



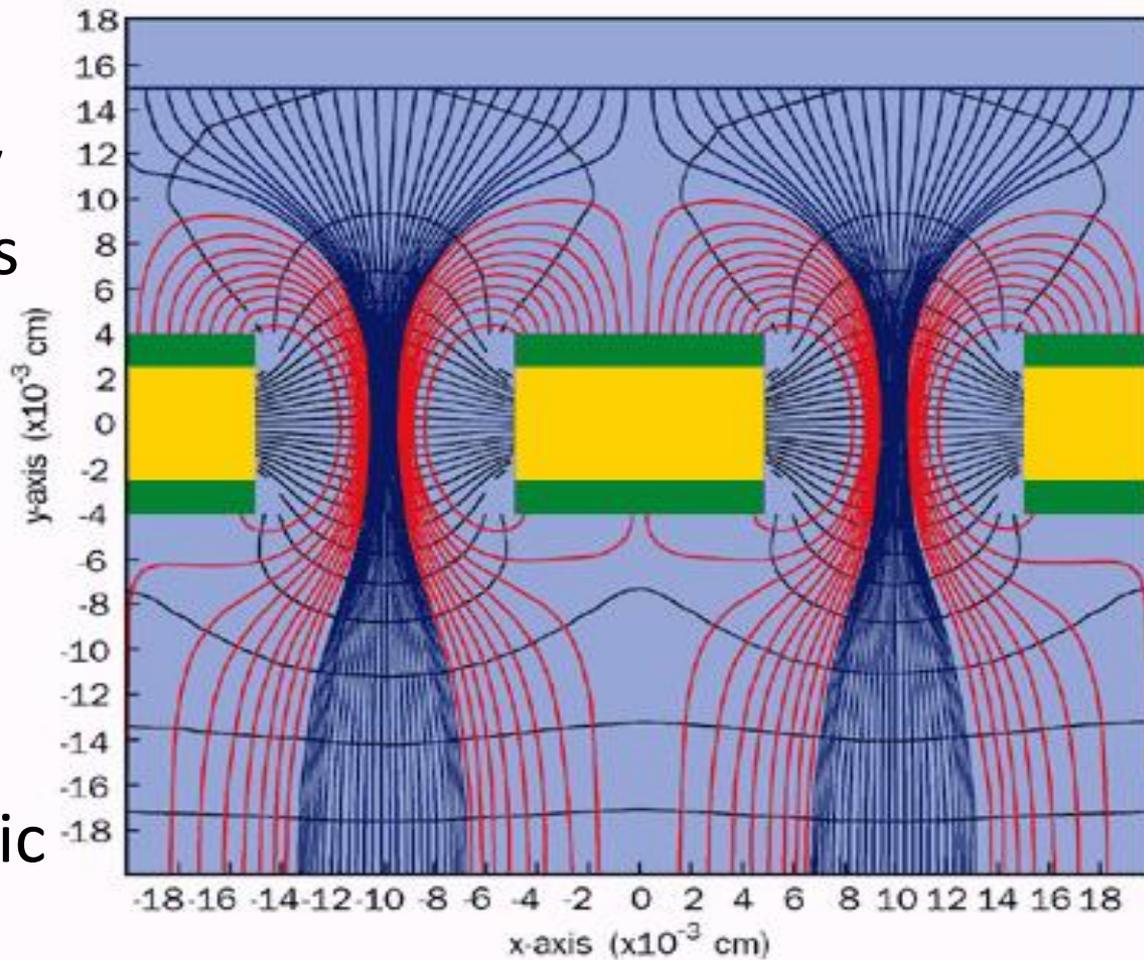
Gas Electron Multiplier Development for Muon Tracking

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Background

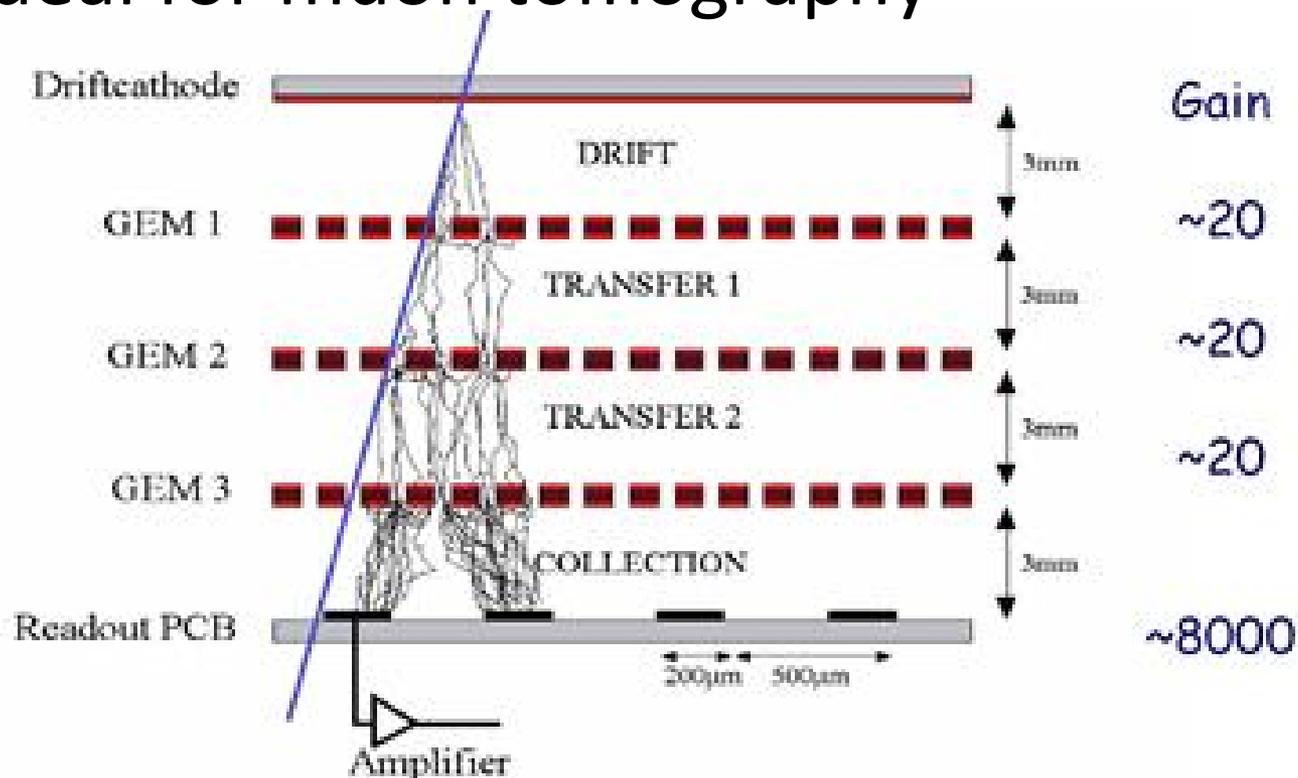


- A Gas Electron Multiplier (GEM)
 - Foils with regularly spaced micro-holes
 - records ionizing particles in two dimensions
 - Produced using chemical piercing
 - Accelerating electric field

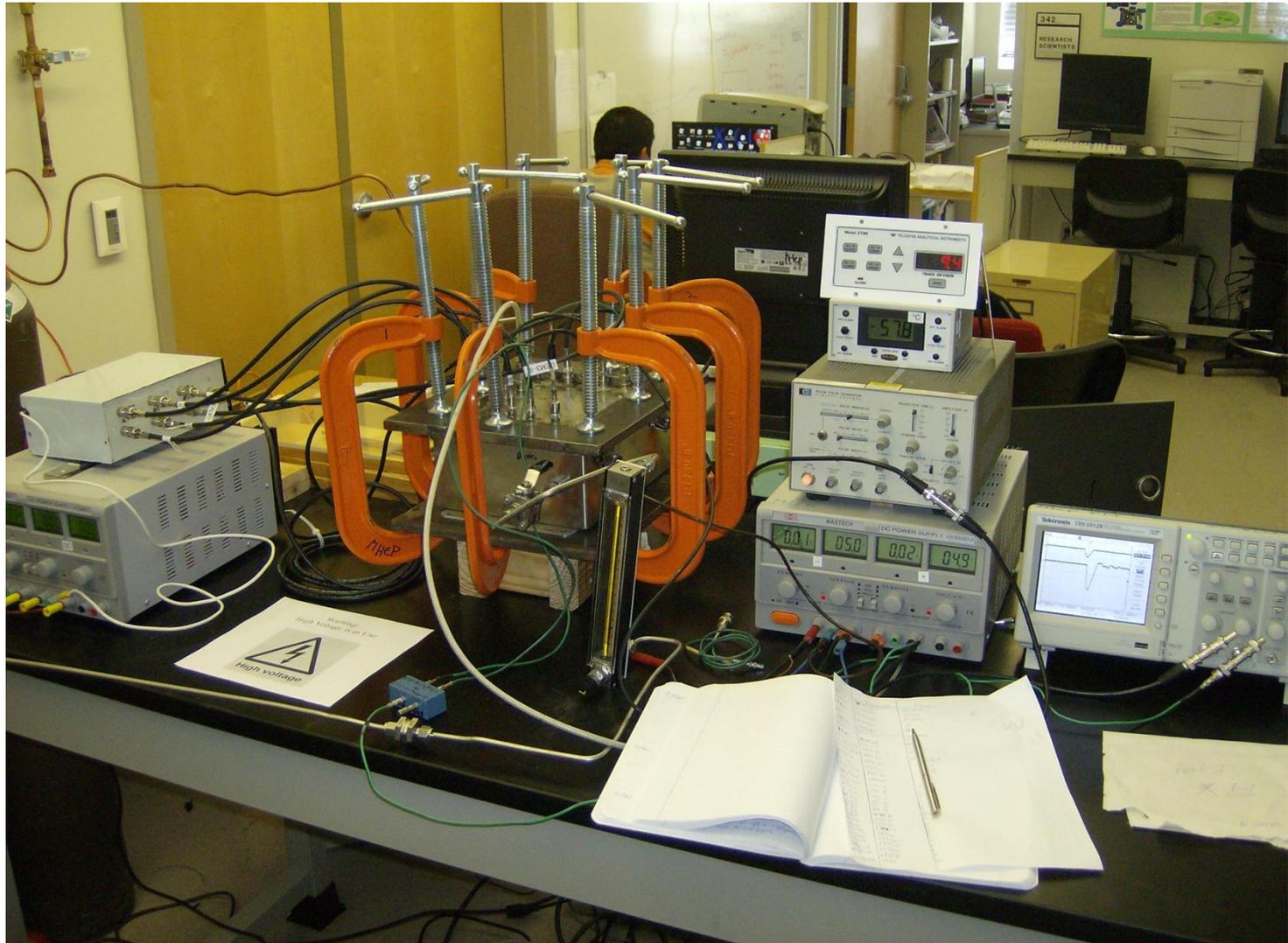


Background

- Electric field multiplies
- Great spatial precision
- Ideal for muon tomography



Our Detector



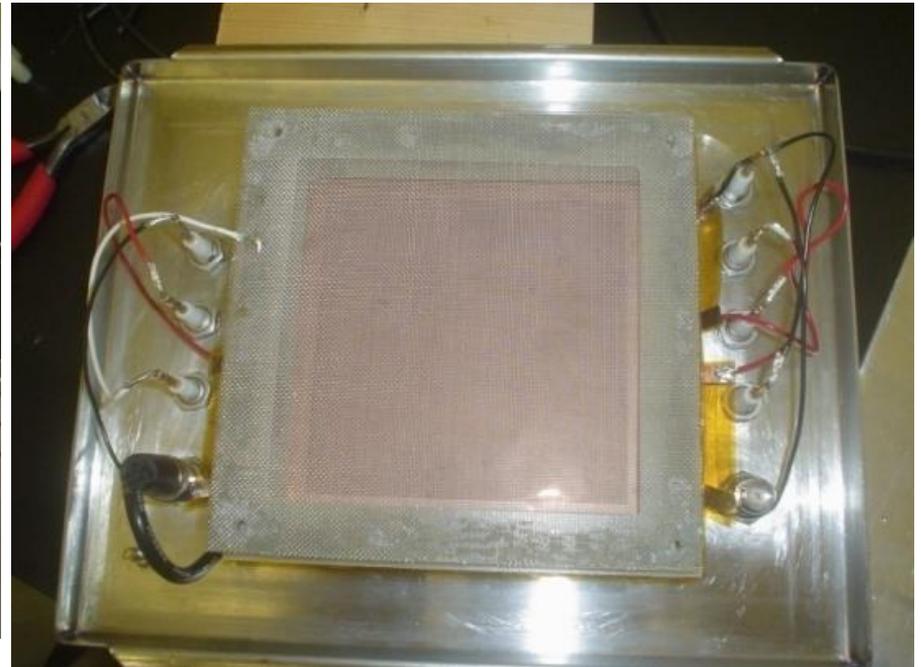
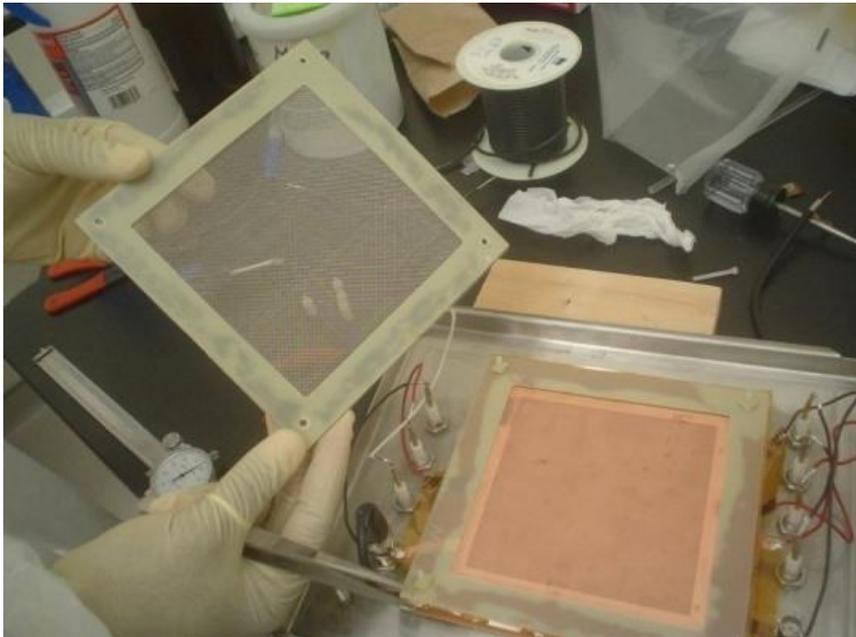


Our Detector

- 3 independent GEM foils for amplification.
 - Purchased from Tech-Etch
 - 4.5''x 4.5''
- Ar/CO₂ gas flows through the detector and is ionized by radiation
 - 70:30 mixture
 - tested with a known ⁵⁵Fe source (5.9keV radiation)
- Potential use for homeland security

Construction

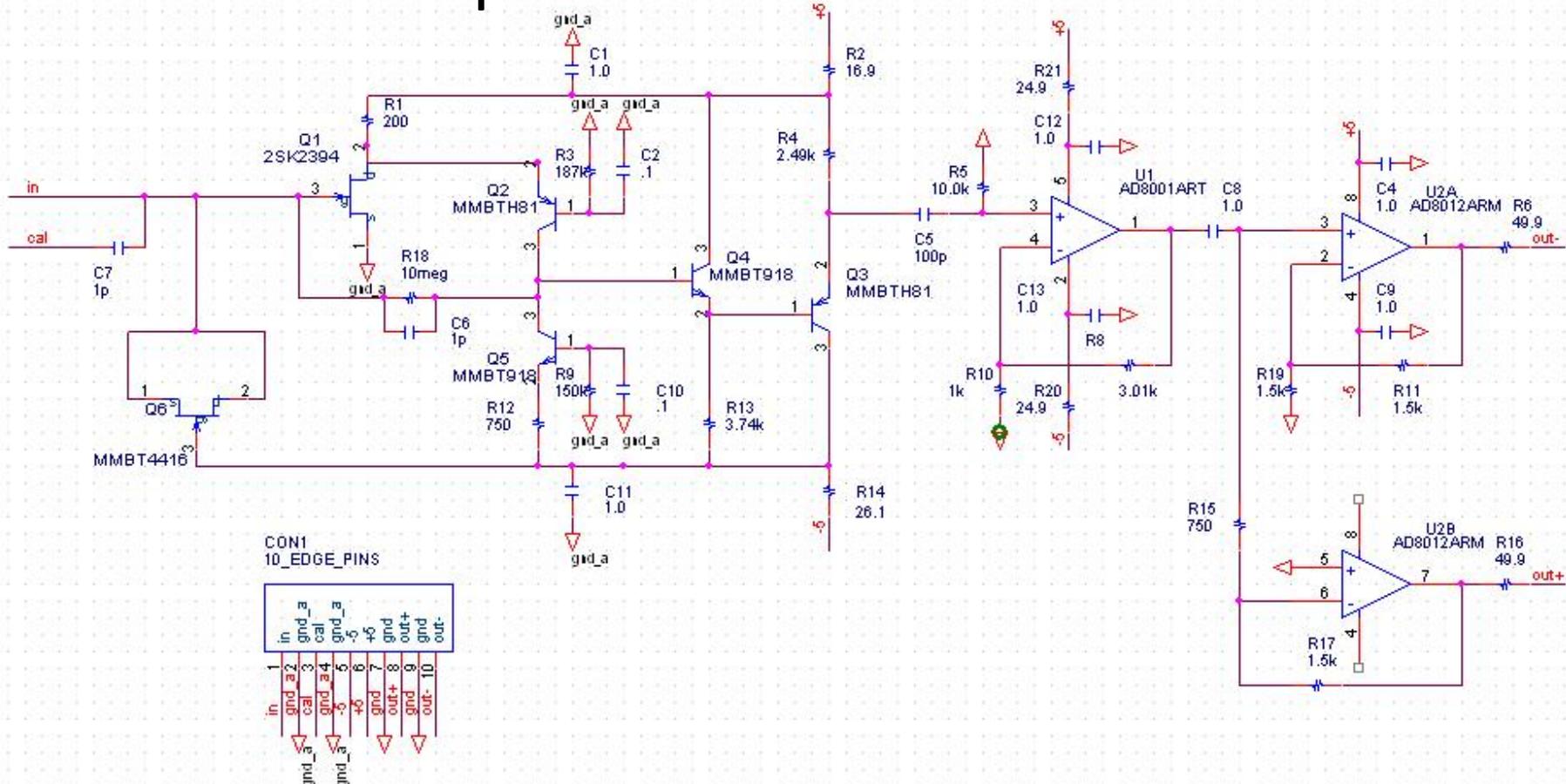
- GEMs are stretched and mounted on G10 (fiberglass) frames
- Assembled onto the lid of the detector



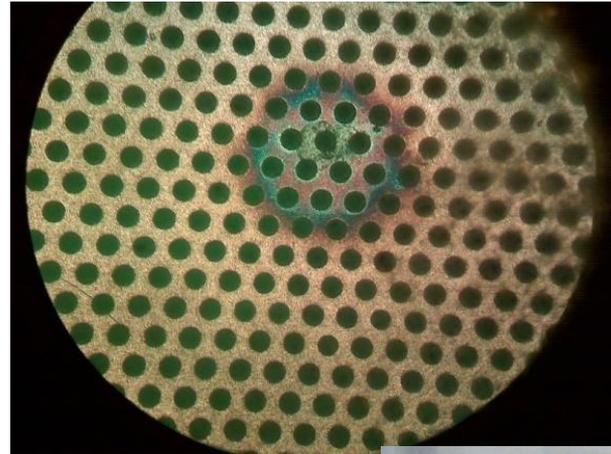
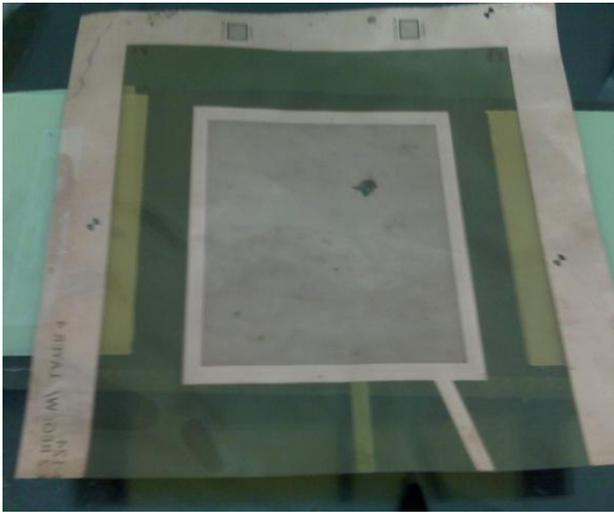


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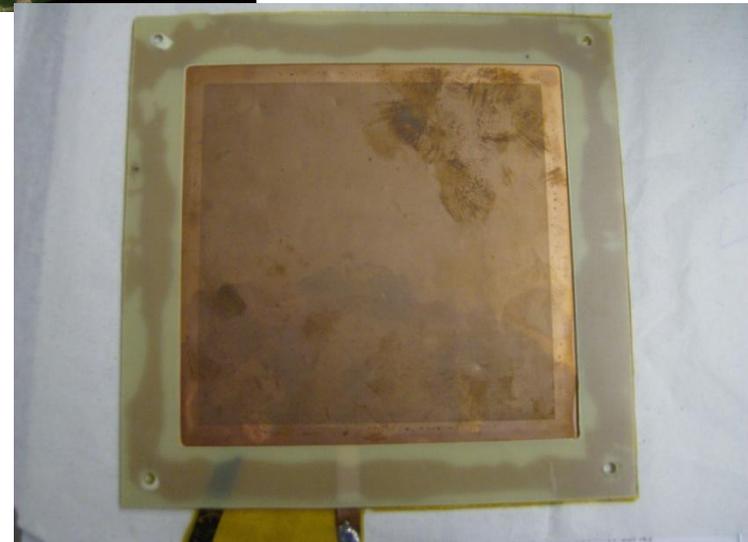
- Charge integrating amplifier chip
- Identical chips exhibit different behavior



Sparking



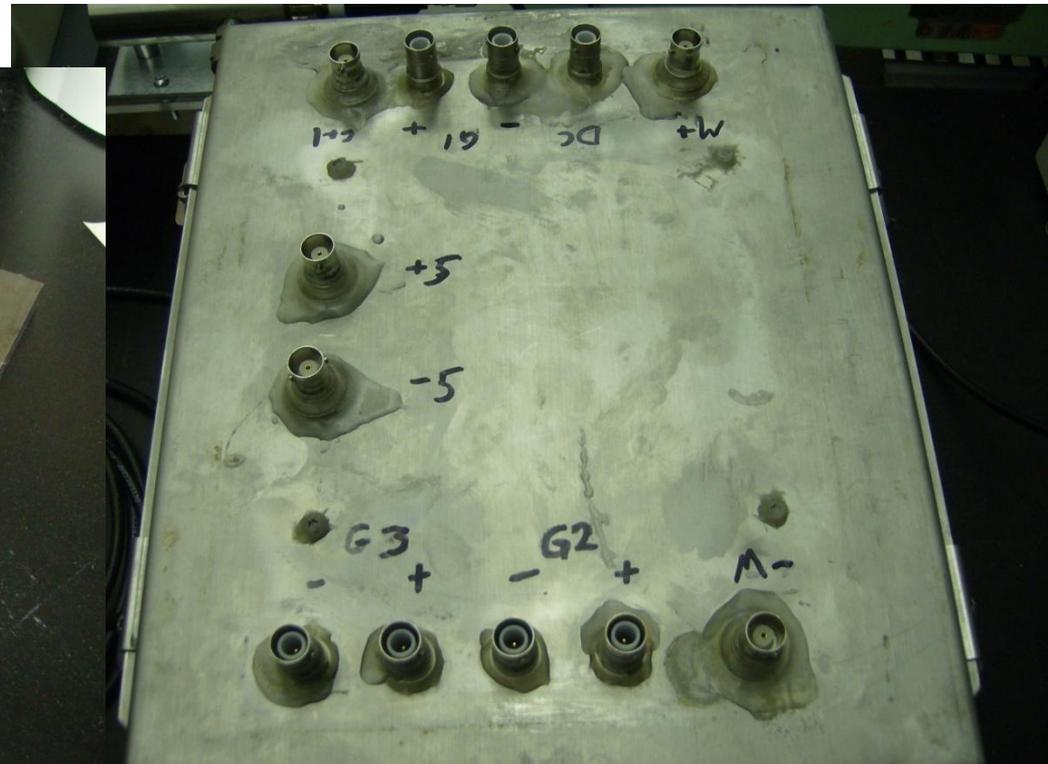
- Caused by...
 - Poor stretching
 - Foreign materials on foil
- Purchased glue dispenser
- Tested clean room
 - Between an ISO 8 and ISO 7



Recent Developments



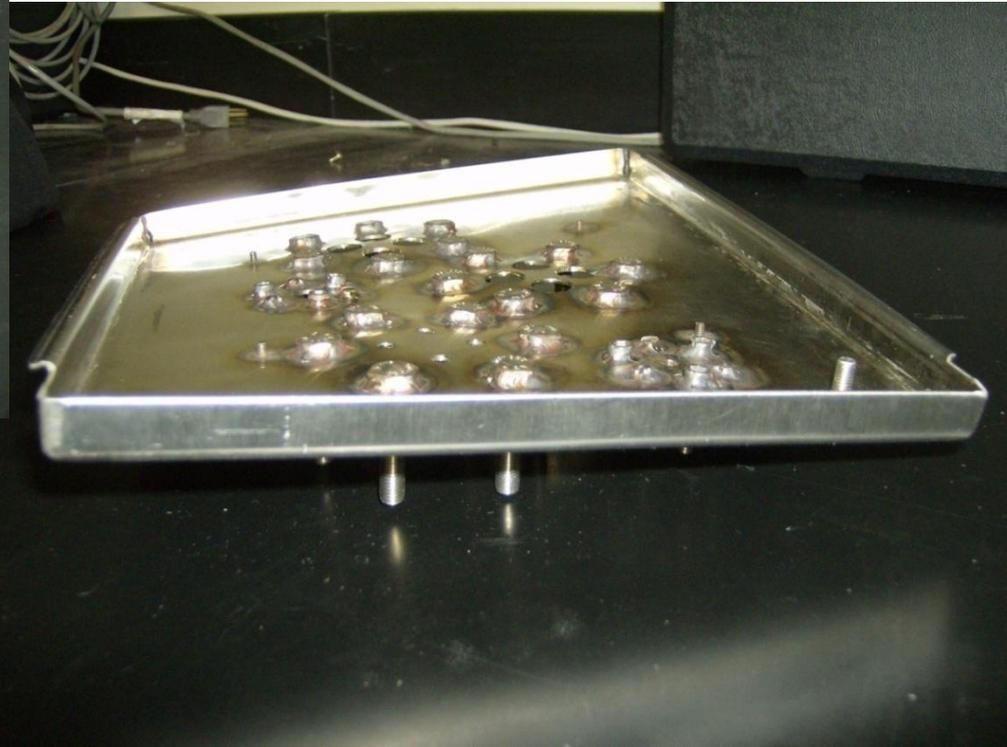
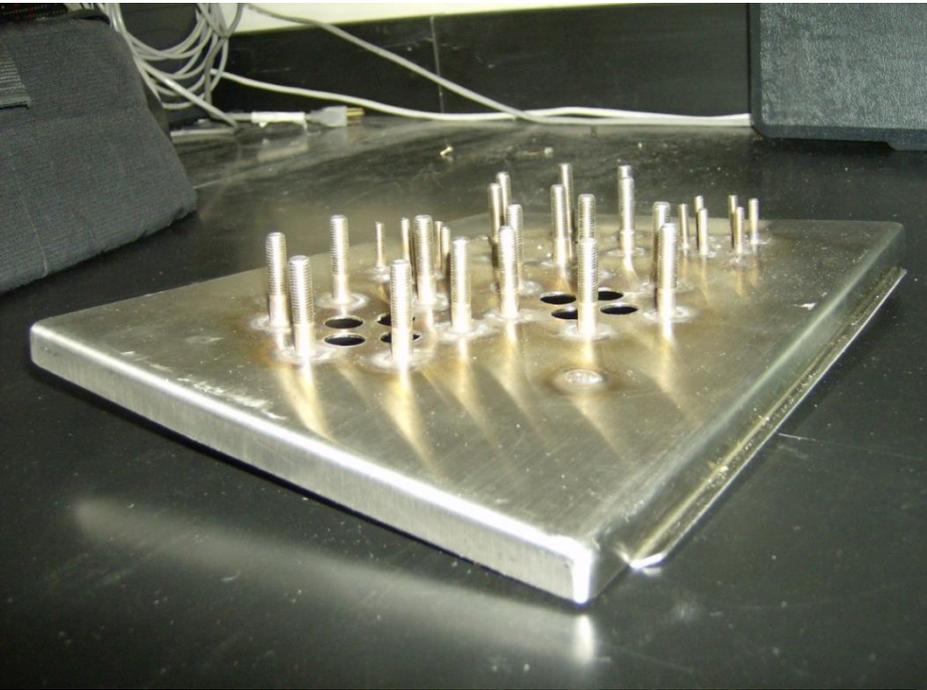
- Produced a new lid for the detector
 - No more leaky, fragile gluing. Components are welded instead



First “New Lid” Attempt



- Warped during welding



Recent Developments

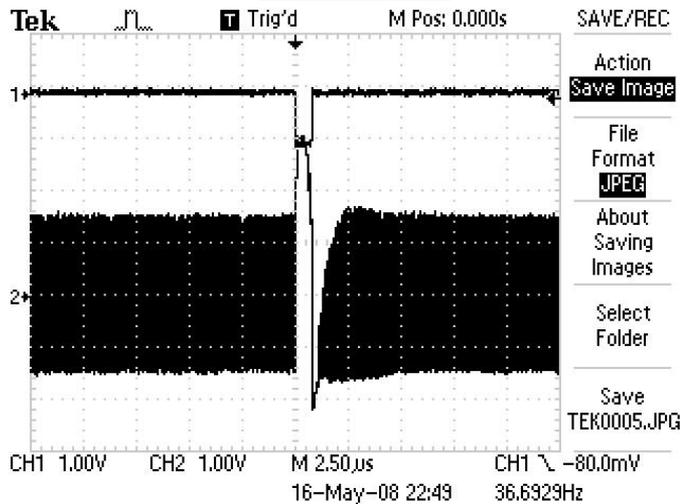


- Readout electronics have been problematic, with a large oscillations due to input capacitance (noise)
 - Attached readout strip directly to the amplifier chip
 - Moved the electronics into the gas box
- Still received too much noise

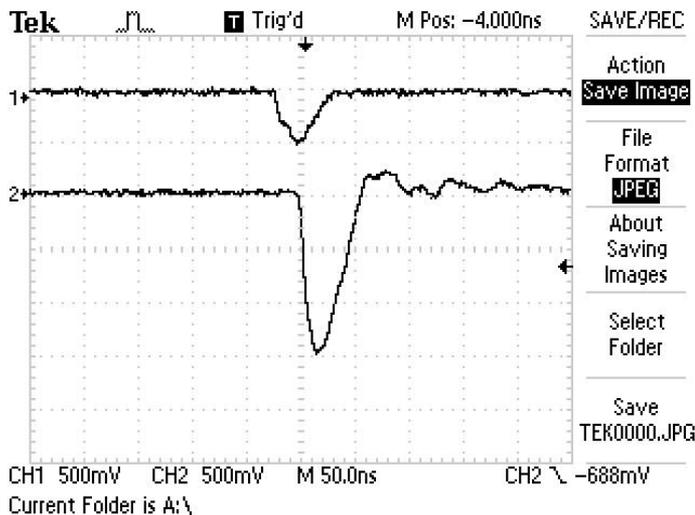


Progress

Before



After



- Reduced the area of the readout plane
 - 7mm by 1mm
 - much cleaner test signals
- New GEMs framed
 - 7 in total



Summary

- New lid (not yet in use)
- New readout
- Much nicer noise levels
- No signals from radiation recorded yet



Future plans

- We are ready to test our new readout against the ^{55}Fe source
- Next step, producing a larger detector