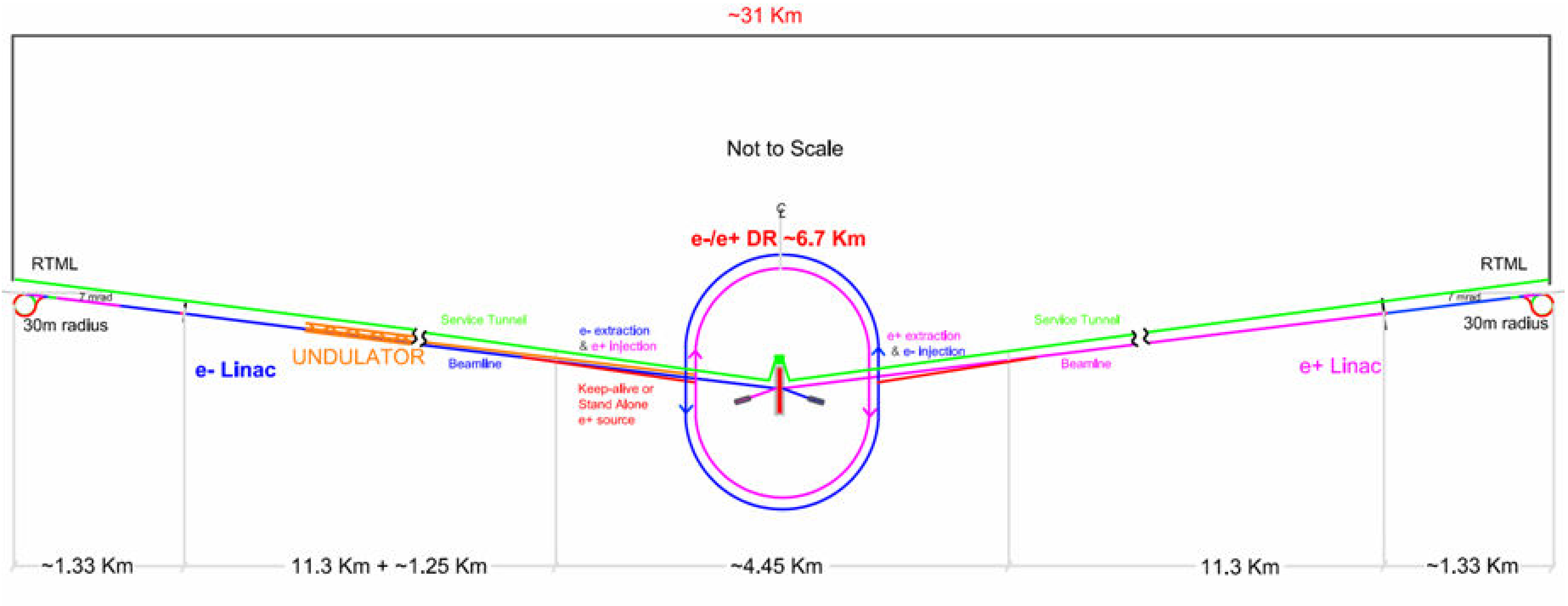
Status projektów ILC/CLIC

Spotkanie plenarne FiTAL
18 czerwca 2010

Overall ILC Layout from RDR

1st Stage: 500 GeV; central DR et al. campus; 2 “push-pull” detectors in 14 mrad IR.

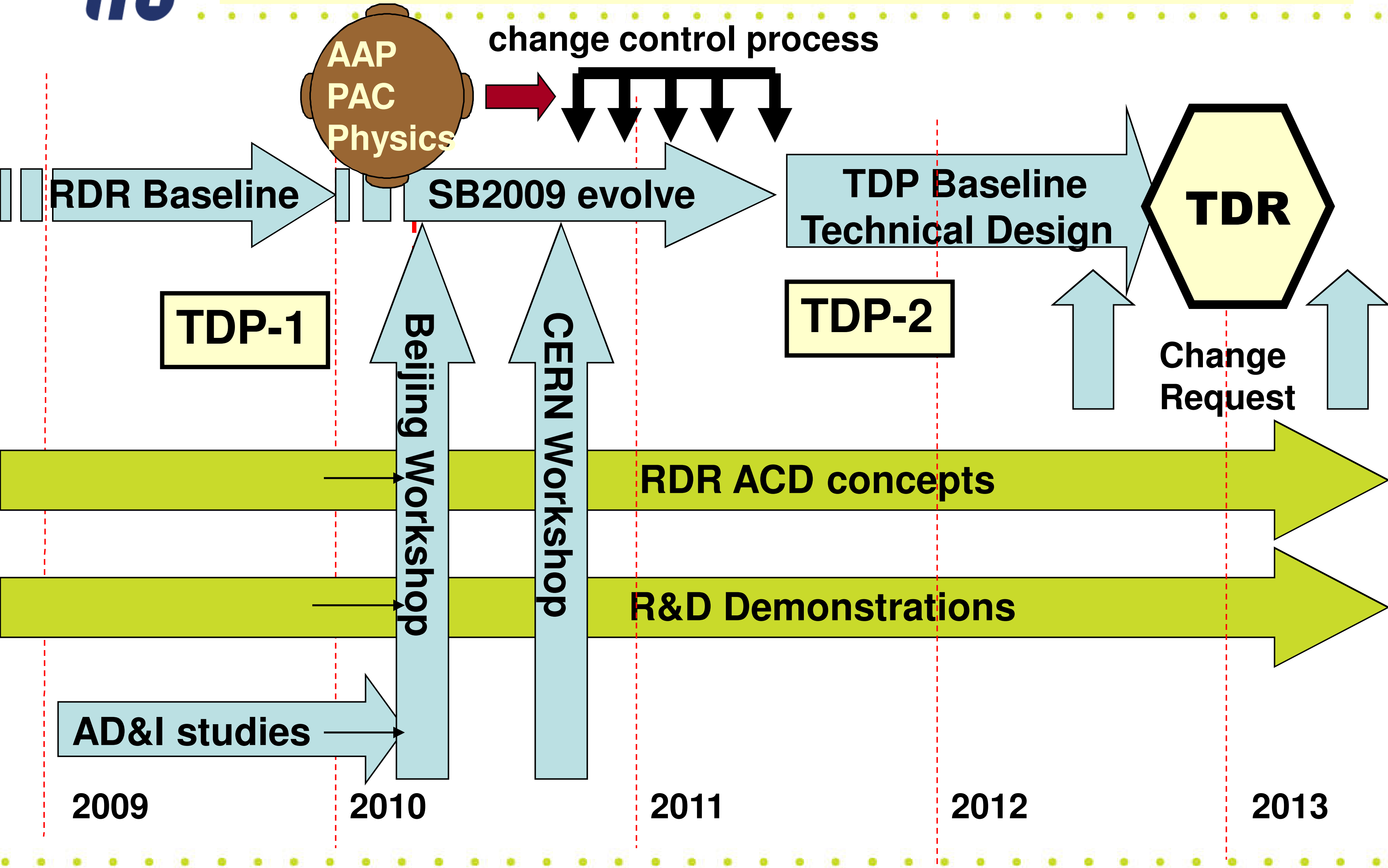


Schematic Layout of the 500 GeV Machine

RDR → <u>*2012*</u> Technical Design

- **Strong Basis for SCRF technology in each ILC region**
  - Cavity fabrication and test: Each region
  - Global Cryomodule: KEK +
- **Large scale <u>*Costed*</u> technology demonstration**
  - EU XFEL (5% of ILC); first beam mid-2014
- **Siting: adaptation to best suit potential hosts**
- **Beam – based studies and demonstrations**
  - High power SCRF linac operation: DESY +
  - Electron-cloud beam dynamics: Cornell +
  - Beam delivery technology: KEK +

Technical Design Phase and Beyond

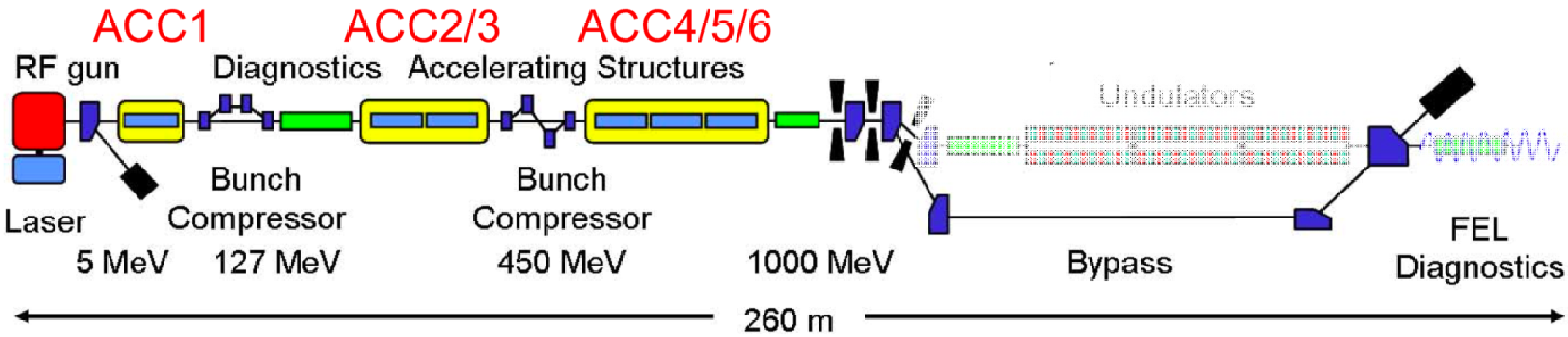


Global Plan for SCRF R&D

Year	07	2008	2009	2010	2011	2012
Phase	TDP-1				TDP-2	
Cavity Gradient in v. test to reach 35 MV/m	→ **Process** Yield 50%				→ **Production** Yield 90%	
Cavity-string to reach 31.5 MV/m, with one-cryomodule		Global effort for string assembly and test (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration			FLASH (DESY) , NML (FNAL) STF2 (KEK, extend beyond 2012)			
Preparation for Industrialization				Production Technology R&D		

High Power SCRF Linac Operation

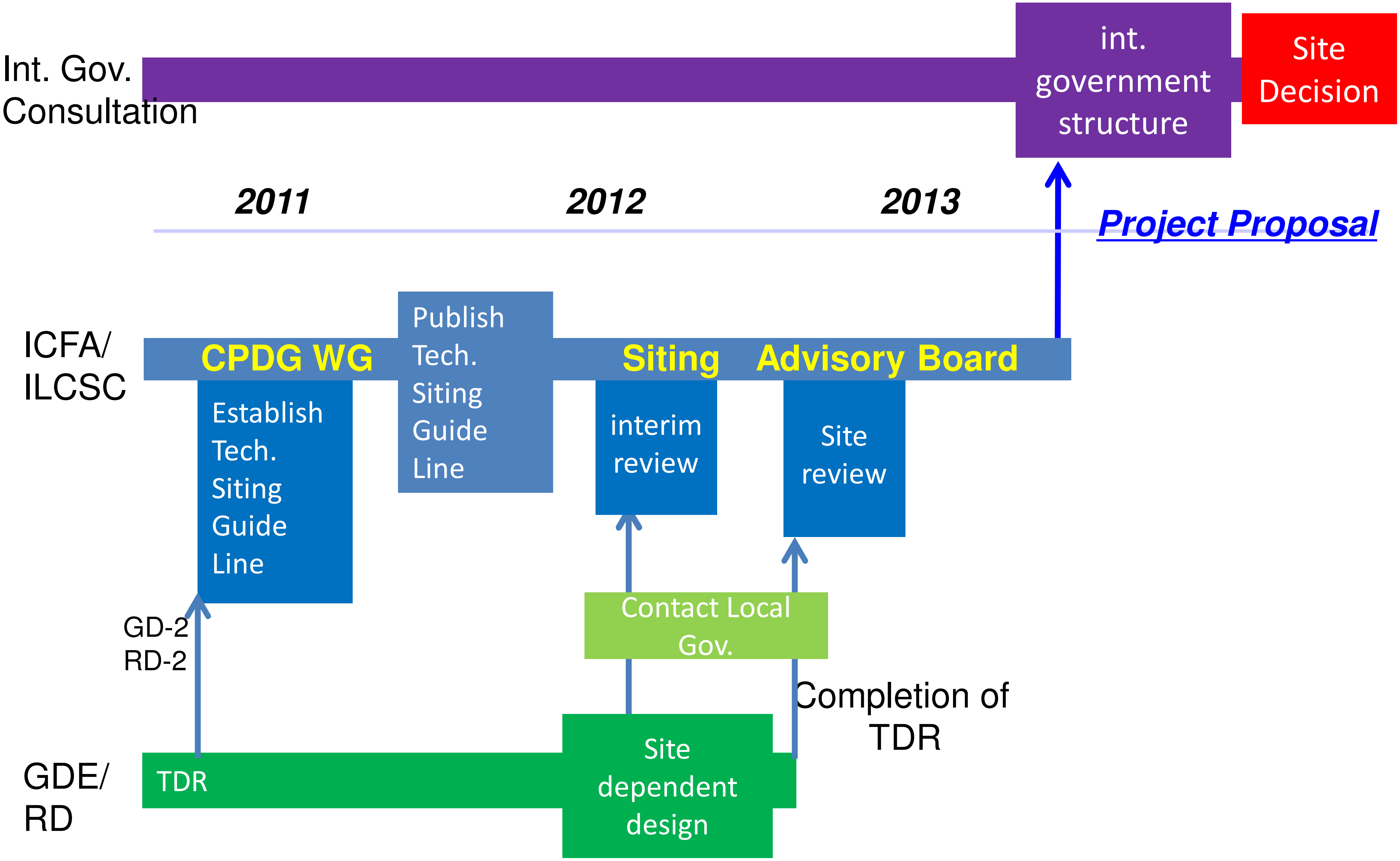
DESY/FLASH 9mA – 36 kW



		XFEL X-Ray Free-Electron Laser	ilc	FLASH design	FLASH experiment
Bunch charge	nC	1	3.2	1	3
# bunches		3250*	2625	7200*	2400
Pulse length	μs	650	970	800	800
Current	mA	5	9	9	9

DESY, ANL, FNAL, SLAC, KEK

Site Selection Process - Timeline



From Technical Design Report to ILC
(or beyond 2012)

- Steps to a Project – Technical (2-3 years)
  - **R&D for Risk Reduction and Technology Improvement**
  - **Engineering Design**
  - **Industrialization**
- Project Implementation
  - **Government Agreements for International Partnership**
  - **Siting and site dependent design**
  - **Governance**
- Time to Construct
  - **5-6 years construction**
  - **2 years commissioning**
- Project Proposal / Decision keyed to LHC results
- ILC Could be doing physics by early to mid- 2020s

ILC Cost – fact & fiction

- RDR cost (value) = 6.62 B$ (US 2007)
  (+ 24M person-hours explicit labor ~ $1.4B) => $8B
- So why do you keep hearing ludicrous figures like $20B?
  - DOE accounting - Add some contingency (note GDE estimates include some, but not all (DoE) contingency. It needs to be done item by item. (conservatively + 20%)
  - Escalation to "then year dollars" using arbitrary inflation estimate This is the big factor that people use – escalating for ~ 15-20 years gives ~ 200%
  - For the total project, this gives **~$20B+** (then year $$)
- But e.g. Japan has ~ 0 inflation!
- US will never build the entire machine
- GDE aims that savings from rebaselining will maintain RDR cost in 2012

Physics case for ILC

- have been in the LC community since 1990
- NLC, JLC, TESLA, CLIC, ...
- many ups and downs in hopes and perceptions about ILC
- don't think physics case has been really changed since then

(reassuring & disappointing)

Why the ILC?

- I could pick many statements. Here are 2:
- CERN Council Strategy Document:
  - **"It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide an unique scientific opportunity at the energy frontier."**
- OECD Science Ministerial Statement (2004)"
  - **"..noted the worldwide consensus of the scientific community, which has chosen an electron-positron linear collider as the next accelerator-based facility… endorsed the OECD GSF statement on ILC…."**

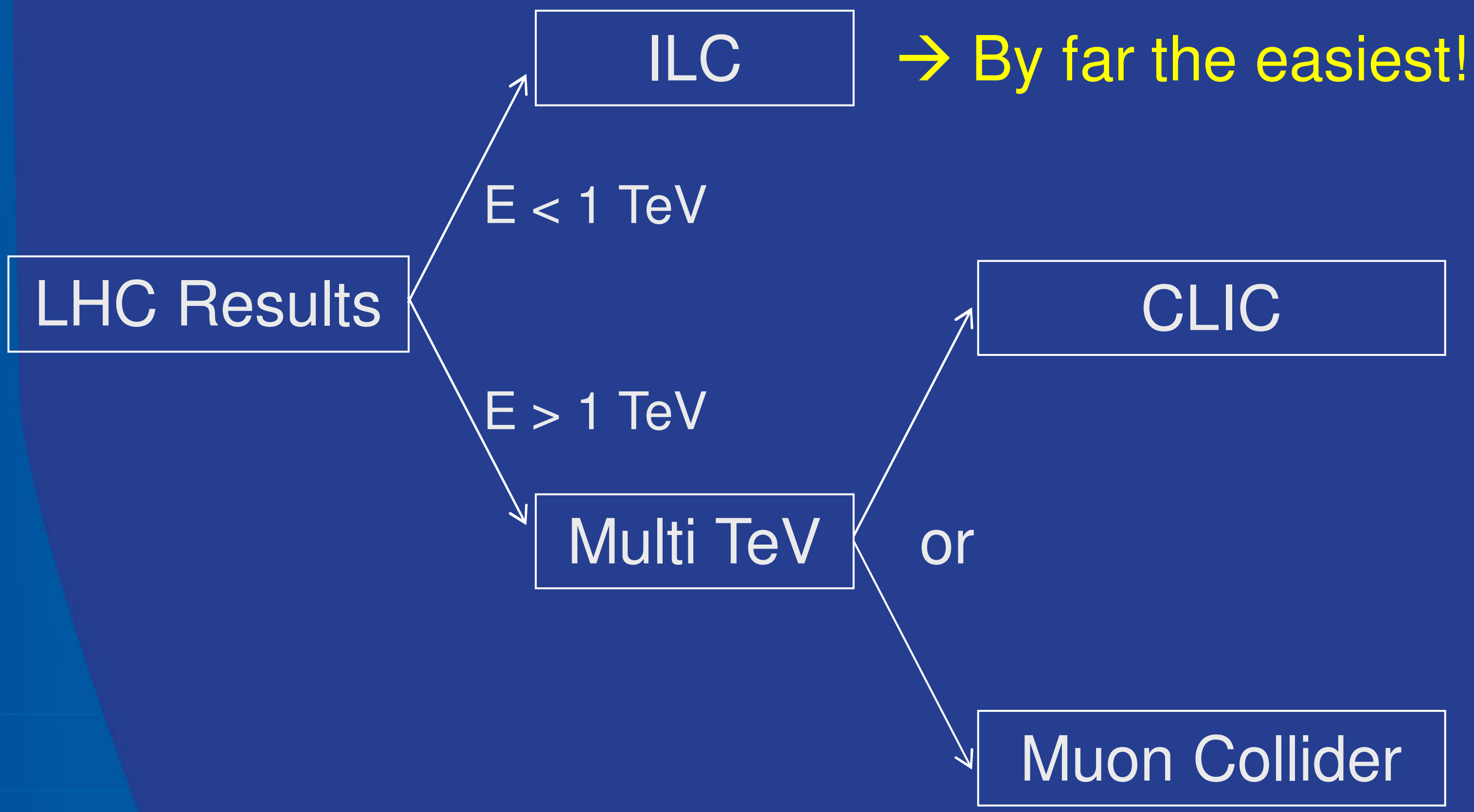
4. In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility.*

5. It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*

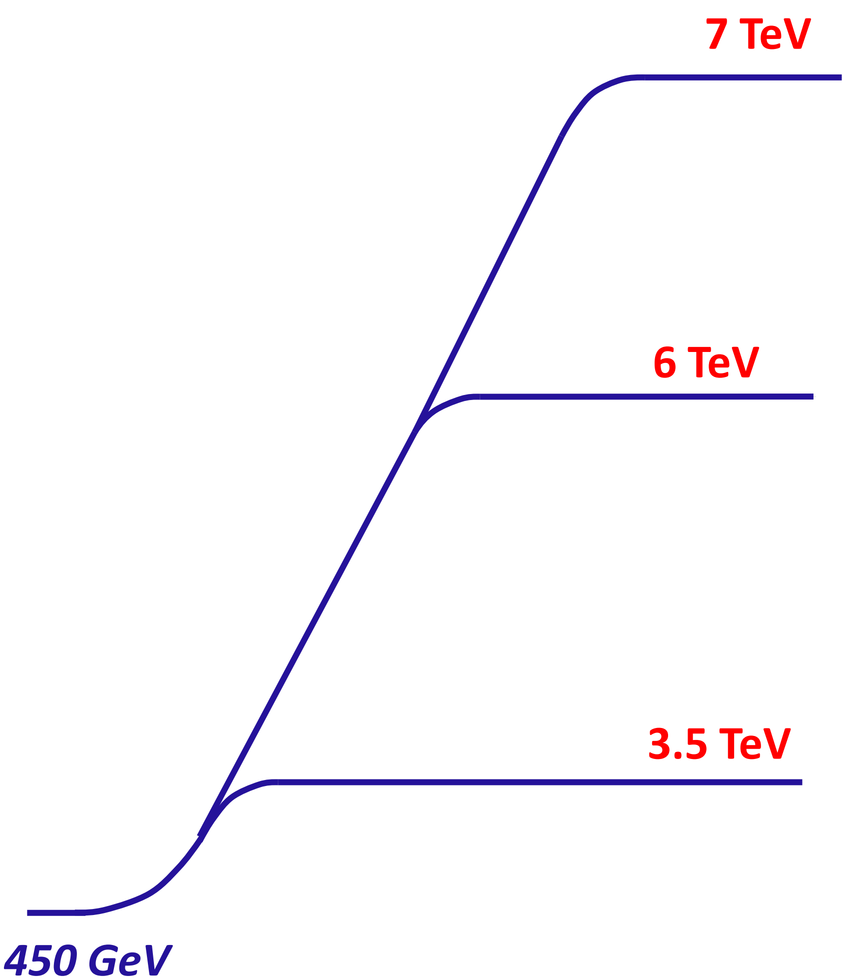
ILC is pushed farther into the future

- Fact
- At this point, I can’t imagine politicians approving ILC without seeing LHC data
- With LHC slipping, ILC slips together

Lepton Colliders beyond LHC

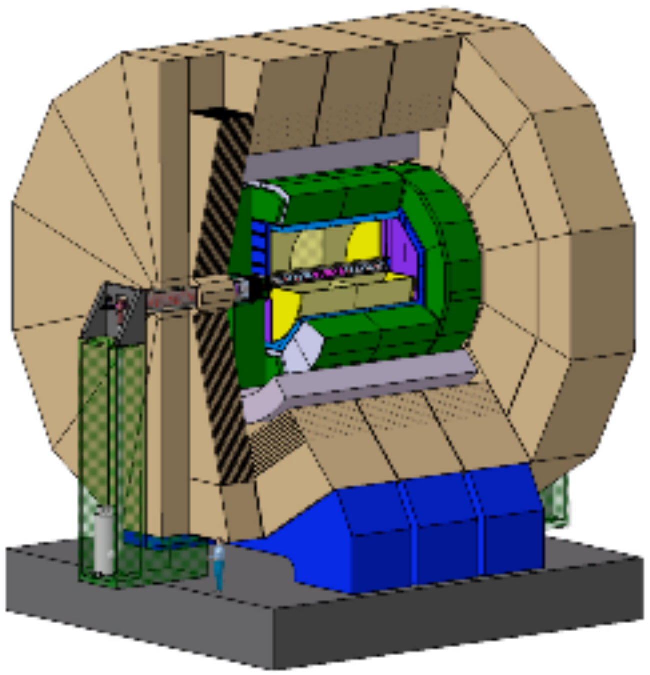


Energy: the way back



When	What
2014 ?	**Train magnets** Should be easy to get to 6TeV…. 7 TeV will take time
2013	
2012	**Long shut-down:** **Interconnections** & completion of pressure relief system
2010 – 2011	**Run @ 3.5TeV**
January 2010	**Connectors fixed** Commission nQPS system **Commission circuits to 6kA**

ILD status & plan



LOI Mar.2009

Paris Jan.2010

performance study
evaluate technologies
integration

solid & reliable design

DBD end of 2012

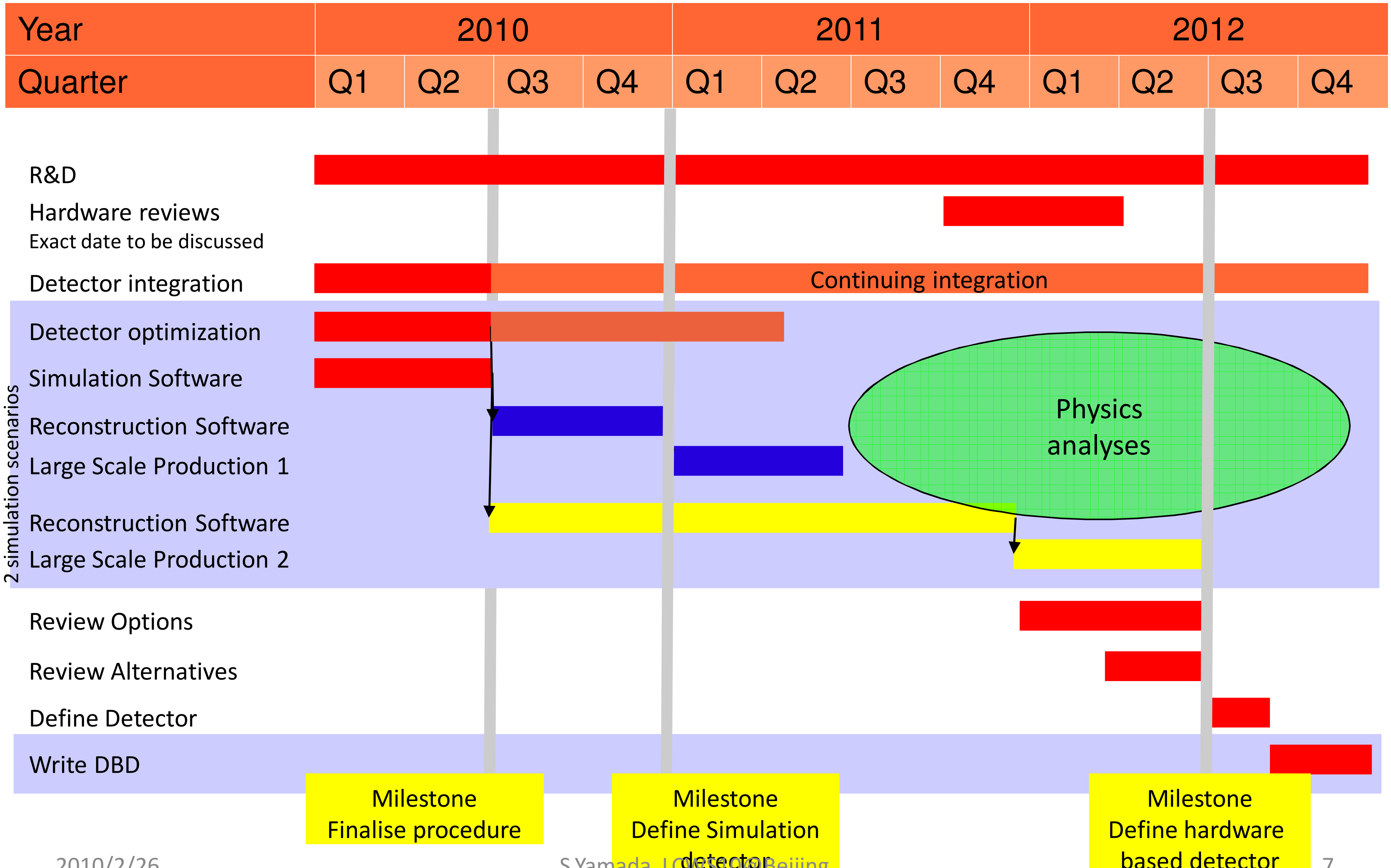
信州大学
SHINSHU UNIVERSITY

Tohru Takeshita for ILD concept group

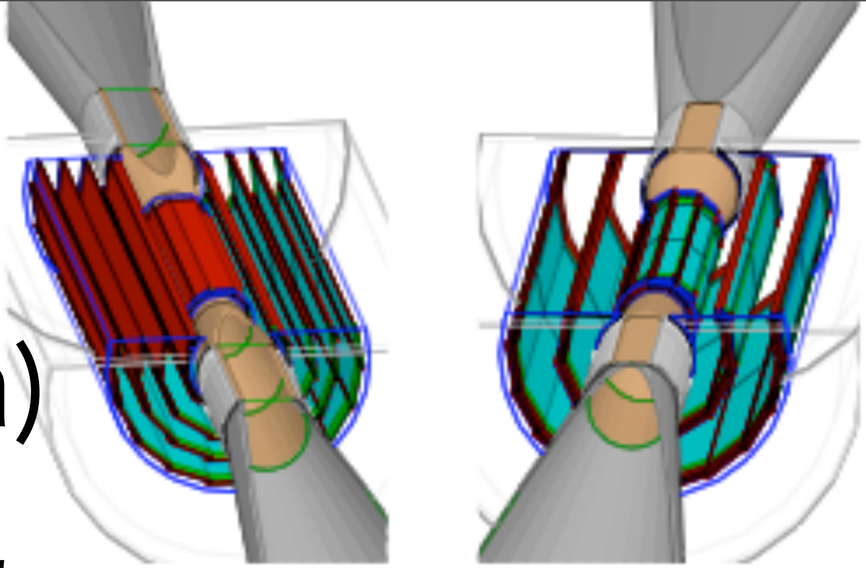
ILD base lines

- **simulation base line** SBL performance
  - a unique set of sub-det. with reality
  - includes detailed det. model
  - will be defined in 2010
- **detector base line** DBL technology
  - realistic technical solutions for sub-det.
  - discuss with R&D group
  - will have a review in 2012

ILD Main Milestones　(Updated Feb.2010)



VTX status



Flavor tagging & vtx. charge

- beam background study (sim)

  two photons as well

- granularity & material budget

  0.16%X0/ layers (double layer)

- occupancy & rad. dose

- two designs: in sensor and ladder comb.

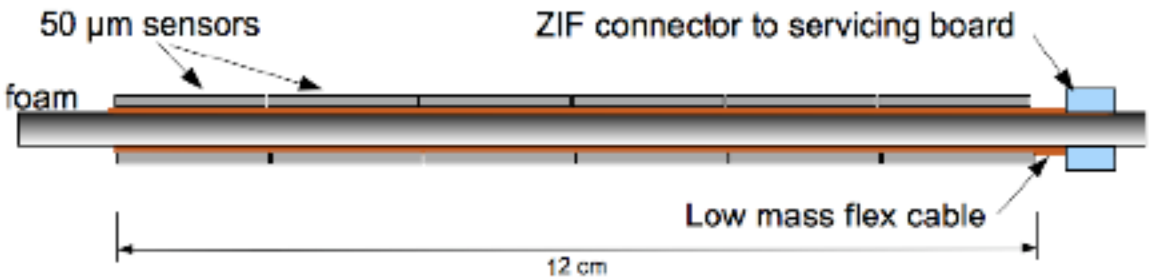
  MIMOSA/FPCCD/DEPFET/APSEL/3D

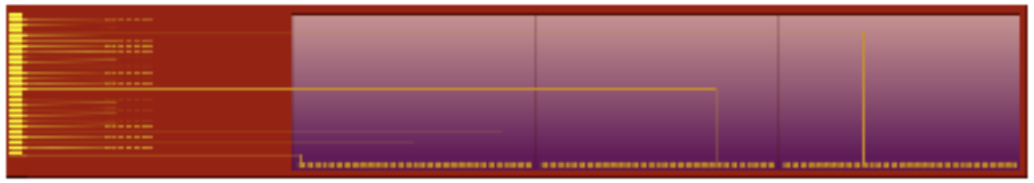
  - single/double sided

    5 / 6=2*3 layers

  - mech. ladder

  - innermost unsupported

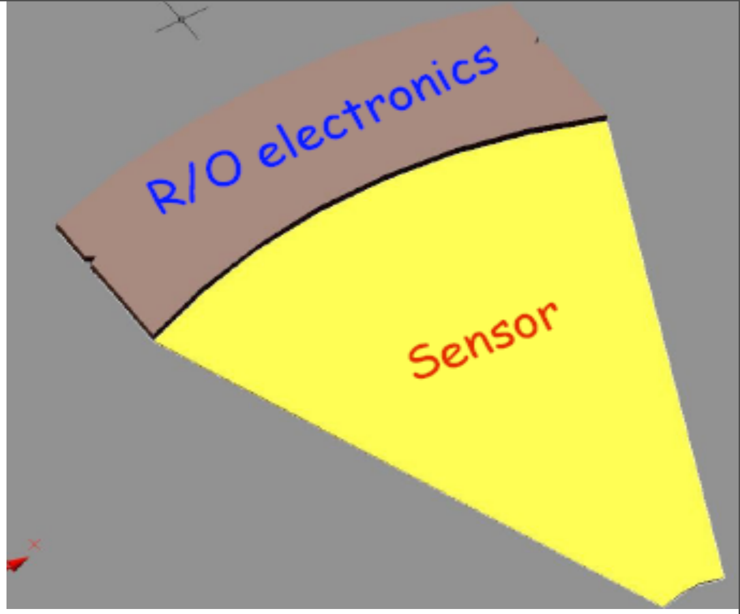




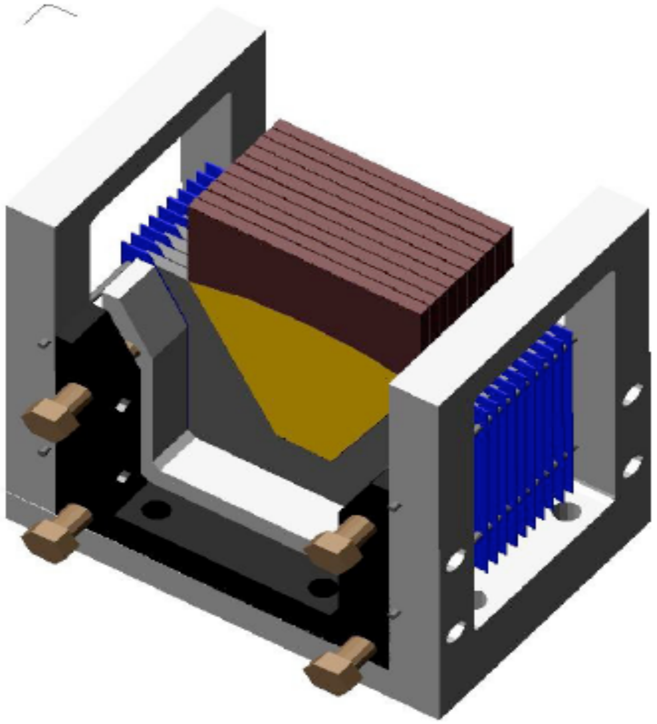
VTX plan

- 2011:parameters frozen
  - sensor parm. for pixel technologies
  - ladder designs
  - Cryostat & service
- 2012: performance
  - sensor performance
  - ladder parameters : material budg.
  - alignment
  - engineering integration

FCAL plan



- 2010 : Full assembly of a prototype sector LumiCal & BeamCal
    - sensor & ASICs
    - DAQ development
    - lab and beam test
- 2011 : Beam Test
- 2012 : analysis & prepare DBD



World-Wide CLIC&CTF3 Collaboration

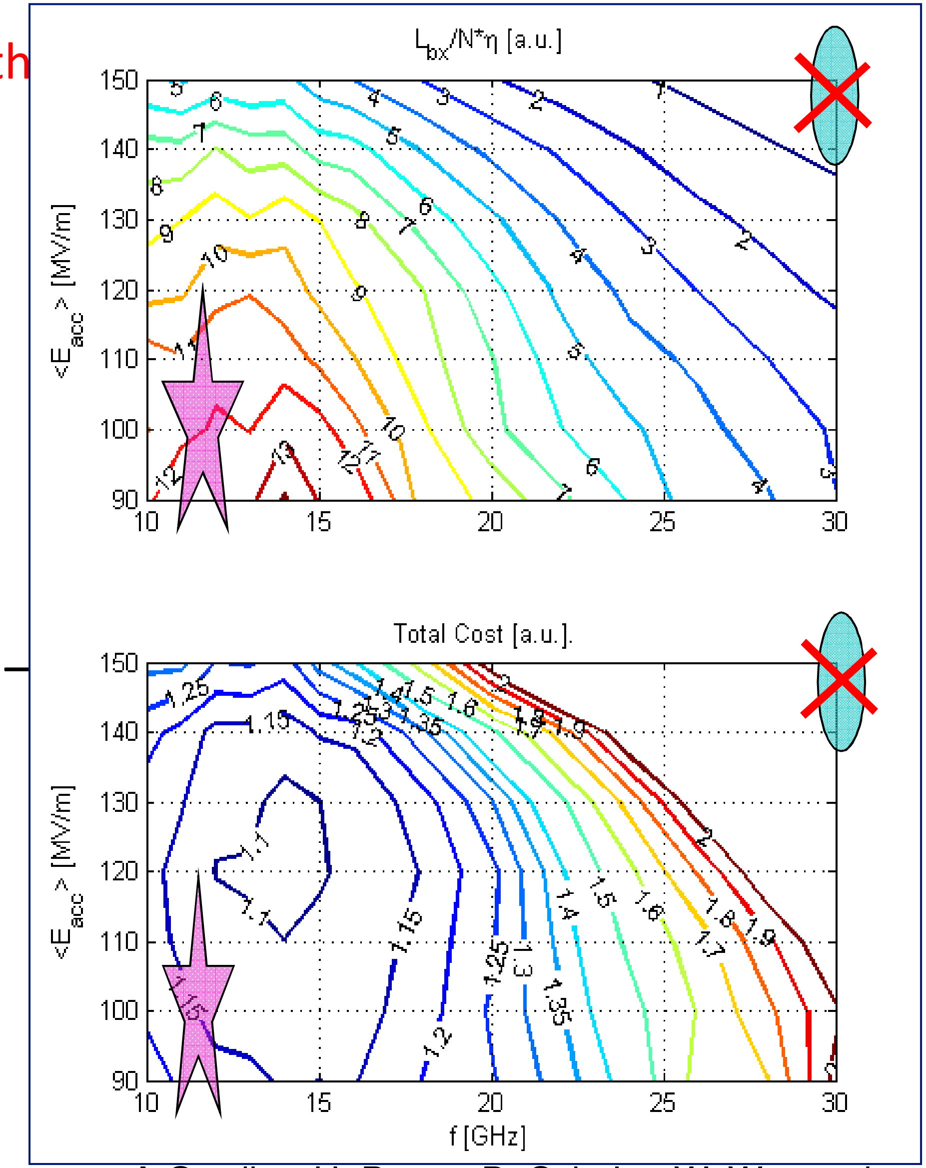
http://clic-meeting.web.cern.ch/clic-meeting/CTF3_Coordination_Mtg/Table_MoU.htm

33 Institutes involving 22 funding agencies from 18 countries

- Aarhus University (Denmark)
- Ankara University (Turkey)
- Argonne National Laboratory (USA)
- Athens University (Greece)
- BINP (Russia)
- CERN
- CIEMAT (Spain)
- Cockcroft Institute (UK)
- Gazi Universities (Turkey)
- Helsinki Institute of Physics (Finland)
- IAP (Russia)
- IAP NASU (Ukraine)
- INFN / LNF (Italy)
- Instituto de Fisica Corpuscular (Spain)
- IRFU / Saclay (France)
- Jefferson Lab (USA)
- John Adams Institute (UK)
- JINR (Russia)
- Karlsruhre University (Germany)
- KEK (Japan)
- LAL / Orsay (France)
- LAPP / ESIA (France)
- NCP (Pakistan)
- North-West. Univ. Illinois (USA)
- Patras University (Greece)
- Polytech. University of Catalonia (Spain)
- PSI (Switzerland)
- RAL (UK)
- RRCAT / Indore (India)
- SLAC (USA)
- Thrace University (Greece)
- University of Oslo (Norway)
- Uppsala University (Sweden)

Optimisation Results

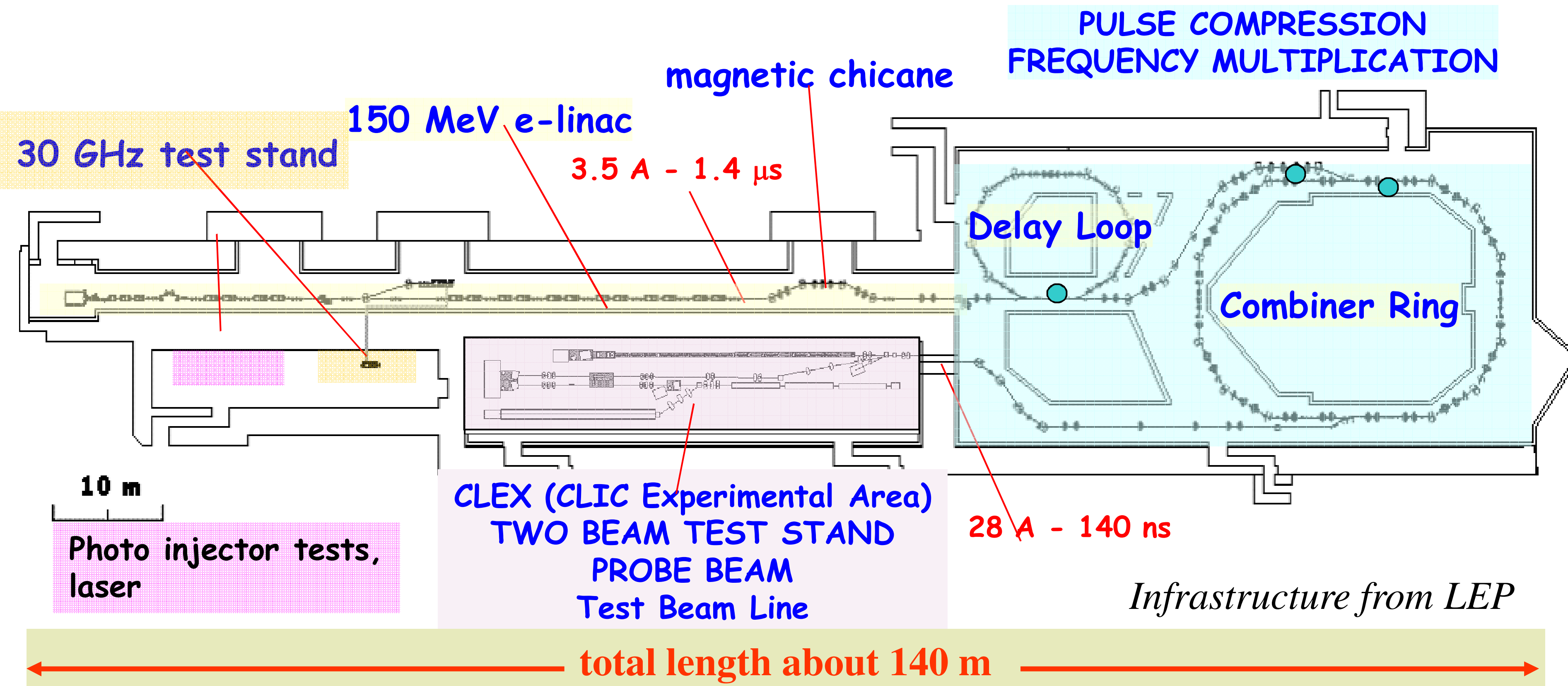
- Optimisation - figure of merit:
  - Minimum project cost for 3TeV with $L_{0.01}=2\ 10^{34}cm^{-2}s^{-1}$
- Structure limits
  - RF breakdown – scaling (E_{surf}<260MV/m , $P/C\tau^{1/3}$ limited)
  - RF pulse heating (ΔT<56°K)
- Beam dynamics
  - Beam-beam effects
  - Damping rings, BDS
  - Main linac emittance preservation – wake fields
- Cost model
- Merged into one big model
- Chose 100MV/m and 12GHz



A.Grudiev, H. Braun, D. Schulte, W. Wuensch.

Two-Beam Acceleration: CLIC Test Facility (CTF3)

- Demonstrate Drive Beam generation
  (fully loaded acceleration, beam intensity and bunch frequency multiplication x8)
- Demonstrate RF Power Production and test Power Structures
- Demonstrate Two Beam Acceleration and test Accelerating Structures



CLIC Plan

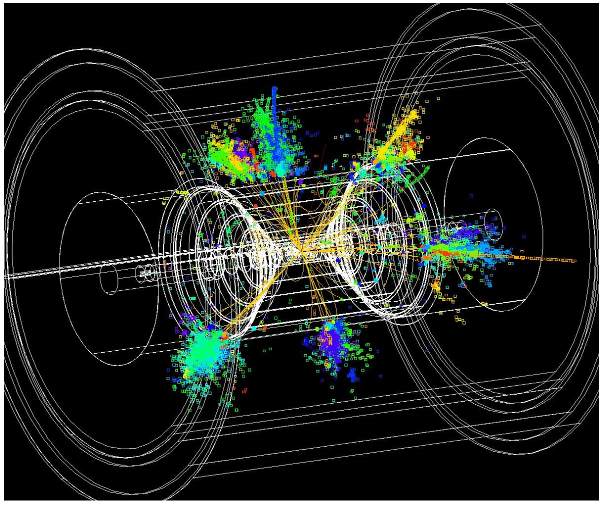
- Divided the identified critical issues into three categories (endorsed by ACE)
  - Failure to solve a feasibility issue implies that the CLIC technology is fundamentally not suited to build a machine of interest for high energy physics
  - Performance issues can compromise the performance
  - Cost issues have significant impact on cost

- For the CDR concentrate on addressing feasibility issues (mid 2011 to council)
  - Targeted conclusion: It is worth to make a technical design of such a machine
  - A baseline is being developed, involving many new experts
  - Will have turned the feasibility issues mostly into performance issues
    - Programme is in place and needs some continuation afterwards
  - A number of important performance issues addressed
  - A number of important cost issues addressed

- In the TDR phase more detail is needed (2016)
  - Targeted conclusion: One can propose this machine as a project
  - Something that is not a feasiblity issue could kill a project
  - Addressing the performance issues
  - Reducing cost
  - A workplan for the TDR phase is being finalised

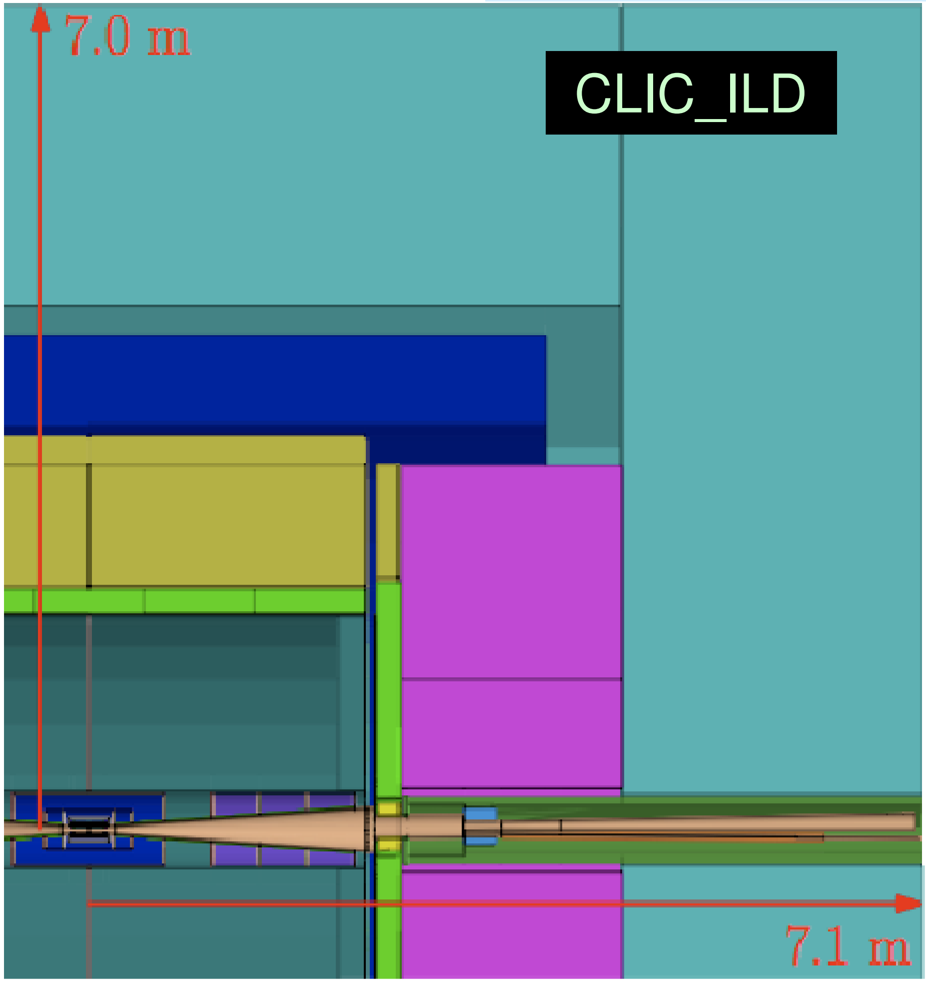
CLIC Detector Issues

- Detector requirements are close to those for ILC detectors
  - First studies indicate that ILC performances are sufficient
  - Adapt ILD and SID concepts for CLIC
  - Close collaboration with validated ILC designs
- Differences to ILC
  - Larger beam energy loss
  - Time structure (0.5ns vs. ~300ns)
  - Higher background
    - High energy
    - Small bunch spacing
  - Other parameters are slightly modified
    - Crossing angle of 20 mradian (ILC: 14 mradian)
  - Larger beam pipe radius in CLIC (30mm)
  - Slightly denser and deeper calorimetry



- Linear collider detector study has been established at CERN beginning of 2009 (led by L. Linssen, see **http://www.cern.ch/lcd)**

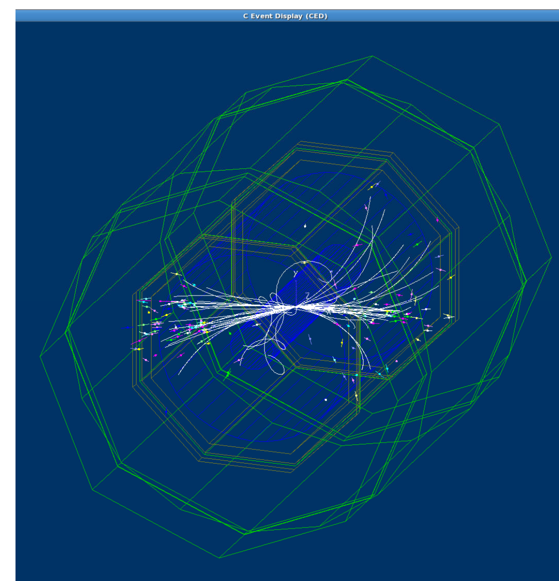
ILD concept adapted to CLIC



Changes to the ILD detector:

- 20 mrad crossing angle
- Vertex Detector to ~30 mm inner radius, due to Beam-Beam Background
- HCAL barrel with 77 layers of 1 cm tungsten
- HCAL endcap with 70 layers of 2 cm steel plates
- Forward (FCAL) region adaptations

Fully implemented in Mokka/Marlin



Andre Sailer
Berlin Humboldt /CERN

Updated Mandate Document (proposed by CLIC people)

Joint Working Group on General Detector Issues

- ILCSC has encouraged formation of a CLIC/ILC General Issues working group on detectors by the two parties with the following mandate:
  - **Promoting the physics and the detectors of the Linear Collider**
  - **Identifying synergies between the detectors of ILC and CLIC in performance studies, detector R&Ds, and Software tools**
  - **Discussing detailed plans for the ILC and CLIC efforts, in order to explore possible collaborations such as critical R&Ds on sub-detectors, coil studies, push-pull mechanism and MDI aspects**
  - **Discussing a possible format of collaboration between the ILC validated detector groups and CLIC**
-
- The conclusions of the working group will be reported to the ILCSC and ***CLIC Steering Committee*****.**

Podsumowanie

- Intensywne prace nad projektem ILC
  Mimo problemów finansowych i manpower

- Najbliższe 3 lata mogą być decydujące
  - **Ostateczny projekt akceleratora**
  - **Ostateczne projekty detektorów (kolaboracje)**
  - **Pierwsze wyniki z LHC (?)**
  - **Nowy CERN Council Strategy Document** (2012?)

- W końcu musi zostać podjęta decyzja...