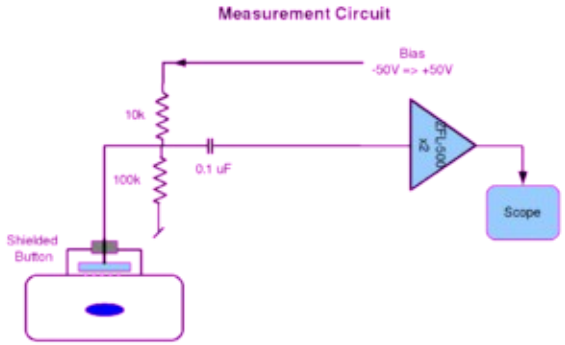
Cornell University
Laboratory for Elementary-Particle Physics

# *First Attempt to Simulate the Shielded Button Measurements with ECLOUD*

*All material for this talk, including full sets of the analysis plots, may be obtained at www.lepp.cornell.edu/~critten/cesrta/ecloud/7apr10*




Jim Crittenden

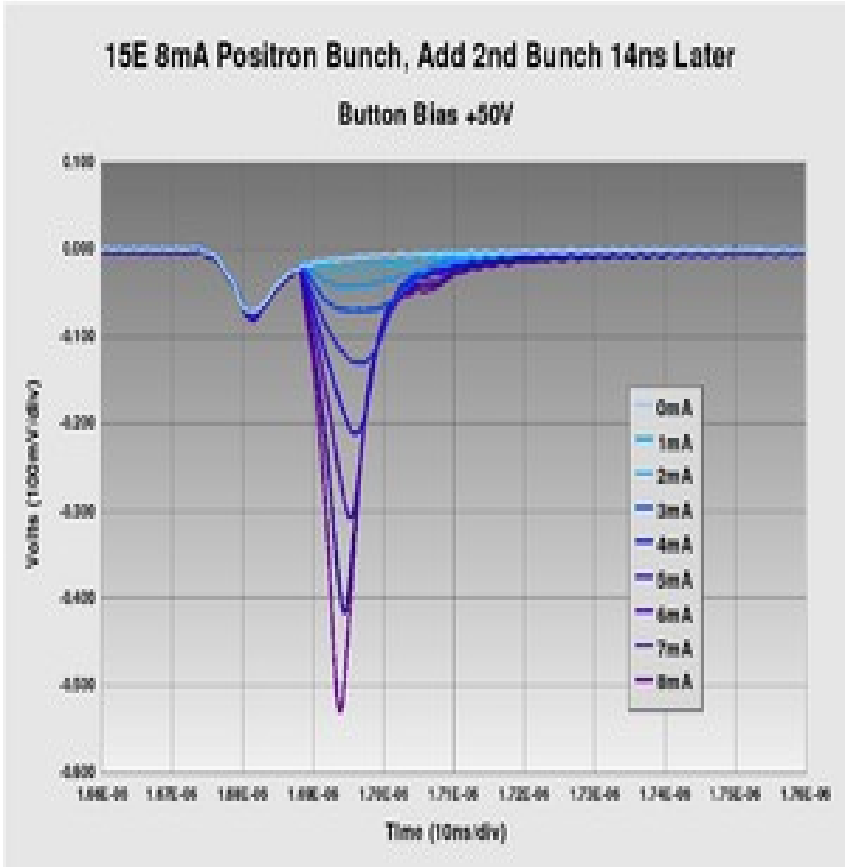
*Cornell Laboratory for Accelerator-Based Sciences and Education*

***Electron Cloud Meeting***

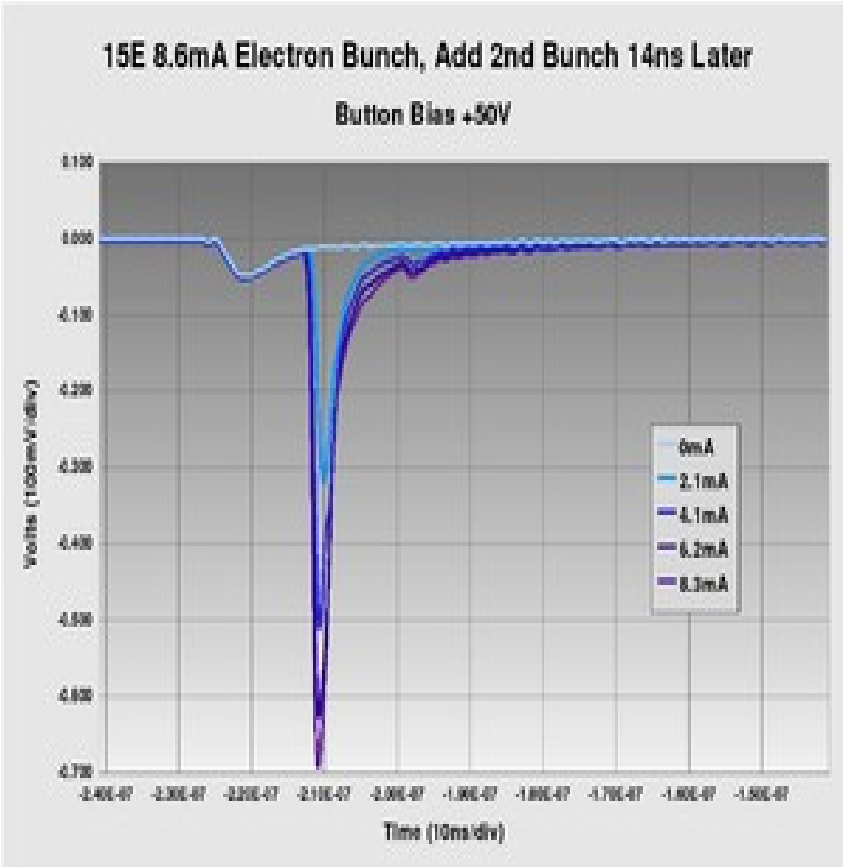
***7 April 2010***

*Measurements of 16 March 2010*
*5.3 GeV, two bunches, 8 mA, 15E (TiN)*
*https://webdb.lepp.cornell.edu/elog/CTA+MS/528*

## *Positrons*



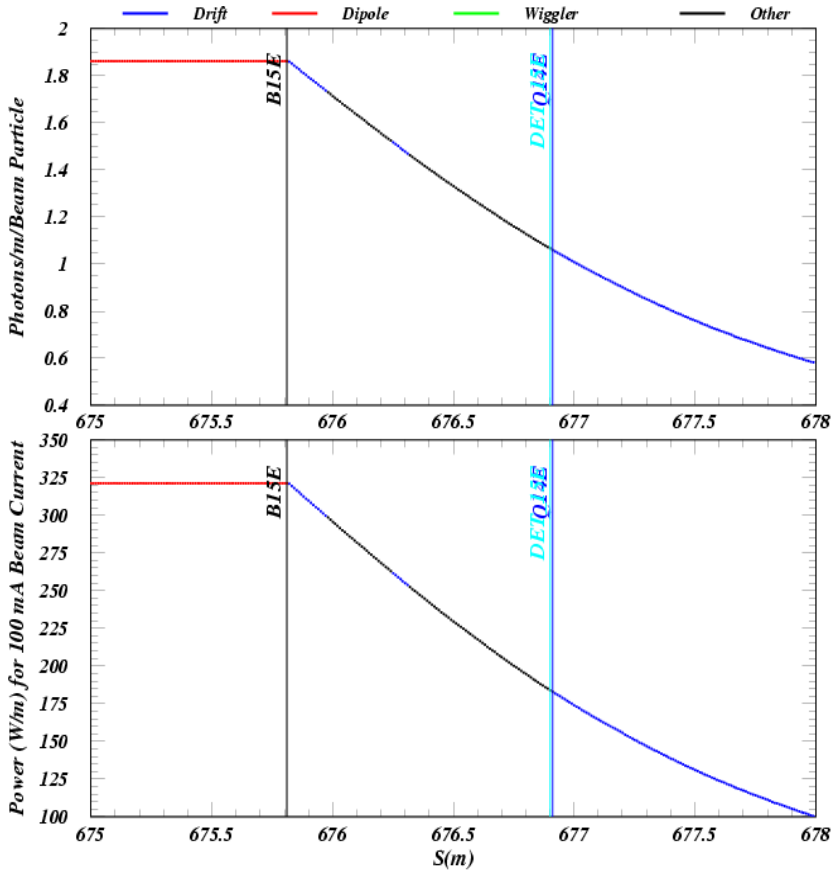

## *Electrons*



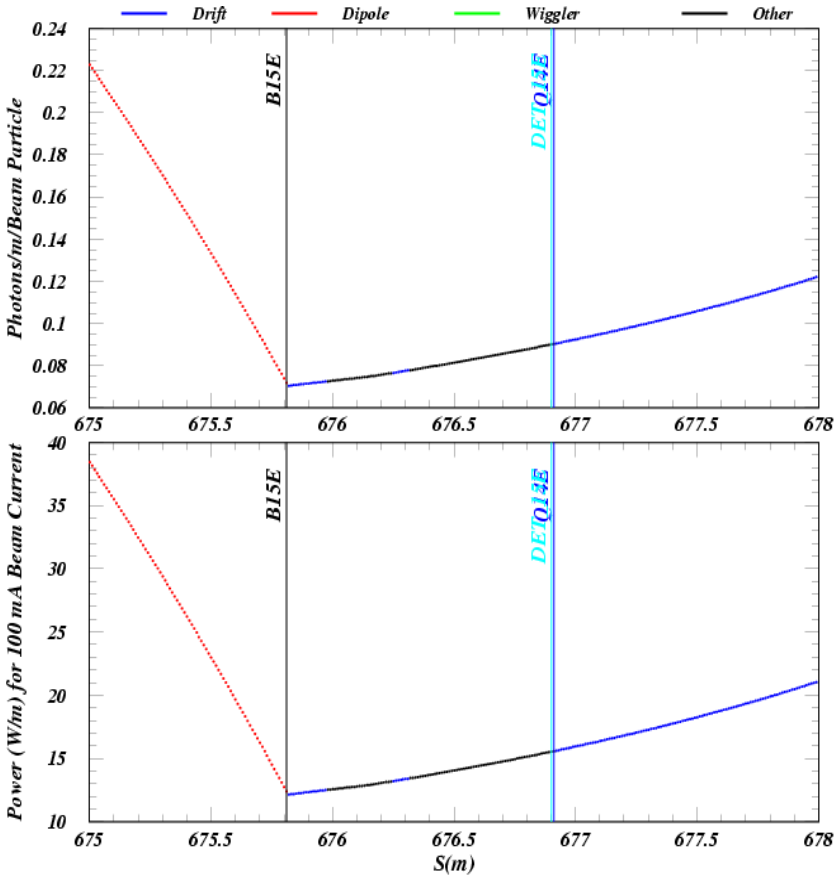

***The time scales are absolute, synchronized to the bunch passage.***
***The time resolution is subnanosecond, both rising and trailing edge.***
***The electron beam shows a remarkably sharper time structure.***

# Synchrotron Radiation Analysis of Pretzel-off CHESS optics

## Positrons




## Electrons




***The direct synchrotron radiation photon rate is an order of magnitude smaller for electrons.***

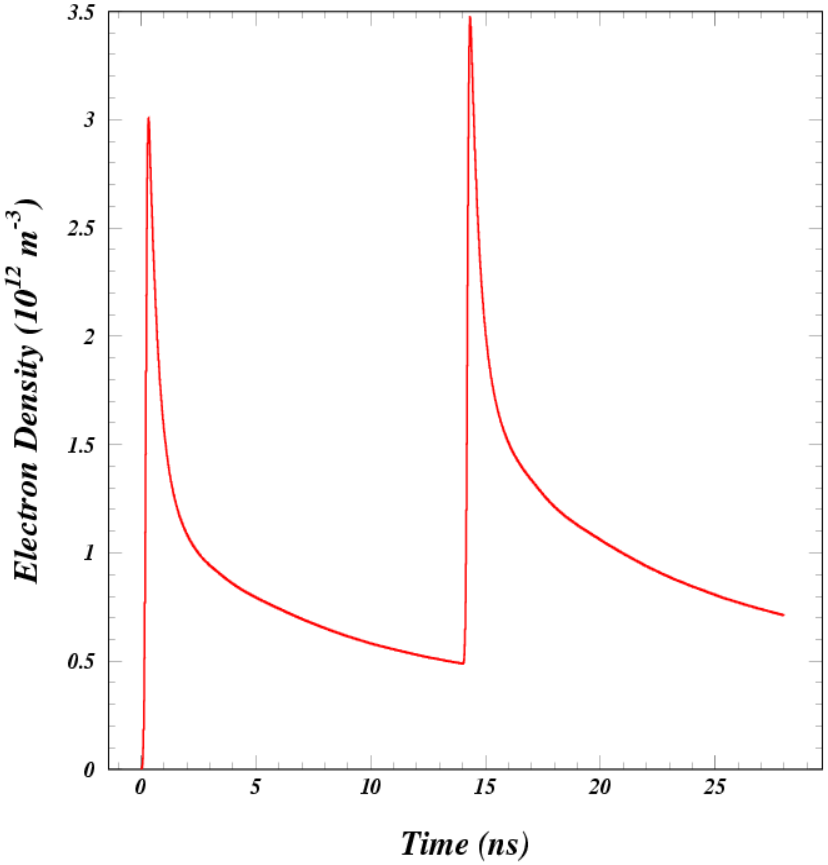
# ECLOUD input parameters

| | | |
|---|---|---|
| Bunch population | $N_b$ | 1.28e11 (8 mA) |
| Number of bunches | $N_b$ | 2 |
| Bunch gap | $Ngap$ | n.a. |
| Bunch spacing | $L_{sep}[m]$ | 4.2 (14 ns) |
| Bunch length | $\sigma_z[mm]$ | e+: 18.8 e-: 18.8 |
| Bunch horizontal size | $\sigma_x[mm]$ | e+: 0.222 e-: 0.205 |
| Bunch vertical size | $\sigma_y[mm]$ | e+: 0.0185 e-: 0.0191 |
| Photoelectron Yield | $Y$ | 0.1 |
| Photon rate ( γ / m / e ) | $dn_\gamma/ds$ | e+: 1.00 e-: 0.118 |
| Antechamber protection | $\eta$ | n.a. |
| Photon Reflectivity | $R$ | 20% |
| Max. Secondary Emission Yeld | $\delta_{max}$ | 1.0 (0.9 t.s. & 0.1 rediff) |
| Energy at Max. SEY | $E_m[eV]$ | 400 |
| SEY model | Cimino-Collins $(\delta(0)=0.5)$ | |

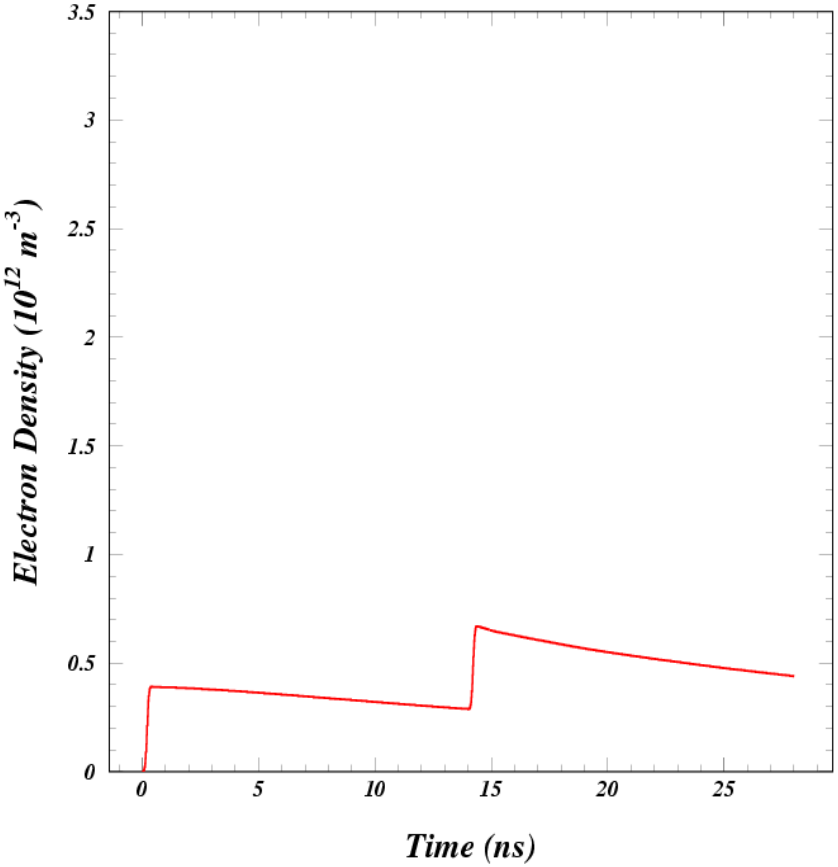
***SEY estimated for processed TiN.***
***Numerical parameters large: 1000 steps, 101 kicks, 250k m.p. per bunch.***

# Beampipe-averaged Cloud Density

## Positrons




## Electrons

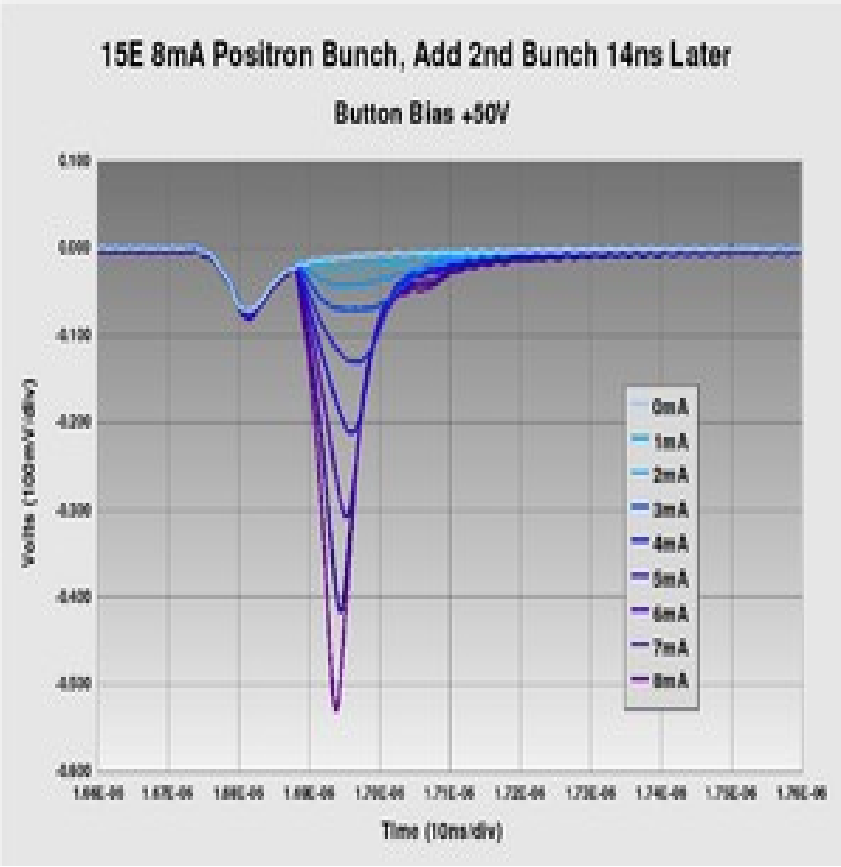



***The direct synchrotron radiation photon rate is an order of magnitude smaller for electrons and the decay time between bunches is much greater.***

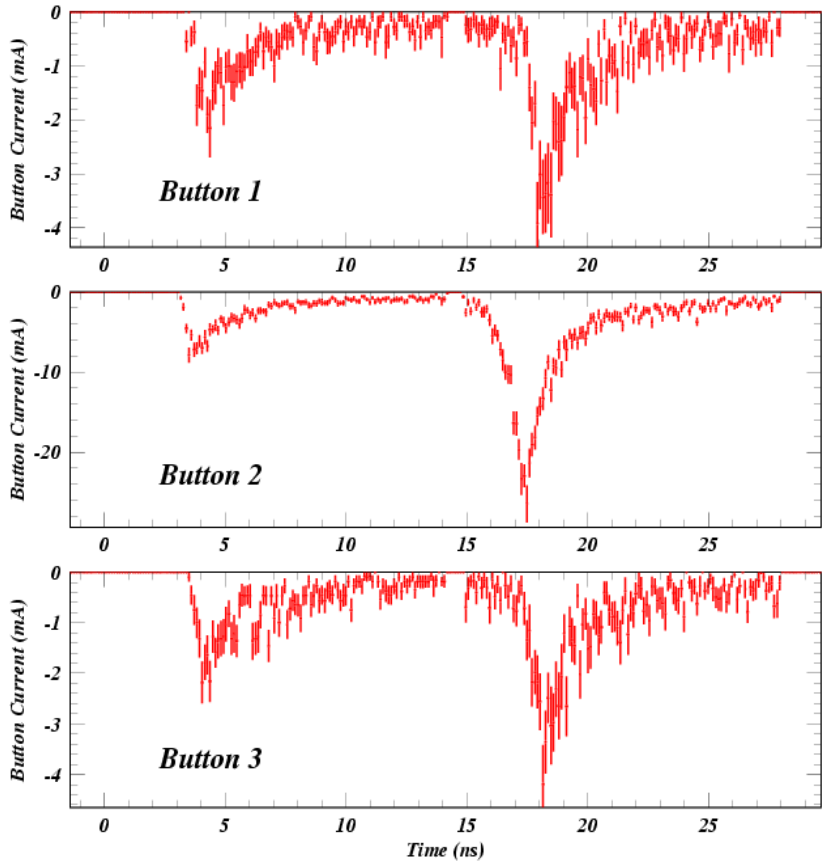
***But the beampipe-averaged density is only weakly related to the shielded button signal.***

# Comparison of Simulated Signal to Measurement
## -- Positrons --

**Measurement (Central Button)**



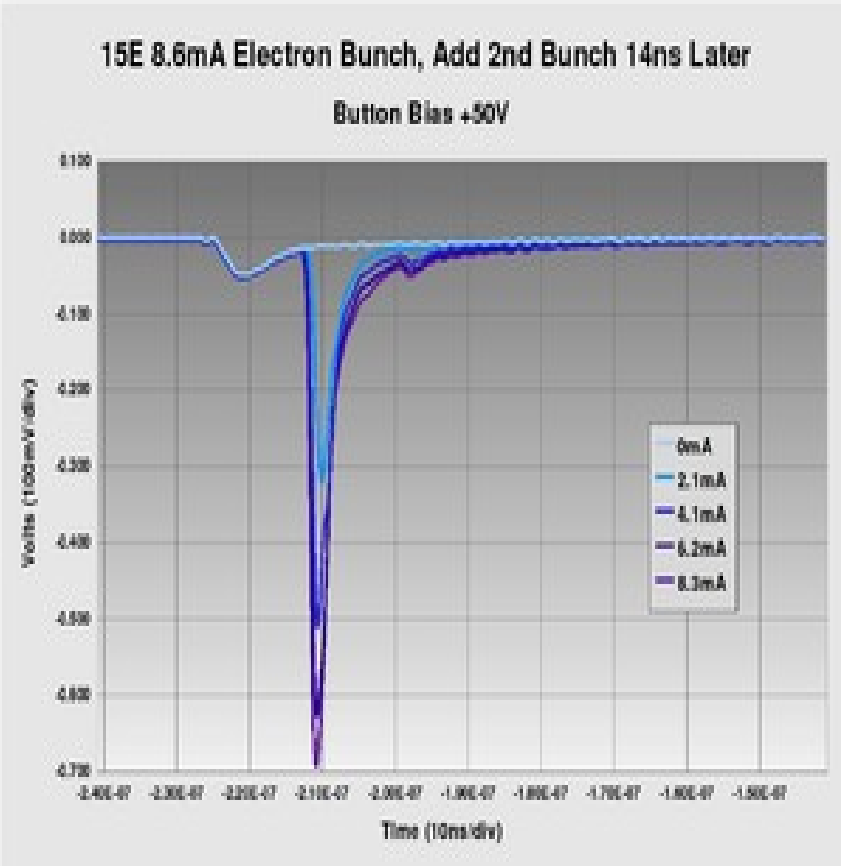

**ECLOUD Simulation**



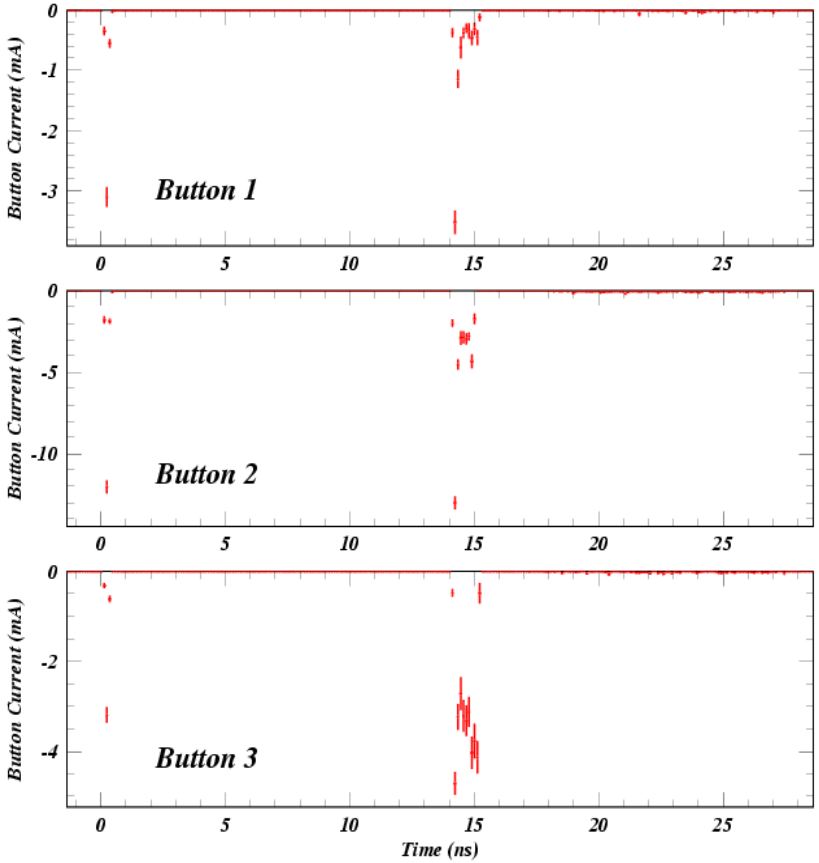

*Simulation counts cloud charges in three adjacent 1-cm wide stripes centered on the top of the beampipe.*
*The angle of incidence is required to be less than 45 degrees ($\cos\theta > 0.7$, probably not strict enough).*
*Any macroparticle contributing to the shielded button signal is removed from the cloud.*

# Comparison of Simulated Signal to Measurement
## -- Electrons --

### Measurement (Central Button)




### ECLOUD Simulation




***Many types of discrepancy for the case of the electron beam.***
***Particularly notable are the relative magnitudes of the two signals and the sharper time structure in the simulation.***