Node-pore sensing: A label-free platform to screen single cells for their phenotypic profile

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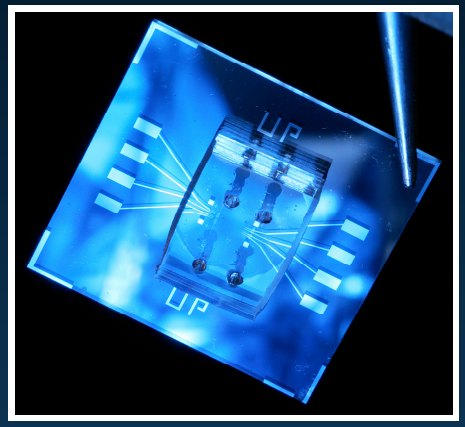
Node-Pore Sensing

Determining the Phenotypic Profile of Cells



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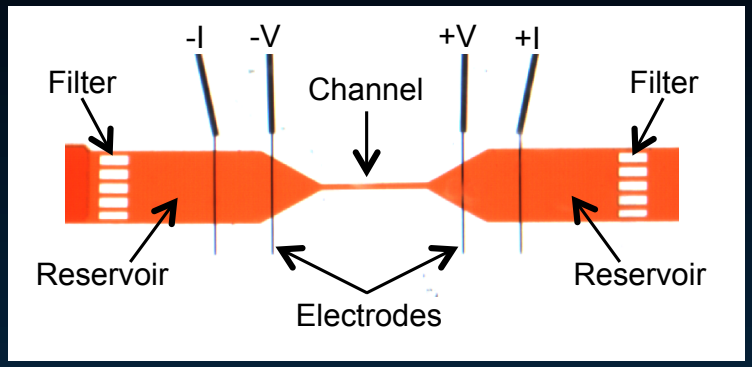
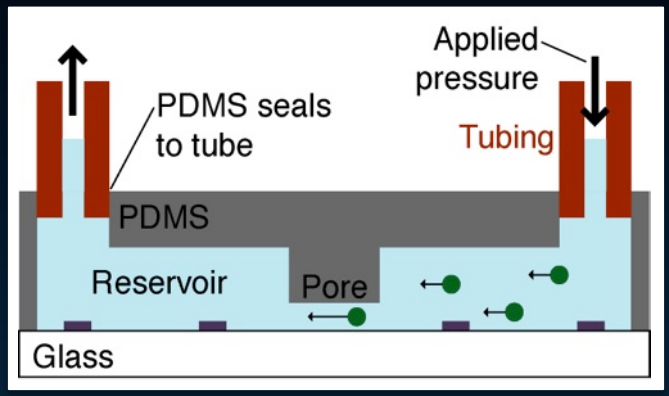
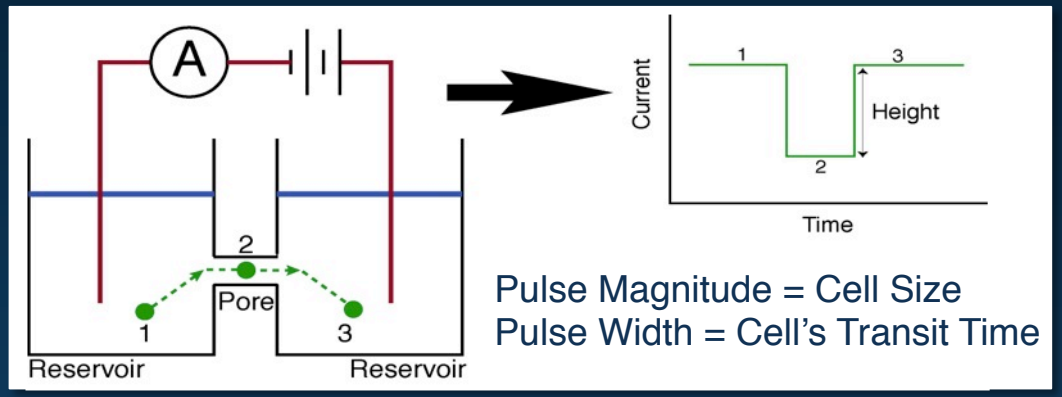
Resistive-Pulse Sensing

Label-free method for single-cell screening



Channel size: 2200 µm x 22 µm x 24 µm
(L x W x H)





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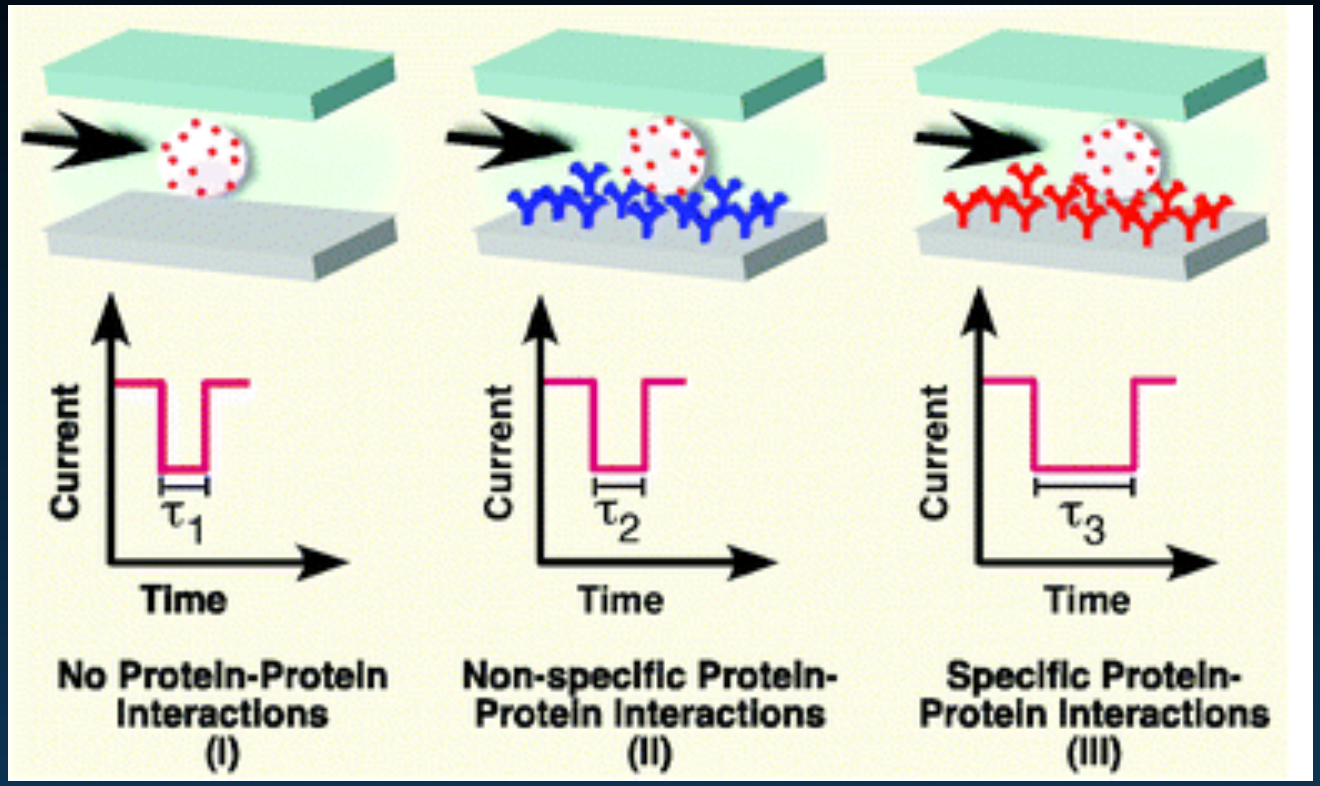
US Patent 7,279,883
Chapman et al., Integrative Biology 2013

Carbonaro et al., Lab Chip 2008

Surface-Marker Screening

Label-Free



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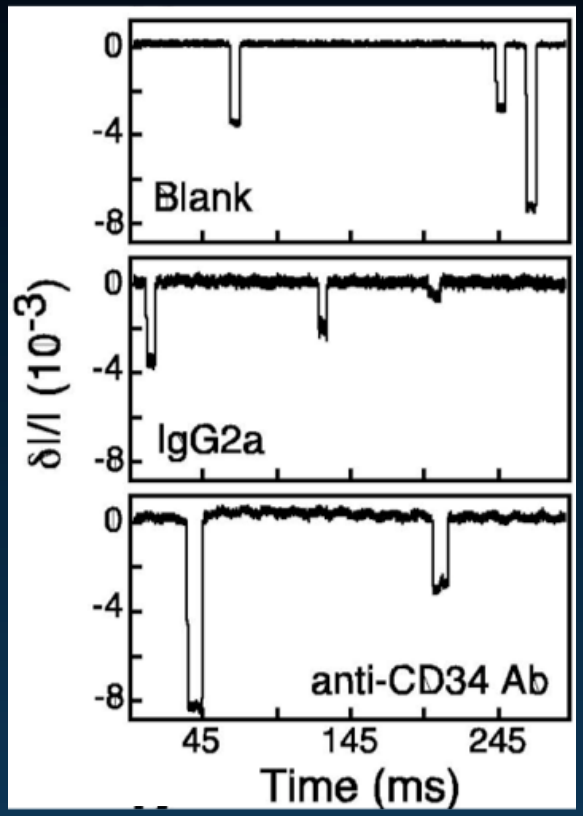
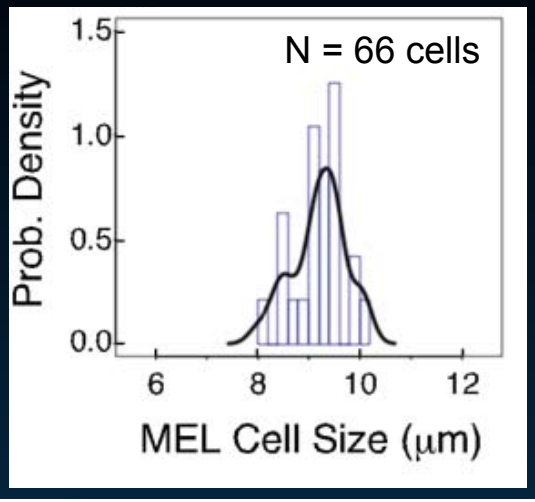
Carbonaro et al., Lab Chip 2008
Chapman et al., Integrative Biology 2013

Proof-of-Principle

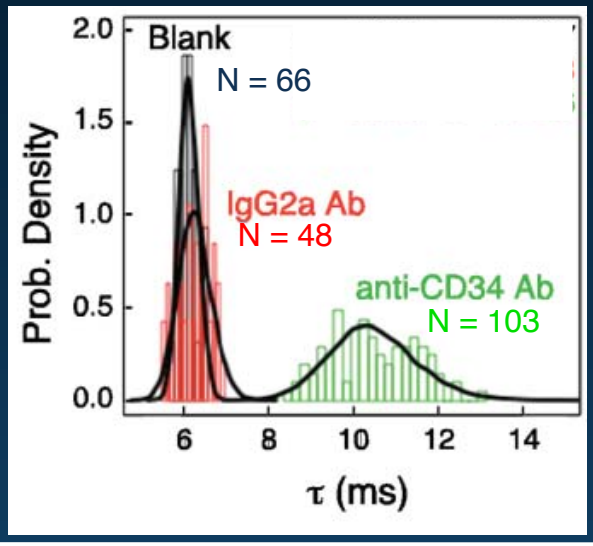
Murine Erythroleukemia Cells (CD34+)



15 μm x 15 μm x 800 μm pores, 1.5 psi
10^5 cells/mL



Cell Size



Presence of CD34 marker

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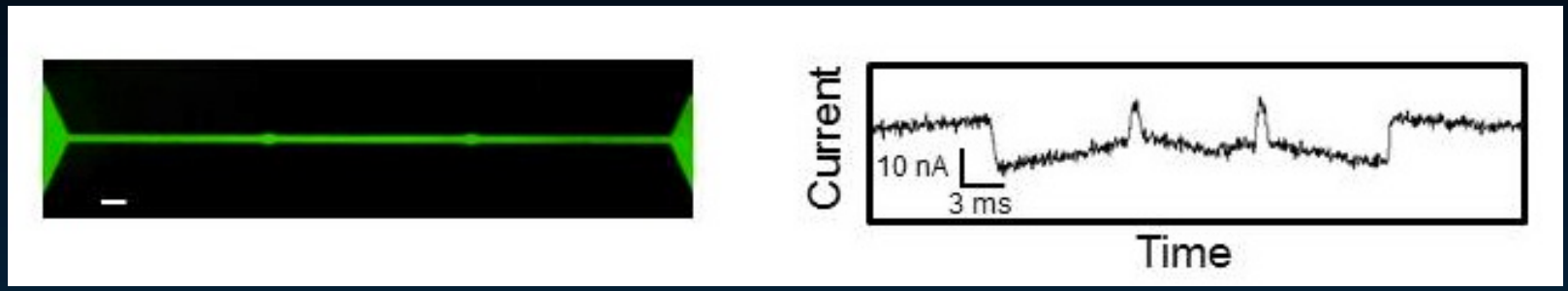
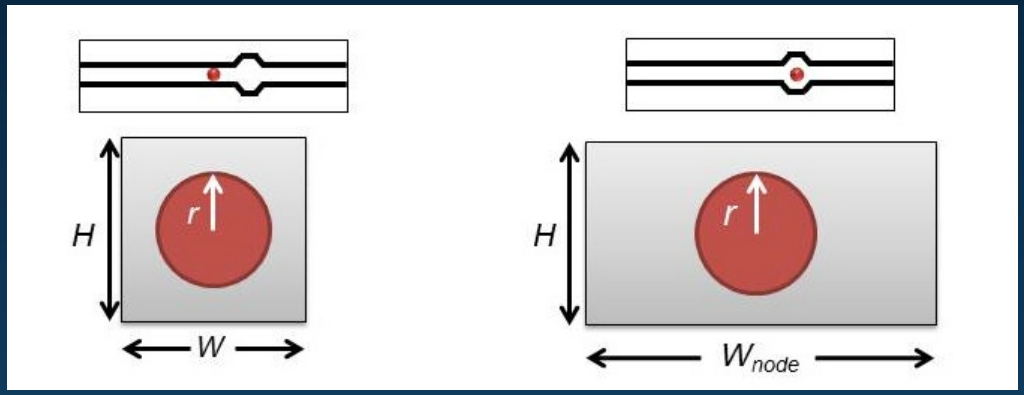
Carbonaro et al., Lab Chip 2008

Works great, but how does can you screen for multiple surface markers simultaneously?

Node-Pore Sensing



$J_{node} < J_{channel}$



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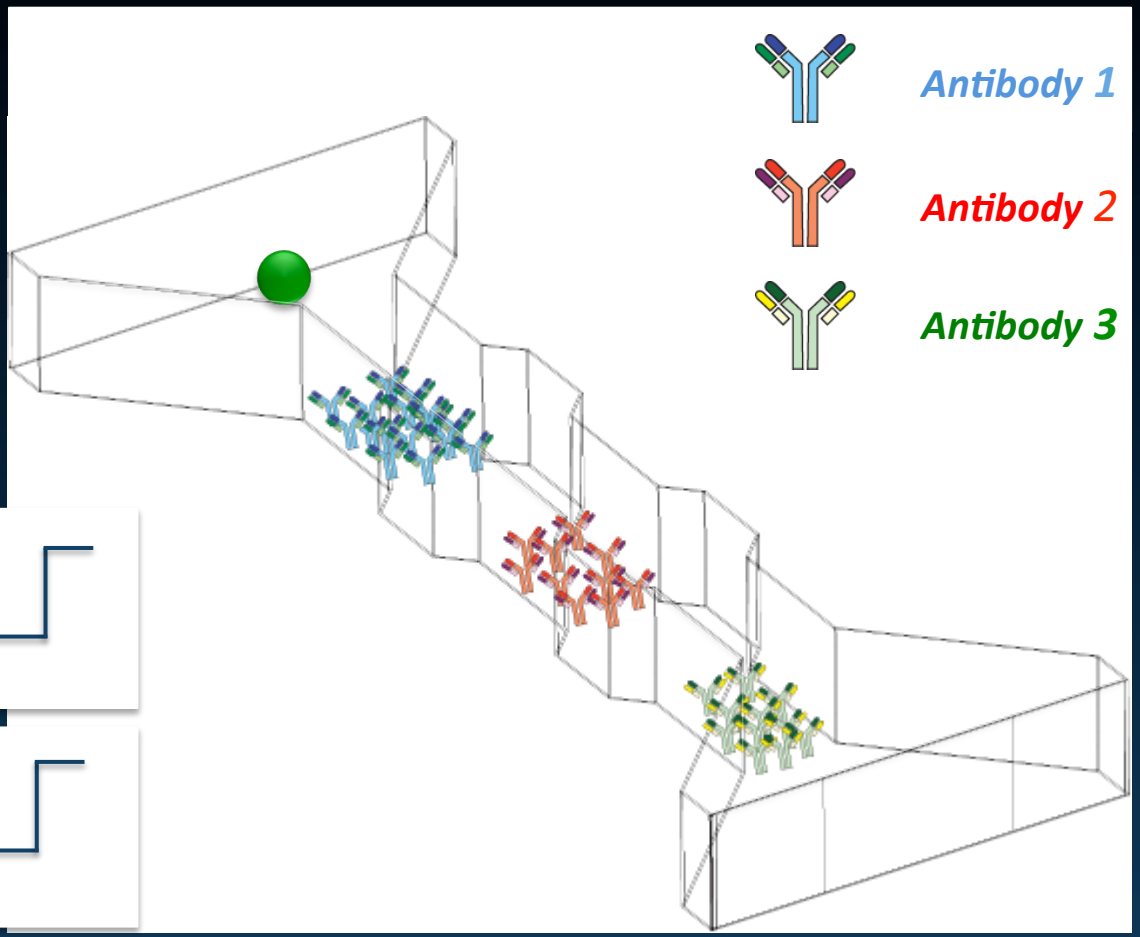
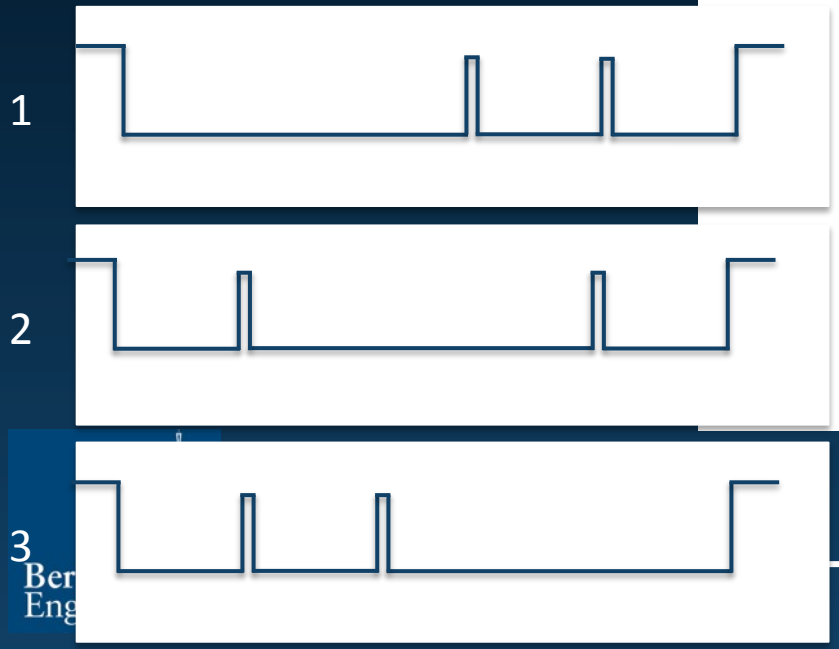
Balakrishnan, et al., Lab Chip 2013

US Patent App 61/544,232

Multi-Marker Screening

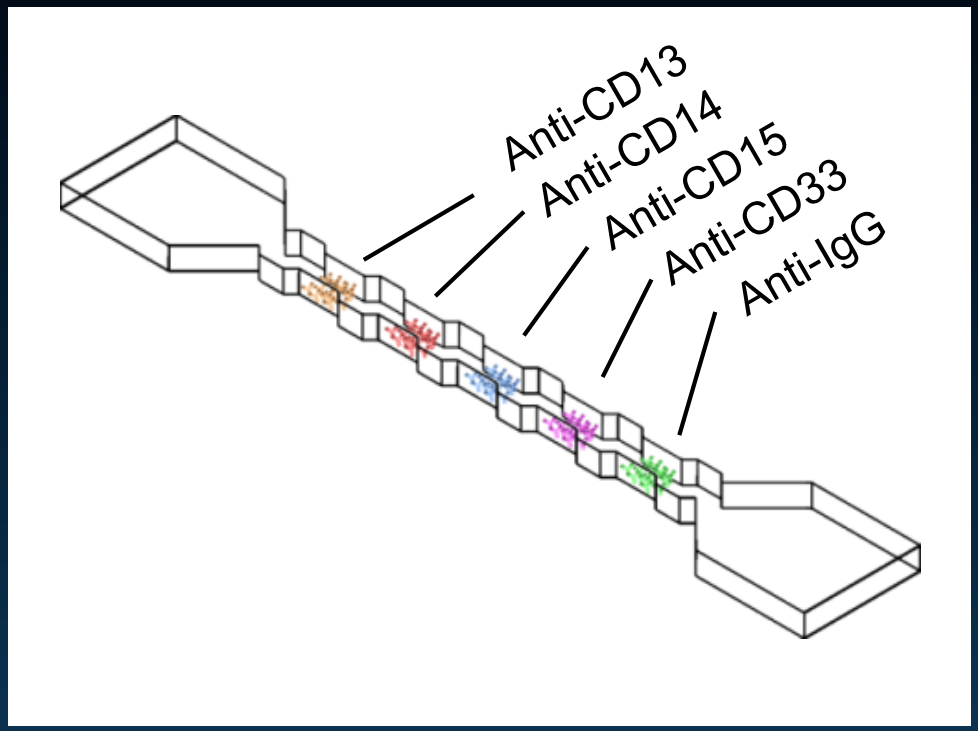




Balakrishnan et al., to be submitted (2014)

Screening Multiple Markers

CD13, CD14, CD15, and CD33



- Channel dimensions: 18 μm x 18 μm (H x W); 1150 μm segments
- Nodes: 58 μm wide x 50 μm long
- Antibody concentration: 1 mg/mL

Balakrishnan et al., to be submitted (2014)

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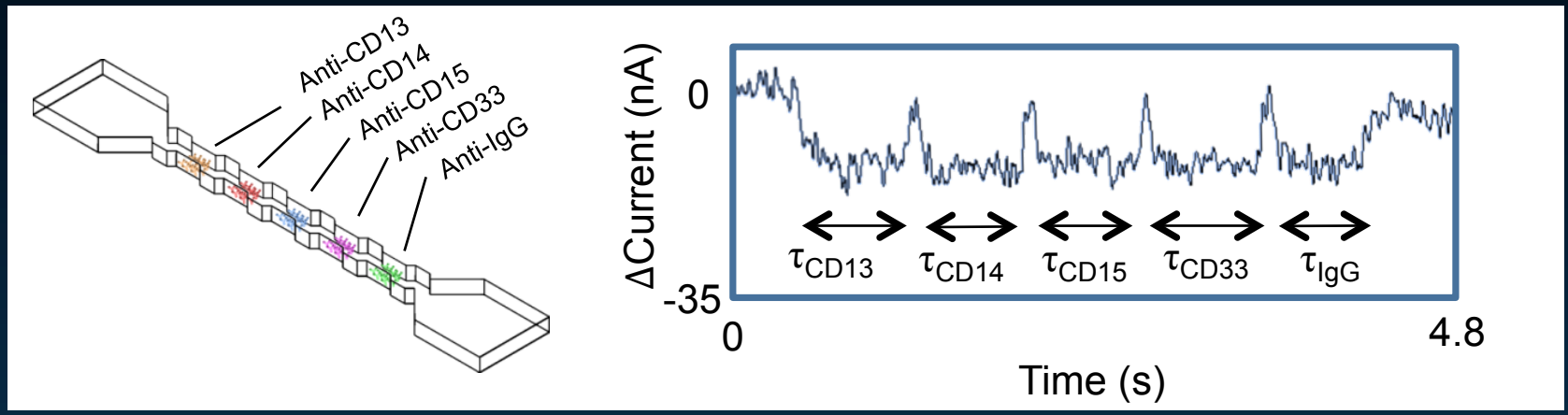
What Does the Raw Data Look Like?



Balakrishnan et al., to be submitted (2014)

Screening of NB4 Cells

Human APL Cell Line that Responds to ATRA

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Balakrishnan et al., to be submitted (2014)

How We Compare to FACS

Balakrishnan et al., to be submitted (2014)

Screening AP1060 Cells

Human APL Cell Line Resistant to ATRA

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Balakrishnan et al., to be submitted (2014)

Screening a Mixed Population

1:1 NALM-1: AP1060 Cells

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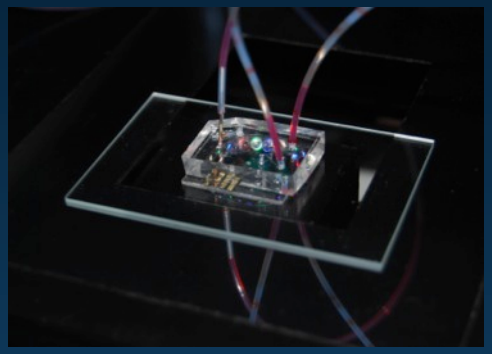
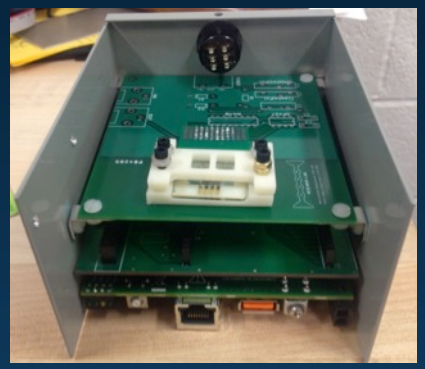
Balakrishnan et al., to be submitted (2014)

Where Are We Now with Our Screening?

- We've started screening patient samples obtained from the tissue banks at U. Chicago School of Medicine
- Making a true "POC" system





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Node-Pore Sensing for Multi-Marker Screening

How far can we go?

How many markers can we screen?

Can we go beyond multi-color flow cytometry?

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Acknowledgements

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