CLIC CB, Updates, University of Oslo
Prof. Erik Adli, Dec 13, 2023

Development of advanced beam focusing for proton therapy (application of CERN-technology)

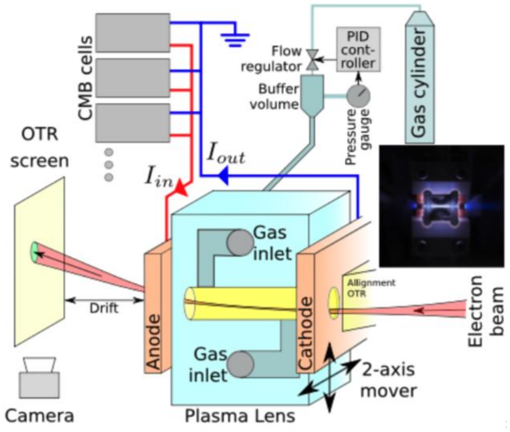
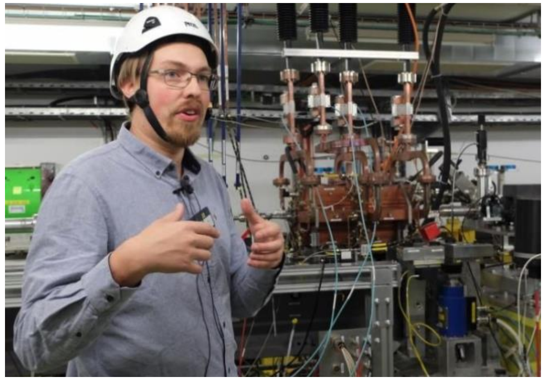


FIG. 1. Overview of the most relevant components of the CLEAR Plasma Lens Experiment and the path of the beam. Insert: Plasma lens capillary during a discharge.

Development of novel active plasmas lenses for strong beam focusing and future colliders. Two paper published, **first post-covid experimental run Aug. 2023.**



Collaboration with CERN, Oxford and DESY

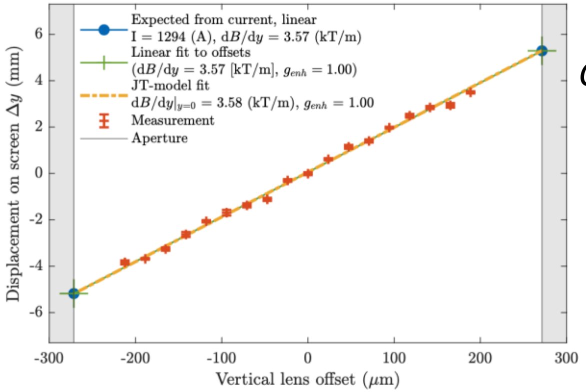
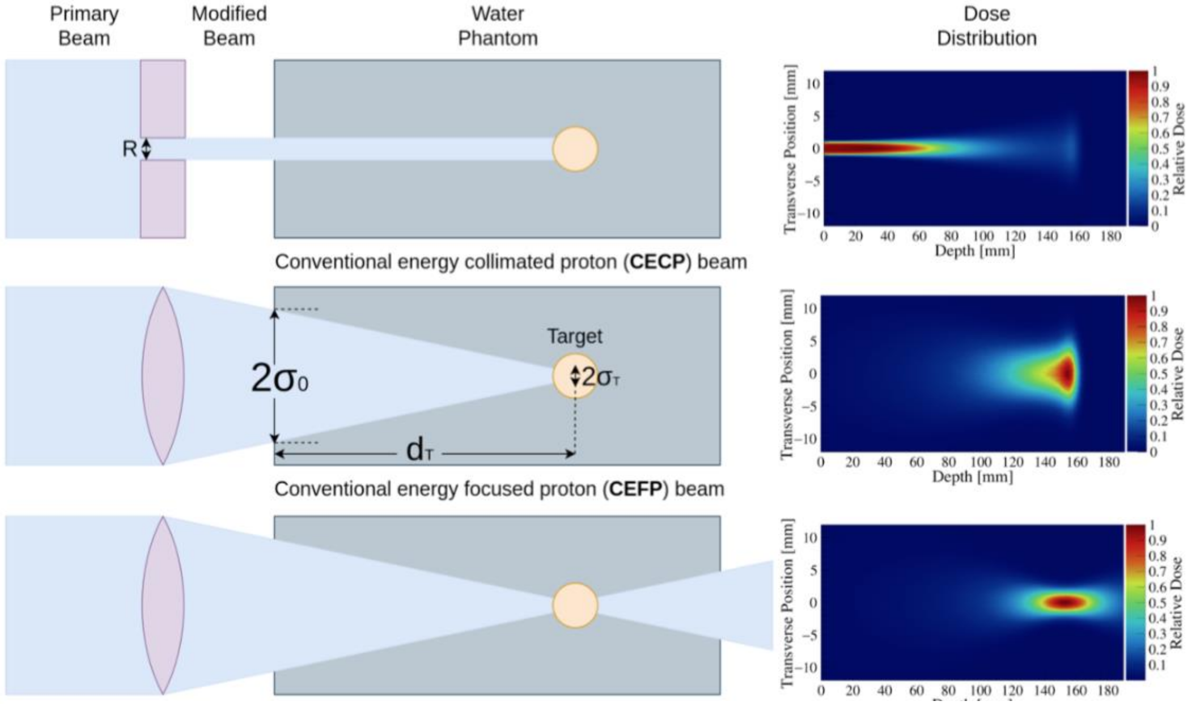


FIG. 3. Beam displacement as a function of lens offset in argon on peak current, for measuring the field gradient.

New master student, Elisabeth R. Lindstad.

K. N. Sjobak, NFR YRT Application, "Hyperfocus": Particle accelerator final focus systems for improving precision of dose delivery for medical applications and irradiation test stands

We study how our expertise in advanced beam optics, for example needed for future particle colliders, can be applied to improve proton therapy.



Principle of advanced beam shaping techniques for proton therapy. From [4].

[1] K. Sjøbæk, E. Adli et al., "SStrong focusing gradient in a linear active plasma lens" **Phys. Rev. Accel. Beams 24, 121306 (2021)**

[2] S-Y. Kim, K. Moon, M. Chung, K. Sjøbæk, E. Adli et al., "Witness electron beam injection using an active plasma lens for beam-driven plasma wakefield accelerators" **Phys. Rev. Accel. Beams 24, 121304 (2021)**

[3] **F. Reaz**, "Advanced beam shaping for spatially fractionated proton beam therapy", Master thesis, UiO, 2021

[4] **F. Reaz, K. N. Sjobak**, E. Malinen, N. Edin, **E. Adli**, "Sharp dose profiles for high precision proton therapy using focused proton beams", Nature **Sci Rep 12**, 18919 (2022)]

[5] K. Kokurewicz et al., "An experimental study of focused very high energy electron beams for radiotherapy", Nature **Commun Phys 4, 33 (2021)** https://www.nature.com/articles/s42005-021-00536-0

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CLIC Wake Field Monitor as a detuned Cavity Beam Position Monitor: Explanation of center offset between TE and TM channels

Kyrre Ness Sjobak,[1,2,*] Hikmet Bursali,[2,3] Antonio Gillardi,[2,4] Reidar Lillestøl,[1] Wilfrid Farabolini,[2] Steffen Doebert,[2] Erik Adli,[1] Nuria Catalan Lasheras,[2] and Roberto Corsini[2]

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[2] *CERN, CH-1211 Geneva 23, Switzerland*
[3] *Department of SBAI, Sapienza University of Rome, Italy*
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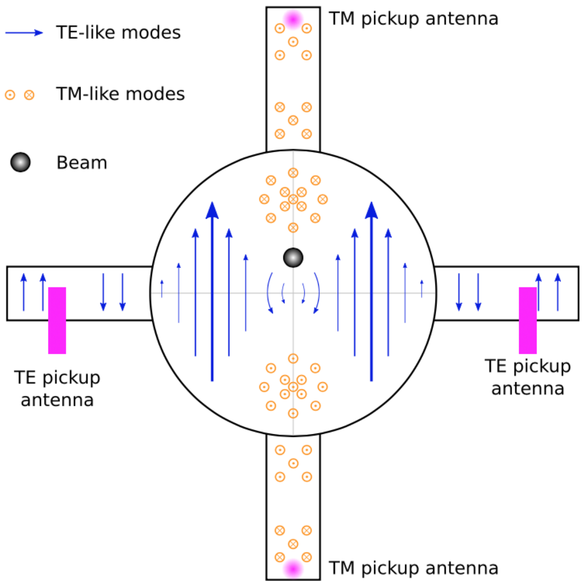
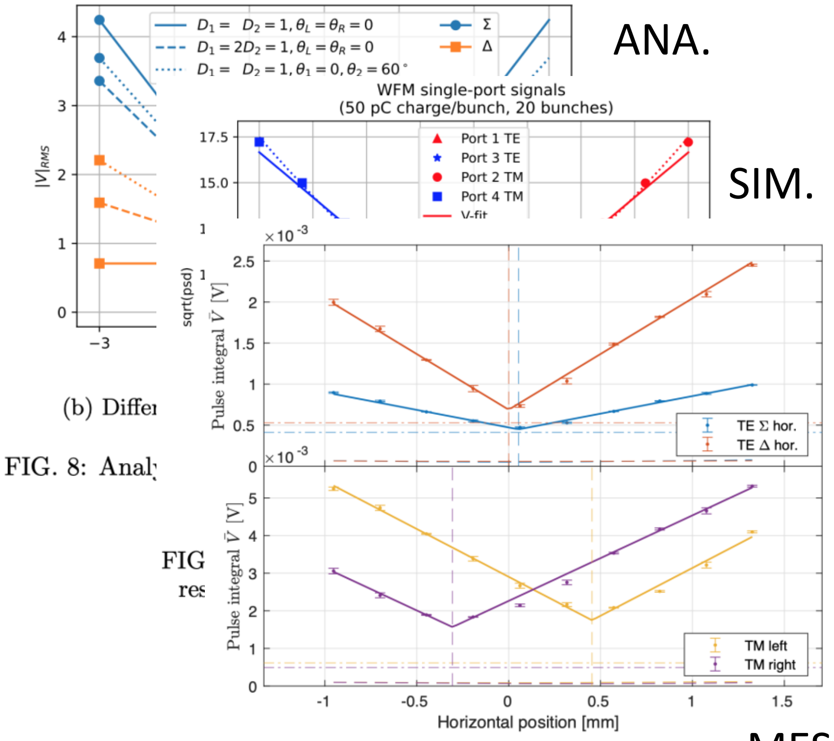
(Dated: September 26, 2023)

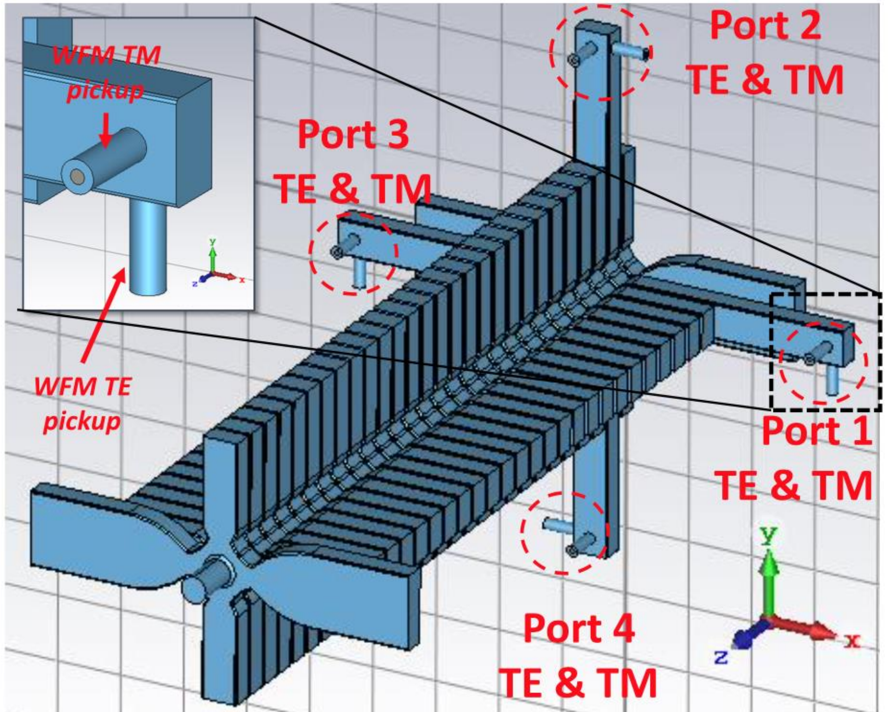
The Wake Field Monitor (WFM) system installed on the CLIC prototype accelerating structure in CERN Linear Accelerator for Research (CLEAR) has two channels for each horizontal/vertical plane, operating at different frequencies. When moving the beam relative to the aperture of the structure, a disagreement is observed between the center position of the structure as measured with the two channels in each plane. This is a challenge for the planned use of WFMs in the Compact Linear Collider (CLIC), where they will be used to measure the center offset between the accelerating structures and the beam. Through a mixture of simulations and measurements, we have discovered a potential mechanism for this, which is discussed along with implications for improving position resolution near the structure center, and the possibility determination of the sign of the beam offset.

Kyrre N. Sjobak et al, arXiv:2307.06681 (2023)





(a) Horizontal scan, TM hybrids bypassed. MES.



Finally, the results are in itself interesting in that they point out important issues with the type of beam position monitoring systems as are used here, where unlike with a typical resonant cavity BPM there is no strong mode that is being excited. This could inform both future wake field monitor designs, and other beam position monitoring systems based on diffraction of the beam field through apertures in the beam pipe.

Conclusion of a long story started by postdoc Reidar Lillestøl, in 2014 !

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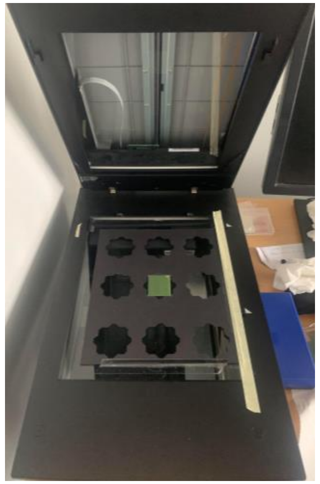
Vilde F. Rieker, CERN-UiO PhD
VHEE/FLASH Real Time Dosimetry Monitoring

Benchmarking against well established and dose-rate independent dosimetry methods

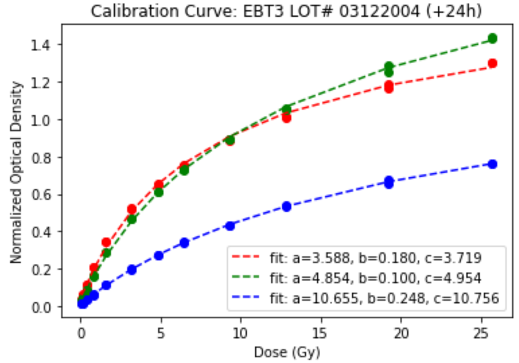
Cut and engrave radiochromic films

Calibrate

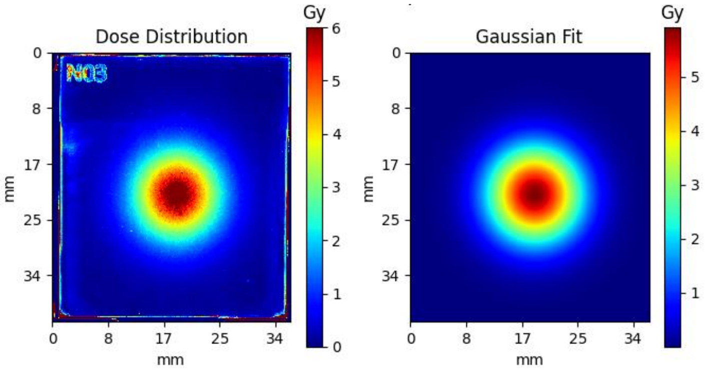
Irradiate



Scan (one by one)



Process to find relationship between dose and darkening for given batch



Process to determine dose distribution and correlate with beam parameters

… which are "passive", i.e. manual, time consuming and repetitive.

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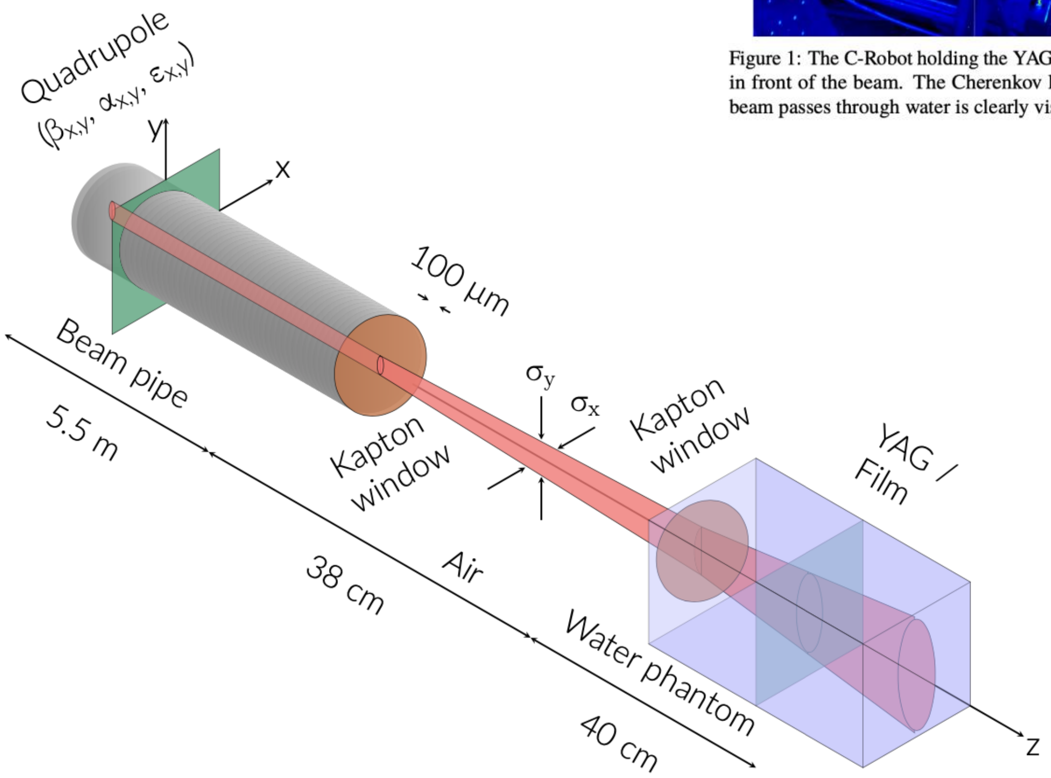
Vilde F. Rieker, CERN-UiO PhD

Experimental Setup



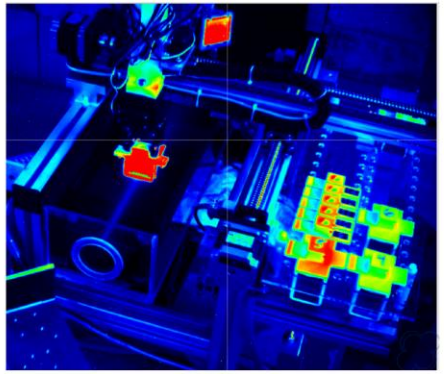
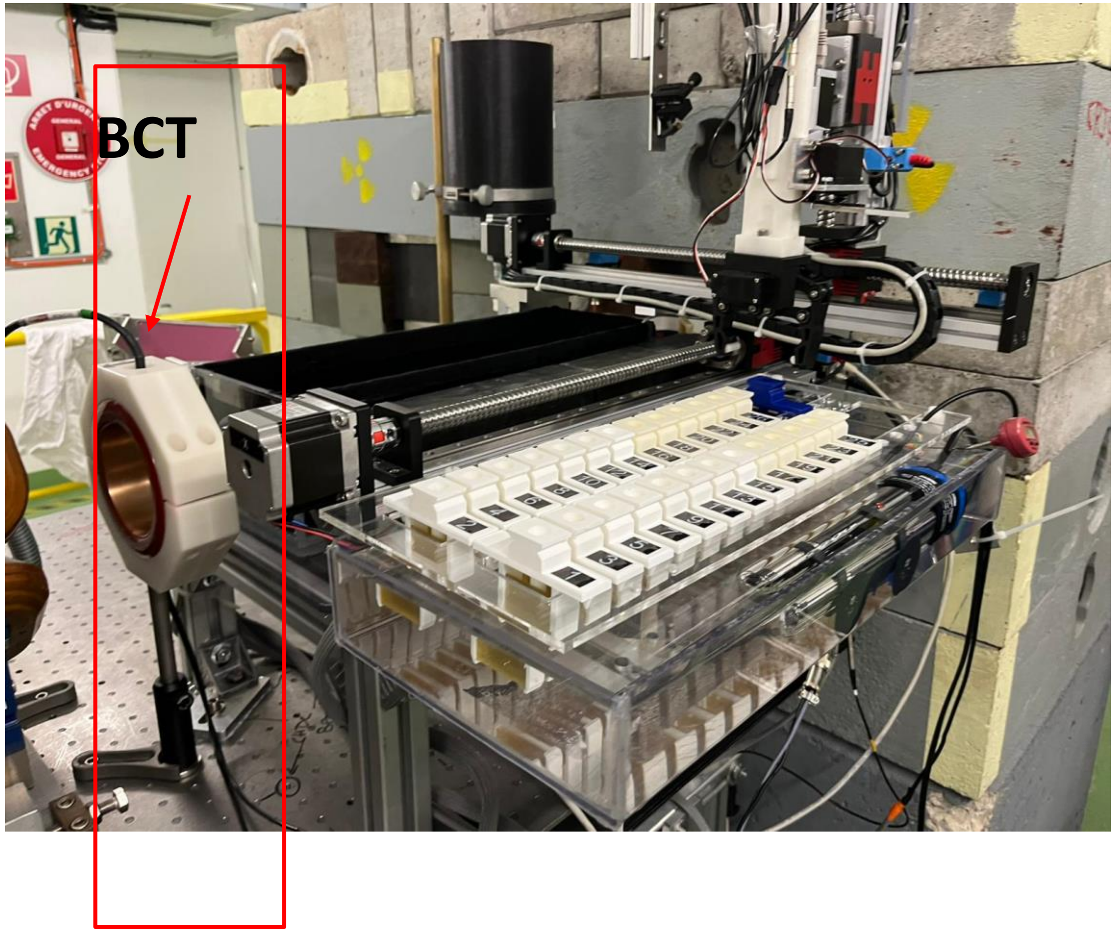


Figure 1: The C-Robot holding the YAG screen inside water in front of the beam. The Cherenkov light emitted as the beam passes through water is clearly visible.



Vilde F. Rieker, CERN-UiO PhD

Beam Size Evaluation in CLEAR

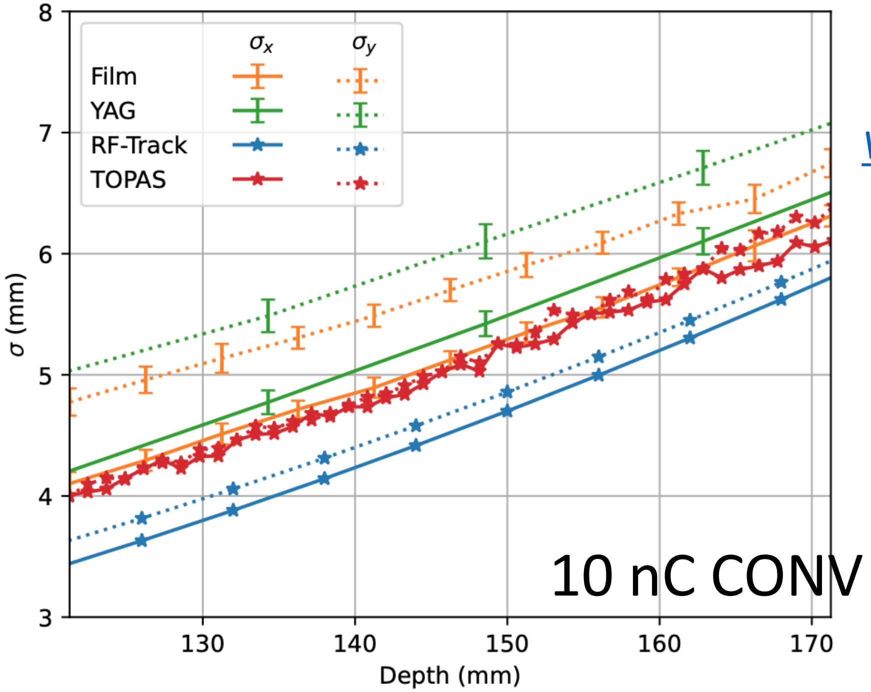


Figure 4: The evolution of the 1σ beam size as a function of depth, as measured by the films and YAG screens irradiated under CONV conditions.

V.F. Rieker et al., IPAC'23

14th International Particle Accelerator Conference,Venezia JACoW Publishing
ISBN: 978-3-95450-231-8 ISSN: 2673-5490 doi: doi/jacow-ipac2023-thpm060/index.html

BEAM INSTRUMENTATION FOR REAL TIME FLASH DOSIMETRY: EXPERIMENTAL STUDIES IN THE CLEAR FACILITY*

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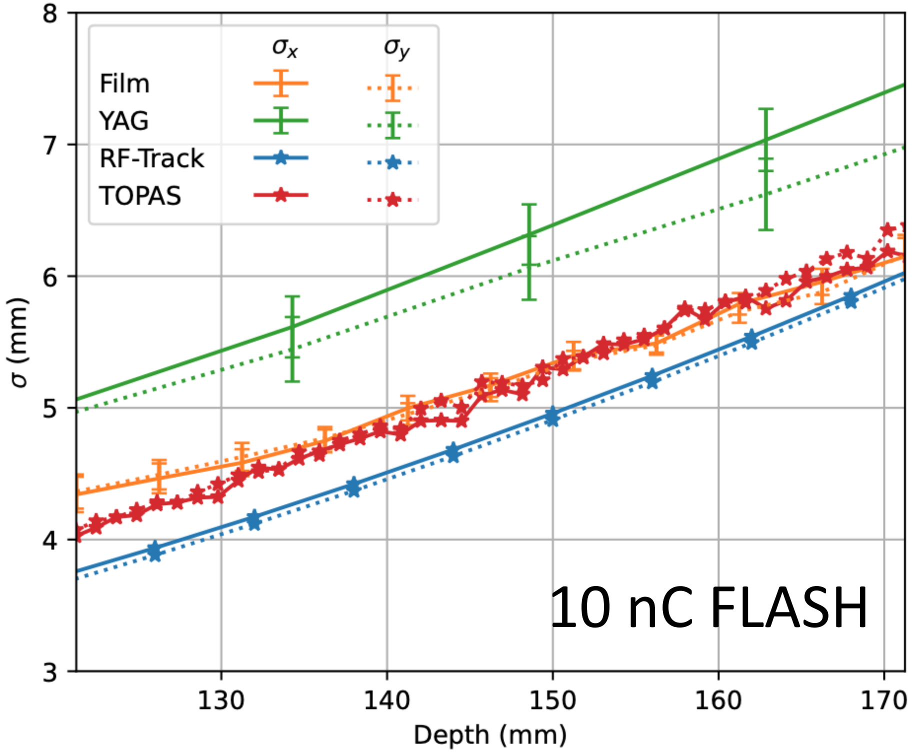

Figure 5: The evolution of the 1σ beam size as a function of depth, as measured by the films and YAG screens irradiated under FLASH conditions.

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Plasma acceleration (FRIPRO project)

Positron acceleration in plasma wakefields

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(Dated: September 20, 2023)

A hybrid, asymmetric, linear Higgs factory based on plasma-wakefield and radio-frequency acceleration

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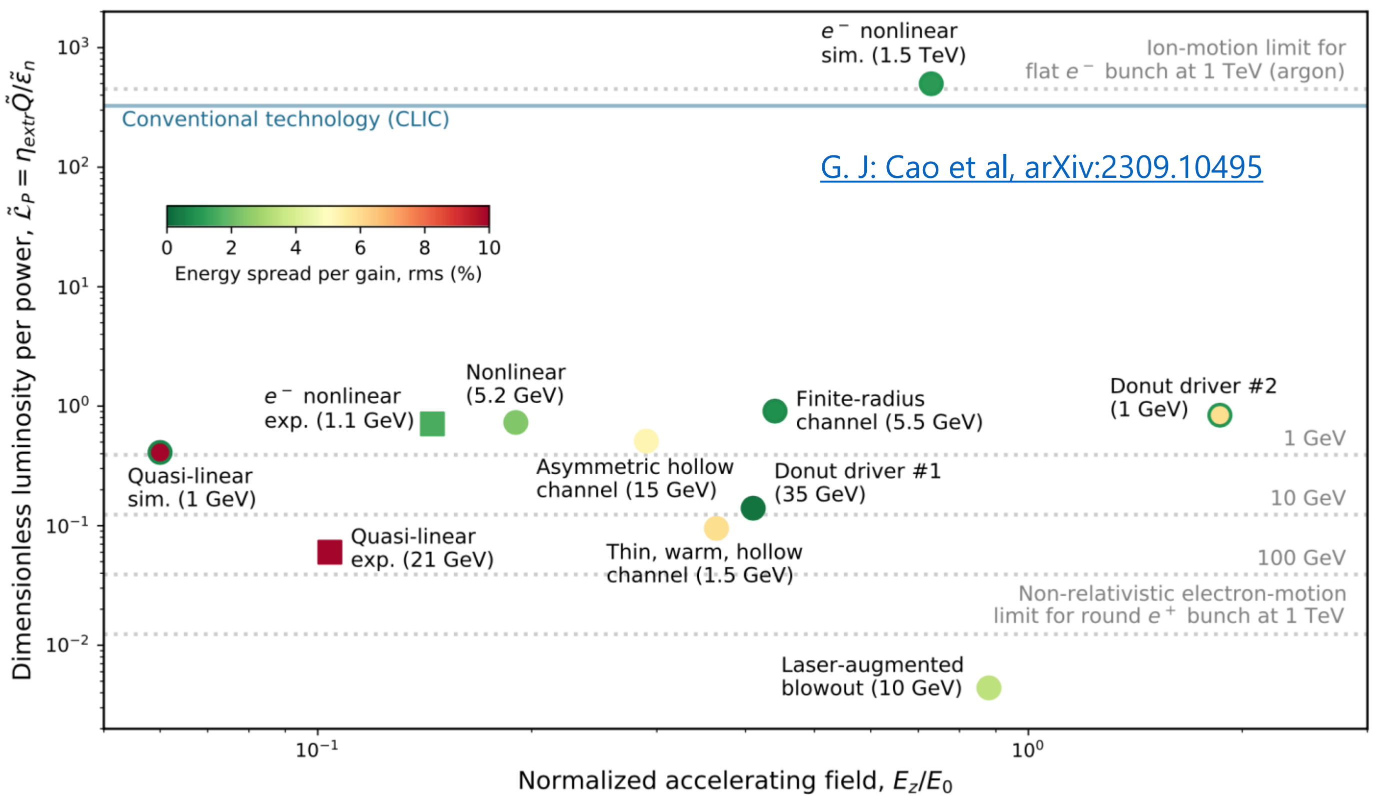
Keywords: plasma-wakefield, Higgs, factory, hybrid

- **Postdoc, Carl Lindstrøm**
- **Postdoc, Ben Chen**
- **PhD Ole Gunnar Finnerud**
- **Master Daniel Kalvik**

2024+: Additional *ERC-project,* Carl Lindstrøm

Comparison of proposed positron schemes (+electron schemes and RF)



G. J: Cao et al, arXiv:2309.10495

B. Foster, R. D'Arcy and C. A. Lindstrøm, *New J. Phys.* **25,** 093037 (2023)