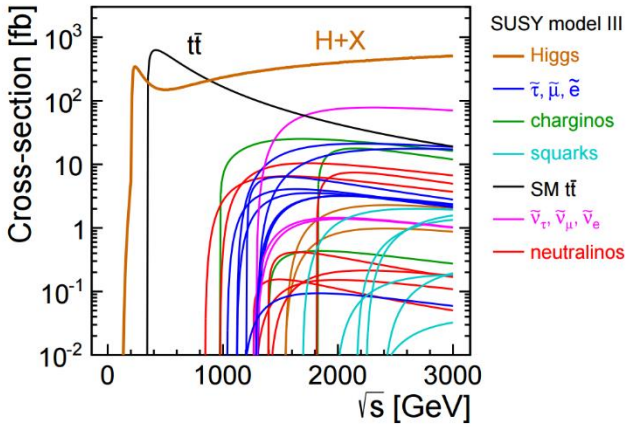
An Electro-Optical Wakefield Monitor for High Gradient Measurements at CLEAR

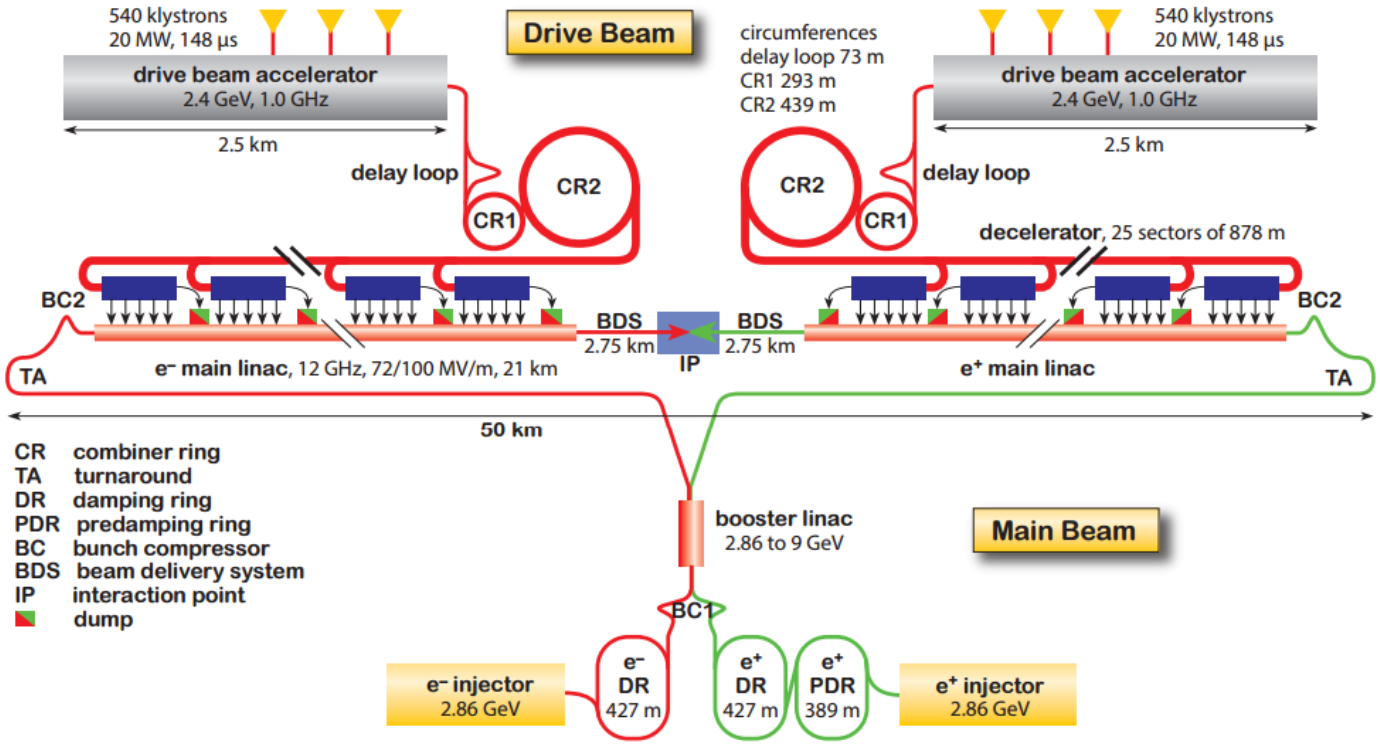
Jan Paszkiewicz

Compact Linear Collider

- Linear e+e- collider
- Staged implementation up to 3 TeV
- 100 MV/m gradient



Cross-sections for possible new interactions. [1]

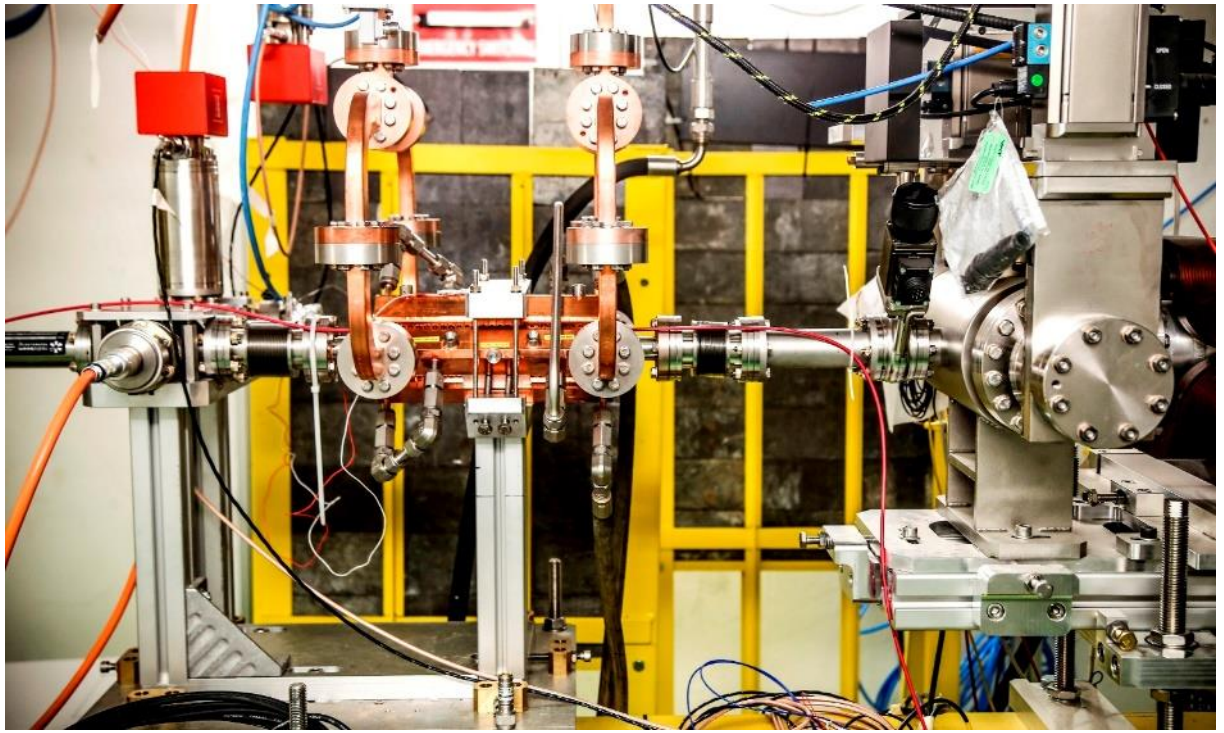


Overview of the CLIC layout for 3 TeV. [1]

High Gradient Accelerating Structures

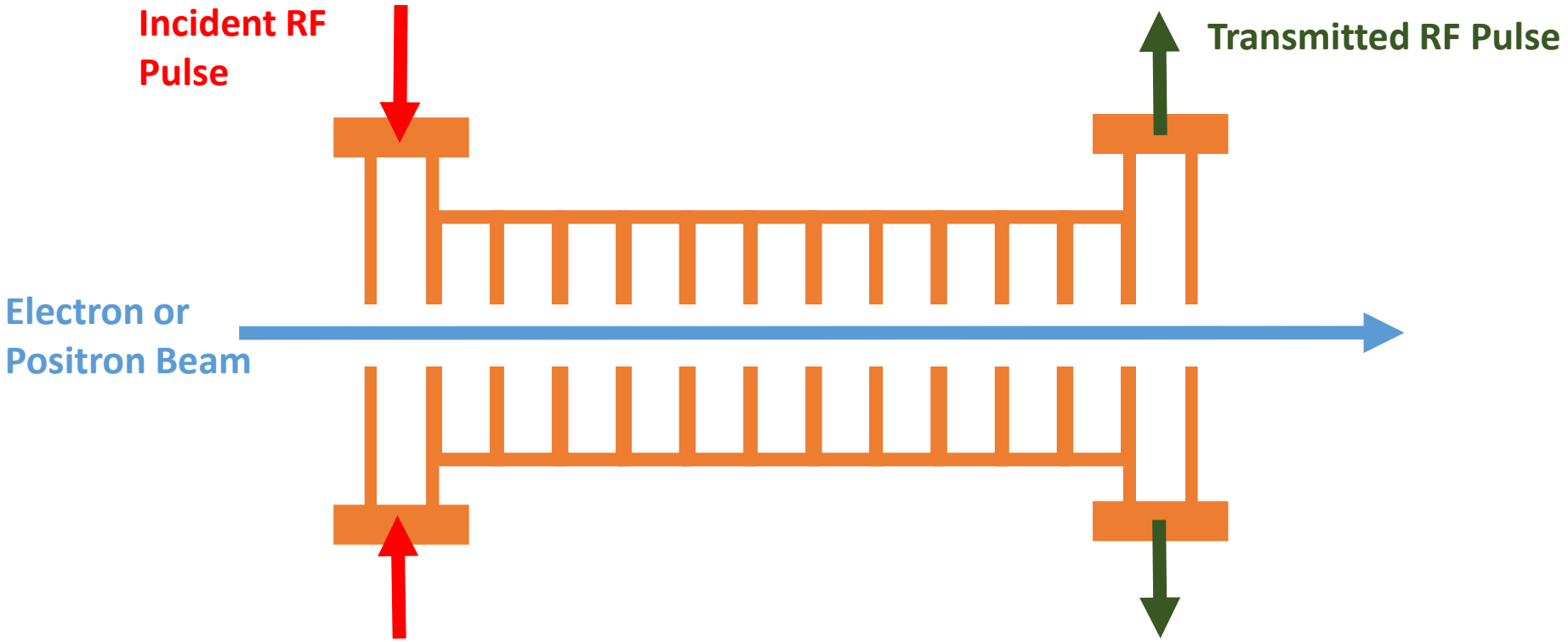
- 100 MV/m
- Cu normal conducting
- X-band (11.994 GHz)
- 50 MW peak RF power
- Breakdown rate limit of 3×10^{-7} – impact on CLIC luminosity

$$BDR \propto {E_0}^{30} \tau^5$$

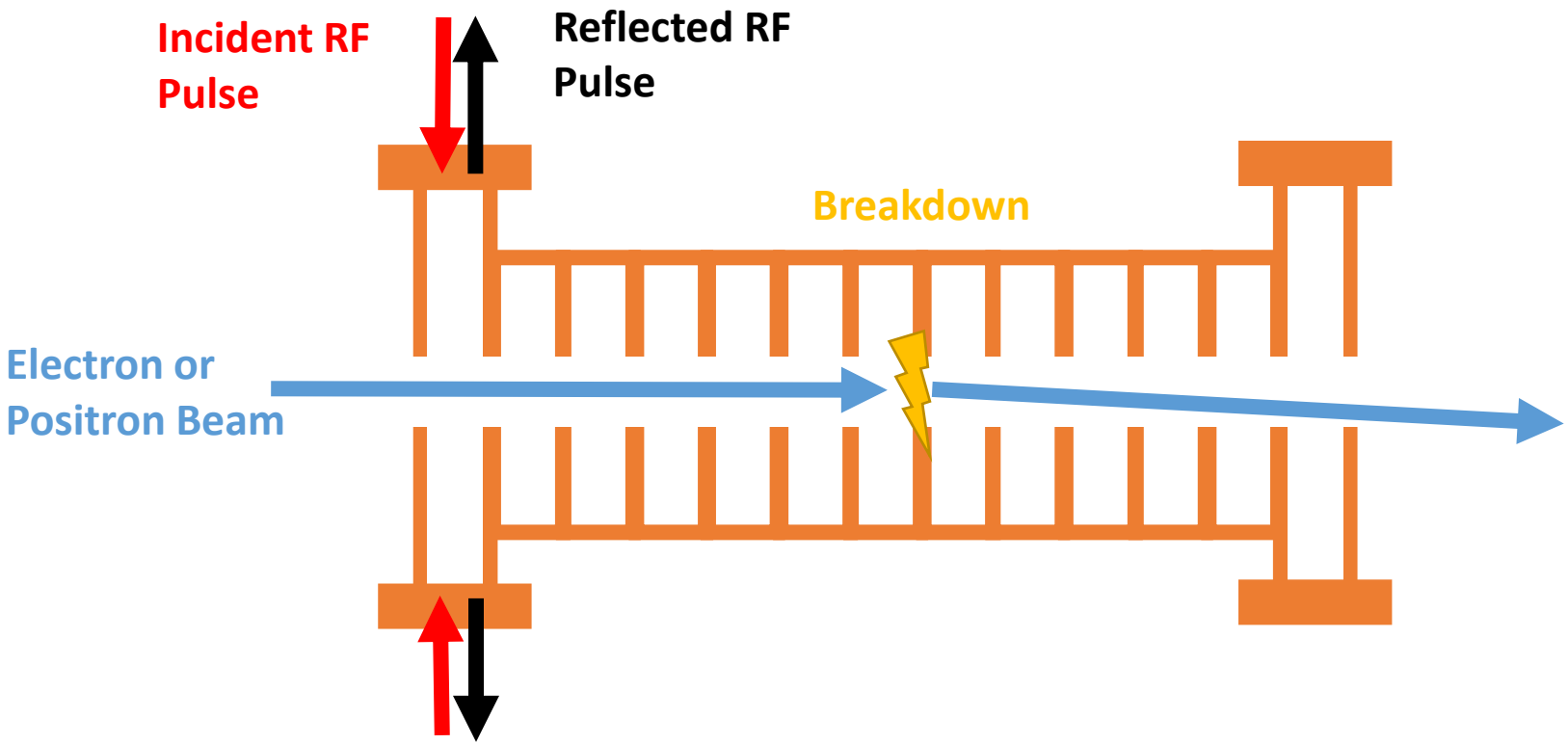


Accelerating structure under test in Xbox 2. Photo courtesy of Matteo Volpi.

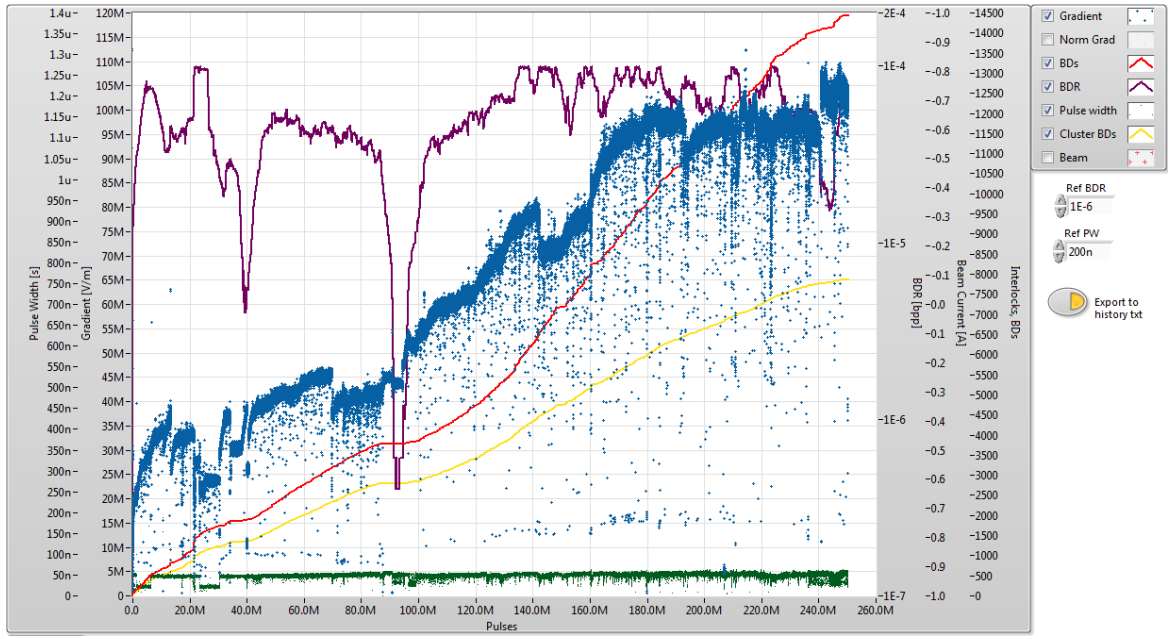
Field Emission and Breakdown



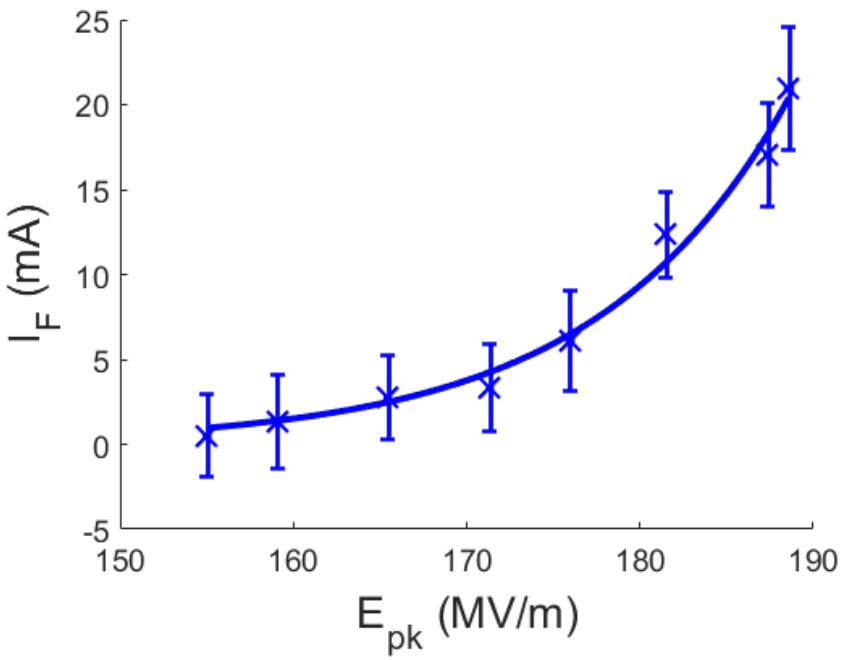
Field Emission and Breakdown



Field Emission and Breakdown

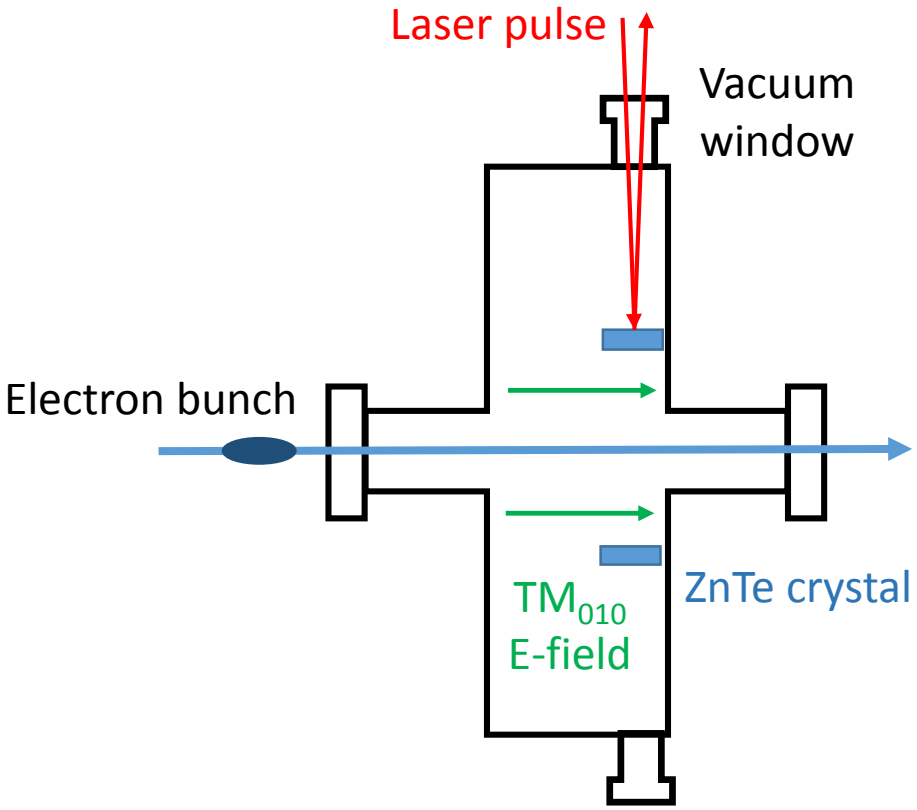


Conditioning curve for an X-band accelerating structure.

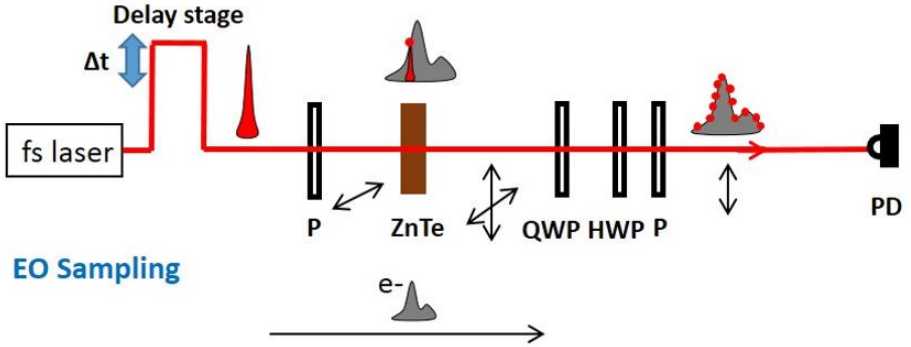


Measured field emitted current as a function of peak field.

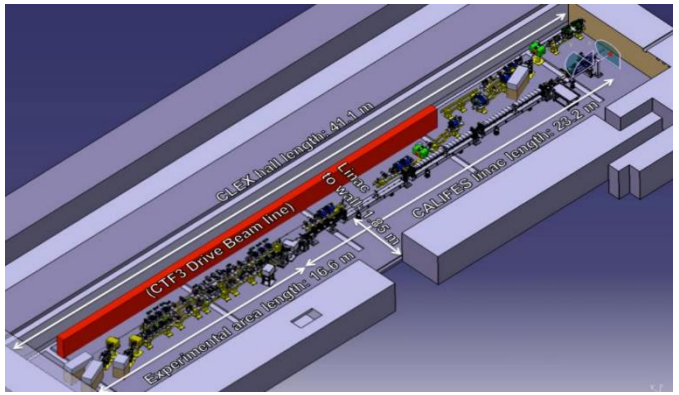
Electro-Optical Wakefield Measurements



Proposal for a wakefield monitor cavity for CLEAR.

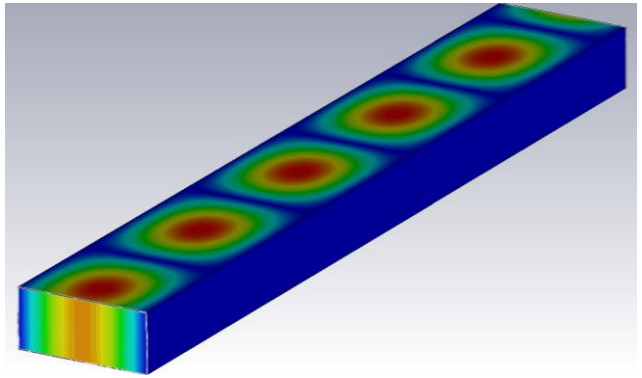


Electro-optical sampling principle. [2]

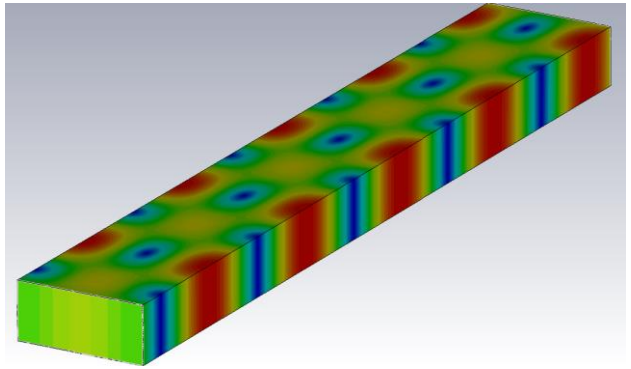


Layout of the CLEAR facility. [3]

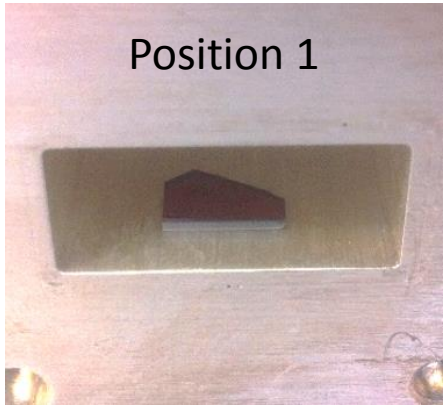
ZnTe RF Characterisation - Setup

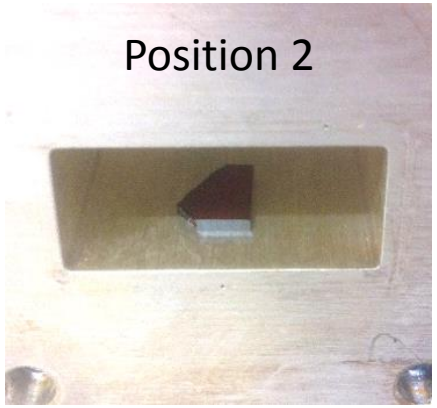


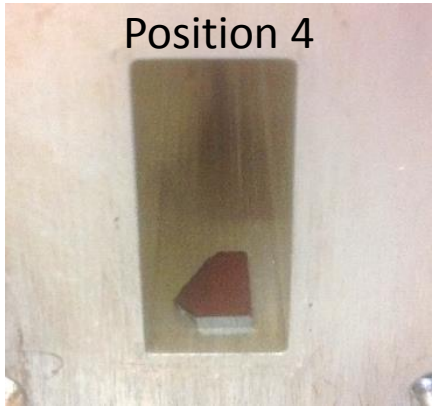
E-field in TE10 mode.



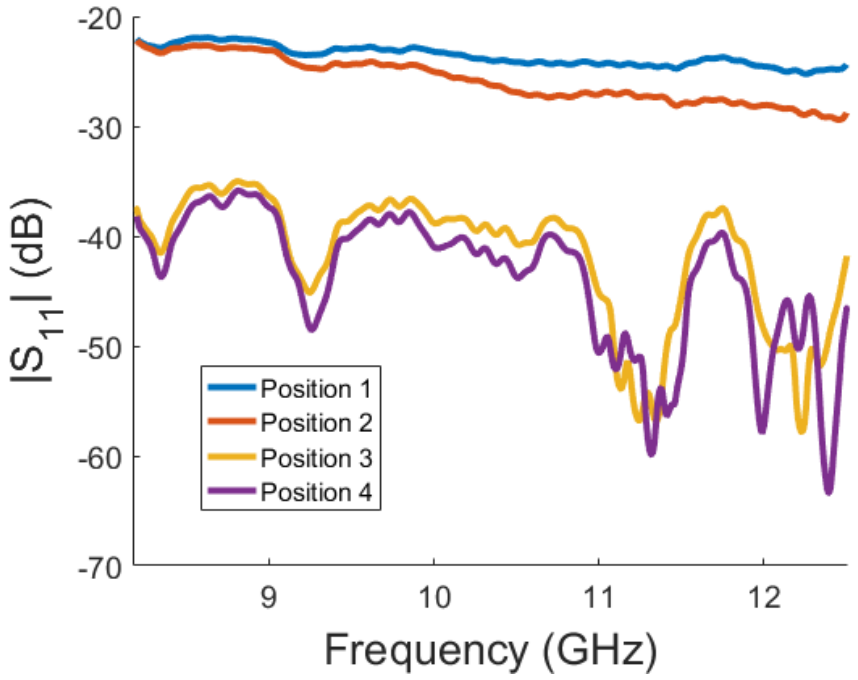
H-field in TE10 mode.



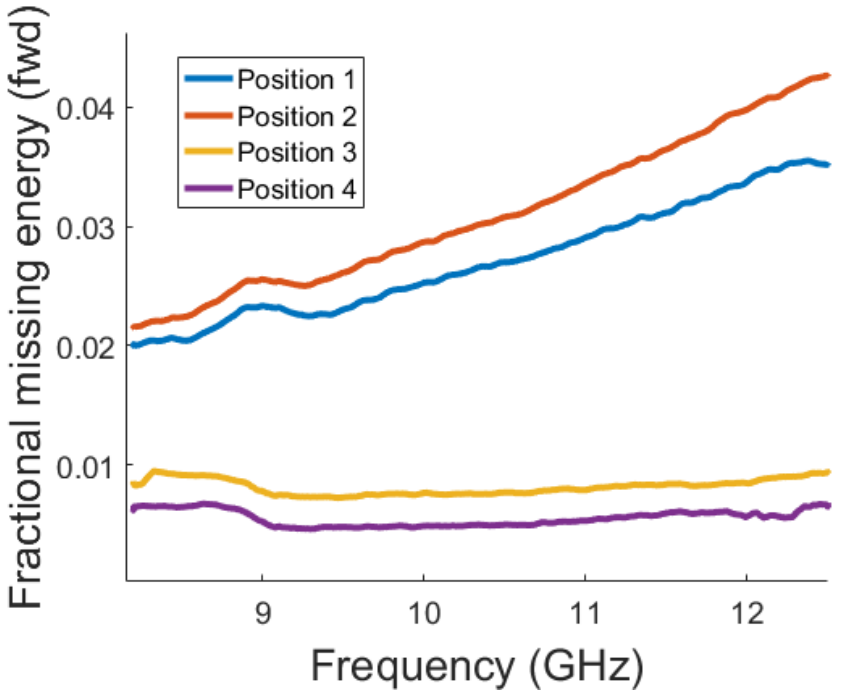




ZnTe RF Characterisation – Data

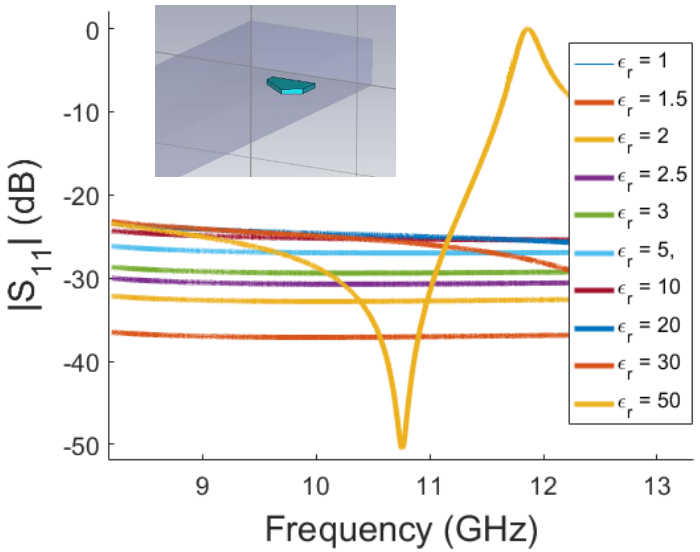


Magnitude of reflected signal.

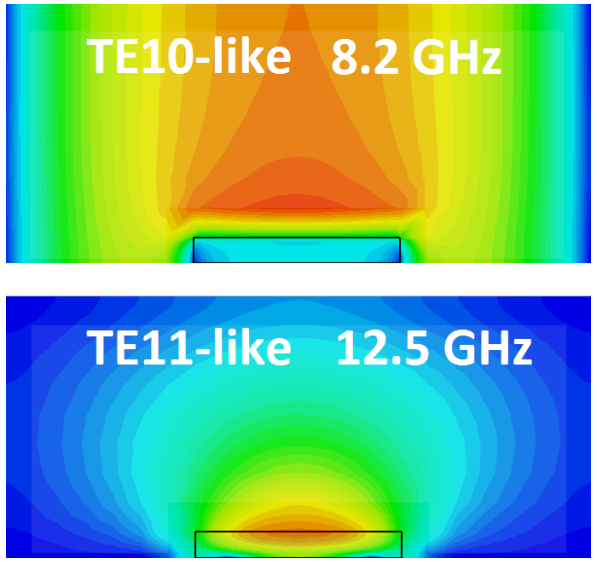


Missing energy as a function of frequency.

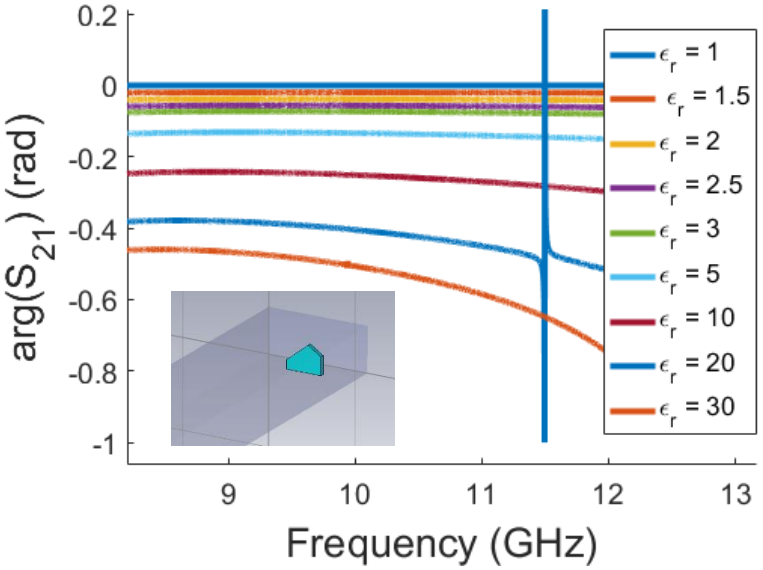
ZnTe RF Characterisation – Simulations



Magnitude of reflection at various simulated values of ε_r. (Position 1)

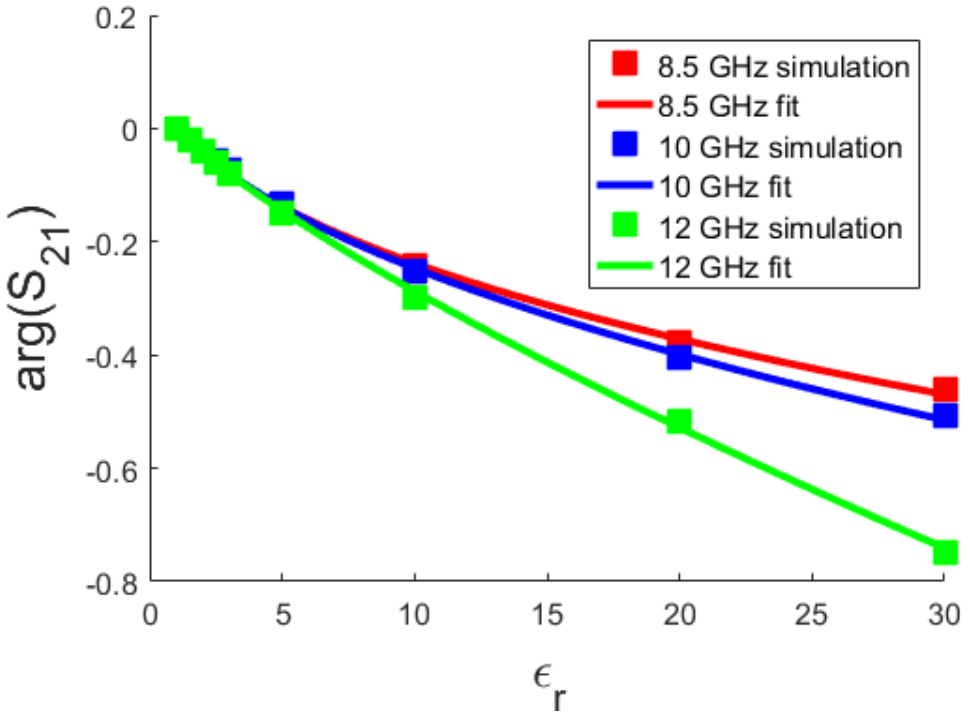


E-field distribution showing overmoding near resonant peak.

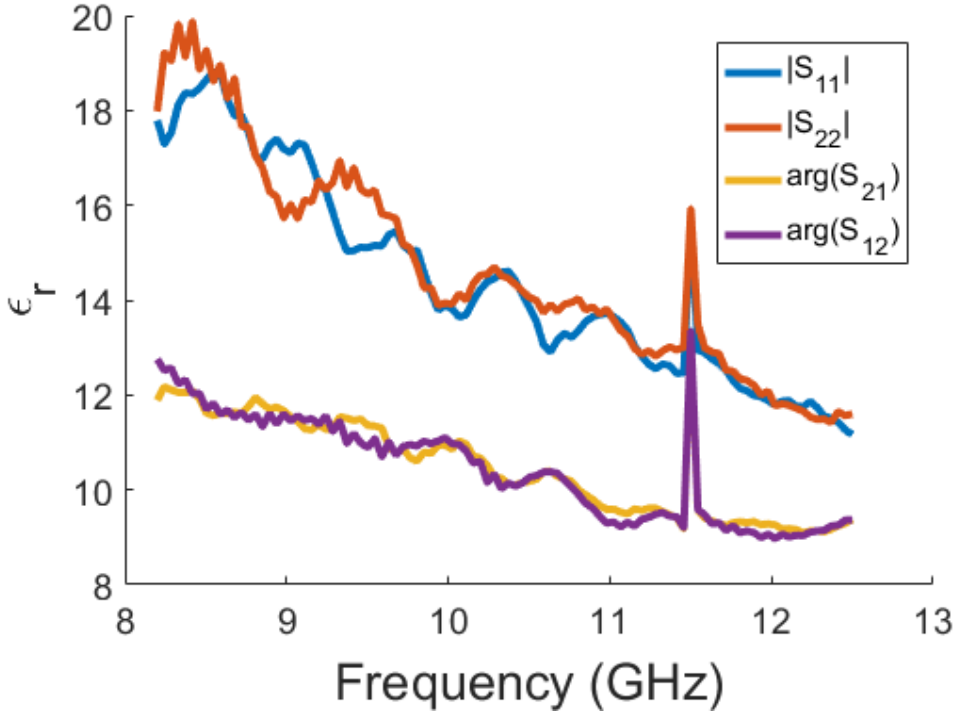


Phase shift of transmitted signal at various simulated values of ε_r. (Vertical position)

ZnTe RF Characterisation – Current Results



Simulated phase shift as a function of ε_r. (Vertical position)



Extracted ε_r using different measured data. (Vertical position)

Plans for Further Work

- Design of wakefield monitor cavity
- Calibration of cavity using RF sources
- Integration into laser sampling system at CLEAR
- Studies of high gradient phenomena in accelerating structures
- Measurement of high gradient effects on beam

References

[1] The CLIC Programme: towards a staged e +e − Linear Collider exploring the Terascale, CLIC Conceptual Design Report, edited by P. Lebrun, L. Linssen, A. Lucaci-Timoce, D. Schulte, F. Simon, S. Stapnes, N. Toge, H. Weerts, J. Wells, CERN-2012-005.

[2] R. Pan, Electro-Optic Diagnostic Tehcniques for the CLIC Linear Collider, PhD thesis, University of Dundee, 2015.

[3] M. Brugger, R. Corsini, T. Lefevre, B. Salvant, S. Stapnes, W. Wuensch, M. Petrarca, S. Reiche, C. Welsch, E. Adli, P. N. Burrows, The CLEAR facility at CERN, 2016.