Cornell University
Laboratory for Elementary-Particle Physics

ECLOUD Model Development for Shielded Pickup Measurements of Electron Cloud Development in an Uncoated Aluminum Vacuum Chamber

First model developed 10/2010 (see ECLOUD10 and EC Simulation Planning Meeting 3/11/2011)

Many modeling improvements since then:

1) Synrad3D photon rates and absorption site distributions
2) Flexible photoelectron generation model (QE and energy distribution)
3) More sophisticated, tuned SPU acceptance functions and hole secondary generation
4) More accurate CESR vacuum chamber profile including vertical side walls

Preparation for upcoming SPU data-taking with unconditioned bare and TiN-coated aluminum v.c. at 15E/W.

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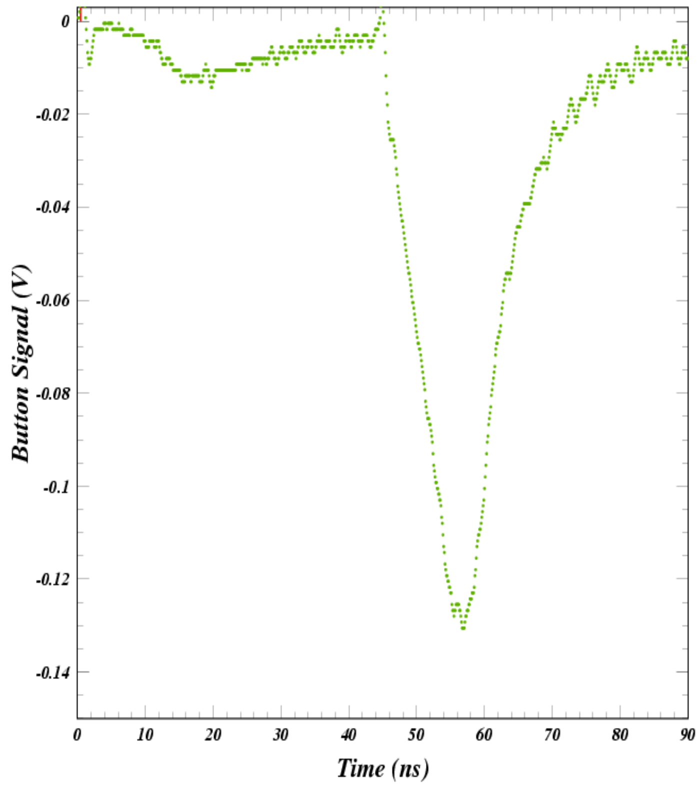
Cornell Laboratory for Accelerator-Based Sciences and Education

Electron Cloud Meeting

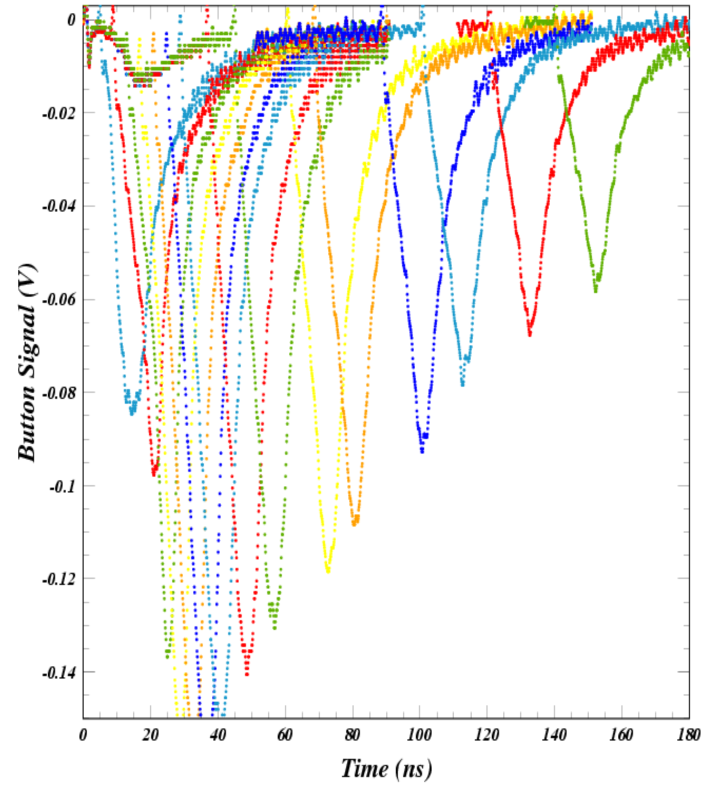
15 August 2012

Witness Bunch Method for Constraining Model Parameters
Example : 5/9/2010 2.1 GeV e+ 3 mA/bunch Al v.c. 15W

Shielded pickup scope trace for two bunches 44 ns apart

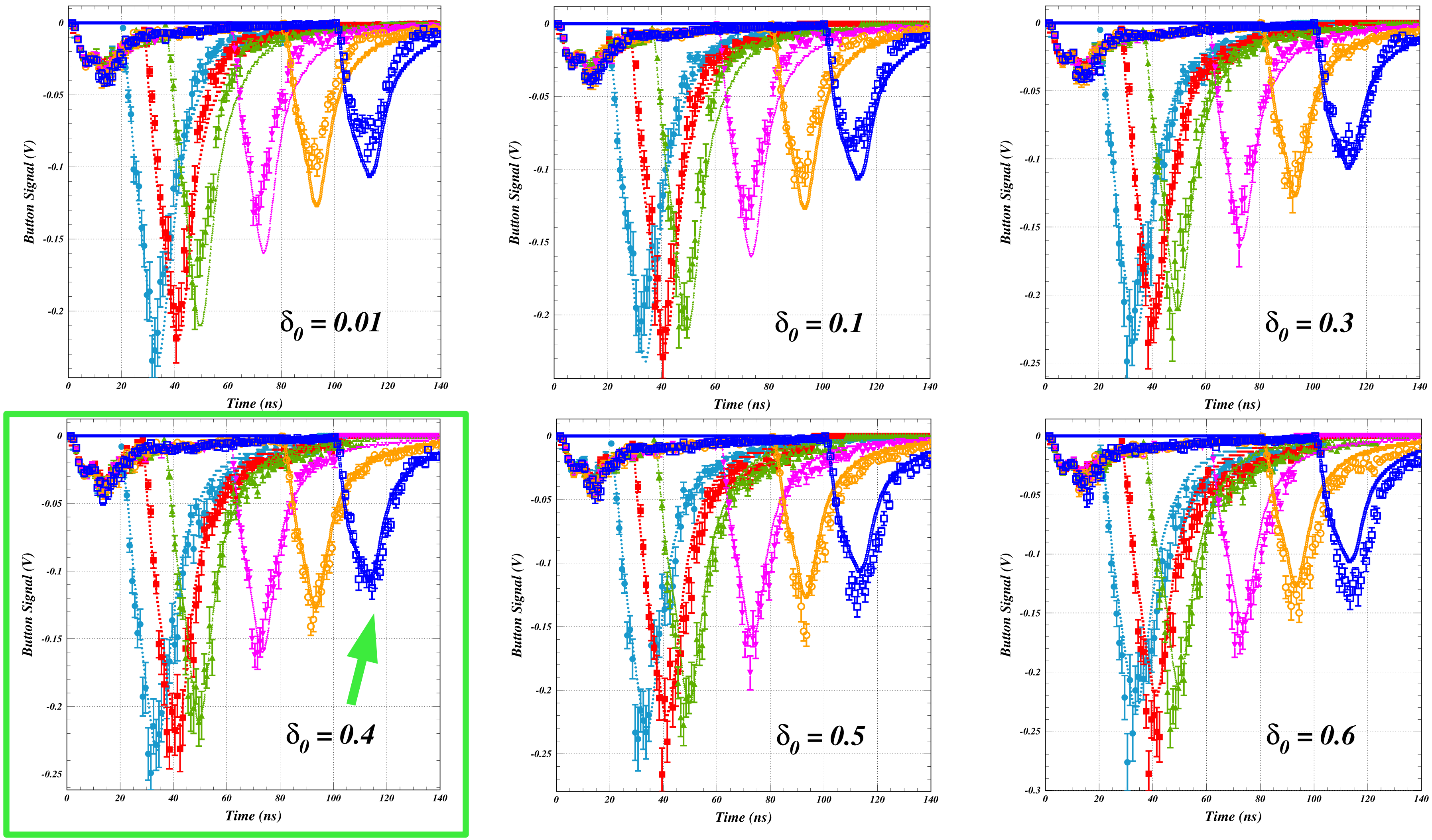


Superposition of 15 such traces illustrating the sensitivity to cloud lifetime



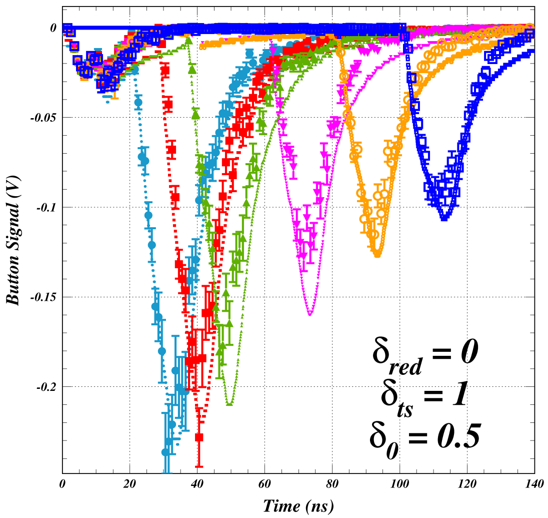
The single bunch signal arises from photoelectrons produced on the bottom of the vacuum chamber. Its shape is closely related to the photoelectron kinetic energy distribution and the beam kick. The witness bunch signal includes the single-bunch signal as well as the that produced by cloud particles accelerated into the shielded pickup by the kick from the witness bunch. The witness signal is therefore sensitive to the SEY model.

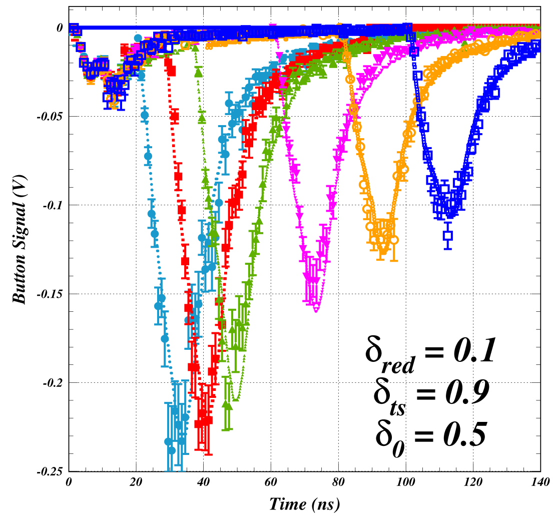
Witness Bunch Study for Uncoated Aluminum 5/17/2010
15W 5.3 GeV 3 mA/bunch e+ 4-ns spacing
2010 model now updated to use Synrad3D results and vacuum chamber profile with vertical side walls

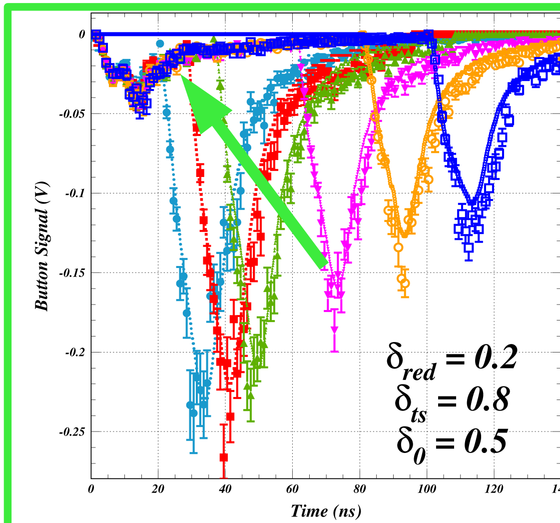


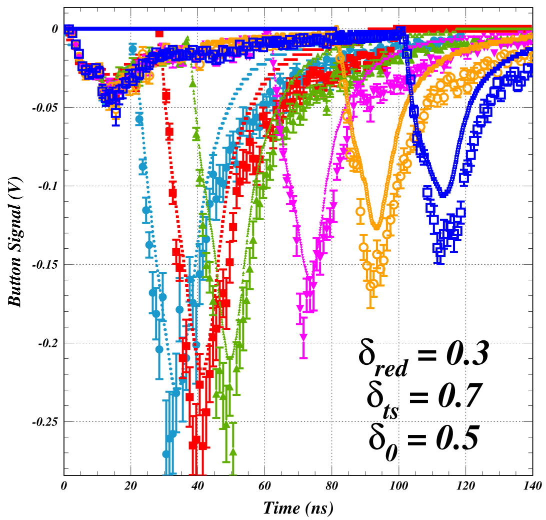
Satisfactory result after exhaustive parameter search (6 weeks!), but true secondary yield value LOW (δ_{ts}=0.8 !)

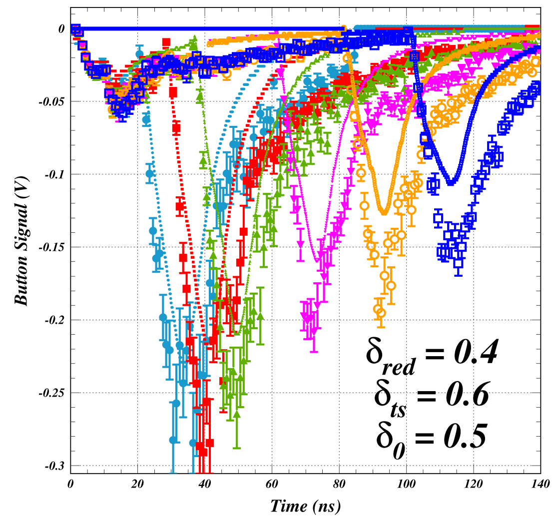
Discriminating between the true and rediffused secondary yield processes











The rediffused secondary yield process determines the trailing edge of the signal from a single bunch.

This trailing edge is insensitive to δ_0.

The late witness bunch signal used to determine δ_0 is also sensitive to the rediffused yield process.

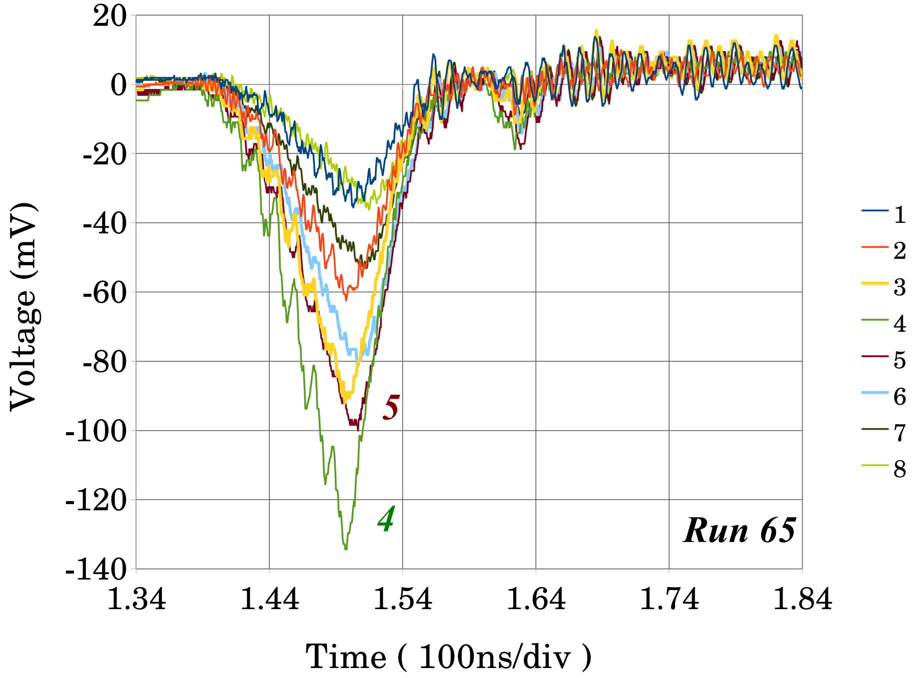
The witness bunch method does provide discriminating power between the true and rediffused processes. But work remains to understand the low optimized value for the true secondary yield.

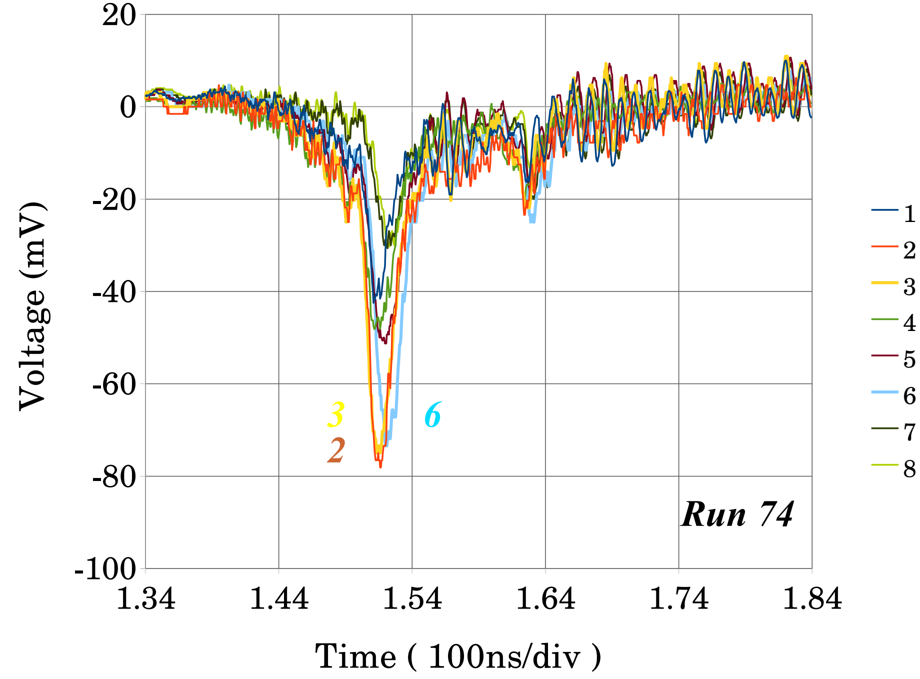
Near-term Modeling and Measurement Work With the Shielded Pickup Detectors

- ***Continue work on the present model for uncoated aluminum.***
  - ***It is a poor match to the data for bunch spacings less than 20 ns. Why?***
- ***Develop the model for the TiN-coated vacuum chamber at 15W.***
  - ***SPU measurements in a conditioned TiN-coated chamber at 15W were made 12/2010.***
- ***Take full set of witness bunch measurements on new Al and TiN 8/23-24.***
  - ***Immediate comparison to the model to see if SEY yields are high.***
  - ***Repeat in November to see conditioning effects.***
- ***Develop a model for the time-resolved RFA detectors in L3.***
  - ***SPU acceptance functions and collector definitions needed.***

New Time-Resolved RFA's in PEP-II Chicane Dipole Field On/Off

3/13/2012 5.3 GeV e+ 10 bunches 8 mA/bunch Al (L3#4)





Chicane dipole field off

Central collectors dominate.

Chicane dipole field 45 G

Central collectors show a depletion zone. This is known to arise from the peak of the SEY curve and provides information on E_{max}.