The Open Microscopy Environment:

12th Annual Users Meeting

University of Dundee, Scotland

Jason Swedlow

The OME Consortium

#ome2017

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

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!!!

wellcome

bbsrc
biotechnology and biological sciences research council

CORBEL

GLOBAL BIOIMAGING
growing collaboration

EURO-BIOIMAGING

MULTI MOT

Dundee OME Team

Jason Swedlow

Sebastien Besson

Jean-Marie Burel

Mark Carroll

Helen Flynn

David Gault

Kenny Gillen

Roger Leigh

Simone Leo

Simon Li

Dominik Lindner

June Matthew

Josh Moore

Will Moore

Balaji Ramalingam

Gabriella Rustici

Aleksandra Tarkowska

Petr Walczysko

Harald Waxenegger

Eleanor Williams

Wilma Woudenberg

The OME Consortium

Paul
French

Gaudenz
Danuser

Ilan
Davis

Gianluigi
Zanetti

Peter
Sorger

Spencer
Shorte

Alvis
Brazma

Rafael
Carazo-Salas

Edoard
Bertrand

THIS MEETING…..

Meeting Purpose

12th Annual User's Mtg

- Attendees
  - OME Consortium
  - Invited Speakers
  - Broad cross-section of users

- *Day 1:* Presentations
  - Lightning Talks
  - Project Overview
  - Invited Speakers

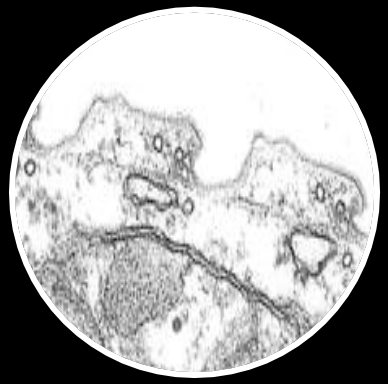
- *Day 2:* Workshops & Demos

- *Day 3*: Talking, Planning, Coding

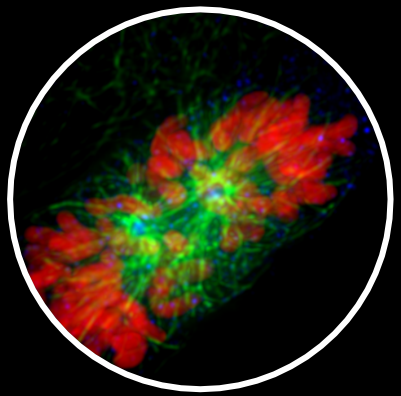
- Progress Report
- Future development priorities & planning

THE PROBLEM

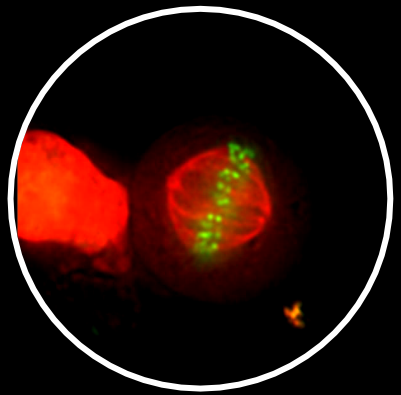
The Image Problem…
is Ubiquitous



Organelles

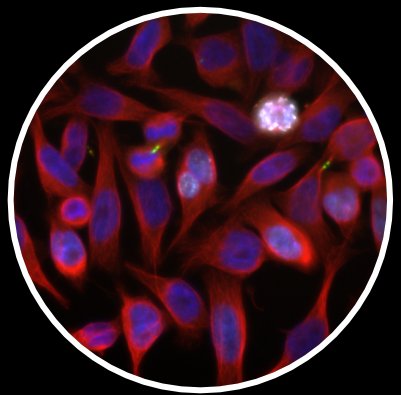


Cells

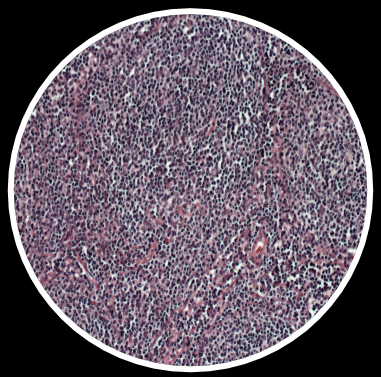


Dynamics

Physiology



Lead Discovery
Target Validation



Pathology

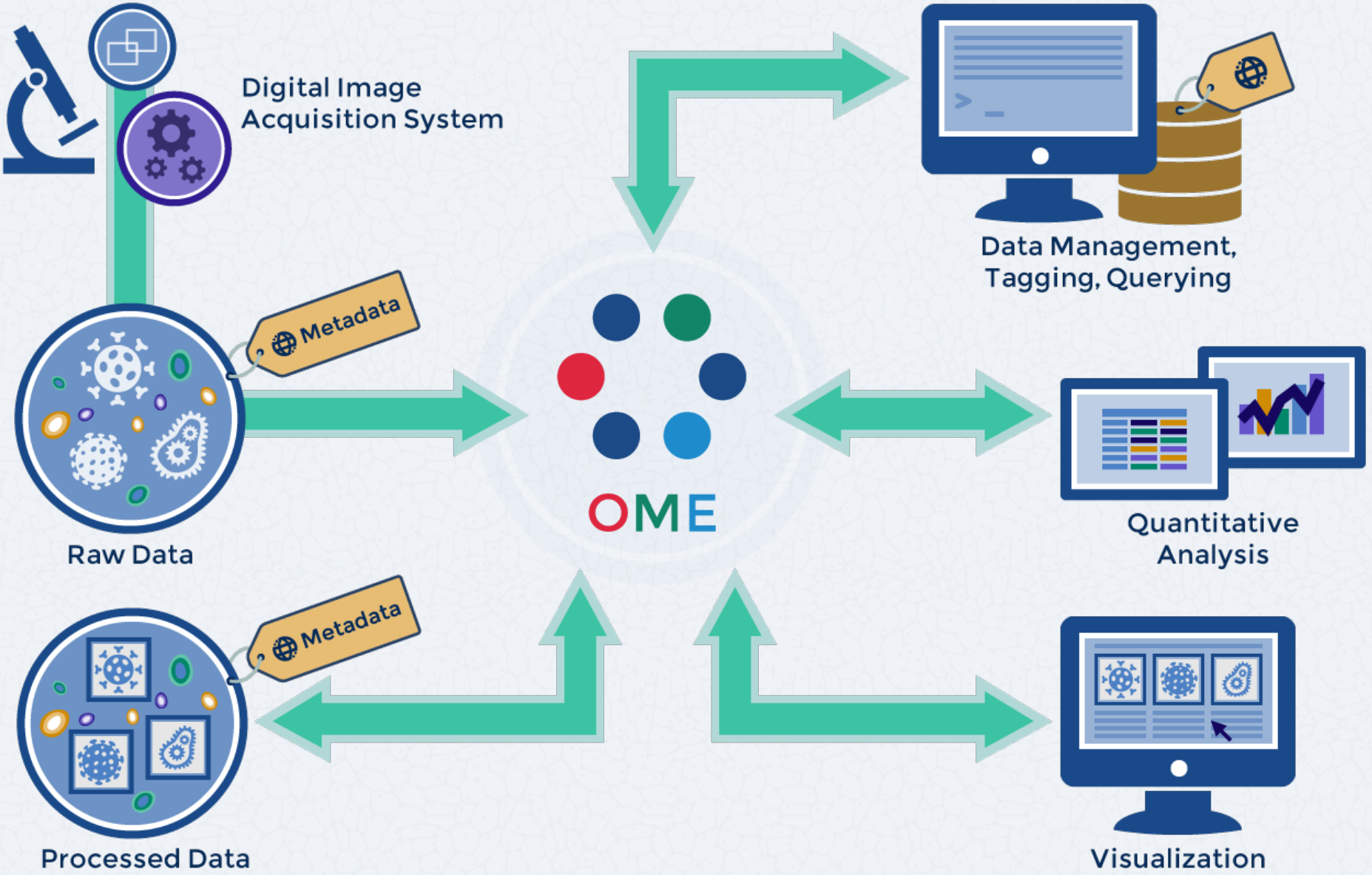
In Vivo

A pretty picture?

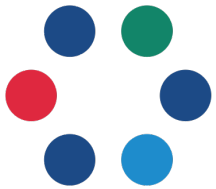
A measurement?

A resource?

…Towards Image Informatics



What We Do



OME DATA MODEL

OME-TIFF

OMEFILES

BIO-FORMATS

OMERO

IDR

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


Sebastien Besson


Roger Leigh

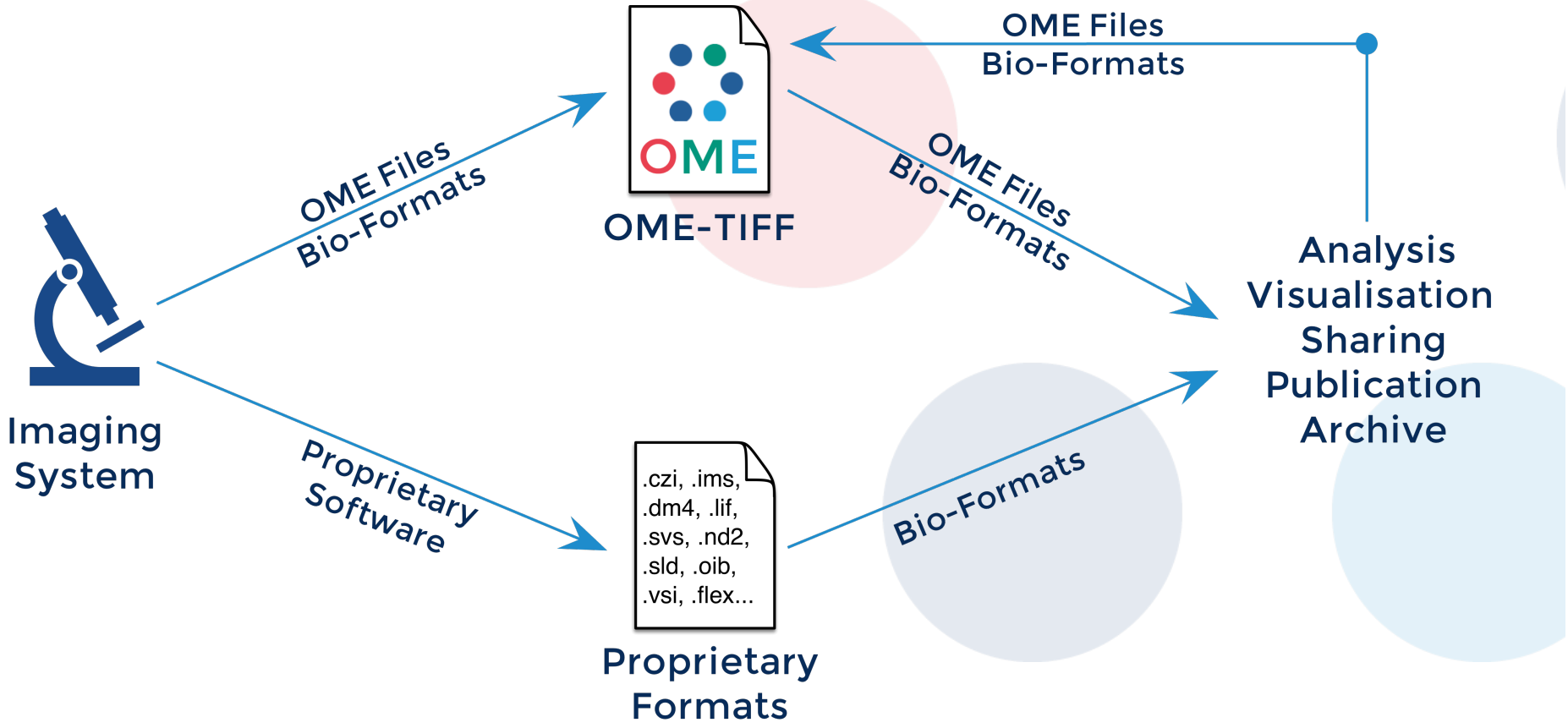

David Gault


Melissa Linkert

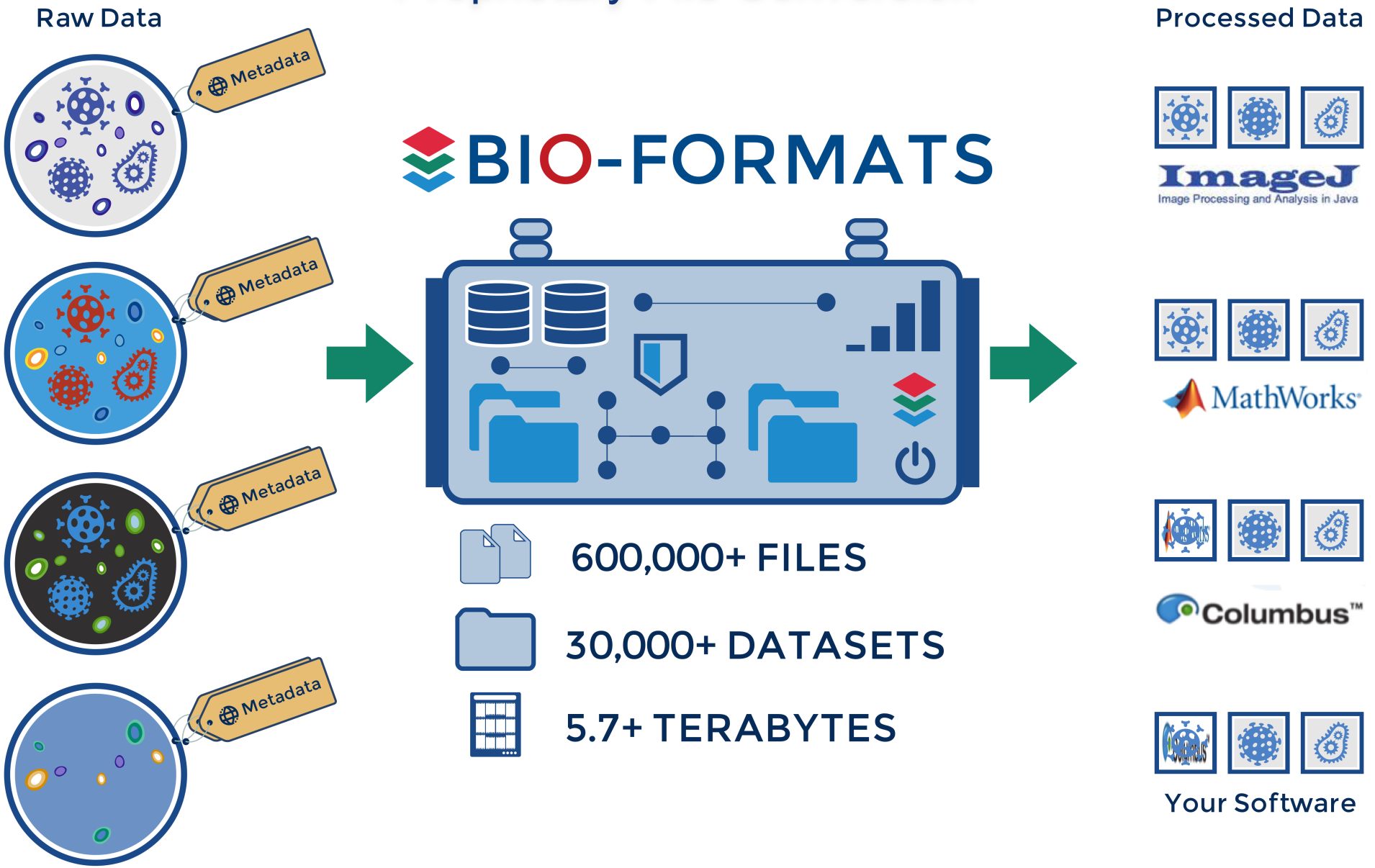

Simone Leo


Balaji Ramalingam

OME File Formats

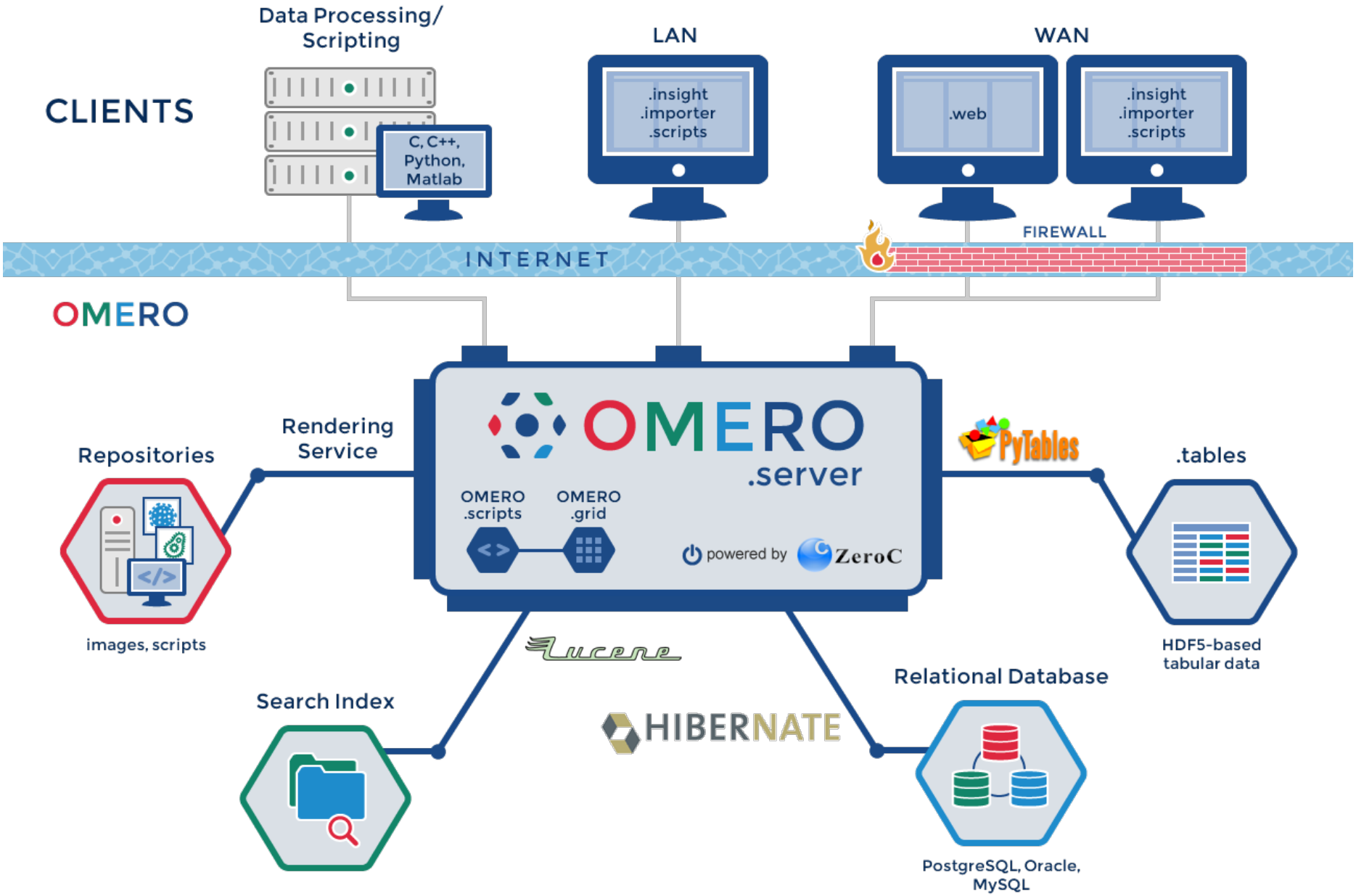


BIO-FORMATS:
Proprietary File Conversion



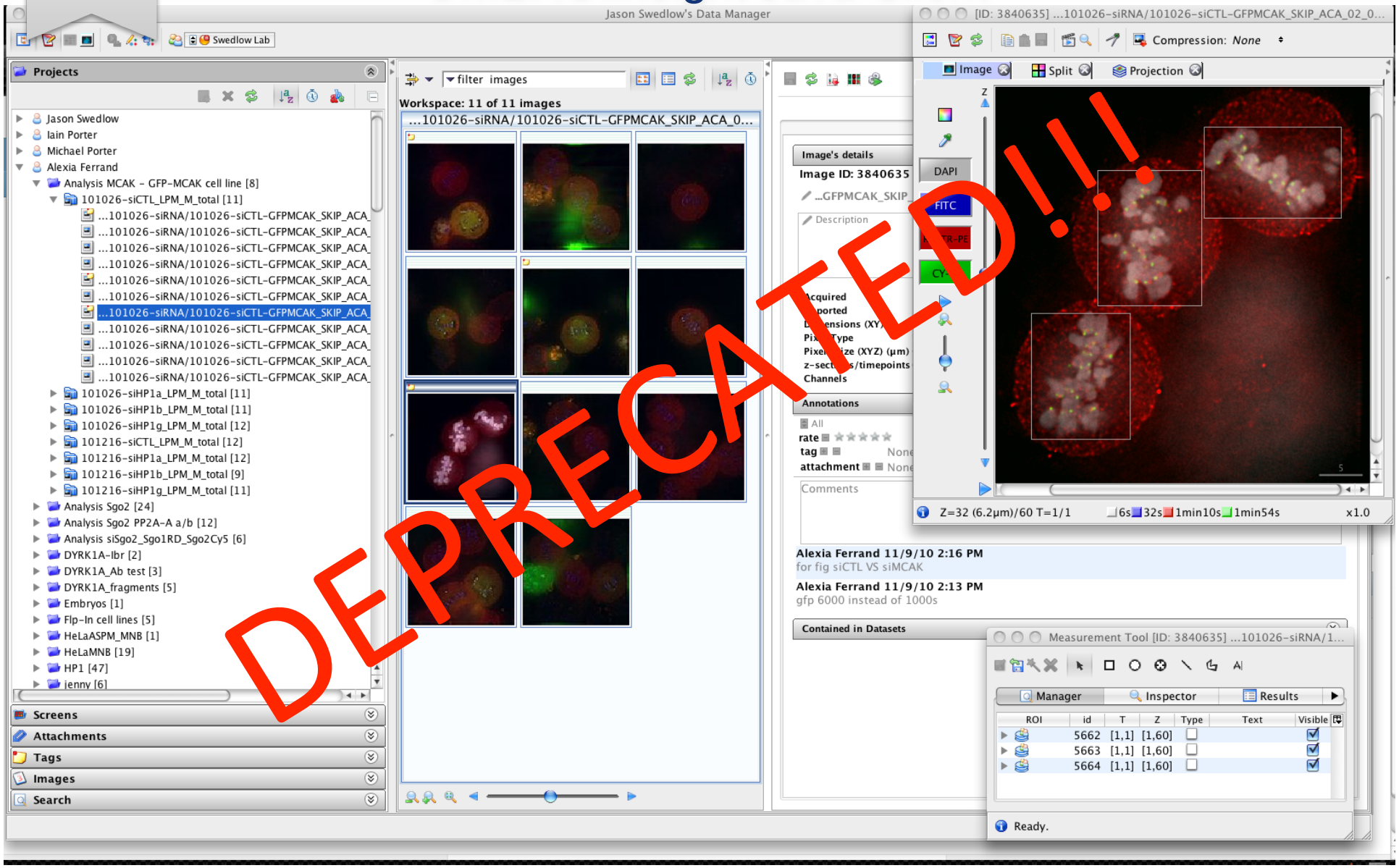
→ Apps using Bio-Formats were started >100,000 times per day in 2015 & 2016 ←

The OMERO Platform



Allan et al, 2012, Nature Methods

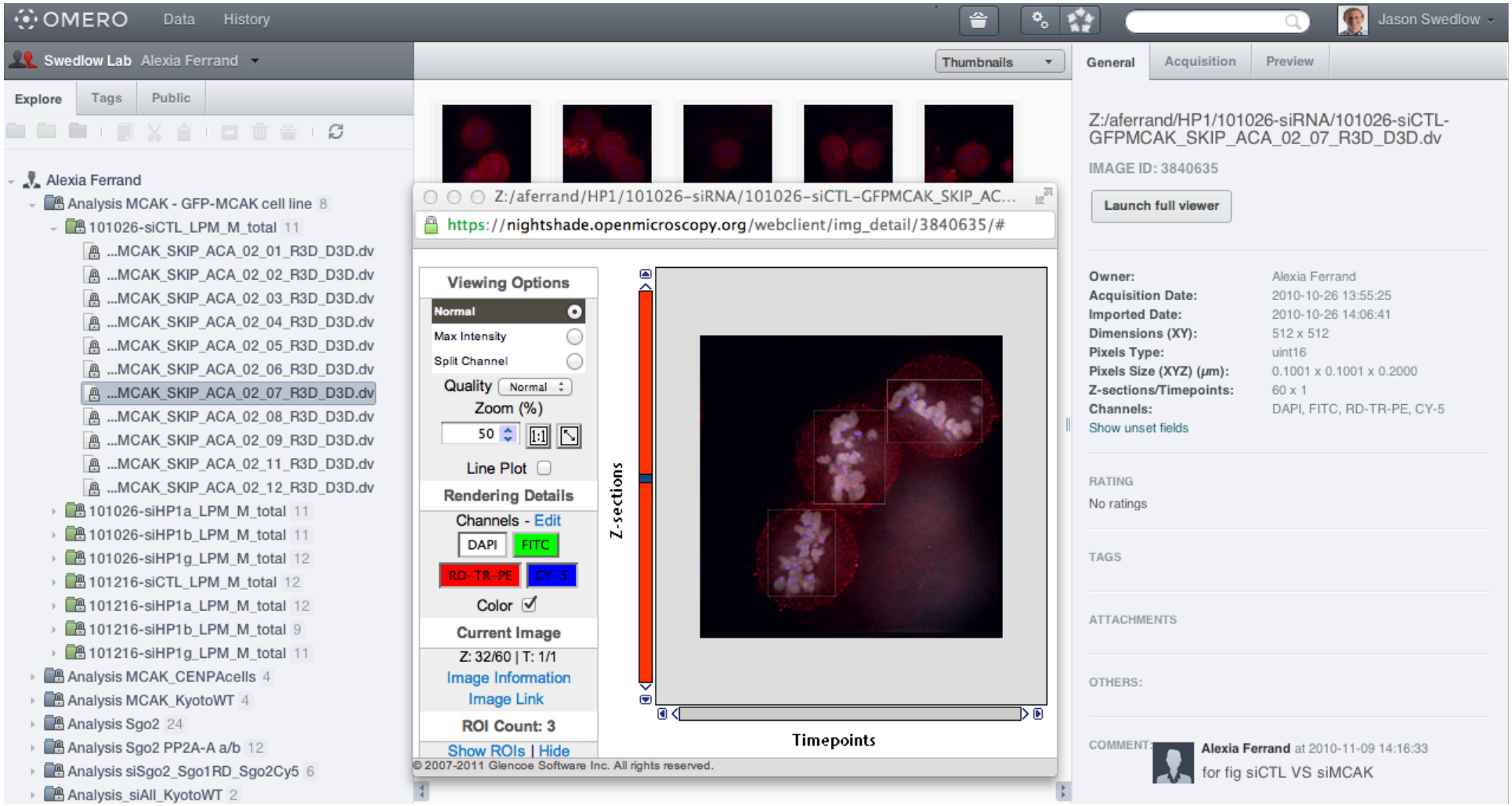
OMERO & BIO-FORMATS:
OMERO.insight Java Client



DEPRECATED!!!

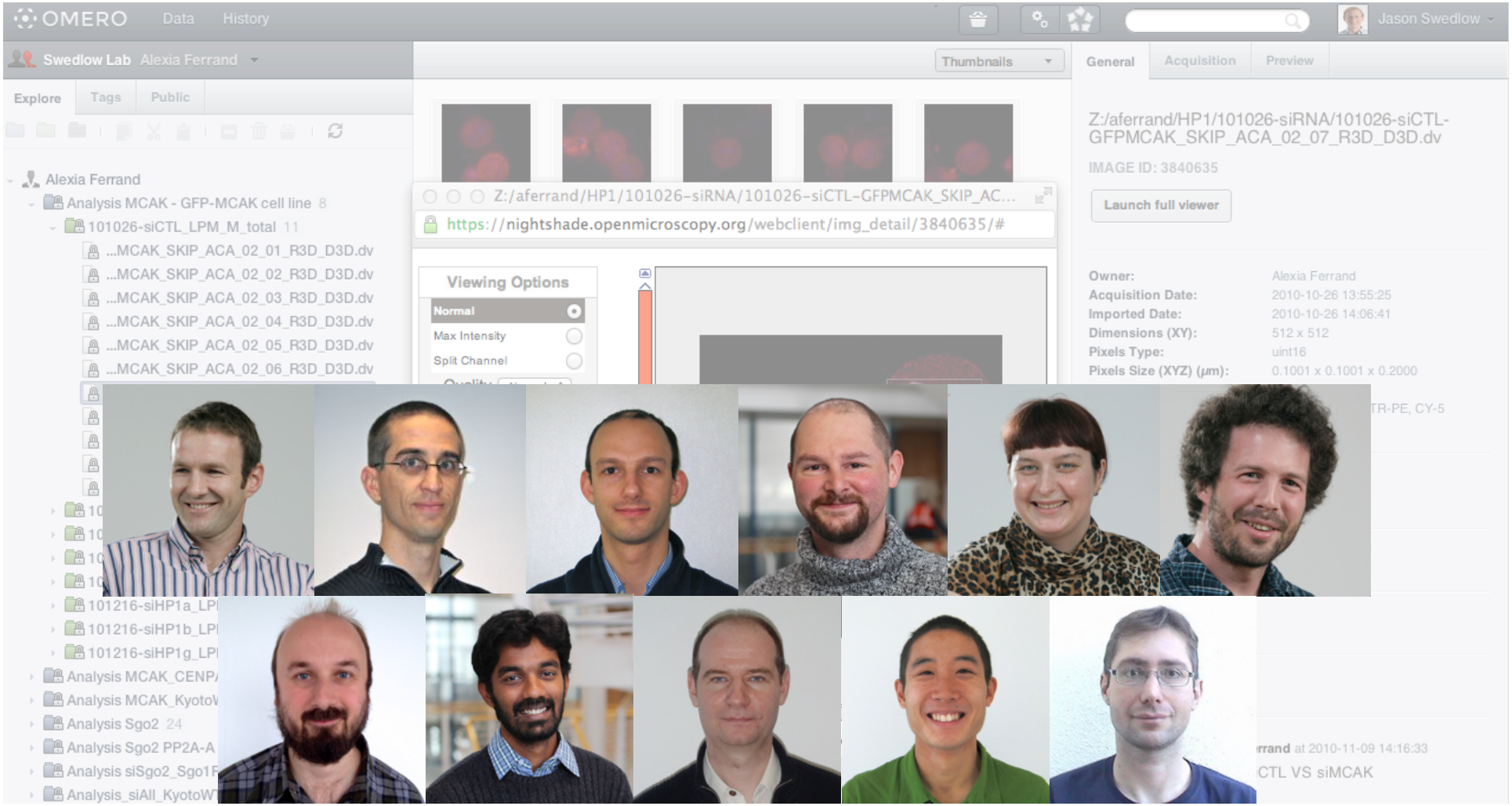
Allan et al, 2012, Nature Methods

OMERO & BIO-FORMATS: OMERO.web Client

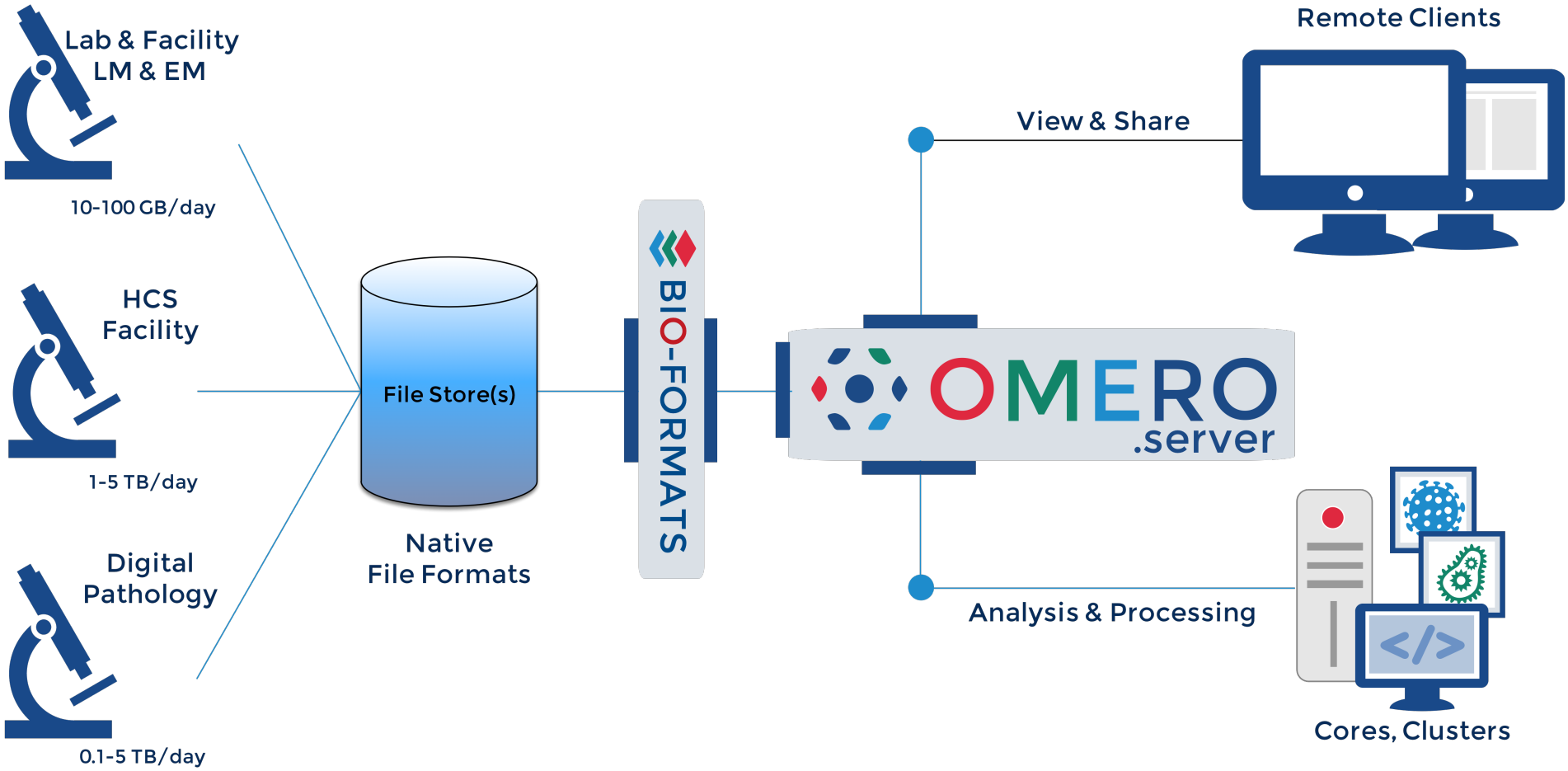


Allan et al, 2012, Nature Methods

OMERO & BIO-FORMATS:
OMERO.web Client

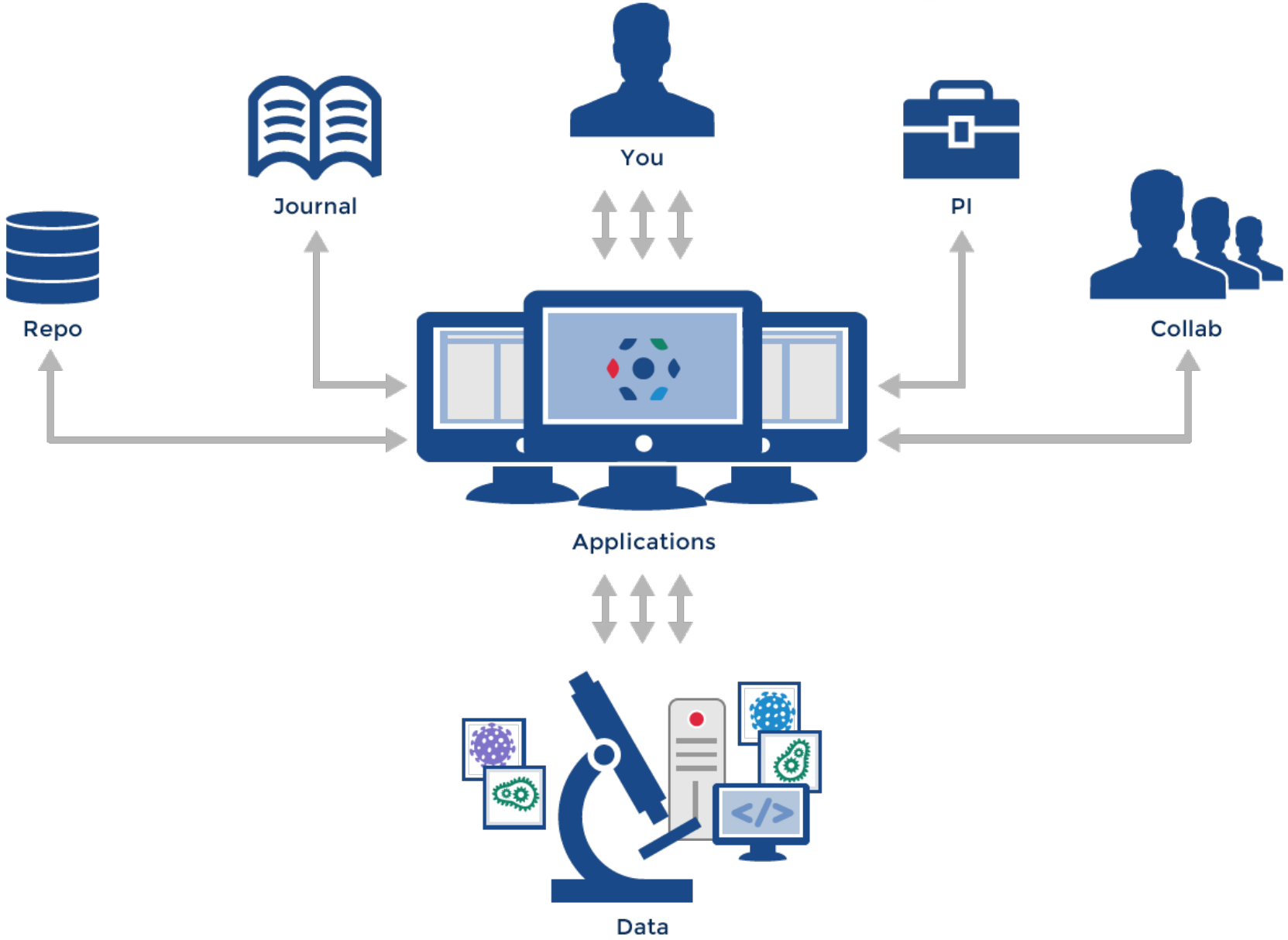


OMERO & Bio-Formats:
Interfaces for Image Data Access



The Standard Paradigm

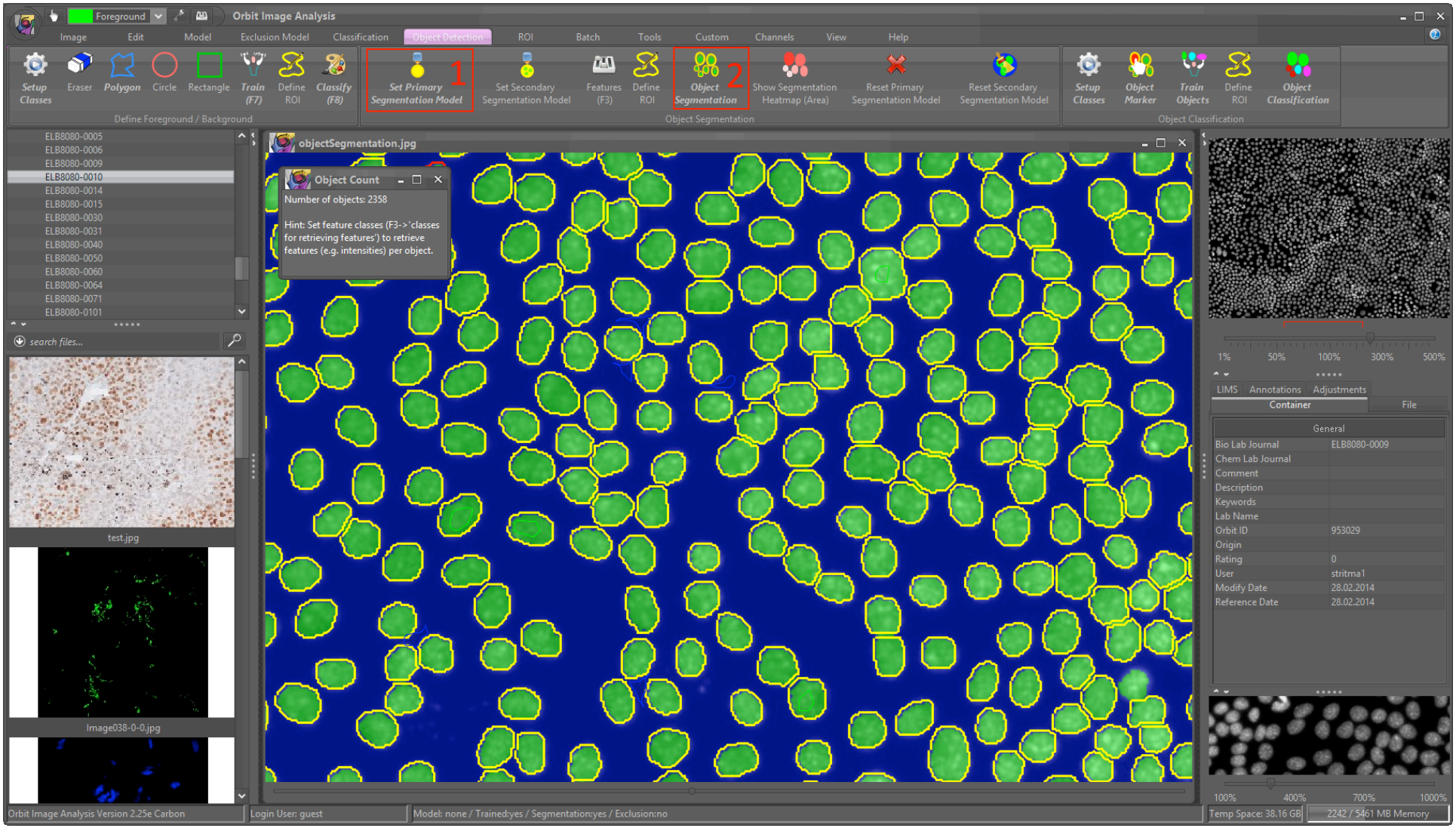
The “Scientific Data” Paradigm



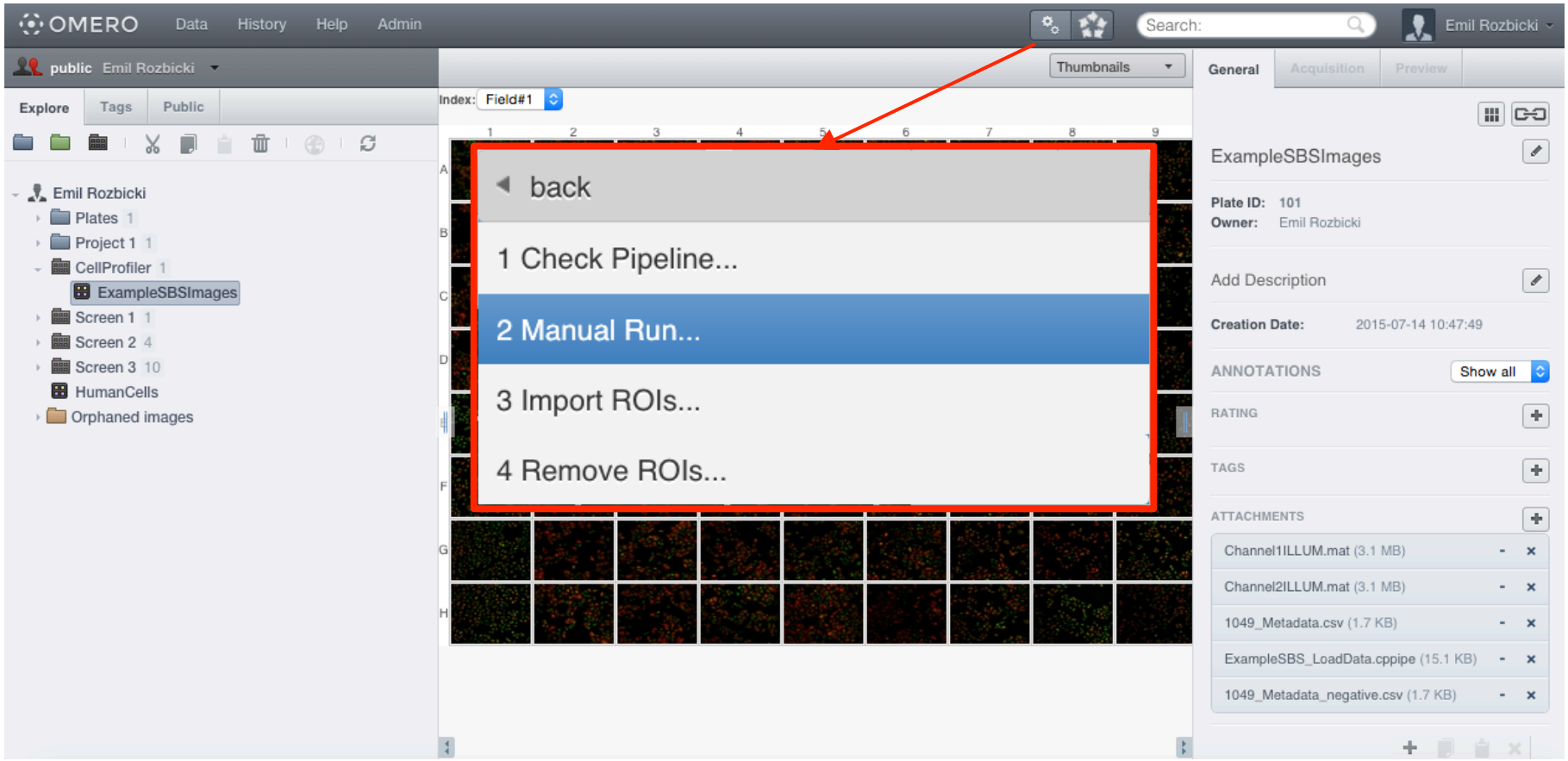
Gray et al, 2005, Scientific Data Management in the Coming Decade, Microsoft Research

INTEGRATING ANALYSIS…

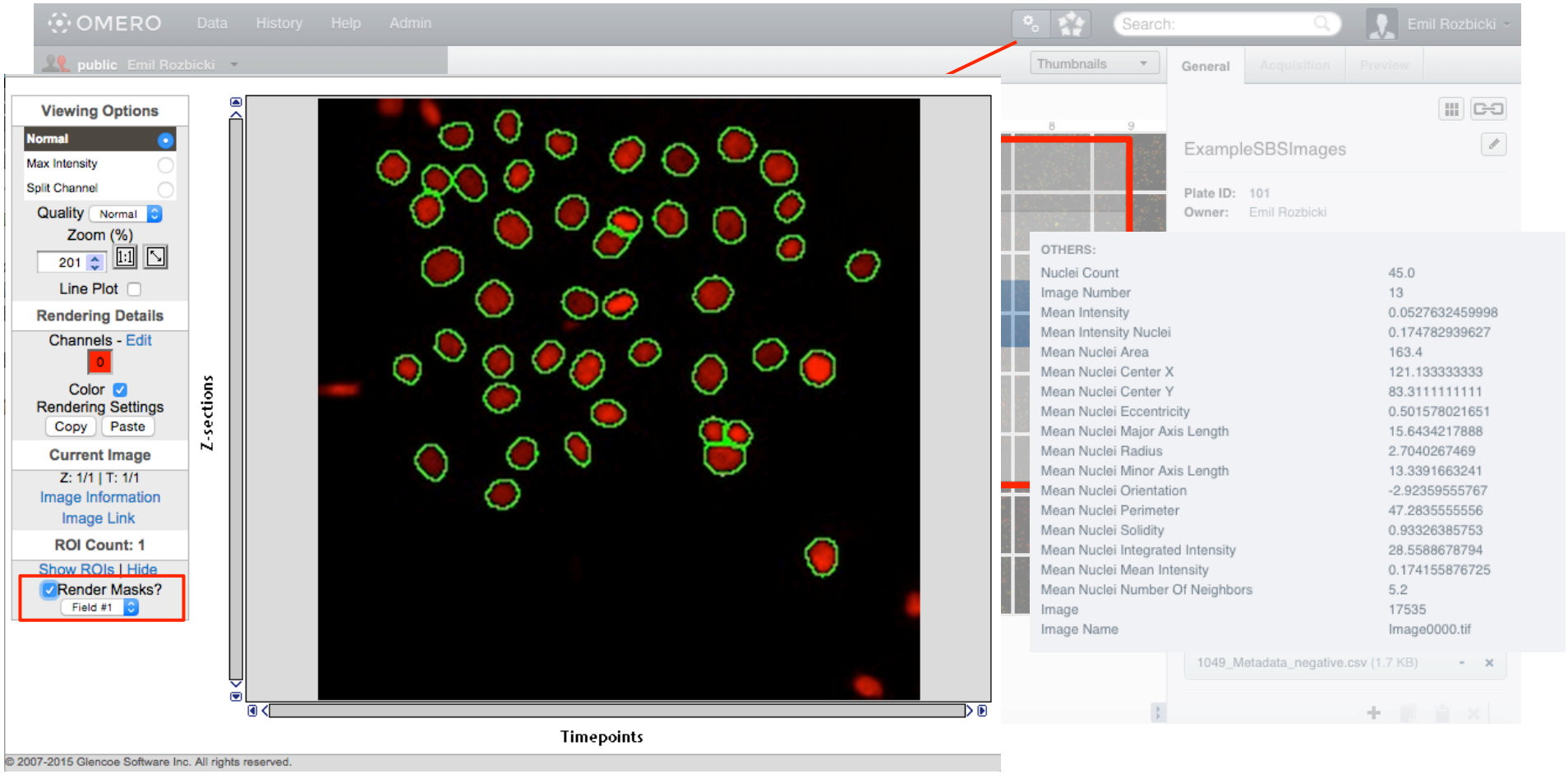
Orbit.bio


Orbit Image Analysis
Foreground
Image
Edit
Model
Exclusion Model
Classification
Object Detection
ROI
Batch
Tools
Custom
Channels
View
Help
Setup Classes
Eraser
Polygon
Circle
Rectangle
Train (F7)
Define ROI
Classify (F8)
Define Foreground / Background
Set Primary Segmentation Model
1
Set Secondary Segmentation Model
Features (F3)
Define ROI
Object Segmentation
2
Show Segmentation Heatmap (Area)
Reset Primary Segmentation Model
Reset Secondary Segmentation Model
Object Segmentation
Setup Classes
Object Marker
Train Objects
Define ROI
Object Classification
Object Classification
ELB8080-0005
ELB8080-0006
ELB8080-0009
ELB8080-0010
ELB8080-0014
ELB8080-0015
ELB8080-0030
ELB8080-0031
ELB8080-0040
ELB8080-0050
ELB8080-0060
ELB8080-0064
ELB8080-0071
ELB8080-0101
search files...
test.jpg
Image038-0-0.jpg
objectSegmentation.jpg
Object Count
Number of objects: 2358
Hint: Set feature classes (F3->'classes for retrieving features') to retrieve features (e.g. intensities) per object.
1%
50%
100%
300%
500%
LIMS
Annotations
Adjustments
Container
File
General
Bio Lab Journal
ELB8080-0009
Chem Lab Journal
Comment
Description
Keywords
Lab Name
Orbit ID
953029
Origin
Rating
0
User
stritma1
Modify Date
28.02.2014
Reference Date
28.02.2014
100%
400%
700%
1000%
Orbit Image Analysis Version 2.25e Carbon
Login User: guest
Model: none / Trained:yes / Segmentation:yes / Exclusion:no
Temp Space: 38.16 GB
2242 / 5461 MB Memory

OMERO & CellProfiler



OMERO & CellProfiler



Examples of Analysis Integration

FLIMfit– fluorescence lifetime fitting (Matlab)

ImageJ/Fiji, Icy– Pluggable, desktop Image processing tools (Java)

Orbit– Feature-based segmentation, tracking (Java)

WND-CHRM-- weighted nearest neighbor machine learning (Python)

ThunderSTORM and PALMSiever– Localisation SRM (ImageJ, Matlab)

OMERO2CV– LSFM Multi-View Reconstruction (C++, OpenCV, ITK)

uTrack– Globally optimised object tracking (Matlab)

CellProfiler– HCS segmentation and features (Python)

Jupyter– web-based image processing w/ NumPy, OpenCV, ITK (IPNB)

mTools– Otsu, basic segmentation (Matlab)

OMERO.figure– web app (JSON)

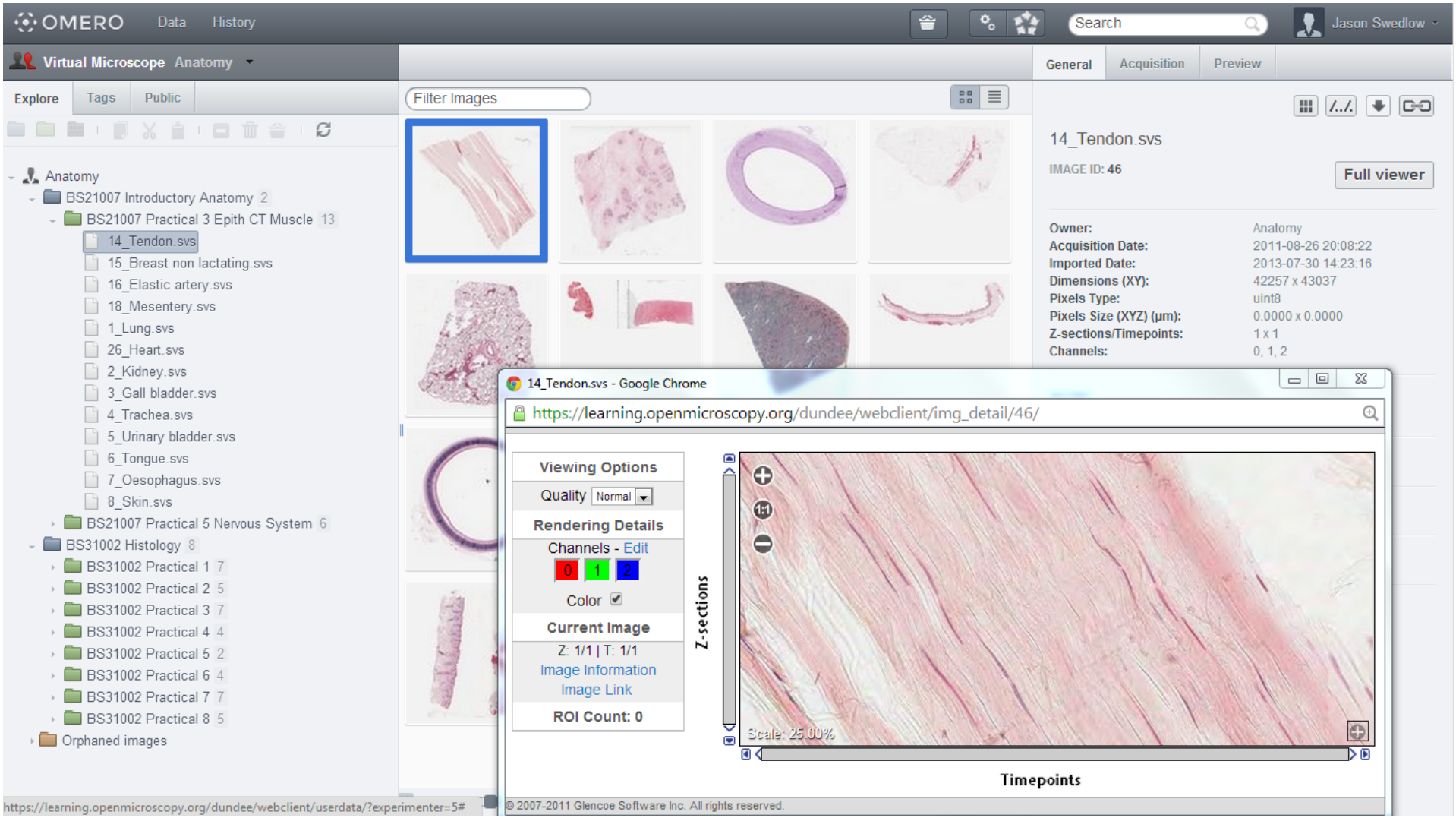
Columbus Acapella®-- commercial Big Data processing…

DATA SHARING, PROVENANCE, INTEGRATION…

Security Model

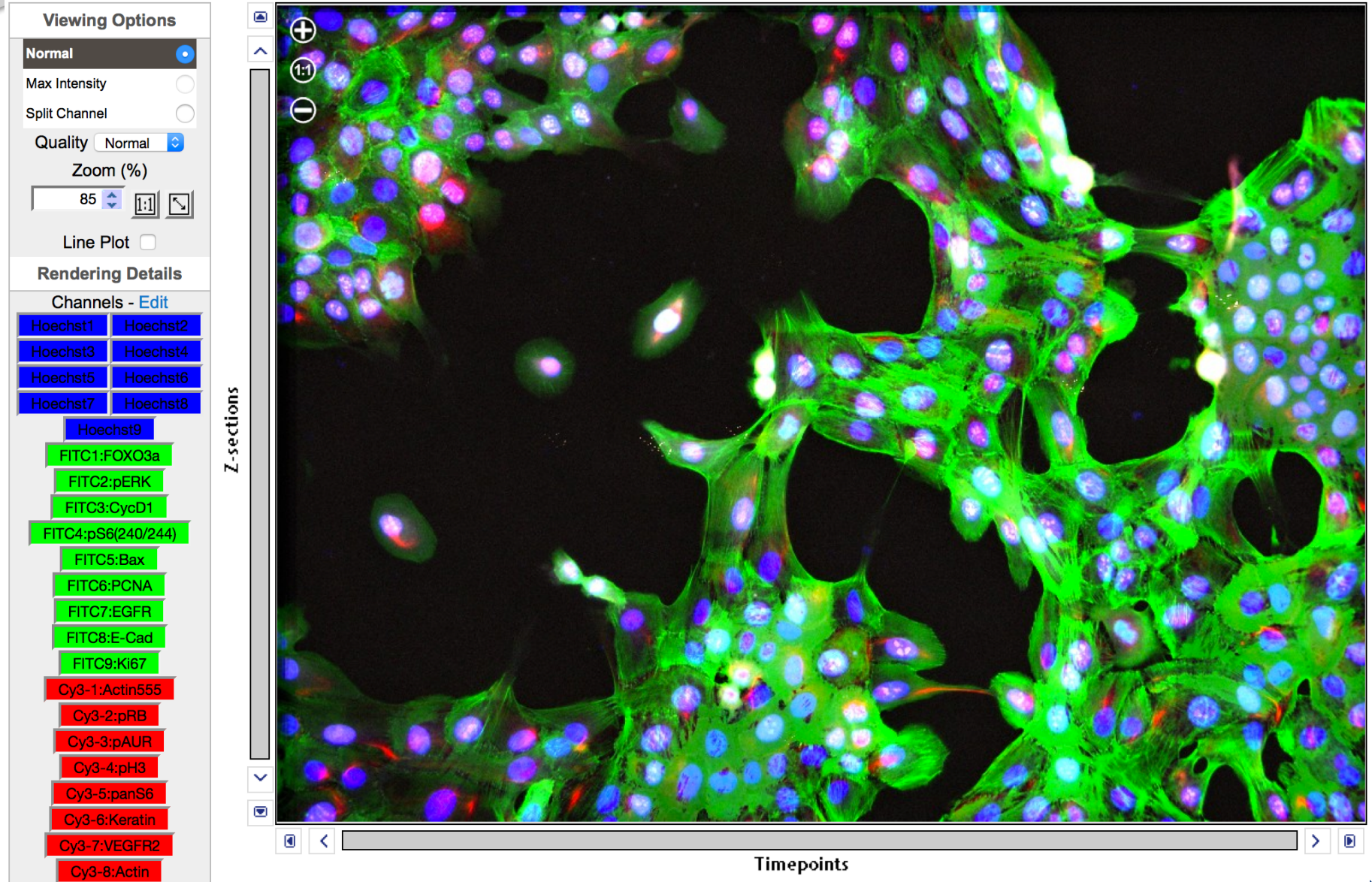
PERMISSIONS	Read	Annotate	Write	Privacy
Private	✓	✓	✓	You
Group-Read	✓	✗	✗	
Group-Annotate	✓	✓	✗	Your Group
Group-Write	✓	✓	✓	
Public-Read	✓	✗	✗	
Public-Annotate	✓	✓	✗	Anyone
Public-Write	✓	✓	✓	

OMERO & BIO-FORMATS:
Pathology Instruction

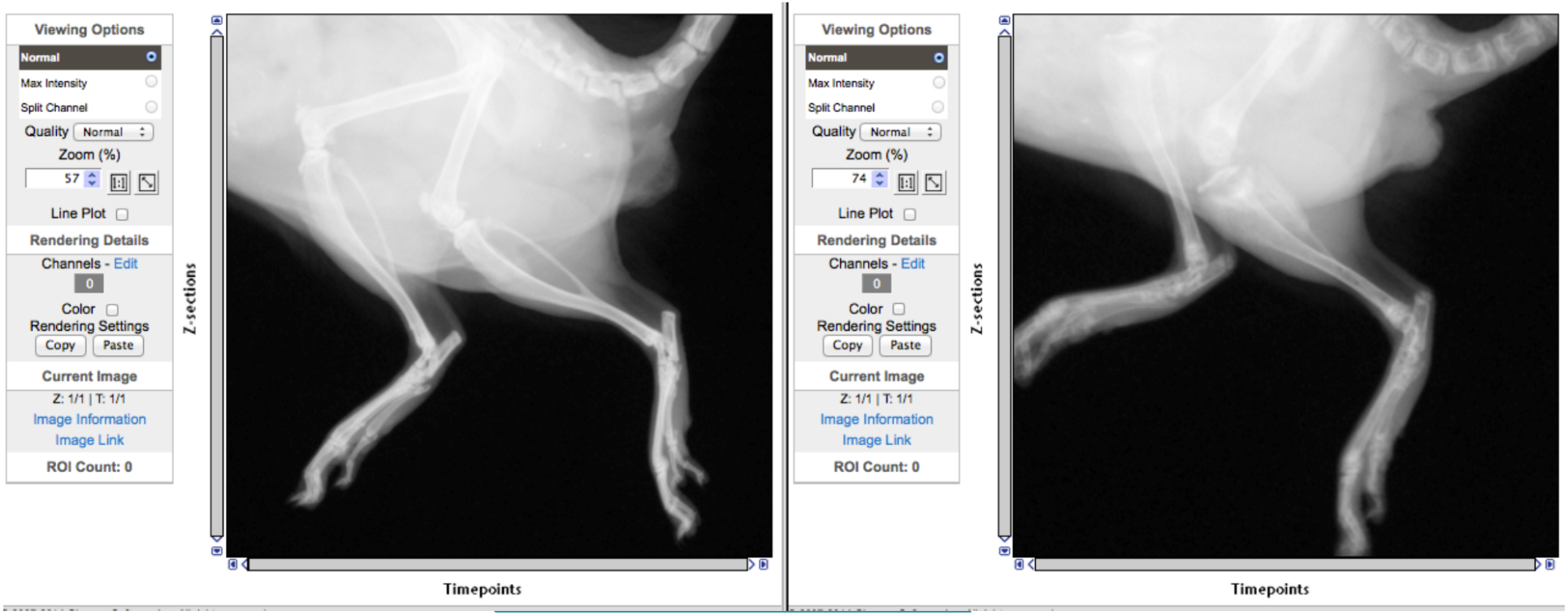


Paul Felts, Dundee; learning.openmicroscopy.org; u:course, pw:omero

OMERO & BIO-FORMATS:
HMS LINCS Database: 27 Channel Cyclic IF



OMERO & BIO-FORMATS: KOMP2/IMPC

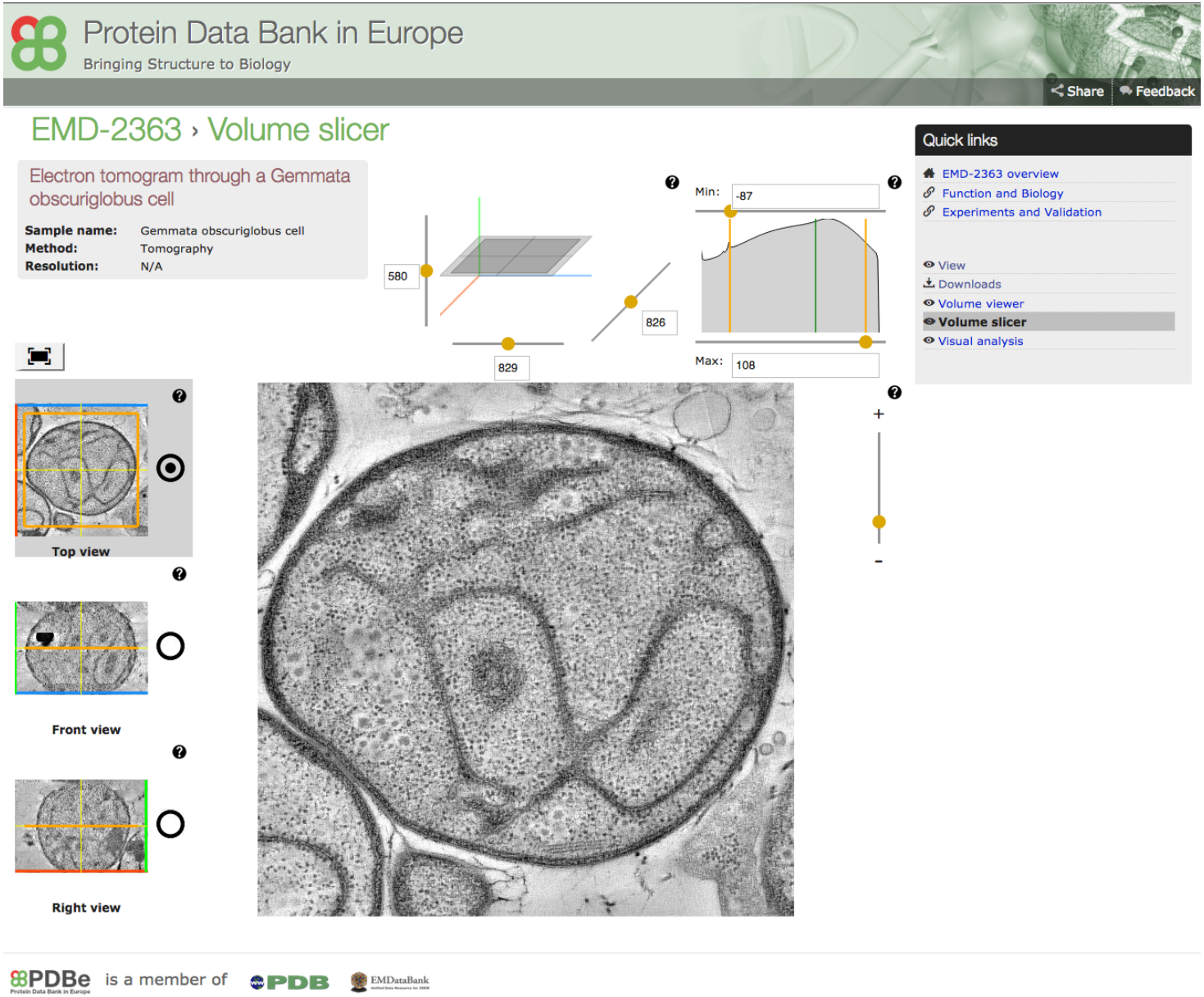


Control

Mutant

OMERO IN USE

EMPIAR/EMDataBank / PDBe



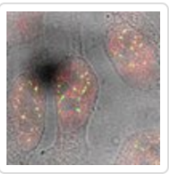
OMERO @ Liverpool

OMERO.gallery Logged in as: Public User

Liverpool CCI OMERO Gallery

You can browse projects below

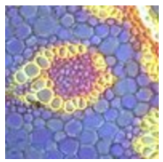
See Lab Public



- Projects: 2
- Datasets: 25
- Images: 785

Explore »

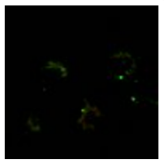
PostAcquisition



- Projects: 0
- Datasets: 2
- Images: 5

Explore »

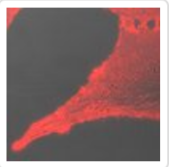
Levy Lab Public



- Projects: 2
- Datasets: 31
- Images: 791

Explore »

Fernig Lab Public



- Projects: 2
- Datasets: 11
- Images: 444

Explore »

David Mason, Liverpool

SSBD @ Riken

SSBD Database

≫ Japanese

Browse through categories: Home | Resources | Manuals | Publicatons | News | Software

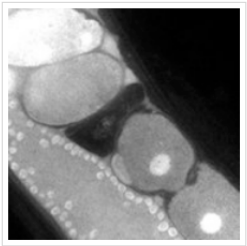
Data Search | Image Search

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

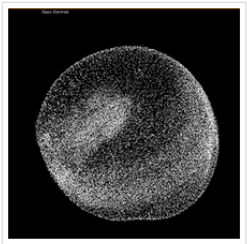


Calcium response and shape changes in oocyte of C. elegans

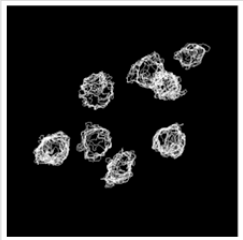
Nuclear division dynamics in C. elegans wild-type embryo

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

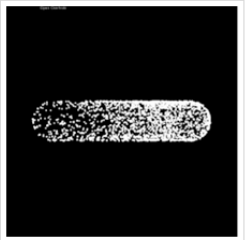
Quantitative data



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

Links

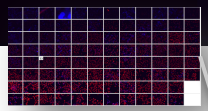
NBDC RDF Portal, RIKEN Meta Database, WDDD,
OME, Ensembl, WormBase

NBDC National Bioscience Database Center | JST | RIKEN

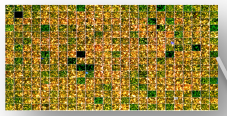
Copyright © RIKEN/NBDC/JST, Contact

The IDR

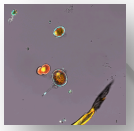
IDR 0006



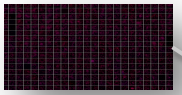
Gene Product Targeting HCS



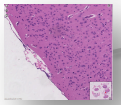
Genetic HCS



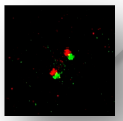
Geographic HCS



Chemical HCS

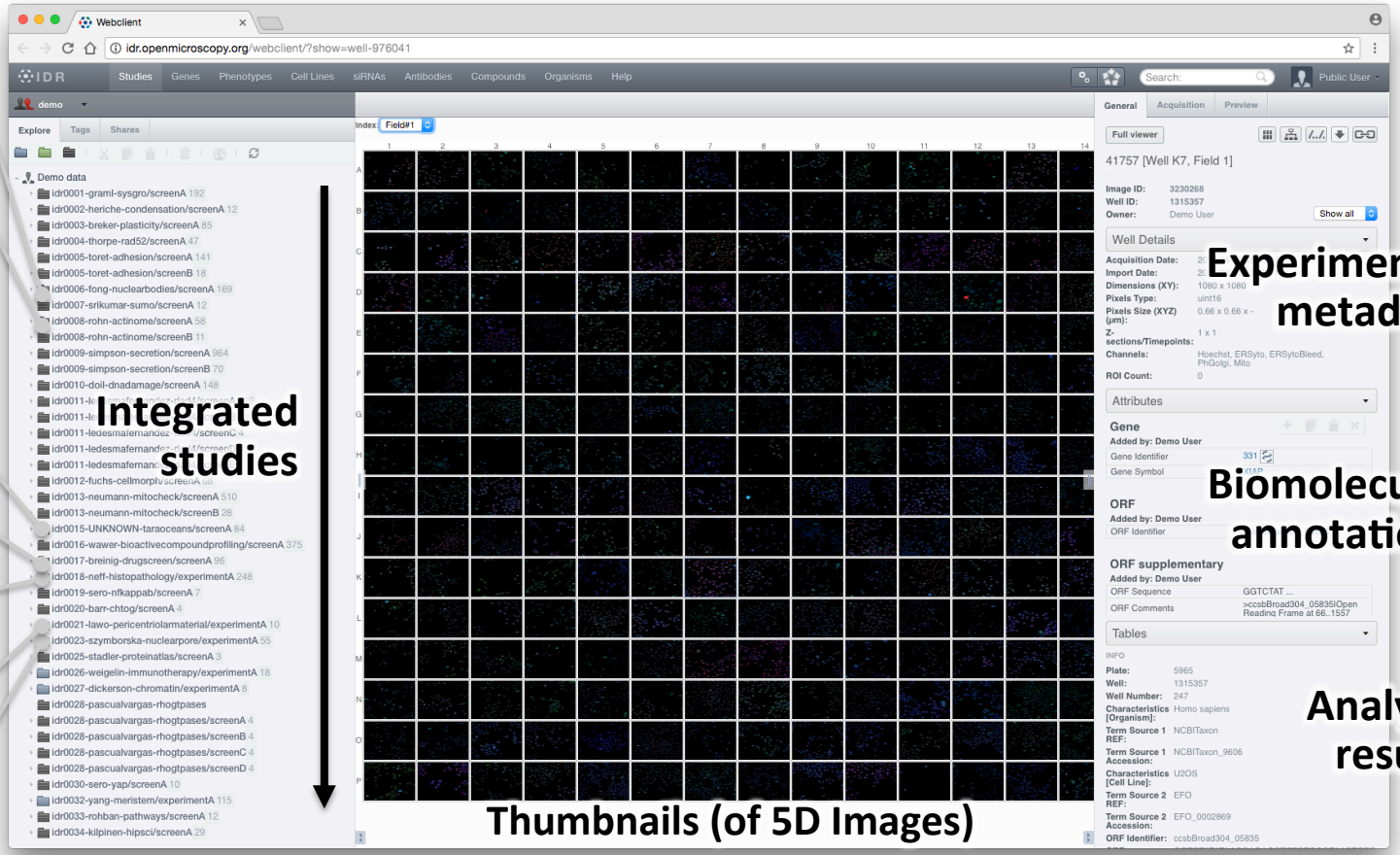


Histopathology



3D-SIM

Super-resolution



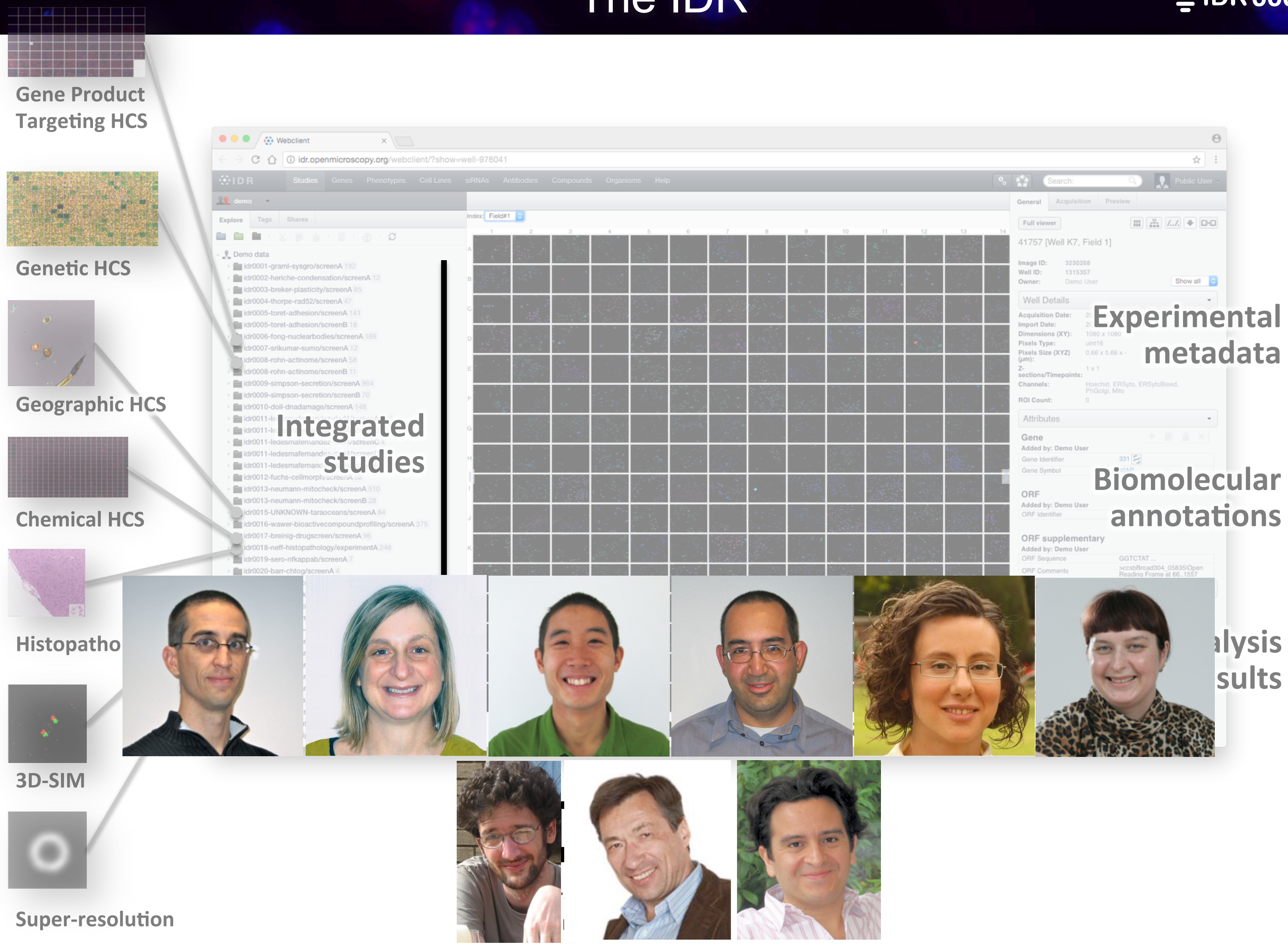
Cross-data browsing

Cloud analysis

Download (local analysis)

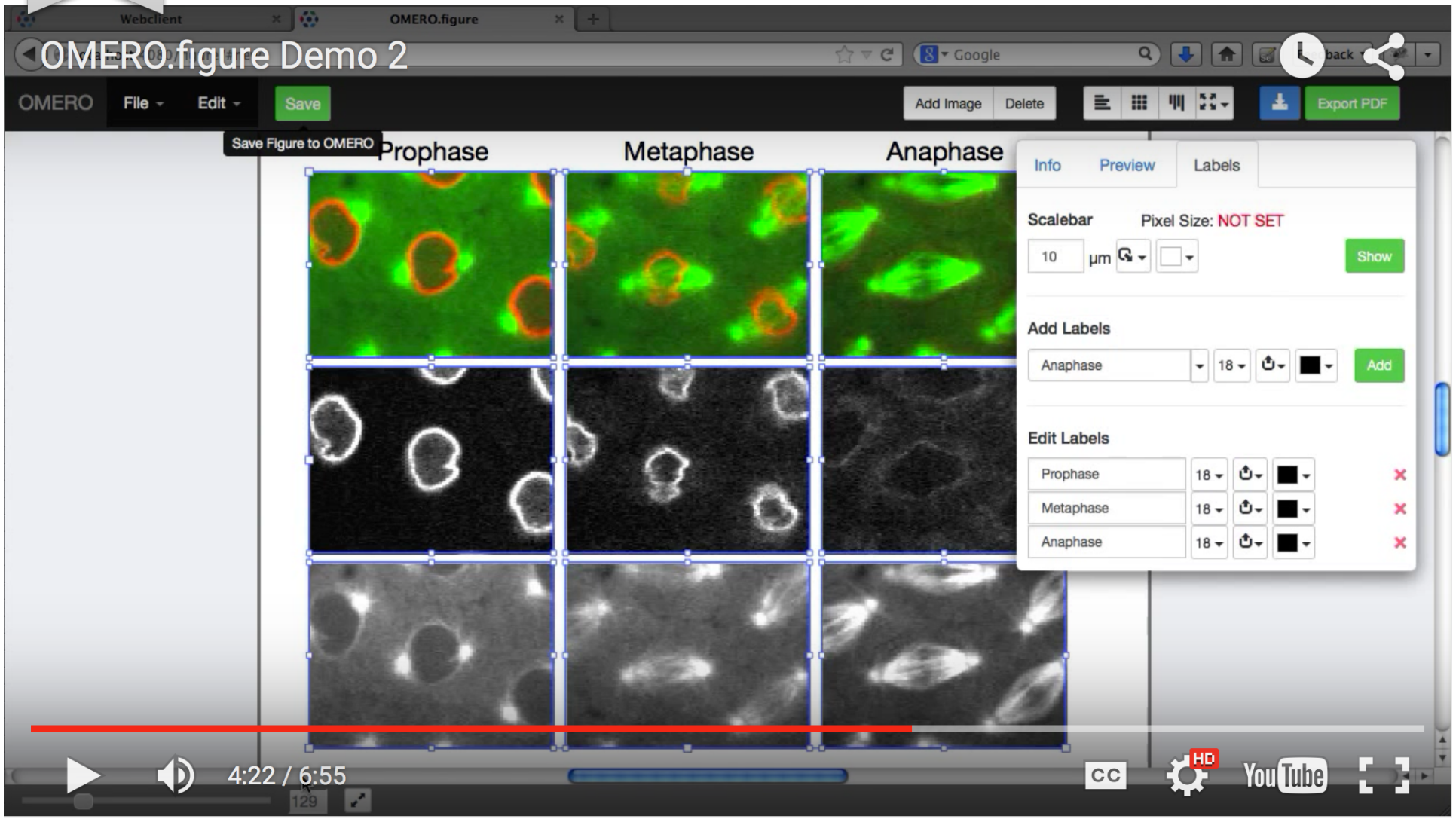
The IDR

IDR 0006



WEB APPS…

OMERO.figure



Will Moore, OME (Google: “OMERO figure”)

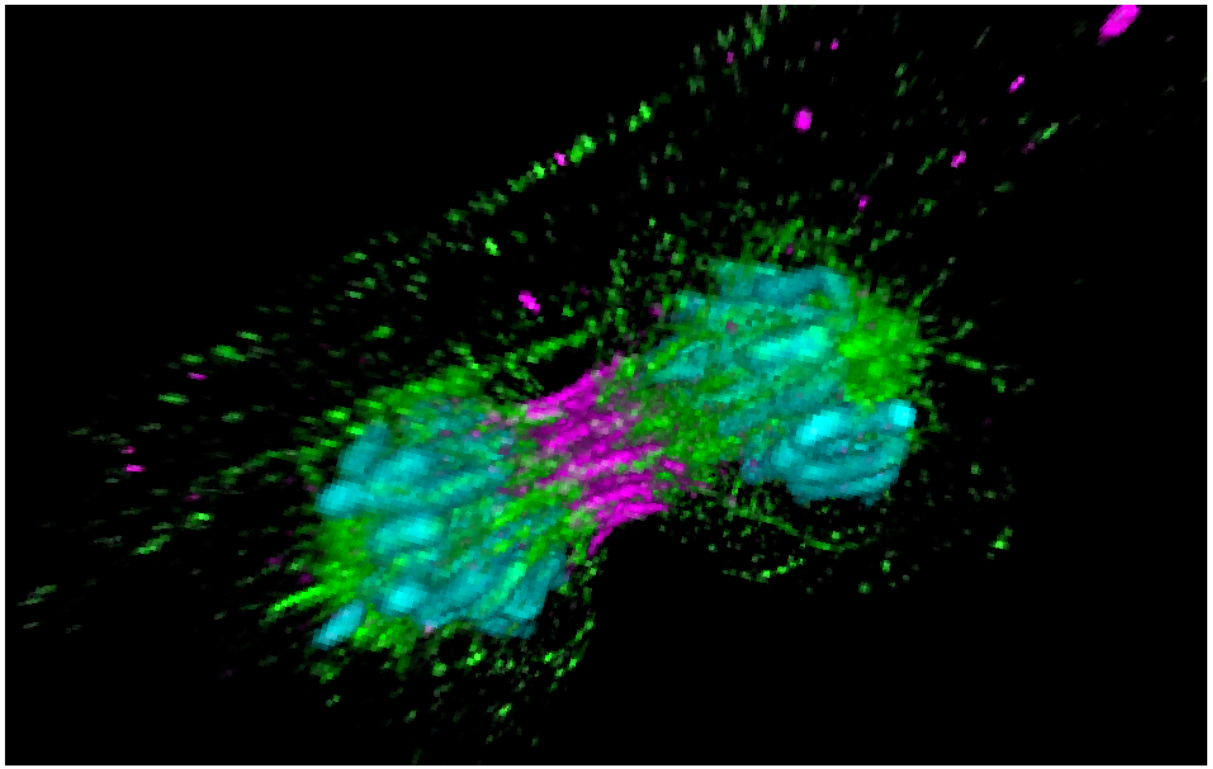
OMERO IN USE

FPBioImage

First Person Bioimage

jason/PTRE/P-TRE_10_R3D_D3D.dv

Press M for a full list of controls



Images generated in OMERO.

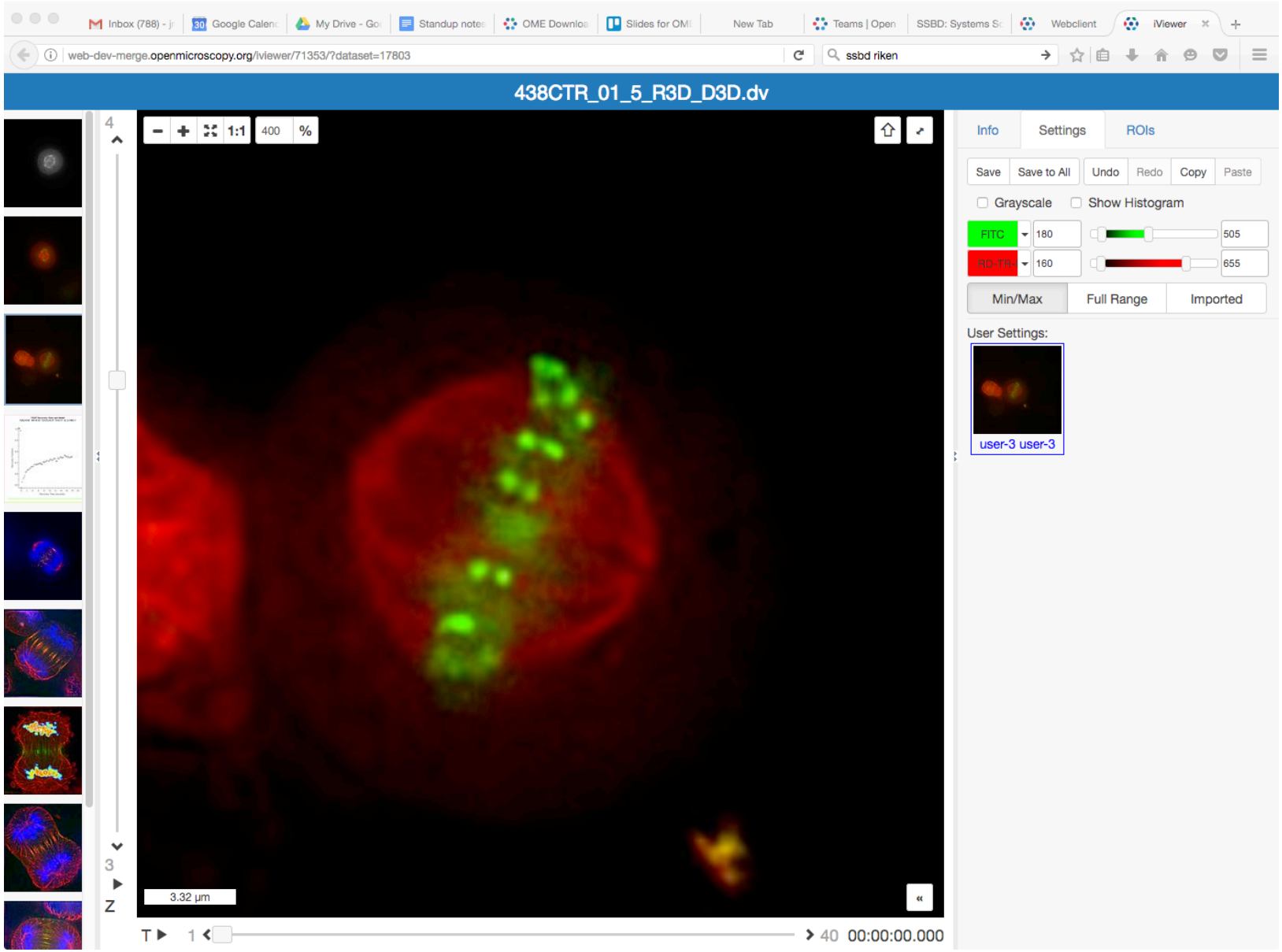
© Marcus Fantham

See the paper in Nature Photonics

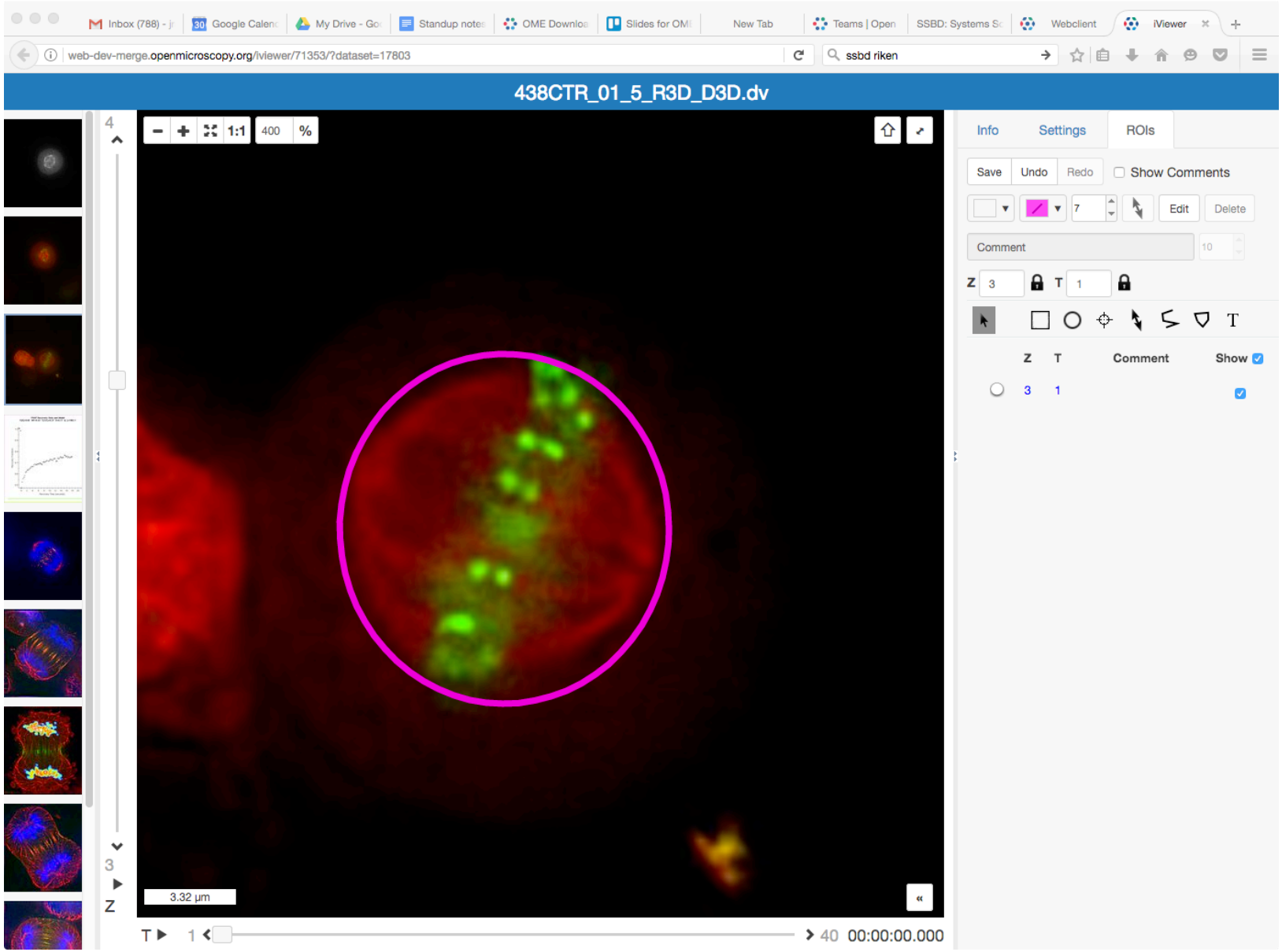
THE LASER ANALYTICS GROUP

UNIVERSITY OF CAMBRIDGE

OMERO.iviewer

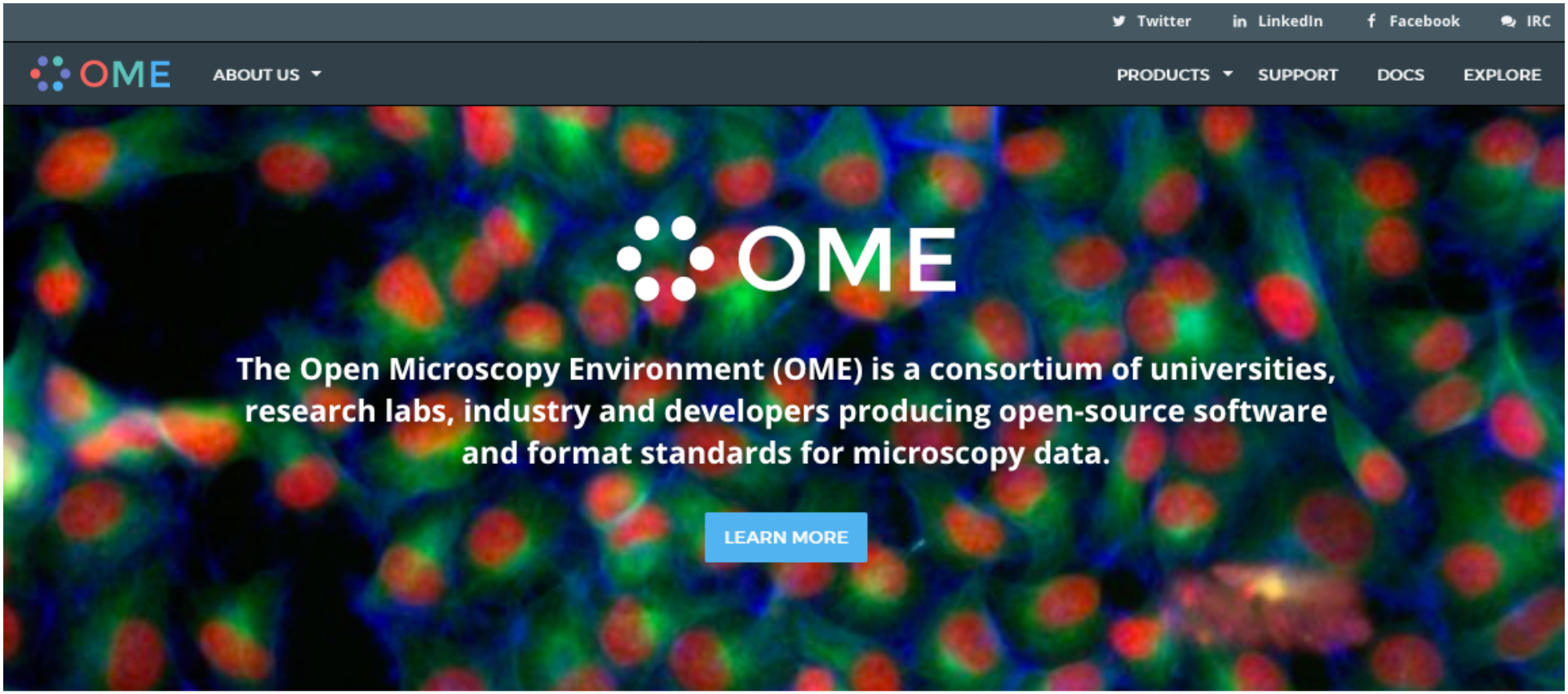


OMERO.iviewer



NEW WEB SITE…

Coming soon….



https://openmicroscopy.github.io/www.openmicroscopy.org/

FUNDING

OME Grant Funding

- BBSRC IDR (2015 - 2106)
- Horizon 2020 (2016 – 2018)
  - MULTIMOT
  - Euro-BioImaging PPII
  - CORBEL
  - Global BioImaging
- BBSRC BBR Extended Metadata (2014 - 2017)
- Wellcome Biomedical Resource Bio-Formats Updates 2017 - 2019

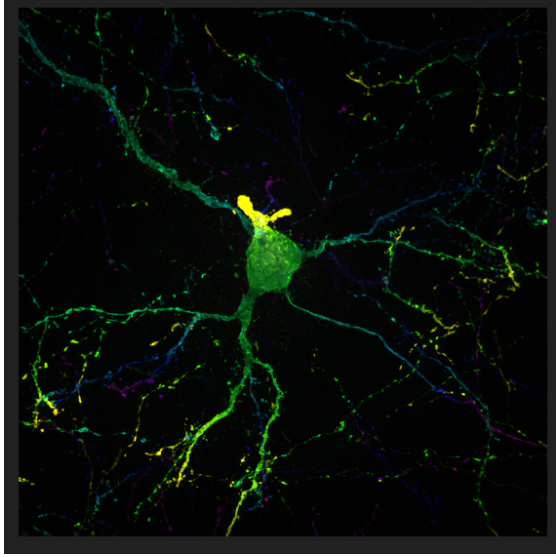
BIO-FORMATS:
Opportunities for Academic/Commercial Collaborations

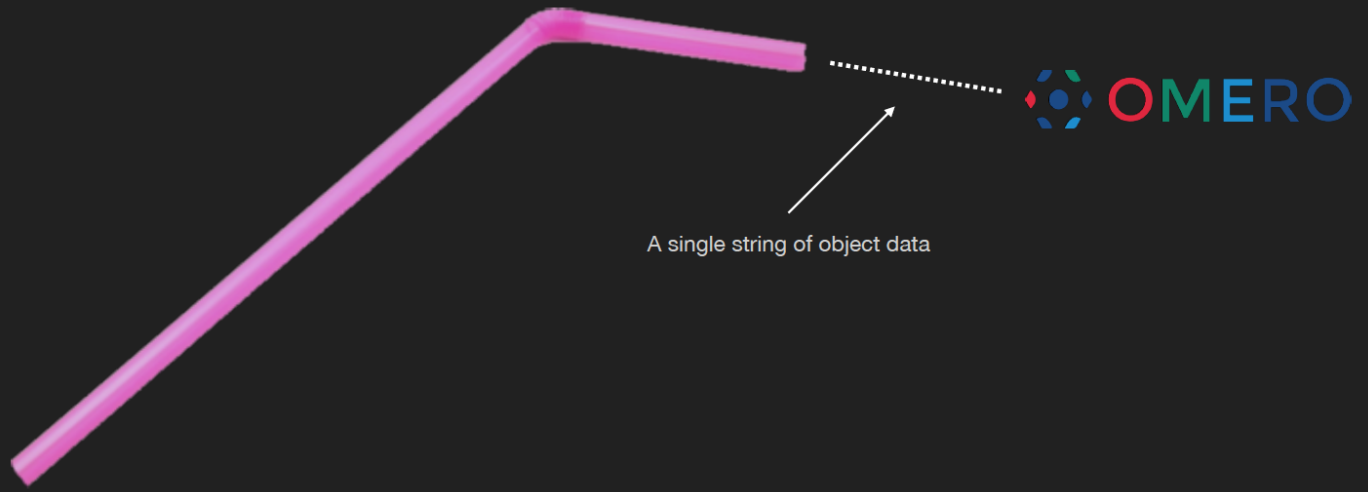
- 3i: Building and maintaining a SlideBook file format reader
- PerkinElmer: Commission Glencoe to provide open source Harmony HCS format reader
- ZEISS: Commission Glencoe to build open source JPEG-XR decoder
- Olympus Europe: Commision Glencoe to build open source OIR reader

→ *See blog.openmicroscopy.org for more info*

OME2016: Luke Hammond/QBI

The Blitz Gateway





OMERO

A single string of object data

* Blitz is also non scalable

22

OME2017: Thank you BD2K!!!

- OHSU & HMS BD2K award for OMERO Scaling Updates
  - Read-Only OMERO
  - Session Portability

What About Brexit?!?!?!?!

- OME mostly UK-funded
  - Wellcome Trust, BBSRC– ~£10M since 2011
- Funding Infrastructure is Hard
  - Harder when ££$ are tight, uncertain times
- Future Opportunities
  - National/Trans-national Research Infrastructures
    - BioImagingUK, France BioImaging, German BioImaging, Japan BioImaging, NCI…
  - Partnerships with research labs, institutions, projects
    - UK, USA, Europe, Japan
    - Academic, Industrial, Commercial

2017/2018 PRIORITIES?

Some words to think about…

- New Modalities (MS, Raman, X-ray, etc.)
- Multi-modal/Correlative
- Federation:
  - SSO
  - Distributed Data
- Import/Export
- Ontologies
- OMERO Gateway
- Apps
- Microservices
- Notebooks
- Client Architecture
- Archiving
- …

Thank you!

Jason Swedlow

Sebastien Besson

Jean-Marie Burel

Mark Carroll

Helen Flynn

David Gault

Kenny Gillen

Roger Leigh

Simone Leo

Simon Li

Dominik Lindner

June Matthew

Josh Moore

Will Moore

Balaji Ramalingam

Gabriella Rustici

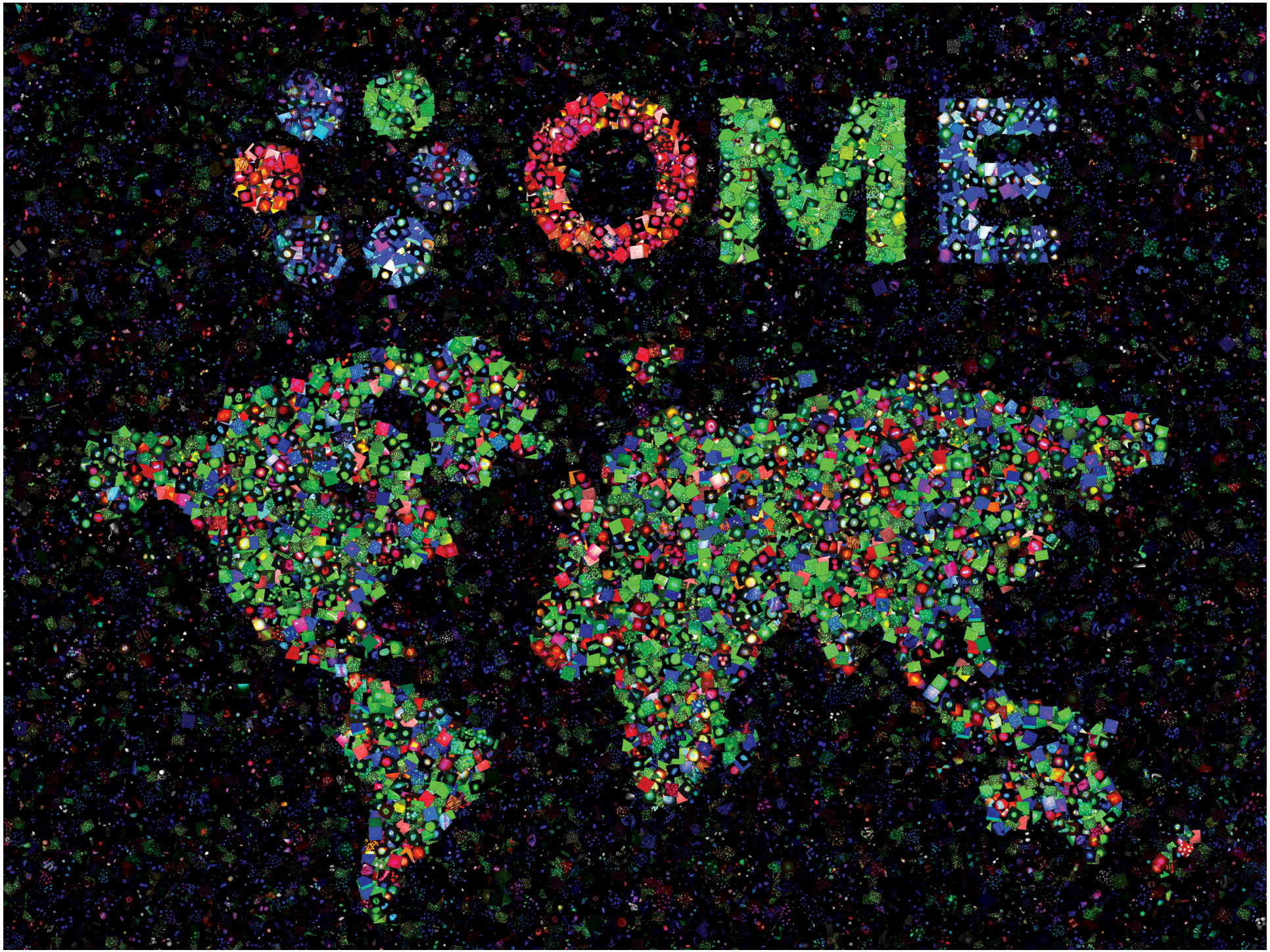
Aleksandra Tarkowska

Petr Walczysko

Harald Waxenegger

Eleanor Williams

Wilma Woudenberg


SOME