Persistent Hardware Descriptors: persistent identification of instrument instances and hardware configurations

Caterina Strambio-De-Castillia

Anita Bandrowsky

James Chambers

David Grunwald

Nate Herzog

Josh Moore

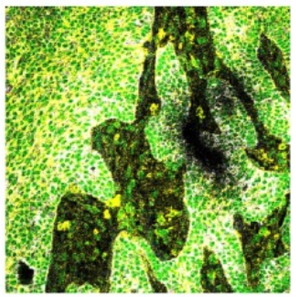
Judith Lacoste

Adrian Zai

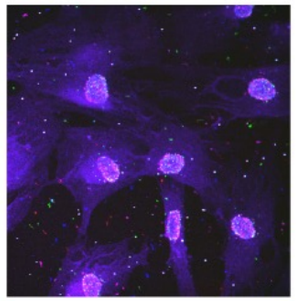
NERLSCD 2025 Annual Conference
October 10th, 2025

Bioimages: complex data and metadata

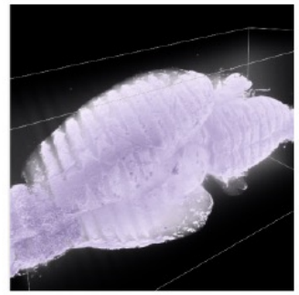
Diversity in imaging applications/modalities



Multiplexed

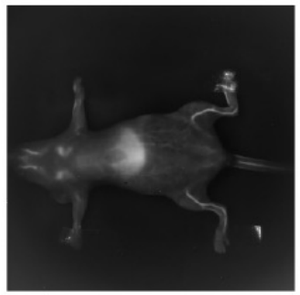


Spatial tx

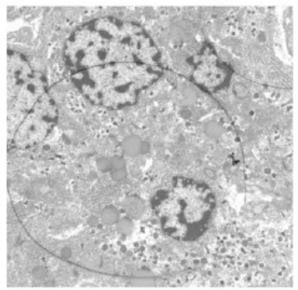


Light-sheet

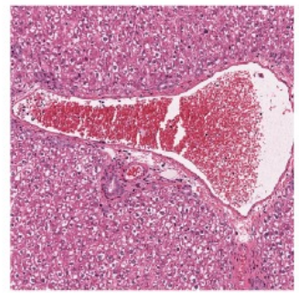
Infraread



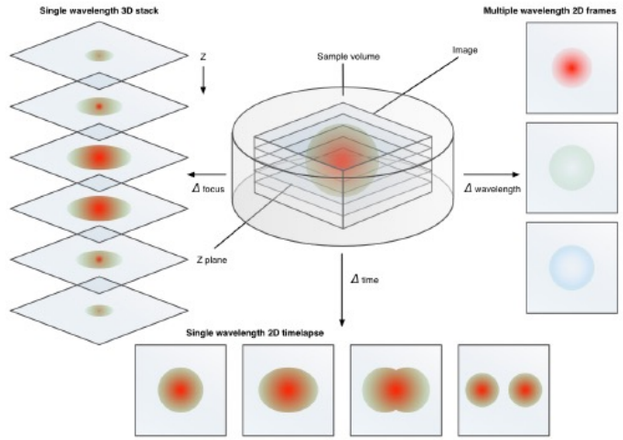
Scanning EM



Digital pathology



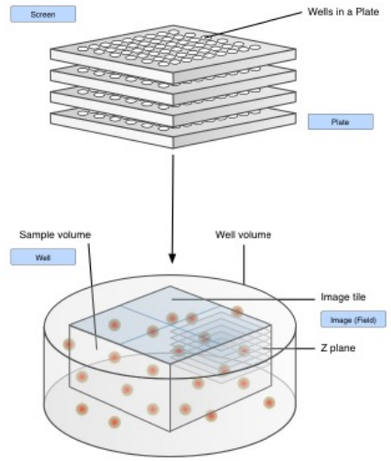
Moore and Kunis, 2024; https://doi.org/10.5281/zenodo.11235513



5D Images

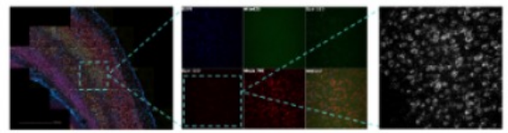
3D, multi-color, movies, or any combination

https://ome-model.readthedocs.io/



High-content Screen

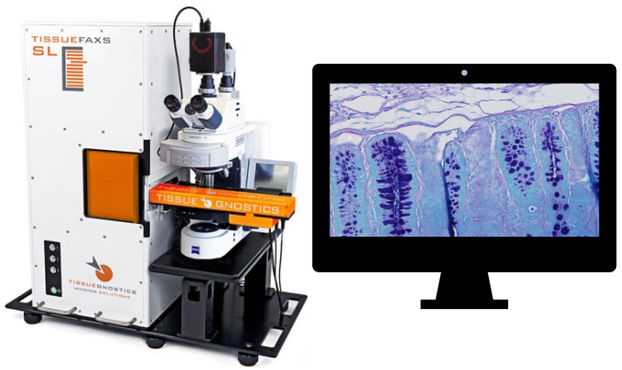
Complex Acquisitions



Single-cell tissue

Microscopy Core Facilities

Full-service core-facilities



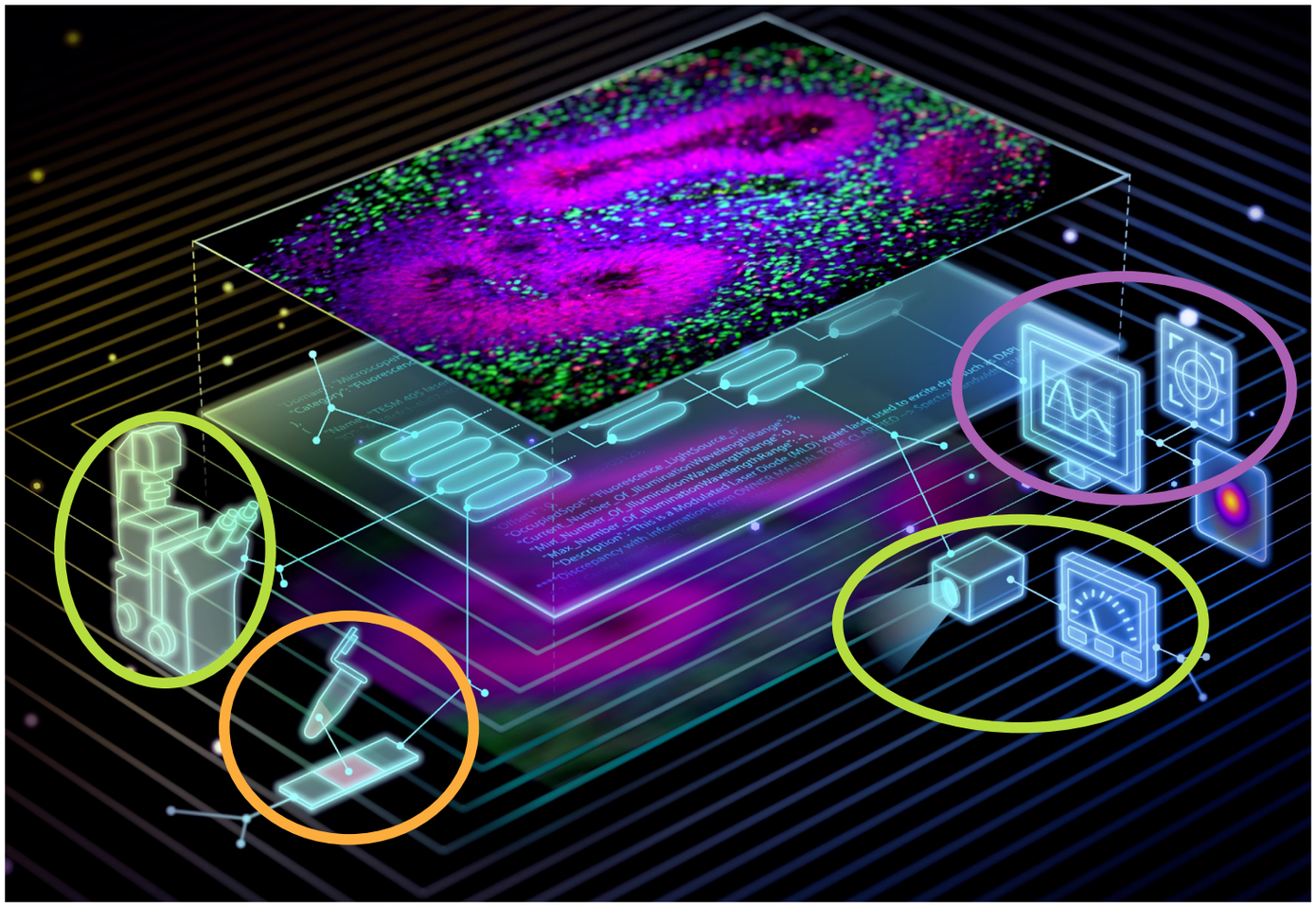
- Digital pathology (brightfield and fluorescence slide scans)
- Spatial omics
- Multiplexed FISH/RNA Scope

Researchers using microscopes at core-facilities and in individual labs

- Widefield microscopy
- Confocal microscopy
- Super-resolution microscopy
- Live-cell imaging

- Multiple production sites
- Diverse samples + experimental conditions
- Thousands of diverse microscopes with multiple parts
- Multiple modalities
- >150 file formats
- TB, PB, ….
- Multiple analysis software
- Need to integrate with other data-types

BioImage Metadata



© Thao Do (Allen Institute, Seattle, WA, USA)
Nature Methods FOCUS issue on Reporting and Reproducibility in Microscopy:
https://www.nature.com/collections/djiciihhjh

All information that is needed to interpret, evaluate the quality reproduce and share microscopy images

- Sample preparation
- Image Acquisition
  - Hardware configuration
  - Acquisition setting
  - Quality Control
- Image data processing and analysis

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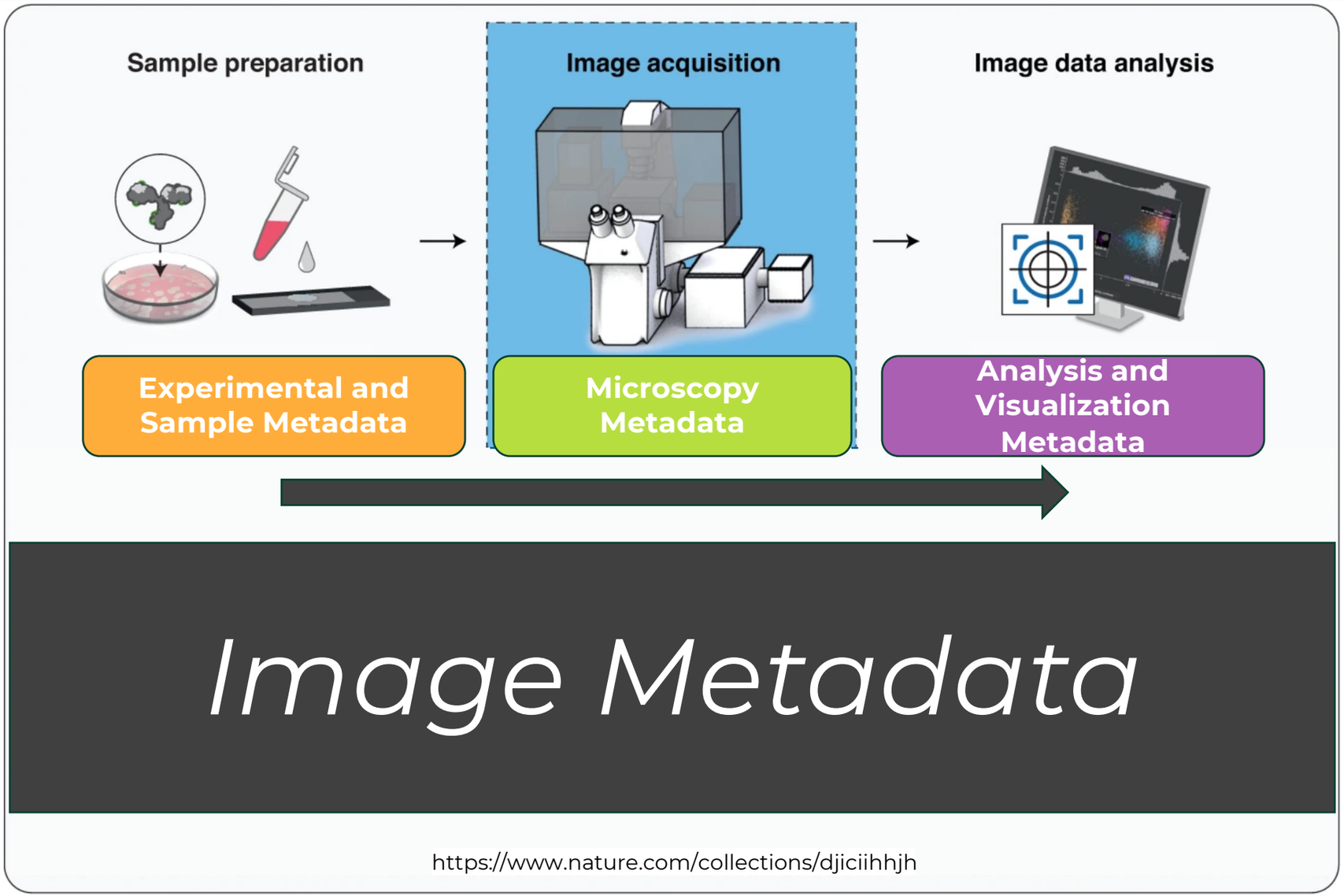
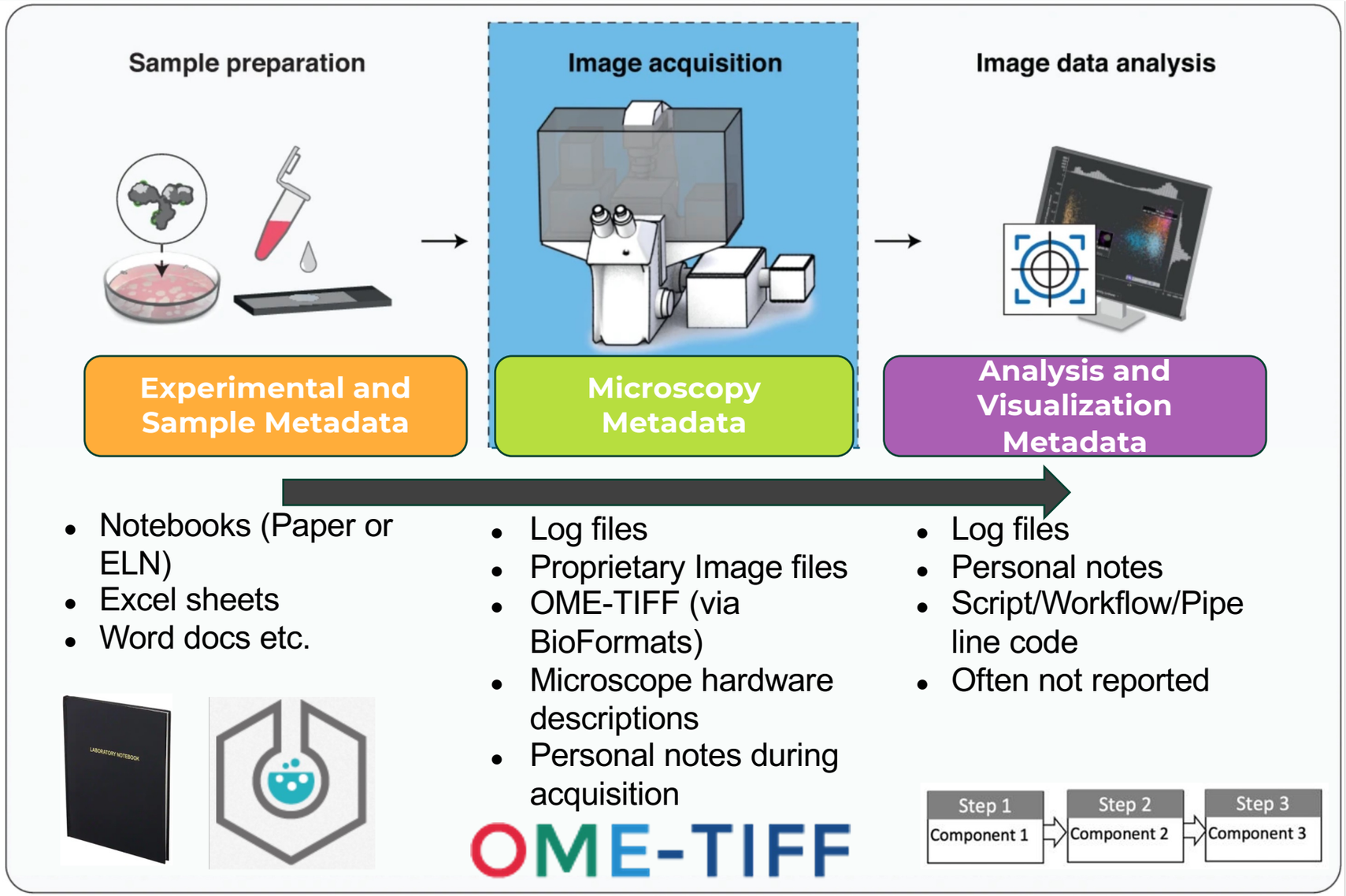
Image Metadata is key for producing high-quality FAIR data



https://www.nature.com/collections/djiciihhjh

CC BY

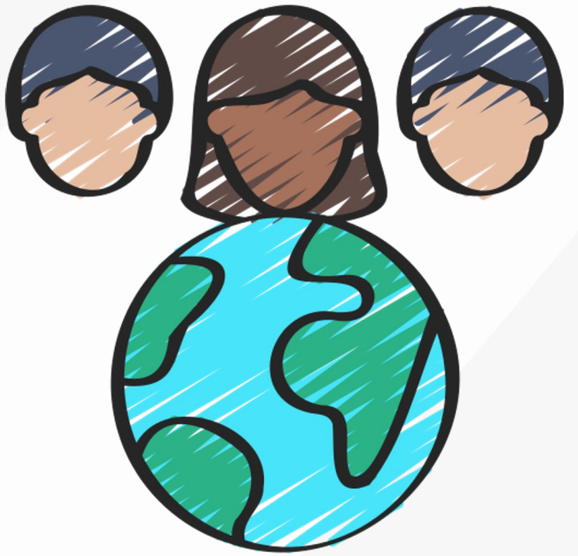
Fragmentation is the enemy



Take home: data FAIR-ification cannot be done in isolation

Local expertise

Community Guidelines, Specifications and Tools



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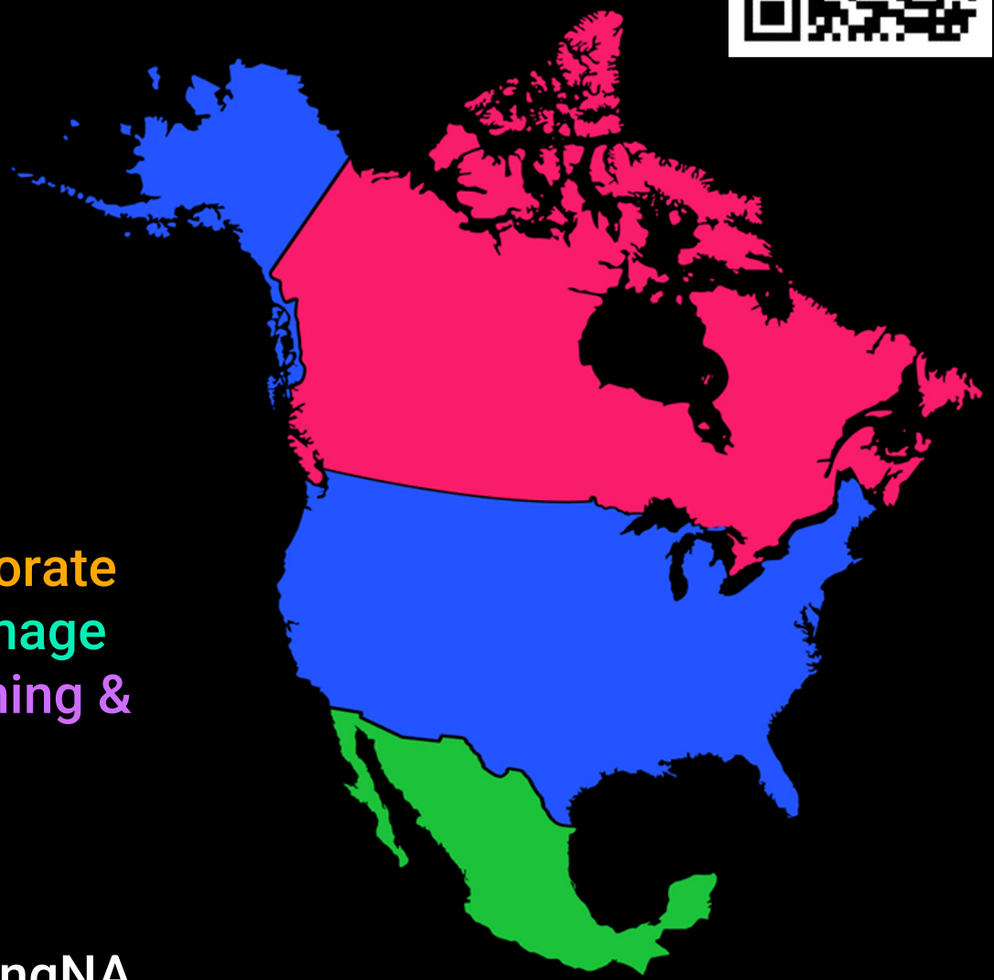
Icon attribution: xnimrodx and juicy_fish

BioImaging North America (BINA)

Mission: Engaging bioimaging scientists across North America by creating an inclusive and supportive community to share, advance and succeed together.



Events and Newsletter each month!

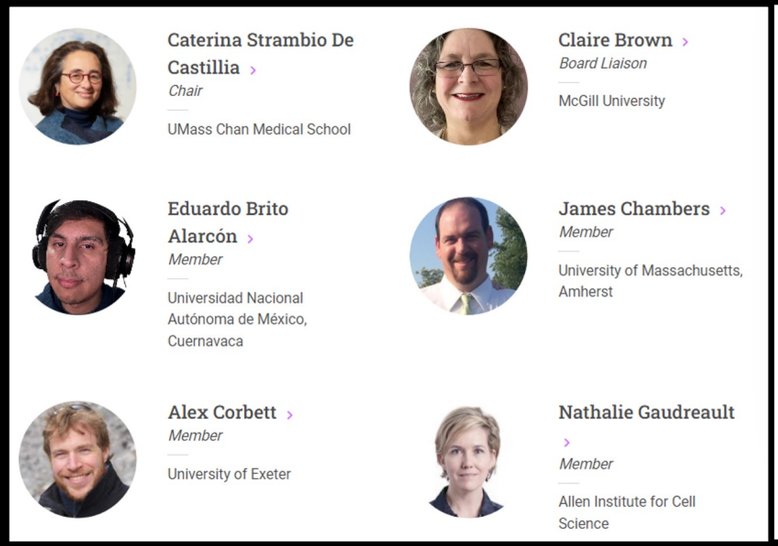
8 Working Groups: Builders, Communications, Corporate Partners, Diversity, Equity & Inclusion, Early Career, Image Informatics, Quality Control & Data Management, Training & Education

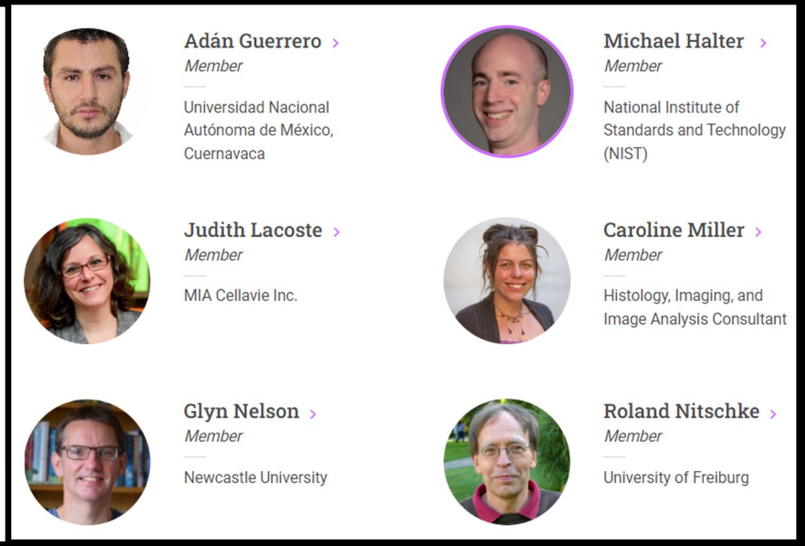
www.BioImagingNorthAmerica.org/join

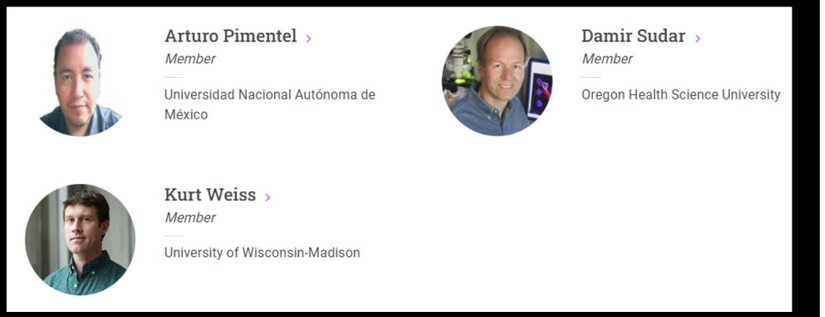
contact@bioimagingna.org

@BioimagingNA

Quality Control & Data Management Working Group







- Quantitative assessment and calibration of microscope performance,
- Rigorous record-keeping of data generation and processing conditions
- Connection of imaging dataset with machine-readable metadata describing its “provenance.”

Pop-Up EoE: taking the fear out of RDM

Beth Cimini

Vanessa Orr

Nikki Bialy

Past Events

Pop-Up EoE, @ BINA 2022 October 2022 Woods Hole, MA

Pop-Up EoE, @ ABRF (Association of Biomolecular Resource Facilities) May 2023, Boston, MA

Pop Up EoE at LABIxBINA: BioImaging Across the Americas Sep 2023, Morelos, Mexico

Quotes from Past Exchange of Experience Participants:

- "Wonderful experience! Thank you so much for organizing!" ~Anonymous, PoP-Up EoE participant
- "Thank you for an amazing two days!" ~Anonymous, PoP-Up EoE participant
- "This was a wonderful experience and I really appreciate the organizing staff for their thoroughness and thoughtfulness." ~Anonymous, PoP-Up EoE participant
- "It was an amazing experience and I am very grateful for being part of this community. I learned a lot, not only during the conference, but watching [the communications] and logistics." ~Anonymous, PoP-Up EoE participant

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BINA does not stand in isolation

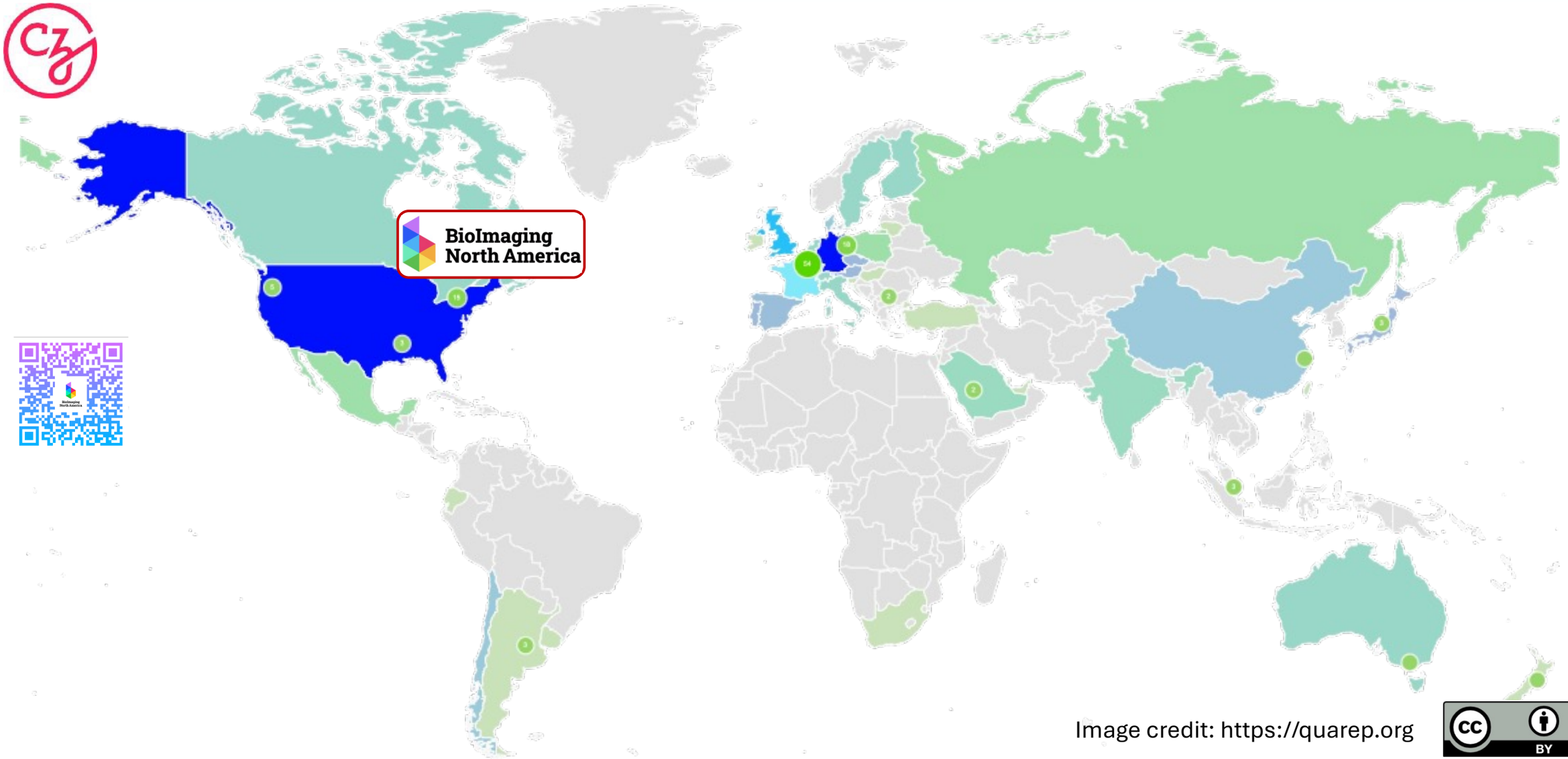

Image credit: https://quarep.org

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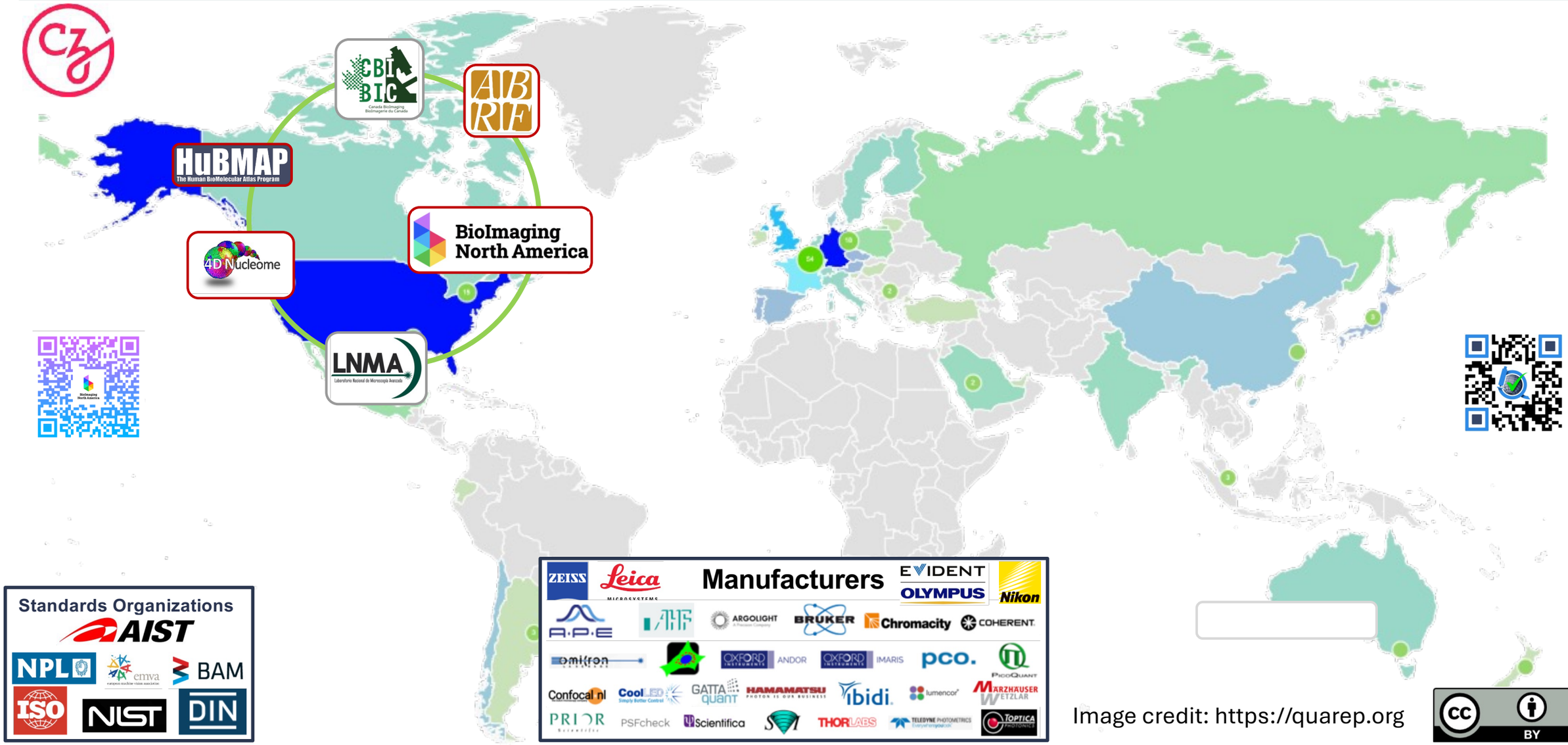
BINA partnerships with other consortia and manufacturers



Standards Organizations

AIST NPL emva BAM ISO NIST DIN

Manufacturers

ZEISS Leica MICROSYSTEMS EVIDENT OLYMPUS Nikon A·P·E ARGOLIGHT BRUKER Chromacity COHERENT emkron ANDOR OXFORD INSTRUMENTS IMARIS pco. PicoQuant Confocal.nl CoolLED GATTAquant HAMAMATSU ibidi lumencor MARZHÄUSER WETZLAR PRIOR PSFcheck Scientifica THORLABS TELEDYNE PHOTOMETRICS TOPTICA PHOTONICS

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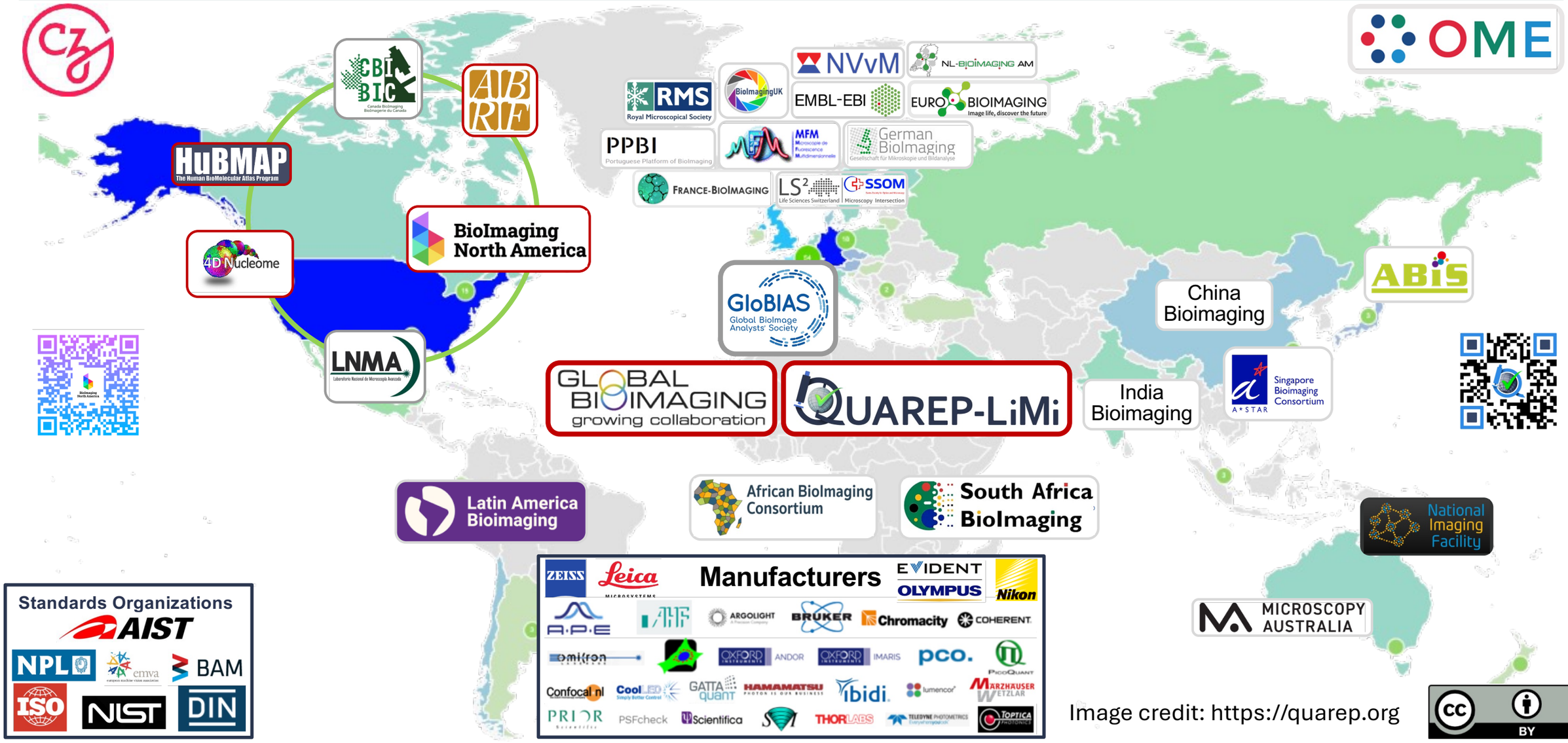
BINA belongs to a network of international organizations spanning the globe



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Microscopy metadata: describing image acquisition

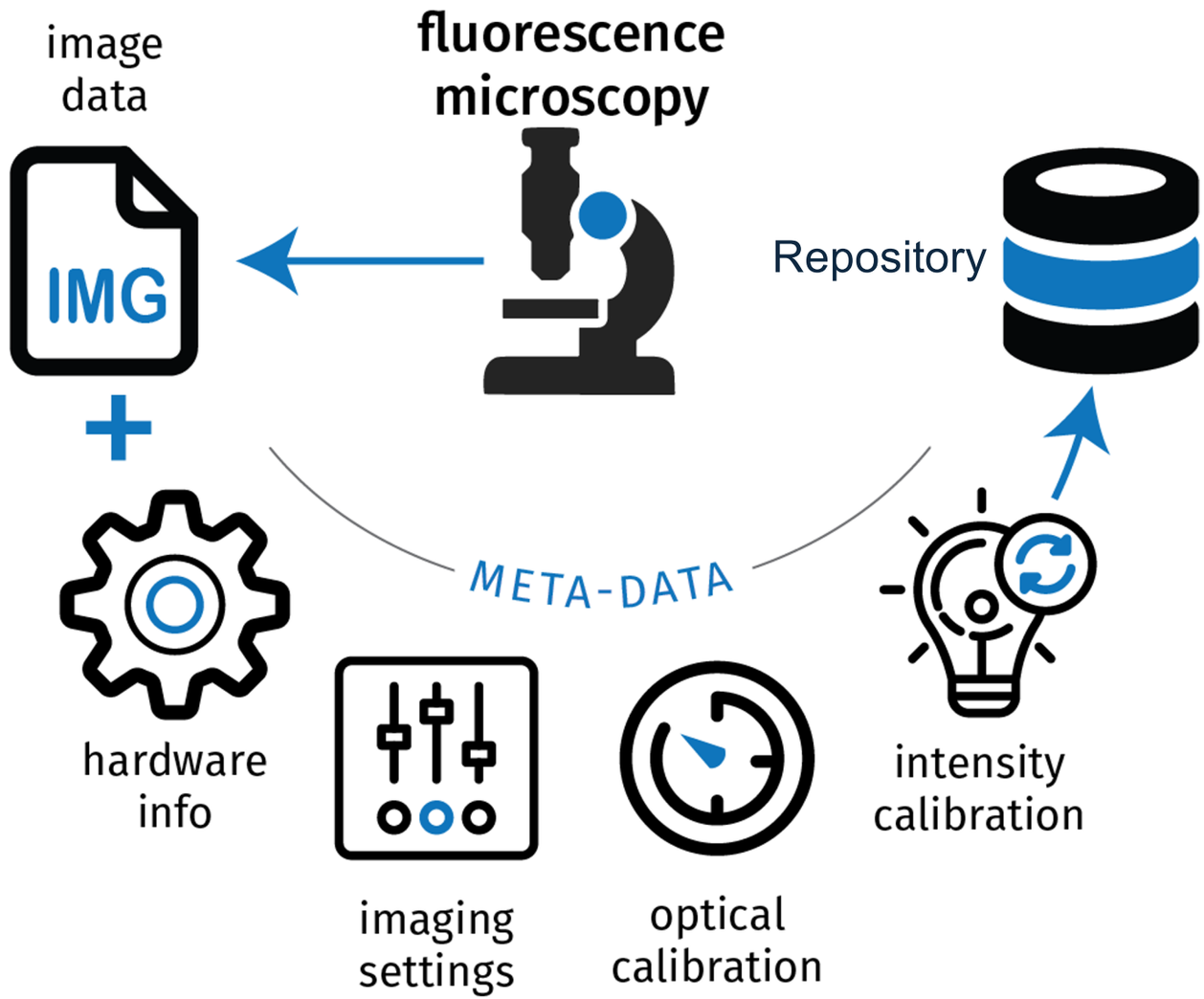
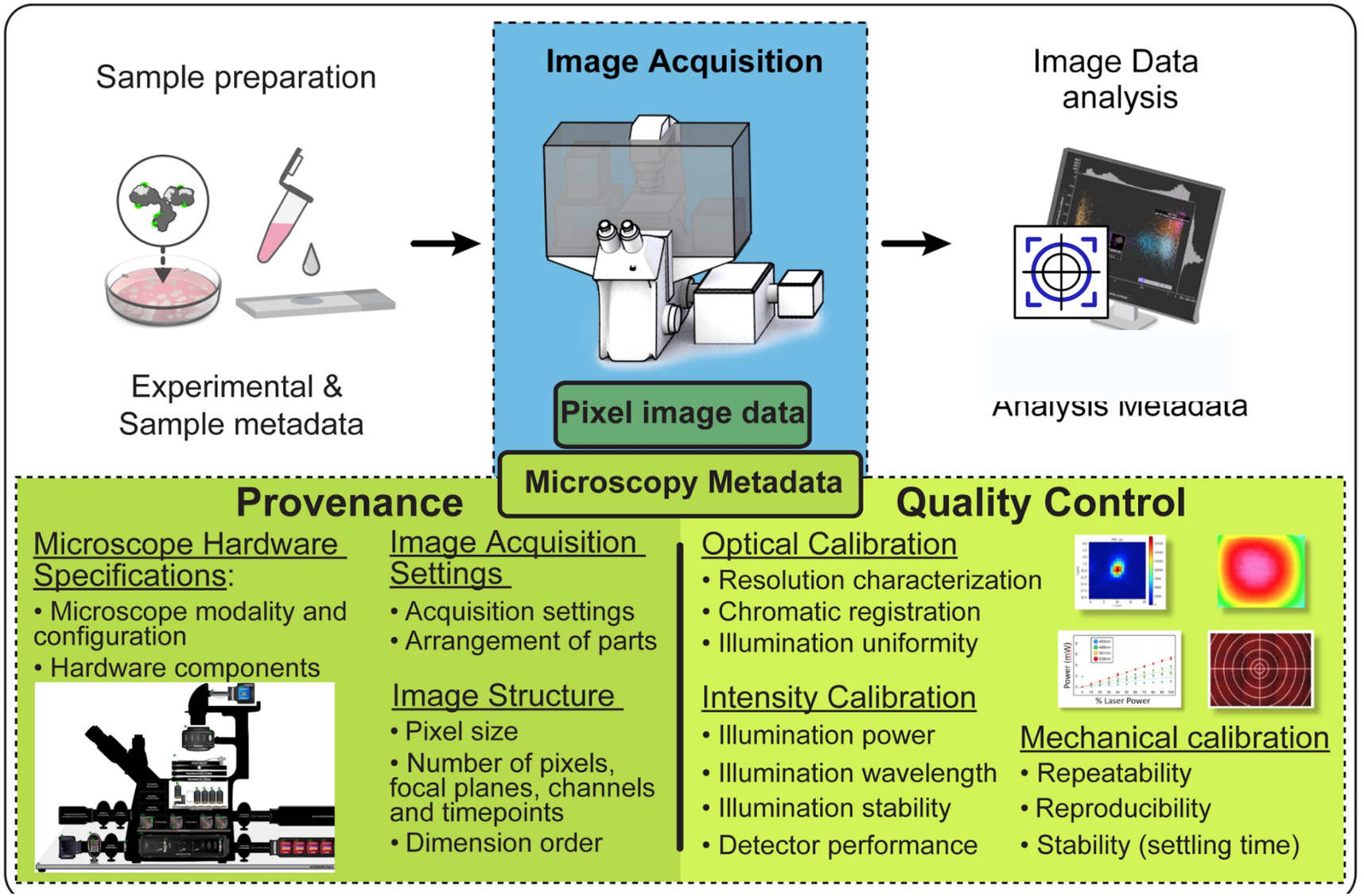


Image Acquisition Metadata: Hardware, Settings and QC



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Community standards: Microscopy Metadata Specifications to expand the OME-data model

Comment

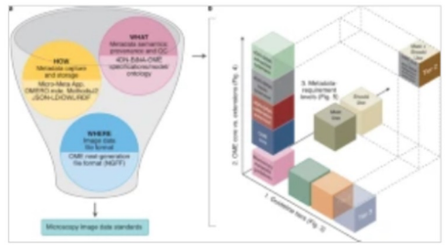
3 Dec 2021

Nature Methods

Towards community-driven metadata standards for light microscopy: tiered specifications extending the OME model

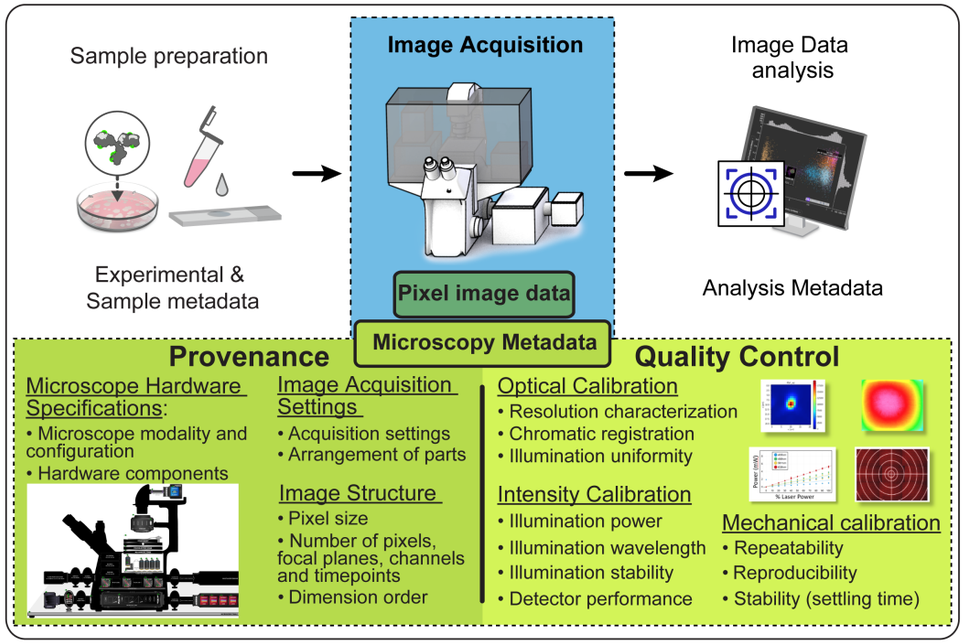
Rigorous record-keeping and quality control are required to ensure the quality, reproducibility and value of imaging data. The 4DN Initiative and BINA here propose light Microscopy Metadata Specifications that extend the OME Data Model, scale with experimental intent and complexity, and make it possible for scientists to create comprehensive records of imaging experiments.

Mathias Hammer, Maximiliaan Huisman ... Caterina Strambio-De-Castillia



4D Nucleome

BioImaging North America



OME

QUAREP-LiMi

Hammer et al. (2021) *Nat Methods*;
https://doi.org/10.1038/s41592-021-01327-9

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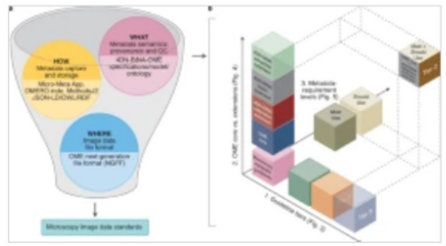
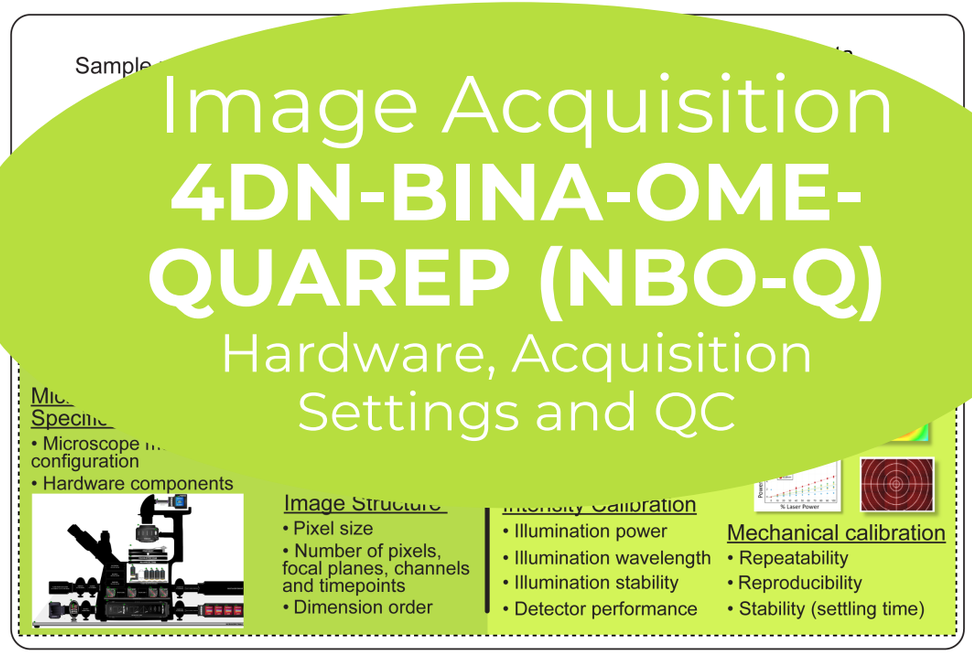


4D Nucleome

BioImaging North America



OME

QUAREP-LiMi

Hammer et al. (2021) *Nat Methods*;
https://doi.org/10.1038/s41592-021-01327-9

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Community tools: Micro-Meta App can be used to capture NBO-Q Image Acquisition metadata

Brief Communication

Open Access

3 Dec 2021

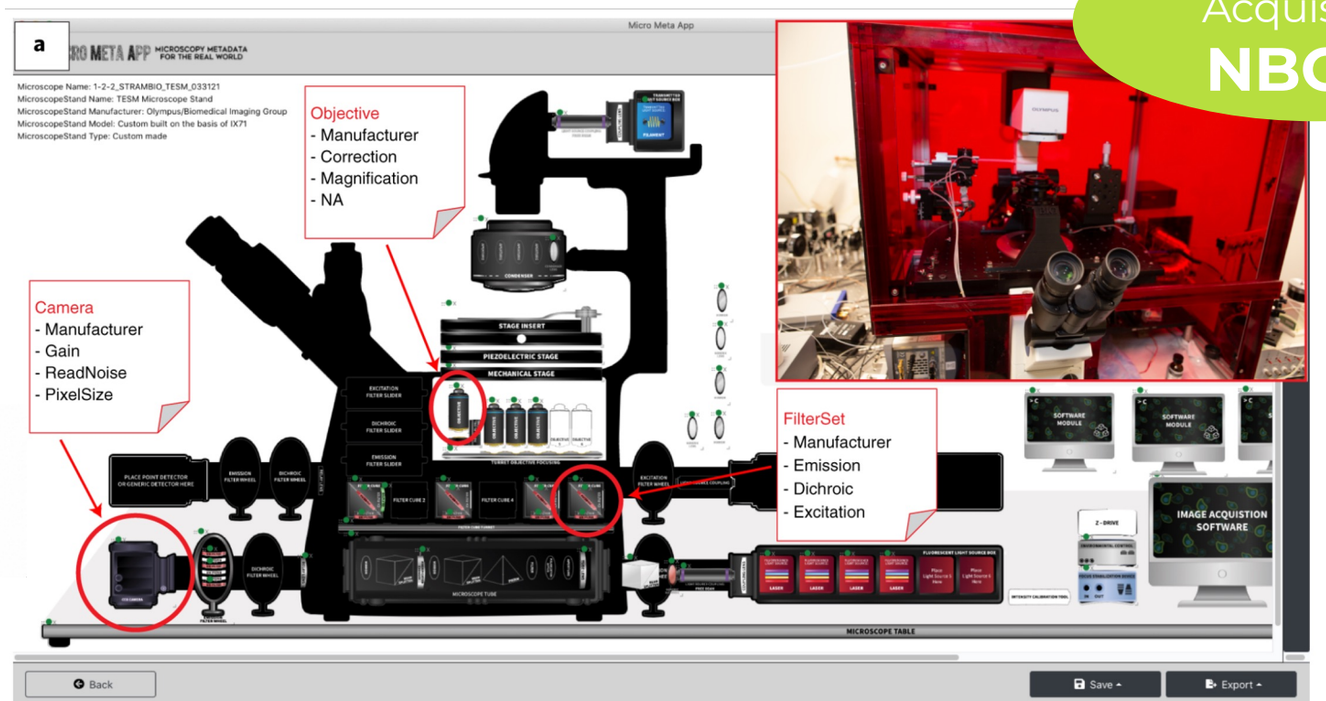
Nature Methods

Micro-Meta App: an interactive tool for collecting microscopy metadata based on community specifications

Micro-Meta App is an intuitive, highly interoperable, open-source software tool designed to facilitate the extraction and collection of relevant microscopy metadata as specified by recent community guidelines.

Alessandro Rigano, Shannon Ehmsen ... Caterina Strambio-De-Castillia

Image Acquisition **NBO-Q**



4D Nucleome

BioImaging North America

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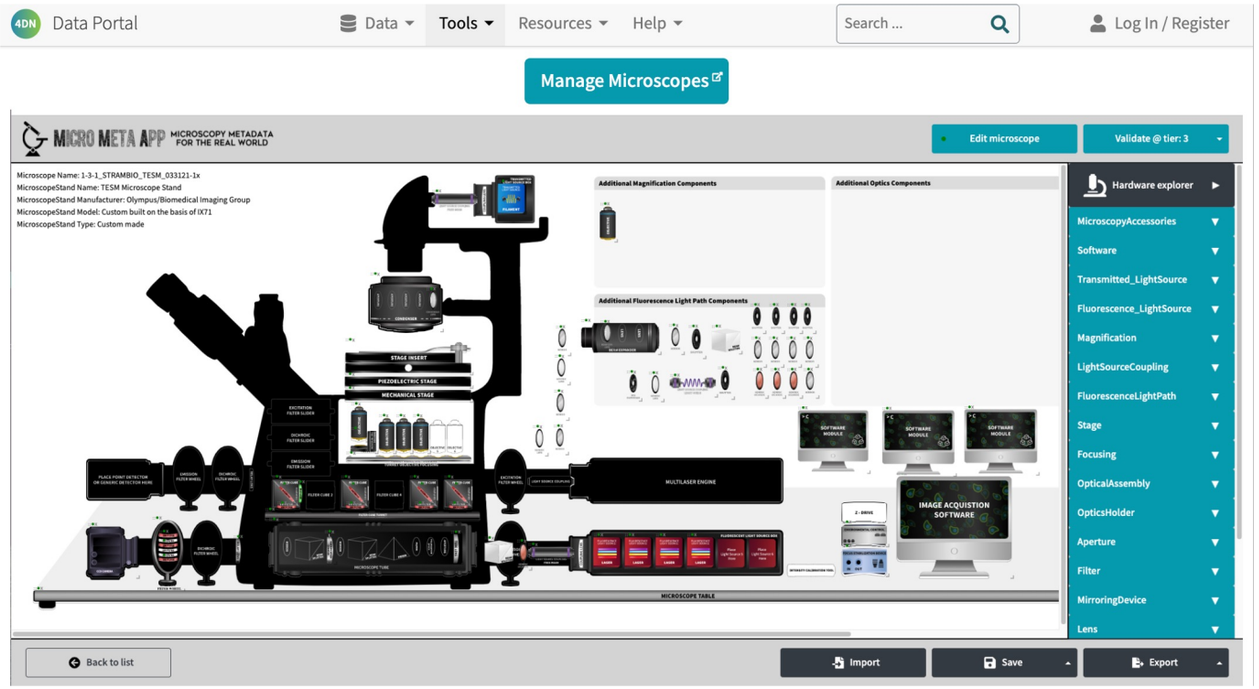
Who is using NBO-Q and/or Micro-Meta App?

- NIH 4D Nucleome
- BINA
- Canada BioImaging
- NIH HuBMAP & SenNet
- RIKEN
- Inscoper
- Pending: Brain Image Library, others?



4D Nucleome

BioImaging North America

QUAREP-LiMi

CBI BIC
Canada BioImaging
BioImagerie du Canada

HuBMAP
Human BioMolecular Atlas Program

SenNet

Data Resource Center @ PSC

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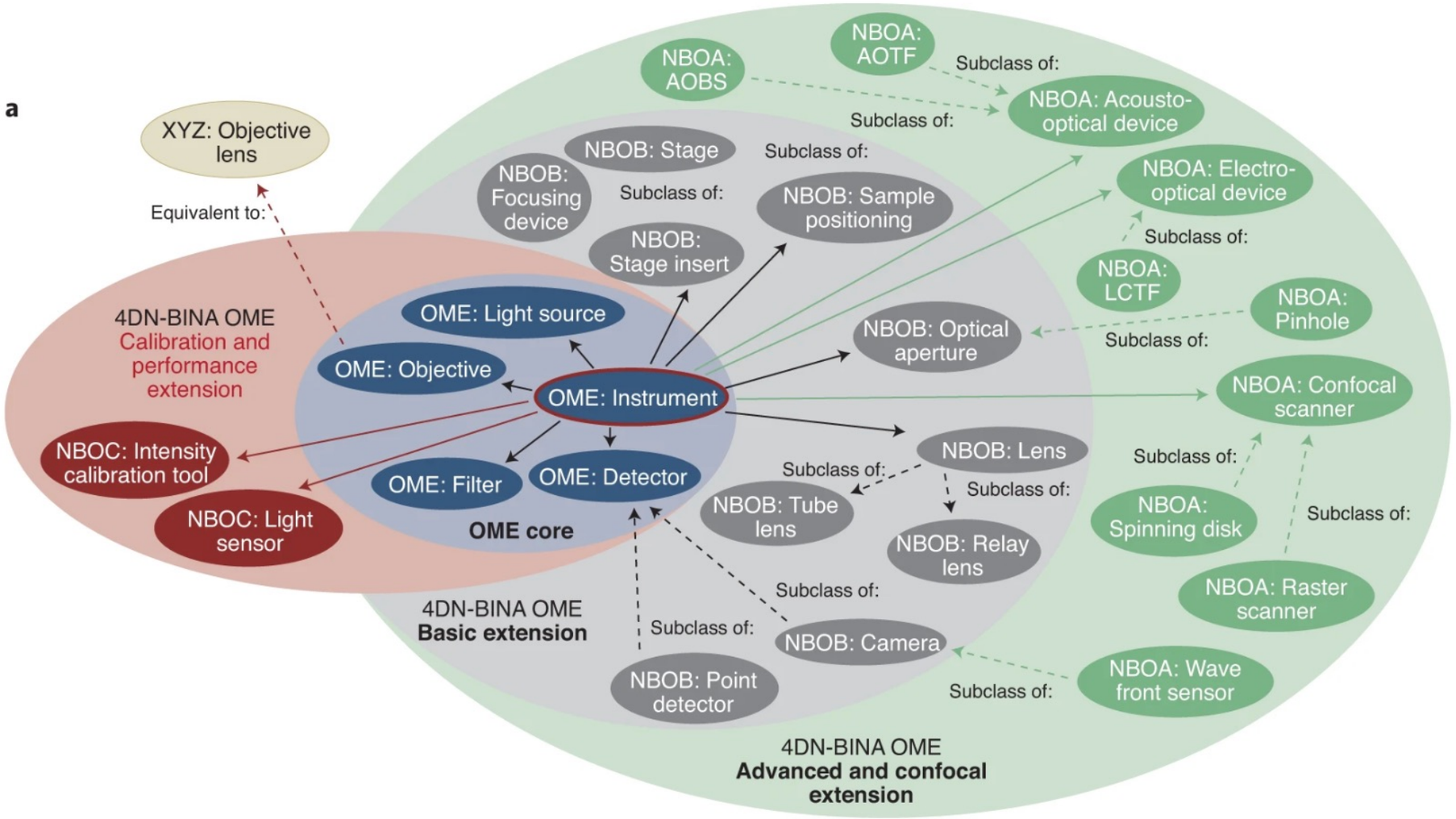
Community standards: Microscopy Metadata Specifications to expand the OME-data model



Community standards: Microscopy Metadata Specifications to expand the OME-data model

QUAREP-LiMi

Now the official host and responsible party!

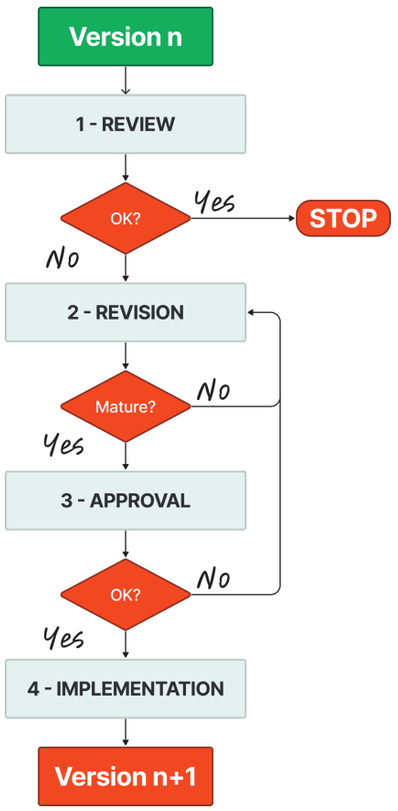
Who is the care taker of NBO-Q?

QUAREP-LiMi

WG 7 – Metadata

The Work Group 7 focuses on various aspects of **Image Metadata** (initially primarily Microscopy Metadata but also Sample and Analysis Metadata). These span from defining and continually revising the **4DN-BINA-OME (NBO) Microscopy Metadata** model, to facilitating metadata capture through user-friendly tools, to integrating the captured metadata into cloud-ready storage containers such as the newly developed **Open Microscopy Environment** (OME) **Next-Generation File Format** (NGFF). To

QUAREP-LiMi *bylaws*



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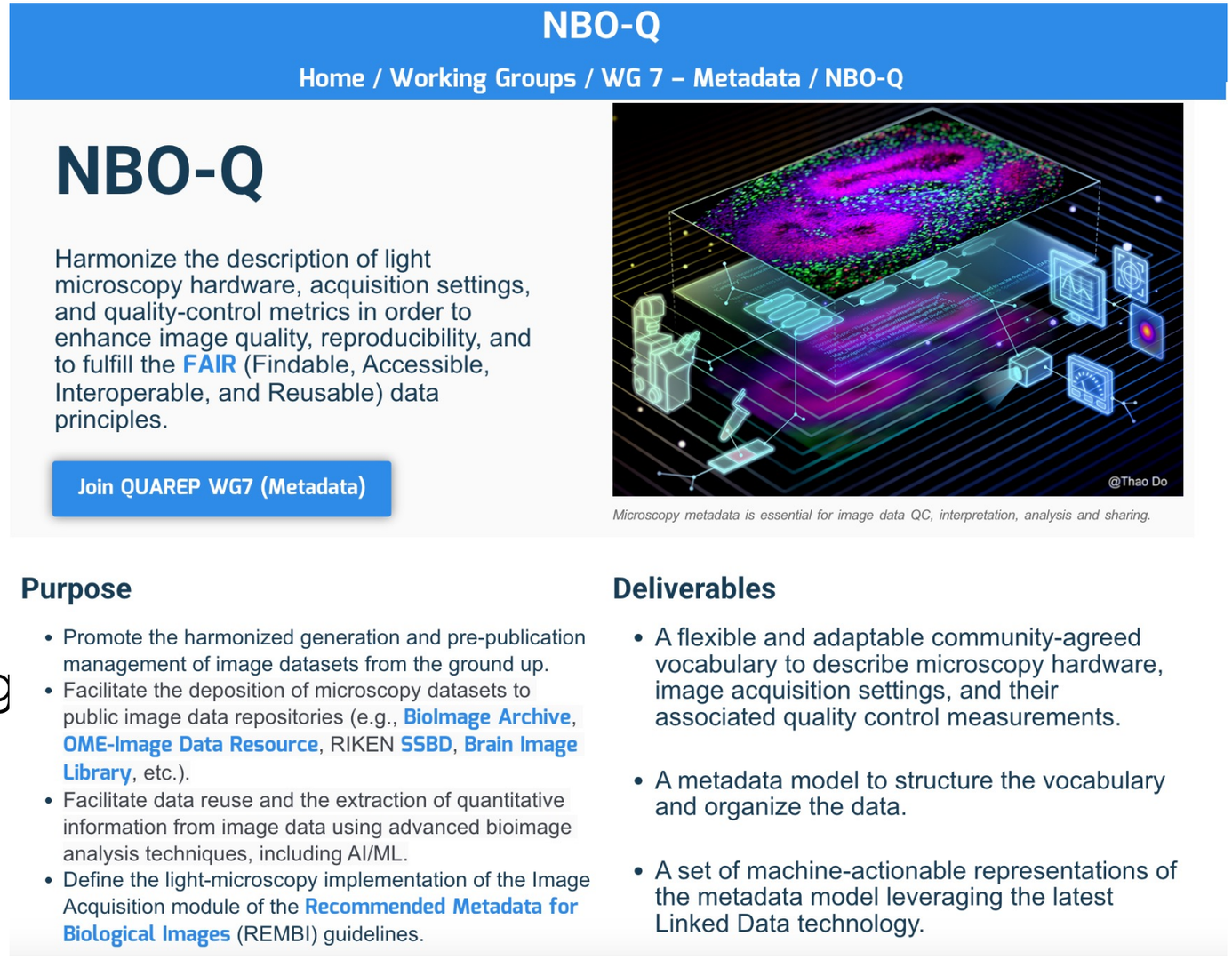
NBO-Q Light Microscopy Metadata Model

QUAREP-LiMi

- Hosted and maintained by QUAREP-LiMi
- Covers hardware configuration, image acquisition settings and quality control metadata
- Revision process codified by Best Practices document
- Large community of imaging scientists, microscopy experts, manufacturers and standards organizations stakeholders



https://quarep.org/working-groups/wg-7-metadata/

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QUAREP-LiMi: WG2 and WG7 partnership

WG 2 – Detection system performance

Home / Working Groups / WG 2 – Detection system performance

WG 2 - Objectives

WG2 focuses on the detection system, comprising the detection path and its detector(s), and how it measures the signal from the sample.

Members of WG2 aim to standardize the characterization of the detection system performance and create standard procedures for monitoring it over time, thereby revealing performance issues that could affect data reproducibility. Therefore, WG2 will define universal, externally measurable parameters applicable to any type of detector (e.g., photons, linearity, noise), together with measurement tools and protocols for measuring these parameters from common detector types. These universal parameters will be specified according to each distinct type of detector's internal parameters, which have already been defined by the community. They will enable the evaluation and comparison of different detection systems, thus pinpointing the most suitable technology for given applications.

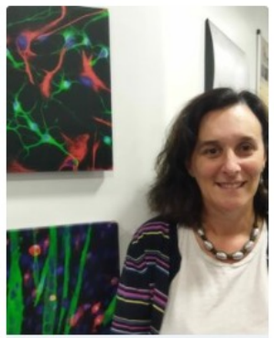
WG 2 - Co-Chairs

Gert-Jan Bakker

Research Scientist at RIMLS
Co-Chair of WG 2

Call: +31 24 36 142 96

Email: Gert-Jan.Bakker@radboudumc.nl



Valeria Berno

Imaging Facility Specialist at The Advanced Light and Electron Microscopy BioImaging Center (ALEMBIC) of San Raffaele Hospital
Co-Chair of WG 2

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Email: berno.valeria@hsr.it

David McFadden

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Email: david.andrew.mcfadden787@gmail.com

Britta Schroth-Diez

Deputy Service Leader at MPI-CBG
Co-Chair of WG 2 and WG 14

Call: +49-351-210-2522

Email: schroth@mpi-cbg.de

WG 7 – Metadata

Home / Working Groups / WG 7 – Metadata

WG 7 - Objectives

The Work Group 7 focuses on various aspects of Image Metadata (initially primarily Microscopy Metadata but also Sample and Analysis Metadata). These span from defining and continually revising the 4DN-BINA-OME (NBO) Microscopy Metadata model, to facilitating metadata capture through user-friendly tools, to integrating the captured metadata into cloud-ready storage containers such as the newly developed Open Microscopy Environment (OME) Next-Generation File Format (NGFF). To promote the uptake of metadata tools and models, educational material and outreach strategies are also developed.

To carry on these tasks, **WG7 is organized into four** Subgroups (see "Subgroup" tab below), each of which carries out specific objectives. These subgroups are created, paused, or dissolved on a needs basis as agreed by the WG7 as a whole.

The **general meeting serves as a space for reporting back** on the progress that has been achieved within the Subgroups, **connecting the dots, strategic planning**, and **general discussions**.

The Subgroups (see "Subgroup" tab below) **identify specific tasks** to be carried out to move our work forward. To participate, please first fill in the general QUAREP-LiMi membership form and then enter your name here. **Still confused?** No worries, we have a specific list of tasks that you can check out to know exactly how you can lend a hand.

WG 7 - Co-Chairs

Aastha Mathur

Coordinator Image Data Services at EuroBioImaging
Co-Chair of WG 7

Email: aastha.mathur@eurobioimaging.eu

Josh Moore

Senior Research Data Management Officer at German BioImaging
Co-Chair of WG 7

Email: joshua.moore@gerbi-gmb.de

Caterina Strambio De Castillia

Ass. Professor in Mol. Medicine
Chan Zuckerberg Imaging Scientist
Co-Chair of WG 7

Call: +1 (508) 856-2383

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Governance gives QUAREP a path forward towards NBO-Q v3.0 in partnership with key stakeholders

QUAREP-LiMi

The making of microscope camera standards

Cameras are a crucial part of microscopes and are also built into many kinds of instruments. To make their output comparable takes standards.

Vivien Marx

The academics and company scientists in the group Quality Assessment and Reproducibility for Instruments & Images in Light Microscopy (QUAREP-LiMi) are developing standards for microscopy camera output.

As in other areas of standards development, working with companies is crucial; "after all they are the expert of the hardware they are producing," says Caterina Strambio-de-Castillia, a researcher at the University of Massachusetts Medical School's Program in Molecular Medicine and a Chan Zuckerberg Imaging Scientist, who spearheads this effort within QUAREP-LiMi. A separate story in this issue of *Nature Methods* about emerging standards in microscopy can be found in this issue.

Part of the work in developing standards for cameras in microscopy and imaging is about creating common definitions as a public resource. "The QUAREP-ers are moving on all that quite well," says Jason Swedlow of the University of Dundee, who

Cameras are a crucial part of microscopes and imaging systems. Agreeing on standards to provide defined descriptions for aspects such as gain or readout speed is tricky. Credit: W. Bulgar/Science Photo Library

technology feature

Check for updates

Imaging standards to ease reproducibility and the everyday

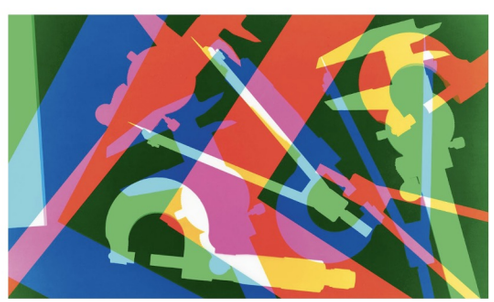
Imaging and microscopy technology advances in leaps and bounds. To address accumulated pain points, academics and companies are making headway on standards.

Vivien Marx

With a view to transparency and reproducibility in microscopy, scientists are hammering out standards to address, for instance, the surprises of fluctuating illumination power, the jungle of file formats, the mysteries of missing metadata and the diversity of camera outputs. A second story in this issue of *Nature Methods* focused on camera standards can be found here.

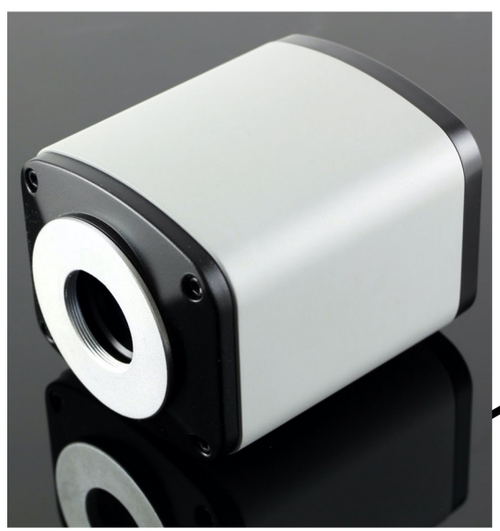
"We need standards," says Roland Nitschke of the University of Freiburg. Developing standards in imaging is a noble deed that can make some eyes glaze over even beyond the glaze arising from long hours at the microscope. Those who feel they lack the time to pitch in on standards might be glad to hear that some not-so-distant developments stand to help microscopy users pull out their hair a bit less. Here's a peek at how some emerging standards could address real-world pain points.

Standards development is not a task for



Emerging standards in microscopy are being set up to address many pain points in the field. Credit: TEK Image/Science Photo Library

- **January – August 2022**: 10+ focused feedback sessions to build consensus
- **Completed first parsing of camera hardware specifications and image acquisition settings!**
- **Due SOON:** Revision of **4DN-BINA-OME-QUAREP** Camera Metadata model + vocabulary



Camera
- Manufacturer: *Xyz*
- Catalog Nr: *0000*
- Mount: *C-mount*
- FrameRate: *20 fps*
- ReadOutRate: *30 MHz*

CC BY

EVIDENT
OLYMPUS
ZEISS
Leica MICROSYSTEMS
Nikon
pco.
Scientifica
OXFORD INSTRUMENTS
ANDOR
TELEDYNE PHOTOMETRICS
HAMAMATSU
PHOTON IS OUR BUSINESS

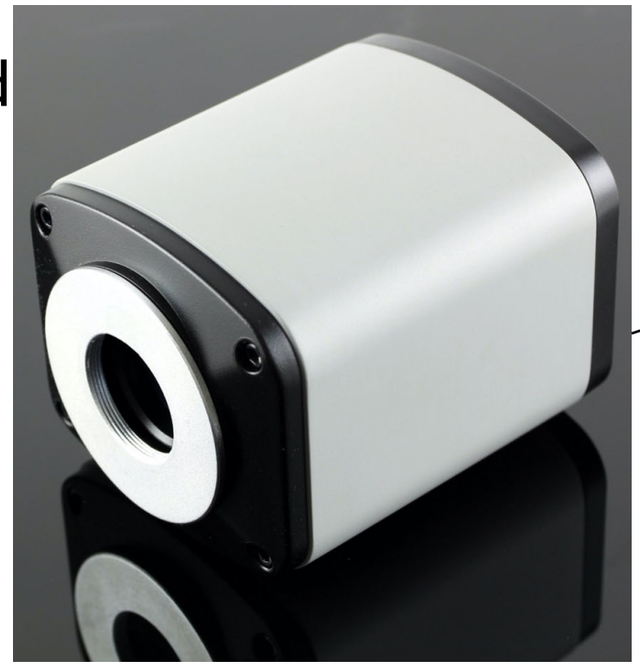
QUAREP-LiMi

WG2 & WG7 joint endeavor

Partnership with manufacturers and vendors

Glossary + Metadata Model

- Terms (a.k.a. attributes) used to describe the camera hardware and image acquisition settings
- Agreed upon descriptions of each term
- Define sets of relationships between the terms that reflect the real-life scenario



Camera
- Manufacturer: ***Xyz***
- Catalog Nr: ***0000***
- Mount: ***C-mount***
- FrameRate: ***20 fps***
- ReadOutRate: ***30 MHz***

Agreed upon by all major stakeholders in the community (manufacturers, custodians, users)

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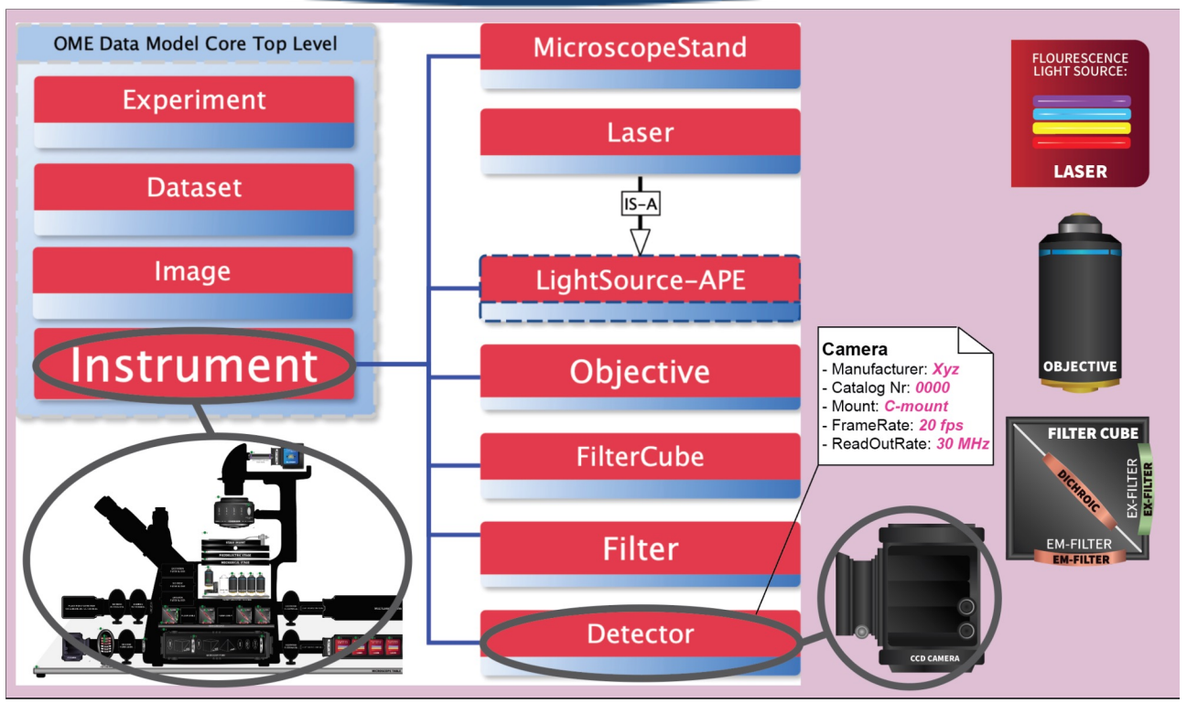
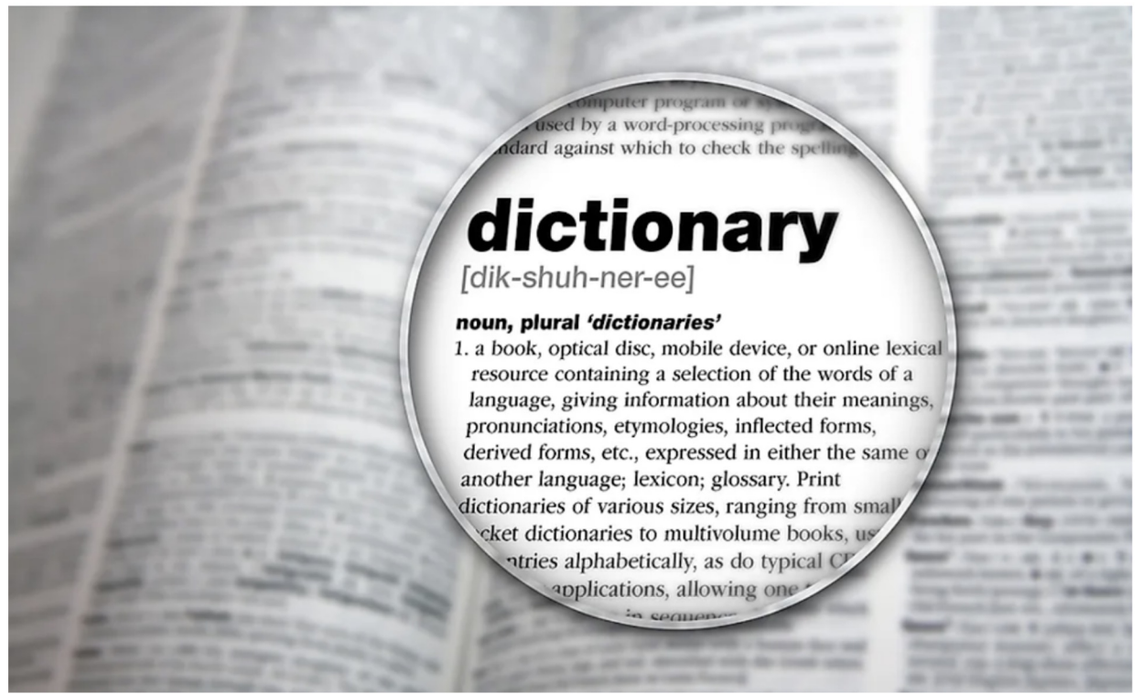
Microscopy glossary and metadata model



- Exchange of information with Manufacturers
- Automate capture of Metadata
- Next-Generation Image Metadata framework
- Shared storage solutions

- Communication and Reporting
- Reproducibility and Quality Control
- Education and Dissemination



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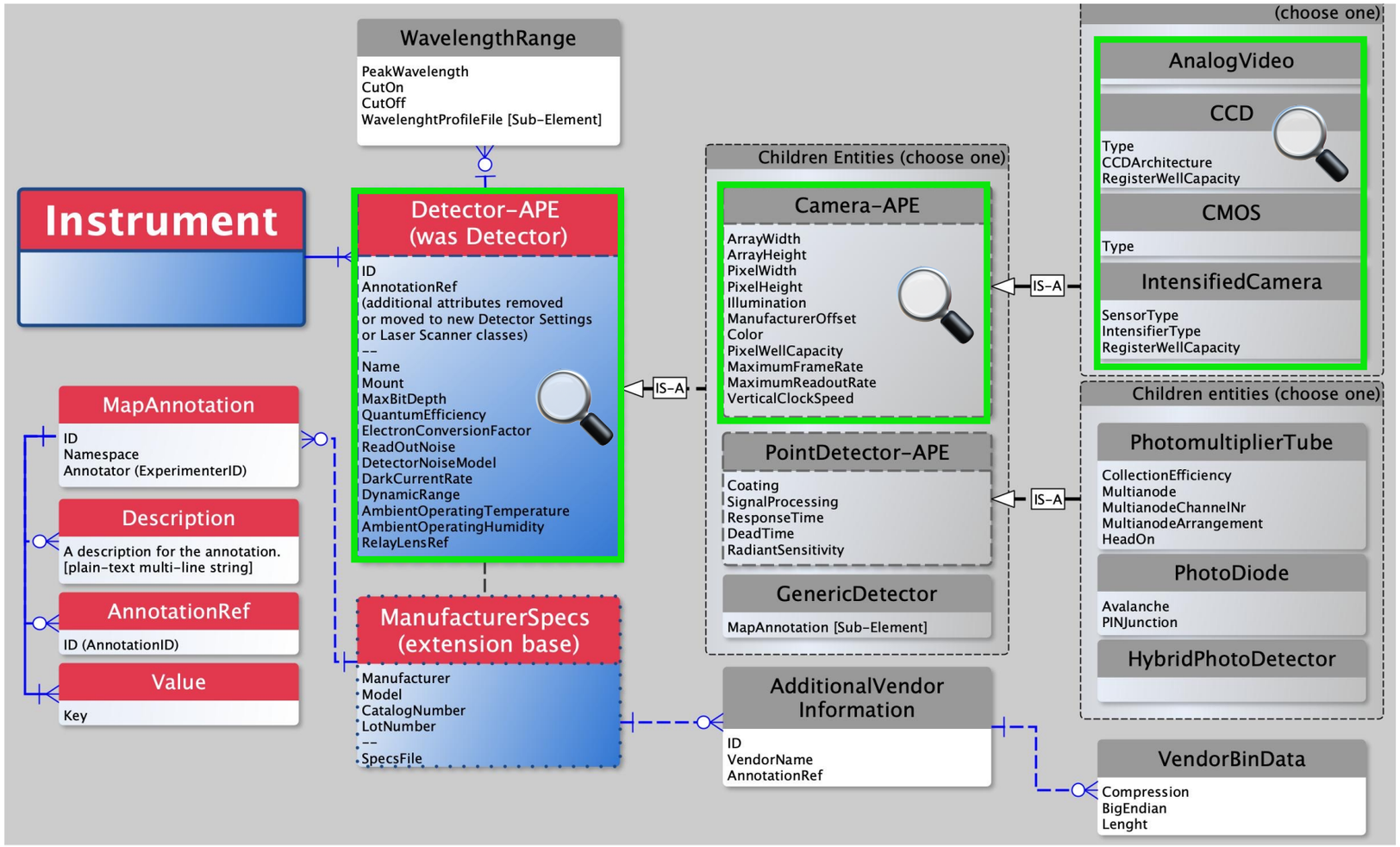
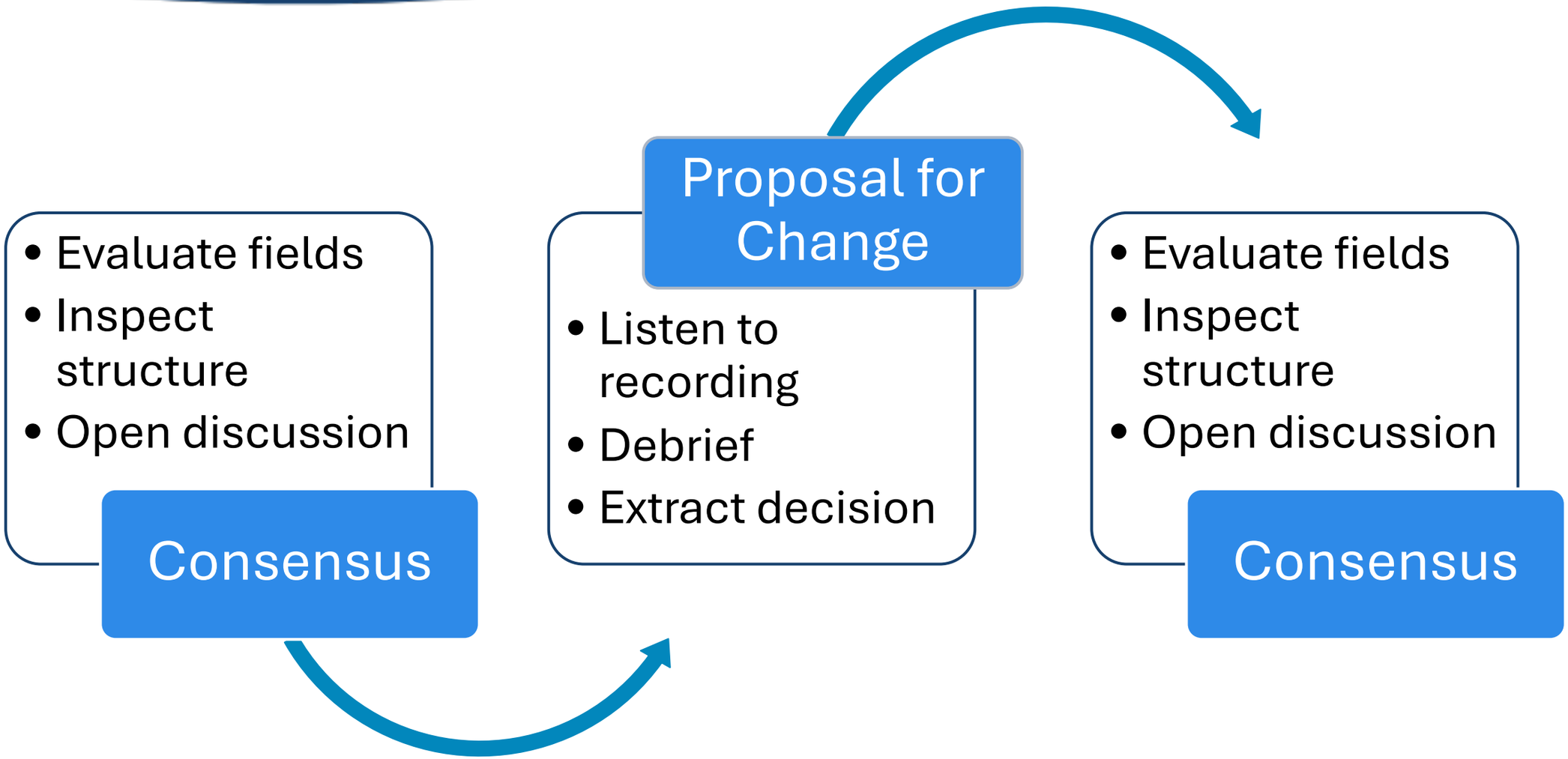
Starting point NBO 2021 published version



QUAREP-LiMi

WG2 & WG7 joint endeavor

Focus groups to review model elements and attributes

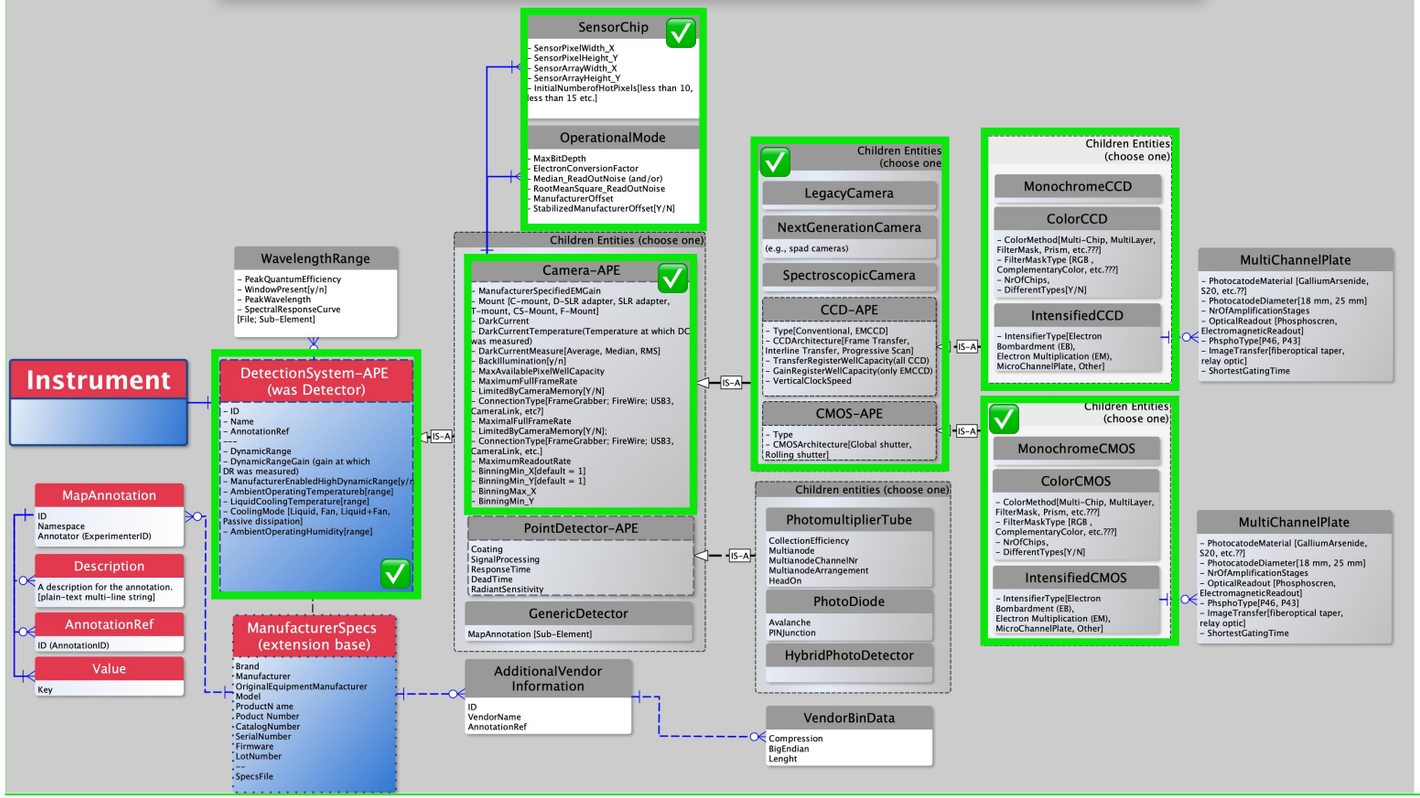


QUAREP-LiMi

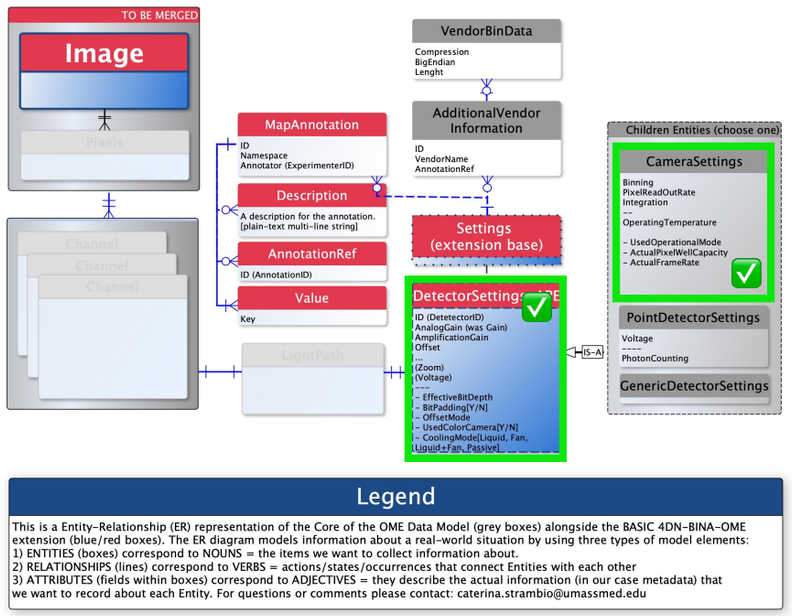
WG2 & WG7 joint endeavor

Outcome NBO-Q 2025 version

OME Core vs. NBO Basic Extension vs. NBOQ DETECTIONSYSTEM Hardware Specifications



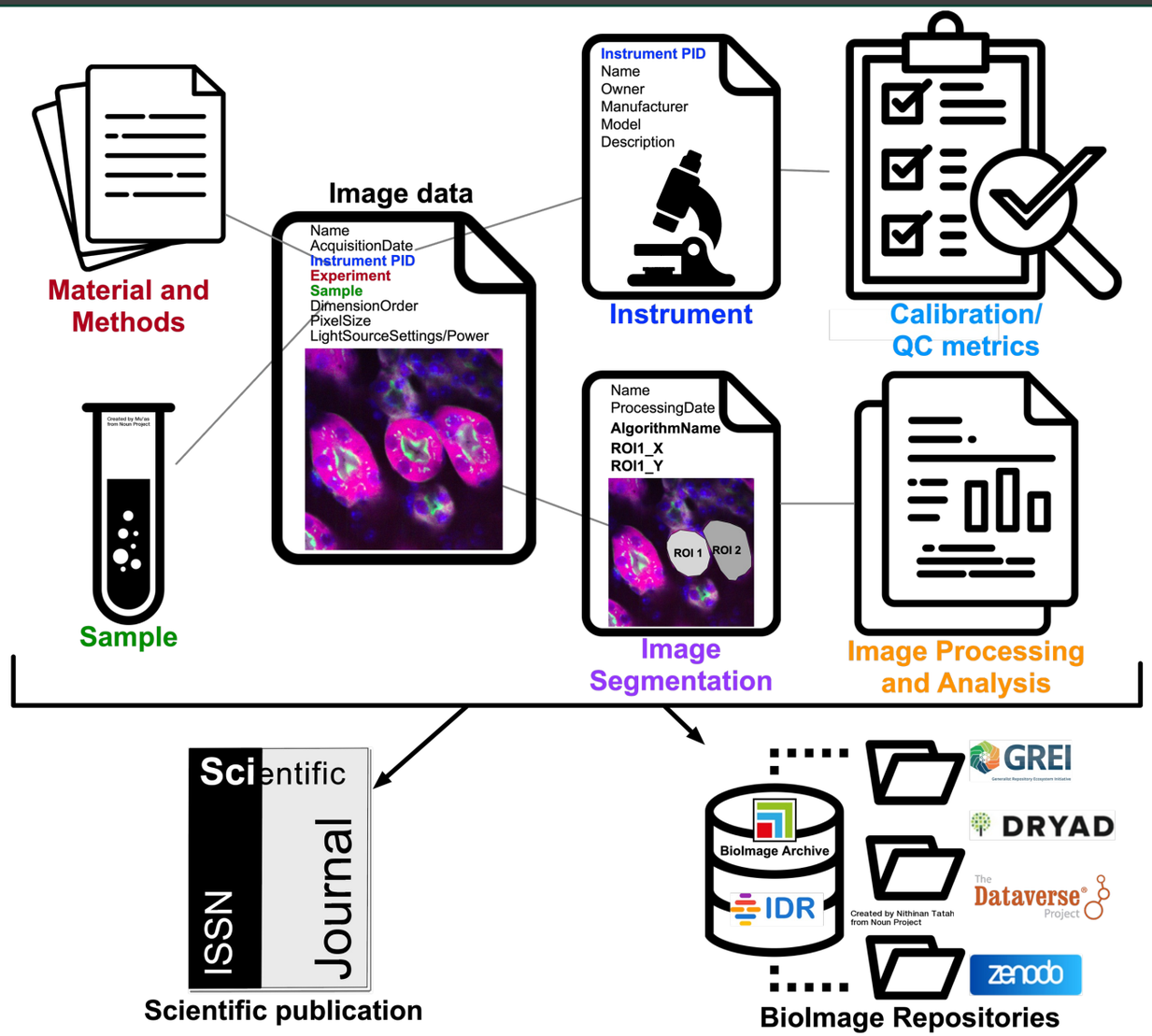
OME Core vs. NBO Basic Extension vs. NBOQ DETECTIONSYSTEM Acquisition Settings



Legend

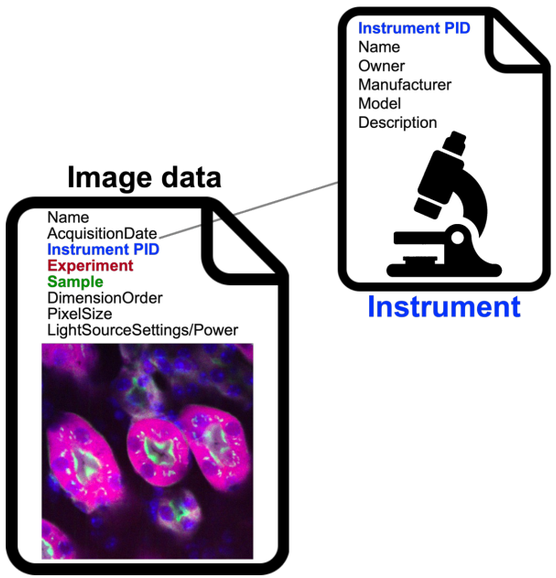
This is a Entity-Relationship (ER) representation of the Core of the OME Data Model (grey boxes) alongside the BASIC 4DN-BINA-OME extension (blue/red boxes). The ER diagram models information about a real-world situation by using three types of model elements:
1) ENTITIES (boxes) correspond to NOUNS = the items we want to collect information about.
2) RELATIONSHIPS (lines) correspond to VERBS = actions/states/occurrences that connect Entities with each other
3) ATTRIBUTES (fields within boxes) correspond to ADJECTIVES = they describe the actual information (in our case metadata) that we want to record about each Entity. For questions or comments please contact: caterina.strambio@umassmed.edu

Where is bioimage metadata?



PIDs can help maintain links between different essential information

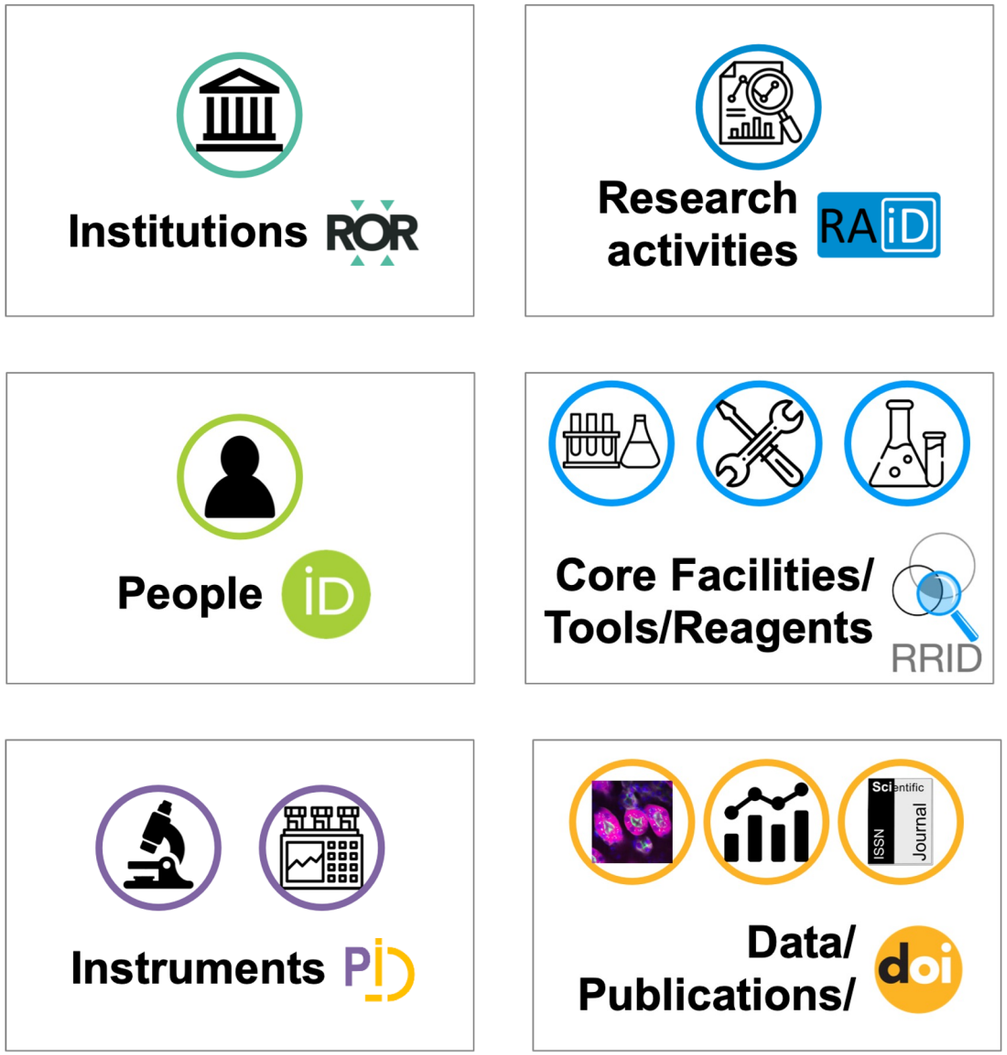
Persistent Hardware Descriptors help making data FAIR



Linked PIDs for

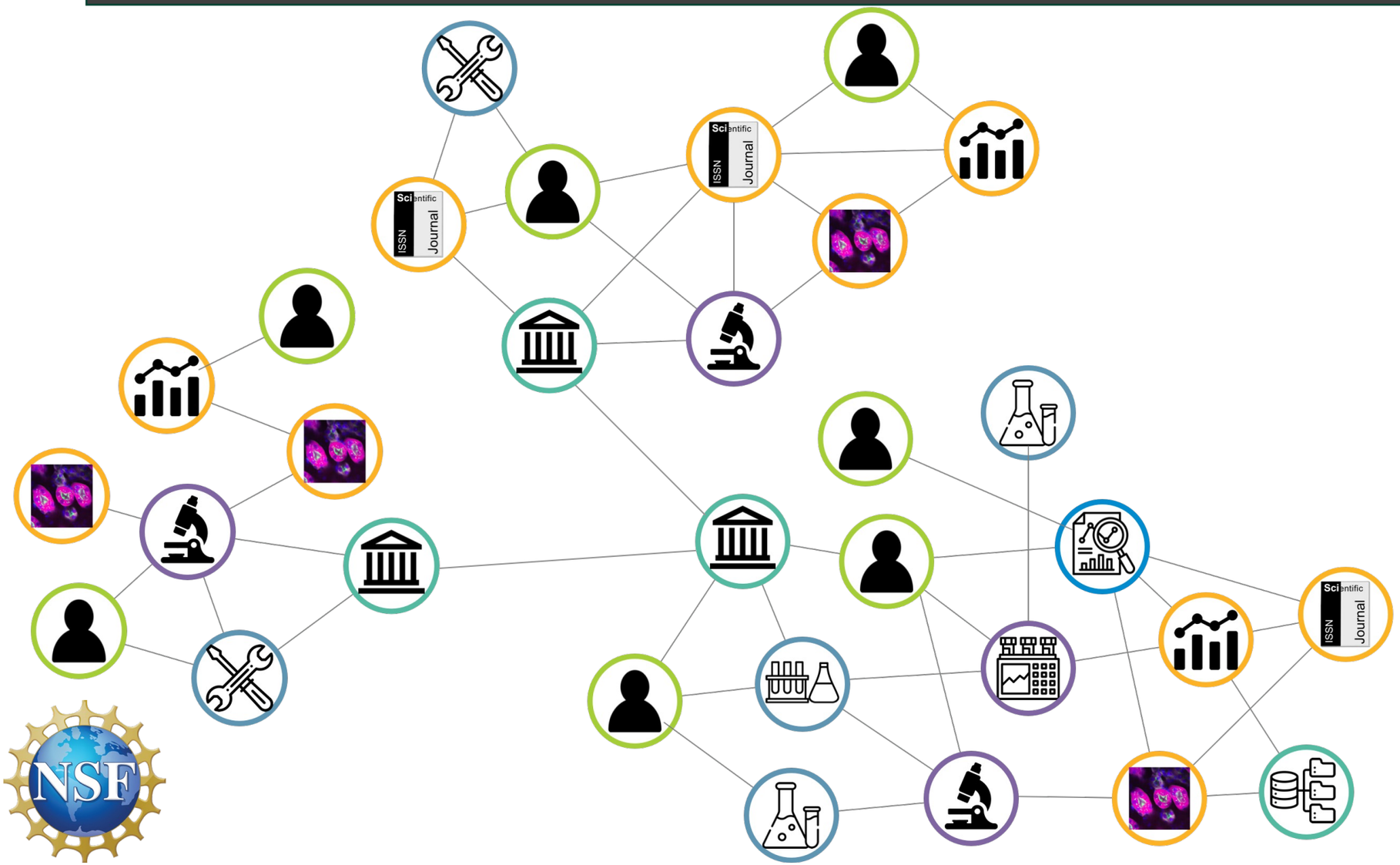
- Instrument instance
- Instrument model
- Hardware configuration

What are Persistent Identifiers?



- PIDs are **unique alphanumeric codes** that can be assigned to individual resources.
- They are often associated with **metadata registries** describing the entities they refer to.
- They are often **“minted” by an authority** that is responsible for their preservation.
- They resolve to **lasting landing pages**.
- **Different PIDs** are recommended for different types of resources

PIDs are used to link people and research resources to data and publications



Institutions

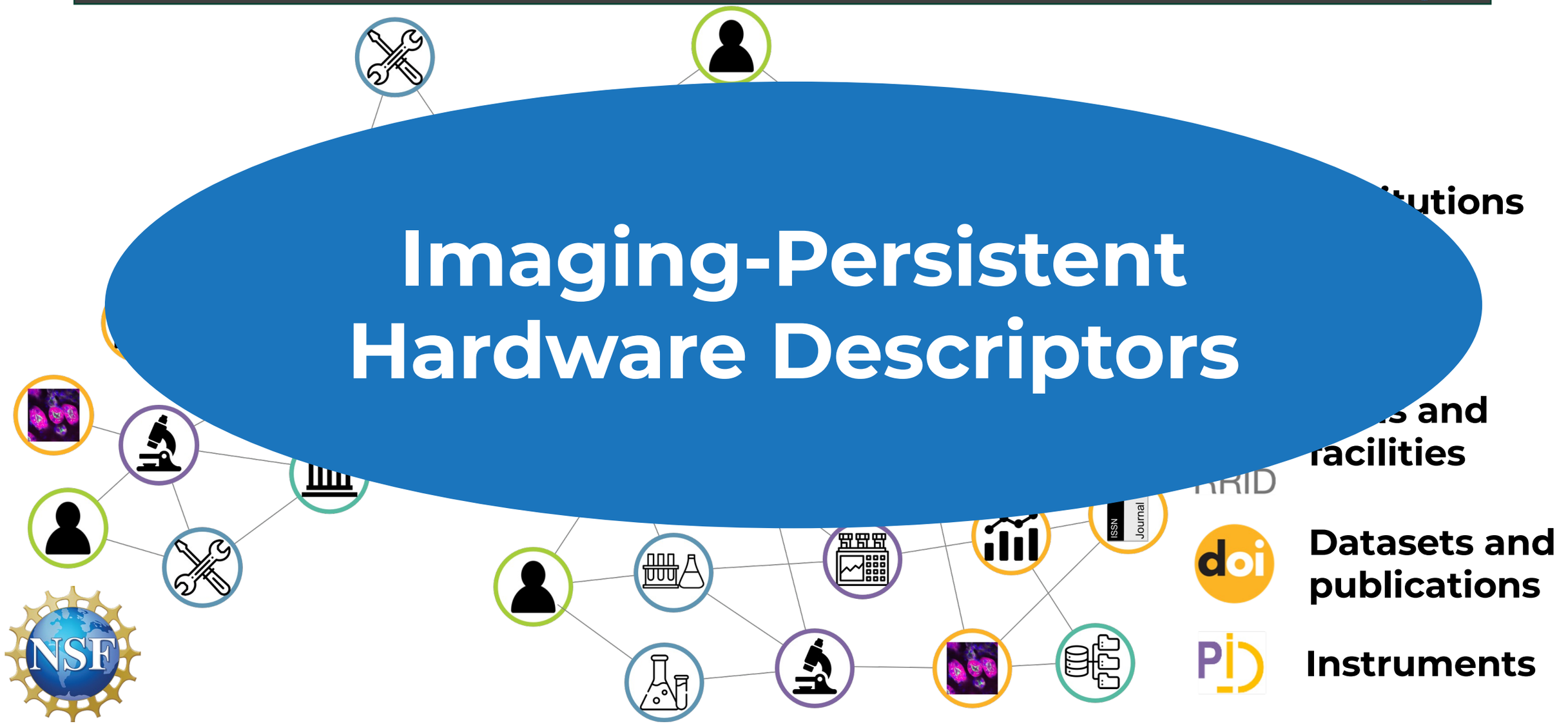
People

Tools and facilities

Datasets and publications

Instruments

PIDs are used to link people and research resources to data and publications



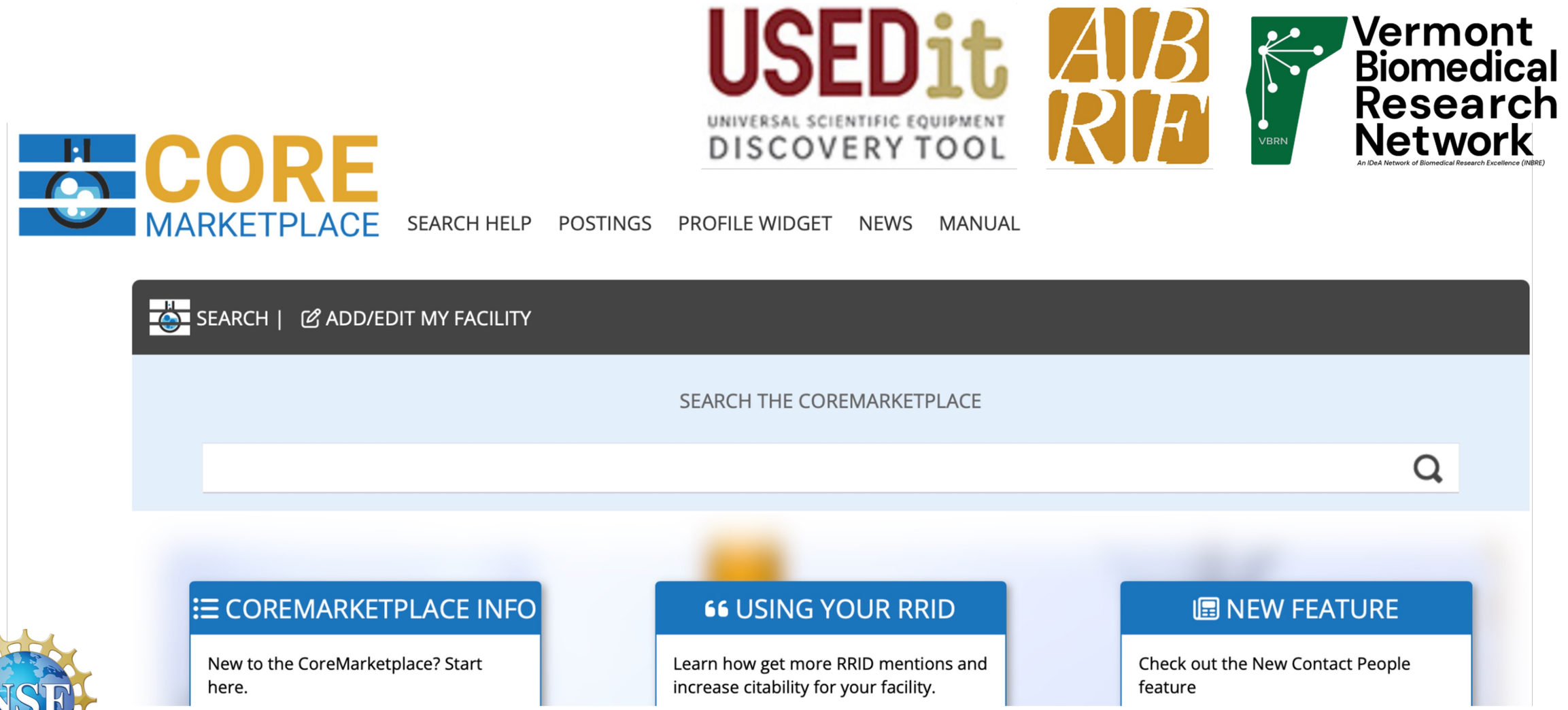
itutions

s and facilities

Datasets and publications

Instruments

Core Marketplace + RRID: supporting the persistent identification of core-facilities



Core Marketplace + RRID: supporting the persistent identification of core-facilities

FDI Lab
FAIR Data Informatics

SciCrunch

Find Plasmids | Find Cells | Find Organisms

PIDINST: Metadata schema for the persistent identification of instruments

Persistent Identification of Instruments

ABOUT US RESOURCES

We seek to explore a community-driven solution for globally unique identification of measuring instruments operated in the sciences. The group has developed a Metadata Schema for Persistent Identification of Instruments, which is endorsed by the Research Data Alliance as a Recommendation. Our primary task is to actively engage with and support communities in schema implementations and aim, thus, at widespread adoption of the Recommendation.

Outcomes

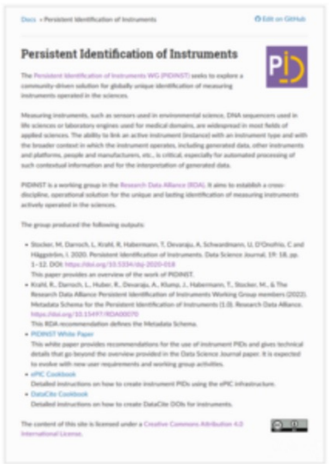
Metadata Schema for the Persistent Identification of Instruments

RDA Recommendation

| Metadata Schema

Persistent Identification of Instruments

| Journal Article

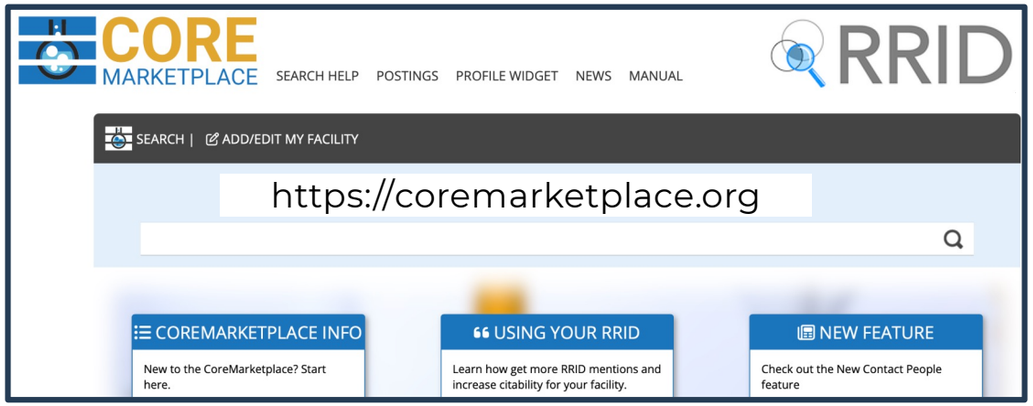

Persistent Identification of Instruments

| White Paper

https://www.rd-alliance.org/groups/persistent-identification-instruments-wg/activity/

https://www.pidinst.org/

Imaging-PHD: Combining complementary resources to build new functionalities

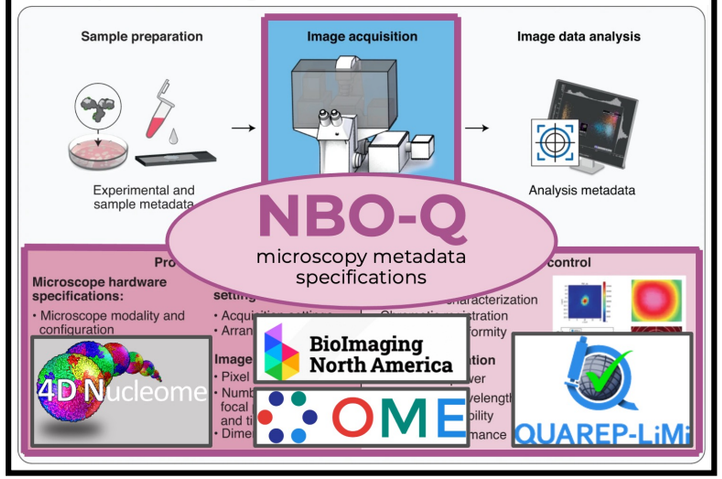


https://wu-bimac.github.io/MicroMetaApp.github.io/

ID	Property
1	Identifier
2	SchemaVersion
3	LandingPage
4	Name
5	Owner
6	Manufacturer
7	Model
8	Description
9	InstrumentType
10	MeasuredVariable
11	Date
12	RelatedIdentifier
13	AlternateIdentifier

https://docs.pidinst.org/en/latest/

https://doi.org/10.1038/s41592-021-01327-9



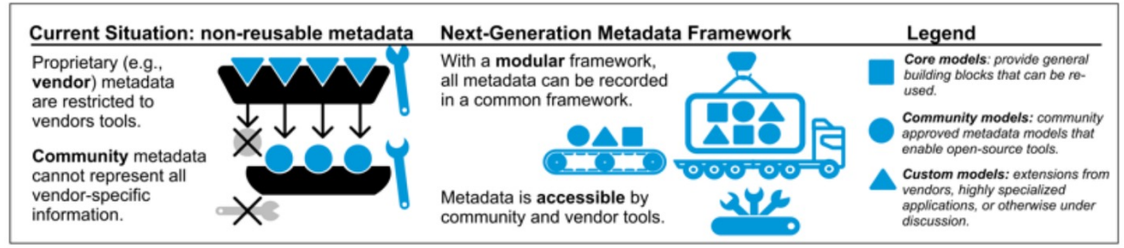


Figure 1 Next-generation metadata will provide the community a composable collection of metadata schemas to remove barriers to re-use and collaboration.

10.5281/zenodo.1126501610

The team and the community

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Physics, Photonics

UMass Chan MEDICAL SCHOOL

James Chambers
Core Manager

UMASS

Judith Lacoste
Quality-Control

Josh Moore
Next Gen Metadata

German BioImaging
Gesellschaft für Mikroskopie und Bildanalyse

BioImaging North America

QUAREP-LiMi

CBI BIC
Canada BioImaging
BioImagerie du Canada

OME

4D Nucleome

HuBMAP
Human BioMolecular Atlas Program

Adrian Zai
Research Informatics

Anita Bandrowsky
RRID

Nate Herzog
CoreMarketplace

NSF

UMass Chan MEDICAL SCHOOL

SciCrunch
FDI Lab
FAIR Data Informatics

Vermont Biomedical Research Network
An IDeA Network of Biomedical Research Excellence (INBRE)

AIBRIE

CORE MARKETPLACE

RDA

DataCite

Labs and Core Facilities have different overlapping needs for the Instrument Data Management

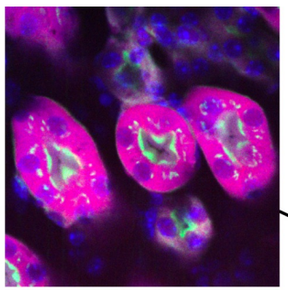


Image data

GREI DRYAD IDR zenodo The Dataverse Project

phatplus

BioImage repositories

?

prettycons

Core facility inventories/website

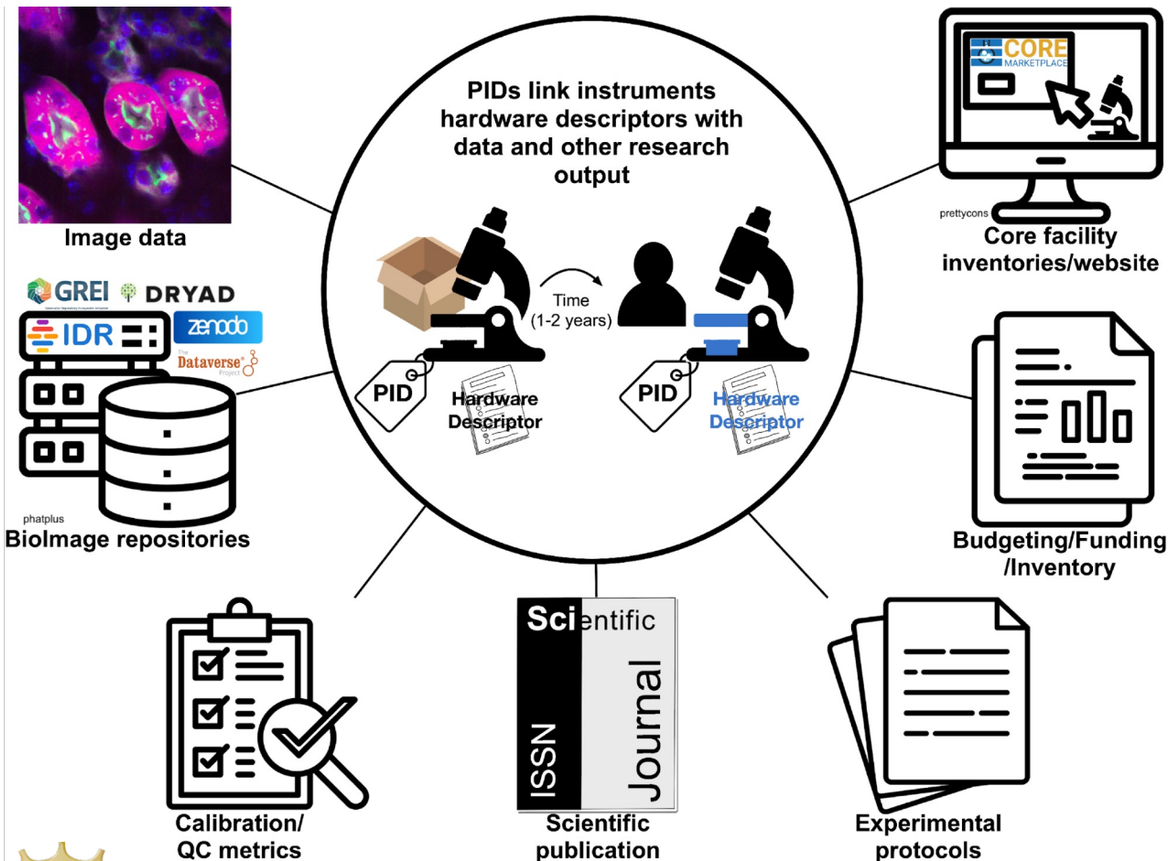
Budgeting/Funding /Inventory

Calibration/ QC metrics

Scientific publication

Experimental protocols

Persistent Hardware Descriptors: make live easier for cores and labs



Metadata is Scattered

- Critical imaging metadata is stored across disparate locations (files, devices, documents).
- This fragmentation hinders reproducibility, reuse, and proper attribution.

What Are Persistent Identifiers (PIDs)?

- Unique, long-lasting digital codes assigned to entities like instruments, datasets, and people.
- Maintained by trusted authorities and resolve to stable landing pages with rich metadata.

Why PIDs Are Essential

- **Linking**: Connect hardware, datasets, publications, and contributors.
- **Preservation**: Maintain long-term accessibility and integrity of research assets.

Christmas tree decoration

Model nr. 001

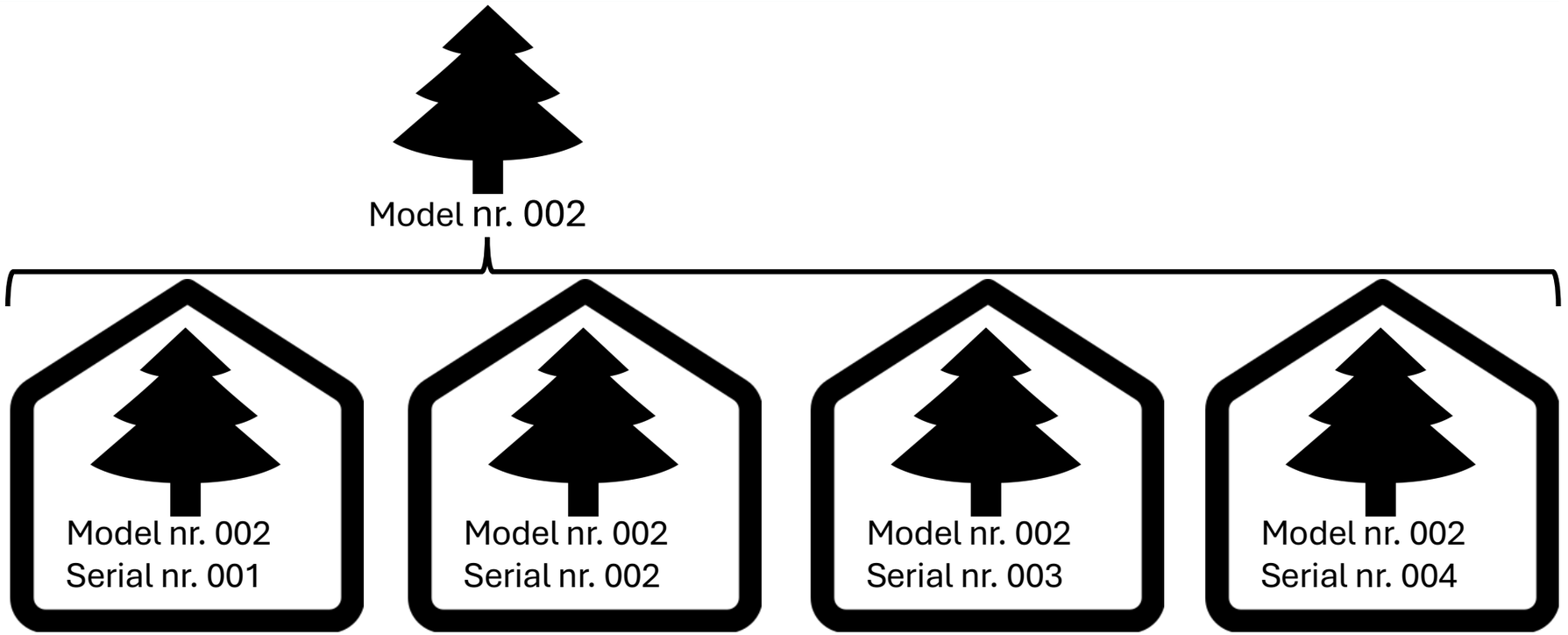
Model nr. 002

Model nr. 003

Model nr. 004

Model nr. 005

Christmas tree decoration



Christmas tree decoration

Model nr. 002

Model nr. 002
Serial nr. 002

Model nr. 002
Serial nr. 002
Config nr. 001

Year 2

Model nr. 002
Serial nr. 002
Config nr. 002

Year 5

Model nr. 002
Serial nr. 002
Config nr. 003

Year 10

Model nr. 002
Serial nr. 002
Config nr. 003

Christmas tree decoration

Model nr. 001 Model nr. 002 Model nr. 003 Model nr. 004 Model nr. 005

Model nr. 002
Serial nr. 001

Model nr. 002
Serial nr. 002

Model nr. 002
Serial nr. 003

Model nr. 002
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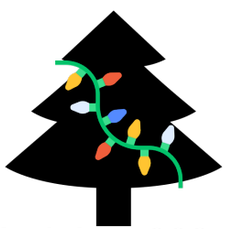
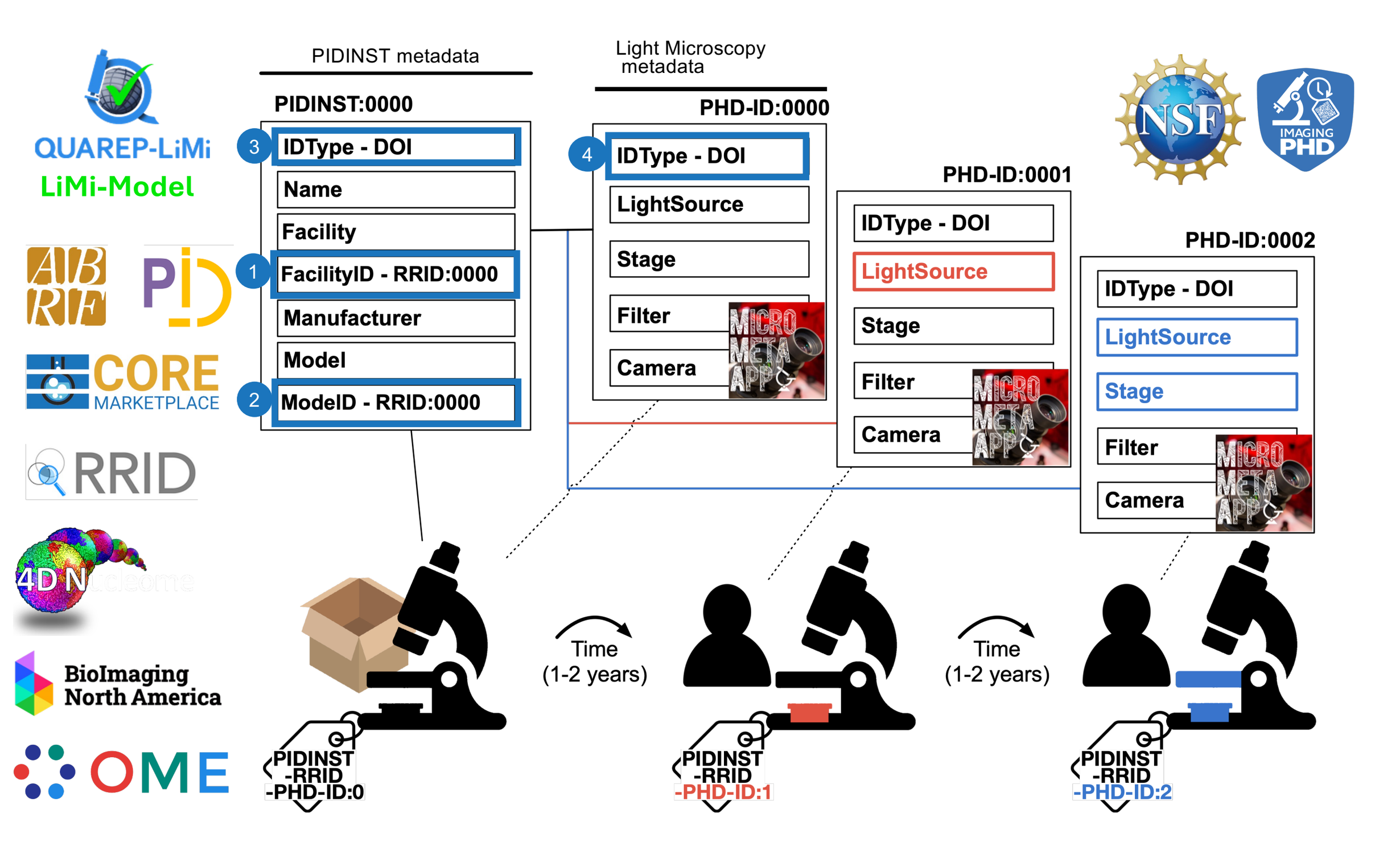
Model nr. 002
Serial nr. 001

Model nr. 002
Serial nr. 002



Model nr. 002
Serial nr. 003

Model nr. 002
Serial nr. 004


QUAREP-LiMi
LiMi-Model
PIDINST metadata
PIDINST:0000
3
IDType - DOI
Name
Facility
1
FacilityID - RRID:0000
Manufacturer
Model
2
ModelID - RRID:0000
Light Microscopy metadata
PHD-ID:0000
4
IDType - DOI
LightSource
Stage
Filter
Camera
PHD-ID:0001
IDType - DOI
LightSource
Stage
Filter
Camera
PHD-ID:0002
IDType - DOI
LightSource
Stage
Filter
Camera
NSF
IMAGING PHD
CORE MARKETPLACE
RRID
4D Nucleome
BioImaging North America
OME
Time (1-2 years)
Time (1-2 years)
PIDINST -RRID -PHD-ID:0
PIDINST -RRID -PHD-ID:1
PIDINST -RRID -PHD-ID:2

QUAREP-LiMi

LiMi-Model

PIDINST metadata

PIDINST:0000

3 IDType - DOI

Name

Facility

1 FacilityID - RRID:0000

Manufacturer

Model

2

Light Microscopy metadata

PHD-ID:0000

4 IDType - DOI

LightSource

Stage

PHD-ID:0001

IDType - DOI

LightSource

PHD-ID:0002

IDType - DOI

LightSource

Stage

Core Facility → RRID: SRC_XYZQ

Model → RRID:SRC_XYZW

Instance → PIDINST:10.1000/XYZ-

Hardware Descriptor → PHD: 10.1000/XYZ

Time (1-2 years)

Time (1-2 years)

PIDINST -RRID -PHD-ID:0

PIDINST -RRID -PHD-ID:1

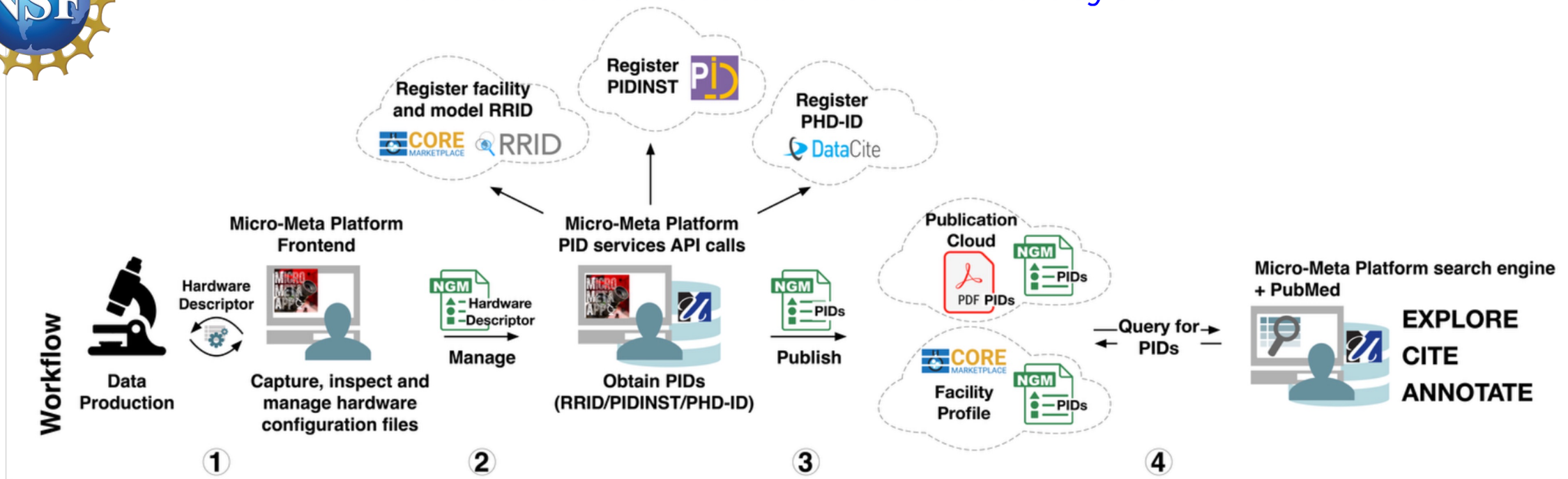
PIDINST -RRID -PHD-ID:2

BioImaging North America

OME

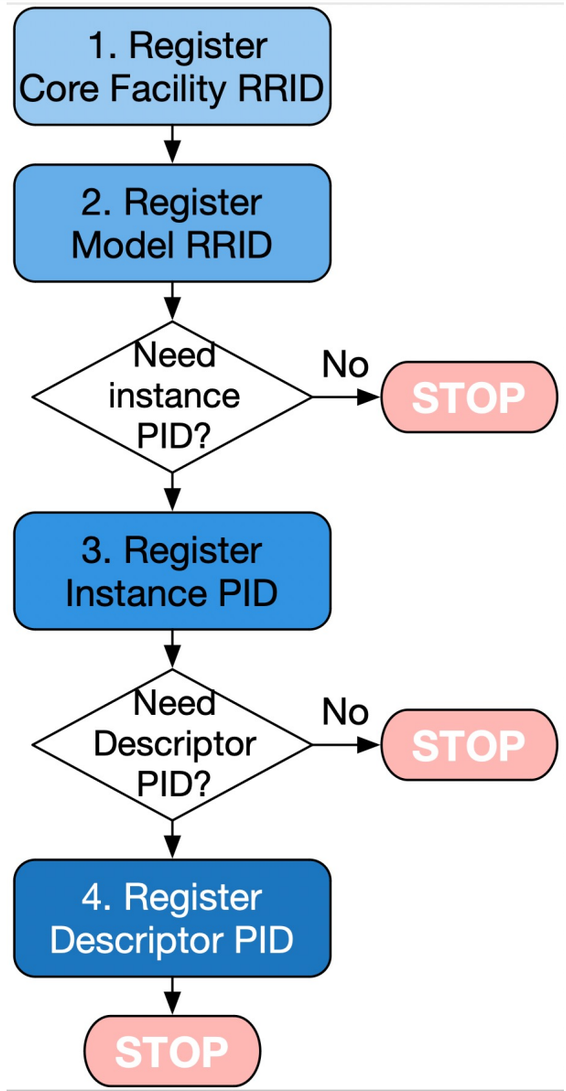
Deliverable - Micro-Meta Platform Workflow and Architecture

Capturing, registering, and reusing persistent hardware metadata across the research lifecycle.



FAIR Facilities and Instruments: PID recommendations

1. **Flexible PID recommendations:** based on the requirements of different use cases and different scientific domains
2. **Capability of assigning PID in different tiers.** For example:
   1. Core Facilities
   2. Instrument Model/Type
   3. Instrument Instance
   4. Descriptor (Hardware Configuration / Settings / Parameters)
3. **PID concatenation**
4. **PID connection**



FAIR Facilities and Instruments: PID recommendations

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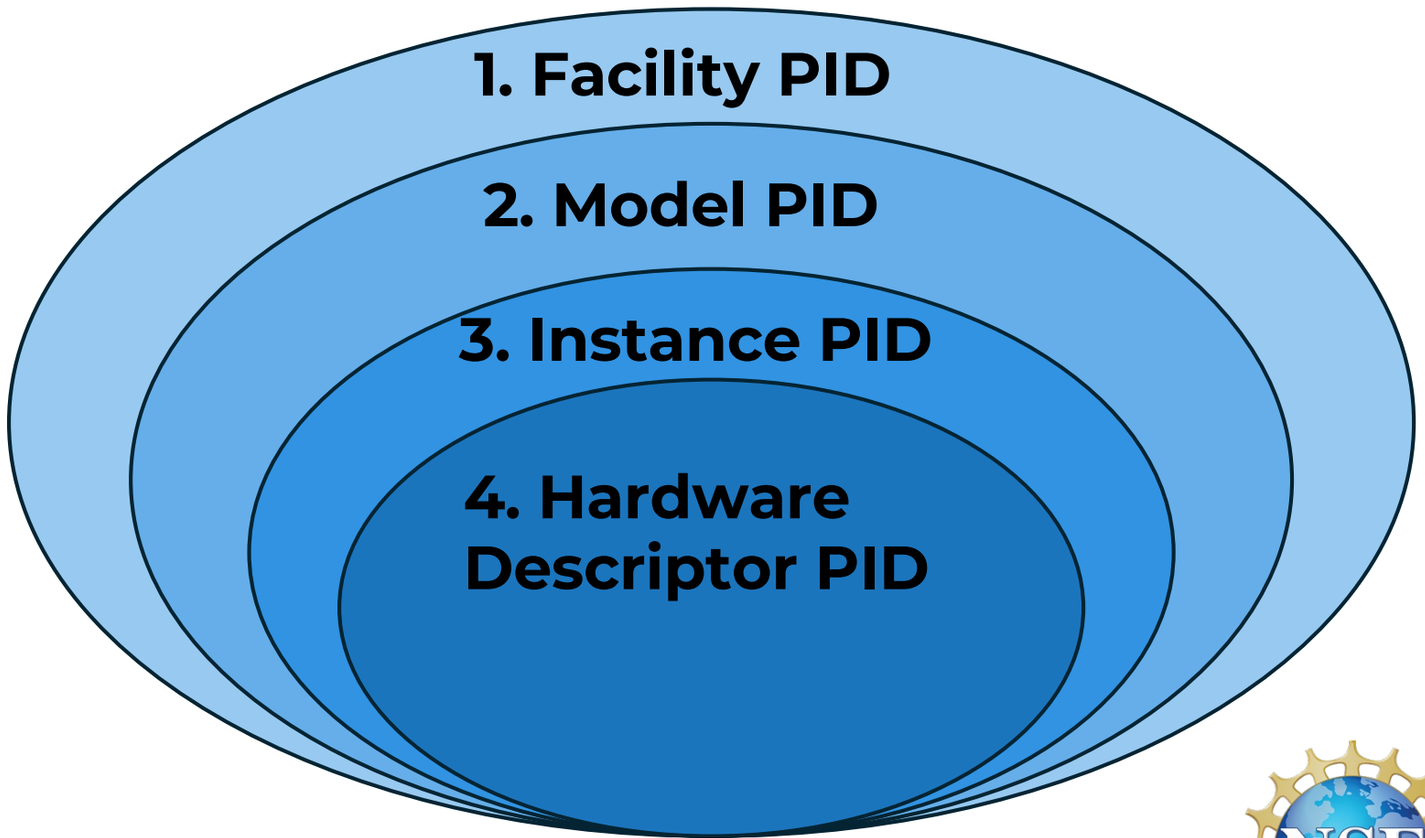


NGM facilitates getting the full technical descriptions of microscopes from vendors

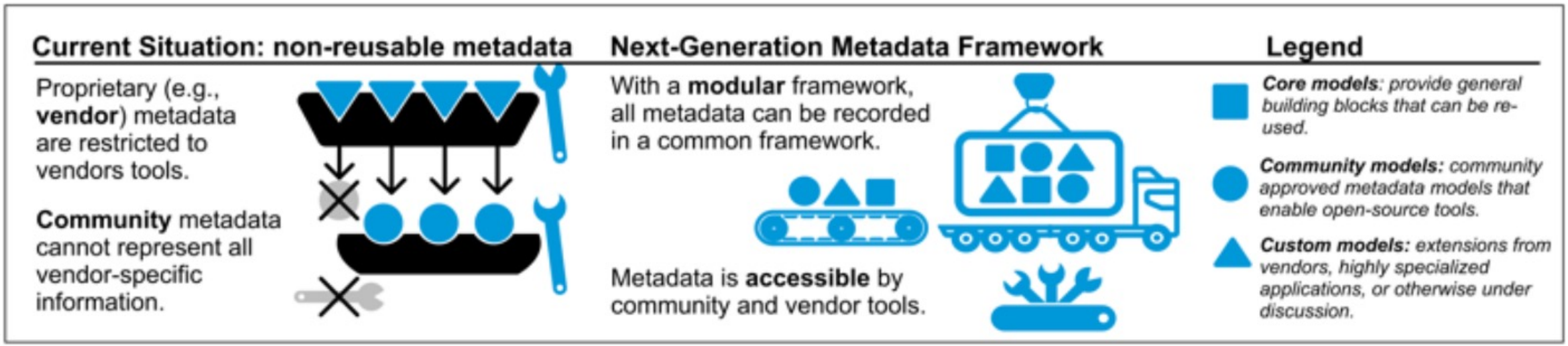
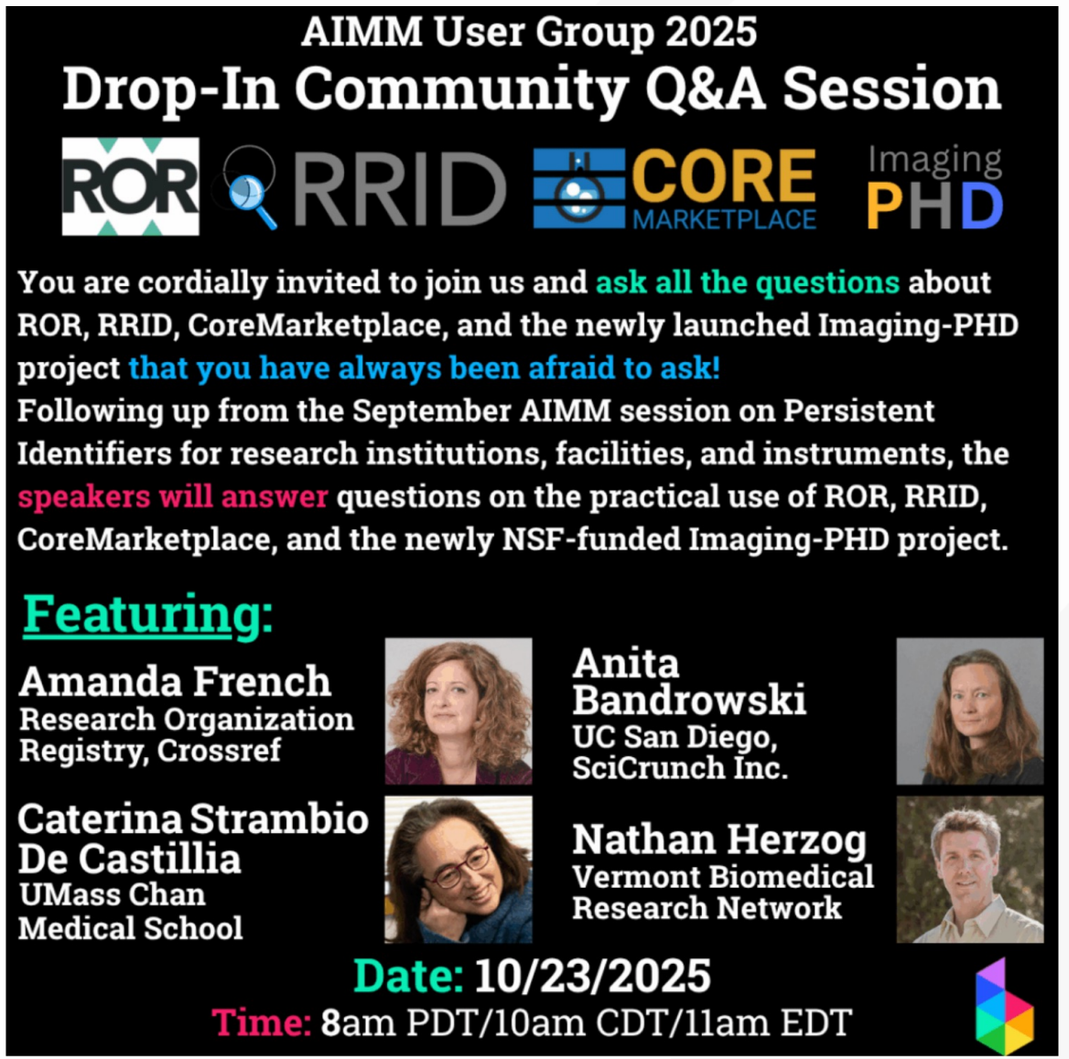


Figure 1 Next-generation metadata will provide the community a composable collection of metadata schemas to remove barriers to re-use and collaboration.

Moore and Strambio-De-Castillia, 2024; 10.5281/zenodo.112650161

Save the date: AIMM UG Community Event on PIDs for Cores and Instruments



This is your chance to **finally ask the questions you've always been afraid to ask** about Persistent Identifiers (PIDs) for Facilities and Instruments!

When:

- **October 23rd 2025,**
- **8 am US PT / 11 am US ET / 5 pm EU CT**

Why attend?

- Get **practical guidance** on using
- ROR, RRID, and CoreMarketplace
- and the new Persistent Hardware
- Descriptor (PHD) project.

Registration →

THANK YOU!

UMass Med + Canada Bioimaging

Judith Lacoste

Thomas Stroh

Claire Brown

Pina Colarusso

Alex Rigano

Alice Kang

Stephen Ogg

BINA+QUAREP-LiMi

- Alison North, The Rockefeller University
- Roland Nitschke, Uni Freiburg
- Britta Schroth-Diez, Max Plank, Dresden
- Damir Sudar, Uni Oregon, QIS
- Caroline Miller
- Nikki Bilay + Vanessa Orr, BINA
- BINA Quality Control and Data Management WG
- QUAREP-LiMi WG7 – Metadata

Grunwald lab – UMMS-RTI

- David Grunwald
- Mathias Hammer
- Max Huisman
- Farzin Farzam

4DN Community

- 4DN IWG: Sarah Aufmkolk, Lacra Bintu, Alistair Boettingerr, Steve Wang, Ting Wu
- DCIC: Burak Alver, Andrea Cosolo,
- Shannon Ehmsen,
  Koray Kirli, Rahi Navelkar, Peter Park, Andrew Schroder, Serkan Utku Ozturk

HuBMAP Community and Pittsburgh Supercomputing Center (PSC)

- Katy Borner, Phil Blood, Chris Csonka, Stephen Fisher, Brendan Honick, Ajay Pillai, Alex Ropelewski

Imaging Scientists Community

- Lisa Cameron, Duke
- Michelle Itano, CZI, UNC
- Paula Montero-Llopis, HMS
- Jennifer Waters, CZI, HMS

OME community

- Jason Swedlow, OME
- Josh Moore, OME
- Shuichi Onami, RIKEN

UMass Chan MEDICAL SCHOOL

4D Nucleome

BioImaging North America

QUAREP-LiMi

OME

HuBMAP

Human BioMolecular Atlas Program

NIH National Institutes of Health

Chan Zuckerberg Initiative