



Update on CDR issues; Organization of technical work towards CDR

1. CDR vs TDR
2. CDR schedule
3. Highest priority work: Feasibility (:=Critical) Items
4. Organization of Technical Work
Creation (2008) of CTC
→ Working groups, examples
5. Tools:
 - EDMS documentation, CLIC PBS
 - workshops/reviews
 - R&D summary sheets, Feasibility Benchmarks

Our definition of a CDR ?

- Proof that all components of a facility and their interplay are conceptually understood
- Quantify expected overall performance and related component requirements
- Scientific case for the accelerator
- Detection Concepts/Efficiency/background figures for Physics Detector
- Evolution path to TDR
- Proof of feasibility issues and cost estimate

What needs to be added for the TDR ?

- Readiness to receive funding for building a facility, this implies
- Technical design of all components which are critical for schedule
 - Technical feasibility of all components; working prototypes for all critical technologies
 - Detailed site consideration
 - Detailed construction Schedule
 - Detailed material cost and manpower resource estimates and risk analysis

Basics of CDR (unchanged from last ACE)

- 3 TeV option for CLIC as baseline for the optimization of the parameters.
- Construction staging starting from the lowest demanded energy (let us say 500 GeV) as indicated by LHC results up to the full 3 TeV machine.
- Parameter changes and optimization for the “500 GeV” machine plus additional consequences for later energy upgrades in a separate chapter
- 4 volumes
- Volume 3:
 - Detailed description of the CLIC machine most critical subjects
 - Description of the physics and beam dynamics of all machine components following the order in the CLIC PBS.
 - Technology chapters grouped together by disciplines.

Present layout of CDR

Vol1: Executive Summary: target 20 pages, value estimate

Vol2: Physics at CLIC

write-up progress will depend on LHC results; presently we use the report from 2004

Vol3: The CLIC accelerator and site facilities

Vol4: The CLIC physics detectors

→ https://edms.cern.ch/file/1001132/CLIC_CDR-LAYOUT_08.xlsx

CDR schedule

- Due to the LHC technical accident several resources, which were scheduled to start working on CLIC, are still working on the LHC.
- The original publication date of July 2010 had to be delayed and the first “90% draft for volume 3; ready in summer 2009” has been canceled.
- The new target publication date is December 2010.
- The present technical work (including this meeting) consist in establishing a realistic work-plan to see what results can be obtained by end 2010.

List of CLIC items



- Effort started in April 2008 with an overview of CLIC subjects by D.Schulte and H.Braun
- Successive discussions in the CSC, CTC, etc produced as working document an excel spreadsheet called “List of critical items”.

This file is (almost) kept up-to-date in EDMS:

[https://edms.cern.ch/file/918791/8/list-open-points_all CLIC ver20022009 V8.xlsx](https://edms.cern.ch/file/918791/8/list-open-points_all_CLIC_ver20022009_V8.xlsx)

This file contains a classification of the subjects by
“critical = feasibility item”, “performance item”, “cost item”.

Daniel’s talk has shown all details and has explained the selection of the:

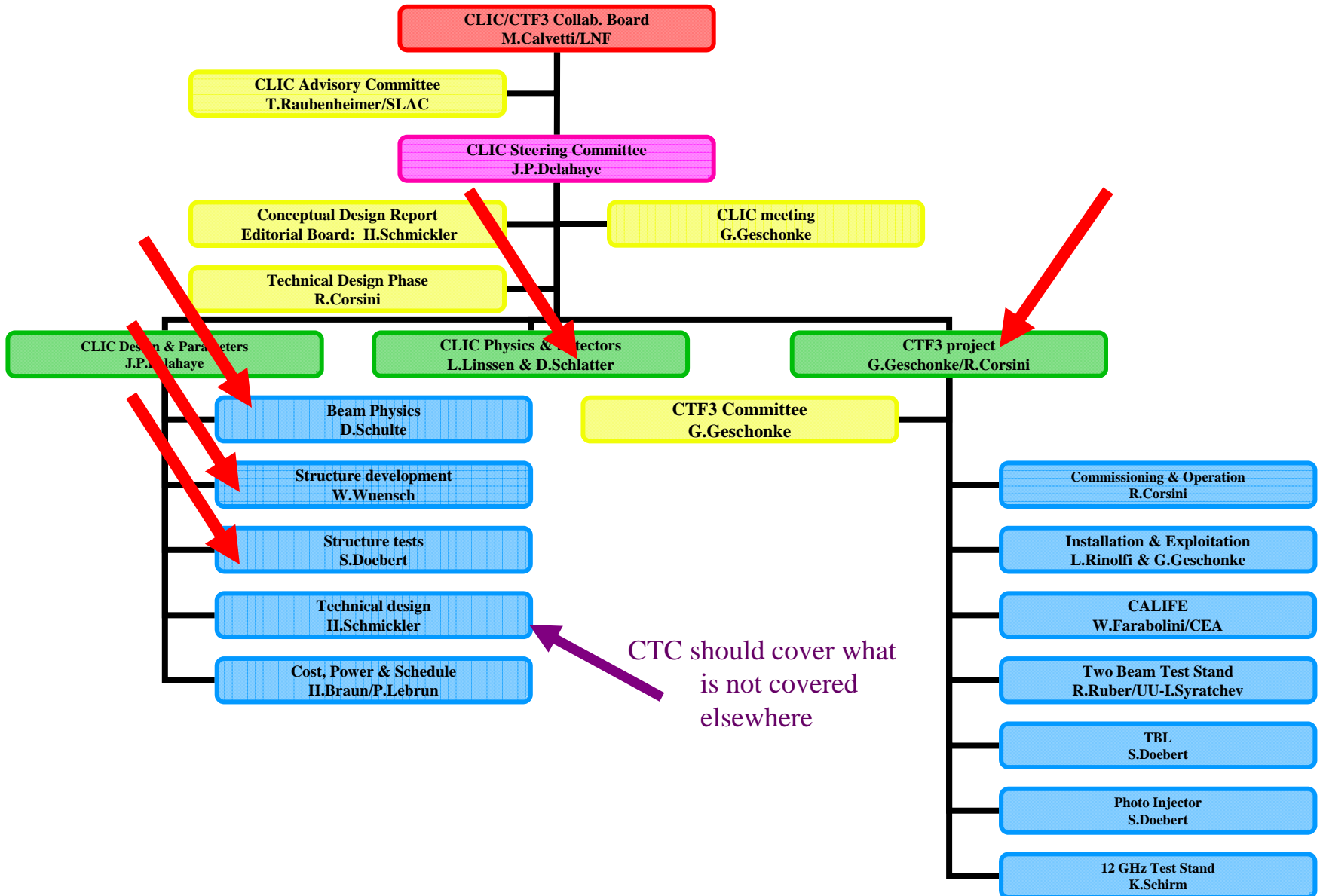
- list of critical items (next slide), which summarizes the high priority working fields of the CLIC study.

Feasibility Items

SYSTEMS		Critical parameters
Structures	<u>Main Beam Acceleration Structures:</u> Demonstrate nominal CLIC structures with damping features at the design gradient, with design pulse length and breakdown rate .	100 MV/m 240 ns $< 3 \cdot 10^{-7}$ BR/(pulse*m) RF to Beam efficiency > 30%?
	<u>RF Power production structures:</u> Demonstrate nominal PETS with damping features at the design power, with design pulse length, breakdown rate and on/off capability	136 MW, 240 ns $< 10^{-7}$ BR/(pulse*m)? Beam to RF efficiency >? On/Off < 20 ms
Two Beam	<u>Two Beam Acceleration (TBA):</u> Demonstrate RF power production and Beam acceleration with both beams in at least one Two Beam Module equipped with all equipments	Two Beam Acceleration with simultaneous & nominal parameters as quoted above for individual components
Drive Beam	<u>Drive Beam Production</u> - Beam generation and combination - phase and energy matching - Potential feedbacks	100 Amp peak current 12GHz bunch repetition frequency 0.2 degrees phase stability at 12 GHz $7.5 \cdot 10^{-4}$ intensity stability
	<u>RF power generation by Drive Beam</u> - Rf power extraction - Beam stability	90% extraction efficiency Large momentum spread
Beam Physics	<u>Generation and Preservation of Low Emittances</u> Damping Rings, RTML and Main Linacs	Emittances(nm): H= 600, V=5 Absolute blow-up(nm): H=160, V=15
Stabilization	<u>Main Linac and BDS Stabilization</u>	Main Linac : 1 nm vert. above 1 Hz; BDS: 0.15 to 1 nm above 4 Hz depending on final doublet girder implementation
Operation and reliability	<u>Operation and Machine Protection</u> Staging of commissioning and construction MTBF, MTTR Machine protection with high beam power	drive beam power of 72 MW @ 2.4 GeV main beam power of 13 MW @ 1.5 TeV
Detector	<u>Beam-Beam Background</u> Detector design and shielding compatible with breakdown generated by beam beam effects during collisions at high energy	$3.8 \cdot 10^8$ coherent pairs



CLIC Chart 09



Mandate CLIC Technical Committee (CTC)

- **General objective:**

Towards a Project Oriented and Cost Conscious CLIC Design in preparation for the Conceptual Design Report to be edited in 2010.

- **Specific responsibility:**

Set-up and keep updated:

- an overall nomenclature of the components of the whole project,
- a complete and coherent CLIC Work Breakdown Structure with components specifications derived from the present design by the Parameters WG
- The related documentation structure integrating a description of all technical components

Review the ensemble of technical equipments in the present CLIC design in terms of:

- Specifications
- Technical feasibility
- Fabrication and prospective in industrialization
- Integration (machine/tunnel)
- Interface with the detectors
- Installation
- Schedule (including fabrication & installation)
- Cost (investment and exploitation)

New CLIC EDMS documentation



- preserved existing CLIC documentation and organization of CLIC documentation
- has CLIC PBS added
- uses CLIC PBS for new additional project information:
parameter specs, functional specs, engineering specs...

<https://edms.cern.ch/nav/CERN-0000060014>

CTC Working Groups

- **Civil Engineering and Services:** see example on next slides
- **Two Beam Module:** Germana's talk Wednesday
- **Machine Detector Interface:** see example on next slides
- **Machine Operation & Protection:** Michel's talk Wednesday
- **Stabilization:**
Claude's talk on Wednesday; combination with beam based feedback and alignment activities to a new working group in discussion
- **Instrumentation:** see example on next slides



CLIC Technical Cttee

Events in this category:

 Search (more options) ?

▼ 2009

December 2009

- 15 CLIC Technical Committee - Meeting #27
- 01 CLIC Technical Committee - Meeting #26

November 2009

- 17 CLIC Technical Committee - Meeting #25
- 03 CLIC Technical Committee - Meeting #24

October 2009

- 20 CLIC Technical Committee - Meeting #23
- 06 CLIC Technical Committee - Meeting #22 - Progress of the alignment study

September 2009

- 15 CLIC Technical Committee - Meeting #21 - Outcome from two-beam module review
- 01 CLIC Technical Committee - Meeting #20 - Progress of stabilisation and beam feedback WG

July 2009

- 21 CLIC Technical Committee - Meeting #19 - Action plan MDI WG
- 07 CLIC Technical Committee - Meeting #18 - Action plan MPWG - Outcome from instrumentation WS

June 2009

- 16 CLIC Technical Committee - Meeting #17 - Alignment system and impact on module design

May 2009

- 19 CLIC Technical Committee - Meeting #16 / Tunnel cross-section and Drive beam BPM
- 05 CLIC Technical Committee - Meeting #15 / MDI

April 2009

- 28 CLIC Technical Committee - Meeting #14 / CLIC machine protection working group
- 07 CLIC Technical Committee - Meeting #13 / RF system for the drive beam linac

March 2009

- 10 CLIC Technical Committee - Meeting #12

February 2009

- 03 CLIC Technical Committee - Meeting #11

January 2009

- 09 CLIC Technical Committee - Meeting #10

▼ 2008

December 2008

- 02 CLIC Technical Committee - Meeting #9

November 2008

- 04 CLIC Technical Committee - Meeting #8

October 2008

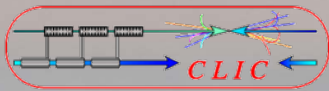
- 09 CLIC Technical Committee - Meeting #7

Tools

- ◀ Browse Categories
- ▶ Events Overview
- ▶ Calendar
- ▶ Site Map
- ▶ Room Booking
- ▶ Statistics
- ▶ Search
- ▶ Indico News
- ▶ Help
- Add Event
 - Lecture
 - Meeting
 - Conference

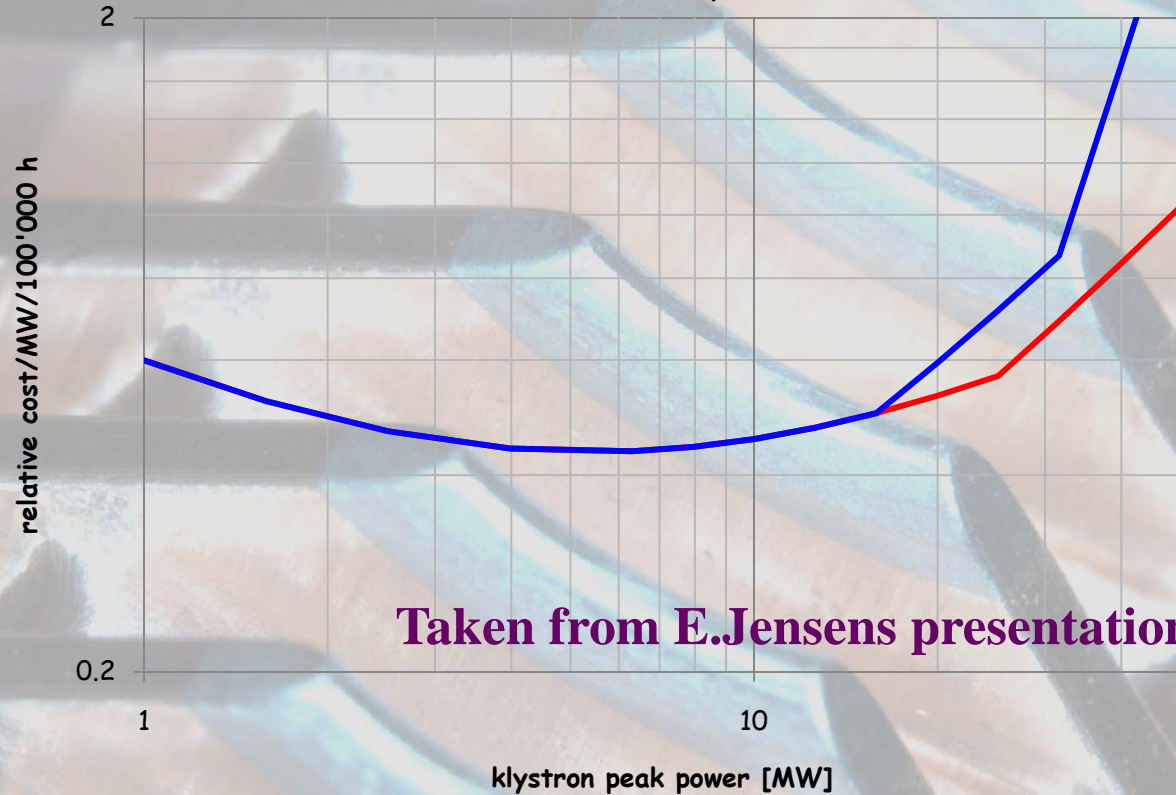


Not only "critical issues"; also contribution to performance and cost issues.



Cost for 100,000 operating hours and MW

- Even if this model may be wrong, there will be a cost per MW and per operating hour: With the above model, this becomes:



- Blue: present state of the art
- Red: assuming a major investment into the development of a dedicated 30 MW tube

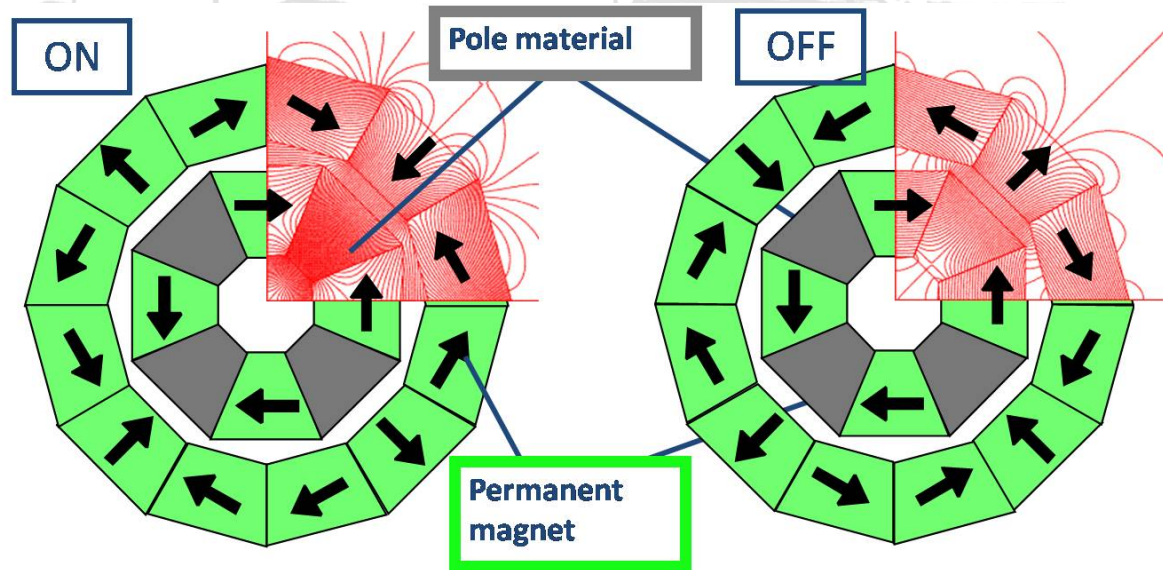
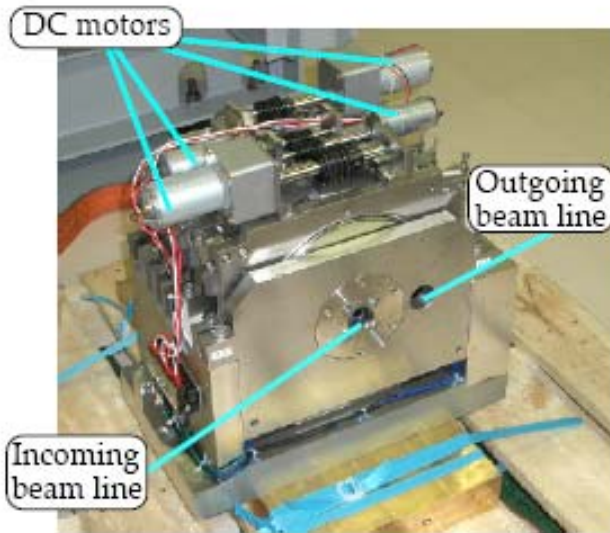
CLIC FF doublet parameters

QF1 QD0		
L*	3.5	m
Gradient	200 - 575	T/m
Length	3.26 - 2.73	m
Aperture (radius)	4.69 - 3.83	mm
Outer radius	< 35 - < 43	mm
Octupolar error	106	T/m ³
Dodec. error	1016	T/m ⁵
Peak field	0.94 - 2.20	T
Field stability	10 ⁻⁴	
Energy spread	± 1	%

+ tuning range of FF: several %

- Present (old) design: based on permanent magnets
recall of problems: physical size of PM magnet elements, temperature coefficient,
radiation damage, tuning possibility, mechanical stability

Double Ring Structure –Adjustable PMQ-



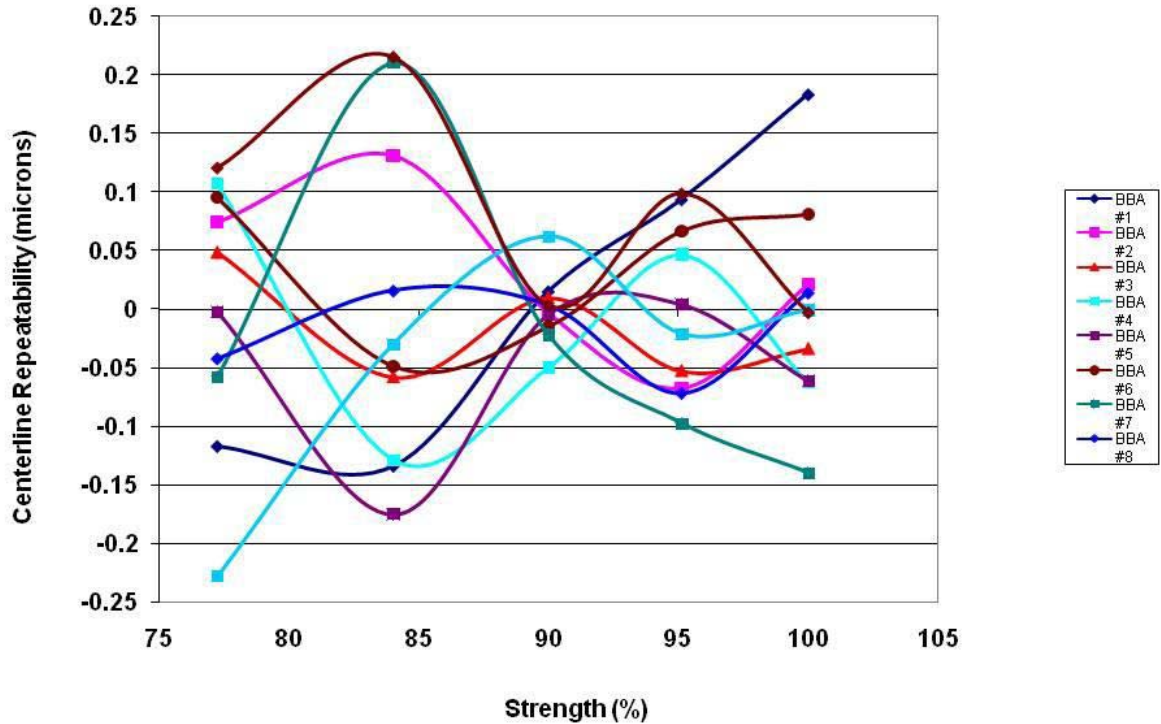
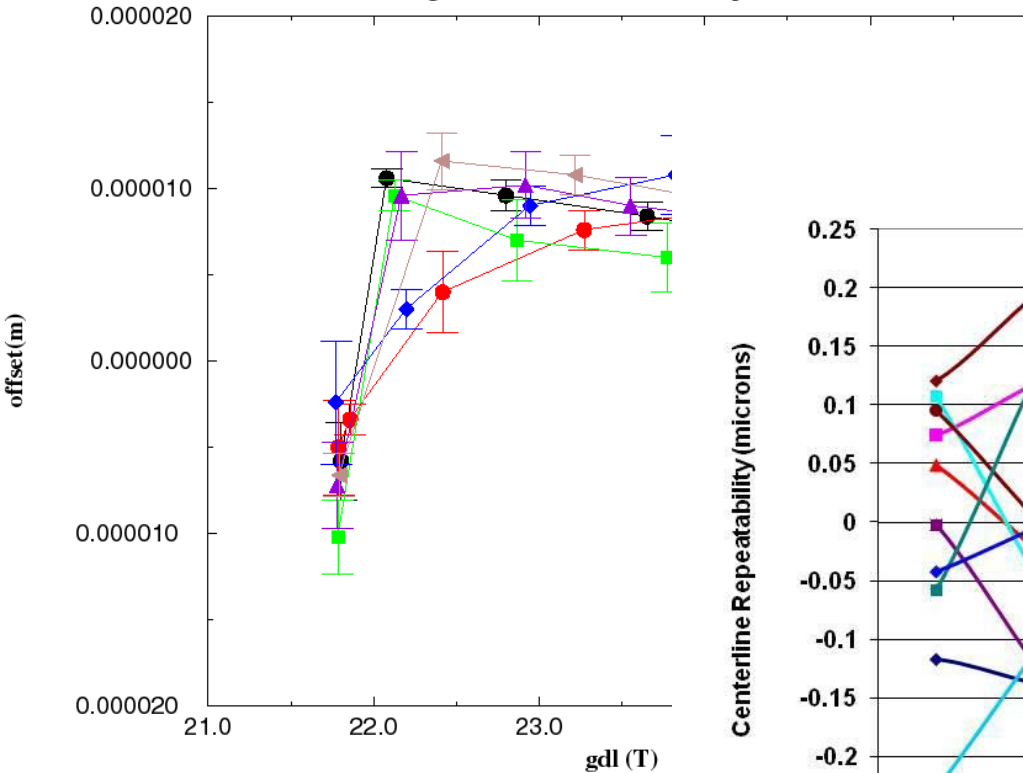
- High gradient → heat load during adjustment

The double ring structure

PMQ is split into inner ring and outer ring. Only the outer ring is rotated 90° around the beam axis to vary the focal strength.

Magnetic Center Shift

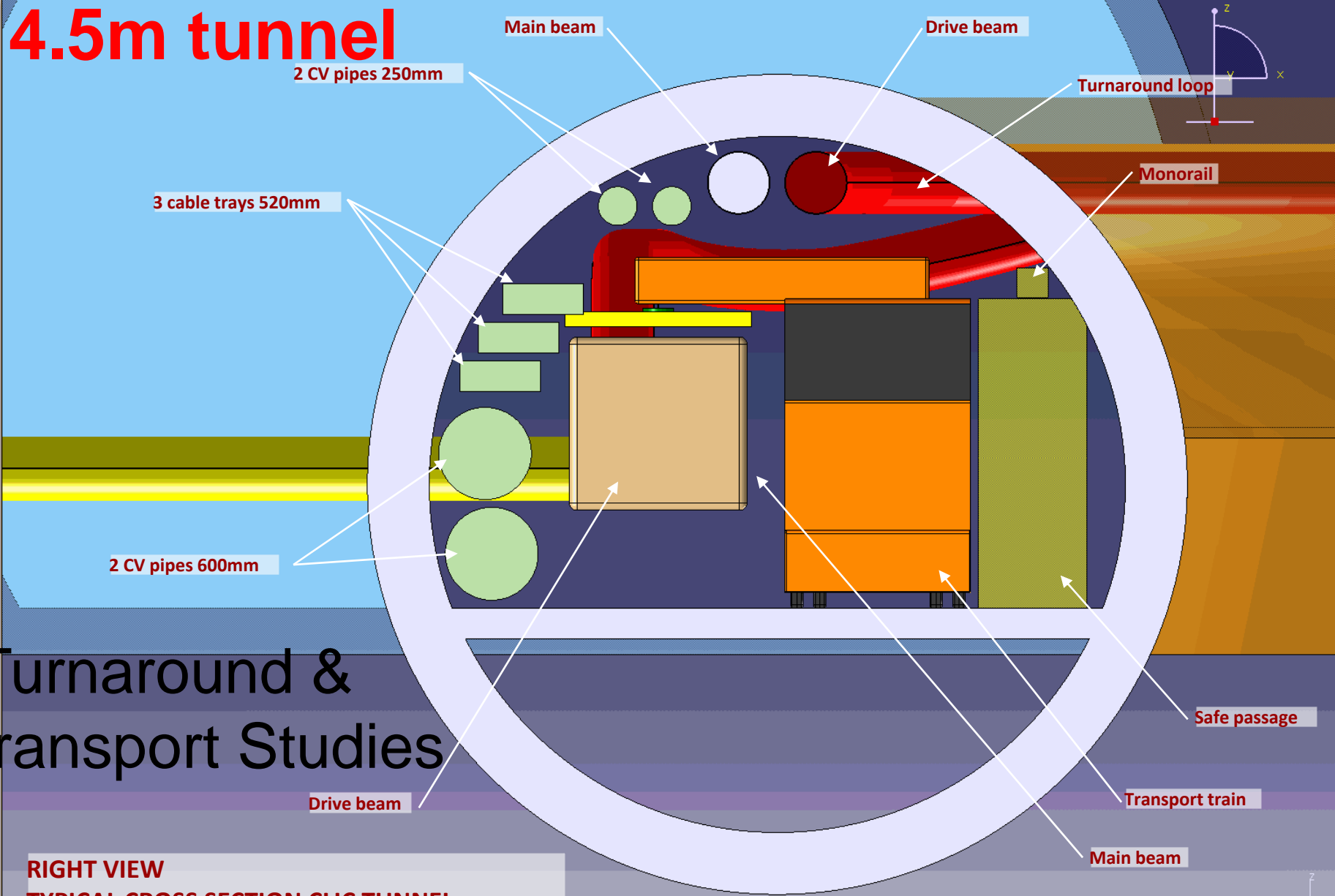
FSSQ0011 Relative Y_Center
Quad center at various shunt positions



Present situation with FF magnet:

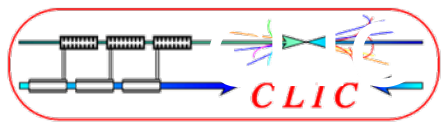
- Have to reconsider SC option, permanent magnet option (tuning range?), or normal conducting option or combination of these
- Needs for each option strong interaction with physics detector project
- Will have to review aperture requirements within beam dynamics WG
- Work will happen within next months in the newly formed (and reinforced) MDI working group
- MDI WG will have to produce urgently input to stabilization WG
- No experimental work before CDR; studies and simulations only

4.5m tunnel



Turnaround & transport Studies

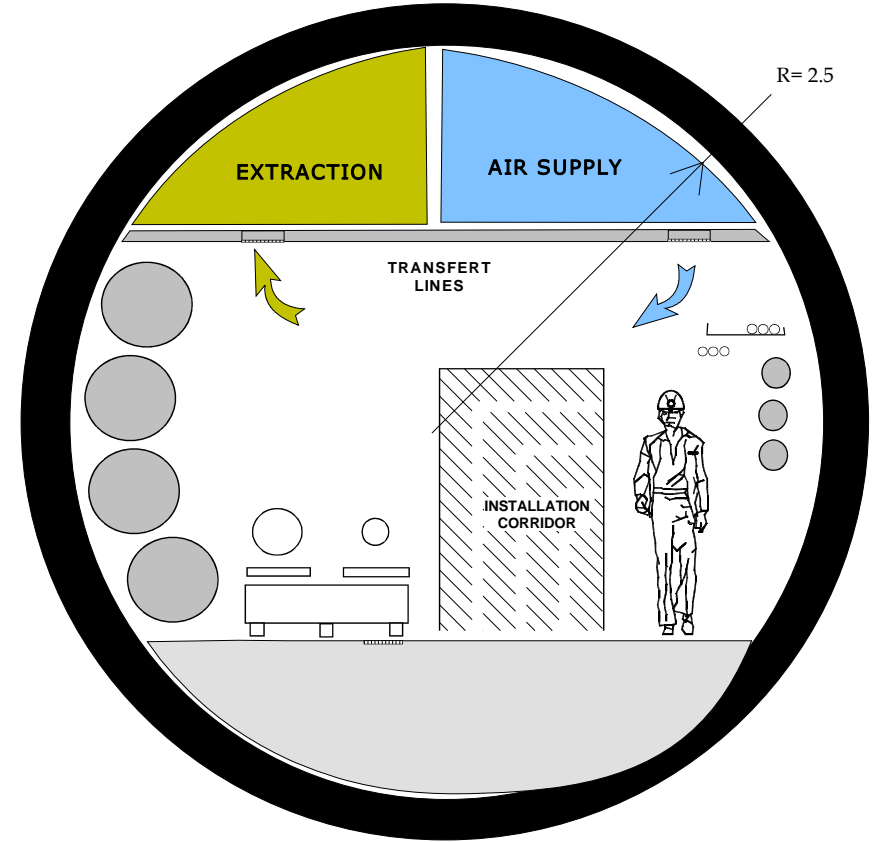
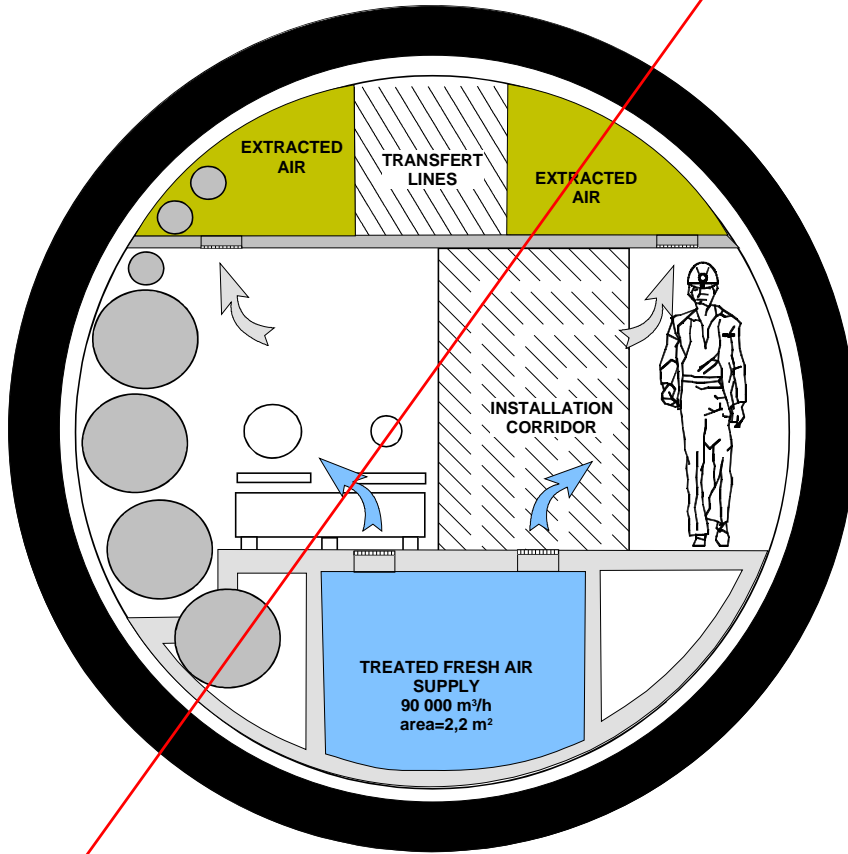
RIGHT VIEW
TYPICAL CROSS SECTION CLIC TUNNEL



Ventilation Concepts

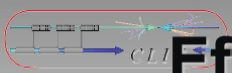
Advantages of transversal ventilation :

- Safety (see CLIC note from F.Corsanego EDMS 827669)
- Much better control of temperature & humidity gradient along the tunnel

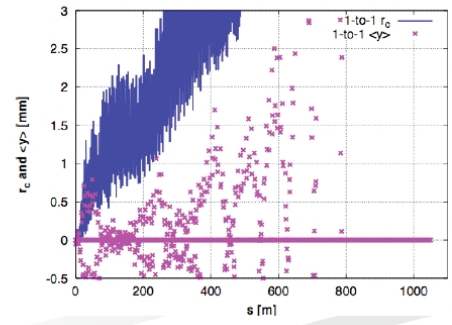
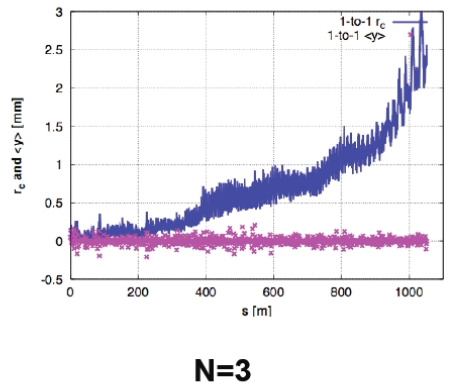
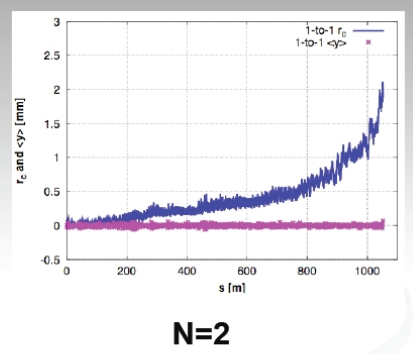
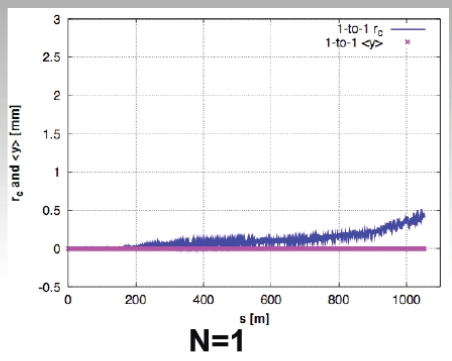


DB BPMS

- Present specs:
 - about 40000 BPMs in all 48 decelerators
 - 2 um resolution
 - 20 um precision (and also 20 um quad alignment)
- Cost with present technologies: 15 ksfr/BPM
→ order of 600 MSfr for the DB BPMS
- 1) Launch cost reduction work in BI group and collaborators
- 2) Rediscuss need for 40000 BPMs
- 3) Complete Specs (Beam Types, Operating Temperature Range...)



Effect on reducing number of BPMs



Taken from E.Adli's presentation

(perfect BPMs and single machine simulated, for illustration purposes)

Choice not obvious: tradeoff between number of BPMs and precision; availability, cost versus precision, risk....

Workshops/Reviews



- April 2009: Workshop on Wire Position Sensors for Alignment Systems; Search for Collaborators
- June 2009 (next week): Beam Instrumentation workshop
Purpose: Review CLIC beam instrumentation requirements;
Identify together with BI group unsolved technology problems
Define and launch most important studies and prototyping
- September 2009: Two beam module Review
Purpose: Present all integration issues, discuss some of the old design choices, define new baseline for the CDR

Charge of this ACE meeting



The CLIC project is aiming to demonstrate the feasibility of the Two Beam Accelerator concept on the 2010-timescale so that a complete evaluation of technical options for a future linear collider can be made once data from the LHC is available. To this end, the CLIC project is planning to document the status of the TBA technology and the CLIC design in a Conceptual Design Report to be written by the end of 2010.

The Committee is invited to review, assess and comment on these plans. In specific, the committee is asked to evaluate:

1. a prioritized list of the most relevant CLIC technical issues and their classification by feasibility, performance and cost impact.
2. the R&D status and plans to address the critical issues in terms of objectives and schedule
3. the R&D program and the schedule to complete a CLIC Feasibility Demonstration as well as a Conceptual Design Report by the end of 2010
4. A first proposal of technical objectives and planning for the Technical Design Phase in the years 2011 - 2015



Complementary information:

- List of CLIC critical items file
- List of “all” CLIC items file
- Written evaluations for R&D plans for most critical items

→ all copied into indico

Summary

- CTC was created in 2008
- CTC complements existing work in CTF3, Structures WGs, Beam dynamics WG and LCD Project
- Start of complementary QA documentation in EDMS
- Definition and follow-up of technical work
- Together with CSC (and other WGs) elaboration of R&D plans and workpackage definitions for resource holders (will eventually lead to a CLIC WBS)