

Electron Cloud Experimental Upgrade in the Main Injector

Bob Zwaska

Project X Collaboration Meeting

September 11, 2009

With: C.Y. Tan, Mike Backfish, Kevin Duel, and Lee McCuller

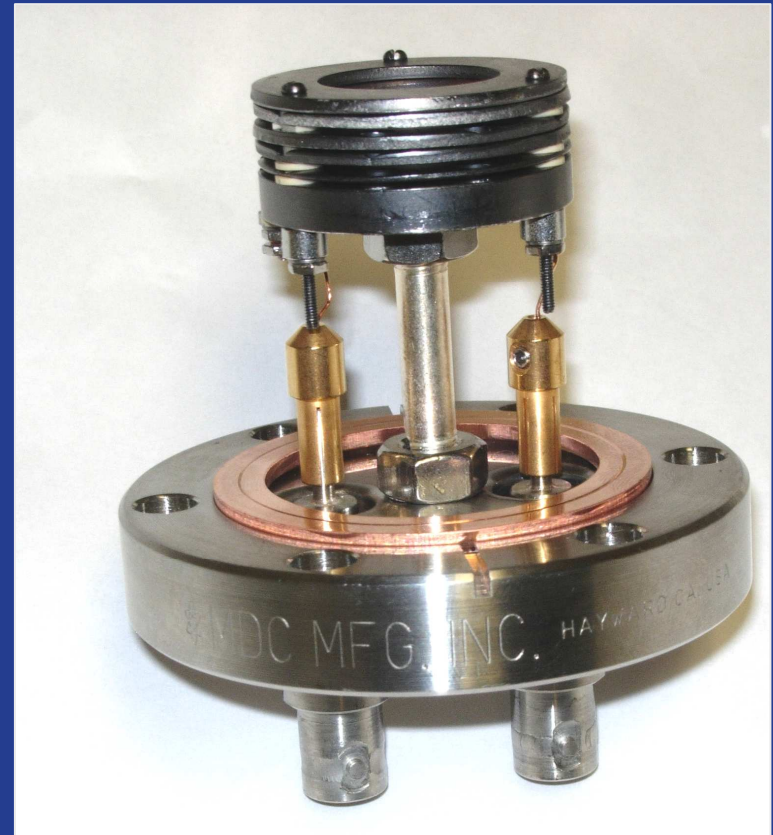
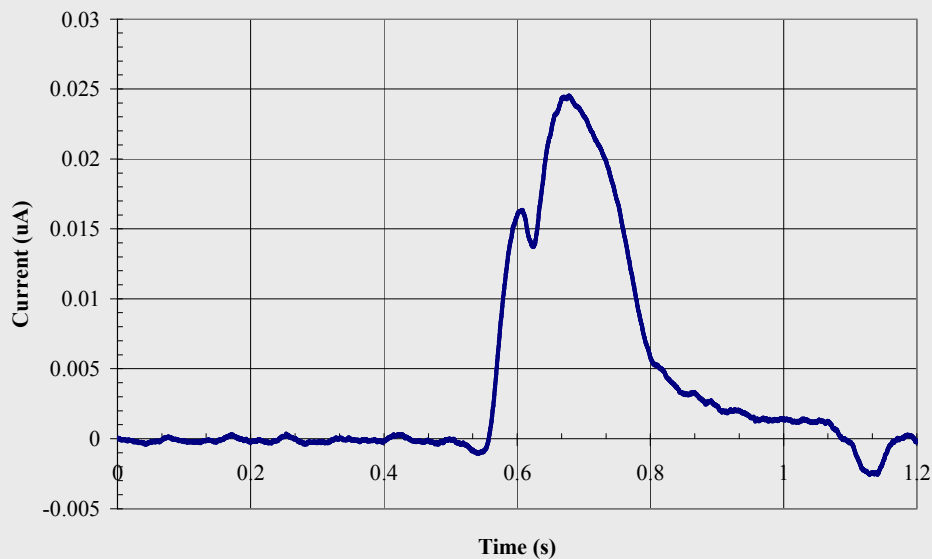


Outline

- Previous Installation and Measurements
- New Installation in Main Injector
- Detector Detail
- Summary & Plans

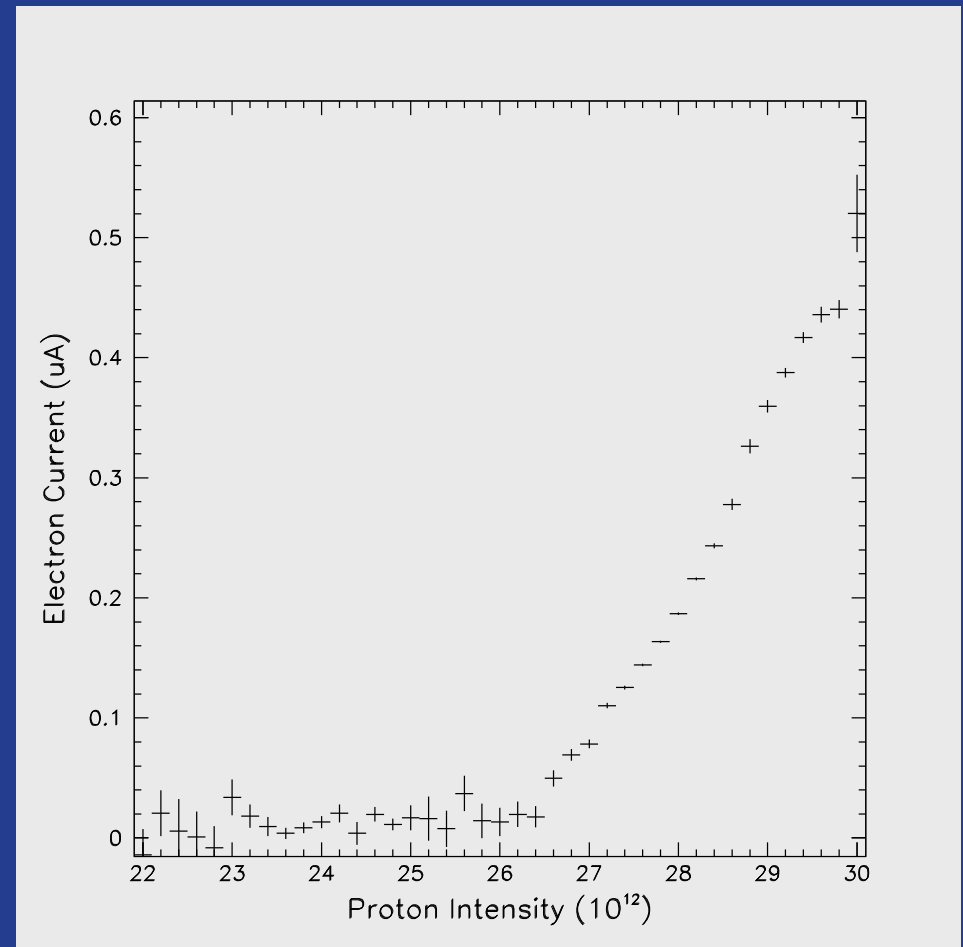
Previous Installation & Measurements

- Argonne RFA (Borrowed)
 - Installed in drift region
- Allowed direct observation of Cloud
 - Time- (energy-) dependent signal



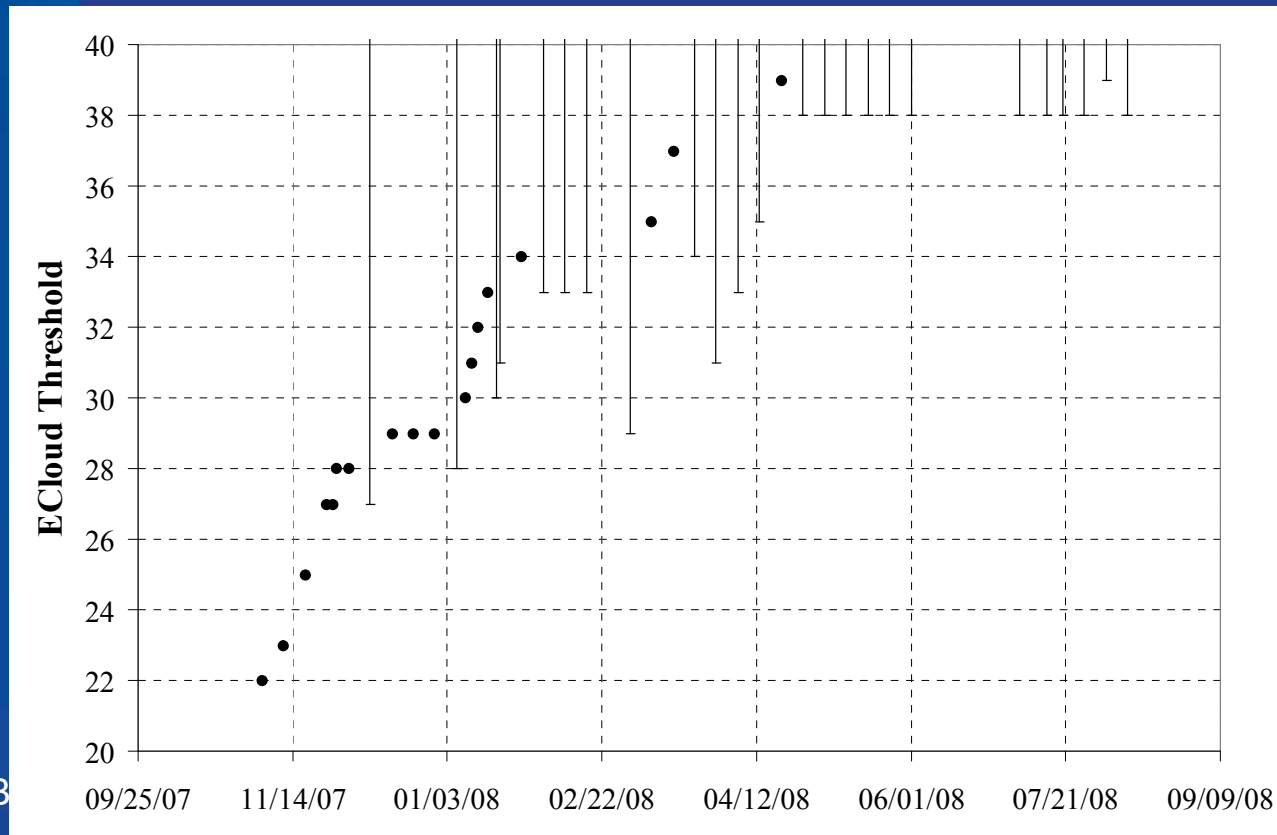
Threshold

- Large number of cycles sampled at maximum current
- Clear turn-on at higher intensities
 - Threshold at $\sim 26 \times 10^{12}$ protons
 - Threshold later moved higher
- Allowed fitting of Furman's simulation to data, giving an SEY



Beam Pipe Surface Conditioning

- Threshold evolved with time, moving higher as MI established higher-intensity operation
- When 11 batch became operational, threshold increased quickly (Jan, 2008)
- As beam intensity increased to $40e12$, the threshold eventually increased beyond range



Limitations of Previous Installation

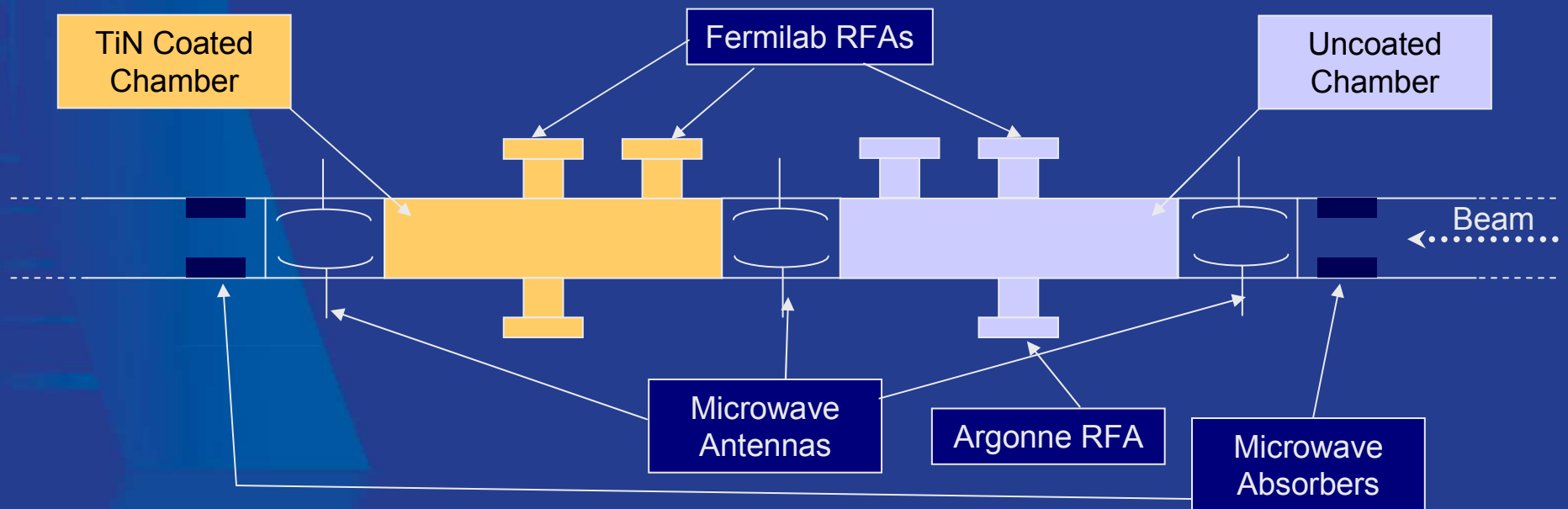
- System suffered from noise/interference
 - Noise floor was too large to explore threshold in detail
 - Energy scans were not possible
- Qualitative difference with simulation persisted
 - Data showed a energy-dependence that was not evident in simulation

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
 - Measure spatial extinction of ECloud



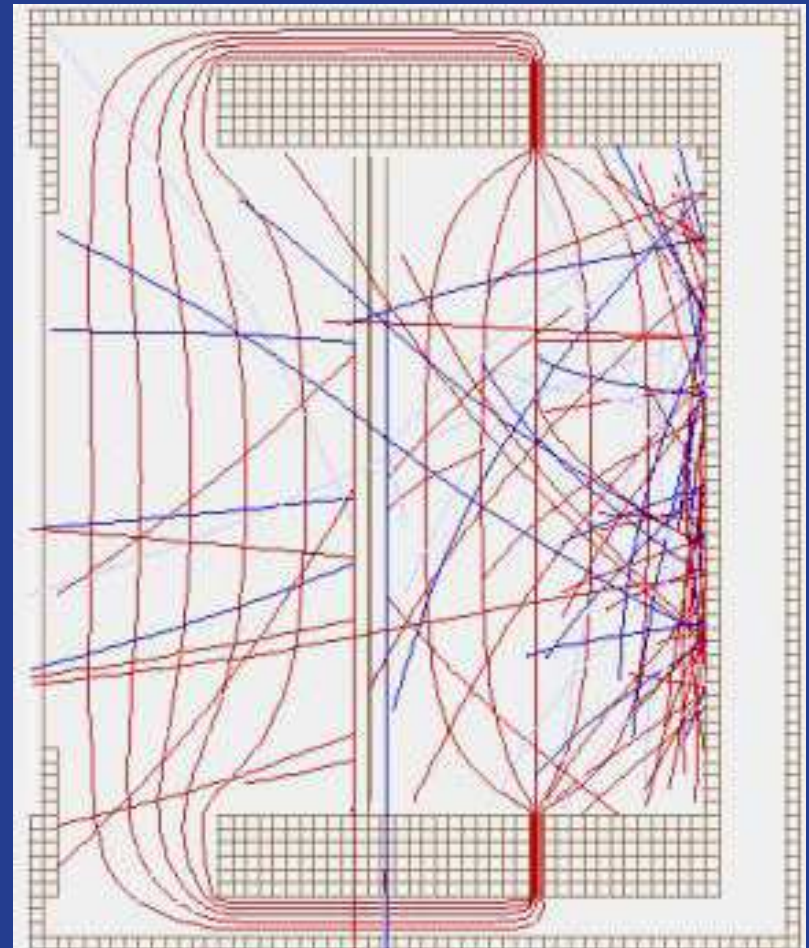
New Detectors

- New RFAs evolved from Argonne style
- Maximize signal with enlarged area and by removing ground grid
 - Ground is provided by the beam pipe
- Shaping of electrodes optimizes energy filter performance
 - Also, more hermetic
- Amplifier/filter in tunnel
 - Better-quality cables to surface



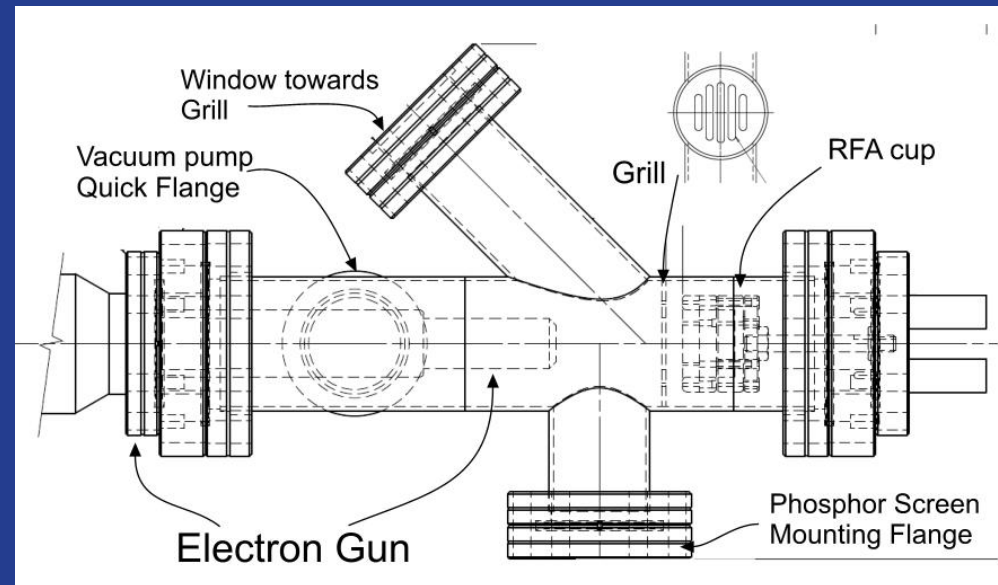
Simulation

- Electrode layout optimized with Simlon simulation
- Track electrons through a detailed grid
- Summer student added secondary emission functionality
 - Still being validated, but looks promising



Test Stand

- Test new detectors with electron gun
- Demonstrated that the detectors work as expected
- Will allow further exploration of detector effects
 - Secondary emission
 - Magnetic Field
 - Detailed calibration



Summary & Plans

- Major upgrade of the ECloud experimental area in the Main Injector is complete
- Measurements will be made within the next few weeks as high-intensity beam becomes available
 - Validating TiN in the Main Injector
- New detectors will allow an enhanced set of measurements
 - Provide new cross-checks to simulation
- Planning further upgrades to installation
 - Considering the ELOUD1 & ELOUD3 stands from SLAC

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