RF Studies: a Two Part Program

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1) MTA Work (starting May 15+)

- 805 MHz
  - Grid (Mohammad's Thesis)
  - Domed window - Tests stability of thin window
  - High Pressure cavity - Measures high pressure breakdown
  - Button tests - Look at different materials
- 201MHz (under construction)
  - Conditioning - How fast, how much radiation produced
  - Dark current measurements - How can we improve the running conditions

2) Surface Studies Proposal - material, plasma and surface physics, ANL/Northwestern

- Simulations - What triggers breakdown? What parameters are variables?
- High Electric Field Tests - How do solids fragment? What does the process look like?
- High Current density - What is the limiting current density? (CLIC seems close.)
- RF cavity tests - After we understand the process, how much real control?
  - Submitted to DOE Apr 16.
  - Planning submission to EPRI and perhaps NSF

We have a model of rf breakdown and dark currents

Talks at
   High Gradient Workshop
   Fermilab, Northwestern, Argonne, SLAC, (U of Chicago Monday)
   Muon Collaboration meetings

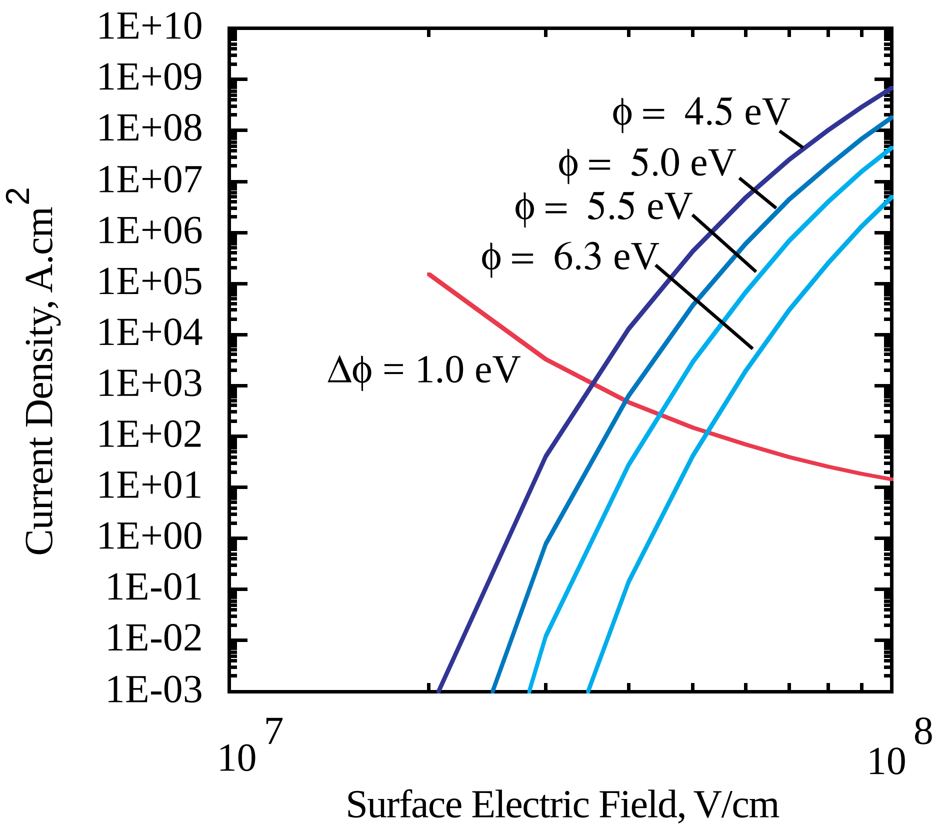
The model assumes:
   Cavities break down at field emission sites when high fields fragment the surface.
   fragments are heated by field emission (P = 0.1 W) / (V = 5 μ * 5 μ * 1 nm)
   The model says the surface matters.

The model is relevant to
   Normal conducting Linear Colliders (NLC, GLC, JLC, CLIC)
   Superconducting Linear Colliders (TESLA)
   Synchrotron rf
   Linacs
   Power distribution
   Klystron design

MICE rf is based on extrapolations.

We could still have some surprises with backgrounds.
These would be expensive in time and money, (and programmatically)
rf continues to need a high priority

The best option is to use high workfunction coatings. Huge gains are possible.
We don't understand B fields, but $\boldsymbol{I}_{\text{Field Emitt}}$ x $\boldsymbol{B}$ forces must be bad, lower currents good.



Surface studies should help MICE.

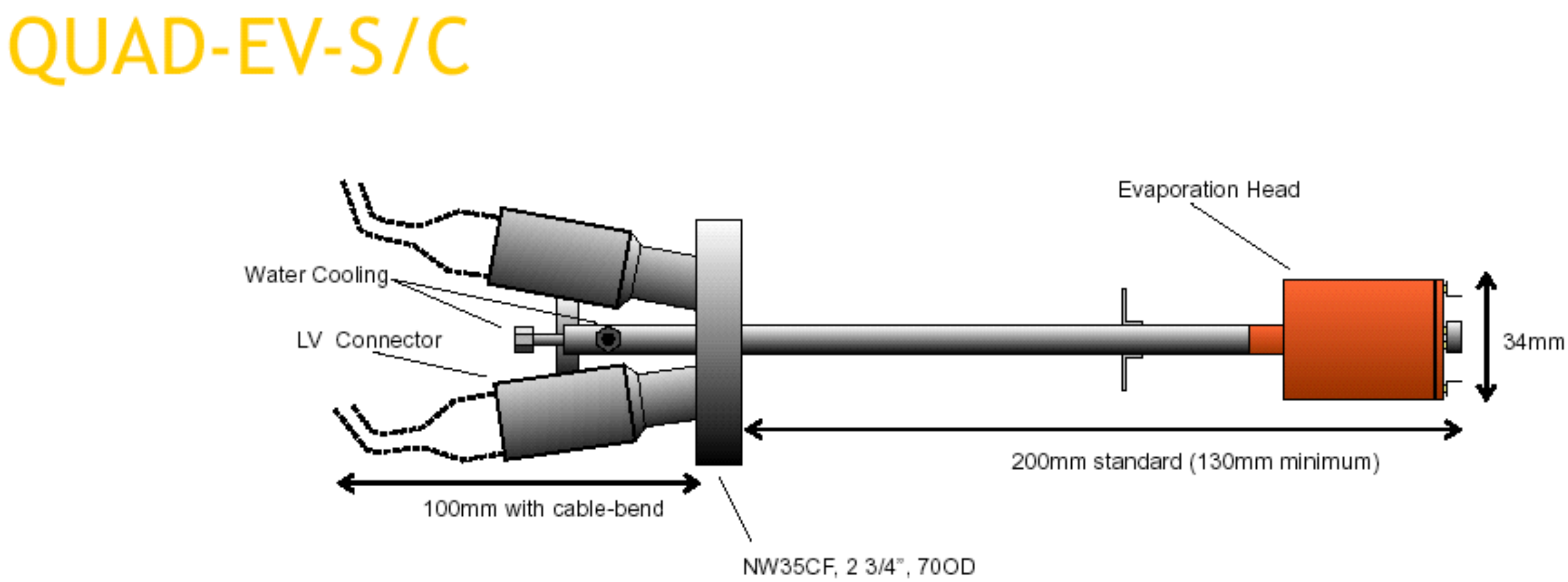
The breakdown and dark current studies aim directly at MICE.
- We need a systematic look at high work function materials for 201 MHz.
- Tests with the 201 MHz cavity are expensive, time consuming and risky.

Using an APFIM, we can experimentally measure how well we can control the surface
- Procedure
  1) Produce field emitter from any metal
  2) Clean (or dirty it)
  3) Measure the Field Emission
  4) Coat it in-situ (with monolayer, multilayer coatings)
  5) Re measure the Field Emission
  6) Measure how well the coating sticks to the substrate (removing it atom by atom)
  7) Remove coating, go to 2)

- A single pumpdown can do (6 substrates) x (4 coating materials) = 24 expts.
  plus multi-layers
- Unfortunately, for fast results
  - The material science people are busy doing other things.
  - The deposition system costs ~20k$
  - People, money and time are in demand
  - Materials science people are interested in programs, not single measurements

Some of the equipment is complex.

The Quad Evaporator costs about 20 k.



Simpler tests with existing equipment are possible, and we are pursuing the options.

We have funding from an Argonne LDRD for this.

We will also be looking at breakdown issues in the surface program.

Summary

The programs at the MTA and the ANL/Northwestern surface studies are complementary

They are relevant to MICE and MUCOOL.

They should have a high priority.