

MIPP TPC

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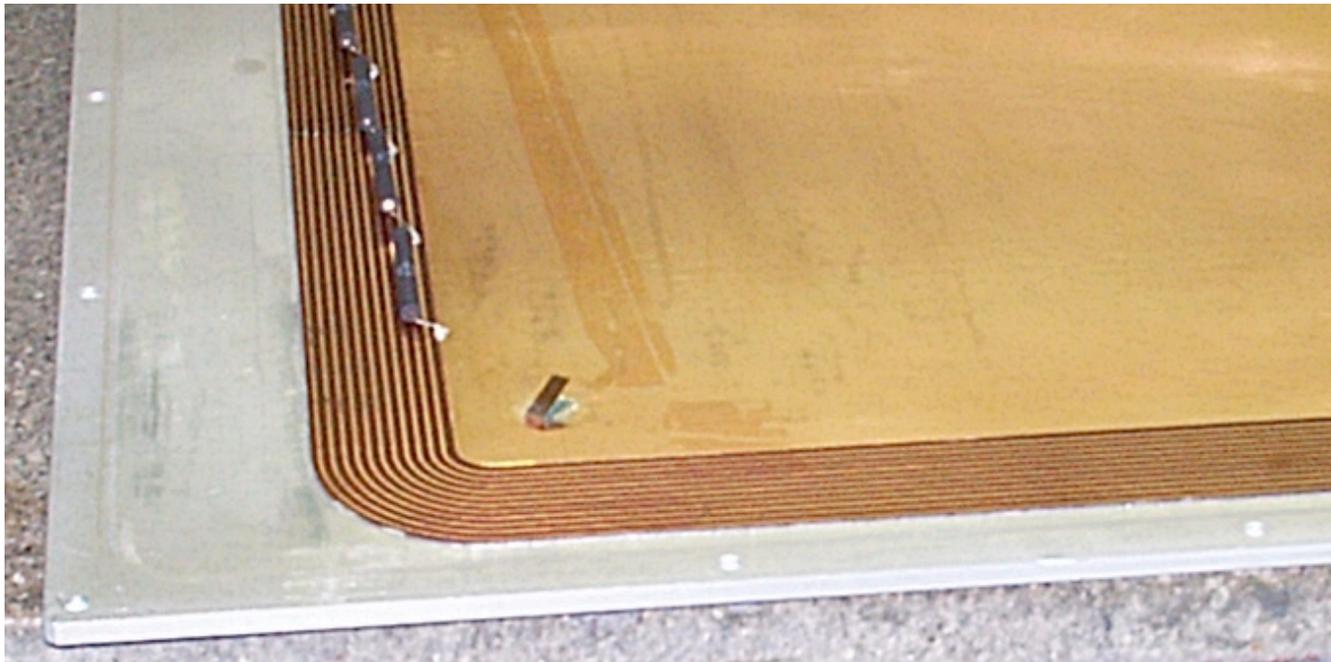


Fermilab, 11 June2004

February To Do List – Cathode Sparking



- Ramped to 10 kV in N₂ :)
- Ramped to 5.6 kV in P10 :(
 - Go back to N₂ and retest - today Done.
 - Open lid and inspect? Done.
 - Plastic window to locate arc visually? Done.



TPC lid resistor ladder repaired, cathode stable at 10 kV in P10.

February To Do List – High Voltage Control



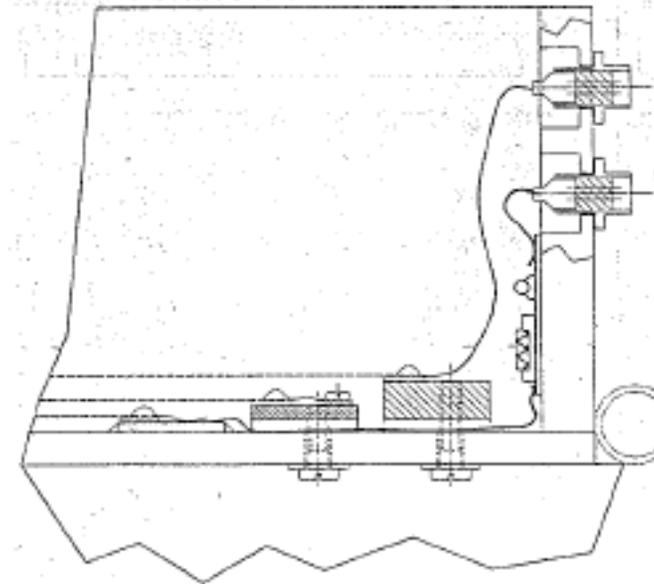
- **Cathode**
 - Cathode HV control program
 - Can communicate with HV supply
 - Control code in progress

- **Anode HV Control** **Done***
 - Final ramping code not yet public

February To Do List – Gating Grid



- **Gating Grid**
 - Fix pot knob, rack slide **Done**
 - Connect cables to TPC **Done**
 - Test operation (waveforms on scope) **Finally done**
 - **First had to find, fix all the ground faults**
 - **2 of 4 Field Cage support blocks had rotated to touch end gating grid wires**



February To Do List – Gating Grid

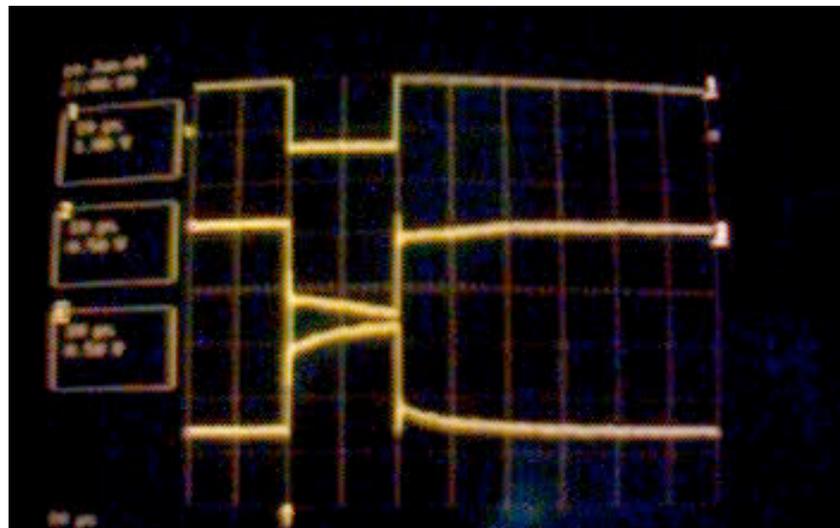


- Rebuilt all four cables correctly to remove ground faults
- Built terminator boxes for cables ends at TPC
 - Eliminated ringing!

- **Traces:**

Top	Gate
Middle	“Positive” Grid
Bottom	“Negative” Grid

Monitor outputs are distorted; real pulses have 100 ns time constants.



February To Do – Random



- **With TPC Out of JGG**
 - Install water leak sensor, pan,
 - pump shut off

Done.
Not done!
Deferred
 - Work on 3 bad sticks
Deferred
 - Electronics bay purge and covers
Tested, ineffective!

- **Gas**
 - P10 Mixer
Done
 - O₂ Monitor, H₂O Monitor
Ordered

- **Analyze “spare” stick data, make repairs** **Deferred**

Other Work Completed



- **Calibrated all Anode HV channels**
 - Repaired bad channels
 - Modified one board to match high current sensitivity of other two
 - Common voltage, current readback calibration is adequate, on web
- **TPC Trigger and Monitoring**
 - Installed gate generators for all TPC DAQ gates
 - GG GATE make grid transparent for the event
 - TPC GATE DLY wait for GG transients
 - TPC GATE conversion window for ADCsThese generate BUSY (in addition to DSPs, PPCs)
 - Have most of monitoring modules
 - TPC CLK
 - TPC TRG TPC clock phase wrt TPC GATE
 - GG voltages, on and off pulseNeed to condition signals, cable, test.
 - Need TPCTrg software detector, to set gates, read monitoring data

Other Work Completed



- **Grounded DC racks**
- **Have 4 RTDs**
 - **Need mounting blocks to install them**
- **Replaced upstream GG Twinax connector**
- **Replaced lid O-ring (last “active” original)**
- **Found leak in upstream beam window edge**
 - **Leak rate has been going up slowly**
 - **Oct 2001** **4.0 l/h @ 0.2 in H₂O**
 - **Jan 2004** **6.7**
 - **Apr 2004** **7.2**
 - **Jun 8, 2004** **>10**
 - **Temporarily sealed with elephant goop**
 - **Jun 10,2004** **5.9**
 - **Rebuild this window during long shutdown?**

Broken Wires



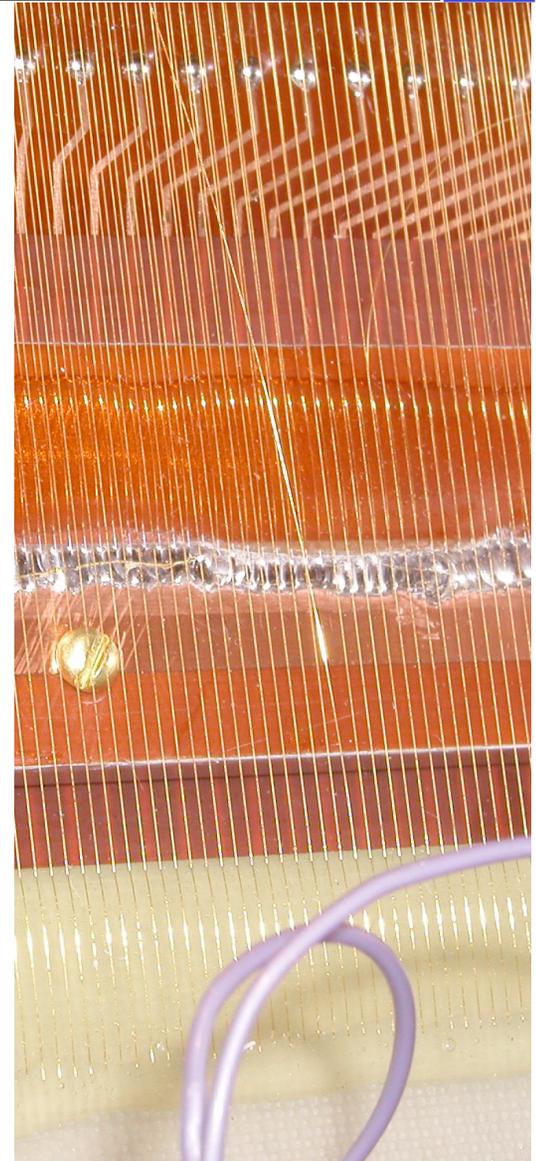
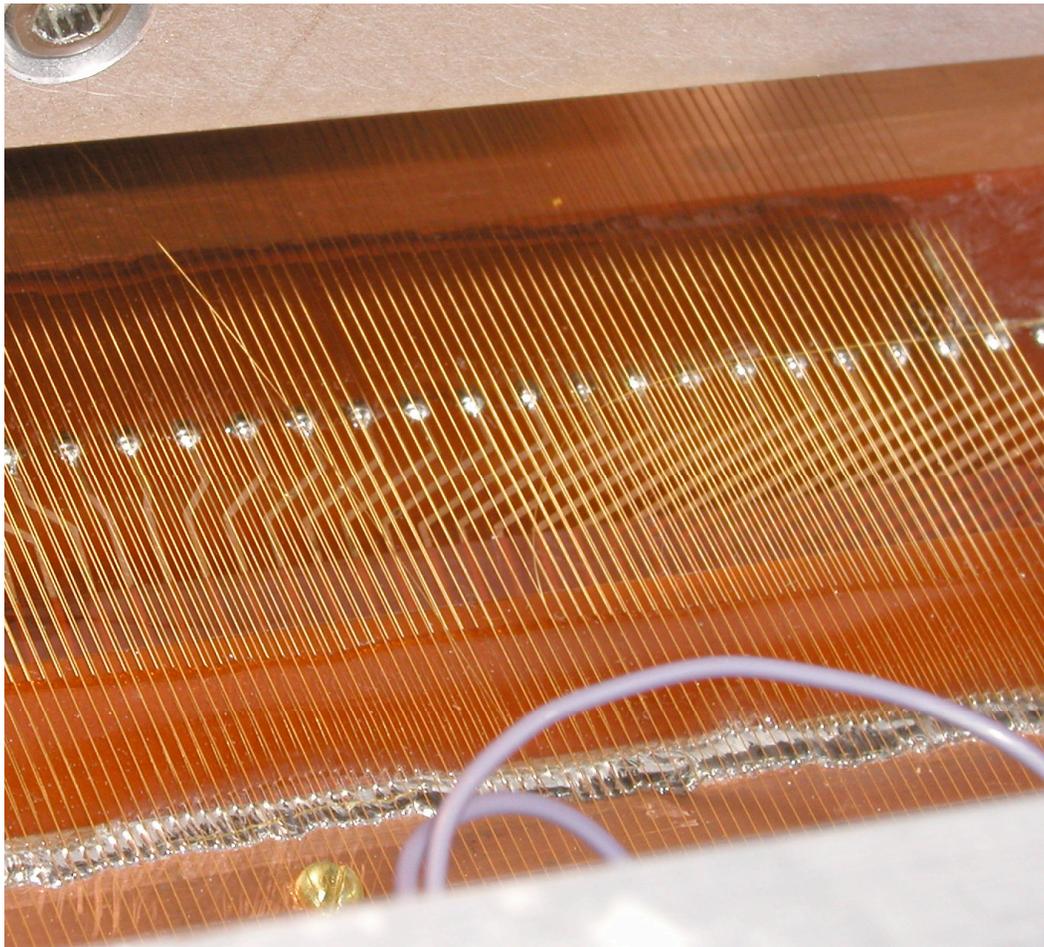
- **History (relevance unknown)**
 - 5/7/04 All anodes and GG worked, waiting for triggers
 - ~5/12/04 Change made to TrigProc to read at high rates
Reduced 17 ms TPC GATE/BUSY to 500 ns
Maximum rate with DAQ ~1 kHz, w/o DAQ ~30 kHz
TPC and GG still triggered!
 - 5/13/04 Testing new anode HV code; anodes still OK
 - 5/21/04 Testing new anode HV code. Anodes 0,3(4?),5 are grounded
 - 5/24/04 Anode 4(3?) now grounded

- **What's New**
 - GG running
 - In JGG field
 - With beam

Inside on Memorial Day – 3 Broken Wires



- Going Left - GG
- Going Right - GND



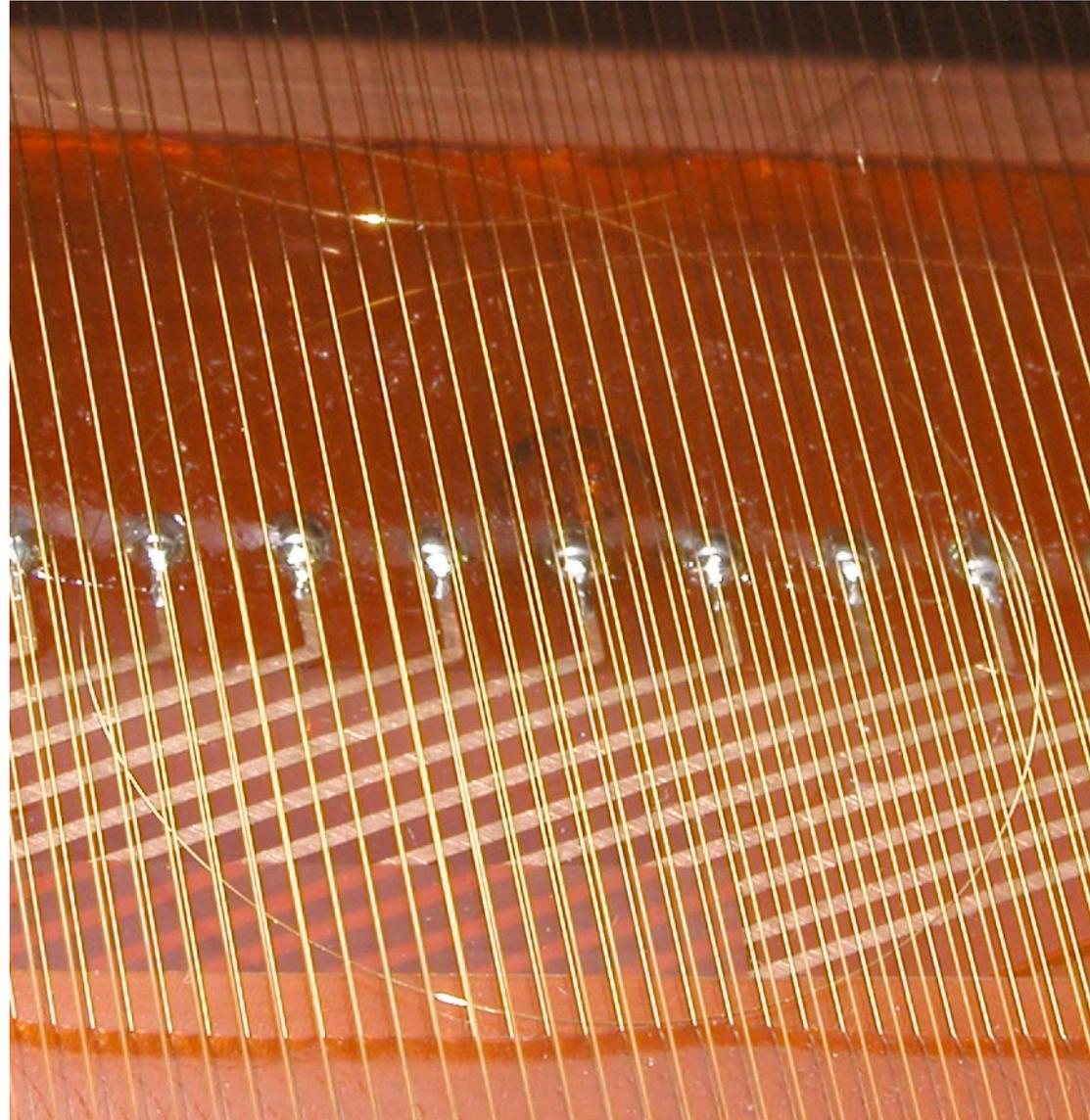
11 June 2004 10

Peter Barnes, LLNL

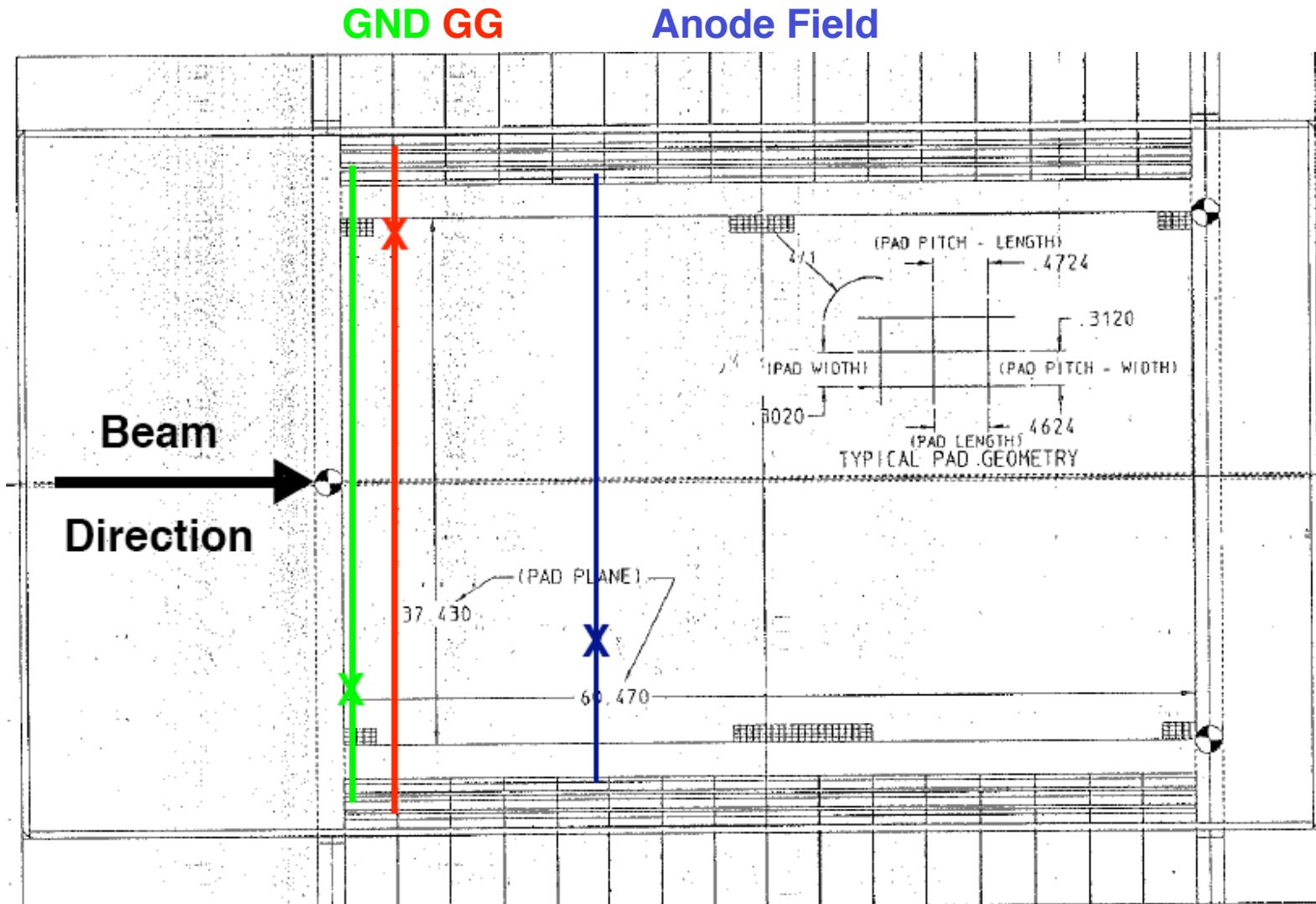
Inside on Memorial Day – 3 Broken Wires



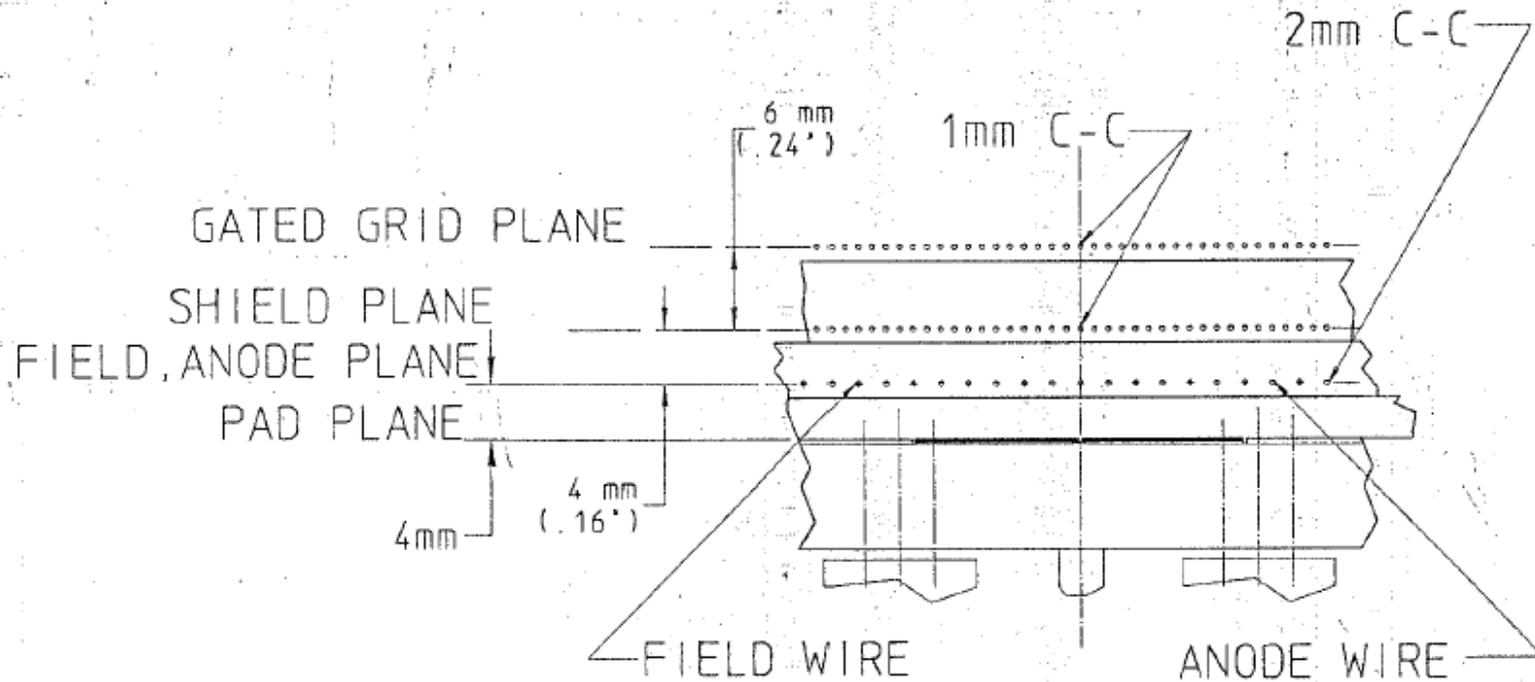
- **Anode Field**
- **Work Team**
 - David M.
 - Holger
 - Raja



Break Locations



Wire Geometry



- **Note there are 3 anode sense wires per 12 mm pad row.**
- **Typical charge sharing is 3 pad rows.**

Other Information



- **All three wires are probably 75 μm (AWG 40) Au plated BeCu**
 - (Anode sense wires are probably 20 μm Au plated W)
- **GND and Field wires are at ground**
 - (Anode sense wires are at 1350 V)
- **GG wire was GG0 “Positive” +20 V pulsed to -80 V for 10 μs**
 - (“Negative” is -180 V pulsed to -80 V for same duration)
- **GG Electrical Characteristics**
 - Wire capacitance is ~ 18 pF/wire
 - Fed through 50 Ω
 - 100 ns rise/fall time
- **Winding tension was probably the same as STAR:**
 - 75 μm BeCu 120 g
 - 20 μm W 50 g
- **Field wire showed “blackening” for ~ 2 cm around the break**
- **Wires taken to Lab 5 (?) for microscopic study**
 - Pictures not yet available
 - One wire showed necking at break
 - No signs of corrosion



- **New GG Driver Gave an Over-Voltage Pulse?**
 - Used digital scope to sample >100K traces
 - Peak-to-peak 101.6 ± 0.9 V, lowest 98.4, highest 106.2
 - Average 1000 traces, then compute trace - average, 5K traces
 - Range is 7 V
- **Ohmic Heating of GG? (e.g. at a latent defect?)**
 - 100 V on 18 pF is 1.8 nC, in 100 ns is 18 mA *peak*
 - Maximum *average* current for AWG 40 is 22 mA
 - Our worst duty factor was $10 \mu\text{s} \times 30 \text{ kHz} = 0.3$
 - But > 10 kHz GG Driver gives mostly undervoltage pulses
 - Besides, GG break was *away* from connection
- **Corrosion? Bad gas? Air (Water) Exposure?**
 - No signs of corrosion
 - No signs of glow discharge (moderate currents, ~100 nA)

Theories – Mechanical Vibration



- **Exciting Mechanical Resonance**
 - Fundamental frequency likely ~100 Hz, lossy due to G10, epoxy
 - Highest tension will be at ends; breaks are well inboard

Possible Excitation Sources:

- **JGG SCR failure - Field Ripple? Mechanical Vibration?**
 - Failure occurred before 4/15/04, coil hum audibly different
 - Walt Jaskierny says this results in 60 Hz ripple
 - But this is way off resonance?!?
- **Rapid Changes in JGG Current**
 - Thanks to the wonderfully intuitive ACNET user interface
 - Is the maximum current limited? Maximum ramp rate?
- **JGG Short**
 - Seems to be unstable, leading to field noise?

Theories – Field Effects



- **Lorentz Force**
 - $\mathbf{F} = I \mathbf{l} \times \mathbf{B}$ = 22 mA 0.5 m 0.7 T = 0.08 N = 0.8 g
- **Displacement Current in the Magnetic Field?**
 - But j_D is a property of dielectrics, not a real current in the wire

Present State



- **All three broken wires removed**
 - Both segments cut at epoxy
 - Stubs covered in epoxy
- **Anode 5 has one wire shorted to a field wire**
 - Attempts to free this resulted in breaking the wrong sense and field wires
 - Feed resistor disconnected to isolate this wire from HV
- **Chamber back together, leak checked, purged, on P10**
- **Anodes at 1300 V for 3 days**
 - But Anode 3 trips! Holding at 1000 V for 24 hours.
 - At most 5 nA excess current, suddenly trips
 - Haven't yet tried another HV channel
- **Missing wires will have negligible effect on the physics**
 - GG and GND are upstream of the first pad row
 - Missing Field wire impacts charge measurement on

Plan



- **Complete analysis of broken wire ends**
- With no smoking gun, assume the GG just broke.**
- **GG in JGG field for 24 hours (Anodes off)**

 - **GG with no field, beam, monitoring on scope (Anodes off)**
 - Start with GG GATE disabled, so no pulsing
 - **GG with JGG and beam, Anodes off**
 - Start with GG GATE disabled, so no pulsing
 - **GG, Anodes, JGG, Beam**