

# Low entry barrier, user oriented image metadata annotation workflow for OMERO

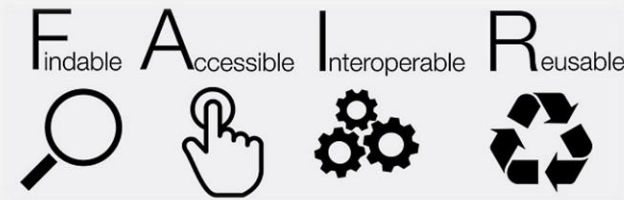
Jens Wendt, Muenster Imaging Network, NFDI4BioImage



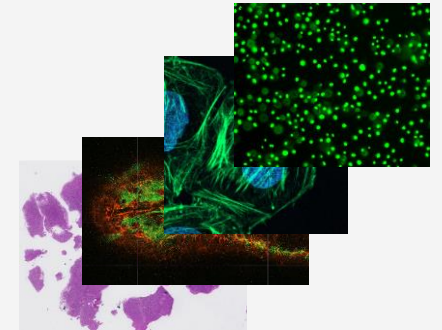
# Research Data Management, Why and How

- Research Data Management (RDM) → how to handle large amounts of (image) data

- Implementing FAIR principle →

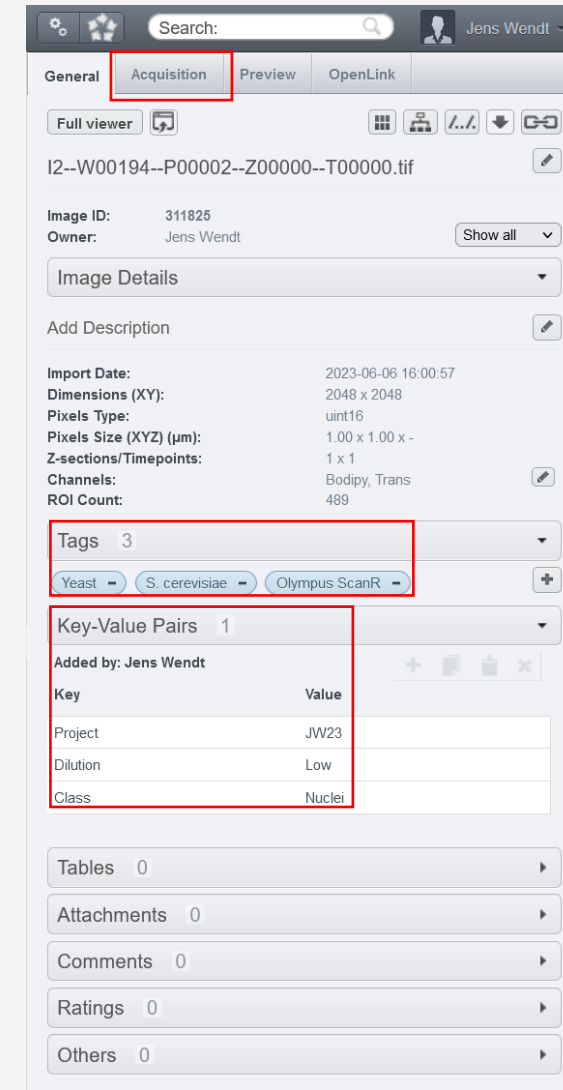



- Open-source OMERO as community accepted gold-standard solution







# OMERO and Metadata

- Metadata → Findability + Reusability
- Technical metadata ↔ Experimental metadata
- Metadata implementation in the form of Tags and Key-Value pairs



Search:   Jens Wendt

General Acquisition Preview OpenLink

Full viewer    




12--W00194--P00002--Z00000--T00000.tif 

Image ID: 311825  
Owner: Jens Wendt Show all

Image Details

Add Description 

Import Date: 2023-06-06 16:00:57  
Dimensions (XY): 2048 x 2048  
Pixels Type: uint16  
Pixels Size (XYZ) (µm): 1.00 x 1.00 x -  
Z-sections/Timepoints: 1 x 1  
Channels: Bodipy, Trans   
ROI Count: 489

Tags 3

Yeast S. cerevisiae Olympus ScanR

Key-Value Pairs 1

Added by: Jens Wendt

Key	Value
Project	JW23
Dilution	Low
Class	Nuclei

Tables 0

Attachments 0

Comments 0

Ratings 0

Others 0

# Metadata standards

- Recommended Metadata for Biological Images (REMBI)



<b>Study</b>	
<i>(contains 1 or more Study components)</i>	Study type
	Study description
	General dataset info
<b>Study component</b>	
<i>(contains Image data and Analysed data)</i>	Imaging method
	Study component description
<b>Biosample</b>	
	Identity
	Biological entity
	Organism
	Intrinsic variable
	Extrinsic variable
	Experimental variables
<b>Specimen</b>	
<i>(linked to Biosample)</i>	Experimental status
	Location within Biosample
	Preparation method
	Signal/contrast mechanism
	Channel - content
	Channel - biological entity
<b>Image acquisition</b>	
<i>(linked to Specimen)</i>	Instrument attributes
	Image acquisition parameters
<b>Image data</b>	Type
	Format & compression Dimension
	Channel information
	Image processing method Contrast
<b>Image Correlation</b>	
<i>(linked to 1 or more Image data)</i>	Spatial and temporal alignment
	Fiducials used
	Transformation matrix/ other info
	Related images and relationship
<b>Analysed data</b>	
	Analysis result type
	Data used for analysis
	Analysis method and details

Sarkans, U., Chiu, W., Collinson, L. *et al.* REMBI: Recommended Metadata for Biological Images—enabling reuse of microscopy data in biology. *Nat Methods* **18**, 1418–1422 (2021).

# The first step, and then... ?



Upload



The screenshot shows the OMERO web interface. On the left, there is a thumbnail of a fluorescence microscopy image showing a cell with green and red channels. On the right, the 'General' tab is active, displaying the following information:

- Experiment-335.czi
- Image ID: 167654
- Owner: Jens Wendt
- Image Details (dropdown menu)
- Add Description (edit icon)
- Acquisition Date: 2022-09-23 14:52:13
- Import Date: 2022-10-05 17:05:55
- Dimensions (XY): 3578 x 2817
- Pixels Type: uint8
- Pixels Size (XYZ) (µm): 0.15 x 0.15 x 2.00
- Z-sections/Timepoints: 16 x 1
- Channels: tdTom-T1, TaYFP-T2
- ROI Count: 0
- Tags: 0
- Key-Value Pairs: 0
- Tables: 0
- Attachments: 0
- Comments: 0
- Ratings: 0
- Others: 0

The 'Tags', 'Key-Value Pairs', and 'Tables' sections are circled in red in the original image.

## Current solutions

- OMERO.insight extension MDE
- OMERO.forms (OMERO.web plugin)
- OMERO.web script 'KeyVal\_from\_csv'
- ...

```
<?xml version="1.0" encoding="UTF-8"?>
<MDEConfiguration>
  <MDEPredefinitions>
    <SetupPre Name="Universal" />
    <SetupPre Name="MyCustomSetup">
      <ObjectPre Type="MyCustomObject">
        <TagData DefaultValues="" Name="ExampleKey_1" Type="TextField"
          Unit="" Value="Example Value 1A" Visible="true" />
        <TagData DefaultValues="" Name="ExampleKey_2" Type="TextField"
          Unit="" Value="Example Value 2A" Visible="true" />
      </ObjectPre>
      <ObjectPre Type="MyCustomObject">
        <TagData DefaultValues="" Name="ExampleKey_1" Type="TextField"
          Unit="" Value="Example Value 1B" Visible="true" />
        <TagData DefaultValues="" Name="ExampleKey_2" Type="TextField"
          Unit="" Value="Example Value 2B" Visible="true" />
      </ObjectPre>
    </SetupPre>
    <SetupPre Name="Example Setup: Fields">
      <ObjectPre Type="Available InputFields" >
        <TagData DefaultValues="2" Name="Tag of Type ArrayField"
          Type="ArrayField" Unit="" Value="3,4" Visible="true" />
        <TagData DefaultValues="3" Name="Tag of Type ArrayField with Unit"
          Type="ArrayField" Unit="s" Value="3,4,6" Visible="true" />
        <TagData DefaultValues="" Name="Tag of Type TextArea" Type="TextArea"
          Unit="" Value="this is a text" Visible="true" />
        <TagData DefaultValues="" Name="Tag of Type TextField" Type="TextField"
          Unit="" Value="this is also a text" Visible="true" />
        <TagData DefaultValues="" Name="Tag of Type TextField with Unit" Type="TextField"
          Unit="mm" Value="millimeter value" Visible="true" />
        <TagData DefaultValues="Value1,Value2,Value3" Name="Tag of Type ComboBox" Type="ComboBox"
          Unit="" Value="Value1" Visible="true" />
        <TagData DefaultValues="" Name="Tag of Type ComboBox val from ontology href" Type="ComboBox"
          Unit="" Value="" Visible="true">
          <ontology URL_restapi="http://data.bioontology.org" Acronym="BAO" ID_href="http://www.bioassayontology.org/bao#BAO_0150008" />
        </TagData>
        <TagData DefaultValues="Value1,Value2,Value3" Name="Tag of Type CheckComboBox" Type="CheckComboBox"
          Unit="" Value="Value1" Visible="true" />
        <TagData DefaultValues="" Name="Tag of Type Timestamp" Type="TimeStamp"
          Unit="" Value="2020-01-01" Visible="true" />
      </ObjectPre>
      <ObjectPre ID="" Type="OME:Objective">
        <TagData DefaultValues="" Name="ID" Type="TextField" Unit=""
          Value="" Visible="true" />
        <TagData DefaultValues="" Name="Model" Type="TextField"
          Unit="" Value="HCX PL APO CS 40x/0.75-1.25" Visible="true" />
        <TagData DefaultValues="" Name="Manufacturer"
          Type="TextField" Unit="" Value="Leica" Visible="true" />
        <TagData DefaultValues="" Name="Nominal Magnification"
          Type="TextField" Unit="" Value="40.0" Visible="true" />
        <TagData DefaultValues="" Name="Calibration Magnification"
          Type="TextField" Unit="" Value="40.0" Visible="true" />
        <TagData DefaultValues="" Name="Lens NA" Type="TextField"
          Unit="" Value="" Visible="true" />
        <TagData
          DefaultValues="Oil,Water,WaterDipping,Air,Multi,Glycerol,Other"
          Name="Immersion" Type="comboBox" Unit="" Value="Oil" Visible="true" />
        <TagData
          DefaultValues="UV,PlanApo,PlanFluor,SuperFluor,VioletCorrected,Achro,Achromat,Fluor,Fl,Fluar,Neofluar,Fluotar,Apo,PlanNeofluar,Other"
          Name="Correction" Type="comboBox" Unit="" Value="PlanApo"
          Visible="true" />
        <TagData DefaultValues="" Name="Working Distance"
          Type="TextField" Unit="µm" Value="220.0" Visible="true" />
        <TagData DefaultValues="" Name="Iris" Type="TextField"
          Unit="" Value="true" Visible="true" />
        <TagData DefaultValues="" Name="User:Refraction Index"
          Type="TextField" Unit="" Value="" Visible="true" />
        <TagData DefaultValues="Air,Oil,Water,Glycerol,Other"
          Name="User:Medium" Type="comboBox" Unit="" Value="" Visible="true" />
        <TagData DefaultValues="" Name="User:Correction collar"
          Type="TextField" Unit="" Value="" Visible="true" />
      </ObjectPre>
    </SetupPre>
  </MDEPredefinitions>
</MDEConfiguration>
```

## Our solution

- Focus on low entry-barrier → high user adoption
- Still provide as much functionality as possible
- Two simple steps:
  - Annotate Images with Tags via context menu in the Explorer
  - Run an OMERO.web script

## How do we do it?

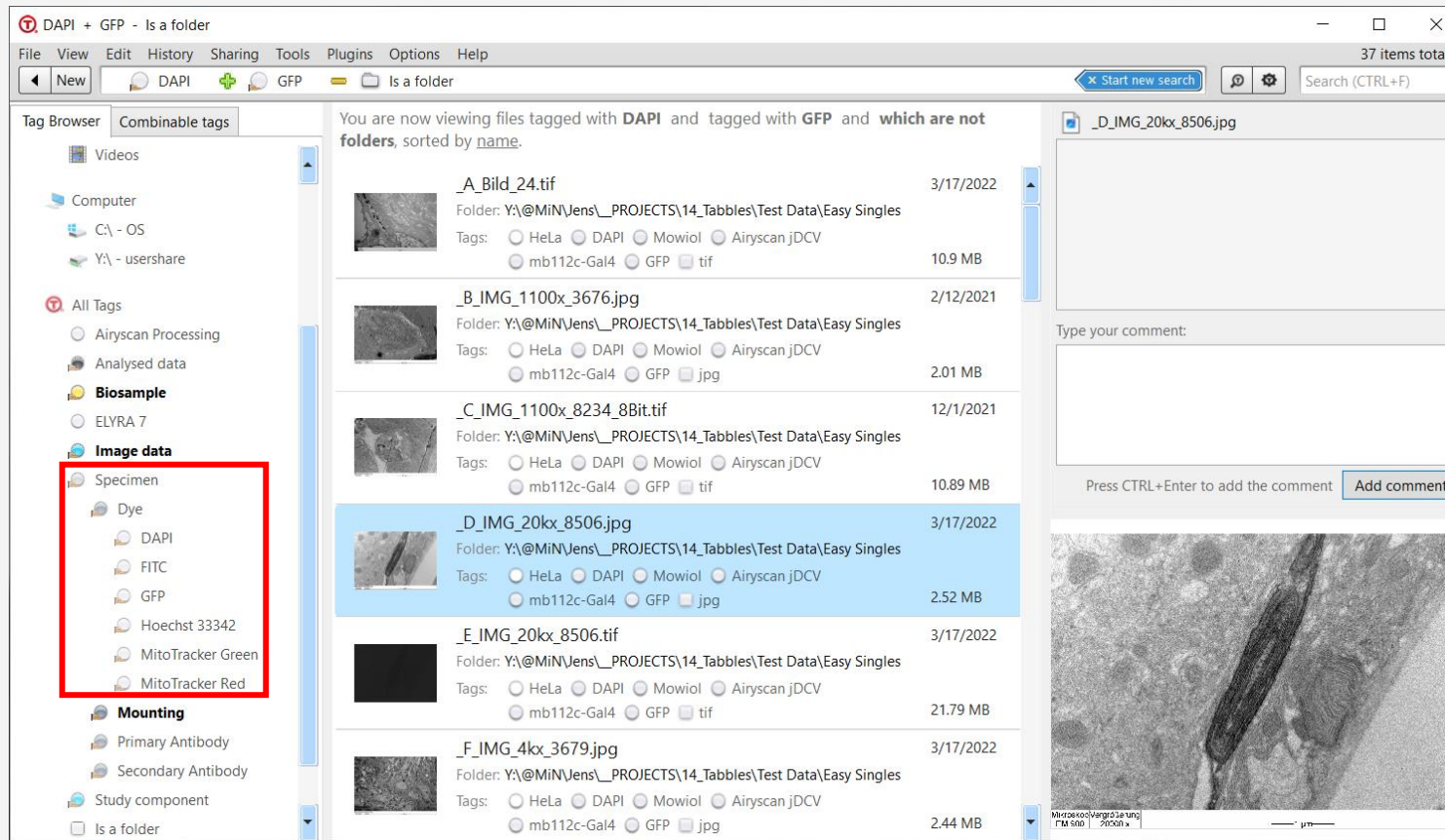
- File tagging software Tabbles



- Tags can be shared/synchronized between groups/workstations
- Elaborate auto-tagging rules possible for folders and sub-folders
- Data is stored in a Microsoft SQL database
- Nested Tags possible



# Tag Structure



Details

Category-level

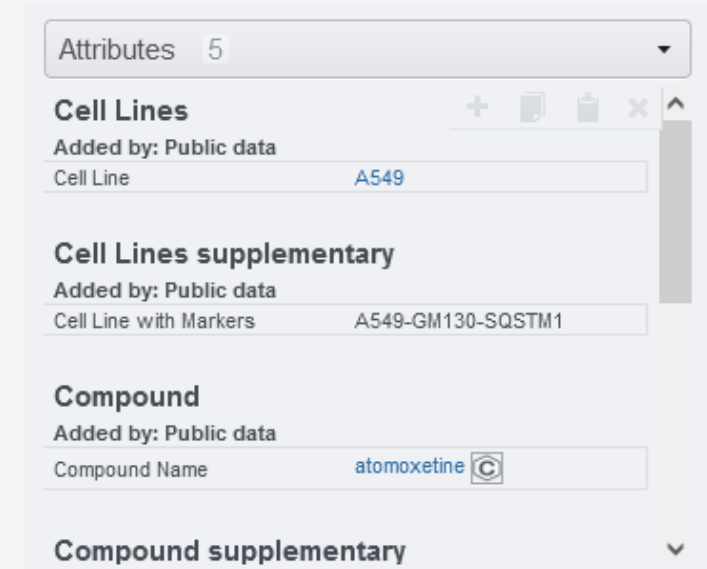
Key-level

Value-level

- Adopt REMBI structure
- Allows implementation of OMERO.mapr with different Namespaces

## What is the OMERO.web script doing exactly?

- OMERO.web script queries the SQL database and resolves the Tables Tags into OMERO MapAnnotations (Key-Value pairs) and TagAnnotations (Tags)
- Use OMERO.mapr plugin to create structured Key-Value pairs like IDR
  - Thumbnails with Hyperlinks
  - Implemented search function for Values



Attributes 5

**Cell Lines** + [copy] [trash] [close] [up arrow]

Added by: Public data

Cell Line	<a href="#">A549</a>
-----------	----------------------

**Cell Lines supplementary**

Added by: Public data

Cell Line with Markers	<a href="#">A549-GM130-SQSTM1</a>
------------------------	-----------------------------------

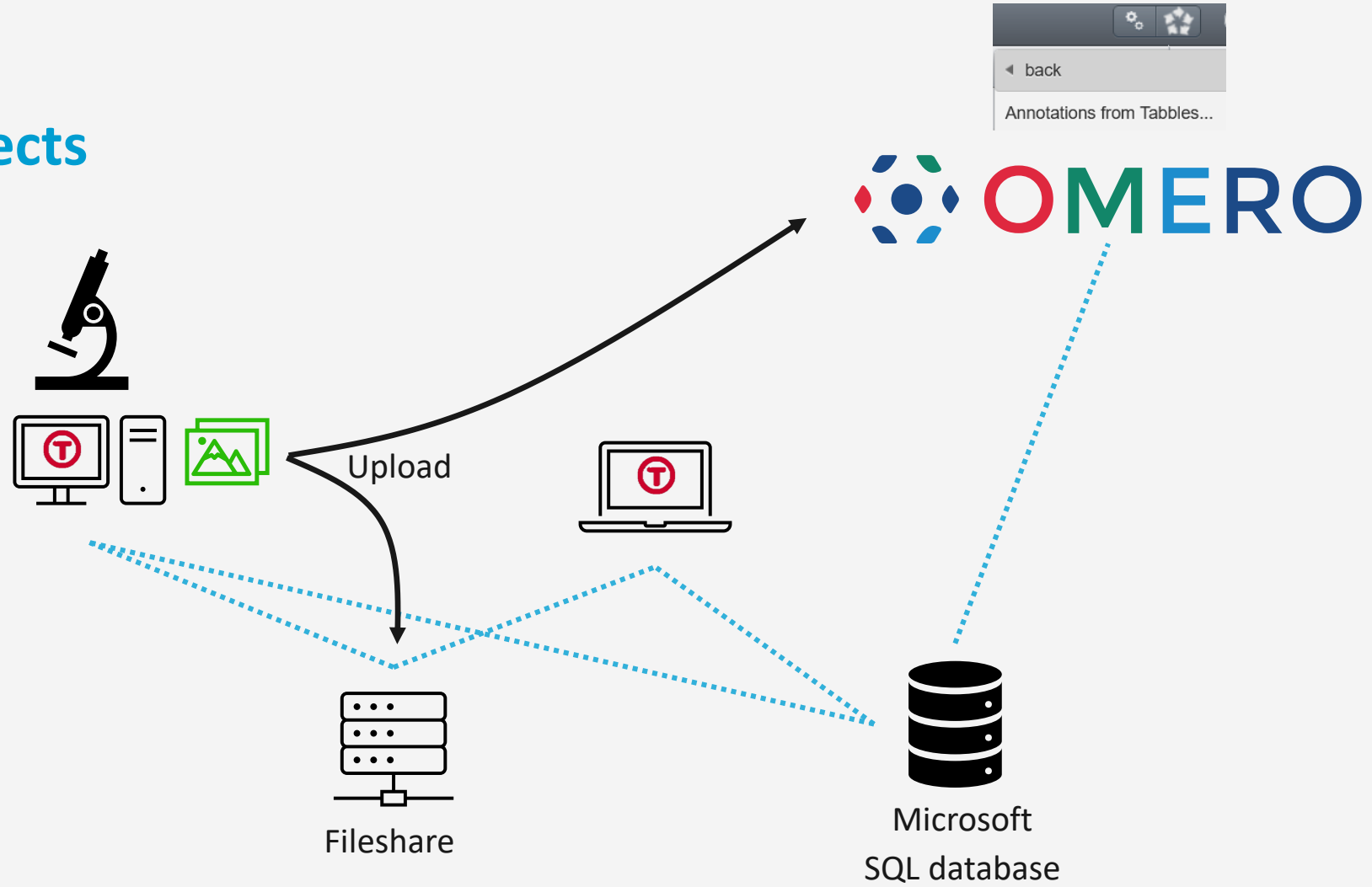
**Compound**

Added by: Public data

Compound Name	<a href="#">atomoxetine</a> ©
---------------	-------------------------------

**Compound supplementary** [down arrow]

# How it all connects



## Advantages

- Only two intuitive, quick steps
- Supports not only Key-Value pairs but also Tags
- If you are doing in-place import, the script could be run automatically after the import
- (Detailed) auto-tagging rules can create the majority of tags automatically
- Tags are synchronized/shared between different workstations/groups
- You can update Metadata at a later time

## Disadvantages

- Tabbles is a proprietary Software (modest licensing fees)
- Tabbles only support Windows (most Microscope workstation run Windows)
- Initial setup of SQL database and OMERO.mapr needed (~2-3h)
- Some limits for tag naming conventions
- Not providing all the in-depth functionality  
OMERO.forms and OMERO.insight MDE have

## Questions?

[https://github.com/MuensterImagingNetwork/annotations\\_from\\_tabbles/tree/dev](https://github.com/MuensterImagingNetwork/annotations_from_tabbles/tree/dev)