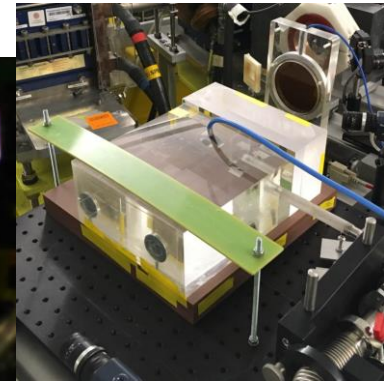
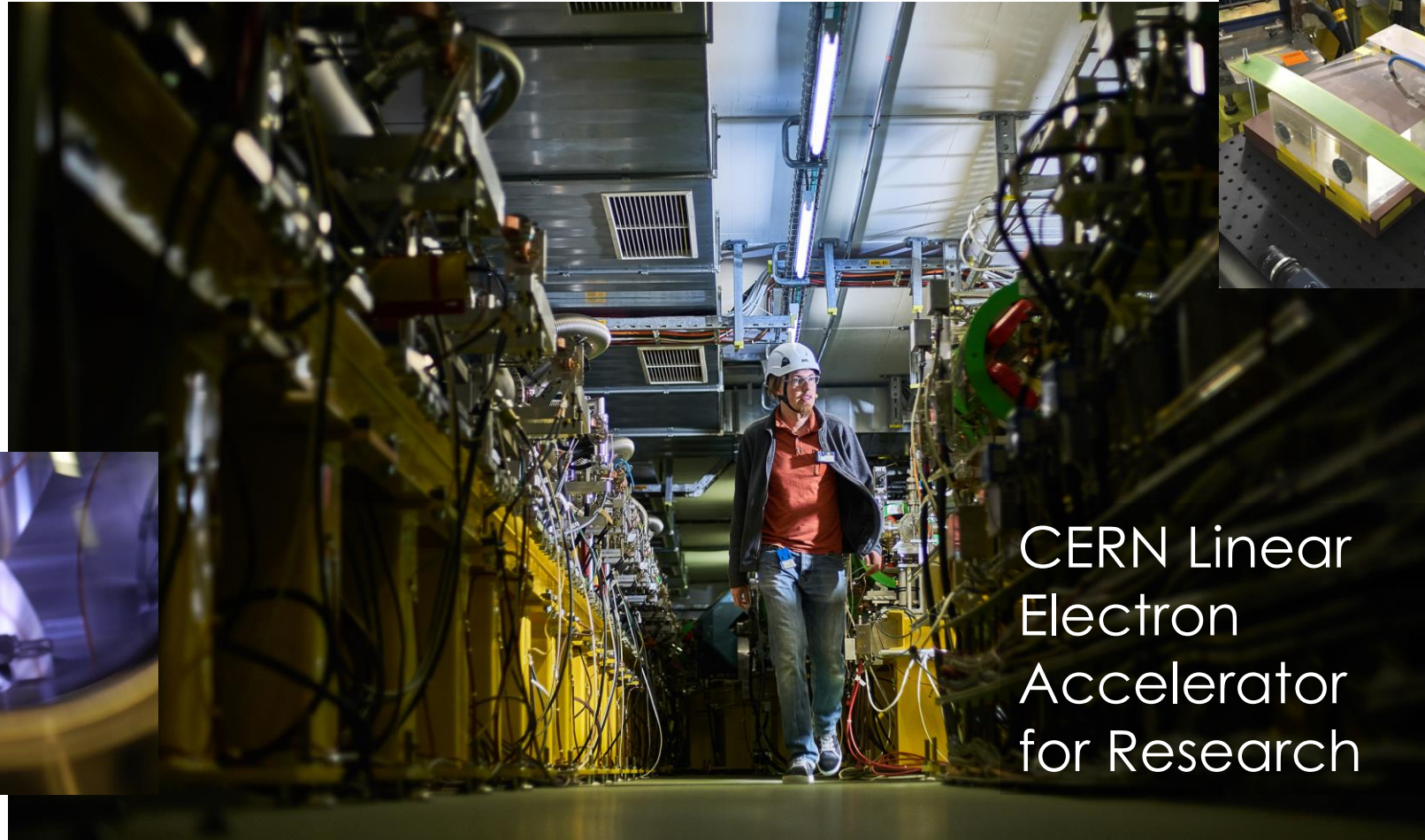
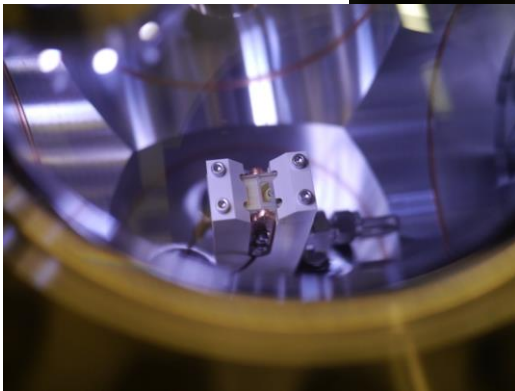


Overview of CLEAR activities and outlook

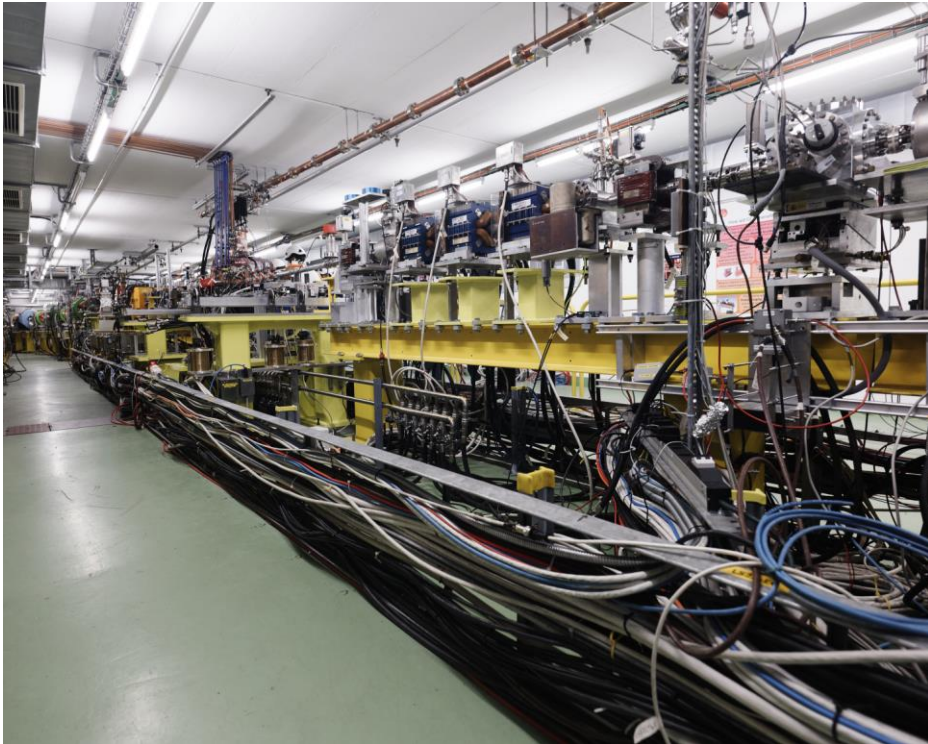
R. Corsini

for the CLEAR Team

A. Aksoy, J. Bateman, A. Chauchet,
S. Curt, S. Doebert, W. Farabolini,
D. Gamba, E. Granados, P. Korysko,
A. Malyzhenkov, M. Martinez Calderon,
V. Rieker, C. Robertson, K. Sjobaek,
L. Wroe



CERN Linear
Electron
Accelerator
for Research



CLEAR is a versatile 200 MeV electron linac + a 20 m experimental beamline, operated at CERN as a multi-purpose user facility.

Scientific and strategic goals:

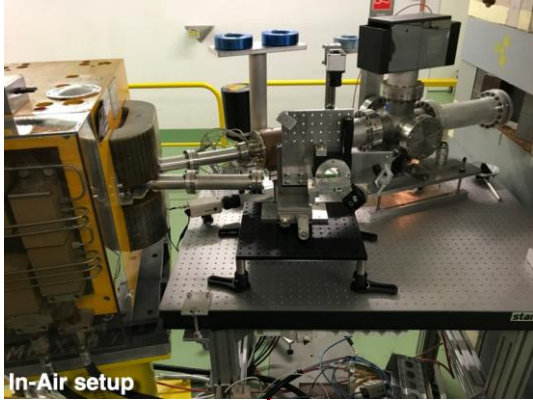
- Providing a test facility at CERN with high **availability**, easy **access** and **high quality e- beams**.
 - Performing **R&D** on **accelerator components**, including **beam instrumentation** prototyping and **high gradient RF** technology
 - Providing an **irradiation facility** with high-energy electrons, e.g. for testing electronic components in collaboration with **ESA** or for medical purposes (**VHEE/FLASH**)
 - Performing **R&D** on **novel accelerating techniques** – electron driven **plasma** and **THz** acceleration.
- Maintaining CERN and European **expertise for electron linacs** linked to future collider studies
- Using CLEAR as a **training** infrastructure for the next generation of accelerator scientists and engineers.

- CLEAR was initially approved as a **2 + 2 years program**, operating since **August 2017**.
- CERN reviews were held in **2019** and **2021** to confirm and further extend its operation.
- CLEAR is a standalone installation, running also during Long Shutdowns. In a typical year **30-40 weeks** of beam operation are provided, between March and December.
- The operation team comprises on average **1 staff, 1 fellow and 1 associate**, plus contributions of some students and part-time associates. A total of about **3 staff FTE/year** is allocated to the facility, including technical support.
- The CLEAR **material budget** is of the order of **800 kCHF/year** (including M to P)
- CLEAR operation is currently approved **until end 2025**.
- A CLEAR **budget line** (M+P) is present in the current MTP **beyond 2025**.
- A **review** is planned in **2024**, in order to approve (or not) its operation beyond 2025.

Draft MTP2023

Accelerator technologies and R&D	Total 2023-2028 M+P [MCHF]
RF technologies R&D	55.2
High-field superconducting accelerator magnets R&D	136.3
Proton-driven plasma wakefield acceleration (AWAKE)	33.5
CERN Linear Electron Accelerator for Research (CLEAR)	9.2
Other accelerator R&D	18.9

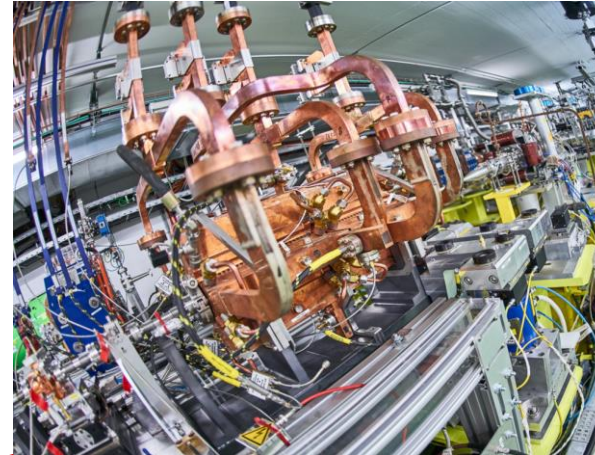
M. Lamont, 329th IEFC meeting



In-air test stand

Testing ground for beam diagnostics R&D and THz radiation studies

Irradiation for medical and other applications

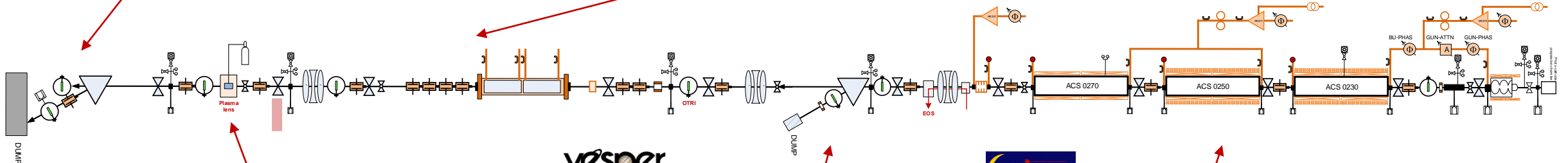


Former CLIC Test-Stand

(High-gradient and linear colliders R&D)

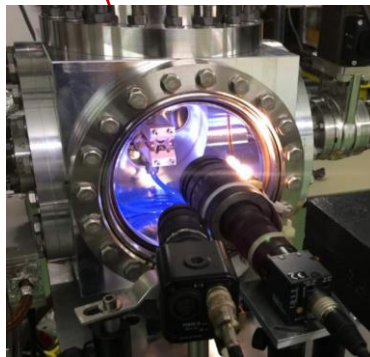


Now mainly used for Beam Instrumentation tests



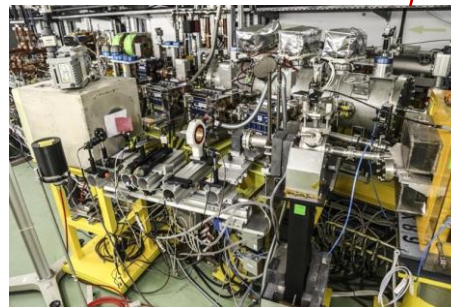
The Plasma Lens Experiment

Novel concepts of plasma-based focusing and acceleration



VESPER

Beam irradiation facility for studies on radiation damage of electronics and medical applications



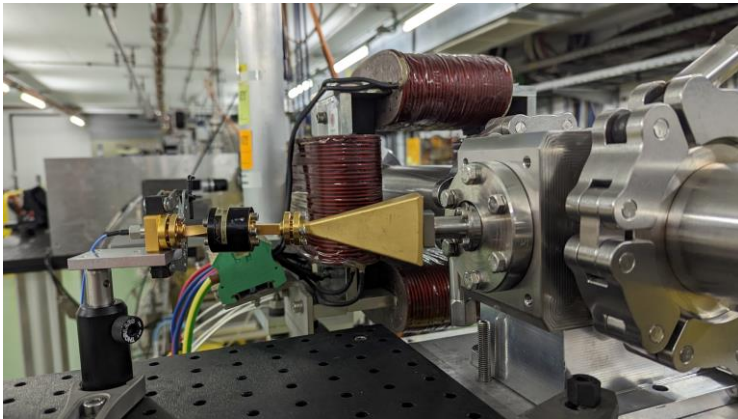
CALITES electron linac

Flexible accelerator providing 200 MeV electron beams to all CLEAR users

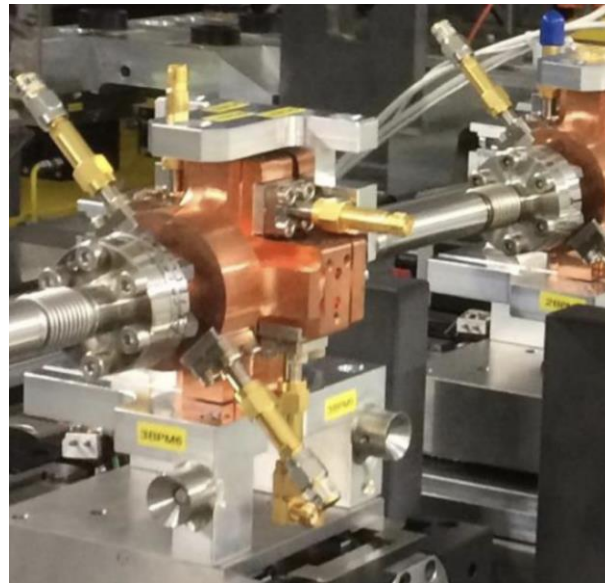


- 27 Experiments
- About 18 User Groups internal/external
- More than 13 external collaborating institutes
- Beam from February 27th to December 15th (with 3 weeks summer stop)
- 39 weeks of operation in total

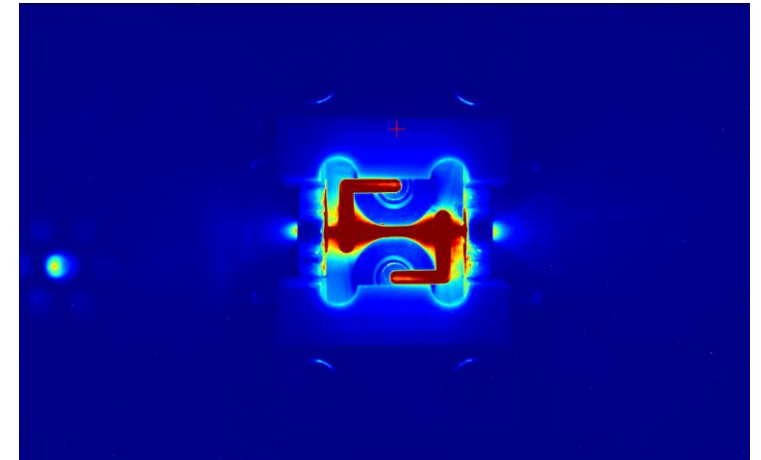
A few Highlights:



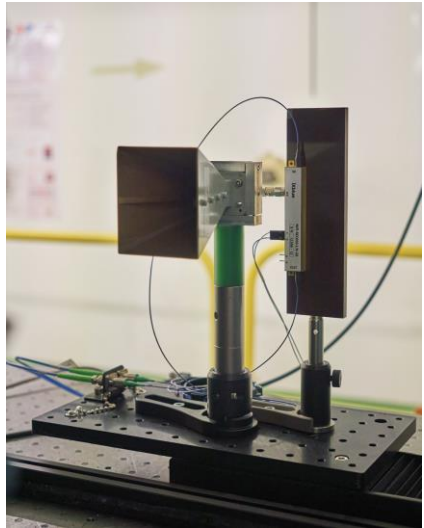
AWAKE Cherenkov Diffraction
Radiation BPM (CERN/BI)



High-resolution CLIC cavity
BPMs (CERN/BI, RHUL)

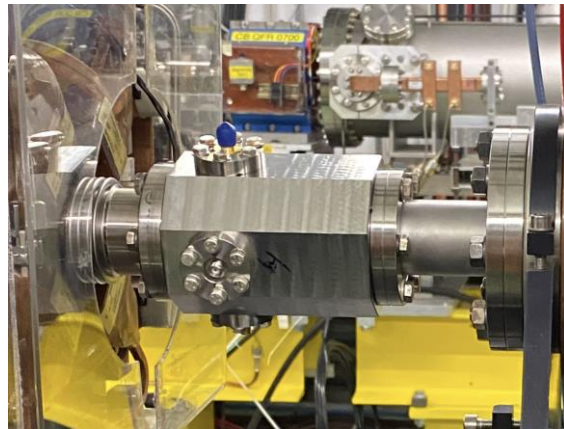
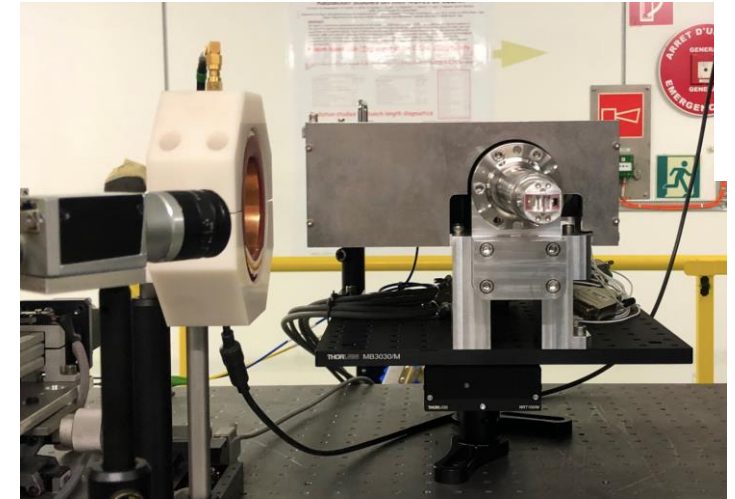


Plasma lens defocusing tests
(Oslo U./CERN/Oxford U./DESY)

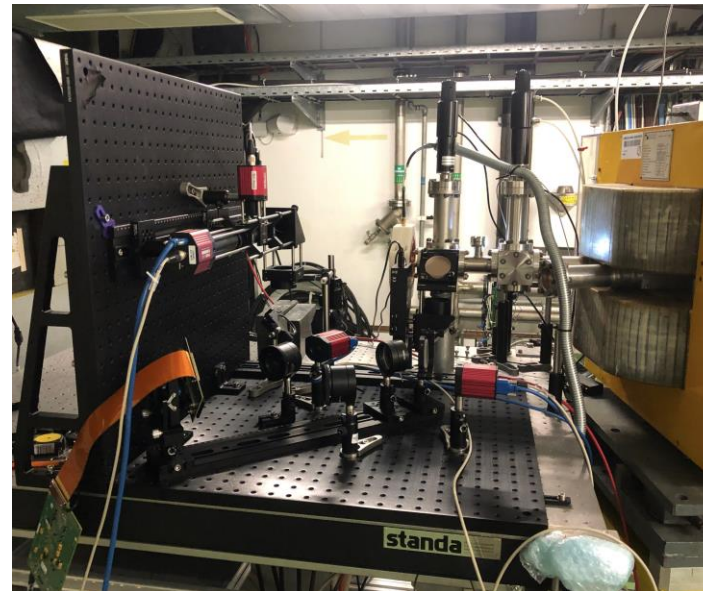


Coherent Cherenkov diffraction radiation dielectric buttons
FCC-ee bunch length monitors
(CERN/BI)

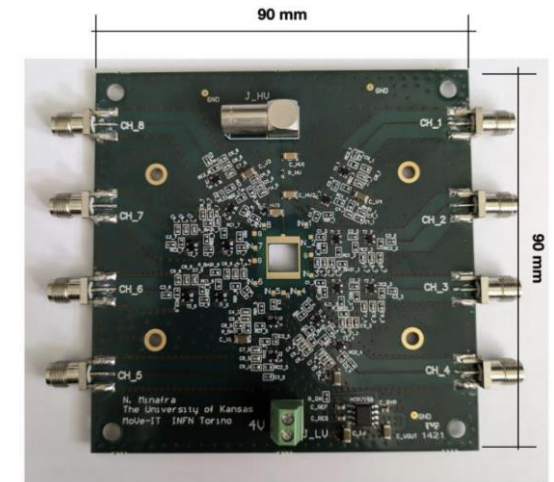
Bunch Profile Monitor
for FCC-ee (Karlsruhe)



Broadband Pick-up for the
Positron Production Project –
FCC-ee collaboration (PSI)

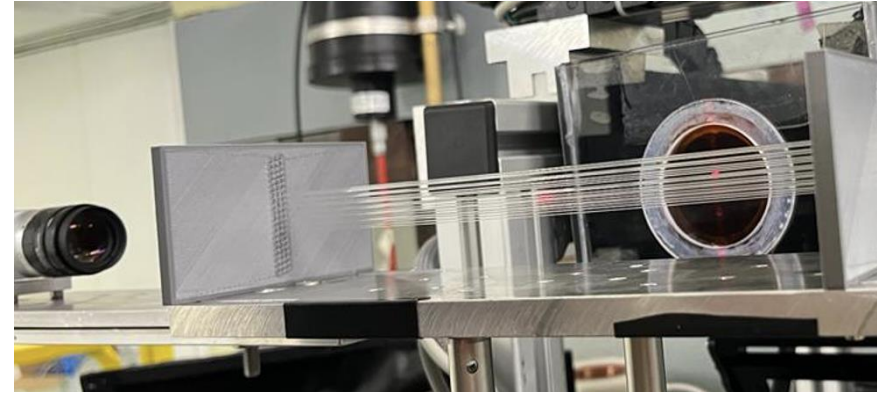
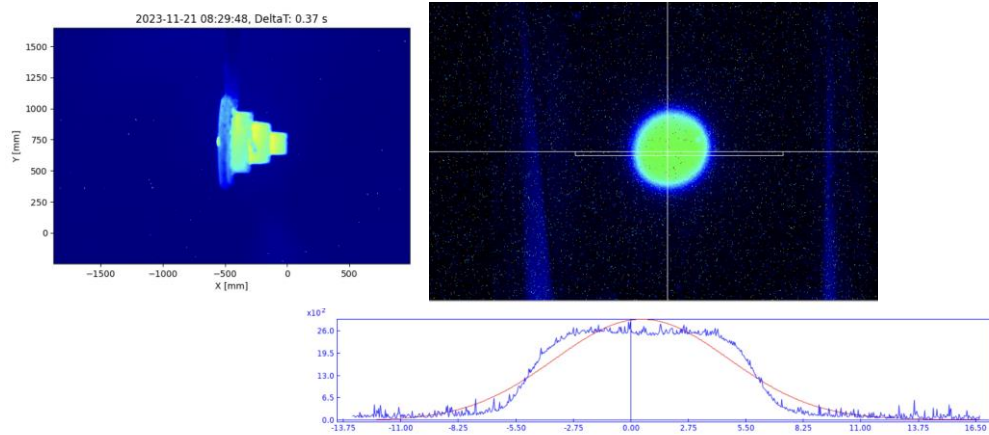


Novel OTR-based emittance meas.
system for AWAKE (Liverpool U.)



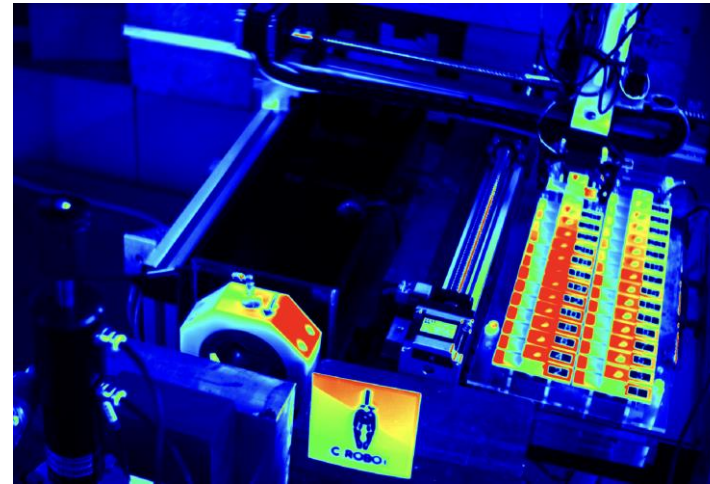
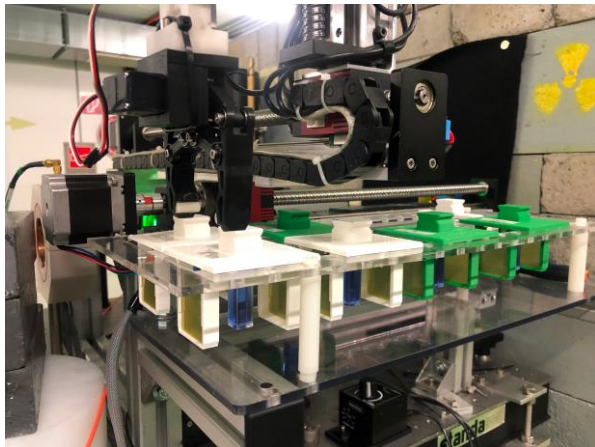
Beam testing of PCB +
detectors using different
technologies (Kansas U.)

Double-scattering system for uniform beam delivery for VHEE radiotherapy (CERN, Oxford U.)

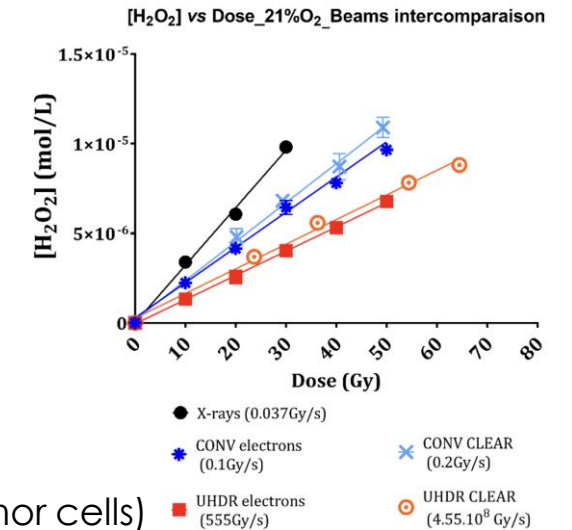


Fibre-optic beam profile and dose monitor for VHEE radiotherapy at ultra-high dose rates (CERN/BI, Oxford U.)

Real-time dosimetry for VHEE radiotherapy using cuvettes (Strathclyde U.)



Chemistry and biology (plasmids, zebra fish eggs, healthy/tumor cells) irradiation studies for VHEE/FLASH (CERN, CHUV, HUG, Manchester U.)



Following discussions with CERN the management we will request in **spring 2024** a **CERN internal review** on the potential extension of CLEAR operation beyond 2025.

- Review date: **April 2024**.
- Aim: extend operation for a period of about **5 years**.
- Format: similar to the last one, held in 2021 (<https://indico.cern.ch/event/1015632/>)
- In preparation of the review, the next meeting of the **CLEAR Scientific Board** (to be held in February 2024) will have the specific mandate to assess the **scientific case** for an extension.

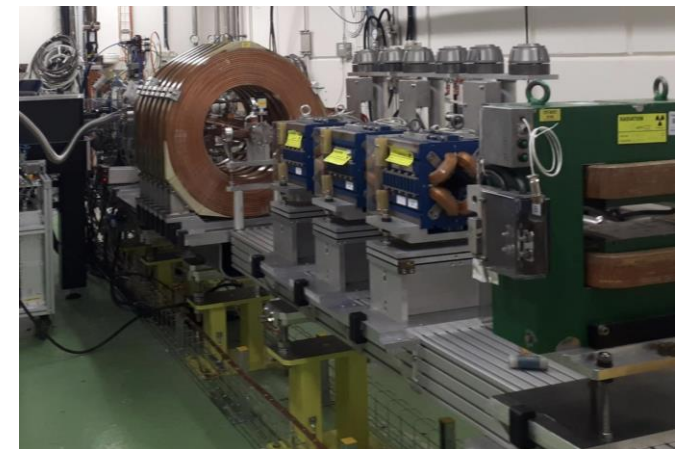
A **decision in mid 2024** would allow to better organize and possibly anticipate the long-term consolidation of the infrastructure (substitution of obsolete material, restock of spares), as well as to prepare the manpower plan.

No major upgrades to the infrastructure are foreseen in case of long-term approval, but rather a continuation of the present operation with a similar resource envelope.

At present the potential improvements/upgrades considered are:

Ongoing

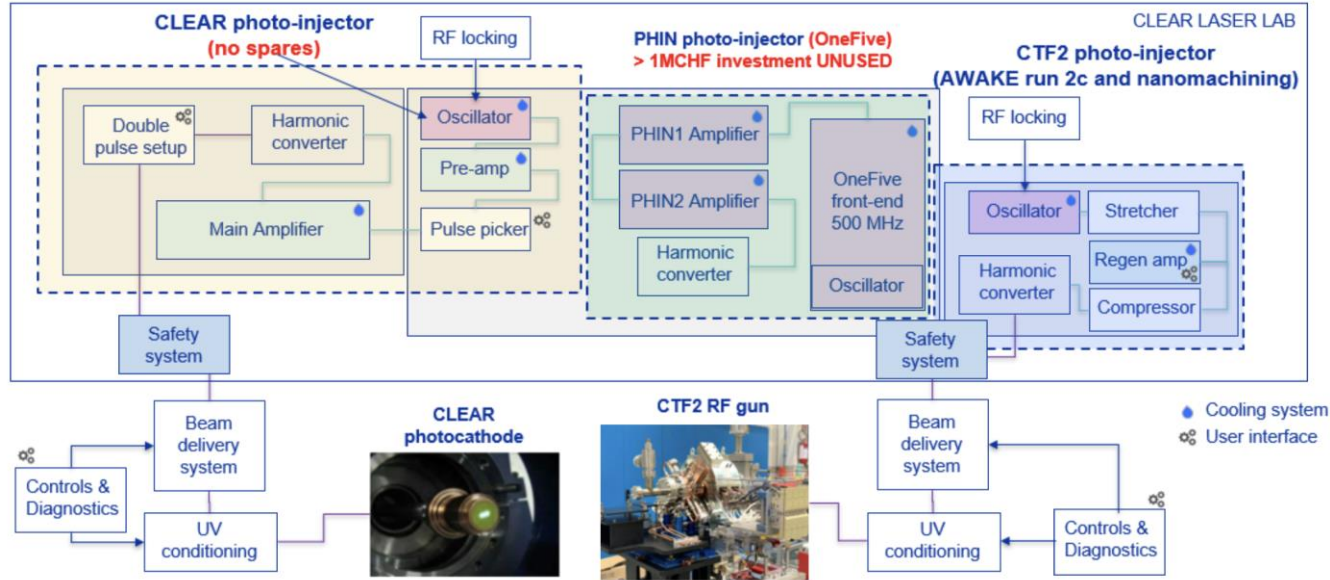
- Improve the present laser system with a new front-end, for added reliability and flexibility. Also this activity should be possible with existing resources and may be completed within 2024, being available for operation in 2025.
- Re-adapt and use part of the old TBL beam line in CLEX, to provide additional test areas to users - this is short-term, relatively limited and we should be able to complete it using the existing resources within 2024 including commissioning, for operation in 2025 and possibly beyond.
- Put in operation for users the new electron source jointly developed by CLIC/AWAKE/CLEAR and being commissioned now in CTF2 - without moving it to the CLEX area. User operation is possible after the source commissioning is completed and before its installation in AWAKE. This last upgrade is optional, most likely happening mainly beyond 2025, and depends on the actual timelines and on the potential user interest. It will also require some (limited) additional resources, particularly in manpower.



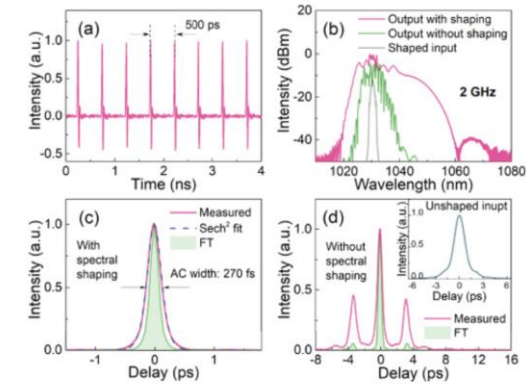
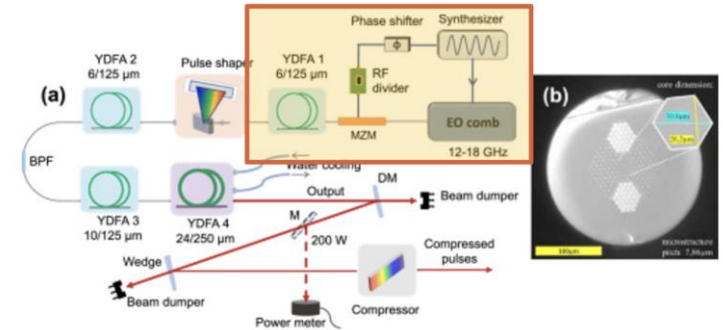
S. Doebert

- In the past 1-2 years, a **campaign** was carried out to **consolidate equipment** and ensure we have enough spares at least **until end 2025**. In particular, the situation for the most expensive items (e.g., klystrons) is now OK, with some small margin.
- A proposal to further consolidate (and improve) the laser system has been recently discussed. This requires about **100 kCHF** over **2023-2024** (see also later slide).
- Beyond 2025, several systems may need further consolidation (e.g., obsolete electronics/controls) – a **full evaluation** of the needs and a costing will be prepared for the review in **spring 2024**.

Laser systems at CLEAR – current status



E. Granados, B. Marsh



CLEAR laser points of failure:

- Ageing oscillator – could be replaced by OneFive system but operating at 500 MHz
- Laser sub-systems often fail and require replacements and spares (chillers, pulse-picker power supplies, laser diodes, laser power supplies, optical elements and motors)

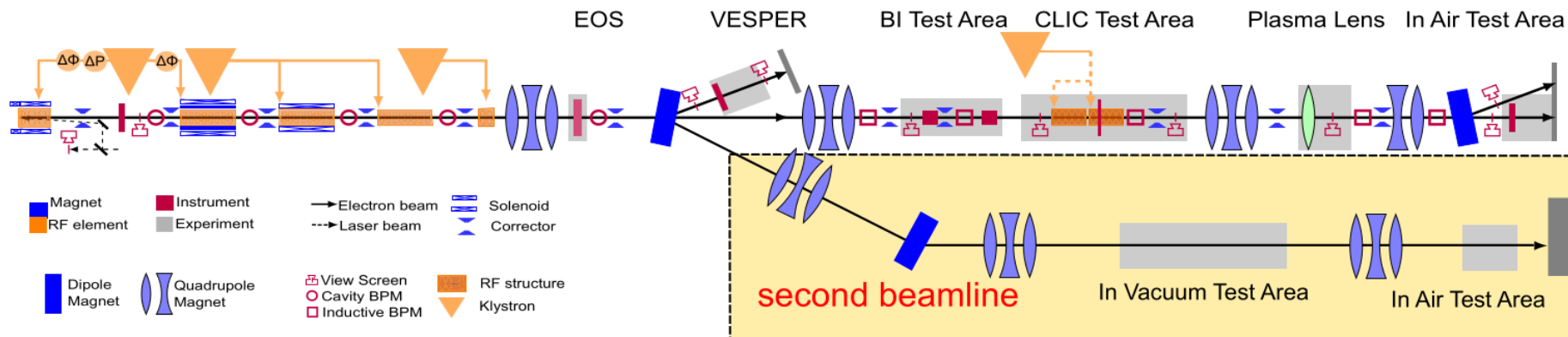


New EO comb front-end

- Enhance significantly CLEAR performances (stability, time structure flexibility, high rep-rate)
- ~ 100 kCHF program over 2 years
- System should be ready at end 2024

Motivations

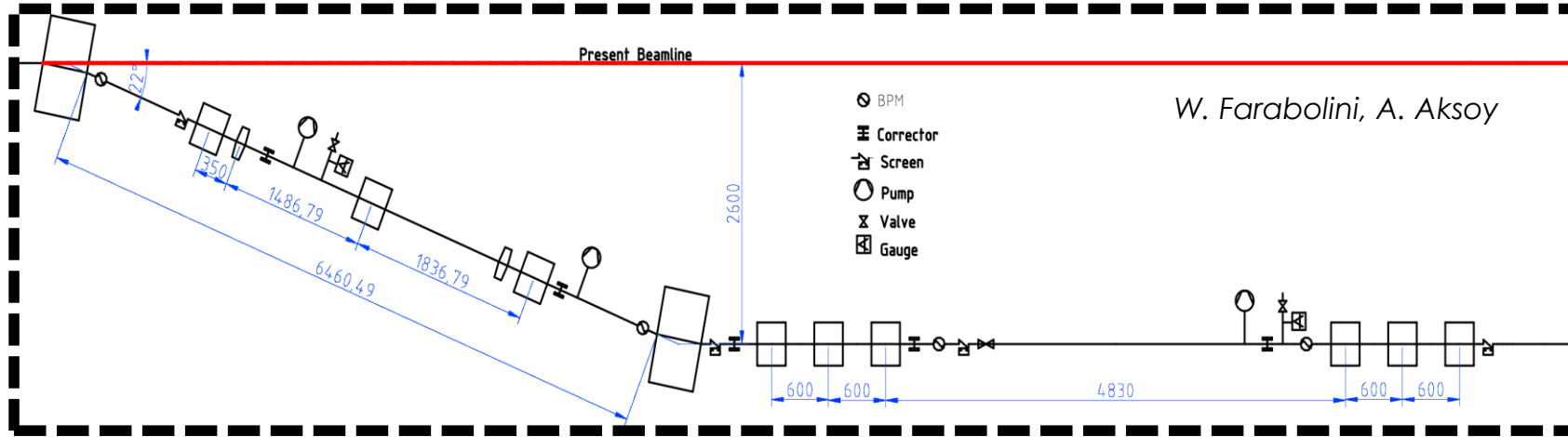
- Create **more in-air and in-vacuum locations** for experiments – avoid repeated mounting/dismounting of experiments and diagnostics equipment, hence **more beam time**
- Added **operational flexibility** – allow for “non compatible” experiments to be performed in the same week or day, with fast turnaround time
- Expand beam parameter space, e.g., **large beam sizes** and **strong focusing**



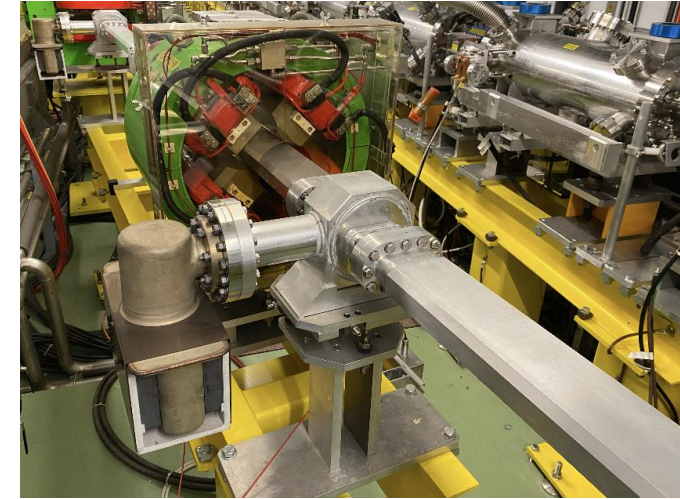
L. Dyks,
W. Farabolini,
A. Aksoy

- Converged on a **simple achromat** solution, branching off at VESPER, angle ~ 25 deg
- Preserve bunch length or allow for moderate compression (**sub-ps bunches** as a requirement)
- Re-use CTF3 dipole and quads + existing power supplies, vacuum components...

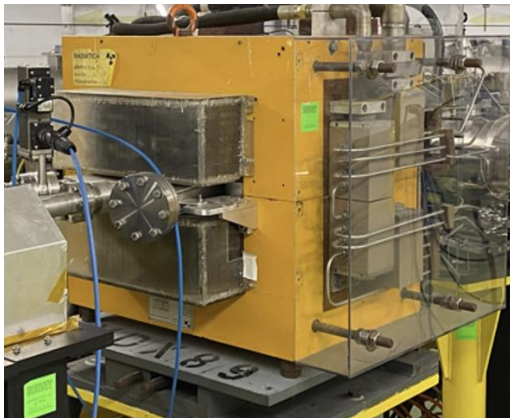
New design, with reduced hardware and re-use of existing components



The line location in former TBL allows for easy connection to installed services (cooling water, compressed air,...) no new power cables are needed, and several HV and signal cables will be re-used



Most vacuum chambers and components from former drive beam chicane and TBL in CLEX, including pumping ports, bellows, pumps, vacuum valves, ...



All magnets and power supplies from dismissed beam lines in CLEX and CTF3



Preliminary cost evaluation ~ 160 kCHF

- 42 kCHF are available from EURO-LABS funds
- Fund the rest from CLEAR operational budget in the period 2023 – 2024
- This is possible due to: 1) main consolidation/spares items until 2025 already covered, and 2) additional contributions to manpower (M to P) from external sources (DEFT, KT-CIPEA, Oxford University)

Goal: at least one full year of operation before potential CLEAR extension

- Aiming at installation of most components during YETS 2023-2024
- Further window to complete installation: July-August 2024
- Commissioning at the latest in 2nd half 2024
- Start of operation for users beginning 2025

EURO-LABS CERN Transnational Access



CERN participates in the EURO-LABS project offering Trans-National Access (TNA) to 9 facilities covering the full spectrum of physics of the Laboratory.

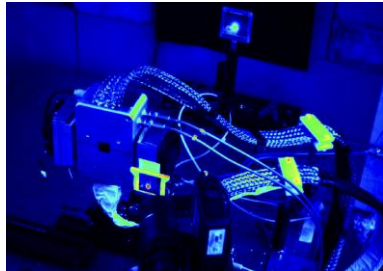
The Euro-Labs project provides support for transnational access to a network of 47 Research Infrastructures (including 3 RIs with Virtual Access) from 18 countries.

Interested research groups are encouraged to identify the facility most appropriate for their needs and to check their eligibility before applying.

EURO-LABS Offers

- Reimbursement of travel and accomodation costs for using the facilities at the Research Infrastructures
- Technical Support and expertise at the laboratories hosting the RI

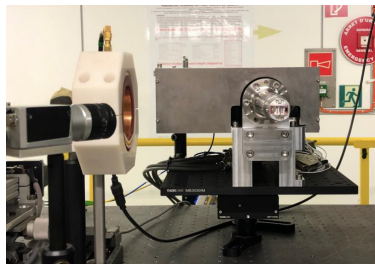
- Four experiment approved for EURO-LABS support in 2023
- Total of 6 weeks of beamline access



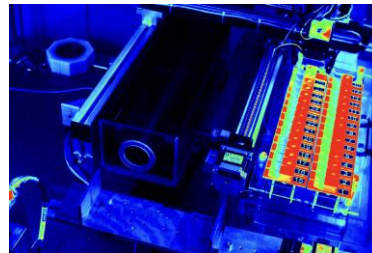
LUXE



LUCID



Bunch Profile Monitor for FCC-ee



Fibre-optic Monitor for UHDR Real-time Dosimetry

Training courses for students being organized

Applied to **FLAMINGLO** EU doctoral network proposal

If approved, funding of two PhD projects in CLEAR for VHEE/FLASH Radiotherapy studies

CLEAR operation restarts on **4th March 2024**.

A **CLEAR Scientific Board** meeting will take place in **February**, in order to assess the 2024 scientific program as usual, and with a **special mandate** to assess and make recommendations on a potential scientific program **beyond 2025**.

The CLEAR Review should then take place in **April** and it will cover the following aspects:

- Status of the facility and results obtained.
- Outcome and recommendations of the CLEAR Scientific Board
- Ongoing studies and prospects and expected user requirements in the next 5 years.
- Consolidation requirements, mode of operation and required resources in the next 5 years.

*Thanks for
your attention*

