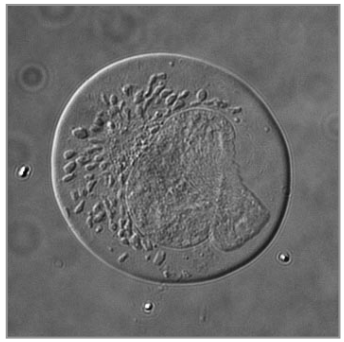
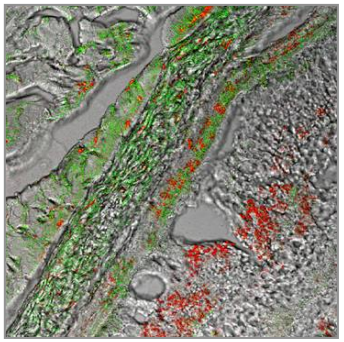
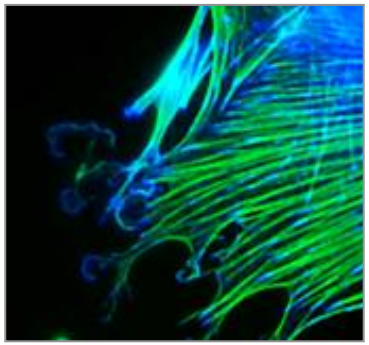
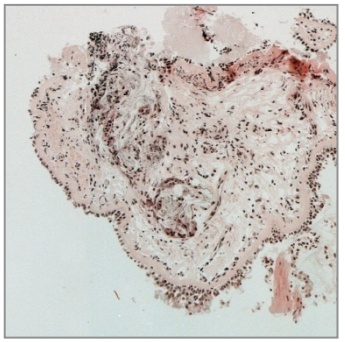
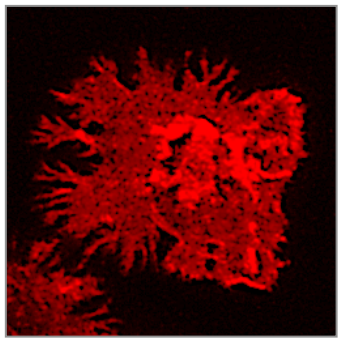
Imperial College London
– South Kensington
Facility for Imaging
by Light Microscopy

Observing Life As It Happens

Martin Spitaler

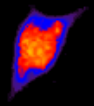
OMERO at Imperial College

OME Meeting Paris,
15 June 2011

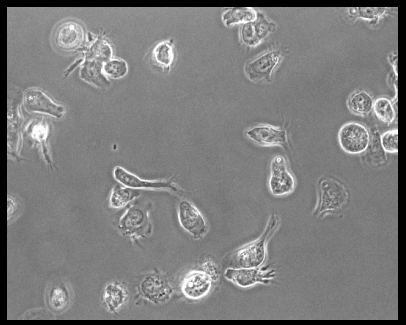






FILM overview: Applications – dimensions & modalities

nm / msec

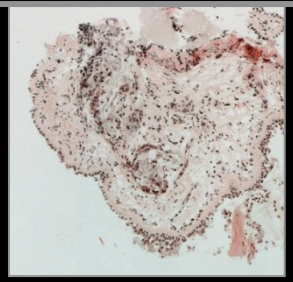


µm / min

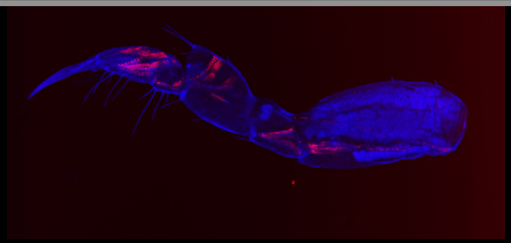


mm / days

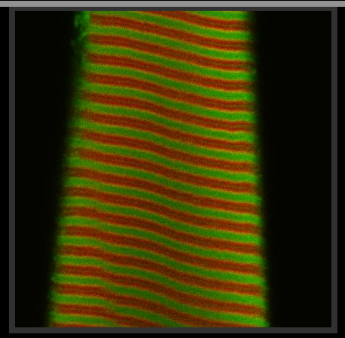
histological staining



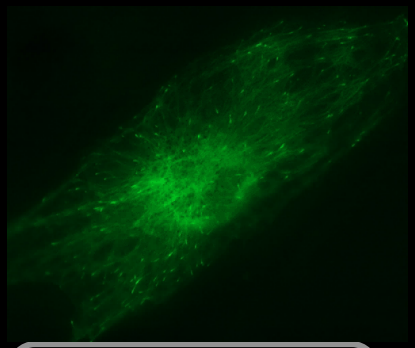
2nd harmonic generation



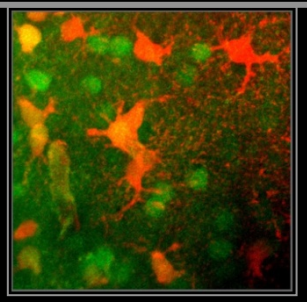
fluorescence lifetime



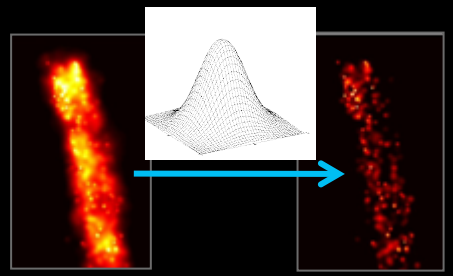
fluorescence intensity



2P microscopy



high-res (PALM , STORM, …)



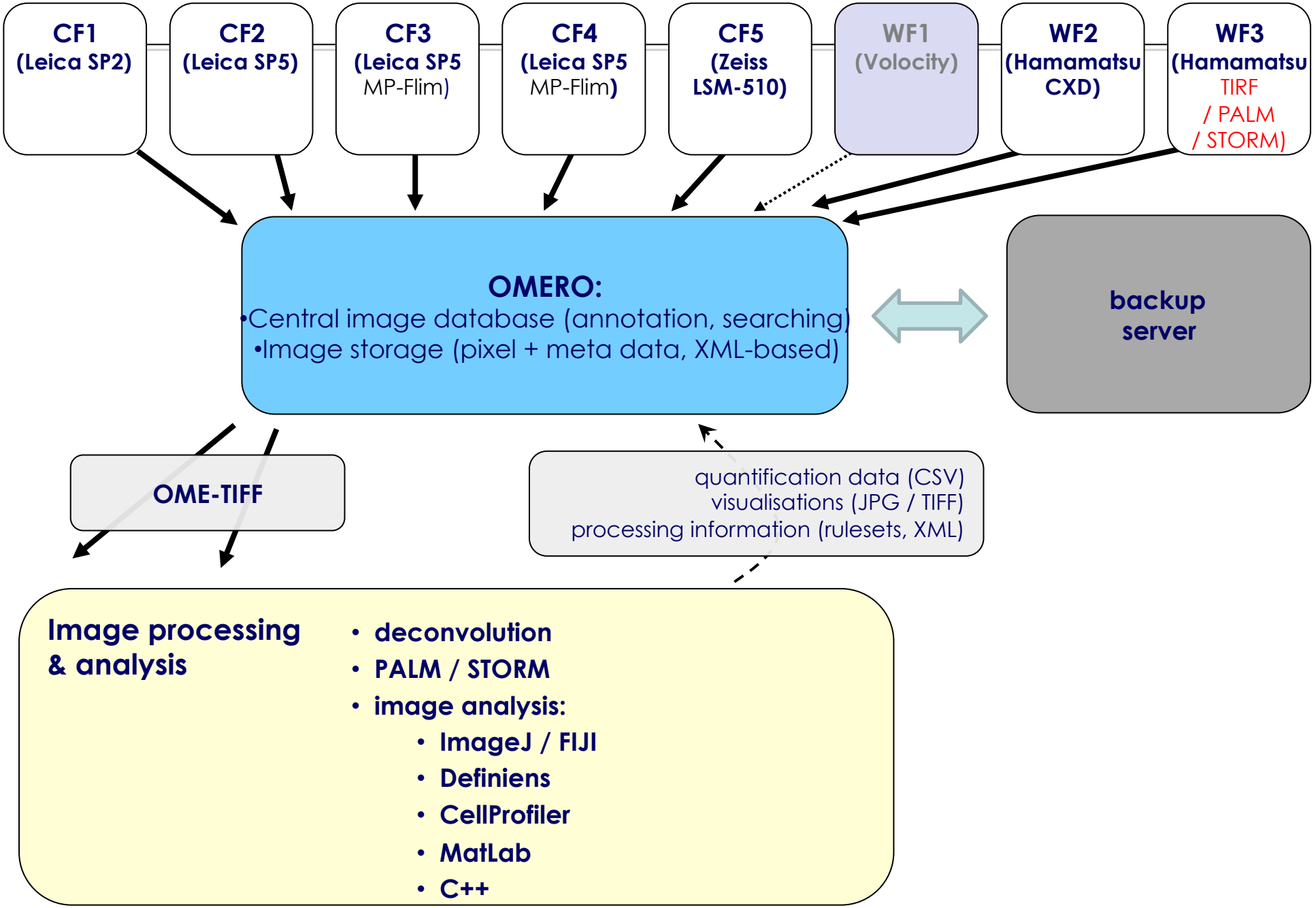
FILM overview: Users

- **Research Areas:**
  - **Medicine**: heart & lung research, atherosclerosis, infection biology, immunology, hereditary diseases (heart and skeletal muscles, eye development), asthma, stem cells, tumour biology
  - **Natural Sciences**: mammalian cell biology, developmental biology, malaria, stem cells, tumour biology, membrane physics & chemistry, infection biology, immunology, photonics, plant development, bacterial drug resistance
  - **Engineering**: stem cell biology, cardiovascular research, drug delivery, nanotechnology, mining
- **Users:**
  - **~500 trained users** (students, postdocs, PIs, professors) from >150 groups across the whole college
  - external users (academic and commercial)
- **Cooperations:**
  - **Systems biology (**mathematical modelling of infection biology)
  - **Photonics** (new imaging techniques)
  - **Mathematics** (medical & microscopy image analysis)

FILM usage 2009-10

Division / Dept'/Course	Users	Faculty	Users
National Heart & Lung Institute	44		
Medicine	10		
Investigative Science	1		
Surgery, Oncology, Reproductive Biology	1	**Medicine**	**56**
Cell and Molecular Biology	40		
Chemistry - Chemistry	7		
Biology	2		
Molecular Bioscience	1	**Natural Sciences**	**50**
Bioengineering	8		
Materials	5		
Chemical Engineering	2	**Engineering**	15
		Total	**121**

Omero in Imperial College / FILM



Timeline

Time scale:

- first test installation: April 2008
- large-scale import test and feedback: June 2009
- first tests with live data: December 2009
- roll-out to facility users: trials from January 2010
- integration with analysis: from end 2010
- general roll-out to facility users: from end 2010
- first customisations (export scripts): early 2011

Current status:

- ~ 40 accounts
- ~ 250GB 'real' data
- ~ 1 new user per week
- cross-discipline, cross-faculty

Challenges – Technical

- **Hardware provisioning** – **solved** (for now)
- **Data transfer speed** – **in progress**
- **Data cleanup** (e.g. deleting test and temporary data from storage and backup) - **needed**

Challenges – Functional

- Support for new / unusual file formats:
  - lifetime data (flim)
  - multispectral images (e.g. Leica 'lambda scan', Zeiss Meta)
  - superresolution images (PALM / STORM)
  - *future: multidimensional images (mass-spec images, ~200-dimensional)*
- Integration with imaging pipelines:
  - connectors with processing (deconvolution, stochastic localisation) and analysis tools – **work in progress**:
    - direct import from Leica SP5 – Matrix via OME-TIFF **- tested**
    - direct export to Definiens via OME-TIFF **– solved**
    - export scripts for stacks, max proj. **– solved / in progress**
  - linking raw data – processed data – results – quantifications **- planned**

Challenges - Practical

Issues:

- Slow uptake by users
- User awareness of need and advantages
- Users prepared to adapt workflow
- Needed standardisation across labs (consistent tagging)
- Confidence in reliability (data integrity, backup, confidentiality)

Solutions:

- Advertising events (FILM Club, Microscopy Day, in lab meetings, …)
- Trainings (personal, Omero training in preparation)
- Using and testing software, data, implementations, tools, … in the facility
- Local solutions (e.g. export scripts) and feedback to OMERO team

Challenges - Financial

Issues:

- long-term commitment to data storage
- significant commitment of time and hardware investment

Solution - Business plan:

- Full Economic Cost (FEC) calculation for long-term sustainability, including:
  - costs of storage (imported data, archived data, temporary processing space)
  - costs of maintenance (in Imperial College: FILM and Bioinformatics staff time)
  - costs of development (new tools, integration, testing, …)
- long-term, predictable financial commitments for users *(built into grant applications)*
- transparent costing *(advertising and education)*
- cost-benefit model, advertising added value (data safety, streamlined workflow = faster results, reduced experimental downtimes and experiment duplication (e.g. with student turnover), access to new tools (mathematical modelling, data mining, …), better data quality (enforced annotation)

Challenges – Usability

General issues / User feedback:

- sharing incomplete and only in Webclient, hierarchy and archived data lost
- data cannot be moved / copied between GROUPS
- too many clicks (intuitive standard OS functions like CTRL or SHIFT-click for selection missing)
- formats(!) new formats (flim) and reliability (bugs)

Wishlist:

- import mask with compulsory and optional annotations (sample, preparation, staining, …), customisable per lab
- personalised view of metadata (they want to decide which ones are shown)
- search across USERS and GROUPS
- customisation via menu OPTIONS (e.g. autocontrast vs. full-range, thumbnail vs. list view, rendering compression)
- tag hierarchies:
  - used across users (one hierarchy for all lab members)
  - visible in TAGGING WINDOW
- tag functionality:
  - tags are not visible and can't be deleted from multiple images
  - editing tag names
- visualisation of owner not used across groups (needs re-setting by every user)
- progress bar for rendering, loading, export, tagging, …
- option to change default compression (*de facto* crash at large dataset)
- export: raw data, views, movies, …

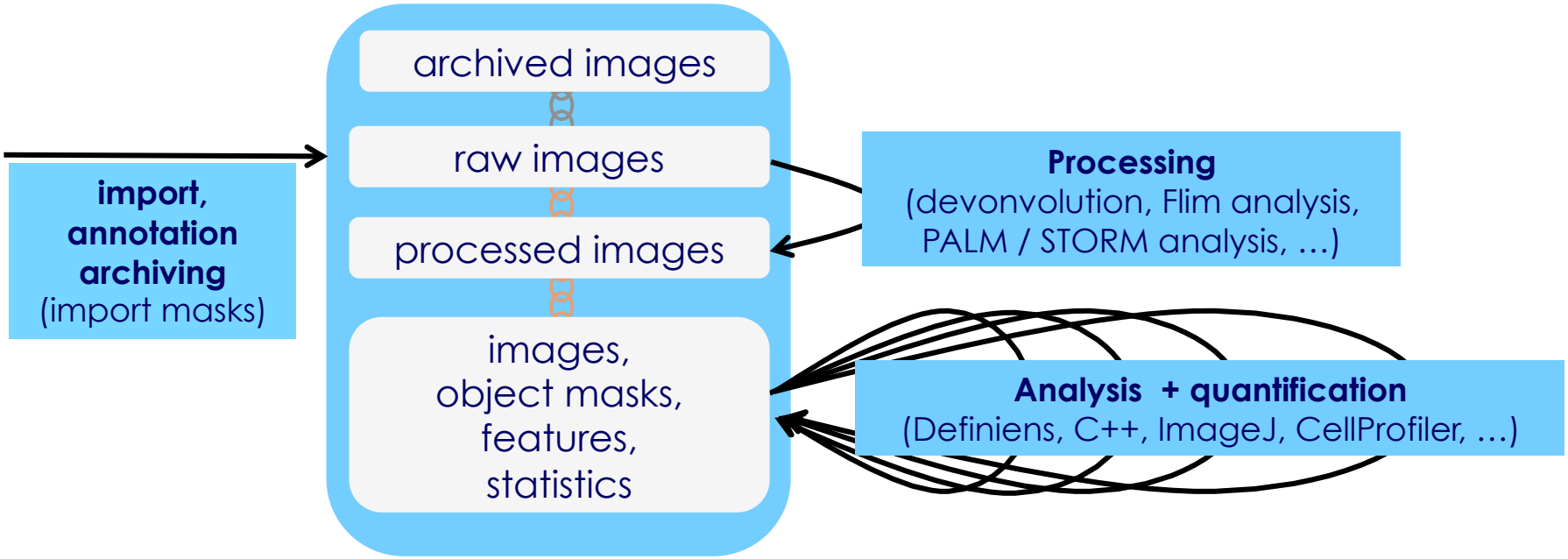
Successes

- System is now stable
- Most file formats supported, generally reliable (occasional problems with metadata or large files)
- Routine usage
- Access anywhere
- Server-side processing (large potential)
- Wider implications starting to appear (large potential):
    - streamlined workflows
    - format standardisation
    - improved efficiency
    - data integrity

Lessons learnt

- needs education and training alongside technical solutions
- for large-scale implementation, needs good technical support
- needs constant feedback between users, facility / support, developers, manufacturers
- chicken-and-egg situation:
  - users need a working solution before committing to it
  - informatics support need usage before investing time and money on it
  - facility caught in between, having neither the problem (large amounts of data) nor the solution (hardware, programming skills); trying to convince both sides to move on regardless
  - → it's a long-term commitment with risks for all sides, no guaranteed reciipe to make it work, other than good communication
- essential: long-term technical and financial plan

Future plans: Integration



Future plans: Integration

archived images

raw images

processed images

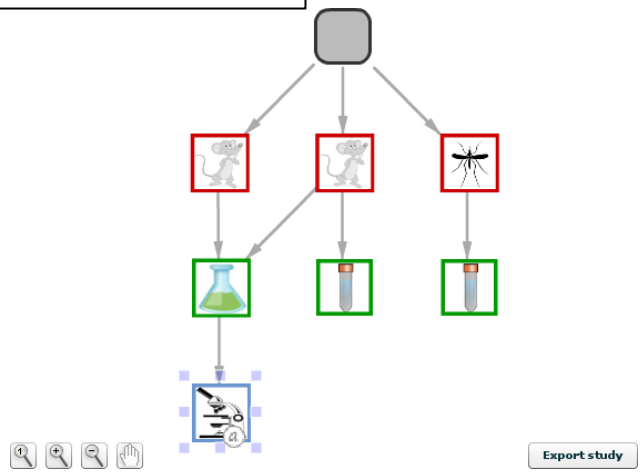
images,
object masks,
features,
statistics

import,
annotation
archiving
(import masks)

Processing
(devonvolution, Flim analysis,
PALM / STORM analysis, …)

Analysis + quantification
(Definiens, C++, ImageJ, CellProfiler, …)

- feedback to Omero team and manufacturers
- interaction support - users



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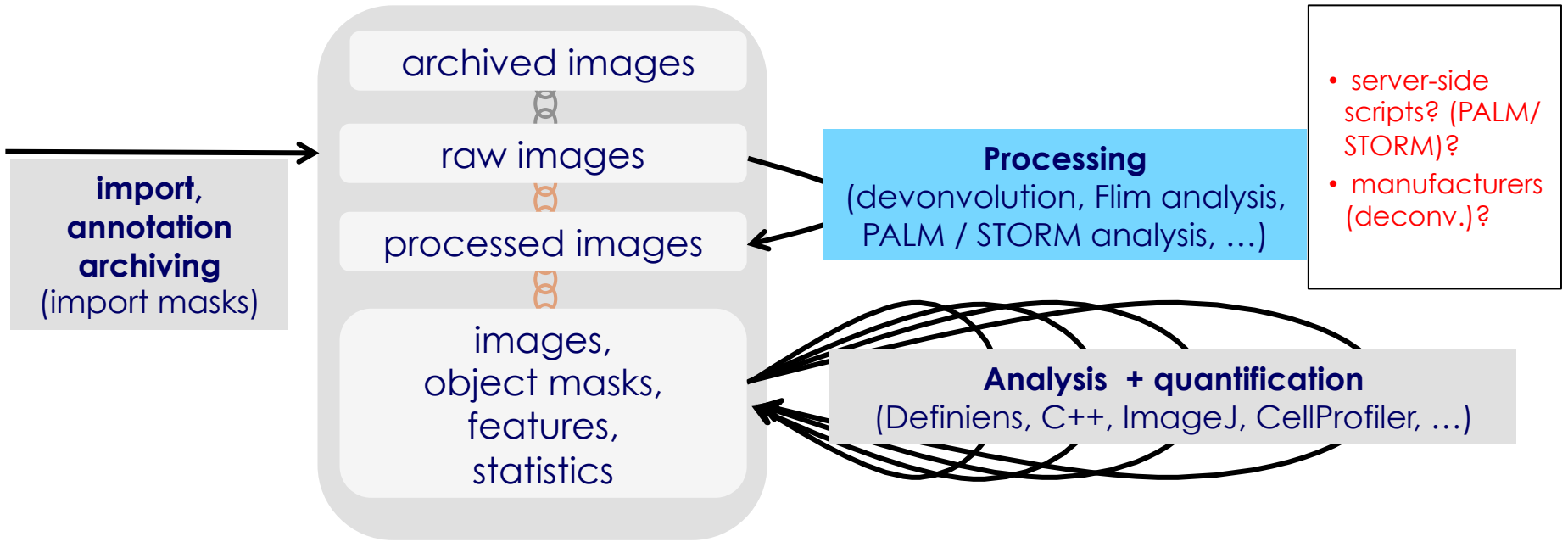

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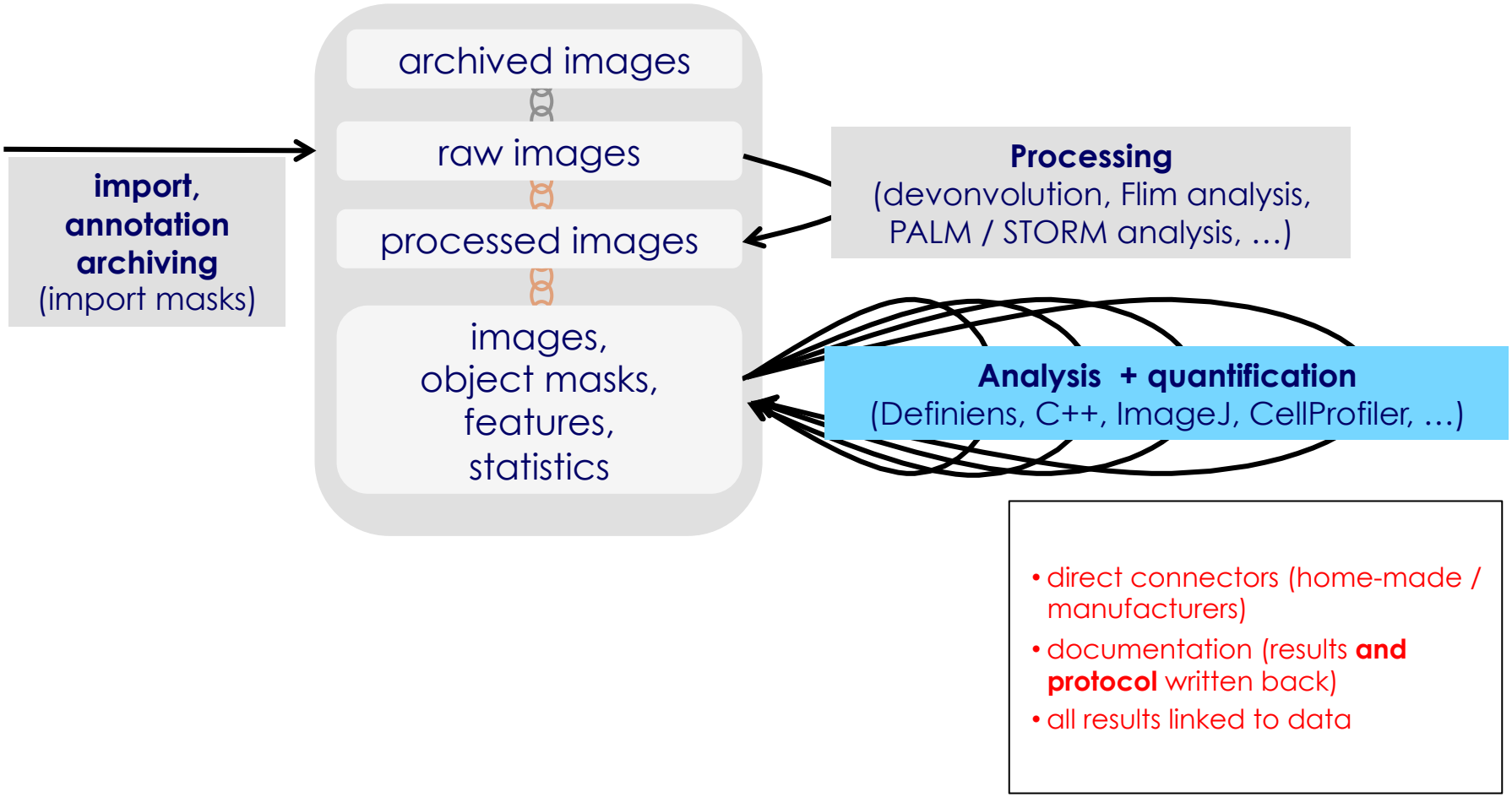
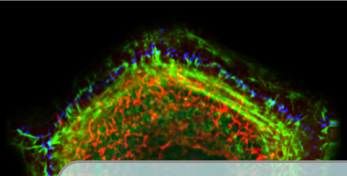
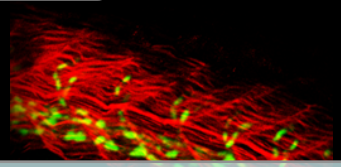
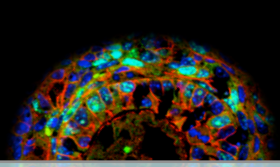
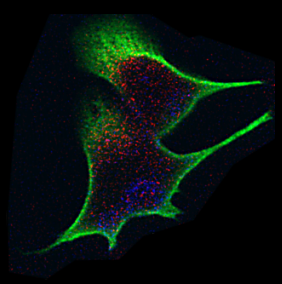
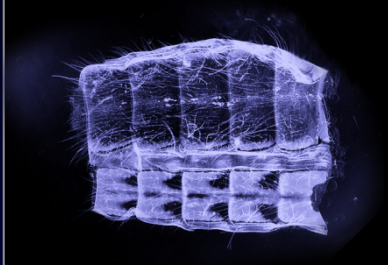
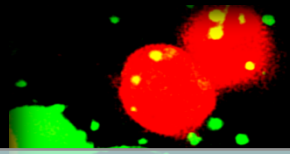
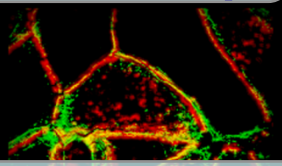
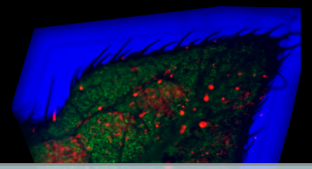


Thanks to…

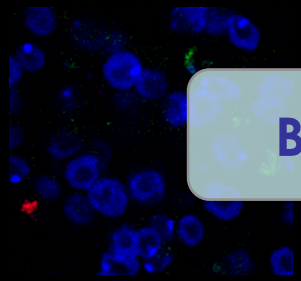
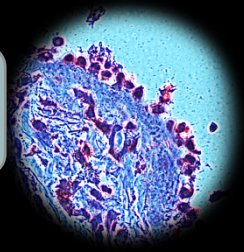





FILM Crew:
Prof. Tony Magee, Mark Scott & Steve Rothery

CISBIC / Bioinformatics Support Service:
Mark Woodbridge, Chris Tomlinson, Sarah Butcher

OME Team:
Jason Swedlow, Melissa Linkert, Will Moore,
Scott Loynton, Jean-Marie Burel, all others

BBSRC

Definiens Support