Effective Velocity and Time Offsets in the Barrel Calorimeter

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Method

1. Plot the z-coordinate of the points in the cluster versus the z-coordinates of the matched track for every channel and perform a linear fit on the outcome
2. The two quantities are related as follows:

$$z_{point} = p_0 + p_1 \cdot z_{track} \tag{1}$$

or more explicitly:

$$\frac{c_{eff,soft} \cdot (t_u - t_d)}{2} = \frac{c_{eff,soft} \cdot (t_{u,0} - t_{d,0})}{2} + \frac{c_{eff} \cdot (t_u - t_d)}{2} \tag{2}$$

where:

t_u : upstream time

t_d : downstream time

$t_{u,0}$: upstream time for particles hitting the center of BCAL

$t_{d,0}$: downstream time for particles hitting the center of BCAL

$c_{eff,soft} = 16.75 \frac{cm}{ns}$ (value from DBCALGeometry)

c_{eff} : the value we are after

$\Delta t = t_{u,0} - t_{d,0}$: the time offset

Method

Therefore:

$$c_{eff} = \frac{c_{eff,soft}}{p_1} \tag{3}$$

$$\Delta t = \frac{2 \cdot p_0}{c_{eff,soft}} \tag{4}$$

3. z_{track} calculation:

   - Take 4 radii (middle of each layer) inside the BCAL and find z_{track} for each layer using these radii
   - Use cuts to throw away points that are ”far” from the 45° line
   - ”Far” means: $|z_{track} - z_{point}| > 40cm, 30cm, 20cm$

4. Datasets

   - Spring Runs 3137, 3138 (field off)
   - Cosmics Runs 3218, 3220, 3221

Effective Velocity - Run 3138 ($B = 0$)

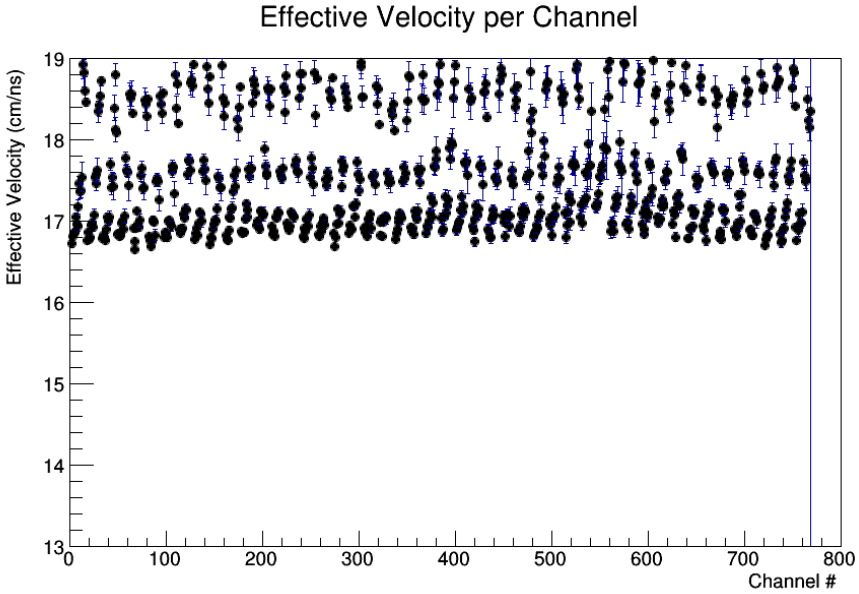

Figure 1: Effective velocity for Run 3138

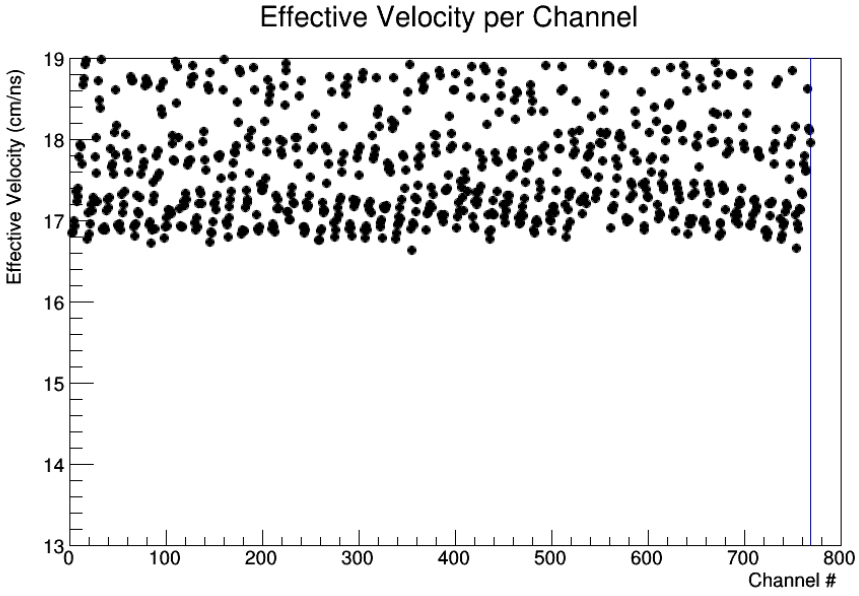

Figure 2: Effective velocity for Run 3138 (TGraphErrors)

Effective Velocity - Cosmics

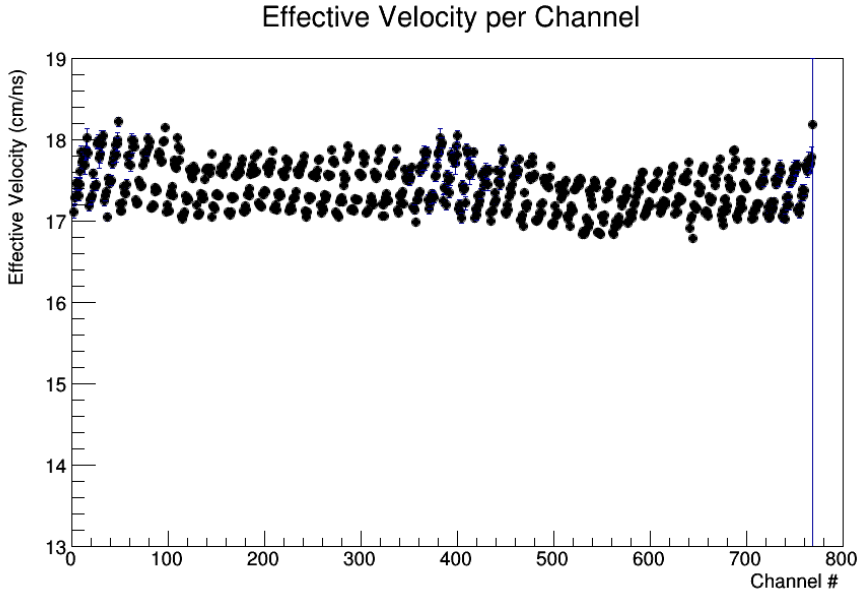

Figure 3: Effective velocity for Runs 3218, 3220, 3221

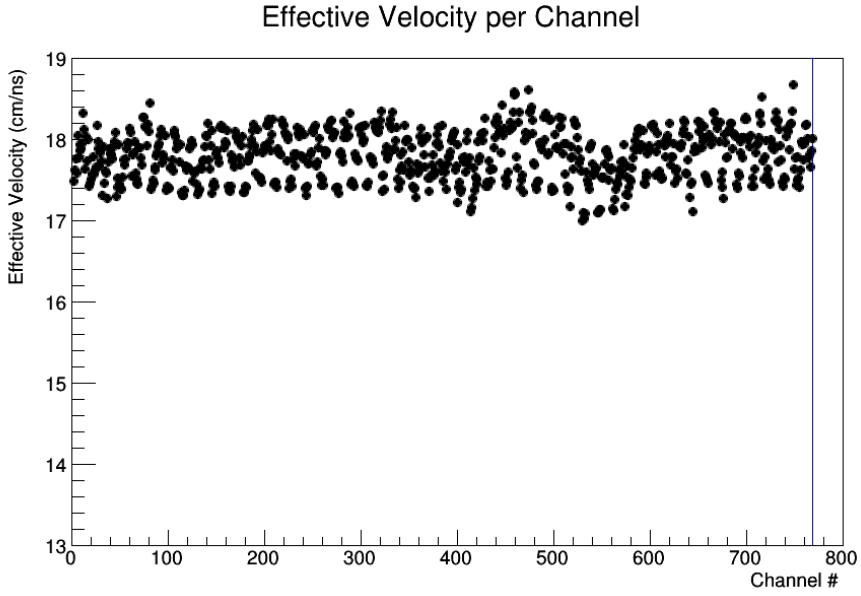

Figure 4: Effective velocity for Runs 3218, 3220, 3221 (TGraphErrors)

Effective Velocity - Run 3138 ($B = 0$) - 40cm cut

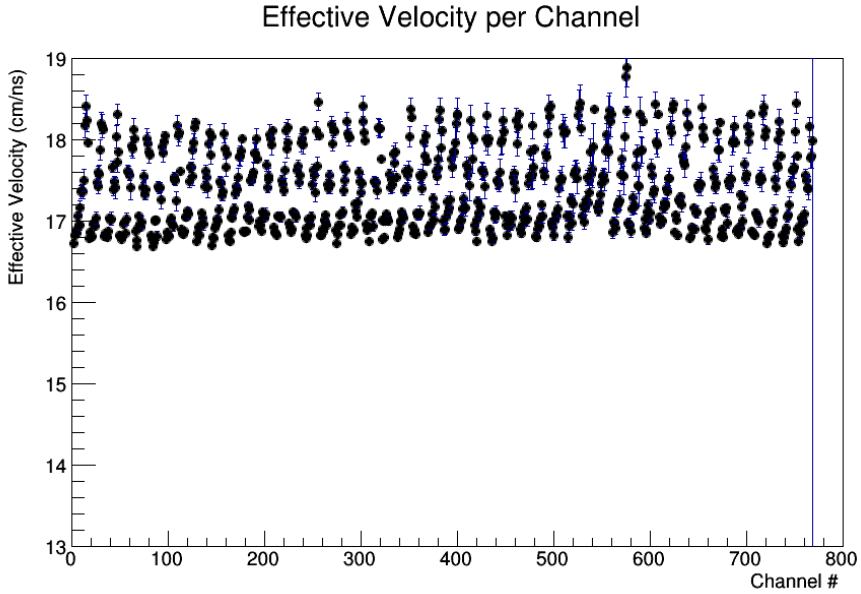

Figure 5: Effective velocity for Run 3138 with 40cm cut

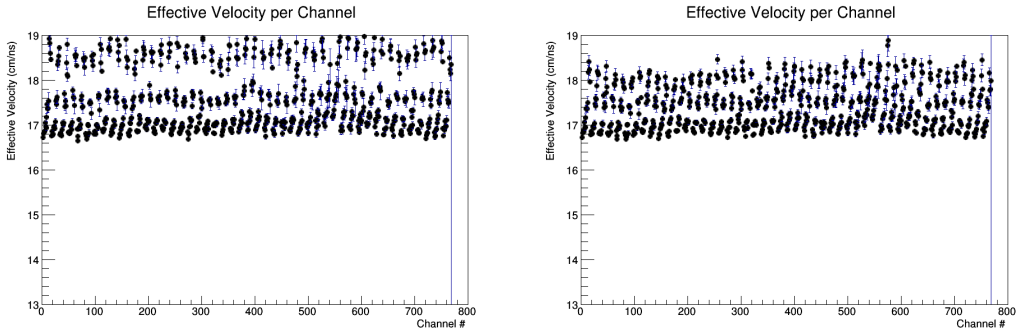

Figure 6: Effective velocity for Run 3138 1) without cuts (left) and 2) with 40cm cut (right)

Effective Velocity - Cosmics - 40cm cut

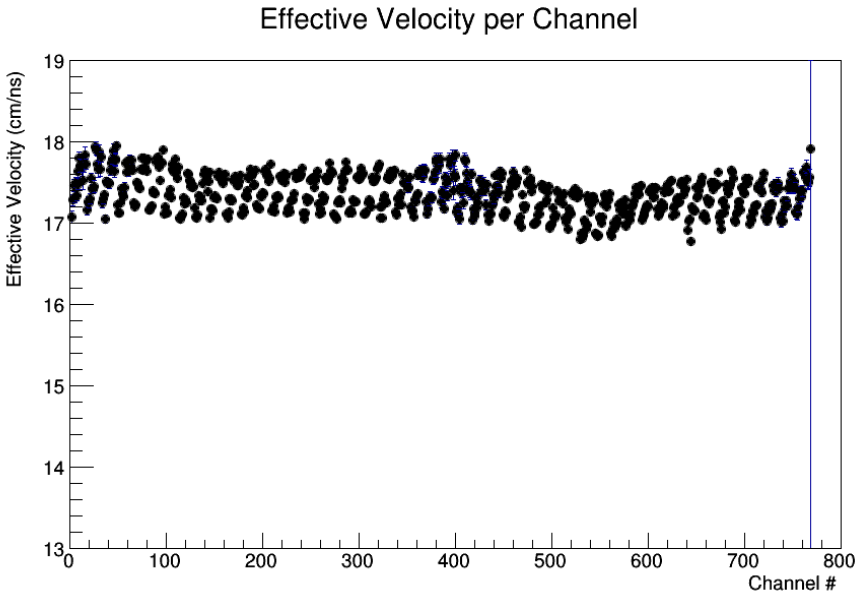

Figure 7: Effective velocity for Runs 3218, 3220, 3221 with 40cm cut

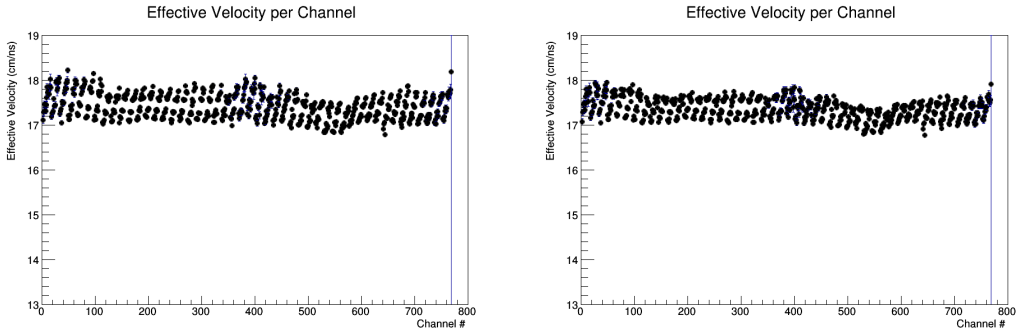

Figure 8: Effective velocity for cosmics 1) without cuts (left) and 2) with 40cm cut (right)

Effective Velocity - Run 3138 ($B = 0$) - 30cm cut

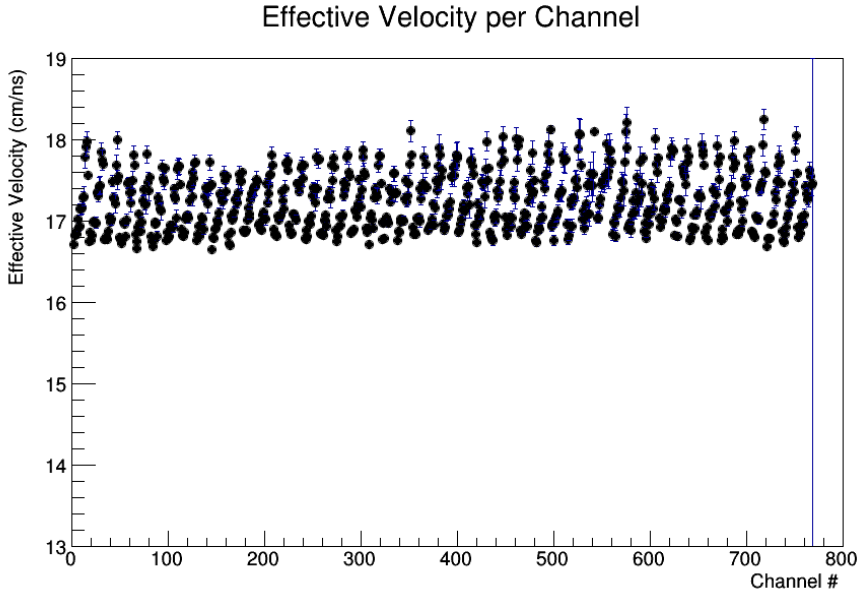

Figure 9: Effective velocity for Run 3138 with 30cm cut

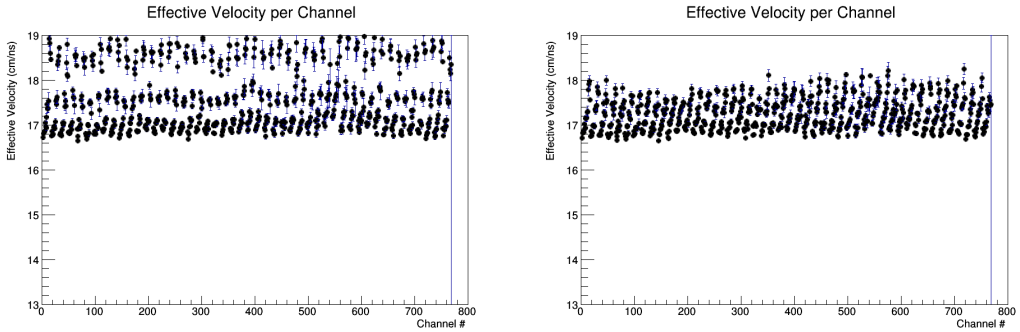

Figure 10: Effective velocity for Run 3138 1) without cuts (left) and 2) with 30cm cut (right)

Effective Velocity - Cosmics - 30cm cut

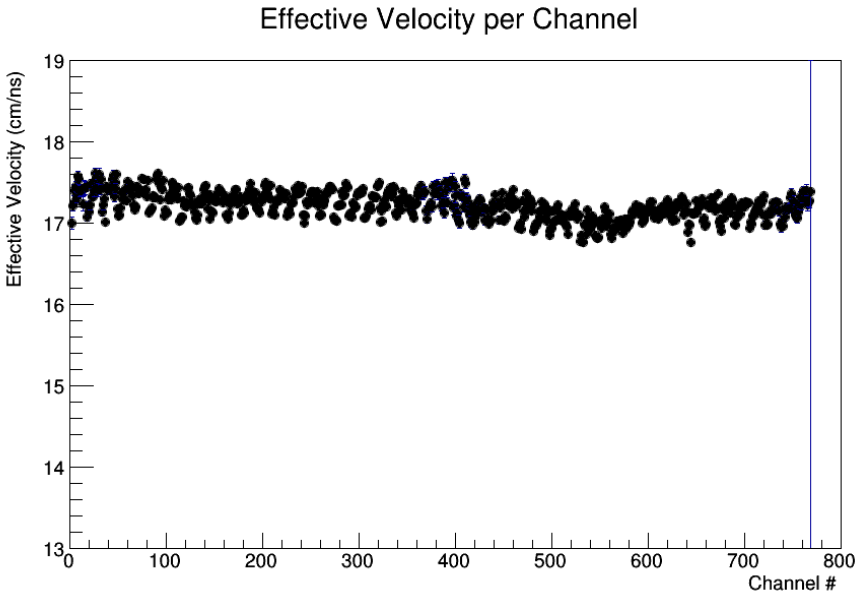

Figure 11: Effective velocity for Runs 3218, 3220, 3221 with 30cm cut

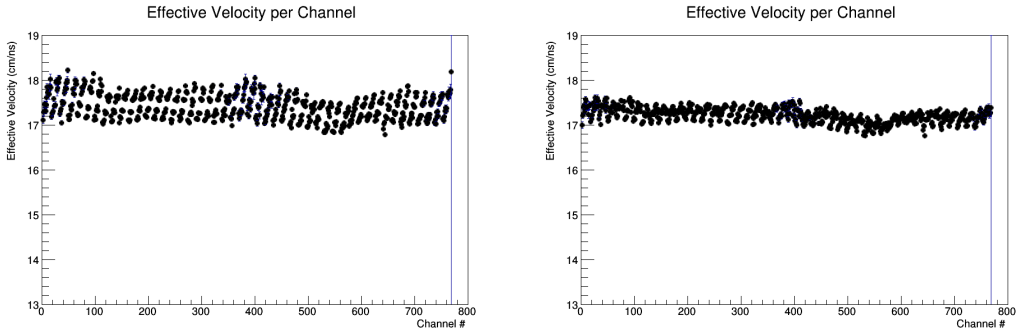

Figure 12: Effective velocity for cosmics 1) without cuts (left) and 2) with 30cm cut (right)

Effective Velocity - Run 3138 ($B = 0$) - 20cm cut

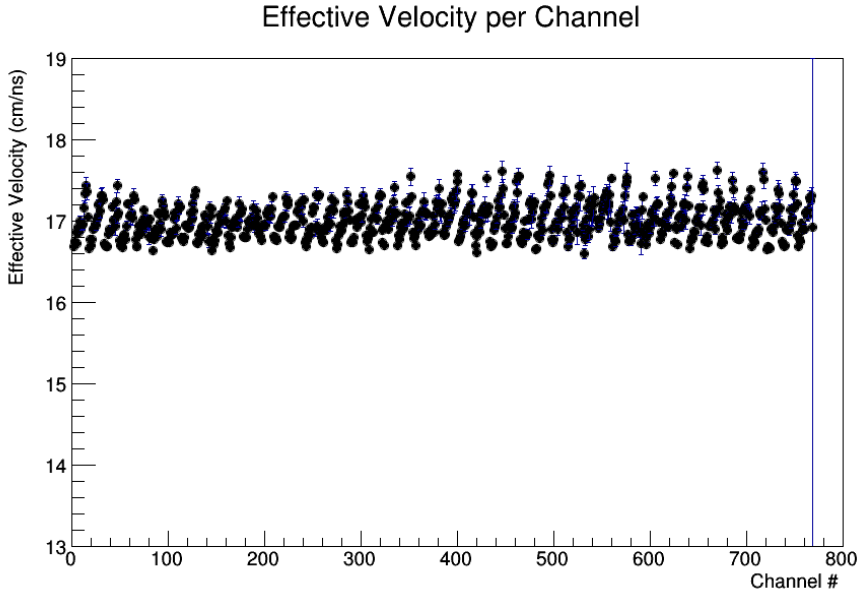

Figure 13: Effective velocity for Run 3138 with 20cm cut

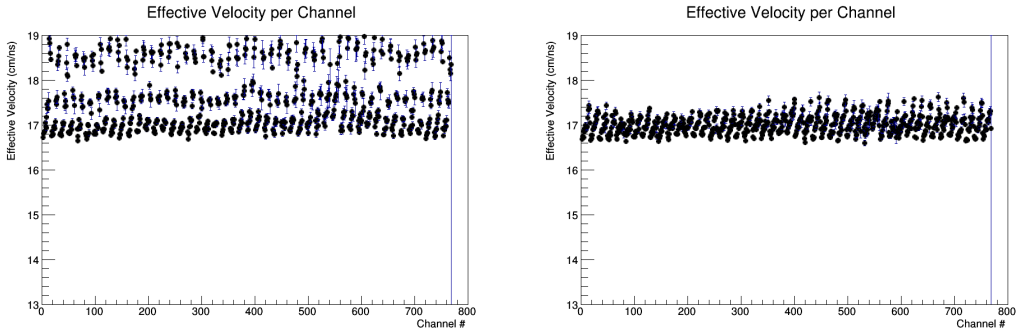

Figure 14: Effective velocity for Run 3138 1) without cuts (left) and 2) with 20cm cut (right)

Effective Velocity - Cosmics - 20cm cut

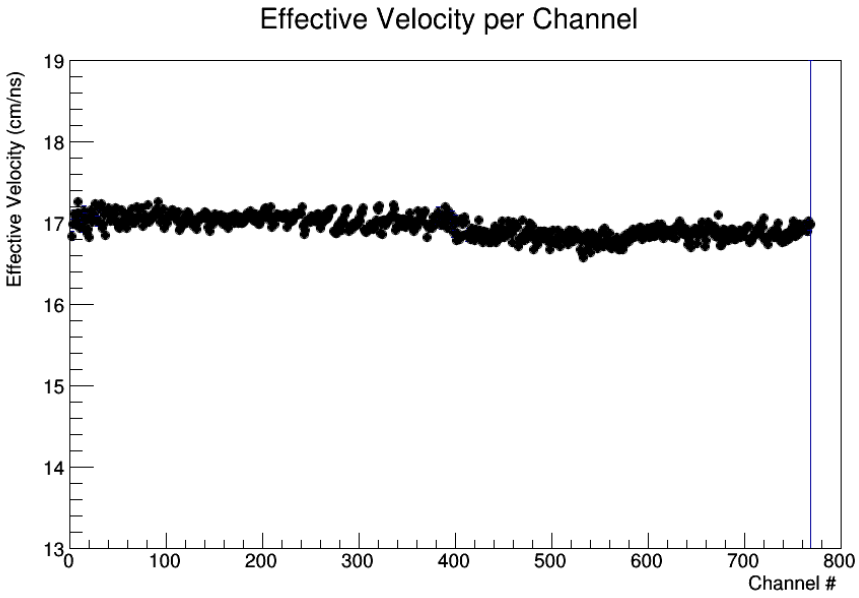

Figure 15: Effective velocity for Runs 3218, 3220, 3221 with 20cm cut

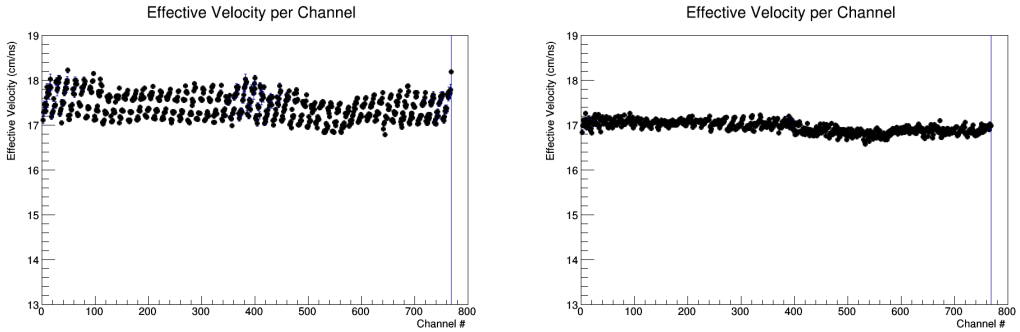

Figure 16: Effective velocity for cosmics 1) without cuts (left) and 2) with 20cm cut (right)

Effective velocity - Cuts

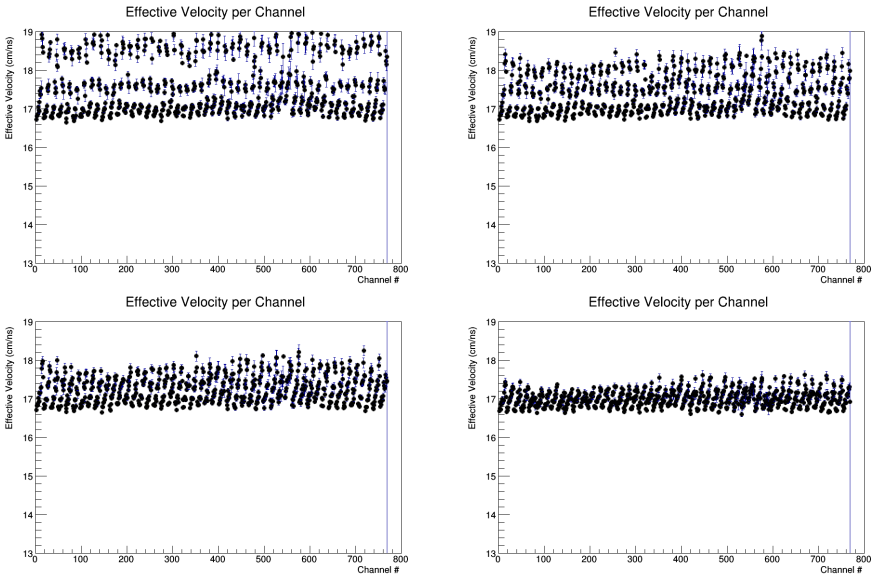

Figure 17: Run 3138: Top left: No cut, Top right: 40cm cut, Bottom left: 30cm cut, Bottom right: 20cm cut

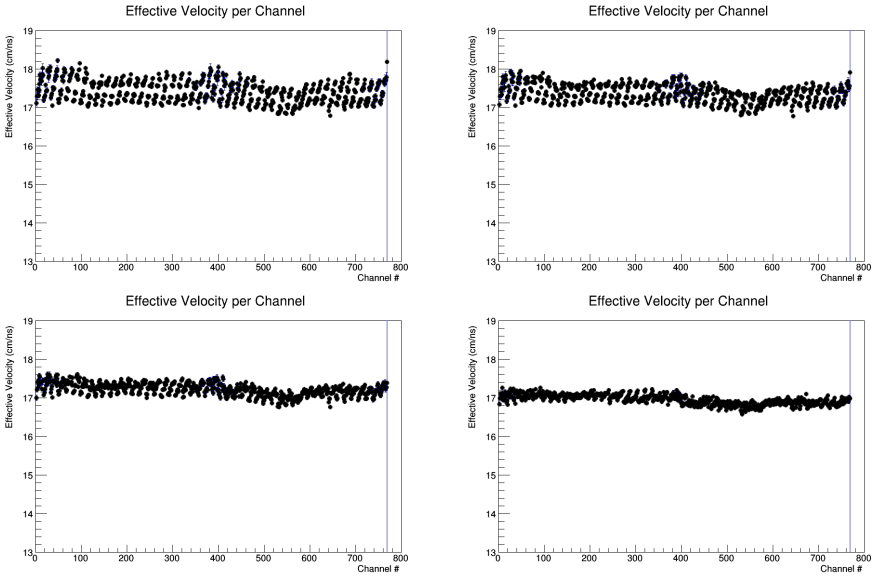

Figure 18: Cosmics: Top left: No cut, Top right: 40cm cut, Bottom left: 30cm cut, Bottom right: 20cm cut

Time Offsets - Run 3138 ($B = 0$)

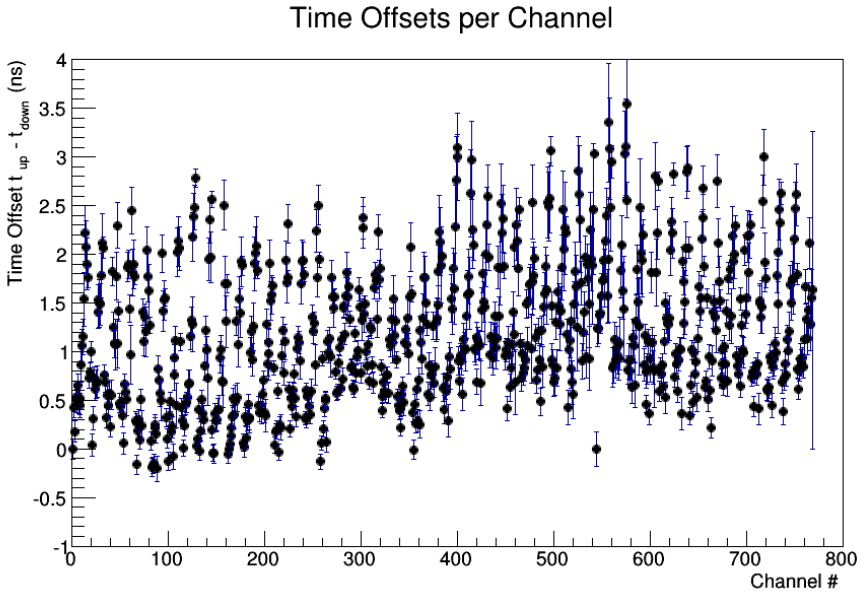

Figure 19: Time Offsets for Run 3138

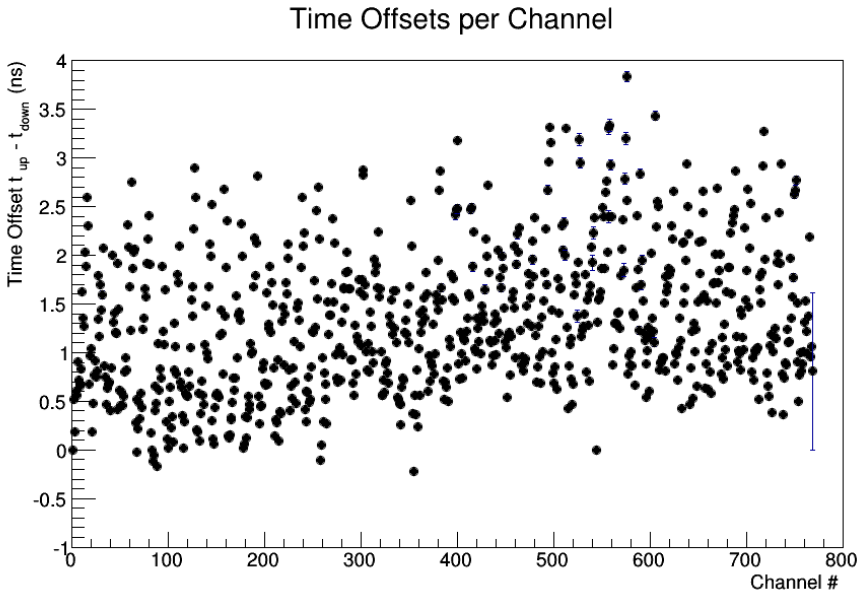

Figure 20: Time Offsets for Run 3138 (TGraphErrors)

Time Offsets - Cosmics

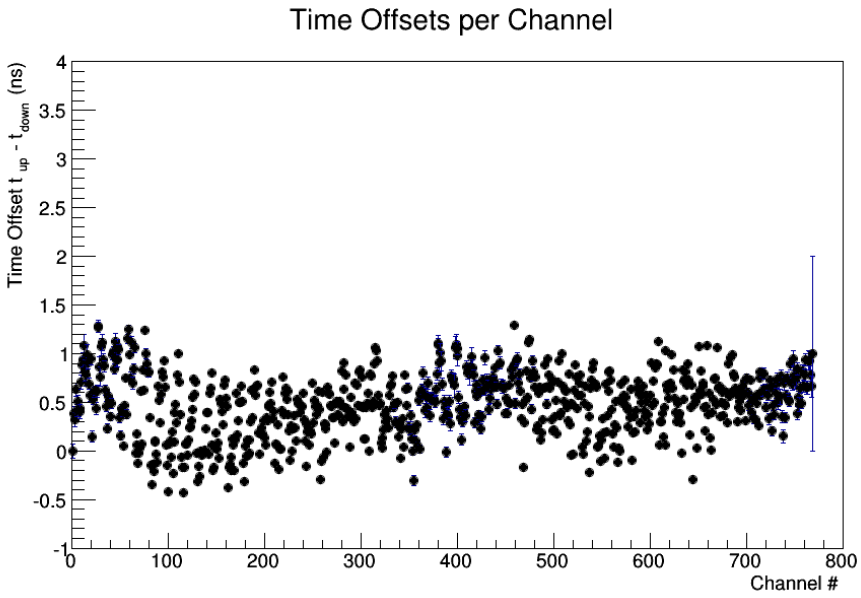

Figure 21: Time Offsets for Runs 3218, 3220, 3221

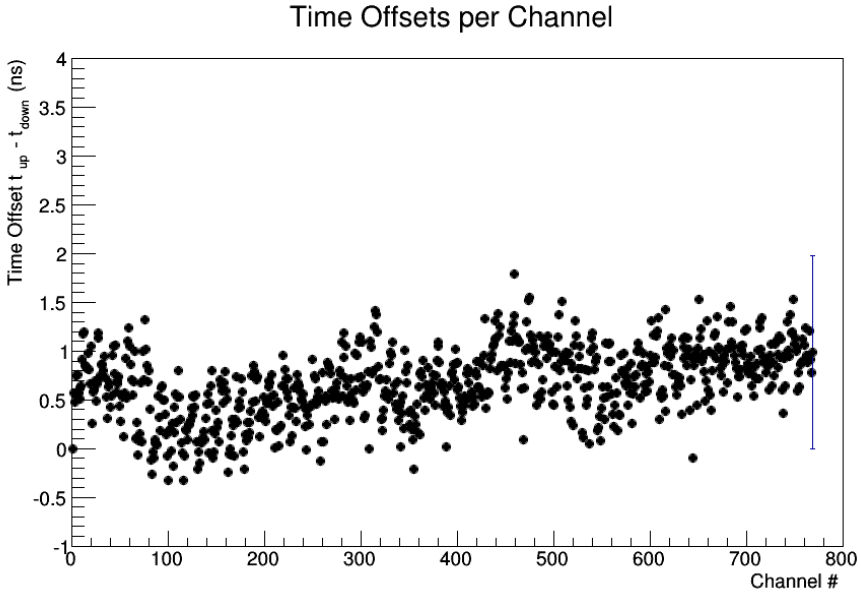

Figure 22: Time Offsets for Runs 3218, 3220, 3221 (TGraphErrors)

Time Offsets - Run 3138 ($B = 0$) - 40cm cut

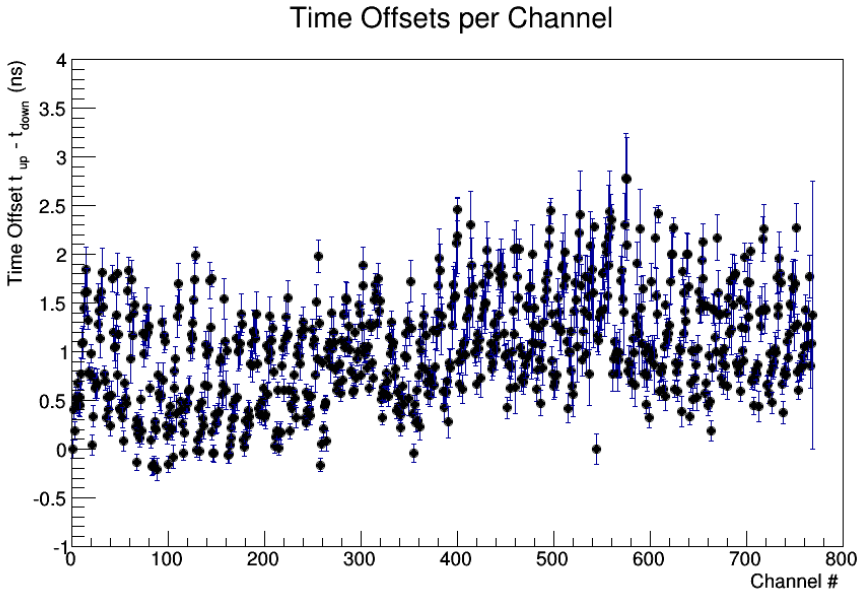

Figure 23: Time Offsets for Run 3138 with 40cm cut

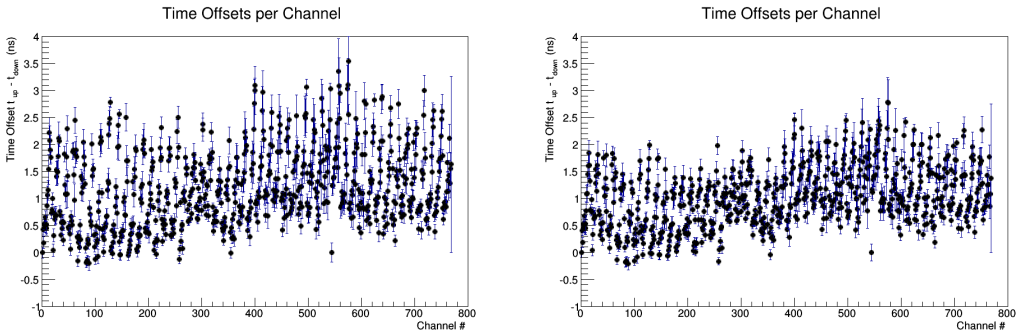

Figure 24: Time Offsets for Run 3138 1) without cuts (left) and 2) with 40cm cut (right)

Time Offsets - Cosmics - 40cm cut

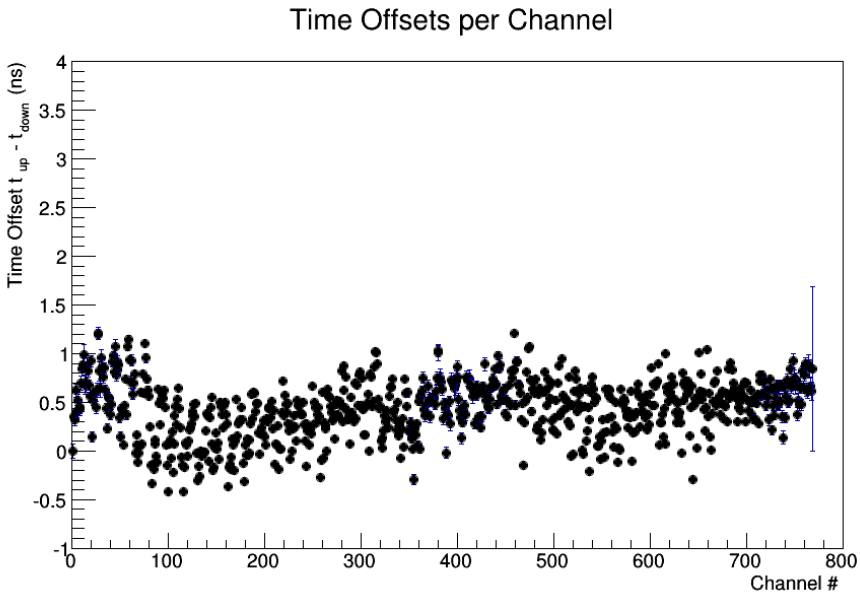

Figure 25: Time Offsets for Runs 3218, 3220, 3221 with 40cm cut

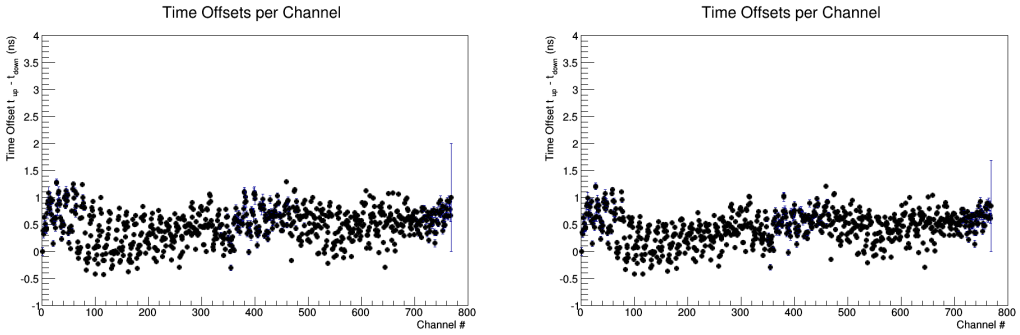

Figure 26: Time Offsets for cosmics 1) without cuts (left) and 2) with 40cm cut (right)

Time Offsets - Run 3138 ($B = 0$) - 30cm cut

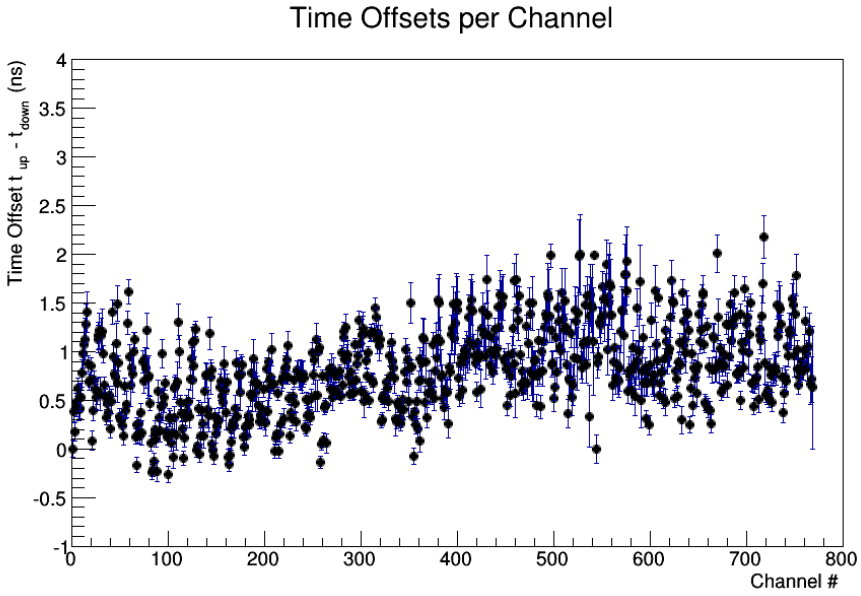

Figure 27: Time Offsets for Run 3138 with 30cm cut

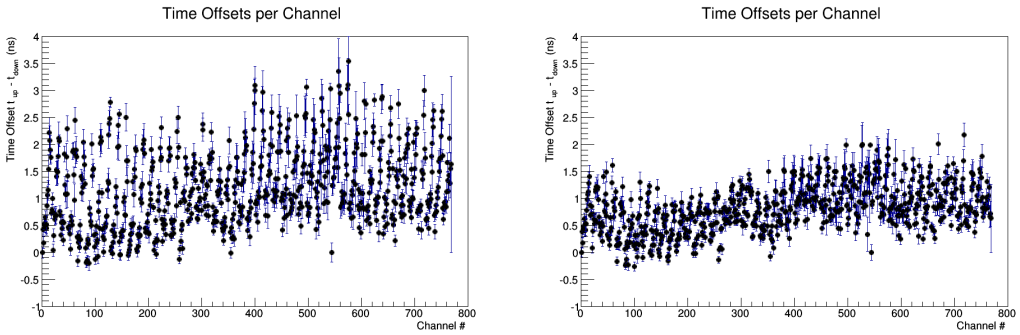

Figure 28: Time Offsets for Run 3138 1) without cuts (left) and 2) with 30cm cut (right)

Time Offsets - Cosmics - 30cm cut

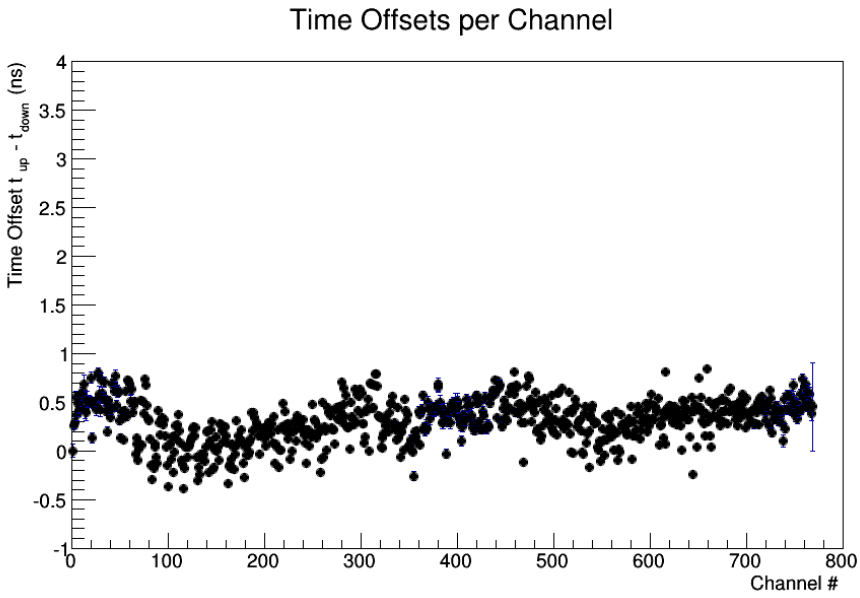

Figure 29: Time Offsets for Runs 3218, 3220, 3221 with 30cm cut

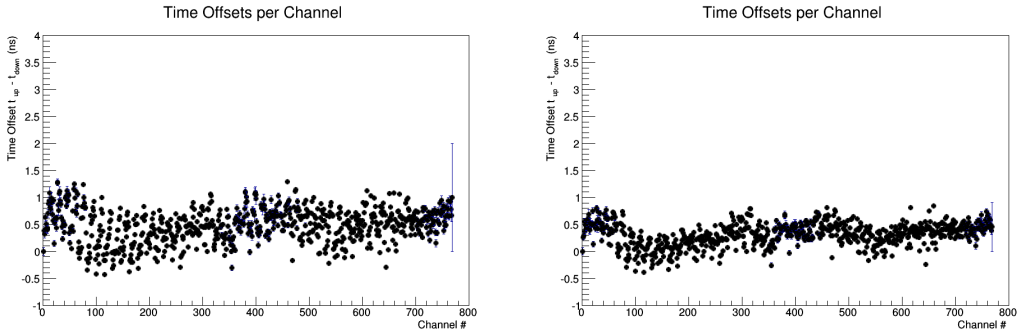

Figure 30: Time Offsets for cosmics 1) without cuts (left) and 2) with 30cm cut (right)

Time Offsets - Run 3138 ($B = 0$) - 20cm cut

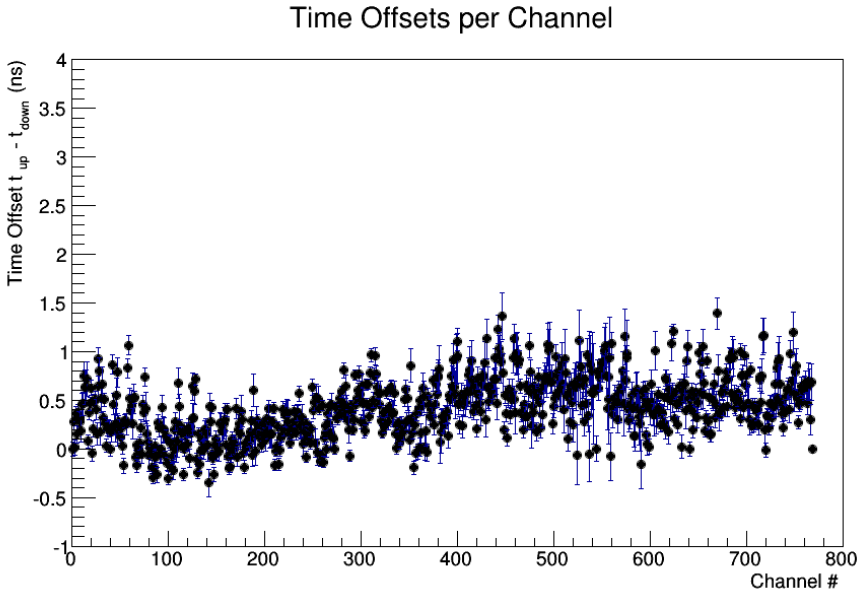

Figure 31: Time Offsets for Run 3138 with 20cm cut

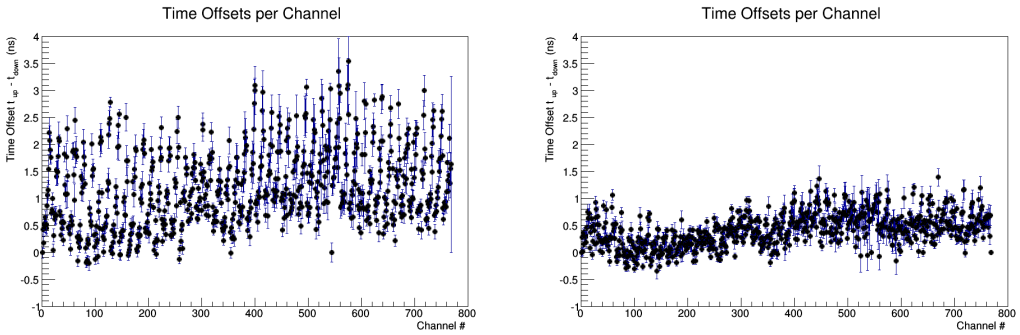

Figure 32: Time Offsets for Run 3138 1) without cuts (left) and 2) with 20cm cut (right)

Time Offsets - Cosmics - 20cm cut

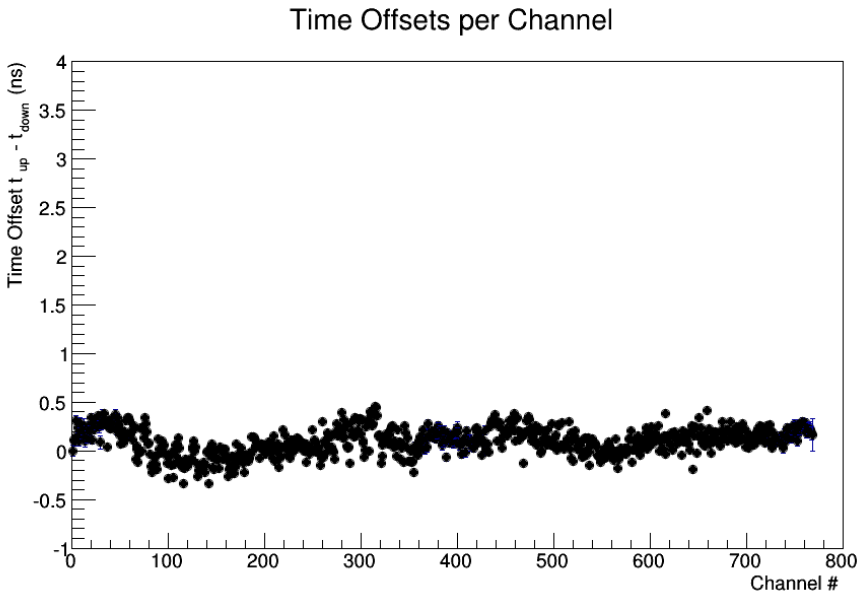

Figure 33: Time Offsets for Runs 3218, 3220, 3221 with 20cm cut

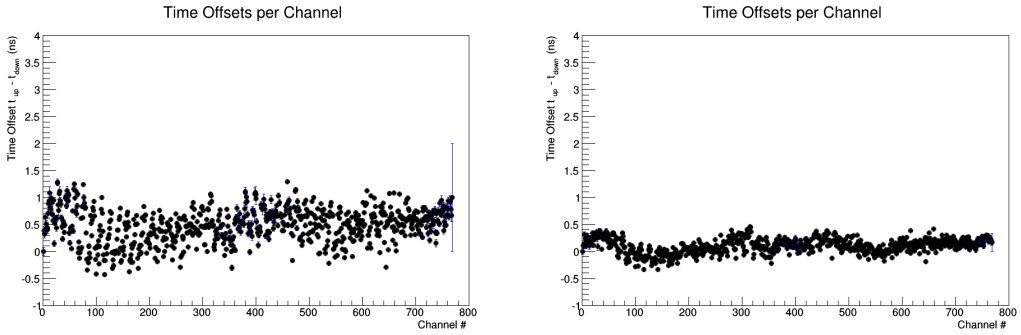

Figure 34: Time Offsets for cosmics 1) without cuts (left) and 2) with 20cm cut (right)

Time Offsets - Cuts

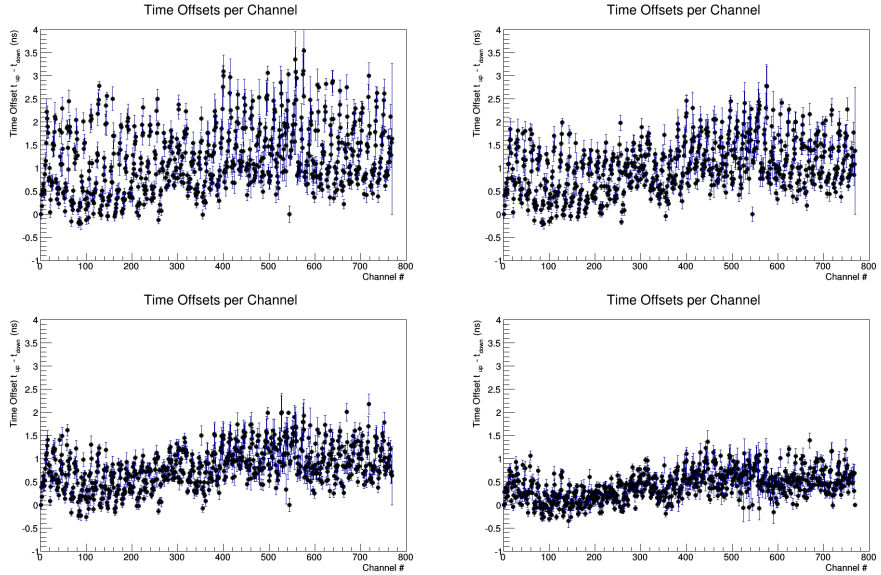

Figure 35: Run 3138: Top left: No cut, Top right: 40cm cut, Bottom left: 30cm cut, Bottom right: 20cm cut

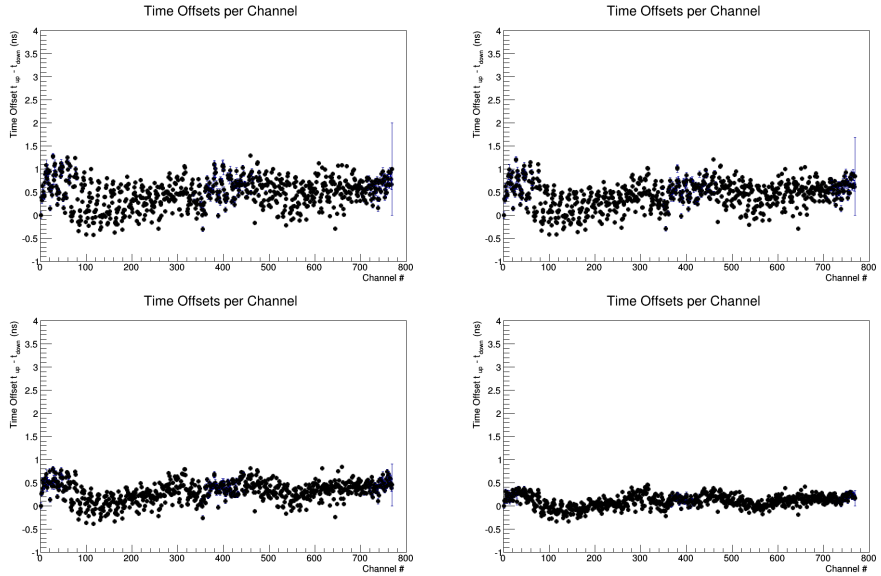

Figure 36: Cosmics: Top left: No cut, Top right: 40cm cut, Bottom left: 30cm cut, Bottom right: 20cm cut

Percentage of thrown points

Run	Cut (cm)	Layer	Percentage of thrown points (%)
3138	40	1	0.8
		2	1.4
		3	4.0
		4	10.0
	30	1	1.6
		2	3.8
		3	11.6
		4	22.1
	20	1	9.8
		2	12.7
		3	25.5
		4	38.1
Cosmics	40	1	0.6
		2	0.3
		3	0.8
		4	4.1
	30	1	3.2
		2	2.7
		3	6.5
		4	13.9
	20	1	15.3
		2	18.2
		3	25.5
		4	29.4