

Restoring Contaminated Wires, Removing Gas Contaminants and Aging Studies of Drift Tube Chambers

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for the D0 Collaboration
Aging Workshop at DESY
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OUTLINE

- Problem
 - Sheath of crud covering the D0 Muon chamber wires.
- Solution
 - by Herman Haggerty and Tom Marshall
- Gas Filtering
 - by Kurt Krempez and John Krider
- Aging Studies
 - by Vladimir Malyshev, J.I.N.R., Dubna

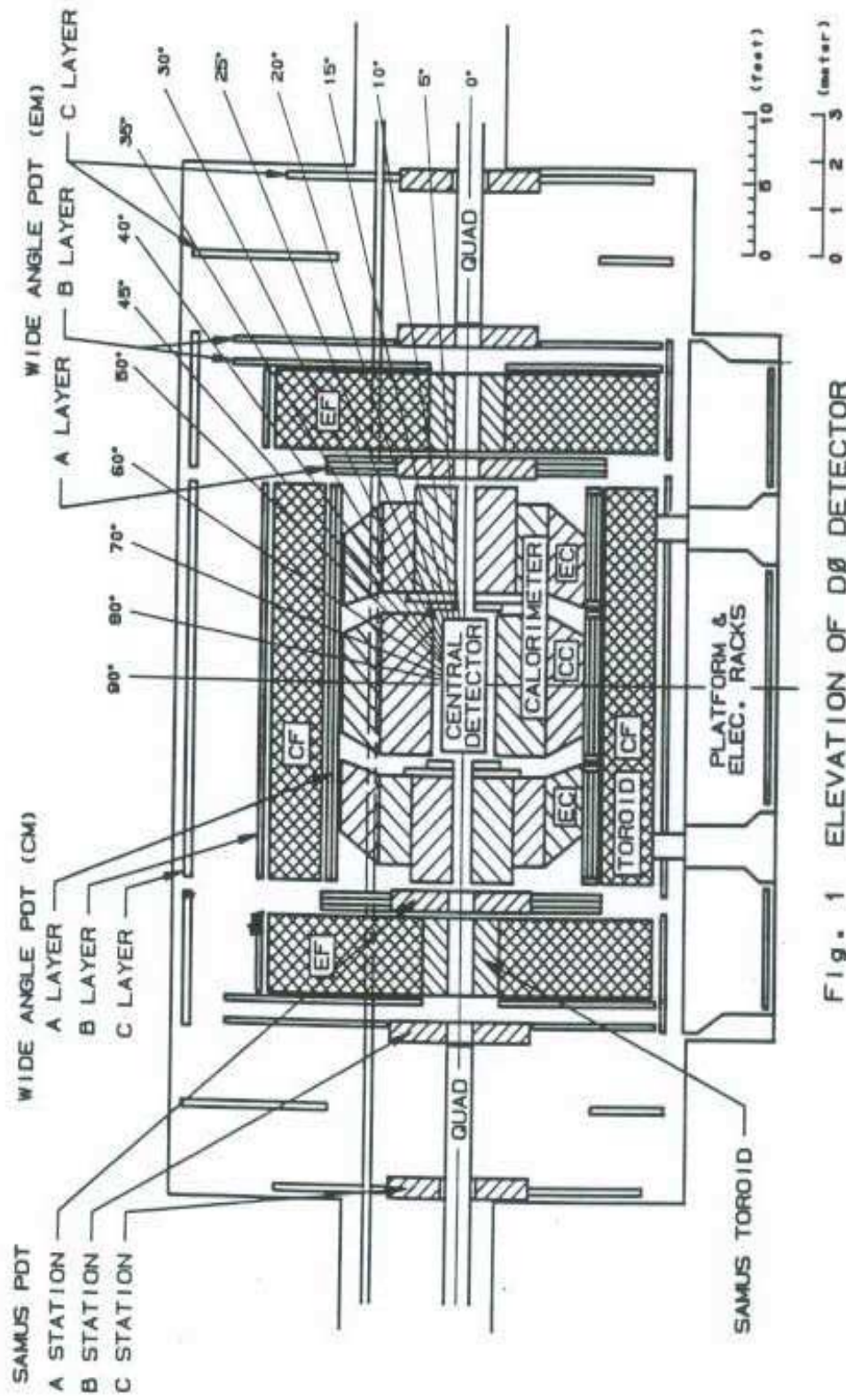
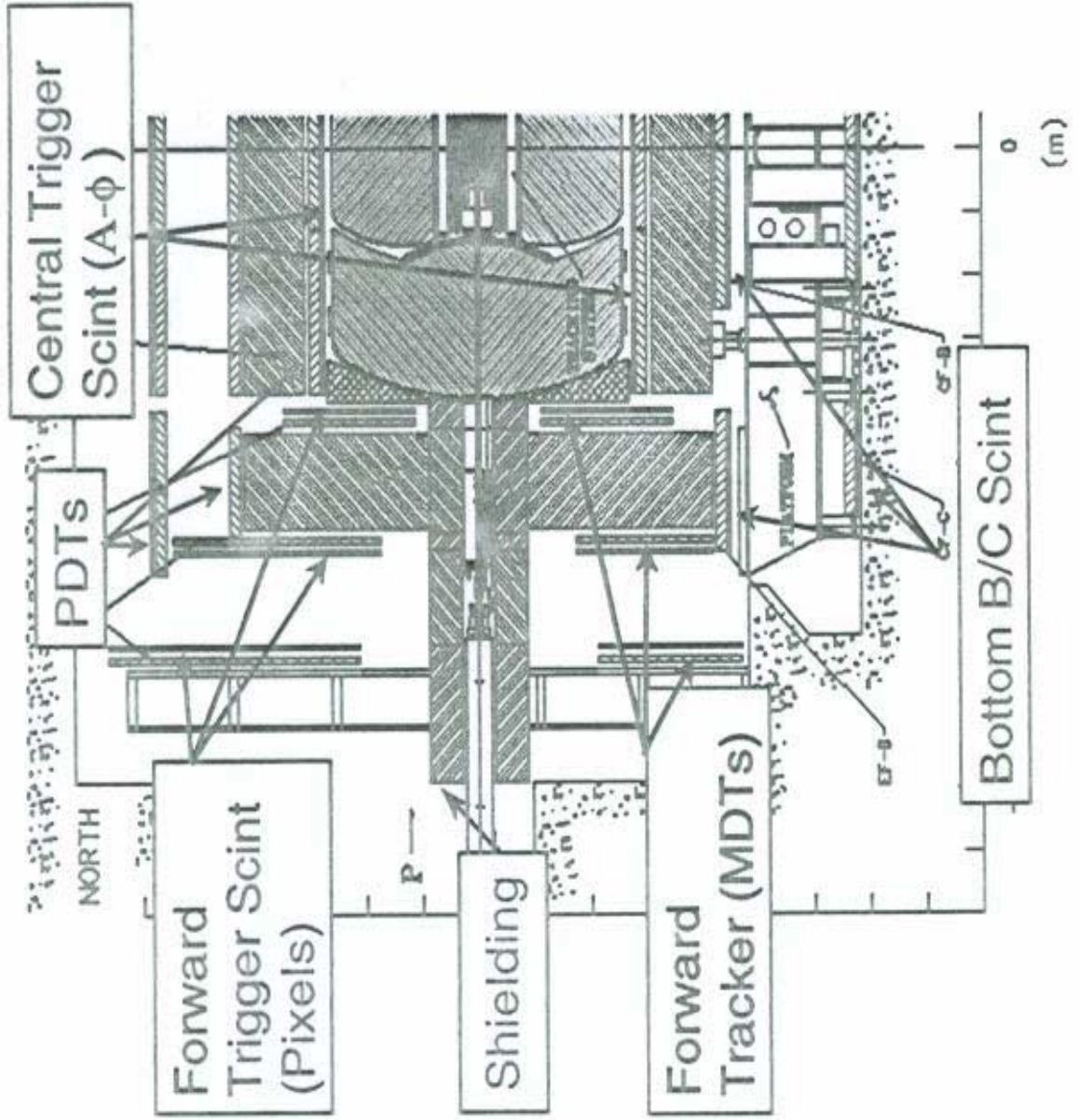


Fig. 1 ELEVATION OF D0 DETECTOR



Muon Detector Upgrade



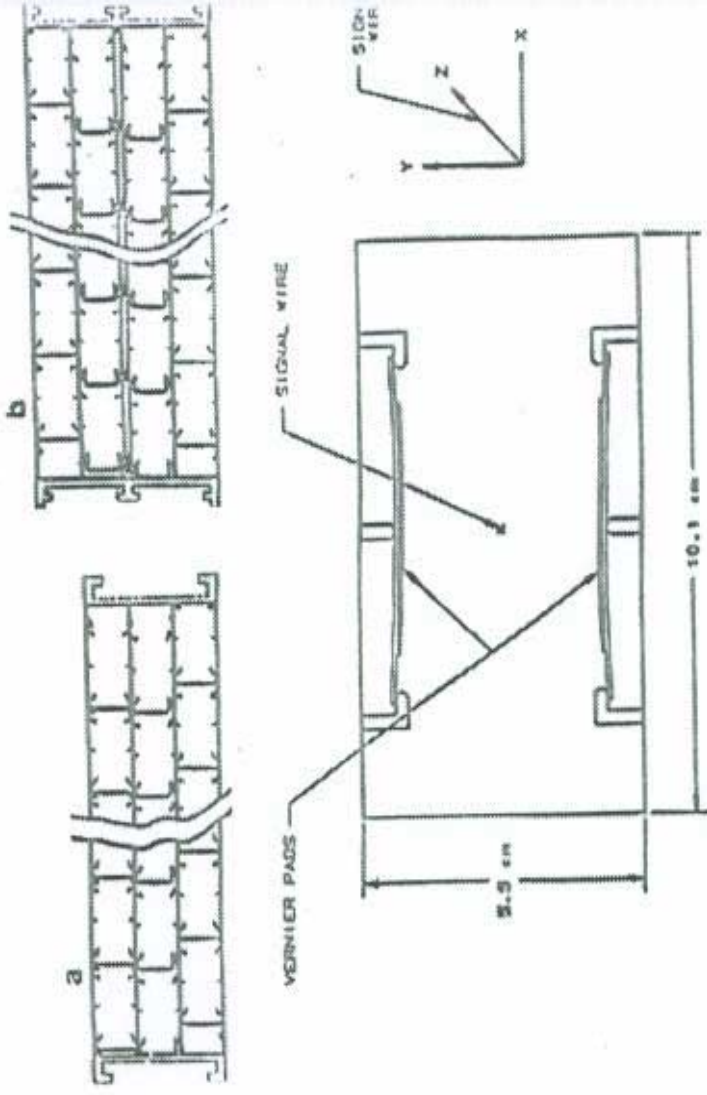


Figure 4: Wamrus.

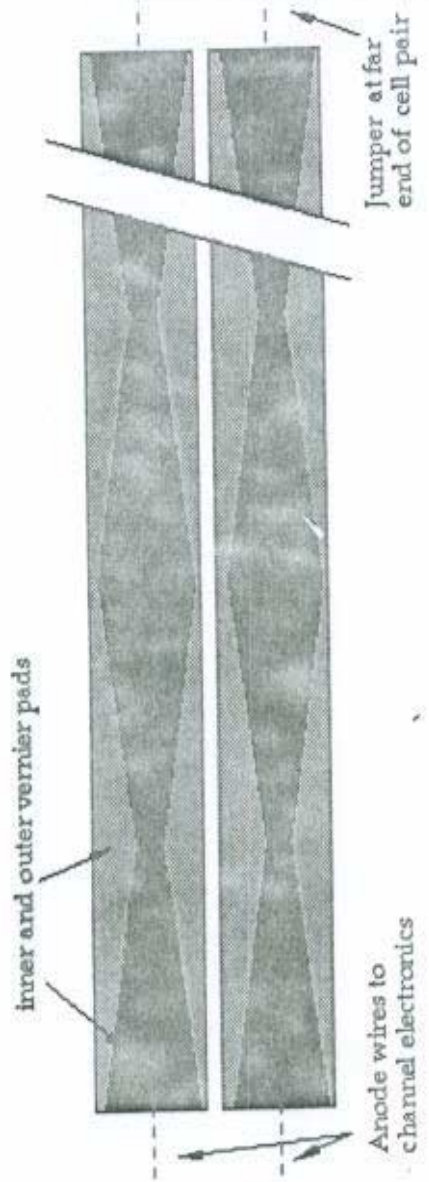


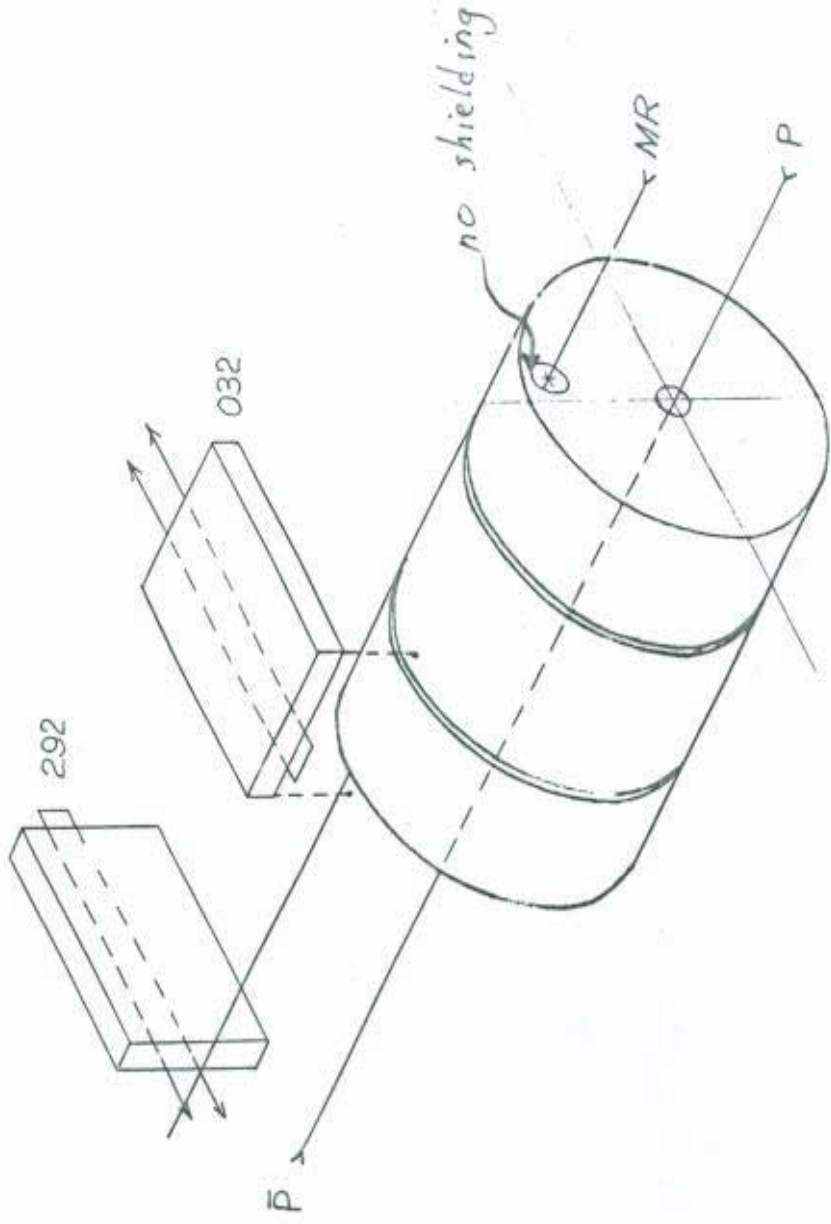
Figure 5: Wamrus pads.

Start of Run I

- **Operating Blind**
 - Sped up electronics and shortened signal pulses
 - Added shielding to reduce halos from MR and Tevatron.
- **Ugly Truth Revealed**
 - Although all chambers share one recirculating gas system, many are dead, some are half dead and half good, and a few are fine.

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RADIATION INDUCED CONTAMINATION



Extract and Replace Wire

- **Bad News**
 - Wire coated with crud.
- **Good News**
 - No deposits on cathodes or walls
 - New wire restores original gain
- **Really Bad News**
 - Must clean wires in situ. Several hours to change 1 wire, 50% of wires inaccessible.

Crud Properties

- Scrapes off easily
- Dissolves in Ammonia and water
- Argonne Lab Analysis
 - perhaps CASAMITE, a urea-formaldehyde based powdered resin glue
 - recently, we found that styrene fumes could form the crud
- Source of Crud
 - the Glas-Steel polyester-epoxy resin from the cathode pad

Crud Properties Continued

- Easy to Make

- grind up some Glas-Steel
- pass chamber gas over powder vapor and into test chamber
- adjust HV on wire to draw a current of about 1 microamp/inch. Crud will form in a few hours, independent of the % of CF₄ in the gas.
- 10 microamps/inch on a dirty wire cleans it after several days; not practical, but interesting

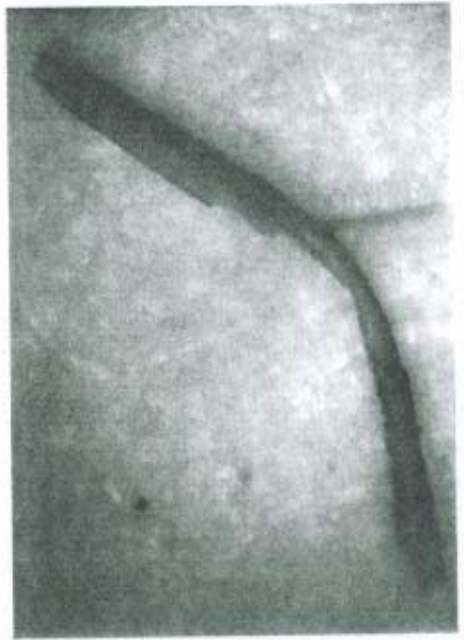
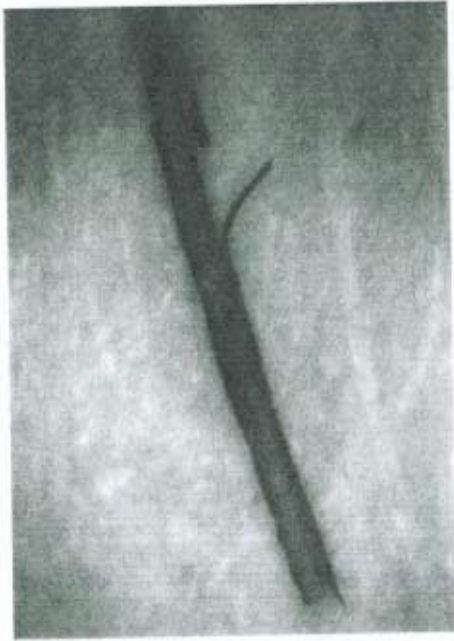
Crud Removal Attempts

- Ammonia
 - No good; just formed a beautiful copper patina
- Water
 - No good; Cell walls became coated with Aluminum Oxide
- High Current
 - No, but when trying to speed up effect we got
LUCKY

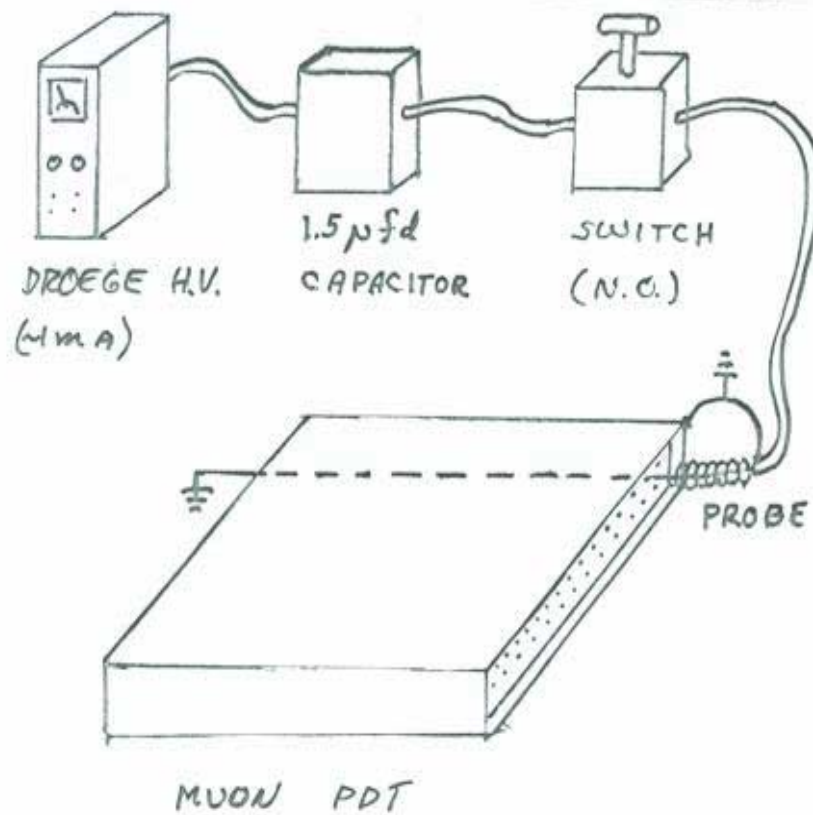
Flash Cleaning (ZAPPING)

- If the wire is heated **quickly** to a temperature close to the melting point of Gold, **the crud BLOWS AWAY!**
 - Less than 2 milliseconds is “quickly”

ZAPPED CRUD (BLOWN OFF SHEATH)



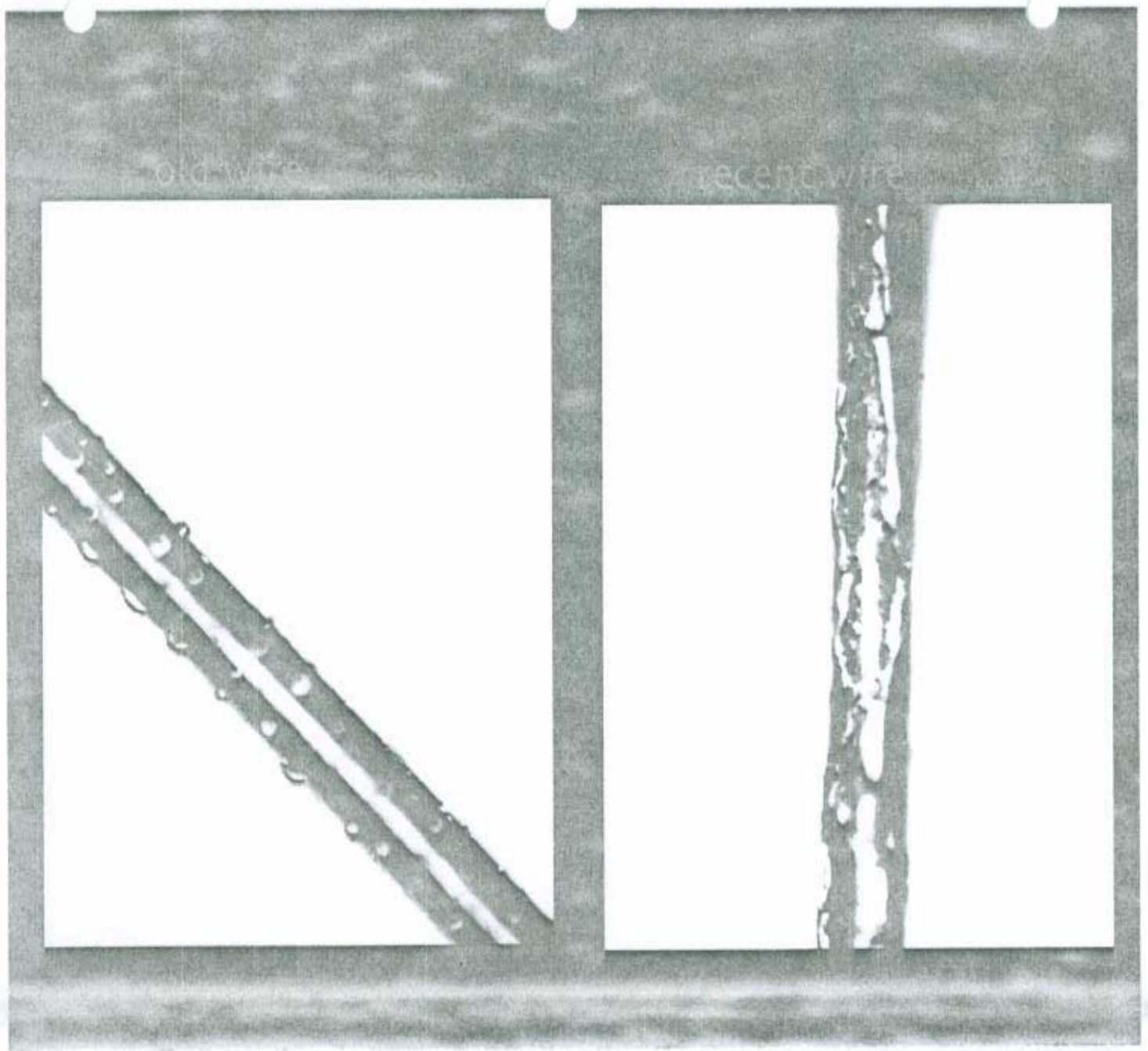
ZAPPER Schematic

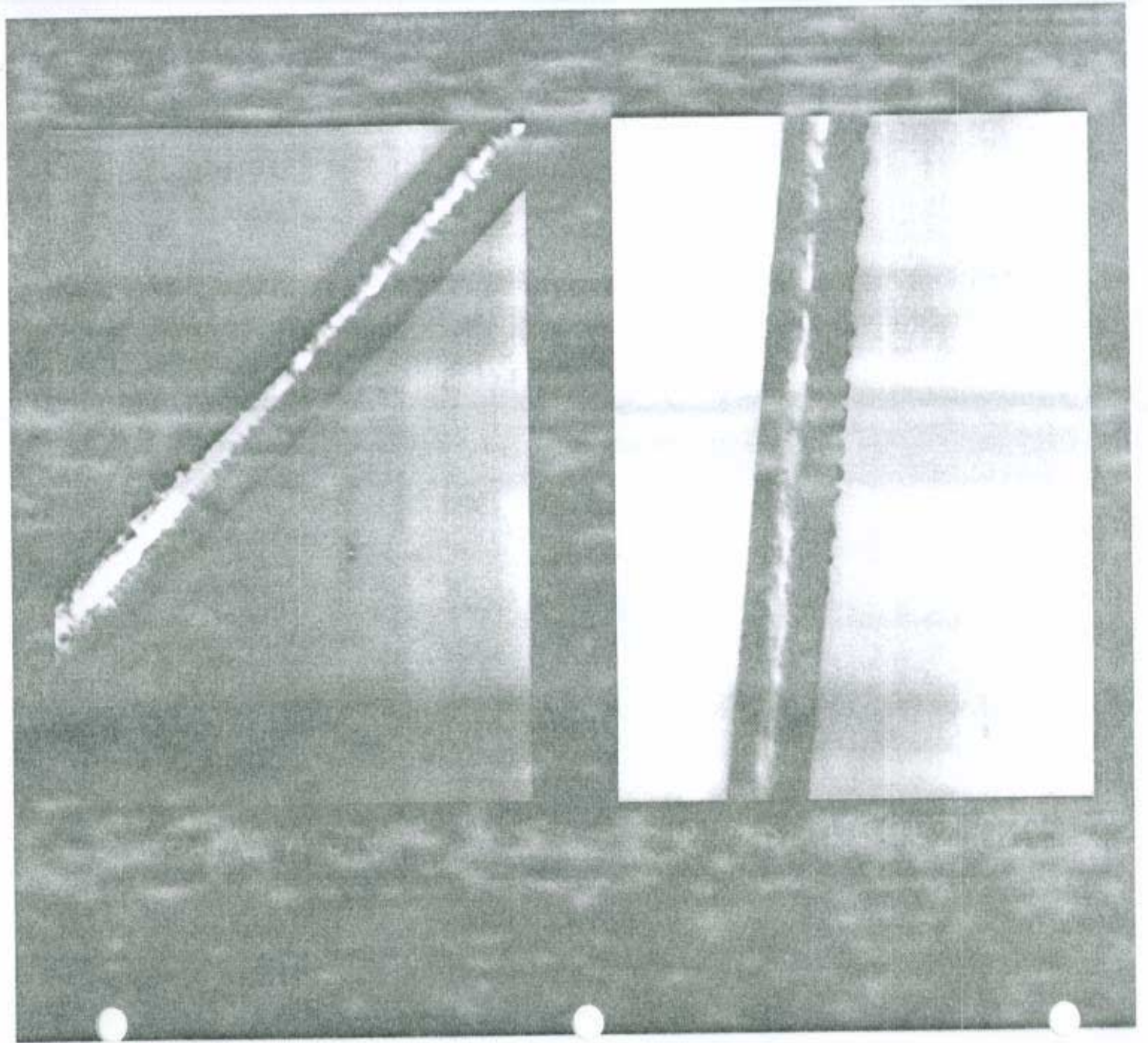


- Operating Voltage Range: 3500 - 6280 volts
• 75" 228"
- Stored Energy: 9.5 J - 31 J

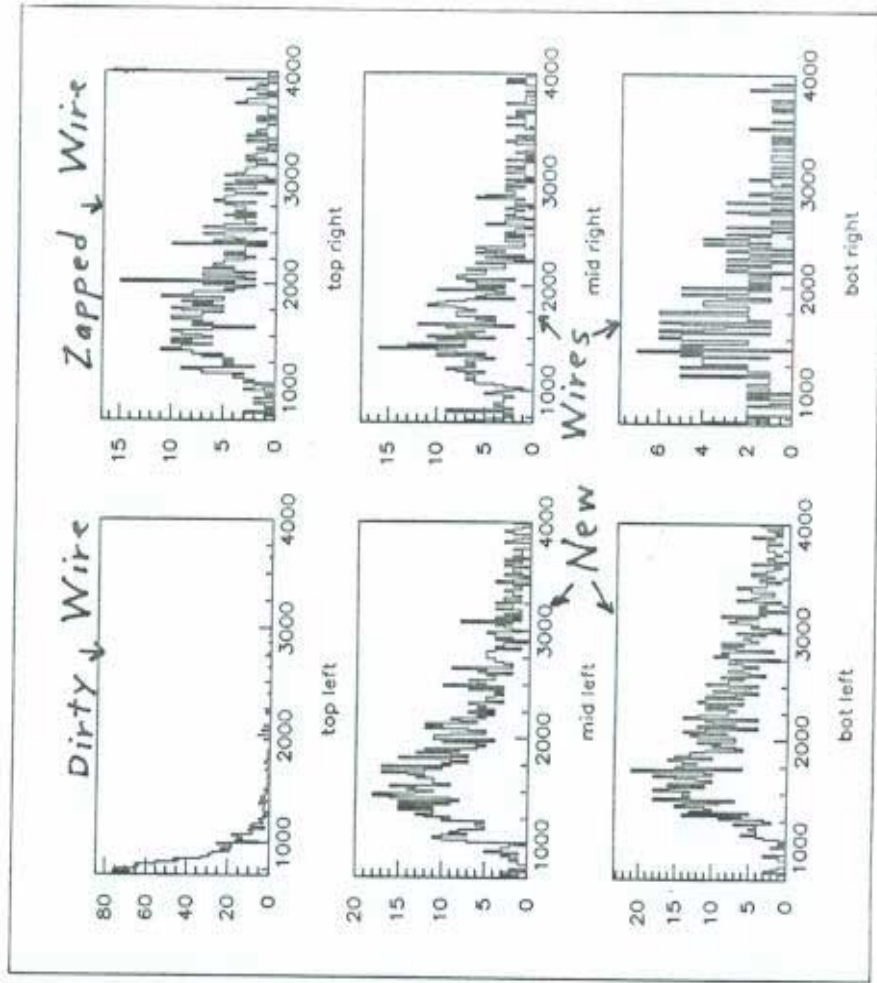
Other ZAPPING Properties

- Heating Too Slow
 - crud forms a tough coating that is hard to remove and is no longer soluble
- Heat Too Hot
 - Gold melts and beads up (wire still works)
- Heat Just Right
 - Gold can change color (depends on wire vender) (orange, green, white tints seen)
- Multiple ZAPPING is OK





PULSE HEIGHT DISTRIBUTION



Gas Cleaning

- **Cold Trap for Run I**
 - recirculating gas passed through a refrigerator set to a few degrees above the temperature of dry ice
 - recontamination 9X slower, but still seen in highest radiation areas
- **Activated Carbon for Run II**
 - doubled the gas flow rate through chambers
 - using 300 pounds A. C. for 300 CFH flow rate

Aging in Forward Drift Chambers

- Run I

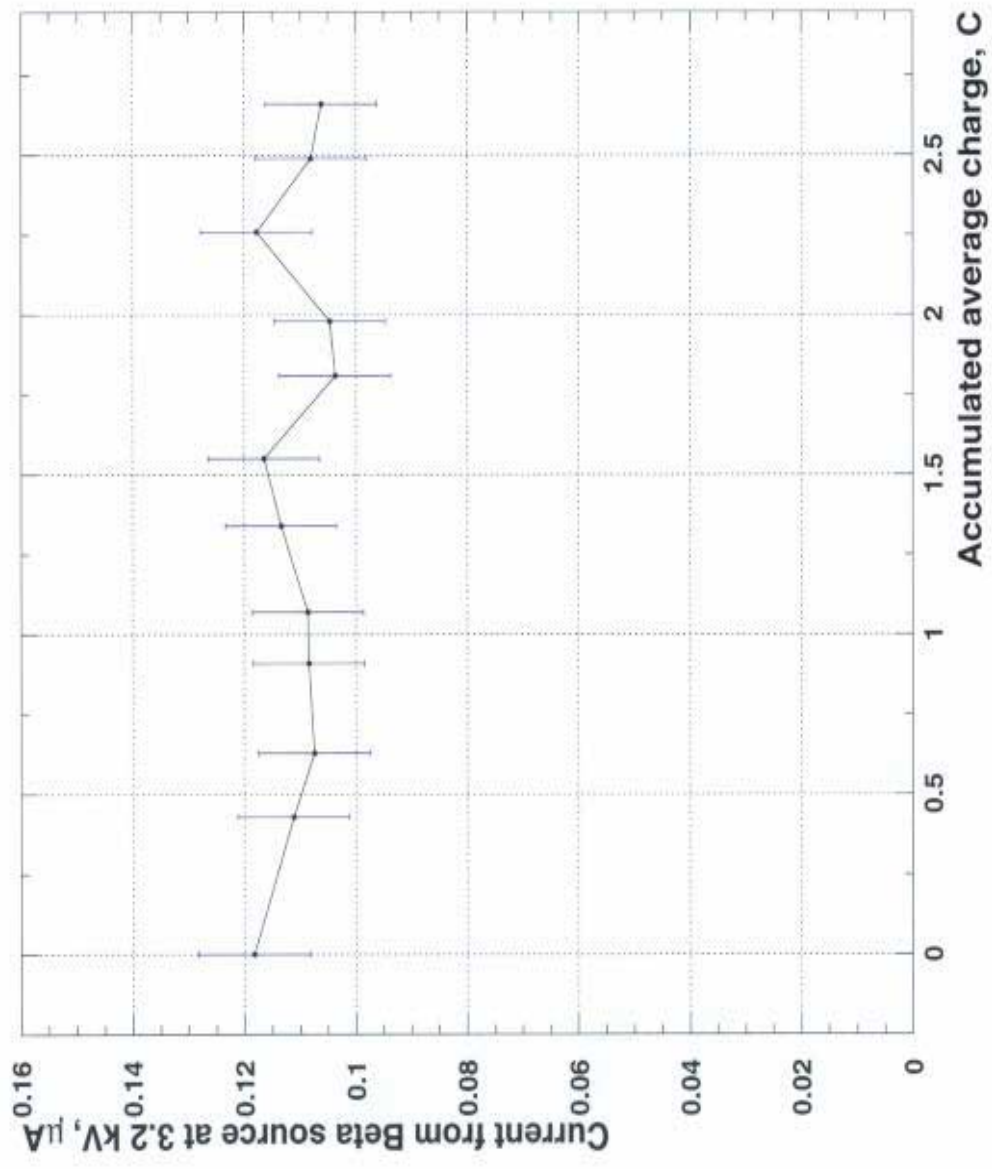
- 1” diameter stainless steel tubes with 90% CH₄, 10% CH₄ gas, 50 micron (W-Au) anode wire
- no aging seen

- Run II

- Iarocci-type mini-drift tubes (MDTs) with 1 cm by 1 cm cells up to 583 cm in length
- also 90/10 gas, 50 micron wire

Mini-Drift Tube (MDT) Aging Test

- Spare FAMUS module used for test
- ~1 cm of wire is exposed to Sr 90 source
- ~25 ml/min of FAMUS MDT exhaust gas flows through test module
- Accumulated charge of current from source at 3.2 kV is measured
- Prelim. result: no aging to within +/- 10% is observed after charge accumulation of 2.5 C/cm



CONCLUSIONS

- **ZAPPING** is a simple way to clean 1000's of wires in situ (we have zapped 15,000)
- Only works on a select type of crud
- Ionization + chemicals can produce some strange chemistry
- Only use well tested materials