

A Light for Science



European Synchrotron Radiation Facility



A European site



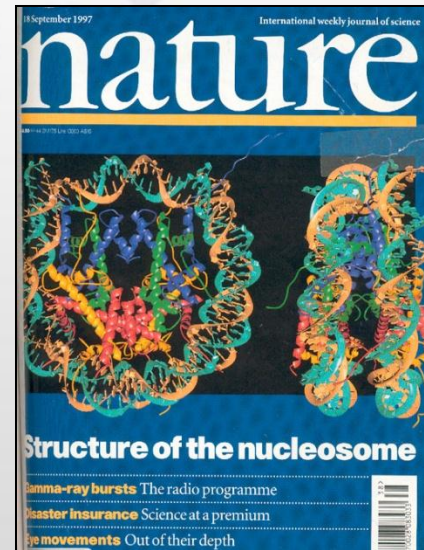
Some results in biology



Blue-tongue virus



Yeast prion



Ribosome

Nucleosome

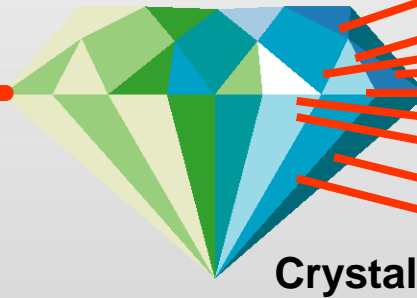


X-ray diffraction

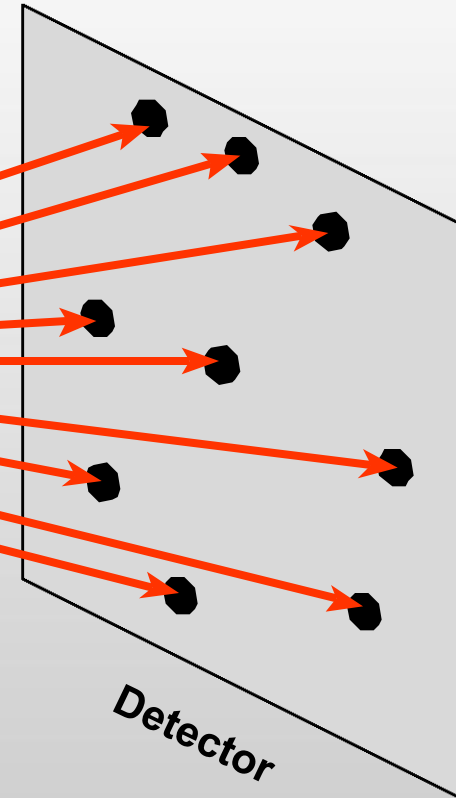


First X-ray diagramme by Laue in 1912.

X-ray beam



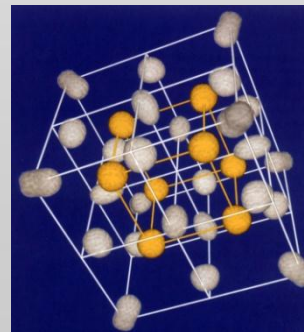
Crystal



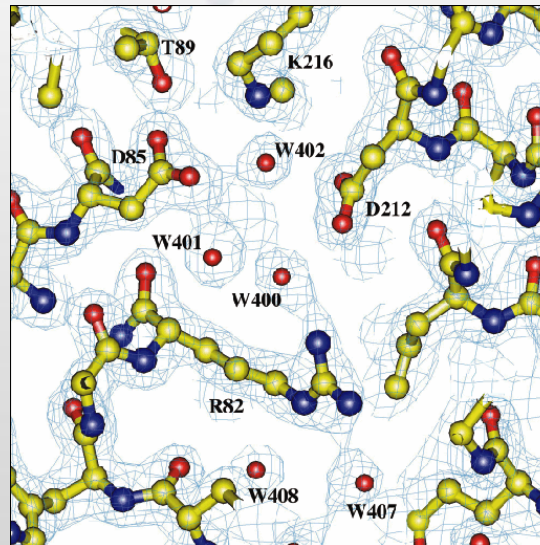
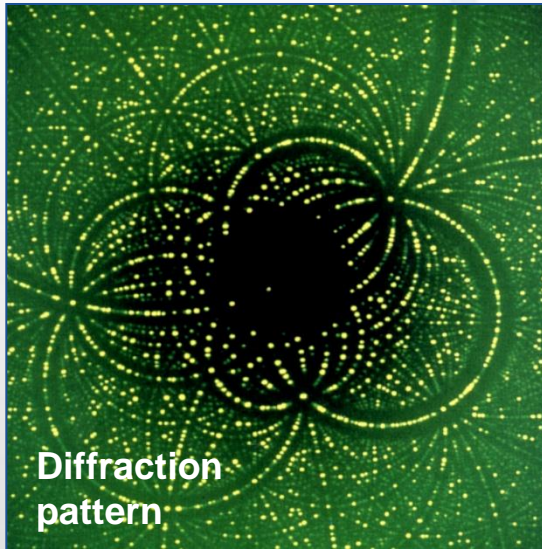
Detector

Bragg's law: $2 d \sin\theta = n\lambda$

- λ : wavelength
- θ : incident angle
- d : distance between 2 atomic plans
- n : integer

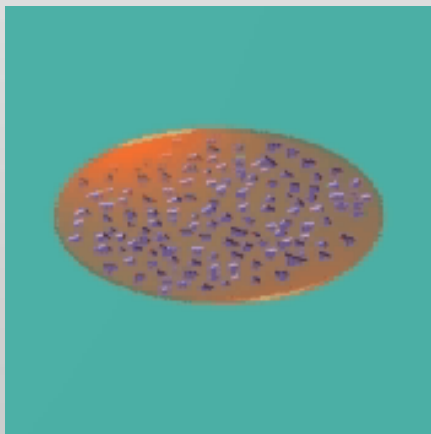
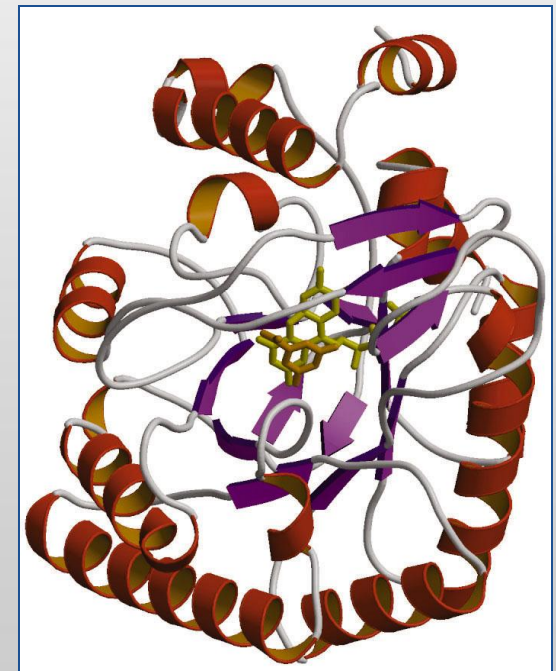


Protein crystallography



Electron density map

3D structure



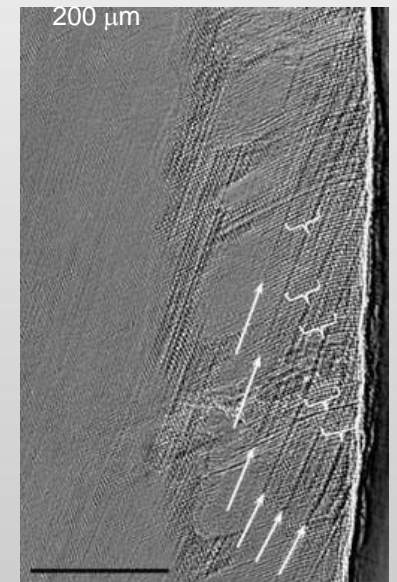
Protein crystallisation

Palaeontology

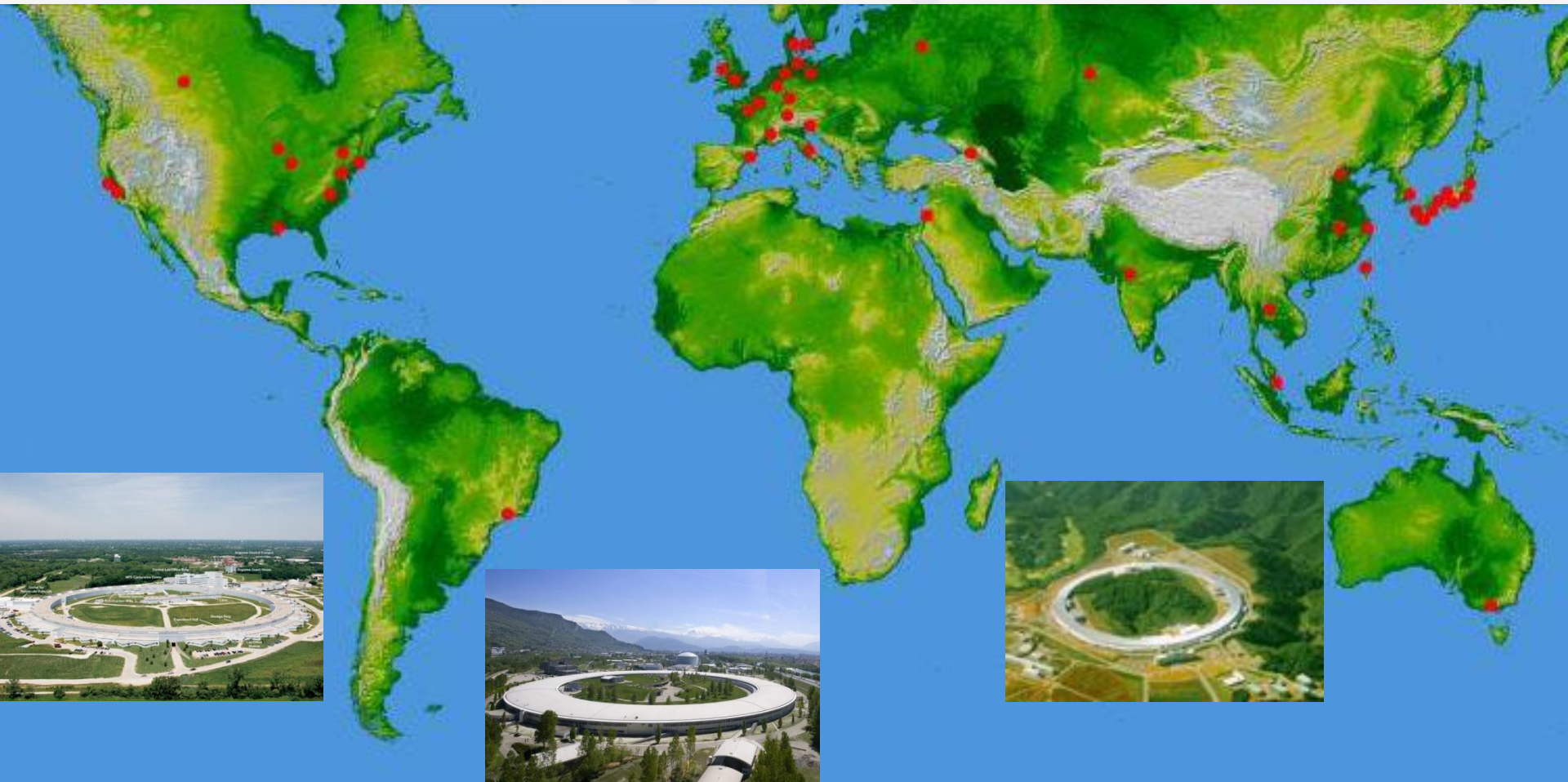
- **Toumai, our earliest ancestor, 7 million years old**



- **Life history of a fossil tooth, 160 000 years old**



About 50 synchrotrons in the world



History of the ESRF

● 1975



Project of a synchrotron capable of producing very brilliant hard X-rays.

● 1988

Signature between the governments of the member countries.

● 1992

First electron beam in the storage ring. Commissioning phase.

● 1994

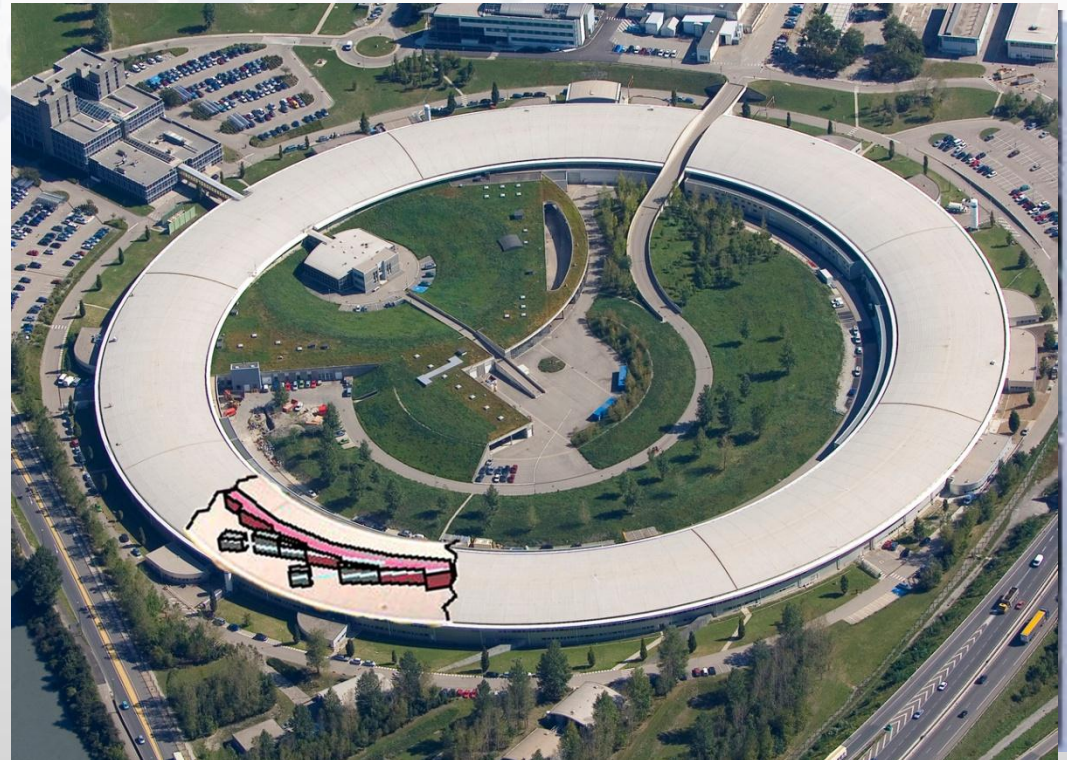
Opening to users. 15 beamlines are available.

● 1998

End of construction. 40 beamlines are operational.

● 2008

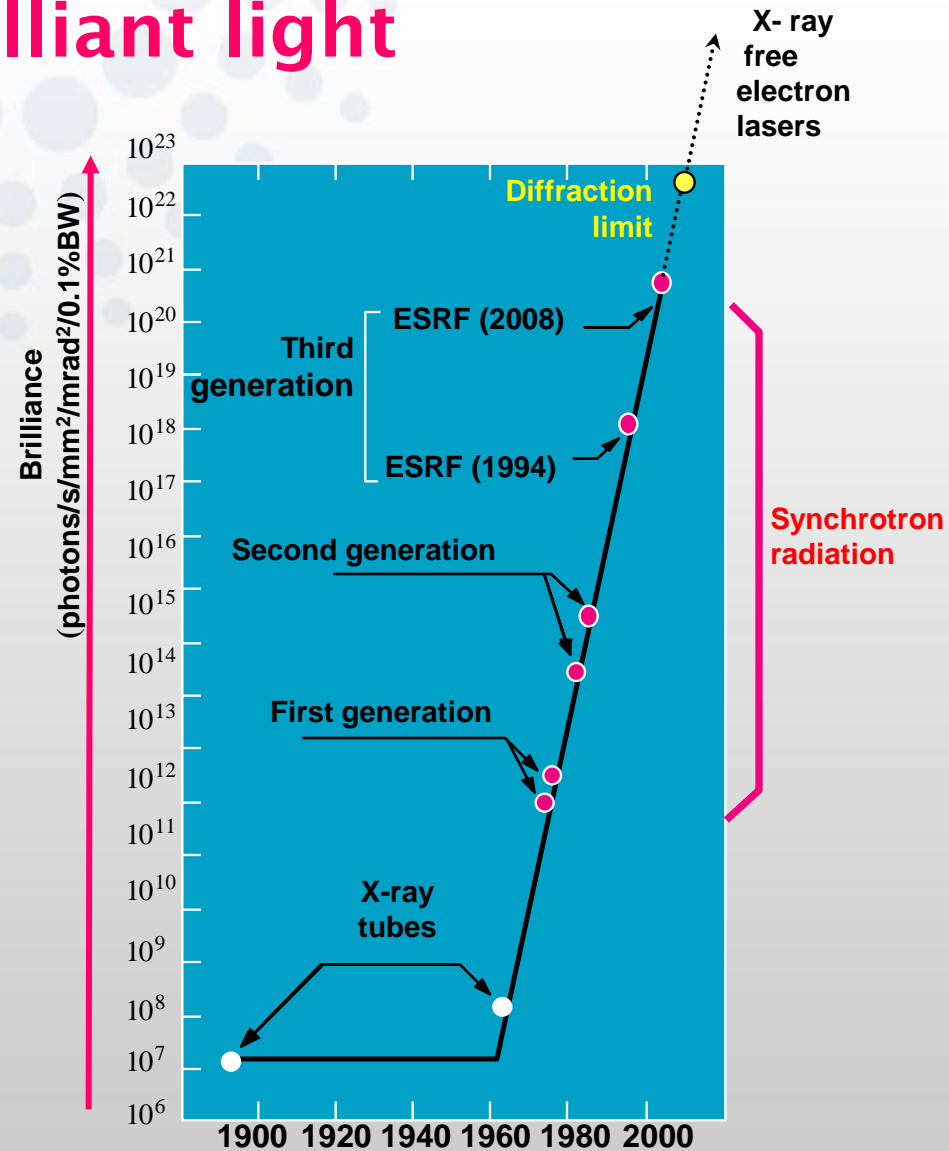
20 years after signature. Start of the upgrade programme.



A very brilliant light

- **Remarkable properties of synchrotron light**
 - Brilliance
 - Coherence
 - Pulsed emission
(duration of a flash: 100 ps)

- **Moreover:**
 - Flux
 - Polarisation
 - Beam stability



Co-operation of 19 countries



The ESRF is a « société civile » under French law, but it is financed and run by 19 countries.

Annual budget: 80 million euros

Staff: 600

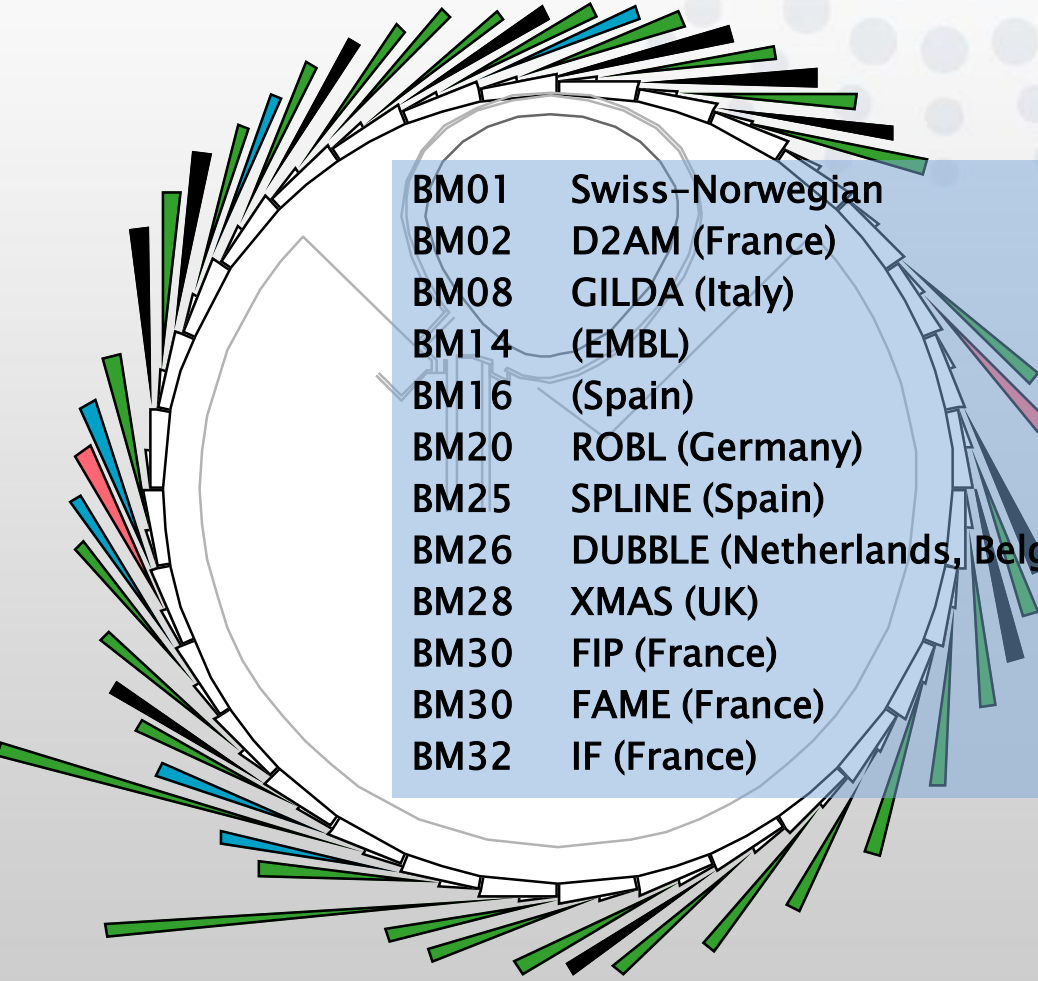
Members:

France	27.5 %
Germany	25.5 %
Italy	15 %
United Kingdom	14 %
Spain	4 %
Switzerland	4 %
Benesync (Belgium, The Netherlands)	6 %
Nordsync (Denmark, Finland, Norway, Sweden)	4 %

Associates:

Centralsync (Czech Republic, Hungary, Slovakia)	1.05 %
Austria	1 %
Israel	1 %
Poland	1 %
Portugal	1 %

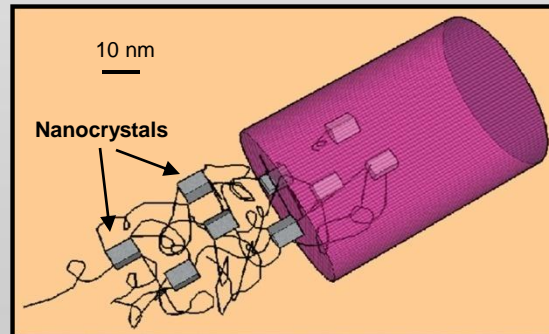
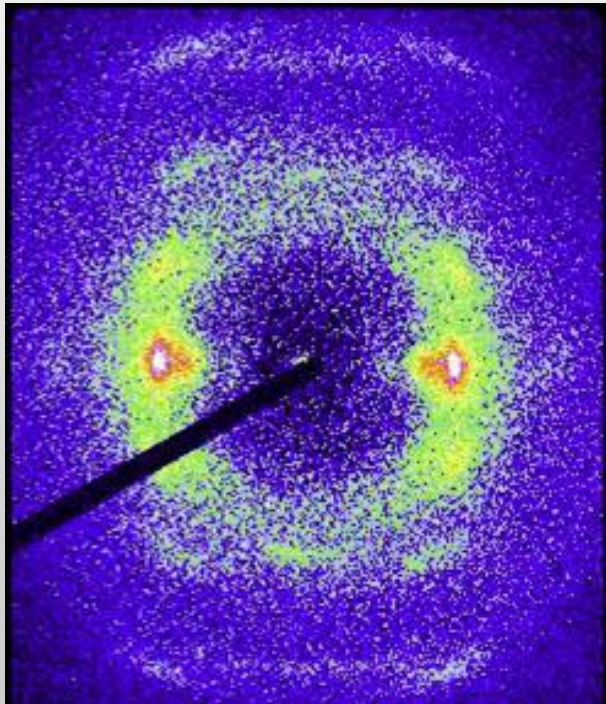
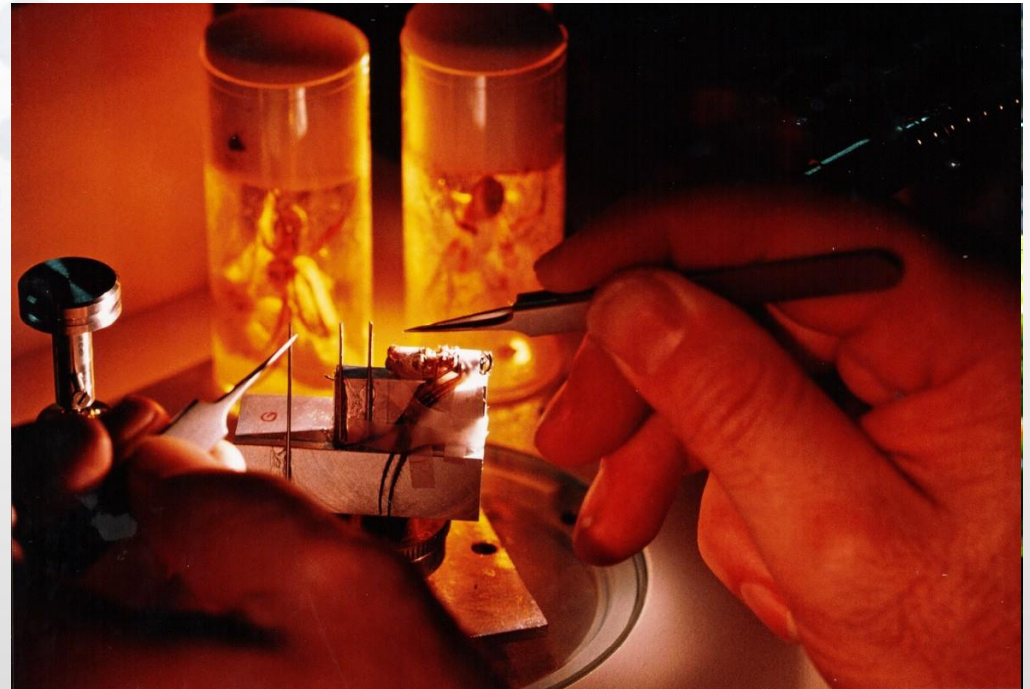
List of beamlines

- 
- BM01 Swiss-Norwegian
 - BM02 D2AM (France)
 - BM08 GILDA (Italy)
 - BM14 (EMBL)
 - BM16 (Spain)
 - BM20 ROBL (Germany)
 - BM25 SPLINE (Spain)
 - BM26 DUBBLE (Netherlands, Belgium)
 - BM28 XMAS (UK)
 - BM30 FIP (France)
 - BM30 FAME (France)
 - BM32 IF (France)

- ID01 Anomalous scattering
- ID02 High brilliance
- ID03 Surface diffraction
- ID06 Instrumentation development
- ID08 Dragon / Spectroscopy using polarised soft X-rays
- ID23 Structural biology (MAD)
- ID09 Biology / High pressure
- ID10 Troika / Multipurpose
- ID11 Materials science
- ID12 Circular polarisation
- ID13 Microfocus
- ID14 Protein crystallography
- ID15 High energy diffraction
- ID16 Inelastic scattering
- ID17 Medical absorption spectroscopy

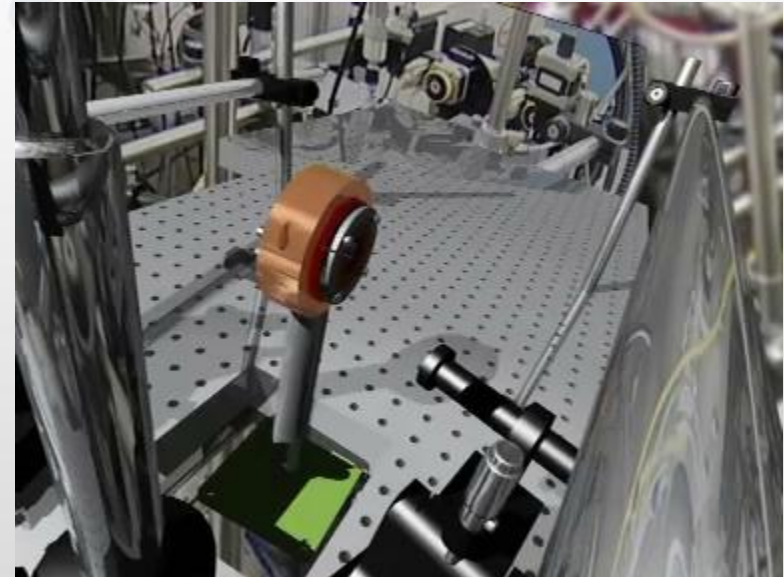
Polymer science

Spider silk thread has outstanding properties: it is both very strong and elastic.



Extreme conditions

One can better know the structure of matter at the center of the Earth ...



... by studying samples put under extreme conditions of pressure and temperature.

Cultural heritage

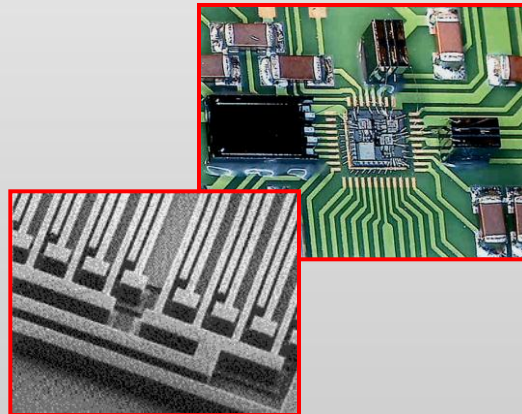
A portrait below a landscape, by van Gogh, revealed by synchrotron light.



Oil painting techniques are older than previously thought (Bamiyan caves, 5th to 9th century).

Industry too

- In collaboration with the public sector
- As proprietary research



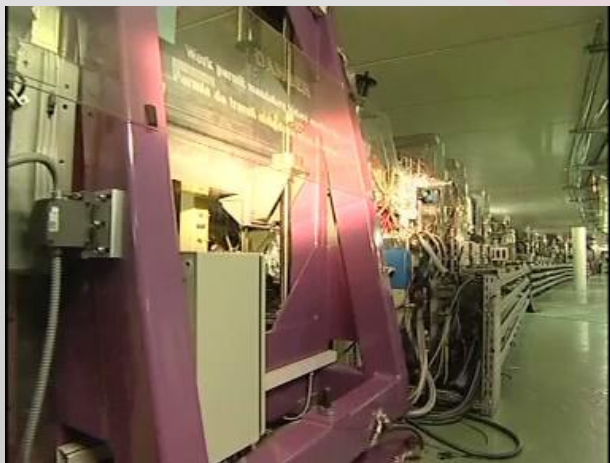
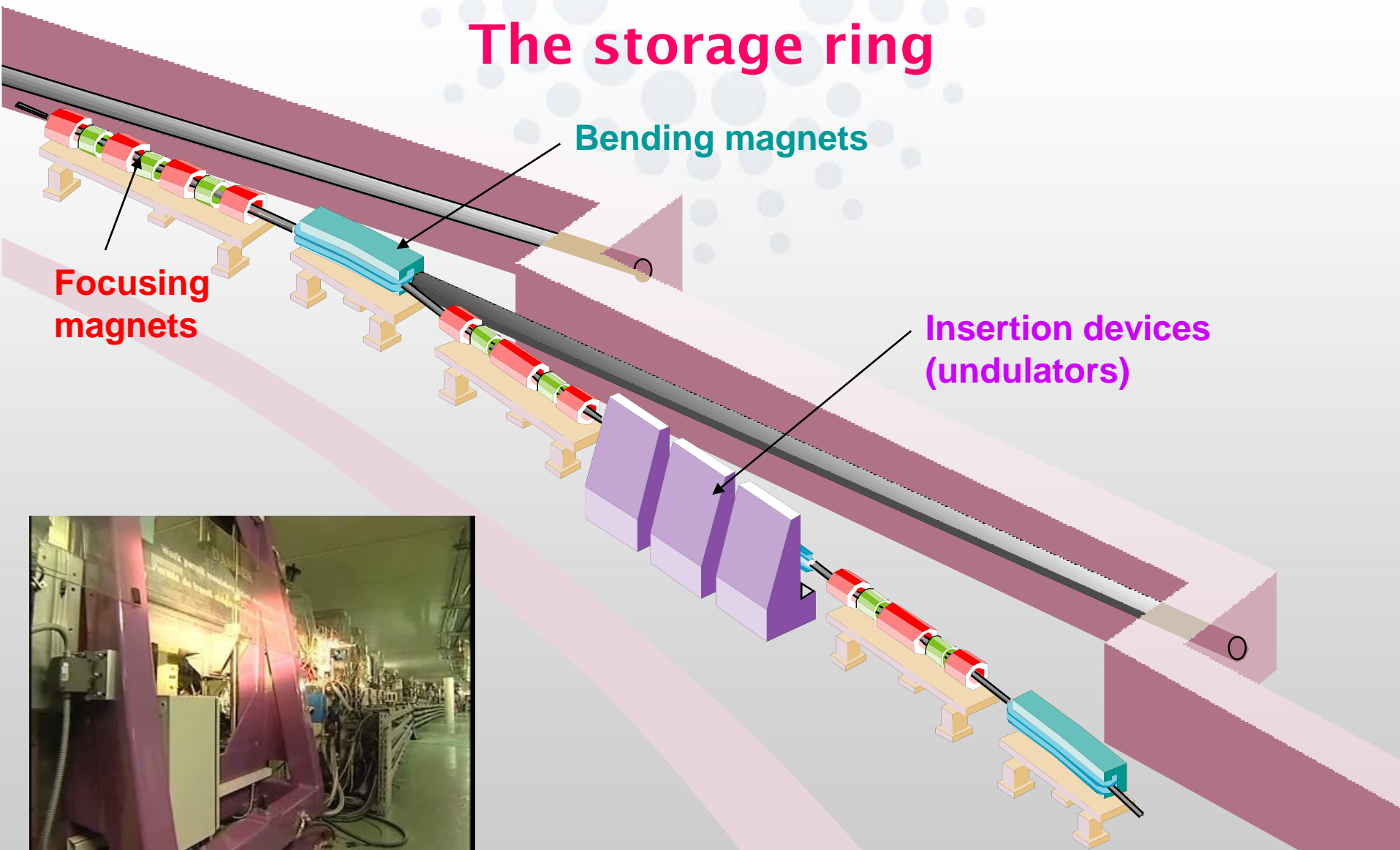
Catalytic converters

**Kinetics
studies
under X-rays
for a better
efficiency**

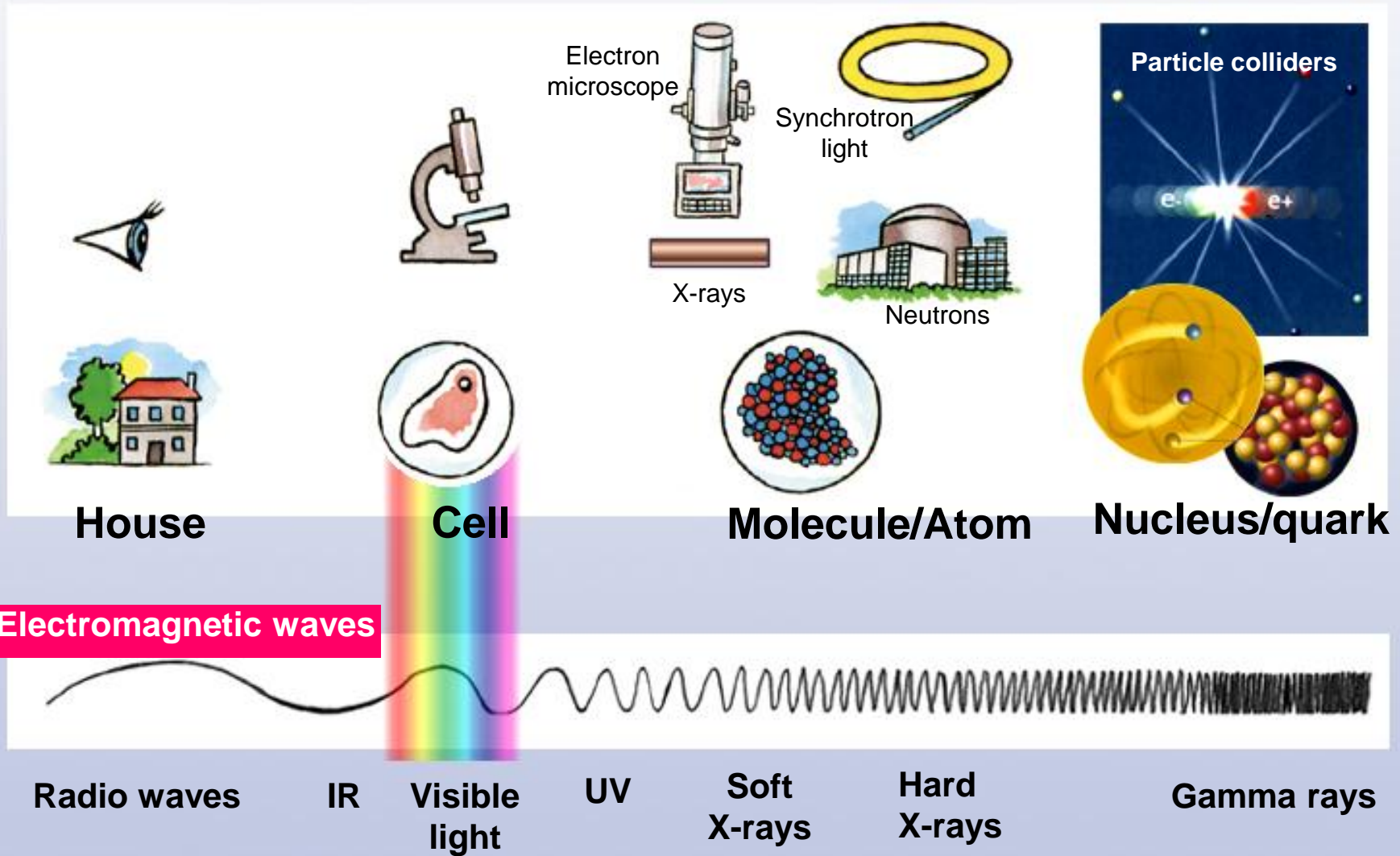




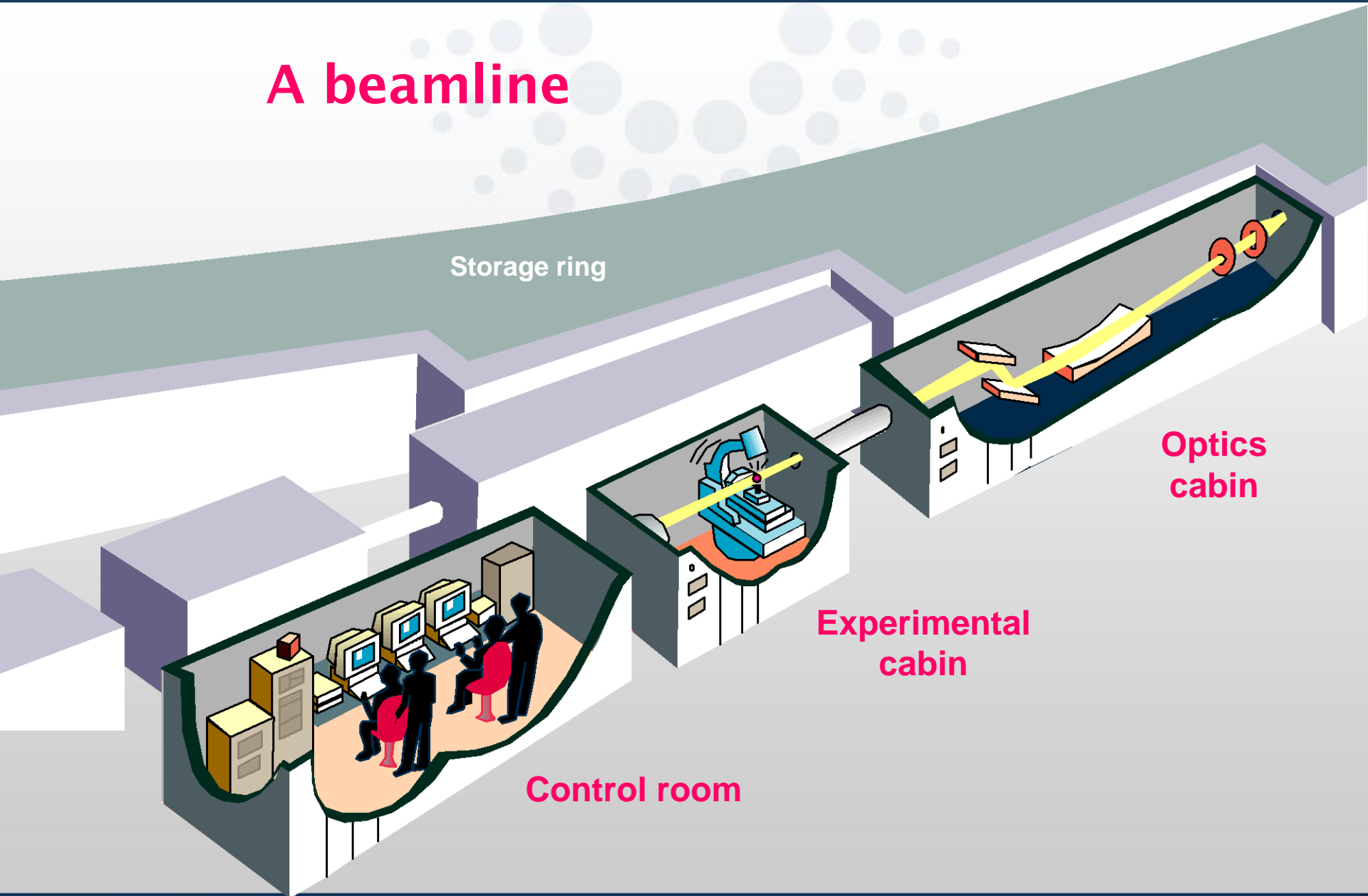
The storage ring



To see the invisible



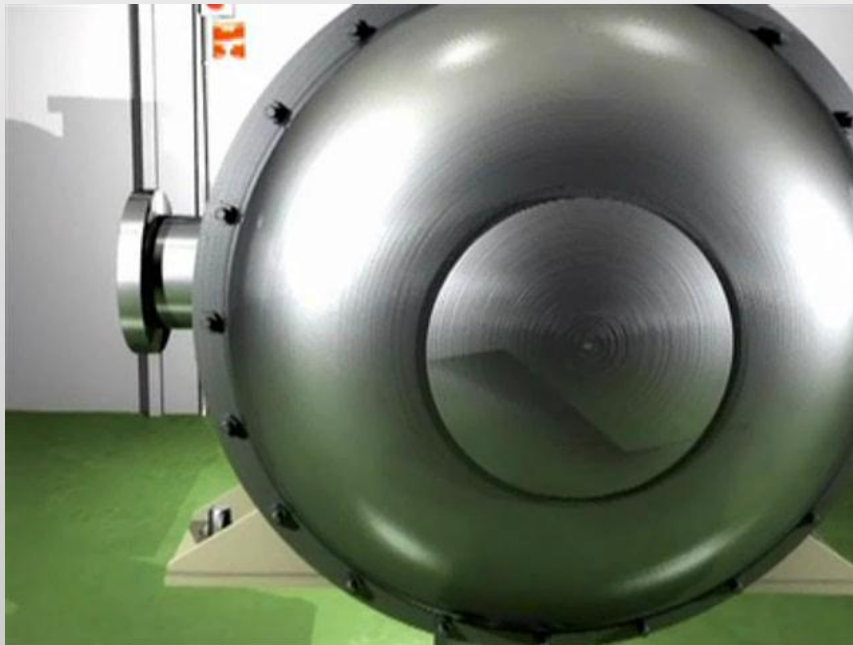
A beamline

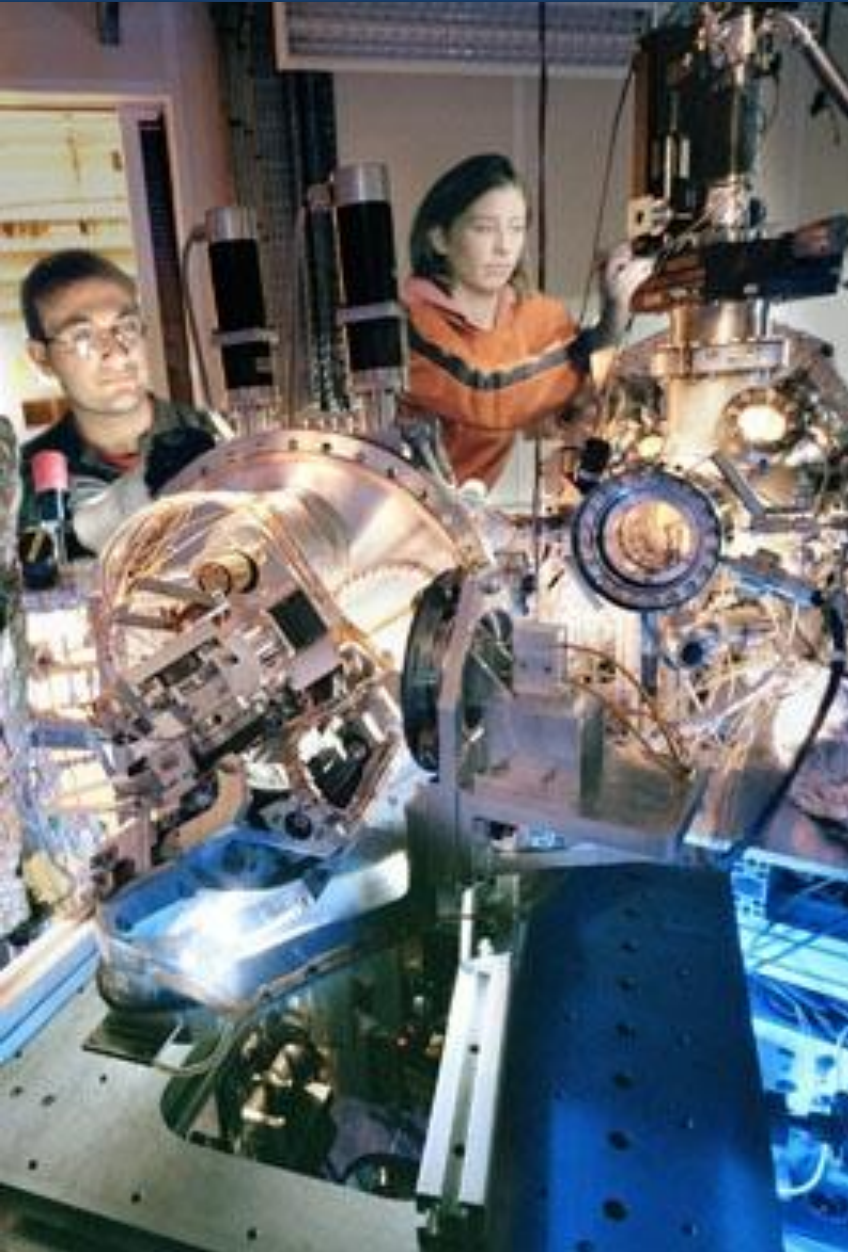


X-ray optics

- Mirror

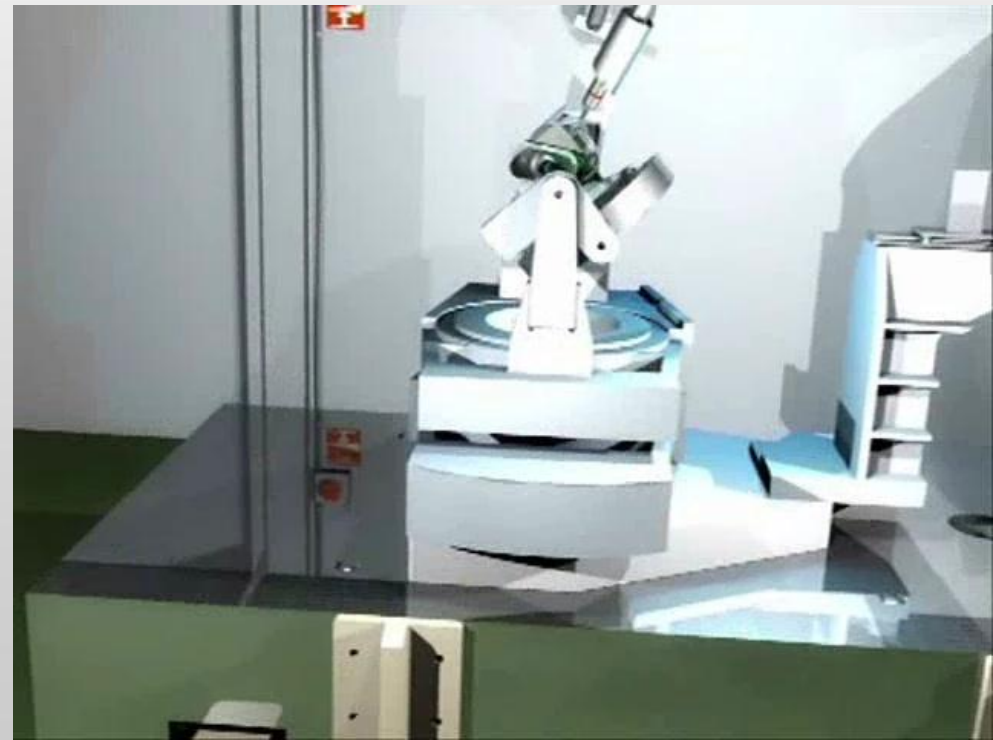
- Monochromator





Experimental station

- Sample
- Detector



A user facility



- Review committees to select the best proposals
- More than 6000 annual user visits
- 1500 publications every year

Upgrade programme

- Nanoscience and nanotechnology
- Structural and functional biology / soft matter
- Pump-probe and time-resolved experiments
- Science at extreme conditions
- X-ray imaging

