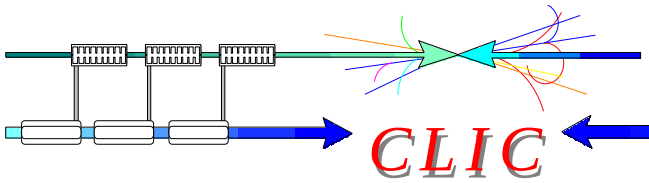
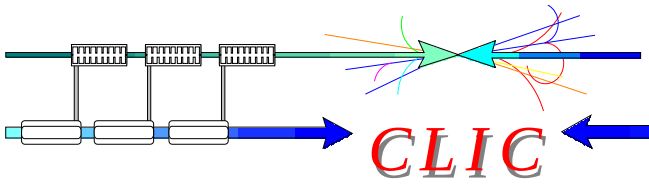


X Band Accelerating Structure Design and Test Program Workshop

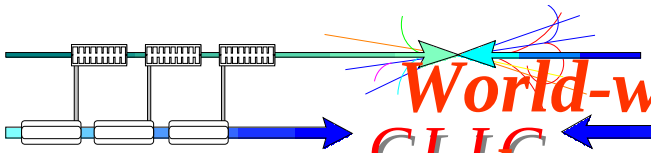
WELCOME

CIEMAT/Spain, CEA SACLAY/France, CERN, HELSINSKI Univ/Finland, IAP/Ukraine, INFN-LNF/Italy, KEK/Japan, KYUNGPOOK Univ/Korea, MANCHESTER Univ/UK, PSI/Switzerland, RRCAT/India, TSINGHUA Univ/China, SLAC/USA, UPPSALA Univ/Sweden.



Outline

- **Motivation for high gradients**
- **Short introduction to the CLIC study**
- **New CLIC Parameters**
- **Objectives of the workshop**
- **Plea for multi-lateral collaboration on high gradient R&D**



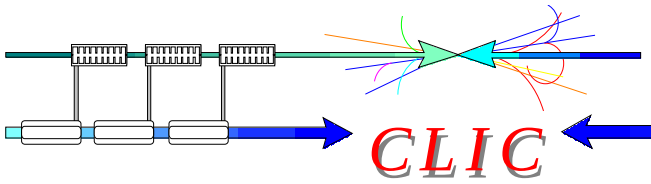
World-wide consensus about a Linear Collider as the next HEP facility complementary to LHC

- 2001: ICFA recommendation of a world-wide collaboration to construct a high luminosity e+/e- Linear Collider with an energy range up to at least 400 GeV/c

- 2003: ILC-Technical Review Committee to assess the technical status of the various designs of Linear Colliders

- 2004: International Technology Recommendation Panel down-selecting the Super-conducting technology for an International Linear Collider (ILC) Linear Collider in the TeV energy range

- 2004: CERN council support for R&D addressing the feasibility of the CLIC technology to possibly extend Linear Colliders into the Multi-TeV energy range.



CLIC @ SPC & Council

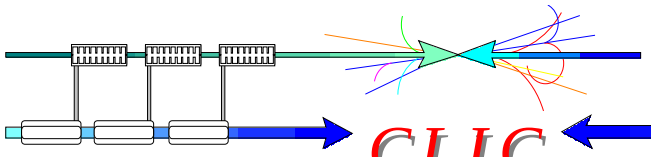
- CERN Scientific Policy Committee (SPC): March 2004
  - The SPC supports the many good arguments on the rich physics potential of CLIC. The range of possibilities would be clarified by the results of LHC

- 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
  - 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

CLIC World wide collaboration

WORLD WIDE CLIC COLLABORATION

Ankara University (Turkey)
Berlin Tech. Univ. (Germany)
BINP (Russia)
CERN
CIEMAT (Spain)
DAPNIA/Saclay (France)
Department of Atomic Energy (India)
Finnish Industry (Finland)
Helsinki Institute of Physics (Finland)
IAP (Russia)
Instituto de Fisica Corpuscular (Spain)
INFN / LNF (Italy)
JASRI (Japan)
JINR (Russia)
KEK (Japan)
LAL/Orsay (France)
LAPP/ESIA (France)
LLBL/LBL (USA)
North-West. Univ. Illinois (USA)
Polytech. University of Catalonia (Spain)
RAL (England)
SLAC (USA)
Svedberg Laboratory (Sweden)
Uppsala University (Sweden)



CERN Council Strategy Group (Lisbon July 2006)

The European strategy *for particle physics*

Particle physics stands on the threshold of a new and exciting era of discovery. The next generation of experiments will explore new domains and probe the deep structure of space-time. They will measure the properties of the elementary constituents of matter and their interactions with unprecedented accuracy, and they will uncover new phenomena such as the Higgs boson or new forms of matter. Long-standing puzzles such as the origin of mass, the matter-antimatter asymmetry of the Universe and the mysterious dark matter and energy that permeate the cosmos will soon benefit from the insights that new measurements will bring. Together, the results will have a profound impact on the way we see our Universe; *European particle physics should thoroughly exploit its current exciting and diverse research programme. It should position itself to stand ready to address the challenges that will emerge from exploration of the new frontier, and it should participate fully in an increasingly global adventure.*

General issues

1. European particle physics is founded on strong national institutes, universities and laboratories and the CERN Organization; *Europe should maintain and strengthen its central position in particle physics.*

2. Increased globalization, concentration and scale of particle physics make a well coordinated strategy in Europe paramount; *this strategy will be defined and updated by CERN Council as outlined below.*

Scientific activities

3. The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance.* A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focussed R&D; *to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*

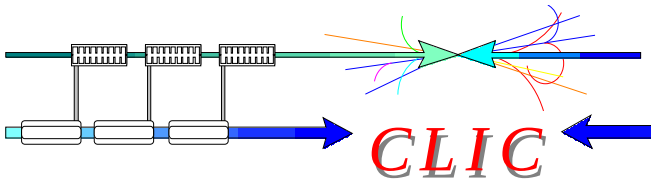
4. In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play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

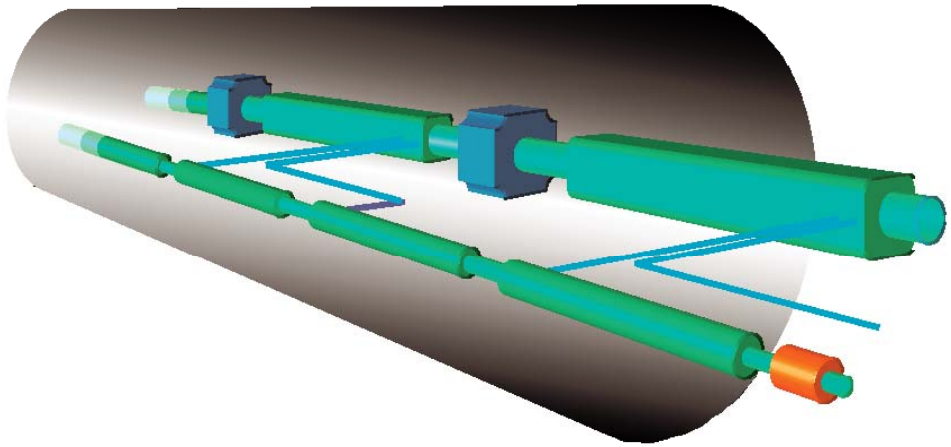
6. Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; *Council will play an active role in promoting a coordinated European participation in a global neutrino programme.*

7. A range of very important non-accelerator experiments take place at the overlap between particle and astroparticle physics exploring otherwise inaccessible phenomena; *Council will seek to work with ApPEC to develop a coordinated strategy in these areas of mutual interest.*

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.*



THE COMPACT LINEAR COLLIDER (CLIC) STUDY

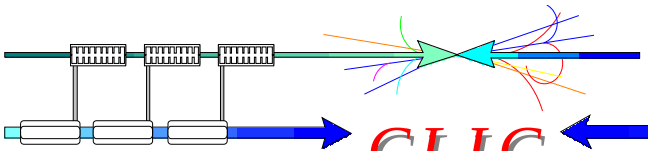


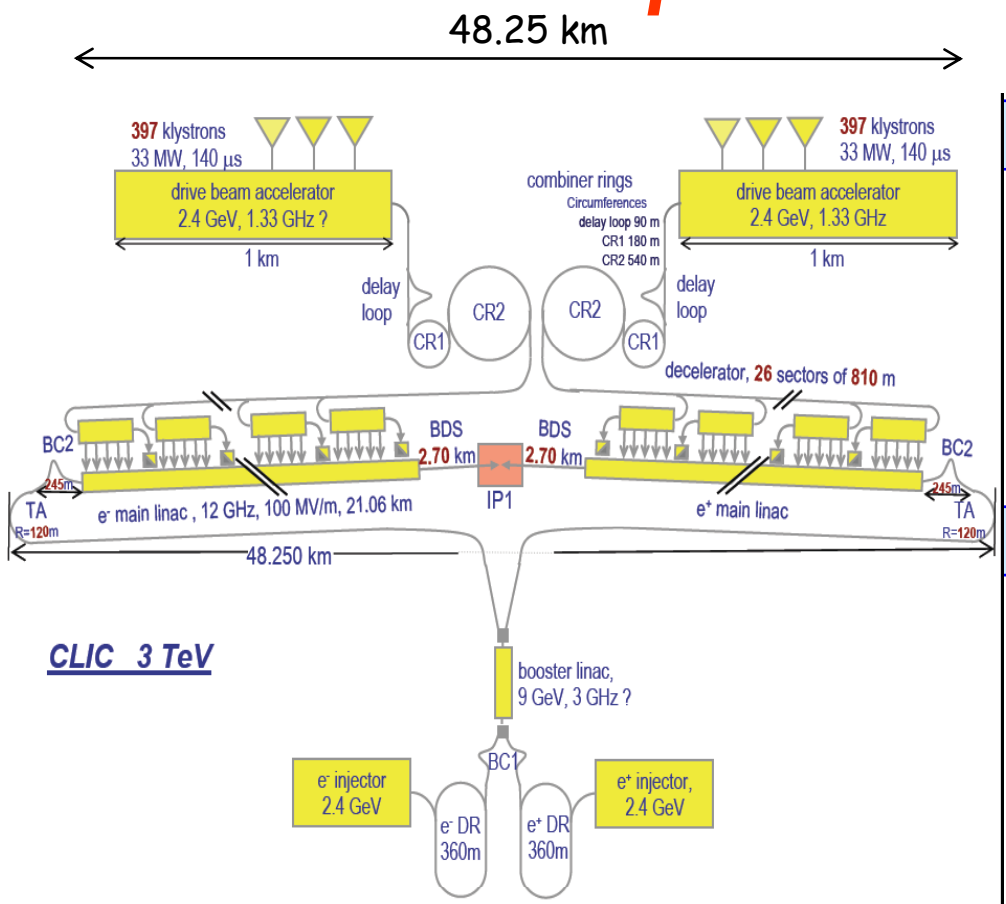
The CLIC study is a site independent feasibility study aiming at the development of a realistic technology at an affordable cost for an e± Linear Collider in the post-LHC era for Physics in the multi-TeV center of mass colliding beam energy range.

http://clic-study.web.cern.ch/CLIC-Study/

CERN 2000-008, CERN 2003-007, CERN 2004-005

CLIC technology for Multi-TeV Linear Colliders





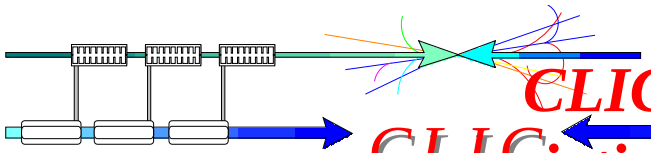
Overall layout
Colliding energy of 3 TeV

- High acceleration gradient (100 MV/m)

- "Compact" collider-overall length≈48 km
  - Normal conducting accelerating structures
  - High acceleration frequency (12 GHz)

- Two-Beam Acceleration Scheme

  - RF power generation at high frequency
  - Cost-effective & efficient (~ 10% overall)
  - Simple tunnel, no active elements
  - "modular" design, can be built in stages
  - Easily expendable in energy

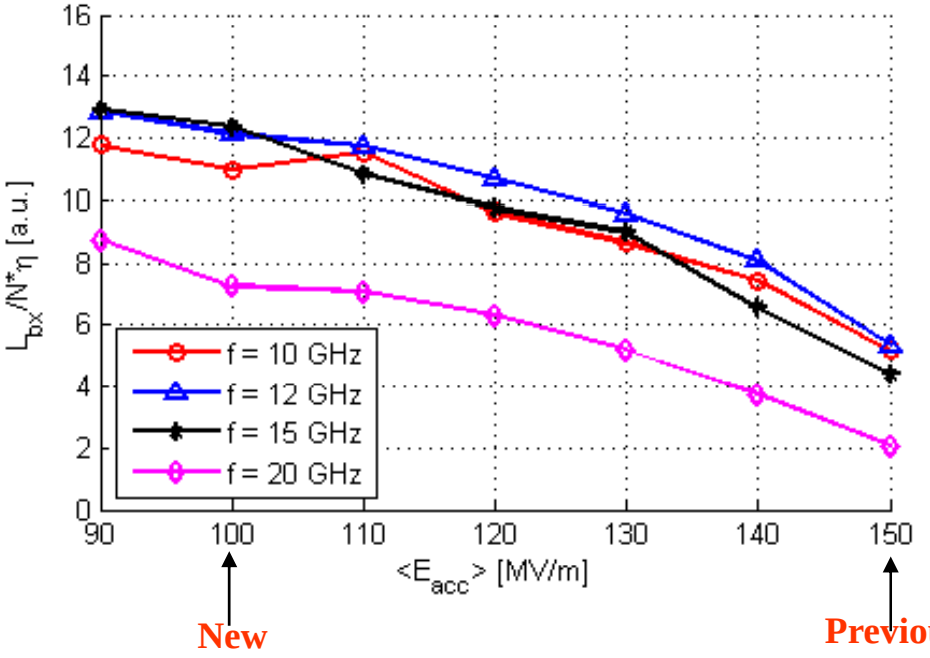


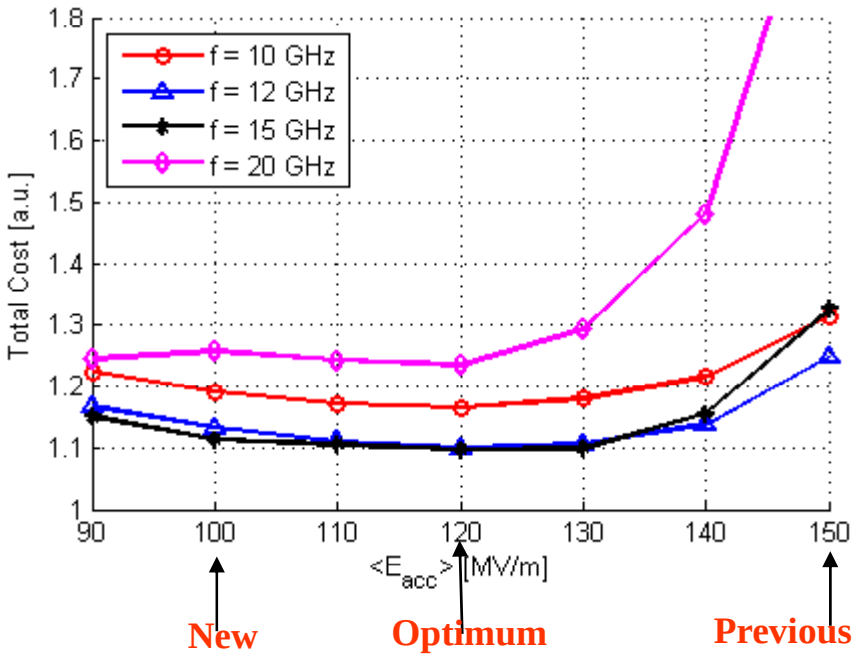
CLIC performances (FoM) and cost (relative) variation as a function of the accelerating gradient

CLIC

E_{cms} = 3 TeV $L_{(1\%)}$ = 2.0 10^{34} $cm^{-2}s^{-1}$

(A.Grudiev)



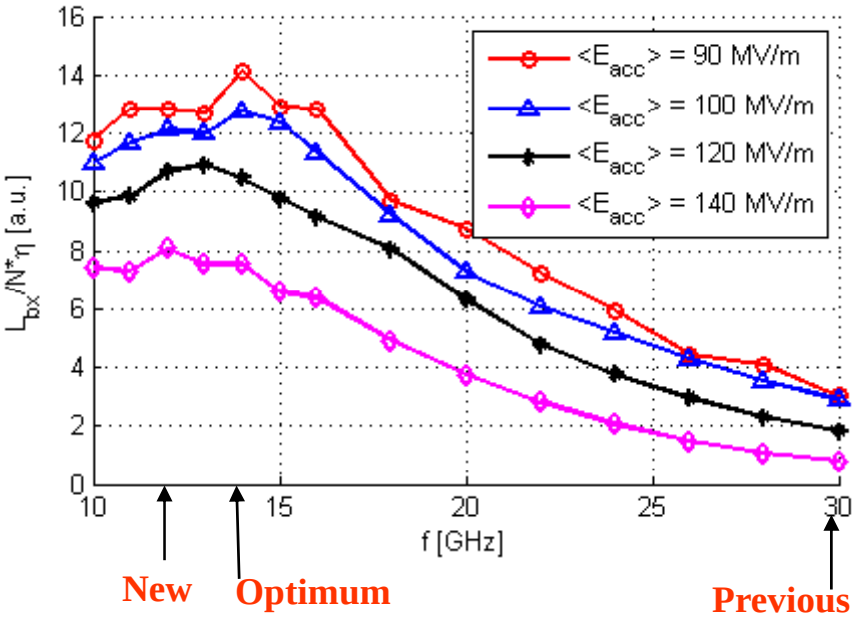


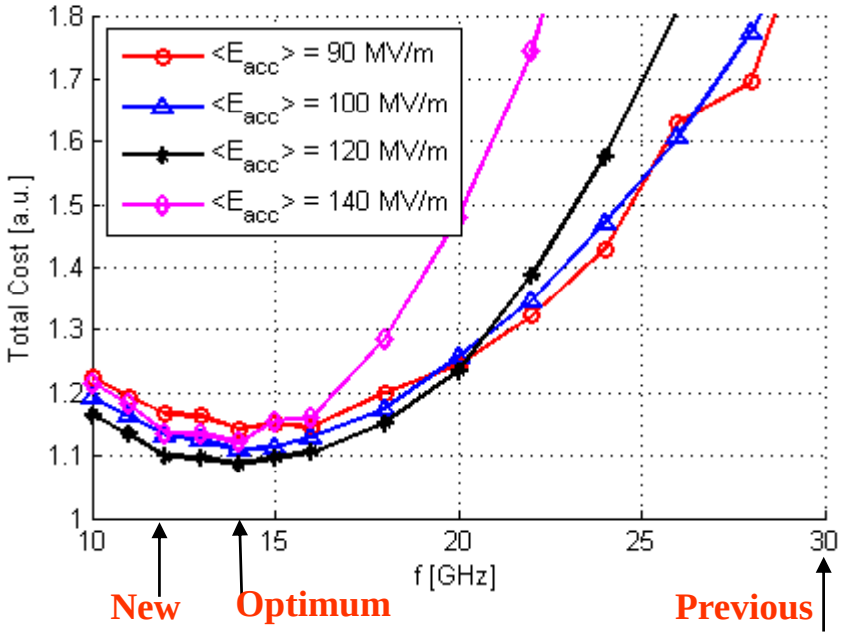
- **Performances increasing with lower accelerating gradient (mainly due to higher efficiency)**
- **Flat cost variation in 100 to 130 MV/m with a minimum around 120 MV/m**

CLIC performances (FoM) and cost optimisation as function of RF frequency

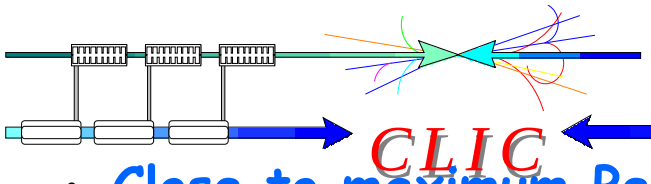
E_{cms} = 3 TeV $L_{(1\%)}$ = 2.0 10^{34} $cm^{-2}s^{-1}$

(A.Grudiev)



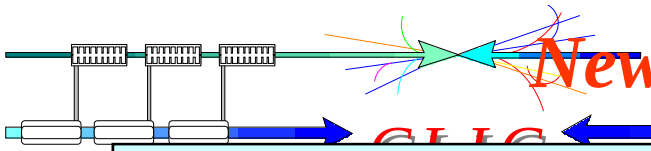


- **Maximum Performance around 14 GHz**
- **Flat cost variation in 10 to 16 GHz frequency range with a minimum around 14 GHz**



The beauty of 12 GHz

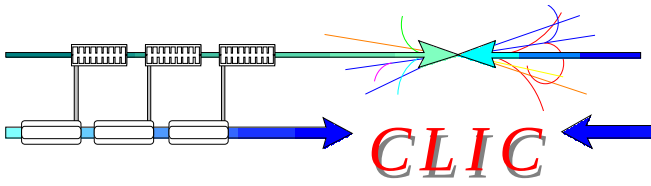
- Close to maximum Performance and minimum Cost (14 GHz)
- Accelerating gradient of 100 MV/m already demonstrated at low breakdown rate with short pulse in non fully equipped structures
- Very close to the NLC and JLC frequency: 11.4 GHz
  - Building up on wide expertise and long-term R&D made during many years on warm structures, RF power sources, beam dynamics at SLAC and KEK
  - Profit from low(er than 30 GHz) frequency for easier fabrication (tolerances, vacuum), relaxed requirements (alignment, timing, etc…),
- RF power generation and frequency multiplication with single stage beam combination in CLIC TBA RF Powers Source
  - Possibly drive beam linac at 1.3 GHz (with possible synergy with ILC MBK developments) and multiplication by 8 (2*4) instead 36
  - High gradients achievable with short RF pulse provided by TBA RF power source
  - Easy adaptation of CTF3 (multiplication factor by 8 instead of 10)
- Stand alone power sources available:
  - Makes the best use of developments and equipments at SLAC and KEK



New CLIC Parameters (December 2006)

Main Linac RF frequency	**30 GHz ⇒ 12 GHz**
Accelerating field	**150 MV/m ⇒ 100 MV/m**
Overall length @ E_{CMS}= 3 TeV	**33.6 km ⇒ 48.2 km**

- **Substantial cost savings and performance improvements for 12 GHz / 100 MV/m indicated by parametric model (flat optimum in parameter range)**
- **Promising results already achieved with structures in test conditions close to LC requirements (low breakdown rate) but still to be demonstrated with long RF pulses and fully equipped structures with HOM damping.**
- **No strong frequency dependence of achieved accelerating gradients in copper structures for RF > 12 GHz**
- **Realistic feasibility demonstration by 2010**
- **Review in 2010 on optimum gradient and frequency based on experiments**



Fruitful collaboration with US High Gradient Research

US collaborative effort of interested US institutes

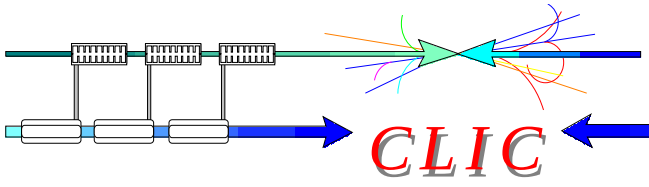
Basic R&D on the understanding and tests of the fields limitations in warm accelerating structures

Initiated by "DOE interested in collaborating with CERN on long range accelerator and technology R&D of importance to the CLIC approach"

Laboratories (ANL, LBNL, NRL,SLAC), Universities (MIT, Maryland), Business associates,

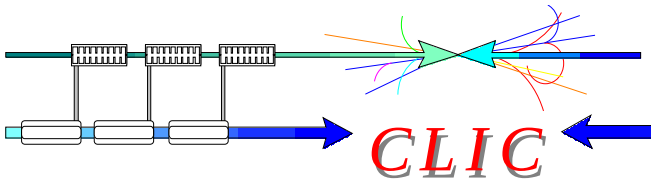
Spokesperson: S.Tantawi/SLAC

Governance with CERN participation (E.Jensen)



Objectives of the X band Accelerating Structure Workshop

- **Very important workshop at a critical moment**
  - A few months after the choice of the new CLIC major parameters: 100 MV/m and 12 GHz
  - Just after a first iteration of CLIC parameters
  - A few years ago from a Conceptual Design Report due by 2010
- **Objectives concerning structure design (today)**
  - Present the present status and present ideas & reflections
  - Take advantage of your expertise for comment, (constructive) criticisms and suggestions for improvements
  - Define future work (preferably in collaborations)
- **Objectives concerning structure testing (to-morrow)**
  - Present the presently envisaged program
  - Take advantage of your expertise for comment, (constructive) criticisms and suggestions for improvements
  - Define the best suited repartition of work taking advantage as much as possible of the existing facilities
  - Define future work (preferably in collaborations)



X band accelerating Structure Workshop

- This workshop: Chairman W.Wuensch
- http://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=15112

- CLIC workshop to be held at CERN on October 16 to 18 2007
  - Overall review of the CLIC study including acc. structures
  - Review of progress and work organisation in dedicated working groups (one of them on structures)
  - Invitation next week
  - Your participation warmly welcome and appreciated

- Looking forward to a very successful workshop in a fruitful & collaborative spirit