Comparison between ABEL, CAIN and Guinea-Pig (GP) forcused on incoherent pair creation

T. Tauchi, ISG4 meeting, KEK, 7/21/1999

Contents

1. Parameters of JLC Design Study

Ecm = 500 GeV

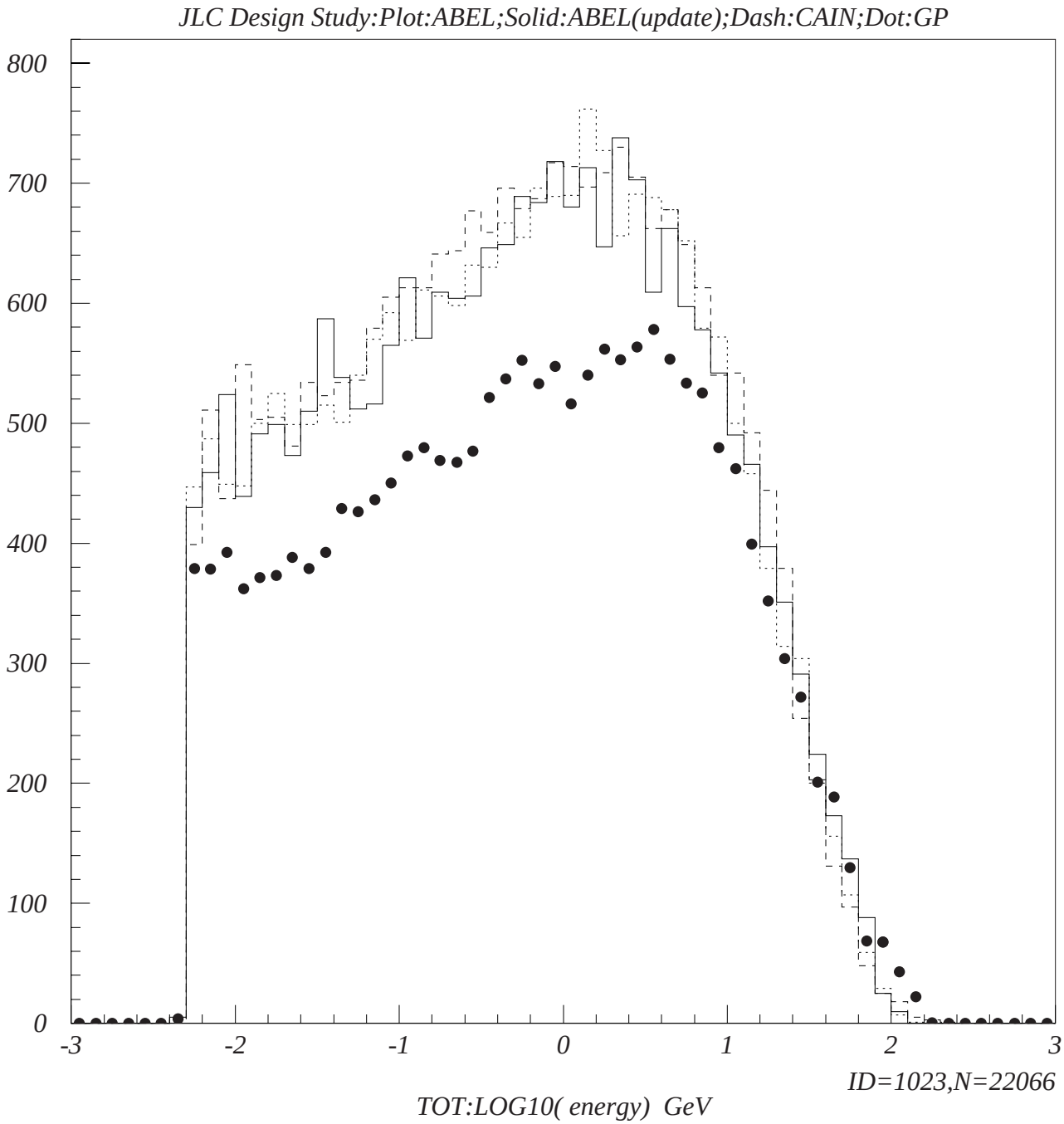
N = 6.45 x 10^9 /bunch

σ_y / σ_x = 3.0nm / 260 nm

β_y / β_x= 0.1mm / 10mm

Headon collision

note: All "cut"s are 4.5 σ in ABEL and CAIN.


JLC Design Study:Plot:ABEL;Solid:ABEL(update);Dash:CAIN;Dot:GP
800
700
600
500
400
300
200
100
0
-3
-2
-1
0
1
2
3
ID=1023,N=22066
TOT:LOG10(energy) GeV

2. Parameters of published "paper"

Ecm = 1000 GeV

N = 2.019 x 10^{10} /bunch

σ_y / σ_x = 3.077nm / 372 nm

β_y / β_x= 0.12356mm / 24.62mm

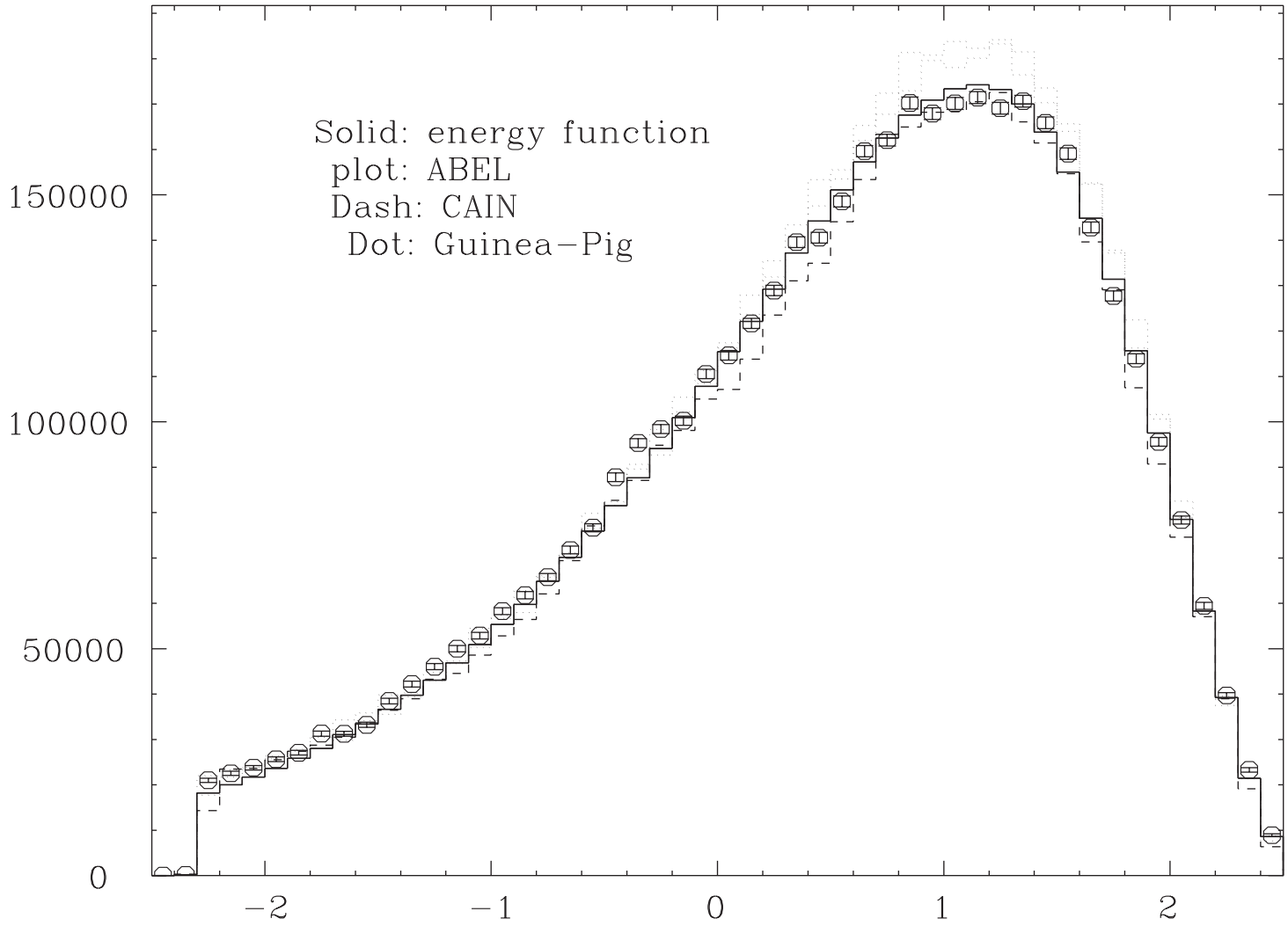
Headon collision

note: All "cut"s are 4.5 σ in ABEL and CAIN.

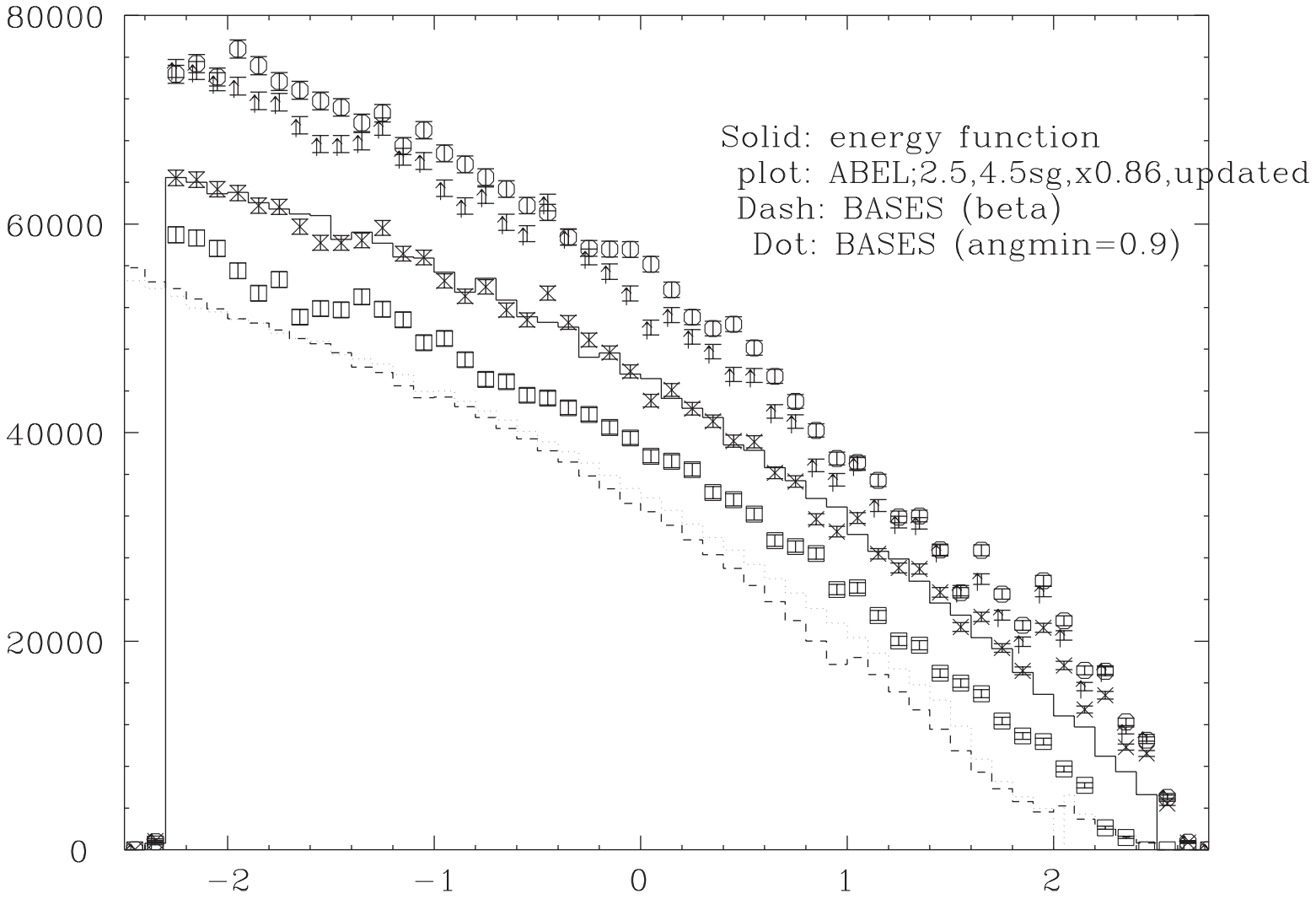
Various luminosities x 10^{30} cm^{-2}/bunch

	ABEL	CAIN	GP
L_{ee}	4.17	4.00	4.15
$L_{e\gamma}^{1}$	3.16	2.93	3.09
$L_{e\gamma}^{2}$	3.17	3.01	3.10
$L_{\gamma\gamma}$	2.76	2.56	2.24
n_γ	2.05	2.00	1.99

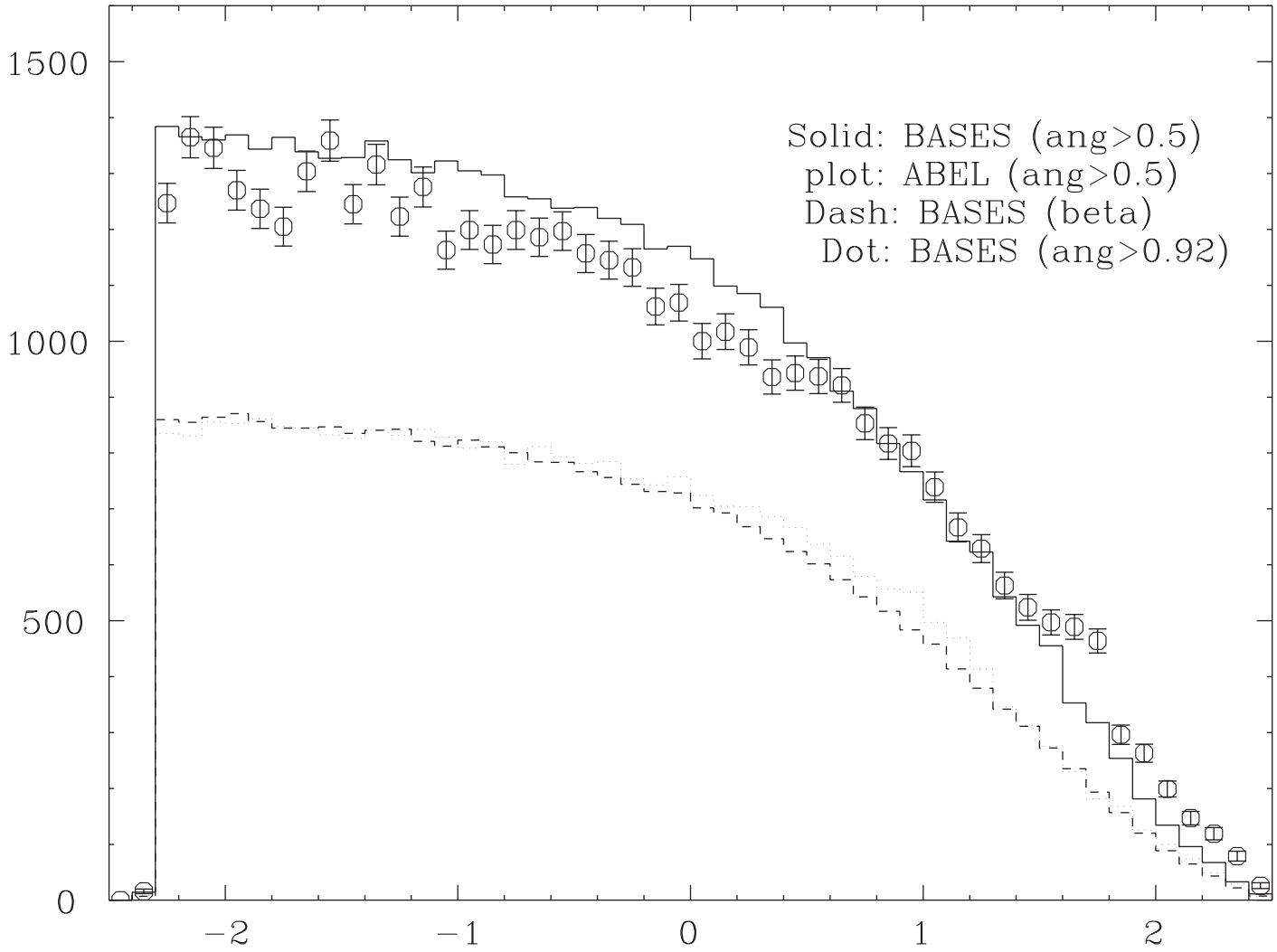
No effect:BH:DLOG10(E in GeV) for pairs

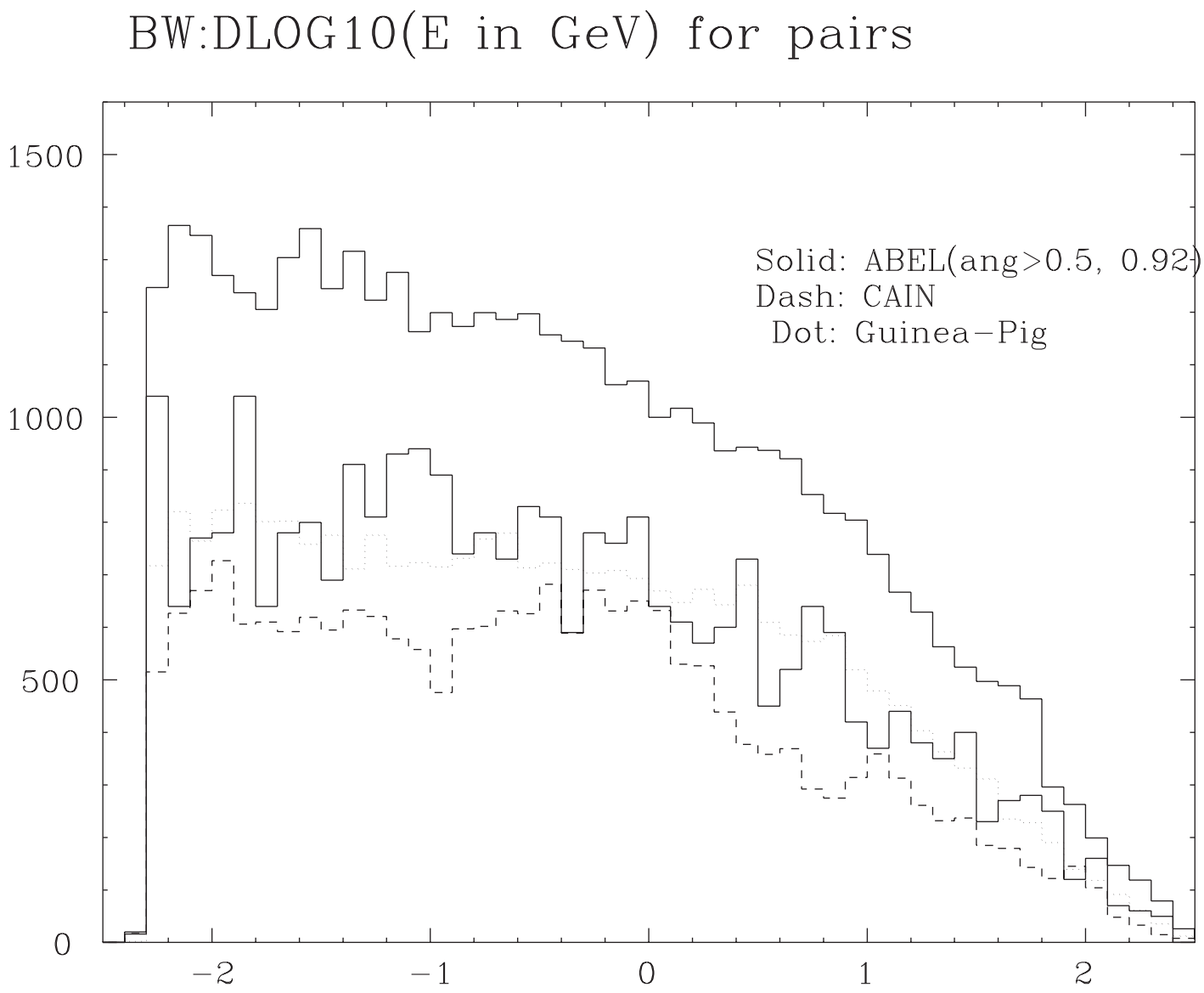


No effect:LL:DLOG10(E in GeV) for pairs

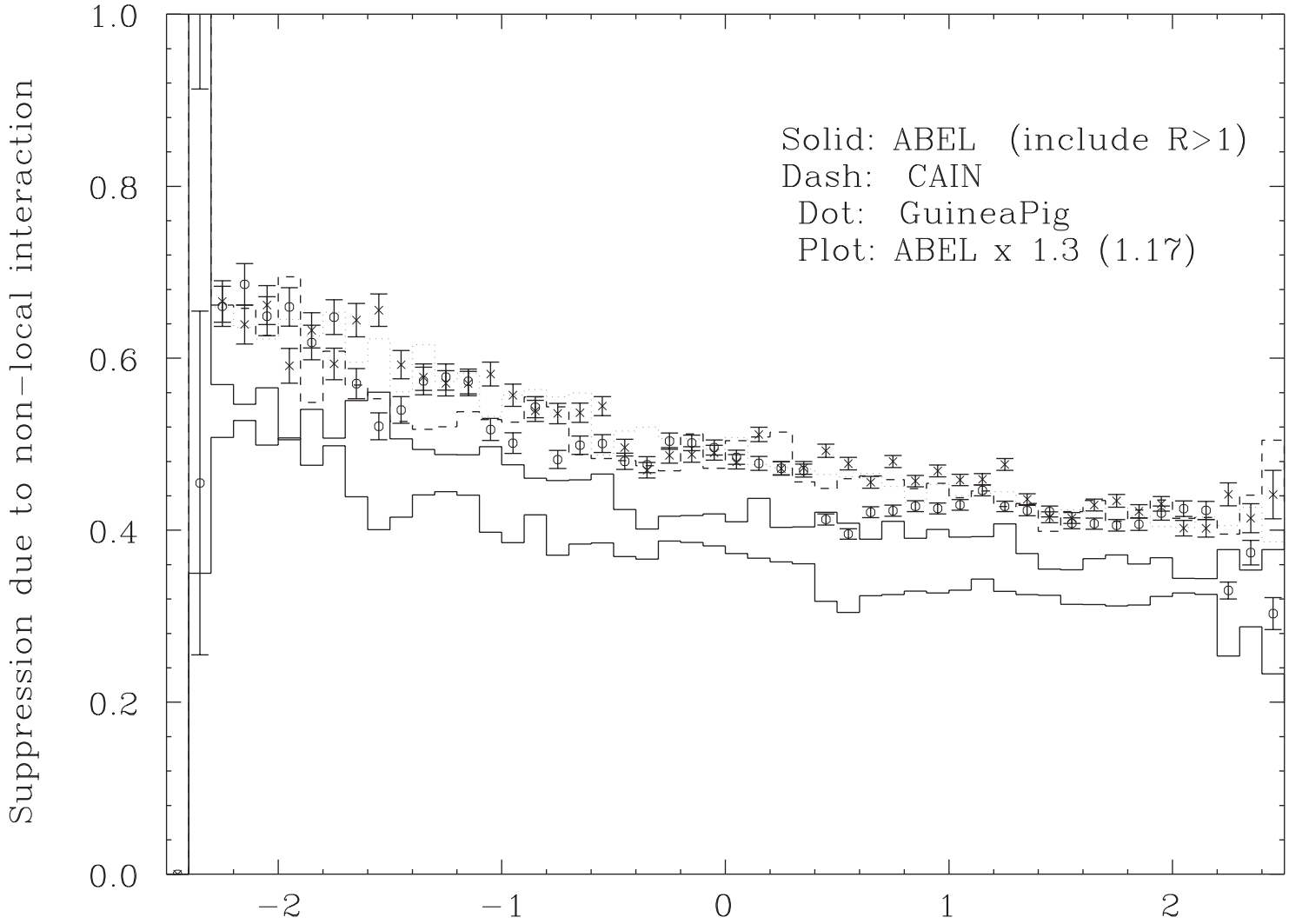


No effect:BW:DLOG10(E in GeV) for pairs

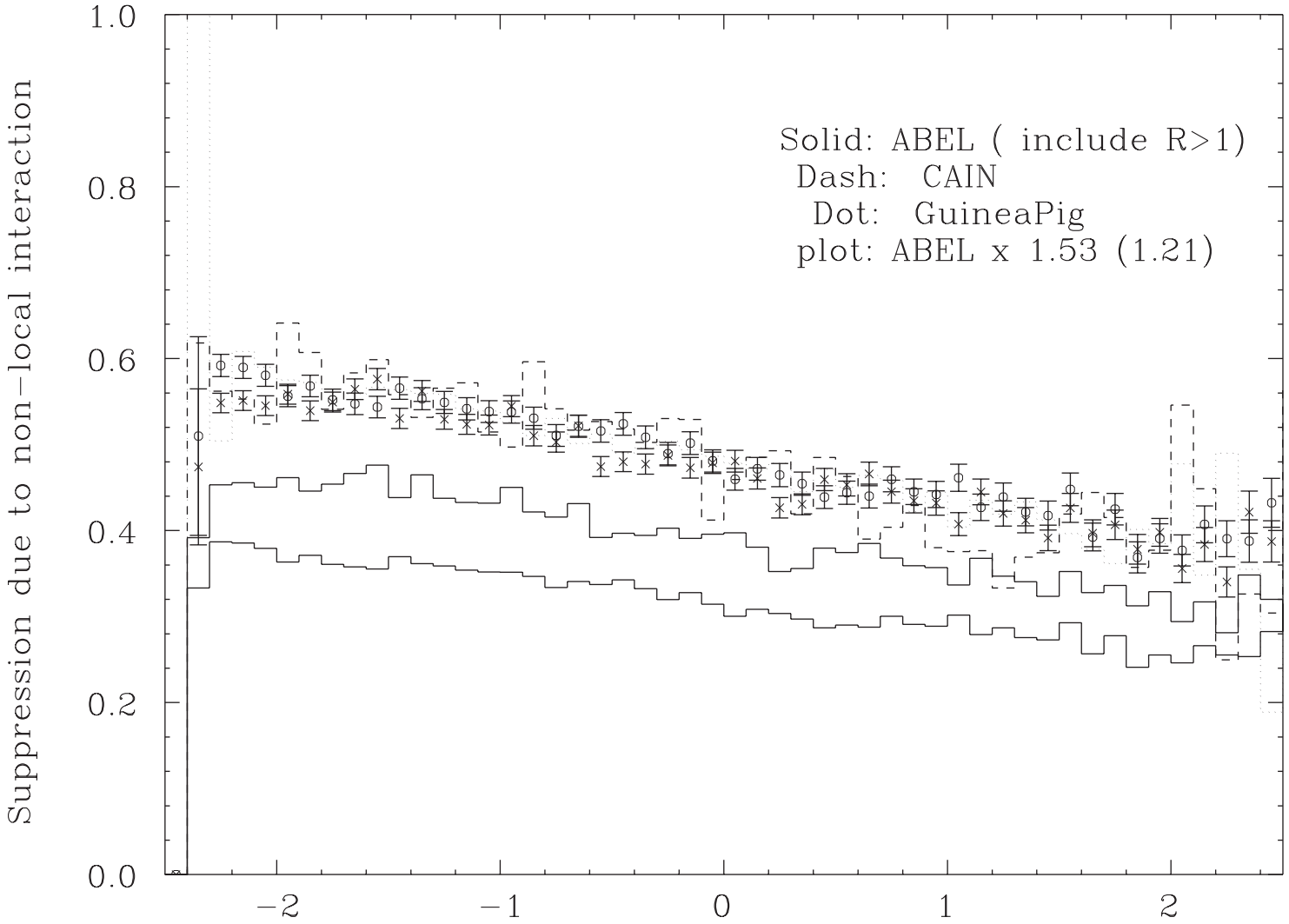



BW:DLOG10(E in GeV) for pairs
1500
1000
500
0
−2
−1
0
1
2
Solid: ABEL(ang>0.5, 0.92)
Dash: CAIN
Dot: Guinea−Pig

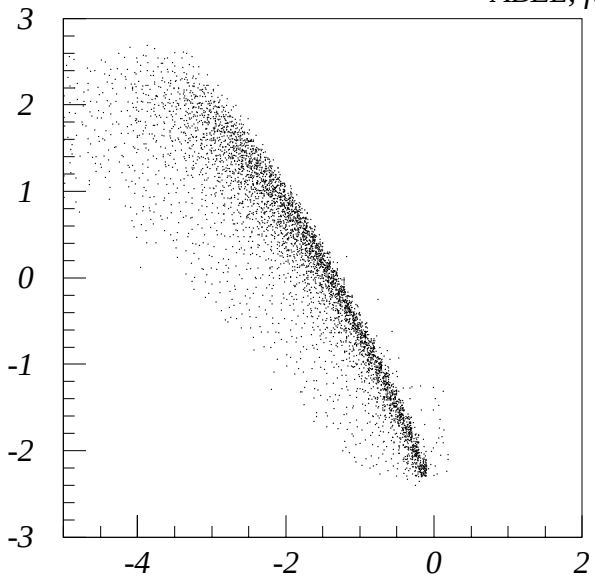
Beam size:BH:DLOG10(E in GeV) for pairs



Beam size effect:LL:DLOG10(E in GeV) for pairs



ABEL, full effect, {≈∧f⇔



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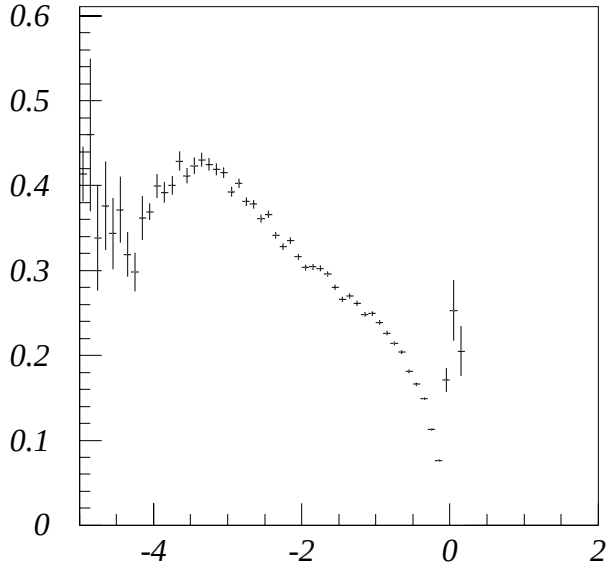
e+:LOG10(ANG) v.s. LOG10(energy in GeV)



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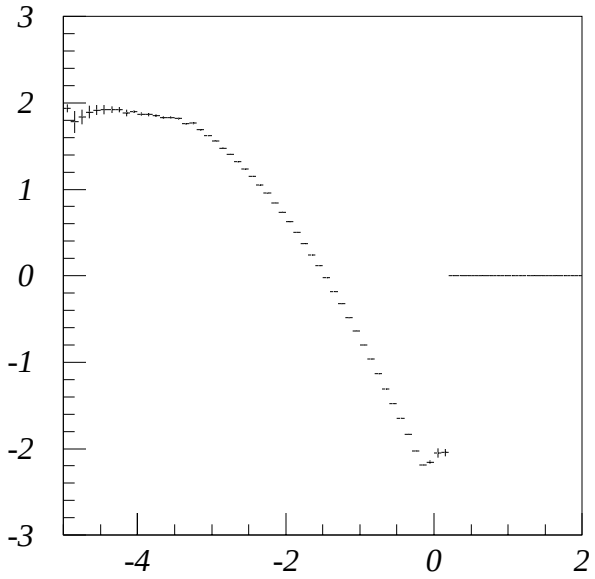
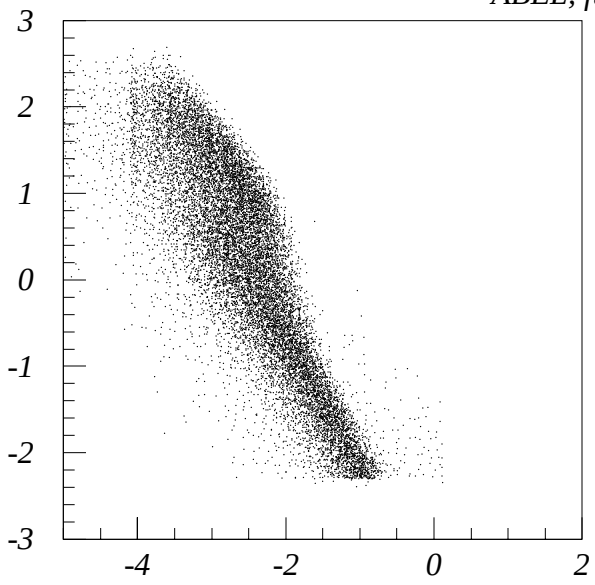
SGX e+:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=103,N=70

AVX e+:LOG10(ANG) v.s. LOG10(energy in GeV)

ABEL, full effect, {≈∧f⇔



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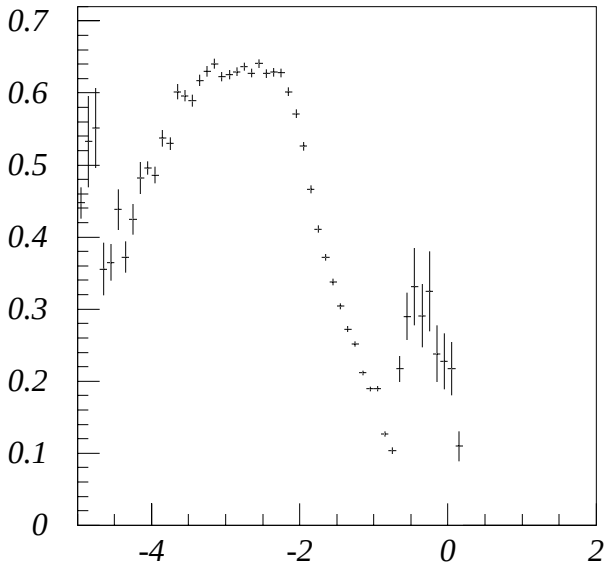
e-:LOG10(ANG) v.s. LOG10(energy in GeV)



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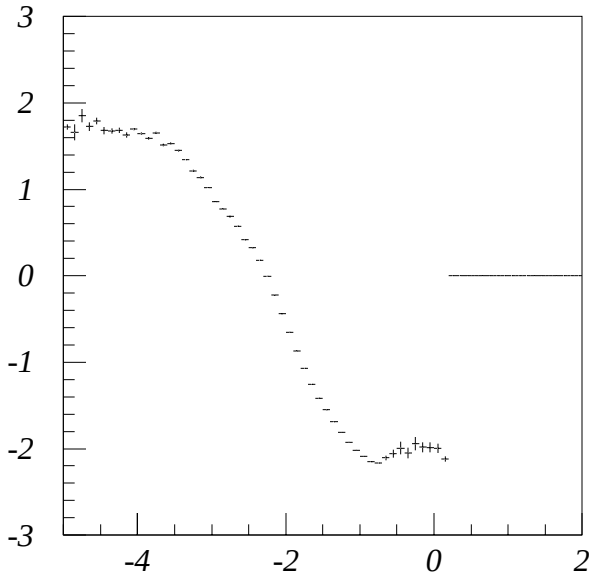
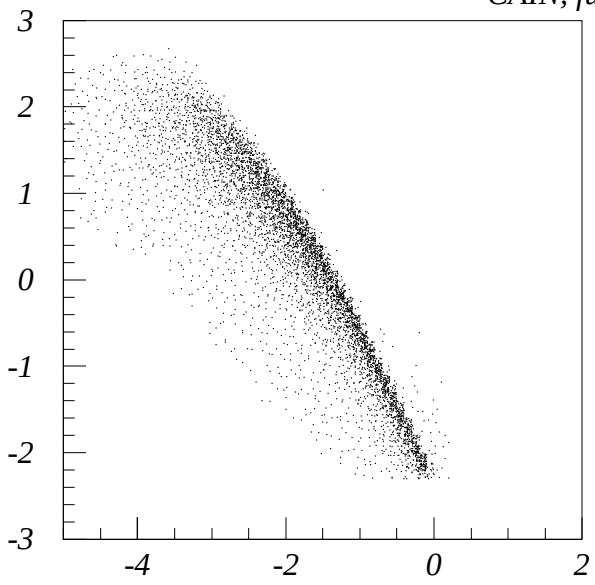
SGX e-:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=115,N=70

AVX e-:LOG10(ANG) v.s. LOG10(energy in GeV)

CAIN, full effects, {≈∧f⇔



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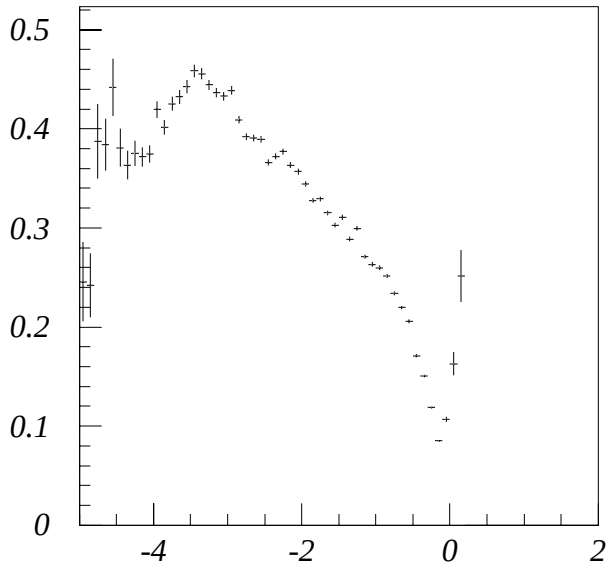
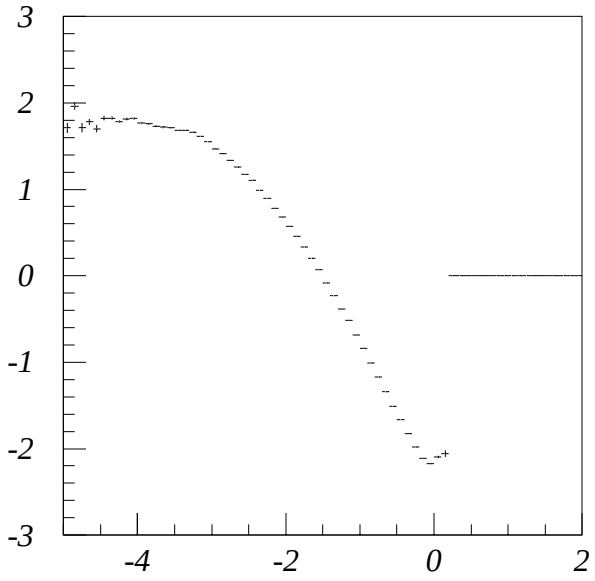
e+:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=104,N=70

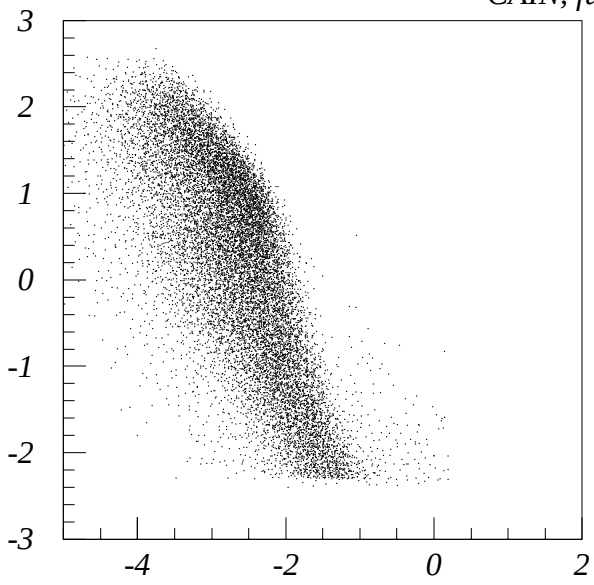
SGX e+:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=103,N=70

AVX e+:LOG10(ANG) v.s. LOG10(energy in GeV)

CAIN, full effects, {≈∧f⇔



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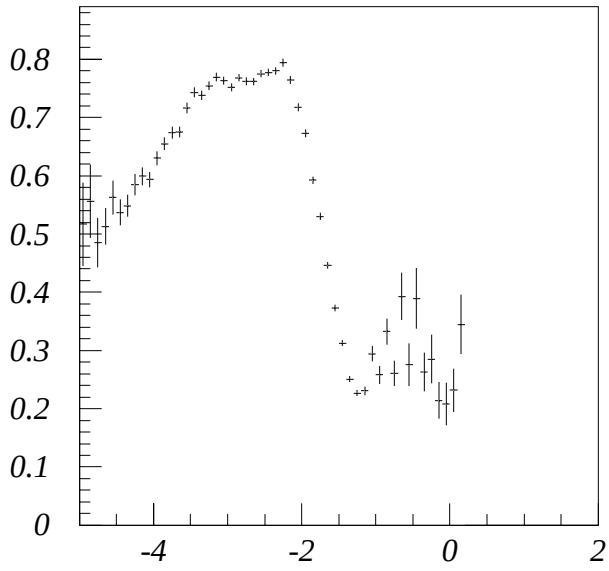
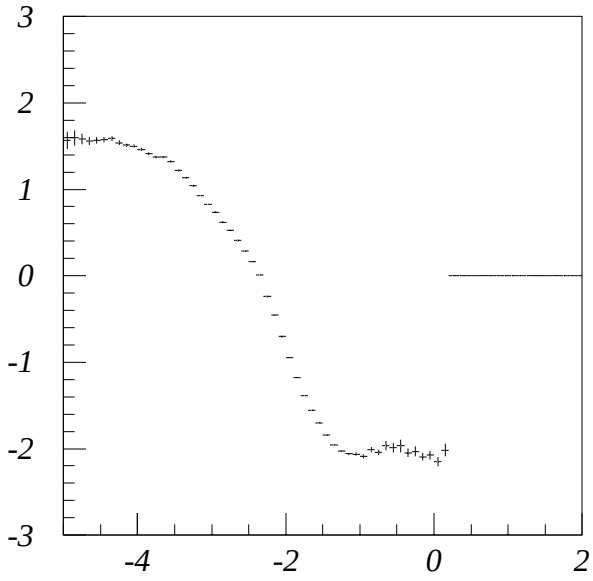
e-:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=116,N=70

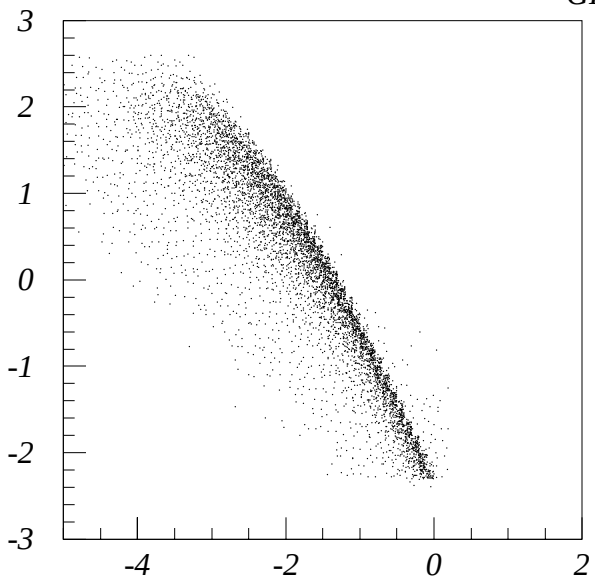
SGX e-:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=115,N=70

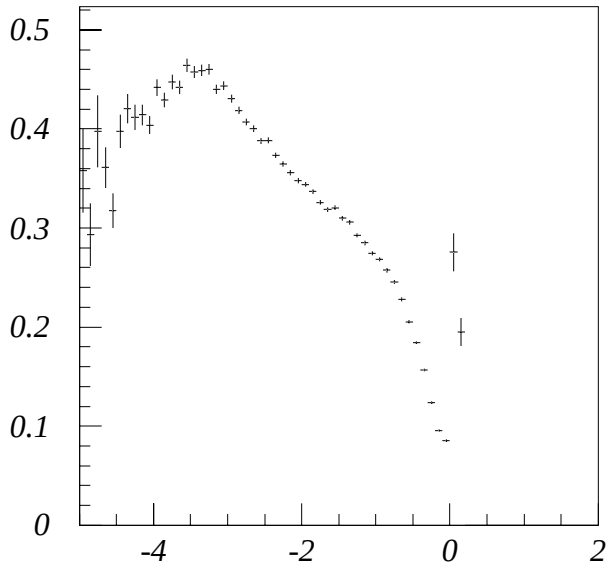
AVX e-:LOG10(ANG) v.s. LOG10(energy in GeV)

GP: full effect



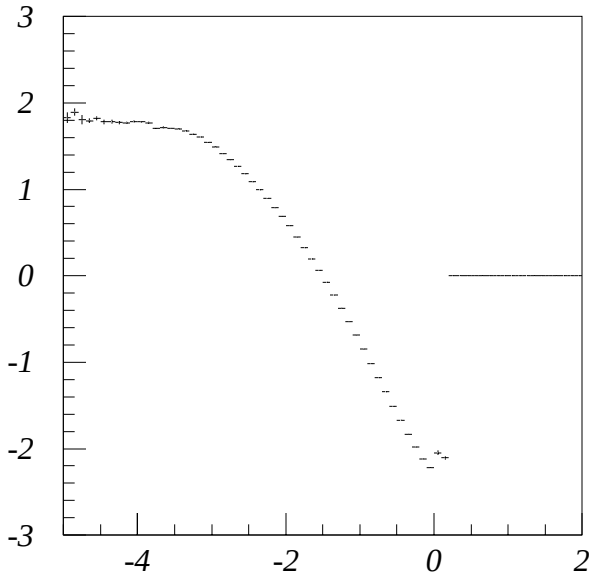
ID=100,N=139652

e+:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=104,N=70

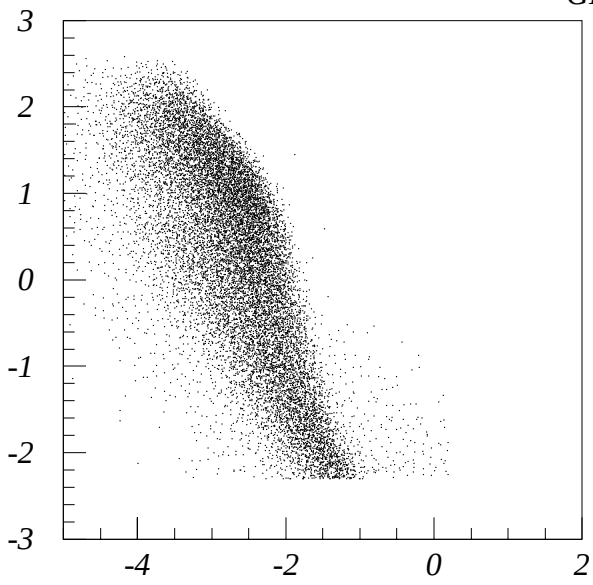
SGX e+:LOG10(ANG) v.s. LOG10(energy in GeV)



ID=103,N=70

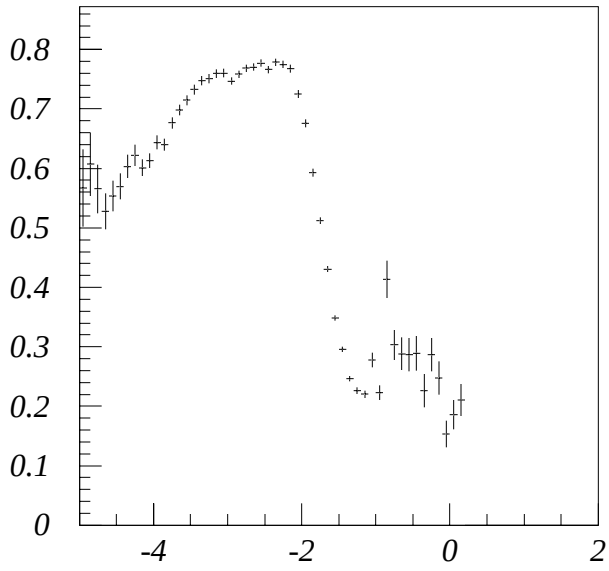
AVX e+:LOG10(ANG) v.s. LOG10(energy in GeV)

GP: full effect



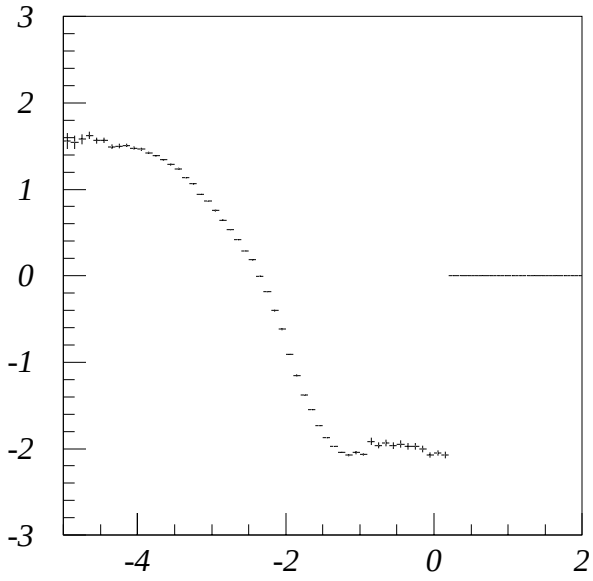
ID=110,N=139690

e-:LOG10(ANG) v.s. LOG10(energy in GeV)



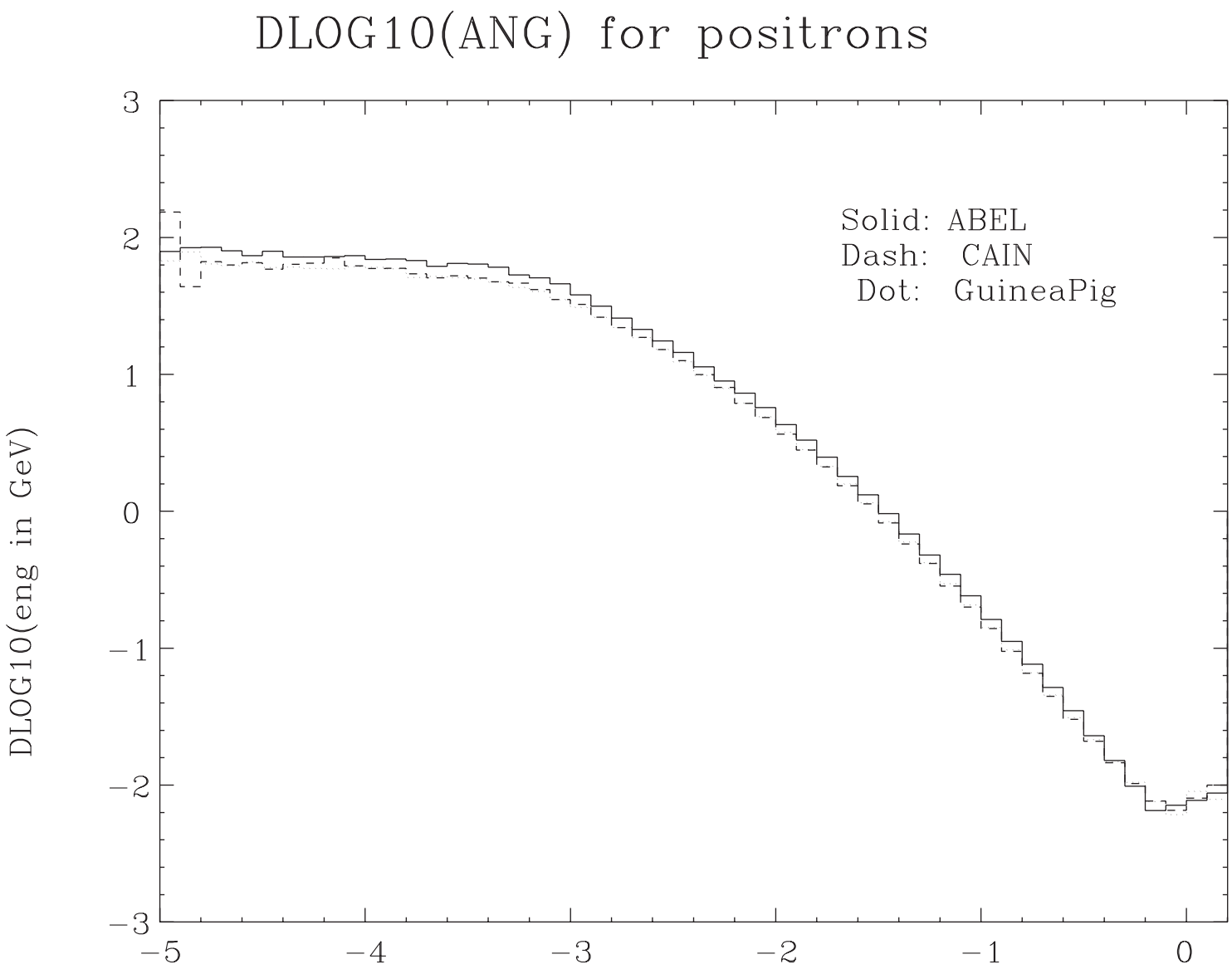
ID=116,N=70

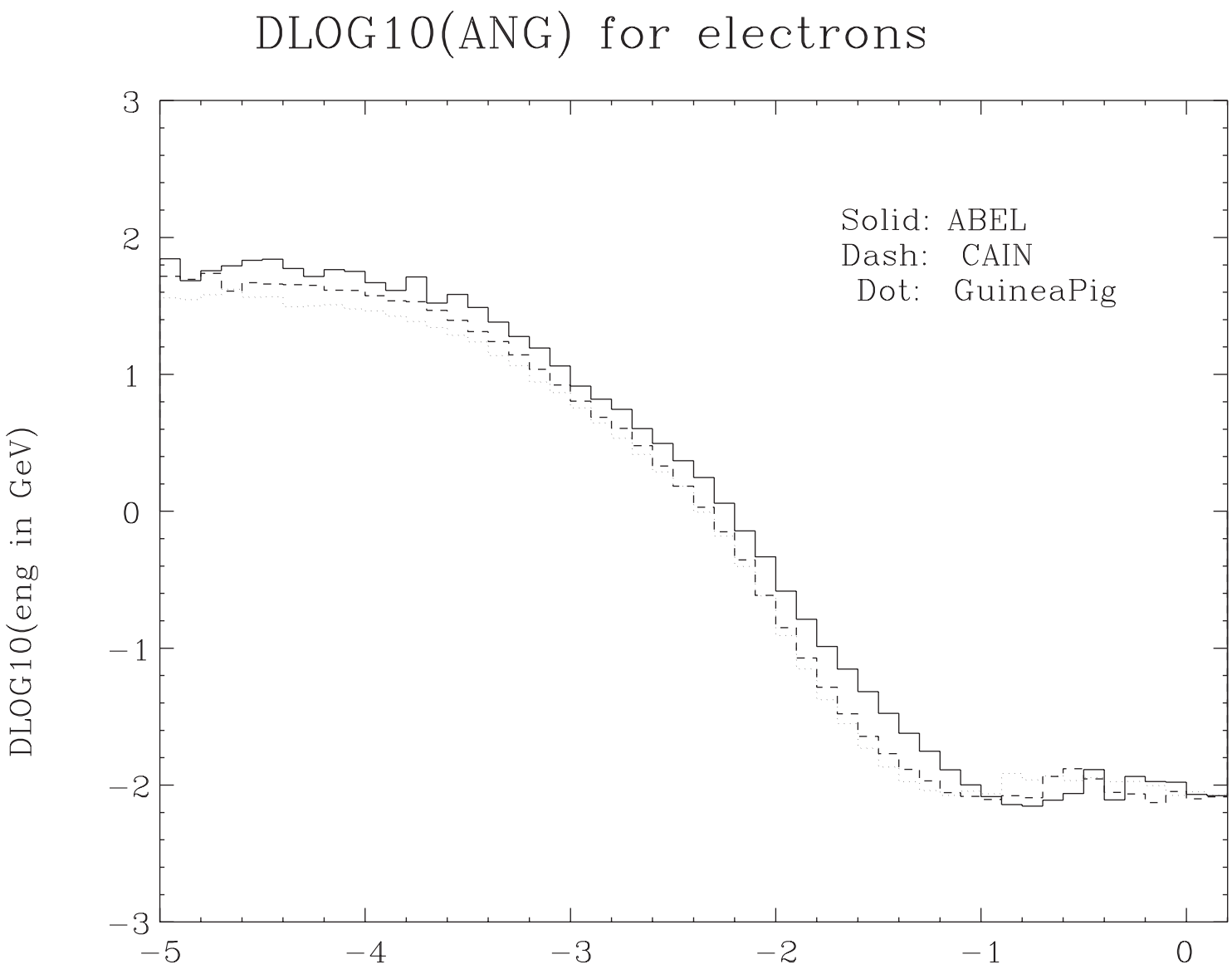
SGX e-:LOG10(ANG) v.s. LOG10(energy in GeV)



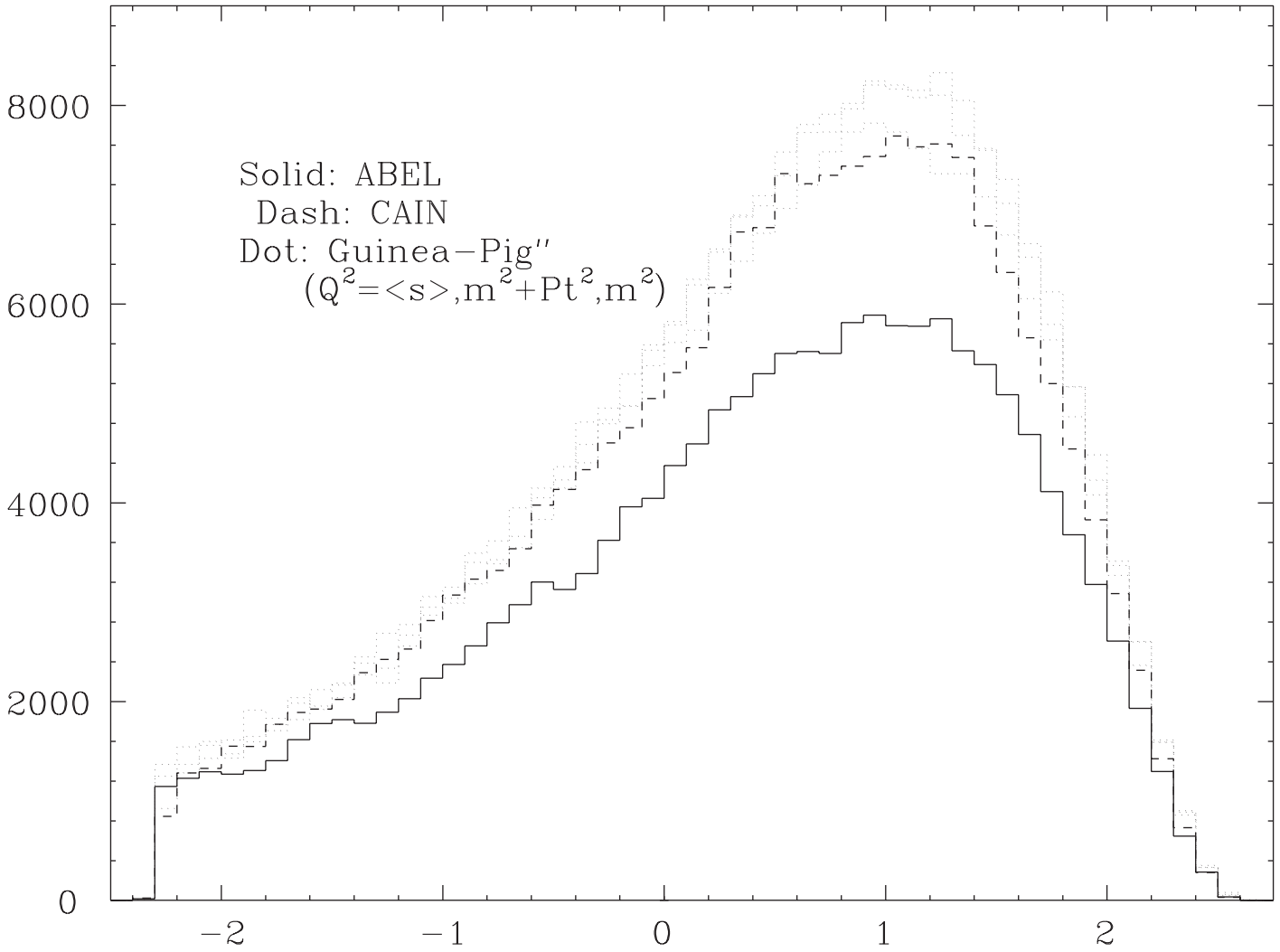
ID=115,N=70

AVX e-:LOG10(ANG) v.s. LOG10(energy in GeV)

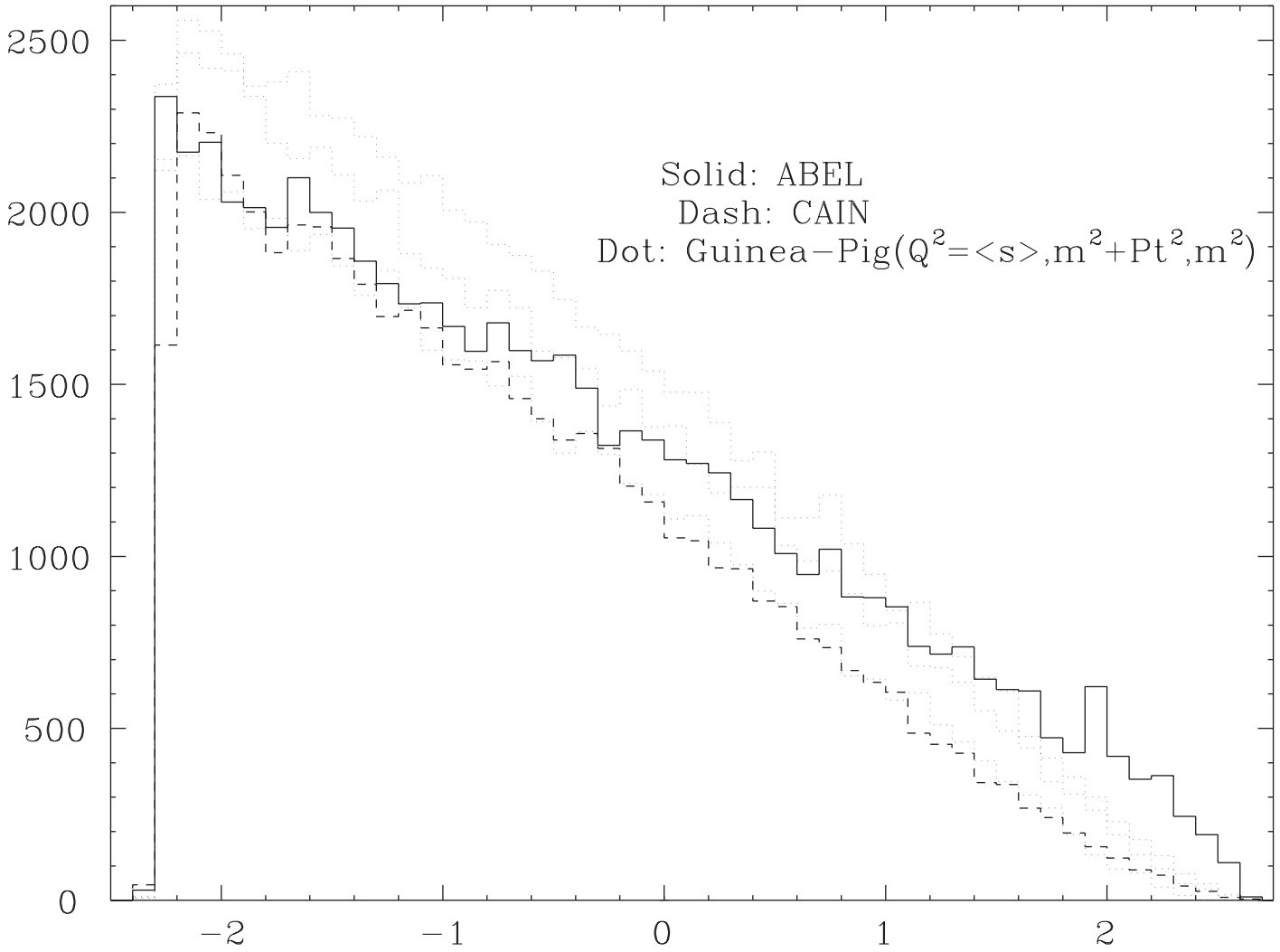

DLOG10(ANG) for positrons
Solid: ABEL
Dash: CAIN
Dot: GuineaPig
DLOG10(eng in GeV)
3
2
1
0
−1
−2
−3
−5
−4
−3
−2
−1
0


DLOG10(ANG) for electrons
Solid: ABEL
Dash: CAIN
Dot: GuineaPig
DLOG10(eng in GeV)
3
2
1
0
−1
−2
−3
−5
−4
−3
−2
−1
0

Full effect: BH:DLOG10(E in GeV) for pairs



Full effect: LL:DLOG10(E in GeV) for pairs



Results of published "paper"

(1) Full effects

GP has 3 options for virtual photon spectrum;

pairs.q2 = 0 for $Q^2 = m^2$

1 $Q^2 = m^2 + P_t^2$

2 $Q^2 = s_{\gamma\gamma}$

The cross sections are ordered as pairs.q2 !

CAIN's Q^2 is m^2.

(2) All effects are switched off to see more details.

beam size effect (non-local interaction)

external field effect

These are suppression of cross sections with virtual photons, that is, σ_{LL} and σ_{BH}.

ABEL has higher cross sections of LL and BW.

(3) Beam size effect is ON.

ABEL has larger suppressions LL and BH.

4. Modification of ABEL

(1) Patch factors

They were changed by comparing with β-dependent cross sections (i.e. $\cos\theta$ -> $\beta\cos\theta$), which were calculated nuemerically by BASES integrations.

LL : 0.90 <- 0.70

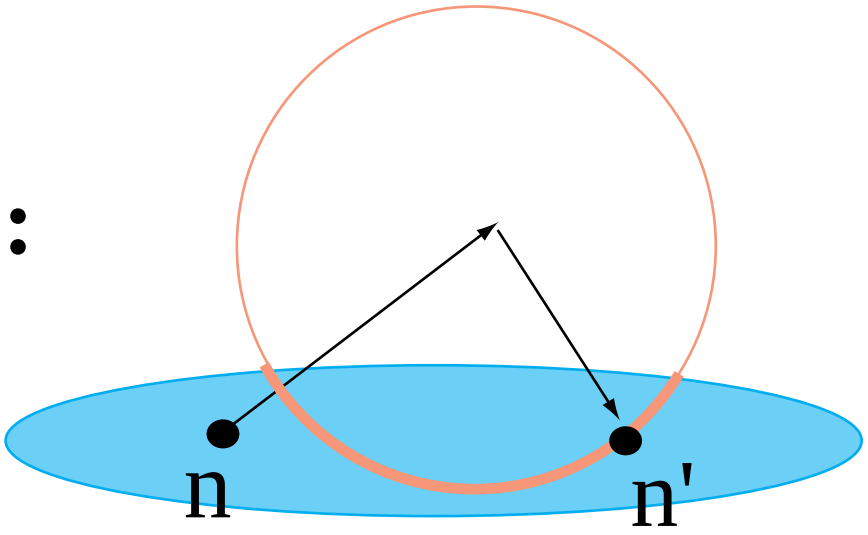
BH : same 0.92 <- 0.92

BW: 0.92 <- 0.50

(2) Beam size effect

Taking account of large aspect ratio of beams;

LL:

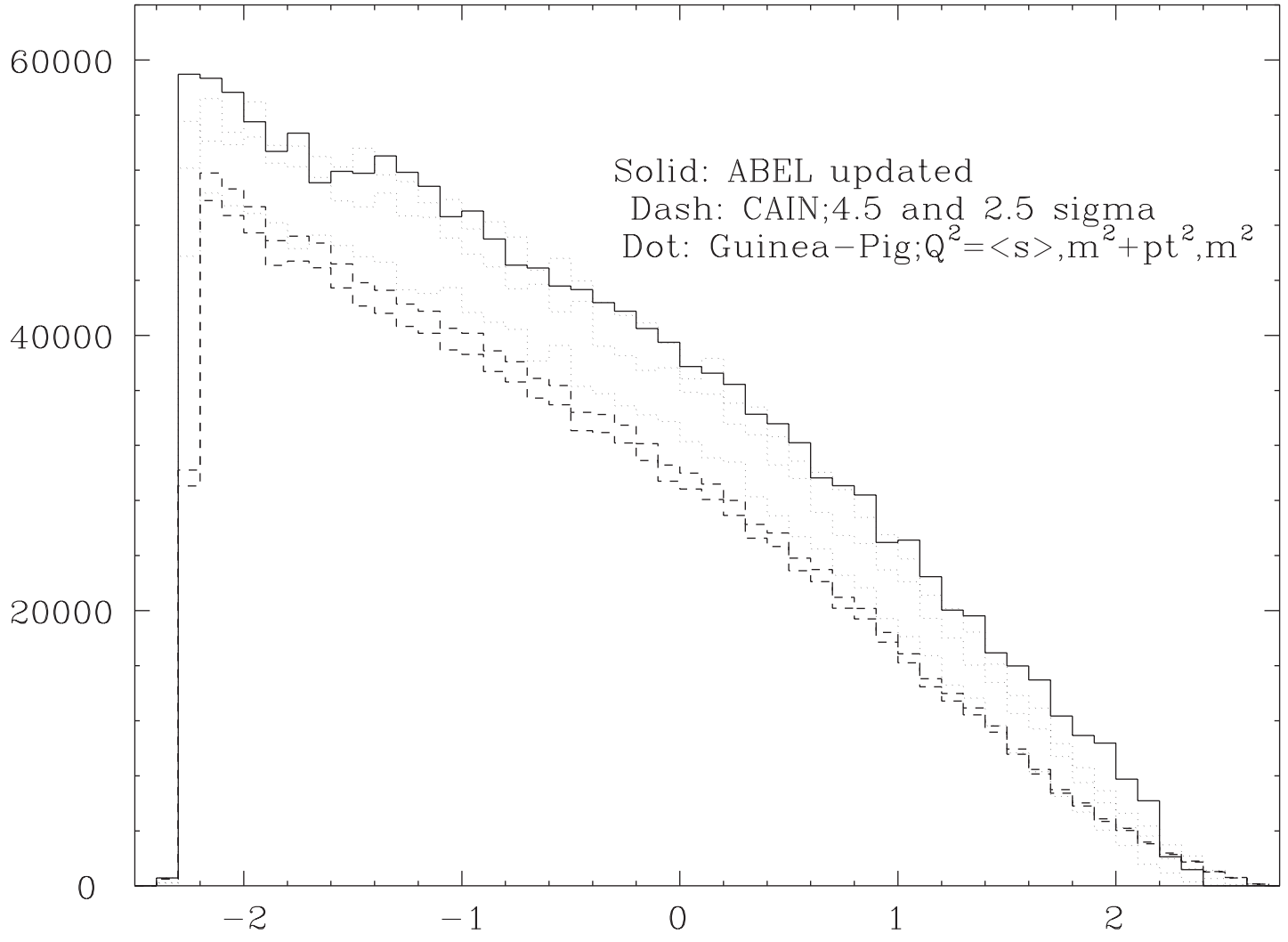


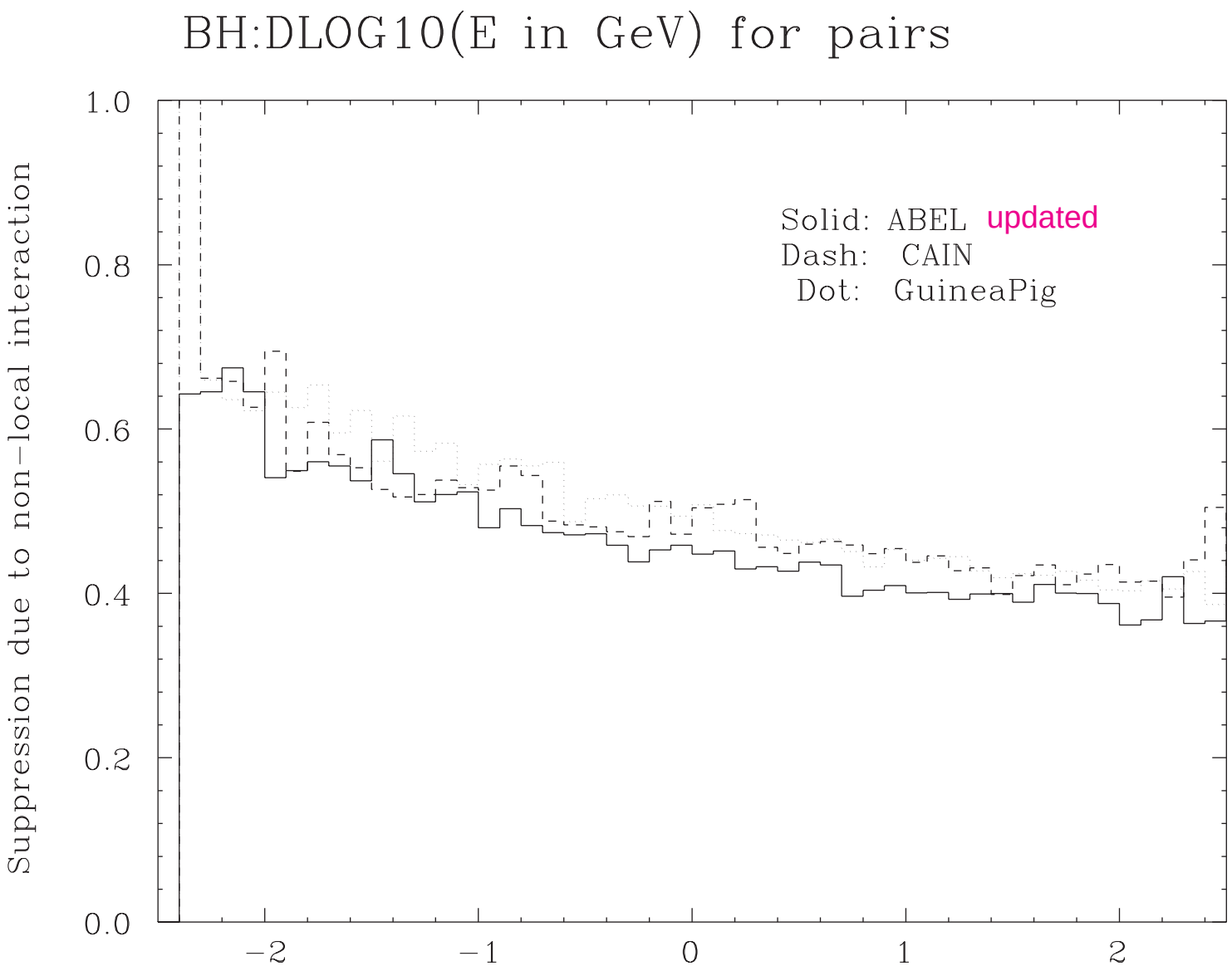
Suppression factor = $n\, n' / n^2$

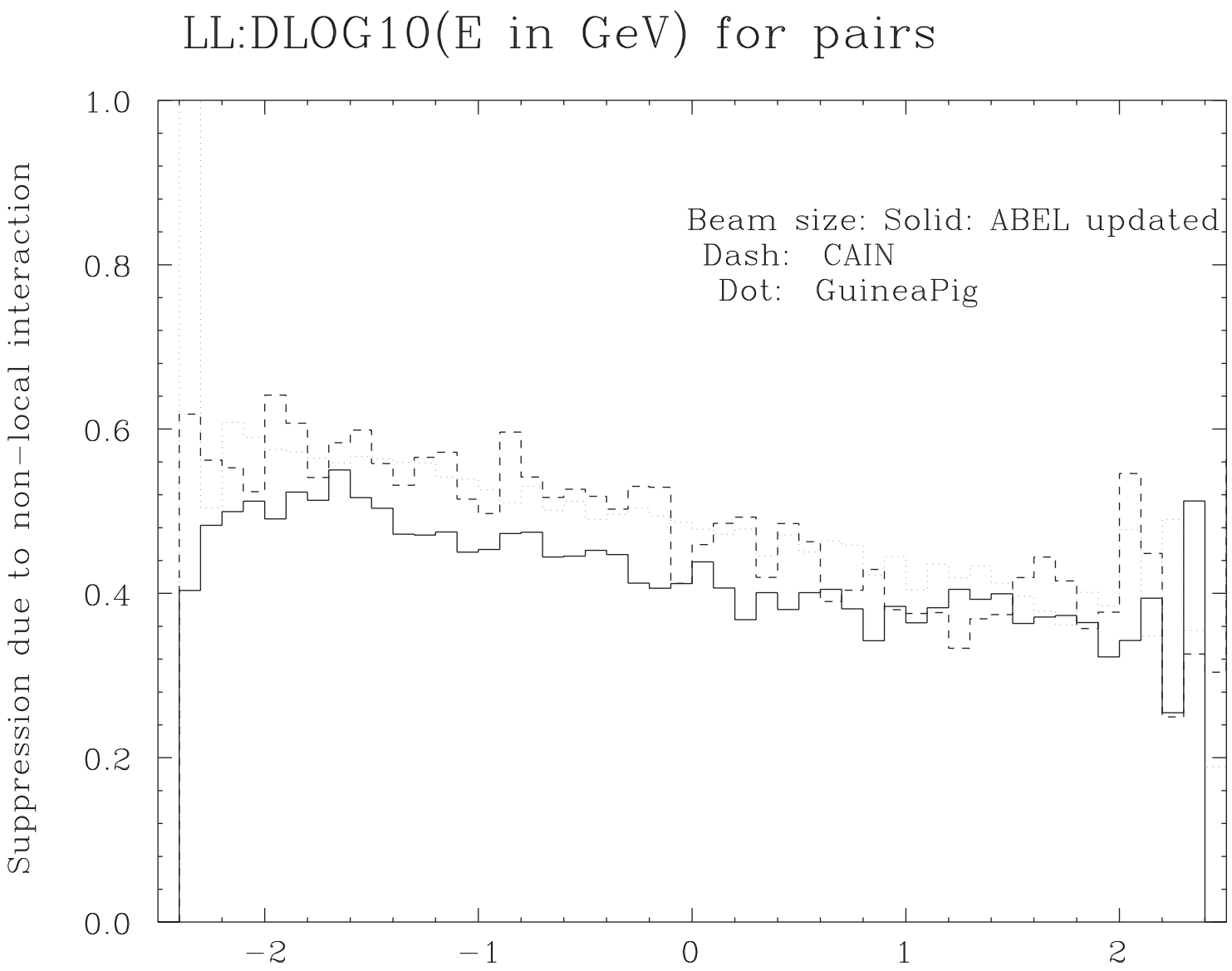
previously allows all region on a circle, but only thick region must be considered.

also a case of $n\, n' / n^2 > 1$ is taken account of.

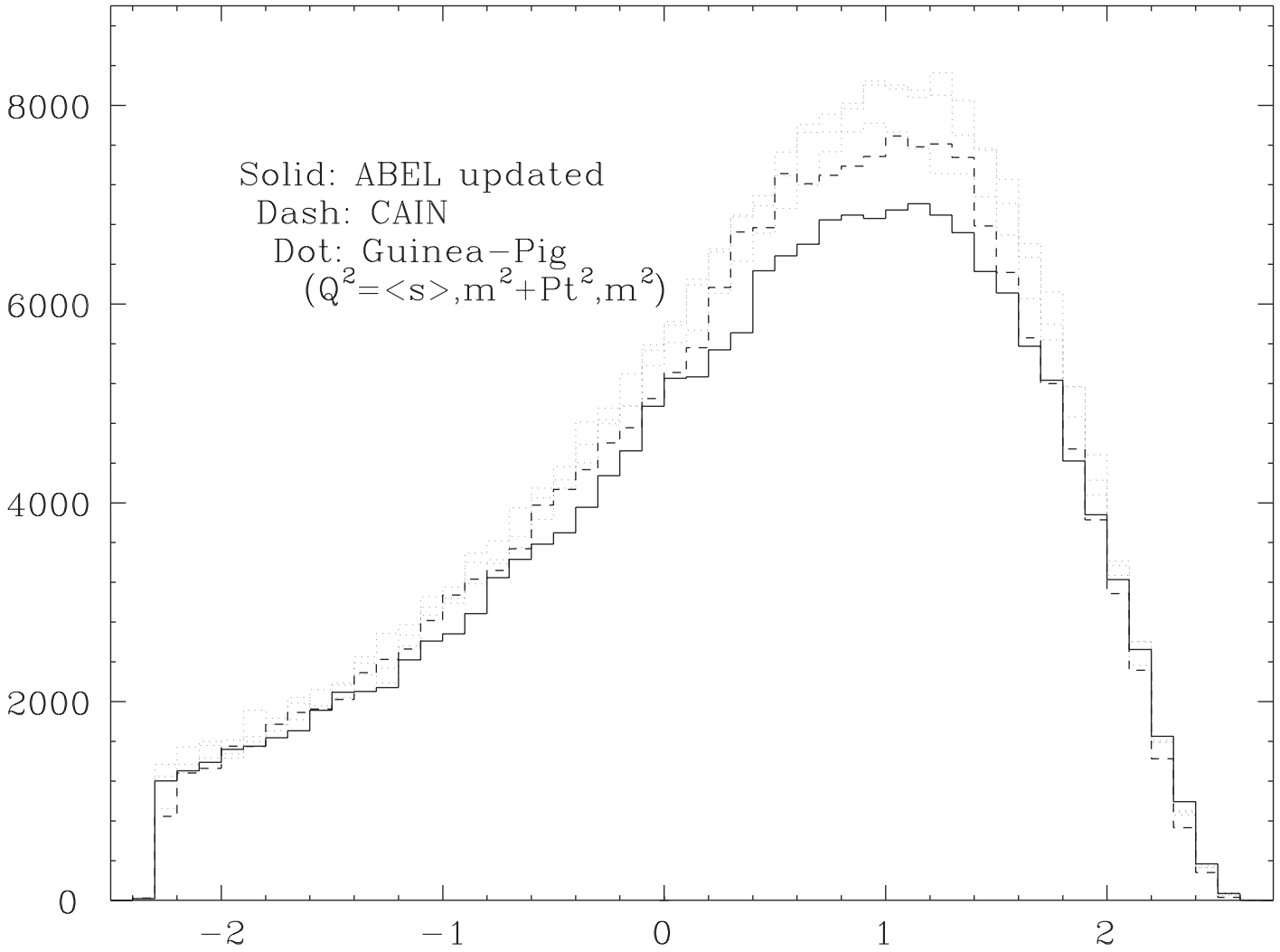
No effect:LL:DLOG10(E in GeV) for pairs



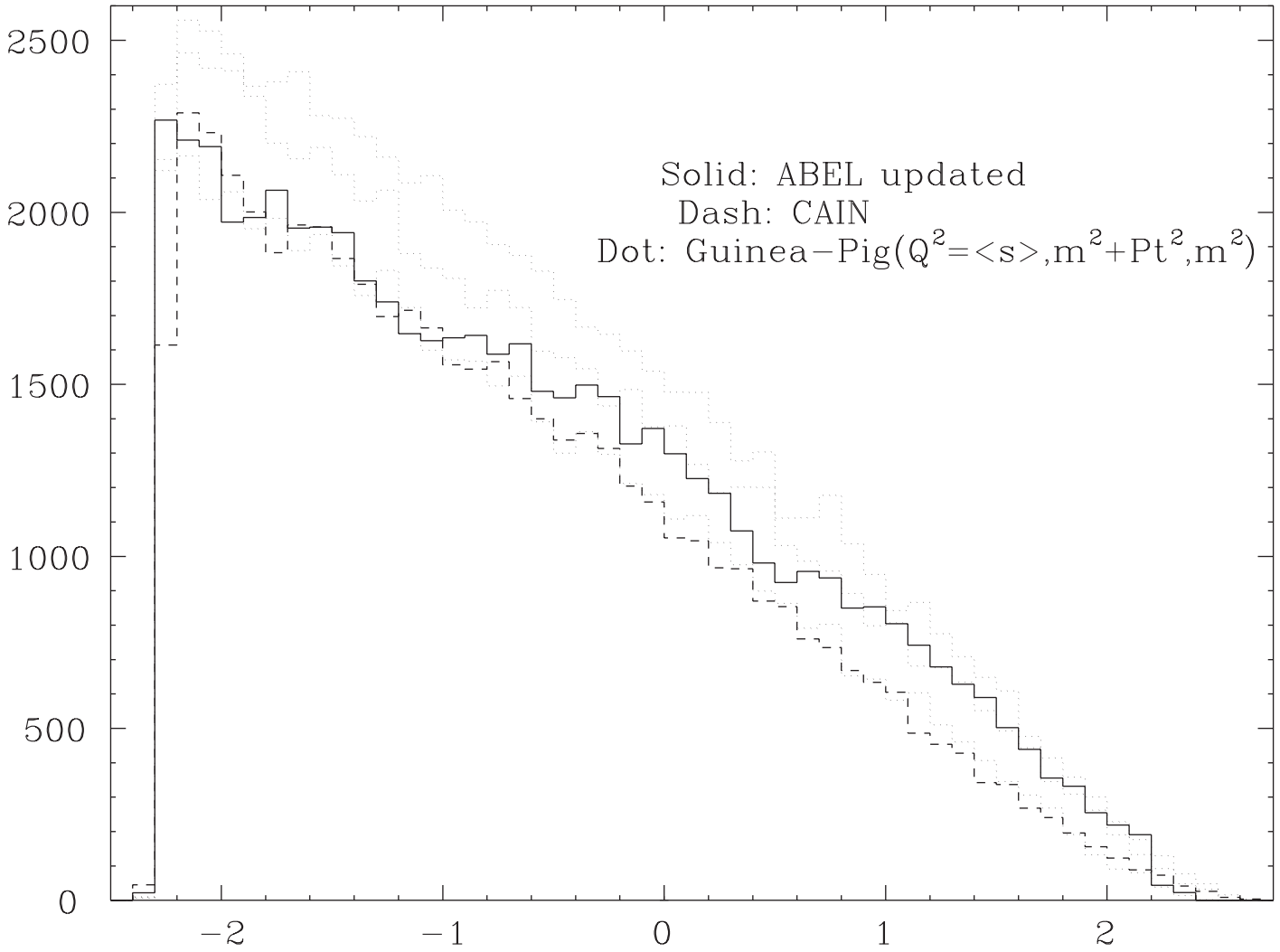

BH:DLOG10(E in GeV) for pairs
Suppression due to non-local interaction
1.0
0.8
0.6
0.4
0.2
0.0
−2
−1
0
1
2
Solid: ABEL updated
Dash: CAIN
Dot: GuineaPig


LL:DLOG10(E in GeV) for pairs
Suppression due to non-local interaction
1.0
0.8
0.6
0.4
0.2
0.0
−2
−1
0
1
2
Beam size: Solid: ABEL updated
Dash: CAIN
Dot: GuineaPig

Full effect: BH:DLOG10(E in GeV) for pairs



Full effect: LL:DLOG10(E in GeV) for pairs



5. Some results of JIM simulations

Following numbers are those per bunch crossing. Numbers in parentheses are normalized ones of 10 bunch crossings.

	γ at r=30cm	tracks r>40cm		hits r>40cm	
ABEL	52 (115.1)	10 (18,3)	3 (3.5)	117 (315.3)	1 (4.9)
updated-ABEL	62	18	4	215	9
CAIN	107	16	4	294	5
GP	67	14	1	142	3

So, there is no significant difference within statistical errors.

6. Conclusions

1. Three agree on various luminosity calculations and beam-beam deflections.

2. ABEL has about 20% less pairs compared with CAIN and GP.

But,	"no effect"	beam size effect
LL	x 1.8	x 0.63
BH	same	x 0.78
BW	x 1.5	-

3. CAIN agrees very well with GP (pair_q2=0).

4. ABEL was updated for the beam size effect and patch factors (0.9, 0.92, 0.92 for LL, BH, BW). There are still difference in the beam size effects although they are small as;

	beam size effect
LL	x 0.90
BH	x 0.94

5. Overall, three programs give consistent results for backgrounds based on JIM simulations even for previous ABEL.