MTA Rf Test Plans

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Muon Collaboration Weekly Meeting

Jun 3, 2005 - Fermilab

Muon Collaboration

MuCool

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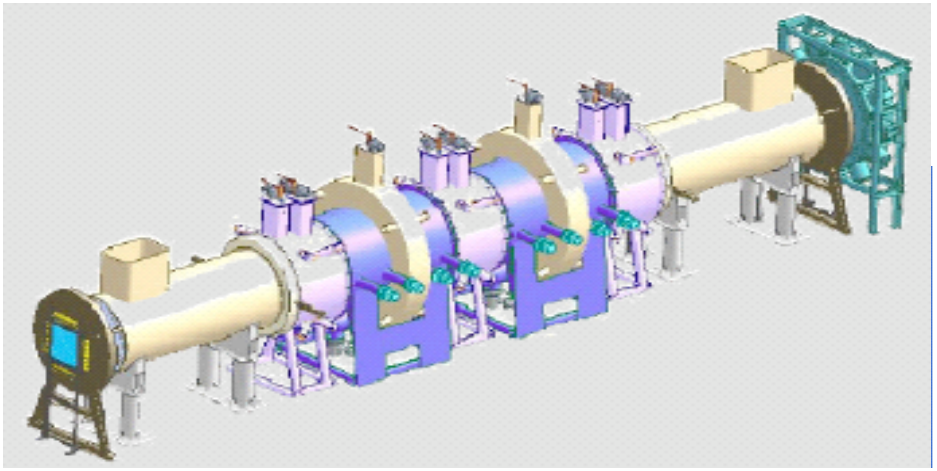
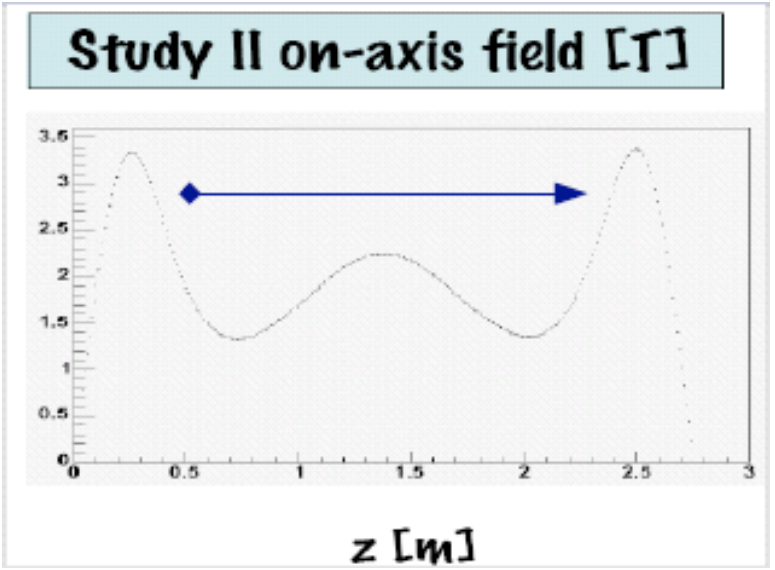
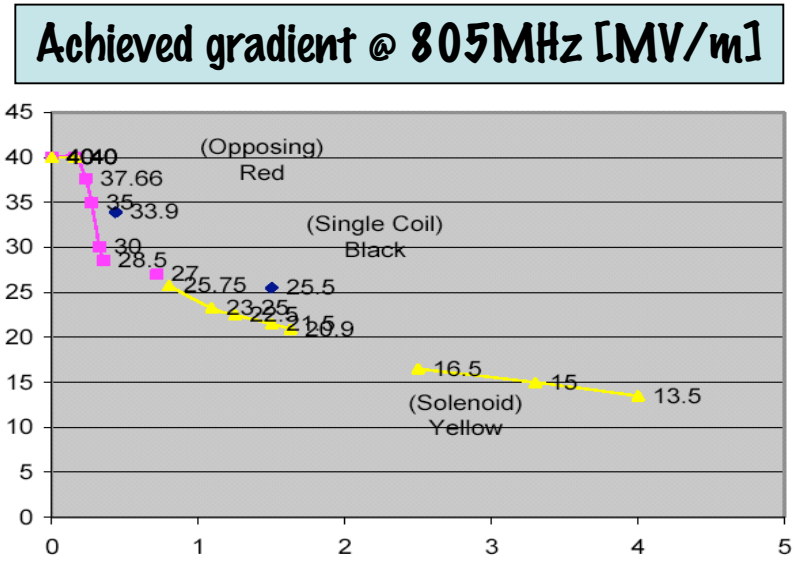
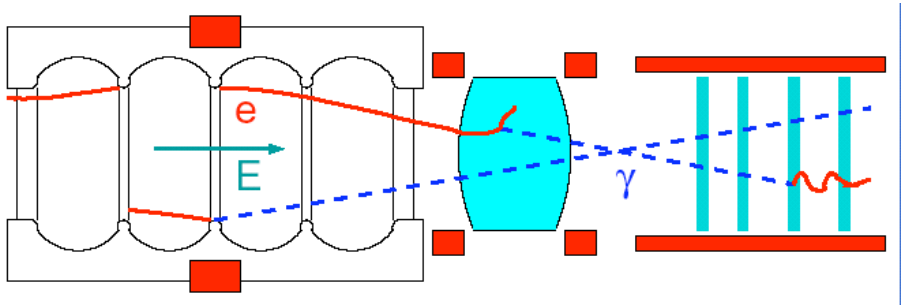
The Problem

- High-gradient Cu rf cavities in high magnetic field is a significant R&D risk for Muon Collaboration
  - Magnetic field focuses dark currents and lowers onset of breakdown
  - Ionization cooling channel packed with high-stored-energy cavities with thin windows in high magnetic field
  - In MICE, tracking detectors next to rf cavities are subject to x-ray backgrounds
- We have to demonstrate reliable and low-background operation









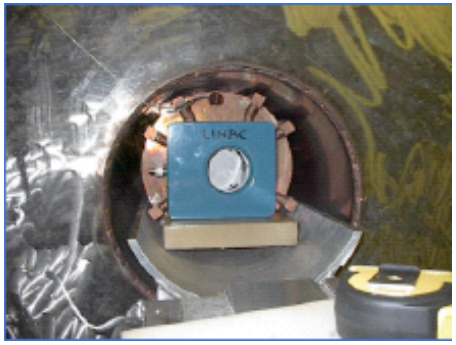
The Cast

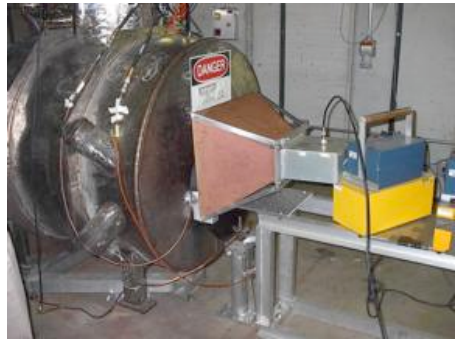
- Argonne: J. Norem
- Berkeley: D. Li, S. Virostek, M. Zisman
- Fermilab: A. Bross, M. Kucera, A. Moretti, B. Norris, M. Popovic, Z. Qian
- Geneva: R. Sandstrom
- IIT: W. Luebke, Y. Torun
- JLab: R. Rimmer
- Muons Inc.: M. Alsharoa, P. Hanlet, R. Johnson, K. Yonehara

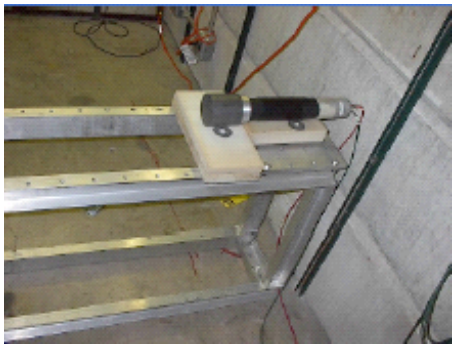
The Tools

- Want to measure electron, photon fluxes, spectra
  - Radiation meter
  - Beam transformer
  - Scintillator blocks
  - Scintillating fibers
  - NaI crystal
  - Ge diode
  - Photographic paper
  - Polaroid film
  - Rf antenna
  - Thermocouples
  - Microphones
  - Microscope, STM



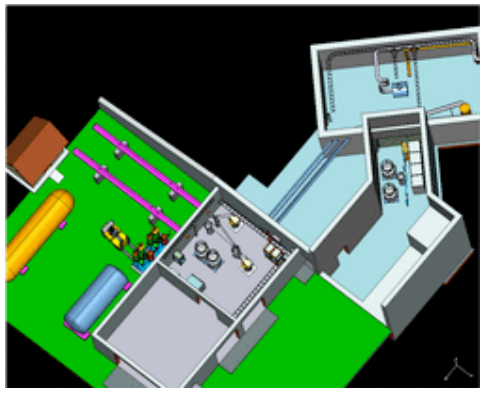



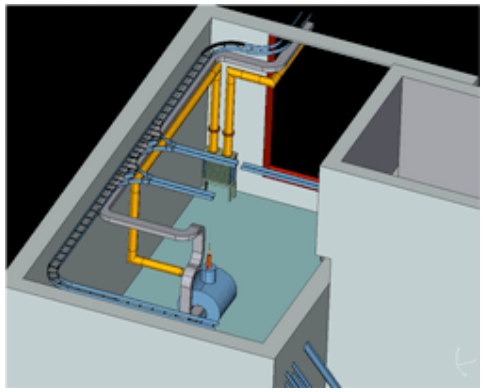


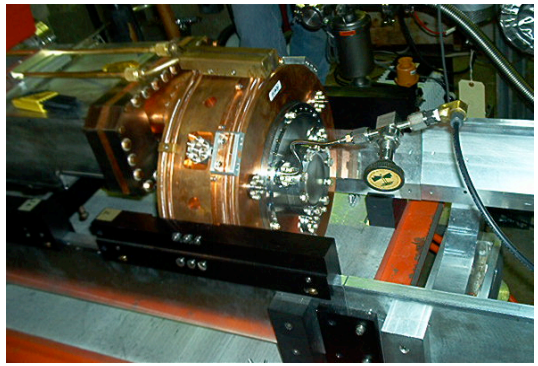



The Facility

- MTA has
  - 5T solenoid
  - 201, 805MHz power
  - Cryo infrastructure
  - Cabling for remote diagnostics
- We are installing
  - 805MHz pillbox cavity
  - 201MHz pillbox cavity





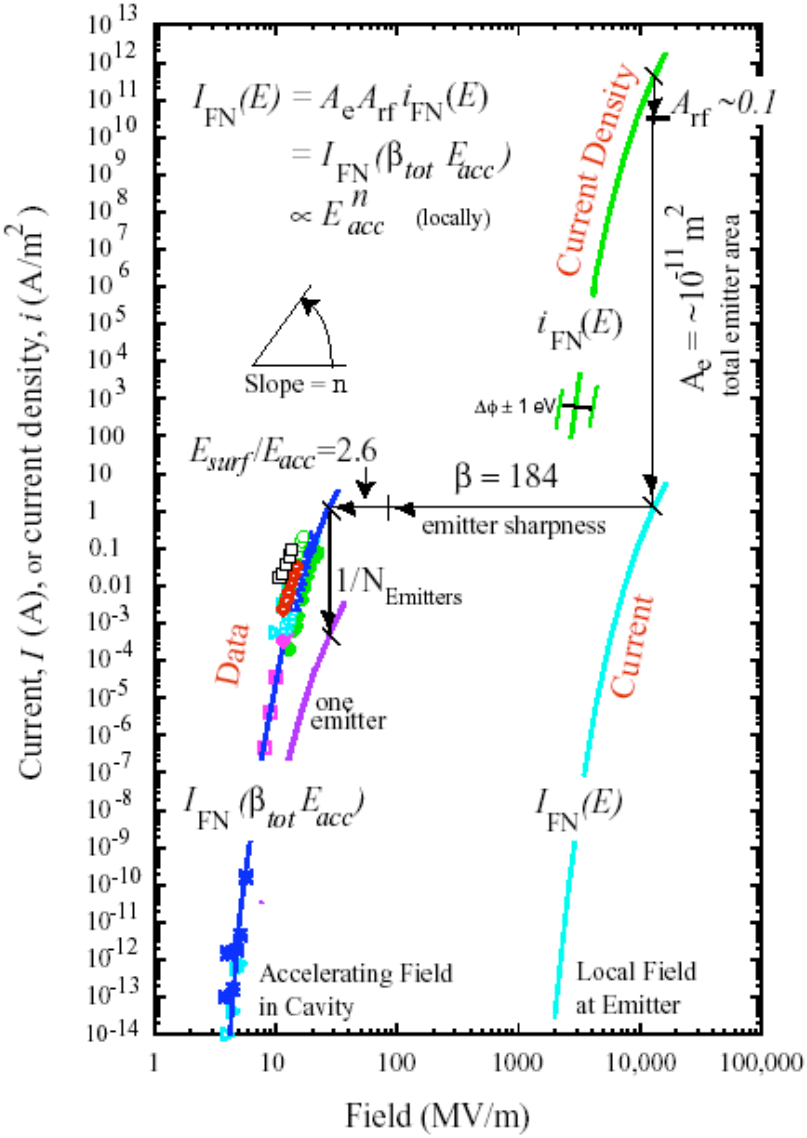


Dark Currents

- Precursor to breakdown
- Electrons tunnel through work function of metal
- Current rises very steeply with field (hard to make measurements)

$$j_{FN}(E) = \frac{A}{\phi}(\beta E)^2 exp\left(-\frac{B\phi^{3/2}}{\beta E}\right)$$

$$n = \frac{E}{j}\frac{dj}{dE} \simeq 2 + \frac{67.4\text{GV/m}}{\beta E}$$



Specific Goals

- Systematic study of breakdown for NC rf in high magnetic field
  - Develop general understanding, explore connection to rest of rf community
- Measure rf-induced background rates, spectra and noise for MICE
- Map cavity performance as a function of magnetic field for MuCool/MICE
- Identify and test promising materials, surface treatment, coatings

Plans

- 805MHz program to resume "real soon" at the MTA, need to assess schedule/priorities again
  - Will start with curved Be windows
  - Button hardware ready
  - Have grids to test
- Cabling installed
- Detectors being set up
  - purchased NaI crystal, PMT and base
- DAQ being set up
  - Reinstalled OS, programs on control PC
- 201MHz will start up shortly afterward