MI Issues

Ioanis Kourbanis (FNAL)/Thomas Roser(BNL)

Initial Project X Collaboration Meeting

November 22, 2008

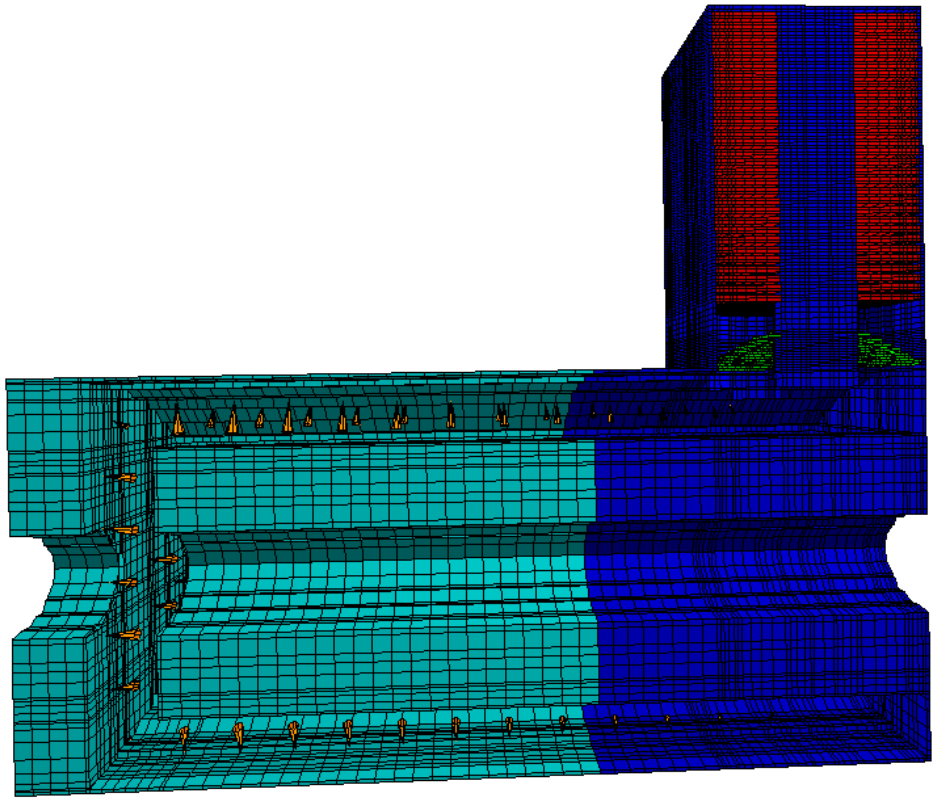
MI in Project X

- Accelerate 1.6E14 protons to 120 GeV with 99% acceleration efficiency for a total power of 2.1MW.
  - 4.4 times the current beam intensity
  - 3 times the bunch intensity we can currently achieve.
  - 6 times the current beam power (x3 the NOvA beam power)
- Major issues that need to be addressed include:
  - New rf systems (fundamental and second harmonic)
  - E-cloud
  - Transition crossing
  - Loss control and activation

MI RF Systems

- Have an initial design for the fundamental 53MHz system that meets the power and voltage requirements.
  - Very conservative design uses a lot of power to guarantee stability.
- We agreed that is important to finalize the 53 MHz cavity design in about a year in order to proceed with prototype development.
- SLAC offered to help with field modeling and LLRF beam stability simulations (including a second harmonic)
- BNL is going to investigate if they can help with tuner design.
- Fermilab is going to proceed with paper design of a second harmonic cavity (106 MHz)

New Cavity Design for MI



D. Wildman

Blue: copper
Teal: stainless steel
Green: ceramic window
Red: ferrites

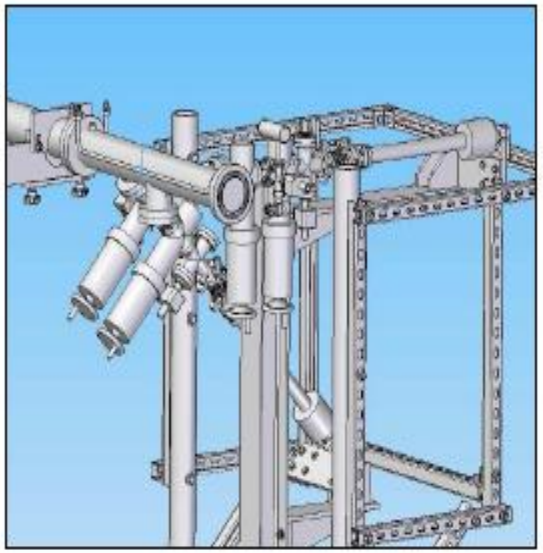
Advantages
- Perpendicular biased
- Low rf tuner losses
- Use existing bias PS

E- Cloud Measurements

- We already have an extensive set of e-cloud measurements in MI.
  - Pressure rises
  - Used an RFA detector (borrowed from Argonne) as electron counter.
- Recently in collaboration with LBNL used the microwave transmission method to evaluate the electron density with some very interesting results.
  - Berkeley has offered to work in proving us with tools that greatly simplify this measurement.
- Fermilab is developing improved RFA detectors that are going to be tested in CESR before are installed in MI.

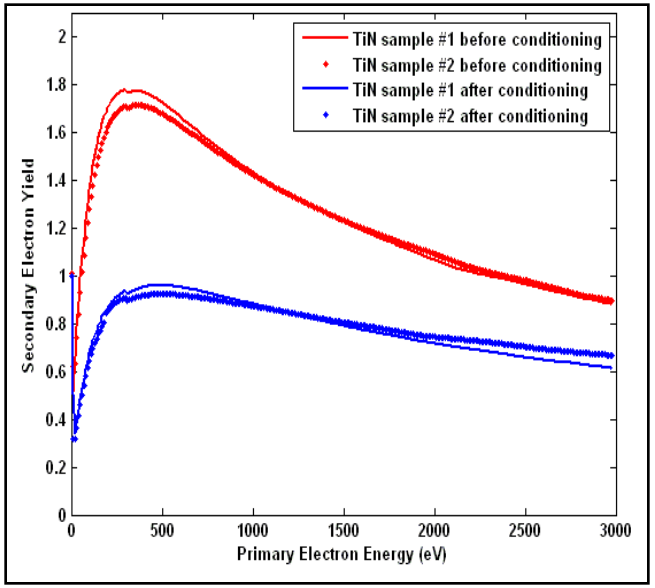
E-Cloud Measurements cont.

- SLAC has developed test stands for e-cloud measurements we plan to use in MI.
  - Design allows measuring the beam conditioning effects on different surface materials



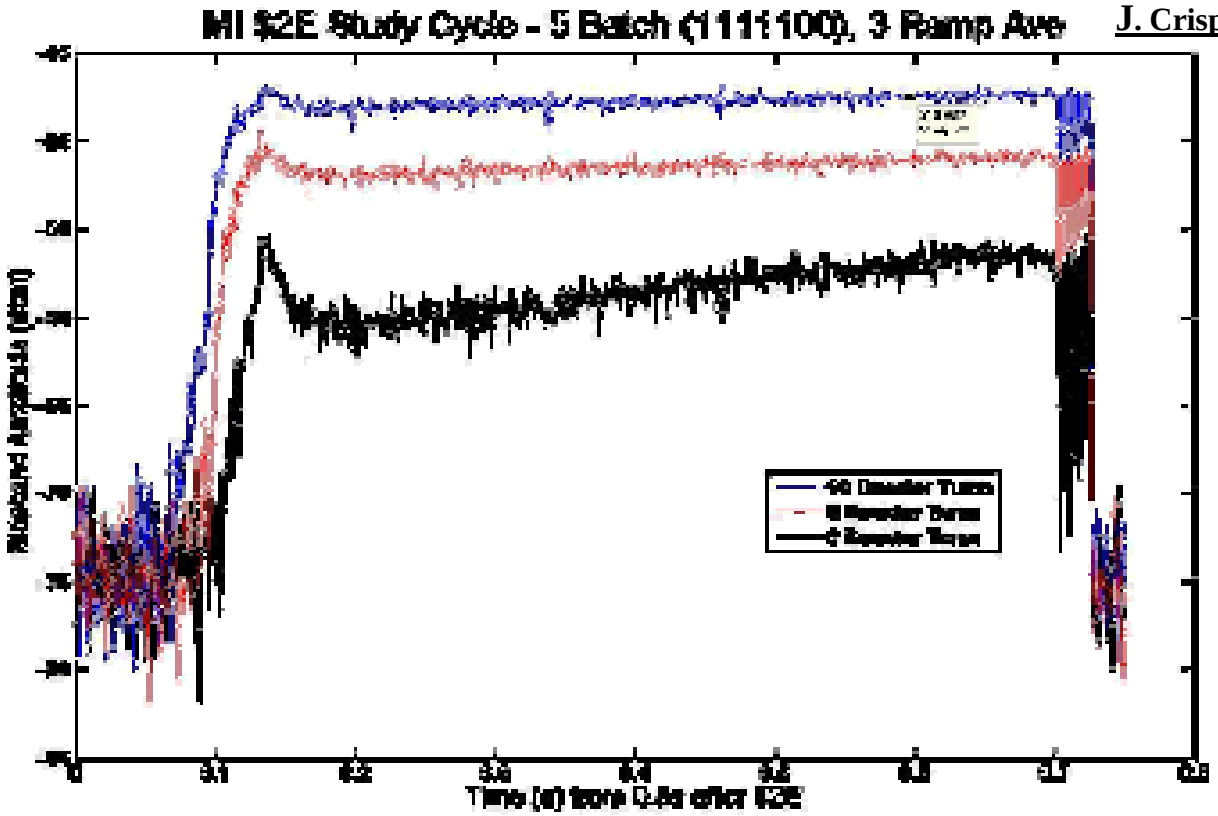
•Allows removal of beam pipe surface "buttons" without breaking vacuum.
•Explicit measurement of SEY for different materials, with different beam exposures.

M. Pivi et al.



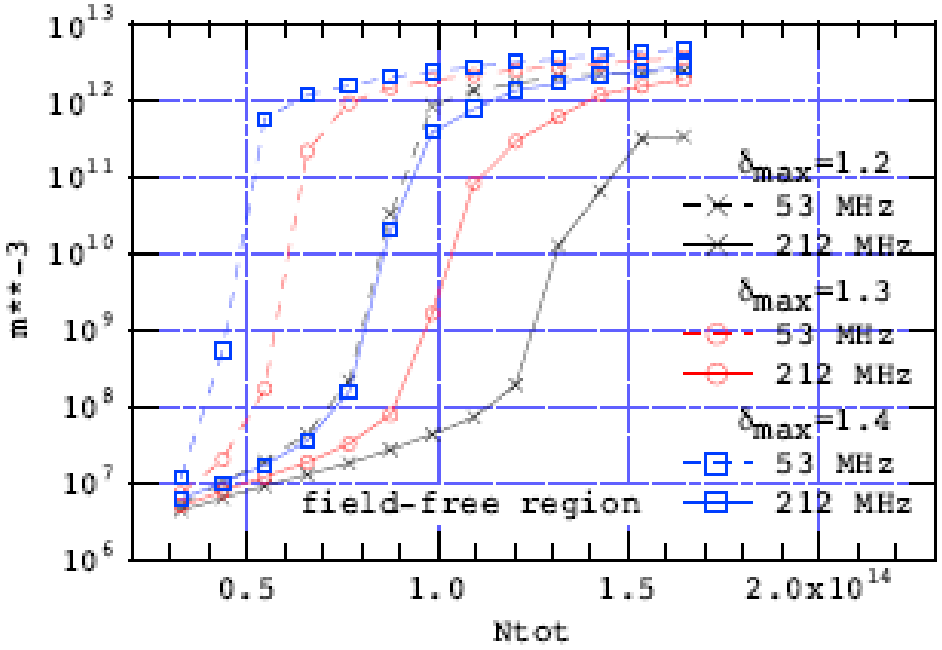
E-cloud microwave measurements in MI

J. Crisp, N. Eddy, S. de Santis



E-Cloud Simulations

- Great progress is being made in MI e-cloud simulations y using the LBNL code POSINT (Furman).
  - By using the RFA beam measurements the effective secondary emission yield was predicted.
  - E-cloud build up for two different rf frequencies (53MHz, 212MHz) was compared.
- The new microwave measurements need to be compared with the code predictions.
  - The difference between the build up in field free region and field regions needs to be understood.
- SLAC offered to help with comparison with the CLOUDLAND code and with beam dynamic simulations.



M. Furman

Average simulated electron density in MI for two different frequencies vs. total beam intensity.

E-cloud (mitigation methods)

- In FY09 we plan to coat 1m long MI beam pipe with TiN (done at BNL) and install it in MI straight section.
  - Directly compare the signal between coated/un-coated pipe by using the new RFA detectors.
- We agreed that it is important to investigate the possibility of coating the MI beam pipe ASAP.
  - Plan to test coating of the MI pipe in a dipole sometime in early FY2010.
  - Both BNL and SLAC offered to help providing engineering support and expertise.
  - Investigate other ways to do coating.

Loss control

- The MI collimator scheme will work also for Project X.
  - SLAC offered to help with evaluating collimation efficiency
- Need to identify the loss mechanism for the 99% MI acceleration efficiency.
  - LBNL offered to help with modeling of low losses because of space charge.

Instabilities/Transition crossing

- The BNL experience with their first order gamma-t jump for RHIC has been good. It was stressed that controlling of the chromaticity through the jump is critical.
  - A fast transverse instability is observed during the transition jump. It is dependent on longitudinal density and it cured with chromaticity and octupoles.
  - There is an R@D plan for developing broad band feedback systems able to damp these kind of fast instabilities.
- No issues were found with our MI gamma-t design.