CLIC module

Experimental program for module array

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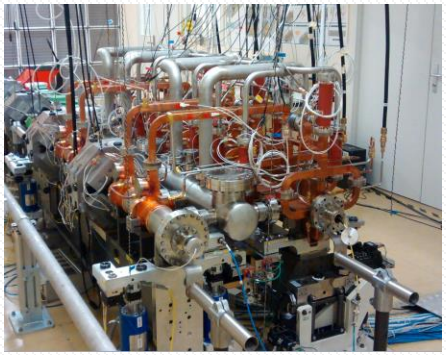
Introduction

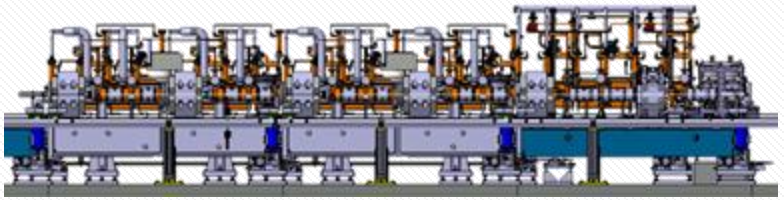
2011 - 2015

- One module T0-1
- First attempt to study the thermo-mechanical behaviour of CLIC **(Phase-I)**



2016 - …

- Module array: Three modules T0-1, T0-2, T1
- Extension of experimental program **(Phase-II)**



Objectives

Active pre-alignment

- Fiducialization
- Alignment girders and components

Observation

Thermo-mechanical behaviour under operating conditions

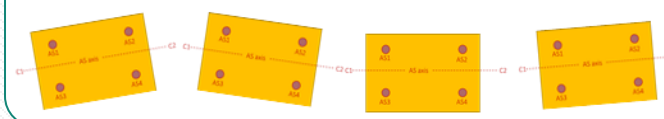
Action

Translate to real CLIC

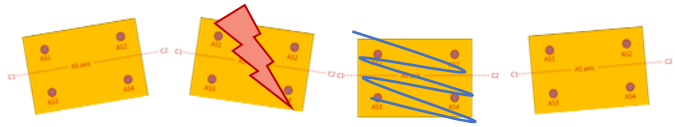
Objectives

Ultimate objective: Learn how to…

Pre-align/inverse-align



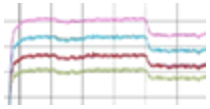
Preserve pre-alignment under operating conditions



Know position of components in real-time

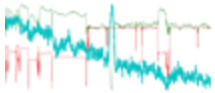
FEA Simulator

Can we use temperature?



React to breakdown

Can we regulate with water flow?



Experimental program

Active pre-alignment

Test	Description
Fiducialization of components and supports for T0#2 and T1	• Adjustment and test of new V-shaped supports • Installation of fiducials and sensors interfaces • Magnetic measurements for DBQ
Alignment of components on their supports	• Measurements and adjustments • Preparation of the 2 standard DBQ supports : assembly & validation • Preparation of the 2 non-standard DBQ supports : design, assembly & validation
Alignment of girders	
Installation of sensors	• Calibration & test • Validation in situ • Installation of cables & acquisition system • Analysis of data
Active algorithm	• Implementation • Validation

Experimental program

Observation

Test	What we do	What we learn
Articulation point	• Shocks, loads, constraints • T°	• Investigate stability over time
Thermo-mechanical test without vacuum	• Nominal operation mode • Transients	• Comparative assessment T0-1, T0-2 • Study T1 • Modules interconnection • Comparative assessment of cradle sensors • MB-DB dependence
Vacuum tests	Apply vacuum	• Displacement of girders • Roll • Displacement of cradles
Thermo-mechanical test under vacuum	• Vacuum • Nominal operation mode • Transients	• Steady-state and time constants under vacuum • Modules interconnection • MB-DB dependence
Failure modes	• SAS breakdown • PETS breakdown	• Temperature and displacement during breakdown • Maximum acceptable duration for breakdown
Vibration tests	Add accelerometers	• Sources of vibration • Dangerous eigen-frequencies

Experimental program

Action

Test	Description
Inverse alignment	Pre-align in negative displacements and test if under nominal operation the components align at correct zero position
Regulate breakdown displacements	• Time constant depends on water flow • Develop control algorithm to regulate water flow towards minimization of displacement
Displacement prediction	• Can we predict displacement from temperature using a simple mathematical model? • Development of real-time displacement diagnostic • Comparison with simulator • How many temperature inputs do we need?
CTF3/CLIC	Relate module to CTF3 • CLEX • Dogleg

Experimental program

Document

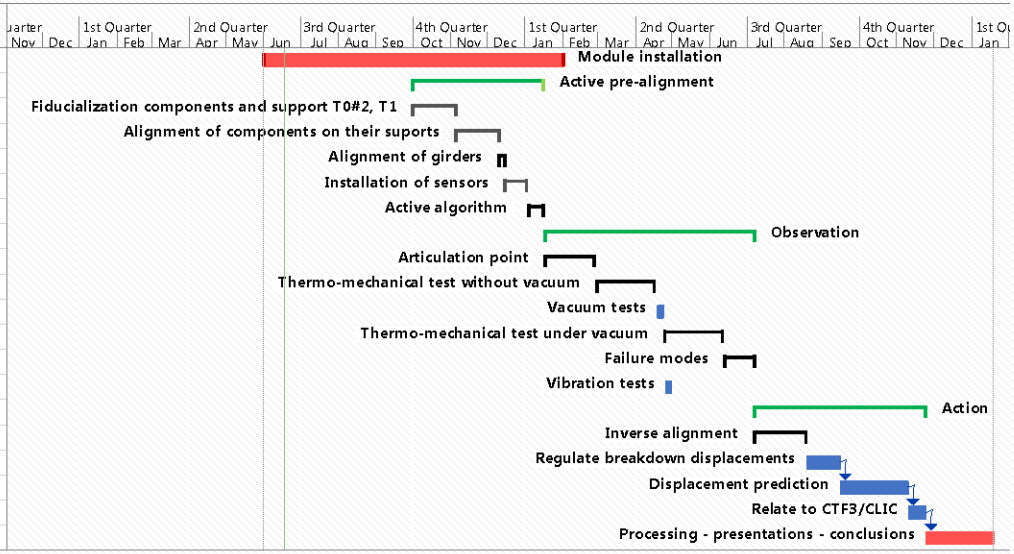
Meet CLIC tolerances?

Finalize measurement methods

Finalize procedures

Planning

ID	Task Mode	Task Name	Duration	Start	Finish
1		Module installation	176 days	Mon 01/06/15	Sun 31/01/16
2		Active pre-alignment	77 days	Thu 01/10/15	Fri 15/01/16
3		Fiducialization components and support T0#2, T1	25 days	Thu 01/10/15	Wed 04/11/15
7		Alignment of components on their suports	26 days	Thu 05/11/15	Thu 10/12/15
11		Alignment of girders	2 days	Fri 11/12/15	Mon 14/12/15
13		Installation of sensors	14 days	Tue 15/12/15	Fri 01/01/16
18		Active algorithm	10 days	Mon 04/01/16	Fri 15/01/16
20		Observation	123 days	Mon 18/01/16	Wed 06/07/16
21		Articulation point	30 days	Mon 18/01/16	Fri 26/02/16
24		Thermo-mechanical test without vacuum	35 days	Mon 29/02/16	Fri 15/04/16
32		Vacuum tests	5 days	Mon 18/04/16	Fri 22/04/16
33		Thermo-mechanical test under vacuum	35 days	Mon 25/04/16	Fri 10/06/16
41		Failure modes	18 days	Mon 13/06/16	Wed 06/07/16
47		Vibration tests	5 days	Mon 25/04/16	Fri 29/04/16
48		Action	100 days	Thu 07/07/16	Wed 23/11/16
49		Inverse alignment	30 days	Thu 07/07/16	Wed 17/08/16
51		Regulate breakdown displacements	20 days	Thu 18/08/16	Wed 14/09/16
52		Displacement prediction	40 days	Thu 15/09/16	Wed 09/11/16
53		Relate to CTF3/CLIC	10 days	Thu 10/11/16	Wed 23/11/16
54		Processing - presentations - conclusions	40 days	Thu 24/11/16	Wed 18/01/17



Thank you for your attention

More details

Themo-mechanical tests

Measurement	Test	Time (days)
Steady-state		10
T	Nominal temperatures only	2
T, M	Zero-DBQ only-Zero	2
T, M	Zero-Unloaded-Zero	2
T, M	Zero-Loaded-Zero	2
T, M	Unloaded-Loaded-Unloaded	2
Transients		15
T	f_1, P_1, 20°C	1
T	f_2, P_1, 20°C	1
T	f_3, P_1, 20°C	1
T	f_1, P_2, 20°C	1
T	f_2, P_2, 20°C	1
T	f_3, P_2, 20°C	1
T	f_1, P_3, 20°C	1
T	f_2, P_3, 20°C	1
T	f_3, P_3, 20°C	1
T, M	f_1, P_1, 20°C	3
T, M	f_3, P_1, 20°C	3
Failure modes		8
T	SAS/PETS breakdown	2
T, M	Loaded-SAS breakdown-Loaded	2
T, M	SAS breakdown-PETS off-SAS breakdown	2
T, M	Loaded-PETS off-Loaded	2

More details

For type 0 & type 1 (RF components)

- New support for the sensors, directly fixed on the girder and no more on the cradle
  - Design of a specific support, manufacturing & validation on the girder allowing a repeatable position after a change of T°
  - To be integrated on TBTM
  - Adaptation of the design on the cradle

- DB quad support + 5 DOF motorization
  - Assembly of 2 supports
  - Design of 2 additional supports
  - Motorization & validation

- Development of an active pre-alignment algorithm
  - Change the acquisition system
  - Add sensors
  - Solve rigid links between girders

- validation of the “inverse alignment strategy”

Regulate breakdown displacement