

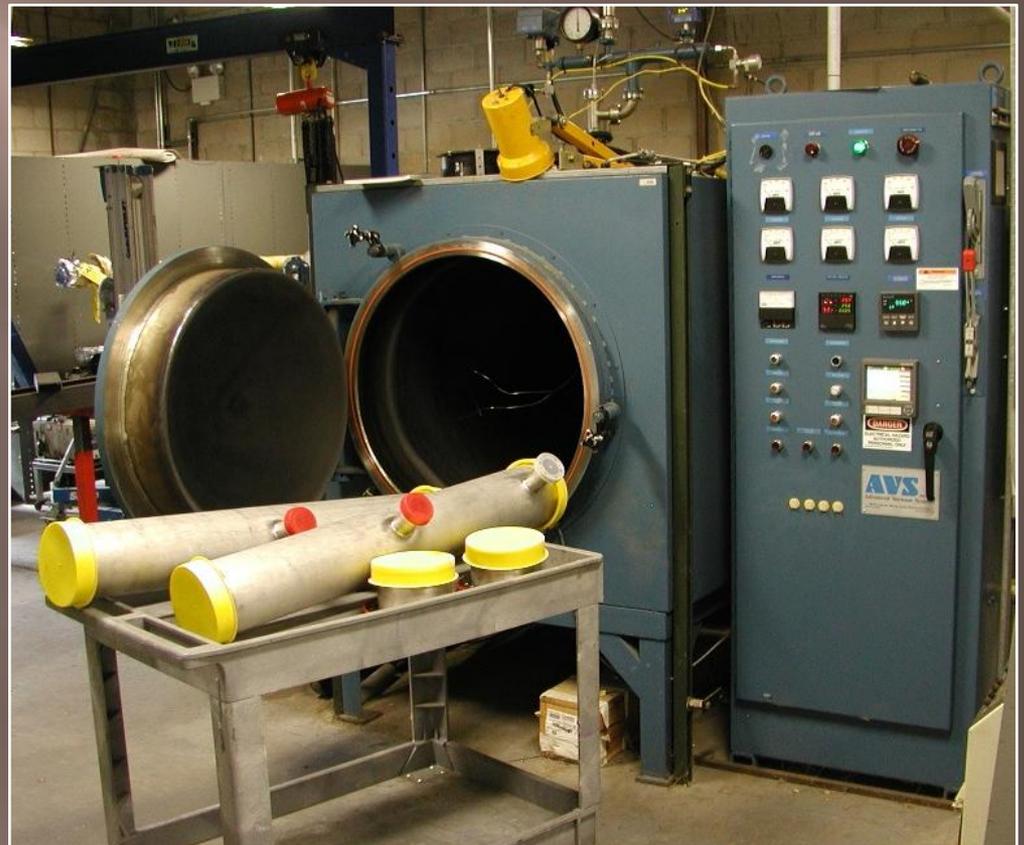
# TITANIUM NITRIDE MAGNETRON SPUTTERING

Performed at Brookhaven National Lab  
for Fermilab Main Injector  
Electron Cloud Studies  
June 2009

Linda Valerio  
September 11, 2009

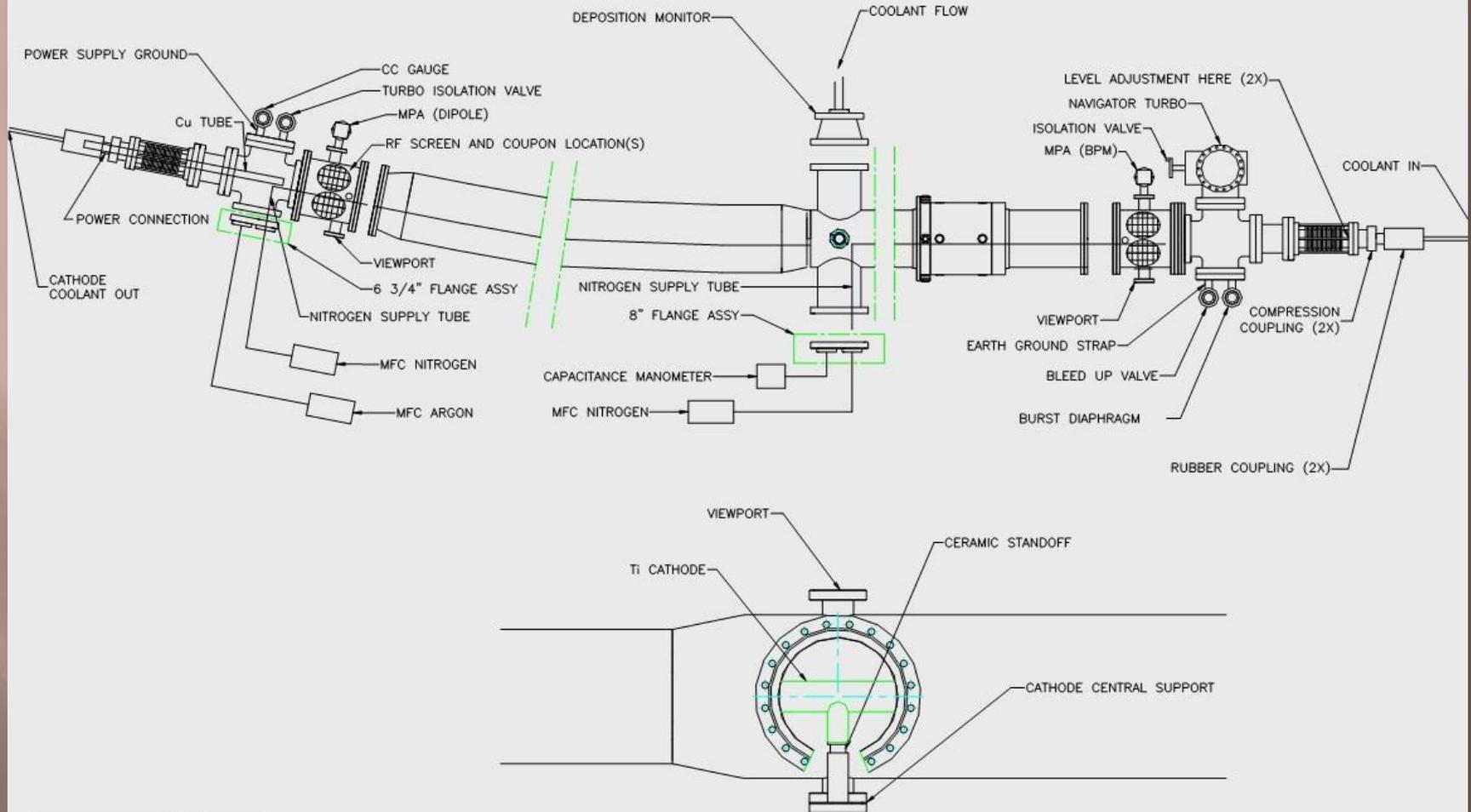
# Preparation

- ▣ Beam tube cleaned according to UHV practices.
- ▣ Vacuum fired at 450 C.
- ▣ Assembled into coating system.



Two Fermilab 6" OD tubes in process.

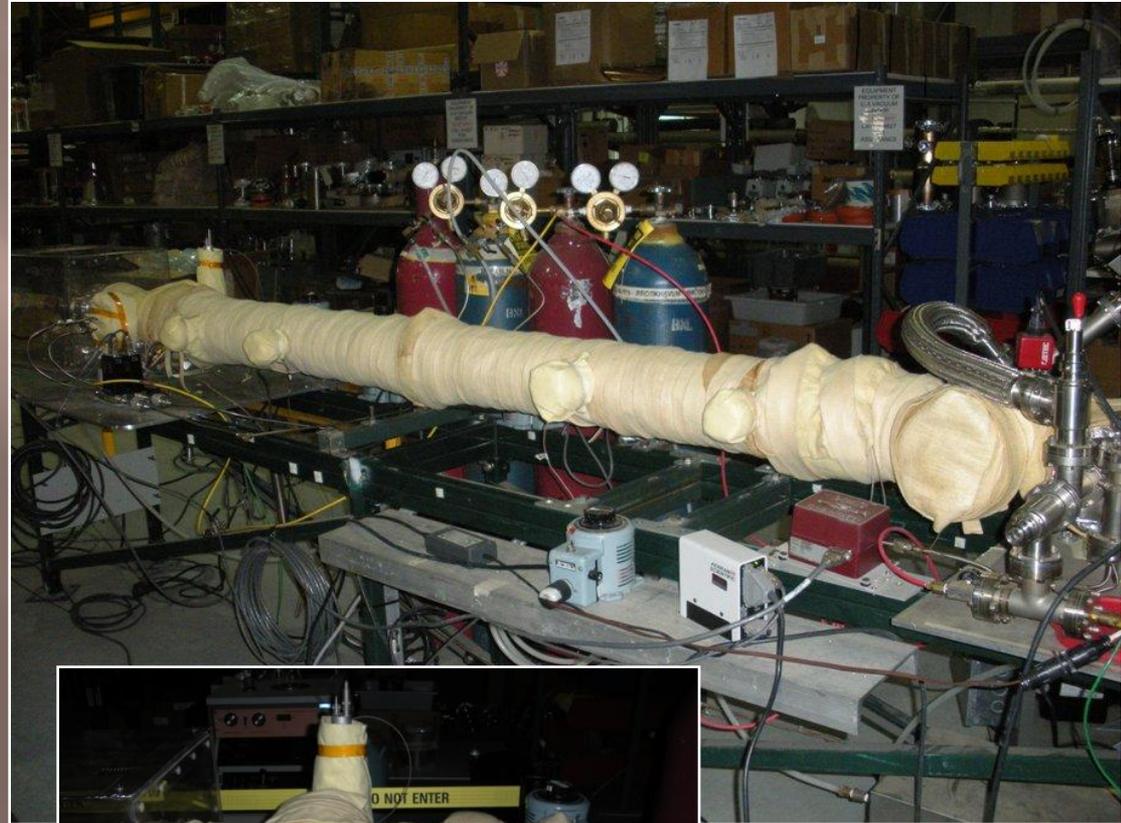
# Coating System



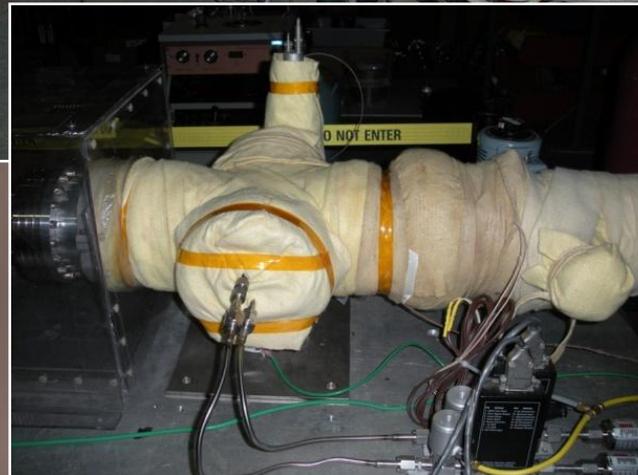
# Coating System



Power and cooling connections.

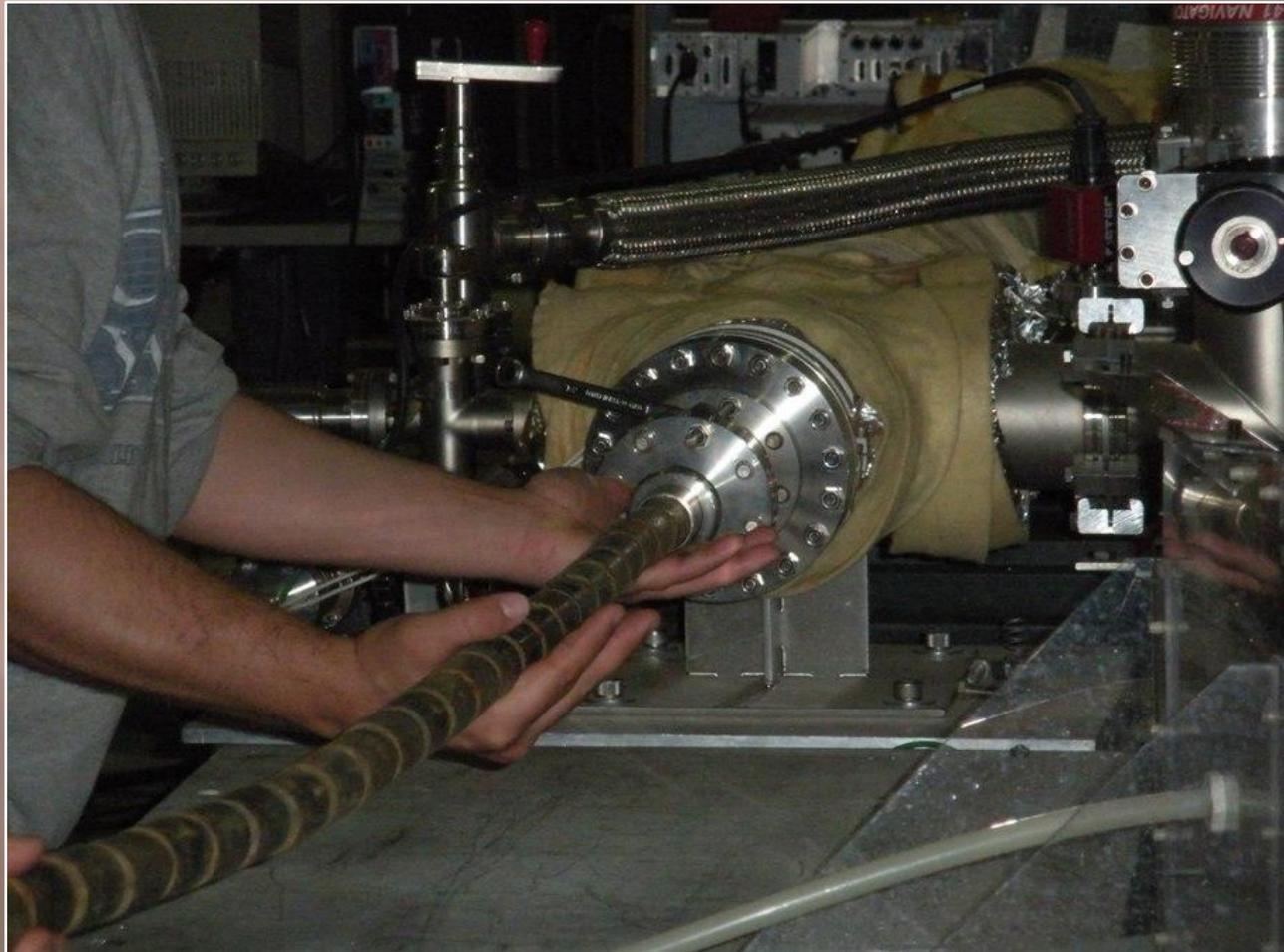


Overview of system with two Fermilab tubes.



Gas introduction flange.

# Titanium Cathode Assembly



Insertion of magnet string into Ti cathode.

# The Coating Process

- ▣ Balance temperature, pressure, flow rate, and voltage to control deposition.
- ▣ Start with Argon only for pure Ti layer, then add Nitrogen.
- ▣ Monitor voltage discharge characteristics, plasma color, and partial pressures on RGA to confirm process.
- ▣ The Fermilab setup started at 200 C and  $4 \times 10^{-7}$  Torr and took less than an hour.

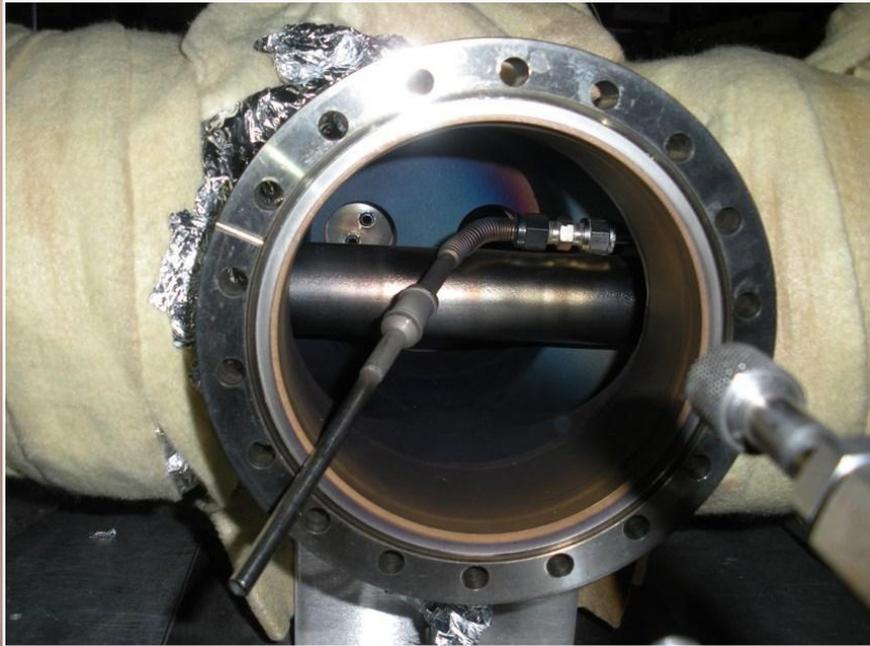


Argon plasma



Argon + Nitrogen plasma

# System Disassembly

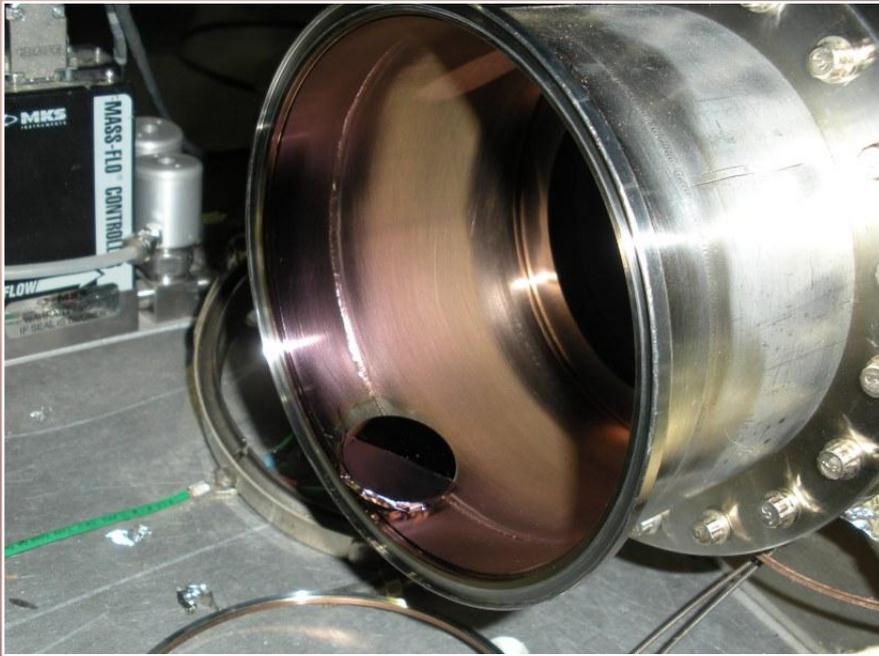


Nitrogen insertion tube attached to titanium cathode still inside chamber.

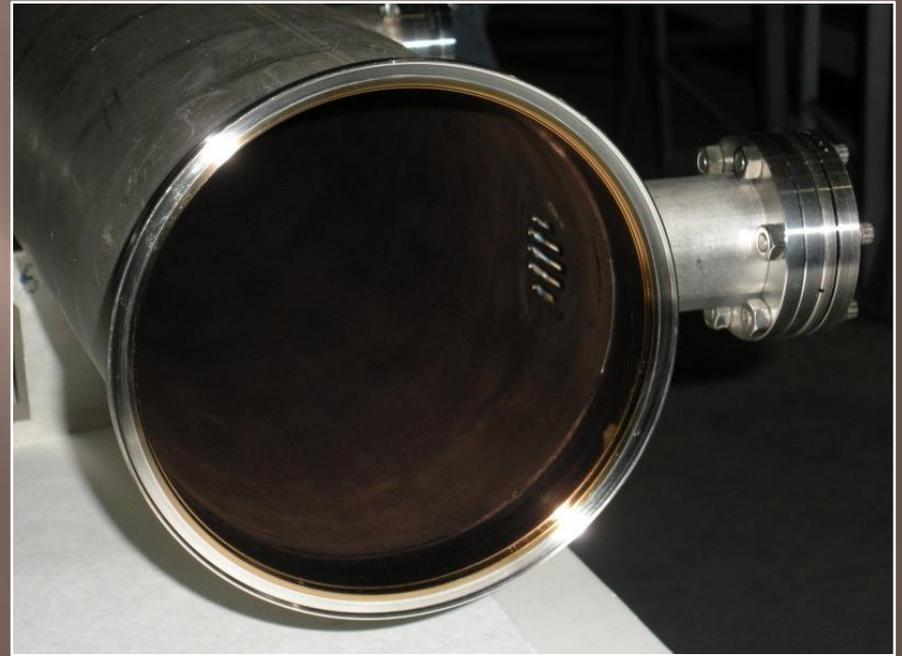


Titanium cathode with nitrogen distribution tube. Magnet string position indicated by discoloration.

# Coating Complete

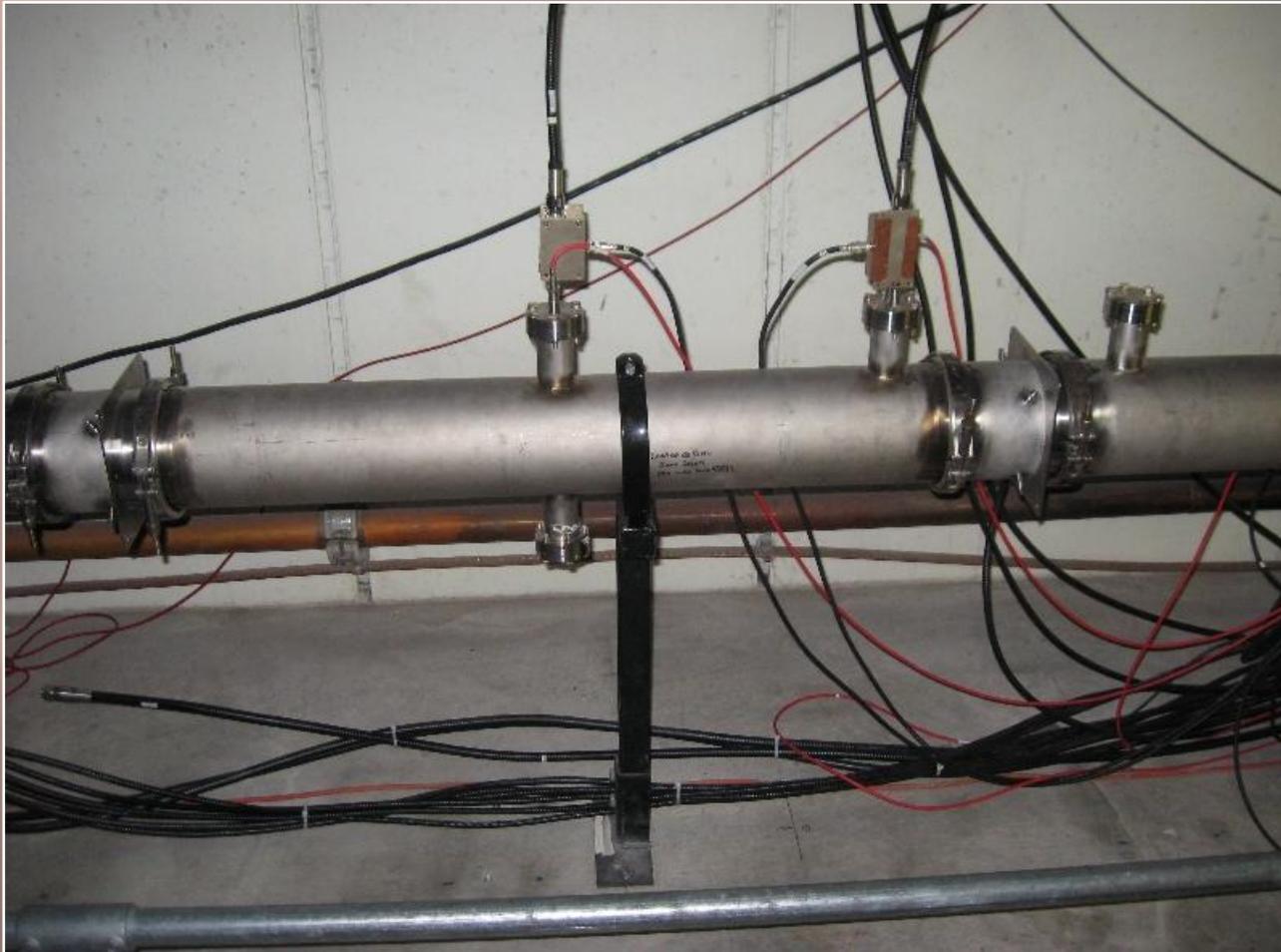


Coating analysis coupons were inserted adjacent to production tubes.



Finished Fermilab tube.

# Installed in Main Injector



One coated tube installed during Summer 2009 shutdown at MI-521.  
One uncoated tube also installed, with electron cloud detectors on both.

# Current Status

- ▣ Main Injector startup September 10, 2009 – first opportunity to start electron cloud studies with coated tube.
- ▣ Brookhaven will also coat a Main Injector elliptical tube.
- ▣ Fermilab has a separate collaboration with SLAC to coat a Main Injector elliptical tube using electrostatic sputtering (no magnets).
- ▣ Eventually, comparison of both methods will be done to determine which is better suited for Main Injector.