

Organize your image data with OMERO

First Steps with OMERO

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Outline

- What is OMERO?
- Access the OMERO system
 - Desktop client OMERO.Insight
- In the web browser

Getting images into OMERO

- Data organization in OMERO
 - Projects
 - Datasets
 - Images
 - Tags
 - Key-value pairs

Learning Objectives

After completing this lecture, you will have understanding of

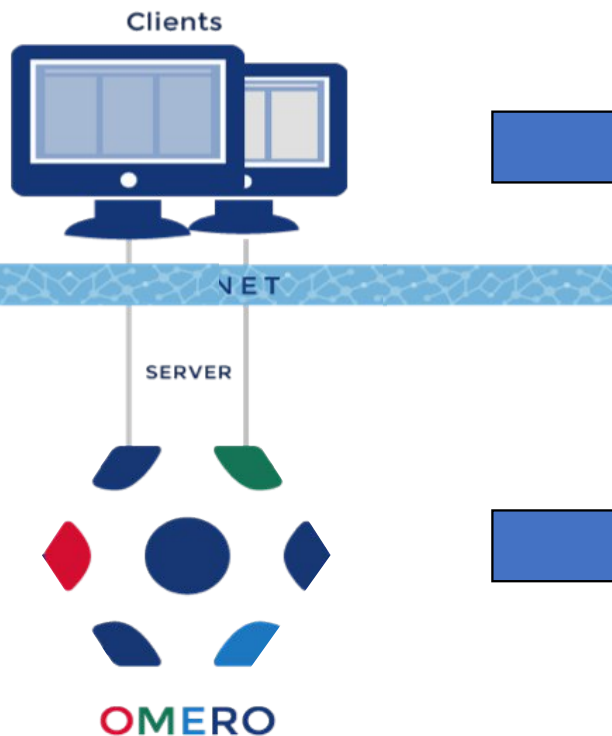
- How to login to OMERO using the desktop client or the web browser
- The various panels and their functions in OMERO
- How to browse images and open images in a viewer
- How to import images from your desktop into OMERO
- How data is organized into
 - Projects
 - Datasets
 - Images
- The role of Tags and Key-Value pairs in OMERO

What is OMERO?

OMERO: An open-source software for image data management

OMERO = „OME Remote Objects“

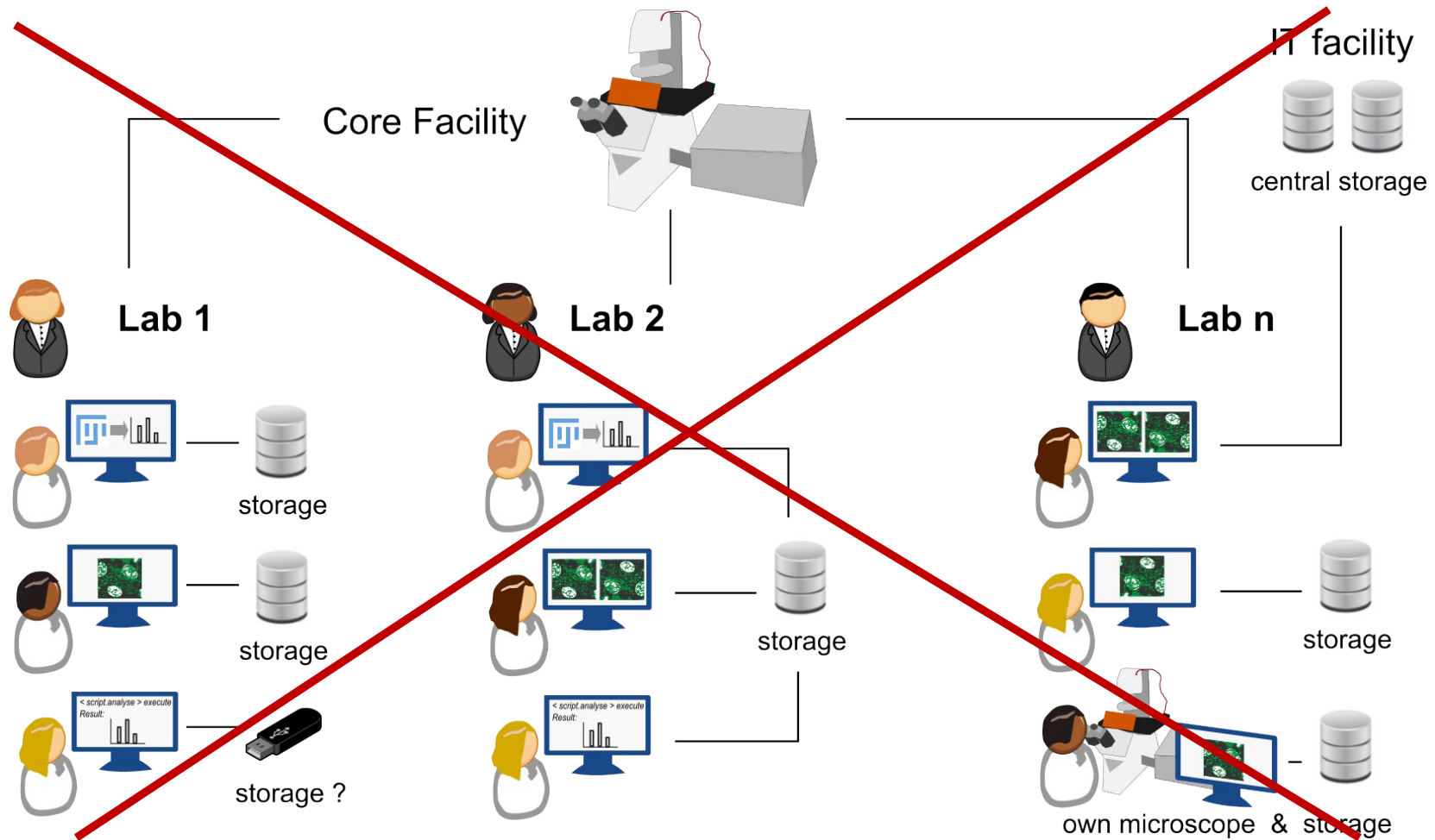
Created by the **O**pen **M**icroscopy **E**nvironment Consortium (OME)



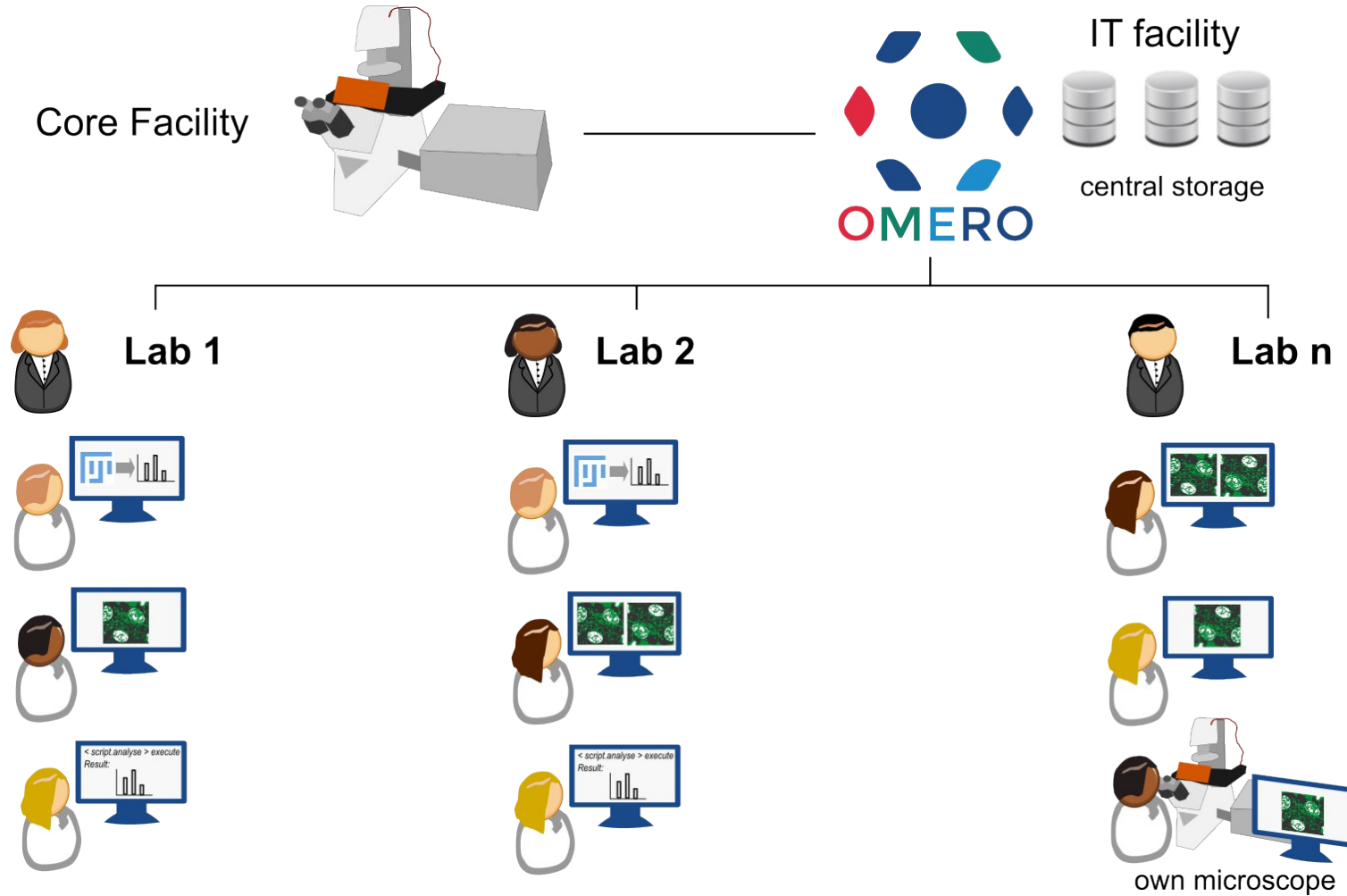
- User computer
- Microscope computer
- Processing / analysis server

- Installed on an institute or central IT server
- Storage and handling of imaging data
- Accessible from outside via „clients“

From isolated data silos...



... to centralized, structured data management



OMERO at the MPI for Evolutionary Biology

Service provided for all institute affiliates by the IT DEPARTMENT

Get your account & log in with your user credentials (MPI Username/Password)

web access: <https://ome.evolbio.mpg.de>

Use OMERO

- for yourself
- with your group
- with collaboration partners
- ***from the intranet or via***

VPN

Enter your user name
& password



OMERO.web 5.11.0.

© 2007-2021 University of Dundee & Open Microscopy Environment
OMERO is distributed under the terms of the GNU GPL. For more information, visit openmicroscopy.org
Download OMERO.insight for [Mac OS X](#), [Windows](#), [Linux](#)



Advantages of using OMERO

- **Organize** your original image files in a central storage location
 - Unique IDs for images; data can be linked via IDs
 - View your images, add annotations, tags, and comments to your images
- **View & explore** images, and adjust, save and share visualization settings
 - Create publication-ready figures connected to original image files
- **Export** image data to different formats
- **Analyze** image data
 - Built-in analysis functions
 - Connect to popular image analysis software like Fiji or Napari
- **Share** your data with colleagues
- and more...

Log in and look around

Two ways of connecting to the OMERO server as a user

„OMERO.insight“ client

OR

„OMERO.web“ client

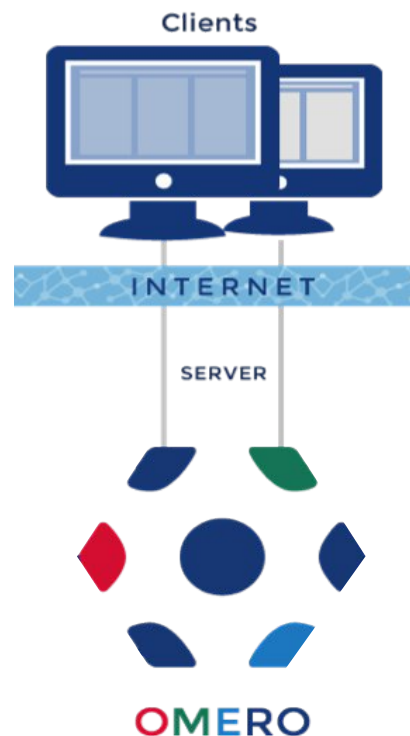
both clients offer similar functionalities

Desktop client

- Installed by the user on a local computer
- *Recommended for:*
 - Importing data into OMERO
 - Importing metadata

Browser-based web-client

- Access OMERO in your webbrowser
- *Recommended for:*
 - Visualizing data
 - Analyzing and managing data
 - Annotating data (e.g., with tags)
 - Running scripts
 - *It is not used to upload data!*




Adapted from <https://omero.readthedocs.io/en/latest/users/index.html>
More information on clients: <https://omero.readthedocs.io/en/latest/users/clients-overview.html>

Connecting with OMERO.insight 1/3

1. Install the „OMERO.insight“ client:


<https://www.openmicroscopy.org/omero/downloads/>

2. Open „OMERO.insight“ on your computer

3. Click on the wrench icon  to open the server settings list

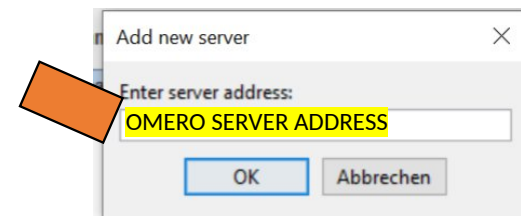
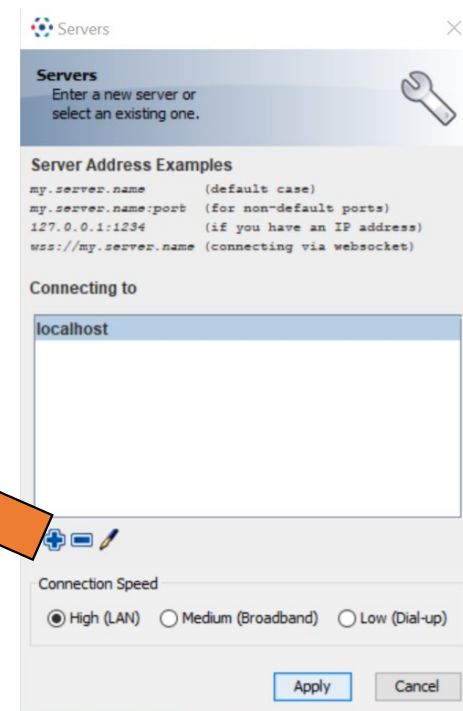


Connecting with OMERO.insight 2/3

4. Click the  symbol to add a new server to the list

5. Enter your OMERO-server address

At the MPI: **ome.evolbio.mpg.de**



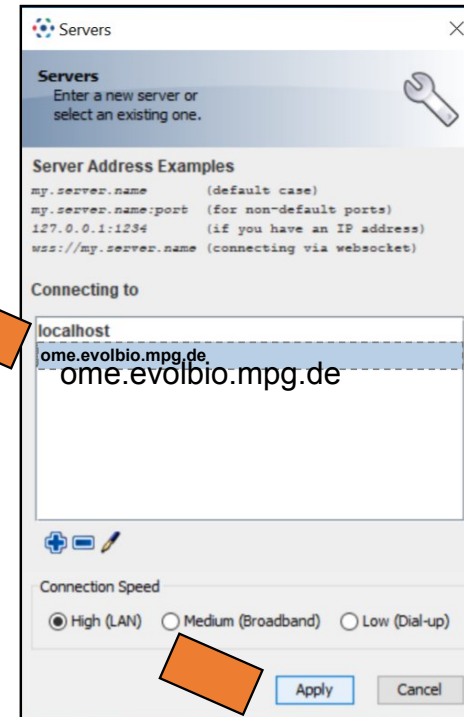
Connecting with OMERO.insight 3/3

4. Check the server address in the list and click „Apply“

5. Enter your MPI username and password to login

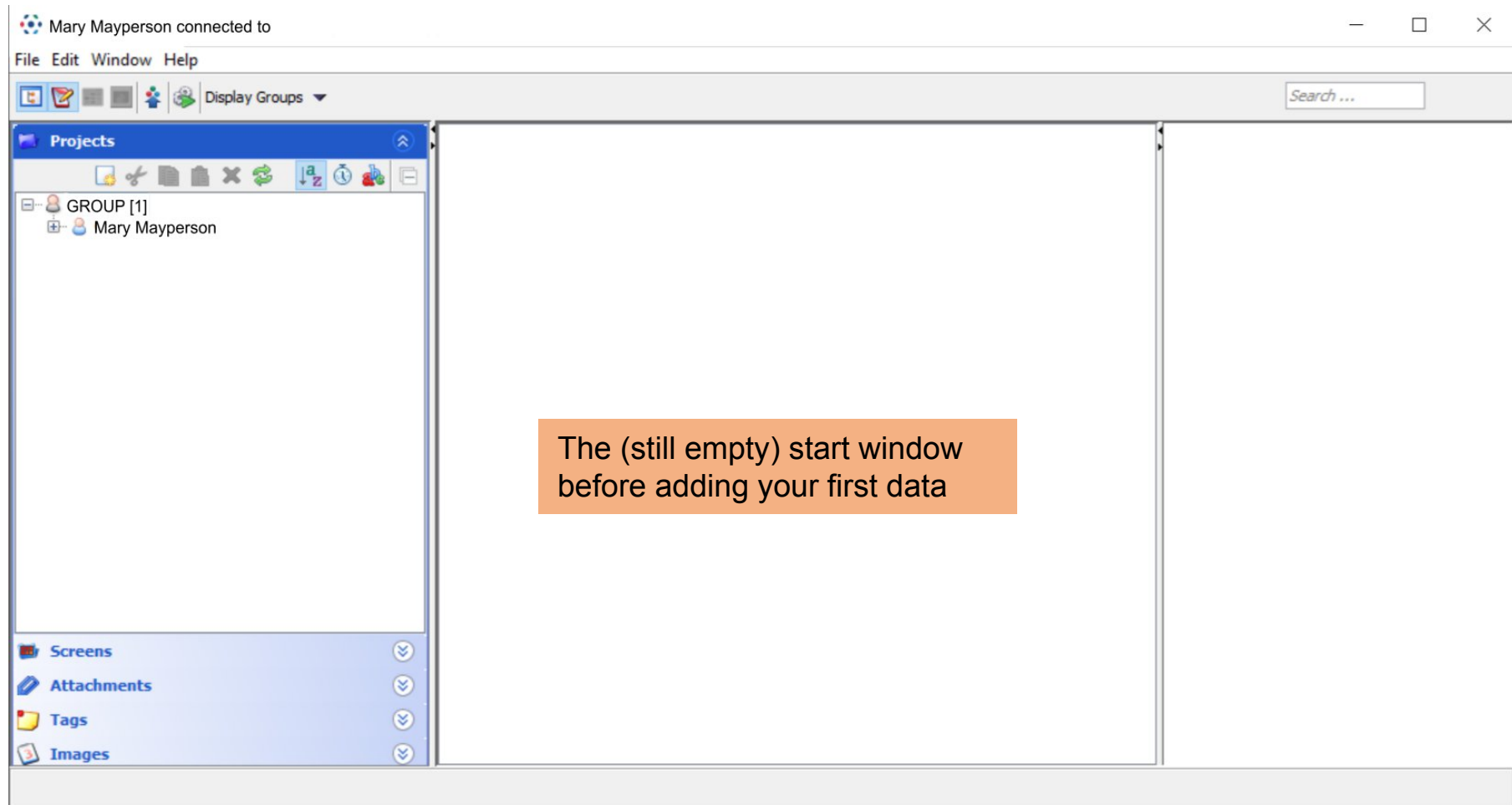


The screenshot shows the OMERO.insight login interface. At the top is the OMERO.insight logo. Below it, there is a text input field containing 'ome.evolbio.mpg.de' with a lock icon to its right. An orange rectangle highlights this field. Below the server address field are two input fields: 'Username: myusername' and 'Password: *****'. Below these are 'Login' and 'Quit' buttons. At the bottom, there is a version number '5.7.0' and a footer text: 'OMERO is distributed under the terms of the GNU GPL. For more information, visit openmicroscopy.org'. The OME logo is at the very bottom.



The screenshot shows a 'Servers' dialog box. It has a title bar with a close button. Inside, there is a section 'Servers' with the text 'Enter a new server or select an existing one.' and a wrench icon. Below this is a section 'Server Address Examples' with the following text: 'my.server.name (default case)', 'my.server.name:port (for non-default ports)', '127.0.0.1:1234 (if you have an IP address)', and 'wss://my.server.name (connecting via websocket)'. Below the examples is a section 'Connecting to' with a list box containing 'localhost', 'ome.evolbio.mpg.de', and 'ome.evolbio.mpg.de'. An orange rectangle highlights the list box. Below the list box are icons for adding, removing, and editing servers. Below these icons is a section 'Connection Speed' with three radio buttons: 'High (LAN)' (selected), 'Medium (Broadband)', and 'Low (Dial-up)'. An orange rectangle highlights the 'High (LAN)' radio button. At the bottom are 'Apply' and 'Cancel' buttons.

OMERO.insight client: first log-in



Assignment

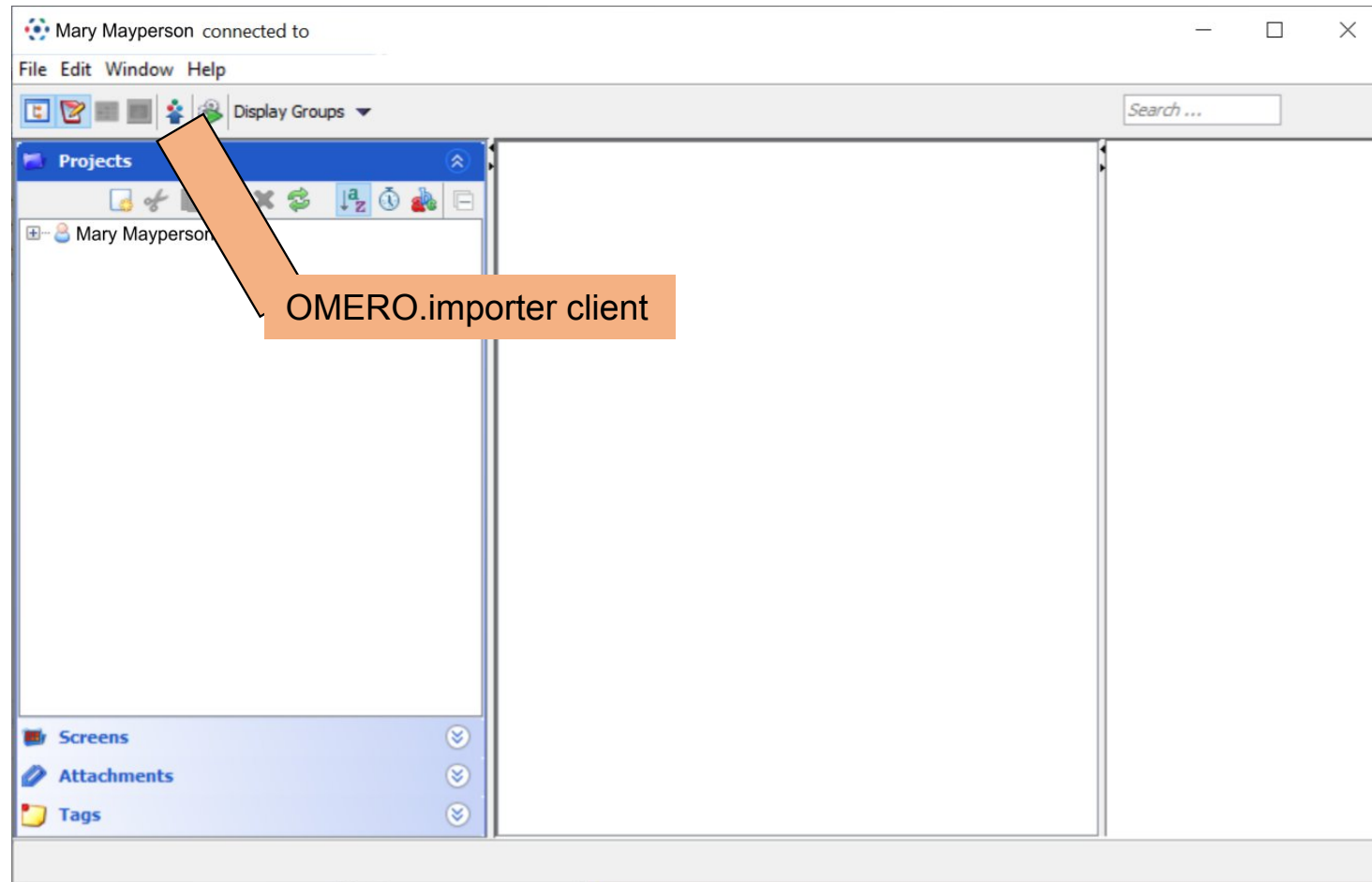
- 1) Launch OMERO.insight
- 2) Configure the server settings, remove the “localhost” server
- 3) Connect to OMERO with your MPI Username and Password
- 4) Which Group are you in? Which other Groups can you see?
- 5) Give feedback: How do you feel about the appearance of OMERO.insight?

Upload data to OMERO using OMERO.importer 2/7

3) Open
OMERO.importer client
by clicking on the
icon



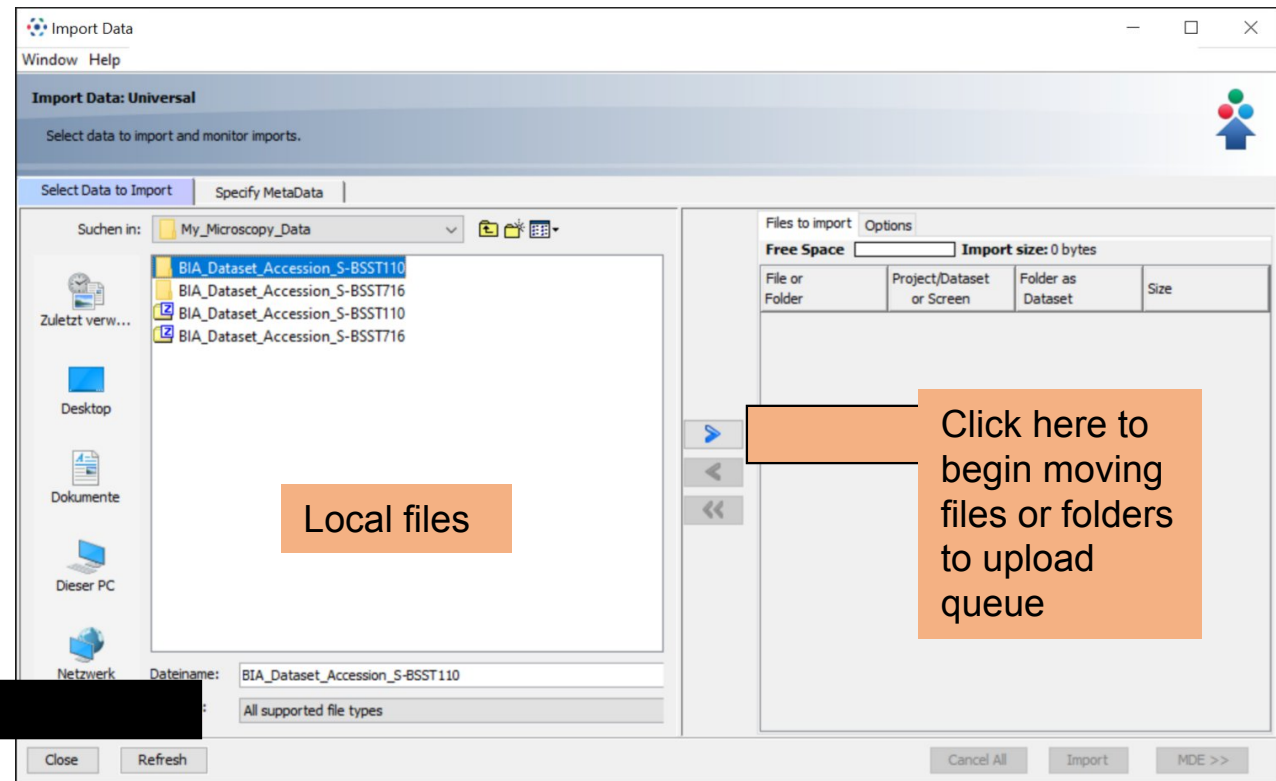
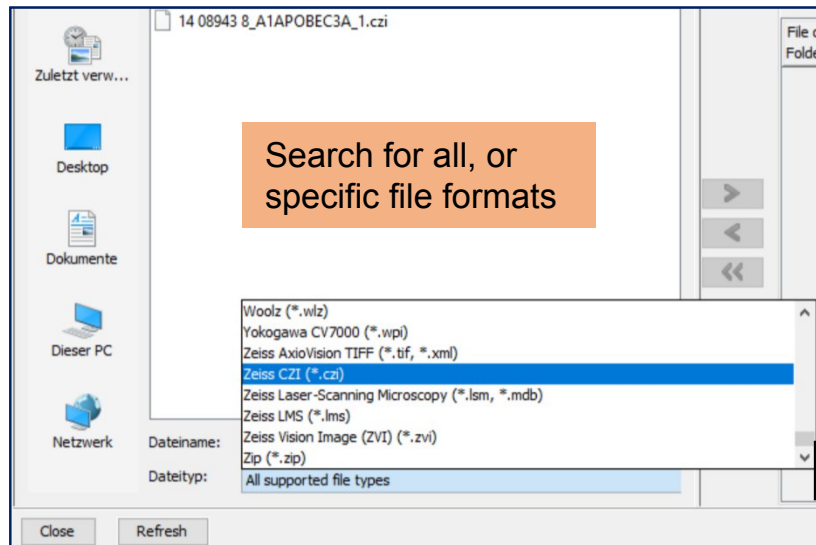
(OMERO importer is
integrated into
OMERO.insight)



Upload data to OMERO using OMERO.importer 3/7

4) Navigate through the file browser, which shows your local file organization, to find the data for upload

- individual files
- folders



Example Data: <https://www.ebi.ac.uk/biostudies/BiolImages/studies/S-BSST110> (Barry et al., *Clin Cancer Res*, doi:10.1158/1078-0432.CCR-17-3374)

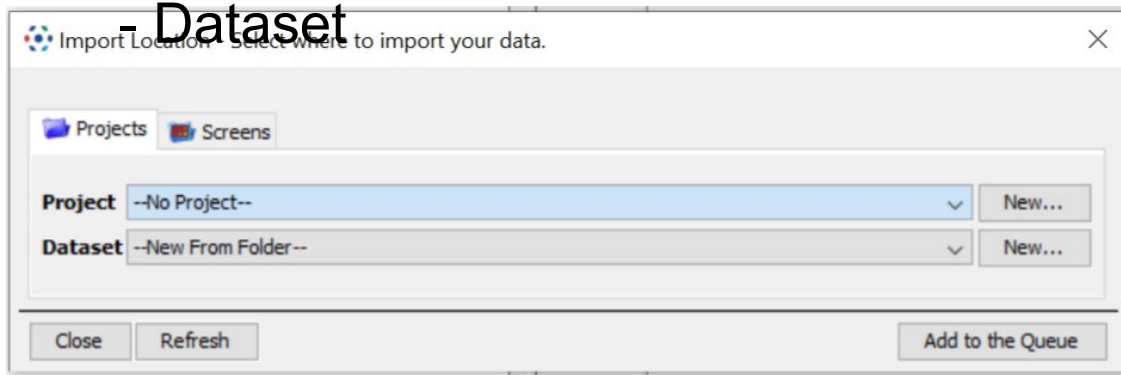
Upload data to OMERO using OMERO.importer 4/7

5) After you have clicked , choose the upload destination (or create

„New“)

- Project

- Dataset



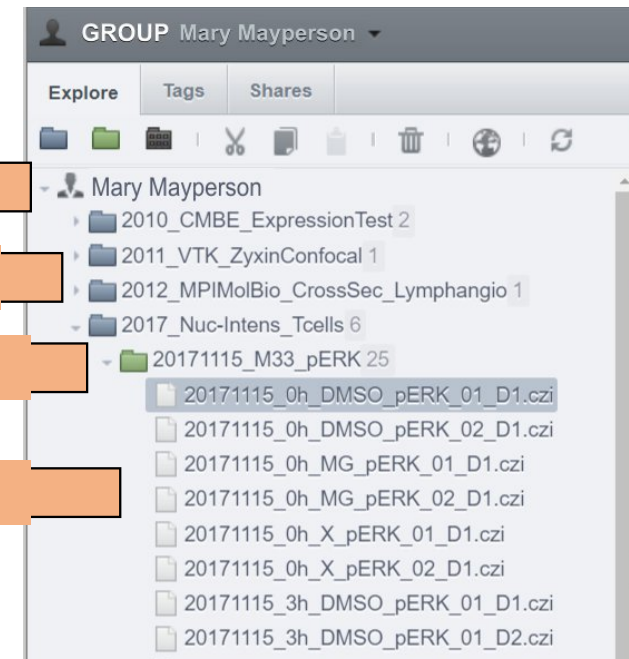
Reminder: This is how the data tree is organized in OMERO.web (this screenshot is not part of the upload process)

user/group

Project (blue)

Dataset (green)

Image(s) (grey)

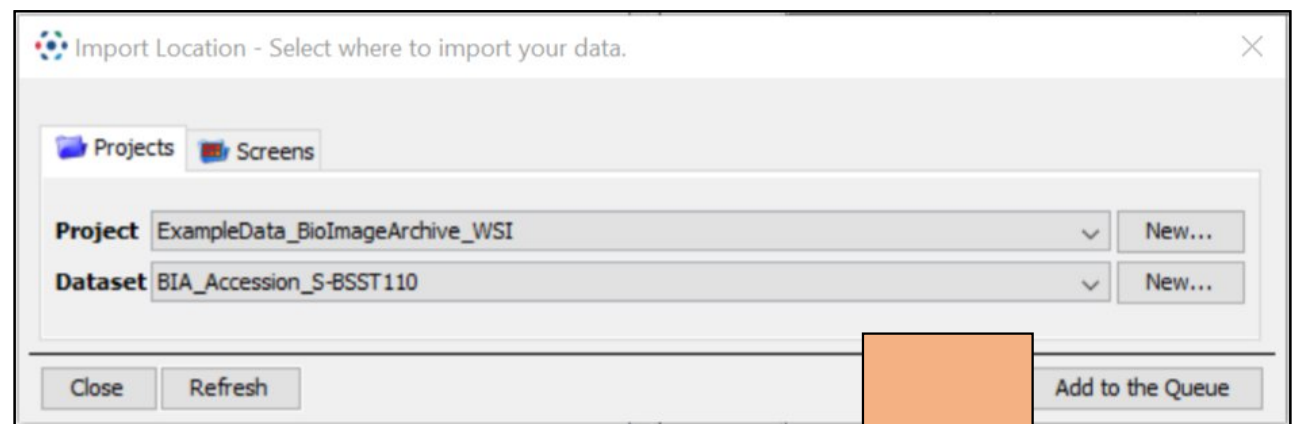
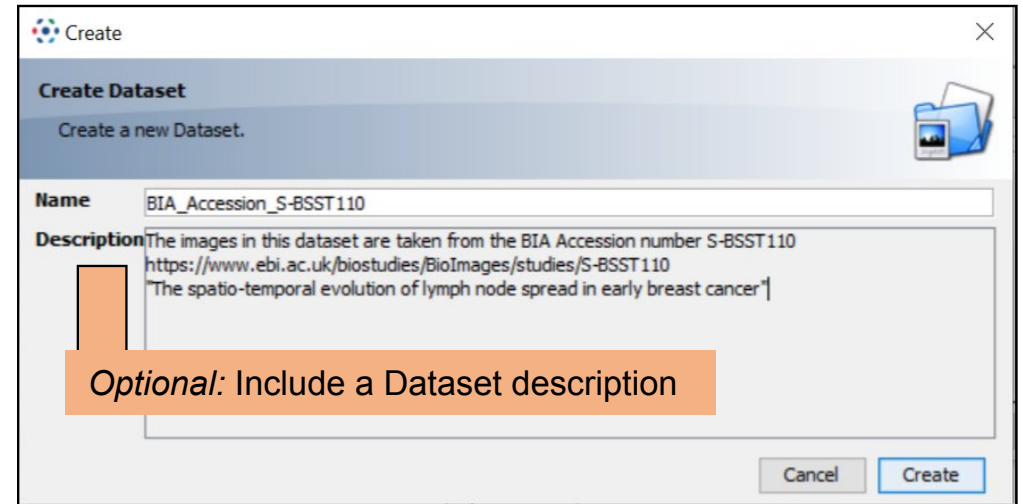


Upload data to OMERO using OMERO.importer 5/7

Example: Upload of data with the creation of a new Project and a new Dataset

(This example data was downloaded from the BioImage Archive)

Click Add to the Queue to finish this step.



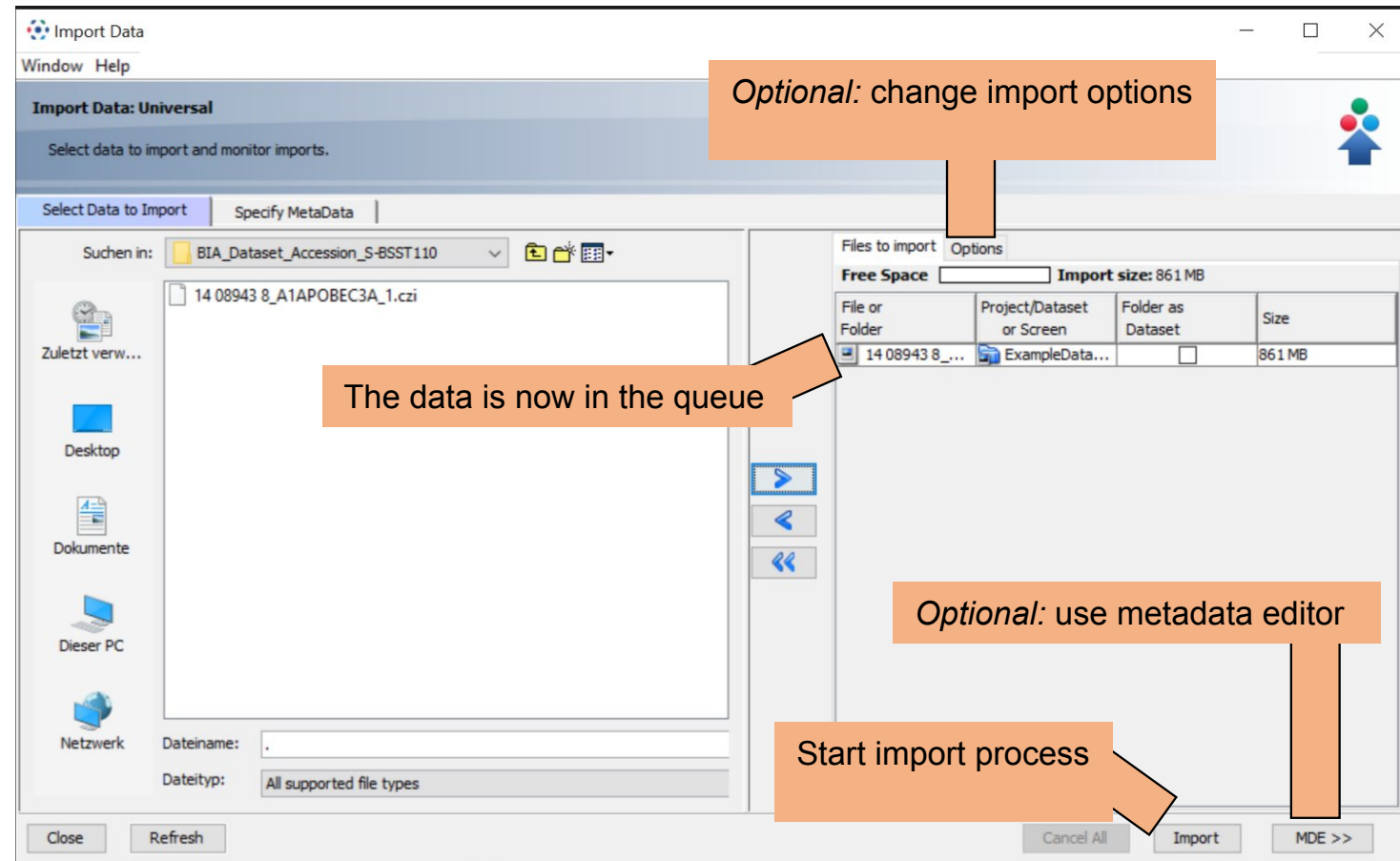
Upload data to OMERO using OMERO.importer 6/7

6) The dataset or file is now in the import queue;

Optional:

- Change import options
- Use metadata editor

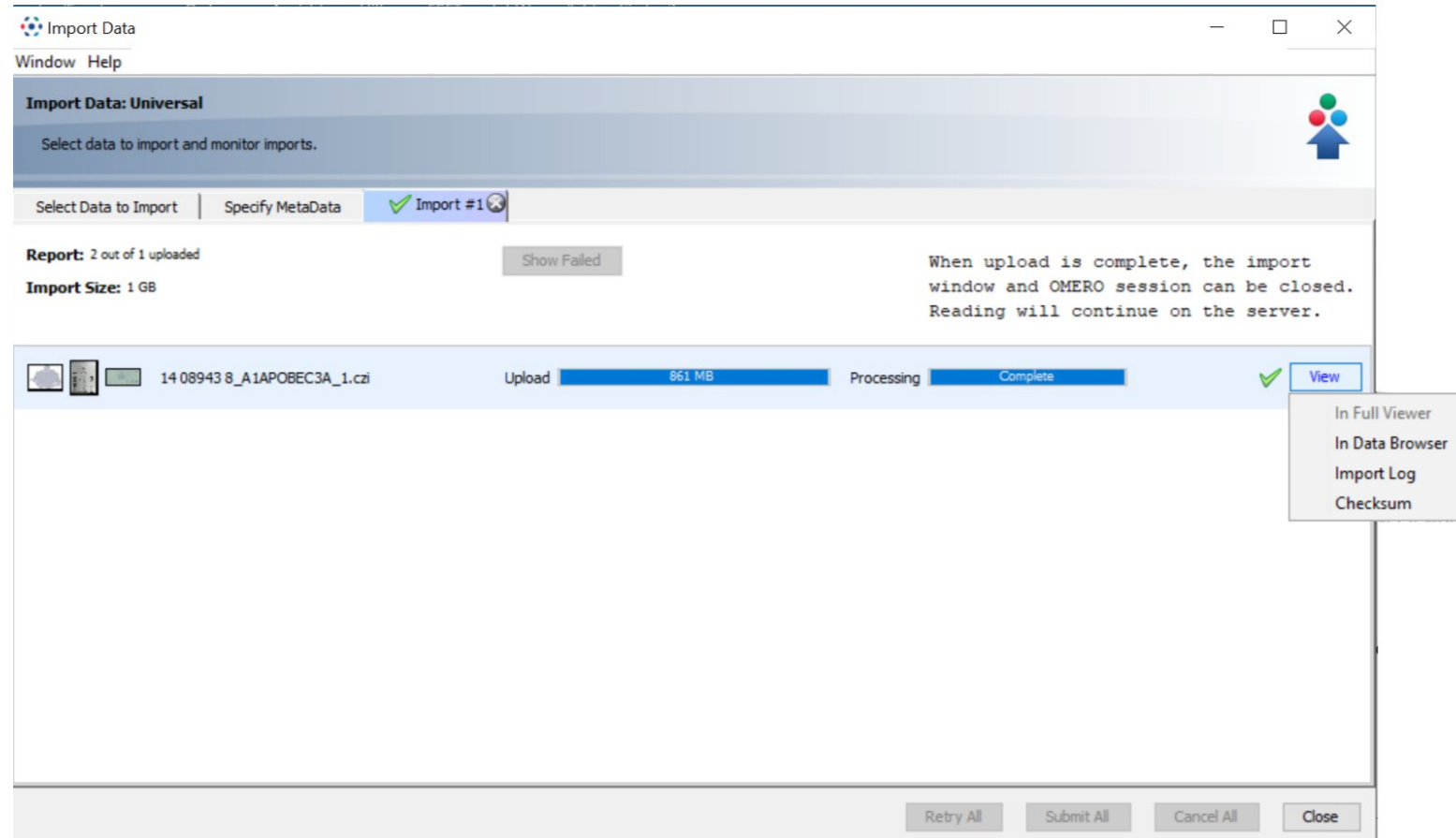
You can start the import



Upload data to OMERO using OMERO.importer 7/7

6) Monitor the upload status and success

Close OMERO.importer and inspect the files with OMERO.insight or OMERO.web



Assignment

In OMERO.Insight:

- 1) Create a new OMERO Project named “OMERO-Training”
- 2) In the new Project, create a new OMERO Dataset named “Example-01”
- 3) Copy the directory */mpistaff/OMERO-Training/Datasets/Example-01* to your PC
- 4) Upload the two images into the new Dataset
- 5) Confirm images ended up in the right location
- 6) Repeat steps 3-5 with */mpistaff/OMERO-Training/Datasets/Example-02* **but this time** create the Dataset using the “Create from folder” option
- 7) Query the following information from the image metadata:
 - 1) Image size (x-y pixels, number of z stacks, number of timepoints, number of channels)
 - 2) Pixel size (in micrometer)
 - 3) Number of channels
- 8) Discuss: Is it safe to delete the local data (the data you downloaded in step 3)? Why is it **recommended**?

Elements of the OMERO user interface(s)

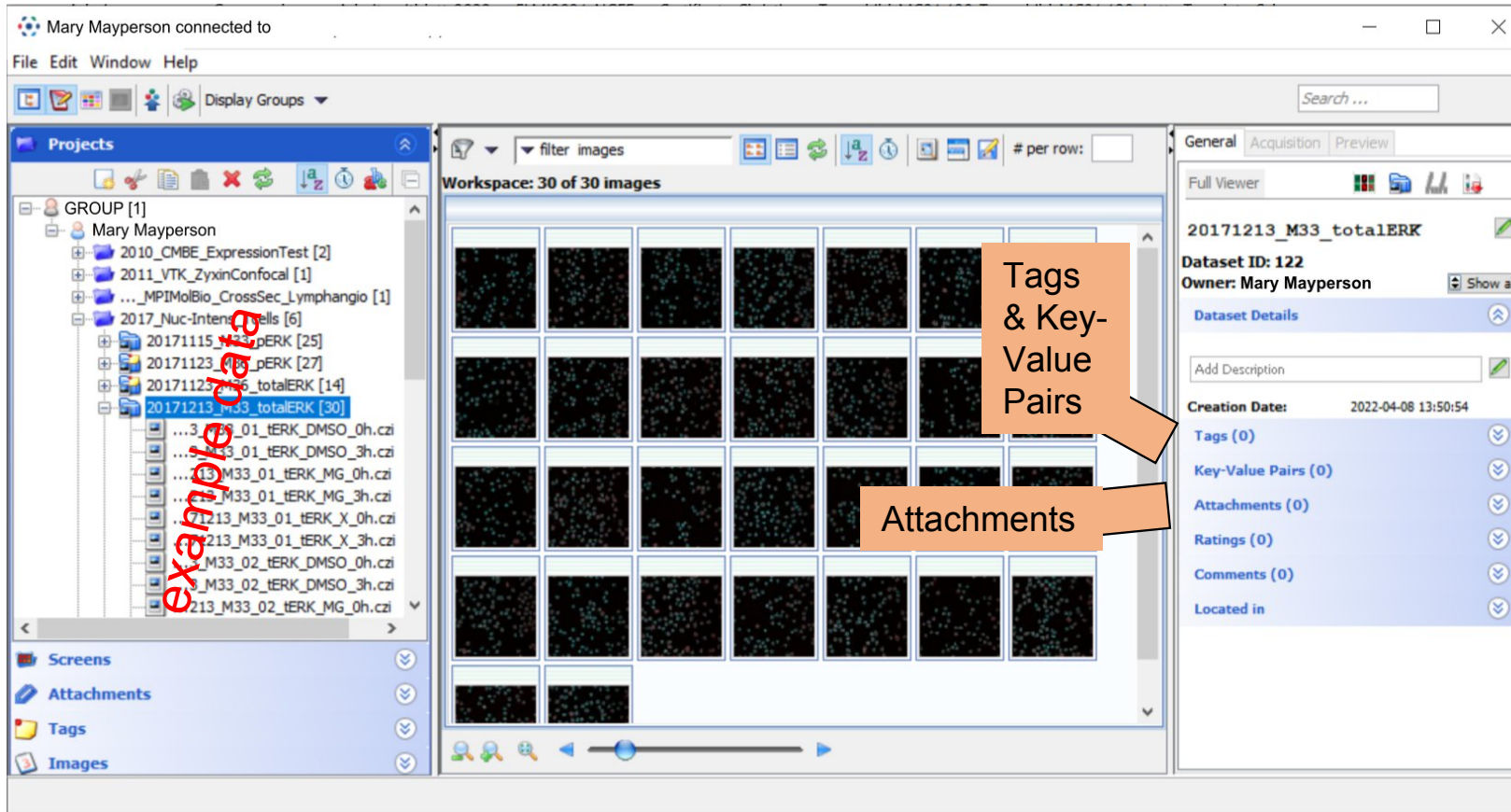
OMERO.insight client: overview

The screenshot shows the OMERO.insight client interface. The top menu bar includes File, Edit, Window, and Help. Below it is a toolbar with various icons. The left sidebar contains a 'Projects' panel with a tree view of the data hierarchy. The main workspace displays a grid of 30 image thumbnails. The right sidebar shows the 'General' tab with dataset details for '20171213_M33_totalERK'.

Annotations:

- Data tree**: Points to the 'Projects' panel on the left.
- Hierarchy:**
 - user/group
 - project(s)
 - dataset(s)
 - image(s)
- Display settings and image import using the integrated OMERO.importer**: Points to the top toolbar.
- Thumbnail preview of images in the dataset**: Points to the grid of image thumbnails in the workspace.
- Information on your data(set) and metadata**: Points to the 'General' tab on the right sidebar.

OMERO.insight client: overview



- Use OMERO.importer 
- Run scripts 
- Annotate
 - during import
 - after import
- Organize projects, datasets and images
- Download and export
- Attachments
- Visualization

Connecting with OMERO.web

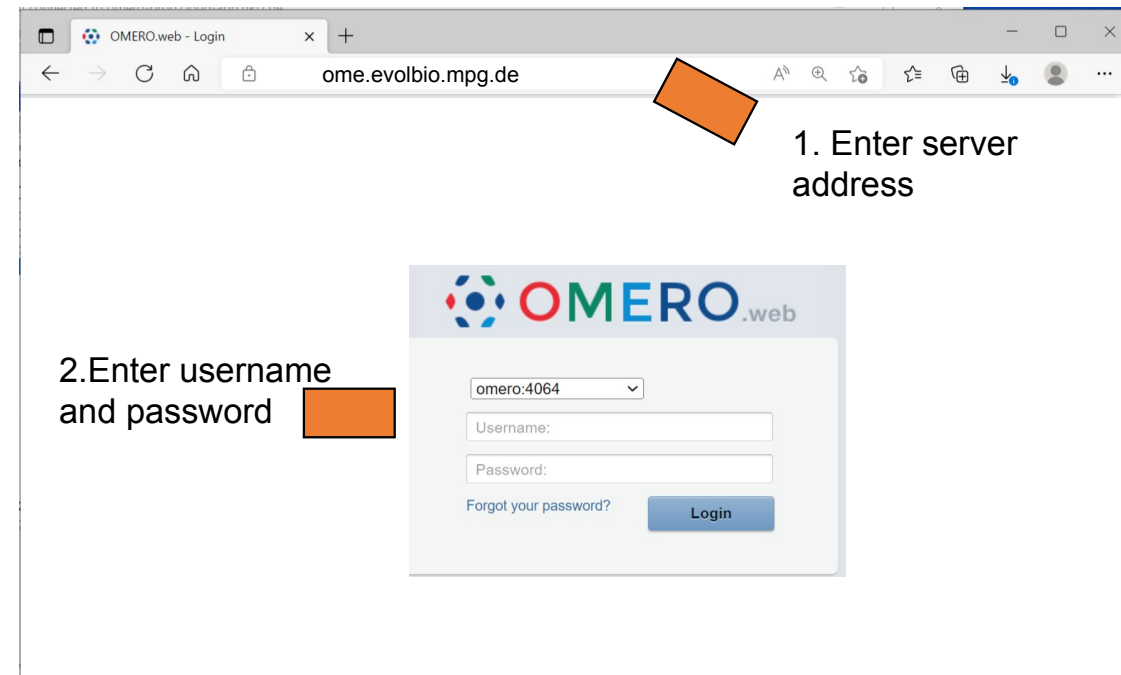
1. Open an internet browser and enter the address of your OMERO server

At the MPI: <https://ome.evolbio.mpg.de>

2. Enter your MPI username and password

Be sure to connect

- from the institute's network
- via a VPN connection



Webclient

https://

OMERO Data History Mapr Figure Help Tag Search

GROUP Mary Mayperson

Explore Tags Shares

Mary Mayperson

- 2010_CMBE_ExpressionTest 2
- 2011_VTK_ZyxinConfocal 1
- 2012_MPIMolBio_CrossSec_Lymphangio 1
- 2017_Nuc-Intens_Tcells 6
 - 20171115_M33_pERK 25
 - 20171115_0h_DMSO_pERK_01_D1.czi
 - 20171115_0h_DMSO_pERK_02_D1.czi
 - 20171115_0h_MG_pERK_01_D1.czi
 - 20171115_0h_MG_pERK_02_D1.czi
 - 20171115_0h_X_pERK_01_D1.czi
 - 20171115_0h_X_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_01_D1.czi
 - 20171115_3h_DMSO_pERK_01_D2.czi
 - 20171115_3h_DMSO_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_02_D2.czi
 - 20171115_3h_DMSO_pERK_03_D1.czi
 - 20171115_3h_DMSO_pERK_03_D2.czi
 - 20171115_3h_MG_pERK_01_D1.czi
 - 20171115_3h_MG_pERK_01_D2.czi
 - 20171115_3h_MG_pERK_02_D1.czi
 - 20171115_3h_MG_pERK_02_D2.czi
 - 20171115_3h_MG_pERK_03_D1.czi
 - 20171115_3h_MG_pERK_03_D2.czi
 - 20171115_3h_X_pERK_01_D1.czi
 - 20171115_3h_X_pERK_01_D2.czi

Add filter

20171115_0h_DMSO_pERK_01_D1.czi

Full viewer

20171115_0h_DMSO_pERK_01_D1.czi

Image ID: 58103
Owner: Mary Mayperson

Image Details

Add Description

Import Date: 2022-04-08 13:50:20
Dimensions (XY): 1912 x 1912
Pixels Type: uint16
Pixels Size (XYZ) (µm): 0.07 x 0.07 x -
Z-sections/Timepoints: 1 x 1
Channels: Ch2-T1, Ch1-T2
ROI Count: 0

Tags 0

Key-Value Pairs 2

Added by: Mary Mayperson

| Key | Value |
|------------------|--------------------|
| CellType | CD4+ T cell |
| Organism | Mus musculus |
| Organ | Spleen |
| IsolationMethod | MACS negative sort |
| ActivationMethod | anti-CD3/anti-CD28 |

Data explorer

Thumbnails

Annotations

example

OMERO.web overview

The screenshot shows the OMERO.web webclient interface. On the left is the 'Data tree' showing a hierarchy of groups and images. The center displays a 'Thumbnail preview of images in the dataset' as a grid of image thumbnails. On the right, the 'User settings' and 'Information on your data(set) and metadata' are shown, including image details and key-value pairs.

Data tree

Hierarchy:
-user/group
--project
---dataset
----image(s)

example tags

Tags & key value pairs

Thumbnail preview of images in the dataset

User settings

Information on your data(set) and metadata

20171115_0h_DMSO_pERK_01_D1.czi

Image ID: 58103
Owner: Mary Mayperson

Image Details

Add Description

Import Date: 2022-04-08 13:50:20
Dimensions (XY): 1912 x 1912
Pixels Type: uint16
Pixels Size (XYZ) (µm): 0.07 x 0.07 x -
Z-sections/Timepoints: 1 x 1
Channels: Ch2-T1, Ch1-T2
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| Key | Value |
|------------------|--------------------|
| CellType | CD4+ T cell |
| Organism | Mus musculus |
| Organ | Spleen |
| IsolationMethod | MACS negative sort |
| ActivationMethod | anti-CD3/anti-CD28 |

OMERO.web overview – The „Acquisition“ tab

The screenshot displays the OMERO.web webclient interface. The top navigation bar includes links for Data, History, Mapr, Figure, Help, Tag Search, and Forms Designer. The user is logged in as Mary Mayperson. The left sidebar shows a file tree under the group 'Mary Mayperson', with a folder '20171115_M33_pERK 25' selected. The central area shows a grid of 20 thumbnail images of cell cultures. The right-hand panel is titled 'Acquisition metadata' and contains sections for 'Original Metadata', 'Global Metadata', and 'Microscope'. The 'Global Metadata' section lists various parameters such as 'BeamSplitterServoPosition' and 'Filter'. The 'Microscope' section includes fields for 'Type', 'Model', 'Nominal magnification', 'Lens NA', 'Immersion', 'Correction', and 'Detector'.

Acquisition metadata

Original Metadata

Global Metadata

Download

|BeamSplitterServoPosition #4 0
|BeamSplitterServoPosition #5 0
|BeamSplitterServoPosition #6 0
|BeamSplitterServoPosition #7 0
|BeamSplitterServoPosition #8 0
|Filter #1 MBS 488/561/633
|Filter #2 Plate
|Filter #3 Mirror
|Filter #4 Rear
|Filter #5 Plate
|Filter #6 MBS -405
|Filter #7 Mirror
|Filter #8 Rear
|Identifier #1 MainBeamSplitterDe
|Identifier #2 MainBeamSplitterDe

Microscope

Type: Unknown
Show unset fields

Objective:

Model: i Plan-Apochromat 63x/1.40 Oil Di
Nominal magnification: 63.0
Lens NA: 1.4000000000000004
Immersion: Oil
Correction: Unknown
Show unset fields

Detector:

Information is extracted from the original file by the Bio-Formats reader library automatically

Essential information is transformed to a user-friendly, readable format

OMERO.web overview – the „Preview“ tab

Webclient

OMERO Data History Mapr Figure Help Tag Search Forms Designer

GROUP Mary Mayperson

Explore Tags Shares

Mary Mayperson

- 20100617_HUVEC_Tranfections 1
- 2010_CMBE_ExpressionTest 2
- 2011_VTK_ZyxinConfocal 1
- 2012_MPIMolBio_CrossSec_Lymphangio 1
- 2017_Nuc-Intens_Tcells 6
 - 20171115_M33_pERK 25
 - 20171115_0h_DMSO_pERK_01_D1.czi
 - 20171115_0h_DMSO_pERK_02_D1.czi
 - 20171115_0h_MG_pERK_01_D1.czi
 - 20171115_0h_MG_pERK_02_D1.czi
 - 20171115_0h_X_pERK_01_D1.czi
 - 20171115_0h_X_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_01_D1.czi
 - 20171115_3h_DMSO_pERK_01_D2.czi
 - 20171115_3h_DMSO_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_02_D2.czi
 - 20171115_3h_DMSO_pERK_03_D1.czi
 - 20171115_3h_DMSO_pERK_03_D2.czi
 - 20171115_3h_MG_pERK_01_D1.czi
 - 20171115_3h_MG_pERK_01_D2.czi
 - 20171115_3h_MG_pERK_02_D1.czi
 - 20171115_3h_MG_pERK_02_D2.czi
 - 20171115_3h_MG_pERK_03_D1.czi
 - 20171115_3h_MG_pERK_03_D2.czi
 - 20171115_3h_X_pERK_01_D1.czi
 - 20171115_3h_X_pERK_01_D2.czi

Thumbnails

Add filter

Full viewer

Switch to Full Viewer (iviewer) for more functions

Your rendering settings are shown live

Adjust rendering settings, and copy or save them to other images.

Zoom: [Slider]

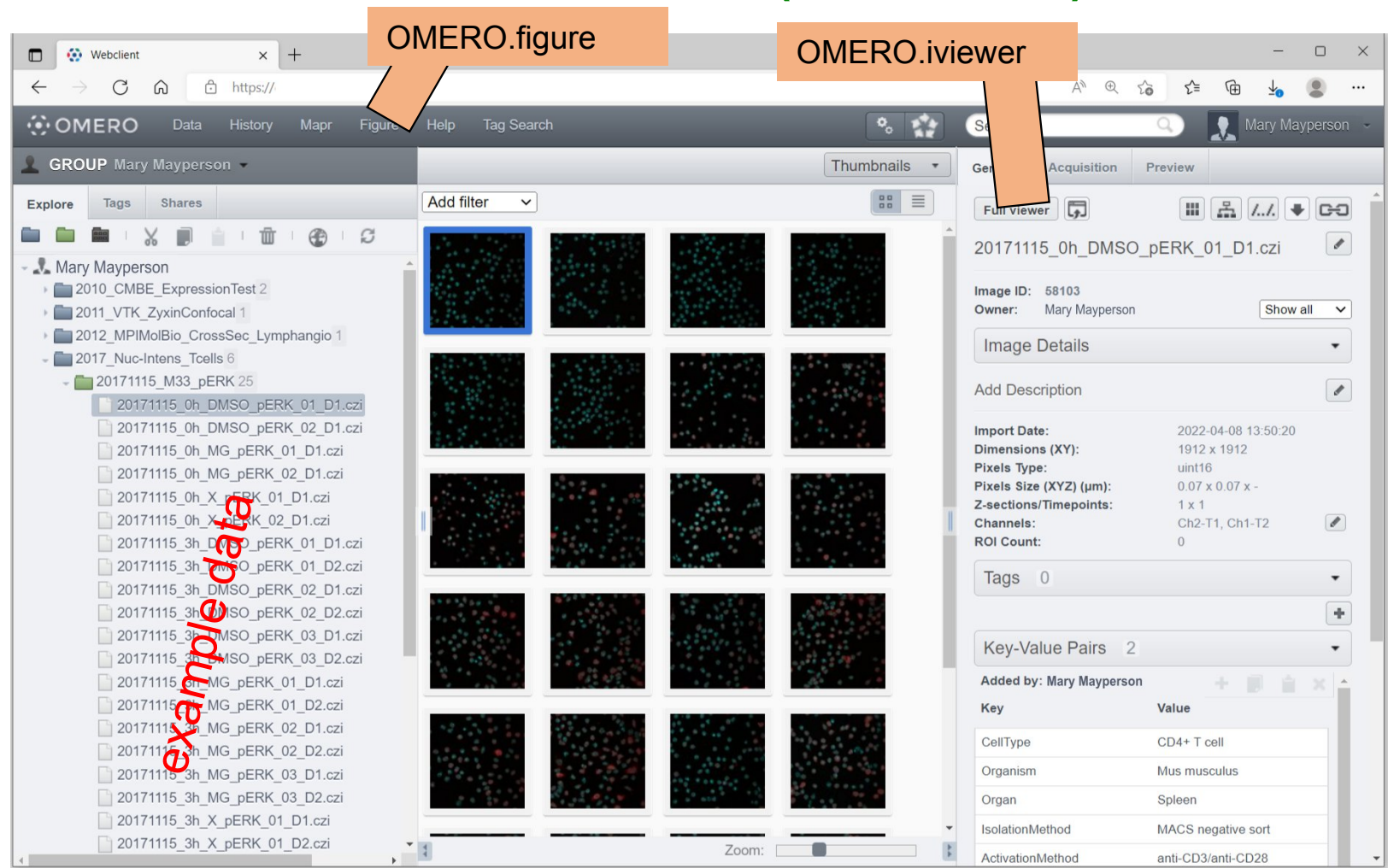
example

OMERO.web – customization with extensions (admin side)

OMERO.web can look different between instances, depending on what your admin has installed.

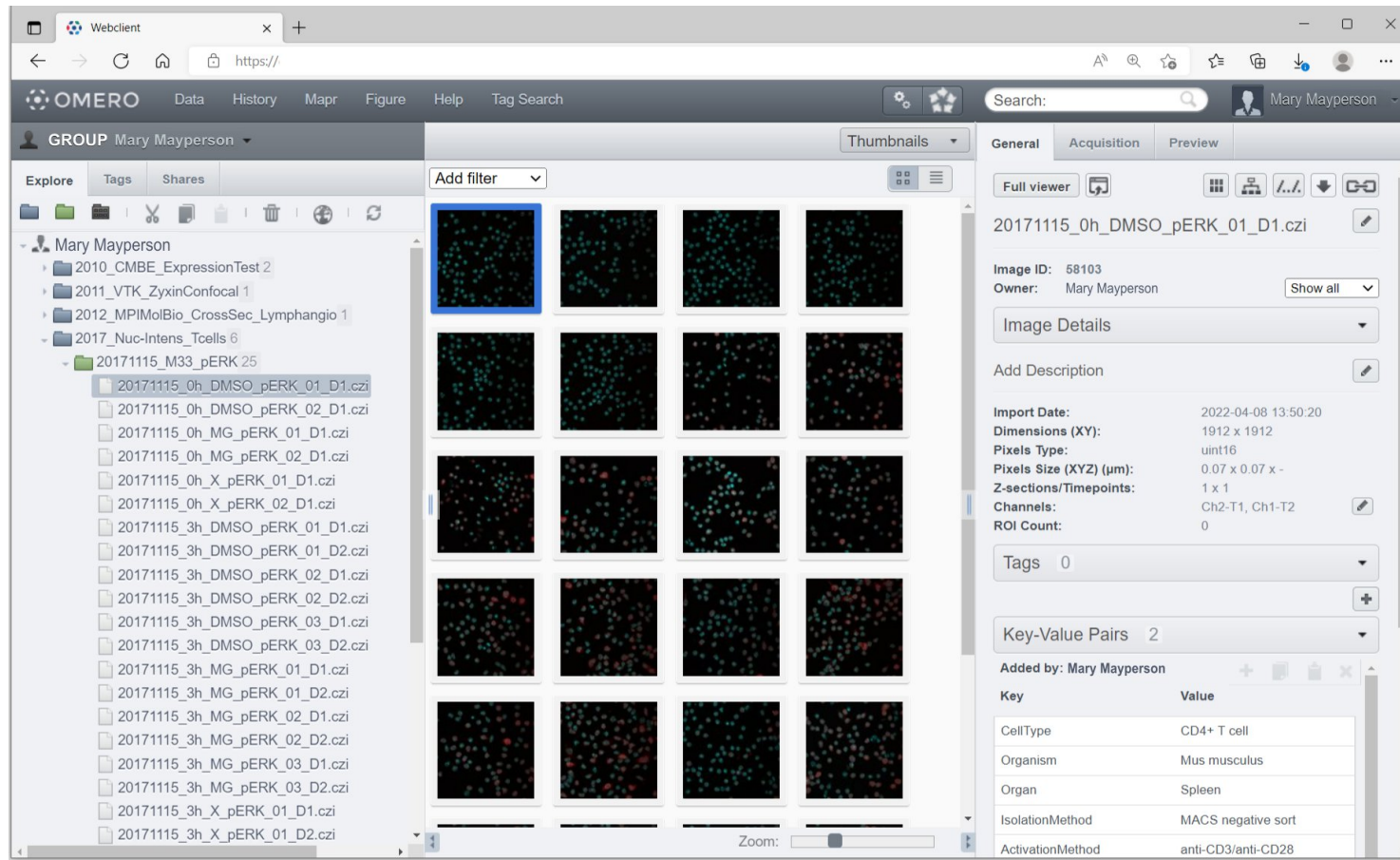
Examples are
OMERO.figure and
OMERO.iviewer

Follow the link below
to learn more about
extensions
(See also Chapter 9)



OMERO guide: https://omero-guides.readthedocs.io/en/stable/web_addons.html

OMERO.web client: functions overview



- *Manage data, i.e.:*
Organize projects, datasets, and images
- *Annotate metadata with tags and Key-Value Pairs*
- *Download and export*
- *Run scripts*
- *Add attachments*
- *Visualize Data*
- *Share for collaboration*
- *Use OMERO.web extensions (e.g., OMERO.figure)*

Inspect the uploaded files in OMERO (here: using OMERO.web)

Data remains in the original file format but is presented to you by the software!

A multi-scene image

The original file is never changed by OMERO, even when you change rendering settings or metadata in OMERO.

The screenshot displays the OMERO.web webclient interface. The browser address bar shows `https://my-local-omero.server`. The interface is divided into several sections:

- Left Panel (Explore):** Shows a tree view of the user's data. Under the group "Mary Mayperson", there is a folder "ExampleData_BiolImageArchive_WSI_1" containing a sub-folder "BIA_Accession_S-BST110_3". Inside this folder, three files are listed: "14 08943 8_A1APOBEC3A_1.czi [0]", "14 08943 8_A1APOBEC3A_1.czi [label image]", and "14 08943 8_A1APOBEC3A_1.czi [macro image]". Below this is an "Orphaned Images" section.
- Center Panel:** Displays three preview thumbnails of the selected image. The first thumbnail shows a multi-scene image (a cell). The second thumbnail shows a label image with handwritten text "14 08943 8", "APOBEC 3A", and "H15 844". The third thumbnail shows a macro image of a cell.
- Right Panel (Metadata):** Shows the metadata for the selected image. The "General" tab is active, displaying fields such as "Image ID: 15201", "Owner: Mary Mayperson", "Acquisition Date: 2017-05-17 16:33:20", "Import Date: 2022-07-20 12:52:06", "Dimensions (XY): 148200 x 109017", "Pixels Type: uint8", "Pixels Size (XYZ) (µm): 0.11 x 0.11 x -", "Z-sections/Timepoints: 1 x 1", "Channels: TL Brightfield, TL Brightfield, TL Brightfield", and "ROI Count: 0". There are also sections for "Tags", "Key-Value Pairs", "MDE" (Metadata Extension), "Tables", "Attachments", "Comments", "Ratings", and "Others".

Annotations on the screenshot:

- "A multi-scene image" points to the first thumbnail.
- "Preview thumbnails" points to the three thumbnails in the center.
- "Metadata" points to the right panel.
- "This would be a result of the optional usage of MDE before the Import" points to the "MDE" section in the metadata panel.

Important notes about Data Upload to OMERO

- Data is stored in *the original file formats* (raw data is conserved!)
- The storage location is not directly accessible for users via file explorers, only via OMERO (exception: „in-place import“)
- The uploaded data is never changed or corrupted by OMERO
- The original data can be retrieved from OMERO if desired
- The storage location is on the central MPI storage system
 - reliable, fast access
 - backup

(Main) options to upload data into OMERO

Upload using **OMERO.importer**

- Is integrated into the **OMERO.insight** client
- Easy, graphical user interface

☾ *Recommended for most users*

Persons with restricted admin rights can upload data for other users, too.

Upload using the **Command Line Interface (CLI)**

- See the OMERO guide for details:
<https://omero-guides.readthedocs.io/en/latest/upload/docs/import-cli.html>
- *Good to know:*
There is an option called „*in-place import*“ (by an admin), which allows to use OMERO with non-central storage locations. Discuss this option with your admin if required.
<https://omero-guides.readthedocs.io/projects/upload/en/stable/import-cli.html?highlight=in%20place#in-place-import-cli>

User groups and permission levels in OMERO

User groups in OMERO and where to find them

Find the groups and group members in OMERO.web



Prof Julie



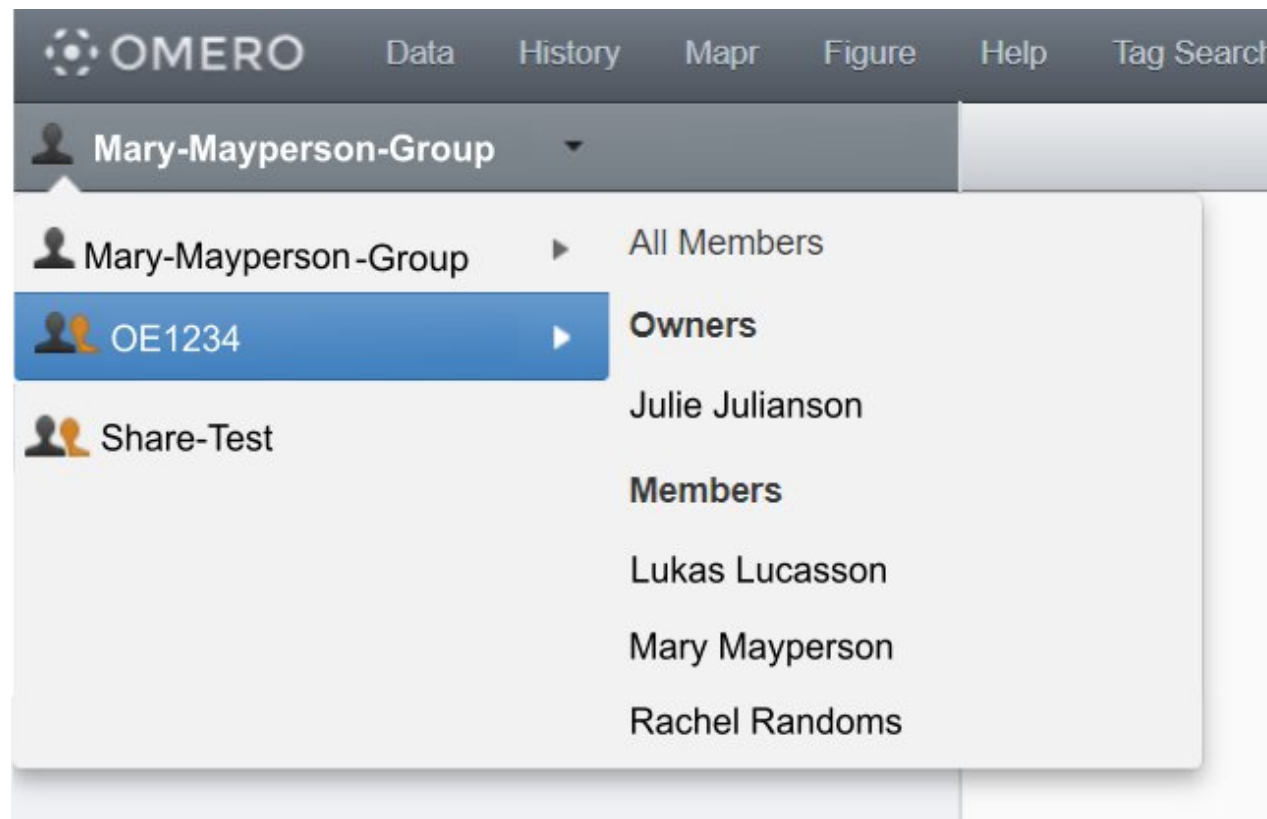
Rachel



Mary



Lukas



For details see: <https://omero.readthedocs.io/en/stable/sysadmins/server-permissions.html>

Which types of user groups exist in OMERO?



Prof Julie



Rachel



Mary



Lukas

- Uploaded data belongs to a specific user in a specific group
- In user groups, the users have different roles:
 - Group owner (one or more)
 - Group members
- The OMERO administrator has access to all groups
- Group owners can change group permission levels

Group permission levels

Private

Read-only

Read-Annotate

Read-Write



For details see: <https://omero.readthedocs.io/en/stable/sysadmins/server-permissions.html>

WARNING: permission changes: <https://docs.openmicroscopy.org/omero/5.6.3/sysadmins/server-permissions.html#changing-group-permissions>

Group permission levels overview:



Private

Members can only see their own data. The owner can see all data. Good for data storage, but limits any collaboration.



Read-only

Members can see everyone's data, but not annotate, edit, or delete other's data. Owner has more rights.

Read-Write



Members can view and annotate other's data, but not edit or delete it. Owner has extended rights.



Members can view, annotate, edit or delete other's data. Used as if all members co-own all data. Strong collaboration with high level of trust.

Can only be granted by an admin!

Upload data to OMERO using OMERO.importer - metadata

Optional, intermediate step during the import:

Review and annotate metadata using **OMERO.mde**, a metadata editor based on MDE.mic (Kunis et al., 2021, Nat. Meth.). Allows to edit:

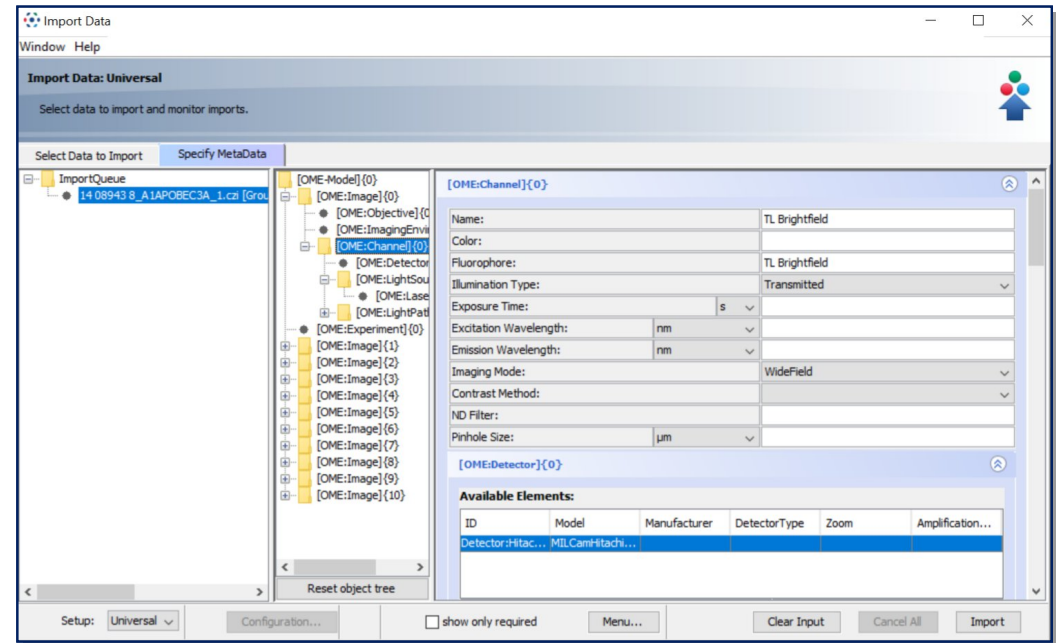
- metadata of individual files,
- annotate the import queue in batch,

Supports standardized, but configurable

- metadata vocabularies and ontologies
- See also:*

- Chapter 7 (Metadata Curation)
- OMERO.mde user guide:

<https://omero-guides.readthedocs.io/en/latest/mde/docs/index.html>



Organize your image data with OMERO

Data Organization in OMERO

Carsten Fortmann-Grote

Content

- Folder hierarchies vs. Data objects
- Projects and Datasets
- Rethinking folders as file properties
- Tags and how to use them for data organization
- Key-value pairs: Enrich your metadata

Questions/considerations around data organization and management

- Local computer vs. shared drives

(Where?)

- Backed-up network drives vs. safety copies on hard drives (Where?

Who?)

- Version control software vs. manual versioning (file names) (How?)

- Arbitrary file naming vs. (any level) of standardization (How?

Who?)

- Management software vs. file folder hierarchies (How?)

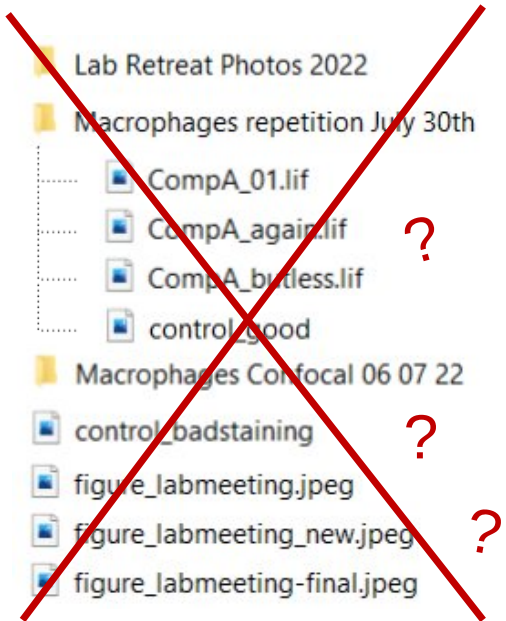
- Documentation in paper notebook vs. electronic lab notebook (How? Who?)

- Original data vs. derived data

(What? How?)

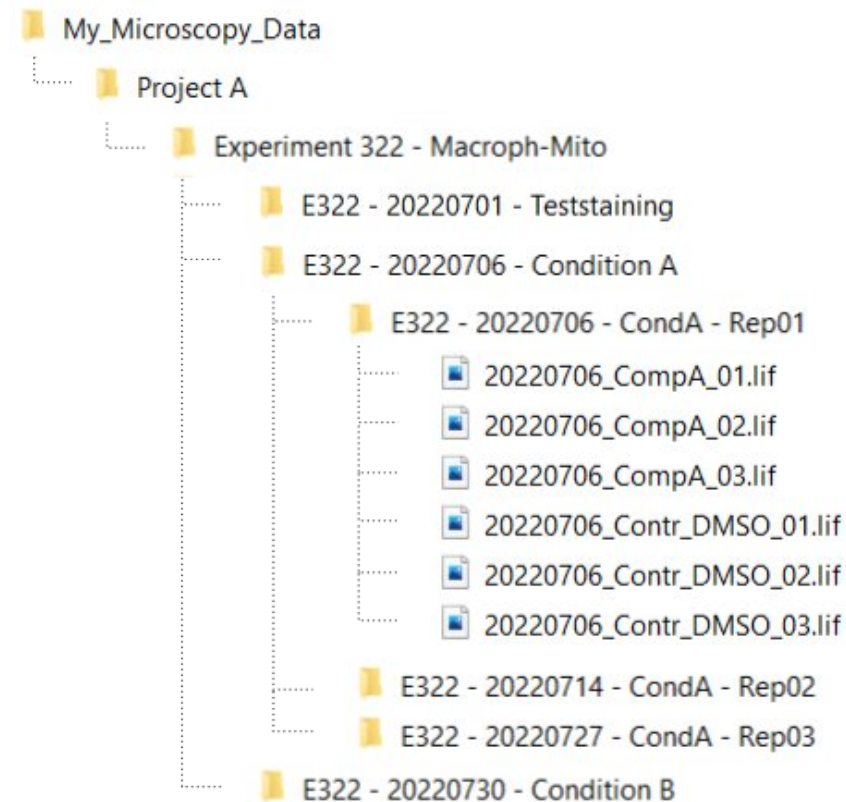
Managing data in classical file folder hierarchies

Not managed



Understanding the data is only possible for the data producer (if at all)

Managed in a file system hierarchy (arbitrary example)



Understanding the data is possible based on the researcher's documentation

Hierarchy structure standardization?

- At the individual's level
- At the group's level
- At the collaboration level
- Discipline-specific standards

No preview and limited direct access to metadata

A data management system helps to organize data (here: OMERO)

Example:
Access with
OMERO.web

Example: A file with a
„multi-scene image“

- Managed data
- Preview available
- Access to metadata
- User-friendly but machine-accessible

The screenshot displays the OMERO web client interface. The browser address bar shows <https://my-local-omero.server>. The interface is divided into several sections:

- Left Panel (Explore):** Shows a tree view of data under the group 'Mary Mayperson'. It includes folders like 'ExampleData_BiolImageArchive_WSI 1' and 'BIA_Accession_S-BSST110 3', with files such as '14 08943 8_A1APOBEC3A_1.czi [0]', '14 08943 8_A1APOBEC3A_1.czi [label image]', and '14 08943 8_A1APOBEC3A_1.czi [macro image]'. There is also an 'Orphaned Images' folder.
- Center Panel:** Displays three preview thumbnails of the selected image. The first is a blue-tinted histological section. The second is a label with handwritten text '14 08943 8', 'APOBEC-3A', and 'H15 844'. The third is a green-tinted histological section.
- Right Panel (Metadata):** Shows detailed information for the selected image '14 08943 8_A1APOBEC3A_1.czi [0]'. It includes fields for Image ID (15201), Owner (Mary Mayperson), Acquisition Date (2017-05-17 16:33:20), Import Date (2022-07-20 12:52:06), Dimensions (XY: 148200 x 109017), Pixels Type (uint8), Pixels Size (XYZ) (0.11 x 0.11 x 1), Z-sections/Timepoints (1 x 1), Channels (TL Brightfield, TL Brightfield, TL Brightfield), ROI Count (0), Tags (0), Key-Value Pairs (1), MDE (Added by: Mary Mayperson, OME-Model: [0], OME-Experiment: [0], ExperimentType: Whole Slide Image), Tables, Attachments (0), Comments (0), Ratings (0), and Others (0).

Preview thumbnails

Metadata

Example Data: <https://www.ebi.ac.uk/biostudies/BiolImages/studies/S-BSST110> (by Barry et al., Clin Cancer Res, doi:10.1158/1078-0432.CCR-17-3374)



Data organization in OMERO – part 1

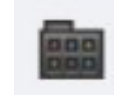
OMERO.web offers a tree-view data hierarchy in the **Explore** tab



Projects



Datasets



Screens (multi-well plates)

user/group

Projects (blue)

Datasets (green)

Image(s) (grey)

GROUP Mary Mayperson

Explore Tags Shares

- Mary Mayperson
 - 2010_CMBE_ExpressionTest 2
 - 2011_VTK_ZyxinConfocal 1
 - 2012_MPIMolBio_CrossSec_Lymphangio 1
 - 2017_Nuc-Intens_Tcells 6
 - 20171115_M33_pERK 25
 - 20171115_0h_DMSO_pERK_01_D1.czi
 - 20171115_0h_DMSO_pERK_02_D1.czi
 - 20171115_0h_MG_pERK_01_D1.czi
 - 20171115_0h_MG_pERK_02_D1.czi
 - 20171115_0h_X_pERK_01_D1.czi
 - 20171115_0h_X_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_01_D1.czi
 - 20171115_3h_DMSO_pERK_01_D2.czi
 - 20171115_3h_DMSO_pERK_02_D1.czi
 - 20171115_3h_DMSO_pERK_02_D2.czi

Dataset within project

Non-nested Dataset

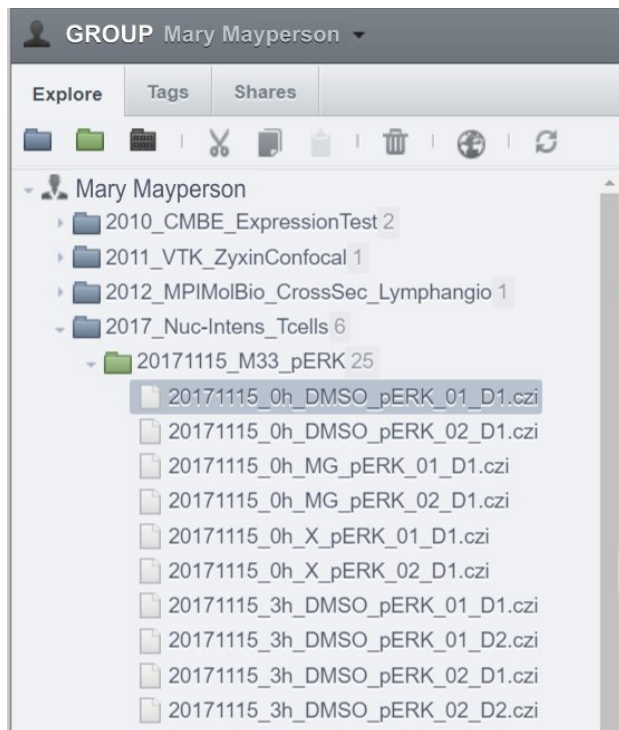
Scenes from multi-scene image (e.g., slide scanner)

Explore Tags Shares

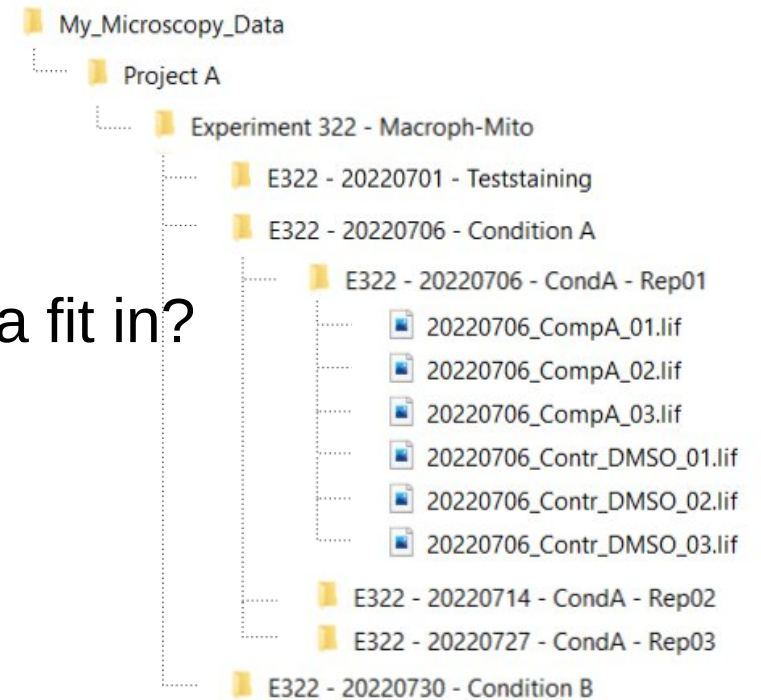
- Mary Mayperson
 - ExampleData_BiolImageArchive_WSI 1
 - BIA_Accession_S-BSST110 3
 - 14 08943 8_A1APOBEC3A_1.czi [0]
 - 14 08943 8_A1APOBEC3A_1.czi [label image]
 - 14 08943 8_A1APOBEC3A_1.czi [macro image]
 - Orphaned Images

Re-think data organization: File folder hierarchy vs. object-oriented data structure in OMERO?

If OMERO offers only a two-folder deep hierarchy...



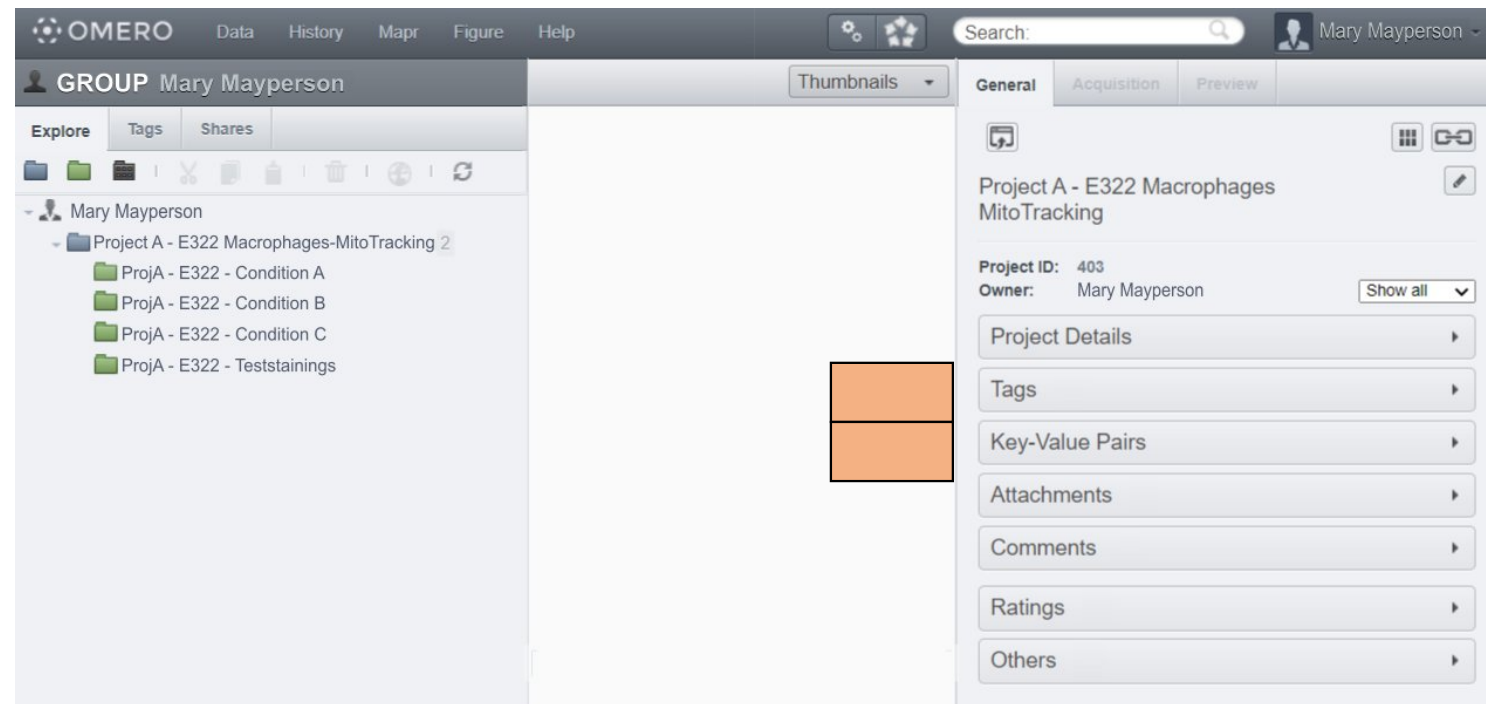
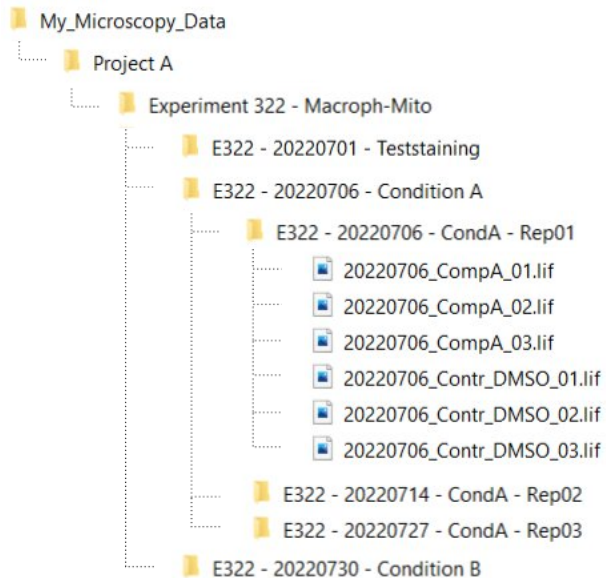
... how does my data fit in?



File folder hierarchy in explorer vs object-based data structure

A file folder hierarchy is itself a form of metadata

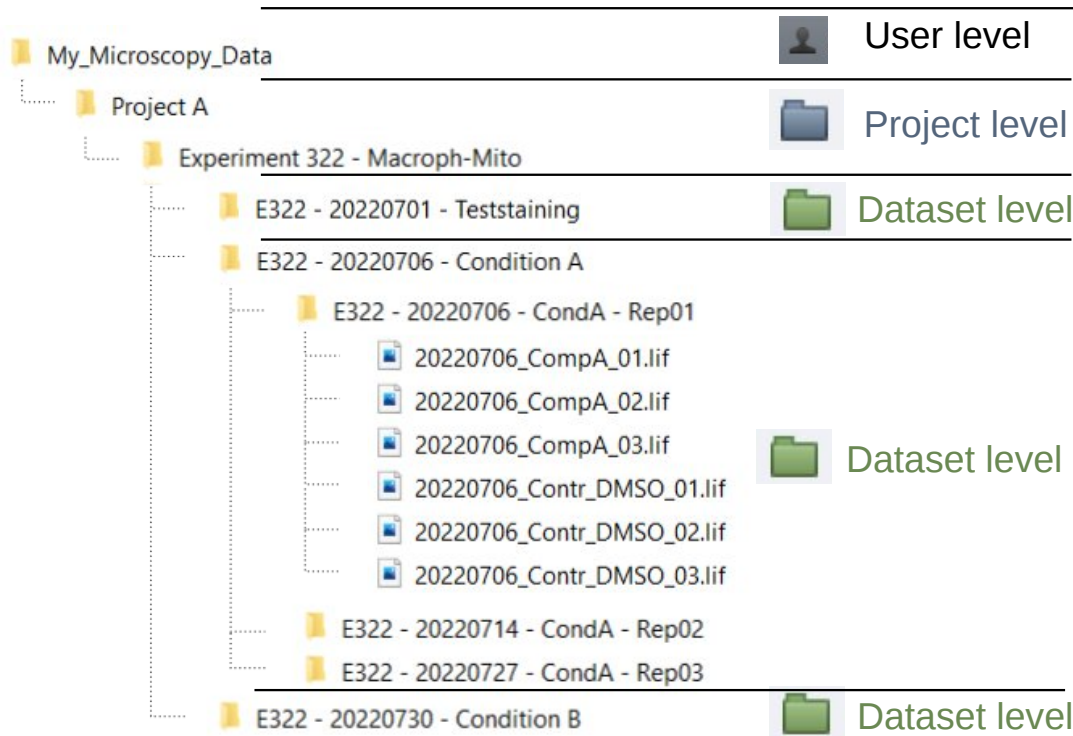
OMERO uses *structured metadata*:
Tags and Key-Value Pairs



調 Annotate data with Tags and Key-Value Pairs

Re-think data organization: Object-based data organization

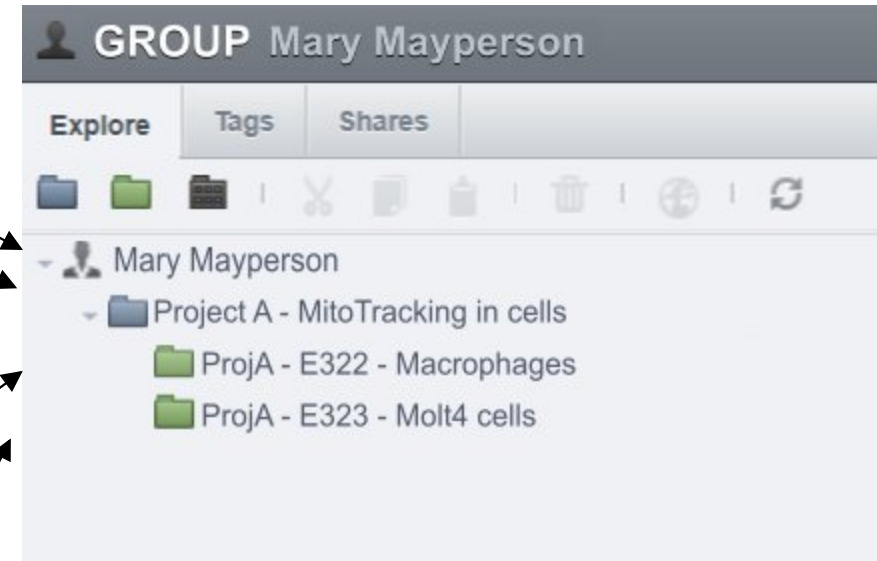
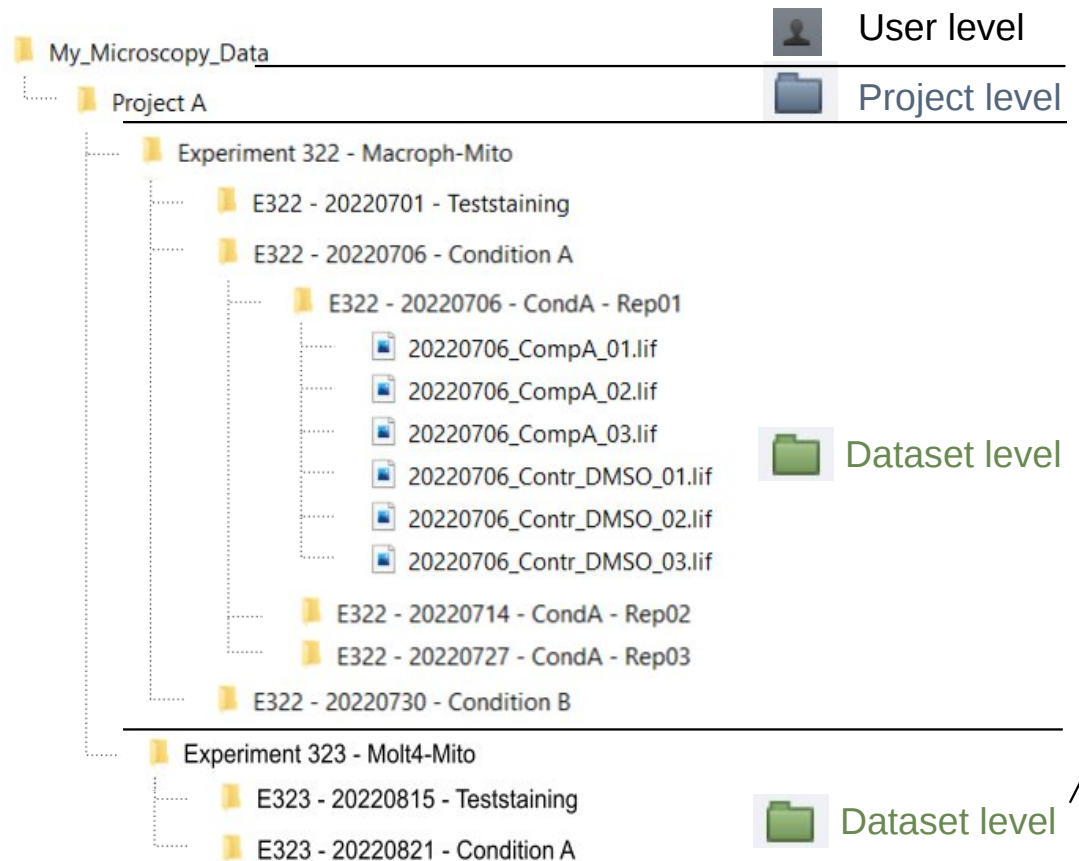
Organization example 1



Use Tags for information across datasets and to *substitute for deep folder hierarchies*
(調 How? See the following slides and chapters!)

Re-think data organization: Object-based data organization

Organization example 2

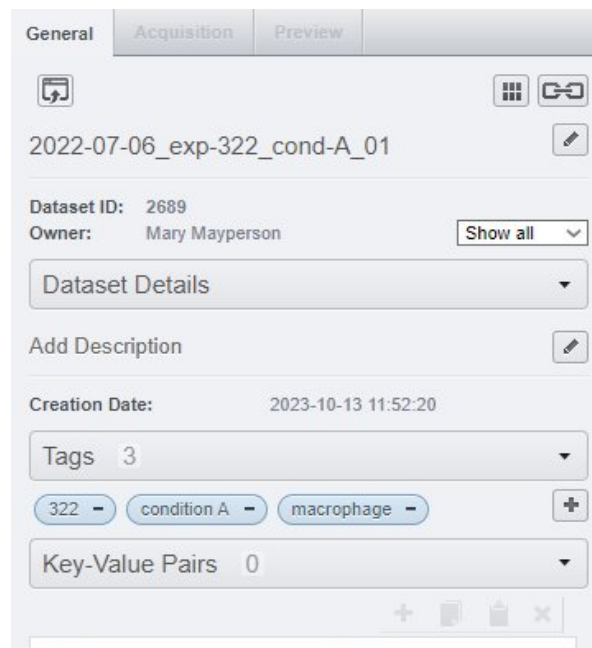
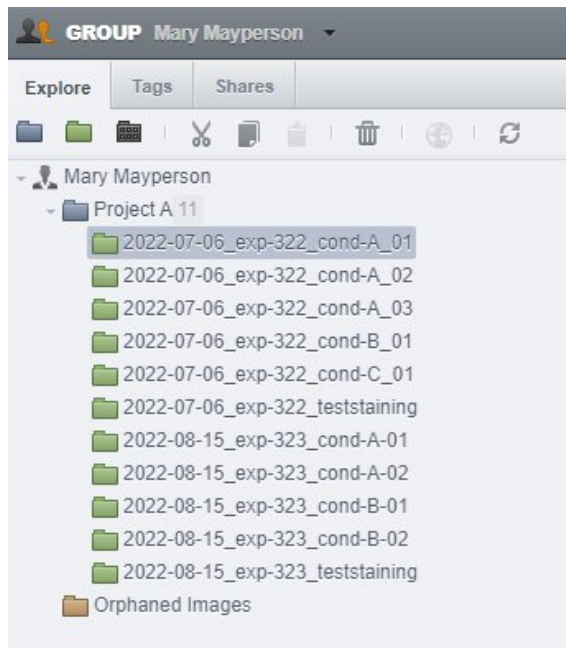


Use **Tags** for information across datasets (e.g., „Compound A“, „DMSO control“, etc.)
Use **Key-Value Pairs** to enrich with metadata details
(調 How? See the following slides and chapters!)

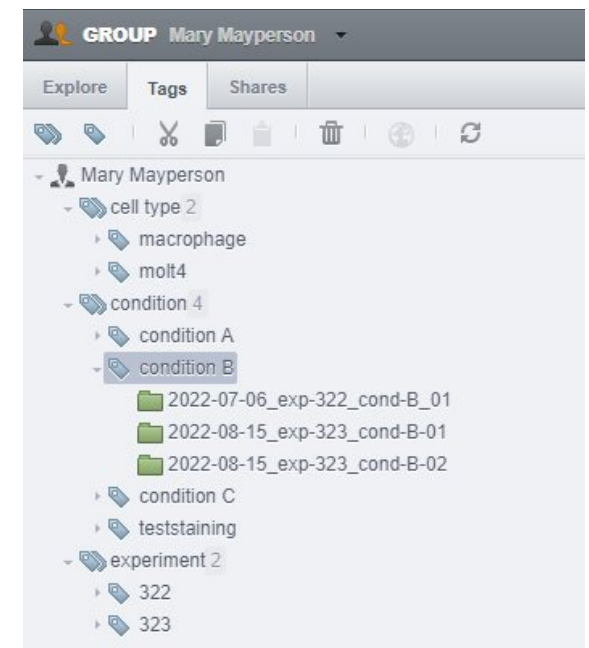
Re-think data organization: Object-based data organization

Organization example

Datasets on a flat list act as a "data library"



All folders are mapped to tags



- Images of an experiment are divided to obtain datasets of the same sample + condition + experiment + ...
- As the "data library" grows, the tags grant a flexible and efficient filtering
- Because images have the same "origin", they are implicitly annotated all at once (by annotating the dataset)

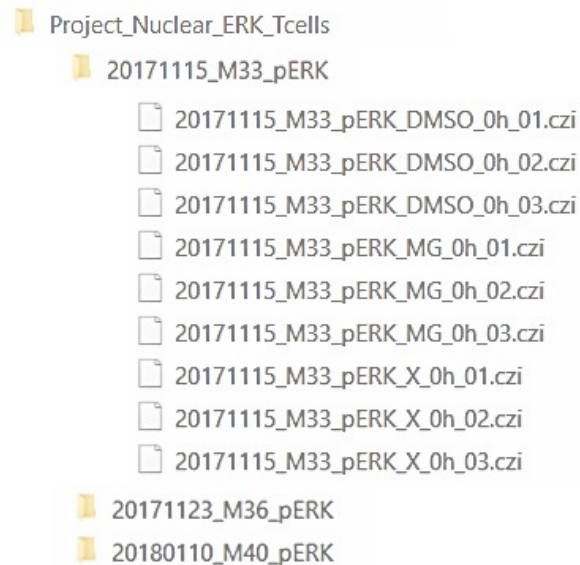
Why so complicated? I want my folders back!

Example of a problem: Searching datasets and images in a file explorer

Original file structure

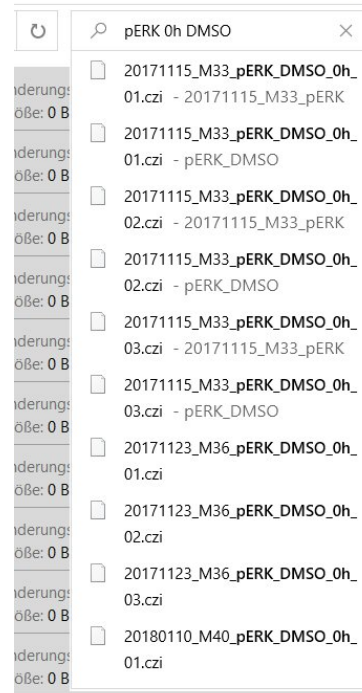
purpose:

Compare different treatments
per time point for each
staining target



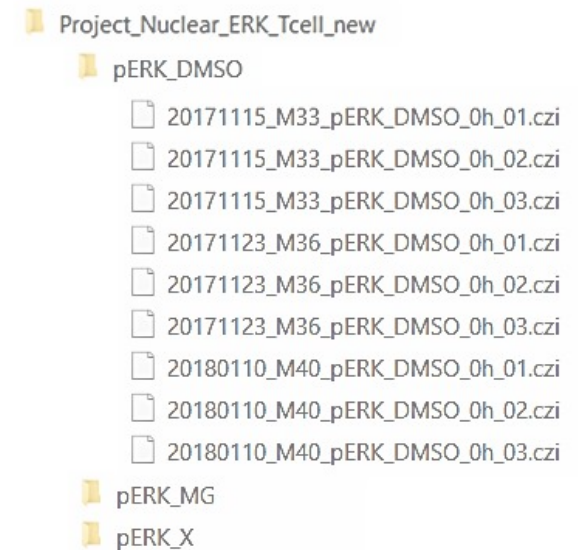
New intention:

Compare all „DMSO“ control
images for „pERK“ staining at „0
h“ of incubation



What is the solution?

- access individual files
- or
- rearrange the file structure?



Solution: Using the search function based on metadata

Instead of file-path-centered thinking...

D:\MaryMayperson\MyData\Project_Nuclear_ERK_Tcells\20171115_M33_pERK\20171115_M33_pERK_DMSO_01.czi

VS

D:\MaryMayperson\MyData\Project_Nuclear_ERK_Tcells_new\pERK_DMSO\20171115_M33_pERK_DMSO_01.czi

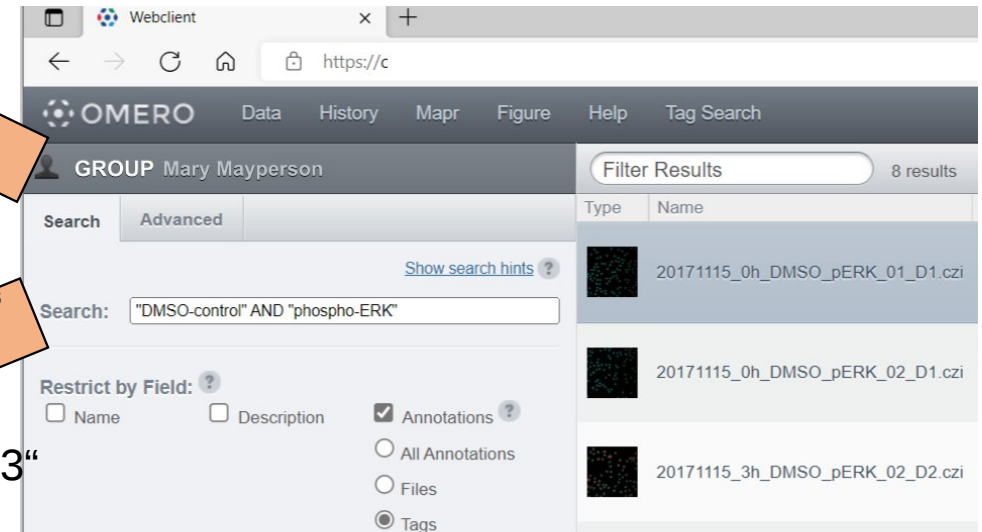
...think of tag combinations, instead:

User: Mary Mayperson

Tags: „DMSO“ AND „phospho-ERK“ AND „0h“

or

Tags: „DMSO“ AND „phospho-ERK“ AND „M33“



(see also: subchapter 6.1)

Re-think data organization!

This is an important concept:

OMERO is *not* intended for use as a file hierarchy system

OMERO is object-oriented

How to leverage the potential of object-oriented data organization using Tags and Key-Value-Pairs will be shown throughout the following chapters

Re-think data organization: Object-based data organization

How to organize data in OMERO?

- Structure data *according to your (group's) needs*
- Make use of **Key-Value** Pairs (or Tags) for data organization (instead of deep folder hierarchies)
- Explore ways of data organization and discuss them with your research group

調 What are Tags and Key-Value Pairs?

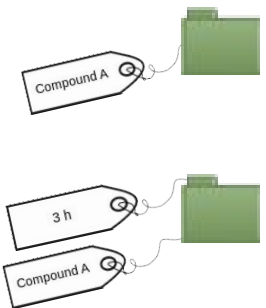
What are Tags and their advantages?

Tags denote a property of an entity, similar to a price tag in the supermarket

- Tags allow a dynamic re-representation of the data tree (Tag-based search)
- Tags can help organize data across datasets and projects (e.g., similarities, relationships)

Examples (**Tags**):

- „show all data treated with **compound A**“
 - „show all data recorded with **instrument A**“
 - etc...
-
- **Note: Tags are associated with users and groups!** In a shared group, we recommend discussing which tags to use and potentially assigning a user who curates and manages the tags
 - For private data, tags can be used based on user preference alone



What are Key-Value Pairs and their advantages?

Key-Value Pairs allow (standardized) annotation of detailed metadata

Consists of

- **Key:** Denotes a real-world object or an abstract concept that has a specific value (out of several or many possible values)
- **Value:** Number or text-string that describes the object denoted under „Key“

Examples:

Key: „cell type“

Value: „CD4+ T cell“

Key: „disease model“

Value: „experimental autoimmune encephalomyelitis“

調 Allows structured and standardized metadata details curation

Tags and Key-Value Pairs in OMERO (recommendations)

Tags and Key-Value Pairs can be added to:

- Images
- Groups of Images
- Datasets
- Projects

Tags are linked to users or groups

Advanced users:

Annotate Tags and Key-Value Pairs using ontologies and ontology terms (see Chapter on Metadata Curation)

I3D:bio recommendation:

- Use tags for data organization across datasets and projects (categorization)
- can substitute deep folder hierarchies
- Use Key-Value Pairs for metadata enrichment

Tags and Key-Value Pairs (here: in OMERO.web)

The screenshot displays the OMERO.web webclient interface. On the left, a file tree under the group 'Mary Mayperson' lists various image files. The main area shows a grid of 20 thumbnails of fluorescence microscopy images. An orange callout box with the text 'Tags and Key-Value Pairs' points to the right-hand panel. This panel contains the 'General' tab for the selected image '20171123_M36_1_D0h_pERK.czi'. It shows the image ID (57934), owner (Mary Mayperson), and a table of key-value pairs. The table lists metadata such as primary and secondary antibodies, cell type, organ, organism, and strain.

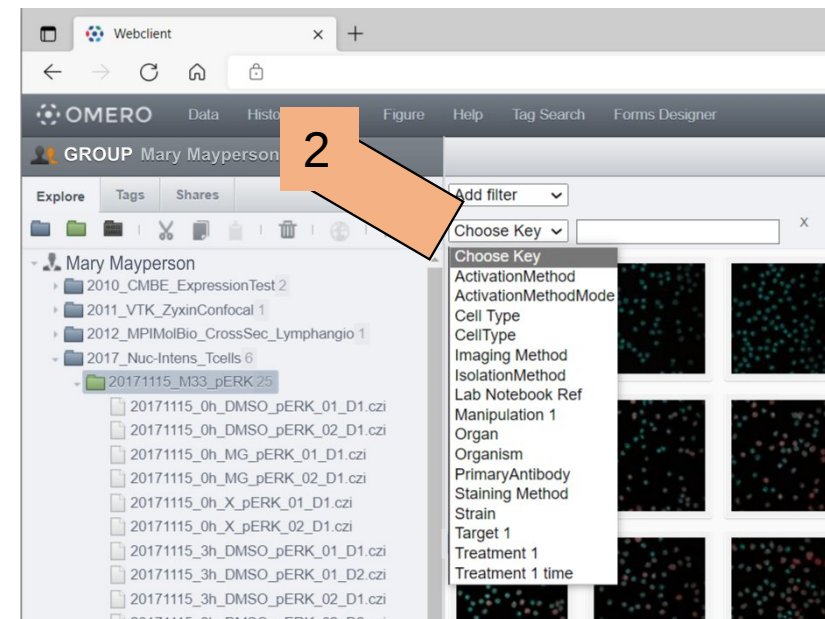
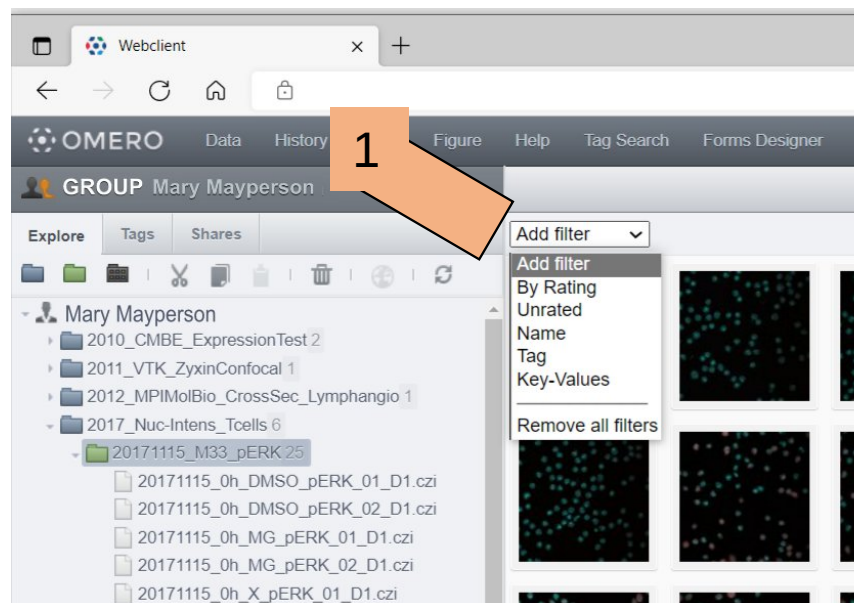
Tags 0

Key-Value Pairs 2

| Key | Value |
|--------------|----------------------------------|
| primary_AB | anti-p-ERK1/2 (Cell Signaling) |
| secondary_AB | goat anti-rabbit Alexa-Fluor-647 |
| Cell type | CD4+ T cells |
| Organ | spleen |
| Organism | Mus musculus |
| Strain | C57BL/6 |

Filter Datasets for Tags and Key-Value Pairs (here: in OMERO.web)

At the Dataset-level, use filters to show a set of images based on Key-Value-Pairs or Tags



Example shown here: Filtering by Key-Values
(also showing which Keys were used on this Dataset)

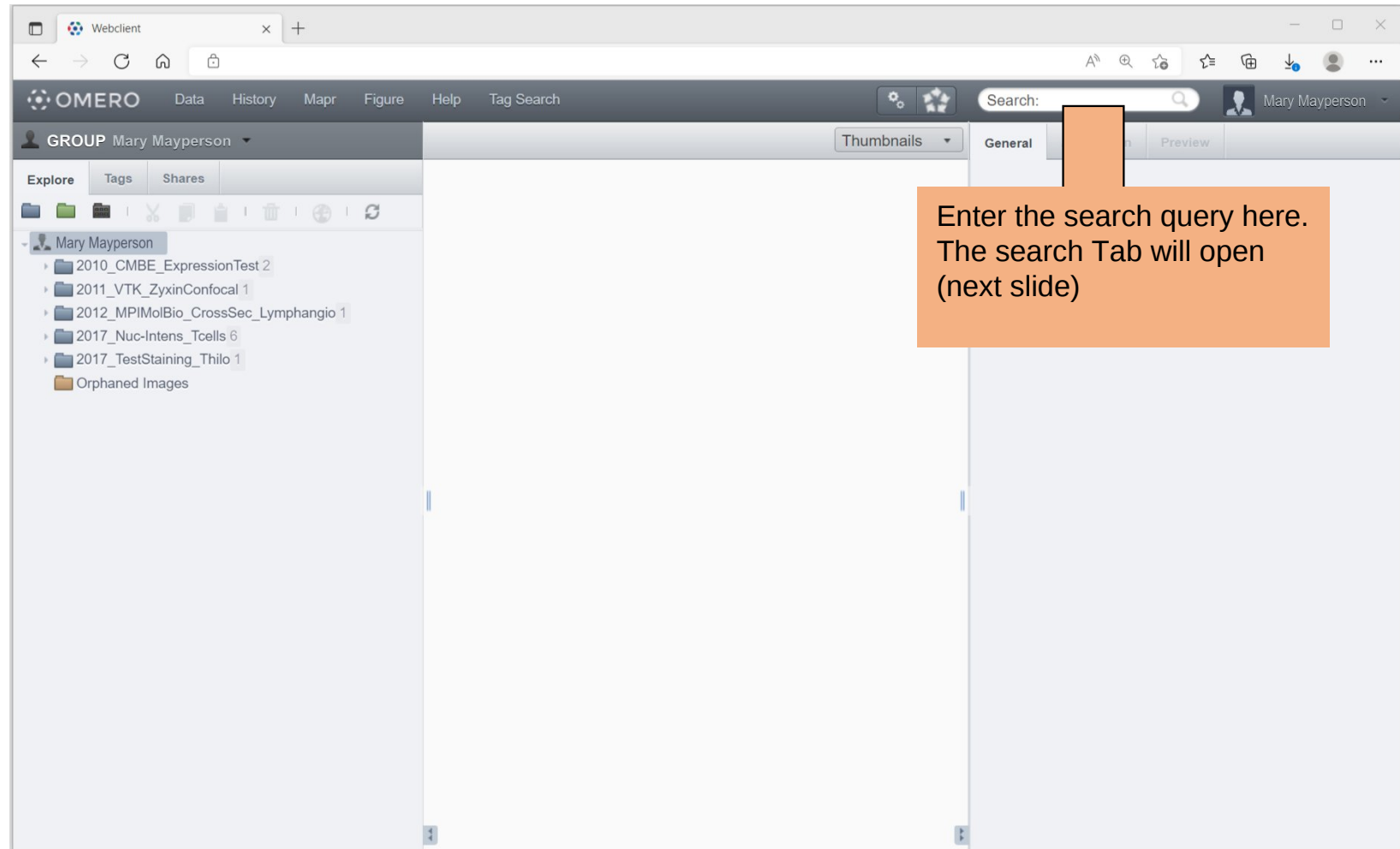
(You can also filter by Name or Rating)

Search function to find data, e.g., based on Tags or Key-Value Pairs

1/3

Use the *Search* field to look for data across

- Users
- Groups
- Projects
- Datasets



Search function to find data, e.g., based on Tags or Key-Value Pairs

2/3

Refine your search query

Optional:
Restrict for which fields you wish to search

Example 1:
Search for images with both **Tags**

The screenshot shows the OMERO Webclient interface. The search bar contains the query "DMSO-control" AND "phospho-ERK". The search results are displayed in a table with columns: Type, Name, Acquired, Imported, Group, and Link. The results show 8 items, all of which are images. The interface also includes a 'Filter Results' section with options to restrict by field (Name, Description, Annotations, Files, Tags) and search for (Images, Datasets, Projects, Wells, Plates, Screens). The 'Tags' section shows two tags: 'phospho-ERK' and 'DMSO control'. The 'Key-Value Pairs' section shows two pairs: 'PrimaryAntibody' with value 'anti-phospho-ERK' and 'CellType' with value 'CD4+ T cell'.

| Type | Name | Acquired | Imported | Group | Link |
|-------|---------------------------------|---------------------|---------------------|--------|--------|
| Image | 20171115_0h_DMSO_pERK_01_D1.czi | 2022-04-08 13:50:20 | 2022-04-08 13:50:20 | OE0629 | Browse |
| Image | 20171115_0h_DMSO_pERK_02_D1.czi | 2022-04-08 13:50:22 | 2022-04-08 13:50:22 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_02_D2.czi | 2022-04-08 13:50:31 | 2022-04-08 13:50:31 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_03_D2.czi | 2022-04-08 13:50:32 | 2022-04-08 13:50:32 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_01_D2.czi | 2022-04-08 13:50:34 | 2022-04-08 13:50:34 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_01_D1.czi | 2022-04-08 13:50:44 | 2022-04-08 13:50:44 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_02_D1.czi | 2022-04-08 13:50:53 | 2022-04-08 13:50:53 | OE0629 | Browse |
| Image | 20171115_3h_DMSO_pERK_03_D1.czi | 2022-04-08 13:50:41 | 2022-04-08 13:50:41 | OE0629 | Browse |

Search function to find data, e.g., based on Tags or Key-Value Pairs 3/3

Refine your search query

Optional:
Restrict for which fields you wish to search

Example 2:
Search for images with specific value in **Key-Value Pairs**

The screenshot shows the OMERO webclient interface. The search bar contains 'CD4+'. The 'Restrict by Field' section is highlighted with an orange box. The search results table shows 66 results. The right sidebar shows the 'Key-Value Pairs' section, which is also highlighted with an orange box. The 'Key-Value Pairs' section shows a table with 'Key' and 'Value' columns. The 'CellType' key has the value 'CD4+ T cell'.

| Type | Name | Acquired | Imported |
|-------|---------------------------------|---------------------|---------------------|
| Image | 20171115_0h_X_pERK_01_D1.czi | 2022-04-08 13:50:14 | 2022-04-08 13:50:14 |
| Image | 20171115_0h_X_pERK_02_D1.czi | 2022-04-08 13:50:17 | 2022-04-08 13:50:17 |
| Image | 20171115_0h_MG_pERK_01_D1.czi | 2022-04-08 13:50:18 | 2022-04-08 13:50:18 |
| Image | 20171115_0h_MG_pERK_02_D1.czi | 2022-04-08 13:50:23 | 2022-04-08 13:50:23 |
| Image | 20171115_0h_DMSO_pERK_01_D1.czi | 2022-04-08 13:50:20 | 2022-04-08 13:50:20 |
| Image | 20171115_0h_DMSO_pERK_02_D1.czi | 2022-04-08 13:50:22 | 2022-04-08 13:50:22 |
| Image | 20171115_3h_DMSO_pERK_02_D2.czi | 2022-04-08 13:50:31 | 2022-04-08 13:50:31 |
| Image | 20171115_3h_DMSO_pERK_03_D2.czi | 2022-04-08 13:50:34 | 2022-04-08 13:50:34 |
| Image | 20171115_3h_DMSO_pERK_01_D2.czi | 2022-04-08 13:50:34 | 2022-04-08 13:50:34 |

Search: CD4+

Restrict by Field:

- ☐ Name
- ☐ Description
- ☒ Annotations
 - ☒ All Annotations
 - ☐ Files
 - ☐ Tags

Search for:

- ☒ Images
- ☐ Wells
- ☐ Datasets
- ☐ Plates
- ☐ Projects
- ☐ Screens

Scope:

In group: All Groups

Data owned by: All Users

Date: Import date

Search

Filter Results: 66 results

General

Image ID: 58100

Owner: Mary Mayperson

Image Details

Add Description

Import Date: 2022-04-08 13:50:14

Dimensions (XY): 1912 x 1912

Pixels Type: uint16

Pixels Size (XYZ) (µm): 0.07 x 0.07 x -

Z-sections/Timepoints: 1 x 1

Channels: Ch2-T1, Ch1-T2

ROI Count: 0

Tags: 1

Key-Value Pairs: 2

Added by: Mary Mayperson

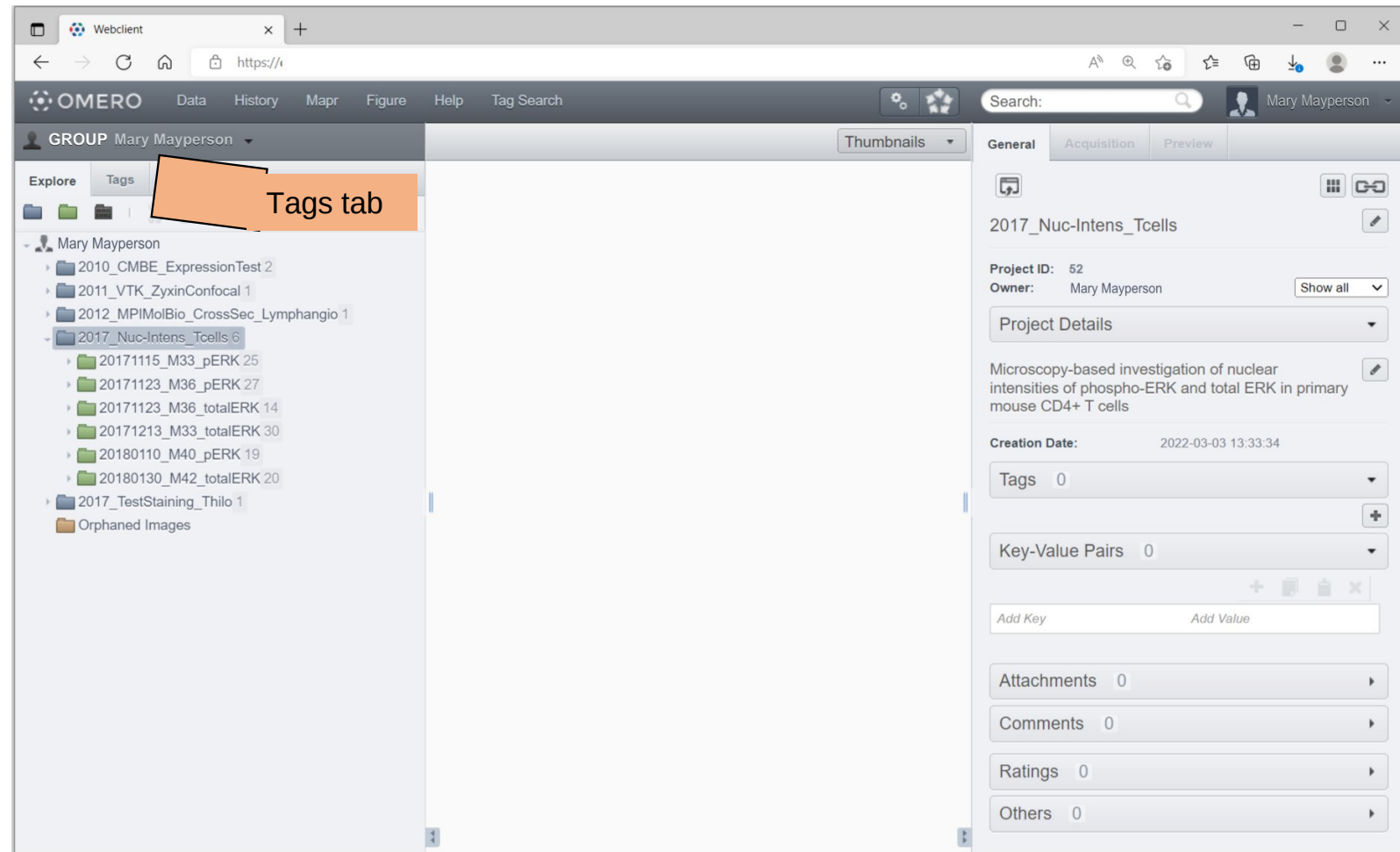
| Key | Value |
|-----------------|------------------|
| PrimaryAntibody | anti-phospho-ERK |

Added by: Mary Mayperson

| Key | Value |
|-----------------|--------------------|
| CellType | CD4+ T cell |
| Organism | Mus musculus |
| Organ | Spleen |
| IsolationMethod | MACS negative sort |

No need to search – Use Tags for dynamic data re-organization (1/3)

If you have annotated your data with Tags, use the Tags tab to view files based on the Tags



No need to search – Use Tags for dynamic data re-organization (2/3)

The Tags tab allows for a dynamically re-organized data-tree representation based on your Tags

調 Advantage over deep folder hierarchies

Webclient

OMERO Data History Mapr Figure Help Tag Search

GROUP Mary Mayperson

Explore Tags Shares

Mary Mayperson

- Compound X
- DMSO control**
- 20171115_0h_DMSO_pERK_01_D1.czi
- 20171115_0h_DMSO_pERK_02_D1.czi
- 20171115_3h_DMSO_pERK_01_D1.czi
- 20171115_3h_DMSO_pERK_01_D2.czi
- 20171115_3h_DMSO_pERK_02_D1.czi
- 20171115_3h_DMSO_pERK_02_D2.czi
- 20171115_3h_DMSO_pERK_03_D1.czi
- 20171115_3h_DMSO_pERK_03_D2.czi
- 20171123_M36_D1_1_D3h.czi
- 20171123_M36_D1_2_D3h.czi
- 20171123_M36_D1_3_D3h.czi
- 20171123_M36_D1_4_D3h.czi
- 20171123_M36_D2_1_D3h.czi
- 20171123_M36_D2_2_D3h.czi
- 20171123_M36_D2_3_D3h.czi
- 20171123_M36_D2_4_D3h.czi
- 20171123_tERK_D_01_0h.czi
- 20171123_tERK_D_01_3h.czi
- 20171123_tERK_D_02_0h.czi
- 20171123_tERK_D_02_3h.czi
- 20171123_tERK_D_03_3h.czi
- 20171123_tERK_D_04_3h.czi
- 20171213_M33_01_tERK_DMSO_0h.czi

Add filter

Thumbnails

General Acquisition Preview

DMSO control

Tag ID: 19545

Owner: Mary Mayperson

Add Description

Owner: Mary Mayperson

Creation Date: 2022-03-02 10:42:44

Image Count:

Dynamically show all DMSO-control treated samples across Datasets and Projects

Using Tag Search (OMERO.webtagging extension)

Tag Search
allows combining
tags
(if it is installed)

Example:
Review all
images from
control-treated
samples for the
staining target
across
repetitions

The screenshot displays the OMERO webclient interface. The top navigation bar includes 'Data', 'History', 'Mapr', 'Figure', 'Help', and 'Tag Search' (highlighted with an orange box). The 'TAG SEARCH' panel on the left shows 'Selected Tags' as 'DMSO control' and 'phospho-ERK'. The 'Filter Results' table on the right lists 8 images with names like '20171115_3h_DMSO_pERK_03_D1.czi' and '20171115_0h_DMSO_pERK_01_D1.czi'. The 'Preview' section on the left shows 'Project: 0', 'Dataset: 0', 'Screen: 0', 'Plate: 0', 'Plate Acquisition/Run: 0', and 'Image: 8'.

| Object | Name | Import Date | Group | Link |
|--------|---------------------------------|---------------------------|-------|--------|
| | 20171115_3h_DMSO_pERK_03_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_03_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |

Using Tag Search (OMERO.webtagging extension) – create figures

Example:
Use the Tag Search results to prepare a comprehensive figure using OMERO.figure

The screenshot shows the OMERO webclient interface. On the left, the 'TAG SEARCH' section displays 'Selected Tags: DMSO control' and 'phospho-ERK'. Below this, the 'Preview' section shows 'Project: 0', 'Dataset: 0', 'Screen: 0', 'Plate: 0', 'Plate Acquisition/Run: 0', and 'Image: 8'. The main area displays a table of search results with columns: Object, Name, Import Date, Group, and Link. The table lists several objects with names like '20171115_3h_DMSO_pERK_03_D1.czi' and '20171115_0h_DMSO_pERK_01_D1.czi', all imported on April 8, 2022, at 12:50 p.m., and belonging to the 'GROUP'. On the right, the 'General' tab is active, showing a context menu with options: 'Image viewer', 'OMERO.figure' (highlighted), 'OMERO.iviewer', and 'FPBioimage'. Below the menu, there are sections for 'Added by: Mary Mayperson' with '8 Annotations linked to: 8 objects', including 'PrimaryAntibody: anti-phospho-ERK'. Other sections show 'CellType: CD4+ T cell', 'Organism: Mus musculus', 'Organ: Spleen', 'Attachments: 1', 'Comments: 0', 'Ratings: 0', and 'Others: 0'.

| Object | Name | Import Date | Group | Link |
|--------|---------------------------------|---------------------------|-------|--------|
| | 20171115_3h_DMSO_pERK_03_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_03_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |

<https://downloads.openmicroscopy.org/help/pdfs/web-tagging.pdf> (last access: 2023-08-23)



Using Tag Search (OMERO.webtagging extension) – quick split view

Example:
Use the Tag Search results to produce a quick comparative figure of the Split View

The screenshot shows the OMERO webclient interface. On the left, the 'TAG SEARCH' section displays 'Selected Tags: DMSO control' and 'phospho-ERK'. Below this, the 'Preview' section shows 'RESULTS' with counts for Project (0), Dataset (0), Screen (0), Plate (0), Plate Acquisition/Run (0), and Image (8). The main area displays a table of search results with columns: Object, Name, Import Date, Group, and Link. The table lists 8 objects, all from the 'GROUP' Mary Mayperson, with names like '20171115_3h_DMSO_pERK_03_D1.czi' and '20171115_0h_DMSO_pERK_01_D1.czi'. On the right, the 'General' tab is active, showing 'Selected 8 objects'. A context menu is open over the 'Split View Figure...' option, which also includes 'Thumbnail Figure...' and 'Make Movie...'. The 'Annotations' section shows 'Tags: 2' and 'Key-Value Pairs: 0'. The 'Add annotations to 8 objects' section shows 'Add Key' and 'Add Value' buttons. The 'Added by: Mary Mayperson' section shows '8 Annotations linked to: 8 objects' with a table of annotations: PrimaryAntibody (anti-phospho-ERK), CellType (CD4+ T cell), Organism (Mus musculus), and Organ (Spleen). The 'Attachments' section shows 1 attachment, 'Comments' shows 0 comments, 'Ratings' shows 0 ratings, and 'Others' shows 0 others.

| Object | Name | Import Date | Group | Link |
|--------|---------------------------------|---------------------------|-------|--------|
| | 20171115_3h_DMSO_pERK_03_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_01_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_0h_DMSO_pERK_02_D1.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_02_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |
| | 20171115_3h_DMSO_pERK_03_D2.czi | April 8, 2022, 12:50 p.m. | GROUP | Browse |

Using Tag Search (OMERO.webtagging extension) – quick split view

Create Split View Figure - Profil 1 - Microsoft Edge

https://omero

OMERO

Split Panels Grey: ☐ Merged Names: ☒

Image Name ▼

Ch2-T1 ☒ Ch1-T2 ☒

20171115_3h_DMSO_pERK_03_D1.czi

20171115_0h_DMSO_pERK_01_D1.czi

20171115_3h_DMSO_pERK_01_D2.czi

Ch2-T1

Ch1-T2

Ch2-T1
Ch1-T2

View Script

Cancel

Create Figure

Webclient

https://o

OMERO

Data History Mapr Figure Help Tag Search

Search:

Mary Mayperson

GROUP Mary Mayperson

Filter Results

Activities

Clear List

Split View Figure

Split view figure created and attached to image 20171115_3h_DMSO_pERK_03_D1.czi.

Annotations

Tags 2

Key-Value Pairs 16

Add annotations to 8 objects

Add Key Add Value

Added by: Mary Mayperson

8 Annotations linked to: 8 objects

PrimaryAntibody anti-phospho-ERK

Added by: Mary Mayperson

8 Annotations linked to: 8 objects

CellType CD4+ T cell

Organism Mus musculus

Organ Spleen

Attachments 0

Comments 0

Ratings 0

Others 0

TAG SEARCH

Selected Tags: DMSO control ☒ phospho-ERK ☒

Preview: ☒

RESULTS

Project: 0

Dataset: 0

Screen: 0

Plate: 0

Plate Acquisition/Run: 0

Image: 8

Object Name Import Date

20171115_3h_DMSO_pERK_03_D1.czi April 8, 2022, 12:50 p.m.

20171115_0h_DMSO_pERK_01_D1.czi April 8, 2022, 12:50 p.m.

20171115_3h_DMSO_pERK_01_D2.czi April 8, 2022, 12:50 p.m.

20171115_3h_DMSO_pERK_02_D1.czi April 8, 2022, 12:50 p.m.

20171115_0h_DMSO_pERK_02_D1.czi April 8, 2022, 12:50 p.m.

20171115_3h_DMSO_pERK_02_D2.czi April 8, 2022, 12:50 p.m.

20171115_3h_DMSO_pERK_03_D2.czi April 8, 2022, 12:50 p.m.

More information on the search syntax in OMERO:

See the OMERO guides:

<https://omero-guides.readthedocs.io/projects/introduction/en/latest/search-omero.html>

Organize your image data in OMERO

Metadata Annotations

Carsten Fortmann-Grote (MPI), Thomas Zobel (WWU)

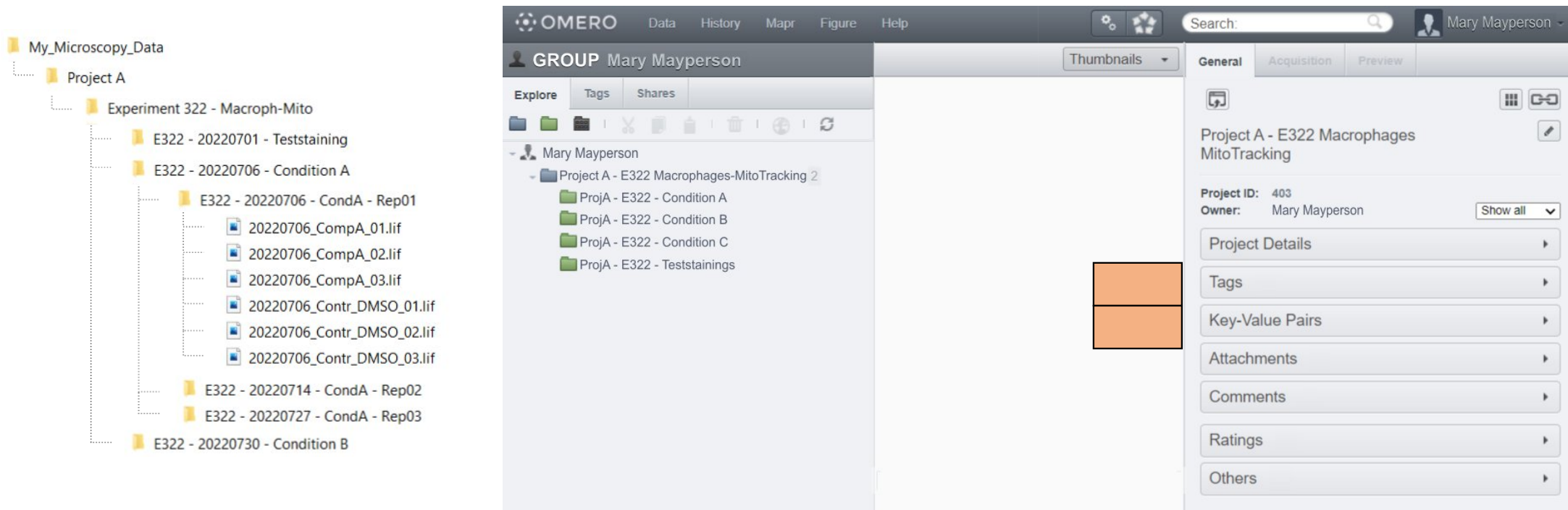
Outline

- Recap: Data organization in OMERO
- What is Metadata?
- Why should I worry about Metadata?
- How does OMERO treat Metadata
- Metadata Tags
- Metadata Key-Value pairs
- Metadata tables

Recap: Data Organization in OMERO

A file folder hierarchy is itself a form of metadata

OMERO uses *structured metadata*, e.g., with **Tags** and **Key-Value Pairs**



The image displays the OMERO web interface. On the left, a file tree shows a hierarchy: 'My_Microscopy_Data' > 'Project A' > 'Experiment 322 - Macroph-Mito'. Under this experiment, there are several folders and files, including 'E322 - 20220701 - Teststaining', 'E322 - 20220706 - Condition A', and 'E322 - 20220706 - CondA - Rep01'. The main panel shows the 'GROUP Mary Mayperson' with a tree view of 'Project A - E322 Macrophages-MitoTracking 2'. The right panel shows the 'General' tab for 'Project A - E322 Macrophages MitoTracking', displaying 'Project ID: 403' and 'Owner: Mary Mayperson'. Below this are expandable sections for 'Project Details', 'Tags', 'Key-Value Pairs', 'Attachments', 'Comments', 'Ratings', and 'Others'. Two orange rectangular boxes are overlaid on the right side of the interface, one above the 'Tags' section and one above the 'Key-Value Pairs' section.

調 Annotate data with Tags and Key-Value Pairs

What is „metadata“?

In general, metadata is often called „data about the data“.

In bioimaging, metadata accompanies the actual image (pixel) data:

- Technical metadata *(automatically recorded or added manually)*
 - Information about the instrument, including hardware components, filter settings, etc.
- Sample metadata *(researcher's documentation or published protocol)*
 - Information about the specimen, organ, cell type, sample type, test group, etc., and the experimental procedures during sample preparation, e.g., sample fixation, staining, use of antibodies, etc.
- Analysis metadata

Where to find the metadata?

Image file header Sidecar / additional file Electronic labbook Paper notebook In the data organization ...

Why does metadata matter? – the societal perspective

Good scientific practice principles (DFG Code of Conduct: doi:[10.5281/zenodo.6472827](https://doi.org/10.5281/zenodo.6472827))

- Data is fully and correctly described
- Results are reproducible

Open Science principles ([OECD recommendations](#), adopted 2006, amended 2021)

- Publicly funded research output should be available open access

FAIR data principles (Wilkinson et al., 2016, *Sci Data*, doi: [10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18))

- Data should be Findable, Accessible, Interoperable, and Reusable

**調 Rich metadata enhances reproducibility, trust, and openness,
contributing to sustainable research**

Why does metadata matter? – the personal perspective

Funding agency demands

- (Minimum) metadata standards become mandatory for third-party funding, e.g.:
[DFGguidelines](#), [ERCguidelines](#)

Career Advancement

- Publications with links to deposited data correlate with more citations, see Colavizza et al., 2020, *PLoS ONE*, doi: [10.1371/journal.pone.0230416](https://doi.org/10.1371/journal.pone.0230416)
- Sharing (reusable) data can foster new collaboration

Future-Me

- Metadata will help your colleagues find and reuse your own data in the future

Rich metadata annotation adds value to the research data

Metadata „standards“ in bioimaging?

Which metadata should be collected?

- Research-discipline-specific recommendations
- Bioimaging-specific recommendations:
 - Sarkans *et al.* (2021) REMBI: Recommended Metadata for Biological Images – enabling reuse of microscopy images in biology. *Nat Methods*, Dec;18(12). doi: [10.1038/s41592-021-01166-8](https://doi.org/10.1038/s41592-021-01166-8).
 - Hammer *et al.* (2021) Towards community-driven metadata standards for light microscopy: tiered specifications extending the OME model. *Nat Methods*, Dec;18(12). doi: [10.1038/s41592-021-01327-9](https://doi.org/10.1038/s41592-021-01327-9).
- Repository-specific requirements
 - e.g., the Image Data Resource (IDR): <https://idr.openmicroscopy.org/about/submission.html>
(see also: Ellenberg *et al.*, 2018, *Nat Methods*, doi: [10.1038/s41592-018-0195-8](https://doi.org/10.1038/s41592-018-0195-8))

What is the “correct” or “best” way to work with metadata in OMERO?

There is not “one correct” way!



OMERO offers possibilities for structured metadata for bioimaging data.

As a researcher or research group, familiarize yourself with OMERO’s possibilities.

- ! Like with good experimental design, the suitable metadata enrichment for your data should be part of your (group’s) considerations when performing research.



How is metadata organized in OMERO?

Metadata is contained:

1. In the data organization tree (implicitly)
2. Under the General tab
 - Image Details
 - **Tags**
 - **Key-Value Pairs**
 - Attachments
 - Ratings
3. Under the Acquisition tab:
 - Original metadata

The screenshot shows the OMERO webclient interface. An orange arrow labeled '1' points to the 'Explore' sidebar on the left, which displays a hierarchical tree of data organization. Another orange arrow labeled '2' points to the 'General' tab on the right, which contains 'Image Details' and 'Key-Value Pairs' sections. A third orange arrow labeled '3' points to the 'Acquisition' tab on the right. A red diagonal watermark 'original' is visible across the center. An orange box labeled 'Tags and Key-Value Pairs' points to the 'Key-Value Pairs' section in the 'General' tab, which contains a table of metadata.

| Key | Value |
|------------------|--------------------|
| CellType | CD4+ T cell |
| Organism | Mus musculus |
| Organ | Spleen |
| IsolationMethod | MACS negative sort |
| ActivationMethod | anti-CD3/anti-CD28 |

Key-Value Pairs

Key-Value Pairs allow (standardized) annotation of detailed metadata

Consist of

- **Key:** Denotes a real-world object or an abstract concept that can be assigned a specific value (of several or many possible values)
- **Value:** Number or text string that specifies the object denoted under „Key“

Examples:

Key: „cell type“

Value: „CD4+ T cell“

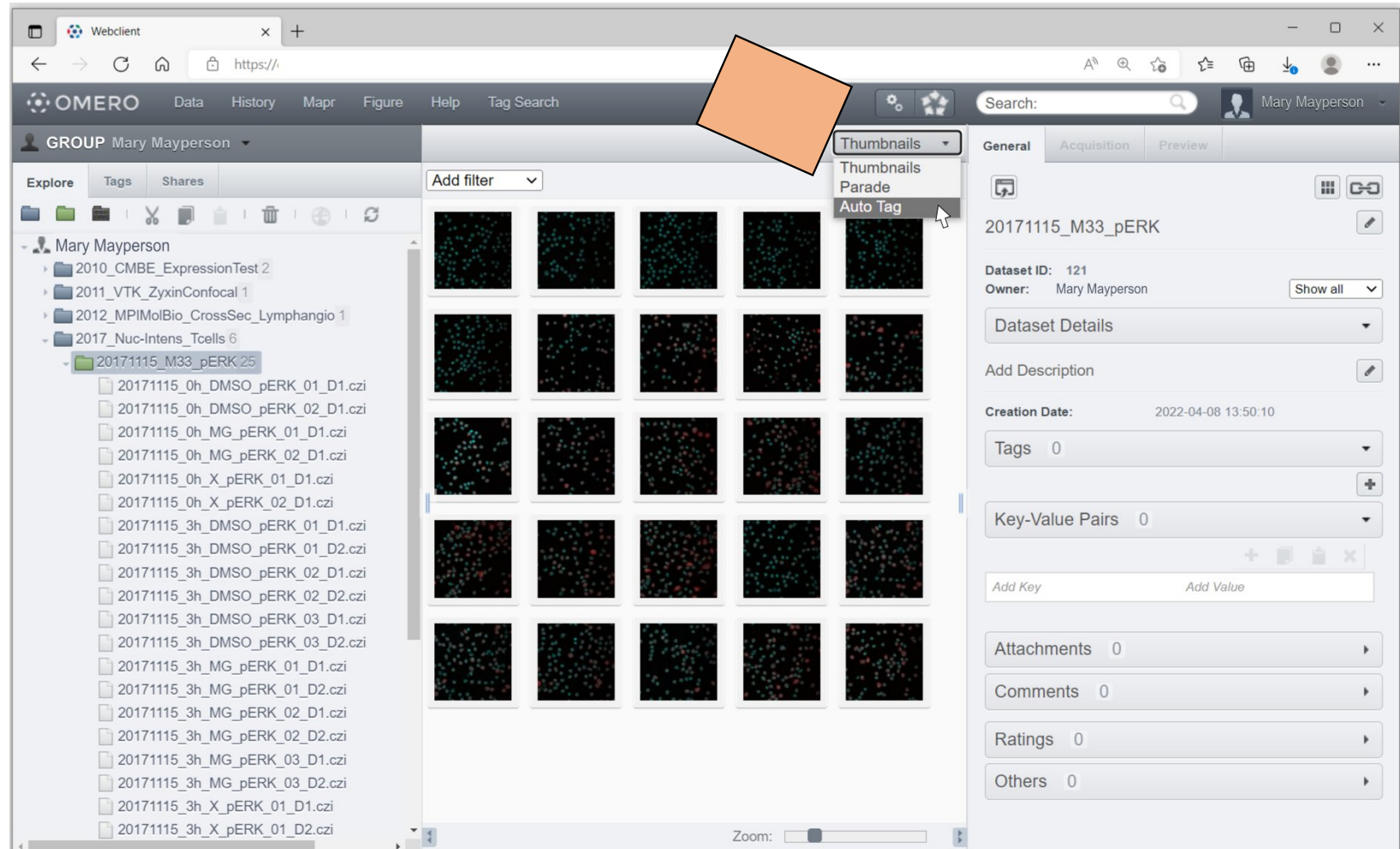
Key: „disease model“

Value: „experimental autoimmune encephalomyelitis“

Using Auto Tag (OMERO.webtagging extension) 1/6

Auto Tag can assist in automatically extracting possible Tags from your data.

1. Change the view mode to Auto Tag



Key-Value Pairs

Metadata details in form of Key-Value Pair annotation

Key-Value Pairs allow (standardized) annotation of detailed metadata

Consists of

- **Key:** Denotes a real-world object or an abstract concept that can be assigned a specific value (of several or many possible values)
- **Value:** Number or text string that specifies the object denoted under „Key“

Examples:

Key: „cell type“

Value: „CD4+ T cell“

Key: „disease model“

Value: „experimental autoimmune encephalomyelitis“

Key-Value Pairs are part of the metadata (here: in OMERO.web)

Key-Value Pairs can be annotated

- at the Image level
- at the Dataset level
- at the Project level

The screenshot shows the OMERO.web webclient interface. On the left, a file tree under 'Mary Mayperson' lists various image files. The main area displays a grid of image thumbnails. On the right, the 'General' tab of the metadata panel is active, showing details for the selected image '20171123_M36_1_D0h_pERK.czi'. The 'Key-Value Pairs' section is expanded, showing a table of annotations added by Mary Mayperson. An orange callout box with the text 'Key-Value Pairs' points to this section.

| Key | Value |
|--------------|----------------------------------|
| primary_AB | anti-p-ERK1/2 (Cell Signaling) |
| secondary_AB | goat anti-rabbit Alexa-Fluor-647 |
| Cell type | CD4+ T cells |
| Organ | spleen |
| Organism | Mus musculus |
| Strain | C57BL/6 |

Options to annotate Key-Value Pairs in OMERO

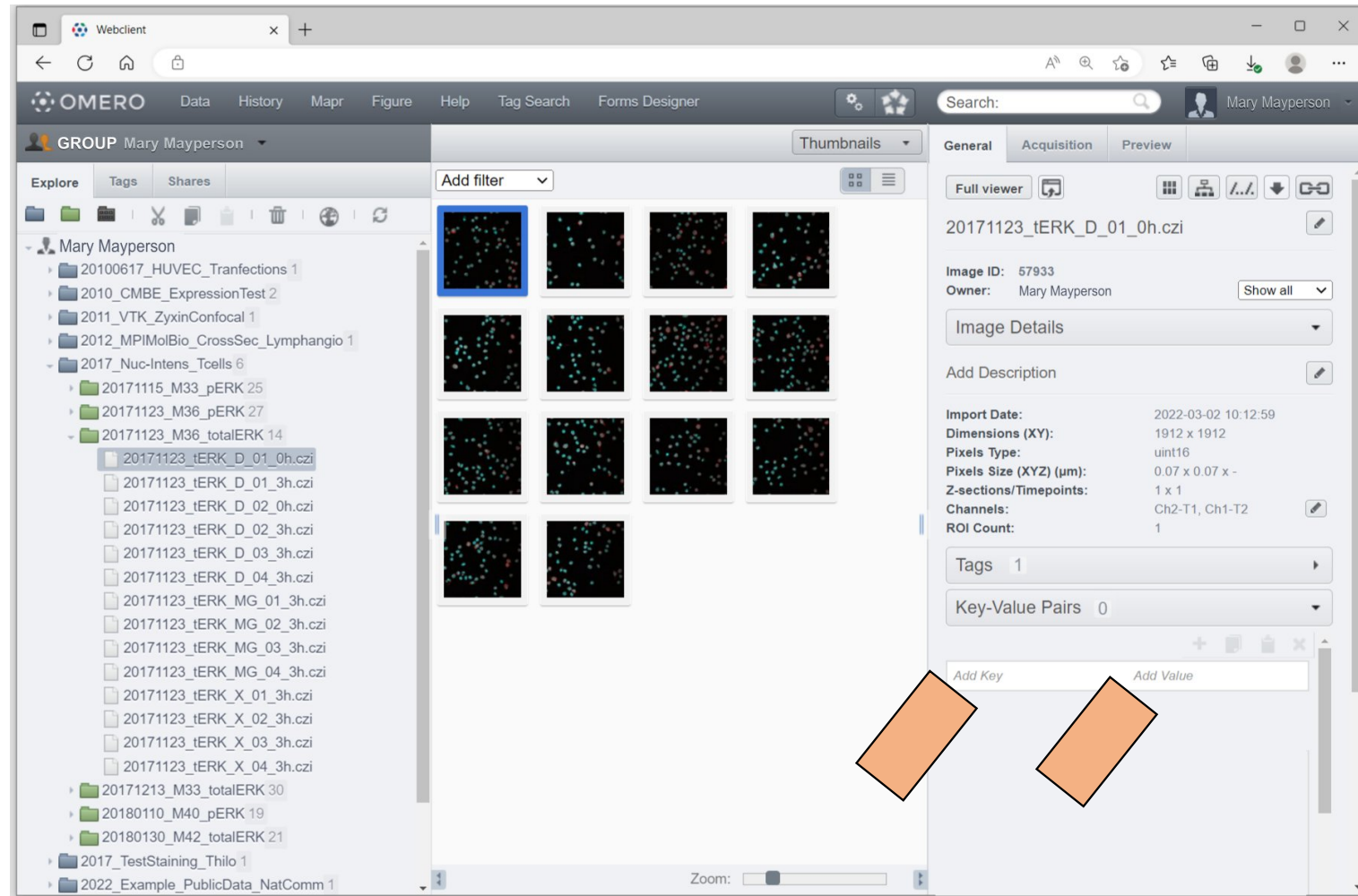
- Manual Key-Value Pair annotation
- **Using Bulk Annotation Tools**
- Using the Metadata Editor Tool OMERO.mde (only during data upload with the OMERO.insight client)

Manual annotation of Key-Value Pairs in OMERO

To add a Key-Value Pair manually,
select

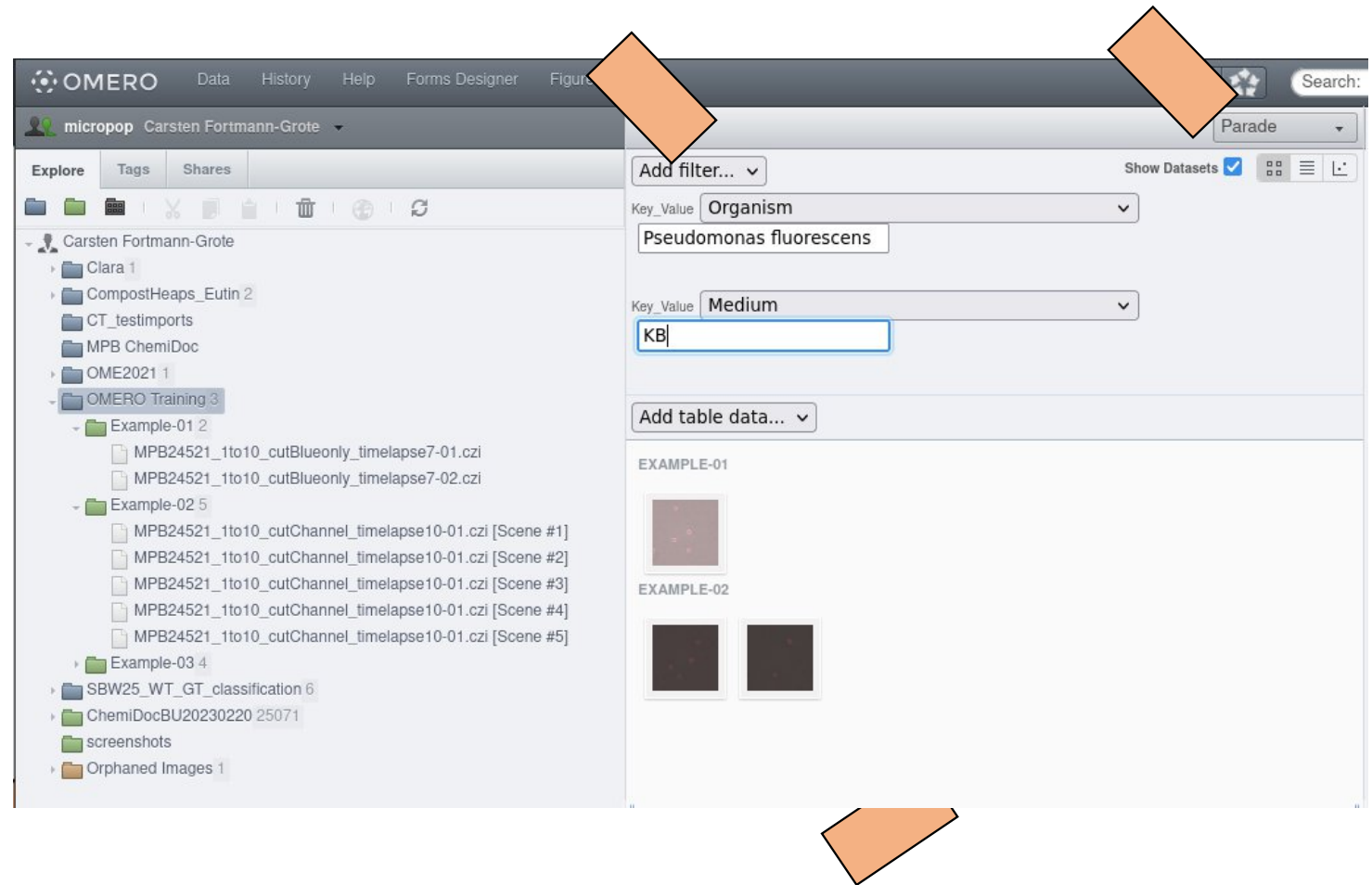
- an image
- a collection of images
- a Dataset
- a Project

and fill out the fields
under the Key-Value
Pairs toggle



Filter by Key-Value pairs

Faceted search
In the Parade view
across Datasets in
one Project



Search for a specific Key-Value Pair

Using the combination of
<Key>:<Value>
in the search field allows you to
directly search in
your data for a
specific Key-Value
Pair annotation

The screenshot shows the OMERO webclient interface. The search bar contains the text "Organ spleen". The search results list shows several images, including "20171123_M36_1_D0h_pERK.czi". The right panel displays the details for the selected image, including the image ID, owner, and key-value pairs.

Search: Organ spleen

Restrict by Field:

- ☐ Name
- ☐ Description
- ☒ Annotations
- ☐ Files
- ☐ Tags

Search for:

- ☒ Images
- ☒ Datasets
- ☒ Projects
- ☐ Wells
- ☐ Plates
- ☐ Screens

Scope:

In group: All Groups

Data owned by: Mary Mayperson

Date: Import date

Filter Results: 53 results

| Type | Name | Acquired |
|-------|---------------------------------|---------------------|
| Image | 20171123_M36_1_D0h_pERK.czi | 2022-03-02 10:13:00 |
| Image | 20171123_M36_1_D3h_negative.czi | 2022-03-02 10:13:02 |
| Image | 20171123_M36_D1_1_MG3h.czi | 2022-03-02 10:12:16 |
| Image | 20171123_M36_D2_4_D3h.czi | 2022-03-02 10:12:18 |
| Image | 20171123_M36_D2_2_D3h.czi | 2022-03-02 10:12:21 |
| Image | 20171123_M36_D1_4_MG3h.czi | 2022-03-02 10:12:26 |
| Image | 20171123_M36_D2_3_D3h.czi | 2022-03-02 10:12:28 |
| Image | 20171123_M36_D2_2_MG3h.czi | 2022-03-02 10:12:28 |

General | Acquisition | Preview

Full viewer

20171123_M36_1_D0h_pERK.czi

Image ID: 57934
Owner: Mary Mayperson

Image Details

Add Description

Import Date: 2022-03-02 10:13:00
Dimensions (XY): 1912 x 1912
Pixels Type: uint16
Pixels Size (XYZ) (µm): 0.07 x 0.07 x -
Z-sections/Timepoints: 1 x 1
Channels: Ch2-T1, Ch1-T2
ROI Count: 0

Tags 0

Key-Value Pairs 0

Added by: Mary Mayperson

| Key | Value |
|--------------|----------------------------------|
| primary_AB | anti-p-ERK1/2 (Cell Signaling) |
| secondary_AB | goat anti-rabbit Alexa-Fluor-647 |
| Cell type | CD4+ T cells |
| Organ | spleen |
| Organism | Mus musculus |
| Strain | C57BL/6 |

Assignment

- 1) Locate your “Example-01” Dataset in OMERO Web
 - 1) Add a key-value pair to all images:
 - 2) Organism: *Pseudomonas fluorescens* SBW25
 - 3) Add another key-value pair to all images: Medium: KB for the first and medium: LB for the second image
 - 4) Perform 2) and 3) for the Example-02 (set different media for some images)
 - 5) Confirm the annotations in OMERO.web (refresh!)
 - 6) Select the OMERO-Training Project
 - 7) Change the central panel view to “Parade”
 - 8) Use the filter function on your project to locate all images with organism “*Pseudomonas fluorescens* SBW25” and medium LB or KB
 - 9) Search your images for all data with medium: LB or KB

Assignment

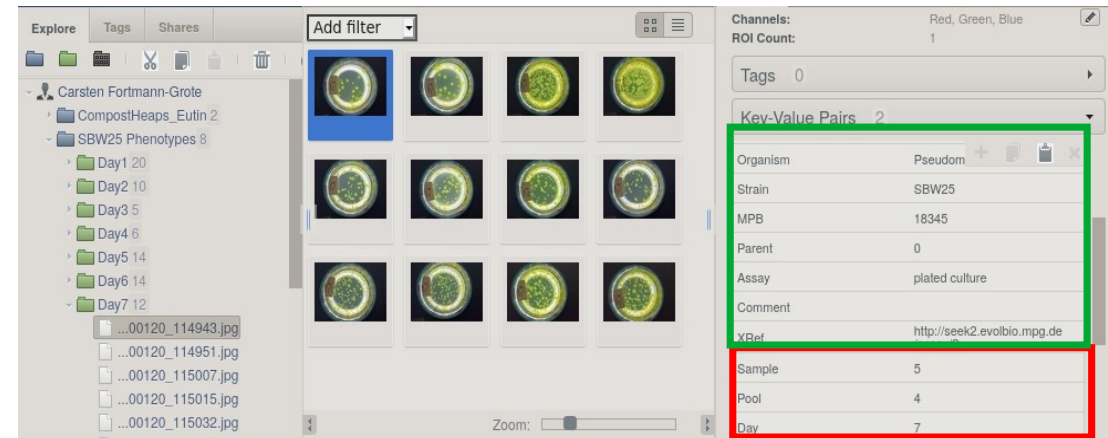
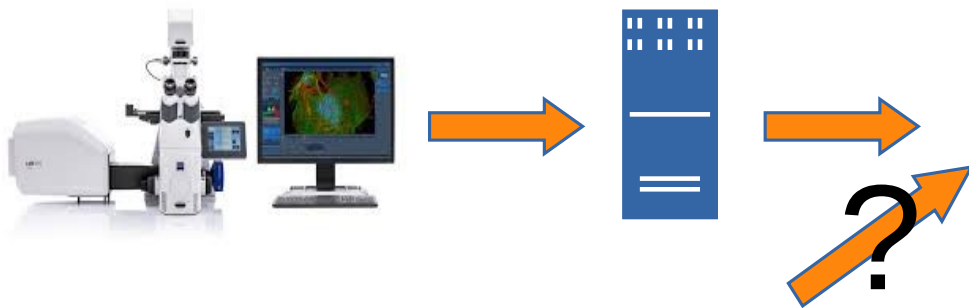
- 1) Locate your “Example-01” Dataset in OMERO Web
 - 1) Add a key-value pair to all images:
 - 2) Organism: *Pseudomonas fluorescens* SBW25
 - 3) Add another key-value pair to all images: Medium: KB for the first and medium: LB for the second image
 - 4) Perform 2) and 3) for the Example-02 (set different media for some images)
- 5) Confirm the annotations in OMERO.web (refresh!)
- 6) Select the OMERO-Training Project
- 7) Change the central panel view to “Parade”
- 8) Use the filter function on your project to locate all images with organism “*Pseudomonas fluorescens* SBW25” and medium LB or KB
- 9) Search your images for all data with medium: LB or KB

Key-Value Pairs in OMERO

Key-Value Pair enrichment with OMERO Bulk Annotation Tools

Based on an original script by Christian Evenhuis
<https://github.com/evenhuis/omero-user-scripts>
(Modified by other users' contributions, see
<https://github.com/ome/omero-scripts> for latest version)

Turning spreadsheets into map annotations



| | A | E | F | G | L | M | N |
|----|-------------------------|-------------------------|--------|-------|--------|------|-----|
| 1 | filename | Organism | Strain | MPB | Sample | Pool | Day |
| 2 | IMG_20200120_114943.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 5 | 4 | 7 |
| 3 | IMG_20200120_114951.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 5 | 4 | 7 |
| 4 | IMG_20200120_115032.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 4 | 3 | 7 |
| 5 | IMG_20200120_115041.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 4 | 3 | 7 |
| 6 | IMG_20200120_115109.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 3 | 4 | 7 |
| 7 | IMG_20200120_115118.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 3 | 4 | 7 |
| 8 | IMG_20200120_115158.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 2 | 4 | 7 |
| 9 | IMG_20200120_115210.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 2 | 4 | 7 |
| 10 | IMG_20200120_115313.jpg | Pseudomonas fluorescens | SBW25 | 18345 | 1 | 4 | 7 |
| 11 | | | | | | | |

Common metadata

Specific metadata

- Avoid manual annotation of each individual image
- Add **common metadata** attributes through web form
→ template annotation spreadsheet
- Enter **specific metadata** into spreadsheet
- Import annotations from spreadsheet
- → all metadata available as key-value pairs

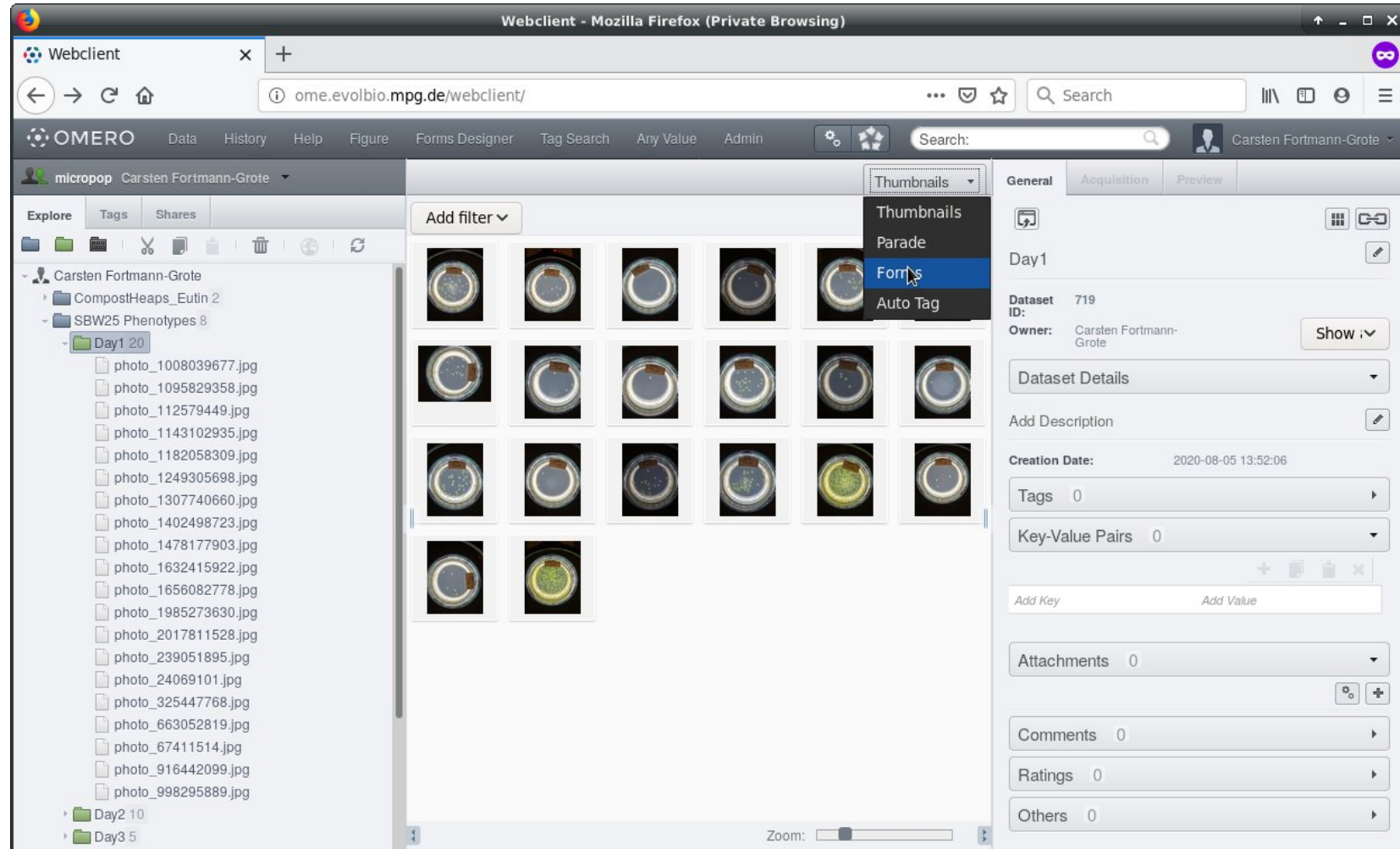
Annotation workflow

- 1) Annotate container object (dataset/project) with **common metadata** → *omero.forms*
- 2) Copy map annotations from dataset to images
- 3) Export **common metadata to template spreadsheet** → *KeyVal_to_csv.py*
- 4) Edit spreadsheet to enter image **specific metadata**.
- 5) Re-import the finalized spreadsheet as dataset attachment.
- 6) Extract **specific metadata** from attached spreadsheet and populate the map annotation of each image → *KeyVal_from_csv.py*



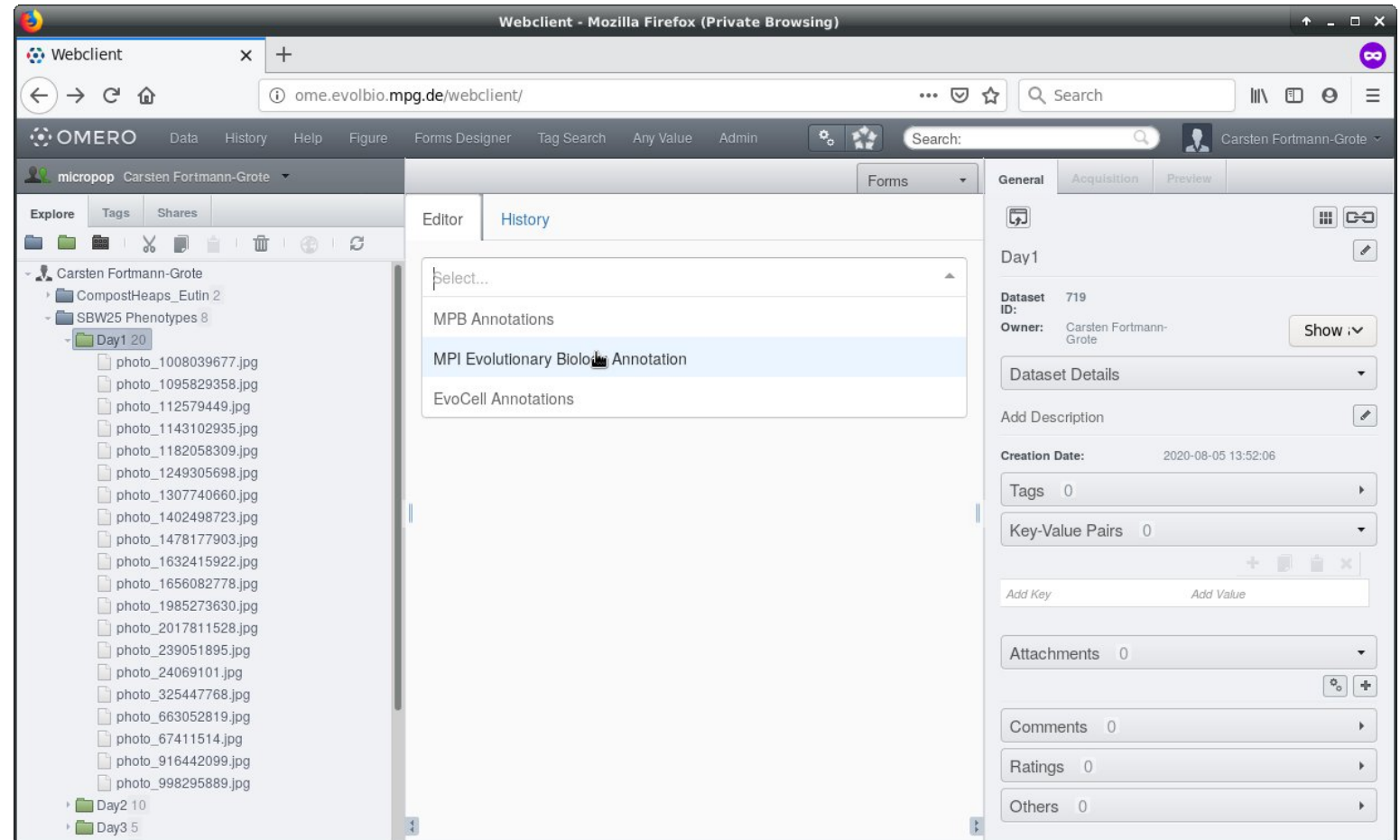
Using OMERO Forms

- 1) Select dataset
- 2) Select Forms from dropdown menu



Using OMERO Forms

- 1) Select dataset
- 2) Select Forms from dropdown menu
- 3) Select form template



Using OMERO Forms

- 1) Select dataset
- 2) Select Forms from dropdown menu
- 3) Select form template
- 4) Enter data into form
- 5) Submit

MPB Annotation Form

A minimal information template for MPB microscopy images

Author (First Last)

Image type

Organism

Strain

MPB Number*

Parent image ID

Investigation*

Study*

Assay*

Comment

Cross Reference (link)

Submit

Using OMERO Forms

- 1) Select dataset
- 2) Select Forms from dropdown menu
- 3) Select form template
- 4) Enter data into form
- 5) Submit form
- 6) Check annotations

A minimal information template for live & microscopy images

Author (First Last)
Loukas Theodosiu

Image type
still

Organism
Pseudomonas fluorescens

Strain
SBW25

MPB Number*
0

Parent image ID
0

Investigation*
Evolution of Colony Morphology

Study*
Long term SBW25 evolution experiment

Assay*
Plated culture photography

Comment

Cross Reference (link)

Submit

Day1

Dataset ID: 719
Owner: Carsten Fortmann-Grote **Show**

Dataset Details

Add Description

Creation Date: 2020-08-05 13:52:06

Tags 0

Key-Value Pairs 1

ADD NEW ADD VALUE + - X

hms.harvard.edu/omero/forms/kvdata/MPB Annotations
Added by: Carsten Fortmann-Grote

| | |
|---------------|--------------------------------------|
| Author | Loukas Theodosiu |
| Type | still |
| Organism | Pseudomonas fluorescens |
| Strain | SBW25 |
| MPB | 0 |
| Parent | 0 |
| Investigation | Evolution of Colony Morphology |
| Study | Long term SBW25 evolution experiment |
| Assay | Plated culture photography |

Attachments 0

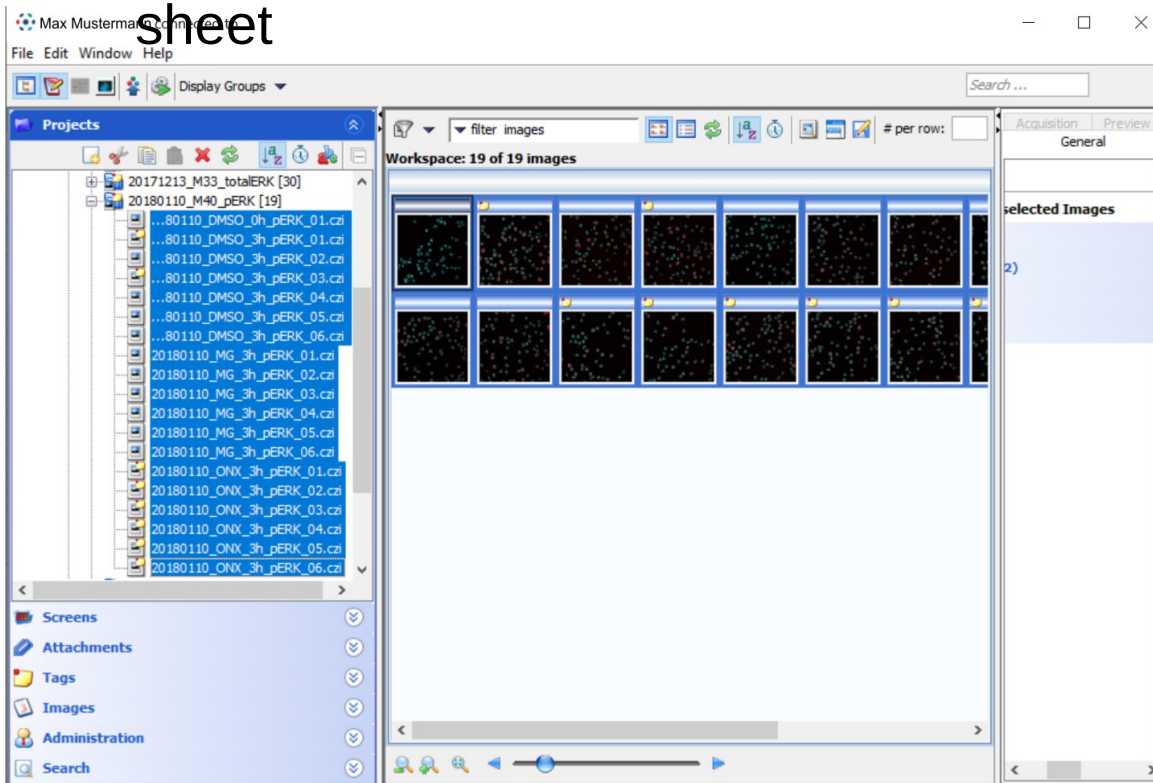
Comments 0

Ratings 0

Others 0

Key-Value Pair Annotation with the „KeyVal from csv“ script (1/7)

- 1) Prepare a table with Keys in row 1. The first Key should be „Image“
- 2) Select a group of images in OMERO.insight (*not* in OMERO.web)
- 3) Copy the image names and paste them under the Key „Image“ into a table sheet



| | A | B | C | D |
|----|------------------------------|----------|--------|----------------------|
| 1 | Image | Organism | Strain | Anatomical structure |
| 2 | 20180110_DMSO_0h_pERK_01.czi | | | |
| 3 | 20180110_DMSO_3h_pERK_01.czi | | | |
| 4 | 20180110_DMSO_3h_pERK_02.czi | | | |
| 5 | 20180110_DMSO_3h_pERK_03.czi | | | |
| 6 | 20180110_DMSO_3h_pERK_04.czi | | | |
| 7 | 20180110_DMSO_3h_pERK_05.czi | | | |
| 8 | 20180110_DMSO_3h_pERK_06.czi | | | |
| 9 | 20180110_MG_3h_pERK_01.czi | | | |
| 10 | 20180110_MG_3h_pERK_02.czi | | | |
| 11 | 20180110_MG_3h_pERK_03.czi | | | |
| 12 | 20180110_MG_3h_pERK_04.czi | | | |
| 13 | 20180110_MG_3h_pERK_05.czi | | | |
| 14 | 20180110_MG_3h_pERK_06.czi | | | |
| 15 | 20180110_ONX_3h_pERK_01.czi | | | |
| 16 | 20180110_ONX_3h_pERK_02.czi | | | |
| 17 | 20180110_ONX_3h_pERK_03.czi | | | |
| 18 | 20180110_ONX_3h_pERK_04.czi | | | |
| 19 | 20180110_ONX_3h_pERK_05.czi | | | |
| 20 | 20180110_ONX_3h_pERK_06.czi | | | |
| 21 | | | | |
| 22 | | | | |
| 23 | | | | |
| 24 | | | | |
| 25 | | | | |
| 26 | | | | |

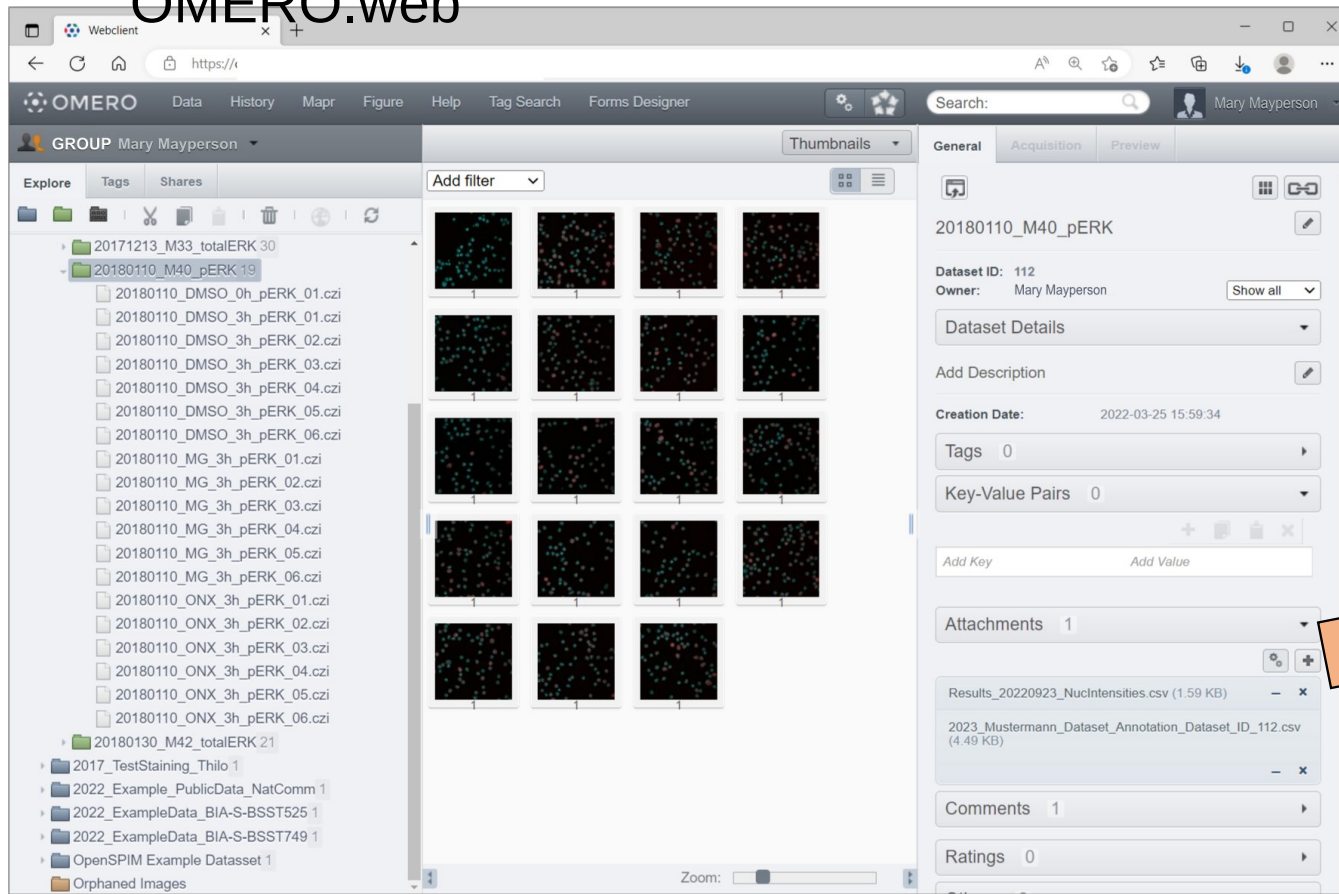
Key-Value Pair Annotation with the „KeyVal from csv“ script (2/7)

- 4) Fill the Values for each Key and each image as necessary
- 5) Save the table as CSV (Comma delimited) (*.csv)

| | A | B | C | D | E | F | G | H | I | J |
|----|------------------------------|--------------|---------|----------------------|---------------------------------|--------------------------------------|--------------------------------|---------------------------------------|------------------------|--------------------------|
| 1 | Image | Organism | Strain | Anatomical structure | Cell Type | Cell Activation | Concentrated - Cell Activation | Unit - Concentrated - Cell Activation | Time - Cell Activation | Compound Based Treatment |
| 2 | 20180110_DMSO_0h_pERK_01.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | unstimulated | | 0 ug/mL | 0 h | polar aprotic solvent |
| 3 | 20180110_DMSO_3h_pERK_01.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 4 | 20180110_DMSO_3h_pERK_02.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 5 | 20180110_DMSO_3h_pERK_03.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 6 | 20180110_DMSO_3h_pERK_04.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 7 | 20180110_DMSO_3h_pERK_05.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 8 | 20180110_DMSO_3h_pERK_06.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | polar aprotic solvent |
| 9 | 20180110_MG_3h_pERK_01.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 10 | 20180110_MG_3h_pERK_02.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 11 | 20180110_MG_3h_pERK_03.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 12 | 20180110_MG_3h_pERK_04.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 13 | 20180110_MG_3h_pERK_05.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 14 | 20180110_MG_3h_pERK_06.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 15 | 20180110_ONX_3h_pERK_01.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 16 | 20180110_ONX_3h_pERK_02.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 17 | 20180110_ONX_3h_pERK_03.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 18 | 20180110_ONX_3h_pERK_04.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 19 | 20180110_ONX_3h_pERK_05.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 20 | 20180110_ONX_3h_pERK_06.czi | Mus musculus | C57BL/6 | Spleen | CD4-positive, alpha-beta T cell | antibody-mediated anti-CD3 anti-CD28 | 5, each | ug/mL | 3 h | enzyme inhibitor |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |

Key-Value Pair Annotation with the „KeyVal from csv“ script (3/7)

6) Go to the Dataset in
OMERO.web

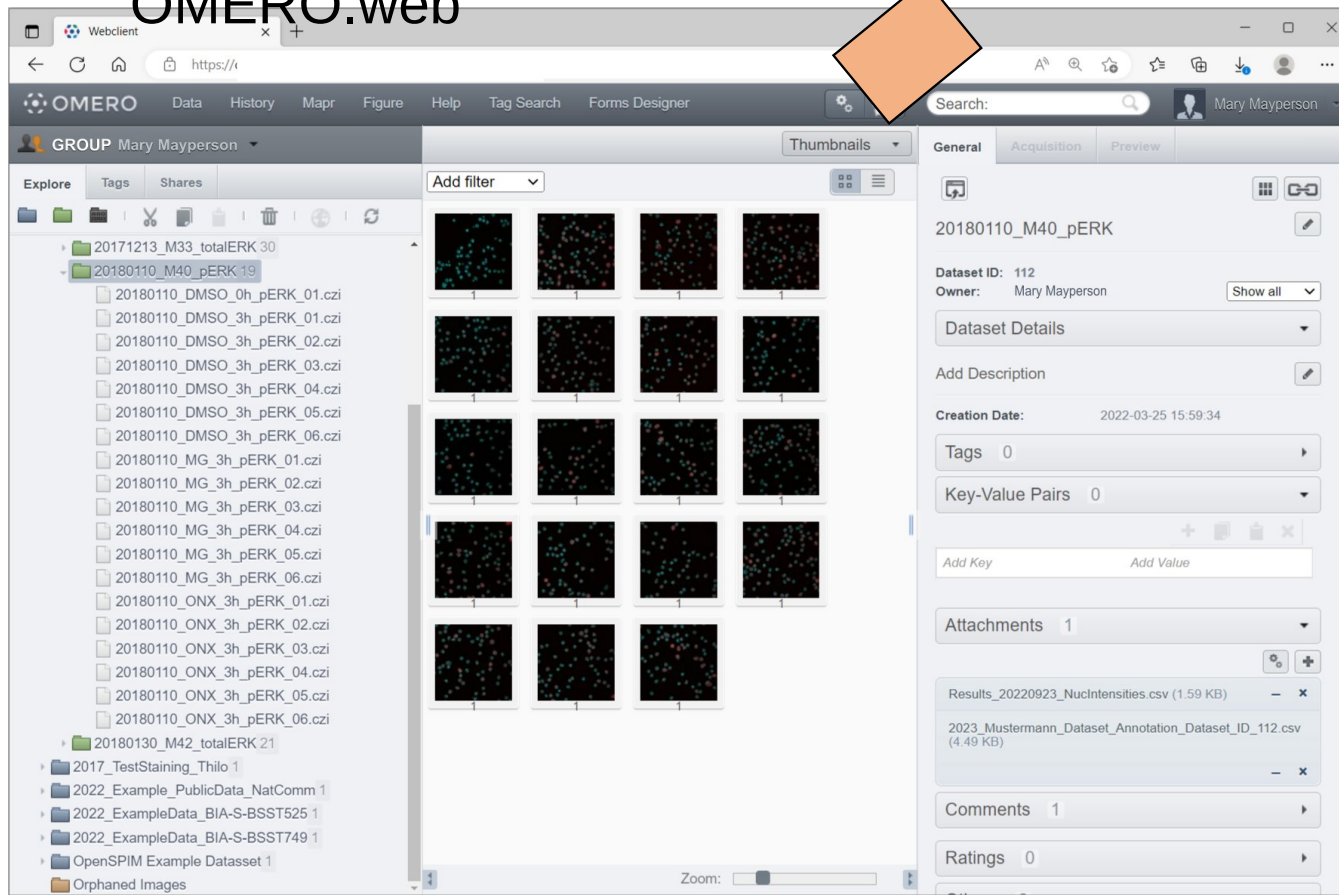


Select the Dataset that contains the images for annotation (do not select an individual image!)

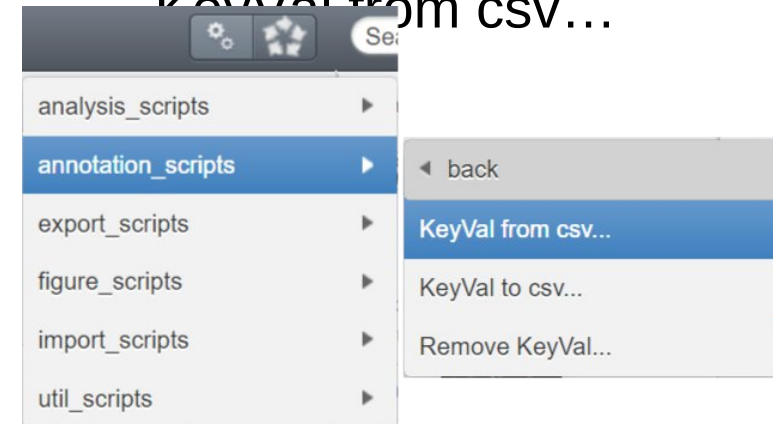
Upload the CSV-table as an attachment to the Dataset

Key-Value Pair Annotation with the „KeyVal from csv“ script (5/7)



8) Go to the Dataset in OMERO.web



9) Go to the scri
()
go to
annotation_scripts
go to
KeyVal from csv...

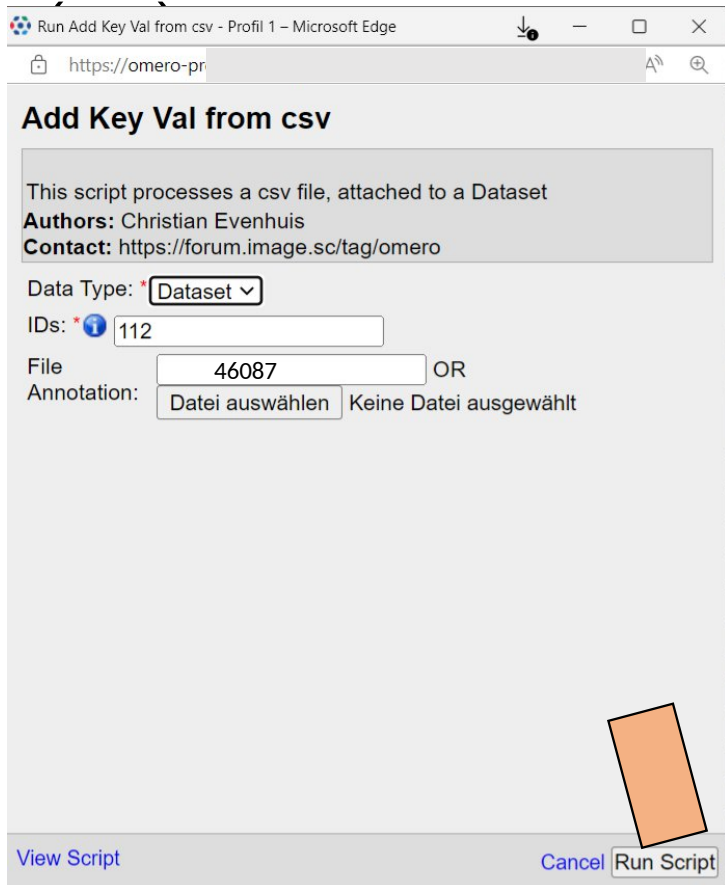


Optional:

Mark the table using the  icon followed by  before step 9

Key-Value Pair Annotation with the „KeyVal from csv“ script (6/7)

10) Enter the File Annotation **Annotation ID:**) if you have not marked the tab ☒



Run Add Key Val from csv - Profil 1 - Microsoft Edge

https://omero-pr

Add Key Val from csv

This script processes a csv file, attached to a Dataset
Authors: Christian Evenhuis
Contact: <https://forum.image.sc/tag/omero>

Data Type: **Dataset** ▼

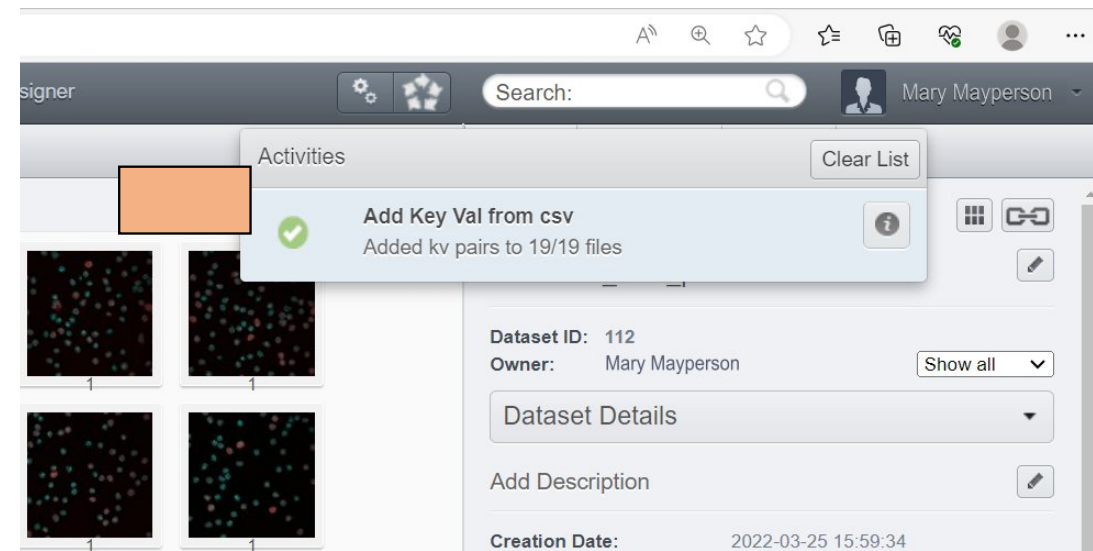
IDs: ⓘ 112

File 46087 OR

Annotation:

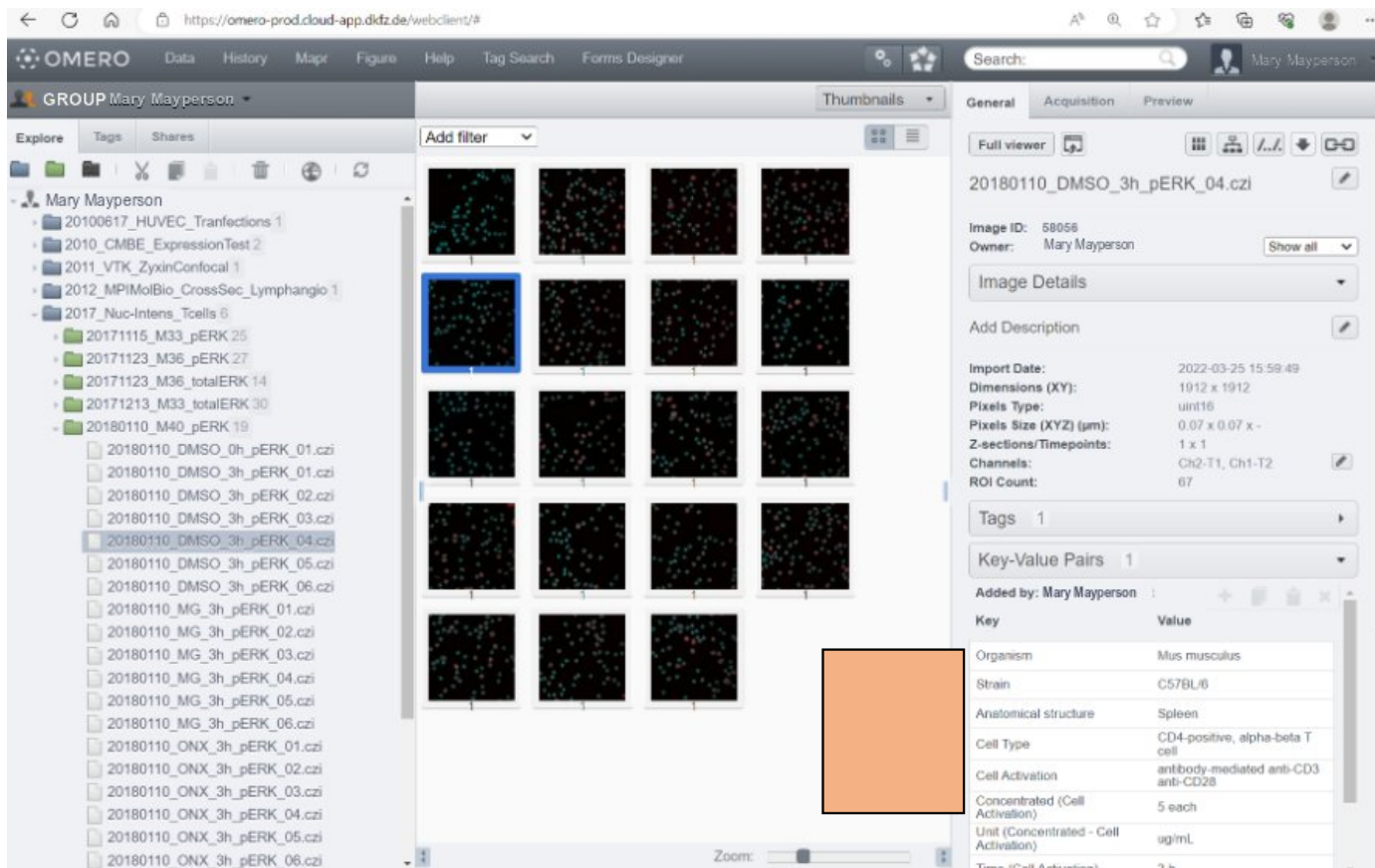
[View Script](#)

9) Run the script to upload the Annotations
Review the script result:



Key-Value Pair Annotation with the „KeyVal from csv“ script (7/7)

11) Check the images for successful Key-Value Pair population



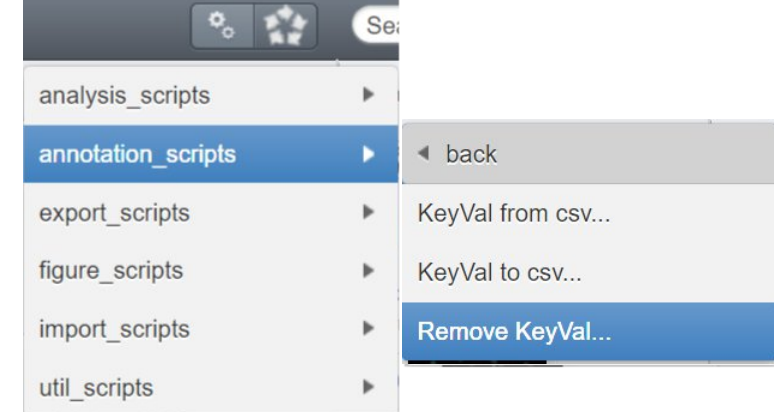
Optional:

You can also remove all the Key-Value Pairs. Mark the files for which KV-Pairs should be deleted and go to:

Scripts

調 annotation_scripts

調 Remove KeyVal...



Assignment

- 1) Upload images in */mpistaff/OMERO-Training/Dataset/Example-03* to a new OMERO Dataset
- 2) Annotate the Dataset using the generic MPI EvolBio Form
- 3) Copy the new key-value pairs annotations to all images
- 4) Create a new key-value pair with key="Plating date" and value="2020-10-12"
- 5) Run the keyval-to-csv script. Refresh
 - 1) Download and edit the csv in a spreadsheet editor
 - 2) Add new columns "Sample"
 - 3) and fill in the values using the information from the plate labels.
- 6) Save the spreadsheet as csv
- 7) Import the spreadsheet as a file annotation to the Dataset created in step 1)
- 8) Run the keyval-from-csv script
- 9) Confirm the new key-value pairs on the data
- 10) Use the filter or search functions to filter your data based on the new key-value pairs
- 11) Feedback: How do you think this workflow fits into your routine?

Using ontologies with Key-Value Pairs in OMERO

For humans, natural language terms are good to understand the data.

For computers, natural language terms can be ambiguous.

- Unique identifiers are optimal for **machine readability** but are hard for humans to read. (e.g., a URI or URL)

OMERO does not provide a direct connection between the Key-Value Pair terms and ontologies so far.

調 What are the current recommendations?

Ontology-based Annotation in OMERO - recommendation

To create machine-actionable metadata for your data, make use of **ontology terms** and **ontology term source references**:

- Use the ontology-derived term for a specific Key as the Value
- Add the ontology term URL as the Value for a second Key using the same <Key> + „Term Accession Number“

KEY

Biological entity
Biological entity Term Accession Number

VALUE

T cell receptor complex
http://purl.obolibrary.org/obo/GO_0042101



Adopted from the REMBI guidelines: [10.1038/s41592-021-01166-8](https://isa-specs.readthedocs.io/en/latest/isatab.html), in combination with ISA-TAB: <https://isa-specs.readthedocs.io/en/latest/isatab.html> (last access: 2023-08-16)



How should data be annotated to be sufficiently enriched?

The specific content of your annotation depends on your

- research field
- experimental setup
- analysis strategy
- intended reuse potential for your data.

Bioimaging-specific recommendations:

- Sarkans et al. (2021) REMBI: Recommended Metadata for Biological Images – enabling reuse of microscopy images in biology. *Nat Methods*, Dec;18(12):1418-1422.

doi: [10.1038/s41592-021-01166-8](https://doi.org/10.1038/s41592-021-01166-8).

- Hammer et al. (2021) Towards community-driven metadata standards for light microscopy: tiered specifications extending the OME model. *Nat Methods*, Dec;18(12):1427-1440.

doi: [10.1038/s41592-021-01327-9](https://doi.org/10.1038/s41592-021-01327-9).

The MetaData Editor (MDE)

Key-Value Pair Annotation with OMERO.mde

Import Data

Window Help

Import Data: Membrane Dye Database

Select data to import and monitor import

Select Data to Import Specify MetaData

ImportQueue

- 4i BODIPY Ctl.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 24h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 24h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY Ctl.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 48h.tif [Group: OE0629, Project: 20]
- 4i BODIPY FSH-PTX 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY KSR 15% 72h.tif [Group: OE0629, Project: 20]
- 4i BODIPY KSR-PTX 72 h.tif [Group: OE0629, Project: 20]

[OME-Model]{0}

- [OME:Image]{0}
- [OME:Experiment]{0}

[OME:Image]{0}

Name:

Description:

Acquisition Time:

Dim X x Y:

Pixel Depth:

Pixel Size (XY):

Dim Z x T x C:

Time Increment: ms

Stage Label (XY): reference frame

[OME:Objective]{0}

ID:

Model:

Manufacturer:

Nominal Magnification:

Calibration Magnification:

Lens NA:

Immersion:

Correction:

Working Distance:

Iris:

User::Refraction Index:

User::Medium:

User::Correction Collar:

Reset object tree

Setup: Membrane Dye Database Configuration... show only required Menu... Clear Input Cancel All Import

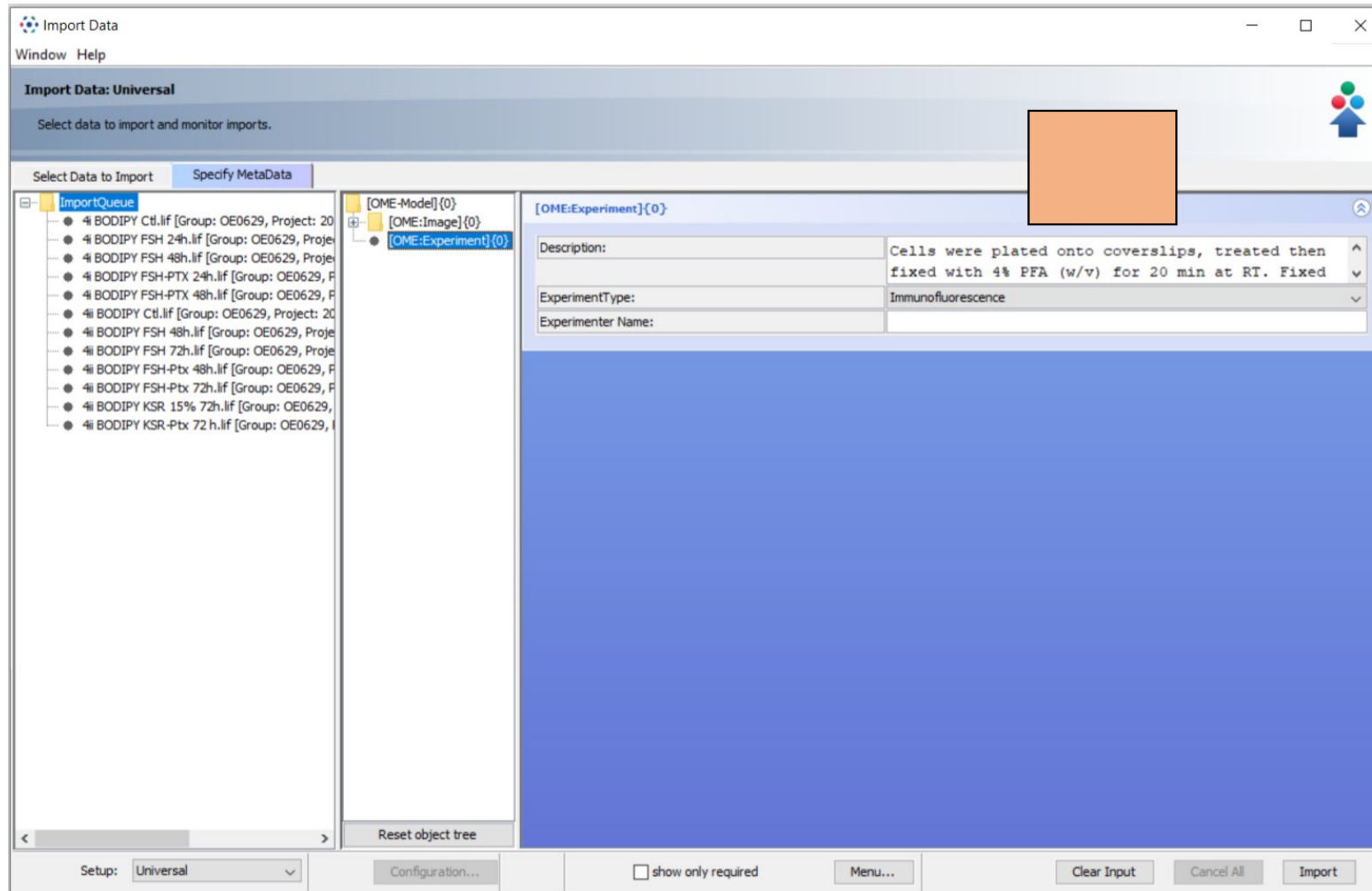
In **OMERO.insight**, go to the

Specify MetaData

tab before importing the selected import queue.

(OMERO.mde is integrated into the OMERO.insight client)

Key-Value Pair Annotation with OMERO.mde



Use the entry masks of OMERO.mde's user interface to review the automatically extracted metadata from the files and to annotate metadata before import.

(OMERO.mde is fully configurable and complies with the OME Data Model)

Review the Key-Value Pairs after upload (here: OMERO.web)

The screenshot displays the OMERO.web webclient interface. On the left, a sidebar shows the user 'Mary Mayperson' and a list of folders, including '2022_ExampleData_BIA-S-BSST749'. A sub-folder 'Figure 4 192' is expanded, showing a list of image files. The main area displays a grid of 24 thumbnail images of cells stained with DAPI (blue) and BODIPY (green). The right panel shows the details for the selected image, '4i BODIPY FSH 24h.tif [Series019]'. The 'Key-Value Pairs' section is expanded, showing a table with the following data:

| Add Key | Add Value |
|---------|---|
| MDE | Cells were plated onto coverslips, treated then fixed with 4% PFA (w/v) for 20 min at RT. Fixed cells were incubated with 5 µg/ml BODIPY 493/503 (Thermo Fisher Scientific) for 25 min at RT in the dark. Coverslips were mounted onto slides using Fluoromount G with DAPI (ThermoFisher Scientific) and cells imaged via confocal microscopy. |

Note:
MDE-generated
Key-Value Pairs
cannot be edited
manually after
import!



Example Data: Hanyaloglu et al. (2021). *BioStudies*, S-BSST749. Retrieved from <https://www.ebi.ac.uk/biostudies/Biolimages/studies/S-BSST749>



Assignment

- 1) Copy the file */mpistaff/OMERO-Training/mdeConfiguration.xml* to the *omero/* directory inside your home directory
- 2) (Re)start OMERO.Insight
- 3) Launch the Importer and put the dataset */mpistaff/OMERO-Training/Datasets/Example-02* on the queue.
- 4) **Before starting the import queue**, click “MDE” in the lower right corner.
- 5) Under Setup, select “Example Setup: Study Info”.
- 6) In the Metadata panel, select “Study Info”
- 7) Fill out the study information
- 8) - Select “Pseudomonas fluorescens SBW25” from the Organism dropdown.
- 9) Launch the import
- 10) Confirm that all imported images are annotated with MDE metadata
- 11) Discuss for your research group, which metadata fields (aka “keys”) would you suggest for a customized metadata entry form? Would you prefer to annotate during import or afterwards (e.g. using the bulk annotation procedure explained earlier).



Organize your image data with OMERO

Getting more out of OMERO

Carsten Fortmann-Grote (MPI), Thomas Zobel (WWU)

Content

- Creating publication ready figures with OMERO.figure
- Connect OMERO to Fiji, Napari, python, R, ...
- Using OMERO on the command line

Learning objective

After this lecture, you will know how to

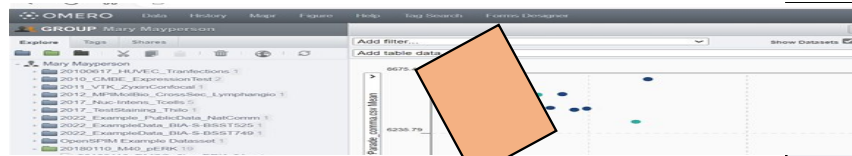
- Create reproducible figures for publications and presentations
- Load images into image analysis environments
- Attach the analysis results to OMERO
- Download and upload images from the command line

Organize your image data with OMERO

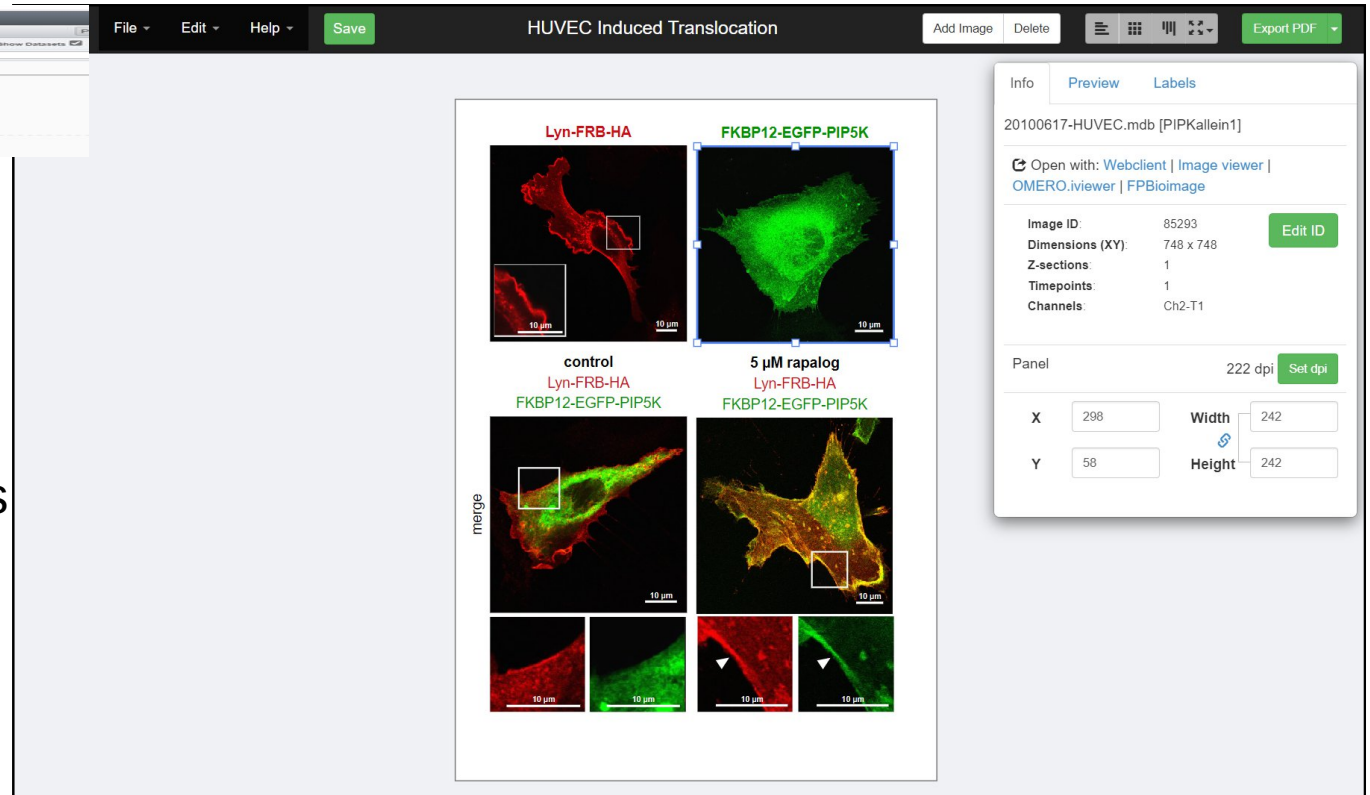
OMERO.figure

Carsten Fortmann-Grote (MPI), Thomas Zobel (WWU)

OMERO.figure – create publication-ready figures in OMERO



- Images are linked to original files (no JPEG/TIFF/PNG exports!)
- Export your figure to a vector pdf
- Access the original images from the figure at any time
- Automatize inset creation and labelling



Learn how to use OMERO.figure:

OMERO.figure for beginners introduction (P. Walczysko): <https://www.youtube.com/watch?v=i3jXplmD81s>

(~20 min)

OMERO.figure workshop (W. Moore): <https://www.youtube.com/watch?v=E0Fgw1uUAXA&t=1440s>

(~35 min)

EPFL BIOP OMERO Wiki: https://wiki-biop.epfl.ch/en/Image_Storage/OMERO/OMEROFigure

(online read & video demo)

OMERO.figure demo by E. Ratamero: <https://www.youtube.com/watch?v=YeCFaB7VAAQ>

(~10 min)



5

Official guide: <https://omero-guides.readthedocs.io/en/latest/figure/docs/index.html>

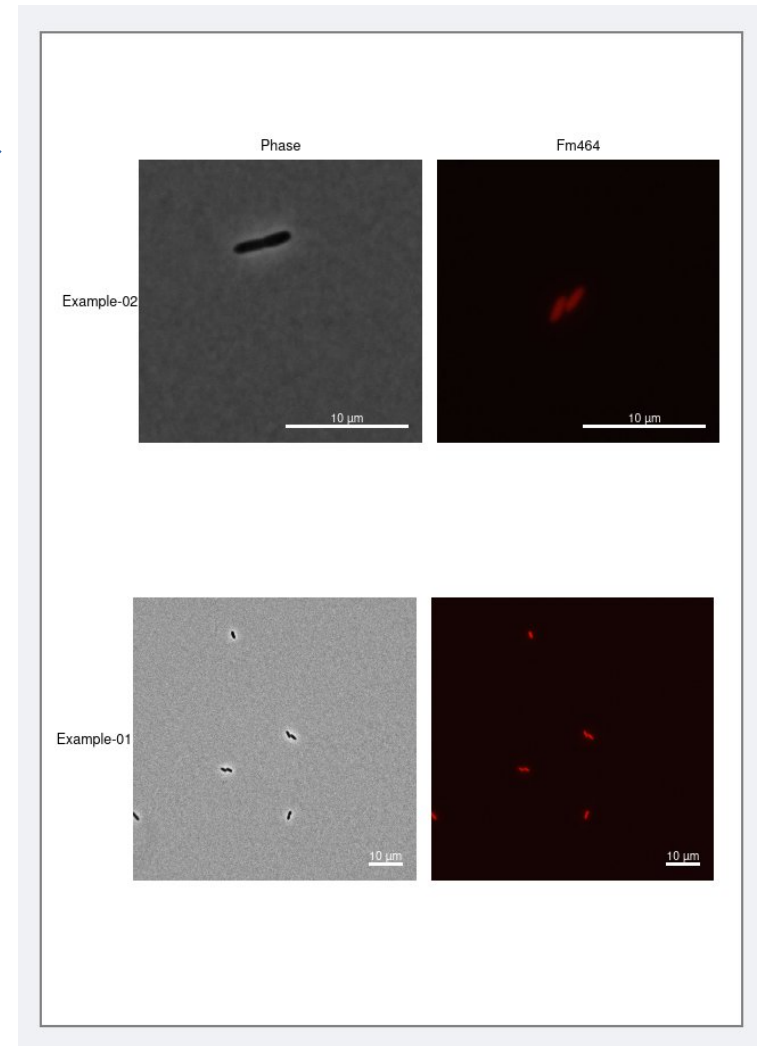


Assignment

Try reproducing this figure



- 1) Select two images from Example-01
- 2) Open them in OMERO.figure
- 3) Select zoom
- 4) Pan viewport
- 5) Add images from Example-02
- 6) Zoom and pan
- 7) Select left column, deselect Fm464 channel
- 8) Select right column, deselect Phase channel
- 9) Label columns and rows



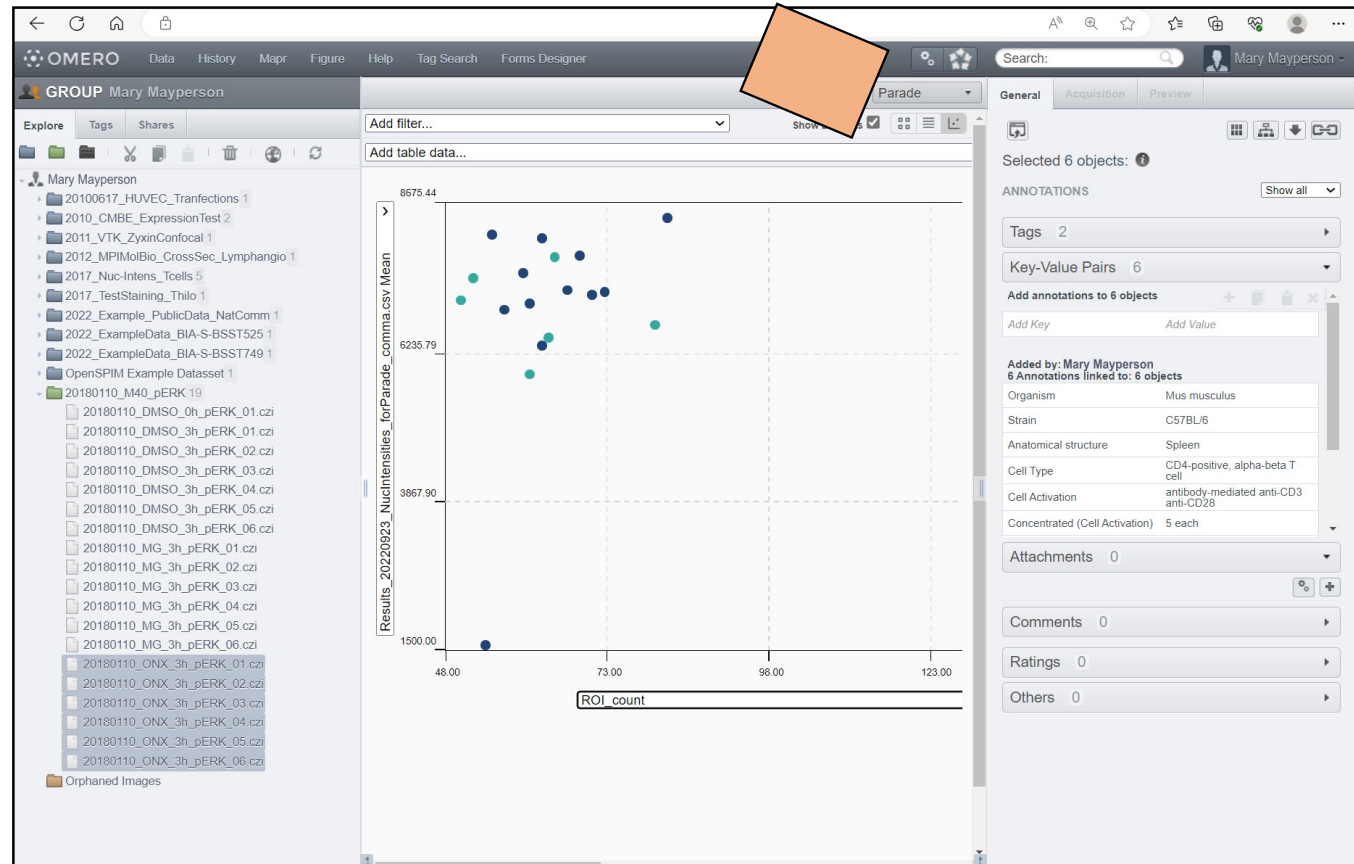
Organize your image data with OMERO

OMERO.parade

Carsten Fortmann-Grote (MPI), Thomas Zobel (WWU)

OMERO.parade – data mining in metadata and analysis results

- Review pooled metadata, annotation quantifications, or csv-table based analysis results in dot-plots or tables within OMERO.
- Access the original linked image directly from the dots in the dot-plot
- **NOTE:**
 - Specific formatting requirements for csv attachments from analysis results must be met! (e.g., use “,” and not “;” as the delimiter!)
 - Datasets must be outside of Projects for the analysis to work.



Organize your image data with OMERO

Fiji and OMERO

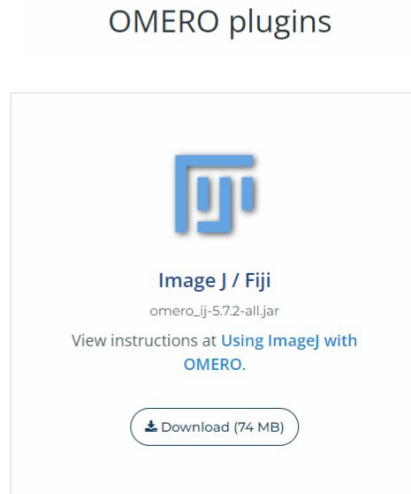
Carsten Fortmann-Grote (MPI), Thomas Zobel (WWU)

Connect Fiji and OMERO (1/2)

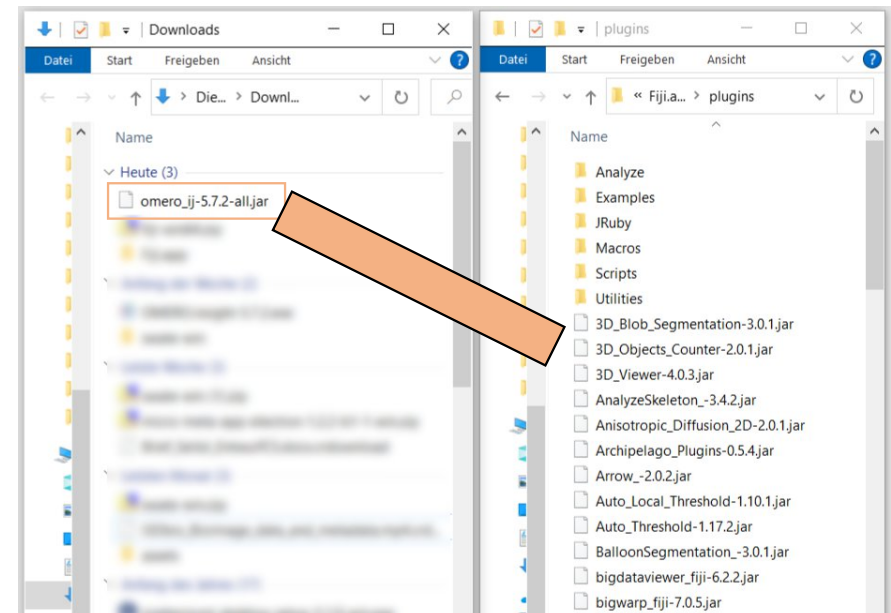
Prerequisite:

You have downloaded Fiji (<https://fiji.sc>) and have access to the OMERO instance (direct or VPN)

1. Download the OMERO plugin for Fiji from the OME downloads website: <https://www.openmicroscopy.org/omero/downloads>

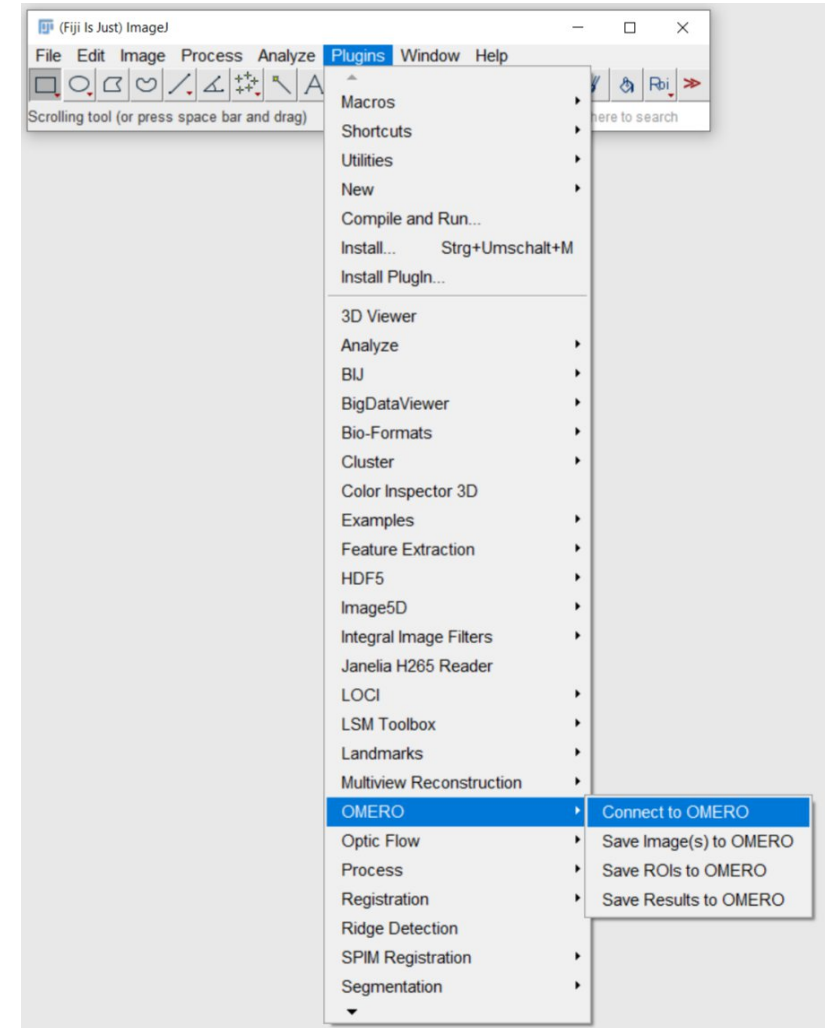


2. Move the *omero-ij-x.x.x-all.jar* file to the *Plugins* folder of your Fiji application



Connect Fiji and OMERO (2/2)

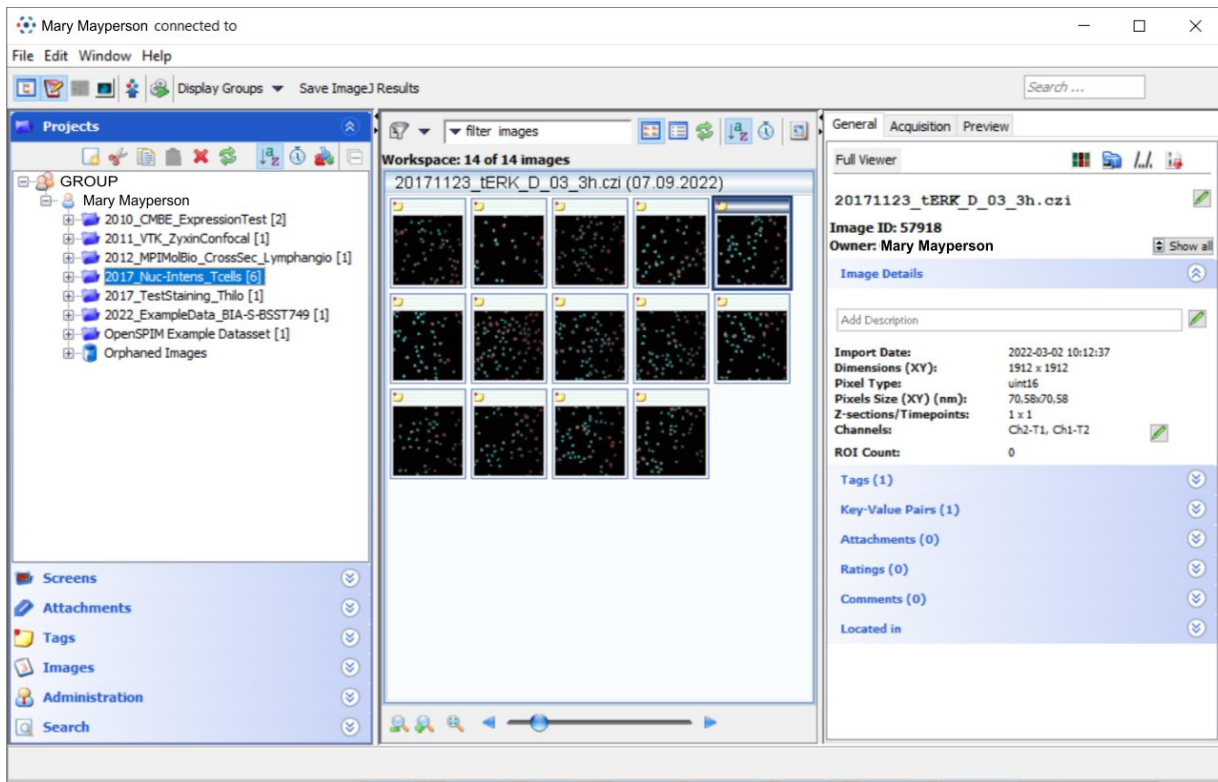
3. Open Fiji and go to *Plugins* 調 *OMERO* 調 *Connect to OMERO*
4. Log in to OMERO with your user credentials.



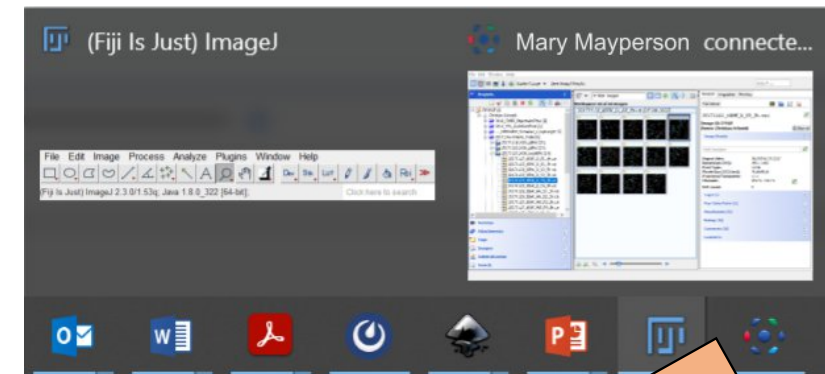
The Fiji-OMERO plugin looks almost precisely like OMERO.insight, but is, in fact, part of the open Fiji application

OMERO plugin for Fiji versus OMERO.insight

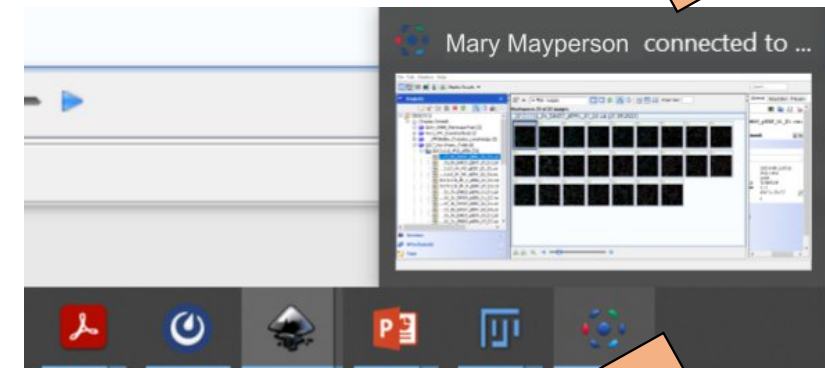
NOTE: The window looks similar to OMERO.insight, but it is a different application. For example, OMERO.insight has no View in ImageJ function nor allows Save ImageJ Results.



You can distinguish the applications by their appearance in the task bar.



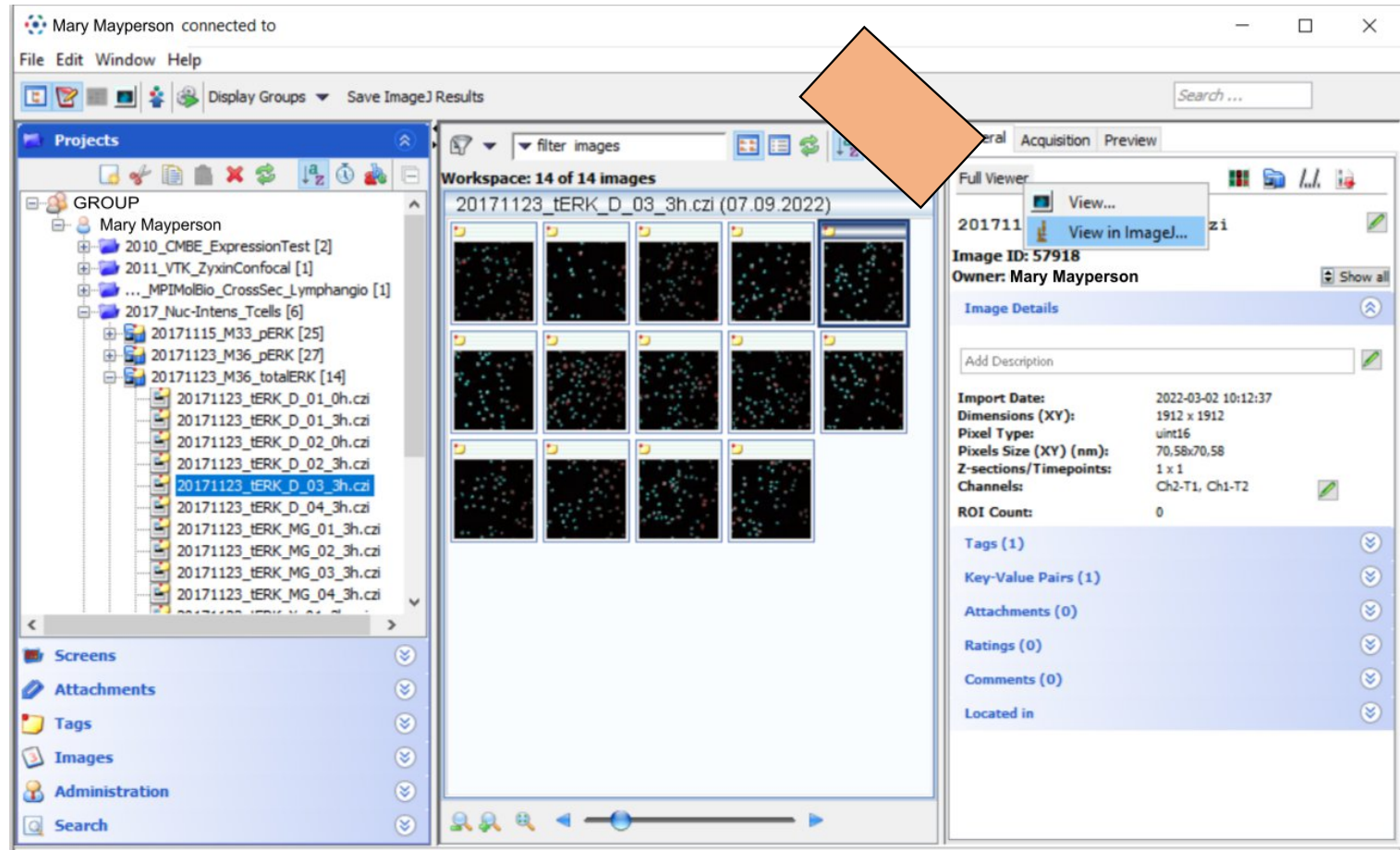
OMERO plugin for Fiji



OMERO.insight

Select image(s) to open in Fiji (1/2)

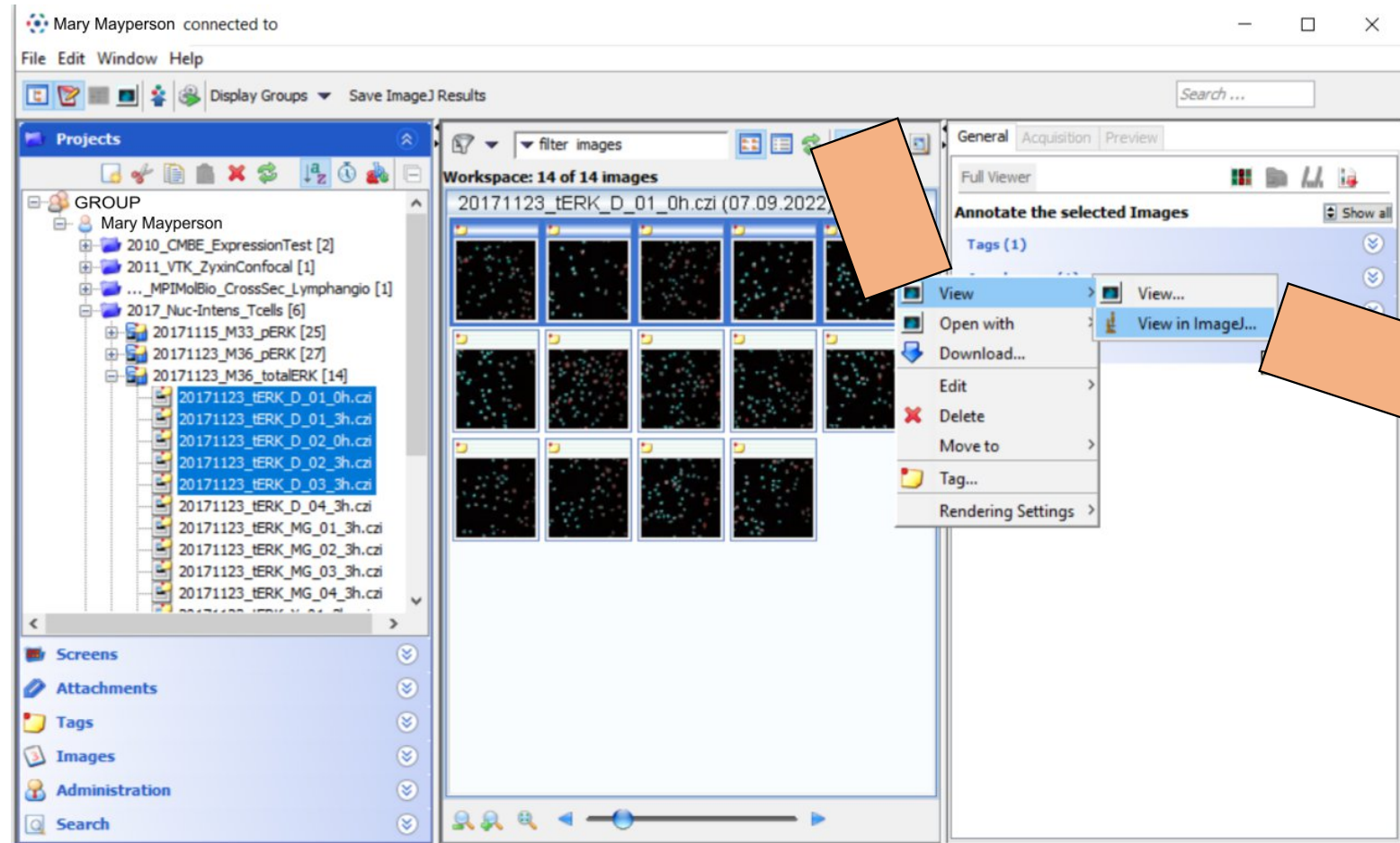
1. Select image(s) from the file tree
2. Open in Fiji by clicking Full Viewer and then View in ImageJ...



Select image(s) to open in Fiji (2/2)

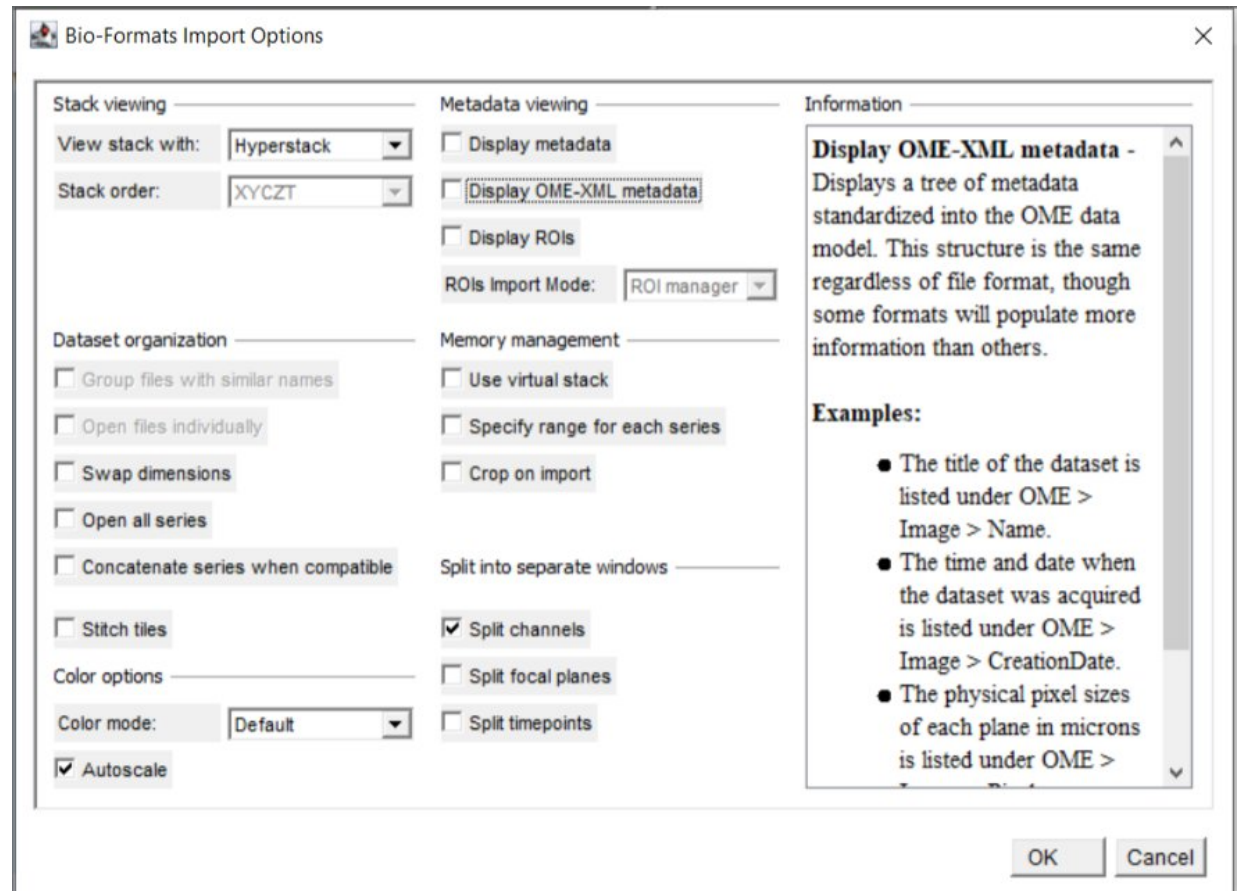
OR

3. Open image(s) by
right-click → View →
View in ImageJ...

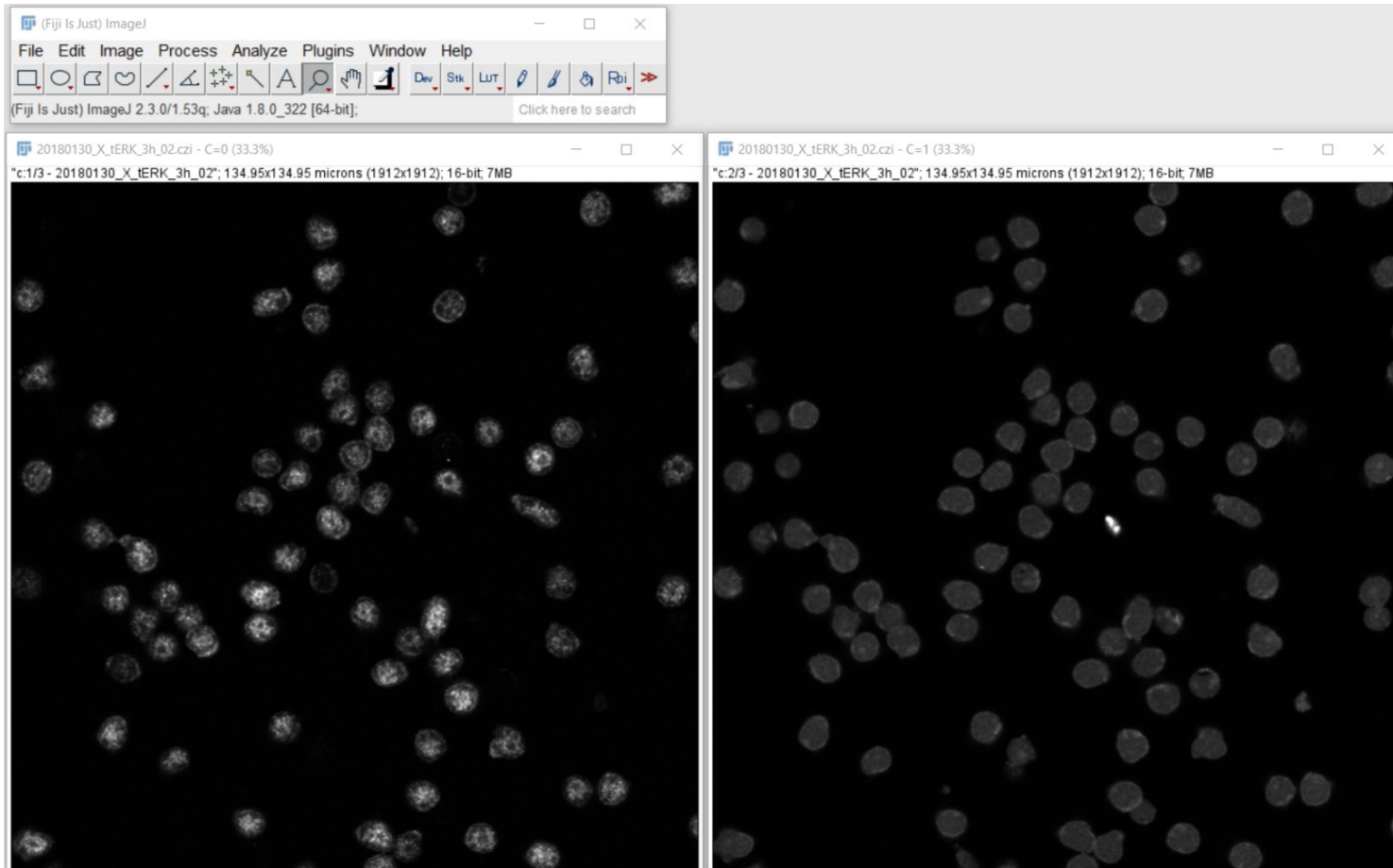


Choose settings for loading the image(s) in Fiji

Use your preferred settings to open the image(s) as required for your work



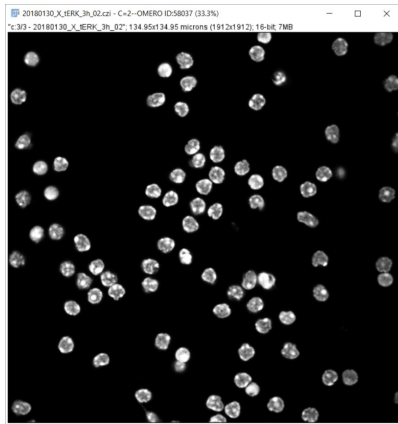
View your images in Fiji and work with the image for processing and analysis



Example – processing & analysis workflow to segment and count nuclei

Perform your workflow in Fiji

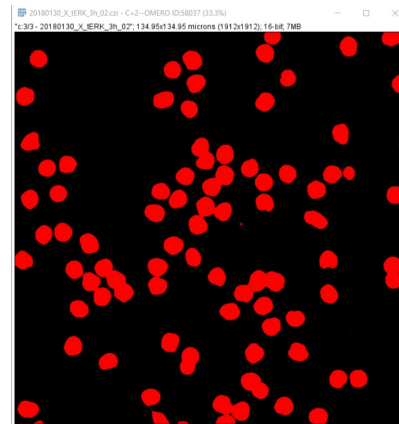
(here: segmentation and cell counting based on nuclear staining with DAPI)



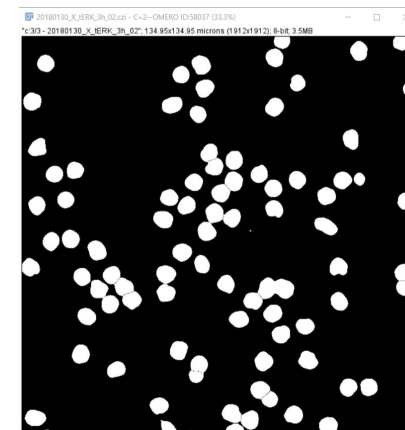
Gaussian blur



Thresholding
(Huang)



Watershed

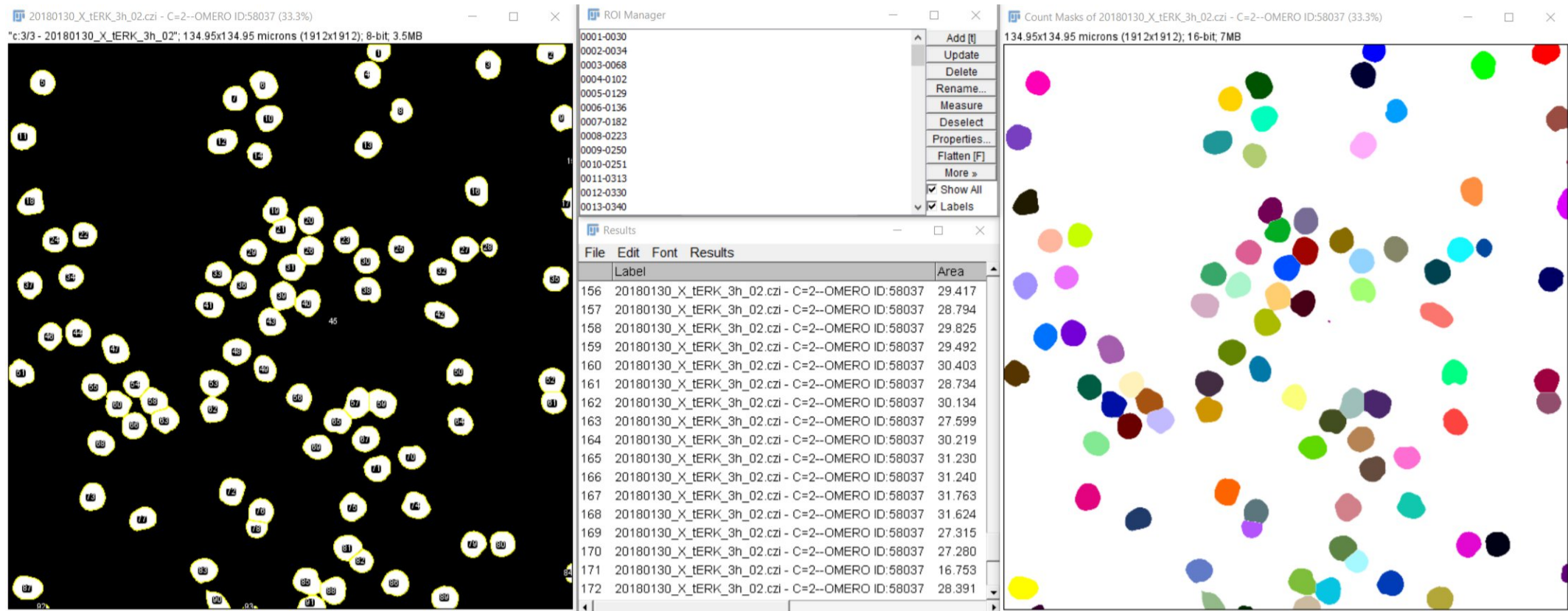


Analyze
Particles

Example – processing & analysis workflow to segment and count nuclei

Perform your workflow in Fiji

(here: segmentation and cell counting based on nuclear staining with DAPI)



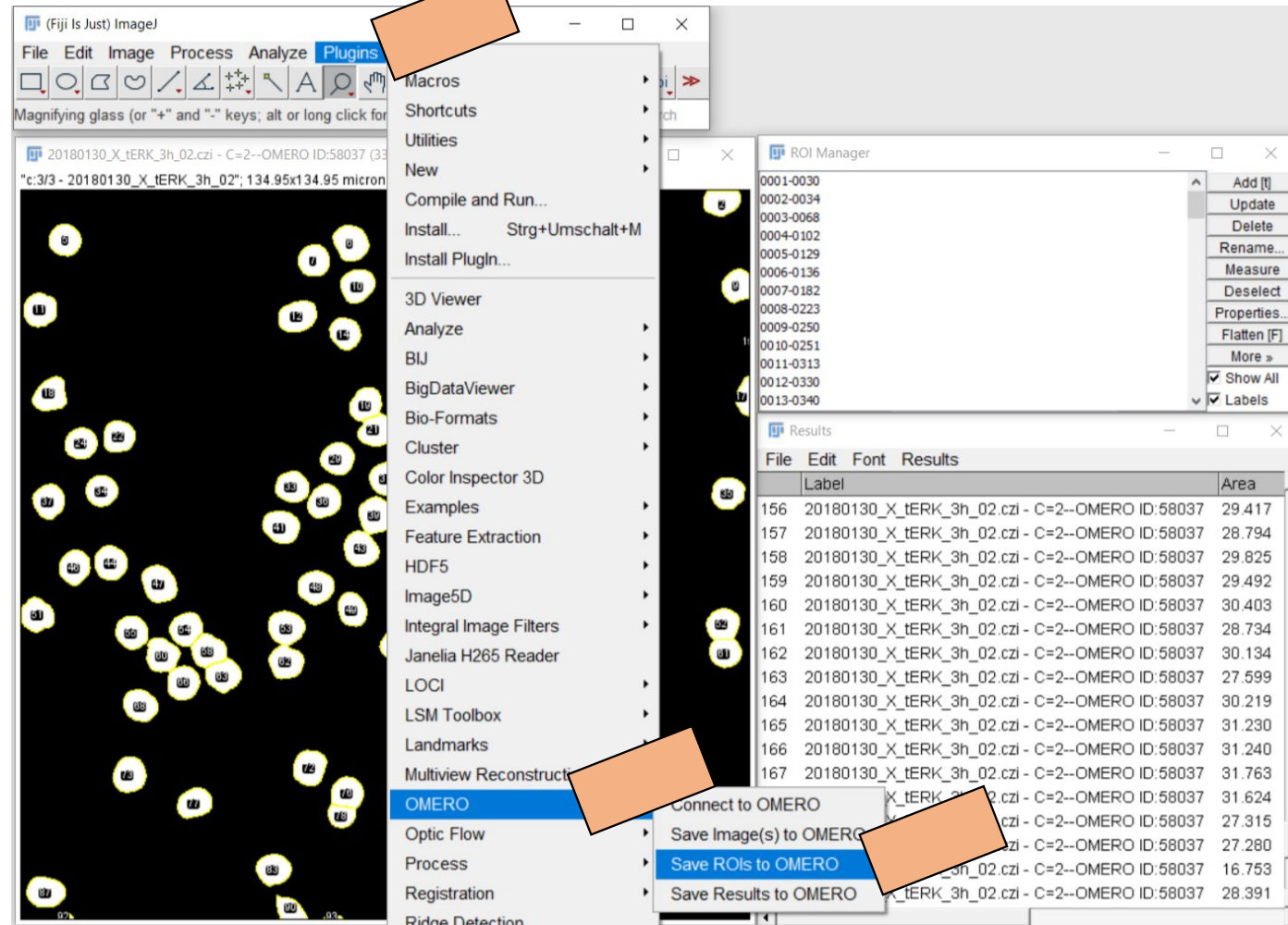
Save Regions of Interest (ROIs) and Measurement Results to OMERO

Save to OMERO using the plugin

Plugins

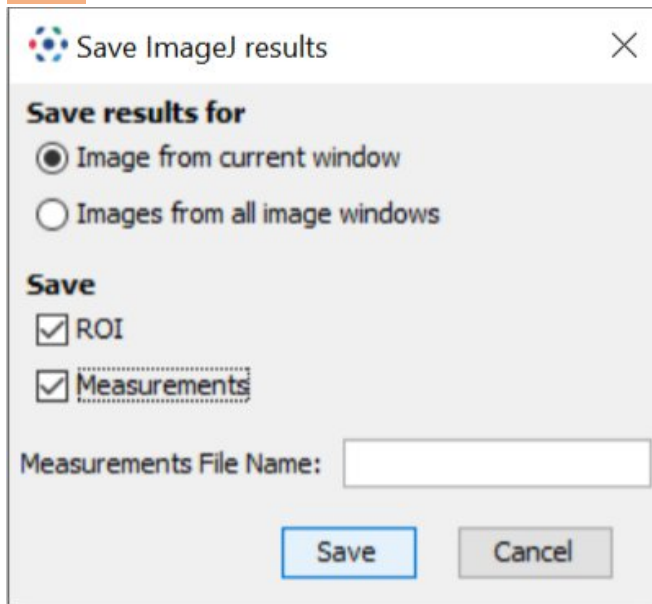
調 OMERO

調 Save ROIs to OMERO

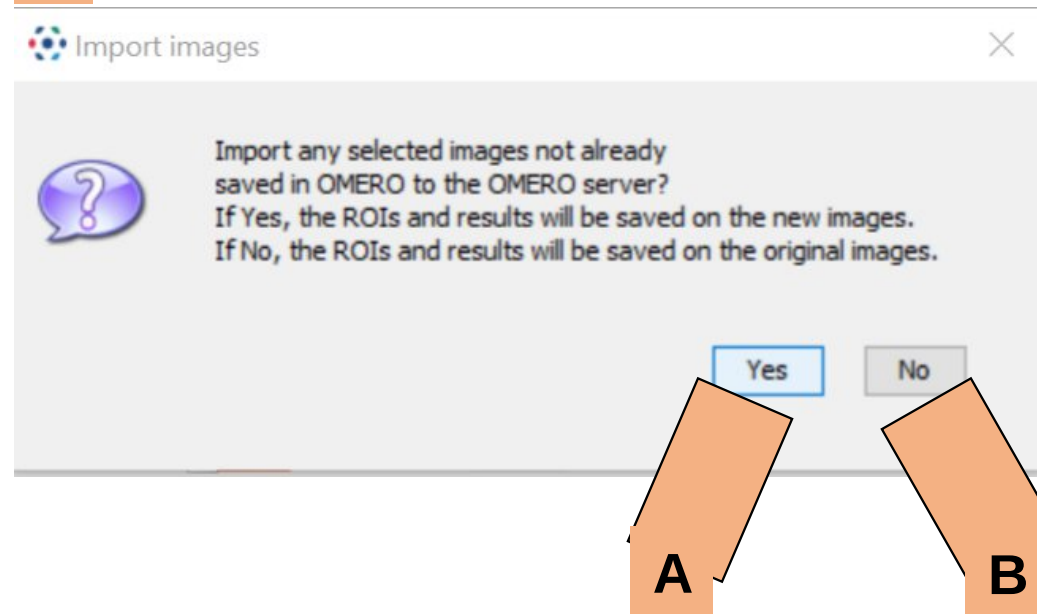


Choose settings for saving in OMERO

1



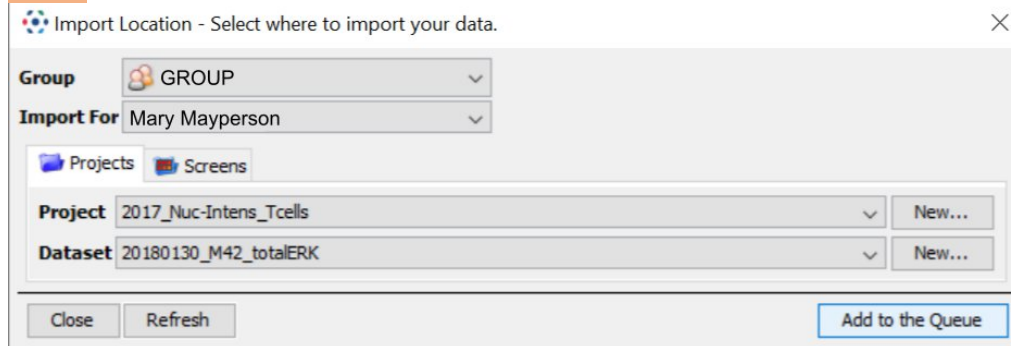
2



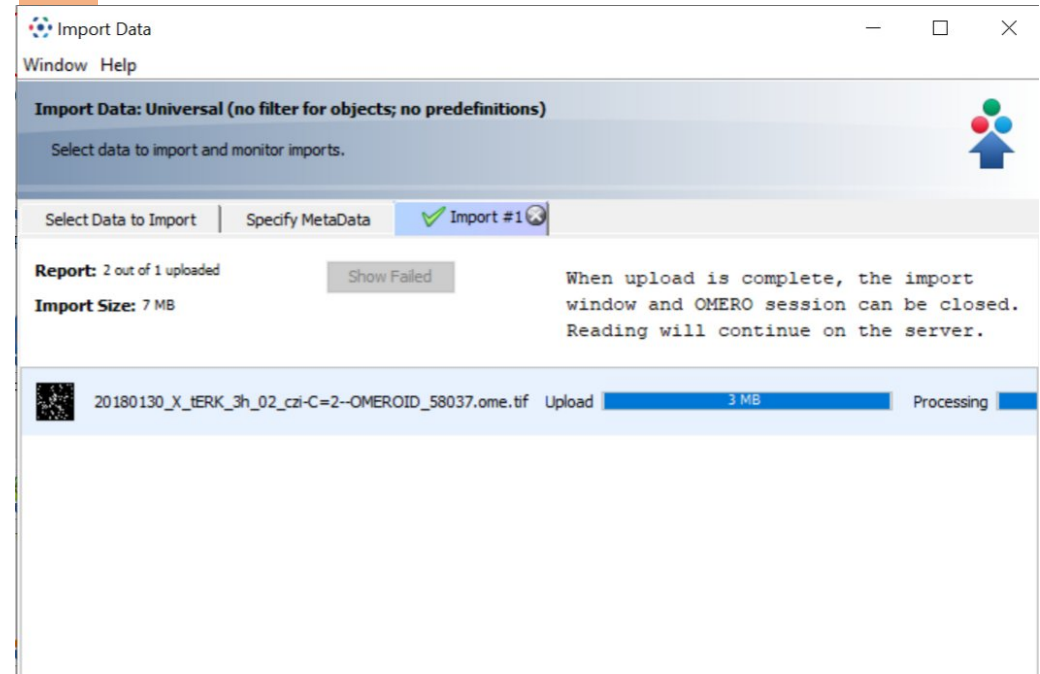
A – Upload the mask image to OMERO as a new image

Choose upload destination (Group, User, Project, Dataset) and upload

1



2



A – View the imported mask image and the analysis results (e.g., in OMERO.web)

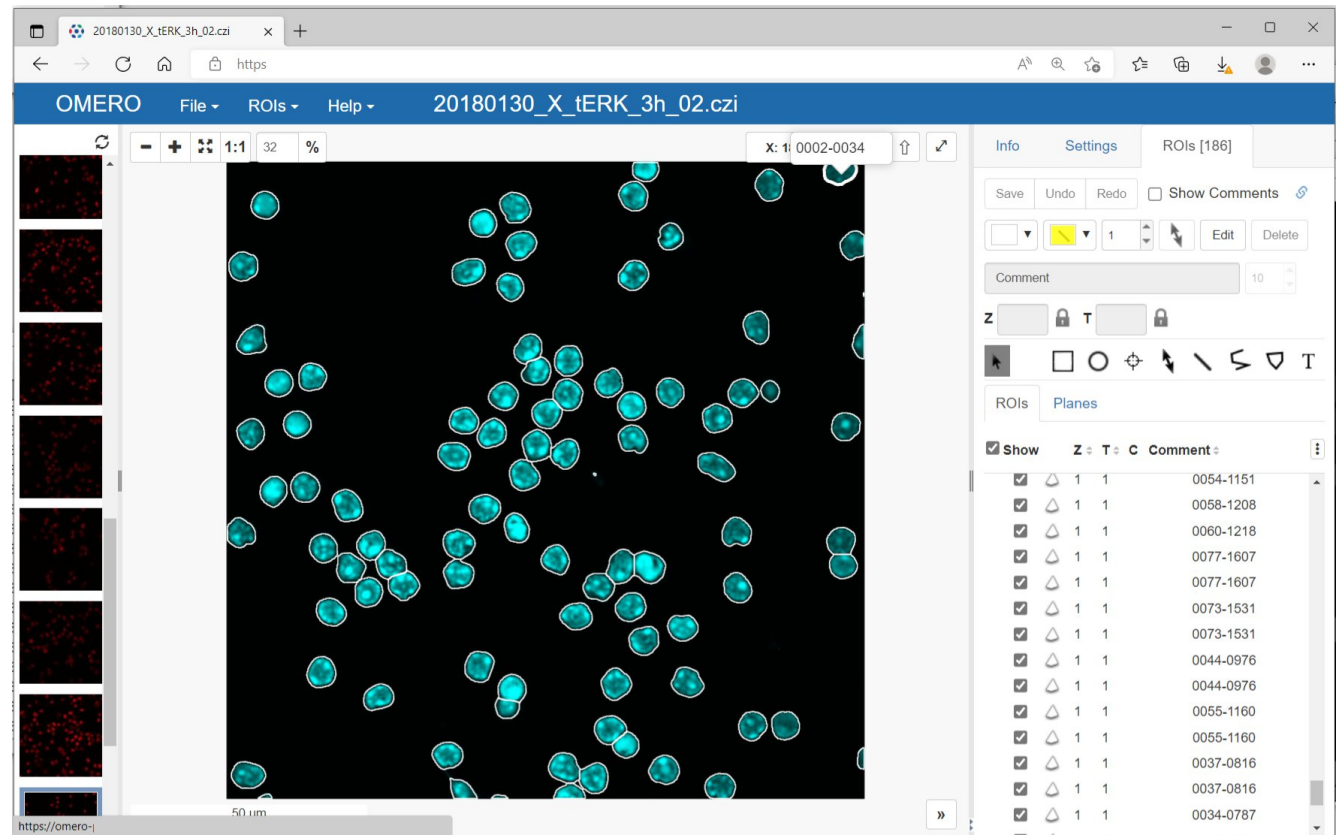
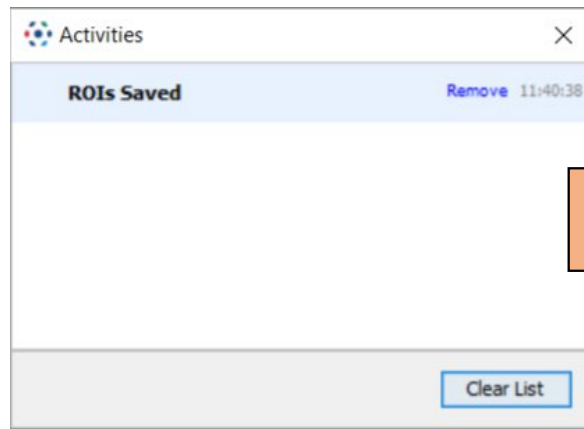
The screenshot displays the OMERO.web webclient interface. On the left, a file explorer shows a list of files, including '20180130_DMSO_tERK_0h_01_czi-C=2--OMERO'. The main area shows a grid of image thumbnails. One thumbnail, showing a white mask on a black background, is highlighted with a blue border. On the right, the 'General' tab of the image details panel is visible, showing metadata for Image ID 58712, including dimensions (1912 x 1912), pixel type (uint8), and ROI count (93). Below the metadata, there are sections for Tags, Key-Value Pairs, Tables, and Attachments. The Attachments section shows a file named 'ImageJ-20180130_X_tERK_3h_02_czi-C=2--OMEROID_58037-Results-2022-09-07.csv (18.30 KB)'.

ROI image uploaded as new file (new ID!)

Results uploaded as attachment in csv-format

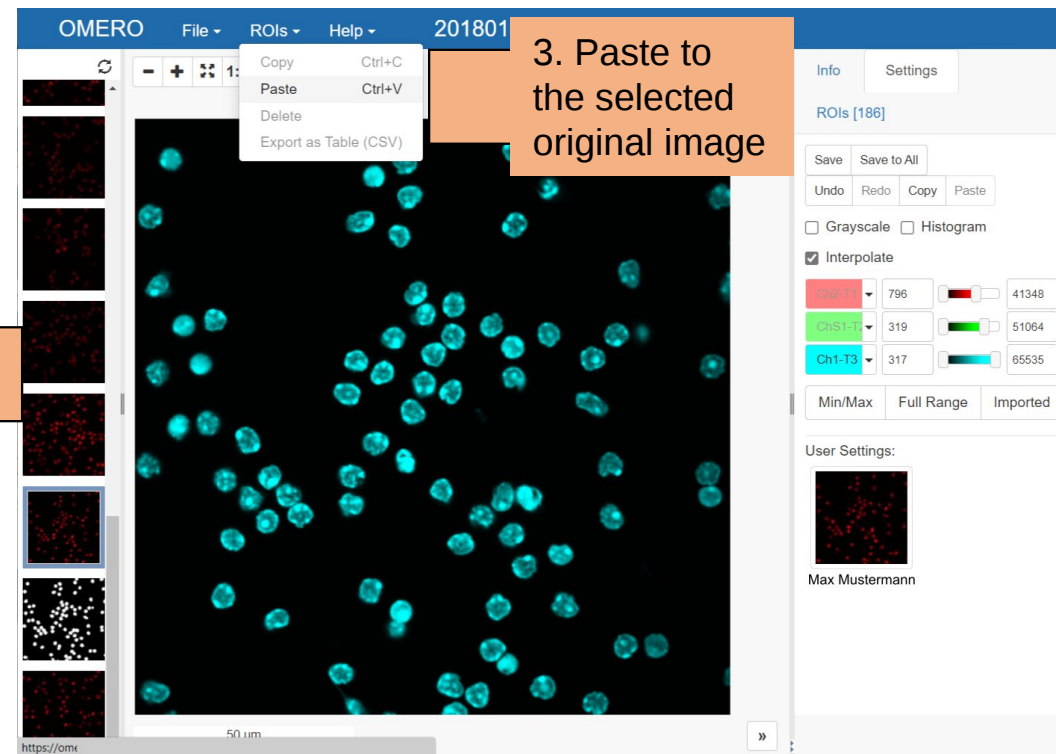
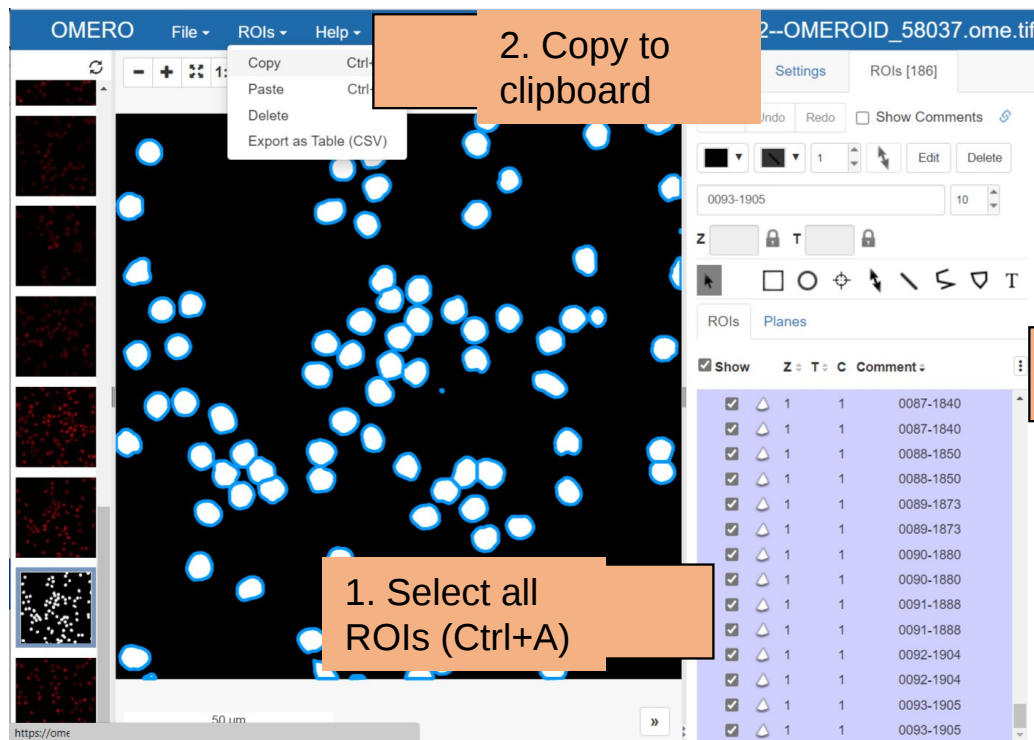
B – Add the ROI to the original image in OMERO

Review the ROIs on the original image with OMERO.iviewer



A and B combined

In the OMERO.iviewer you can copy the ROI from the segmentation image to the original image manually, too.



Extended resources on using Fiji and OMERO

Official OMERO guide:

<https://omero-guides.readthedocs.io/en/latest/fiji/docs/index.html>

A workshop on image analysis with Fiji and OMERO:

<https://learning.rc.virginia.edu/notes/fiji-omero/>

Workshop recordings by the Open Microscopy Environment Consortium on YouTube, including scripting in Fiji:

https://www.youtube.com/watch?v=W5EDx3yKA_o

(<https://www.youtube.com/watch?v=dOtnEO-nmlg>)

Image Analysis Lecture by Robert Haase (TU Dresden):

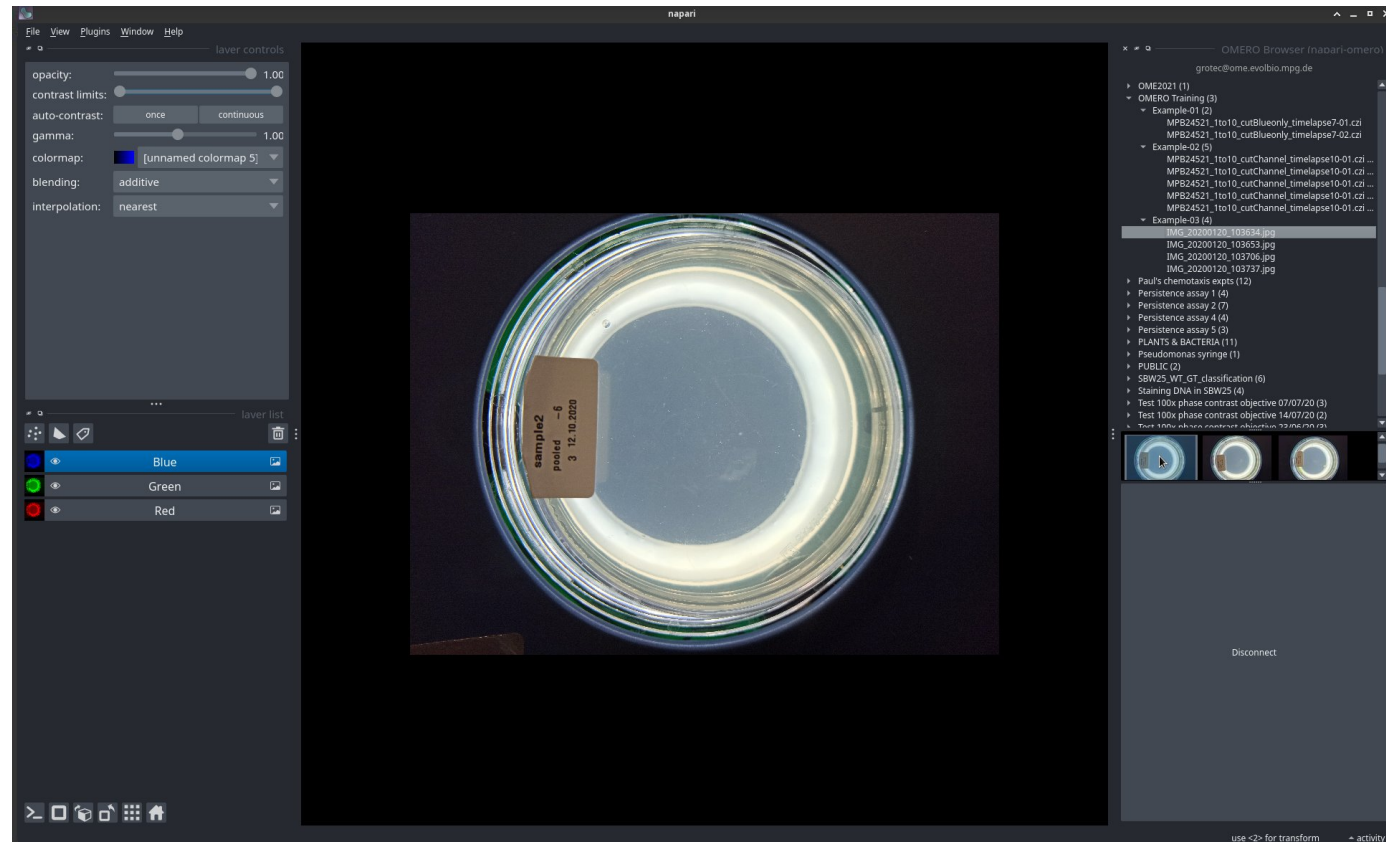
<https://www.youtube.com/playlist?list=PL5ESQNfM5lc7SAMstEu082ivW4BDMvd0U>

Help for Image Analysis or OMERO-related issues - Image.sc forum:

<https://image.sc>

Open OMERO Images from napari

- Run 'napari-omero'
- Enter OMERO login data, connect
- All Projects will be listed
- Click on image to display in central panel



Open OMERO Images from matlab

- Download omero-matlab toolbox from <https://openmicroscopy.org/omero/downloads>
- Run "loadOmero();"
- Create session
- Load data

```
>> client=loadOmero("ome.evolbio.mpg.de");  
>> session = client.createSession("grotec", " ");  
>> images=getImages(session, 7363759);  
>> pixels=images.getPrimaryPixels();  
>> plane=getPlane(session, images, 0, 0, 0);
```


Open OMERO Images from python

- Install omero-py (pip install -u omero-py)

```
[1]: import omero
     from omero.gateway import BlitzGateway
```

```
[2]: import getpass
```

Connect to omero

```
[4]: conn = BlitzGateway('grotec', getpass.getpass(), host='ome.evolbio.mpg.de')
     conn.connect()
```

```
.....
```

```
[4]: True
```

```
[5]: im= conn.getObject(obj_type='Image', oid=6752780)
```

```
...
```

```
...
```

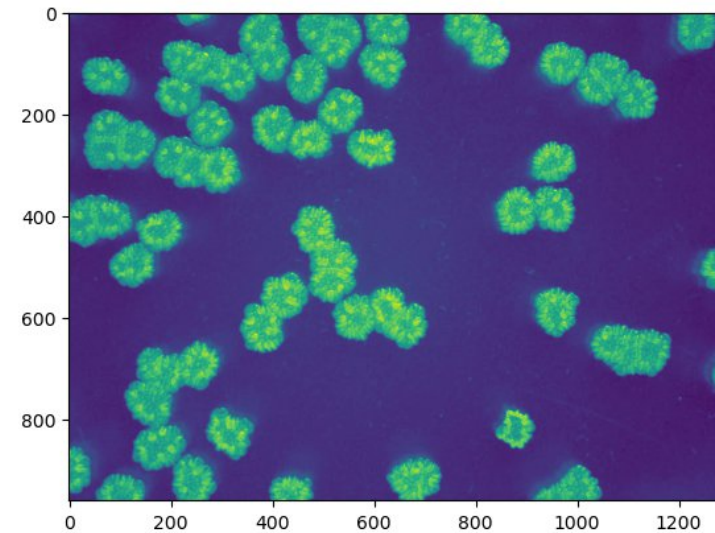
```
...
```

```
[9]: pixels = im.getPrimaryPixels()
```

```
[14]: from matplotlib.pyplot import imshow
```

```
[15]: imshow(pixels.getPlane(0,0,0))
```

```
[15]: <matplotlib.image.AxesImage at 0x7f793881f0a0>
```



Open OMERO Images from R

Uses R package “romero”

```
In [ ]: # Load the libraries
library(romero.gateway)
library(EBImage, warn.conflicts = FALSE)
```

Log in to the OMERO server

```
In [ ]: user_name = readline('Username: ')
user_password <- getPass::getPass('OMERO password: ')

server <- OMEROServer(host = 'wss://workshop.openmicroscopy.org/omero-ws', port = 443L, username=user_name, password=
server <- connect(server)
paste('Successfully logged in as', server@user$getName())
```

Load and display an image

Exercise: Go to the image 'siControl_N20_Cep215_I_20110411_Mon-1509_0_SIR_PRJ.dv' in your 'R-dataset', find the 'Image ID', copy it and paste it below.

```
In [ ]: imageId <- REPLACE_WITH_IMAGE_ID
image <- loadObject(server, "ImageData", imageId)
paste("Image", imageId, "loaded.")
```

Load the pixel values and display the image

```
In [ ]: # There is just one plane, so z = 1 and t = 1
z <- 1
t <- 1

# Load the second channel
channelIndex <- 2

pixels <- getPixelValues(image, z, t, channelIndex)
```

Detailed instructions at https://omero-guides.readthedocs.io/en/latest/r/docs/r_walkthrough.html

Connect to OMERO on the command line

Get annotations

```
grotec@micropop046:~  
▶ omero login  
Previously logged in to ome.evolbio.mpg.de:4064 as grotec  
Server: [ome.evolbio.mpg.de:4064]  
Username: [grotec]  
Skipped session 48774f12-8aa9-434c-a759-40557a903c47 due to property conflicts: omero.group: micropop!=None  
Password:  
Created session for grotec@ome.evolbio.mpg.de:4064. Idle timeout: 10 min. Current group: micropop  
(ome)  
grotec@micropop046:~  
▶ omero obj get MapAnnotation:1985018 mapValue  
Using session for grotec@ome.evolbio.mpg.de:4064. Idle timeout: 10 min. Current group: micropop  
(Type,still),(Organism,Pseudomonas fluorescens),(Strain,SBW25),(MPB,15447),(Parent,0),(Investigation,Deep Learning for MPB)
```

Connect to OMERO on the command line

Download individual image

```
grotec@micropop046:~  
► omero download Image:6752780 6752780  
Using session for grotec@ome.evolbio.mpg.de:4064. Idle timeout: 10 min. Current group: micropop  
Fileset: 6754019  
Downloading file ID: 20397520 to 6752780/0085-01.jpg  
(ome)  
grotec@micropop046:~  
► ls 6752780  
0085-01.jpg
```

Batch download all images in a Dataset

```
grotec@micropop046:~  
► omero export --file 3524 --iterate Dataset:3524  
grotec@micropop046:~  
► ls 3524  
6752778.ome.tiff 6752779.ome.tiff 6752780.ome.tiff
```

Assignment

- 1) Download an image in your OMERO space via (select one)
- 2) Fiji
- 3) Napari
- 4) Command line

1) Discuss pros and cons of “point and click” clients like OMERO.insight or OMERO.web vs. programmatic access methods like omero-py or the command line methods





Organize your image data with OMERO – Training Workshop at MPI Evolutionary Biology

Welcome

- Organizational items:
 - ✓ Collaborative notepad at <https://s.gwdg.de/tMB3rr> (<https://s.gwdg.de/tMB3rr>)
 - ✓ Signature list
 - ✓ Breaks
 - ✓ Lunch
 - ✓ Assignments

I need a coffee break!!! **NOW!!!** but if we just started

Important links

- Workshop indico website: <https://workshops.evolbio.mpg.de/e/ome2023>
(<https://workshops.evolbio.mpg.de/e/ome2023>)
- This pad: <https://s.gwdg.de/tMB3rr> (<https://s.gwdg.de/tMB3rr>)
- MPI OMERO: <http://ome.evolbio.mpg.de> (<http://ome.evolbio.mpg.de>)
- OMERO Docs: <https://omero.readthedocs.io/en/v5.6.9/> (<https://omero.readthedocs.io/en/v5.6.9/>)
- OMERO Downloads: <https://www.openmicroscopy.org/omero/downloads/>
(<https://www.openmicroscopy.org/omero/downloads/>)

Contact

- computing@evolbio.mpg.de (<mailto:computing@evolbio.mpg.de>)

Code of Conduct

Although this is not a Carpentries (<https://carpentries.org>) event, we adopt their code of conduct. In brief:

- Use welcoming and inclusive language

- Be respectful of different viewpoints and experiences
- Gracefully accept constructive criticism
- Focus on what is best for the community
- Show courtesy and respect towards other community members

For more details, please visit https://docs.carpentries.org/topic_folders/policies/code-of-conduct.html (https://docs.carpentries.org/topic_folders/policies/code-of-conduct.html).

CoC incidents

If you suspect, witness, or become involved in a violation of the code of conduct, please do at least one of the following:

- Make a written note about your experience
- Report the incidence to the workshop organizer, the institute's occupational safety officer, equal opportunities spokesperson, managing director or any other person you trust

Software

OMERO clients (insight, fiji plugin, matlab)

<http://www.openmicroscopy.org/omero/downloads/> (<http://www.openmicroscopy.org/omero/downloads/>)

FIJI

<https://imagej.net/software/fiji/downloads> (<https://imagej.net/software/fiji/downloads>)

Install napari-omero

Installs omero-py and napari as dependencies.

```
conda create -c conda-forge -n ome 'python=3.9'
conda activate ome
conda install napari-omero pyqt
```

Windows

Launch Windows Subsystem Linux (WSL) from your Desktop, then

```
wget https://repo.anaconda.com/miniconda/Miniconda3-py310_23.10.0-1-Linux-x86_64.sh
chmod u+x Miniconda3-py310_23.10.0-1-Linux-x86_64.sh
./Miniconda3-py310_23.10.0-1-Linux-x86_64.sh -b
source miniconda3/bin/activate
conda create -n ome -y -c conda-forge 'napari-omero' pyqt
```

Launch

```
conda activate ome
napari-omero
```

Program

Dec 7th 2023

| Begin | End | Topic |
|-------|-------|--|
| 9:00 | 9:15 | Welcome and Introduction |
| 9:15 | 10:30 | Introduction and first steps |
| 10:30 | 10:45 | Break |
| 10:45 | 11:15 | Using the Viewer |
| 11:15 | 12:00 | Data Organization in OMERO |
| 12:00 | 13:00 | Lunch break |
| 13:00 | 13:45 | Annotation with Tags and Key-Value Pairs |
| 13:45 | 14:00 | Break |
| 14:00 | 14:45 | Bulk Annotations with forms and spreadsheets |
| 14:45 | 15:15 | Creating figures with OMERO |
| 15:15 | 15:30 | Connecting ImageJ and OMERO |
| 15:30 | 16:00 | Summary, Q&A, feedback |

Example datasets

/mpistaff/OMERO-Training/Datasets/

License information

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