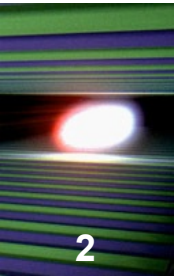


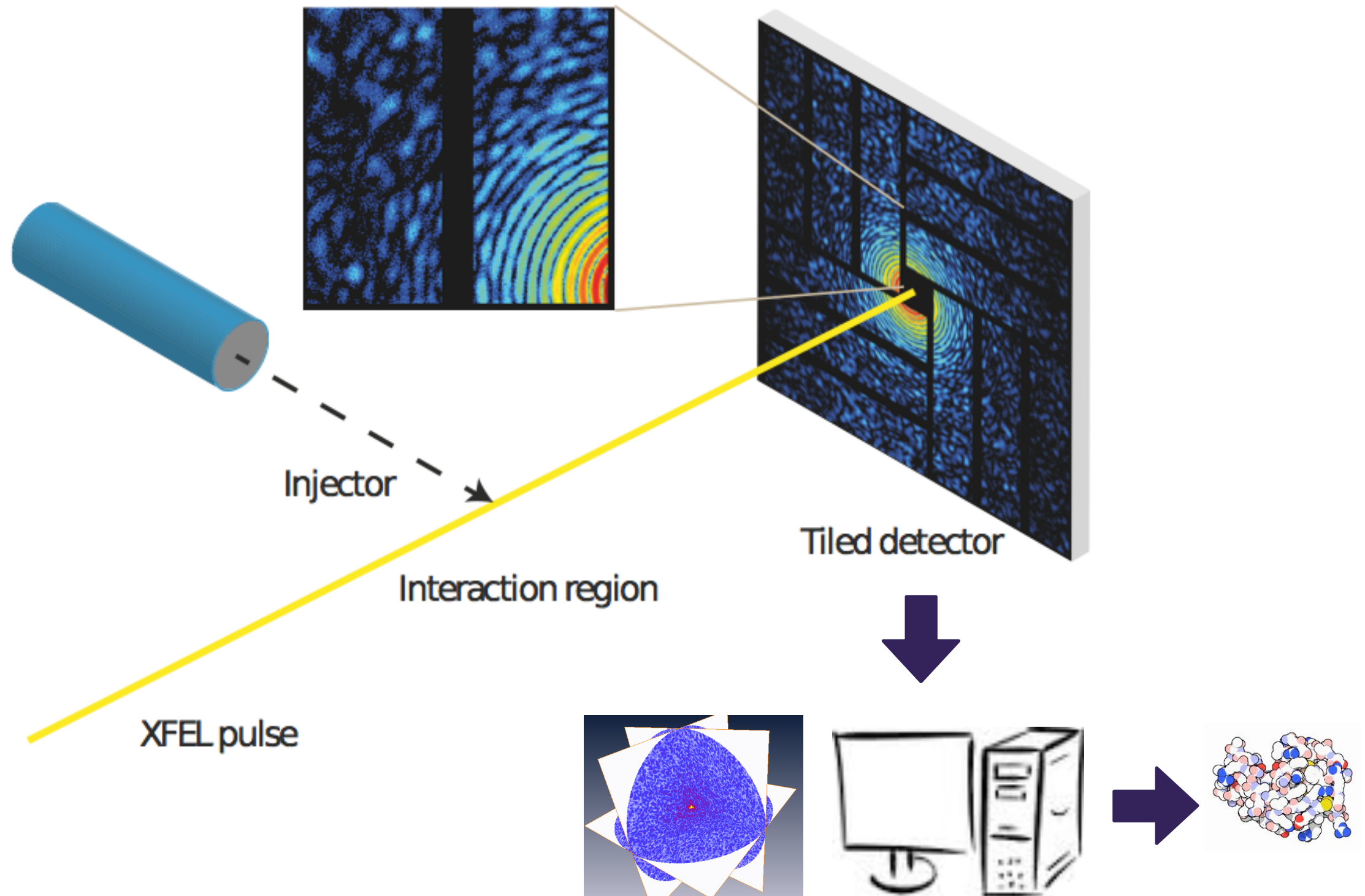
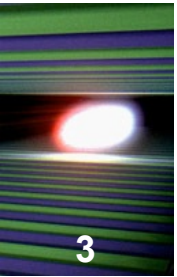
First Bio-imaging experiment at the European XFEL



Adrian Mancuso



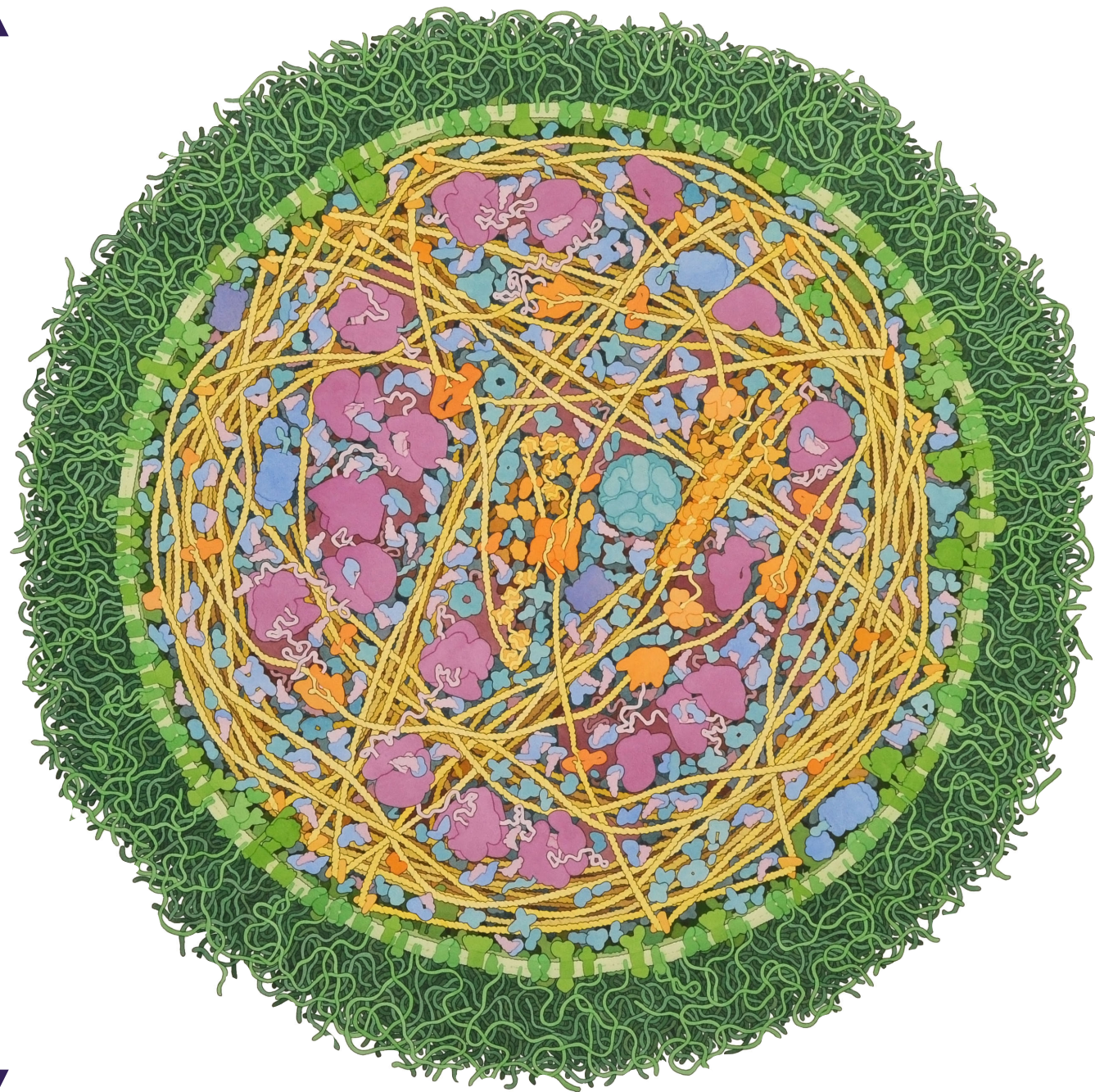
- Key Concepts for an imaging system
- THE Sample
- Beamline Components
- Sample Environment
- Detector & Analysis
- Needed Infrastructure & Commissioning



Interesting things to imagine inside a cell (possibly crystalline sample):

- DNA
- DNA polymerase
- Ribosome
- elongation factor G
- aminoacyl-tRNA synthetases
- topoisomerases
- Rec system for DNA repair
- chaperonin GroEL
- proteasome ClpA
- glycolytic enzymes
- pyruvate dehydrogenase complex
- ATP synthase
- secretory proteins
- sodium pump
- zinc transporter
- magnesium transporter
- ATP-binding cassette transporter
- magnesium transporter
- lipoglycan

250 to 500 nm

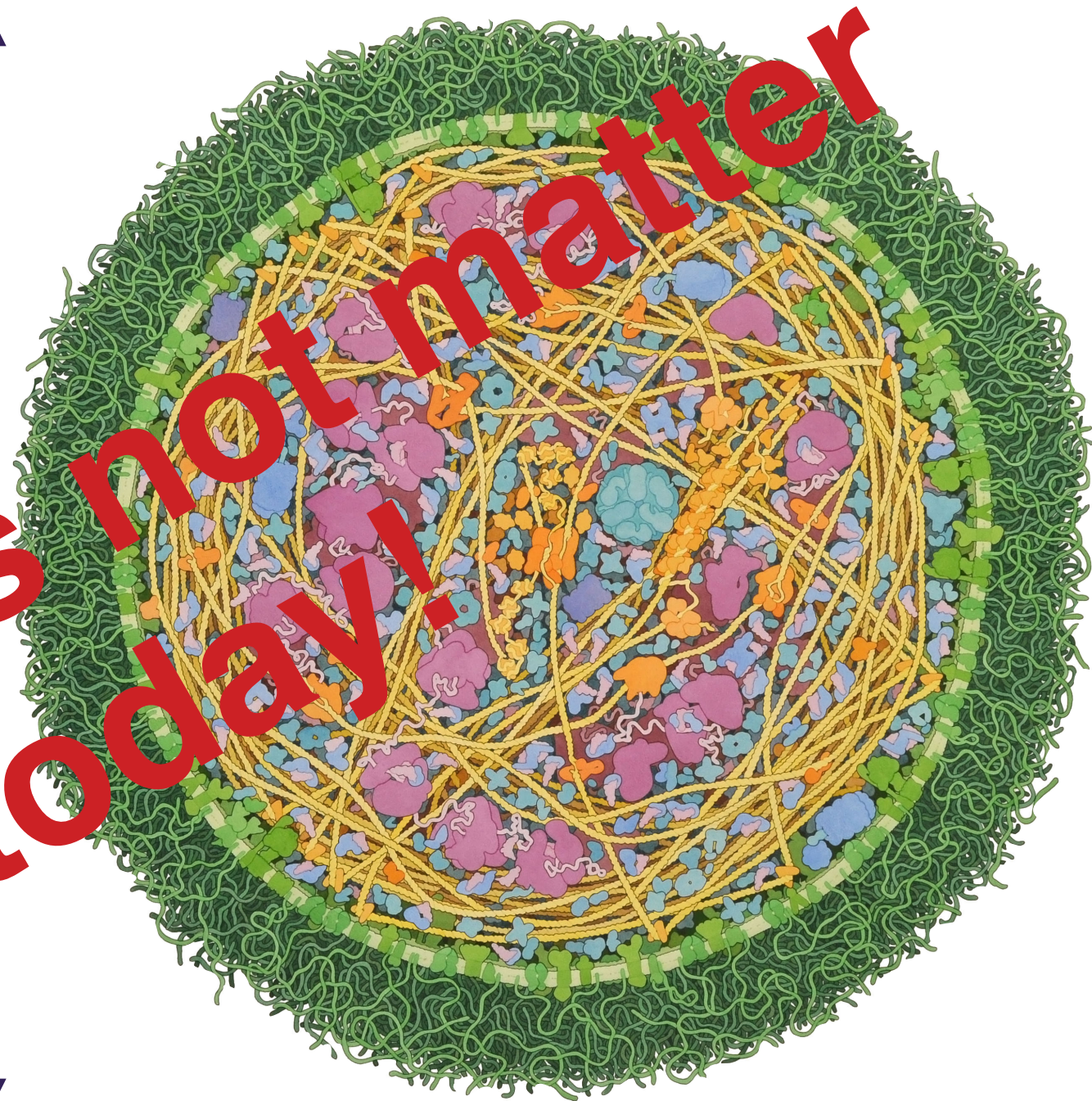


Mycoplasma mycoides
Watercolor by David S. Goodsell,
Scripps Research Institute 2011

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- iron binding cassette transporter
- magnesium transporter
- lipoglycan

up to 500 nm



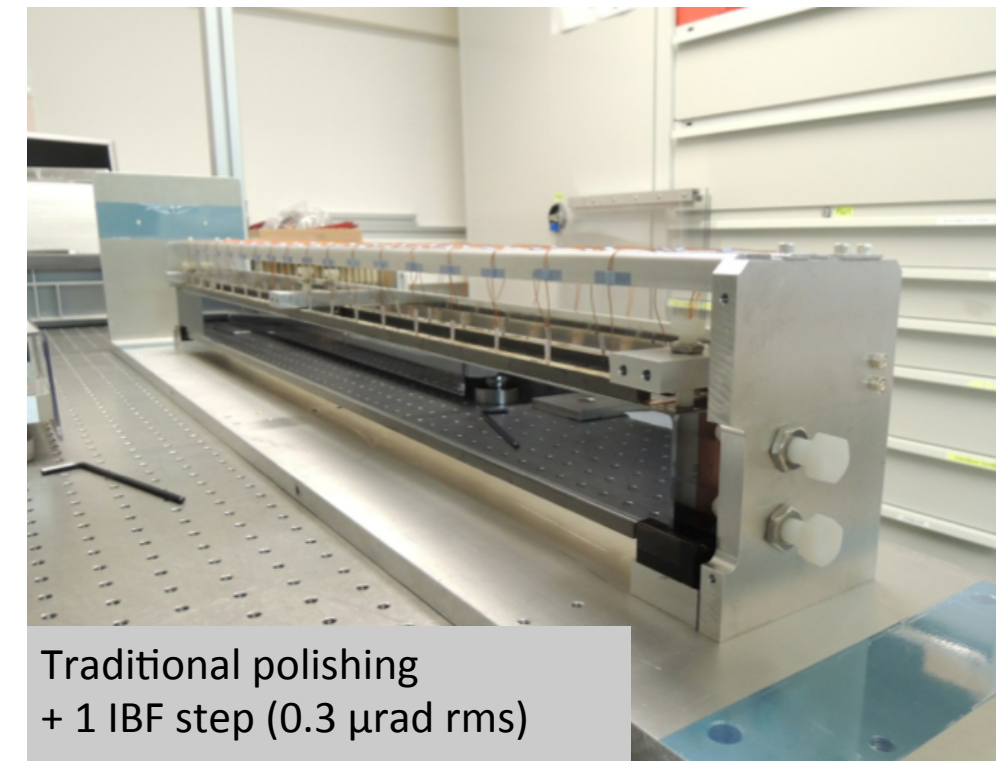
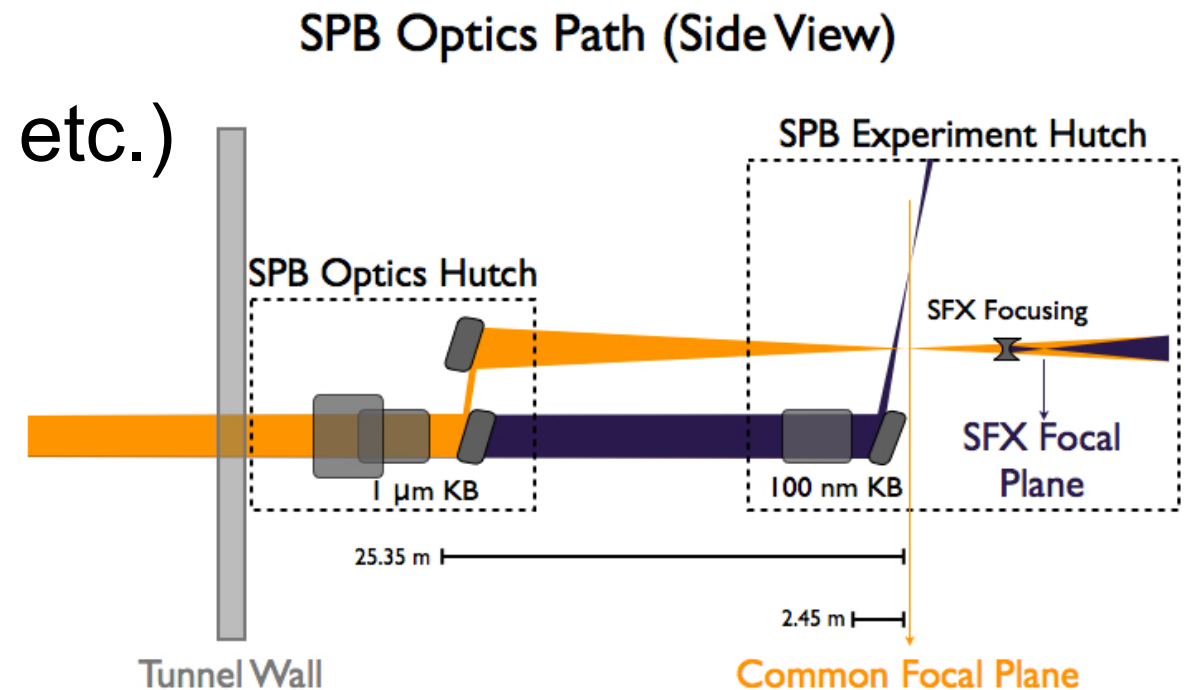
Mycoplasma mycoides
Watercolor by David S. Goodsell,
Scripps Research Institute 2011

■ Required Infrastructure:

- Facility Services (Power, Water, Air, etc.)
- Hutch
- Protection (MPS, EPS, PPS)
- Vacuum systems
- Control system
- Pop-in screen monitors
- XBPM
- Beam Conditioning Slits

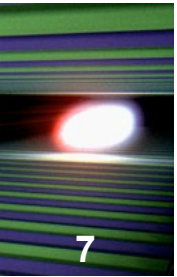
■ Required Commissioned Components

- Attenuators
- Viewing Screens / diagnostics
- Power slits
- KB mirrors



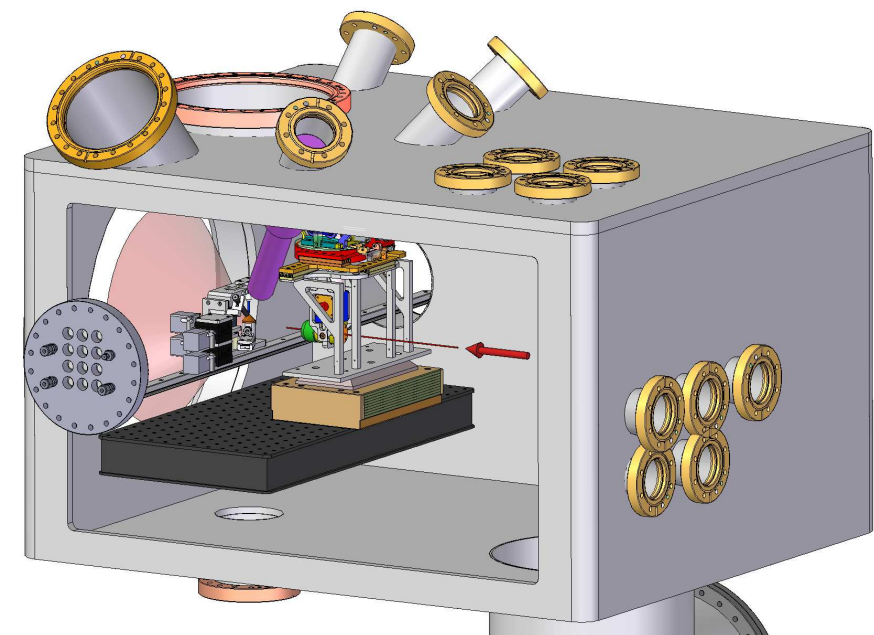
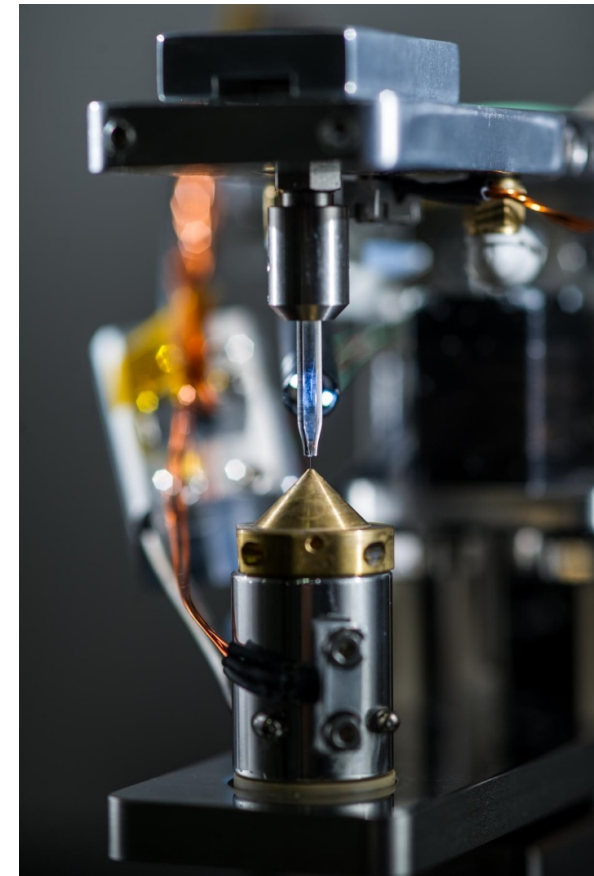
Traditional polishing
+ 1 IBF step (0.3 μrad rms)

Developed by Riccardo Signorato



- Required Infrastructure:
 - Facility Services (Power, Water, Air, etc.)
 - Control system
 - Vacuum systems

- Interactions of FELs with liquid jets are not well understood & requires investigation with X-rays
 - Well commissioned diagnostics required to observe the liquid jet



■ Required Infrastructure:

- Facility Services (Power, Water, Air, etc.)
- Protection (MPS, EPS)
- Vacuum systems
- Control system
- DAQ system
- Big rail

■ Required Commissioned Components:

- Detectors
 - Including Calibration

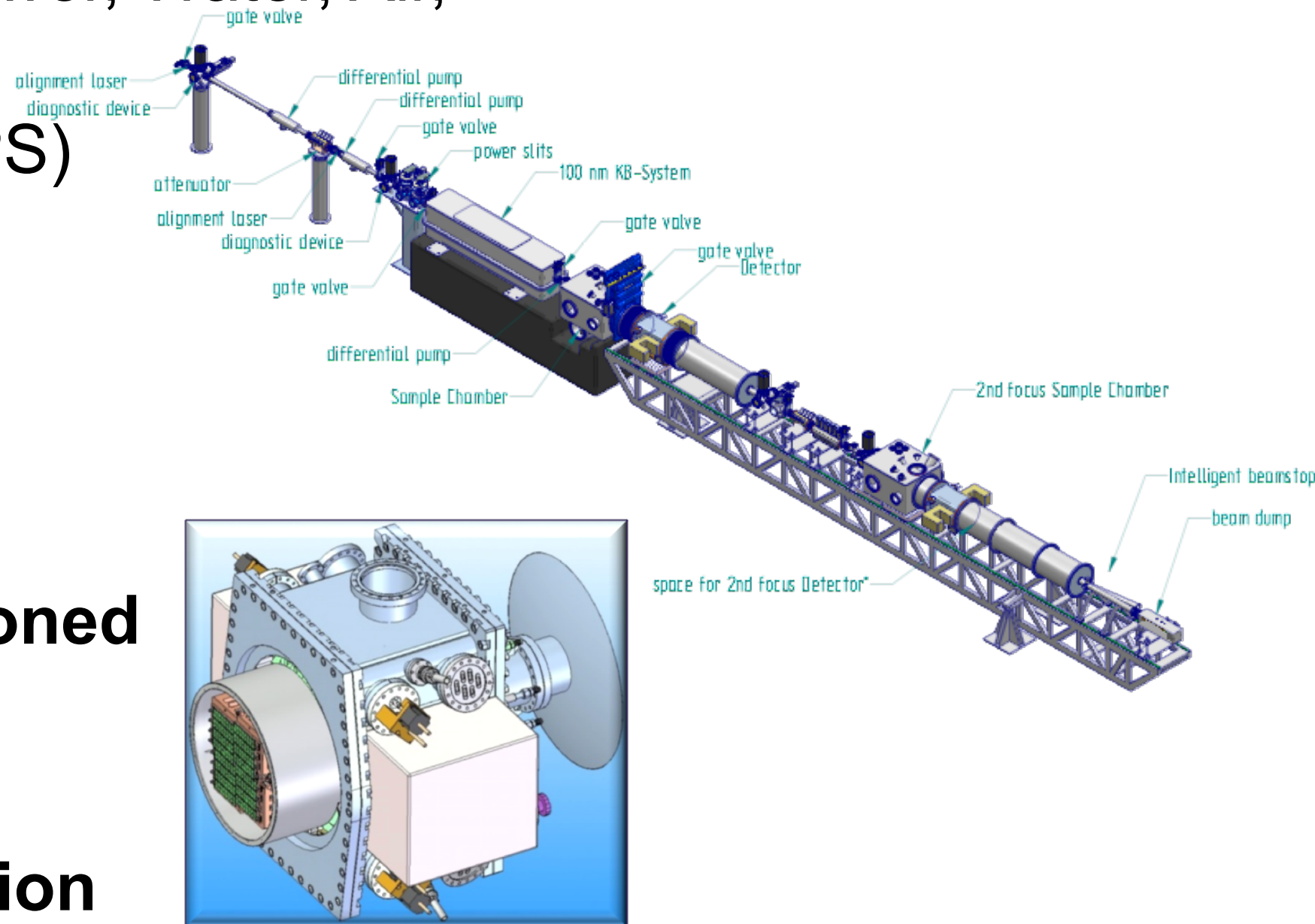
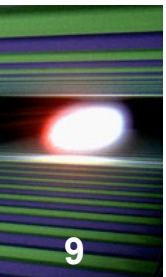


Image: AGIPD consortium



- Required Infrastructure:
 - DAQ system
 - Computing Infrastructure
 - Scientific algorithms
 - Permission controls
 - I/O monitor per pulse
 - E_{loss} & λ per pulse

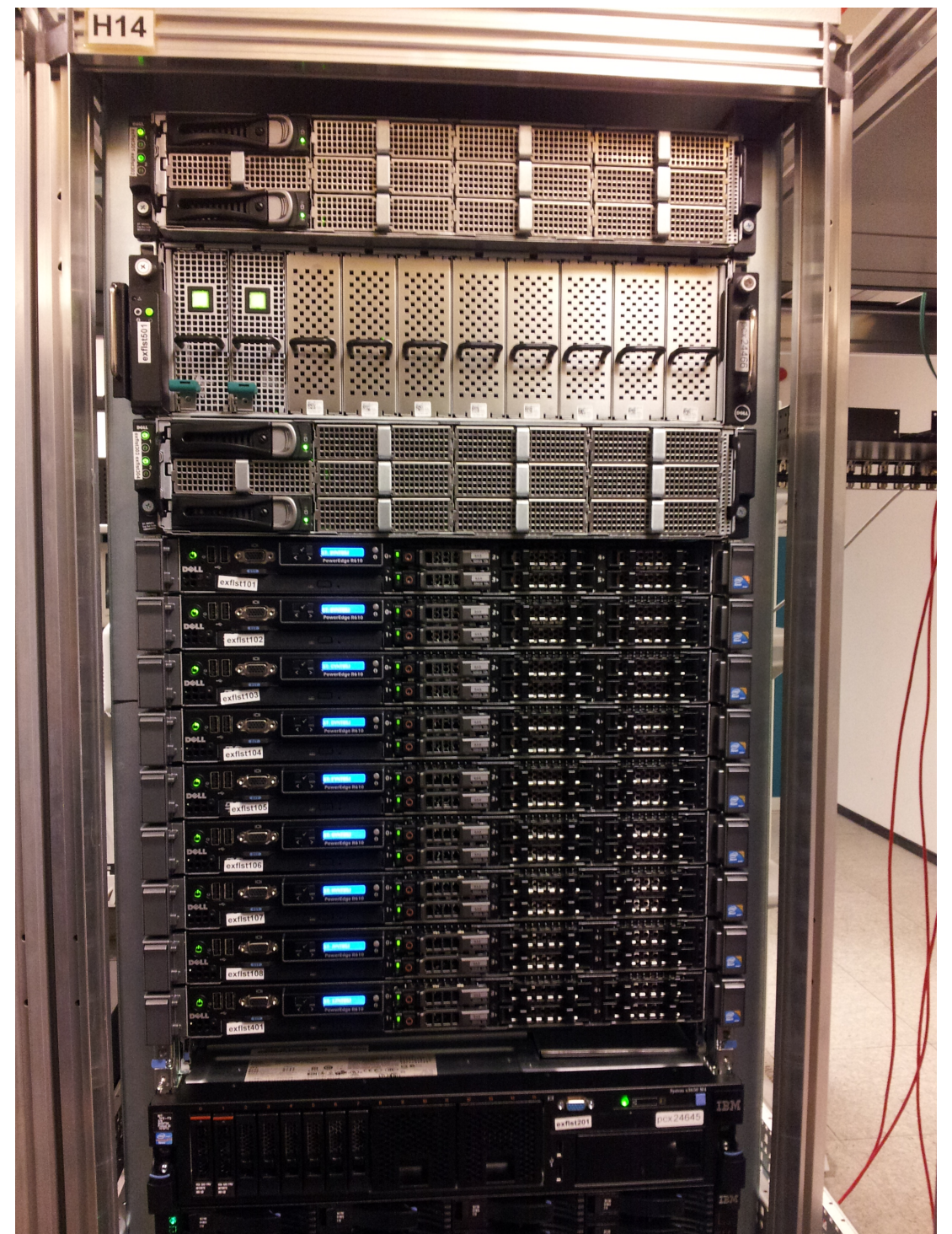
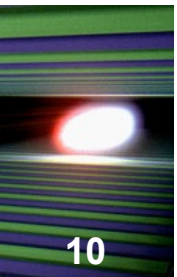


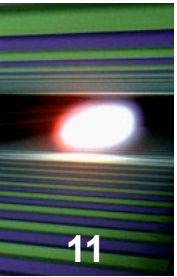
Image courtesy Krzysztof Wrona



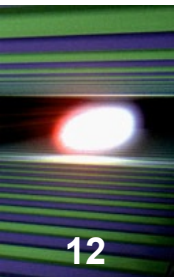
- Facility Services (Power, Water, Air, etc.) ♣♠♦
- Hutch ♣
- Protection (MPS, EPS, PPS) ♣♦
- Vacuum systems ♣♠♦
- Control system ♣♠♦
- DAQ system ♦♥
- Pop-in screen monitors ♣♦
- XBPM ♣
- Beam Conditioning Slits ♣
- Big Rail ♦
- Computing Infrastructure ♥
- I0 monitor ♥
- Eloss & λ ♥

♣ *Source and optics*
♠ *Sample environment*
♦ *Detector*
♥ *Data analysis*

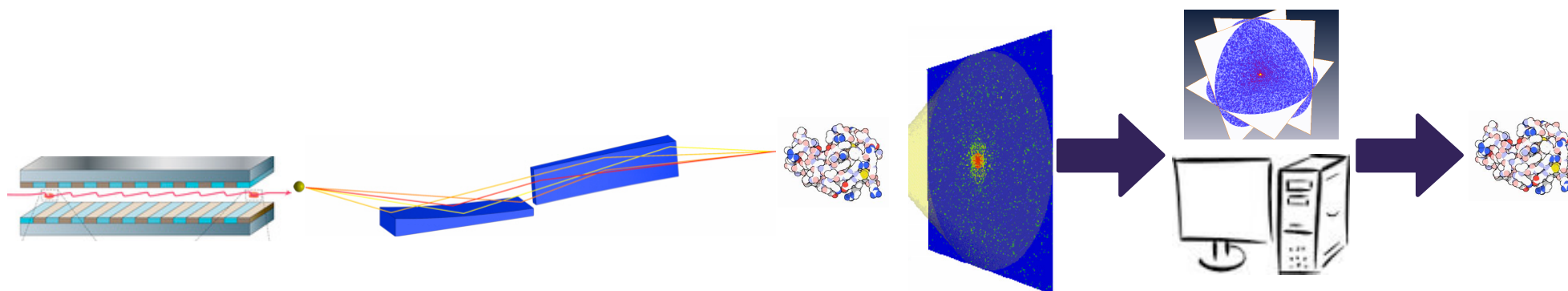
Required Beamline Commissioned Components (Needing X-rays and in systematic order)



- Attenuator
- Viewing Screens & Diagnostics
- Power Slits
- KB optics
- Beamdump
- Cleanup slits
- Detectors
- Sample Injector and FEL interaction testing
- **Then start to implement the first experiment**



- Any facility infrastructure that can be tested and brought into operation without X-rays should be: vacuum systems, DAQ & Controls, beamline mechanics, etc.
- We will need to commission beamline components with the FEL: Attenuators, viewing screens, slits, and mirrors
- The detector needs to be characterised, calibrated, aligned, and then commissioned.
- The sample environment also might have unknown interactions with the FEL that could take time to determine.
- All requires time with beam.



Images: *Nature Photonics* 4, 814–821 (2010), x-ray-optics.de, pdb.org, J. Phys. B: At. Mol. Opt. Phys. 43 (2010) 194016, SPB CDR

SPB/SFX team & collaborators, March 2014



Top row: Patrik Vagovic, Chun Hong Yoon, Klaus Giewekemeyer, Hamid Dadgostar, Gannon Borchers
Bottom row: Steffen Raabe, Tokushi Sato, Adrian Mancuso (co-ordinator), Andrew Aquila, Stephan Stern
Absent: Leonard Chavas (deputy co-ordinator), Nadja Reimers

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