

# On Bringing Bioimaging Data into the Open(-World)

Josh Moore (🐦notjustmoore)  
**12th International SWAT4HCLS Conference**  
Edinburgh, 9-12 December, 2019



**University  
of Dundee**

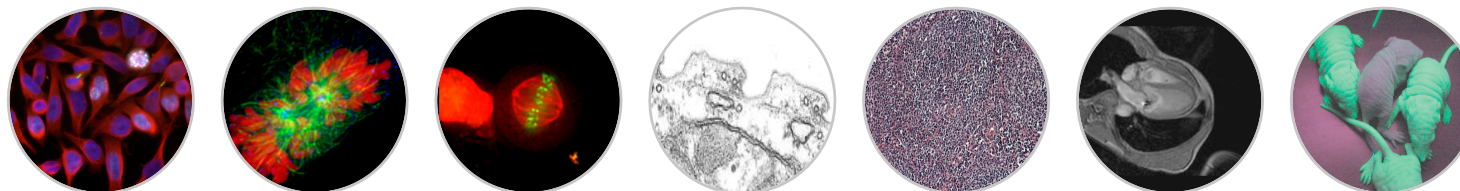
Open Microscopy Environment  
Centre for Gene Regulation & Expression  
College of Life Sciences, University of Dundee  
Dundee, Scotland, UK



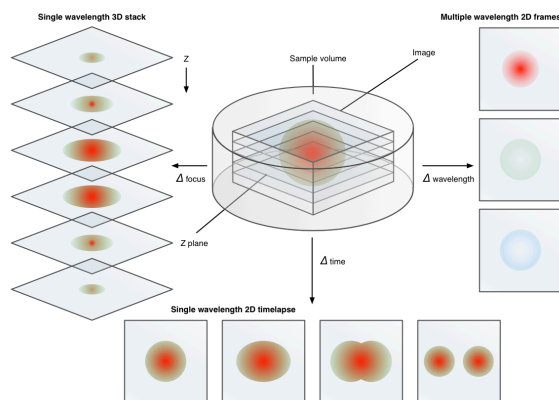
**openmicroscopy**  
**Permission to share**

# Describing Diversity

## Imaging Modalities

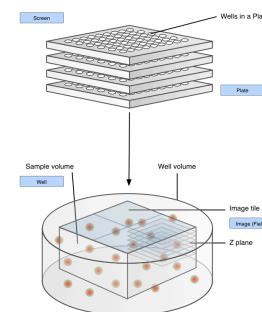


## 5D Images

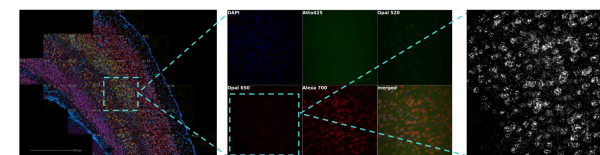


- 3D
- multi-color
- movies
- or any combination thereof

## Complex Acquisitions



High-content screen



Single-cell tissue



# Research Infrastructure Stack

Public  
Resource

Data  
Management

Format  
Parsing

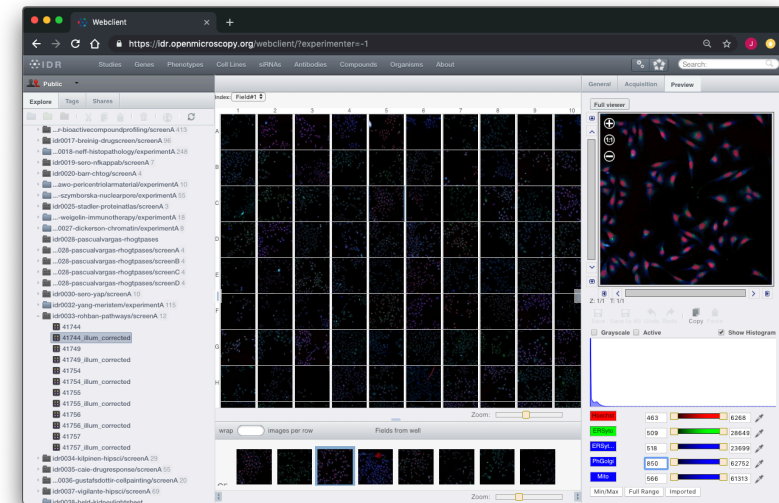
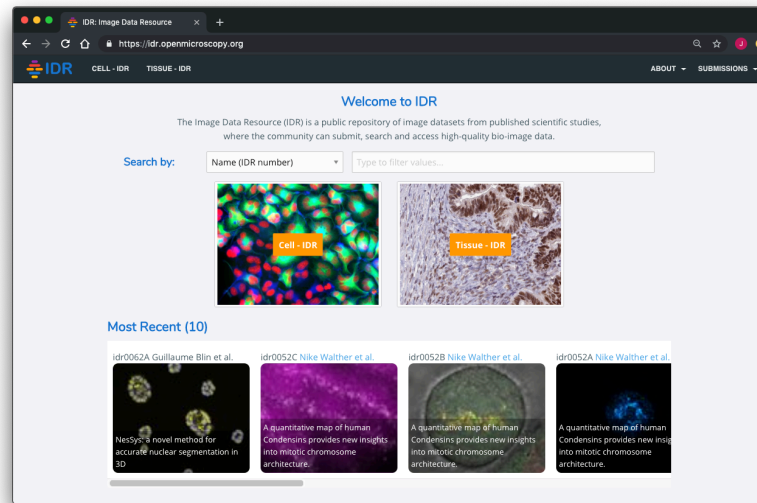
File  
Formats

Public  
Resource

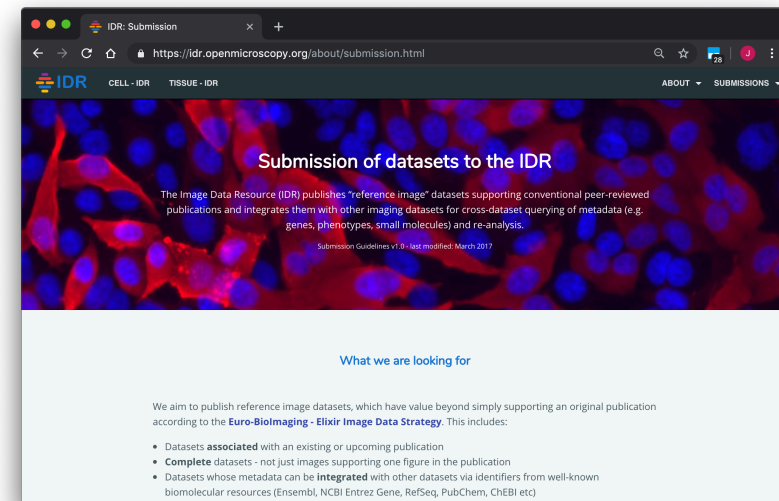
Data  
Management

Format  
Parsing

File  
Formats



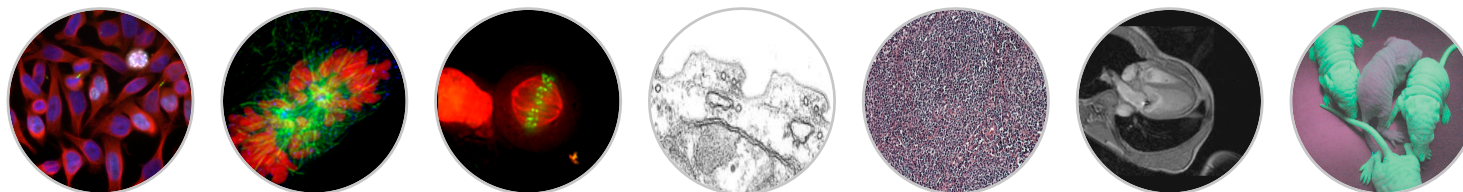
Metric	Dec 2019
Image Data Size	146 000 000 000 000 (TB)
Planes	61 200 000
Image files	21 800 000
Total Images	8 370 000
Experiments	1 100 000
Genes	80 000
Datasets	9 510
Phenotypic Classes	281
External Links	433 000



# Linked and Curated Data

Public  
Resource

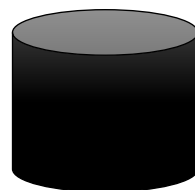
**Imaging  
Modalities**



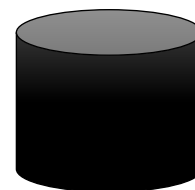
Data  
Management

Format  
Parsing

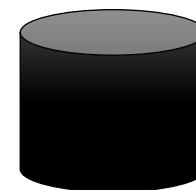
**Biomolecular  
Resources**



Genes



Compounds



Cell Lines

File  
Formats

**Controlled  
Vocabularies**



Phenotypes



Ground Truth



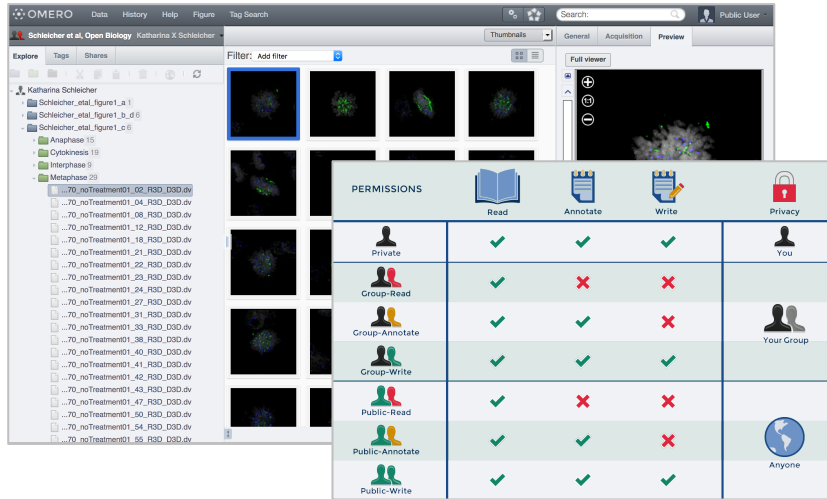
## Collaborate on data publication

Public  
Resource

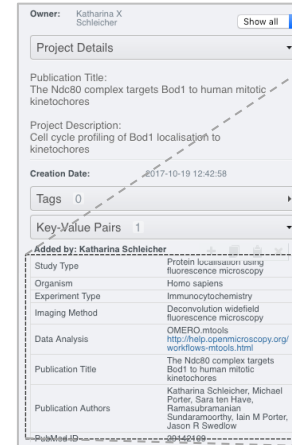
Data  
Management

Format  
Parsing

File  
Formats

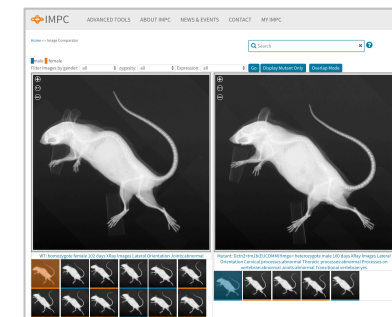
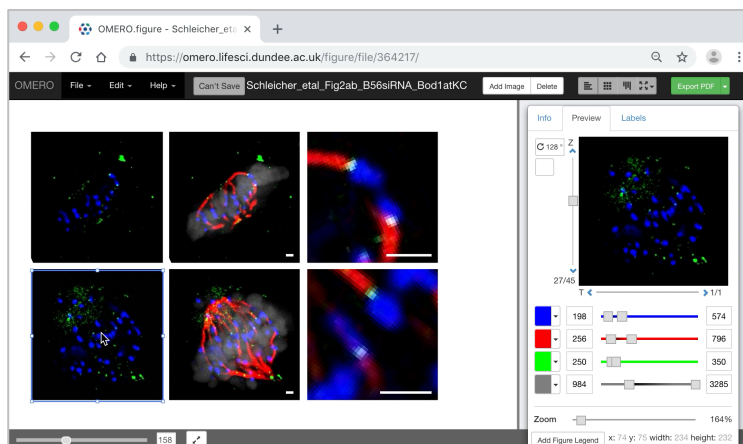


## Annotate

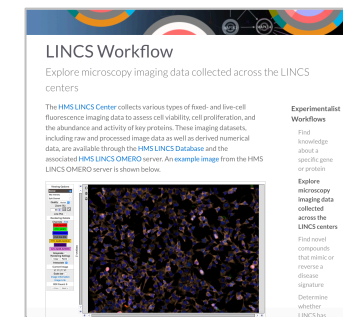


Study Type	Protein localisation using fluorescence microscopy
Organism	Homo sapiens
Experiment Type	Immunocytochemistry
Imaging Method	Deconvolution widefield fluorescence microscopy
Data Analysis	OMERO.mtools <a href="http://help.openmicroscopy.org/workflows-mtools.html">http://help.openmicroscopy.org/workflows-mtools.html</a>
Publication Title	The Ndc80 complex targets Bod1 to human mitotic kinetochores
Publication Authors	Katharina Schleicher, Michael Porter, Sara ten Have, Ramasubramanian Sundaramoorthy, Iain M Porter, Jason R Swedlow
PubMed ID	29142109
PMC ID	tba
Publication DOI	10.1098/rsob.170099
License	Attribution 4.0 International (CC BY 4.0) <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>
Data Publisher	University of Dundee
Data DOI	<a href="http://dx.doi.org/10.17867/1000109">http://dx.doi.org/10.17867/1000109</a>

## Rapidly edit figures



<https://www.mousephenotype.org>



<https://lincs-omero.hms.harvard.edu>



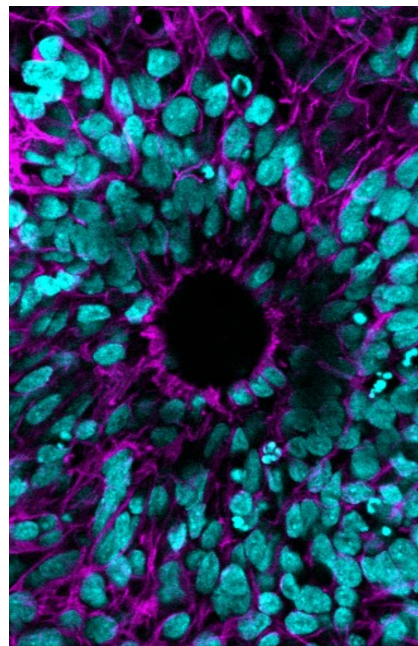
<http://ssbd.qbic.riken.jp/>

Public  
Resource

Data  
Management

Format  
Parsing

File  
Formats



BIO-FORMATS

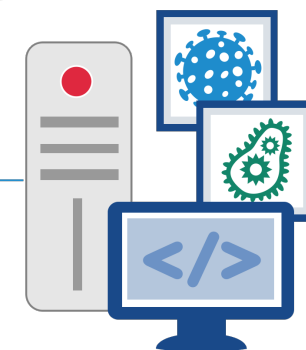
OMERO  
.server

View & Share

Remote Clients



Analysis & Processing



Cores, Clusters

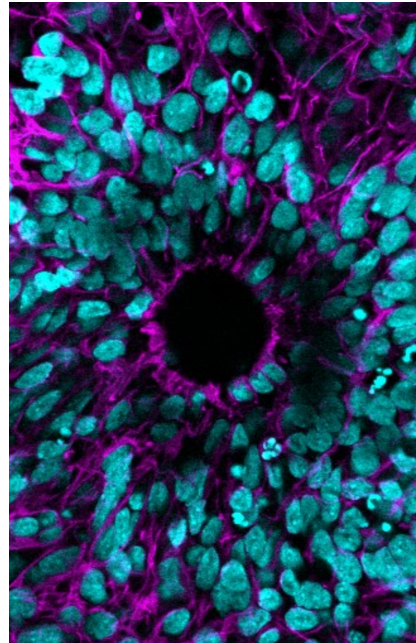
# Translation of over 150 File Formats

Public  
Resource

Data  
Management

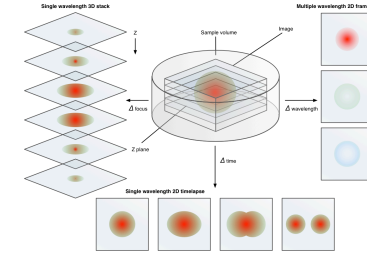
Format  
Parsing

File  
Formats



BIO-FORMATS

OMERO  
ImageJ  
Fiji  
KNIME  
CellProfiler  
XuvTools  
...



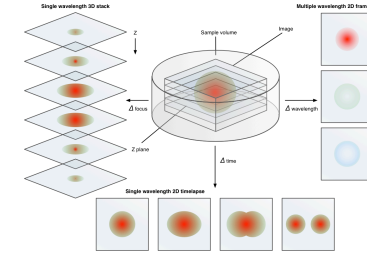
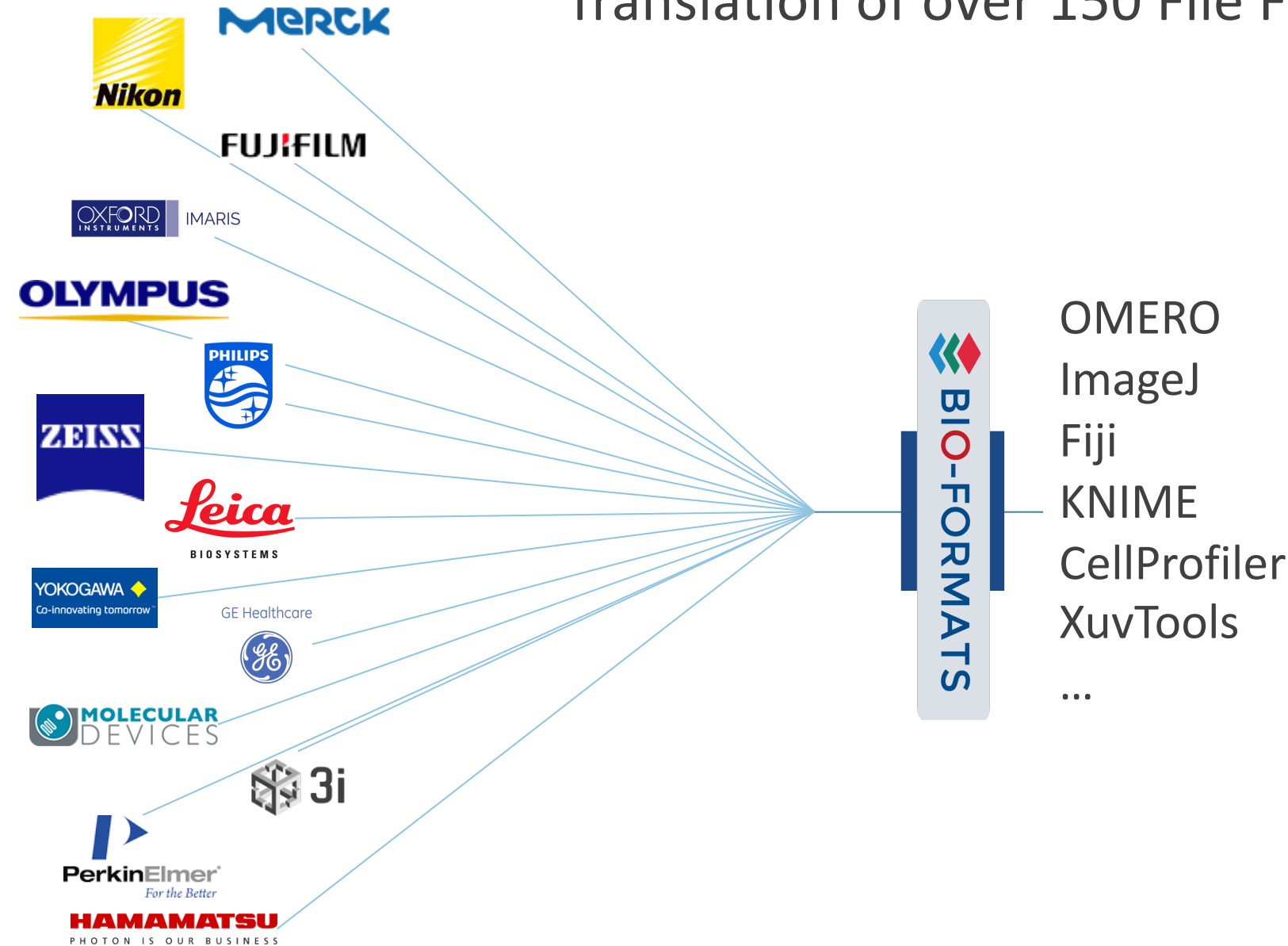
+

```
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtLinePeriod #1=3.00000
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetX #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetY #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtSuperSampling #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtZoom #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingX #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingY #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingZ #1=9.999999999
Experiment|AcquisitionBlock|AcquisitionModeSetup|SimRotations #1=3
Experiment|AcquisitionBlock|AcquisitionModeSetup|TimeSeries #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|TrackMultiplexType #1=Z
Experiment|AcquisitionBlock|AcquisitionModeSetup|UseRois #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomX #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomY #1=1
Experiment|AcquisitionBlock|Laser|LaserName #1=HeNe633
Experiment|AcquisitionBlock|Laser|LaserName #2=Diode 405-30
Experiment|AcquisitionBlock|Laser|LaserName #3=Argon
Experiment|AcquisitionBlock|Laser|LaserName #4=HeNe594
Experiment|AcquisitionBlock|Laser|LaserPower #1=0.00500000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #2=0.02999999999999999999
Experiment|AcquisitionBlock|Laser|LaserPower #3=0.02500000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #4=0.002
```

...



## Translation of over 150 File Formats



+

```
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtLinePeriod #1=3.00000
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetX #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetY #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtSuperSampling #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtZoom #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingX #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingY #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingZ #1=9.999999999
Experiment|AcquisitionBlock|AcquisitionModeSetup|SimRotations #1=3
Experiment|AcquisitionBlock|AcquisitionModeSetup|TimeSeries #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|TrackMultiplexType #1=Z
Experiment|AcquisitionBlock|AcquisitionModeSetup|UseRois #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomX #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomY #1=1
Experiment|AcquisitionBlock|Laser|LaserName #1=HeNe633
Experiment|AcquisitionBlock|Laser|LaserName #2=Diode 405-30
Experiment|AcquisitionBlock|Laser|LaserName #3=Argon
Experiment|AcquisitionBlock|Laser|LaserName #4=HeNe594
Experiment|AcquisitionBlock|Laser|LaserPower #1=0.0050000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #2=0.029999999999999999
Experiment|AcquisitionBlock|Laser|LaserPower #3=0.025000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #4=0.002
```

...

# OME-TIFF: Community supported format

Public  
Resource

Data  
Management

Format  
Parsing

File  
Formats

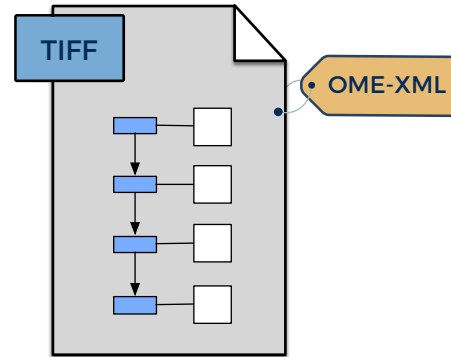
2005

## OME-TIFF and Bio-Formats

K. Eliceiri, E. Hathaway,  
M. Linkert, and C. Rueden  
<http://www.loci.wisc.edu/ome/>



# OME-TIFF: Community supported format



## Open standards

TIFF: imaging pixel data

OME: imaging metadata

## Long-term support

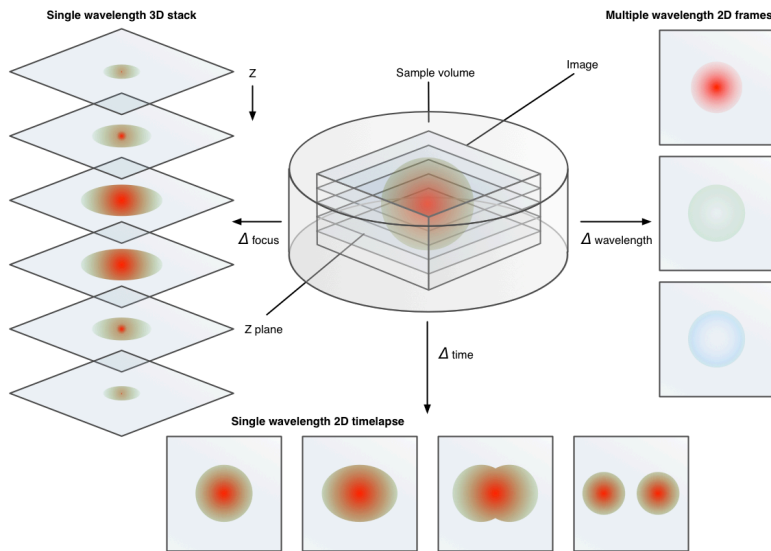
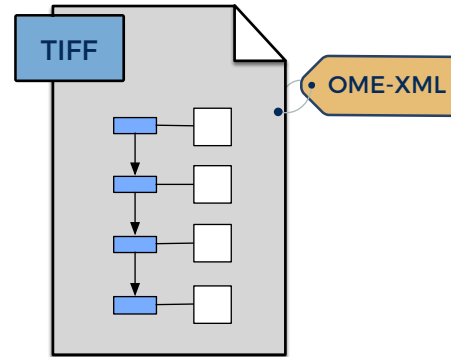
Upgrades and downgrades for  
each new version of the format

## Vendor buy-in

Number of platforms export  
OME-TIFF as an exchange  
format



# OME-TIFF: Community supported format



Targets												
Source	2003-FC	2007-06	2008-02	2008-09	2009-09	2010-04	2010-06	2011-06	2012-06	2013-06	2015-01	2016-06
2003-FC	--											
2007-06	poor	--										
2008-02	poor	poor	--									
2008-09	poor	poor	poor	--								
2009-09	poor	poor	poor	poor	--							
2010-04	poor	poor	poor	poor	poor	--						
2010-06	poor	poor	poor	poor	fair	fair	--					
2011-06	poor	poor	poor	fair	fair	fair	good	--				
2012-06	poor	poor	poor	fair	fair	fair	good	good	--			
2013-06	poor	poor	poor	fair	fair	fair	good	good	good	--		
2015-01	poor	poor	poor	fair	fair	fair	good	good	good	good	--	
2016-06	poor	poor	poor	fair	fair	fair	good	good	good	good	good	--

The OME-TIFF format — OME | x +

https://docs.openmicroscopy.org/ome-model/5.6.4/ome-tiff/

## Support

OME-TIFF is supported by a number of companies, either by using the format as their main storage format or by providing users the ability to export in OME-TIFF. Below is a list of vendors who are known to support OME-TIFF:

- Accelrys Inc.
- GE Healthcare Life Sciences (formerly Applied Precision)
- Bitplane AG
- Carl Zeiss Microscopy GmbH
- Definiens
- DRVision Technologies LLC
- iMAGIC
- Intelligent Imaging Innovations, Inc.
- Leica Inc.
- Mayachitra Inc.
- Micro-Manager
- Molecular Devices Inc.
- Nikon
- Olympus
- PerkinElmer
- Scientifica
- Scientific Volume Imaging B.V.
- Strand Life Sciences
- TILL Photonics GmbH, now FEI Munich

If you would like to have your name placed on this list, please contact us via one of our [support channels](#).

OME Data Model and File Formats 5.6.4 documentation - previous | next | index

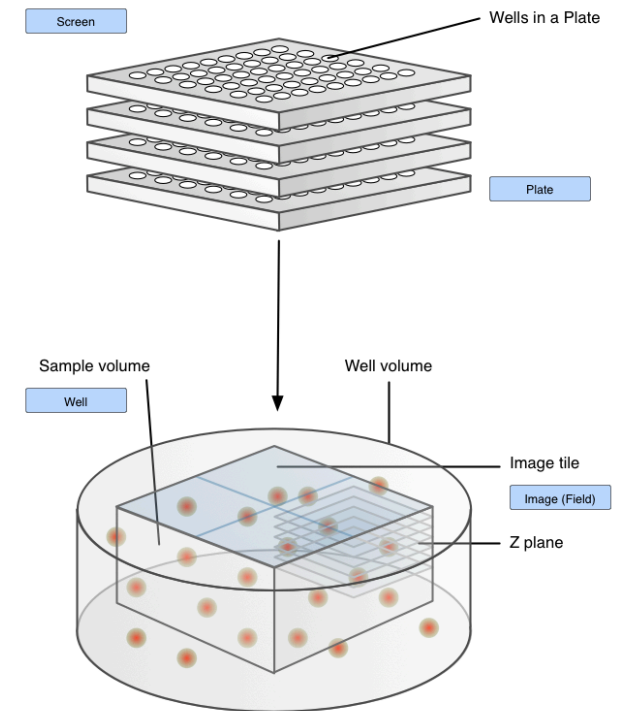
© Copyright 2000-2018, The Open Microscopy Environment. Last updated on Nov 21, 2018. Created using Sphinx 1.7.9.

# Open-World

/ˈəʊp(ə)n wɜːld/

# Cracks in our Closed World

**2008** Multi-year process to specify high-content screening (HCS) model

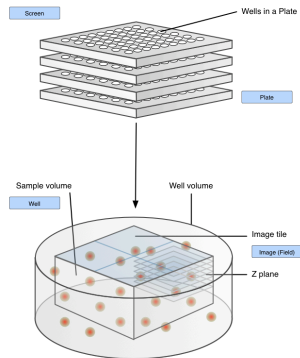




# Cracks in our Closed World

**2008** Multi-year process to specify high-content screening(HCS) model

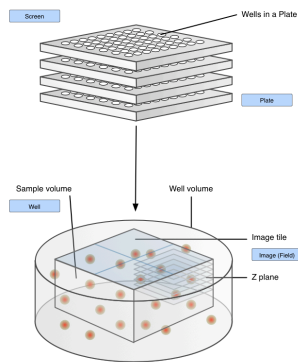
**2010** Structured Annotations (Comment, Scalars, XML)



```
▼<OME xmlns="http://www.openmicroscopy.org/Schemas/OME/2016-06"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.openmicroscopy.org/Schemas/OME/2016-
06 http://www.openmicroscopy.org/Schemas/OME/2016-06/ome.xsd">
  ▼<Image ID="Image:0" Name="6x6x1x8-swatch.tif">
    <AcquisitionDate>2010-02-23T12:51:30</AcquisitionDate>
    ►<Pixels DimensionOrder="XYZCT" ID="Pixels:0:0"
      PhysicalSizeX="10000.0" PhysicalSizeY="10000.0" Type="uint8"
      SizeC="1" SizeT="1" SizeX="6" SizeY="4" SizeZ="1">...</Pixels>
    <AnnotationRef ID="Annotation:1"/>
  </Image>
  ▼<StructuredAnnotations>
    ▼<CommentAnnotation ID="Annotation:1">
      <Value>Fred</Value>
    </CommentAnnotation>
  </StructuredAnnotations>
</OME>
```

# Cracks in our Closed World

- 2008** Multi-year process to specify high-content screening(HCS) model
- 2010** Structured Annotations (Comment, XML, Scalars)
- 2013** RMS meeting lead to the addition of key-value (K/V) pairs

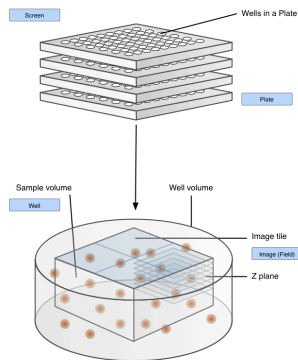


```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
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  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
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  <Image ID="Image:0" Name="6x6x1x8-swatches.tif">
    <AcquisitionDate>2010-02-23T12:51:30</AcquisitionDate>
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      PhysicalSizeX="10000.0" PhysicalSizeY="10000.0" Type="uint8"
      SizeC="1" SizeT="1" SizeX="6" SizeY="4" SizeZ="1">...</Pixels>
    <AnnotationRef ID="Annotation:1"/>
  </Image>
  <StructuredAnnotations>
    <CommentAnnotation ID="Annotation:1">
      <Value>Fred</Value>
    </CommentAnnotation>
  </StructuredAnnotations>
</OME>
```

Study Type	Protein localisation using fluorescence microscopy
Organism	Homo sapiens
Experiment Type	Immunocytochemistry
Imaging Method	Deconvolution widefield fluorescence microscopy
Data Analysis	OMERO.mtools <a href="http://help.openmicroscopy.org/workflows-mtools.html">http://help.openmicroscopy.org/workflows-mtools.html</a>
Publication Title	The Ndc80 complex targets Bod1 to human mitotic kinetochores
Publication Authors	Katharina Schleicher, Michael Porter, Sara ten Have, Ramasubramanian Sundaramoorthy, Iain M Porter, Jason R Swedlow
PubMed ID	29142109
PMC ID	tba
Publication DOI	10.1098/rsob.170099
License	Attribution 4.0 International (CC BY 4.0) <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>
Data Publisher	University of Dundee
Data DOI	<a href="http://dx.doi.org/10.17867/10000109">http://dx.doi.org/10.17867/10000109</a>

# Cracks in our Closed World

- 2008** Multi-year process to specify high-content screening(HCS) model
- 2010** Structured Annotations (Comment, XML, Scalars)
- 2013** RMS meeting lead to the addition of key-value (K/V) pairs
- 2016** IDR development required a formalization of K/V



```
<?xml version="1.0" encoding="UTF-8" ?>
<OME xmlns="http://www.openmicroscopy.org/Schemas/OME/2016-06"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.openmicroscopy.org/Schemas/OME/2016-06 http://www.openmicroscopy.org/Schemas/OME/2016-06/ome.xsd">
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      SizeC="1" SizeT="1" SizeX="6" SizeY="4" SizeZ="1">...</Pixels>
    <AnnotationRef ID="Annotation:1"/>
  </Image>
  <StructuredAnnotations>
    <CommentAnnotation ID="Annotation:1">
      <Value>Fred</Value>
    </CommentAnnotation>
  </StructuredAnnotations>
</OME>
```

Study Type	Protein localisation using fluorescence
Organism	Homo sapiens
Experiment Type	Immunocytochemistry
Imaging Method	Deconvolution widefield fluorescence microscopy
Data Analysis	OMERO.mtools <a href="http://help.openmicroscopy.org/">http://help.openmicroscopy.org/</a>
Publication Title	The Ndc80 complex targets Bod1 to human chromosome spreads
Publication Authors	Katharina Schleicher, Michael Porter, S. Sundaramoorthy, Iain M Porter, Jason F. Winkler
PubMed ID	29142109
PMC ID	tba
Publication DOI	10.1098/rsob.170099
License	Attribution 4.0 International (CC BY 4.0) <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>
Data Publisher	University of Dundee
Data DOI	<a href="http://dx.doi.org/10.17867/10000109">http://dx.doi.org/10.17867/10000109</a>

Attributes 8

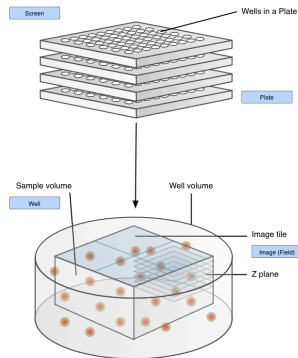
**Cell Lines**  
Added by: Public data  
Cell Line HeLa

**Gene**  
Added by: Public data  
Gene Identifier 9070   
Gene Symbol ASH2L

**Phenotype**  
Added by: Public data  
Phenotype elongated cells  
Phenotype Term Name elongated cell phenotype  
Phenotype Term Accession CMPO\_0000077

# Cracks in our Closed World

- |             |   |
|-------------|---|
| <b>2008</b> | Multi-year process to specify high-content screening(HCS) model |
| <b>2010</b> | Structured Annotations (Comment, XML, Scalars)                  |
| <b>2013</b> | RMS meeting lead to the addition of key-value (K/V) pairs       |
| <b>2016</b> | IDR development required a formalization of K/V                 |
| <b>2019</b> | Community / vendors looking for more!                           |



```
<?xml:namespace prefix="http://www.openmicroscopy.org/Schemas/OME/2016-06"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.openmicroscopy.org/Schemas/OME/2016-06
http://www.openmicroscopy.org/Schemas/OME/2016-06/ome.xsd">
  <Image ID="Image:0" Name="6x61x8-swatch.tif">
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    <Pixels DimensionOrder="XYZt" ID="Pixels:0:0"
PhysicalSizeX="10000.0" PhysicalSizeY="10000.0" Type="uint8"
SizeC="1" SizeT="1" SizeX="6" SizeY="4" SizeZ="1">...</Pixels>
    <AnnotationRef ID="Annotation:1"/>
  </Image>
  <StructuredAnnotations>
    <CommentAnnotation ID="Annotation:1">
      <Value>Fred</Value>
    </CommentAnnotation>
  </StructuredAnnotations>
</OME>
```

Study Type	Protein localisation using fluorescence microscopy
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Publication Authors	Katharina Schleicher, Michael Porter, Sara ten Have, Ramasubramanian Sundaramoorthy, Iain M Porter, Jason R Swedlow
PubMed ID	29142109
PMC ID	tba
Publication DOI	10.1098/rsob.170099
License	Attribution 4.0 International (CC BY 4.0) <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>
Data Publisher	University of Dundee
Data DOI	<a href="http://dx.doi.org/10.17867/10000109">http://dx.doi.org/10.17867/10000109</a>

Attributes8


Cell Lines

Added by: Public data

Cell Line	HeLa
-----------	------


Gene

Added by: Public data

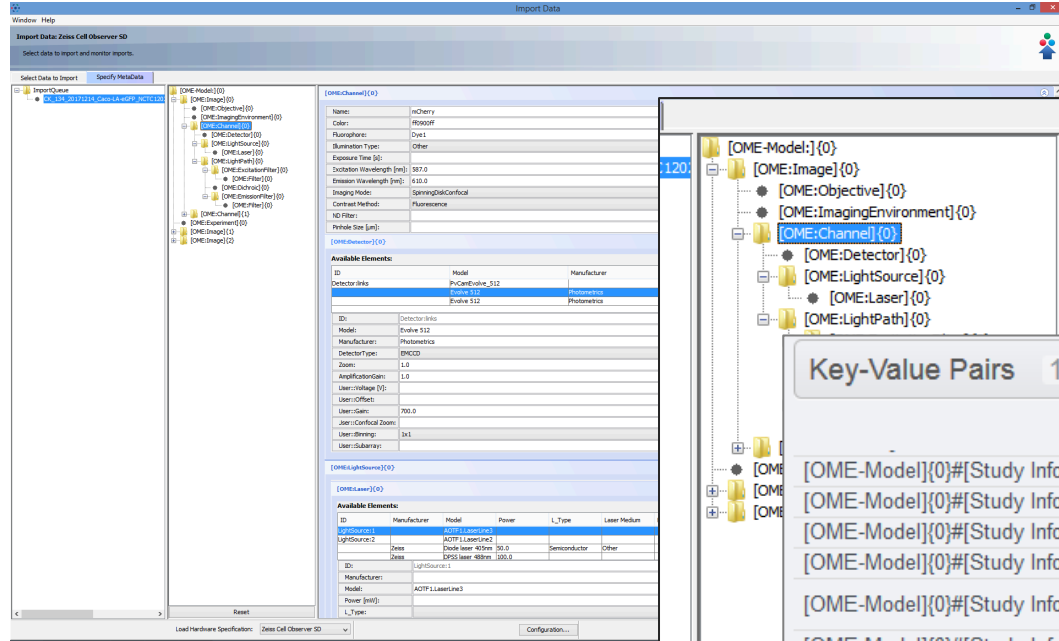
Gene Identifier	9070	
Gene Symbol	ASH2L	

Phenotype

Added by: Public data

Phenotype	elongated cells	
Phenotype Term Name	elongated cell phenotype	
Phenotype Term Accession	CMPO_0000077	

# Community drivers: user-input



[OME-Model:]{0}		[OME:Channel]{0}	
[OME:Image]{0}		Name: mCherry	
[OME:Object]{0}		Color: ffo900ff	
[OME:ImagingEnvironment]{0}		Fluorophore: Dye1	
[OME:Detector]{0}		Illumination Type: Other	
[OME:LightSource]{0}		Exposure Time [s]:	
[OME:Laser]{0}			
[OME:LightPath]{0}			

Key-Value Pairs 1	
[OME-Model]{0}#[Study Info]{0}   Study Type	Protein localisation using fluorescence microscopy
[OME-Model]{0}#[Study Info]{0}   Experiment Type	Immunocytochemistry
[OME-Model]{0}#[Study Info]{0}   Imaging Method	Deconvolution widefield fluorescence microscopy
[OME-Model]{0}#[Study Info]{0}   Publication Title	The Ndc80 complex targets Bod1 to human mitotic kinetochores
[OME-Model]{0}#[Study Info]{0}   Publication Authors	Katharina Schleicher, Michael Porter, Sara ten Have, Ramasubramanian Sundaramoorthy, Iain M Porter, Jason R Swedlow
[OME-Model]{0}#[Study Info]{0}   PubMed ID	29142109
[OME-Model]{0}#[Study Info]{0}   PMC ID	tba
[OME-Model]{0}#[Study Info]{0}   Publication DOI	10.1098/rsob.170099
[OME-Model]{0}#[Study Info]{0}   License	Attribution 4.0 International (CC BY 4.0) <a href="https://creativecommons.org/licenses/by/4.0/">https://creativecommons.org/licenses/by/4.0/</a>
[OME-Model]{0}#[Study Info]{0}   Data Publisher	University of Dundee
[OME-Model]{0}#[Study Info]{0}   Data DOI	<a href="http://dx.doi.org/10.17867/10000109">http://dx.doi.org/10.17867/10000109</a>

User::Voltage [V]:	
User::Offset:	
User::Gain:	700.0
User::Confocal Zoom:	
User::Binning:	1x1
User::Subarray:	

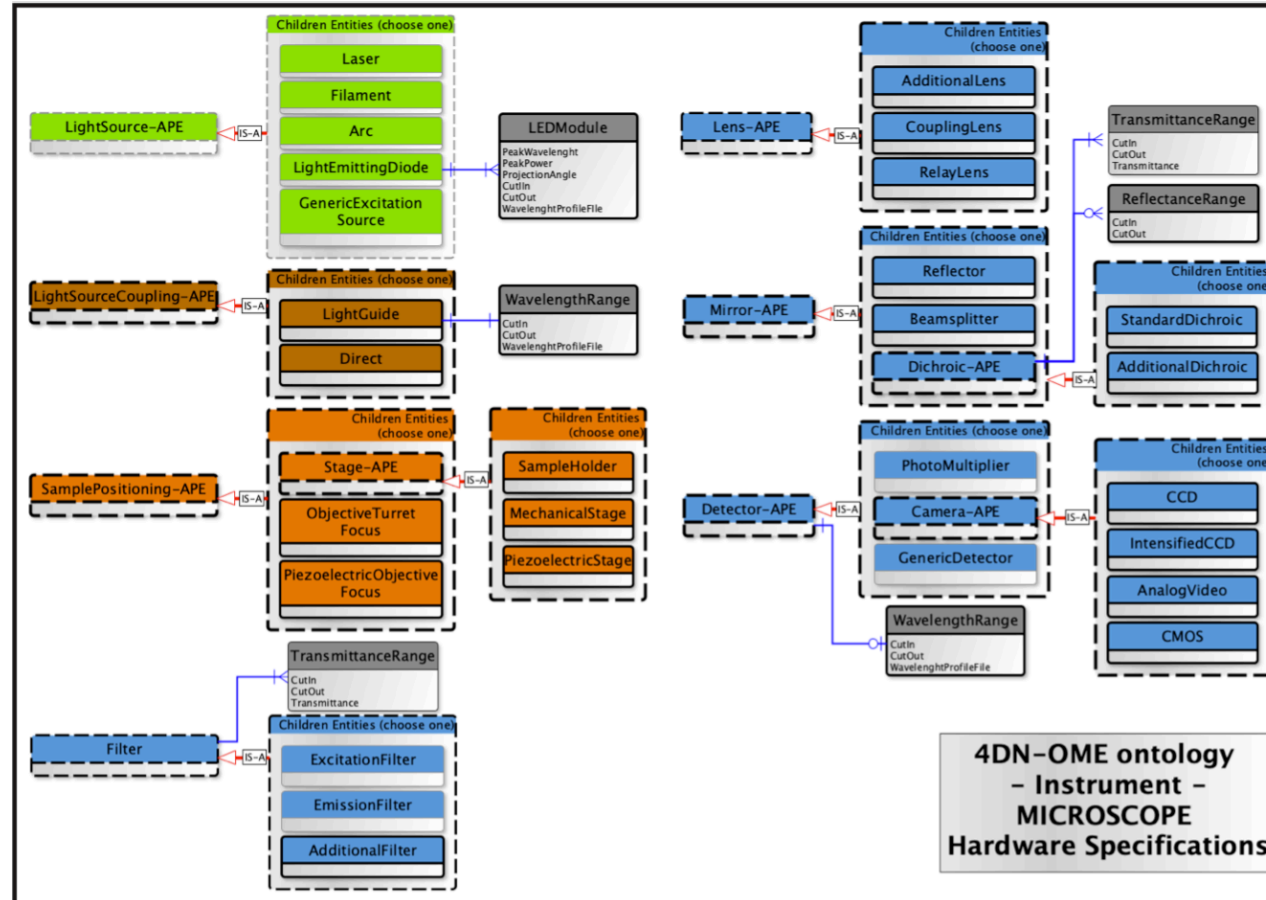
  

[OME:LightSource]{0}	
----------------------	--

**Susanne Kunis**  
U. Osnabrück  
*German BioImaging*



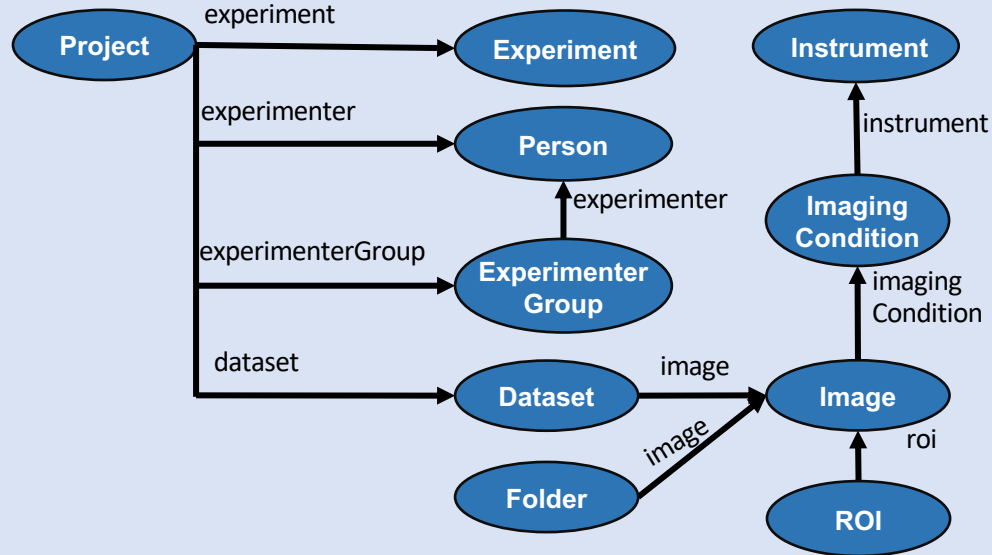
# Community drivers: hardware QC



**Caterina Strambio de Castillia**  
U. Massachusetts  
*4D Nucleome*

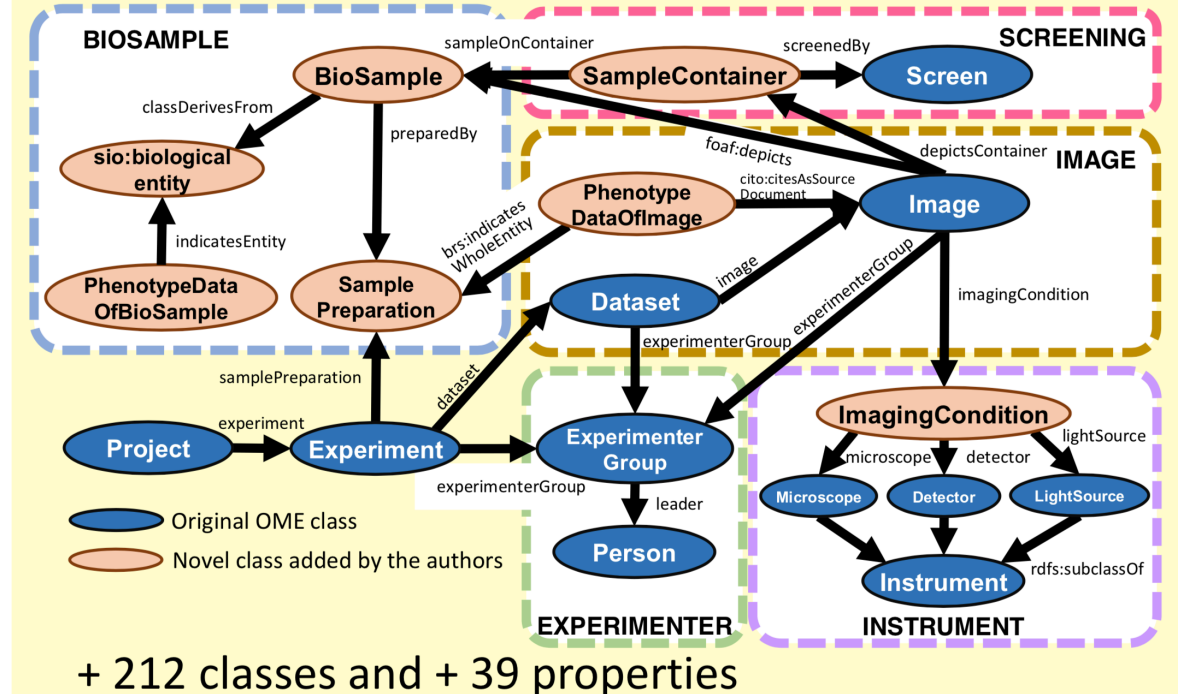
# Community drivers: multimodal

## OME core ontology



130 classes and 210 properties

## (2) Extend the OWL model for electron microscopy (EM)



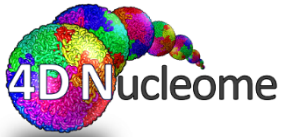
+ 212 classes and + 39 properties

SWAT4HCLS 2018



Norio Kobayashi  
RIKEN

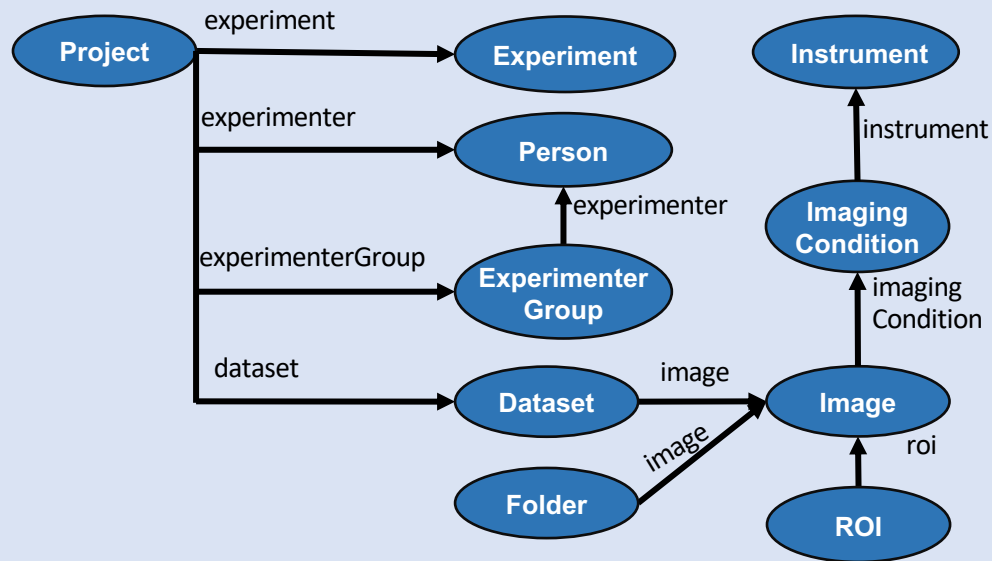




## XML-based model

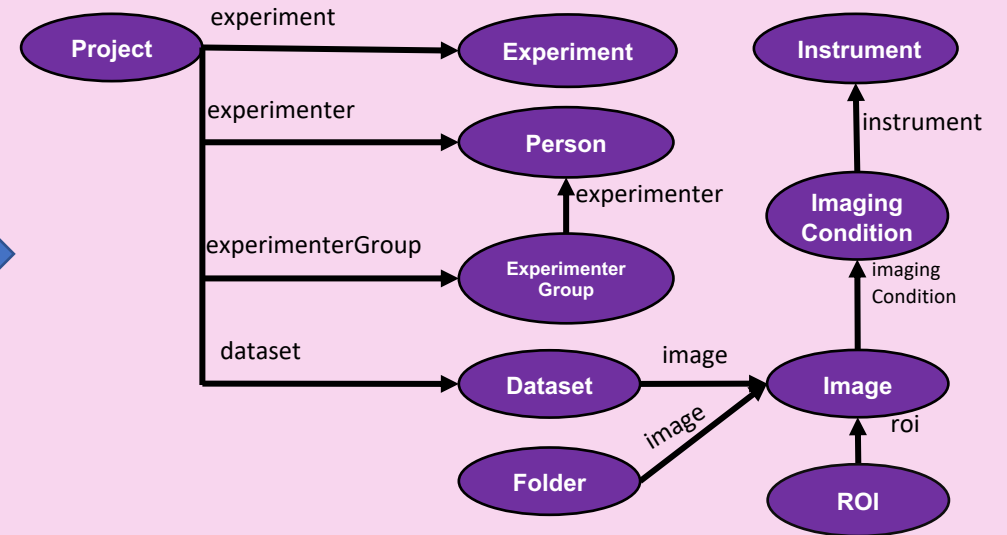
4D Nucleome model is originally defined in XML and the XML model was converted it into OWL.

### OME core ontology



130 classes and 210 properties

### 4D Nucleome ontology



285 classes and 445 properties

It is confirmed that 4D Nucleome ontology is OME-OWL compatible.



Norio Kobayashi  
RIKEN

## Pros & Cons

- + **OWL version of the schema & an extension are available.**
- + **SW reduces the cost of more adhoc XML extensions.**
- + **JSON-LD has some hope of being the exciting front-end.**
- + **SWAT4HCLS provides a body of knowledge that we look forward to contributing to.**
- Early days, and experience in transforms/validation needed.
- “The report of [RDF/OWL’s] death is an exaggeration.” M. Twain
- Complexity/usability will need to be kept in check.
- Bio. (light-)imaging behind in investment on common formats.

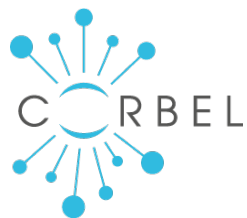
Thanks  
to



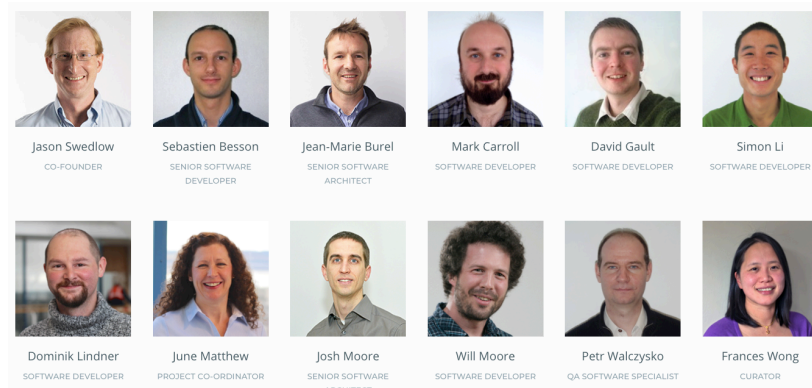
Chan  
Zuckerberg  
Initiative 



















GLOBAL  
BIOIMAGING  
growing collaboration



## The OME Teams















### Former members of the OME team in Dundee

Chris Allan 	Colin Blackburn 	Andrea Falconi 
Gus Ferguson 	Helen Flynn 	Stefan Frank
Kelli Griffiths	Emma Hill	Kenny Gillen 
Roger Leigh 	Simone Leo 	Scott Littlewood 
Brian Loranger	Scott Loynton	Donald MacDonald
Andrew Patterson 	Blazej Pindelski 	Balaji Ramalingam 
Gabriella Rustici	Aleksandra Tarkowska 	Joyce Walsh
Harald Waxenegger 	Simon Wells 	Eleanor Williams 
Wilma Woudenberg		

### Development Teams

Other teams are also working on developing or integrating OME tools.

 Glencoe Software	 Baldock Lab	 Bertrand Lab	 Brazma Lab
 Carazo-Salas Lab	 Danuser Lab	 Davis Lab	 Eliceiri Lab
 French Lab	 Murphy Lab	 Shorte Lab	 Zanetti Lab

## & Co-authors



**Norio Kobayashi**  
RIKEN



**Susanne Kunis**  
U. Osnabrück /  
German BioImaging

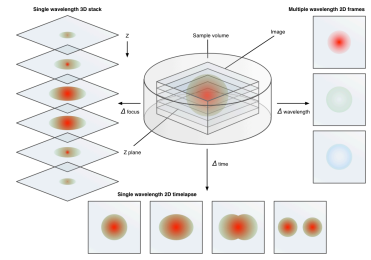
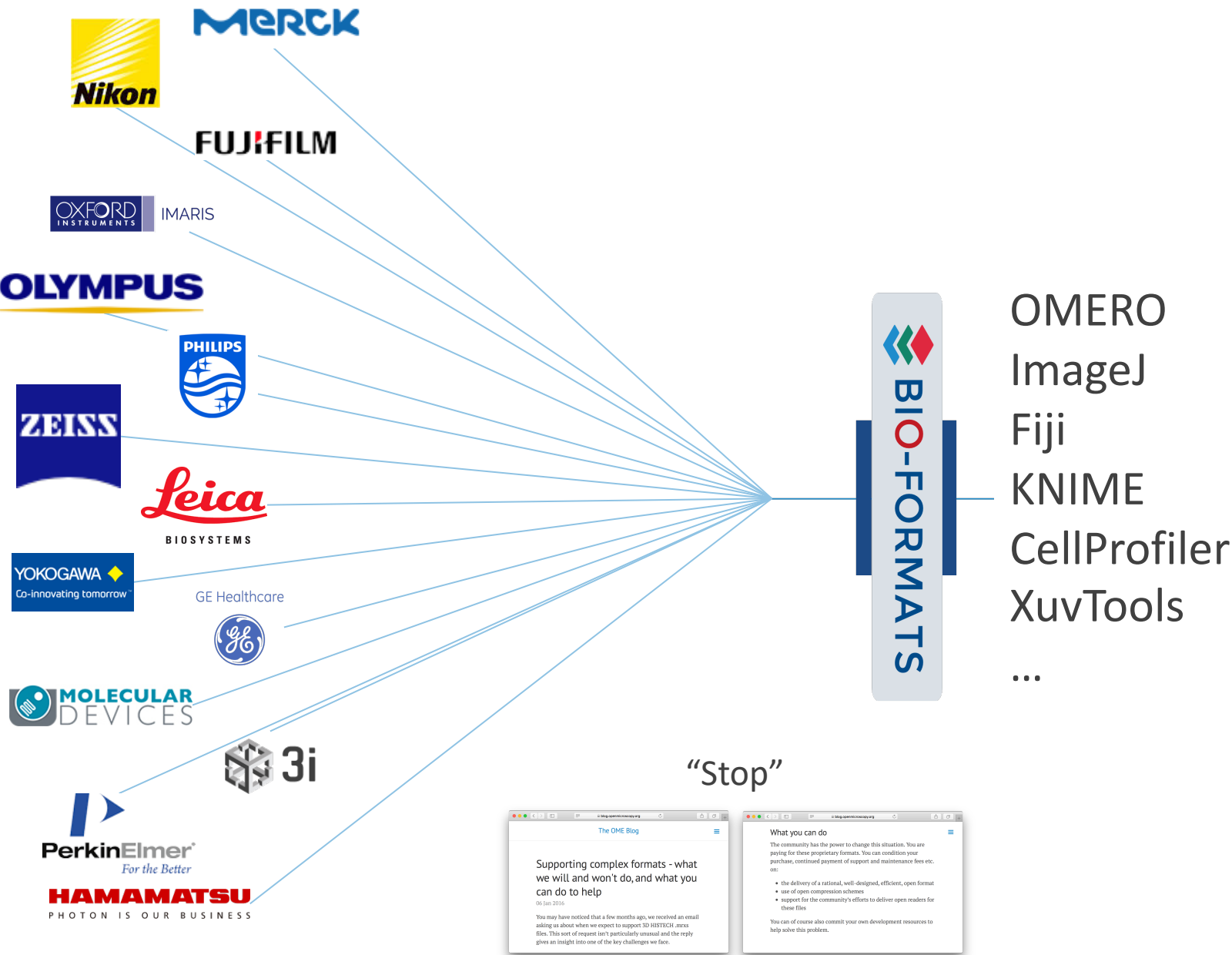


**Caterina Strambio de Castillia**  
U. Massachusetts  
*4D Nucleome*

**Thank you.**

# Extra Slides

**Critical for future applications**  
file formats & sharing



+

```
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtLinePeriod #1=3.00000
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetX #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetY #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtSuperSampling #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtZoom #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingX #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingY #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingZ #1=9.999999999
Experiment|AcquisitionBlock|AcquisitionModeSetup|SimRotations #1=3
Experiment|AcquisitionBlock|AcquisitionModeSetup|TimeSeries #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|TrackMultiplexType #1=Z
Experiment|AcquisitionBlock|AcquisitionModeSetup|UseRois #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomX #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomY #1=1
Experiment|AcquisitionBlock|Laser|LaserName #1=HeNe633
Experiment|AcquisitionBlock|Laser|LaserName #2=Diode 405-30
Experiment|AcquisitionBlock|Laser|LaserName #3=Argon
Experiment|AcquisitionBlock|Laser|LaserName #4=HeNe594
Experiment|AcquisitionBlock|Laser|LaserPower #1=0.00500000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #2=0.02999999999999999999
Experiment|AcquisitionBlock|Laser|LaserPower #3=0.0250000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #4=0.002
```

...





IMARIS

**OLYMPUS**



GE Healthcare



**HAMAMATSU**  
PHOTON IS OUR BUSINESS

# Common format

# OMERO

ImageJ

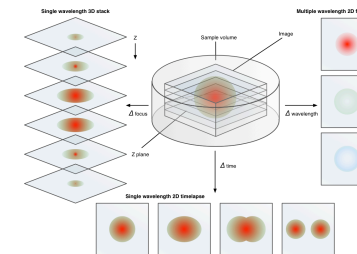
Fiji

# KNIME

# CellProfiler

# XuvTools

...



•

```
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtFrameWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtLinePeriod #1=3.00000
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetX #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtOffsetY #1=0
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionHeight #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtRegionWidth #1=512
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtSuperSampling #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|RtZoom #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingX #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingY #1=4.151329187
Experiment|AcquisitionBlock|AcquisitionModeSetup|ScalingZ #1=9.999999999
Experiment|AcquisitionBlock|AcquisitionModeSetup|SimRotations #1=3
Experiment|AcquisitionBlock|AcquisitionModeSetup|TimeSeries #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|TrackMultiplexType #1=Z
Experiment|AcquisitionBlock|AcquisitionModeSetup|UseRois #1=false
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomX #1=1
Experiment|AcquisitionBlock|AcquisitionModeSetup|ZoomY #1=1
Experiment|AcquisitionBlock|Laser|LaserName #1=HeNe633
Experiment|AcquisitionBlock|Laser|LaserName #2=Diode 405-30
Experiment|AcquisitionBlock|Laser|LaserName #3=Argon
Experiment|AcquisitionBlock|Laser|LaserName #4=HeNe594
Experiment|AcquisitionBlock|Laser|LaserPower #1=0.0050000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #2=0.029999999999999999
Experiment|AcquisitionBlock|Laser|LaserPower #3=0.025000000000000001
Experiment|AcquisitionBlock|Laser|LaserPower #4=0.002
```

...



MERCK

FUJIFILM



IMARIS

OLYMPUS



Leica  
BIOSYSTEMS



GE Healthcare



MOLECULAR  
DEVICES



PerkinElmer  
For the Better

HAMAMATSU  
PHOTON IS OUR BUSINESS

Common format

OMERO

ImageJ

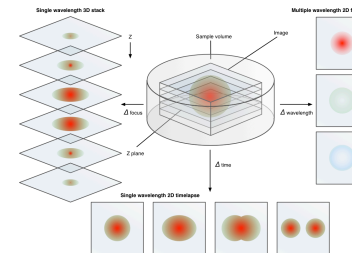
Fiji

KNIME

CellProfiler

XuvTools

...



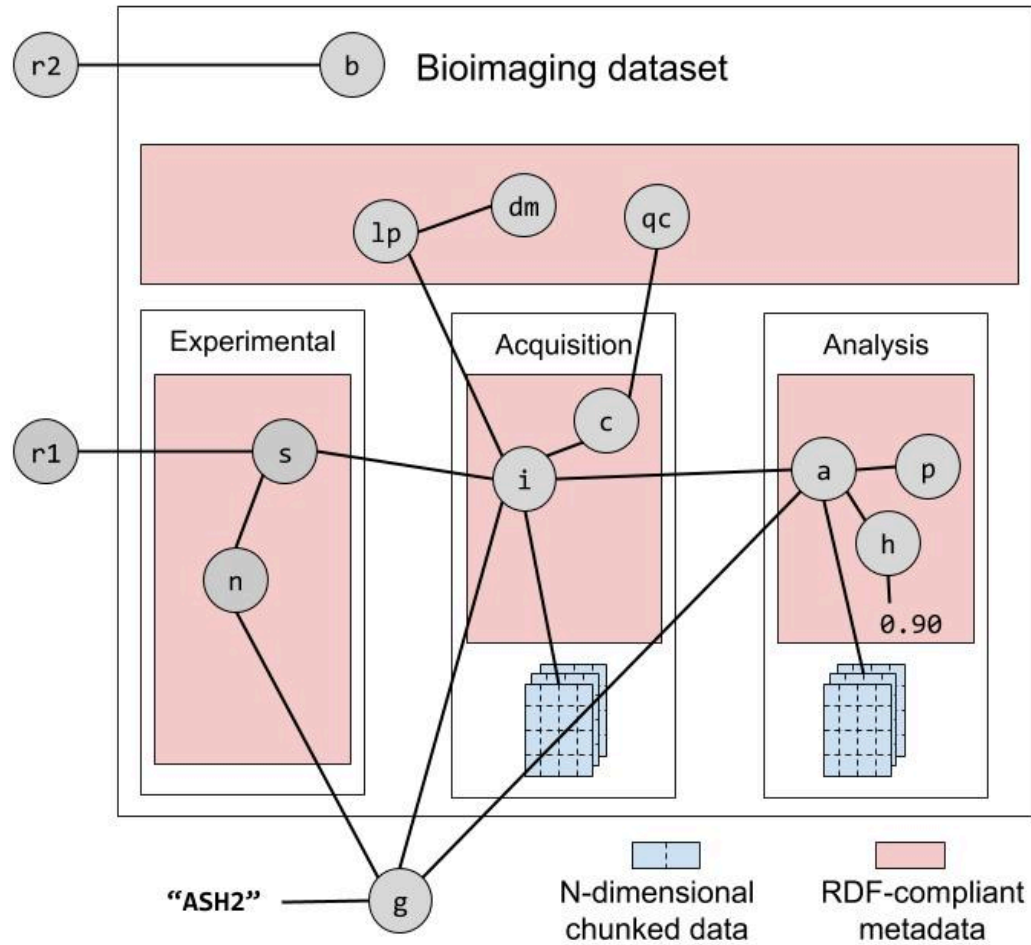
+

```
{  
  vendor_tags:  
    {  
      "zeiss" : {  
        "custom_field": 1  
      }  
    }  
}
```

JSON-LD formats building on:

- schema.org
- bioschema.org
- OBO/OLS/etc.

# Next Generation File Formats



## For Labs

- Better capture of experiment, analysis, etc.
- Broader use/more domains using (similar) formats
- Easier data access, sharing

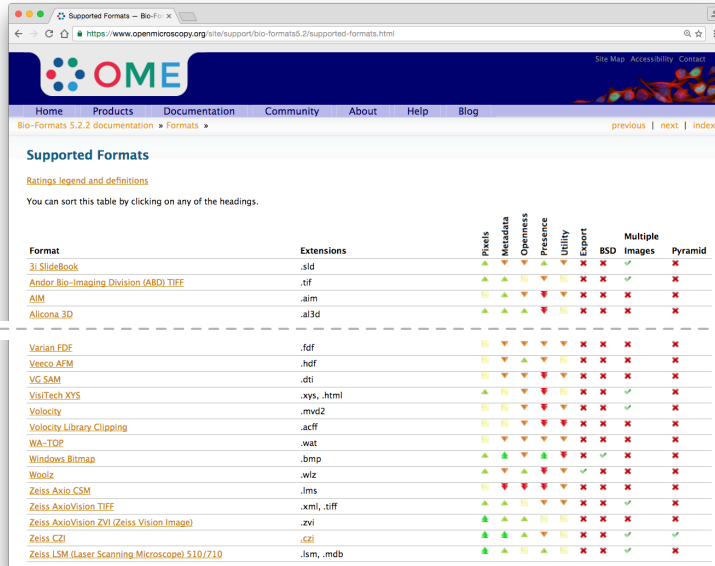
## For Archives

- Richer, easier submissions

## For Added Value DBs

- Easier, faster curation
- More complete, useful integration

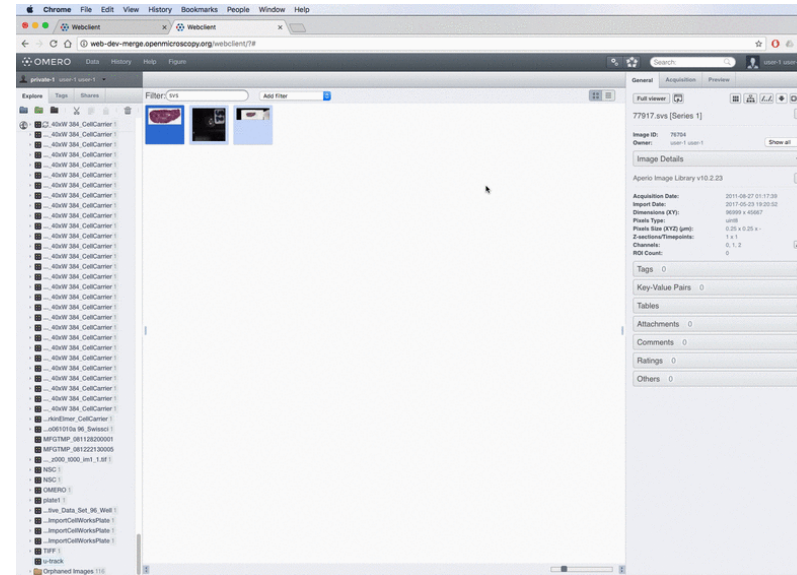
# Other Bioimaging Challenges



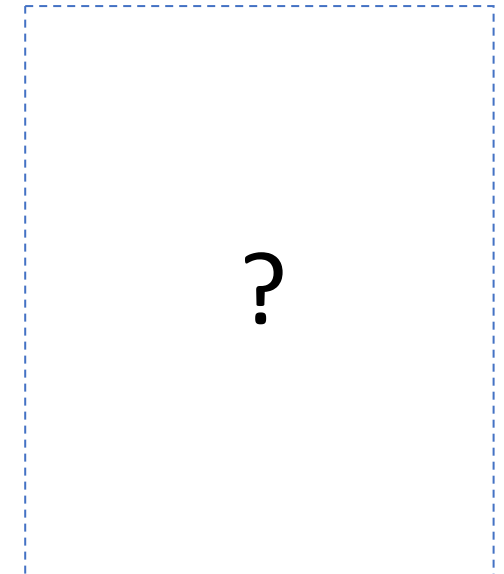
A screenshot of the OME (Open Microscopy Environment) website's 'Supported Formats' page. The page lists various image formats and their compatibility with different OME components. A dashed line with a scissors icon indicates a selection of formats.

Format	Extensions	Pixels	Metadata	Openness	Presence	Utility	Export	BSD	Multiple Images	Pyramid
3D SlideBook	.slid									
Andor Bio-Imaging Division (ABD) TIFF	.tif									
AIM	.aim									
Alicona 3D	.al3d									
Varian FDE	.fdf									
Veeco AFM	.hdf									
VC SAM	.dti									
VisiTech.XYS	.xys, .html									
Velocity	.mvd2									
Velocity Library Clipping	.acff									
WA-TQF	.wat									
Windows Bitmap	.bmp									
Woodz	.wiz									
Zeiss Axio CSM	.jms									
Zeiss AxioVision TIFF	.xml, .tiff									
Zeiss AxioVision ZVI (Zeiss Vision Image)	.zvi									
Zeiss CZI	.czi									
Zeiss LSM (Laser Scanning Microscope) S10/710	.lsm, .mdb									

Large number of  
proprietary formats

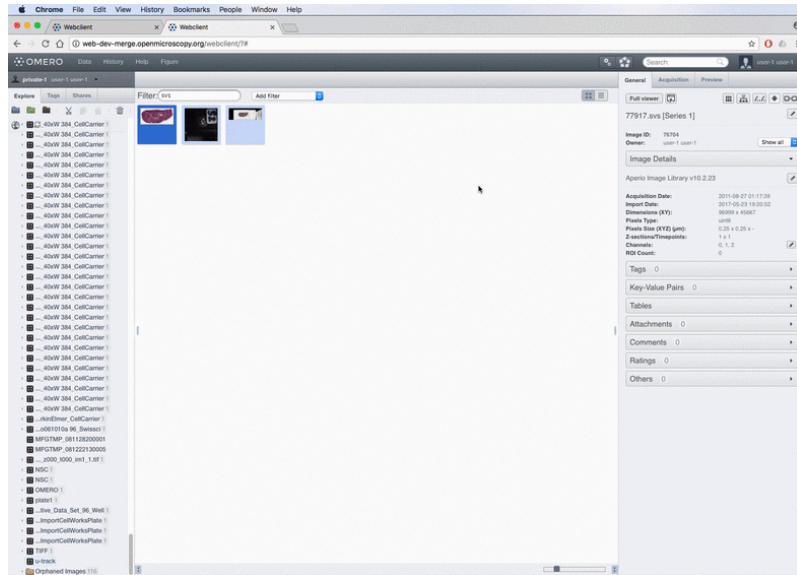


Users want random  
(interactive) access  
to arbitrary regions



“Bioimage databases  
are hard”

# Bioimaging Challenges



Users want random  
(interactive) access  
to arbitrary regions

The screenshot shows the OME Bio-Formats 5.2.2 documentation page. It features a table titled 'Supported Formats' that lists various image formats and their supported features. The table includes columns for Format, Extensions, Pixels, Metadata, Openness, Presence, Utility, Export, Multiple Images, and Pyramid. A dashed line with a scissors icon indicates that the table is scrollable.

Format	Extensions	Pixels	Metadata	Openness	Presence	Utility	Export	Multiple Images	Pyramid
3D SlideBook	.slid	✓	✓	✓	✓	✓	✓	✓	✓
Andor Bio-Imaging Division (AIM) TIFF	.tif	✓	✓	✓	✓	✓	✓	✓	✓
AIM	.aim	✓	✓	✓	✓	✓	✓	✓	✓
Alicona 3D	.al3d	✓	✓	✓	✓	✓	✓	✓	✓
Varian FDF	.fdf	✓	✓	✓	✓	✓	✓	✓	✓
Vesco AFM	.hdf	✓	✓	✓	✓	✓	✓	✓	✓
VG-SAM	.dti	✓	✓	✓	✓	✓	✓	✓	✓
VisiTech.XYS	.xys, .html	✓	✓	✓	✓	✓	✓	✓	✓
Volocity	.mvd2	✓	✓	✓	✓	✓	✓	✓	✓
Volocity Library Clipping	.acff	✓	✓	✓	✓	✓	✓	✓	✓
WA-TOP	.wat	✓	✓	✓	✓	✓	✓	✓	✓
Windows Bitmap	.bmp	✓	✓	✓	✓	✓	✓	✓	✓
Woolz	.wiz	✓	✓	✓	✓	✓	✓	✓	✓
Zeiss Axio CSM	.lms	✓	✓	✓	✓	✓	✓	✓	✓
Zeiss AxioVision TIFF	.xml, .tiff	✓	✓	✓	✓	✓	✓	✓	✓
Zeiss AxioVision ZVI (Zeiss Vision Image)	.zvi	✓	✓	✓	✓	✓	✓	✓	✓
Zeiss CZI	.czi	✓	✓	✓	✓	✓	✓	✓	✓
Zeiss LSM (Laser Scanning Microscope) S10/T10	.lsm, .mdb	✓	✓	✓	✓	✓	✓	✓	✓

Large number of  
proprietary formats

EMBL-EBI  
@emlebi

Today we launch the BioImage Archive, our data resource for storing and sharing reference biological images. Big thanks to our collaborators @embi, @EuroBioImaging, @ELIXIREurope, @EMDB\_EMPIAR, @IDRNews, #Biostudies and funders @UKRI\_Newsebi.ac.uk/about/news/pre... #BioImageArchive

## BioImage Archive

**BioImage Archive - a new hub for biological images**  
EMBL-EBI launches BioImage Archive, a large-scale, centralised, open data resource to host reference  
[ebi.ac.uk](http://ebi.ac.uk)

♡ 344 3:06 PM - Jul 2, 2019 ⓘ

💬 188 people are talking about this ➤