

# Accelerator R&D and a “Bid to Host”

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# Overview

- **LC Accelerator R&D budgets have been flat since FY01 (~\$2.5M) at this level we will never really be a serious “player” in an international arena in which FNAL wants to “bid to host” such a machine.**
- With this limited budget our strategy has been to focus effort in areas where we have some momentum, capabilities, and available people.
  - **Emphasis on NLC RF Structure development & civil/siting studies**
  - Very low level effort on TESLA continues, mostly looking at TESLA cost estimates. However SCRF R&D for other FNAL projects is relevant
- LC Accelerator R&D activities are now mostly in Technical Division
  - BD Accelerator Physics group has been redirected onto Run II.
  - Creation of an x-band power facility on-site has been suspended (\$,people)
  - Successful NLC permanent magnet development was stopped, because lead person is now working on the Tevatron
- **We should all realize that our current LC focus is pretty narrow**
- **If we do not find a way to increase the FNAL budget for LC R&D then it is unlikely that we will host this machine**



# FNAL NLC Collaboration Responsibilities

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## •X-Band Structures Production

- Produce RF structures & strongbacks for High Gradient Testing at SLAC's NLCTA Facility
- Produce structures & strongbacks for Phase II of the NLC 8-Pack Project
- Industrialization of RF Structure Production (**the original mission**)

## •NLC Girder R&D

- Develop girder design
- Construct prototype and conduct vibration and stability studies

## •NLC Site Studies (BD, FESS)

- Conduct suitability studies for identified sites
- Develop civil construction cost estimates for identified sites
  - Develop cost comparisons between warm and cold machines

## •NLC structure fabrication consumes most of ~\$ 2.5 M LC budget



# NLC: RF Structures

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- **NLC RF structure work is done in the TDRF Group**
- **Accomplishments**
  - Completed the IB4 RF structures factory
  - Finished FXB series structure production (no HOM waveguides)
    - Several of these have been tested at the SLAC NLCTA, they are as good (or bad) as structures produced elsewhere in the world
  - Procuring parts for fabrication of FXC series structures for the 8-pack test at SLAC. (these are the first “full featured” structures we will produce... ie they include HOM waveguides)
  - Started low level industrialization efforts (including SBIR support)
  - RF Design
    - Established significant RF design capabilities in the Technical Div
      - People (RF engineers)
      - Software and hardware purchases
      - Improved modeling/analysis techniques
      - eg Input/output coupler design for high gradient structures



# Accomplishments: IB4 RF Structure Factory



Small Vacuum Furnace

Small and Large Vacuum  
Furnaces in Class 1000  
Enclosure in IB4



# Accomplishments: RF Structures

- **Structures Production**
  - FXB Series Structures
    - Six structures were completed
    - Five of them have or will undergo high power testing at SLAC



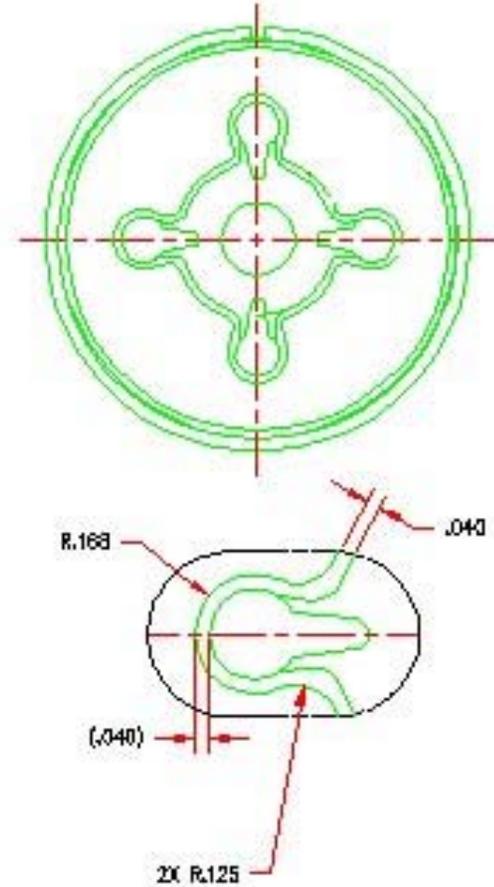
Final assembly of FXB-004 in our large vacuum furnace.

FXB-002 mounted on strongback and ready for shipment to SLAC

# Accomplishments: Full Featured Structures

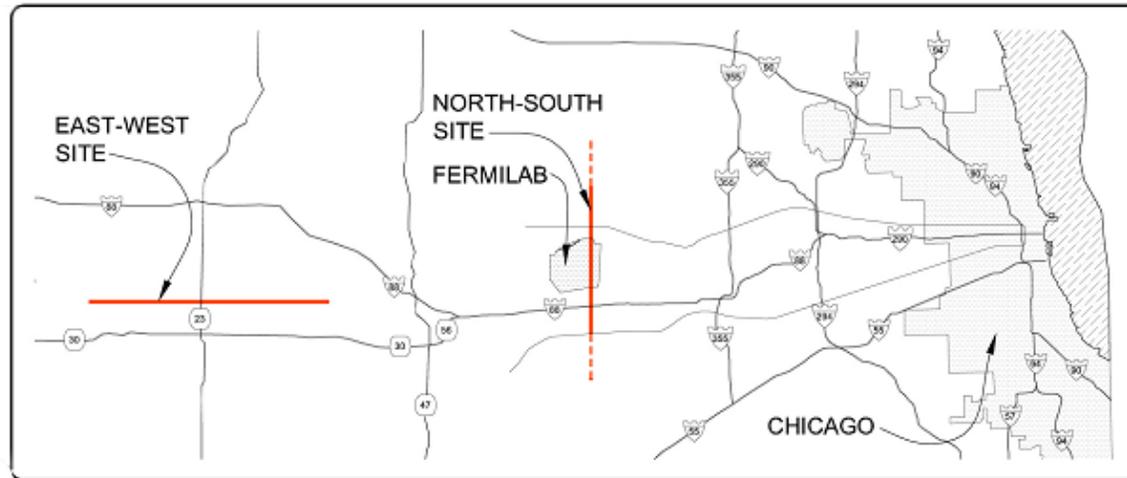
- **Structures Production**

- FXC Series Structures
  - Parts procured for five structures



FXC Disk Design Details

# Linear Collider Site Studies



- Preliminary analyses of N-S and E-W sites near Fermilab FY01-02.
- FY2003 siting activities are being conducted under the auspices of the US Linear Collider Steering Group sponsored warm/cold evaluation:
  - SC linac **and** warm Linear Collider in a deep site near DeKalb, IL
  - Warm **and** SC Linear Collider in a bored tunnel at a California site
  - Analysis of incremental changes/costs for the alternatives.

# TESLA

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- Fermilab remains a member of the TESLA collaboration (and the only US institution affiliated with both NLC and TESLA collaborations) although the effort on TESLA at this point is minimal.
  - Modest continuing consultation support for TTF
  - Engineering/cost study of the TESLA proposal completed in July 2002. Global Accelerator Network (GAN) activities at FNPL
- The most significant involvement of Fermilab relative to a superconducting linear collider is now occurring via the USLCSG sponsored evaluation.
  - Fermilab is providing leadership/support in the accelerator technology, site development, and cost estimating task forces.
  - All of these draw on our considerable past experience in these areas, including the TESLA engineering/cost study.



# SCRf R&D

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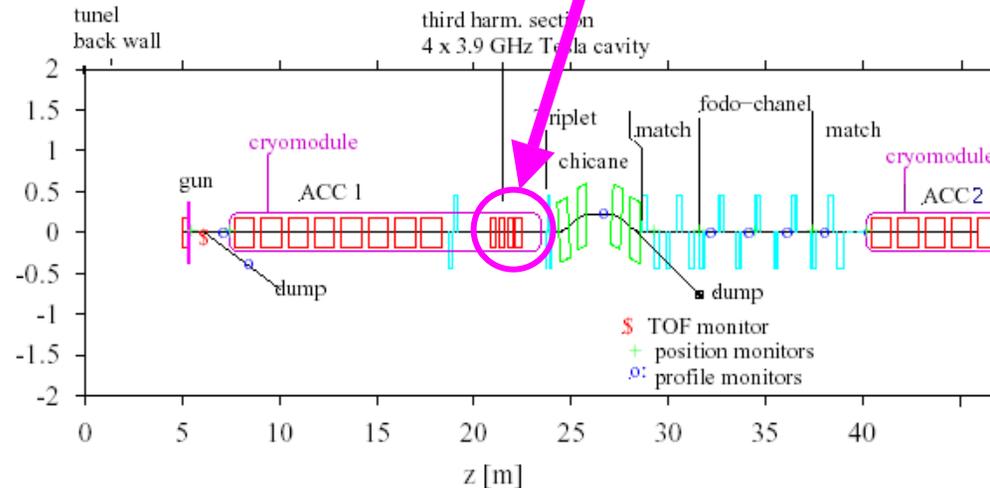
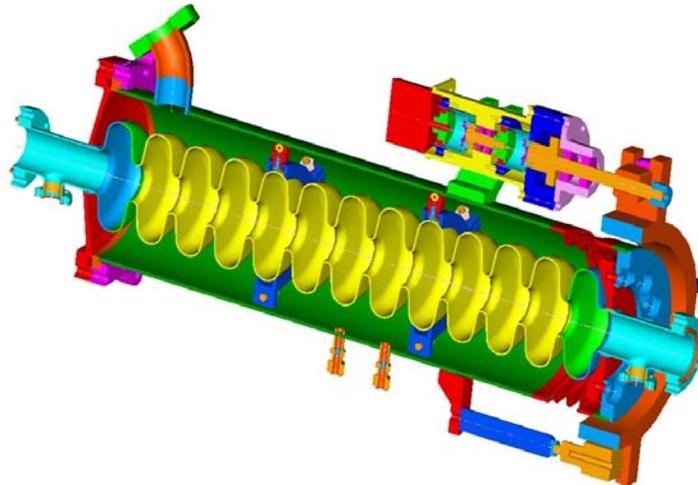
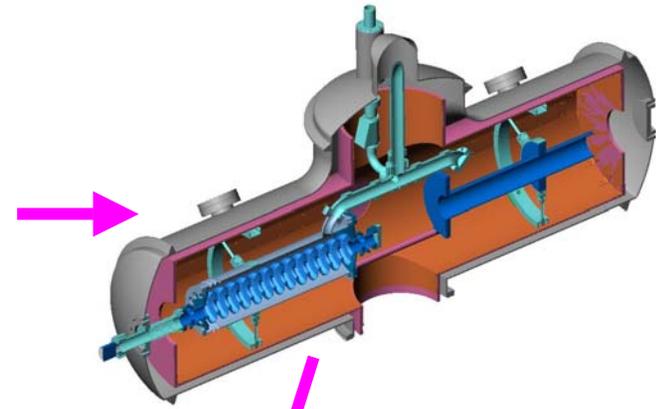
- **FNAL is currently doing very little Superconducting RF R&D in support of the TESLA proposal**
- **TD RF group is working on SCRf R&D for 2 FNAL projects that build SCRf capabilities relevant to a LC if the technology decision is for a cold machine**
  - **CKM:** Collaboration with BD. Goal is to provide SC RF cavities (transverse kick mode) to be used to generate a separated charged K beam for the CKM experiment
  - **A0 3<sup>rd</sup> Harmonic cavity:** Goal is to provide a 3.9 GHz accelerating cavity to linearize high current electron pulses from the A0 photo-injector. (Note: TESLA would like us to build one of these for TTF-II also so there continues to be collaboration in this area)



# SCRF R&D

- **Building our capabilities for the future**

- Develop and build elements of a CKM SCRF module fabrication and test infrastructure
- Design and build a prototype of a 3.9 GHz accelerating cavity for the Photo-Injector Test Stand



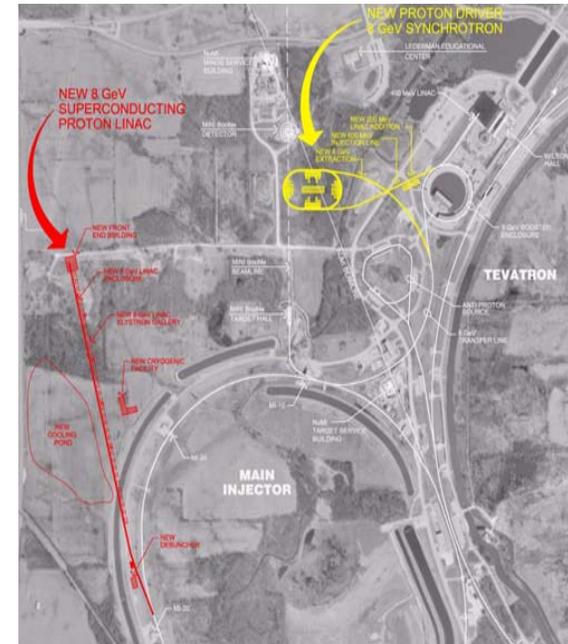
# LC R&D: FY04 plans

- **FY04 Plans ( Funding Guidance = same as FY03)**
  - XBand Structures Production
    - Complete Production of the FXC Series of Structures---5 units of H60VG3S17 design without HOM manifolding, couplers, and loads.
    - Parts Procurement and Start of Construction of the FXD Series of Structures---4 units of H60VG4S17-DDS design with HOM manifolding, couplers, and loads.
    - 4.8 m of structures get tested in NLC 8-pack test (4 C's , 2 D's, 2 from KEK)
  - NLC: Main Linac Girder R&D
  - NLC: RF Design and Testing
  - NLC: Industrialization
    - Improve Production Methods and Reduce Costs
    - Expend More Effort/Resources in Support of SBIR Program
  - SCRF: 3<sup>rd</sup> Harmonic work & CKM ?? (PD ? More in a second)
  - Site Studies
  - University Linear Collider Machine R&D ( low level support )
  - Make a significant contribution to the “warm and cold” evaluation of linear colliders commissioned by the USLCSG.
- **All of this leading to a LC Technology choice in 2004**



# SC Linac: Proton Driver

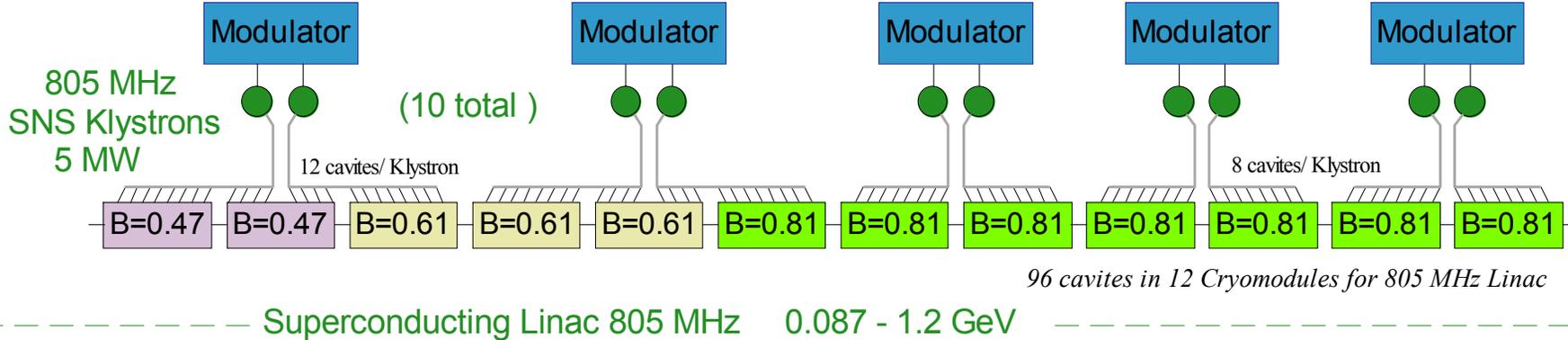
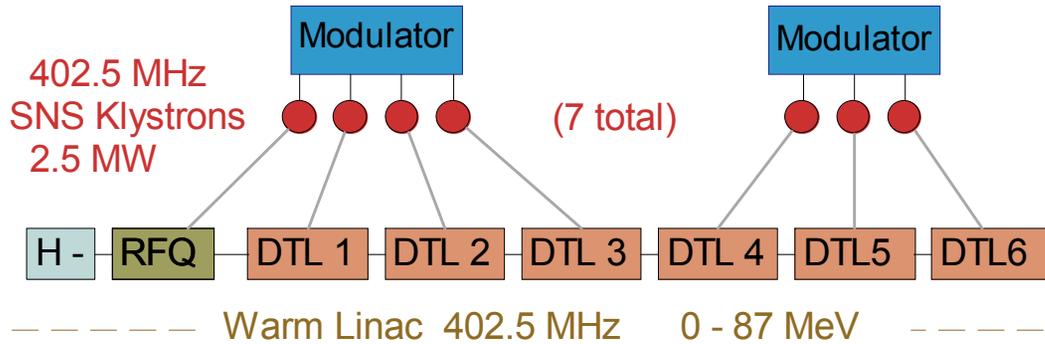
- **Proposed by Bill Foster**
- **Would provide MW proton beams for a future FNAL physics program**
  - Development of a SC Linac version of the Proton Driver would develop extensive SCRF expertise and infrastructure relevant to the construction of a “cold technology” Linear collider at Fermilab
  - Could accelerate electrons → Could serve as a few % “engineering test facility” for a cold LC
  - If might allow FNAL to “double count” this effort as both LC R&D and effort towards the near-term FNAL Physics program



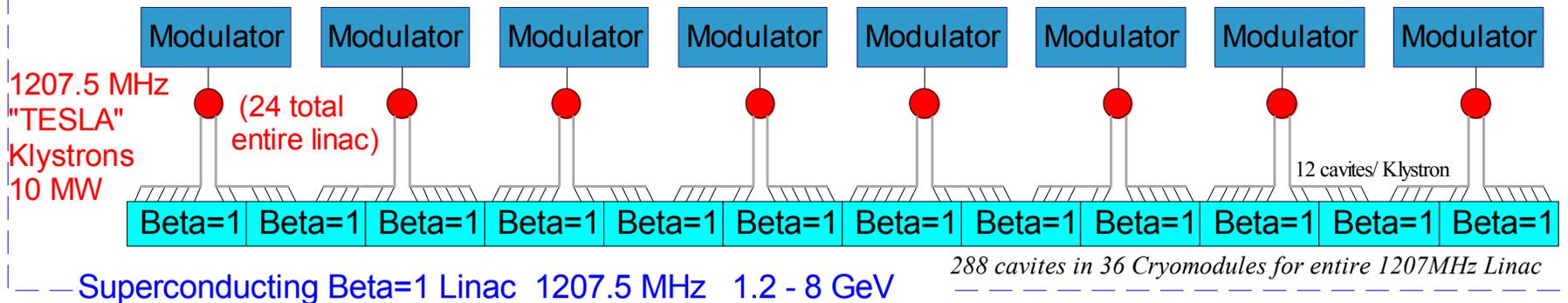
**• Probably more expensive than synchrotron version of proton driver... but has many appealing features**

# 8 GeV RF LAYOUT

- 41 Klystrons (3 types)
- 31 Modulators 20 MW ea.
- 7 Warm Linac Loads
- 384 Superconducting Cavities
- 48 Cryomodules



*x 3 for Full Linac (2.3 GeV Section Shown)*



# Thoughts on an FNAL Bid to Host

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- **IF we are serious about wanting this machine at/near FNAL we need to:**
  - Host the Central Design Group (Don't ask, just do it!)
  - Build the Engineering Test Facility(ETF) for whichever technology is chosen.
  - An SCRF based Proton Driver = ETF for the cold LC technology... it also makes possible an excellent physics program... we should just propose and do this.
  - If “warm” technology were to be chosen then we could also build a warm ETF and couple it to an FEL facility.



# Conclusions

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- **FNAL has an active role in the world wide LC R&D effort**
- **We are working on both warm and cold RF structures**
- **We have only a low level of effort on NLC girders, PM quadrupoles, etc.**
- **We are also working on LC site and civil studies**
- **We are also active in USLCSG comparison studies of the warm and cold technologies**
- **However, the overall effort at Fermilab, and in the world is sub-critical if we ever want this machine to be a reality**
- **A SC Linac based Proton Driver might both enhance the FNAL physics program AND serve as an engineering test facility for a cold technology LC we should propose this!**

