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Instituto de Ingeniería Biológica y Médica

Scaling Up Bioimaging with Microfluidic Chips Workshop 2025 - Session 1

Asst. Prof. Dr. Tobias Wenzel
twitter: @MakerTobey @WenzelLab

Outline

- LIBRE hub
- Open Source Hardware and the Wenzel Lab
- Our microfluidics resources potentially relevant to you
- The scope of this remote workshop

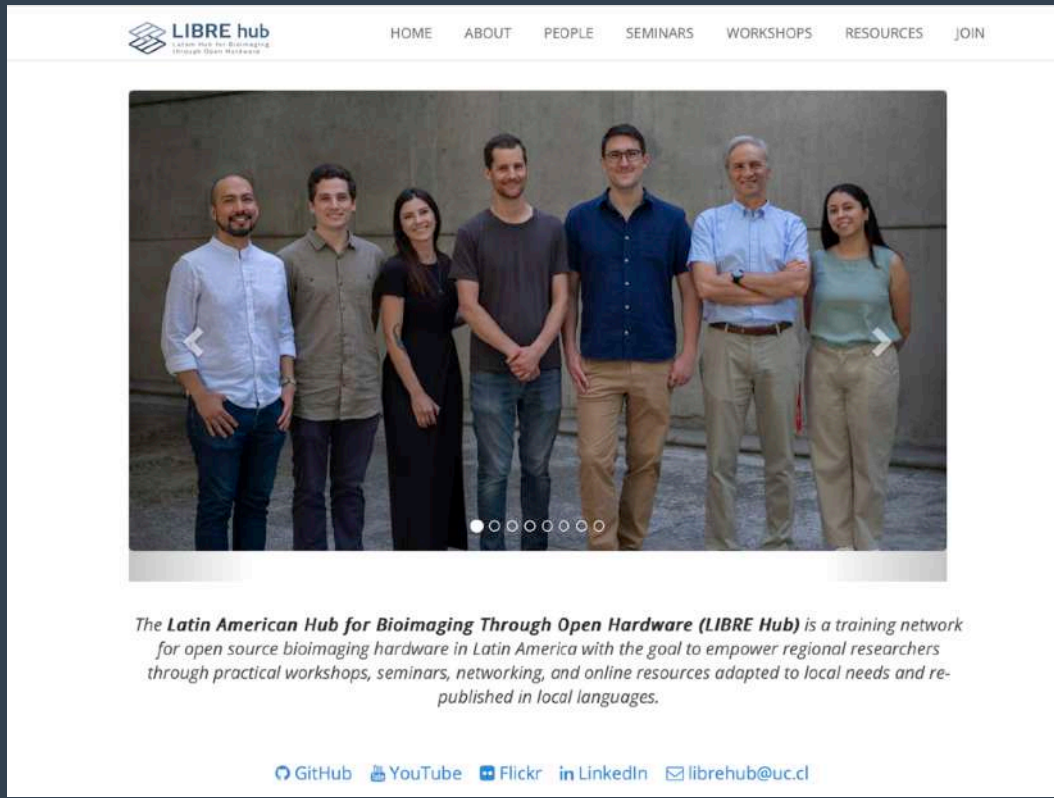
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Zuckerberg
Initiative 

iibm 

Instituto de Ingeniería Biológica y Médica

- Tobias Wenzel
#OpenHardware
- Pablo Irarrázaval
#openMRI
- Vicente Parot
#compMicroscopy

Latin American Hub for Bioimaging through Open Hardware (LIBRE hub)



The screenshot shows the LIBRE hub website. At the top, there is a navigation bar with links: HOME, ABOUT, PEOPLE, SEMINARS, WORKSHOPS, RESOURCES, and JOIN. Below the navigation bar is a large photograph of seven people (four men and three women) standing in a row against a plain wall. Below the photograph is a row of seven small circles, with the first one filled in. Underneath the photograph, there is a paragraph of text describing the hub. At the bottom of the page, there is a footer with social media links for GitHub, YouTube, Flickr, LinkedIn, and an email address: librehub@uc.cl.

LIBRE hub
Latin Hub for Bioimaging
through Open Hardware

HOME ABOUT PEOPLE SEMINARS WORKSHOPS RESOURCES JOIN

The **Latin American Hub for Bioimaging Through Open Hardware (LIBRE Hub)** is a training network for open source bioimaging hardware in Latin America with the goal to empower regional researchers through practical workshops, seminars, networking, and online resources adapted to local needs and re-published in local languages.

GitHub YouTube Flickr LinkedIn librehub@uc.cl

Dec.2021-Nov2025

Building a LatAm science maker community

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+ Create

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🏠
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LIBRE hub

@librehub · 538 subscribers · 75 videos

The Latin American Hub for Bioimaging Through Open Hardware (LIBRE_hub) is a training ...more

librehub.github.io and 4 more links

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Taller Obtaining your first spin-echo with a low-cost ...

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⇒ 7 videos

Taller MRI de bajo costo

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⇒ 15 videos

Tutoriales

View full playlist

⇒ 11 videos

Napari for Bioimage Analysis Workshop

View full playlist

⇒ 45 videos

LIBRE_hub Seminars

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We can help you share your designs!

English

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244

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Lvl 18

LIBRE hub

@WenzelLab

4,317802





87 followers6 following



AdvancedExpertWhite Dwarf

+ Follow

Message




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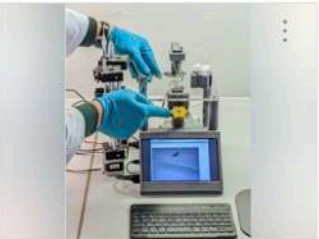
Highlighted models

All models








Adaptable Pipette Holders

 62  5  261 







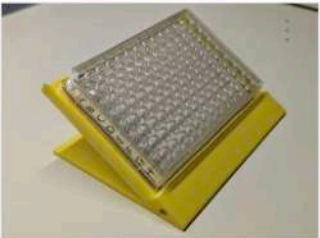
Strobe-enhanced microscopy stage

 18  5  41 








Moldular tube holders

 35  5  147 








96 well-plate locator stand

 62  4.5  351 







Open-Source Syringe Pumps

 71  5  142 



Optical filter cubes - open-UC2 (improved)

 28  0  95 



LIBRE hub

Initiative to further Open Source Hardware based Bioimaging in Latin America - CZI funded; check also: <https://github.com/wenzel-lab>

[Unfollow](#)

26 followers

Chile

<https://librehub.github.io>

company/librehub

[@librehub](https://twitter.com/librehub)

<https://chanzuckerberg.com/imagin...>

[@WenzelLab](https://twitter.com/WenzelLab)

librehub@uc.cl

Popular repositories

napari-LatAm-workshop-2023

Public

Napari training material for a workshop by the CZI funded initiatives LIBRE hub, Napari, and several amazing volunteers

Shell 10 6

Advanced-Scientific-Computing-Using-Julia

Public

Julia is a modern programming language, ideal for scientific computing, designed for fast, extensible, and reproducible code. In this two-day workshop, you'll get hands-on: start with a practical e...

HTML 8 1

MRI-processing-2023

Public

Webpage of the workshop "MRI: Processing your Data"

HTML 4 3

LIBREhub.github.io

Public

This is repository for LIBRE hub project web page. We use Jekyll to run our GitHub page.

HTML 3 1

fiber-coupled-laser-illumination

Public

Modular fiber-coupled laser illumination

gitbuilding-for-beginners

Public

Forked from [biodotpe/gitbuilding-for-beginners](#)

View as: Public

You are viewing the README and pinned repositories as a public user.

You can [create a README file](#) or [pin repositories](#) visible to anyone.

[Get started with tasks](#) that most successful organizations complete.

Discussions

Set up discussions to engage with your community!

[Turn on discussions](#)

People





Wenzel Lab

Wenzel Lab at IIBM, Universidad Católica de Chile, check also: <https://github.com/LIBREhub>

Unfollow

23 followers

Santiago, Chile

<https://wenzel-lab.github.io/en/>

@WenzelLab

wenzellab

company/92802424

<https://www.printables.com/@Wenz...>

Popular repositories

droplet-sorter-master

Public

Master repository that documents how the different parts come together of the open source hardware Fluorescence Activated (Microfluidic) Droplet Sorter (FADS).

☆ 14

modular-microfluidics-workstation-controller

Public

Repository for the development of the modular parts of a free and open source microfluidic workstation.

G-code

☆ 9

2

droplet-sorting-FPGA-controller

Public

IT setup for realtime analysis of microfluidic droplets with FPGA board (RedPitaya) based on python pyprl library

Python

☆ 8

syringe-pumps-and-controller

Public

Design of 3d printable syringe pumps and dual controller.

JavaScript

☆ 5

2

high-voltage-pulse-generator

Public

Custom electronics solution for microfluidic droplet sorting pulses

flow-microscopy-platform

Public

Our open hardware flow microscopy platform is a more comprehensive version of our strobe-enhanced microscopy stage design, including the

View as: Public

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Discussions

Set up discussions to engage with your community!

[Turn on discussions](#)

People



Strobe-enhanced microscopy stage

by Pierre Padilla-Huamantínco, Matías Hurtado-Labarca, and Tobias Wenzel
Latin American Hub for Bioimaging Through Open Hardware (LIBRE hub)

Strobe-enhanced microscopy stage

Build the 3-level microscopy stage

Print the plastic parts

Laser cut the acrylic
parts

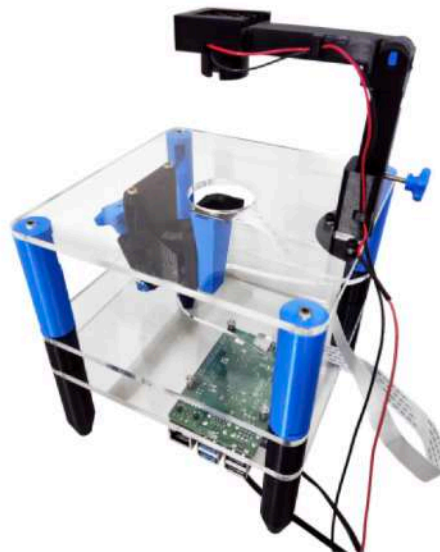
Assemble the focus
mechanism

Assemble the basics
optics module

Attach parts to the
top plate

Attach parts to the
middle plate

3-level microscopy stage



Before you start building the station, you will need to source all the components listed in our [bill of materials](#) ([HTML](#), [CSV](#)), which is given on the next page.

Instructions

Workshops for Latin America

LIBRE hub | Chilean Zuckerman Initiative

MRI: PROCESANDO TUS PROPIOS DATOS

Taller de 2 días de LIBRE hub

Taller teórico y práctico para conocer y utilizar software público para procesar la señal y reconstruir imágenes de resonancia magnética, basado en el lenguaje de programación Julia.

¡Inscríbete!

ANFITRIÓN: PABLO IBARRAZAVAL

20 y 21 de noviembre 2023
Campus San Joaquín, Pontificia Universidad Católica de Chile

LIBRE hub | Chilean Zuckerman Initiative

INTRODUCTION TO NAPARI FOR BIOIMAGE ANALYSIS

Attendees will learn to leverage the features of napari, a powerful, open-source, Python-based platform for bioimage analysis at our three-day online workshop. With dedicated Spanish and Portuguese language support, participants across Latin America will learn the basics of how to navigate bioimaging datasets and enhance their research capabilities.

Sign up here!

HOSTED BY:
Latin America Bioimaging | **LIBRE hub**

Date: August 13 and 15, 2023
Registration closes: 10/08/2023



LIBRE hub | Chilean Zuckerman Initiative

LOW-COST LASER ILLUMINATION FOR MICROSCOPY

2-Day in-person LIBRE hub Workshop

Attendees will learn to build a basic laser module for microscopy using a blue (488nm) fiber-coupled laser diode, a current source, and speckle diffuser. Expandable for various colors and control options.

Sign up here!

HOST: Vicente Parot Ph.D.

December 11-12, 2023
Campus San Joaquín, Pontificia Universidad Católica de Chile

LIBRE hub | Chilean Zuckerman Initiative

STROBE ILLUMINATION FOR BIOMIMICRY OF FAST PROCESSES

Hands-on Workshop by LIBRE hub

Attendees will learn how to build, use, and modify our low-cost microfluidic droplet generation workstation as part of their research.

Sign up here!

HOST: Tobias Wenzel Ph.D.

04-06 July 2023
Campus San Joaquín, Pontificia Universidad Católica de Chile
Registration closes: 26/06/2023

Open Source Hardware and the Wenzel Lab

Open Source Hardware

Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. (...) [OSHWA]

Why Open Instrumentation?

- Accessing advanced biomedical methods
- Build creative tools that address new custom problems
- Reduction of cost
- Maintaining the equipment in-house
- Easy to automate and work with useful data formats
- Better collaborations - reproducibility, user lead dev.

OPEN ACCESS

ESSAY

Open hardware: From DIY trend to global transformation in access to laboratory equipment

Tobias Wenzel 

Published: January 17, 2023 • <https://doi.org/10.1371/journal.pbio.3001931>

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Abstract

Introduction

Conclusions

Acknowledgments

References

Abstract

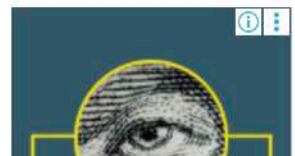
Open hardware solutions are increasingly being chosen by researchers as a strategy to improve access to technology for cutting-edge biology research. The use of DIY technology is already widespread, particularly in countries with limited access to science funding, and is catalyzing the development of open-source technologies. Beyond financial accessibility, open hardware can be transformational for the access of laboratories to equipment by reducing dependence on import logistics and enabling direct knowledge transfer. Central drivers to the adoption of appropriate open-source technologies in biology laboratories around the world are

67
Save

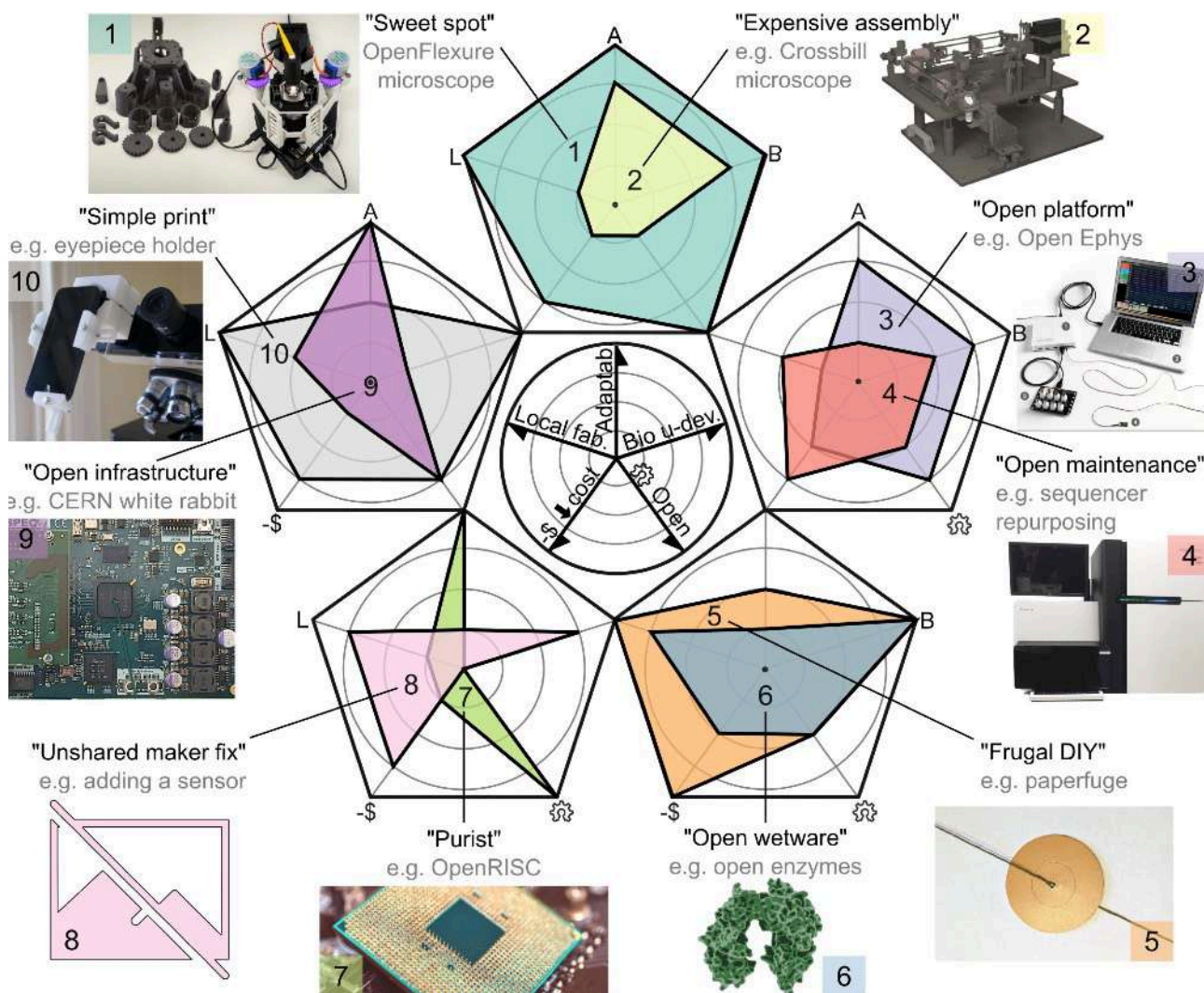
52
Citation

10,099
View

140
Share



Types of Open Hardware



01/2023
 Open hardware:
 From DIY trend to
 global
 transformation in
 access to
 laboratory
 equipment.
 T. Wenzel

Open Hardware industry examples

Table 1. Examples of open hardware companies relevant for biology laboratories.

Company name	Field or product	Link
Tindie	Online marketplace for open electronics and hardware products. Sales platform for makers and small businesses	https://www.tindie.com/
SparkFun	Designs, manufactures, and sells open microcontroller development boards and breakout boards	https://www.sparkfun.com/
Seeed Studio	Integrated platform for creating hardware solutions for IoT, AI, and Edge	https://www.seeedstudio.com/
Sci-Bots	Dropbot, digital microfluidic control system	https://sci-bots.com/
Sanworks	Automated systems for neuroscience research	https://sanworks.io/
Safecast	Crowdsourced environmental data with open hardware, originally radiation in Japan now also air quality globally	https://safecast.org/
Red Pitaya	FPGA-powered boards as multifunction laboratory and engineering instrument	https://redpitaya.com/
Public Lab	Community science tools for environmental monitoring	https://www.publiclab.org/
Prometheus Science	Open hardware for biology consulting	https://prometheus-science.com/
Precious Plastic	Plastic recycling equipment	https://preciousplastic.com/
OpenTrons	Pipetting robot and addons	https://opentrons.com/
OpenQCM	Quartz Crystal Microbalance, e.g., for protein affinity measurements at molecular resolution	https://openqcm.com/
OpenFlexure Industries	Manufactures the openflexure microscope and openflexure block stage	https://openflexure.com/
Open Ephys	Electrophysiology laboratory tools	https://open-ephys.org/
OpenBCI	Brain-computer interface platform	https://openbci.com/
Open Acoustic Devices	Designs supports and deploys acoustic hardware and software for environmental and wildlife monitoring projects, audio moth	https://www.openacousticdevices.info/
Olimex	Developer and provider for development tools for embedded market, including non-open boards	https://www.olimex.com/
neurogig	Instruments for neurophysiology laboratories	https://neurogig.com/
Kitspace	Share and order electronic projects with the automatic component shopping list generator for github projects	https://kitspace.org/
IOReodeo	Designing and selling biolab hardware, now mainly potentiostats	https://iorodeo.com/
Elphel	Imaging hardware and software	https://www.elphel.com/
Beneficial Bio	Network of social enterprises for biolabs	https://beneficial.bio/
BeagleBoard	BeagleBone computers	https://beagleboard.org/
Backyard Brains	Demonstration instruments for neuroscience education	https://backyardbrains.com/
Arduino	Designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices	https://www.arduino.cc/
Apertus	AXIOM cameras	https://www.apertus.org/axiom
Adafruit	Designs, manufactures, and sells a number of electronics products, electronics components, tools, and accessories	https://www.adafruit.com/
3D printer providers such as Prusa (Prusa Research), LulzBot (FAME 3D), Voron, Rostock Max (seemecnc)	Providers of open source commercial 3D printers	https://www.prusa3d.com https://lulzbot.com https://vorondesign.com https://www.seemecnc.com

Source: Our publication in PLOS Bio 2023:
Open hardware: From DIY trend to global transformation in access to laboratory equipment. T. Wenzel

Community values

GOSH Manifesto

[Deutsch](#) | [English](#) | [Español](#) | [Français](#) | [Português](#) | [中文](#) | [বাংলা](#) | [日本語](#)

The Global Open Science Hardware (GOSH) movement seeks to reduce barriers between diverse creators and users of scientific tools to support the pursuit and growth of knowledge. These are our principles:

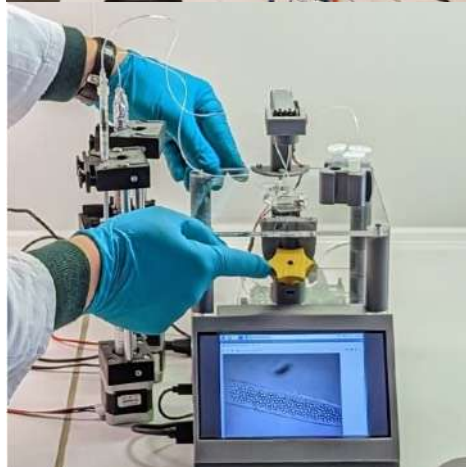
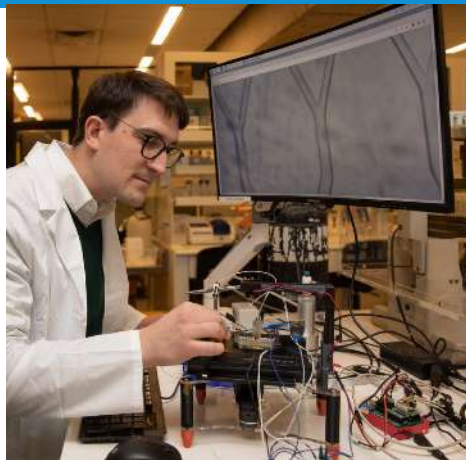
10	Javier Serrano	Spain	CERN
9	Bengt Sjöln	Sweden	independent
8	Tobias Wenzel	Germany	University of Cambridge
7	Richard Bowman	UK	University of Cambridge
6	Kshitiz Khanal	Nepal	Open Knowledge Nepal
5	Rafael Pezzi	Brazil	Centro de Tecnologia Acadêmica IF/UFRGS and ALICE/CERN
4	Puneet Kishor	USA	independent
3	Mikael Fernstrom	Ireland	University of Limerick
2	Greg Austic	USA	PhotosynQ
1	Max Liboiron	Canada	Civic Laboratory for Environmental Action Research (CLEAR)

Undersigned

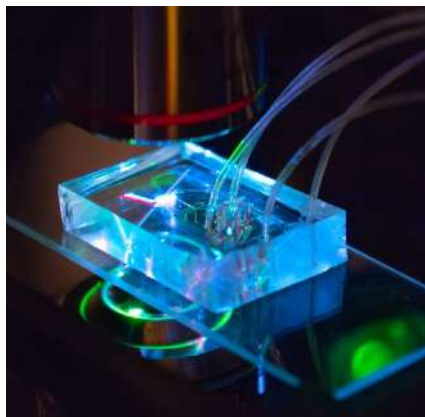
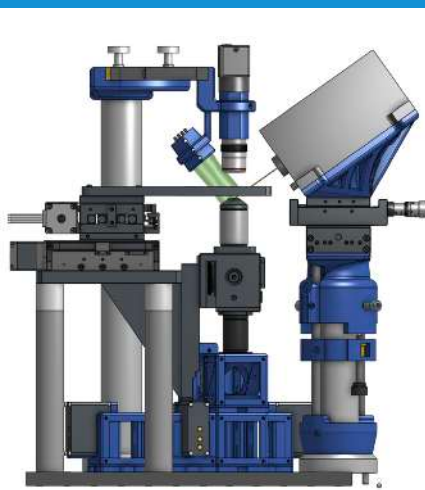
- ▼ GOSH is accessible
- ▼ GOSH makes science better
- ▼ GOSH is ethical
- ▼ GOSH changes the culture of science
- ▼ GOSH democratizes science
- ▼ GOSH has no high priests
- ▼ GOSH empowers people
- ▼ GOSH has no black boxes
- ▼ GOSH is impactful tools
- ▼ GOSH allows multiple futures for science

Developing instruments for high-throughput biomedical analysis

Advanced fluid handling platforms



First droplet sorting cytometer in Latin America



Low-cost light sheet microscope



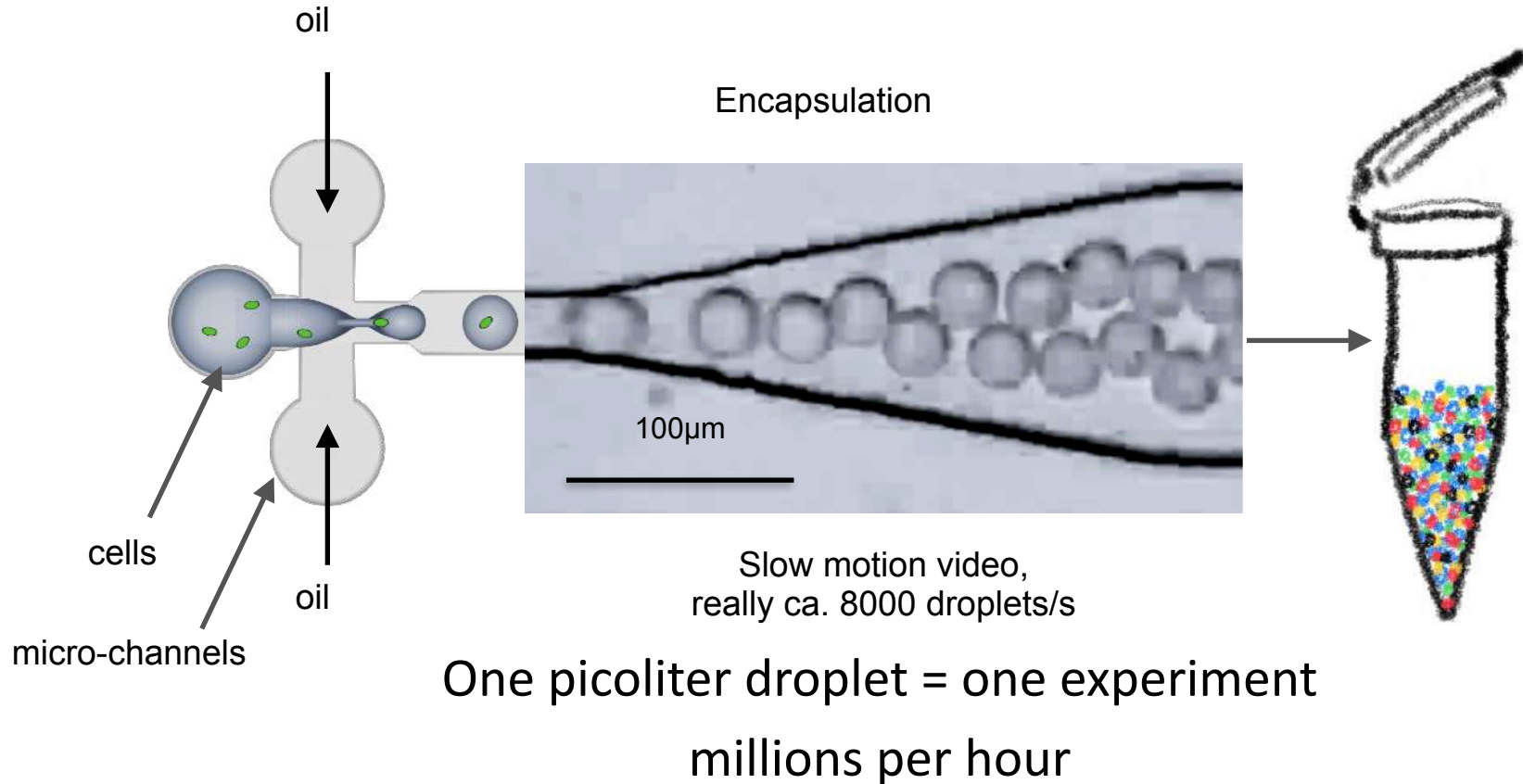
Advanced Microscopy



Trainings

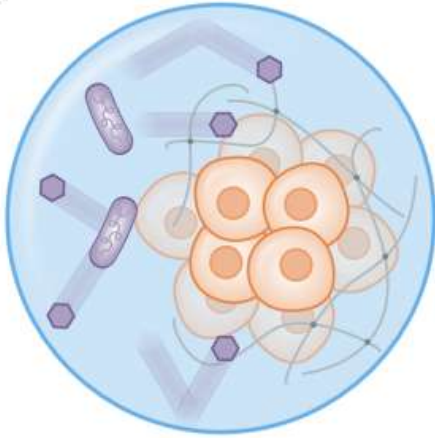


Microfluidic droplets - record-keeping high-throughput

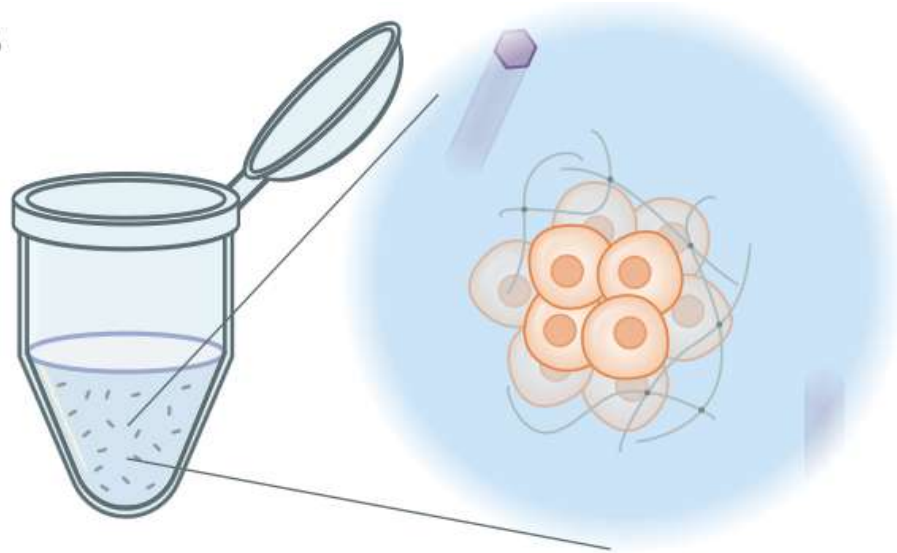


Interactions are best studied in droplets

A



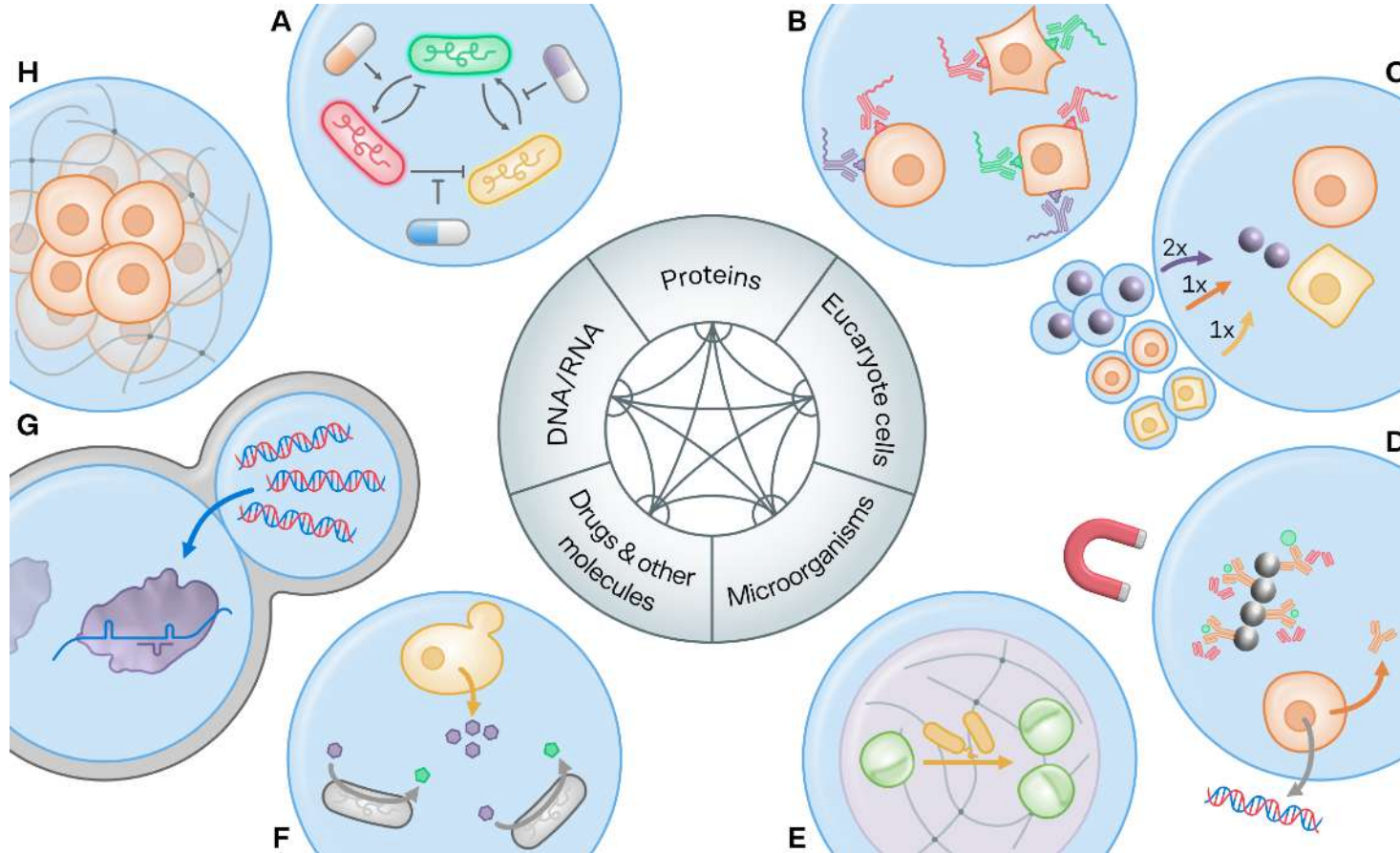
B



Variation of:

Leveraging interactions in
microfluidic droplets for
enhanced biotechnology screens
C. Vitalis & T. Wenzel
Current Opinion in
Biotechnology, 2023/08

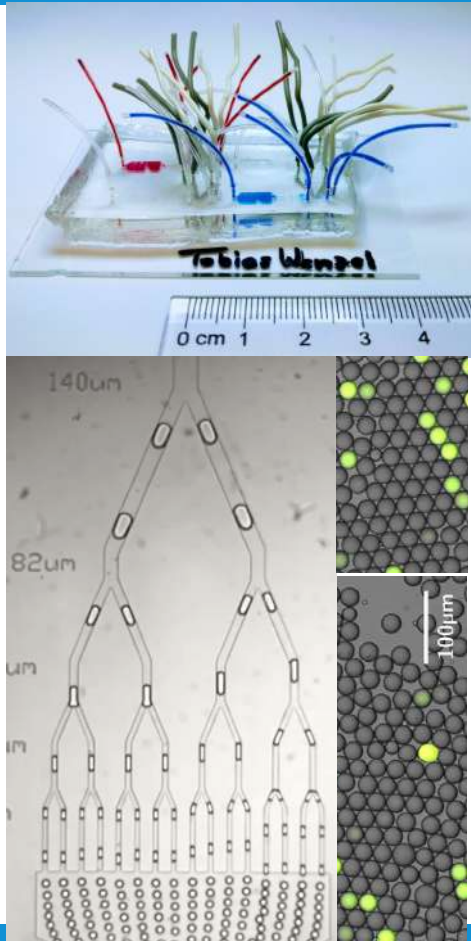
Many interactions can be studied in droplets!



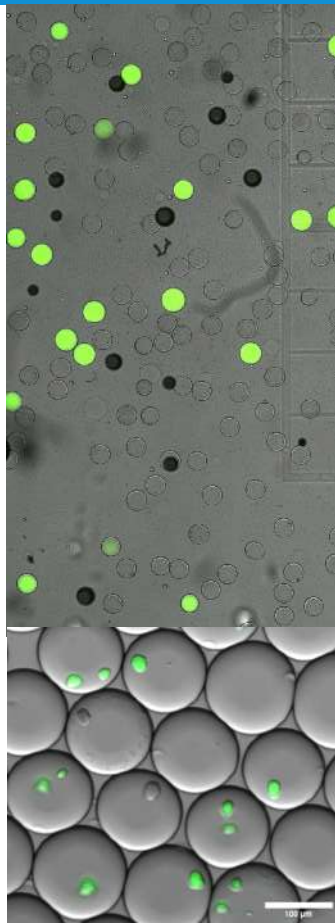
Leveraging interactions in
microfluidic droplets for
enhanced biotechnology screens
C. Vitalis & T. Wenzel
Current Opinion in
Biotechnology, 2023/08

Tobias Wenzel - Microfluidics for controlled organoid tissue engineering

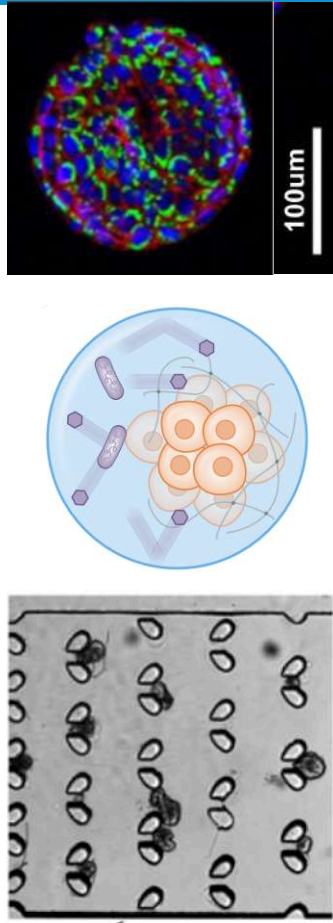
Millions of microfluidic droplets per experiment



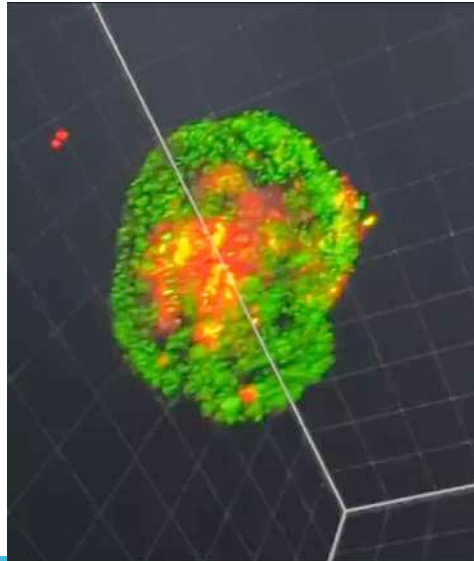
Single-cell analysis and single genomes



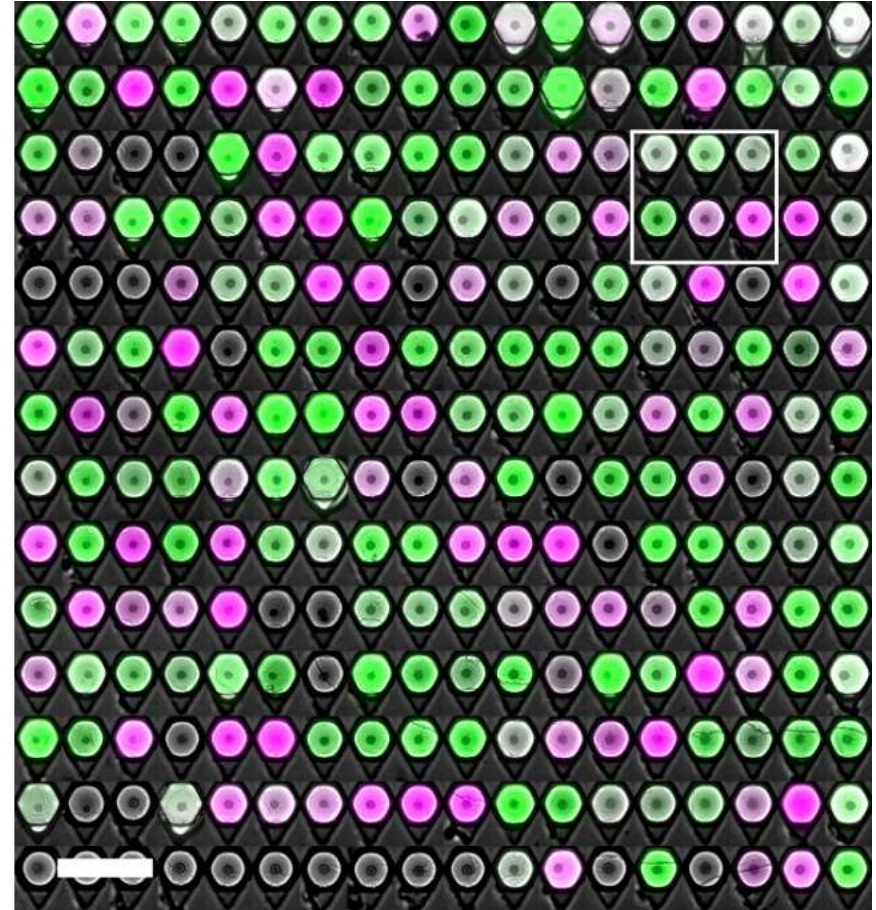
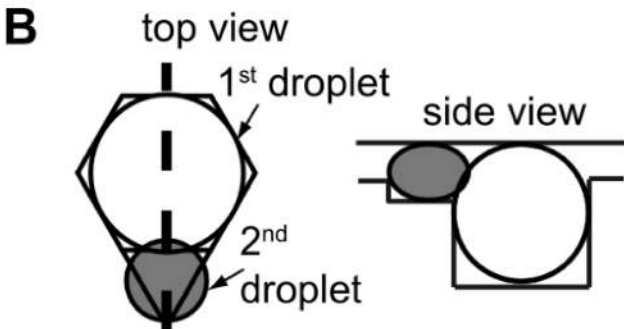
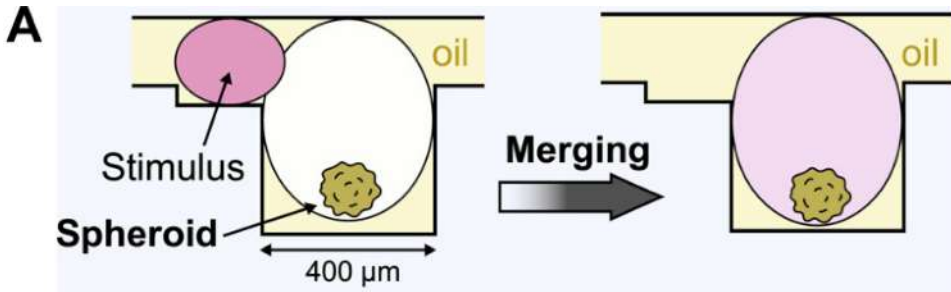
Gastric and intestinal organoid culture



Organoid 3D-imaging



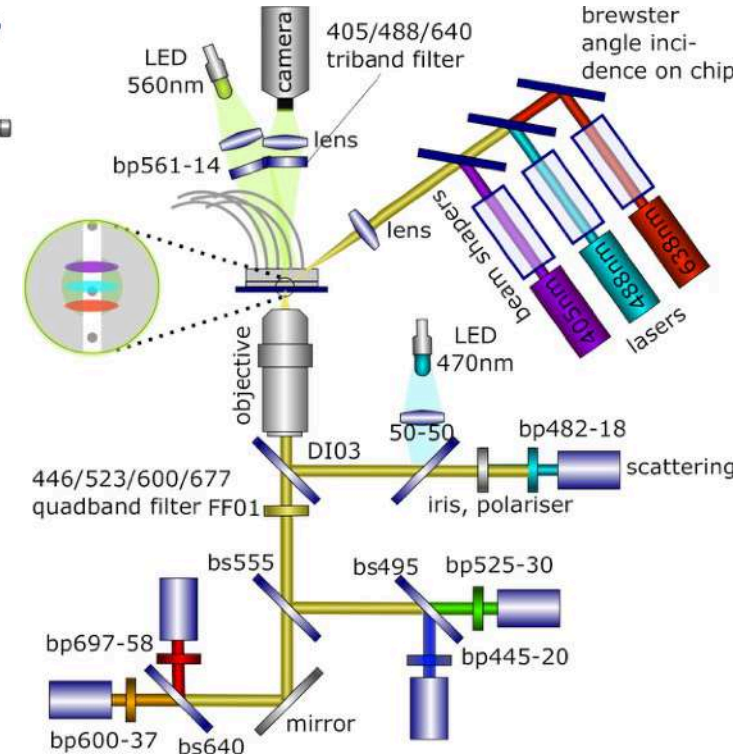
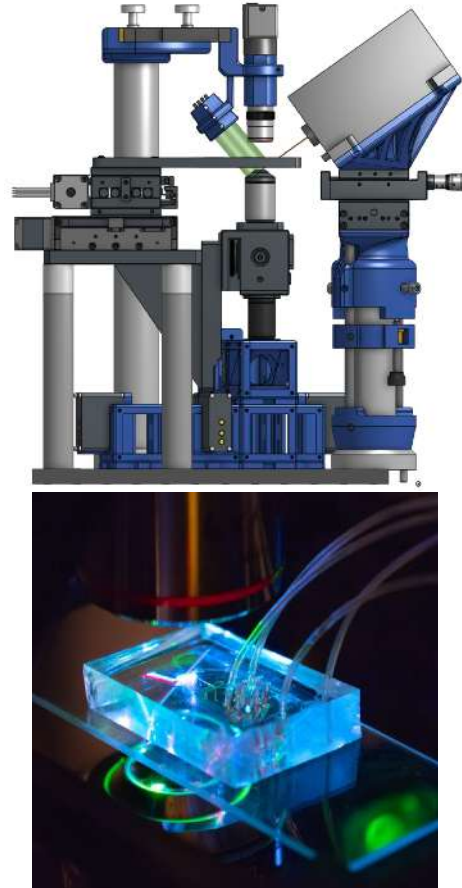
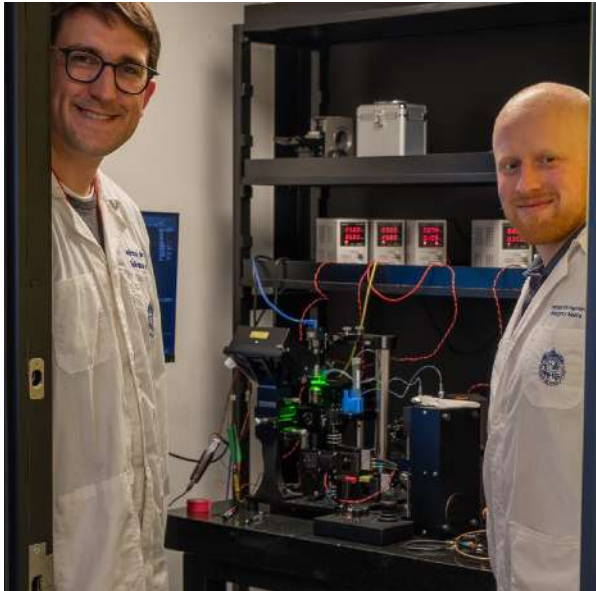
- High throughput analysis of host-pathogen interactions in droplets

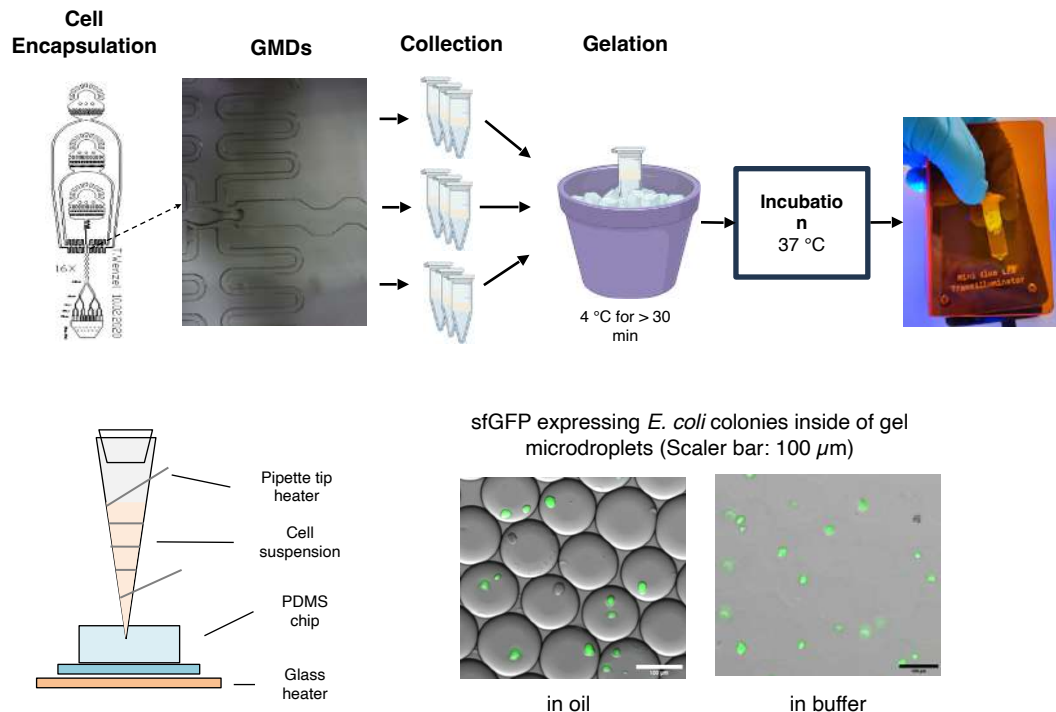
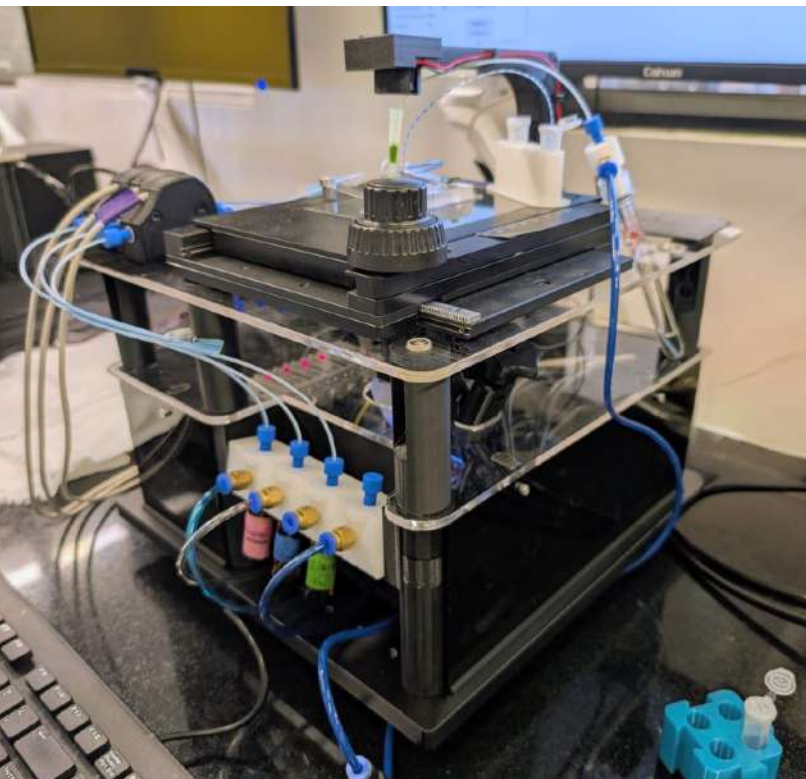


Our microfluidics resources potentially relevant to you

Open source cytometry & droplet sorting (FADS)

- Microscope alignment stage(s)
- High-speed imaging with strobe
- Realtime FPGA electronics
- High voltage and electrodes on-chip
- Laser + Optics
- Pumps





Reference: Padilla-Huamantínco, P., Durán, E., Wenzel, T. Plasmid Stability Analysis with Open-Source Droplet Microfluidics. J. Vis. Exp. (214), e67659, doi:10.3791/67659 (2024).

Low-Cost Open Hardware Droplet Workstation



Open Source Syringe Pumps and Controller

- Low-cost
- Precise low-flows (with gearbox)
- Allows manual intervention
- And remote automation



https://wenzel-lab.github.io/syringe-pumps-and-controller/2_syringe-pump.html

The scope of this remote workshop

- Community building to advance microscopy with microfluidics
- Introduction (this) and lecture (YouTube, to follow)
- 1x 1:1+ consultation for application test planning (you need to make the actual plan!)
- If appropriate, we will send a microfluidic chip and tubing for testing
- Testing on your own
- Community call to share testing results



Gracias equipo!



FONDECYT
Fondo Nacional de Desarrollo
Científico y Tecnológico

**Chan
Zuckerberg
Initiative** 

CIFAR

