

Deconvoluting Bo Data

Preparing for ArgoNeut Data

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March 3, 2009

Outline

- New Bo cosmic ray data
- Un-processed signals
- Deconvolution
 - Remove electronics shaping
 - Consider channels that have narrow Gaussian filter (ala ArgoNeut)
 - Incorporating Carl's deconvolution scheme
 - Not done yet...

New Bo Data

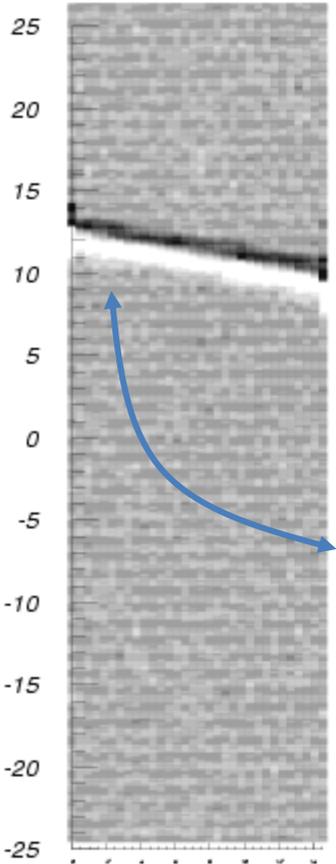
- LARTPC Doc#2

Comment Tag	Run Number	General			Voltages			Data Collection		Counter Info (Position as Labeled around Bo—see figure; Depth from top of main flange to top of counter.)				Bo Health
		Events Logged	Times		Bias Voltages		Cathode (kV)	Trigger Delay (usec)	Sample Rate (MHz)	Counter 1		Counter 2		
			Start Time	Stop Time	Plane A (V)	Plane C (V)				Position	Depth	Position	Depth	
Config 4	260	74	2/12/09 18:14	2/13/09 7:35	-300	400	-25	354	5	N	16.75	E	22.5	2.5
Config 4	262	60	2/13/09 9:06	2/13/09 15:17	-360	480	-25	354	5	K	16.75	C	22.5	2.5
Config 4	265	63	2/13/09 18:16	2/14/09 13:15	-360	480	-25	472	5	K	26.75	C	32.5	4.8
Config 4	267	101	2/17/09 11:32	2/18/09 7:28	-360	480	-25	354	5	N	16.75	E	22.5	4
Config 4	268	45	2/18/09 8:04	2/18/09 15:23	-360	480	-25	472	5	N	26.75	E	32.5	4
Config 4	270	90	2/18/09 16:53	2/19/09 10:20	-360	480	-25	354	5	N	8.75	E	14.5	7

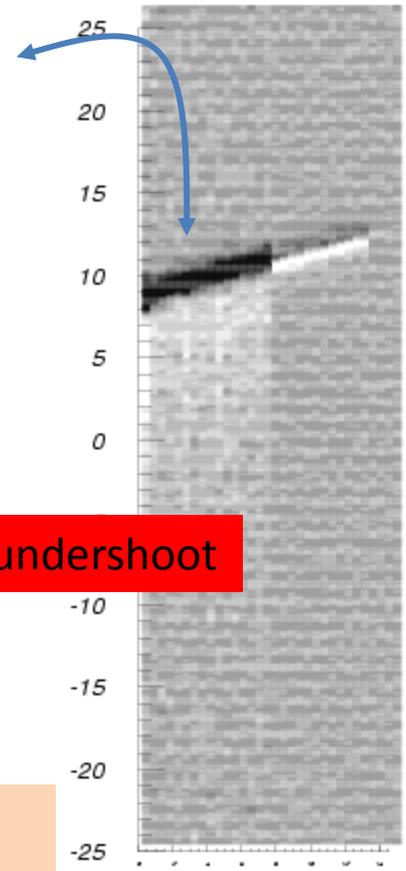
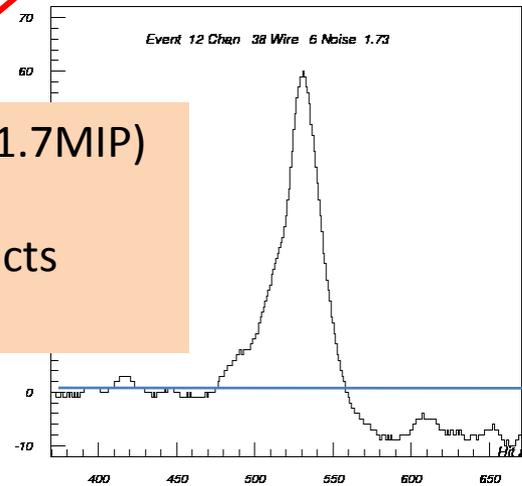
- Run 270 – Tracks perp to 2nd induction plane
– ~12 cm drift

Run 270 Event 12

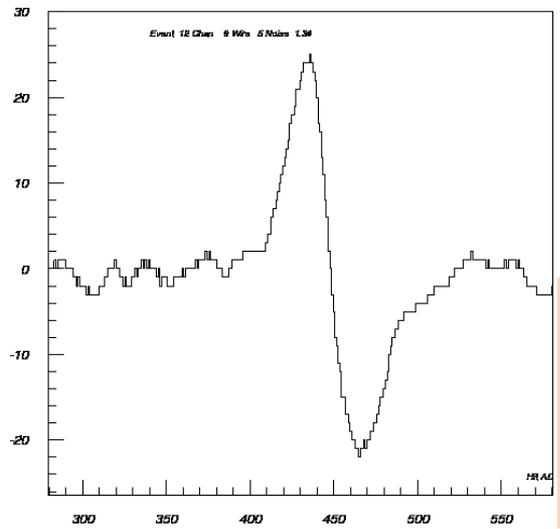
Note: Normal Peak ~ 35 cts



+Peak 60 cts (1.7MIP)
FWHM 24
Noise rms 1.7 cts
"S/N" ~ 35



$\sim 12\%$ max undershoot

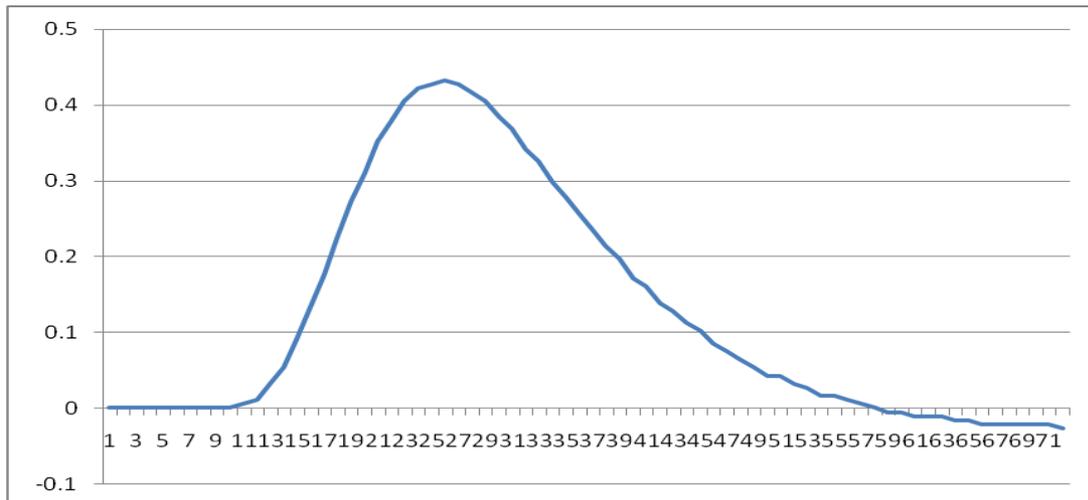


+Peak 25 cts
FWHM 23
Noise rms 1.3 cts
"S/N" ~ 19

Electronics Response

- Bench measurement of the step function response of the narrow Gaussian unipolar filter by Dan Edmunds (MSU)

http://www.pa.msu.edu/~edmunds/LArTPC/T962/Preamp_Filter_Card/Testing/

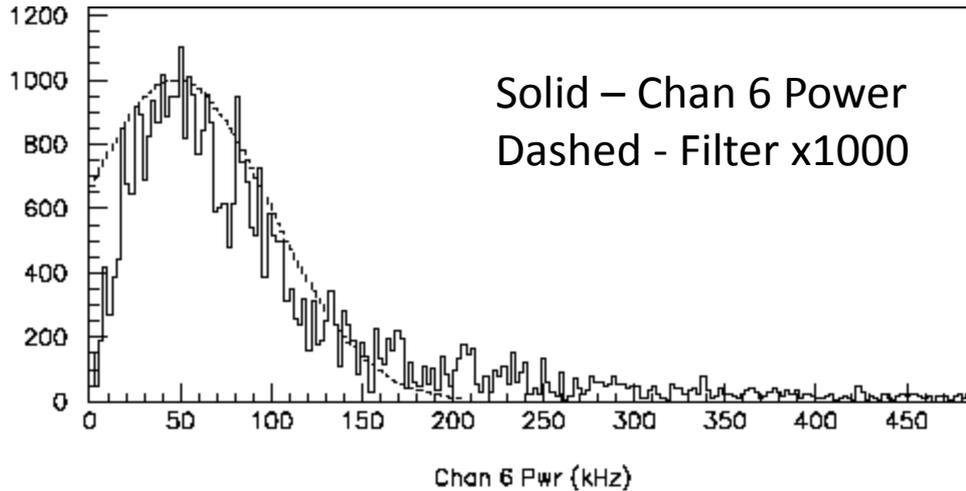


~6% max undershoot
72 μ s RC

Deconvolution Scheme Change

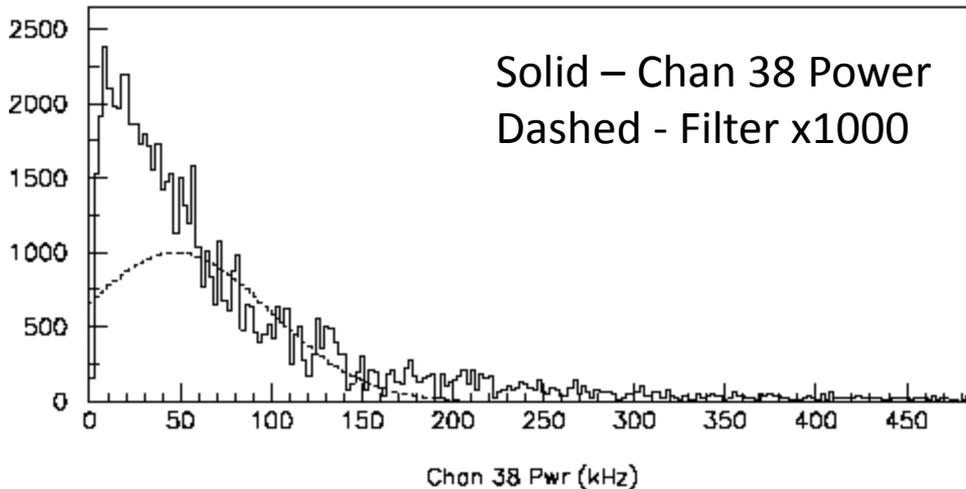
- Old scheme – needed for long waveforms
 - Kernel = $\mathcal{F}(\text{Preamp}) * \mathcal{F}(\text{Shaper } \delta \text{ function})$
 - Preamp RC = 200 μs 
 - Smooth Dan's step function response measurement $\rightarrow \delta$ function
- New scheme – OK for short waveforms
 - Kernel = $\mathcal{F}(\text{Shaper step function})$
 - No smoothing done to step function response
 - Model undershoot RC = 52 $\mu\text{s} = \frac{1}{200} + \frac{1}{72}$

Filter

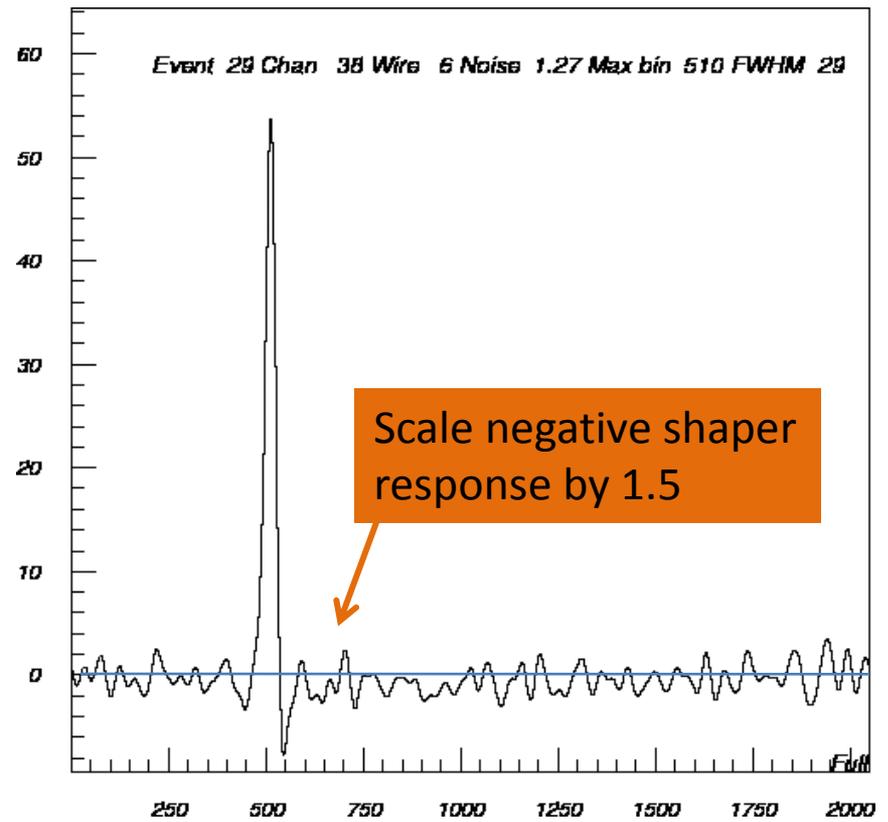
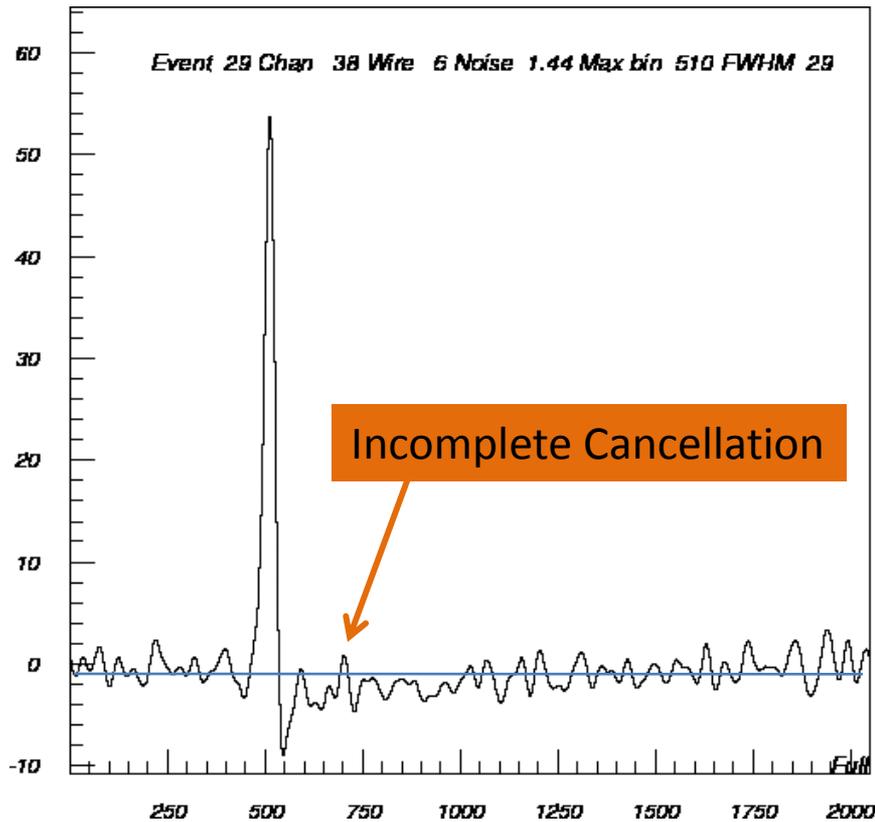


Conservative filter parameters
→ Remove high frequency noise

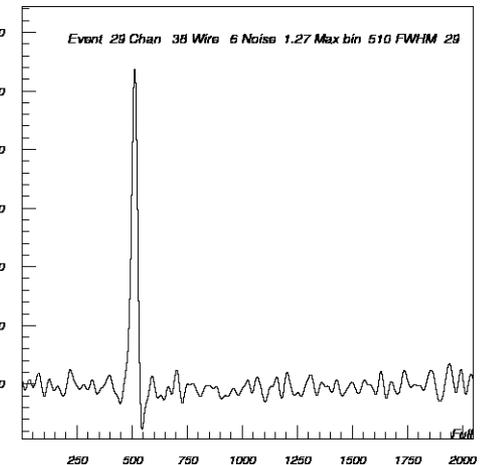
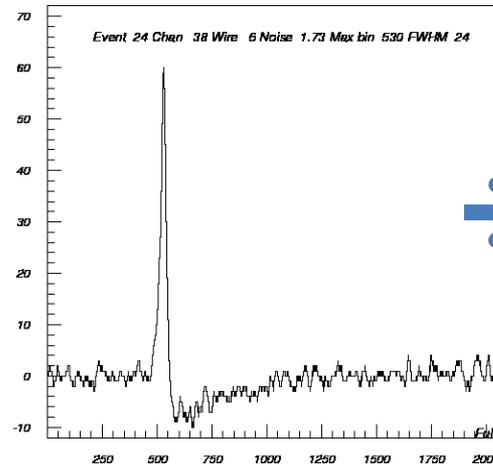
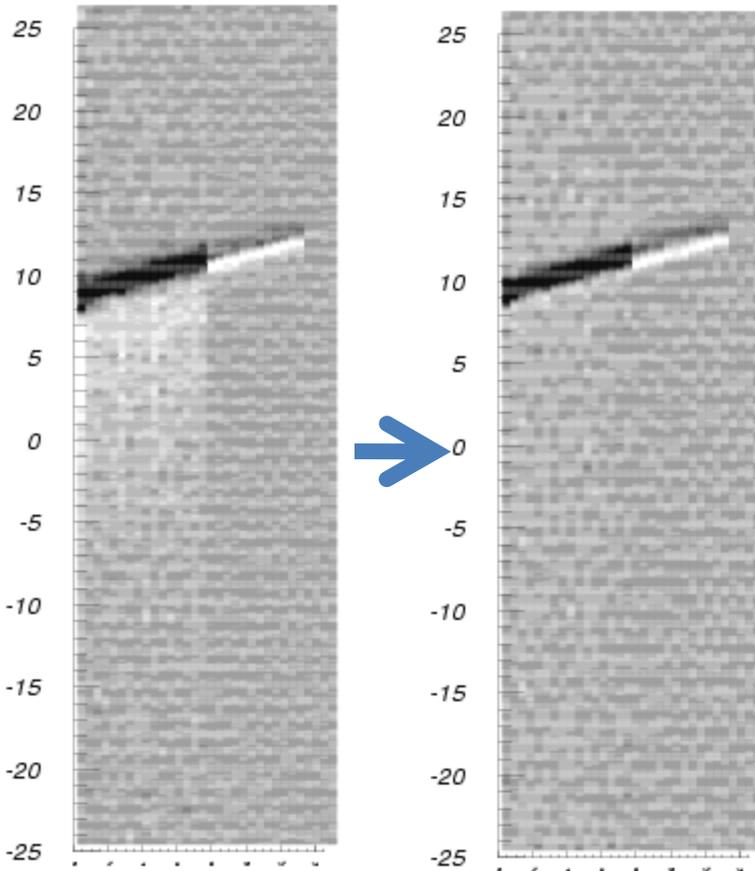
Center = 50 kHz
Width = 70 kHz



Collection Plane Deconvoluted



Collection Plane Deconvoluted



+Peak 60 cts
FWHM 24
Noise rms 1.7 cts
"S/N" ~ 35

+Peak 55 cts
FWHM 29
Noise rms 1.3 cts
"S/N" ~ 42

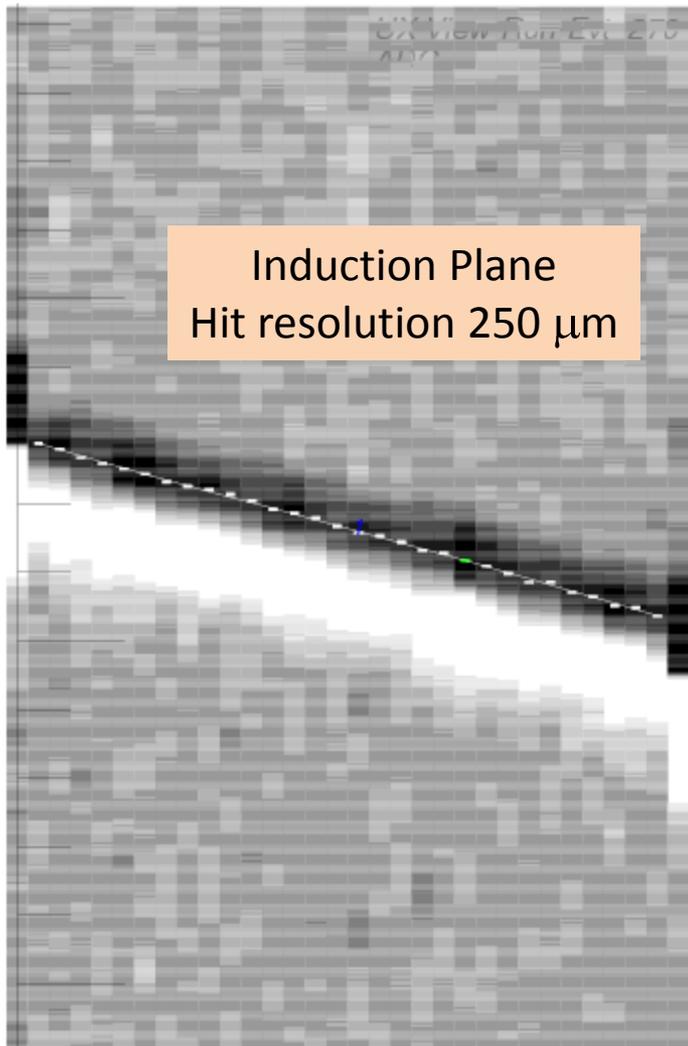
Shape Fit Hit Resolution No Deconvolution

15

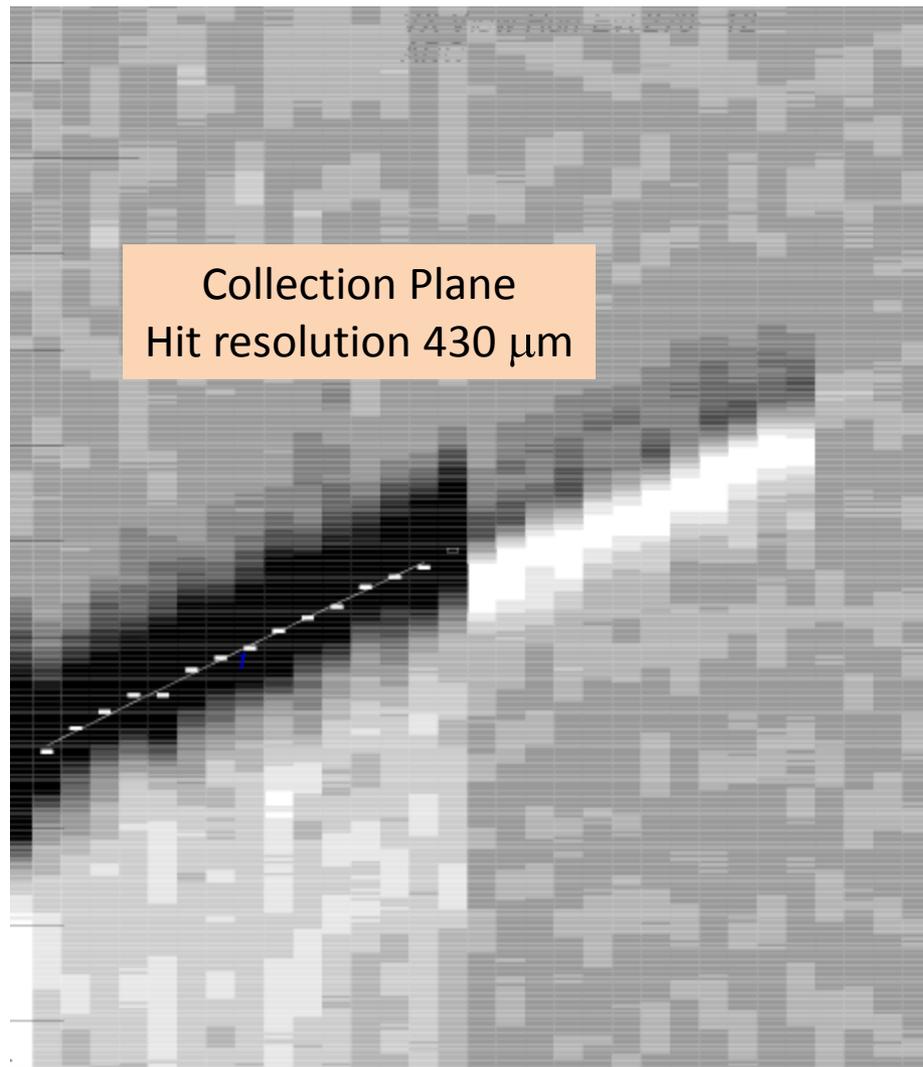
Induction Plane
Hit resolution 250 μm

10

5



Collection Plane
Hit resolution 430 μm

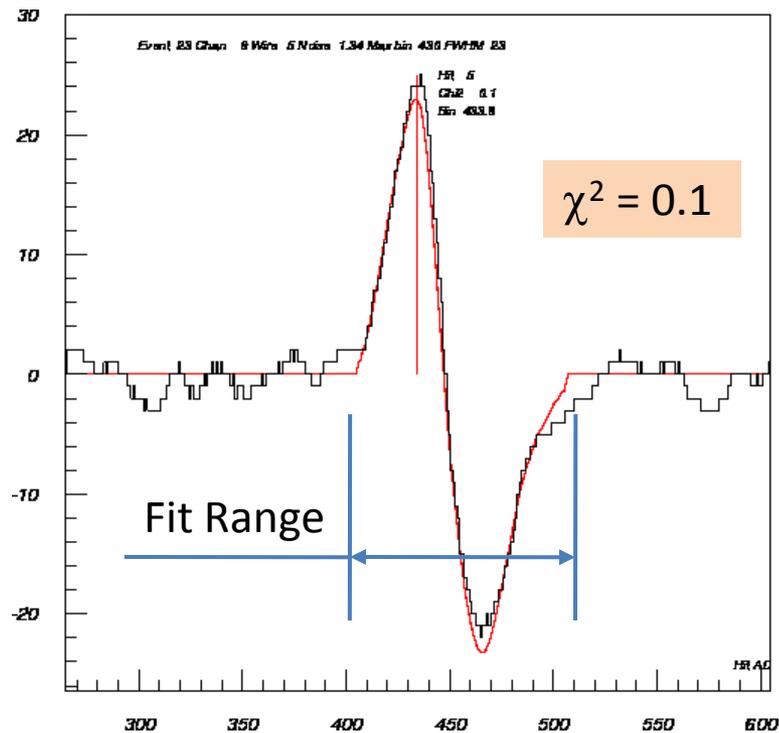


Shape Fits

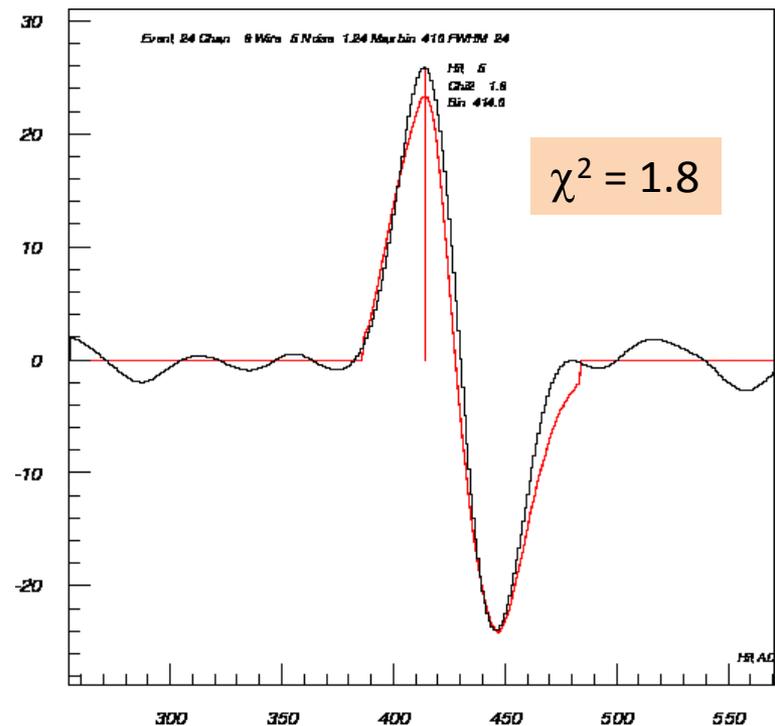
Induction Plane – Ch 6 (1 MIP)

Note: Fit weight = $1 / (\text{noise rms})^2$

No Deconvolution



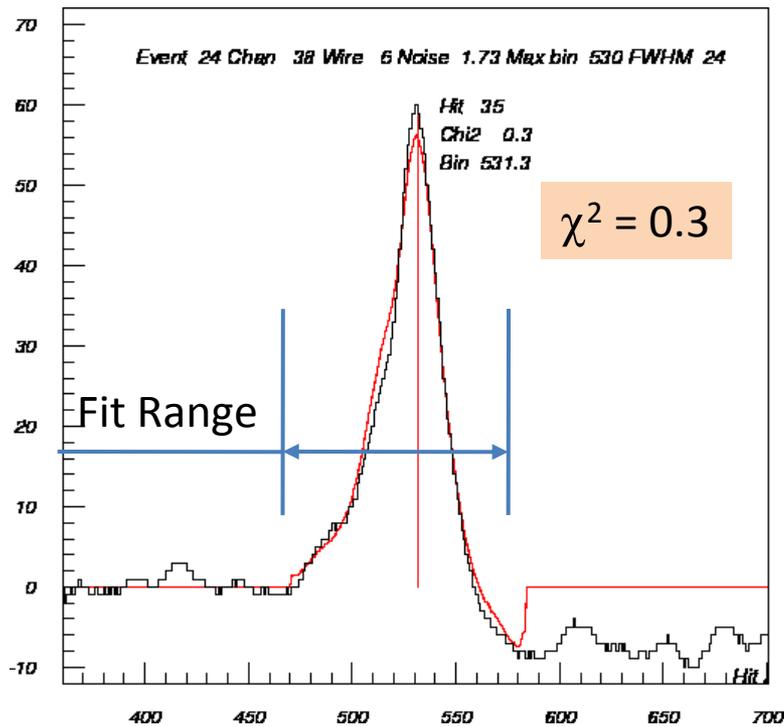
Convolved



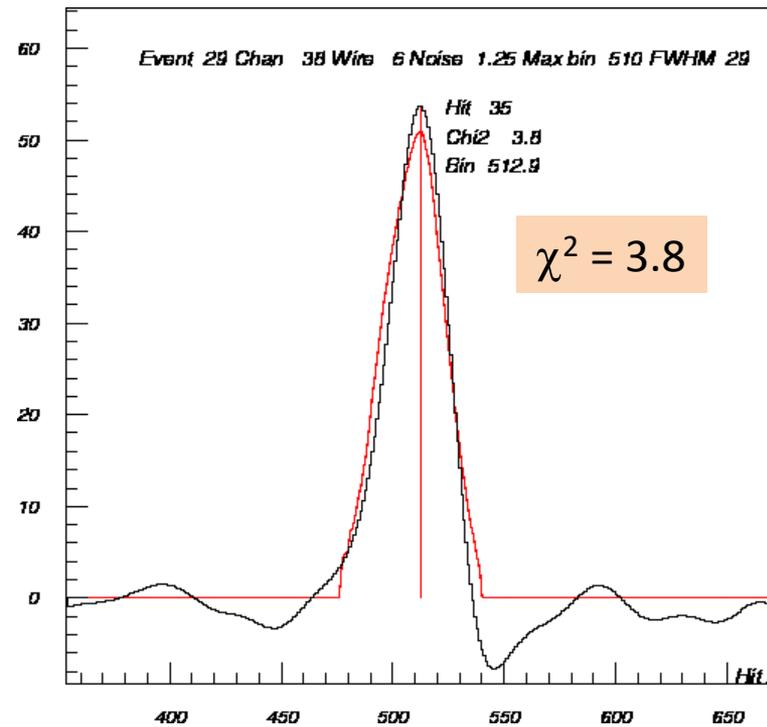
Shape Fits

Collection Plane – Ch 38 (1.9 MIP)

No Deconvolution



Convolved



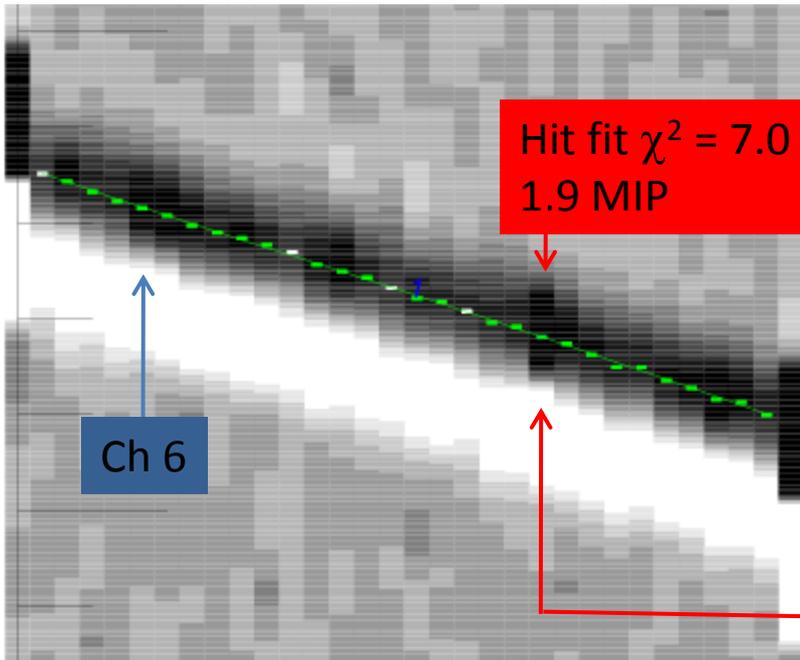
Hit Resolution Deconvolution

Hit Coding: Color ~ MIP's

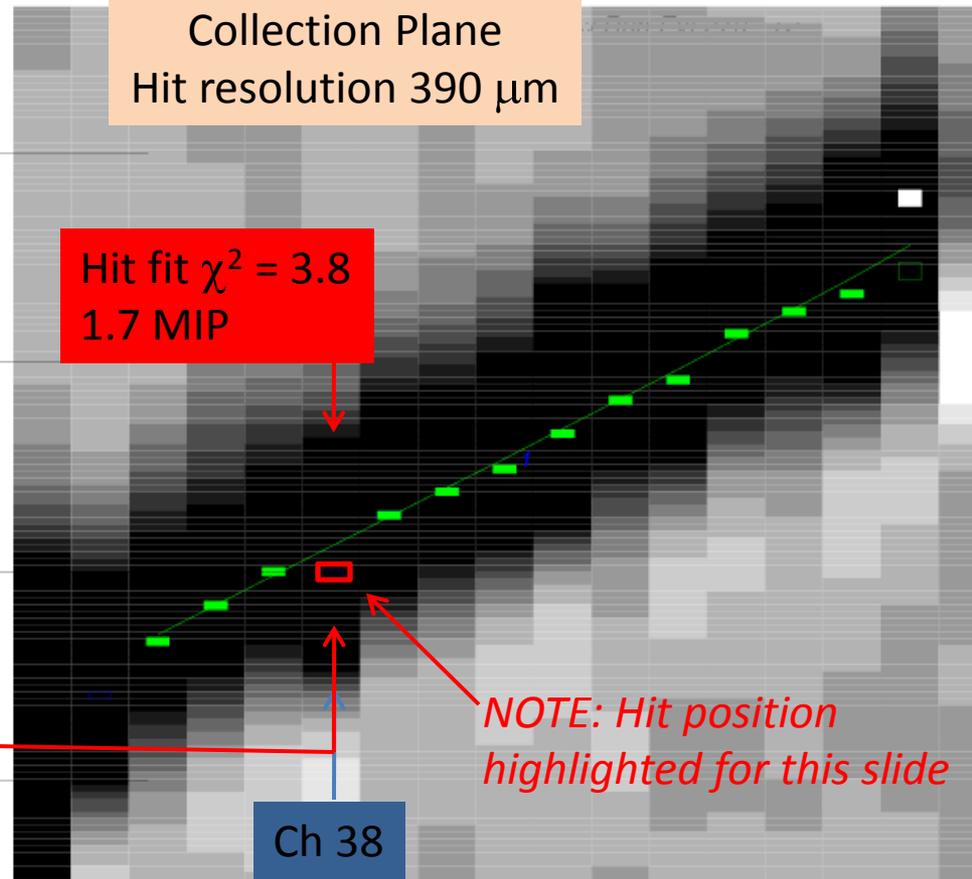
Solid box → included in the track fit

Open box → hit not fit to any track

Induction Plane
Hit resolution 230 μm

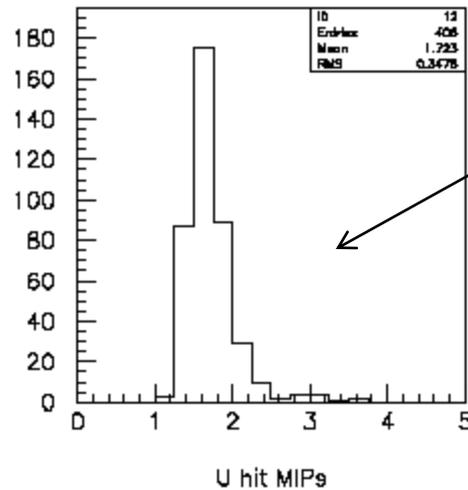
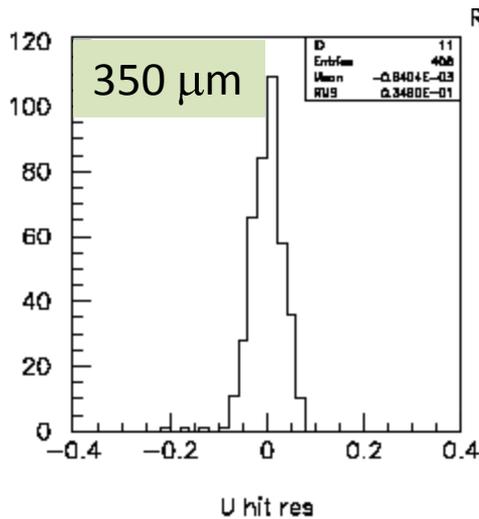


Collection Plane
Hit resolution 390 μm

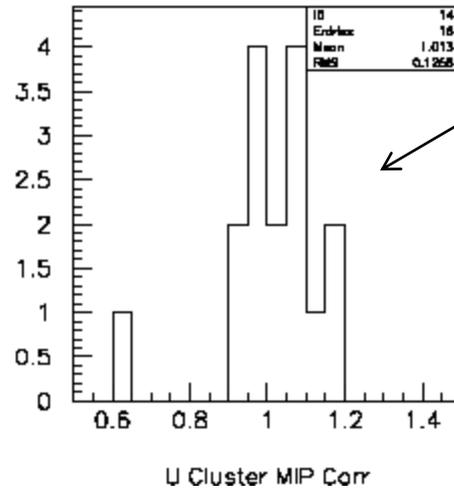
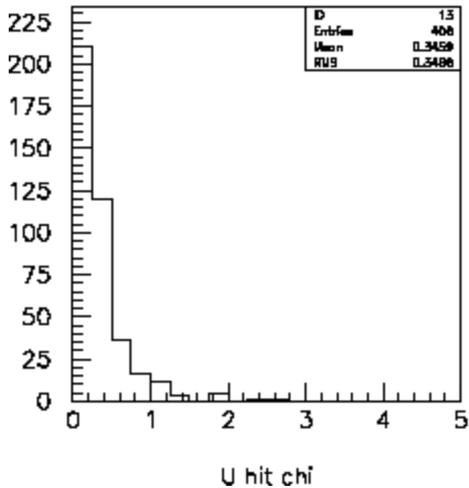


Run 270 Histograms - 18 Events

Induction Plane



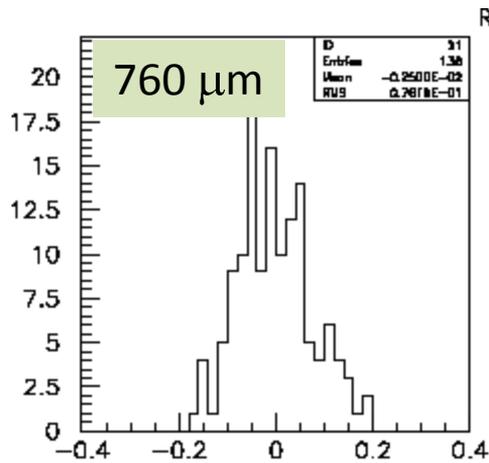
Uncorrected MIP equivalents found from the shape fit.



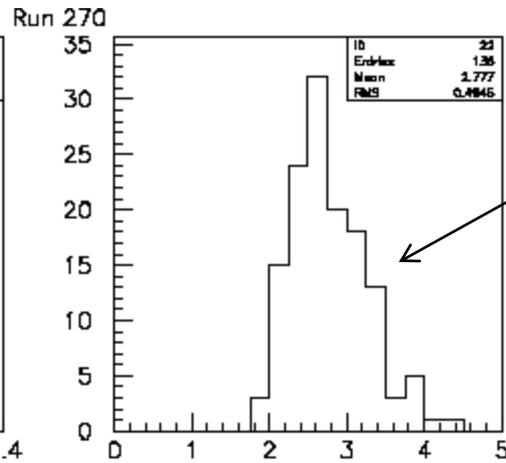
Corrected MIPs = Ave MIP/hit * 3D Path length correction

Run 270 Histograms - 18 Events

Collection Plane

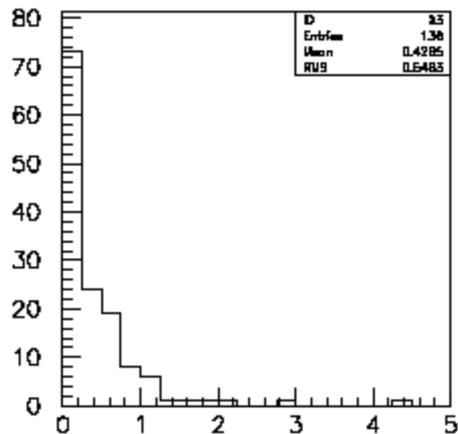


V hit res

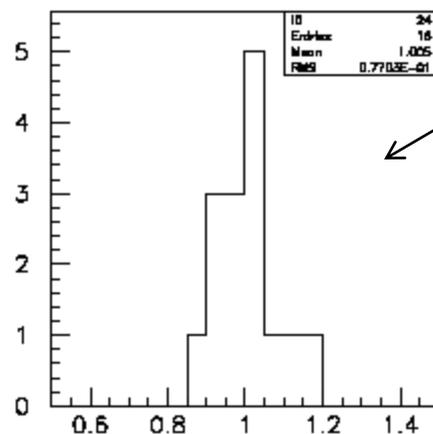


V hit MIPs

Uncorrected MIP equivalents found from the shape fit.



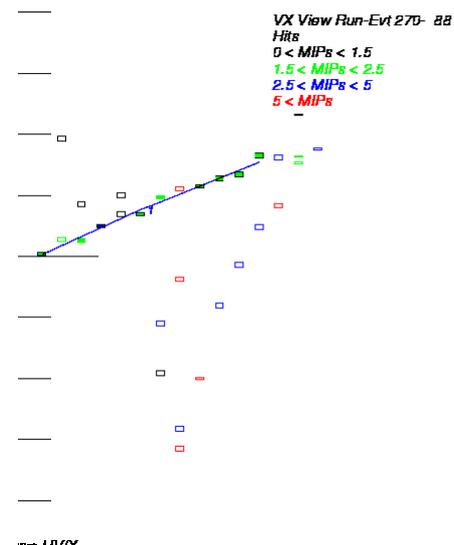
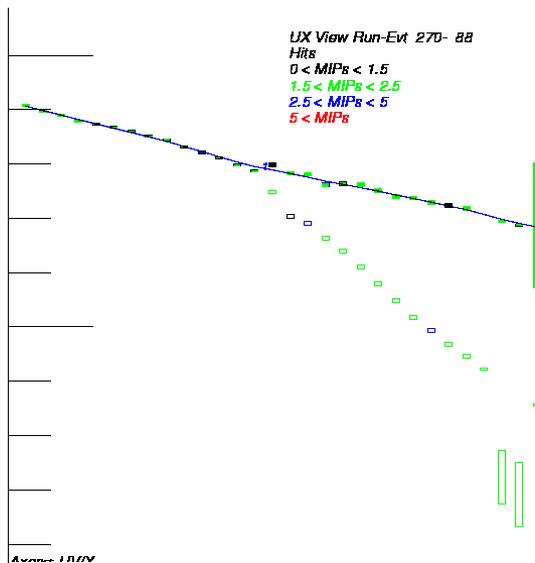
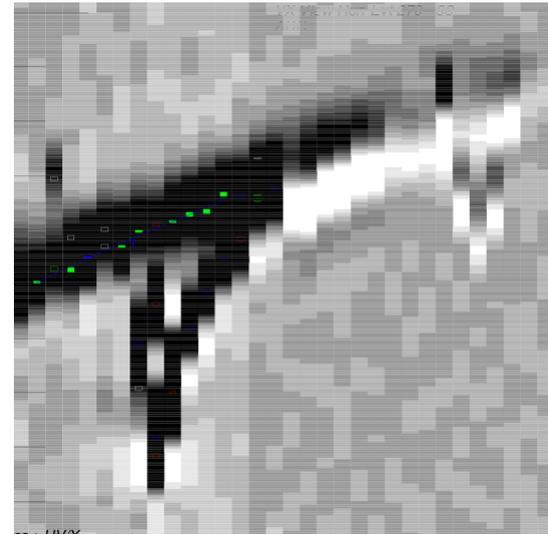
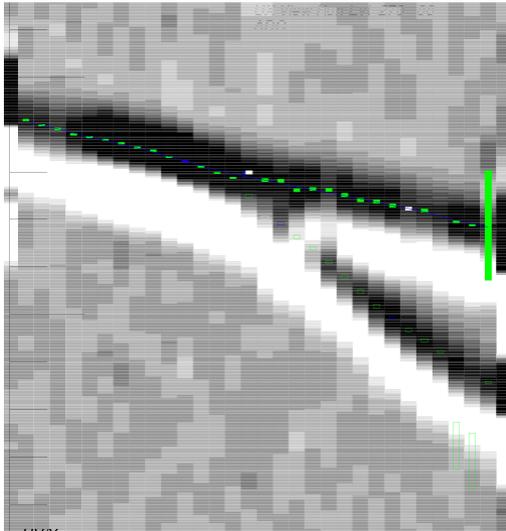
V hit chi



V Cluster MIP Corr

Corrected MIPs = Ave MIP/hit * 3D Path length correction

Run 270 Event 88



Summary

- Demonstrate collection plane tail removal w simple deconvolution scheme
 - Shaper undershoot is ~50% higher in data than Dan's bench measurement
- Slight improvement (?) in hit resolution with simple deconvolution
- Hit reconstruction code is adequate for first ArgoNeut data