Welcome Address to the ICFA Nanobeam 2002 Workshop

Prof. Luciano Maiani
Director General CERN

26th Advanced ICFA Beam Dynamics Workshop on
Nanometre-Size Colliding Beams

Lausanne, 2-6 September 2002

ICFA, the International Committee for Future Accelerators, was created to facilitate international collaboration in the construction and use of accelerators for high energy physics.

It was created in 1976 by the International Union of Pure and Applied Physics. Its purposes, as stated in 1985, are as follows:

- To promote international collaboration in all phases of the construction and exploitation of very high energy accelerators.

- To organize regularly world-inclusive meetings for the exchange of information on future plans for regional facilities and for the formulation of advice on joint studies and uses.

- To **organize workshops** for the study of problems related to super high-energy accelerator complexes and their international exploitation and to foster research and development of necessary technology.

Sixteen members, selected primarily from the regions most deeply involved in high energy physics.

About 90 participants from more than 30 institutes in Europe, Asia, the US.

About 90 scheduled presentations.

Workshop topics:

1. **Production and control of nanometre-size beams,**
2. **Component stabilization against disturbing effects such as ground motion,**
3. **An understanding of the achievable limits,**
4. **Calibration of the beam energy for precision measurements**
5. **Laser wires as a novel beam diagnostic.**

Particle accelerators:

among the most powerful scientific instruments mankind has built

essential for advancing our knowledge about the structure of matter

Particle colliders:

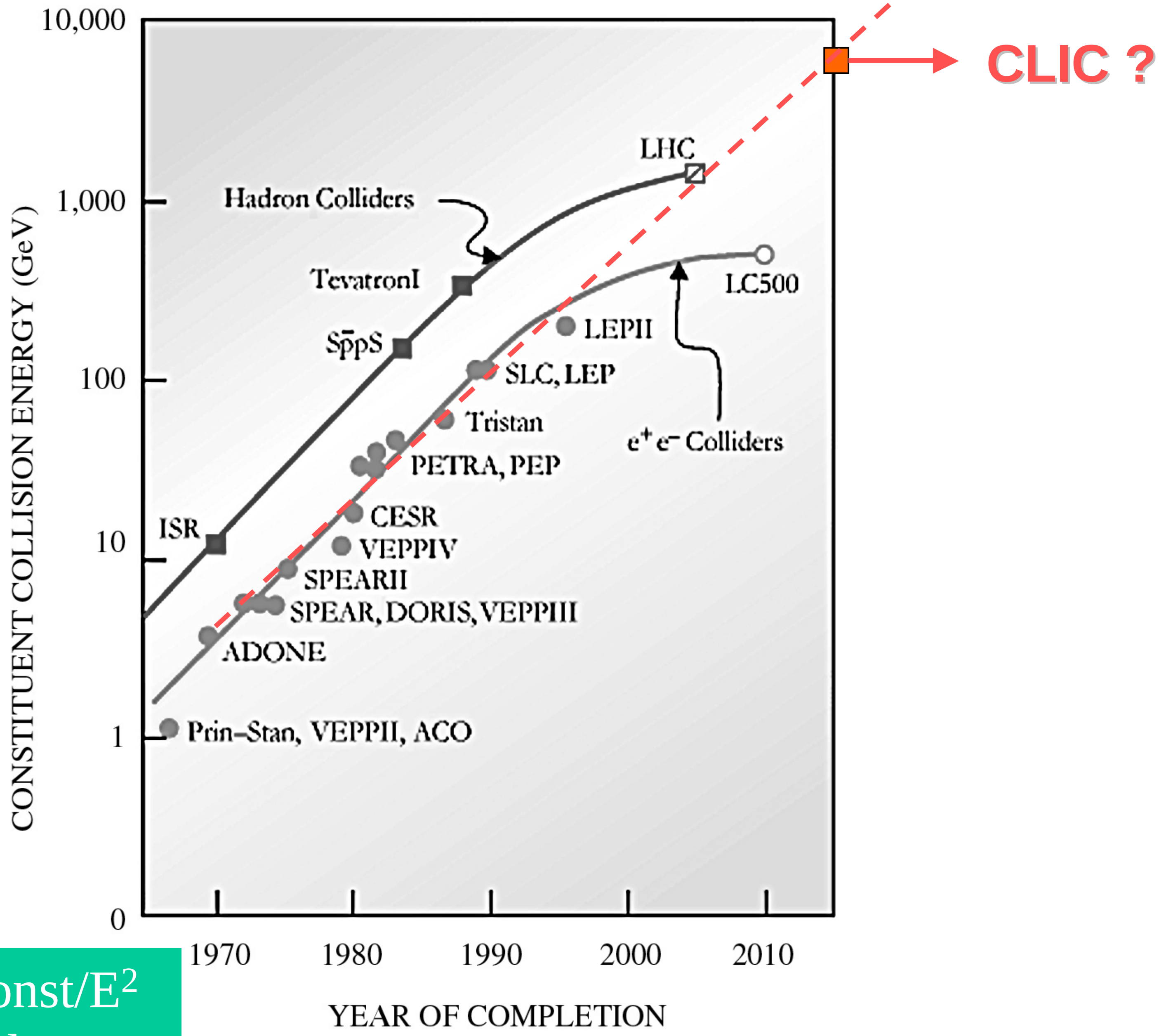
particle physics (energy + luminosity)

Synchrotron radiation facilities:

biology, material science (brilliance)

Both require smaller and smaller transverse beam cross sections!

Livingston plot:



Cross sections ~ const/E^2
Higher energy needs
smaller and smaller beams

(M. Tigner)

The quest for new science is also the quest for small beams:

Typical collision-point beam size for particle physics

circular colliders	linear colliders
1970s: ~50 μm	
1990s: ~2.5 μm (LEP, B factories)	~0.5 μm (SLC)

Sub-micron beams (nanobeams) have been achieved for particle physics at the SLC!

At the same time tremendous progress at the synchrotron light sources; submicron orbit stability established!

The road to high-energy nanobeams has been opened

30 μm	= width of the human hair
1 nm	= size of a water molecule

All future linear colliders aim at spot sizes **< 5 nanometres**

This opens new challenges for accelerator physics (how to generate these beams) and technology (sub-nanometre vibration tolerances).

Accelerators can benefit from and further drive strong scientific and industrial advances in technology:

- gravitational wave detectors (talk F. Raffaele),
- transmission electron microscopy,
- production of microchips,
- nanotechnology,…

Sub-angstrom electron beam
(120 keV) in Scanning Transmission Electron Microscope
P.E. Batson et al, Nature 418 (2002)

Accelerator R&D at CERN

CERN remains committed to future accelerator R&D even in difficult times.

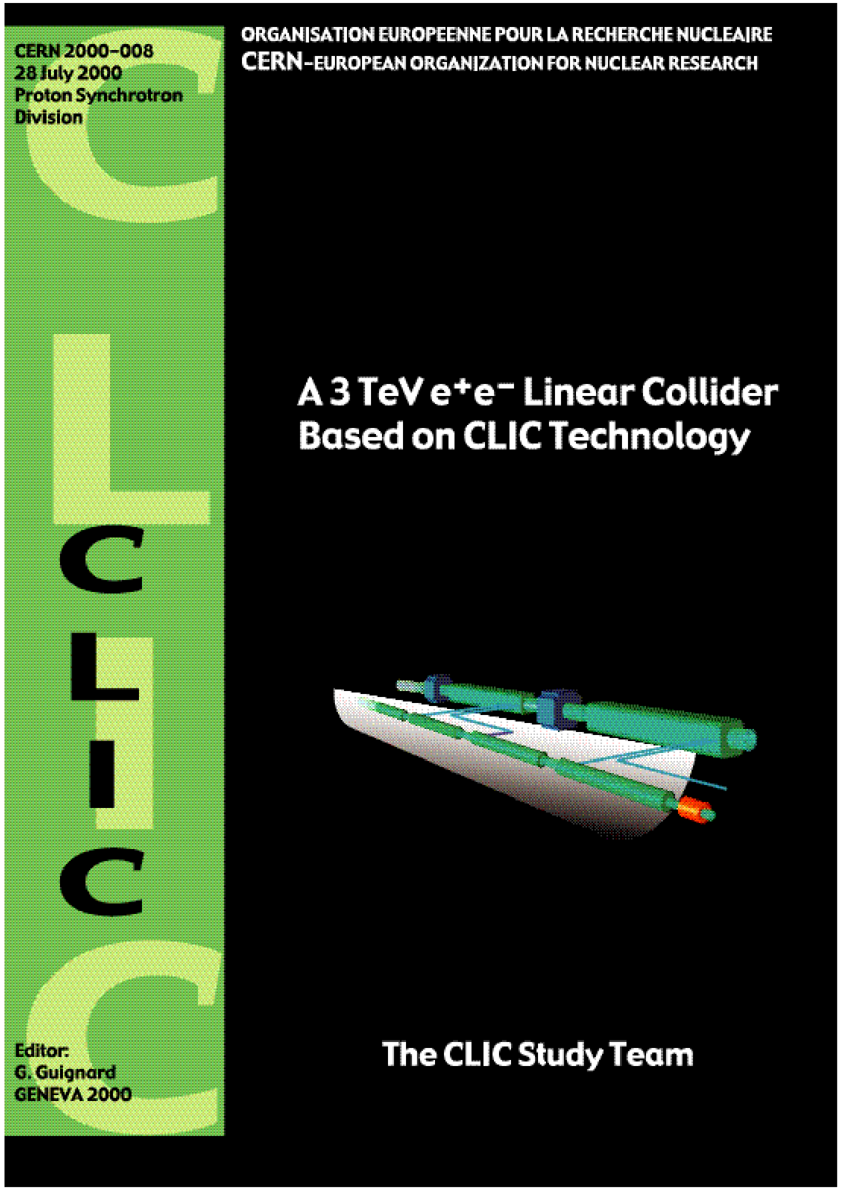
Particle-physics requirements beyond LHC guide CERN's interest towards a 3-TeV linear collider.
(see talk by John Ellis)

CLIC activity at CERN

Collaboration and support from other labs and universities
Excellent progress despite of limited resources

- 150 MV/m accelerating gradient demonstrated,
- Drive-beam combination shown (preliminary CTF3),
- Magnet stabilization to sub-nanometre level *(talks at this workshop)*

The CLIC study at CERN: Compact Linear Collider



International collaboration:

Berlin TU (Germany) , Daresbury (UK),
DESY (Germany), INFN/LNF (Italy),
FNAL (USA), TJNAF (USA),
JINR & IAP (Russia), LAL (France),
KEK (Japan), LBL (USA) , RAL (UK),
Royal Institute of Stockholm (Sweden),
SLAC (USA) , Uppsala (Sweden)

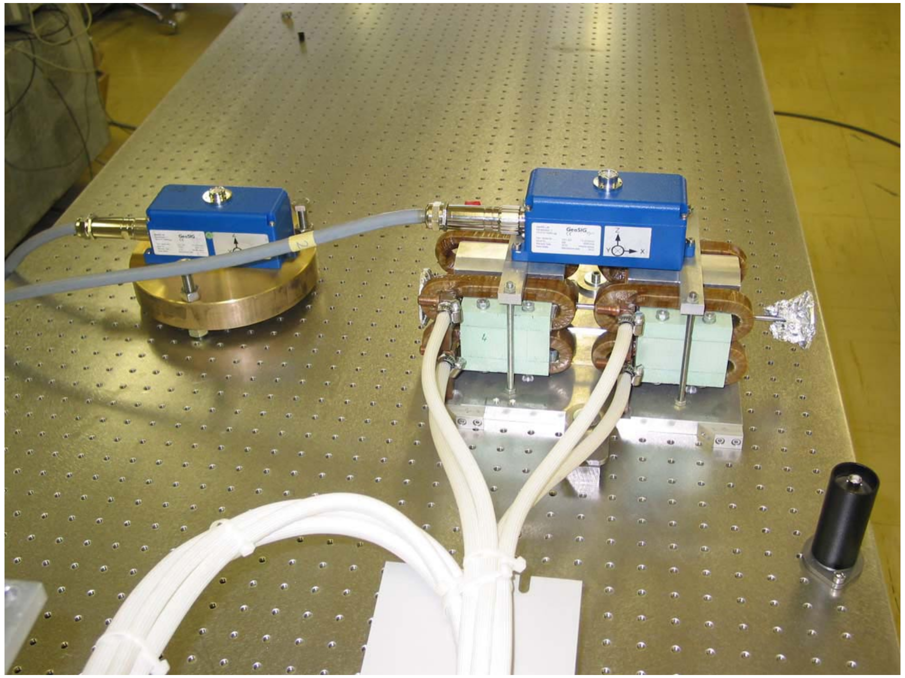
The CLIC team:

R. Assmann, F. Becker, R. Bossart, H. Burkhardt, H. Braun, G. Carron, W. Coosemans, R. Corsini, E.T. D'Amico, J.-P. Delahaye, S. Doebert, S. Fartoukh, A. Ferrari, G. Geschonke, J.-C. Godot, L. Groening, G. Guignard, S. Hutchins, J.-B. Jeanneret, E. Jensen, J. Jowett, T. Kamitani, A. Millich, O. Napoly (Saclay, France), P. Pearce, F. Perriollat, R. Pittin, J.-P. Potier, S. Redaelli, A. Riche, L. Rinolfi, T. Risselada, P. Royer, T. Raubenheimer (SLAC, Stanford, USA), F. Ruggiero, R. Ruth (SLAC, Stanford, USA), D. Schulte, G. Suberlucq, I. Syratchev, L. Thorndahl, H. Trautner, A. Verdier, I. Wilson, W. Wuensch, F. Zhou, F. Zimmermann

CLIC STABILITY STUDY

R. Assmann, W. Coosemans, G. Guignard, N. Leros, S. Redaelli, W. Schnell, D. Schulte, I. Wilson, F. Zimmermann

Latest stabilization technology applied to the accelerator field



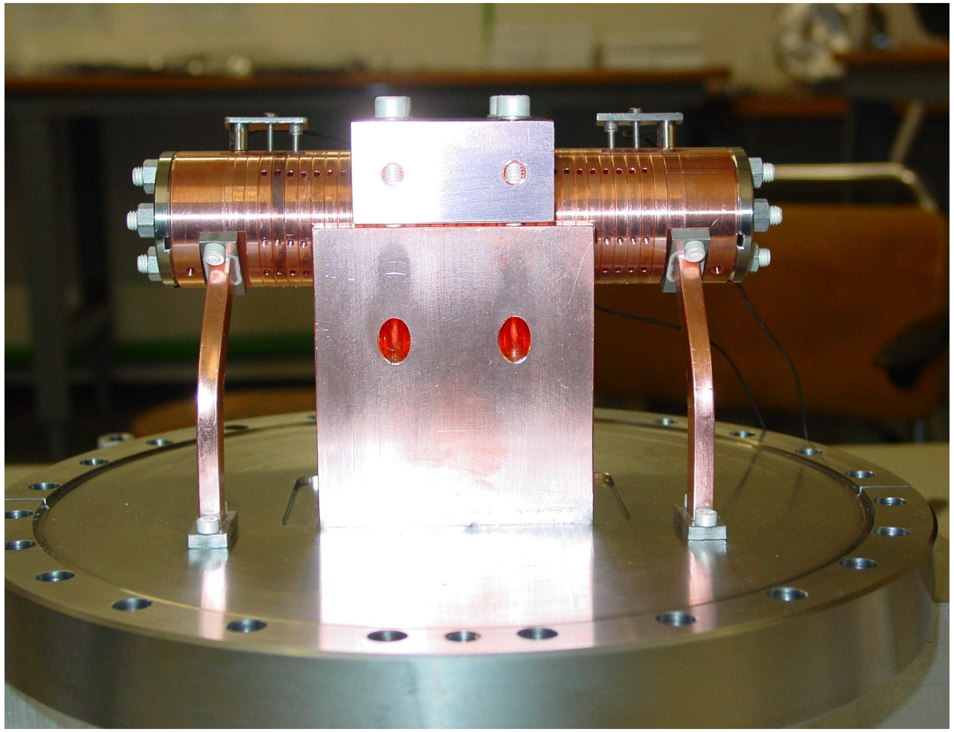
Stabilizing quadrupoles to the **0.5 nm** level!

(up to 10 times better than supporting ground, above 4 Hz)

CERN has now one of the **most stable places on earth's surface**!

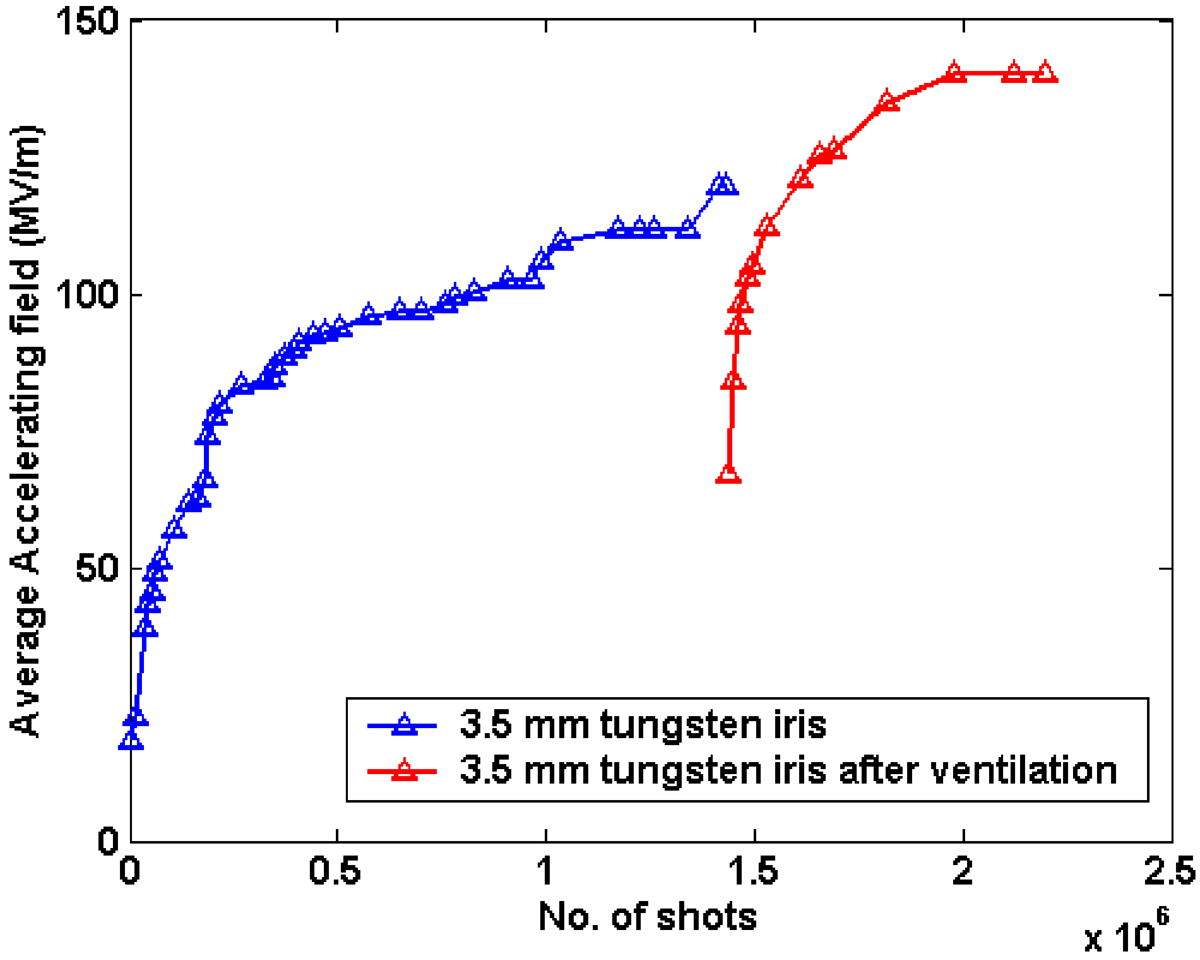
CLIC tungsten-iris structure:

150 MV/m



W. Wuensch

30 cell tungsten-iris structure
Conditioning history (last update:17/06/02).

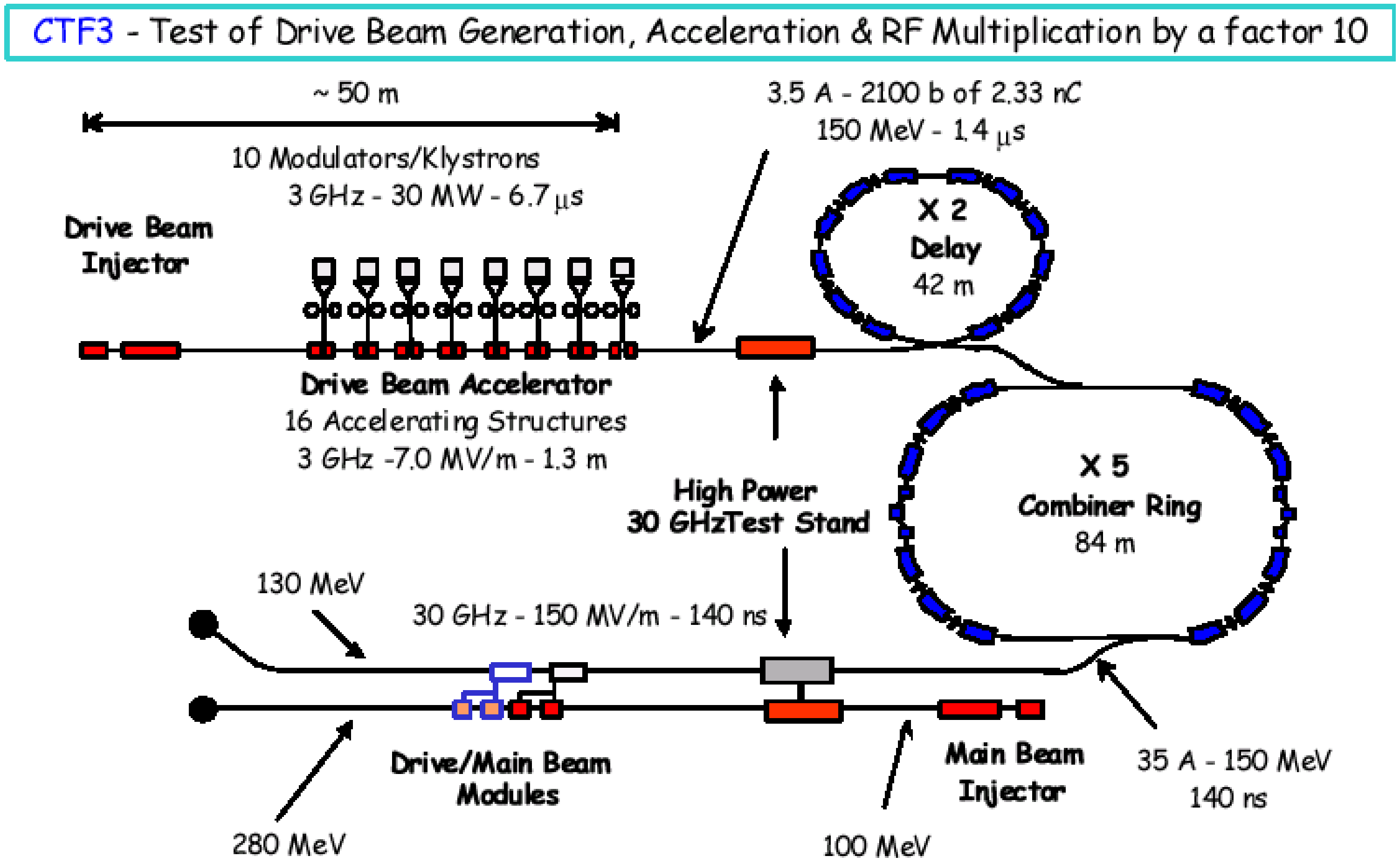


170 MV/m peak
Accelerating
380 MV/m peak
Surface

30 GHz
16 ns pulse

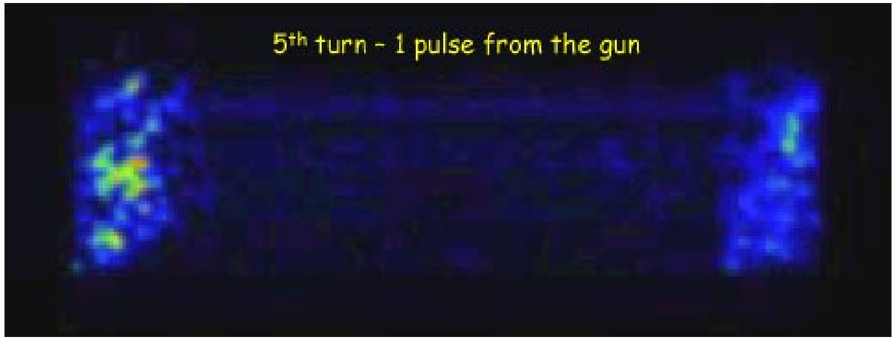
CLIC Test Facility CTF3

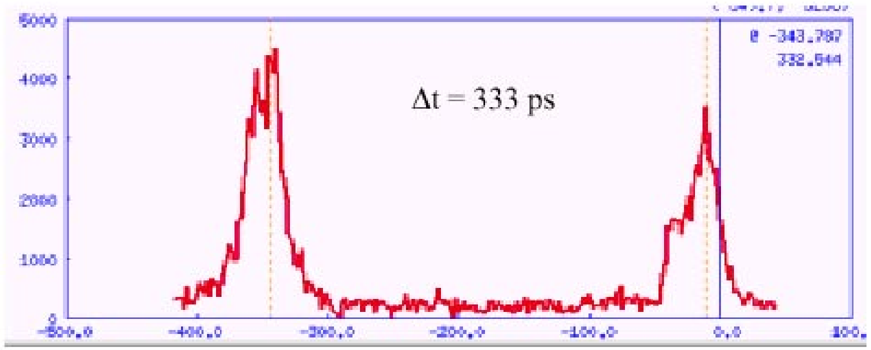
Demonstrate that CLIC power generation works as required



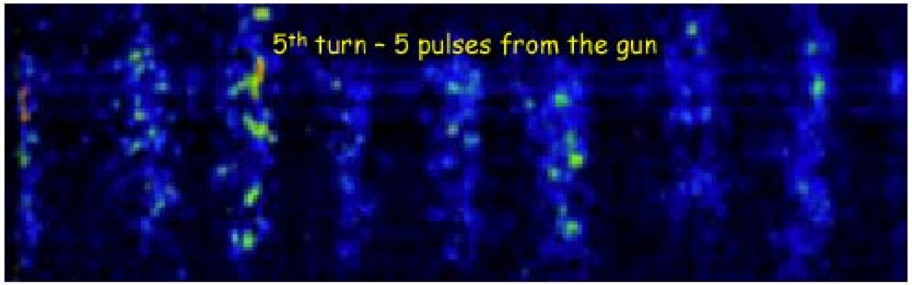
ongoing for next 3-4 years

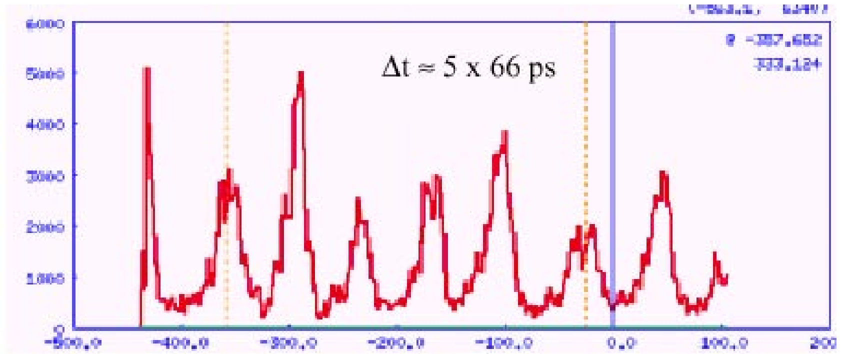
First experimental demonstration of bunch frequency multiplication





x 5





21st June 2002

R. Corsini, L. Rinolfi, P. Royer, F. Tecker

ICFA recommendation: Next machine should be a linear collider at 500 GeV.

CLIC is an option for the CERN future, reaching beyond LHC/LC500 and opening the multi-TeV e+e- frontier.

Progress at future X-ray FELs, synchrotron-light sources, ...

This workshop shows the need for exchanging new ideas and results between the different projects and communities.

Collaboration with universities and industry allows maintaining critical momentum for future accelerator R&D.

Technology is advancing fast. We can both profit and further push its frontier.

Workshop goals:

1. Describe a path towards proving **feasibility of colliding and non-colliding nanometer-size beams**, document existing solutions, and identify open questions.
2. Develop a **coherent program for future research and development**.
3. Strengthen and expand **international and inter-disciplinary collaborations**.

Nanobeams are one possible way into the future.

ICFA needs your help in exploring this path!