Recent progress and development plans for materials science at SACLA

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SACLA Uses' Meeting 2022
Breakout Session B1
"Recent achievements and future perspectives in materials science at SACLA"

Principal Updates at SACLA

BL1

- Experimental station for soft-XFEL opto-spintronics (SACLA Basic Development Program)

BL2&3

- Coil system to produce a pulsed ultrahigh magnetic field (SACLA Basic Development Program)

- Cooling system for ultrafast (optical laser pump-XFEL probe) measurement

- MIR~THz pump laser system

New experimental station for opto-spintronics

BL1

SACLA Basic Development Program

Developing the general purpose-type experimental station for soft-XFEL opto-spintronics

PI: Prof. I. Matsuda＆Prof. Mimura (Univ. of Tokyo)
Special thanks to Dr. Motoyama (Univ. of Tokyo)

Resonant Magneto-optical Kerr effect

Type I

- Time Resolutions < 70fs
- Temperature RT〜15 K
- External magnetic field： - 0.3 T ~ 0.3 T
- *Operando* measurement

Currently open for user operations

Upgrade: User-friendly

Type II

- Time Resolutions < 70fs
- Spot Size： < 500 nm
- Temperature： RT (Low Temperature)
- External magnetic field： +/-0.5 T (Tunable)
- Sample transfer

Currently under developments with Motoyama/Mimura group

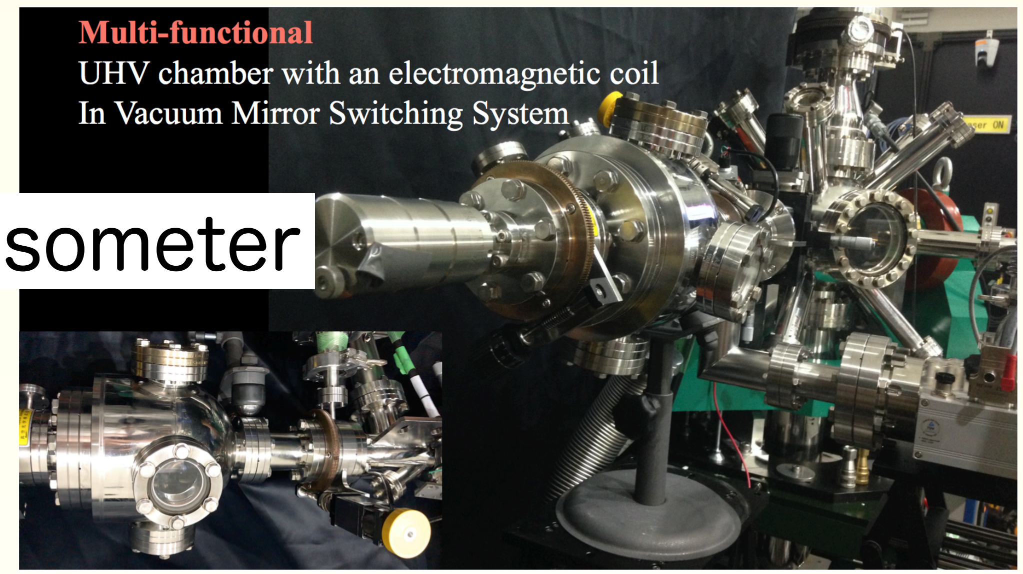
Unification to a single system

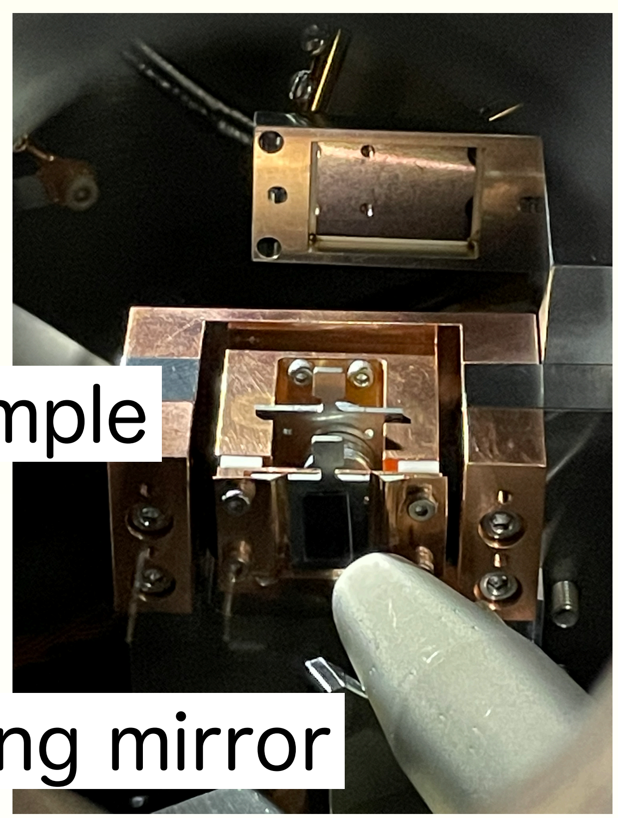
M. Araki, **YK**, *et al.*, e-JSSN **18**, 231 (2020)
T. Sumi, **YK**, *et al.*, e-JSSN accepted

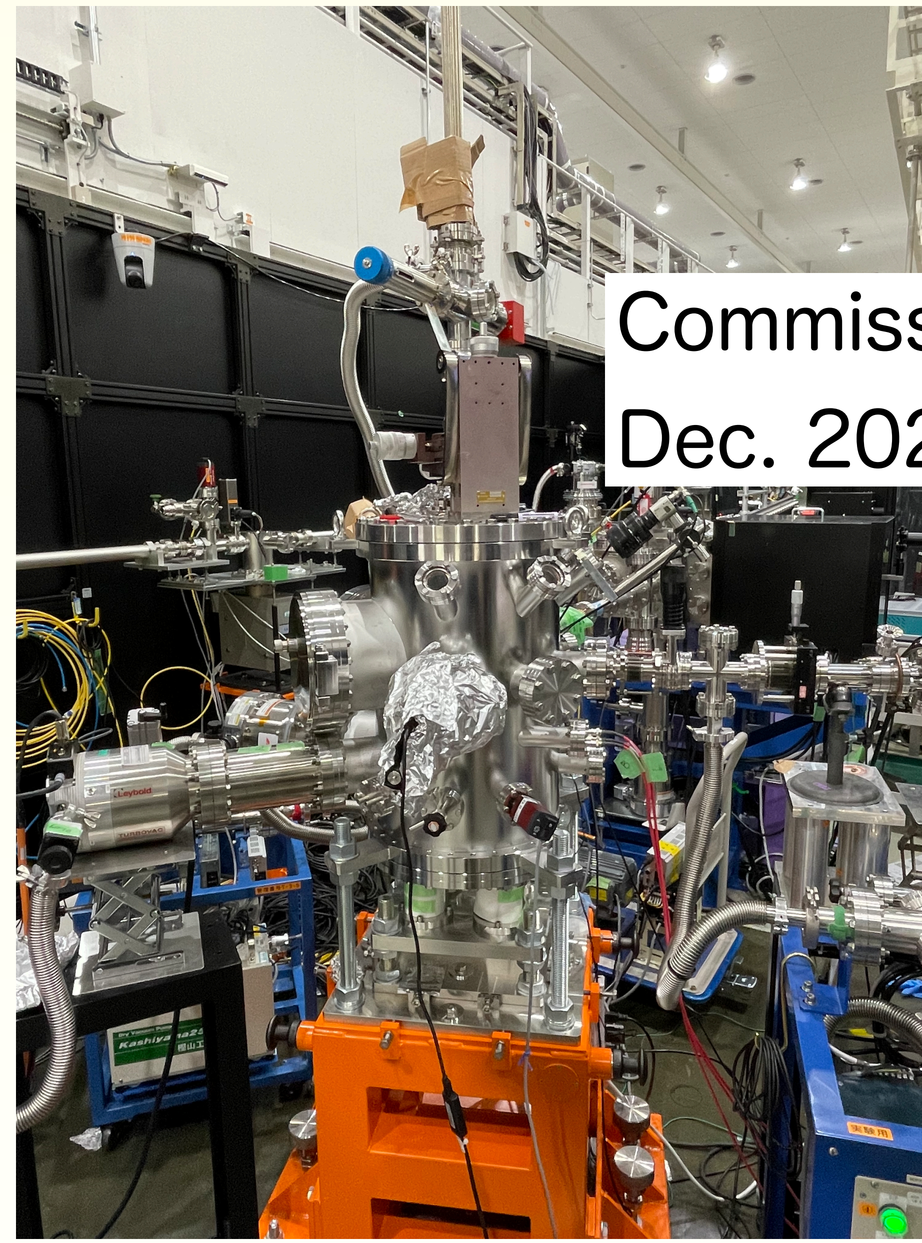
Prof. Matsuda talked yesterday.
Let us discuss at the round-table discussion.

New experimental station for opto-spintronics

BL1



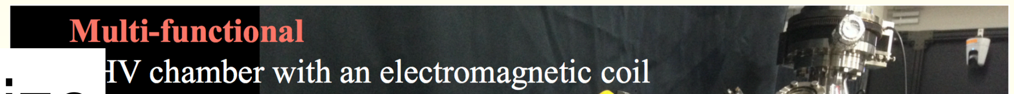




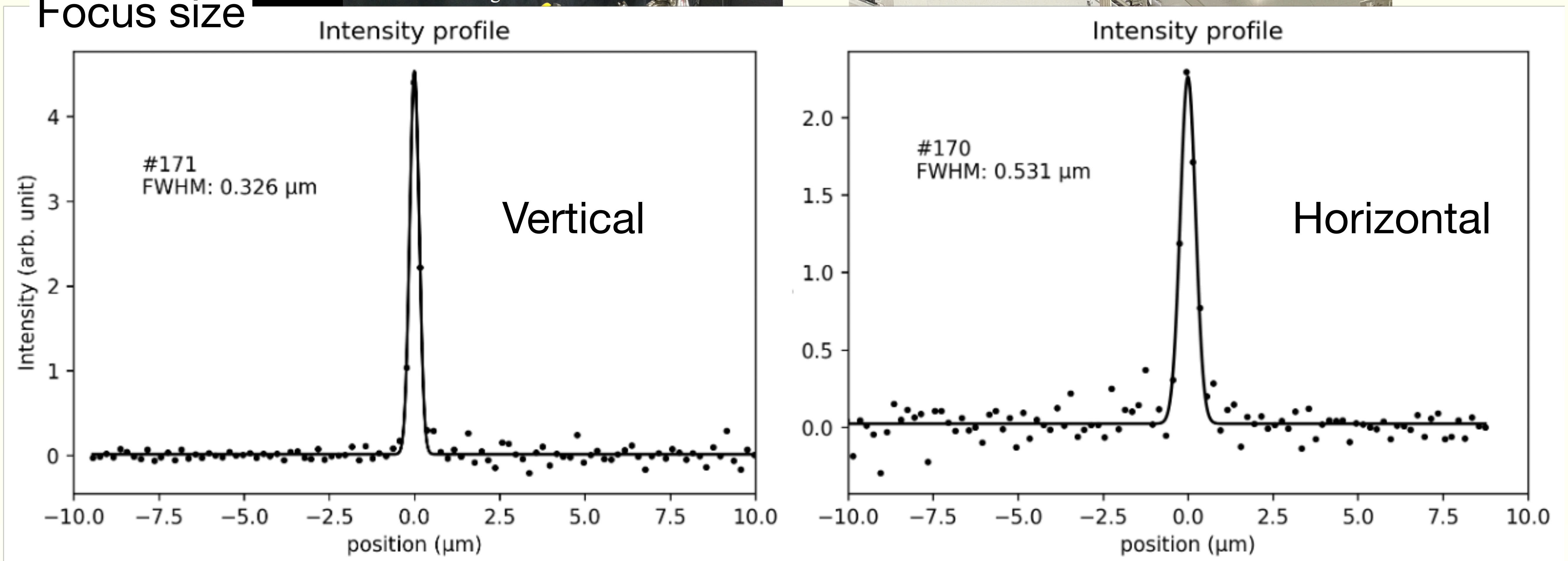
Available from 2022A!

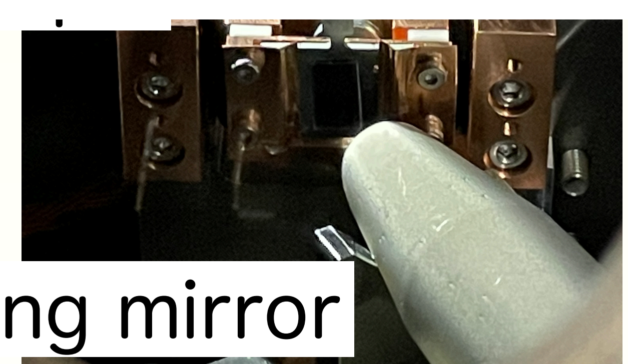
New experimental station for opto-spintronics

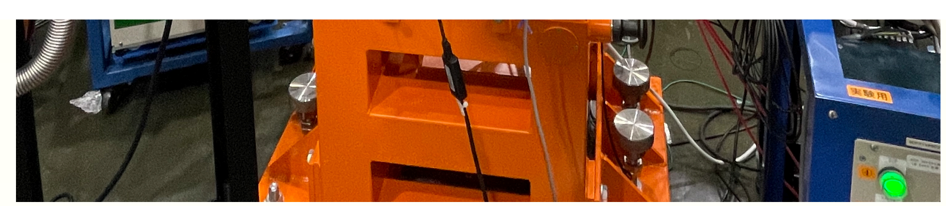
BL1



Focus size



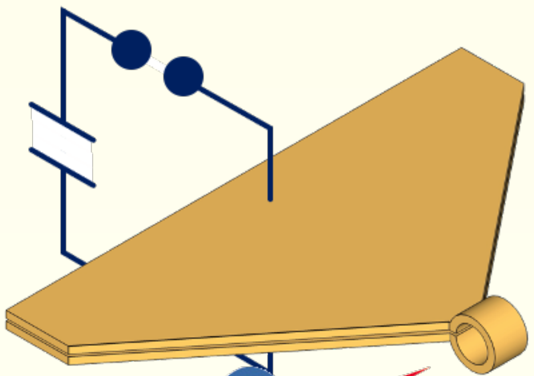




Nano-focusing mirror

Available from 2022A!

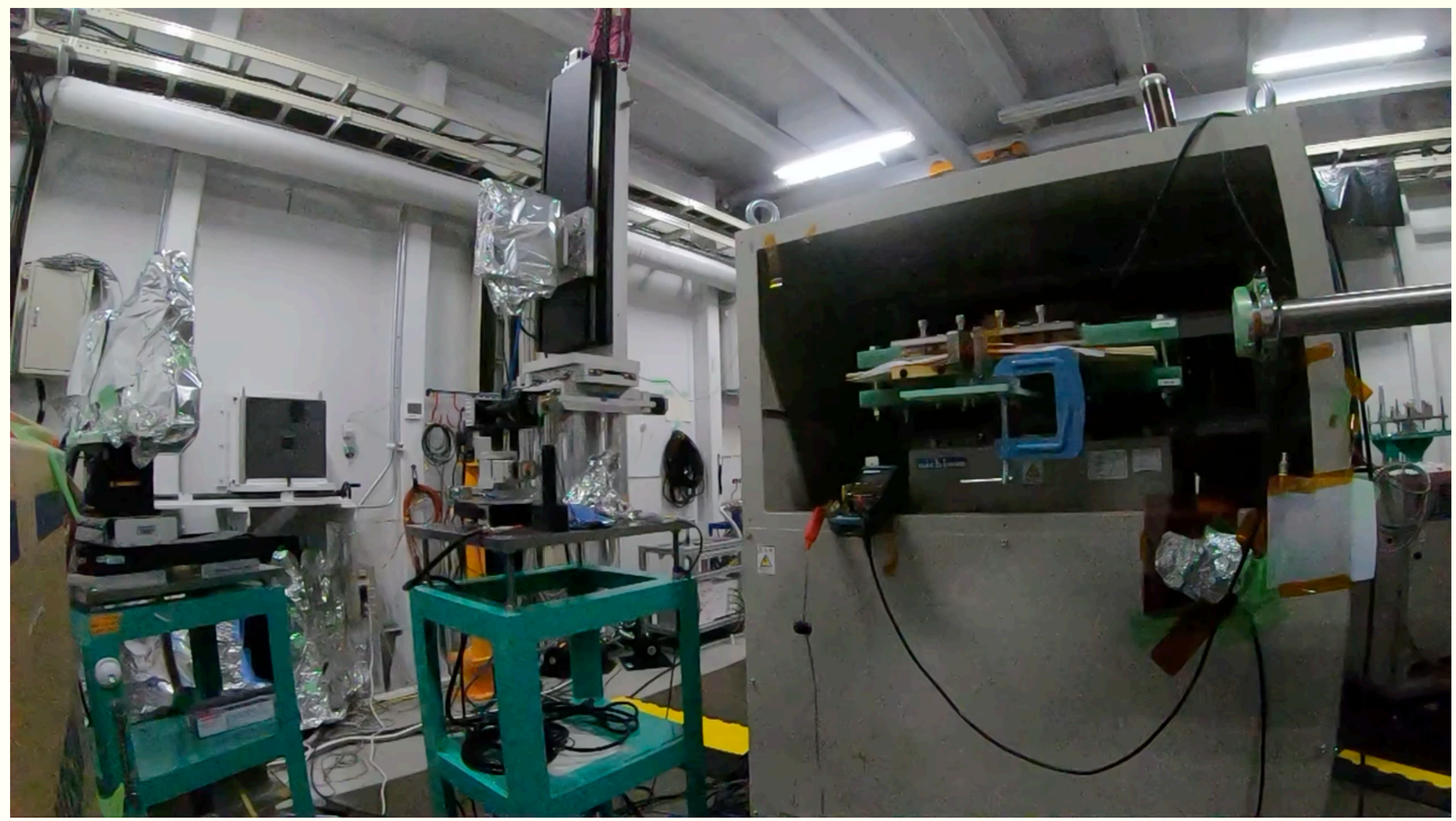
Beyond 100 T



BL2&3

PI: Dr. A. Ikeda (UEC)
talked this morning.

SACLA-XFEL - Portable Single Turn Coil



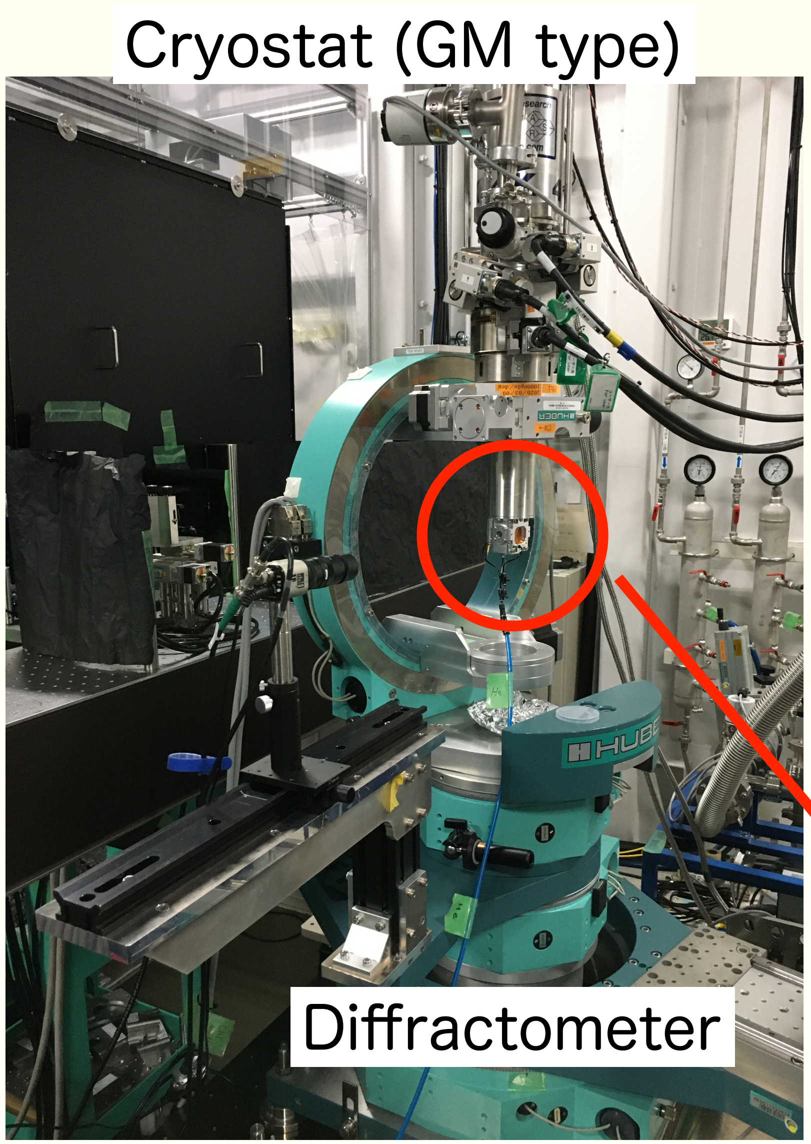
Max 78 T was achieved at SACLA!

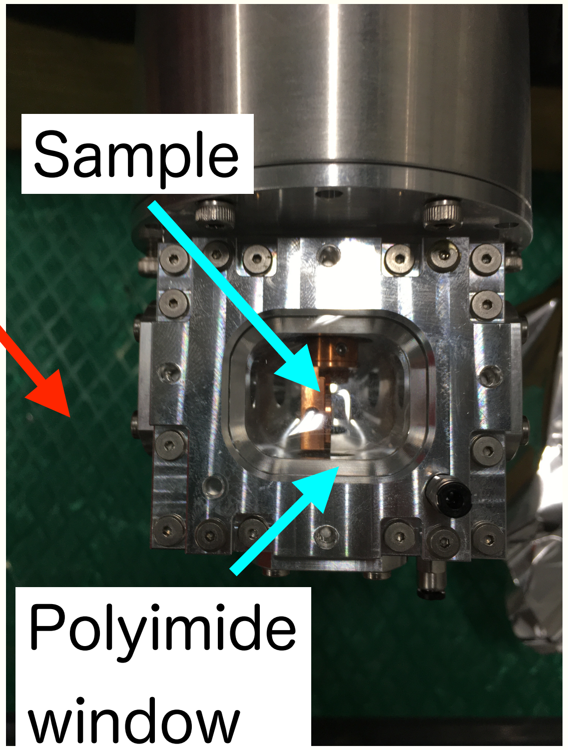
A. Ikeda, **YK** *et al.*, arXiv:2202.05406

Under development to perform X-ray experiments in the pulsed ultrahigh magnetic field beyond 100 T (SACLA Development Program)

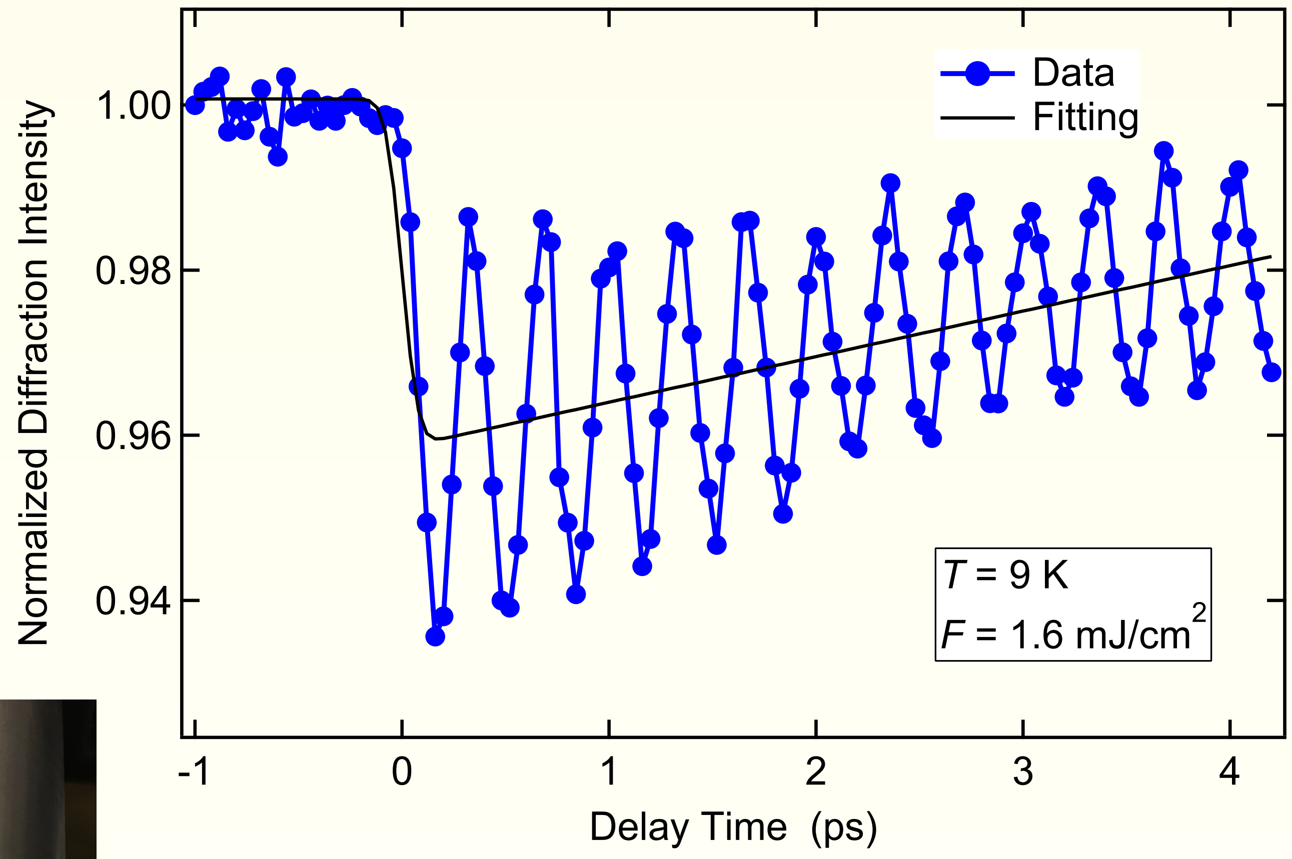
Cryostat for P&P experiments

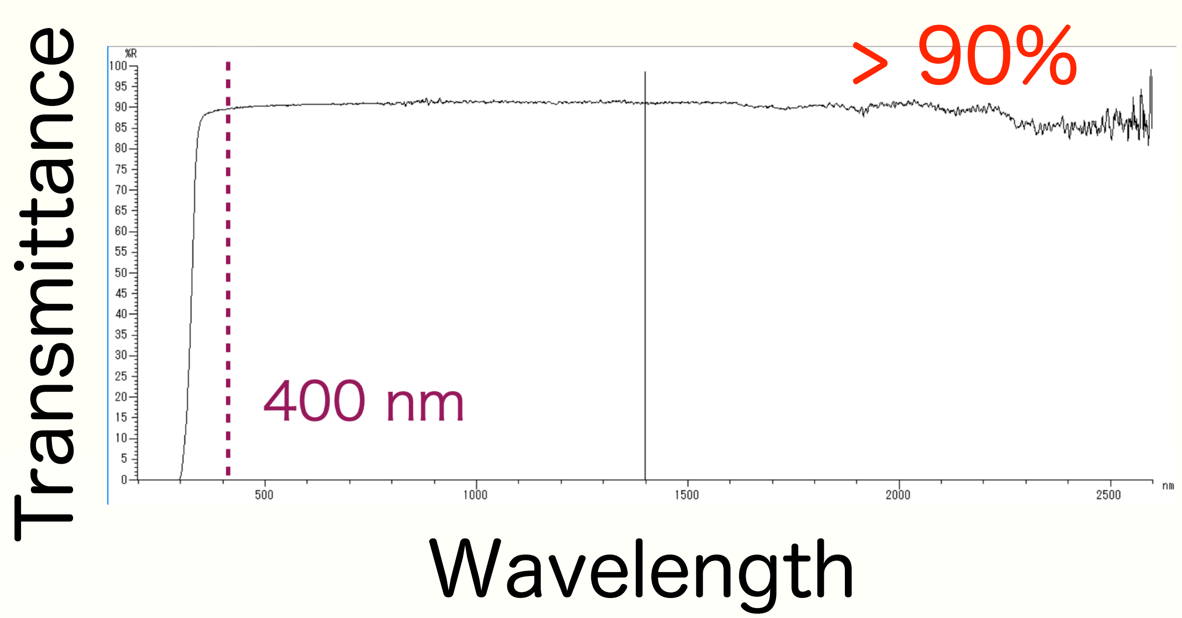
BL3





P&P XRD for coherent phonon of Bi@9 K



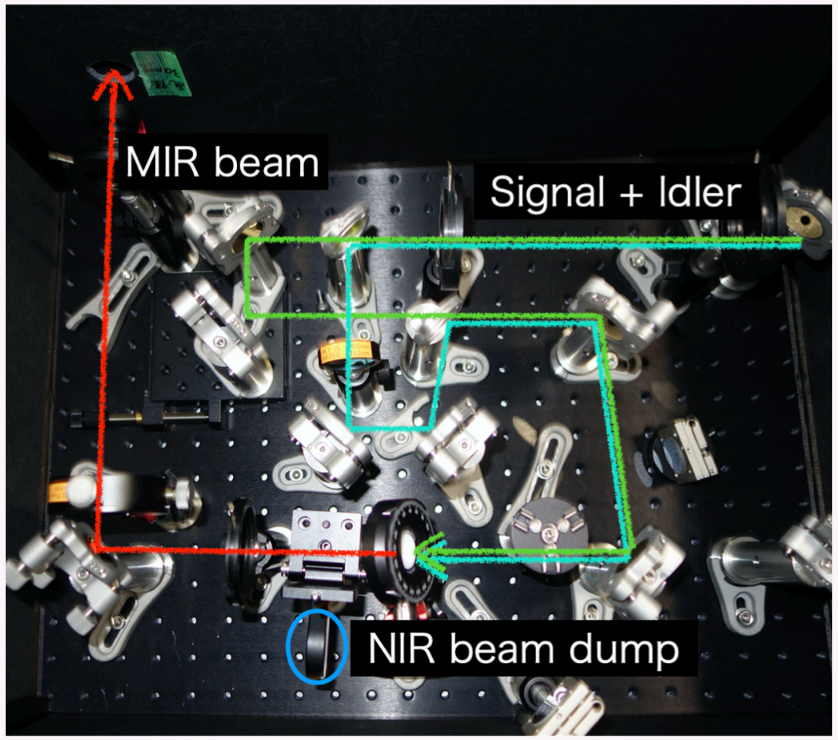


YK *et al*., arXiv:2105.13146.

MIR laser system

BL3

MIR

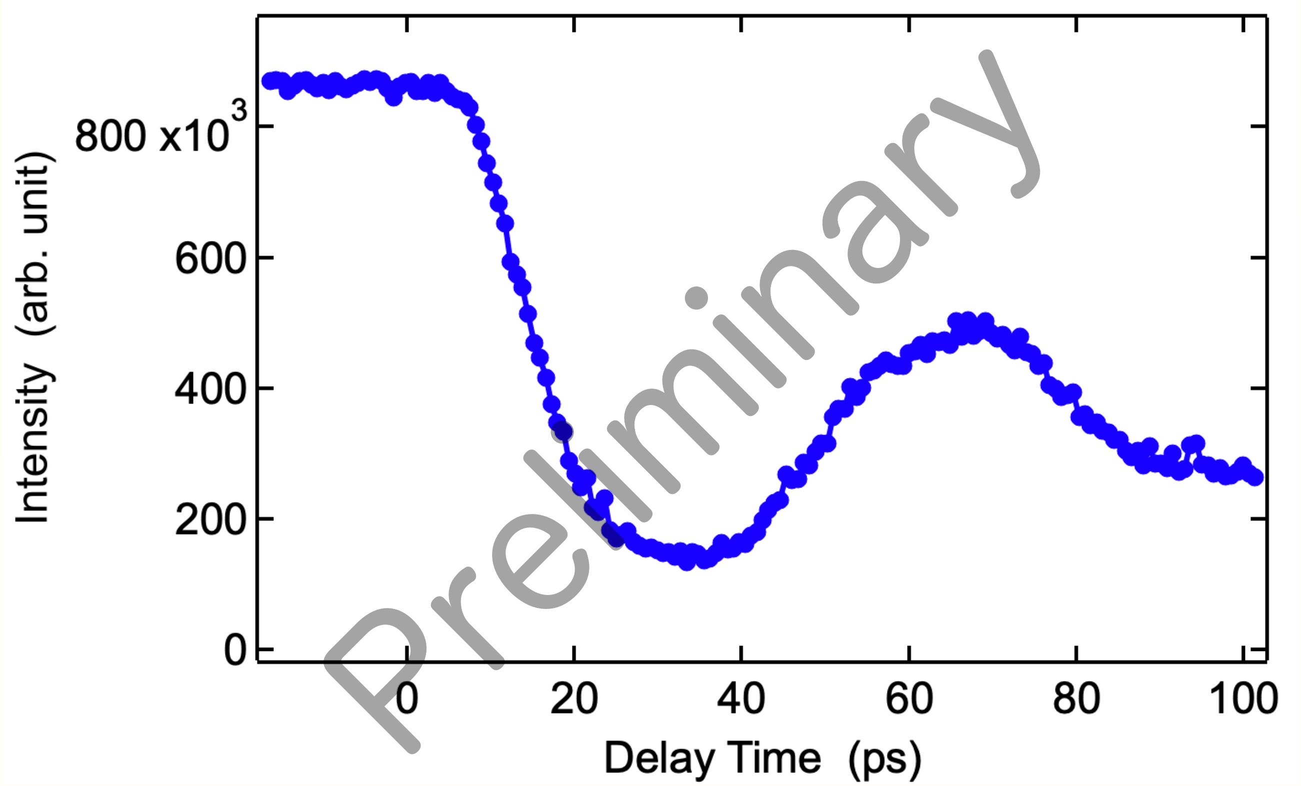


MIR generation unit

Mid-IR
Wavelength:
2 ~ 11 μm ($AgGaS_2$, Eksma)
3 ~ 18 μm (GaSe, Eksma)
Pulse energy:
< 20 μJ @15 μm
Focus size:
~400 μm (FWHM)

MIR pump XRD experiment at SACLA

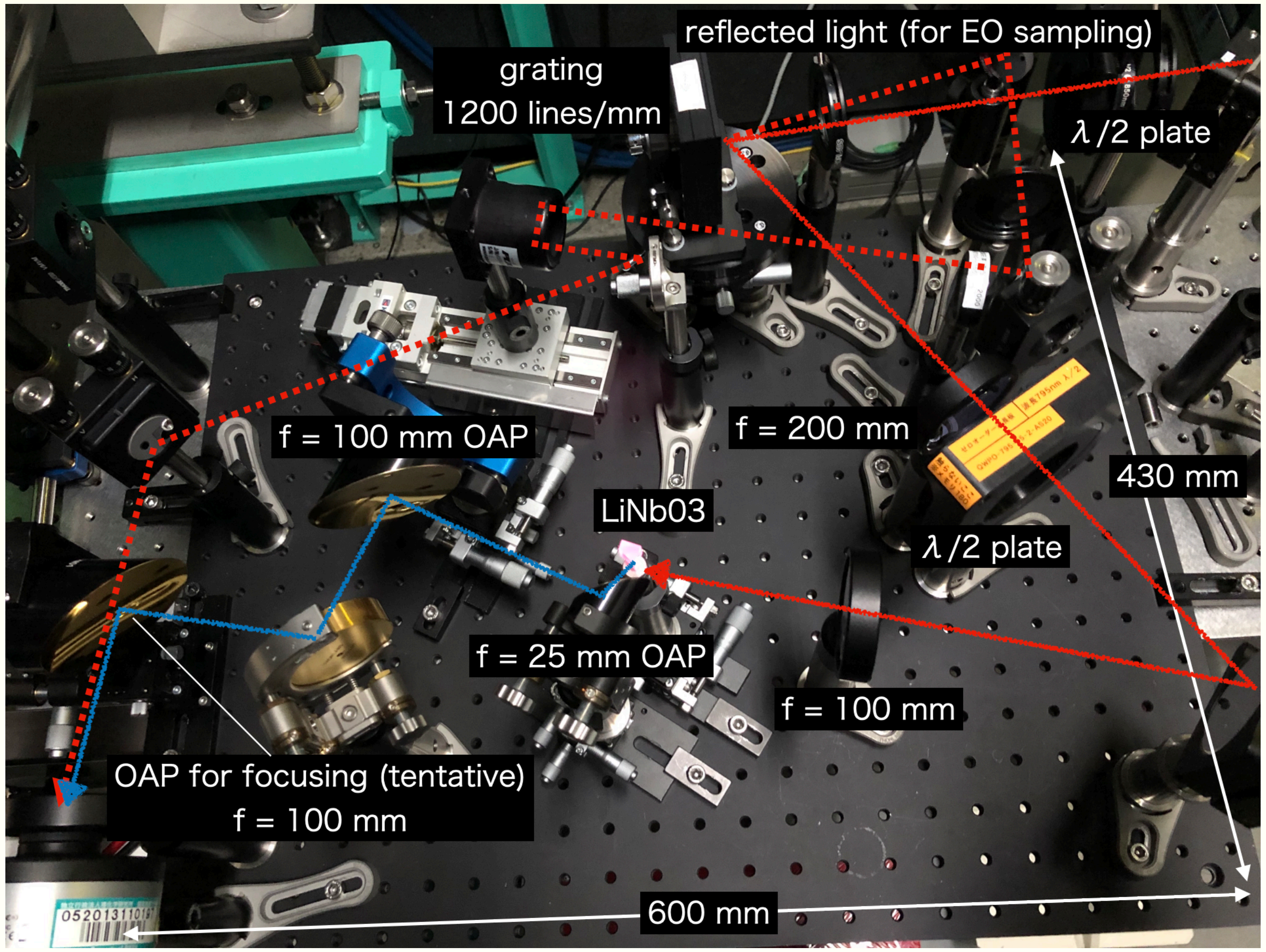
T_{min} = 6.5 K



THz laser system

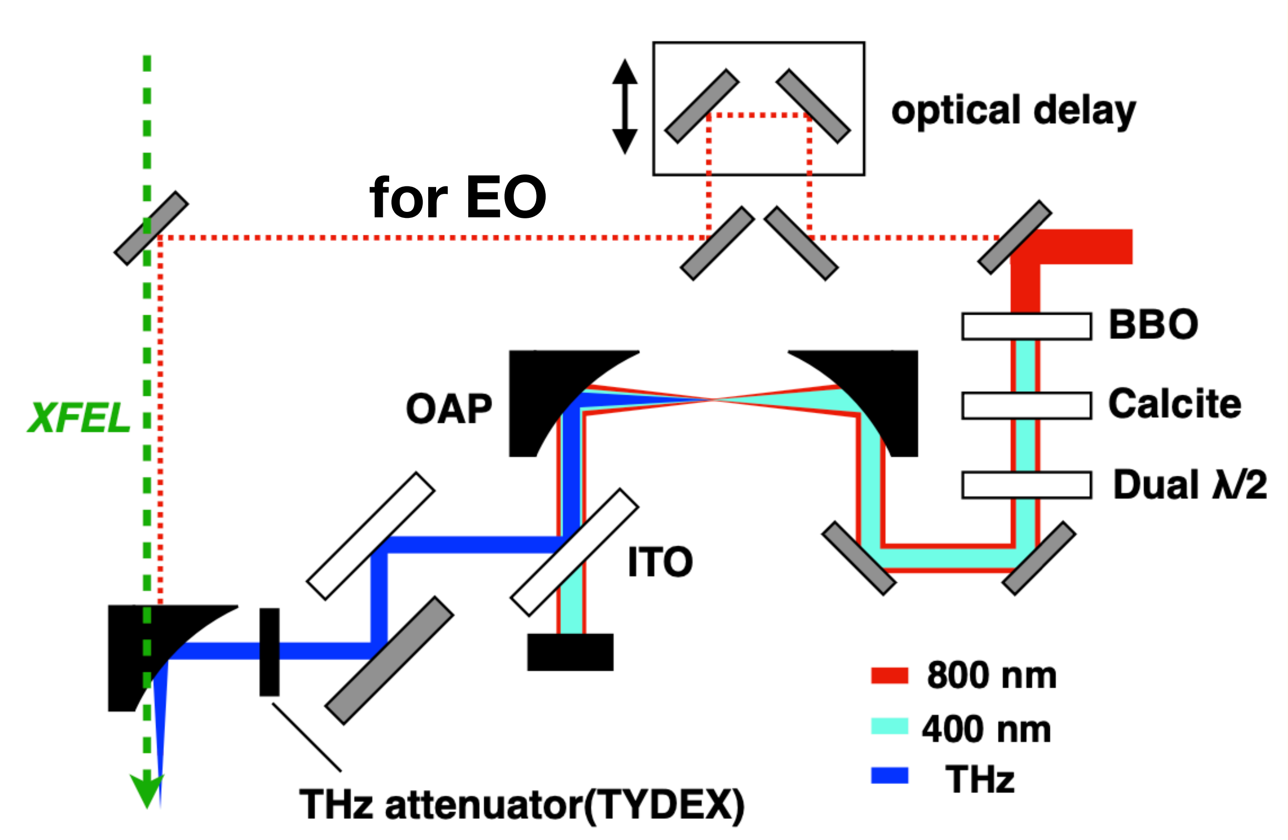
BL3

Tilted-pulse-front method



Size: ~ϕ3~4 mm
Energy: < 100 kV/cm

Two-color air plasma method



Size: ~ϕ1 mm
Energy: ~ 1 MV/cm (preliminary)

Summary

BL1

- Experimental station for soft-XFEL opto-spintronics

→The nano-focus system will be available from 2022A. Combining the optical laser for P&P experiments is under development.

BL2&3

- Coil system to produce a pulsed ultrahigh magnetic field (SACLA Basic Development Program)

→A magnetic field of 78 T has been achieved. We are continuing to develop toward the realization of 100 T.

- Cooling system for ultrafast (optical laser pump-XFEL probe) measurement

→The cryostat for P&P experiments has been developed. P&P XRD was performed at < 10 K.

- MIR~THz pump laser system

→MIR laser has been used for P&P experiments. THz laser system will soon be available.