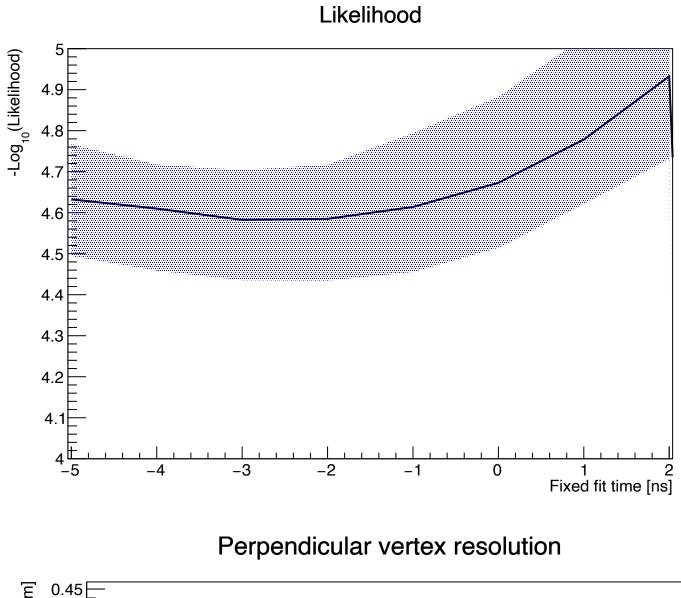
Vertex fit Elongation study

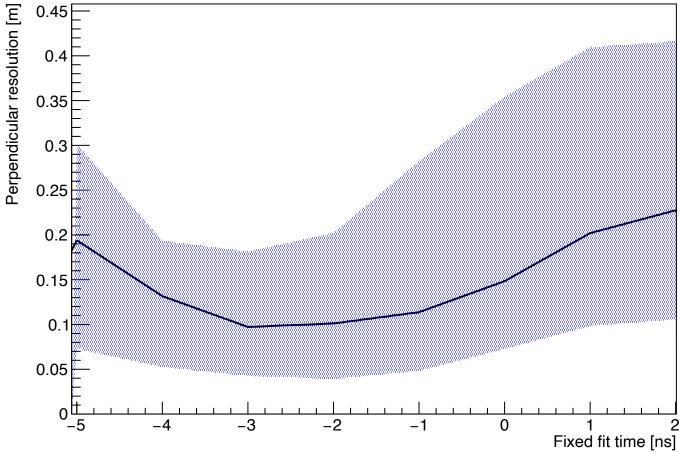
2020-11-13 - Thijs van Eeden



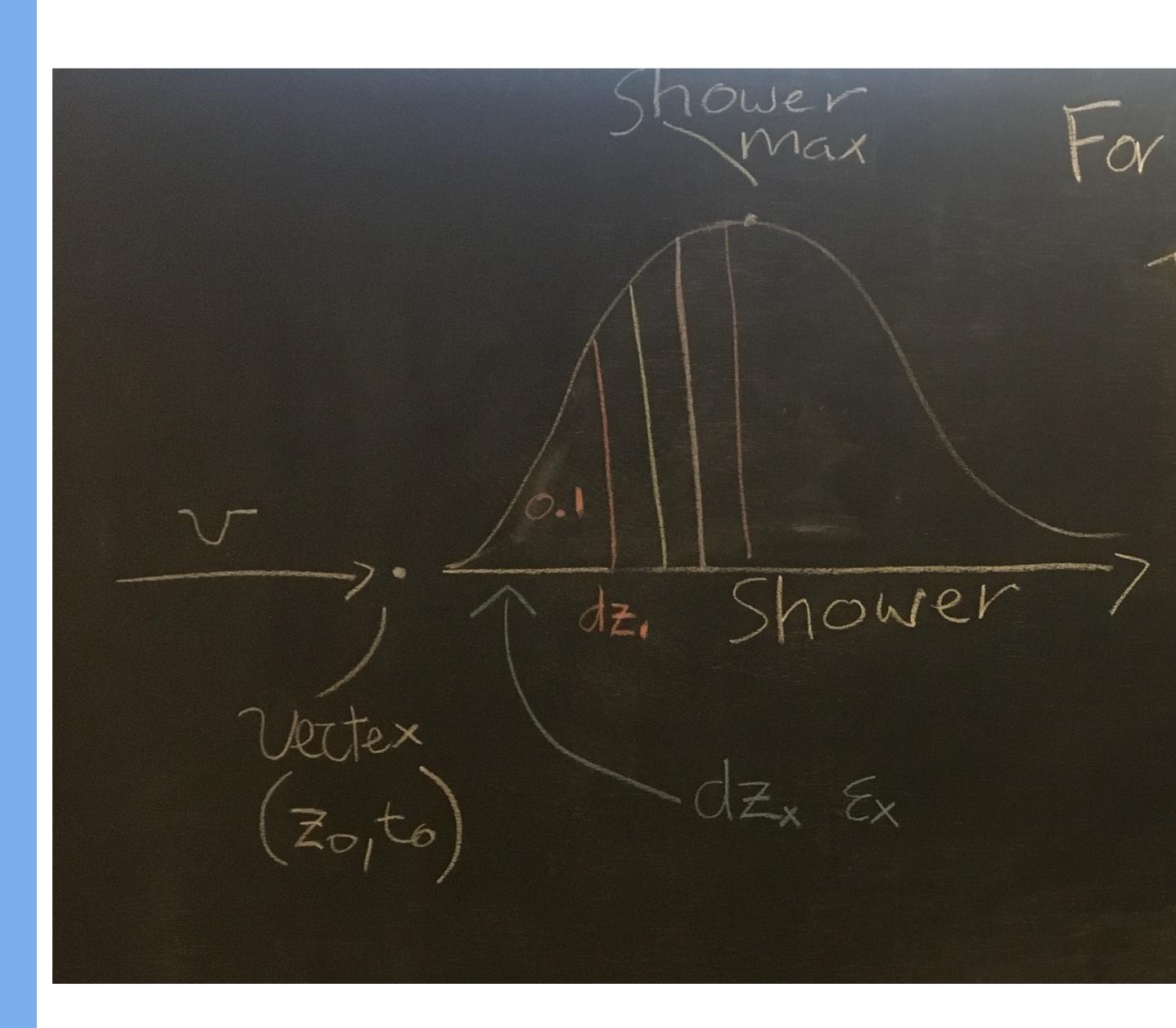
- 100 TeV shower events
- Every event is reconstructed with different starting times
- Vertex reconstructed using MC hits

Recap









For E=0.1, dz. = 3 m at loster Two additional Samples · dzx for Ex < 0.1 · Lowez E contabution at vectex (Zo, to)







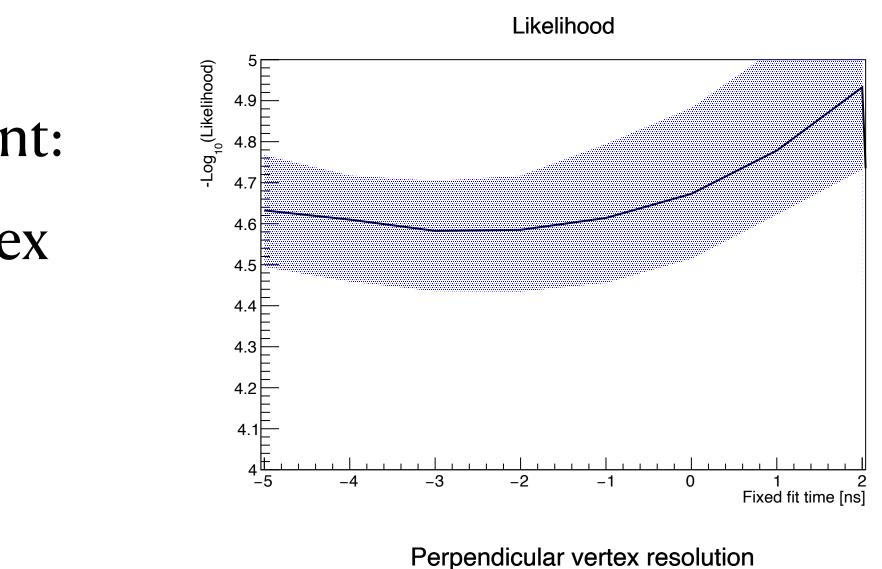
Elongation improvement

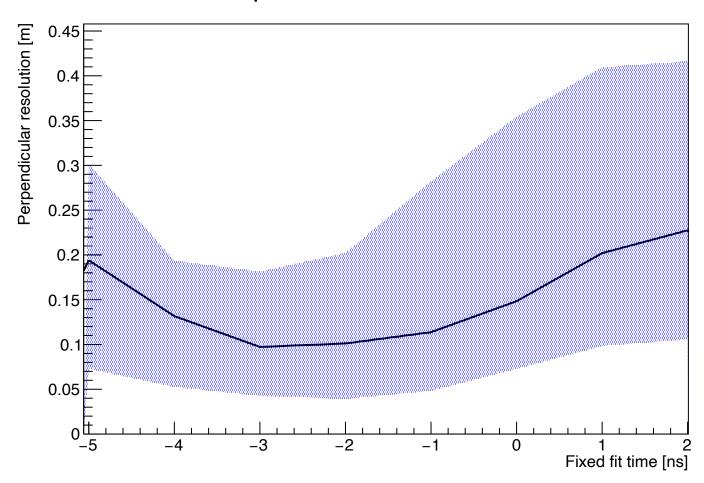
Reconstruct the same 100 events for different:

- Energy fractions of contribution at vertex
- **Sampling fractions** between vertex and 1st 10% sampling point

What happens to the

- Bias of the resolution
- The minimum -log(Lik)
- The time at which they are optimal







Perpendicular bias

No extra sampling (like before)

Optimal bias for Energy fraction — 0.01 (gives 7.5 cm)

At what fitted time is the bias Optimal?

Best perpendicular resolution for fit times [-5:3]

0.076 0.076 0.076 0.076 0.072 0.075 0.075 0.075 0.077 0.077 0.083 0.083 0.083 0.083 0.083 0.085 0.085 0.085 0.085 0.082 0.085 0.085 0.085 0.085 0.082 0.011 0.11 0.11 0.11 0.11 0.15 0.15 0.15 0.15 0.16 0.25 0.25 0.25 0.25 0.25 0.1 0.11 0.11 0.11 0.11 0.1 0.15 0.15 0.15 0.16 0.15 0.25 0.25 0.25 0.25 0.25 0.25 0.1 0.15 0.15 0.15 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.1 0.11 0.11 0.11 0.11 0.11 0.1 0.15 0.15 0.25 0.25 0.25 0.1 0.38 0.38 0.38 0.38		•							
$ \begin{array}{c} & & & & & & & & & & & & & & & & & & &$	0.0	0.1	0.083	0.09	0.086	0.084	0.08		- 0.35
- 0.083 0.037 0.014 0.0	Energy fraction 0.1 0.050.025	0.076	0.076	0.076	0.076		0.072		
- 0.083 0.037 0.014 0.0		0.075	0.075	0.075	0.075	0.077	0.077		- 0.30
SC - 0.15 0.15 0.15 0.16 0.15 - - 0.1 SC - 0.25 0.2		0.083	0.083	0.083	0.083	0.083	0.083		- 0.25
SC - 0.15 0.15 0.15 0.16 0.15 - - 0.1 SC - 0.25 0.2		0.085	0.085	0.085	0.085	0.08	0.082		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.11	0.11	0.11	0.11	0.11	0.11		- 0.20
$\begin{array}{c} 123 \\$		0.15	0.15	0.15	0.15	0.16	0.15		- 0.15
$ \begin{array}{ccccccccccccccccccccccccccccccccccc$		0.25	0.25	0.25	0.25	0.25	0.25		
	1.0	0.38	0.38	0.38	0.38	0.38	0.37		- 0.10
0.0 IE-06 IE-05 0.0001 0.001 0.01 Sampling fraction		0.0	' 1e-06	ہ 1e-05 Sampling	0.0001 9 fraction	0.001	0.01	_	

Perpendicular resolution [m]

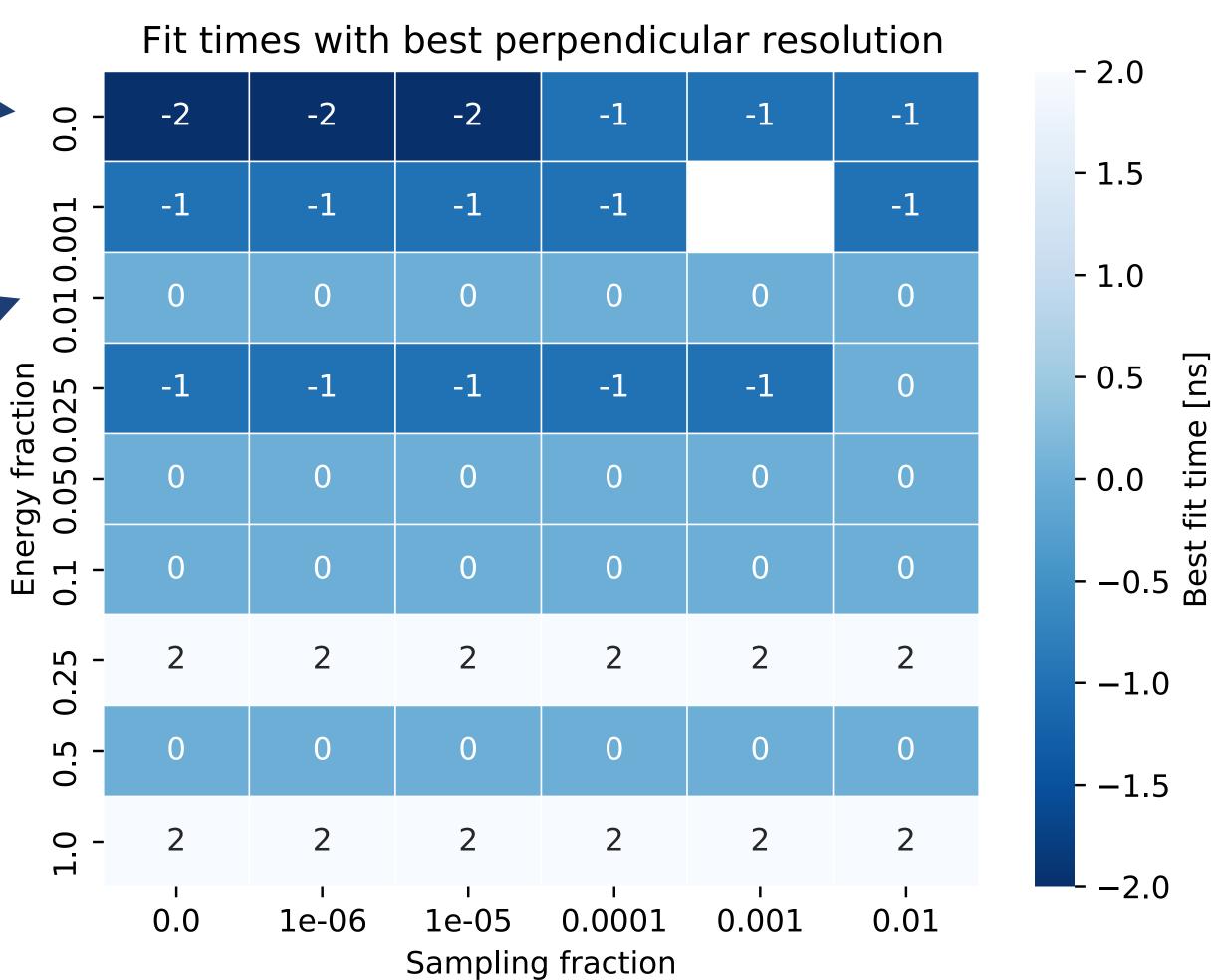
5

No extra sampling (like before) – Best bias found at negative times

Optimum in perpendicular bias found at fitted time = 0

What happens to the likelihood?

Fitted time





Likelihood

-log(Likelihood)/len(hits) is comparable for all experiments

At which fitted time is the -log(Likelihood) at a minimum?

Best likelihood for fit times [-5:3]

0.0	4.6	4.6	4.6	4.6	4.6	4.6		- 4.90	
Energy fraction 0.1 0.050.025 0.010.001	4.6	4.6	4.6	4.6		4.6		- 4.85	
	4.6	4.6	4.6	4.6	4.6	4.6		- 4.80 ±	
	4.6	4.6	4.6	4.6	4.6	4.6		- 4.80 I	
	4.6	4.6	4.6	4.6	4.6	4.6			
Ener 0.1 0	4.6	4.6	4.6	4.6	4.6	4.6		<u>ج</u> - 4.70	
0.25		4.6	4.6	4.6	4.6	4.6		- 4.65	
0.5 0	4.7	4.7	4.7	4.7	4.7	4.7			
1.0	4.9	4.9	4.9	4.9	4.9	4.9		- 4.60	
0.0 1e-06 1e-05 0.0001 0.001 0.01 Sampling fraction									







Optimum in likelihood with best found at fitted time = -1

Row where likelihoods are optimal at t =0 had a resolution of 11 cm instead of 7.5 cm

Fitted time

Fit times with best likelihood

	- 2.0						
0.0	-1	-2	-1	-1	-1	-2	- 2.0
100	-2	-2	-2	-2		-1	- 1.5
0.010.0	-1	-1	-1	-1	-1	-2	- 1.0
<u> </u>	-2	-2	-2	-2	-2	0	- 0.5
Energy fraction 0.1 0.050.025	-2	-2	-2	-2	-2	-2	- 0.0 - +
Energ 0.1 0	0	0	0	0	0	0	0.5 d
0.25	2	2	2	2	2	2	1.0
0.5 -	2	2	2	2	2	2	1.5
1.0	2	2	2	2	2	2	
	0.0	1e-06	1e-05 Sampling	0.0001 9 fraction	0.001	0.01	2.0





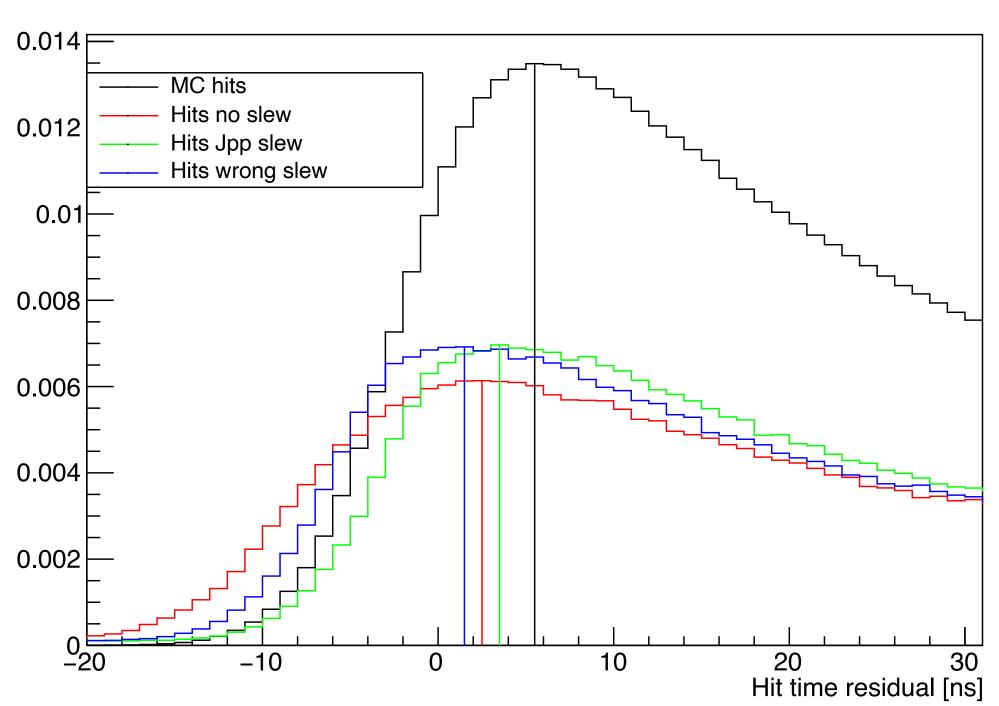
Conclusion

- at the vertex, found at true event time
- No extra sampling necessary
- BUT: likelihood is at a minimum at t = -1, so fit will pull to t = -1

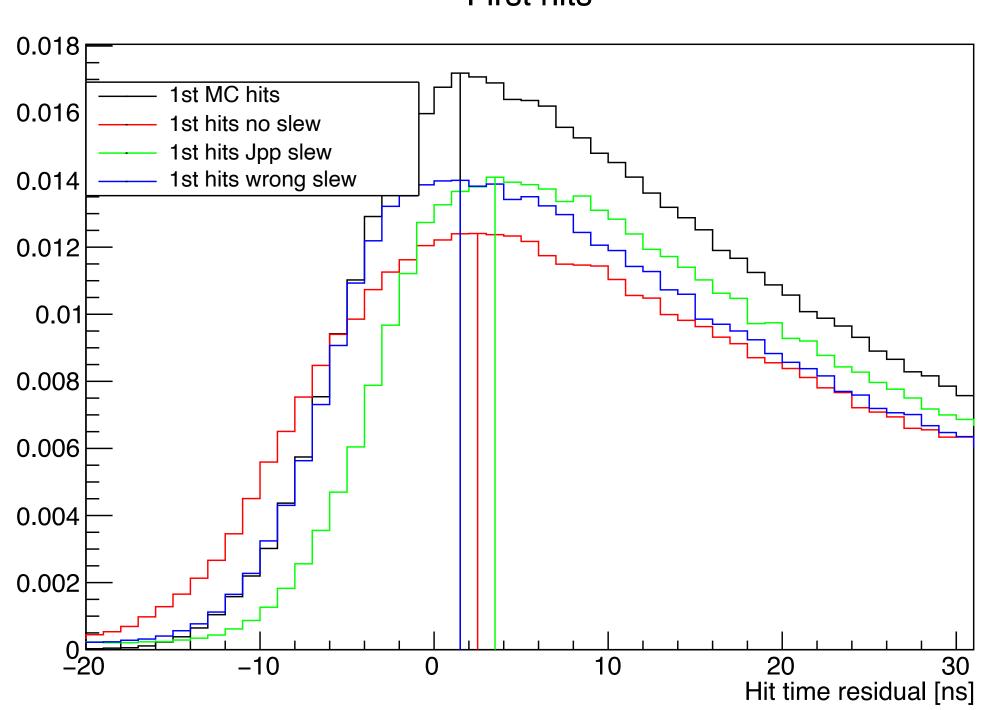
• Optimum in perpendicular bias when putting contribution with 1% of the energy



Real hits problem



All hits



First hits

