Recent Progress in the ECLOUD Simulation for the Cloud Lifetime Study Using Witness Bunch Data

All material for this talk may be obtained at www.lepp.cornell.edu/~critten/cesrta/ecloud/3nov10

See also previous talks on simulations for the shielded button data on 4/21, 4/28, 5/12, 7/7, 7/14, 8/4, 9/8, 9/22/2010

A primary purpose of the shielded pickup project (time-resolved measurements) is to measure the cloud lifetime.
This lifetime is sensitive to the secondary yield for low-energy cloud particles hitting the vacuum chamber wall.
First results on the sensitivity to the parameter δ_0 using witness bunch data was shown on 9/22/2010 and at ECLOUD10.

Those results showed problems with the rising edge of the primary signal and normalization discrepancies at the level of a factor of 4. These have been resolved recently.
Also, the modeling of secondaries generated in the SPU port holes has been added to ECLOUD.

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Electron Cloud Meeting

3 November 2010

ECLOUD simulation for the cloud lifetime study using 5 mA/bunch e+ data at 15E (TiN)

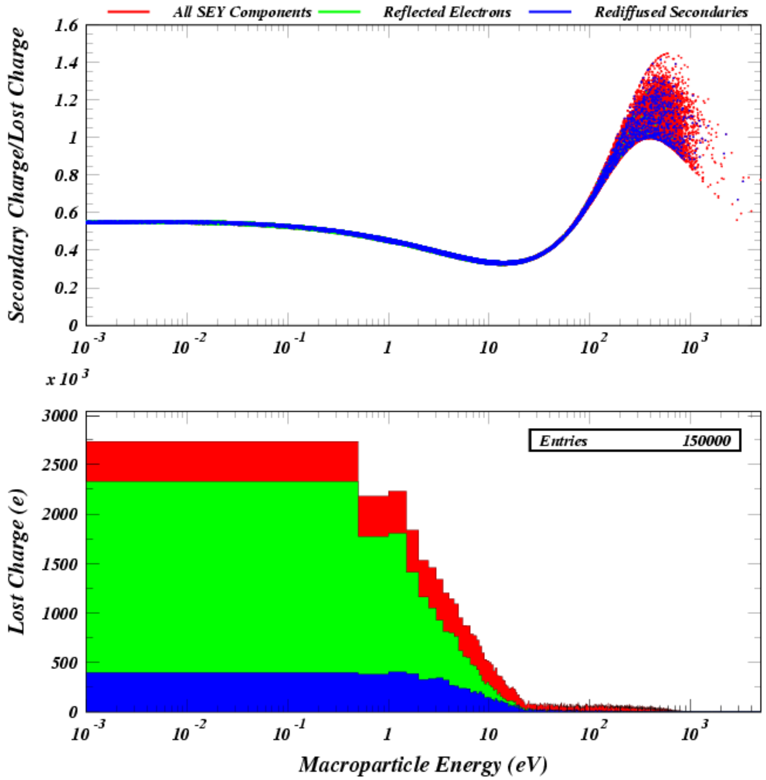
Secondary Yield Model

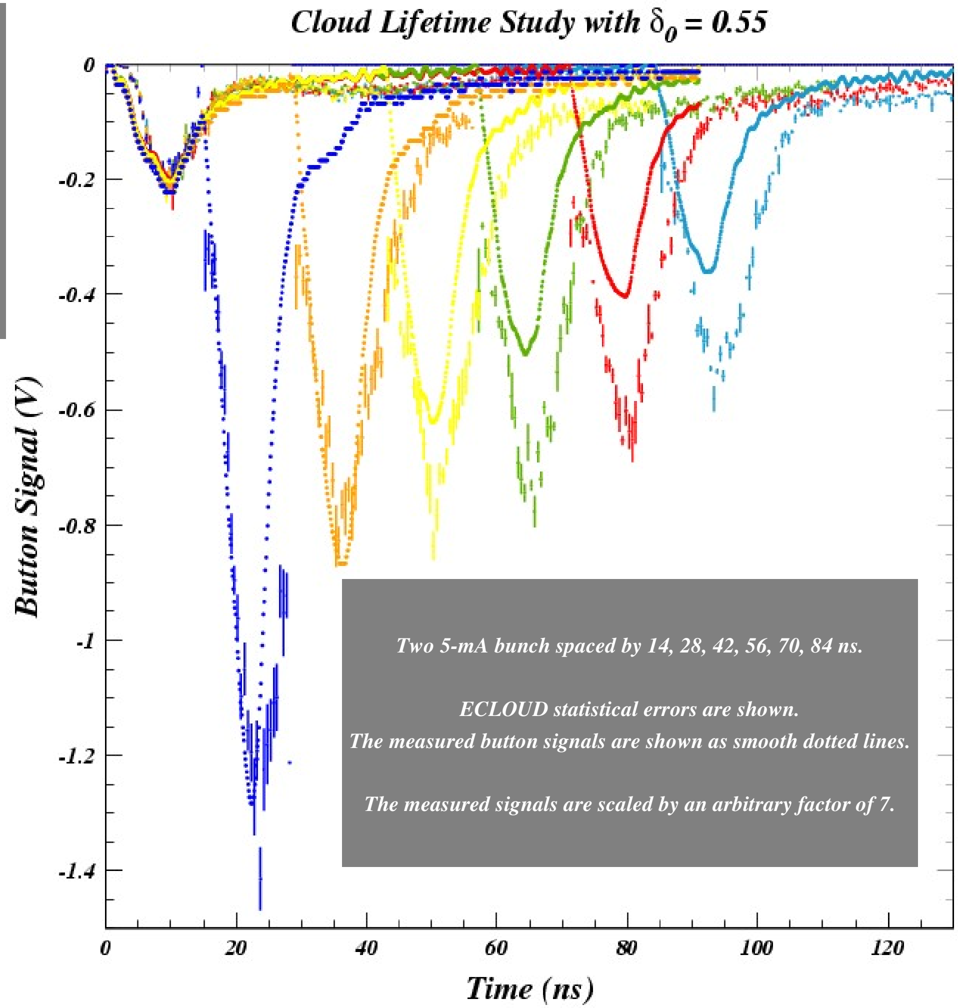
True secondary yield: 0.9

True secondary peak energy: 400 eV

Rediffused yield: 0.1

Elastic yield δ_0: 0.55

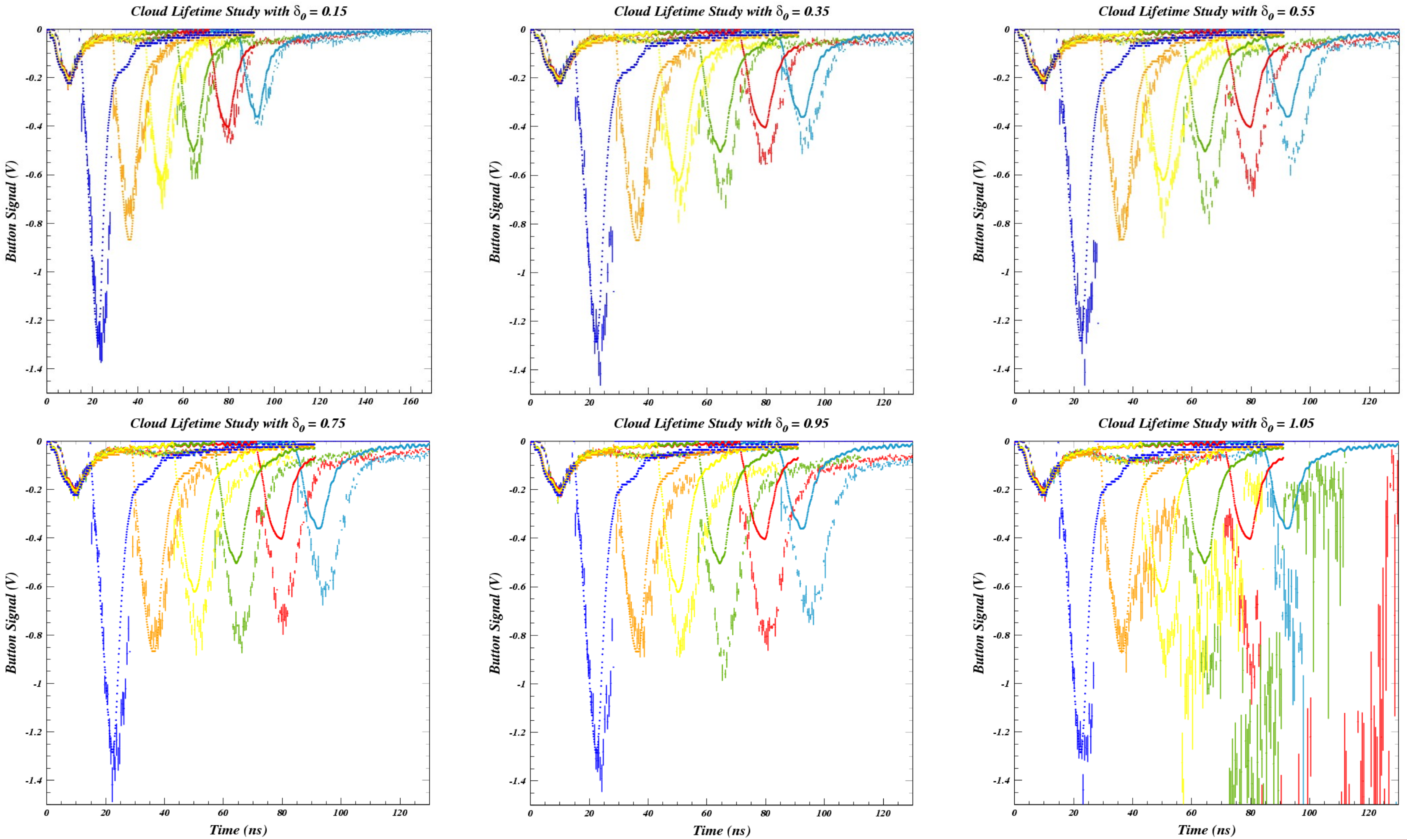




Simulated cloud lifetime too long: reduce elastic yield?

ECLOUD cloud lifetime sensitivity to elastic yield δ_0

-- Status as of ECLOUD10 --



The optimal value for δ_0 (0.15) is lower than has been generally assumed (0.5-0.7).
Note that not only the simulated peak signal value for witness bunch signals is better, but also the width.

Could such a low elastic yield be a characteristic of TiN coating?

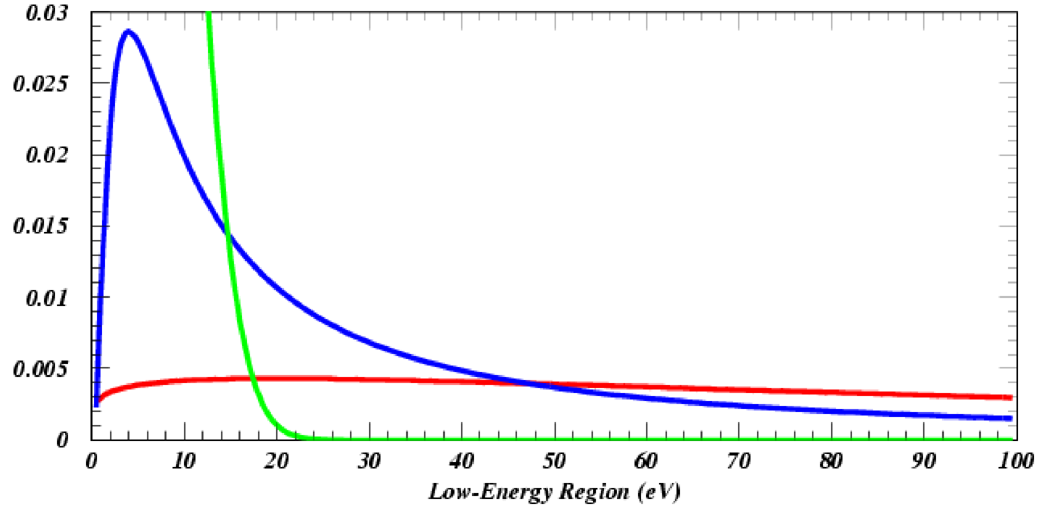
Our tune shift simulations gave reasonable cloud decay times with a value of 0.5 for uncoated aluminum chambers.

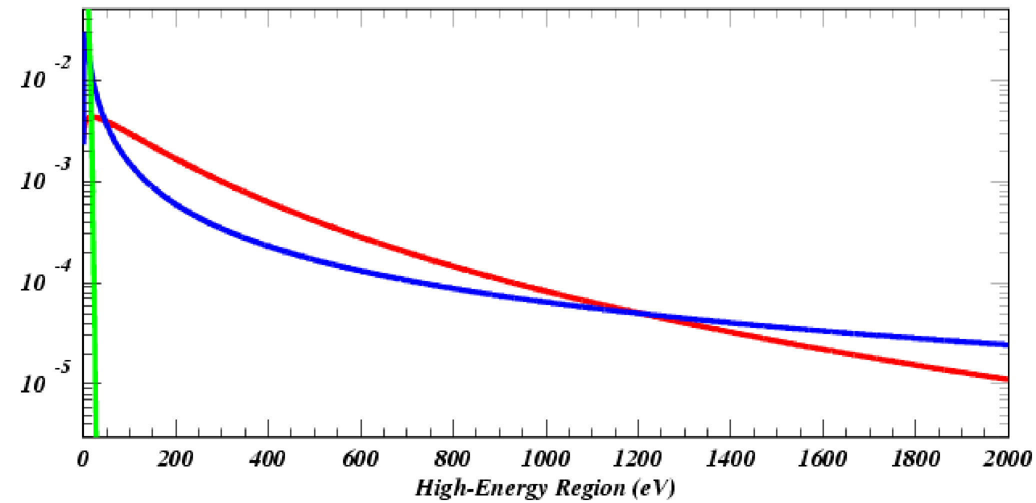
New photoelectron energy distribution

Green: ECLOUD original

Red: ECLOUD10

Blue: better match to data

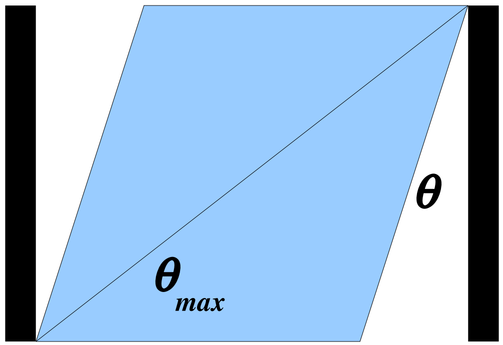




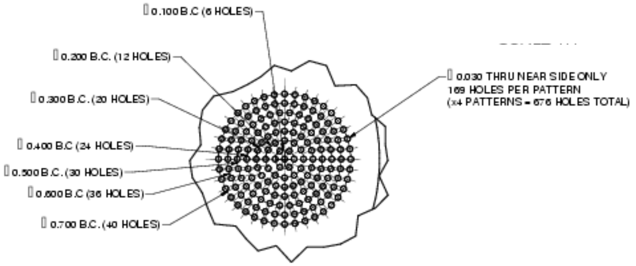
New SPU Acceptance Model

I) Transparency for perpendicular incidence: $A_{\theta=0} = 0.298$

II) Angle acceptance: $A_\theta = (1 - \theta / \theta_{max})^2$



III)Position Acceptance: $A_x = sqrt(1-x^2/r^2)$



IV) Energy acceptance: E > 0.01 eV

After the photoelectron energy distribution was corrected a very low energy tail of signal macroparticles inconsistent with the measured signal appeared. John pointed out that these will not traverse the holes if 1 Gauss stray field is present.

Secondaries generated in the SPU port holes

Red: All signal macroparticles

Blue: Hole secondaries

1) *Direct signal:* $Q_{mp} A_{\theta=0} A_{\theta} A_{x}$

2) *Signal from secondaries:* $Q_{mp} A_{\theta=0} A_{x} A_{\theta 2}$

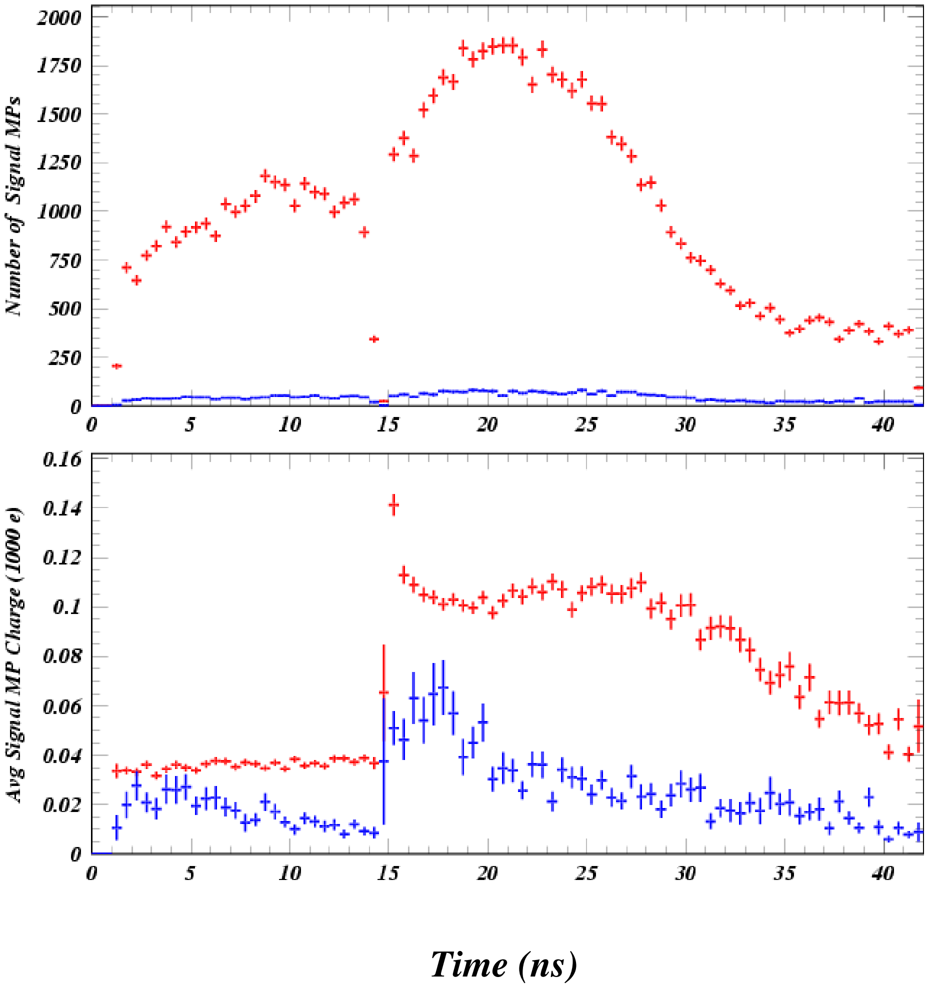
The acceptance in the secondary angle $A_{\theta 2}$ *depends on the average depth and hence on the incident angle θ.*

3) *Normal secondaries generated with*

$$Q_{mp} (1 - A_{\theta=0} A_{x})$$

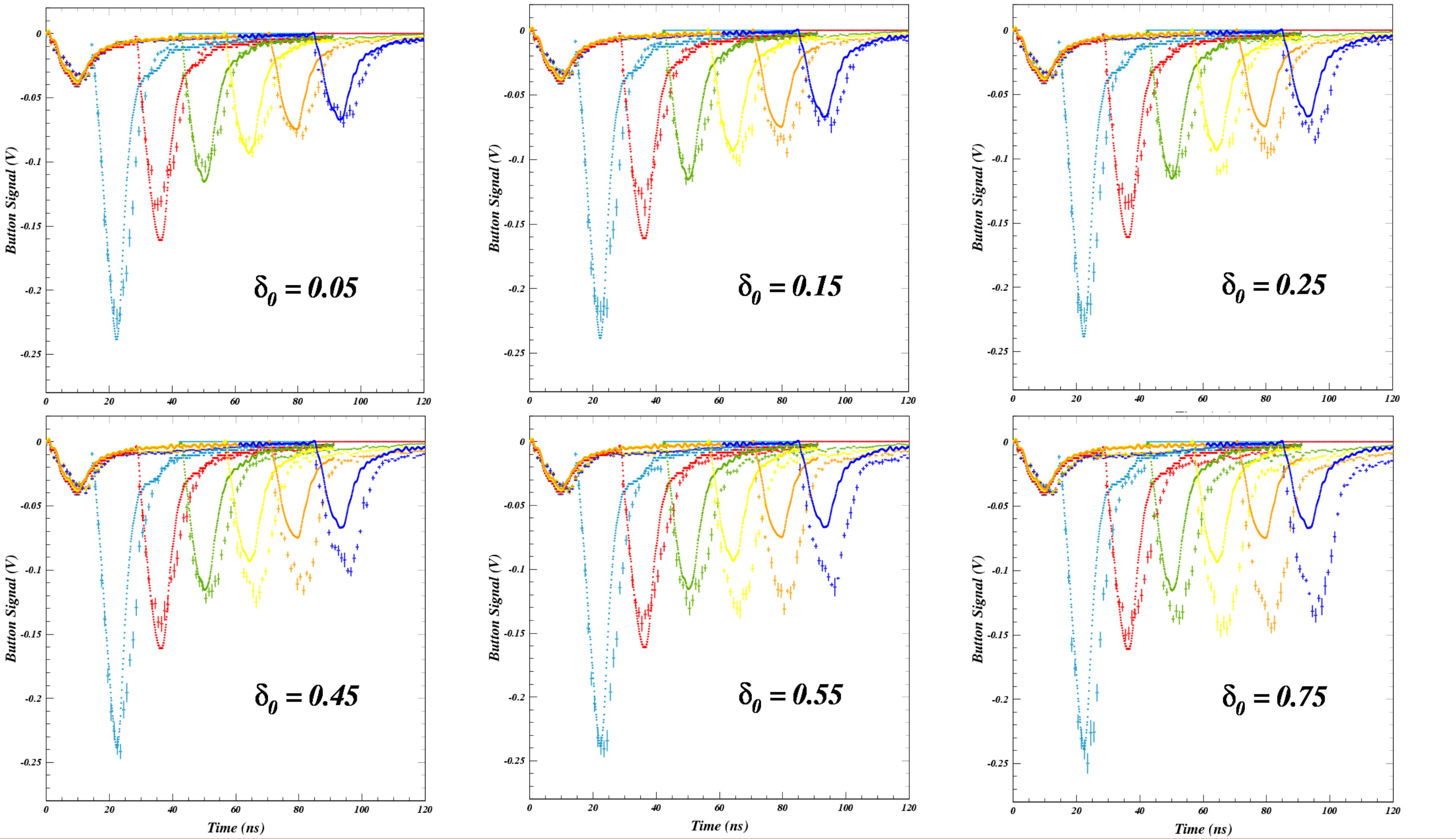
4) *Ignore hole secondaries which hit the hole wall*

5) *Ignore secondaries which re-enter the beampipe*



ECLOUD cloud lifetime sensitivity to elastic yield δ_0

-- Present status --



After the SPU acceptance model was implemented, the normalization to the 4-ns 15w Al 5/17 data was within 10%.
For this 14-ns 15e TiN 3/27 data, the normalization was high by a factor of 2, so the quantum efficiency has been halved in this simulation.
The ratio of the first bunch signal to those of the witness bunches requires a reflectivity of 40% rather than 20%, consistent with SYNRAD3D.
The model of the width of the witness bunch signals was improved by lowering the total secondary yield value from 1.0 to 0.8.