THE MODULE STUDY PLANS

DISCUSSION FOR A WORKPLAN IN 2021 - 2026

CASC 22.09.2015 - 20

CLIC Project Meeting– December 2020

Contributions from S. Doebert, M. Aicheler, M. Capstick, A. Petry, H. Mainaud Durand, R. Corsini, W. Farabolini.

OUTLINE

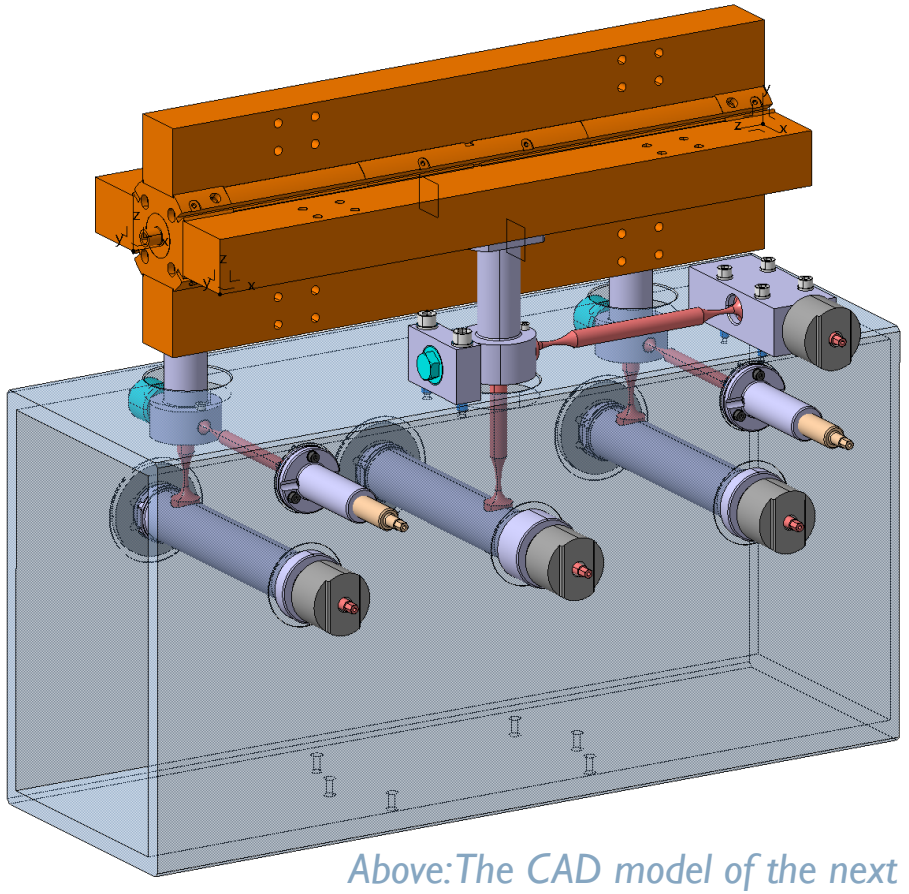
- Module activities in 2020
- Proposal for an experimental program in 2021 - 2026
- Concluding remarks.

MODULE ACTIVITIES IN 2020

Activities related to the development of an alignment platform

See presentation by M. Capstick in last June's CLIC Project meeting:
https://indico.cern.ch/event/921325/

Above: Prototype 2 (Including Thermal Test AS) – Jukka Vainola



Above: The CAD model of the next generation (V3) SAS alignment system prototype – Matthew Capstick

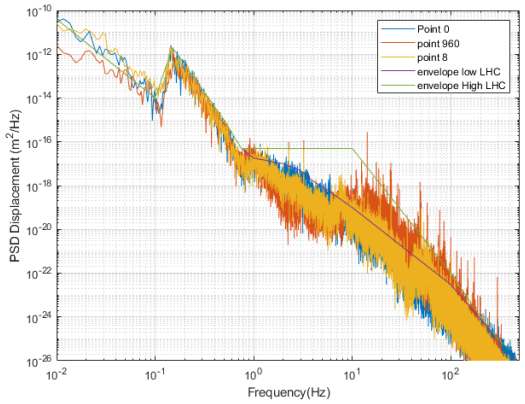
MODULE ACTIVITIES IN 2020

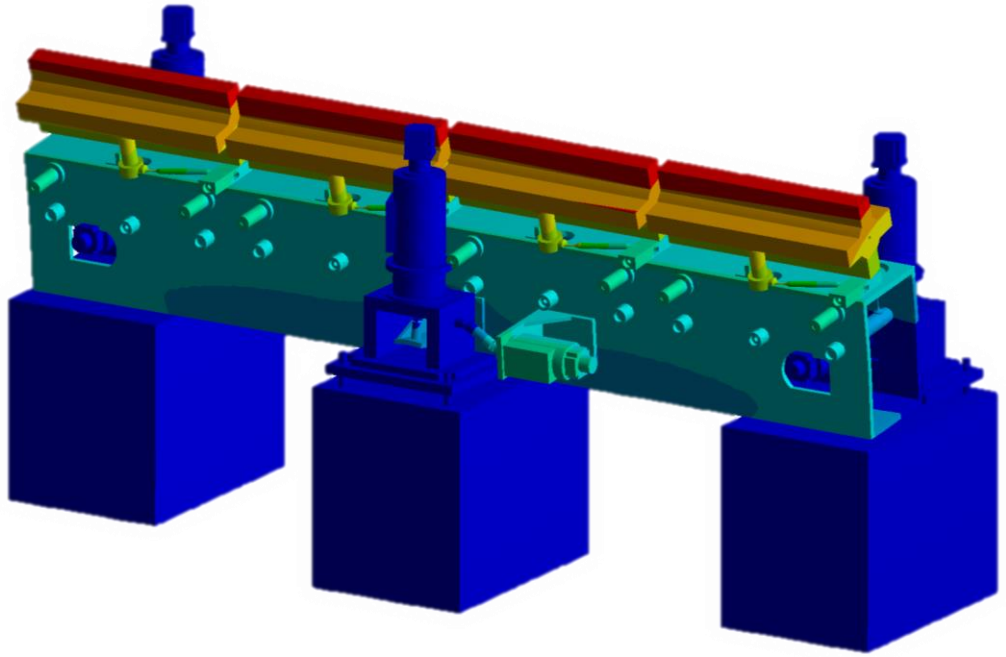
Activities related to the development of an alignment platform

See presentation by M. Capstick in last June's CLIC Project meeting:
https://indico.cern.ch/event/921325/

Known Sources of Vibration

- CLIC operational frequency:
  - 50Hz (or 100Hz)
  - The ground noise
- Other sources of vibrations:
  - Water cooling circuits
  - Tunnel air flow
  - Other, unquantified sources of mechanical vibration





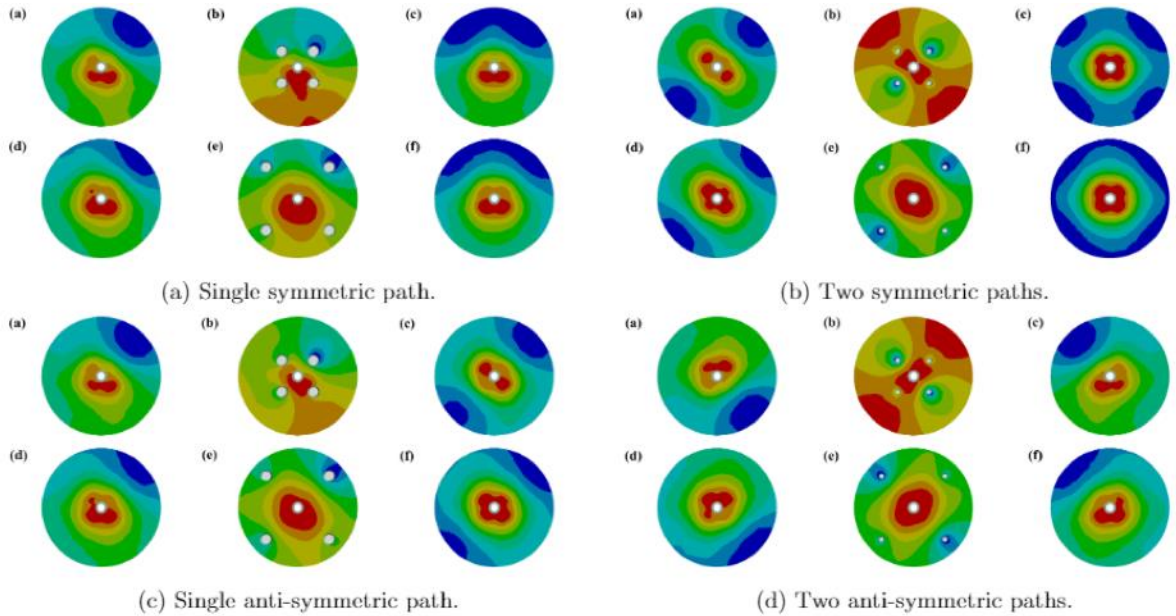
Studies for the development of a "Universal Adjustment Platform

Collaboration with M. Sosin (EN-SMM-HPA)

MODULE ACTIVITIES IN 2020

Characterization of cooling channels and cooling paths w.r.t. SAS deformation

Work performed by HIP summer trainee Alice Petry – CLIC Note in preparation



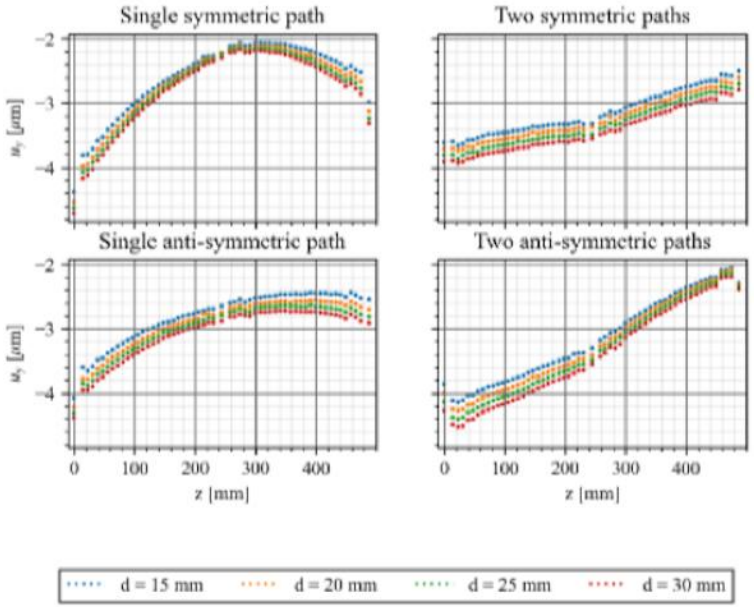
(a) Single symmetric path.

(b) Two symmetric paths.

(c) Single anti-symmetric path.

(d) Two anti-symmetric paths.

Y-axis deformation



INITIATIVE FOR A CLIC K-MODULE PROGRAM

- Different scenarios were discussed by the CLIC Module fabrication WG and the finality of this initiative, the relevant points are:
  - Finalize the design of individual components in the perspective of assembling a full klystron-based module, define or refine interfaces (relevance for projects adopting x-band technology);
  - Finalize the general alignment strategy and build the relevant procedures;
  - Complete the study of the whole RF Unit (RF source + Module) and test it at an unprecedented RF power level;
  - Build operational experience with a K– RF Unit and perform beam tests, if possible.

GUIDELINES FOR A CLIC K-MODULE EXPERIMENTAL PROGRAM

3 Areas of Activity:

Integration, mechanics and alignment;

Thermo-mechanics and RF conditioning;

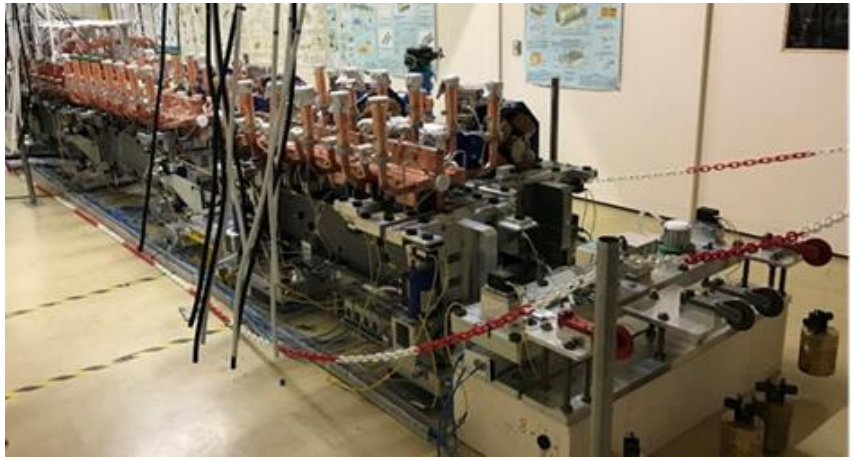
Operation with beam (in CLEAR);

	ACTIVITIES	AREA
1	General mechanical integration, including vacuum and water cooling - assembly sequences	LAB + CLEAR
2	General alignment, girder and SAS; vibration and environmental studies	LAB + CLEAR
3	Dynamic alignment: mechanical constraints, including vacuum	LAB + CLEAR
4	Thermo-mechanical behaviour of the CLIC K-Module	LAB + Xbox
5	Validation of RF critical components and general RF power handling of the system	Xbox
6	RF conditioning and operational studies of the CLIC K-Unit (RF power source and Module)	Xbox
7	Experimental program with beam in the CLEAR tunnel	CLEAR

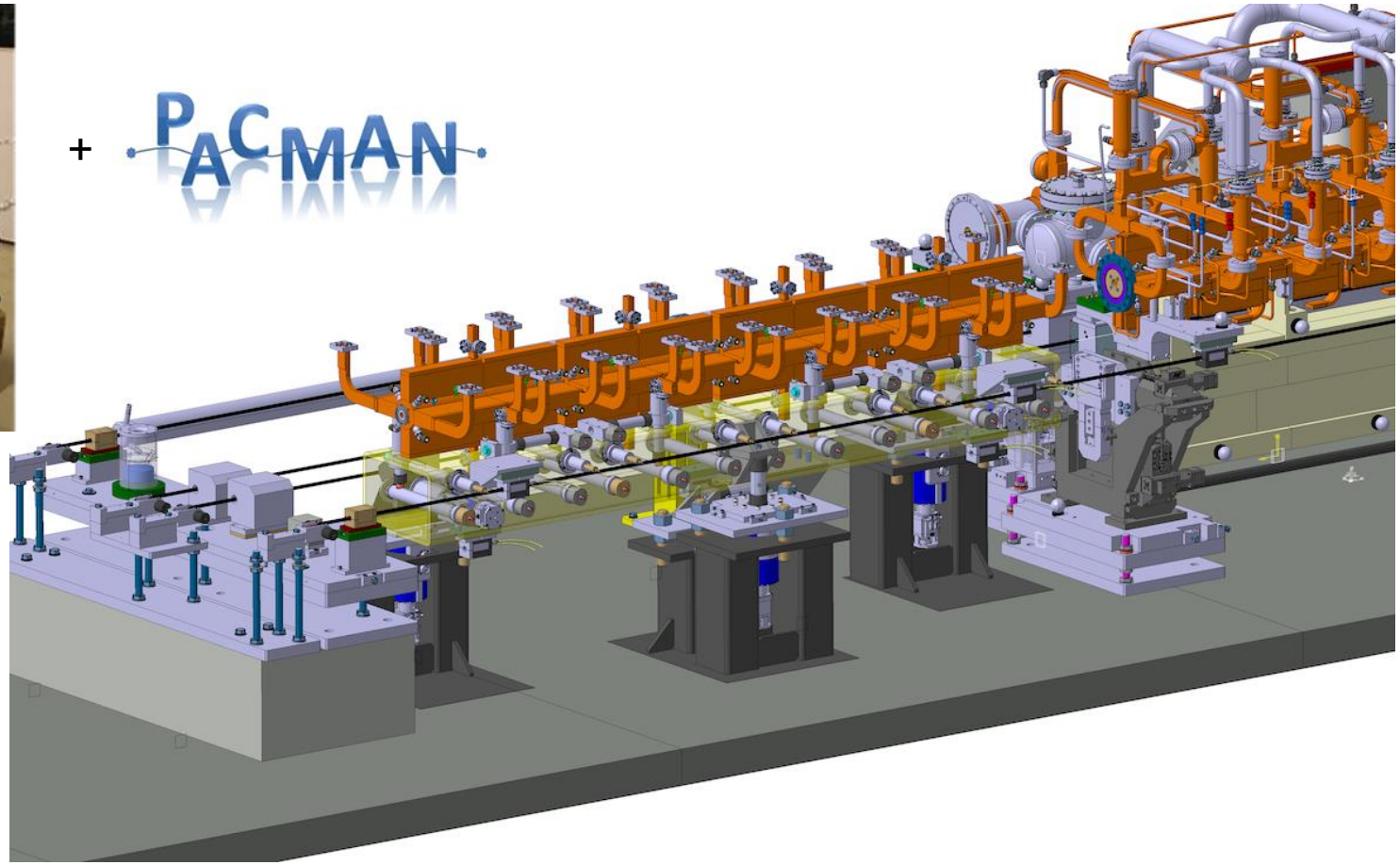
EXPERIMENTAL PROGRAM : MECHANICS AND ALIGNMENT

1	**General mechanical integration, including vacuum and water cooling - assembly sequences**	LAB + CLEAR
	Development of a technical specification for production	LAB
	Fiducialisation "à la PACMAN"	LAB
	Procedures for assembly and installation	LAB
2	**General alignment, girder and SAS; vibration and environmental studies**	LAB + CLEAR
	Absolute alignment of components, including longitudinal	LAB
	Transport test	LAB
	Test alignment in a real accelerator environment	LAB + CLEAR
	Perform alignment at different ambient temperatures, from 20 °C	LAB
	Vibrational modes characterization (collaboration Oxford ?)	LAB
3	**Dynamic alignment: mechanical constraints, including vacuum**	LAB + CLEAR
	Experience dynamic alignment with waveguide constraints, vacuum forces and thermal stresses	LAB + CLEAR

EXPERIMENTAL PROGRAM : MECHANICS AND ALIGNMENT



\+ PACMAN

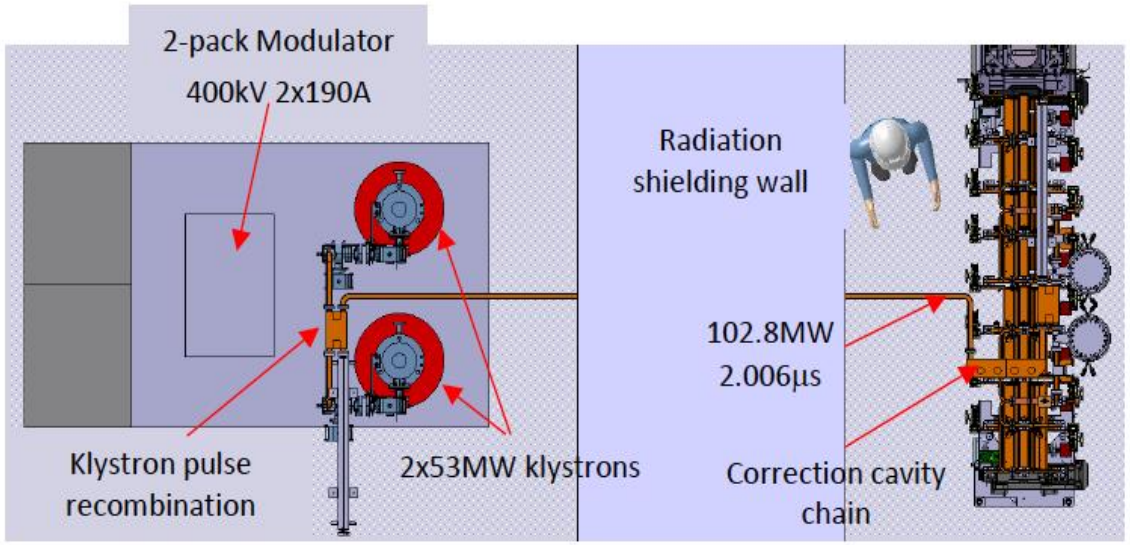


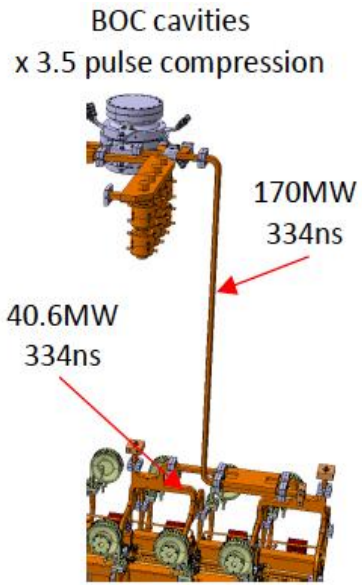
Laboratory space for alignment studies and integration of the new girder layout.

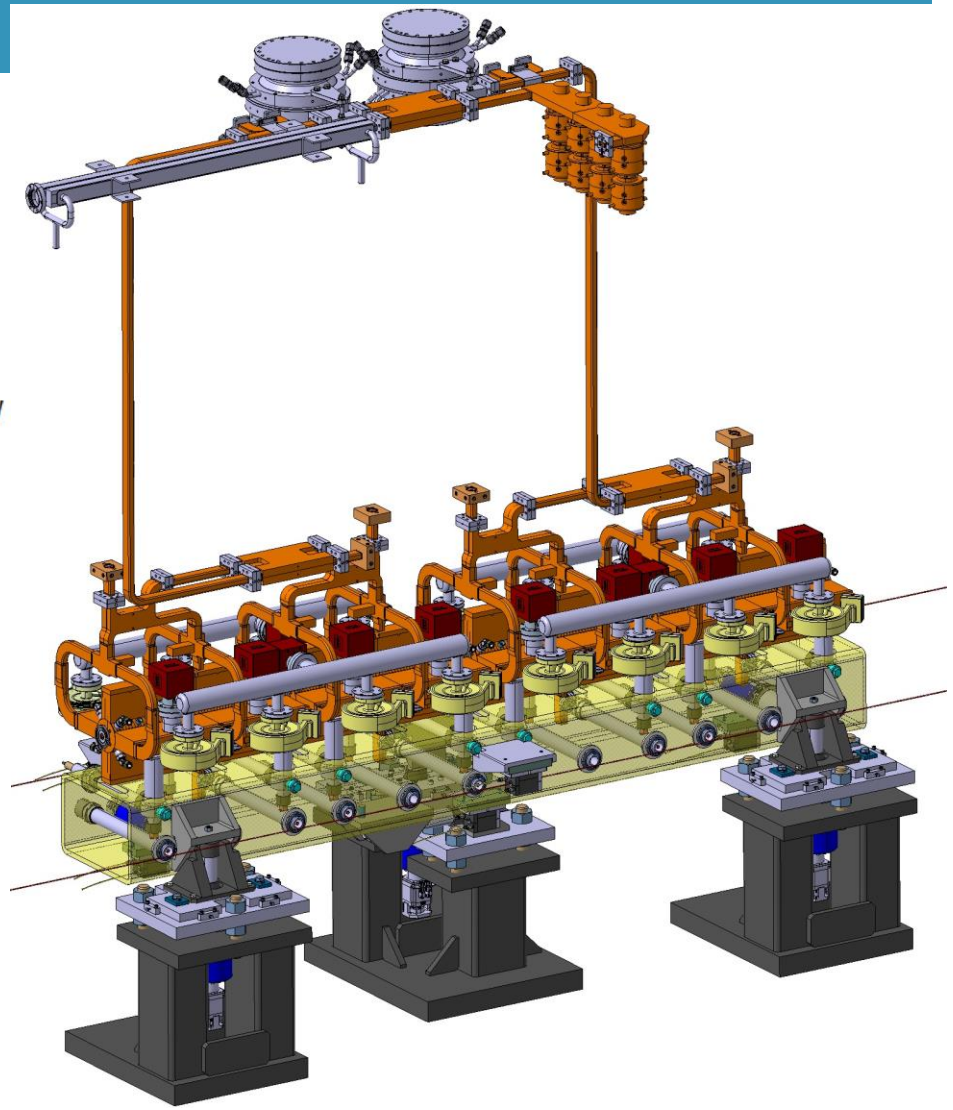
EXPERIMENTAL PROGRAM : THERMO-MECHANICS AND RF CONDITIONING

4	**Thermo-mechanical behaviour of the CLIC K-Module**	LAB + Xbox
	FEA thermal model benchmarking	LAB + Xbox
	K-Module cooling circuit optimization	LAB + Xbox
	Influence of temperature on sensors, targets, movers (in progress, HL-LHC)	LAB + Xbox
5	**Validation of RF critical components and general RF power handling of the system**	Xbox
	Waveguide circuit stabilization	Xbox
6	**RF conditioning and operational studies of the CLIC K-Unit (RF power source and Module)**	Xbox
	Develop and optimize commissioning strategies for the complete RF K-unit	Xbox
	Experience different operational conditions (start-up, breakdown, stable operation)	Xbox

EXPERIMENTAL PROGRAM : THERMO-MECHANICS AND RF CONDITIONING





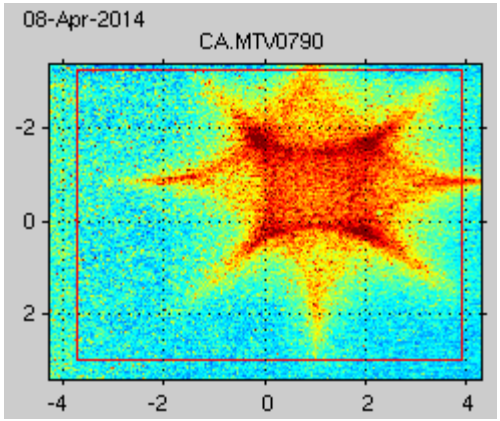


EXPERIMENTAL PROGRAM : OPERATION WITH BEAM

7	**Experimental program with beam in the CLEAR tunnel**	CLEAR
	Alignment and beam performance	CLEAR
	- Study beam sensitvity to alignment quality	CLEAR
	- Study the operation of active alignment driven by signals from BPMs and WFMs	CLEAR
	- Study the vibrational aspects and their impact on beam quality	CLEAR
	- Assess installation and maintainability easiness with the constraints of a beam line	CLEAR
	RF Operation	CLEAR
	- Develop strategies to handle breakdowns in the presence of beam	CLEAR
	- Apply transient beam loading compensation strategies to preserve beam quality	CLEAR
	- Study how to maintain correct AS phasing during operation	CLEAR
	- Study beam emittance preservation and its sensitivity to the residual RF harmonic content	CLEAR
	Facility operation	CLEAR
	- Study the sensitivity of electronics to the radiation environment of the accelerator	CLEAR
	- Assess the effectivenes of the temperature stabilization control	CLEAR
	- Demonstrate a reliable 200 MeV beam energy gain in a single module	CLEAR

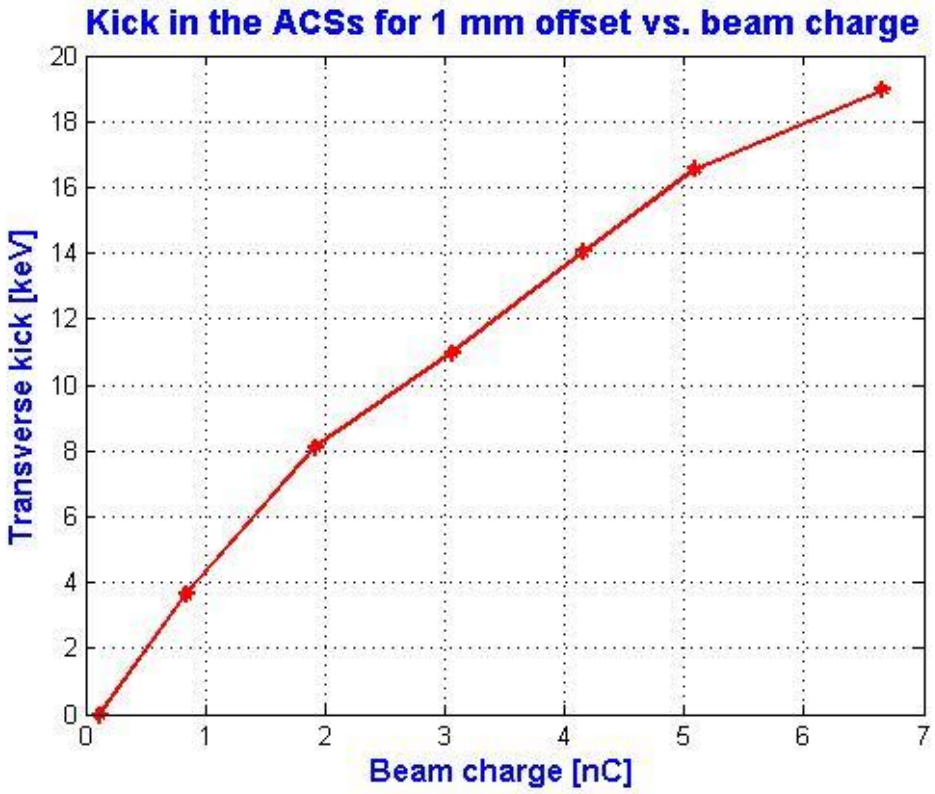
CLEAR EXPERIMENTAL PROGRAM : FEW EXAMPLES

SLIDES BY W. FARABOLINI – CLIC WORKSHOP 2015



A mix depending
on bunch length

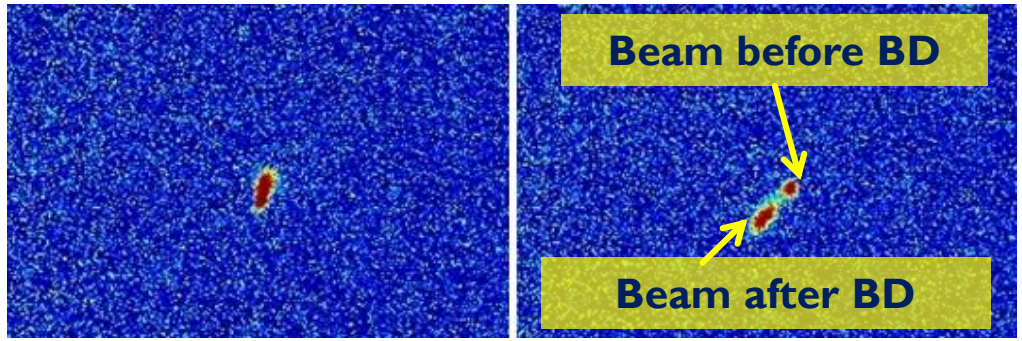
Octupole component in CLIC accelerating structure, **Jim Alexander**, Mon 26/01 14:40



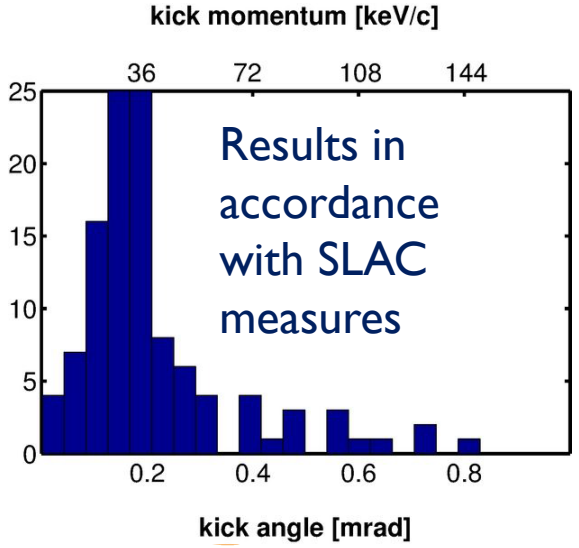
Kick up to 19 kV for 1 mm offset and 0.22 nC per bunch,
30 bunches: 85.5 kV /nC /mm /m

CLEAR EXPERIMENTAL PROGRAM : FEW EXAMPLES

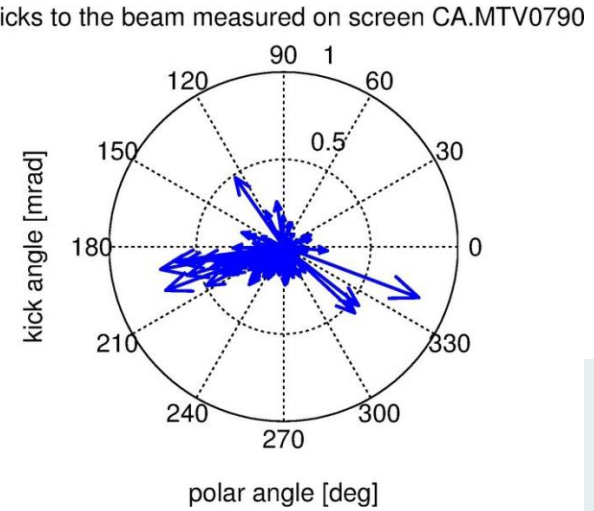
SLIDES BY W. FARABOLINI – CLIC WORKSHOP 2015

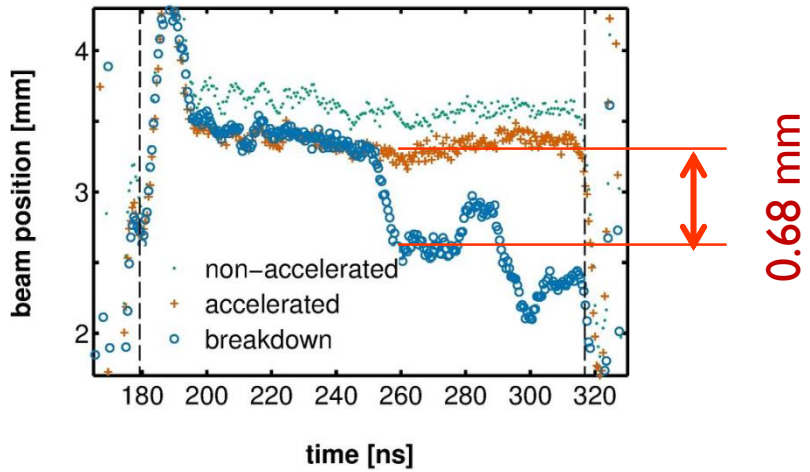


On YAG screen without BD



With BD



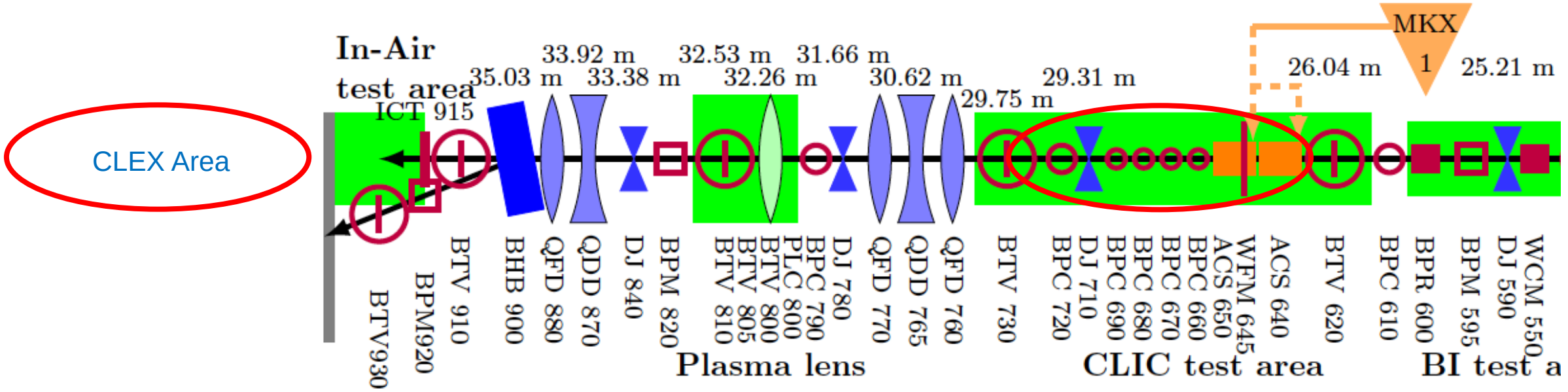


Time resolved position on cavity BPM

A. Palaia PhD Thesis

EXPERIMENTS WORTH to be CONTINUED with much more statistics

CLEAR EXPERIMENTAL PROGRAM : AREAS FOR INSTALLATION



Possible installation in the CLIC Test Area or in the CLEX Area
(to be checked by the Beam Dynamics team)

CONCLUDING REMARKS

- The proposed Module program is articulated in 3 areas of activity, at this moment only the first area (integration, mechanics and alignment) is financed;
- The full program would provide valuable data and experience to all those projects that intend to adopt the x-band technology as their baseline;
- The coordination of the program by CERN would assure the overall coherence of the different developments;
- We hope that such program meets the interest of the collaborating partners who intend to engage resources into the x-band technology.