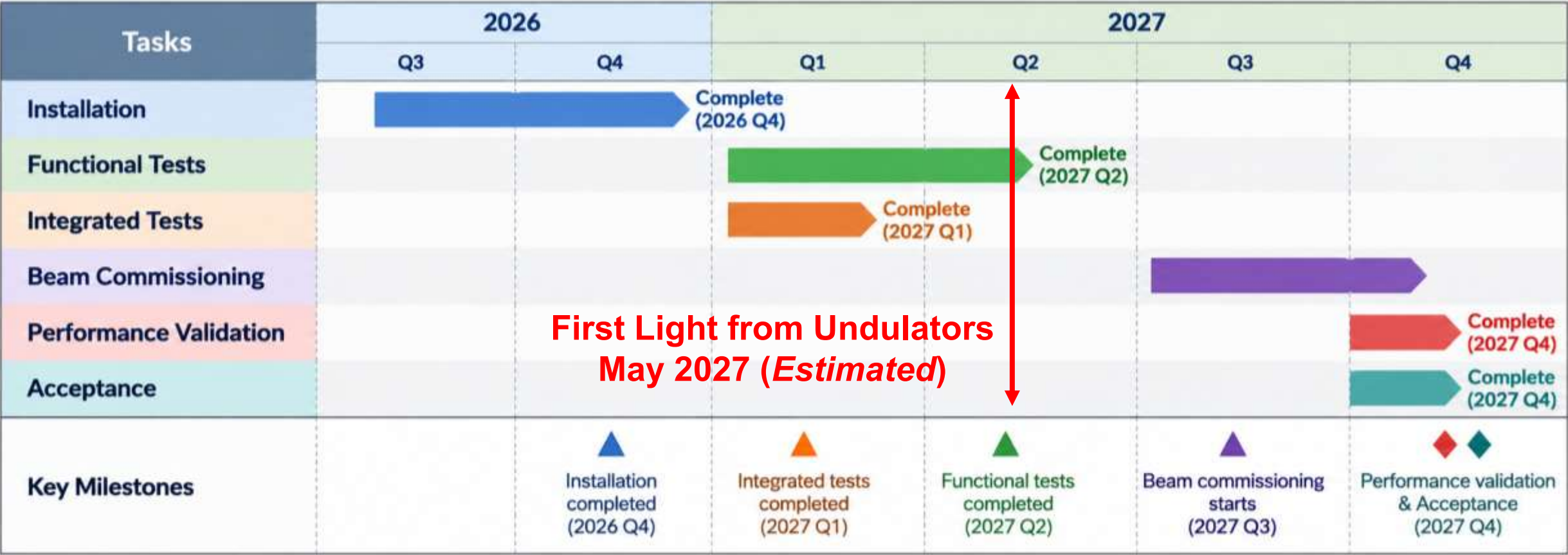


CDS Instrument: Status Updates and Roadmap to Early Science

Zhibin Sun, on behalf of CDS Team

Oct. 20, 2026

Installation and Commissioning Timeline



Functional Module and Commissioning Windows

2027

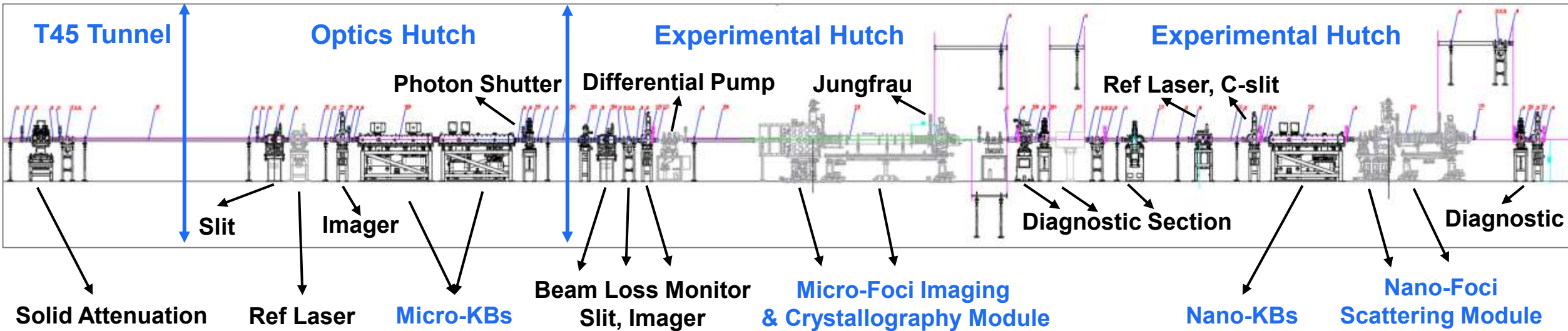
FUNCTIONAL MODULE / SCOPE		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
01	Vacuum, Interlock & Differential Pumping Pumps, gauges, valves and interlock	APR-JUL								
02	Controls, DAQ, Trigger & Timing Synchrotron and related systems In coordination with General Experimental Technology Department (GET)	APR-JUL								
03	Beamline Optics & Photon Diagnostics at IP Offset mirrors and beam transport GMD, GATT, SATT, imagers and reference lasers					AUG-NOV				
04	Beam Profile & Focus at IP 100 nm focus characterization Knife-edge scan, <u>ptychography</u> and wavefront sensing							OCT-NOV		
05	Diffraction: Fixed Targets, <u>Atomizer & ADL</u> 100 nm focus; fixed metallic nanoparticles on Si3N4 membranes; aerosol injector at 100 Hz								NOV-DEC	

Emphasized by TAC

Suggested by TAC

Suggested by TAC

CDS @ SHINE: Updates since Last TAC



- **Factory Manufacturing:** All instrument finished factory manufacturing.
- **Offline Integration:** All the CDS core instrument under integration.
- **Offline Tests:** All the X-ray Optics are under offline testing.
- **Final Installation:** Started on September 2026.
- **Hutch Facilities:** DONE.

Two Interaction Points:

Four-bunch-Mirror KBs, 1158 m, 1 μm Foci
Tight KBs, 1175.9 m, 100 nm Foci

Updates on Hutch Facilities Installation

Hutch Facilities, Users' Lab. Pump Laser Hutch, and Control Area DONE



Size: 31m (L) x 7m (W)

Experimental Hutch

Power, Water, Gas, Crane, Camera Ready
Cable Trays, AC System, Ceiling Lights Ready



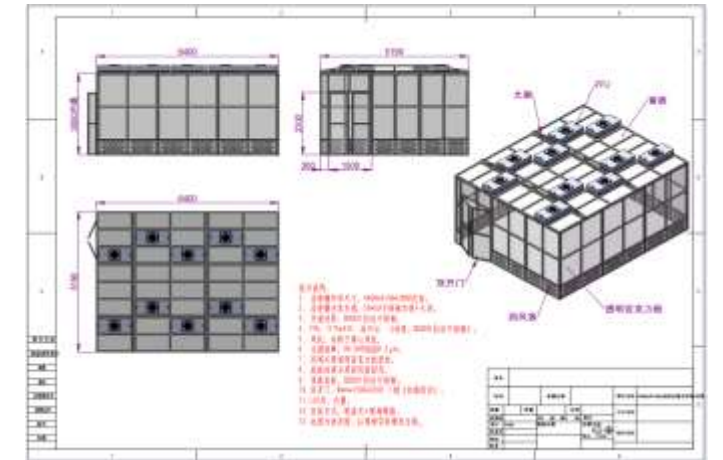
WP from Laser Group

Pump Laser Hutch

Power, Gas, AC System, Interlock,
Ceiling Light, etc. Ready



Control Area Ready



Near-Hutch Preparation Room

Starts Installation Next Year

Standard Bio-Lab for Users
Under Construction ~ 130 m²

Updates on FEE Instrument Installation

Started the FIRST installation from September. Here only show WPs from CDS instrument.



Solid Attenuator @ 1134m
Finished Installation

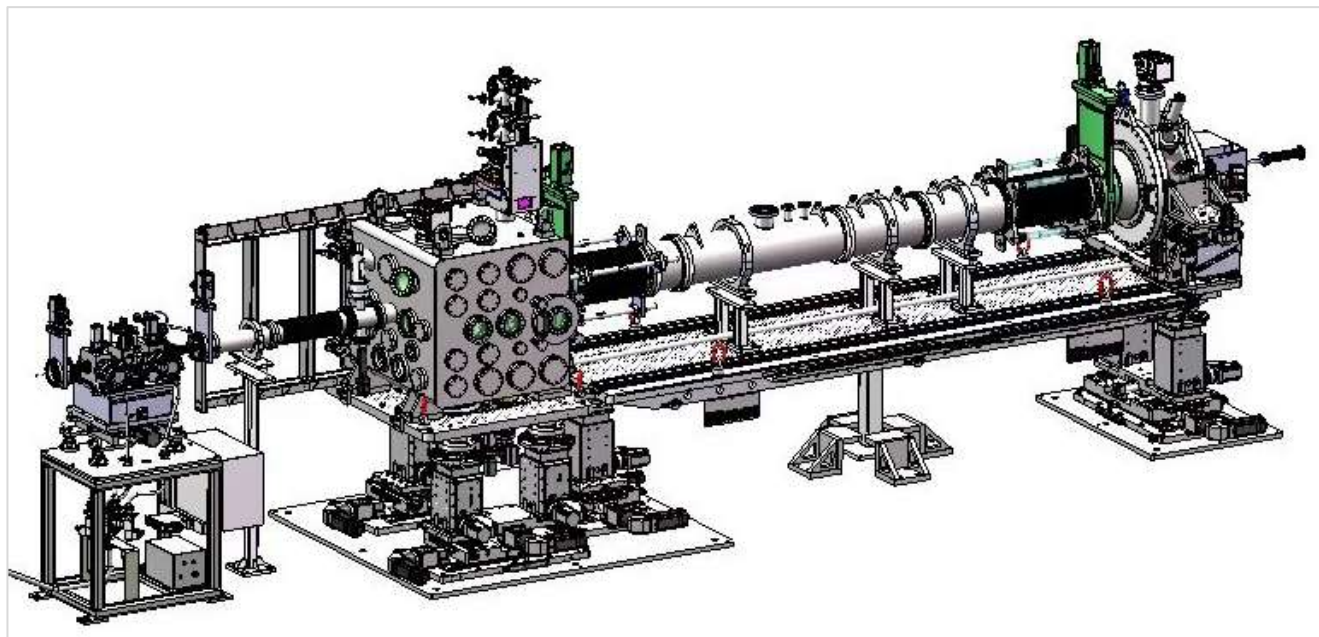


Differential Pump @ 1153.9m
Ready for Installation

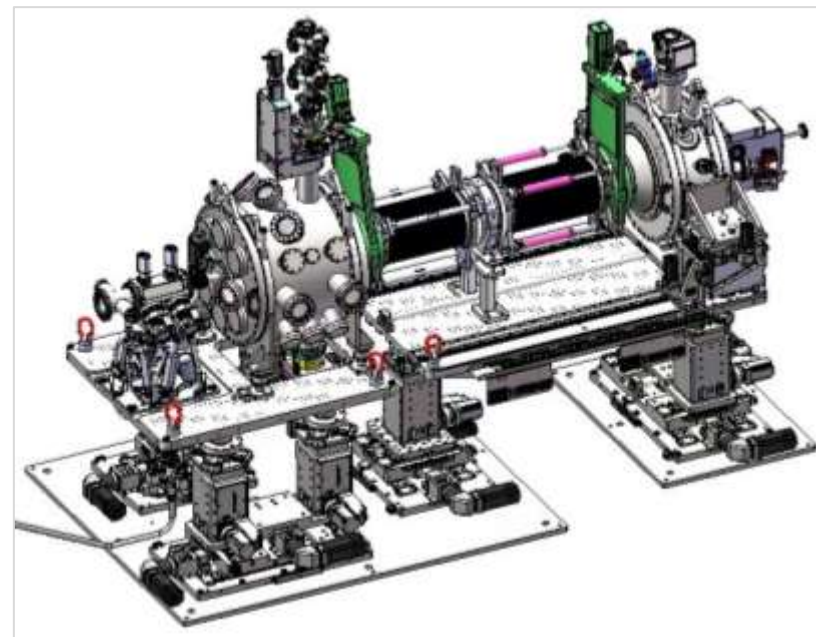


Ref. Laser @ 1141.8m & 1170m
Ready for Installation

Updates on Chamber-Mover Sub-system Integration



1 μ m Foci Module, Detector: 150 ~ 4000 mm



100 nm Foci Module, Distance: 100 ~ 2000 mm



Chambers



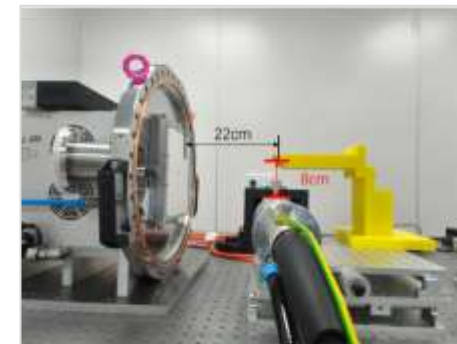
Mover Rails



Connection Frame



Motor Tests



JF Detector

Nov.15-Dec.30: Installation

Updates on Chamber-Mover Sub-system Integration



Installation of steel plate base has been finished last week.

Integration of the sample chamber, detector platform, ADC mover system is under going.

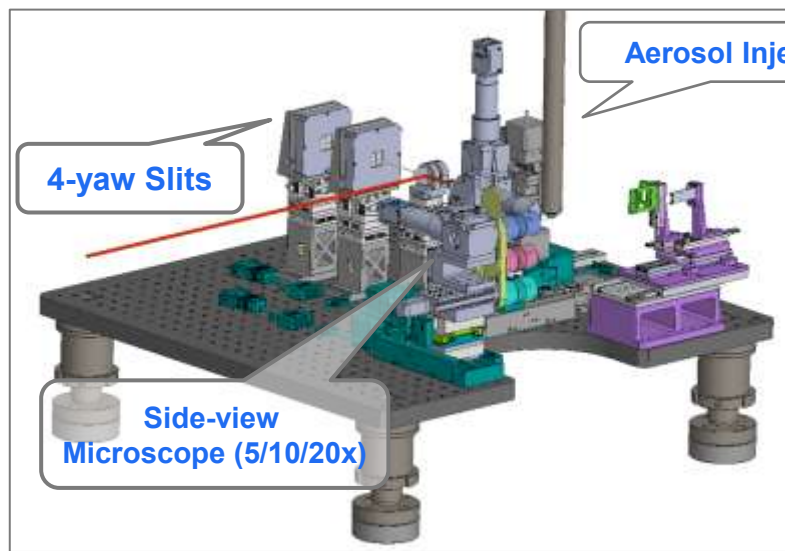
Modular assembling will be finished by the end of this month.

Hutch Installations Started this Month

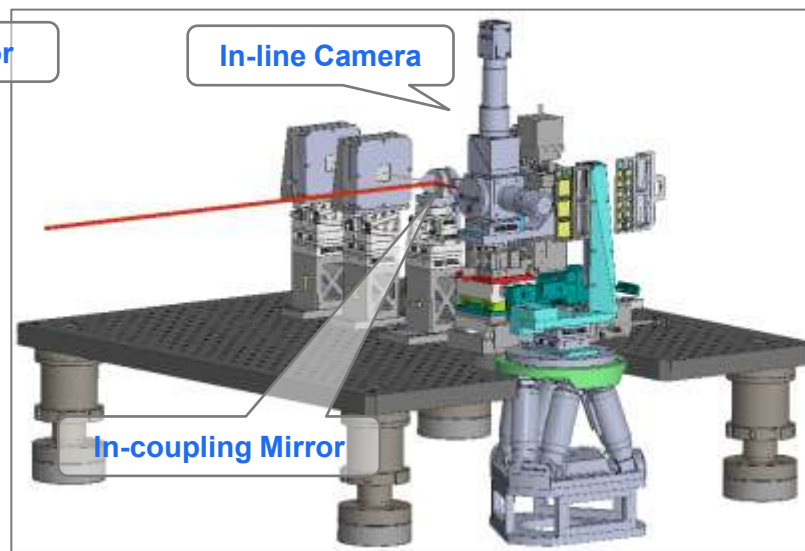


Beam Loss Monitor, Power Slits, Imagers, and Beamstop installed at the most front and rear.
Reserve the central space for KBs and Core Instrument.

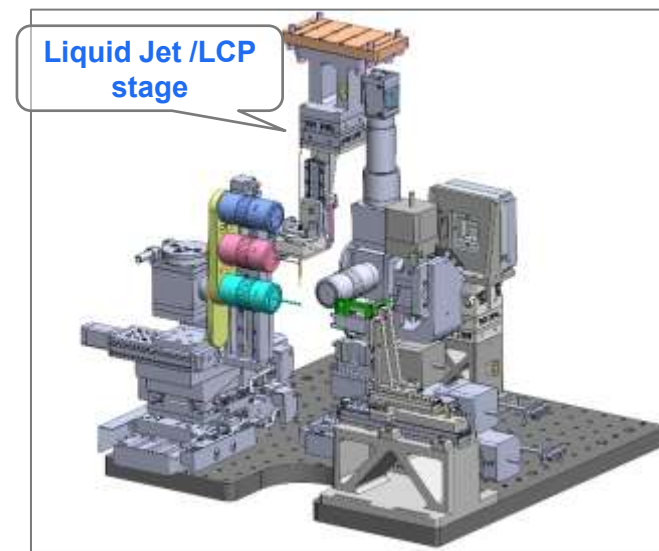
Standard Geometries for SPI, SFX, and Scattering



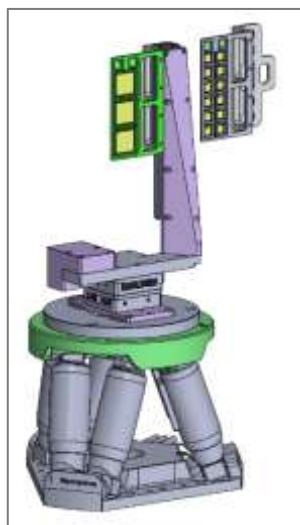
1 μm Foci with Injectors



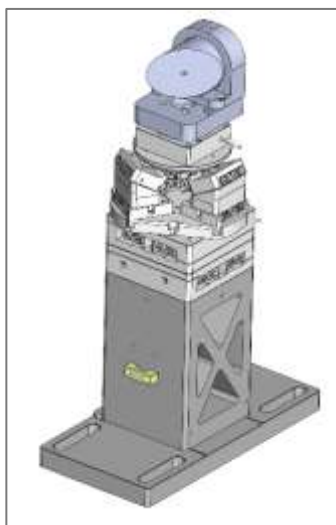
1 μm Foci with Fixed Target



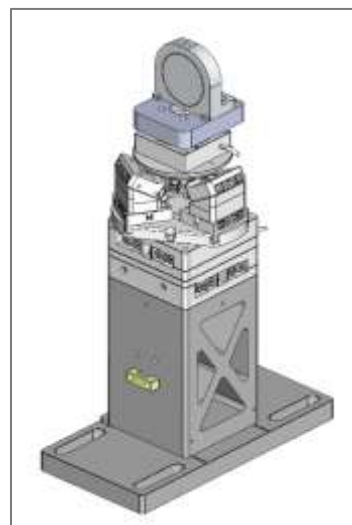
100 nm Foci with Liquid Jet



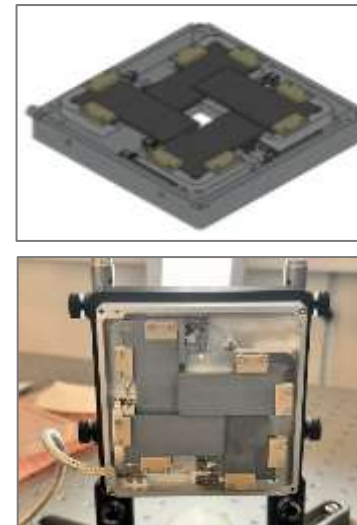
Beam Diag.



In-coupling Mirror



Side-view

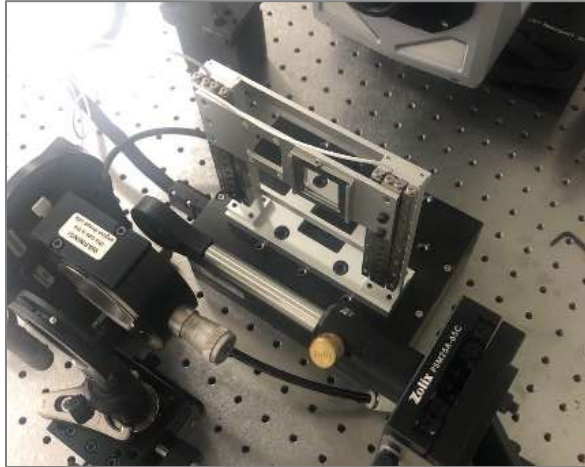


Slits

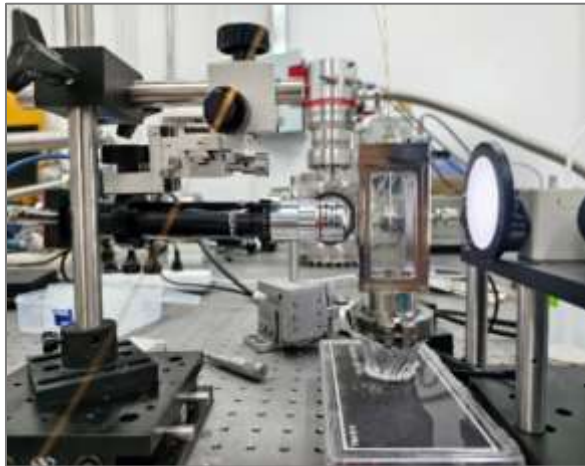
Motors Arrived:
SmarAct: >50
Kohzu: > 20
Symetrie: 2

Integration: Nov. 2nd
Module Tests: Dec. 1st

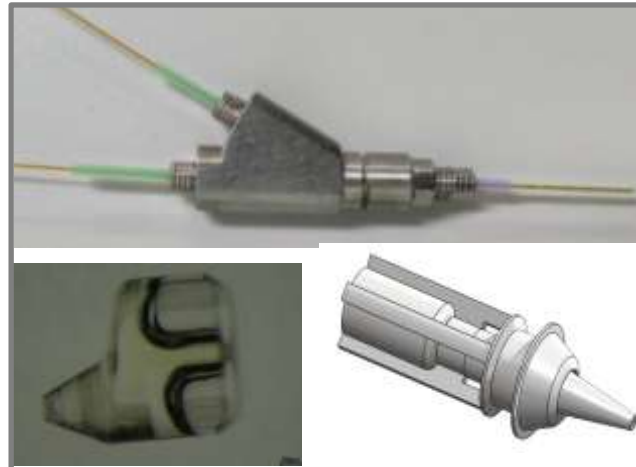
Sample Environment and Delivery



Fixed Target (1kHz)
Ready for Users



Liquid Jet Characterization
Ready for Use



Gas Dynamic Virtual Nozzle (GDVN)



Max-Planck Anti-Settler
From Prof. Schlichting, MPIImF

Ready for SFX Users



LCP under Development
3D Printed, Arizona Type

Under Development



Nebulization,
Ready

ESI 3482, Modified Atomizer

Uppsala AFL-100 under Tests

Under Development

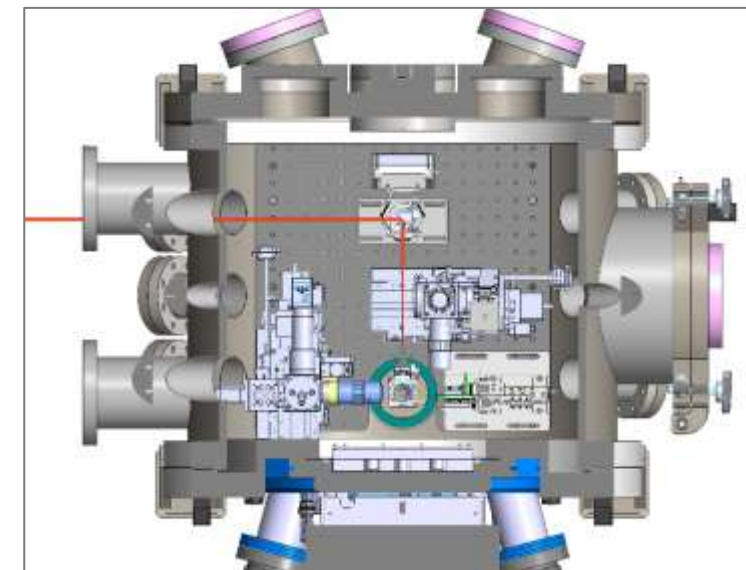
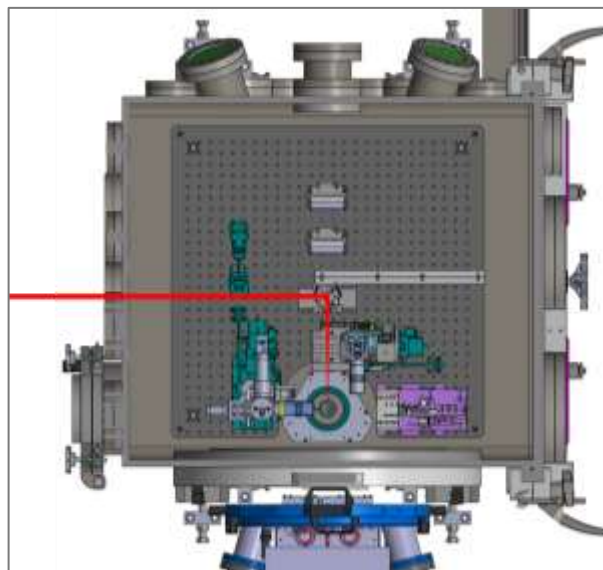
Working closely with
Pro. Ilme. Schlichting @ MPIImF
Prof. Filipe Maia @ Uppsala U.
Prof. Christoph Bostedt @ PSI
Prof. Changyong Song @ POSTECH

Pump Laser, In-coupling, and Timing Tool

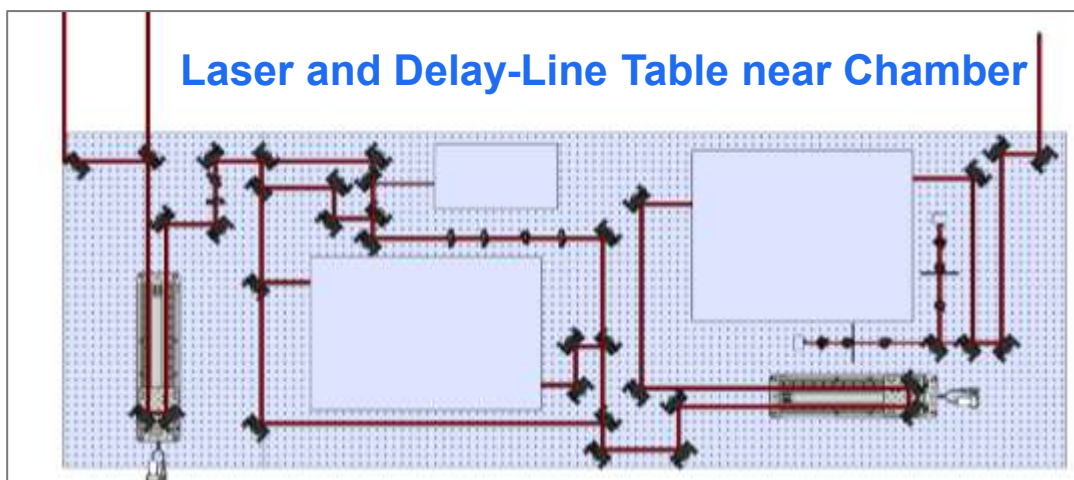
Pump Laser Parameters

Parameter	Specification
Fundamental center wavelength	1030 $\pm$ 10 nm
Wavelength conversion	FHG: 258 nm / THG: 343 nm / SHG: 515 nm OPA: 400–2500 nm
Repetition rate	$\geq$ 100 kHz
Pulse duration	$\leq$ 50 fs at 1030 nm
Focused spot size at sample (1/e ² diameter)	30–200 μ m
Pulse energy at sample	$\geq$ 100 μ J at 100 μ m spot size and 1030 nm
Pointing stability at sample	$\pm$ 10 μ m at 100 μ m spot size
Energy stability	< 10%
Pump-probe delay adjustment precision	5 fs
Pump-probe delay adjustment range	–100 ps to 3 ns

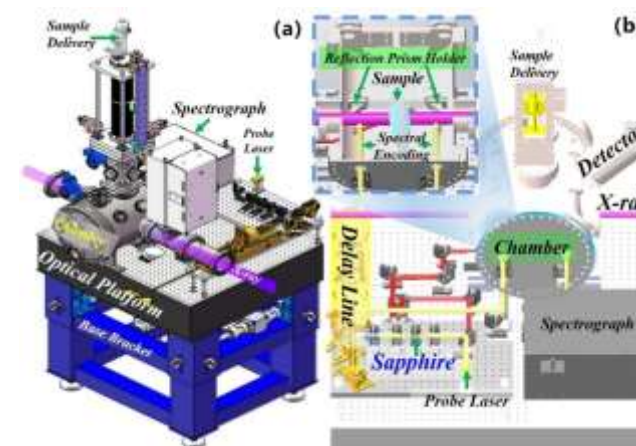
In-coupling to Two Chambers: Co-linear



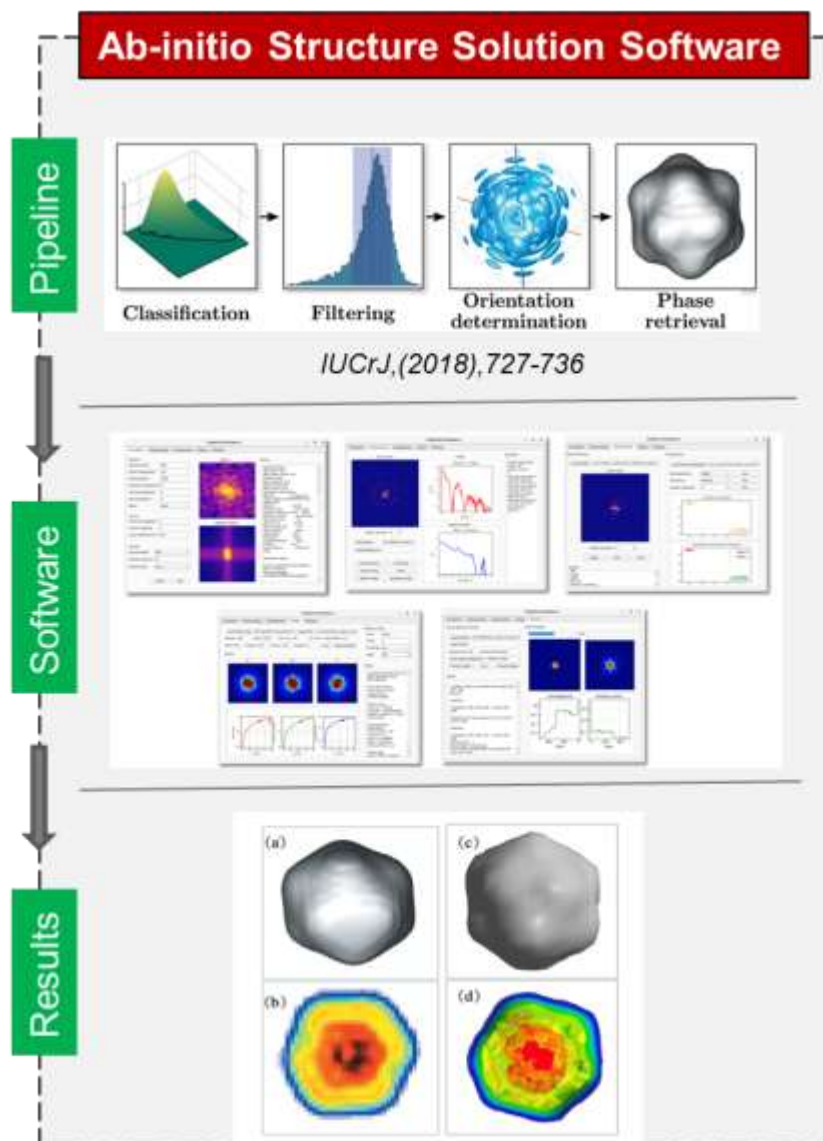
Another stronger pump laser with lower rep. rate?



OAP mirror with taper hole ($\varnothing$ 2mm)



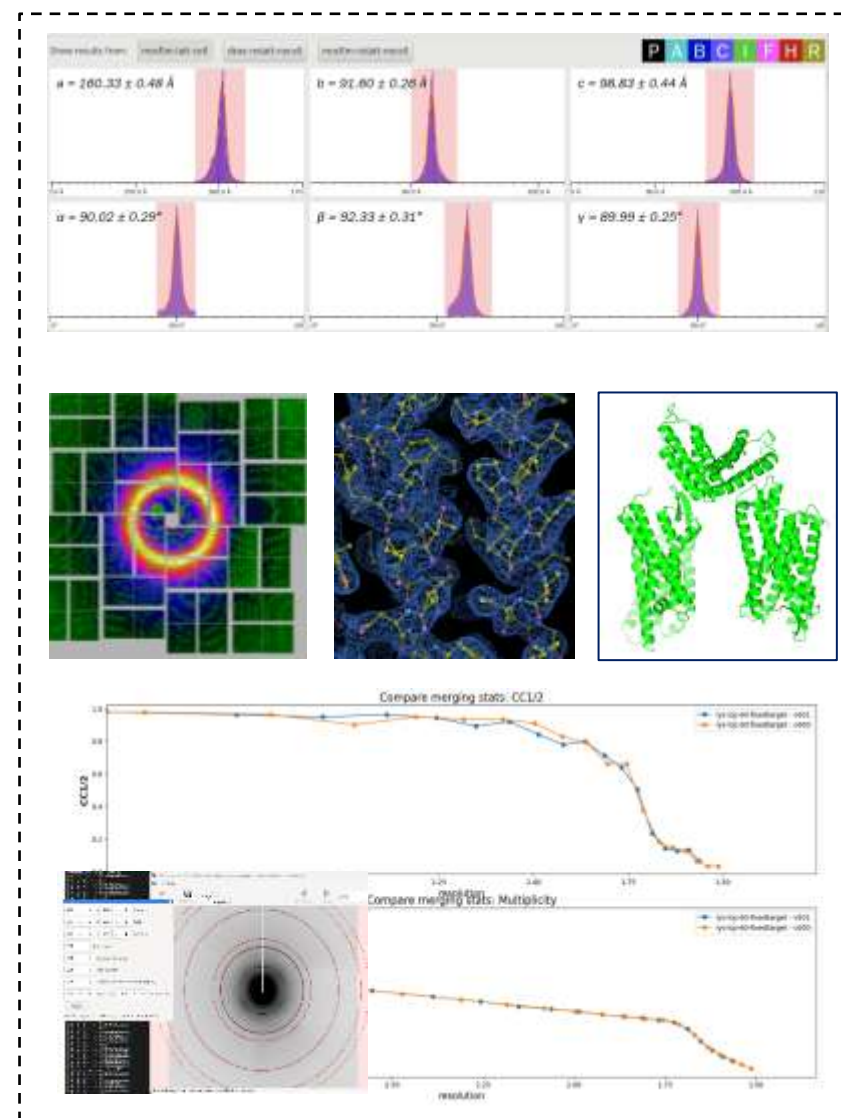
Online *Real-time* Data Analysis for SPI and SFX



Start-2-End Analysis Suits



Online GPU+CPU GUI



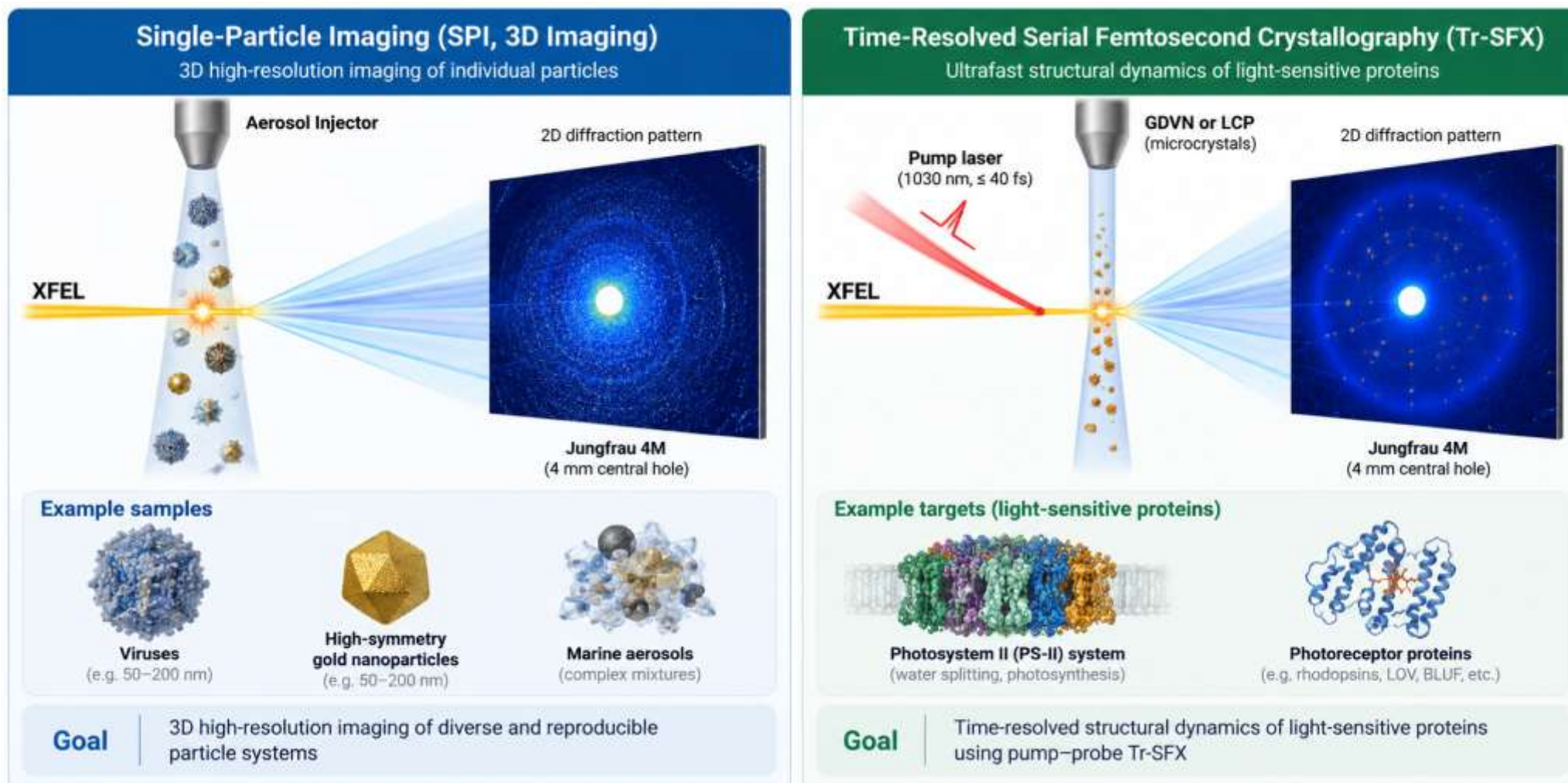
SFX Suites (CrystFEL and DIALS)

Relative Working Packages Updates

- Timing Tool and Pump Lasers (*Laser Group*). Purchasing & Ordering
- DAQ, Control, Timing, Trigger, and Synchrotron (*GET Depart.*) Started Interface
- Servers, Storage, Data Transportation, HPC (*GET Depart.*) Almost DONE
- Detector: 4M JF (Two, 4mm Central Hole arrived) (*Detector Group*). First JF arrived
- X-ray Optics, Beamline Equipment (*Beamline Design Group*) Under Tests
- Photon Diagnostics (*Diagnostic Group*). Under Installation

Early Science Programme

Following the successful path of CXI and SPB/SFX, We'll focus on (Tr-) SPI and Tr-SFX at the beginning.



First Experiments and Preparations

Potential Pilot Experiment-SPI:

High-throughput Imaging of Biological Particles and Nanocrystals

Collaborations:

Prof. Zihao Rao (STU),

Prof. Quan Wang (STU),

Prof. Changyong Song (POSTECH),

Prof. Christoph Bostedt (EPFL & PSI),

Prof. Filip Maia (Uppsala U.), *etc.*

Parameters Required:

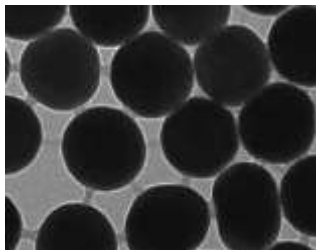
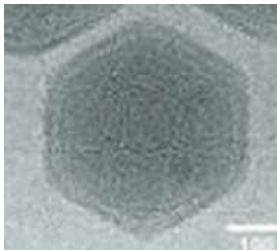
Photon Energy	5 keV
Pulse Length	< 100 fs
Pulse Intensity	> 100 μ J
Repetition Rate	100-1000 Hz
Beam Mode	Pink Beam

Check List:

Check List:		Status:	
Sample Delivery	Aerosol Inject.	Under Tests	Atomizer & ESI
Detector	4M Jungfrau	Ready	/
DAQ & Control	Parallel Work	On Going	/
Pump Laser	800 nm, 35 fs	> 100 μ J, 100 μ m	TT under Tests
Online Analysis	S2E	Classification	Phasing

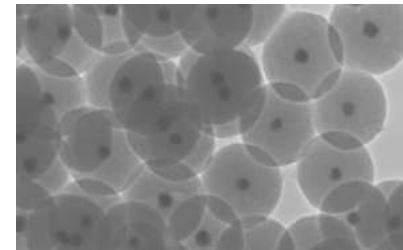
Samples for Static Imaging:

Melbourne Virus, Gold NPs, NaCl Aerosols.



Samples for Dynamic Imaging:

Multi-phase Metallic NPs



Gold, Platinum, Iron
Core-shell Structure
100 nm Diameter

First Experiments and Preparations

Potential Pilot Experiment Tr-SFX:

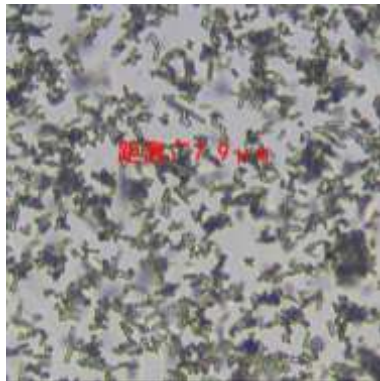
Dynamic Structure Change of Receptors with Pump Lasers.

Collaborations:
Prof. Jiangyun Wang (IBP, CAS),
Prof. Ilme Schlichting (MPIImF),
Prof. Wenkai Zhang (BNU),
Prof. Hongjie Li (STU),
Prof. Bei Ding (SJTU),
Prof. Lijin Tian (IB, CAS), *etc.*

Parameters Required:	
Photon Energy	9.5 keV
Pulse Length	< 100 fs
Pulse Intensity	> 100 uJ
Repetition Rate	100 Hz
Beam Mode	Pink Beam

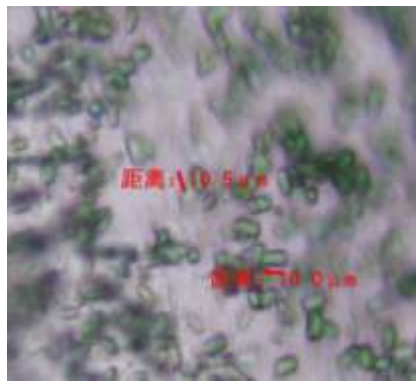
Check List:		Status:	
Sample Delivery	GDVN	Ready	With Anti-settler
	HVE	Under Tests	3D Printed
Detector	4M Jungfrau	Ready	/
Pump Laser	518-800 nm	< 100 uJ, 100 um	/
Online Analysis	CrystFEL	Ready	/

Samples for Benchmark: Lysozyme



Crystal Protocol Ready
Injection Under Tests

Samples for Tr-SFX: CBCR



Crystal Protocol Ready
Injection Under Tests
Time Delay under Calculations

Summary



- The CDS instrument starts the core instrument installation **in September**.
- All core instrument installation work will be completed **by the end of the year**.
- **Status check and cross-groups work packages (WPs)** require closer attention to ensure smooth integration and readiness for the next phase.

Outlook



- The schedule is tight, human resources are limited, and the technical goals are challenging, which makes the next phase demanding.
- **With close coordination, continued support, and the joint efforts of all teams,** we are confident to achieve successful commissioning and first experiments.

Thank You!

*My sincere thanks to all the experts, technical teams,
and vendors who have made this possible.*



Zhibin Sun



Qing Xie



Menglu Hu



Chenxi Wei



Jianhua Zhang



Yonggan Nie