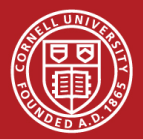


Cornell University
Laboratory for Elementary-Particle Physics

Progress in Modeling the Time-Resolved Retarding Field Analyzer Measurements

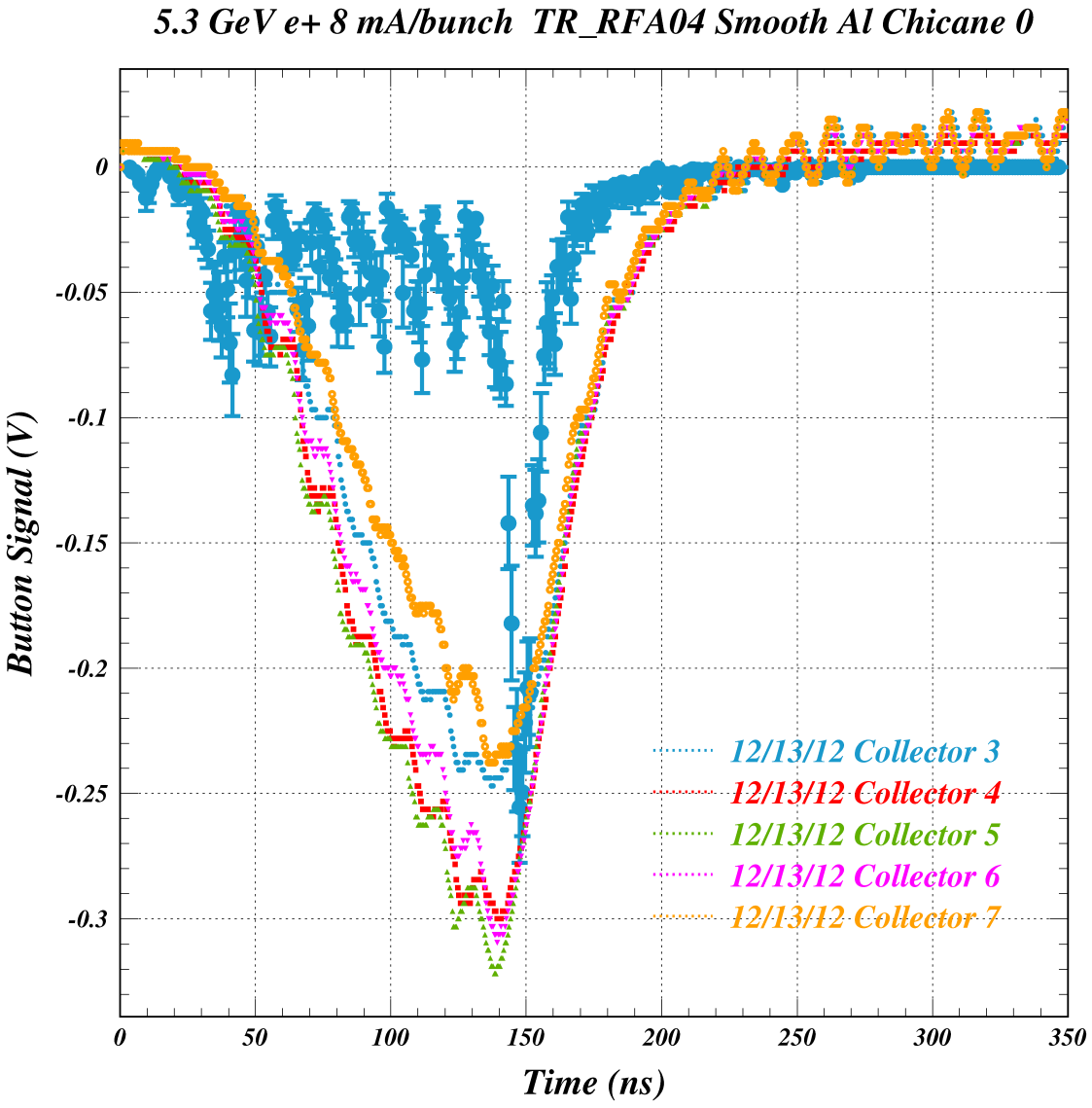
Jim Crittenden

Cornell Laboratory for Accelerator-Based Sciences and Education

Electron Cloud Meeting

10 April 2013

Reminder of the status as reported last week



First Attempt

Synrad3D: RFA49W4

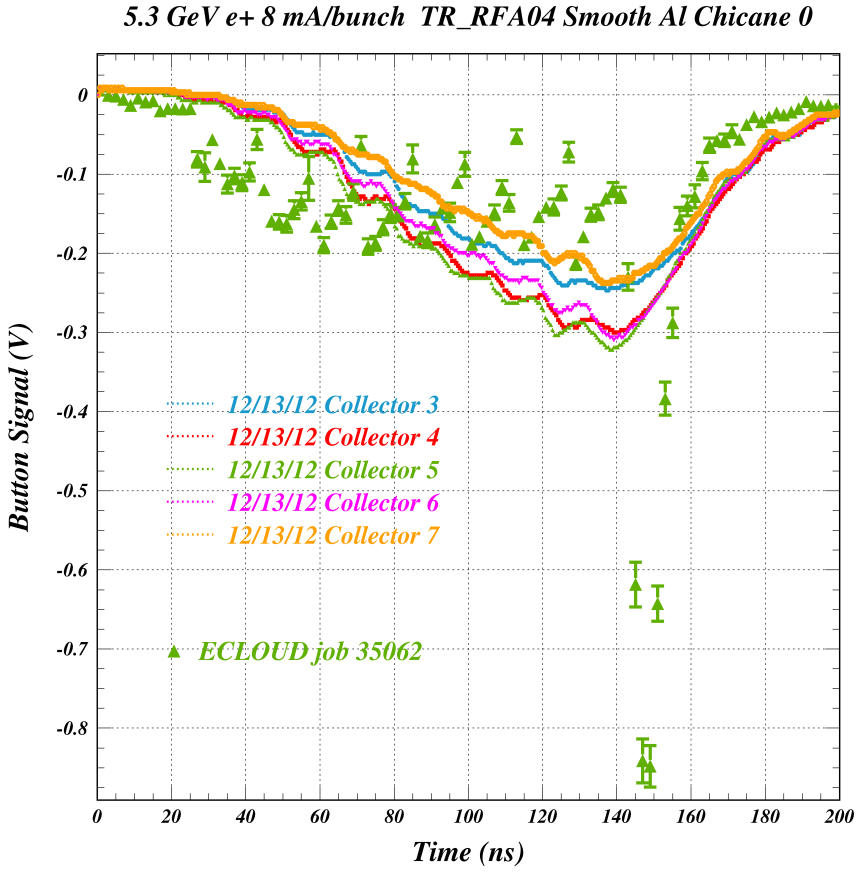
SEY model for Aluminum

5.3 GeV
14-ns spacing
10 e+ bunches
8 mA/bunch

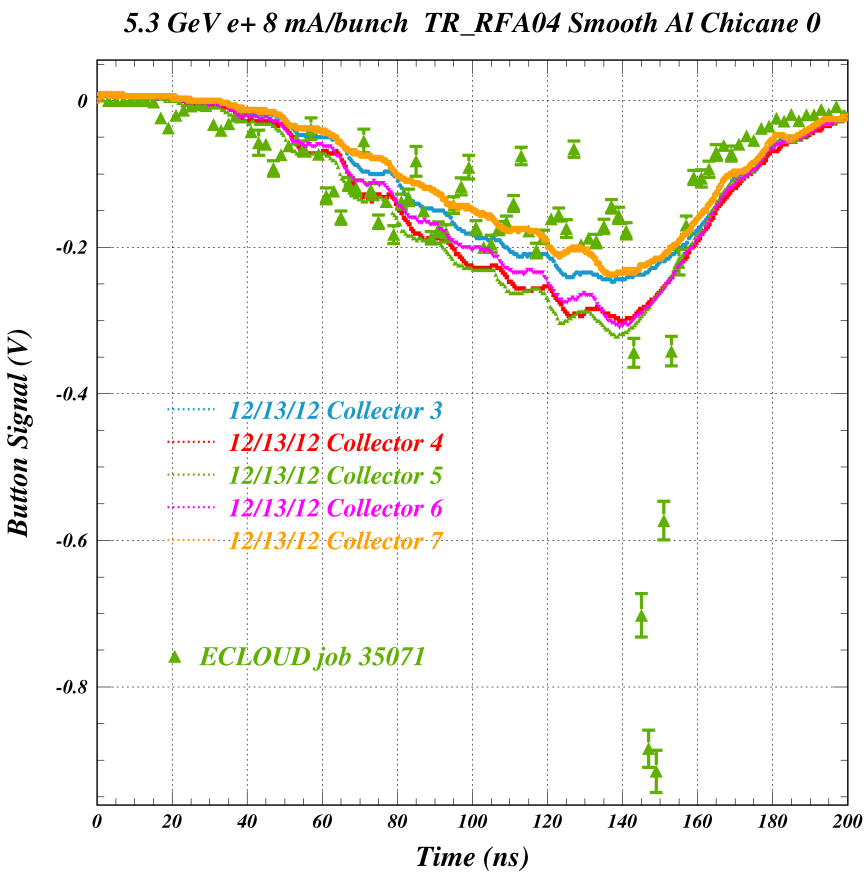
Round beampipe 4.45 cm radius
Aluminum surface

Improve binning. Remove reflected photon contribution.

First Attempt



Remove reflected photons

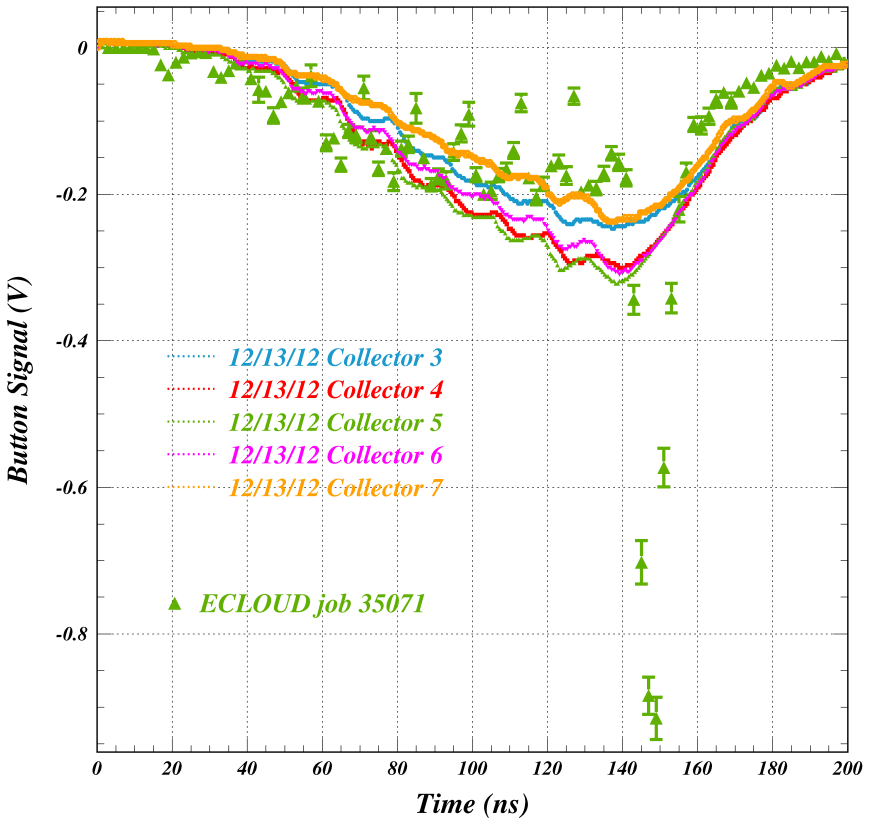


The measurement appears to exclude a significant contribution from reflected photons.

Increase secondary emission

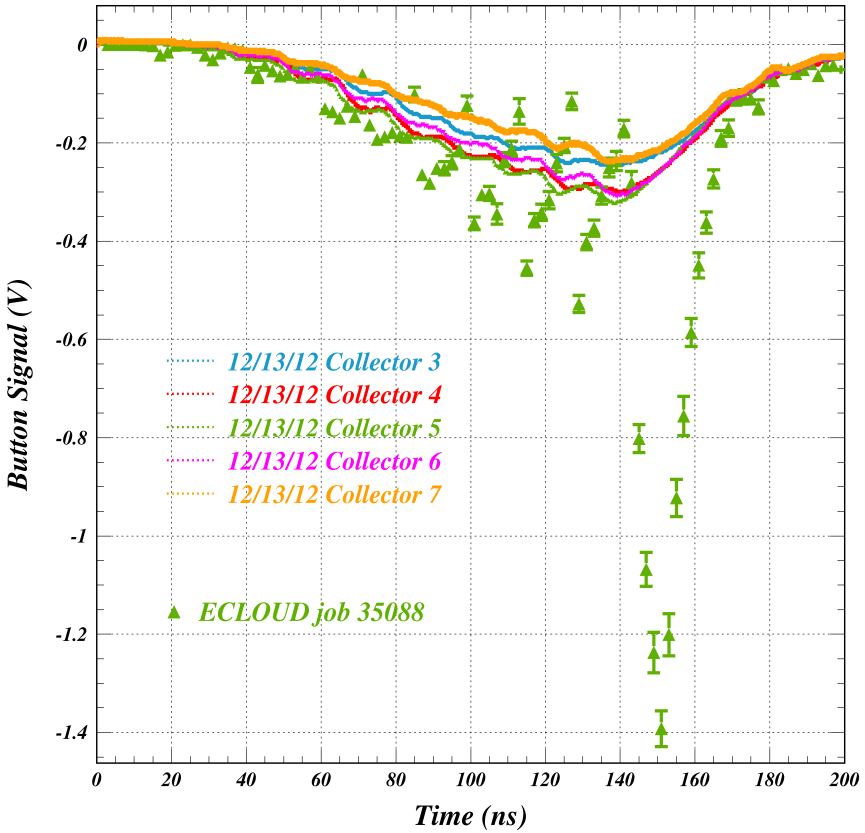
Remove reflected photons

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



$\delta_{ts} = 1.8 \rightarrow 2.2$ $\delta_{red} = 0.2 \rightarrow 0.4$

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0

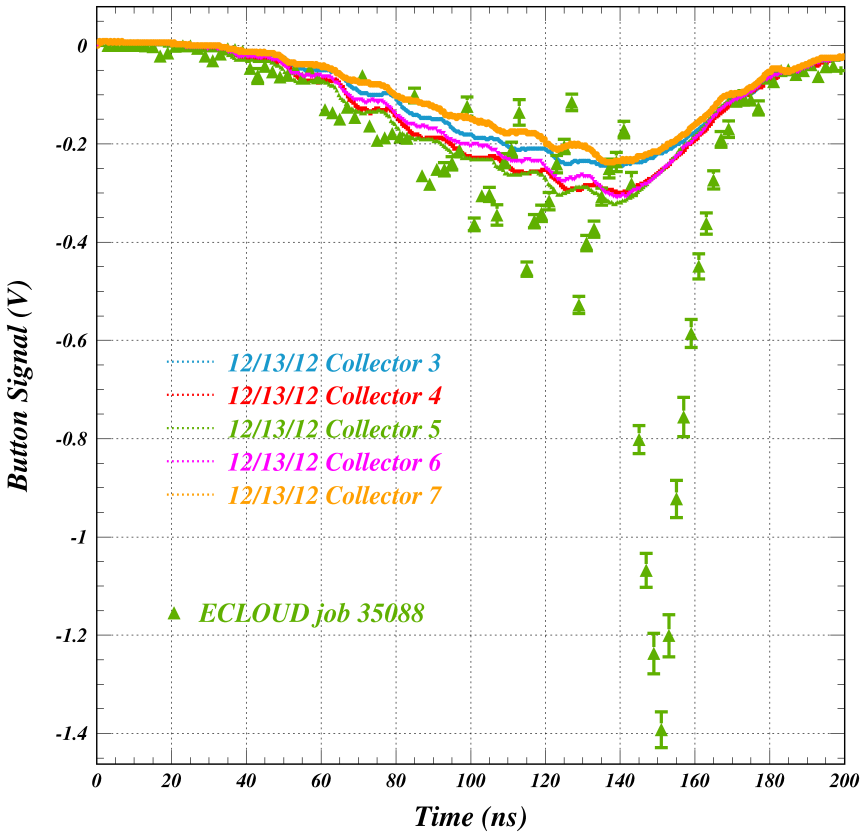


Cloud growth more consistent with less-processed aluminum.

Introduce RC filter

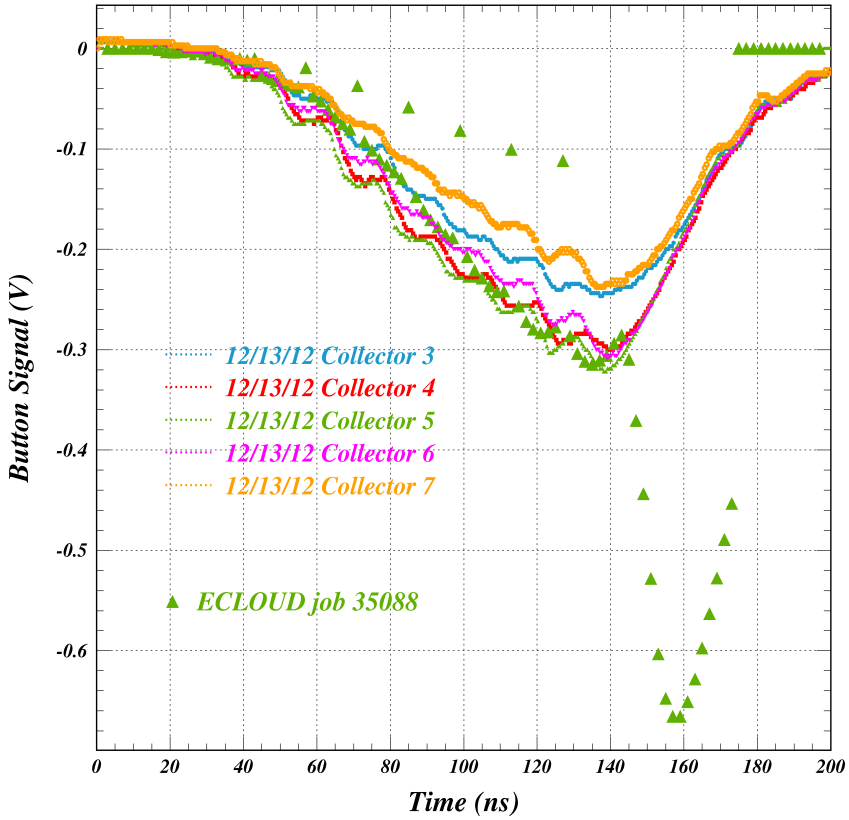
$\delta_{ts} = 1.8 \rightarrow 2.2 \quad \delta_{red} = 0.2 \rightarrow 0.4$

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



RC = 20 ns

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0

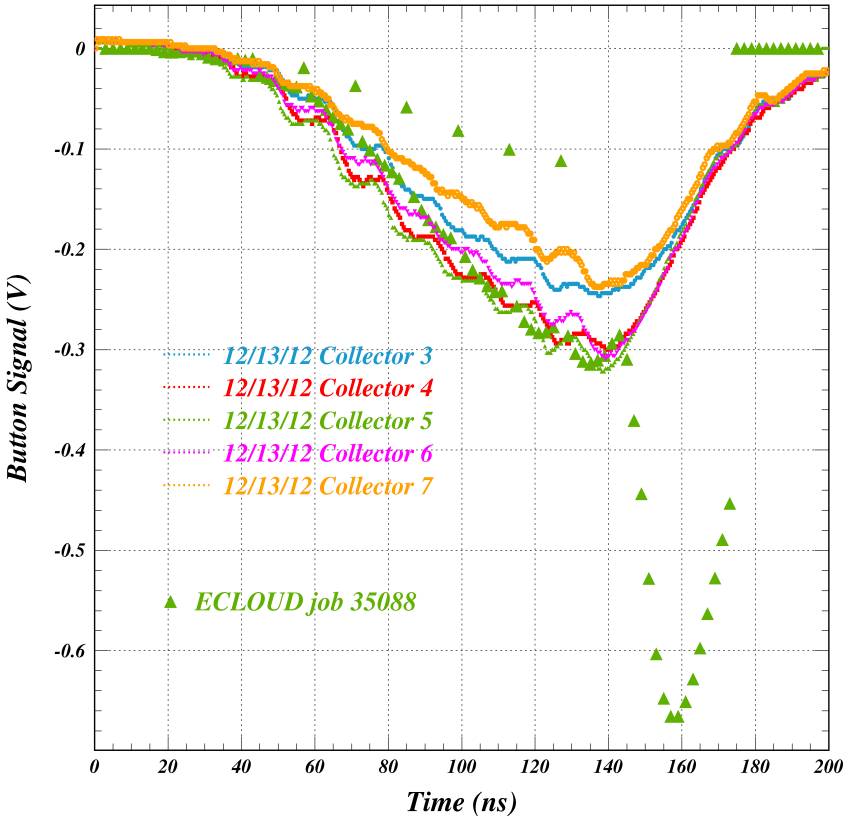


Cloud growth rate now approximately correct.

Adjust SPLAT function

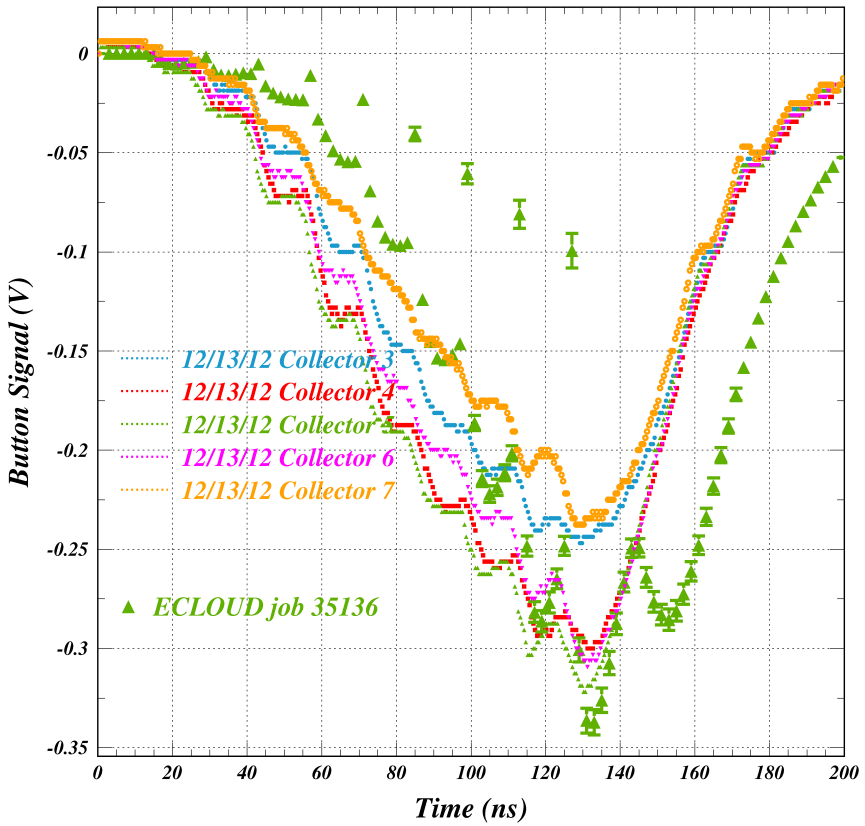
RC = 20 ns

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



Remove suppression of signal from high-energy electrons

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0

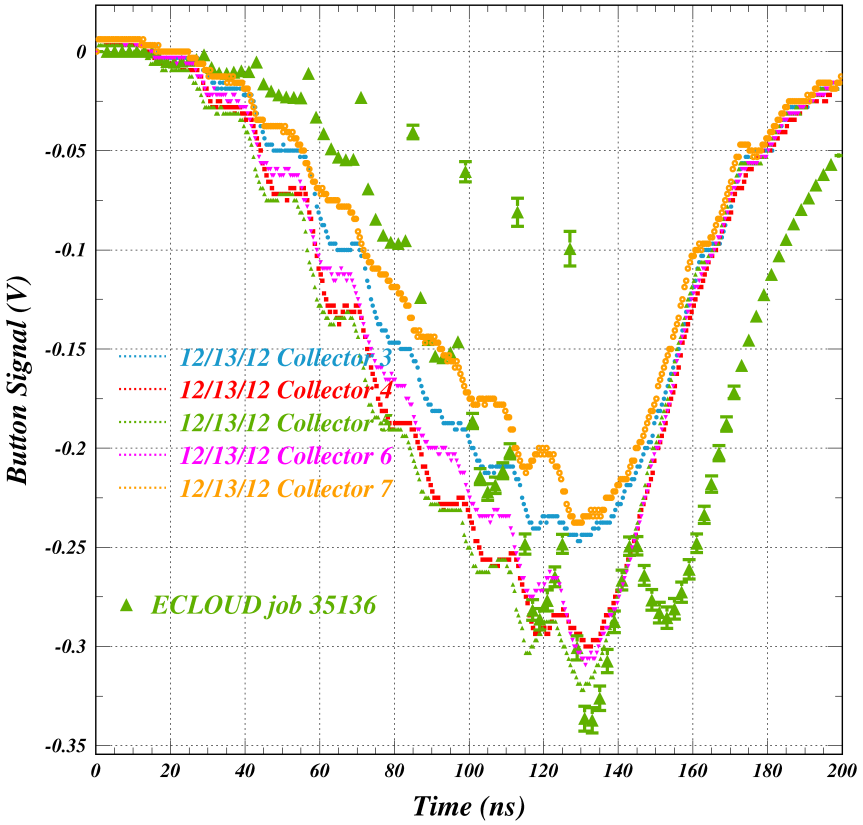


The suppression of signal from high-energy electrons necessary to model the shielded-pickup data is inconsistent with the time-resolved RFA measurement.

Add high energy photoelectrons as found necessary for SPU reflected photons

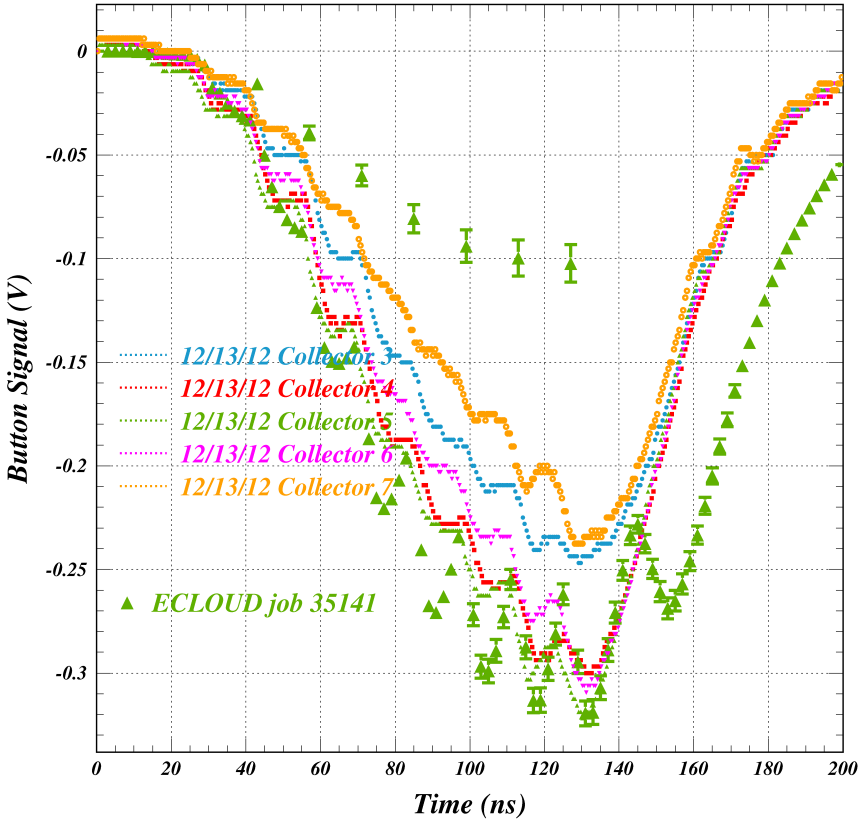
Remove suppression of signal from high-energy electrons

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



Add high-energy photoelectrons

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0

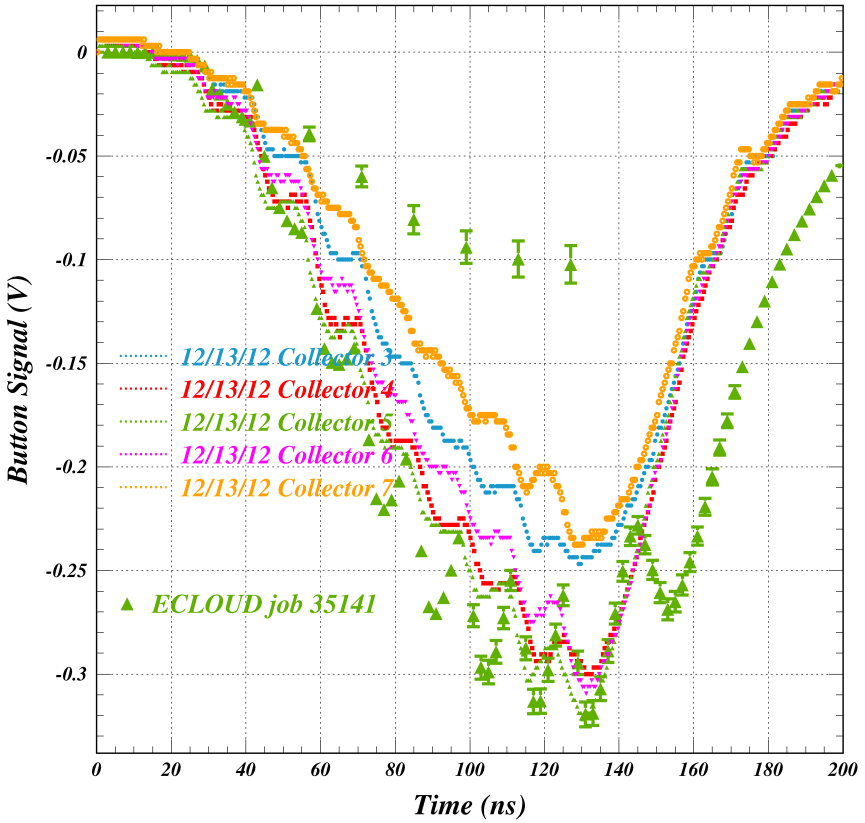


Up to now, used only very low-energy photoelectrons (1 eV), because the high bunch current determined their energy. Adding high energies has a small, but helpful effect.

Raise RC time constant from 20 to 25 ns

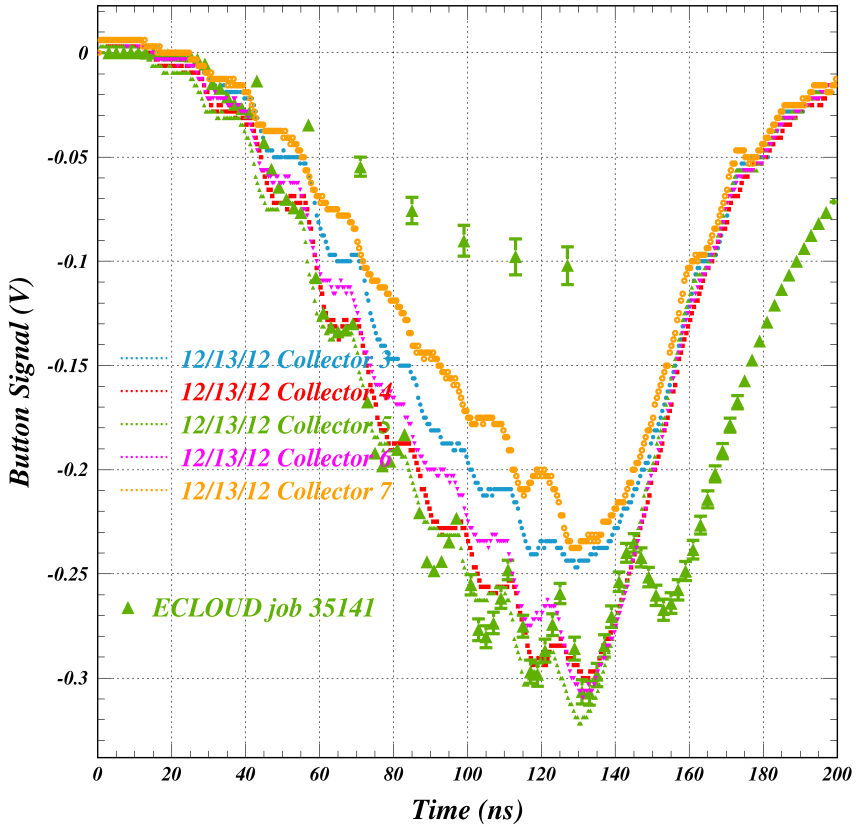
Add high-energy photoelectrons

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



RC = 20 → 25 ns

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0

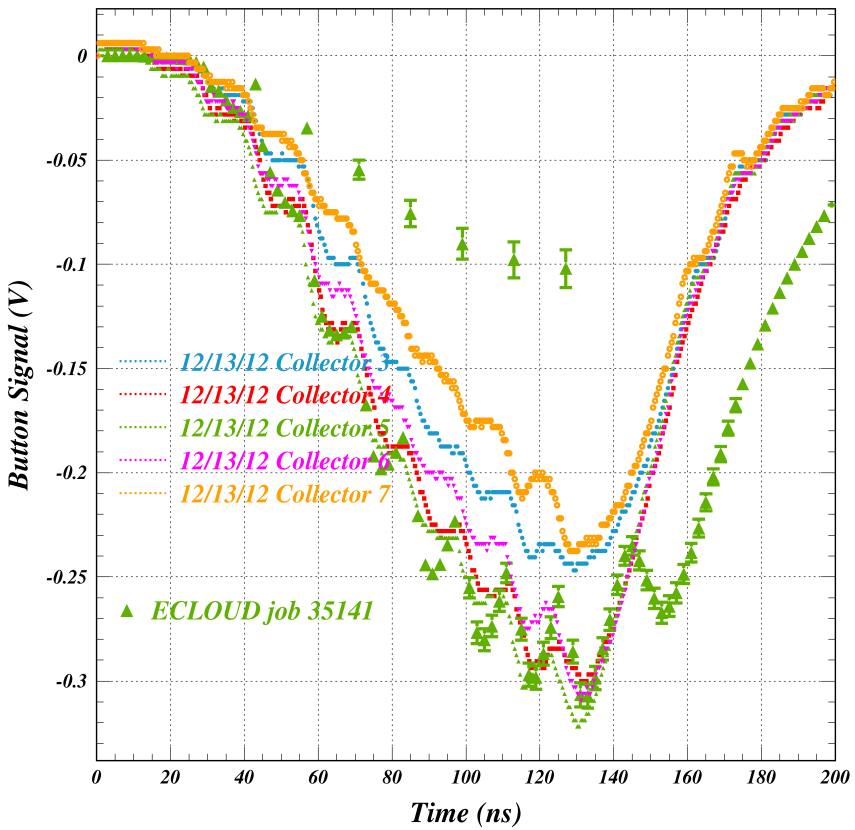


The detector time constant affects the peak-to-valley ratio and the overall rise of the signal. Raising it from 20 ns to 25 ns improves both.

Remove SPLAT function entirely and require electron arrival energy > 120 eV

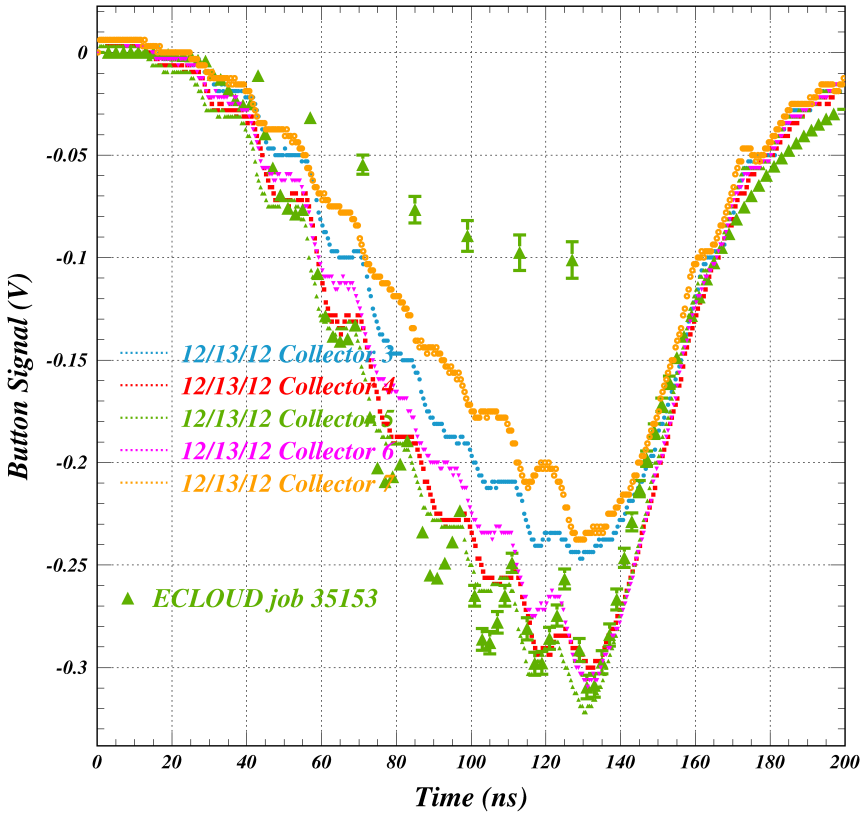
RC = 25 ns

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



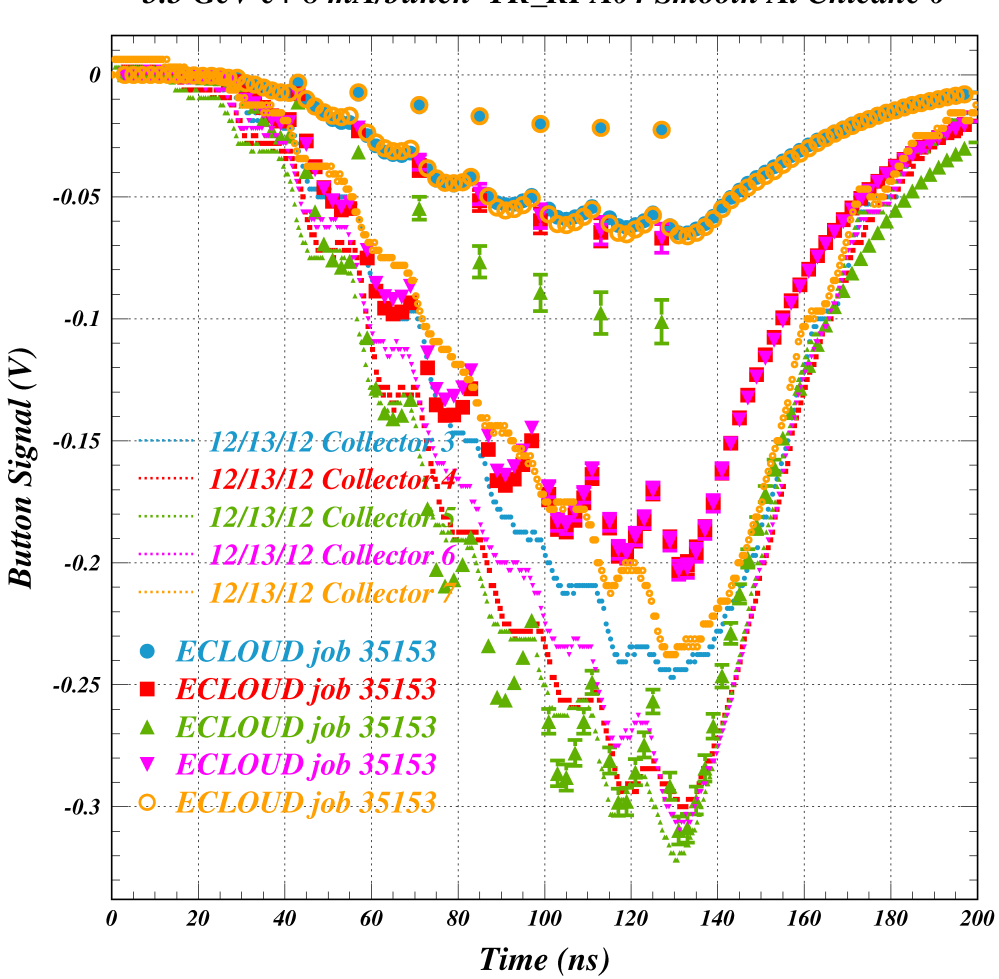
Require E_e > 120 eV

5.3 GeV e+ 8 mA/bunch TR_RFA04 Smooth Al Chicane 0



The "bounceback" signal consists exclusively of electrons with energies below 120 eV. Why shouldn't they make a signal?

Why is the cloud "too narrow?" Is the angle acceptance function too strict?



None of the studies describe in this talk had much effect on the collector signal ratios shown here. The left/right comparisons are sensitive to the modeled beam position at the 1-mm level.

Next steps

**Investigate the too-small modeled signal in the time bin containing the beam bunch.
Could be either a bin-offset problem or an artifact of the RC time constant convolution.
Or something else.**

Find which parameters affect the dependence of the signal on collector position.

**Study the dependence on the chicane field.
An acceptance function has been dreamed up and coded, but not yet studied.
I'll show it next week.**

Write the IPAC'13 paper and poster.

Raise RC time constant from 20 to 25 ns

Add high-energy photoelectrons

RC = 20 → 25 ns

The detector time constant affects the peak-to-valley ratio and the overall rise of the signal. Raising it from 20 ns to 25 ns improves both.

SPU and time-resolved RFA collector geometries

	Shielded pickups	Time-resolved RFAs
Number of holes	169	261
Hole diameter	0.76 mm	1.7 mm
Transparency	29.8%	15.4%
Hole depth	1.8 - 2.4 mm	5.0 - 7.5 mm
Tan Θ_{max}	0.32 - 0.42	0.23 - 0.34
Θ_{max}	18-23 degrees	13-19 degrees
Number of collectors	3	9
Collector pitch	14 mm	5.8 mm
Collector width	18 mm (round)	5.8 mm