

# Summary WG 5 - Facilities

Hiroshi Sakai (KEK)

Michaela Arnold (TU Darmstadt)

# Program

<b>Status of cERL [TUO01]</b>	<i>Miho Shimada (KEK)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	10:30 - 10:50
<b>CBETA: Achievements, Challenges, Status, and Plans [TUO02]</b>	<i>Joseph Berg (Brookhaven National Laboratory)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	10:50 - 11:10
<b>Status of the S-DALINAC with focus on ERL operation [TUO03]</b>	<i>Michaela Arnold (TU Darmstadt)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	11:10 - 11:35
<b>Status of the ERL project bERLinPro: Final commissioning preparations [TUO04]</b>	<i>Axel Neumann (HZB)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	11:35 - 11:55
<b>MESA facility report [TUO05]</b>	<i>Timo Stengler (University Mainz)</i>
<i>WG5</i>	11:55 - 12:20
<b>Lunch</b>	
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	12:20 - 13:20
<b>PERLE Status and Plans [TUO06]</b>	<i>Walid Kaabi (IJCLab-CNRS)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	13:20 - 13:45
<b>Progress on Terahertz Light Production at TRIUMF e-Linac [TUO07]</b>	<i>Hui Wen Koay (TRIUMF)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	13:45 - 14:05
<b>BriXSino: an ERL proposed facility at INFN Milan LASA Laboratory [TUO08]</b>	<i>Dario Giove (INFN-LASA)</i>
<i>Kobayashi Hall, High Energy Accelerator Research Organization (KEK)</i>	14:05 - 14:25

# Activity of cERL in FY2023

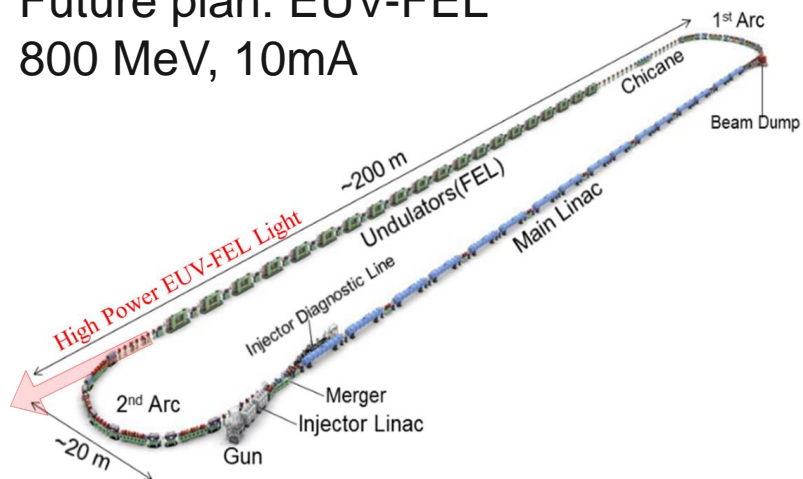


cERL: test facility  
17-20 MeV, 1mA



(c) Rey.Hori / KEK

Future plan: EUV-FEL  
800 MeV, 10mA

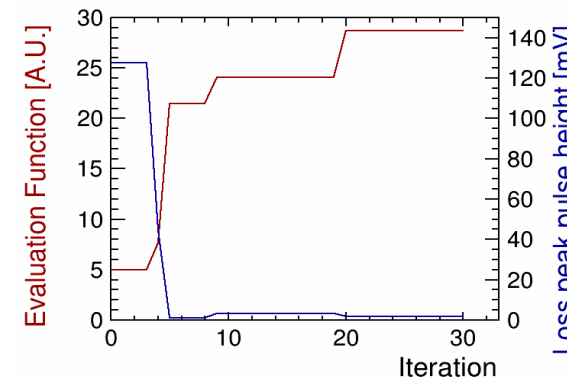
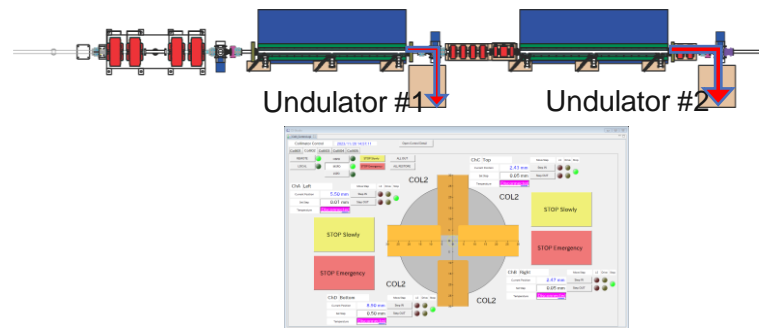


## 1) ~1mA (952μA) CW operation was successfully demonstrated

- With undulators & energy recovery without beam loss by using collimator and loss monitor

## 2) Machine learning for 1mA operation

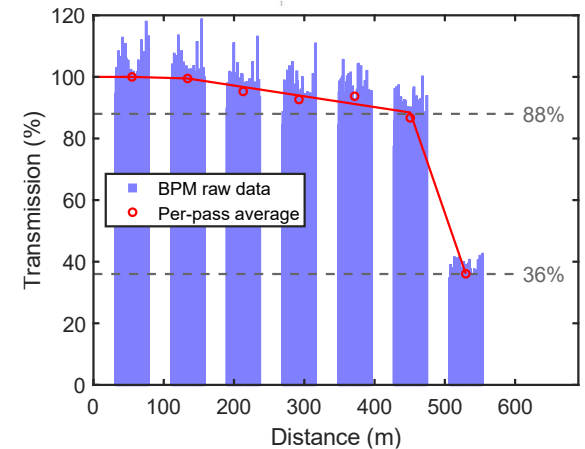
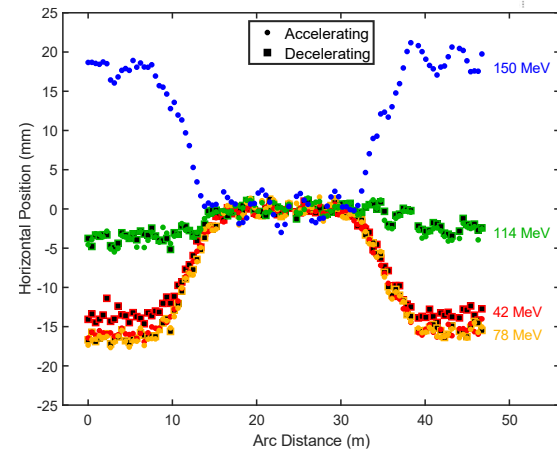
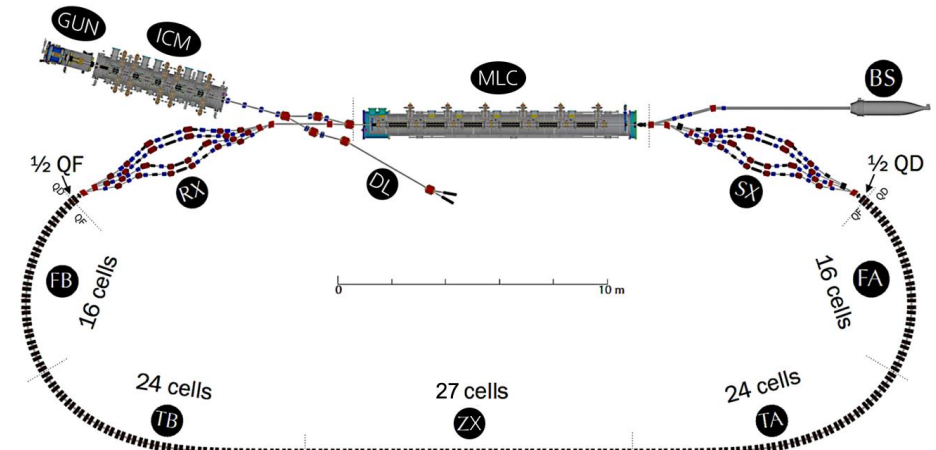
- For tuning QMs near the undulators
- For collimator tuning before accelerating of main cavity



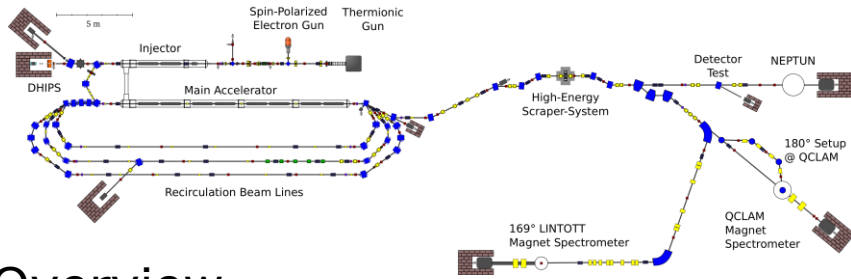
## 3) High bunch charge (60pC) beam ERL operation tried for FEL generation

# CBETA

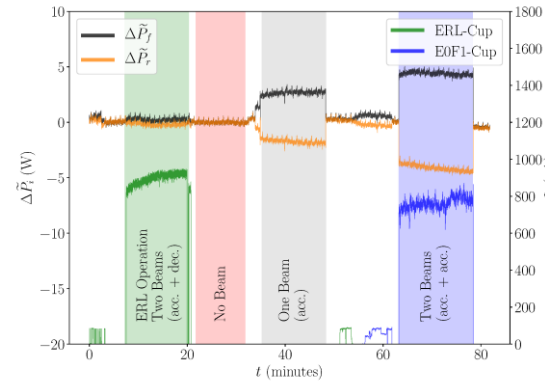
- Configurable to 4-pass, 150 MeV
- Permanent magnet FFA return loop
- 1-pass, reached 70  $\mu\text{A}$
- 4-pass at low current
- Challenges to overcome
  - Losses in 4-pass
  - RF stability
- Can run if funded



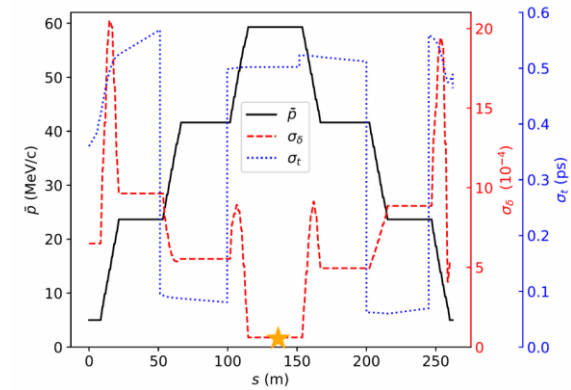
# S-DALINAC: TAKE HOME MESSAGE



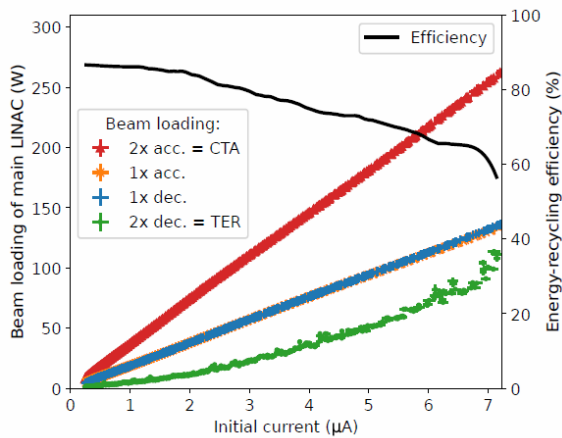
Overview



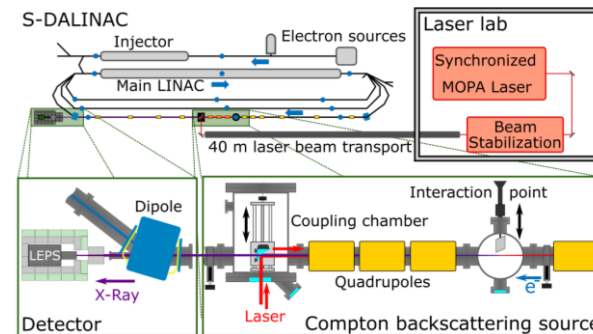
One-turn ERL operation



Three-turn ERL study



Two-turn ERL operation



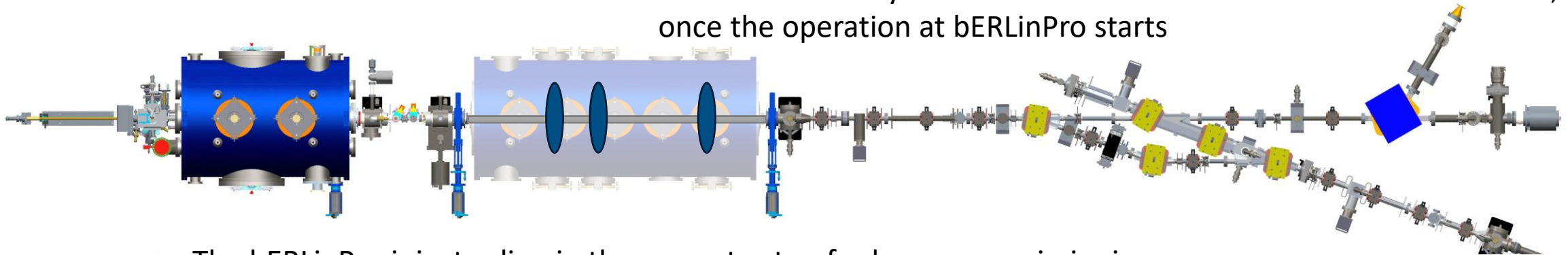
Experiment: Laser Compton Backscattering

# Current status of the bERLinPro facility



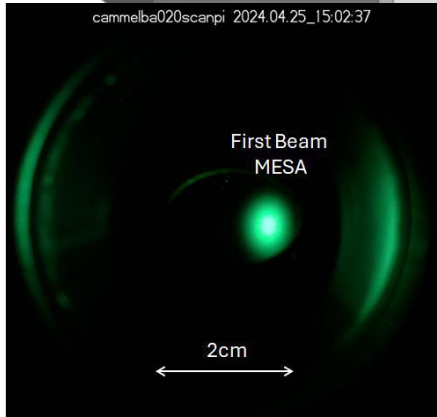
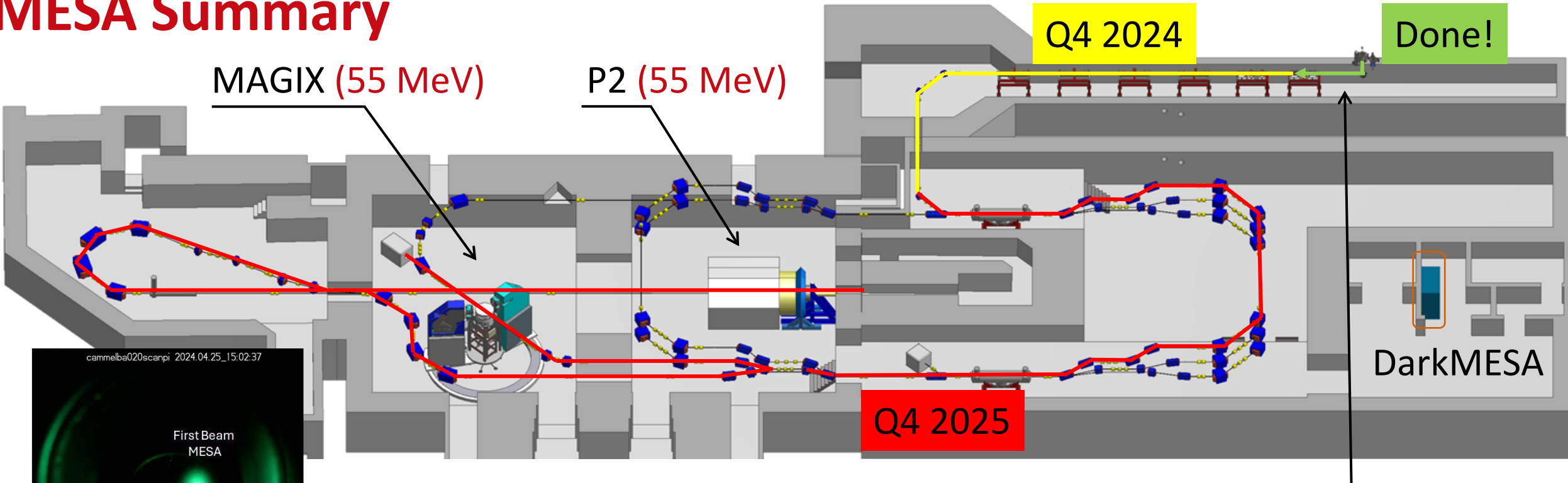
View from the injector line beam-dump towards the SRF photo-injector: Ready for beam commissioning

- Successful twice cooldown and follow-up RF test of the SRF photo-injector with field levels for beam energies  $\geq 2$  MeV and  $I_{\text{avg}} \leq 10$  mA given by the RF coupler power limit (Jan-May 2024)
- Finalization of all required components for the injector characterization and first beam operation, e.g. diagnostics, cathode laser, photo-cathode transfer system
- Awaiting permit for beam operation starting from about mid of October 2024
- Work on assembly of Booster has started and will come to full force, once the operation at bERLinPro starts



The bERLinPro injector line in the current setup for beam commissioning

# MESA Summary

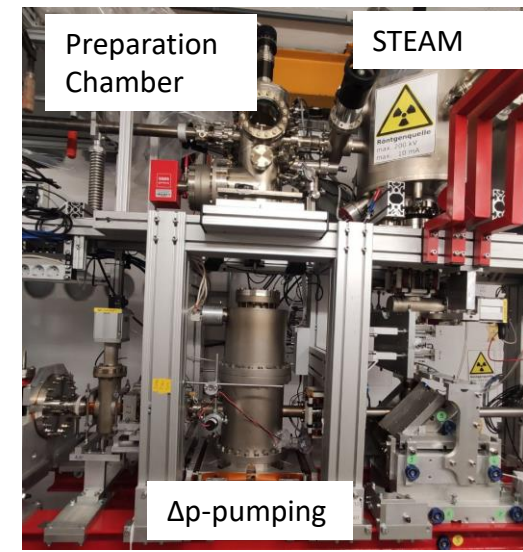


## Achievements:

- First Beam! (100 keV)
- Most parts delivered/in delivery
- LINAC + Spin manipulation installed

## Challenges:

- Cool down Cryomodules
- RF and system control
- Experimental Set-ups

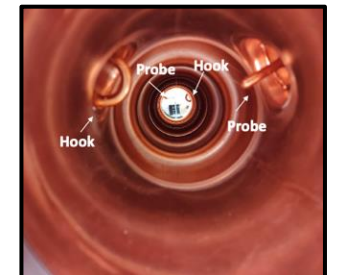
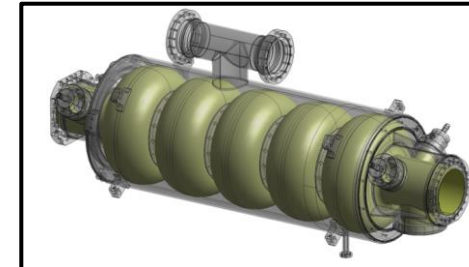
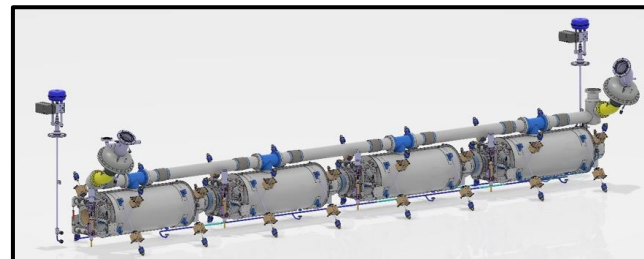
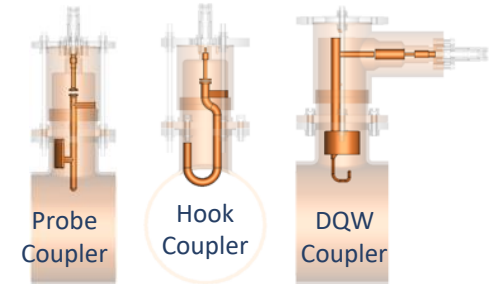
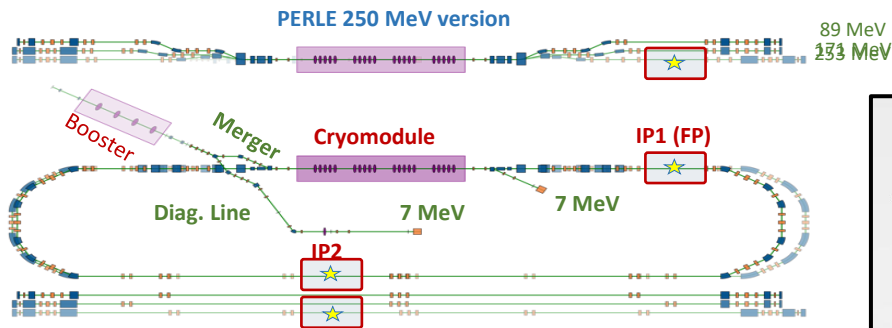
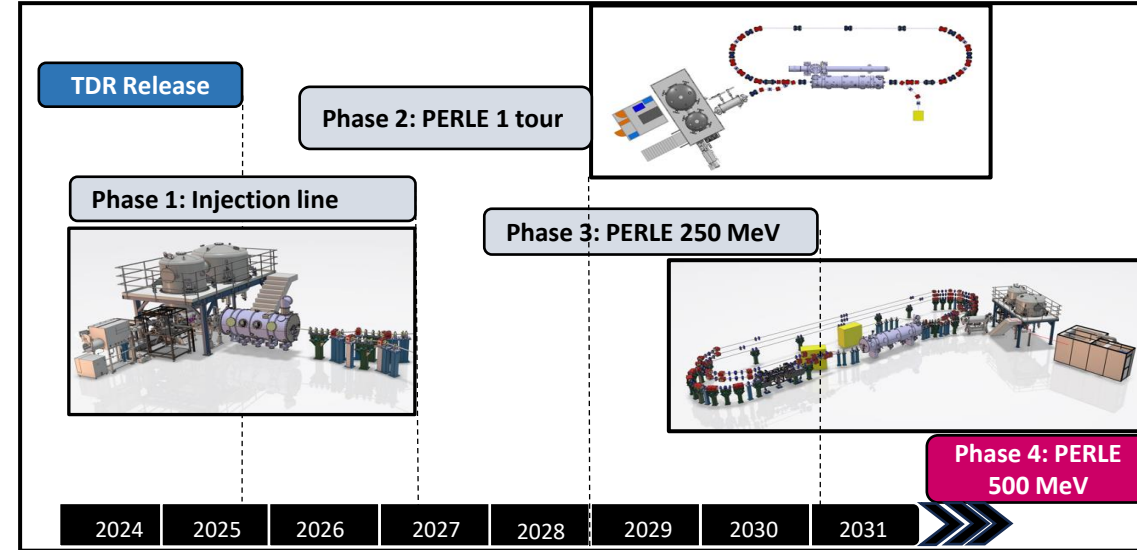




# PERLE Status and Plans :

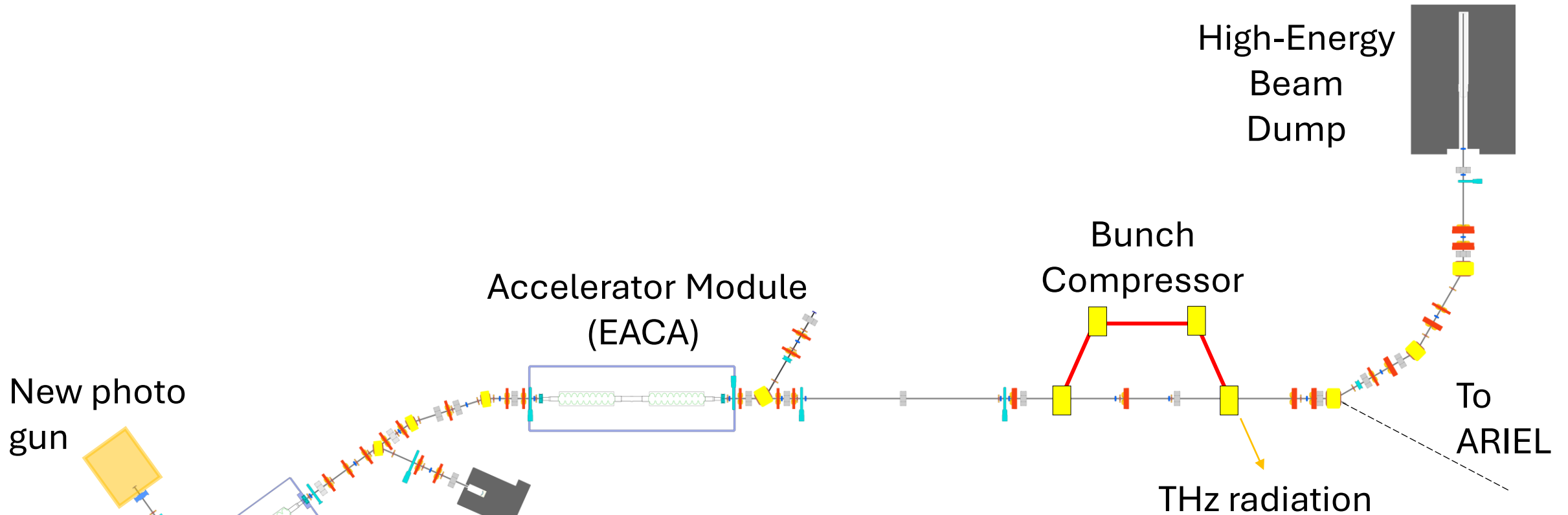
Walid Kaabi

- Important progress on design phase, **PERLE TDR release is foreseen on fall 2025.**
- **Staging approach adopted to build PERLE** in respect to available funds & in-kind contributions. **More funds are needed for the complete program.**
- **DC-gun + photocathode+ preparation chamber** acquired from RI within a **Collaboration Agreement.**
- Construction of the **LINAC cryomodule** is supported by the **European Program iSAS** (with IN2P3 matching funds + CM vessel from ESS).
- **Funds obtained within RI2 national program (CNRS).** it secure **the full injection line and a part of a first tour equipment construction.**





# Progress on Terahertz Light Production at TRIUMF e-Linac

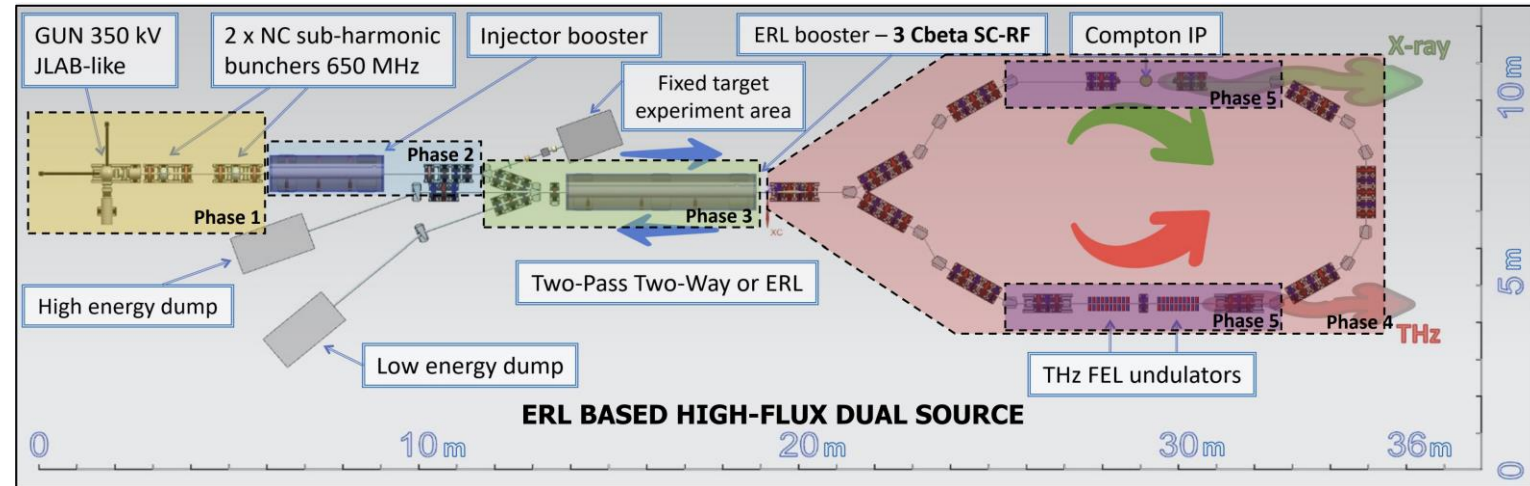


## Strategies:

- **Current stage:** Demonstrate the production of THz light with current e-Linac setup by optimizing the RF phase of injector and buncher to minimize the longitudinal beam size.
- **Next stage:** Installation of a bunch compressor to gain experience with tuning the accelerator for bunch compression and test various schemes of THz generation.
- **Later stages:** Installation of a high-brightness photo-gun perpendicular to current low-energy beamline to produce ~picoseconds pulsed beams with energy 500 keV or above.

# An ERL proposed facility at INFN -LASA Laboratory

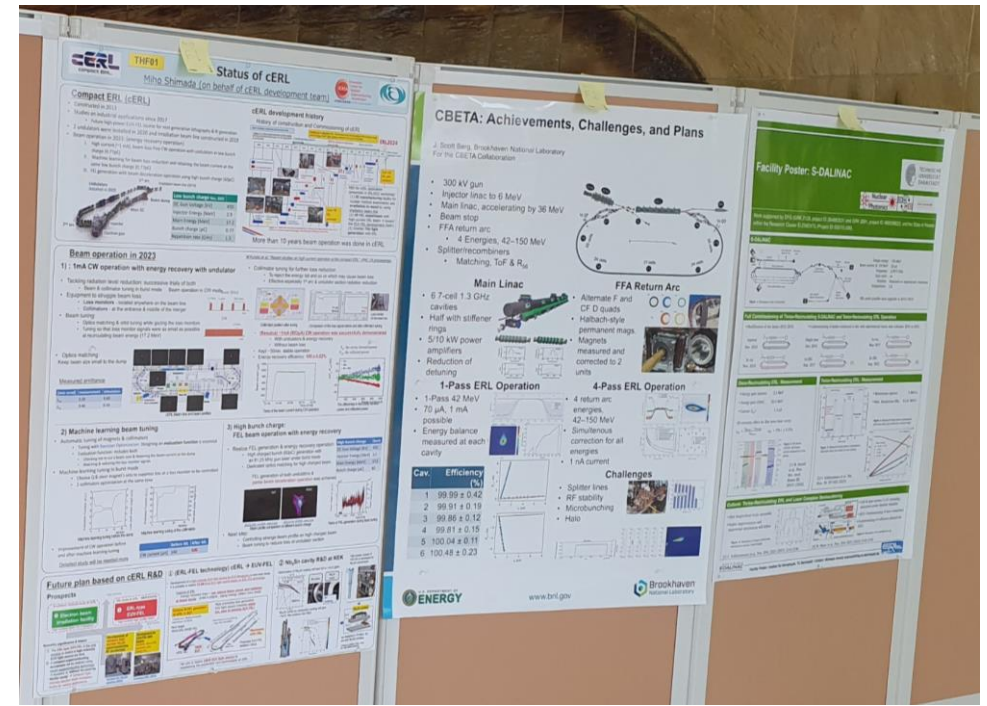
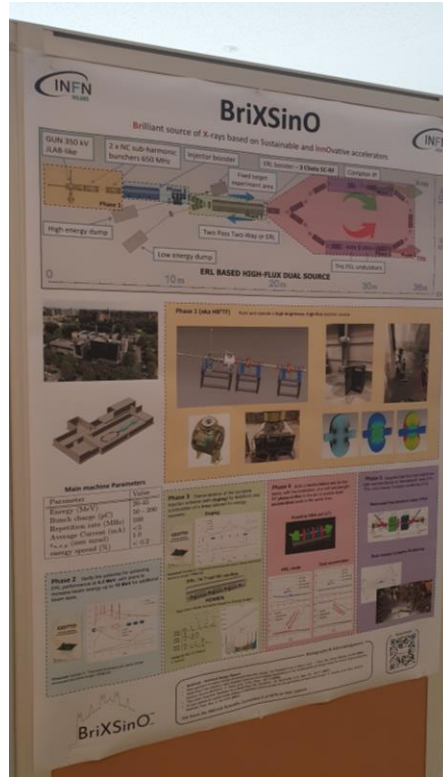
Parameter	Value
Energy (MeV)	20-45
Bunch charge (pC)	50 - 200
Repetition rate (MHz)	100
Average Current (mA)	<5
$\epsilon_{n,x,y}$ (mm mrad)	1.0
energy spread (%)	< 0.2



- A “newly” conceived scheme of ERL with **counter propagating beams** is proposed in BriXSinO.
- This **scheme allows** to explore not only the **ERL operation** but also the **two-pass operation** where the beam is reaccelerated when reinjected in the accelerating module at reduced current.
- A further operation mode for BriXSinO is the use of its **injector for fixed target experiments** performed with maximum electron energy of 10 MeV and 5 mA average current.  
This high intensity beam enables both **experiments of flash therapy** (total charge in a 200 ms time interval up to 1 mC), as well as converting the electron beam into **bremstrahlung photons with energy peaked at 7 - 8 MeV at an impressive flux of  $10^{16}$  photons/s** (i.e. up to 30 kW X-Ray beam).
- Also experiments of **positronium generation** for fundamental studies of matter-antimatter asymmetry can be conducted at this test station.

- ✓ In September 2022, the first part of the accelerator, a **High Voltage photoinjector DC operated** followed by a couple of room temperature cavities, has been partly funded by INFN under the supervision of the **CSN5 Committee (HB2TF project)**.
- ✓ In October 2022, an additional funding was granted by INFN to complement an allocation made in 2021 for establishing **a dedicated test stand for BriXSinO laser related research**. Within this R&D, we obtained a maximum power of 30 kW in air in the Fabry-Perot prototype cavity.
- ✓ In March 2023, a **revised version of the original Technical Design Report** of BriXSinO has been discussed by the proposers and the INFN Milano Director with the INFN Executive Council, the chair of the INFN MAC and the INFN-Accelerator committee.
- ✓ As part of the PNRR-IRIS program and with a significant INFN specific contribution, in 2024, **the construction of two laboratories will begin within the LASA premises: SML (Superconducting Magnet Laboratory) and AATF (Advanced Accelerator Test Facility)** for a total of 2100 m<sup>2</sup> spread over an underground bunker and two external floors.
- ✓ In July 2023, a **Horizon Europe application** named “Innovate for Sustainable Accelerating Systems with Energy Recovery” (**iSAS**) has been approved and a specific item is the development of an **innovative RF power coupler** for the superconductive linac foreseen in BriXSinO.
- ✓ **In 2025 the assembly of all the components of the photoinjector along with the first buncher cavity will be assembled and tested**

# Facility Poster



# Facility Overview List

The image shows a large, detailed spreadsheet titled "Facility Overview List" mounted on a wall. The spreadsheet is organized into multiple columns and rows, containing a vast amount of data. The columns include facility names, dates, and various numerical values, likely representing performance metrics or operational data. The text is too small to read clearly, but the structure is that of a comprehensive data table. The spreadsheet is mounted on a wall with a wood-grain pattern.

- Please check your facility
- Send your updates to us
  - BriXSino update on the way

Thanks to all contributions and discussions!

