Component Development



- Outline
  - Program Overview
  - Progress & goals
  - Plans
  - Summary

Component Development

L2 Organization

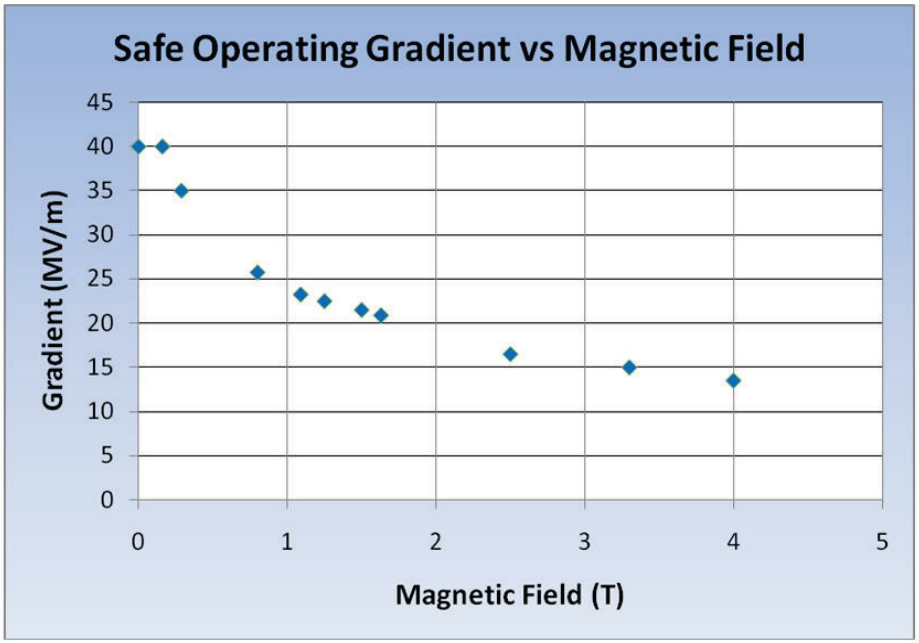
- Normal Conducting RF
  - Derun Li, LBNL, RF scientist for the MuCool program
- Superconducting RF
  - Don Hartill, Professor Cornell University
- Magnets
  - John Tompkins, Deputy Head Fermilab (TD) Magnet Systems Department
- Targets and Absorbers
  - Kirk McDonald, Princeton University & co-spokesperson of the MERIT experiment
- MuCool Test Area Coordinator
  - Yagmur Torun, Professor Illinois Institute of Technology

Primary Goals

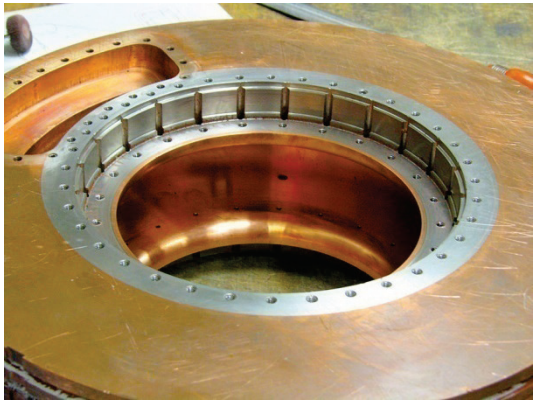
- Establish the viability of the concepts and components that will be used in the design reports
  - Neutrino Factory Reference Design Report (NF-RDR)
  - Muon Collider Design Feasibility Study Report (MC-DFSR)
- Establish the engineering performance parameters to be assumed in the design studies
- Provide a good basis for cost estimates.

NCRF

- Significant degradation in maximum stable operating gradient with applied B field



- 805 MHz RF Pillbox data
  - Curved Be windows
  - E parallel B
  - Electron current/arcs focused by B
- Degradation also observed with 201 MHz cavity
  - Qualitatively, quite different





Details will be presented in RF parallel

NCRF Program
R&D Strategy

- *Technology Assessment (continuation of existing multi-pronged program)*
  - Surface Processing
    - Reduce (eliminate?) surface field enhancements, field emission
      - SCRF processing techniques
        - » Electro-polishing (smooth by removing) + HP H_2O rinse
      - More advanced techniques (Atomic-Layer-Deposition (ALD))
        - » Smooth by adding to surface (conformal coating @ molecular level)

    Vacuum
  - Materials studies: Use base materials that are more robust to the focusing effects of the magnetic field
    - Cavity bodies made from **Be** or possibly Mo
  - Magnetic Insulation
    - Inhibit focusing due to applied B
  - High-Pressure Gas-filled (H_2) cavities

Phase I RF Program (2+ year)

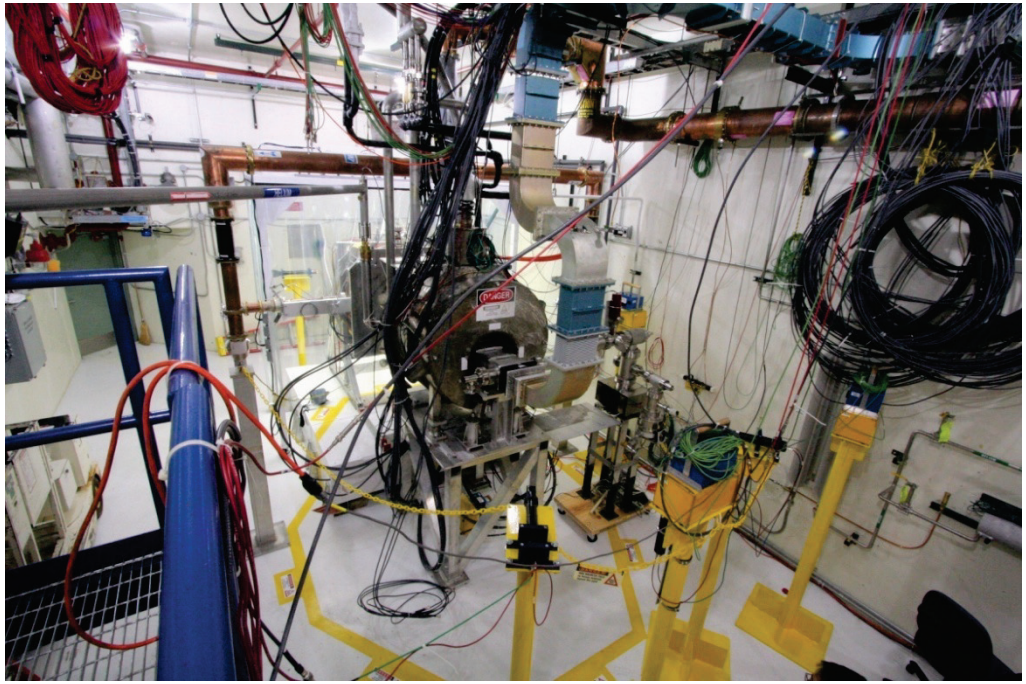
- Complete tests on Magnetic Insulation
  - Tests completed - concept dropped *(DnS'd)*
- Materials tests: Be
  - Button cavity test (Y. Torun)
  - Be wall cavity (D. Li)
- Beam tests of HP H_2 filled cavity (Yonehara)
- All-Seasons Cavity tests (AB)

Future

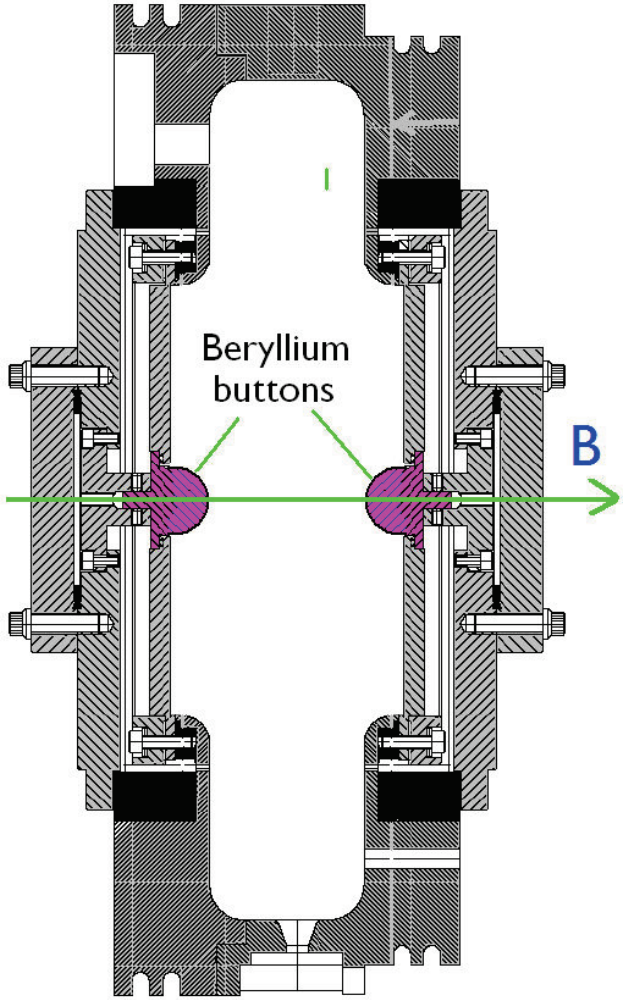
- MICE 201 MHz production cavity test
- New 805 MHz pillbox (Z. Li)
- 201 MHz tests in higher B field
  - Need new SC magnet - FY2014

RF Test Facility

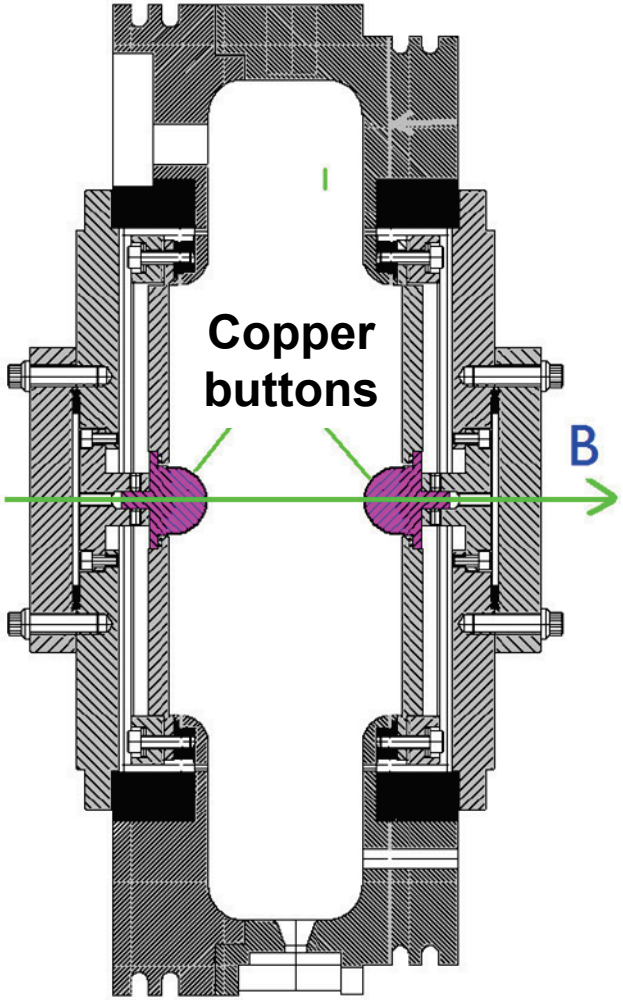
- MuCool Test Area
  - RF Power
    - 201 MHz (5MW)
    - 805 MHz (12 MW)
  - Class 100 clean room
  - Instrumentation
    - Ion counters, scintillation counters, optical signal, spectrophotometer
  - 4T SC Solenoid
    - 250W LHe cryo-plant
  - 400 MeV p beam line



Be Button Tests



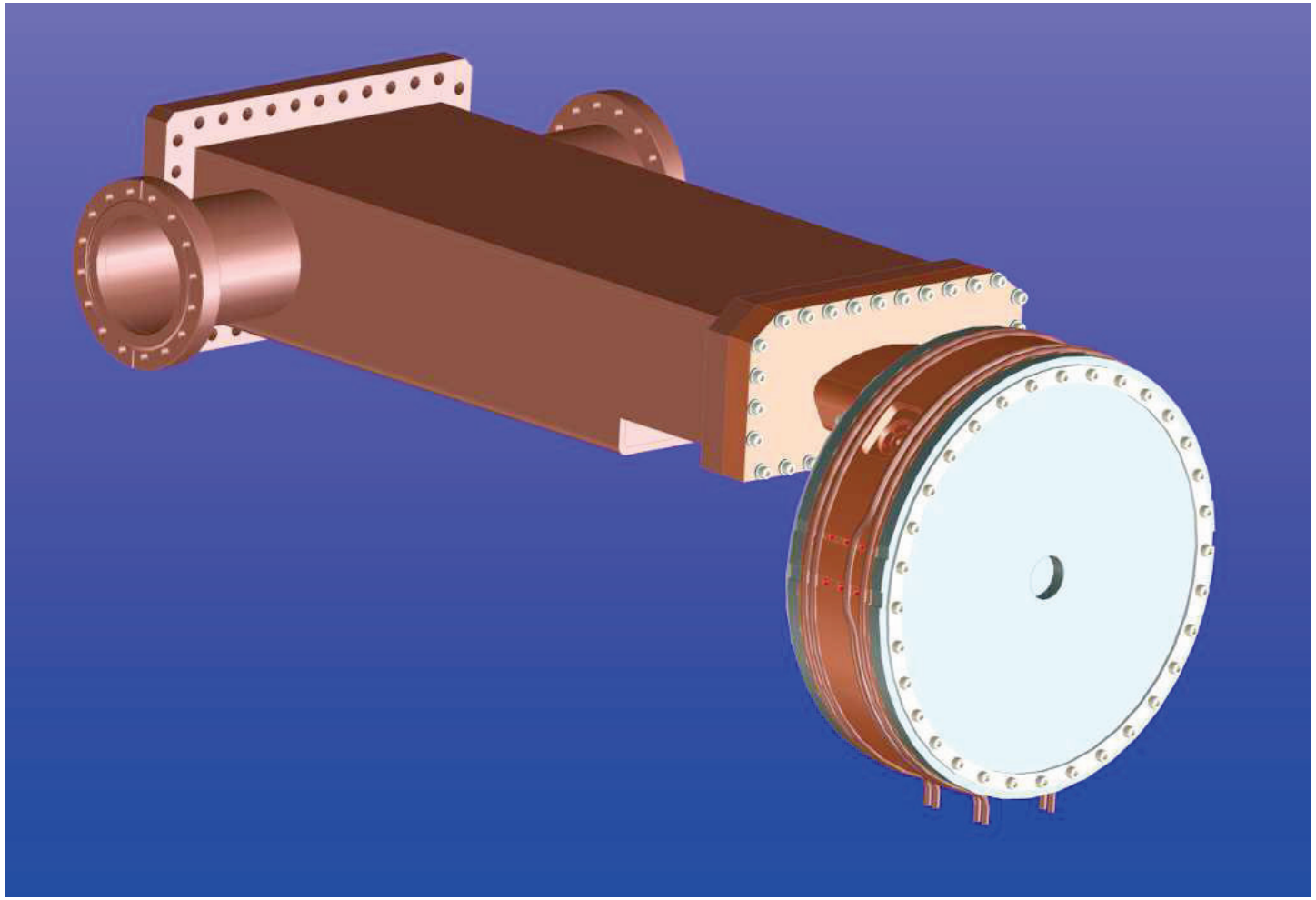
VS.



Yagmur Torun

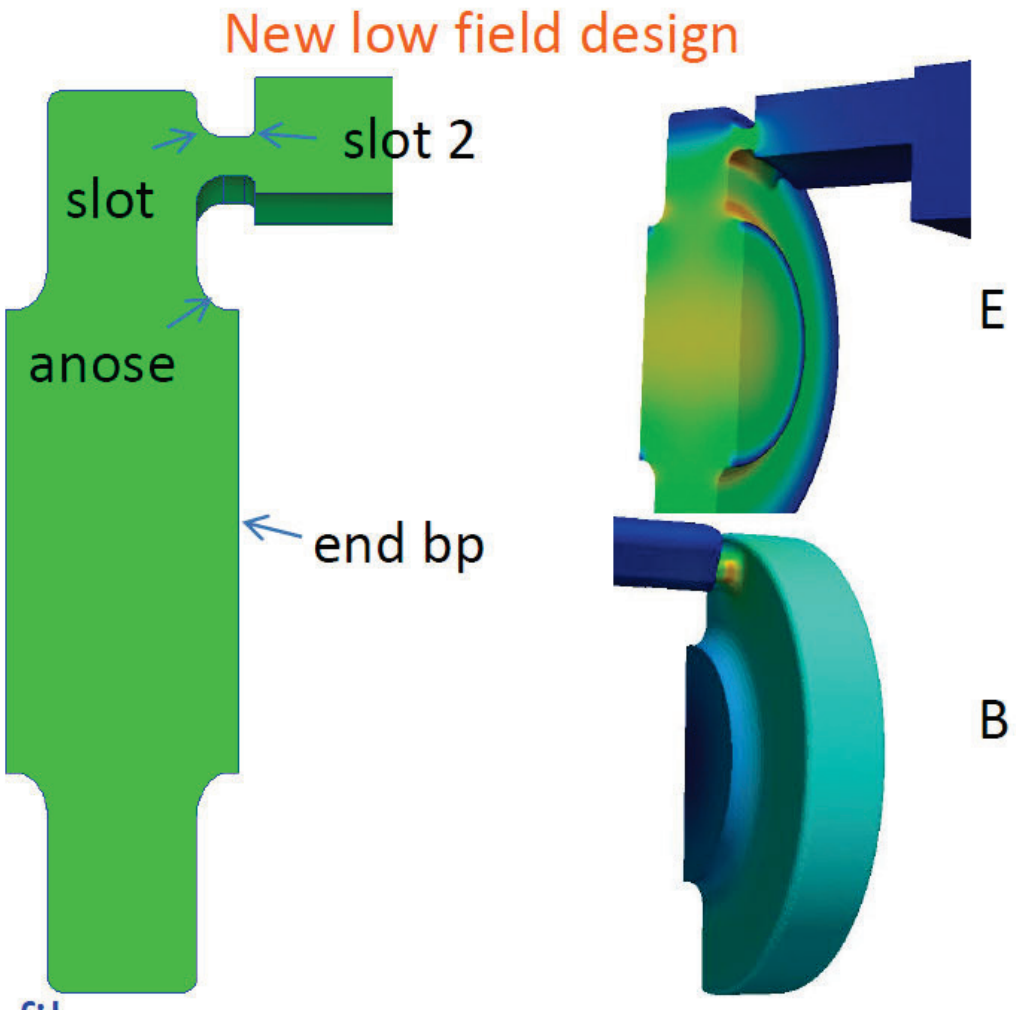
Be-Wall Cavity

Derun Li

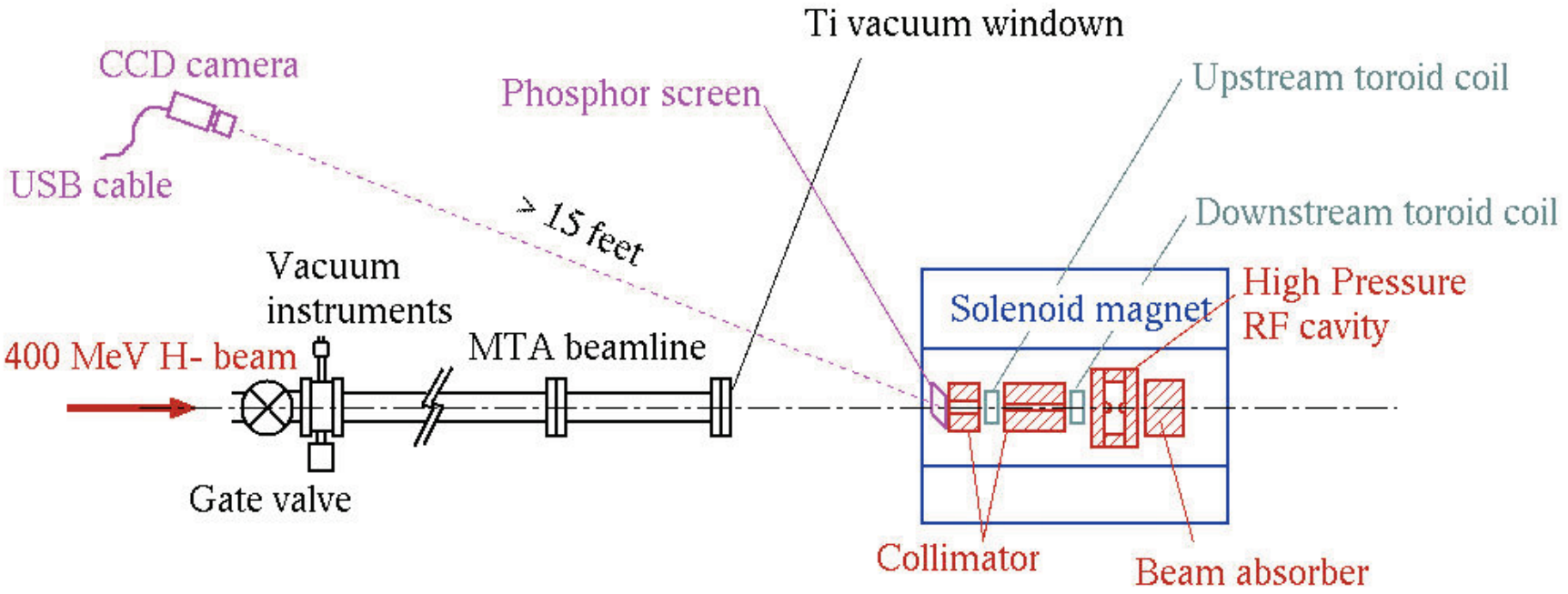


New 805 MHz Pillbox

Zhenghai Li

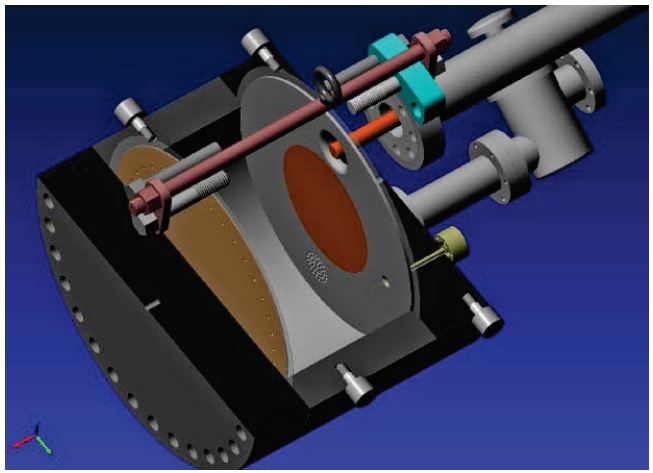


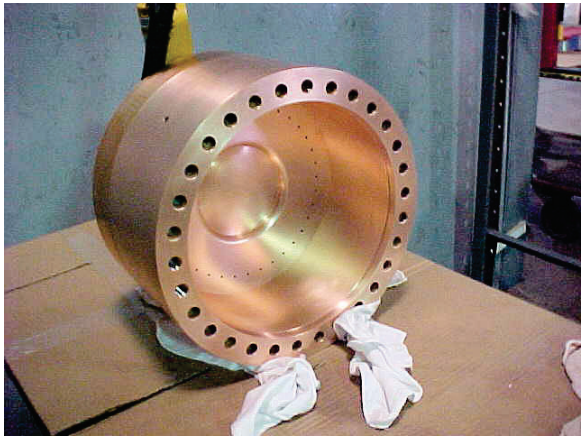
High-Pressure H_2 filled Cavity

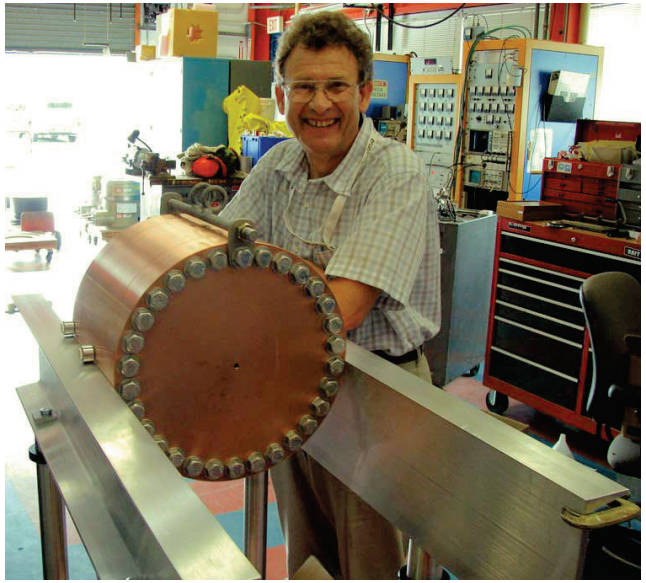


Katsuya Yonehara

All-Seasons Cavity

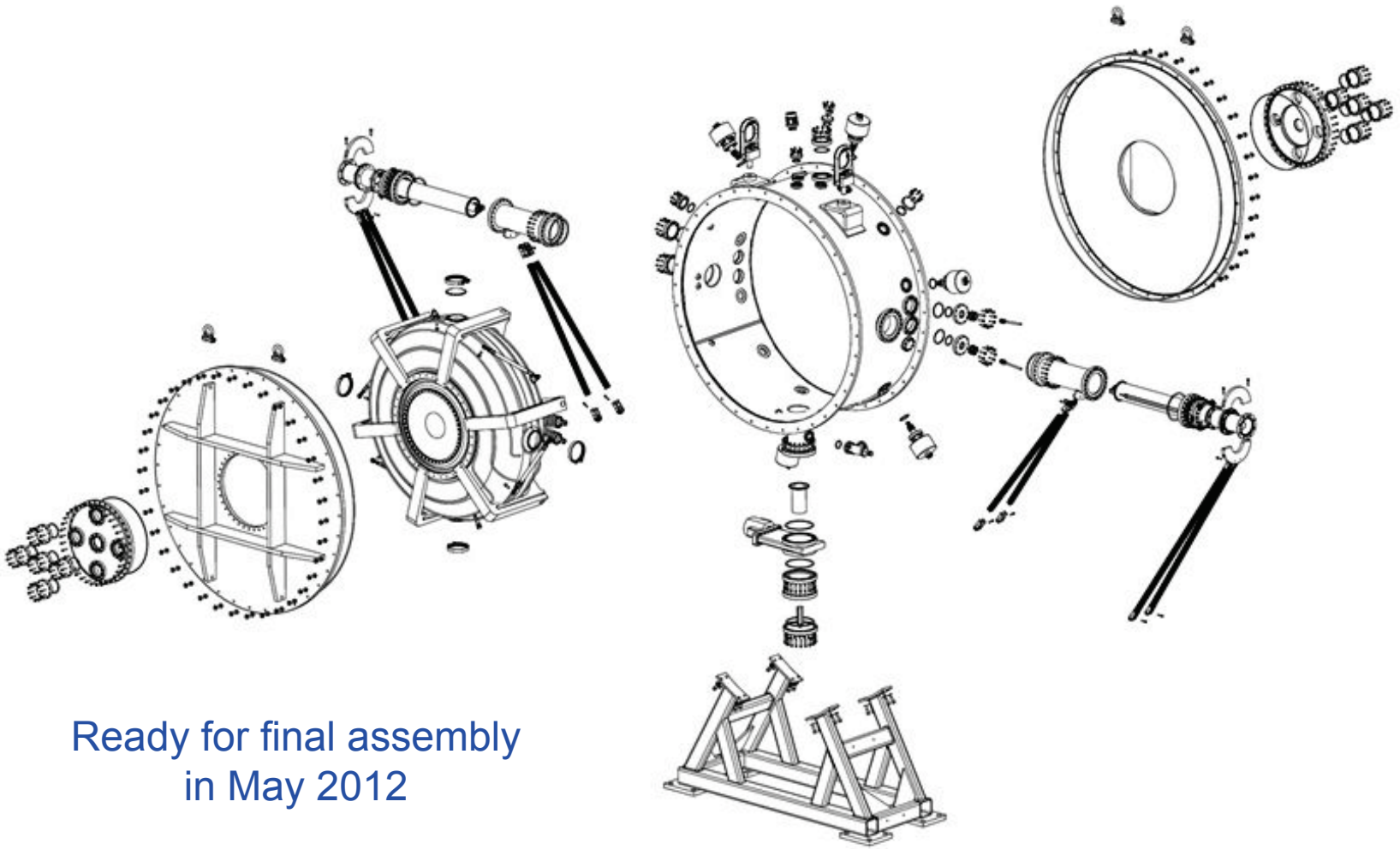






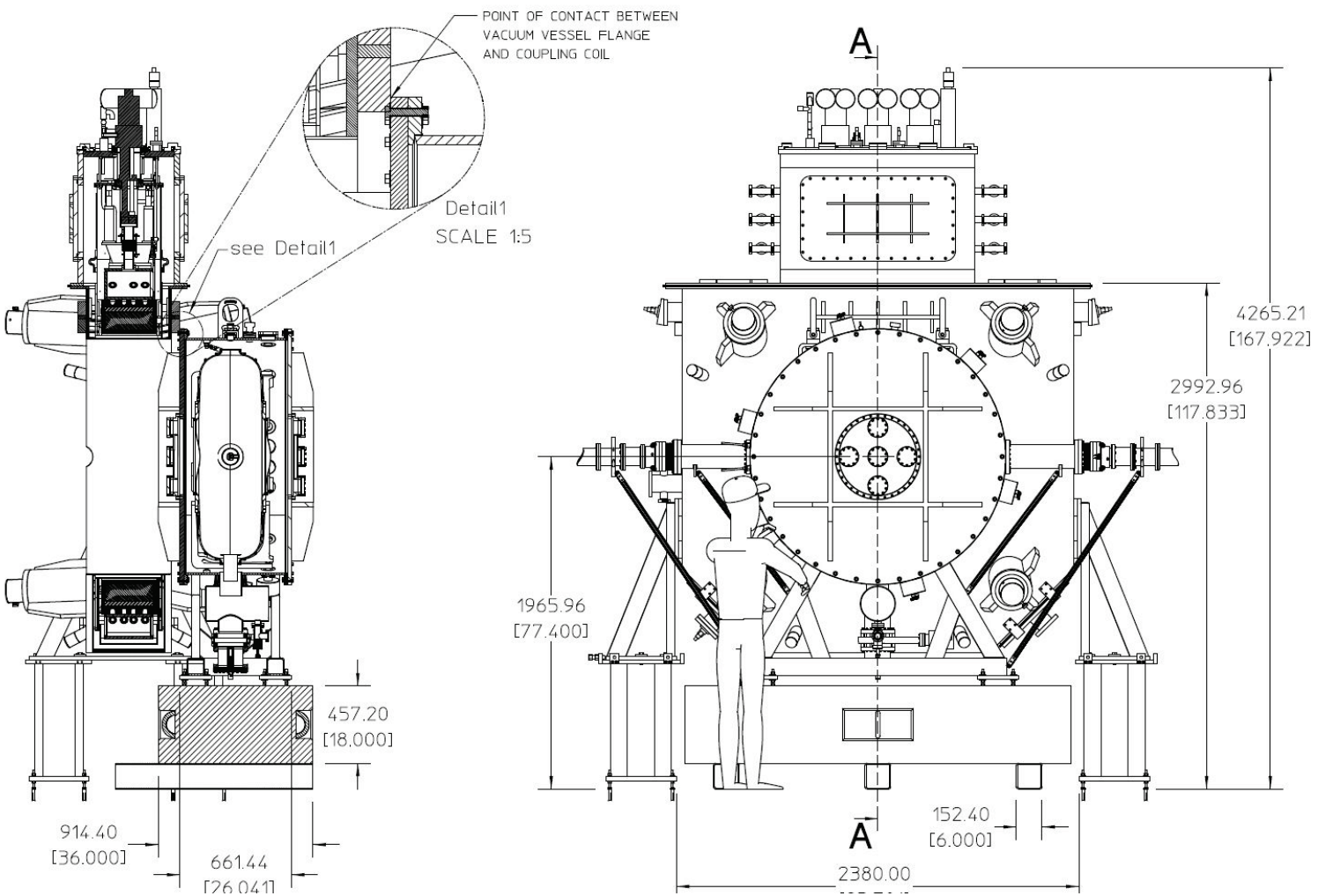
- Tested at B=0 & B=3T
  - Two cycles: B_0, B_3, B_0 & B_3
- No difference in Max Stable Op. Gradient
  - RF pickup did not work
    - Gradient ≈ 25 MV/m ± 5%
- Paradigm shift for vacuum RF in B?

MICE 201 MHz Production Cavity Test



Ready for final assembly
in May 2012

MICE RFCC$_{lite}$ Test in MTA



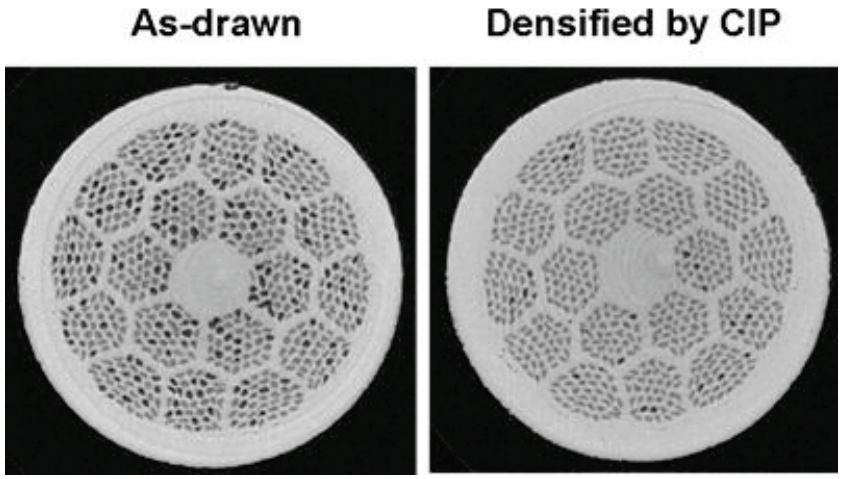
Magnet R&D - Overview

Neutrino Factory and Muon Collider accelerator complexes require magnets with quite challenging parameters

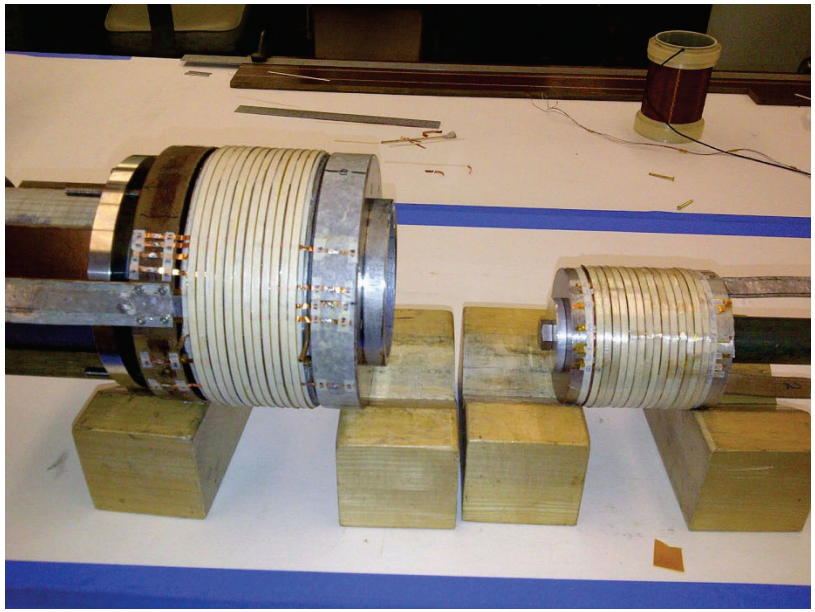
- HTS solenoid R&D to assess the parameters that are likely to be achieved
  - What is the highest practical achievable solenoid field & what is the R&D required before these solenoids can be built?
- Magnet design R&D for collider ring and IR magnets that have to deal with the expected high level of energy deposition from μ decay electrons
  - What is the optimal design for the collider ring magnets that will enable them to operate in the presence of the decay electrons? Paper studies only (with D&S group)
- Fast Ramping Magnets utilized in rapid-cycling synchrotron for final acceleration for the MC

Magnet R&D – HTS

- HTS Solenoid
  - Develop functional specifications for the high field solenoid & perform tests



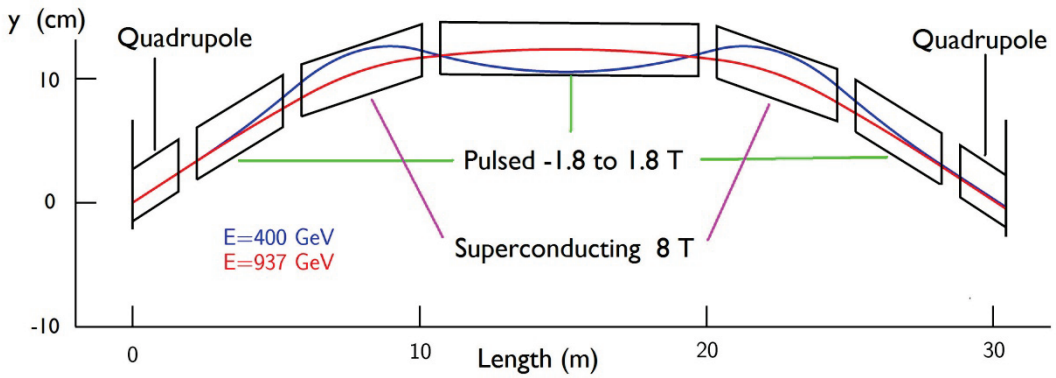
HTS conductor cable R&D
Tengming Shen



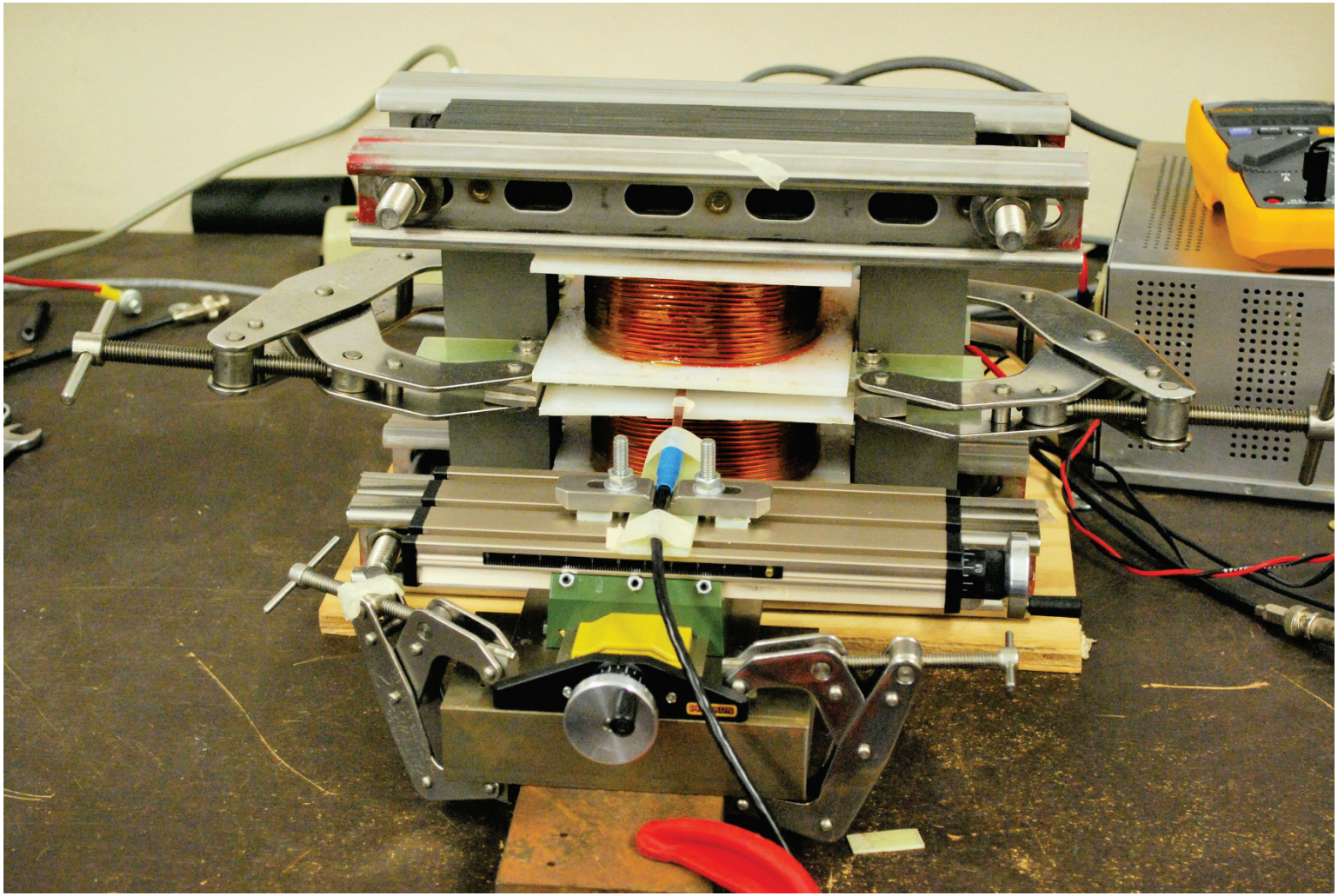
HTS pancake magnet tests
Ramesh Gupta

Magnet R&D
μCollider Ring & Acceleration

- Collider Ring Magnets (A. Zlobin)
  - Produce effective conceptual designs for
    - IR quads & dipoles
    - Collider ring dipoles and quads
- Fast Ramping Magnets (400 Hz) (D. Summers)
  - Building prototypes with goal to produce 30 cm test magnets



400 Hz prototype



Targetry

- This year has been primarily limited to paper studies
  - Nozzel & jet *(Y. Zhan)*
  - MHD Simulations *(R. Samulyak)*
  - Particle production *(X. Ding)*
  - Energy management *(N. Souchlas)*
  - Magnet configurations *(R. Weggel)*

Component Development RF Plans/Milestones

	MILESTONE	DELIVERABLE	INSTITUTION
RF / MTA			
RF-1	Complete Be button test	MAP note; Q2	FNAL
RF-2	Complete 2nd HPRF cavity beam test	Draft Journal paper; Q4	FNAL
RF-3	Prepare MTA for MICE production cavity test	Inspection; Q3	FNAL
RF-4	Upgrade CAMAC DAQ system	Inspection; Q2	IIT
RF-5	Analyze pillbox cavity Be button data	MAP Note; Q2	IIT
RF-6	Analyze box cavity data	MAP Note; Q1	IIT
RF-7	Analyze 2nd HPRF beam test data	MAP Note; Q4	IIT
RF-8	Analyze MTA magnet map data	MAP Note; Q1	IIT
RF-9	Finish MTA environmental monitoring setup	Inspection; Q1	IIT
RF-10	Test acoustic sensors on RF cavity	Presentation; Q3	IIT
RF-11	Support MTA RF R&D	Inspection; ongoing	JLab
RF-12	Complete Be-wall cavity design	Engineering note; Q3	LBNL
RF-13	Support MTA RF R&D	Inspection; ongoing	LBNL
RF-14	Support MTA RF R&D	Inspection; ongoing	ANL
RF-15	Complete RF cavity & coupler waveguide design	Design review; Q2	SLAC
RF-16	Complete cavity drawing package	Engineering note; Q3	SLAC
RF-17	Cavity assembly & cold test, and assist in high power test at MTA	MAP note; Q4	SLAC

Component Development
Magnet Plans/Milestones

MAGNETS			
MAG-1	Wind, react, and test small-scale Bi-2212 coil which has all the key elements of a 30T insert	MAP Note; Q4	FNAL
MAG-2	Document 400Hz, 1.8T dipole results	Conf. paper; Q2	U. Miss
MAG-3	Develop BH curves for grain oriented steel with Epstein frame	MAP note; Q3	U. Miss
MAG-4	Produce OPERA-2D map for rap. cycling dipole	MAP note; Q3	U. Miss
MAG-5	Develop code to handle grain oriented steel	MAP note; Q3	U. Miss
MAG-6	Complete 2nd round magnet measurements	MAP note; Q2	U. Miss
MAG-7	Make 2nd rap. cycling dipole prototype	Inspection; Q4	U. Miss

Component Development
Targetry Plans/Milestones

TARGET			
T-1	Design integrated coil/shielding config. for target	IPAC12 paper; Q3	BNL
T-2	Continue target area design studies	MAP note; Q3	Princeton
T-3	Contribute to IDS-NF target design	Report; Q4	Princeton
T-4	Develop Hg target system concepts for IDS-NF	IPAC paper; Q3	ORNL

Summary

- The RF program continues a multi-pronged attack on the technology
  - The MTA is now a smoothly running facility that is unique in the world
  - Magnetic Insulation *(voted off the island)*
  - Materials studies
    - SCRF processing
    - Cavity materials (Be)
  - High-pressure H_2 filled RF exposed to p beam
  - Continuing 201 MHz program
    - MICE production single-cavity test system
    - Future studies @ higher B field

Summary II

- Magnet program is primarily addressing cooling issues
  - Final cooling via very-high-field HTS solenoids
- But also addresses the other critical magnet issues for the MC complex
  - Ring magnets
    - Open-plane dipoles, quads, etc
  - Acceleration
    - Fast-ramping magnets
- Targetry has mostly been limited to paper studies due funding limitations.

END

Now lets gone on to the "Meat"

Well, coffee first