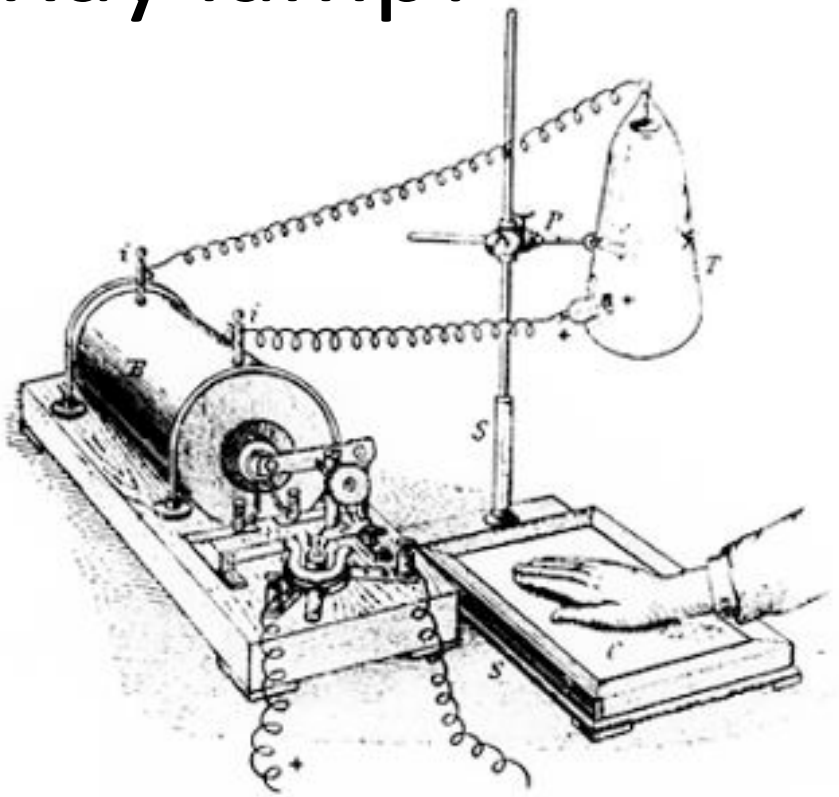
How to create access to global research facilities? Synchrotrons - MAX IV

Christoph Quitmann

European Convention of Engineering Deans, 2014-03-03

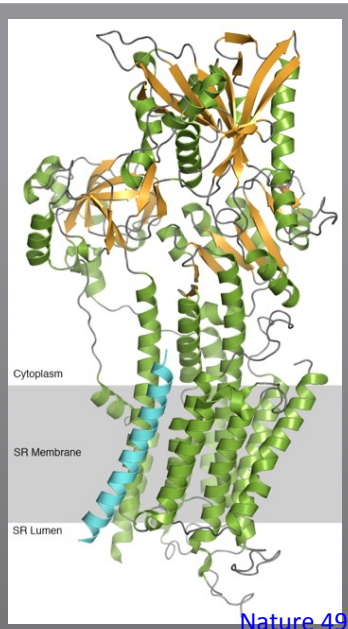
MAX IV – An X-Ray lamp!

MAX IV – An X-Ray lamp!



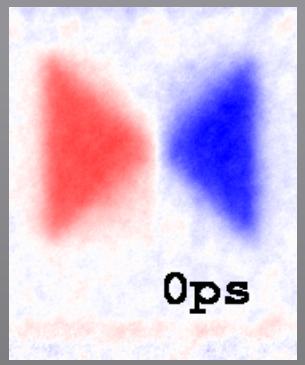
Then	Now
mm, min	nm, fs
Hard materials	soft tissue
2d	4d (x, y, z, t)
Table top	Table-top & SR

Small – Atoms



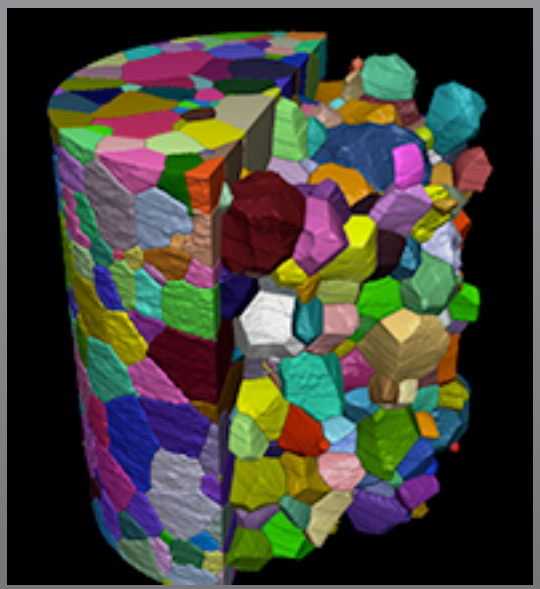
Nature 495, 265–269 (2013)

Fast – Switching



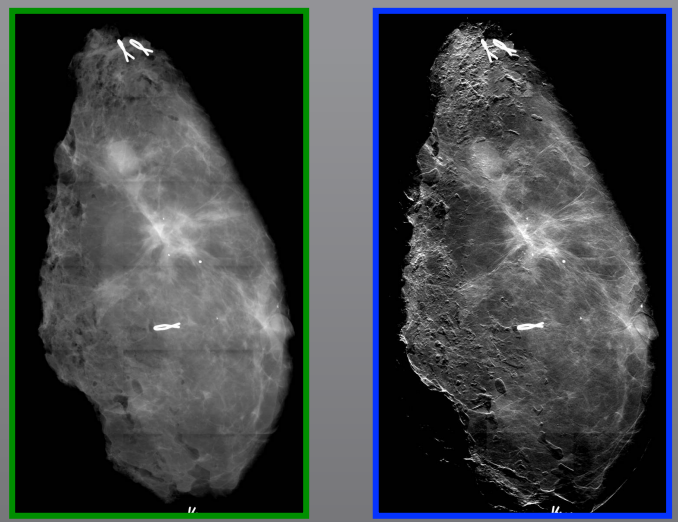
(PRL) 94, p. 217204

Complex – Materials



H. Friis Poulsen et al.
www.imaging.dtu.dk

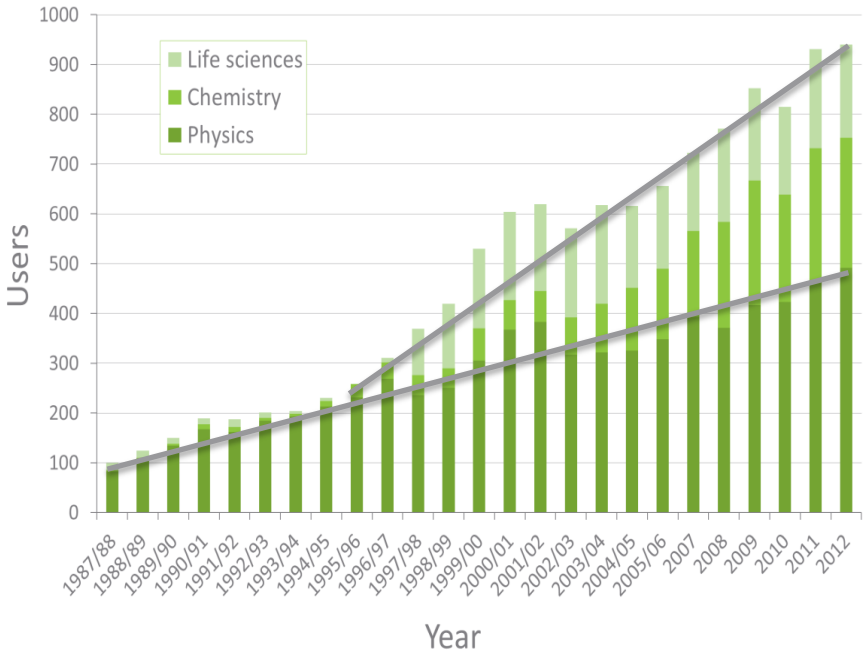
Relevant – Medicine

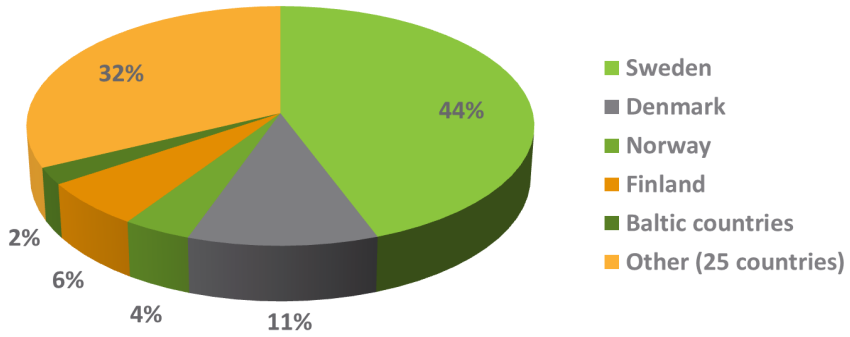


Invest. Rad. 2011;46:801-806

A National Laboratory

Academic





Commercial

~ 5% of total available beamtime

Imaging Resource
BONE SUPPORT
AkzoNobel
Tomorrow's Answers Today
HALDOR TOPSØE
SARomics
Colloidal Resource
novo nordisk®
AstraZeneca
Tetra Pak
PROTECTS WHAT'S GOOD™
L E O
Höganäs
sasol
novaled
MAX IV

How to create access to global research facilities?

- **we share research facilities! How do we connect?**
  - EU - Access programs (CALIPSO, ELISA, CECILIA, BioStruct, ….)
  - Synchrotrons world-wide

- **the education of engineers will be different. How?**
  - Interdisciplinary

- new abilities are required for the teachers. Which?

- **industry and university share common goals. How?**
  - Collaboration on precompetitive research
  - Industrial use of large scale facilities

MAX IV

€-Transnational Acess: A success story

- **CALIPSO (2012 - 2015)**
  - 14 European synchrotrons and free electron lasers travel and subsistence support to users.

- **BioStruct-X (2011 – 2015)**
  - Biological Structure determination at synchrotron facilities.
  - Transnational Users research projects determination of structures of biological macromolecules and cellular and subcellular ultra structures.
- **SUPPORT FOR USERS FROM THE BALTIC COUNTRIES AND POLAND**
  - Swedish Research Council (VR) part of Baltic Science Link project.
- **SWEDSTRUCT**

  VR-funded, structural biology infrastructure in Sweden.

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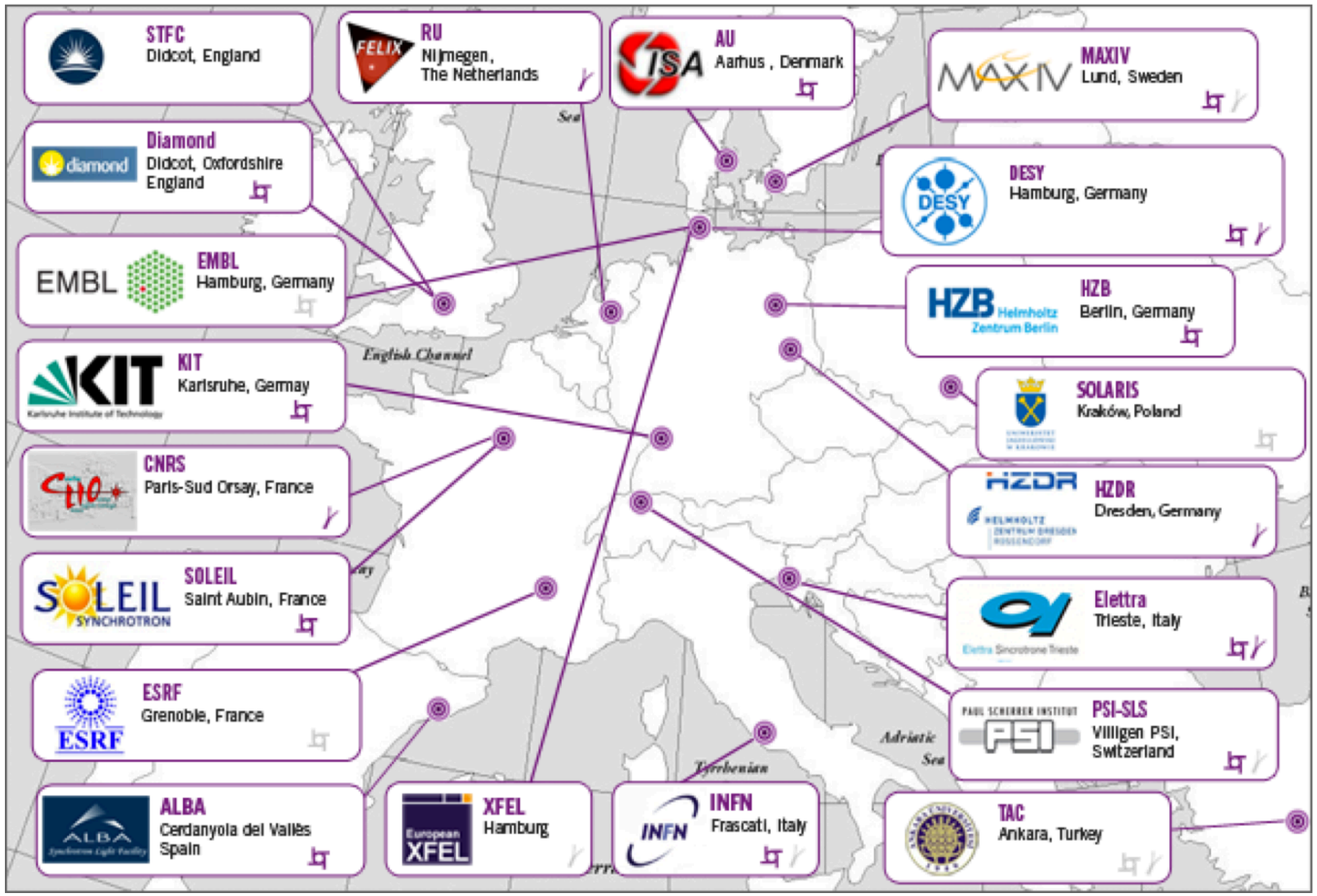
CALIPSO - Way for light

- Synchrotrons, Free Electron Lasers:
- Access support
- Harmonized decisions
- Instrument development



http://www.calipso.wayforlight.eu/

International network

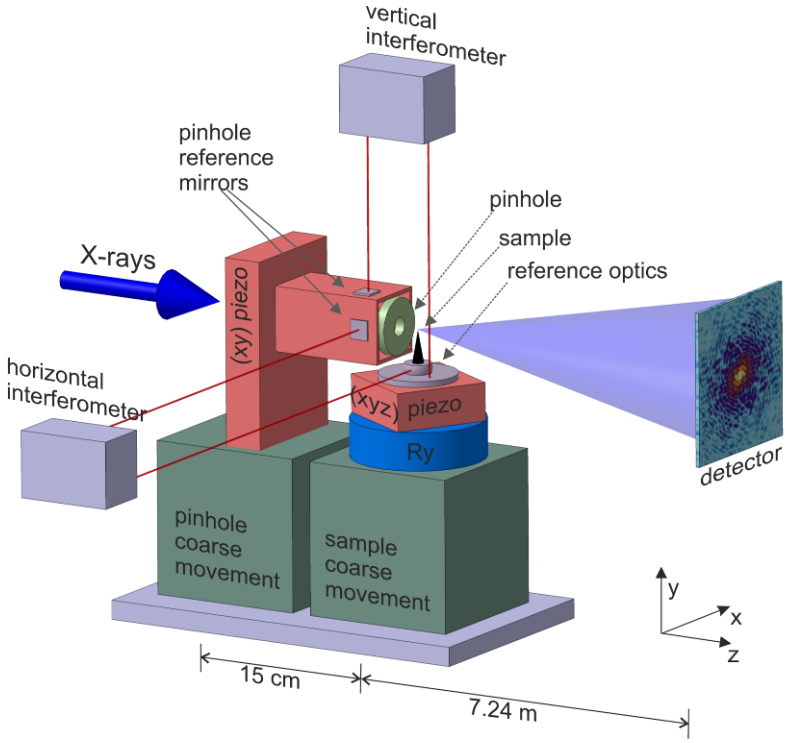
MAX IV

Free access to world-class facilities at any step of your career

- MAX IV Laboratory:
  - Research infrastructure with public / private funding

  - Calls for proposals (1-2/year)
  - Peer reviewed
    - Scientific merit
    - Feasibility
    - Availability
  - Value:
    - 10^3 SEK/h * 10 – 10^2 h

The education of engineers will be different. How?



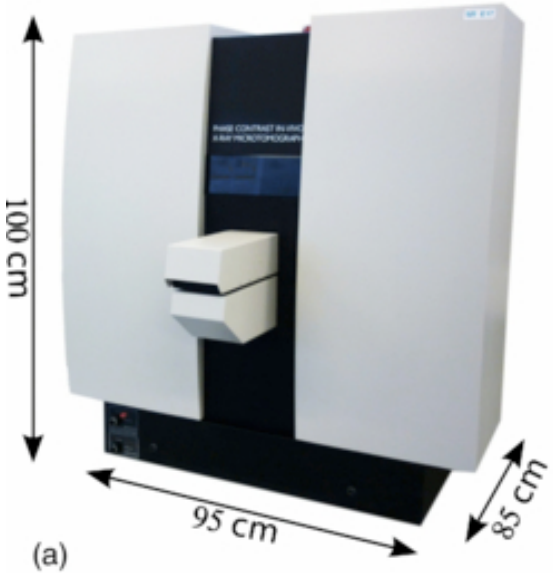
- OMNY (Paul Scherrer Institut, SLS)
- nano-positioning (optical interferometer)
- Cryogenics
- UH vacuum
- SR interface

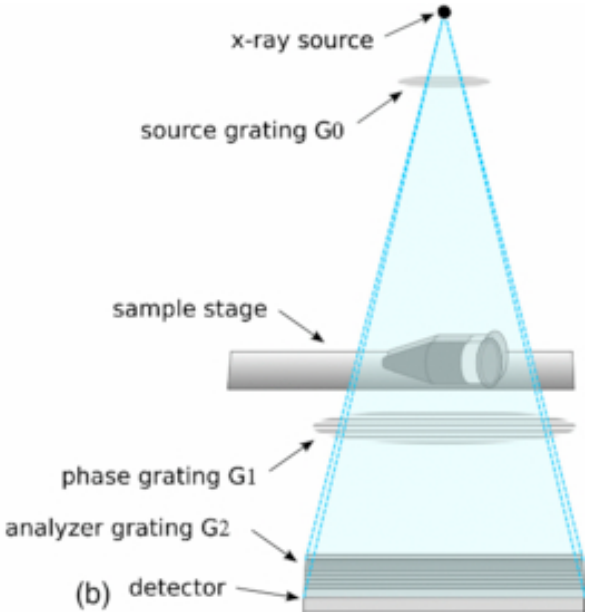
- Interdisciplinary
  - Hard & software
  - Electronics & mechanics
  - Buy in & build in-house
  - Cryo & vacuum & nano & Terra
  - Engineering = science
  - Data set ≈ 5 TB

M. Holler, et al., Rev. Sci. Instrum. 83, 073703 (2012)

Industry and university share common goals. How?

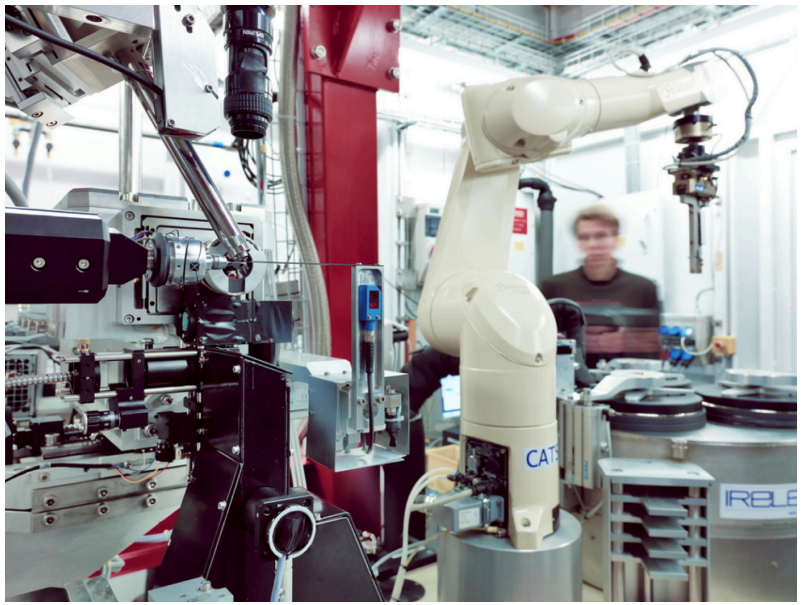
- Collaboration on precompetitive research
  - Fundamental research
  - Scientific application
  - Technology development
  - Product development
  - Marketing
  - ….



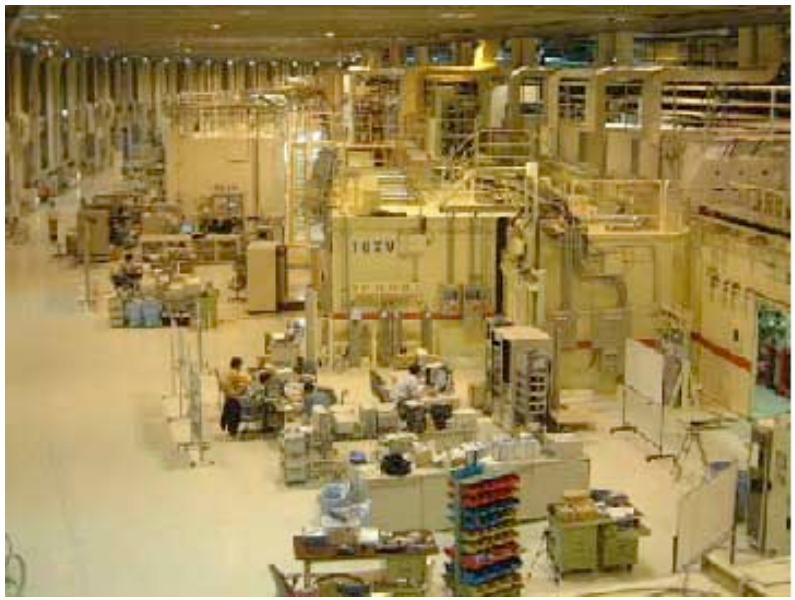


Industry and university share common goals. How?

- Shared industrial use of large scale facilities



PX III, Swiss Light Source, PSI



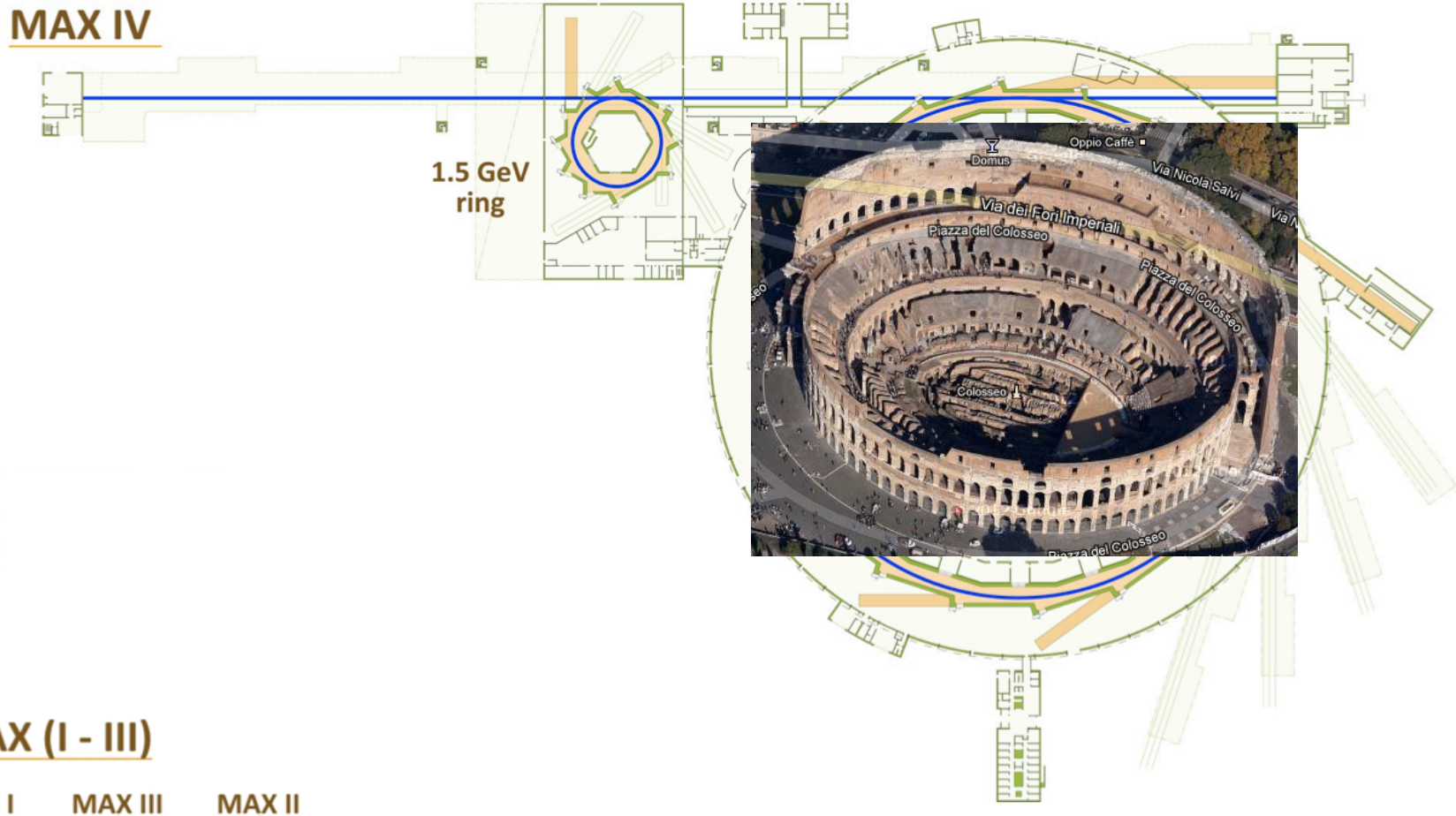
Sunbeam SPring8, Japan

Boehringer Ingelheim proteros biostructures NOVARTIS

Mitsubishi Tanabe Pharma ACTELION

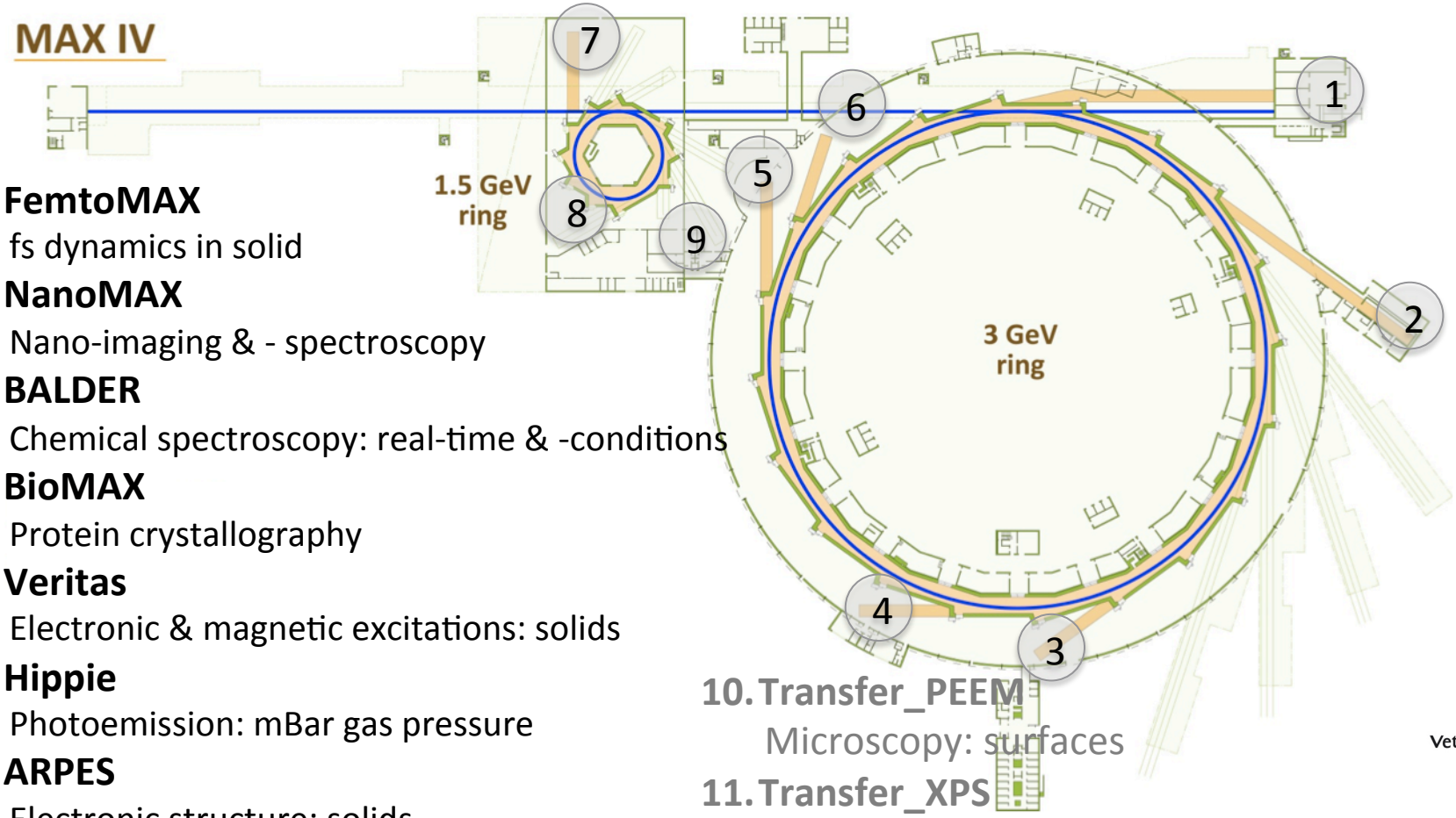
MAX IV

The MAX IV Project



Linac	3 GeV
Length (m)	300
Bunch charge	100 pC @ 10 Hz
Pulse (FWHM)	30 fs – 5 ps
Full energy injector	1.5 / 3 GeV

Rings	3 GeV	1.5 GeV
Circumference (m)	528	96
Straight sections	20	12
Emittance (nm rad)	< 0.3	6
Beam (σ in μm) [H x V]	50 x 6	184 x 13



1. **FemtoMAX**
   fs dynamics in solid
2. **NanoMAX**
   Nano-imaging & - spectroscopy
3. **BALDER**
   Chemical spectroscopy: real-time & -conditions
4. **BioMAX**
   Protein crystallography
5. **Veritas**
   Electronic & magnetic excitations: solids
6. **Hippie**
   Photoemission: mBar gas pressure
7. **ARPES**
   Electronic structure: solids
8. **FinEstBeaMS**
   Electronic structure: gases, aerosols
9. **SPECIES**
   Electronic & magnetic excitations: surfaces
10. **Transfer_PEEM**
    Microscopy: surfaces
11. **Transfer_XPS**
    Electronic structure: surfaces & gases
12. **CoSAX**
    Geometric structure & correlation: (bio) liquids
13. **Soft*i*MAX**
    Microscopy & method development

Vetenskapsrådet

What is MAX IV Laboratory?

MAX IV Inauguration
Tuesday, June 21st 2016, noon (CEST 13:08:55)