Beam diagnostics R&D in CLEAR

S. Mazzoni for the CLEAR BI teams

CLEAR review 2024, 29/5/2024

CLEAR for Beam Instrumentation R&D

CLEAR is a strategic facility for CERN and other BI group for R&D to improve detection methods or technologies

- 10 tests performed in 2023, 7 planned for 2024.
- 8 PhD thesis in the last three years based on CLEAR tests
- IBIC23 / 24: Three contribution, two invited oral contributions
- IPAC23 / 24: five contributions
- Projects / experiments / studies: CLIC, FCCee, AWAKE, North Area, …

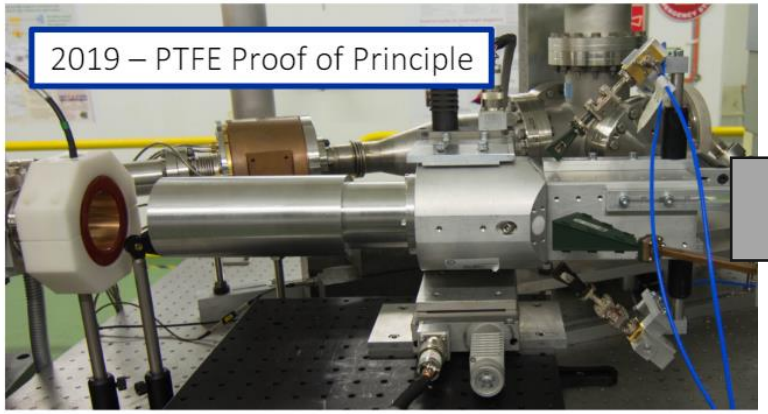
CLEAR for Beam Instrumentation R&D

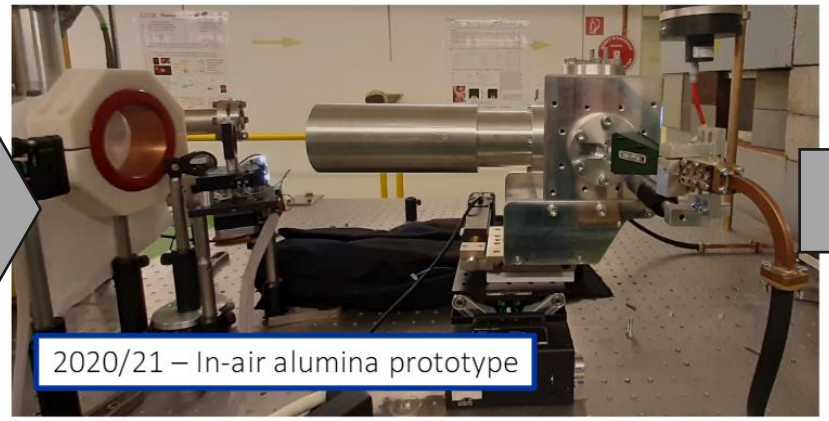
- **10 tests performed in 2023, 7 planned for 2024:**
  - Coherent ChDR for longitudinal profile (A. Schloegelhofer, CERN & TU Wien)
  - ChDR BPM studies (B. Spear, CERN & Oxford U.)
  - Sub-ps bunch profile via electro-optical spectral decoding (E. Senes, K. Pakuza CERN)
  - Electro-optical spectral decoding for FCCee (M. Reissig, KIT)
  - Optical Beam Loss Monitors (M. King, CERN & Liverpool U.)
  - Cavity BPMs test (A. Lyapin, Royal Holloway U.)
  - Novel emittance measurement (J. Wolfenden, Liverpool U.)
  - Broadband pickup study (N. Vallis, PSI)
  - Coherent ChDR bunch length (C. Davut, Manchester U.)
  - Scintillator resolution tests (F. Pannell, D. Cooke, UCL)
  - Hollow core fibres tests (R. Larsen, CERN)
  - Scintillator light yield test (D. Singh, CERN)
  - BPM simulation tests (E. Howling, CERN & Oxford U.)

R&D programmes

- **Availability of CLEAR allows to develop a long-standing, coherent programme in topics such as diffracted radiation emission, electro optical encoding techniques, optical BLMs**
- **Example: development of a beam position monitor based on diffracted Cherenkov Radiation from prototyping (2019) to (almost) operational instrument installed in AWAKE in 2022/23…via 3 PhDs!**

E. Senes et al. Selective electron beam sensing through coherent Cherenkov diffraction radiation, accepted for publication in Phys. Rev. Research 2024





Projects / studies / facilities

- **CLEAR is serving present and future projects**
  - Coherent ChDR for longitudinal profile (A. Schloegelhofer, CERN & TU Wien)
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FCC
AWAKE
CLIC
NA
generic R&D

Projects / studies / facilities

- **CLEAR key test facility for Advanced Wakefield Experiment (AWAKE) at CERN: beam position, calibration of spectrometer. For run 2c recently approved: novel emittance measurement techniques, short bunch length monitoring**
- **CLEAR can become a very important asset for FCCee if approved: coherent radiation studies, studies for injector complex. CLEAR can be complementary to light sources. Scope of CLEAR contribution will depend on resources / upgrades of facility (eg more beamlines, higher energy,…)**

Education

- **Tests part of a PhD programme (2023/24):**
  - Coherent ChDR for longitudinal profile (A. Schloegelhofer, CERN & TU Wien)
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  - Electro-optical spectral decoding for FCCee (M. Reissig, KIT)
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CLEAR instrumental in formation. No long shutdown, one week of beam time is guaranteed (thanks to CLEAR team extra efforts)

Institutes

M. Benedikt[2], S. Burger[1], P. Burrows[3], D. Cooke[9], P. Craievich[7], C. Davut[8], M. Gasior[1], L. Grimm[4], B. Haerer[4], E. Howling[1,3], P. Karataev[6], M. King[1,5], M. Krupa[1], R. Larsen[1,], K. Lasocha[1], T. Lefevre[1], A. Lyapin[6], S. Mazzoni[1], A. S. Mueller[4], G, Niehues[4], I. Ortega[1] , F. Pannell[9], C. Pakuza[1,3], M. Reissig[4], B. Salvachua[1], A. Schloegelhofer[1,2], E. Senes[1,3], D. Singh[1], B. Spear[1,3], C. Swain[5], N. Vallis[7], C. Welsch[1], M. Wendt[1], M. Wing[9], J. Wolfenden[5], G. Xia[8],

1 CERN
2 TU Wien
3 University of Oxford
4 KIT
5 University of Liverpool
6 Royal Holloway University of London
7 Paul Scherrer Institute
8 University of Manchester
9 University College of London

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