

# Rf Background Status and Plans



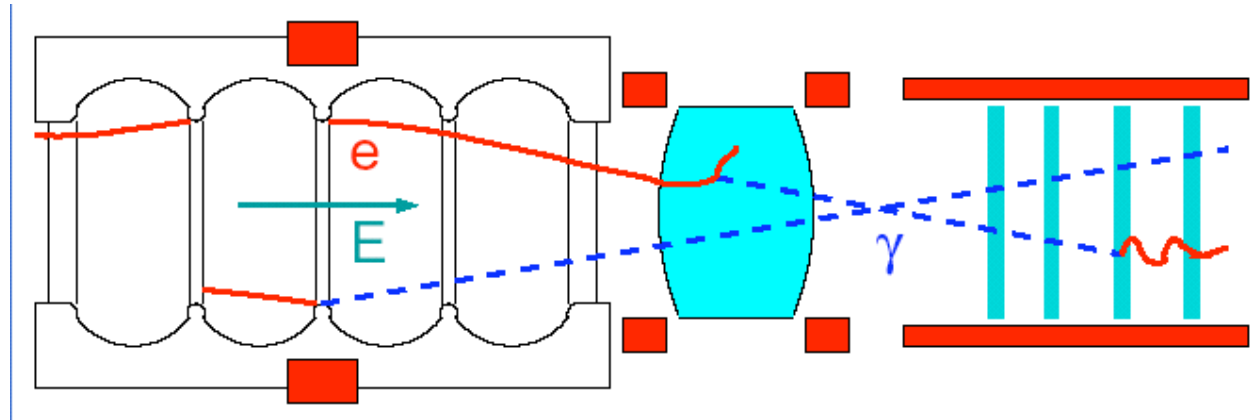
Yağmur Torun, IIT

MUTAC Review

Apr 28, 2004 - BNL

# Recap

- Dark currents appear to be precursors to breakdown
- Magnetic field focuses dark current and lowers onset of breakdown
- Ionization cooling channel is packed with high-stored-energy cavities with thin windows in high magnetic field
- In MICE, tracking detectors are placed next to rf cavities and are subject to x-ray backgrounds from electron bremsstrahlung

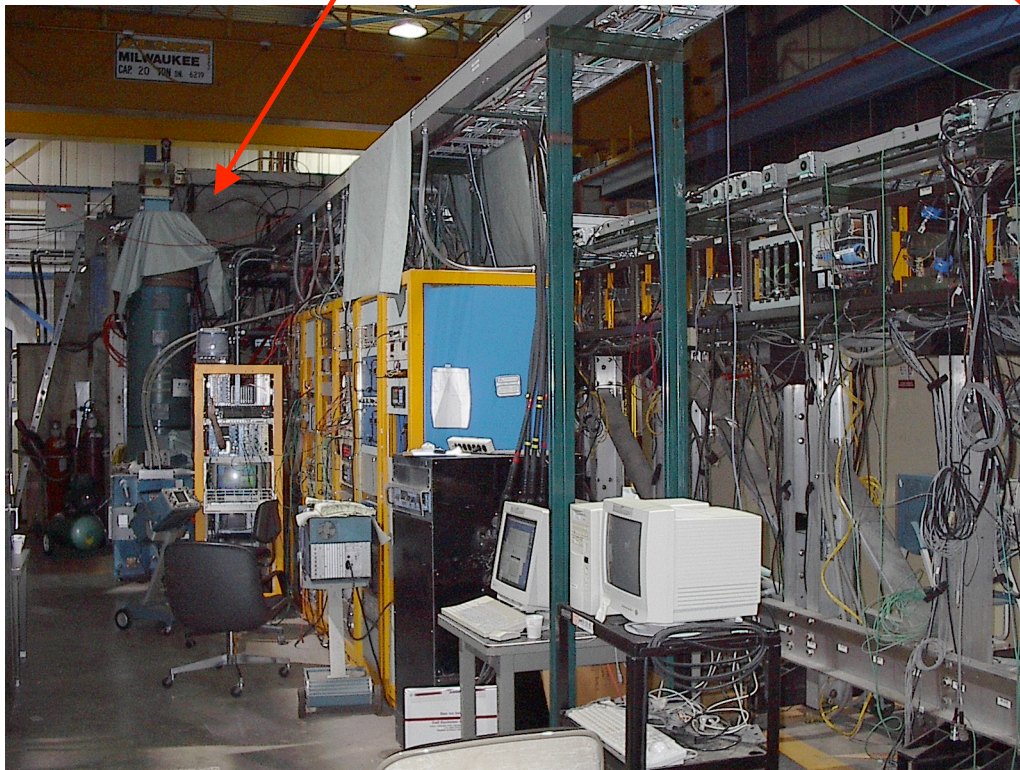
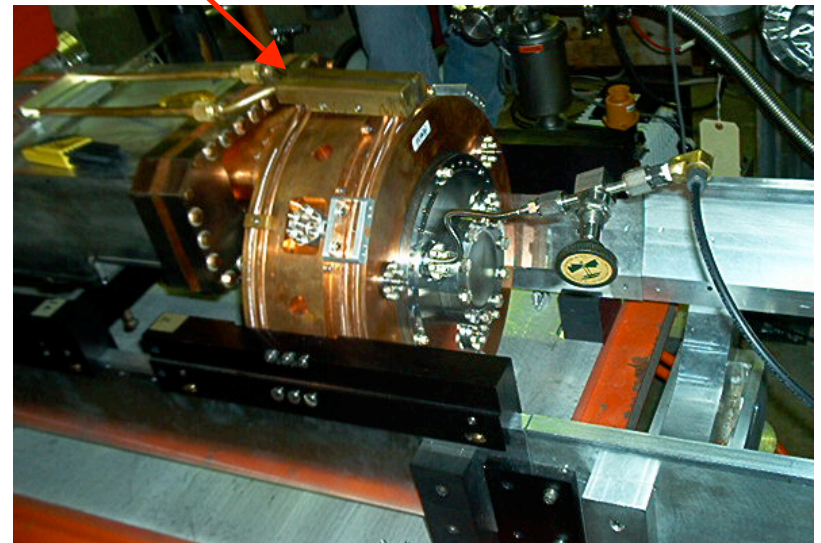
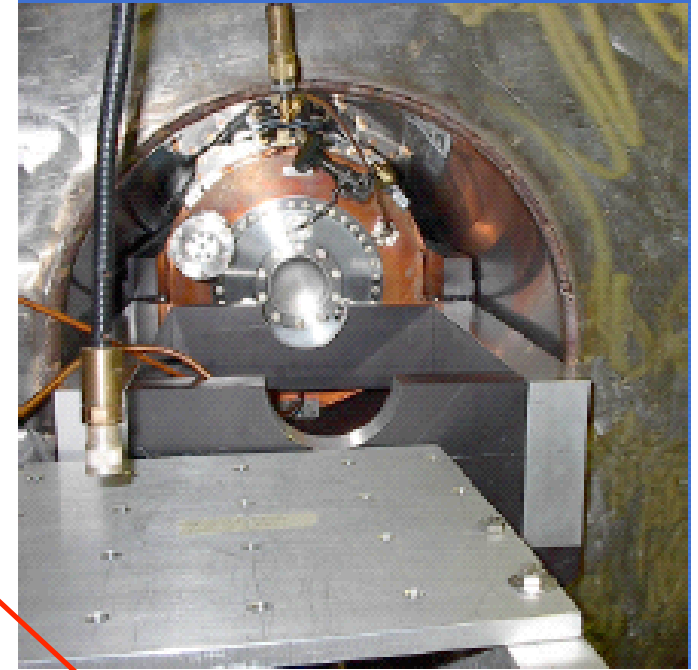


## Progress last year

- **Published open-iris 6-cell cavity data: Phys. Rev. ST Accel. Beams 6, 072001, Jul 03 -- the first systematic study of breakdown for NC rf in high magnetic field**
- **Collected more data at Lab-G (Fermilab) during pillbox cavity running**
- **Measured rf-induced background rates and spectra**
- **Measured rf noise**
- **Mapped cavity performance as a function of magnetic field**
- **Hosted high gradient rf workshop, exchanged ideas and data with rest of the community**

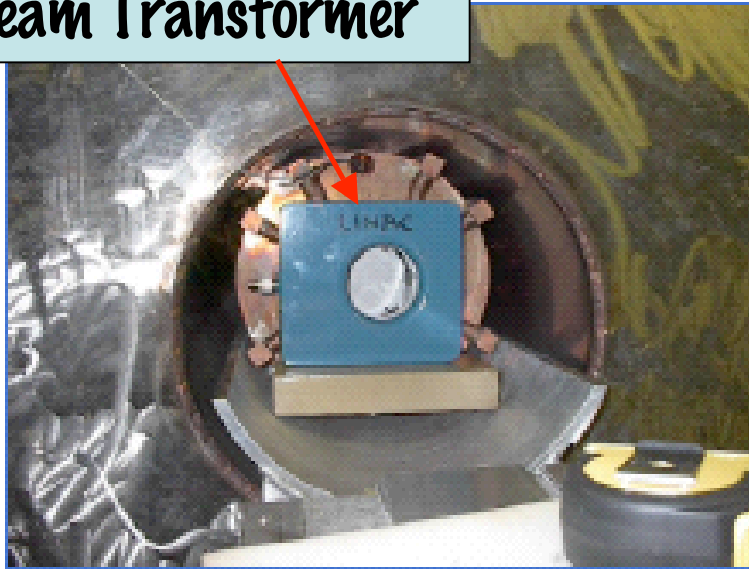
# Lab-G: Hardware Setup

- 805MHz pillbox cavity with removable endplates
- In 5T solenoid magnet
- 1.2MW klystron

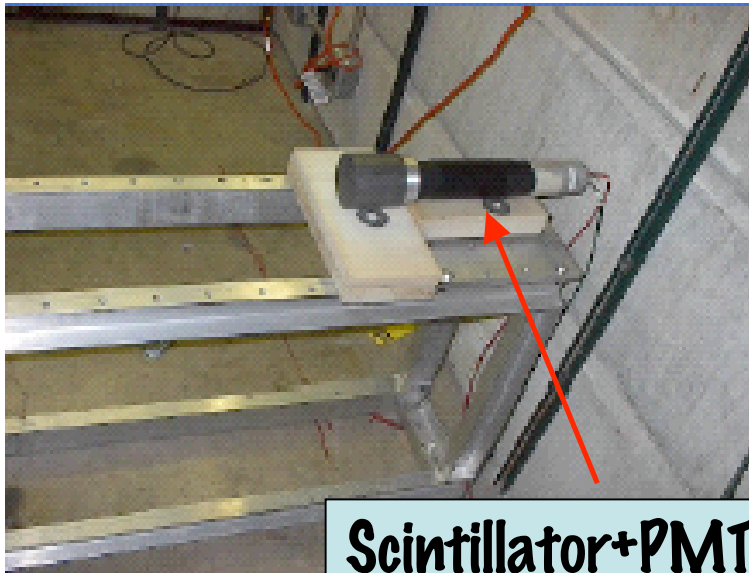


# Lab-G: Detectors

Beam Transformer



Ge Diode



Scintillator+PMT

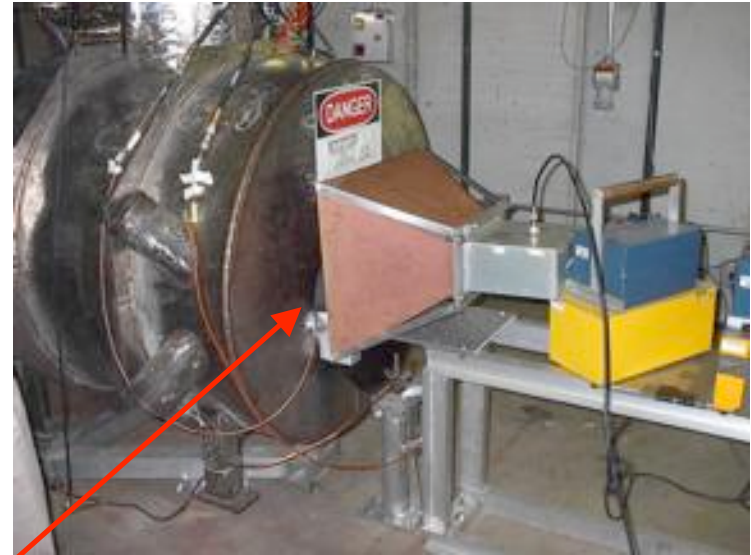


Scintillating fibers

# Lab-G: Detectors



**Photographic plates**

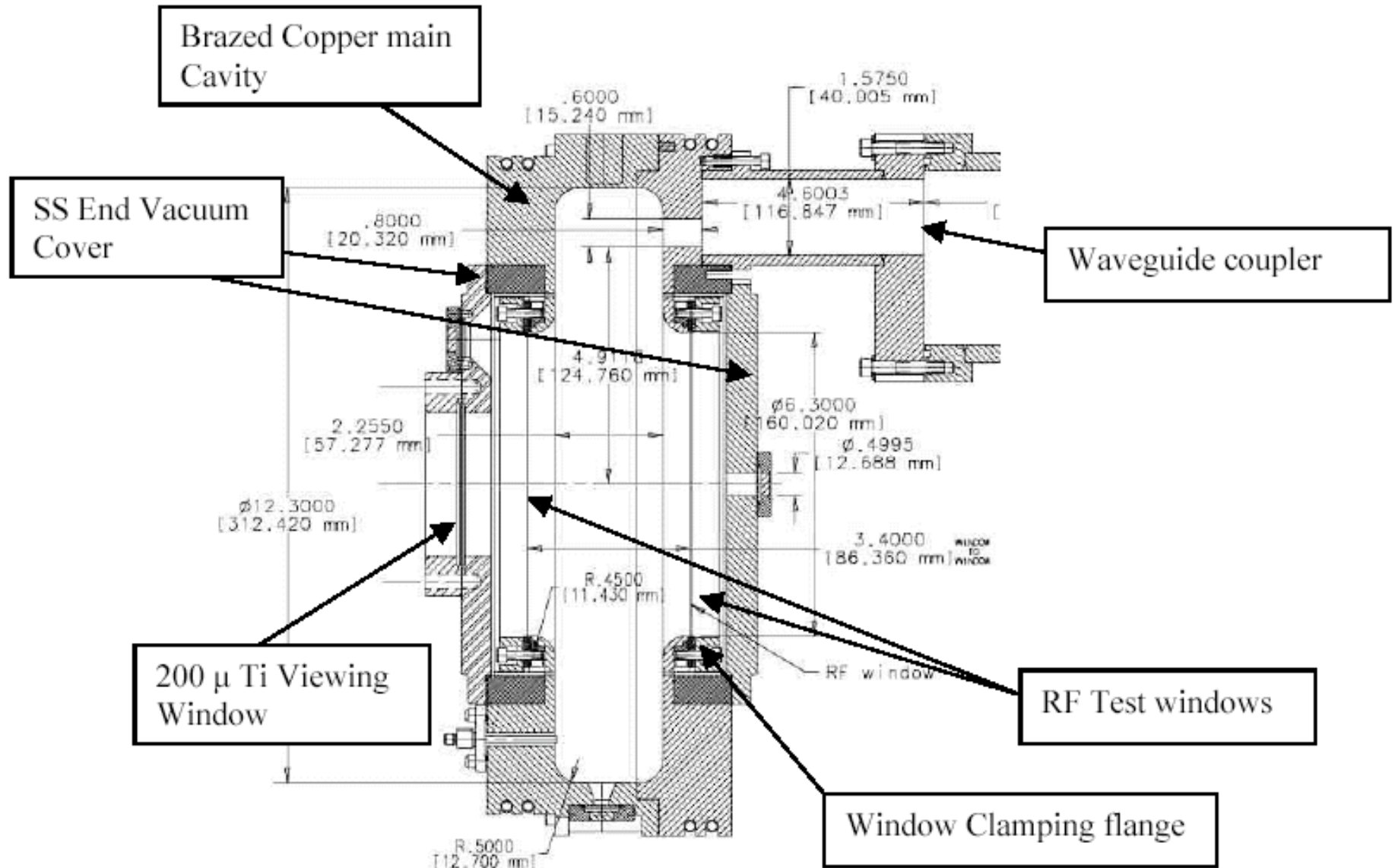


**Antennae**



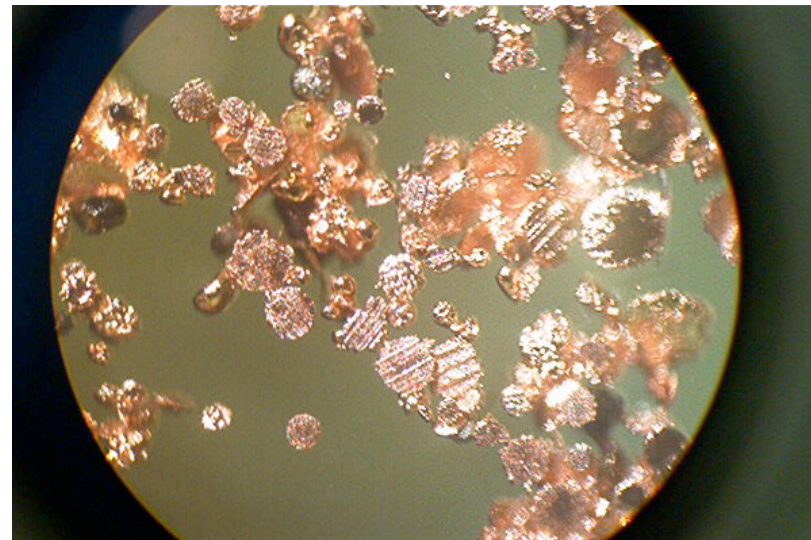
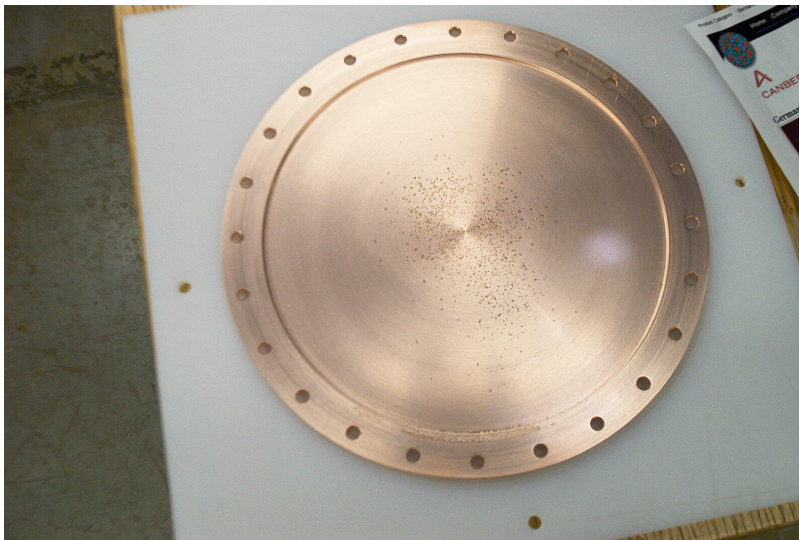
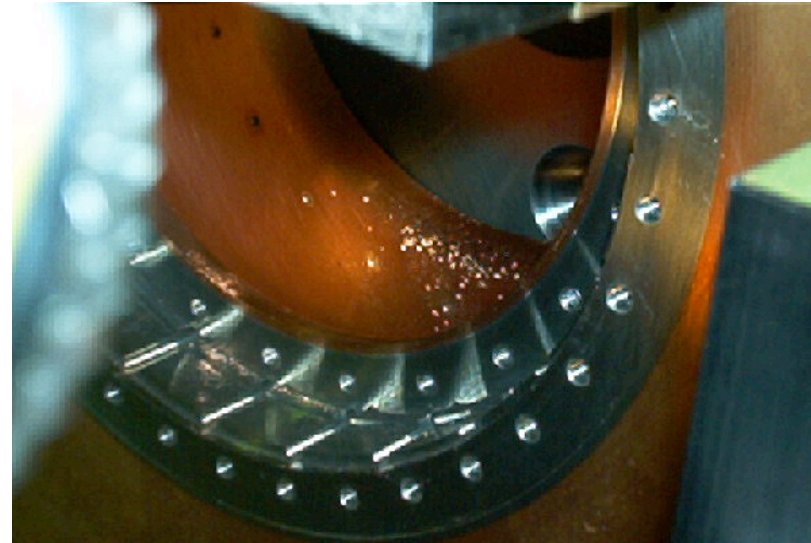
**Radiation monitors**

# 805 MHz Pillbox Cavity



# Inspection: Cu Endplate

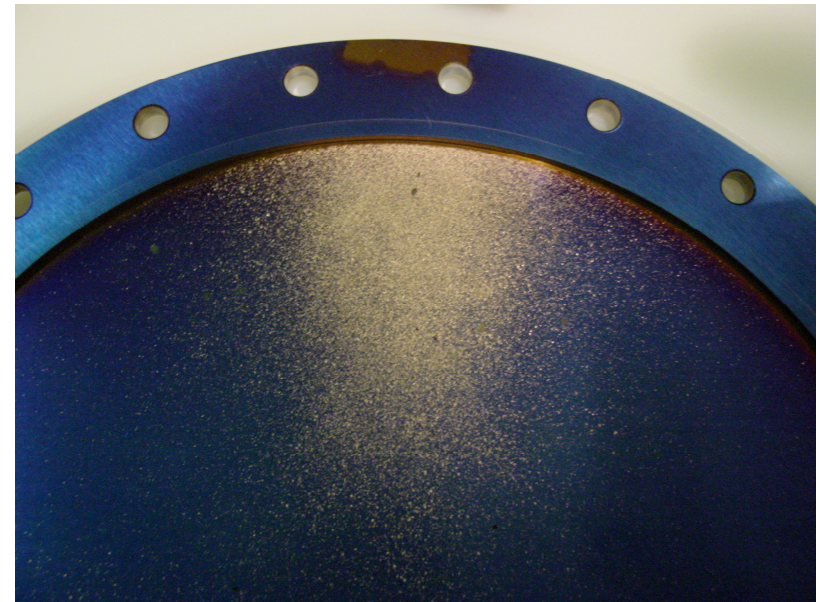
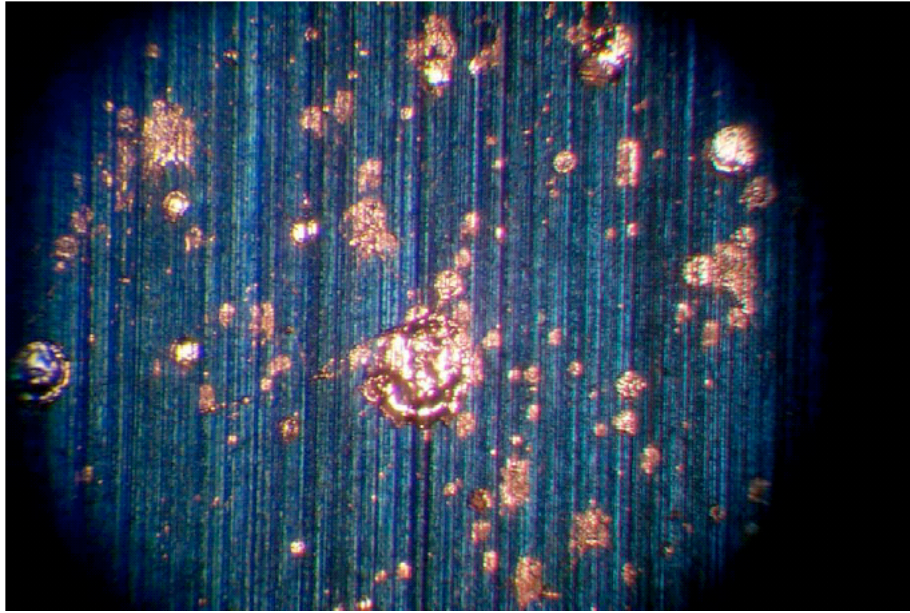
- Cu dust observed on disassembly
- Corresponding pits on Cu endplate





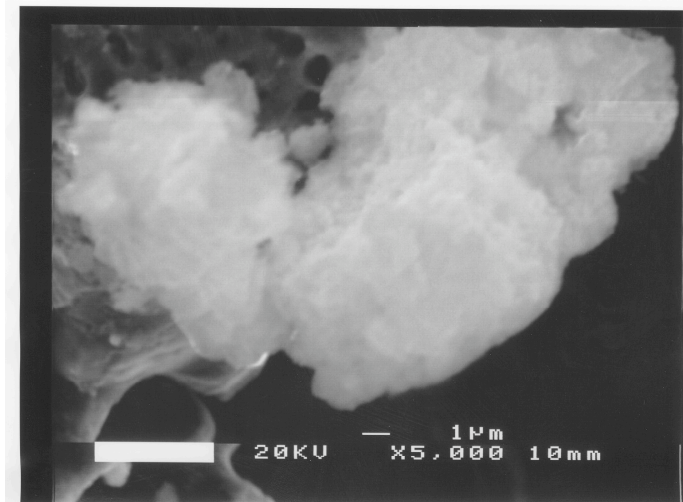
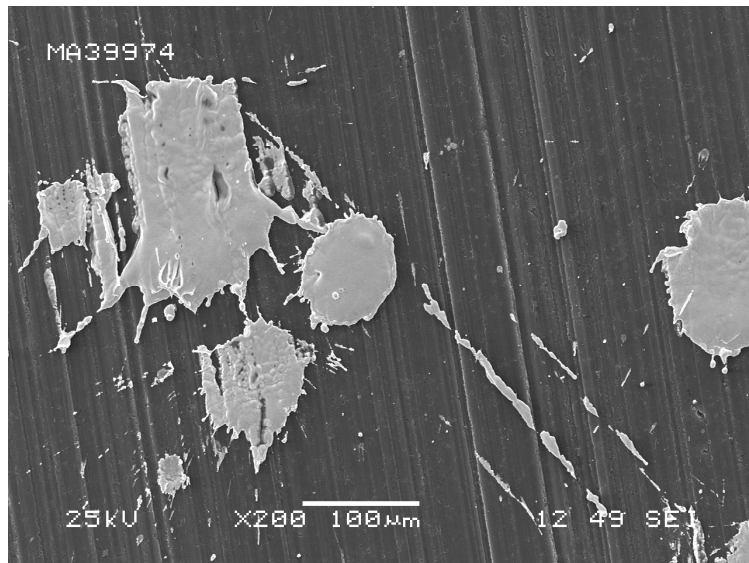
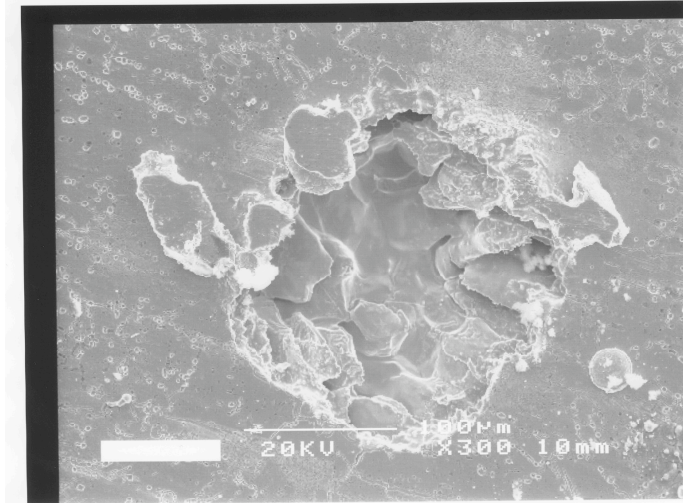
# Inspection: TiN-coated Be Window

- Cu deposited over window surface
- No damage to coating or Be window



# Inspection: TiN-coated Be Window

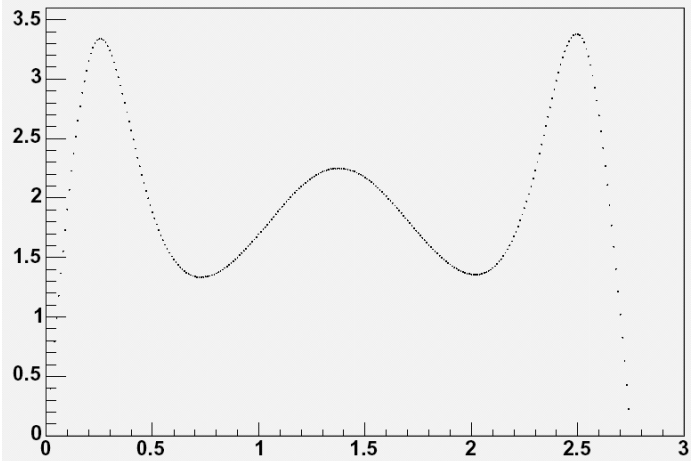
- SEM analysis confirmed Cu blobs on surface



# Effect of Magnetic Field

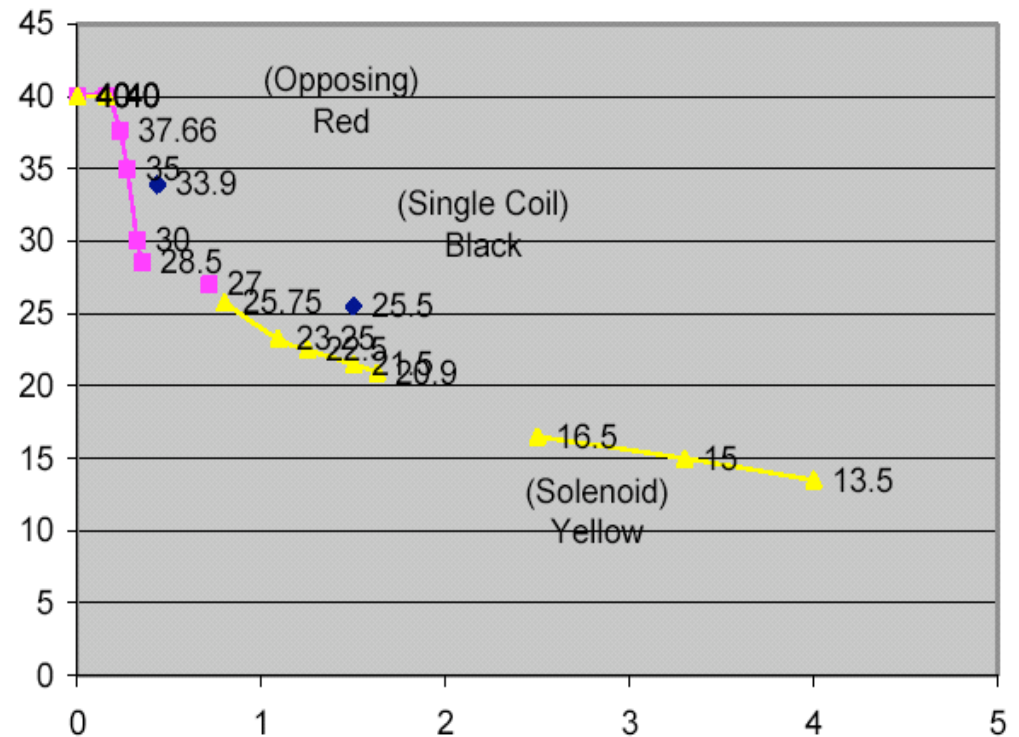
- Onset of increased sparking at low field
- 201 MHz cavities need to operate in 1.5-2.5T

Stud II on-axis field [T]



z [m]

Peak safe operating gradient [MV/m]



Field at window [T]

# Workshop on High Gradient Rf

## Oct 7-9 2003, ANL (J. Norem)

- Over 80 participants from major labs, universities and industry in North America, Europe and Japan
- Executive committee: C. Adolphsen (SLAC), S. Holmes (FNAL), N. Toge (KEK)
- Program committee: V. Dolgashev, T. Higo (KEK), **D. Li** (LBNL), **A. Moretti** (FNAL), **J. Norem** (ANL), **R. Rimmer** (JLab), N. Solyak (FNAL), I. Syratchev (CERN), Z. Yusof (ANL)
- Local: **S. Geer** (FNAL), **A. Moretti** (FNAL), **J. Norem** (ANL), N. Solyak (FNAL), **Y. Torun** (IIT), Z. Yusof (ANL)

# Workshop on High Gradient Rf

- Lots of data from prototype structures
- Both normal and superconducting rf
- Review of instrumentation
- Simulation results
- Breakdown models
- Lots of interest in Lab-G results: our high magnetic field capability is unique
- Discussion of future work and possible collaboration
- Workshop page at <http://www.hep.anl.gov/rf>
- Presentations at <http://mice.iit.edu/rfworkshop>
- Summary (J. Norem) in CERN Courier Jan-Feb 04

# Status

- Lab-G klystron reclaimed as Linac spare at Fermilab, Lab-G 805MHz program stopped at the end of 2003
- Preparing for setup in the **MuCool Test Area**
- Controls and cabling being installed for the MTA
- Cu is the weak link for achieving high gradients, TiN coating seems to work well -- sample insertion device designed for studying other materials/coatings
- Preparing second Lab-G paper (NIM A) for pillbox data
- Projected dark currents safe for window integrity and background rates for MICE

# Plans

- **805MHz program should be back on early summer at the MTA**
- **Will have better automated data acquisition**
- **We will be studying other materials (Mo, Cr, W, etc.) that could withstand higher peak fields**
- **A surface physics initiative is in planning (J. Norem) for understanding breakdown processes**
- **201 MHz program will start Fall 04 (possibly in parallel with 805), it's critical that we confirm expected background rates for MICE**
- **Detailed simulation of the effects of background for MICE also in progress**