

## Fermilab LHC Project (1998-2007)

In TD-ICB Jim Strait, Jim Kerby, Bob Kephart, and Ray Orback Examining the LHC IR Quad Superconductor Cable Sample  
(May 06, 2004)



# The LHC IR Quads Production Team In TD-ICB with Dr. Orback (May 06, 2004)



# Toasting the successful test of the LHC IRQ cryostat repair

Retrofit installed and ready for test

June 22,  
2007



Test results at full pressure



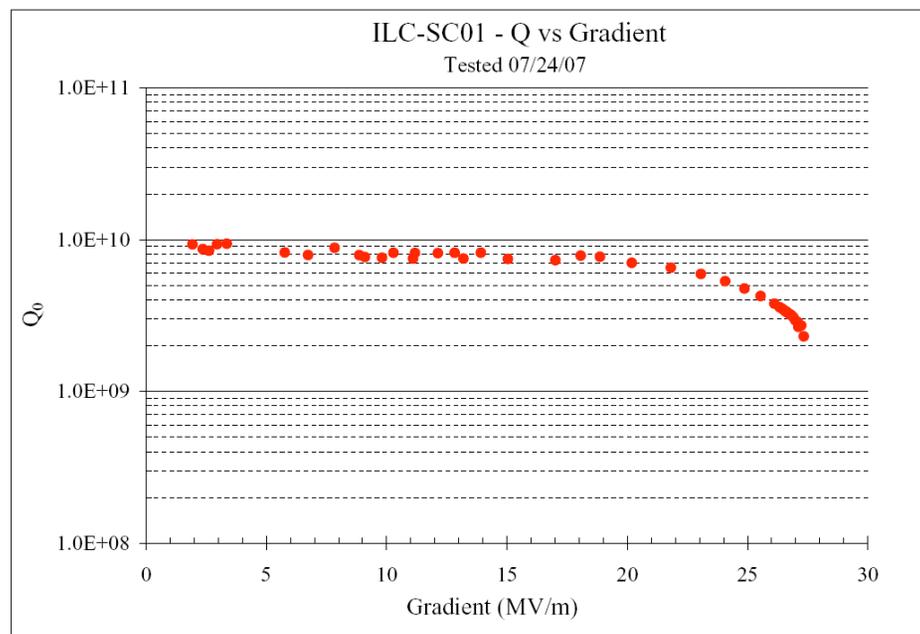


TD-IB1 ILC Cavity  
Vertical Test Stand;  
Construction Completion,  
Test, and Full Operational  
Readiness Clearance  
(July 2007)





First Cavity  
Test Result  
on July 24,  
2007



## Major Contributors to the Acid Etching Facility in the MDTL (2006-2007)



Rich  
Ruthe



Dave  
Burk



Jamie  
Blowers



Gary  
Lorenz



Romesh  
Sood



With Major Contributions from Dave Baird, Tim Miller, Allan Rowe, ES&H, The Medical Group, FESS, Fermilab Fire Department, Shipping –Receiving, and the TD Material Control Dept.

Charlie Cooper, Donna Hicks, Giorgio Apollinari

# New Chemical Etching Facility for SRF Cavity Processing (Operational, April 06, 2007)



Safety Shower – Auto Calls Fire Depart. if Used

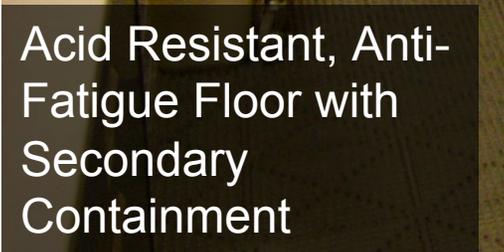


Acid Resistant  
Flame Retardant  
Clear Lexan  
Walls

Acid Resistant  
Hood with Air  
Flow Monitor  
and Alarm



HF Acid  
Gas  
Detector



Acid Resistant, Anti-Fatigue Floor with Secondary Containment

Expert Reviewed Set of Operating and Training Procedures

# TD-IB2 Booster Corrector Magnets Production In Full Swing (2005-2007)



Doug Kelly, Dan Smith, Pat Sanchez, Bill Robotham, Steve Sorenson



Jan Szal and Jim Jablonski



Dennis Gaw



Pat Sanchez and Inpeng Samayavong

## TD-IB2 Booster Corrector Magnets Production In Full Swing (2005-2007)



Ollie Kiemschies and Sergio Sanchez



Chuck Pribyl and Doug Kelly



Earl Shaffer and Junior Jones



Todd Thode, Jan Szal, Luciano Elementi,  
Dean Connolly, and James Williams

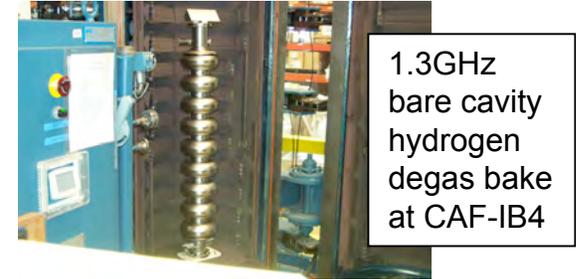
## TD-IB2 Booster Corrector Magnets Production In Full Swing (2005-2007)



Kurt Turville, Wayne Ostrom, Inpeng Samayavong

Kurt Turville and Chuck Pribyl

# TD-MP9 CRYOMODULE ASSEMBLY FACILITY

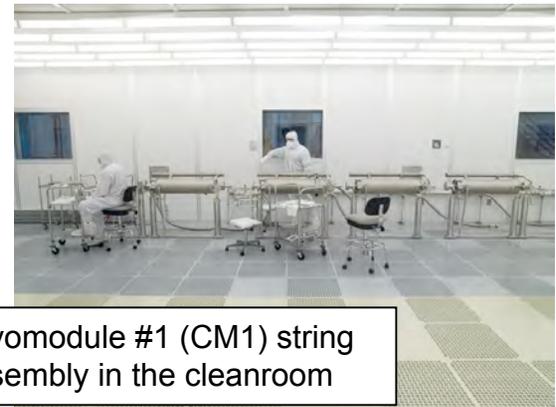


Clean room technicians from FNAL & DESY working together during CM1 string assembly



## CAF-MP9 Clean Room Team:

- Brian Smith, Marco Battistoni (FNAL)
  - Birte van der Horst, Steven S. (DESY)
- CAF-MP9 fully operational (June 2007)



# TD-ICB CRYOMODULE ASSEMBLY FACILITY

(as July 2007)



## CAF Team members:

-Tug Arkan, Glenn Smith, Brian Smith, Marco Battistoni, Jeff Wittenkeller, Jim Rife, Mark Chlebek, Gary Vezain



CAF-ICB production floor renovated

5/14/2007



CAF-ICB assembly fixtures installation

7/13/2007



Big Bertha at CAF-ICB

# FNAL - Technical Division / Zanon - April 2007

## the first 325MHz Single Spoke Resonator



# TD-IB4/MDB First Room Temperature 325 MHz cavity for the High Intensity Neutrino Source project, April 2007



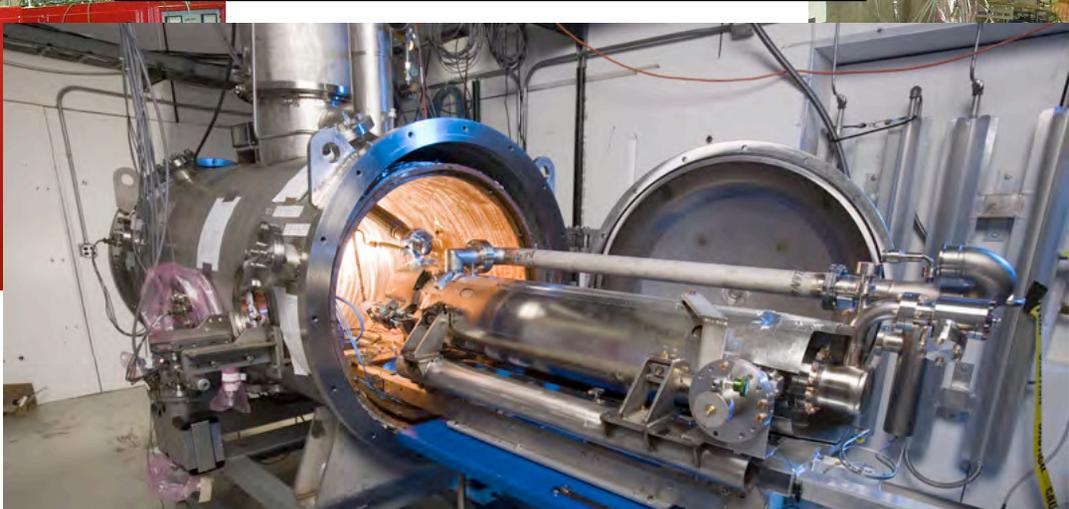
L. Ristori, G. Romanov, T. Khabiboulline, R. Webber, G. Apollinari

# ILC Cavities Horizontal Test Stand

*Ready for operations  
in August 2007*



300 kW RF  
klystron system



Ron Kellett, Dan Olis,  
Ryan Montiel prepare  
for coupler installation



Andy Hocker, Elvin Harms, Ron Kellett, Rocky  
Rauchmiller prepare cavity C22

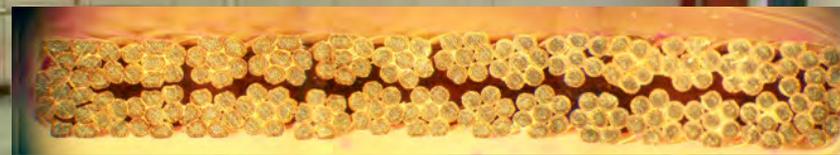


Brian Smith, Jeff Wittenkeller, Marco  
Battistoni deliver cavity C22 to MDB

TD-IB3 Development and Test of Nb<sub>3</sub>Sn, Nb<sub>3</sub>Al and BSCCO Rutherford cables in collaboration with OST, NIMS, IHEP (2005-2007)



Nb<sub>3</sub>Sn

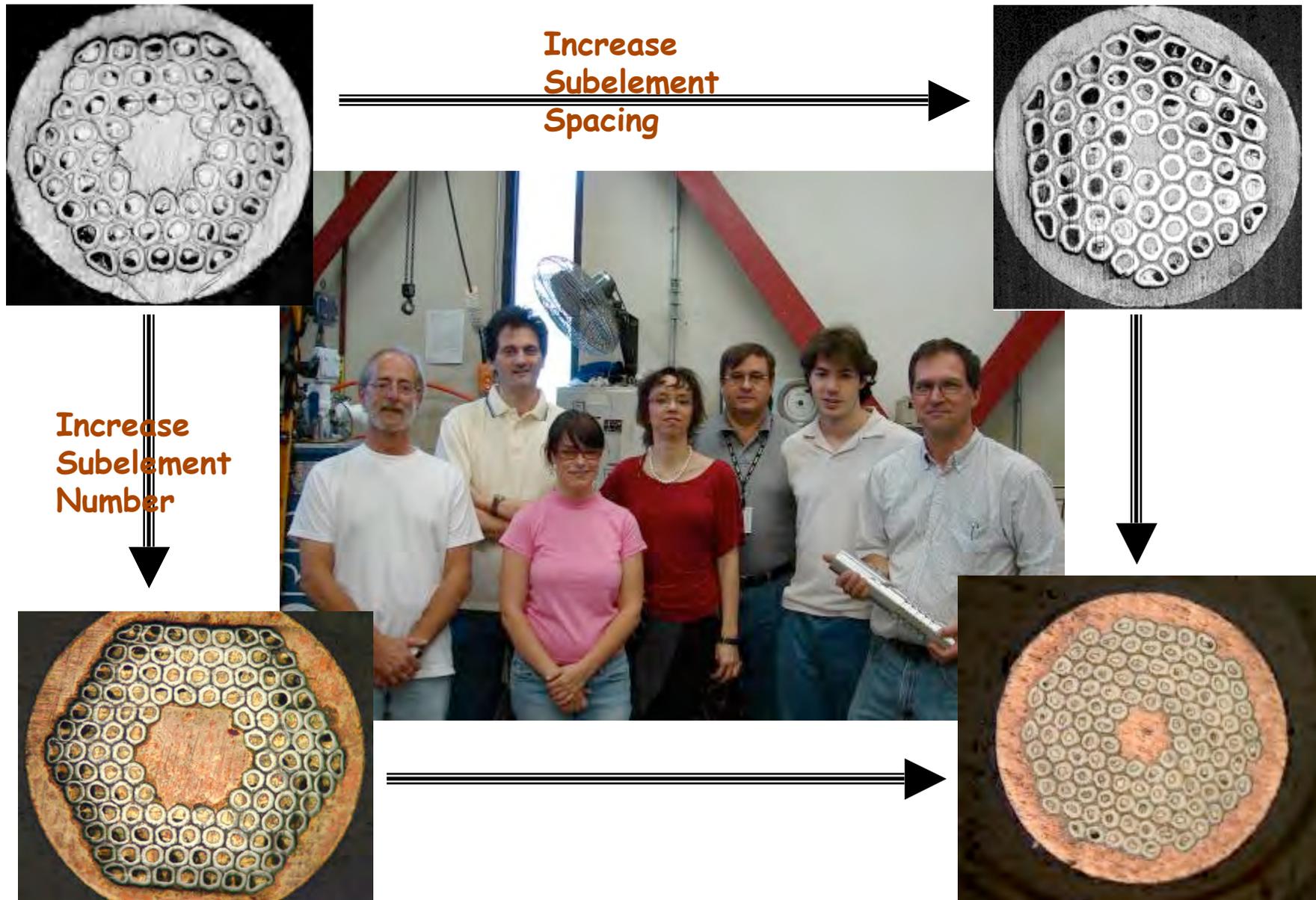


Nb<sub>3</sub>Al

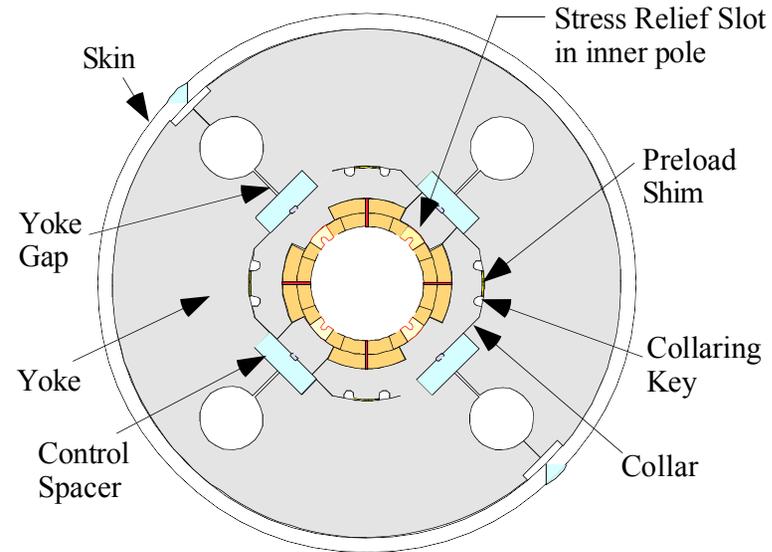
BSCCO



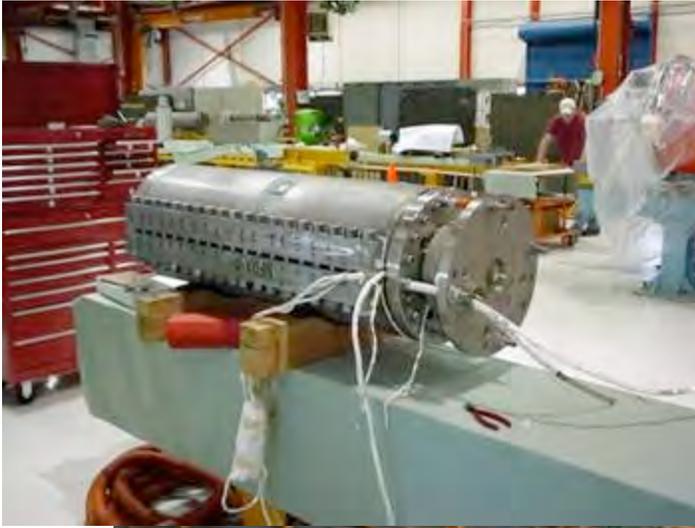
# TD-IB3 Development and Study of New Nb<sub>3</sub>Sn Strand for HEP in collaboration with OST (2005-2007)



# TD-IB3 Development and Test of 90-mm Nb<sub>3</sub>Sn Quadrupole Models for the LHC IR upgrade in collaboration with LARP (2005-2007)

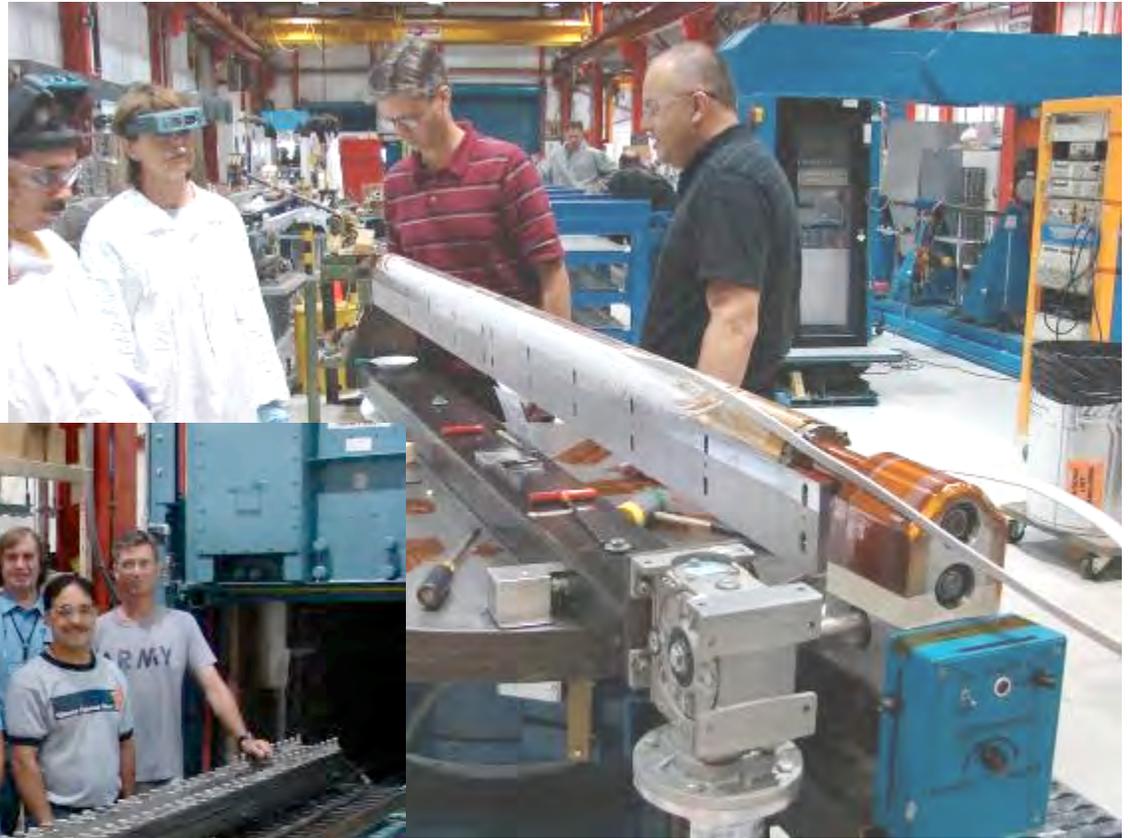


**TD-IB3 Successful development and test of series of 1m long Nb<sub>3</sub>Sn dipoles and the first 2m long Nb<sub>3</sub>Sn dipole coil (2005-2007)**



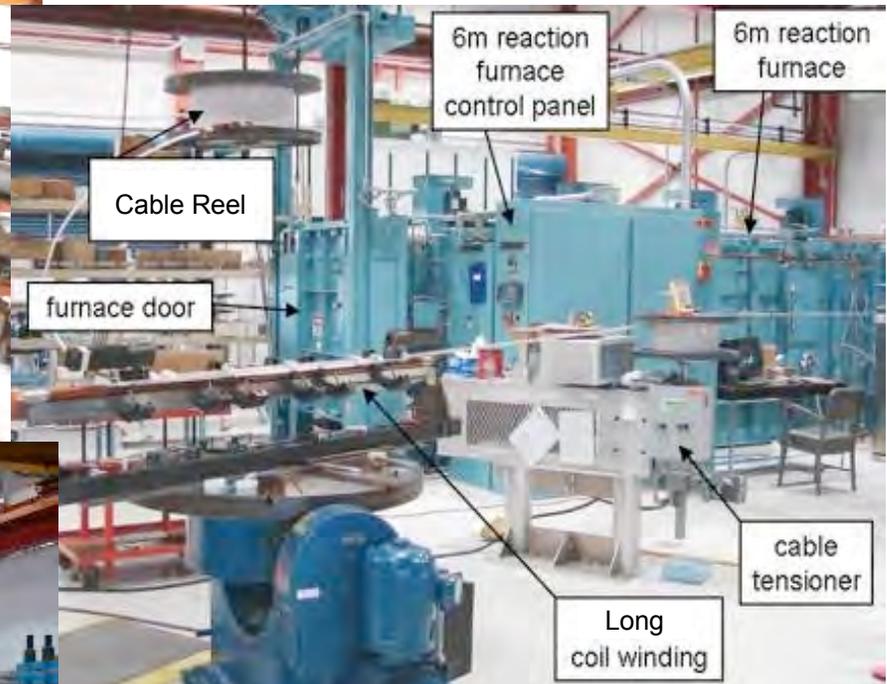
# TD-IB3 Long Nb<sub>3</sub>Sn Dipole Coil Construction (2006-2007)

Coil Winding



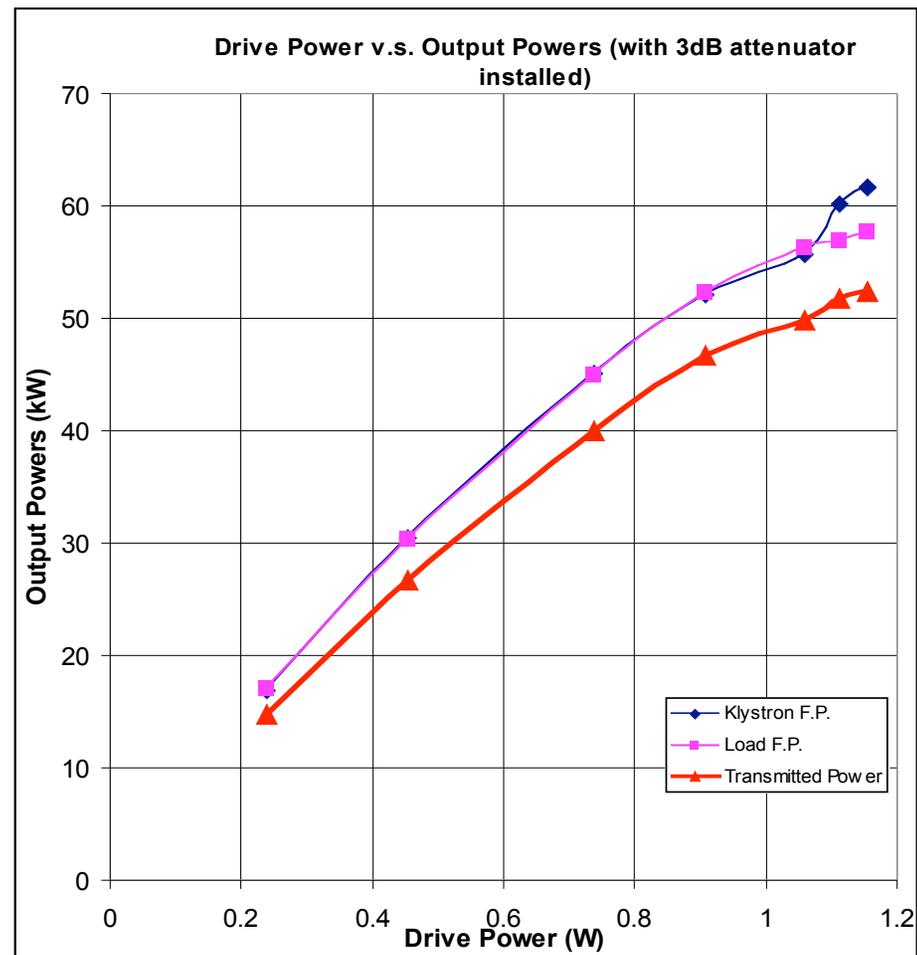
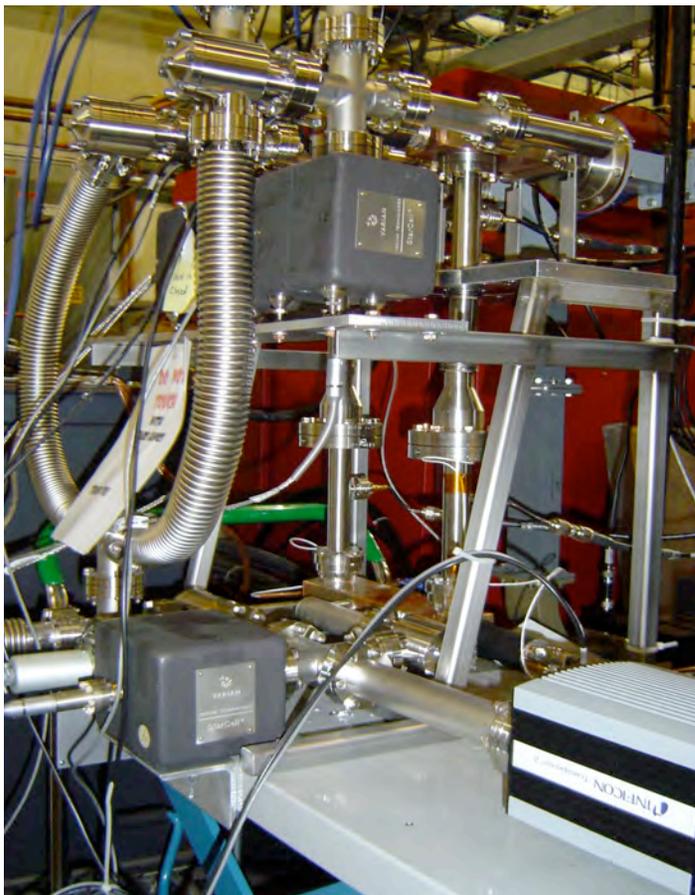
First 4 meter long Nb<sub>3</sub>Sn coil after reaction

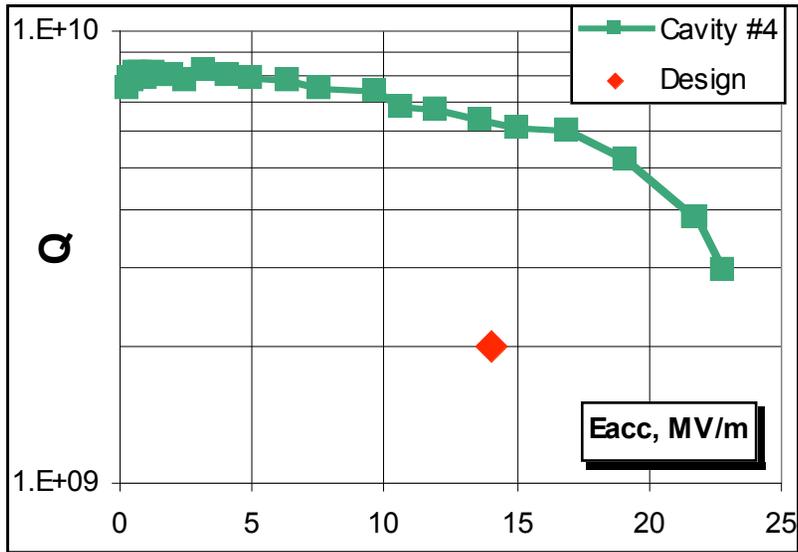
# TD-IB3 Relocation of Superconducting Magnet Facility from ICB to IB3 (2006-2007)



# TD-Team Design and High Power Test of the 3<sup>rd</sup> harmonic cavity couplers. (Test done on February 2007)

**Team** N. Solyak – RF design of the coupler, D. Mitchell – mechanical design of the coupler, T. Khabiboulline – RF design of the test stand and low power measurements, D. Olis – mechanical design of the test stand, J. Li – multipactor calculations, J. Read, Tom Kubicki, – high power distribution system, E. Harms – power processing of the couplers. P. Prieto – electronics, D. Nicklaus - software





3.9 GHz 3<sup>rd</sup> harmonic cavity #4 reached 23 MV/m, limited by quench in the cavity. No x-rays, no multipactor was observed. (May 2007)

This cavity with HOM antennas installed reached 12 MV/m in CW, limited by quench in the HOM antenna.

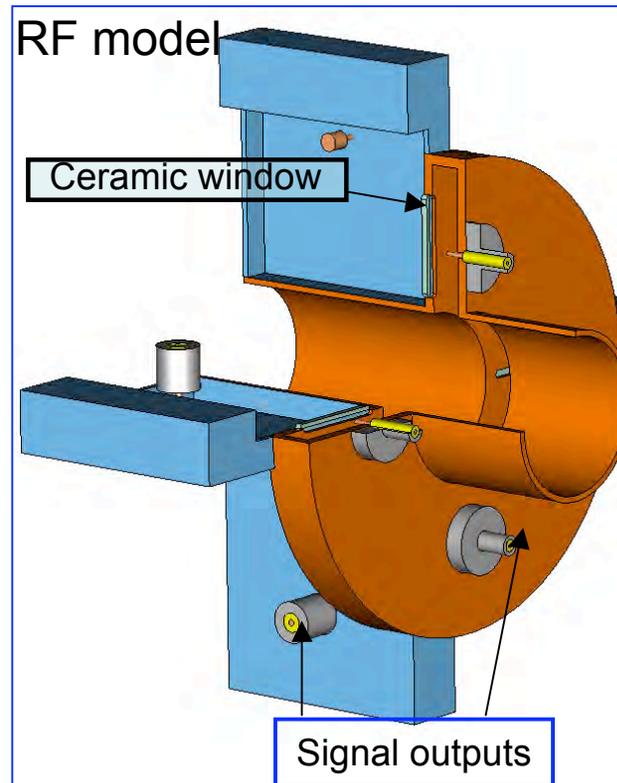
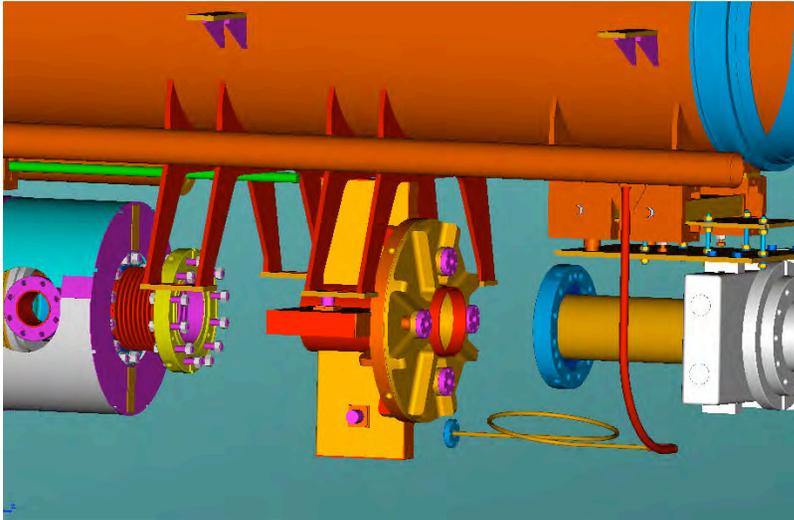


# Cold L-Band Cavity Beam Position Monitor (TD+AD) (Design Completed, March 2007)

BPM in ILC cryomodule

RF design is completed  
4 BPM's under construction  
Test starts 2008

Manfred WENDT  
Nathan EDDY  
Linda VALERIO  
Kevin OBRIEN



Nikolay SOLYAK



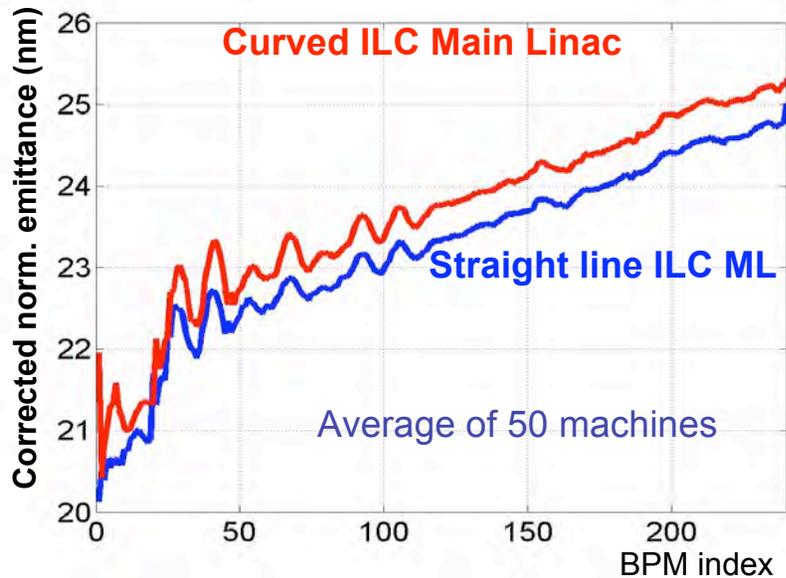
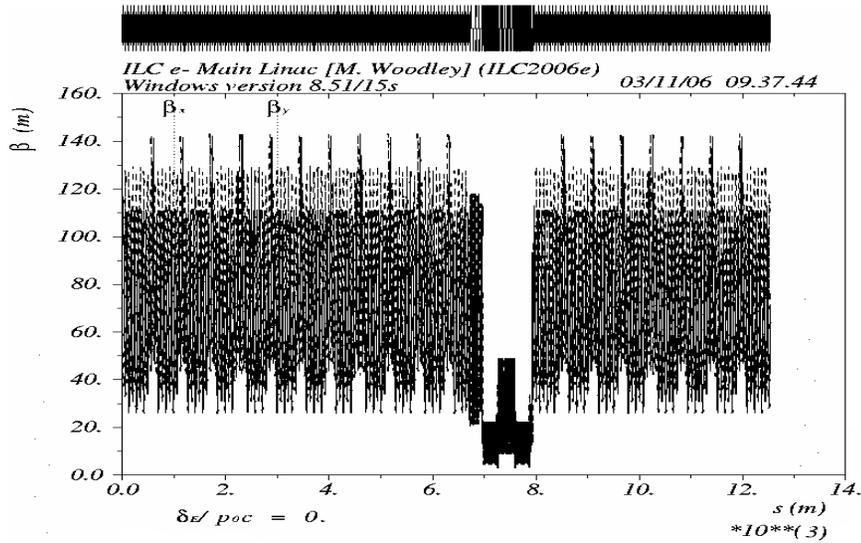
Gennady Romanov



Andrei Lunin

Frequency, dipole monopole	1.468 GHz 1.125 GHz
Resolution	< 1 $\mu\text{m}$
Dynamic range	$\pm 1$ mm
Operating temperature	2 °K
Mechanical tolerances	<10 $\mu\text{m}$

# Emittance Preservation in curved Linac



## Goals:

- Main Linac Lattice design
- Develop Beam Based Alignment techniques, which provide small emittance dilution in ML

## Completed in FY07

### ML Static Tuning

- Emittance dilution Studies in the curved ILC Linac
- Studies of Alignment Sensitivity
- Effect of incoming beam jitter and Quad vibration.
- Failure analysis of a corrector, quad or BPM.

### Dynamic Tuning in presence of ground motion

- Adaptive Alignment and 121 correction technique

### New Simulation Packages – CHEF

- Benchmarking
- Static and dynamic tuning simulations on grid machine



Nikolay SOLYAK



Alex VALISHEV



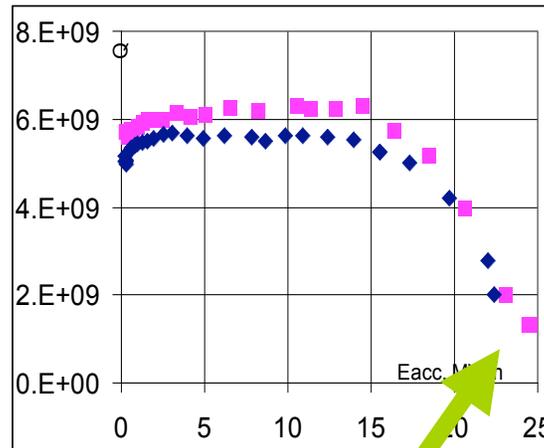
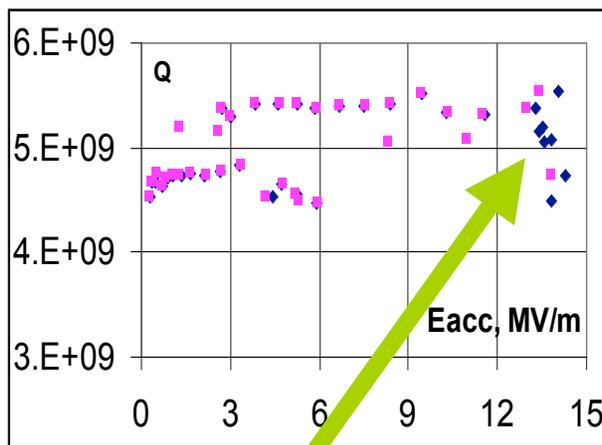
Paul LEBRUNE

Kirti RANJAN  
 Francois OSTIGUY  
 Valentin IVANOV  
 Leo MICHELOTTI  
 Lynn GARREN

# SIMULATIONS OF MULTIPACTOR (MP)

A new Analyst (Omega3P) - powerful tool for MP phenomena investigation for complex RF devices in real 3D fields has been used for simulations of MP in:

3<sup>rd</sup> harmonic, TESLA, SNS  $\beta=0.61$  and  $\beta=0.81$ , ICHIRO cavities



- ❑ Strong MP results in a quench observed in 3<sup>rd</sup> harmonic cavity old HOM couplers design at  $E_{acc} \sim 14$  MV/m
- ❑ **NO MP at new HOM coupler design**  
 $E_{acc}$  achieved  $\sim 23$  MV/m
- ❑ **Completed March 2007**



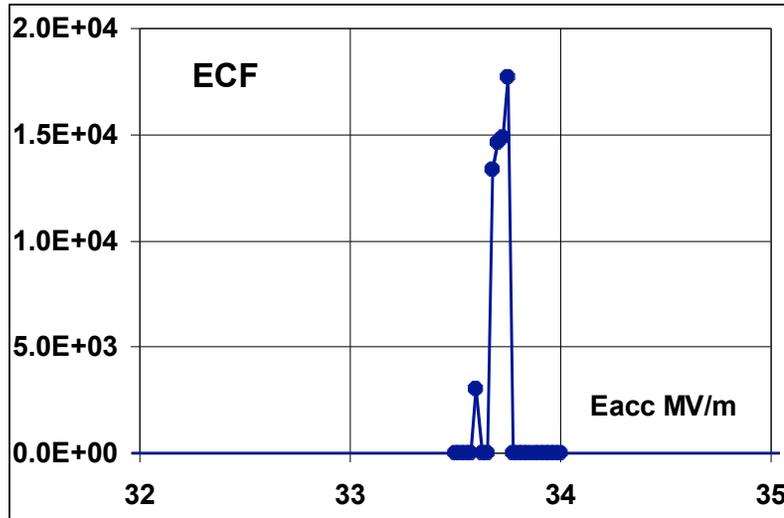
Nikolay SOLYAK



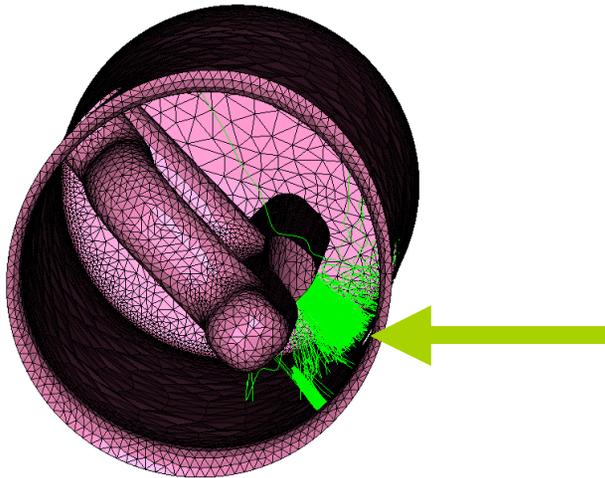
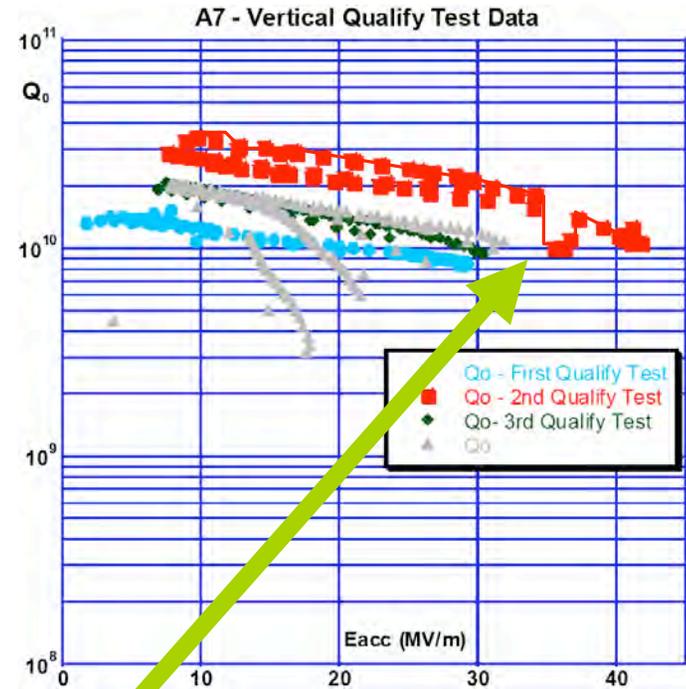
Ivan Gonin

John DeFord  
STAR inc.

# MULTIPACTOR IN TESLA CAVITY (June 2007)



ANALYST predict MP at  $E_{acc} \sim 33.7 \text{ MV/m}$

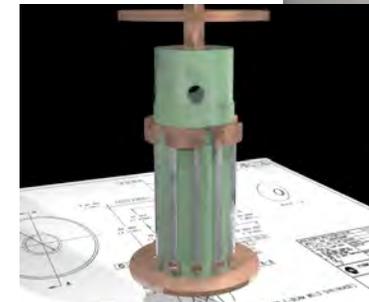
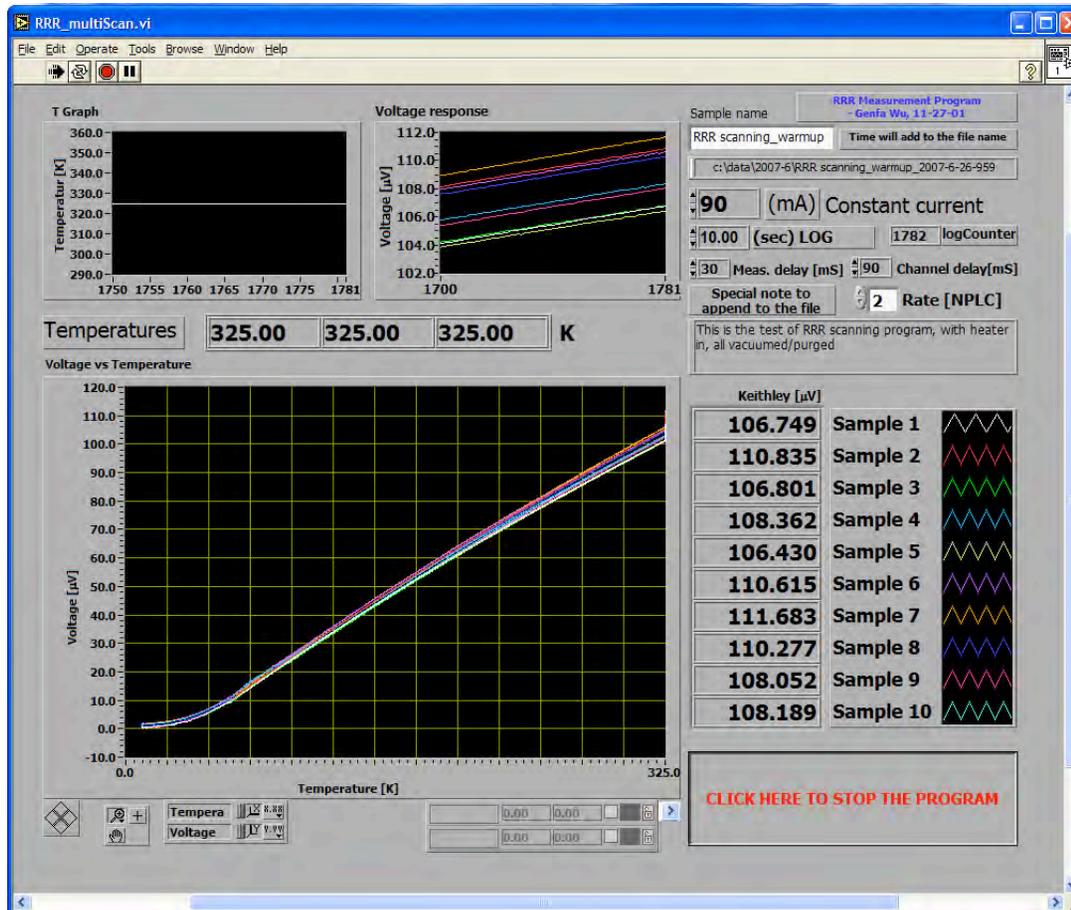


MP explains **Q-drop** during vertical test at JLab and localize the **place of MP**. ILC operating gradient  $E_{acc} = 31.5 \text{ MV/m}$  is close to MP level.

**Possible HOM coupler design modification needed!**

# 10 Sample RRR test station (May 2007)

Team Member: P Bauer, C. Boffo, K. Ewald, F, McConologue, R. Schuessler, O. Frianeza, G. Wu, ...



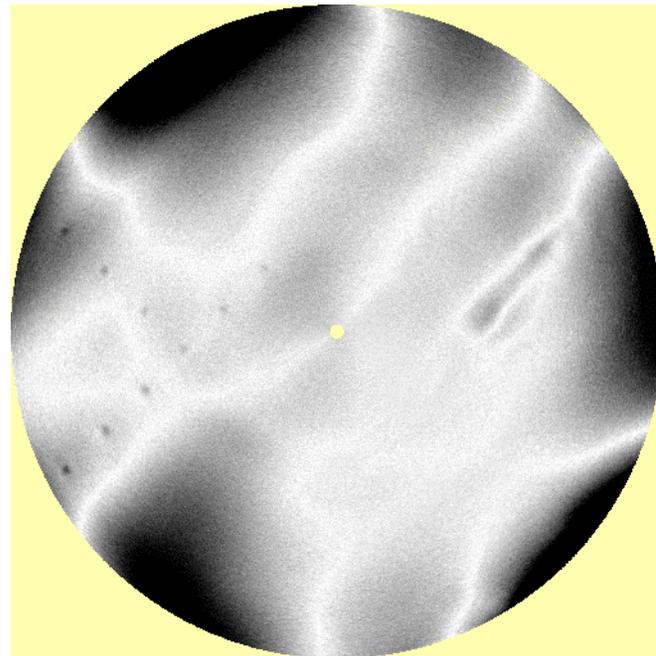
For quick measurement of large number of samples

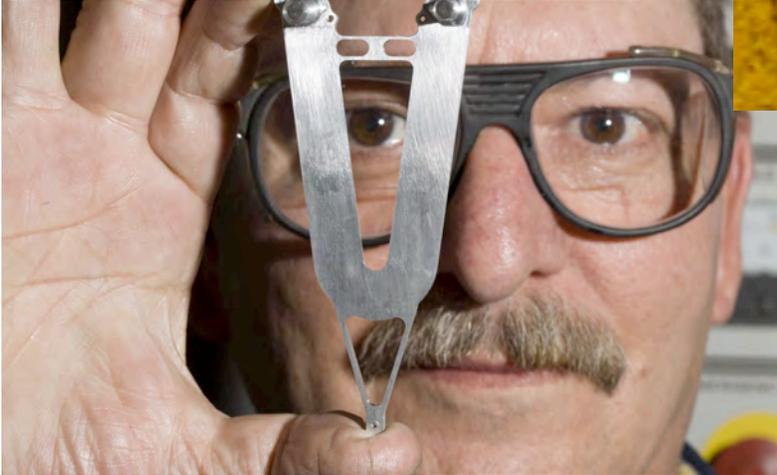
## TD-IB3 Eddy Current Scanning (May 2006)

Team members: M. Battistoni, P. Bauer, C. Boffo, D. Connolly, L. Elementi, K. Ewald, O. Lira, F. McConologue Y. Terechkine, R. Schuessler, O. Frianeza, G. Wu



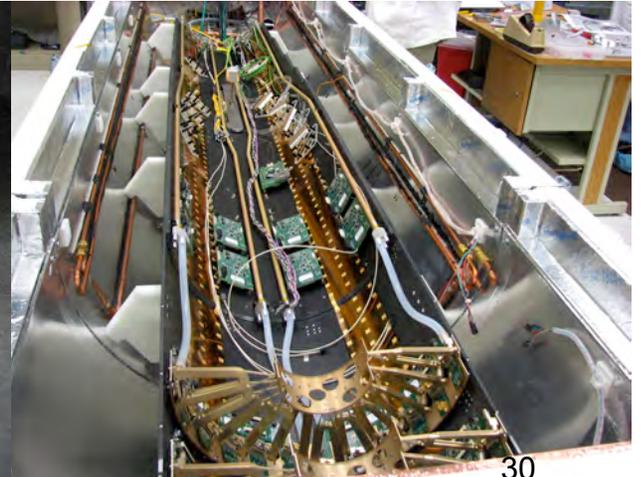
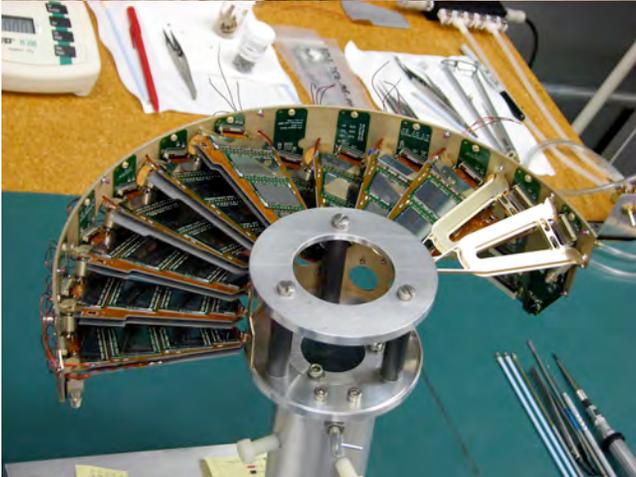
**> 800 Niobium sheets  
scanned at FNAL**



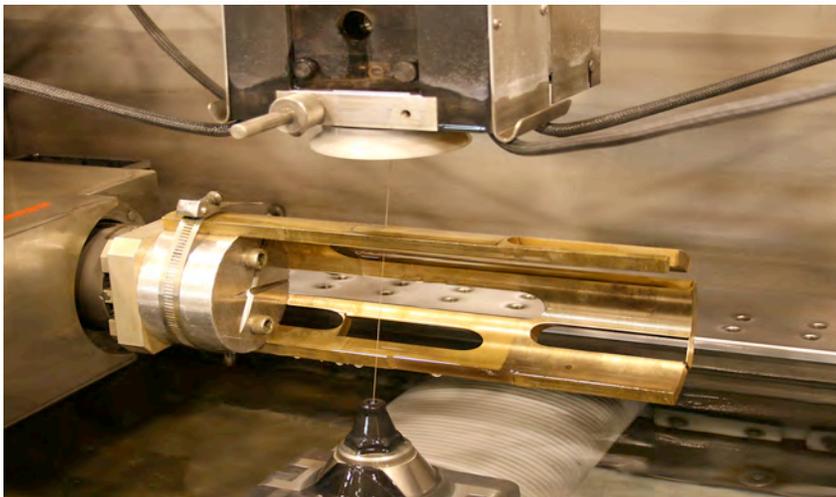
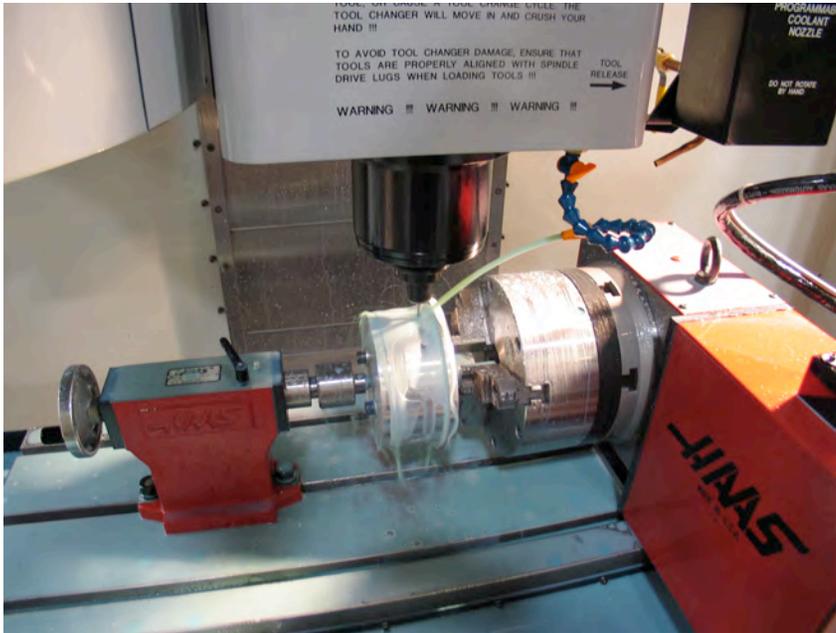


Fermilab/TD-Machinist Harry Parkhurst Viewing Finished CMS Silicon Pixel Detector Water Channel

December 12, 2006



Inner Ring For CMS Pixel Detector  
Being Machined In CNC Center



Wire E.D.M. Of LARP 90mm QUAD  
LEAD END POLES JUNE 2006

Fermilab/TD Machinist Greg Bulat  
Modifying Numi Horn Outer Housing



Shop As Seen December 2006





**Fermilab Machinist Mike Berens Machines Numi Striplines  
(February 2007)**

