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SDC
SOLENOIDAL DETECTOR NOTES

ERRATUM/ADDENDUM TO: ON THE "MASSLESS GAP" ADJUSTIMENT OF DETECTED ENERGY FOR PASSIVE MATERIAL IN FRONT OF A CALORIMETER

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Erratum/Addendum to: On the "massless gap" adjustment of detected energy for passive material in front of a calorimeter*

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ABSTRACT

In my recent note on the massless gap adjustment of detected energy for passive material, I have used and quoted a global function for the correction factor α_{mg} that does not match the requirements I listed when introducing it. The purpose of this note is to supply a function that does satisfy those requirements. The results fall within the errors of those quoted in the original note, and all conclusions remain unchanged.

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I have recently studied the "massless gap" adjustment of detected energy in calorimeters,[1] a technique seriously considered in particular for the liquid-argon design[2-5] that has been discussed for SDC but also of potential relevance for the tile-fiber design favored presently. For a correction to be useful, it has to be applicable at any thickness of passive material and incident electron energy one may encounter; thus, an overall function of the material thickness and incident energy is needed:

$$E_{corr} \;=\; \alpha_{mg}(d,E)\cdot E_{front} \;+\; E_{back} \tag{01}$$

with d being the thickness of the passive material in units of radiation length,X_0, E_{corr} the corrected energy, E_{front} the energy/signal from the massless gap, E_{back} the energy observed beyond the massless gap in the calorimeter, and E the incident energy obtained *e.g.* from the central tracking system. For large energies or small material thicknesses independently, the correction factor has to converge to $\alpha_{mg} = 1.0$ as in those limits nothing is left to correct for. The function I have quoted in and used for the original note[1] (eq.(3.3) there)

$$\begin{aligned} \alpha_{mg}(d,E) &= 1.0 \;+\; a_1\cdot d \;+\; a_2\cdot e^{-a_3\cdot E} \\ a_1 &= 0.7729 \\ a_2 &= 3.888 \\ a_3 &= 0.14435 \end{aligned} \tag{02}$$

does *not* satisfy the requirement for the asymptotic behavior. I have therefore now changed it to

$$\begin{aligned} \alpha_{mg}(d,E) &= 1.0 \;+\; a_1\cdot d \;\cdot e^{-a_2\cdot E} \\ a_1 &= 1.189 \\ a_2 &= 0.0120 \end{aligned} \tag{03}$$

and rerun the analysis program with this new function. Again, the trivial angular dependence for the SDC coil through $sin\theta$ is taken out explicitly as in the original

note. The updated tables 2 and 3 of the original note are given below; the linearity is mostly slightly improved while the resolutions are nearly the same as for the old function. The resolution parameters for the square-root law are thus hardly changed also. A revised version of figure 8 shows the new results. Note that the new function lives with only two free coefficients rather than three.

REFERENCES

1) H.-J.Trost, On the "massless gap" adjustment of detected energy for passive material in front of a calorimeter, ANL/HEP/TR-92/06 and SDC-92-187, 31 January 1992

2) A.M.Jonckheere, Simulating D0 and Hermeticity Studies or How to Effect a Detector Design, Proc. Workshop on Detector Simulation for the SSC, August 24-28, 1987, ed. L.E.Price, ANL-HEP-CP-88-51, Argonne National Laboratory, Argonne, Illinois, USA 1988, p.270, p.175

3) H.Hirayama, Effects of dead material to the electro-magnetic calorimeter and energy/resolution recovery with "massless gap", JSD-NOTE-1990-30 and SDC-90-00108, Nucl.Instr.Meth. A302 (1991) 427

4) Ch.Hearty, Resolution and hermeticity of the liquid argon electromagnetic calorimeter as a function of pseudorapidity, SDC-90-00145-REV

5) SDC Liquid Argon Group, Calorimeter conceptual design - liquid argon option, 5 August 1991 (uncatalogued)

TABLE CAPTIONS

2. Resolutions for different massless gap correction schemes: no correction, individual mean, energy independent mean, individual function, revised overall function

3. Mean responses for different massless gap correction schemes: no correction, individual mean, energy independent mean, individual function, revised overall function

FIGURE CAPTIONS

8. Resolution dependence (revised) on a) the thickness of passive material and b) the angle of incidence into the coil and calorimeter

Table 2a : Resolutions (in GeV) for different massless-gap correction schemes: Dependence on thickness of passive material (overall function revised)

	no correction	individual mean	individual function	energy independent	overall function
10 GeV					
0 X_0	0.4975				
1 X_0	0.4633	0.4882	0.4803	0.4656	0.4806
2 X_0	0.5356	0.5296	0.5291	0.5280	0.5274
3 X_0	0.6322	0.6366	0.6131	0.5904	0.6441
5 X_0	0.9567	0.8978	0.9826	0.8912	0.9057
20 GeV					
0 X_0	0.6790				
1 X_0	0.7001	(0.7001)	0.6834	0.7008	0.7050
2 X_0	0.7591	0.7539	0.7537	0.7546	0.7589
3 X_0	0.9960	0.8746	0.9092	0.8743	0.9127
5 X_0	1.261	1.132	1.132	1.134	1.1386
50 GeV					
0 X_0	1.032				
1 X_0	1.144	(1.144)	(1.144)	1.137	1.127
2 X_0	1.229	1.156	1.145	1.152	1.137
3 X_0	1.582	1.281	1.392	1.313	1.282
5 X_0	2.415	1.705	1.812	1.734	1.739

For values in parentheses, no sensible correction could be determined and therefore none was applied (i.e. the factor was set to 1.0 flat).

Table 2b: Resolutions (in GeV) for different massless-gap correction schemes: Dependence on angle of incidence (overall function revised)

	no correction	individual mean	individual function	energy independent	overall function
10 GeV					
90°	0.4711	0.4725	0.4867	0.4556	0.4709
45°	0.4926	0.4768	0.4862	0.4724	0.4669
35°	0.5544	0.5475	0.5595	0.5474	0.5587
30°	0.5941	0.5776	0.6024	0.5733	0.5494
20 GeV					
90°	0.6990	0.6943	0.7232	0.7029	0.7074
45°	0.6728	0.6739	0.6884	0.6537	0.6729
35°	0.7266	0.7272	0.7455	0.7046	0.6990
30°	0.8235	0.7618	0.8279	0.7561	0.7286
50 GeV					
90°	1.067	1.064	N/A	1.057	1.105
45°	1.108	1.101	N/A	1.067	1.080
35°	1.207	1.213	N/A	1.235	1.193
30°	1.311	(1.311)	N/A	1.211	1.192

For values in parentheses, no sensible correction could be determined and therefore none was applied (i.e. the factor was set to 1.0 flat). At 50 GeV, no reasonable individual fits were obtained.

Table 3 : Responses (in GeV) for different massless-gap correction schemes: Dependence on thickness of passive material (overall function revised)

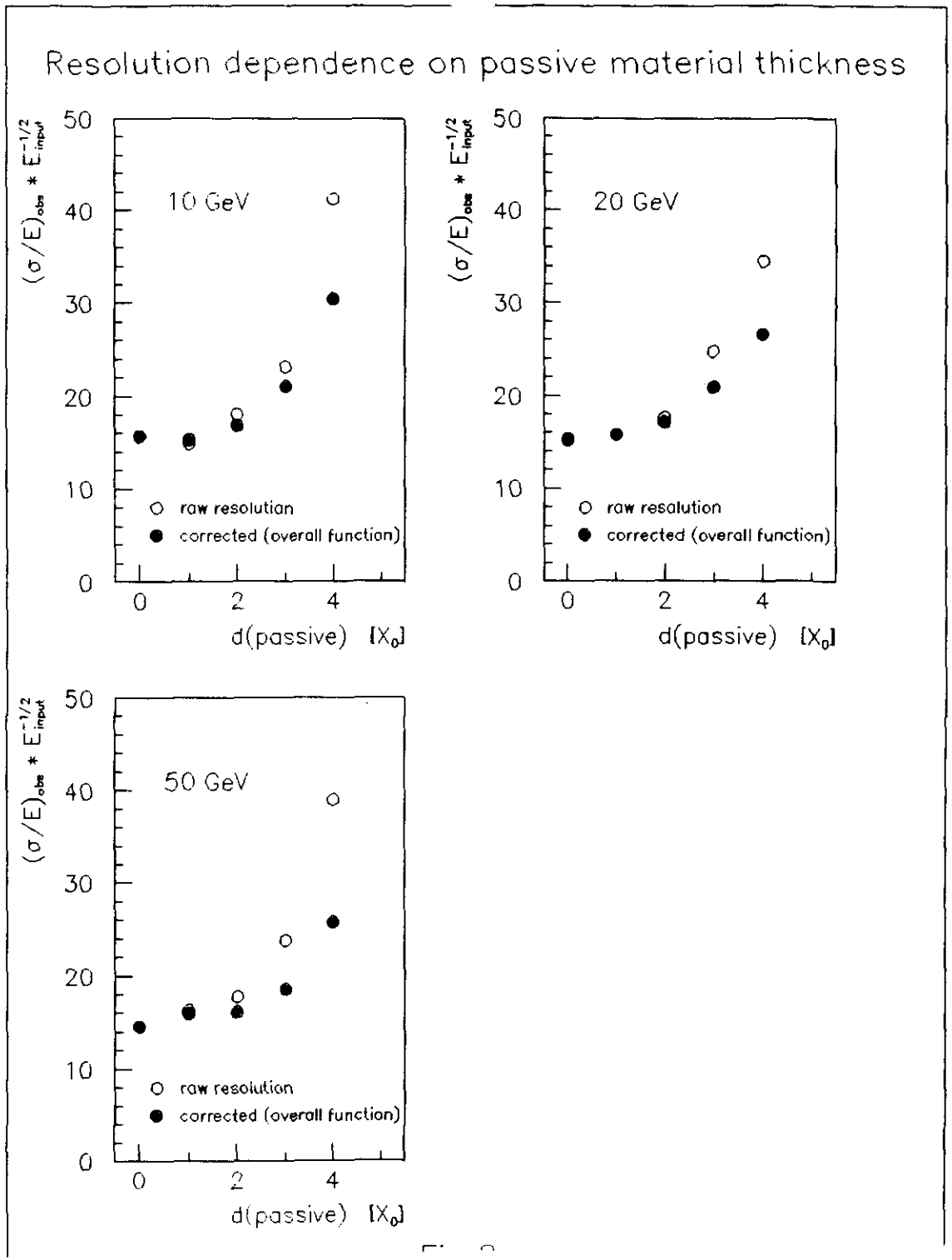
	no correction	individual mean	individual function	energy independent	overall function
10 GeV					
0 X_0	10.01				
1 X_0	9.845	9.991	9.904	9.850	9.951
2 X_0	9.430	9.869	9.801	9.694	9.914
3 X_0	8.662	9.767	9.692	9.393	9.682
5 X_0	7.351	9.621	9.622	9.248	9.428
20 GeV					
0 X_0	19.95				
1 X_0	19.83	(19.83)	19.71	19.84	19.96
2 X_0	19.26	19.66	19.66	19.61	19.88
3 X_0	18.02	19.39	19.52	19.23	19.51
5 X_0	16.12	19.33	19.33	19.33	19.15
50 GeV					
0 X_0	49.90				
1 X_0	49.78	(49.78)	(49.78)	49.81	49.96
2 X_0	49.02	49.44	49.39	49.59	49.83
3 X_0	47.17	49.07	48.99	49.23	49.10
5 X_0	43.91	48.64	48.78	50.02	47.79

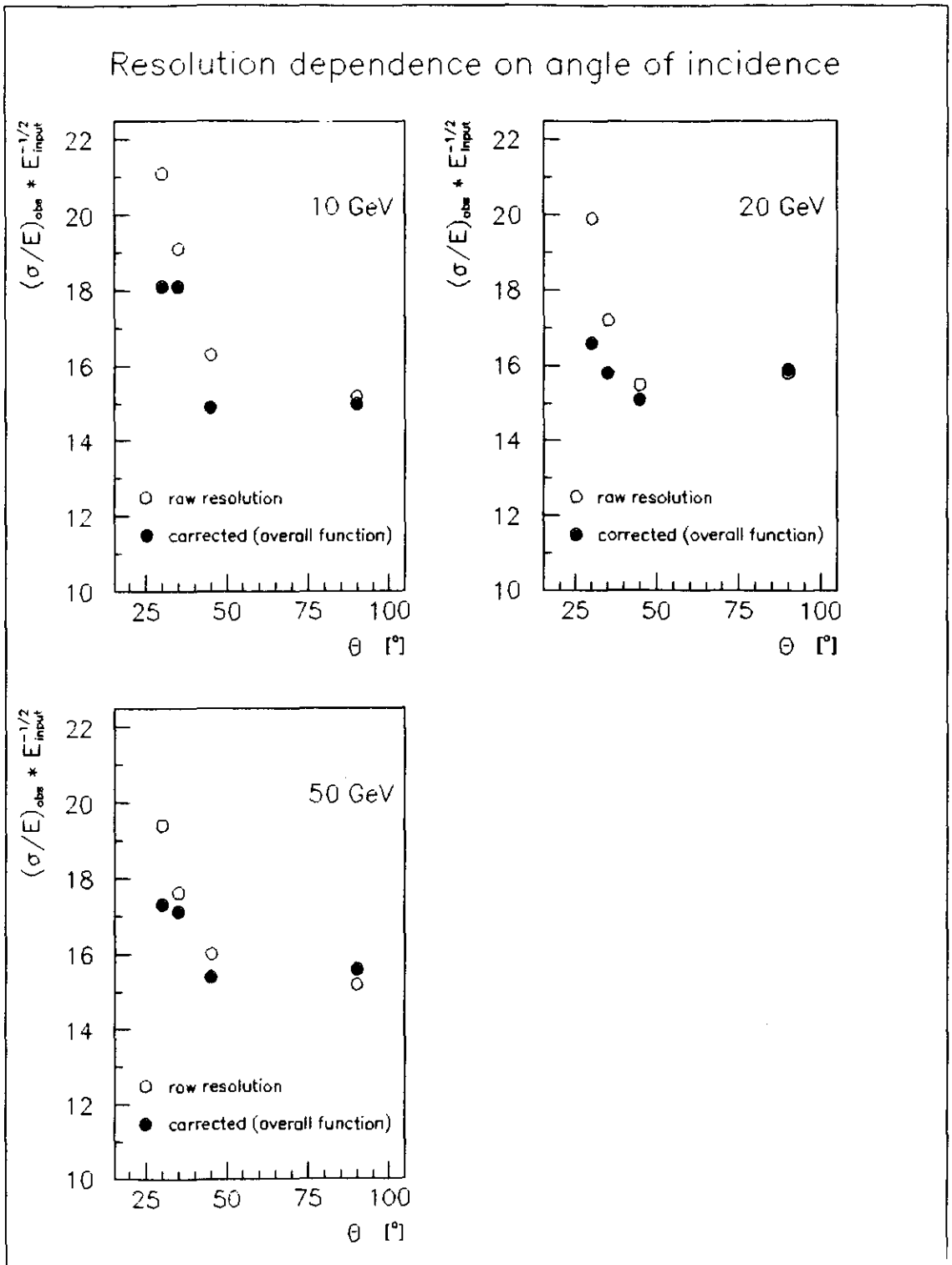
For values in parentheses, no sensible correction could be determined and therefore none was applied (i.e. the factor was set to 1.0 flat).

Table 3 : Responses (in GeV) for different massless-gap correction schemes: Dependence on angle of incidence (overall function revised)

	no correction	individual mean	individual function	energy independent	overall function
10 GeV					
90°	9.781	9.784	9.825	9.830	9.947
45°	9.534	9.605	9.590	9.659	9.897
35°	9.200	9.339	9.330	9.430	9.740
30°	8.904	9.153	9.123	9.233	9.579
20 GeV					
90°	19.78	19.78	19.60	19.83	19.94
45°	19.40	19.49	19.48	19.55	19.98
35°	18.94	19.14	19.10	19.27	19.82
30°	18.47	18.76	18.81	18.99	19.66
50 GeV					
90°	49.67	49.69	N/A	49.76	49.96
45°	49.11	49.19	N/A	49.38	49.70
35°	48.46	48.50	N/A	49.00	49.31
30°	47.78	(47.78)	N/A	48.62	48.83

For values in parentheses, no sensible correction could be determined and therefore none was applied (i.e. the factor was set to 1.0 flat). At 50 GeV, no reasonable individual fits were obtained.


Resolution dependence on passive material thickness
10 GeV
20 GeV
50 GeV
raw resolution
corrected (overall function)
d(passive) [X0]
(σ/E)obs * E-1/2input
0
10
20
30
40
50
0
2
4


Resolution dependence on angle of incidence
$(\sigma/E)_{obs} * E_{input}^{-1/2}$
10 GeV
20 GeV
50 GeV
raw resolution
corrected (overall function)
θ [°]
22
20
18
16
14
12
10
25
50
75
100