EMBO; a European Life Science Academy

EMBL; a model for European Life Science Research and Policy

Prof. Iain W. Mattaj
EMBL Director General

SIBBM Meeting
2 July 2015

EMBL

EMBO

An organization of leading life scientists that fosters new generations of researchers to produce world-class scientific results.

EMBC

- Founded in 1969
- Intergovernmental organisation
- 27 member states
- Funds General Programme of EMBO

EMBO Members

- More than 1700 leading scientists (including 79 Nobel Laureates)
- Annual peer election
- Influence life science research and policy
- Guide all EMBO activities to deliver high-quality programmes

EMBO Main Activities

Programmes

- Fellowships
  - Long-term
  - Short-term
- Courses & Workshops
- Young Investigators
- Installation Grants
- Science Policy

Journals

- The EMBO Journal
- EMBO reports
- Molecular Systems Biology
- EMBO Molecular Medicine

Annual Meetings

- The EMBO Meeting
- Annual Conference on Science & Society (EMBL/O)

EMBO Courses & Workshops

- 11,000 attendees annually
- 94 scientific meetings in 2015
- 22 management courses in 2015
- Keynote lectures by EMBO members
- 6 EMBO/EMBL Symposia

Benefits for meeting organisers

- Financial support
- Assistance in poster/website design
- Access to top scientists/speakers
- Advertising through EMBO's network of scientists

EMBO Fellowships

Long-term fellowships

- Co-funded by the EC
- Young scientists (within 2 yrs of PhD)
- International mobility and exchange
    - two-year research visits

Short-term fellowships

- Within 10 years of PhD
- Research visits of up to three months
- Scientific exchange between laboratories
    - Transfer of techniques/technologies
    - Long-lasting collaborations
    - Jointly authored publications

EMBL

- EMBL was founded in 1974, as **European Intergovernmental Research Organisation**, following the CERN model, to create a center of excellence for molecular biology research in Europe

- Former Directors General

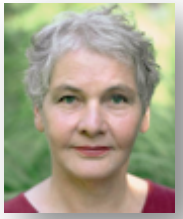

John Kendrew


Lennart Philipson


Fotis C. Kafatos

Nobel Prize in Chemistry 1962

- Many award winning scientists



Nobel Prize in Medicine 1995

EMBL Member States

Member States (21)

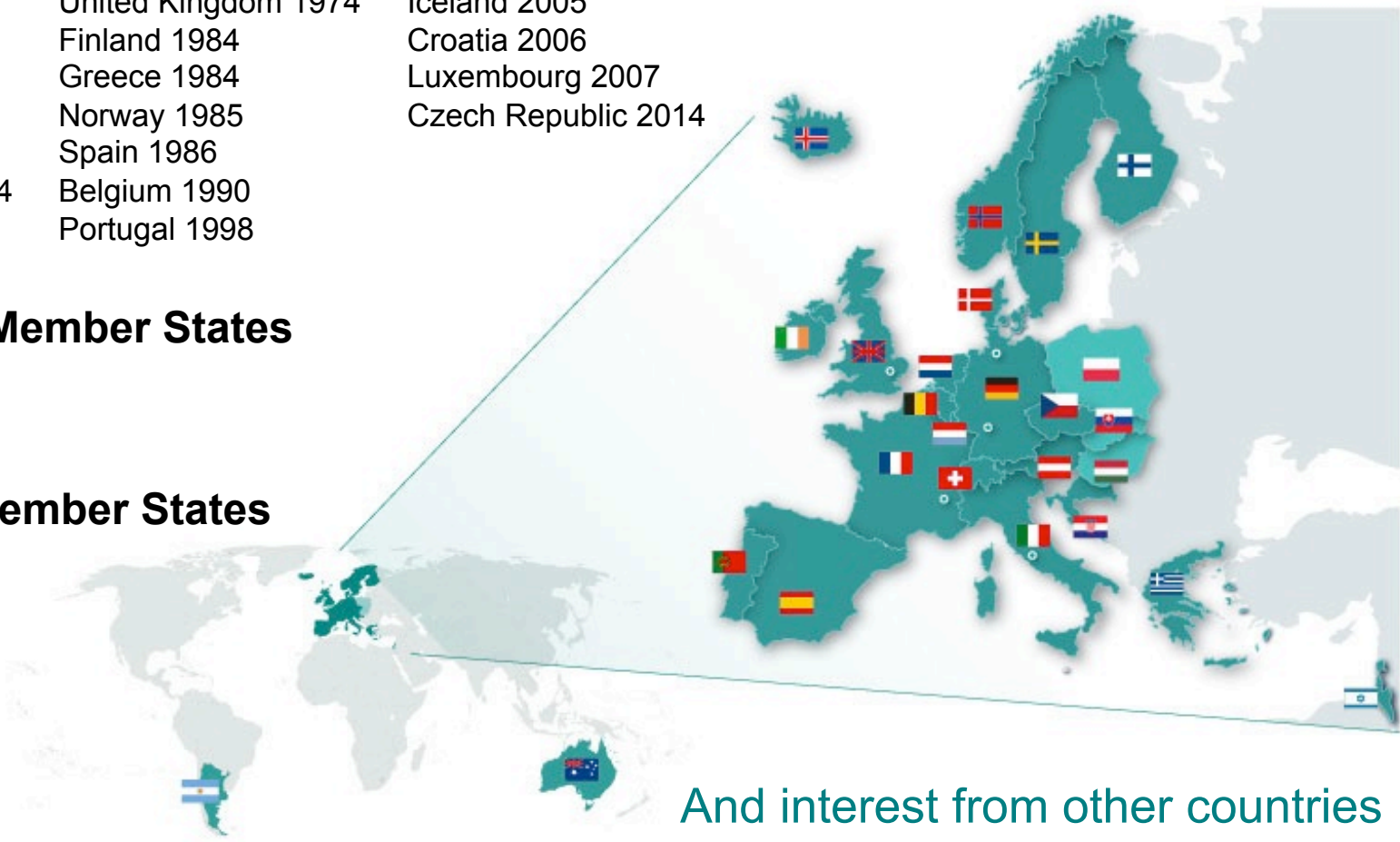
Austria 1974
Denmark 1974
France 1974
Germany 1974
Israel 1974
Italy 1974
Netherlands 1974
Sweden 1974
Switzerland 1974
United Kingdom 1974
Finland 1984
Greece 1984
Norway 1985
Spain 1986
Belgium 1990
Portugal 1998
Ireland 2003
Iceland 2005
Croatia 2006
Luxembourg 2007
Czech Republic 2014

Associate Member States

Australia 2008
Argentina 2014

Prospect Member States

Slovakia 2014
Hungary 2014
Poland 2014



And interest from other countries

EMBL Sites

Structural biology

EMBL-EBI

Bioinformatics

Life sciences

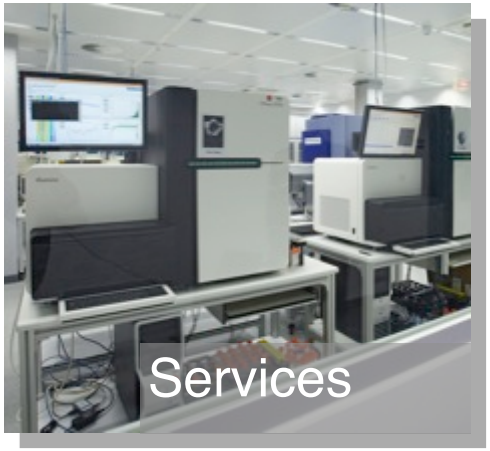
Structural biology

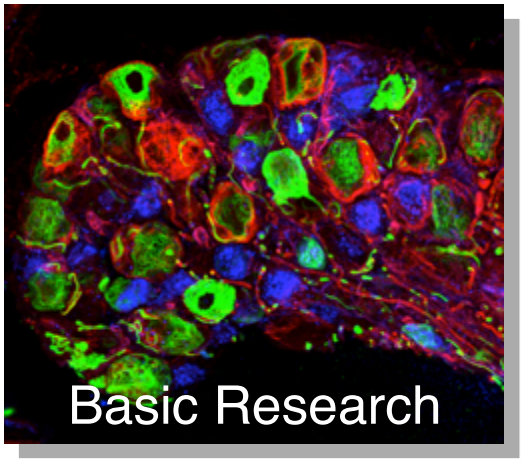
Mouse biology

>1600 people >80 nationalities

EMBL

EMBL's Five Missions

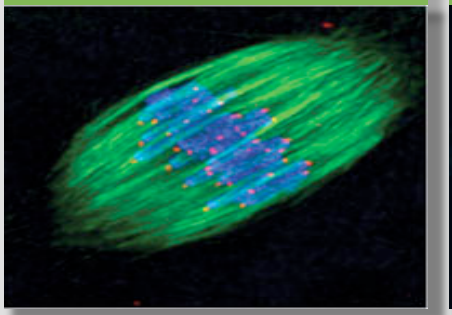




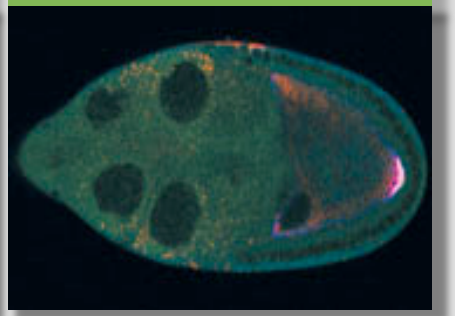
The EMBL Research Units

Heidelberg

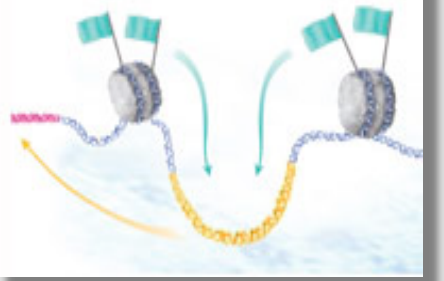
Cell biology and biophysics



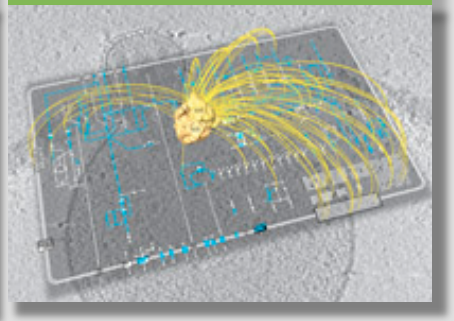
Developmental biology



Genome biology



Structural and computational biology



+ Director's research, core facilities and central administration;

EMBO

Structural biology - Hamburg

DESY – European XFEL
CSSB

Structural biology - Grenoble

ILL, ESRF, IBS, UVHCI, PSB

European Bioinformatics Institute - Hinxton

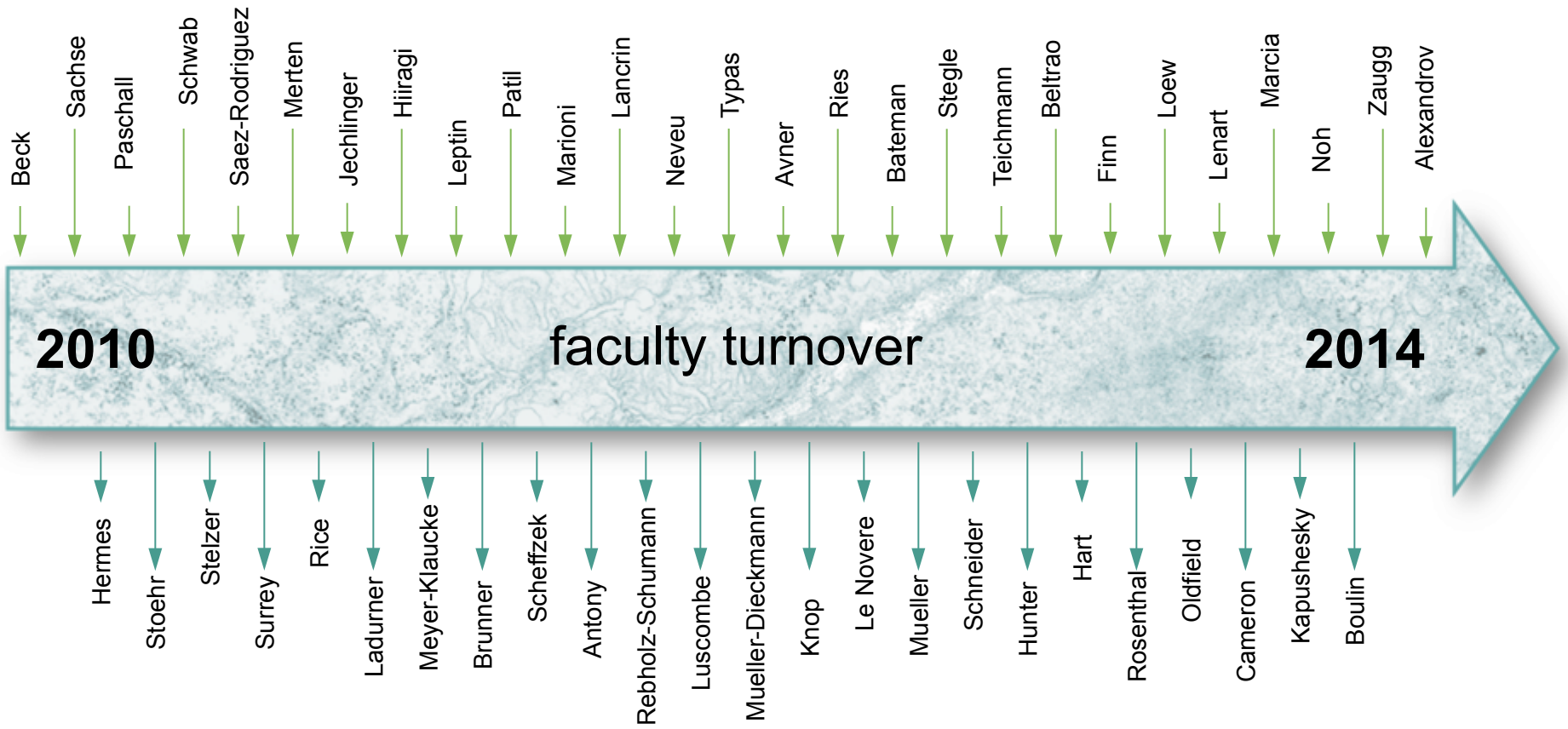
Wellcome Trust Sanger Institute

Mouse biology - Monterotondo

EMMA, CNR

Continuous renewal and refocussing

EMBL's staff turnover system: turnover of faculty = renewal of expertise

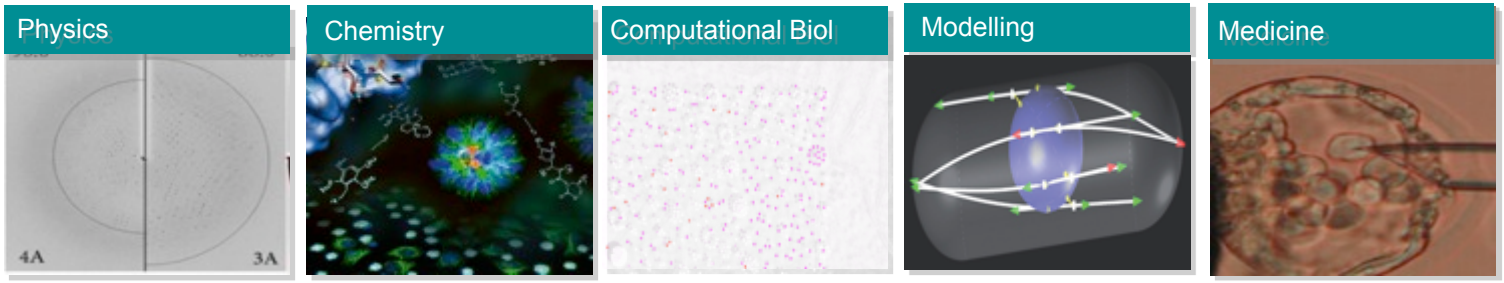


>80% of EMBL alumni take up positions in EMBL member states

EMBL

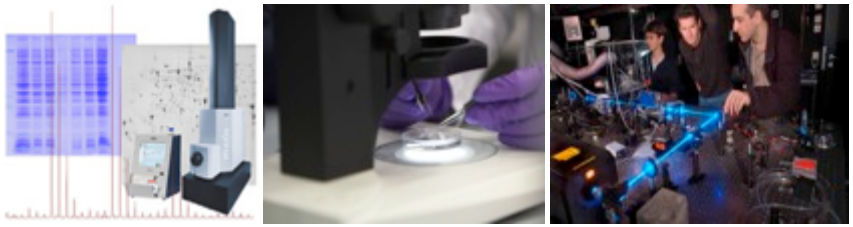
EMBL environment for young researchers

- Interdisciplinary Research - research beyond molecular biology



- Collaborative environment

- Infrastructure and support



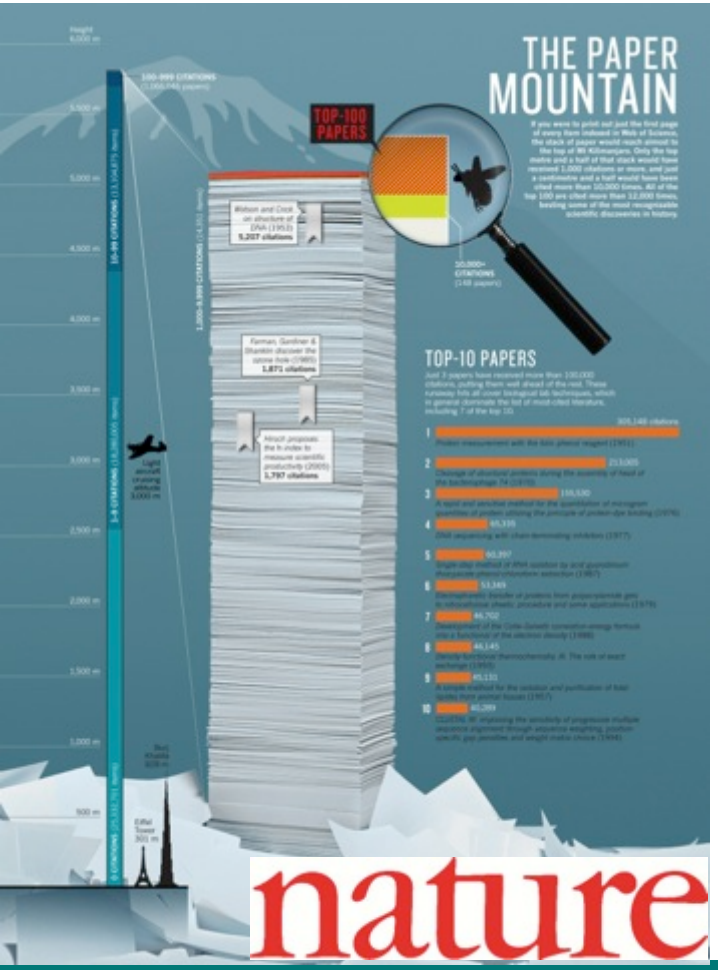
- Focus on research, few other tasks (e.g. teaching)

EMBL's organisational structure serves as a model for other research institutions

Top 100 papers Web of Science

WEB OF SCIENCE™

THOMSON REUTERS



100 most highly cited papers of all time

With > 12,000 citations

EMBL

- 45 biochemical methods / bioinformatics papers
  - 4 papers by EMBL scientists (1 in top 10)

Van Noorden, R. et al. The top 100 papers. Nature 2014

ERC Investigators at EMBL

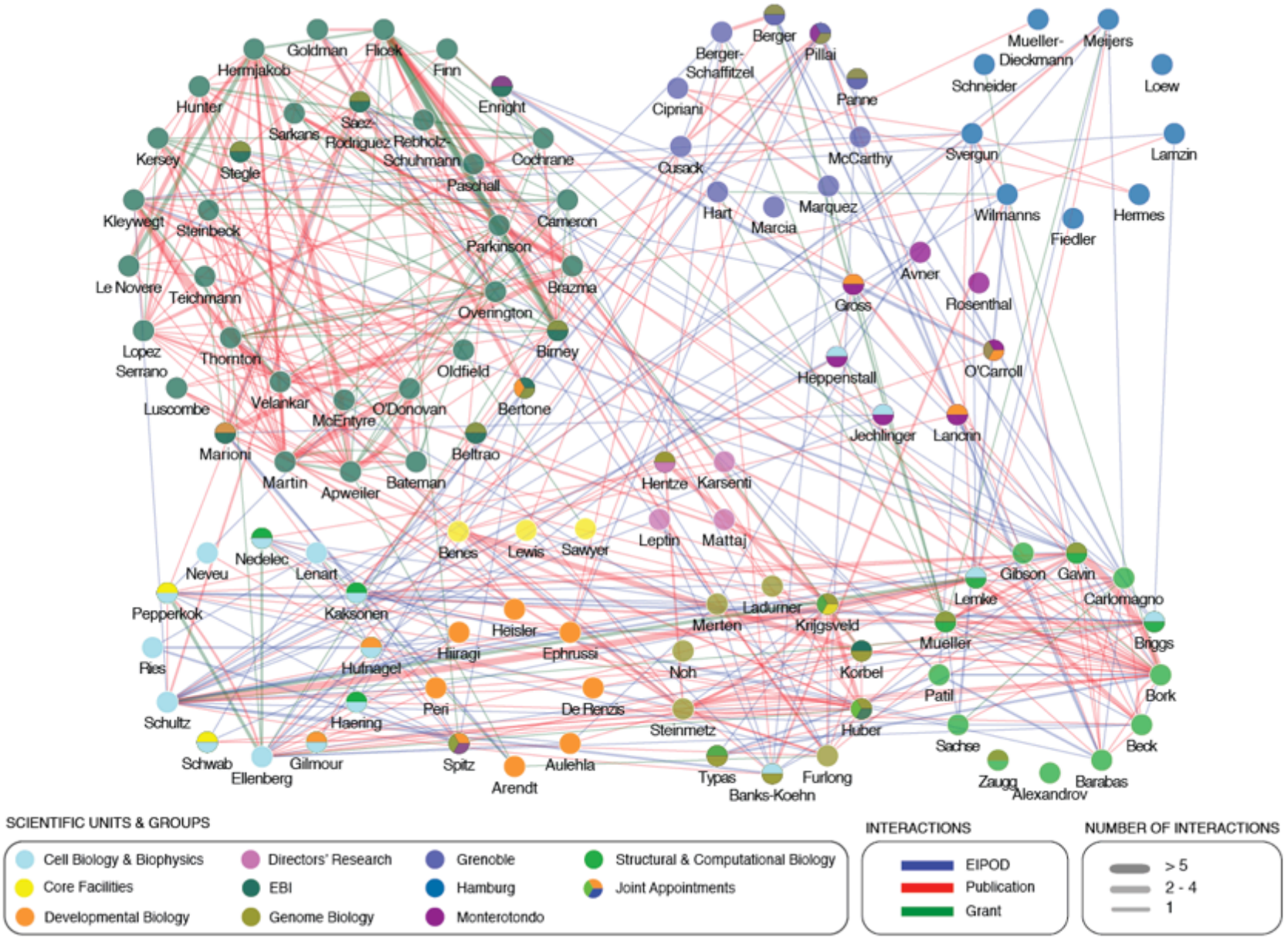
21 Grants (~ 30% of RGLs)

Consolidator Grants

Advanced Grants

Starting Grants

Interdisciplinary research at EMBL in 2012-2014



Scientific publications in collaboration in 2012-2014

484 By EMBL

1471 By EMBL with over 800 collaborating organisations worldwide

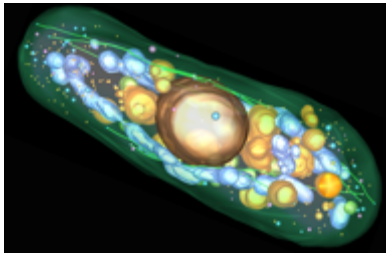
1288 By EMBL in collaboration with organisations in member states

1955 Total

EMBL Programme 2017-2021

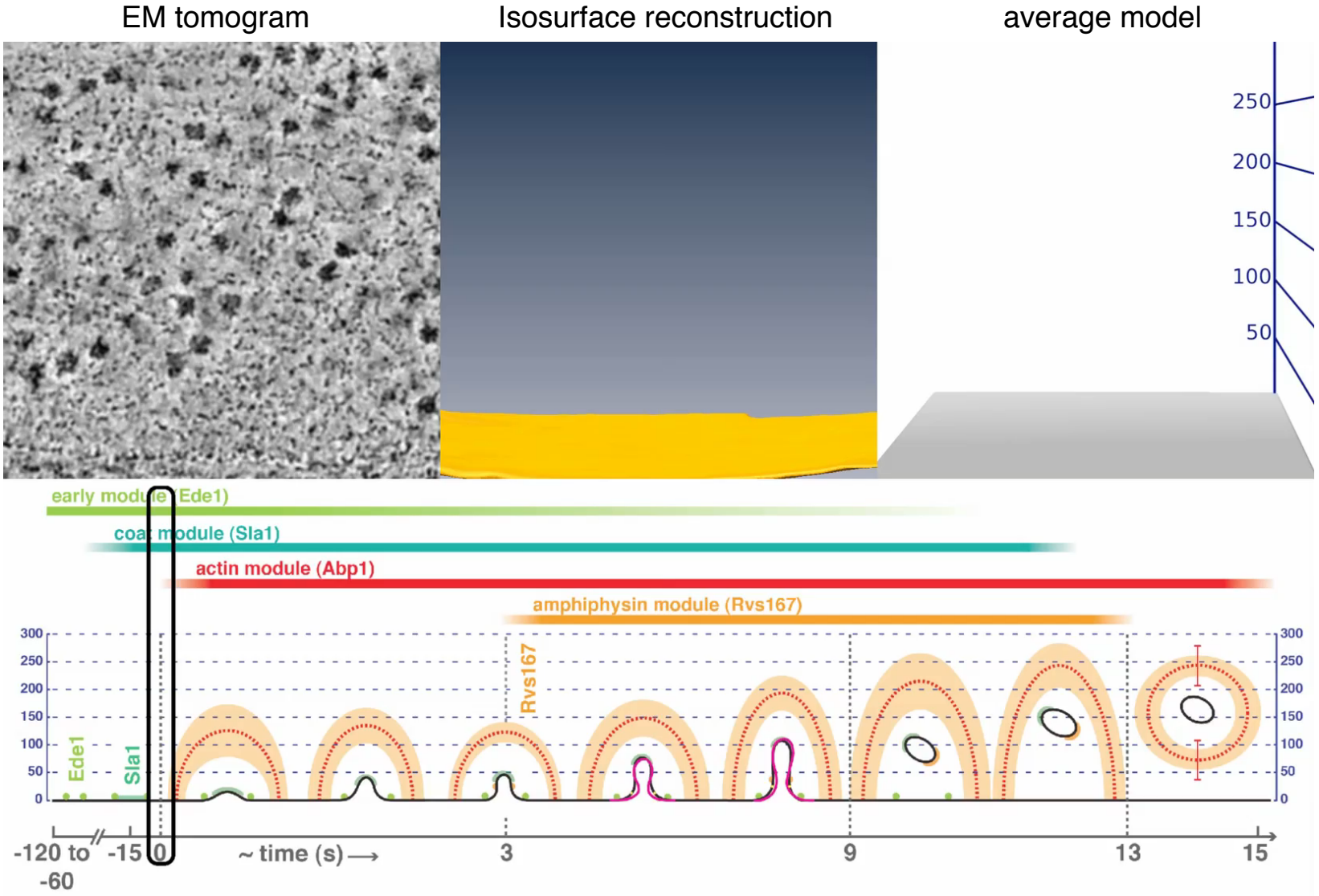
The BIG Data Challenge

Bridging scales & resolutions



Towards Human Biology & Molecular Medicine

Correlative microscopy of endocytosis

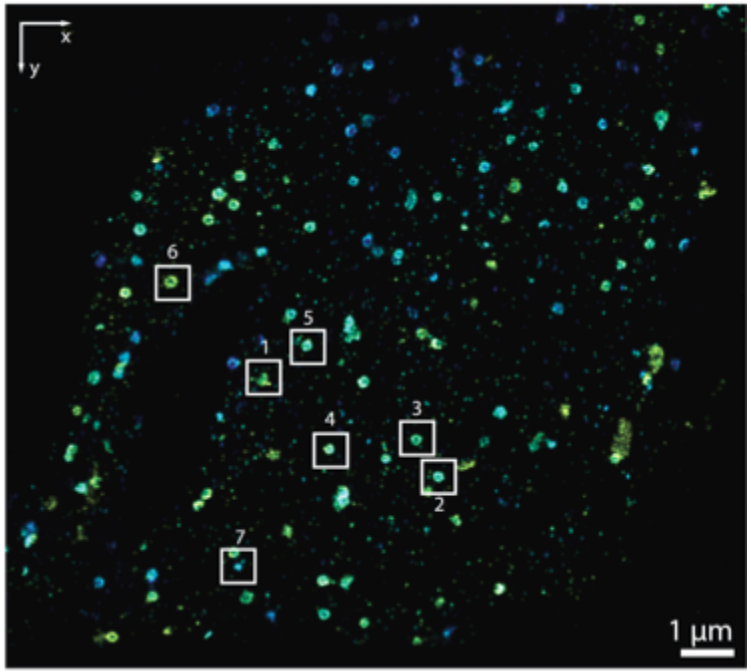


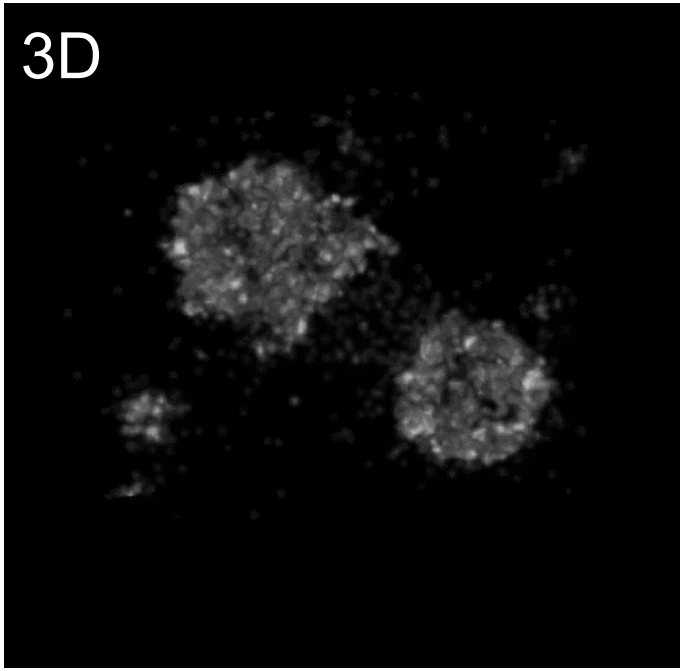
Kukulski et al., 2012, Cell 150:508

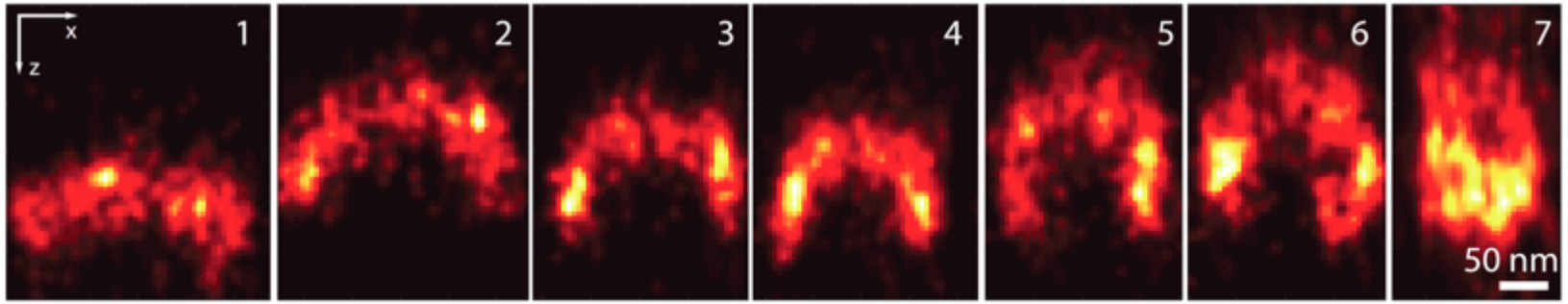
EMBL

Superresolution imaging of vesicle assembly

anti-clathrin/Alexa647 (sec) (color codes depths)



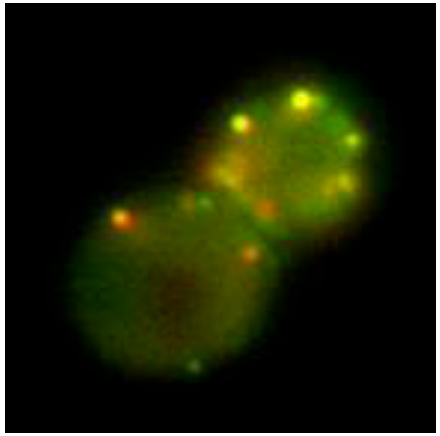




Picco et al., 2015, Elife 4

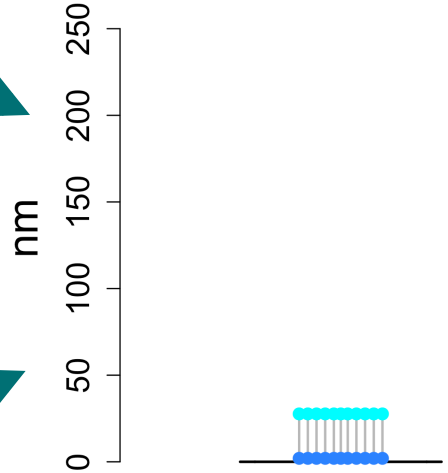
EMBL

Towards a comprehensive dynamic molecular model of endocytosis



Live cell imaging

Data Integration and Modeling

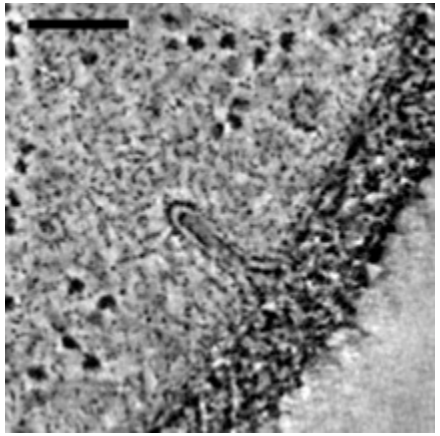


$$\dot{\Gamma} = \frac{1}{2}(\dot{\psi} - C_0)^2 - \frac{\sin^2\psi}{2R^2} + \bar{\sigma} + \Pi R \sin\psi$$

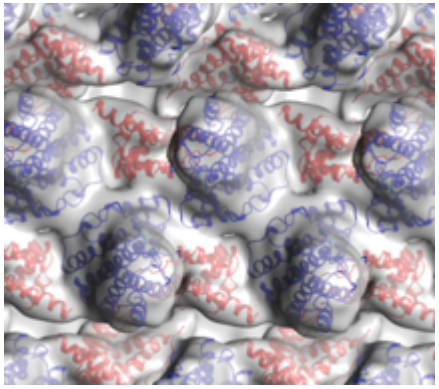
spontaneous curvature

membrane elasticity

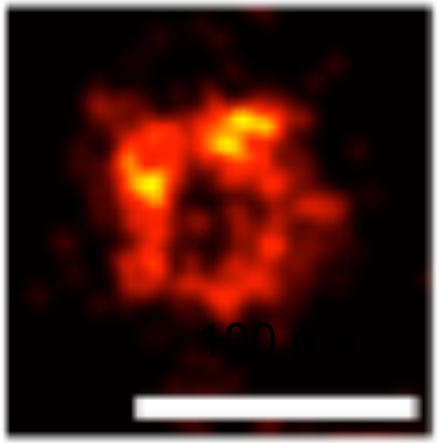
turgor pressure



Correlative EM



Structural biology



Superresolution microscopy

The TARA Oceans Project

- 35,000 samples in 4 years
  - Metagenomic, metatranscriptomic, microscopic, oceanographic and geochemical data
- 160 international scientists
- Scientific activity coordinated by EMBL

EMBL

Tara Oceans Science

Tara Oceans studies plankton at a planetary scale

Initial analysis of partial data

from 579 samples:

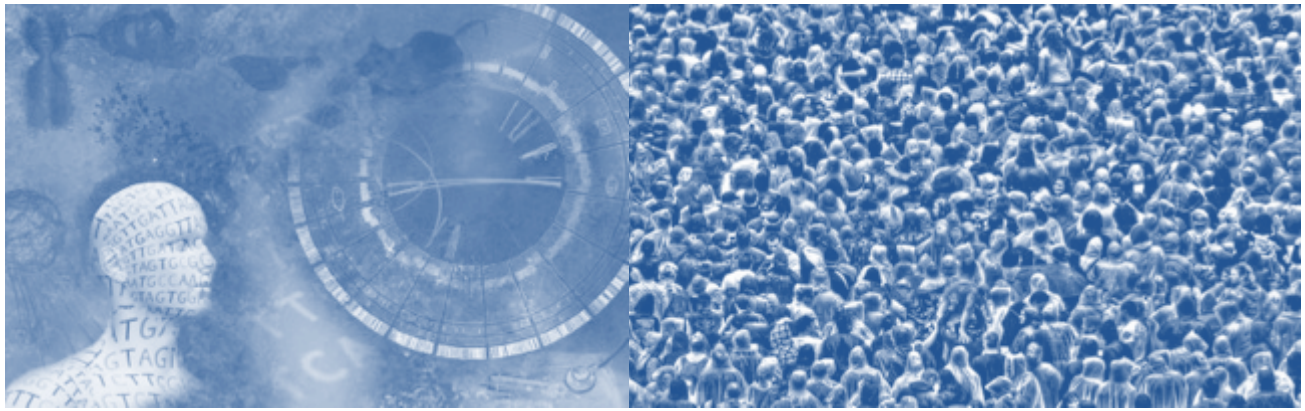
- > 20 publications
- 5 research articles featured in a special issue of *Science*

- Mapping of 40 million genes
- >10,000 new eukaryotic species
- ~30,000 new prokaryotic species
- Insights into climate change

EMBL

Pan cancer analysis of whole genomes

We currently cannot compare genomic rearrangements between tumor types



- Investigate commonalities & differences in molecular patterns in different types of cancer
- Discover new driver mutations (in coding & non-coding regions)
- Reveal mechanisms involved in cancer progression

Pan-Cancer: a test case for cooperative big science in genomics

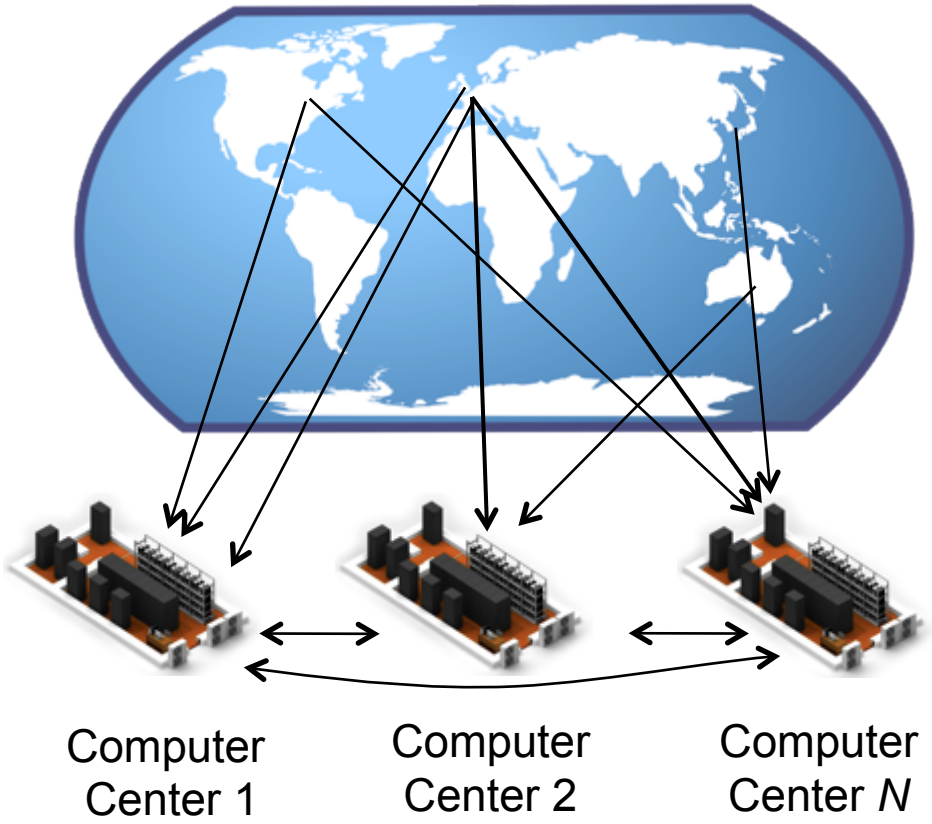
Data analysis phases:

I. Submission & remapping

II. Mutation & SV detection

III. Synchronization between computing centers

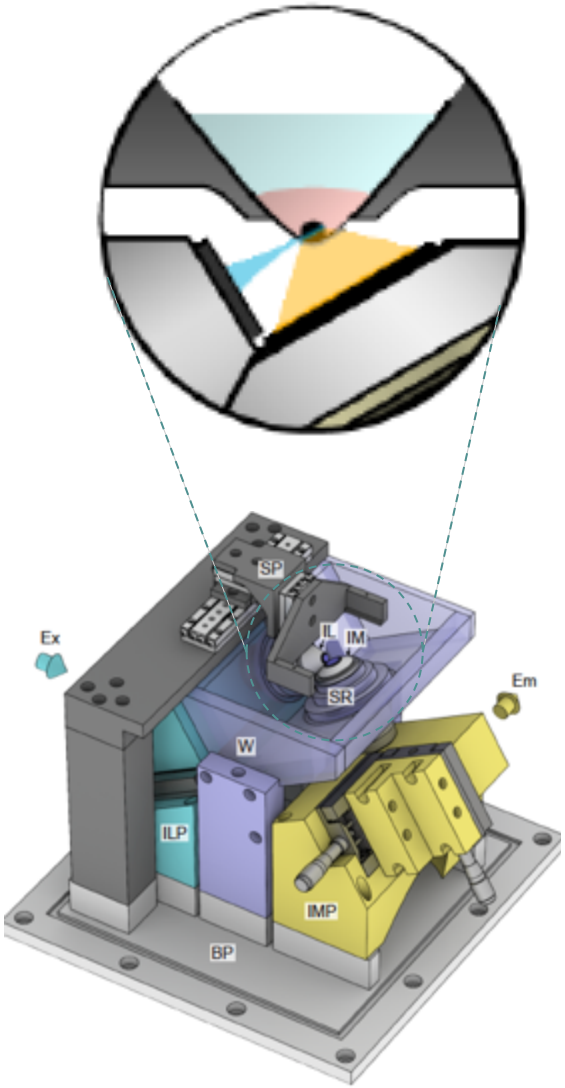
IV. Data mining, hypothesis generation & testing

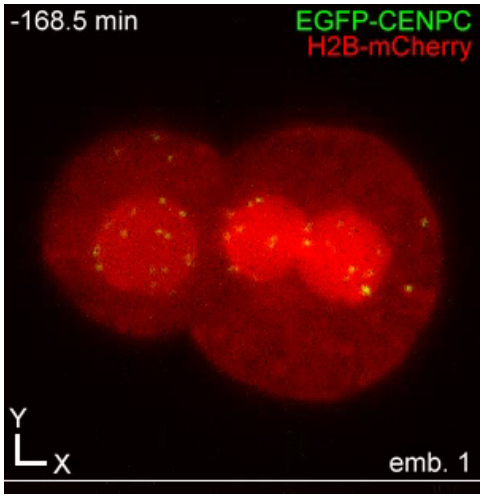


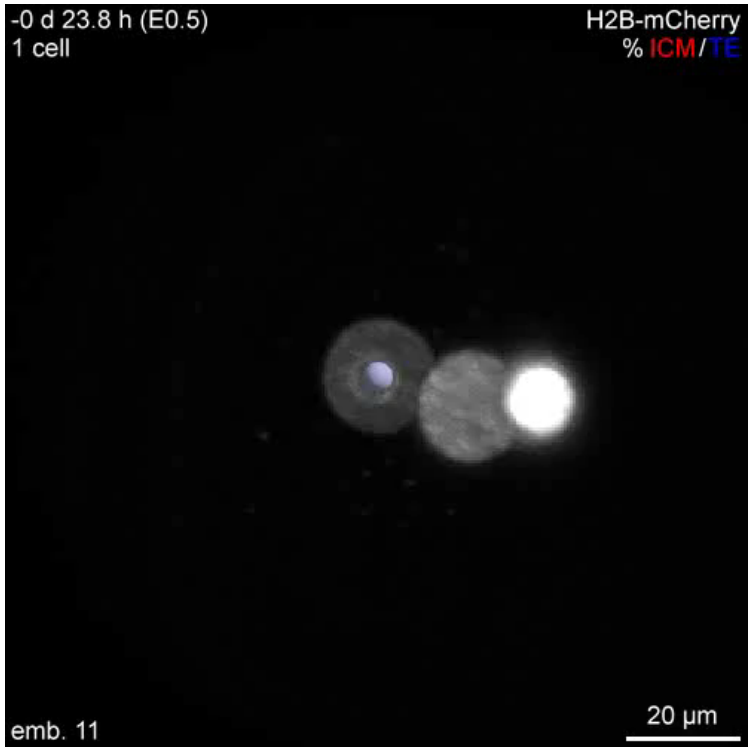
Cloud computing centers:

Europe (EMBL-EBI, EMBL-HD/DKFZ, Barcelona)
US (Chicago)
Asia (Riken, ETRI/Seoul)

An inverted light sheet microscope for *in toto* imaging of mouse preimplantation development



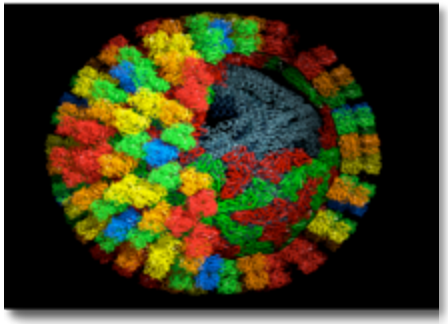




EMBL

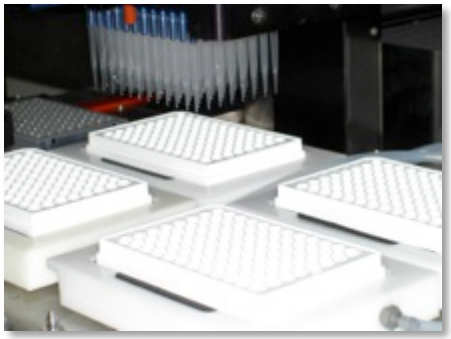
EMBL Infrastructure and Services

+ Training



Structural Biology
~ 2,500 user visits per year
many users of complementary services

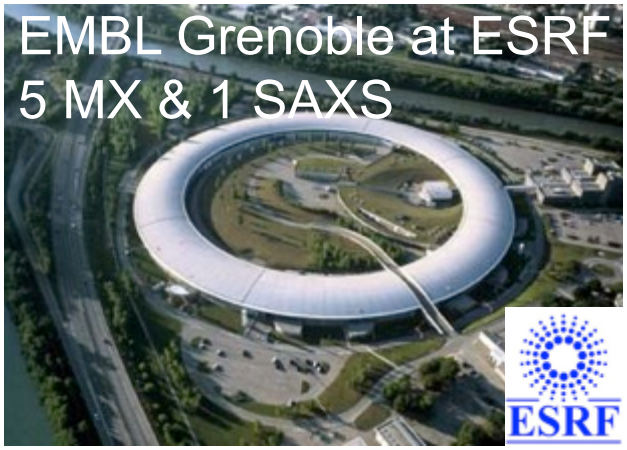
Bioinformatics at EBI
> 11,000,000 web visits per day



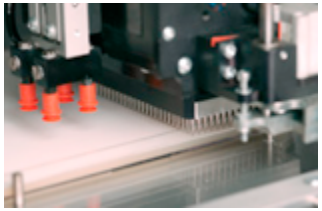
Core Facilities
> 1,200 internal and external users per year

Christian Boulin Fellowships

EMBL Services in Structural Biology



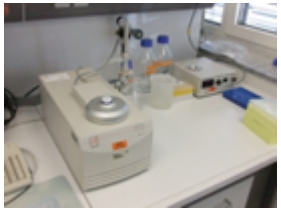
Beamlines are integrated into advanced facilities for biological sample preparation, characterisation, crystallisation, X-ray data processing and evaluation



High-throughput expression

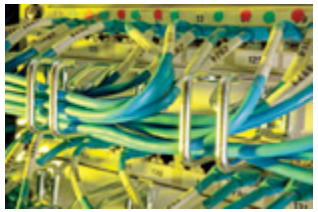
High-throughput crystallisation

Analysis of interactions



Sample Preparation & characterisation

High-throughput crystallisation



Computational facilities & software

NEUTRONS FOR SCIENCE

Access to Neutron Sources
Deuteration Isotope Labelling Facility

European XFEL

ATSAS 2.5

7.4 ARP wARP

EMBL

Infrastructure: Data resources at EMBL-EBI

Genes, genomes & variation

European Nucleotide Archive | Ensembl | 1000 Genomes | European Genome-phenome Archive
Ensembl Genomes | Metagenomics portal

Gene, protein & metabolite expression

ArrayExpress | Expression Atlas | Metabolights | PRIDE

Literature & ontologies

Europe PubMed Central
Gene Ontology
Experimental Factor Ontology

Proteins & protein families

InterPro | Pfam | UniProt

Molecular structures

Protein Data Bank in Europe
Electron Microscopy Data Bank

Chemical biology

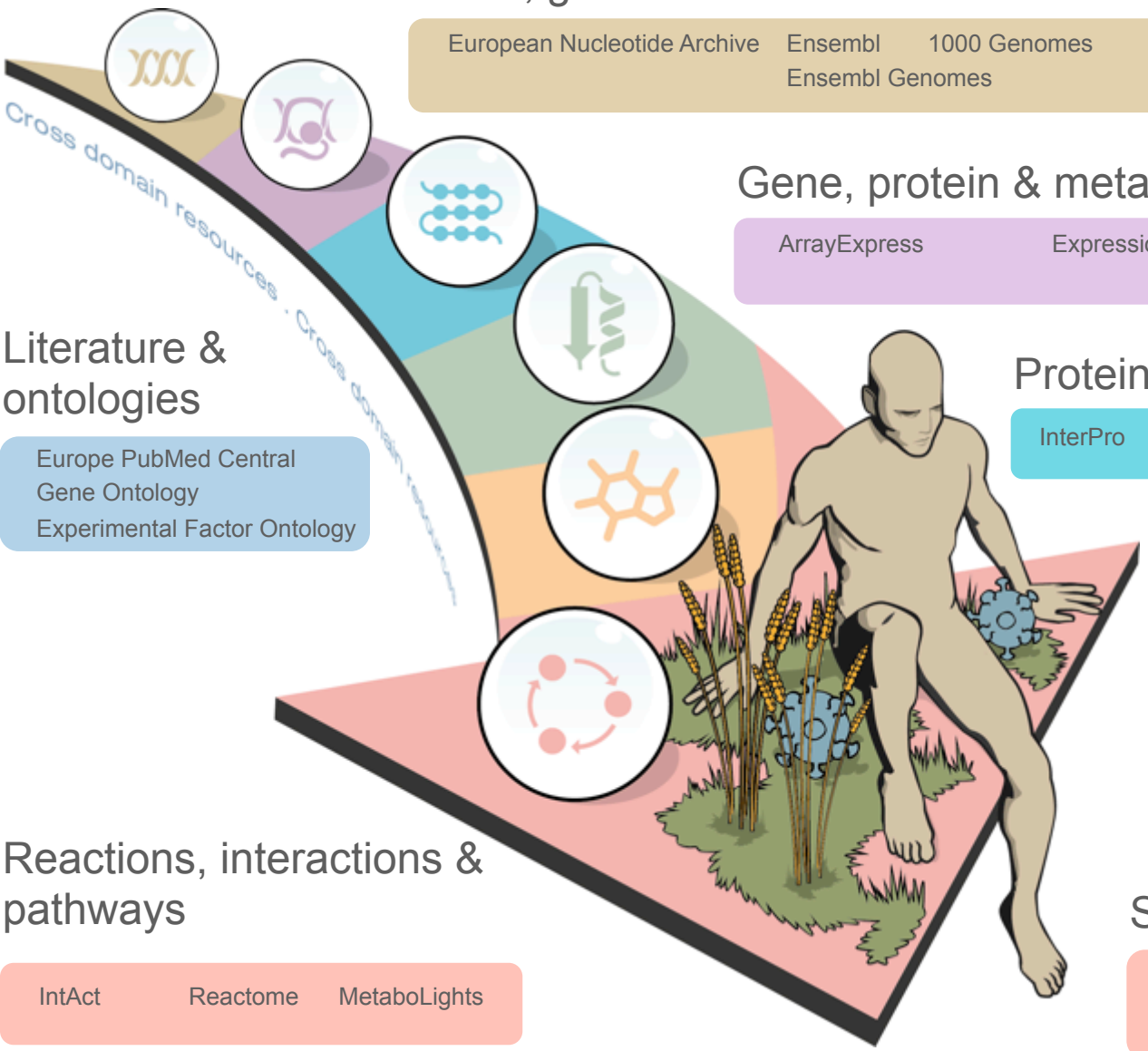
ChEMBL | ChEBI

Reactions, interactions & pathways

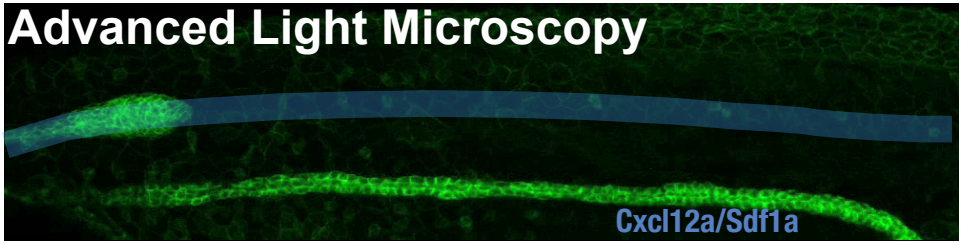
IntAct | Reactome | MetaboLights

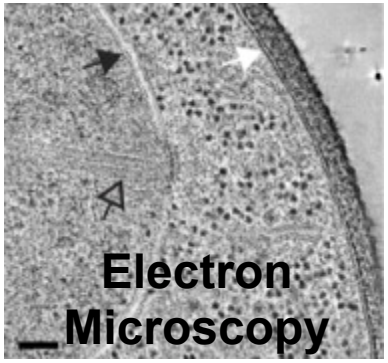
Systems

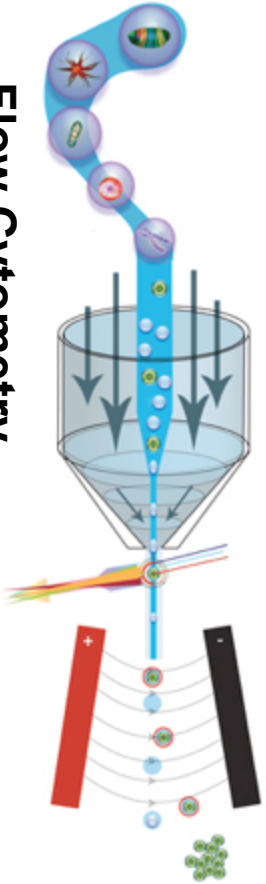
BioModels
Enzyme Portal
BioSamples

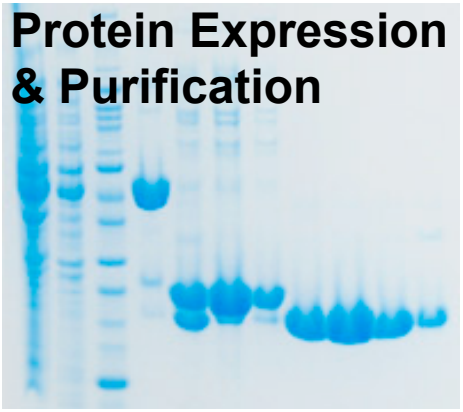


EMBL Scientific Core Facilities

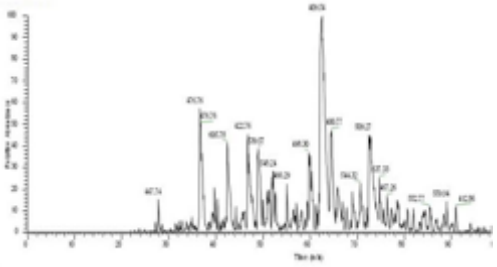




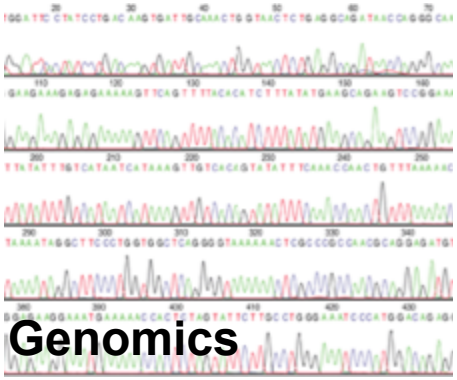


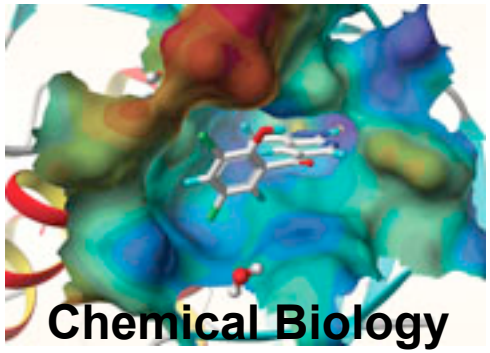


Proteomics



Transgenics (MR, HD)





Training at EMBL

EMBL International Center for Advanced Training

Internal

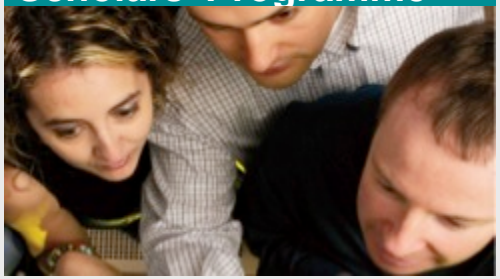
EMBL International PhD Programme

EMBL Postdoctoral Programme

External

EMBL Courses & Conferences

EMBL Visitors' & Scholars' Programme



EICAT Partners

General Training & Development Progr.

European Learning Lab for the Life Sciences

EMBL's fixed-term contract system means we also constantly train new research, service and administrative staff

EMBL International PhD Programme

- Joint PhD degree with 25 universities in 17 countries, including Milan in Italy
- ~ 250 students from over 40 countries

Postdoctoral programmes

- ✓ EMBL Interdisciplinary Postdocs (EIPODs)
- ✓ Classical Postdoctoral Scheme
- ✓ EMBL Sanger Postdocs (ESPODs)
- ✓ EMBL-EBI BRC* Postdocs (EBPOD)

(*BRC: NIHR Cambridge Biomedical Research Centre)

External Training 2014

- Courses and conference programme across all 5 EMBL sites
  - 22 conferences and 43 courses
  - > 6000 participants from > 80 countries
    - **CPP fellowships and/or travel grants**

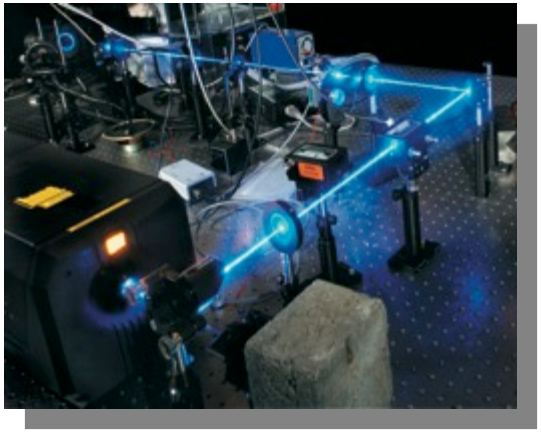
EMBL 2014

- Off-site training (mainly by EBI staff)
  - ~ 150 training events

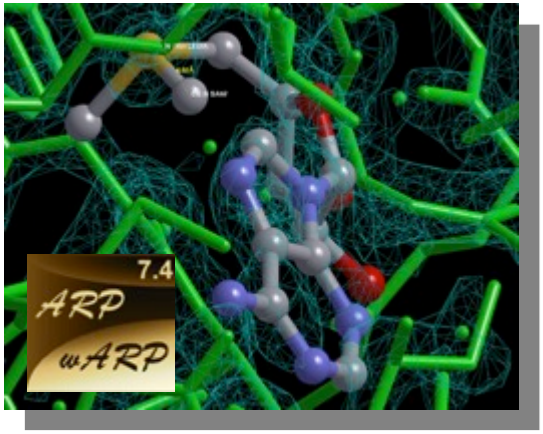
- Online bioinformatics training at EBI
  - 90 online courses with > 130k unique users
- Visitors' and Scholars' Programme
  - > 500 visitors/year

Technology Development

- EMBL develops a broad spectrum of technology and instrumentation for life science research
- Cross-fertilisation between research activities and technology development



Imaging technology

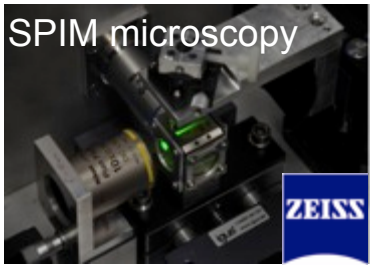


Software development

Synchrotron instrumentation

Technology Transfer

The scientific community and society at large benefit from EMBL's technology development and research discoveries



EMBL

Idea → Discovery or Invention → EMBLEM TECHNOLOGY TRANSFER → Protection → Licensing / Start-up company

EMBL Technology Fund

GENE BRIDGES
DNA ENGINEERING SPECIALISTS

Cenix BIOSCIENCE

savira pharmaceuticals

cellzome

>170 patents granted
~ 2800 license & collaboration agreements
16 spin-outs

EMBL interactions with industry

Institutional

- ATC Corporate Partnership Programme
- EMBL-EBI Industry Programme
- Centre for Therapeutic Target Validation
- EMBL/EMBLEM Science Days
- EI_3POD

Project-based

- EU-funded programmes
- Technology co-development and beta-testing
- Research collaborations
- Scientific consulting

The Centre for Therapeutic Target Validation

Collaboration to pinpoint processes in the human body that impact on disease

Harness the power of “big data” & the human genome to accelerate the search and improve success rate for discovering new medicines

EMBL-EBI

Public-private initiative:

gsk GlaxoSmithKline

wellcome trust sanger institute

GSK: expertise in disease biology

EMBL-EBI: expertise in life science data integration and analysis

Wellcome Trust Sanger Institute: expertise in genomics in disease

The CTTV is a model for further future strategic & long-term collaborations with commercial partners.

Integration of life science research in Europe

EMBL Partnerships

ESFRI-BMS projects

ESFRI European Strategy Forum on Research Infrastructures

European Science Policy and Strategy

European Commission

EIROforum

EMBL Partnerships

- Close cooperative affiliation
- Establish network of international centres of scientific excellence and advanced training modelled on EMBL
- Exploit complementarity or synergy
- Transfer know-how

ESFRI-BMS Projects

ESFRI European Strategy Forum on Research Infrastructures

EMBL provides strategic advice and coordinates pan-European research infrastructure projects on the ESFRI roadmap

EURO-BIOIMAGING

- open user access to complete range of state-of-the-art imaging technologies

elixir

- archiving, integration, analysis and exploiting of large datasets produced in life science research

instruct Integrating Biology

- expertise and access to high quality instruments for structural cell biology

BioMedBridges

- shared e-infrastructure for 12 biomedical science RIs (data management, ethical and legal framework, etc.)

European Science Policy and Strategy

Relations with the European Commission

- Memorandum of Understanding
- Observer status in EMBL Council
- Bi-annual joint work programme
- EMBL-EC Annual Meeting
- Regular meetings to exchange information

Relations with the European Parliament and EU Council

EMBL

EURO*fusion*

esa

ESRF

All EMBL Alumni – 6690:
networked to put *life* into *science*

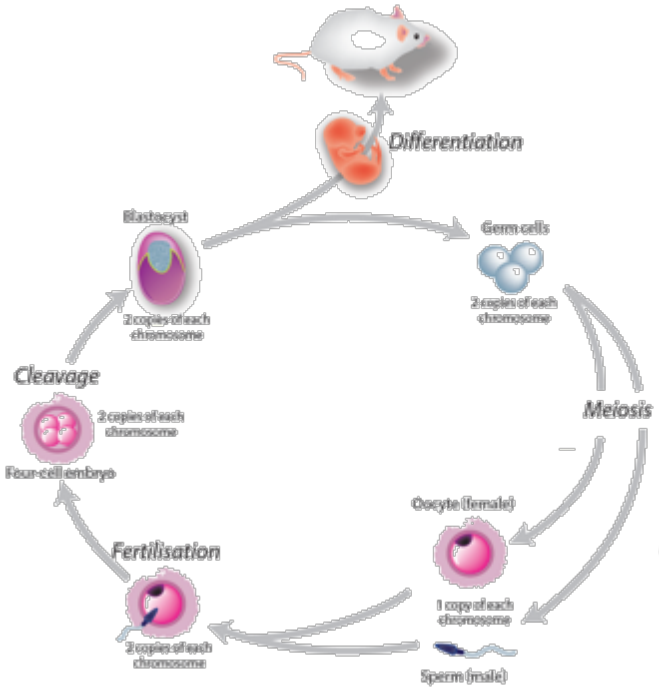
EMBL ALUMNI

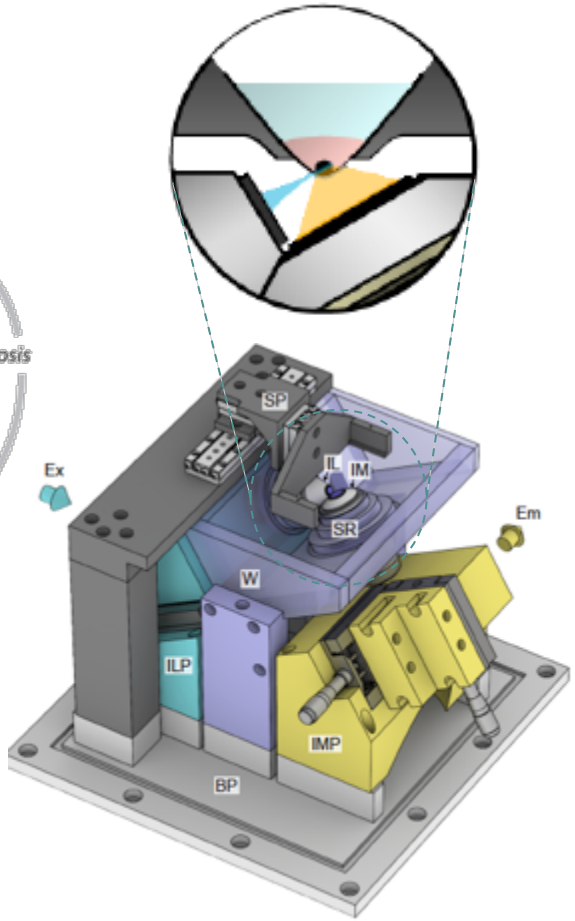
www.embl.org/alumni – 31 December 2014

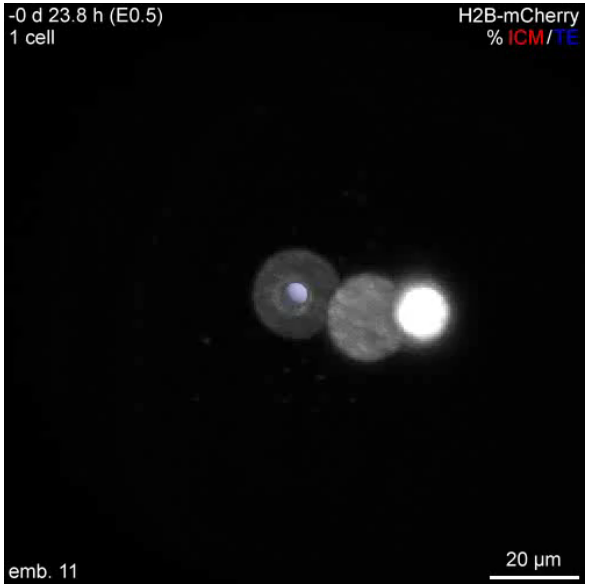
EMBL

Thank you!

New Imaging Technologies are Revolutionising Research







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EMBL Patent P 783 (EP 13 167 360.0), with Lars Hufnagel, EMBL workshops; Strnad et al., under review