TS day on CLIC

The goal of the CLIC module working group

G. Riddone

05.07.2007

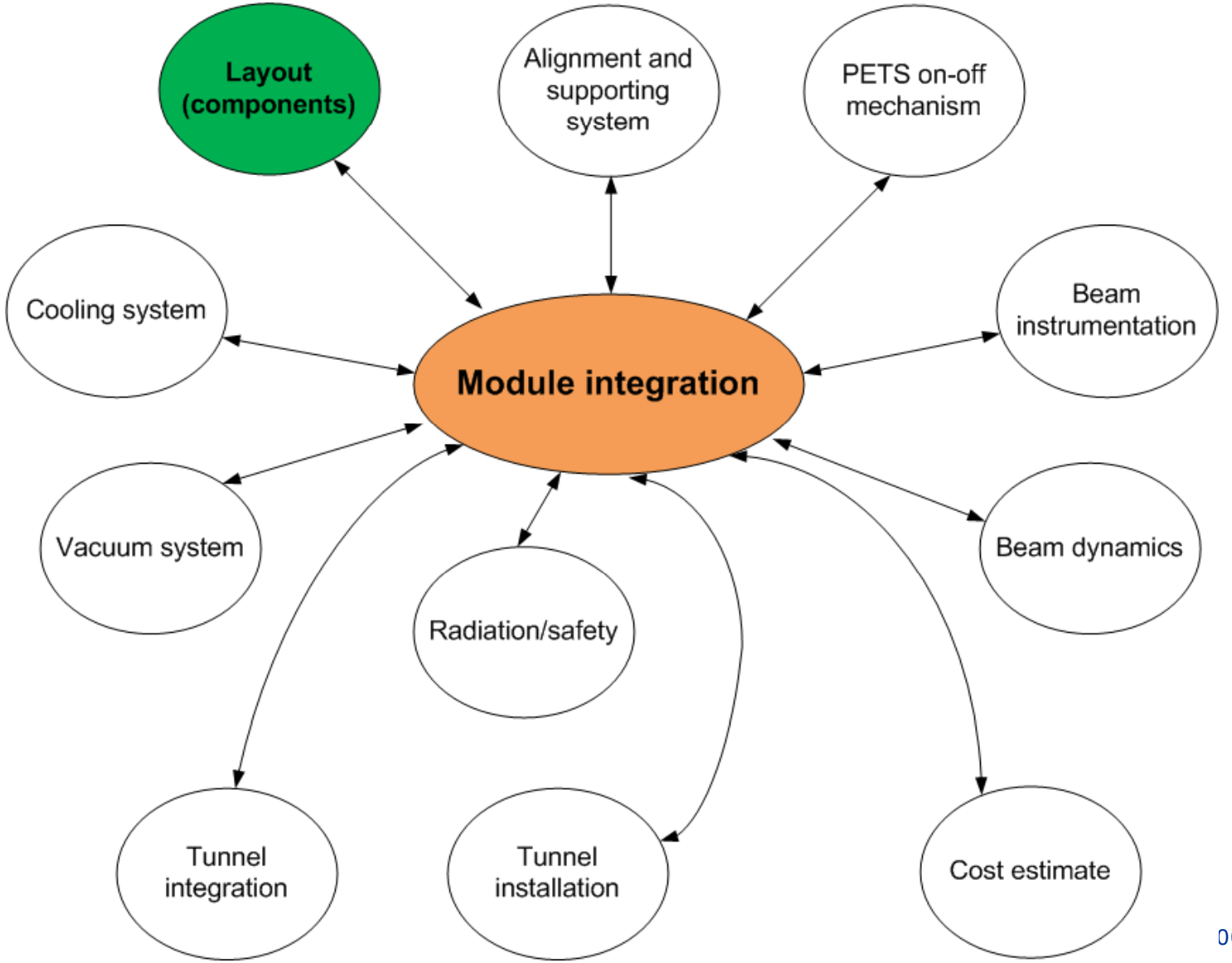
Content

- Introduction
- Layout
- Module integration
- Tunnel integration
- Status and future work
- Conclusions

Mandate

- Develop
  - general layout,
  - system integration,
  - space hindrance,
  - number of components and their position
- Specify the alignment/supporting system
- Specify the cooling system
- Specify the vacuum system
- Specify the beam instrumentation
- Study the tunnel integration and installation
- Identify critical points
- Estimate the cost

Activity domains



Members

Layout
- W. Wuensch
- I. Syratchev: PETS
- A. Grudiev: accelerating structures (AS)
- T. Zickler: Quadrupoles

Module integration
- R. Leuxe
- T. Sahner - M. Taborelli
- W. Wuensch

Vacuum system
- P. Costa-Pinto - P. Chiggiato
- N. Hilleret

Alignment/supporting system
- H. Mainaud-Durand – T. Touzet (survey/alignment)
- R. Nousiainen (supports)
- J. Huopana (structure assembly)

Cooling system
- R. Nousiainen

Beam dynamics and stabilisation
- D. Schulte

Beam instrumentation
- L. Søby

PETS on-off mechanism
- B. Nicquevert

Tunnel integration, installation
- JL. Baldy
- G. Riddone
- C. Wyss

Radiation
- H. Vincke

Cost estimate
- G. Riddone
- C. Wyss

Layout

Main beam: **accelerating structure length**
Drive beam: PETS length

→ Module length

The module length defines the drive beam quadrupole length (+ BPM) and the main beam quadrupole lengths (+BPM)

↓

Feasibility of the quadrupoles is then to be verified

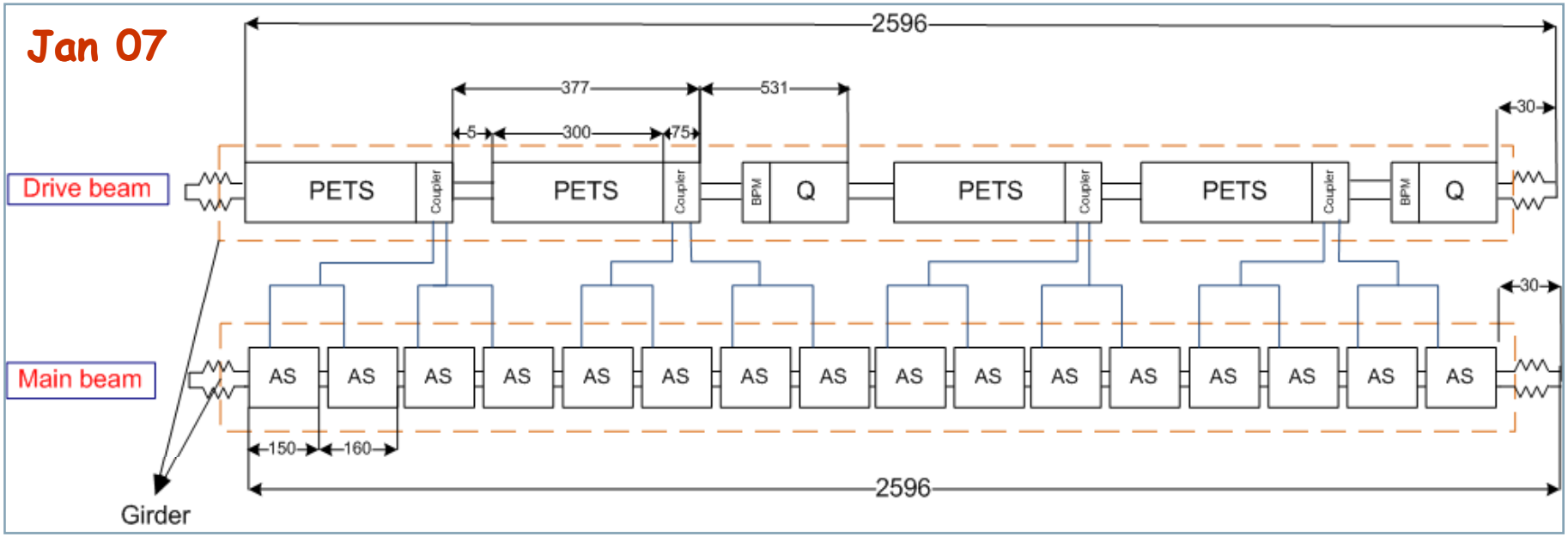
SINCE Jan 2007

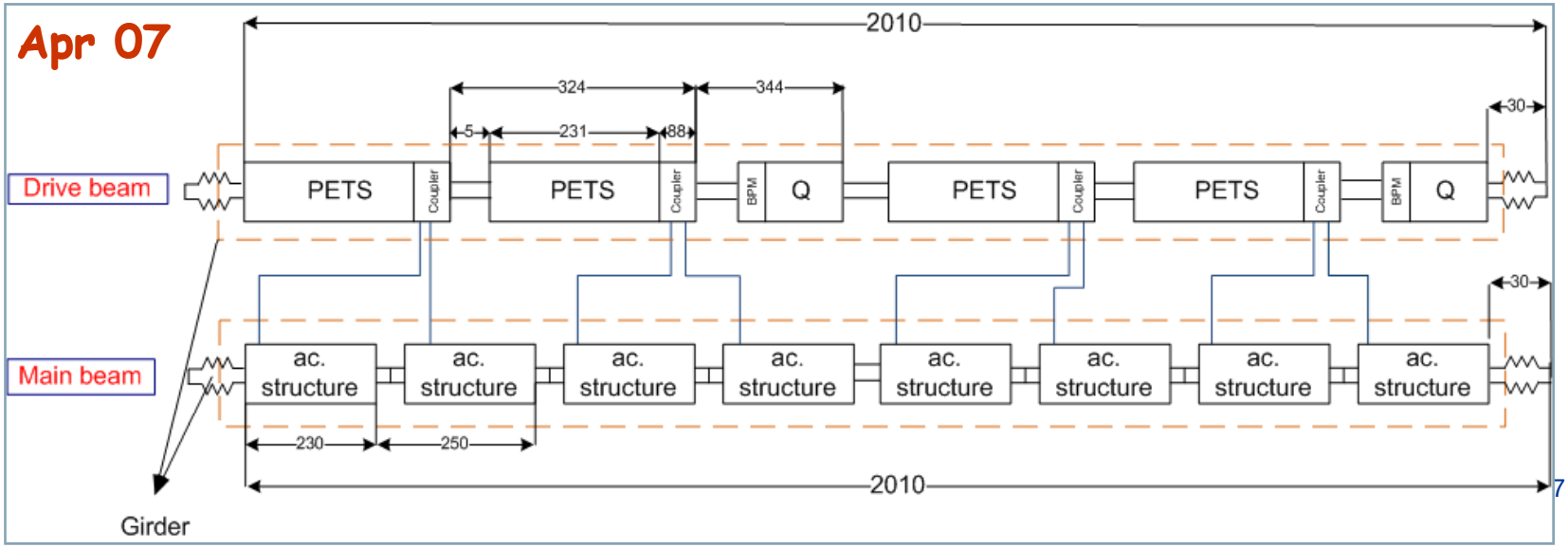
- 1st Layout @ 12 GHz, 100 MV/m following change of parameters at the end of 2006 (January-April 2007)

- Updated layout from mid of April 2007
  - standard module (from April 2007)
  - quadrupole modules: pairs of accelerating structures replaced by quadrupole (from June 2007)

Flexibility is required

Standard module

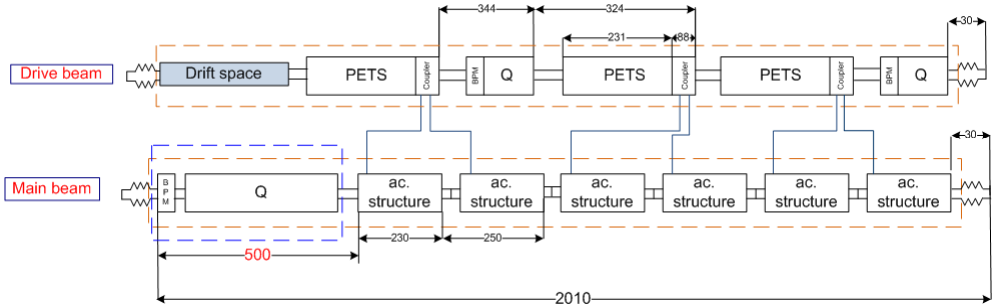




× 16748

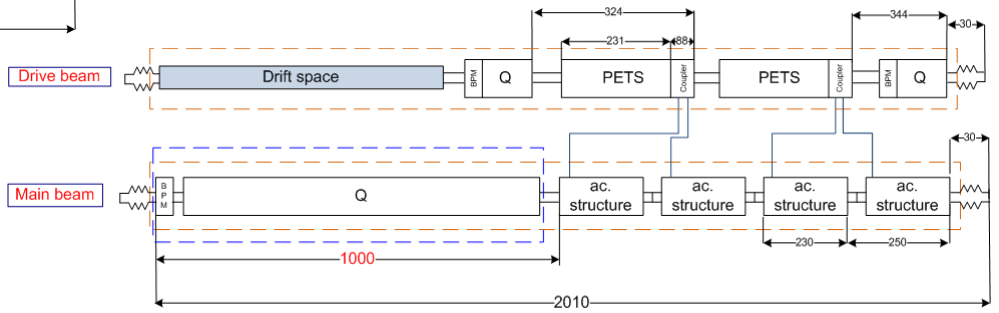
7.07.05

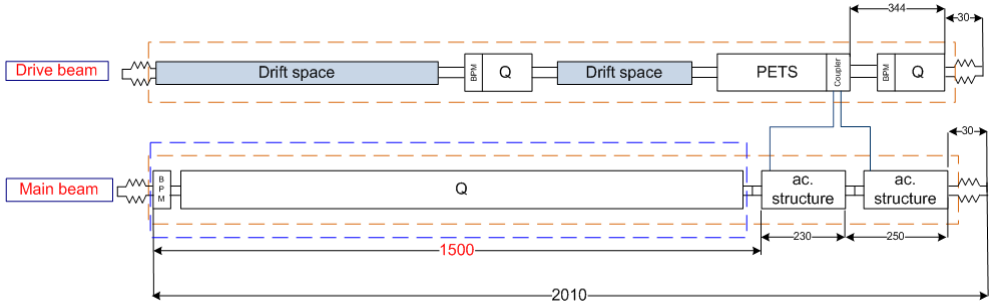
Quadrupole type modules



Type 1 (x 288)

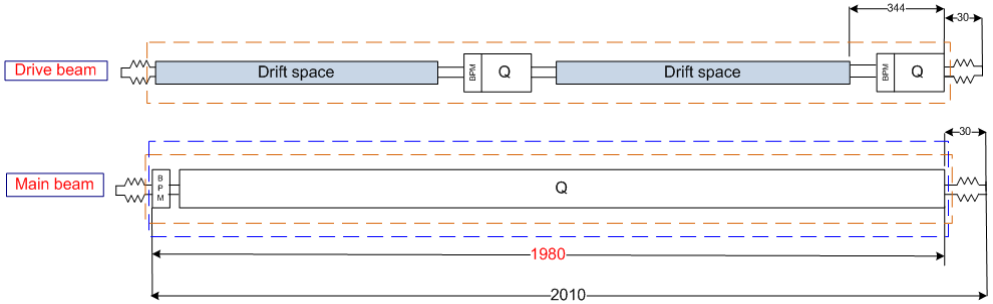
Type 2 (x 1328)





Type 3 (x 948)

Type 4 (x 1448)



Module integration

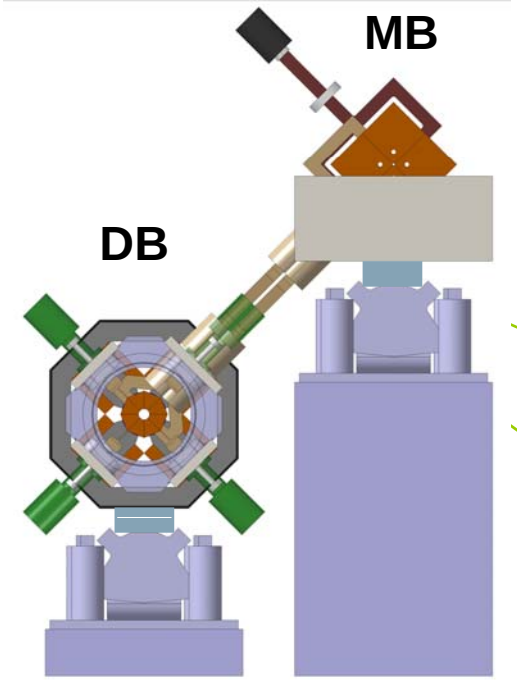
- Decision to work in parallel to input definition
- Baseline approach:
  1. Definition of the layout
  2. Identification of the main systems (alignment/supporting system, vacuum,..) and tunnel constraint
  3. First round integration
     1. Definition of input for space reservation
     2. Choice of more complicated solutions
     3. Integration of main systems in terms of space reservation
  4. Detailed study of each system and parallel integration

Module integration

- Main boundary conditions (in addition to input on accelerating structures and PETS)
  - PETS-accelerating structure inter-axis: 750 mm
  - Acc. structures: quadrants
  - Tank for PETS and tank for acc. structures
  - PETS and accelerating structures with common vacuum
  - Separate PETS and accelerating structure girders

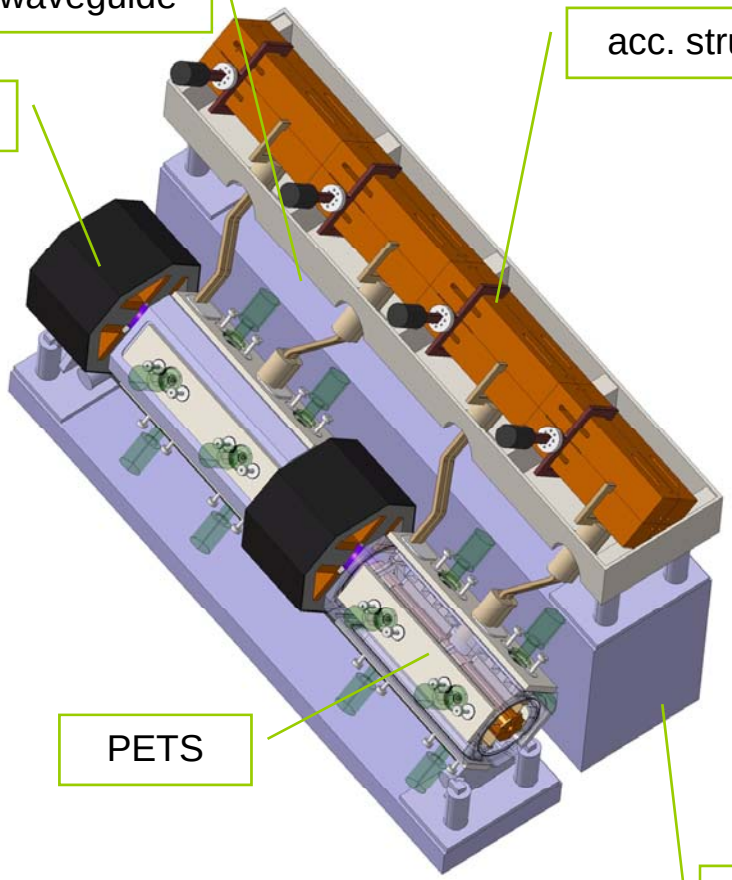
  - BPM attached to drive beam quadrupoles
  - Separate BPM and main beam quadrupoles
  - BPM attached to each accelerating structures

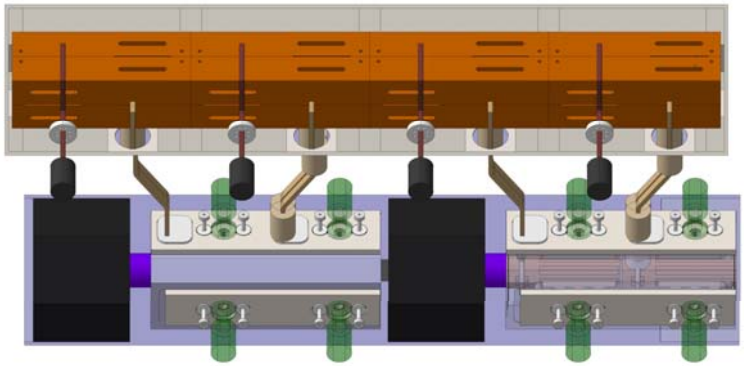
Standard module



girder

cradle

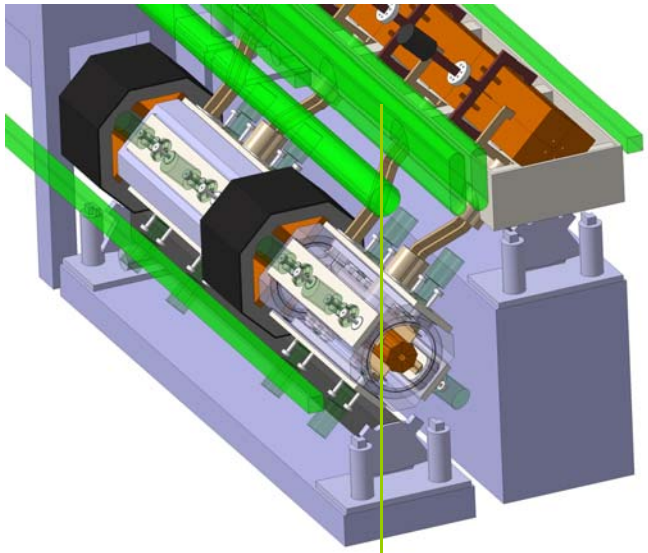


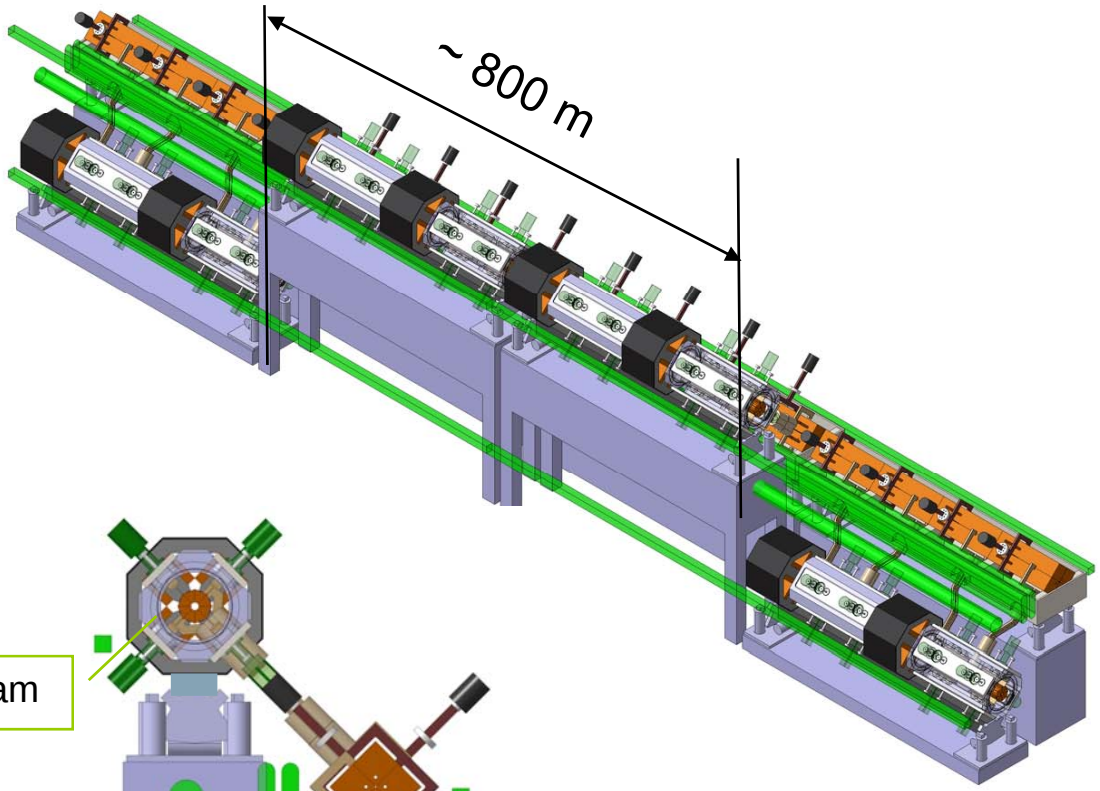


PETS on-off mechanism

R. Leuxe

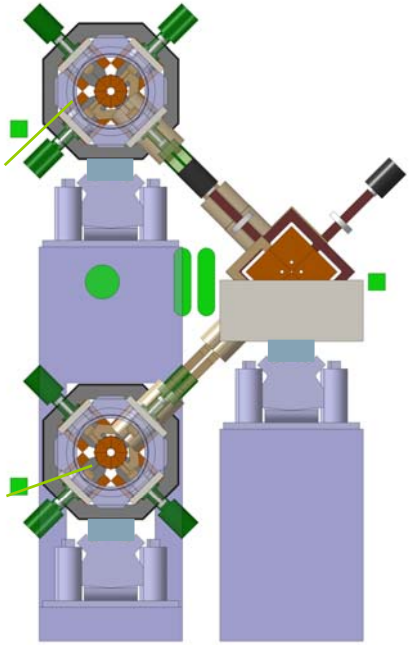
Standard module





space reservation for the alignment system

upper drive beam



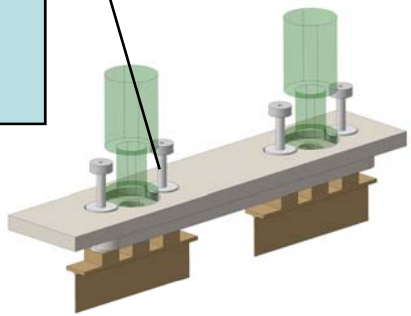
lower drive beam

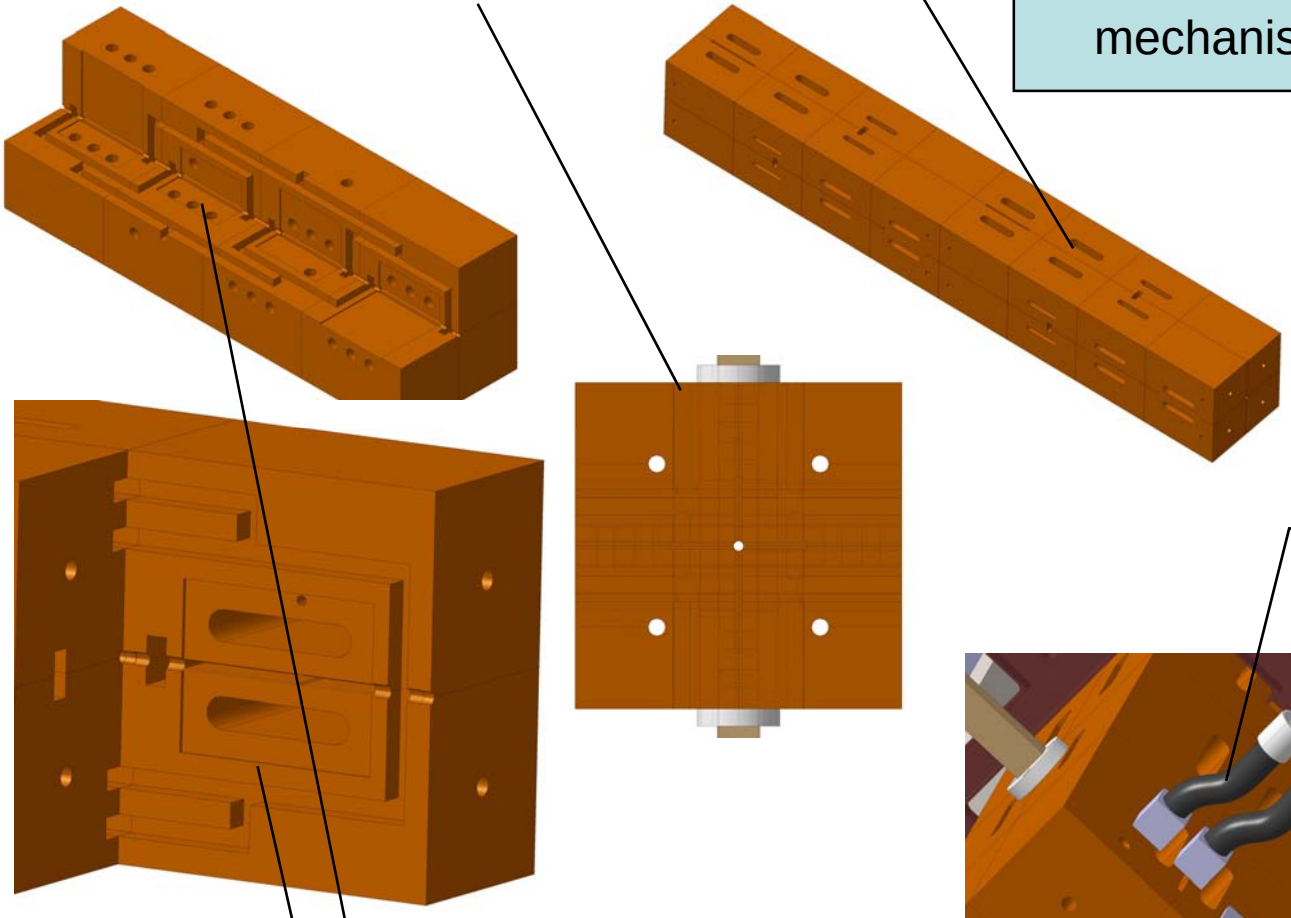
R. Leuxe

Standard module - Details

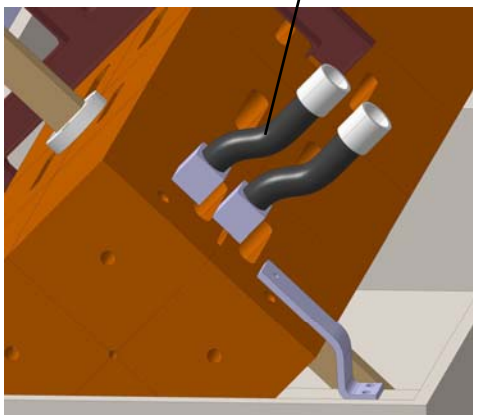
AS quadrants

ON-OFF mechanism





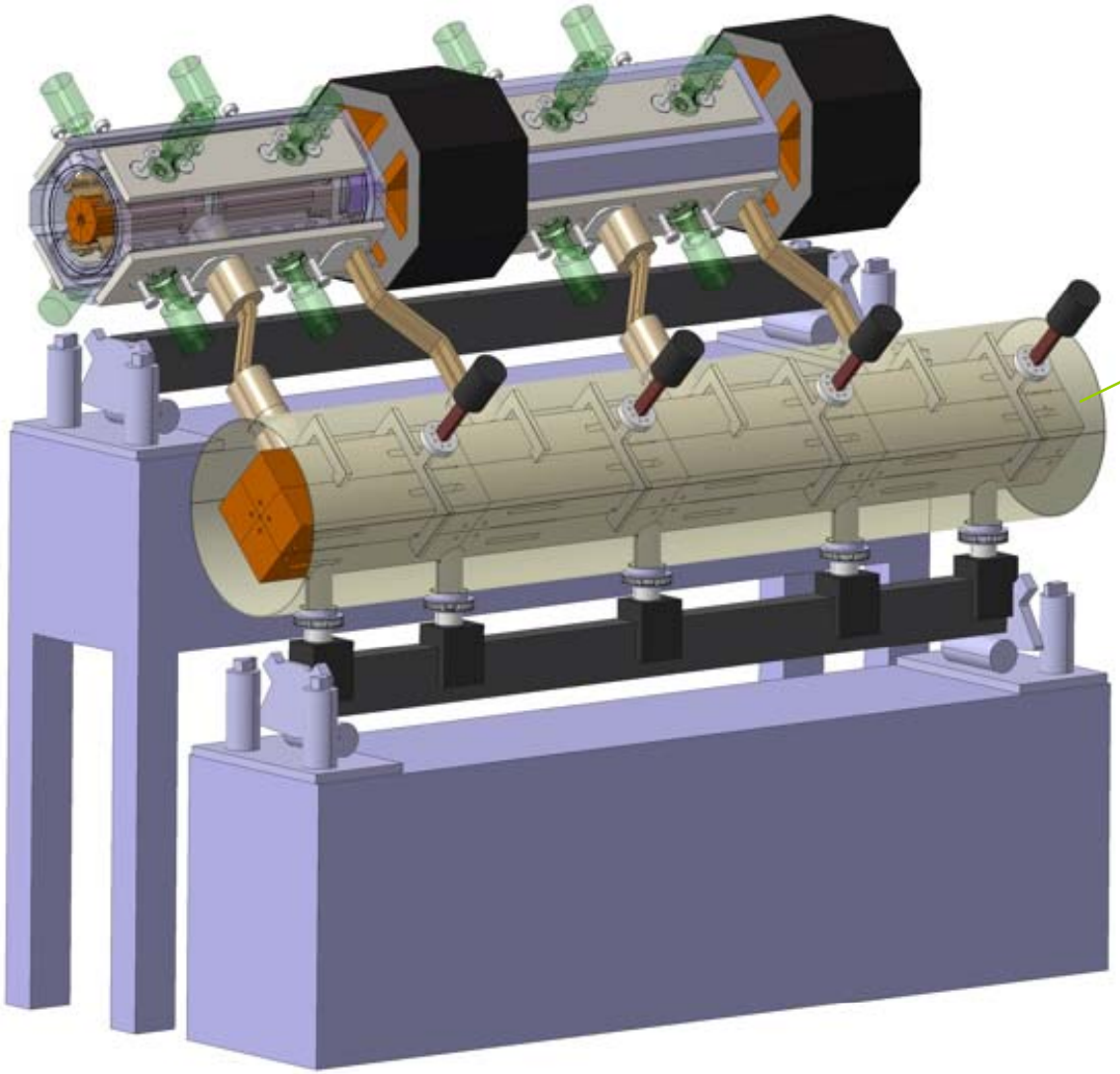
AS BPM



Internal routing of the WG

R. Leuxe

Standard module

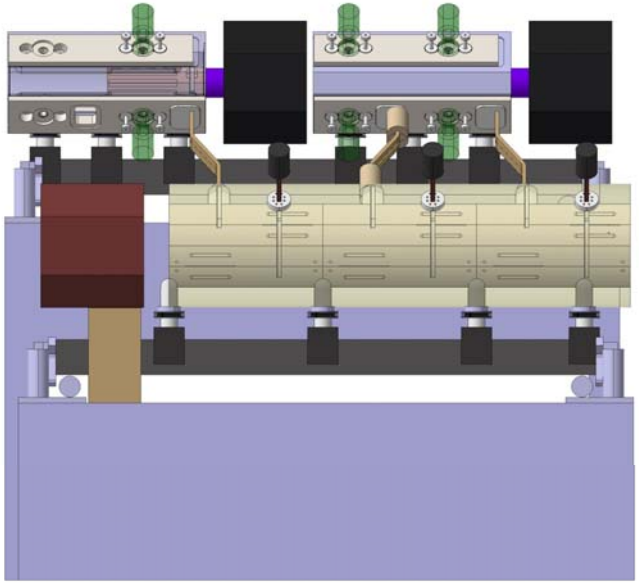


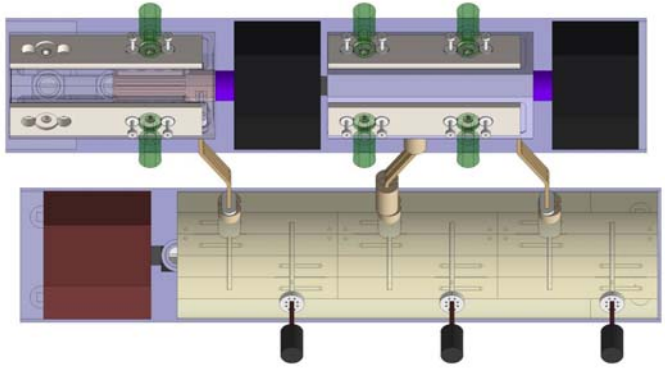
Exemple of iteration

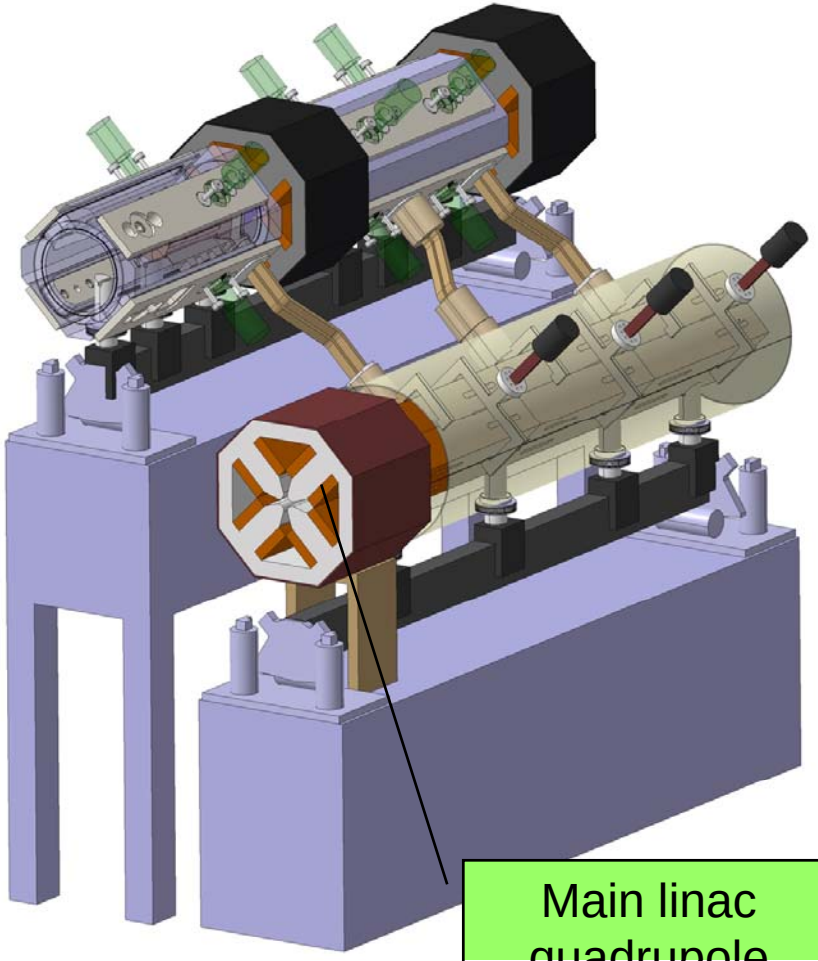
Supporting system: integration of space reservation and consequent change of AS tank

R. Leuxe

Quadrupole module type #1







R. Leuxe

System specification

- At present work is carried out in parallel on different subjects:
  - Alignment/supporting system (beam dynamics working group)
  - AS assembly
  - Vacuum system (main beam 8 m^2 surface to be pumped)
  - Cooling system (dissipated power 600 kW/AS)
  - BPM definition
  - RF network definition (loads, flanges for waveguide connections)

These activities have to be developed in close collaboration with integration study

Alignment system

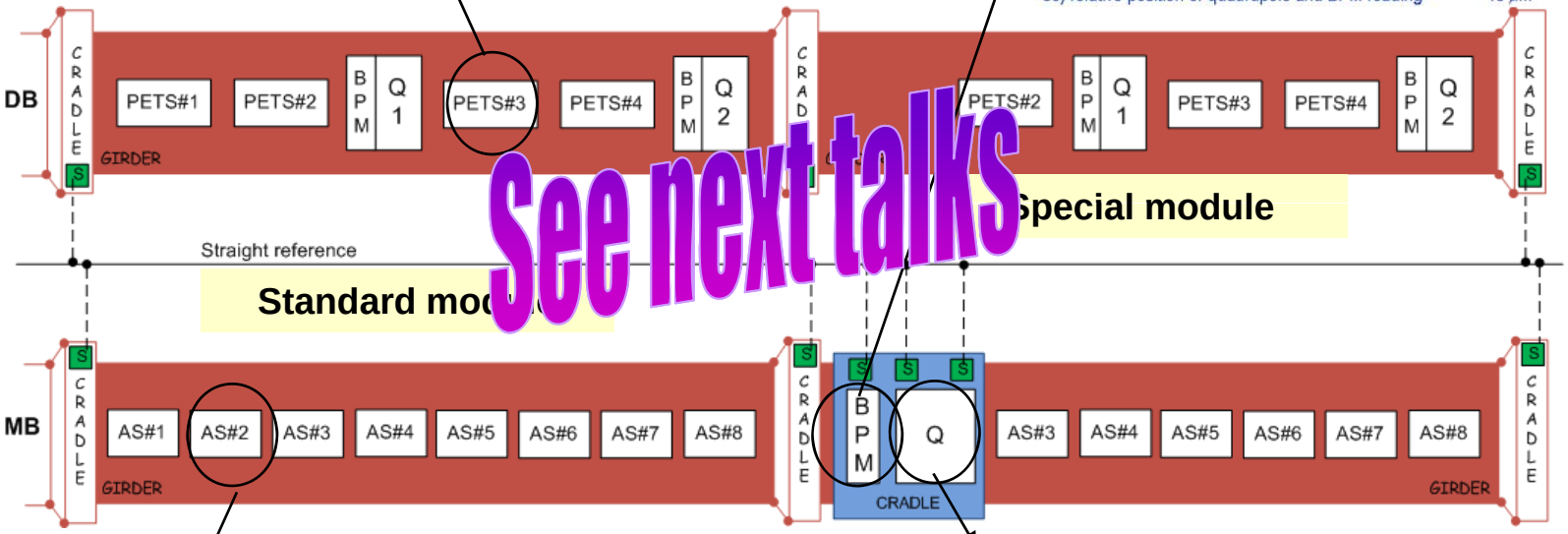
PRE-ALIGNMENT

Ref.	1	Inherent accuracy of reference (link between two adjacent girders)	10 μm	1σ
Ref. to cradle	2	Link "local" reference/sensor	20 μm	1σ
	3	Link sensor/cradle	5 μm	1σ
Cradle to girder	4	Link cradle/girder	5 μm	1σ
Girder to PETS	5a 5b	Link girder/PETS Inherent precision of PETS	20 μm	1σ
		TOTAL Tolerance	31 μm 93 μm	1σ 3σ

PRE-ALIGNMENT

Ref.	1	Inherent accuracy of reference	10 μm	1σ
Ref. to cradle	2	Link "local" reference/sensor	5 μm	1σ
	3	Link sensor/cradle	5 μm	1σ
Cradle to BPM	8a	Link cradle/quadrupole BPM axis	5 μm	1σ
BPM	8b	Inherent precision of quadrupole BPM axis	5 μm	1σ
		TOTAL Tolerance	14 μm 40 μm	1σ 3σ

BEAM-BASED ALIGNMENT:
8c) relative position of quadrupole and BPM reading 10 μm 1σ



PRE-ALIGNMENT

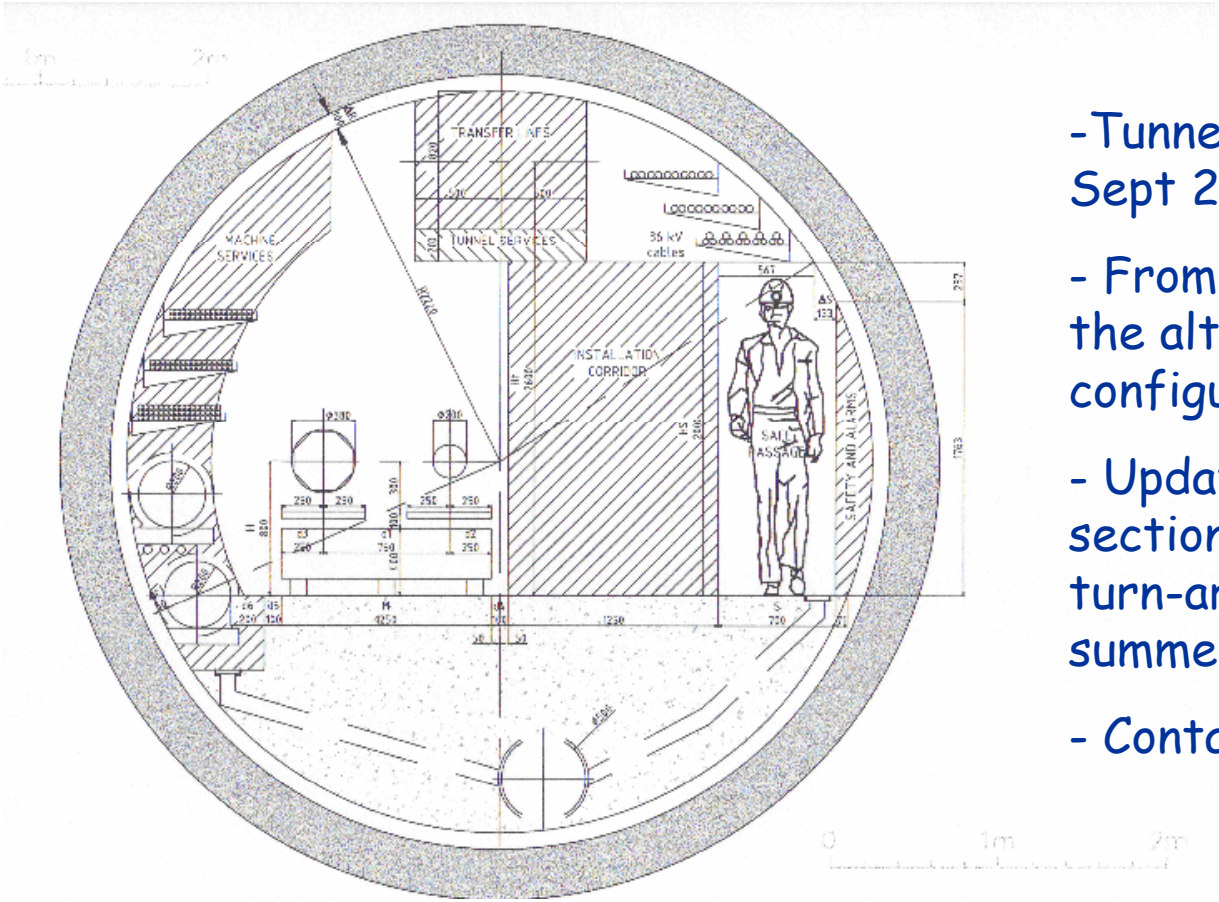
Ref.	1	Inherent accuracy of reference (link between two adjacent girders)	10 μm	1σ
Ref. to cradle	2	Link "local" reference/sensor	5 μm	1σ
	3	Link sensor/cradle	5 μm	1σ
Cradle to girder	4	Link cradle/girder	5 μm	1σ
Girder to AS	5a 5b	Link girder/acc. structure Inherent precision of structure	5 μm	1σ
		TOTAL Tolerance	14 μm 40 μm	1σ 3σ

BEAM-BASED ALIGNMENT
6) relative position of structure and BPM reading 5 μm 1σ

PRE-ALIGNMENT

Ref.	1	Inherent accuracy of reference	10 μm	1σ
Ref. to cradle	2	Link "local" reference/sensor	5 μm	1σ
	3	Link sensor/cradle	5 μm	1σ
Cradle to quad.	7a	Link cradle/quadrupole	5 μm	1σ
Quad.	7b	Inherent precision of quadrupole	10 μm	1σ
		TOTAL Tolerance	17 μm 50 μm	1σ 3σ

Tunnel integration



-Tunnel cross-section dated Sept 2006

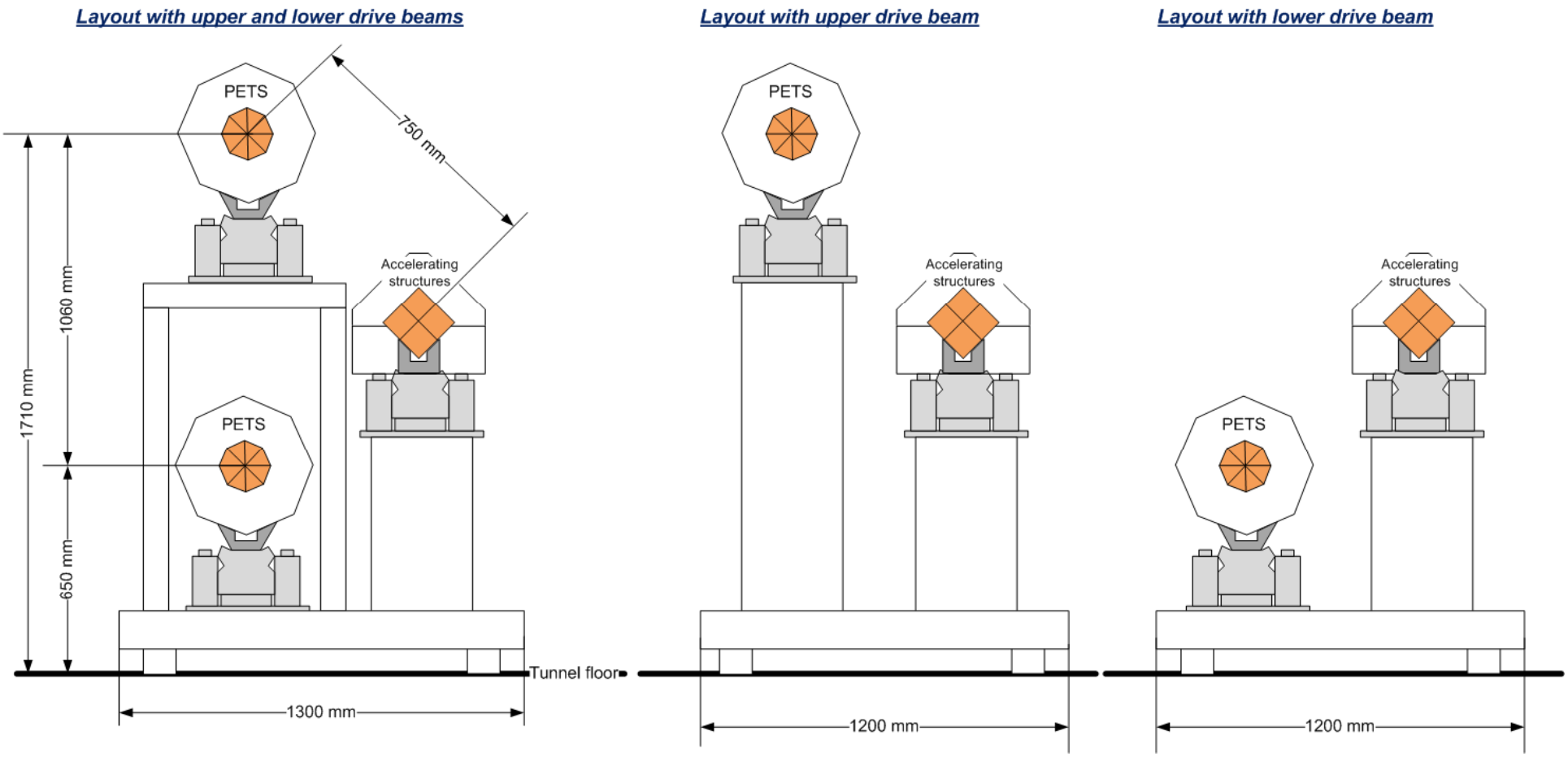
- From Jan 2007, working on the alternate drive beam configuration

- Update of the cross-section (➔ regions with turn-around loop) from summer 2007

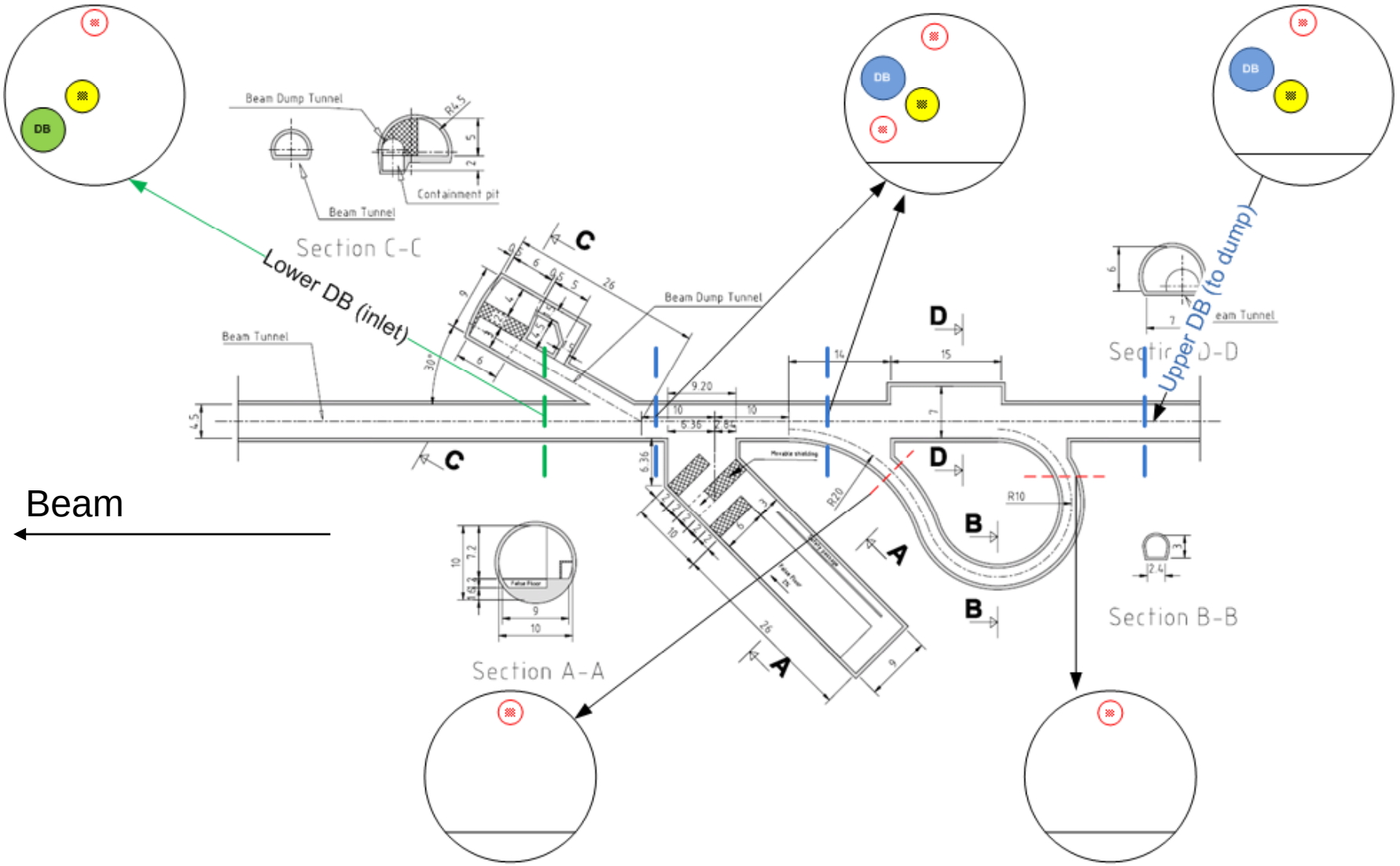
- Contacted TS/CE in CW26

CLIC beam layout

Baseline configuration

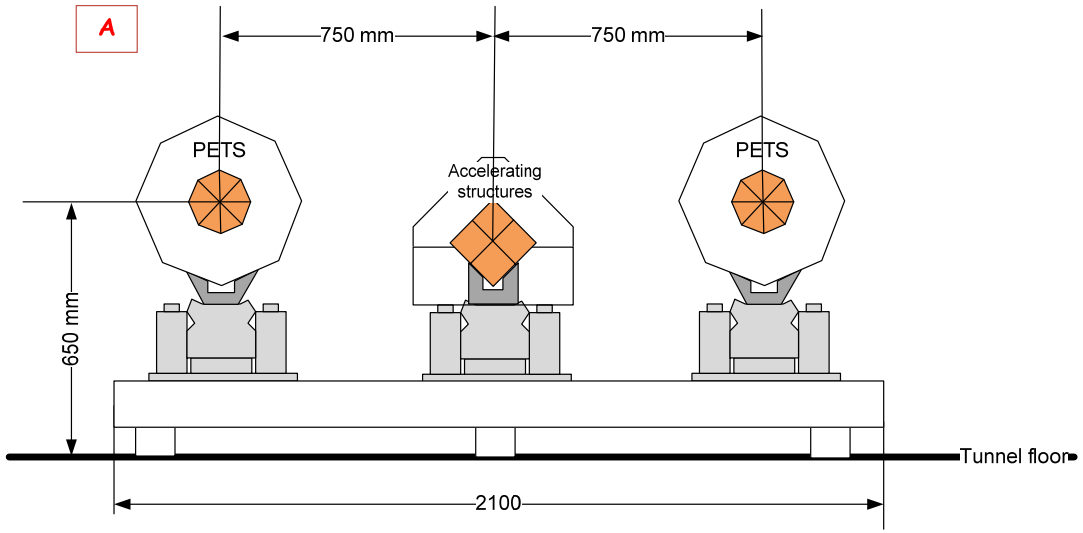


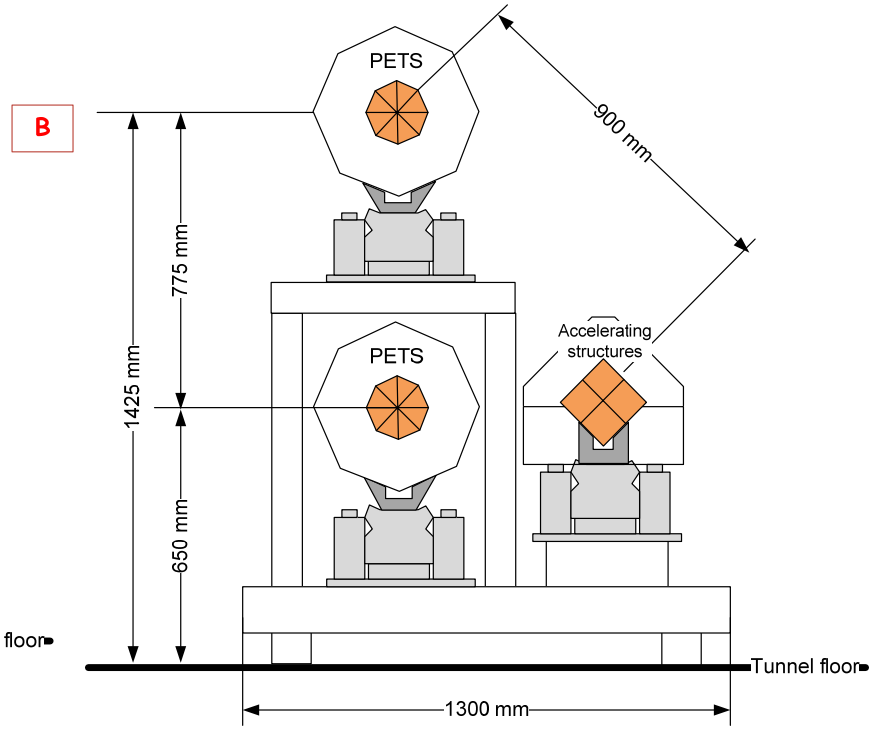
Drive beam alternate configuration

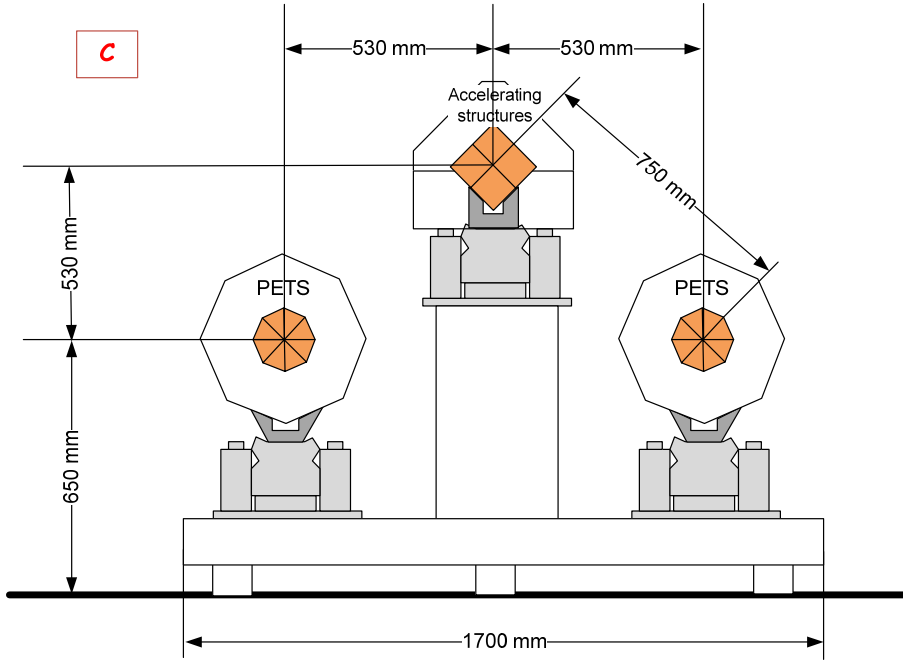


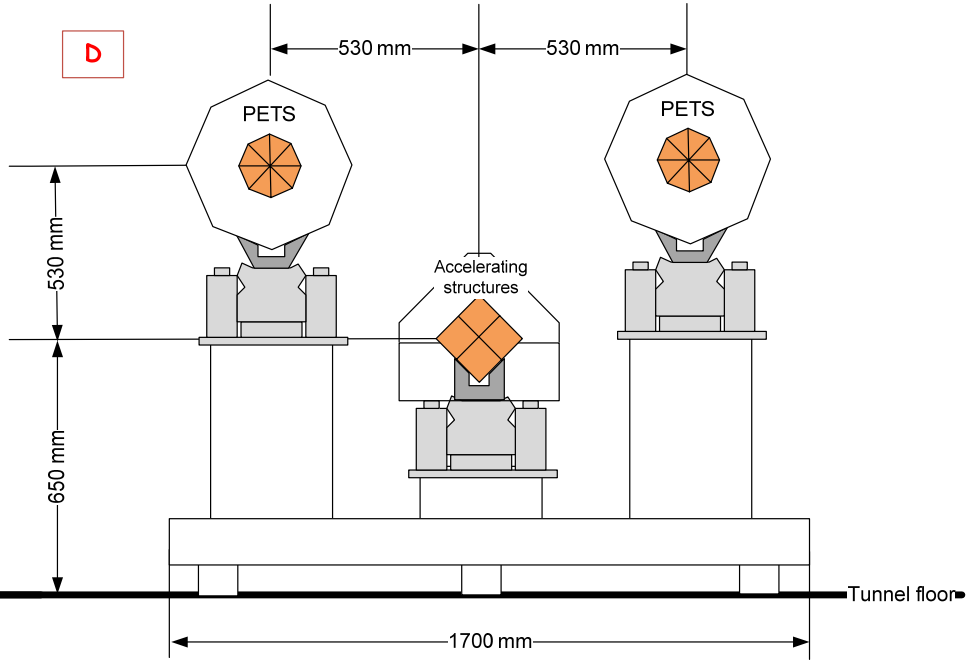
CLIC – Drive beam loop and beam dump

CLIC beam tunnel layout
Options









Status & future work

- Standard module
  - First round integration: at ~ 85 % (deadline: end of July 07)
  - Alignment/supporting system: in progress (deadline: June 2008)
  - Vacuum system: started in CW26 (deadline: Dec 2007)
  - Cooling system started in CW26 (deadline: Sept 2007)
  - BPM: started in May 2007 (deadline: June 2008)
  - PETS on-off mechanism: started (deadline: prototype 1Q of 2008)
  - RF network definition: in progress
  - Module integration: integrate layout changes and initiate next level of design with consequent system coherence verification
- Quadrupole type modules
  - First round integration: started in CW25 (deadline: end of Oct 2007)
  - Quadrupole detailed design: available in August 2007
- Tunnel
  - New cross-section under definition ➔ deadline Sept 2007
  - Continuous update following detailed definition of the different systems
- Cost estimate
  - Revision needed by Sept 2007 (e.g. alignment/stabilisation system to be updated)
  - Continuous update

Next meetings

14. 09 July 2007 (Vacuum p1)
15. 16 July 2007 (BPM update)
16. 13 August 2007 (MB Q)
17. 27 August 2007 (ac. structure assembly, integration)
18. 10 September 2007 (cooling)
19. 24 September 2007 (tunnel cross-section, integration)
20. 08 October 2007 (alignment/sup. system update)
21. 22 October 2007 (integration)
22. 05 November 2007 (cost estimate, naming)
23. 19 November 2007 (RF network)
24. 03 December 2007 (integration)
25. 17 December 2007 (vacuum p2)

Conclusions

- Dedicated development programs of systems including high-power rf structures, micron precision pre-alignment, nanometer stabilization, beam instrumentation, active alignment and beam dynamics, etc. are carried out
- An important priority is the integration of these various systems into the CLIC module which will be repeated over twenty thousand times along the length of CLIC ➔ resources for integration
- The module study raises feasibility issues, identifies areas needing study and design, addresses important aspects of cost and provides basic parameters for other areas of the study
- Flexibility will be required to integrate new configuration and layout
- Test module in CLEX from 2009:
  - System integration
  - Alignment system
  - Stabilization system

A lot of work has been performed on the module thanks to the collaboration and technical support of all the WG members

Documentation available in EDMS