

# STATUS OF THE CLEAR

W. Farabolini

E. Adli, R. Corsini, S. Curt, S. Doebert, D. Gamba, C. A. Lindstrøm,  
G. McMonagle, K. N. Sjobaek, P. Skowronski, F. Tecker

CTF3 scientific program completed as planned in December 2016

*What to do with CTF3 hardware & building?*



Interest in CALIFES



## Expression of Interest for the future operation of the CALIFES linac

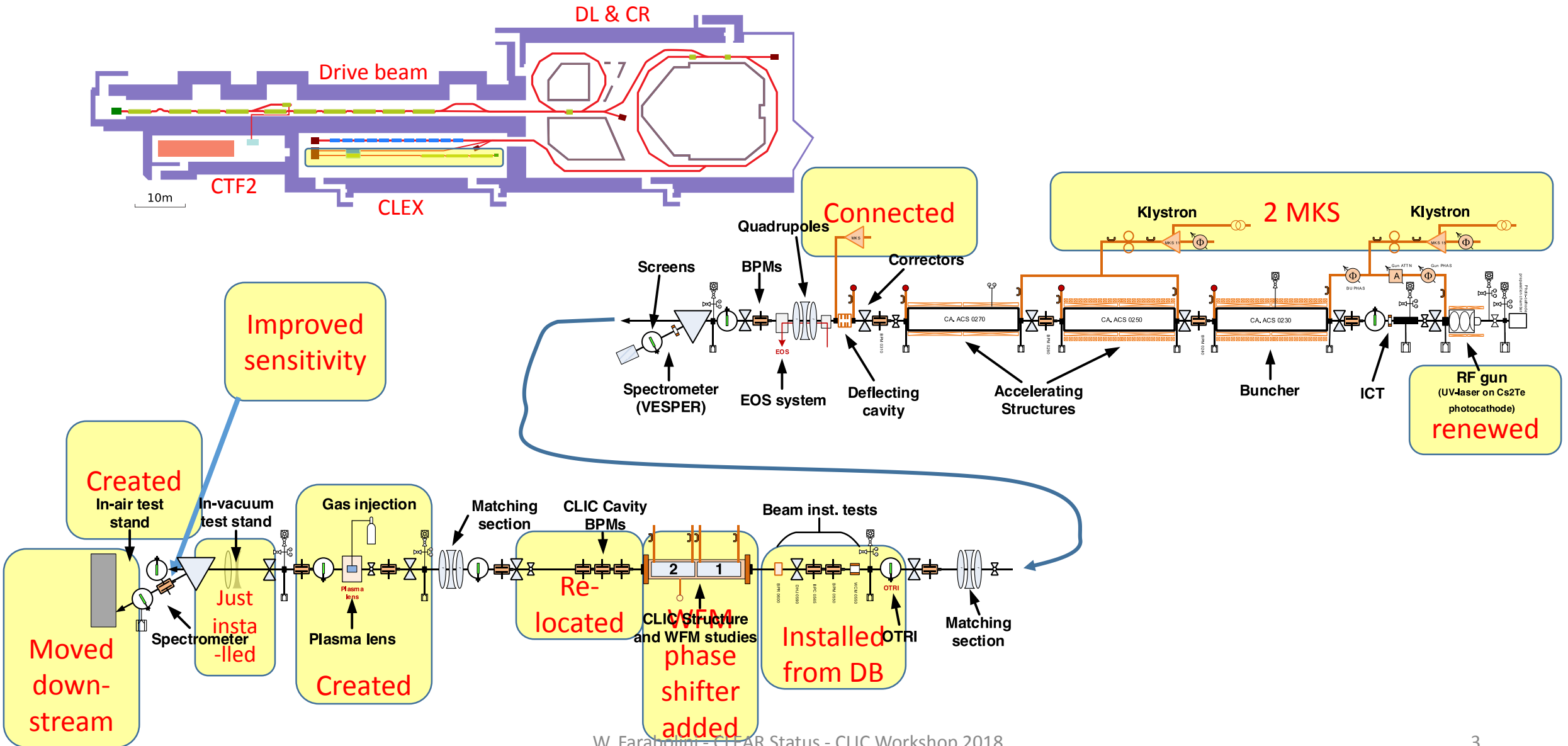
---

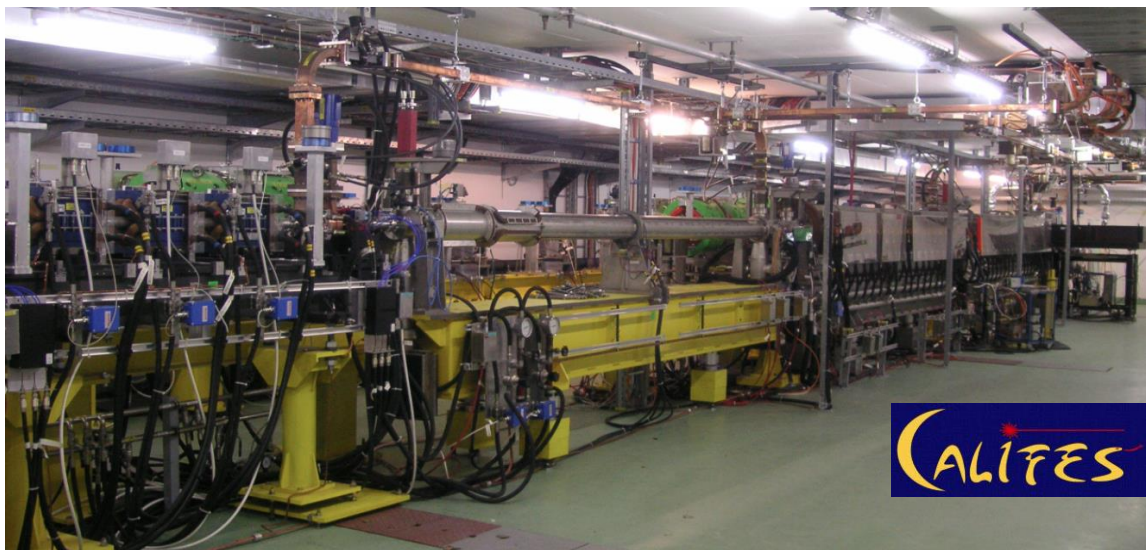
Prepared by: E.Adli (Univ. of Oslo), P.Burrows (Univ. of Oxford), R.Corsini (CERN), S. Stapnes (CERN)

### Abstract

In this document we propose to operate the CALIFES electron linac at CERN, presently used as the probe beam line of CTF3, as a stand-alone user facility from 2017 onwards when CTF3 is closed down. The possible uses include general accelerator R&D and studies relevant for existing and possible future machines at CERN, involving a potentially large external user community. The resources required are around 2 MCHF/year (M+P).

- Longer document send in February 2016  
[CALIFES\\_document.pdf](#)
- Positive statement by the CLIC Review Panel in March 2016
- **CALIFES Workshop**, October 2016
- Final proposal (**CLEAR**) and approval in December 2016





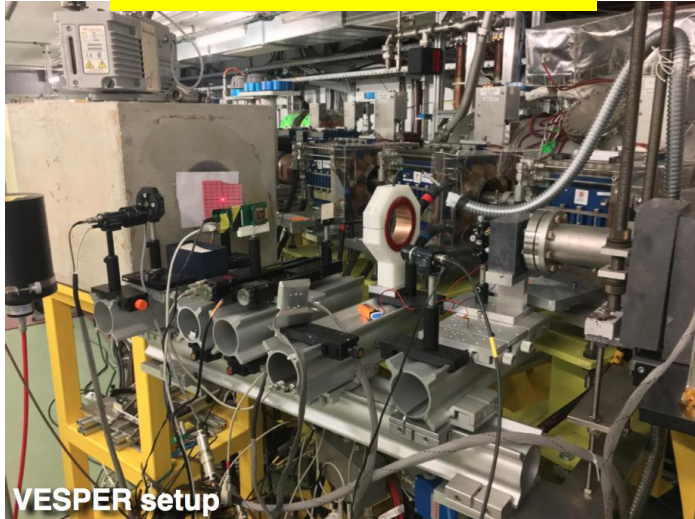
Waveguides from building 2001 to 2010

Beam parameters	Range	Comments
Energy	60 – 180 MeV	More flexible with 2 klystrons. > 220 MeV expected with pulse compression.
Energy Spread	< 1 MeV (FWHM)	
Bunch Charge	1 pC – 200 pC	Photocathode changed but limited laser power. Goal: 0.6 nC.
Bunch Length	2.4 ps – 8 ps	0.1 ps according to simulation. Velocity bunching studies to be resumed
Normalized emittances	3 $\mu\text{m}$ to 30 $\mu\text{m}$	Bunch charge dependent
Repetition rate	0.8 to 5 Hz	25 Hz with klystrons and laser upgrade
Number of micro-bunches in train	1 to >150	Single bunch capability assessed
Micro-bunch spacing	1.5 GHz (Laser)	3.0 GHz: Dark current

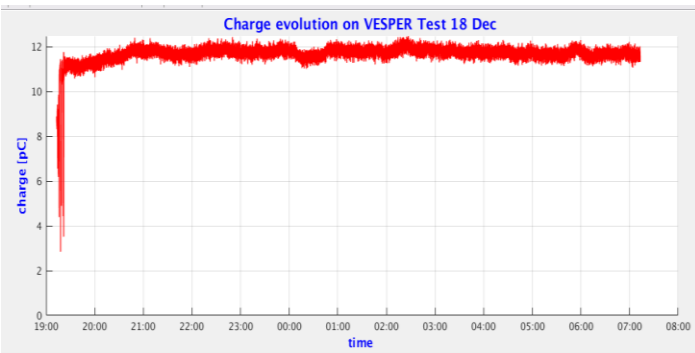
# CLEAR operation in 2017 (from August)

Week			
33 First beam! August 18	34 Cont'd commissioning	35 Cont'd commissioning	36 First beam to users VESPER
37 Installation of plasma lens	38 Beam through plasma lens	39 VESPER	40 Beam tuning, plasma lens
41 BCM improvement WFM	42 WFM First spark plasma lens	43 Inductive BPMs LAL: injector optimization	44 Cavity BPMs
45 Laser spot study VESPER	46 TRAD/ESA at VESPER THz studies	47 Combined WFM and Cavity BPMs	48 AWAKE screen Plasma lens
49 VHEE phantom irradiations	50 Plasma lens, instrumentation, THz	51 Plasma lens, instrumentation, THz VESPER	52 Instrumentation, THz VESPER

## Electronics irradiations



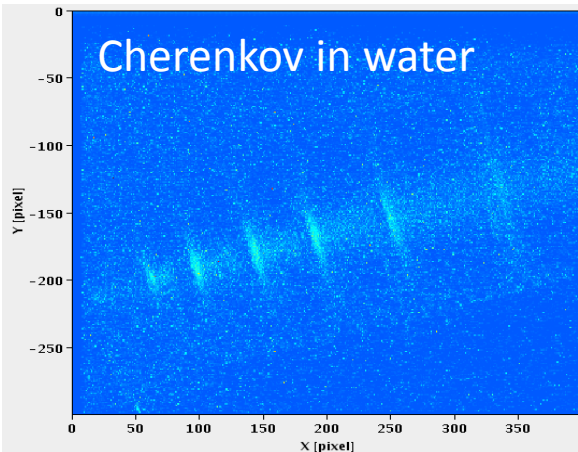
VESPER setup



Electronics Irradiation Tests in VESPER.

Maris Tali, Ruben Garcia Alia, this session

## VHEE



Results of the VHEE studies in VESPER/CLEAR.

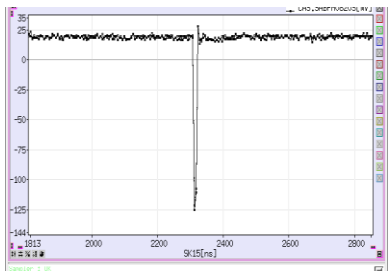
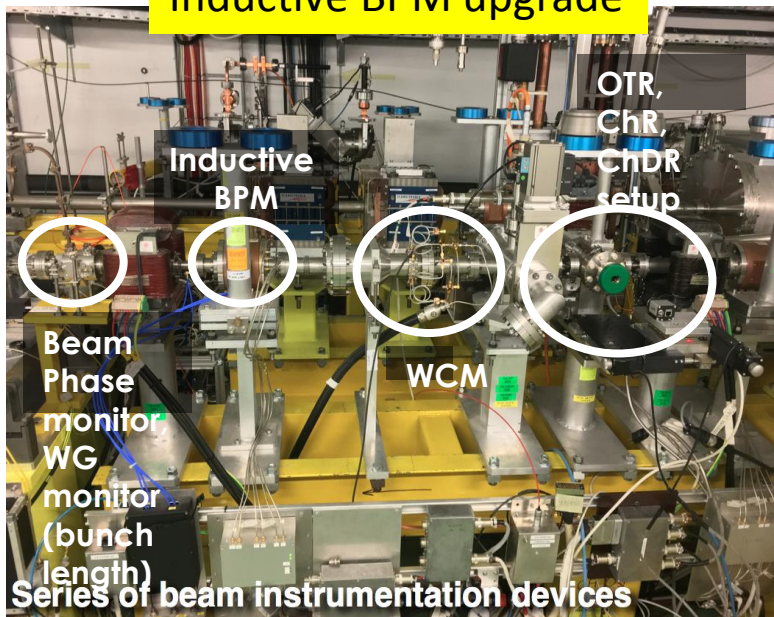
Agnese Lagzda, Roger Jones, this session

## Scintillation screen test



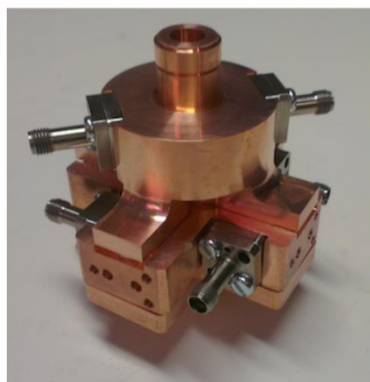
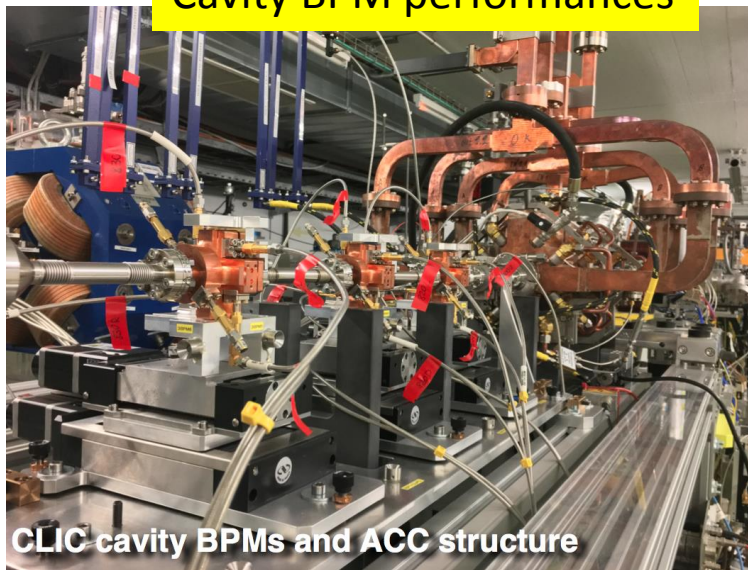
Test and calibration of scintillator for AWAKE electron spectrometer.  
Fearghus Keeble

## Inductive BPM upgrade



Beam Instrumentation upgrade and development  
 Michal Grupa, this session

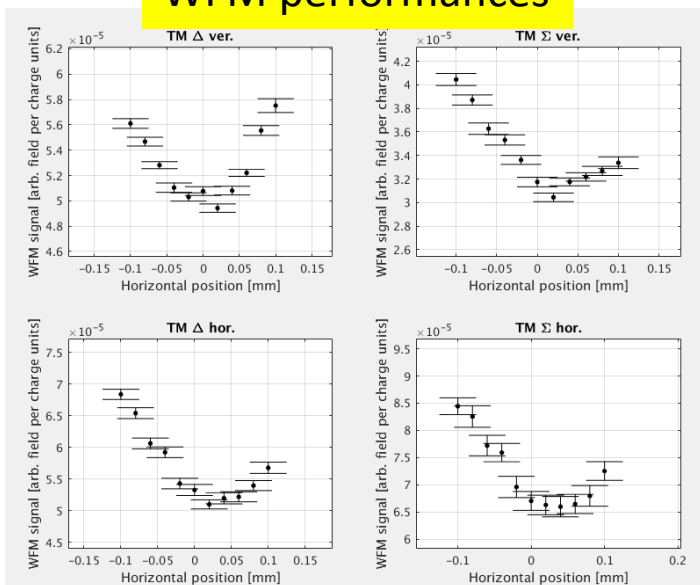
## Cavity BPM performances



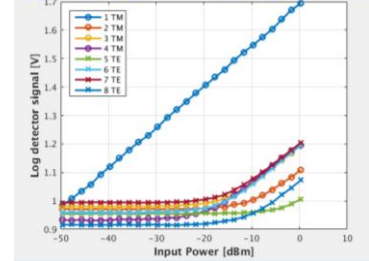
Status and plans for the Cavity BPMs

Johanes Nadenau, this session  
 W. Farabolini - CLEAR Status - CLIC Workshop 2018

## WFM performances

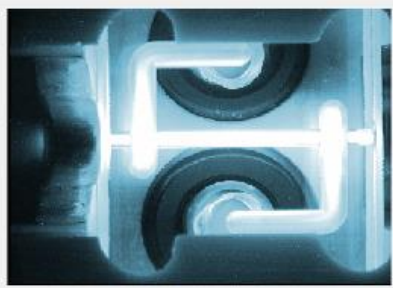
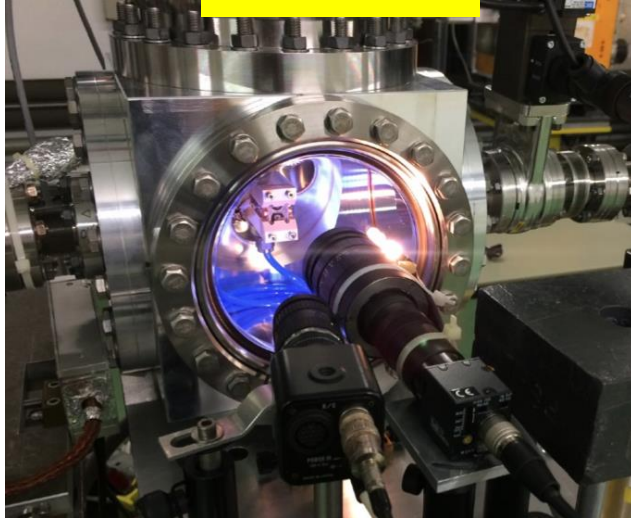


Log-detector response for channel 5 injection at 17 G



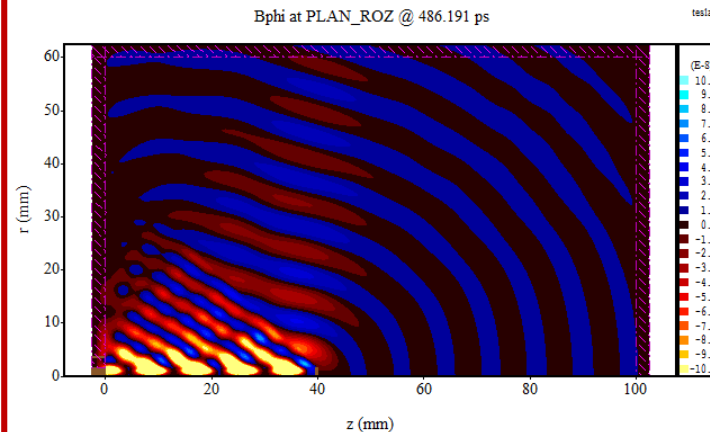
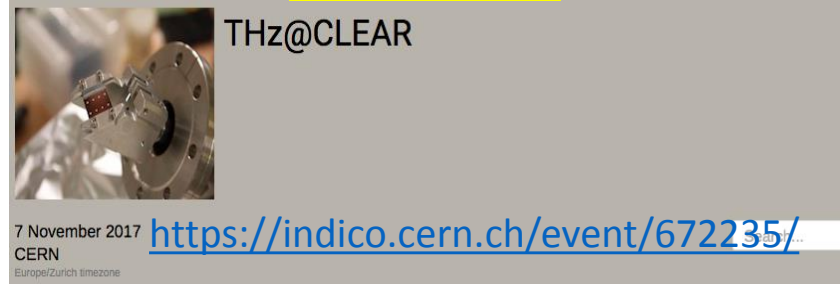
Update on Wake-Field Monitor Studies in CLEAR  
 Kyrre Sjøbæk, this session

## Plasma Lens



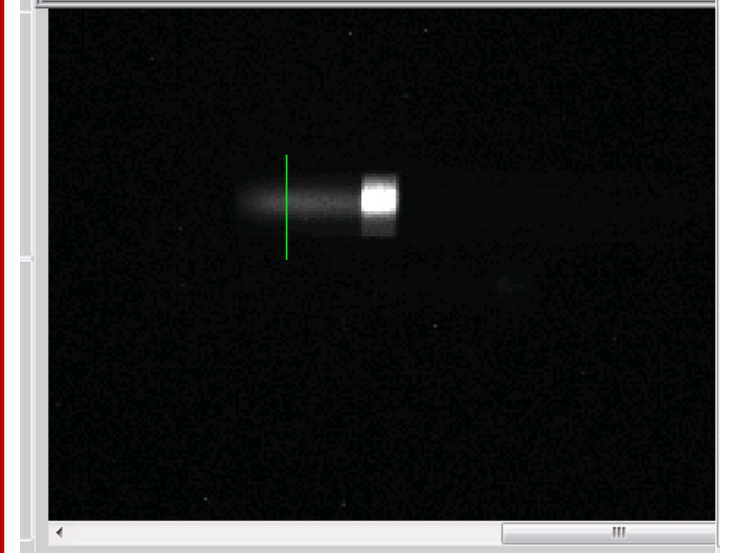
1/ The Plasma Lens Experiment at CLEAR: Experimental Set-Up and Results  
 2/ Progress on active plasma lens technology in CLEAR  
 Carl Lindstrøm, this session and 23 Jan 2018, 16:40

## THz studies



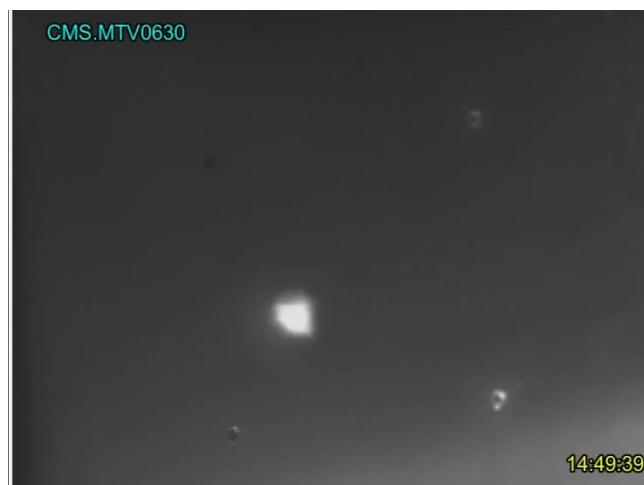
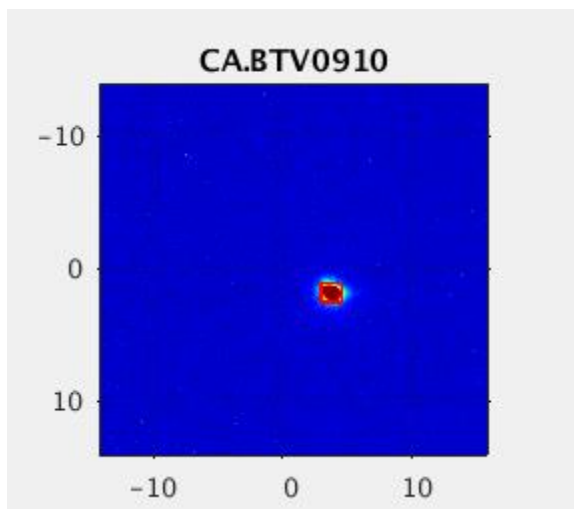
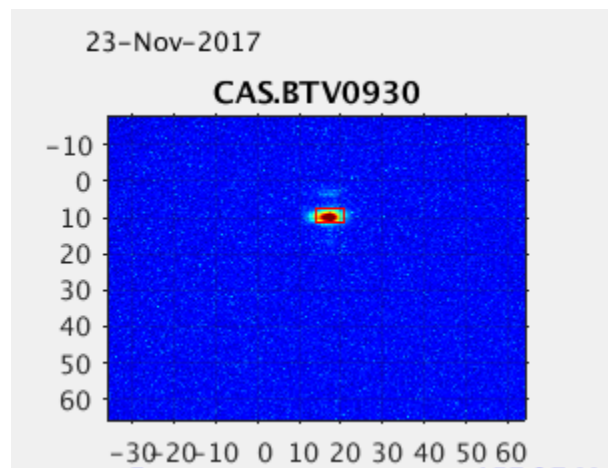
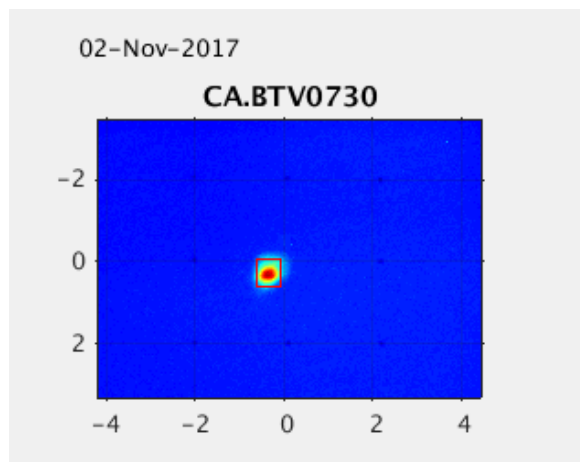
THz@CLEAR: source and diagnostics for the electron acceleration  
 Alessandro Curcio, this session

## Cherenkov diffraction



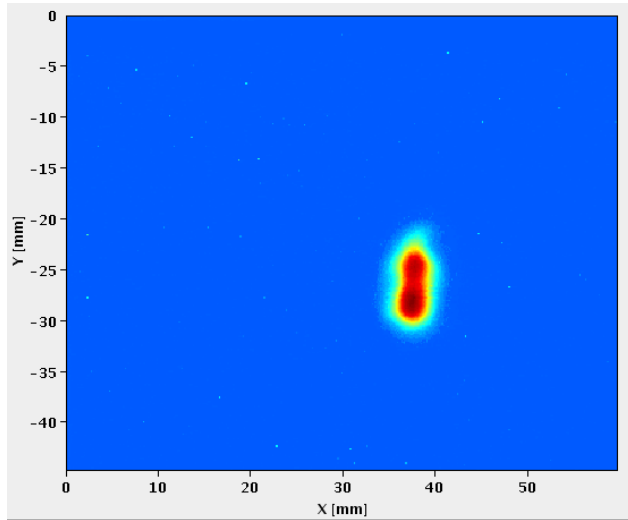
Non-invasive beam diagnostic for advanced accelerators: Cherenkov Diffraction radiation, Robert Kieffer, Thibault Lefevre, Tues 23 Jan, 17:05





Good beam aspect is not all.

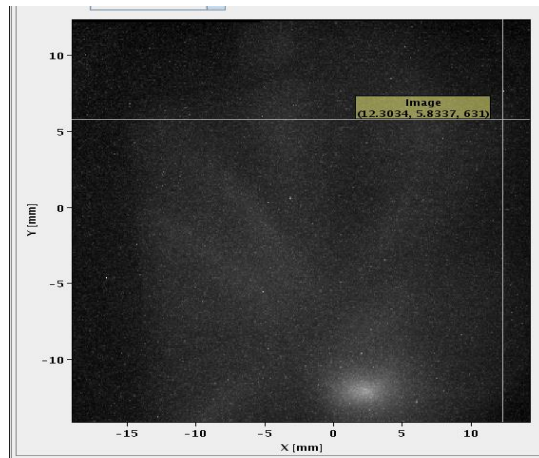
- Problems with high charges ( $>100$  pC)
- Position jitter
- Charge jitter and drift
- Time structure
- Bunch length



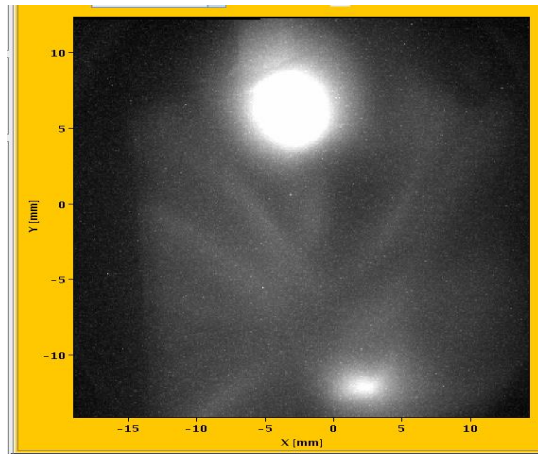
Laser shape on virtual cathode

- Improve beam shape, stability (position and energy)
- Improve the diagnostics and the controls
- Minimize pulse picker leakage
- Consolidate the installation (new stack of diodes, new oscillator, more power)
- Improve the transport: **move the laser closer to the gun**
- **Variable pulse distance capability**

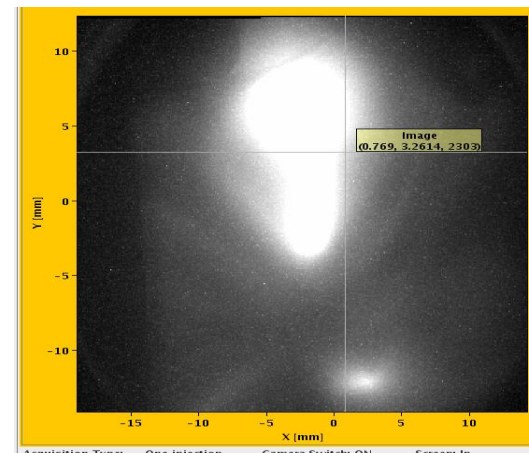
A new fellow expert in laser to arrive in February



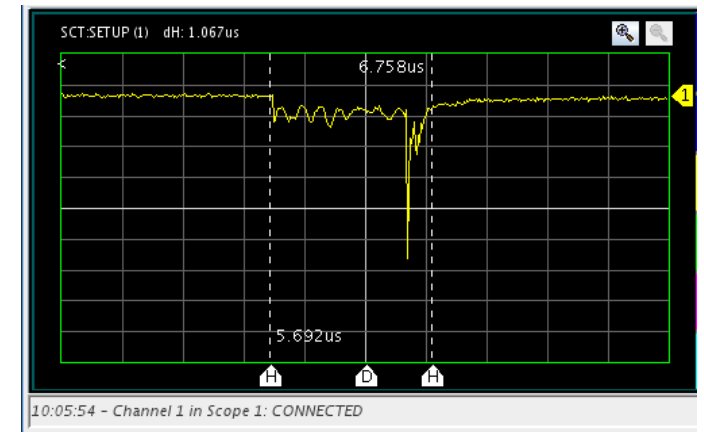
Dark current



Dark current + laser leakage



Dark current + laser leakage + 1 bunch

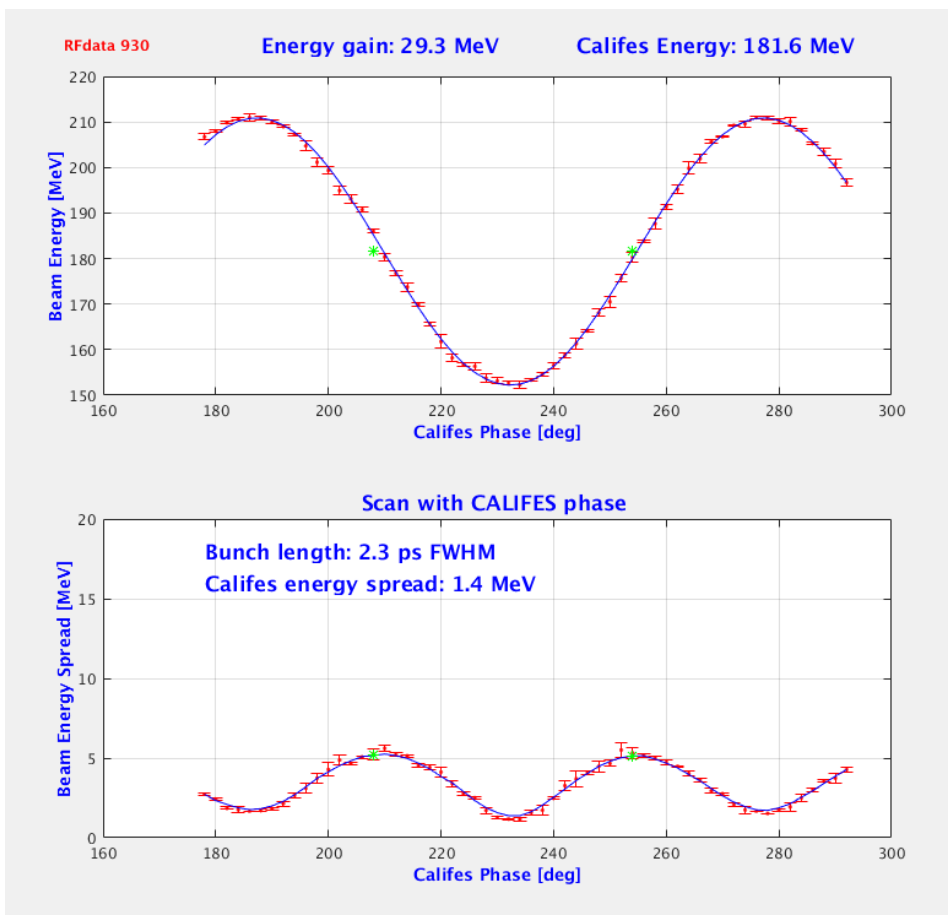
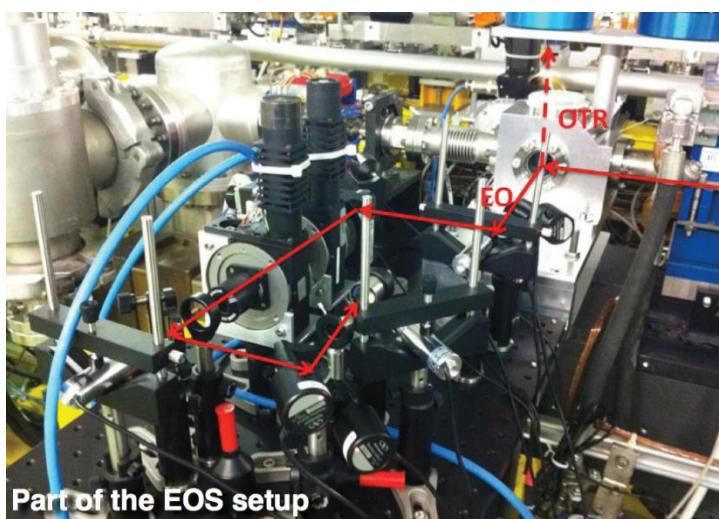
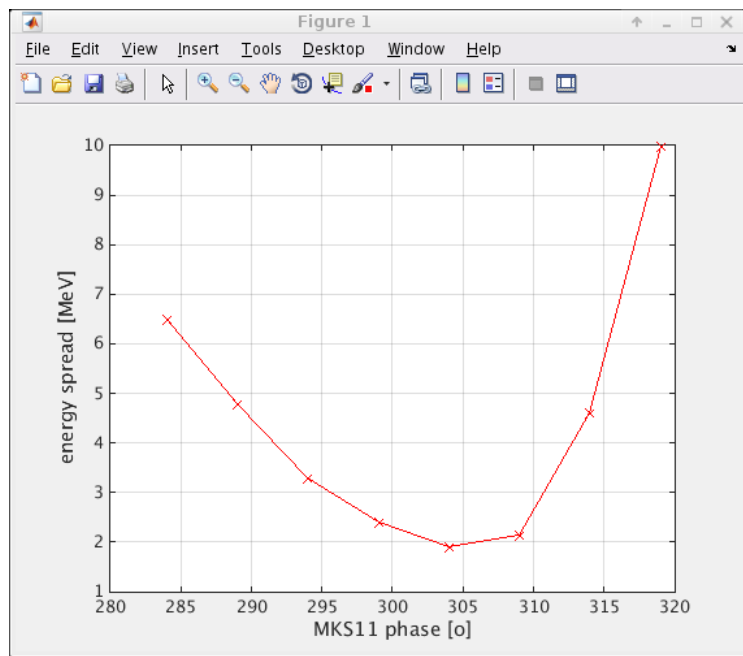


laser leakage and a bunch detected by PM (beam loss)



# Full set of diagnostics for bunch length measurement

- Streak camera (on laser and on beam)
- S-band deflecting cavity (MKS31 permanently connected)
- Energy spread at zero crossing on LIL structures
- Energy spread at zero crossing on X-band structures (once connected)
- BPR and THz radiation (non interceptive)
- Electro-optical sampling (BI plan for EOS revival, Ishkhan Gorgisyan)



Phase scan with X-band structures (19 oct 2016)

Phase scan with LIL structures (A. Curcio)

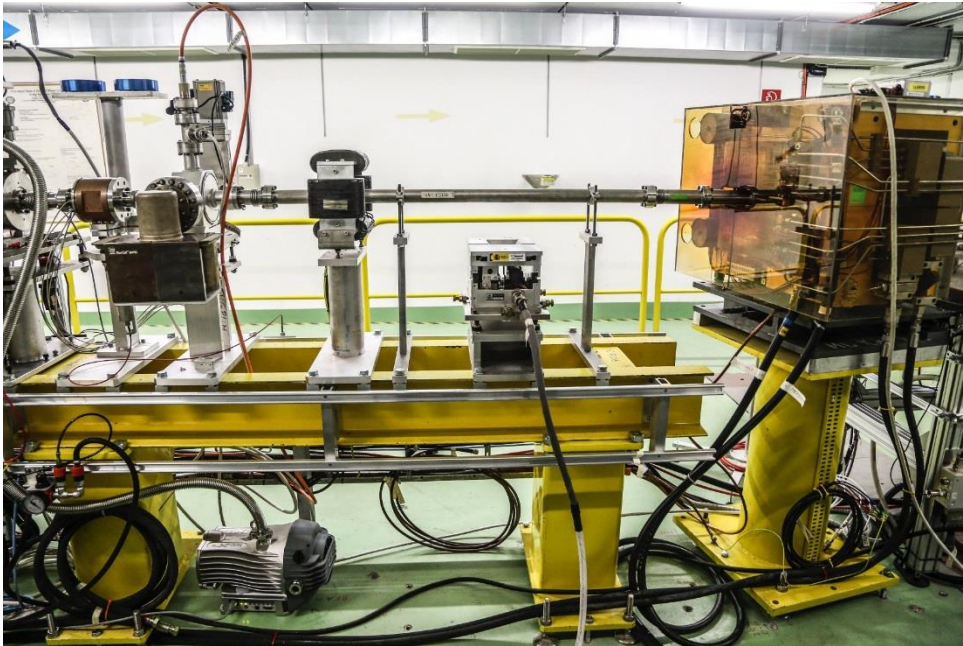
- Calibration of all the S-band RF measurements chains
- Check of the RF chains (phase shifter, preamplifier, Klystron stability...)
- Re-establish RF pulse compression for higher energy
- MKS11, 15 and 31 new command control for compatibility after LS2
- **Connect X-band klystron to CLIC module**



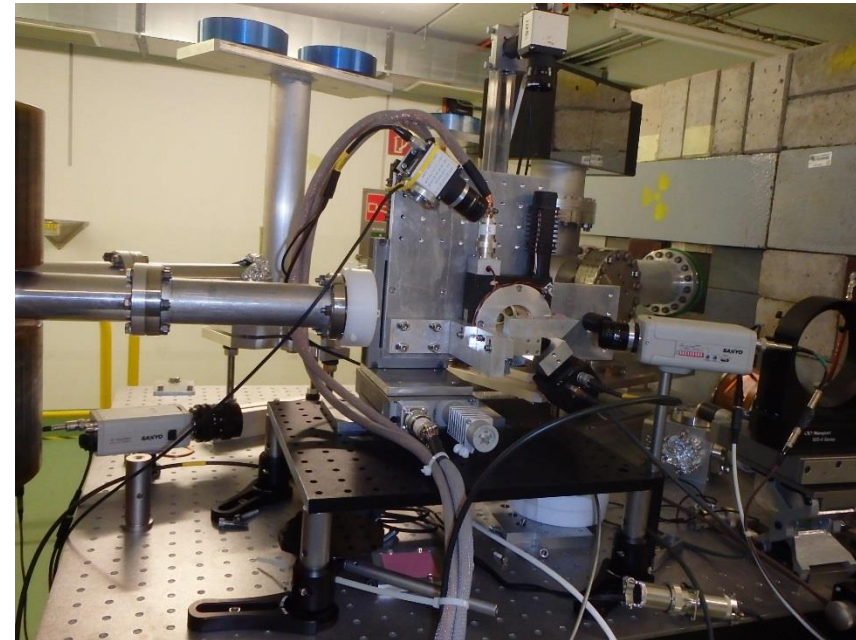


# clear+ Other improvements

- Additional quads (emittance measurement after PL and in-air beam size)
- Additional OTR screen for emittance measurement
- Camera multiplex
- Laser for user's installation alignment
- Additional Beam Current Monitor
- Breadboard table for VESPER



In-vacuum test stand



In-air test stand

- CLEAR has successfully been prepared in 2017 and then delivered beam to many experiments.
- Requests from users have (surprisingly ?) been quite numerous.
- The CLEAR International Scientific Committee is now established (kick-off meeting – 11 Dec. 2017)
- We have an ambitious program of consolidation and facility development.

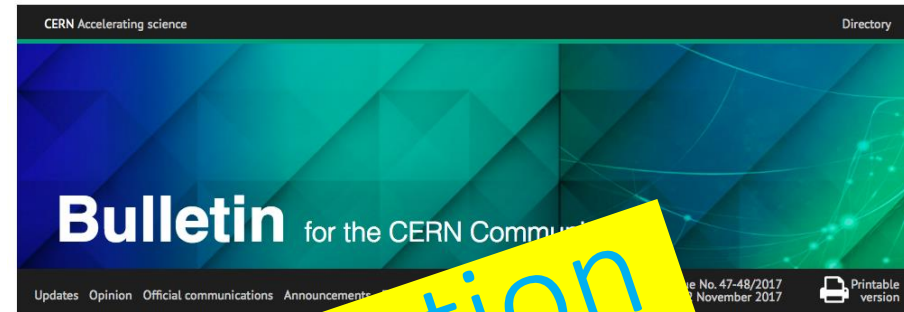


**CERN COURIER**

Oct 13, 2017

**CLEAR prospects for accelerator research**

...s plasma-lens experiment (expand for full image)  
...w user facility for accelerator R&D, the CERN Linear Electron Accelerator for Research (CLEAR), started operation in August and is ready to provide beam for experiments. CLEAR evolved from the former CTF3 test facility for the Compact Linear Collider (CLIC), which ended a successful programme in December 2016. Following approval of the CLEAR proposal, the necessary hardware modifications started in January and the facility is now able to host and test a broad range of ideas in the accelerator field.

**CLEAR prospects for accelerator research**

The CERN Linear Electron Accelerator for Research (CLEAR) will enhance and complement the existing accelerator R&D programme at CERN. (Image: Julien Ordan/CERN)

Thank you for your attention