Global technical and scientific collaboration in the Photon and Neutron Community

Rudolf Dimper

Global Open Science Cloud Workshop
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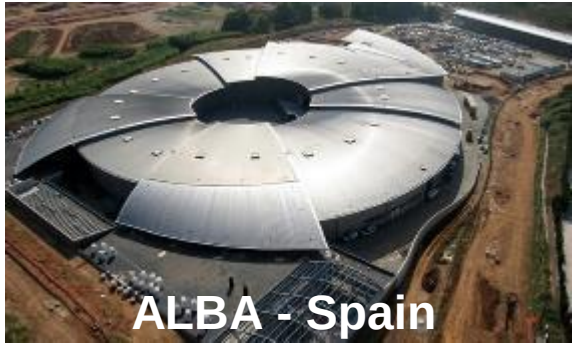
Outline

- Global Photon and Neutron (PaN) RIs landscape
- Common challenges
- Projects and networks

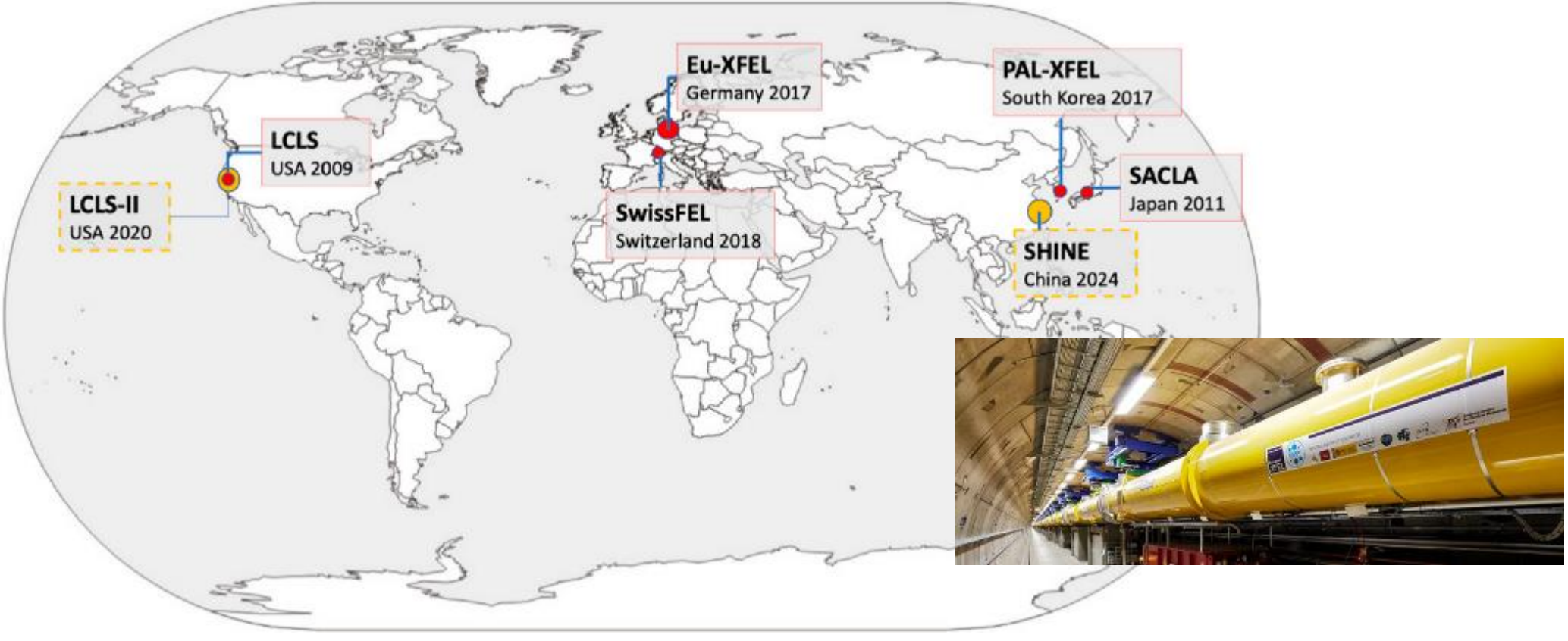
Accelerator based Photon RIs

Accelerator based Photon RIs – low energy Storage Rings

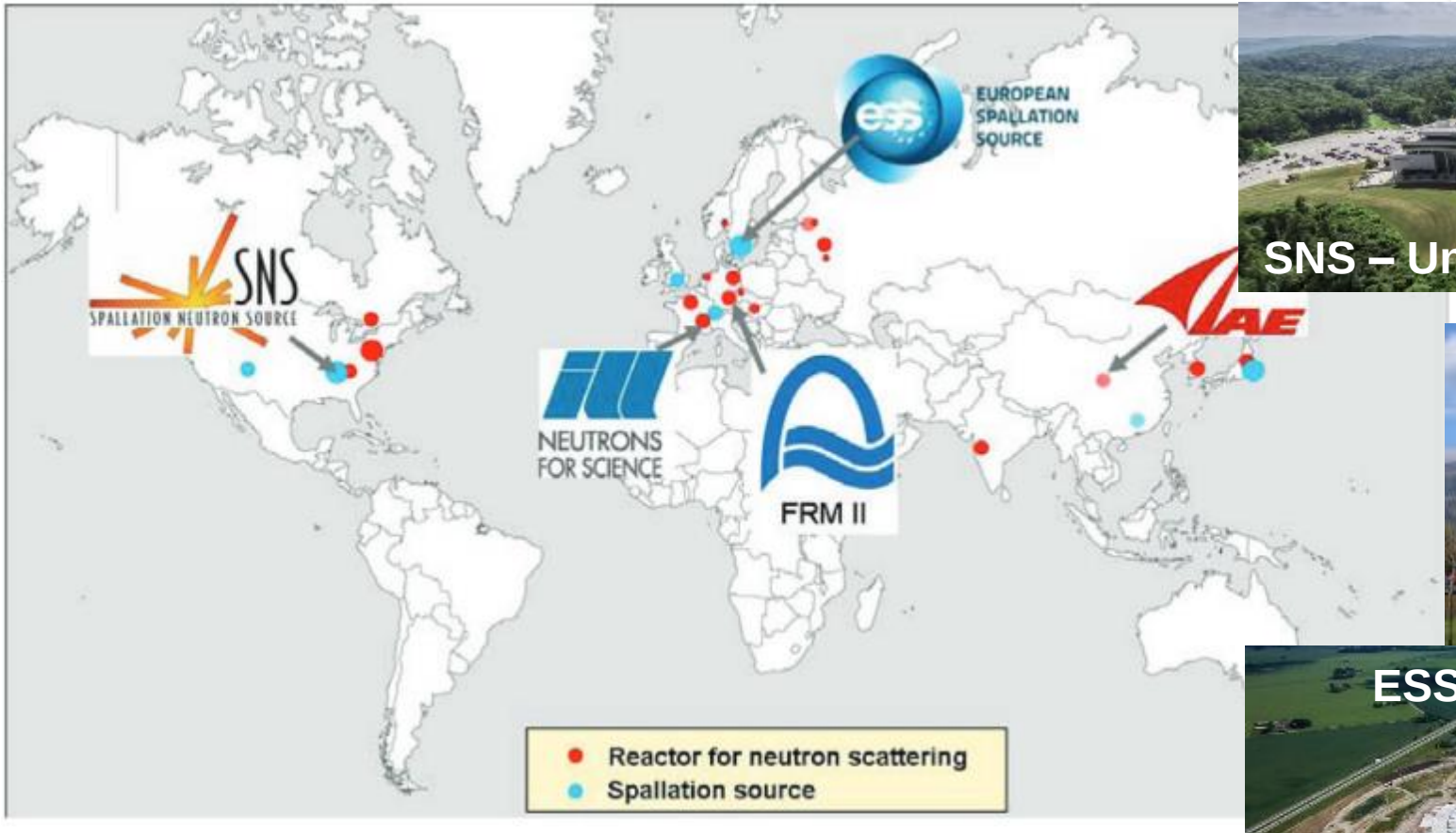


Accelerator based Photon RIs – high energy Storage Rings

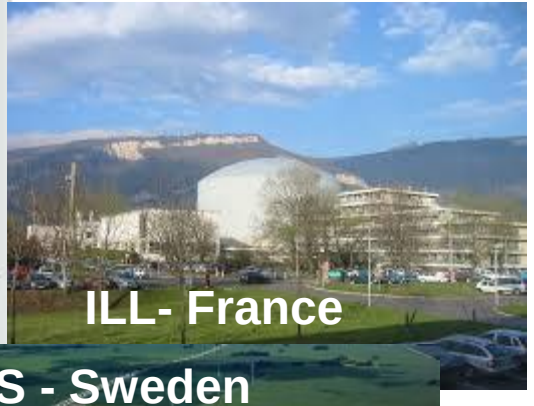
Accelerator based Photon RIs – Free Electron Lasers



Neutron RIs


EUROPEAN
SPALLATION
SOURCE
SNS
SPALLATION NEUTRON SOURCE
NEUTRONS
FOR SCIENCE
FRM II
IAE
Reactor for neutron scattering
Spallation source


SNS – United States


ILL- France

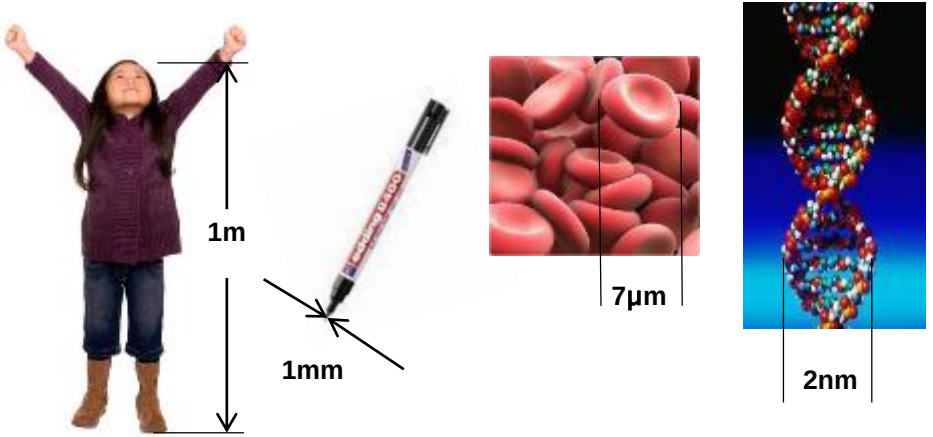

ESS - Sweden

PaN RIs – Analytical Facilities for structure of matter research

- PaN Research Infrastructures are *User Facilities*
- Scientists come to carry out experiments on the beamlines of the facilities
- The user community of PaN facilities consists of ~40 000 scientists in Europe alone with an annual turnover of 20-25%
- Thousands of publications annually orginated from experments in PaN RIs
- Research spans all “structure of matter” fields and addresses many societal challenges (health, energy, environment…)
- PaN facilities generate tens of PB/y

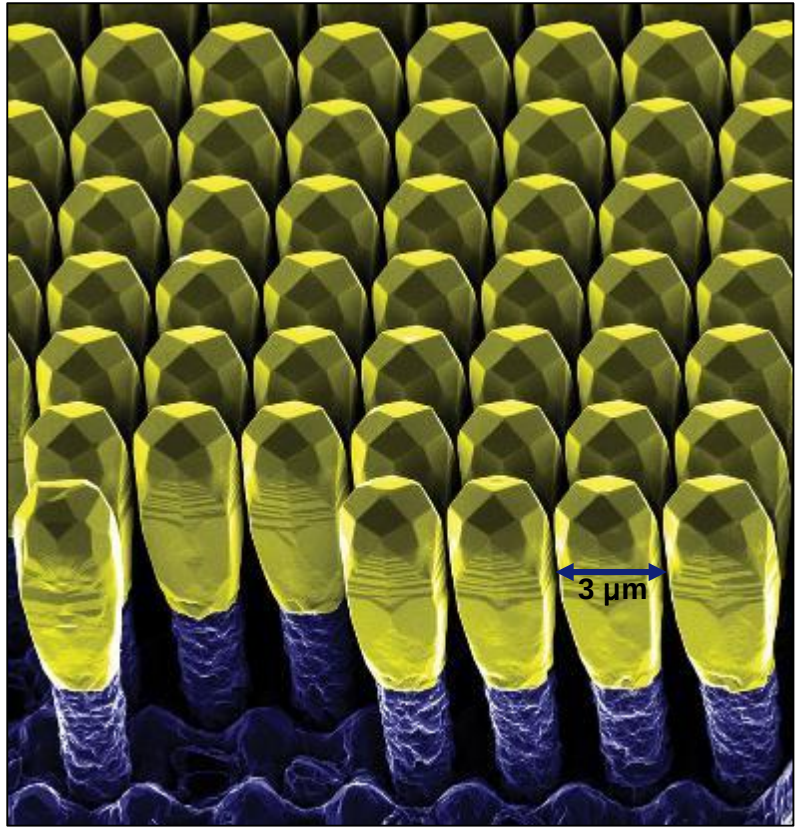
An example – Nano-science – Perfect germanium crystals on silicon

What is a nanometer?



We talk about Nano-Science < 100 nm, i.e. the distance of less than 1 000 atoms!

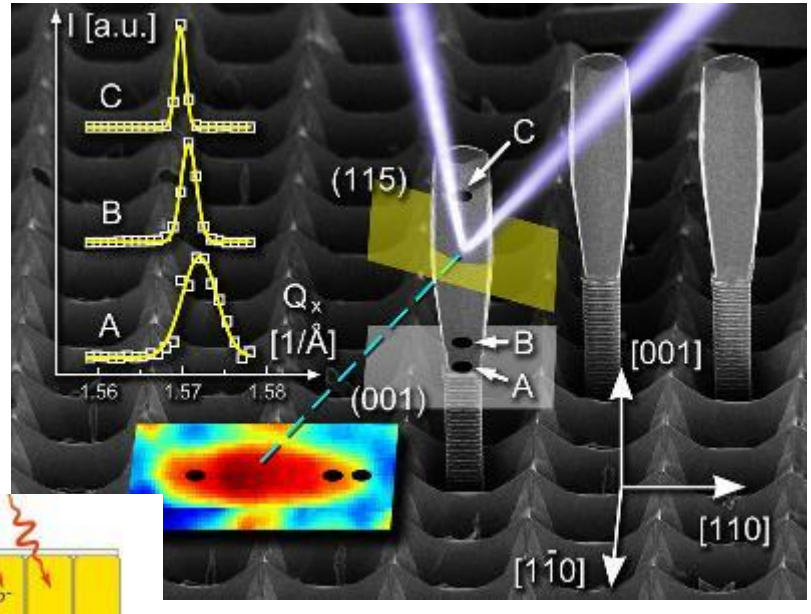
A striking application of Nano-Science is the micro electronics industry with transistors as small as 10 nm (100 atoms!)

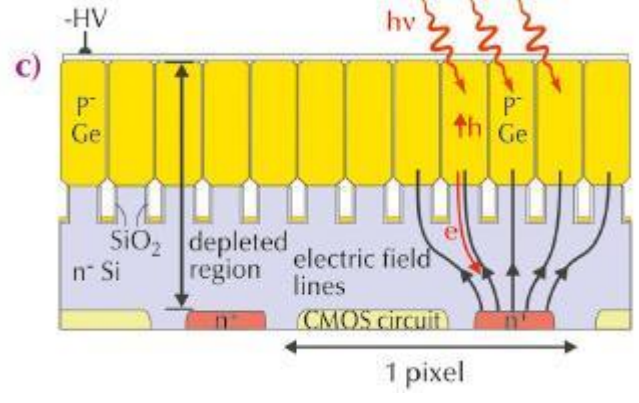


C.V. Falub (a), M. Medua (b,c), D. Chrastina (d), F. Isa (d), A. Marzegalli (e), T. Kreiliger (a), A.G. Taboada (a), G. Isella (d), L. Miglio (e), A. Dommann (f) and H. von Känel (a), *Scientific Reports* 3, 2276 (2013)

An example – Nano-science – Perfect germanium crystals on silicon

- Observing crystal growth requires nano beams
- Work done at ESRF/ID01 with a beam of 300 x 500 nm at 11 keV





Concept of a high-resolution X-ray imaging detector with a monolithically integrated Ge absorber on a CMOS chip

Relevance

Perfect semiconductor crystals are needed for:

- ✓ high-brightness light emitting diodes
- ✓ power transistors
- ✓ high resolution X-ray detectors

Common Challenges – Data management

- PaN RIs create large and complex data sets
- Data needs to be compressed/reduced in real-time → Need for sophisticated algorithms
- Large data sets (TB) are difficult to transport and sometimes the best solutions is to analyse data on-site
    - Data analysis software more and more complex
    - Optimisation on multi SPU/GPU systems required
    - Batch processing
    - HPC/HTC environment
    - Machine Learning increasingly important for dealing with large data sets

Common Challenges – Data management

- FAIR is difficult and long to implement
  - Data policies
  - Rich metadata harvesting
  - Data catalogue
  - Search engine
  - Persistend identifiers
  - Long-term data preservation

- FAIR is not EOSC specific – it is simply best practice!
- FAIR is costly and long to implement – we are greatful for the support from H2020 to make rapid progress on this
- FAIR is the foundation of data management but we need to make sure everybody understands and supports the principles

EU + Global collaborations – LEAPS and LENS

LEAPS – the League of European Accelerator-based Photon Sources – is a strategic consortium initiated by the Directors of the Synchrotron Radiation and Free Electron Laser user facilities in Europe.

The League of advanced European Neutron Sources, LENS, is a consortium working to promote cooperation between European-level neutron infrastructure providers offering transnational user programs to external researchers.

EOSC ESFRI projects PaNOSC and ExPaNDS

Partner facilities

PaNOSC
ExPaNDS

Photons (LEAPS)

EGI
eli
CERIC
Central European Research Infrastructure Consortium

Neutrons (LENS)

DESY
CESNET
STFC

The ExPaNDS project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 857641.
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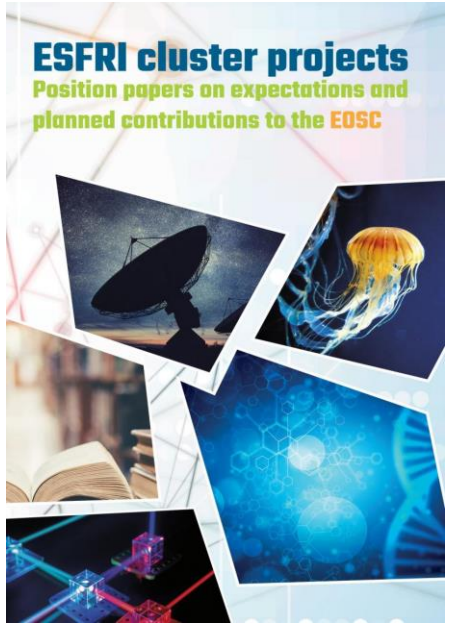
Courtesy: H. Dosch

The European Synchrotron | ESRF

EU + Global collaborations – ESFRI Science Cluster Projects



Common Science Clusters and e-Infrastructure SRIA feedback:
https://zenodo.org/record/4044010#.X3wbg-dS8uV

Common ExPaNDS and PaNOSC SRIA feedback:
https://www.eoscsecretariat.eu/system/files/expands_and_panosc_position_paper_on_eosc.pdf

ESFRI Cluster projects position paper:
https://zenodo.org/record/3675081

EU + Global collaborations – 3-way Meeting

The 3-way meeting brings together the four high-energy synchrotrons for exchanging on best practices and collaborations on instrumentation, accelerator technology and IT.

Beginning of 2020 the focus was on data management and machine learning

EU + Global collaborations – EIROforum

EIROforum bring together the eight largest European Intergovernmental Research Organisations

The EIROforum IT technical working group exchanges on:

- IT technology + policies
- license management
- cybersecurity
- best practices
- EOSC
- relations with the Commission
- relations with industry

EIROforum members

CERN
EMBL
EUROfusion
ESA
ESO
ESRF
European XFEL
ILL

PaN priorities for working together

Needs of the RIs

Data compression algorithms – specific to each science domain (method)

Data analysis software

Machine Learning for automation and data processing/analysis

Needs of our User Community

Access to IT infrastructure: Network, Storage, CPU/GPU

Access to Open Data, Open Software

Many thanks for your attention