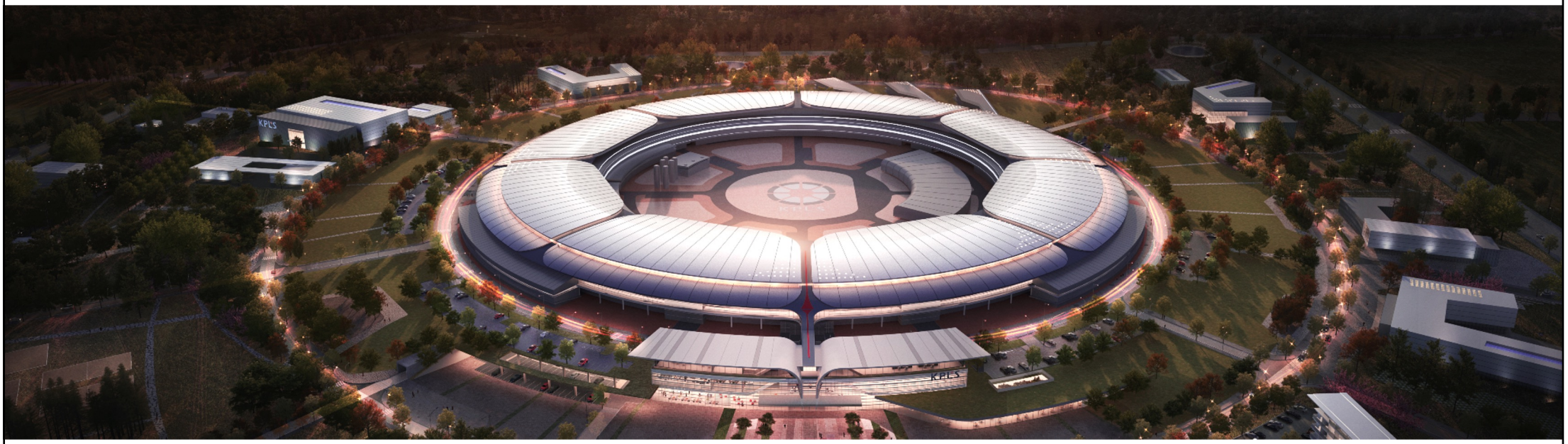
MXCuBE-ISPyB Joint Meeting (Nov 17-19, 2025)



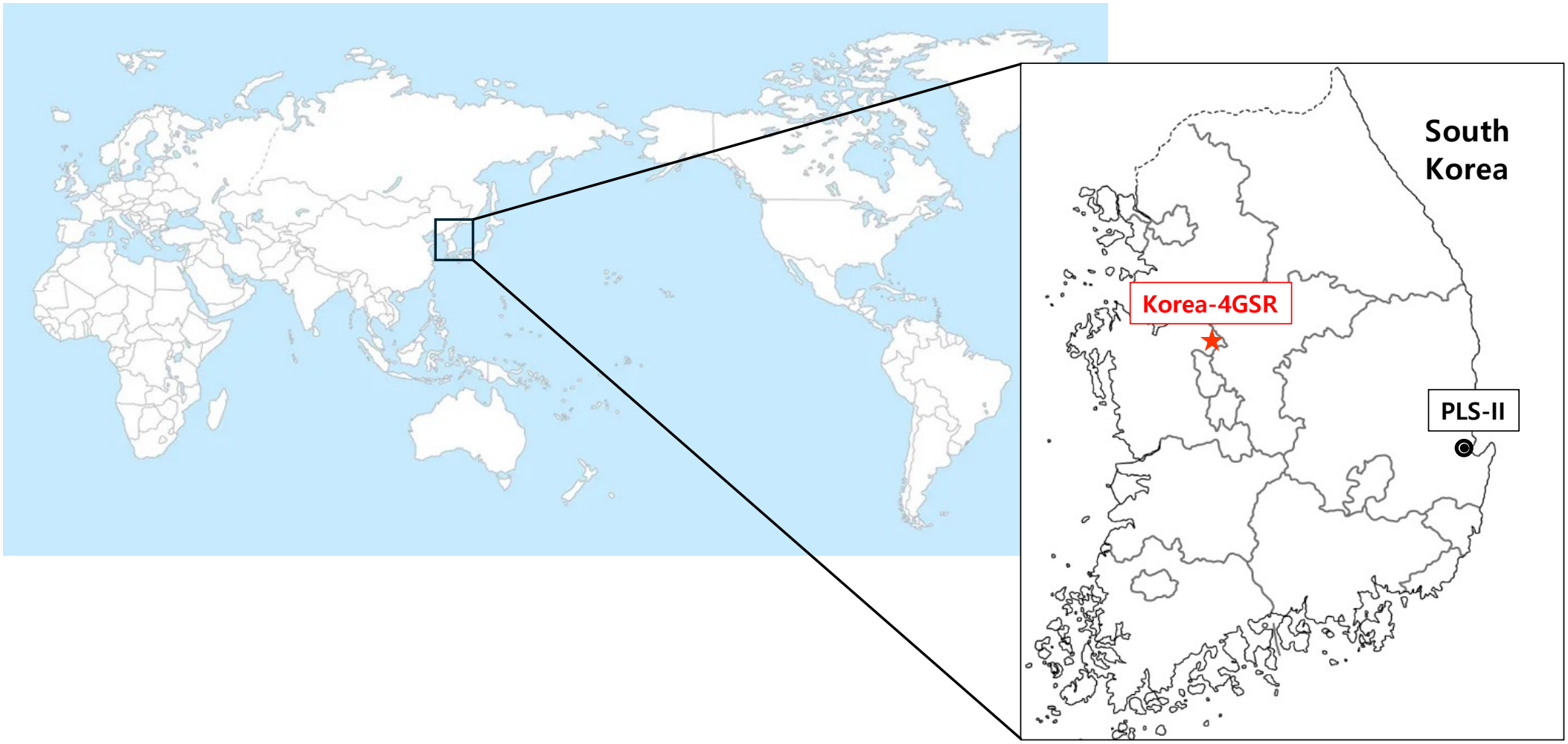
Bio Nanocrystallography (BioNX) beamline at Korea-4GSR

: Expression of Interest in Joining the MXCuBE Collaboration

2025. 11. 19

Mi-Jeong Kwak

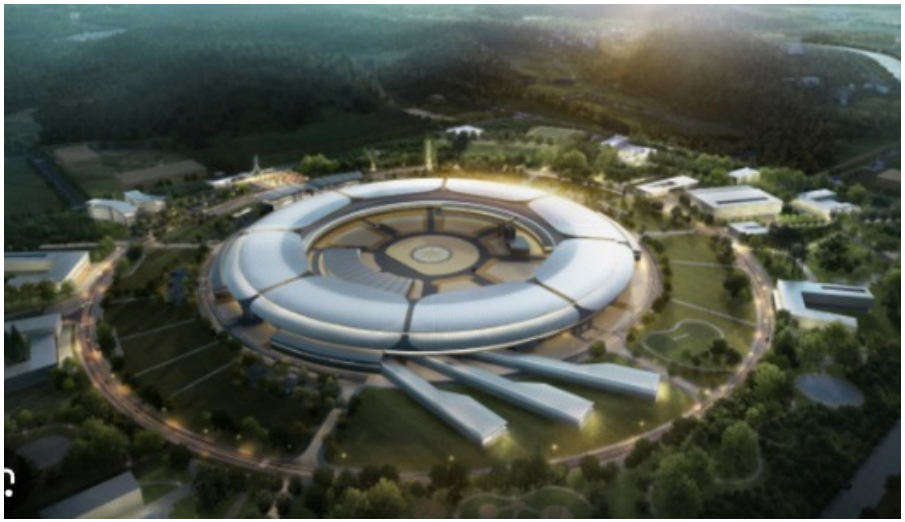
Where we are?



Construction of Korea-4GSR

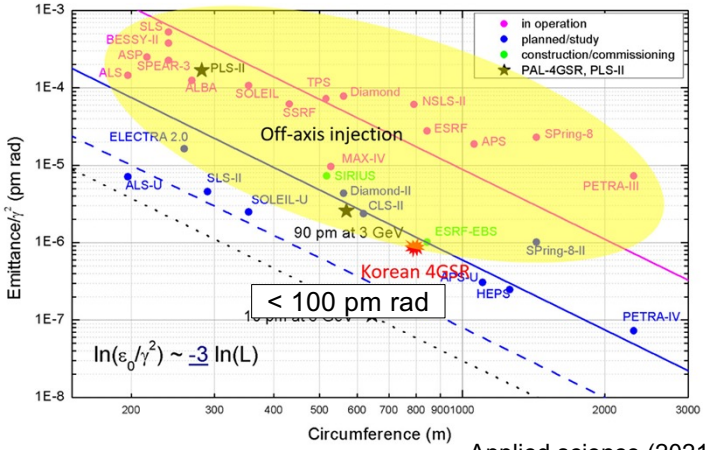
Site construction

Construction is planned to be completed in 2029
User service targeted for early 2031



Schematic drawing of Korea-4GSR

Target emittance



Applied science (2021)

The Brighter Light
The Bright Science

Feature of K-4GSR

Low emittance

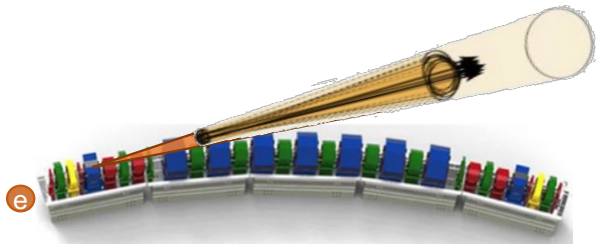
*Emittance: A value related to the divergence and size of the electron beam; lower emittance indicates better beam quality and stability

High Brightness

High Energy

High Coherence

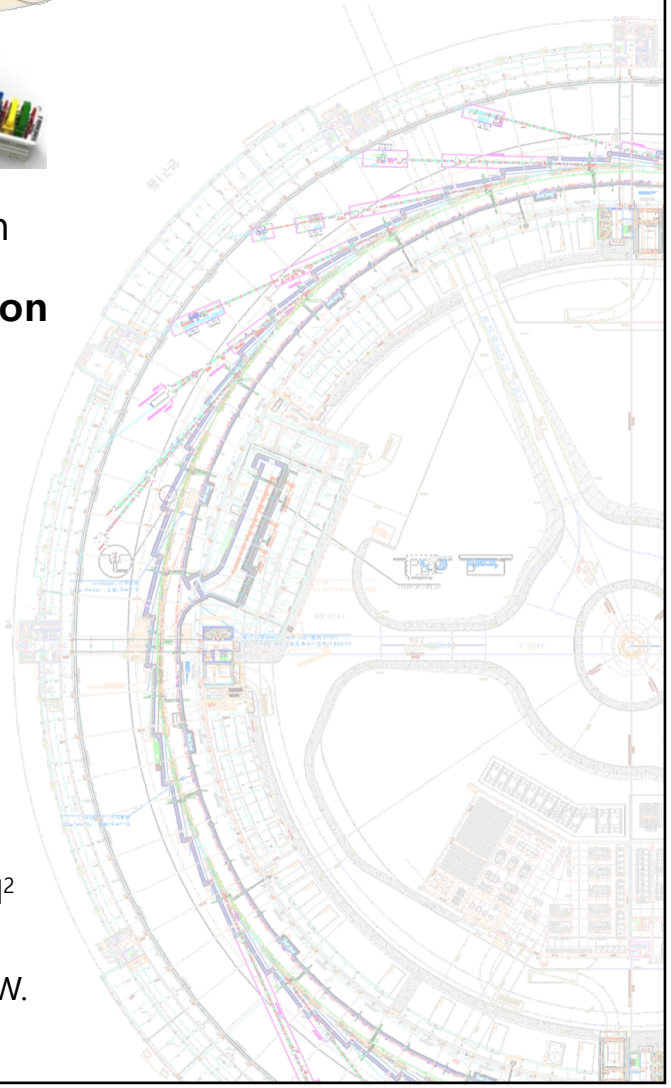
*Coherence: The degree to which photons maintain the same phase relationship



4^{th} Gen electron bunch

Multi-purpose synchrotron

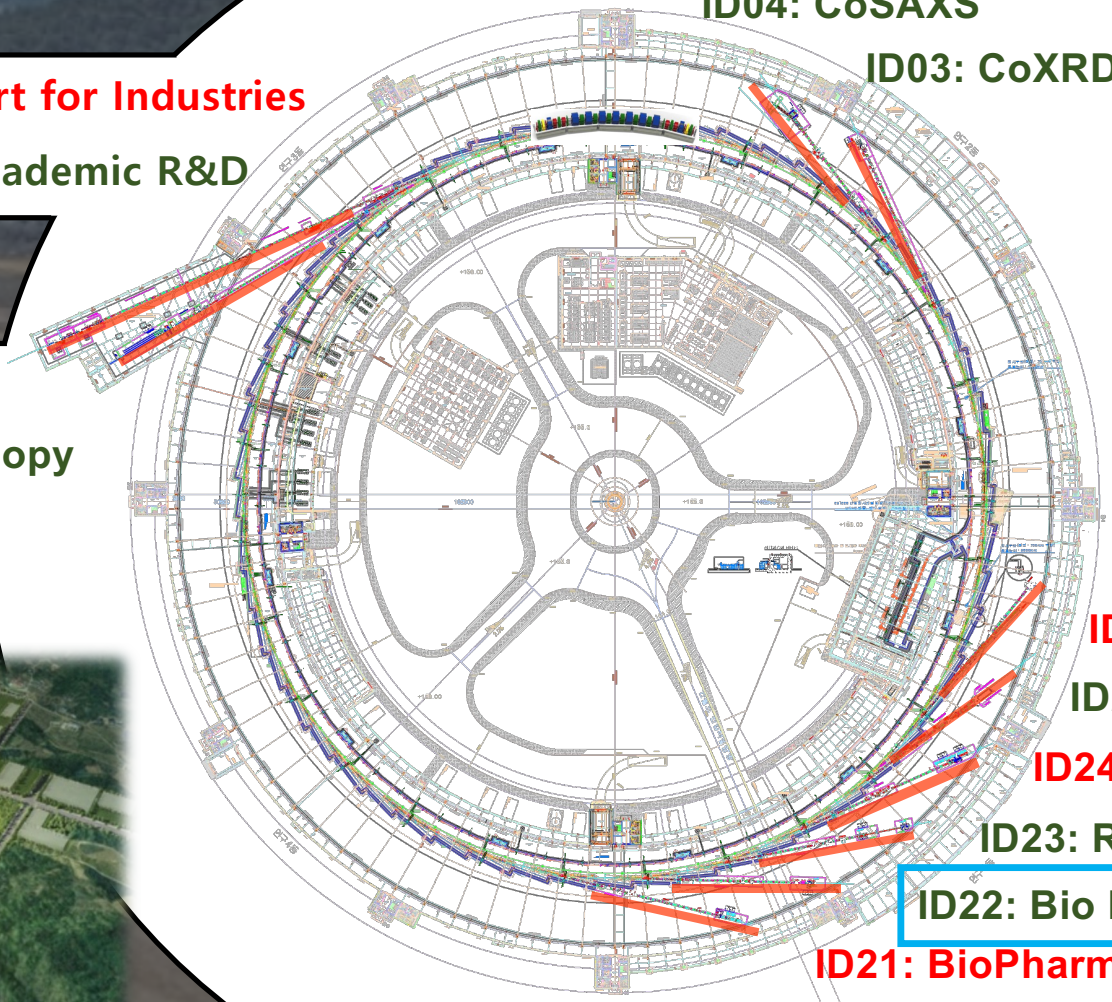
Circumference	798.8 m
Beam Energy	4 GeV
Beam Current	400 mA
Emittance	< 100 pm·rad
Beam Size (at IVU20 Source)	about 19 x 6 μm^2 (R.M.S.)
Brightness	10^{21} ~ 10^{22} phs/s/mm^2/$mrad^2$
Coherent flux (at IVU20 Source)	~ about $4x10^{14}$ ph/s/0.1%B.W.



Outline of Korea-4GSR Initial Beamlines

The Brighter Light
The Bright Science!

- Priority Support for Industries
- Support for Academic R&D



ID04: CoSAXS

ID03: CoXRD

ID10: NanoProbe

BM10: HE Microscopy

- Semiconductor
- Energy
- Material Science
- Bio
- Chemistry
- Environment
- GeoScience

ID26: Soft X-ray NanoProbe

ID25: NanoARPES

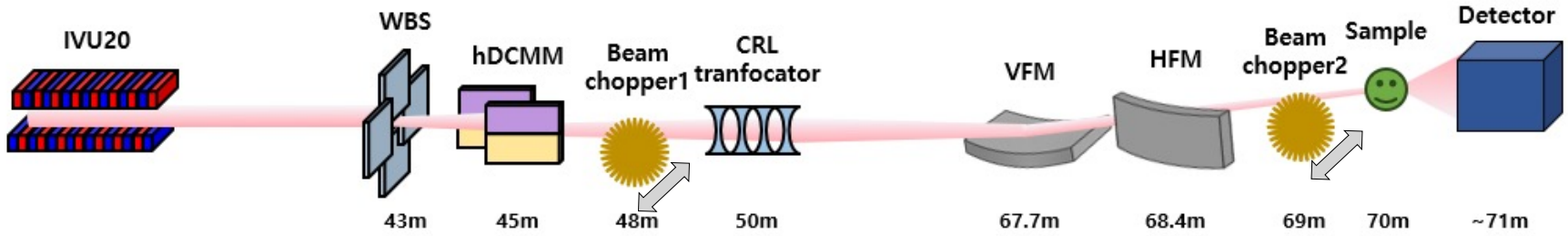
ID24: Material Structural Analysis

ID23: RealtimeXAFS

ID22: Bio Nano Crystallography

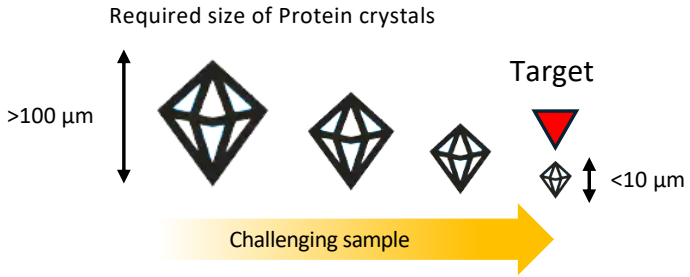
ID21: BioPharma - BioSAXS

Overview of BioNX beamline

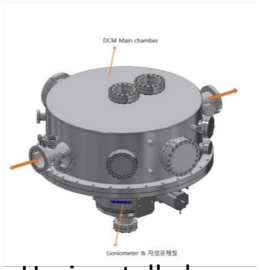


Design Summary

1. Micro-focusing beam
2. High flux



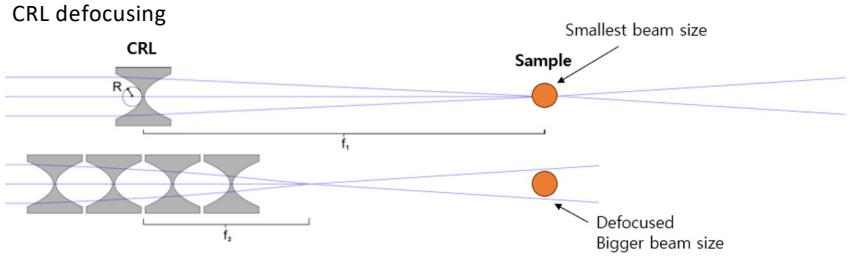
4. Stability



Horizontally bounced Monochromator

5. Pulsed beam

Beam chopper

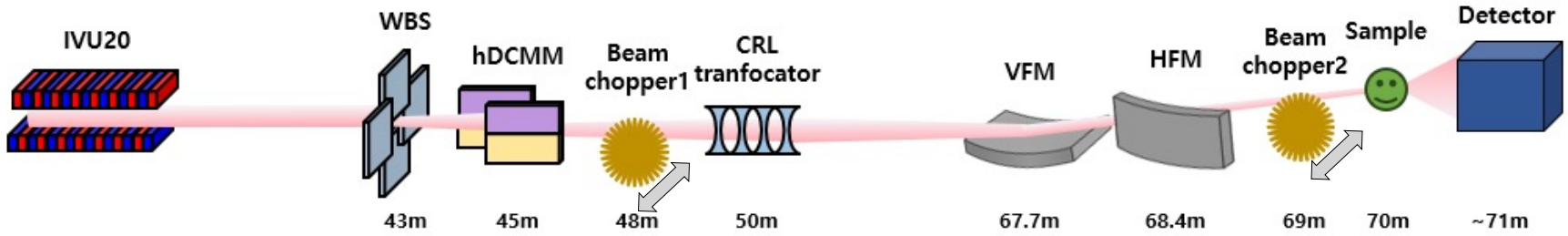


3. Rapid beam resizing

6. High-throughput

Sample exchange robot system

Overview of BioNX beamline



Content	Details
Light source	IVU20 (3 m)
Photon energy (keV)	8 – 25 (12.4, 20 keV mainly)- Crystal 10-15 keV – ML
Wavelength (Å)	0.5~1.55
Energy resolution (ΔE/E)	< 2 x 10^{-4} (DCM), ~1% (DMM)
Beam size at sample (μm²)	1x1 ~ 50x50 @ 12.4 keV 1x1 ~ 5x5 @ 20 keV
Photon flux (ph/s)	>10^{14}
Techniques	SX, SSX, ISX, HTS* MX
Measurement speed	>100 Hz
Processing capacity	600 crystals/day
Auxiliary Facilities	On-site sample preparation laboratory

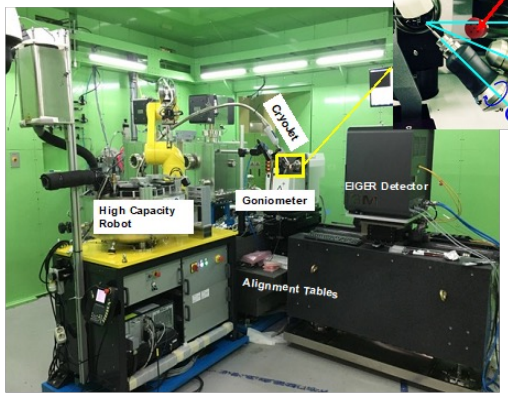
*) SX: Standard crystallography, SSX: Serial synchrotron crystallography,
ISX: In-situ crystallography, HTS: High throughput screening

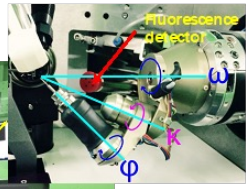
Beamline science

1. Micro to nano crystallography
2. Room-temperature crystallography
3. Automated high-throughput screening

→ Serial crystallography, In-situ crystallography, High-throughput experiment

End-station





Multi-axis goniometer

Layout

High precision diffractometer

- Sphere of confusion: 100 nm
- Raster scan at 15 mm/s
- Rotation speed: 720 deg/s
- Easy to change various goniometer heads

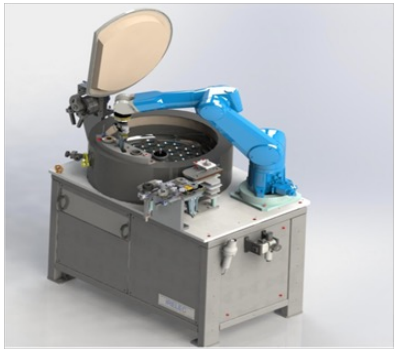
Silicon drift X-ray detector

- X-ray fluorescence
- Element scan

EIGER2 XE 16M

- Frame rate: 560 Hz (16 bit), 700 Hz (8 bit)
- Active area: 311 x 328 mm2
- Energy range: 6-40 keV

High-Capacity Sample Exchange Robot

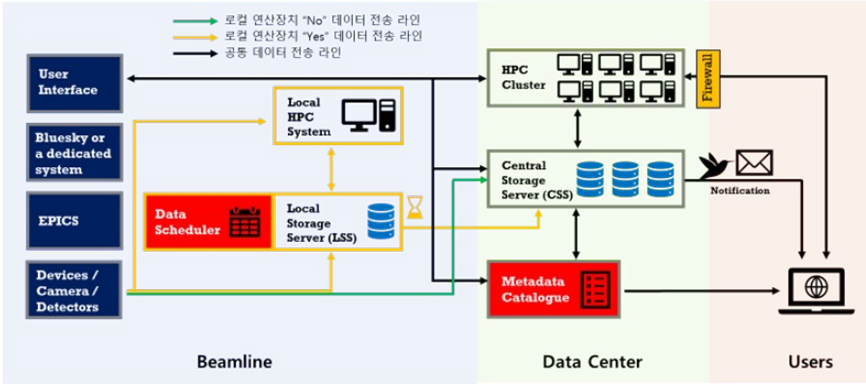


592 sample/storage chamber
~600 sample/day

Data acquisition/management

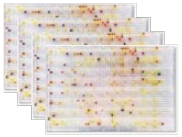
Web-based User Interface (WUI)
Remote access

Computing infrastructure



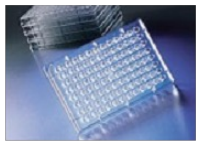
- **Local HPC system and data center**

Sample preparation laboratory



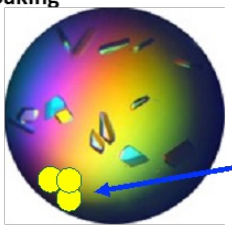
~ fragment library
on ECHO plates
(ex. 1200 fragments)

Precise, Accurate, and Efficient Liquid transfer using sound



~ Soaking fragments into crystal drops on plate
~ 30 sec for 100 fragments (one crystallization plate)
~ singleton soaking

~ Crystallization Plates
(ex. 1200 crystal drops)



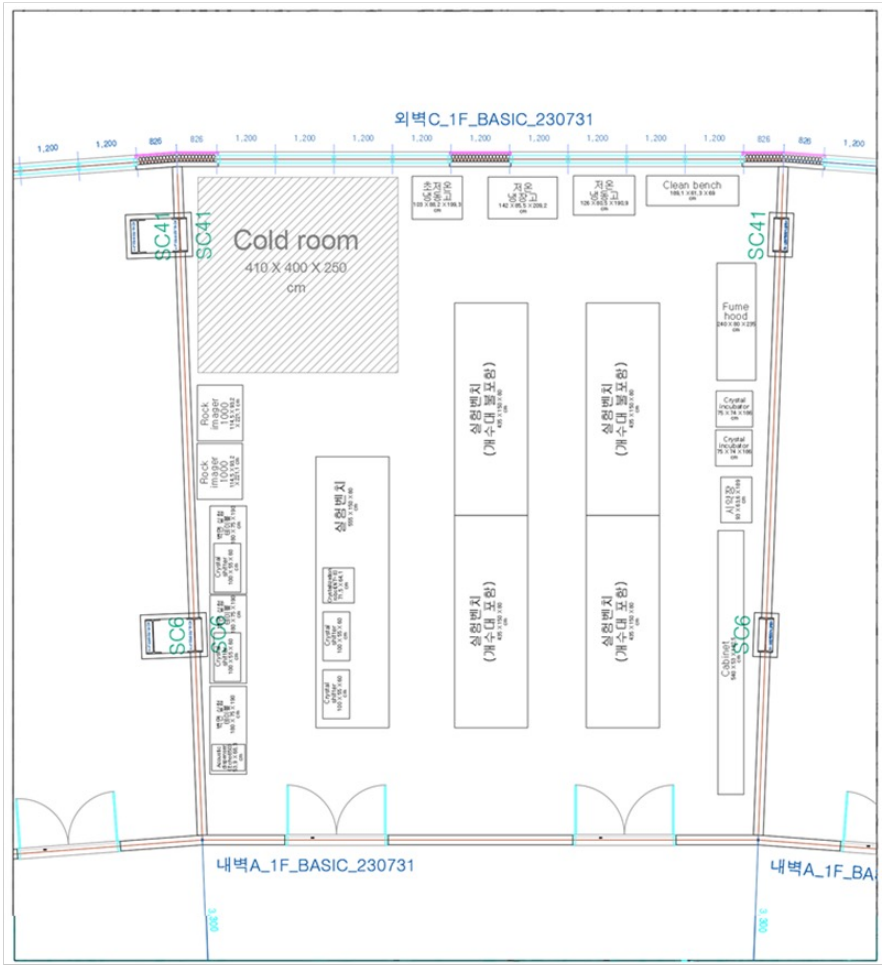
~ 2 µL

Shooting fragment solution
(~ 100 nL)

Crystallization robot Crystal imaging system

- **Facility for sample preparation of FBDD experiment**
- **Support drug discovery experiment**

Floor plan of sample preparation laboratory



What we need

-making the Beamline environment user-friendly!

User-friendly beamline control system

User

MXCuBE-Web

Sample

Beamline

Result files

Management software (LIMS)

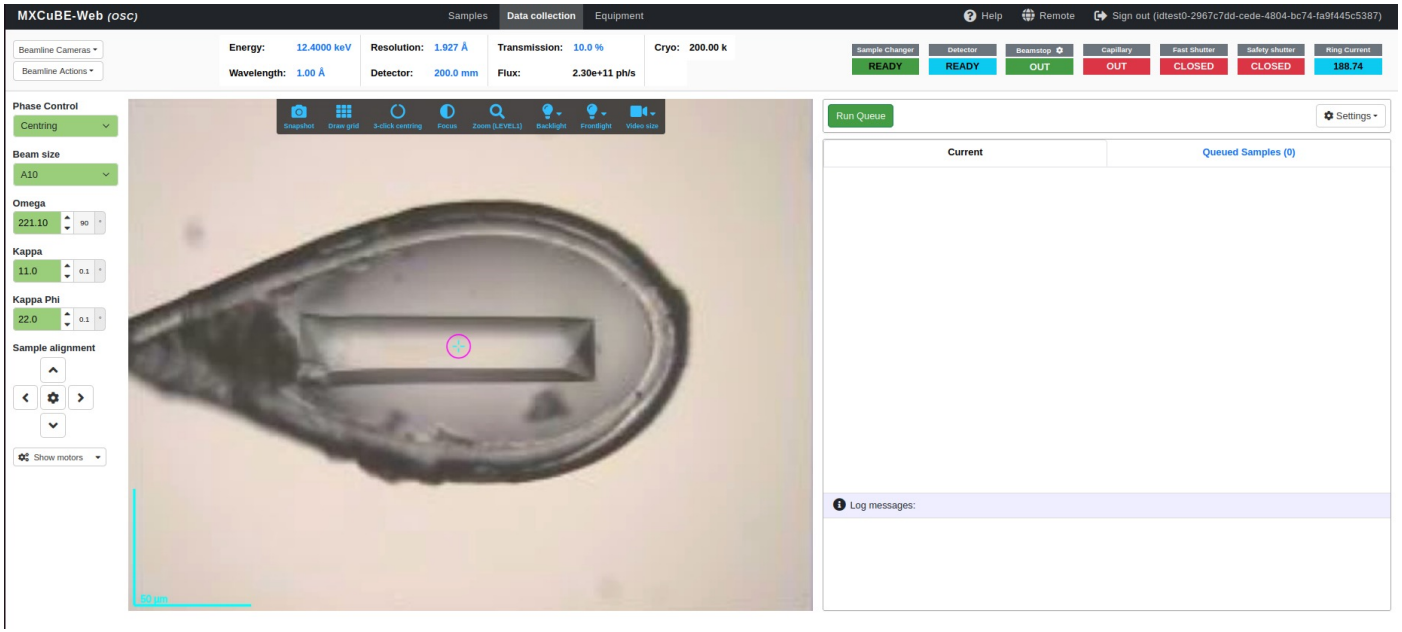
ISPyB

DRAC

MXLIMS

→ We would like to integrate them into our beamline system

Test installation-simulation mode



We are currently doing..

- MXCuBE-Web

- Installation completed to test bed

- How to EPICS system connection?

- Checking the possibility of integrating with LIMS to MXCuBE

Acknowledgement

MX group
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Byungkwan Cho
Hyungjin Kim
Seop-Goo Kim

"Korea-4GSR Project"

KOREA BASIC SCIENCE INSTITUTE KBSI 한국기초과학지원연구원

PAL

충청북도 CHUNGCHEONGBUK-DO

과학기술정보통신부
Ministry of Science and ICT


Korea Photon Light Source
계획의 전제
과학기술 기초역량 강화를 위한 세계 최고 수준의 차세대 다목적 방사광 가속기 구축.
선도적 원천기술 및 미래핵심기술 확보를 위한 R&D 과학기술 인프라의 요람.
차세대 첨단기술의 집약적 활용으로 국가 기술경쟁력 강화에 기여.
KEY MAP
Thank you for your attention!
(mjkwak@postech.ac.kr)