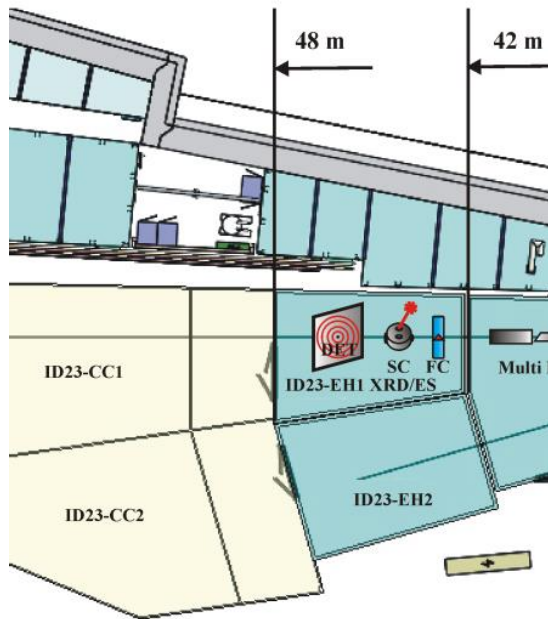




| The European Synchrotron



## Plans for an XRD/XRI/XES beamline for dynamic compression studies at ESRF

Svitlyk V., Torchio R., Pascarelli S., Briggs R.,  
Clavel C., Glatzel P., Kabanova V., Mathon O.,  
Mezouar M., Rack A., Wulff M.

European Synchrotron Radiation Facility

**Studies of Dynamically Compressed Matter with X-rays,  
ESRF, Grenoble, March 29-30, 2017**

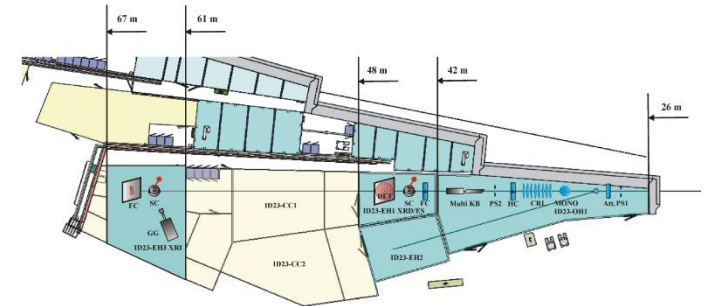
## HPLF II Project

- follows the HPLF I project (XAS dynamic studies at ID24 with 100 J laser)
- complement the XAS with XRD/XRI/XES technique
- more efficient utilization of the laser
- extending the  $P$  and  $T$  range accessible for XRD by static compression
- dynamic behavior of matter with XRD/XRI/XES
- the beamline will fully benefit from the ESRF EBS program



**Facility with a unique combination of XAS, XRD, XRI, XES techniques**

## Dynamic Compression Facility



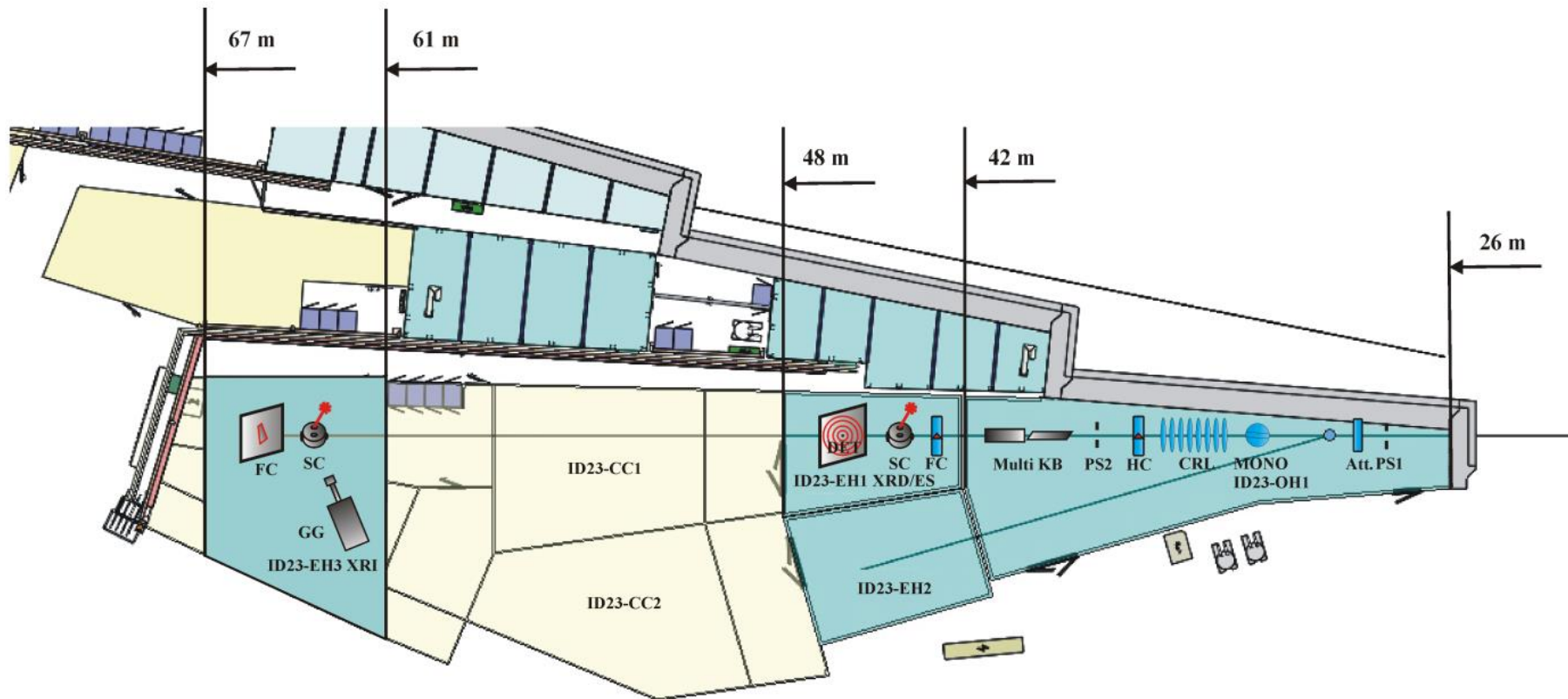
- **ns-lived highly compressed/strained states of matter**, including low-Z systems using absorption/diffraction/scattering/imaging/emission methods (all inclusive package)



- scientific fields include: **high pressure physics and chemistry** (new states of matter and new materials), **earth and planetary science**, applied **engineering materials** (strong involvement of industry)

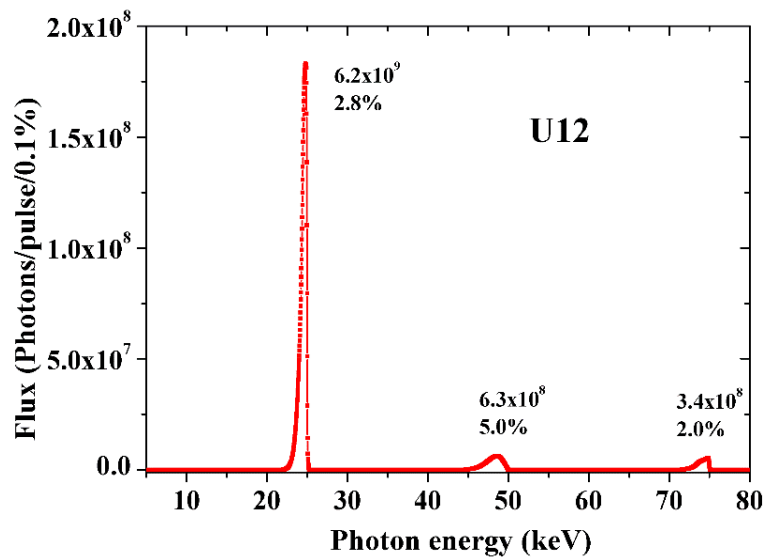
## Laser sharing:

- proximity to ID24 => ID23 (possible location)

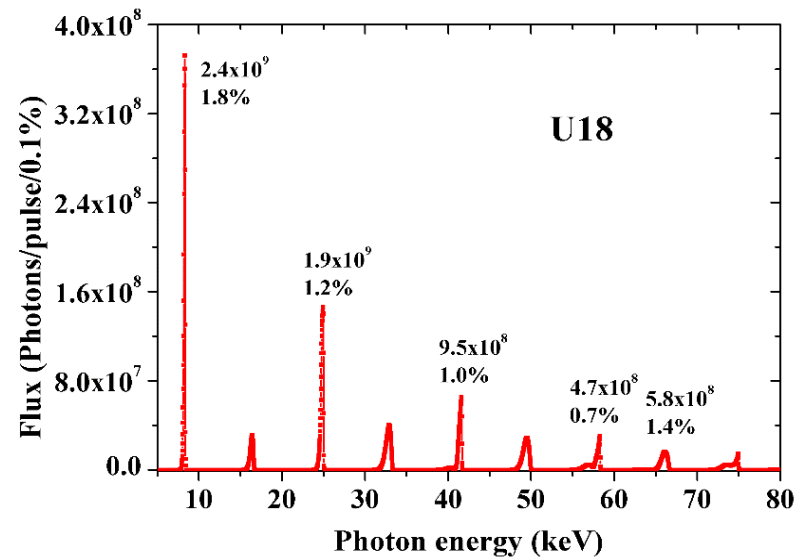


## Source and optics hutch

- U12 single harmonic + U18 undulators



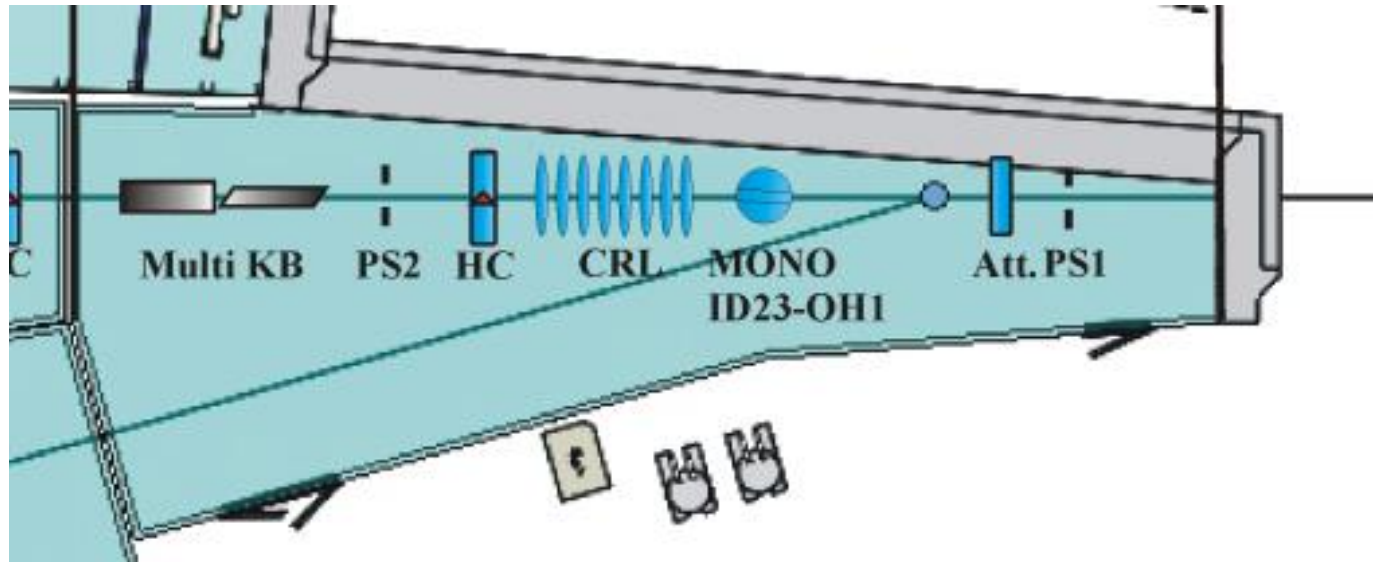
low energies



high energies with high resolution

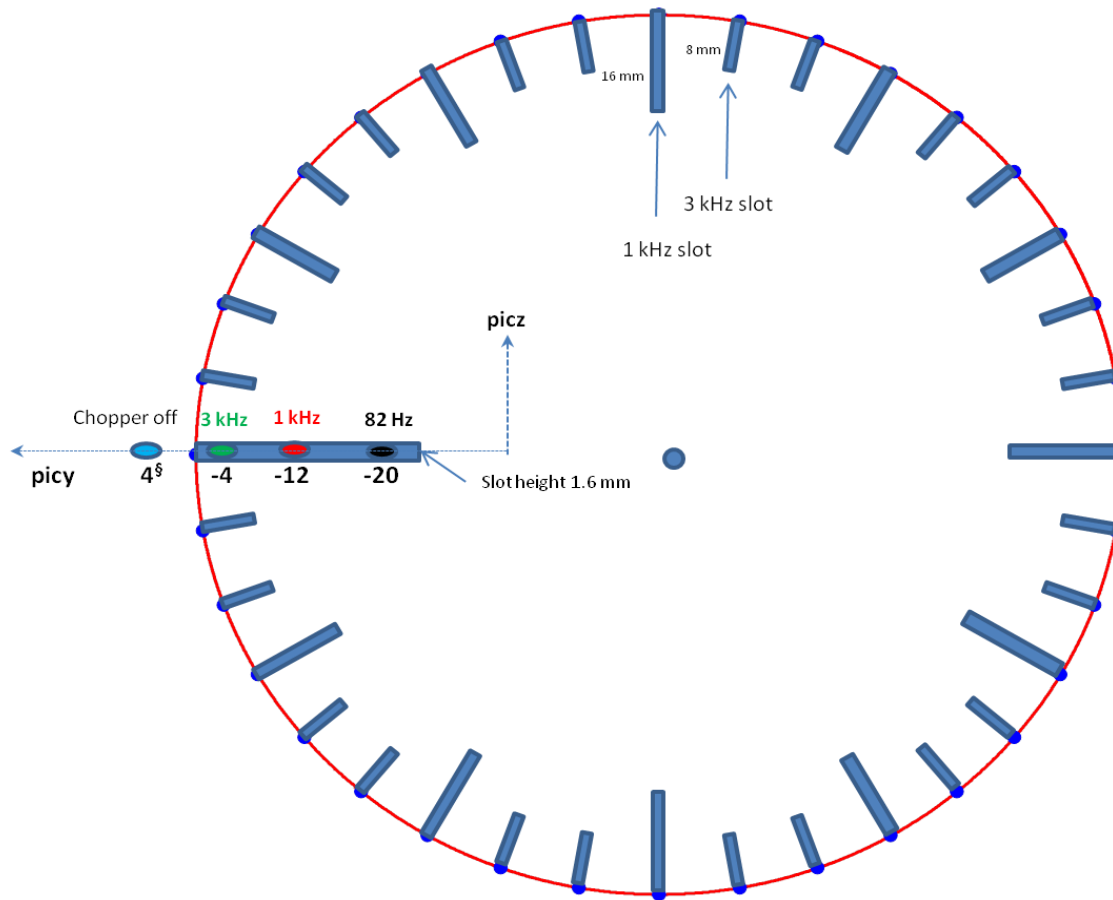
## Source and optics hutch

- modular optics hutch for XRD and XRI



## Isolation of a single X-ray pulse

- a system of choppers with a ms shutter (ID09 scheme)

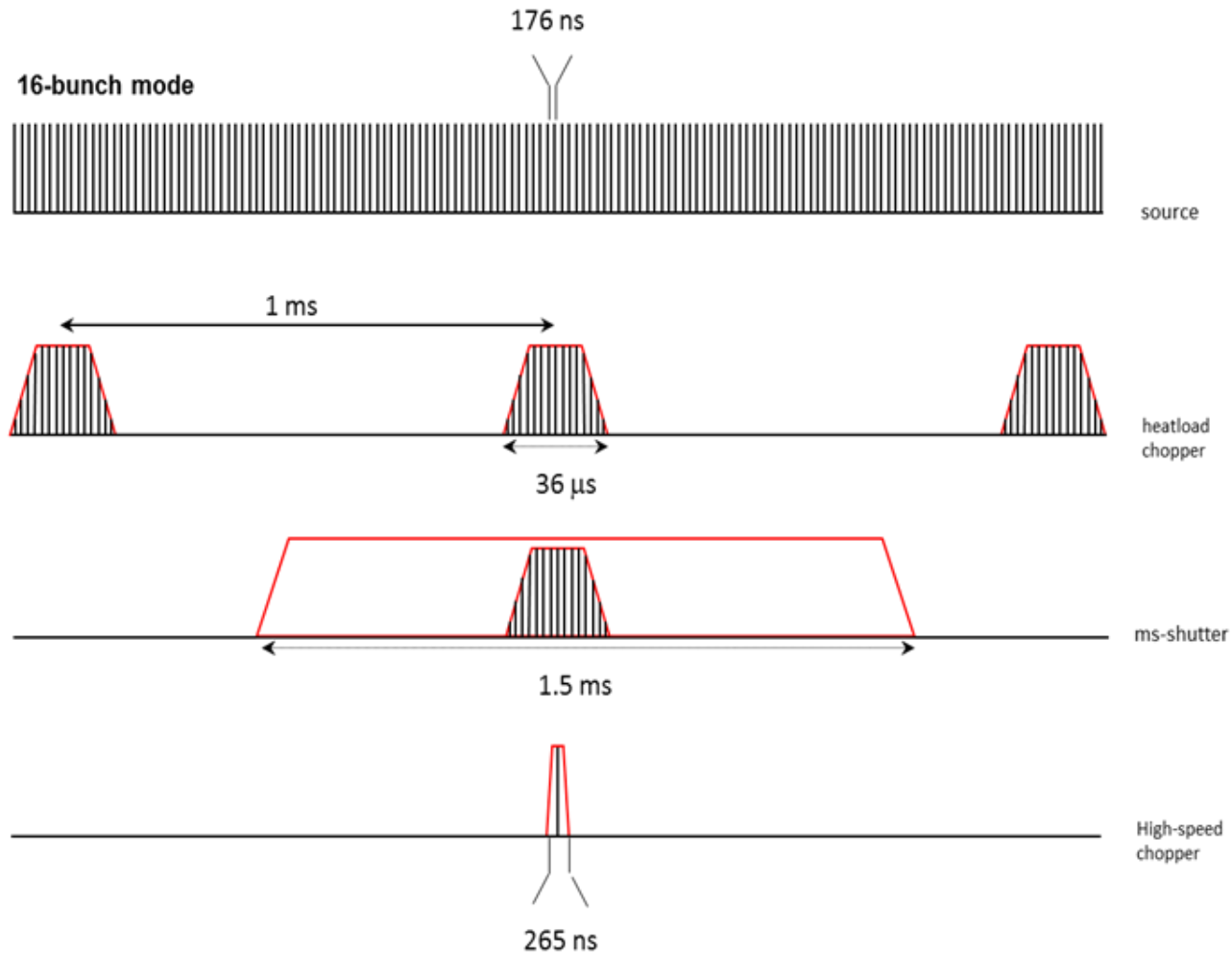


Heatload chopper @ 82.2 Hz



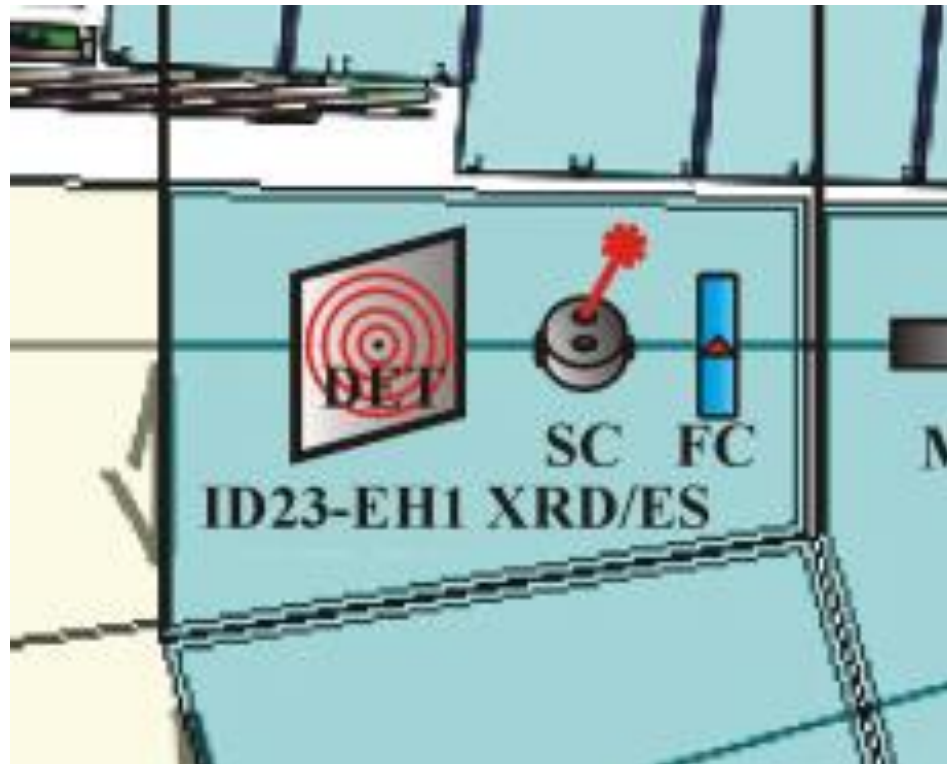
## Isolation of a single X-ray pulse

- a system of choppers with a ms shutter (ID09 scheme)



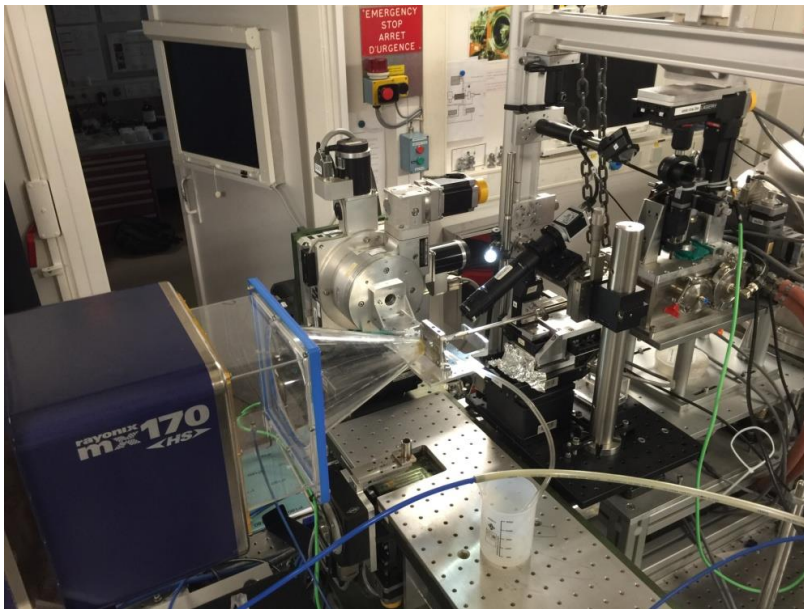
## XRD/ES hutch:

- beam size:  $5 \times 5 \mu\text{m}^2$
- XRD: A fast Rayonix HS-170 integrating detector
- XES: A high-luminosity analyzer + fast detector



## XRD detector:

- **Rayonix HS-170:** 170 x 170 mm<sup>2</sup>; pixel size: 44.2 x 44.2 μm<sup>2</sup>, 3840x3840

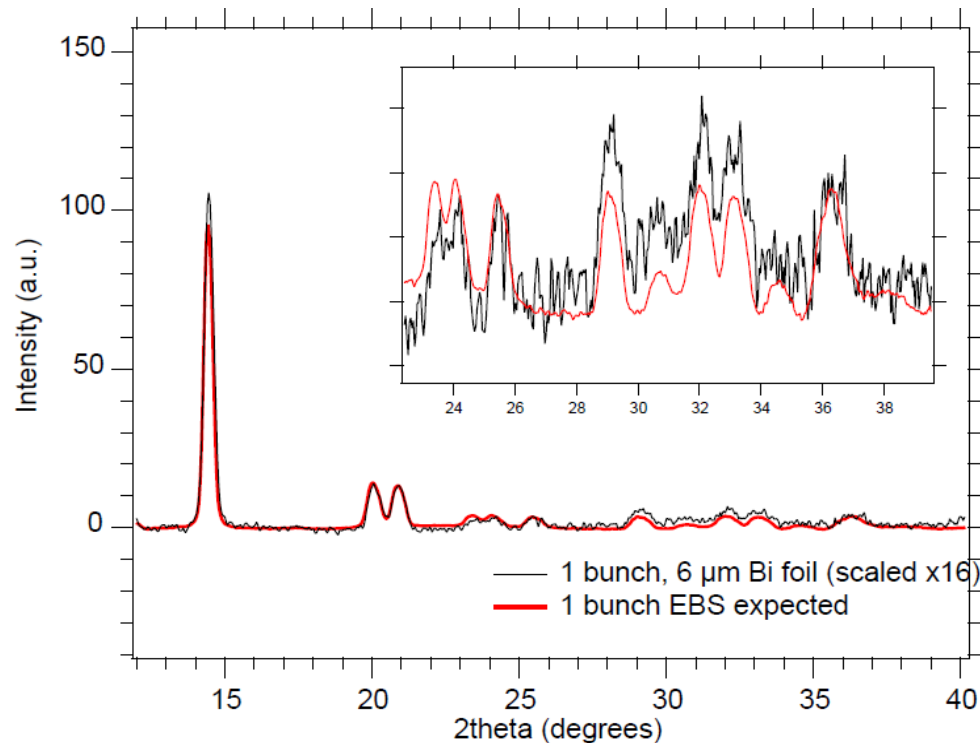


QE: 90% < 15 keV  
30% > 30 keV

ID09

## XRD/ES hutch:

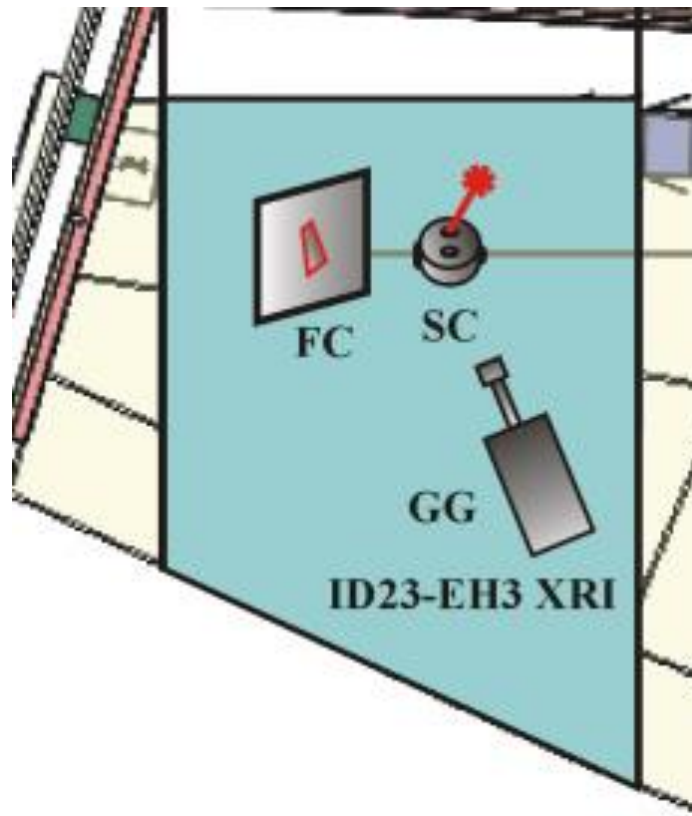
- expected diffraction quality

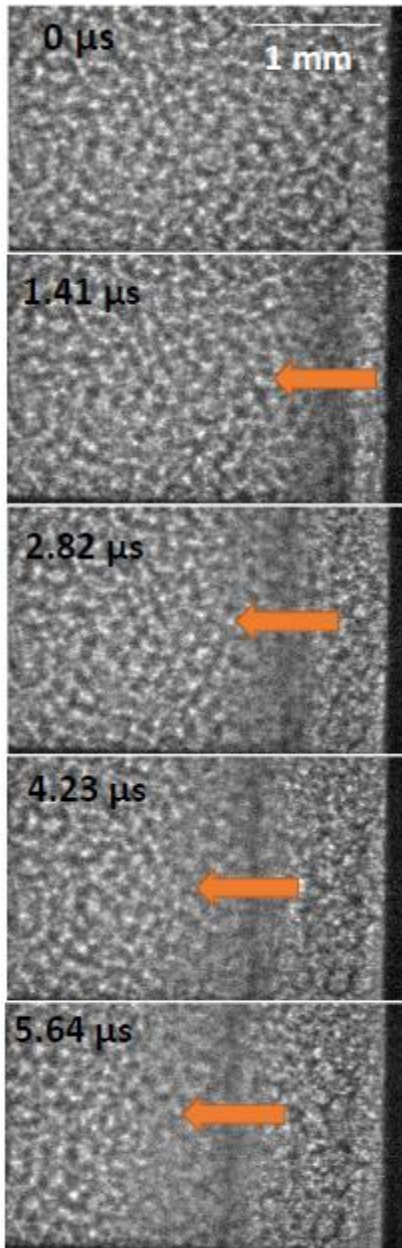


Single pulse diffraction pattern of Bi foil collected using a single 100 ps X-ray pulse at ID09 (black) at 15 KeV compared to the average of 20 bunches to simulate the increased flux on the future Dynamic Compression Facility. Courtesy of Richard Briggs (ESRF).

## XRI hutch:

- **beam size: 1x1 to 3x3 mm<sup>2</sup>**
- **indirect detection: fast scintillators coupled to high-speed visible light cameras**
- **space to install a gas gun**





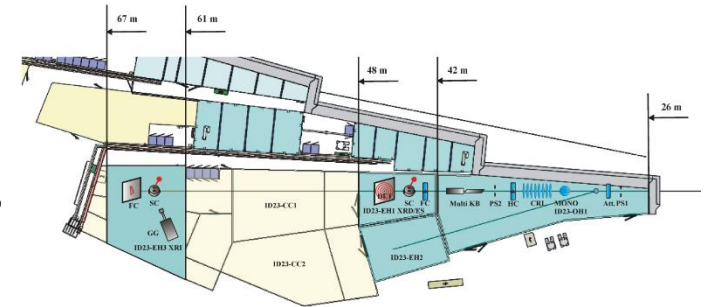
## XRI hutch:

- high-Z systems

Propagation of a laser-induced shock wave through a polystyrene foam. Images were acquired using a single bunch of the 4-bunch mode (ID19, 30 keV).

Courtesy: ENSAM, HZDR, ENSMA, ESRF, Univ. of Rennes.

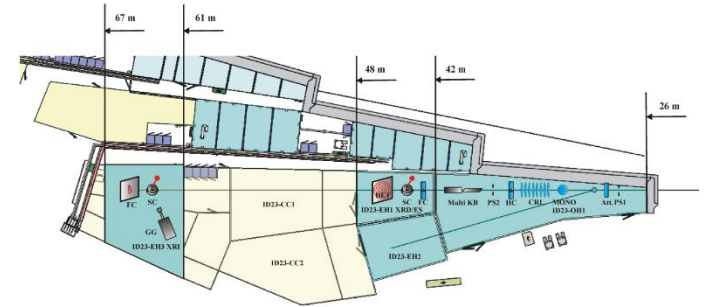
## Dynamic Compression Facility: complementarity with other facilities



- **XFELs (E-XFEL, LCLS, SACLA):**
  - higher energies
  - more stable beam
- **Large high energy laser facilities (OMEGA, LULI, NIF, JANUS, Orion...)**
  - higher beam quality vs. backlighters
  - **XRI: dynamics by acquiring real movies of a single event**
- **DCS high energy laser APS**
  - XAS and XES
- **ESRF**
  - static compression high pressure activities: ID27, ID15b, ID06LVP, ID18, ID24, BM23, ID12, ID20
  - in-situ real-time hard X-ray imaging: ID15a, ID31, ID19, ID06HXRM
  - time-resolved diffraction/scattering: ID09

## Dynamic Compression Facility

- all advantages of the ESRF infrastructure
- ✓ continuous operation mode
- ✓ easier access



Thank you