



# SCIENCE LINK



**Baltic Sea Region**  
Programme 2007-2013

Part-financed by the European Union  
(European Regional Development Fund)

# Science Cooperation in the Baltic Sea Region the MAX IV Perspective

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Science Link Contact and Consultation Point, Sweden

Slides produced by Dr Axel Steuwer, MAX IV Laboratory

Science Link Mid-Term Conference, June 10-11 2013, St. Petersburg



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## Lund, city centre



## Lund Science Village

Goal: To become the world's best research and innovation environment







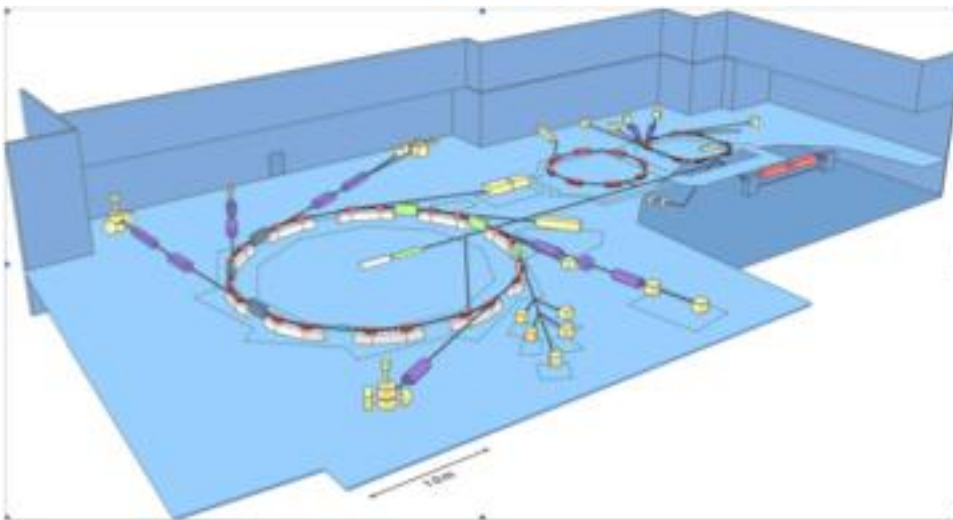
LUND  
UNIVERSITY



MAX Lab

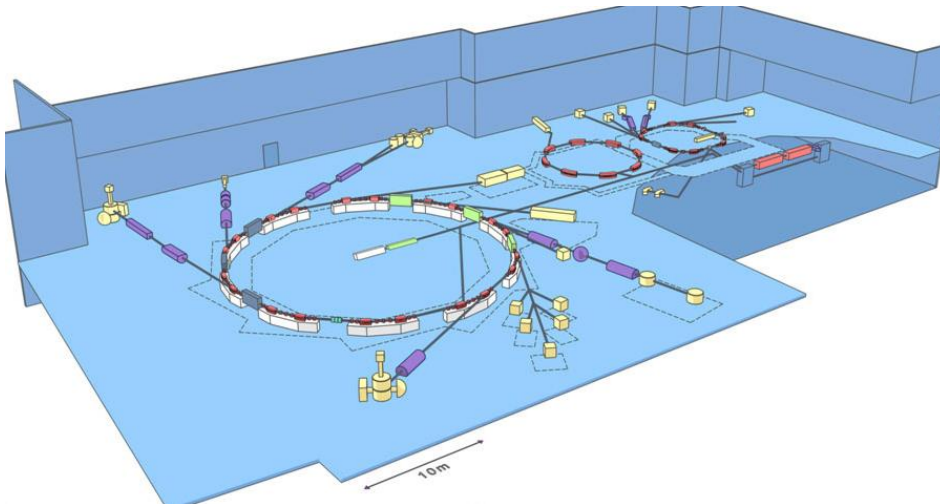
+

MAX IV Project

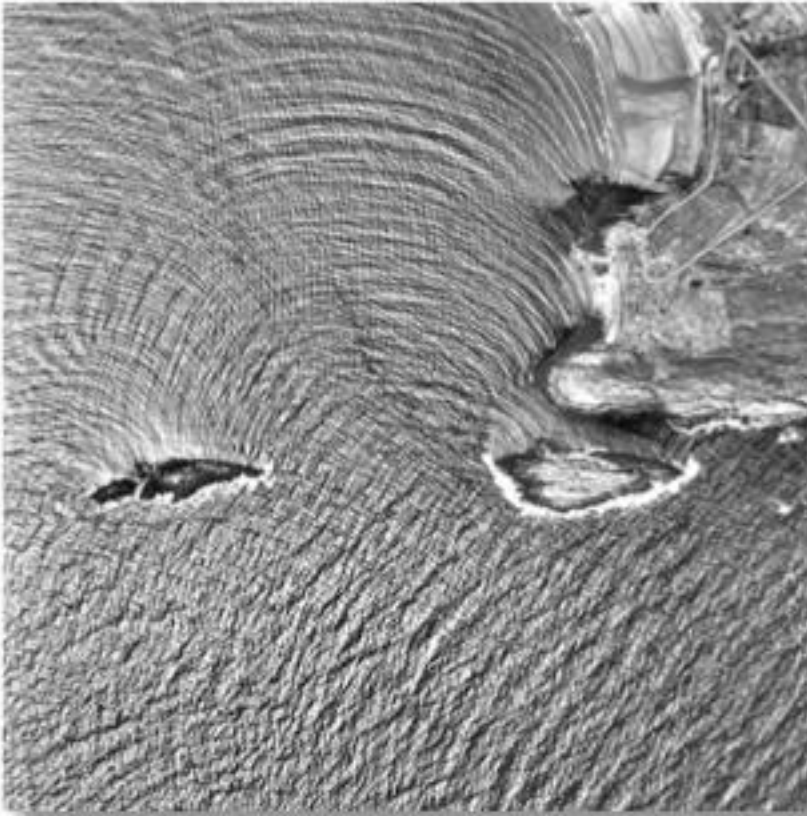


# MAX-Lab. A knowledge institution.

- Three existing rings, MAX I-II-III
- User facility
- 1000 Users p.a.
- Hundreds of Scientific Publications p.a.
- 50 PhDs p.a.

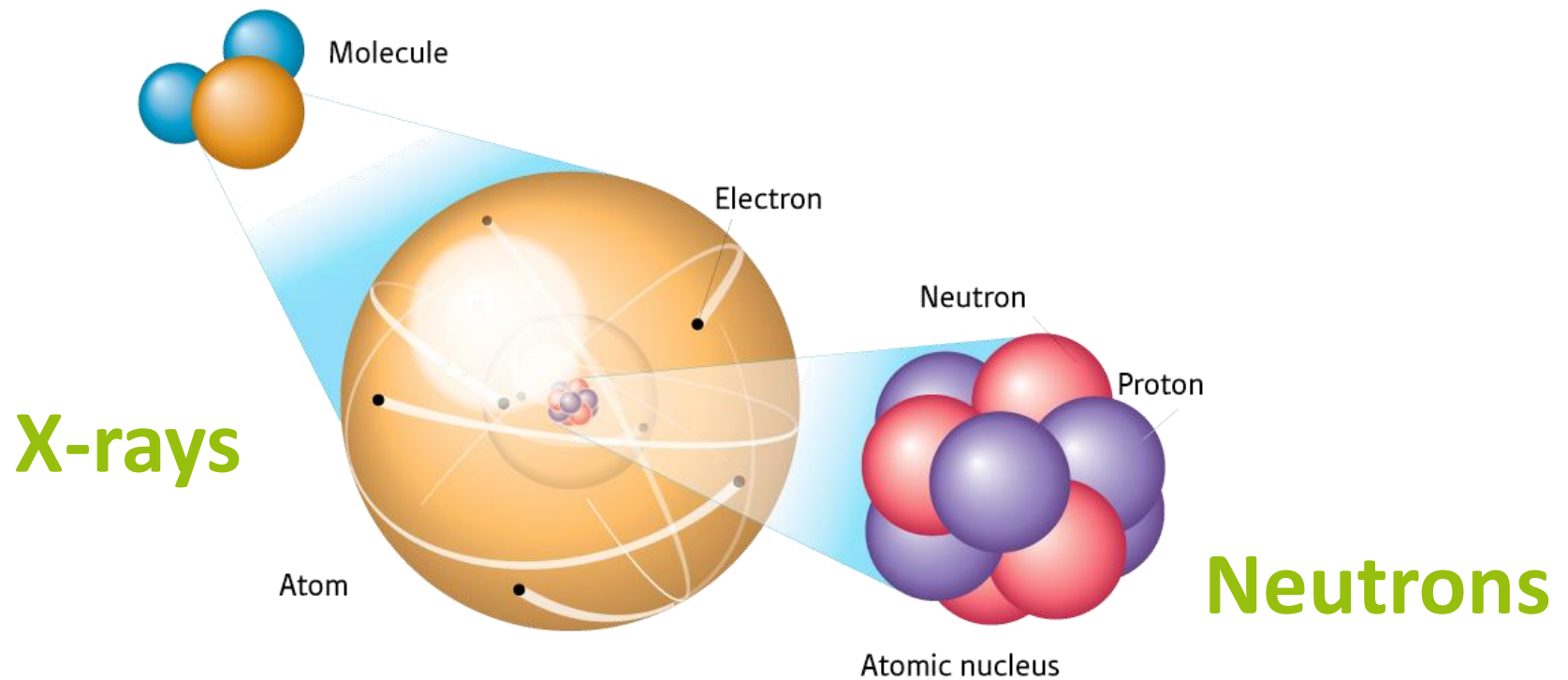


## MAX IV. Making waves.

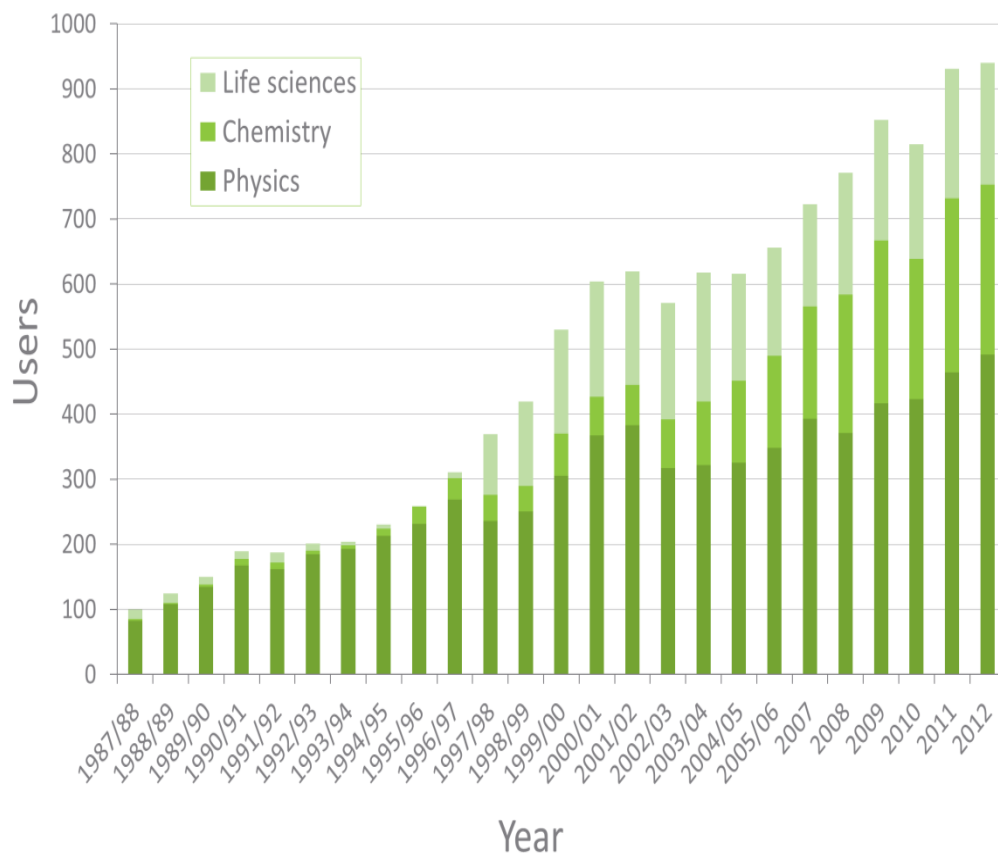


Consider ESS/Max-IV equal in terms of functionality

# MAX IV v ESS. Complementarity.

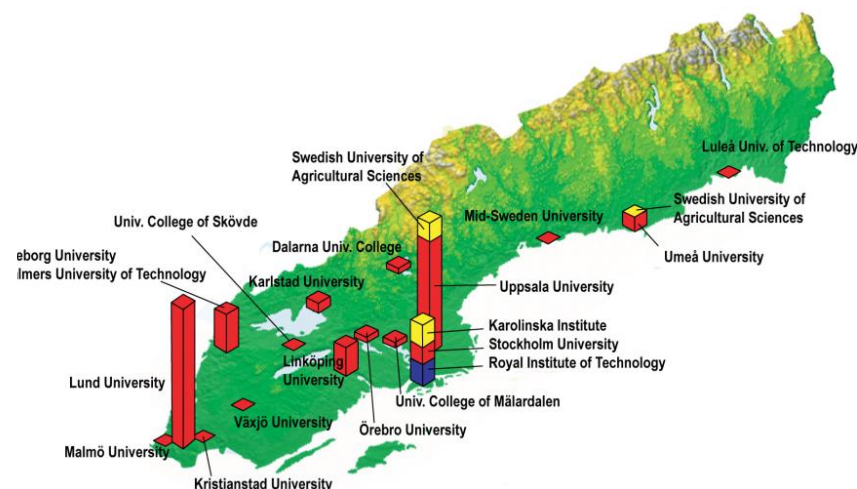


# MAX Lab. A User Facility

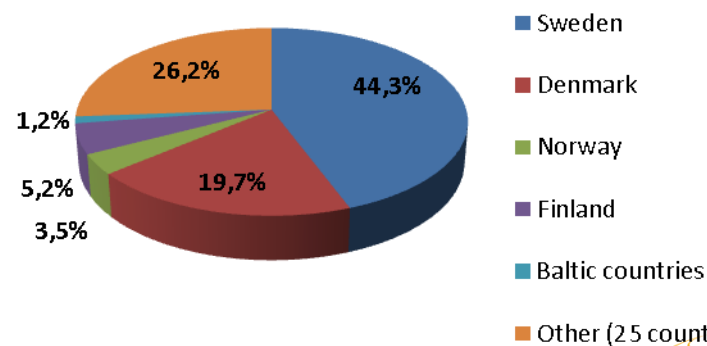


MaxII

A truly national laboratory ...



.. and international



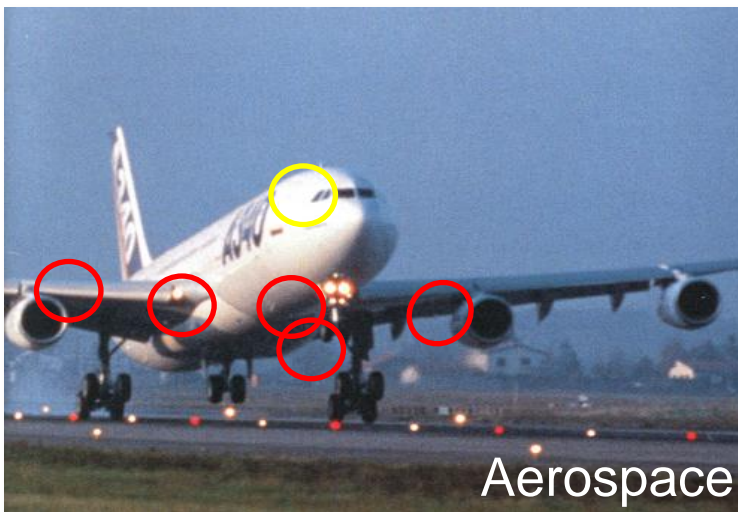


# Synchrotron X-rays. General Applications

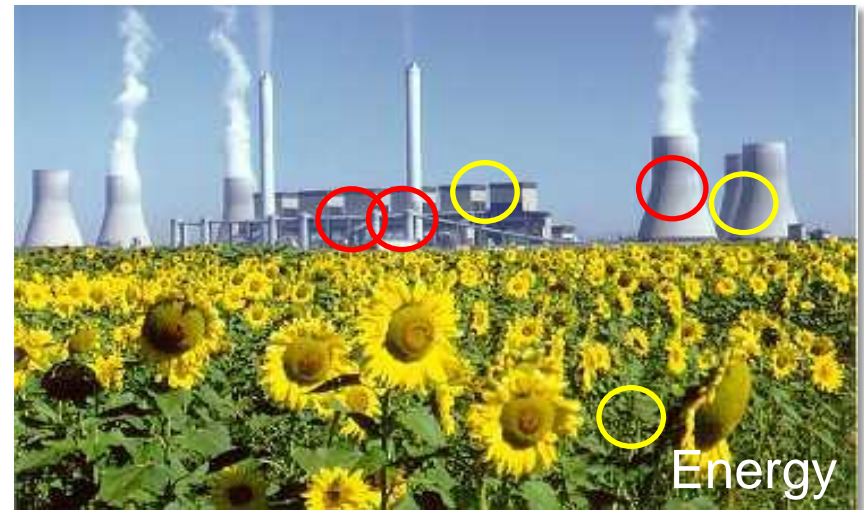
Consumer, Health, Life, IT



Automotive

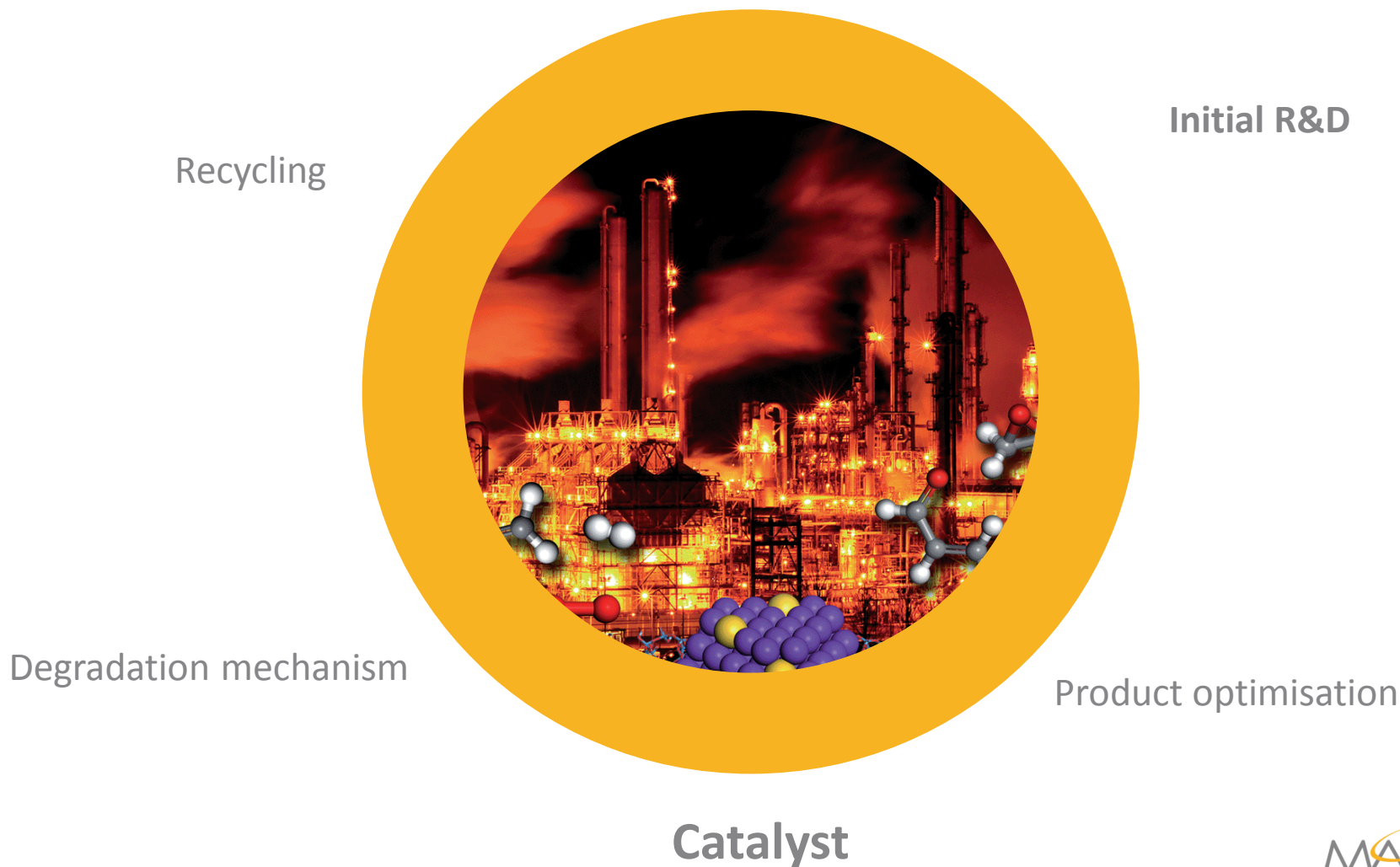


Aerospace



Energy

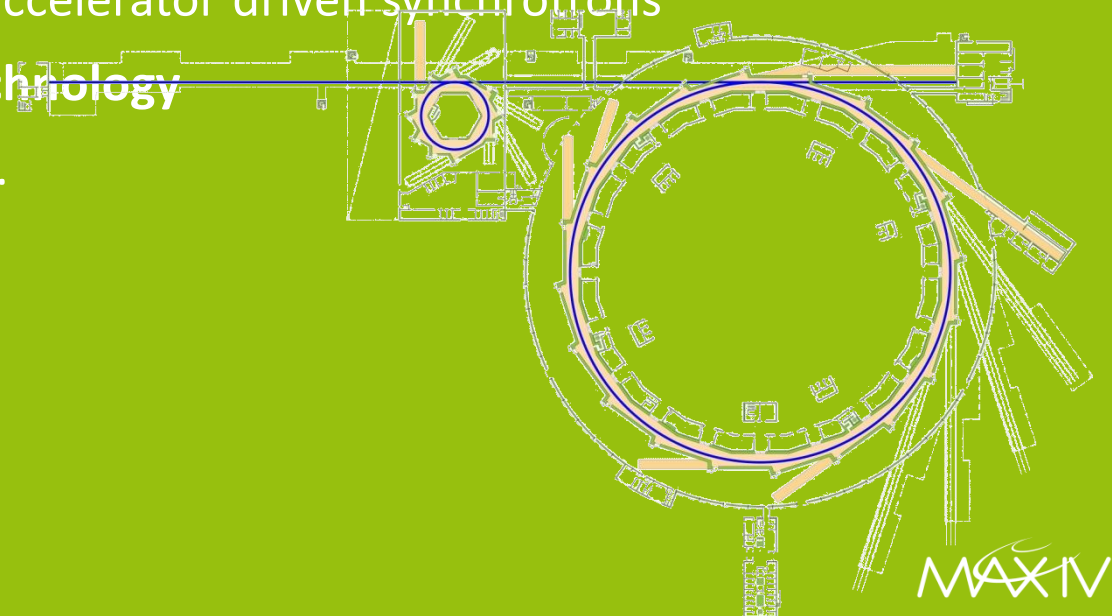
# Process Development. Life cycle



# What is MAX IV ?

- Swedish national infrastructure project (internationalisation)
- Total construction cost around 300 M EUR
- Approx. 40 M EUR operating budget
- Latest generation synchrotron source
- Flux rivalling Free Electron Lasers
- 25 years of experience in accelerator driven synchrotrons
- **Pioneering accelerator technology**
- From 1000-3000 Users p.a.
- 200+ staff

Reduce, Reuse, Recycle





# MAX IV. The architectural design.





# MAX IV – overview

3 GeV Linac

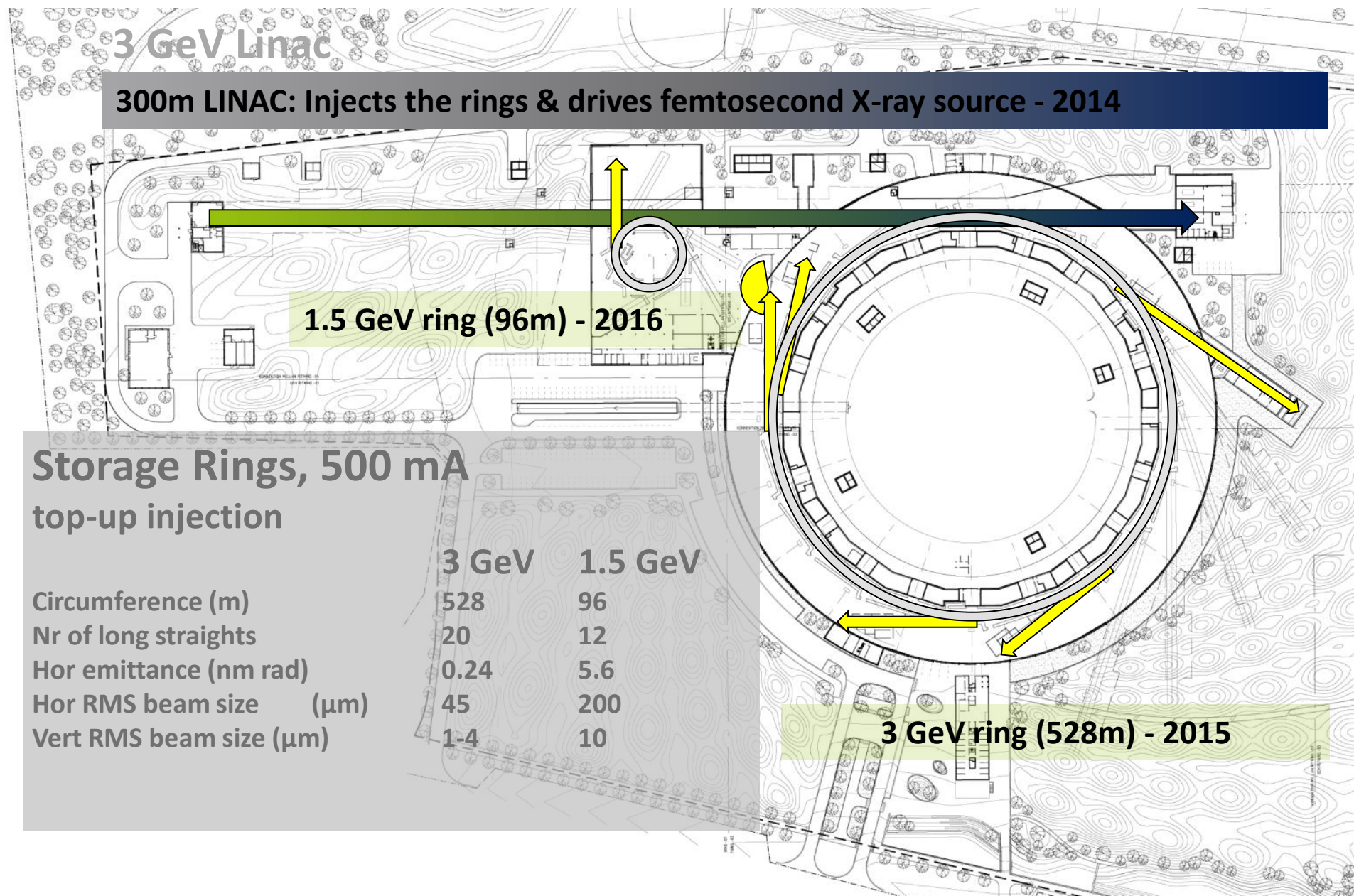
300m LINAC: Injects the rings & drives femtosecond X-ray source - 2014

1.5 GeV ring (96m) - 2016

Storage Rings, 500 mA  
top-up injection

	3 GeV	1.5 GeV
Circumference (m)	528	96
Nr of long straights	20	12
Hor emittance (nm rad)	0.24	5.6
Hor RMS beam size (μm)	45	200
Vert RMS beam size (μm)	1-4	10

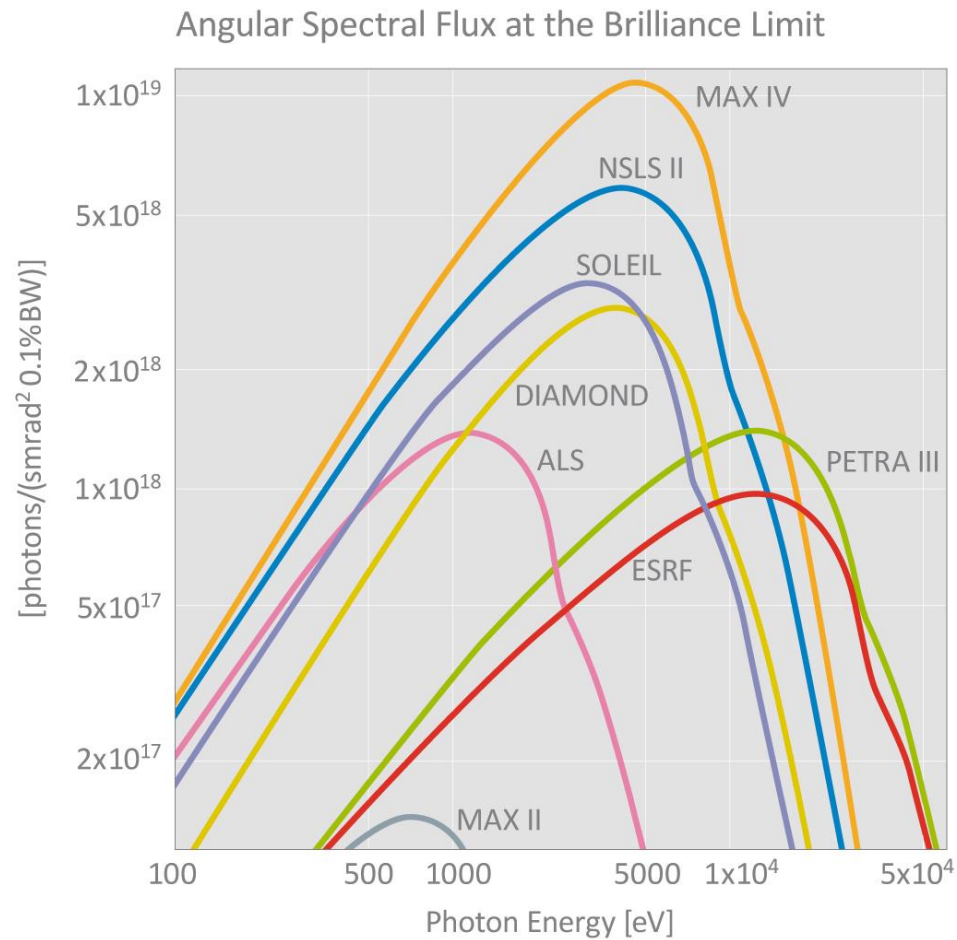
3 GeV ring (528m) - 2015



# Emittance. A Comparison

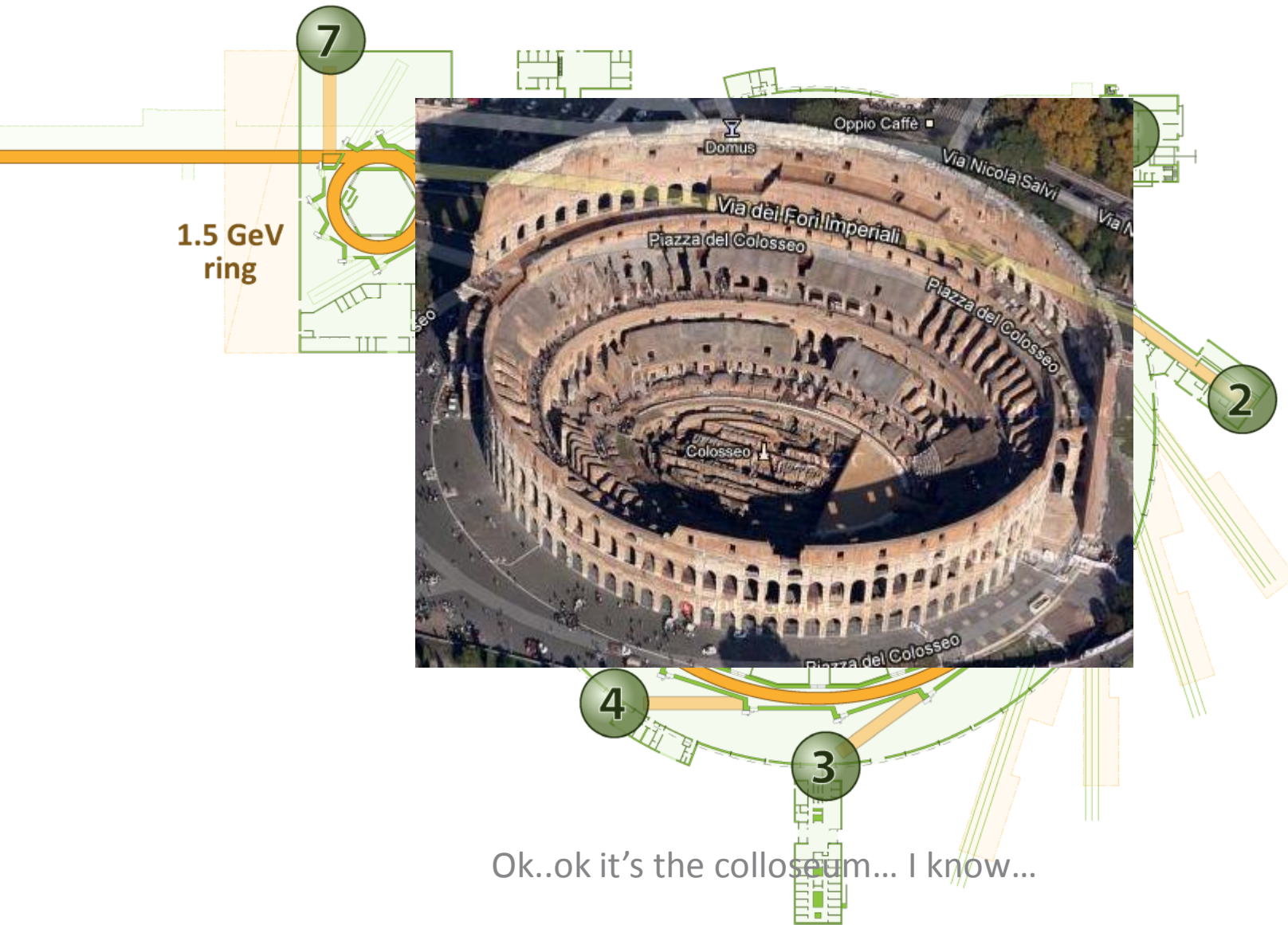
Facility	Location	Started	Emittance, nmrad
ELETTRA	Trieste, Italy	1993	7-9.7
ESRF	Grenoble, France	1994	4
MAX II	Lund, Sweden	1997	8.8
BESSY II	Berlin, Germany	1998	5.2
SLS	Villigen, Switzerland	2001	5
SOLEIL	Paris, France	2007	3
DIAMOND	Oxford, UK	2007	2.74
PETRA III	Hamburg, Germany	2010	1
NSLS II	Brookhaven, USA	2015	0.6-1
<b>MAX IV</b>	<b>Lund, Sweden</b>	<b>2015</b>	<b>0.24-0.36</b>

# Brilliance: A Comparison





# MAX IV. The Circus MAXimus



Ok..ok it's the colloseum... I know...



# The most ambitious project in Swedish Research Infrastructure!

1. >25 years of successful work
2. Breakthrough technology
3. Combines: research, education, innovation



4. Platform for research & innovation
5. A magnet for ideas, people, instruments
6. A motor for the region



ESS MAX IV  
i regionen-TITA



# Major Funders of the MAX IV Laboratory



CHALMERS



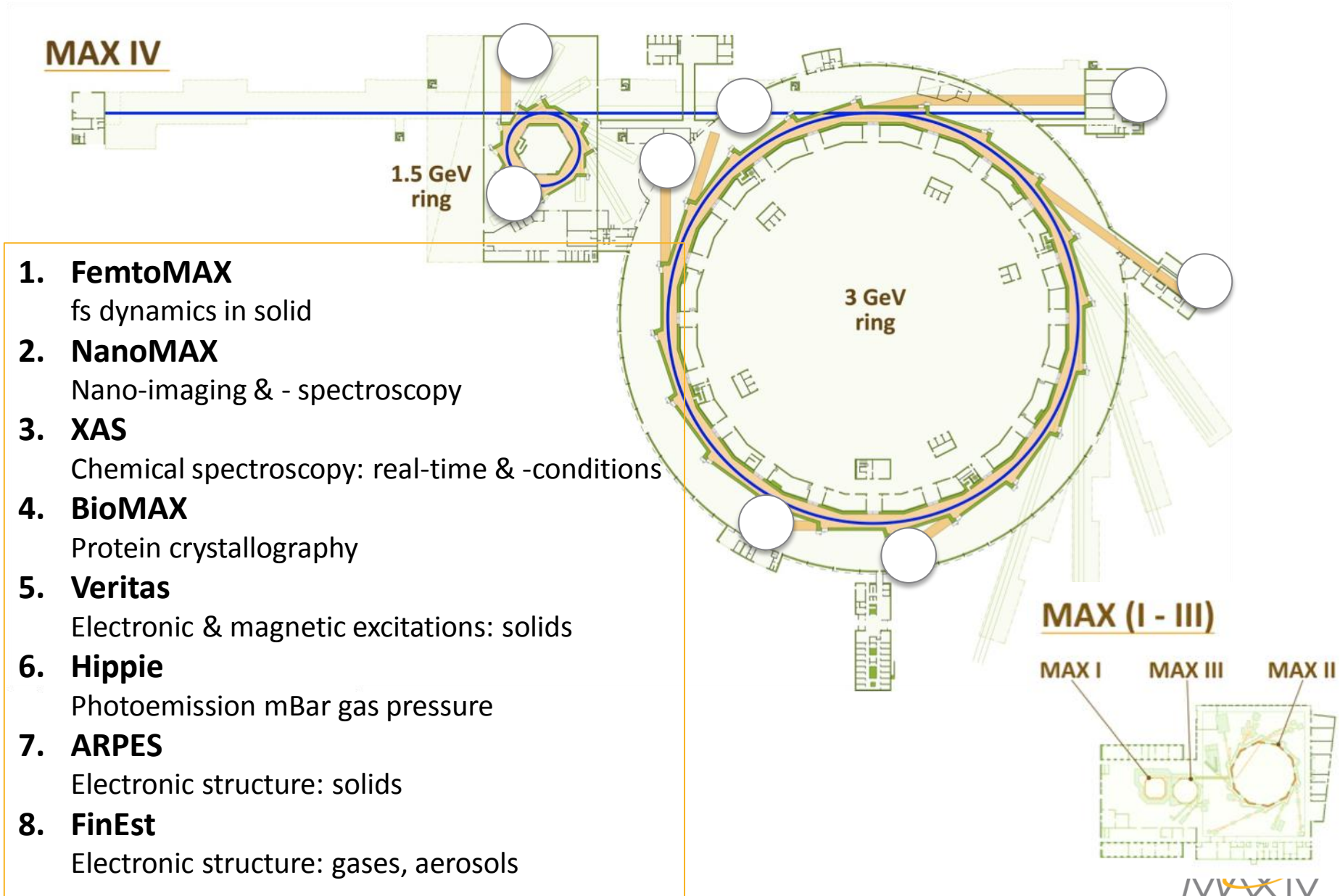
UNIVERSITY OF  
GOTHENBURG



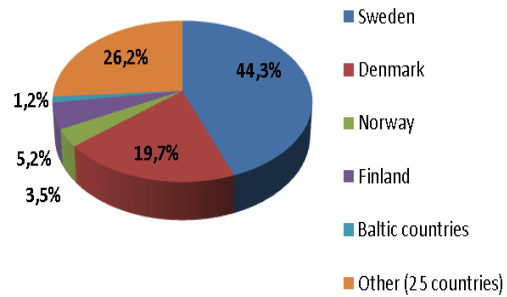
Stockholm  
University



# MAX IV. The beam lines.



# MAX IV. The Öresund/Baltics



Science Link

1911 Cassiopeia

Danish Diffraction-Imaging  
Beam line

Internationalisation.



FinEst beam line

Solaris



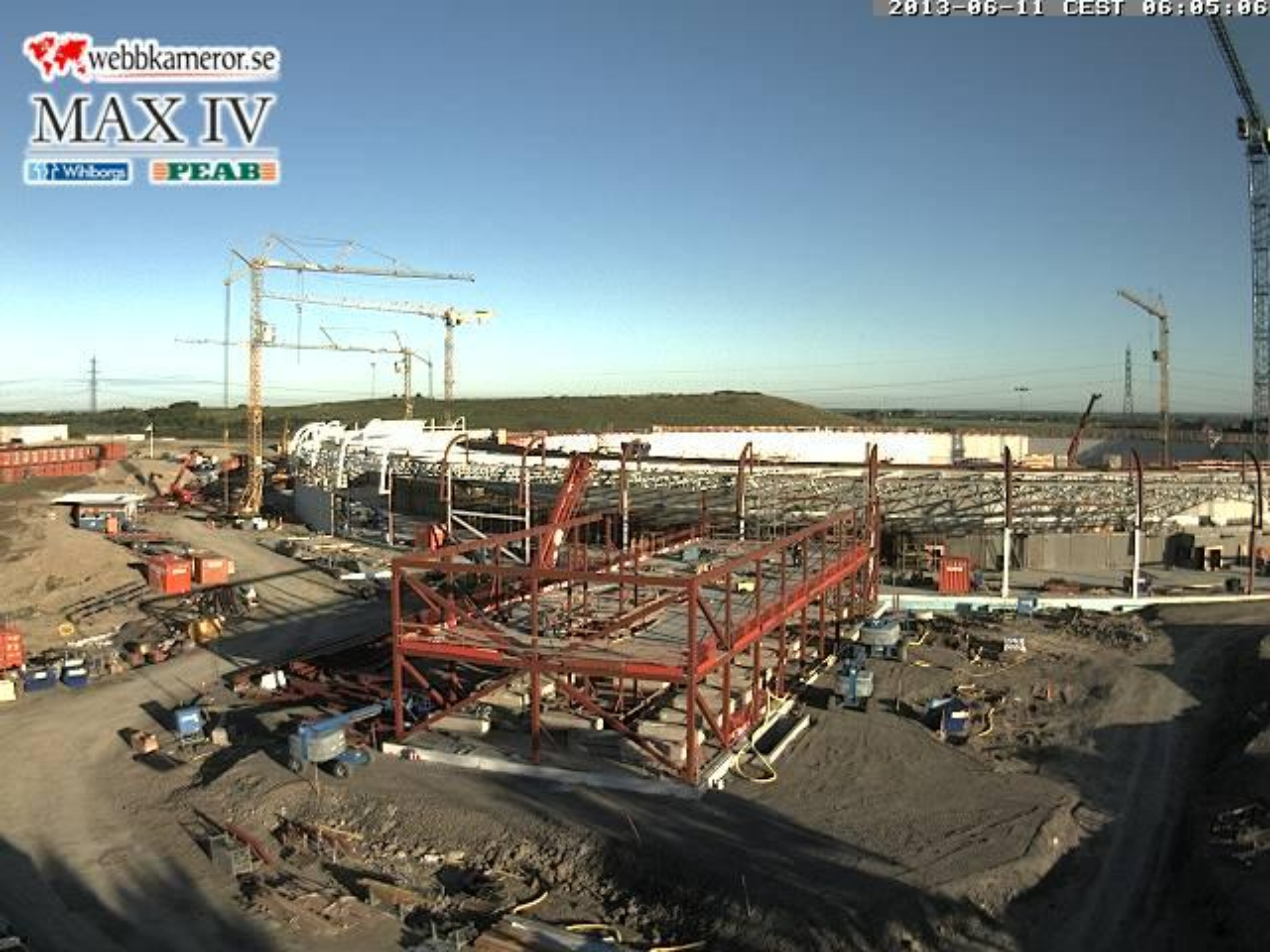
# The Site in 2011













**Components are being installed  
in the LINAC hall!**





# **Innovation & Cross Border Collaboration**

# Innovation. A Culture

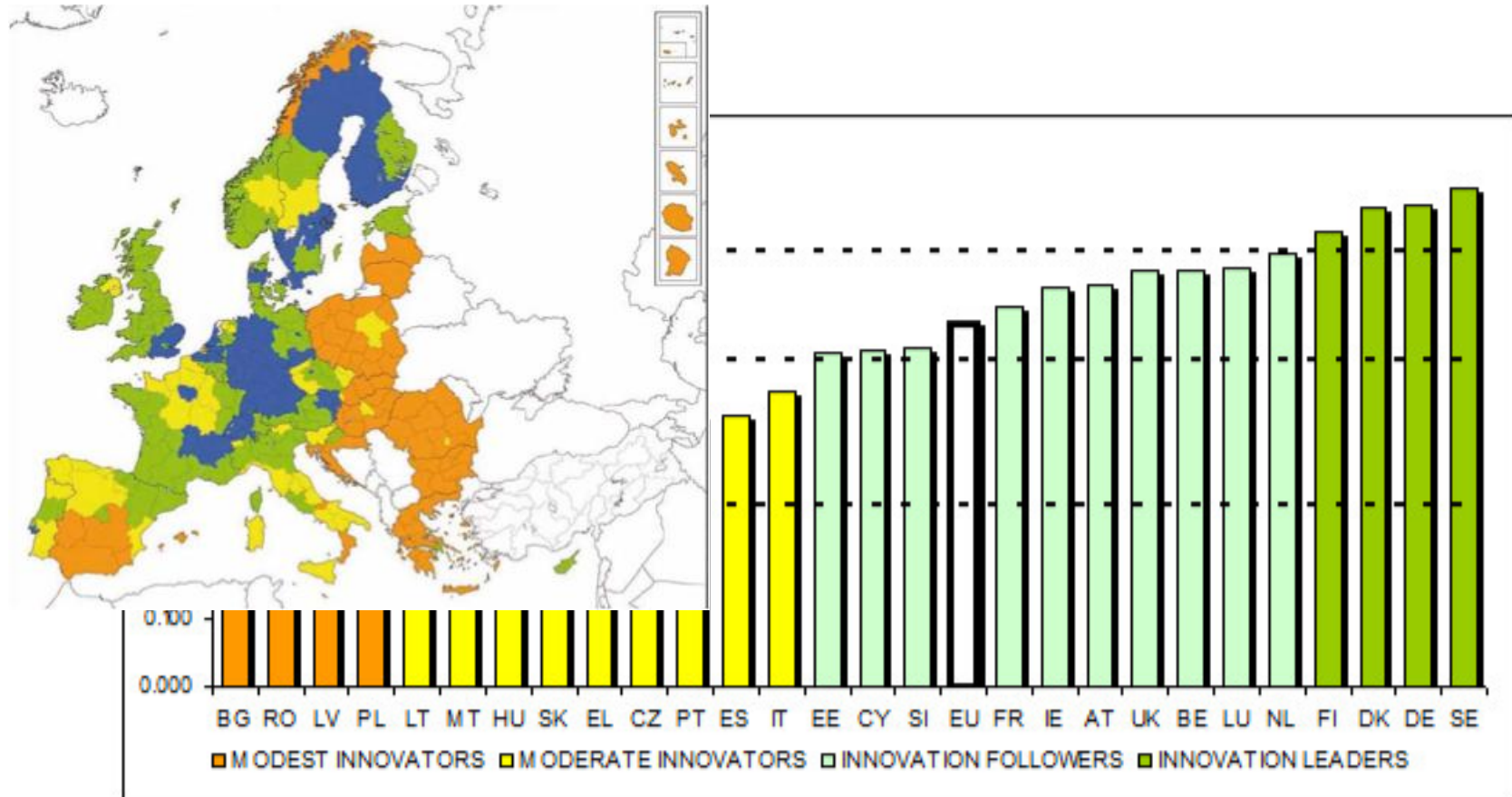


Swedish Governmental Agency for Innovation Systems, integrates research and development in technology, transport, communication and working life. **VINNOVA's mission is to promote sustainable growth by developing effective innovation systems and funding problem-oriented research.**

Through its activities in this field, VINNOVA aims to make a significant leading centre of economic growth.

The VINNOVA Policy series includes material that reflects on VINNOVA's position in different issues. For example: strategically important opinions expressed in government referrals, reports from special government commissions, strategic planning, or other documents where VINNOVA makes a policy-statement

# Sweden. Innovation Score Board



SE, DK Innovation leaders, regional leaders

1/3 of all EU BioLife funding

# Nurturing innovation?

- Facilities (LU, LTH, MAX IV Lab, ESS..)
- System (Skatteverket..)
- Support
  - Local (Ideon, LUIS...)
  - Regional (Region Skane, CPH)
  - National (Vinnova)
- Teacher's Exemption
- **Entrepreneurial Spirit**



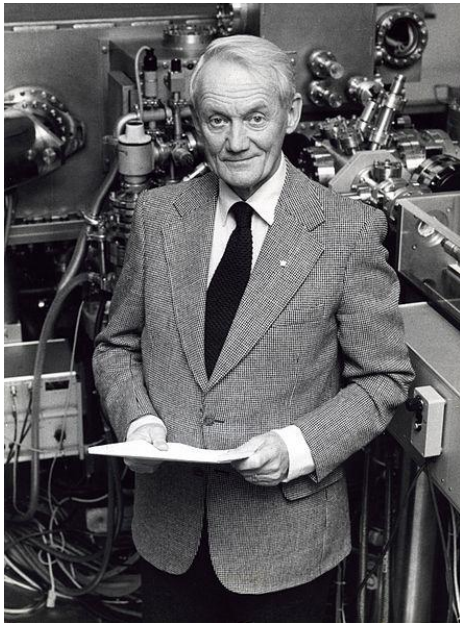


# Tradition.

- Kai Siegbahn, Nobel Prize 1981 (shared)
- Manne Siegbahn, Nobel Prize 1925

IKEA  
VOLVO  
SAAB  
Ericsson  
SKF  
Alfa Laval  
ASEA

Astra  
Pharmacia  
Nobel Industries  
Absolut  
Tetra Pak  
Atlas Copco  
Electrolux  
Hasselblad  
Metro  
...  
...

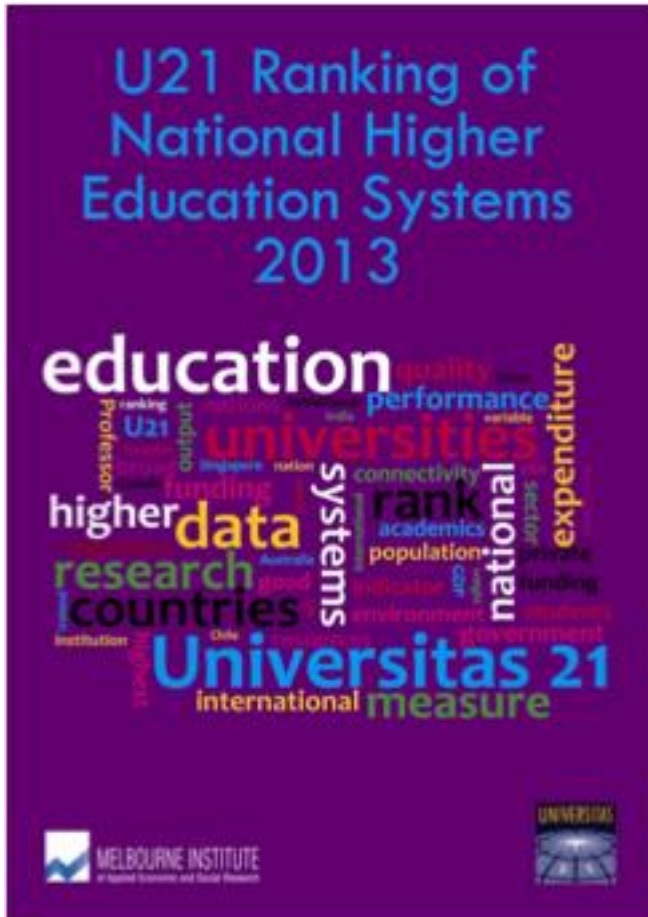


Electron Spectroscopy for Chemical Analysis (ESCA), now usually described as X-ray photoelectron spectroscopy (XPS)

Discoveries and  
research in the field  
of X-ray  
spectroscopy



# Sweden's higher education is #1



## Criteria: Resources, Environment, Connectivity and Output

### Top Five:

United States,  
Sweden,  
Switzerland,  
Canada  
Denmark

# Max IV Laboratory: Innovation



**Research & Development**  
Using synchrotron X-rays

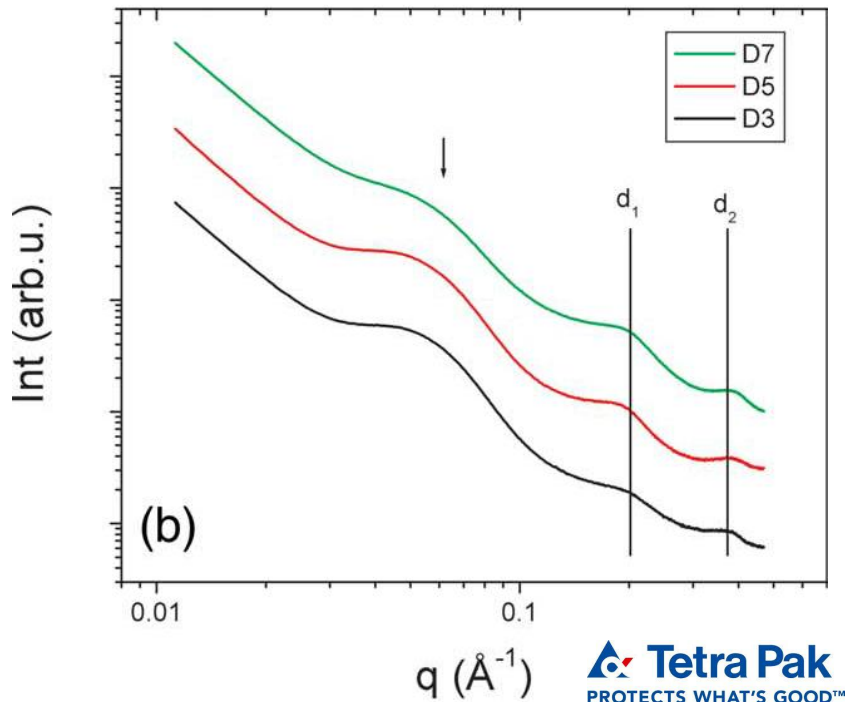


**Technology & Method**  
Development

# MAX IV. Industry & Innovation

- Example:

Oriented inorganic particles as gas diffusion layer in packaging.



HALDOR TOPSØE



novaled



Höganäs

MAXIV



AkzoNobel  
Tomorrow's Answers Today



Colloidal Resource

AstraZeneca

**Tetra Pak**  
PROTECTS WHAT'S GOOD™



# Nano-Biotech-Pharma Innovation



INNOVATIVE NANOSCALE THERAPEUTICS

Simpler, smarter,  
safer medications

## MAIN MENU

### TECHNOLOGIES

- FLUDCRYSTAL® NP  
Injection depot »
- FLUDCRYSTAL® NP  
Injection nanoparticles »
- FLUDCRYSTAL®  
Topical bioadhesive »
- FLUDCRYSTAL® NP  
Transdermal nanoparticles »
- FLUDCRYSTAL® NP  
Oral nanoparticles »


## Technologies



**FluidCrystal® Injection depot**  
The new generation parenteral depot  
featuring prefilled syringe compatibility



3999

## lar Lipid Resolved

Tiberg,<sup>†,1</sup> and

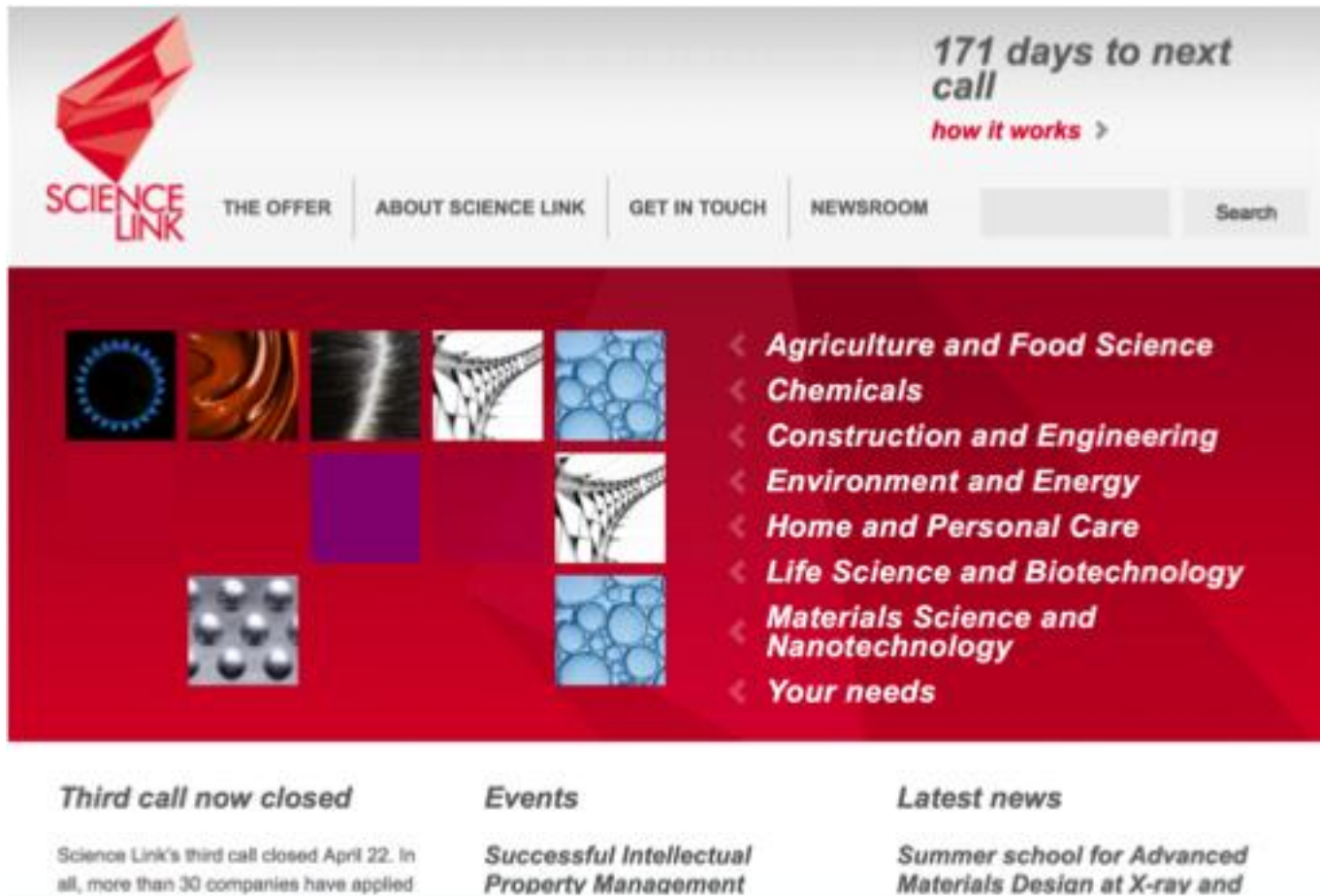
ty, P.O. Box 124,  
inku 12, LT-08662  
Sweden

008

id-crystalline phases,  
X-ray diffraction and  
l monooleate (GMO)  
t(OH) stabilized with  
-phase nanoparticles  
uronic F-127. Time-  
r nanoparticles when  
phatidylcholine. The  
's, a strong interaction  
ions as well as a later  
lies on the interaction  
ak shifted with time  
HPNPs upon mixing  
interactions between  
here the GMO-based  
r surface than do the  
l, where significantly  
liquid-crystalline phase. This  
ynchrotron small-angle X-ray  
action between different lipid



# Science Link.



Interreg Funding:  
***Enhancement of  
Cross-border  
Cooperation  
between  
Research  
Infrastructures in  
the Baltic Sea  
Region.***

Science Link is a network between research facilities of photon and neutron sources and its users. The project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region

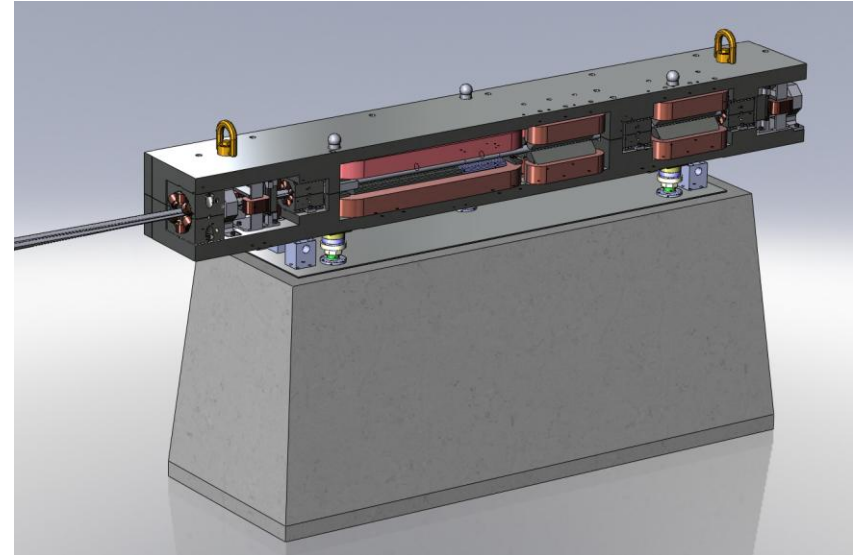
Biannual Calls 32 Proposals (19)(9), 13 From Sweden

Start Oct 2011, 33M  
3.5 M EUR

# Cross Border Innovation. Achromats



Accelerator Magnets  
Spectrometer Magnets  
Precision Magnet Power Supplies  
Ion Implanters and Ion Sources  
Insertion Devices for Synchrotrons  
Beam Diagnostic Instrumentation  
Field Measurement Equipment  
Pre-Injectors for Synchrotrons  
Turnkey Ion Accelerator Systems  
Turnkey Boosters for Synchrotrons



Order for 9.5 M EUR for magnets (rings & linac)

Nine other Synchrotron X-ray Facilities are considering this technology in their upgrade

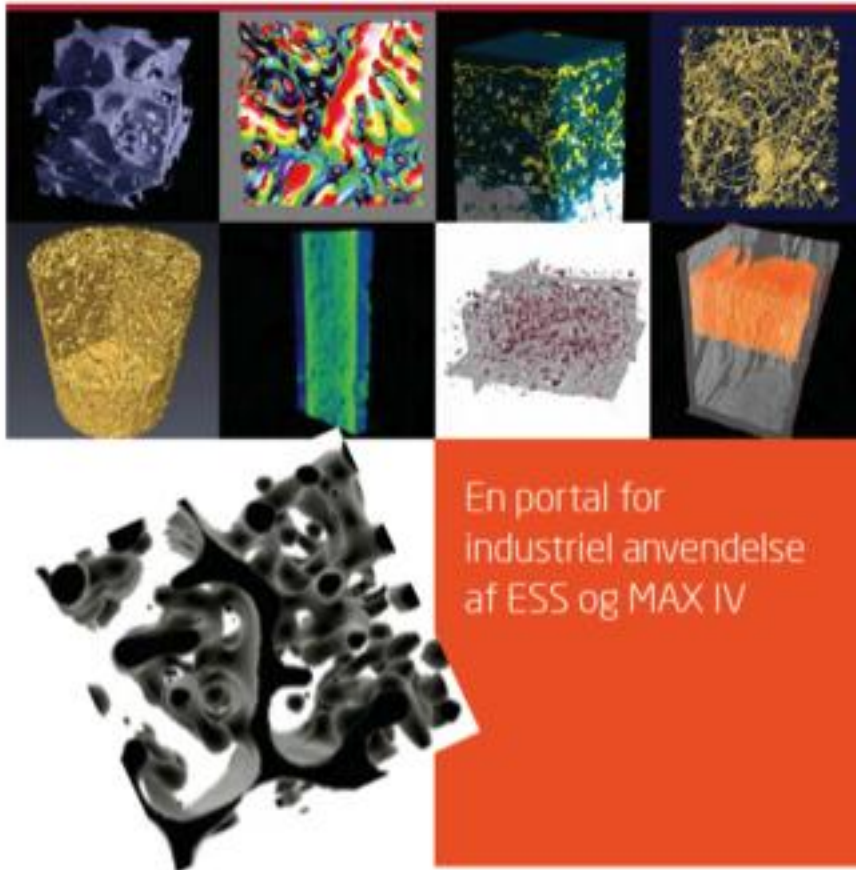
Also: JJ Xray 100 k SEK

# Imaging Centre

Danmarks Tekniske Universitet



## 3D Imaging Center

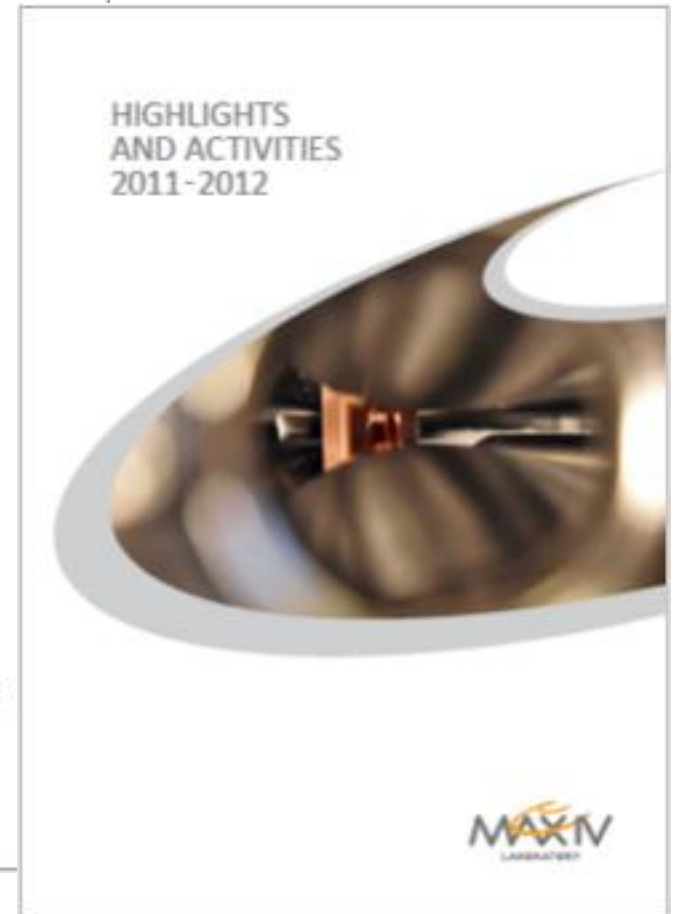


## DTU Imaging Centre

Both DTU & CU received funds to develop & explore links to MAX IV & ESS



# MAX IV. Further reading.



Available on [www.maxlab.lu.se](http://www.maxlab.lu.se)



## Science Village Scandinavia







SCIENCE  
LINK



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# Thank you!

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