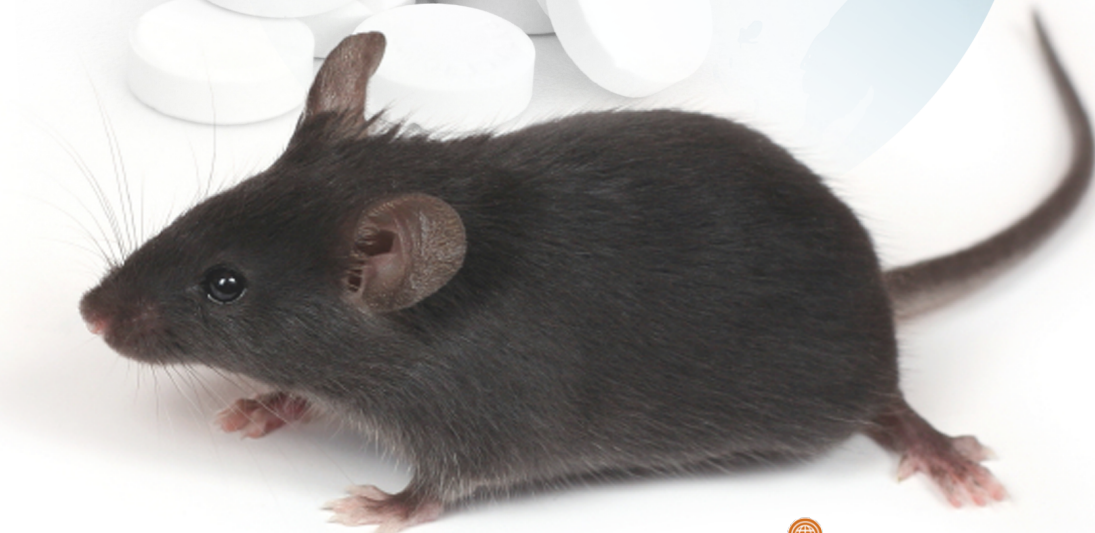
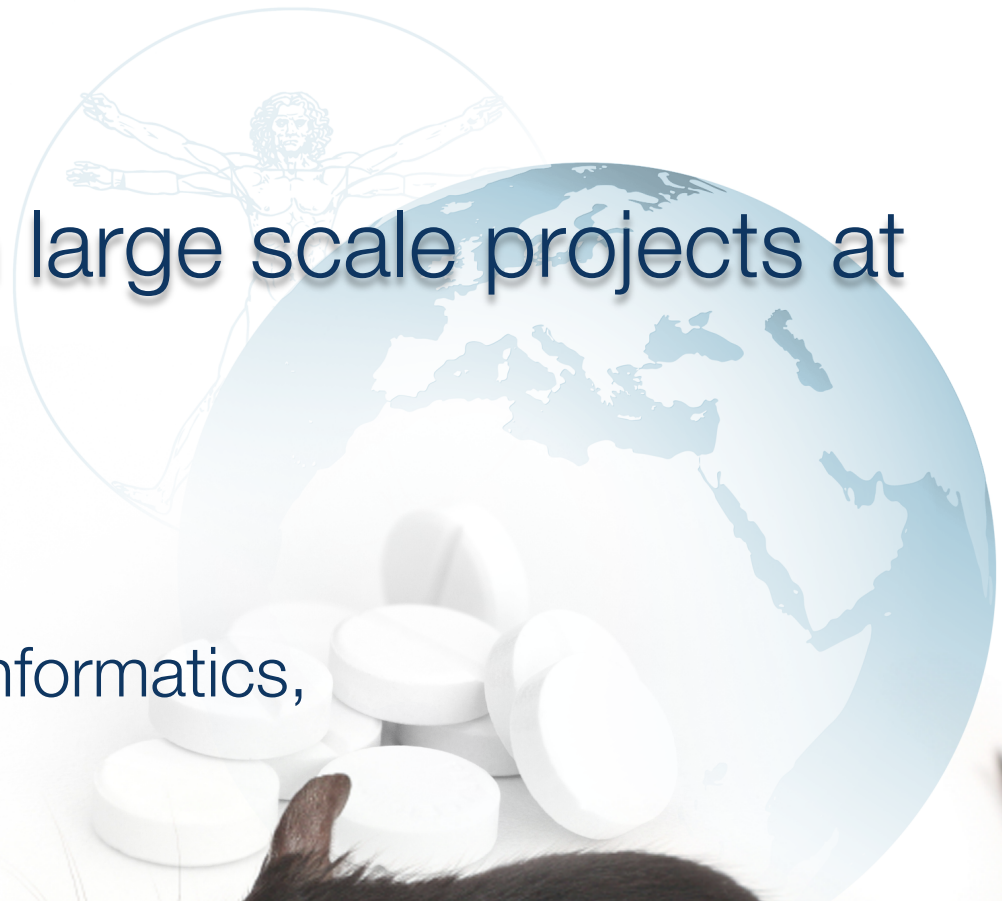


# Use of OMERO in large scale projects at EMBL-EBI

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EMBL-EBI

June 2, 2015



# Outline

- Discuss how IMPC is using OMERO
- Presenting and disseminating 2-D images phenotype images
- Piloting federation, 3-D images
- Touch upon two other projects at EMBL-EBI using OMERO
  - PhenolImageshare
  - PDBe



# IMPC

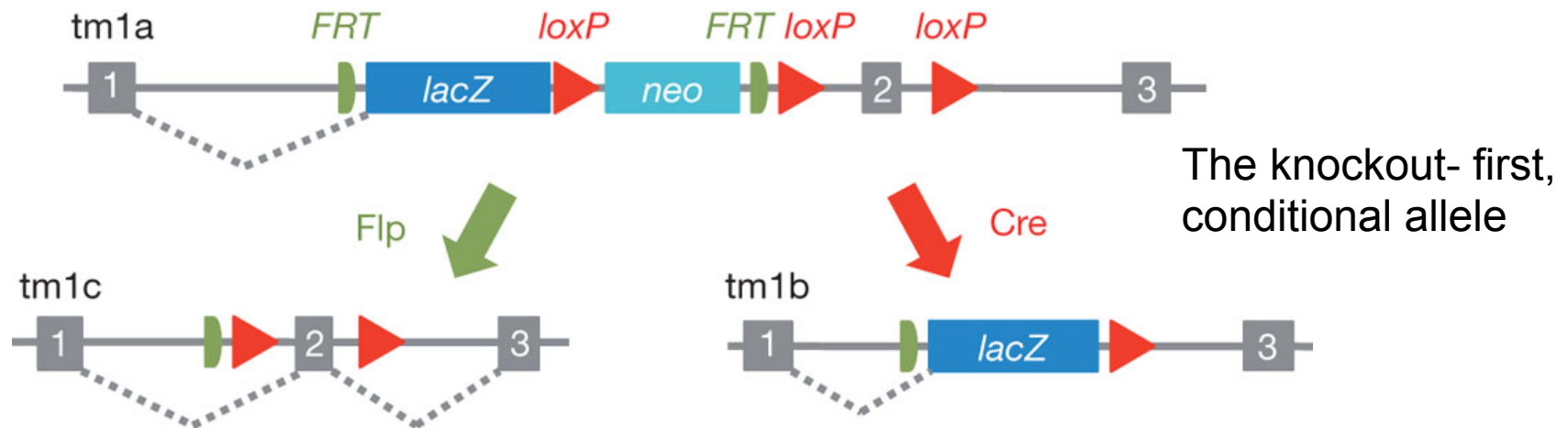
International Mouse Phenotyping Consortium



[www.mousephenotype.org](http://www.mousephenotype.org)

# IMPC Goals

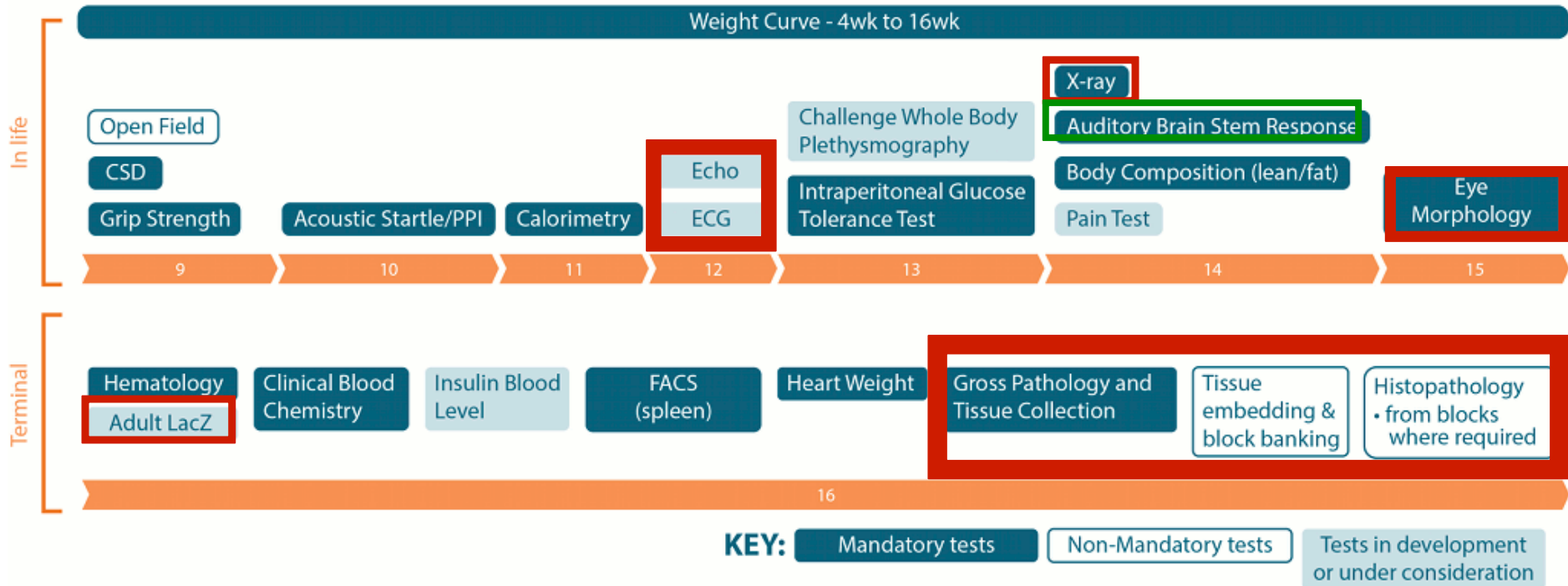
- Create and phenotype over 20,000 mutant mouse lines
- Emphasize on disease associated genes, genes with little known function
- Provide a centralized data center and portal for free, unrestricted access to analysed and raw data



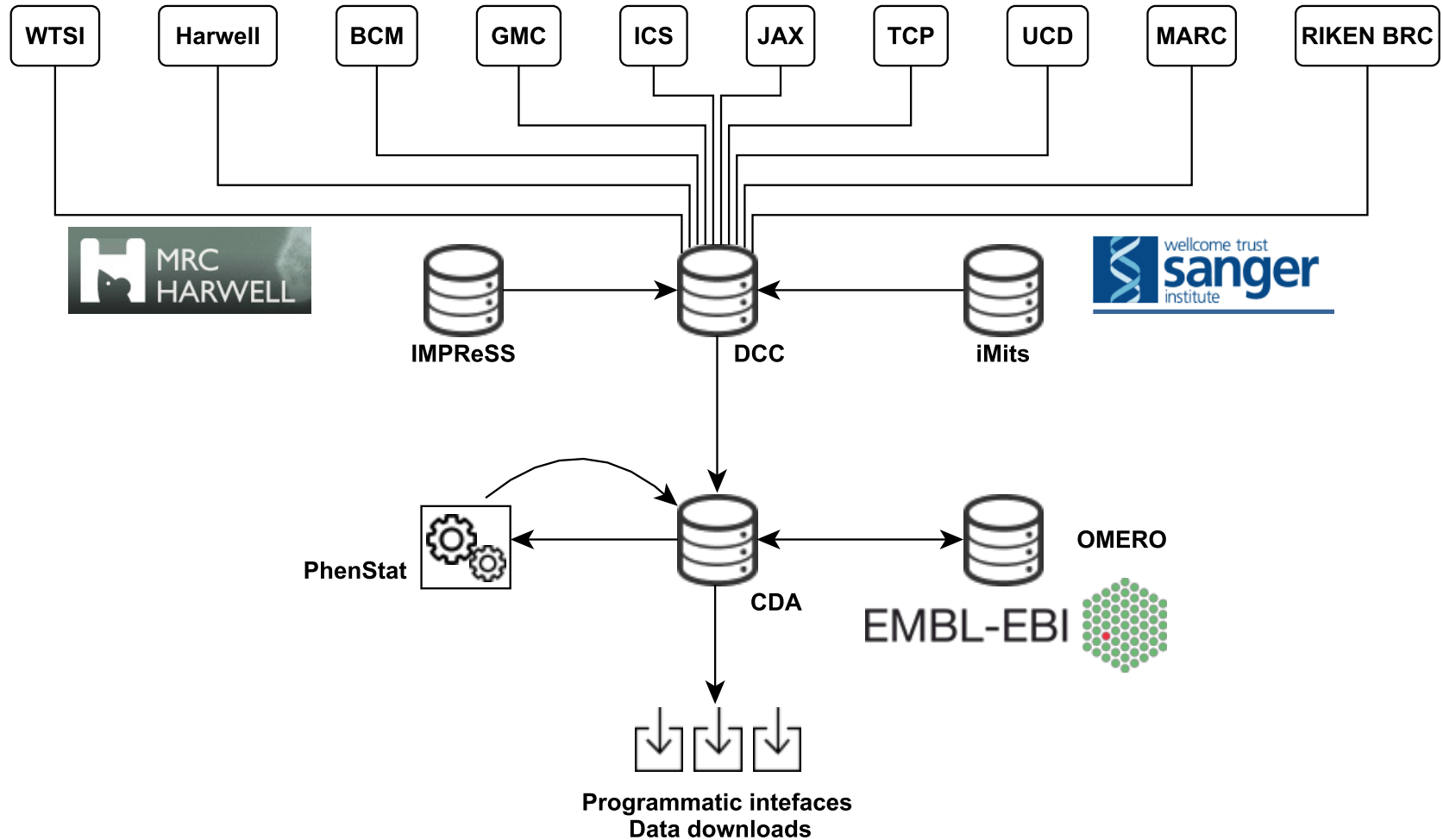
WC Skarnes *et al.* *Nature* **474**, 337-342 (2011)



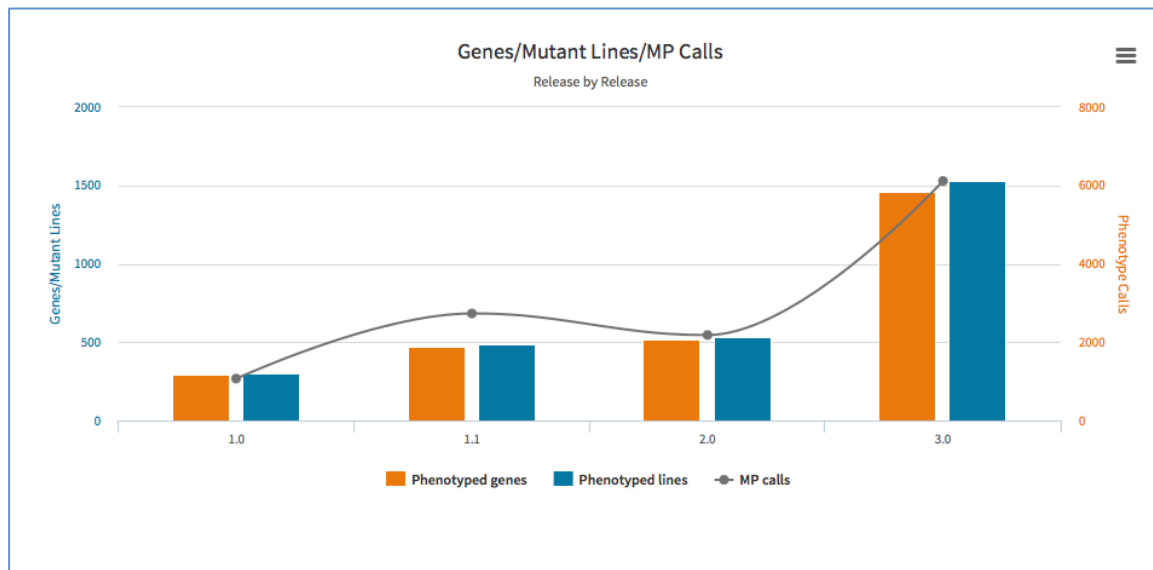
# Adult Phenotyping Pipeline



# Mouse Phenotyping Informatics Infrastructure: High Quality Data, Reproducible Analysis



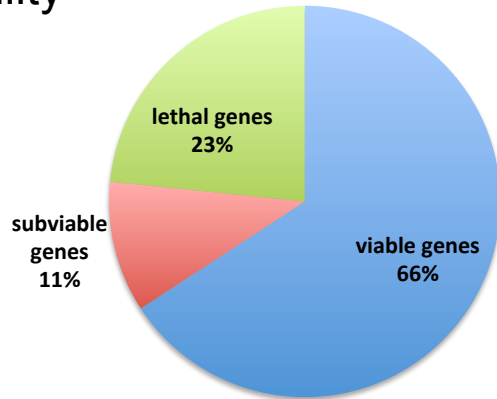
# Data Release 3.0 For Adult Landmark Paper



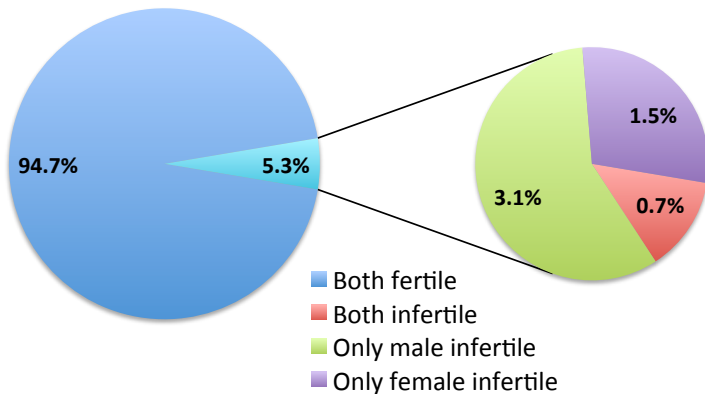
<b>Phenotyped Genes</b>	<b>1,453</b>
<b>Phenotyped Lines</b>	<b>1,579</b>
<b>Genotype to Phenotype calls</b>	<b>6,395</b>
<b>Mutant mice analyzed</b>	<b>28,658</b>
<b>Control mice analyzed</b>	<b>9,669</b>
<b>Number of data points</b>	<b>14,288,659</b>
<b>Number of images</b>	<b>98,521</b>

# Overview of phenotype calls

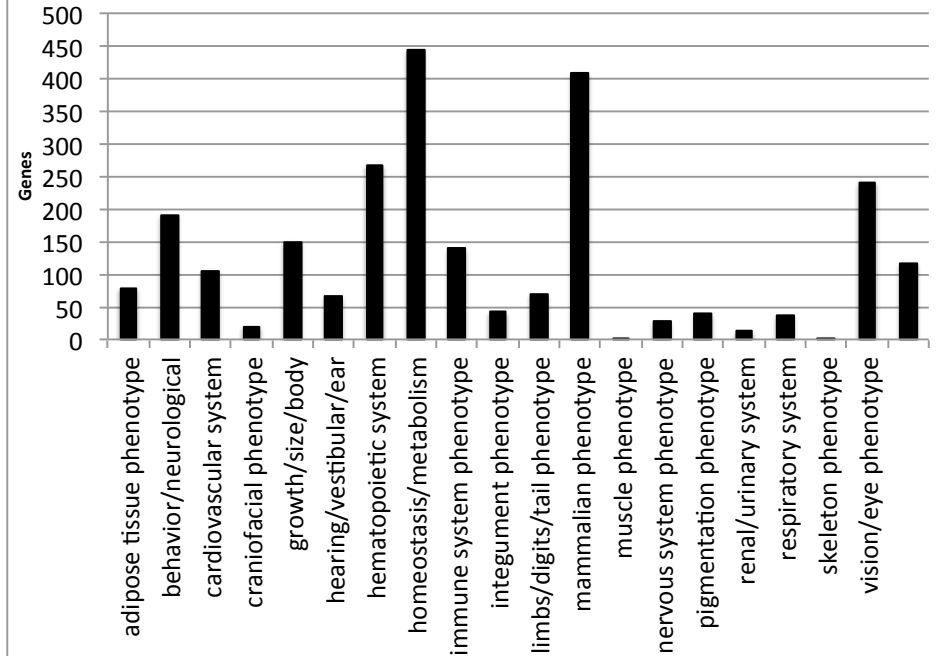
## Viability



## Fertility



## Phenotype Calls

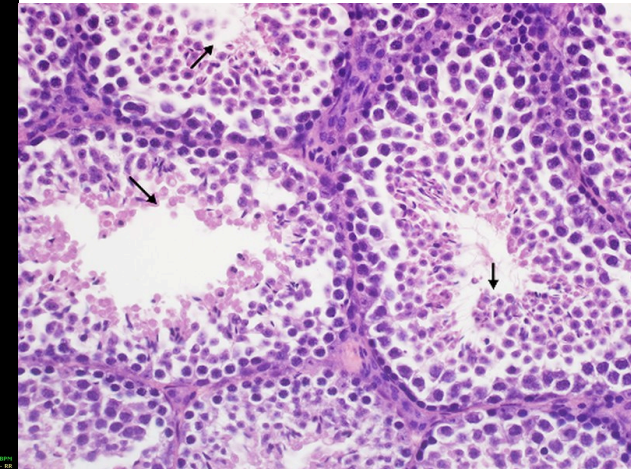
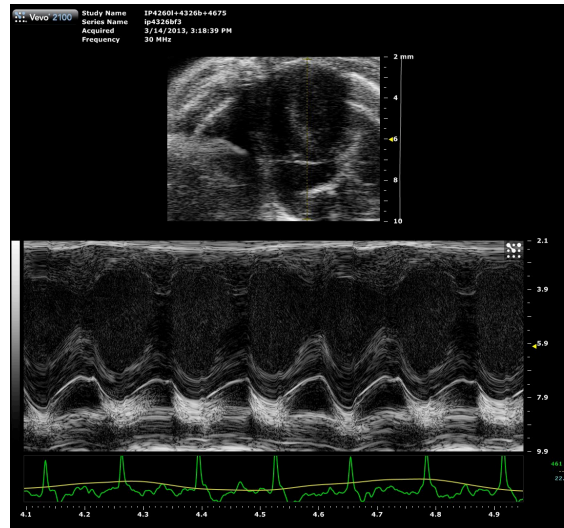
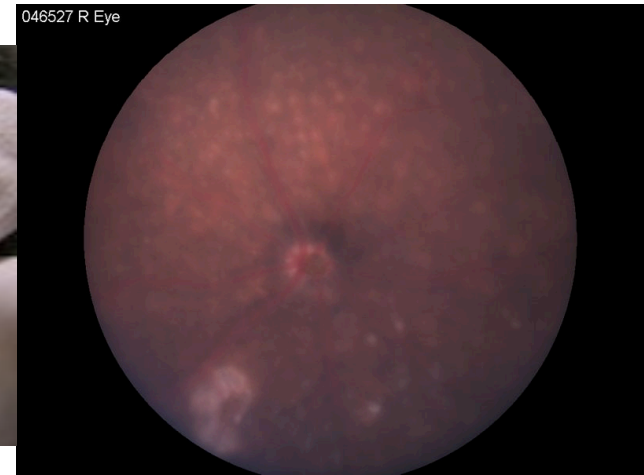


phenotype calls by gene

# Many different image types

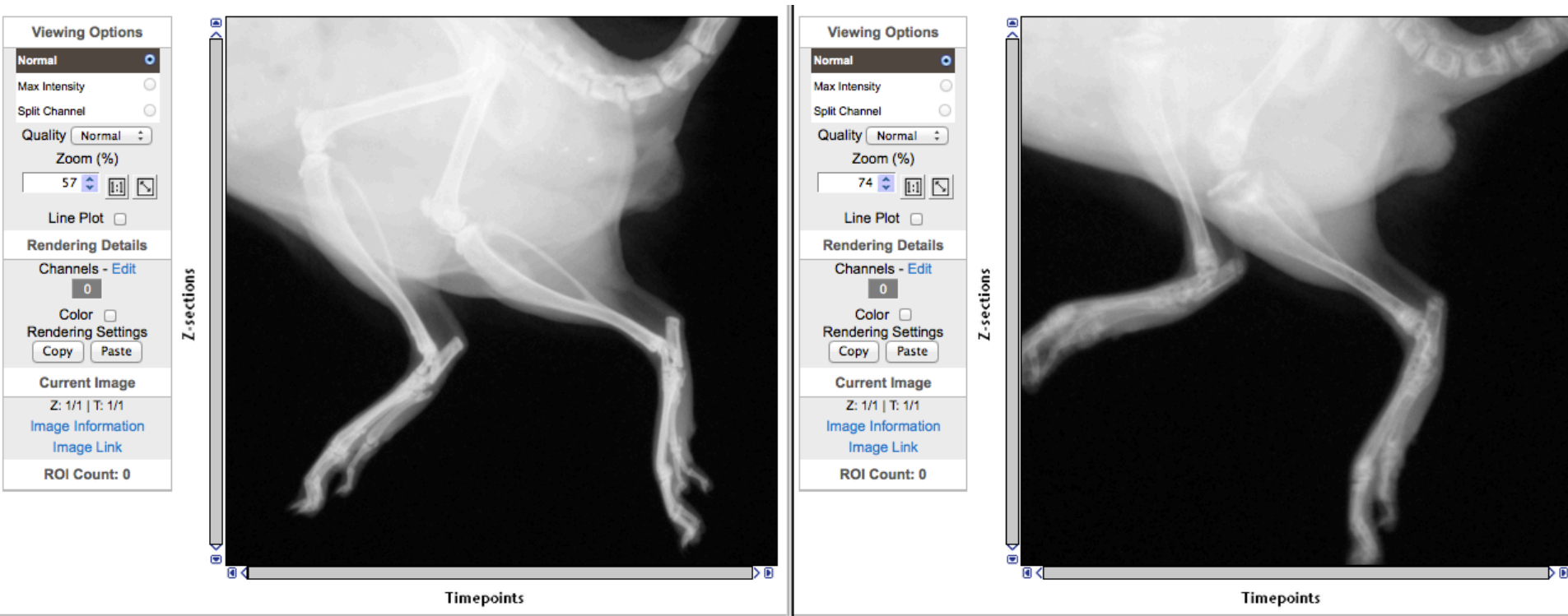
## Filter your search

- ▼ IMPC Images 105942
- ▼ Procedure
  - Adult LacZ 14666
  - Auditory Brain Stem Response 1164
  - Combined SHIRPA and Dysmorphology 926
  - Echo 8763
  - Electroretinography 1133
  - Electroretinography 2 57
  - Eye Morphology 1027
  - Gross Pathology and Tissue Collection 1246
  - Histopathology 79
  - Sleep Wake 2478
  - X-ray 74403



# Images support phenotype associations

Tibia length -**Cyp27b1**<sup>tm1b(EUCOMM)Hmgu</sup>



Control

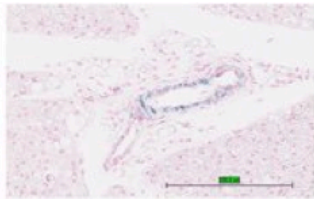
Mutant

# LacZ expression images (over 14,000)

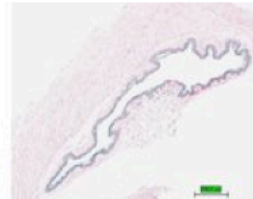
## Expression Data



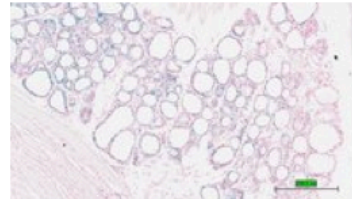
### All Images



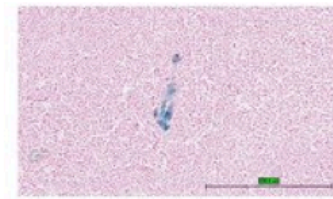
[adipose tissue\(3\)](#)  
Adipose (Brown) expression



[digestive system\(7\)](#)  
Esophagus expression



[endocrine system\(3\)](#)  
Thyroid expression

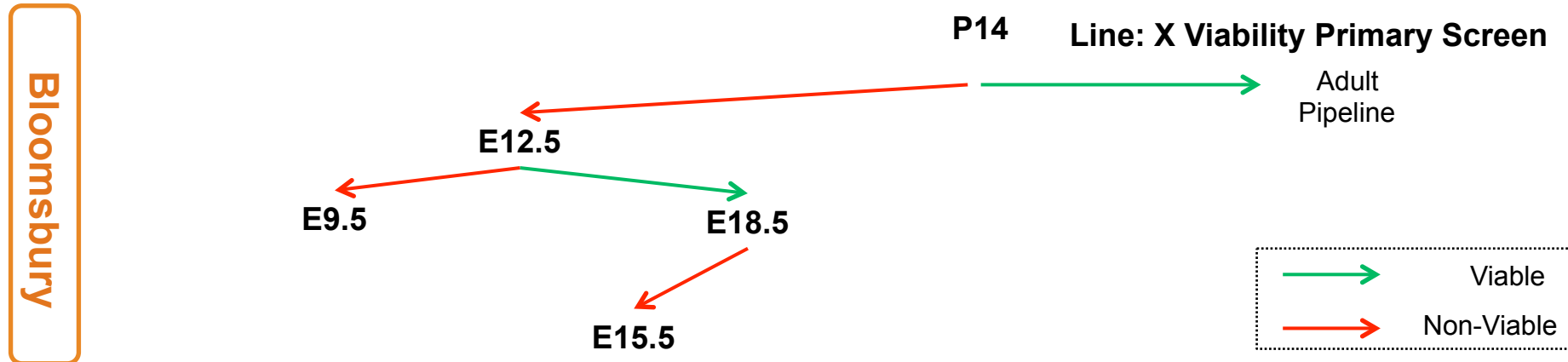


[immune system\(3\)](#)  
Spleen expression

Anatomy	#HET Specimens	HOM Images?	WT Expr	Mutant Expr	Images
Adipose (Brown)	4	false	✗	✓(1/4)	
Adipose (Mesenteric)	4	false	✗	✓(2/4)	
Adipose (gonad)	4	false	✗	✗	
Adrenal	4	false	✓(1/71)	✓(1/4)	



# Bloomsbury report on mouse embryo phenotyping: recommendations from the IMPC workshop on embryonic lethal screening



**Triage Table: Current IMPC Ratios**

Decision Point	Viable	Sub-viable	Lethal
P14	65.3	11.6	23.1

**Estimated Ratios Embryo**

Decision Point	Viable	Lethal
After E15.5	15%	15%
E9.5 to E15.5	20%	10%
Before E9.5	25%	5%

# Embryo IMPC Imaging Modalities

E8.5	E9.5	E12.5	E14.5	E15.5	E18.5	P7
Live OCT (BCM)						

**BCM:** Baylor College of Medicine

**JAX:** The Jackson Laboratory

**DTCC:** Davis Toronto Chori Consortium

**TCP:** Toronto Center for Phenogenomics

**HAR:** MRC Harwell (Pilot)

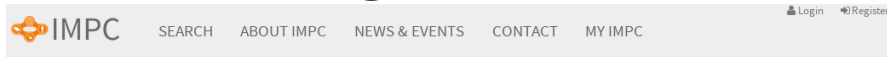
**JMC:** Japan Mouse Clinic (Pilot)

**ICS:** Institut Clinique de la Souris (Pilot)

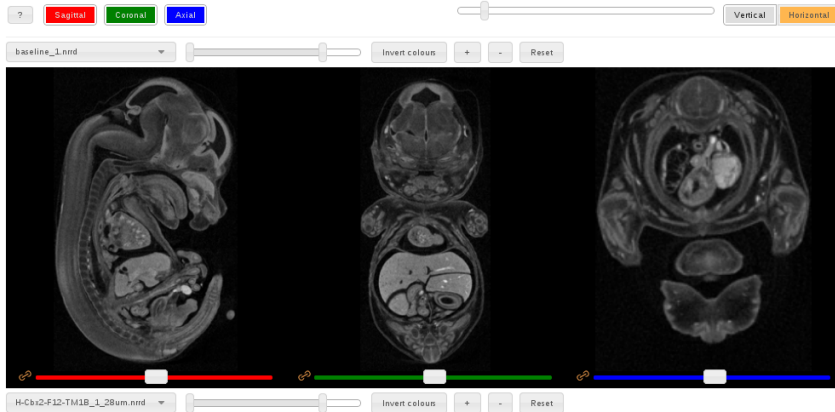
**DMDD:** WTSI, NIMR, Uni. of Edinburgh



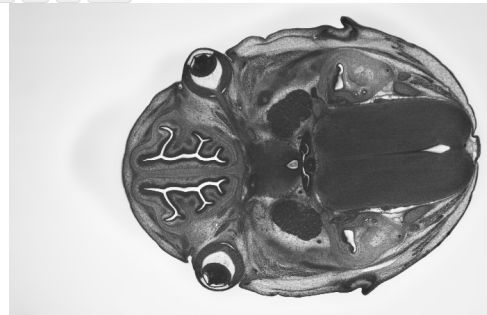
# 3-D image data



Home » EmbryoViewer



$\mu$ CT



HREM



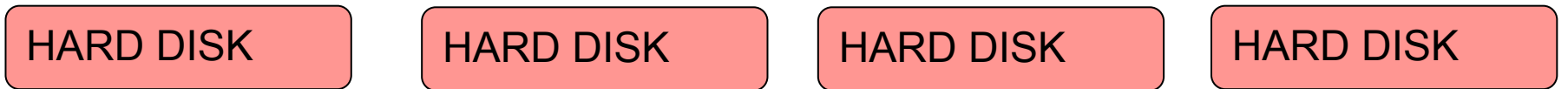
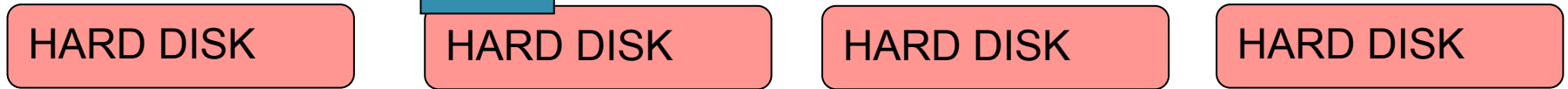
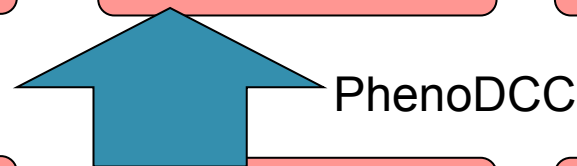
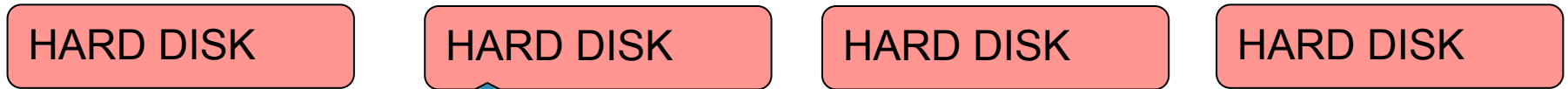
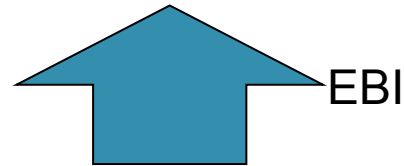
OPT

- OCT, OPT,  $\mu$ CT, HREM, MRI all output Voxels

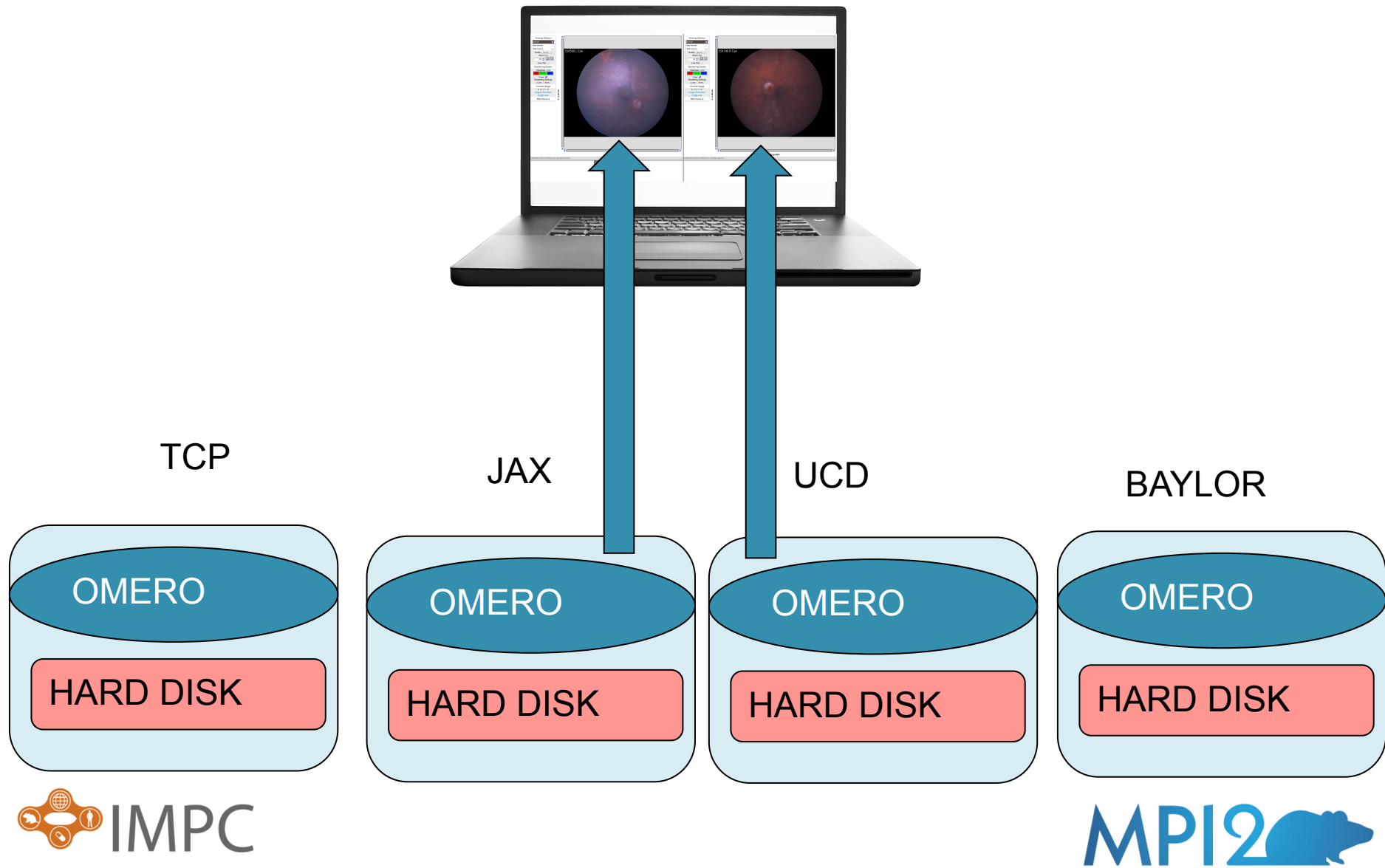
# Why use OMERO?

- EBI team choose to use OMERO for adult phenotyping images because:
  - Open Source platform used in many places including EBI
  - Converts many different imaging formats (BioFormats)
  - Active development
  - Store the metadata as part of the image (OME-TIFF)
  - Allows Federation

# Current Image Flow / Disk Usage

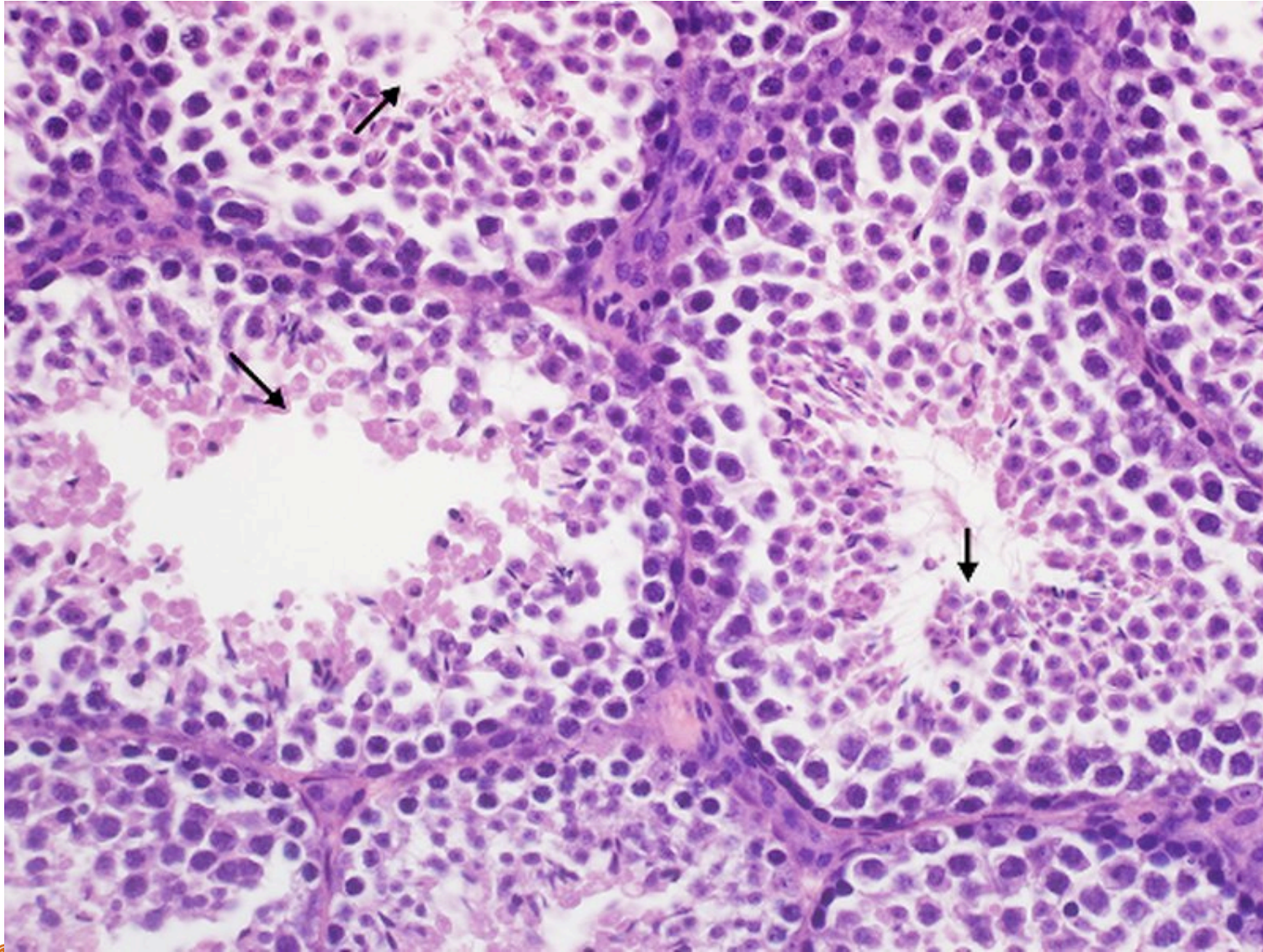


# Image Federation





# Challenges



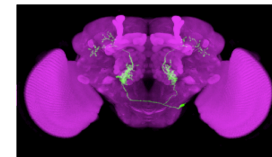


# Was it worth it? Yes!!

- Images on portal, being pushed to 3<sup>rd</sup> parties
- Engaged developers
  - Workshop
- Piloting Image federation with JAX, other IMPC parties interested
- Others at EBI are using OMERO

# Project: PhenolImageShare

- Pilot project for online image annotation and imaging resource federation
  - EMBL-EBI and Univ. of Edinburgh
- Focus on genotype-phenotype data
- Cross-species integration platform
  - Cellular, Fly, Mouse, Human
- Phenotype annotations through web interface
- Supports ROI drawing, free text and ontology term annotations (with autosuggest)
- <http://www.phenoimageshare.org/>



Images courtesy of <http://www.virtualflybrain.org/> and <http://www.ebi.ac.uk/panda-srv/tracer/>

FS FS2 FS3 FS4

Enter freetext: abnormal hair cycle Search

**Filters 1**

+

- + Mutants 66471
- + Wildtype 28345
- + ImagingMethod 89075
- + Stage 94812
- + Taxon 94816
- Anatomy
- Go!
- Gene
- Go!
- Phenotype
- Go!

94816 records

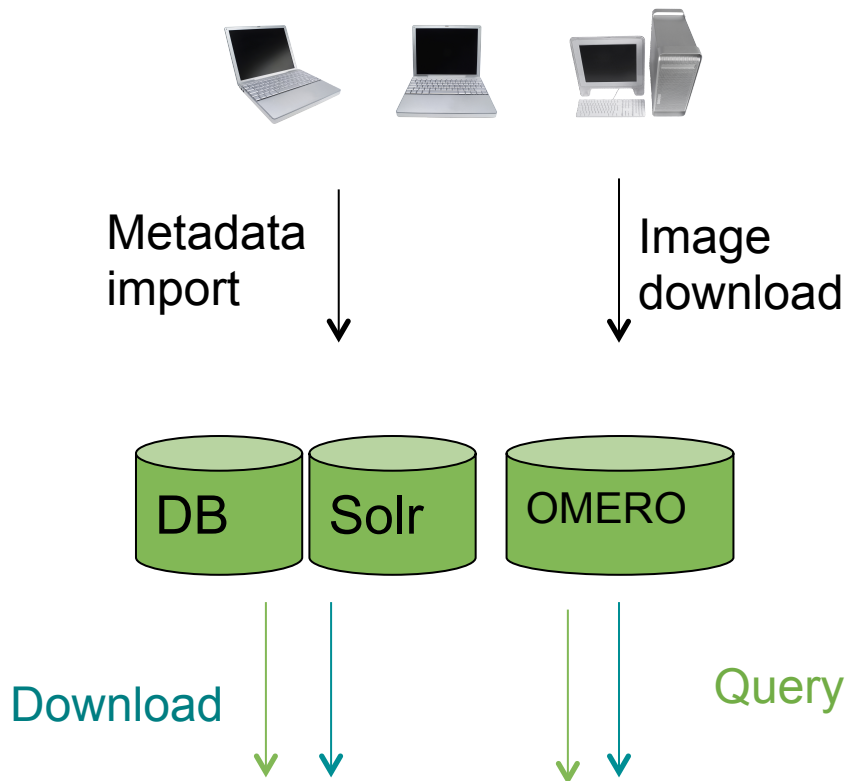
1n record

**Image**

	<b>Expression:</b> None , <b>Anatomy:</b> eye, <b>Phenotype:</b> cataracts,iris synechia,fused cornea and lens,corneal opacity, <b>Gene:</b> Trim66
	<b>Expression:</b> ovary,oviduct,uterus, <b>Anatomy:</b> None , <b>Phenotype:</b> None , <b>Gene:</b> Pik3r2
	<b>Expression:</b> urinary bladder, <b>Anatomy:</b> None , <b>Phenotype:</b> None , <b>Gene:</b> Pik3r2
	<b>Expression:</b> lower urinary tract,seminal vesicle, <b>Anatomy:</b> None , <b>Phenotype:</b> None , <b>Gene:</b> Pik3r2
	<b>Expression:</b> testis, <b>Anatomy:</b> None , <b>Phenotype:</b> None , <b>Gene:</b> Pik3r2

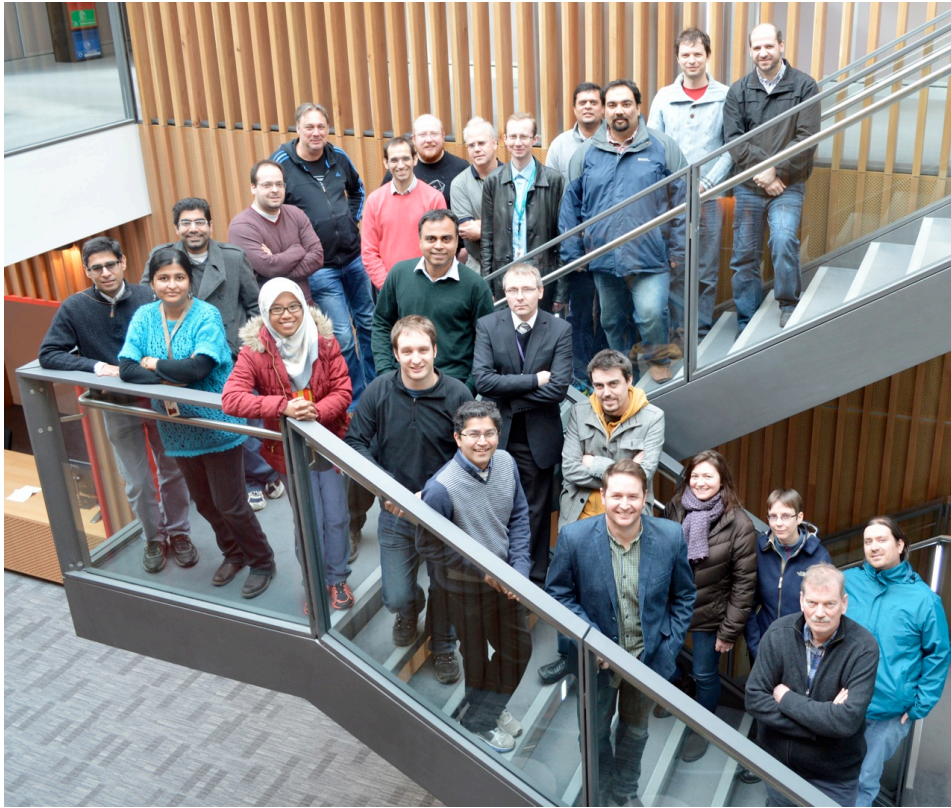
- abnormal hair cycle
- abnormal head shape
- abnormal incisor color
- abnormal ear rotation
- abnormal iris pigmentation

# Metadata split not just an IMPC challenge!



- Embed metadata in OMERO- TIFF
- Proposed in march:
  - Bioformats API to read/ write data
  - Store the Regions Of Interest (ROI) and annotations with the image
  - Reading extensive metadata from TIFF header
  - OMERO 5.1
- Phenoimageshare widget?

# Resource: PDBe ([pdbe.org](http://pdbe.org))



PDBe Team members 2015

- The Protein Data Bank in Europe supports the deposition, annotation, and dissemination of macromolecular structure data
- Member of EMDataBank ([emdatbank.org](http://emdatbank.org)) archive for electron microscopy
- Using Bioformat to convert raw EM images

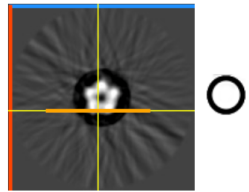
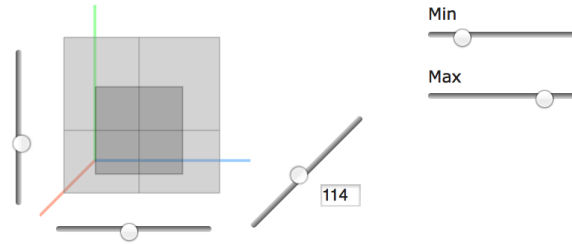
# PDBe Volume browser

**Sample:** Wild type conformation of the tip complex from the type III secretion system of *Shigella flexneri*, bound to the needle

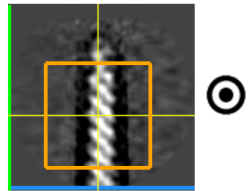
**Method:** Single-particle

Resolution: 24Å (FSC 0.5, semi-independent)

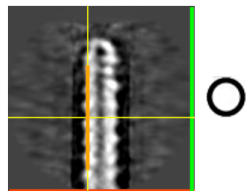
PDBe page is [EMD-2801](#)



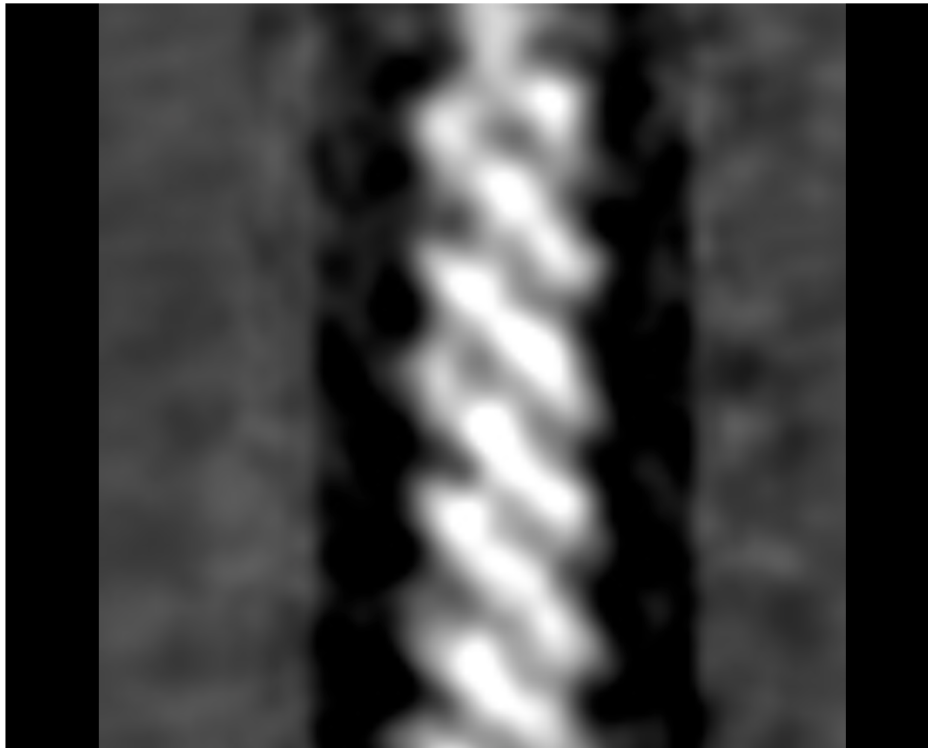
Top view



Front view



Right view



- Volume browser near production
- 3-D views onto structure data
- Ex. Type III secretion system of *Shigella flexneri*

# PDBe Challenges

- Loading 1000's of volumes into OMERO often crashes because of lock file issues
- Prefer a clean process for moving data from OMERO server to server (from staging to production).
  - From what we can see right now OMERO does not have any functionality to **sync OMERO instances** or to have **a master slave mode** ....?

*From Ardan Patwardhan*



# Conclusions

- Using OMERO has benefited multiple groups at EBI
- Open source, active development has been key to this
- Some commonalities in challenges across the groups
  - Robustness in synching across OMERO instances
  - Easing the ability to get metadata, ontologies into the OMERO-TIFF problem
  - 3-D viewing support

# Acknowledgements-

## Funding: U54 HG006370-02

- **MRC Harwell:**

- Andrew Blake
- Armida Di Fenza
- Natalie ring
- Duncan Sneddon
- Gagarine Yaikhom
- Henrik Westerberg
- Luis Santos
- Tanja Fiegel
- Hilary Gates
- Ann-Marie Mallon
- Steve Brown

- **Welcome Trust Sanger Institute:**

- Natasha Karp
- Richard Easty
- Robert Wilson
- Peter Matthews
- David Melvin
- Bill Skarnes
- Phenodigm
  - Damian Smedley
  - Anika Oellrich
  - Jules Jacobsen

- **European Bioinformatics Institute:**

- Chao-Kung Chen
- Jeremy Mason
- Jonathan W.G. Warren
- Gautier Koscielny
- Natalja Kurbatova
- Ilinca Tudose
- Terry Meehan
- Paola Roncagila
- Mike Relac
- Helen Parkinson
- Paul Flicek

- **NIH**

- Mark Moore
- Colin Fletcher

Phenoimageshare funded by  
BBSRC: PhenolImageShare

