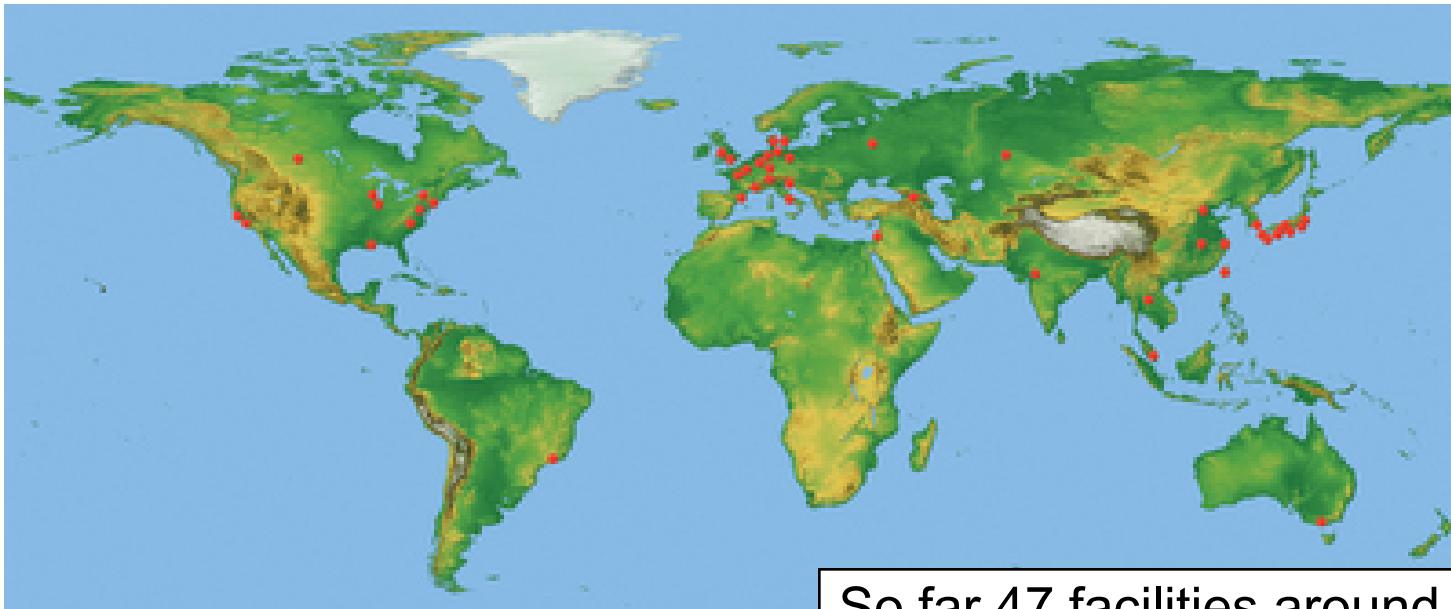


Overview of SLRI

ดร. แพร จิรวัฒน์กุล
สถาบันวิจัยแสงซินโครตรอน (องค์การมหาชน)

Synchrotron Facility



So far 47 facilities around the world



Spring 8



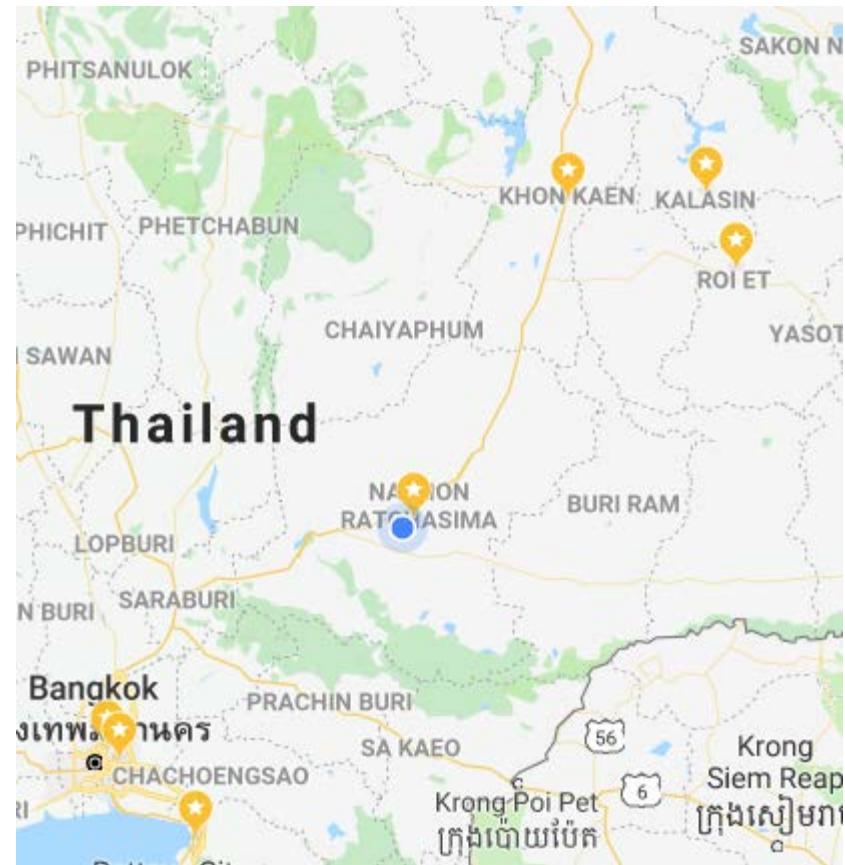
ESRF



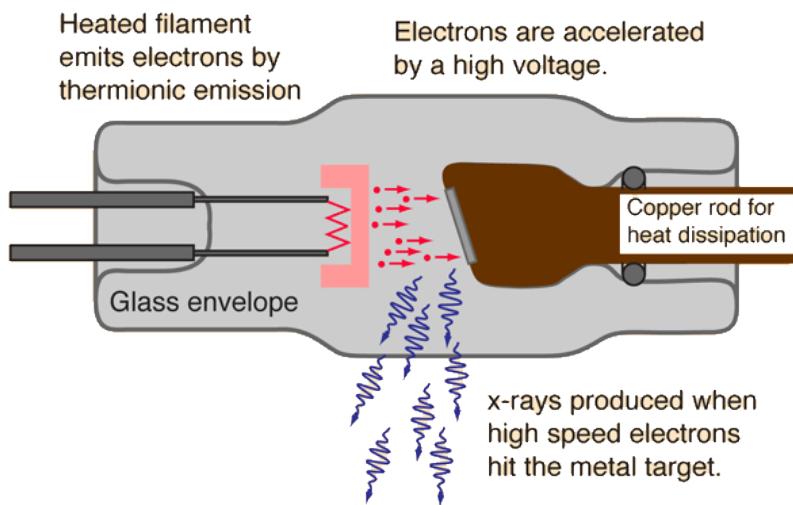
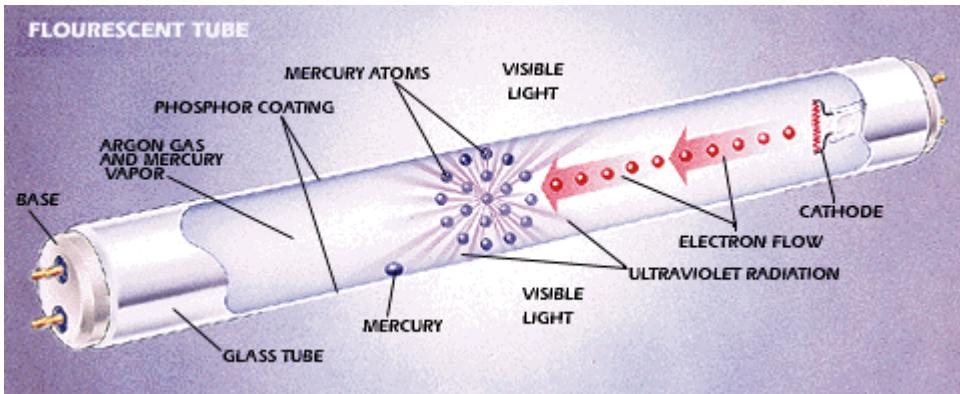
APS

Fig credit: Nature Photonics 9, 281 (2015), <http://www.spring8.or.jp>,
<http://www.esrf.eu>, <http://cars.uchicago.edu/>

Synchrotron Light Research Institute (Public Organization)



Light from bound electrons

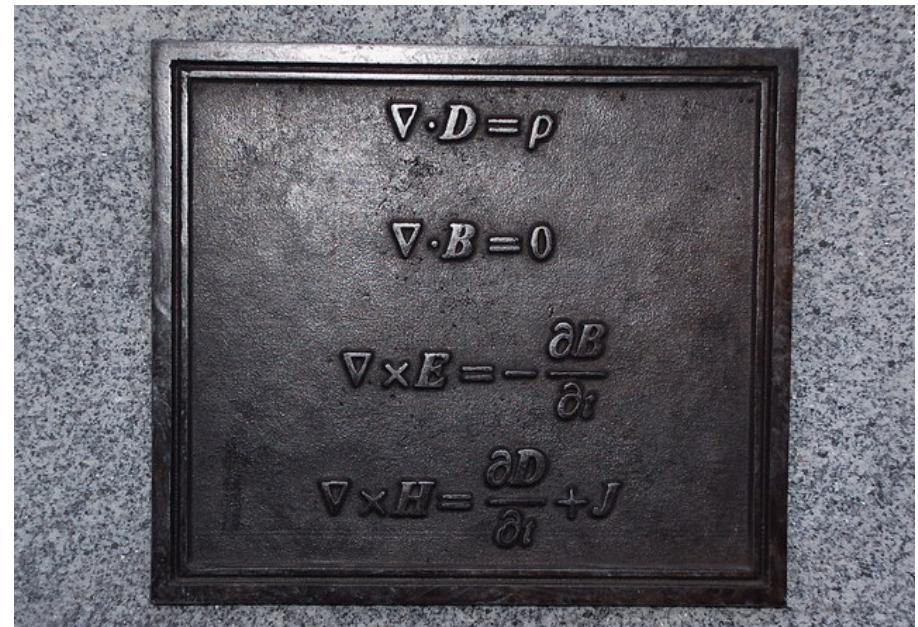


- Single photon energy
- Low in intensity

Light from free electrons

- Continuous energy
- Defined direction
- High intensity

Maxwell's equation 1873



“Accelerated charges emit light.”

Light from free electrons

Have we seen this phenomenon before?

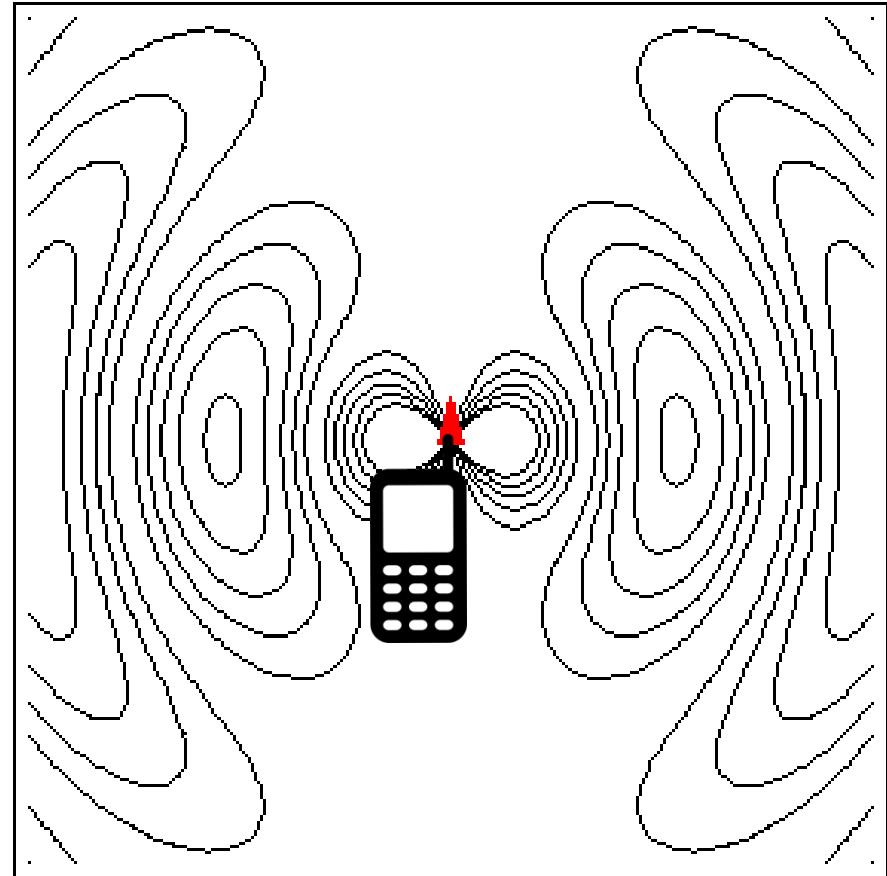
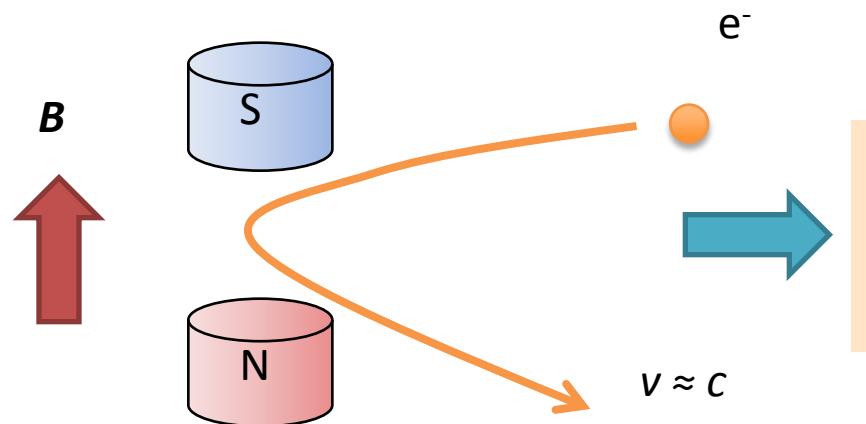


Fig. credit: https://en.wikipedia.org/wiki/Crab_Nebula

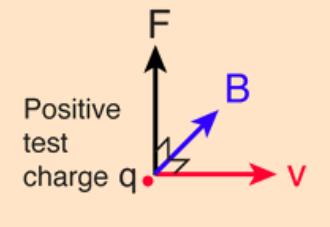
Light from synchrotron

“Magnet”

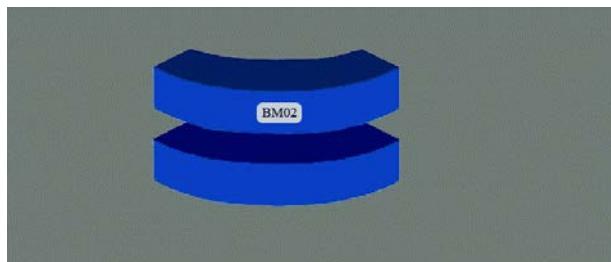


Lorentz Force Law

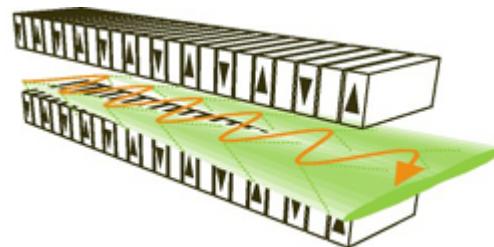
$$\vec{F} = q\vec{v} \times \vec{B}$$



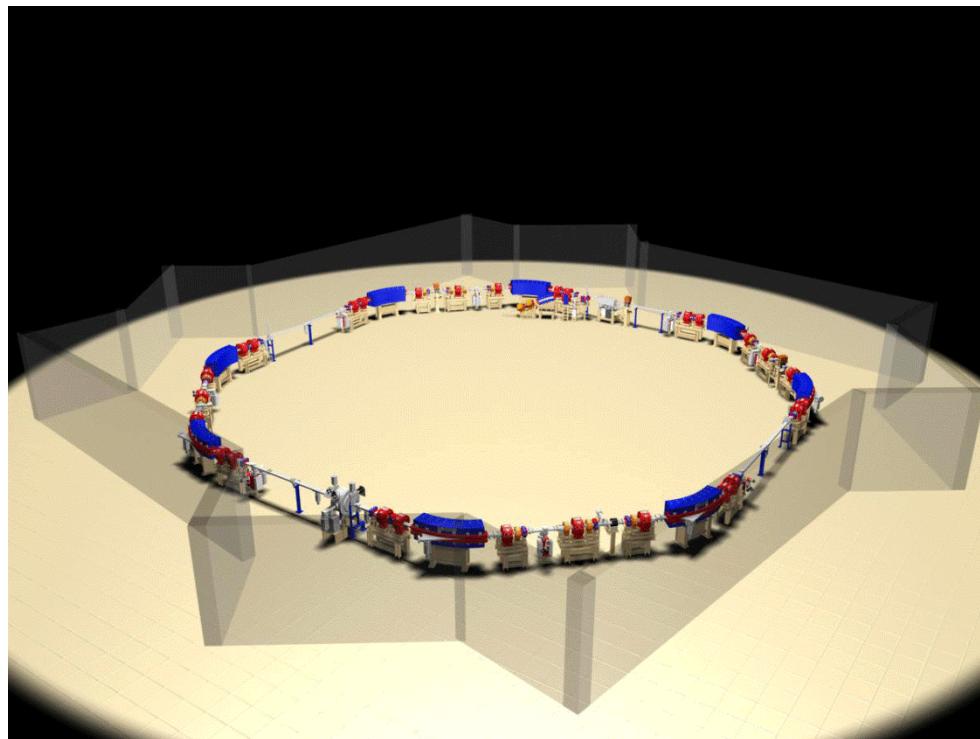
Bending magnet



Insertion device:
Multi-pole wiggler/undulator



Light from synchrotron



“Synchrotron produces high intensity light from an acceleration of electrons moving at the speed approaching the speed of light.”

Light from synchrotron

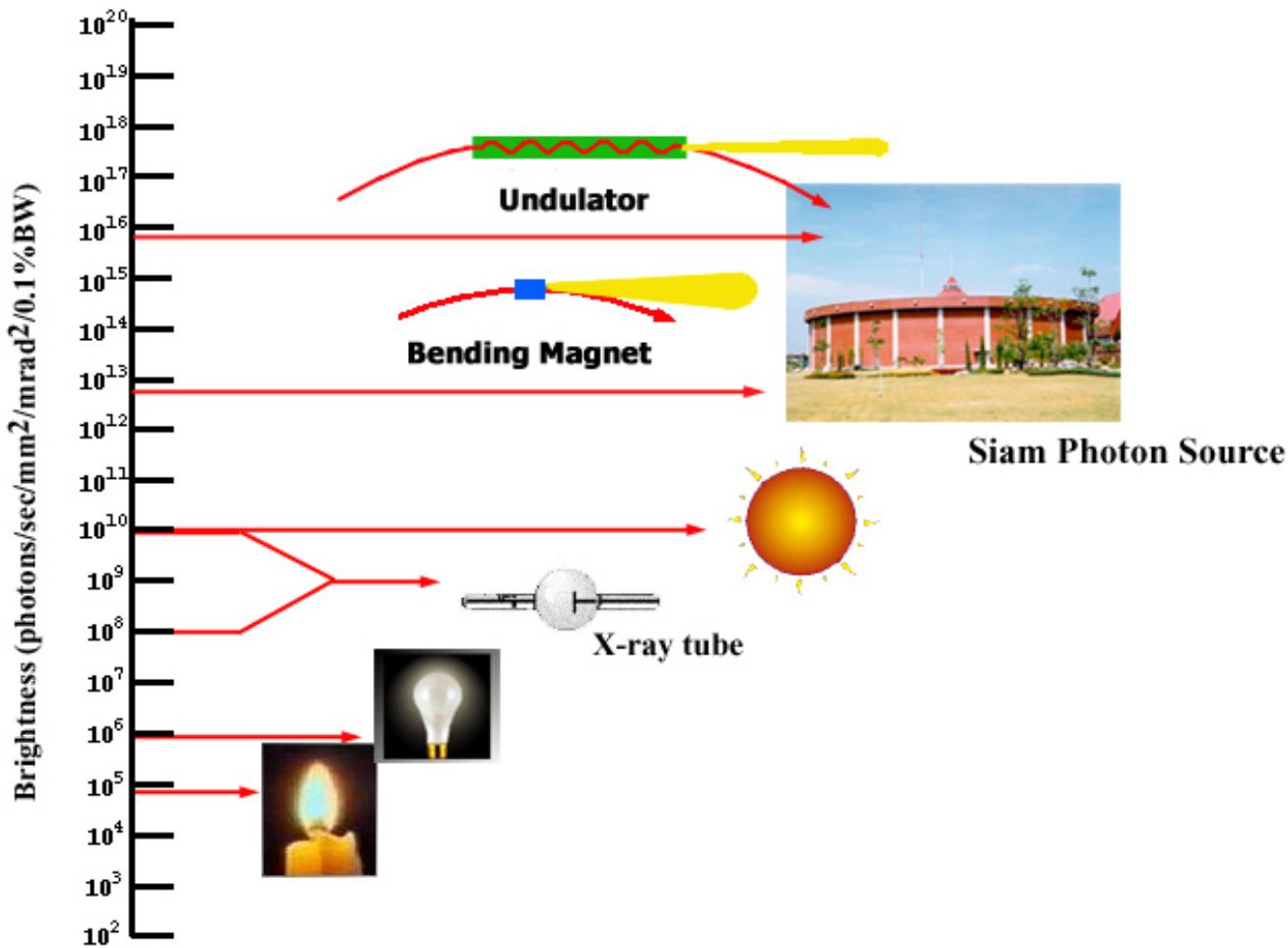


Fig. credit: S. Rugmai, SLRI

Light from synchrotron

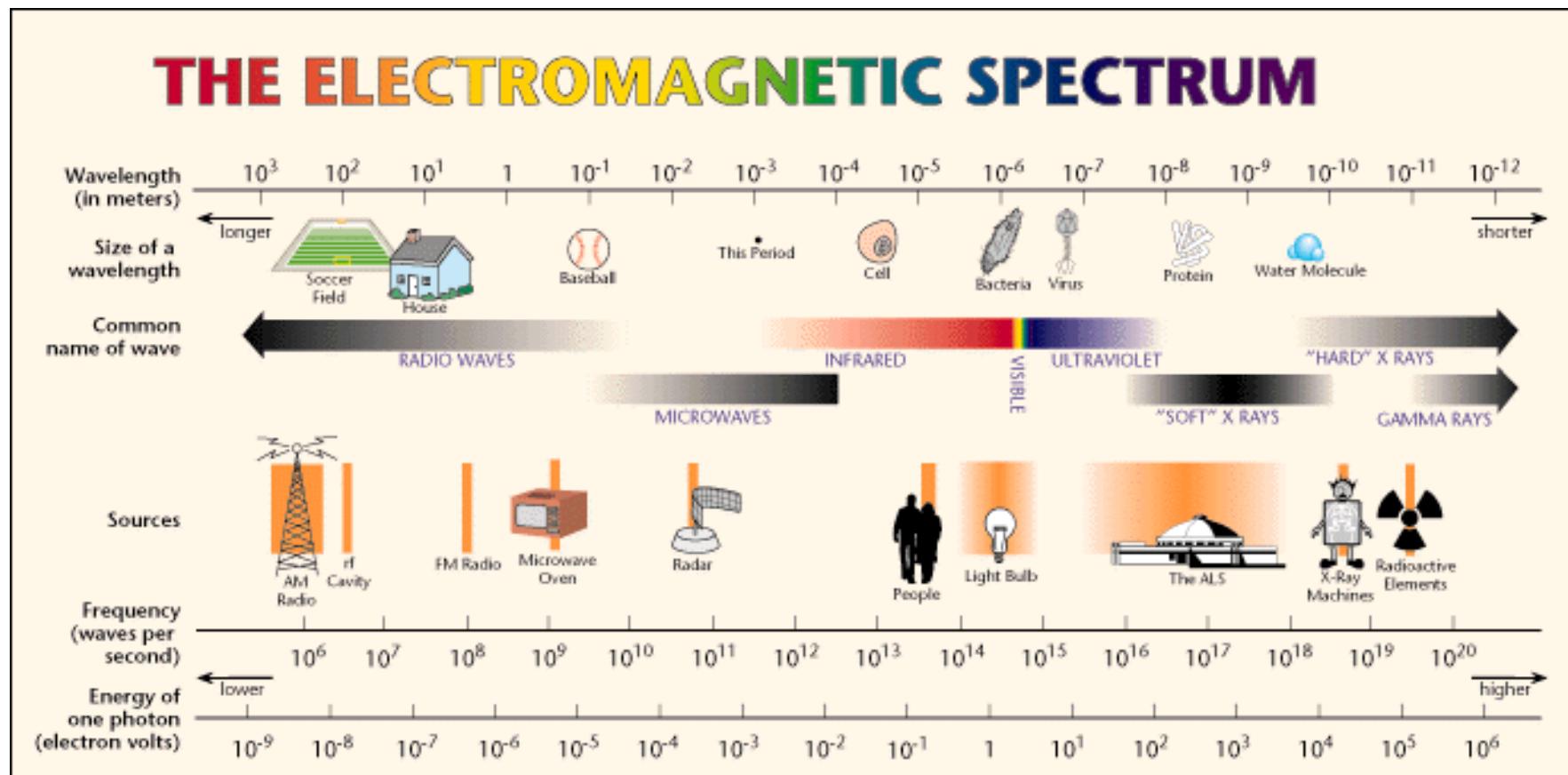
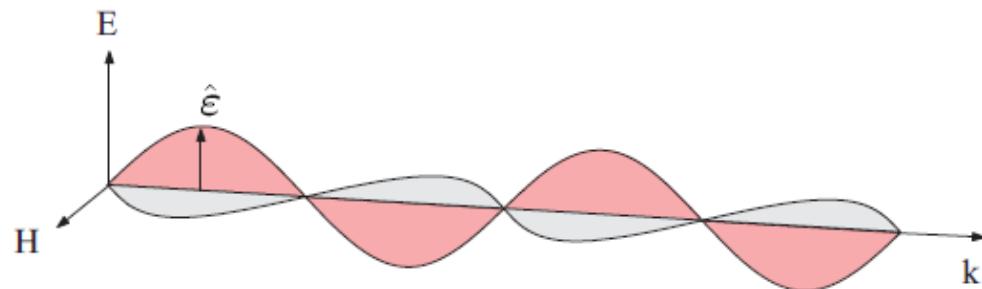
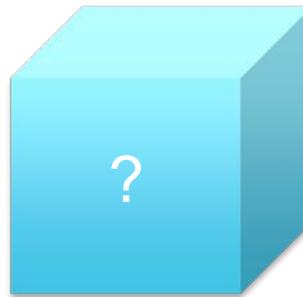
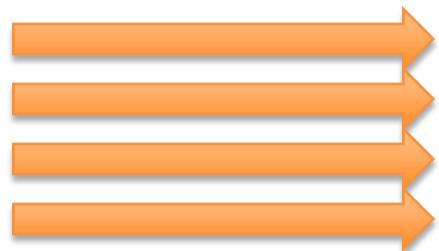


Fig. credit: <http://www2.lbl.gov/MicroWorlds/ALSTool/EMSpec/EMSpec2.html>

X-rays interaction with matter



Incident photon



Scattering
Heat



No interaction

Absorption

SLRI beamlines

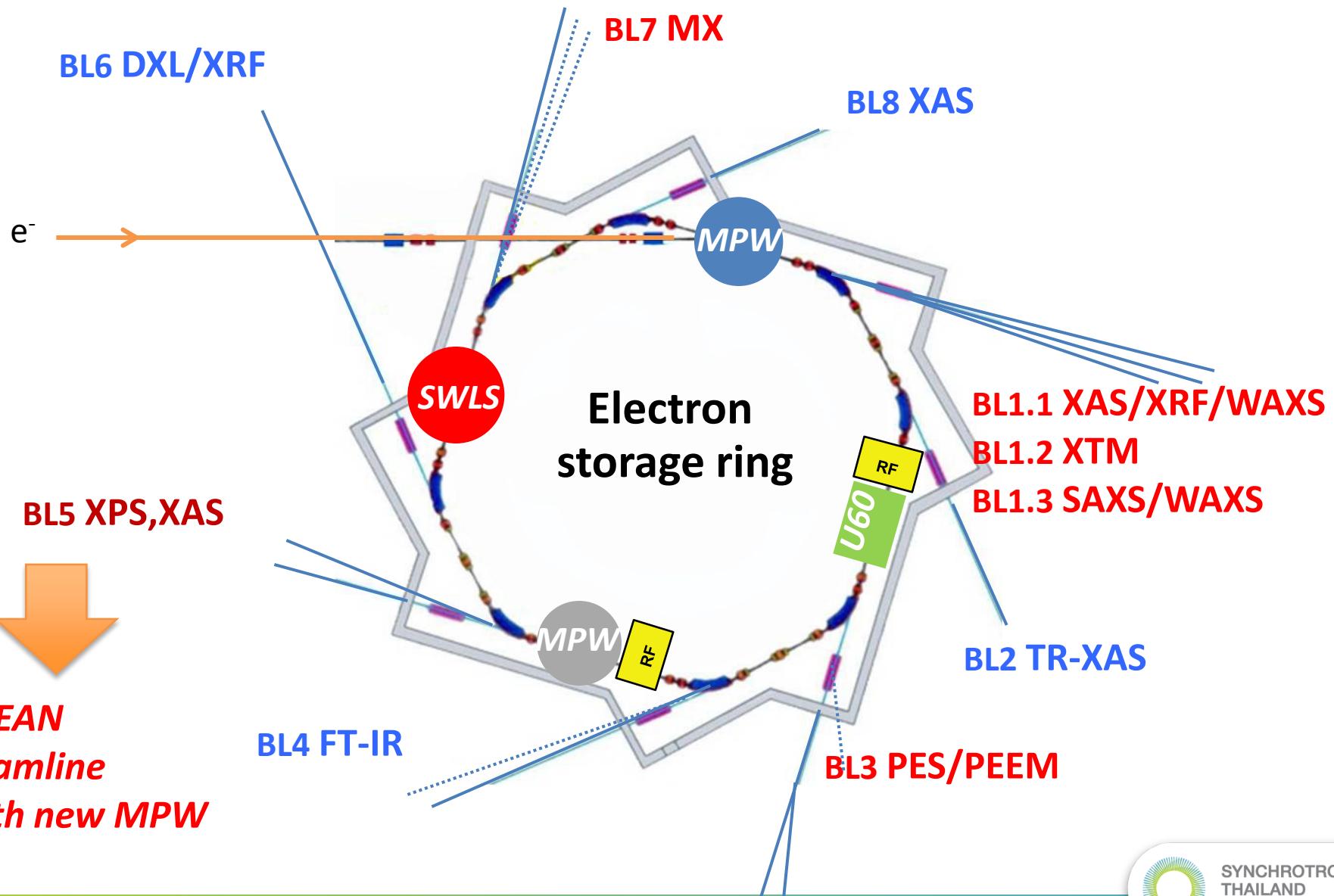
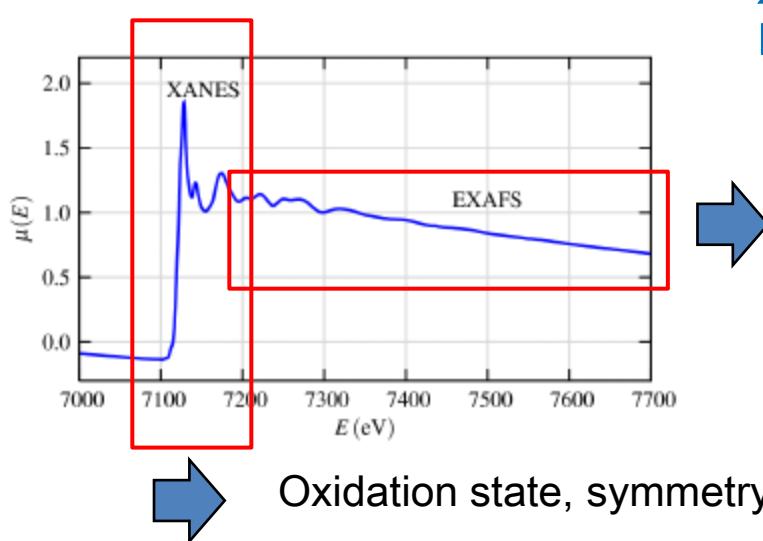
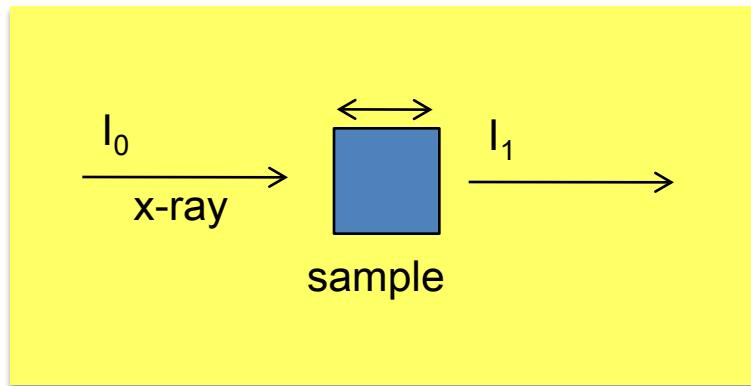


Fig. credit: H. Nakajima, SLRI



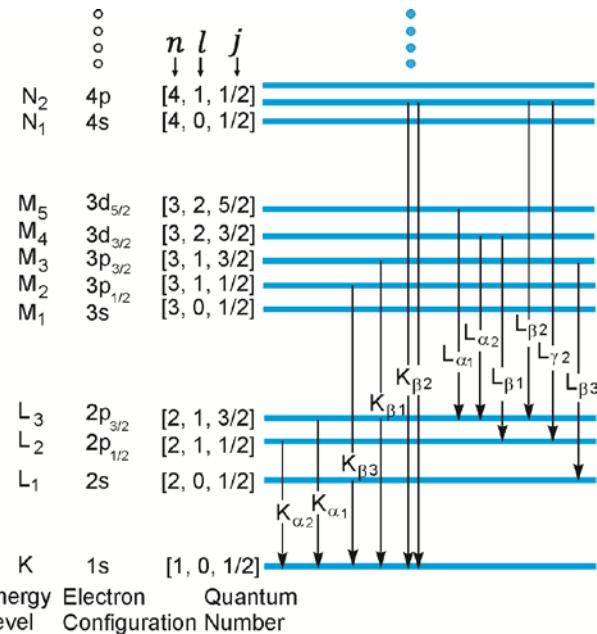
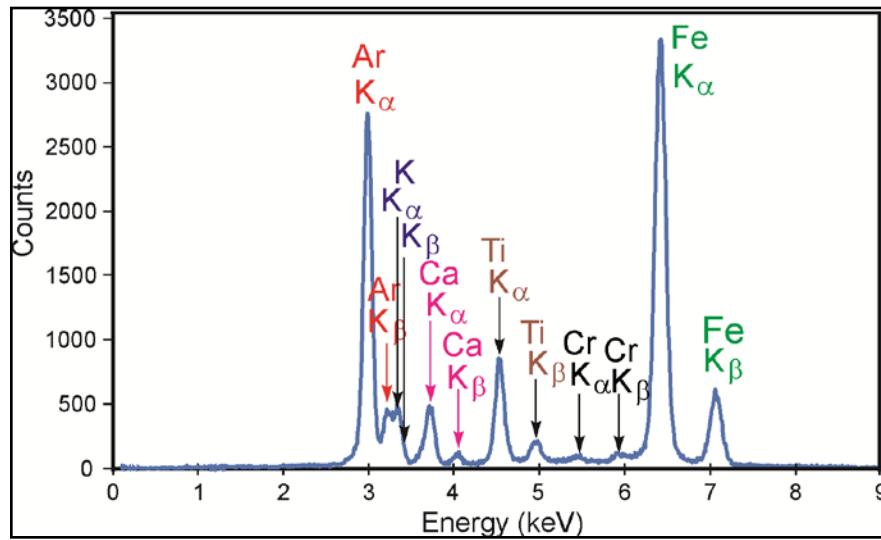
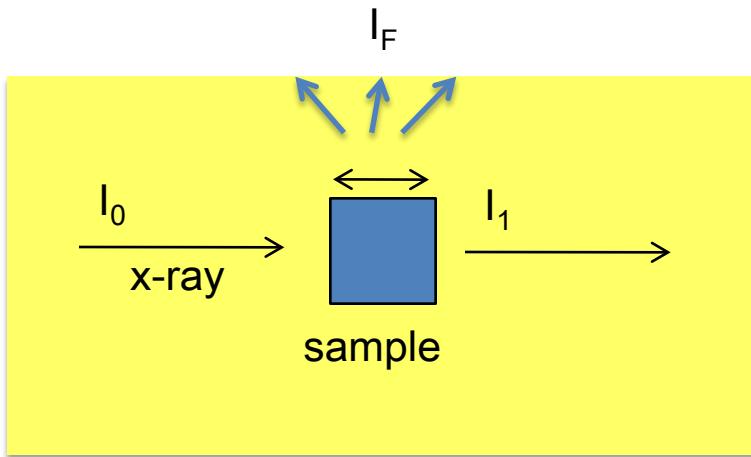
XANES – x-ray absorption near-edge spectroscopy
EXAFS – Extended x-ray absorption fine-structure

Local coordination environment

Application

- local structure refinement
- Speciation

X-ray Fluorescence, XRF (BL1.1W, BL2.2, BL5.2, BL8, BL6b)

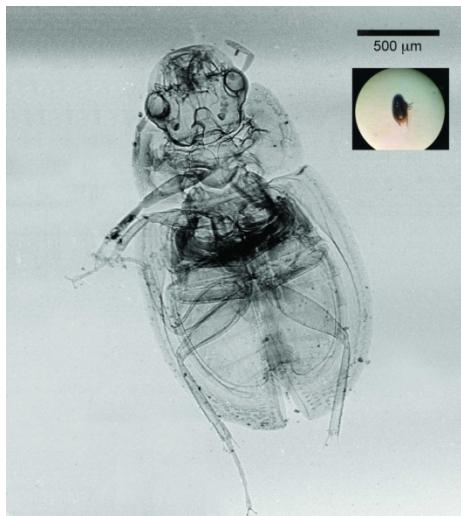
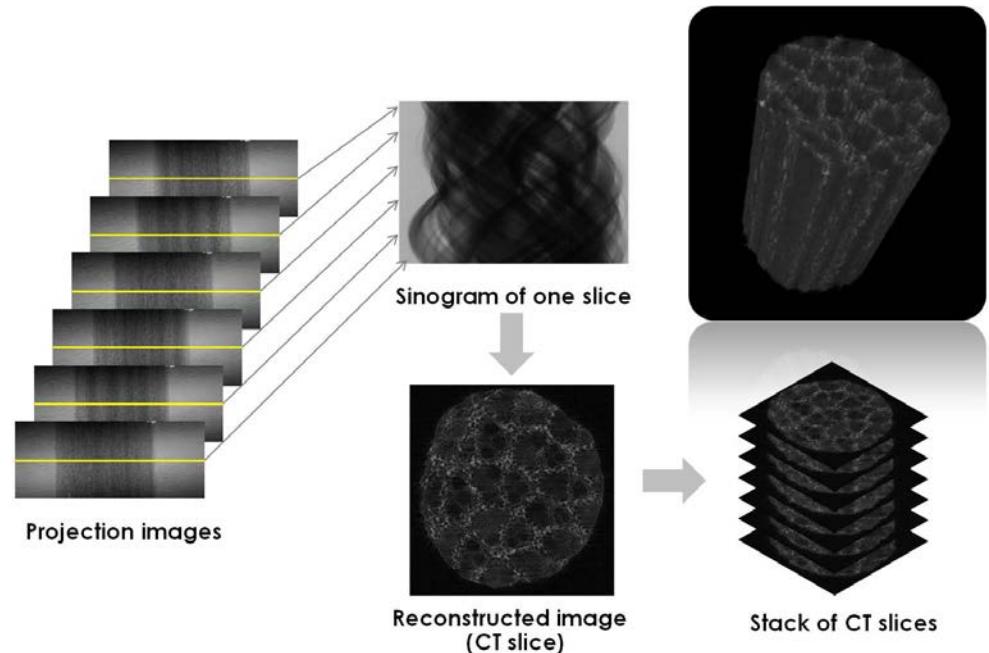
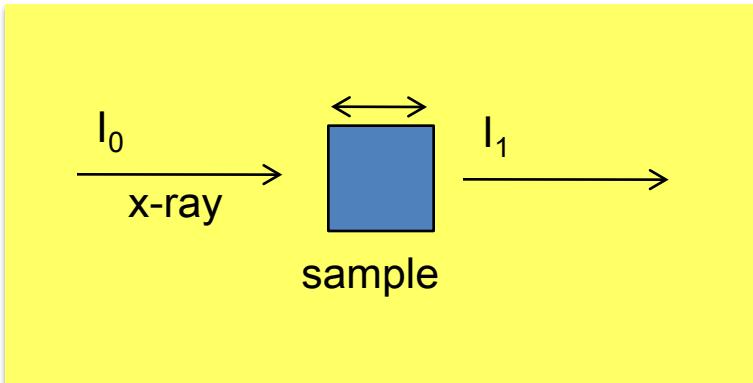


Application

- Elemental identification
- Elemental mapping

Fig. credit: <http://www.amptek.com/xrf.html>

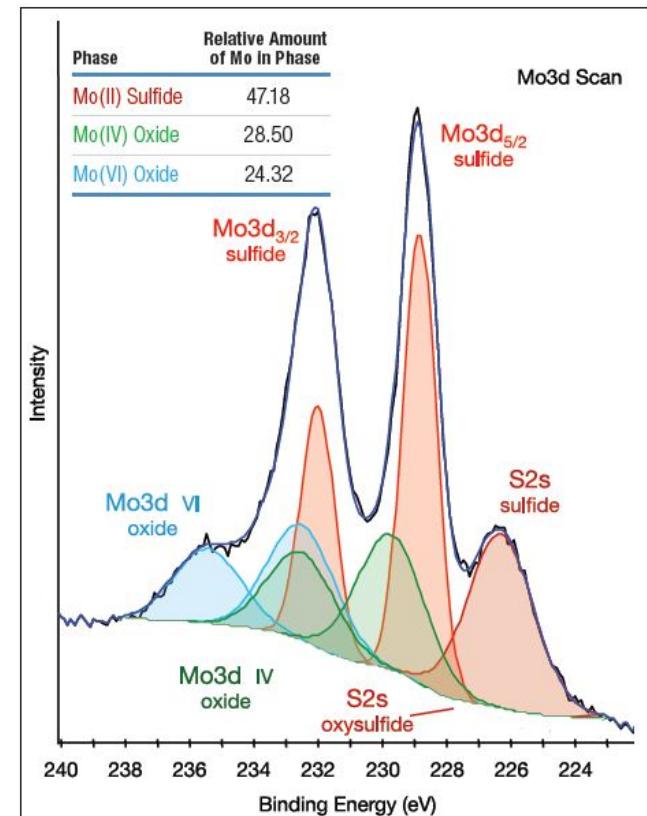
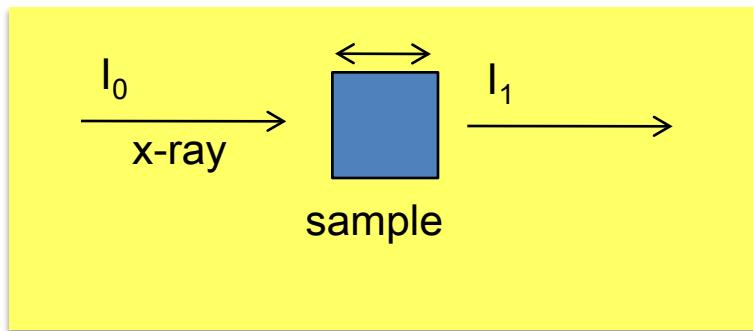
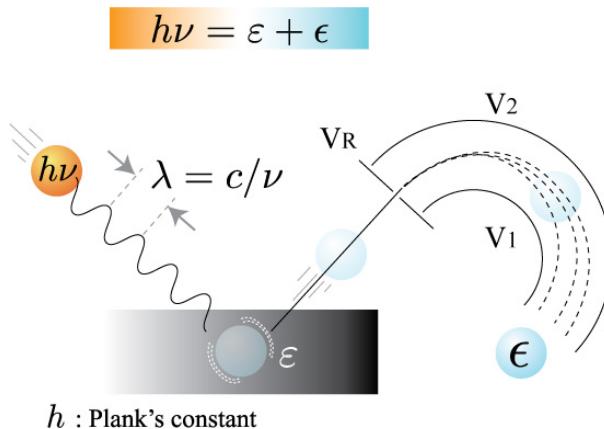
Imaging and Tomography (BL1.2W)



Application
- Microstructure

Fig. credit: www.slri.or.th

X-ray photoelectron emission spectroscopy, PES, XPS (BL3.2Ua, BL5.3)

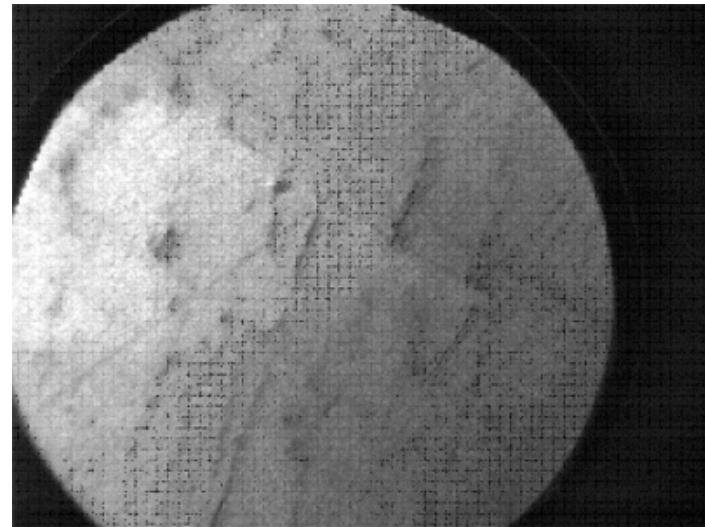
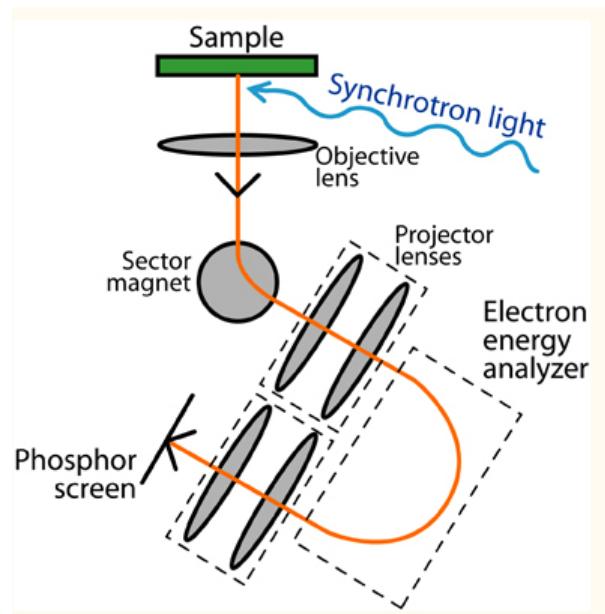


Application

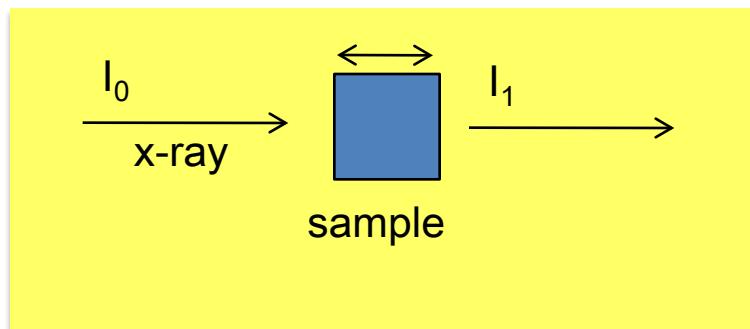
- Work function
- Chemical state

Fig. credit: <http://www.slri.or.th>, <http://www.alux.lu.se/research/synchrotron-radiation-sources/x-ray-photoemission-spectroscopy-xps/>, <https://www.azom.com/article.aspx?ArticleID=12038>

X-ray photoelectron emission microscopy, PEEM (BL3.2Ub)



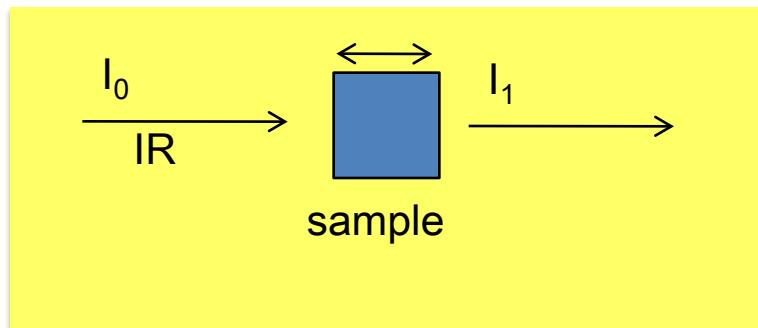
PEEM image of tungsten. Field of view is 75 microns.



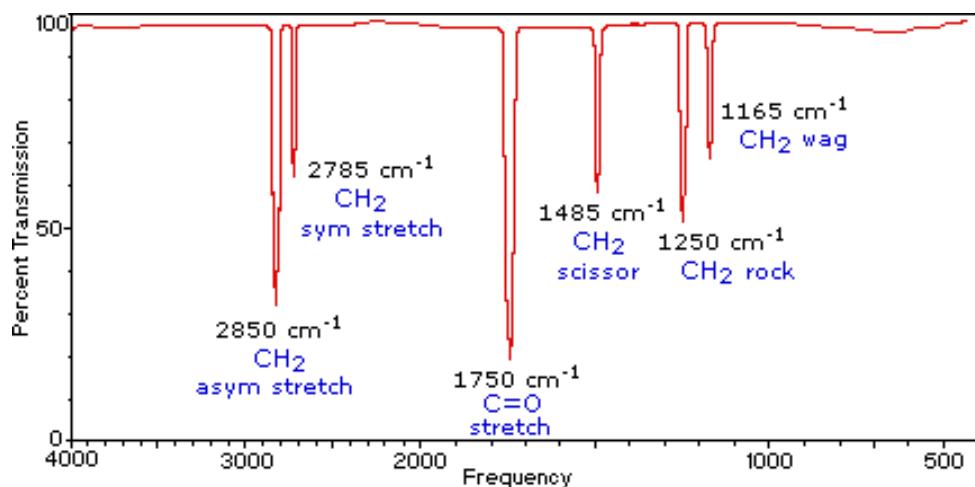
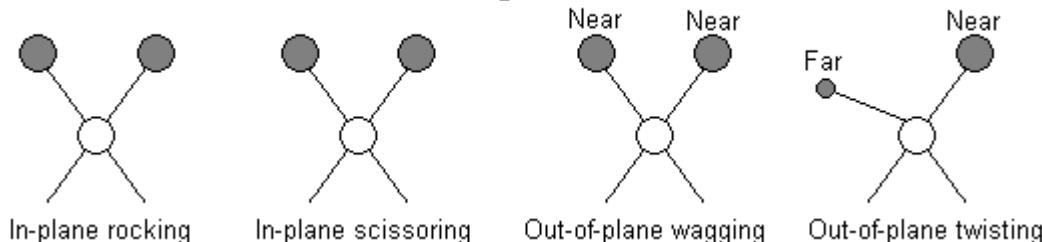
Application
- Image of chemical information

Fig. credit: www.slri.or.th

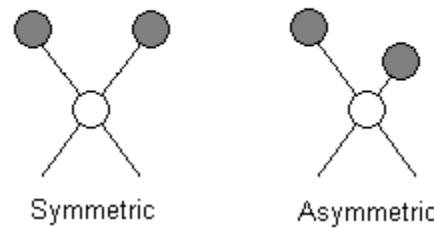
Infrared spectroscopy and imaging (BL4.1)



Bending vibrations



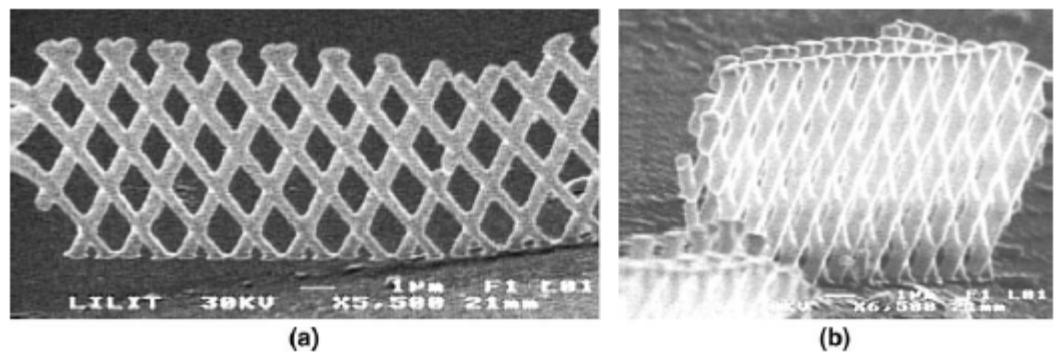
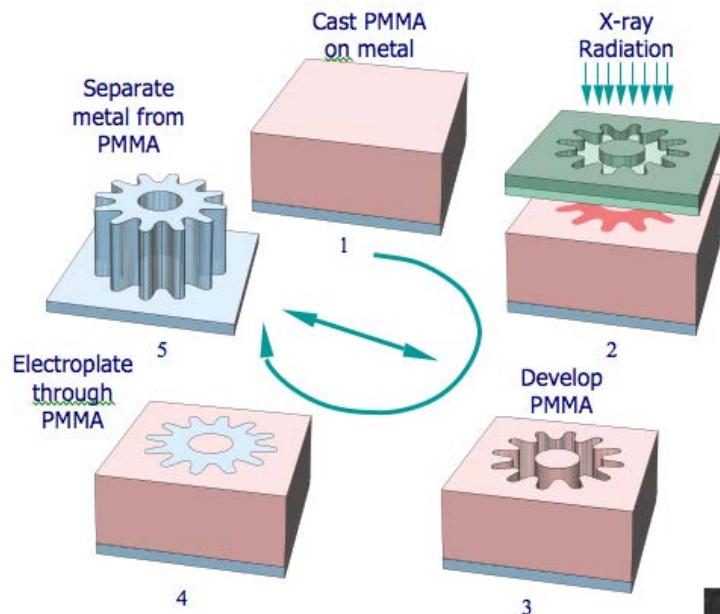
Stretching vibrations



Application

- Functional group identification
- mapping

Absorption: Deep X-ray Lithography, DXL (BL6a)

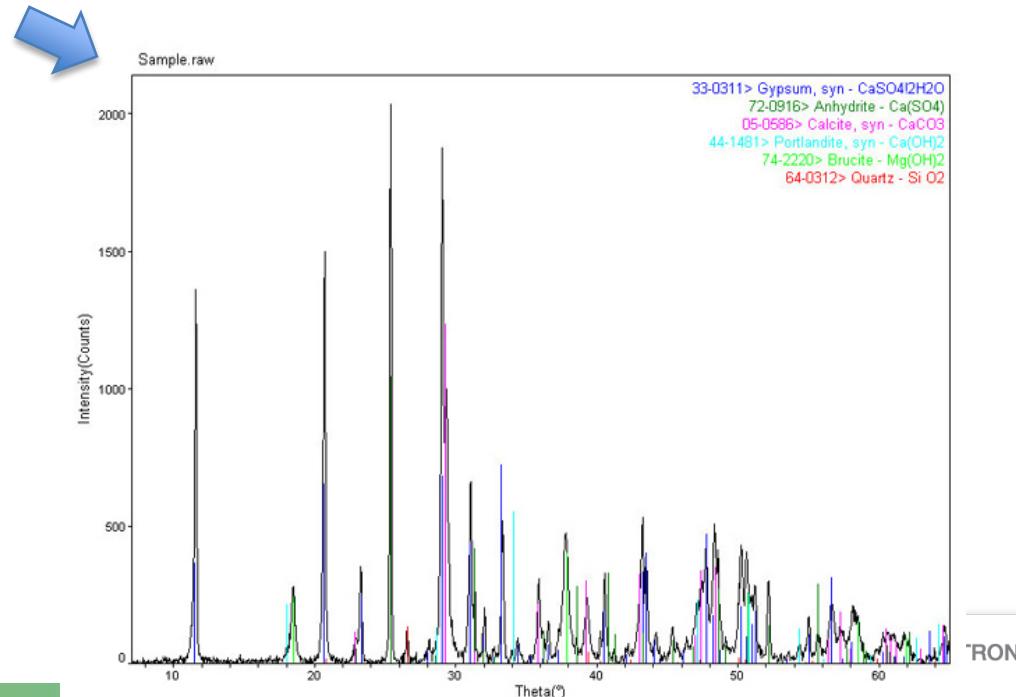
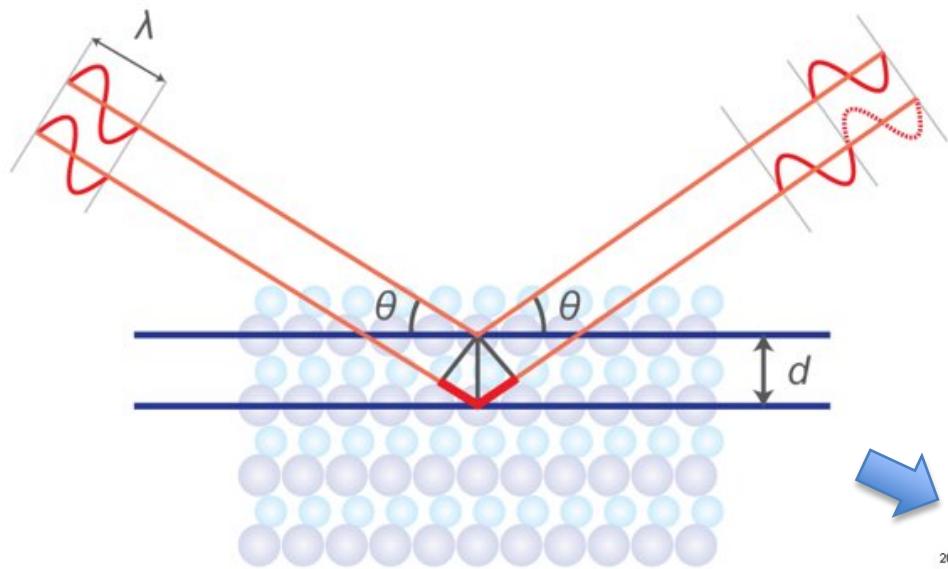


Application
- micro fabrication

Fig. credit: <https://www.mems-exchange.org/MEMS/fabrication.html>

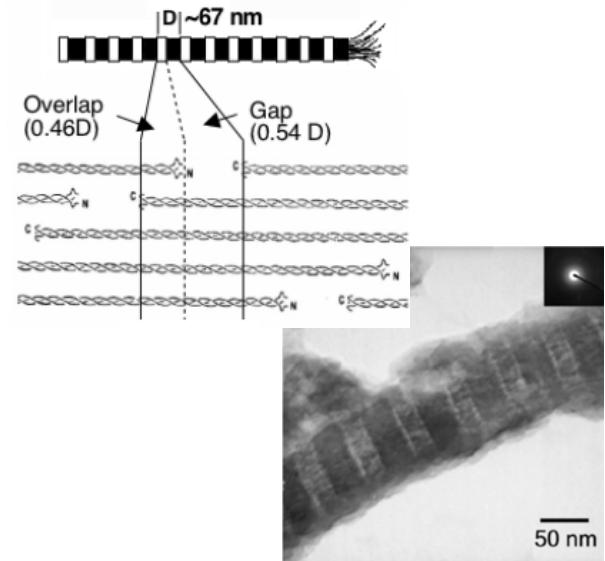
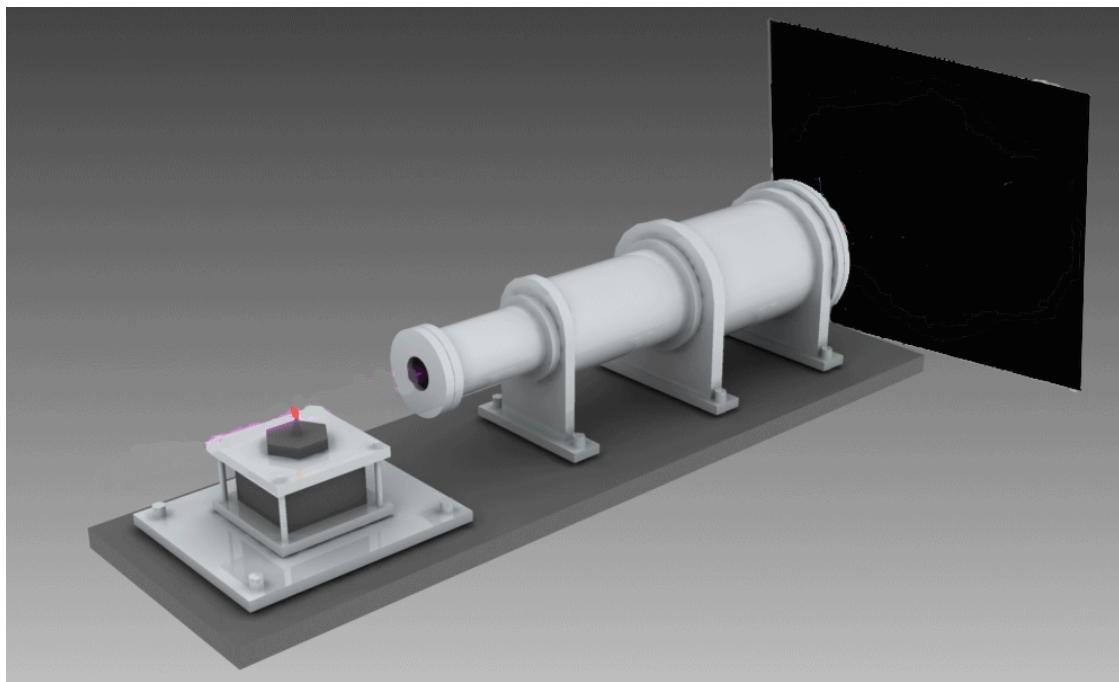
Romanato, F., et al., Microelectronic Engineering 73–74, pp 870–875 (2004).

X-ray Diffraction, XRD (BL1.1W)



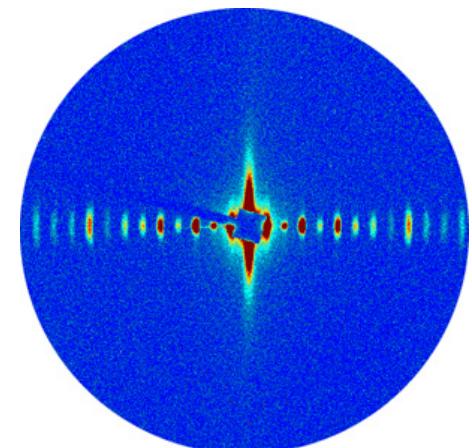
Application

- Phase identification
- Stress/strain analysis
- Crystal structure refinement

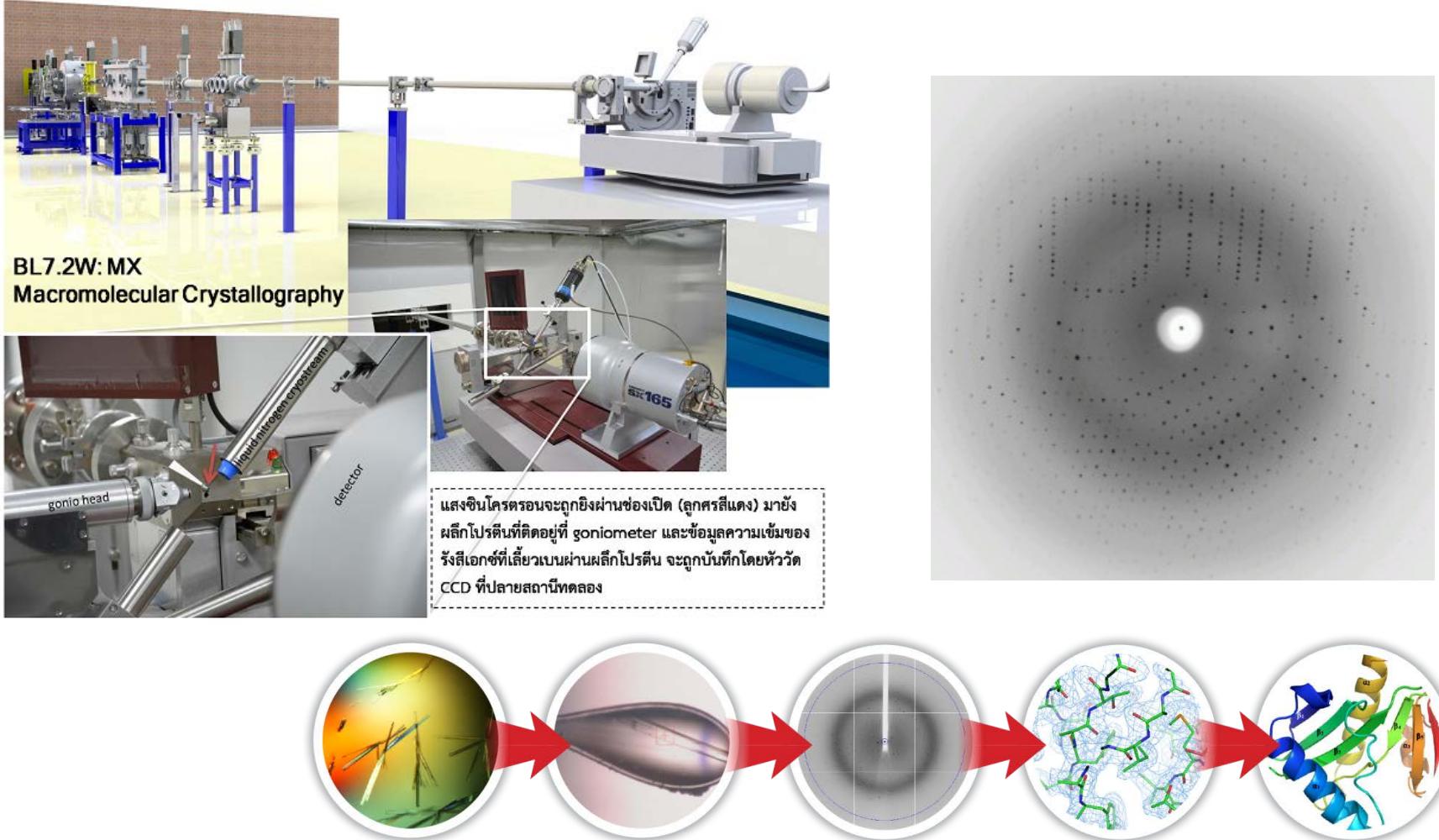


Application

- nano structure
- particle size and size distribution
- crystal structure
- crystal orientation
- crystallinity



Macromolecular crystallography, MX (BL7.2W)



Application
- crystal structure of protein

Fig. credit: www.sri.or.th

???

