



University-based LC R&D Meeting

X-Band Work in Fermilab Technical Division: Status Report and Future Plans

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Outline

- **Mission**
- **Organization**
- **Work Accomplished**
- **Status of Ongoing Work**
- **Future Plans**
- **Opportunities for University Participation**
- **Summary**

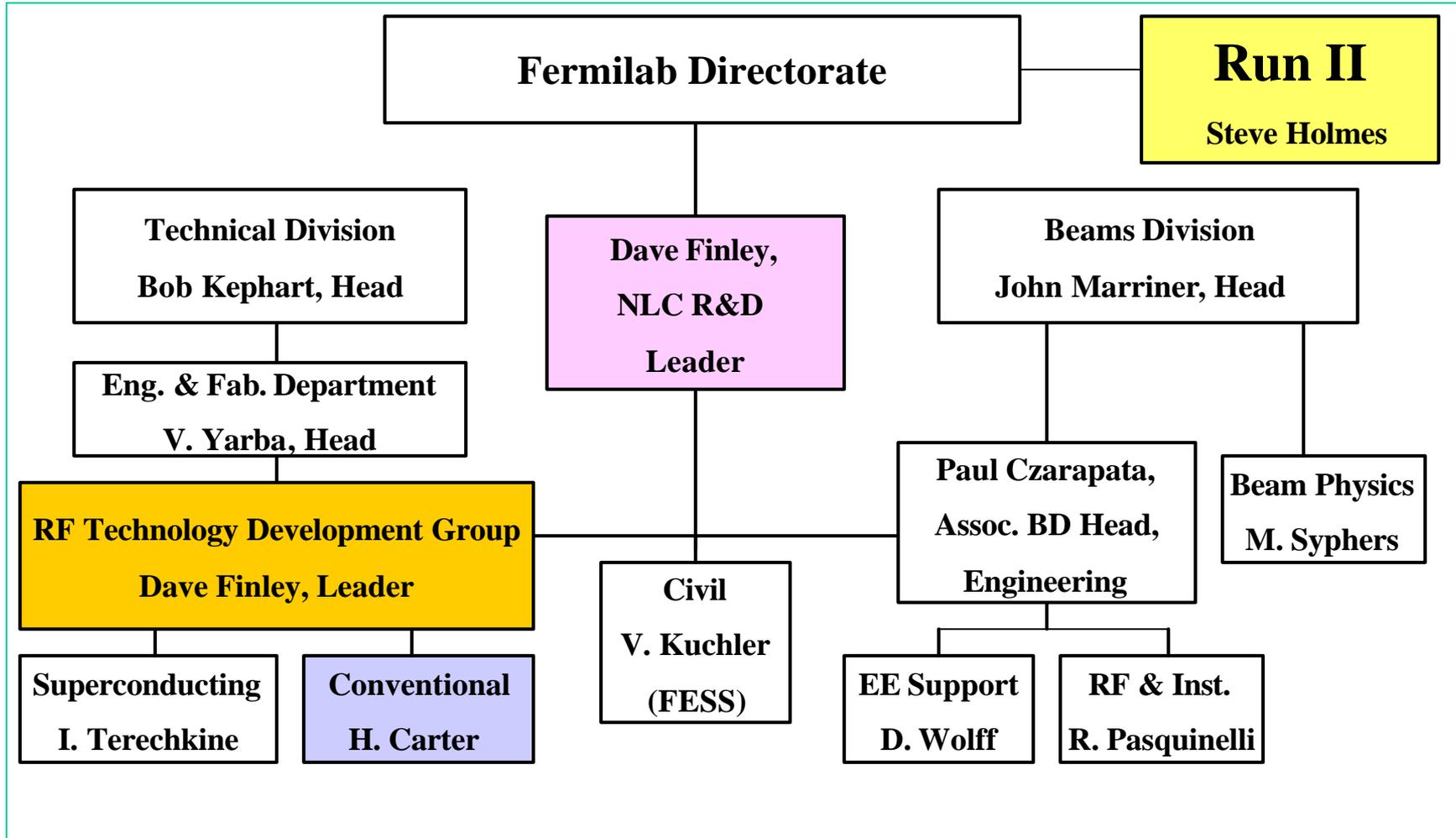


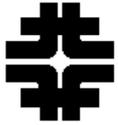
Mission

- **Original mission was to develop industrialization of the structure manufacturing process. This included:**
 - **Developing vendors to supply structure component parts**
 - **Developing vendors to supply assembled structures**
- **Our mission has evolved into the above, plus as a higher priority, we are to supply test structures in support of the Eight Pack Program at SLAC**

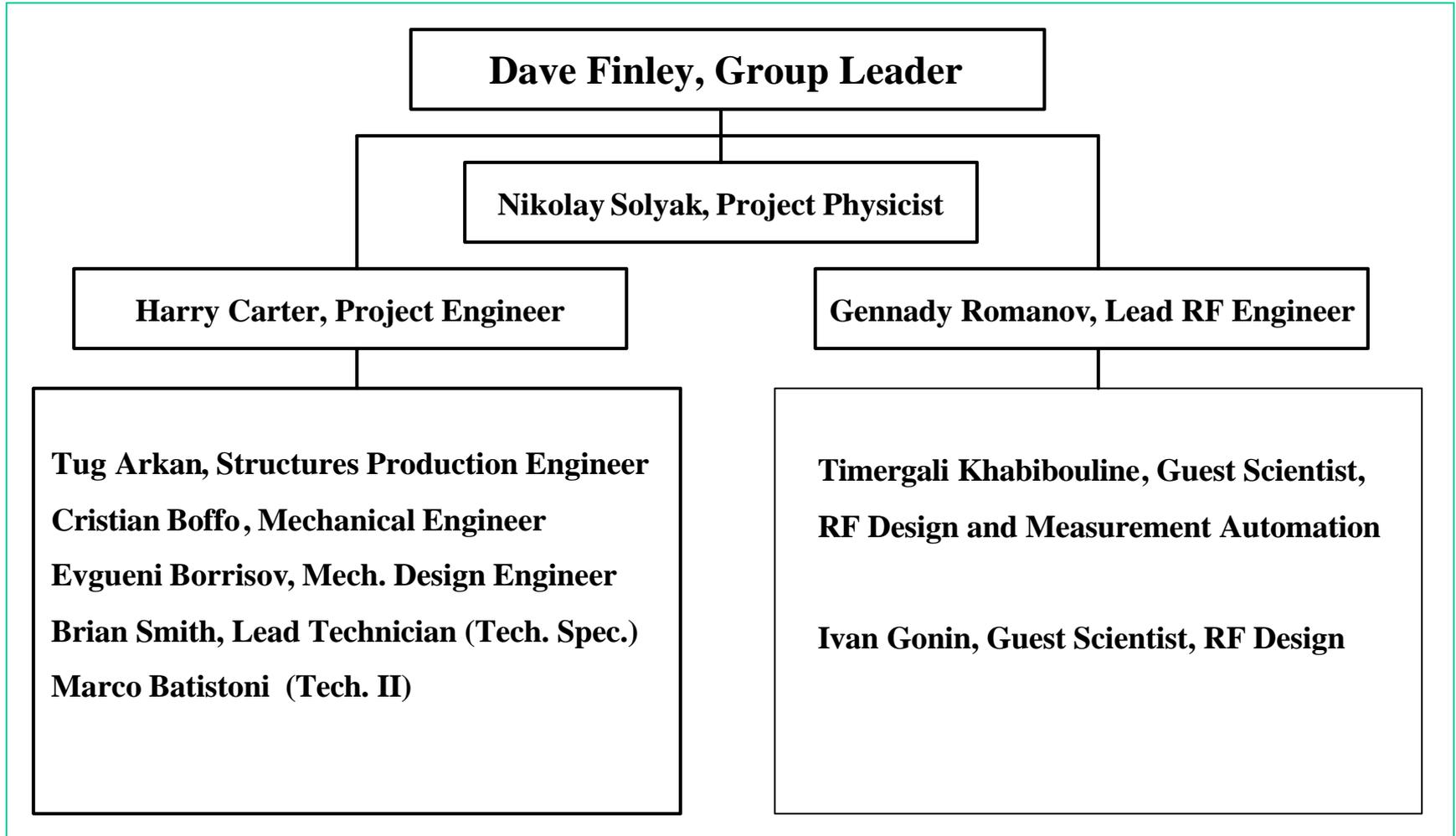


Organization: NLC Collaboration at Fermilab





RF Technology Development (Conventional) Group Personnel & Responsibilities





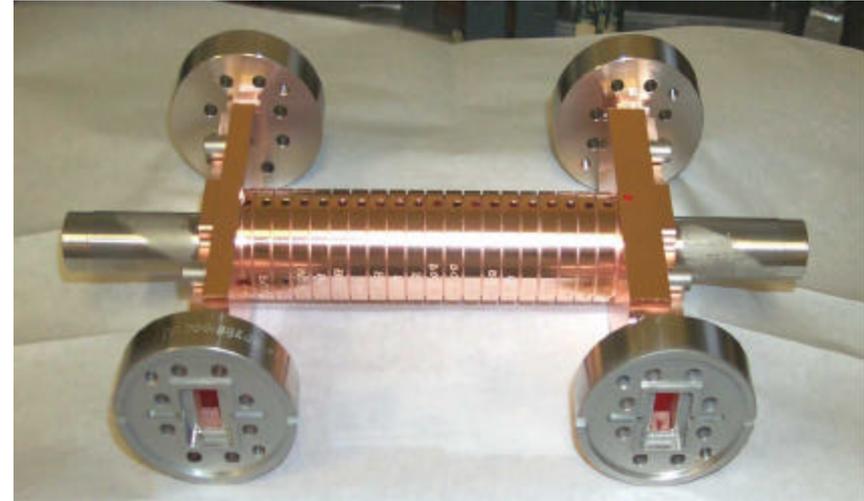
Work Accomplished

- Structure Production
- Engineering Teams
- RF Development & Testing
- Girders
- Special Projects



Work Accomplished: Structure Production

- We have produced three 20 cm. long traveling wave structures thus far: FXA-001, FXA-002, and FXA-003.
- We are in the process of producing **FXB-001**, a high gradient 0.6m long structure which has been delayed due to the very late delivery of the large vacuum furnace from AVS (just installed and commissioned at IB4 in July)
- We are continuing to improve our fabrication methods and processes
- We are working to broaden our base of vendors capable of producing high precision machined parts (2 for disks and 3 for couplers) for structures





Work Accomplished: Engineering Teams

Originally created to help focus on Technical Division FY02-03 goals for Linear Collider R&D.

For X-Band (NLC)

- **Structures (Mechanical)**
- **Structures (Electrical/RF)**
- **Girders**
- **Vacuum System**
- **Cooling Water System**
- **Specifications Development**
- **Quality Assurance Development**
- **8 Pack Integration**

Both TESLA and NLC

- **FNAL Cleaning Facility**
- **SBIRs**
- **Permanent Magnets**
- **Demonstration of Remote Accelerator Operation**
- **Siting LC's near Fermilab**



Work Accomplished: Girders & Special Projects

Girders

- Girders for FXB structures at NLCTA will remain the “strong-back” design presently used
- NLCTA quadrupole spacing may be adjusted to accommodate a slightly longer strongback that will contain three 0.6 m long structures
- An NLC prototype girder will be developed and tested at Fermilab independent of the Eight Pack Project (not tied to the Eight Pack schedule)

Special Projects

- DLDS Induction Brazing (we are assisting BD in this effort, as well as investigating other possibilities)





Status of Ongoing Work: RF Development & Testing

RF Design Work

- **Have Acquired Software and Hardware to Facilitate RF Design and Analysis ----- We are planning a significant upgrade (hardware and software) to enhance our computational ability in either the end of FY02 or early in FY03**
- **Have Worked to More Fully Understand the Relationship Between Component Mechanical Design and Electrical Performance**
- **We are reviewing both standing wave and traveling wave designs as they become available**
- **Just completed coupler redesign for FXB series of structures**



Status of Ongoing Work: RF Development & Testing

RF Testing:

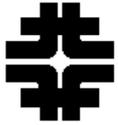
- Have developed single cell, bead pull, and plunger RF measurement hardware and have automated the measurement process using LabView



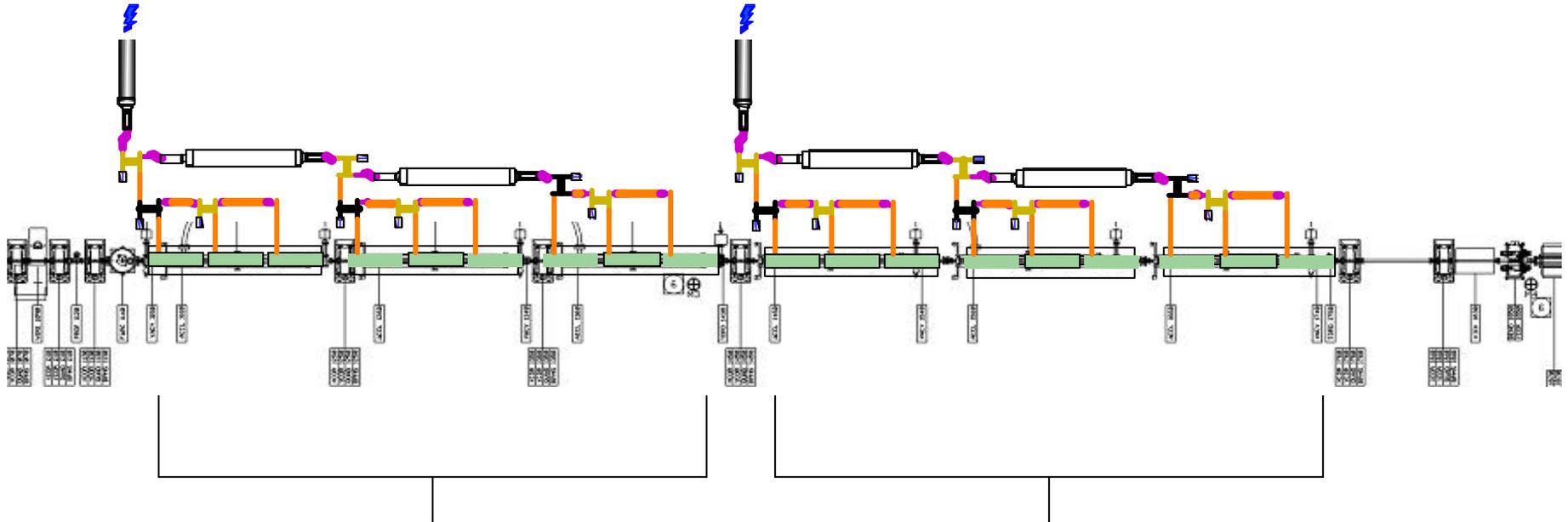


Future Plans: Structures for Eight Pack Test

- Eight Pack Test at SLAC (Dave Schultz, Proprietor)
 - In Phase II, a “pack of eight klystrons” will feed
 - 11.424 GHz X-Band power into a modified DLDS system and power two girders worth of structures with the full power and energy required by the NLC design.
 - The goal is to be operational by mid 2004
- Girder A System: Nine 0.6 m Long High Gradient Test Structures (FXBs, aka H60VG3)
- Girder B System: Nine 0.6 m long NLC Main Linac Structures (FXCs, aka HDDS-1)



The 8-Pack Test in NLCTA



High Gradient Structures (FXBs)
On NLCTA-type Strongbacks
(Girder A)

NLC Prototype Structures (FXCs)
On NLCTA-type Strongbacks
(Girder B)



Future Plans: NLC in TD for FY02

- In the remainder of FY02:
 - Complete FXA-003
 - 20 cm long, conventional machined, high gradient, 45 mm OD
 - Make FXB-001 and 002
 - 60 cm long, conventional machined, high gradient, high phase advance (150 deg.), low group velocity (VG3), 61 mm OD
 - FNAL coupler design with full radius slots, no cell tapering
 - Start to order parts for FXC Prototype
 - Prototype NLC Main Linac Design >>> The Real Thing (at least the first accelerating structure prototype, HDDS-1)
 - 60 cm long, assume diamond turned, real accelerators
 - **Note: Need FXC design (including couplers) by July 2002**

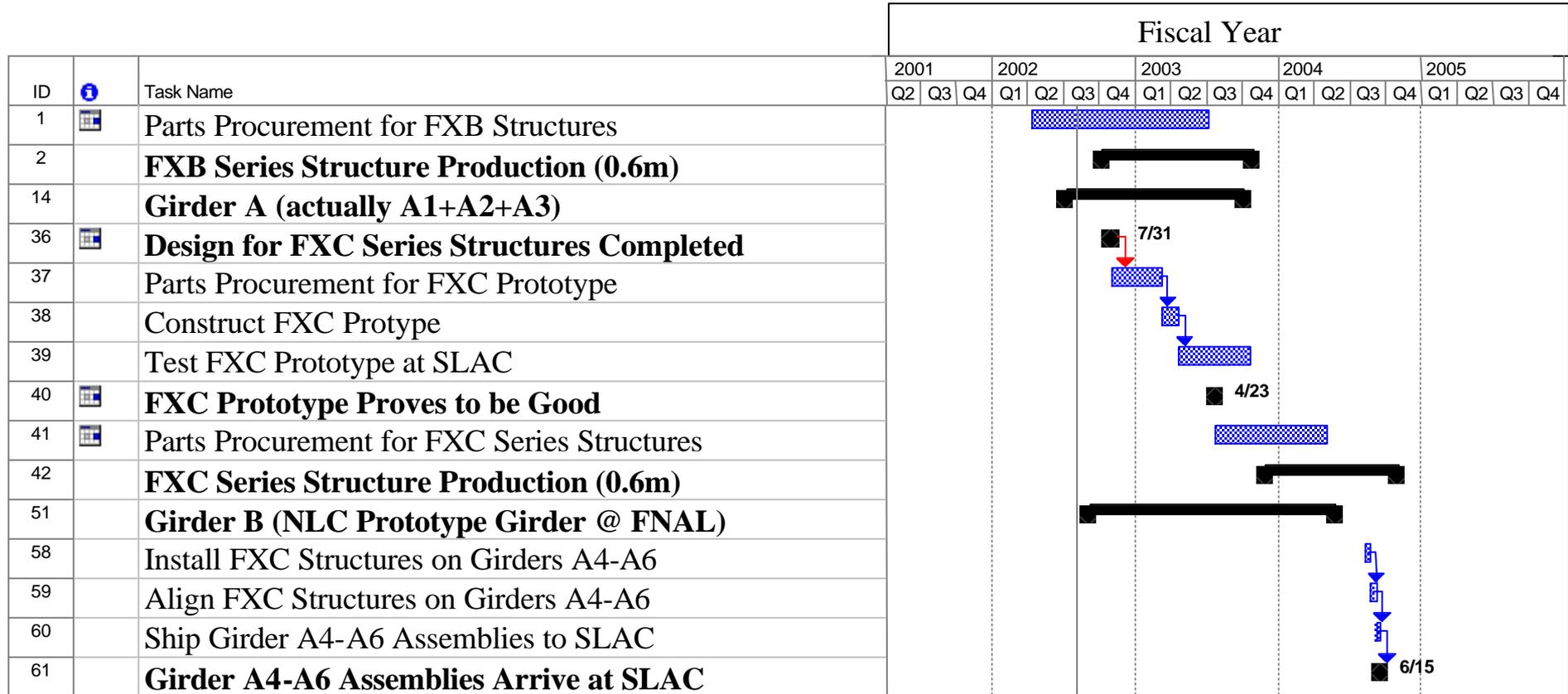


Future Plans: NLC in TD for FY03

- In FY03 (Assume flat funding, \$1.95M):
 - Build FXB-003 thru FXB-011 (Split effort with KEK?)
 - May require new coupler design --- TBD after some high power test results for FXB-001 and 002 are available.
 - Build FXC Prototype, then FXC-001 and 002 (See how many we actually have in mid to late FY03 and decide what to do in FY04 (at least 7 more FXCs required))
 - Finalize NLC girder design and construct prototype for testing (vibration, stability, etc.) at FNAL with “dummy” structures, water cooling, vacuum, waveguide connections, HLS, movers, etc.



Production Schedule





Opportunities for University Participation

- Girder Work at FNAL
 - Hardware development and testing
 - Data acquisition and analysis
 - Vibration
 - Stability
- Small Business Inovative Research (SBIRs)
 - Act as liason to companies participating in SBIR program
 - Possibly assist in technological development
 - Keep collaboration apprised of progress of project
 - Acquire final report for completed project and distribute to collaboration



Opportunities for University Participation

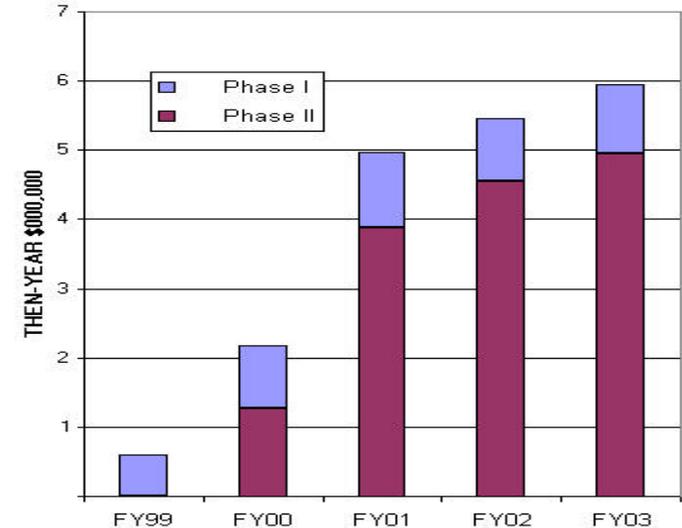
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SBIRs: 2002 Topics

Phase	Company	Topic	Project
I	Energen, Inc., Billerica, MA	LC	An Accelerator Magnet Positioning System for NLC
I	Giner Electrochemical Systems, Newton, MA	LC	Hybrid Electrochemical-Electrolytic Capacitor for Next-generation Electron-Positron Linear Collider
I	Omega-p, Inc., New Haven, CT	LC	Ferroelectric Switch for Active RF Pulse Compression for NLC
I	Surface Manufacturing Inc., Auburn, CA	LC	Precision Measurement Gage for Curved Surfaces
I	UTRON, Inc., Manassas, VA	LC	Microwave Component Fabrication Using the Fast Combustion Driven Compaction Process
I	Zmation, Inc., Portland, OR	LC	Automated Stacking of Ultra Precision Flat Parts
I	Omega-p, Inc., New Haven, CT	RF	Plasma Switch for 11.4 GHz Active SLED-II RF Pulse Compressor
I	Omega-p, Inc., New Haven, CT	RF	150 MW magnicon for the Next Linear Collider
I	Calabazas Creek Research, Saratoga, CA	RF	Development of a 50 MW Multiple Beam Klystron
I	DULY Research, Inc., Rancho Palos Verdes, CA	AC	A Polarized Electron RF Photoinjector
II	Calabazas Creek Research, Saratoga, CA	LC	Multi-Megawatt Circulator for TE01 Waveguide
II	Diversified Technology, Bedford, MA	LC	Toroidal Pulse Transformer for the Next Linear Collider
II	Energen, Inc., Billerica, MA	LC	Active Vibration Control of NLC Magnets
II	Omega-p, Inc., New Haven, CT	LC	High-Power Plasma Switch for 11.4 GHz Microwave Pulse Compressor
II	STI Optronics, Inc., Bellevue, WA	LC	Permanent Magnet Quads with Adjustable Field Strength and Centerline Movement Compensation
II	Calabazas Creek Research, Saratoga, CA	AC	Gridded Sheet Beam Electron Gun for High Power RF Applications
II	Simulation Technology & Applied Research, Mequon, WI	AC	Tau3p-Based Interactive Design Automation Software
II	SVT Associates, Eden Prairie, MN	AC	Advanced Strained-Superlattice Photocathodes for Polarized Electron Sources

**NLC-RELATED SBIR FUNDING
(LC, AC, RF and DA Topics)**





SBIRs: 2003 Suggested Topics

- **Powered metallurgy / copper plating for RF component fabrication**
- **Precision mechanical measurement device(s) for RF component fabrication**
- **Structure assembly using laser-welding techniques**
- **Development of RF QC device(s) for disk manufacturing**
- **Surface treatments for RF components and assemblies**
- **Development of techniques to do QC on copper and/or niobium material(s)**
- **Material(s) development, mechanical properties and microstructure analysis for superconducting RF cavities**
- **Development of new fabrication techniques for superconducting RF cavities**
- **Preservation of the Residual Resistance Ratio (RRR) for materials used in superconducting RF cavities**



Summary

- Delay in receipt of our large vacuum furnace has impacted our structures production schedule, but we will meet our FY02 plan.
- We are continually improving our RF testing and measurement capability in support of structure production.
- We are strengthening our structure and coupler design capability.
- Girder R&D work is in progress.
- Funding will remain a serious constraint on our (as well as the rest of the collaboration's) ability to accomplish our goals in a timely manner.
- Opportunities for university participation in girder R&D at FNAL and as liaisons to companies involved in SBIR work exist. Anyone interested?



Tour and Web Site

- I will be happy to conduct a brief tour of our IB4 structure production facility at the conclusion of this meeting.
- The pathway to our web site is:

<http://www-td.fnal.gov/lc/cv/lc.html>

This talk as well as all others given by personnel in our group are posted on the site.