

Mini-BCAL Test @ Hall B (2012): Time Resolution

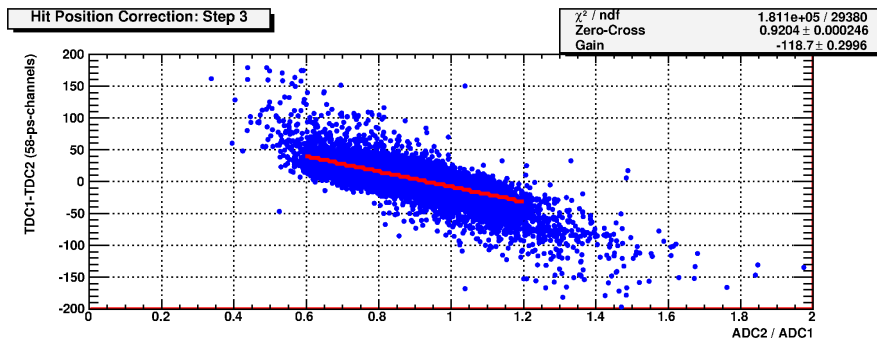
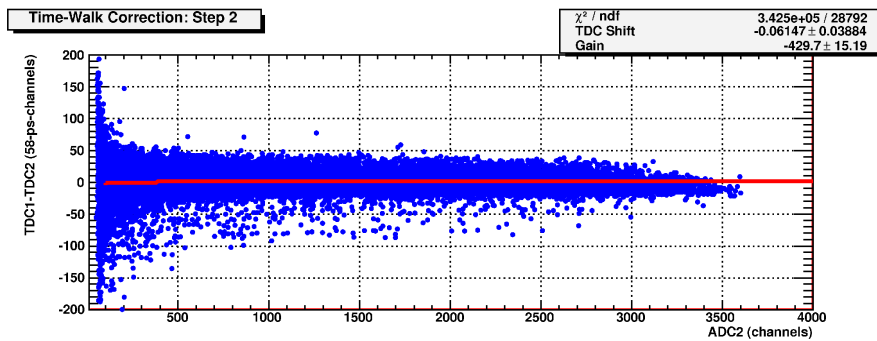
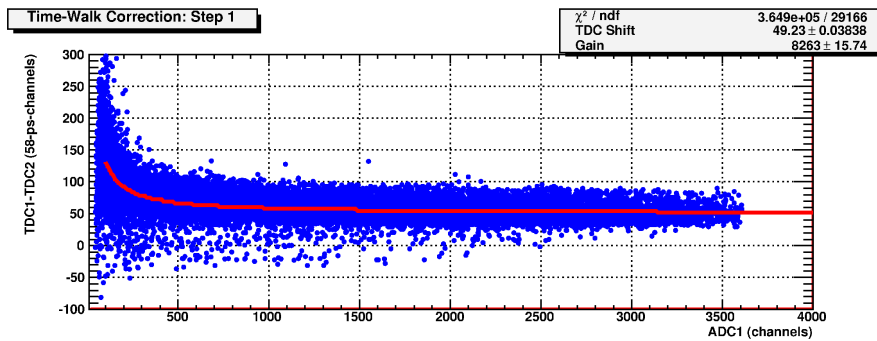
Andrei Semenov

On behalf of UofR Group

GEANT Simulations done by Irina Semenova

November 13, 2012

Single-Cell Layer: Corrections for the Cell (3-1)



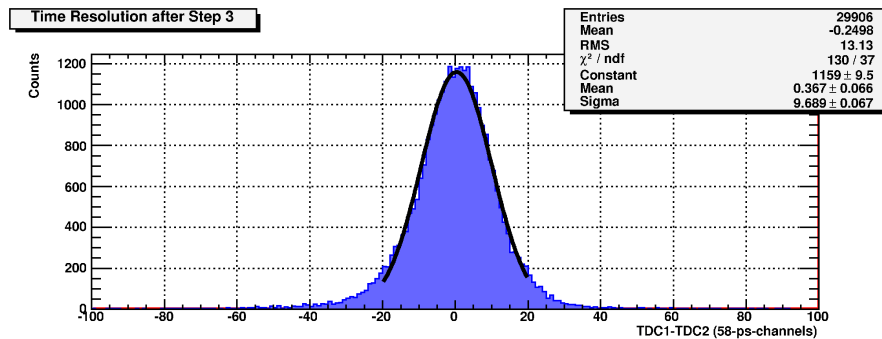
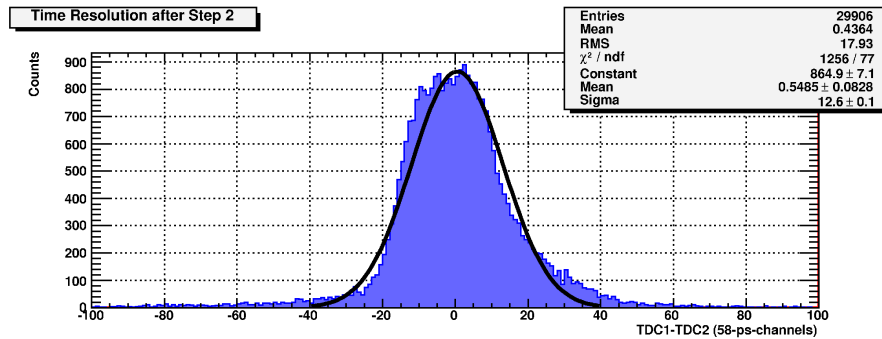
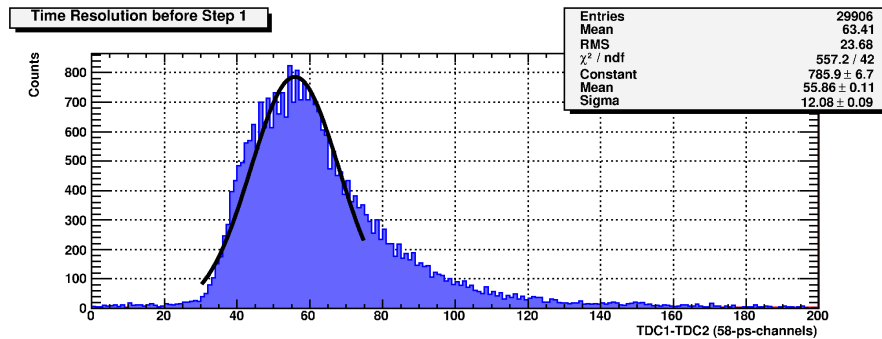
To remove trigger detector time contribution, we work with Upstream-Downstream time difference

Only residual time-walk dependence

Strong correlation of Up/Down amplitudes

Trigger-Size Contribution (Short Attenuation Length for 50-cm mini-BCAL)

Single-Cell Layer: Time Resolution for the Cell (3-1)



Edge-to-edge time propagation:
 $t(e\text{-}2\text{-}e) = 2 \times 10\text{cm} / (18 \text{ cm/ns}) = 1.11 \text{ ns}$

Contribution in the terms of “sigma”:
 $dt(\text{trig}) = 0.34 \times 1.11\text{ns} = 380 \text{ ps}$

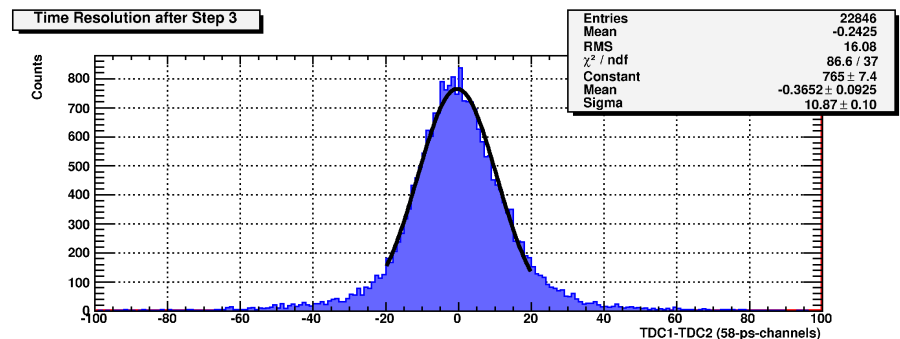
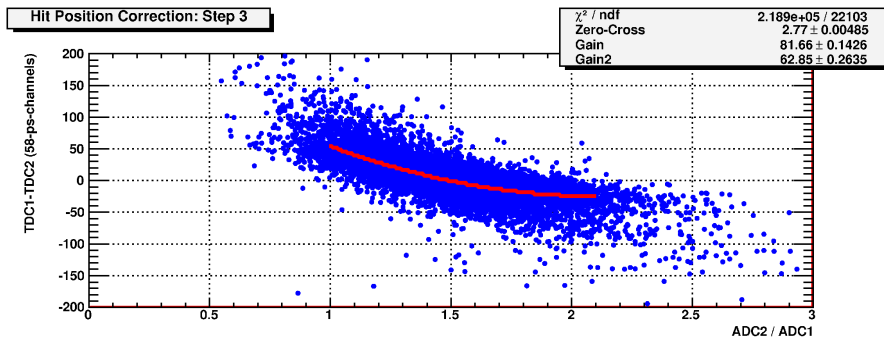
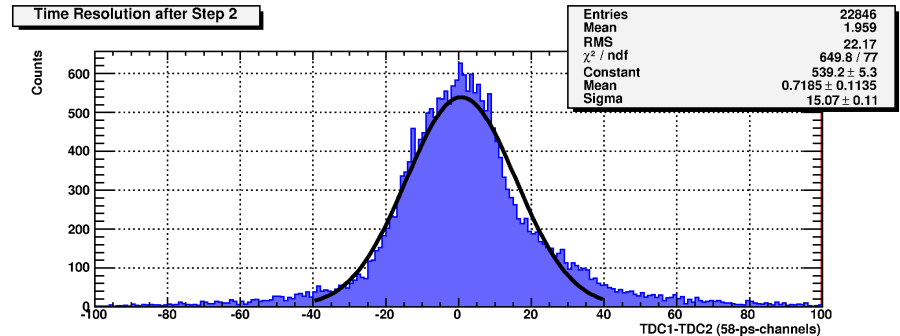
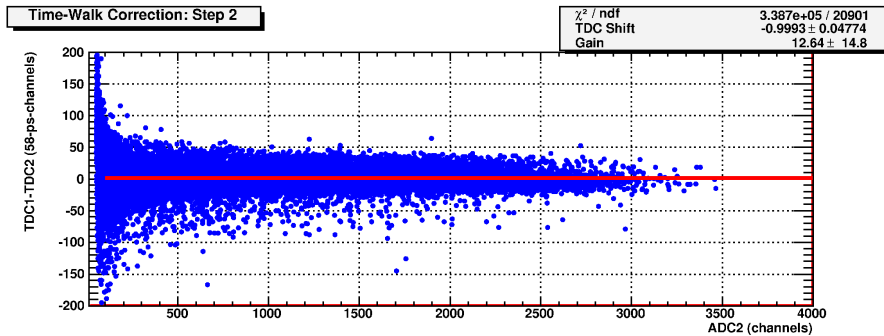
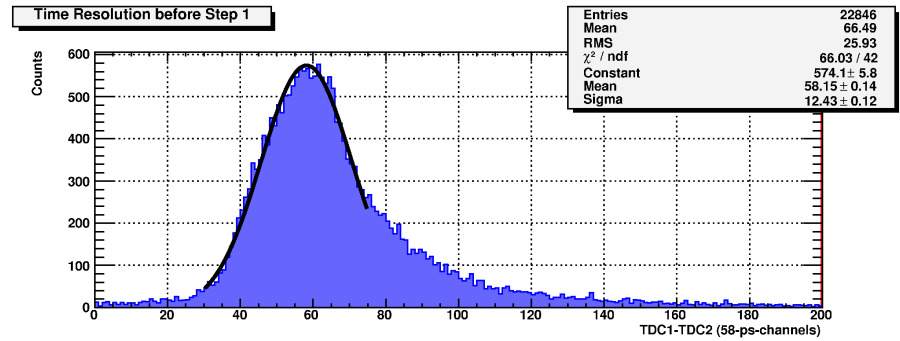
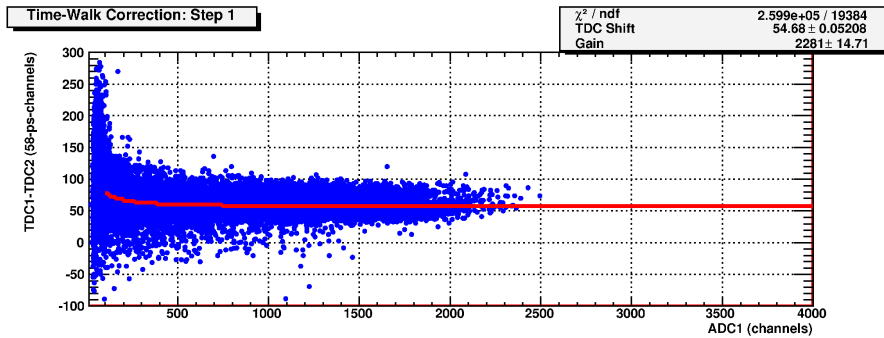
Time resolution before position
correction:
 $12.6\text{ch} \times 58\text{ps} = 730 \text{ ps}$

Expected resolution after position
correction:
 $\text{SQRT}(730^2 - 380^2) = 624 \text{ ps}$

Time resolution after position
correction:
 $9.7\text{ch} \times 58\text{ps} = 563 \text{ ps}$

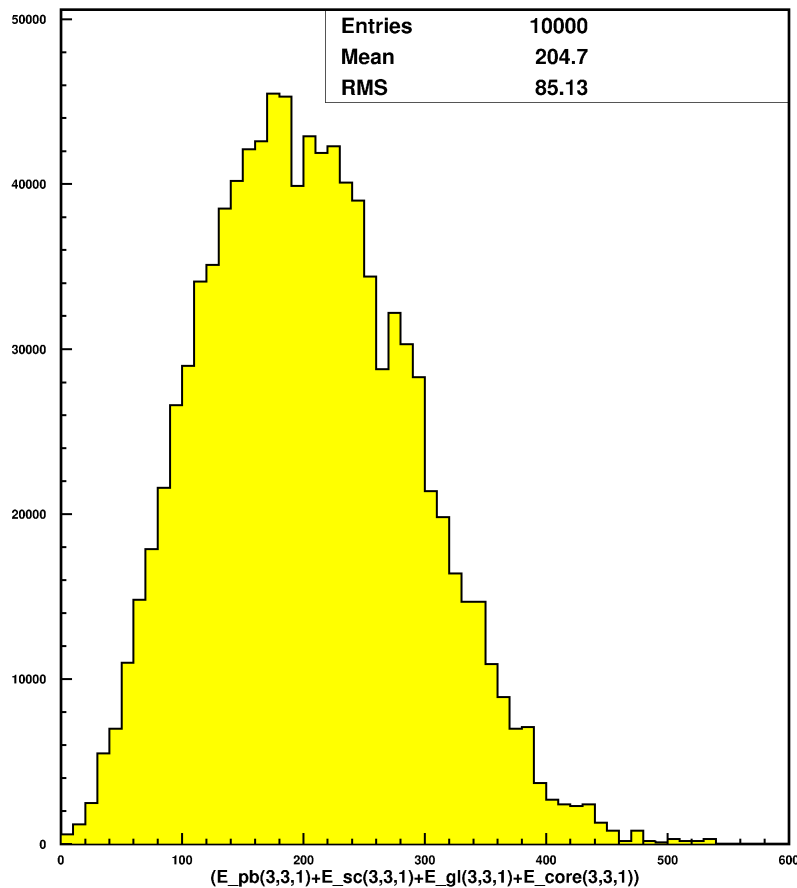
“Mean-time” resolution = $0.5 \times 563 \text{ ps} = 281 \pm 6 \text{ ps}$

Single-Cell Layer: Cell (2-1)



“Mean-time” resolution = $0.5 * 10.9\text{ch} * 58 \text{ ps} = 315 \pm 6 \text{ ps}$

Single-Cell Layer: Energy Deposition & Time Resolution



Cell (3-1):

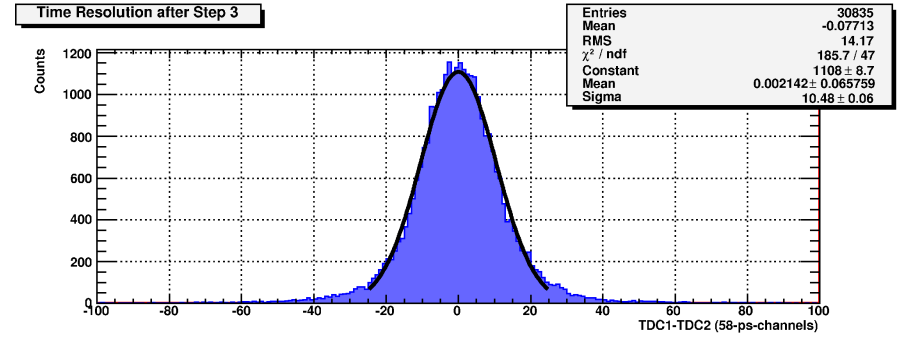
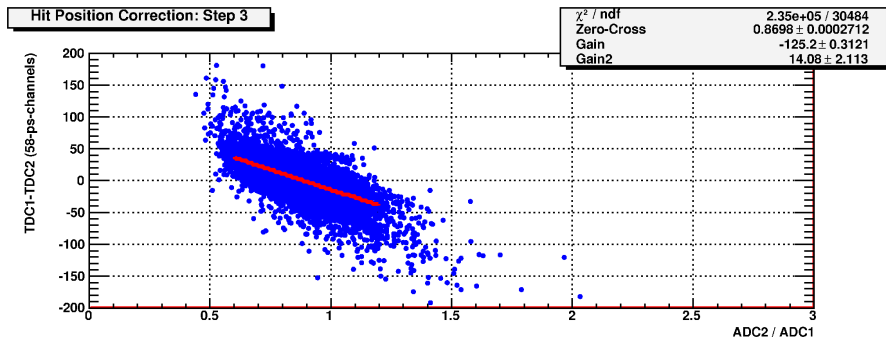
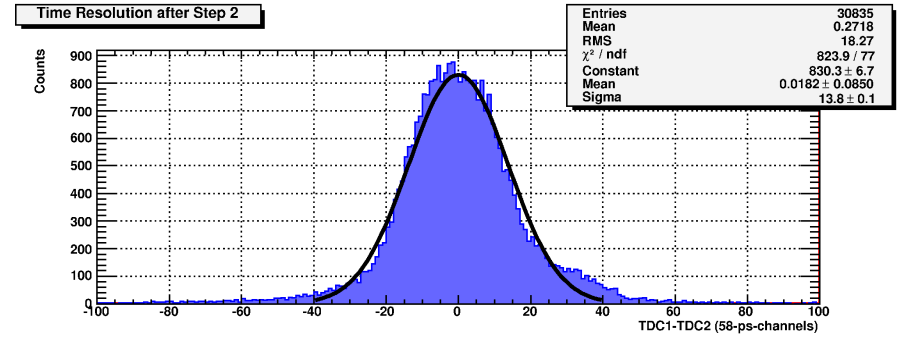
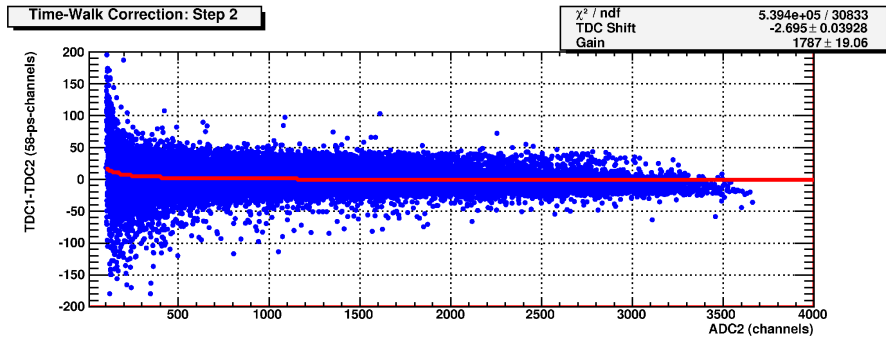
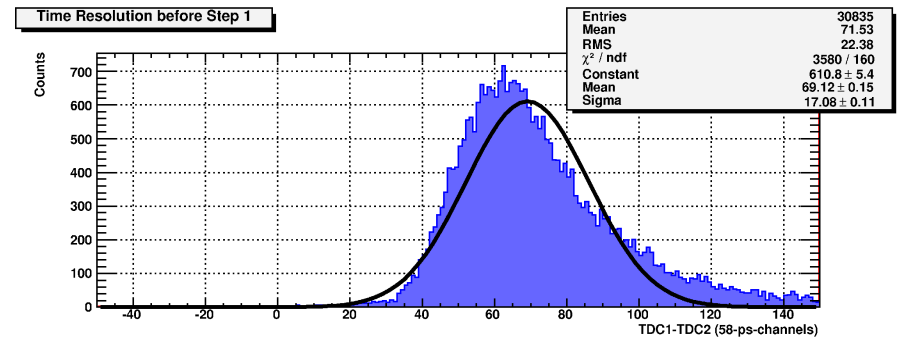
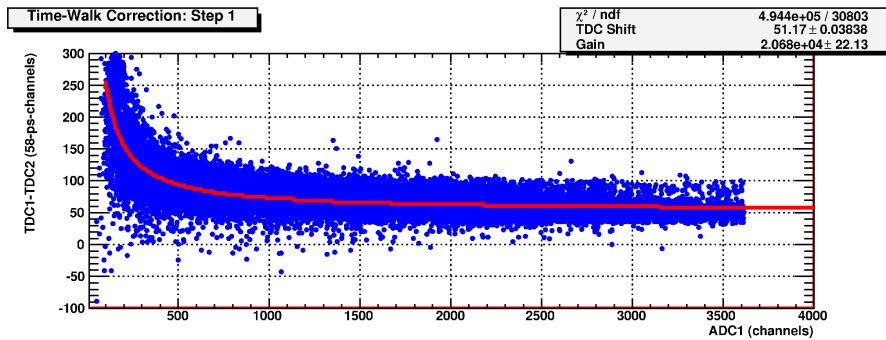
$$281 \text{ ps} = 127 \text{ ps} / \text{SQRT}(E)$$

Cell (2-1):

$$315 \text{ ps} = 142 \text{ ps} / \text{SQRT}(E)$$

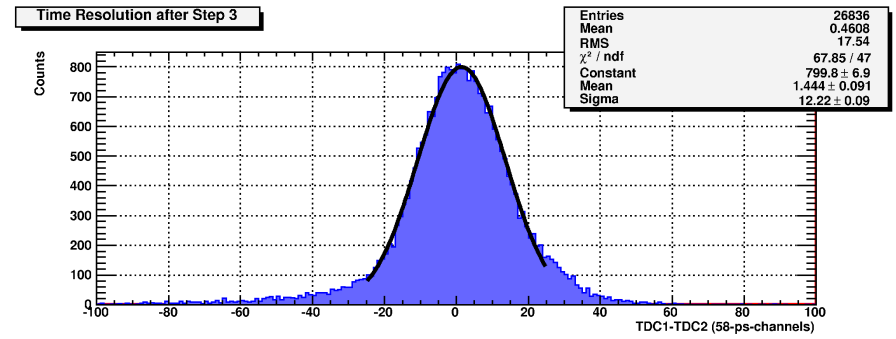
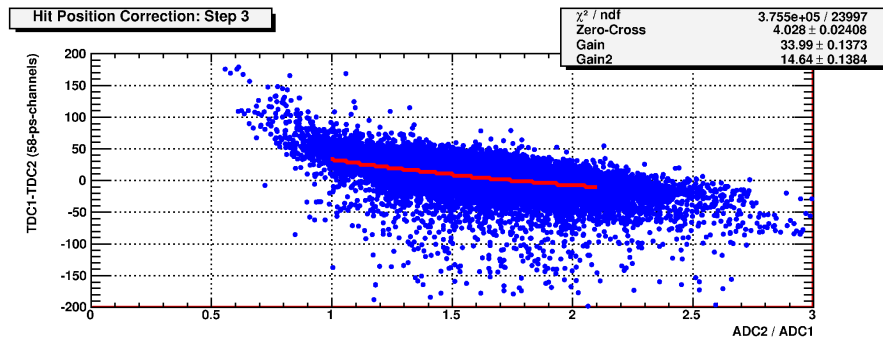
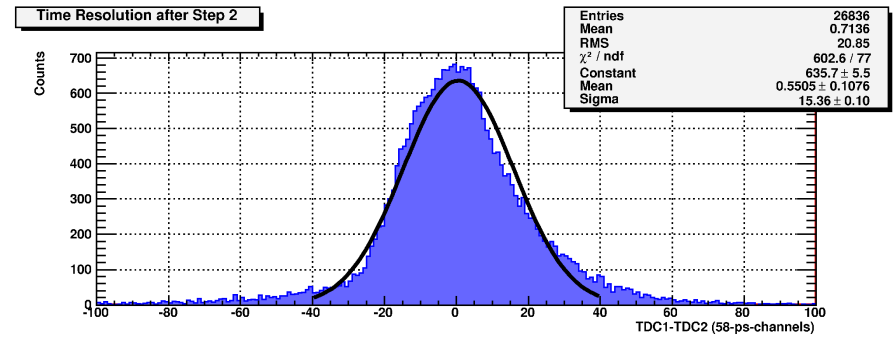
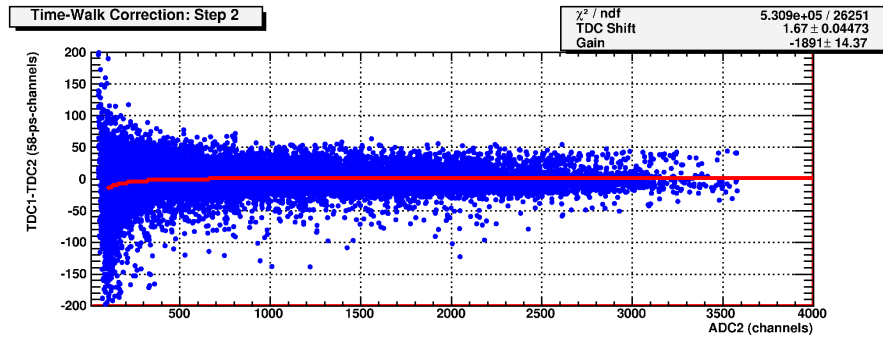
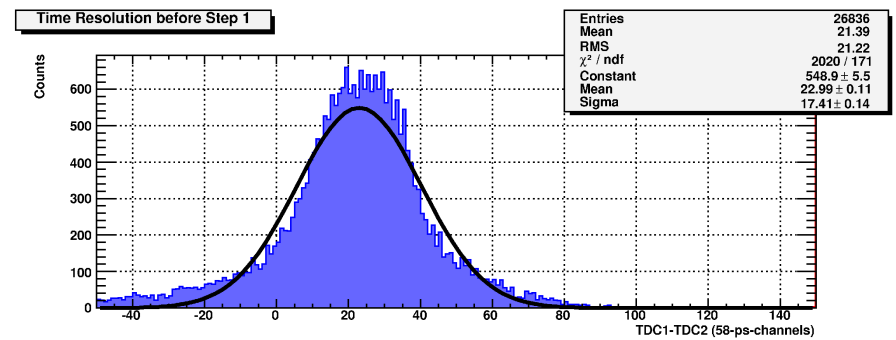
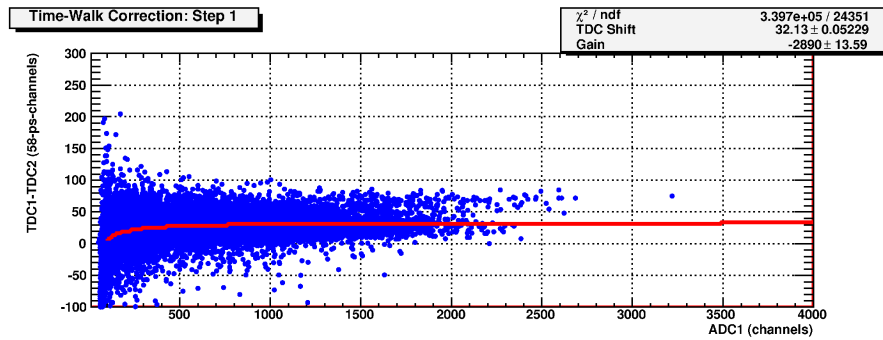
Run 484: 1200-MeV electrons @ 20 degrees

Double-Cell Layer: Cells (3-2) + (3-3)



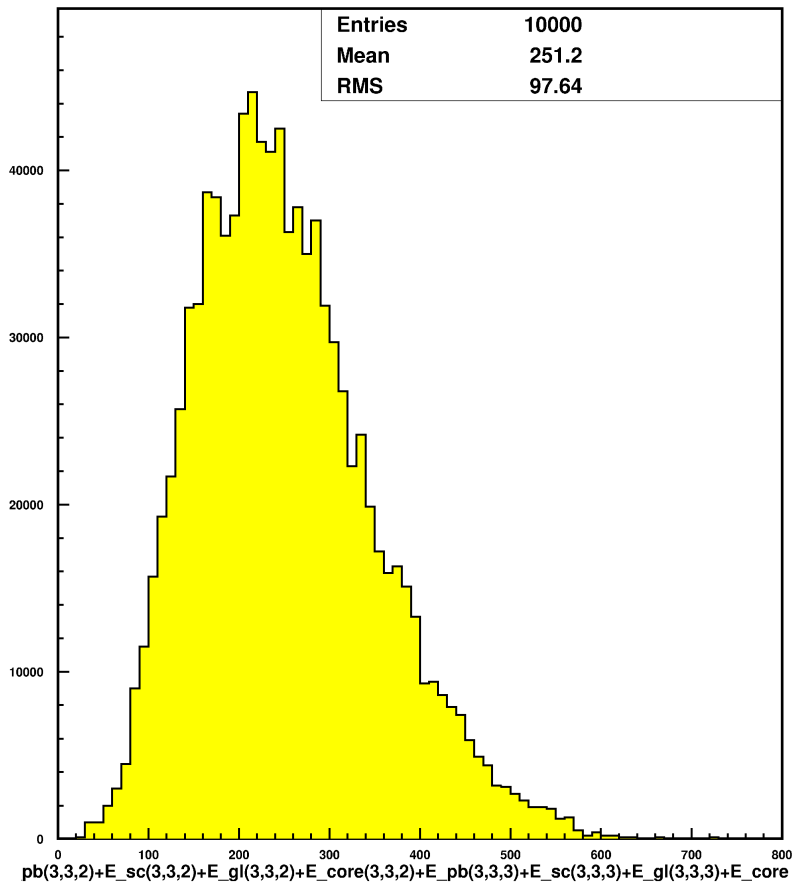
“Mean-time” resolution = $0.5 * 10.5\text{ch} * 58 \text{ ps} = 304 \pm 6 \text{ ps}$

Double-Cell Layer: Cells (2-2) + (2-3)



“Mean-time” resolution = $0.5 * 12.2\text{ch} * 58\text{ ps} = 354 \pm 6\text{ ps}$

Double-Cell Layer: Energy Deposition & Time Resolution



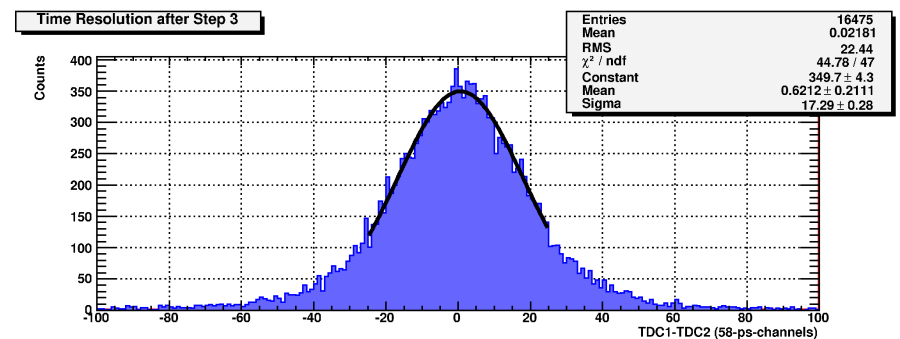
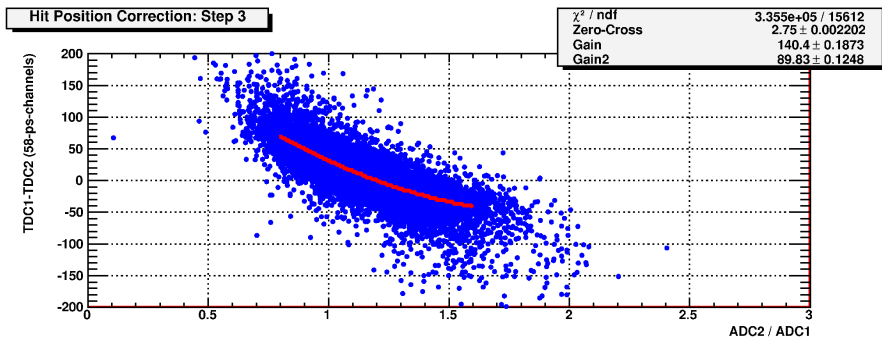
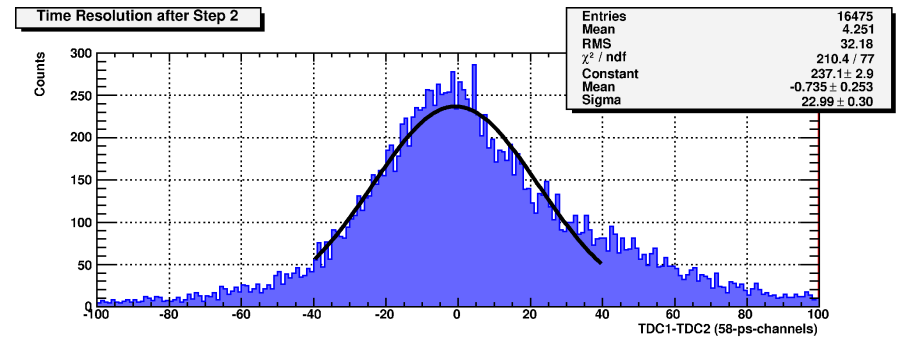
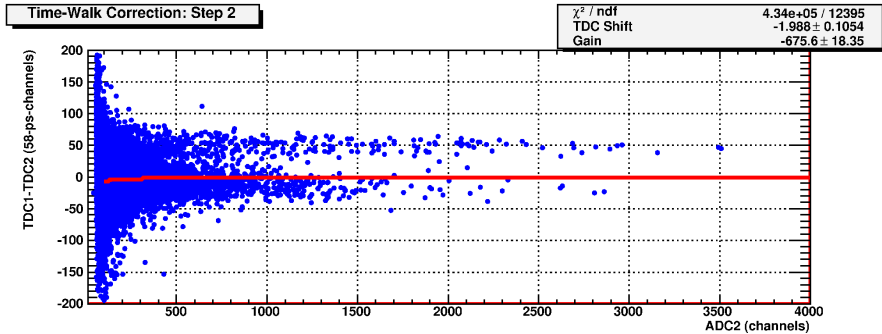
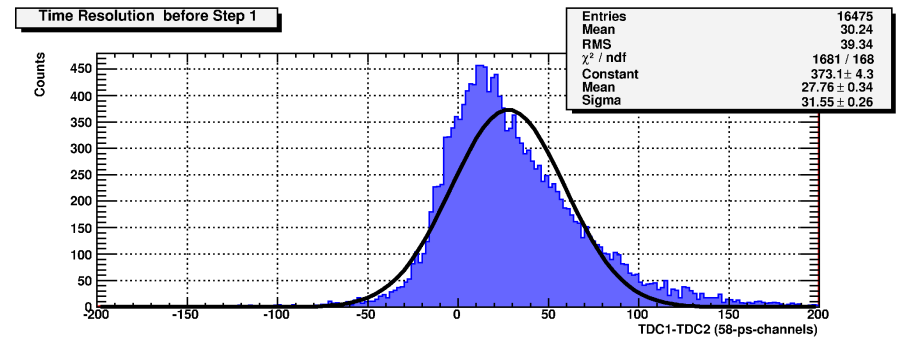
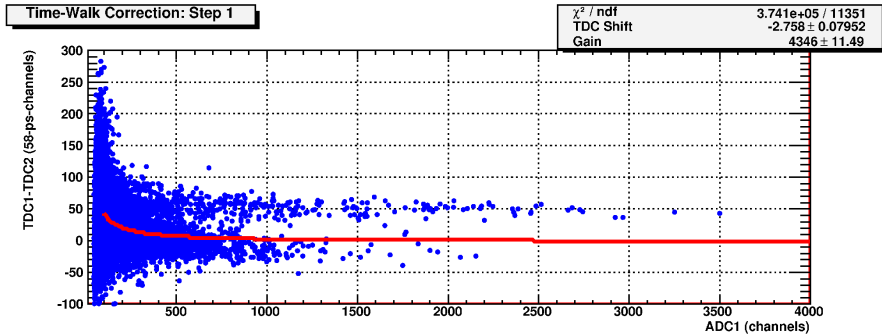
Cells (3-2) + (3-3):

$$304 \text{ ps} = 152 \text{ ps} / \text{SQRT}(E)$$

Cells (2-2) + (2-3):

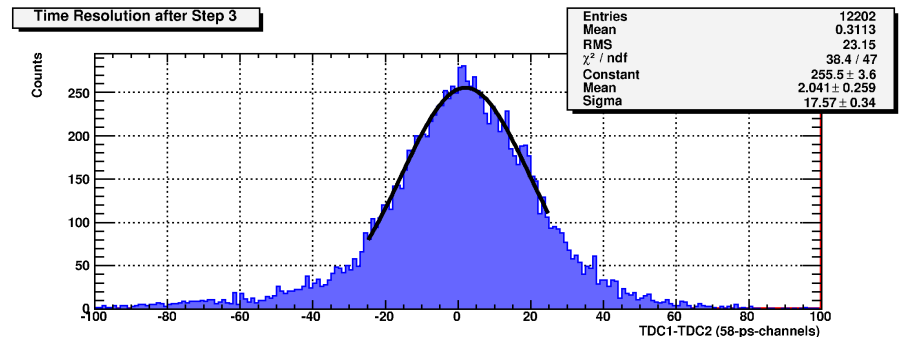
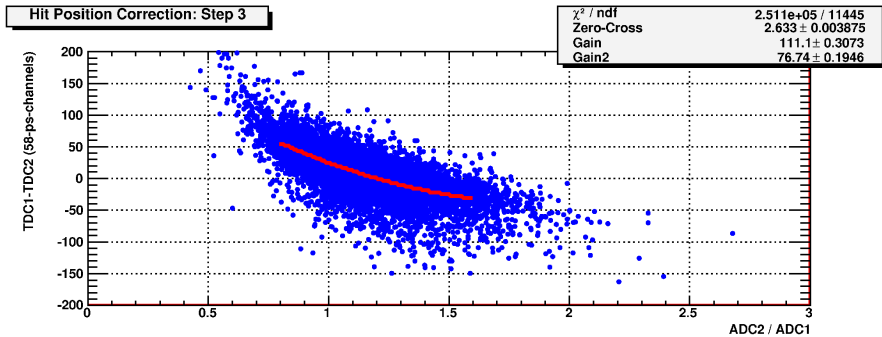
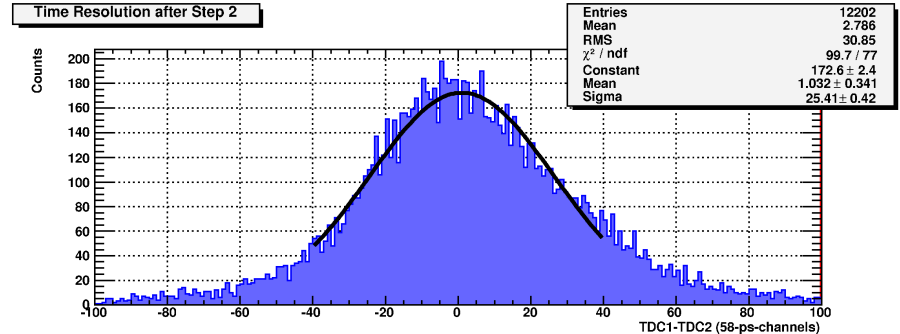
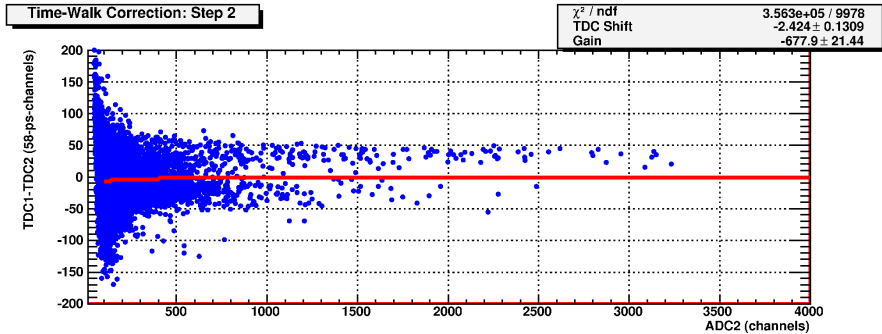
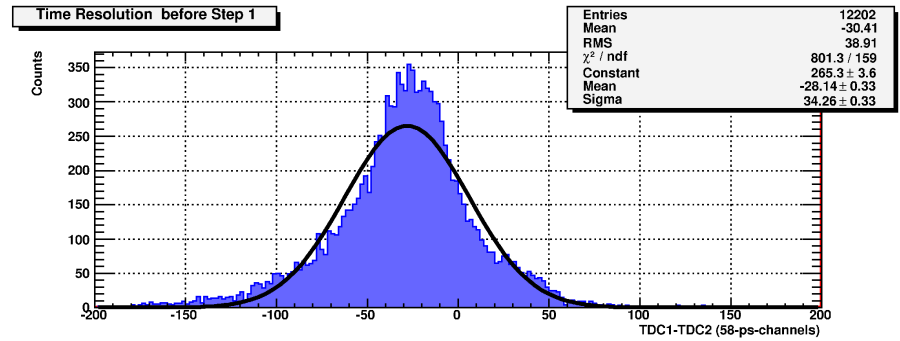
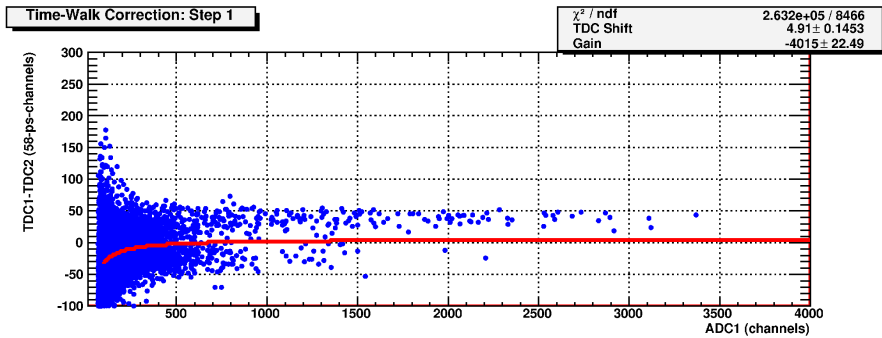
$$354 \text{ ps} = 177 \text{ ps} / \text{SQRT}(E)$$

Triple-Cell Layer: Cells (3-4) + (3-5) + (3-6)



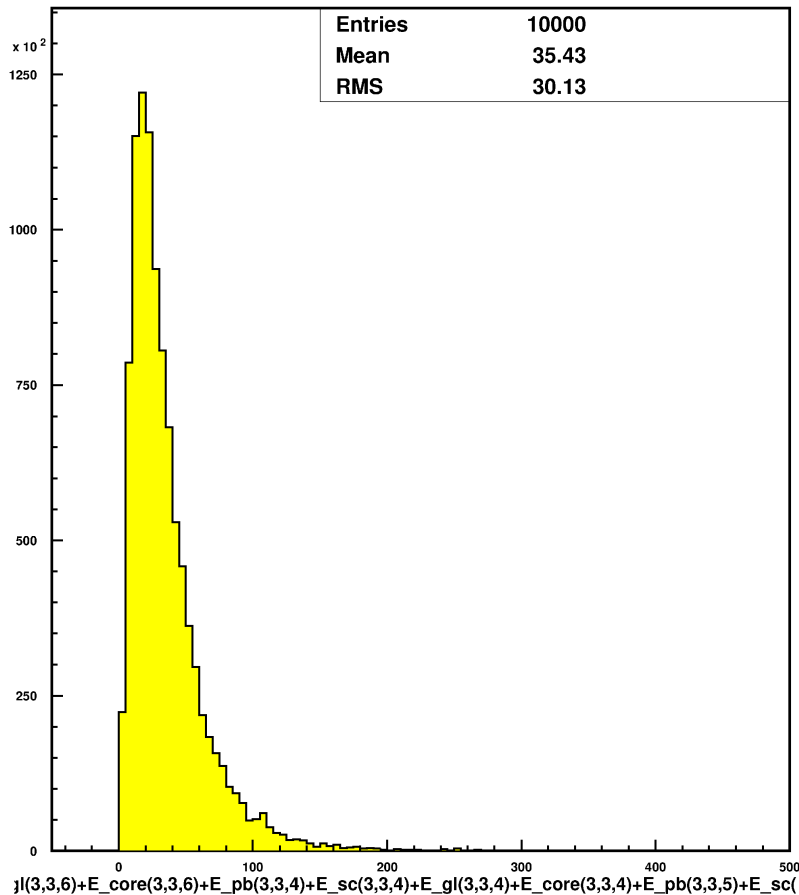
“Mean-time” resolution = $0.5 * 17.3\text{ch} * 58 \text{ ps} = 502 \pm 8 \text{ ps}$

Triple-Cell Layer: Cells (2-4) + (2-5) + (2-6)



“Mean-time” resolution = 0.5 * 17.6ch * 58 ps = 510 ± 10 ps

Triple-Cell Layer: Energy Deposition & Time Resolution



Cells (3-4) + (3-5) + (3-6):

502 ps = 94 ps / SQRT(E)

Cells (2-4) + (2-5) + (2-6):

510 ps = 96 ps / SQRT(E)

Parameterization of the Time Resolution

χ^2 / ndf	96.61 / 4
Floor Term	265 ± 294.5
Stat Term	80.19 ± 100

