SACLA Users' Meeting 2024
Breakout Session A
"Novel opportunities of XFEL experiments with magnetic fields"

Recent progress of "PINK" system

Yuya Kubota
SACLA

PINK system

PINK: Portable INtense Kyokugenjiba

FY2020~2023　SACLA Basic Development Program

X-ray experiment in pulsed ultrahigh magnetic field beyond 100 T with a portable single turn coil system “PINK”

PI: Dr. Akihiko Ikeda (UEC)
Co-researcher: Prof. Yasuhiro Matsuda (Univ. Tokyo)
SACLA side: Yuya Kubota, Yuichi Inubushi

Beamline Parameters

	BL3 (HX)	BL2 (HX)	BL1 (SX)
Photon energy	4 ~ 22 keV	4 ~ 22 keV	40 ~ 150 eV
Bandwidth (ΔE/E)	~3×10^{-3}	~3×10^{-3}	~0.01
Pulse energy	~700 μJ@10 keV	~500 μJ@10 keV	~90 μJ@100 eV
Photon number (/pulse)	> 10^{11}@10 keV	> 10^{11}@10 keV	> 10^{12}@100 eV
Pulse duration	< 10 fs	< 10 fs	~30 fs
Peak power	~60 GW	~50 GW	>100 MW
Repetition rate	30 Hz*1	30 Hz*1	60 Hz

＊1: 60 Hz is available in single beamline operation mode

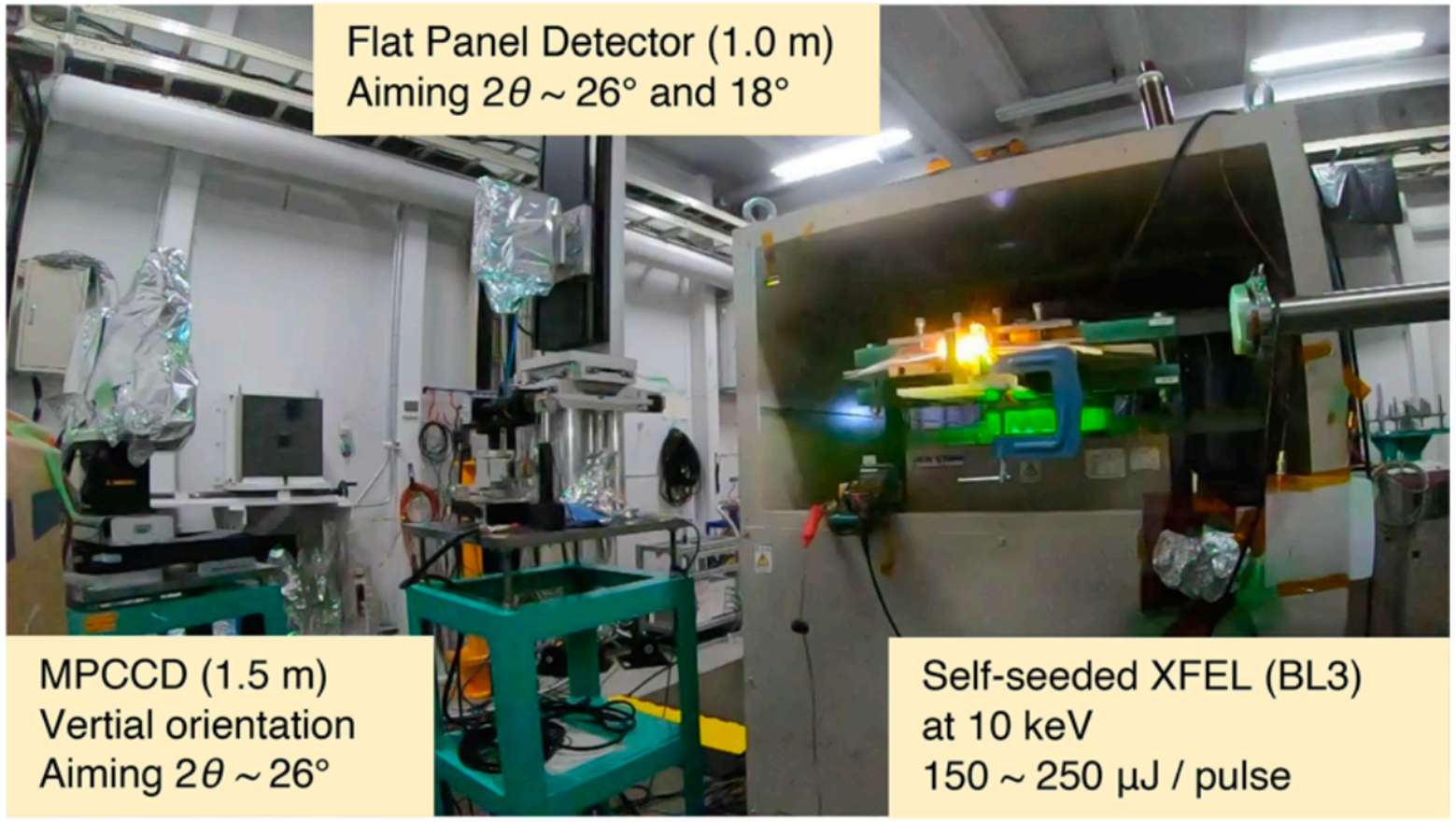
XFEL Parameters

Typical XFEL Parameters for 10 keV at BL3

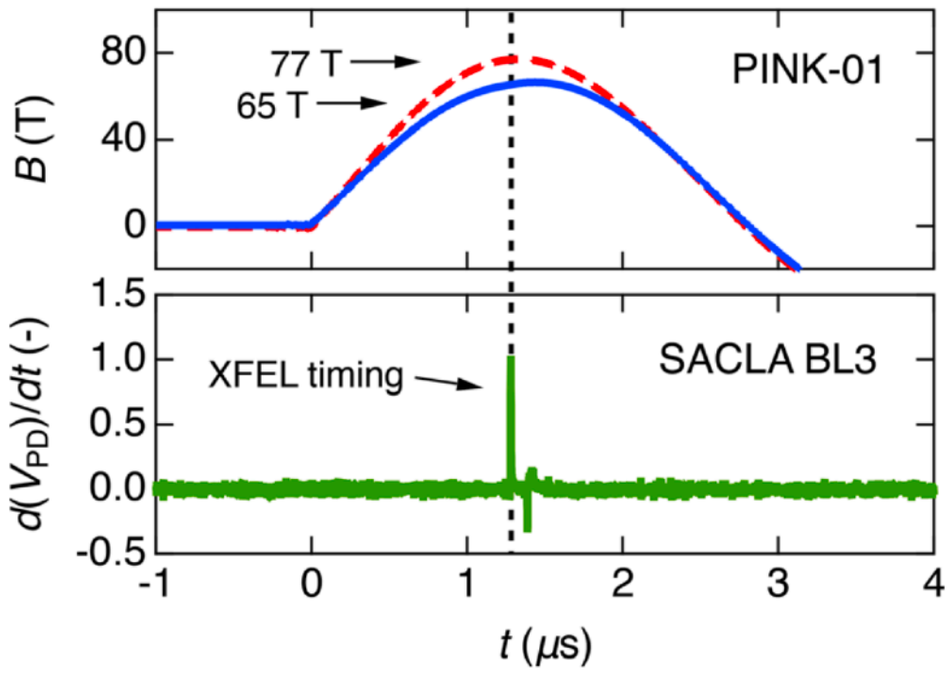
Operation Mode	Pulse Energy (uJ/pulse)	Bandwidth (eV)
SASE	~700	30~40
SASE + DCM	15~20	~1
Seed	250~300	4~5
Seed + DCM	40~50	~1

PINK-01

PINK-01 is the first portable single turn coil system developed at Univ. Tokyo.



77 T!



A. Ikeda *et al.*, Appl. Phys. Lett. **120**, 142403 (2022)

Upgrade to PINK-02 for beyond 100 T

Configuration of PINK-02

Outside EH

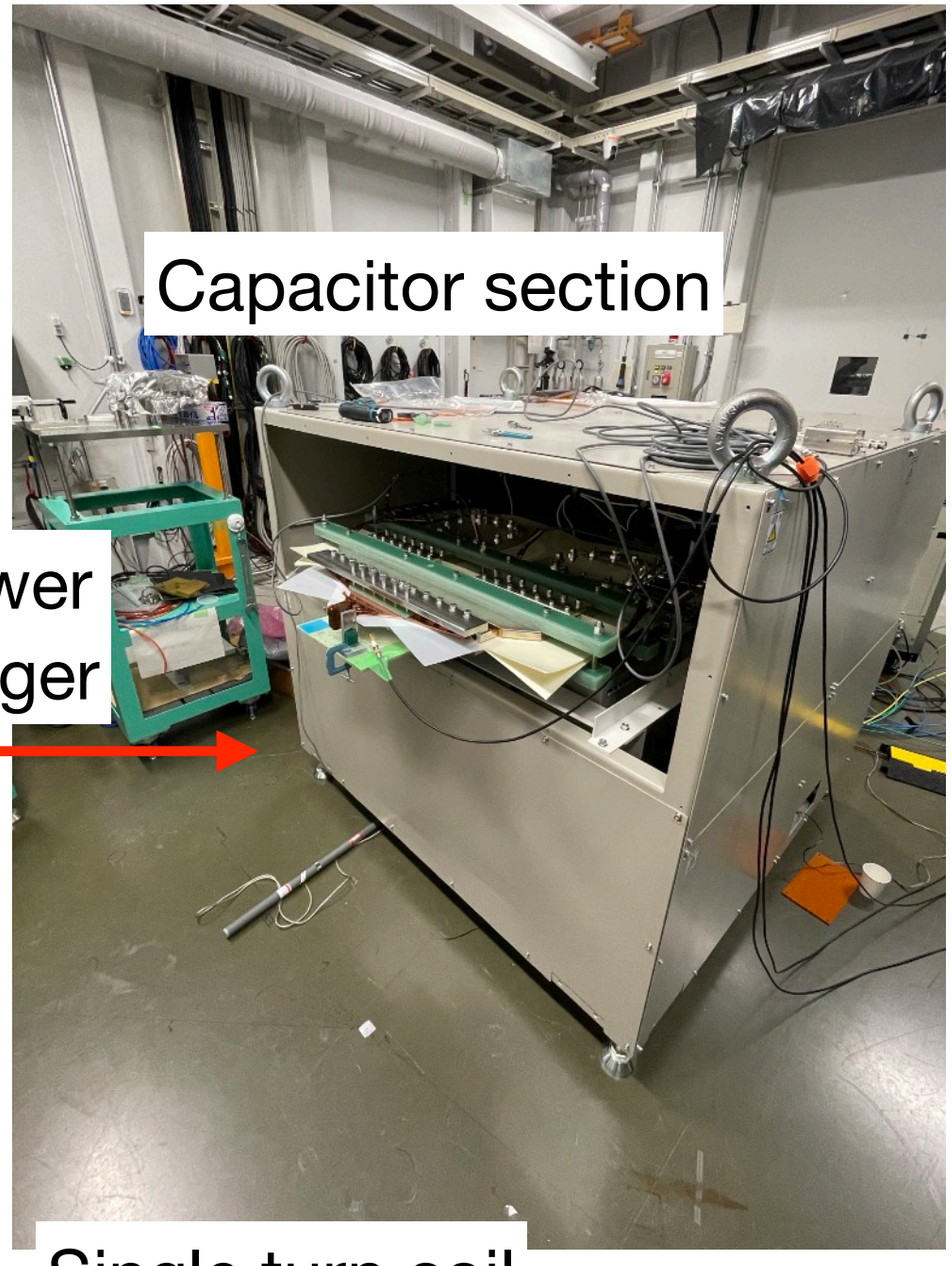
Inside EH

Control unit

Command

Charging section

Power
Trigger



Configuration of PINK-02

Outside EH

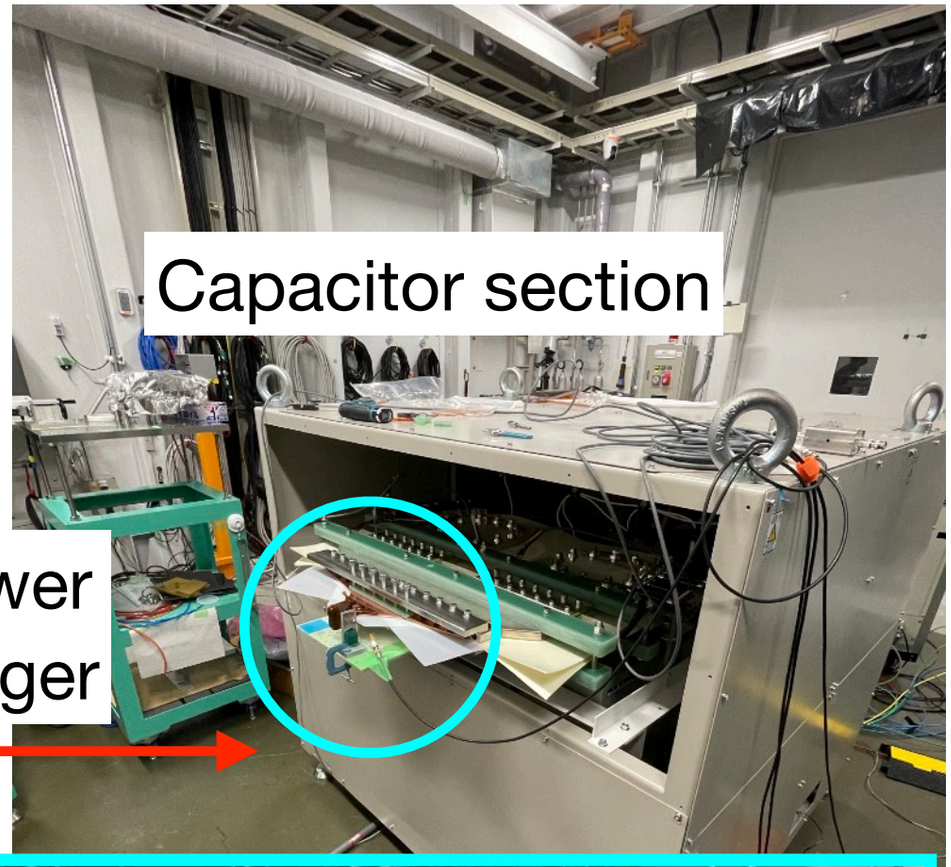
Inside EH

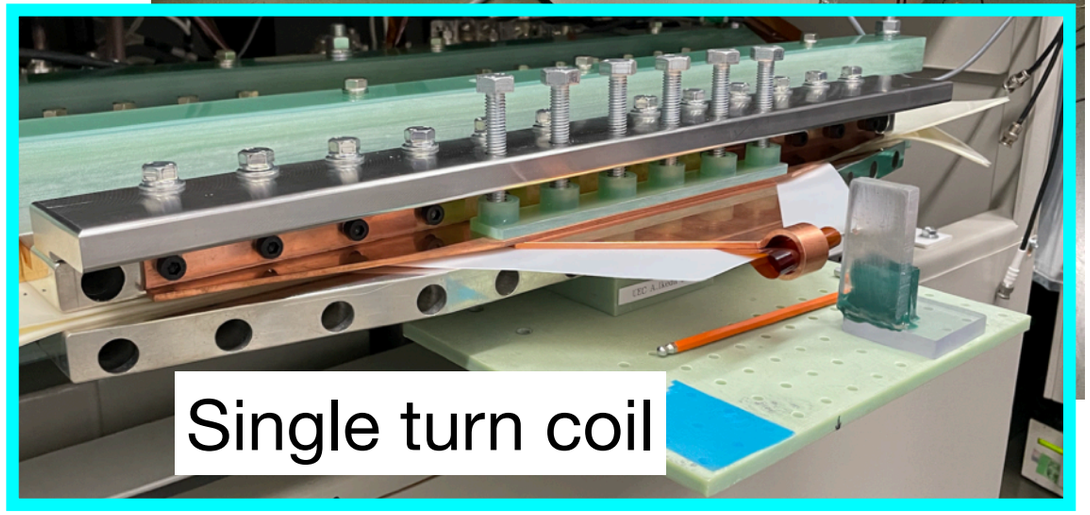
Control unit

Command

Charging section

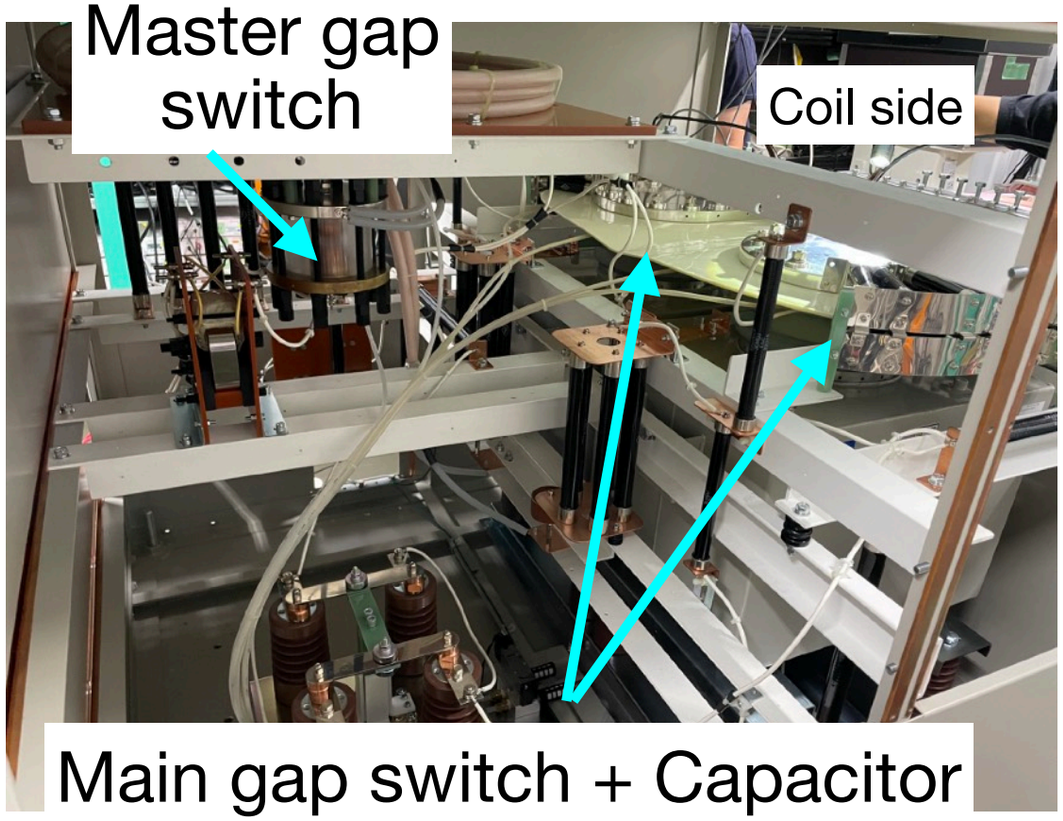
Power
Trigger



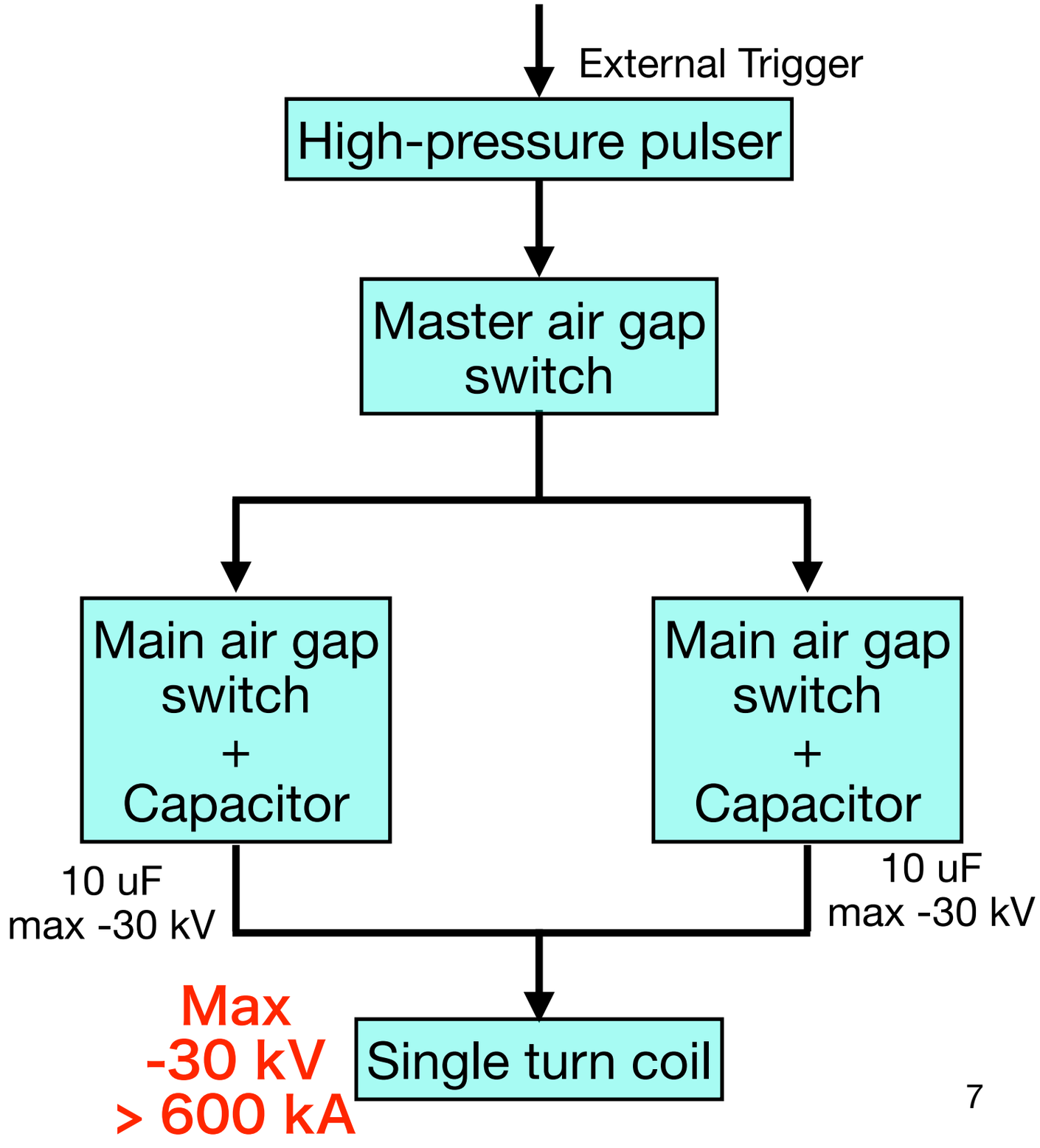


Structure of PINK-02 capacitor section

Inside of capacitor section



Main gap switch + Capacitor ×2



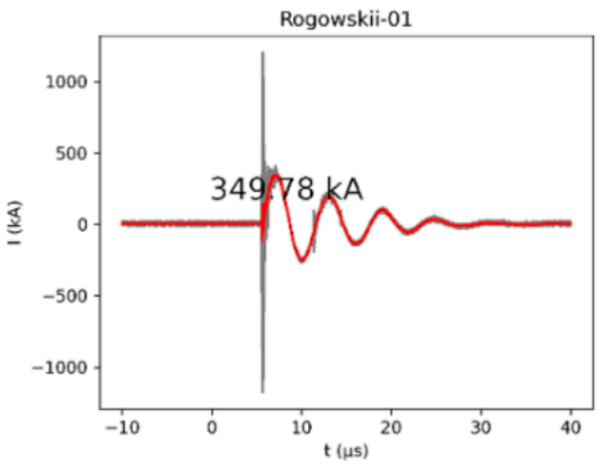
Safety measure

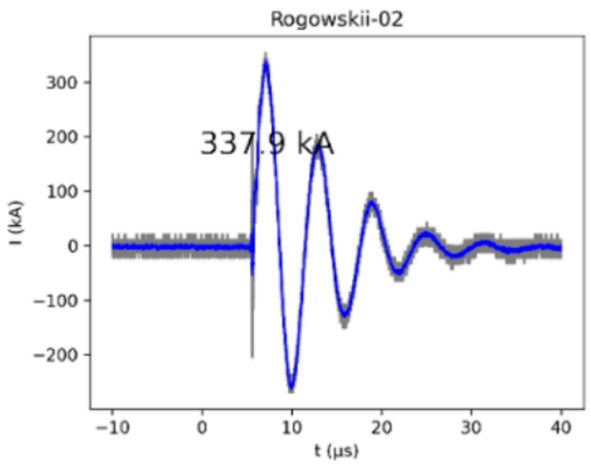
- Multiple interlock mechanisms in the control unit.
  air pressure, trigger, pulser power
- Cannot be charged unless all are unlocked.
- External 1 is interlocked with the door of the experimental hatch.
- The interlock cannot be unlocked unless the door is closed normally.

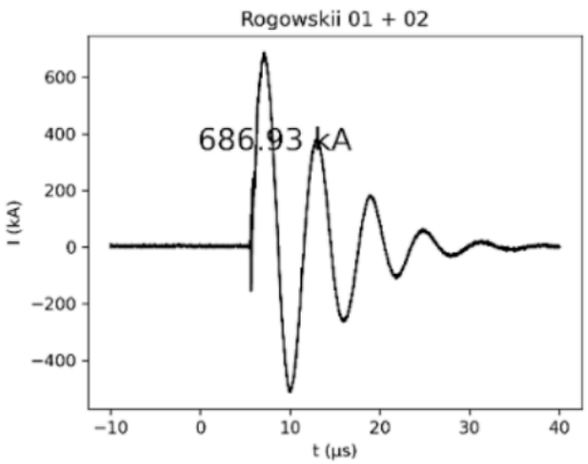
→Ensures that no one is in the vicinity of PINK-02

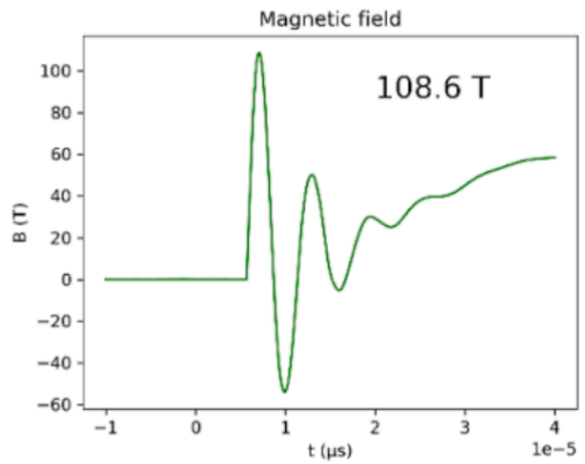
Beyond 100 T

Used ϕ4 coil

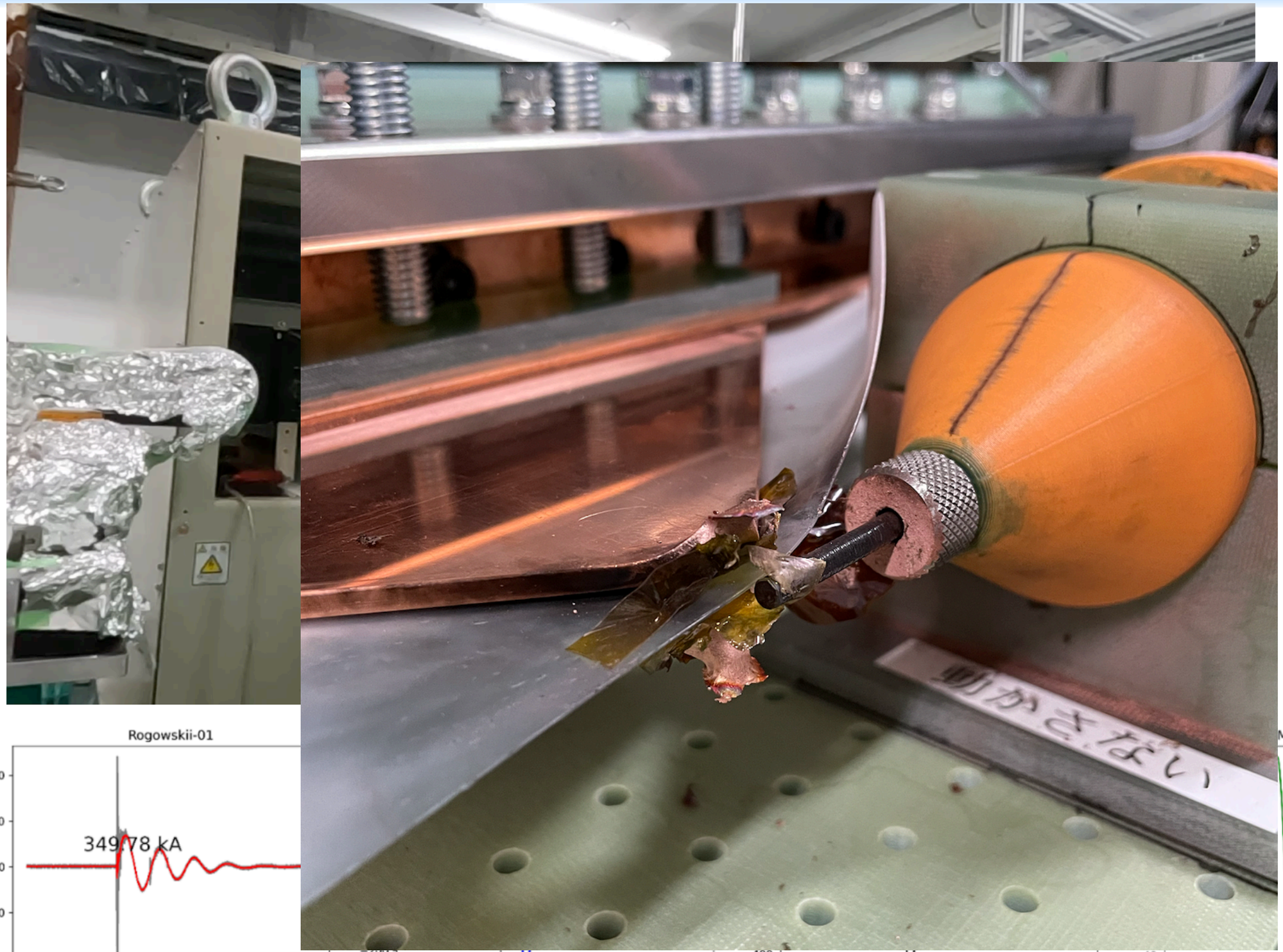






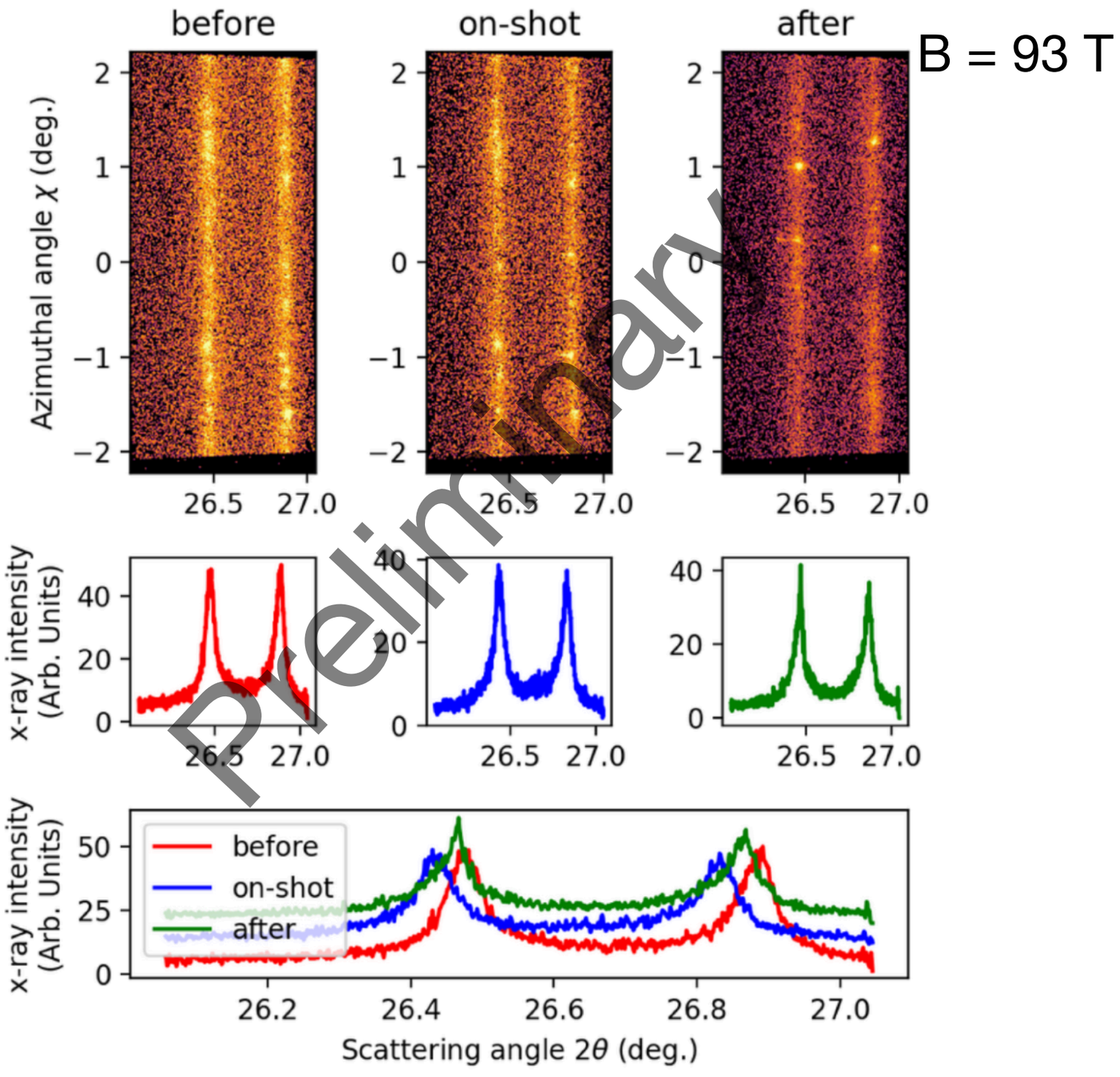


Beyond 100 T



Used ϕ4 coil

XRD under ultra-high magnetic field



Future Tasks

- The air pressure in the main gap switches has not been optimized yet; they sometimes self-destruct (discharge on their own) and the two capacitors are not synchronized.

- Improvement around the sample is required for shared use.
  especially the cooling system

- Should consider more robust countermeasures against explosions.

Summary

- I Introduced PINK-02 developed under the SACLA Basic Development Program.
- The highest performance achieved was over 100 T.
- However, stability issues remain.
- Further improvements, including peripheral devices, will be made for shared use.