European Research Area Board (ERAB)

EGEE09

A Vision for European Research 2030

John Wood

Chair European Research Area Board

Chair International Steering Committee for the European XFEL

Imperial College, London

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The Mandate and Role of ERAB

- Modernisation of European Universities to be fit for purpose – how many can be supported at international level?
- Optimise the relationship between public and privately funded research – "Open Innovation"
- Freedom of Knowledge (5th Freedom)
- Engaging the citizen in the excitement and purpose of research – justifying research to the taxpayer
- The role of ERA in the Global environment

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The future is not what it used to be! Empowering researchers to own the future.

- Research is global – what can little Europe do?
- Grand challenges are pressing – what is the role for small scale research?
- There are too many sub-critical universities. How many can be supported at the international level?

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Burying our heads in the sand- the status quo is not an option!

- The world of research is changing
- Still need for bottom up ideas but….
  - The challenges before the world are so immense that we need to look at how we train people to fit into large teams yet retain their own individual identity and allow room for individual creativity.
  - Is the idea of the conventional Ph.D. past its sell by date? How should we train and conduct research in this environment?
- The need for well managed RIs both physical and dispersed are going to be crucial

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Upcoming issues

- Globalisation of research
- The real impact of e-research
- Increasing requirement to deliver "whole body" solutions within a global context
- Impact of large research infrastructures

- **To what extent do we start to see the student/researcher as a cog in a large machine.**

- **Where is creativity in this context?**

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No longer one technique in one place!

- Many research areas demand a multi-technique approach.
- Users are not necessarily expert in these techniques
  - E.g. Biologists will send samples and remotely access data.
- Access Grid will enable several scientists to control experiments in real time
- Interoperability between equipment and data sets becomes imperative.

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The spotlight is on us!

- Politicians and society want answers to global challenges. Science is seen as a major part of the solution
- Whole body approaches require several different disciplines to work together
- Ensuring a better understanding by funders and policy makers of implications
- How can we ensure training in depth while integrating across disciplines?
- Europe cannot go it alone

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Rutherford Appleton Laboratory

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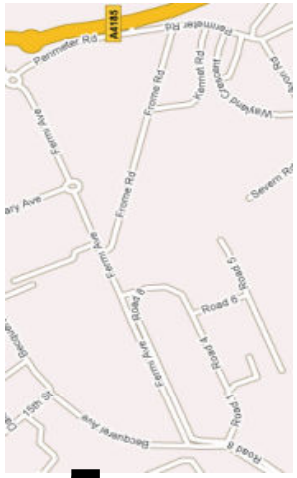
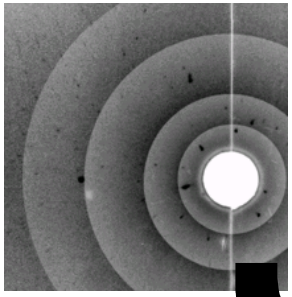
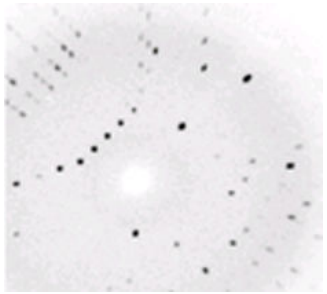
Science driver:-
Integration of Data (and publications)



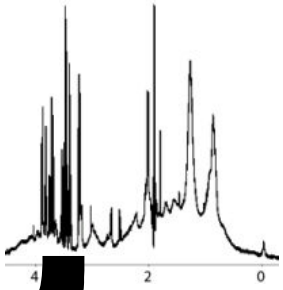
Neutron diffraction

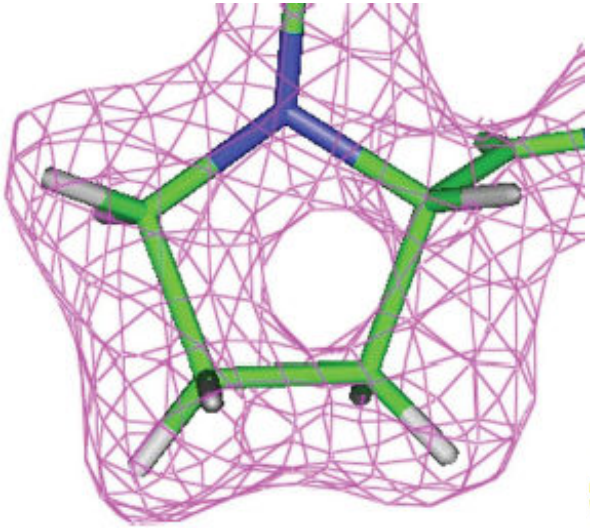


X-ray diffraction



NMR





High-quality structure refinement

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The ESFRI Roadmap is an ongoing process

- **First edition 2006 and updated in 2008 with 44 projects**
- **Preparatory phase funding for most with second round soon**
- **About 10 will fly by 2010**
- **European X-FEL first to go real – civil construction started in 2009 and International convention agreed 2 days ago.**

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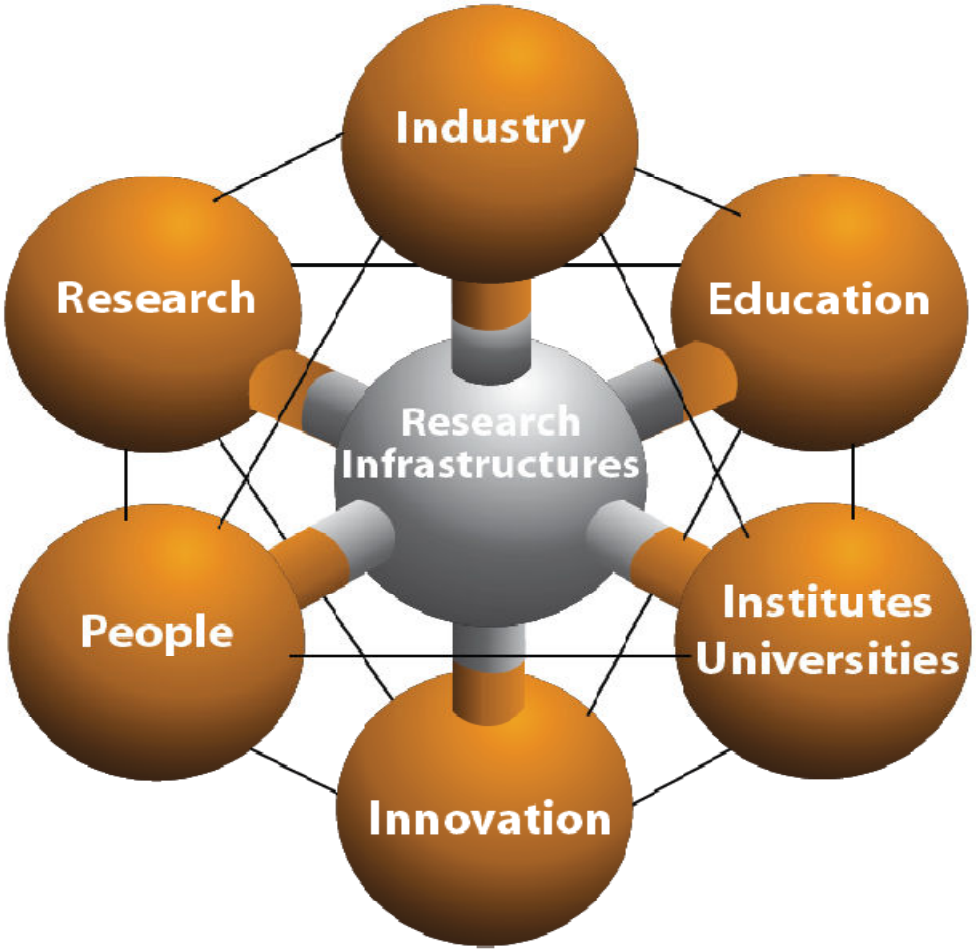
The Centrality of Research Infrastructures for Innovation



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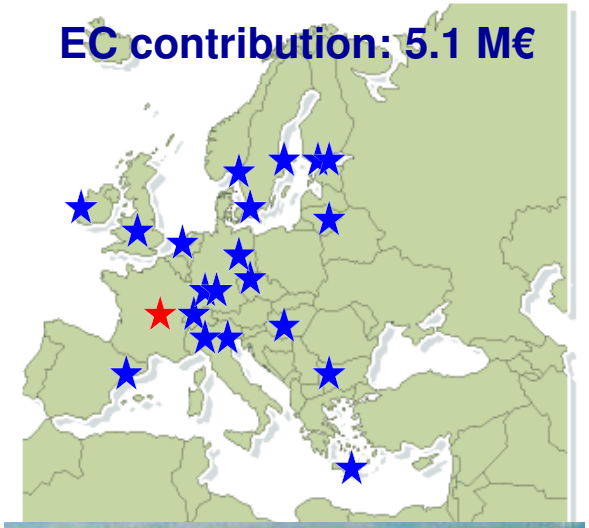
EUSAAR (Environment)

Integrating European research infrastructures for the measurements of atmospheric properties

EC contribution: 5.1 M€



TA (~0.2 M€):

11 ground-based stations for atmospheric research

NA (~3.2 M€):

- Standards and exchange of good practices on sampling, measurement and analysis of aerosol parameters
- Training on aerosol sampling and measurements
- Web portal and Database on aerosol products

JRA (1.7 M€):

- Methodology for determining aerosol optical density
- Standard procedures for aerosol hygroscopic growth determination
- A real time data collection of aerosol measurements

➢ A network of research stations exploiting the diversity of regional backgrounds

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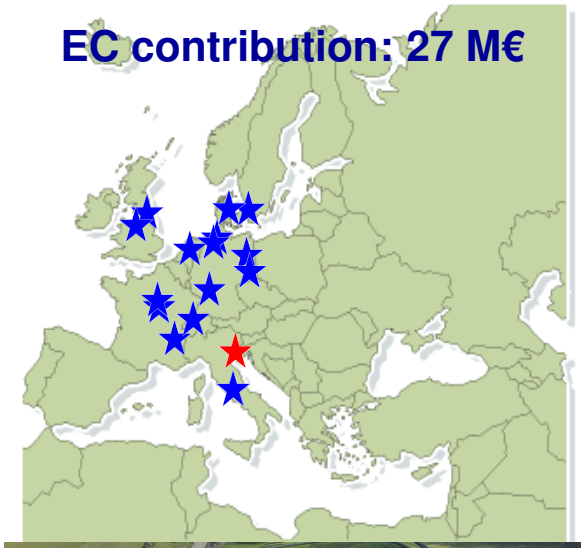
IA-SFS (Analytical Facilities)

Integrating Synchrotron and Free Electron Laser facilities

EC contribution: 27 M€



TA (~19 M€):

- 15 installations, with 4000 users from a very broad spectrum of disciplines

NA (~2 M€):

- Specialized workshops, conferences and schools (support areas of transnational cooperation)
- Exchange of scientists

JRA (~6 M€):

- European platform for Protein Crystallography
- Development of:
  - Instrumentation for Femtosecond Pulses
  - Diffractive x-ray optics
  - Superconducting Undulator
  - Photoinjector for X-ray Free Electron Lasers

➢Offering a common access platform and triggering coherent future developments

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CLARIN

Estimated construction cost	106 M€
First open access foreseen	2008

Social Science and Humanities

- Common Language Resources and Technology Infrastructure
- language resources and technology available and useful to scholars of all disciplines, in particular the humanities and social sciences
- harmonise structural and terminological differences
- based on a Grid-type of infrastructure and by using Semantic Web technology

www.mpi.nl/clarin

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ESFRI Projects for Env. Sciences

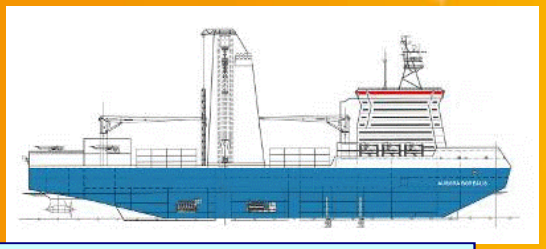
EURO-ARGO

SIOS

IAGOS-ERI

EUFAR-COPAL

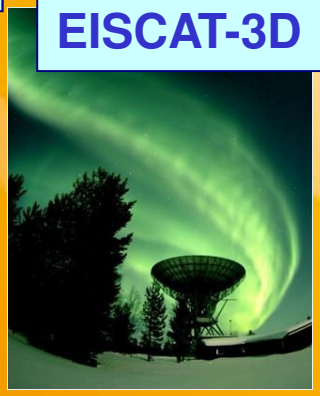
AURORA BOREALIS



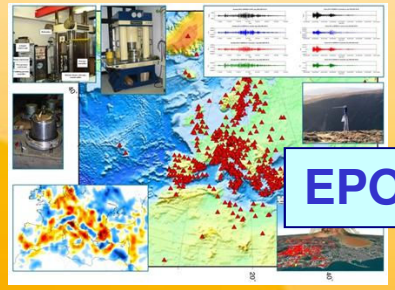
Status 2009

LIFEWATCH

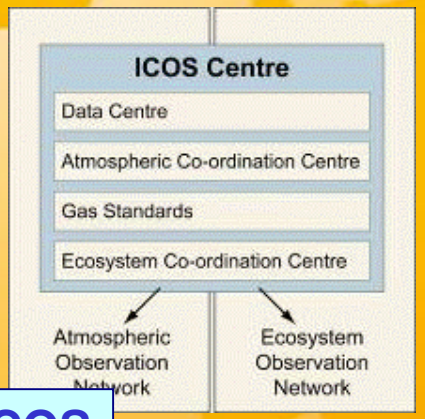
EISCAT-3D



EMSO



EPOS

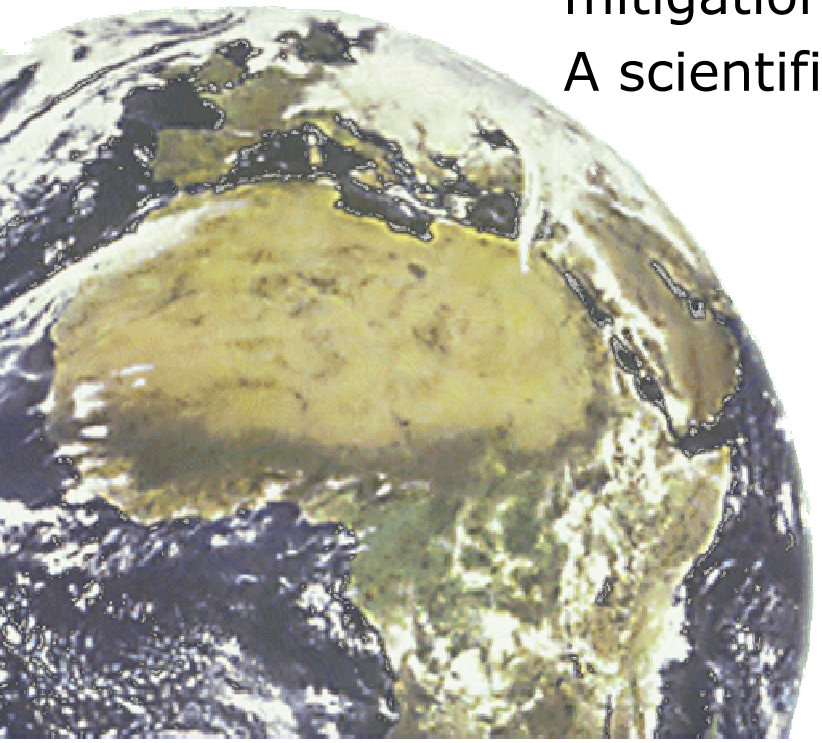


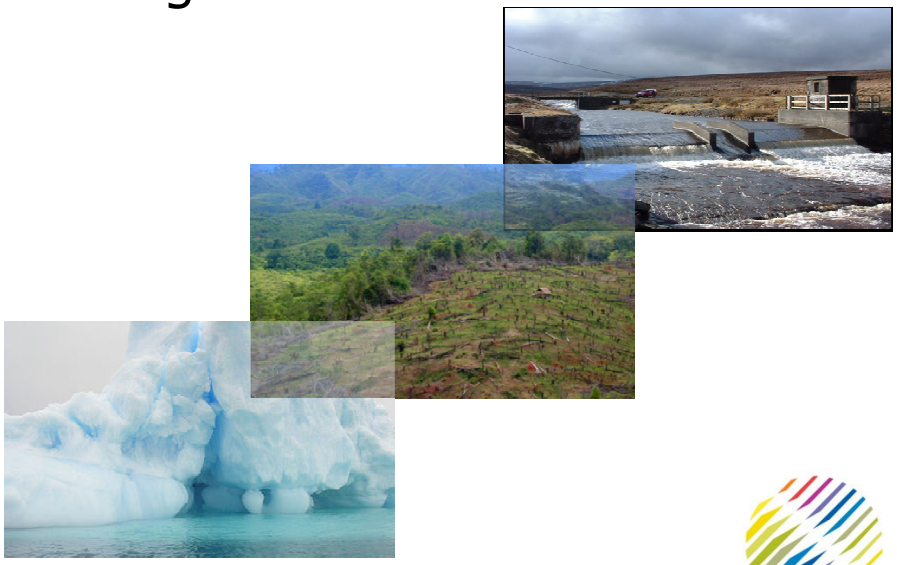
ICOS

LIFEWATCH

Large-scale e-Infrastructures for Biodiversity Research

Biodiversity loss, added to climate change, requires entirely new approaches and mitigation strategies.
A scientific challenge.





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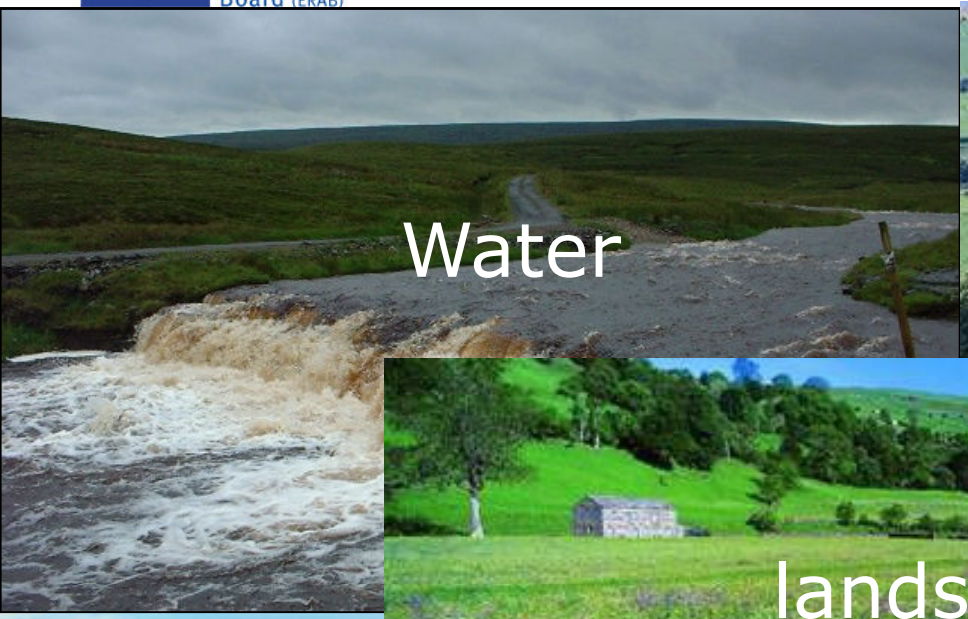

Water

Agriculture

landscapes

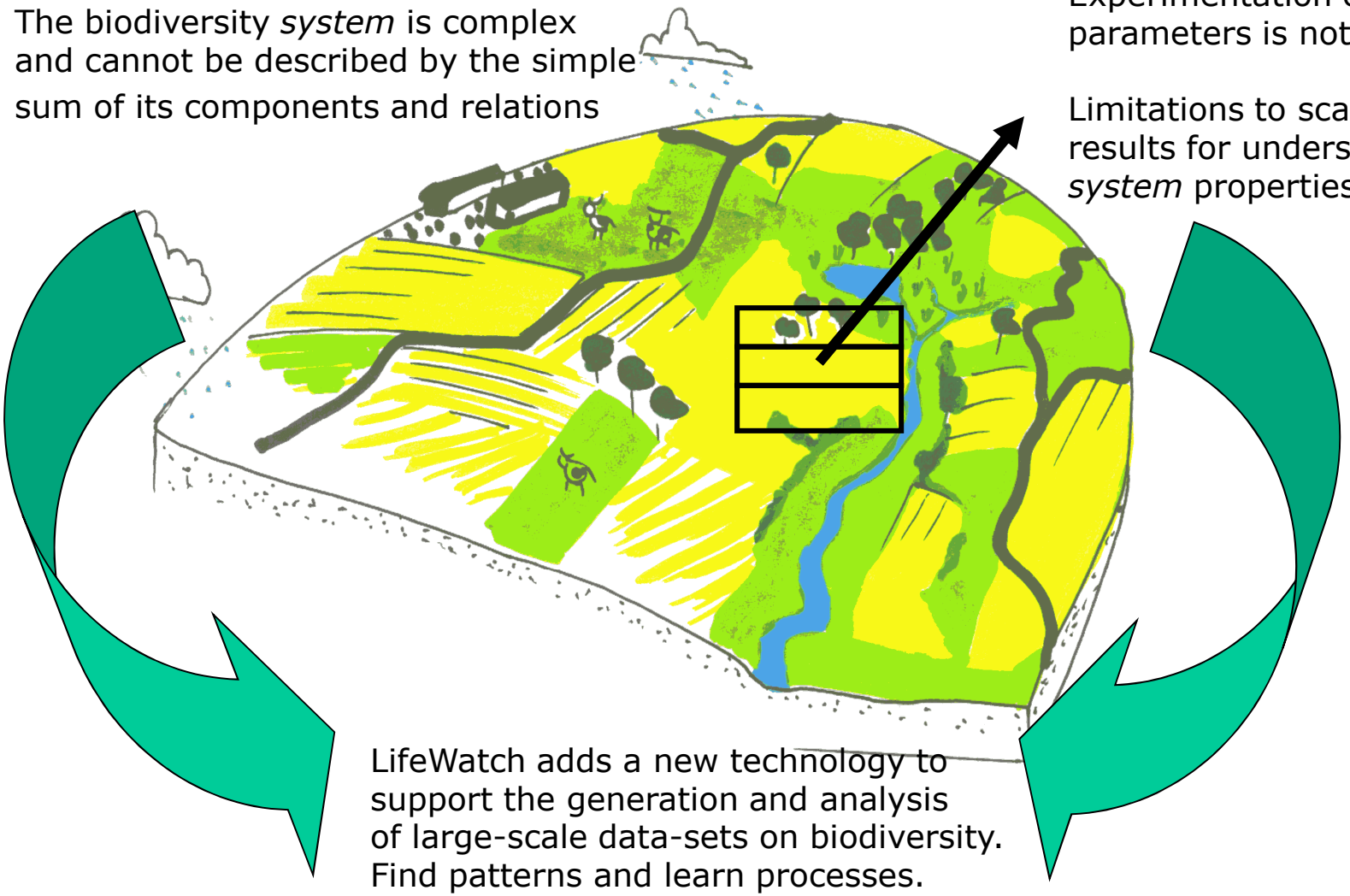
Forestry

Soils / carbon stores

The biodiversity *system* is complex and cannot be described by the simple sum of its components and relations

Experimentation on a few parameters is not enough:

Limitations to scaling up results for understanding *system* properties



LifeWatch adds a new technology to support the generation and analysis of large-scale data-sets on biodiversity. Find patterns and learn processes.

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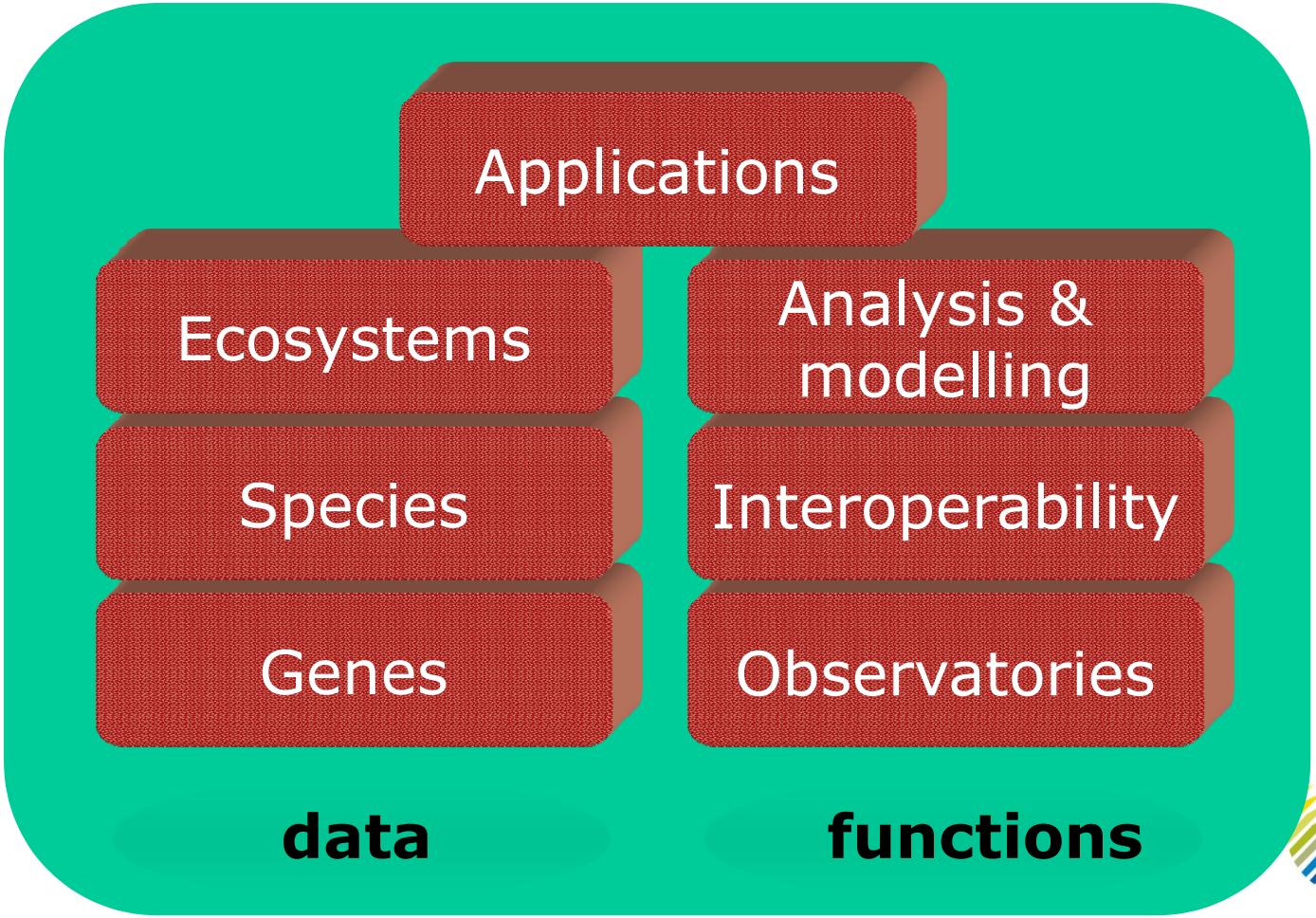
Building blocks of the research infrastructure



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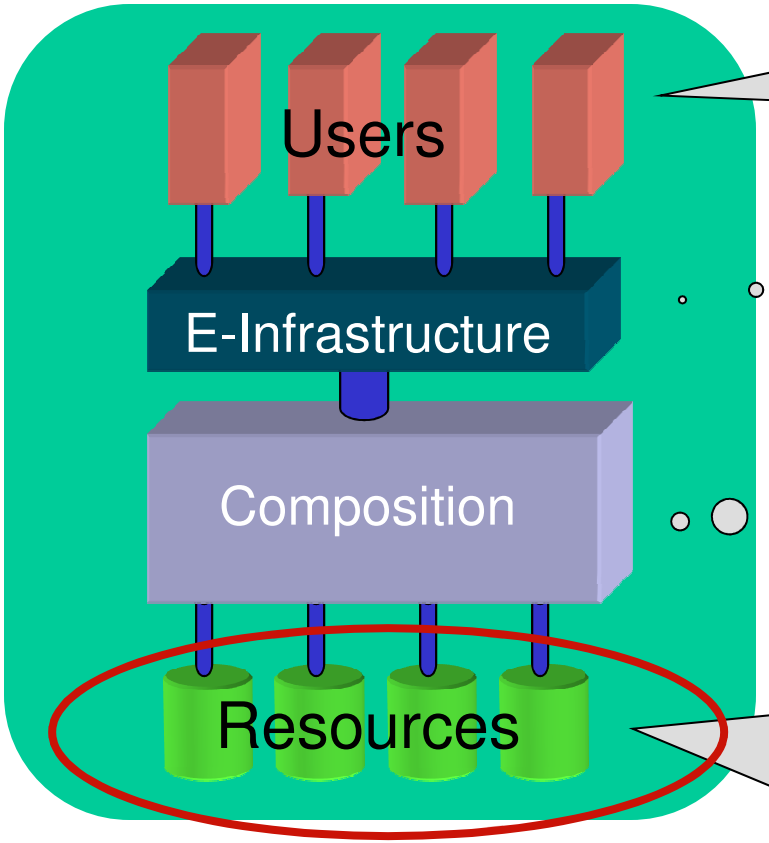
Architecture



Collaboration
- Common Exploratory Environment
- Collaborative Virtual Organisations

Semantic annotation

Analysis and processing
- Integration of resources
- Documented, shared workflows
- Grid computation

Data
- measurements, observations & sensors
- other infrastructures (e.g. ELIXIR)

Statistical software

Distributed computing power

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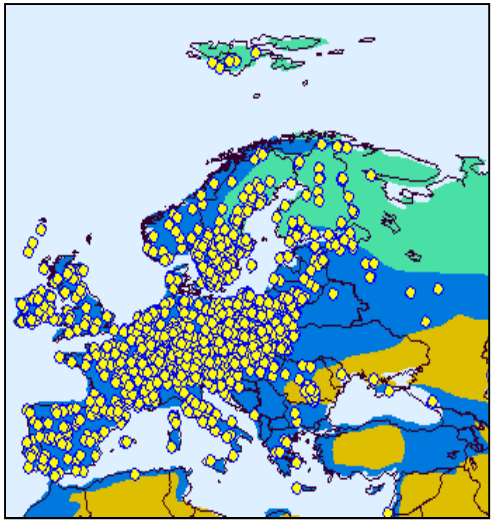
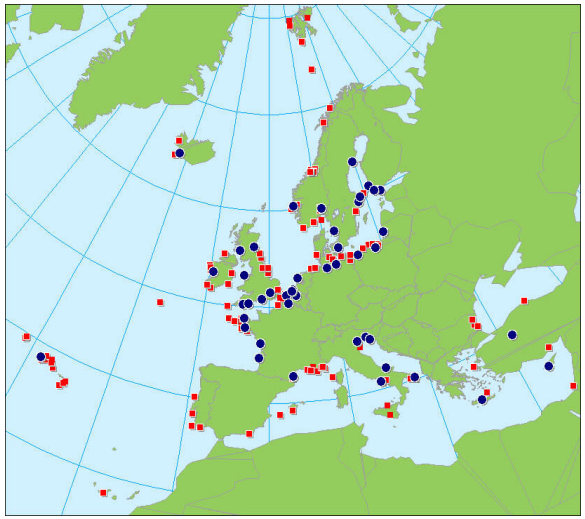
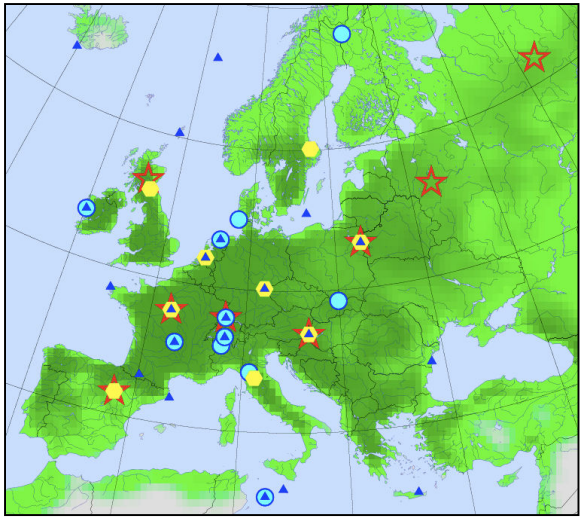
Distributed data generation



Continental ecological monitoring sites



Marine monitoring sites



Greenhouse gas measurements

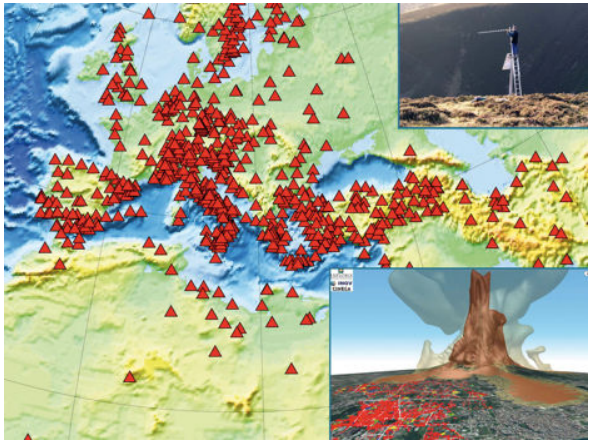


Plate observing system

Biological collections

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Data + users from other infrastructures

ELIXIR EUROPEAN LIFE SCIENCES INFRASTRUCTURE FOR BIOLOGICAL INFORMATION

EMBRC
European Marine Biological Resource Centre

GBIF
free and open access to biodiversity data
GLOBAL BIODIVERSITY INFORMATION FACILITY

eol
Encyclopedia of Life

esa space for europe European Space Agency

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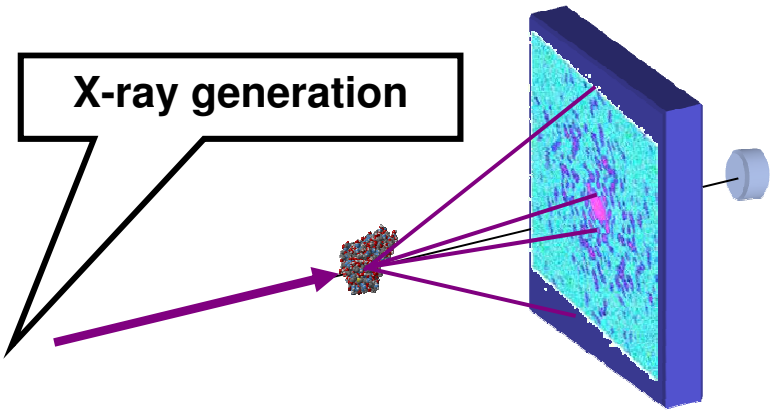
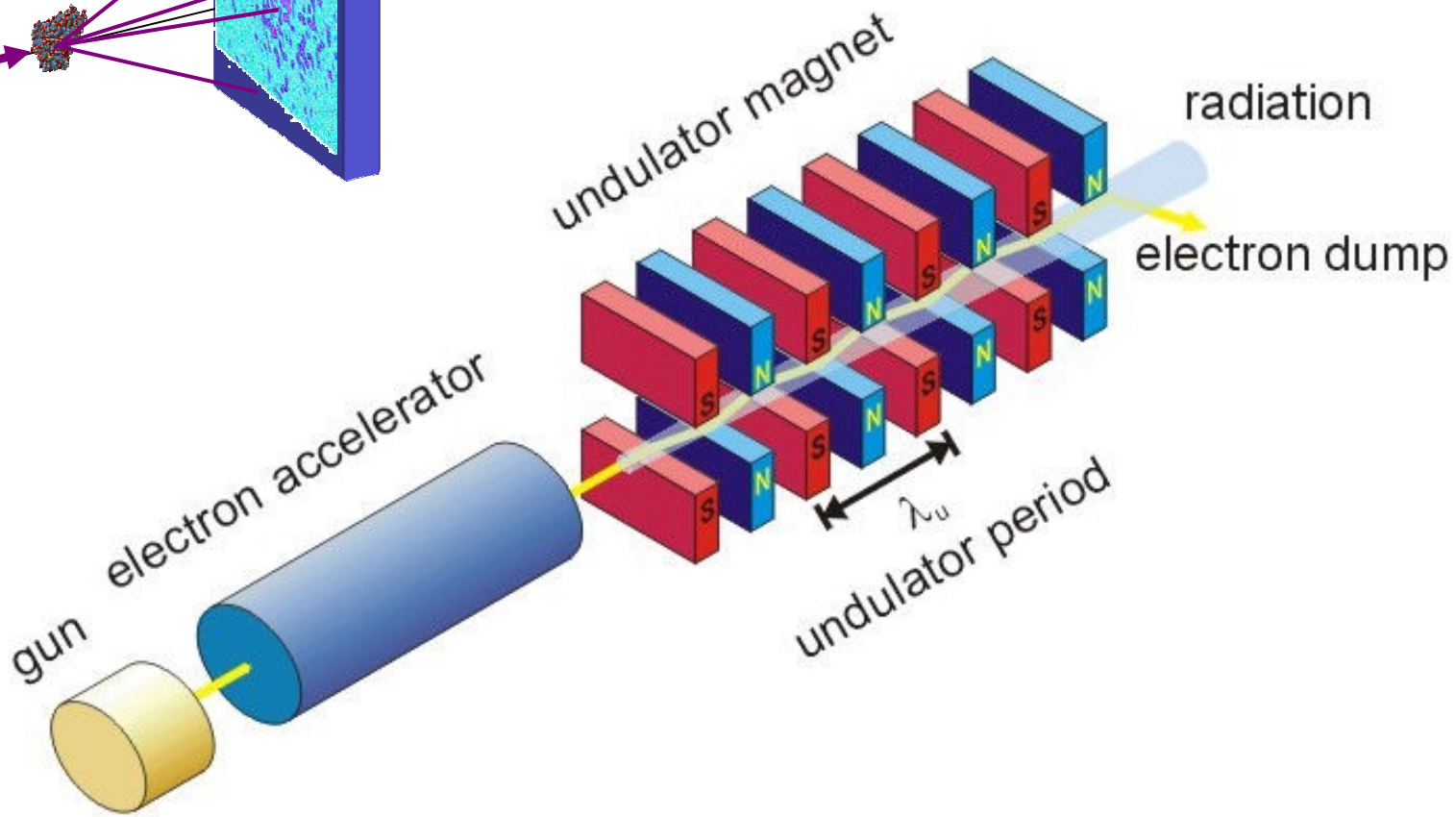
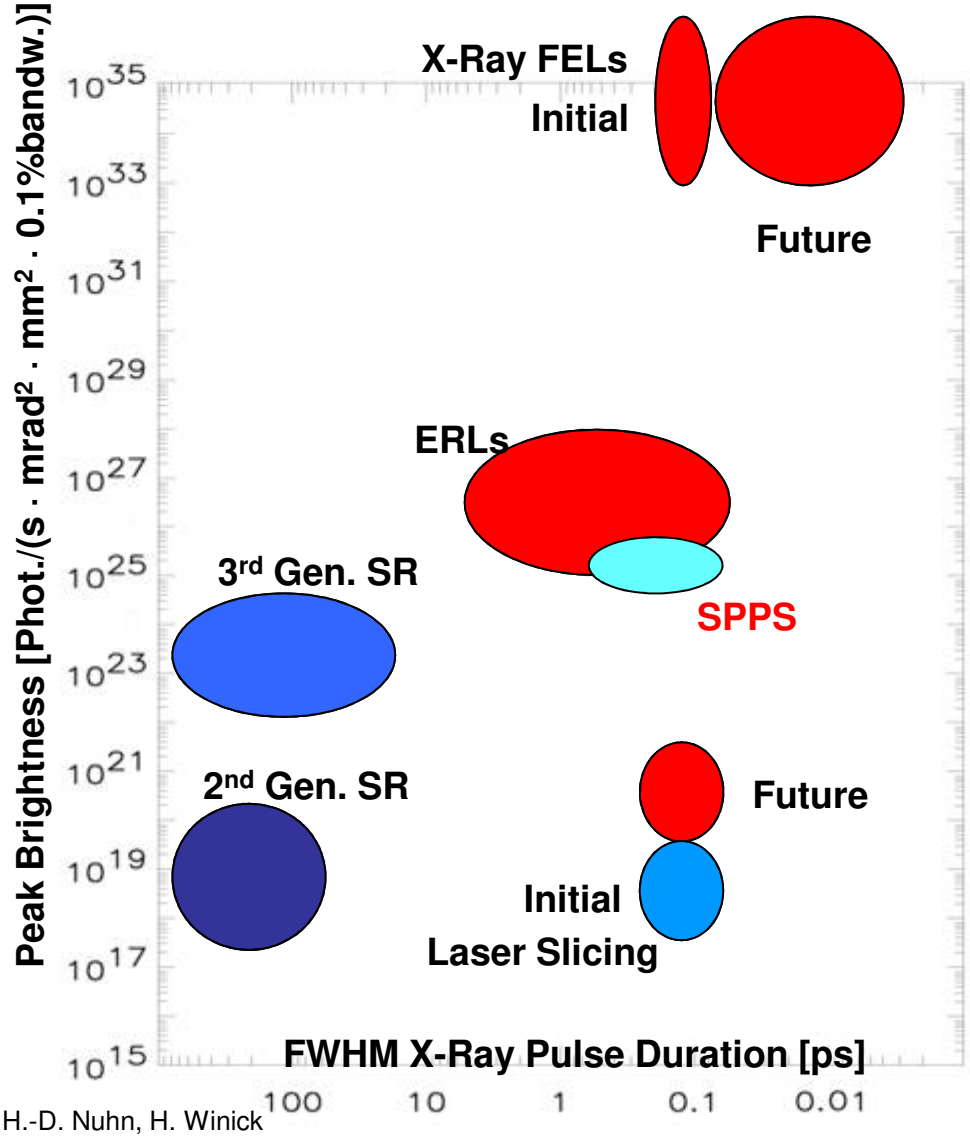
X-ray Free Electron Laser





Peak brightness of pulsed X-ray sources



H.-D. Nuhn, H. Winick

Ultrafast x-ray sources will probe space and time with atomic resolution.

what do we do today and what tomorrow?

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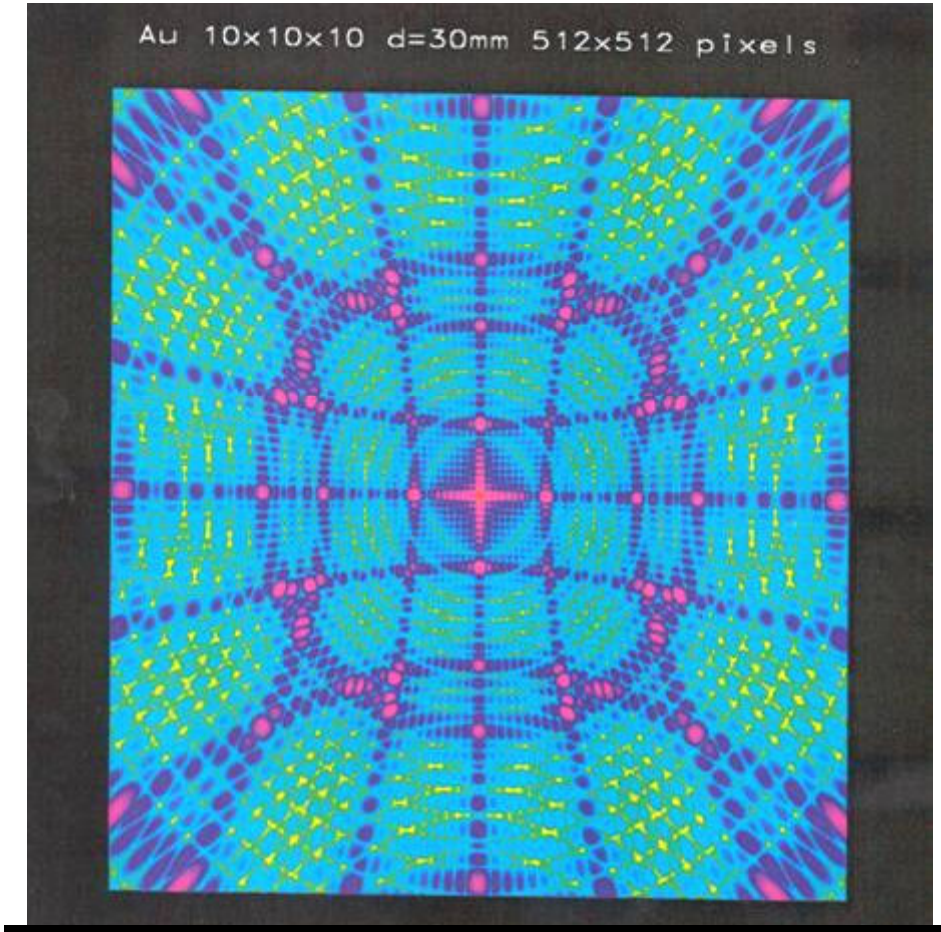
Fascination - FELs for hard X-rays



Diffraction pattern of 10 x 10 x

The X-ray free-electron lasers will provide coherent radiation of the proper wavelength and the proper time structure, so that materials and the changes of their properties can be portrayed at atomic resolution in four dimensions, in space and time.

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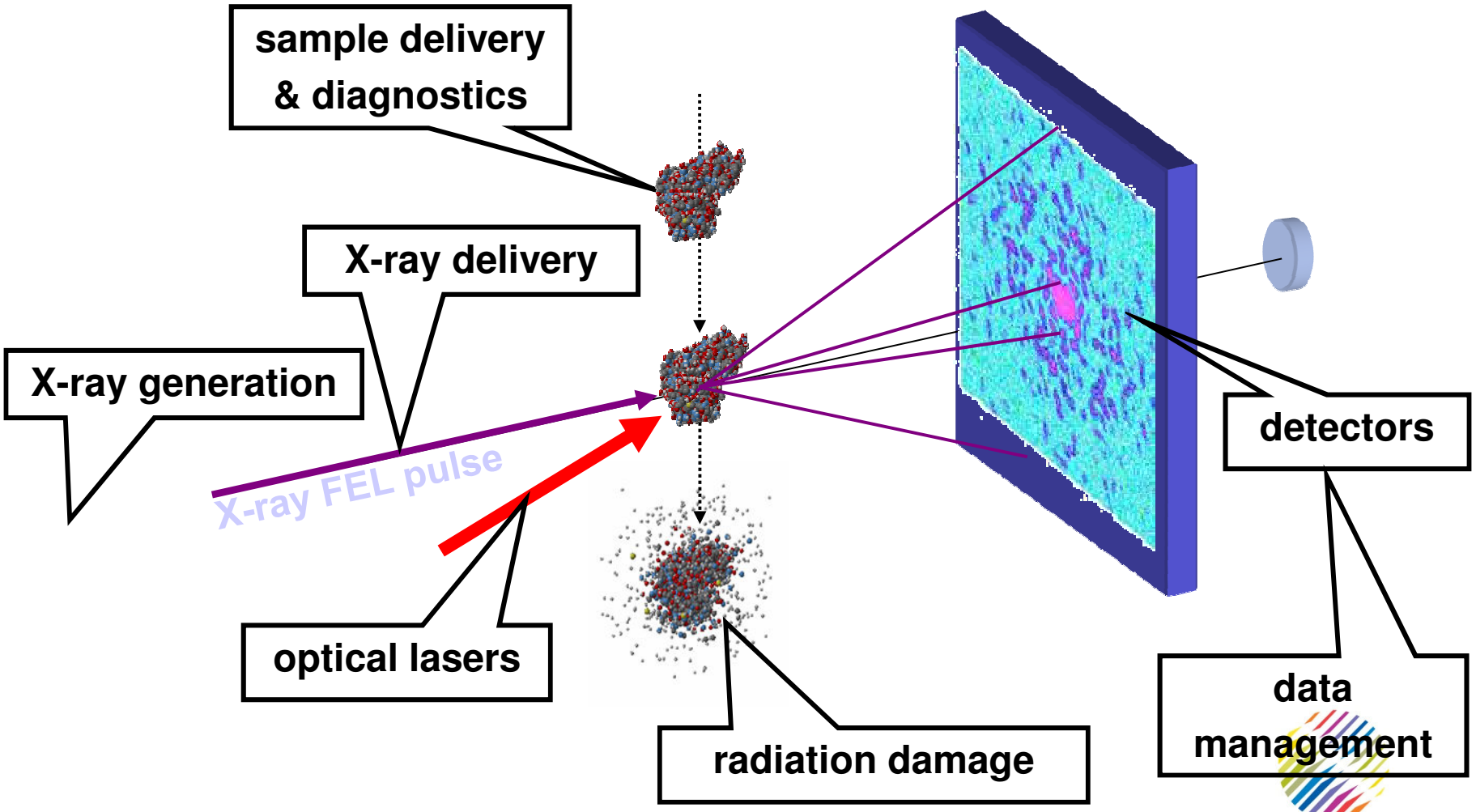
The complete single particle experiment



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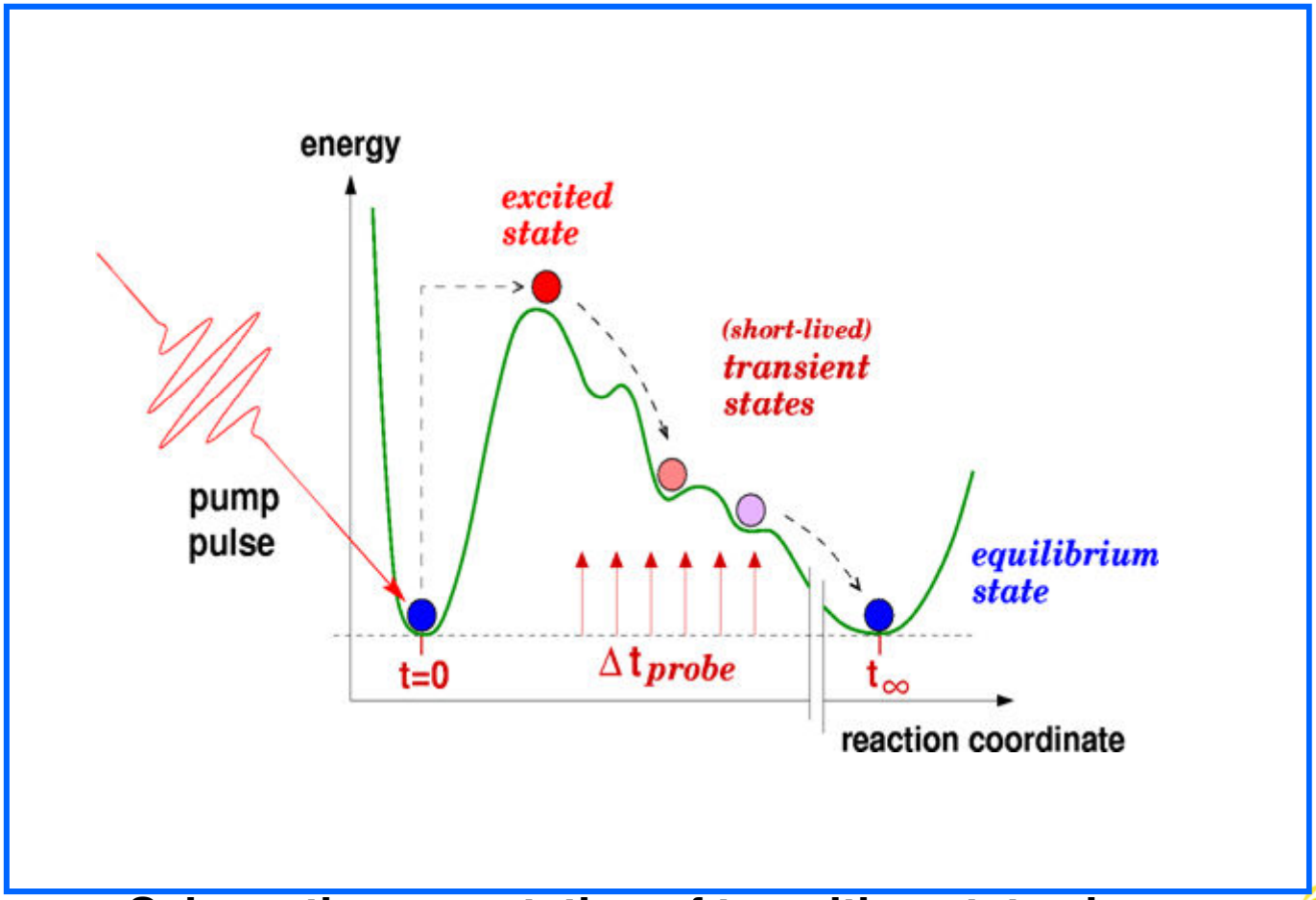
Take a movie of chemical reactions



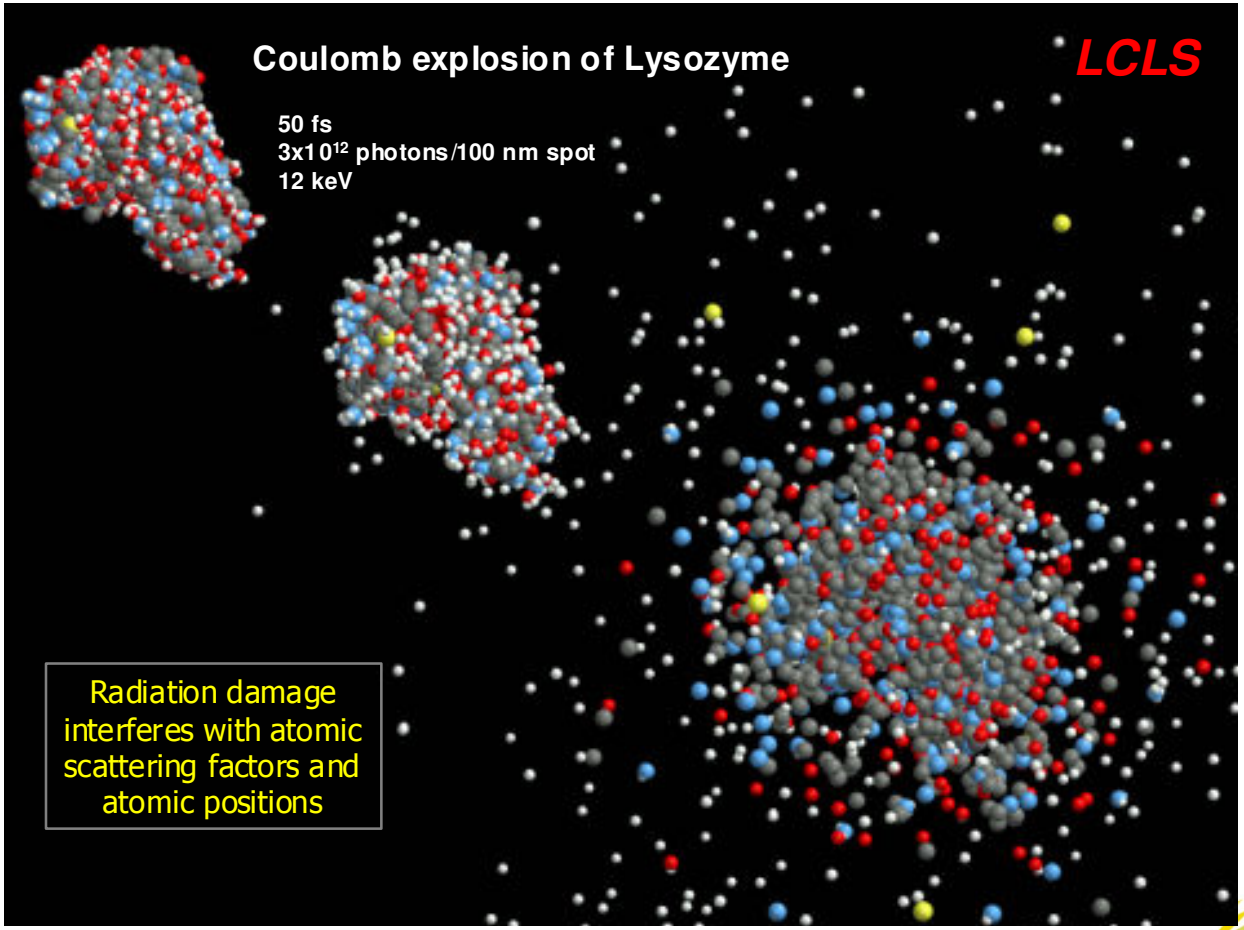
Schematic presentation of transition states in a chemical reaction

Coulomb Explosion von Lyzosym

t=0

t=50 fsec

t=100 fsec



R. Neutze, R. Wouts, D. van der Spoerl, E. Weckert, J. Hajdu: Nature 406 (2000) 752-757

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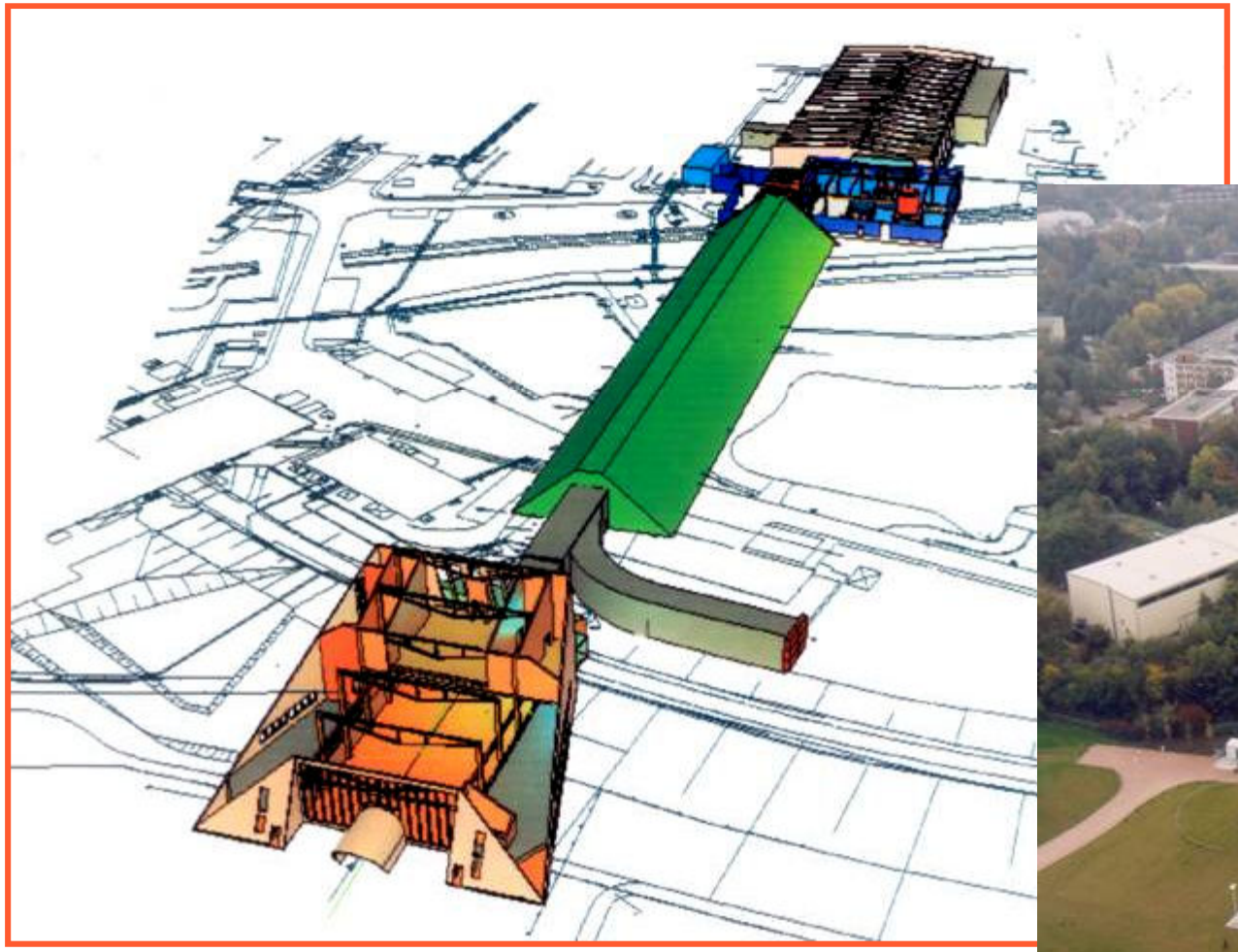
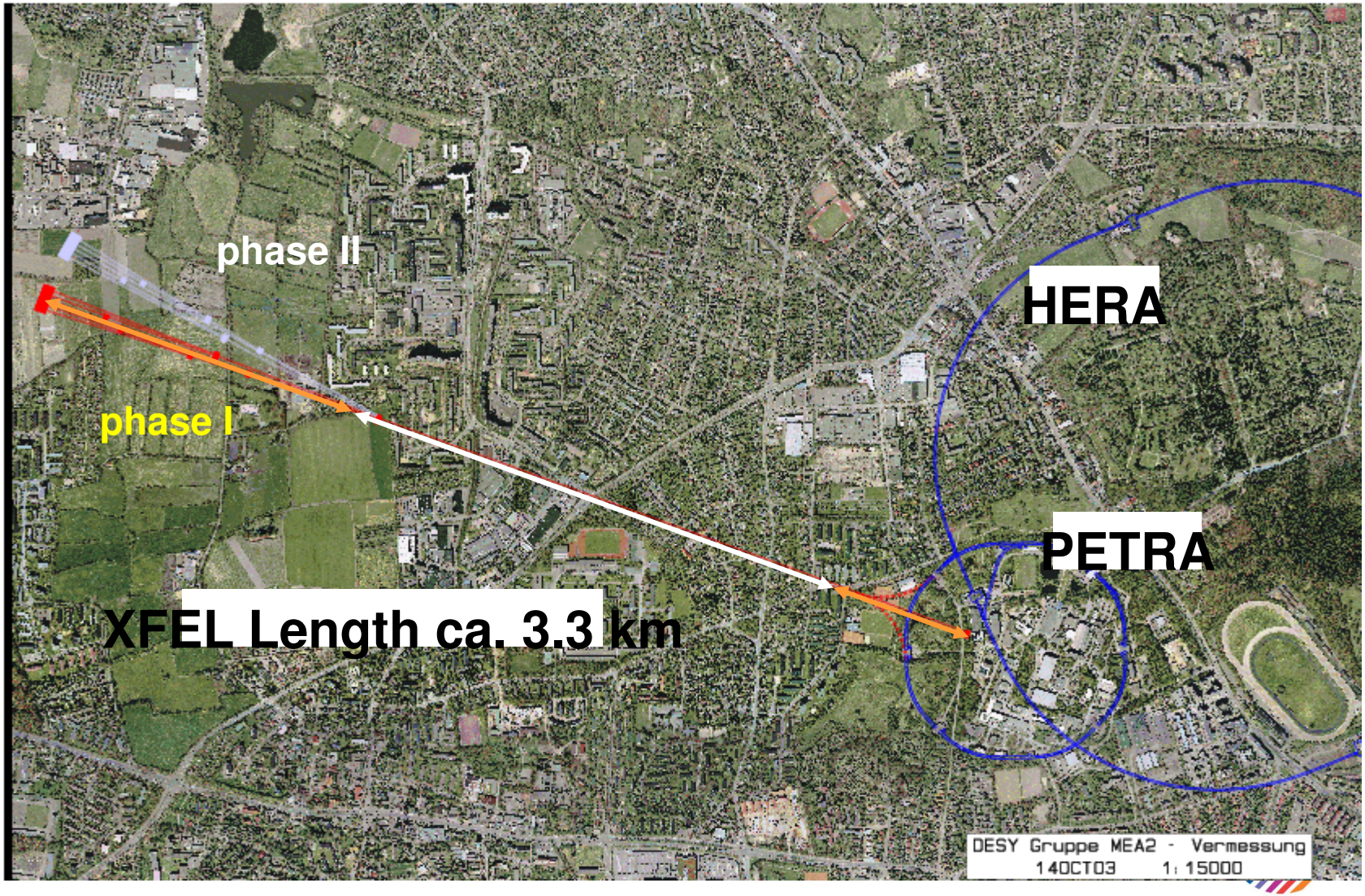
The VUV-FEL user facility at DESY



European XFEL Facility in Hamburg



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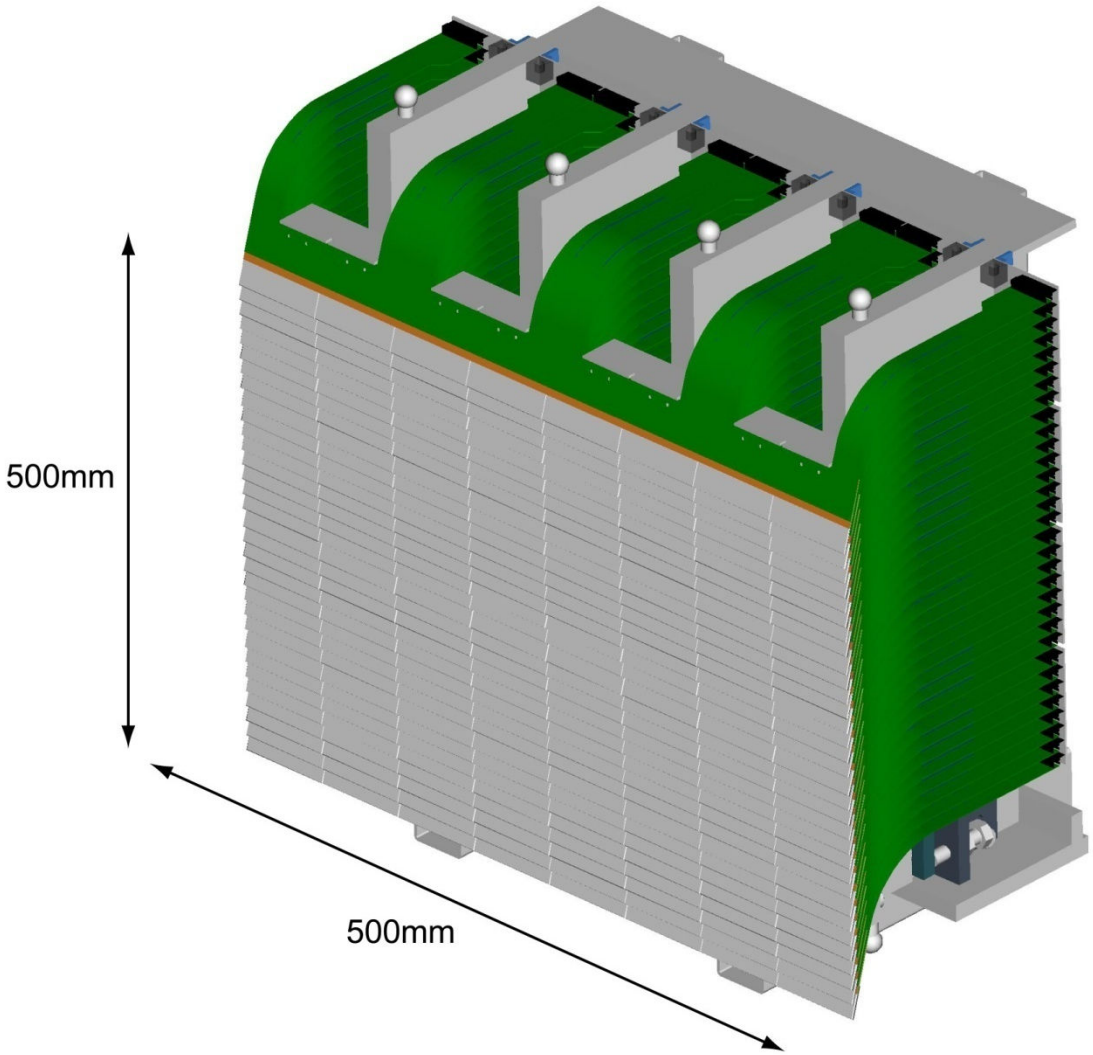
1k x 1k system with 4 x 4 super modules



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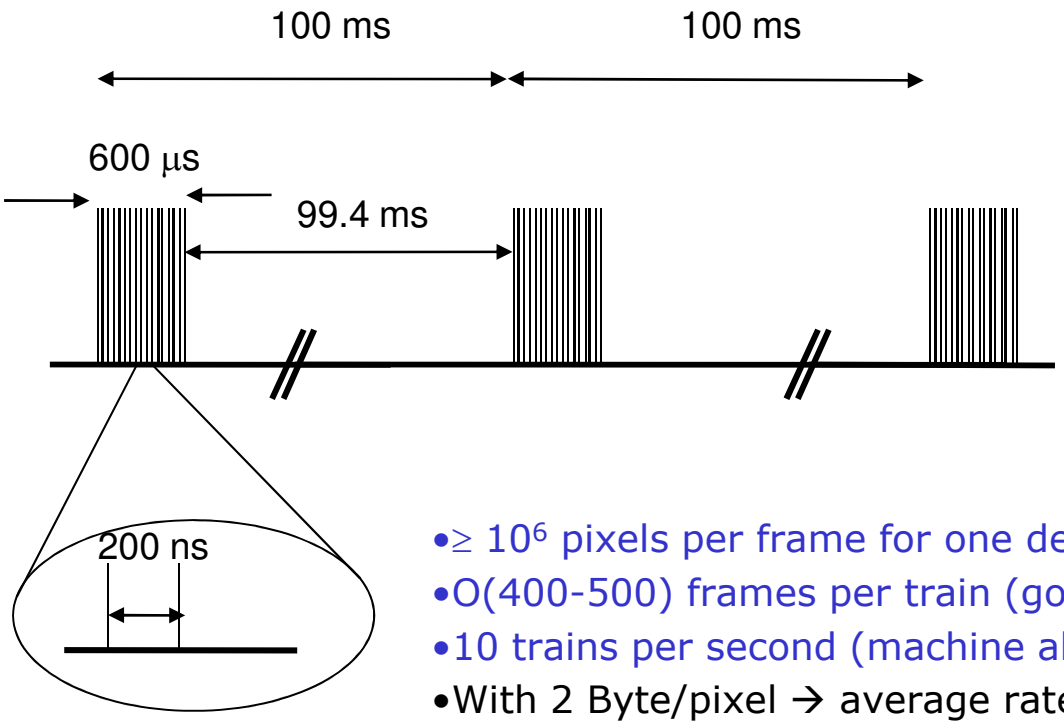
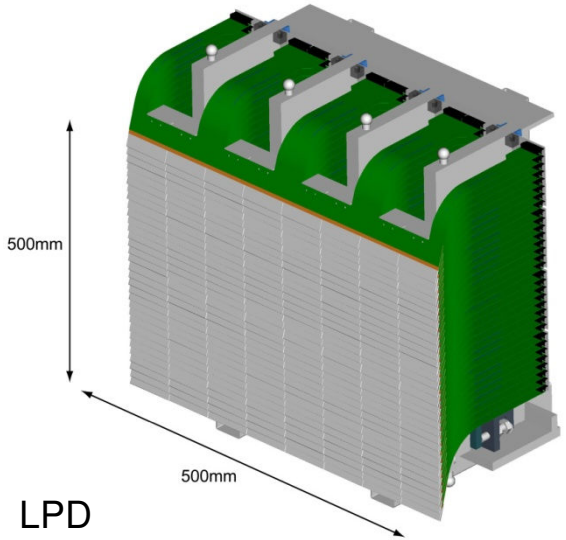
DAQ Challenge: 2D X-Ray Detector Systems





LPD

- ≥ 10^6 pixels per frame for one detector
- O(400-500) frames per train (goal, likely will start with less)
- 10 trains per second (machine allows up to 30 Hz…)
- With 2 Byte/pixel → average rate **≥10 Gbyte/sec for one 2D detector!**
- Time between frames as short as 200ns → buffering needed

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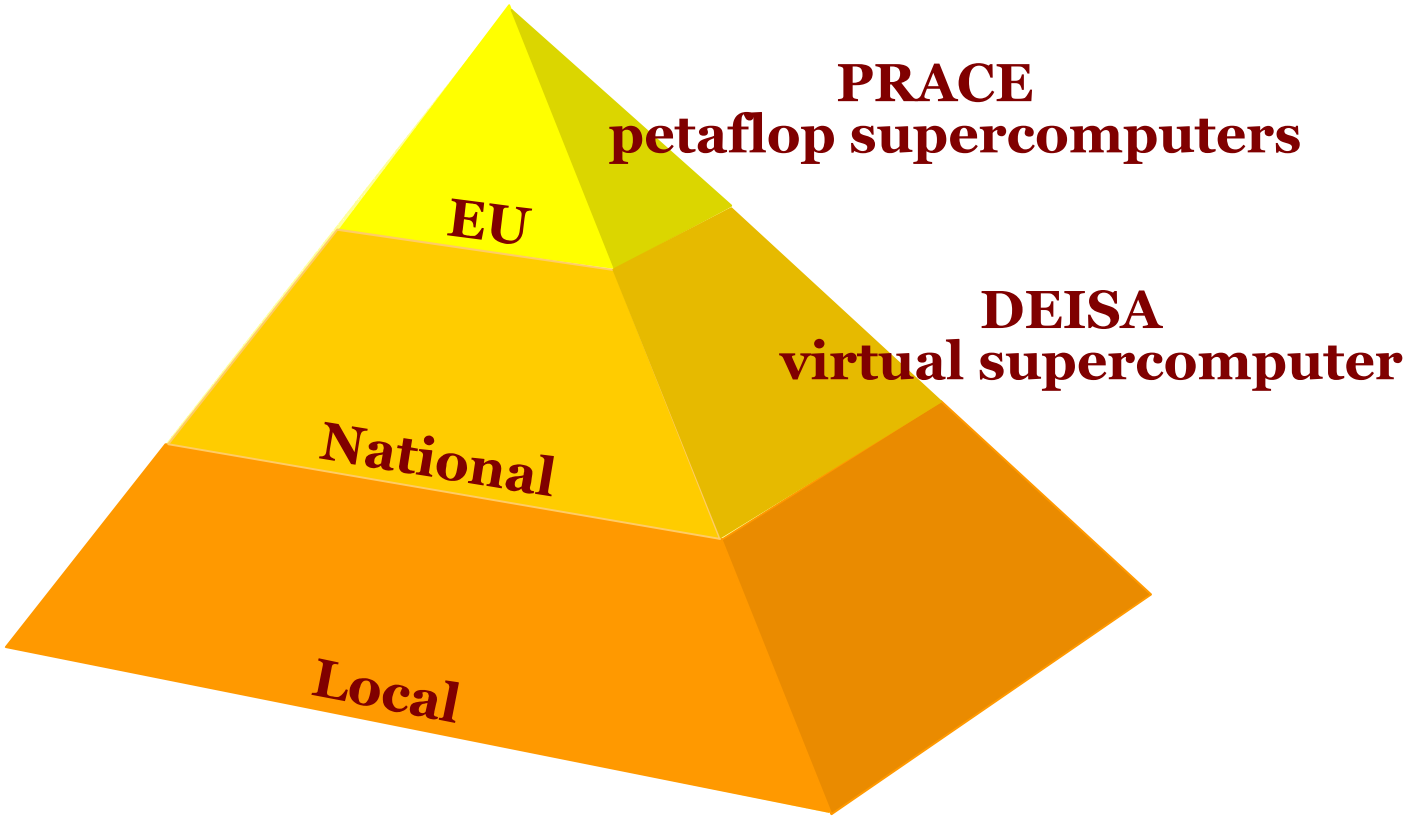
Technology Forecast – Storage at DESY

Year	Rate Capability [Gbyte/sec]	Storage Space [Petabyte]
2009	1	3
2012	5	26
2016	40	200

- not a technology problem
- money and manpower issues
- to be determined:
  - user behaviour
- compression and accept/reject algorithms

- potentially critical: access to data!

new "petaflop" supercomputers



The Information Infrastructure

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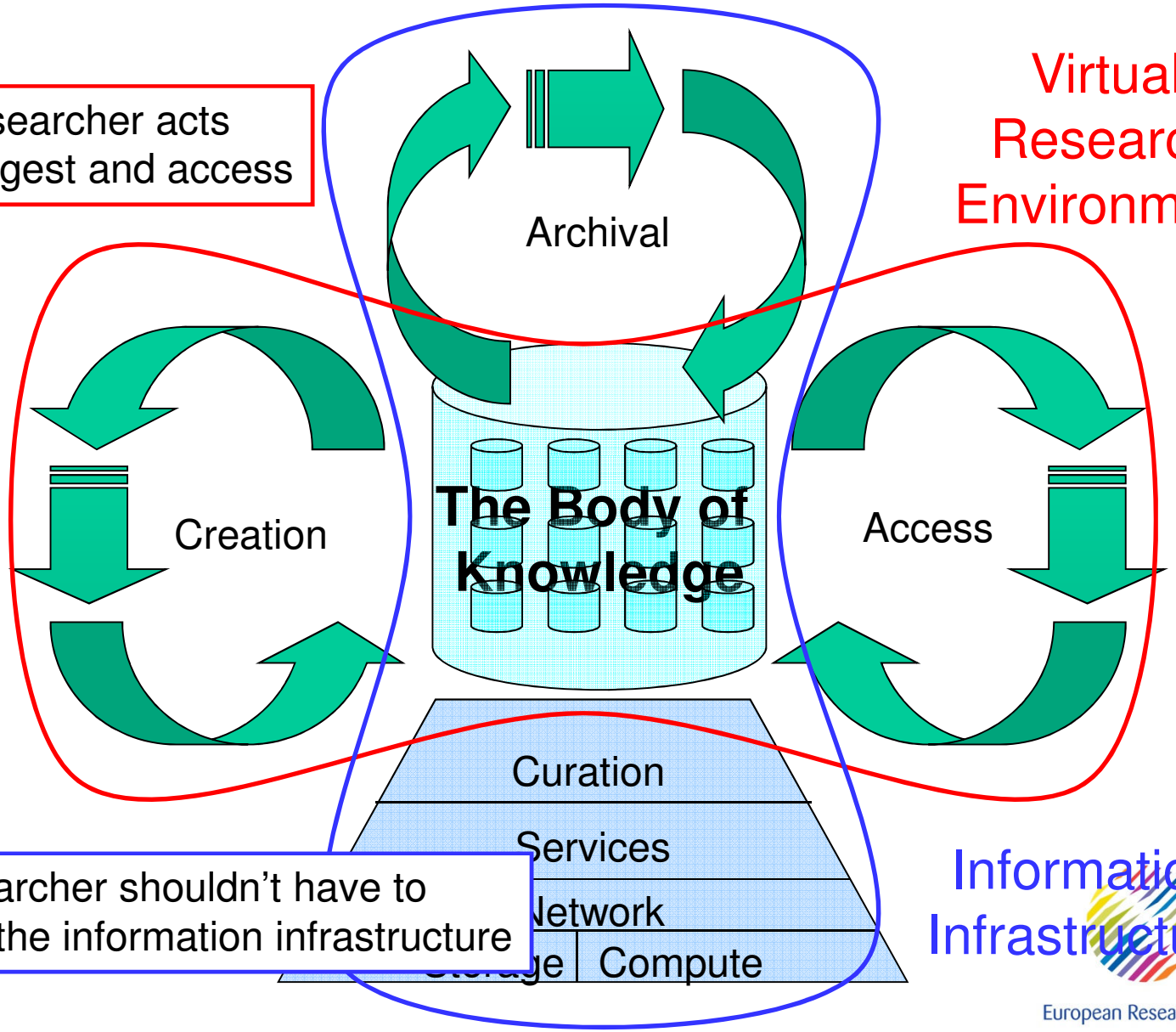
the researcher acts through ingest and access



Virtual Research Environment

Information Infrastructure

the researcher shouldn't have to worry about the information infrastructure

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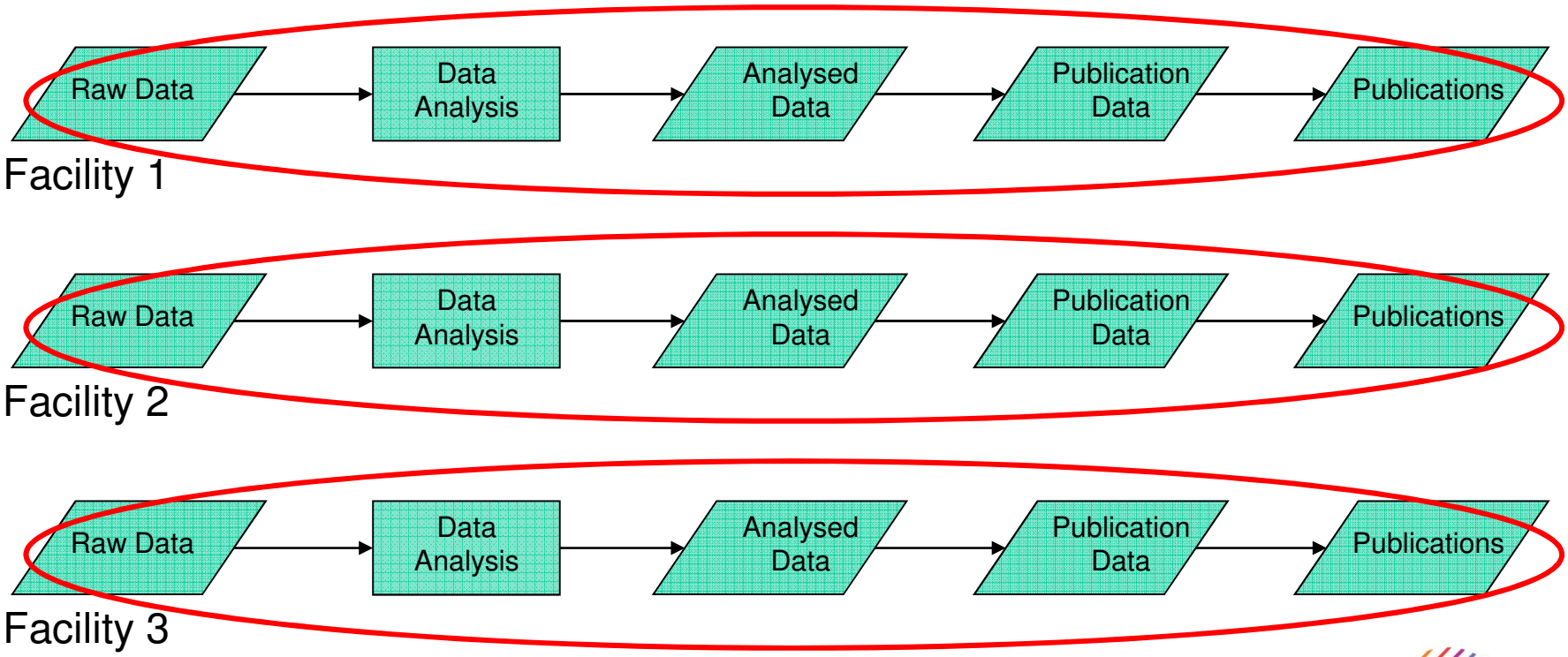
Current View

Distinct Infrastructures / Distinct User Experiences



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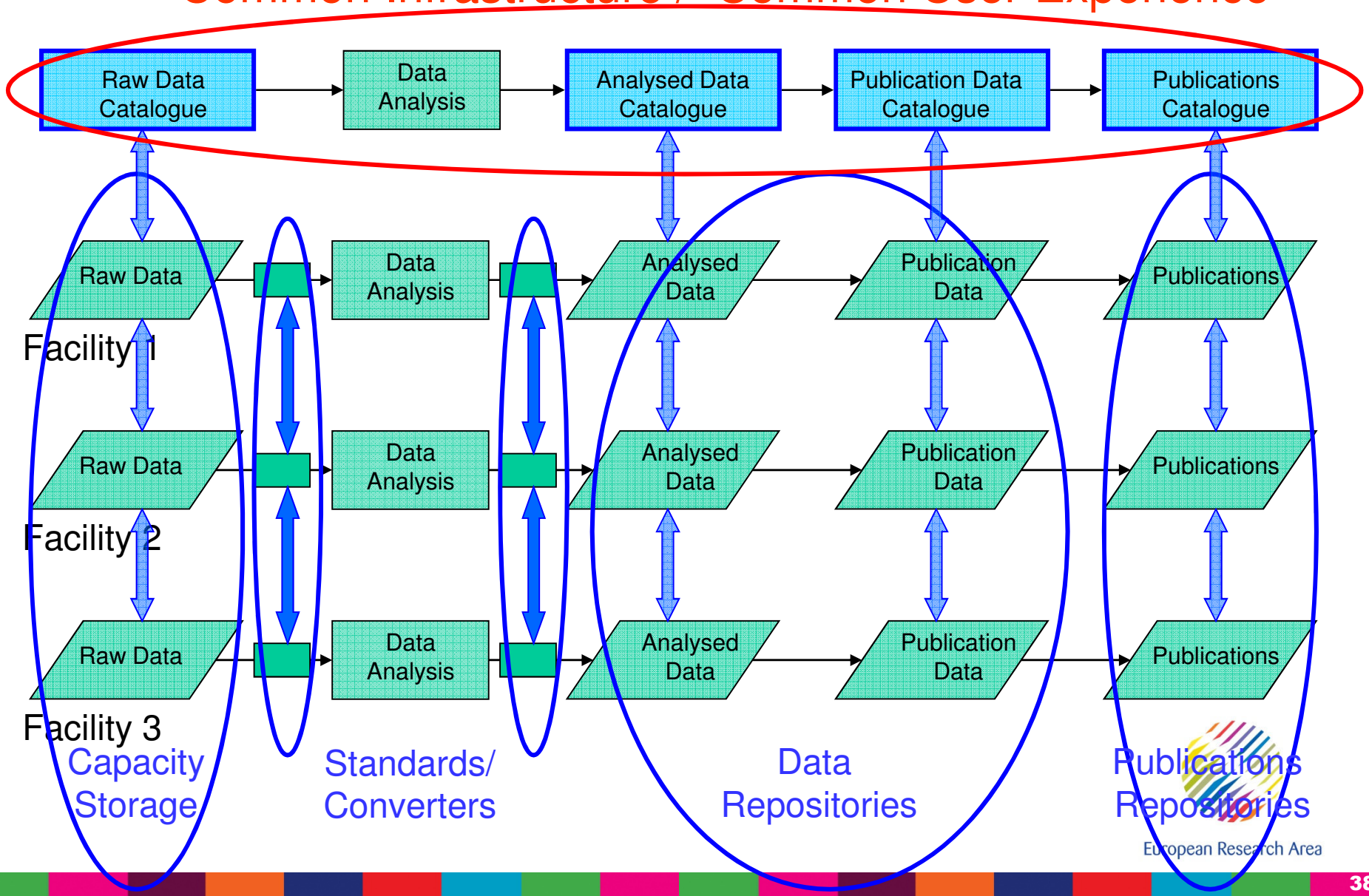
Future View

Common Infrastructure / Common User Experience



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PARSE – Permanent Access to the Records of Science in Europe

- European funded project – 2 years from 2008-2010
- Closely linked with European Alliance for Permanent Access
- Roadmap of Science Data Infrastructure
- Based on UK's Digital Curation Centre
- Is there a need for a common European Data Storage Standard – UK's UK Research Data Storage Service – pilot funding just agreed

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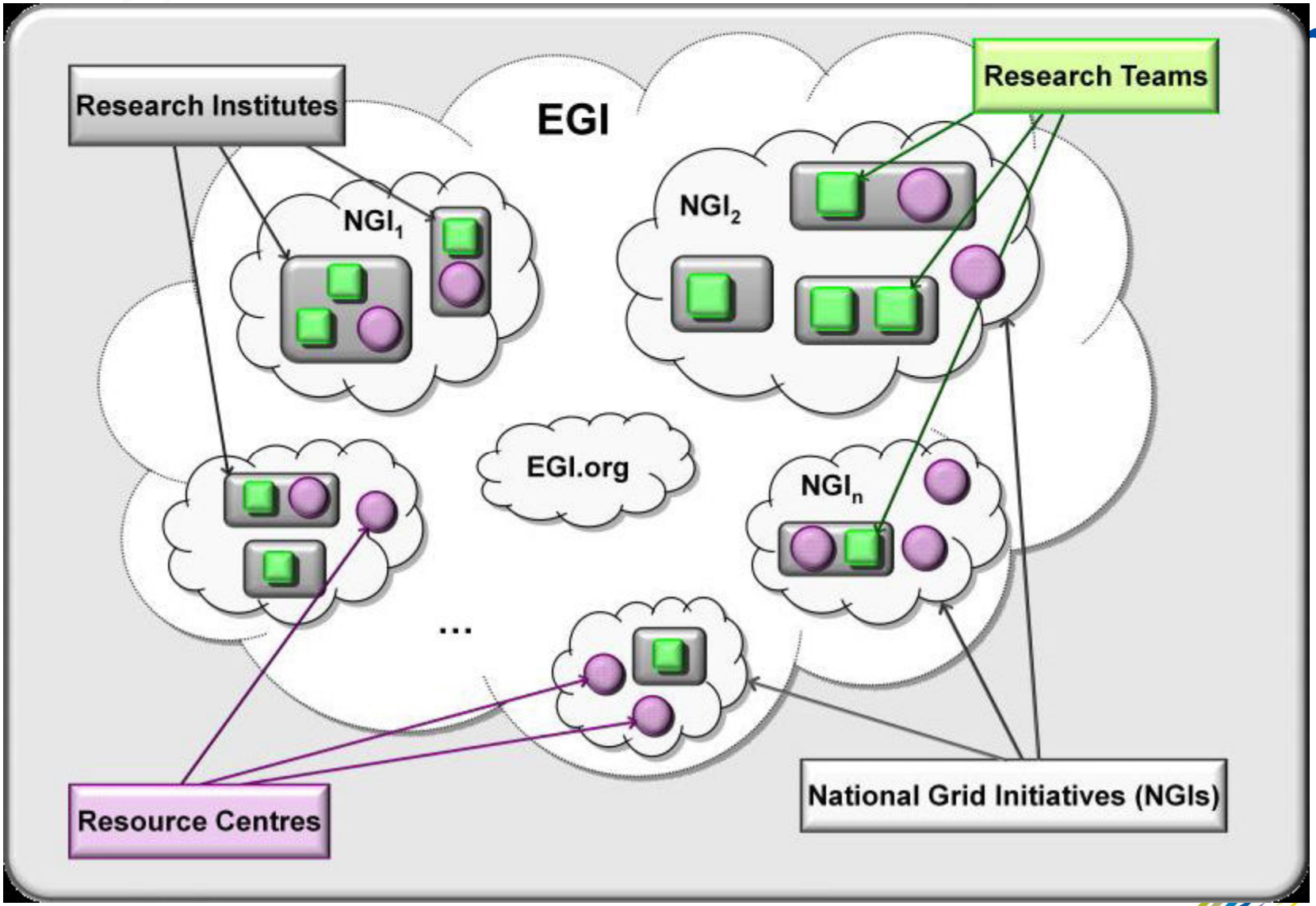
Research Institutes
EGI
Research Teams
NGI1
NGI2
EGI.org
NGIn
...
Resource Centres
National Grid Initiatives (NGIs)

European Research Area Board (ERAB)

The problem will grow

- New large scale facilities are being planned and built around the world.

- They will be run remotely and have to interact in real time with HPC simulations, each informing the other. What will be the role of the researcher once the experiment starts?

- Data storage etc needs to be planned right at the start.

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Big Issues

- Energy requirements
- Who protects the data ad eterna as pubs are linked
- Data Terrorism
- Nation speaking unto nation or project interlinking with project
- Lack of true large scale project management experience
- Protectionism

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Edna St Vincent Millay Sonnet

- Upon this gifted age, in its dark hour,
  Falls from the sky a meteoric shower
  Of facts...they lie unquestioned, uncombined.
  Wisdom enough to leech us of our ill
  Is daily spun; but there exists no loom
  To weave it into fabric...

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Some Conclusions

- Big projects need proper management – the partnership between the single discipline researcher and the global environment is key
- How to develop Knowledge Infrastructures that are dynamic?
- How to globally organise all this activity. EGI and www approach is fine but we need to train researchers to work in this environment?
- Whither the Virtual Research Environment?
- Researchers do not need to know what lies below the surface but they do need to trust the outcomes and the guardians
- The confidence to inform policy at an international level must increase on all sides.

- **We live in an exciting time! It could go horribly wrong!!**

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Thanks

- All the members of ESFRI since the beginning and the people working on individual RIs
- Staff at RAL
- The European XFEL team
- JISC Support for Research Committee

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The ERAB Report

"A New Renaissance for European Research"

6 key themes

- A United ERA
- Societal needs
- Science policy and society
- Open Innovation
- Excellence
- Cohesion

Will be launched on the 6th October in Brussels

European Research Area