



# founding**GIDE**

Founding a **G**lobal **I**mage **D**ata **E**cosystem

# founding**GIDE** community event **2024**

## Challenges and Opportunities for FAIR Image Data in Latin American Bioimaging

Insights from the Data Science for Bioimaging Working Group

*Adán Guerrero*

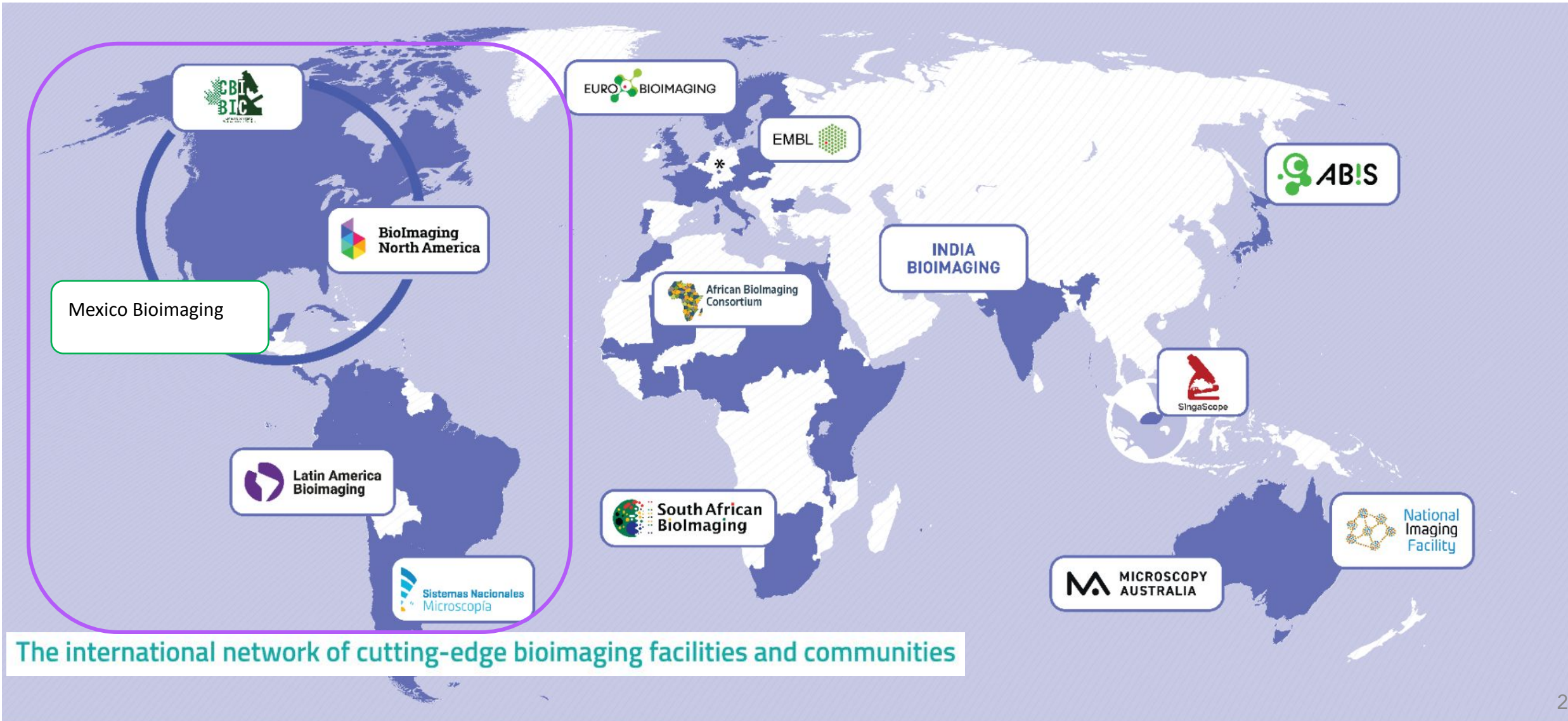
*National Laboratory for Advanced Microscopy  
National Autonomous University of Mexico*

10.5281/zenodo.14290816



**1<sup>st</sup> of November 2024**  
Okazaki Conference Centre,  
**Okazaki, Japan**

# GLOBAL BIOIMAGING (GBI)



# A continent-wide effort of two of the largest imaging communities in the Americas



SEPTEMBER 25-29, 2023

**MEXICO**



Latin America  
Bioimaging



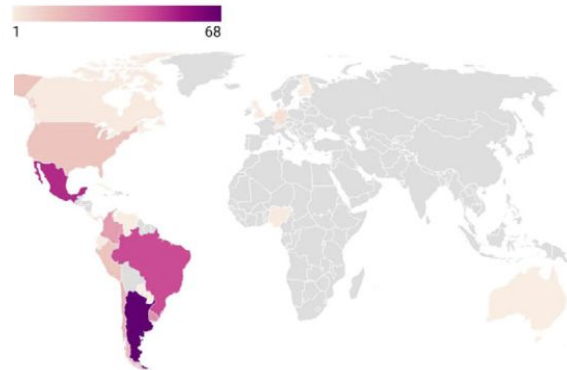
BioImaging  
North America



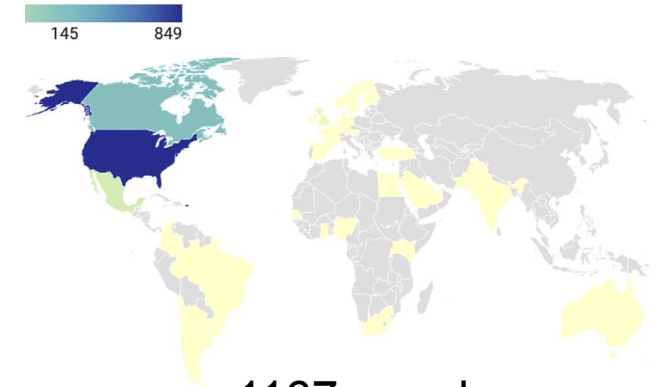
Instituto de Biología  
UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO



LNMA  
Latin American Network of Microscopy and Imaging

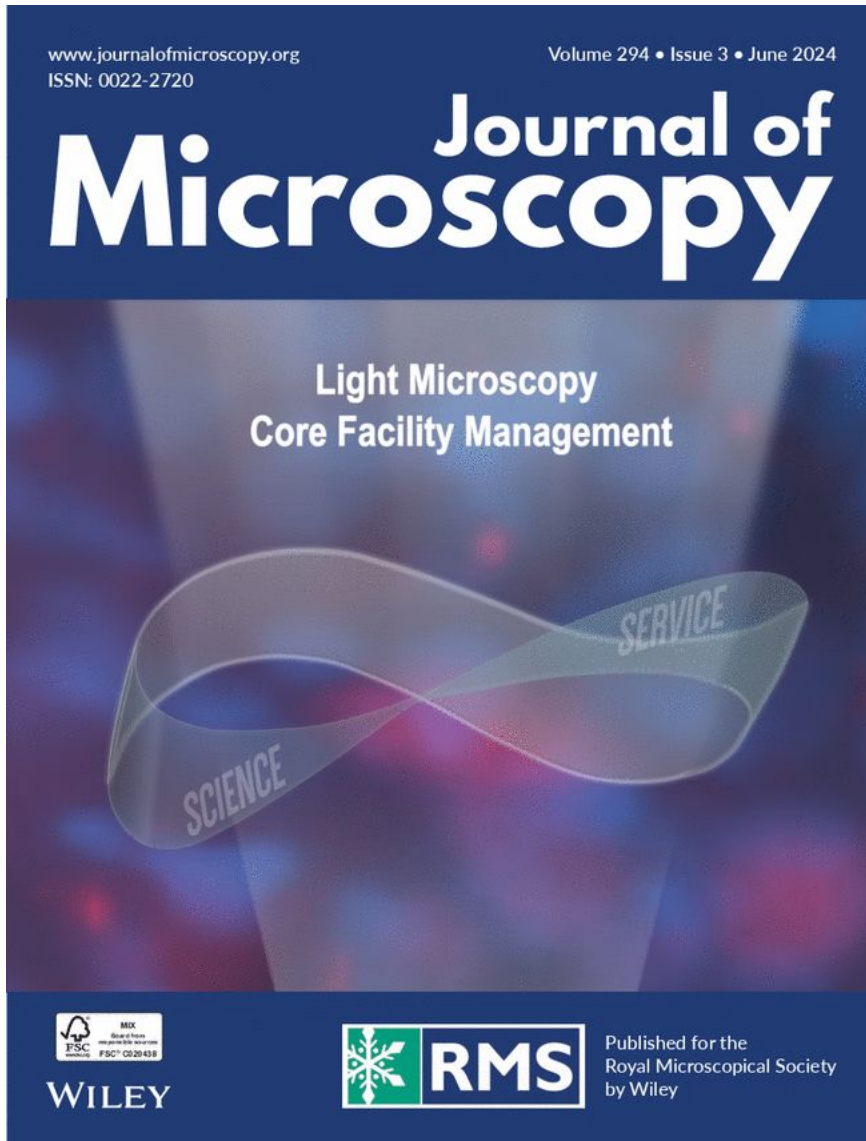


297  
members



1167 members

More recommendations at:



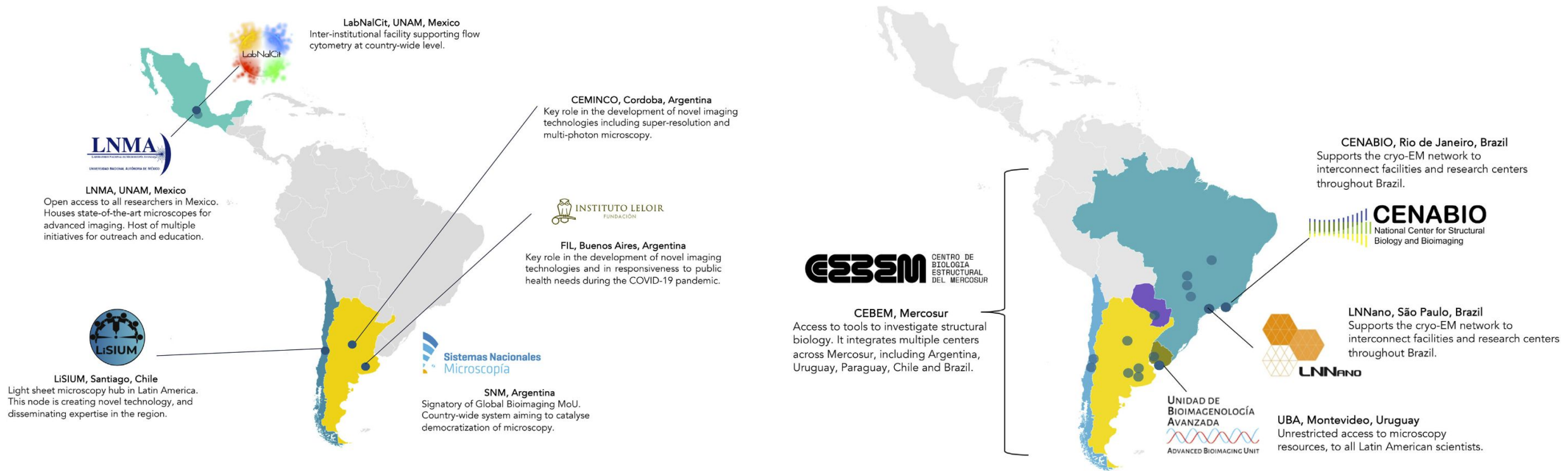
## THEMED ISSUE ARTICLES

Building momentum through networks: Bioimaging across the Americas

*De Niz M. et al.*

<https://doi.org/10.1111/jmi.13318>

# Achievements on expanding core facilities and regional hubs



Process of creation, sustainability, introduction of new technology, serving as reference centers, outreach activities, challenges

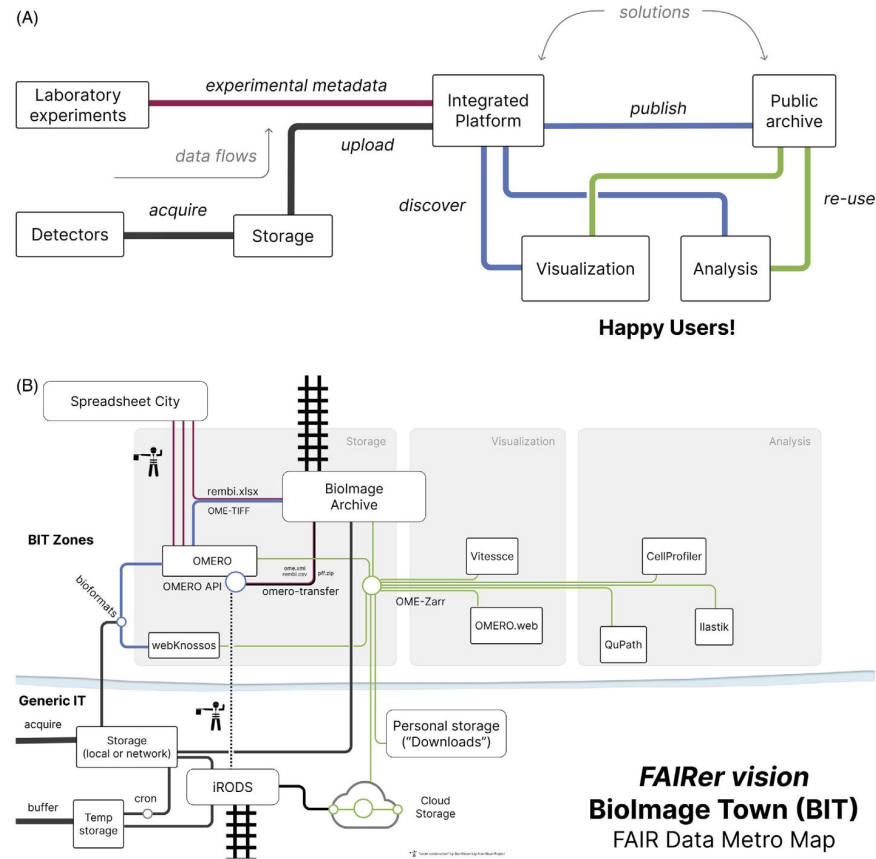
Slide by Mariana De Niz

# Diversifying career pathways in Latin America



Professional graduate programs,  
career diversification, sustainability  
of the imaging scientist career

# Impact: BINA discussion on Managing and Sharing Data and overall impact measurement



## Education and Training Outcomes

### Target audience

- Undergraduate students.
- Postgraduate students.
- General Users.
- Underrepresented minorities.

### Considerations

- Range of topics.
- Human resources.
- Equipment needed.

### Importance of Networking

- Design material.
- Reach a wider audience.
- Coordinate activities.

### Main attributes of a facility

- Cutting edge equipment.
- Training sessions and workshops.
- Reliability & accuracy of data.

## Technology development & applications

### Design unique technology

- Builders WG (BINA)
- Build own tools.
- Make tools accessible to others

### Logistics & Challenges

- Import/establishment.
- Prohibitive cost/logistics.
- Importance of funders.

### QC & Documentation

- Microscope calibration
- Documentation of QC
- Schedule for routine checks.
- Metrology suitcase.

### Workflow for microscopy-derived data

- Hypothesis generation.
- Sample preparation.
- Imaging parameters.
- Image analysis.

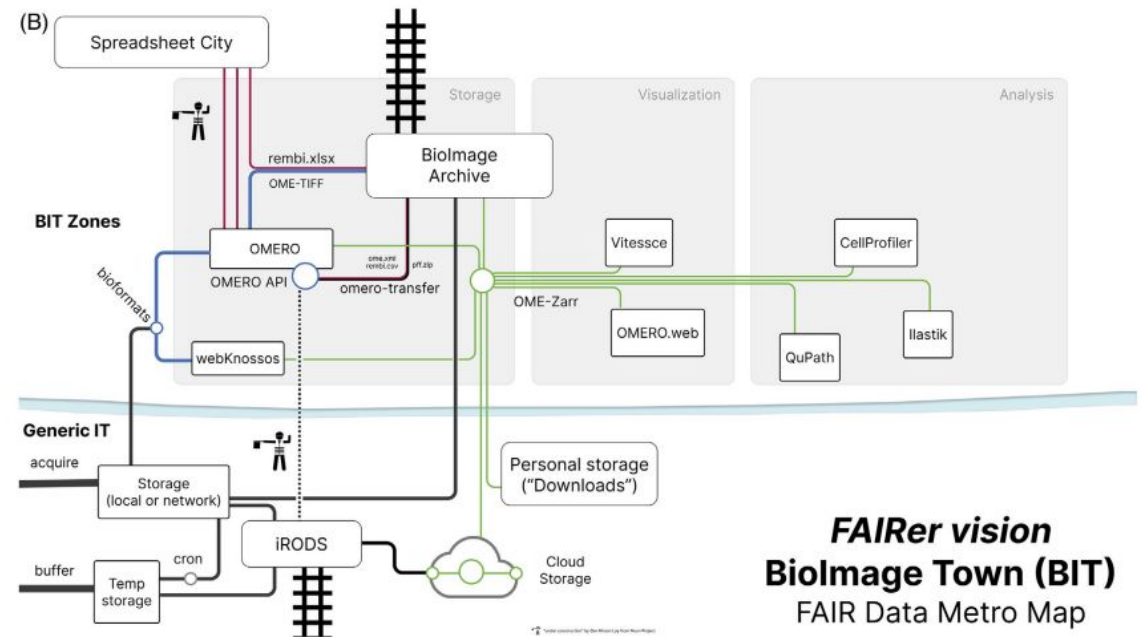
### Quality Control

IMPACT

Bioimage Town, global efforts towards data management, FAIR principles and communicating the importance of metadata

Credit: Josh Moore

Slide by Mariana De Niz



# I asked ChatGPT

How to become knowledgeable about the intricacies of the image data management ecosystem, ...

... and avoid getting lost within the Bioimaging Town metro map?

## ChatGPT:

To avoid getting lost in the complexity, I suggest the following steps

- **Define Your Scope:** Begin by **determining your specific needs** within bioimaging data management
- **Identify key areas:** data acquisition, storage, processing, analysis, and sharing

*...Focusing on a few critical aspects initially can help manage the complexity*



ChatGPT:

To avoid getting lost in the complexity, I suggest the following steps

- **Understand FAIR Principles:**

Familiarize yourself with the principles of Findability, Accessibility, Interoperability, and Reusability (FAIR)

These principles **guide** the management of bioimaging data, ensuring it can be shared and reused effectively

## ChatGPT:

To avoid getting lost in the complexity, I suggest the following steps

### Leverage Data Repositories and Standards:

Make use of well-established bioimaging data repositories like BioImage Archive, Image Data Resource (IDR), and EMPIAR

*.... Let's include to: SSBD, Zenodo, ....*

These platforms provide **examples of how bioimaging data should be structured and stored**, allowing you to learn from existing practices

Additionally, **learn about metadata standards such as OME (Open Microscopy Environment)** that facilitate interoperability between platforms and tools



BioImage Archive



SSBD:repository  
SSBD:database



# Fluorescence Nanoscopy in Bioimaging

To address **critical limitations in using super-resolution microscopy** in biomedical sciences in Latin America.



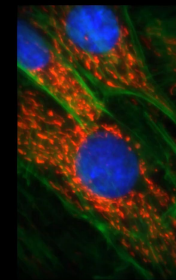
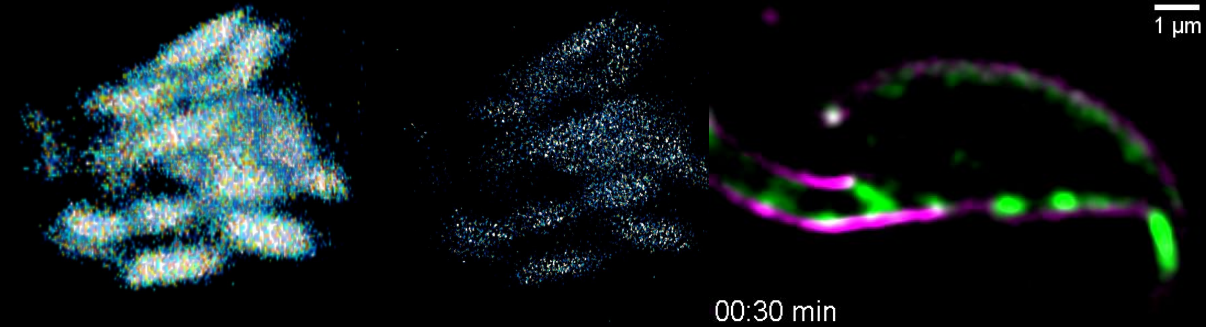
Adan Guerrero



Mariano Buffone



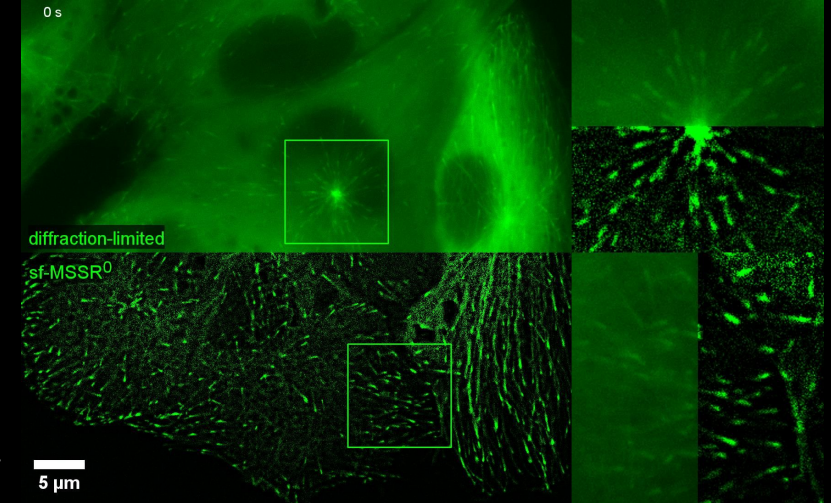
To develop **open-source technology** to provide nanoscopic resolution for images taken with *anv*



Extending resolution within a single imaging frame

Torres-García et. al.

doi: 10.1101/2021.10.17.464398



Two **hands-on workshops** on fluorescence nanoscopy (Mex 2022, Arg 2024).  
A **visiting scholarship** program (2023-2024).  
A **Latin American advanced bioimaging meeting** (2024).

# Extending resolution within a single imaging frame



Torres E., et al.,  
Nat Commun  
(2022)

**M**ean  
**S**hift  
**S**uper  
**R**esolution

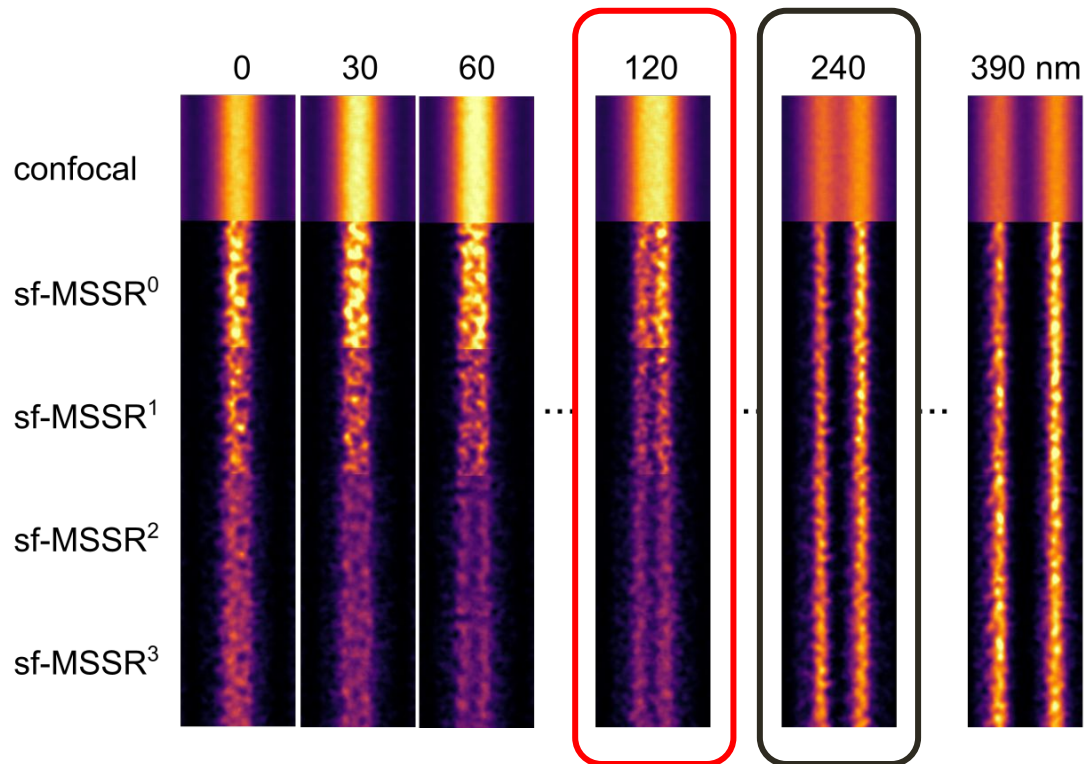
## Methods

### Source data availability

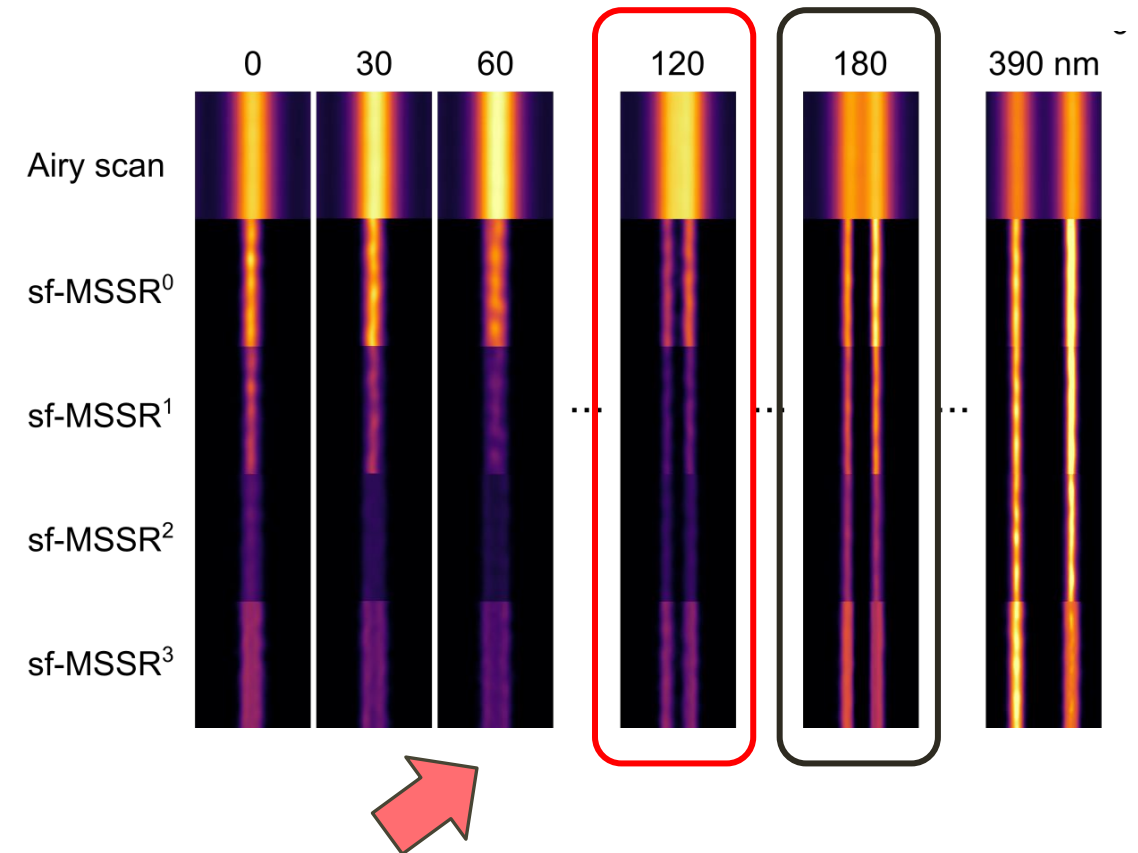
All source data used or generated in this study has been made publicly available in the Zenodo OpenAIRE database, and are accessible through a unique DOI, here provided.

Dataset title	Location	DOI
Gatta-SIM nanorulers.	Fig. 2c.	<a href="https://doi.org/10.5281/zenodo.6941792">https://doi.org/10.5281/zenodo.6941792</a>
Airyscan and Confocal line pattern.	Figs. 3 and 4.	<a href="https://doi.org/10.5281/zenodo.6848342">https://doi.org/10.5281/zenodo.6848342</a>
Synapsed homologs of meiotic mouse chromosomes visualized by TIRFM.	Fig. 4d.	<a href="https://doi.org/10.5281/zenodo.6865142">https://doi.org/10.5281/zenodo.6865142</a>
STED immunofluorescence imaging of histone protein H3K27 in a 2-cell stage mice embryo.	Fig. 6.	<a href="https://doi.org/10.5281/zenodo.6865168">https://doi.org/10.5281/zenodo.6865168</a>
CRISPR-PAINT nanorulers.	Fig. 7b–f, Supplementary Figs. S42–44, Supplementary Movie S1.	<a href="https://doi.org/10.5281/zenodo.6850637">https://doi.org/10.5281/zenodo.6850637</a>

## MSSR ENHANCE SPATIAL RESOLUTION OF CONFOCAL IMAGES DOWN TO 120 NM



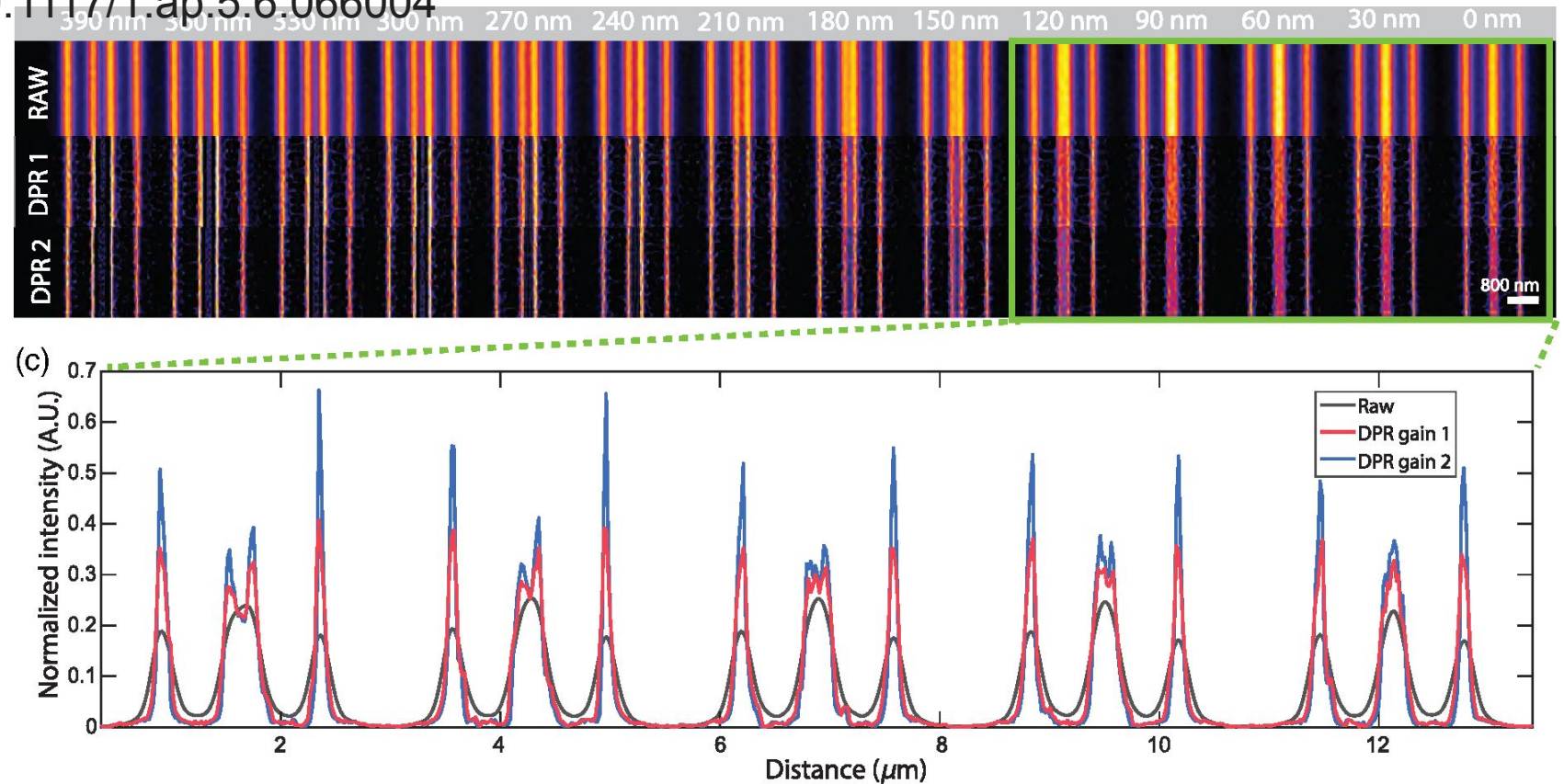
## MSSR ENHANCE SPATIAL RESOLUTION WITHIN AIRY SCAN IMAGES



# Resolution enhancement with deblurring by pixel reassignment

Zhao B, Merz J. Adv Photonics. 2023

Nov-Dec;5(6):066004. doi: 10.1117/1.ap.5.6.066004



... Here, we use raw data acquired by an Airyscan microscope obtained from Refs. 32 and 41

The  
paper

The  
data

# Characterization of immune cells using high-resolution imaging-based flow cytometry

*Hernandez-Guadarrama Y. et al.  
(unpublished)*

## Experimental design

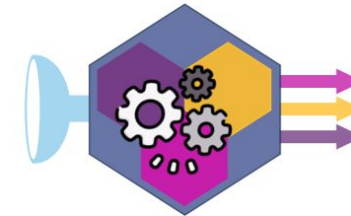


### DOWNLOAD

Download imaging flow cytometry data from open-access digital repositories that adhere to FAIR principles<sup>2</sup>.



Process raw data to obtain flow cytometry images, then reprocess them with the MSSR algorithm to enhance fluorescence image resolution.



### TRANSFORM



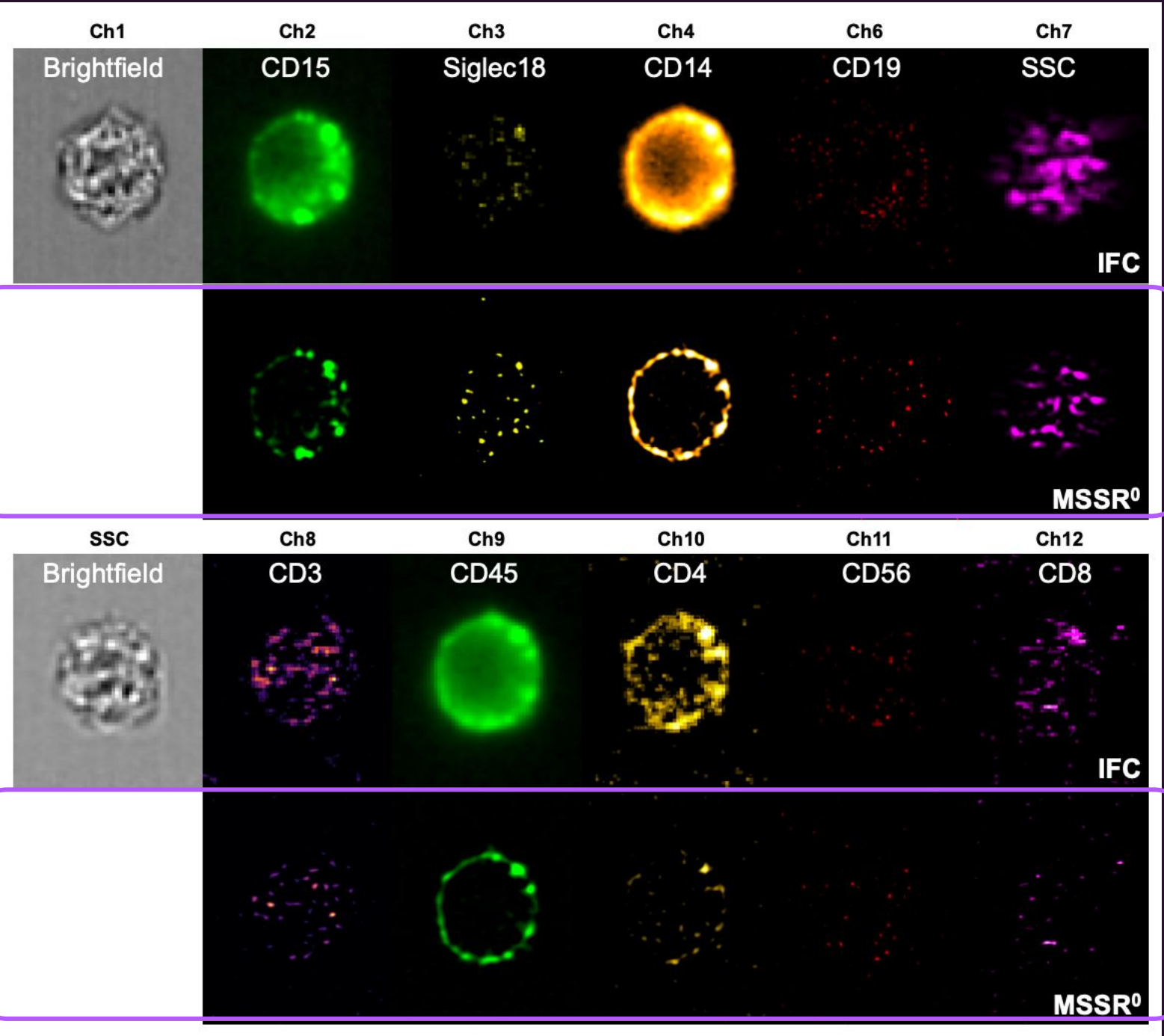
### Analyze

Use deep learning algorithms to map protein expression and localization by classifying cells based on image patterns.

# Flow cytometry images processed with MSSR

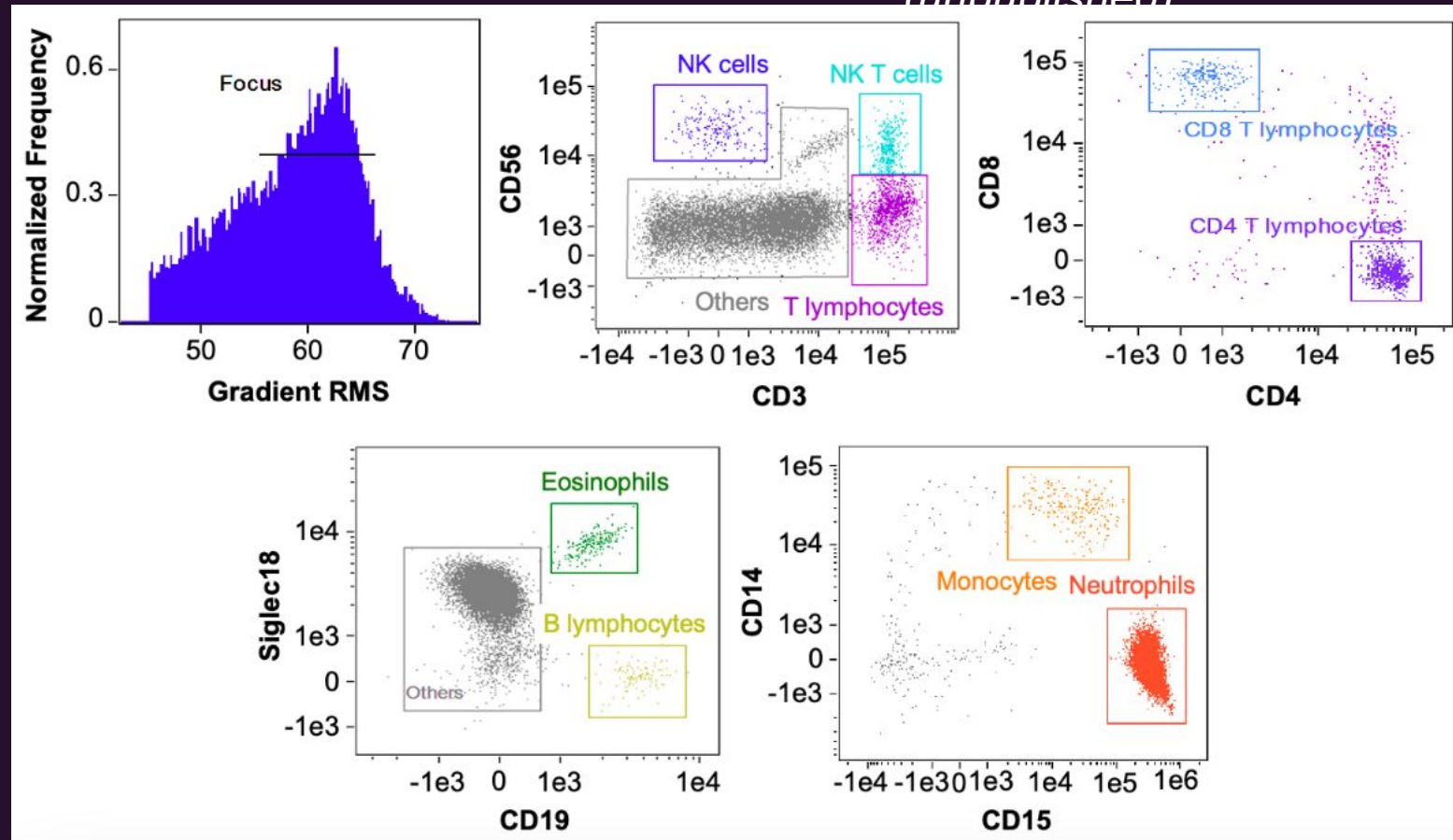
Hernandez-Guadarrama Y. et al. (unpublished)

MSS  
R



# Cell classification through multiparametric analysis

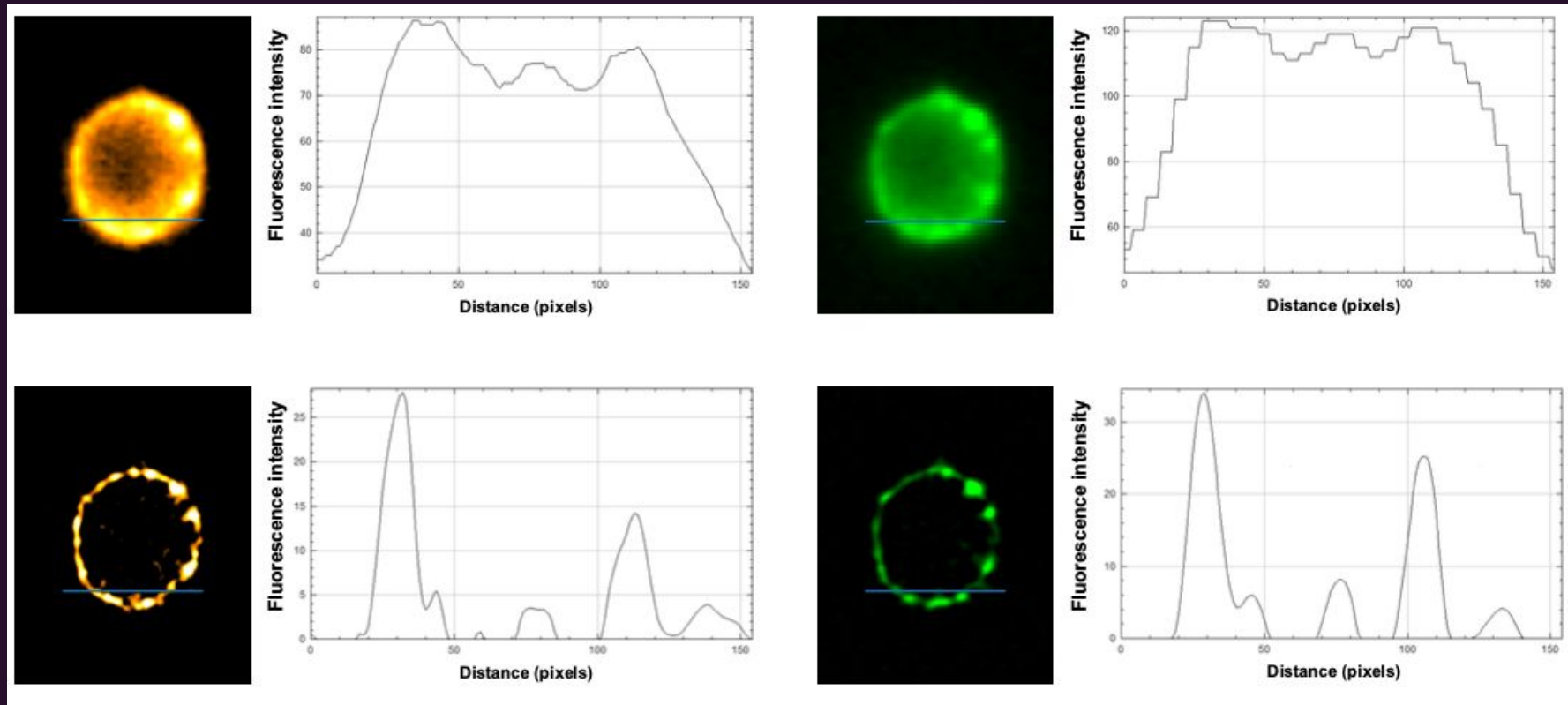
*Hernandez-Guadarrama Y. et al.  
(unpublished)*



Classification of WBC considering the presence or absence of cellular markers characteristic of each cell subpopulation.

## Comparison of pixel intensity in fluorescence images with higher signal in monocytes.

*Hernandez-Guadarrama Y. et al.  
(unpublished)*



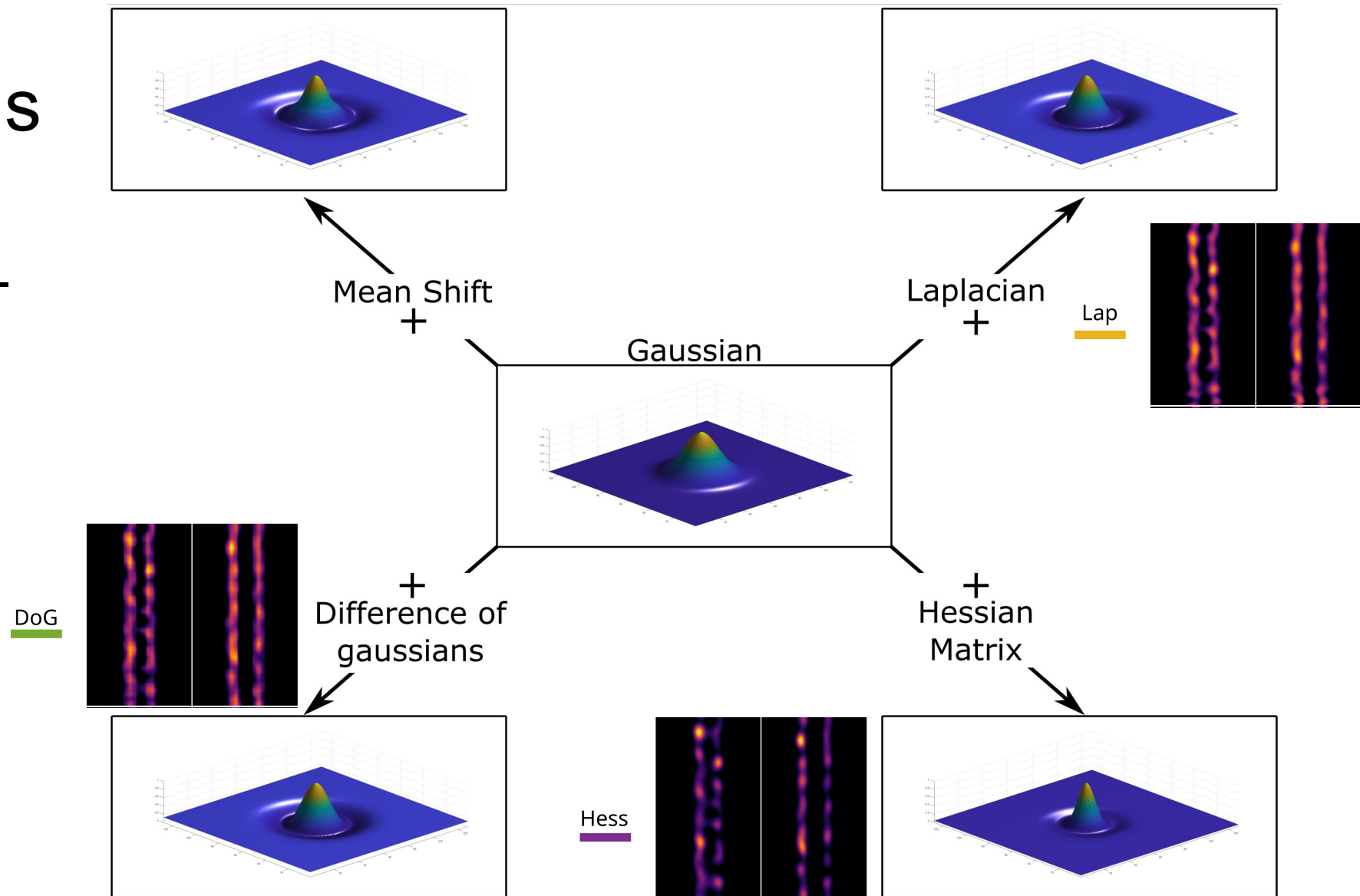
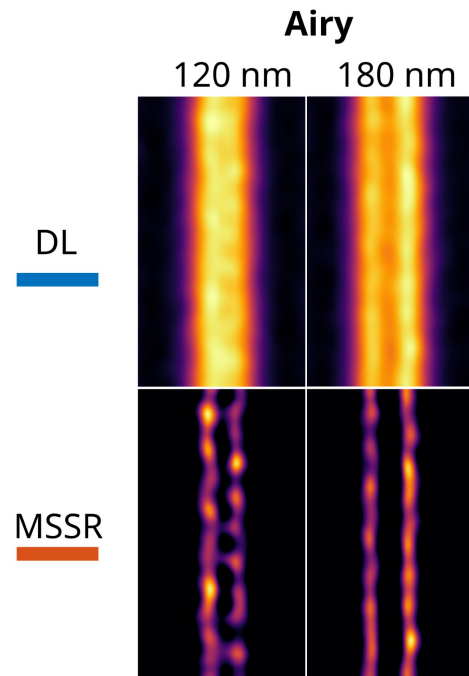
Perspectives:

Analyze protein expression patterns using machine learning algorithms.

Quantify protein levels and correlate these patterns with specific phenotypic characteristics.

# Speeding up messer analysis using wavelets

- Mexican Hats -



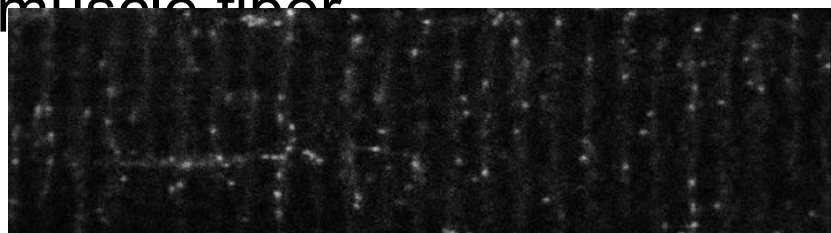
# Benmarching using FAIR data

## SSBD: Systems Science of Biological Dynamics



- S-BIAD564\_5B - 1 Microtubules
- S-BIAD564\_5B - 2 Microglia
- S-JCBD-201304063\_BW - Microtubules
- S-JCBD-201304063\_C - Microtubules
- S-JCBD-201004154\_MovieS1 - Microtubule dynamics

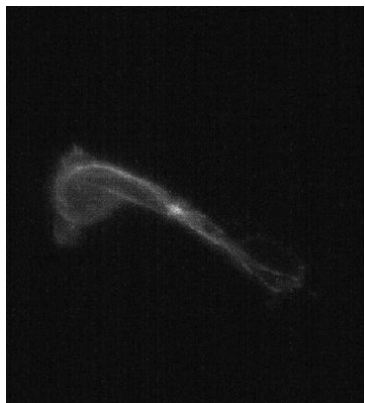
### Dynamics of EB3\*-GFP in a plated skeletal muscle fiber



Shape of the image dataset: (30, 279, 1024)

Method	Python time	Matlab time
Meanshift	723.84 s	277.53 s
DoG	70.92 s	21.05 s
Laplacian	13.60 s	39.79 s
Hessian	331.66 s	32.25 s

### Microtubule dynamics during microglia branch-mediated engulfment



Shape of the image dataset: (201, 473, 419)

Method	Python time	Matlab time
Meanshift	90.78 s	46.32 s
DoG	16.16 s	5.5 s
Laplacian	25.82 s	8.56 s
Hessian	45.06 s	9.51 s

Pinto Cámara, et al., (*in prep*)

ChatGPT:

To avoid getting lost in the complexity, I suggest the following steps

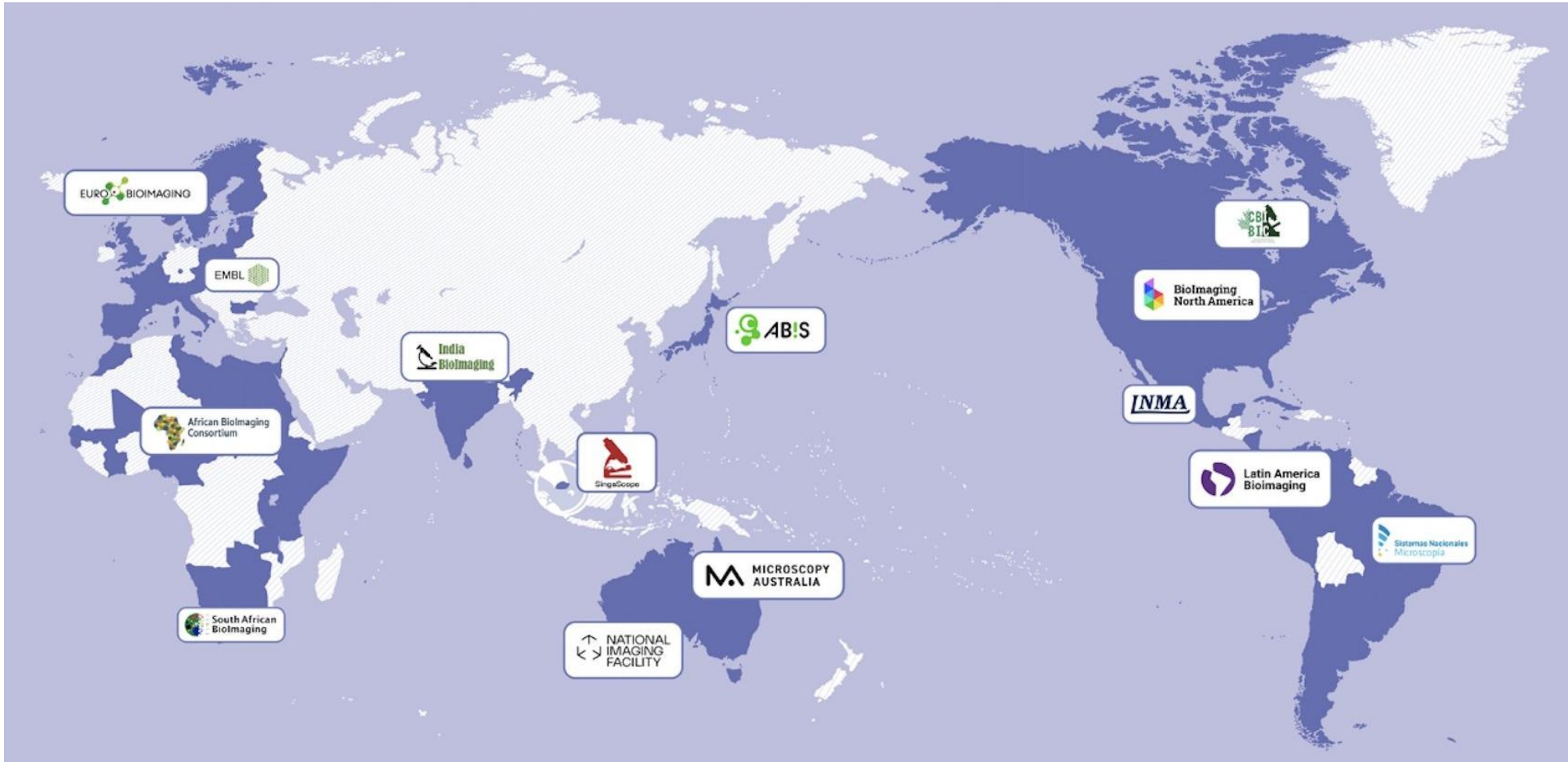
### **Engage with Bioimaging Communities and Resources:**

Connect with relevant working groups and communities such as Euro-BioImaging, Global BioImaging, ~~and NEUBIAS~~ (Network of European BioImage Analysts) **GLOBIAS**

*.... Let's include to: LABI, BINA, QUAREP-LiMi, ...*

These organizations provide a wealth of **resources, guidelines, and expertise** that can help you navigate the data management landscape

# Global BioImaging (GBI)



The international network of cutting-edge bioimaging facilities and communities

ChatGPT:

... Engaging in forums, conferences, and workshops will allow you to stay updated and exchange knowledge with other professionals.

## TOP 7 CZI travel grantees

Cora Pollak, Francisco Silva,  
Lize Engelbrecht, Sunday  
Yinka

Mariana De Niz, Adán  
Guerrero

*Connecting the Mexican  
Bioimaging community  
through science and  
education*



Exchange of Experience VII

## IMAGING IMPACT & SUSTAINABLE DEVELOPMENT GOALS

Montevideo, Uruguay (Hybrid meeting)  
September 14-16th, 2022



GLOBAL  
BIOIMAGING  
growing collaboration

Latin America  
Bioimaging

Chan  
Zuckerberg  
Initiative

ChatGPT:

... **Engaging in forums, conferences, and workshops** will allow you to stay updated and exchange knowledge with other professionals



Image credits: Yuriney Abonza

Day 4: FAIR principles, image data management and image data reuse through the use of image repositories

## Overview

- The first in-person international training course of GBI since the start of the pandemic

- Focused on facility management and image data

- Open to imaging facility managers and technical staff

ChatGPT:

... Engaging in forums, conferences, and **workshops** will allow you to stay updated and exchange knowledge with other professionals



**ABiS-GBI 2023 course - Image data: image analysis, data management and reuse**

- OMERO data management software
- Bioimage Archive
- SSBD database



*Image credits: Esli Carreño & Yuriney*

*Abonza*

- Managing and sharing data

ChatGPT:

... Engaging in forums, conferences, and **workshops** will allow you to stay updated and exchange knowledge with other professionals



Image credits: Yuriney Abonza

- Managing your image data for the long term: FAIR data, REMBI metadata and the BiImage Archive
- BiImage Archive image
- Building reusable bioimage analysis workflows with Nextflow



Image credits: Esli Carreño & Yuriney Abonza

- Fostering Innovation in Data Management for Biomedical Impact

ChatGPT:

**... Engaging in forums, conferences, and workshops** will allow you to stay updated and exchange knowledge with other professionals



WG: Quality Control and Data Management



WG7: Microscopy data provenance and QC metadata



WG: Data Science for Bioimaging



**... help for image analysis**

## Problems of LatAm scientists

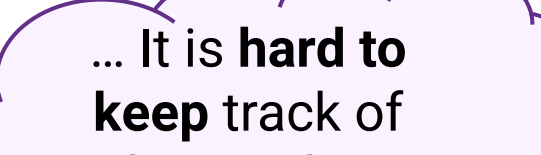
## Networking Session: Image Data Science

A purple cloud shape with a black outline, containing the text "... training in image analysis is hard to find".

... **training** in  
image analysis  
is hard to find



... **need funding**  
to develop  
infrastructures



... It is **hard to keep** track of data and its availability



... need  
**standards and  
guidelines** to for  
data storage,  
and handling

... **help for image analysis**

## Problems of LatAm scientists

*Networking Session: Image Data Science*

... **training** in image analysis is hard to find

... access to end **computing** is expensive or limited

... LatAm in general do not have well **distributed infrastructures**

... **mobility** to access infrastructures is an issue


... **need funding** to develop infrastructures

... It is **hard to keep track** of data and its availability

... need **standards and guidelines** to for data storage, and handling

# Problems of LatAm scientists

*Networking Session: Image Data Science*



... in some countries it  
seems that **the general  
concept of data  
management is not  
present**

## Proposed Actions


- Short term action: **include increasing capacity in training** school by offering different levels (e.g. beginner, intermediate, etc.) or considering more hybrid courses
- Long term strategies for more infrastructures include **lobbying with policy makers and funding bodies**

Important for any action

... to carefully know numbers and develop metrics (how many courses, number of users in need for a specific infrastructure, etc.), to know the baseline and what to do to improve

# Problems of LatAm scientists

*Networking Session: Image Data Science*



... in some countries it  
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present**



# foundingGIDE

Founding a **G**lobal **I**mage **D**ata **E**cosystem

## foundingGIDE community event 2024

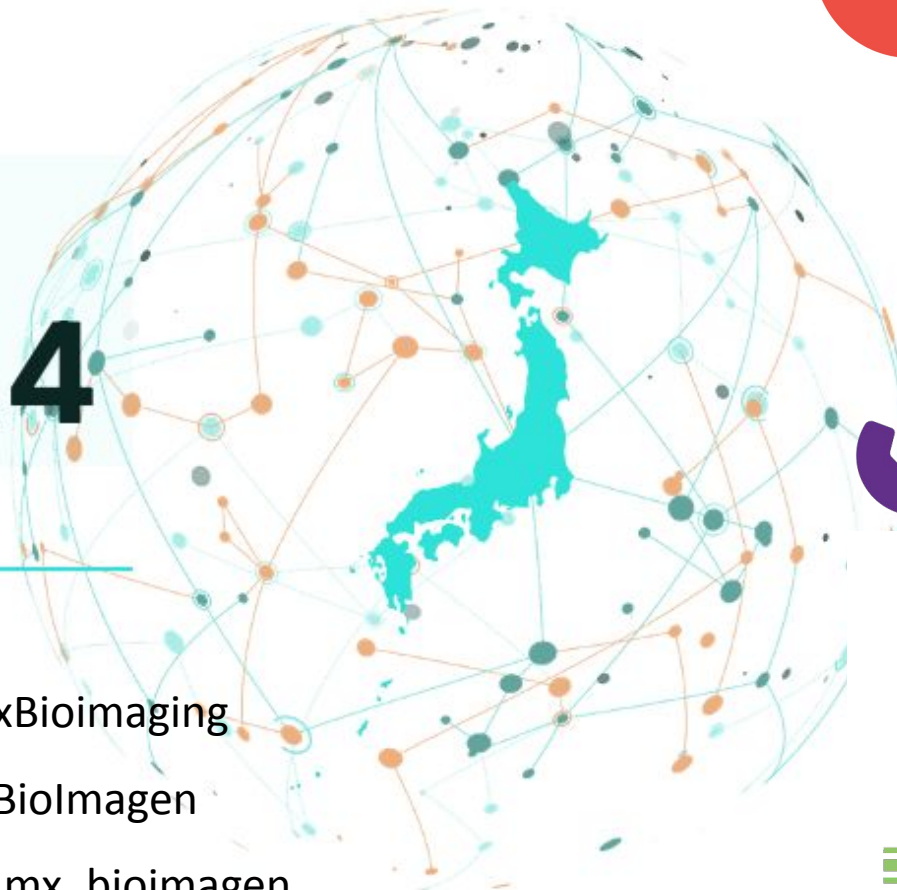
Adán Guerrero  
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*adan.guerrero@ibt.unam.mx*  
*Twitter: AdanGue1*  
[meximagingworkshops.org.mx](http://meximagingworkshops.org.mx)

**Facebook:** MxBioimaging

**Twitter:** Mx\_BioImagen

**Instagram:** @mx\_bioimagen

**YouTube:** Mexican Bioimaging Workshops



CHAN  
ZUCKERBERG  
INITIATIVE

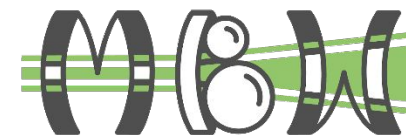


BioImaging  
North America



Latin America  
Bioimaging

GLOBAL  
BIOIMAGING  
growing collaboration



Mexican Bioimaging Workshops



**LNMA**  
Laboratorio Nacional de Microscopía Avanzada

1<sup>st</sup> of November 2024