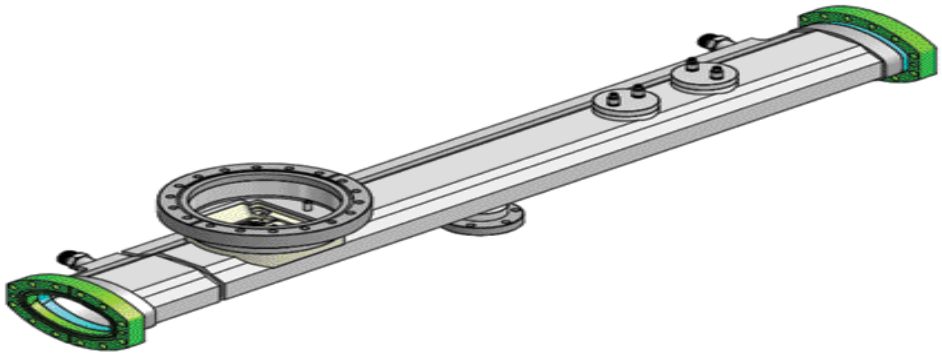
First Results on the Diamond-like Carbon Mitigation Technique From Shielded-Pickup Measurements

– Measurements recorded 4/7 and 4/16 --



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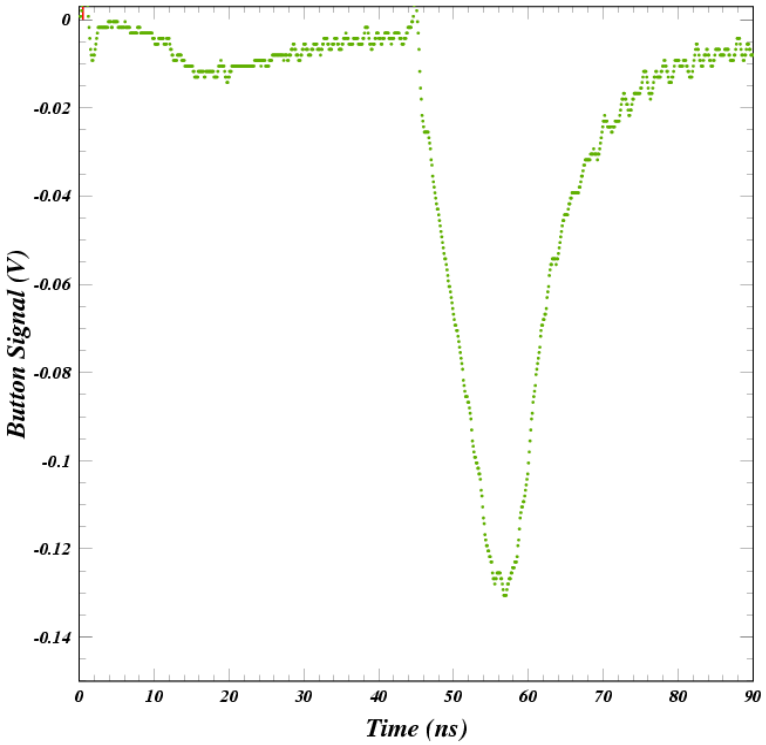
Cornell Laboratory for Accelerator-Based Sciences and Education
Electron Cloud Meeting
20 April 2011

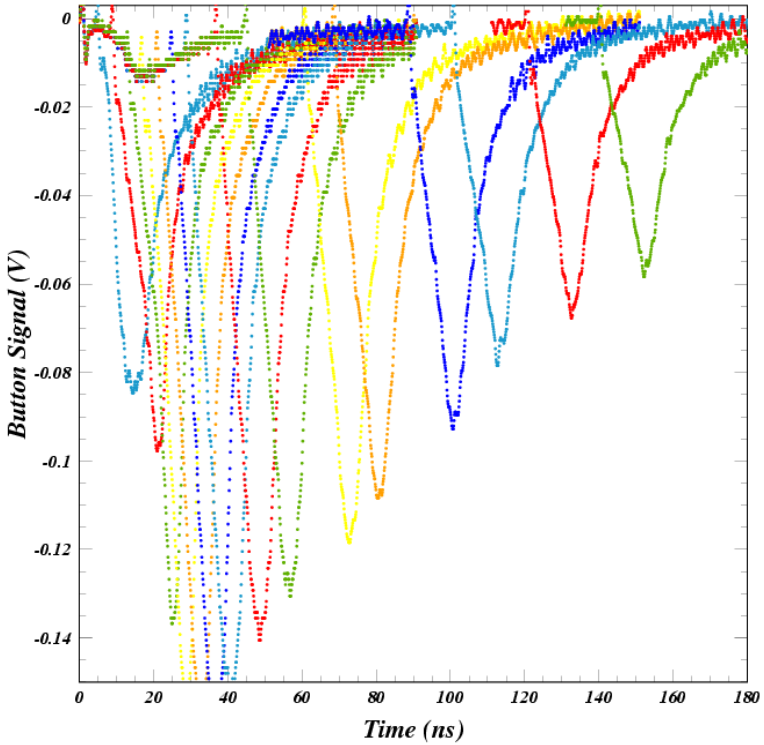
How the Witness-bunch Method Works

Example: 15W, Al v.c., 2.1 GeV, 3 mA/bunch e+ beam, 4-ns spacing

Shielded pickup scope trace for two bunches 44 ns apart



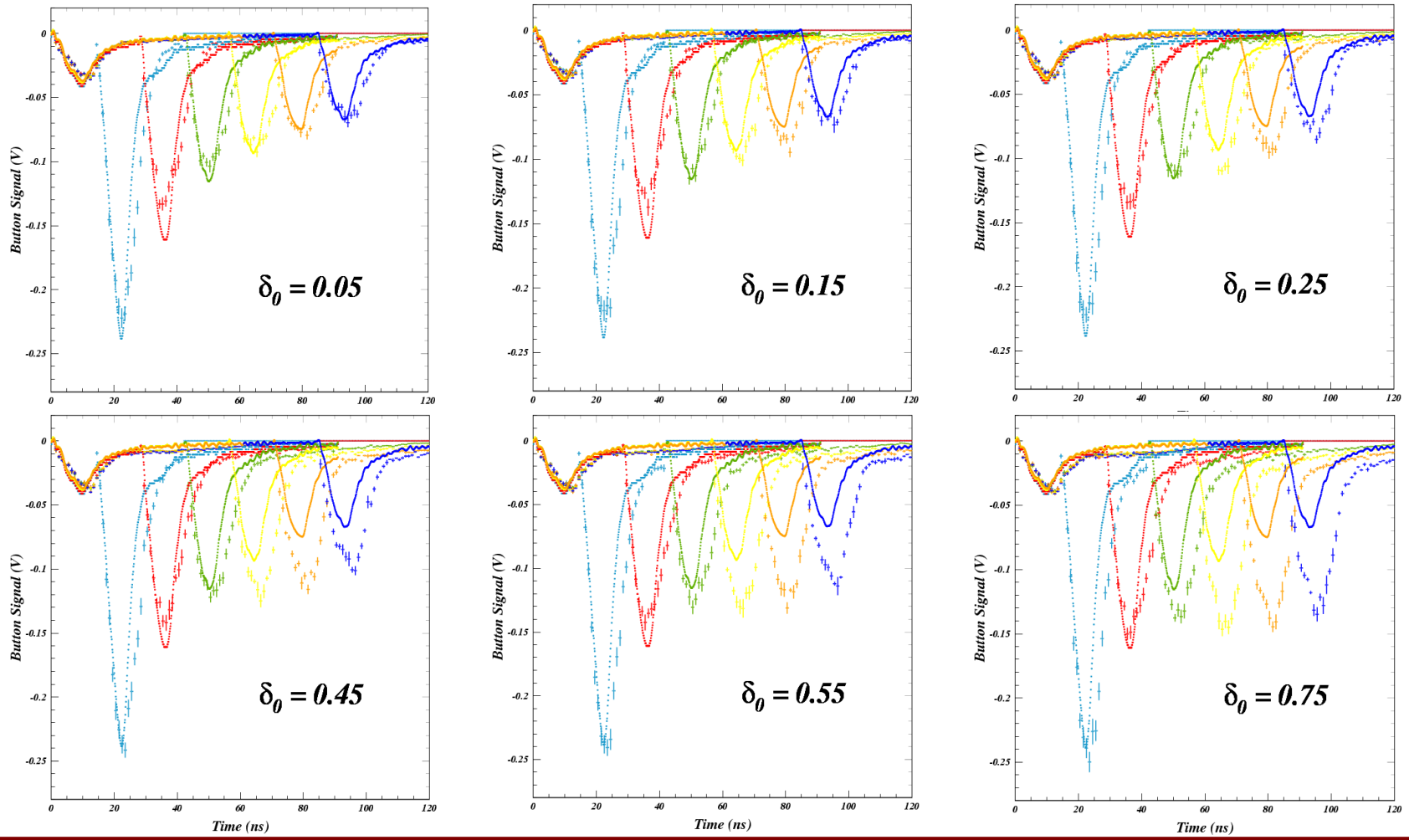
Superposition of 15 such traces illustrating the sensitivity to cloud lifetime



The witness bunch signal includes the single-bunch signal as well as the the signal produced by cloud electrons accelerated into the shielded pickup by the kick from the witness bunch.

Model Sensitivity to Secondary Electron Yield Parameters

3/27/10: 15E, TiN, 5.3 GeV, 5 mA/bunch e+ beam, 14-ns spacing

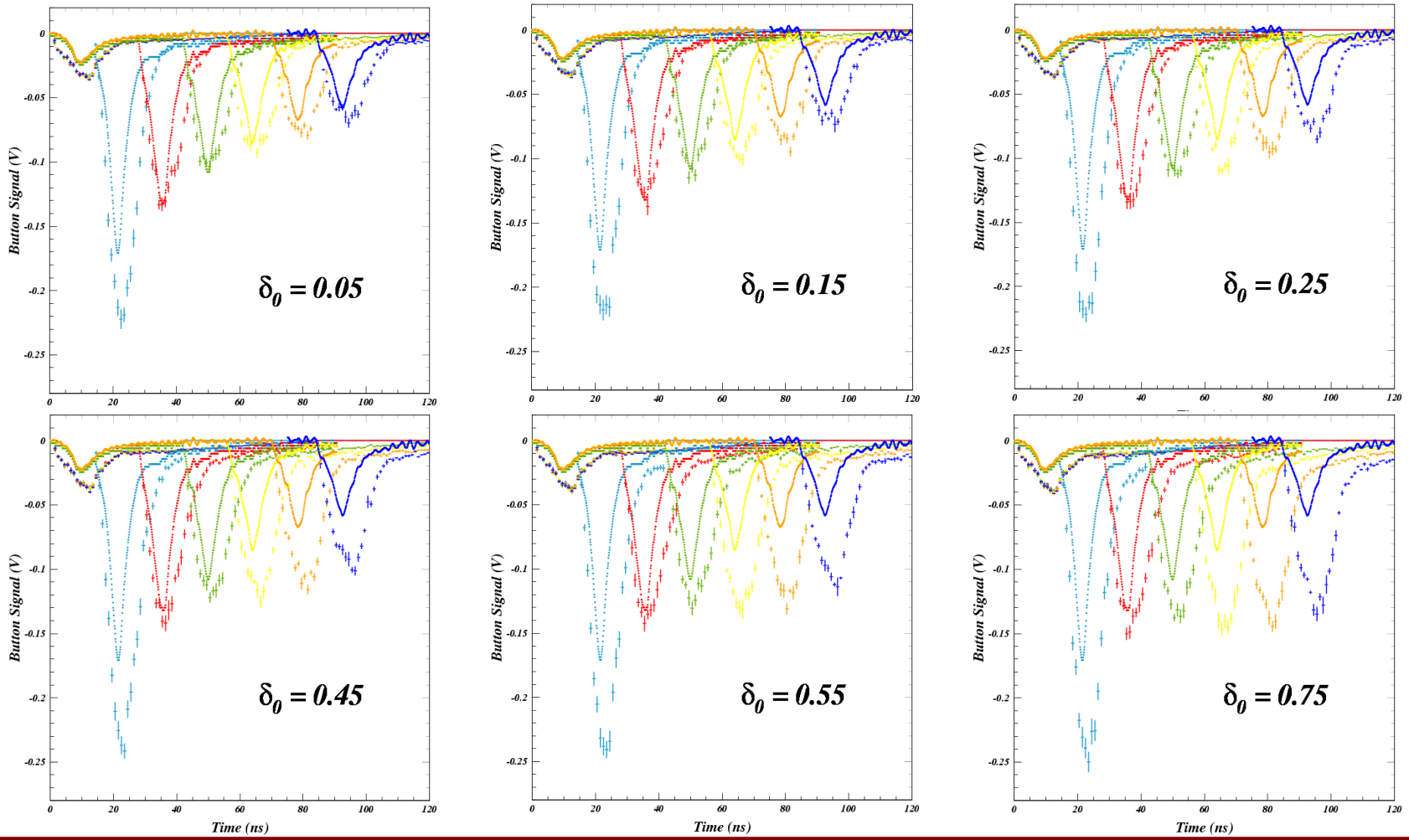


This example of ECLOUD simulations shows a preferred value for the elastic yield in a TiN-coated v.c. of δ_0=0.05. A similar value was found for amorphous carbon coating (two different v.c.), while the value found for bare Al was 0.75.

First Results for Diamond-like Carbon Coating

4/7/11: 15E, DLC, 5.3 GeV, 5 mA/bunch e+ beam, 14-ns spacing

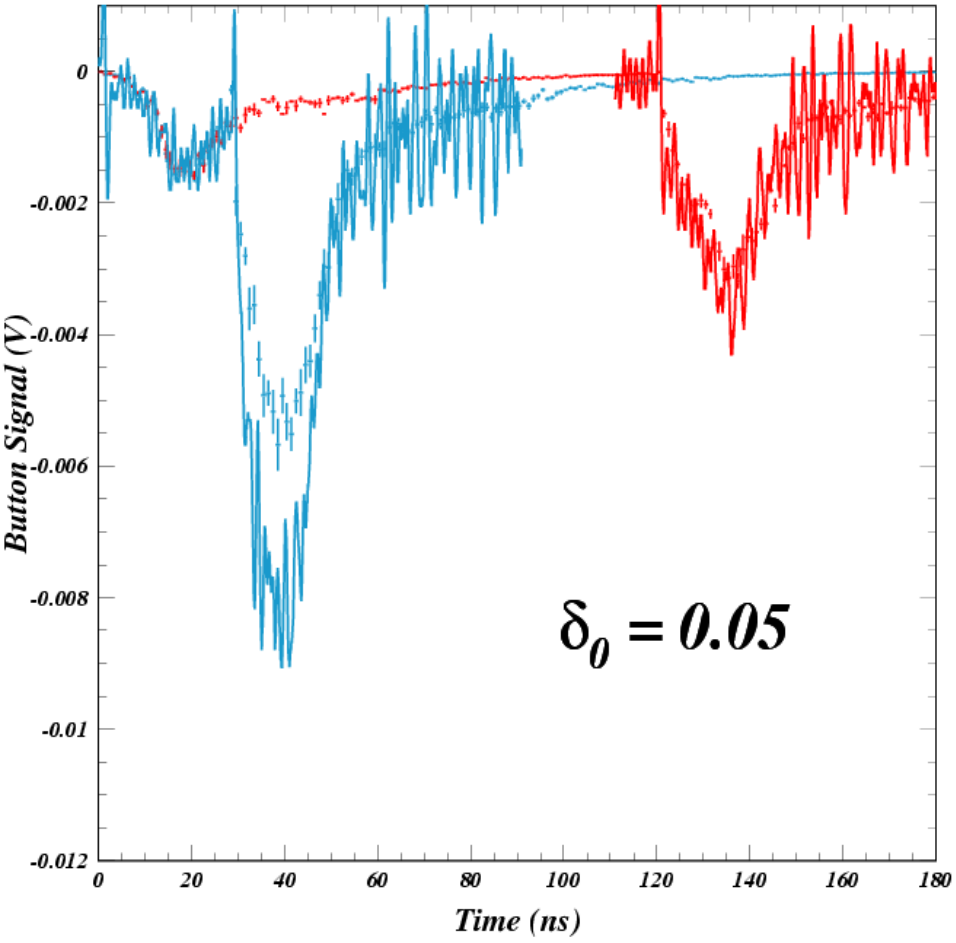
Compare to the model used for TiN at 15E in order to have the same sync rad conditions

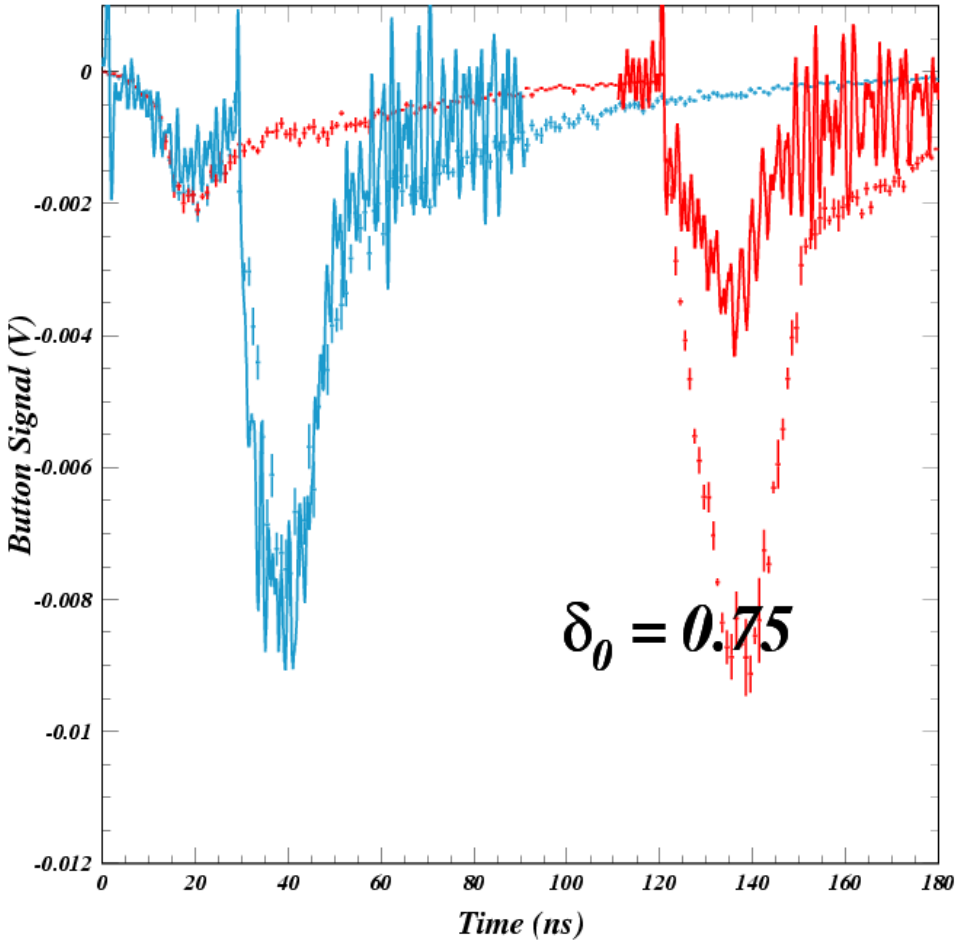


The diamond-like carbon coating exhibits significantly lower values for the quantum efficiency for producing photoelectrons as well as lower secondary yield, both for the true secondary process and the elastic process.

2.1 GeV Witness Bunch Study

We DO have such a study for carbon at 15E, but with 4-ns spacing
5/9/11: 15E, Carbon, 2.1 GeV, 3 mA/bunch e+ beam

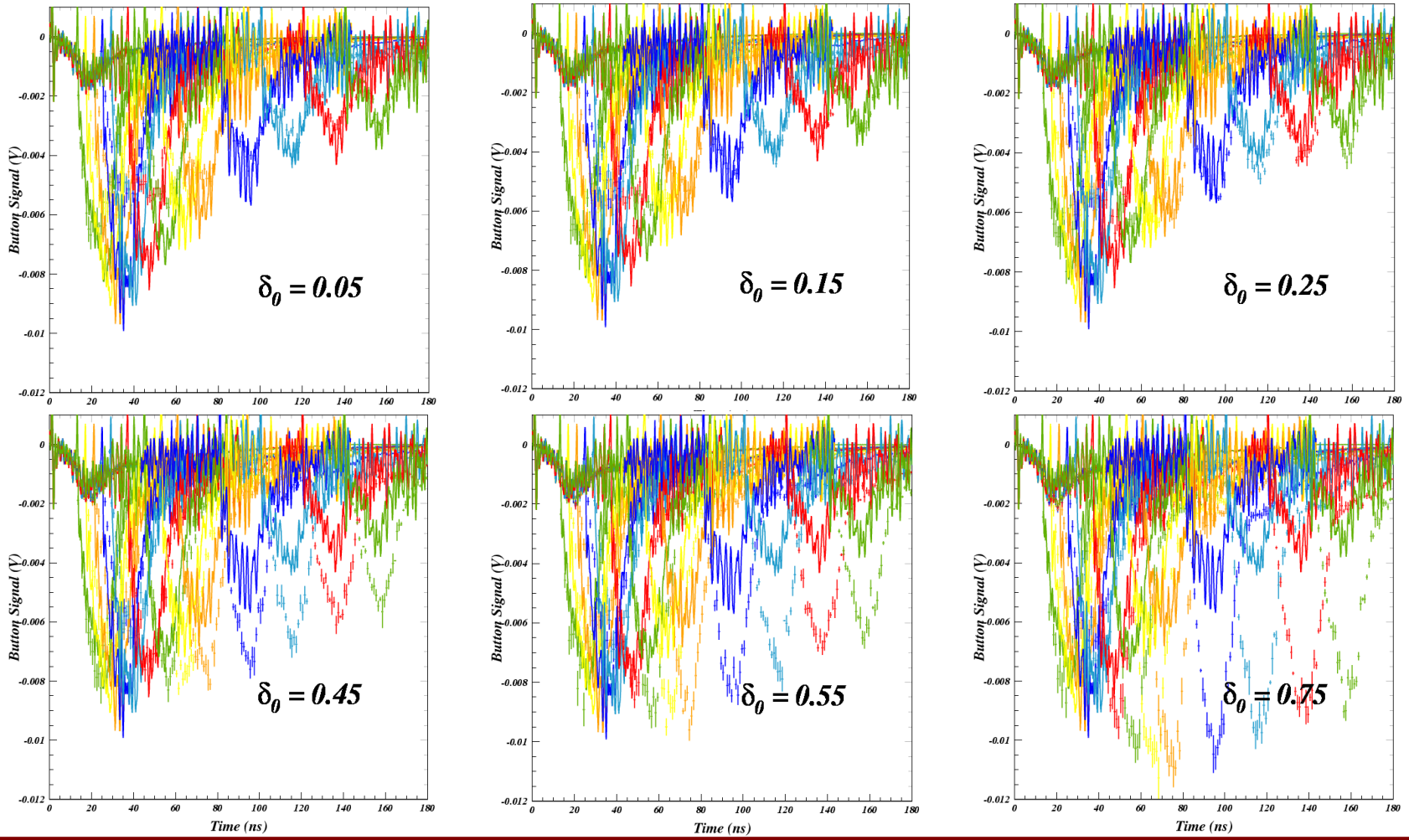




At 3 mA/bunch the carbon signals are very small and the data quality suffers from some oscillation background. Very good model using power-law energy distribution with 50% 5 eV Gaussian for photoelectron energy spectrum. The modeled true secondary yield may be low. Note that the elastic yield affects the early signals as well.

2.1 GeV Witness Bunch Study

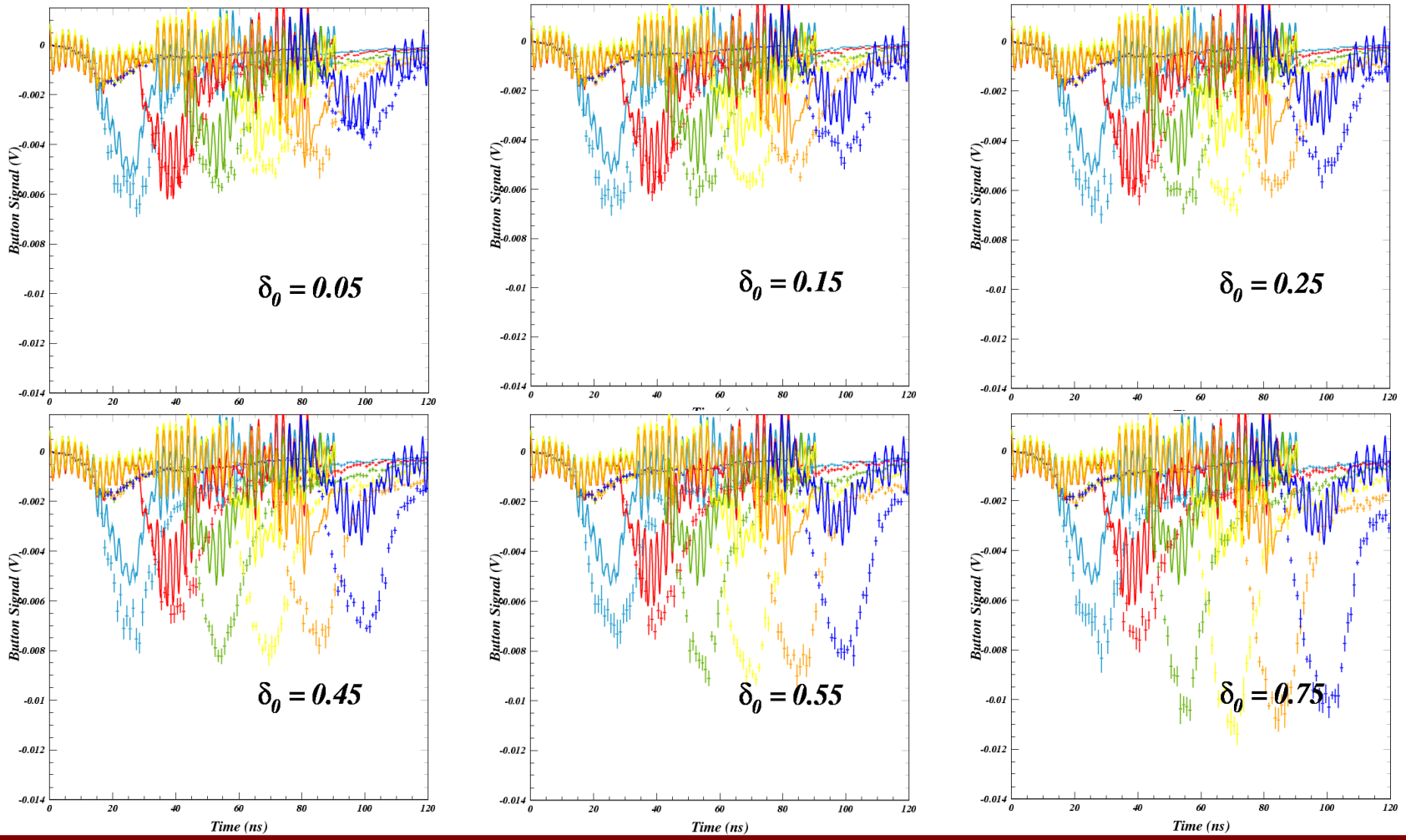
5/9/11: 15E, Carbon, 2.1 GeV, 3 mA/bunch e+ beam, 14-ns spacing
We DO have such a study for carbon at 15E, but with 4-ns spacing



Full scan of elastic yield values for the 9 May 2010 carbon data.
The data quality reduces the discriminating power for the elastic yield. Values greater than 0.25 are excluded.

Compare new DLC measurements to successful carbon model

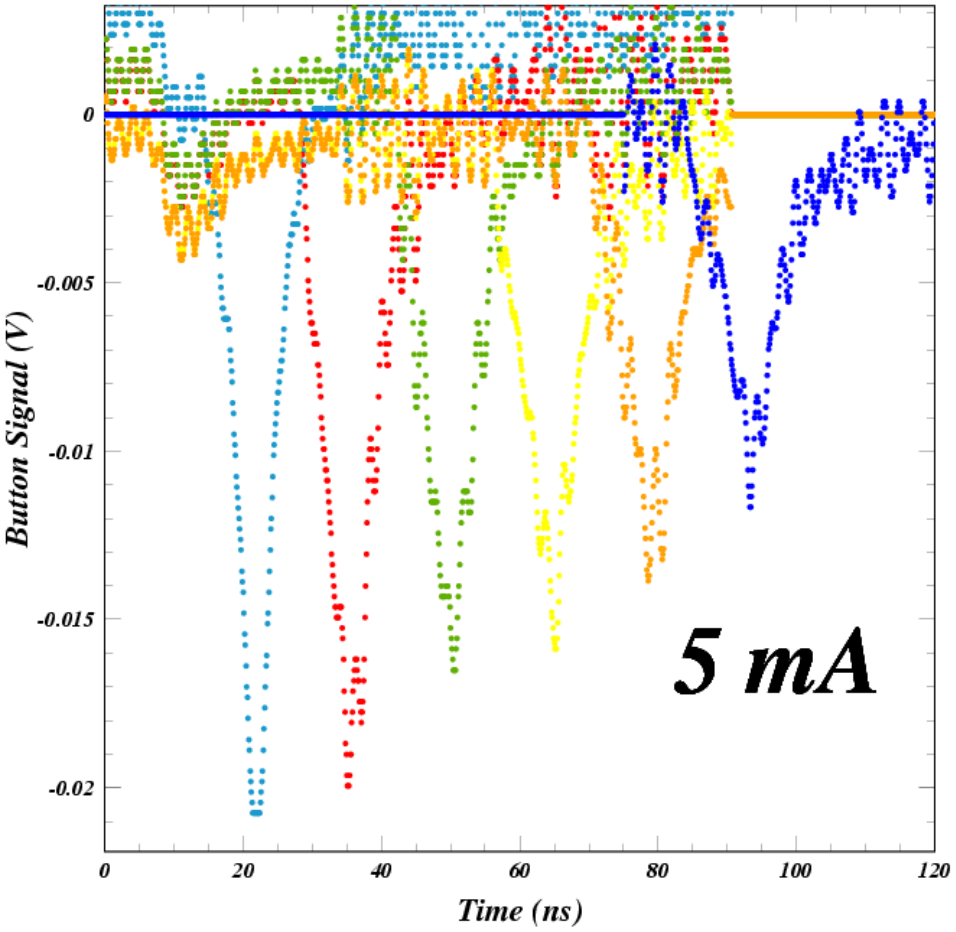
4/16/11: 15E, DLC, 2.1 GeV, 3 mA/bunch e+ beam, 14-ns spacing

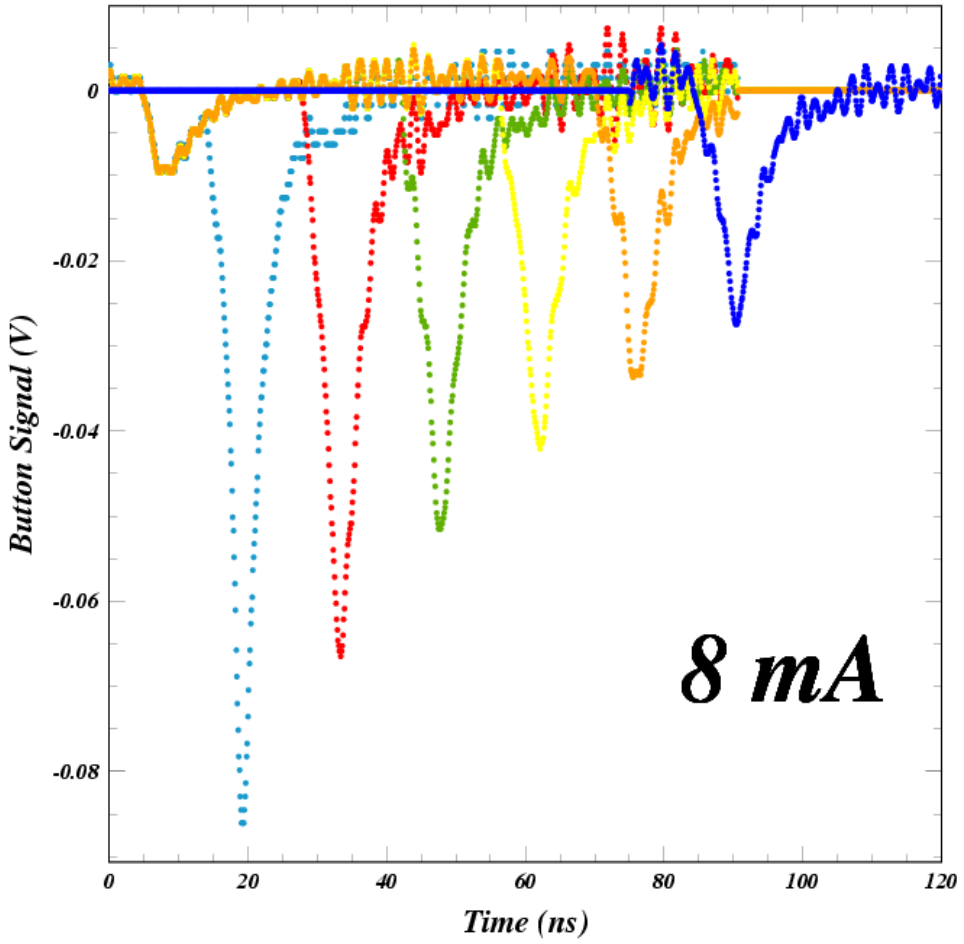


Result shows lower quantum efficiency and secondary yield relative to the carbon chamber just as the 5.3 GeV witness bunch study found lower values relative to TiN.

Witness studies with bunch current scan to improve sensitivity

4/16/11: 15E, DLC, 2.1 GeV, 5 and 8 mA/bunch e+ beam, 14-ns spacing





Model photoelectron energy distribution may require re-tuning because the accepted energy range depends on bunch current.