# The RF Program in the Muon Test Area

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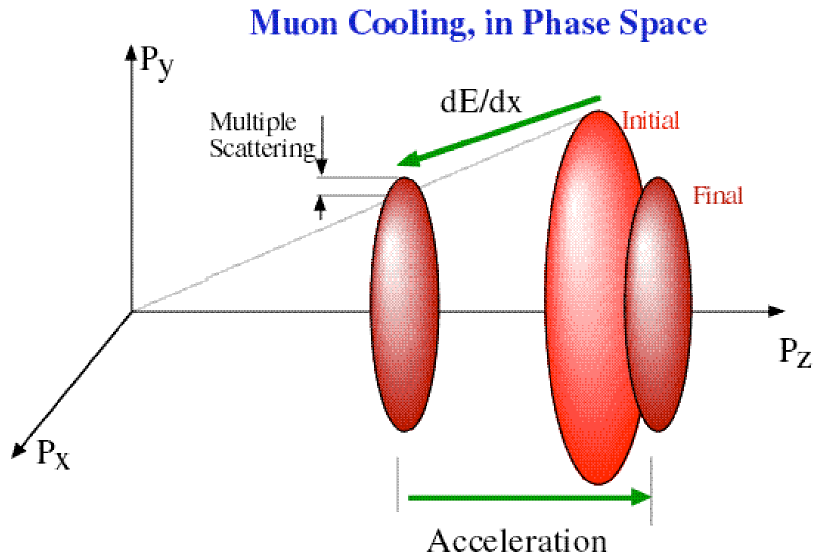
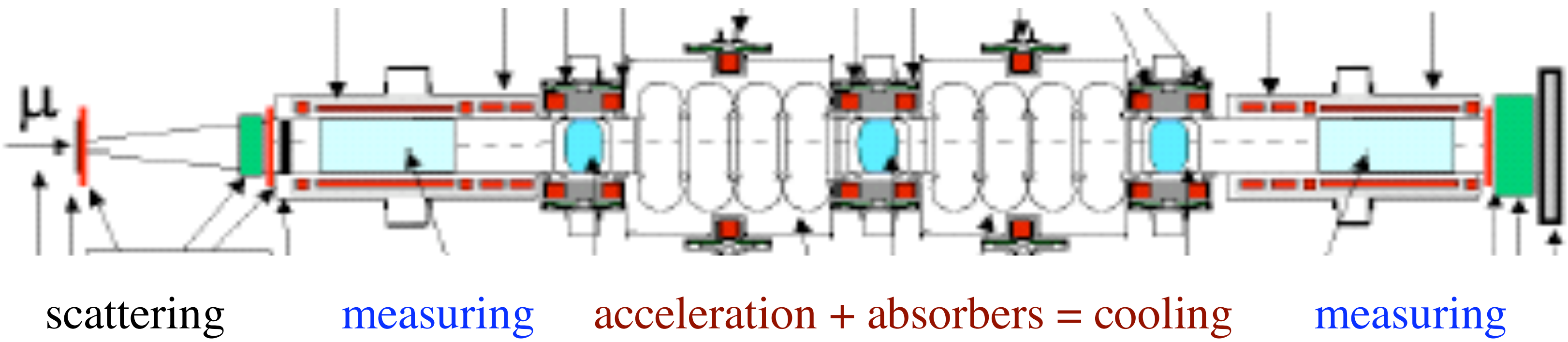
Muon Collaboration

# Muon cooling requires high rf gradients.

- Cooling muons requires absorbers and rf.




- Our Muon Ionization Cooling Experiment (MICE) cannot tolerate high backgrounds.




- Goals: Reduce backgrounds in spectrometers.
  Maximize *E* field with strong solenoidal *B* field

# Our 805 MHz effort in Lab G was very productive.

- Measurements of dark currents
  Very complete data set on dark currents
  Studied damage from dark currents and breakdown events.
  One long Phys. Rev. STAB paper, many conf. papers.

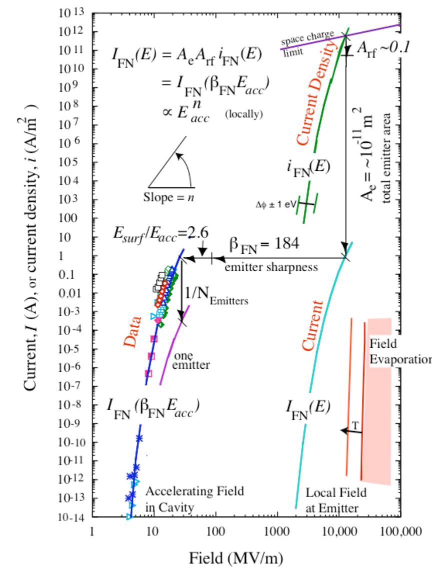
- Measurements with Magnetic field – a new problem
  Showed that B fields reduce max rf gradient
  Turning B field on or off requires new conditioning program

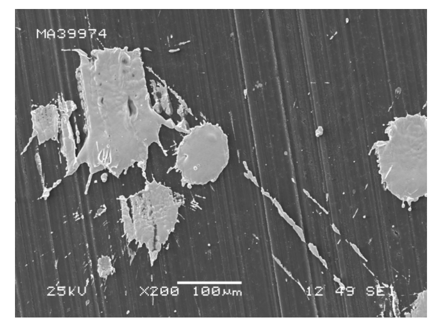
- Measurements with thin windows
  Operation is possible but somewhat unstable.
  New, more rigid, curved windows look good.

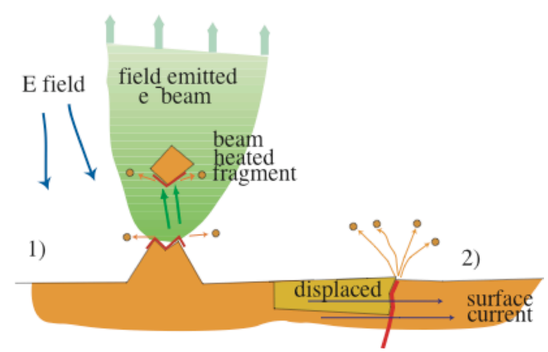
- Measurements with Be Windows
  NO breakdown damage to Be surfaces, while copper was damaged.

- New Model of breakdown
  Tensile stress, ***j*** x ***B*** forces, and high current densities are cause
  Many papers - Nucl. Instr. and Meth. A, coming out soon.
  Acc. Sci. and Tech. talk at FNAL, last December.

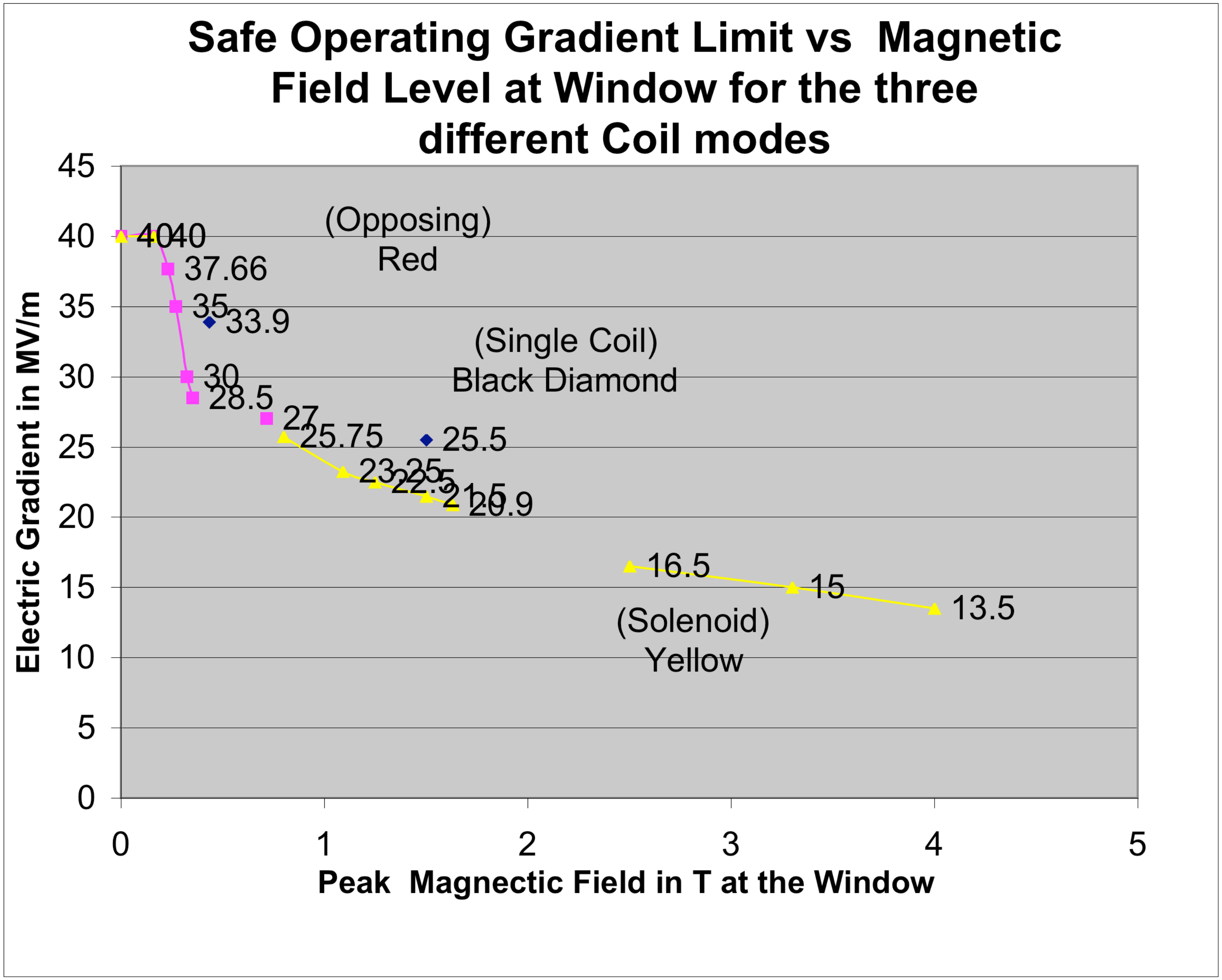
- Three invited papers at LINAC 2004 on this work.



Data on Maximum rf gradients with high solenoidal fields is new.



# We want to test a number of things in the Muon Test Area.

- 805 MHz continuation - easier and cheaper

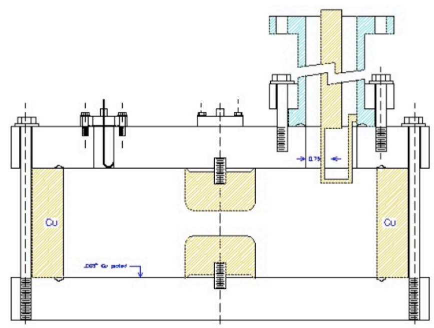
  - <u>LBL Pillbox cavity</u>

    Curved windows - more stable

    Tests of buttons, Be, Mo, Cr, SS etc

    Tests of B field conditioning and surface control

  - <u>High Pressure Cavities</u>




    Cu, Mo, Cr, W electrodes

    Magnetic fields

- 201 MHz Pillbox Cavity – the prototype for the MICE experiment.

    Maximize gradient with high B field

    Look at ways of decreasing dark currents.

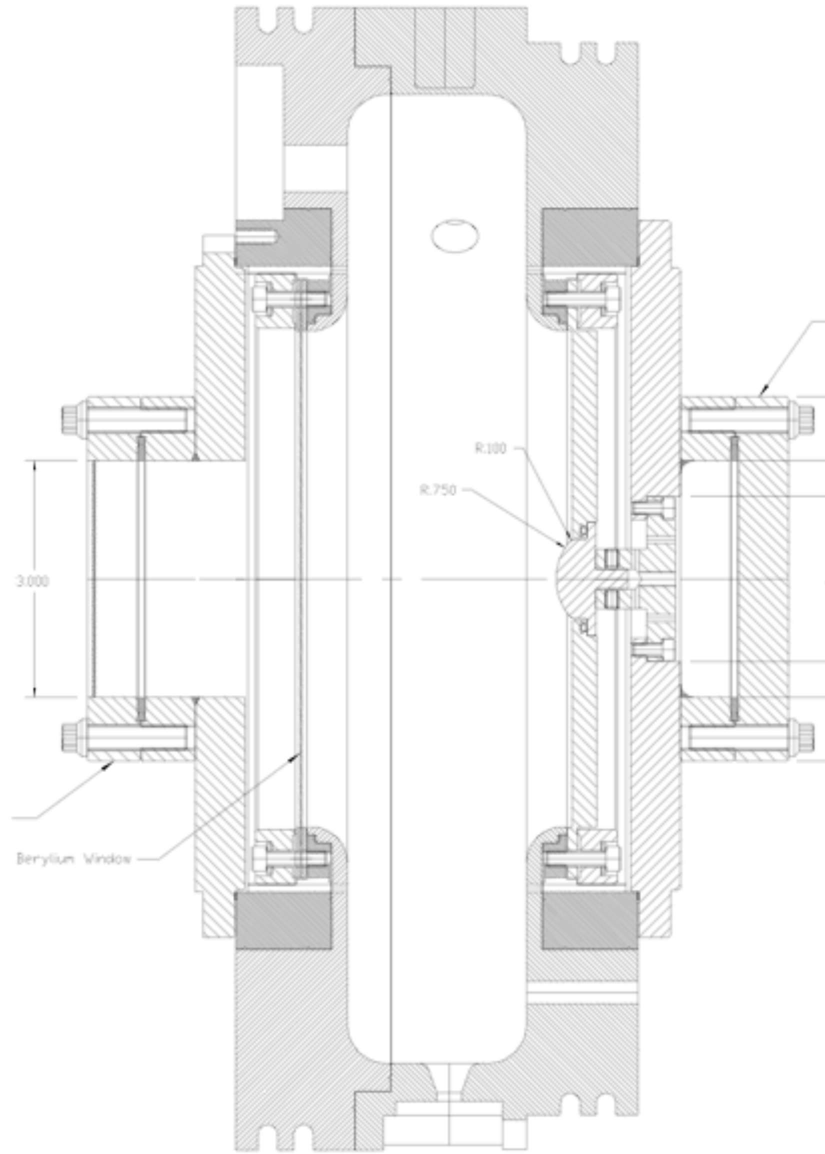
# We will test small samples of different materials.

- Different materials damage in different ways.

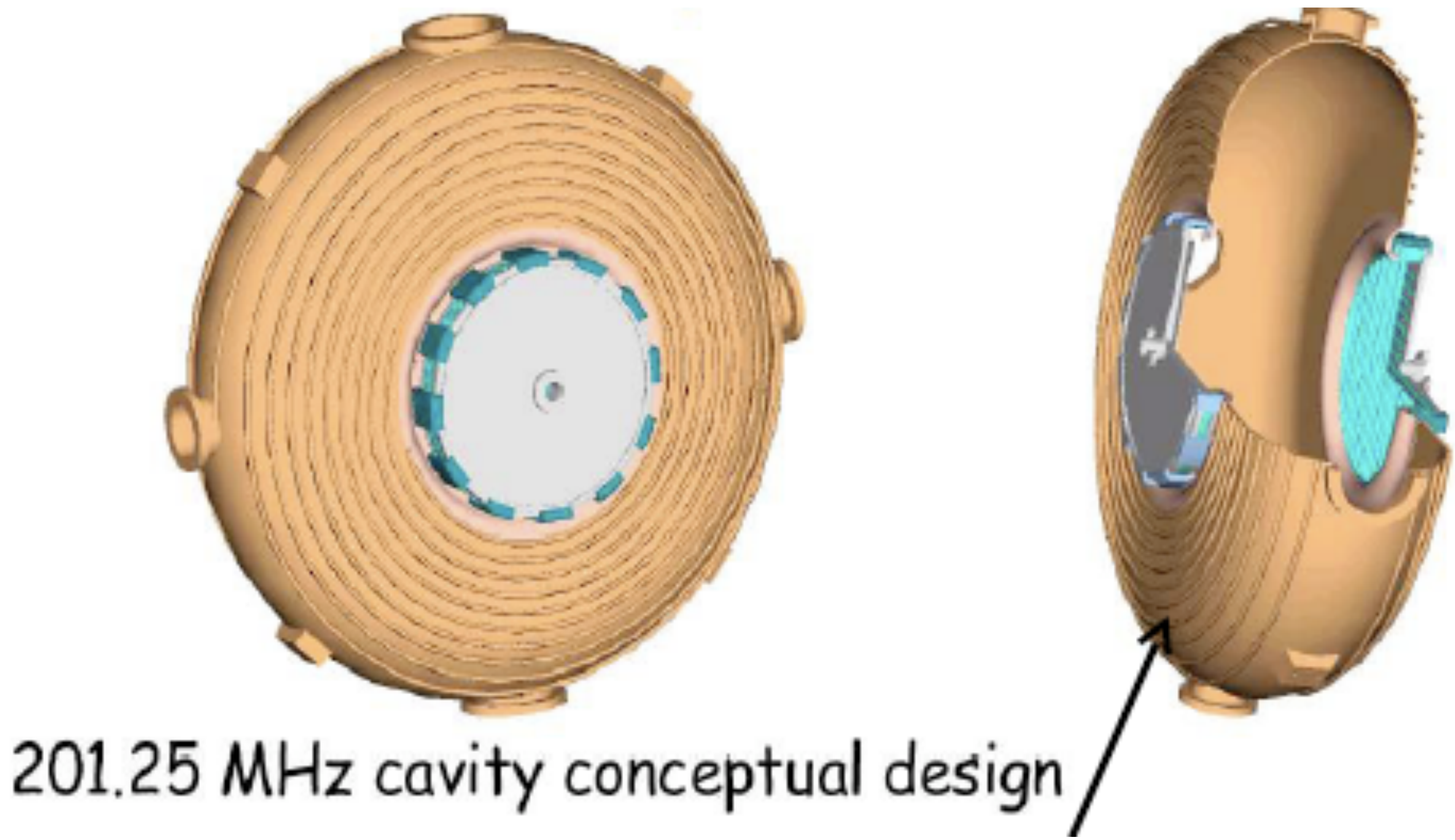
- We will be looking at a variety of materials.
  Stainless
  Molybdenum
  Chromium
  Beryllium
  Copper
  Tungsten
  plus a variety of alloys and coatings

- Magnetic field is a unique factor.
  A useful diagnostic – can see single emitters
  A problem – prevents high gradients

- Can we reduce the “Moretti effect” using coatings with high work function?

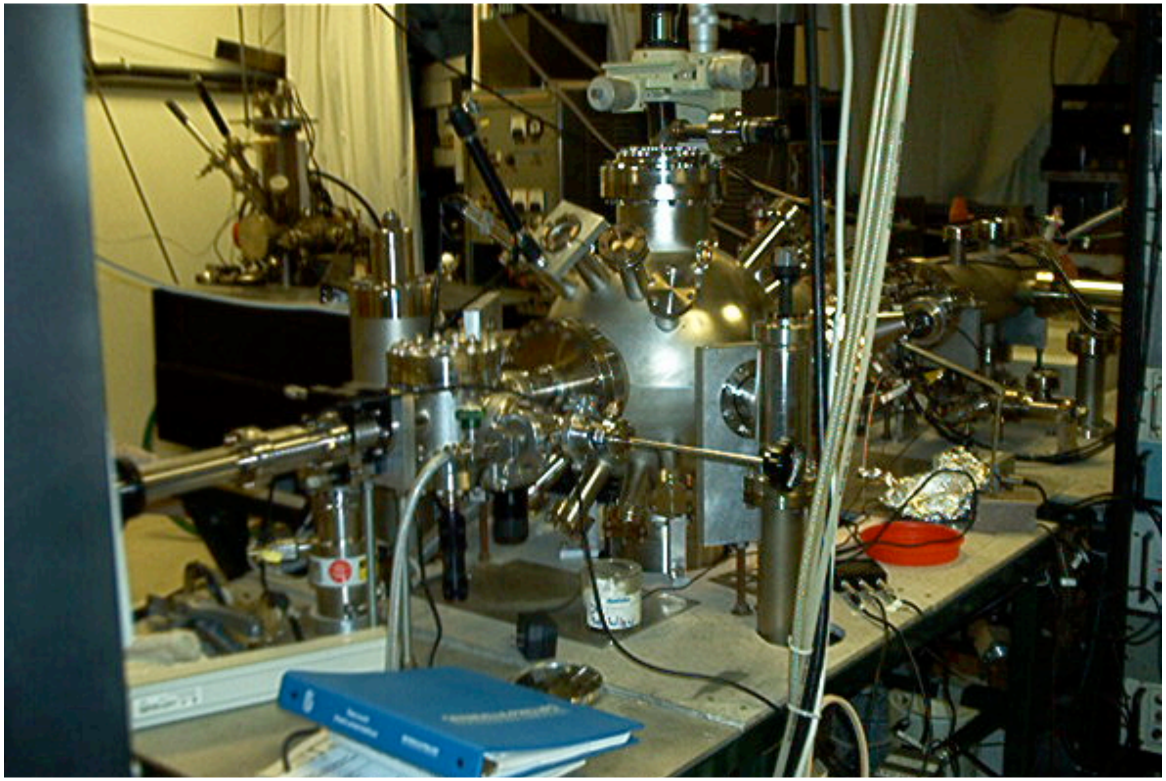


The major change will be the 201 MHz Cavity from LBL.



# We will use the techniques of Nanotechnology to solve rf problems.

- An LDRD supported effort at Argonne has been looking breakdown effects.
- An experimental effort will use Field Ion Microscopy to look at ***E*** field effects.
- Field ion microscopy uses high fields to take apart materials atom by atom, in a way they can be reconstructed in a computer.
- We have hired Jason Sebastian, a NW post doc, to develop an experimental program, testing practical coatings in a field ion microscope.
- All useful parameters can be measured in these machines.
  - Structure
  - Bonding
  - Field emission
  - Cleaning procedures
- Fast turn around.
- This community understands materials and fields.



## Summary

- The Muon Collaboration is continuing a productive program of rf studies in the MTA.
  - Three invited talks at LINAC 2004 in Lubeck Germany.
  - Two refereed papers, many conference papers written.
  - New physical mechanisms discovered - interactions of rf with magnetic fields
  - New models of breakdown.
- The immediate goals are to:
  - minimize dark current/x ray backgrounds
  - maximize the rf gradients in the presence of large solenoidal fields.
- There is a large group involved
  - FNAL
  - Argonne
  - LBL
  - JLab
  - IIT
  - U of IL
- We are trying new technologies, models and materials.
  - Button tests, coatings.
  - Nanotechnology / Field Ion Microscope work
  - Development of breakdown models.

# P. S, We found "New" data on breakdown.

- Breakdown at surfaces and in gasses can be easily seen as separate processes. This data was taken in air and shows the same gradients we see in rf experiments at very small electrode separation.