Linear Collider R&D Opportunities

- My Perspective
- LC R&D Today @ Fermilab
- Some Examples
- Some Advice

My Perspective for Today

RESEARCH

OPERATION

PROJECT

My Perspective for Today

You can start anywhere to get into Accelerators*.

RESEARCH

OPERATION

PROJECT

My Perspective for Today

You can start anywhere to get into Accelerators*.

RESEARCH

OPERATION

PROJECT

*… but very few people are very good at all of these.

My Perspective for Today

You can start anywhere to get into Accelerators*.

RESEARCH

Today, LC is here.

OPERATION

PROJECT

*… but very few people are very good at all of these.

My Perspective for Today

You can start anywhere to get into Accelerators*.

RESEARCH

Today, LC is here.

You want LC to get here.

OPERATION

PROJECT

*… but very few people are very good at all of these.

My Perspective for Today

You can start anywhere to get into Accelerators*.

RESEARCH

Today, LC is here.

You want LC to get here.

OPERATION

PROJECT

Run II is an opportunity.

*… but very few people are very good at all of these.

My Perspective Last Summer

http://tdserver1.fnal.gov/Finley/DF2HEPAPSub.PDF

July 19, 2001

Dear HEPAP Sub-Panel Members:

Thirty years from now it would be good if our science will be as exciting to a twenty-five year old budding physicist as it was for me in 1972. For me, the basis for the excitement is the opportunity to explore the answers to simple sounding questions like:

"What is it all made of?" and "How does it all interact?"

A large part of the excitement is based on the opportunity to actually get at parts of the answers in a time period of three or four years, as appropriate for a student or a junior scientist. And part of the excitement is knowing you are a member of a group that is the best there is, you are making a significant contribution, and you are getting better.

The best physicists have a perspective on science that is broadly rather than narrowly defined. And this is one way our science is able to progress, and why it continues to be exciting. In particular, the two fundamental questions in the first paragraph have spawned other derivative questions when measurements and observations are combined with theories of how it could be. These include:

My Perspective Last Summer

http://tdserver1.fnal.gov/Finley/DF2HEPAPSub.PDF

Meanwhile, our science has come to the point where we are accustomed to contemplating decade-or-more long projects to take the next significant steps. And the resulting facilities will likely be operated and improved for an even longer time. Projects and operations are necessarily focused on rather specific missions, and they rarely offer opportunities for fundamental or exploratory research unrelated to development or improvements. My oral presentation earlier this week to the sub-panel on the A0 Photoinjector described one opportunity, a successful opportunity if one considers the number of PhD students it has recently graduated: four PhD students in about as many years. There are other opportunities, of course, but not many.

My Perspective Last Summer

http://tdserver1.fnal.gov/Finley/DF2HEPAPSub.PDF

In my experience, the resources required for fundamental beam physics research require vigilant and benevolent protection by managers with enough clout to do so. When push comes to shove – whether from above or below - in conflicts between research and projects or operations, research will nearly always lose out. This is often the appropriate and responsible behavior for the short term, but can also be unwise in the long term. One needs a balanced mix of the three if we are to make progress efficiently.

This is the basic point I want to make to the sub-panel: The opportunities for people to enter into our science and to progress in their careers must be nourished, and a balance of accelerator physics research, projects and operations should be supported and encouraged. Then the excitement and progress will likely continue.

Respectfully,
David Finley / Fermilab

Linear Collider R&D Opportunities

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- Some Advice

Two Months Ago

January 30, 2002

To: David Finley

From: Mike Witherell

Subject: Linear Collider R&D Coordination

I would like to ask you to assume the role of Linear Collider R&D Coordinator for Fermilab. In this role you will assume overall responsibility for leadership of the linear collider R&D effort at Fermilab. This includes providing management and technical direction for a program aimed at developing a cost effective approach to an electron–positron linear collider over the next several years, and for coordinating the Fermilab effort within both the U.S. NLC and TESLA Collaborations. These responsibilities will specifically include establishing R&D goals and a scope of work, establishing resource and funding plans, and coordinating execution of and reporting against these plans. These R&D goals should include carrying out the X-band RF work, and expanding our effort on superconducting RF.

Because this involves work spanning both the Beams and the Technical Divisions you will report directly to Steve Holmes in your capacity as Linear Collider R&D Coordinator while remaining assigned to the Technical Division where you have successfully established the X-band program. Both Steve and I look forward to working with you to achieve success in these endeavors. This appointment will be effective on February 1, 2002.

Last Monday (1 of 3)

Subject: April Fools Day LC Cafe Agenda
Date: Sat, 30 Mar 2002 17:43:04 -0600
From: David Finley <finley@fnal.gov>
To: David Finley <finley@fnal.gov>, Court Bohn <clbohn@fnal.gov>, Tom Dombeck <tdombeck@fnal.gov>, Steve Holmes <holmes@fnal.gov>, Mike Syphers <syphers@fnal.gov>, Ralph Pasquinelli <pasquin@fnal.gov>, Paul Czarapata <pcceed@fnal.gov>, Victor R Kuchler <kuchler@fnal.gov>, Peter H Garbincius <garbincius@fnal.gov>, Harry Carter <hfcarter@fnal.gov>

Hi, LC Cafe Mates: Yes, we will meet Monday Apirl 1 in the HiRise Cafeteria. (And No Foolin'.)

The agenda I have in mind at the moment is:

Hi, Mike and Peter and Steve, welcome back.

Big Furnace, Big Trouble.

XBand powerstation
Ian Wilson. CLIC.
Phase II SBIR test of the XBand PC rf gun.
Burke says we can have one klystron any time.

<<< NLC etc

Eight Pack Test
DLDS
Phase II.

TDR report
Final draft sent to authors last week.

<<< TESLA

Last Monday (2 of 3)

KEK visitors
Francois and Higo had a good meeting and the code will likely move to KEK now as well.

<<< KEK

Beam Physics
Mike: Nikolay Solyak is about 20% on TEL for Run II. Since Paul LeBrun is 100% on Run II until about June, I've told Nikolay and Francois that I don't expect much on LC R&D Beam Physics until Run II works.

<<< Run II

srf
3.9 GHz powerstation
HFSS license

Pi3
Jerry Blazey and Court Bohn

April 5 :LC R&D Opportunities for Universities
http://fms.physics.uiuc.edu/conferences/linearcollider/html_files/main.htm

<<< You today

The following Fermilab people have agreed to be contacts on various R&D items
Bohn, Volk, Bernstein, Shiltsev, Carcagno, Carter

Fermilab is involved in many aspects of LC R&D.

Necessary today for an informed LC decision.

Last Monday (3 of 3)

Run II

I will be spending some time on Run II. Thus, Fermilab LC R&D will once again be without a full time leader. I have cancelled my participation in the PAC03 meetings in Albuquerque. Also, Steve has pulled out of the April 5 talk (and any May 10 participation). Run II has reached crisis status. We have to fix that broken thing so that I can get back full time on LC R&D, and so that Steve can get back on it also.

FYI: Upcoming LC events
April 5: Linac2002 abstract deadline
April 5: Workshop on LC R&D Opportunities
April 19: University LC Consortium / Cornell
April 20-23: APS / Albuquerque
May 7-8: NLC Collaboration Meeting
May 9-11: NLC MAC Meeting

AOB?

Now you can start your April Fools Day with traditional behavior.

Cheers. Dave.

My Perspective Last Summer … déjà vu

http://tdserver1.fnal.gov/Finley/DF2HEPAPSub.PDF

In my experience, the resources required for fundamental beam physics research require vigilant and benevolent protection by managers with enough clout to do so. When push comes to shove – whether from above or below - in conflicts between research and projects or operations, research will nearly always lose out. This is often the appropriate and responsible behavior for the short term, but can also be unwise in the long term. One needs a balanced mix of the three if we are to make progress efficiently.

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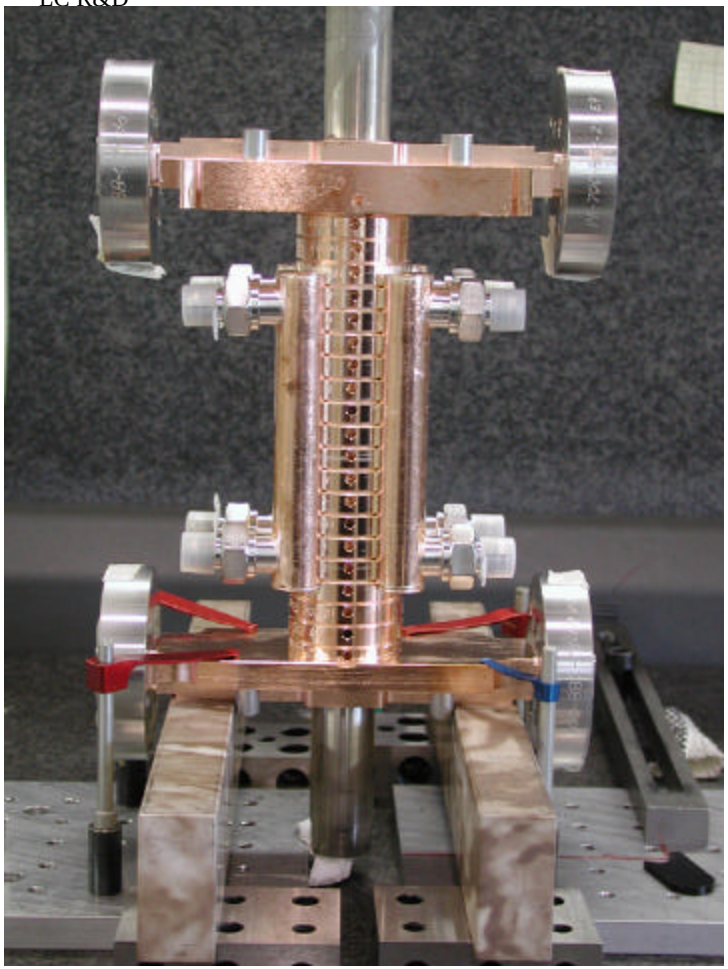
Respectfully,
David Finley / Fermilab

Fermilab has made two X-Band structures.



FXA-001 Setup for Mechanical QC at Fermilab Technical Division, 08/01/01

- They are about 20 cm long.
- They are named FXA-001,and FXA-002.
- FXA-001 took about a year.
- FXA-002 took about a month.

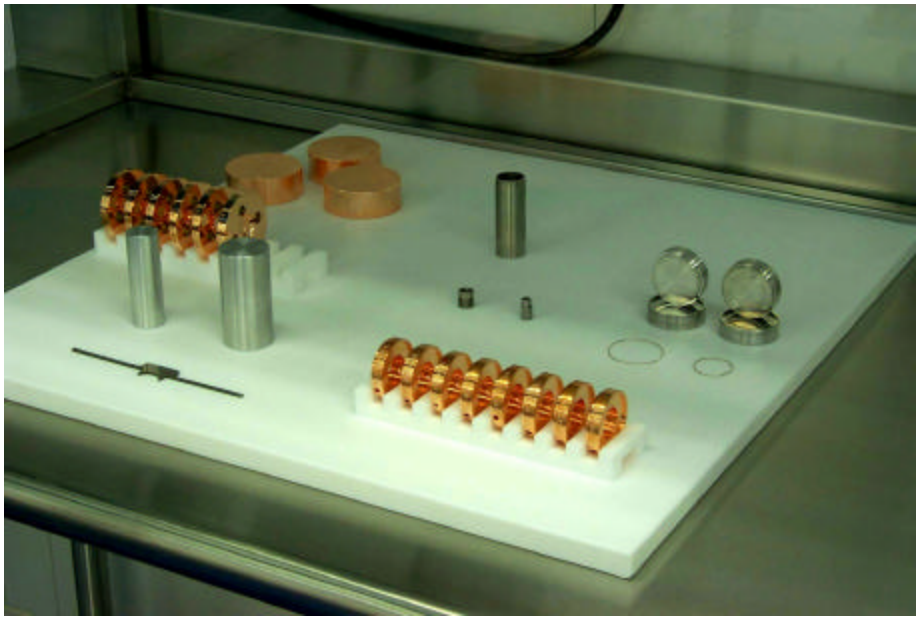
Copper Material and Some Copper Parts (Tug Arkan, SLAC, KEK, Gregg Kobliska & Co.)

LC R&D

9 copper bars ~10 feet long each.

Ordered enough bars for ~10K disks (~100 meters total).

Parts machined in US industries.



Have made both RDDS diamond turned disks, and conventional machined high gradient test disks.

ETF needed ~5K disks.

Eight Pack Test needs ~1K disks.

NLC needs ~1M disks (for 500 GeV center of mass.)

NICADD Furnaces

(Jerry Blazey, Steve Holmes, Tug Arkan, Gregg Kobliska & Co.)

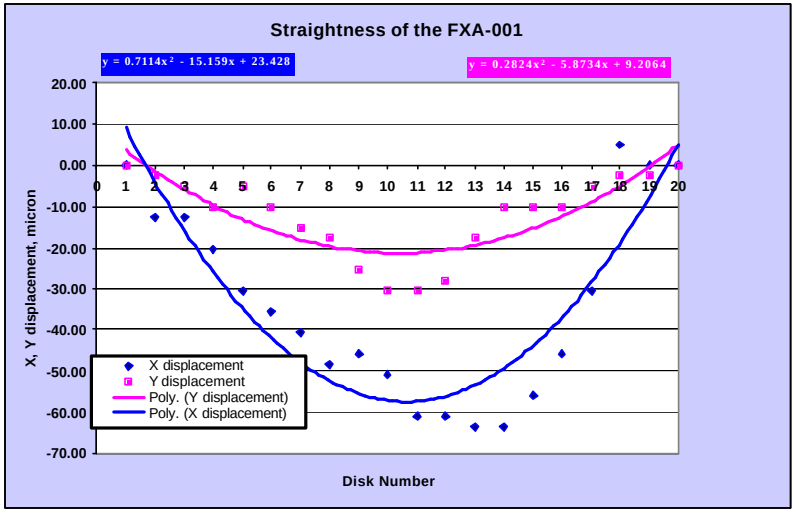
LC R&D

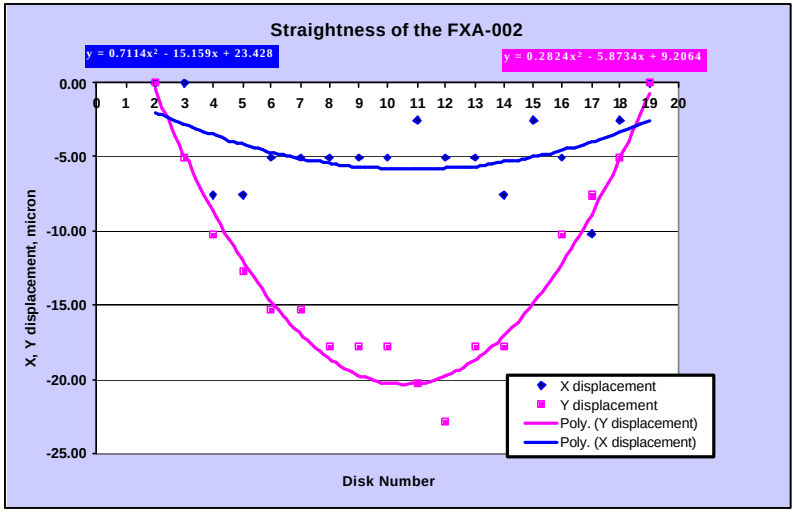
- The small furnace in place in IB4.

- Will be for bonding and brazing studies.
- Will be used to make X-Band sub-assemblies.
- Will likely also be used for electron cooling and maybe scrf.
- Need full sized furnace for final X-Band assemblies. (March 2002.)

Straightness of FXA's

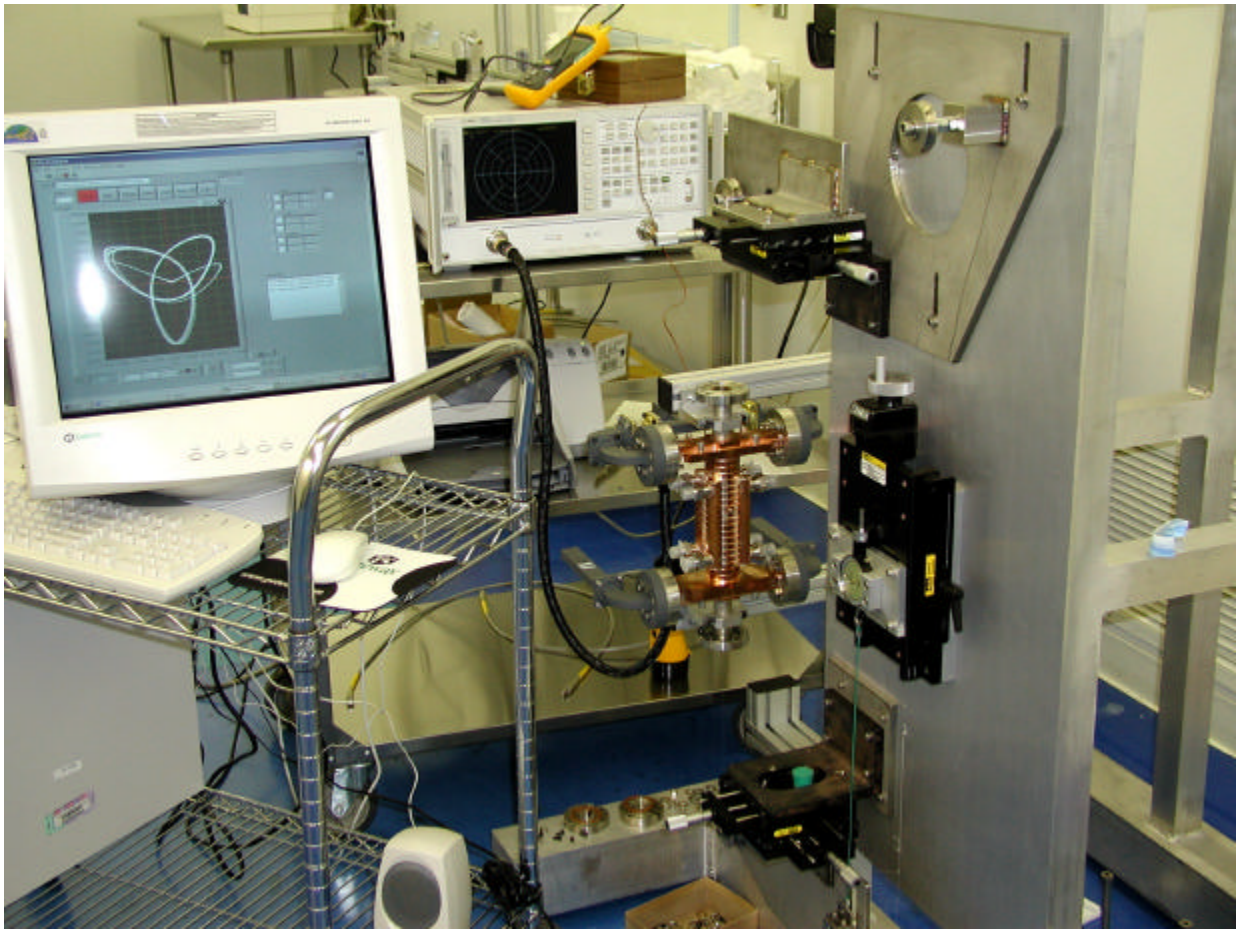
- FXA-001 has bow of about 60 microns. (Need about 10 microns for NLC Main Linac.)
- FXA-002 has bow of about 20 microns (which is consistent with the V-block used to align it.)





RF Measurements on FXA-001

- Bead pull setup in RF Factory Clean Room A.

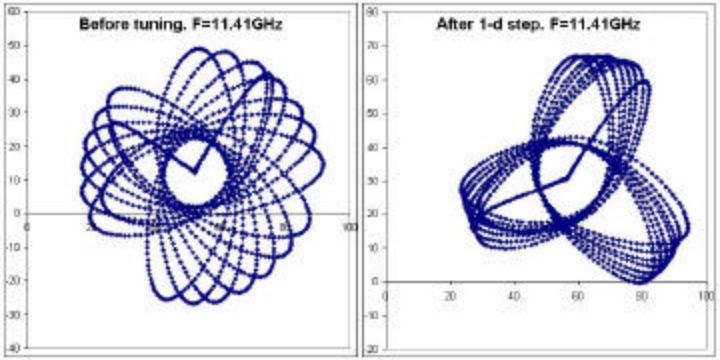


- Note network analyzer (from Beams Division), bead pull support, pulley, data on computer screen, and FXA-001.

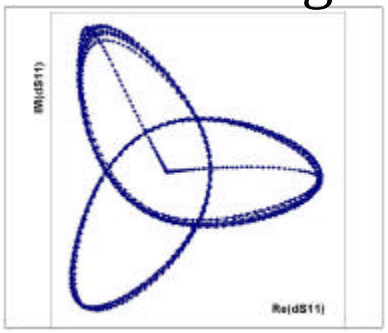
FXA-001 RF Measurements

The bead pull takes about two minutes and is used to tune the structure.

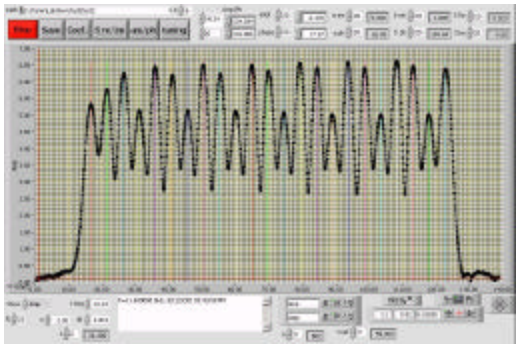
Before, during tuning



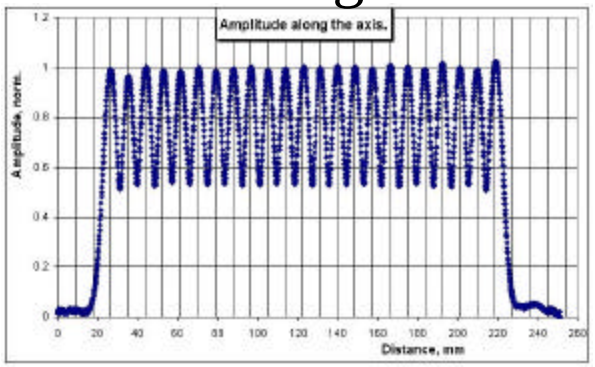
After tuning



Before tuning

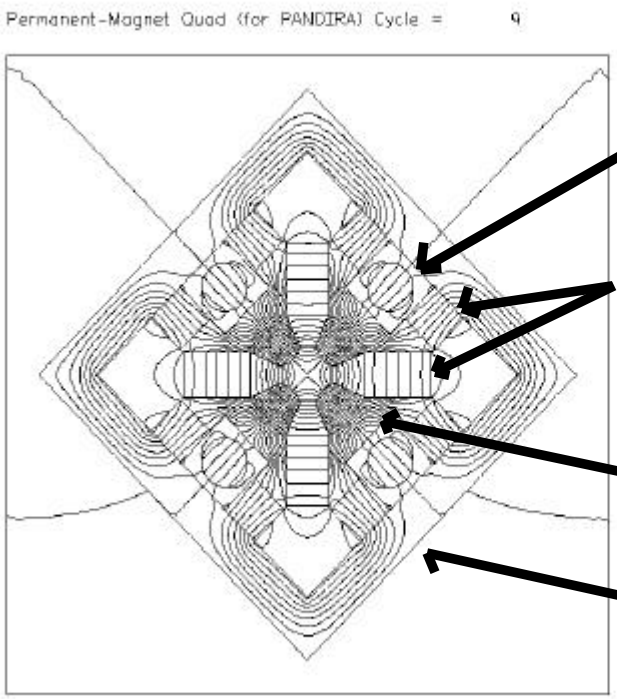


After tuning



NLC Permanent Magnet Research

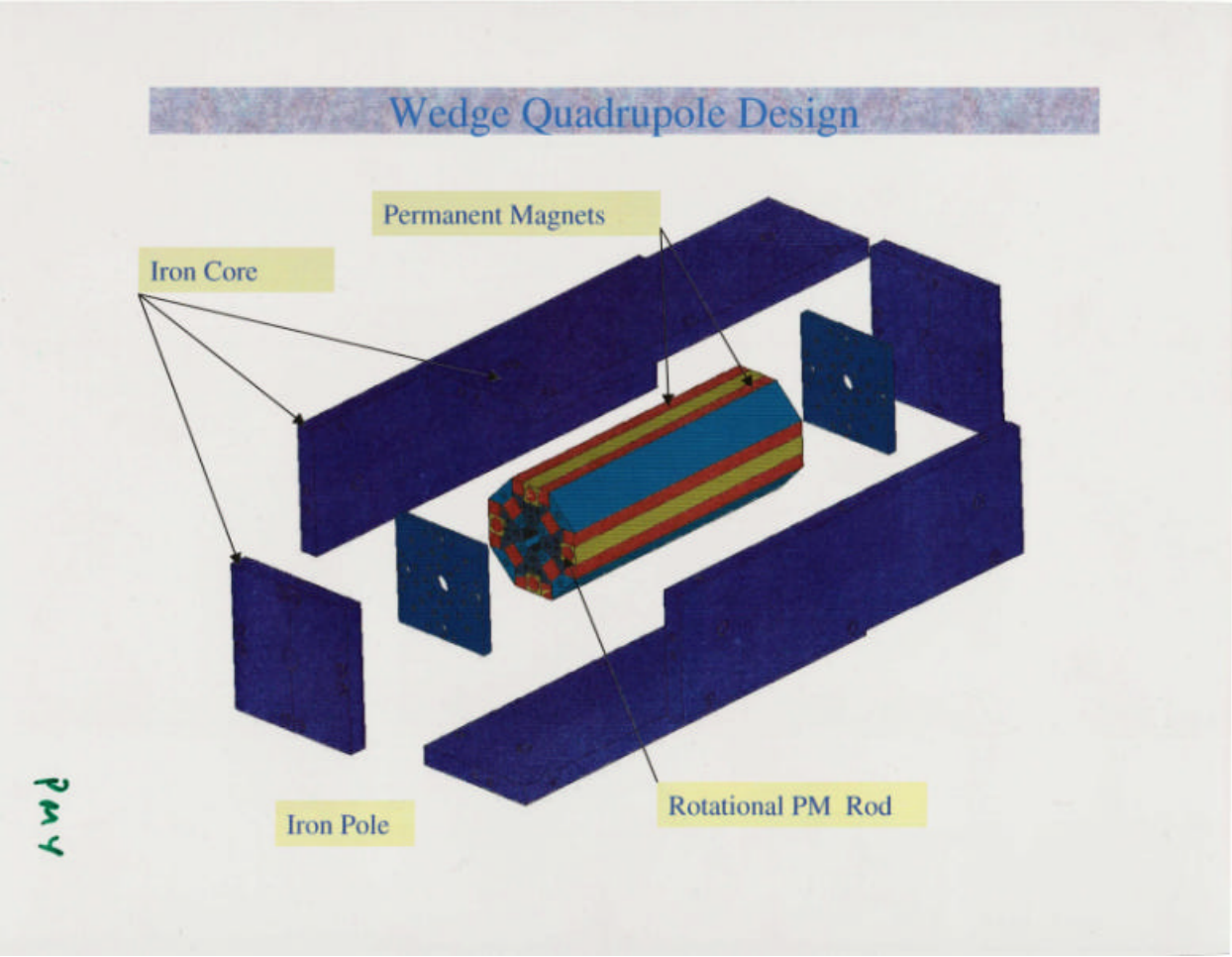
Concept



Courtesy J. Volk et al, PAC01 Chicago

NLC Permanent Magnet Research

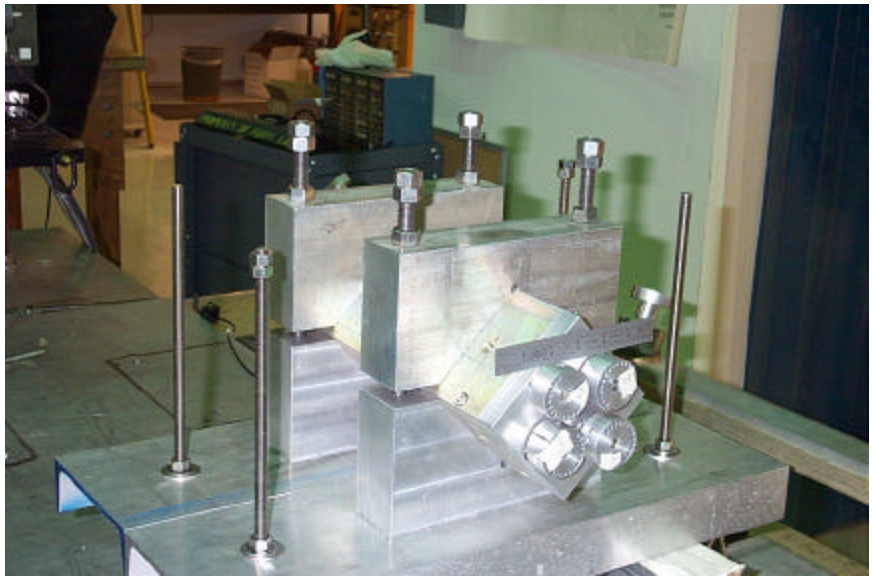
Design

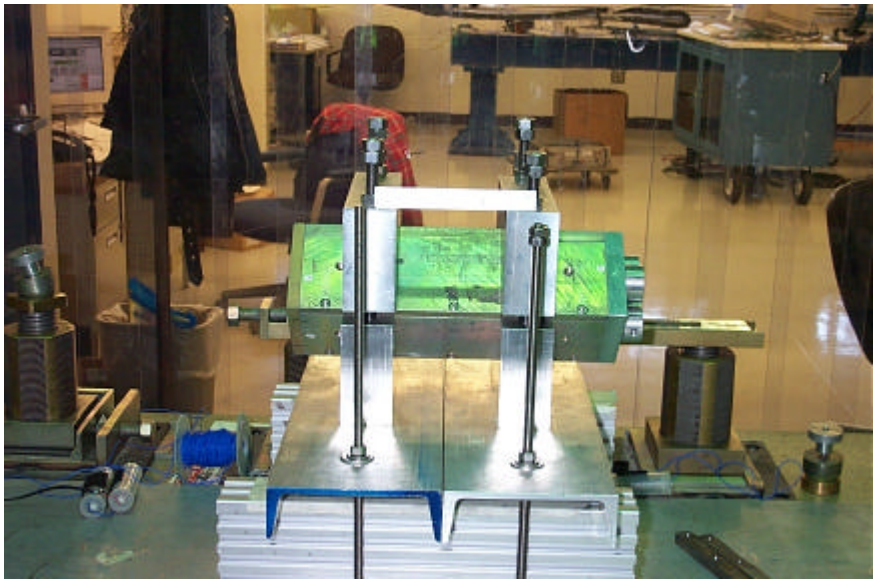


Courtesy J. Volk

NLC Permanent Magnet Research

Reality





NLC Permanent Magnet Research

Measure the fields

Courtesy J. Volk

Think.

Realize temperature control is important.

NLC Permanent Magnet Research

Measure the fields while controlling the temperature …

Control the Temperature …

Think.

Modify the design … etc etc

Courtesy J. Volk

Engineering Teams (as of October 4, 2001) (From Finley's Talk to NLC MAC)

For X-Band (NLC)

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

For LC (TESLA and NLC)

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

A Growing List

• Yes, there are names of people associated with each team and they are NOT all from Fermilab in most cases … because the world's best expertise in all these areas does not yet reside at Fermilab.

Linear Collider R&D Opportunities

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A Few Fermilab Related Examples From "The List" Plus

- My filter for "The List"
  - (Marc Ross will cover instrumentation.)
  - Do more than one option
  - Pick on Fermilab contacts <<< These are the names in RED

- Permanent magnets (see previous slides also)
- Lorentz force compensation in srf cavities
- Vibration control on girders with water flowing
- Ground vibration measurements
- Alignment
- Better vacuum for rf guns
- Electro-optic beam diagnostics (I can't resist)
- Plus: 800 MHz @ Fermilab Lab G.

A Few Fermilab Related Examples From "The List" Plus

- Permanent magnets (see previous slides also)

ID	*short project description*
82	Measure quadrupole field center to 1 micron

Detailed project description

Measure the center of a quadrupole field with a stability of better than 1 micron over a period of several minutes.

This will be used to test whether the center moves as the field is varied.

Priority	*project size*	*skill type*	*Needed by date*
Mediumn-High	Medium	all	
Needed by who	***present status***	***contact person***	
NLC	Prototype done	Jim Volk, Cheryll Spencer	

ID	*short project description*
83	Permanent magnet quadrupole

Detailed project description

Prototype a permanent quadrupole whose field can vary by 20% while the center of the field moves by less than 1 micron.

Priority	*project size*	*skill type*	*Needed by date*
High	Medium	all	
Needed by who	***present status***	***contact person***	
NLC	In progress, help needed	Jim Volk	

A Few Fermilab Related Examples From "The List" Plus

- Lorentz force compensation in srf cavities

ID	*short project description*
81	Dynamic tuners for superconducting cavities, e.g. piezoelectric tuners

Detailed project description

Lorentz forces distort the shape of the superconducting RF cavities causing their resonant frequency to change. This must be corrected by applying a force which varies during the 6 ms RF pulse in order to stabilize the resonant frequency.

Priority	*project size*	*skill type* *Needed by date*
Mediumn-High	Large	Mechnical/cryo
Needed by who	***present status***	***contact person***
TESLA	In progress, help needed	Ruben Cargagno

A Few Fermilab Related Examples From "The List" Plus

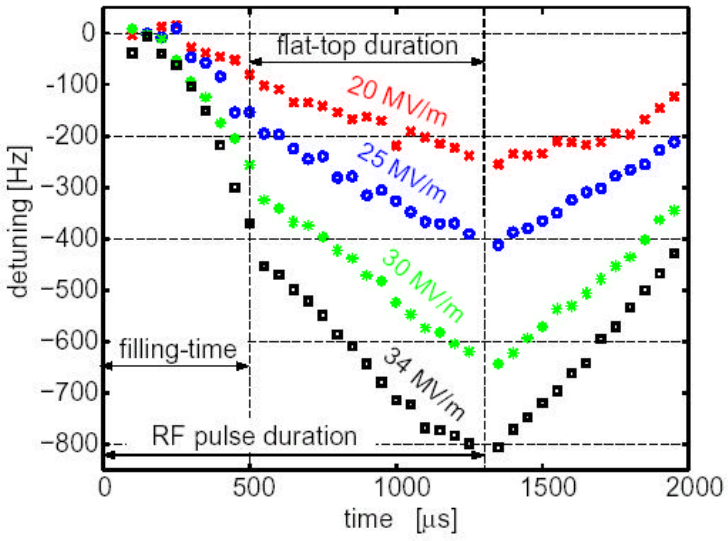
Superconducting RF Controls The Piezoelectric Tuner

- Small (~ μm) mechanical deformations of superconducting RF cavities cause unwanted shifts of the resonance frequency (~ hundreds of Hz)
- Maintaining the accelerating field constant in a detuned structure requires extra RF power. For high-gradient cavities, the extra power is significant.
- The major source of mechanical deformations are:
  - For pulsed cavities, the time-varying Lorentz forces of the RF field
  - For continuous operation, external mechanical vibrations (e.g., from pumps) modulate the resonance frequency of the cavity (microphonics)

A Few Fermilab Related Examples From "The List" Plus

Superconducting RF Controls
The Piezoelectric Tuner

Lorentz Force detuning example



Measured Lorentz-force detuning during pulsed operation of a TESLA 9-cell cavity with different flat-top accelerating gradients.

Microphonics spectrum example

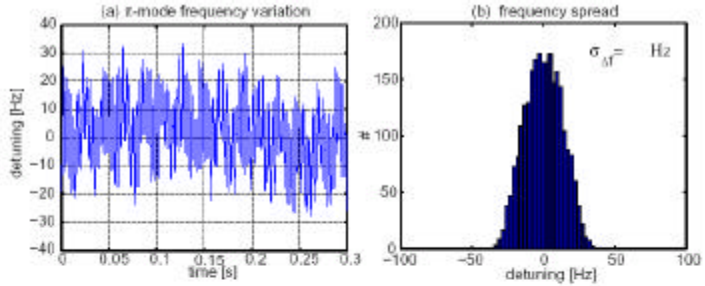


Figure 2.3: Variation of the π-mode frequency in a TESLA 9-cell cavity, which is operated in cw-mode in a test-cryostat. (a) Variation due to microphonics as function of time. (b) Resonance frequency spread.

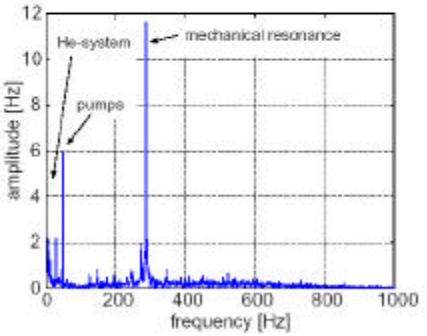


Figure 2.4: Spectrum of the frequency variation due to microphonics, which is shown in figure 2.3.

A Few Fermilab Related Examples From "The List" Plus

Superconducting RF Controls
The Piezoelectric Tuner

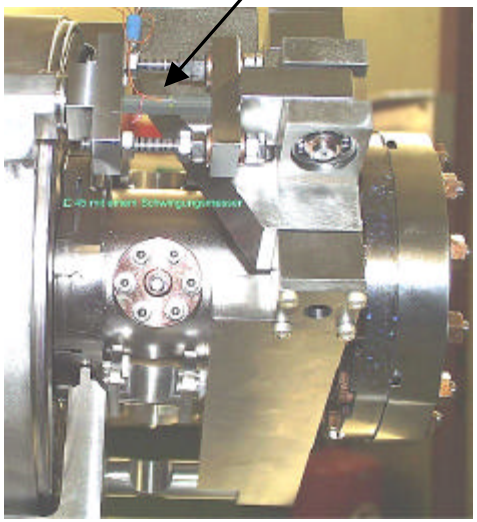
- A fast active control strategy to compensate the Lorentz-force and microphonics detuning has been proposed.
- A fast actuator is needed to actively change the length of the cavity to maintain the resonance frequency constant (<< 1 bandwidth)
- Piezoelectric actuators have been used for this application in prototype cavities for proof of principle experiments.
- Opportunities for R&D in this area include:
  - Development of adaptive feedforward control algorithms
  - Mechanical integration of piezotranslators into a cold tuner
  - Reliability studies of piezotranslators (long term operation at 2K, radiation hardness)
  - Performance limitations and identification of other fast actuators and vibration sensors for this application

A Few Fermilab Related Examples From "The List" Plus

Superconducting RF Controls
The Piezoelectric Tuner

Proof of Principle (M. Liepe et al., Hamburg, Germany)

Piezo actuator



Desy Tuner Prototype

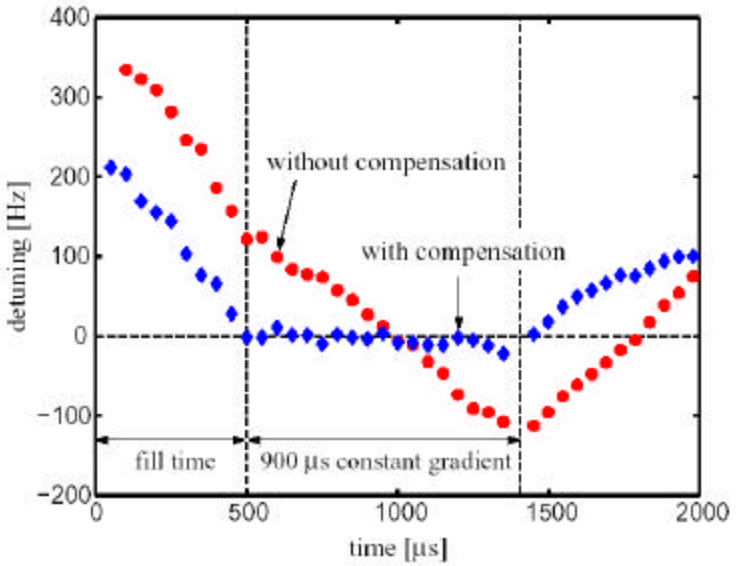


Figure 3.5: Compensation of the Lorentz-force induced frequency shift during the flat-top in pulsed mode cavity operation. Shown is the frequency detuning of the accelerating mode with and without compensation by the piezoelectric tuner. The accelerating flat-top gradient in the TESLA 9-cell cavity is 23.5 MV/m. The pulse structure is shown in figure 2.1.

A Few Fermilab Related Examples From "The List" Plus

- Vibration control on girders with water flowing

ID	*short project description*
35	Linac accelerator structure cooling without vibration

Detailed project description

Major decisions rest on what we do here. The quads which are near the accelerator structure must vibrate less than 10 nm. The structure vibration should be kept not too much more than that as they will be somewhat coupled. The structure must be kept at a constant (within 0.25 degree C) temperature. When the RF is on, about 6 kW per meter of power is dissipated. When the RF is off, no power is dissipated. Turbulent motion of the coolant may cause vibration. How much? Distribution of cooling water is easier (less volume to pump around) if the termperature increase is large. However, a large temperature increase could cause temperature differentials and deformation of the sturcture.

Will regular water work with correct flow rate and a path which goes forward and backwards on the sturcture? Could we use heat pipes?

Priority	*project size*	*skill type*	*Needed by date*
High	Large	Mechnical	6/1/03

Needed by who	*present status*	*contact person*
NLC	unsolved problem	Andrei Seryi, Tom Himel, Harry Carter

A Few Fermilab Related Examples From "The List" Plus

- Ground vibration measurements

ID	*short project description*
55	ground motion studies vs depth

Detailed project description

Ground motion causing the magnets to vibrate can be a problem for both NLC and TESLA. Much has been studied already, but more tests are still needed. In particular knowing how the ground motion varies with depth will help in the decision on how deep the tunnel should be.

Priority	*project size*	*skill type*	*Needed by date*
Mediumn-High	Medium	all	1/1/04

Needed by who	*present status*	*contact person*
NLC and TESLA	In progress, help needed	Andrei Seryi, Vladimir Shiltsev

A Few Fermilab Related Examples From "The List" Plus

- Alignment

ID	*short project description*		
27	conventional alignment plan		
Detailed project description			
Develop an accurate, efficient way to place the components in the tunnel with an accuracy of 100 microns.			
Priority	***project size***	***skill type***	***Needed by date***
Medium	Medium	alignment	6/1/05
Needed by who	***present status***	***contact person***	
NLC and TESLA	Conceptual design	Robert Ruland, Bob Bernstein	

A Few Fermilab Related Examples From "The List" Plus

- Better vacuum for rf guns

ID	*short project description*
72	Obtain vacuum of 1e-12 Torr for polarized RF gun

Detailed project description

Presently polarized electrons are presently made from a diode photo-injector. There is a DC field on the photo-cathode. Higher quality beams can be produced with an RF gun. Unfortunately, the delicate high polarization photo-cathodes are destroyed by the gas in the RF gun. It is believed that achieving a vacuum of 1e-12 Torr in the gun would cure this problem.

Priority	*project size*	*skill type*	*Needed by date*
Medium	Medium	vacuum	1/1/05

Needed by who	*present status*	*contact person*
NLC and TESLA		

A Few Fermilab Related Examples From "The List" Plus

- Electro-optic beam diagnostics (I can't resist)

ID	short project description
73	electro-optic beam diagnostics

Detailed project description

When you pass a beam through an electro-optic material (like a pockles cell is made from) and then pass a laser through the material you can effectively measure the electric fields caused by the beam as it went through. This could be used to experimentally measure wakefields.

A first prototype of this has been successfully tested at DESY.

Priority	project size	skill type	Needed by date
Low	Small	physicist	1/1/07

Needed by who	present status	contact person	
generic accelerator	In progress, help needed	Kai Wittenburg (DESY),	Court Bohn

A Few Fermilab Related Examples From "The List" Plus

- Slip in Kickers (again I can't resist.)

ID	*short project description*
80	Very fast kickers

Detailed project description

A kicker for damping ring beam injection and extraction is needed.. For TESLA it needs to have a rise and fall time of less than 10 ns and a flat-top of 1 ns. Faster rise and fall times would allow the TESLA damping ring to shrink

For NLC the rise and fall times are not very critical, but it needs a flat top of 300 ns.

Priority	*project size*	*skill type*	*Needed by date*
Medium	Large	all	
Needed by who		***present status***	***contact person***
NLC and TESLA			Dan Wolff (who may not know this yet)

LC R&D

A Few Fermilab Related Examples From "The List" Plus

ID	*short project description*
62	Dark current and its relation to breakdown

Detailed project description

Understand the mechanism of dark current in accelerator structures and how processing effects it.

It is needed for NLC and TESLA, but the requirements are different for the two.

Priority	*project size*	*skill type*	*Needed by date*
Medium	Medium	physicist	1/1/04

Needed by who	*present status*	*contact person*
NLC and TESLA	Conceptual design	C. Adolphsen

- The List Plus: 800 MHz @ Fermilab Lab G.

Also contact Steve Geer … see next 3 slides

800 MHz @ Fermilab Lab G.

ID short project description

63 Solid state physics associated with breakdown

Detailed project description

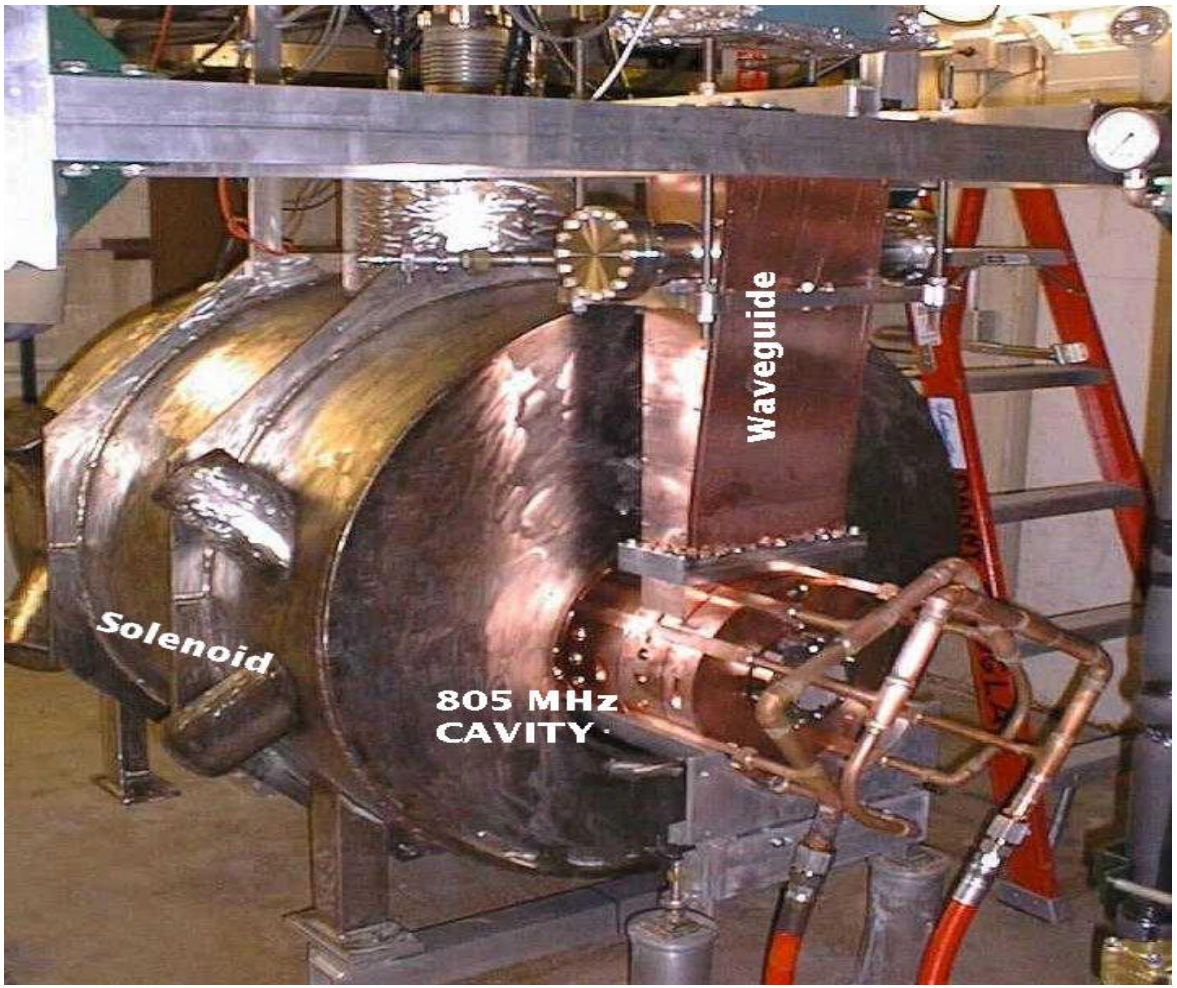
An understanding of this may help us get to higher gradient.

Surface contamination. Sub surface contamination, gas evolution from grain boundaries, surface defects etc are possible causes.

Priority	***project size skill type***	***Needed by date***
Needed by who	***present status***	***contact person*** M. Ross, Perry Wilson

Again also contact Steve Geer … see next 2 slides

We have an 805 MHz Cavity Test Facility at Fermilab



Located at Lab G

12 MW klystron

Linac-type modulator & controls

X-Ray cavern

5T two-coil SC Solenoid

Dark-current & X-Ray instrumentation

805 MHz R&D Program

Right Now:
We are testing the 2nd of two cavities at high gradient, and studying breakdown, x-rays & dark current production as a function of peak surface field. We are also studying what happens in a magnetic field (up to ~4T).

Future Plans:
We plan to investigate dark current, x-rays, and breakdown as a function of the surface preparation of the cavity.

If you are interested:
Contact Steve Geer (sgeer@fnal.gov)

Dark current damage to the cavity end-plate in a 4T magnetic field

Linear Collider R&D Opportunities

- My Perspective
- LC R&D Today @ Fermilab
- Some Examples
- Some Advice

Have You Considered SBIR's?

From: "Peters, Jerry" <Jerry.Peters@science.doe.gov
To: Lots of people
Sent: Thursday, March 28, 2002 3:17 PM
Subject: FY 2003 Call for Topics Notice on SBIR/STTR

Subject: SBIR FY 2003 Call for Topics Notice

Dear Colleague,

About $15M per year goes into the Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Program and out into grants in competition under the annual solicitation. We need your help in getting the money into projects of value to high energy physics.

The FY 2003 Solicitation schedule has moved way up. We need input for editing in April. Please see below for the reason, and see the DOE SBIR web site with the current FY2002 Technical Topics at

http://sbir.er.doe.gov/sbir.

The present High Energy Physics Technical Topics from which we start for
next year follow.

The numbers change each year, but last year we had
20 Advanced Concepts and Technology for High Energy Accelerators
21 Radio Frequency Accelerator Technology for High Energy Accelerators and Colliders
22 High-Field Superconductor and Superconducting Magnet Technologies for High Energy Particle Colliders
23 Technologies for the Next-Generation Electron-Positron Linear Collider
24 High Energy Physics Detectors, and
25 High Energy Physics Data Acquisition and Processing.

Several SBIR's Do LC R&D Today

Examples From http://sbir.er.doe.gov/sbir

TOPIC: ADVANCED CONCEPTS AND TECHNOLOGY FOR HIGH ENERGY ACCELERATORS

Advanced Energy Systems, Inc. 27 Industrial Building Unit E Medford, NY 11763	Axisymmetric, Emittance-Compensated Electron Gun
Haimson Research Corporation 3350 Scott Boulevard Building 60 Santa Clara, CA 95054-3104	A Microwave Beam Monitoring System for Direct Measurement of Ultra Short Electron Bunches
World Physics Technologies, Inc. 1105 Highland Circle Blacksburg, VA 24060-5618	A New Permanent Magnet Design System

Several SBIR's Do LC R&D Today

Examples From http://sbir.er.doe.gov/sbir

TOPIC: RADIO FREQUENCY ACCELERATOR TECHNOLOGY FOR HIGH ENERGY ACCELERATORS AND COLLIDERS

Alameda Applied Sciences Corporation 2235 Polvorosa Avenue Suite 230 San Leandro, CA 94577-2249	Solid State RF PC Pulse Compression for High Power Microwave Generation
Duly Research, Inc. 1912 MacArthur Street Rancho Palos Verdes, CA 90275	A High-Power, Ceramic, RF Generator and Extractor
Omega-P, Inc. 202008 Yale Station Suite 100 New Haven, CT 06520	Quasi-Optical 34 GHZ RF Pulse Compressor

Several SBIR's Do LC R&D Today

Examples From http://sbir.er.doe.gov/sbir

TOPIC: TECHNOLOGIES FOR THE NEXT-GENERATION ELECTRON POSITRON COLLIDER

Energen, Inc. 17 D Sterling Road Billerica, MA 01862-2518	Active Vibration Control of NLC Magnets
Omega-P, Inc. 202008 Yale Station Suite 100 New Haven, CT 06520	High-Power Plasma Switch for 11.4 GHZ Microwave Pulse Compressor
STI Optronics, Inc. 2755 Northup Way Bellvue, WA 98004-1403	Permanent Magnet Quadrupoles with Adjustable Field Strength and Centerline Movement Compensation

Have You Considered SBIR's?

Example From http://sbir.er.doe.gov/sbir

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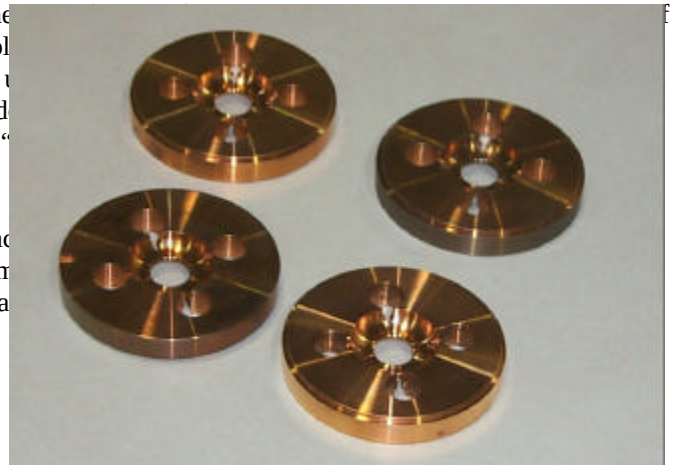
Automated Handling of Ultra Precision Parts--Zmation, Inc., 14811 N.E. Airport Way, Suite 200, Portland, OR 97230; 503-253-8871
Mr. John J. Lee, Jr., Principal Investigator, johnlee@zmation.com
Mr. Craig D. Howard, Business Official, craigDhoward@zmation.com
DOE Grant No. DE-FG03-00ER83131
Amount: $330,000

Accelerator cells for the Next Linear Collider come in families of 200 different, but similar looking parts with tolerances varying from.5 to 50 microns. A total of 2,000,000 cells or 10,000 of each type need to be manufactured. Speed and repeatability associated with automated part handling is essential, and the automated robotic systems must be capable of comparable accuracy and precision. Some device or technique is also required for storing, transporting, and maintaining the pedigree of each part. This project will design and build an automated cart and pallets for the transport and inventory of accelerator cells while maintaining their pedigree between the various manufacturing processes. A vision guided robot will also be designed for transferring the accelerator cells between the carts, pallets, the precision machining center, and the diamond turning machine handling the soft copper accelerator cells and difficulties associated with the accurate pick and pl vision guided robotic system was built for loading and unloading a pallet of accelerator cells for u cart" will be built to transport and inventory a family of 200 accelerator cells that have been load The Phase I robot will be retrofitted to load and unload the precision machining center from the " automated diamond turning machining.



Commercial Applications and Other Benefits as described by awardee: The type of precision mac automotive, aerospace, telecommunication, micro-photonic, and electro-optic industries. Custom diamond turning machine should be candidates to purchase the automated part loading and unloa

The NLC needs a million of these to get to 500 GeV E_{CM}

Summary

- Get involved anywhere: Research / Projects / Operations
- Fermilab is an up an coming player in LC R&D.
- You can hook up with people here, there, everywhere.
- Consider funding sources other than the usual ones.

The End.