

The Open Microscopy Environment:

Annual Users Meeting

University of Dundee, Scotland

Jason Swedlow

The OME Consortium

#ome2018



Centre for Gene Regulation & Expression
Div of Computational Biology
School of Life Sciences, University of Dundee
Dundee, Scotland, UK



 **Glencoe**
SOFTWARE
Seattle, WA, USA
Dundee, UK

Talk Outline

- Thank you!
- This Meeting...
- The Problem
- Our Progress
 - High Level Survey
 - See the Workshops
- Funding...
- Future Priorities...

Thank you!!!

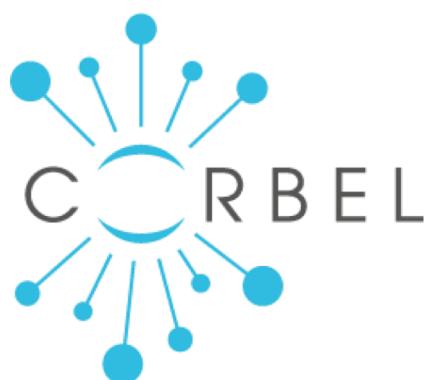


Wilma Woudenberg June Matthew

Thank you!!!



Chan
Zuckerberg
Initiative 



GLOBAL
BIOIMAGING
growing collaboration

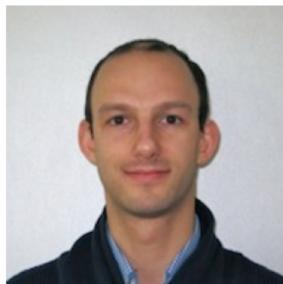


Dundee OME Team



Jason Swedlow

CO-FOUNDER



Sebastien Besson

SENIOR SOFTWARE
DEVELOPER



Jean-Marie Burel

SENIOR SOFTWARE
ARCHITECT



Mark Carroll

SOFTWARE DEVELOPER



Helen Flynn

TECHNICAL WRITER



David Gault

SOFTWARE DEVELOPER



Kenny Gillen

SYSTEM ADMINISTRATOR



Riad Gozim

SOFTWARE DEVELOPER



Roger Leigh

SOFTWARE DEVELOPER



Simon Li

SOFTWARE DEVELOPER



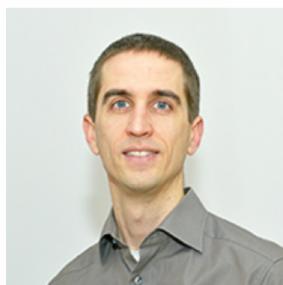
Dominik Lindner

SOFTWARE DEVELOPER



June Matthew

PROJECT CO-ORDINATOR



Josh Moore

SENIOR SOFTWARE
ARCHITECT



Will Moore

SOFTWARE DEVELOPER



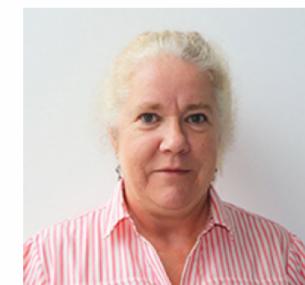
Gabriella Rustici

PROJECT MANAGER



Petr Walczysko

QA SOFTWARE SPECIALIST



Wilma Woudenberg

PA TO JASON SWEDLOW

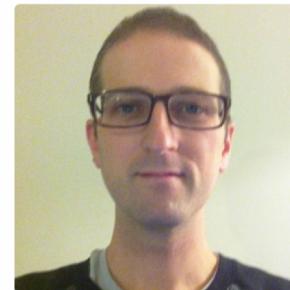
Glencoe Software Team



Jason Swedlow
President & CEO



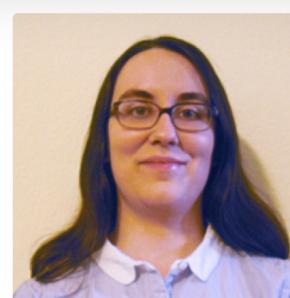
Chris Allan
VP Software Engineering



Joshua Ballanco
Software Developer



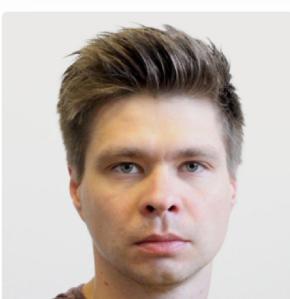
Andreas Knab
Software Developer



Melissa Linkert
Software Developer



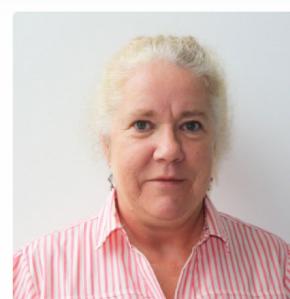
Chris MacLeod
Systems Administrator



Emil Rozbicki
Applications Specialist



Liza Unson
Senior UI/UX Designer



Wilma Woudenberg
PA to Jason Swedlow

The OME Consortium



Paul
French



Gaudenz
Danuser



Ilan
Davis



Gianluigi
Zanetti



Peter
Sorger



Spencer
Shorte



Alvis
Brazma



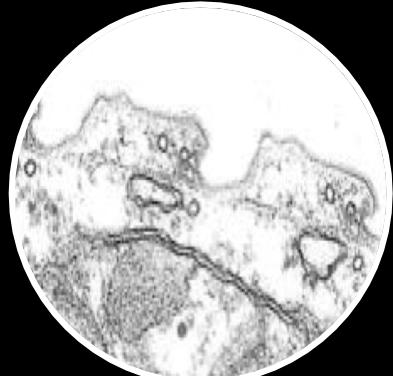
Rafael
Carazo-Salas



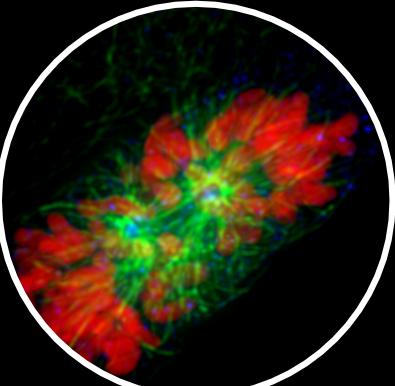
Edoard
Bertrand

THE PROBLEM

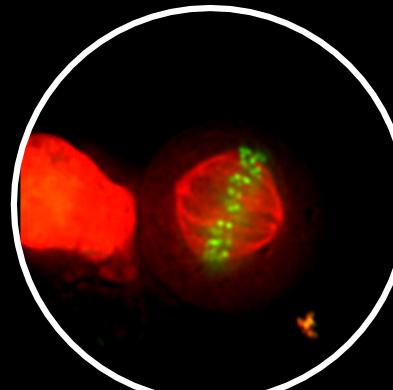
The Image Problem is Ubiquitous



Organelles



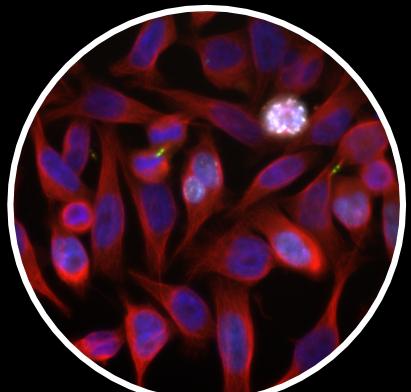
Cells



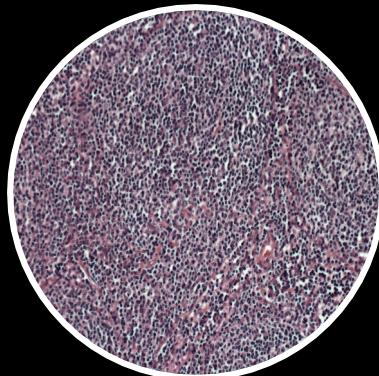
Dynamics



Physiology



Lead Discovery
Target Validation



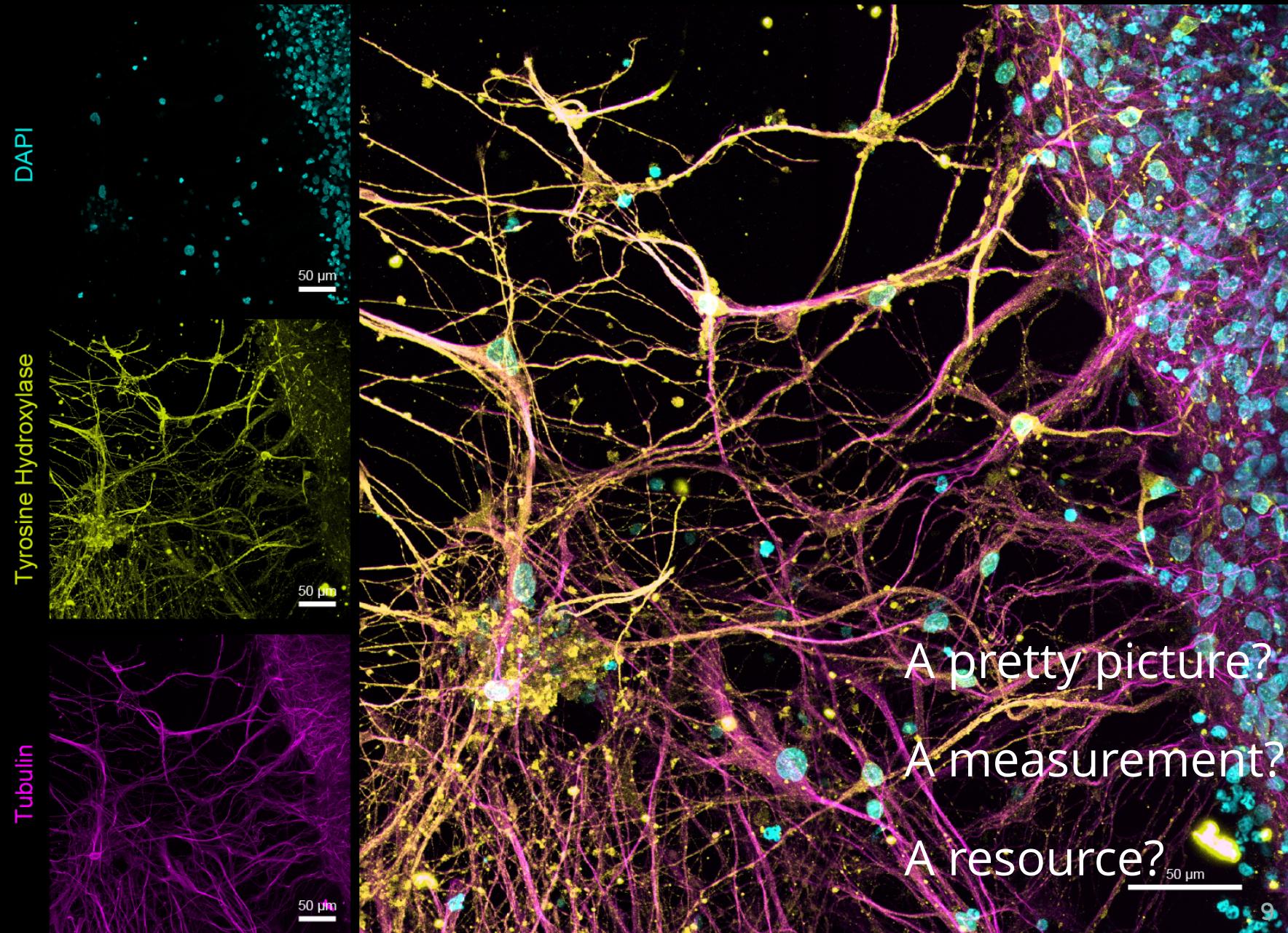
Pathology



In Vivo

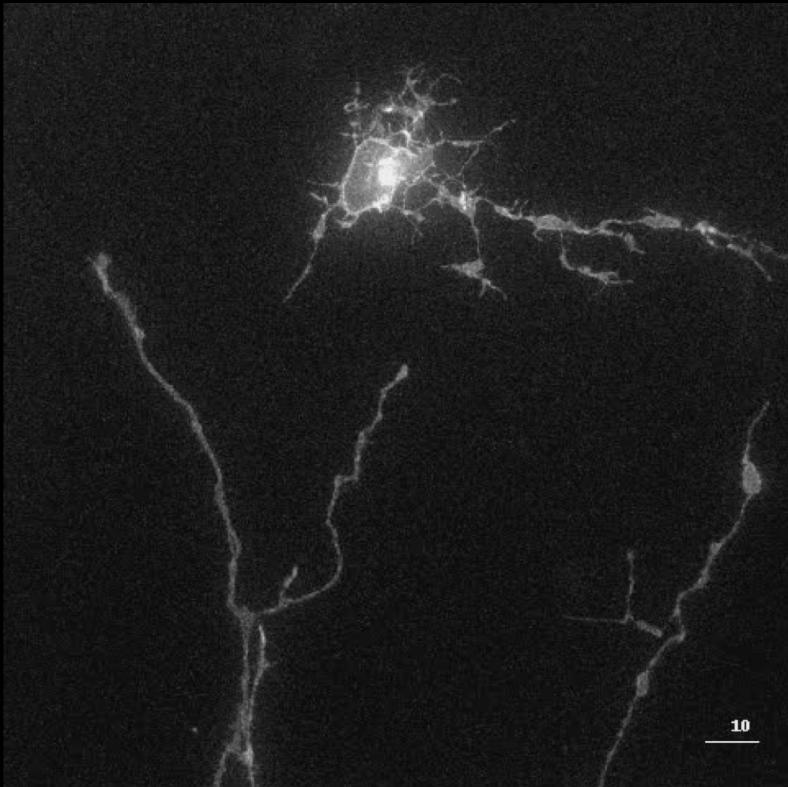
A pretty picture?
A measurement?
A resource?

Solving the Image Problem *is Essential*

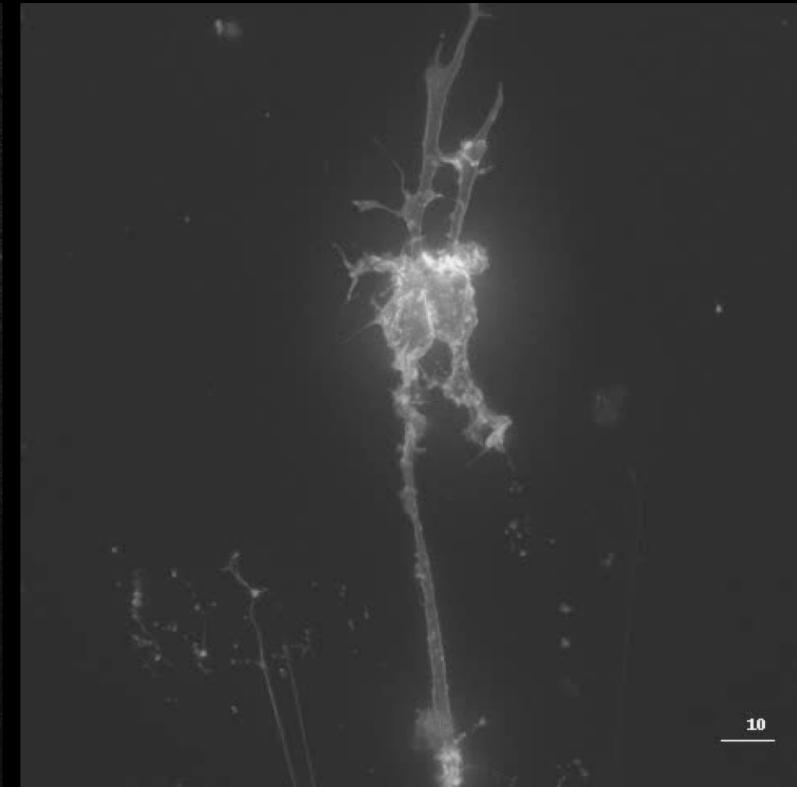


Solving the Image Problem *is Essential*

WT



Bod1^{-/-}



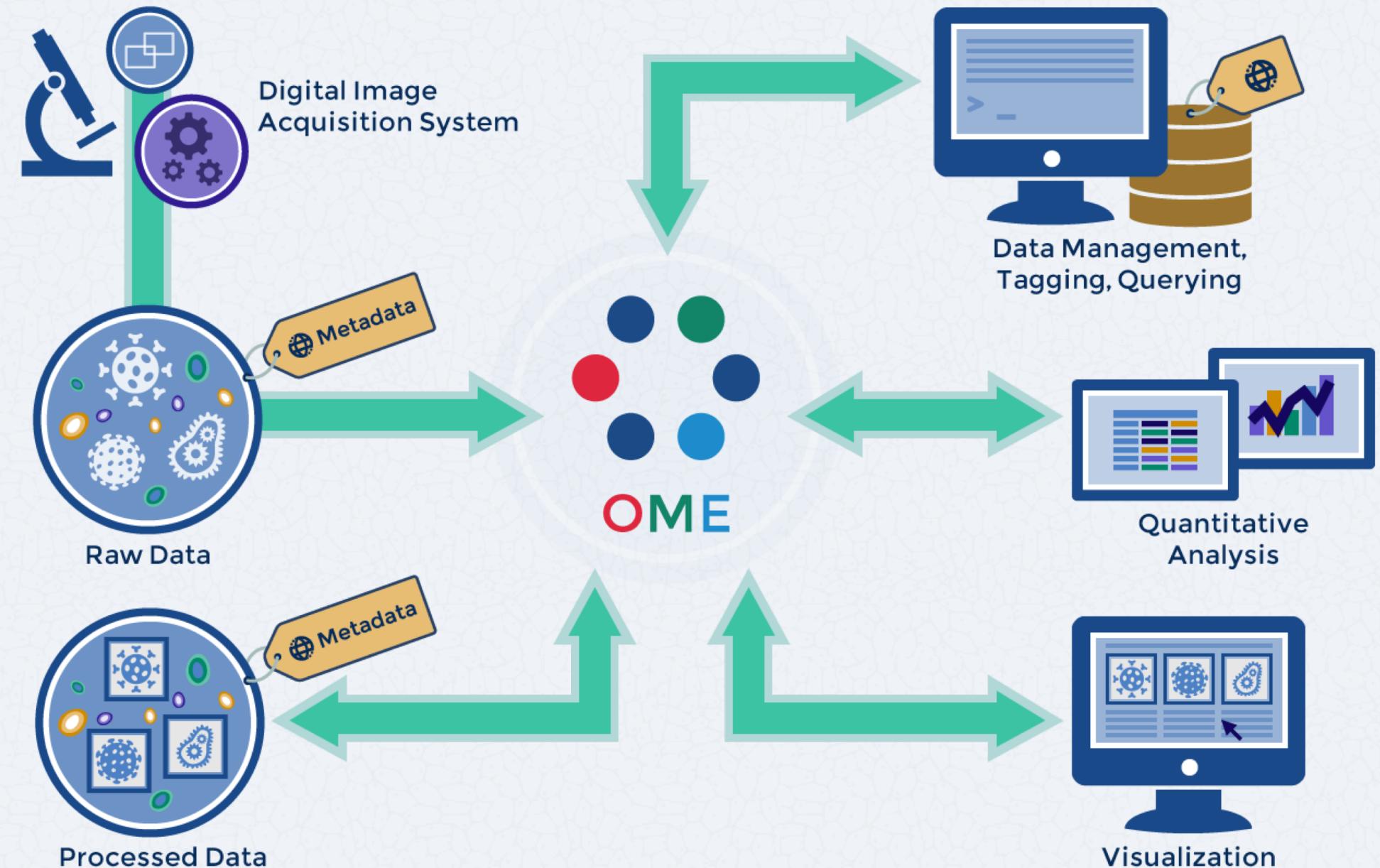
Iain Porter, Alwyn Dady, Kate Storey

A pretty picture?

A measurement?

A resource?

...Towards Image Informatics



What We Do



OME-TIFF



OME File Formats

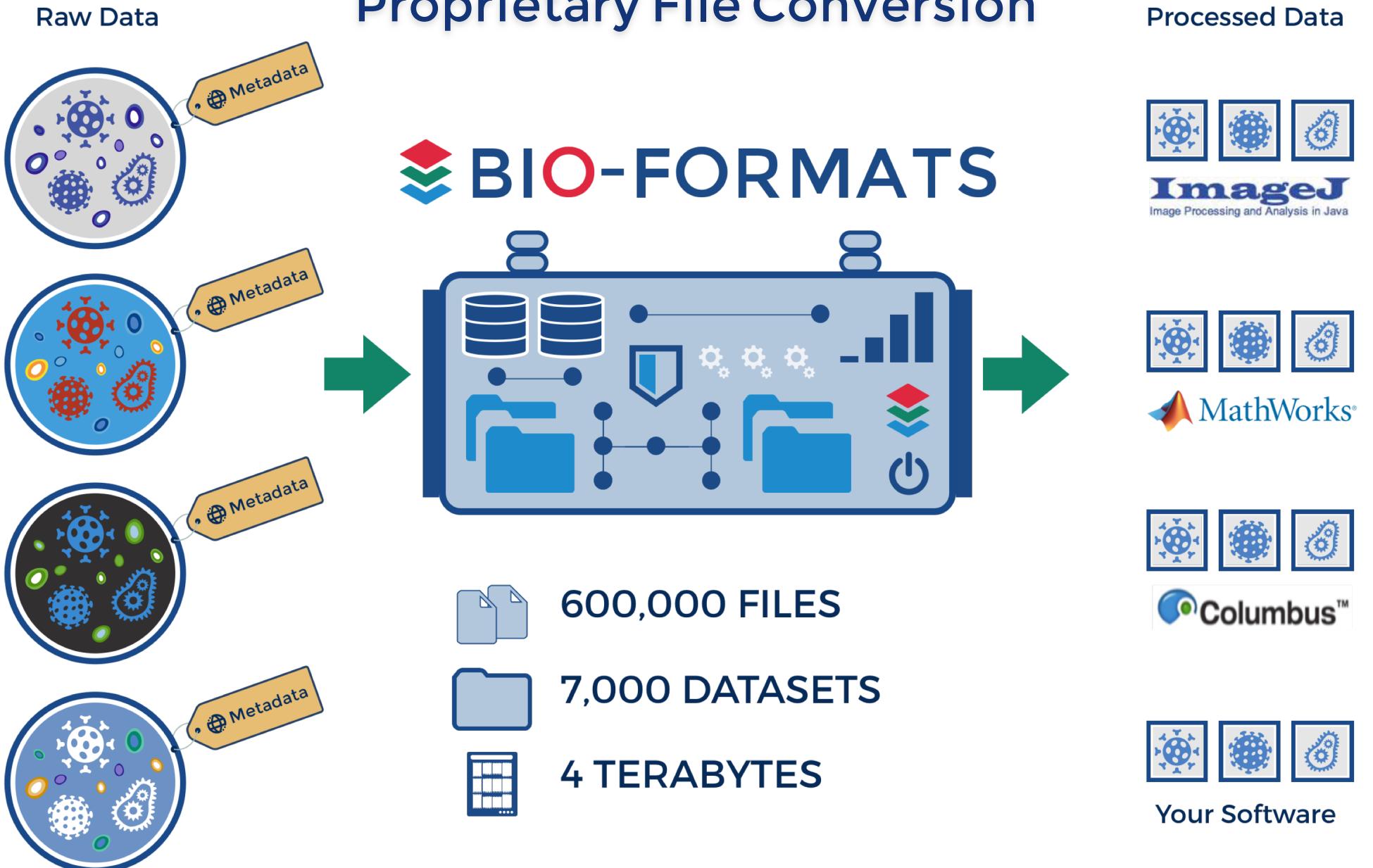
OME-XML ~ OME Data Model

OME-TIFF – TIFF file with OME-XML in the header

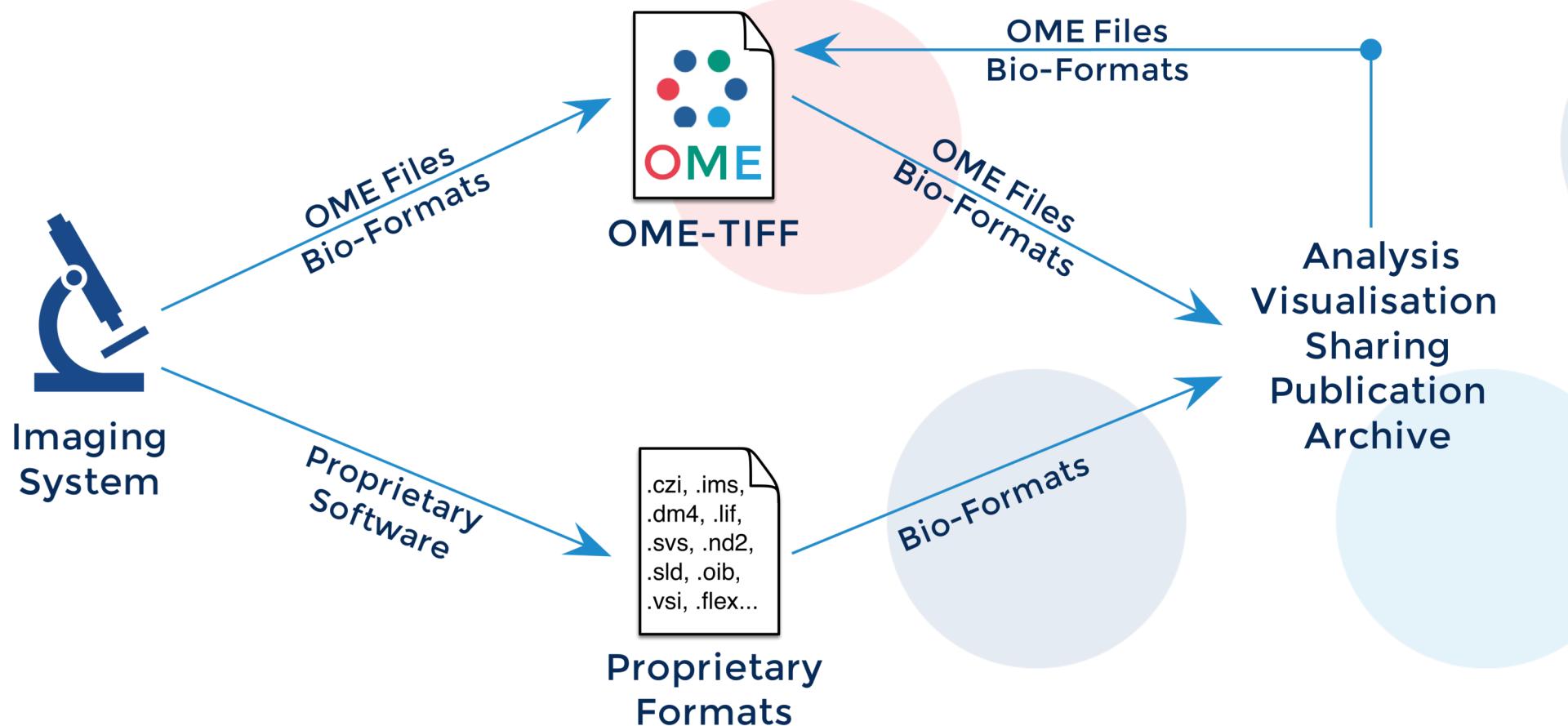
OME Files – C++-based reference implementation of OME Data Model

Bio-Formats – Java-based PFF reader & reference implementation

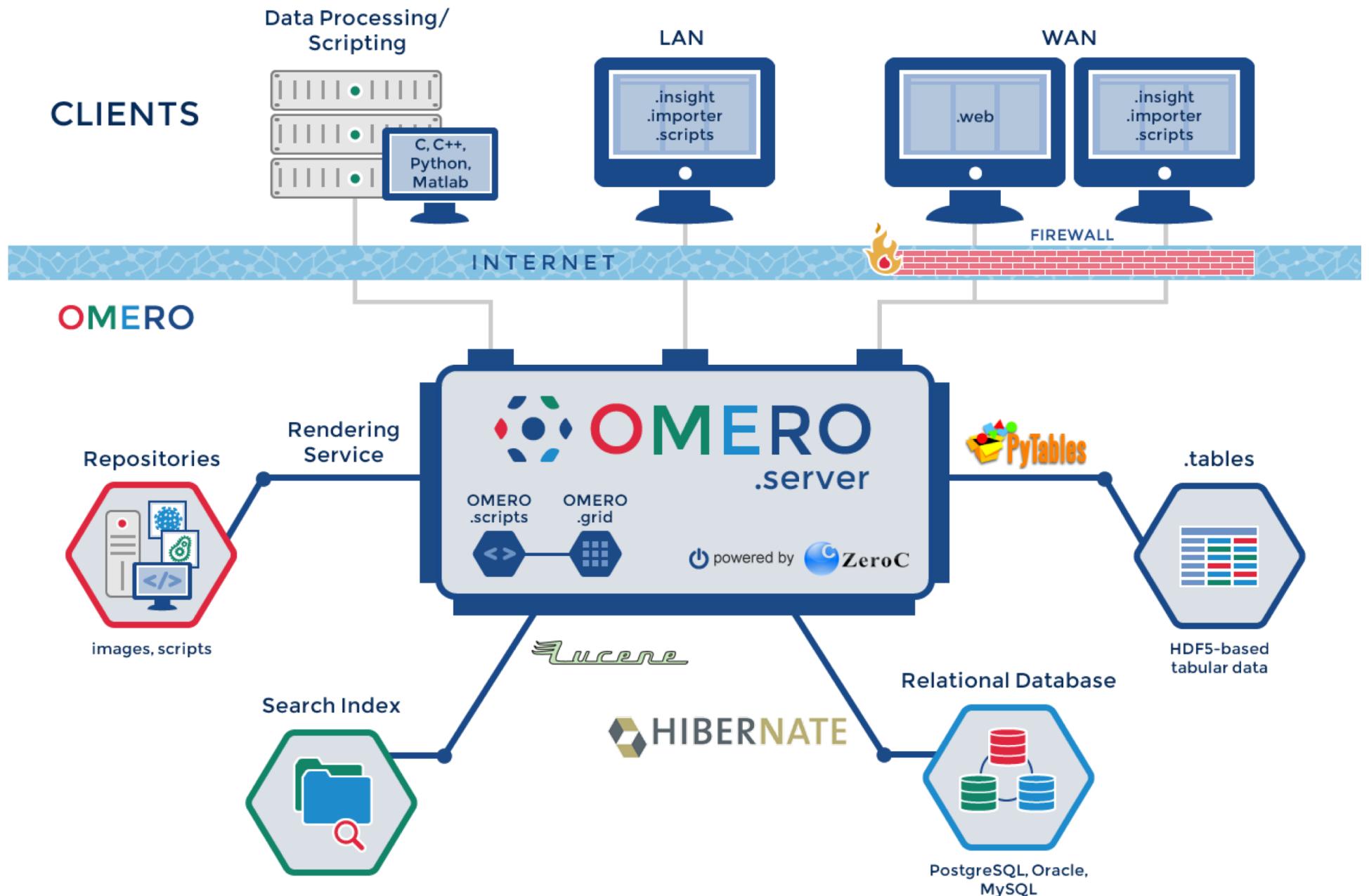
BIO-FORMATS: Proprietary File Conversion



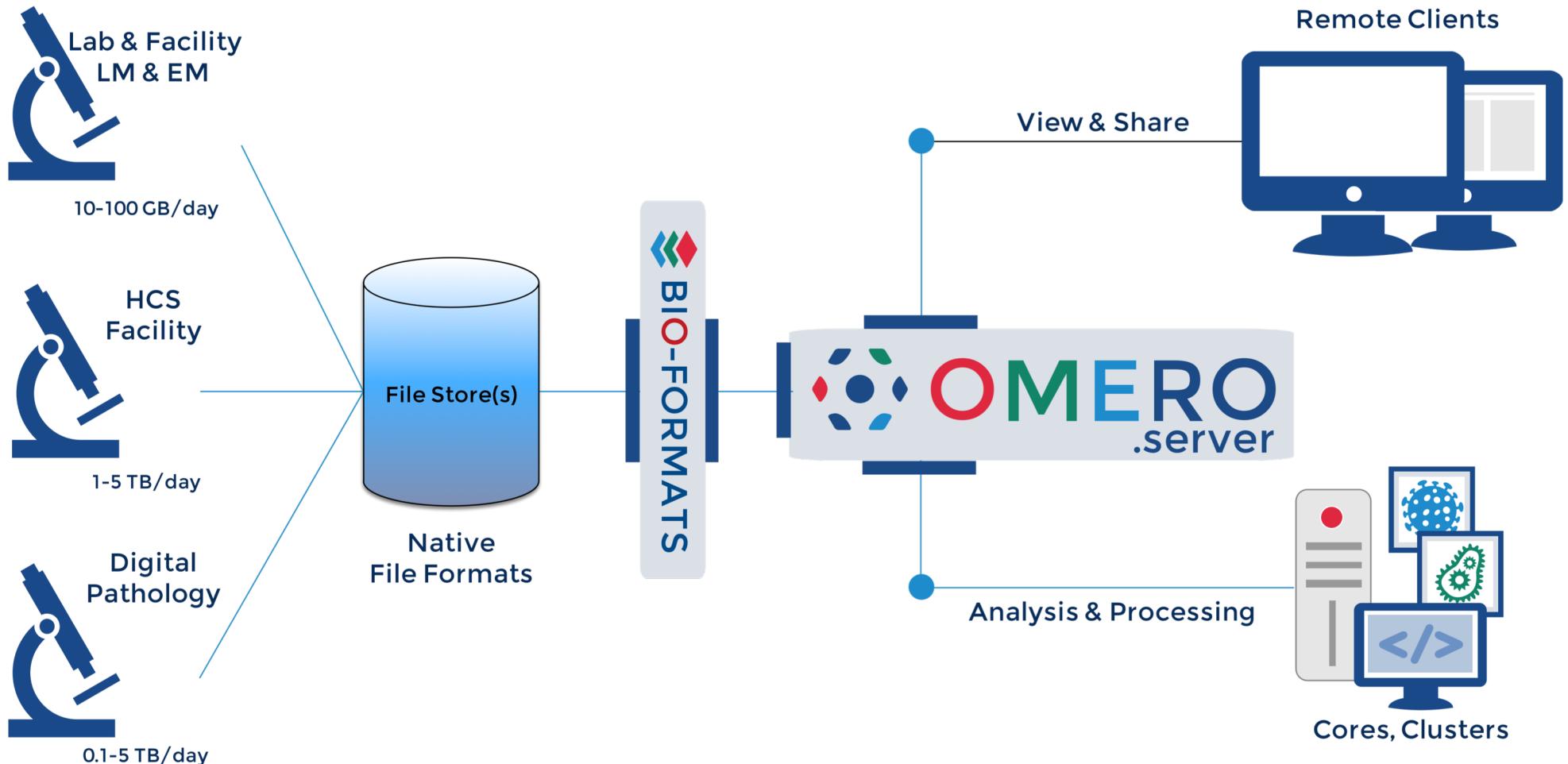
OME File Formats

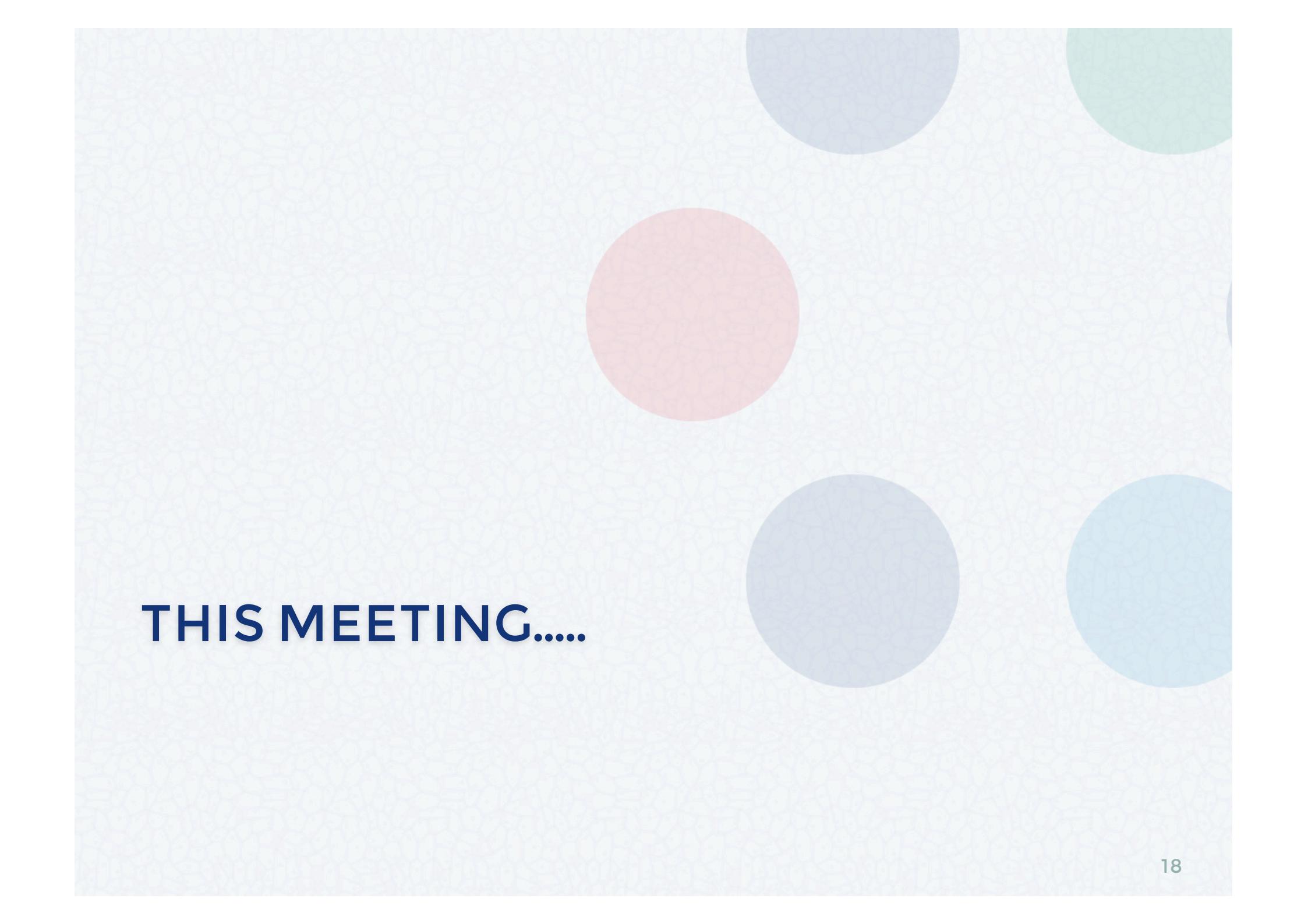


The OMERO Platform



OMERO & Bio-Formats: Interfaces for Image Data Access





THIS MEETING.....

Meeting Programme

13th Annual User's Mtg: Progress Report & Planning

- *Day 1:* Presentations
 - Short Talks
 - Lightning Talks
 - Project Overview
 - Invited Speaker- 4D Nucleome
- *Day 2:* Workshops & Demos
 - Metadata Workflow
 - Formats & Binary Vessels
 - Microservices
 - Deployment
 - KNIME
- *Day 3:* Talking, Planning, Coding

Meeting Themes

Formats

Binary Vessels

Added Value

*Import
Workflows
Mapr*

Data publication

IDR (and SSBD...)

Scaling

Microservices

FORMATS.....

OME Multi-Resolution TIFF

design

TIFF and OME-TIFF sub-resolution support

Introduction

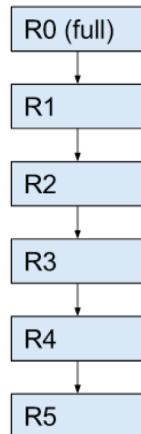
There have been several different proposals for images at different scales in the form of sub-resolutions (image "pyramids") for TIFF and OME-TIFF in Bio-Formats and OME Files, which include:

- Storage of pyramid data in OME-TIFF (Melissa Linkert / Glencoe)
- Use of SubIFDs (Roger Leigh)
- TIFF/OME-TIFF extension to support pyramids (Damir Sudar)

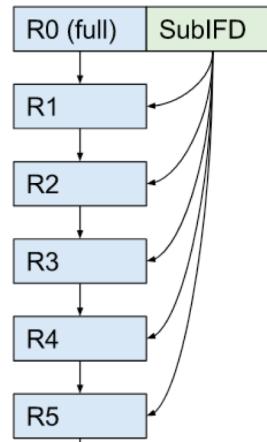
This proposal will summarise the various possible approaches and their tradeoffs, including the practical implementations I have tested while evaluating them.

There are several strategies we could employ for sub-resolutions:

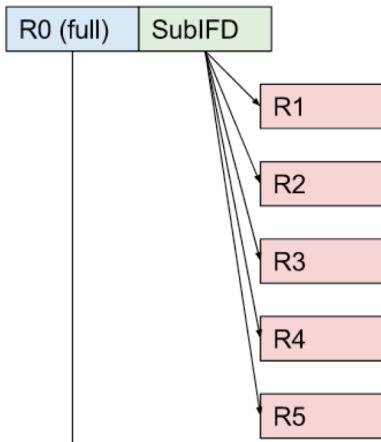
A. Implicit order



B. SubIFD pointing to main IFDs

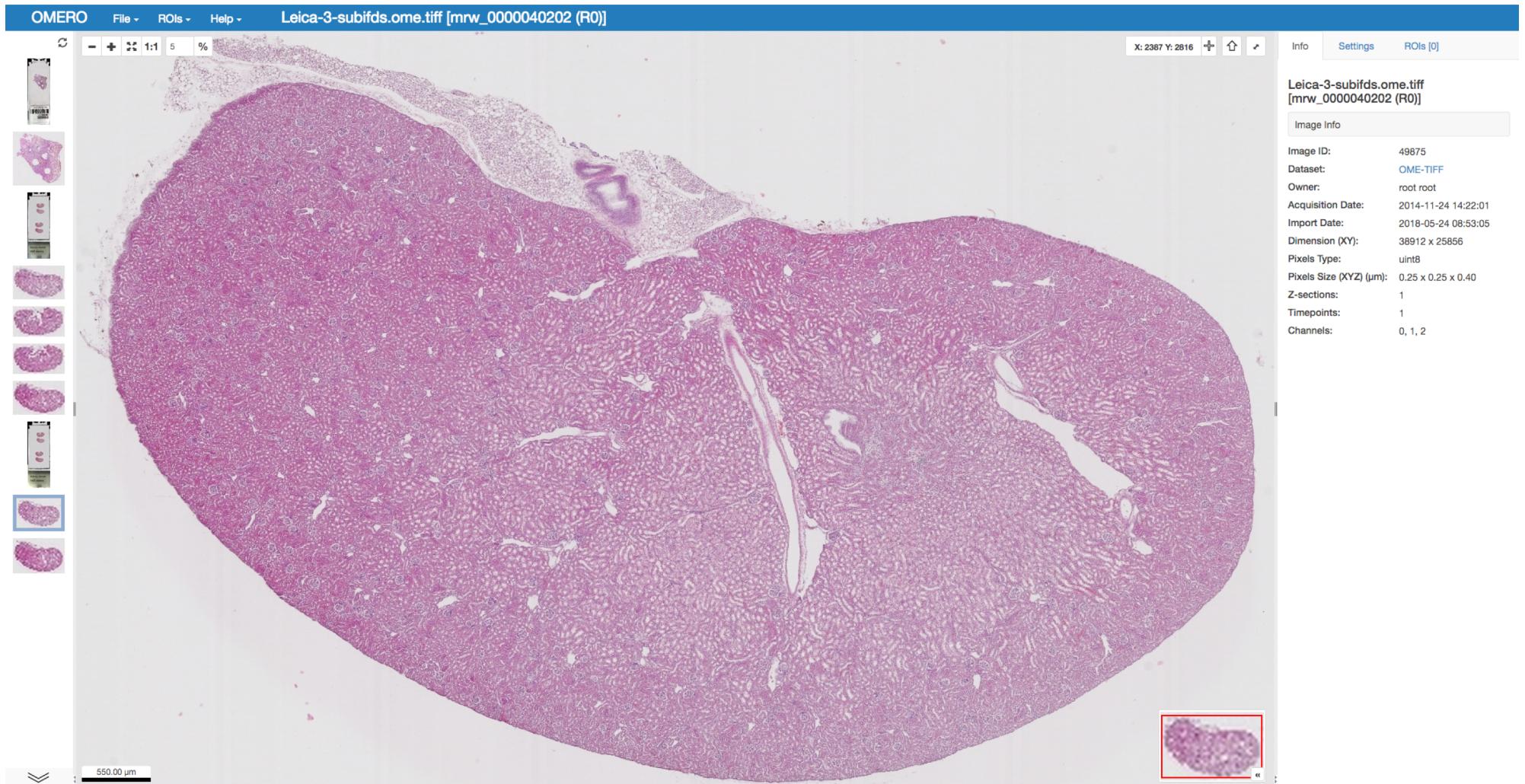


C. SubIFD point to separate IFDs





"OME Tiles"



Roger Leigh, David Gault, Sebastien Besson (OME) & Melissa Linkert (Glencoe)²³



DATA IMPORT.....

OMERO Import Roles

Four suggested workflows

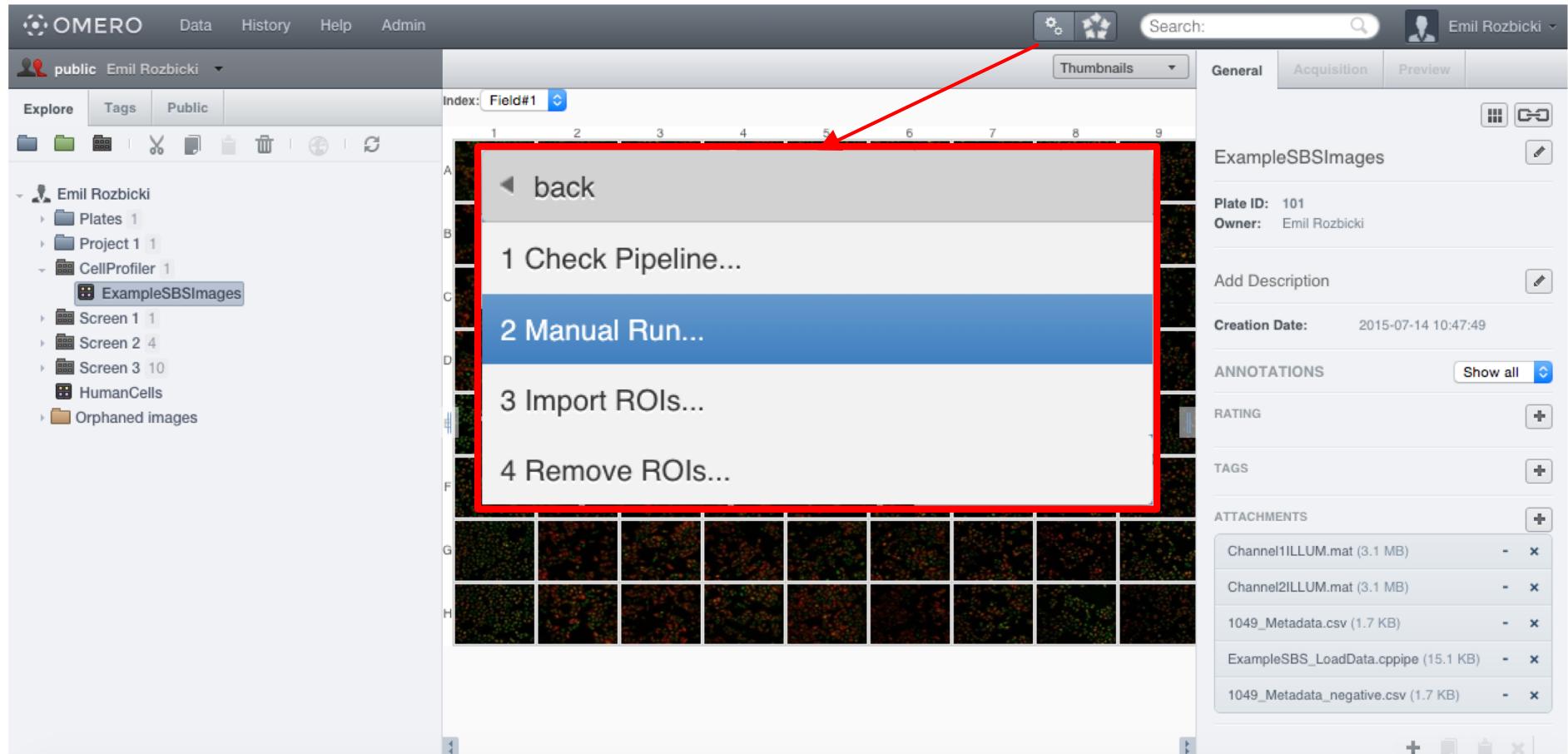
Required Privileges	Data viewer	Importer	Analyst	Group and Data Organizer
Sudo	N	Y	N	N
Write Data	N	N	Y	Y
Delete Data	N	N	N	Y
Chgrp	N	N	N	Y
Chown	N	N	Y(O)	Y
Create and Edit Groups	N	N	N	Y
Create and Edit Users	N	N	N	Y
Add Users to Groups	N	N	N	Y
Upload Scripts	N	N	Y	N

<https://docs.openmicroscopy.org/omero/5.4.6/sysadmins/restricted-admins.html>



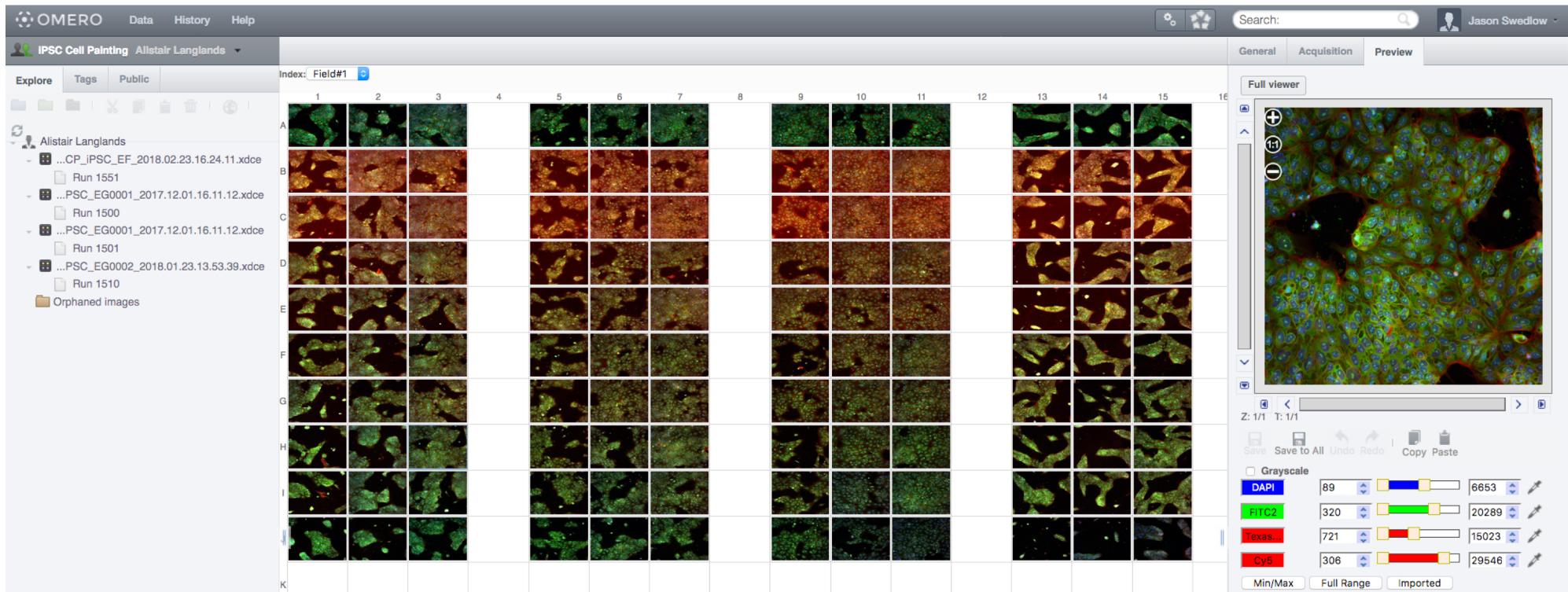
ADDING VALUE.....

OMERO & CellProfiler



Chris Allan & Emil Rozbicki, Glencoe Software

OMERO & CellProfiler



Chris Allan & Emil Rozbicki, Glencoe Software

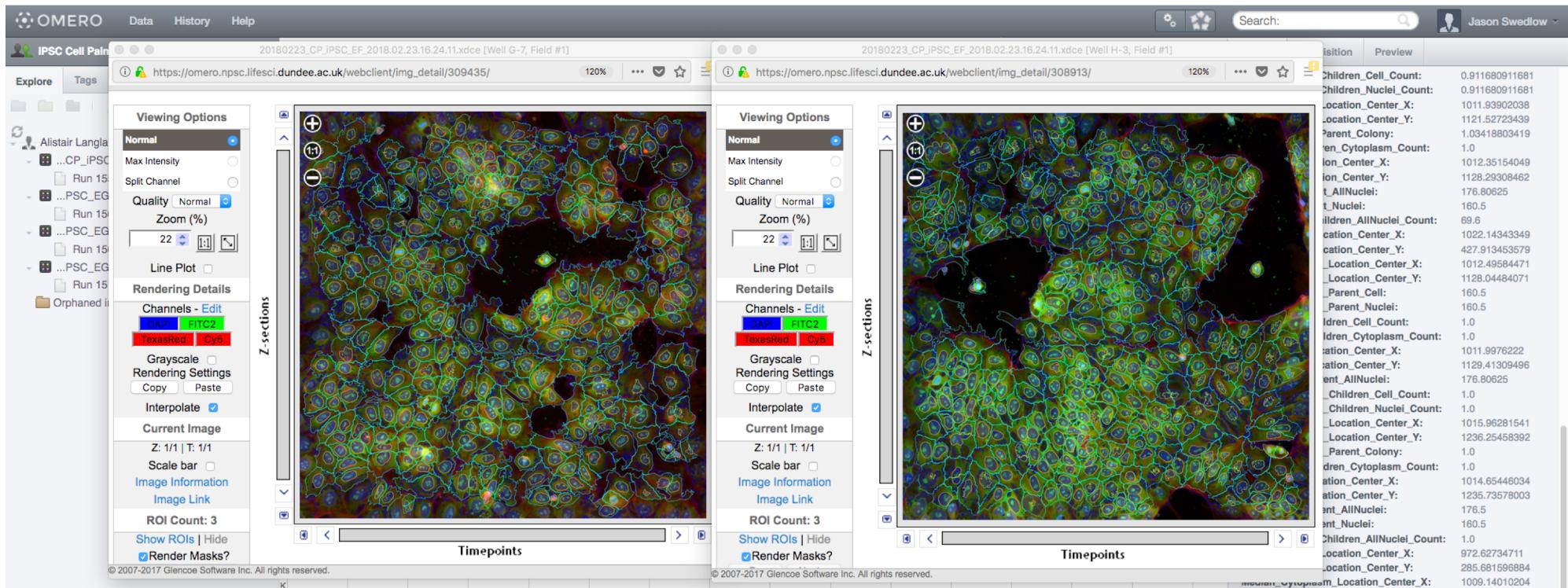
OMERO & CellProfiler

The screenshot shows the OMERO interface for managing microscopy data. On the left, a sidebar lists projects and runs, with 'IPSC Cell Painting' selected. The main area displays a grid of 16 microscopy images labeled A through K across four rows and numbered 1 through 16 across three columns. The images show various cell structures. To the right of the images is a table of analysis results:

	General	Acquisition	Preview
Mean_AllNuclei_Children_Cell_Count:	0.911680911681		
Mean_AllNuclei_Children_Nuclei_Count:	0.911680911681		
Mean_AllNuclei_Location_Center_X:	1011.93902038		
Mean_AllNuclei_Location_Center_Y:	1121.52723439		
Mean_AllNuclei_Parent_Colony:	1.03418003419		
Mean_Cell_Children_Cytoplasm_Count:	1.0		
Mean_Cell_Location_Center_X:	1012.35154049		
Mean_Cell_Location_Center_Y:	1128.29308462		
Mean_Cell_Parent_AllNuclei:	176.80625		
Mean_Cell_Parent_Nuclei:	160.5		
Mean_Colony_Children_AllNuclei_Count:	69.6		
Mean_Colony_Location_Center_X:	1022.14343349		
Mean_Colony_Location_Center_Y:	427.913453579		
Mean_Cytoplasm_Location_Center_X:	1012.49584471		
Mean_Cytoplasm_Location_Center_Y:	1128.04484071		
Mean_Cytoplasm_Parent_Cell:	160.5		
Mean_Cytoplasm_Parent_Nuclei:	160.5		
Mean_Nuclei_Children_Cell_Count:	1.0		
Mean_Nuclei_Children_Cytoplasm_Count:	1.0		
Mean_Nuclei_Location_Center_X:	1011.9976222		
Mean_Nuclei_Location_Center_Y:	1129.41309496		
Mean_Nuclei_Parent_AllNuclei:	176.80625		
Median_AllNuclei_Children_Cell_Count:	1.0		
Median_AllNuclei_Children_Nuclei_Count:	1.0		
Median_AllNuclei_Location_Center_X:	1015.99281541		
Median_AllNuclei_Location_Center_Y:	1236.25458392		
Median_AllNuclei_Parent_Colony:	1.0		
Median_Cell_Children_Cytoplasm_Count:	1.0		
Median_Cell_Location_Center_X:	1014.65446034		
Median_Cell_Location_Center_Y:	1235.73578003		
Median_Cell_Parent_AllNuclei:	176.5		
Median_Cell_Parent_Nuclei:	160.5		
Median_Colony_Children_AllNuclei_Count:	1.0		
Median_Colony_Location_Center_X:	972.62734711		
Median_Colony_Location_Center_Y:	285.681596884		
Median_Cytoplasm_Location_Center_X:	1009.14010204		

Chris Allan & Emil Rozbicki, Glencoe Software

OMERO & CellProfiler



Chris Allan & Emil Rozbicki, Glencoe Software



OMERO.web

Screenshot of the OMERO.web interface showing a 7-dimensional image stack.

The interface includes:

- Header:** OMERO.web, outreach.openmicroscopy.org/webclient/userdata/?experimenter=2, ome 7 dimensional.
- Left Sidebar:** Lab1, trainer-1, trainer-1. Explore, Tags, Shares.
- Thumbnail Grid:** A 4x10 grid of thumbnail images showing fluorescence microscopy data. The first thumbnail is highlighted with a blue border.
- File List:** A detailed list of files under CEP120/2011106 38, including Cep120_gtub_001_SIR_PRJ.dv through Cep120_gtub_027_SIR_PRJ.dv.
- Right Panel:** General tab selected. Includes:
 - Image Details:** Import Date: 2018-05-17 15:59:15, Dimensions (XY): 256 x 256, Pixels Type: float, Pixels Size (XYZ) (μm): 0.04 x 0.04 x 0.13, Z-sections/Timepoints: 1 x 1, Channels: CEP120, TUBG1-N, ROI Count: 5.
 - Tags:** 0
 - Key-Value Pairs:** 7
 - Tables:** omero.batch_roi_export.map_ann
 - Attachments:** 1
 - Comments:** 0
 - Ratings:** 0
 - Others:** 0



OMERO.parade

The screenshot shows the OMERO.parade web client interface. The top navigation bar includes links for Pan El, OME2, UKRI, Webc, Strate, 2018B, 2018C, OME2, preser, Image, Imag, 2018, Space, 6D, Web, Leica-3D, Webc, View, iView, New, TIFF and C, and various search and file management icons.

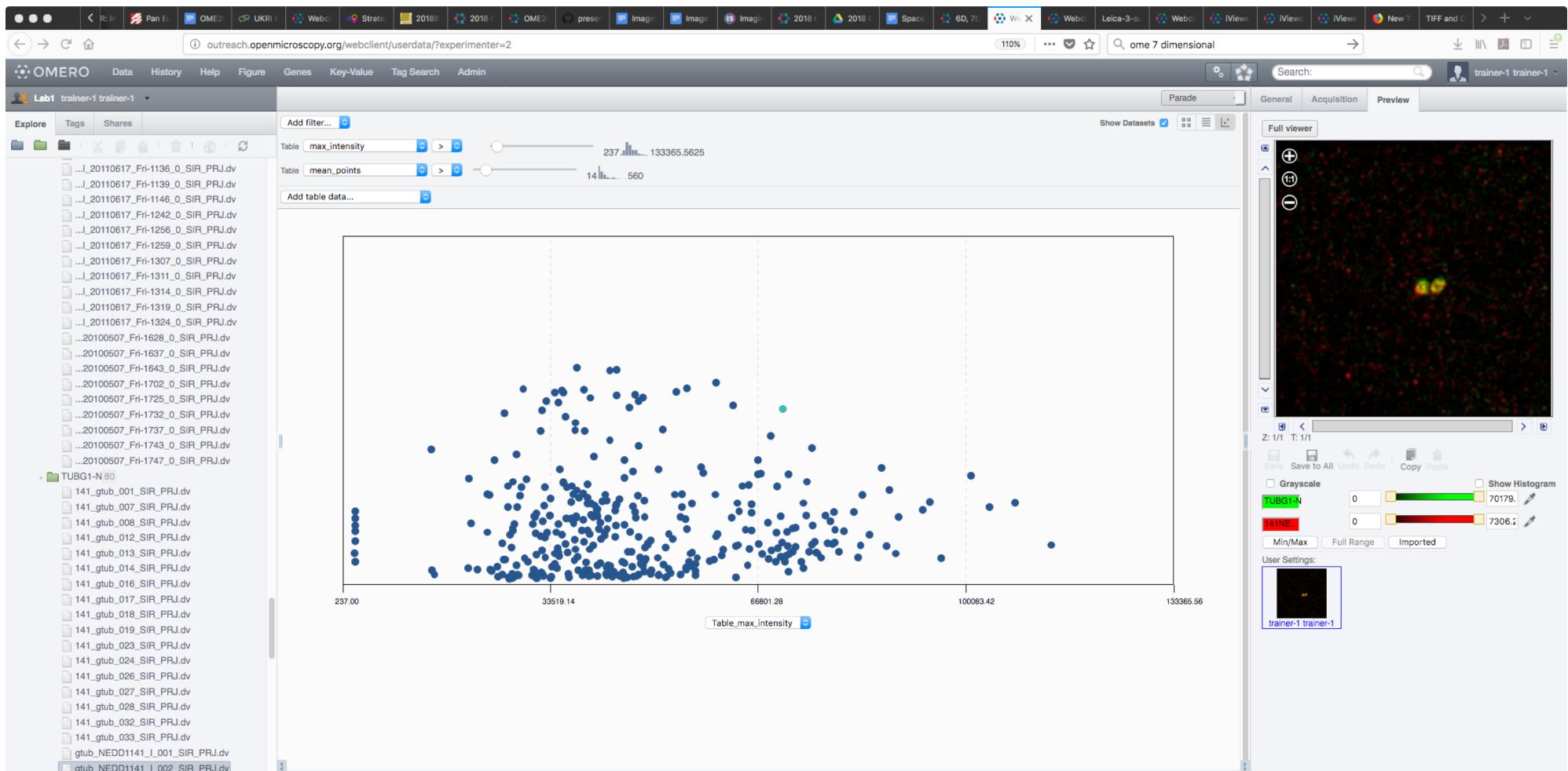
The main interface displays a 7D dataset visualization. On the left, a tree view shows experiment folders: Lab1 (trainer-1), idr021_10 (CDK6RAP2-C_33), CENT22, and CEP120/20111106_38. The CEP120 folder contains numerous sub-folders labeled Cep120_gtub_001_SIR_PRJ.dv through Cep120_gtub_027_SIR_PRJ.dv. The central area shows a grid of 2D images for each dataset, with three rows visible: CEP120/20111106, CEP120/20111209, and CEP152. The right panel provides detailed information about the selected dataset (Cep120_gtub_001_SIR_PRJ.dv), including its Import Date (2018-05-17 15:59:15), Dimensions (256 x 256), Pixel Type (float), and Z-sections/Timepoints (1 x 1). It also lists Key-Value Pairs and other metadata like ROI Count (5) and Tags (0).

Will Moore, OME; Chris Allan & Emil Rozbicki, Glencoe

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OMERO.parade



Will Moore, OME; Chris Allan & Emil Rozbicki, Glencoe



OMERO.mapr

← → ⌂ ⌂

① idr.openmicroscopy.org/mapr/phenotype/?value=CMPO_0000077

IDR Studies Genes Phenotypes Cell Lines siRNAs Antibodies Compounds Organisms About

Public Public data

Type Phenotype... Match case ?

Add filter

Phenotype 1

- CMPO_0000077 (20872) 8
 - ...cualvargas-rhogtpases/screenD (3920) 4
 - ...cualvargas-rhogtpases/screenA (3808) 4
 - ...cualvargas-rhogtpases/screenC (3220) 4
 - ...033-rohban-pathways/screenA (2916) 12
 - 41744 243
 - 41744 [Well A3, Field 1]
 - 41744 [Well A3, Field 2]
 - 41744 [Well A3, Field 3]
 - 41744 [Well A3, Field 4]

OMERO.mapr

Image Details

Acquisition Date:	2013-08-08 09:47:48
Import Date:	2017-03-06 15:39:15
Dimensions (XY):	1080 x 1080
Pixels Type:	uint16
Pixels Size (XYZ) (μm):	0.66 x 0.66 x -
Z-sections/Timepoints:	1 x 1
Channels:	Hoechst, ERSyto, ERSytoBleed, PhGolgi, Mito
ROI Count:	0

Attributes 11

Phenotype

Added by: Public data

Phenotype	low cell density
Phenotype Term Name	decreased cell numbers
Phenotype Term Accession	CMPO_0000052 

Phenotype

Added by: Public data

Phenotype	enriched for extremely elongated
Phenotype Term Name	elongated cell phenotype
Phenotype Term Accession	CMPO_0000077 

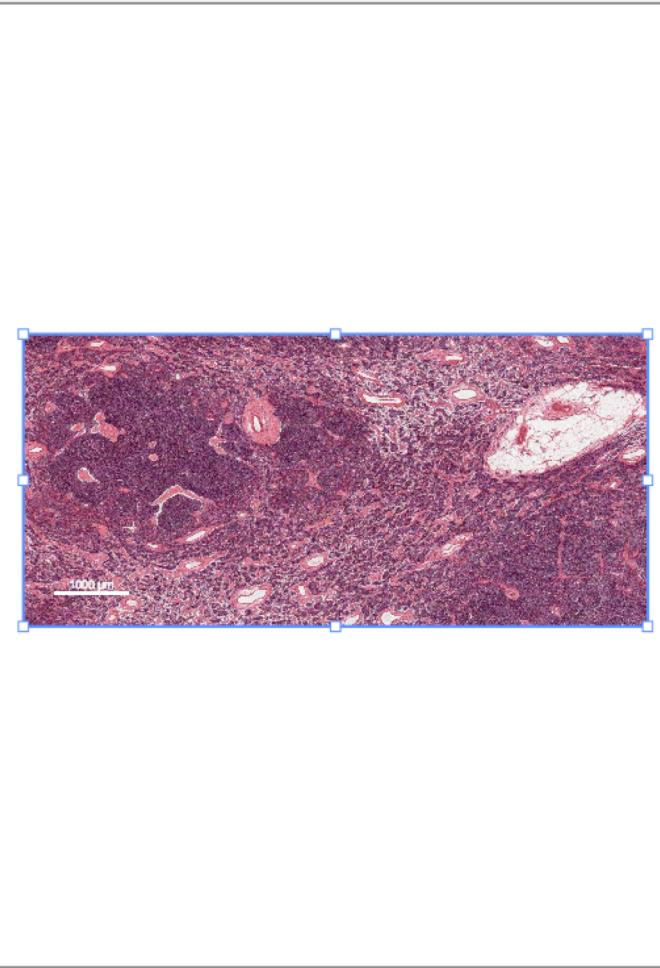
OMERO.iviewer





OMERO.figure Big Images!!!!

OMERO File Edit Help Save Add Image Delete Export PDF



Info Preview Labels

77917.svs [Series 1]

Open with: [Webclient](#) | [Image viewer](#) | [FPBioimage](#) | [OMERO.iviewer](#)

Image ID:	10001	Edit ID
Dimensions (XY):	96999 x 45667	
Z-sections:	1	
Timepoints:	1	
Channels:	0, 1, 2	

Panel 4315 dpi (Export at 1000 dpi) [Set dpi](#)

X	27	Width	545
Y	289	Height	255

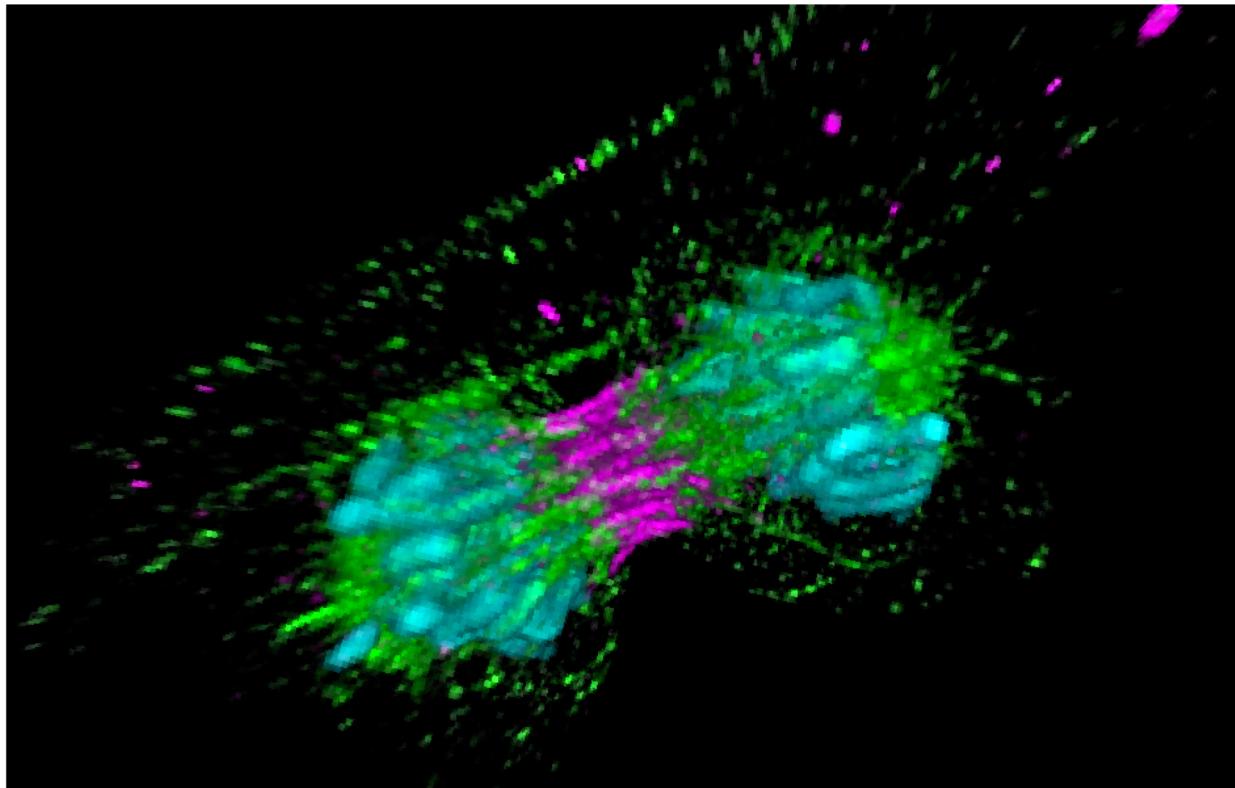


FPBiolImage

First Person Bioimage

jason/PTRE/P-TRE_10_R3D_D3D.dv

Press M for a full list of controls



Images generated in OMERO.



© Marcus Fantham

See the paper in [Nature Photonics](#)

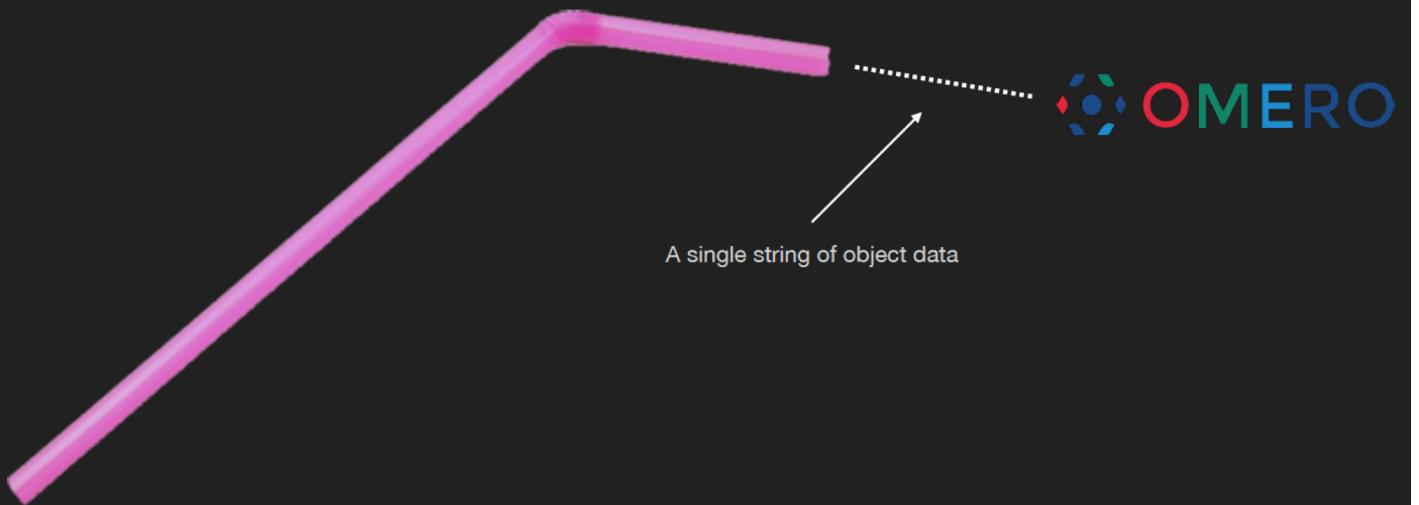
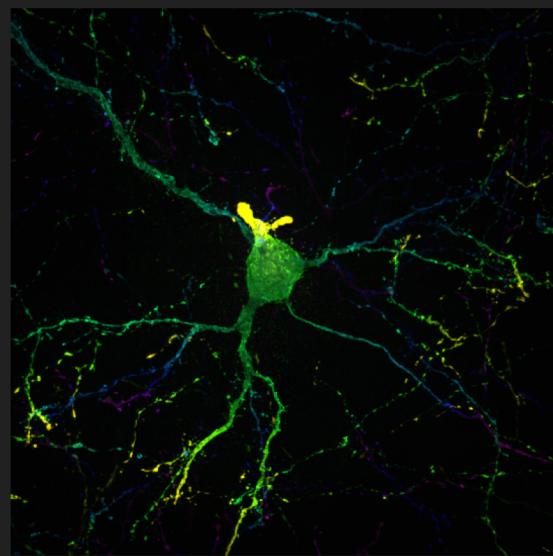


UNIVERSITY OF
CAMBRIDGE

SCALING....

OME2016: Luke Hammond/QBI

The Blitz Gateway

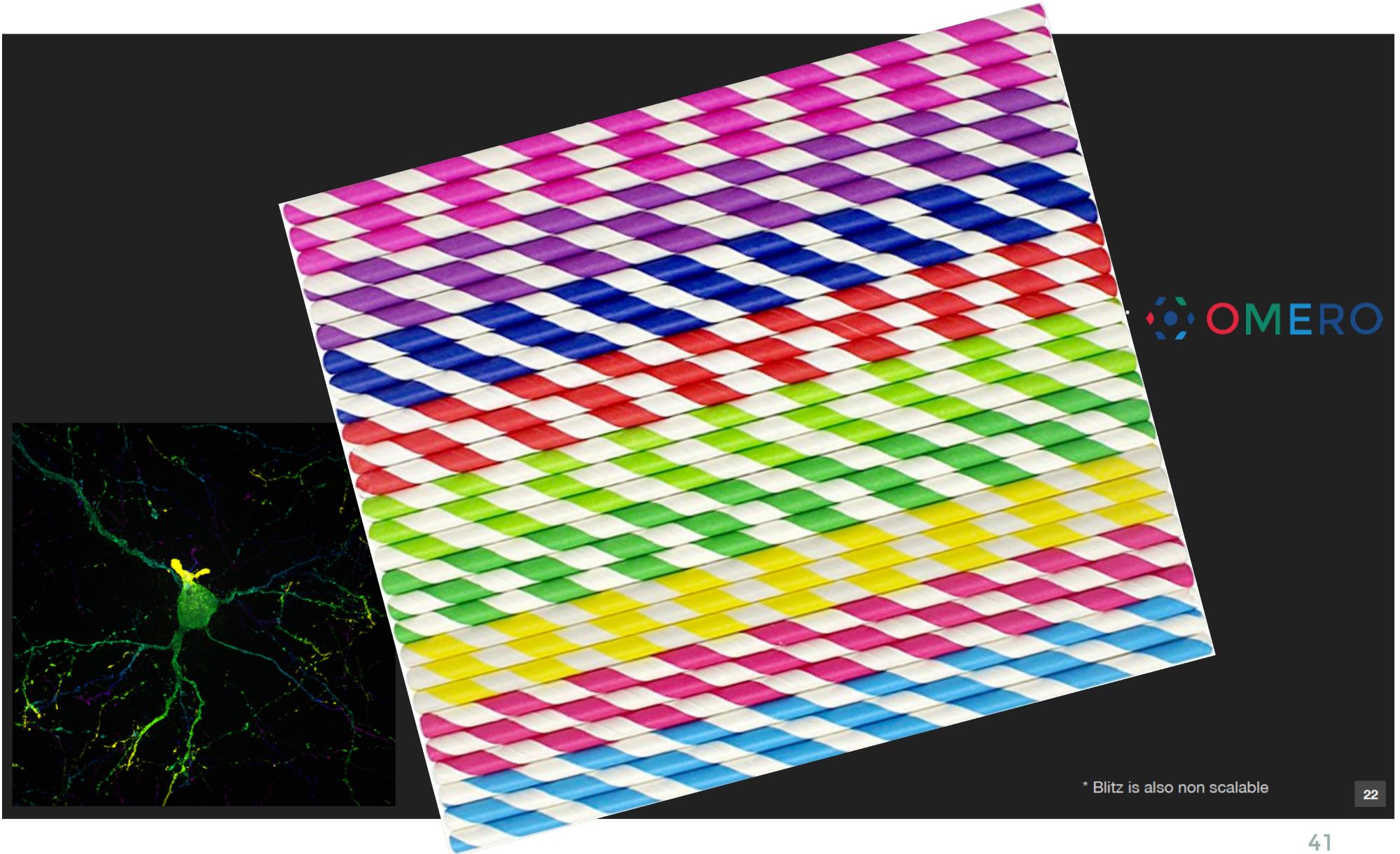


A single string of object data

* Blitz is also non scalable

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OME2018: Microservices





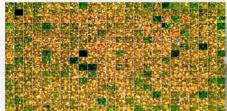
DATA PUBLISHING....

The IDR @ EBI Embassy



<https://idr.openmicroscopy.org>

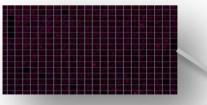
Gene Product
Targeting HCS



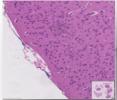
Genetic HCS



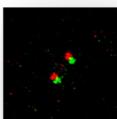
Geographic HCS



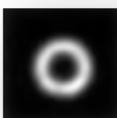
Chemical HCS



Histopathology



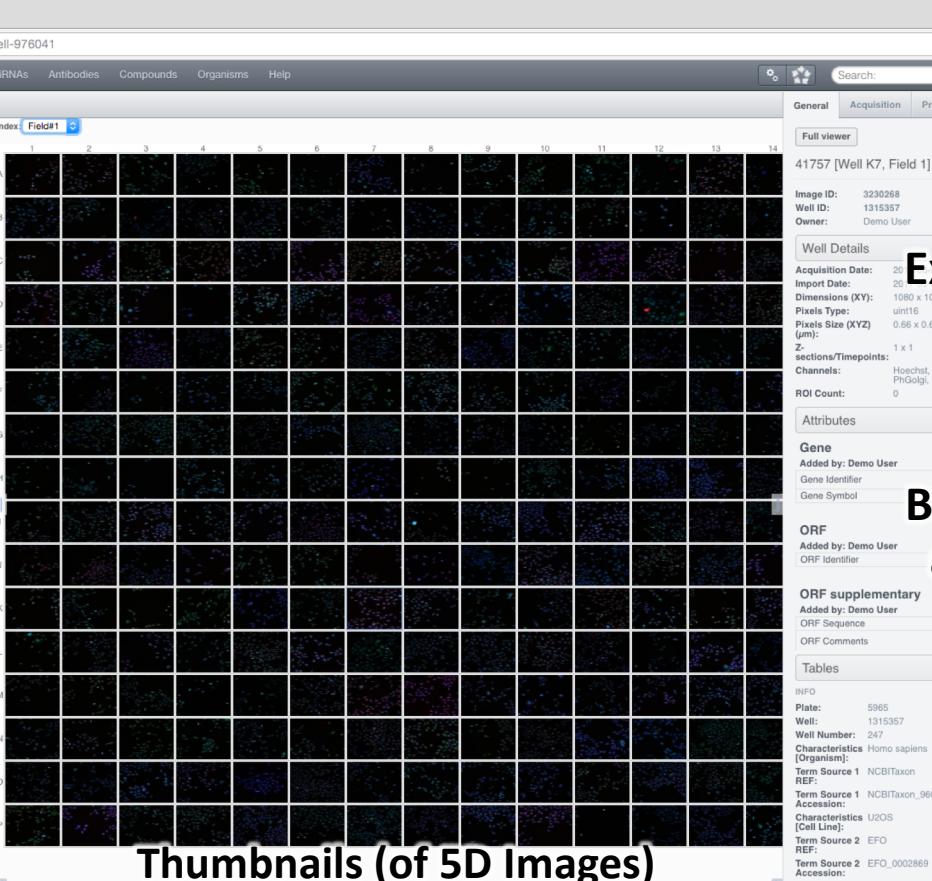
3D-Sim



Super-resolution

Integrated
studies

- Demo data
 - idr001 -grami-sysgro/screenA 192
 - idr002 -hericke-condensation/screenA 12
 - idr003 -breker-plasticity/screenA 85
 - idr004 -thorpe-rad52/screenA 47
 - idr005 -toret-adhesion/screenA 141
 - idr005 -toret-adhesion/screenB 18
 - idr006 -fong-nuclearbodies/screenA 169
 - idr007 -srirukumar-sumo/screenA 12
 - idr008 -rohn-actinome/screenB 58
 - idr008 -rohn-actinome/screenB 11
 - idr009 -simpson-secretion/screenA 964
 - idr009 -simpson-secretion/screenB 70
 - idr010 -dol-nudamamage/screenA 148
 - idr011 -le-tc/screenA 1
 - idr011 -ledesmafernandez-luna/screenC 4
 - idr011 -le-tc/screenD 8
 - idr011 -le-tc/screenE 1
 - idr012 -fuchs-cellmorph/screenA 60
 - idr013 -neumann-mitochondrheck/screenA 510
 - idr013 -neumann-mitochondrheck/screenB 28
 - idr015 -UNKNOWN -tarocceans/screenA 84
 - idr016 -wawer-bioactivecompoundprofiling/screenA 375
 - idr017 -breinig-drugscreen/screenA 96
 - idr018 -neff-histopathology/experimentA 248
 - idr019 -sero-nfkappaB/screenA 7
 - idr020 -baran-chtrog/screenA 4
 - idr021 -lawo-pericentriolarmaterial/experimentA 10
 - idr023 -szymborska-nucleopore/experimentA 55
 - idr025 -stadler-proteinatlas/screenA 3
 - idr026 -weigelin-immunotherapy/experimentA 18
 - idr027 -dickerson-chromatin/experimentA 8
 - idr028 -pascualvargas-hoptpasses
 - idr028 -pascualvargas-hoptpasses/screenA 4
 - idr028 -pascualvargas-hoptpasses/screenB 4
 - idr028 -pascualvargas-hoptpasses/screenC 4
 - idr028 -pascualvargas-hoptpasses/screenD 4
 - idr030 -sero-yap/screenA 10
 - idr033 -rohan-pathways/screenA 115
 - idr034 -kilpinen-hipsci/screenA 29



Thumbnails (of 5D Images)



Cross-data
browsing



Cloud
analysis



Download
(local analysis)

Experimental
metadata

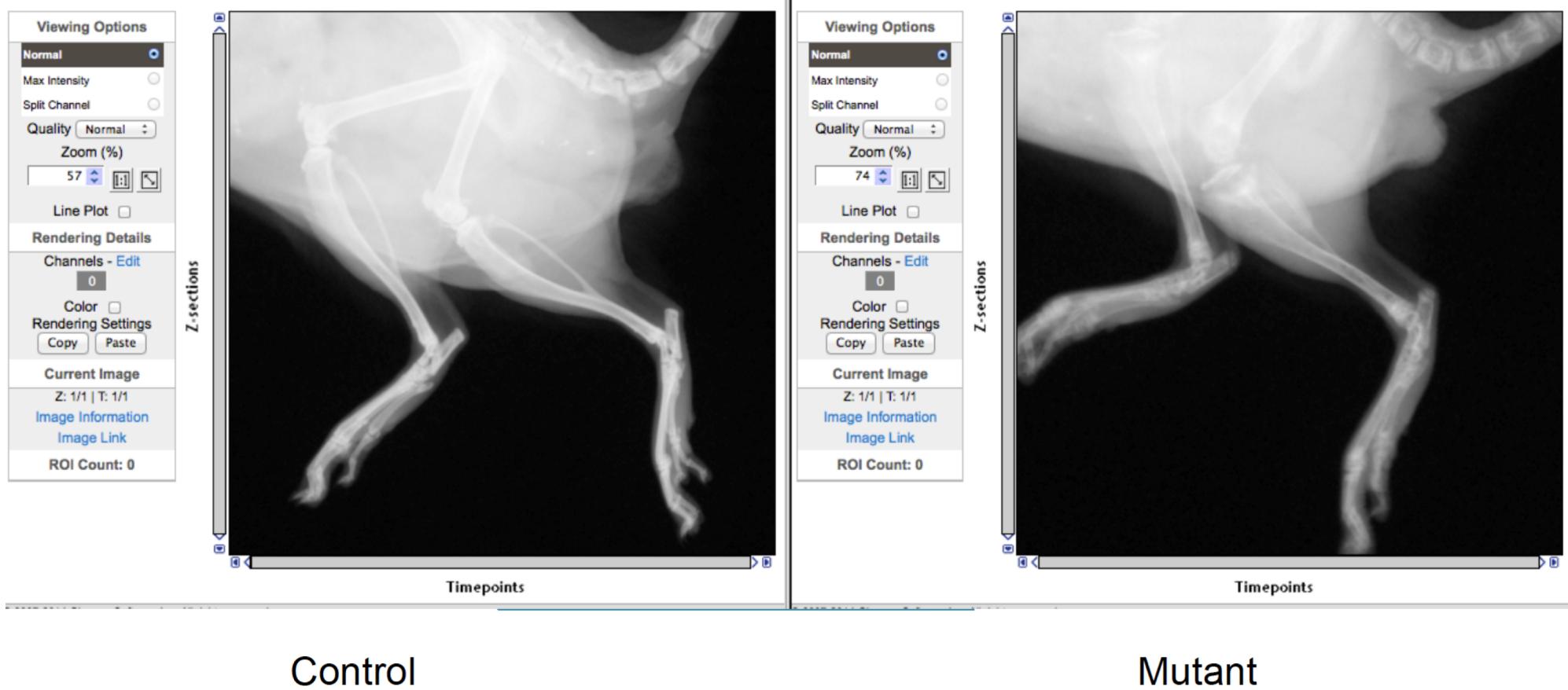
Biomolecular
annotations

Analysis
results





OMERO & BIO-FORMATS: KOMP2/IMPC



www.mousephenotype.org





SSBD @ Riken

SSBD Database

[» Japanese](#)

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[Data Search](#)

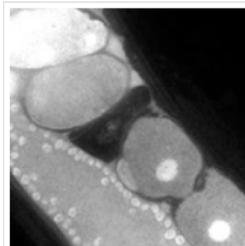
[Image Search](#)

Introduction of SSBD

Systems Science of Biological Dynamics (SSBD) database provides a rich set of open resources for analyzing quantitative data and microscopy images of biological objects, such as single-molecule, cell, gene expression nuclei, etc. Quantitative biological data and microscopy image are collected from a variety of species, sources and methods. These include data obtained from both experiment and computational simulation.

Samples

Microscopy images



Calcium response and shape changes in oocyte of *C. elegans*

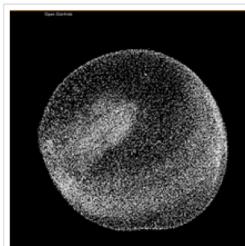


Nuclear division dynamics in *C. elegans* wild-type embryo

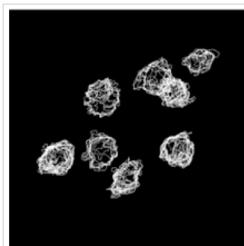


ERK activity in rat kidney epithelial (NRK-52E) cells

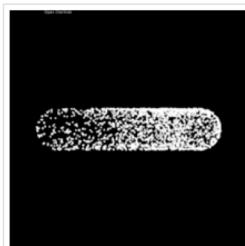
Quantitative data



Nuclear division dynamics in *D. rerio* wild-type embryo



Nuclear division dynamics in *C. elegans* wild-type embryo



Single molecule dynamics in *E. coli* wild-type

News and Events

May. 20. 2017: SSBD API notice

SSBD REST API full service is now available.

Mar. 1. 2017: SSBD API notice

SSBD REST API coordsXYZ is currently unavailable due to recent system maintenance. The service will resume shortly. Please check back later.

[Older news ...](#)

Information

OMERO: Images can be viewed on [OMERO web](#). If you have problem viewing the images on the website, please click on the drop-down arrow on the right of 'public data' on the bar above the data tree, select 'Public' group and 'public data' to view the images (click [here](#) for more details).

OMERO session ID: None

Introducing SSBD Database

Introducing the

SSBD Database
Systems Science of Biological Dynamics

Links

[NBDC RDF Portal](#) [RIKEN Meta Database](#) [WDDD](#)

[OME](#) [Ensembl](#) [WormBase](#)



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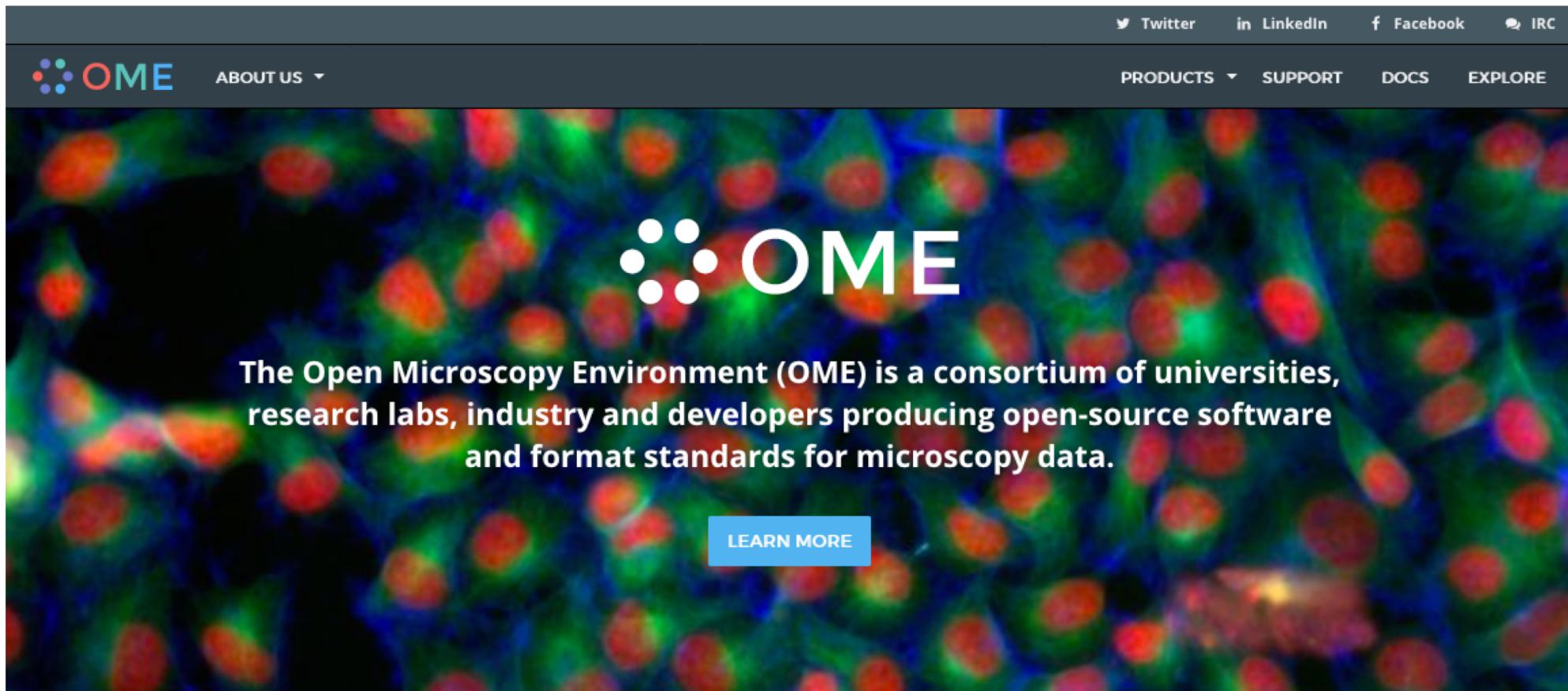
What's in a Name?

IDR is a

- Project
- URL
- Data Resource
- Analysis Resource
- Application Stack
- Database
- GitHub Org
- Deployment
- ???

NEW WEB SITE...

openmicroscopy.org



The Open Microscopy Environment (OME) is a consortium of universities, research labs, industry and developers producing open-source software and format standards for microscopy data.

LEARN MORE

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OME

FUNDING

OME Grant Funding

- Horizon 2020 (2016 – 2018)
 - MULTIMOT
 - Euro-BioImaging PPII
 - CORBEL
 - Global BioImaging
- BBSRC BBR IDR (w/ EMBL-EBI, 2018 – 2021)
- CZI HCA IDR (w/ Broad, 2018 – 2019)
- Wellcome Biomedical Resource Bio-Formats Updates (2017 – 2019)
- *Submissions to Wellcome, H2020 (x3)*

BIO-FORMATS: Opportunities for Academic/Commercial Collaborations

- 3i: Building and maintaining a SlideBook file format reader
- PerkinElmer: Commissioned Glencoe to provide open source Harmony HCS and QPTIFF DigPath readers
- Olympus: Commissioned Glencoe to build open source OIR reader
- FEI: OEM license of Bio-Formats → Amira
- ZEISS: Commissioned Glencoe to build open source JPEG-XR decoder
- ZEISS: OEM license of Bio-Formats → Zen Blue

→ See blog.openmicroscopy.org for more info

Some words to think about...

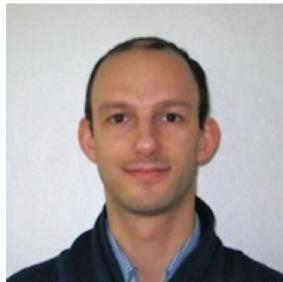
- New Modalities (MS, Raman, X-ray, etc.)
- Multi-modal/Correlative
- Federation:
 - SSO
 - Distributed Data
 - Search
- Apps
- Microservices
- Notebooks
- Client Architecture
- Archiving
- ...

Thank you!



Jason Swedlow

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Mark Carroll

SOFTWARE DEVELOPER



Helen Flynn

TECHNICAL WRITER



David Gault

SOFTWARE DEVELOPER



Kenny Gillen

SYSTEM ADMINISTRATOR



Riad Gozim

SOFTWARE DEVELOPER



Roger Leigh

SOFTWARE DEVELOPER



Simon Li

SOFTWARE DEVELOPER



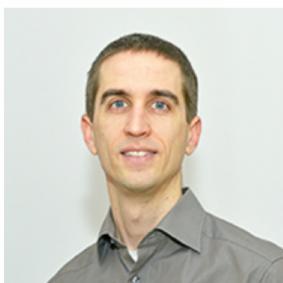
Dominik Lindner

SOFTWARE DEVELOPER



June Matthew

PROJECT CO-ORDINATOR



Josh Moore

SENIOR SOFTWARE
ARCHITECT



Will Moore

SOFTWARE DEVELOPER



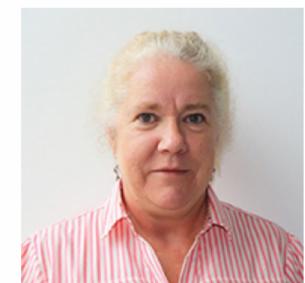
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Petr Walczysko

QA SOFTWARE SPECIALIST



Wilma Woudenberg

PA TO JASON SWEDLOW

