



# WELCOME TO THE EPN CAMPUS

INSTITUT MAX VON LAUE - PAUL LANGEVIN





THE EUROPEAN NEUTRON SOURCE



# Grenoble has an outstanding infrastructure for materials research

Nuclear Magnetic Resonance



Neutrons



X-rays



Microscopy



◆  
CNRS

◆  
ILL

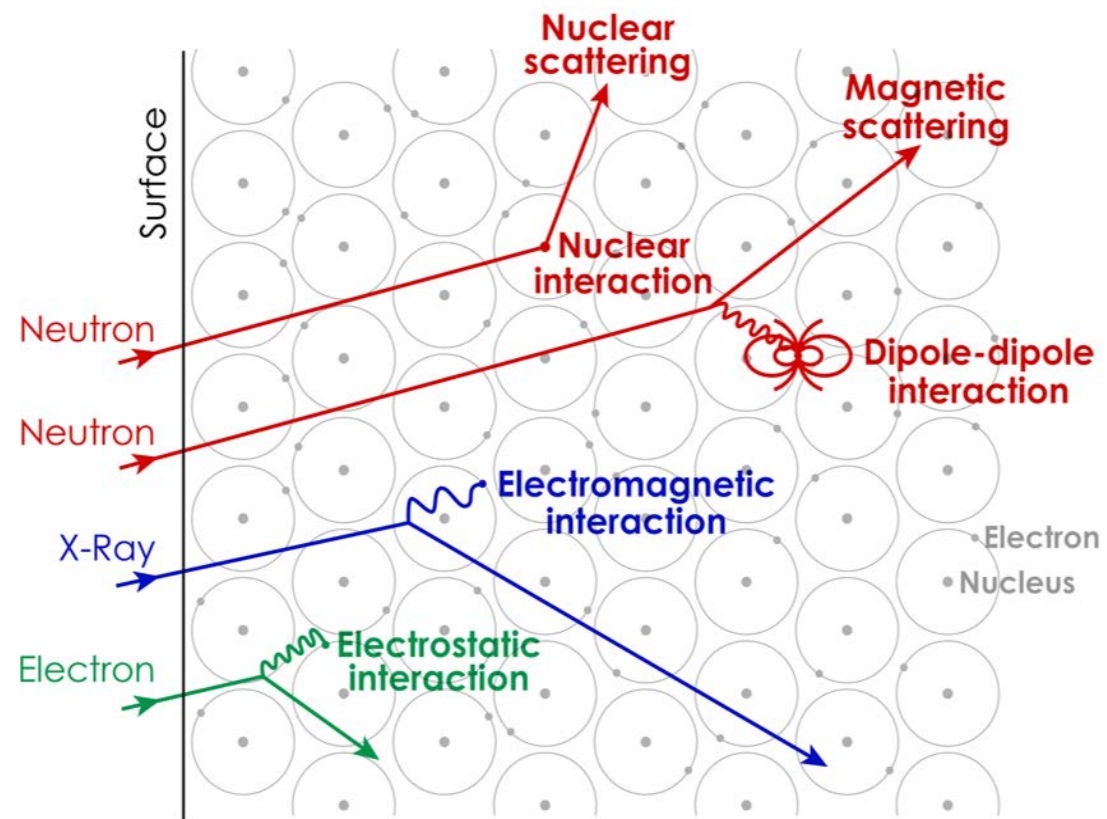
◆  
ESRF

◆  
ESRF/EMBL/IBS

THE EUROPEAN NEUTRON SOURCE

# Looking into materials

- Materials science drives the development of new technologies
- World-leading characterization is required to gain fundamental understanding of the structure and dynamics of materials, beginning at the atomic level
- Researchers use a variety of techniques to determine the position and motion of atoms in materials



Beams of neutrons, X-rays, and electrons interact with materials by different mechanisms

# The unique properties of neutrons provide valuable insights into the structure and dynamics of materials

## Neutrality

As neutral particles neutrons can penetrate deep within materials to reveal buried structures and interfaces

## Magnetism

As magnetic particles neutrons are sensitive to magnetism and magnetic processes in materials

## Wavelength

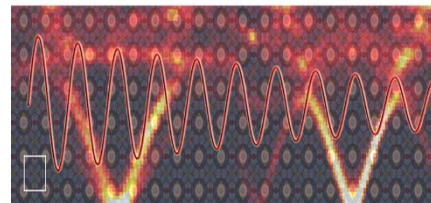
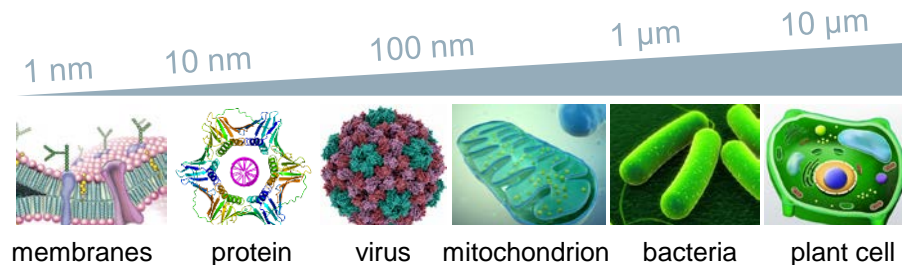
Neutrons have a broad range of useful wavelengths, allowing examination of structures as small as atoms and as large as biological cells

## Energy

Exchanges of energy between neutrons and samples can be detected and used to follow the dynamics of atomic, molecular and lattice processes

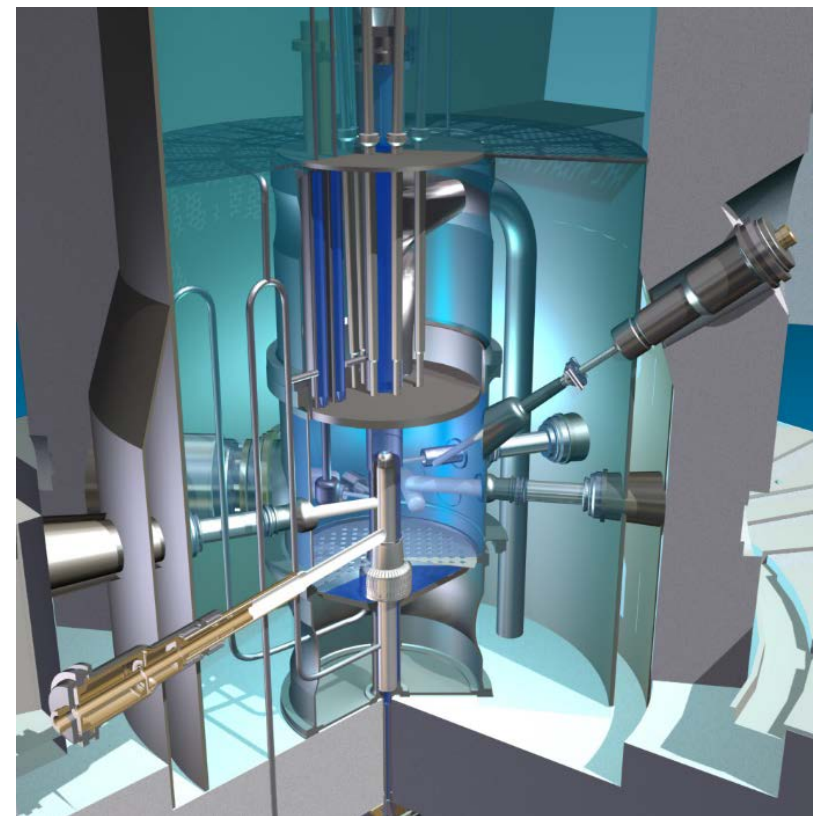
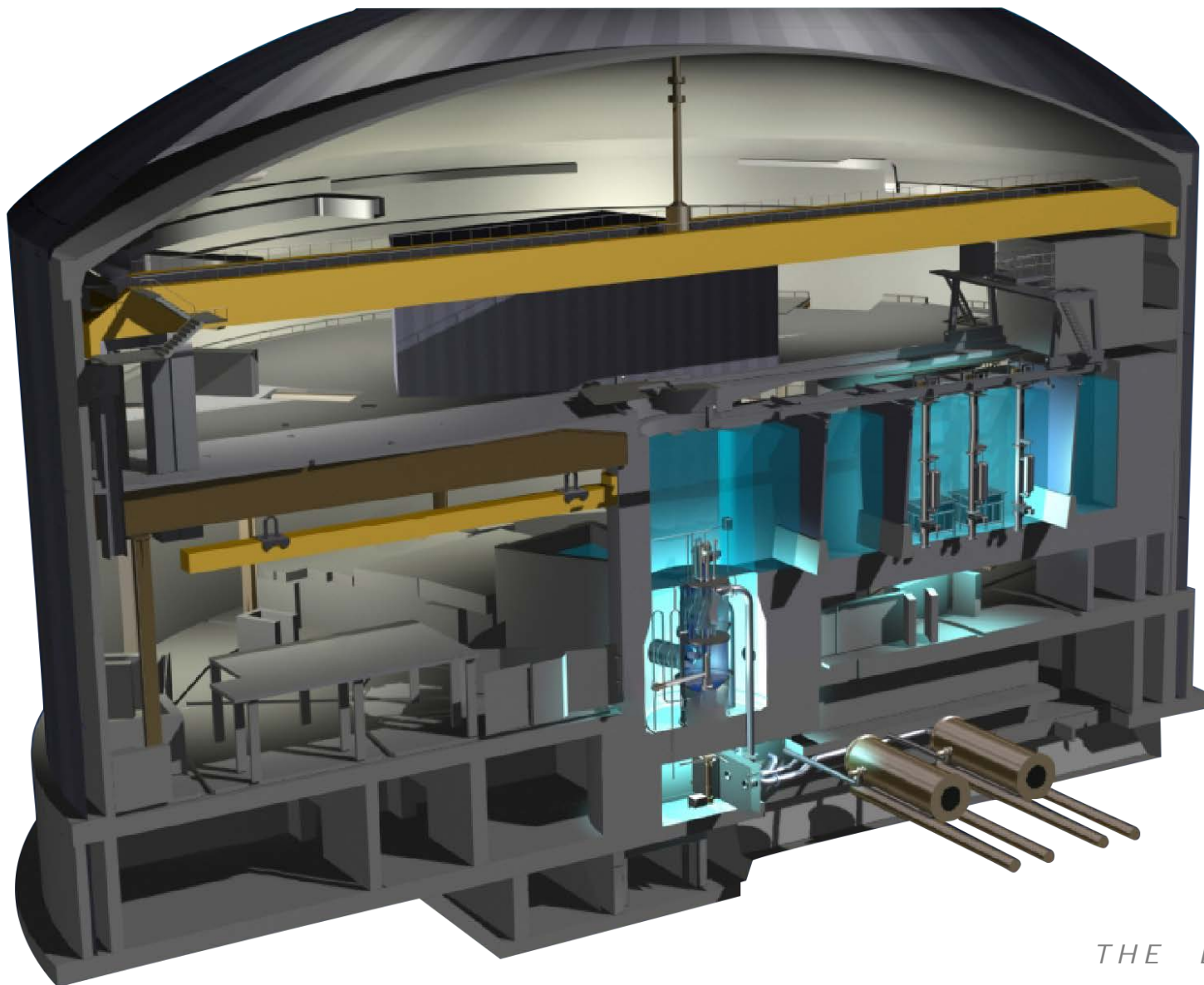
## Selectivity

The ability of neutrons to see light elements, to distinguish between elements with similar atomic number and to distinguish between specific isotopes can provide unique structural and dynamic information



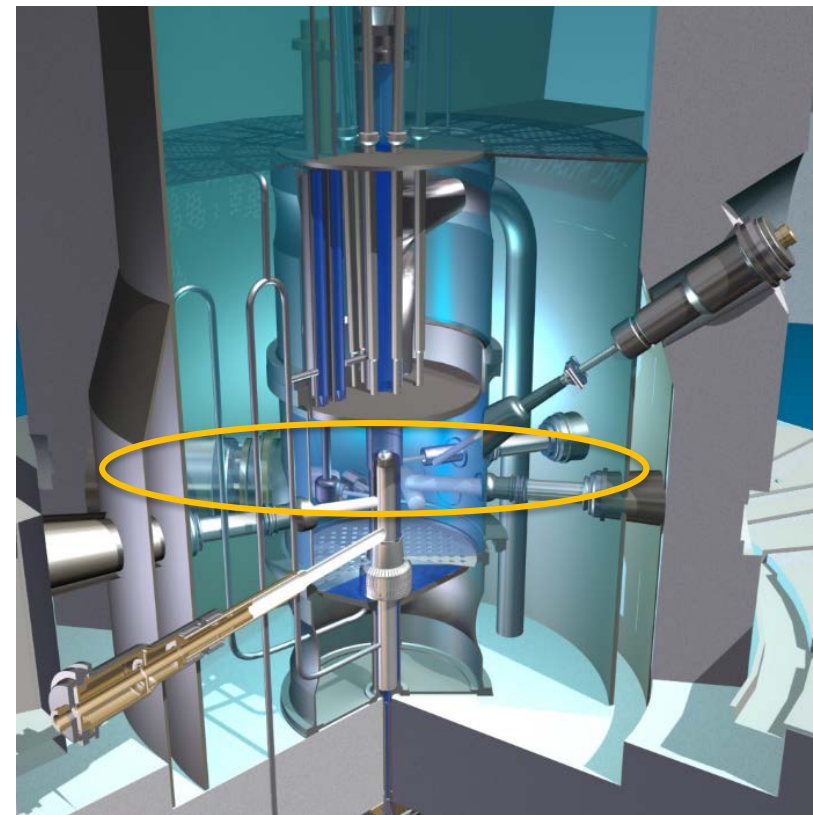


# THE ILL HIGH FLUX REACTOR



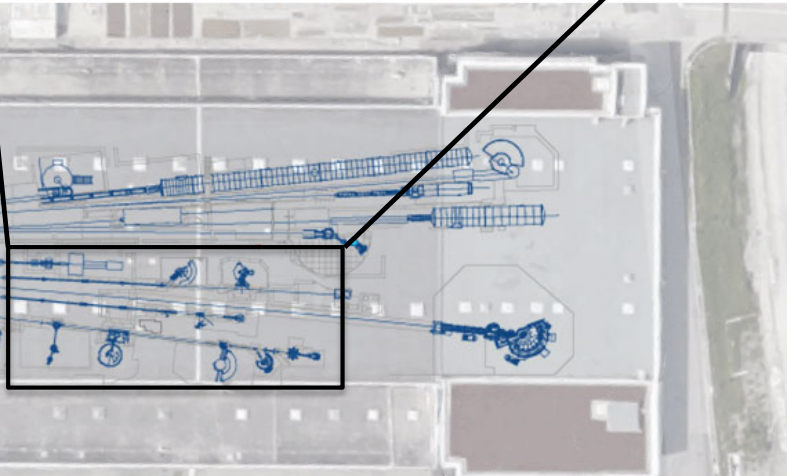
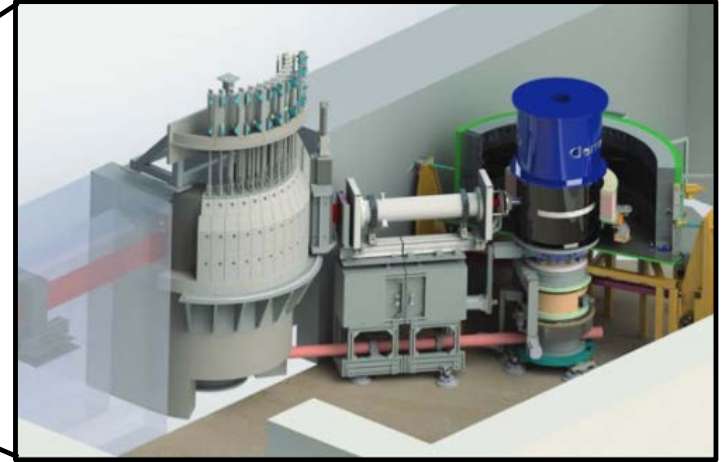
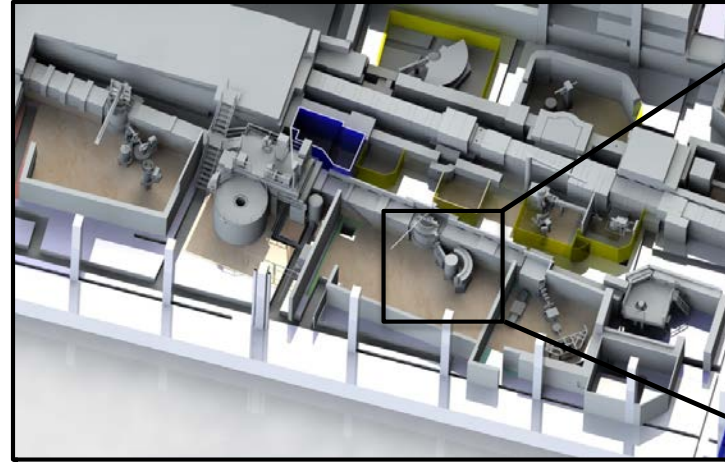
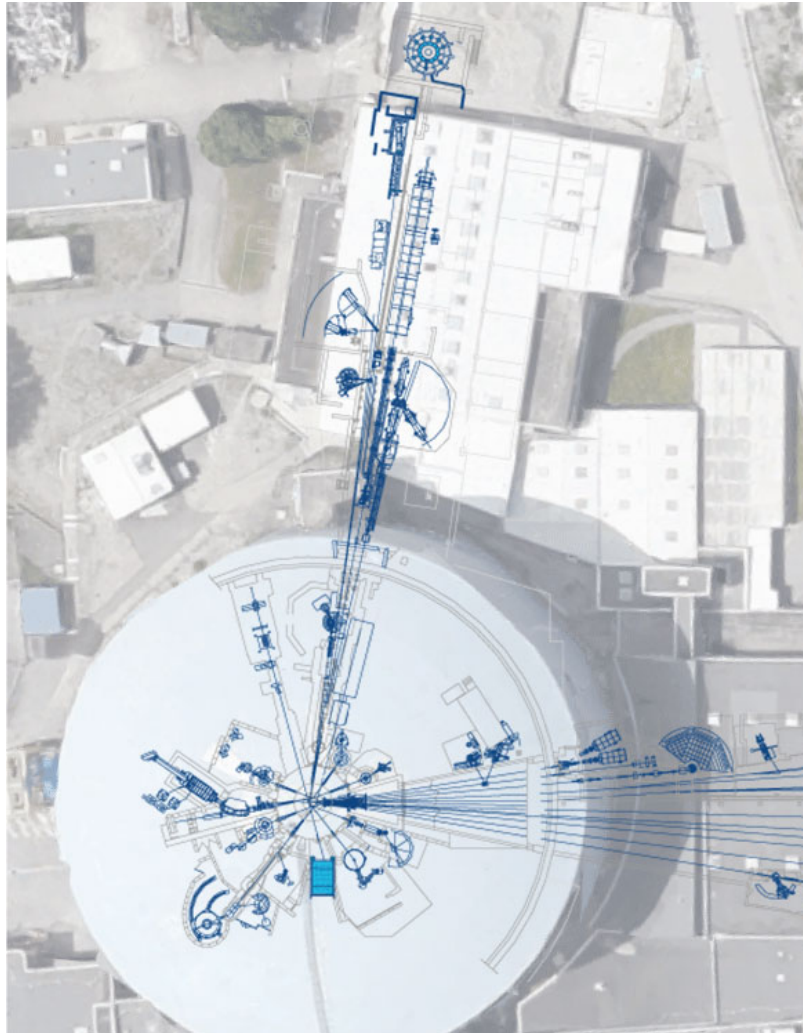
A neutron source generating  $1.5 \times 10^{15}$  neutrons per second per  $\text{cm}^2$ , with a thermal power of 58.3 MW.

# HOW NEUTRONS ARE EXTRACTED AND GUIDED





# THE ILL'S INSTRUMENT SUITE



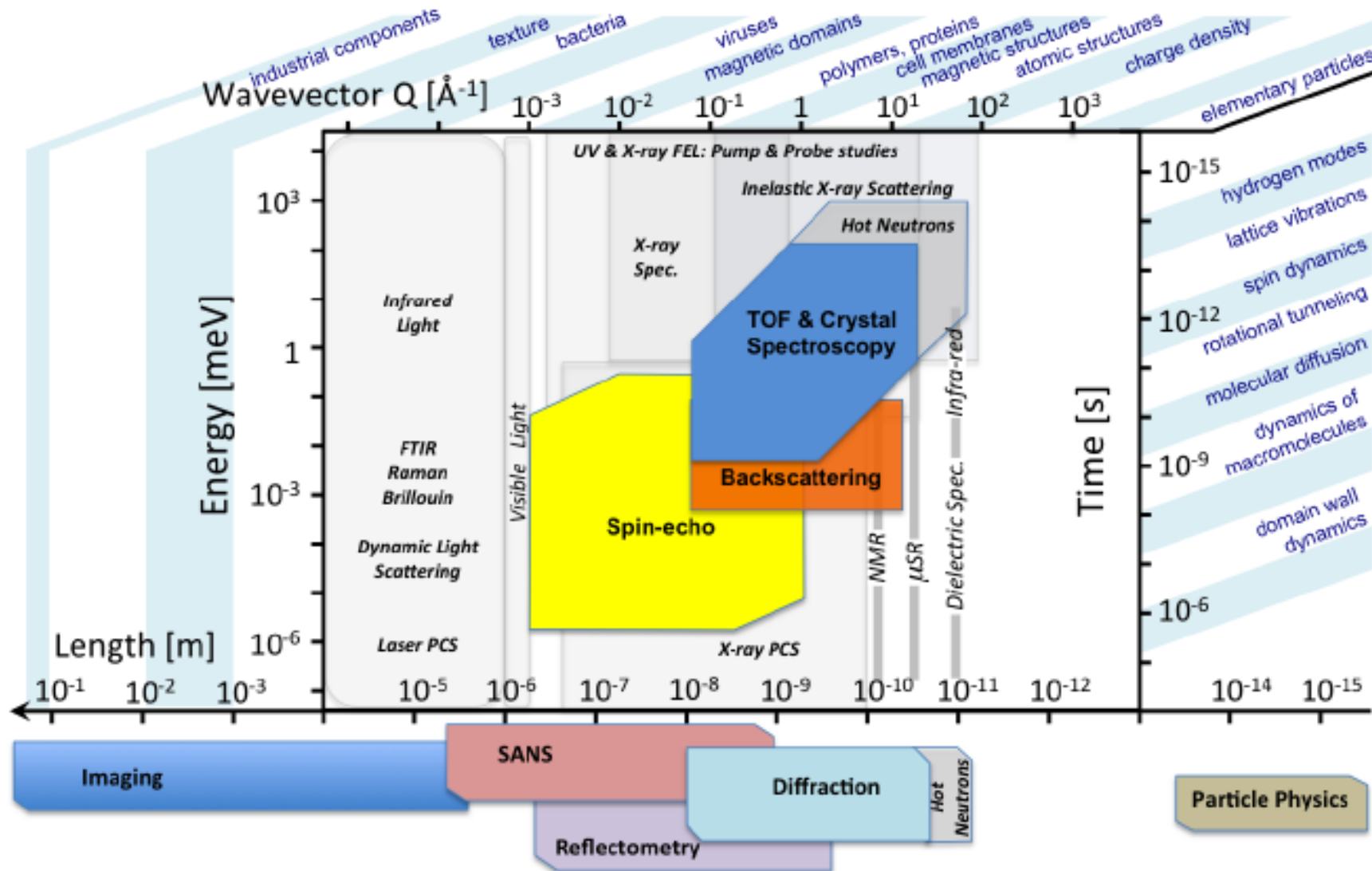




# NEUTRON SCATTERING COVERS MANY ORDERS OF MAGNITUDE

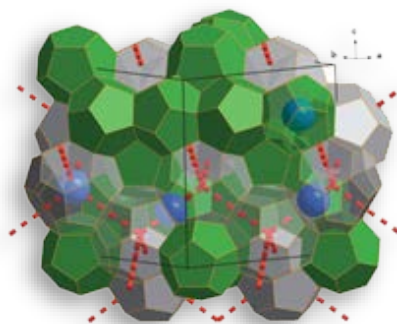
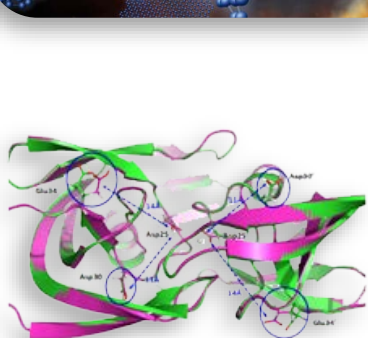
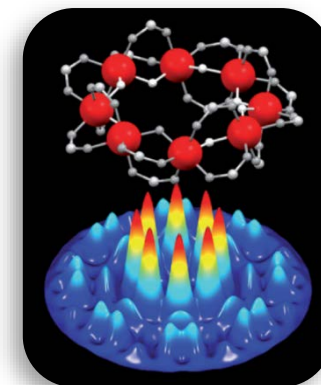
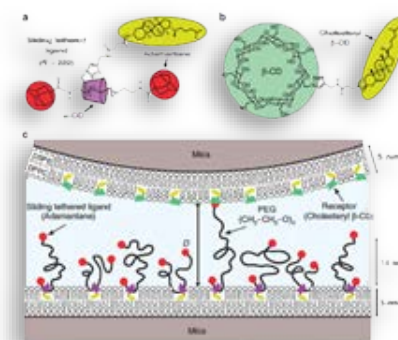
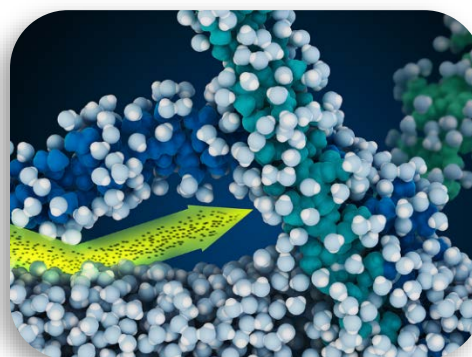
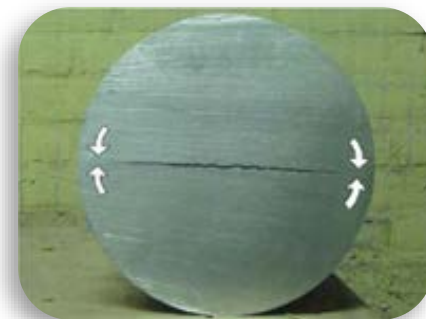
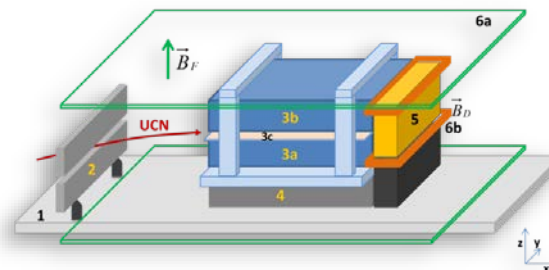
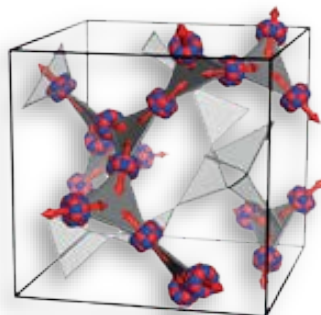
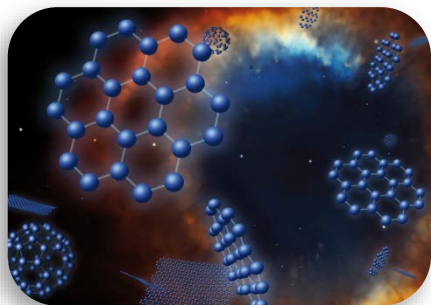
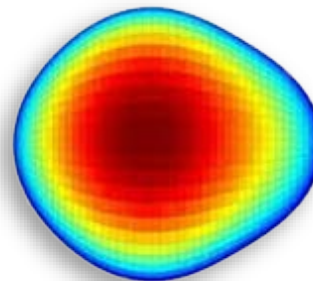
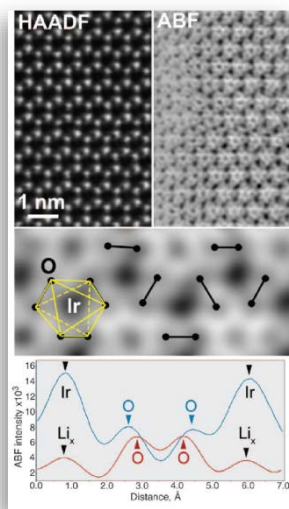
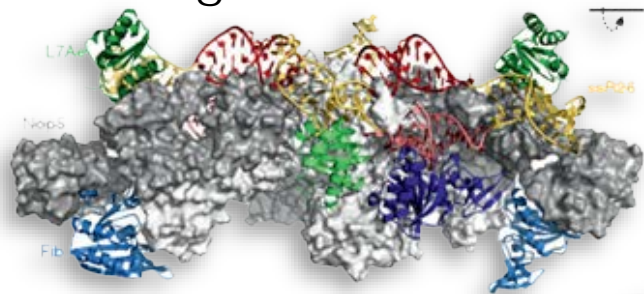
15 ORDERS OF MAGNITUDE IN LENGTH

10 ORDERS OF MAGNITUDE IN TIME



# LIQUIDS, GASES, SOLID MATTERS MAY ALL BE STUDIED WITH NEUTRONS

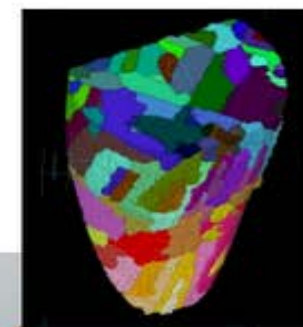
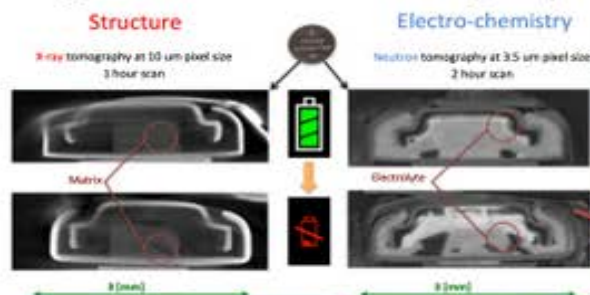
Improved understanding of materials can lead to new modern technologies





# EXAMPLE: NEXT - NEUTRON AND X-RAY IMAGING BEAMLINE

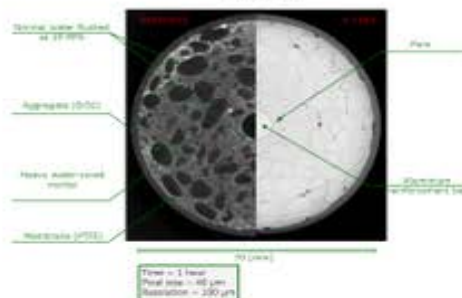
Complementary (x+n) studies at high resolution and high speed



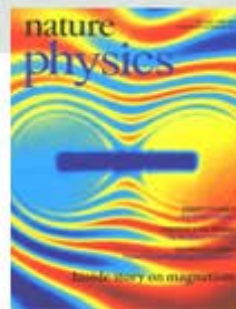
Grating interferometry



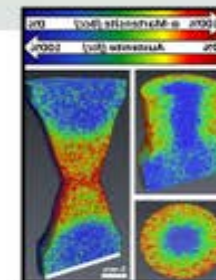
Advanced processing



Polarised



Energy-selective

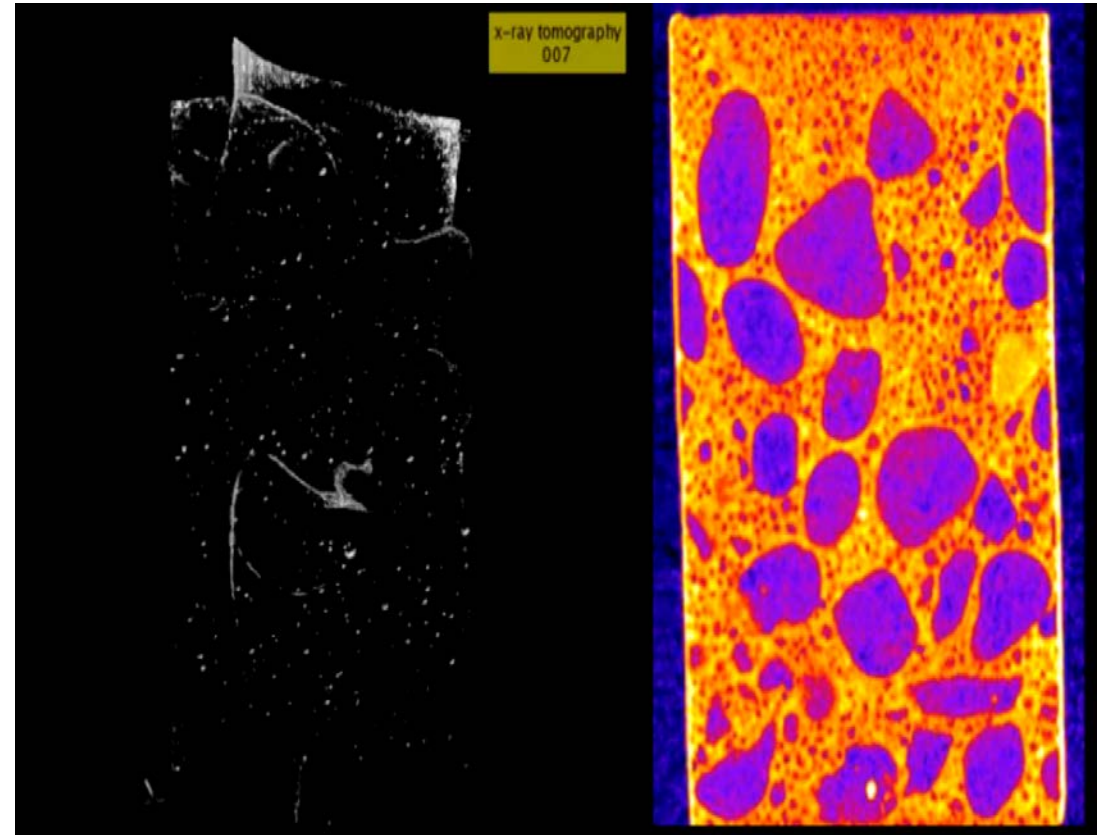
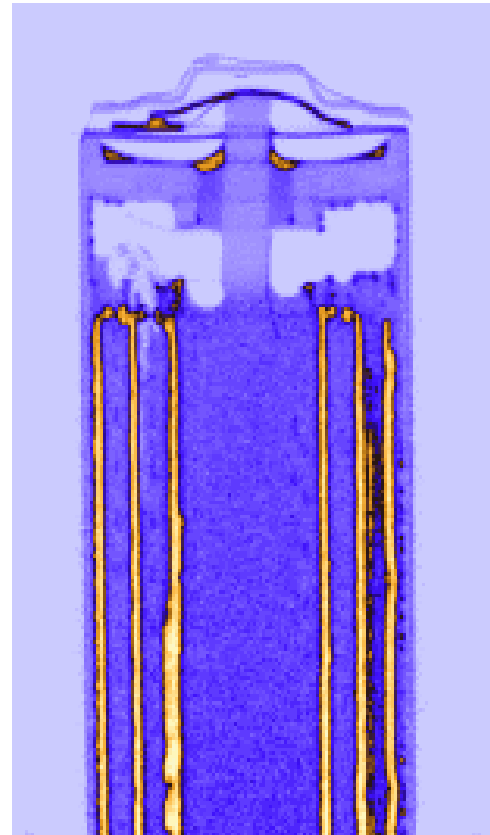






# Neutron imaging examples

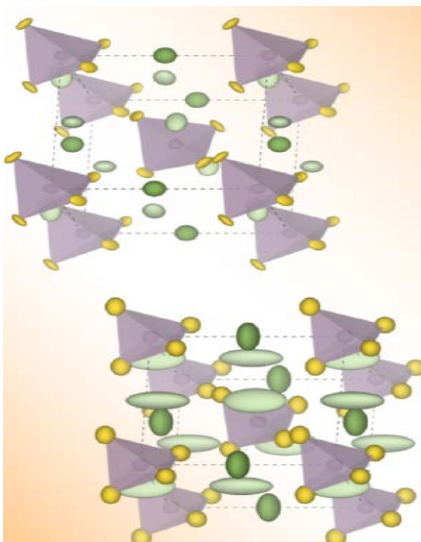
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# Researchers study diverse areas of science at the ILL

## Developing new battery technologies

Solid electrolyte  $\text{Na}_3\text{PS}_4$   
D2B, IN6



Framprakis et al. *Chemistry of Materials*, 2022

## Understanding COVID-19 infection

SARS-Cov-2 spike fusion proteins  
D22, Figaro, IN5, IN15,  
D-Lab, PSCM



Santamaria et al. *J. American Chemical Society*, 2022

## Complex movement of magnons in a skyrmion lattice

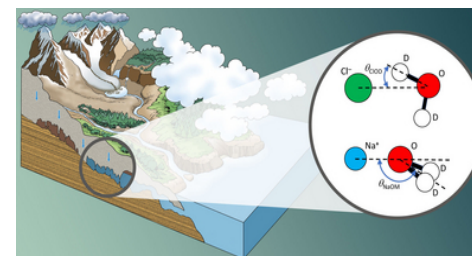
Polarized inelastic neutron scattering of MnSi  
Thales



Weber et al. *Science*, 2022

## Exploring salty water structure - carbon sequestration in deep aquifers

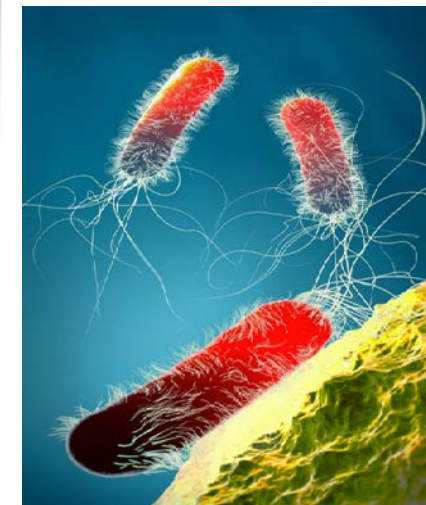
NaCl in D<sub>2</sub>O by in situ high-pressure neutron diffraction, chlorine isotopic substitution  
D4



Polidori et al. *J. Chem. Phys.*, 2021

## Blocking bacterial infection

Neutron crystallography of LecB  
LADI/DALI

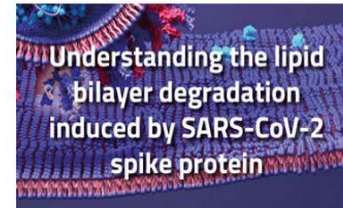


Gajdos et al. *Nature Com.* 2022



# The ILL is Europe's Flagship neutron sources

- Operates one of the most intense neutron source in the world
- Offers constantly the best **cutting-edge instrumentation**
- Is aware of scientific trends to **answer novel needs** amongst the users community
- Attracts and benefits from the best researchers from its associate and partner countries



Scientific Report



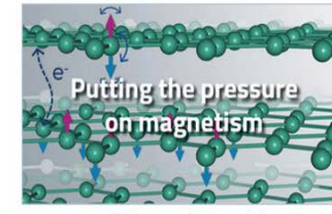
Cement and Concrete Research



Chem. Mater.



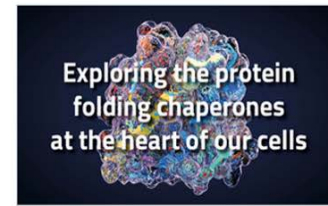
J. Nucl. Med.



Phys. Rev. X



Nature



Nature Communications



Structure



Phys. Rev. Lett.



WE ARE LOOKING FORWARD TO WELCOMING YOU



THE EUROPEAN NEUTRON SOURCE