessible cells based on

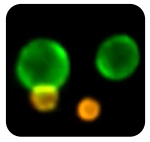
Co-localization



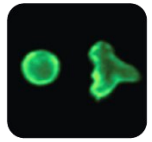
Nuclear vs. cytosolic expression



Number of vesicles or FISH spots



Cell-cell interaction / immune synapse studies



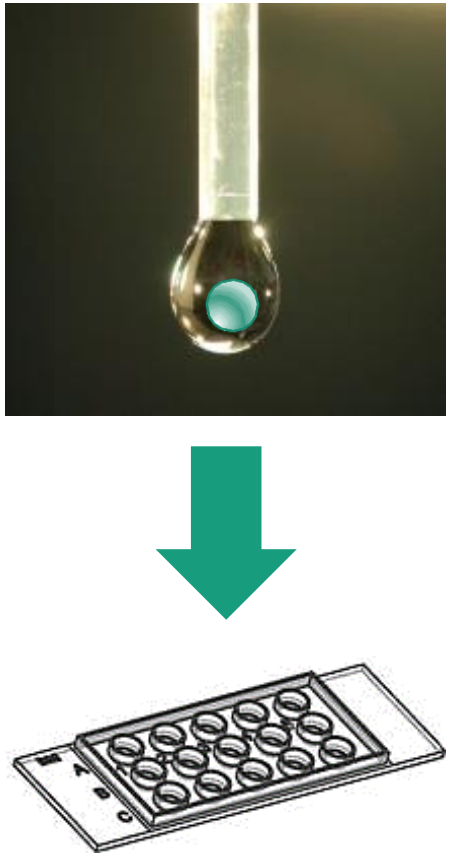
Morphology / size / shape …and many more!

Images taken from: Amnis product brochure

Biocompatible processing and recollection of single cells…

… creates a perfect starting point for single-cell sequencing studies

- ✓ **Low pressure**
  i.e., < 4 psi, < 300 mbar
- ✓ **No aerosol, no voltage, no pressure drop**
- ✓ **Low shear forces**
- ✓ **Physiological medium compositions**
- ✓ **Any vessel type**
  suited for cell recollection (e.g., micro titer plates)
- ✓ **Single-cell deposition**
  e.g. for sequencing studies



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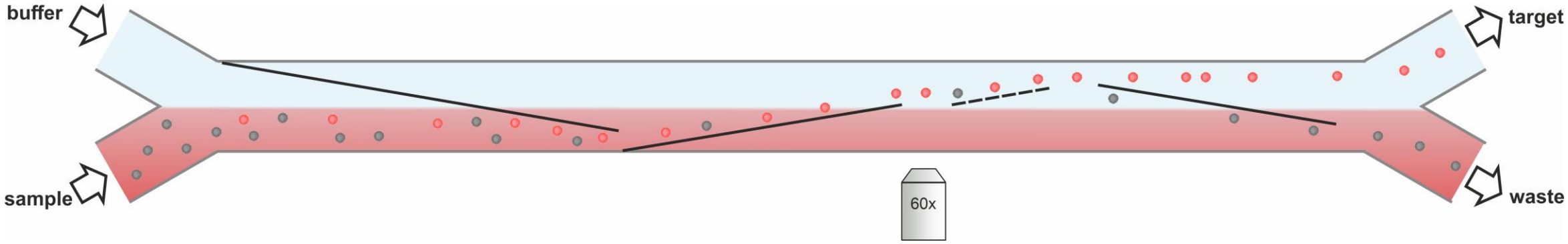
Integrated cell staining and washing protocols…

…enable low-loss processing of valuable cells, even with low cell counts



- ✓ **Biopsies**
- ✓ **Stem cells**
- ✓ **Rare cells**
- ✓ **Genetically modified cells**
- ✓ **etc…**

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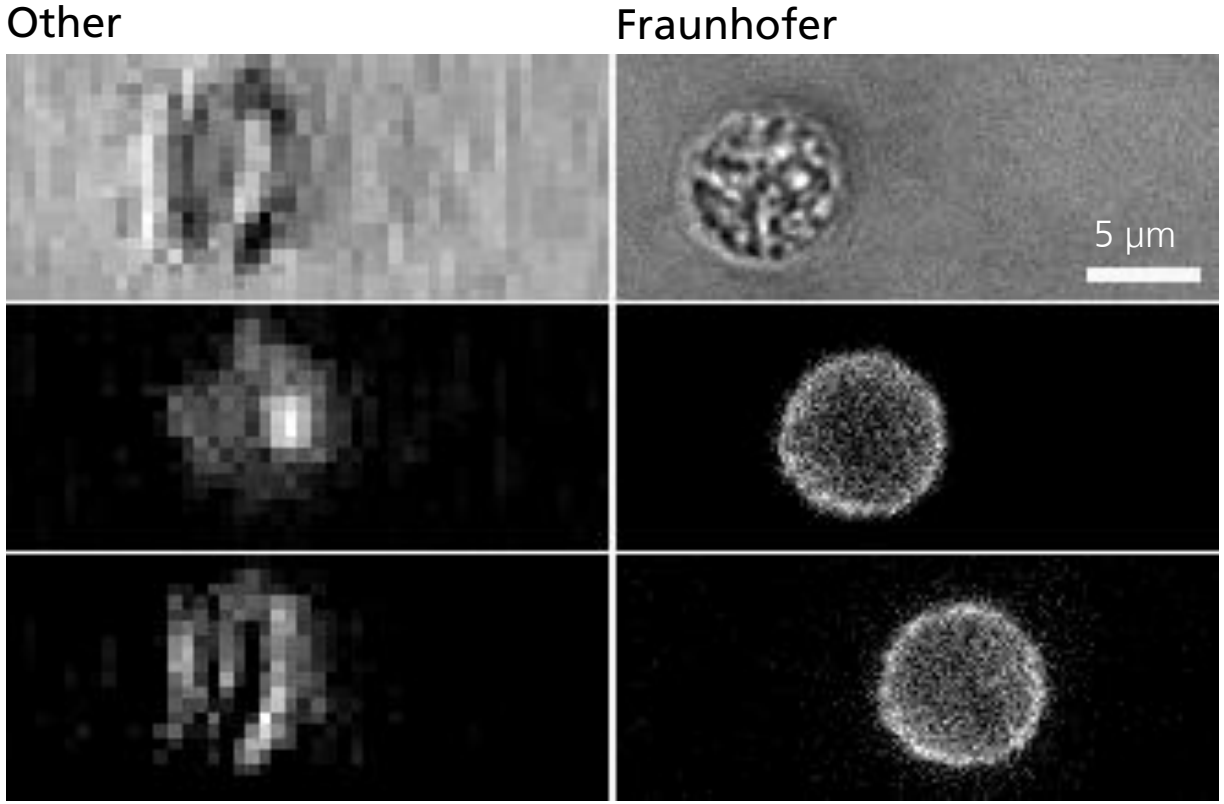
What makes our approach different

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



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

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

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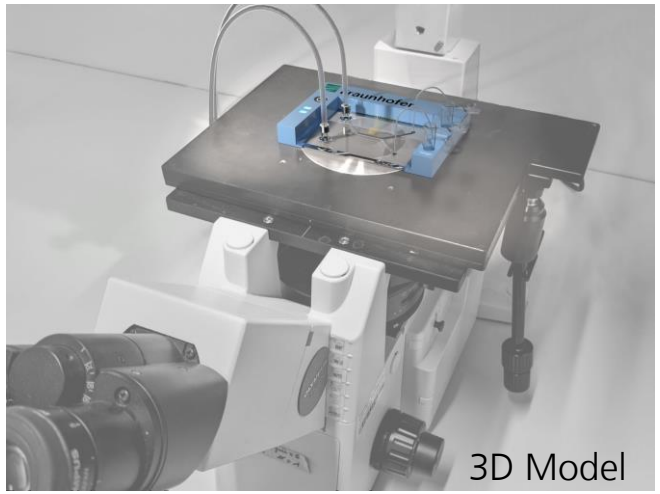
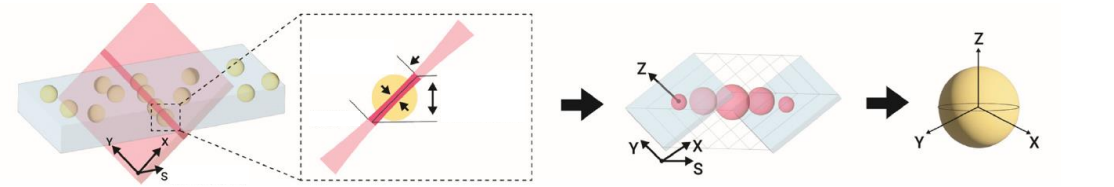
What makes our approach different

Adaptability to many imaging and analysis techniques



Highly flexible imaging and detection

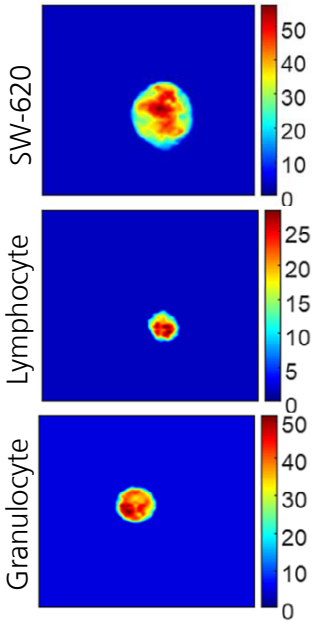
- ✓ **Transmitted light microscopy** e.g., phase contrast, DIC etc…
- ✓ **Fluorescence imaging** e.g., confocal, wide-field etc…
- ✓ **Phase imaging** e.g., interferometric phase microscopy
- ✓ **Optical spectroscopy** e.g., UV, VIS or NIR spectroscopy
- ✓ **RAMAN imaging**
- ✓ **3D imaging** e.g., light sheet microscopy



Light-sheet illumination **Image stacks** **3D reconstruction**

Phase imaging

(optical path delay)



Dudaie et al., *J Biophotonics*. 2020 (11):e202000151

Image adapted from: Son et al., *Lab Chip*, 2023, 23, 624.

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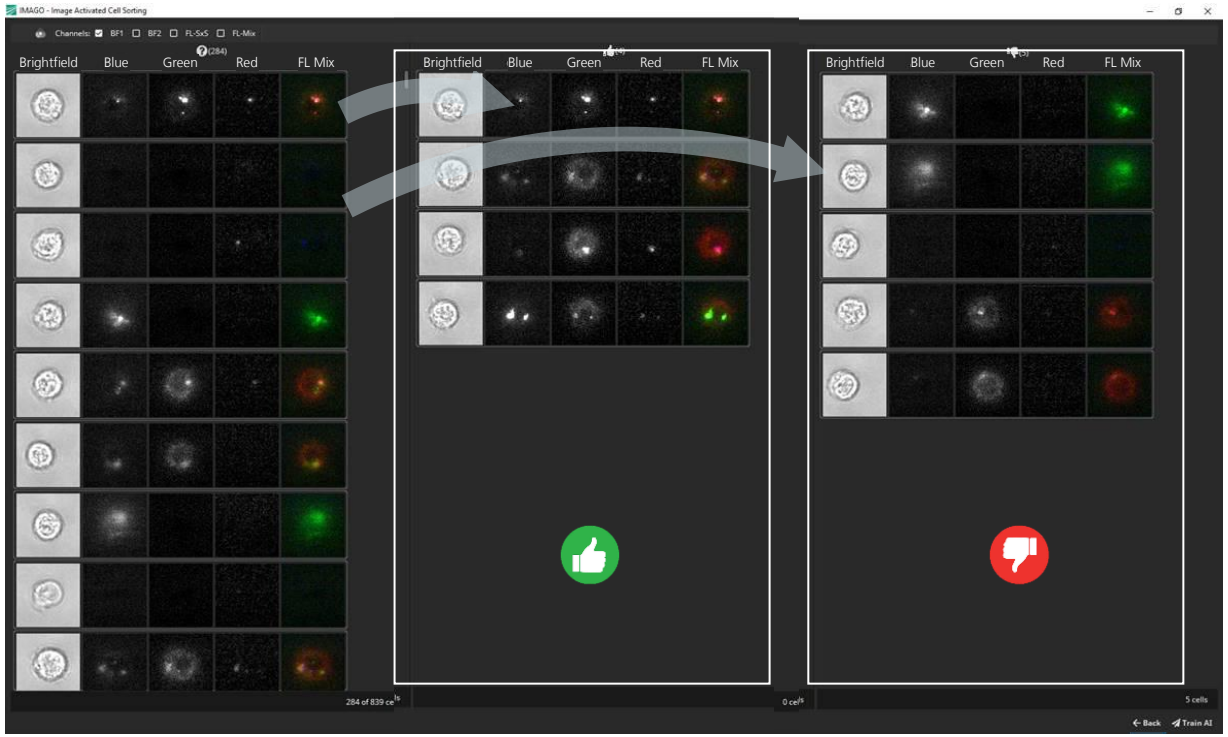
What makes our approach different

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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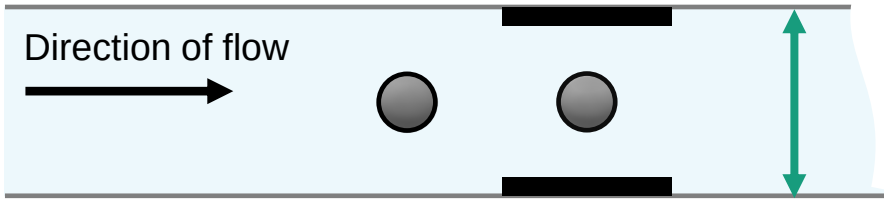
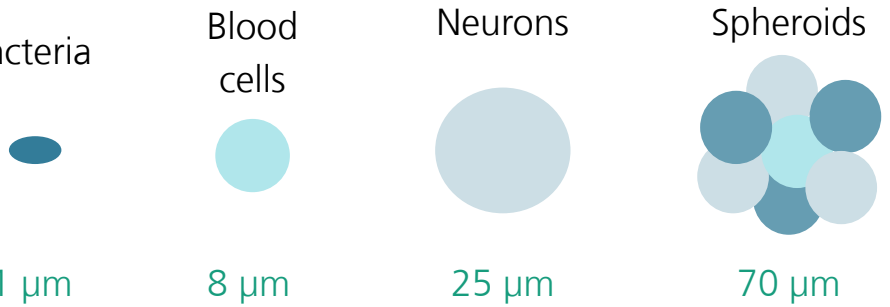
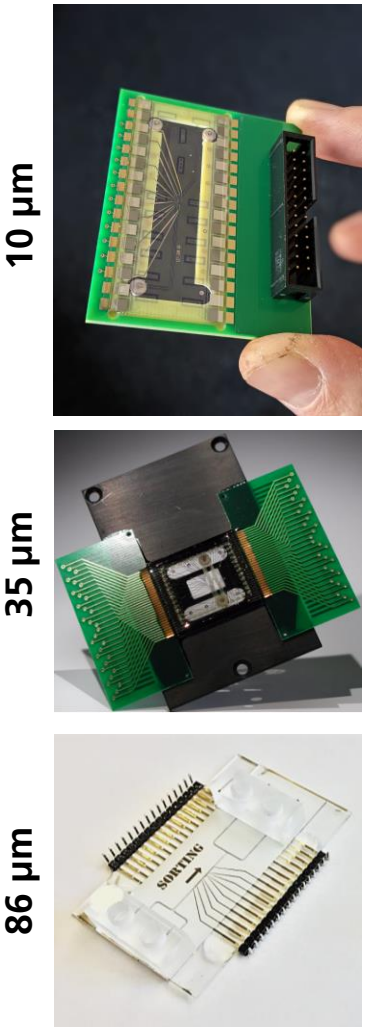
What makes our approach different

Flexible adaptation to a wide range of cell or particle sizes

Object size determines microchannel height







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Fraunhofer IMAGE-Activated Cell Sorting Technology

Summary

- **2-way sorting**
- **High resolution, high quality imaging data**
  - 3-4 colors + bright field
- **AI-supported cell classification**
  - »Train by example« using cell images
- **Low-loss processing of even low cell numbers (10^4 – 10^6 cells)**
  - High yield, high purity
- **Wide spectrum of cell sizes**
  - 1…100 µm 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 e.g. for sequencing studies

See our latest publication

Gerling et al., *Lab Chip*, 2023,23, 3172-3185

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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

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Licensee

- Technology or product licensing:
  - Microfluidic sorting technology
  - AI-based image data analysis
  - Optical system design
  - Microfluidic chips
  - Microscope add-on or Table-top device

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

www.cellsorting.fraunhofer.de

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