BCAL Resolutions

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Timing resolutions
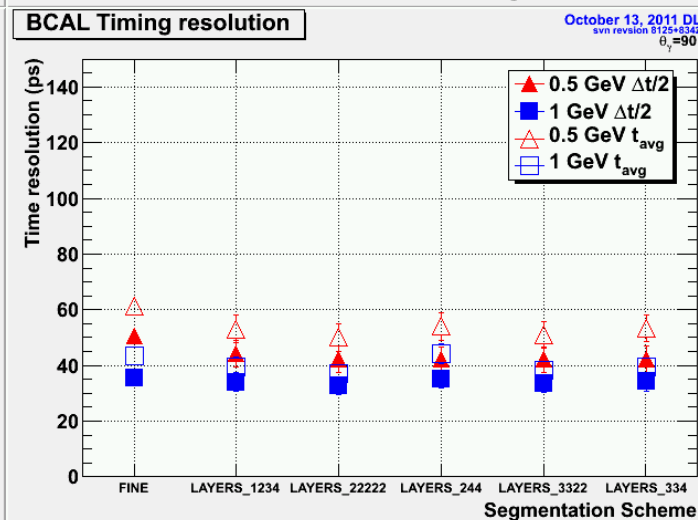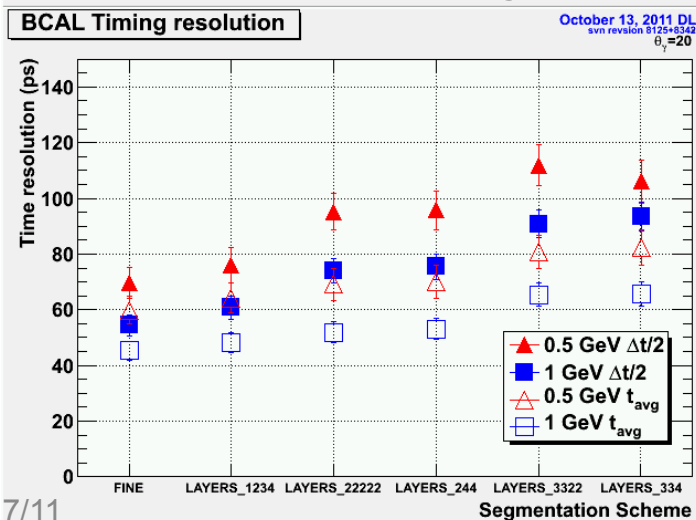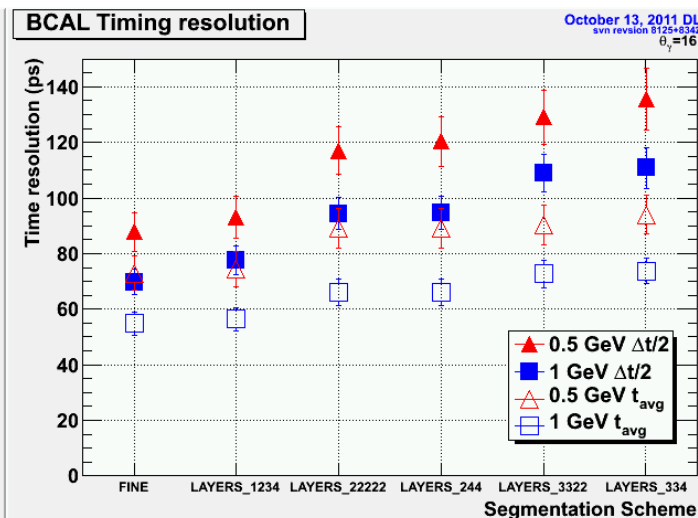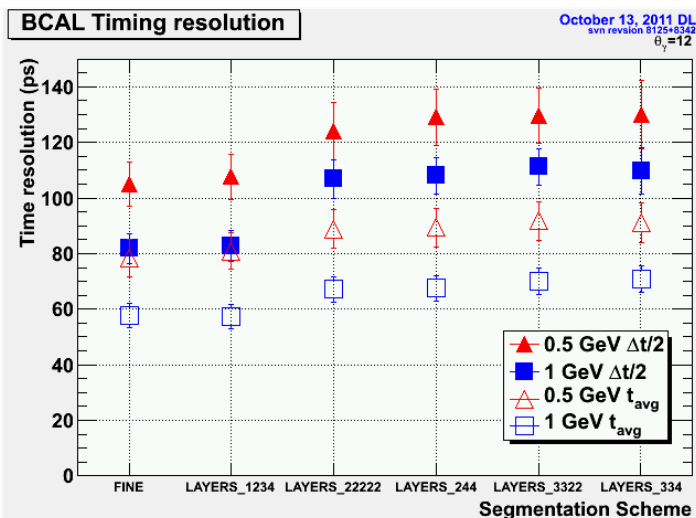
Table 3: Time Average Resolution for $\theta_\gamma = 12°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(78 ± 7)ps	(58 ± 4)ps	13.9%	18.4%
1234	(81 ± 7)ps	(57 ± 4)ps	11.2%	19.0%
22222	(89 ± 7)ps	(67 ± 5)ps	2.4%	5.1%
244	(89 ± 7)ps	(68 ± 5)ps	1.9%	4.6%
3322	(92 ± 7)ps	(70 ± 5)ps	-0.8%	1.1%
334	(91 ± 7)ps	(71 ± 5)ps	0.0%	0.0%

Table 6: Time difference ($\Delta t/2$) Resolution for $\theta_\gamma = 12°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(105 ± 8)ps	(82 ± 5)ps	19.3%	25.5%
1234	(108 ± 8)ps	(83 ± 5)ps	17.2%	24.6%
22222	(124 ± 10)ps	(107 ± 7)ps	4.5%	2.7%
244	(129 ± 10)ps	(108 ± 7)ps	0.8%	1.7%
3322	(130 ± 10)ps	(111 ± 7)ps	0.3%	-1.3%
334	(130 ± 12)ps	(110 ± 8)ps	0.0%	0.0%

Table 4: Time Average Resolution for $\theta_\gamma = 16°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(73 ± 6)ps	(55 ± 4)ps	22.3%	25.7%
1234	(74 ± 6)ps	(56 ± 4)ps	20.9%	23.4%
22222	(89 ± 7)ps	(66 ± 5)ps	5.2%	10.2%
244	(89 ± 7)ps	(66 ± 5)ps	5.0%	10.4%
3322	(90 ± 7)ps	(73 ± 5)ps	3.7%	1.4%
334	(94 ± 7)ps	(74 ± 5)ps	0.0%	0.0%

Table 7: Time difference ($\Delta t/2$) Resolution for $\theta_\gamma = 16°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(88 ± 7)ps	(70 ± 5)ps	35.2%	37.1%
1234	(93 ± 8)ps	(78 ± 5)ps	31.2%	30.1%
22222	(117 ± 9)ps	(94 ± 6)ps	13.6%	14.9%
244	(120 ± 9)ps	(95 ± 6)ps	11.2%	14.5%
3322	(129 ± 10)ps	(109 ± 7)ps	4.7%	1.7%
334	(135 ± 11)ps	(111 ± 7)ps	-0.0%	0.0%

Table 5: Time Average Resolution for $\theta_\gamma = 20°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(60 ± 5)ps	(45 ± 3)ps	27.2%	31.0%
1234	(64 ± 5)ps	(48 ± 4)ps	22.0%	26.4%
22222	(69 ± 6)ps	(52 ± 4)ps	16.0%	21.0%
244	(70 ± 6)ps	(53 ± 4)ps	14.8%	19.1%
3322	(81 ± 6)ps	(65 ± 4)ps	1.8%	0.3%
334	(82 ± 6)ps	(66 ± 4)ps	0.0%	0.0%

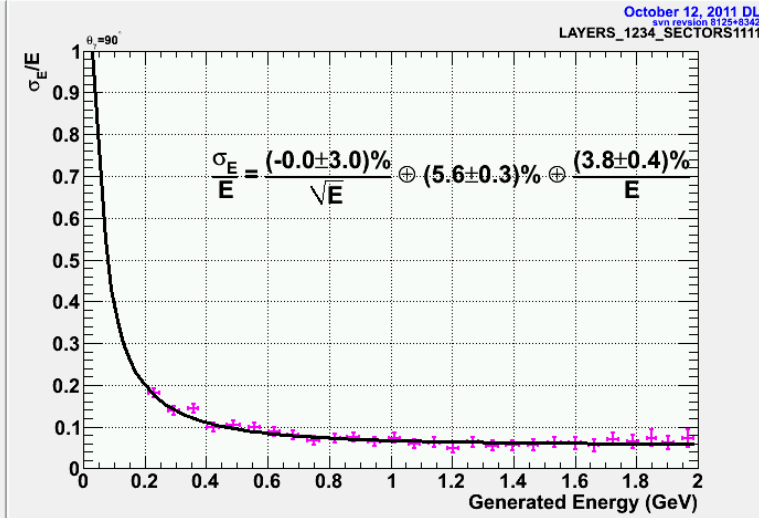Table 8: Time difference ($\Delta t/2$) Resolution for $\theta_\gamma = 20°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(70 ± 6)ps	(54 ± 4)ps	34.3%	41.7%
1234	(76 ± 6)ps	(61 ± 4)ps	28.3%	34.8%
22222	(95 ± 7)ps	(74 ± 4)ps	10.2%	20.7%
244	(96 ± 7)ps	(75 ± 5)ps	9.8%	19.2%
3322	(112 ± 7)ps	(91 ± 5)ps	-5.6%	2.8%
334	(106 ± 8)ps	(93 ± 5)ps	0.0%	0.0%

Table 9: Time Average Resolution for $\theta_\gamma = 90°$.

Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(61 ± 2)ps	(43 ± 1)ps	-14.8%	-10.4%
1234	(53 ± 5)ps	(40 ± 3)ps	0.7%	-0.8%
22222	(50 ± 5)ps	(37 ± 3)ps	6.4%	5.9%
244	(54 ± 5)ps	(44 ± 4)ps	-1.0%	-12.2%
3322	(51 ± 5)ps	(38 ± 3)ps	4.4%	2.5%
334	(53 ± 5)ps	(39 ± 3)ps	-0.0%	0.0%

Table 10: Time difference $(\Delta t/2)$ Resolution for $\theta_\gamma = 90°$.

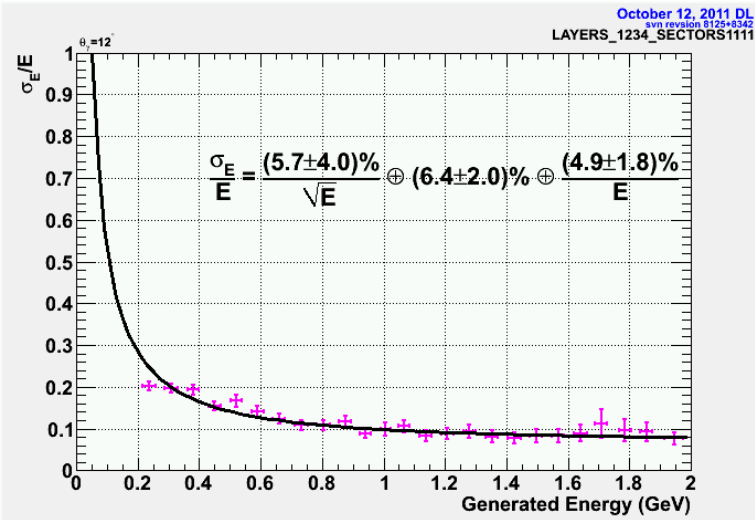| Segmentation Scheme	E=0.5GeV	E=1GeV	% better 0.5GeV	% better 1GeV
FINE	(50 ± 2)ps	(36 ± 1)ps	-19.5%	-4.6%
1234	(44 ± 5)ps	(34 ± 3)ps	-4.3%	0.3%
22222	(42 ± 5)ps	(33 ± 3)ps	0.2%	4.5%
244	(42 ± 5)ps	(35 ± 3)ps	0.4%	-3.1%
3322	(42 ± 5)ps	(34 ± 3)ps	0.2%	1.5%
334	(42 ± 5)ps	(34 ± 3)ps	-0.0%	0.0%

Top-left panel:

$\theta_\gamma=12°$

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$$\frac{\sigma_E}{E} = \frac{(5.7\pm4.0)\%}{\sqrt{E}} \oplus (6.4\pm2.0)\% \oplus \frac{(4.9\pm1.8)\%}{E}$$

Top-right panel:

$\theta_\gamma=16°$

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$$\frac{\sigma_E}{E} = \frac{(7.8\pm2.7)\%}{\sqrt{E}} \oplus (5.0\pm2.4)\% \oplus \frac{(2.5\pm2.9)\%}{E}$$

Bottom-left panel:

$\theta_\gamma=20°$

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$$\frac{\sigma_E}{E} = \frac{(2.7\pm5.0)\%}{\sqrt{E}} \oplus (5.5\pm1.3)\% \oplus \frac{(3.3\pm1.5)\%}{E}$$

Bottom-right panel:

$\theta_\gamma=90°$

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$$\frac{\sigma_E}{E} = \frac{(-0.0\pm3.0)\%}{\sqrt{E}} \oplus (5.6\pm0.3)\% \oplus \frac{(3.8\pm0.4)\%}{E}$$

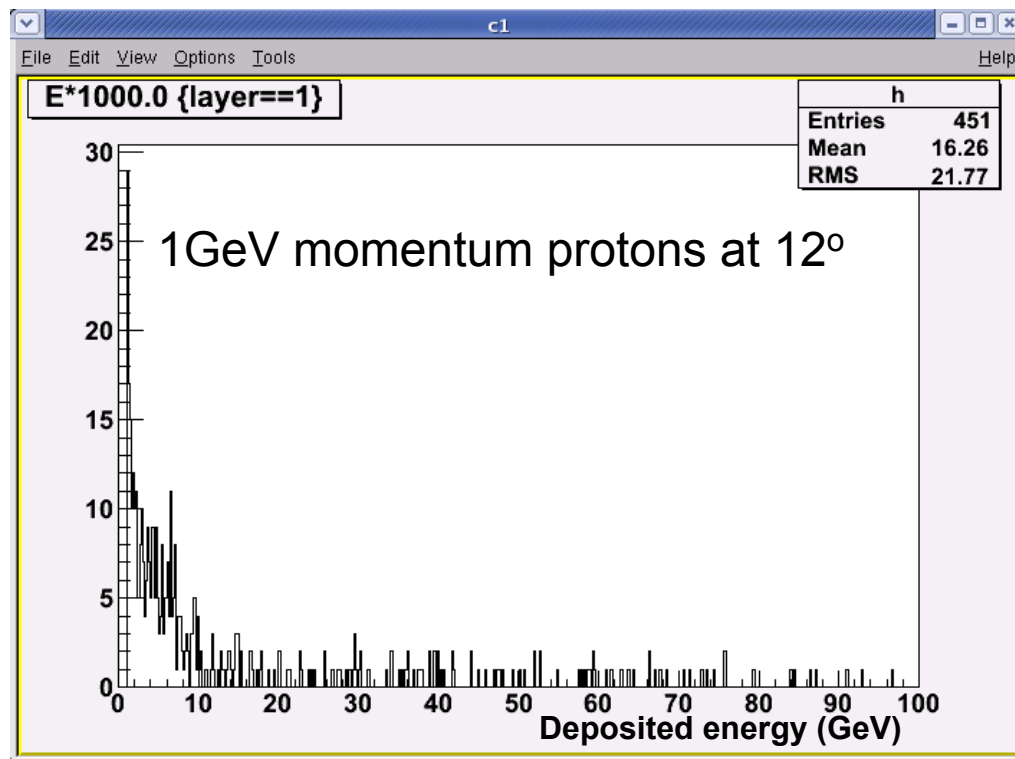All panels: x-axis "Generated Energy (GeV)", y-axis "σ_E/E"

Protons depositing energy in BCAL
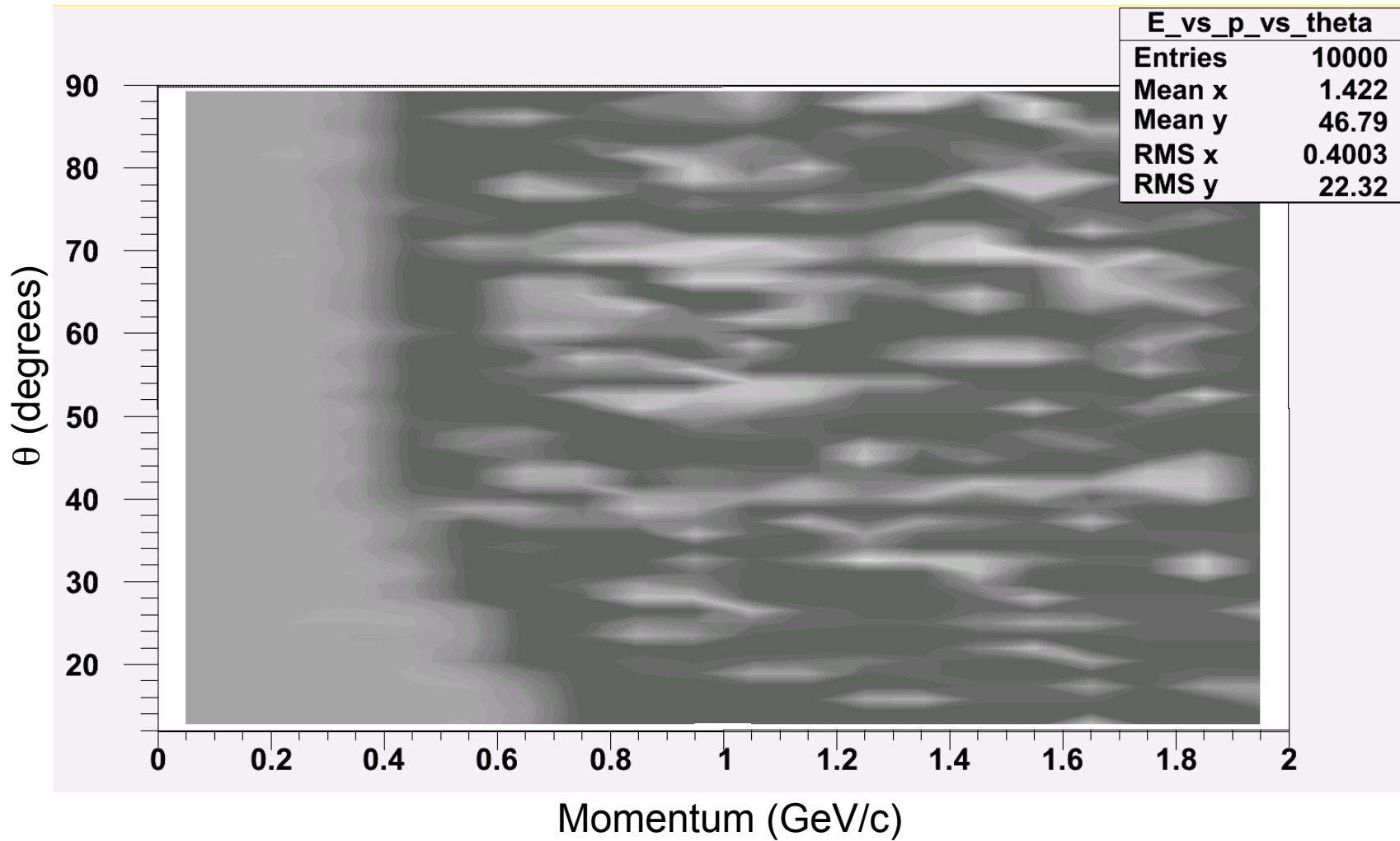
Still working on protons …

Mean energy deposited in 2cm cell:

$$\frac{2MeV}{g/cm^2} \left(\frac{2cm}{21.9cm} \right) (15.50X_o) \left(\frac{7.19g/cm^2}{X_o} \right) = 20MeV$$

1GeV momentum protons at 12°

At 12°, should be
1/sin(12°) = 4.8 times greater

Threshold: ~30MeV near SiPM