CLIC07 Workshop

Summary from « Two-beam hardware and integration » WG

Session on Wed 17.10.2007

G. Riddone, R. Ruber

18.10.2007

- Thanks to all speakers for very professional and valuable presentations

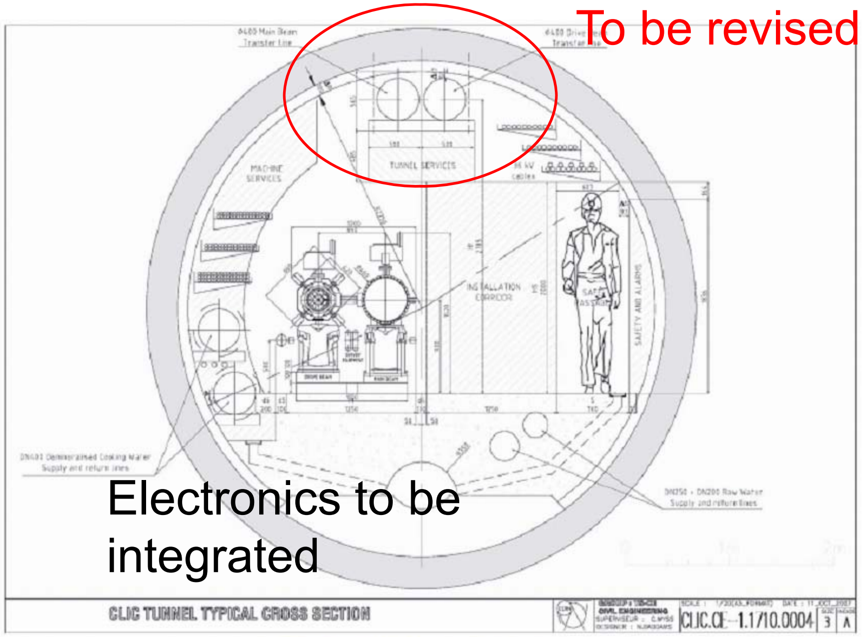
- 22 talks ➔ covering a wide range of topics
  - Tunnel
  - Cooling
  - Transport
  - Module and transfer lines
  - Quadrupole
  - Alignment/stabilisation/supporting system
  - Vacuum requirements/system
  - Beam instrumentation
- A more detailed summary will be prepared within two weeks with clear recommendations/actions

CLIC workshop – Working group: Two beam hardware and Integration

CLIC Civil Engineering Layouts & Tunnel Cross Section

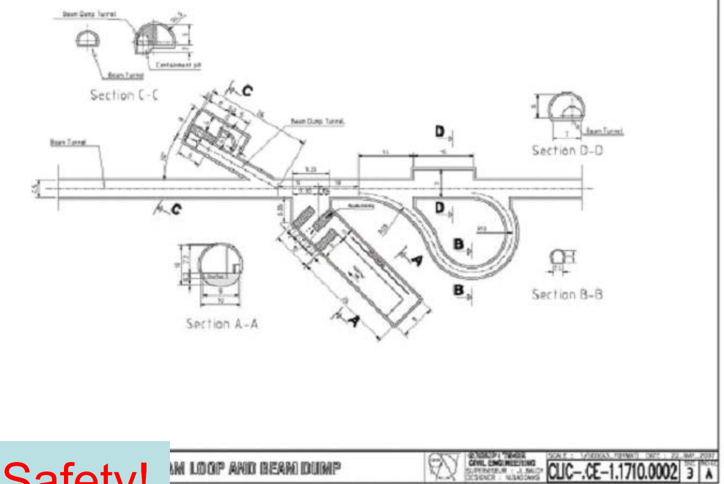
John Osborne TS-CE

Acknowledgements : C.Wyss, J-L Baldy, N.Baddams



- Further in-depth studies needed to better define tunnel cross section, in particular for :
  - Demineralised Water (ΔT to be better understood) and maximum flow to avoid vibration problems.
  - Ventilation System to comply with current Safety requirements for emergency situations.
  - (see talk by J. Inigo-Golfin)
  - Next iteration deadline with updated parameters ?

Return loop: to be optimised



Distance of PITS - Safety!

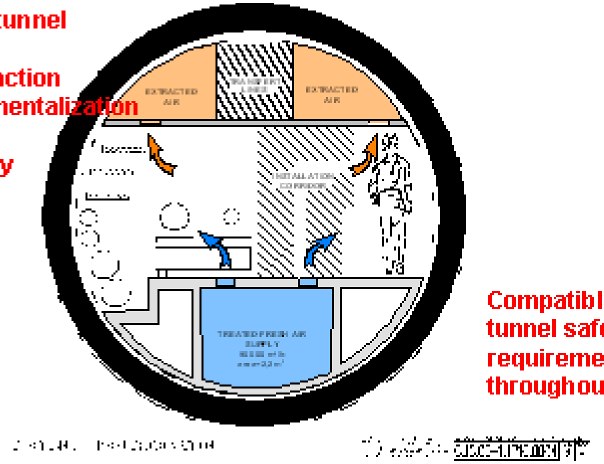
First Considerations on CLIC Cooling System

Ch. Martel, J. Inigo-Golfin
TS/CV

New proposed tunnel section

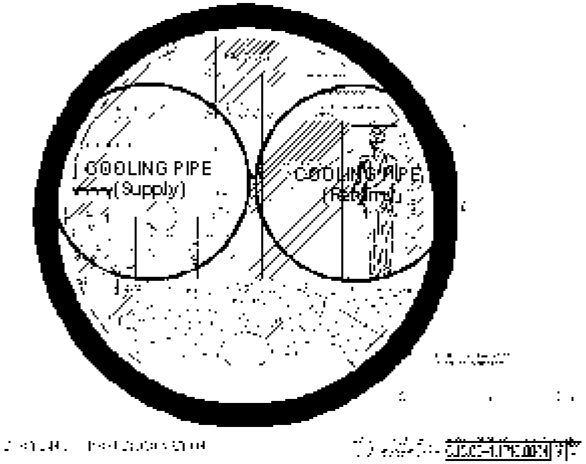
Transversal ventilation

- No ΔT along the tunnel
- Better air cooling
- Real smoke extraction
- Smoke compartmentalization
- Safe evacuation
- Evolutive capacity



Compatible with new tunnel safety requirements throughout the world

Integration of required pipes



Clic - Conclusions

- Refining of requirements necessary, first version of URD should be issued in the coming months with the main sizing parameters,
- Compromises in the design, in view of the very large numbers involved, not to be dismissed without careful consideration.

Transport of the CLIC Modules and Elements

CLIC Workshop October 2007

Two Beam Hardware and Integration Working Group

Keith Kershaw (CERN)

Introduction - Transport system integration into design

- Main concern for today's meeting is transport in the tunnel
- Key items to transport
  1) Modules, module supports
  2) Transfer line /roof elements
  3) Injection rings, loops
  4) Turnaround elements
  5) Drive beam dump

approx 50,000 items with declared weights of max 2 tonnes to be installed within two year period (logistics!)

Don't forget racks, cables, cooling and ventilation, supports...

Information needed for transport

- Dimensions
- Weight
- Support points
- Lift points
- Maximum accelerations (and frequencies)
- Number to be transported and installed
- Support interfaces
- Interconnection details
- Position in tunnel cross section and space around
- Time available for transport and installation

Integration issues

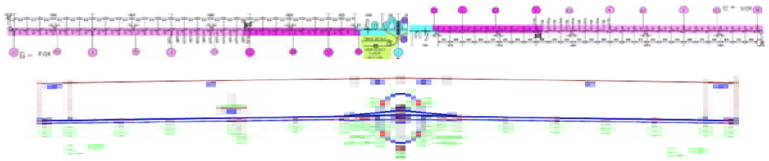
- Space for transport , unloading and transfer
  - With guidance error margin
  - Allow co-activity (passage next to transport zone)
- Space for power rail
- Space for loading lowered items
- Consider logistics (parking and passing places)
- Integration should include space for removal

How to apply scheduling work done for ILC to the CLIC project

Prepared by M Gastal

Goal:

→Present the work done for the construction schedule of ILC project and explore the possibility to apply it to CLIC



Conclusions

→Key milestones:

- → Surface Detector Assembly Building ready for detector: $t = t_0 + 2Y$
- → First tunnel sections ready for services installation: $t = t_0 + 2.5Y$
- → Detector Hall (cavern) ready for detector: $t = t_0 + 4Y$
- → First beam tunnel section ready for machine installation: $t = t_0 + 3Y$

→ More efforts needed to load resources into the schedule and assess coactivity more thorough fully

→ The installation sequence for the machine and detectors have to be designed and inserted in the general schedule

→ A post completion analysis of the CMS project will be presented in early 2008. It should provide useful insight in the installation schedule for the ILC experimental areas

Conclusions

→A draft construction schedule for CLIC could be produced using the same methods used for ILC

→Starting this exercise soon is crucial for the lessons learnt from the LHC project are still fresh in people's mind

→Sources of information to feed into the schedule are available at CERN and come from all departments.

→Keeping a link between the two projects can be mutually beneficial

CLIC workshop
"Two beam hardware and integration" working group

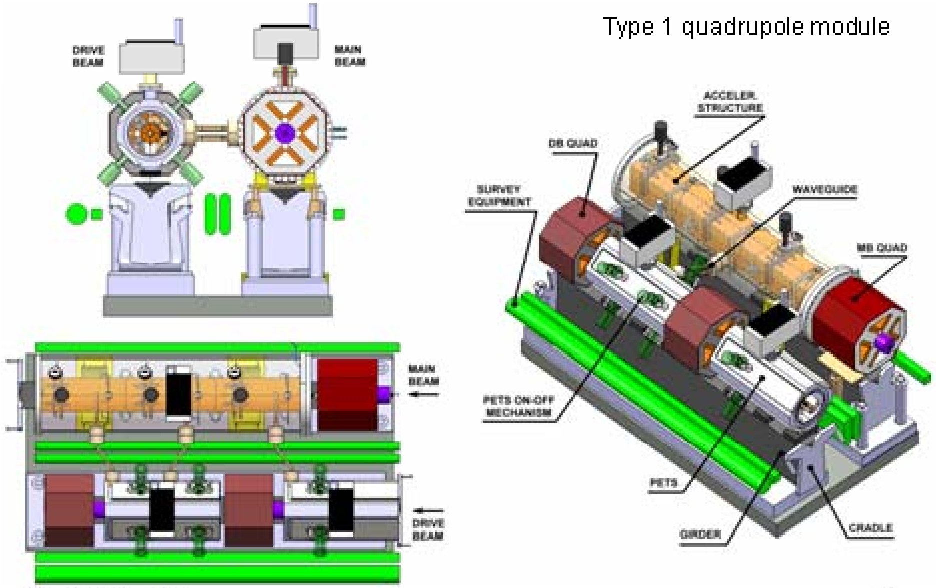
Module layout and main requirement

G. Riddone, A. Samoshkin

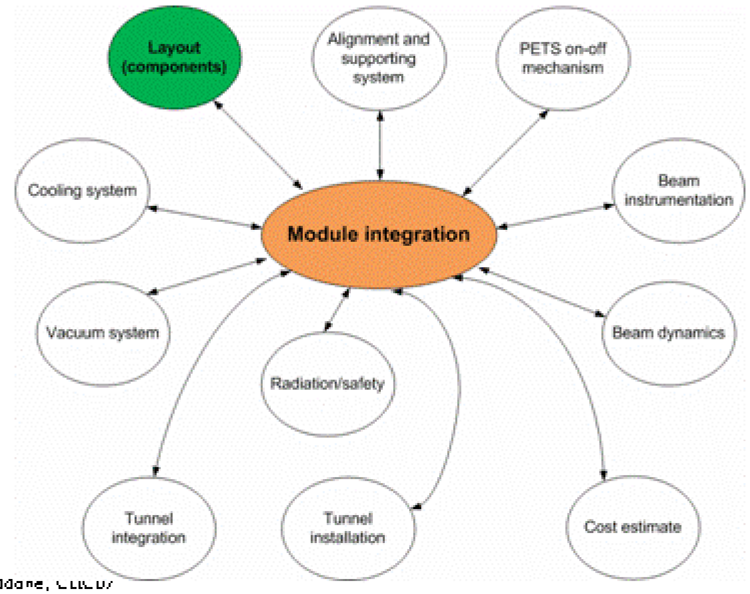
17.10.2007

> 20000 modules

CLIC module



Several activity domains



Conclusions

- Dedicated development programs of systems including, micron precision pre-alignment, nanometer stabilization, cooling, vacuum, beam instrumentation, active alignment and beam dynamics, etc. are needed
- An important issue is the integration of these various systems into the CLIC module which will be repeated over twenty thousand times along the length of CLIC → optimization, reliability, scheduling (see talk of M. Gastal) and cost
- 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
- Test module in CLEX from 2008 (see talks of K. Alam and F. Toral [TBL]):
  - System integration
  - Alignment system
  - Stabilization system

Key-issue

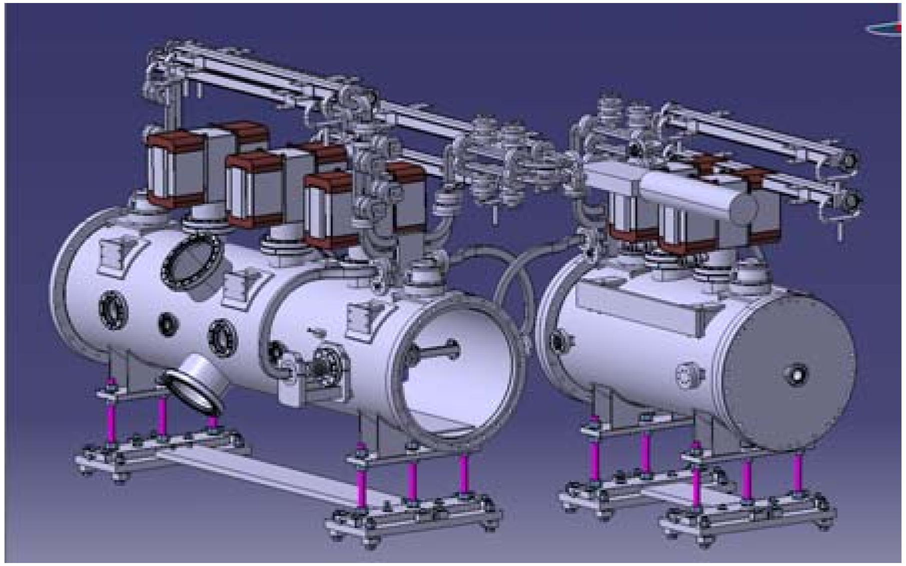
CLIC workshop, 16-18 October 2007

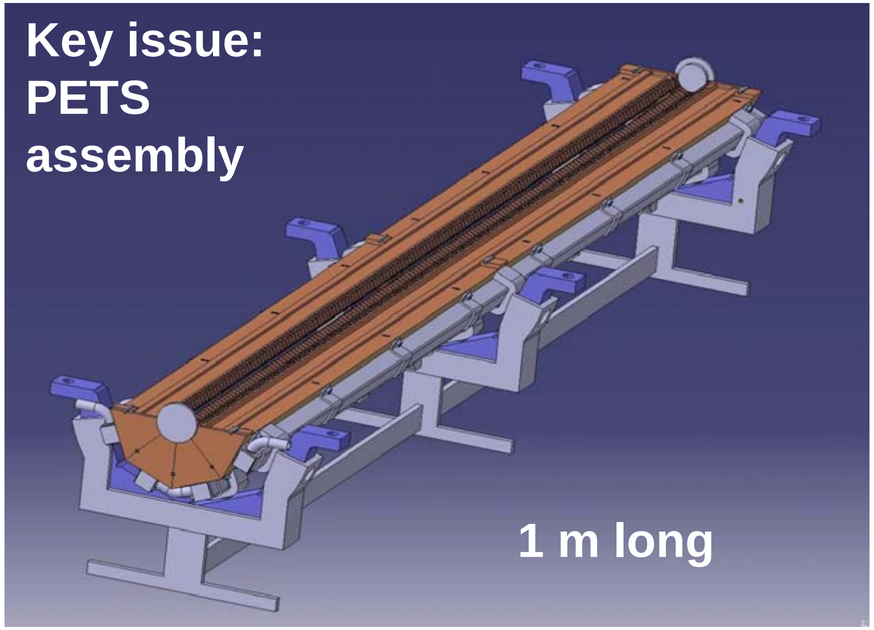
Working group " Two beam hardware and integration"

Test module in the two beam test stand

Khurshid Alam, AB-RF

17.10.2007

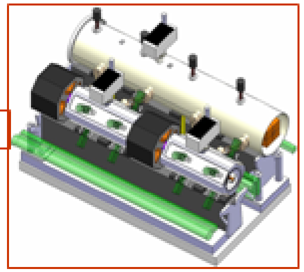




Conclusions

- Progress on the test module in agreement with the schedule
  - PETS assembly strategy will be tested at the end of 2007
  - tank and components needed for phase 1 will be delivered to CERN in march 2007
- Main beam:
  - tank is under study
  - closer CLIC module configuration to be studied (alignment and stabilization features to be integrated)

CLIC module



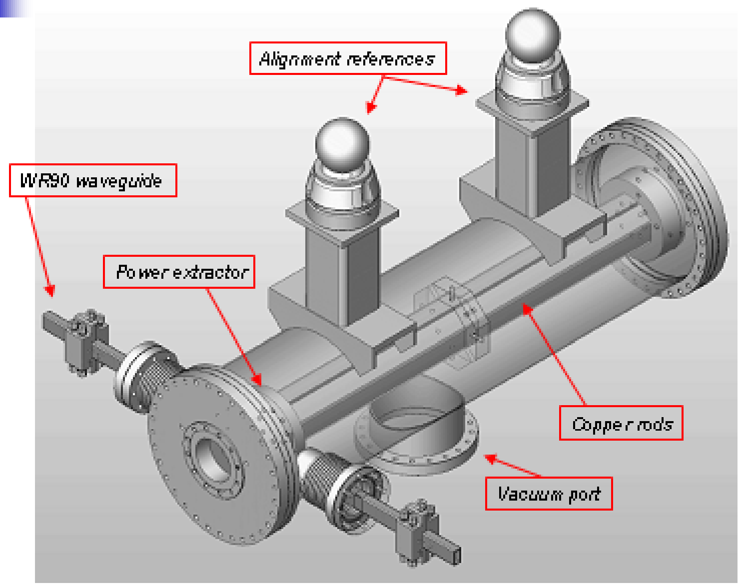
Experience exchange with CIEMAT PETS for TBL

Main features of PETS tank

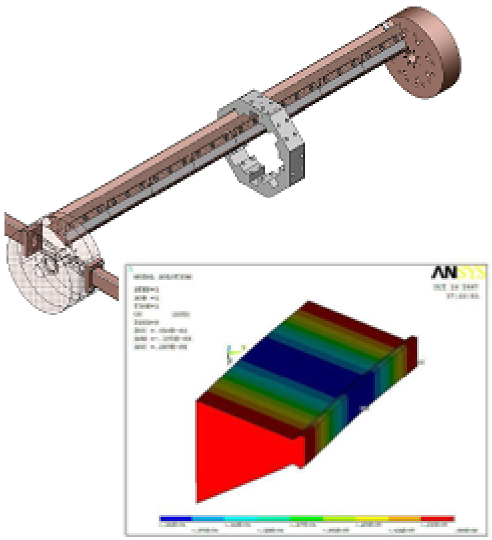
(I will review the present status of the PETS tank design for CTF3. Hopefully, PETS tank will be similar in CLIC)

J. Calero, D. Carrillo, J.L. Gutiérrez, E. Rodríguez, F. Toral
CERN, 17/10/2007

General layout



Copper rods (II)



- End rings: two pins on each rod for alignment and one screw for clamping.
- Enhanced thermal contact: all the rods have the same length and contact pressure is made by bolts.
- Intermediate stainless steel ring: the assembly is stiffer and sag is negligible. Two pins and two screws on each rod.

Height (mm)	Sag (micron)
35	29.3
40	23.4
45	19.2

Conclusions

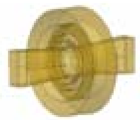
- ➤ Conceptual design of PETS tank is on-going.
- ➤ There are a lot of difficult issues to solve:
  - high precision copper machining,
  - complex assembly,
  - cooling system under high-vacuum conditions,
  - brazing...
- ➤ Test program is being defined.
- ➤ Time schedule is very tight, but more manpower is now available. Tasks will run in parallel.
- ➤ Hopefully, all this experience will be directly transferred to PETS tank in CLIC.

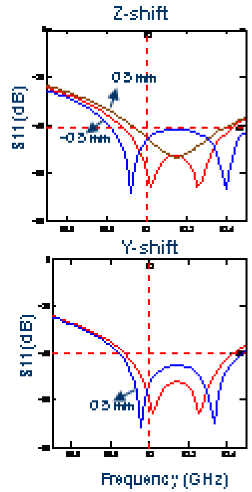
PETS components and waveguide connections

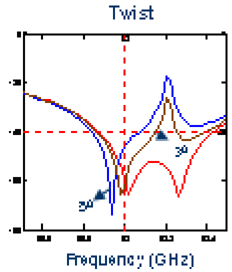
CLIC Workshop 2007

David Carrillo

Choke flange. Shifts & twist







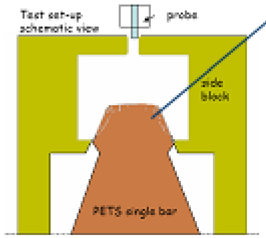
Dynamic range for the accepted performance (S11< -45 dB)

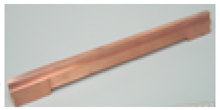
X-shift	± 0.25 mm
Y-shift	± 0.5 mm
Z-shift	± 0.5 mm
Twist	< 5º

x, y shifts do not change the transmitted RF phase

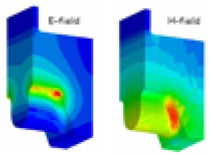
Testing single PETS bar

- A device has been designed to do RF tests of the single PETS bar
- It consists of two side blocks that will be put together with a single PETS bar in order to create inside a mode (TE_{10}) with same phase advance, v_g, etc as the decelerating mode (TM_{01})

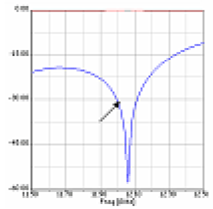




PETS Single bar



Mode TE_{10}



Phase/period=90

Frequency =11.994 GHz

Vg/c=0.466

Conclusions

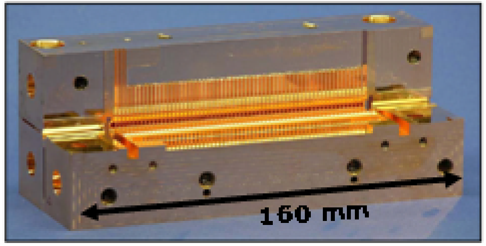
- A Choke flange design has been done, which will allow a flexible connection between PETS and accelerating structures and also will provide a vacuum port
- Single bar test device will allow us to measure RF quality of single bars before putting all together
- Mode launcher designed will be used to introduce and extract power in order to test phase-shift and S parameters for PETS

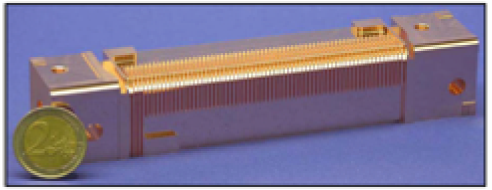
Structure fabrication: dimensional tolerances

M.Taborelli

Contributions of :
G.Arnau-Izquierdo, A.Cherif, D.Glaude, R.Leuxe,
CLIC study team

Copper quadrant structures:





Longest accelerating structure built so far in quadrants

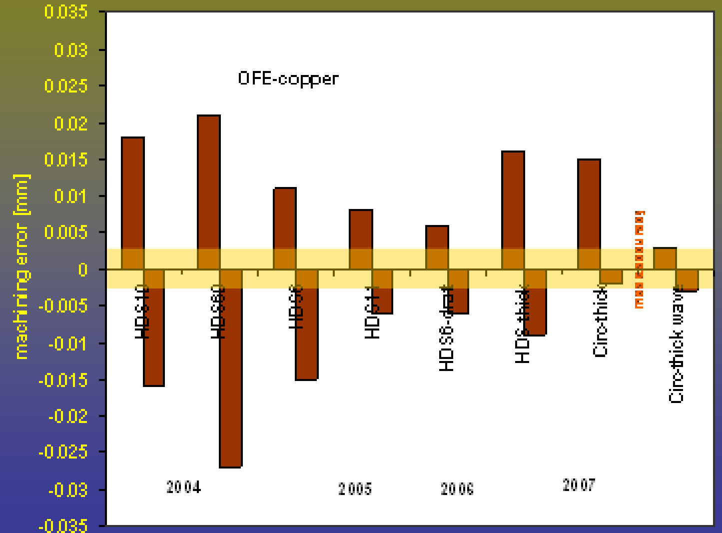
The target is:

+/-1 µm on the shape on parts of 500 mm length

Note: This cannot be achieve by any present available technology on the full size of the part ► regions of necessary accuracy should be re-defined and restricted as much as possible

+/-3 µm alignment accuracy on 2m length

Achieved shape accuracy, milled parts



CLIC workshop "Two beam hardware and integration" working group

Main requirement for module cooling

Risto Nousiainen

17.10.2007

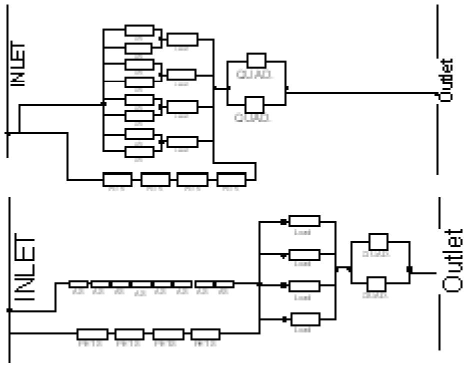
7.7 kW /mod.

Layouts for module cooling

Configuration	-	+	$V_{flow\ module}$	$V_{flow\ meter}$
AS Parallel	Additional volumetric flow	Thermal stability Temperature gradient	3 m^3/hr	7500 m^3/hr
AS Series	8 different structures Thermal stability	Smal volumetric flow High ΔT of water	0,5 m^3/hr	1200 m^3/hr

- Two extreme cases
- Other options:
  - Two AS in series

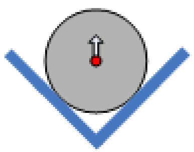
ΔT over one AS 1.5 K



NB: For a standard module.

Discussion

- Main issues:
  - 1. Tolerances
    - Static
    - Dynamic
  - 2. Vibrations
    - Water induced
    - Balance between sufficient cooling and acceptable flow parameters
  - 3. Temperature stabilization
  - 4. Volumetric flow



1 Kelvin causes an misalignment of 7 microns with the current support

Future work

- Previous study:
  - Water induced Quadrupole vibrations
- Future work
  - How to compensate dynamic effects?
  - How to predict water induced vibrations?
  - System design for cooling

CLIC workshop "Two beam hardware and integration" working group

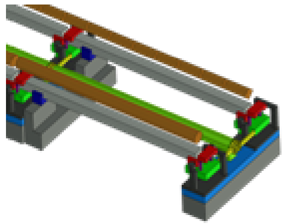
Supporting System

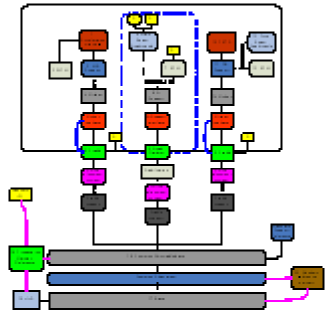
Risto Nousiainen

17.10.2007

Supporting Strategy

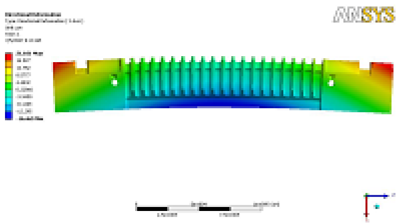
- Improved precision
  - Separate supports
    - AS girder
    - PETS girder + Quad.
    - MB Quadrupole
    - Vacuum tanks
- Flexible interconnections





Discussion

- The main challenges
  - Tolerances
  - Initial error compensation during pre-alignment
    - Thermal
    - Mechanical
  - Operational errors
    - Mechanical stability
    - Thermal expansion
    - Vibrations → Stabilization
  - System integration
    - Alignment
    - Interconnections
    - Vacuum
    - Cooling



Conclusions and future work

- Previous Study
  - Magnet stabilization
  - CTF2, alignment study
  - Cooling induced vibrations
- Current work
  - Specifications for supporting system
  - Conceptual design
- Future work
  - Continuation of vibration measurement
  - System design
  - System integration

Some Remarks on the Fast Beam-Ion Instability and the Vacuum

D. Schulte

Presented by A. Latina

Conclusion

- The fast beam ion instability is more important for the main than for the drive beam
- Expect to need good vacuum for drive beam (1ntorr)
  - need to explore lattice detuning
- We need very good vacuum in the main beam tranfer lines
  - maybe optimised lattice

0.1 nTorr

- In the main linac we avoid the problem by not trapping the ions
- But it is worth checking that the simple estimates are good enough
- Parameters may change
- The ions could affect the feedback systems

⇒ Should be able to simulate ions
  - simple programs exist

⇒ We need to integrate this

THIN FILMS FOR CLIC ELEMENTS

Outline

- Motivation
- The role of MME-CCS
- DB and MB transfer lines
- Main beam
- Main beam quadrupoles
- Other issues
- conclusions

CLIC workshop 17/10/2007 Pedro Costa Pinto TS/MME/CCS

DB and MB transfer line

Total length: 2x 21km
2% filled with 1m long magnets: 2x 420 magnets
Diameter of the beam pipe ϕ=40mm
Limit pressure to avoid ion stimulated desorption: 10^{-10} Torr ("large" molecules)

Static vacuum

		q [illegible]	S [$l s^{-1}$]	L [m]	L [m]	
No bakeout: main gas	H_2O	$1.4.10^{-12}$	40	1.7	2.3	
With bakeout: main gas	H_2	5.10^{-13}	46	5.0	6.8	Possible solution...
With bakeout:	CO	5.10^{-14}	36	9.6	14	
With NEG: not pumped	CH_4	10^{-17}	28	814	1220	Better solution
With NEG: not pumped	Kr	2.10^{-18}	6	1202	1802	

Main Beam

Bakeout excluded: tight mechanical tolerances.

Pumping speed in the accelerating structures is limited

If 10^{-10} torr are necessary... this is a feasibility issue for CLIC!

Dynamics of the H_2O pumping in limited conductance systems must be better understood

- An experimental set-up is being implemented to study H_2O pumping dynamics

Best possible dynamic vacuum must be simulated

- Pumping speed and geometry
- Thermal desorption/adsorption rates
- Surface coverage *vs* time
- Ion desorption yields
- Ionization efficiency per train
- Ion bombardment of the walls
- Breakdown rate
- Gas released per breakdown
- ....

We propose monte carlo and electrical network analogy approach

Conclusions

- MB and DB transfer lines: 10^{-10}torr feasible with bakout or NEG. (NEG better for dynamic vacuum). ***Not a feasibility issue***.
- Main beam: 10^{-10}torr not possible without heating the structures. Best possible dynamic vacuum must be simulated. H_2O behavior must be studied. ***feasibility issue***.
- Main beam quadrupoles: distributed pumping required. ***Probably not a feasibility issue***.
- Combining rings: classical NEG solution. Input is necessary to correctly evaluate the situation. ***Not a feasibility issue***.
- injection lines: maybe a SEY of 0.9 is required. ***feasibility issue***.

acknowledgments

Bernard Jeanneret and Daniel Schulte.