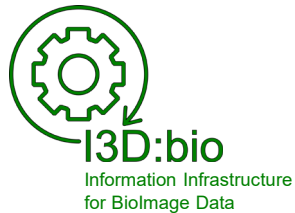


# Research Data Management for Bioimage Data at the HHU

## Metadata Curation: Key-Value Pairs

Tom Boissonnet



Adapted from: Schmidt C., Bortolomeazzi M., Boissonnet T., Fortmann-Grote C. *et al.* (2023). I3D:bio's OMERO training material: Re-usable, adjustable, multi-purpose slides for local user training. Zenodo. DOI: 10.5281/zenodo.8323588  
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# 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 interface. On the left, a file explorer shows a tree structure of datasets. The main area displays a grid of microscopy images. On the right, a metadata panel is visible for the selected image. The 'Key-Value Pairs' section is expanded, showing a table of annotations.

Key-Value Pairs

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

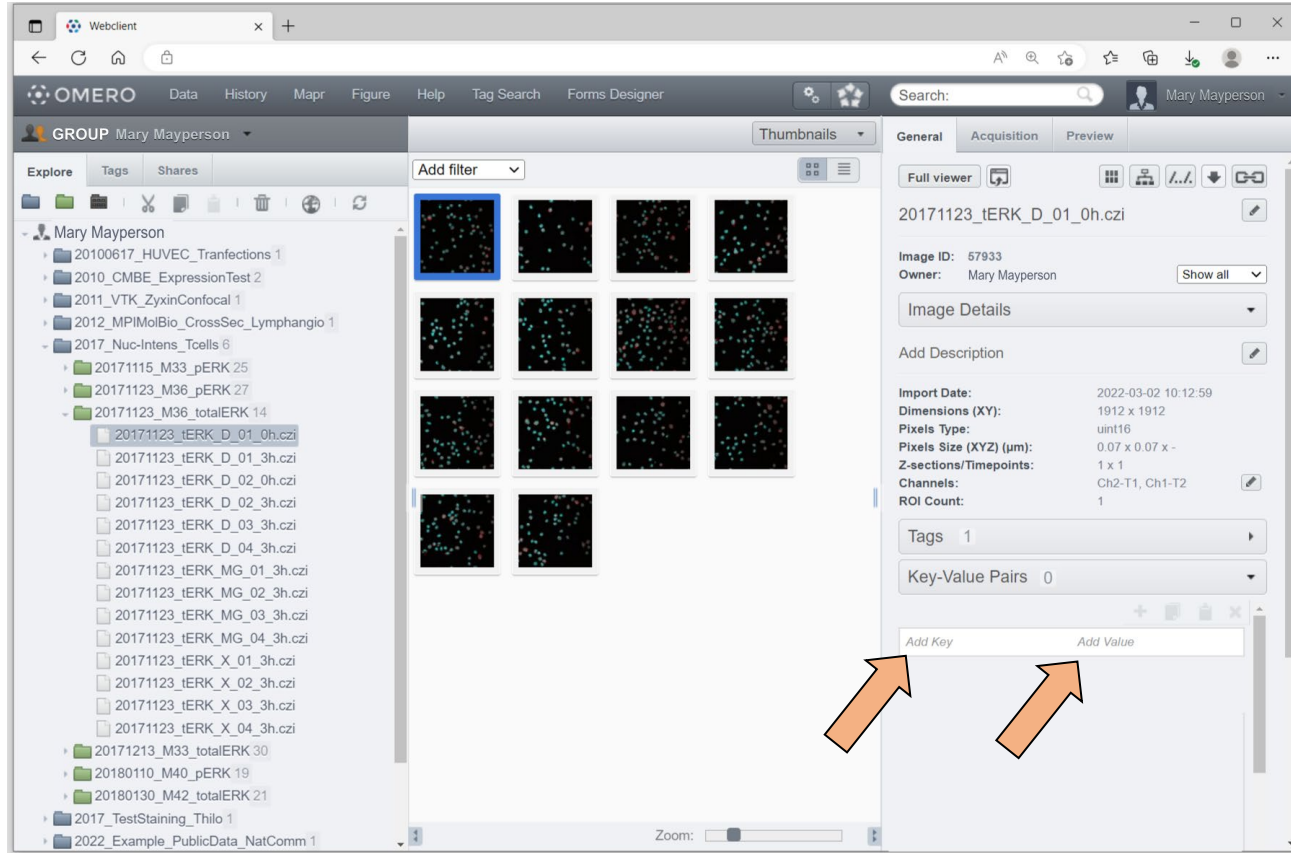
- Manual Key-Value Pair annotation
- Using Bulk Annotation Tools (scripts in OMERO.web, this option is only available if the respective scripts were installed for OMERO.web by the OMERO administrator)
- Using the Metadata Editor Tool OMERO.mde (only during data upload with the OMERO.insight client)

# 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



# 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 at the top right contains the text 'Organ spleen'. The search results table shows a list of images with their names and acquisition dates. The 'Key-Value Pairs' section on the right shows a table of annotations for the selected image.

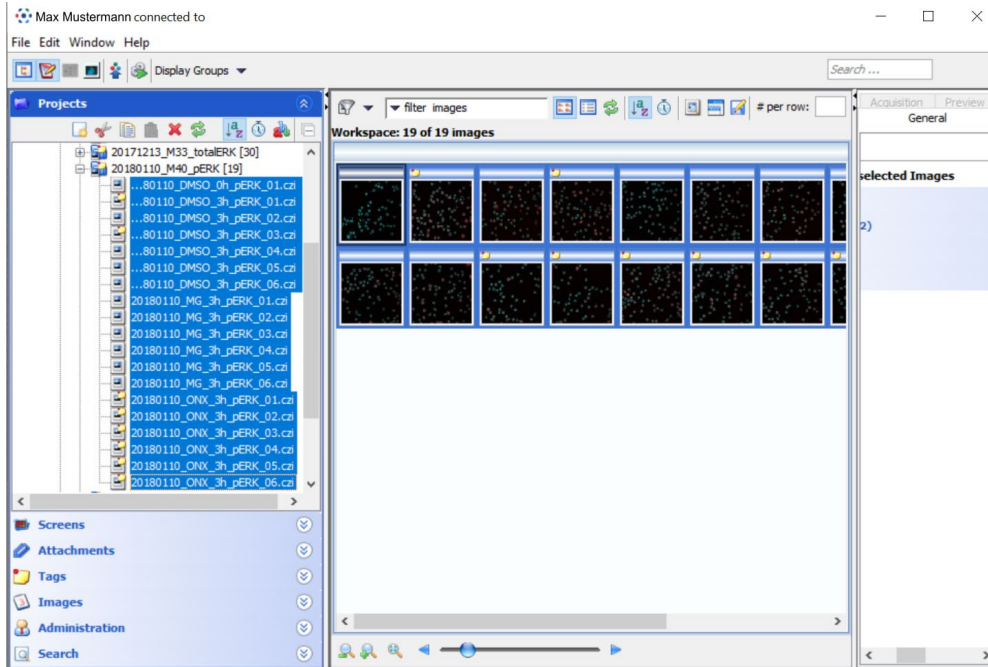
Key	Value
primary_AB	anti-p-ERK1/2 (Cell Signaling)
secondary_AB	goat anti-rabbit Alexa-Fluor-647
Cell type	CD4+ T cells
Organ	spleen
Organism	Mus musculus
Strain	C57BL/6

# 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)

# 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				



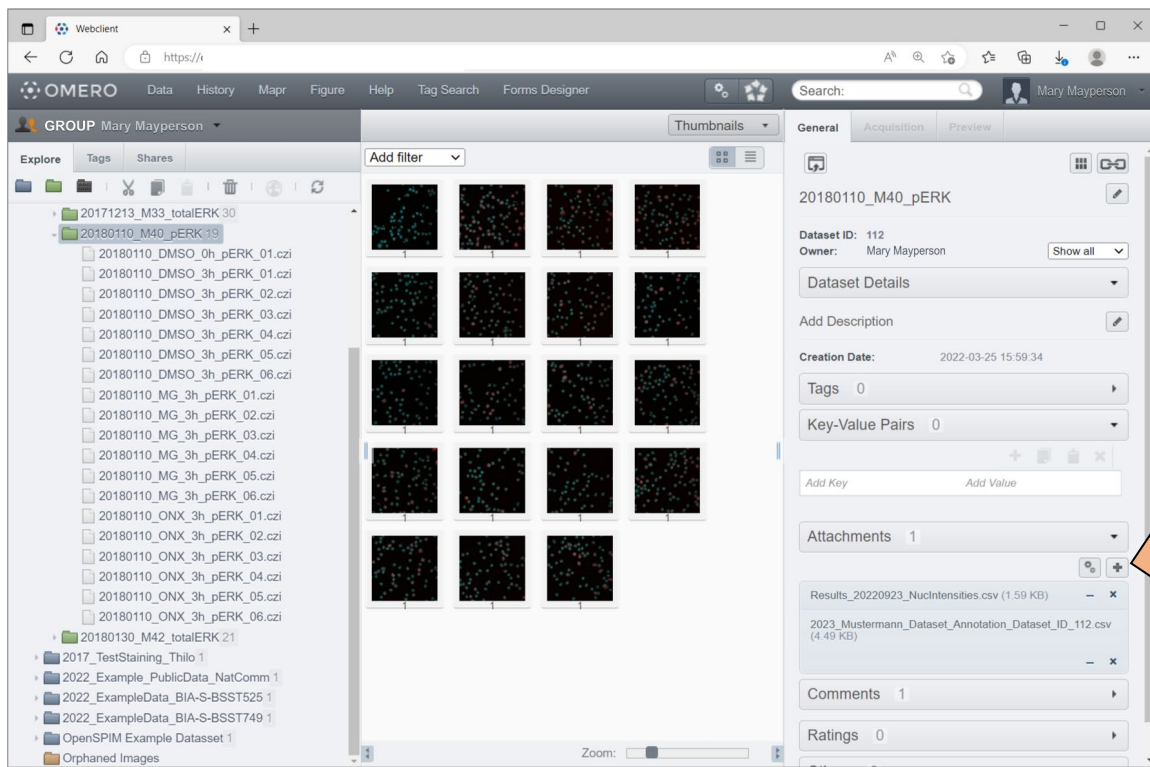
# Key-Value Pair Annotation with the „KeyVal from csv“ script (2/7)

- 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



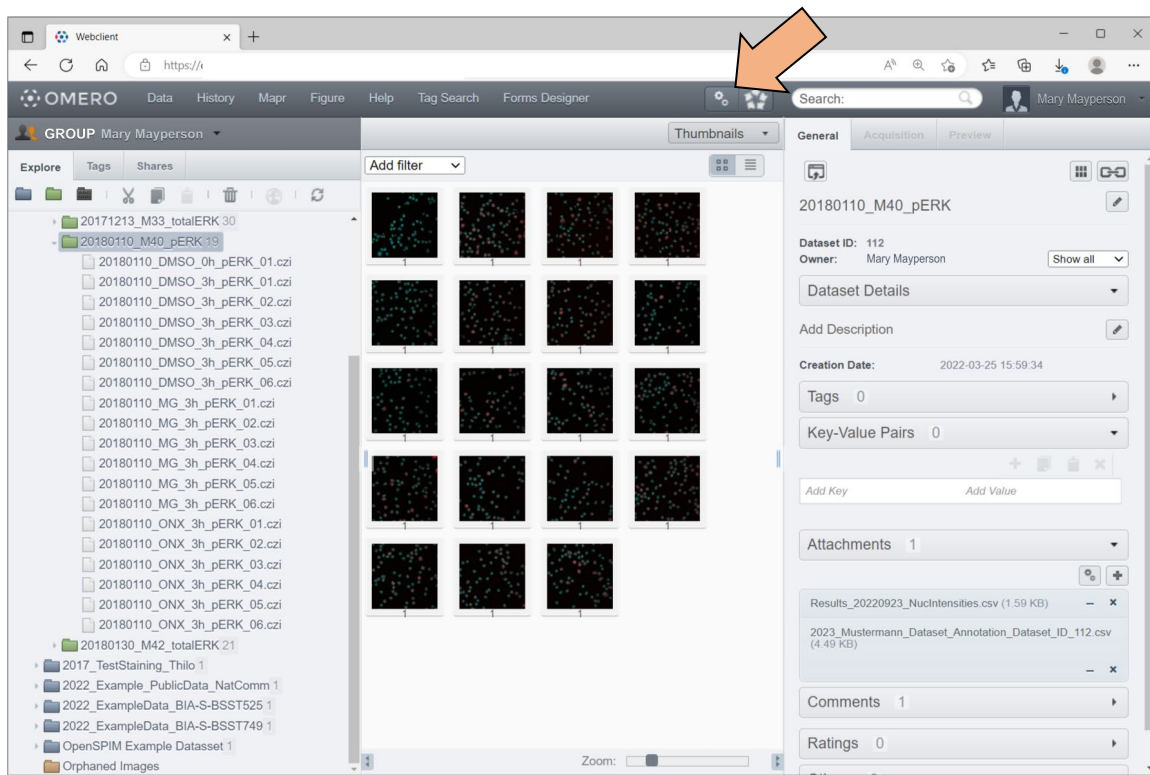
The screenshot displays the OMERO.web web client interface. On the left, the 'Explore' panel shows a tree view of datasets under the group 'Mary Mayperson'. The dataset '20180110\_M40\_pERK 19' is selected, and its thumbnails are visible in the center. On the right, the 'Dataset Details' panel for '20180110\_M40\_pERK' is shown. It includes fields for 'Dataset ID: 112', 'Owner: Mary Mayperson', 'Creation Date: 2022-03-25 15:59:34', 'Tags: 0', and 'Key-Value Pairs: 0'. The 'Attachments' section shows two files: 'Results\_20220923\_NuclIntensities.csv (1.59 KB)' and '2023\_Mustermann\_Dataset\_Annotation\_Dataset\_ID\_112.csv (4.49 KB)'. An orange arrow points to the plus icon next to the 'Attachments' header.


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

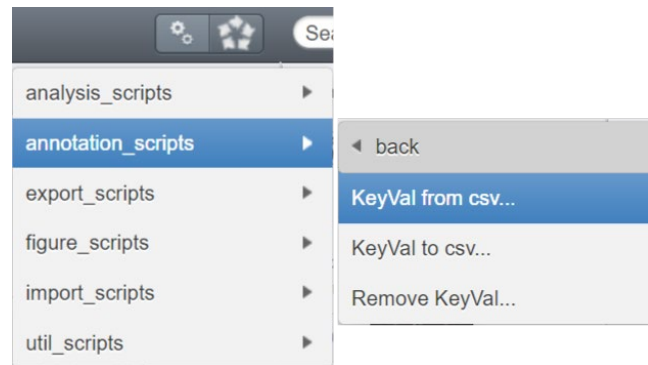
Upload the CSV-table as an attachment to the Dataset

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



8) Go to the Dataset in OMERO.web



9) Go to the scripts (  )  
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 table ()

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:

IDs:

File  OR

Annotation:

[View Script](#)

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

Activities

Add Key Val from csv  
Added kv pairs to 19/19 files

Dataset ID: 112  
Owner: Mary Mayperson

Dataset Details

Creation Date: 2022-03-25 15:59:34

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

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

The screenshot shows the OMERO web interface. On the left, a file tree lists various image files under the user 'Mary Mayperson'. The main area displays a grid of image thumbnails. One thumbnail is highlighted with a blue border. On the right, the 'Image Details' panel is open for the file '20180110\_DMSO\_3h\_pERK\_04.czi'. It shows metadata such as 'Image ID: 58056', 'Owner: Mary Mayperson', and 'Import Date: 2022-03-25 15:59:49'. Below this, a 'Key-Value Pairs' section is expanded, showing a table of annotations:

Key	Value
Organism	Mus musculus
Strain	C57BL/6
Anatomical structure	Spleen
Cell Type	CD4-positive, alpha-beta T cell
Cell Activation	antibody-mediated anti-CD3 anti-CD28
Concentrated (Cell Activation)	5 each
Unit (Concentrated - Cell Activation)	ug/mL
Time (Cell Activation)	3 h

An orange arrow points from the highlighted image thumbnail to the 'Key-Value Pairs' section.

### Optional:

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

→ annotation\_scripts

→ Remove KeyVal...

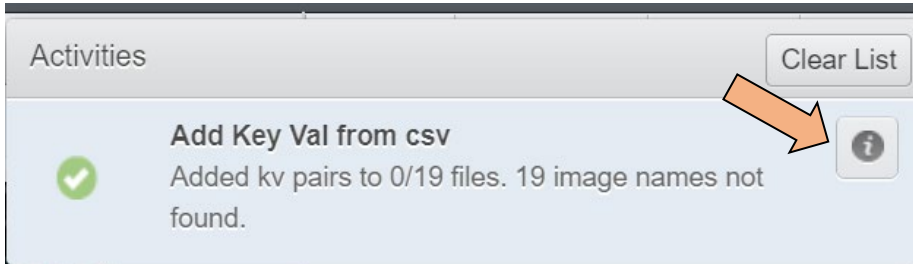
The screenshot shows the 'Scripts' menu in the OMERO interface. The menu is open, displaying a list of script categories: 'analysis\_scripts', 'annotation\_scripts', 'export\_scripts', 'figure\_scripts', 'import\_scripts', and 'util\_scripts'. The 'annotation\_scripts' category is selected, and a sub-menu is visible, showing options: 'back', 'KeyVal from csv...', 'KeyVal to csv...', and 'Remove KeyVal...'. The 'Remove KeyVal...' option is highlighted in blue.

# Key-Value Pair Annotation with the „KeyVal from csv“ script **NOTE!**

The script for Key-Value-Pair Annotation from csv must be installed for your OMERO instance. Please consult with your OMERO administrator if missing

## Important:

Sometimes, the „KeyVal from csv“ script may fail:



```
script params
File_Annotation 46978
IDs [112]
Data_Type Dataset
set ann id 46978
Original File 162024 2023_Test13-5_Mustermann_Dataset_ID_112.csv
Failed to sniff delimiter, using ','
header ['Image;Organism;Strain;Anatomical structure;Cell Type;Cell Activation;Concentrated
(Cell Activation);Unit (Concentrated - Cell Activation);Time (Cell Activation);Compound
Based Treatment;Treatment protocol;Test']
image_index: 0 well_index: -1 plate_index: -1
Image not found: 20180110_DMSO_0h_pERK_01.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_01.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_02.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_03.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_04.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
Can't find object by image, well or plate name
Image not found: 20180110_DMSO_3h_pERK_05.czi;Mus musculus;C57BL/6;Spleen;CD4-positive
```

## Reason:

German and English Excel versions use different delimiters in the CSV file. While the script tries to identify the correct delimiter, it may occur that the delimiter is not correctly determined. This might result in an upload failure if the default delimiter is not the delimiter used in your csv for field separation. Please consult with your OMERO administrator if this issue occurs!



# At a glance: Key-Value Pair Annotation with OMERO.mde (or MDEmic)

The screenshot shows the 'Import Data' window in OMERO.insight. The title bar reads 'Import Data'. Below the title bar is a menu bar with 'Window' and 'Help'. The main area is divided into two tabs: 'Select Data to Import' and 'Specify MetaData'. An orange arrow points to the 'Specify MetaData' tab. The 'Select Data to Import' pane shows a tree view with 'ImportQueue' selected, containing a list of image files. The 'Specify MetaData' pane shows a tree view with '[OME-Model]{0}' selected, containing '[OME:Image]{0}' and '[OME:Experiment]{0}'. The right pane shows the metadata form for '[OME:Image]{0}' and '[OME:Objective]{0}'. The form has fields for 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), ID, Model, Manufacturer, Nominal Magnification, Calibration Magnification, Lens NA, Immersion, Correction, Working Distance, Iris, User::Refraction Index, User::Medium, and User::Correction Collar. At the bottom, there are buttons for 'Setup: Membrane Dye Database', 'Configuration...', 'show only required', 'Menu...', 'Clear Input', 'Cancel All', and 'Import'.

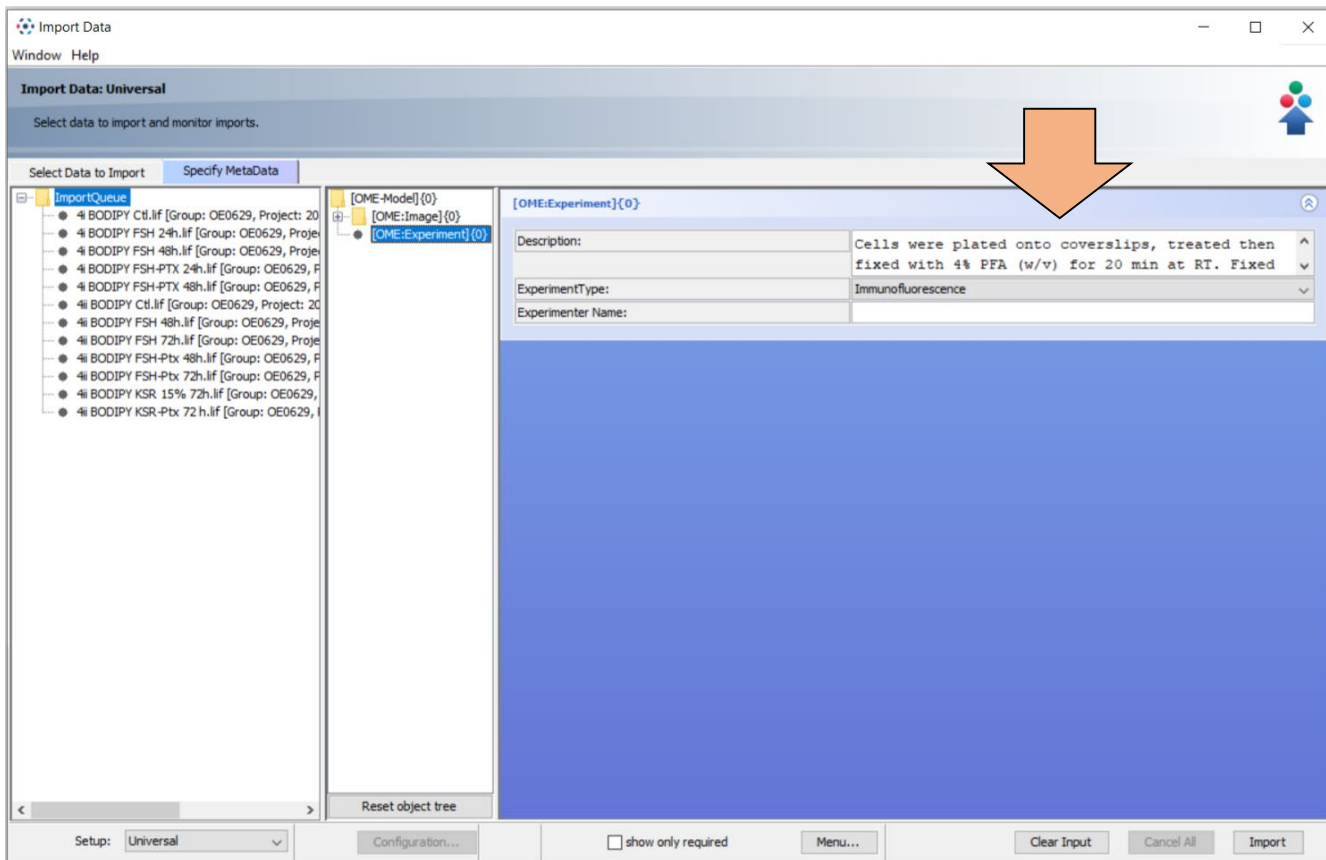
In **OMERO.insight**,  
go to the

**Specify MetaData**

tab before importing  
the selected import  
queue.

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

# At a glance: Key-Value Pair Annotation with OMERO.mde (or MDEmic)



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 file tree shows the user's group 'Mary Mayperson' and various folders, with '4i BODIPY FSH 24h.lif [Series019]' selected. The main area shows a grid of 48 thumbnail images (8 rows by 6 columns) of cells stained with BODIPY (green) and DAPI (blue). An orange arrow points from the grid to the right-hand panel, which provides detailed information for the selected image.

**Image Details:**

- Image ID: 58364
- Owner: Mary Mayperson
- Acquisition Date: 2021-05-07 14:04:05
- Import Date: 2022-08-02 14:33:31
- Dimensions (XY): 512 x 512
- Pixels Type: uint8
- Pixels Size (XYZ) (µm): 0.06 x 0.06 x -
- Z-sections/Timepoints: 1 x 1
- Channels: Leica/EGFP, Leica/EGFP
- ROI Count: 0

**Key-Value Pairs:** 1

**MDE:** Added by: Mary Mayperson

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 (ThermoFisher 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!

## 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.

→ **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](http://purl.obolibrary.org/obo/GO_0042101)

# 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).