

PROGRESS AND PLANS FOR MAIN INJECTOR BEAM PIPE COATINGS

Dave Capista

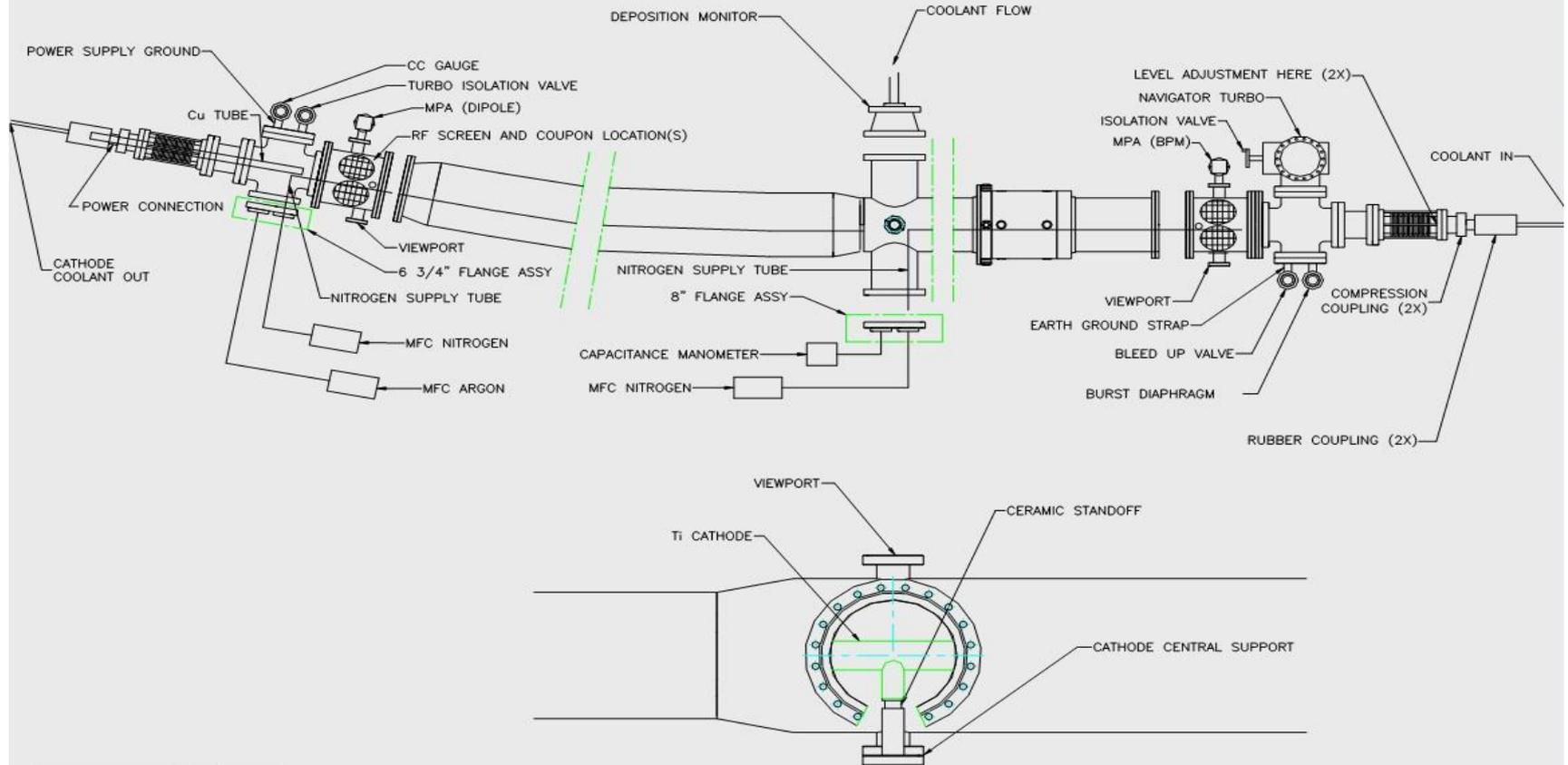
Linda Valerio

Project X Collaboration Meeting
WG3 MI/Recycler
September 8, 2010

PROGRESS AND PLANS FOR MAIN INJECTOR BEAM PIPE COATINGS



- TiN coatings
 - Review Brookhaven coating system
 - SLAC coating system
 - Components coated
 - Materials transferred to Fermilab
 - Coating plans at Fermilab.
- CERN coating experience (2009 anti e-cloud workshop)
 - TiN coatings
 - Amorphous carbon coatings
 - Experiments at Fermilab

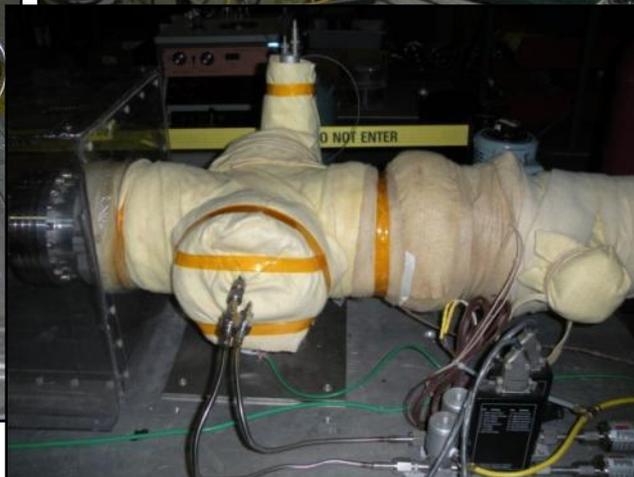




Power and cooling connections.



Overview of system with two Fermilab tubes.



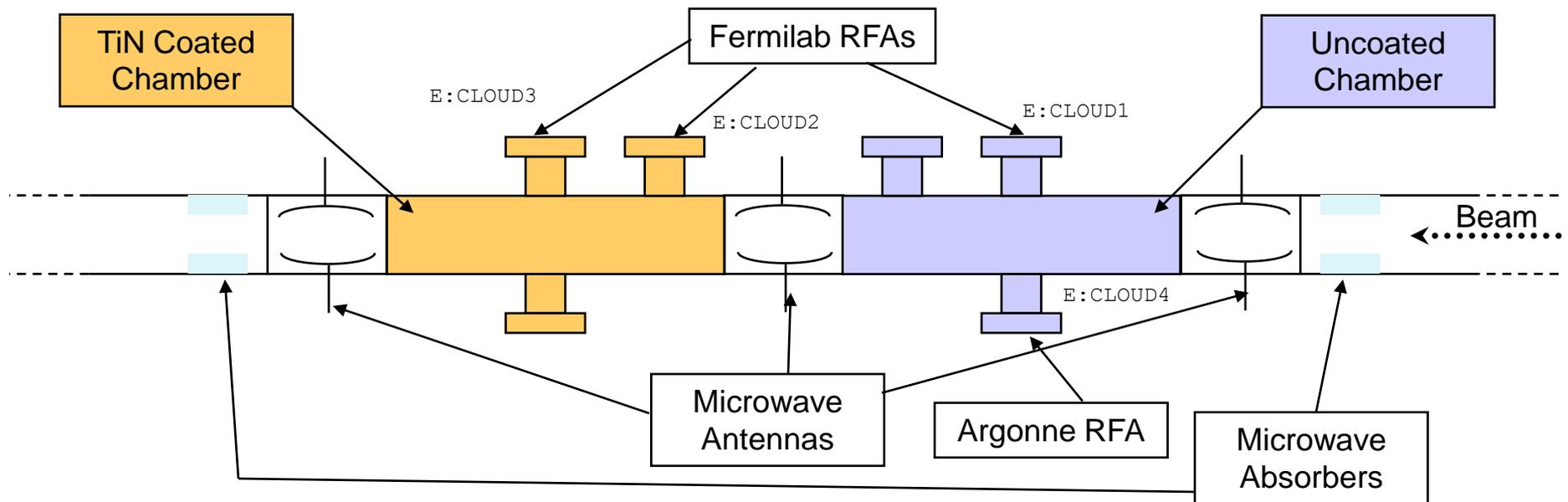
Gas introduction flange.

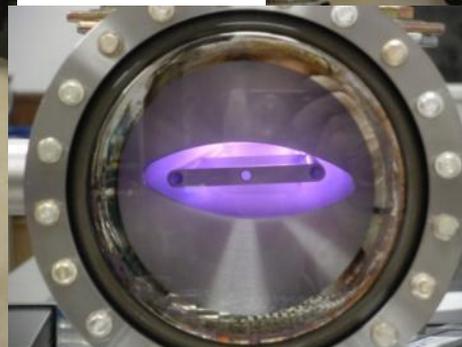
Electron Cloud Experimental Upgrade - 2009

Major upgrade just finished installation, this summer 2009

- 2 New experimental Chambers
 - Identical 1 m SS sections, except that one is coated with TiN
- 4 RFAs (3 Fermilab & 1 Argonne)
- 3 microwave antennas and 2 absorbers
 - Measure ECloud density by phase delay of microwaves

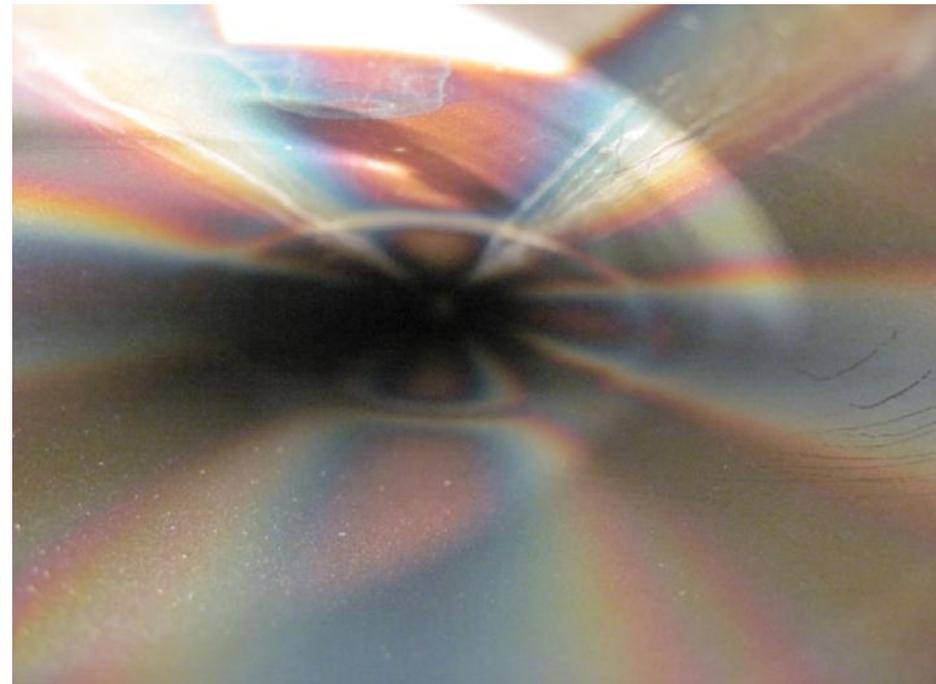
- Primary Goal: validate TiN as a potential solution for Project X
- Secondary Goals:
 - Remeasure threshold and conditioning
 - Further investigate energy-dependence
 - Measure energy spectrum of electrons
 - Test new instrumentation
 - Directly compare RFA and Microwave
 - Measure spatial extinction of ECloud





Overview of coating system. Much simpler the BNL magnetron system. Coating time is much longer than BNL system.

E4R Service Building Coating Tests at FNAL



- Cathode and coated tube has been received at FNAL from SLAC
- Ordering parts to reproduce SLAC test.
- Hope to be able to coat an elliptical pipe by the end of 2010

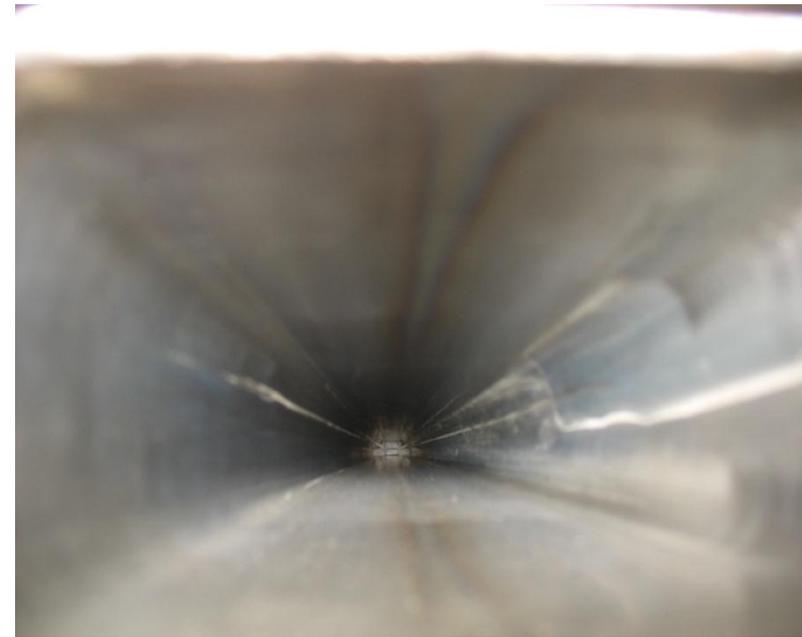


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- Need to be collaborate with SLAC to build a cathode that will accommodate the sagitta of the Main Injector dipoles.
 - Coat a Main Injector dipole with TiN. We hope to be able to accomplish this in 2011.
 - Develop a plan to coat the Main injector dipoles, quads and straight sections.
 - Estimate manpower and time to coat the machine
 - Make a cost estimate for coating the Main Injector.

E-cloud at CERN SPS and old Main Ring.



CERN SPS e-cloud mark.



Main Ring e-cloud mark?

- Main Injector does not show this e-cloud mark.
- Main Ring operated at $4.5E10$ ppb, Main Injector operates at $1E11$ ppb.
- Main Ring and SPS beam tube is SS308, Main Injector is SS316L.



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- Does TiN coating help?
 - not at all (SNS), a little (CESR-TA), a lot (PEP-II, KEKB)
 - J-PARC (no data yet), PSR – sometimes TiN helped
 - relative effect of scrubbing less strong for TiN
 - differences between e+ and e- at CESR-TA
 - benefit of TiN depends on bunch spacing & #bunches
 - SNS 3 years operation, no clear evidence for scrubbing in presence of controlled venting 2 or 3 times per year
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Discussion Points.

Cern anti e-cloud workshop.

Experience with TiN coatings.



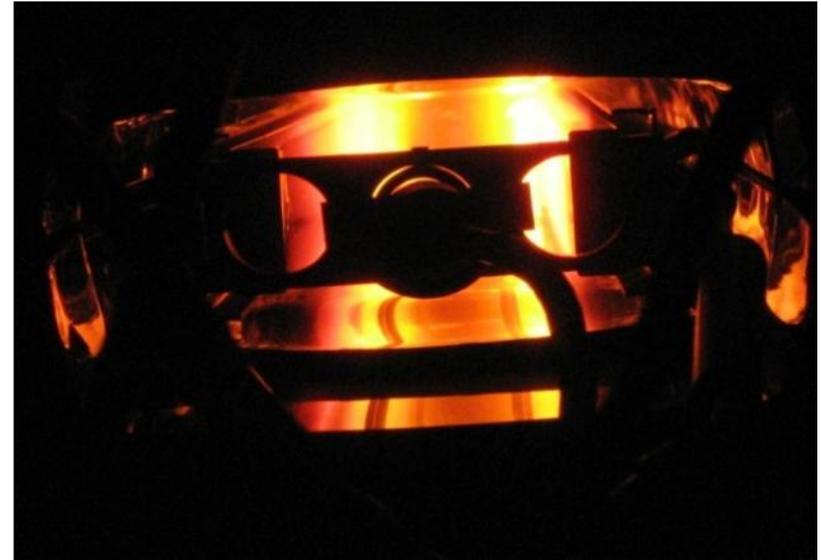
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- TE-wave measurements at cyclotron-resonance - handle with care!
 - how reliable are the predictions?
 - unexpected e-p instability at SNS, at 20% of design intensity with TiN coating, compared with predicted 130% w/o coating
 - SPS dump kicker with 50-ns bunch spacing?
 - FNAL MI e-cloud evolution during acceleration
 - SNS: effect of particles in gap?
 - SNS: problem with build up or with instability?
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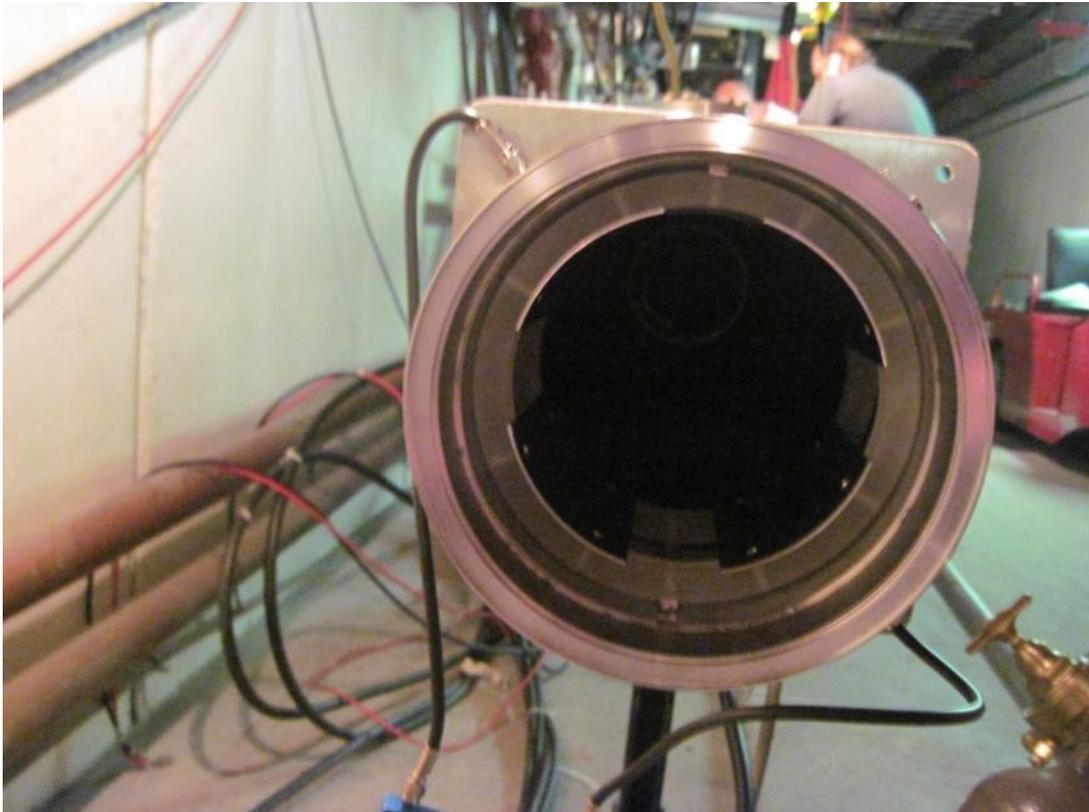
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- SEY values after conditioning?
 - re-diffused component, “anti-dips” for TiN
 - mitigation by higher beam intensity
 - “magnetron effect” - CESR-TA experiment?
 - bremsstrahlung off beam protons
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Project X Amorphous Carbon (a-C) at CERN



- CERN produced a magnetron sputtering system using a double cathode with graphite side blocks inside of a dipole excited to about 40A.
- Difficulties with plasma stability, uniformity of coating, and end effects.

CERN a-C tube in Main Injector



- Installed at MI52 in place of the TiN during the 2010 shutdown.
- Waiting on data and results (next talk?).

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Thank you for your attention.