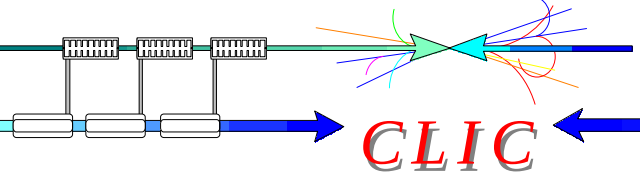
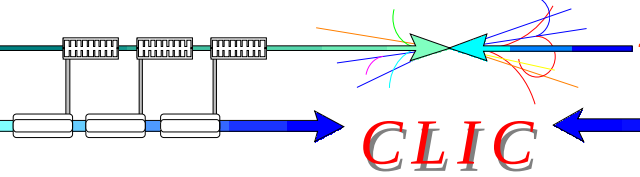


THE CLIC STUDY

- Council policy in respect with Linear Colliders
- CLIC complementary to ILC
- Feasibility of the CLIC scheme
- CTF3, the facility to address the key issues
- Plans and schedule
- Conclusion



World-wide CLIC collaboration

Ankara University (Turkey):	CTF3 beam studies & operation
Berlin Tech. University (Germany):	Structure simulations GdfidL
BINP (Russia):	CTF3 magnets development & construction, DR wiggler & beam dynamics
CERN:	Study coordination, structures devel., CTF3 construction/commissioning
CIEMAT (Spain):	CTF3 septa and kickers, correctors, power extraction structures
DAPNIA/Saclay (France):	CTF3 probe beam injector
EU	Financing of RF photo injector (FP6 JRA)
Finnish Industry (Finland):	Sponsorship of mechanical engineer
INFN / LNF (Italy):	CTF3 delay loop, transfer lines & RF deflectors, ring vacuum chambers
JINR & IAP (Russia):	Surface heating tests of 30 GHz structures
KEK (Japan):	Low emittance beams in ATF
LAL/Orsay (France):	Electron guns and pre-buncher cavities for CTF3
LAPP/ESIA (France):	Stabilization studies, CTF3 beam position monitors
LLBL/LBL (USA):	Laser-wire studies
North-West. Univ. Illinois (USA):	Various CTF3 Beam diagnostics & CTF3 equipment
RAL (England):	Lasers for CTF3 and CLIC photo-injectors
SLAC (USA):	High Gradient Structure testing, structure design, CTF3 injector design
Uppsala University (Sweden):	Beam monitoring systems for CTF3

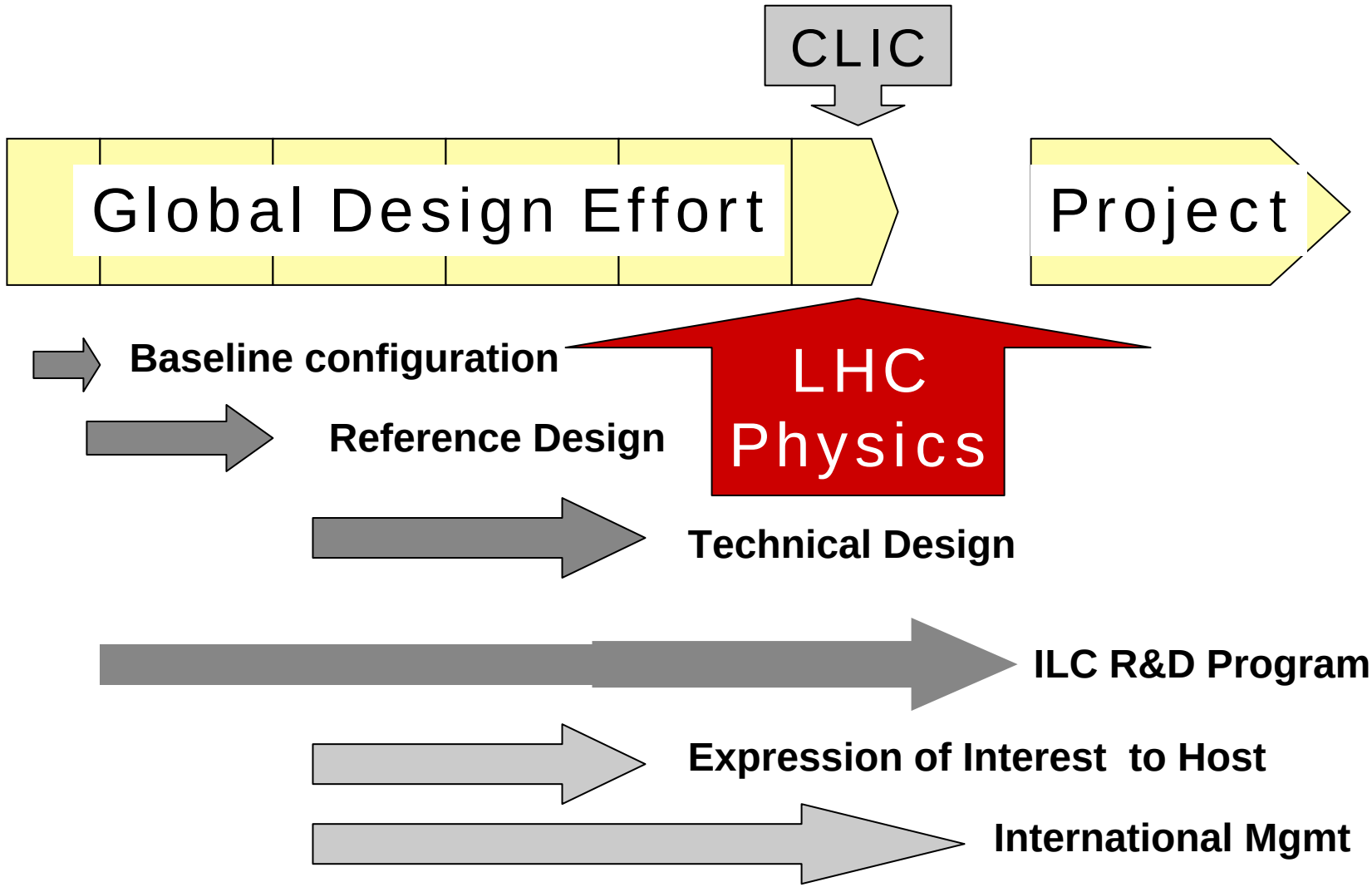
CLIC @ SPC & Council

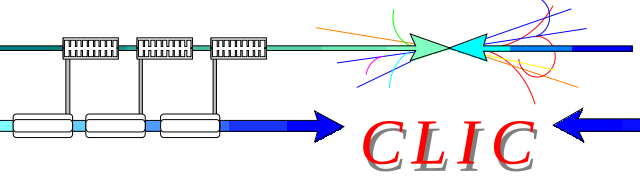
- SPC: March 2004:
  - Summary of CLIC Physics case and proposed accelerated R&D programme (CERN/SPC/841-CERN/2552) with recommendation of a world-wide multi-lateral collaboration of volunteer institutes for tests of feasibility of the CLIC concept for Multi-TeV Linear Collider to arrive before 2010 at a firm conclusion on its possible use
- SPC Chairman's conclusion:
  - The SPC supported the many good arguments on the rich physics potential of CLIC. The range of possibilities would be clarified by the results of LHC
  - The SPC re-expressed its support for the acceleration of the tests of the feasibility of the CLIC concept on the proposed time scale
- Council's summary of conclusions: CERN/2554
  - In line with the conclusion of the SPC, the Council expressed strong support for accelerating the R&D on CLIC as proposed by the management in document_CERN/SPC/841-CERN/2552
- SPC: June 05: Progress follow-up

  Sept 05: Visit CTF3

The ILC Plan and Schedule

(B.Barish/CERN/SPC 050913)





CLIC Specific Key Issues

(as pointed out by ILC-TRC 2003)

Covered by CTF3

R1: Feasibility

- R1.1: Test of damped accelerating structure at design gradient and pulse length
- R1.2: Validation of drive beam generation scheme with fully loaded linac operation
- R1.3: Design and test of damped ON/OFF power extraction structure

R2: Design finalisation

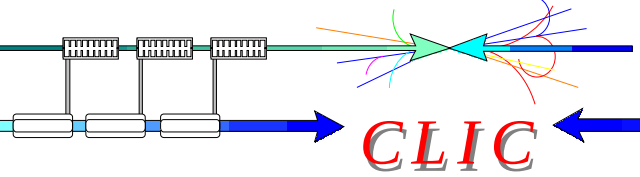
- R2.1: Developments of structures with hard-breaking materials (W, Mo…)
- R2.2: Validation of stability and losses of drive beam decelerator; Design of machine protection system
- R2.3: Test of relevant linac sub-unit with beam

Industrial development

- R2.4: Validation of drive beam 40 MW, 937 MHz Multi-Beam Klystron with long RF pulse

- R2.5: Effects of coherent synchrotron radiation in bunch compressors
- R2.6: Design of an extraction line for 3 TeV c.m.

Covered by EUROTeV



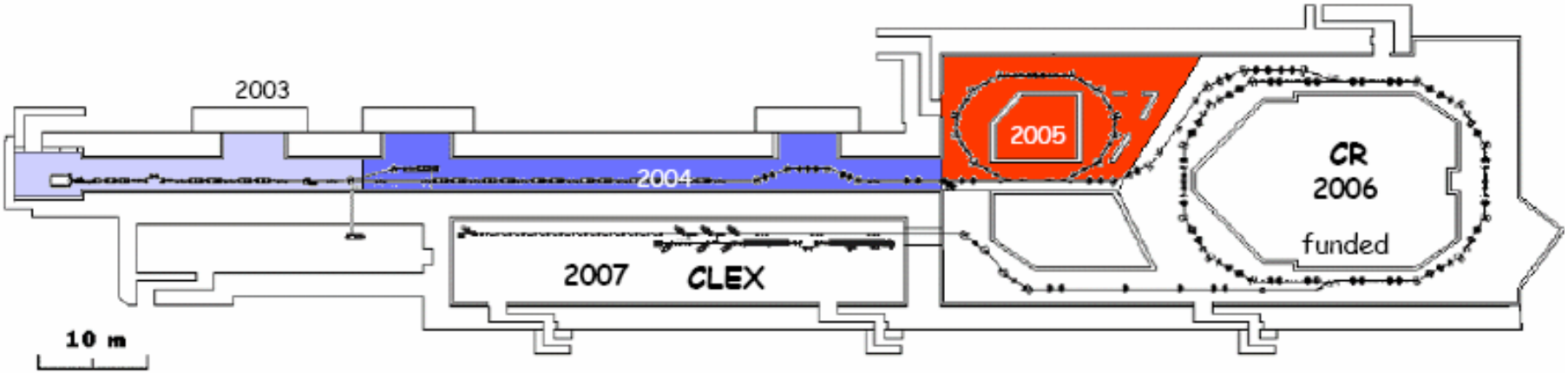
2005 major activities

- Launch Multi-lateral Collaboration of Volunteer Institutes to complete CTF3 and demonstrate CLIC technology before 2010.

  CTF3 Collaboration take-off on 30/11/05

- CTF3:
  - 2nd phase: installation and commissioning delay loop
  - 30GHz power production for accelerating structure tests at nominal field and pulse length
- CLIC optimized parameters (figure of merit: Luminosity/power)
  - New Accelerating Structure (HDS) developments
  - New Power Extraction Structure (PETS)
  - New Damping Ring design
- Participation to ILC design and collaboration on common ILC-CLIC key issues
  - EUROTEV Design Study and CARE
  - Site specific cost study of ILC@CERN
- Launch CLIC cost study
  - Same site and same tools
  - Easy comparison and identify specific cost differences

CTF3 project & schedule



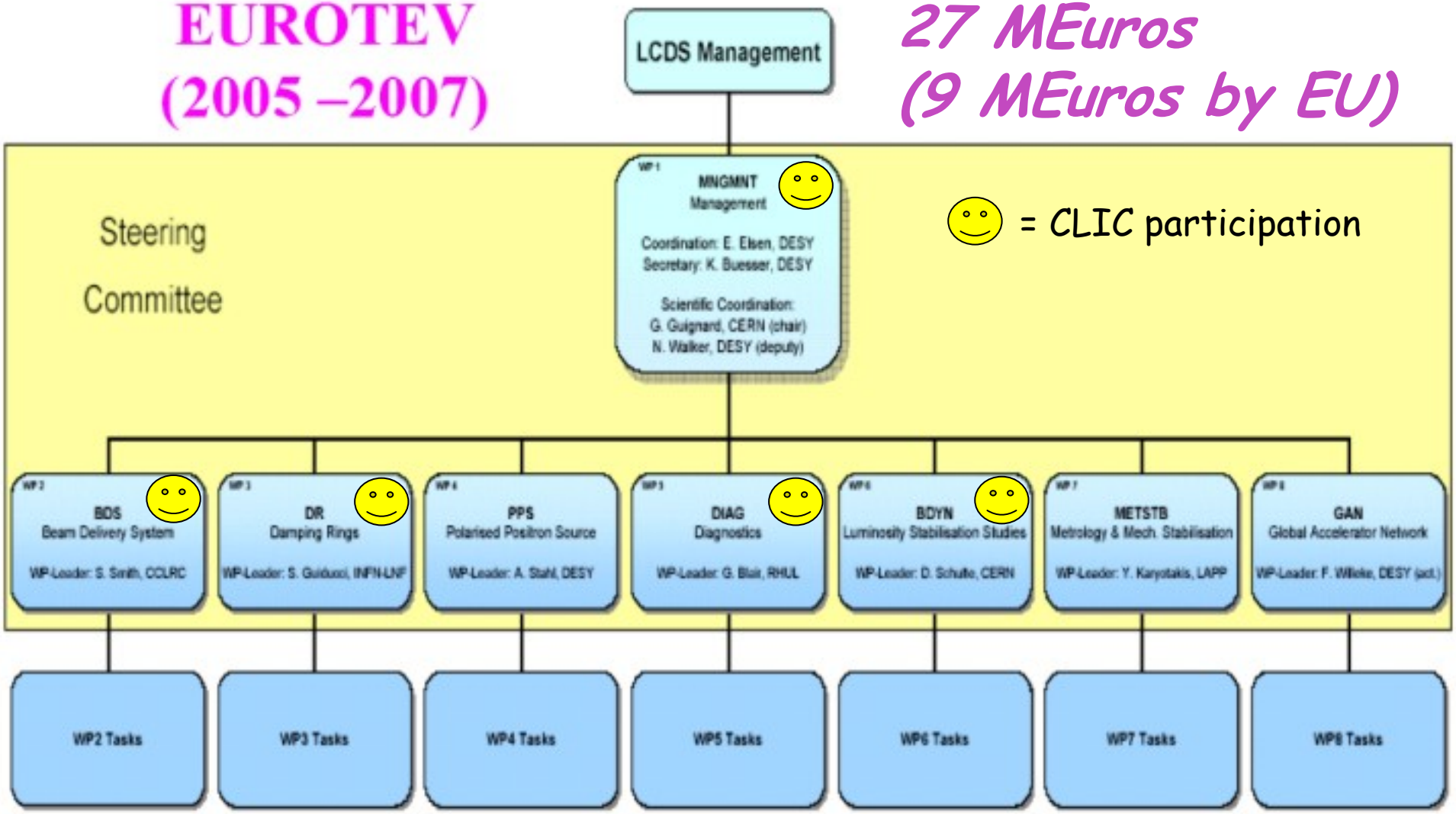
SCHEDULE WITH EXTRA RESOURCES

	2004	2005	2006	2007	2008	2009
Drive Beam Accelerator	■					
30 GHz power test stand in Drive Beam accelerator	■	■				
30 GHz power testing (4 months per year)		■	■	■	■	■
R1.1 feasibility test of CLIC structure				■		
Delay Loop	■	■				
Combiner Ring	■	■	■			
R1.2 feasibility test of Drive beam generation				■		
CLIC Experimental Area (CLEX)		■	■			
R1.3 feasibility test PETS				■		
Probe Beam			■	■		
R2.2 feasibility test representative CLIC linac section					■	
Test beam line		■	■	■	■	
R2.1 Beam stability bench mark tests					■	■

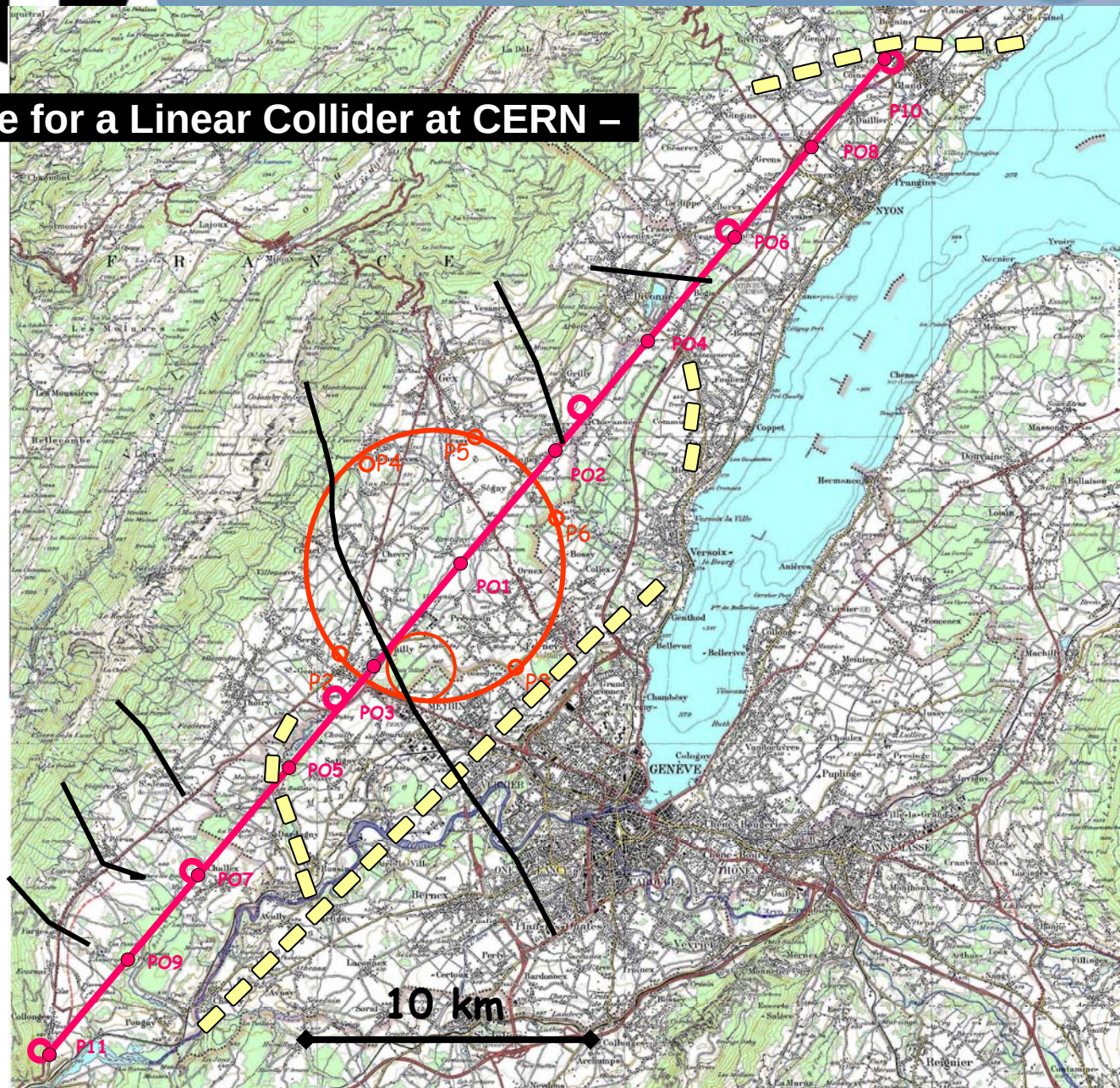
Study of generic key issues common to ILC and CLIC

EUROTEV (2005 –2007)

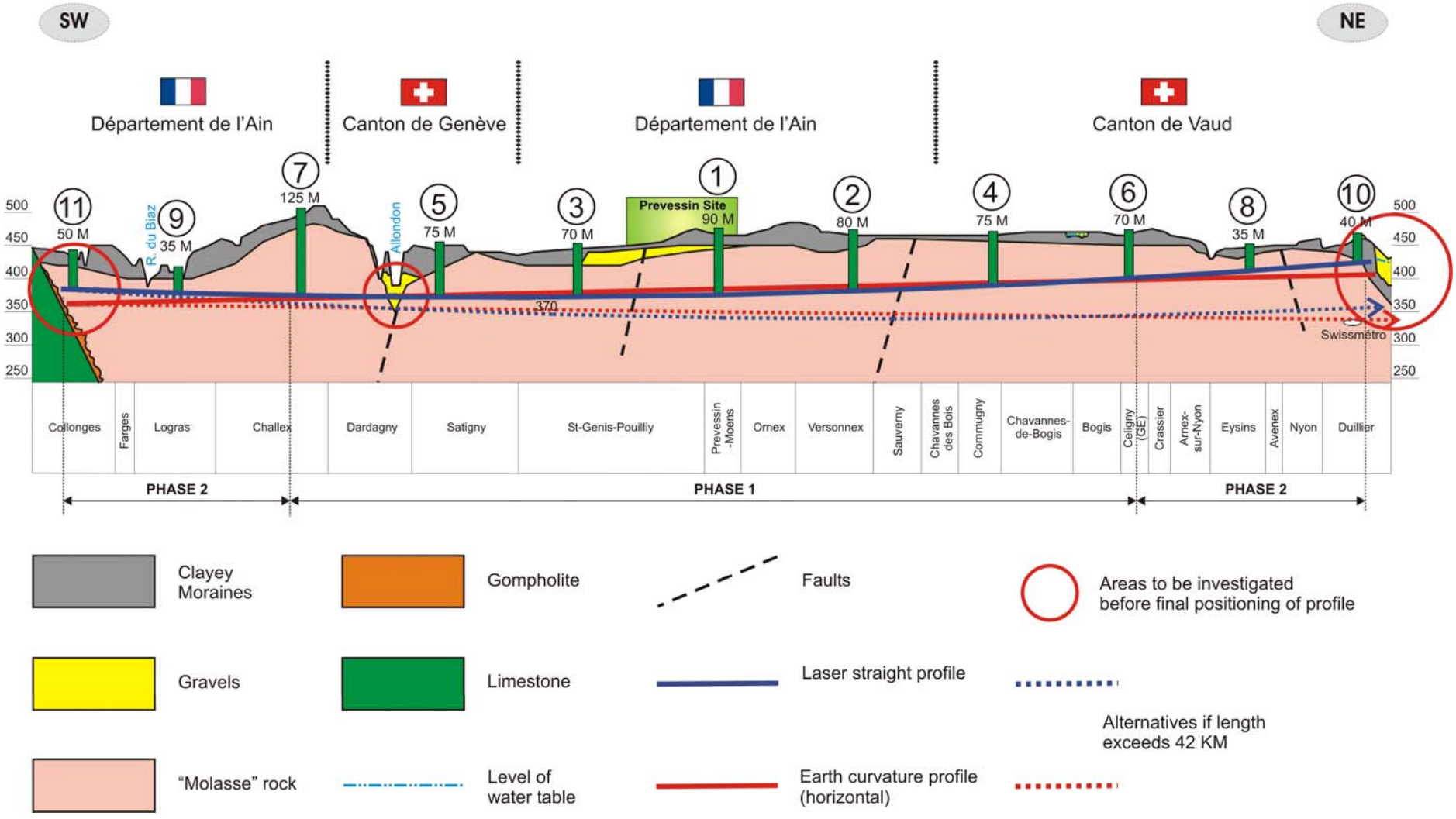
27 MEuros (9 MEuros by EU)



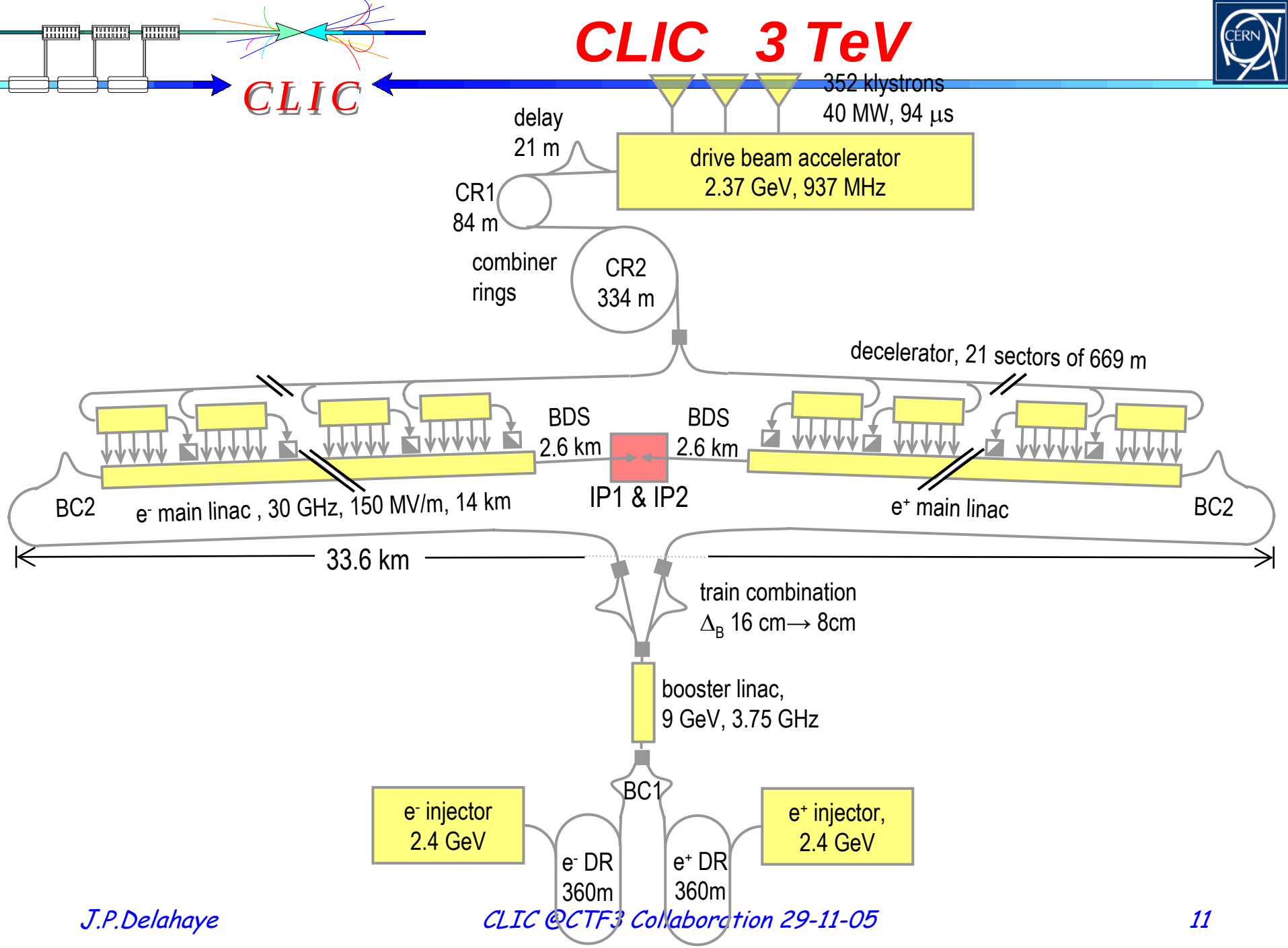
Possible site for a Linear Collider at CERN –

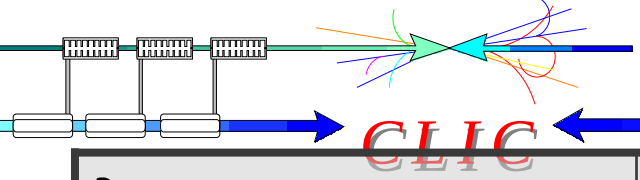


Longitudinal section of a Linear Collider on CERN site–



CLIC 3 TeV


CLIC
352 klystrons
40 MW, 94 μs
delay
21 m
drive beam accelerator
2.37 GeV, 937 MHz
CR1
84 m
combiner
rings
CR2
334 m
decelerator, 21 sectors of 669 m
BDS
2.6 km
BDS
2.6 km
BC2
e⁻ main linac , 30 GHz, 150 MV/m, 14 km
IP1 & IP2
e⁺ main linac
BC2
33.6 km
train combination
Δ_B 16 cm→ 8cm
booster linac,
9 GeV, 3.75 GHz
BC1
e⁻ injector
2.4 GeV
e⁻ DR
360m
e⁺ DR
360m
e⁺ injector,
2.4 GeV



CLIC new parameters

Parameter	Unit	old	new
Center of mass energy	GeV	3000	3000
Main Linac RF Frequency	GHz	30	30
Unloaded / loaded gradient	MV/m	172 / 150	172 / 150
Linac repetition rate	Hz	100	150
No. of particles / bunch	10^9	4.2	2.56
No. of bunches / pulse		154	220
Bunch separation	ns	0.67	0.267
Bunch train length	ns	101	58.4
Total length	km	33.2	33.6
Total site AC power	MW	410	418
η Wall plug to main beam power	%	9.3	12.5
Luminosity	10^{34} cm^{-2} s^{-1}	8	6.5
Luminosity (in 1% of energy)	10^{34} cm^{-2} s^{-1}	3.3	3.3
Beamstrahlung mom. spread	%	21.1	16

reduced bunch charge

reduced bunch spacing

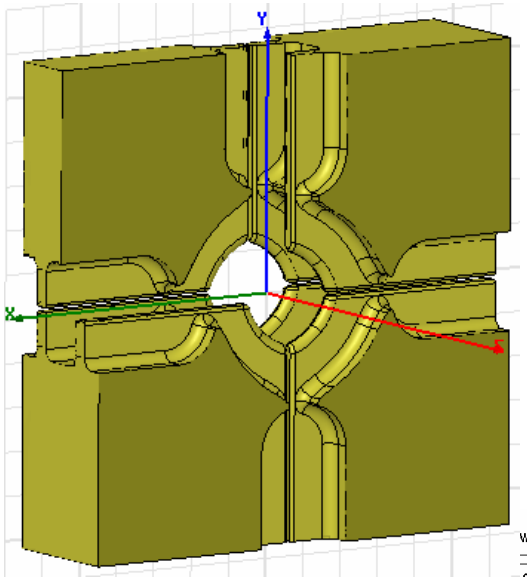
reduced pulse length

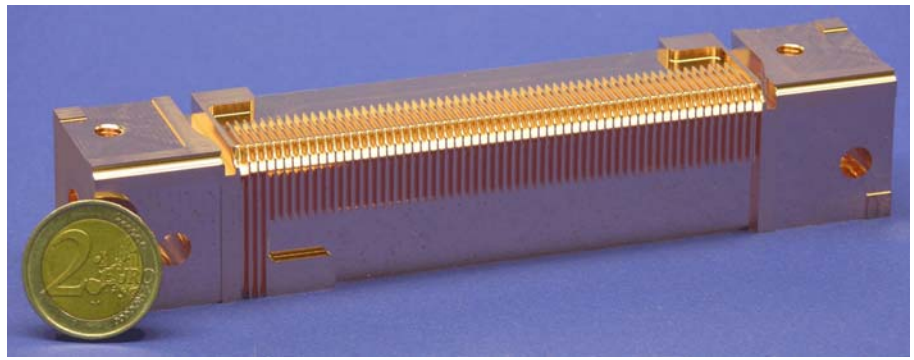
eff. luminosity as before

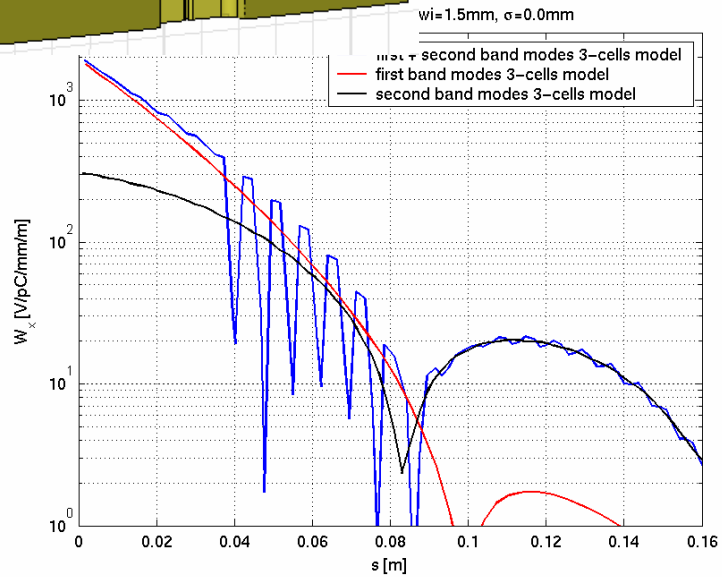
reduced backgrounds

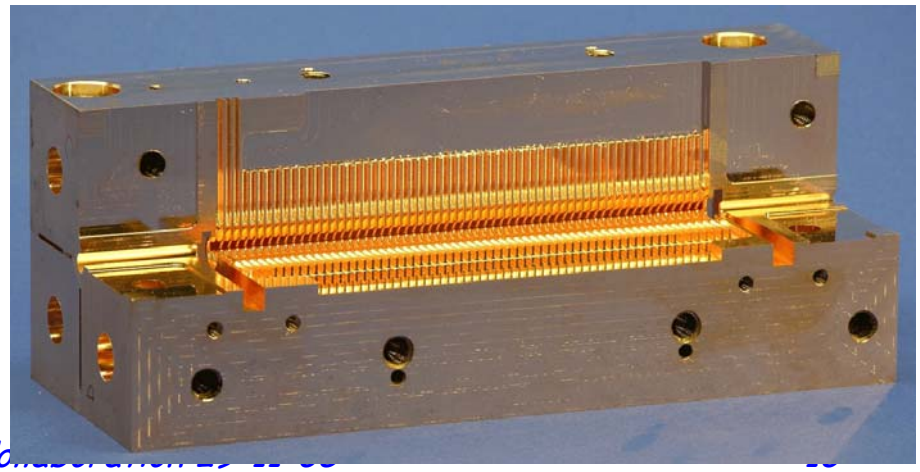
CLIC Accelerating structure: New concept HDS

- *Damping waveguides + slotted iris for improved wakefield damping*
- *Geometry optimized to reduced surface electric and magnetic fields*
- *First high power test early 2006*

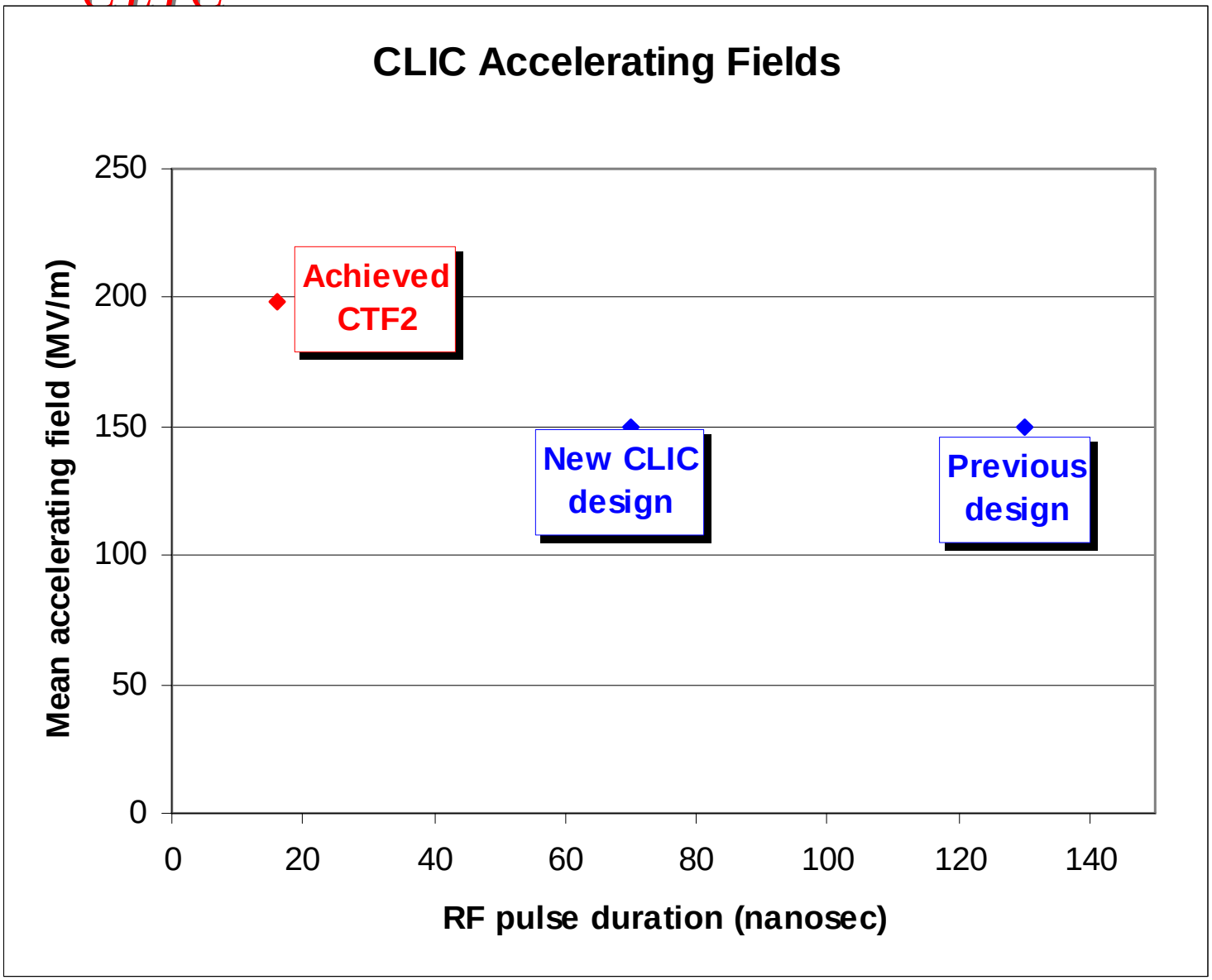


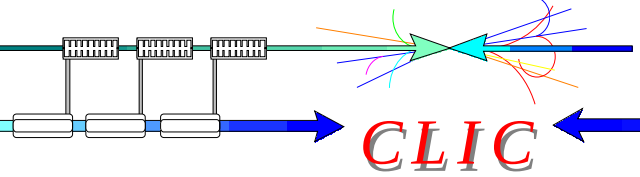






Accelerating fields

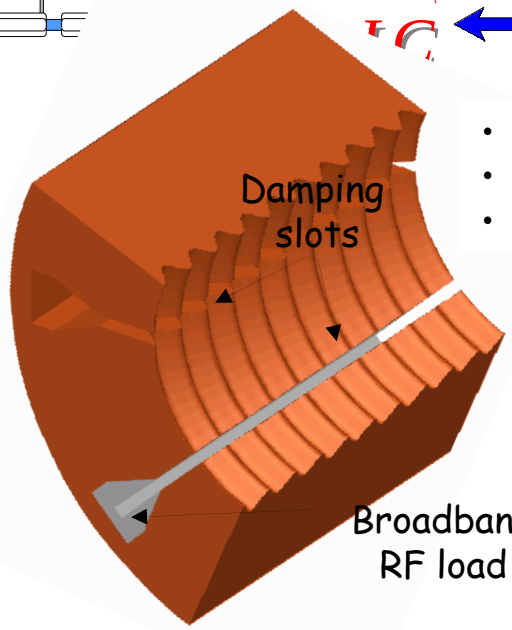




Accelerating Structure R&D and Tests

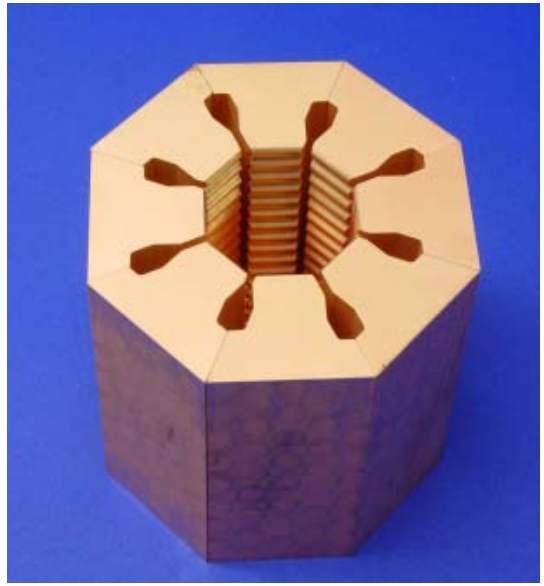
- Fabrication and tests of structures in CTF3 used as RF power source
- R&D on bimetallic structures in strong collaboration with TS department
- Welcome initiative of "US collaboration on High Gradient Research for a Multi-TeV Linear Collider"
  - Perform research to determine gradient potential and normal conducting structures and develop necessary technology
  - Making the best use of existing facilities and building up on wide expertise and long-term R&D at SLAC and KEK
  - Collaboration of US laboratories, Universities, Industries
  - Close collaboration with CLIC study with CERN representative in Advisory council

Design and test of damped ON/OFF power extraction structure for drive beam decelerator

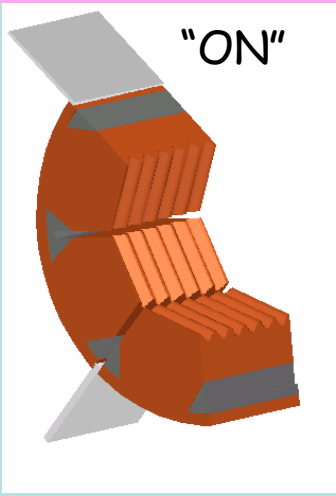


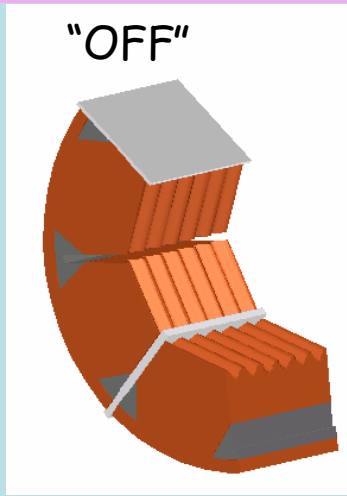
- Large aperture (25 mm)
- Very shallow sinus-type corrugations
- Eight 1 mm-wide damping slots

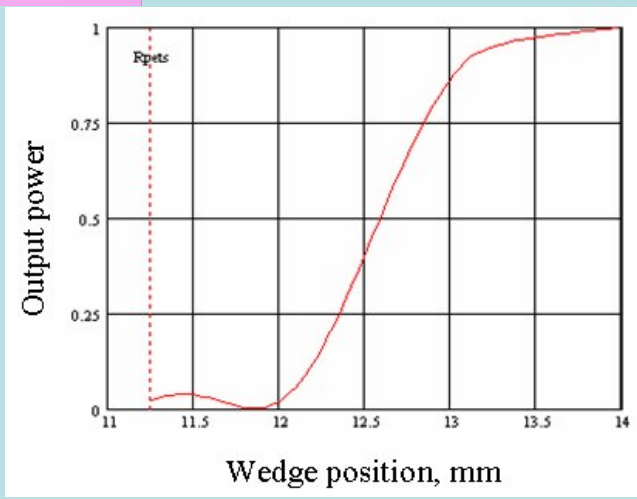
High power tests in CTF3 with beam from 2007 on



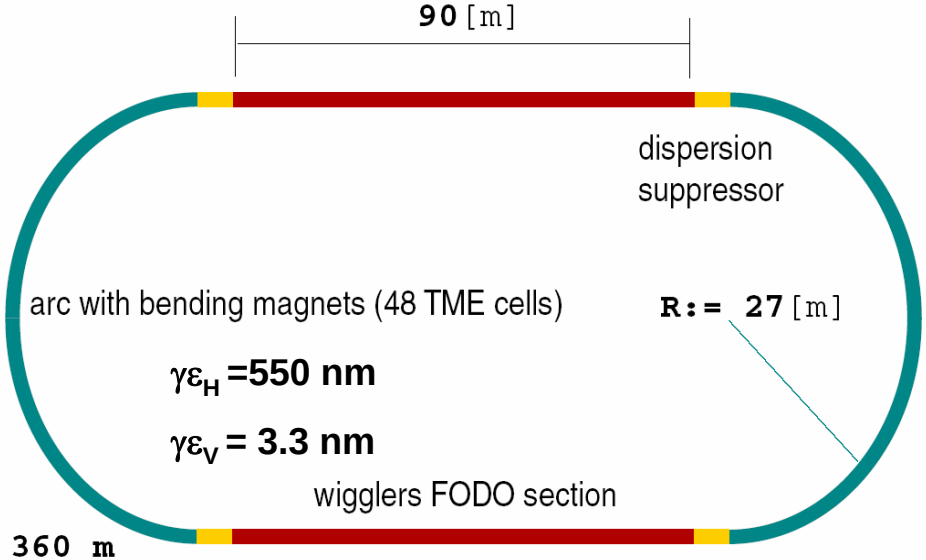
By insertion of 4 1.6 mm thick wedges through the damping slots, sufficient PETS frequency detuning can be achieved:





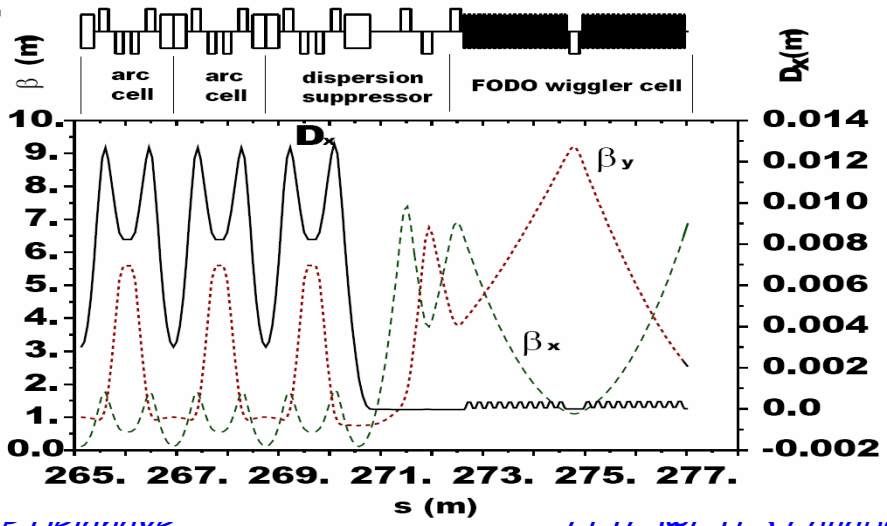


Layout of the CLIC Damping Ring



C:= 360 m
E:= 2.424 GeV

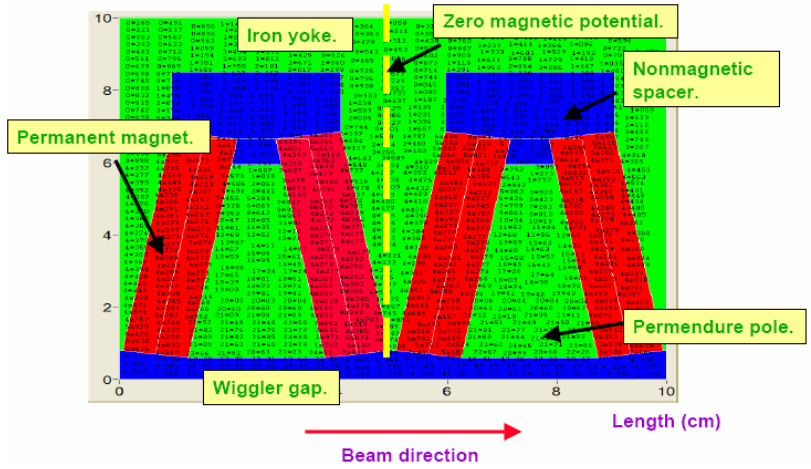
76 wigglers in the ring
length of each wiggler is 2m

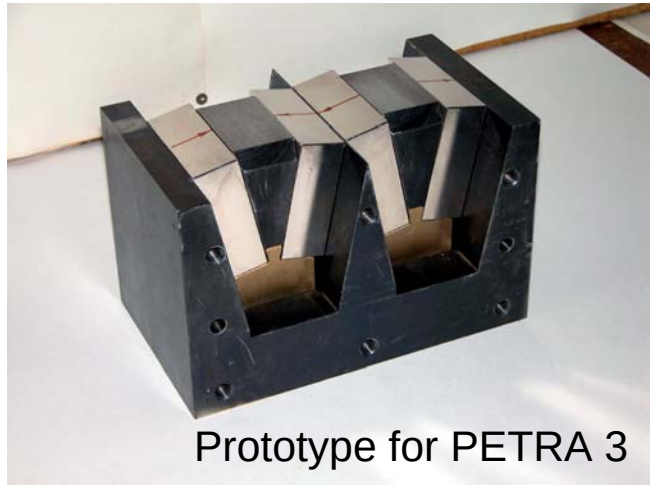


CLIC damping wiggler parameters

Period:	10 cm
Gap:	12 mm
Pole width:	50 mm
Length:	2 m
Field amplitude:	1.7 T
Field quality @ ±1 cm:	10^{-3}
Total length:	160 m

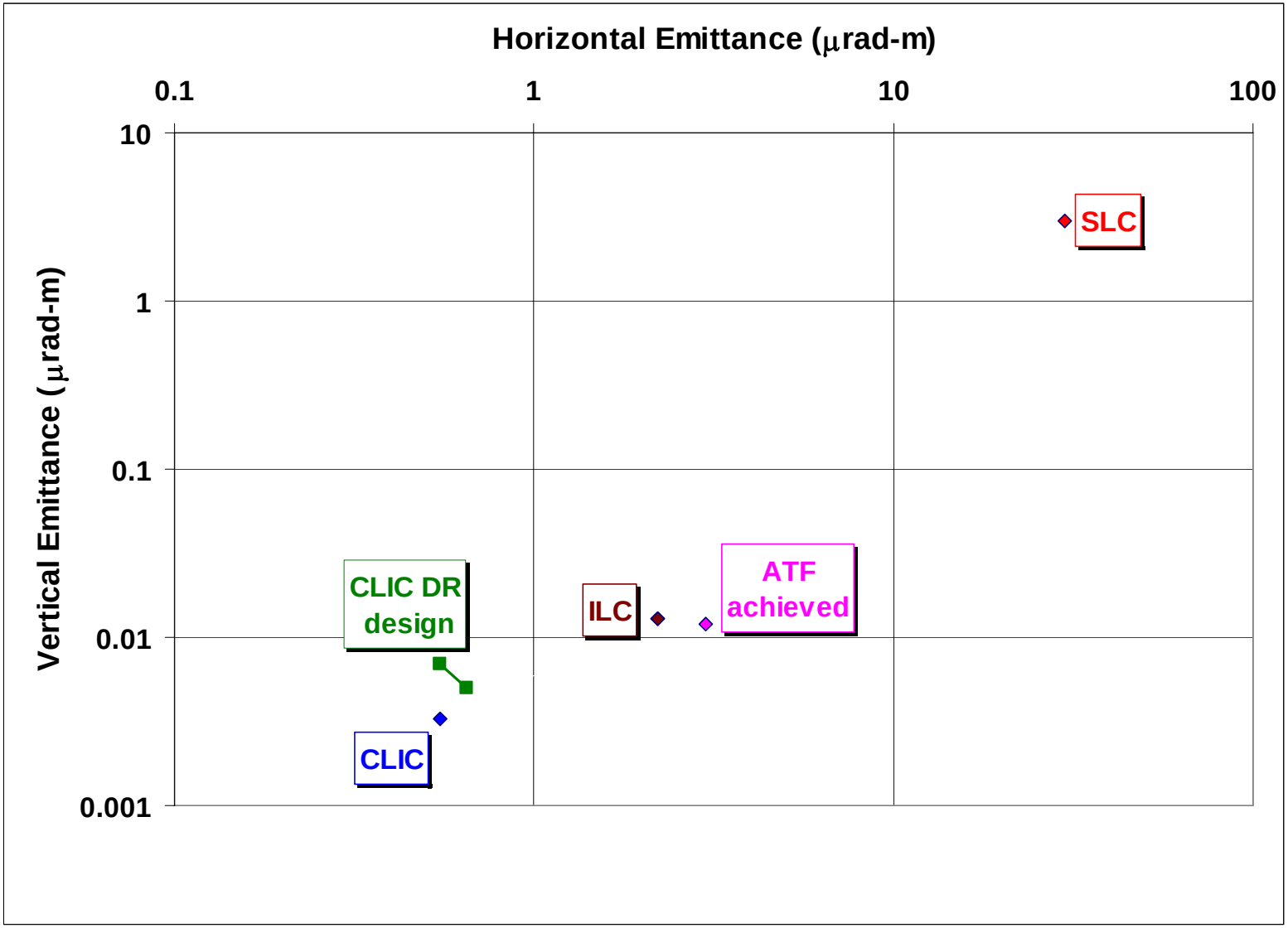
CLIC damping wiggler configuration





Prototype for PETRA 3

Beam emittances at Damping Rings



Conclusion

- ILC and CLIC teams working together in a constructive and fruitful collaboration
- CLIC attractive design parameters and promising performances already achieved
- Well defined program to demonstrate the feasibility of the CLIC technology before 2010
- Completion and commissioning of CTF3 test facility:
  - to demonstrate CLIC RF power production and Two-Beam-Acceleration schemes
  - to serve as an RF power source to test RF components with nominal parameters
- Presently under schedule
- Multi-lateral collaboration of volunteer institutes

Take-off of Extended Collaboration on 30/11/05