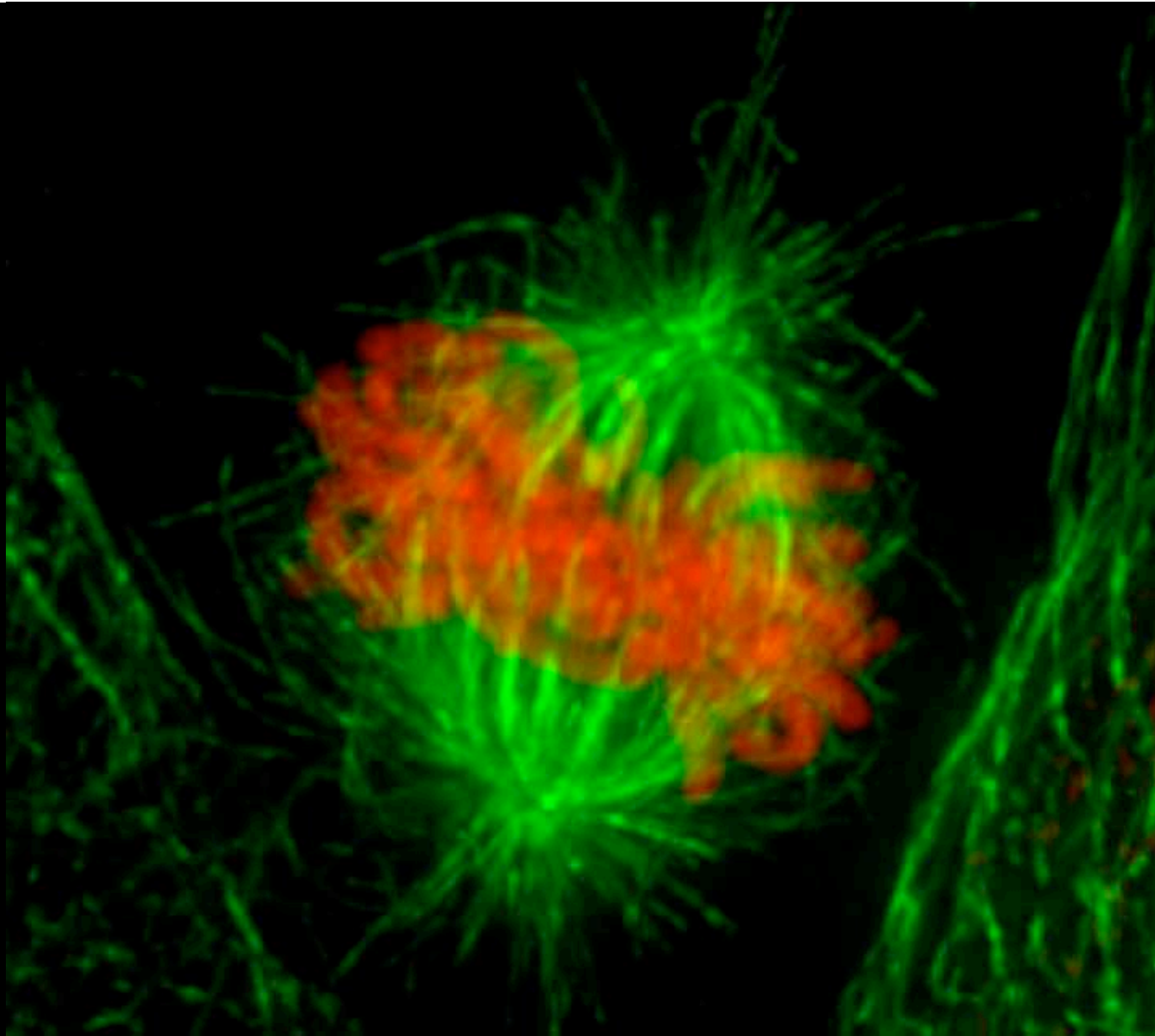


**The Open Microscopy Environment:
Informatics, Visualization and Quantitative Analysis
for Biological Microscopy**

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

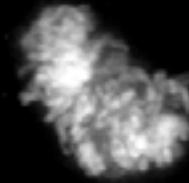


Microtubules

DNA

Live cell imaging- shRNA screen of unknowns

Scram



LRR

Fam44B



15

B-1

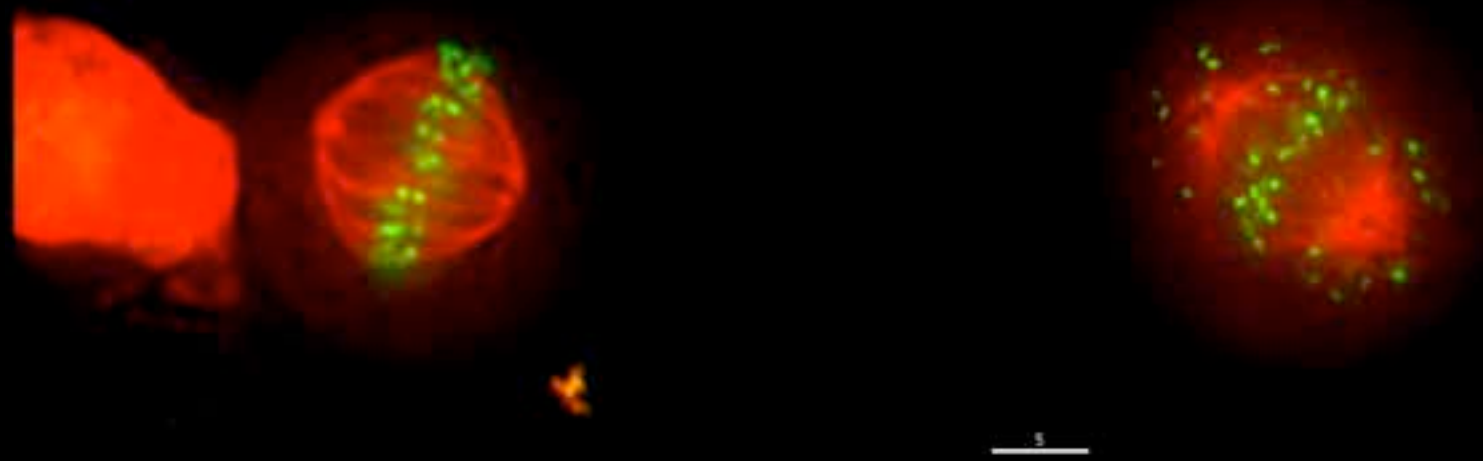


*Iain Porter
Chris Hunter*

Fam44B is Required for Chromosome Alignment

mCherry-tubulin

CENP-B-GFP



Scrambled

Fam44B^{RNAi}

Iain Porter

Links Between Mitosis & Neurogenesis



Chick Embryo Neural Tube

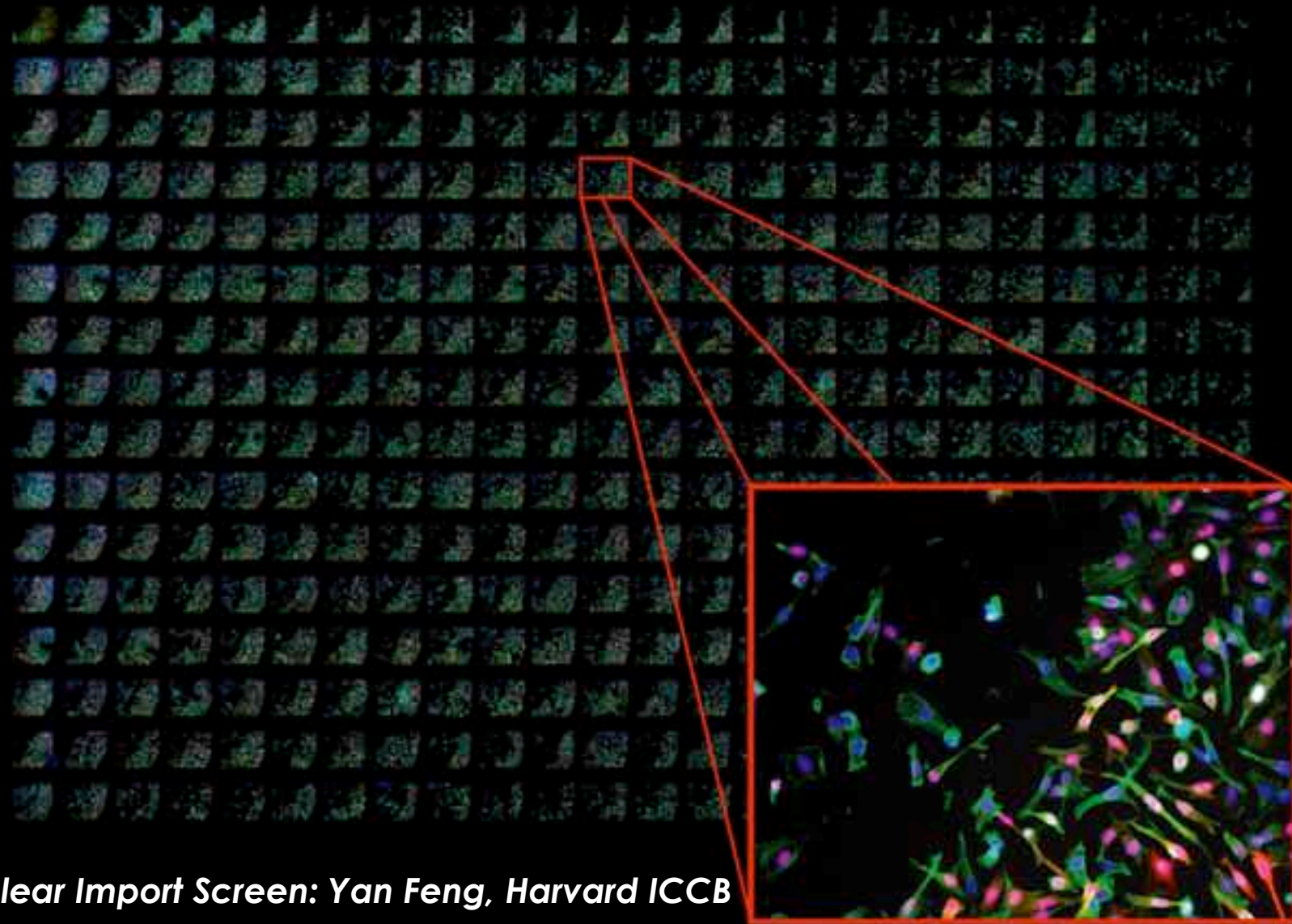
GFP-tubulin

3D Stack/7 mins

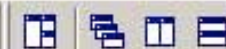
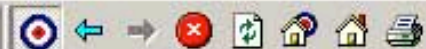
38 hours total

Arwen Wilcock

From Experiment to Analytical Result



Nuclear Import Screen: Yan Feng, Harvard ICCB



DecisionSite Navigator

Navigate Help

Guides
clustering

Tools

Resources
What's new in

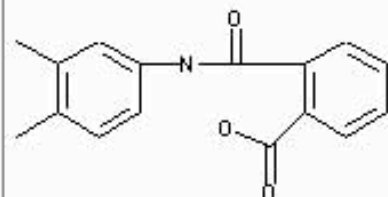
Structures

~ SAR

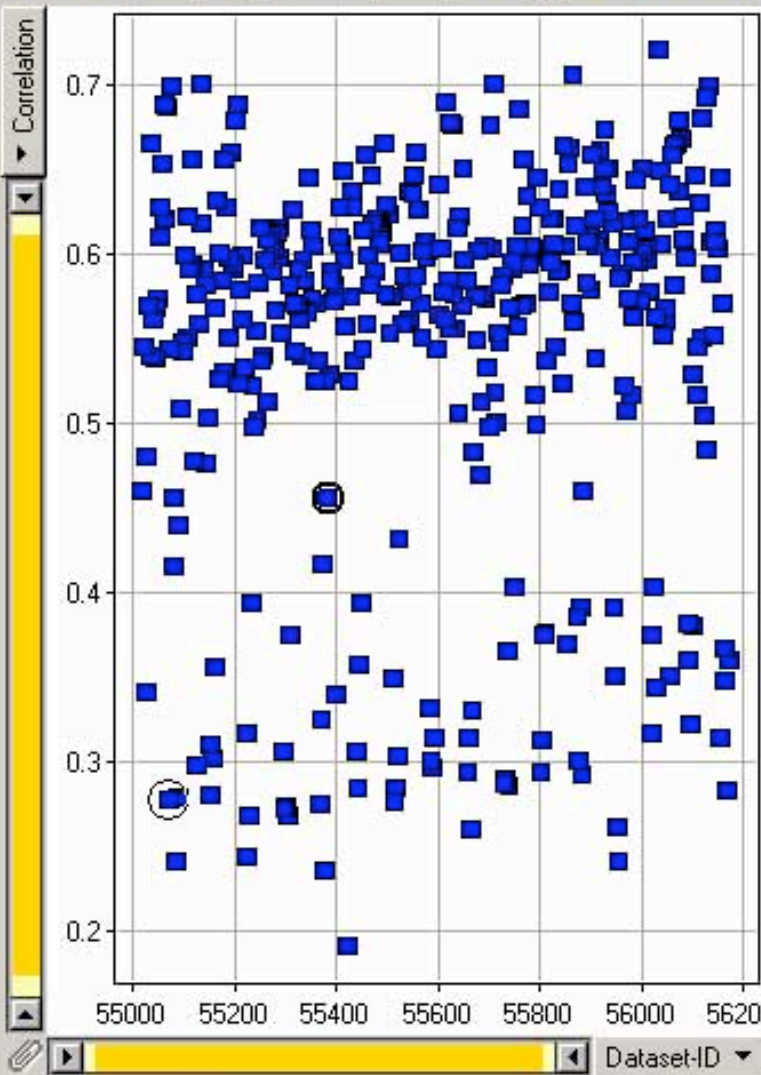
List name: ID search on 18692

Compound list [1]

Structure view
18692



Status



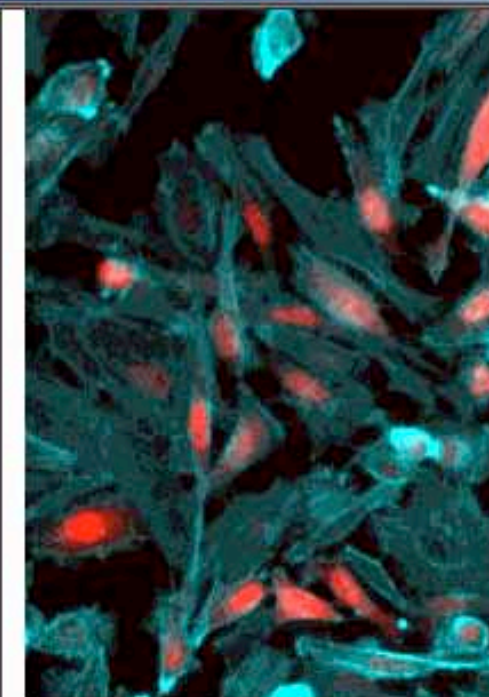
Scatter Plot

Query Devices

Dataset-name
(ALL)

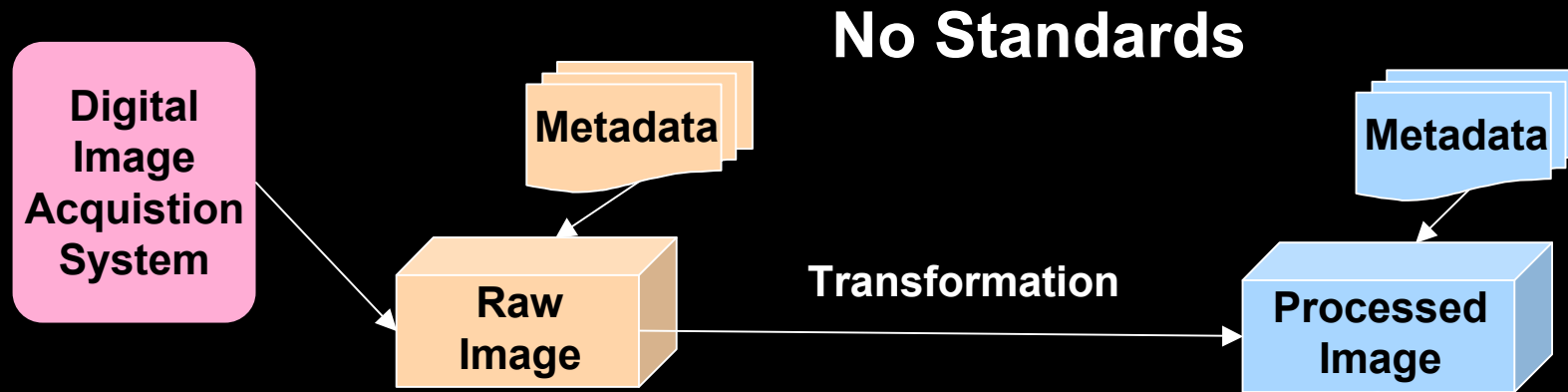
Dataset-ID

Details-on-Demand (Html)



Column	Value
Dataset-name	rfat10x3 zmod2_F02_w1_TIF

Current Paradigm



Visualization



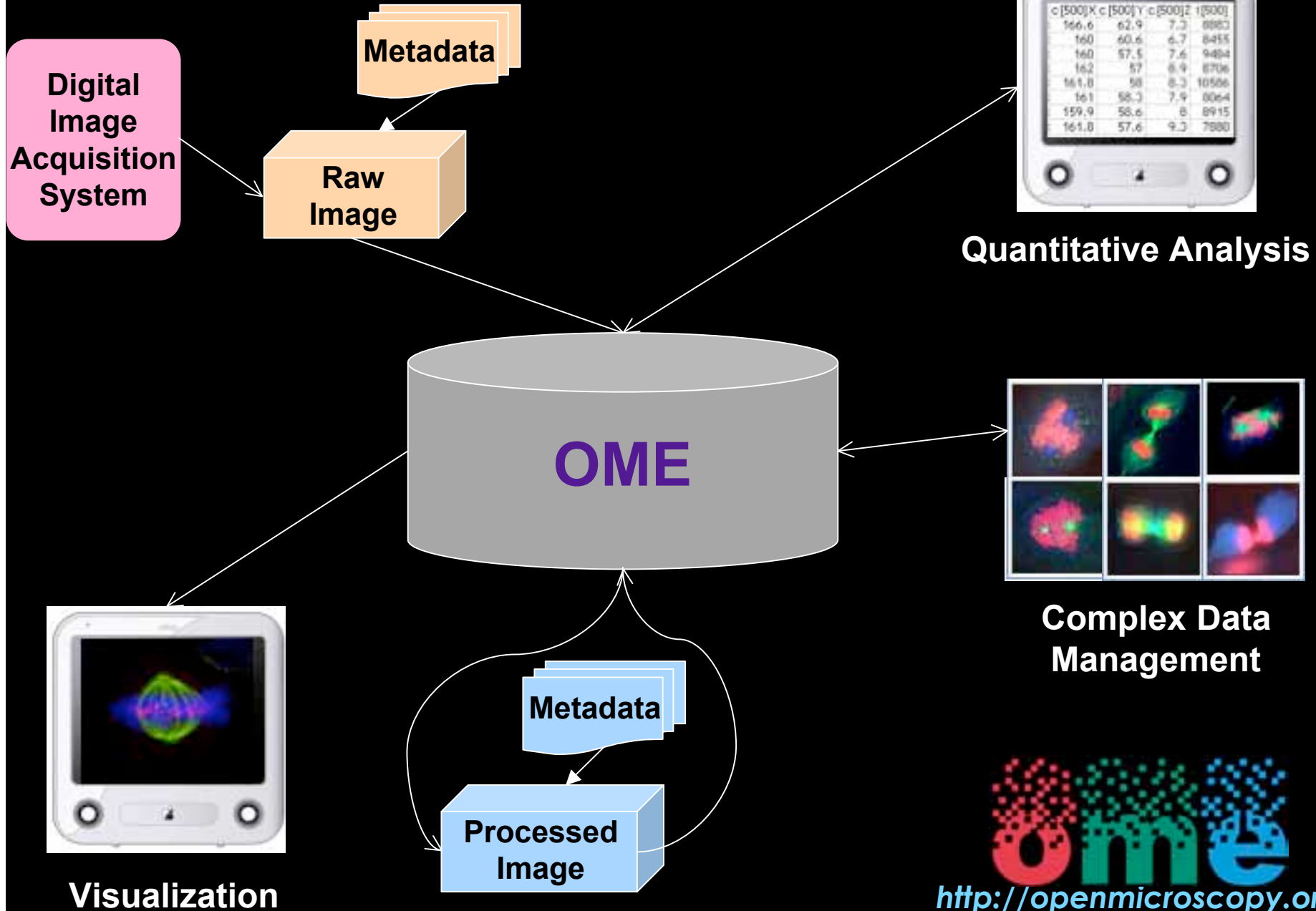
Quantitative Analysis

Experiment?
Image?
Analytics?
Annotations?

“Result”



Towards Image Informatics: OME



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>

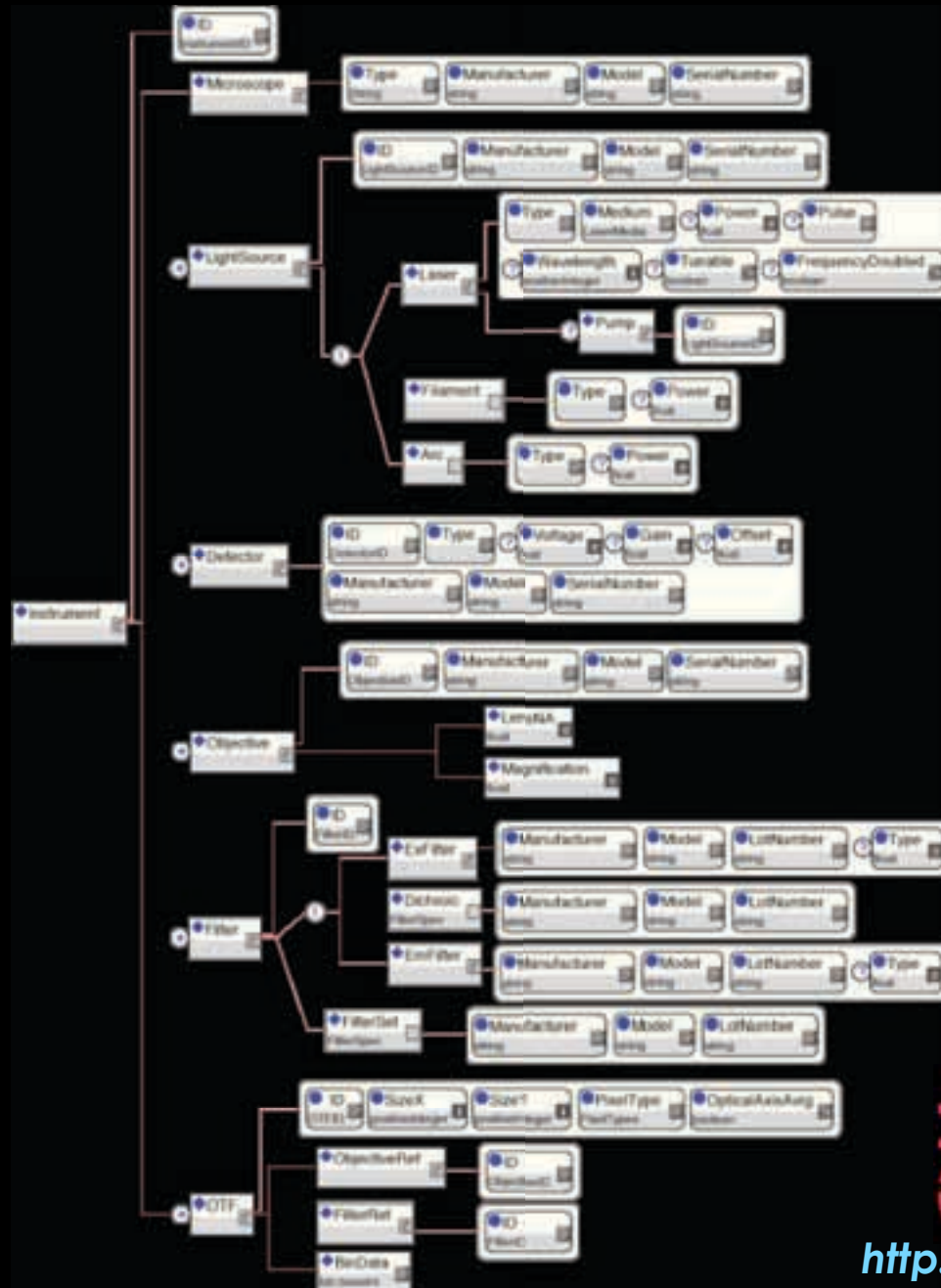
Swedlow et al (2003) Science 300:100-104

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



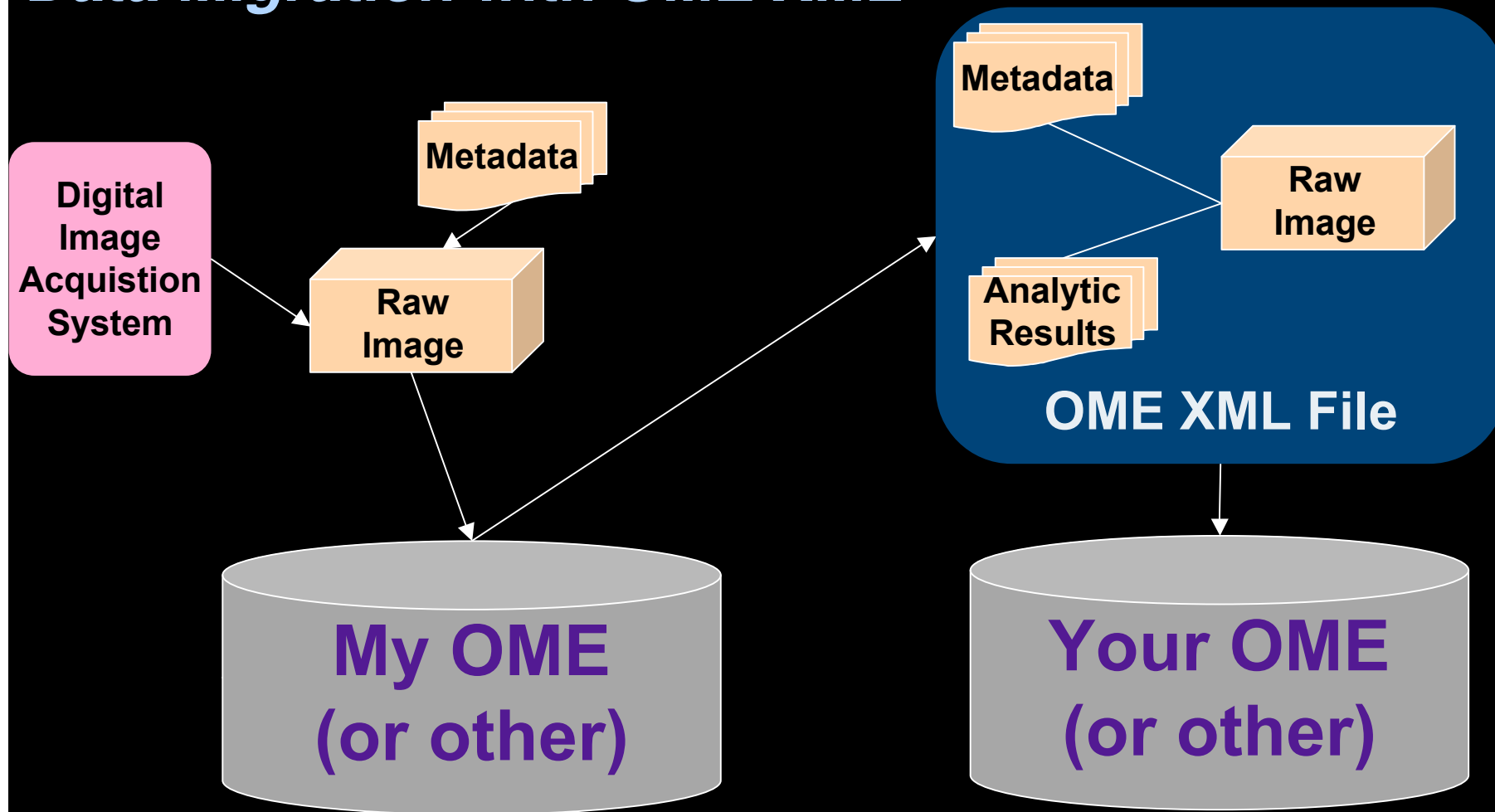
<http://openmicroscopy.org>

The OME Data Model: The Instrument Element



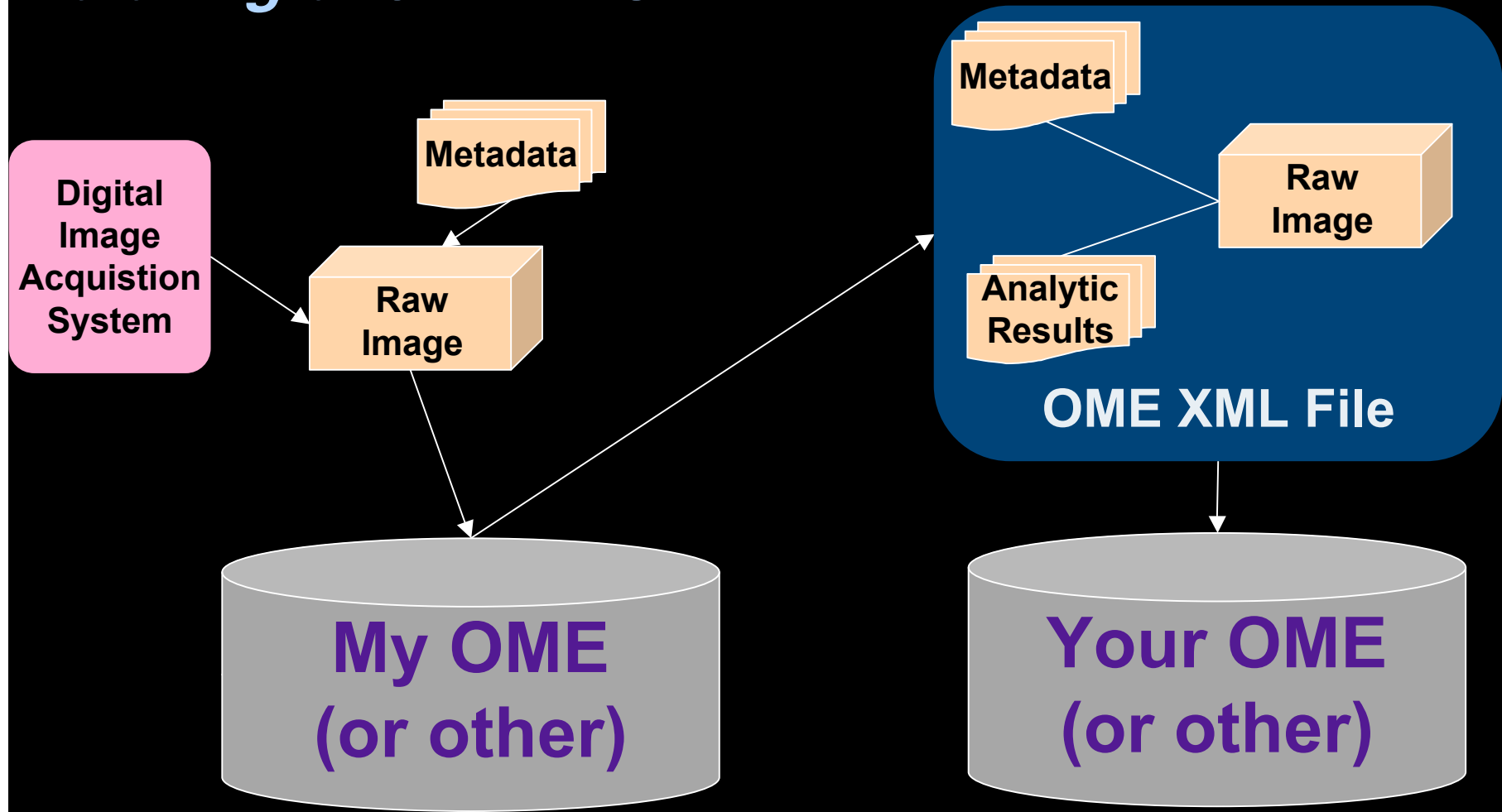
<http://openmicroscopy.org>

Data Migration with OME XML



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

Data Migration with OME XML



Supported:
Applied Precision, LLC
Bitplane AG

OME2.4 System Layout

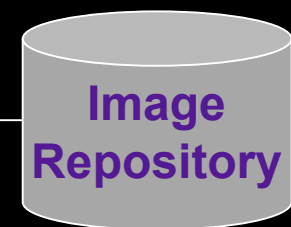
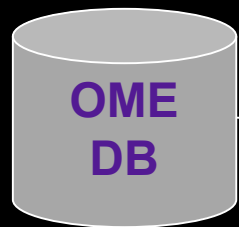
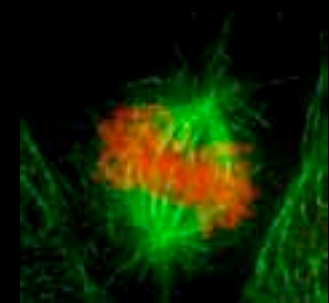


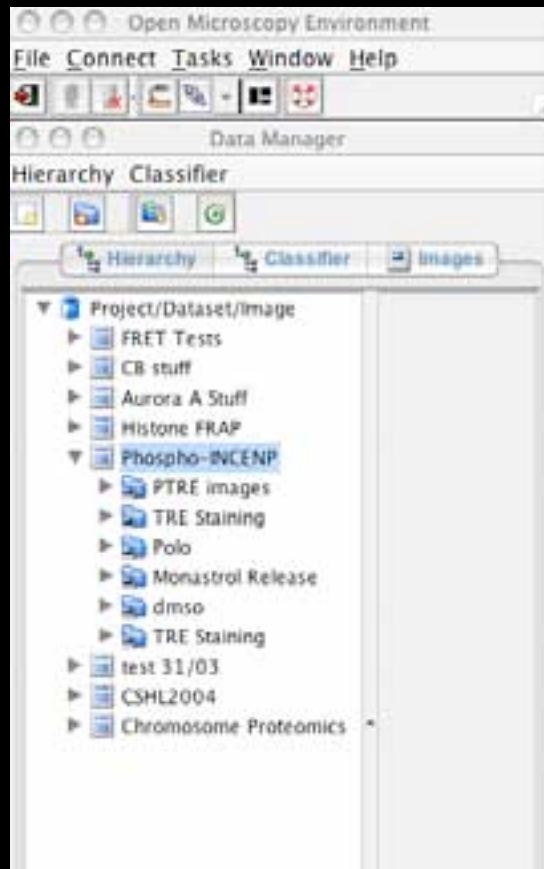
Image ID	name	created
5678	Image1	02-13-03
5679	Image2	02-13-03

Metadata and Analytics



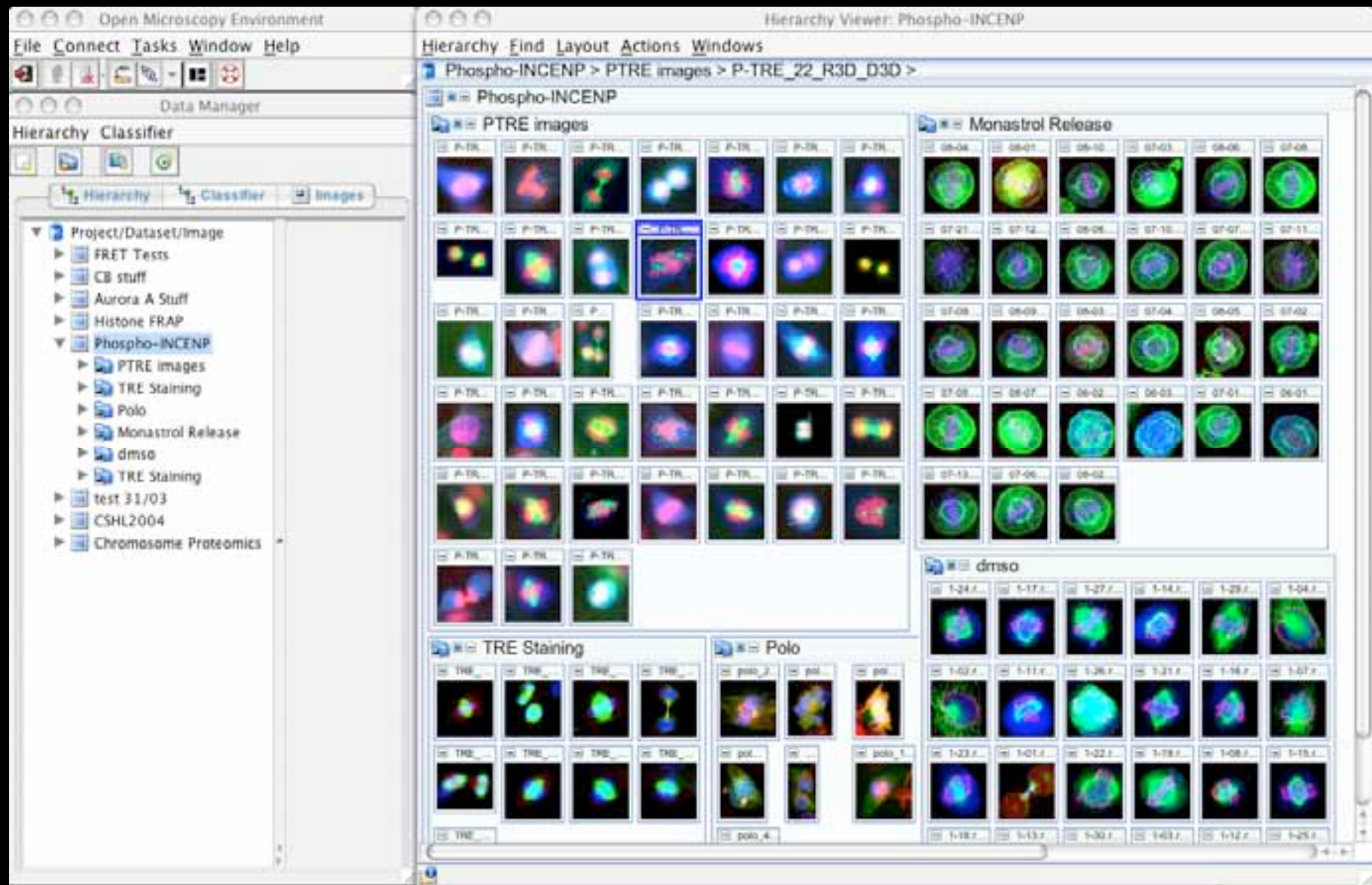
Binary Image Data
"Pixels"

OME 2.4-- Java UI

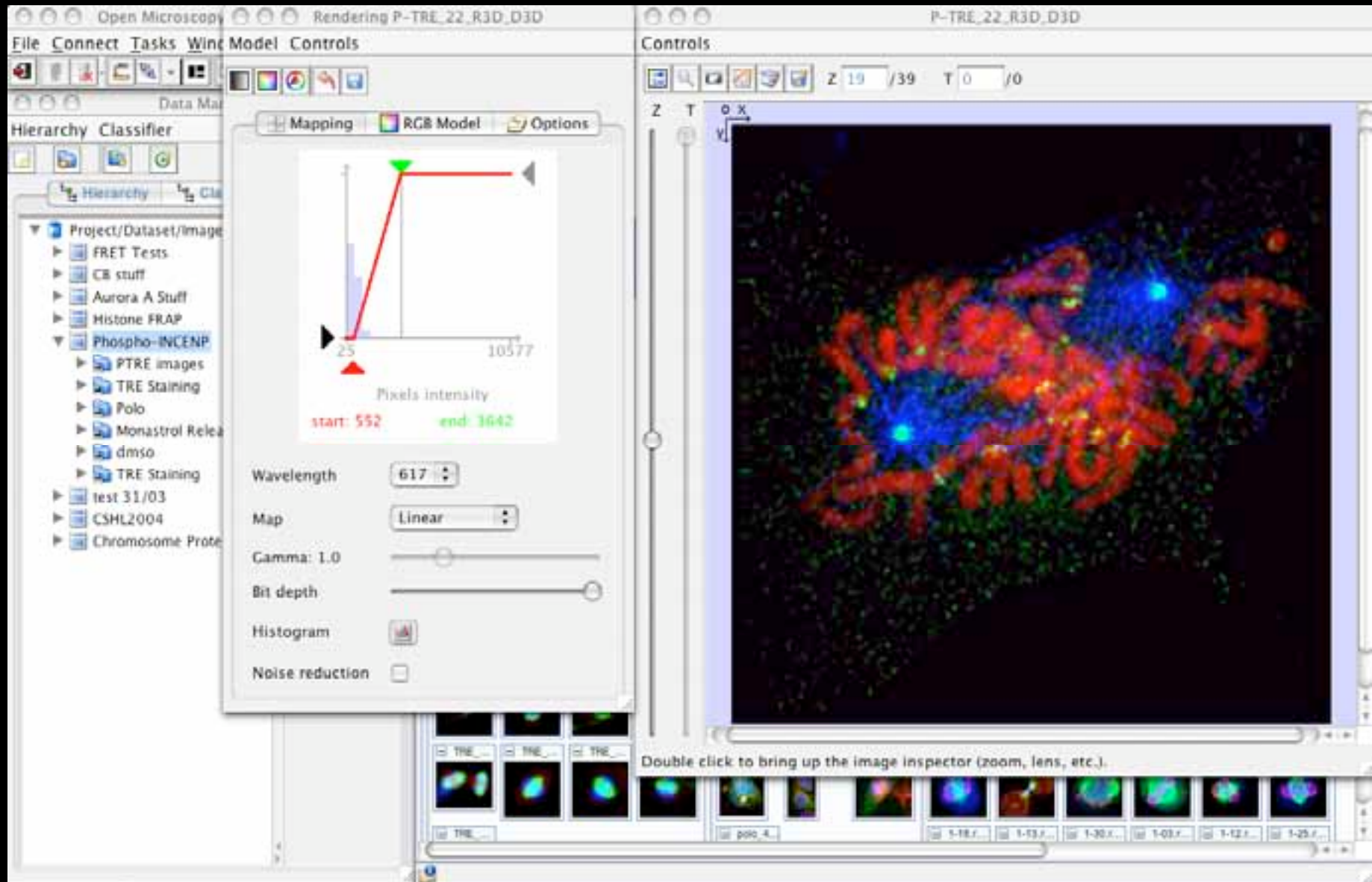


<http://openmicroscopy.org>

OME 2.4-- Java UI



OME 2.4-- Java UI



Mapping RGB Model Options

Mapping

start: 552 end: 1642

Wavelength: 617

Map: Linear

Gamma: 1.0

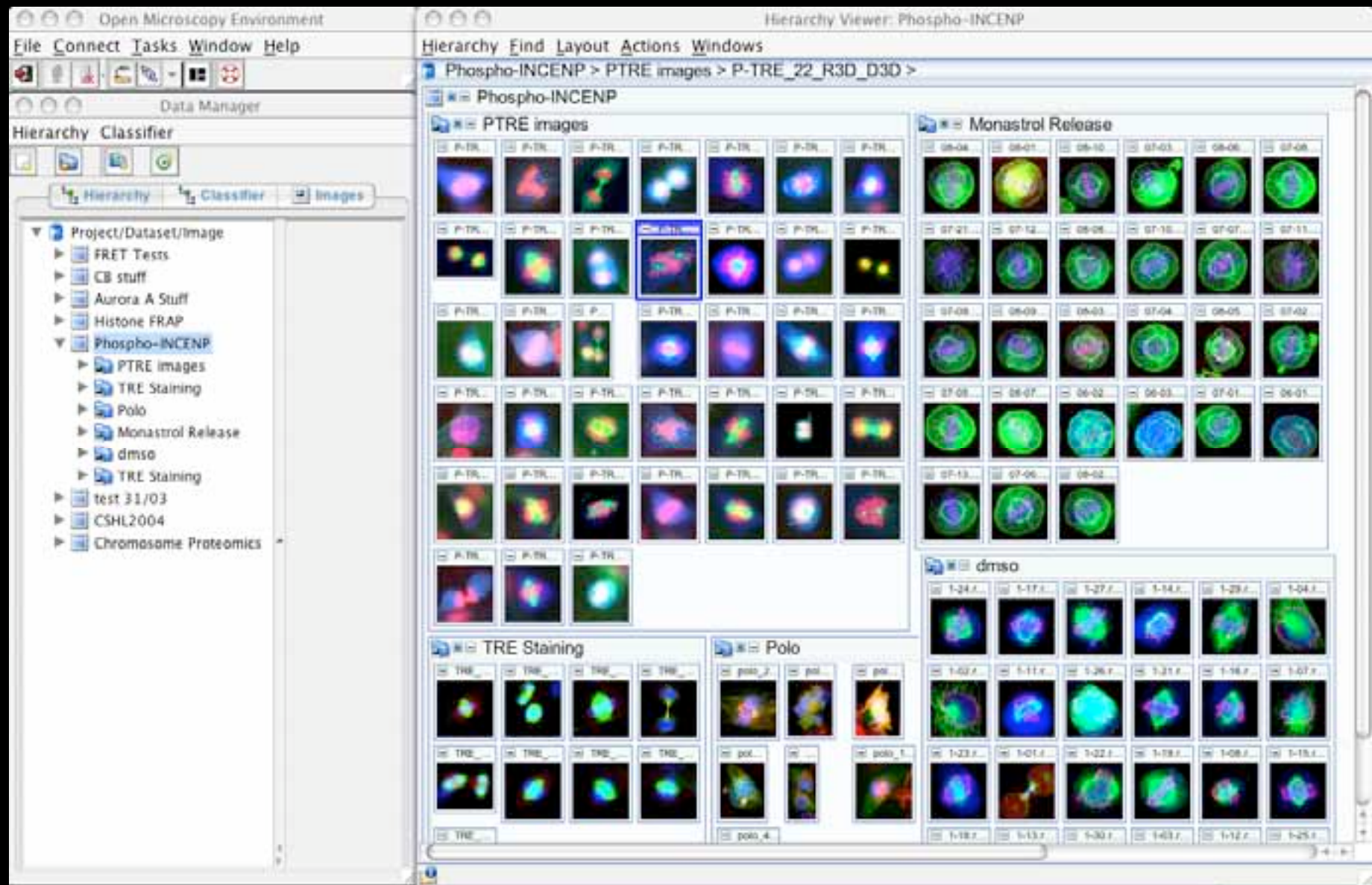
Bit depth

Histogram

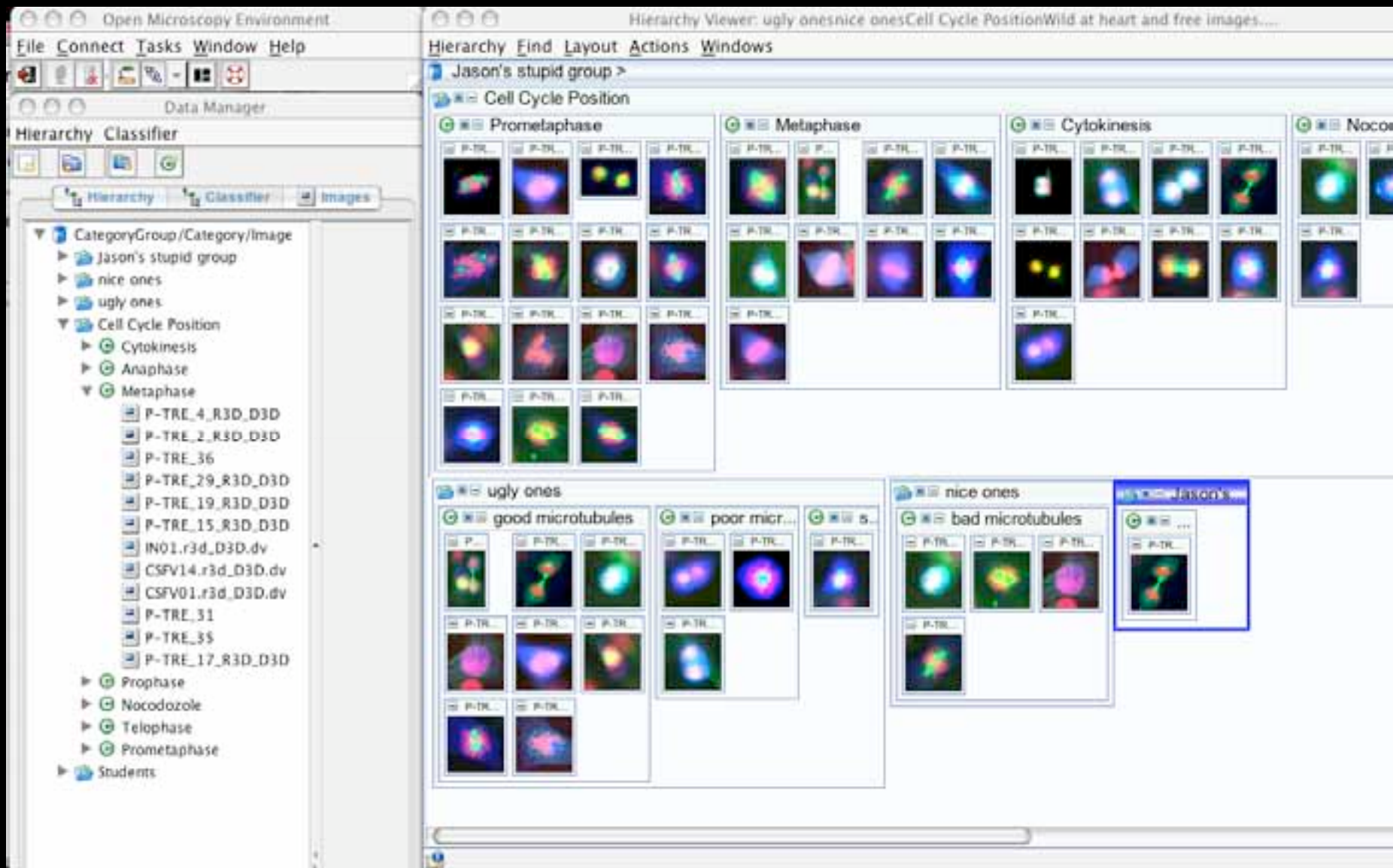
Noise reduction

Double click to bring up the image inspector (zoom, lens, etc.).

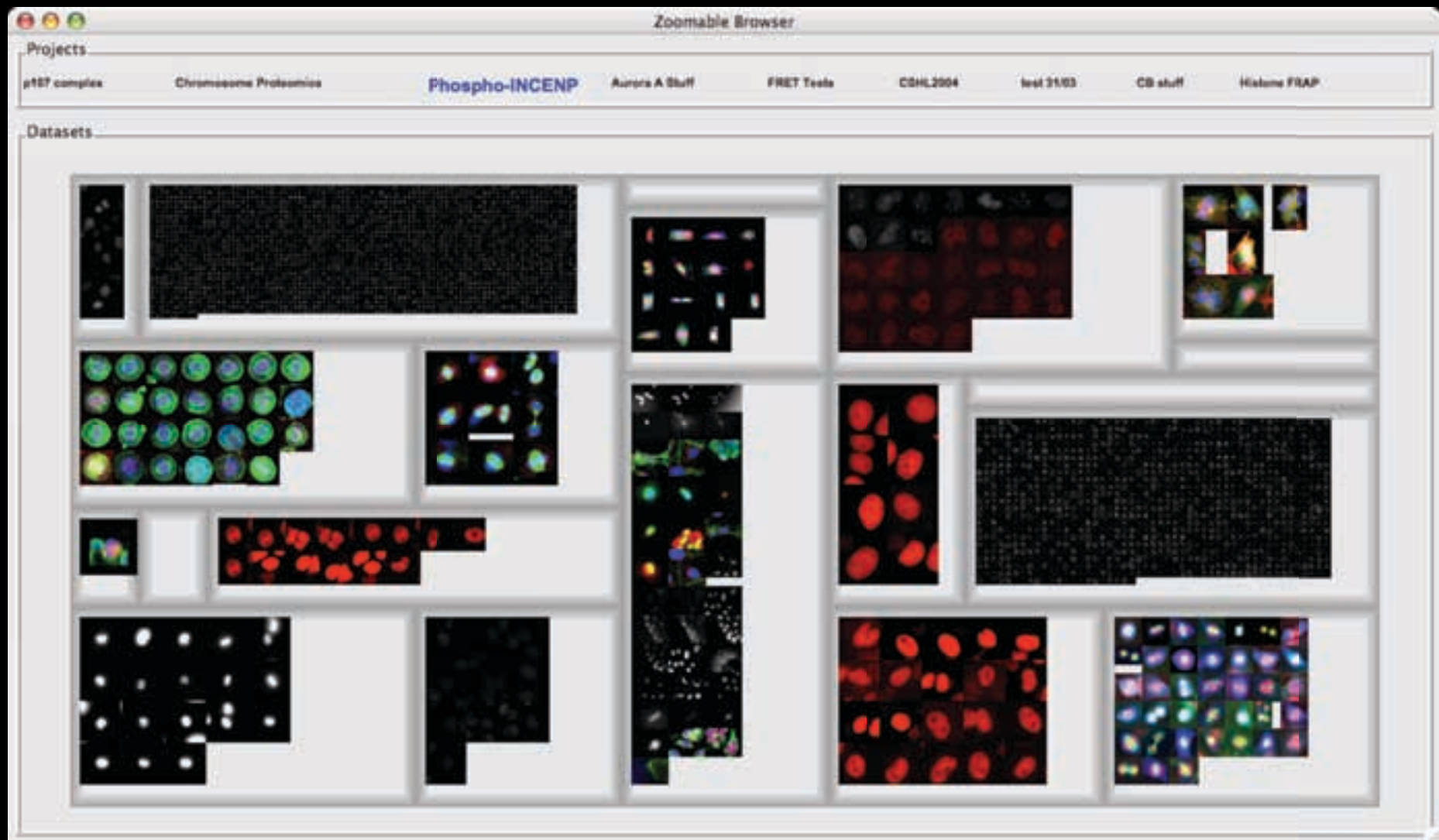
OME 2.4-- Java UI



OME 2.4-- Java UI



OME 2.4-- Java UI



OME 2.5.0 Web Browser UI

The screenshot displays the Open Microscopy Environment (OME) 2.5.0 web browser interface. The page title is "Open Microscopy Environment v2.4.1". The header includes the OME logo and a welcome message for David Schiffmann. The main content area shows a search results grid for datasets, with various microscopy images displayed in a grid format. The interface includes a navigation menu on the left, a search bar, and a header with the OME logo and version number.

Search Results:

Dataset Name	Image Count
06-07.04.05_140405	136 images
10.12.04_335 and 341	71 images
11.10.05 CORRECTED Usi...	136 images
11.10.05 UsiRNAmon111005	21 images
15.04.05 monastrol 335...	11 images
15.04.05 monastrol 335...	134 images
21.04.05 Bub1 floxed a...	80 images
21.04.05 BubR1 floxed	87 images
30.09.05 CenpBsiRNAmon...	38 images
30.09.05 UsiRNAmonBA30...	27 images
UsiRNA201005	12 images
UsiRNAoc161005	76 images
UsiRNAtax131005	11 images
exp 040305 - 335 and 3...	10 images
exp 28.03.05 - 335 and...	11 images
exp. 29.07.04. 335 341...	12 images
fluorescent-beads1-grb...	2 images
movies010905	7 images
test 1_2_3	1 images
test-1-2-and-3	1 images
test1	1 images

David Schiffman
Inke Näthke


OME 2.5.0 Web Browser UI

Dataset: UsiRNA201005

Back Forward Stop Refresh Home AutoFill Print Mail

Address: http://localhost:8080/ome/ome2.5.0/serve.pl?Page=OME_Verb_Details&ID=20&Type=OME_Dataset

Live Home Page Apple Apple Support Apple Store Mac Mac OS X Microsoft MacTools Office for Macintosh RSS

 **Open Microscopy Environment** v2.4.1

Welcome David Schiffmann
No recent project, [create new](#)
Most recent dataset: [UsiRNA201005](#) [\(PopUp\)](#)

Home » » Dataset Detail

Dataset: UsiRNA201005

Projects: (none)

Id: 20, Owner: [David Schiffmann](#), Group: [OME](#),
Locked: [false](#)

Name: [Add Images](#)

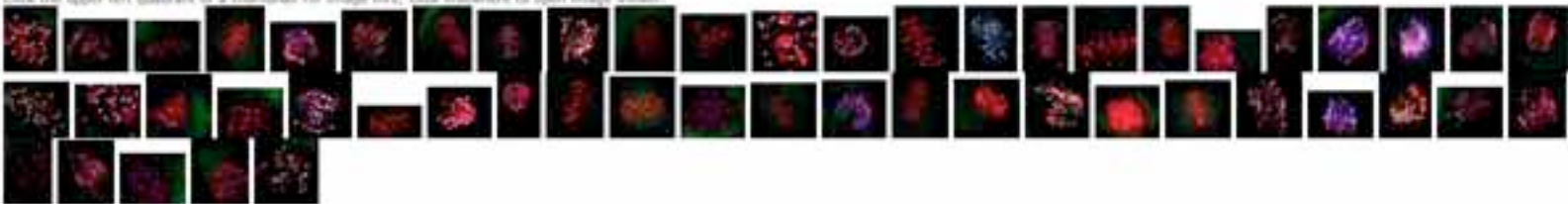
Description [Save](#)
U2OS cells (un-treated), stained for Bub1 (528nm), BubR1 (617 nm), ACA/CREST (685 nm), DAPI. Can visualise BOTH Bub1 and BubR1 in same cells.

Your Current Annotation [Save](#) [Mark Invalid](#) [View all 0 Annotations](#)

[Create a custom annotation of](#)

To cluster thumbnails by Category, select a CategoryGroup. (No CategoryGroups are used by this Dataset)
Can't find what you want in that list? You may want to [Search](#) or [Create](#) a new one.

Images: [More info...](#)
Click the upper left quadrant of a thumbnail for image info; click elsewhere to open image viewer.



Module Executions: (none)
Chain Executions: [More info...](#)

Analysis chain Find and track spots was executed against dataset UsiRNA201005 on 2005-08-24 15:19:16 by David Schiffmann . The ID is 52.	Analysis chain Find and track spots was executed against dataset UsiRNA201005 on 2005-08-24 15:19:16 by David Schiffmann . The ID is 51.	Analysis chain Image server stats was executed against dataset UsiRNA201005 on 2005-08-24 15:19:16 by David Schiffmann . The ID is 50.
--	--	--

OME 2.5.0 Web Browser UI

http://bonedancer.openmicroscopy.org.uk - iA.08.r3d_D3D.dv

Plane

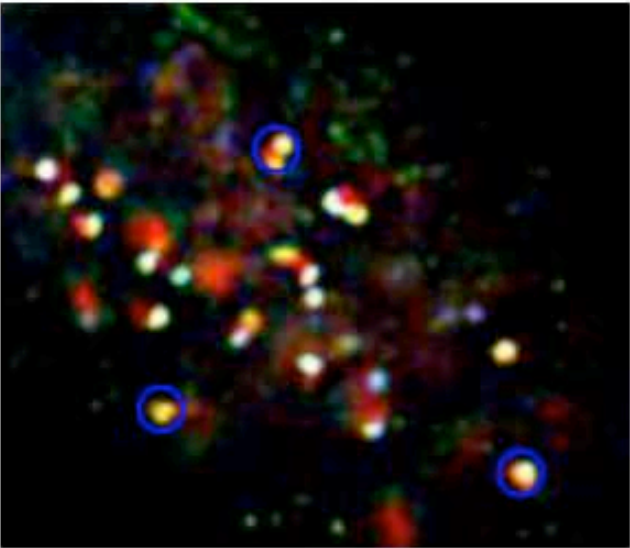
Z-slice: (37/55) Timepoint: (1/1)

Image: Info Stats Save settings Save as TIFF... Preload planes

Resize Toolboxes Overlays

Color Map

Channel	Black Level	White Level
585 On	159	642
617 On	477	2064
528 On	172	797



Transferring data from bonedancer.openmicroscopy.org.uk...

David Schiffman
Inke Näthke

OME: openmicroscopy.org

The screenshot shows a web browser window with the address bar containing <http://openmicroscopy.org>. The browser's address bar also shows several bookmarks: DundeeOME, PubMeds, Fidelity- UK, Yahoo! UK, Microscopy, Blackboard, Horde, Jigsaw, Radio, Human PRD, JeS1, News, and The Calvert Marine. The website's header features the OME logo on the left and the text "Open Microscopy Environment" on the right. Below the header is a navigation bar with a "Welcome" tab and a search box. The main content area is titled "Welcome to the Open Microscopy Environment (OME)" and contains the following text:

OME is an open source software project to develop a database-driven system for the quantitative analysis of biological images. OME is a collaborative effort among academic labs and a number of commercial entities. All OME source code is available under the GNU library general public license (LGPL), but OME is designed to interact with new and existing commercial software. OME programmers have developed standardized file formats for the exchange of image data and database schema for simplifying the automated analysis of images.

This site is under active development; we are adding new articles to the site on a regular basis. In addition, you can find the current progress of our next release by clicking on the "Roadmap2005" section to the left.

Latest News

- 3-May-2005 (*The OME Development Team*)
Paper describing The OME Data Model and [OME XML File](#) is published in [Genome Biology](#).
- 7-Mar-2005 (*The OME Development Team*)
OME 2.4.0 is [released](#). Many [bug fixes and additions](#).
- 2-Sep-2004
[Bitplane AG](#) and [FAMNET](#) have proposed the use of the [OME XML File](#) as an image data migration standard. A C++ class that reads OME XML has been posted by Peter Majer and Marius Messerli of [Bitplane AG](#) on the [FAMNET site](#). Thanks to Peter and Marius for this.
- 24-Aug-2004 (*The OME Development Team*)
OME 2.2.1 is [released](#). Many [bug fixes and additions](#).
- 18-Aug-2004 (*Jason Swedlow, Chris Allan, Ilya Goldberg*)
Migration and Completion of New Web Site
- 01-Jun-2004 (*The OME Development Team*)
OME 2.2.0 is [released](#) to the world! Enjoy!
- 01-Jun-2004 (*Tomaz*)
A [getting started](#) guide with lots of screenshots added.
- 01-May-2004 (*Ilya*)
Image server (omeis) documentation [added](#).
XML schema documentation [added](#).

Additionally, two sections of this website have been expanded: the [System overview](#) and the [Installation instructions](#).

The left sidebar contains a "Project overview" menu with links to: Welcome, About OME, Using OME, Download OME, Roadmap2005, and Project domains. Below this is a "User's documentation" menu with links to: Getting Started/Tutorial, Custom Annotations, Conceptual framework, System overview, and System administration. The "Developer's documentation" menu includes: Newbie's guide, Perl API, Java API, Image server, XML schemata, and Remote framework. The "Developer links" menu includes: CVS, Installation, and Getting involved. At the bottom left, the copyright notice reads: "Copyright © 2004-2005 Open Microscopy Environment".

OME: cvs.openmicroscopy.org.uk/tiki

The screenshot shows a web browser window displaying the homepage of the Open Microscopy Environment (OME). The browser's address bar shows the URL <http://cvs.openmicroscopy.org.uk/tiki/tiki-index.php>. The page has a light blue and white color scheme. At the top, there is a navigation bar with links to various external sites like DundeeOME, PubMeds, and Fidelity-UK. Below this, a copyright notice reads: "This is Tiki v1.8.5 -Polans- © 2002-2005 by the Tiki community Thu 01 of Dec, 2005 (00:33 UTC)".

The main content area is titled "HomePage" and features a large heading "Open Microscopy Environment". Below this heading, there is a "News/Welcome" section with a paragraph of text: "New tiki [HomePage](#) look. All links previously available here are now available from the content below. If there are any concerns, please speak up. Also, a [DataModelProcess](#) is coming which needs to get looked over. Jean-Marie? will have more details."

The page is organized into several columns and sections:

- Left Column:** A "Menu" section with links to Home, Wiki, Image Galleries, Articles, and File Galleries. Below it is a "Featured links" section with links to Documentation, Bugzilla, Mailing Lists, CVS, and SVN.
- Right Column:** A "Login" form with fields for "user:" (containing "jason") and "pass:" (containing "*****"), a "login" button, and links for "[register]" and "[forgot my pass]". Below the login form is a "Last Changes" section listing 30 recent updates, such as "1) ROIAnalysis", "2) Available Agents", "3) Viewer", "4) HiViewer", "5) Shoals", "6) December 2005 San Francisco Meeting", "7) Import Architecture", "8) ConferenceCall 2005-11-34", "9) December 2005 Dundee Meeting", "10) Import", "11) Task Bar", "12) Design Sheets", "13) Project Rationale", "14) Analysis Engine Profiling", "15) Analysis", "16) TaskBar", "17) DataManager", "18) UserRequirements--JeffM_Bri", "19) Conference Calls", "20) ConferenceCall 2005-11-17", "21) CodeManagement", "22) Annotations", "23) WikiTag", "24) HowToCome", "25) Omeas API", "26) Omeas Design", "27) Omeas Sequence Overview", "28) ConferenceCall 2005-11-10", "29) Model Mapping", and "30) Removing Issues".
- Main Content Area:** Below the "News/Welcome" section, there are four columns of links:
 - OME Technology:** Data Model, Analysis, Fast Server, Image Server, Java Server, Shoals, Web client, Import.
 - Links:** Documentation, Bugzilla, Mailing lists, CVS, SVN.
 - Development:** Meetings, Roadmaps, Conference Calls, Building, Testing, QA.
 - References:** General references, Research Reading List, Theses, Dissertations, etc., WikiHelp.

At the bottom of the page, a footer reads: "Created by: [jason](#) last modification: Saturday 01 of October, 2005 (20:21:48 UTC) by [jason](#)".

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



<http://openmicroscopy.org>

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



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."



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 for 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. "



<http://openmicroscopy.org>

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



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



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
-



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?

