

**Interreg**

Öresund-Kattegat-Skagerrak  
European Regional Development Fund



EUROPEAN UNION



**ESS & MAX IV:  
Cross Border  
Science and Society**

# How can industry make use of the tools available at MAX IV and ESS



Linking Industry to Neutrons and X-rays



**EUROPEAN  
SPALLATION  
SOURCE**

# Program (morning)

9.30 Coffee and registration

10.00 Introduction to MAX IV and industrial access modes – Magnus Larsson (MAX IV)

10.25 Introduction to ESS – Pascale Deen (ESS)

10.40 Making use of large research infrastructure through mediator companies - Anna Stenstam (CR)

11.00 The use of large research infrastructures in industrial catalysis - Alfons Molenbroek (Haldor Topsoe)

11.20 Making use of large research infrastructures through academic collaborations. - Lars Johnson (Sandvik)

11.40 Questions and reflections on the morning presentations

12.00 Lunch

# Program (afternoon)

13.00 What different actions can be done at the regional level to strengthen the industrial cooperation and industry relevant research? Examples from Copenhagen. - Jakob Øster (Region Hovedstaden)

13.20 Research institutes, one point of entry for industry - Olof Sandberg (RISE – Research Institutes of Sweden)

13.40 Linking Industry with X-ray and neutron analysis - Jimmy Andersen (LINX project)

14.00 How can an academic research center to be a link between industry and facilities? - Per-Anders Carlsson (Competence Centre for Catalysis)

14.20 Coffee

14.50 Panel discussion – Good examples and room for improvements. What can be done to strengthen the industrial exploitation of research infrastructures? - Sindra Petersson Årsköld

16.00 Bus to MAX IV

16.30 Visit to MAX IV

17.30 Bus to Lund C

# MAX IV Laboratory

- A Swedish research infrastructure
- Financed by VR, Lund University, Vinnova, Region Skåne, Knut & Alice Wallenbergstiftelsen, 12 Swedish Universities
- 200 employees
- A user facility with more than 2000 users yearly at full operation



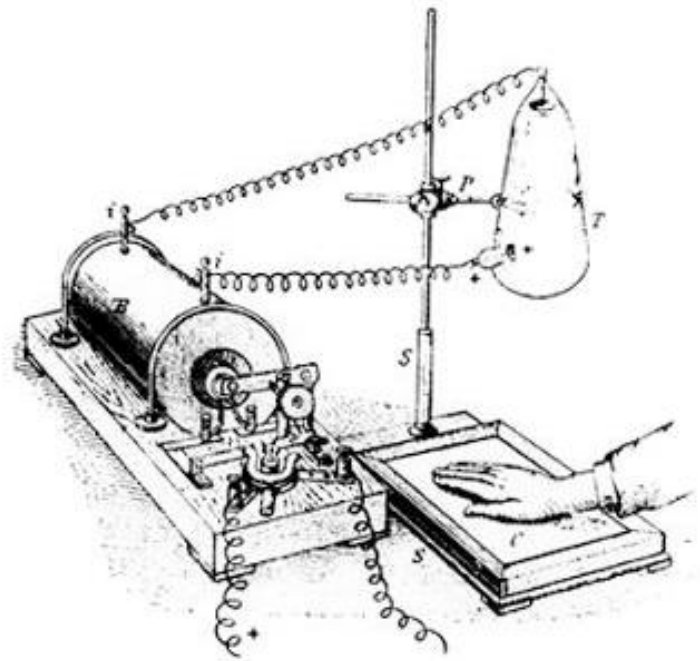


# Röntgenstrålning



Dr. W. C. Röntgen

FOTOGRAF. GEM. STEN. LIT. A. H. ST.



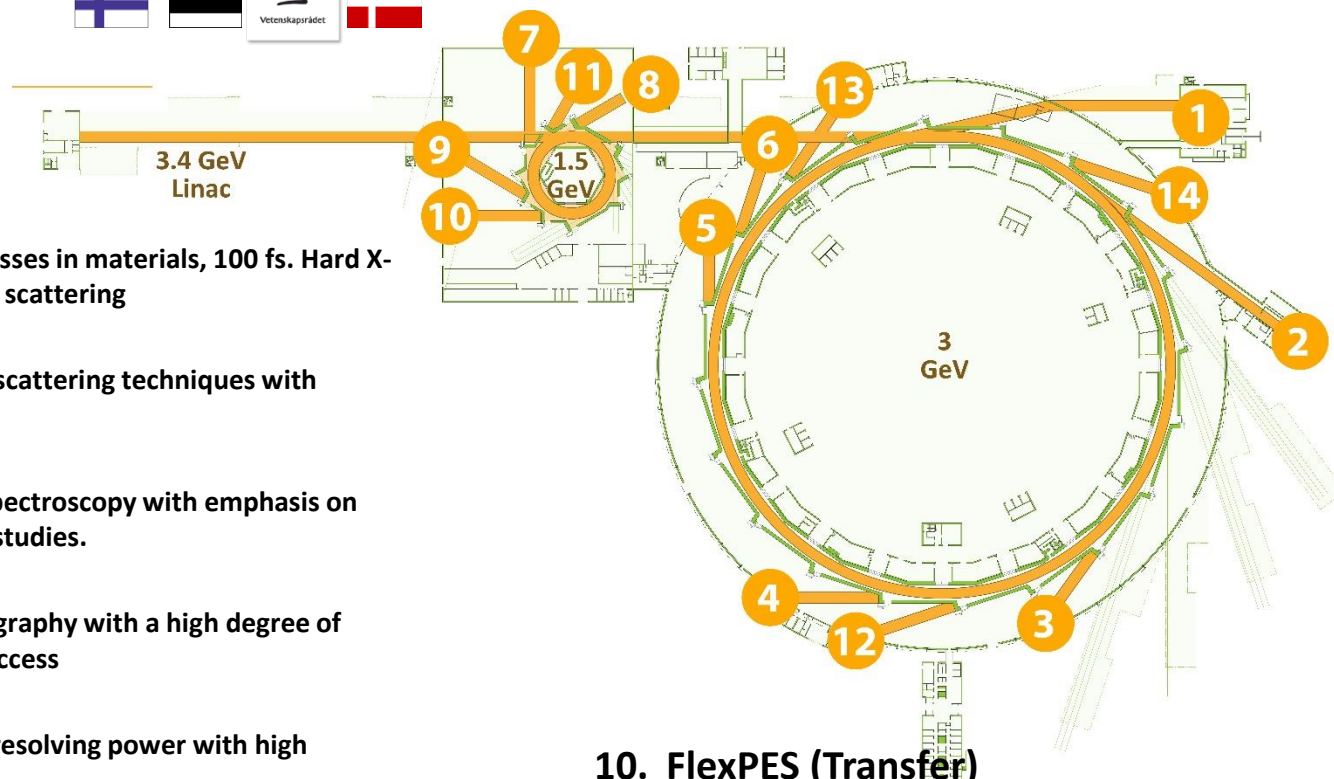




➔ Elektroner  
~~~~~ Röntgenstrålning



# The 14 funded beamlines



## 1. FemtoMAX

Studies of ultra-fast processes in materials, 100 fs. Hard X-rays, diffraction and X-ray scattering

## 2. NanoMAX

Imaging, spectroscopic & scattering techniques with nanometer resolution

## 3. BALDER

(Hard) X-ray absorption spectroscopy with emphasis on *in-situ* and time resolved studies.

## 4. BioMAX

Macromolecular crystallography with a high degree of automation and remote access

## 5. VERITAS

RIXS combining a unique resolving power with high spatial resolution.

## 6. HIPPIE

High-pressure photoelectron spectroscopy

## 7. ARPES

Angle resolved photoelectron spectroscopy for detailed studies of the electronic structure.

## 8. FinEstBeaMS

Estonian-Finnish Beamline for low density matter

## 9. SPECIES (Transfer)

High-pressure photoelectron spectroscopy and RIXS

## 10. FlexPES (Transfer)

Photoelectron Spectroscopy and NEXAFS

## 11. MAXPeem (Transfer)

XPEEM & LEEM

## 12. CoSAXS

SAXS, WAXS, XPCS and imaging

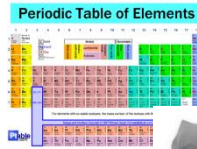
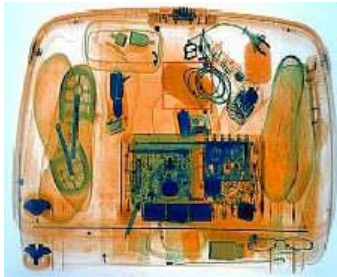
## 13. SoftiMAX

Coherent Soft X-Ray Imaging, STXM...

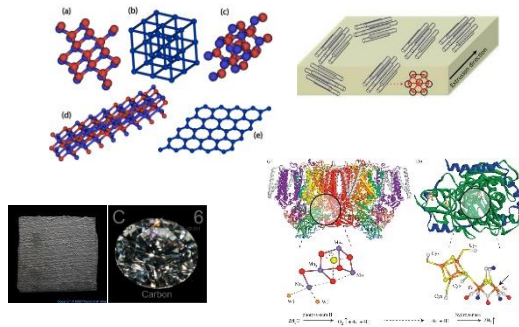
## 14. DanMAX

Danish beamline for imaging and powder diffraction

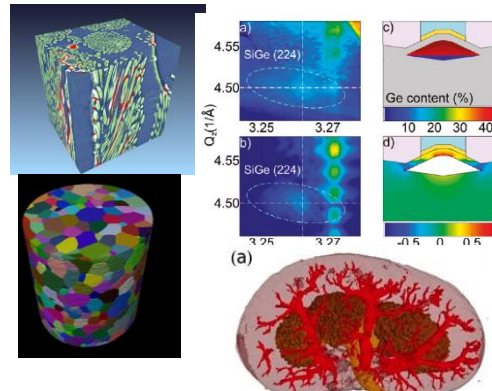
# Looking into things around us



## Structure - Scattering



## Morphology - Imaging



High penetration  
power

Non-destructive  
"Real" samples under  
"real" conditions

High flux  
Time resolution,  
3D -> 4D imaging  
Statics -> Dynamics

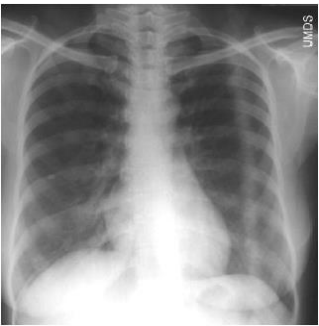
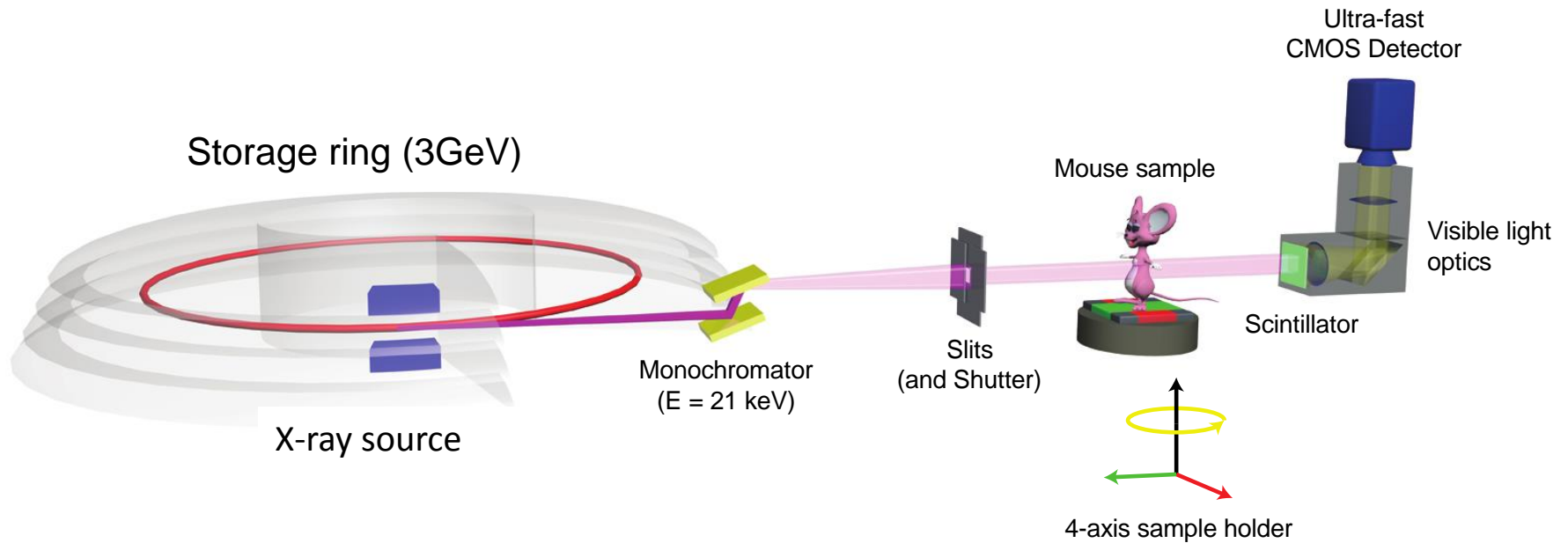
In-situ and  
In operandi  
Materials -> Processes



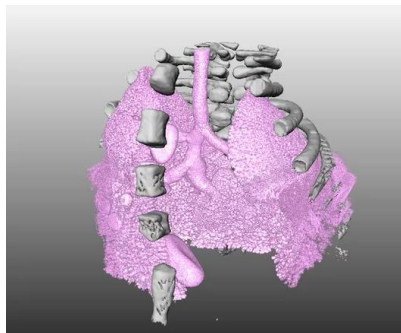


# X-ray imaging

# Tomographic microscopy at synchrotron



Radiographic projection  
clinics



Tomographic reconstruction  
Synchrotron

**Pixel size:** 11  $\rightarrow$  0.3  $\mu\text{m}$

**FOV:** 22 x 22  $\rightarrow$  1 x 1  $\text{mm}^2$

**Projections:** 300–2000

**Exposure times:** 0.1–300 ms

**Total scan time:** 0.05 to 500 s



R. Mokso, *et al.*, Scientific Reports **5** (2015) 8727

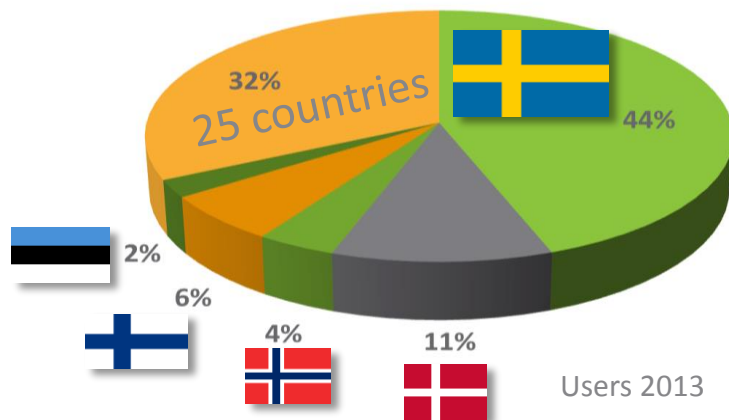
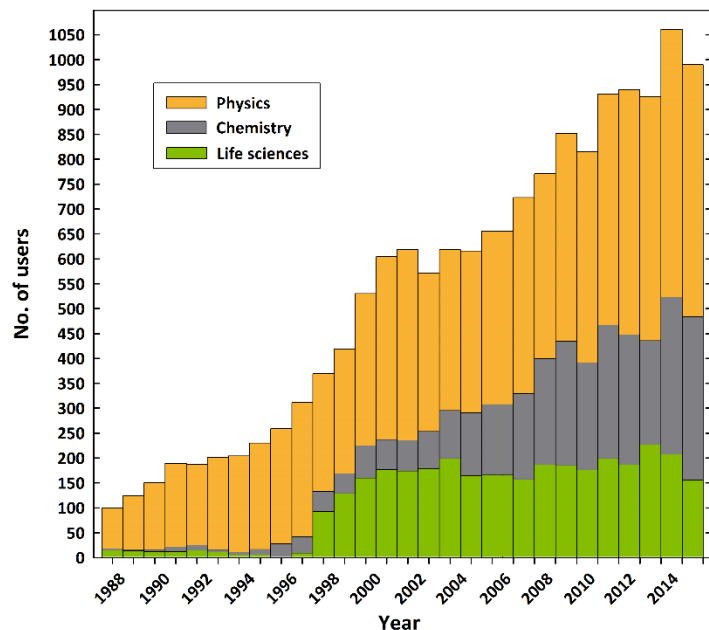




**Industry users**

# MAX IV an International National User Laboratory

## Academic



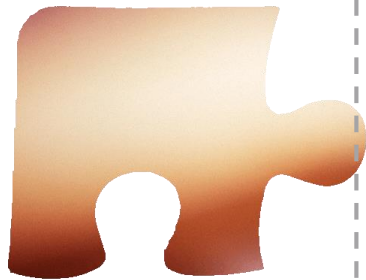
Users 2013

## Commercial



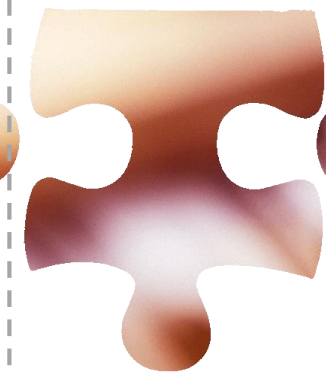
# Connecting Industrial users with MAX IV e.g. “mind the gaps” for new users

- Problem
- Idea
- New product
- Damaged product
- New hypothesis

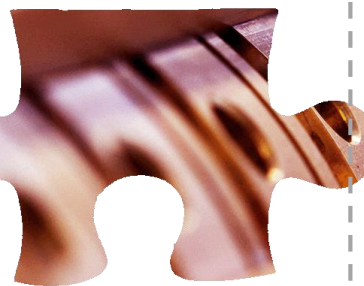


The User

- Translating the problem
- Choice of method
- Sample preparation
- Define test plan



- Develop test methods & new equipment
- Maintain equipment
- Execution of tests

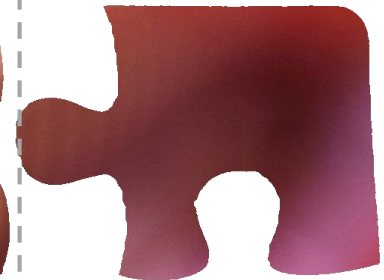


Max IV

- Data formatting
- Data analysis
- Data vs. models and calculations



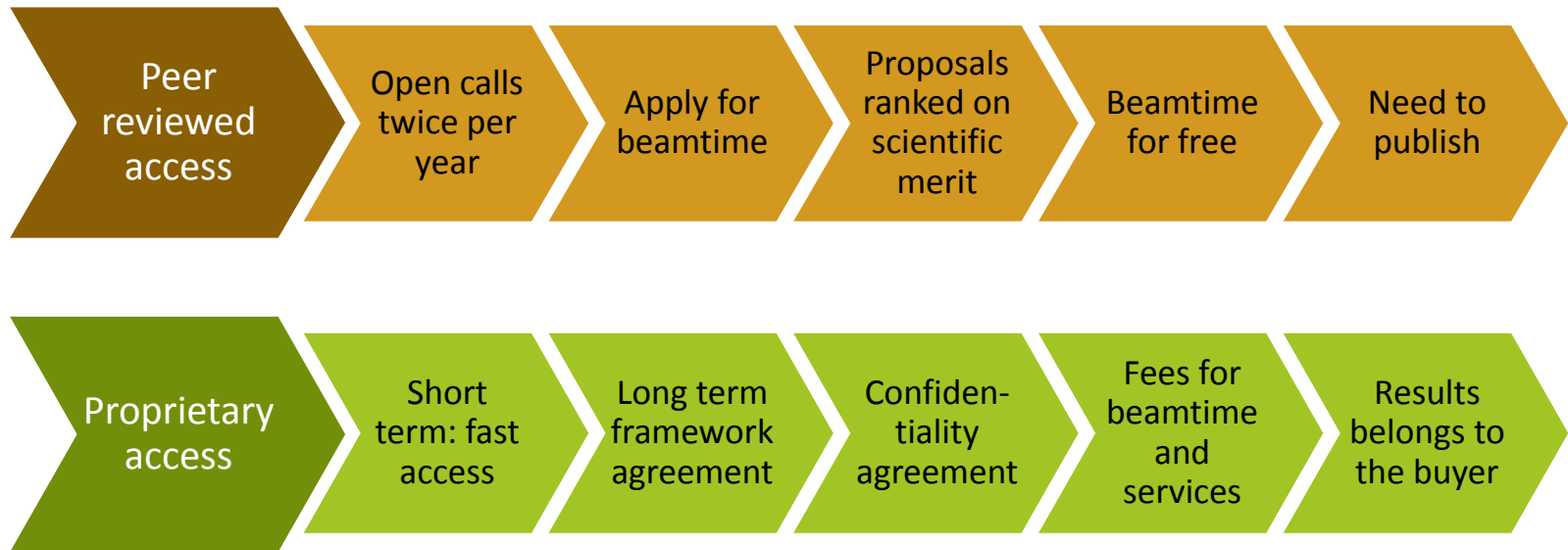
- Solution
- Answer
- Insight
- Confirmation / rejection
- Understanding
- New idea



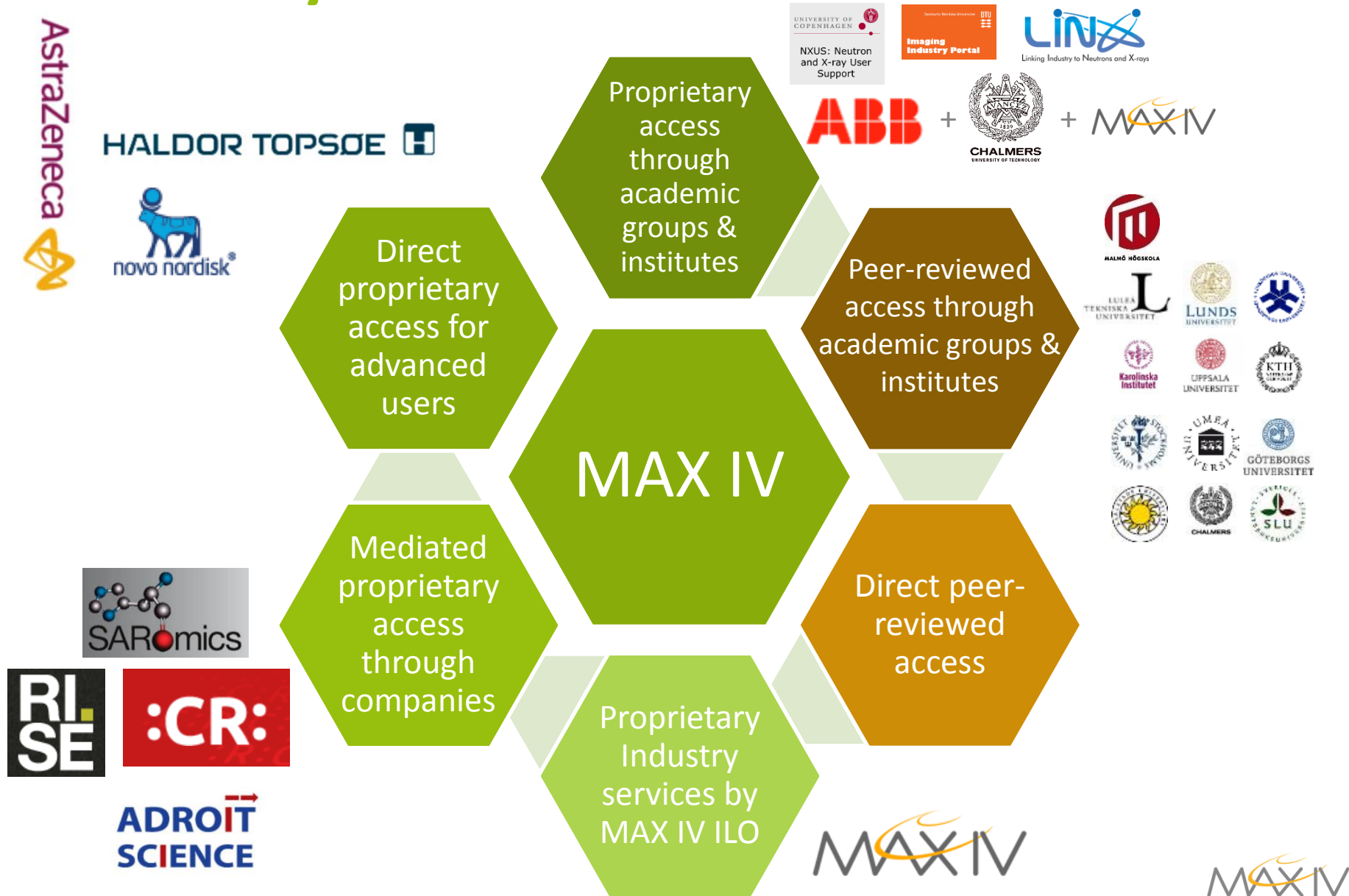
The User



# Two types of access



# Many different routes into MAX IV



# ForMAX – Forest industry at MAX IV



Pågående diskussioner med:



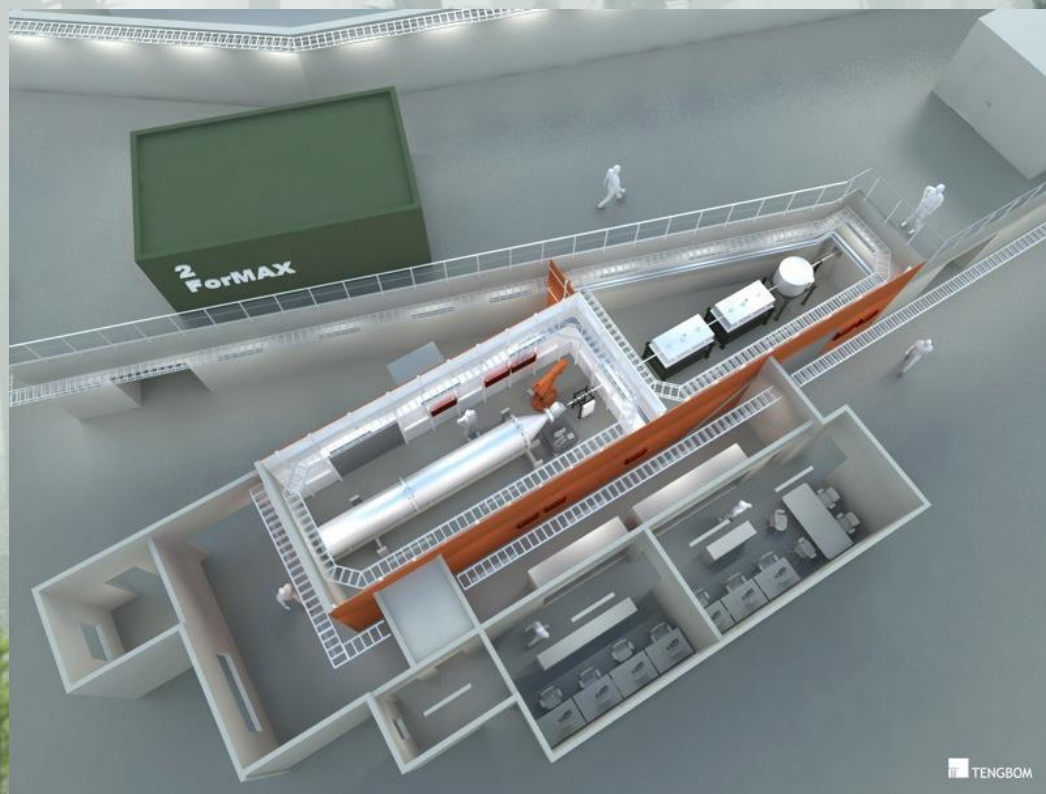
HOLMEN



SVEASKOG



WWSC  
WALLENBERG WOOD  
SCIENCE CENTER





# Strategy - analysis sector by sector

Industry sector and associated Institutes – Trade organisations –  
Research Centres – Universities

Examples of ongoing and planned sector discussions:

- Metals
- Wood materials
- Food & Packaging
- Health & Pharma
- Nanotechnology
- Bio and Soft Materials
- Energy & Energy materials
- Automotive & aerospace



# Thank you!

- Magnus Larsson  
magnus.larsson@maxiv.lu.se  
+46-(0)725-546309