NLC - The Next Linear Collider Project

the LINX proposal

Linear collider IR-FF facility at SLAC

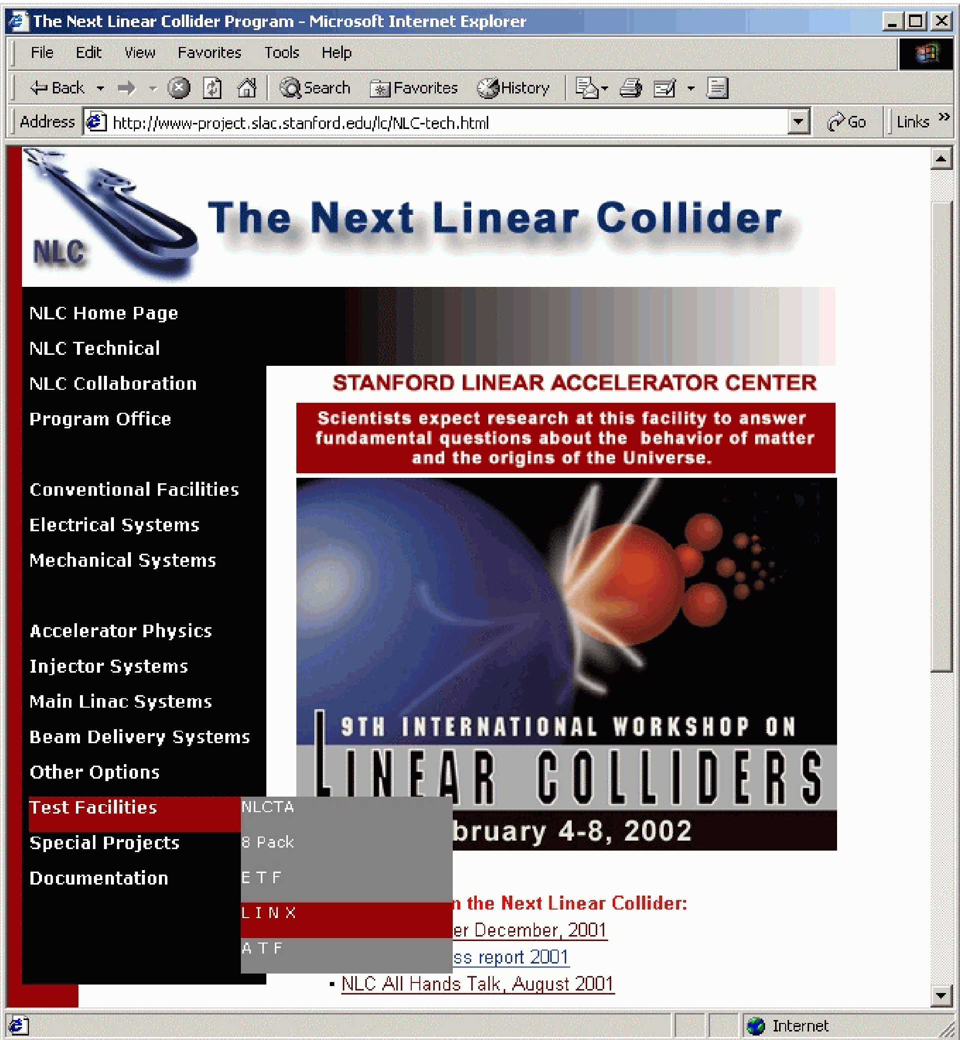
LCD Study Group meeting
January 22, 2002

Andrei Seryi, SLAC

Why do we need IR-FF test facility?

- Interaction Region and Final Focus are two quite critical areas of Linear Collider
- Need to address the challenge of 10^4 luminosity increase (SLC-> NLC)
- Need to reduce start-up time of LC
  to win the battle, train your army

LINX letter of intent



DRAFT

Letter of Intent for the LINX Test Facility at SLAC

NLC Collaboration

Stanford Linear Accelerator Center
Lawrence Livermore National Laboratory
Lawrence Berkeley National Laboratory
Fermi National Laboratory

Martin Breidenbach
Franz-Josef Decker

Stanford Linear Accelerator Center

Philip Burrows
Simon Jolly
Glen White

Oxford University, Oxford, England

Thomas Mattison

University of British Columbia, Vancouver, Canada

NLC

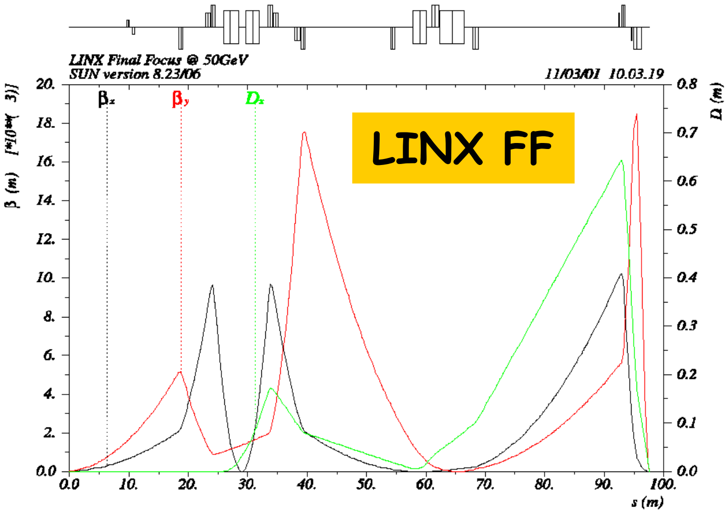
Goals of LINX test facility

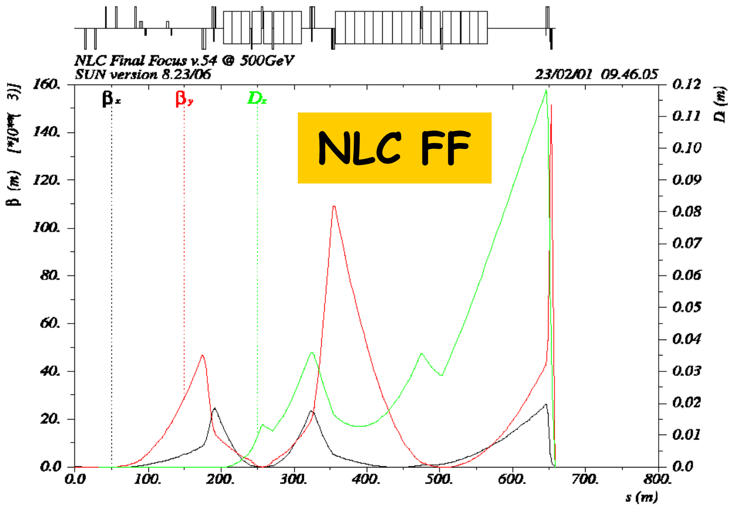
e+e- collisions at SLC with ~50nm beams

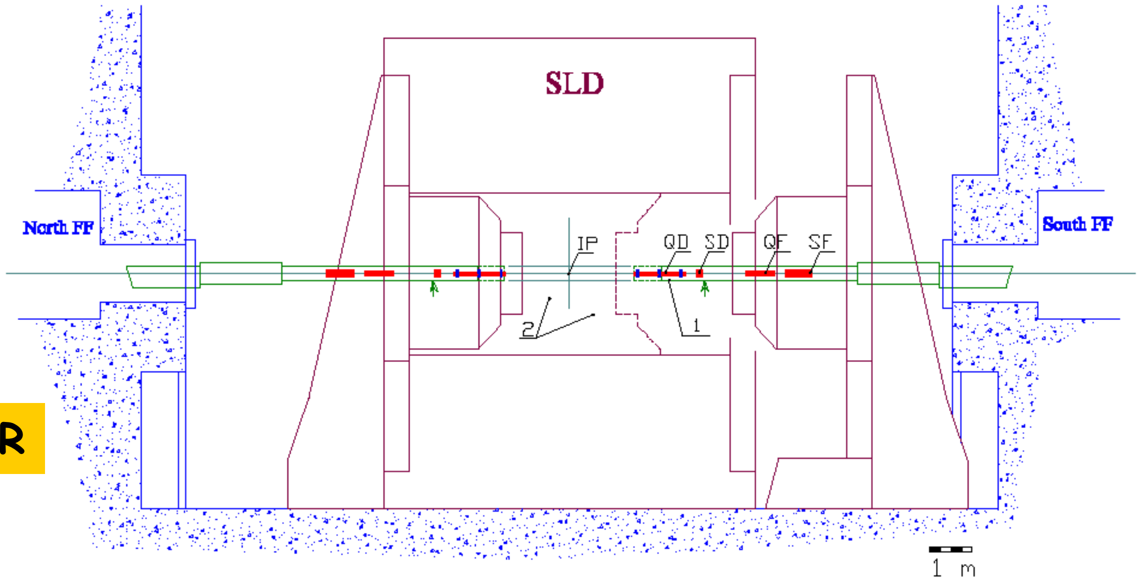
	LINX	NLC
Beam Energy:	30 GeV	250 GeV
DR emittances:	$\gamma\varepsilon_{x,y}$=1100/50E-8m	300/2
FF emittances:	$\gamma\varepsilon_{x,y}$=1600/160E-8m	360/4
IP Betas:	β_x=8mm β_y=0.11mm	same
Bunch length:	σ_z=0.1 - 1.0mm	0.11mm
IP spot sizes:	$\sigma_{x,y}$=1500/55nm	243/3nm
Beam currents:	$N^{\pm}$= 6e9	7.5e9

- Test stabilization techniques proposed for future linear colliders and demonstrate nanometer stability of colliding beams
- Investigate new optical techniques for control of beam background
- Provide a facility where ultra-small and ultra-short beams can be used for a variety of other experiments *(GAMMA-GAMMA)*

LINX
IR and optics



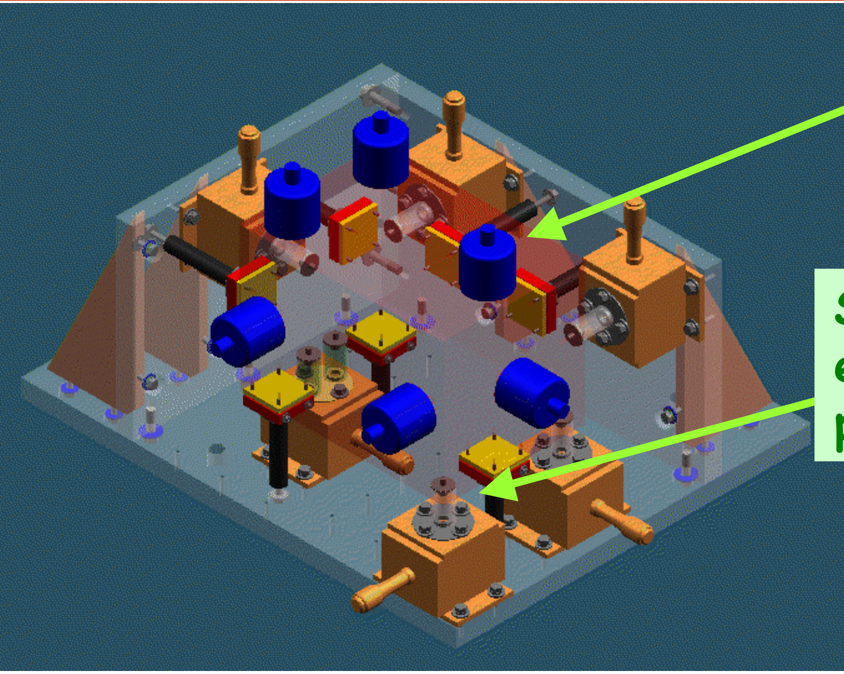




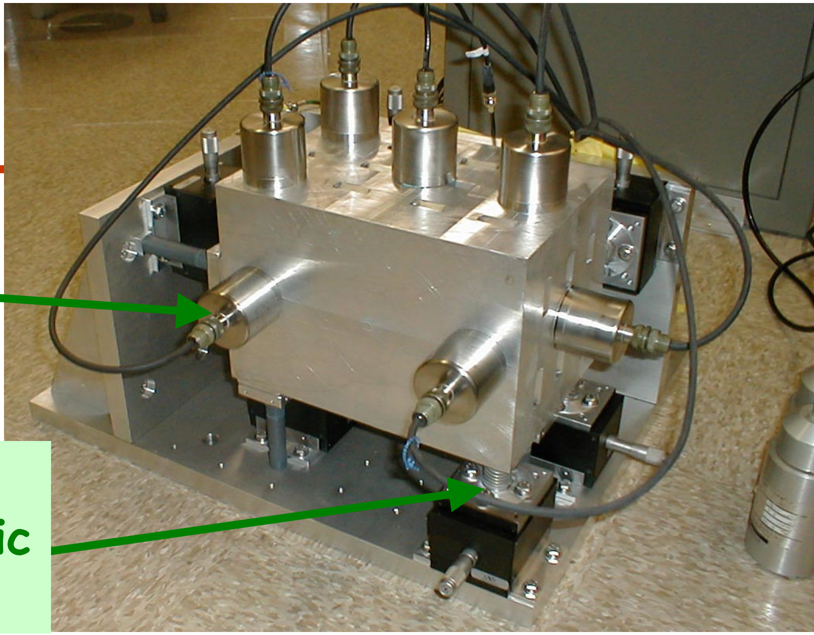
LINX IR

R&D on inertial stabilization of FDs

NLC



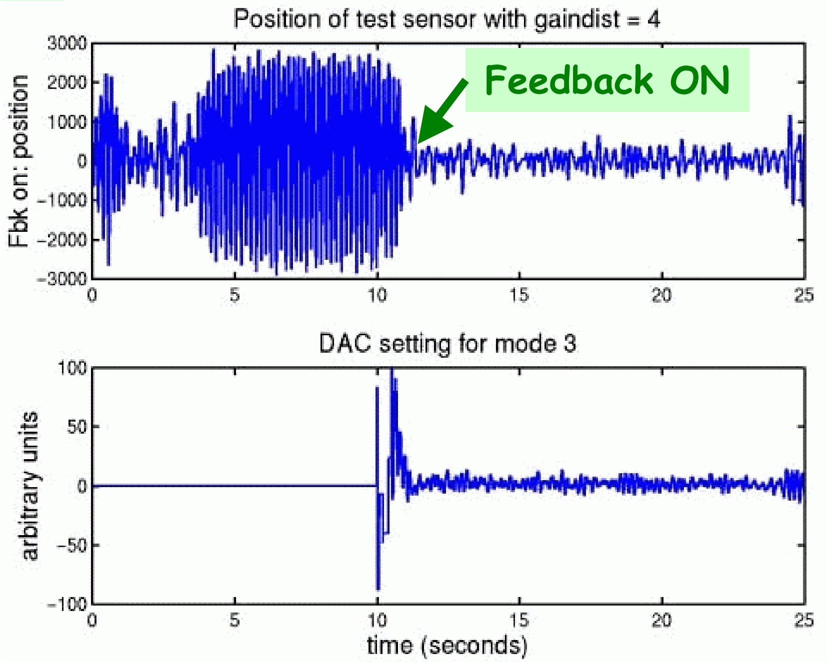
Inertial sensors

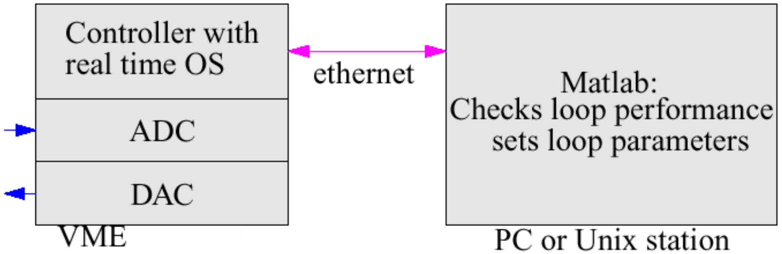


Springs & electrostatic pushers

Joe Frisch, et al.

Single small object in 6D.
Later – extended object(s)

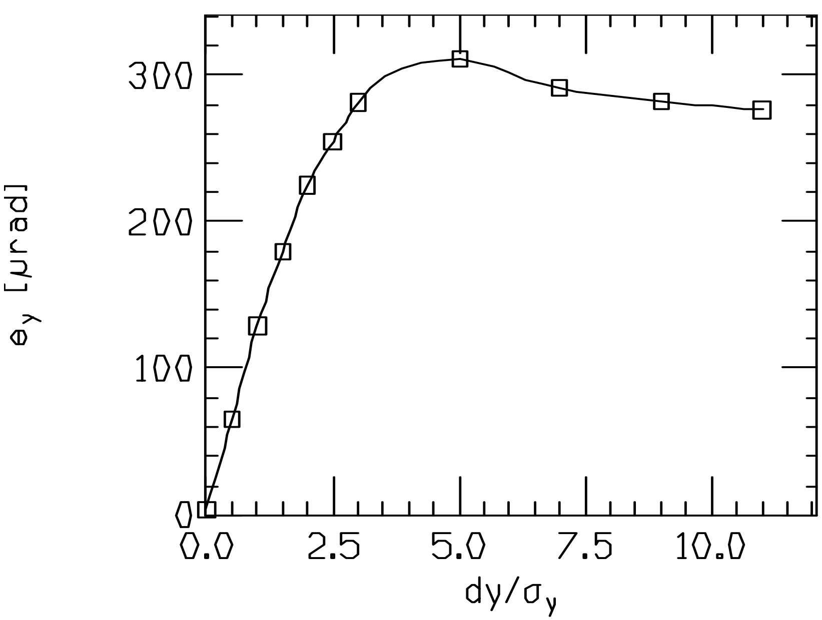


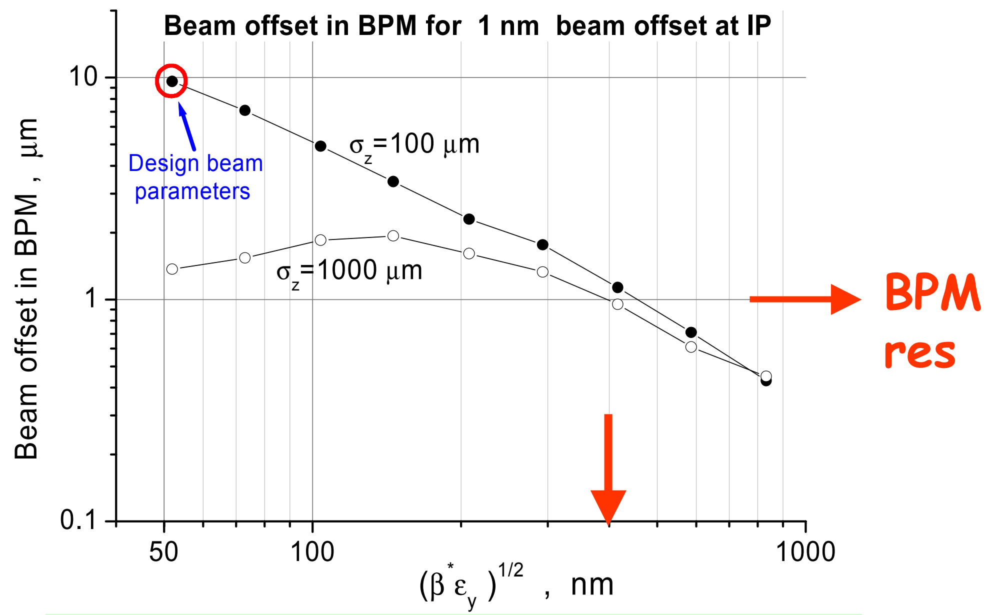


Digital feedback @ real time OS

Nanometer stability of colliding beams

Beam-beam deflection gives **1nm stability resolution**





Beam offset in BPM for 1 nm beam offset at IP

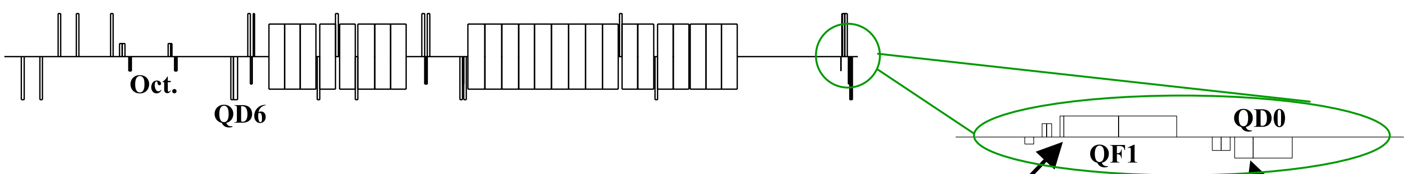
Colliding beams provide a **Direct Model-Independent test** of any engineering solutions to the final doublet stability problem

(Not possible at FFTB)

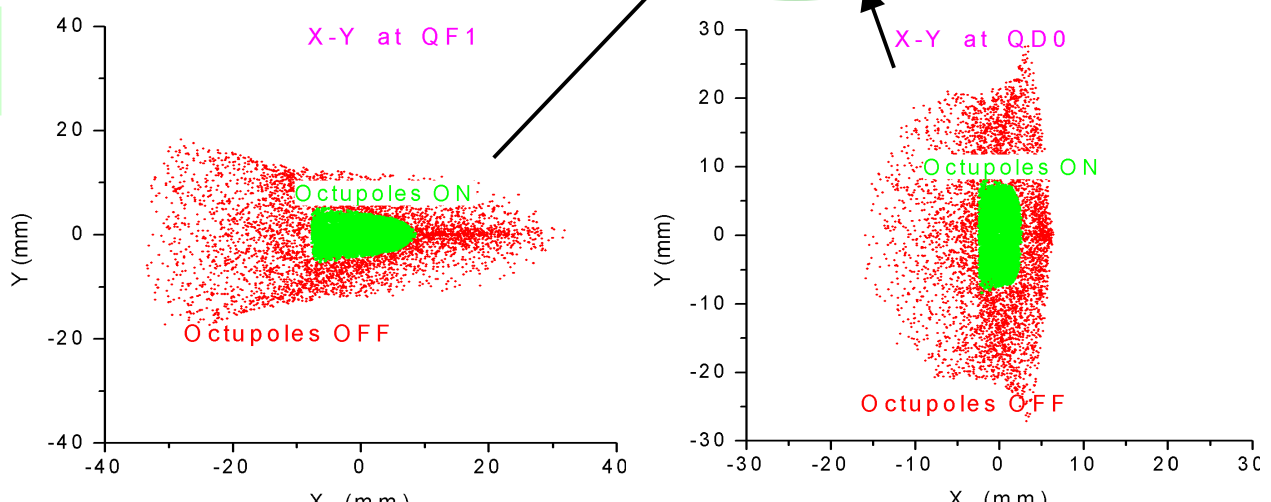
Controlling beam background with nonlinear elements

- Two octupole doublets give tail folding by ~ 4 times in terms of beam size in FD
- This lead to relaxing collimation requirements by ~ a factor of 4

Confidence that comes from an actual demonstration may permit great savings in collimator design, radiation shielding, and muon shielding



Tail folding by means of two octupole doublets in the new NLC final focus



"Tail folding" = put particles from the halo of the beam back into the core

Technical feasibility of LINX

Parasitic to PEP-II Operation: 30 HZ, 30 GeV

Damping Rings:

Typical SLC run:	$\gamma\varepsilon_{x,y}$ =2900/150E-8m-rad	} => need x2-3 improvement
Typical FFTB	$\gamma\varepsilon_{x,y}$ = / 90E-8m-rad	
"Best" SLC	$\gamma\varepsilon_{x,y}$ = / 70E-8m-rad	

LINX: Reduced rep rate allows "long store" AND simple rewiring allows shift of magnetic center of QFs in ring to act as combined function magnets and to decrease $\varepsilon_{x,y}$ by x3

Linac: No different than 1994-1997 FFTB runs and recent (E150,E157) FFTB plasma experiments

Arcs: 30 GeV running reduces SR emittance growth to ~0

Final Focus: Optics are "EASY"; need only:

New doublet w/ sextupoles

New octupole pair to investigate tail control

LINX staging

Step 1: Successfully transport e+ and e- beams to the north and south beam dumps respectively.

Step 2: Demonstrate that the SLC beamlines can still deliver high quality colliding beams.

DECISION POINT TO PROCEED & CONSTRUCT DOUBLET

Step 3: Produce ultra-short beams.

Step 4: Evaluate the effectiveness of background suppression with the new Final Focus optics.

Step 5: Produce ultra-low emittance beams.

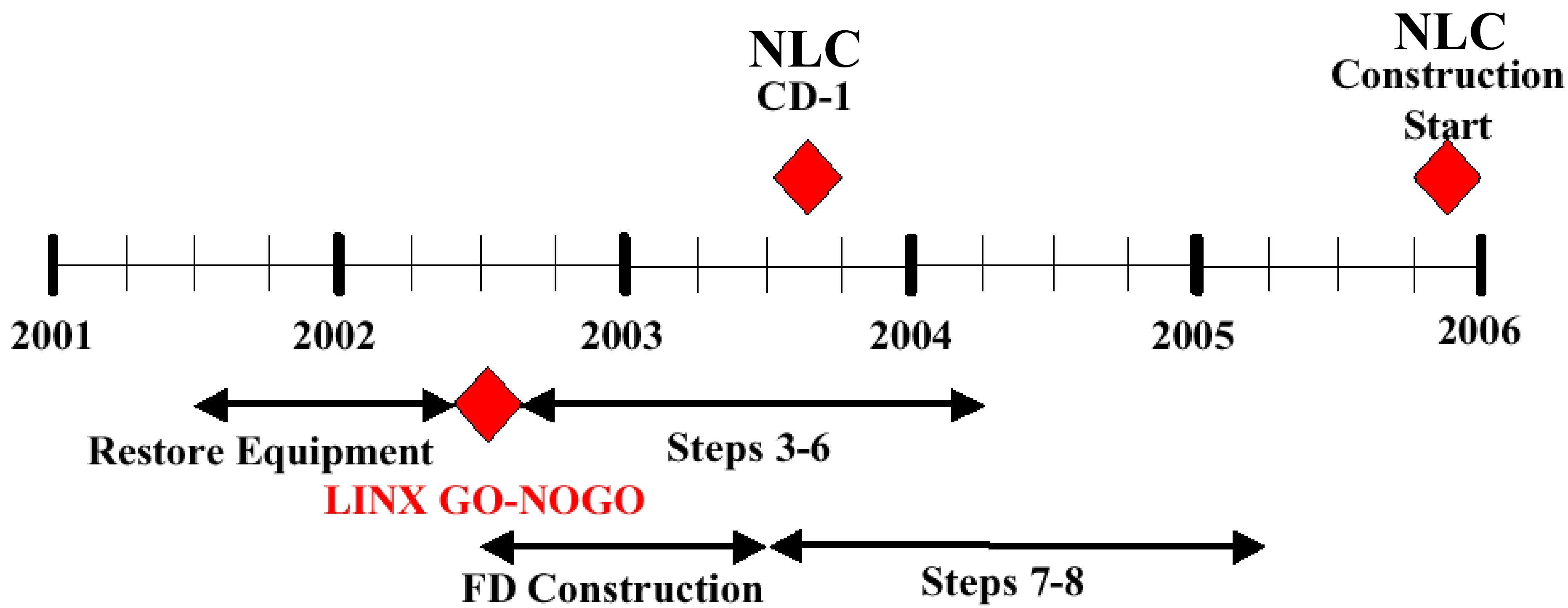
Step 6: Develop fast intra-pulse feedback hardware

INSTALL NEW DOUBLET

Step 7: Produce $<$ 100 nm vertical beam size at the IP.

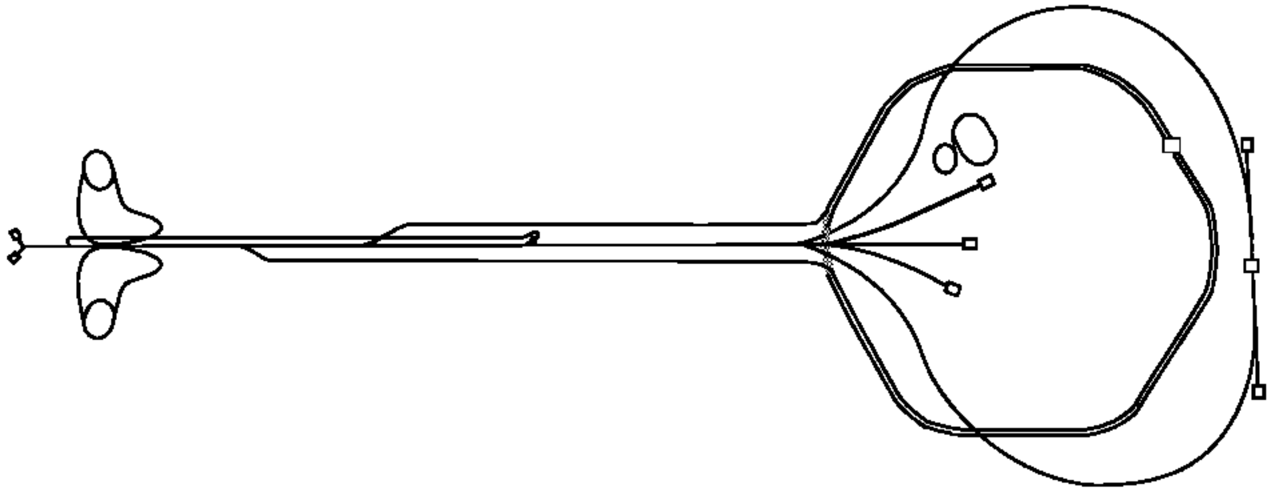
Step 8: Demonstrate nanometer stabilization at the IP.

LINX timeline



Recent progress

- Started vacuum survey of Arcs and FF in September 2001
- Leaks localized or repaired
- Want to concentrate on the South arc, put beam through, do background study (hope for June 2002)
- Need to make several small repairs in BSY – started work in January 2002, for two days. Need to be continued – will have to wait for the next ROD



Summary

LINX engineering test facility is been considered to be created at SLAC on the base of existing hardware

it will help to:

Test stabilization techniques proposed for future linear colliders and demonstrate nanometer stability of colliding beams

Investigate new optical techniques for control of beam background

Provide a facility where ultra-small and ultra-short beams can be used for a variety of other experiments, e.g.

Gamma-gamma collisions, at first technical development, then possibly a physics run