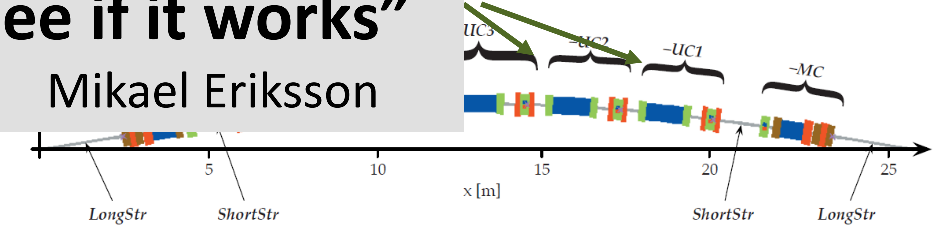
MAX IV & RÅC

Jesper Andersen
Physical Sciences Director
MAX IV Laboratory

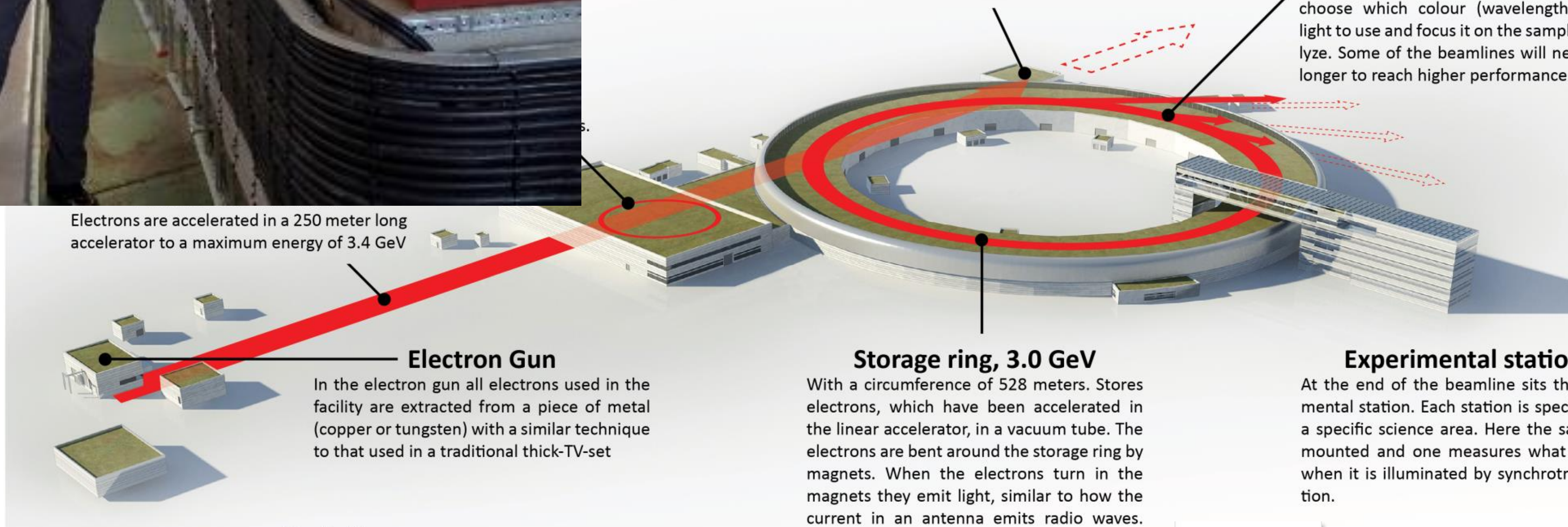
MAX IV

”It will be interesting to see if it works”

Mikael Eriksson



st IVth generation storage ring



Short pulse facility

Extremely short light flashes can be produced here by using the electrons directly from the linear accelerator.

Beamline

The light that is produced by the electrons shines through the beamline to the experimental station. In the beamline one can choose which colour (wavelength) of the light to use and focus it on the sample to analyze. Some of the beamlines will need to be longer to reach higher performance.

Electrons are accelerated in a 250 meter long accelerator to a maximum energy of 3.4 GeV

Electron Gun

In the electron gun all electrons used in the facility are extracted from a piece of metal (copper or tungsten) with a similar technique to that used in a traditional thick-TV-set

Storage ring, 3.0 GeV

With a circumference of 528 meters. Stores electrons, which have been accelerated in the linear accelerator, in a vacuum tube. The electrons are bent around the storage ring by magnets. When the electrons turn in the magnets they emit light, similar to how the current in an antenna emits radio waves. Since the electrons travel with close to the speed of light, the light is called synchrotron radiation and has very special properties.

Experimental stations

At the end of the beamline sits the experimental station. Each station is specialised to a specific science area. Here the samples is mounted and one measures what happens when it is illuminated by synchrotron radiation.

Radiation

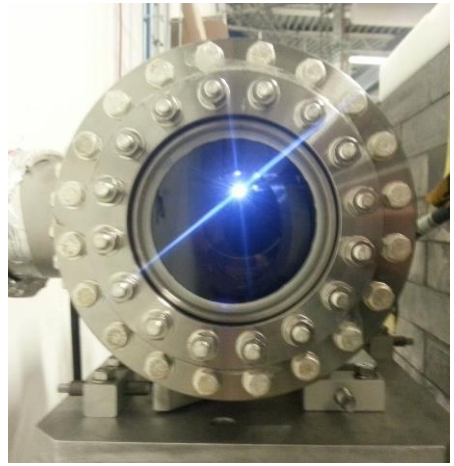
The electrons in the accelerator create a small amount of background radiation when the machine is operated. When the machine is switched off there is no remaining radiation as no radioactive material is produced. The accelerator itself is built into concrete and thus one can work freely in all other areas of the laboratory. If someone would enter the accelerator area the machine will stop automatically.

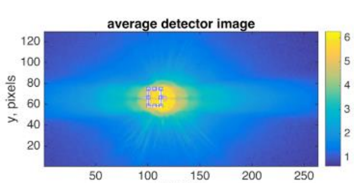
Vetenskapsrådet VINNOVA LUNDS UNIVERSITET SKÅNE

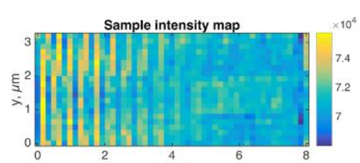
Karolinska Institutet KTH VETENSKAP OCH KONST LUNDS UNIVERSITET UPPSALA UNIVERSITET CHALMERS GÖTEBORGS UNIVERSITET Knut och Alice Wallenbergs Stiftelse

MAX IV Laboratory Inauguration 21-06-2016

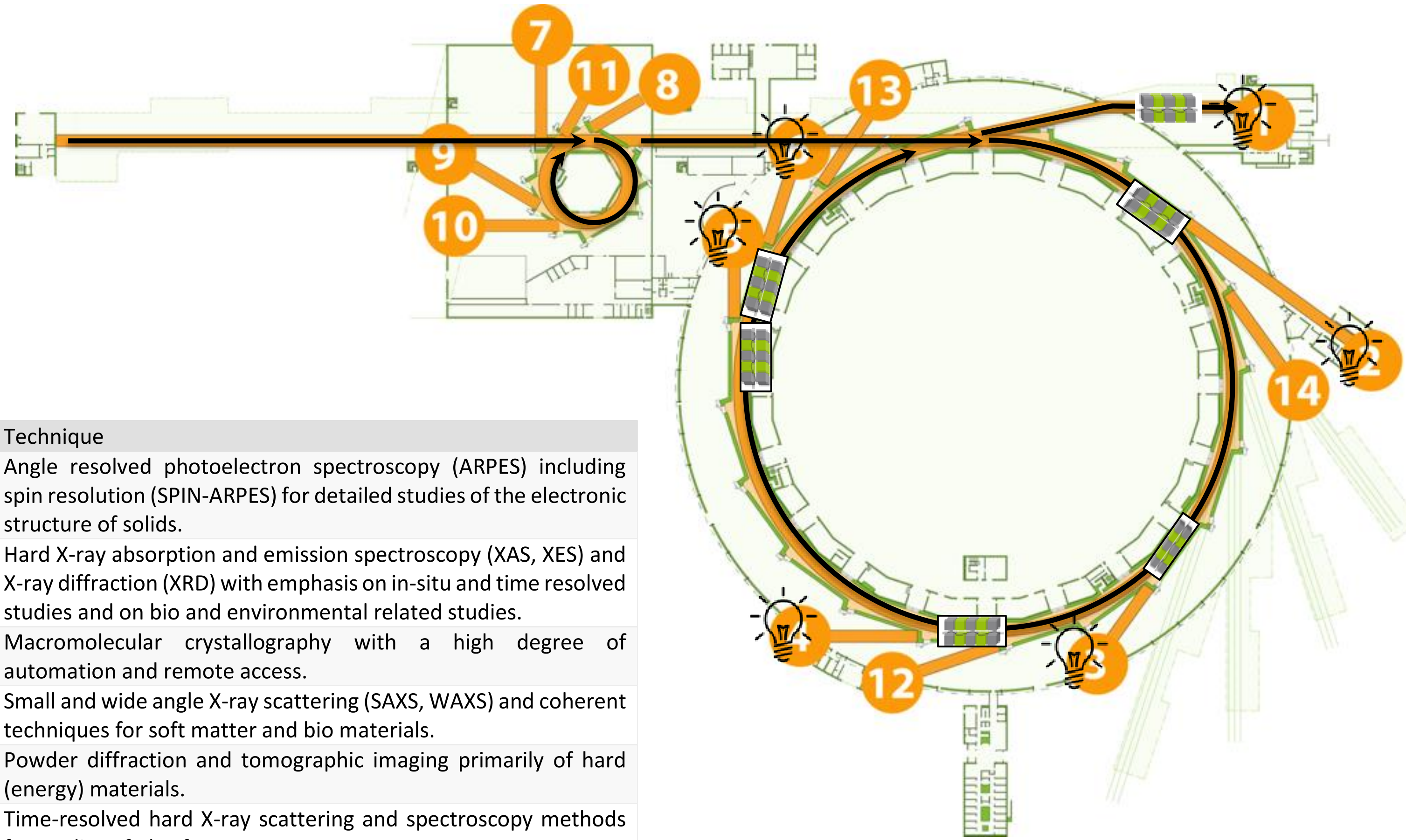
(after 5 years of building and even more years of planning)



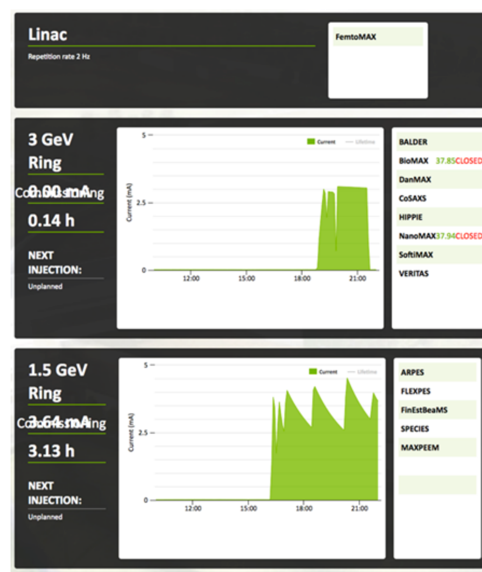




1 Linac
2 Rings
14 beamlines



Beamline		Accelerator	Technique
ARPES	7	1.5 GeV	Angle resolved photoelectron spectroscopy (ARPES) including spin resolution (SPIN-ARPES) for detailed studies of the electronic structure of solids.
Balder	3	3.0 GeV	Hard X-ray absorption and emission spectroscopy (XAS, XES) and X-ray diffraction (XRD) with emphasis on in-situ and time resolved studies and on bio and environmental related studies.
BioMAX	4	3.0 GeV	Macromolecular crystallography with a high degree of automation and remote access.
CoSAXS	12	3.0 GeV	Small and wide angle X-ray scattering (SAXS, WAXS) and coherent techniques for soft matter and bio materials.
DanMAX	14	3.0 GeV	Powder diffraction and tomographic imaging primarily of hard (energy) materials.
FemtoMAX	1	Linac	Time-resolved hard X-ray scattering and spectroscopy methods for studies of ultrafast processes
FinEstBeaMS	8	1.5 GeV	Electron spectroscopies and luminescence methods for studies of low density matter and solids.
FlexPES	11	1.5 GeV	Soft X-ray spectroscopies for studies of low density matter and solids.
HIPPIE	6	3.0 GeV	Near ambient pressure photoelectron spectroscopy on solids and liquids.
MAXPEEM	10	1.5 GeV	Aberration corrected photoelectron microscopy for investigation of surfaces and interfaces.
NanoMAX	2	3.0 GeV	Imaging with spectroscopic and structural contrast techniques and nanometre resolution.
SoftiMAX	13	3.0 GeV	Scanning transmission X-ray microscopy and coherent imaging methods.
SPECIES	9	1.5 GeV	Resonant inelastic X-ray scattering (RIXS) with high resolving power and near ambient pressure photoemission.
VERITAS	5	3.0 GeV	Resonant inelastic X-ray scattering (RIXS) with unique resolving power and high spatial resolution.

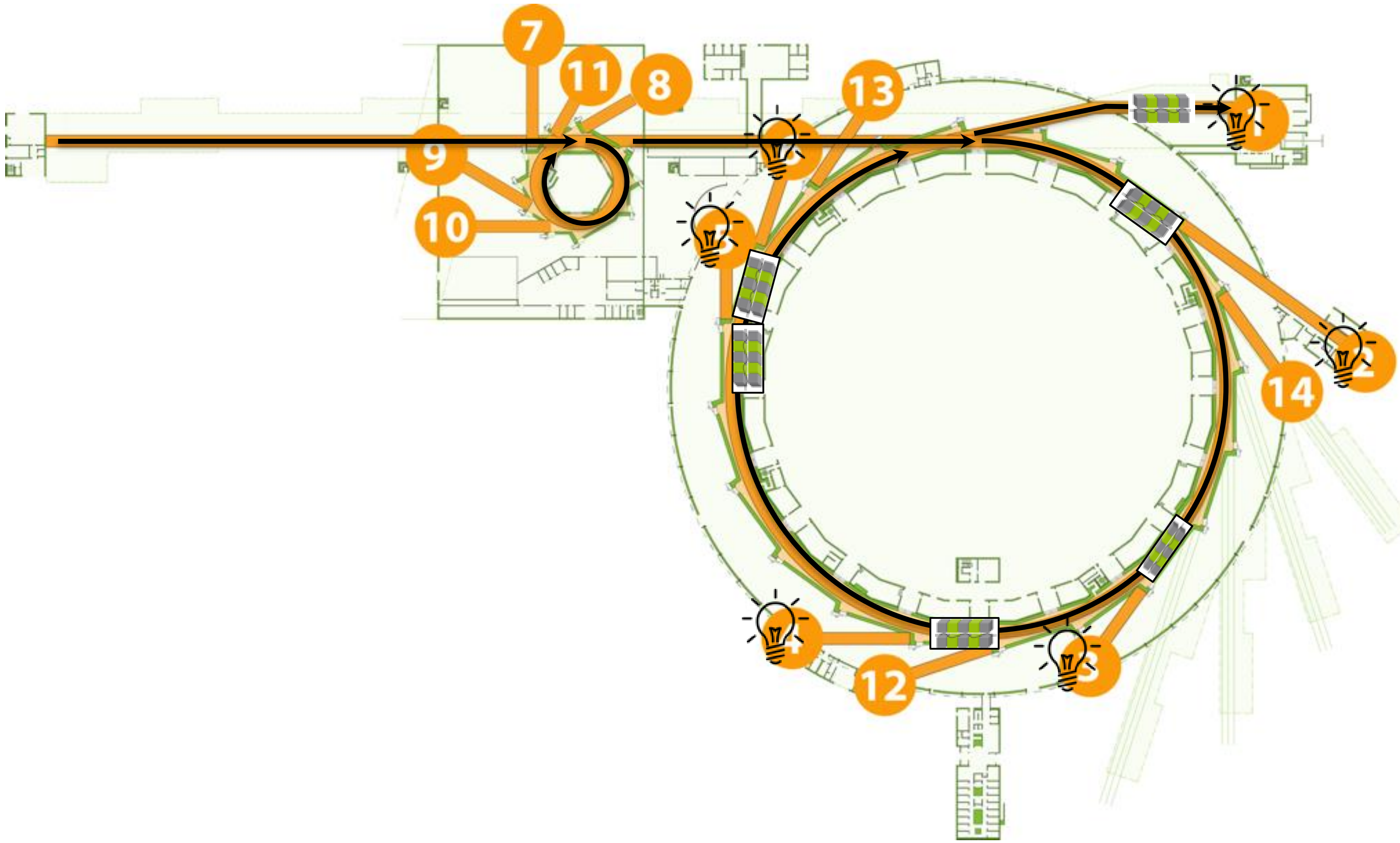


Linac:
Injector 1.5 & 3 GeV & SPF
Injects both rings & delivers light to FemtoMAX

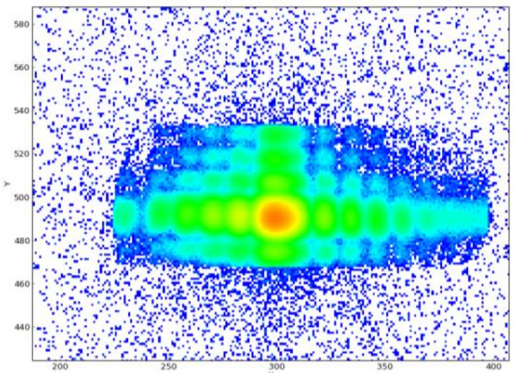
3 GeV:
200 mA, >5 Ah
≈ (340[illegible]30) pm·rad
≈ 8.5 mA single bunch
Delivers light to users

1.5 GeV:
< 200 mA
Commissioning

1 Linac
2 Rings
14 beamlines

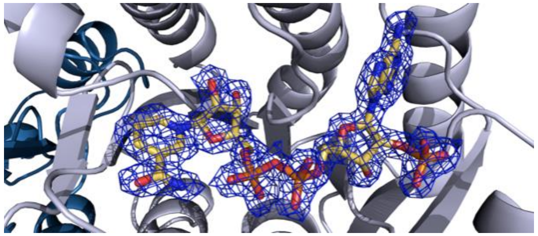


NanoMAX



Coherent x-rays from 2nd source (slit)
2x3 mm, 10 keV, Slit to detector (Pilatus 1M) ≈40 meters

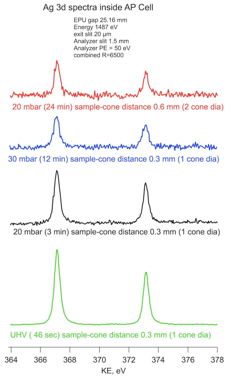
BioMAX



Structure analyzed
Academic & industrial trials
Robot in commissioning

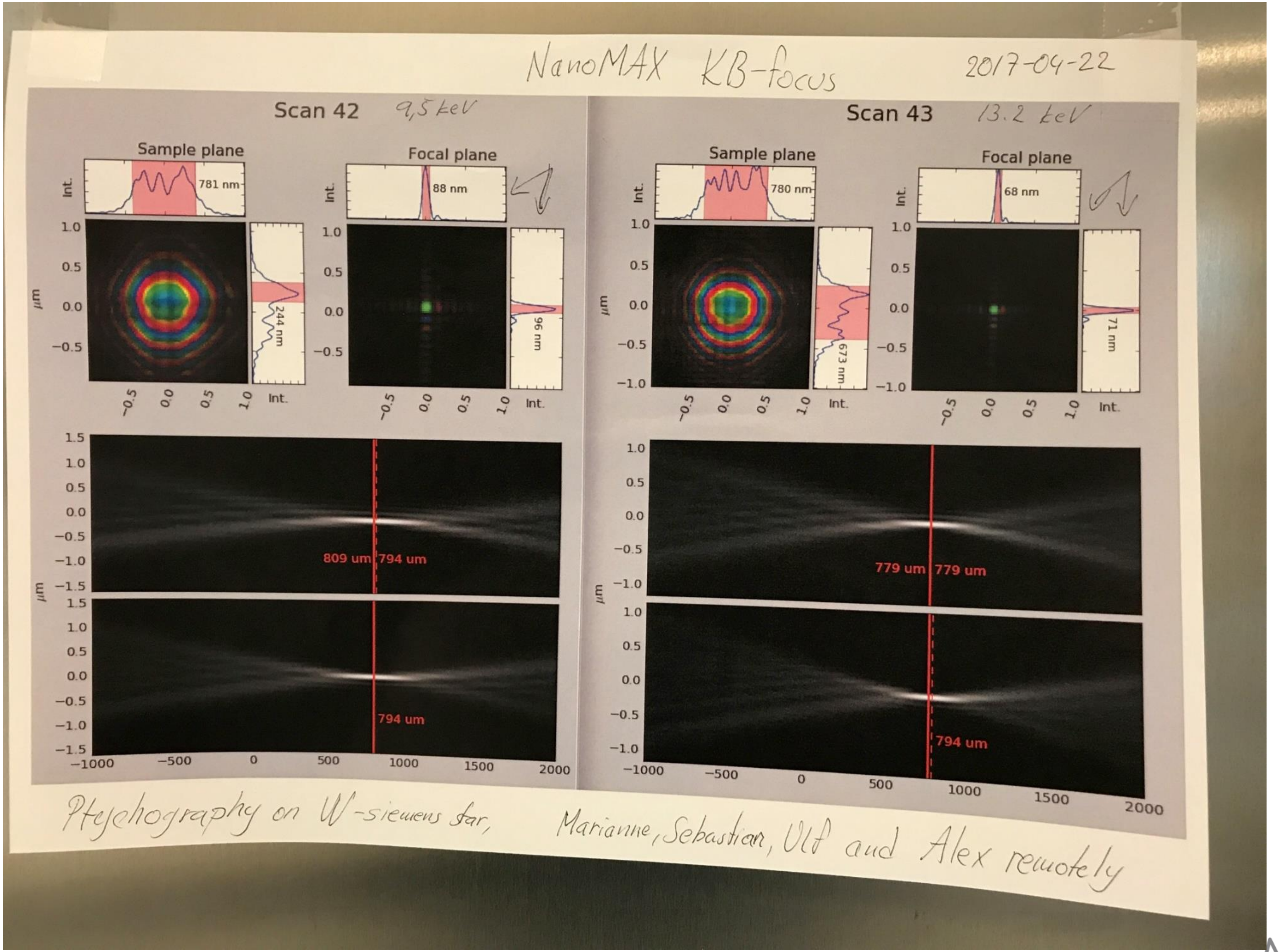
Balder, Hippie & Veritas

1st light from IDs
Commissioning ongoing
Experts selected



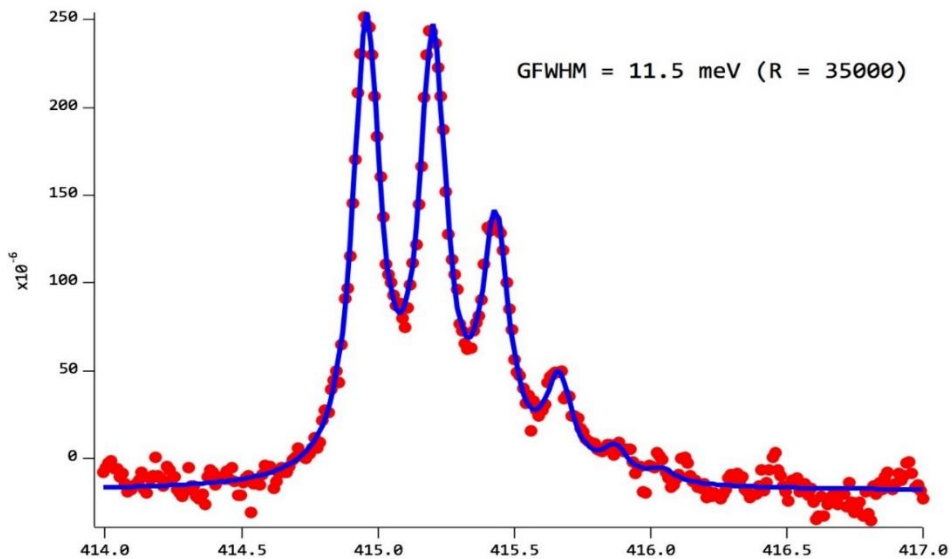
MAX IV

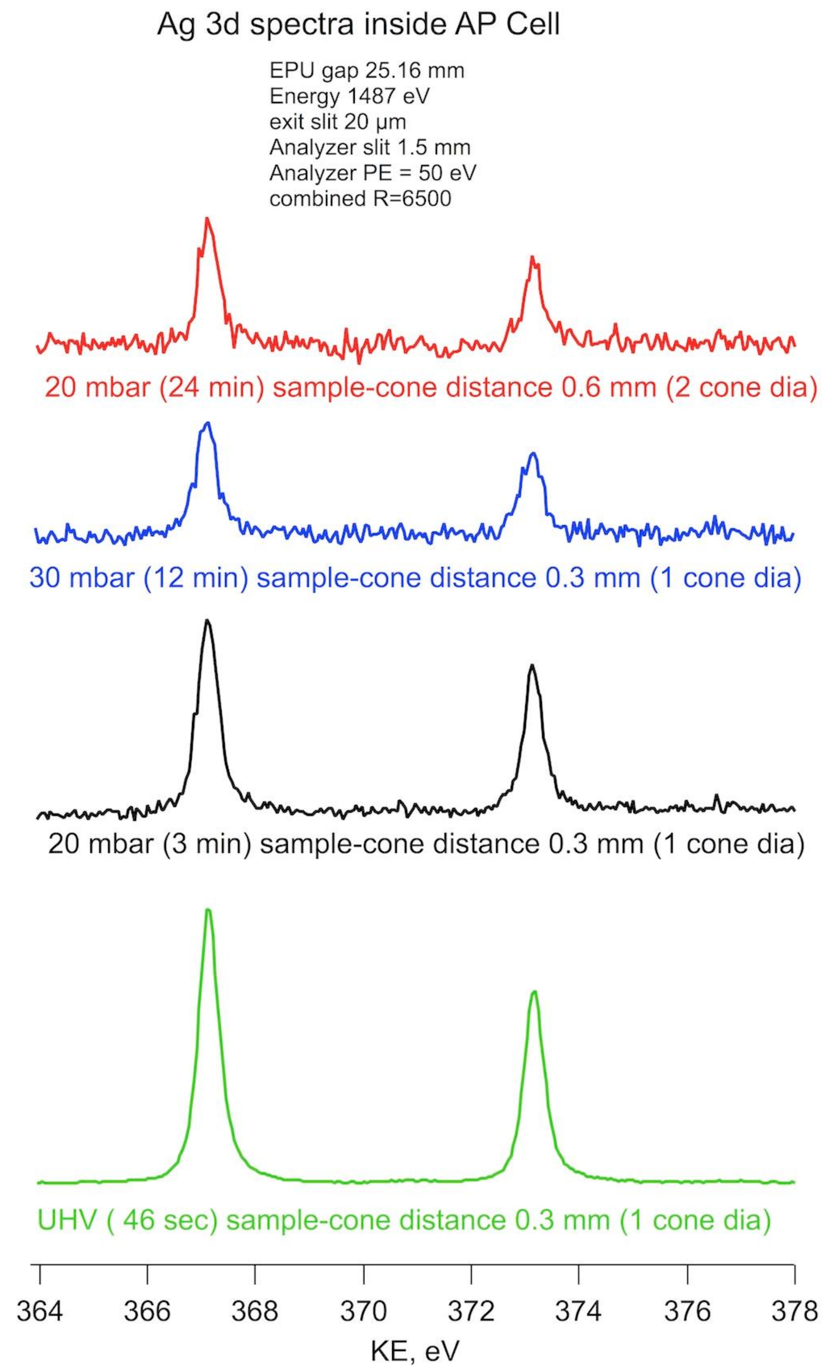
Nano-focus @ NanoMAX



HIPPIE: Status

- Photon energy resolution OK
- 1st spectra from endstation
- Commissioning experts coming soon





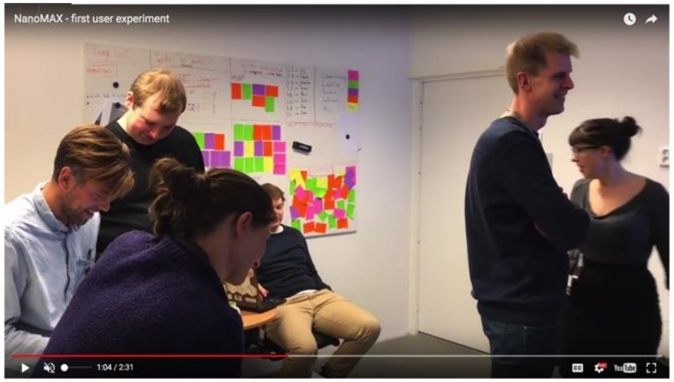

Joachim Schnadt
Spokesperson


Jan Knudsen
Project manager


Andrey Shavorskiy
Beamline scientist

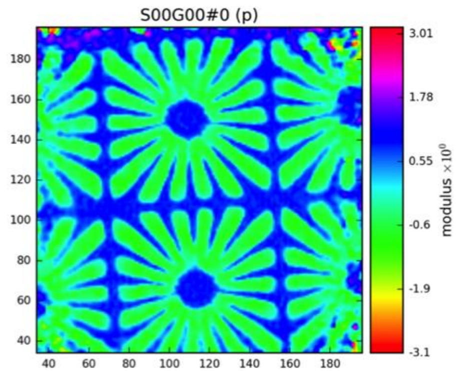

Suyun Zhu
Beamline engineer

MAX IV is operational and starting to accept users!

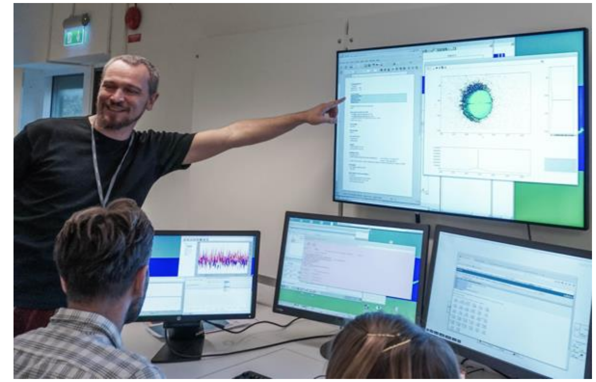


Interview with Ulrich Vogt, KTH, Applied Physics and one of the first external users at MAX IV.

KTH team (U. Vogt et al.) @ NanoMAX
Imaging nano-structures w/ coherent x-rays

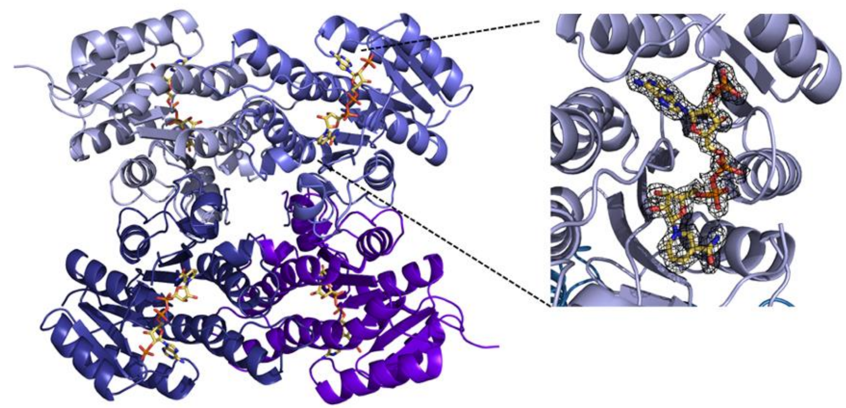


Phase images
≈50nm resolution



DTU team (JW Andreasen et al.) @ NanoMAX
Power-producing layer of new types of solar cells

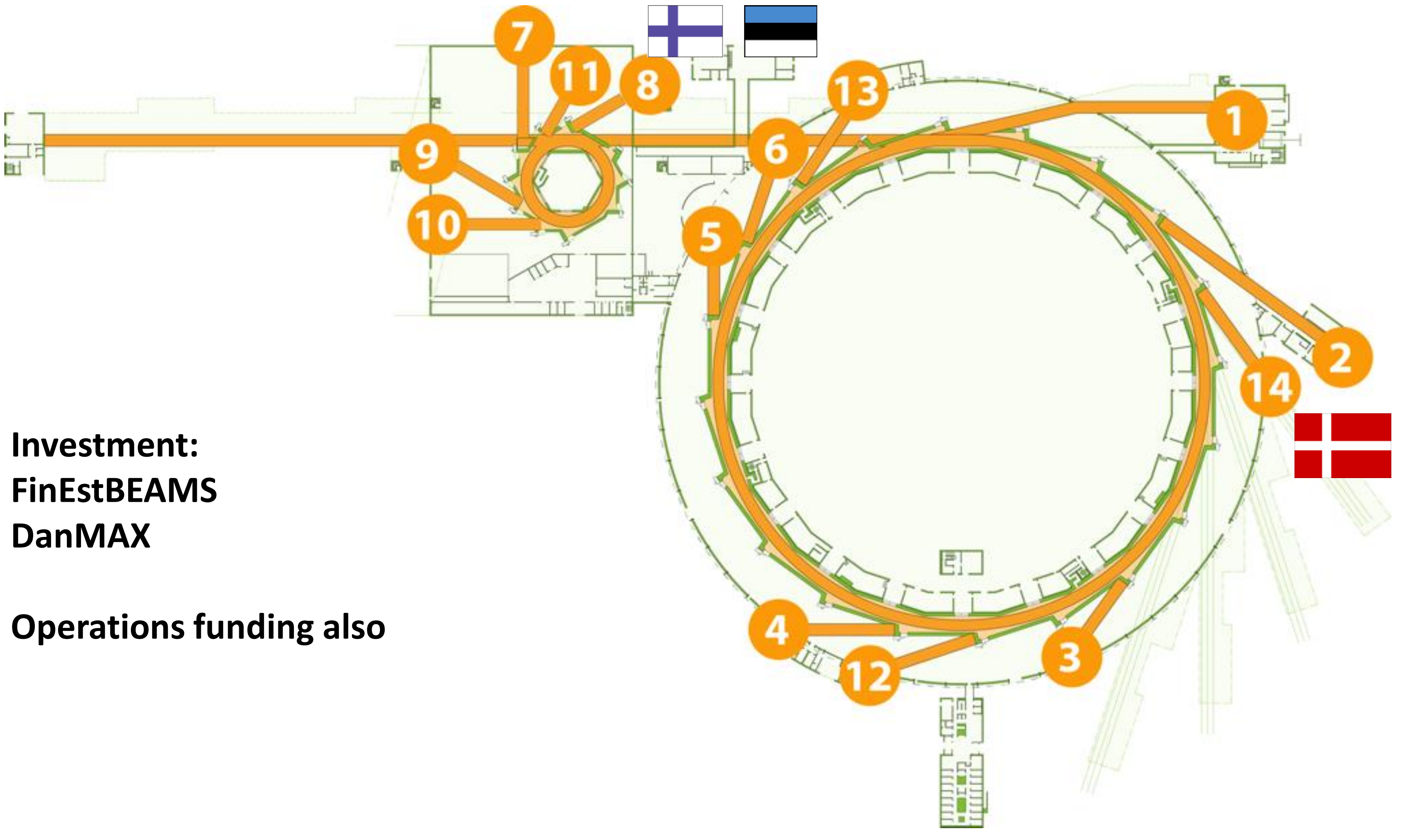
Industry team (www.adroitscience.com) @ BioMAX
Testing sensitivity for polymorph analysis.



KI team (G. Schneider et al.) @ BioMAX
FabG, a target for antibiotic development.

MAX IV & RÅC

Mainly Swedish funding. But also international.



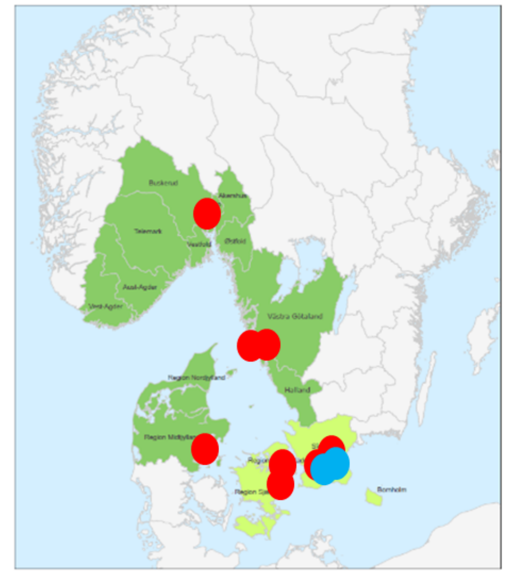
Investment:
FinEstBEAMS
DanMAX

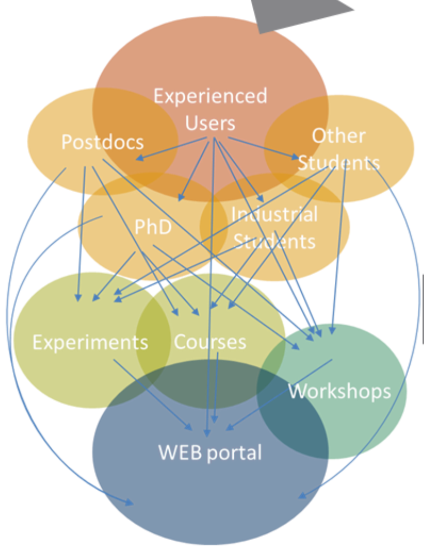
Operations funding also

ESS & MAX IV:
Cross Border
Science and Society

Training and Education

Collaboration with 8 Danish, Norwegian, and Swedish universities in the ÖKS region for improving the capabilities to make full use of MAX IV and ESS. Interreg funded.



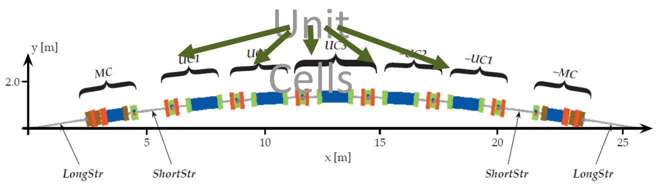


Better use of MAX IV and ESS by ÖKS region

- More researchers able to use the advanced methods
- Increase competence in the region
- Establish cross-border regional collaborations
- Synergetic use of complementary competences

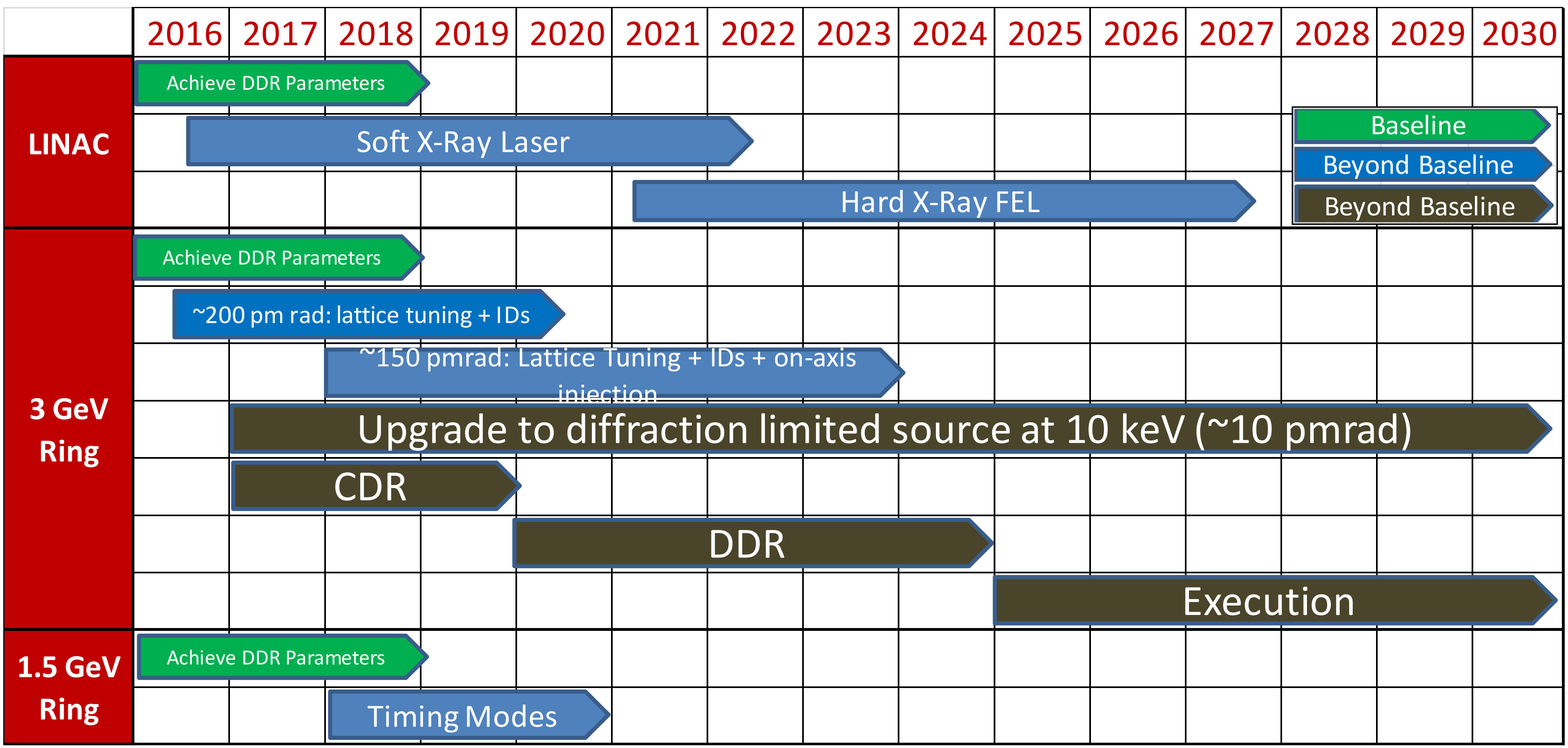
Improved development of MAX IV

Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION
MAX IV



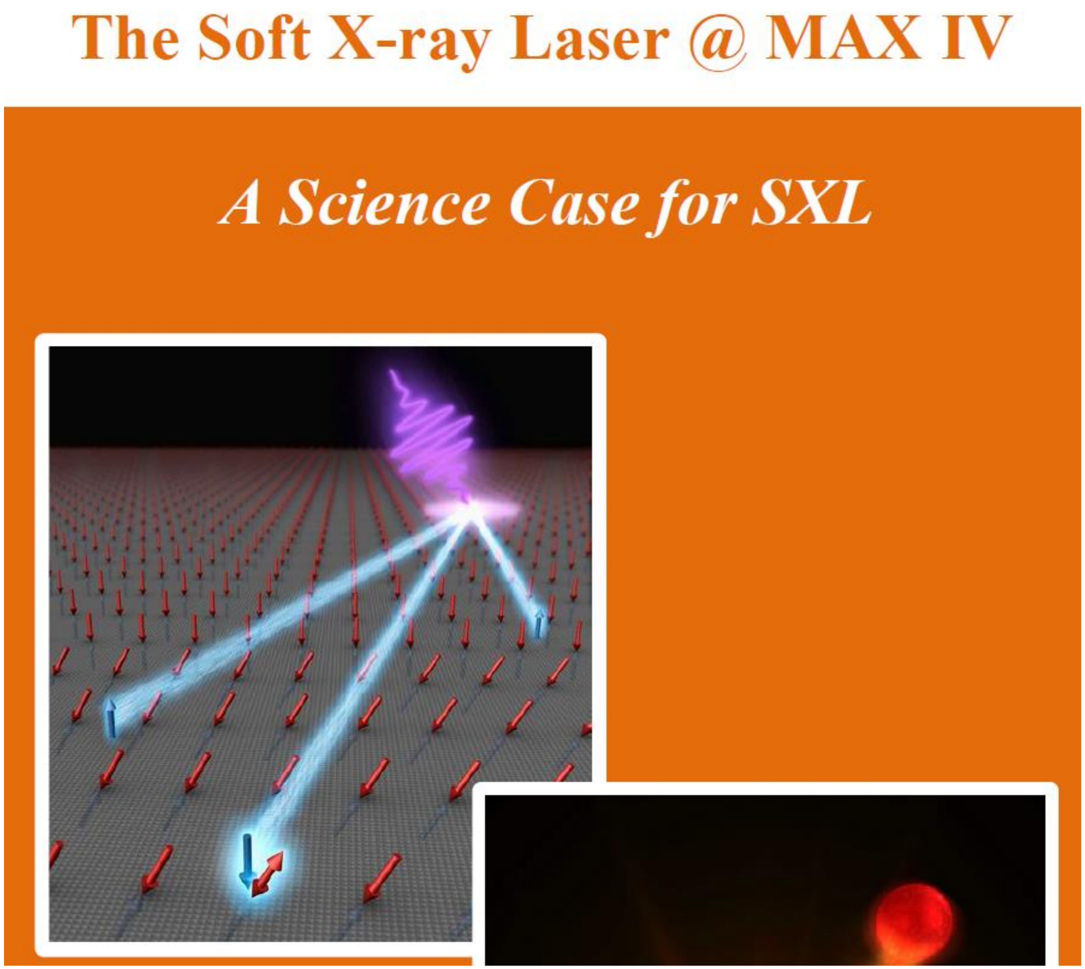
Further development of the radiation sources

Why stop at 7-bend achromat?



MAX IV

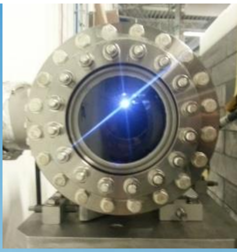
FEL @ MAX IV



Soft X-ray Laser (SXL)

- User driven initiative
- Uses existing Linac
- Step 1 towards a hard X-ray FEL

Questions/comments?

MAX IV