Conventional IDs

for unconventional requirements

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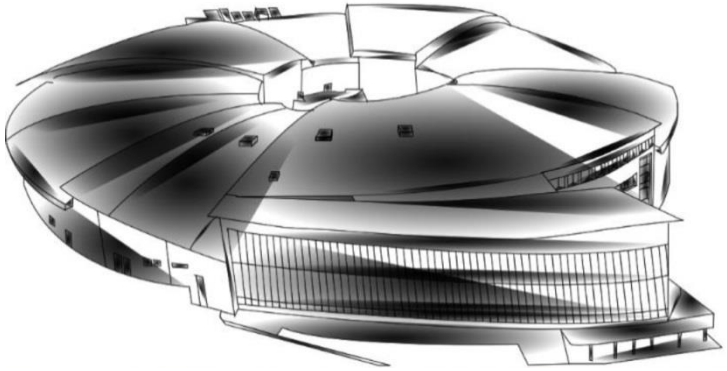


Outline

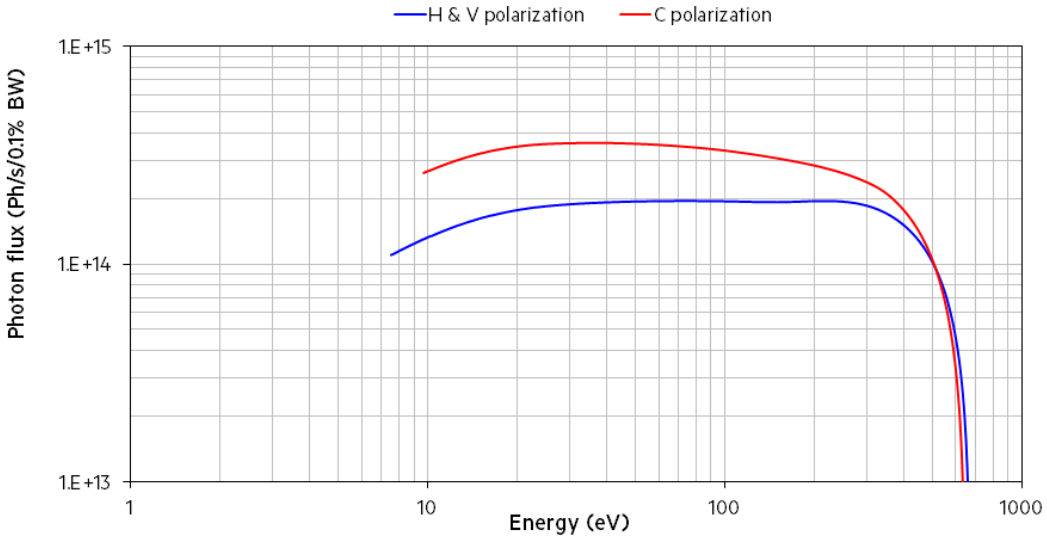
- LOREA
  - Special unconventional requests
  - Conventional solution
  - Colateral damages
- XAIRA
  - Special unconventional requests
  - Conventional solution
- FAXTOR
  - Special requests
  - Conventional solution

LOREA (Low-Energy Ultra-High-Resolution Angular Photoemission for Complex Materials) is a new beam line that will operate in the range of 10 – 1500 eV and will use polarized light.

- **Special *unconventional* request:**
  - Wide spectral range: 10 eV to 1500 eV
  - Circular / elliptical polarized light
  - Same range in H and V polarizations
- **ID conventional solution:**
  - Apple-II type undulator, out vacuum, reaching 10 eV
    - This leads to a huge period (125 mm)
    - With this period, only 500 eV maximum is reached
  - To reach the 1500 eV as maximum, a solution is proposed:
    - At low energies (10 – 500 eV), ID works as undulator
    - At high energies (500 – 1500 eV), ID fix the gap at 35 mm and it works as a wiggler (smooth spectrum). In this mode, a polarization rate of 90% is achievable

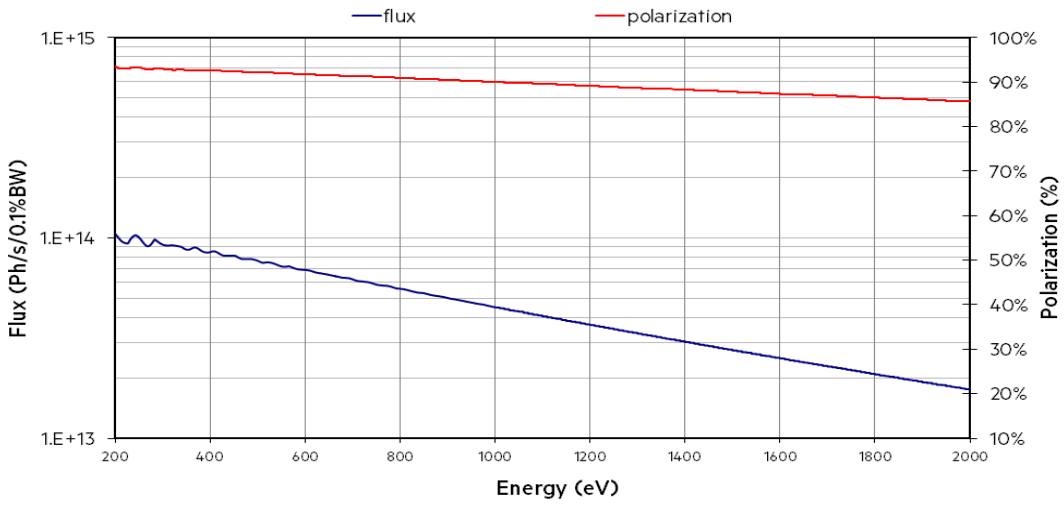
LOREA ID WORKING AT LOW ENERGY RANGE IN UNDULATOR MODE

Aperture slit of 0.5 x 0.5 mrad^2 and Storage Ring current of 100 mA



LOREA ID at 35 mm gap working as wiggler at high energies

Aperture slit 0.75 x 0.75 mrad^2 and current in Storage Ring 100 mA



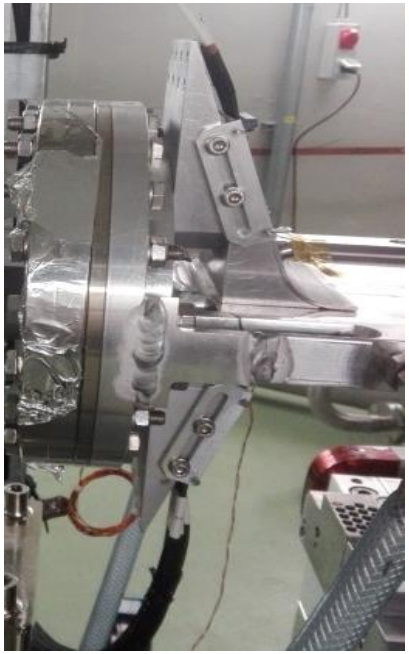
ID built by Kyma

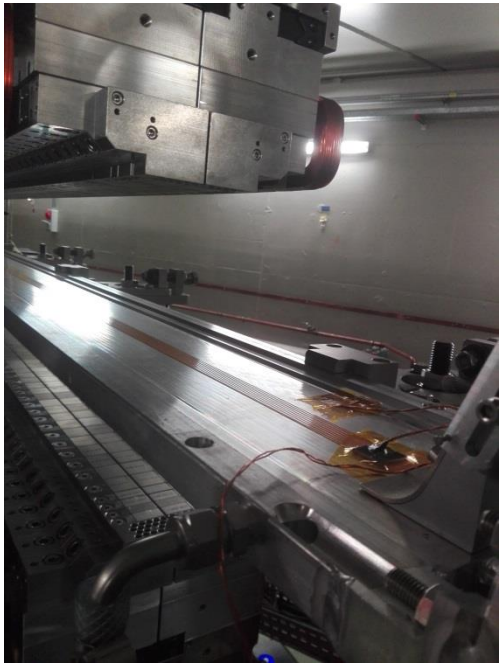
- **Colateral damages:**
  - Huge power emission -> 6 kW
  - High emission fans –> specially in vertical mode
  - High field and long undulator -> big impact on Machine working point with a reduction of Dynamic Aperture

- **Adopted solutions:**
  - High emission fans –> New vacuum chamber and absorber for downstream bending magnet

  - Huge power emission -> Special design of Front End using CuCrZr for the manufacturing of the Movable Masks. Thermomechanical behaviour not as good as Glidcop®, but better than that of OFHC copper and enough to tackle with power.

- **Adopted solutions:**
  - Machine working point and reduction of Dynamic Aperture –> Local correction scheme using long wire belts placed on top and bottom of vacuum chamber powered by 8 independent power supplies.





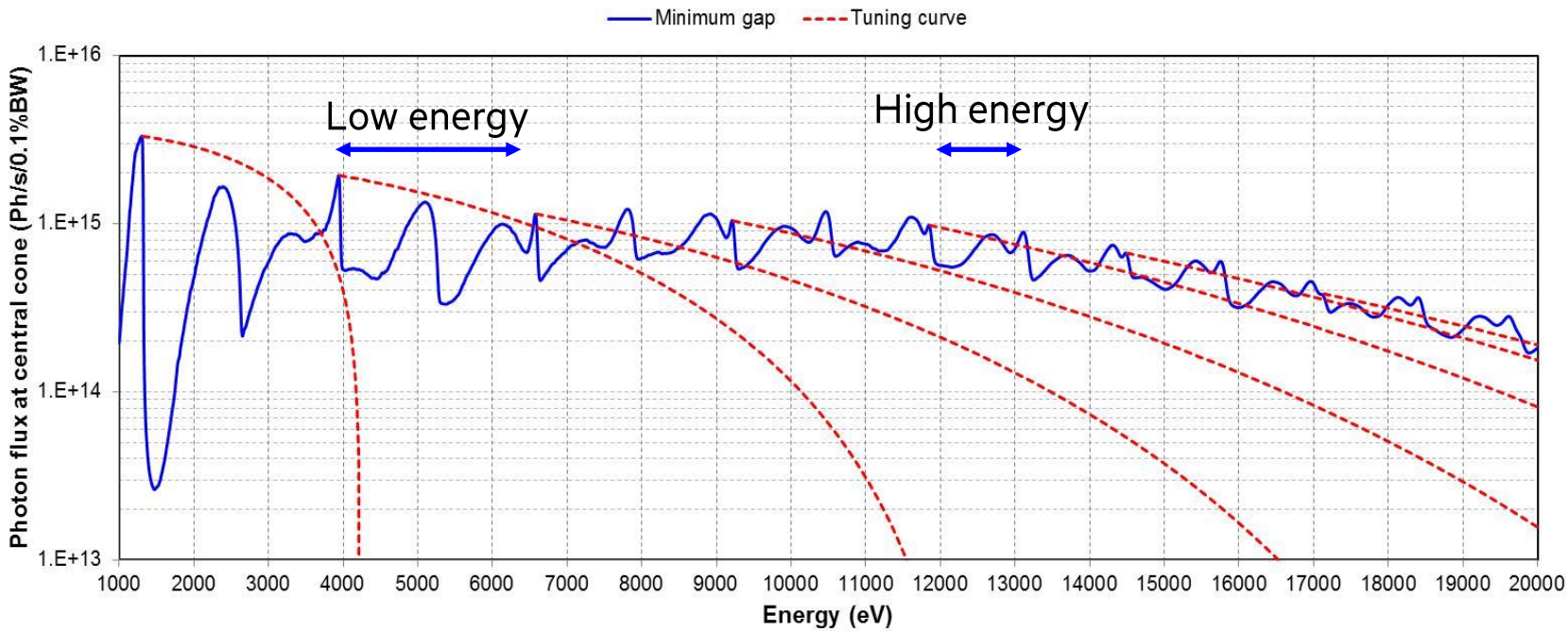

Wire belts heat the chamber (currents are in the range 1-14 A), so additional cooling for vacuum chamber has been installed

XAIRA (Experimental microfocus beamline for macromolecular crystallography) is a microfocus beamline for macromolecular crystallography, specifically designed to deliver high flux X-rays with a beam size down to the micrometer size, fully tunable around all essential K and L edgesto tackle MX projects for which only tiny (<10 μm) or imperfect crystals are obtained.

- **Special *unconventional* request:**

  - Exploit the anomalous signal of the metals naturally occurring in proteins (native phasing), which is enhanced in the case of small crystals and long wavelengths.
  - Deliver high flux and high brilliance optimized in two ranges:
    - (a) Energies between 4 to 6 keV on the 3rd harmonic
    - (b) Energy ~ 12.6 keV on the 9th harmonic, corresponding to the Se K edge
  - Provide an easily tunable photon energy with a range of 4.0 to 20 keV
  - Photon beam size 3×1 μm^2 FWHM (h×v) at ~12.6 keV on the 9^{th} harmonic
  - Photon flux > 3×10^{12} Ph/s in central cone (250 mA in SR) at 1 Å wavelength (12.4 keV)

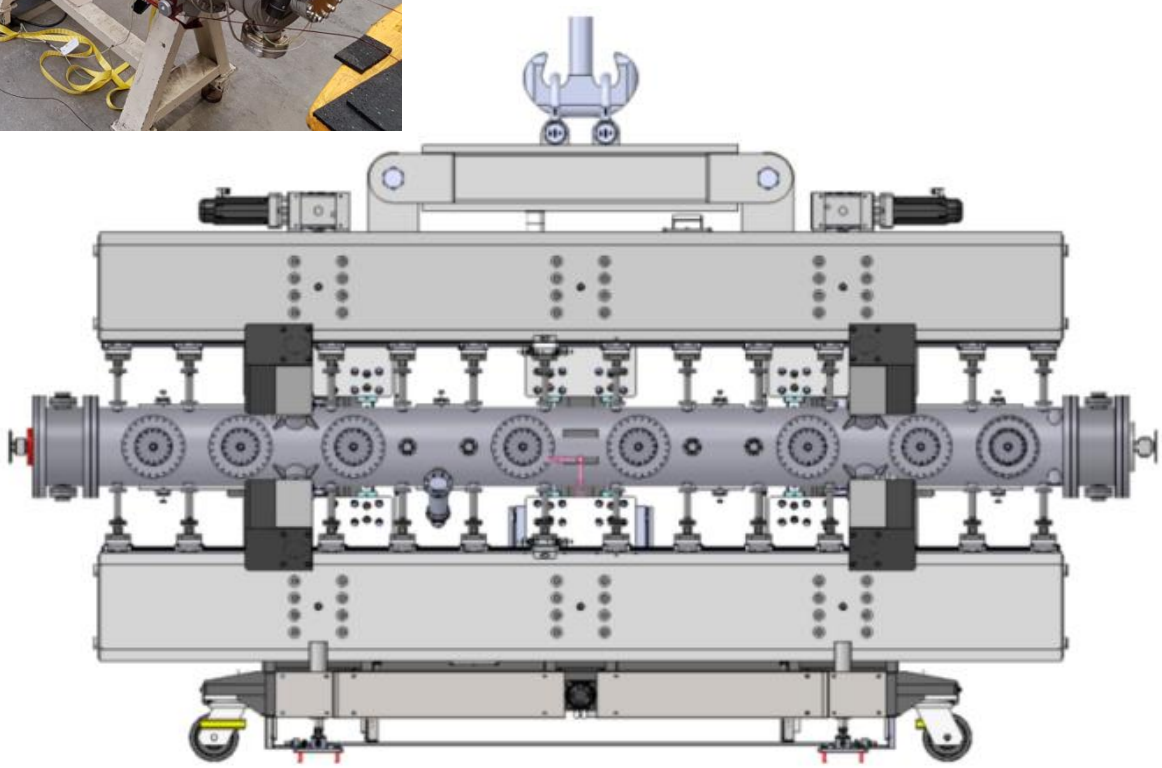
- **Conventional solution:**
  - *In-vacuum* hybrid type undulator (4.8 mm minimum physical gap)
    1. Short period (19 mm) -> reaching 4 keV
    2. Long device (2.3 m) -> high flux
    3. B_0 = 1.2275 T
- **Challenge**: phase error < 2° in such a long hybrid undulator

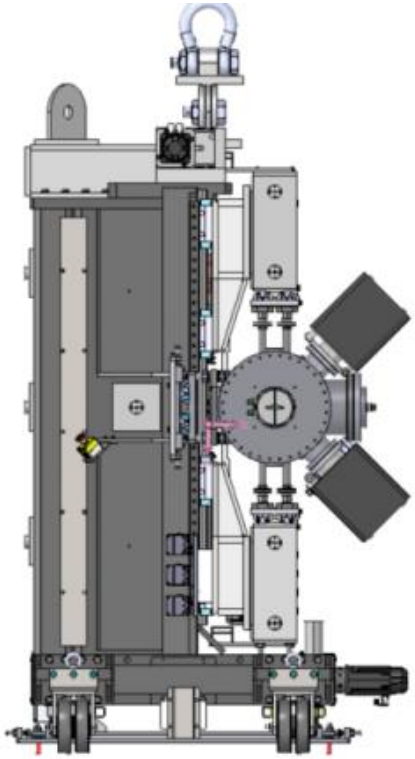


Huge device: length and weigth

Undulator being built by Kyma+Research Instruments

Difficult shimming to achieve phase error < 2º





FAXTOR (Fast X-ray Tomography & Radioscopy Beamline for ALBA) is an X-Ray tomography beamline, specifically designed to deliver high flux X-rays with a small beam size, fully tunable in the range 5 – 50 keV.

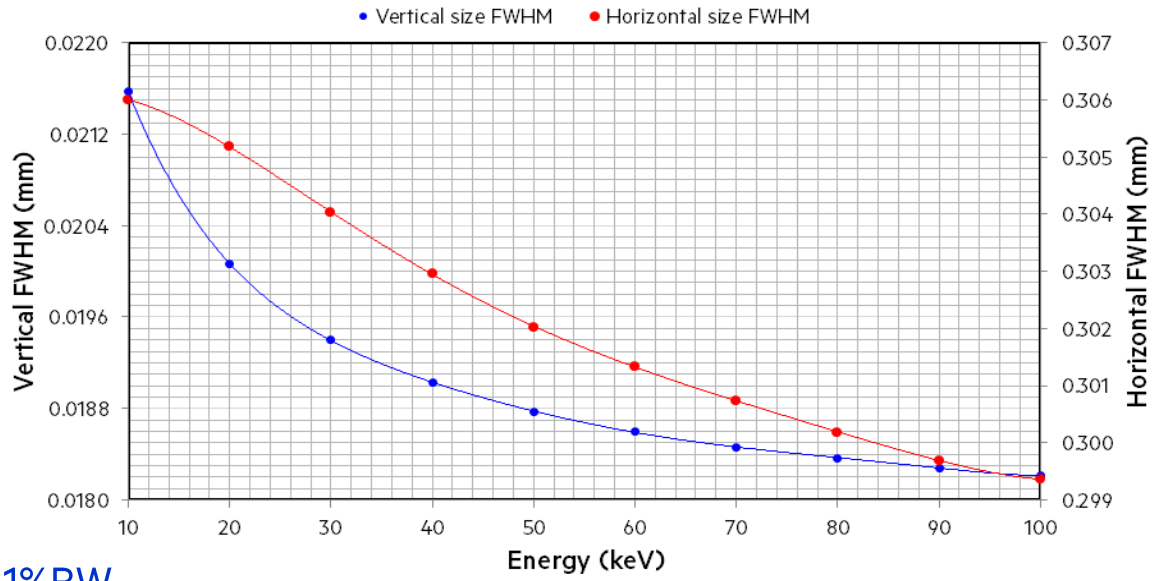
• Special requests:

- Photon source size < 310 H x 30 V μm^2
- Wide photon fan > 1 mrad
- Energy range 10 – 50 keV

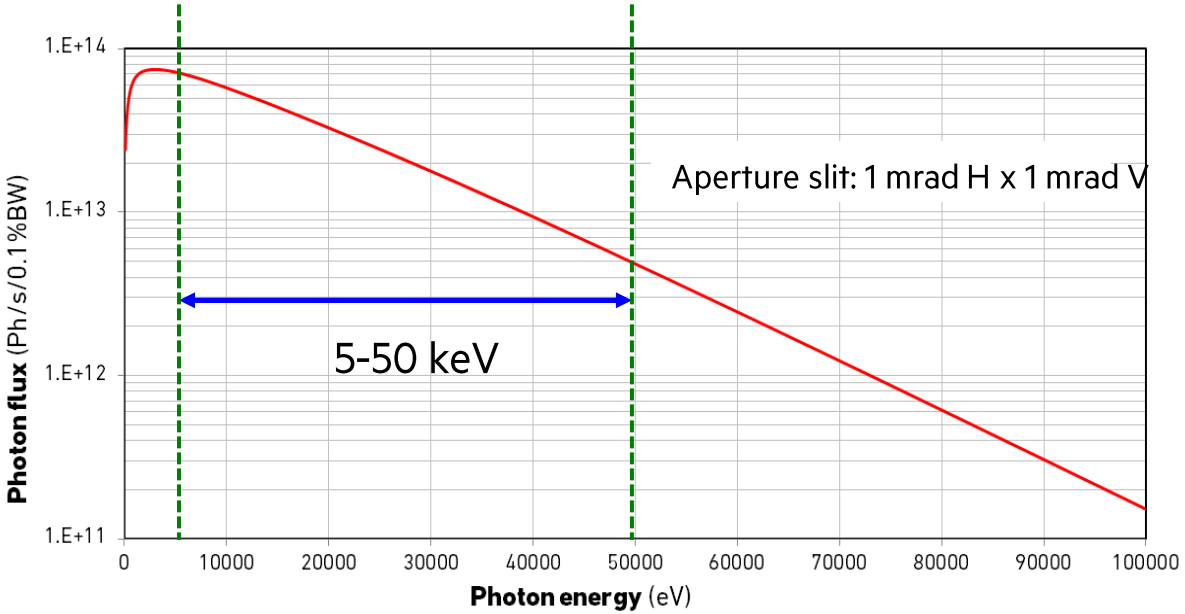
• Conventional solution:

- *In-vacuum* hybrid type wiggler (5 mm minimum magnetic gap)
  1. Short device (250 mm) -> to obtain small source size
  2. Regular period size (50 m) -> to have high B_0 and therefore flux enough in the range 5 – 50 keV

- In vacuum wiggler
- Hybrid-type with side magnets
- 5 periods
- 50 mm period length



- FWHM < 306 H x 22 V μm^2
- Flux at 250 mA in SR > $5 \cdot 10^{12}$ Ph/s/0.1%BW
- H aperture: 2 mrad



CURRENT STATUS:

Ready for tendering

CONCLUSIONS

- Standard solutions can be applied to face challenging scientific requirements
- The same ID can be used in different ways (wiggler / undulator in the LOREA case)
- IDs affectation on beam dynamics can be corrected using local corrections
- Hybrid in-vacuum undulators can be used to cover a long range of energies
- IDs can be used as Tomography photon source in the X-ray range