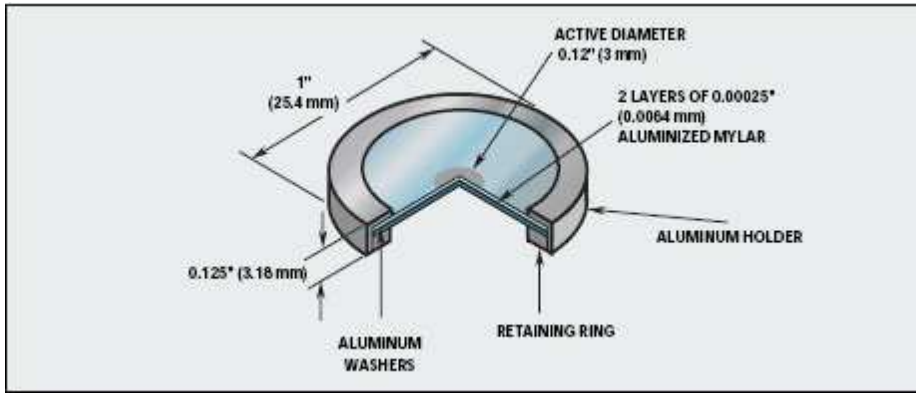
Some Simulations for the SCS Calibration Run

Action items from a discussion a while ago:

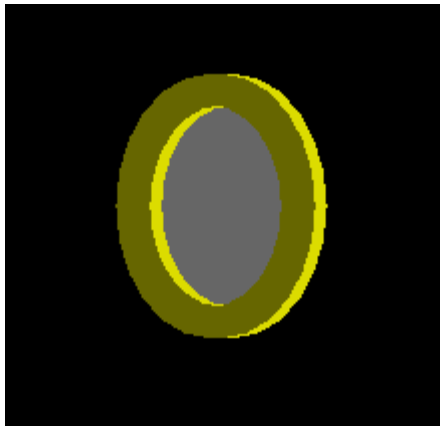
- Implementing real source geometry
- E resolution for point and real sources
- Position resolution for point and real sources
- Double-checking E loss budget upstream of the scintillator
- Timing distribute for correct and “type I” backscattering events
- Energy distribution for correct and various types of backscattering events

Source Geometry

From Isotope Products



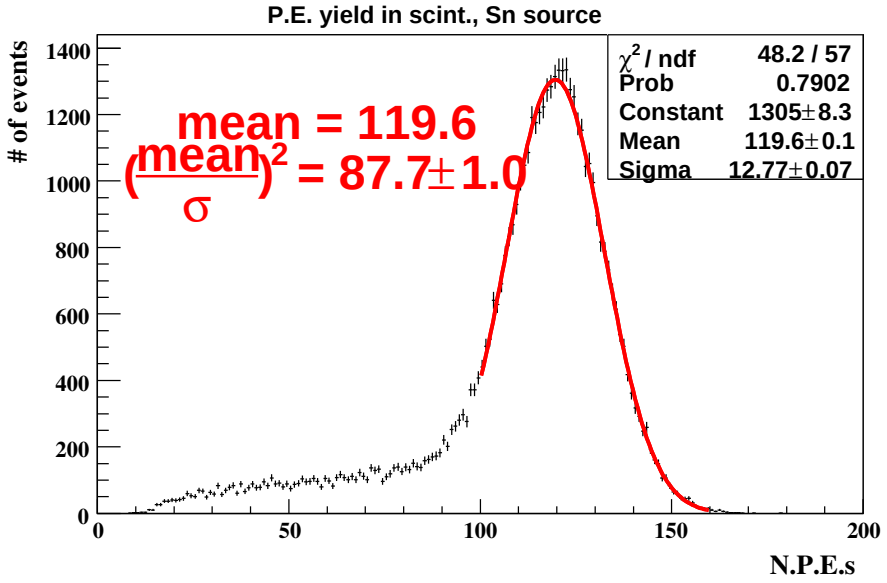
Implementation in G4



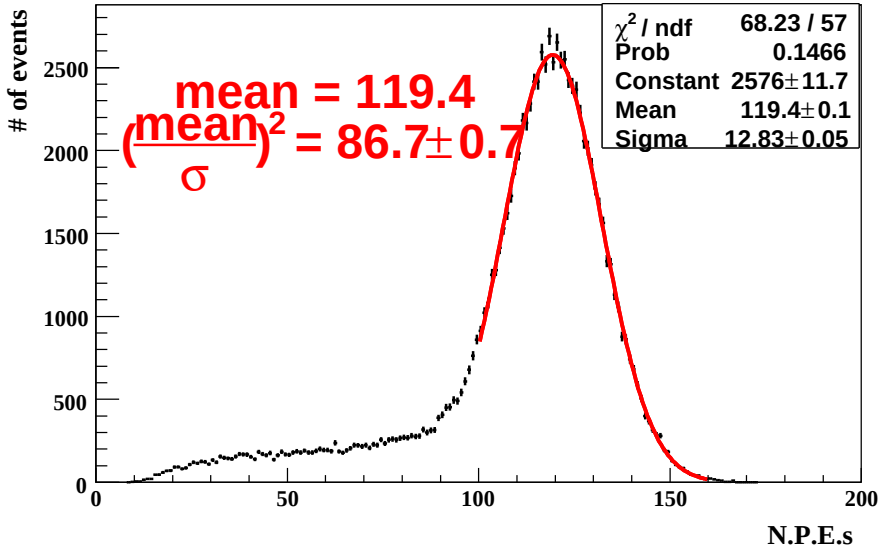
- Aluminum ring clamp: with total thickness of 3.18 mm, OD 25.4 mm, ID 19.4mm
- Source covered by two layers of mylar with 0.0064 mm thickness each
- Source active area: circle with 2 mm OD at the center

E Resolution

Point source



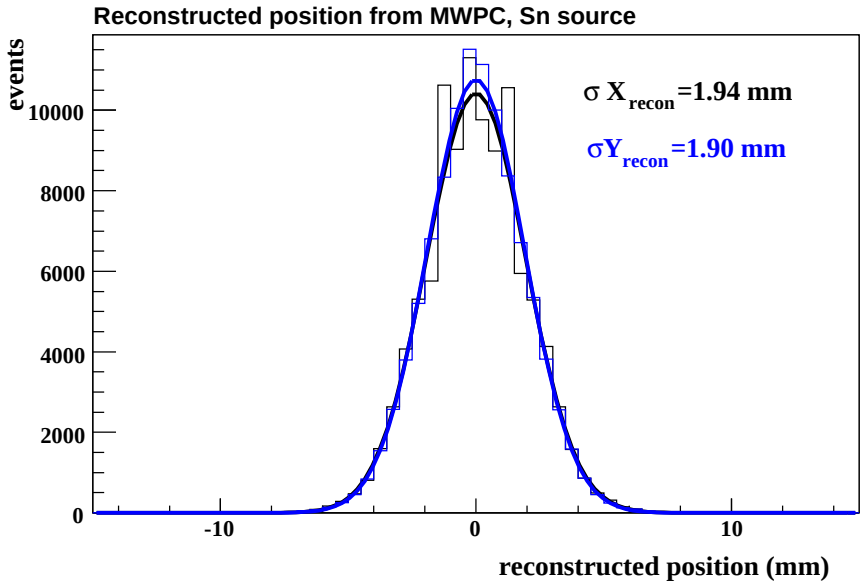
Source within 2 mm diameter



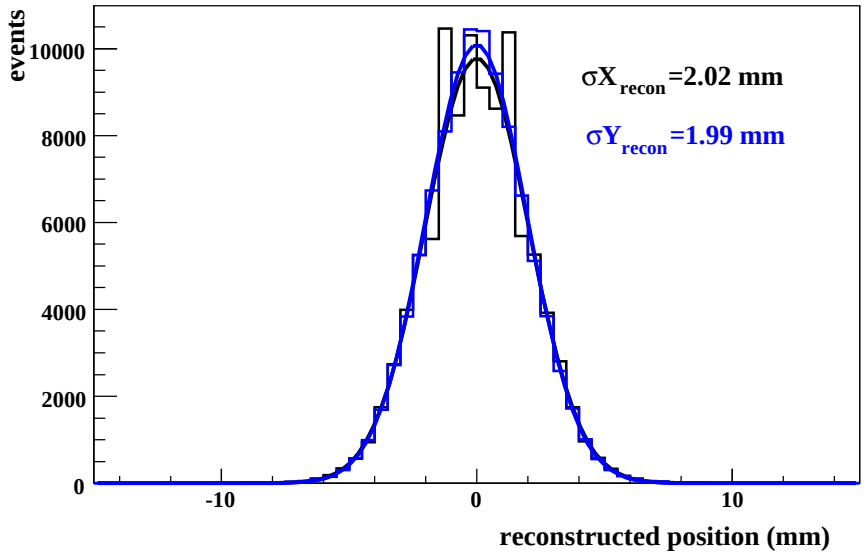
No significant effect.

Position Resolution

Point source



Source within 2mm diameter



Very little effect observed.

This is expected. The RMS on X and Y for uniformly distributed vertex within a 2 mm OD circle is only 0.5 mm.

E Loss Budget

For Sn source,

	MWPC volume	MWPC windows (25 um)	Scintillator Dead Layer	Total
Mean (keV)	9.5	25.8	3.8	35.2
Most probable (keV)	3.7	12.1	1.7	17.8

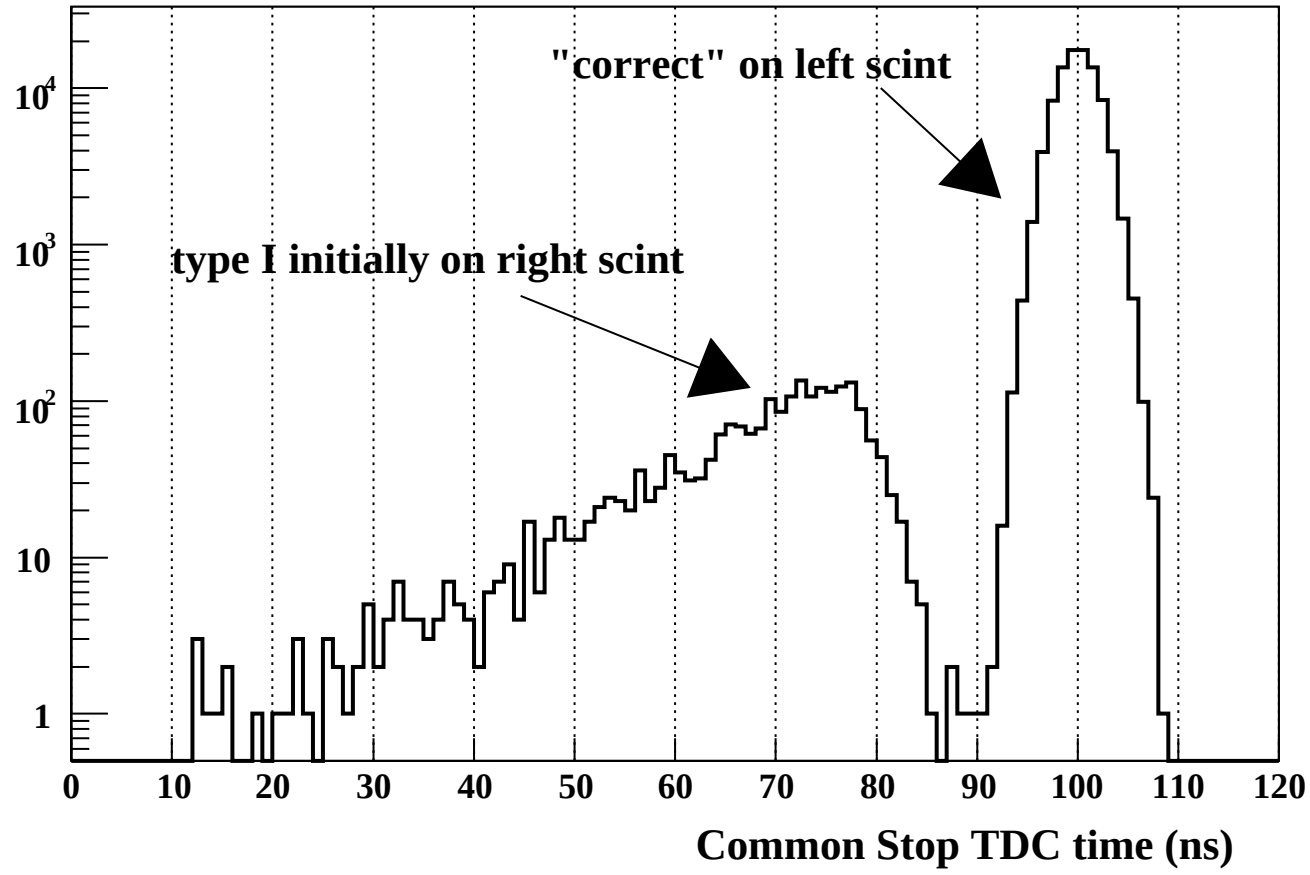
For Bi source,

	MWPC volume	MWPC windows (25 um)	Scintillator Dead Layer	Total
Mean (keV)	6.8	18.0	2.5	25.2
Most probable (keV)	2.9	9.0	1.3	14.5

In agreement with my earlier study in May.

Timing Distribution

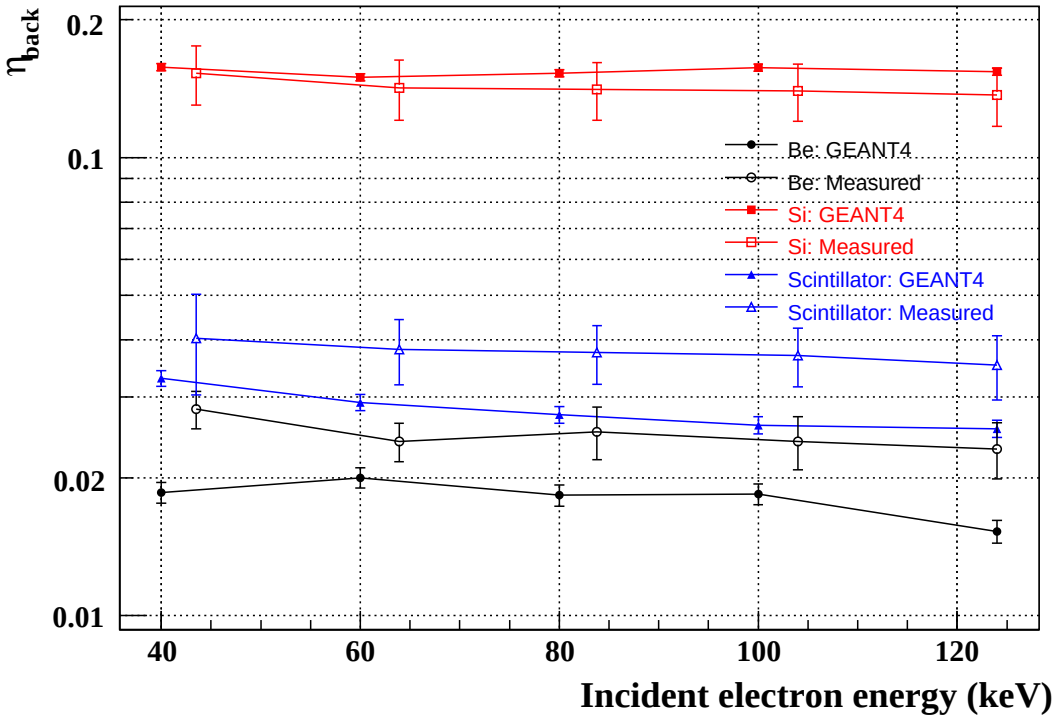
Common Stop TDC timing distribution for left scintillator with 2 ns TDC jitter



Compare this with Fig. 6 in Brad's note: ~24 ns separation between the two timing peaks reproduced.

Benchmark G4 Backscattering Calculation

Use most recent GEANT4.8.1.p02. Check the total backscattering fraction (E_e = 40 – 120 keV) from bulk materials (Be, Si and scintillators) against Jeff's PRC papers.



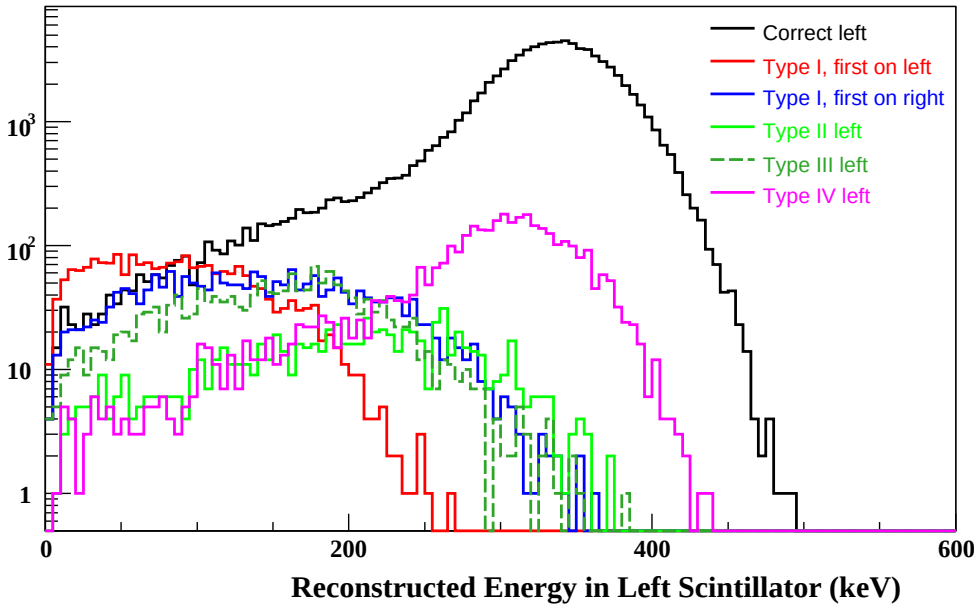
Measured data: "current integration mode"

G4 and data agree within 20%, so Okay to proceed to the next step.

Energy Distributions

For example, my cuts for different types of events for **left** scintillator

Types	Scint L time (ns)	Scint R time (ns)	MWPC E dep	MWPC E dep	Initial Pz
Correct	[0, 100]	[0, 100]	>0	none	<0
Type I (first on left)	[0, 100]	[0, 100]	>0	>0	<0
Type I (first on right)	[0, 100]	[0,100]	>0	>0	>0
Type II	[0,100]	none	>0	>0	>0
Type III	[0,100]	none	>0	>0	<0
Type IV	[0,100]	[0,100]	>0	none	>0



Event fractions:

Correct: 91.31%

Type I: 2.28%

Type II: 0.83%

Type III:1.73%

Type IV:3.84%

Also see Fig. 62 in Brad's note, very good agreement.

Type I and Type II/III event fraction agree with Brad's analysis to 15%:

Brad got 2.3% for type I and 2.3% for type II/III.