



# Gestion du cycle de vie des images en microscopie pour la biologie:

## Extraction de connaissances à partir d'une base de données images

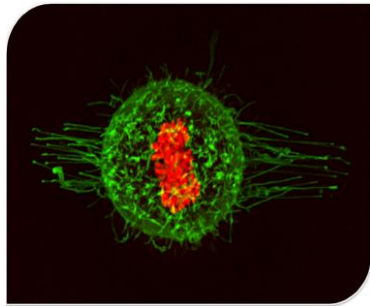


# Problématique de la gestion de données image en microscopie pour la biologie

- **Définition des besoins et contexte.**
- **Formats et outils de gestion de données disponibles, base de données images ouvertes.**
- **Création du data center Curie, choix d'une collaboration avec une compagnie.**
- **Exemple d'utilisation et de partage dans le cadre de projet, et dans le cadre de données rendues publiques.**
- **Exploitation de la base de données**
- **Questions ouvertes**

# Une plateforme de données hétérogènes: 200 To par an):

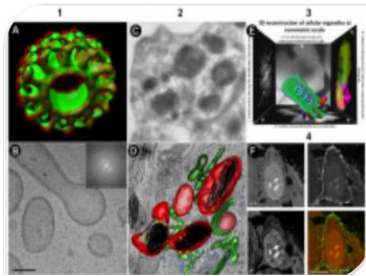
## Cell & Tissue Imaging Facility PICT Institut Curie



### Photonic

16 confocal laser scanning or spinning disk microscopes (3 equipped with femtosecond pulsed laser for multiphoton excitation, + laser photoperturbation modules),

- 8 video-microscopes,
- 3 3D deconvolution microscopes,
- 2 TIRF systems (with FRAP or PALM techniques),
- 2 FLIM systems (TCSPC and phase modulation),
- 2 high-resolution structured illumination microscopes (OMX and Nikon HR-SIM),
- 2 optical sectioning Zeiss Apotome systems
- new in 2015: 2 SPIM, une salle d'imagerie intravitale petit animal (multiphoton)
- several standard widefield microscopes for routine observation or histology.

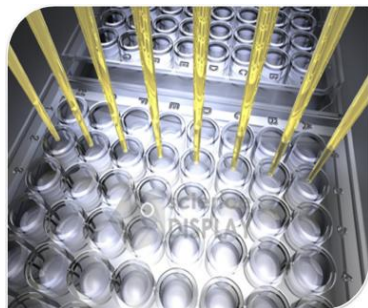


### Electronic

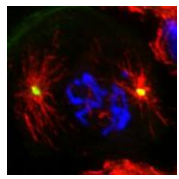
4 electron microscopes (Cryo electron microscopy Cryotomography Cellular tomography, Transmission electron microscopy)

Ion spectroscopy

HCS: 2 InCell systems + Compound Libraries

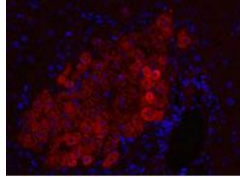
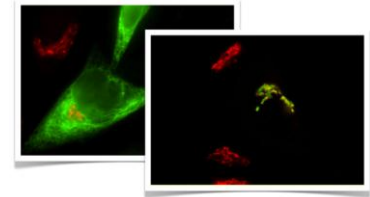


# Dans un contexte de questions scientifiques hétérogènes: ex: UMR144



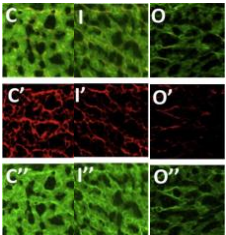
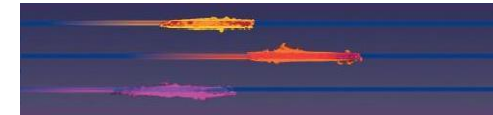
**Biology of centrosomes and Cilia BASTO**

**Dynamics of Intra-Cellular Organization PEREZ**



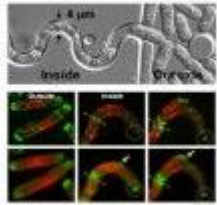
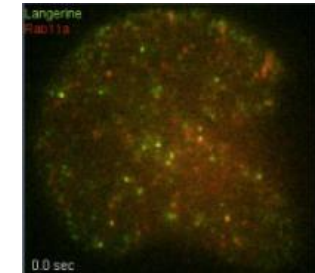
**Morphogenesis and intracellular signalling LOUVARD**

**Biologie cellulaire systémique de la polarité et de la division PIEL**



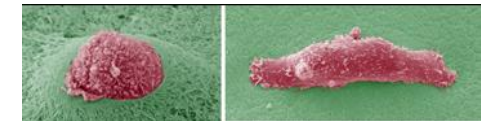
**Biophysical and molecular basis of cell adhesion and migration DUFOUR**

**Space-time imaging of cellular dynamics of organelles and endomembranes SALAMERO**

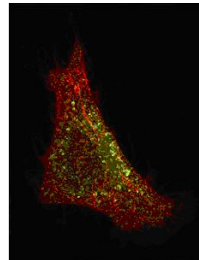


**Cytoskeletal Architecture and Cellular Morphogenesis TRAN**

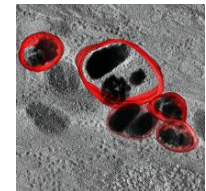
**Membrane and cytoskeleton dynamics CHAVRIER**



**Traffic, Signaling and Delivery JOHANNES**

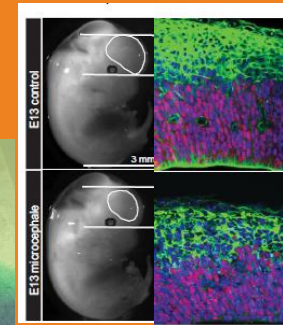
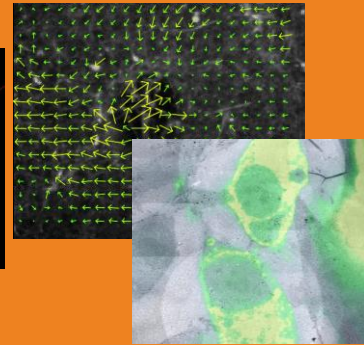
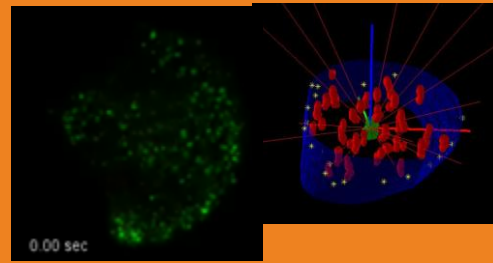
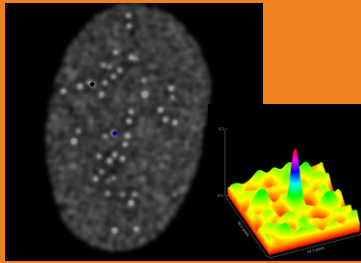


**Structure and Membrane Compartments RAPOSO**



...

# Example of Methods using bio image informatics for cell biology from microscopy



**Molecular dynamics/  
Functional Imaging**

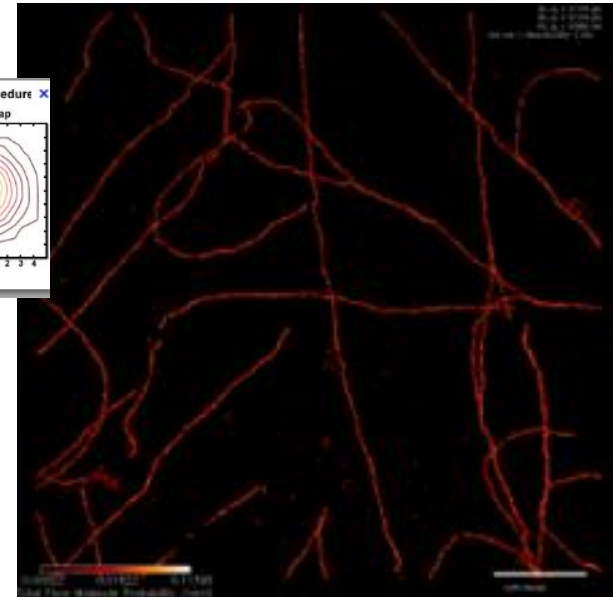
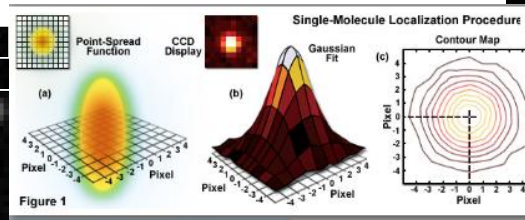
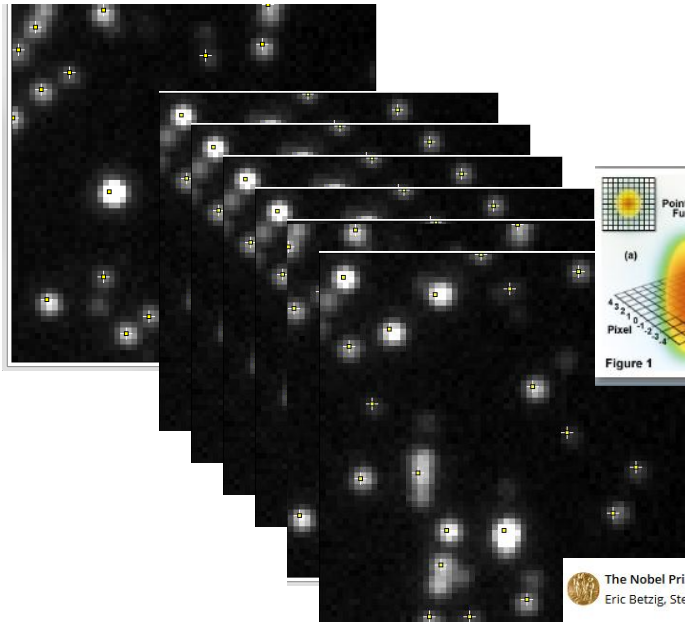
**Single cells studies:  
never single -> cell  
normalisation**

**Deformation  
quantification and  
registration  
(Correlative  
Microscopy)**

**Computational model  
of embryonic brain  
development.**

# Exemple of imaging modalities: HR microscopy

Experimental sequence of 27 529 frames  
(128x128 pixels) 16 bits for 1 final image : 1  
GO



The Nobel Prize in Chemistry 2014  
Eric Betzig, Stefan W. Hell, William E. Moerner

Share this:

## The Nobel Prize in Chemistry 2014



Photo: Matt Staley/HHMI  
**Eric Betzig**  
Prize share: 1/3

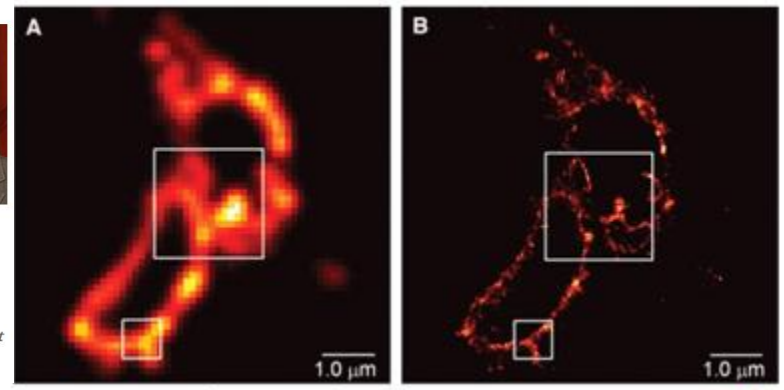


© Bernd Schuller,  
Max-Planck-Institut  
**Stefan W. Hell**  
Prize share: 1/3



Photo: K. Lowder via  
Wikimedia Commons,  
CC-BY-SA-3.0  
**William E. Moerner**  
Prize share: 1/3

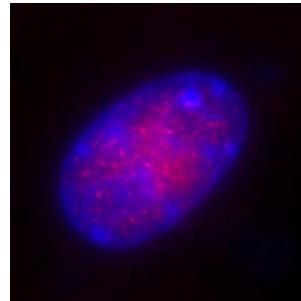
The Nobel Prize in Chemistry 2014 was awarded jointly to Eric Betzig, Stefan W. Hell and William E. Moerner "for the development of super-resolved fluorescence microscopy".



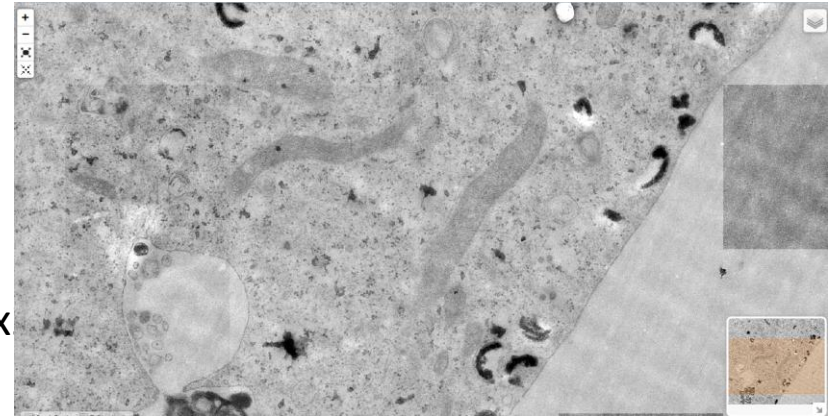
**PALM** etc.. Based on,  
Blinking fluorescent  
proteins



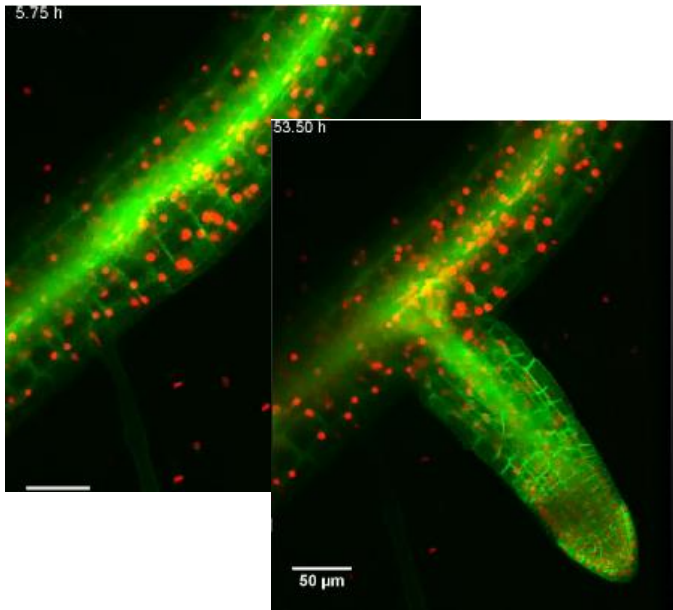
# Nd-Images



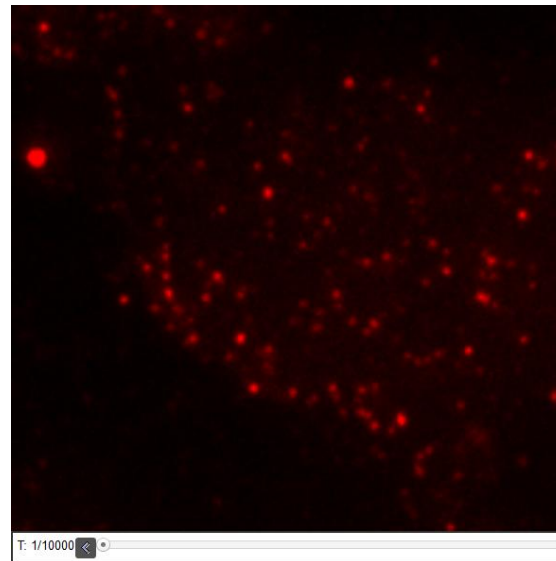
10000x10000x1 byte =100 MB



WF 384x384x50x  
colorsx2 bytes  
=29.5 MB



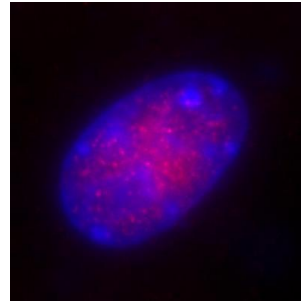
1040x1288x20x300x2  
colorsx2 bytes =3.214GB  
CIL:40982



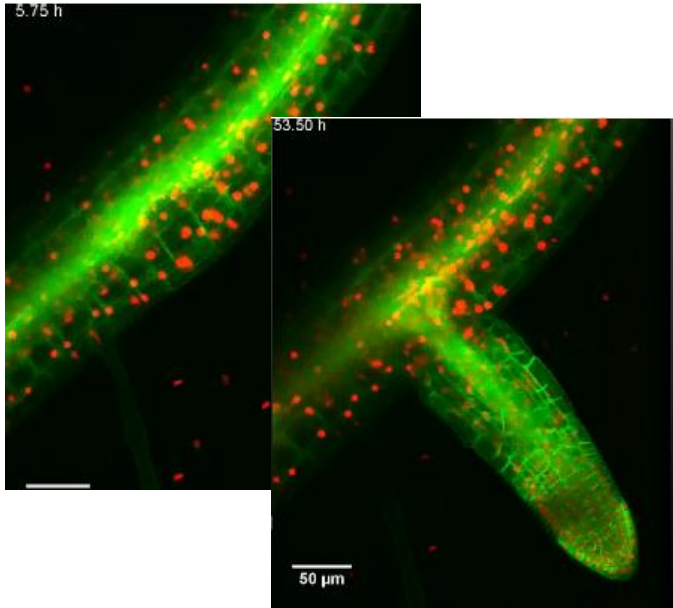
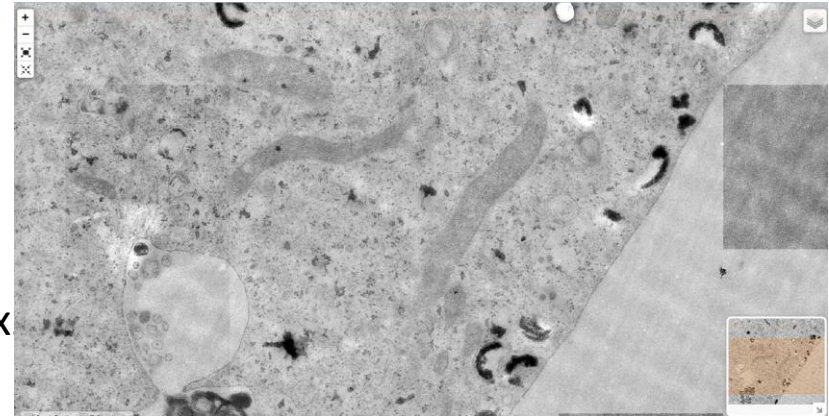
Palm Data  
197\*188\*10000\*2  
bytes= 740MB

# Nd-Images And co.

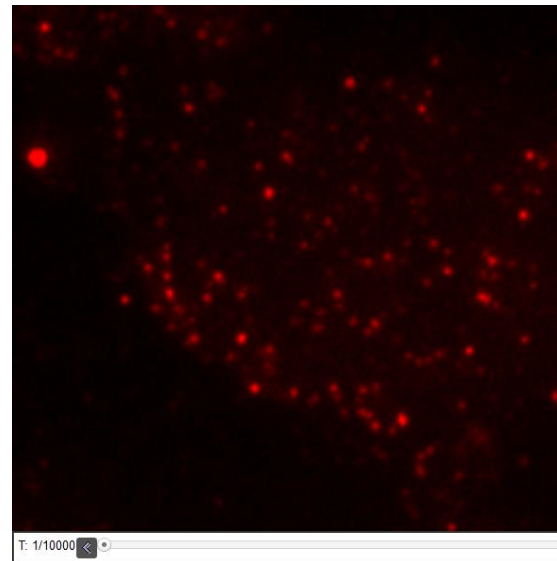
10000x10000x1 byte =100 MB + **3D reconstruction+ mosaick**



WF 384x384x50x  
colorsx2 bytes  
=29.5 MB + **3D deconvolution**



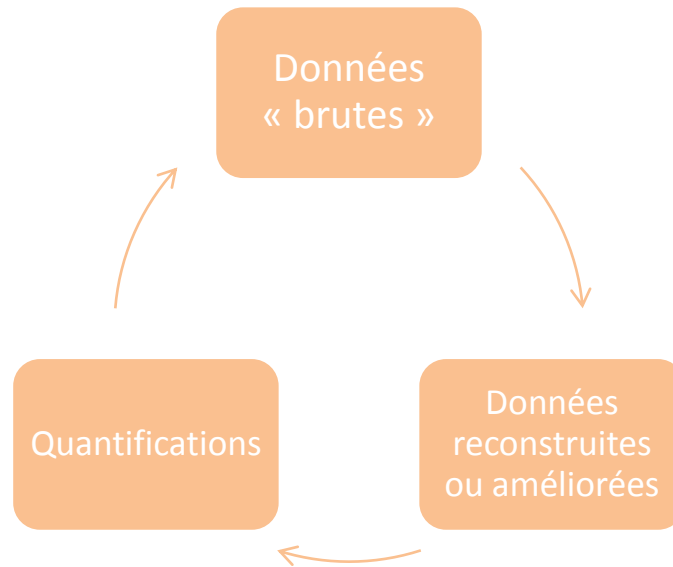
1040x1288x20x300x2  
colorsx2 bytes =3.214GB  
+ **Reconstructed Spim Data**



Palm Data  
197\*188\*10000\*2  
bytes= 740MB  
+ **reconstructed image+ intermediate detection**



-> Un traitement des données indissociables des données brutes.



-> Données mieux résolues, diminution de la phototoxicité, imagerie multimodale (corrélative)

Passage à l'unité de mesure d'archivage au Peta Octet

-> Garantir l'accès aux données 5 ans après publication (responsabilité de l'utilisateur mais aussi de la plateforme?)

## 2 types de besoins

**Donner un accès publique mais sécurisé (cf. Recommandations BioMedBridges)**

**Gérer la production et l'analyse de données « de travail » produites sur une plateforme**

## The Bio-Formats Library

**Bio-Formats, the solution for reading proprietary microscopy image data and metadata.**



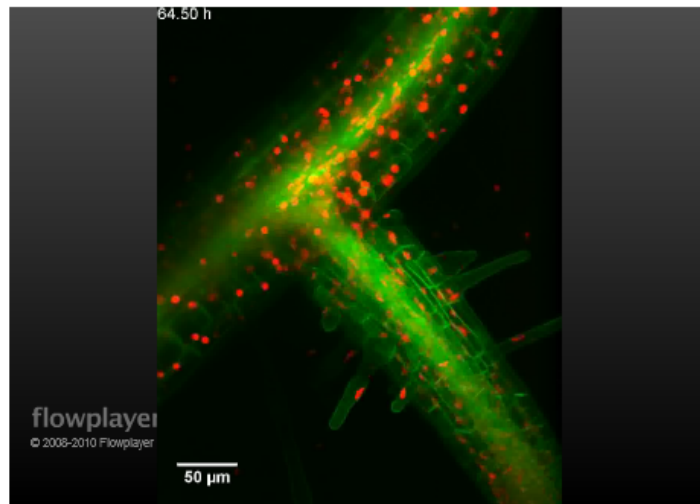
Bio-Formats is a software tool for reading and writing image data using standardized, open formats. Bio-Formats is a community driven project with a standardized application interface that supports open source analysis programs like [ImageJ](#), [CellProfiler](#) and [Icy](#), informatics solutions like [OMERO](#) and the [JCB DataViewer](#), and commercial programs like [Matlab](#).

Bio-Formats is developed by the Open Microscopy Environment consortium, including development teams at [LOCI at the University of Wisconsin-Madison](#), [University of Dundee](#) and [Glencoe Software](#). Licensing and citing information is on the [OME licensing page](#).

Bio-Formats currently reads and converts more than 120 [file formats](#) to the [OME-TIFF](#) data standard.



# Available resources for biological images



Video Data Download Options...

## Licensing



**Attribution Non-Commercial; No Derivatives:** This image is licensed under a Creative Commons Attribution, Non-Commercial, No Derivatives License. [View License Deed](#) | [View Legal Code](#)



Comments:

Add to Photobox

CIL:40982\*

## Description


A video of *Arabidopsis thaliana* showing a lateral root growing out of the primary root. *Arabidopsis thaliana* is widely used as a model organism in plant biology. This movie is created from image stacks recorded every 15 minutes over a period of 75 hours using digital scanned light-sheet microscopy. Second Prize, 2011 Olympus BioScapes Digital Imaging Competition®.

## Technical Details



## Biological Sources

### NCBI Organism Classification

· *Arabidopsis thaliana*   
(thale cress)

### Cellular Component

· plant-type cell wall  
· male germ cell nucleus

## Biological Context

### Biological Process

· lateral root formation  
· root development

## Attribution

## Imaging

### Image Type

· recorded image

### Imaging Mode

· scanned sheet microscopy  
· fluorescence microscopy

### Parameters Imaged

· fluorescence emission

### Source of Contrast

· distribution of a specific protein

### Processing History

· z-stack reconstruction

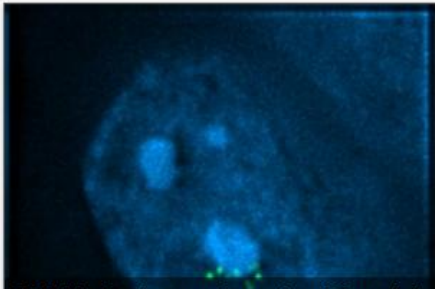
### Sample Preparation

# Available resources for biological images

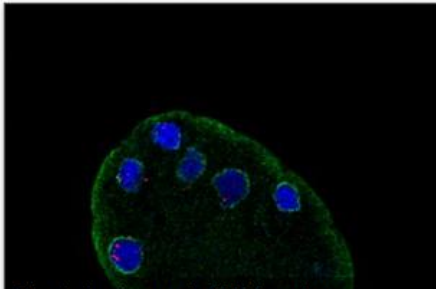
**JCB Data Viewer**   [Home](#) [About](#) [Contact](#) **JCB** | [log in](#)

Welcome to the **JCB DataViewer!** The JCB DataViewer facilitates viewing, analysis, and sharing of multi-dimensional image data associated with articles published in *The Journal of Cell Biology*.

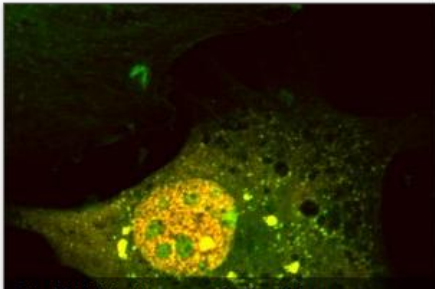
**View**



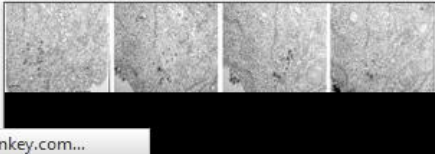
**$\beta$ -Globin cis-elements determine differential nuclear targeting through epigenetic modifications**  
Qian Bian, Nimish Khanna, Jurgis Alvikas, Andrew S. Belmont  
jcb. 2013. 203:767-783 DOI: 10.1083/jcb.201305027.

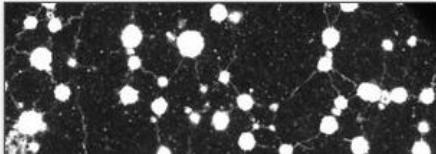


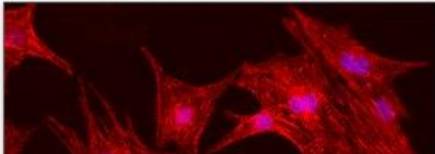
**The shelterin protein POT-1 anchors *Caenorhabditis elegans* telomeres through SUN-1 at the nuclear periphery**  
Helder C. Ferreira, Benjamin D. Towbin, Thibaud Jegou, Susan M. Gasser  
jcb. 2013. 203:727-735 DOI: 10.1083/jcb.201307181.



**The RNA-binding protein Fus directs translation of localized mRNAs in APC-RNP granules**  
Kyota Yasuda, (...), Stavroula Mili  
jcb. 2013. 203:737-746 DOI: 10.1083/jcb.201306058.







nte de www.surveymonkey.com...

# Why do computer scientist needs access to sample annotated images

material to work/test/assess (CHALLENGES)

ACCESS to what other used (also processing)

Biii.info

+ taggathon

[biii.info: BioImage Information Index](#)

[biii.info/](#) - Traduire cette page

Biii is a website for organizing bioimage analysis resources. We manually edit following pages, for you to search tools, workflows and functions for bioimage ...  
Vous avez consulté cette page de nombreuses fois. Date de la dernière visite : 15/12/14

#### Workflows

Home /Workflows. Workflows.  
Recent Edits. Bio-image ...

#### Languages

Languages used for bio image informatics (click for details) ...

#### RoadMap

A tentative roadmap of Biii. Phase 0 (done). Tagging using the ...

#### EuBIAS

EuBIAS Manifesto. Date: June 19, 2013. Authors: Kota Miura ...

#### Components

... new account · Request new password · Home /Components ...

[Autres résultats sur biii.info »](#)

#### Forum

Ported to Drupal by Drupalizing, a Project of More than (just ...

#### tissue

Plot the centroid tracks and area evolution of the cells of a tissue ...

#### About

What Biii can do for you, what you can do for Biii. Existing software ...

#### Feed aggregator

Ported to Drupal by Drupalizing, a Project of More than (just ...

#### Software

NeuronStudio, Susan L. Wearne  
Principal Investigator Patrick R ...

Création d'une base d'outils et workflow logiciels , avec des données tests associées (vers du benchmarking?)

# Available resources for biological images

## Broad Bioimage Benchmark Collection

Annotated biological image sets for testing and validation



[Introduction](#)

[Image sets](#)

[Benchmarking](#)

[Contribute](#)

LEGEND: KINDS OF GROUND TRUTH

- C Counts
- F Foreground/background
- O Outlines of objects
- B Biological labels

### Image sets

#### Identification and segmentation

Accession	Description	Mode	Fields	Ground truth
BBBC001	Human HT29 colon-cancer cells	Fluorescent	6	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">C</span>
BBBC002	<i>Drosophila</i> Kc167 cells	Fluorescent	50	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">C</span>
BBBC003	Mouse embryos	DIC	15	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">C</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span>
BBBC004	Synthetic cells	"Fluorescent"	100	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">C</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span>
BBBC005	Synthetic cells	"Fluorescent"	19,200	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">C</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span>
BBBC006	Human U2OS cells (out of focus)	Fluorescent	52,224	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">O</span>
BBBC007	<i>Drosophila</i> Kc167 cells	Fluorescent	16	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">O</span>
BBBC008	Human HT29 colon-cancer cells	Fluorescent	12	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span>
BBBC009	Human red blood cells	DIC	5	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">O</span>
BBBC010	<i>C. elegans</i> live/dead assay (uneven illumination)	Bright field and fluorescent	384	<span style="border: 1px solid black; border-radius: 50%; padding: 2px;">F</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">O</span> <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">B</span>

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- [Lane Center for Computational Biology](#)
- [Center for Bioimage Informatics](#)
- [Biological Sciences Department](#)
- [Biomedical Engineering Department](#)

#### Most important

- [2D HeLa](#)
- [3D HeLa](#)
- [2D 3T3 RT Set3](#)
- [2D 3T3 RT Set4](#)
- [3D 3T3](#)

#### Other Datasets

- Raw and processed image collections
- [2D CHO](#)
- [2D 3T3 RT Set1](#)
- [2D 3T3 RT Set2](#)
- [3D UCE](#)
- Hand-labeled image collections
- [2D 3T3 and U2OS segmented nuclei](#)
- Other collections
- [UCSF yeast GFP images](#)

#### Supplementary Data

- [ISBI 2006 SimEC2](#)
- [ISMB 2007 Yeast Image Classification](#)
- [Cytometry 2007 Generative Models](#)

#### [2D images of 3T3 and U2OS cells hand-segmented to show nuclear boundaries](#)

L.P. Coelho, A. Sharif and R. F. Murphy (2009). Nuclear segmentation in microscope cell images: A hand-segmented dataset and comparison of algorithms. Proceedings of the 2009 IEEE International Symposium on Biomedical Imaging (ISBI 2009), p. 518-521.

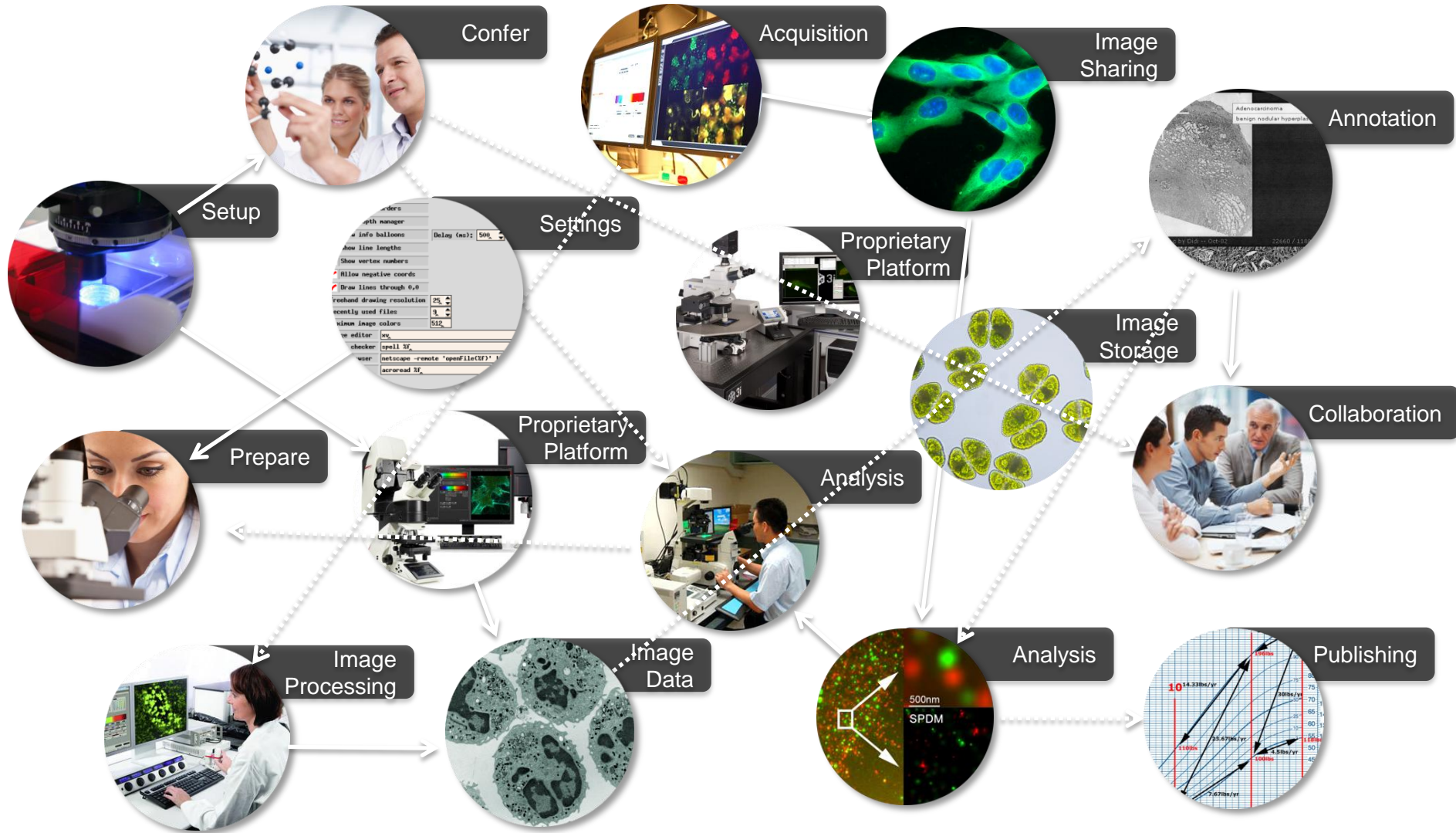
#### [Supplementary Data for Cytometry generative models paper](#)

T. Zhao and R.F. Murphy (2007). Automated learning of generative models for subcellular location: Building blocks for systems biology. Cytometry 71A:978-990.

#### [Supplementary Data for ISMB/ECCB 2007 Yeast Image Classification paper](#)

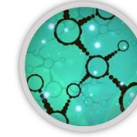


# Researchers deal with huge data and complex analysis workflows





# Requirements for Image data base software



FRANCE-BIOIMAGING

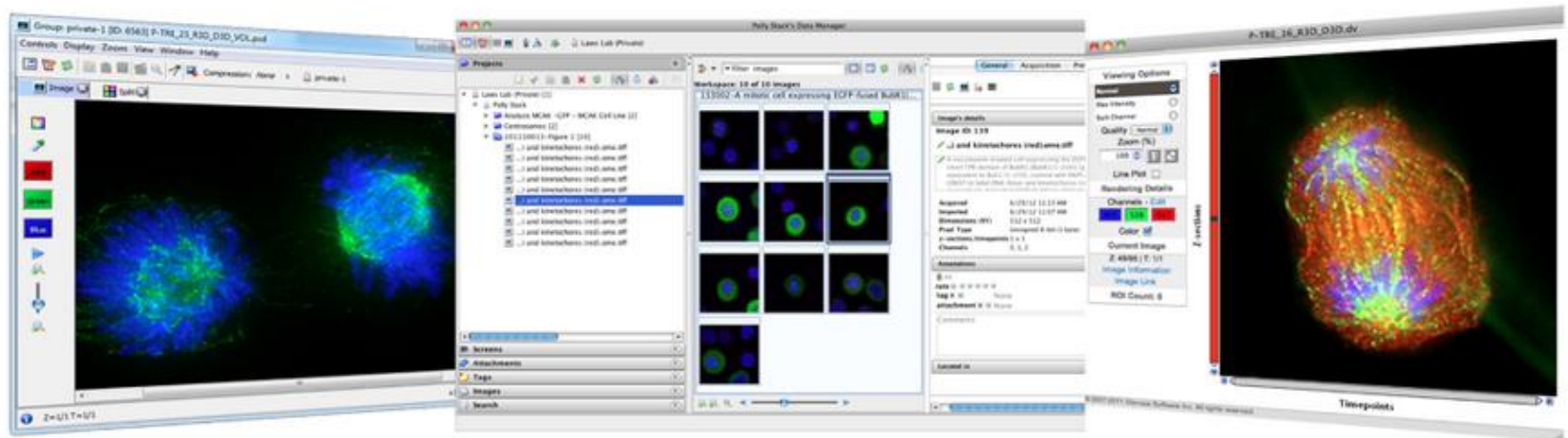
	Montpellier RIO Imaging WIDE	Institut Curie	Institut Interdisciplinaire des Neurosciences, Bordeaux Imaging Center, Bordeaux	IJM	Plateforme Bloemergences	synthèse minimale
<b>Structure Plateforme</b>						
Nombre d'utilisateurs (2011)	environ 600 actifs distribués sur différents sites (12 sites) 10 % venant du secteur privé	400 dont environ 10% externes	environ 100, dont un 20aine en SPT (Gros utilisateurs)	250	20	entre 100 et 1000 dont utilisateurs temporaires
Production annuelle (2011)	> 10 To (devrait augmenter)	>100 To (y compris données traitées)	>50 To (beaucoup de SPT, grosse bande passante : 20Go/h/poste)	>15 To/an pour 10 microscopes (devrais augmenter)	5 To	au minimum 100 to
Production à archiver archivage=archivage à long terme		Seulement un % de la production annuelle: données publiées et Gold standards. Durée de conservation: 4 ans après publication pour données publiées, sûrement plus pour Gold Standard/			100%	Cycle de vie des données: actives, archivées, supprimées.
remarques particulières	Plusieurs sites sur Montpellier	Multi site (Orsay et Paris)			Multi site	Fluidité entre les différents sites. Transparence des sites / projets. Une seule interface pour tous les projets quelque soit le site d'acquisition d'origine. Les données ne sont pas dupliquées et sont au plus près de l'utilisateur (projet) ou des traitements.

# OMERO/ OMERO via Glencoe

## About OMERO

### What is OMERO?

From the microscope to publication, OMERO handles all your images in a secure central repository. You can view, organize, analyze and share your data from anywhere you have internet access. Work with your images from a desktop app (Windows, Mac or Linux), from the web or from 3rd party software.



### Import

Over 100 file formats supported, including all major microscope formats.

### Organize

Organize by 'Project', 'Tags' or acquisition date. Annotate with attachments, comments, ratings.

### View

Move through multiple dimensions, copy and apply rendering settings, zoom and pan 'Big' images.

### Analyze

Draw and measure regions of interest, write Python scripts in OMERO or connect to OMERO from your favorite analysis software.

### Export

Export your images for analysis or publication. Save images as 'figures' ready for presentations.

# BISQUE

The screenshot displays the BISQUE Image Repository interface. At the top, the title "Image Repository" is followed by navigation icons for Upload, Download, Analyze, and Browse. A search bar contains the text "Find resources using tags". On the right, there are "Sign in" and "Help" icons. Below the navigation bar, a secondary toolbar includes "Download", "Share", "Delete", and "Visibility: published". On the far right of this bar, there are controls for "Add images", "Remove selected", and the current "dataset: Experiment3".

The main content area is titled "Preview for 'Experiment3'" and features a grid of six neuron images. Each image is labeled with its filename: "Neuron7DIV21.oib", "Neuron7DIV14.oib", "Neuron7DIV7.oib", "Neuron6DIV14.oib", "Neuron6DIV21.oib", and "Neuron5DIV21.oib". Above the grid is a navigation bar with icons for selection, refresh, and navigation, along with a "Showing 1-6 of total 23" indicator.

On the left side, there is an "Organizer" panel with "Add" and "Reset" buttons and a "Select a tag..." dropdown menu. On the right side, there is an "Annotate and modify" panel with tabs for "Annotations", "Analysis", "Operations", and "Map". Below these tabs are "Add", "Delete", "Import", and "Export" buttons, and a table with "Name" and "Value" columns.

# Wide

Wide File Manager

Folder tree:

- granier
  - 2013-05-26
  - Images
  - 2013-05-27
  - 2013-05-24
  - 2013-05-25
  - 2013-05-28
  - 2013-05-29
  - 2013-05-24
  - 2013-05-31
  - 2013-06-10
- nikuel
- granie
- lartaud

Folder: Images

Thumbnail	File Name	Size
[Folder icon]	..	
[Thumbnail]	20130221_FISH_CEL120_T_RIC00_0C2_of732.MN	747 MB
[Thumbnail]	3.ndbl	159.3 KB
[Thumbnail]	Abrieu-Ballon-137.jpg	659.4 KB
[Thumbnail]	Abrieu-Bavardca-Y27.jpg	185.9 KB
[Thumbnail]	Abrieu-CancerCell-Lyfnrh.jpg	159.1 KB
[Thumbnail]	Abrieu-CancerCell-MG.jpg	461.7 KB
[Thumbnail]	Abrieu-Epoca-148.jpg	248.1 KB
[Thumbnail]	Abrieu-FlyngCell.jpg	155.1 KB
[Thumbnail]	Abrieu-Heboulca-NSC.jpg	253.6 KB
[Thumbnail]	Abrieu-LeMauvaisDeil	448.0 KB
[Thumbnail]	Abrieu-Midras-H1H.jpg	61.8 KB
[Thumbnail]	Abrieu-Nd-Anaphaso-148.jpg	72.6 KB
[Thumbnail]	Abrieu-Nd-Metaphaso	113.3 KB
[Thumbnail]	Abrieu-Nd-rometaphaso	471.4 KB
[Thumbnail]	Abrieu-Pantlème.jpg	285.2 KB
[Thumbnail]	Abrieu-Symbolée.jpg	154.5 KB
[Thumbnail]	Abrieu-Yeastbacel.jpg	

OME Metadata / Original metadata

### Summary

Reset home metadata

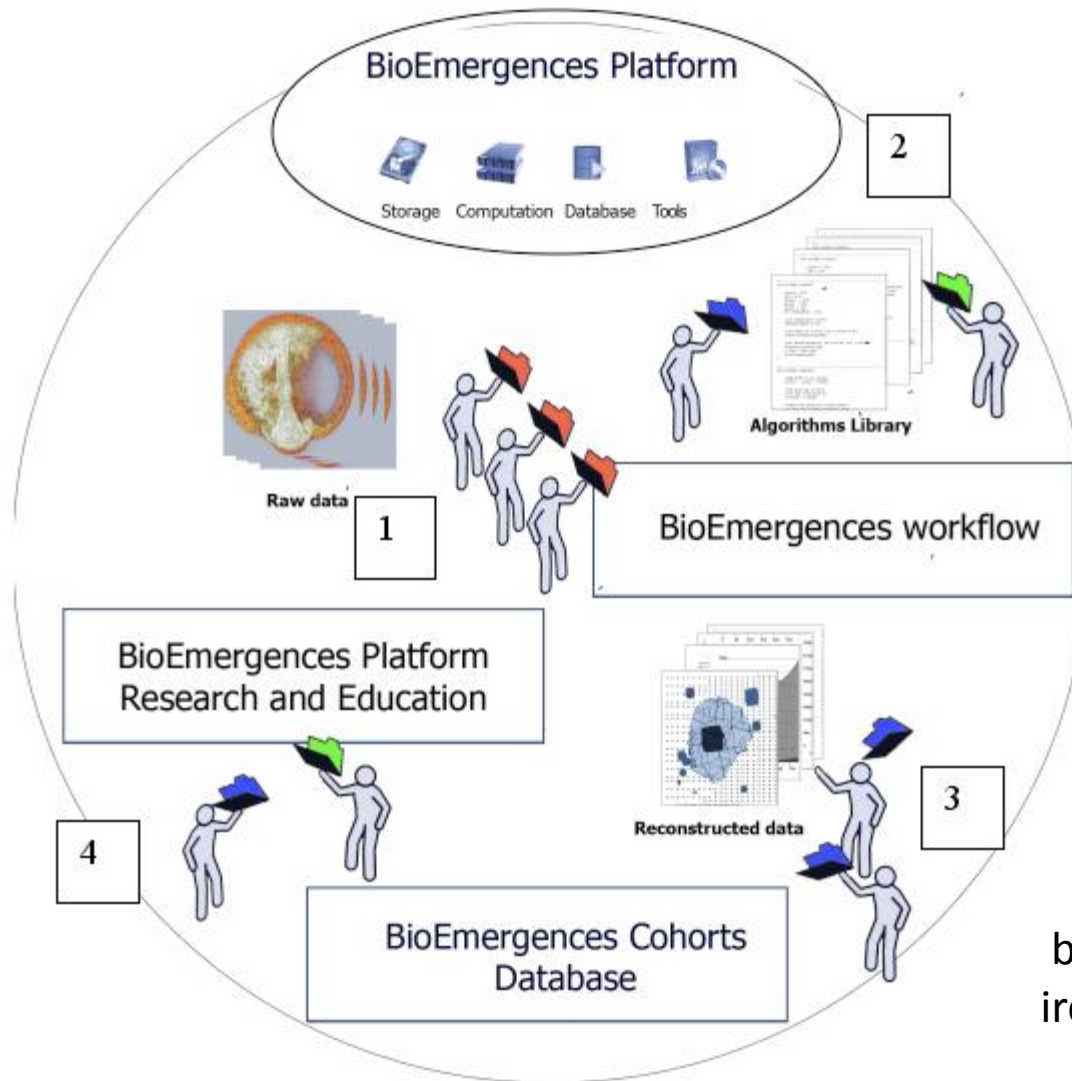
#### Abrieu-Ballon-137.jpg

Owner: granier  
Dimension (XY): 524 x 764 px  
Z-sections / time points: 1 x 1  
Acquisition date: Jul 4, 2013

image:

- image id: urn:sid:mn.crs.fr:image:25120
- image name: 3035.jpg
- Creation date: 2013-07-04T05:18:17
- Description: No description
- Dimension order: XYCZT
- Width: 524 px
- Height: 764 px
- Size Z: 1
- Size C: 3
- Size T: 1
- Physical size X: microns
- Physical size Y: microns
- Physical size Z: empty microns
- Time increment: 0.0 seconds
- Channels:
  - Channel number: 0
  - Samples per pixel: 0

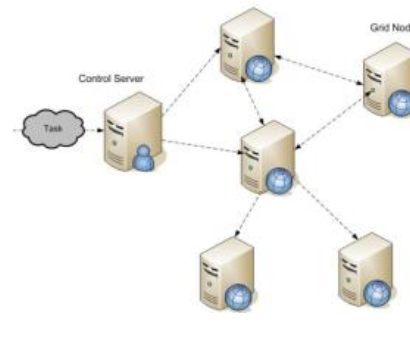
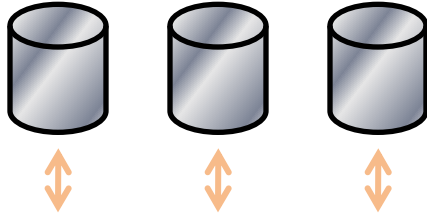
# BioEmergences



based on  
irods

# Image data base

## STORAGE



Processing batch of images on cluster (denoising, deconvolution, ...)

Images Server+ Metadata +annotations (manual or analysis results)/ attachments (publications,xls file...)

Acquisition Client

Web Client

Interface

Web admin for project managing



Automatic analysis without full download, Data fusion, advanced visualisation EXEMPLE

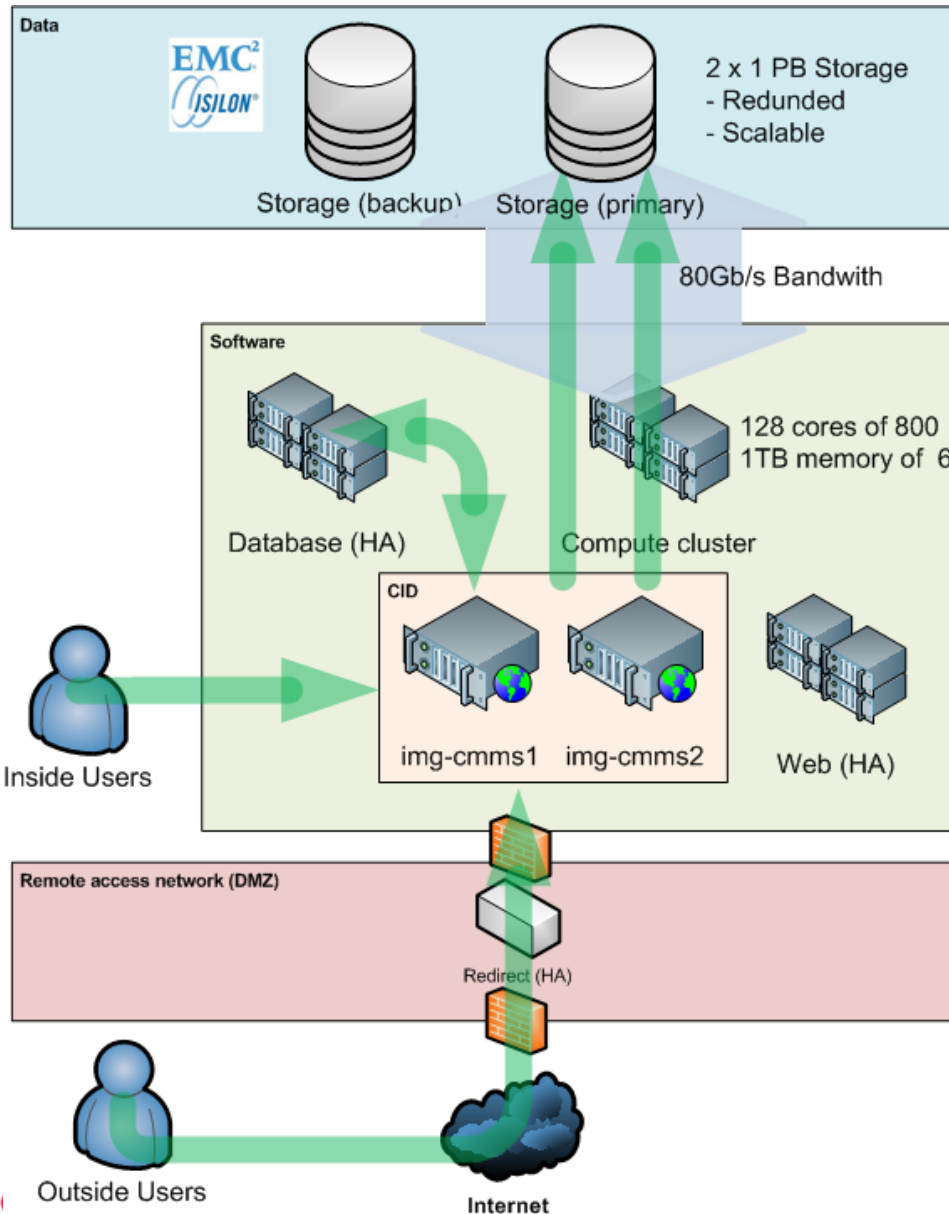


Dynamic Organisation, Visual search or advanced search functionalities

Metadata (pixel size, acquisition time,...) annotations, Parsing nD images Insuring reproducibility by storing all processing



# CID now



## True Collaborative tool :

- All users are accessing the same infrastructure with **hierarchical rights**.
- All images are stored on a **central secured place**, and are **indexed**

## Security & Scalability :

We have an overall **High Availability infrastructure**, with many **parts shared between platforms** (NGS/ Bioinfo/Imaging/...):

- Network
- Storage
- Database
- Computing

## What next ? :

Migrate CID on the Web shared infrastructure.  
Take profit of « big data » processing.

## Some key numbers :

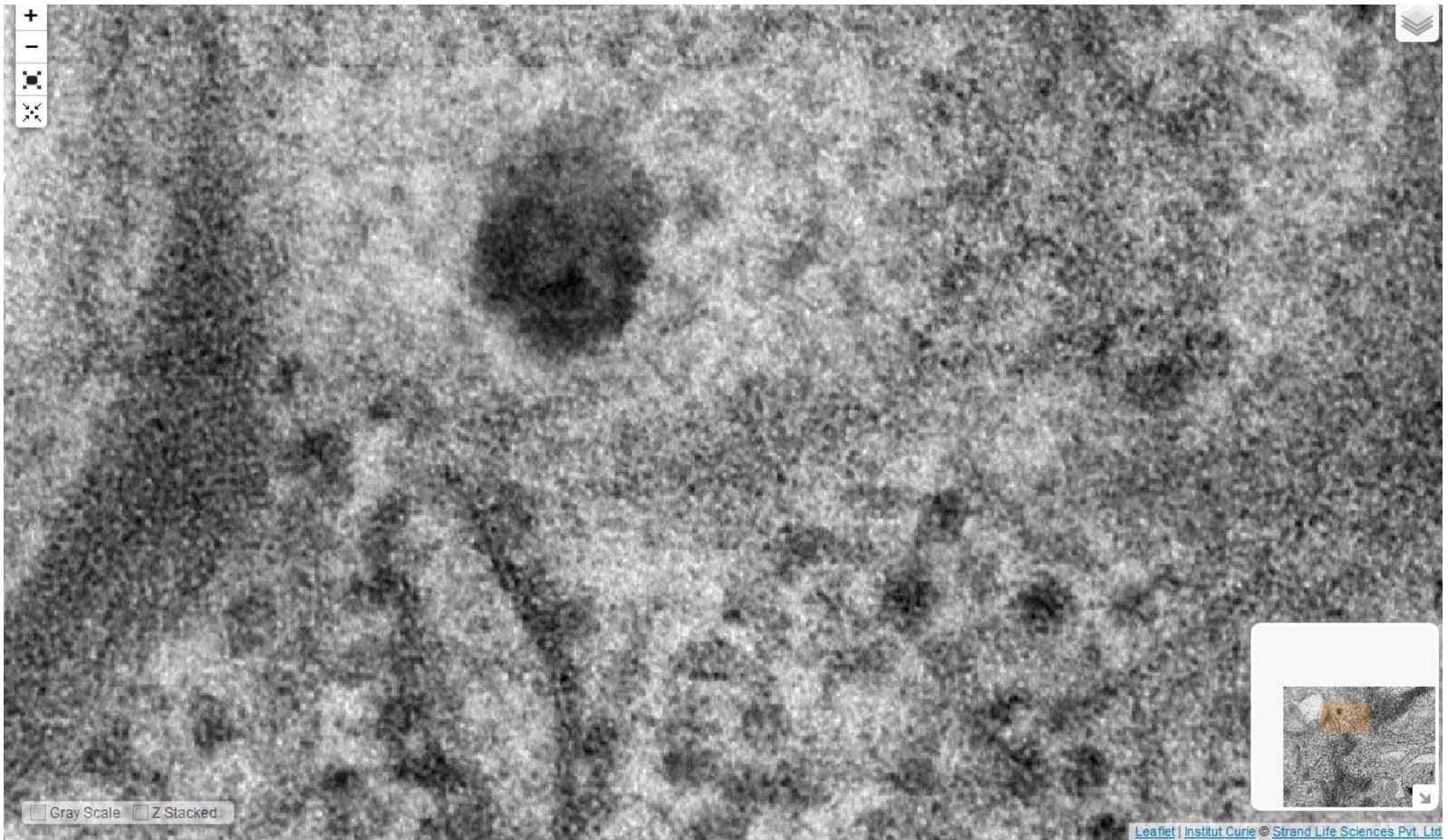
- 800 cores & 6TB compute Cluster
- 1 PB scalable & redundant storage
- High throughput network

**Big Data processing ready ! 😊**



# Exemple of additional clients: Tile Viewer for big data through a url invokation

Search: **imageWidth:[5000 \*]**



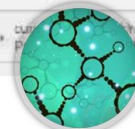


# Example of additional clients: RUBIES: specific for HCS data (compound libraries management etc., hits...) (WebLab based)

The screenshot displays a software interface for handling microscopy data. On the left, a grid of 15x15 microscopy images is shown, with columns 10 and 11 highlighted in yellow. Above the grid, a log shows successful downloads of well images (N13, B11, I6, C24). On the right, a 'Metadata Display Portlet' shows a list of image files and their associated metadata, including 'In well' and 'Wavelength' information. In the foreground, a UML class diagram illustrates the relationships between several classes:

- PieceOfKnowledge** (ComplexType): Contains a `data : anyType` attribute. It is associated with **Annotation** and **LowLevelDescriptor**.
- Annotation** (ComplexType): Associated with **PieceOfKnowledge** via an `annotation [0..*]` relationship and with **Resource** via an `annotation [0..*]` relationship.
- LowLevelDescriptor** (ComplexType): Contains a `data : anyType` attribute. It is associated with **PieceOfKnowledge** via a `desc [0..*]` relationship and with **Resource** via a `resource [1..*]` relationship.
- Resource** (ComplexType): Contains a `uri : anyURI` attribute. It is associated with **ComposedResource** via a `resource [1..*]` relationship.
- ComposedResource** (ComplexType): An abstract class or interface that **Resource** inherits from.

Dmitri Voitsechovitch



FRANCE-BIOIMAGING

# Organisation

Have access with different levels of rights

**Users**  
(administrator/Facility Staff,  
Team Leader, project  
Manager, Team Member)

**Active**  
**Suspended**  
**Deleted**

Access to records are  
defined by access to  
projects

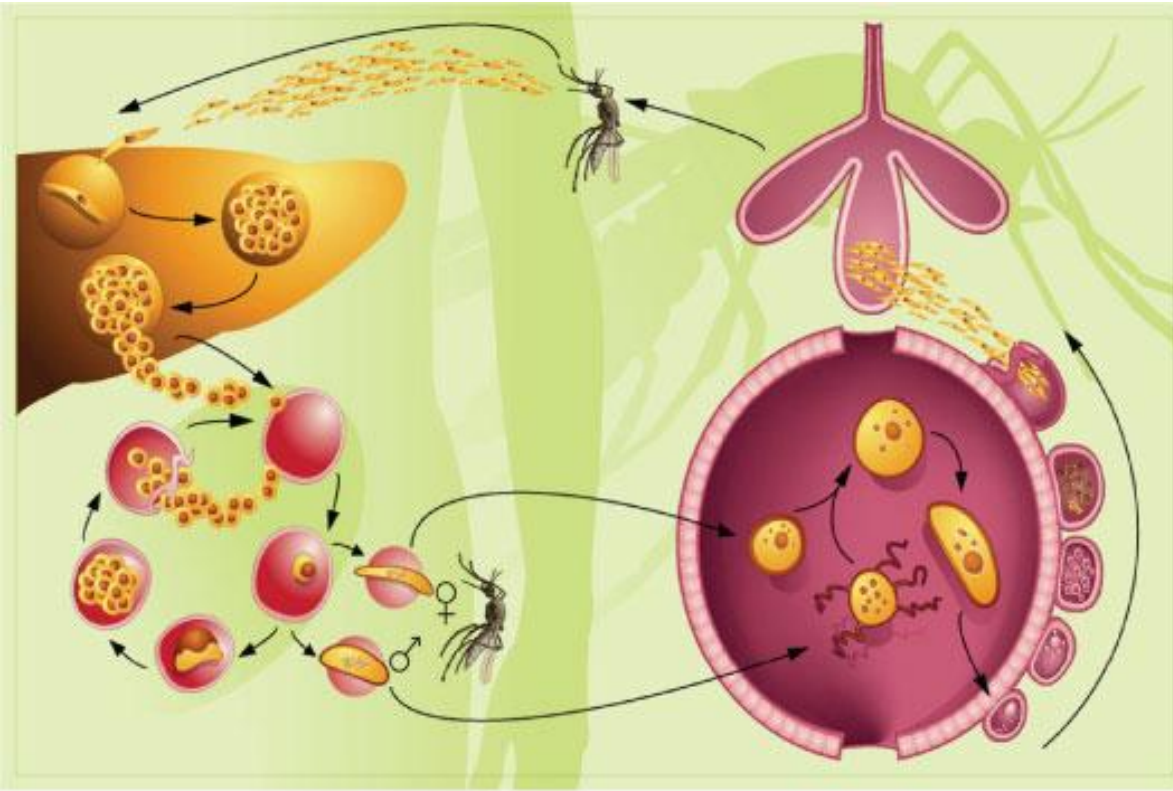
**Projects (=//  
rdf graphe  
nommé?)**

**Active**  
**Archived**

Are part of one or several  
projects (without  
duplication)

**Records (=imagedata)  
+Metadata, annotations,  
attachments+ history and  
links (SQL + noSql)**

# Example of on-going project (under submission).



## **Malaria parasite invasion in the mosquito tissues**

Gloria Volohonsky

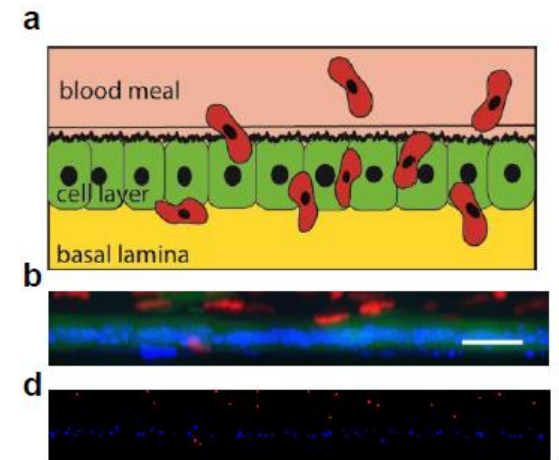
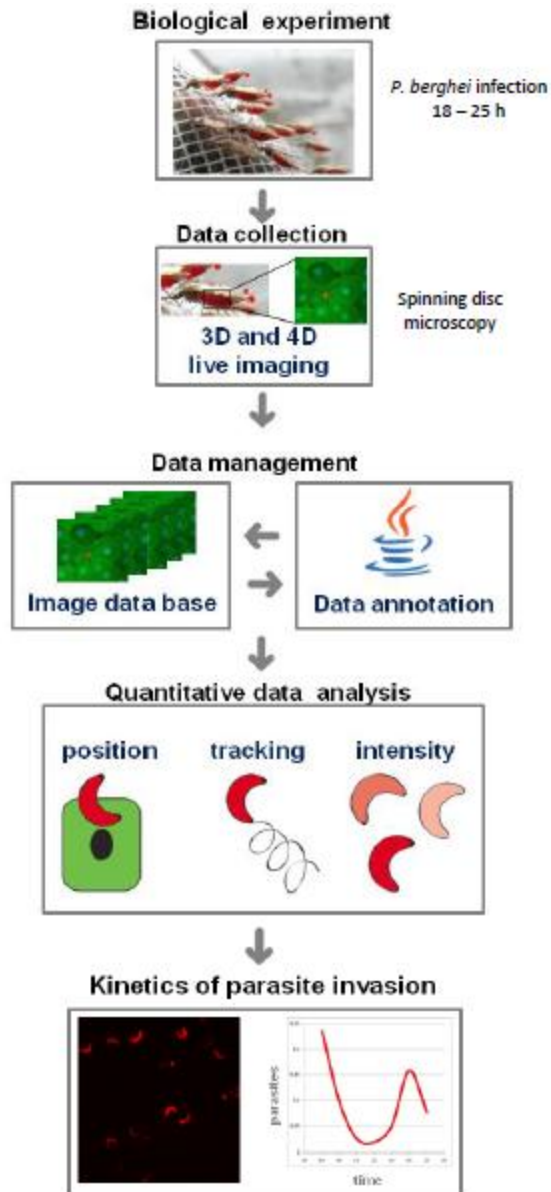
IBMC Anopheles group

Unistra

Elena Levashina

Max Planck Institute for  
Infection Biology

# malaria parasite invasion in the mosquito tissues



# Data are annotated

Perrine Gilleteaux

Launch Acquisition Administrator Settings Help

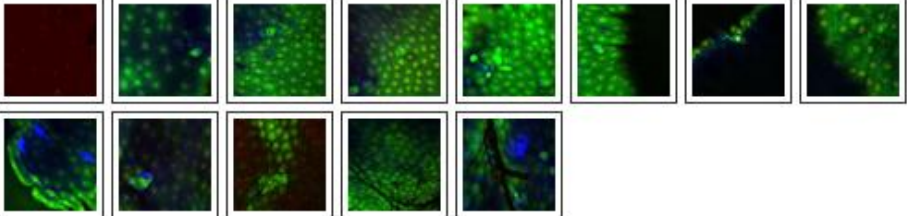
Reset Zoom Set Thumbnail Screenshot Results Actions Enter Query

parasite invasion in the  All Channels  Full Resolution Attachments

### Navigator

- ▼ Malaria parasite invasion in the mosquito tissues
  - ▶ mosquito (7B):36
  - ▼ mosquito (DSX):53
    - ▶ TPI (19):2
    - ▶ TPI (19.5):2
    - ▶ TPI (20):6
    - ▶ TPI (20.5):3
    - ▶ TPI (21):2
    - ▶ TPI (21.5):1
    - ▶ TPI (22):13
    - ▶ TPI (22.5):1
    - ▶ TPI (23):1
    - ▶ TPI (23.5):7
    - ▶ TPI (24-25):15
  - ▼ mosquito (G12):61
    - ▶ TPI (19):3
    - ▶ TPI (19.5):1
    - ▶ TPI (20):9
    - ▶ TPI (21):8

Thumbnail Fields



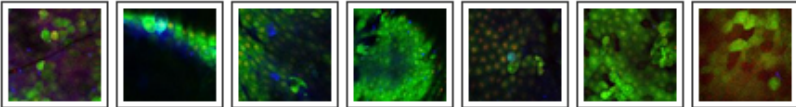
Apply Selection

# Data are annotated. Results of processing at the record level are uploaded by the processing algorithm

**Navigator**

- ▼ Malaria parasite invasion in the mosquito tissues
  - ▶ mosquito (7B):36
  - ▼ mosquito (DSX):53
    - ▶ NparasitesSemiManual (-8.70):22
    - ▶ NparasitesSemiManual (8.70-17.40):13
    - ▼ NparasitesSemiManual (17.40-26.10):8
      - ▶ Dextran (no):1
      - ▼ Dextran (yes):7
        - ▶ TPI (20):1
        - ▶ TPI (20.5):1
        - ▶ TPI (23.5):4
        - ▼ TPI (24.5):1
          - ▶ REVERSE ():1
      - ▶ NparasitesSemiManual (26.10-34.80):5
      - ▶ NparasitesSemiManual (34.80-43.50):2
      - ▶ NparasitesSemiManual (43.50-52.20):1
      - ▶ NparasitesSemiManual (60.90-69.60):1
      - ▼ NparasitesSemiManual (78.30-87.87):1
        - ▼ Dextran (yes):1

**Thumbnail** | **Fields**



**Apply Selection**

# Annotation automatically created are also be visual.

The screenshot displays the Avadis iMANAGE software interface. At the top, the user is identified as "Valentine de Villefort". The main navigation bar includes buttons for "Navigator", "Bookmark", "Search", "Workflows", "Tasks", "Downloads", and "Projects". On the right side of the top bar, there are buttons for "Launch Acquisition", "Settings", "Help", and "Logout". Below this, a secondary navigation bar contains "Annotate", "Download", "Share", "Transfer", and "Delete".

The left sidebar shows a thumbnail gallery for "Malaria Parasite Invasion Mosquito Tissues". The central image viewer displays a multi-channel microscopy image with blue, green, and red channels. Four green boxes highlight specific features labeled 1, 2, 3, and 4. The right sidebar contains a "History" panel with the following entries:

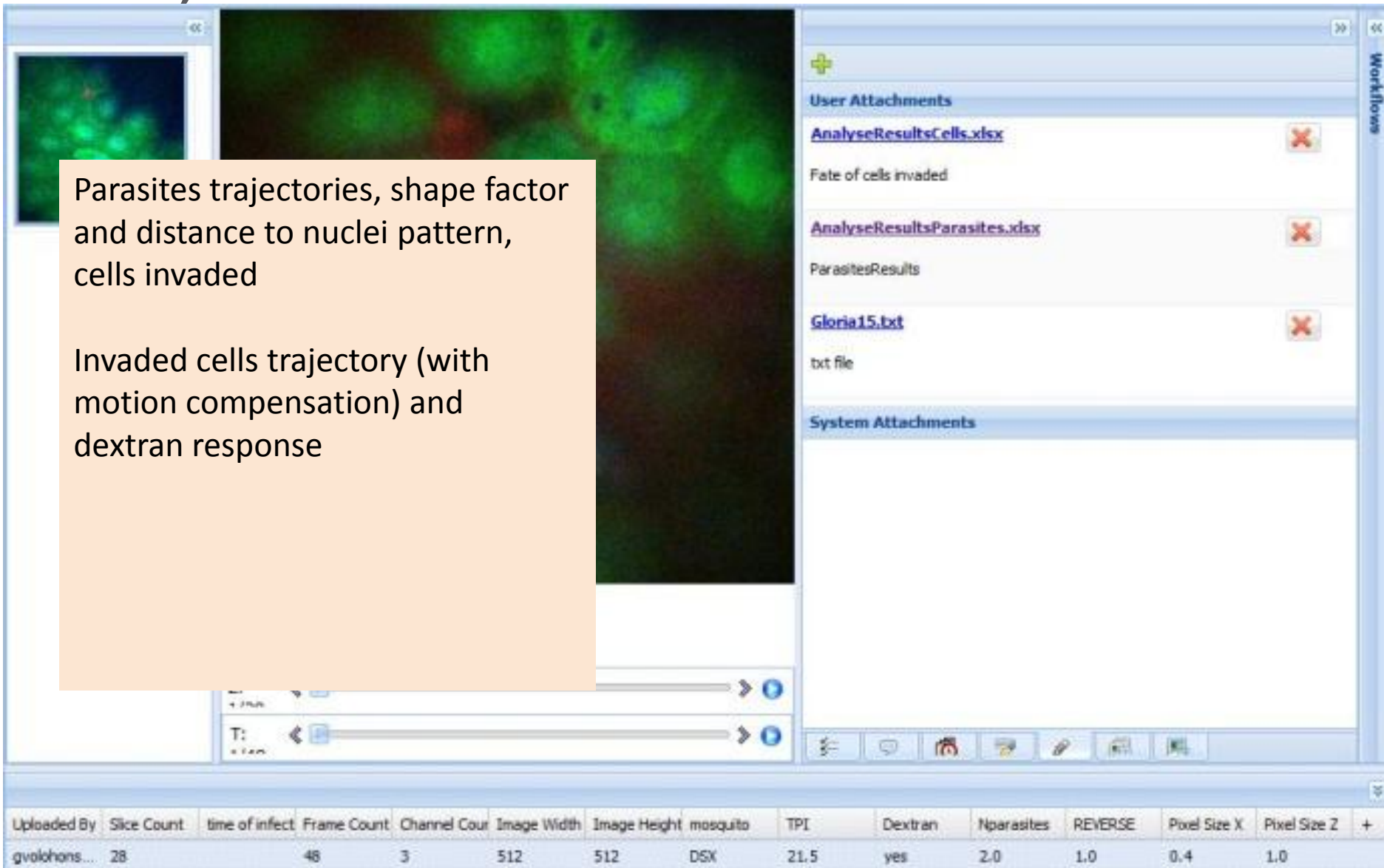
- User Annotation Added by Gloria Volohonsky**  
user annotation (Dextran, no) is added by gvlohonsky on record 1771  
3/27/13 9:32 AM
- User Annotation Added by Gloria Volohonsky**  
user annotation (TPI, 22.5) is added by gvlohonsky on record 1771  
3/27/13 9:32 AM
- User Annotation Added by Gloria Volohonsky**  
user annotation (mosquito, G12) is added by gvlohonsky on record 1771  
3/27/13 8:58 AM
- Task Executed by Facility Administrator**

The bottom of the interface shows a "Page 451 of 4586" indicator and a "User Annotation" section. The central image viewer also displays "Z: 19/47" and "T: 10/120" coordinates.

# Information at the object level (here parasites and cells)

Parasites trajectories, shape factor and distance to nuclei pattern, cells invaded

Invaded cells trajectory (with motion compensation) and dextran response



The screenshot displays a software interface for microscopy data analysis. The main window shows a large microscopy image of cells with green and red fluorescence. A smaller thumbnail of the same image is visible in the top-left corner. On the right side, there is a 'User Attachments' panel containing three files: 'AnalyseResultsCells.xlsx', 'AnalyseResultsParasites.xlsx', and 'Gloria15.txt'. Below this panel is a 'System Attachments' section which is currently empty. At the bottom of the interface, there is a table with various parameters for the data set.

Uploaded By	Slice Count	time of infect	Frame Count	Channel Cour	Image Width	Image Height	mosquito	TPI	Dextran	Nparasites	REVERSE	Pixel Size X	Pixel Size Z	+
gvolkhons...	28		48	3	512	512	DSX	21.5	yes	2.0	1.0	0.4	1.0	



# Example of analysis: proportion of parasites crossing the cell layer against time post infection

Script in Matlab: surface fitting by a global 3rd degree polynomial in x and Y of the nuclei position to re expressed all parasites coordinates relatively to the cell layer

```
ispace.login(true,Server,443,AppID, password); CONNECTION
```

```
projectList = ispace.getActiveProjects(); SEARCH DATA
```

```
is=ImageSpaceObject.getImageSpace();
```

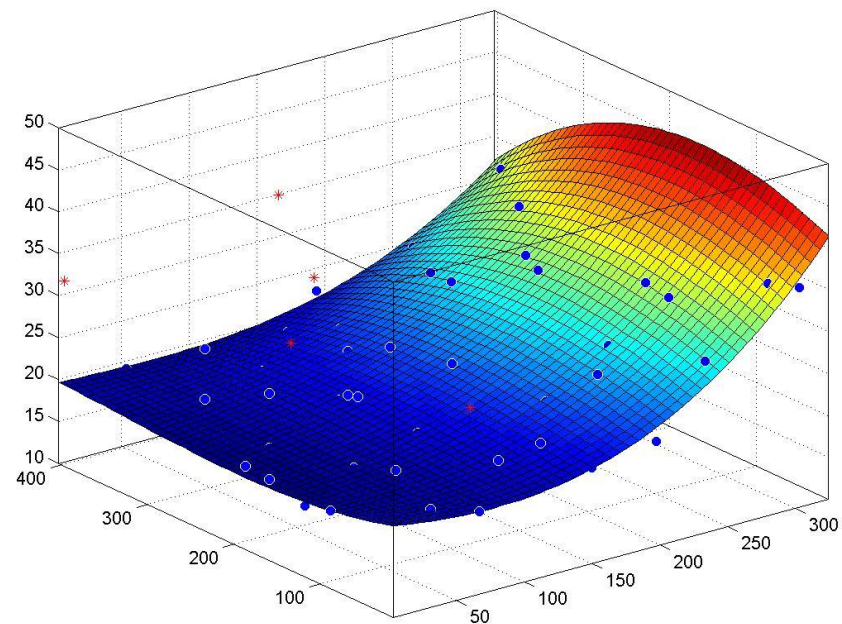
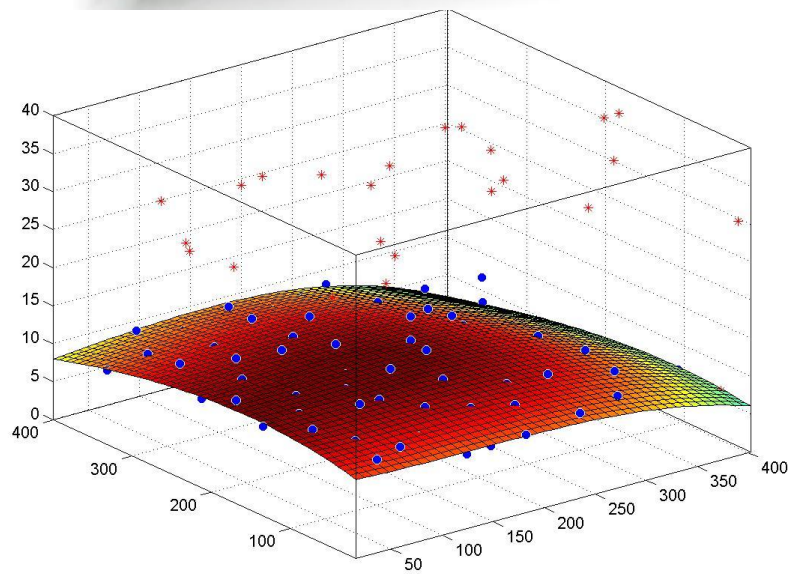
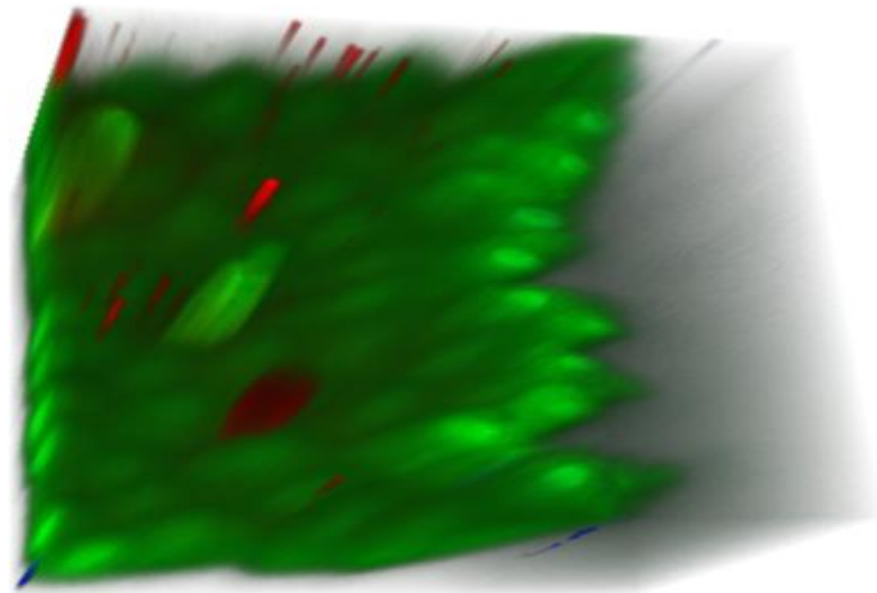
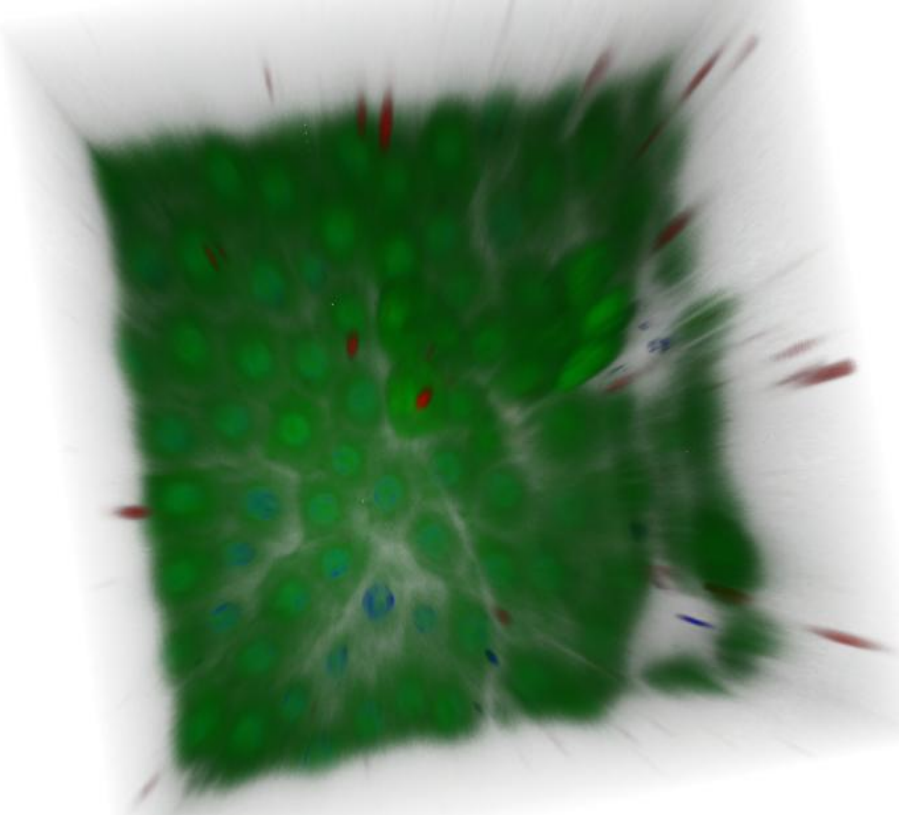
```
projectSpecGuids=is.search('DSX', 'Malaria parasite invasion  
in the mosquito tissues', conditions, 100);
```

```
for i=1:length(projectSpecGuids) GET DATA AND PROCESS DATA
```

```
test=rec.getAttachments();
```

```
Upload Results and fill History
```

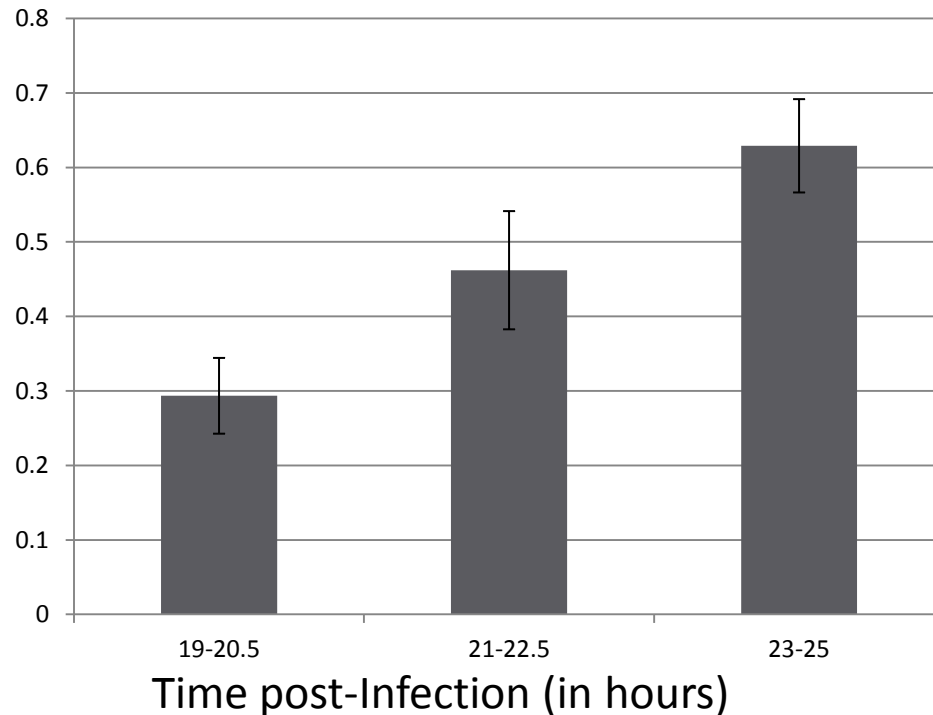
```
end
```



## Example of request done from Matlab to the database: for Anopheles Gambiae (DSX)

Probability that the parasites can NOT cross the midgut epithelial tissue

computed as the ratio of parasites not having crossed (inside or under the cell layer) against total number of parasites)



Once ready for publication: Making the dataset public or creating an account for reviewer:

**Administration** ✕

**Projects** ✕

Projects | Memberships | Team-Project Association | User Annotations

Choose Project:  ▾

**Members**

|  |  |  |

User	Project	Role
gvolohonsky	Malaria parasite invasion in the mosquito tissues	Manager

**Add Member**

User:  ▾

Role:  ▾

# Questions ouvertes

## -L'interopérabilité plutôt que la centralisation

Interopérabilité déjà possible (standardisation de la définition des ROI, API commune (proposition faites de webservices 'de traduction', web sémantique pour inférer les demandes: ex requete: image reponse image et api dispos) inférence de type?.

## - Intégration de données hétérogènes:

Un seul serveur ou des bases liées par API?  
client tiers de liage (Exemple projet Shiva KDI Bioinfo Curie)

- Réduction des volumes: Données à conserver?  
Nouveaux formats éparses? Nouveaux format de compression?

# Acknowledgments

**Conception et spécifications :CID iManage PICT IBISA Curie, Curie IT department, Strand Life sciences**

**Plugins add ons: Pict IBISA, Serpico INRIA**

**Funding: France Bioimaging, Cancéropole Ile de France.**

**Réseaux: France BioImaging (Bio Image Informatics Node (ex IPDM)), EUBIAS/ BIAS, RtMFM/MIFOBIO, GDR2588, EuroBioimaging/EuLife, Réseau RBDD**

## Need (1/2)

### **No image data conversions, no duplication**

- Uploads data to a secure server in the original format
- Unique id for data (check sum like)

### **Supports sharing and collaboration with access control**

- Allows users to upload, view, update or download data based on their access privileges

### **Supports multiple ways of attaching meta-information**

- Annotations, comments and file attachments
- Analysis results as query-able visual objects

- **Supports Archiving** (data moving to another long-term storage but still searchable)

## Need (2/2)

### **Facilitates custom visualization and analysis**

- Access data from preferred analysis and visualization tools
- Access relevant bits of data to build efficient web and mobile Applications

### **Facilitate quota of storage and facility administration**

### **Facilitate easy access to analysis and visualization applications hosted on other servers**

- Run analysis on dedicated compute clusters
- Access applications hosted and published by other users

### **Highly Scalable**

- Supports on-the-fly addition of server nodes to scale concurrent usage