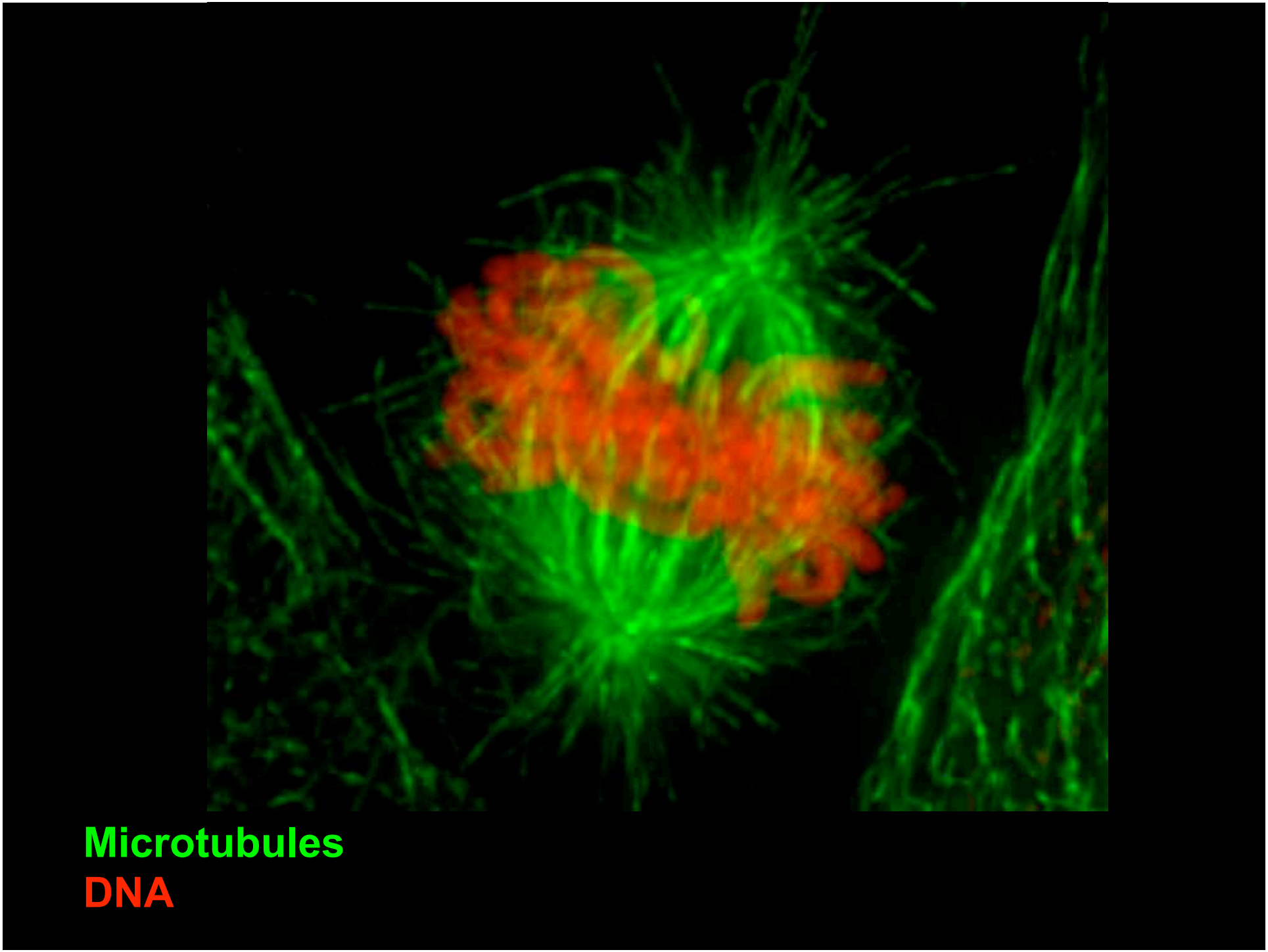
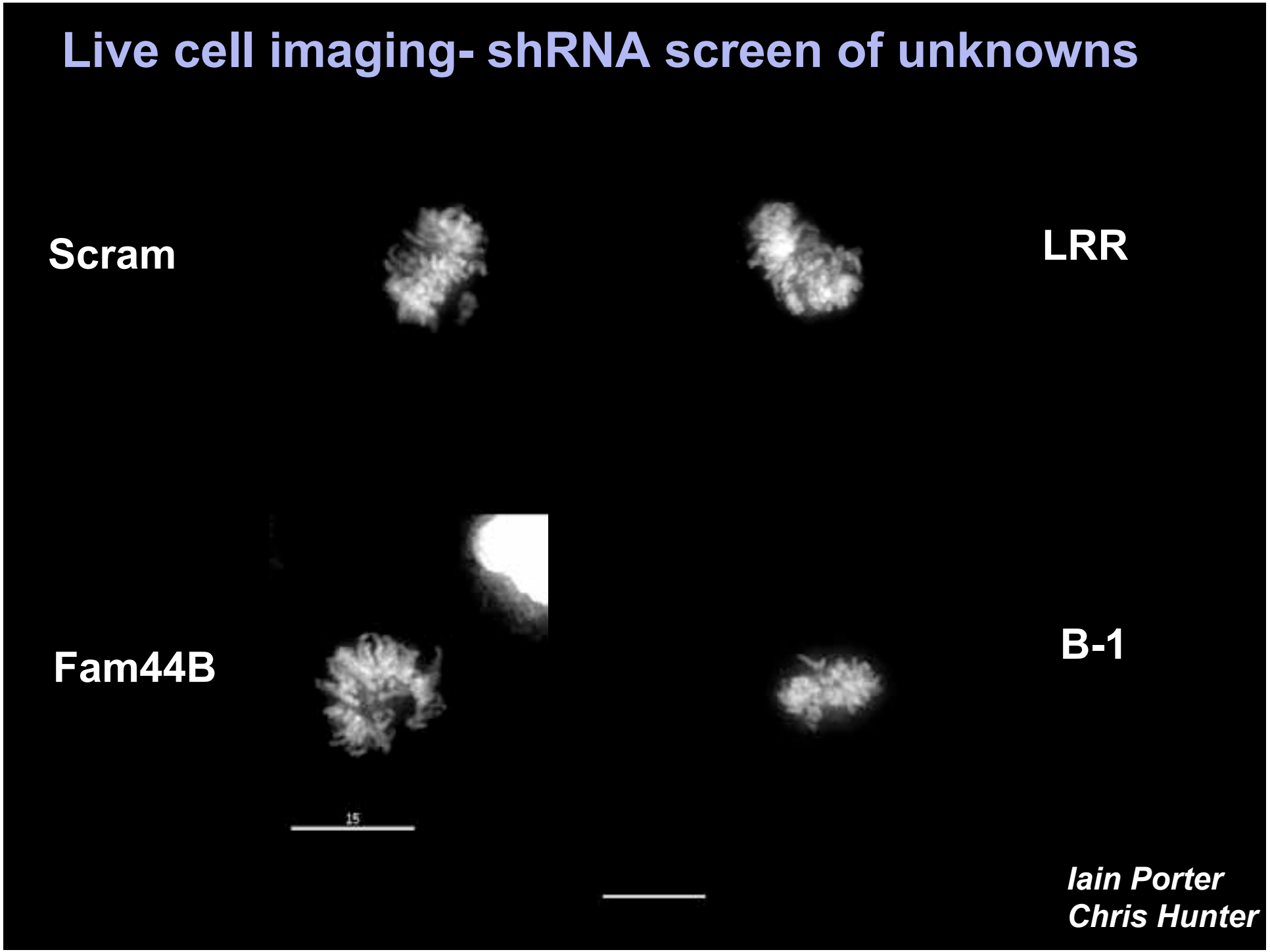
The Open Microscopy Environment: Informatics, Visualization and Quantitative Analysis for Biological Microscopy

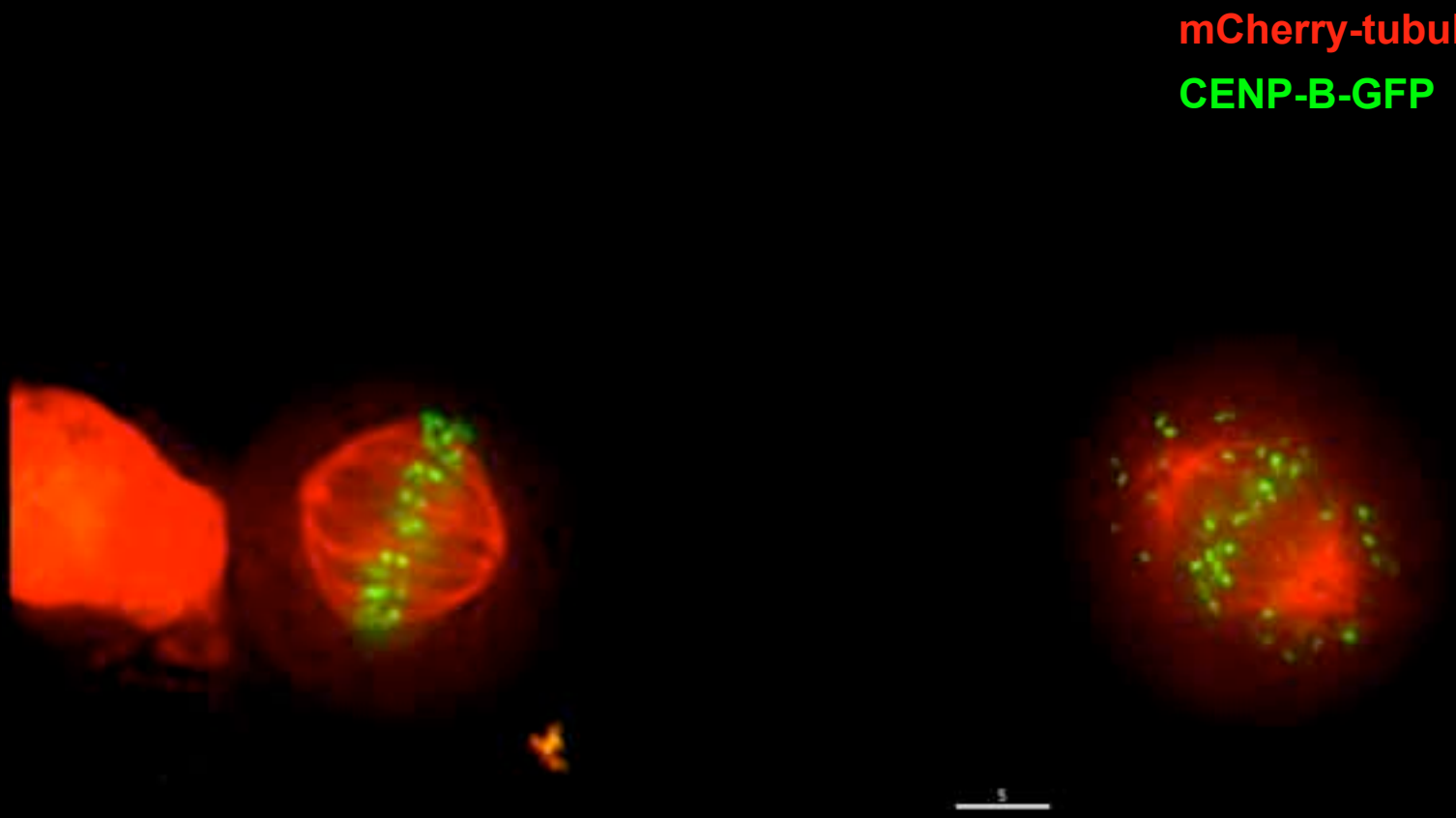
Jason Swedlow
Division of Gene Regulation and Expression
Wellcome Trust Biocentre
University of Dundee
Scotland


Microtubules
DNA

Live cell imaging- shRNA screen of unknowns

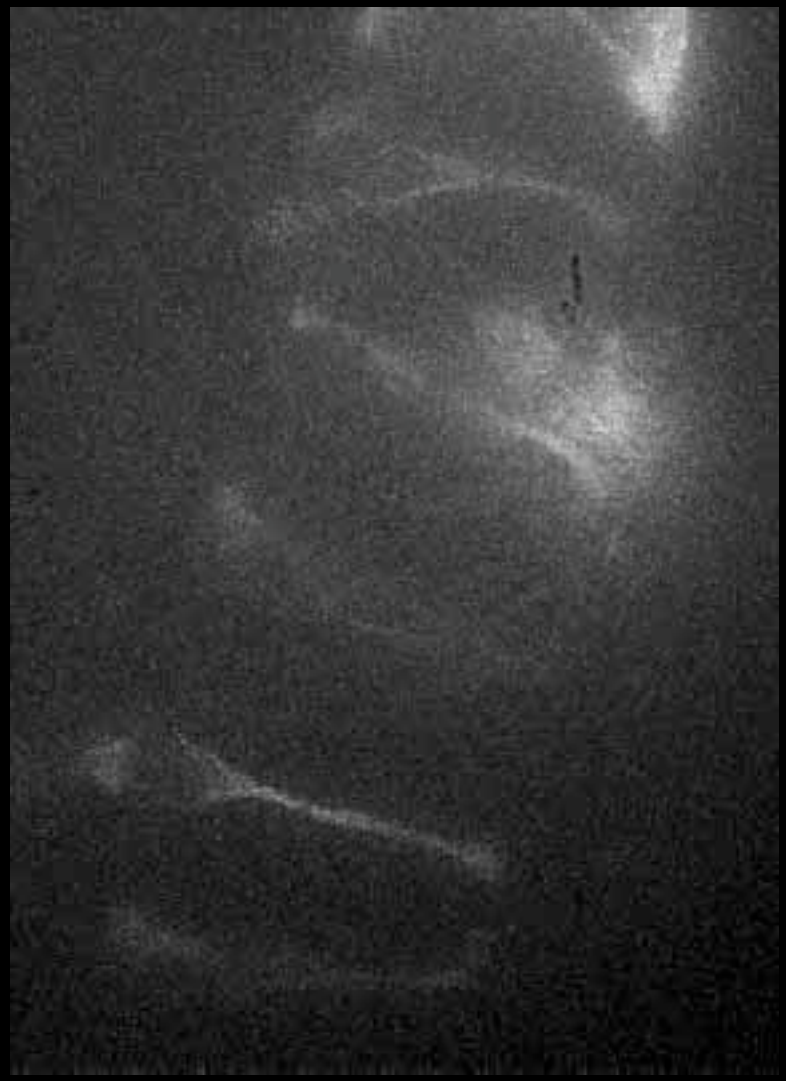


Fam44B is Required for Chromosome Alignment



Iain Porter

Links Between Mitosis & Neurogenesis



Chick Embryo Neural Tube

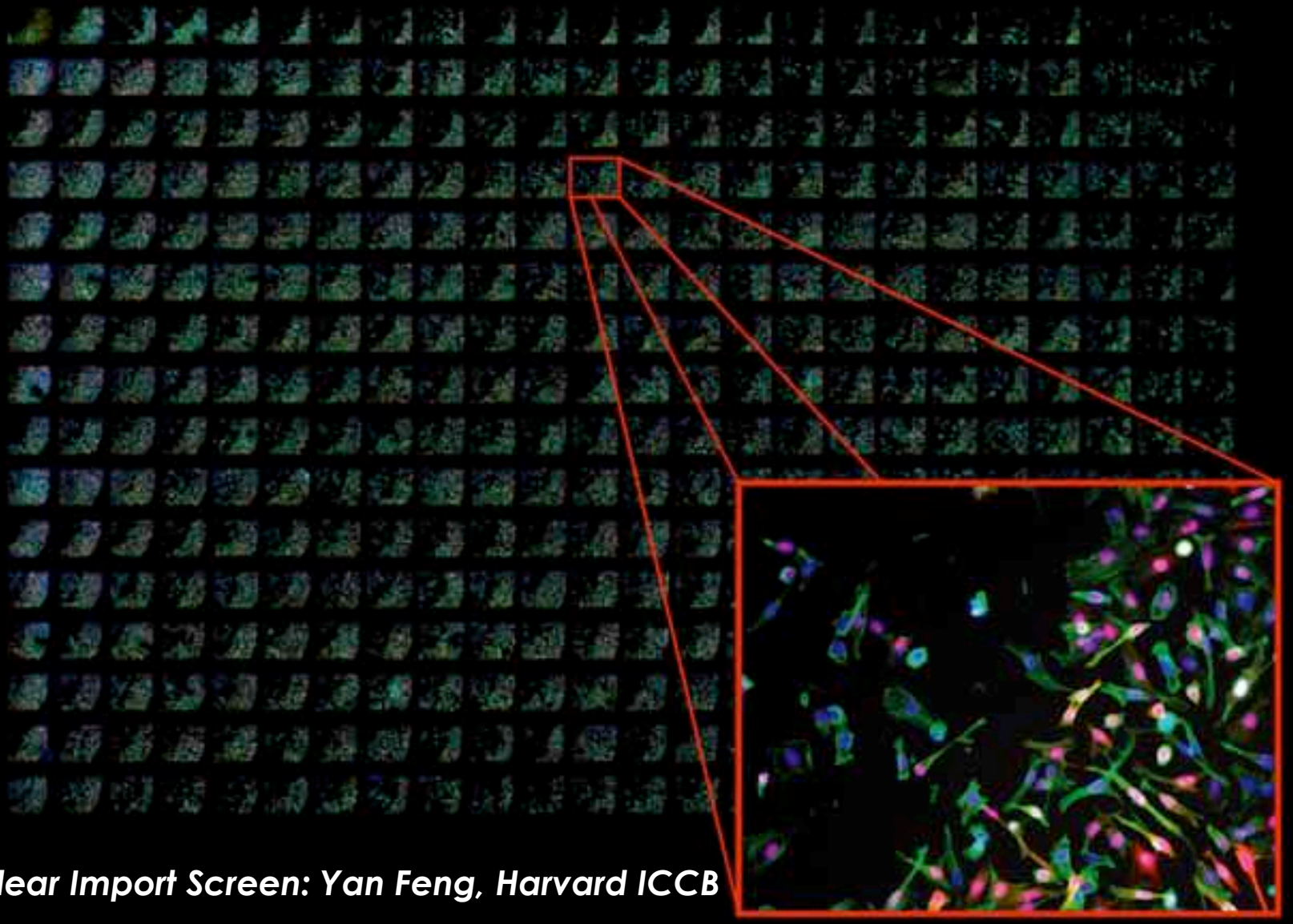
GFP-tubulin

3D Stack/7 mins

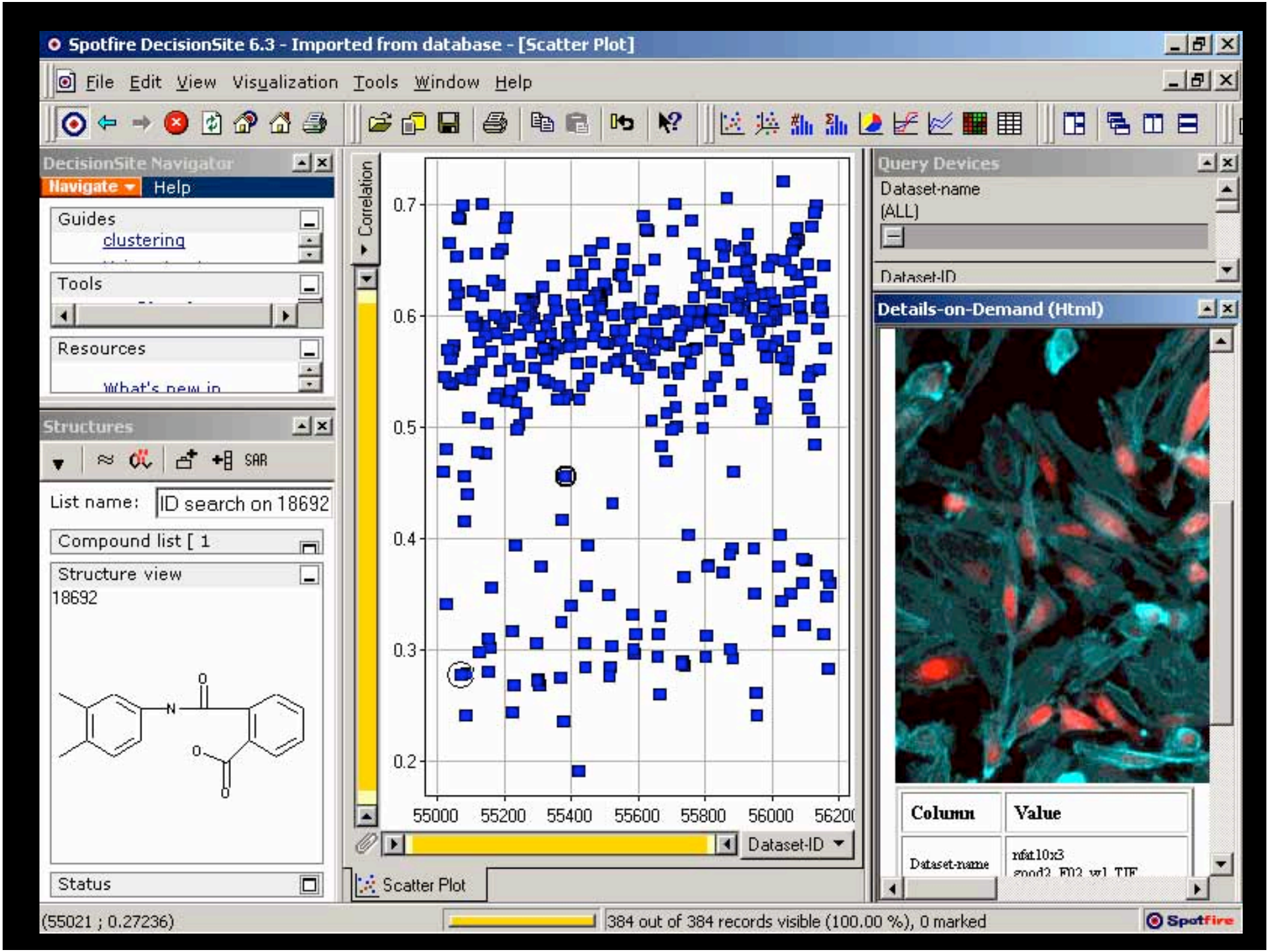
38 hours total

Arwen Wilcock

From Experiment to Analytical Result



Nuclear Import Screen: Yan Feng, Harvard ICCB


Spotfire DecisionSite 6.3 - Imported from database - [Scatter Plot]
File Edit View Visualization Tools Window Help
DecisionSite Navigator
Navigate Help
Guides
clustering
Tools
Resources
What's new in
Structures
SAR
List name: ID search on 18692
Compound list [1
Structure view
18692
Status
Correlation
0.7
0.6
0.5
0.4
0.3
0.2
55000 55200 55400 55600 55800 56000
Dataset-ID
Scatter Plot
Query Devices
Dataset-name
(ALL)
Dataset-ID
Details-on-Demand (Html)
Column
Value
Dataset-name
rifat10x3
(55021 ; 0.27236)
384 out of 384 records visible (100.00 %), 0 marked
Spotfire

Current Paradigm

No Standards

Digital Image Acquistion System

Metadata

Raw Image

Transformation

Metadata

Processed Image

Visualization

Quantitative Analysis

Experiment?
Image?
Analytics?
Annotations?

"Result"

http://openmicroscopy.org

Towards Image Informatics: OME

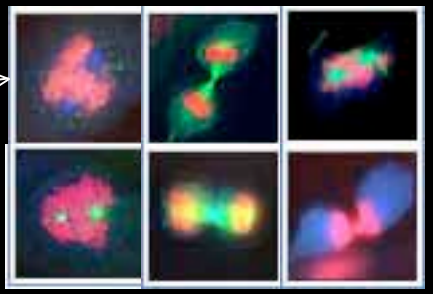
Digital Image Acquisition System

Metadata

Raw Image

Quantitative Analysis

OME



Complex Data Management

Visualization

Metadata

Processed Image

http://openmicroscopy.org

OME: Status 2005

- Progress
- Team
- Acceptance
- Funding
- Usage and Adoption

http://openmicroscopy.org

OME: What Can You Do…..

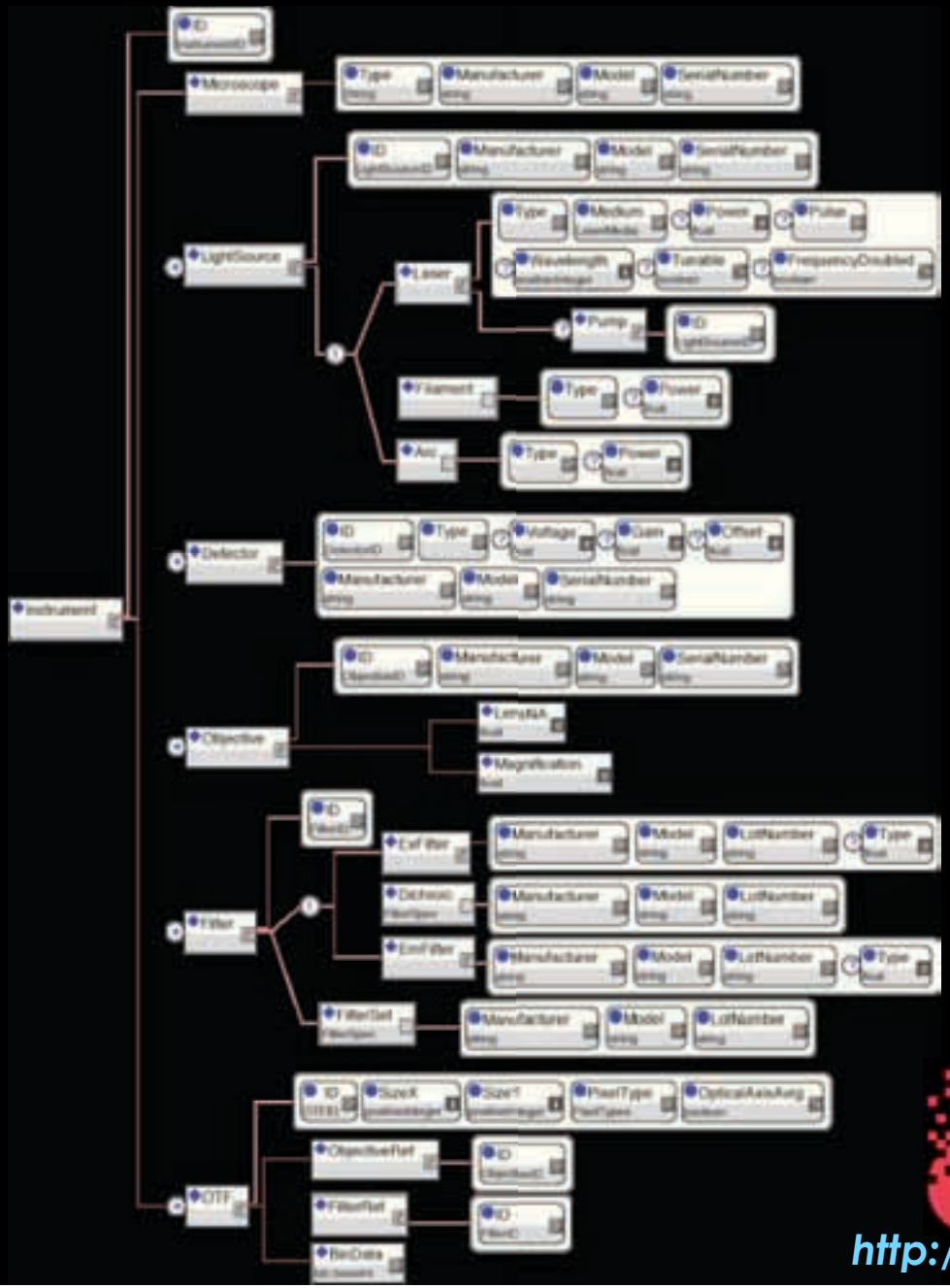
- Manage image data, metadata, and analytics
- Visualize images, hierarchies
- Store analytic data (run on OME server)
- Search on hierarchies, metadata
- Specify visual phenotypes
- Query and access metadata, analytics, annotations
- Export to OME XML, CSV, .xls

http://openmicroscopy.org
http://cvs.openmicroscopy.org.uk

Swedlow et al (2003) Science 300:100-104
Goldberg et al (2005) Genome Biol. 6:R47

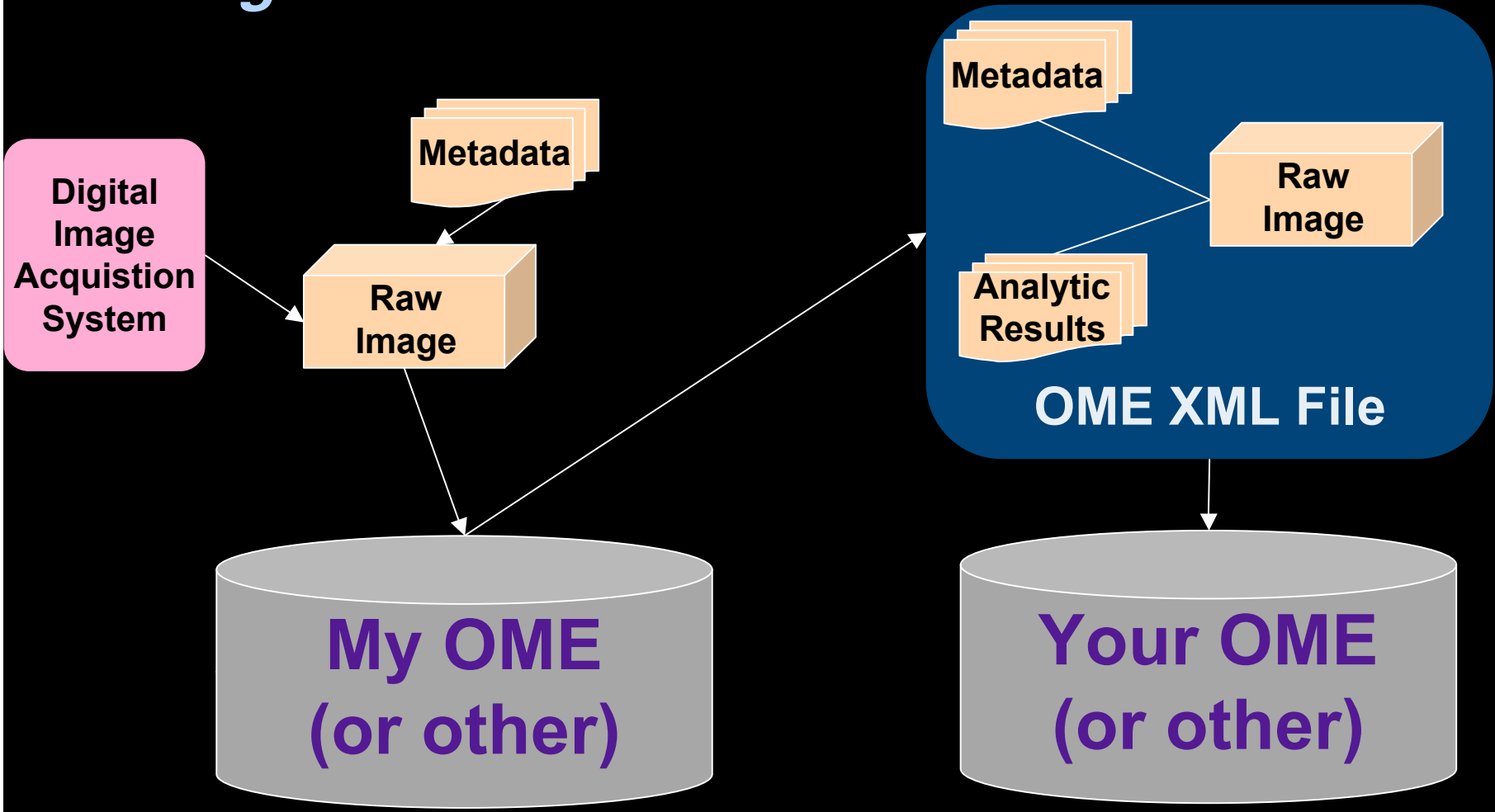
http://openmicroscopy.org

The OME Data Model: The Instrument Element



http://openmicroscopy.org

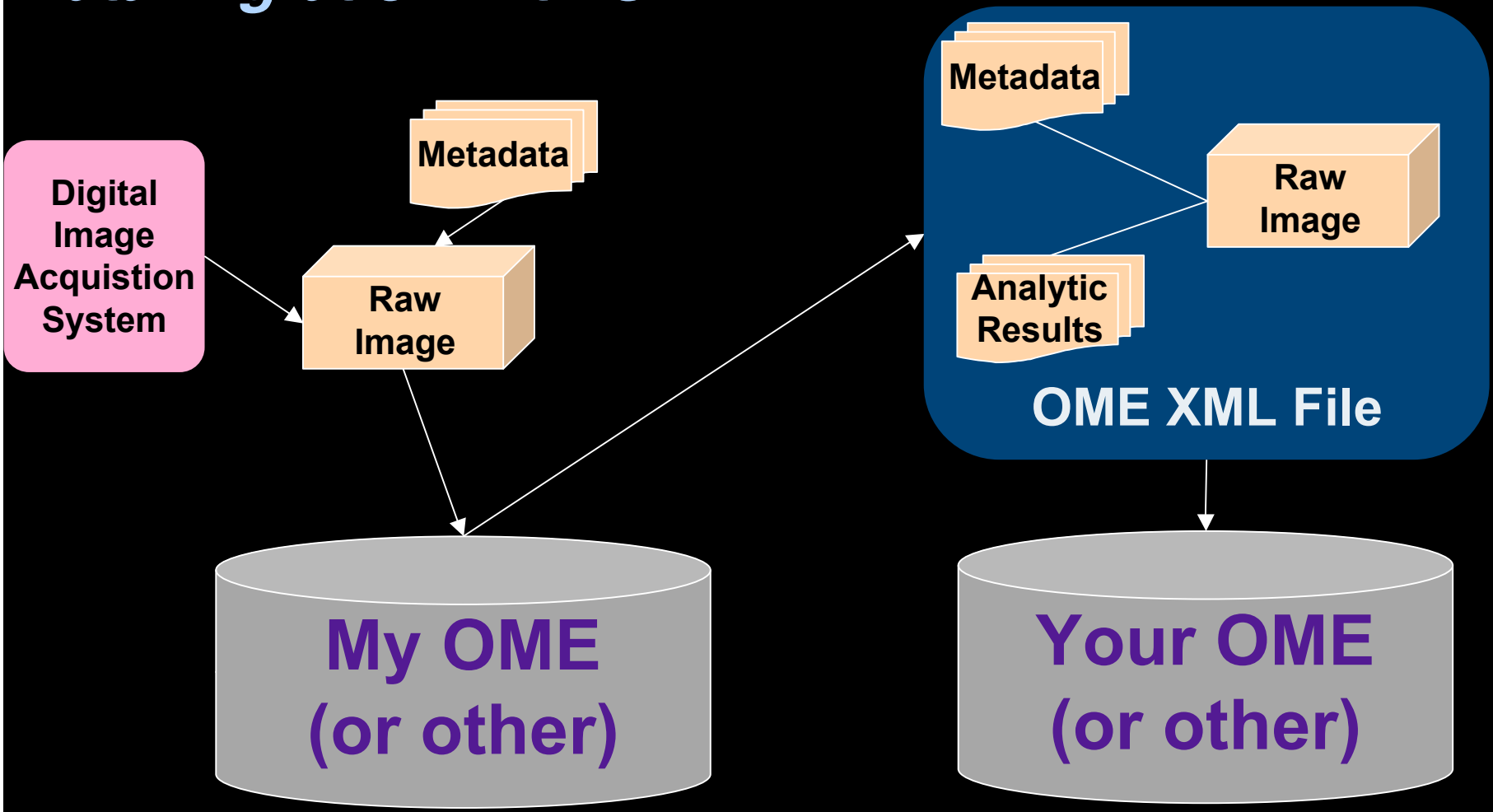
Data Migration with OME XML



Goldberg et al (2005) Genome Biol. 6:R47

http://openmicroscopy.org

Data Migration with OME XML



Supported:

Applied Precision, LLC

Bitplane AG

http://openmicroscopy.org

OME2.4 System Layout

OME DB

OMEDS

Services

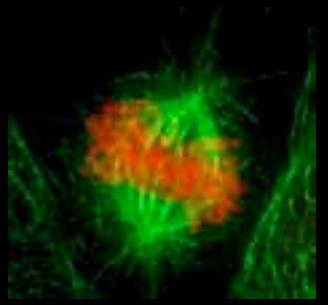
OMEIS

Image Repository

Image_ID	name	created
5678	Image1	02-13-03
5679	Image2	02-13-03

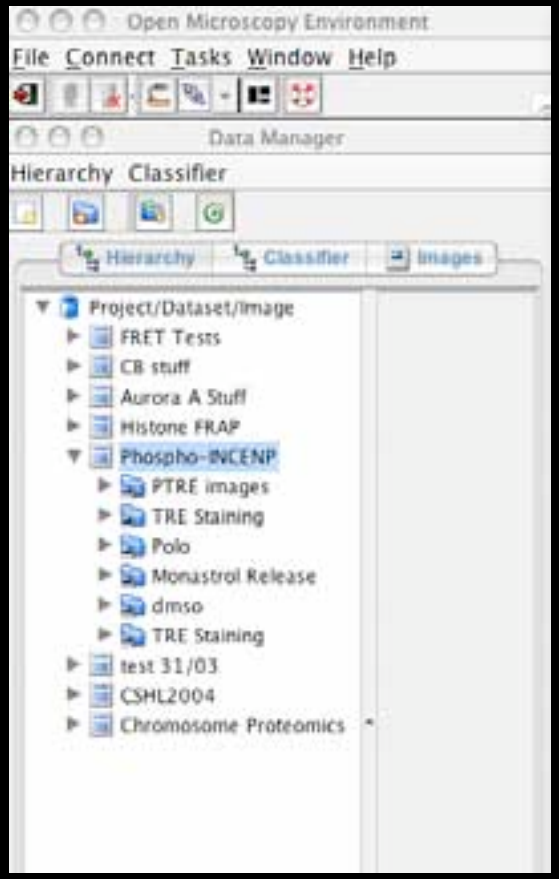
Metadata and Analytics

Microscope



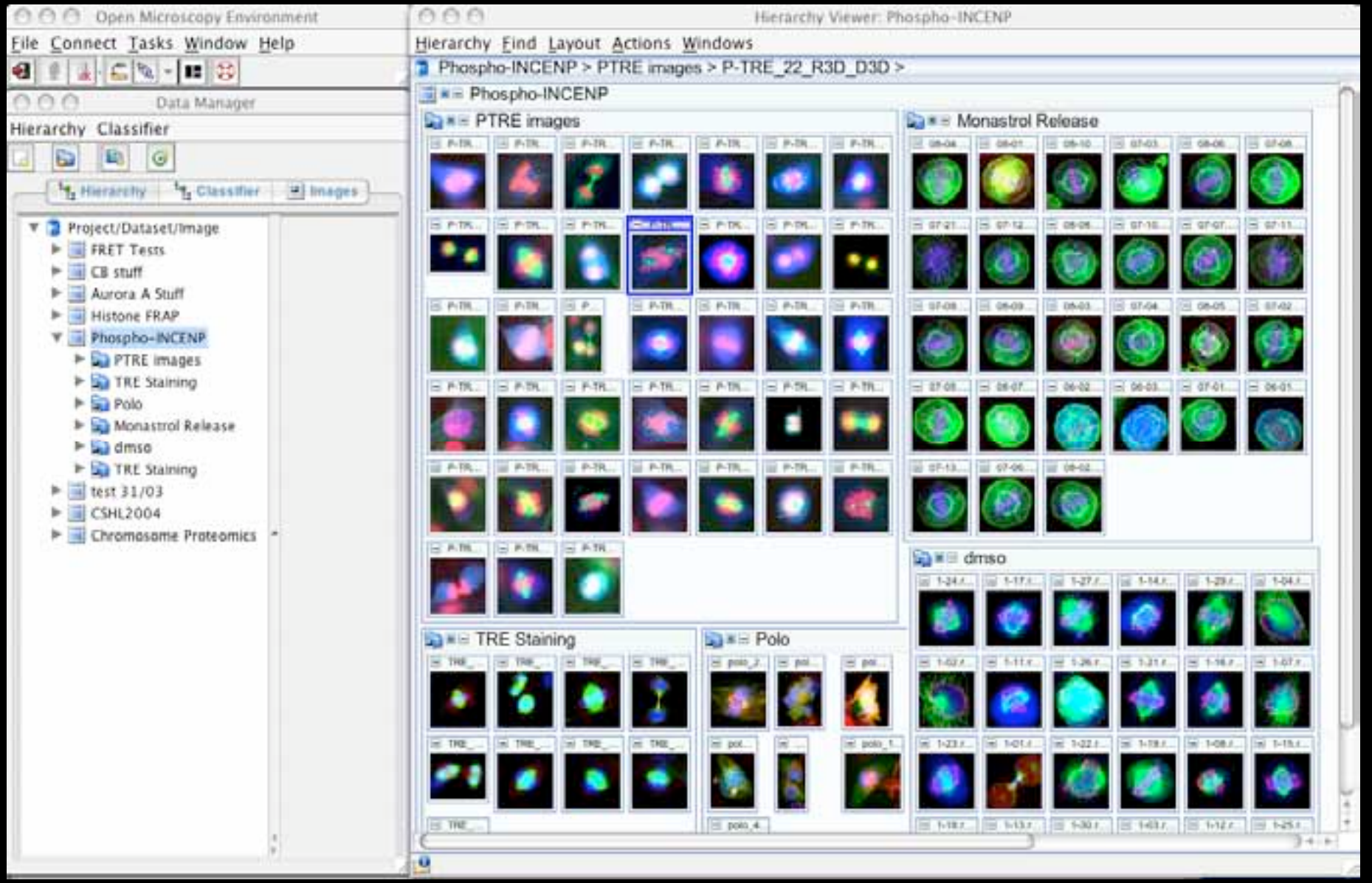
Binary Image Data "Pixels"

OME 2.4-- Java UI

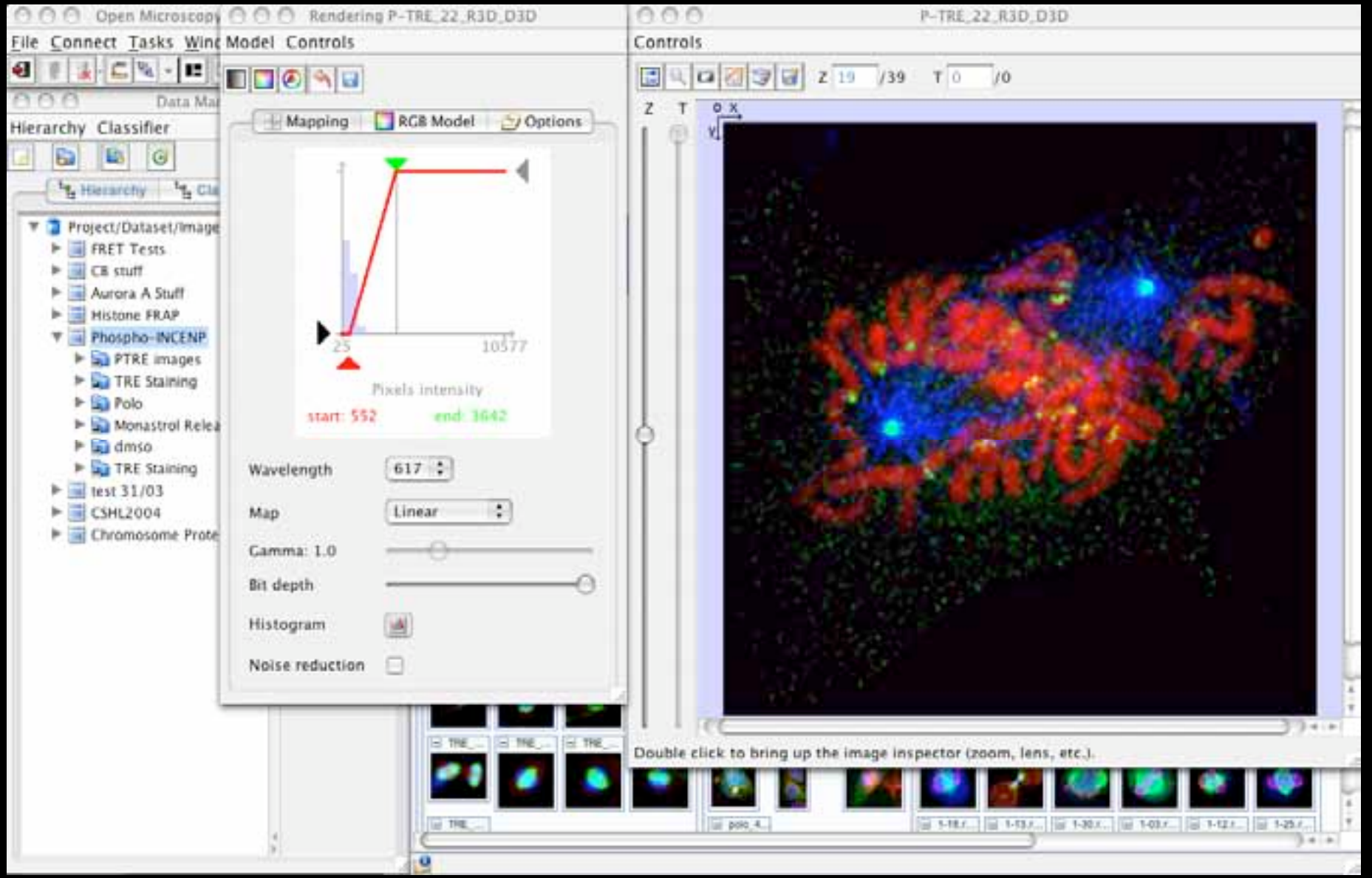


http://openmicroscopy.org

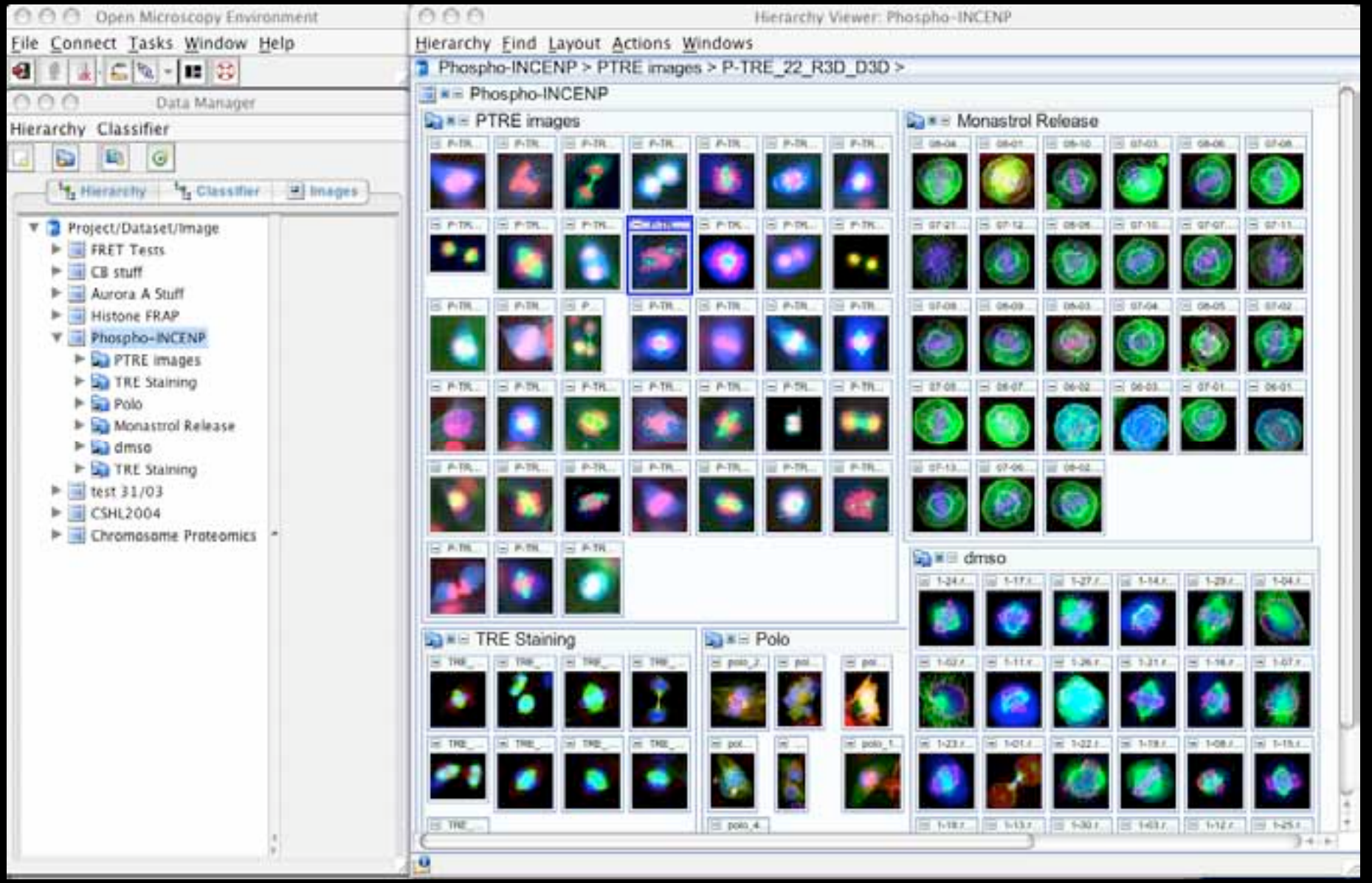
OME 2.4-- Java UI



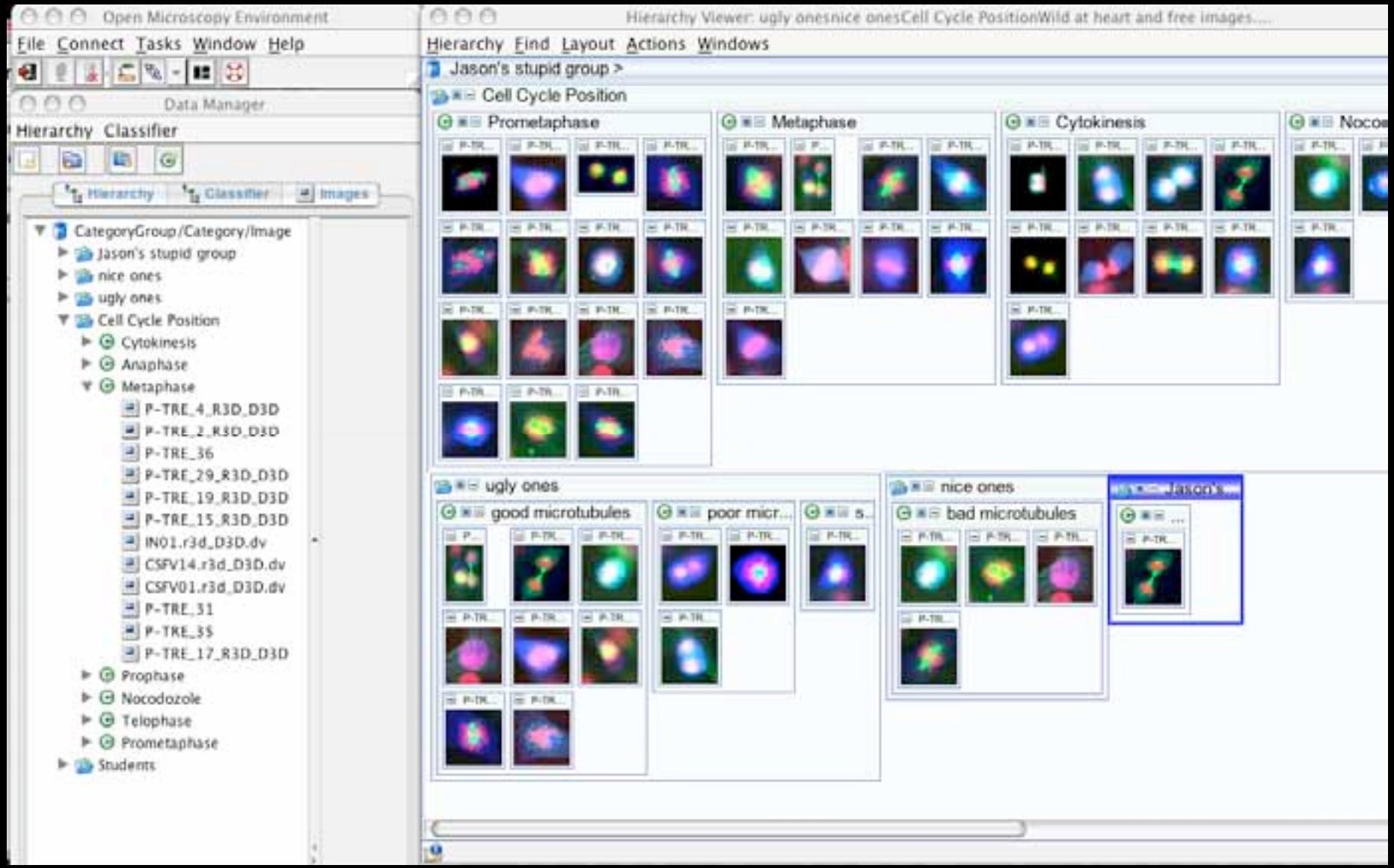
OME 2.4-- Java UI



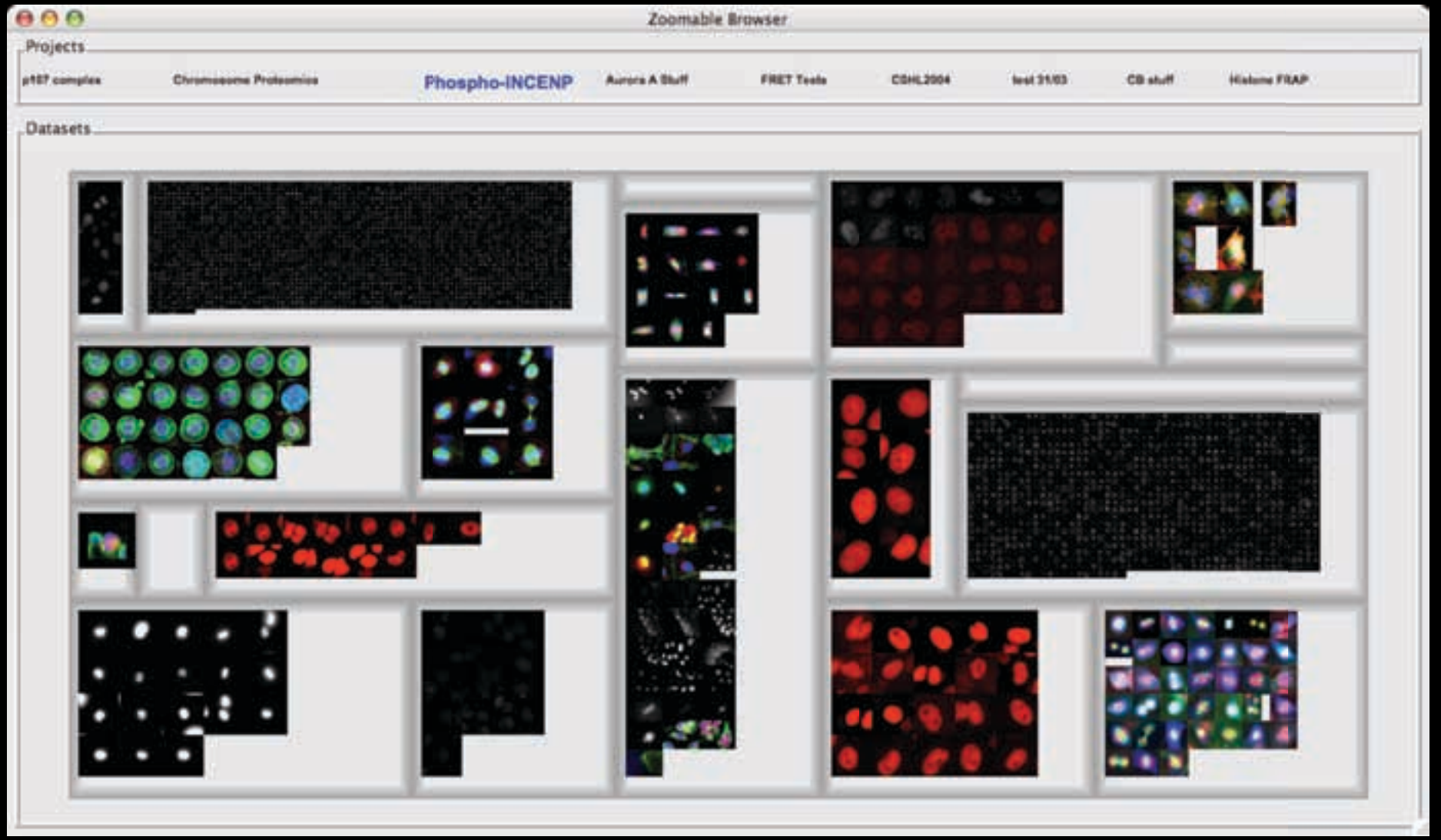
OME 2.4-- Java UI



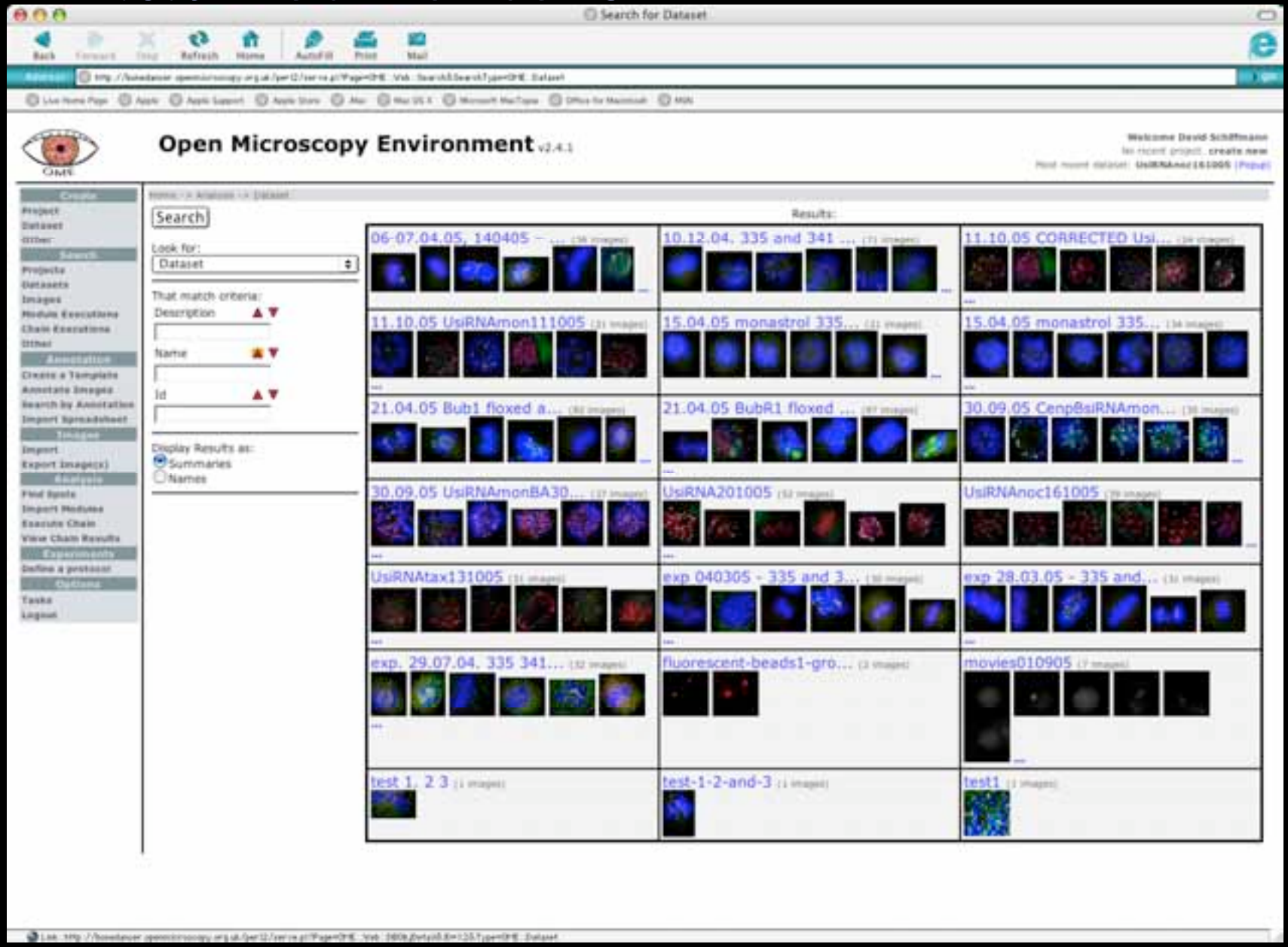
OME 2.4-- Java UI



OME 2.4-- Java UI

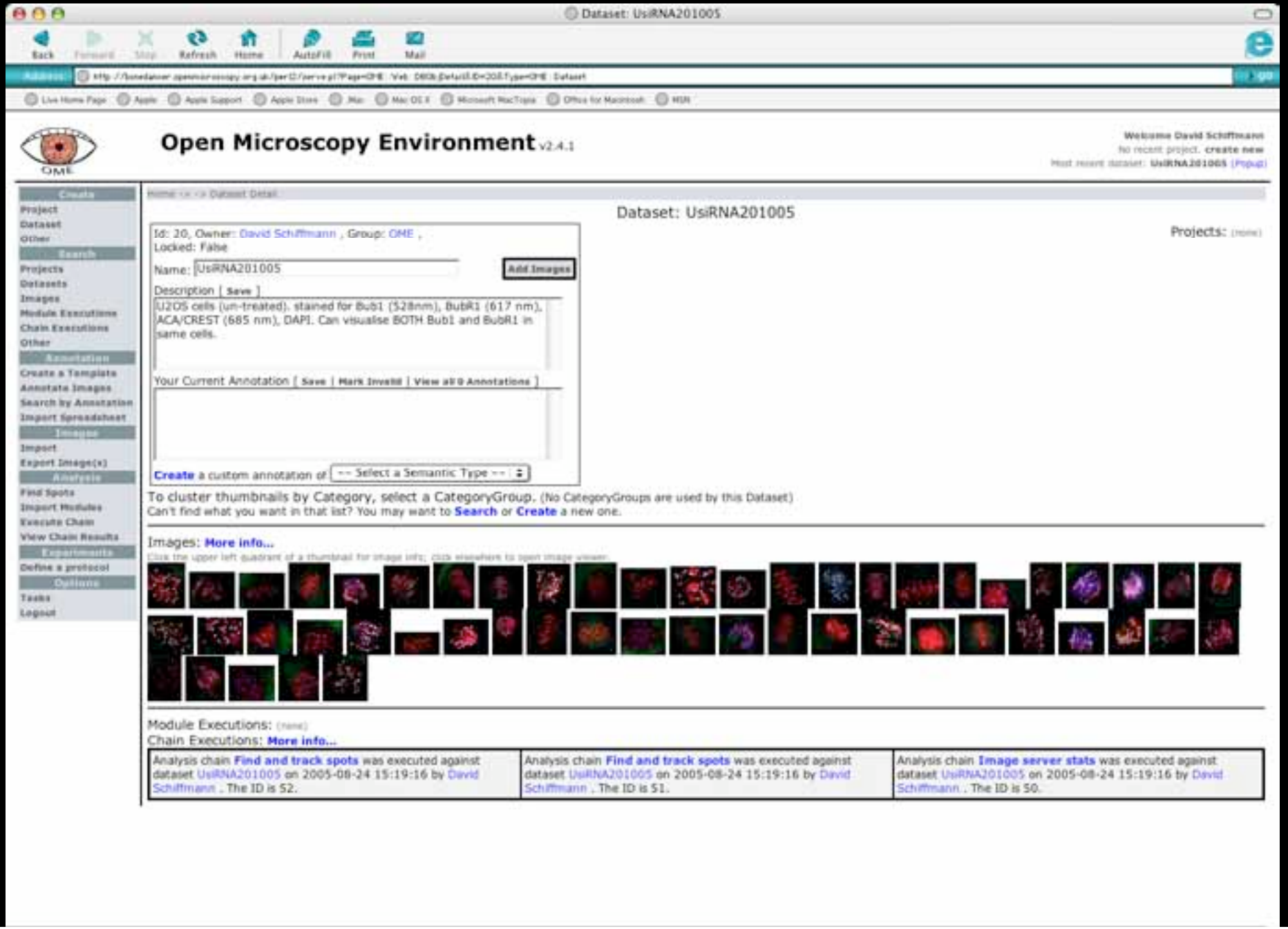


OME 2.5.0 Web Browser UI

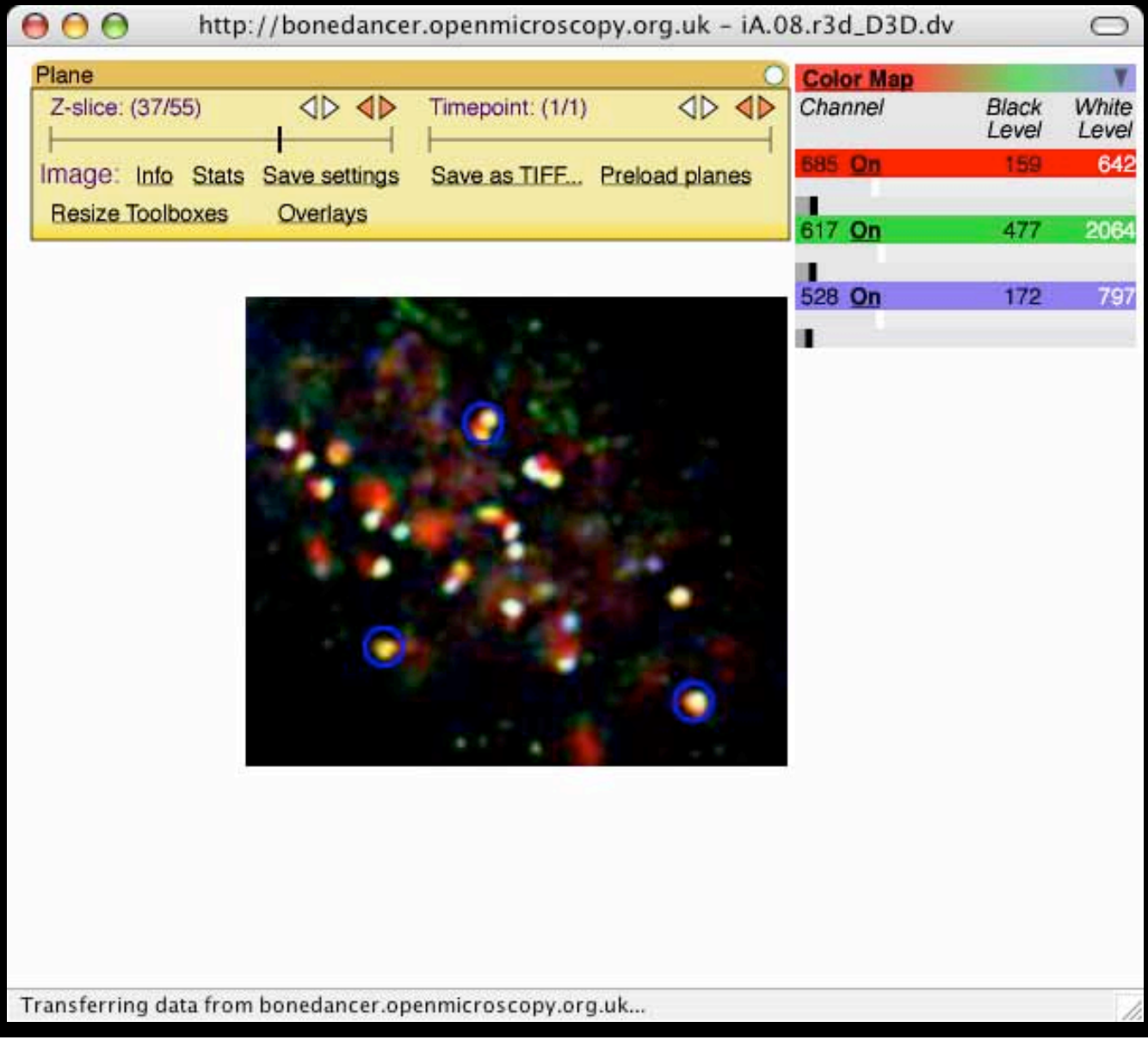


David Schiffman
Inke Näthke

OME 2.5.0 Web Browser UI

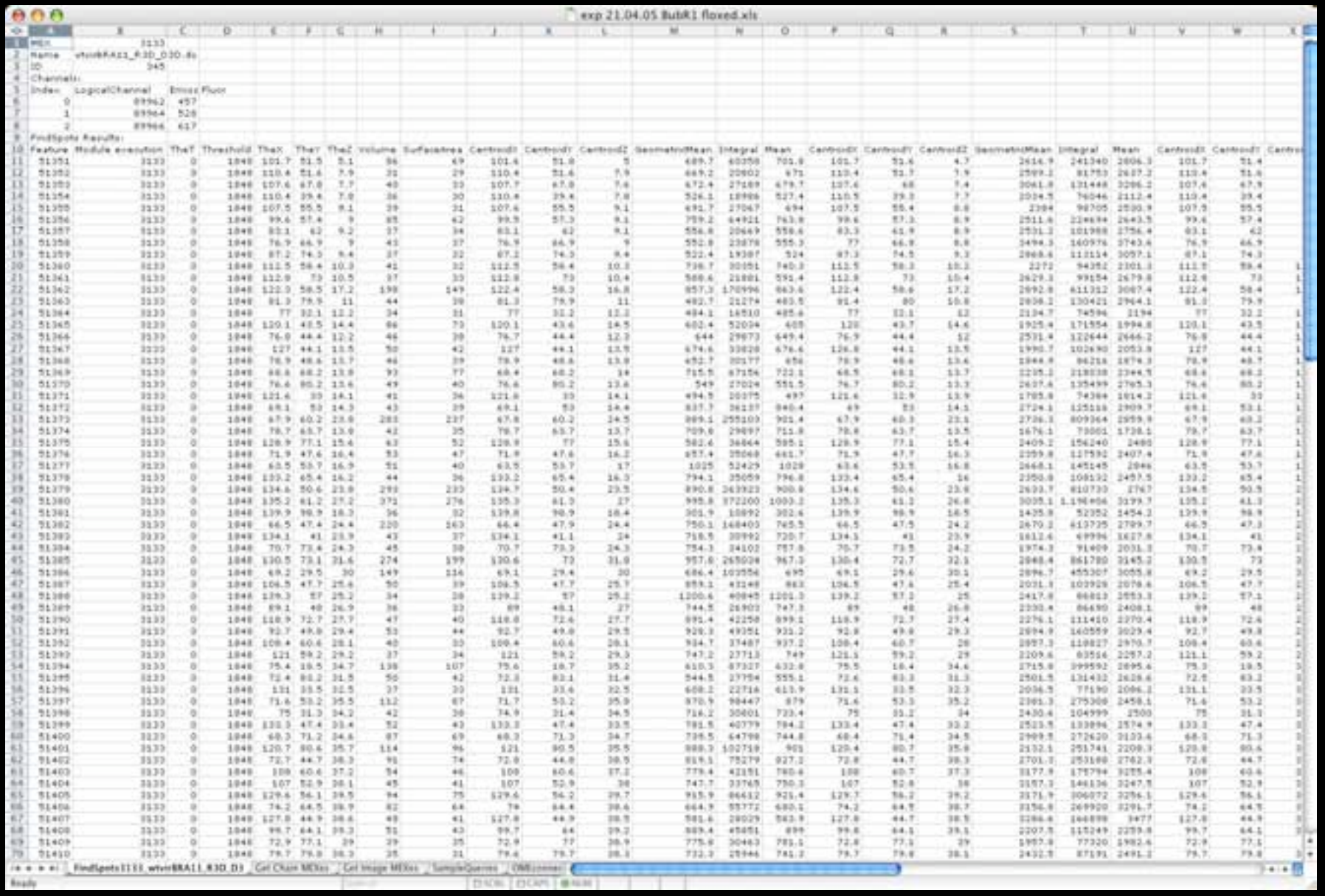


OME 2.5.0 Web Browser UI



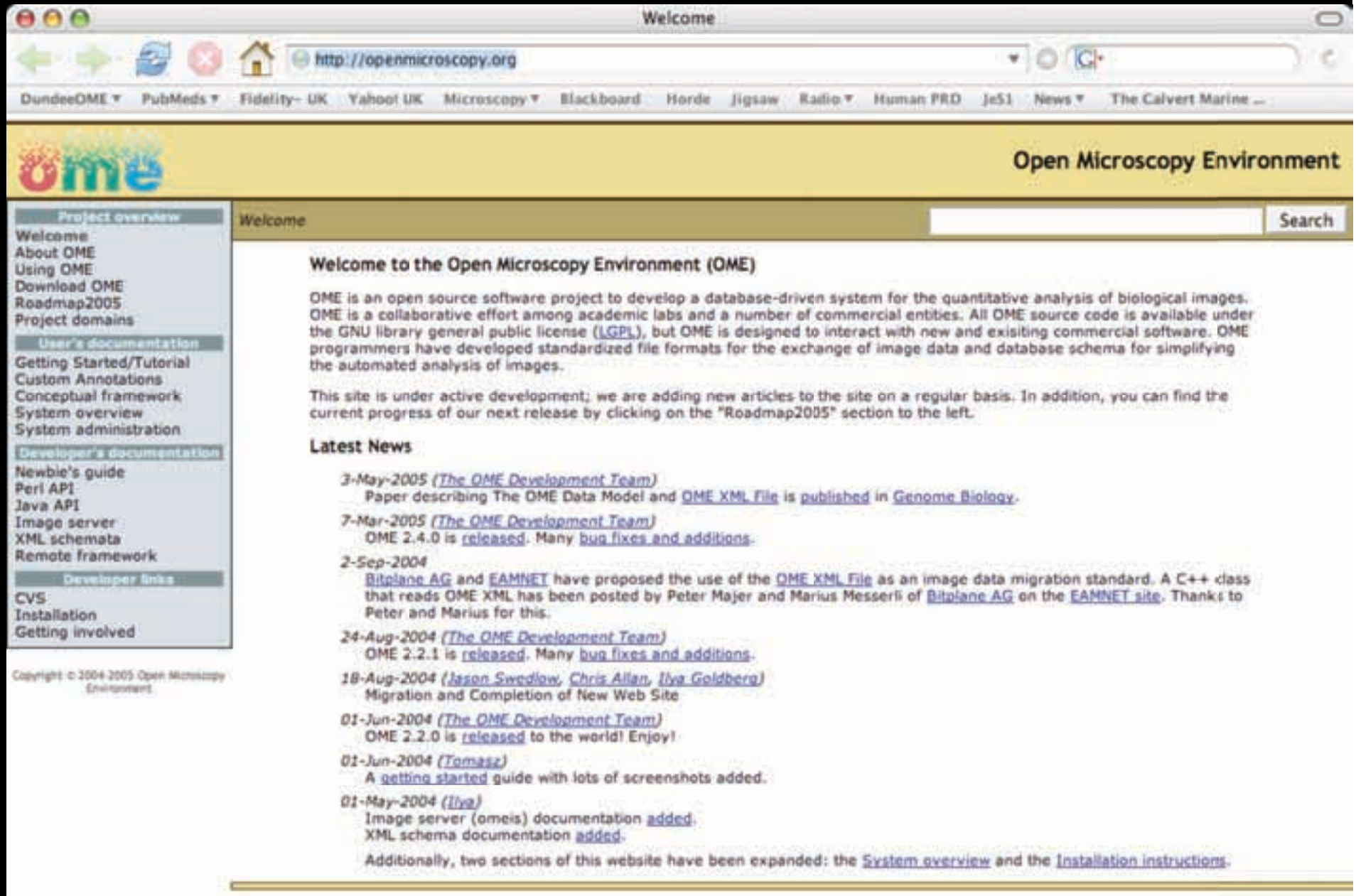
David Schiffman
Inke Näthke

OME 2.5.0 Web Browser UI

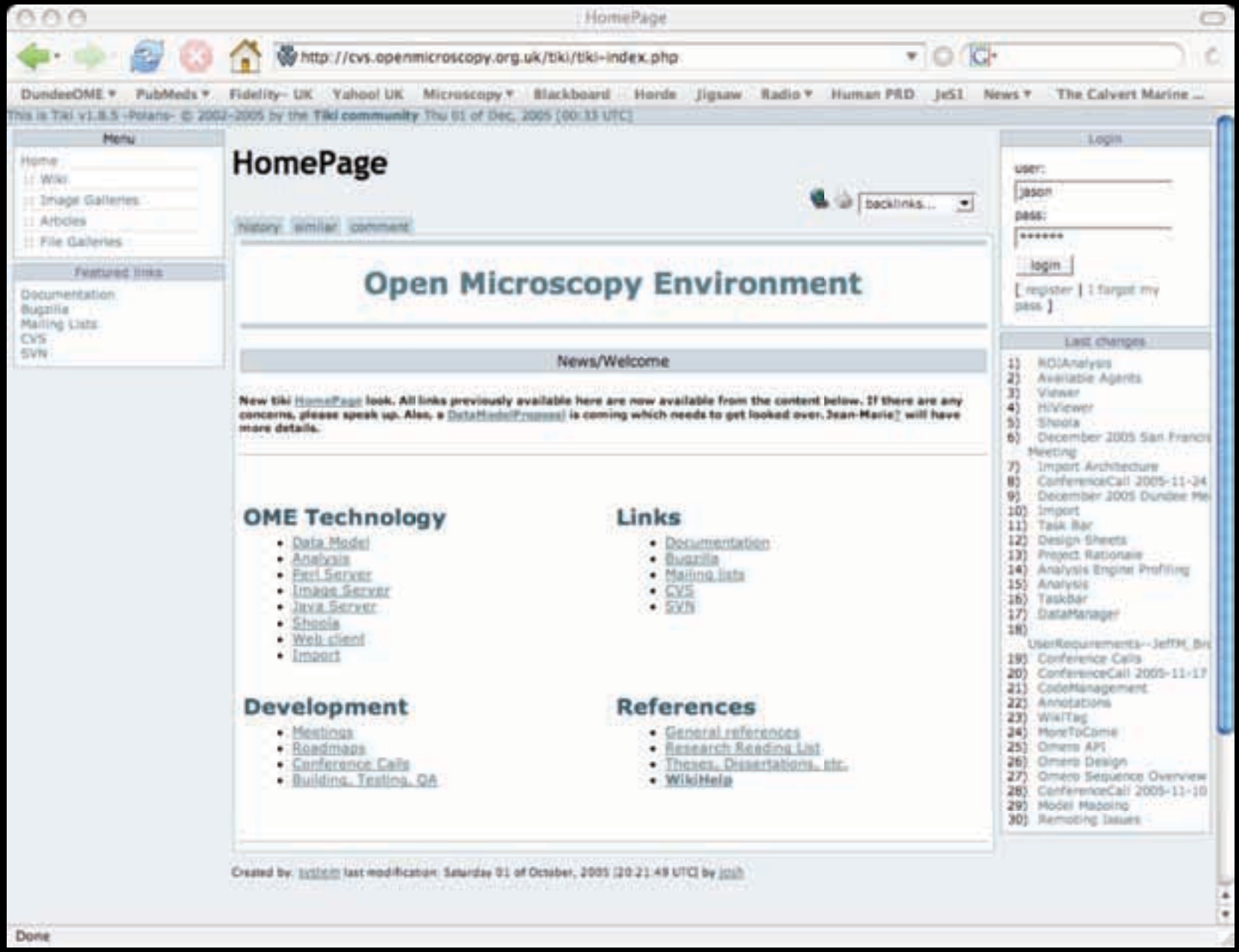


David Schiffman
Inke Näthke

OME: openmicroscopy.org



OME: cvs.openmicroscopy.org.uk/tiki



OME: Team 2005

- Dundee - Chris Allan, Jean-Marie Burel, Josh Moore, Brian Loranger, (Donald McDonald +1 TBD)
- Baltimore - Ilya Goldberg, Josiah Johnston, Harry Hochheiser, Tomasz Macura
- MIT - Sheldon Chan, Tony Scelfo
- Univ Wisconsin - Kevin Eliceiri, Curtis Rueden

http://openmicroscopy.org

OME: Funding

- Dundee - Wellcome Trust (-10/06), BBSRC (12/09), BBSRC (12/06)
- Baltimore - NIH (renewal pending)
- Univ Wisconsin - NIH

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OME: Usage

- Data Model
  - ✓Genome Biology paper
  - ✓Updates coming…
- OME XML
  - ✓Use by Bitplane, APLLC (,GE?)
  - ✓OME TIFF (Dec 2005)
- OME Software
  - ✓Many downloads and attempted installs
  - ✓Little evidence of take-up by users
  - ✓Increasing developer community

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OME: Building a Community

- What is the minimal set of metadata we need to record about an image?

User 1:"Data scaling (x, y, z, t, ch)
Microscope type
Ex/Em wavelengths
Pinhole (if approp)
Collected by X
Date collected
"Raw" or "Processed"

User 2: "None. However important metadata might be, images still can have enormous value without metadata."

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OME: Building a Community

- What actions do we take if an incoming file does not provide some of this metadata? Do we use defaults, or do we force the user to give us the data??

User 1: ”Defaults will be a disaster - people or too busy or too lazy - force by any means! Offer batch/templates for meta data annotation and if there must be some compromise then a grace period of say 30 days may be issued after which the images are removed (uploader could be spammed during the 30 days for reminder).”

User 2: “No actions taken. Nothing is as frustrating to novel users as being forced to enter data they are not interested in. It is even worse to prompt users fro parameters they have no clue about. Everything possible should be done to read all possible metadata out of the files themselves and to make metadata input as painless as possible (templates, and/or copying metadata among images is useful), but nothing should be forced. ”

OME Adoption-- Barriers

- Install too hard (also huge code maintenance burden)
- Extensibility system too complicated
- Incomplete documentation
- Internal Analysis Engine
- No defined API
- Incomplete file support
- Insufficient user functionality

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OME: Roadmap 2005

- Data Model Updates (S/P/W/I; many others)
- Server redesign and updates
- Easier install; faster performance
- "Clicky" Installer (OS X only)
- OMEIS updates (OME Rendering Engine)
- Automated Bayesian classifier
- Shoola UI upgrades
- File format update-- OME TIFF

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OME: Roadmap 2006 (Q1 - Q2)

- OMERO Release
- Release of improved OMEIS
- Improved display of complex data
- Integration of OME Data Model with MODs
- Flexible analysis capture
- ……..

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OME: Some Questions

- Are UIs needed?
- How much extensibility?
- What are the critical user functions?
- What is (how do we specify) the minimal set of metadata?
- What is policy for remove/delete?
- How do we deploy a new server?
- How do we expand the developer community?
- Do we manage the community?

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