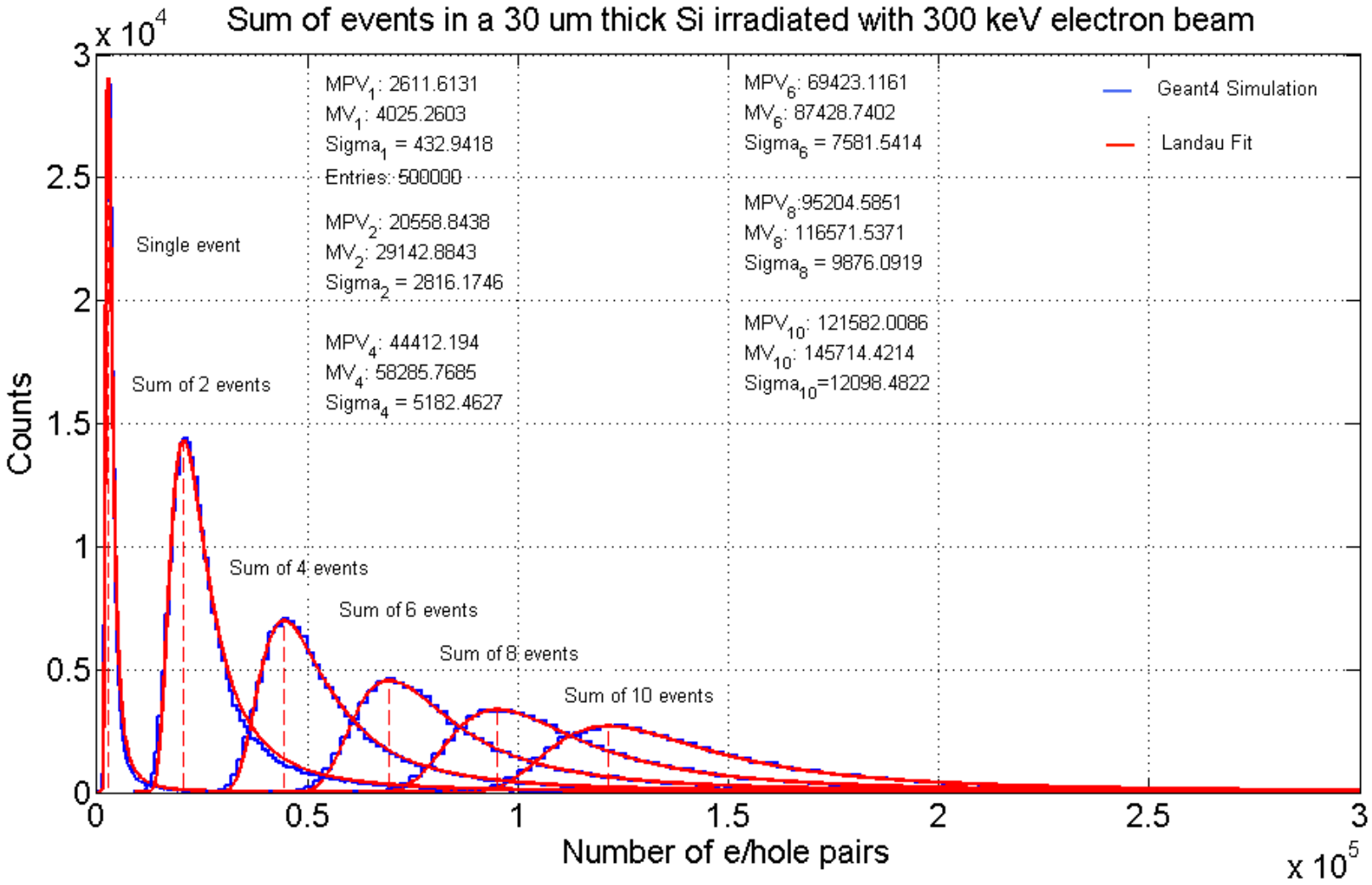
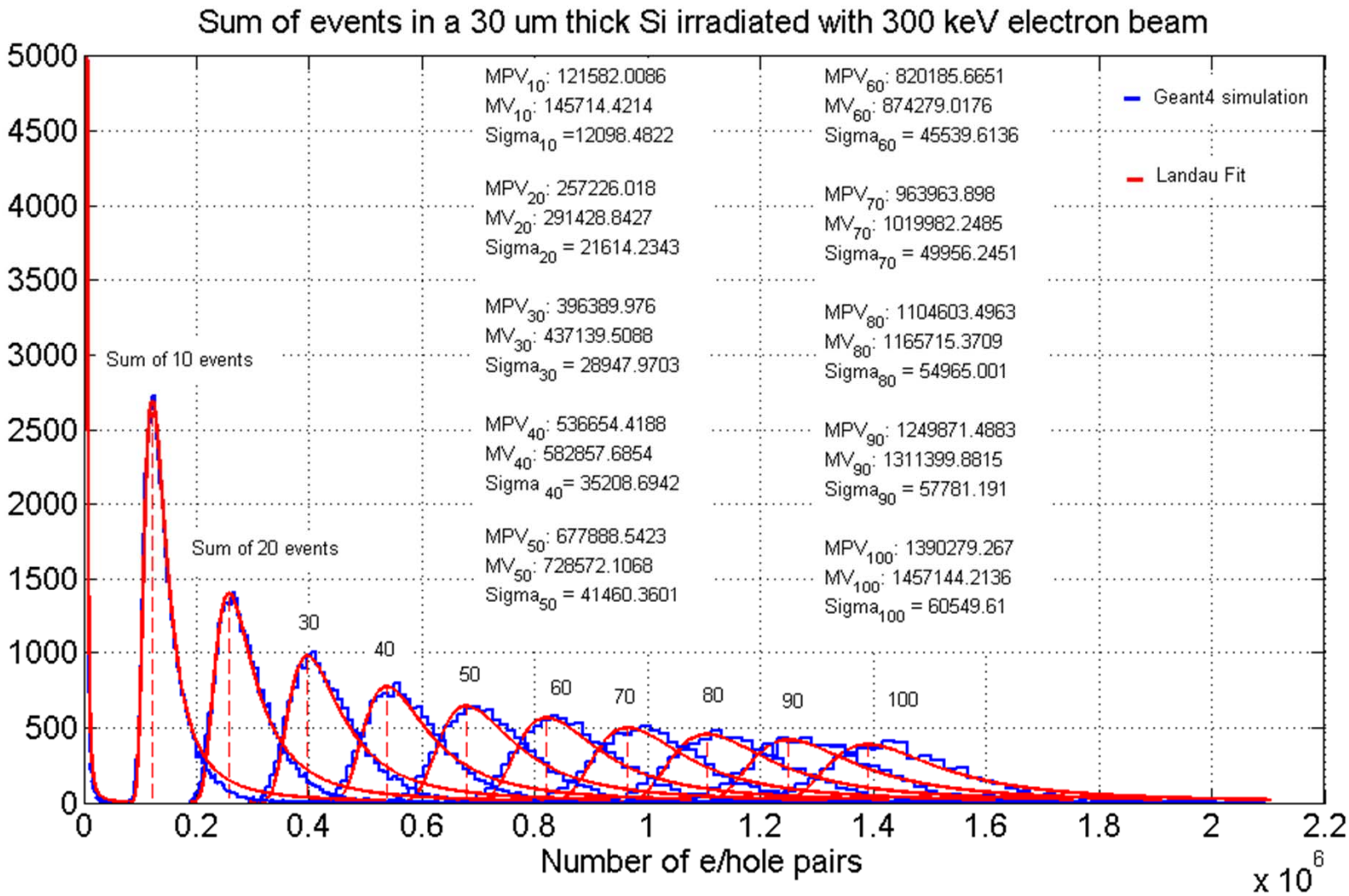
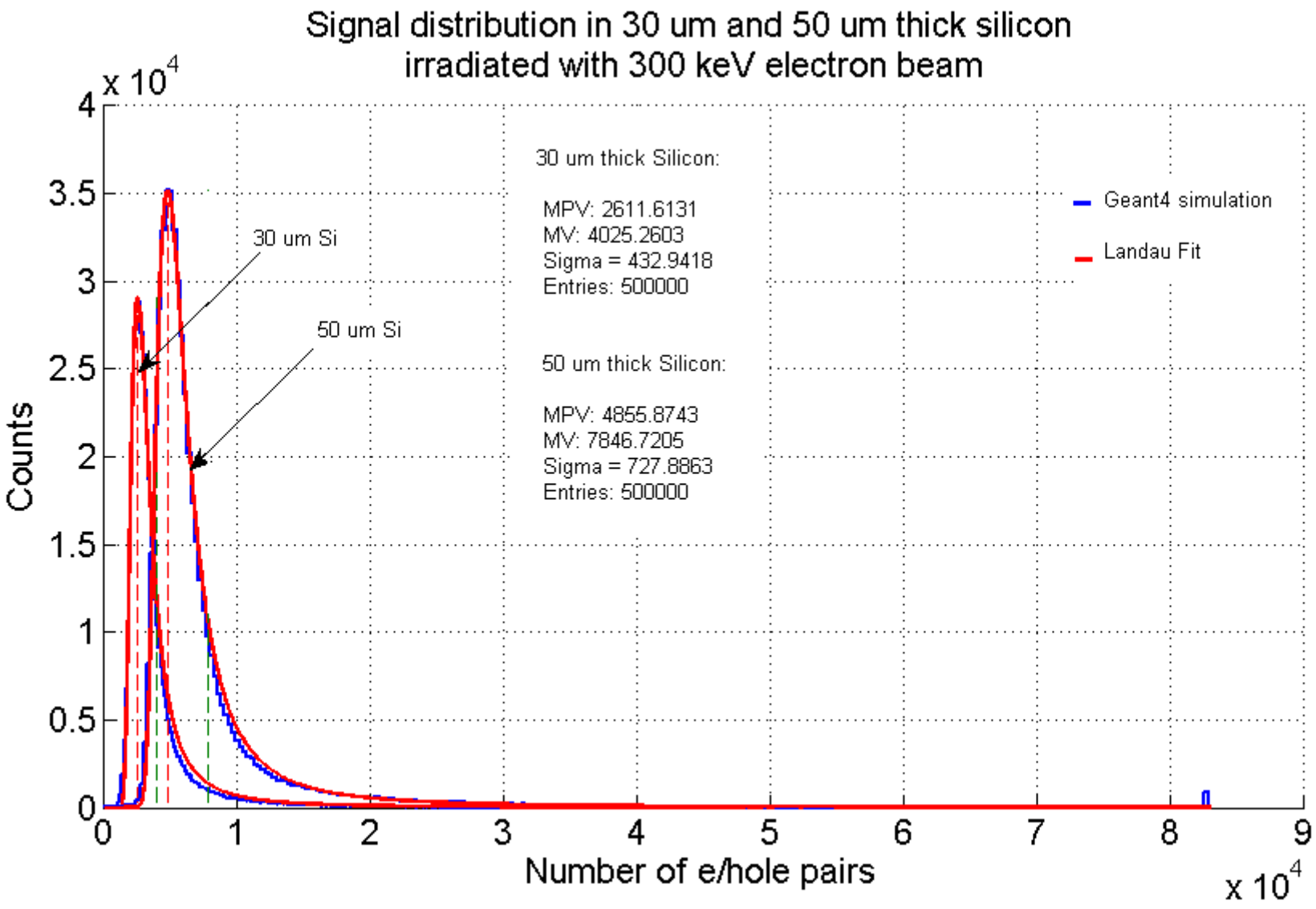
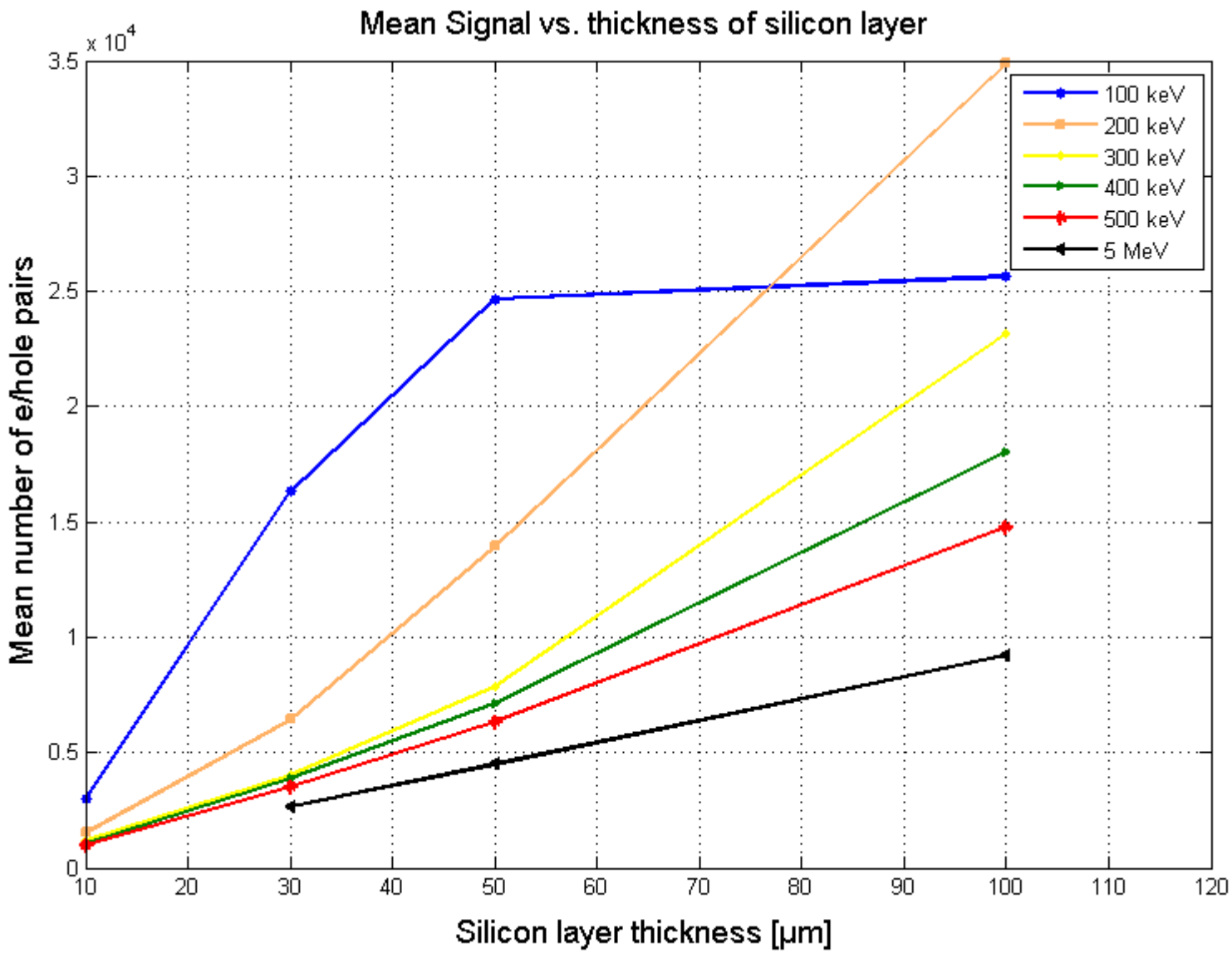
1. Which sensitive layer thickness? 30 or 50 µm?
    - From a statistical point: No indication that 30 µm is worse than 50 µm!

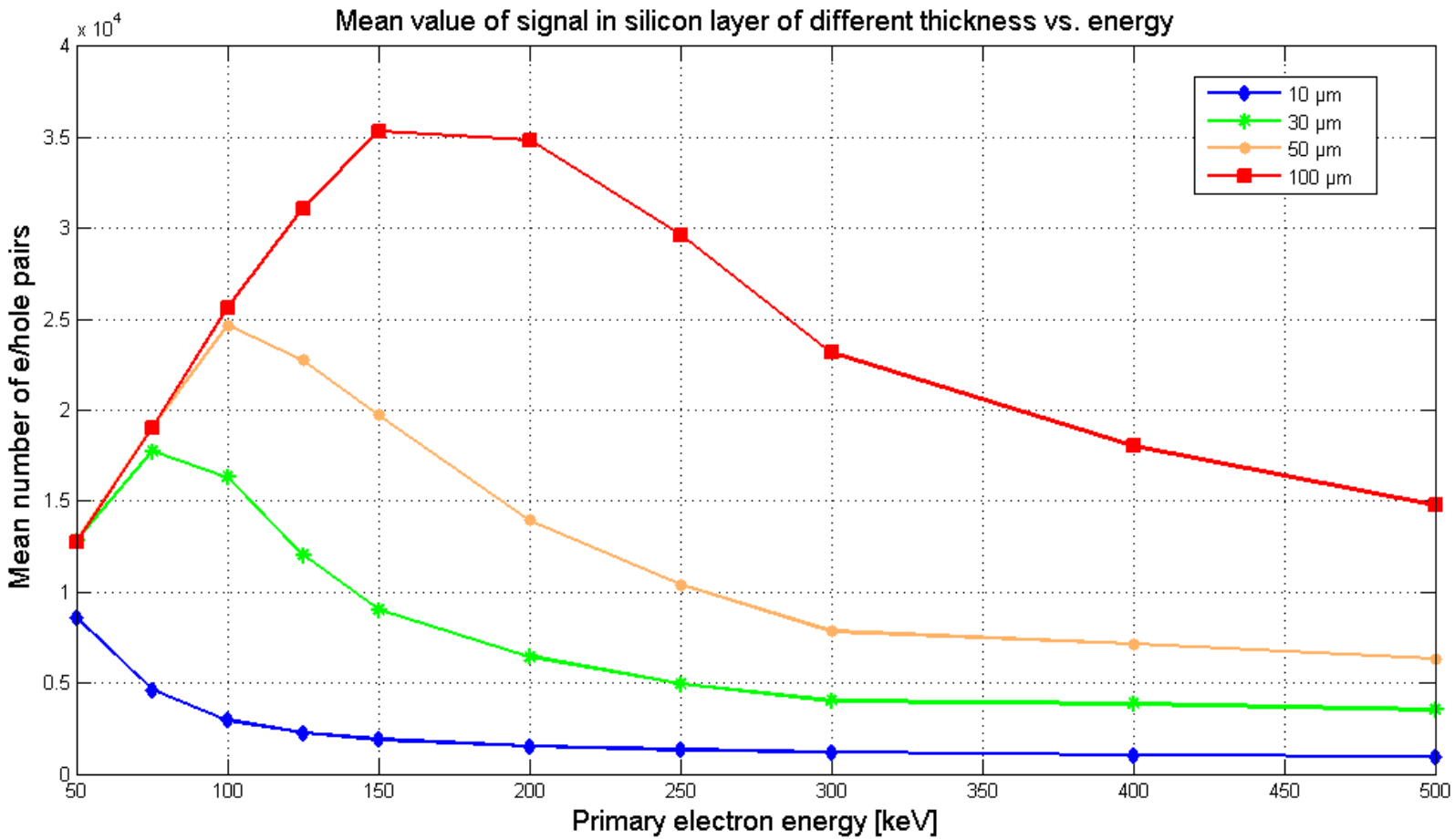
2. Can we allow a support layer to the thin sensitive layer?
    - From a statistical point: Probably….

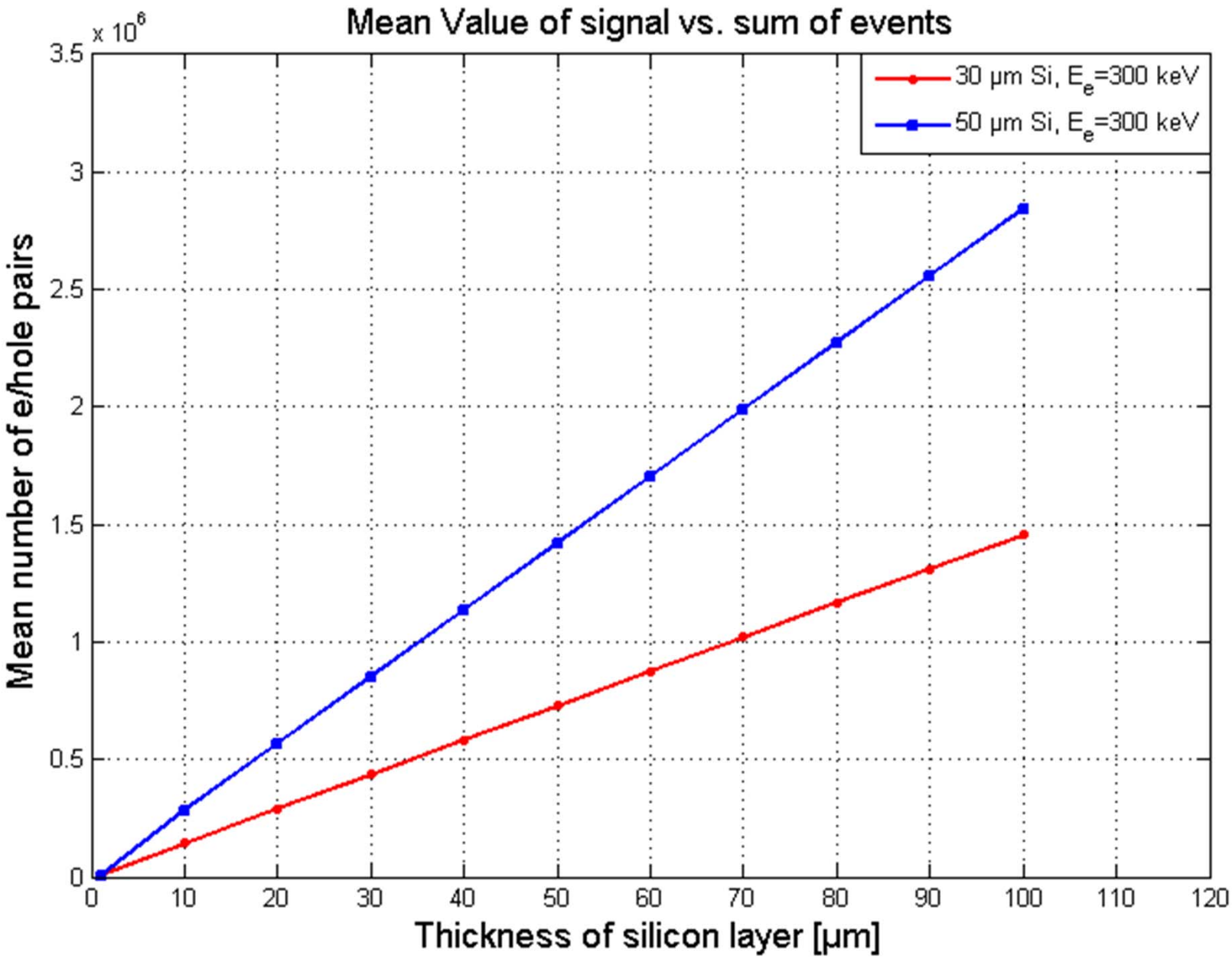

Sum of events in a 30 um thick Si irradiated with 300 keV electron beam
x 10^4
Counts
Number of e/hole pairs
x 10^5
MPV1: 2611.6131
MV1: 4025.2603
Sigma1 = 432.9418
Entries: 500000
MPV2: 20558.8438
MV2: 29142.8843
Sigma2 = 2816.1746
MPV4: 44412.194
MV4: 58285.7685
Sigma4 = 5182.4627
MPV6: 69423.1161
MV6: 87428.7402
Sigma6 = 7581.5414
MPV8:95204.5851
MV8: 116571.5371
Sigma8 = 9876.0919
MPV10: 121582.0086
MV10: 145714.4214
Sigma10=12098.4822
Geant4 Simulation
Landau Fit
Single event
Sum of 2 events
Sum of 4 events
Sum of 6 events
Sum of 8 events
Sum of 10 events

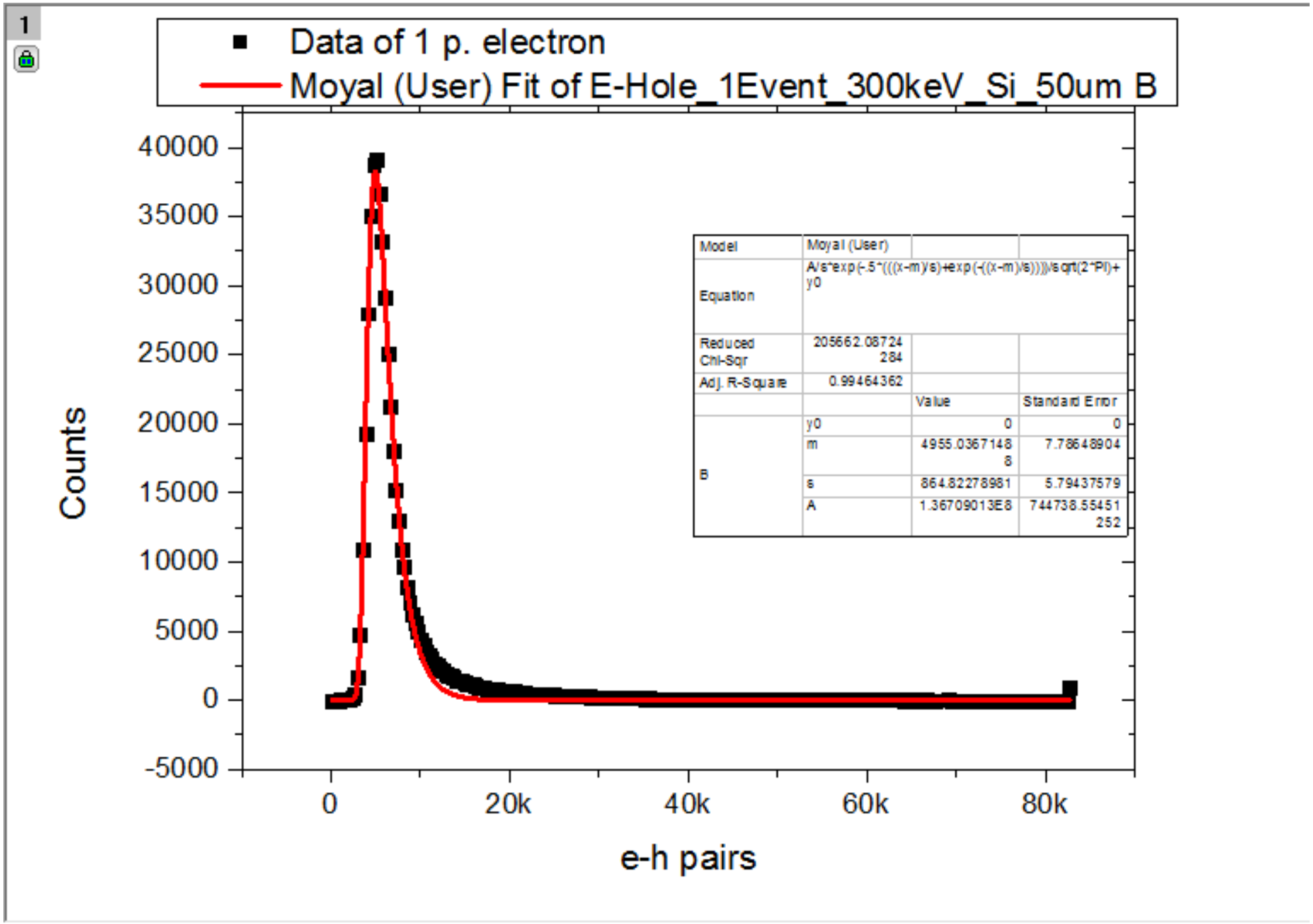

Sum of events in a 30 um thick Si irradiated with 300 keV electron beam
MPV10: 121582.0086
MV10: 145714.4214
Sigma10 =12098.4822
MPV20: 257226.018
MV20: 291428.8427
Sigma20 = 21614.2343
MPV30: 396389.976
MV30: 437139.5088
Sigma30 = 28947.9703
MPV40: 536654.4188
MV40: 582857.6854
Sigma 40= 35208.6942
MPV50: 677888.5423
MV50: 728572.1068
Sigma50 = 41460.3601
MPV60: 820185.6651
MV60: 874279.0176
Sigma60 = 45539.6136
MPV70: 963963.898
MV70: 1019982.2485
Sigma70 = 49956.2451
MPV80: 1104603.4963
MV80: 1165715.3709
Sigma80 = 54965.001
MPV90: 1249871.4883
MV90: 1311399.8815
Sigma90 = 57781.191
MPV100: 1390279.267
MV100: 1457144.2136
Sigma100 = 60549.61
Geant4 simulation
Landau Fit
Sum of 10 events
Sum of 20 events
30
40
50
60
70
80
90
100
Number of e/hole pairs
x 10^6


Signal distribution in 30 um and 50 um thick silicon
irradiated with 300 keV electron beam
x 10^4
4
3.5
3
2.5
2
1.5
1
0.5
0
Counts
30 um Si
50 um Si
30 um thick Silicon:
MPV: 2611.6131
MV: 4025.2603
Sigma = 432.9418
Entries: 500000
50 um thick Silicon:
MPV: 4855.8743
MV: 7846.7205
Sigma = 727.8863
Entries: 500000
Geant4 simulation
Landau Fit
0
1
2
3
4
5
6
7
8
9
Number of e/hole pairs
x 10^4


Mean Signal vs. thickness of silicon layer
x 10^4
3.5
3
2.5
2
1.5
1
0.5
0
Mean number of e/hole pairs
10
20
30
40
50
60
70
80
90
100
110
120
Silicon layer thickness [µm]
100 keV
200 keV
300 keV
400 keV
500 keV
5 MeV


Mean value of signal in silicon layer of different thickness vs. energy
x 10^4
4
3.5
3
2.5
2
1.5
1
0.5
0
Mean number of e/hole pairs
50
100
150
200
250
300
350
400
450
500
Primary electron energy [keV]
10 μm
30 μm
50 μm
100 μm


Mean Value of signal vs. sum of events
x 10^6
3.5
3
2.5
2
1.5
1
0.5
0
Mean number of e/hole pairs
0
10
20
30
40
50
60
70
80
90
100
110
120
Thickness of silicon layer [µm]
30 µm Si, E_e=300 keV
50 µm Si, E_e=300 keV

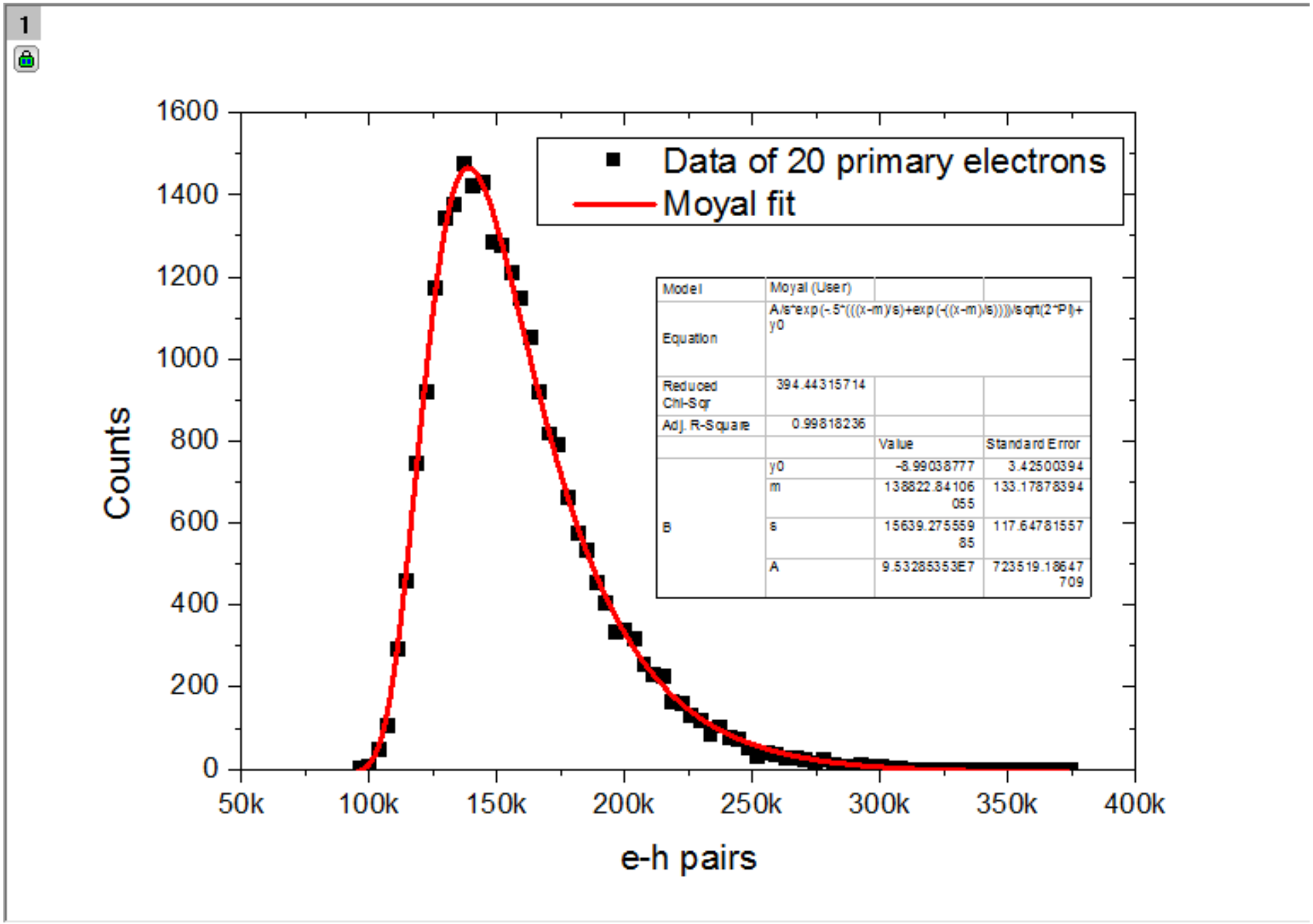

1
Data of 1 p. electron
Moyal (User) Fit of E-Hole_1Event_300keV_Si_50um B
Counts
e-h pairs
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
0
20k
40k
60k
80k
Model
Moyal (User)
Equation
A/s*exp(-.5*(((x-m)/s)+exp(-((x-m)/s))))/sqrt(2*PI)+y0
Reduced Chi-Sqr
205662.087242 84
Adj. R-Square
0.99464362
Value
Standard Error
B
y0
0
0
m
4955.03671488
7.78648904
s
864.82278981
5.79437579
A
1.36709013E8
744738.55451252

$$moyal := \frac{1}{2} \frac{A\, e^{-0.5\,\lambda - 0.5\, e^{-\lambda}} \sqrt{2}}{\sqrt{\pi}} + y0$$

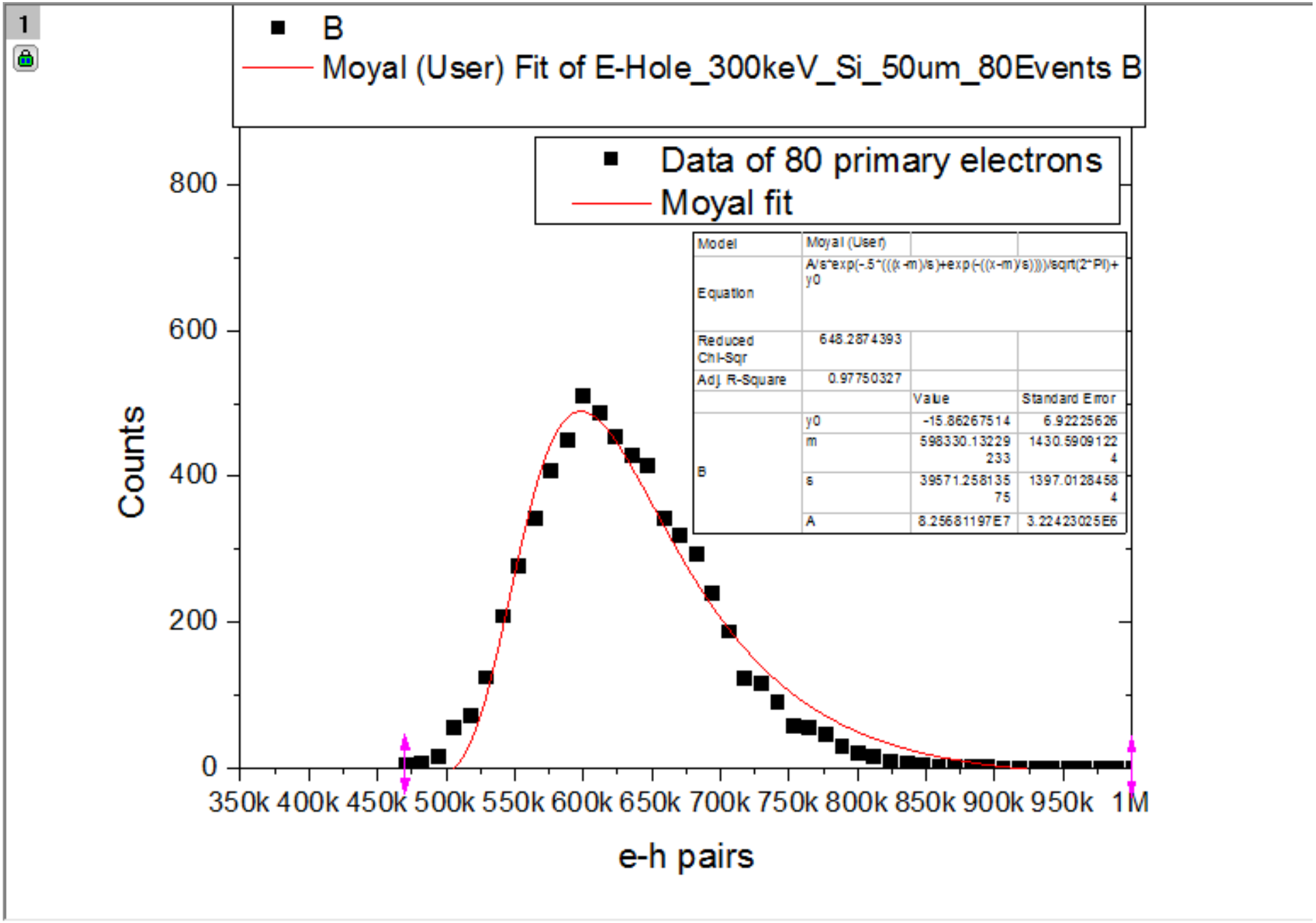
$$\lambda := \frac{x - m}{s}$$

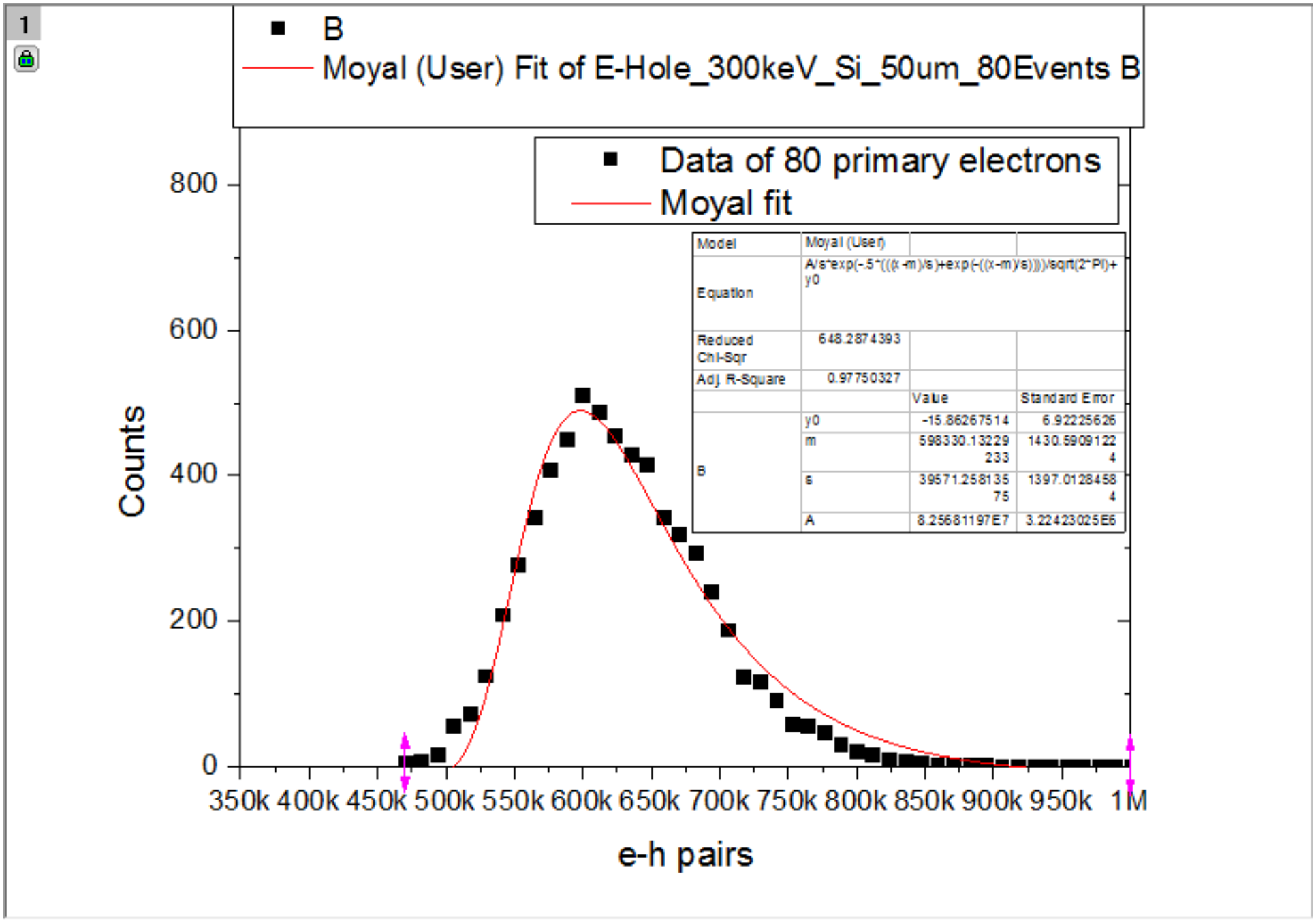
m: most prob. Value
s: “Width”

Int(moyal, m-2s, m+2s) = 70%

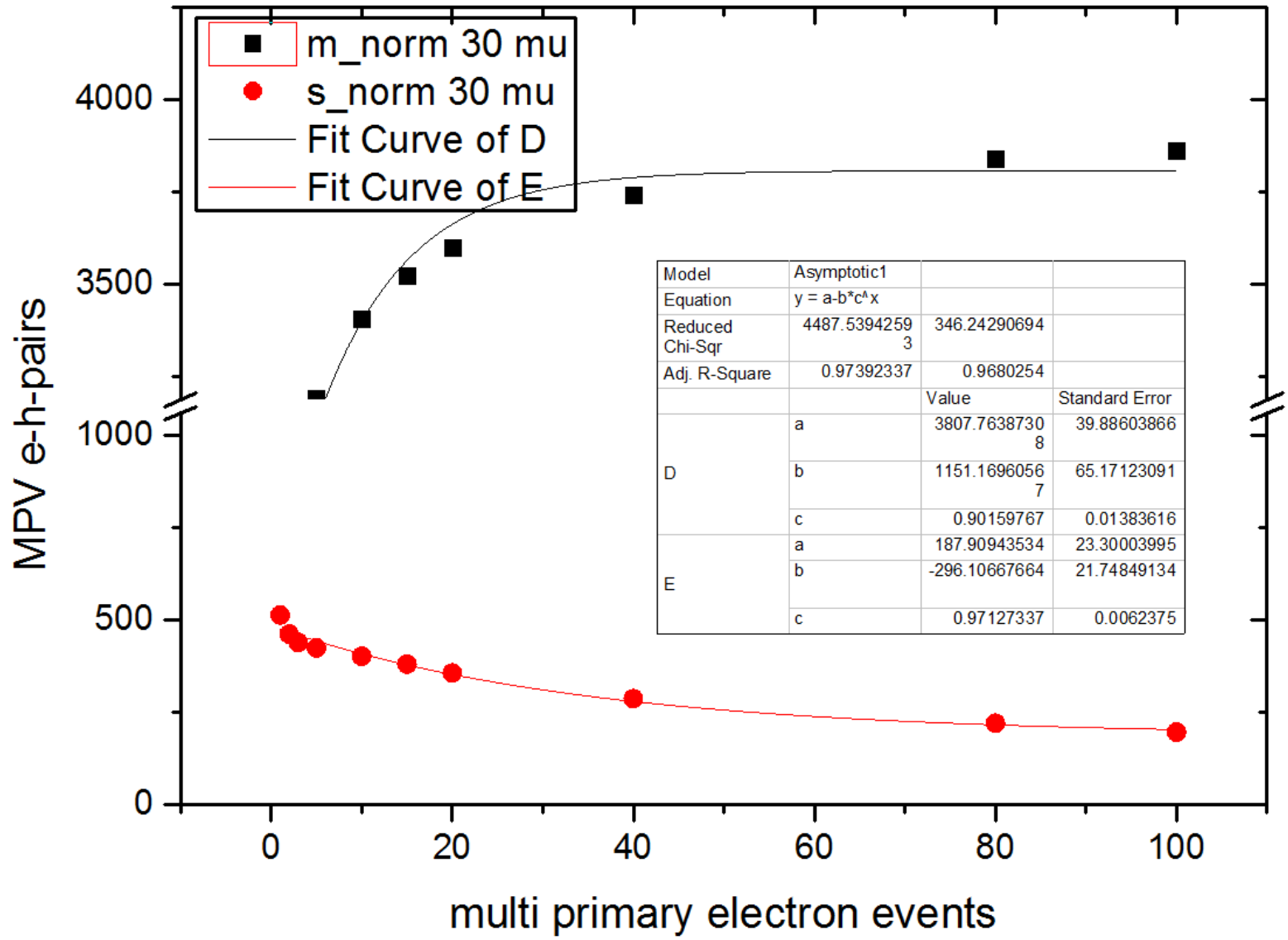


Model	Moyal (User)		
Equation	A/s*exp(-.5*(((x-m)/s)+exp(-((x-m)/s))))/sqrt(2*PI)+y0		
Reduced Chi-Sqr	394.44315714		
Adj. R-Square	0.99818236		
		Value	Standard Error
B	y0	-8.99038777	3.42500394
	m	138822.84106055	133.17878394
	s	15639.27555985	117.64781557
	A	9.53285353E7	723519.18647709

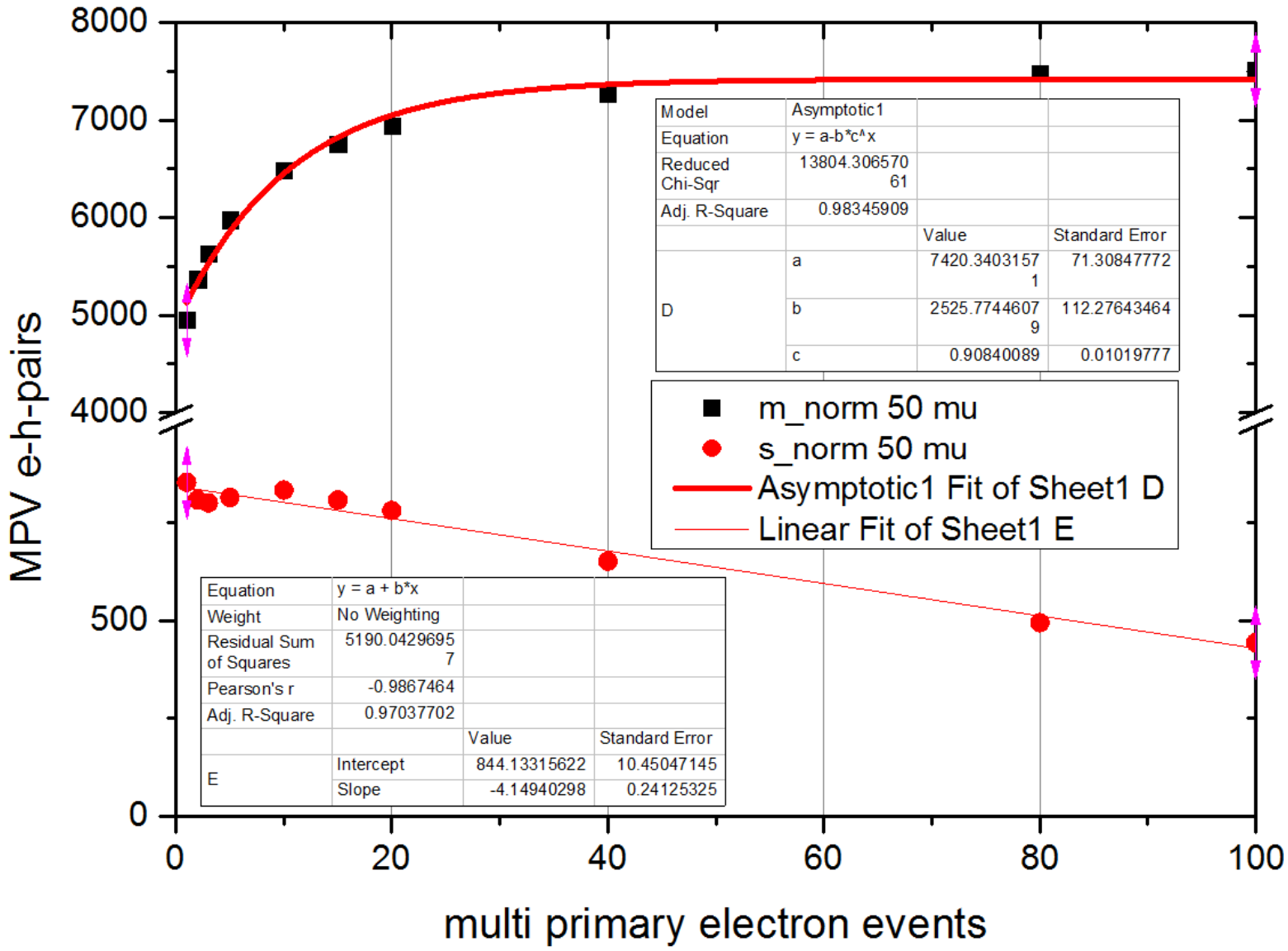

1
B
Moyal (User) Fit of E-Hole_300keV_Si_50um_80Events B
Data of 80 primary electrons
Moyal fit
Model
Moyal (User)
Equation
A/s*exp(-.5*(((x-m)/s)+exp(-((x-m)/s))))/sqrt(2*PI)+y0
Reduced Chi-Sqr
648.2874393
Adj. R-Square
0.97750327
Value
Standard Error
B
y0
-15.86267514
6.92225626
m
598330.132292334
1430.59091224
s
39571.25813575
1397.01284584
A
8.25681197E7
3.22423025E6
Counts
800
600
400
200
0
350k 400k 450k 500k 550k 600k 650k 700k 750k 800k 850k 900k 950k 1M
e-h pairs



Model	Moyal (User)		
Equation	A/s*exp(-.5*(((x-m)/s)+exp(-((x-m)/s)))/sqrt(2*PI)+y0		
Reduced Chi-Sqr	648.2874393		
Adj. R-Square	0.97750327		
		Value	Standard Error
B	y0	-15.86267514	6.92225626
	m	598330.13229233	1430.59091224
	s	39571.25813575	1397.01284584
	A	8.25681197E7	3.22423025E6

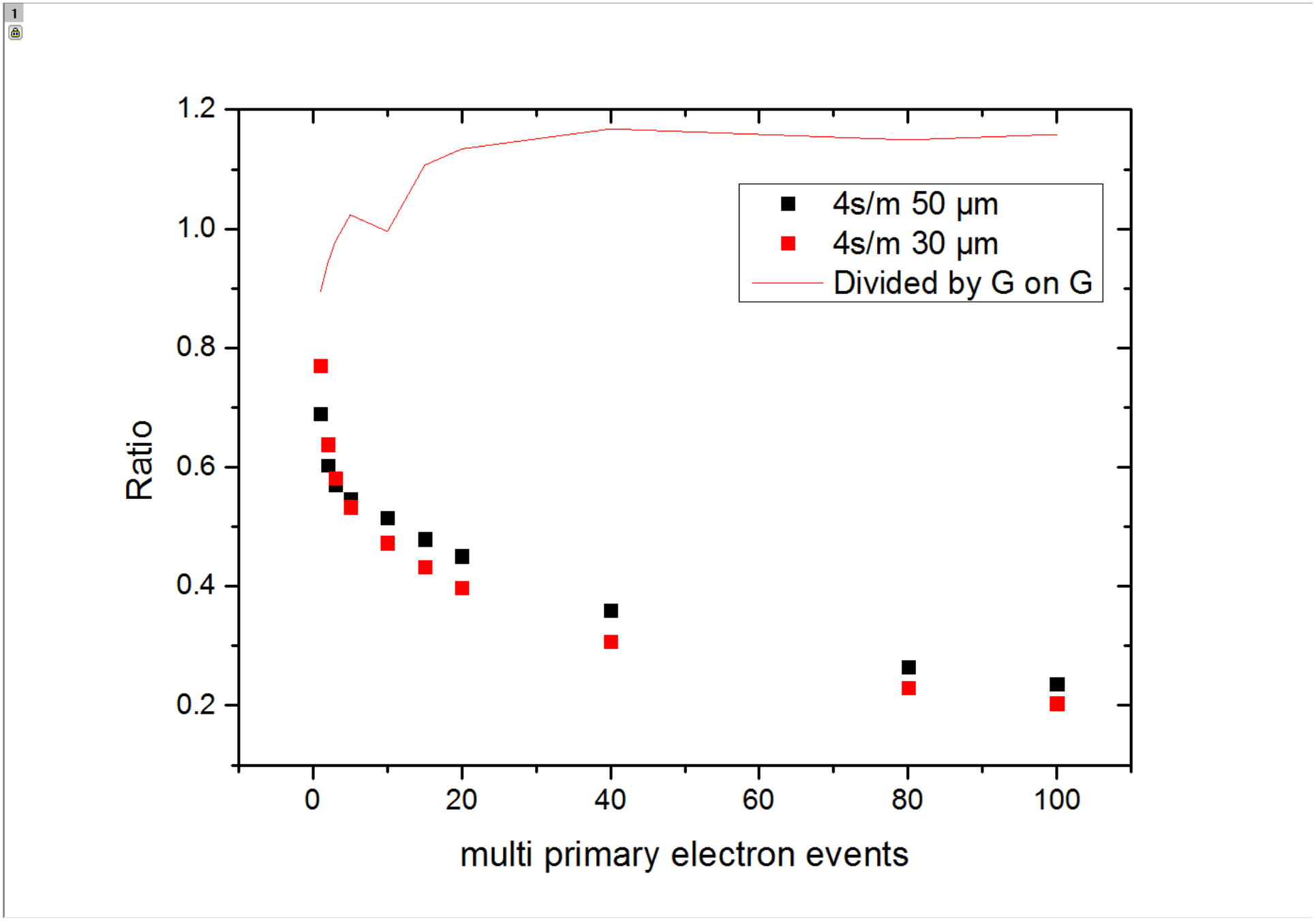


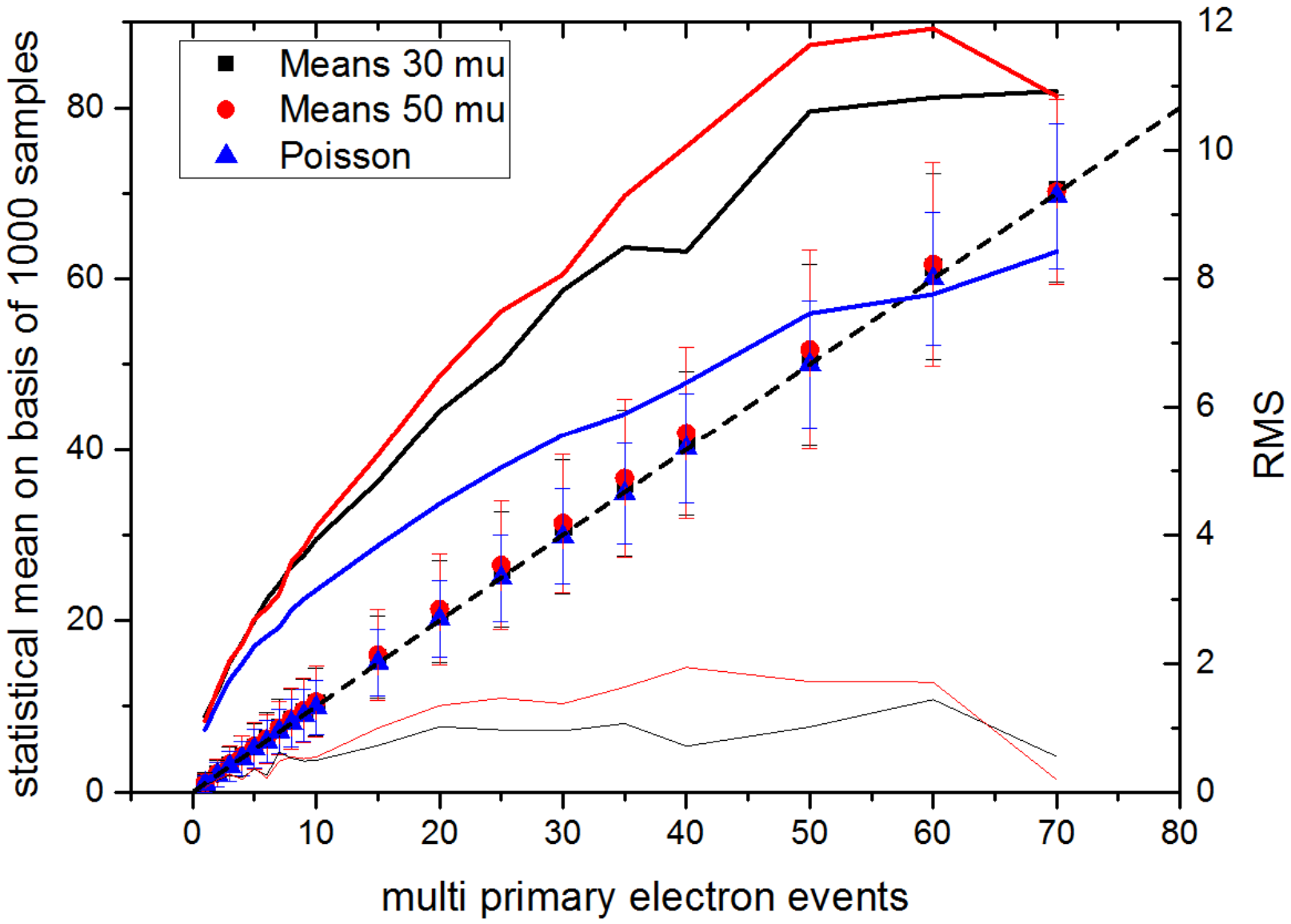
Model	Asymptotic1		
Equation	y = a-b*c^x		
Reduced Chi-Sqr	4487.53942593	346.24290694	
Adj. R-Square	0.97392337	0.9680254	
		Value	Standard Error
D	a	3807.76387308	39.88603866
	b	1151.16960567	65.17123091
	c	0.90159767	0.01383616
E	a	187.90943534	23.30003995
	b	-296.10667664	21.74849134
	c	0.97127337	0.0062375



Model	Asymptotic1		
Equation	y = a-b*c^x		
Reduced Chi-Sqr	13804.30657061		
Adj. R-Square	0.98345909		
		Value	Standard Error
D	a	7420.34031571	71.30847772
	b	2525.77446079	112.27643464
	c	0.90840089	0.01019777

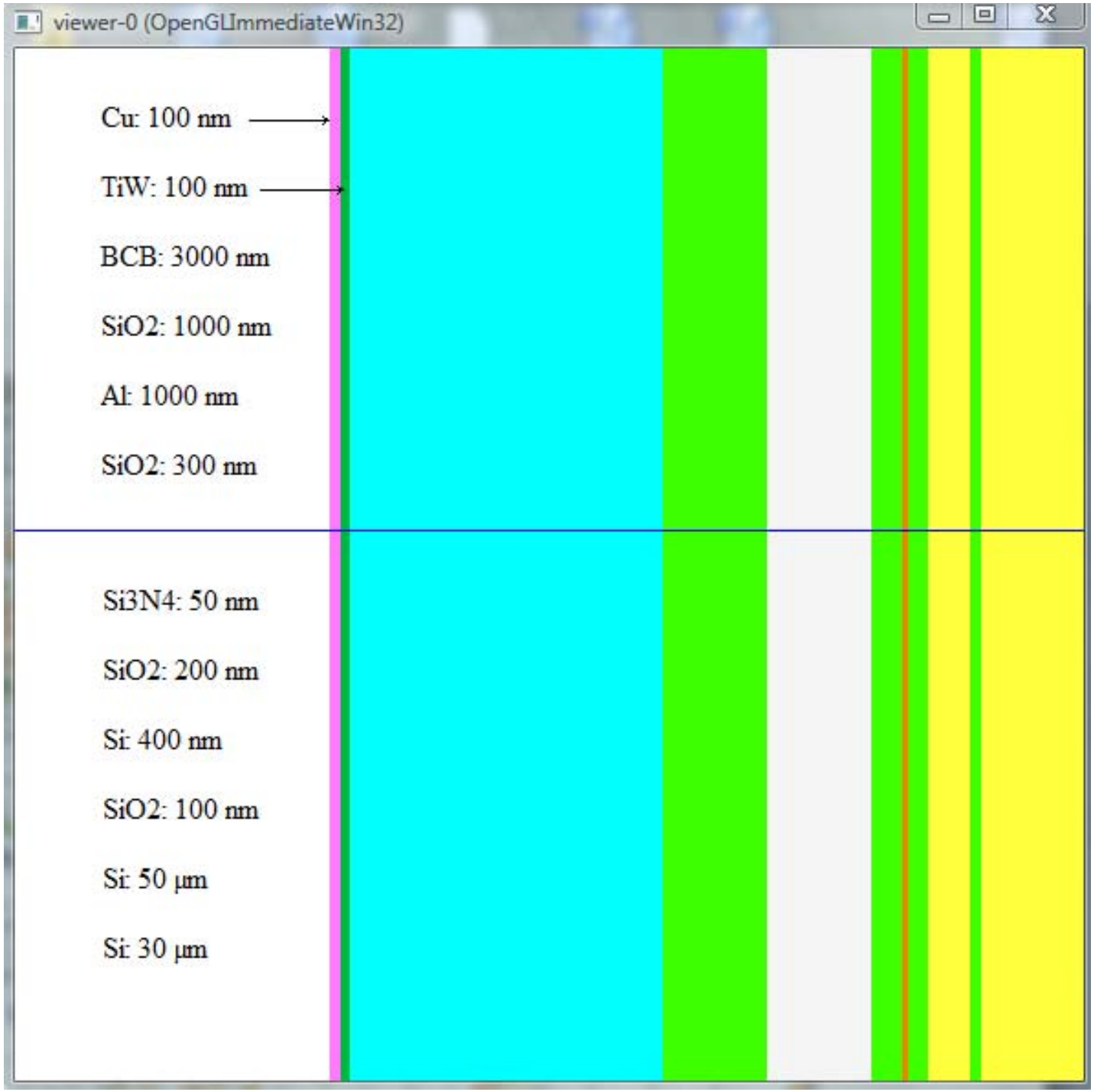
Equation	y = a + b*x		
Weight	No Weighting		
Residual Sum of Squares	5190.04296957		
Pearson's r	-0.9867464		
Adj. R-Square	0.97037702		
		Value	Standard Error
E	Intercept	844.13315622	10.45047145
	Slope	-4.14940298	0.24125325

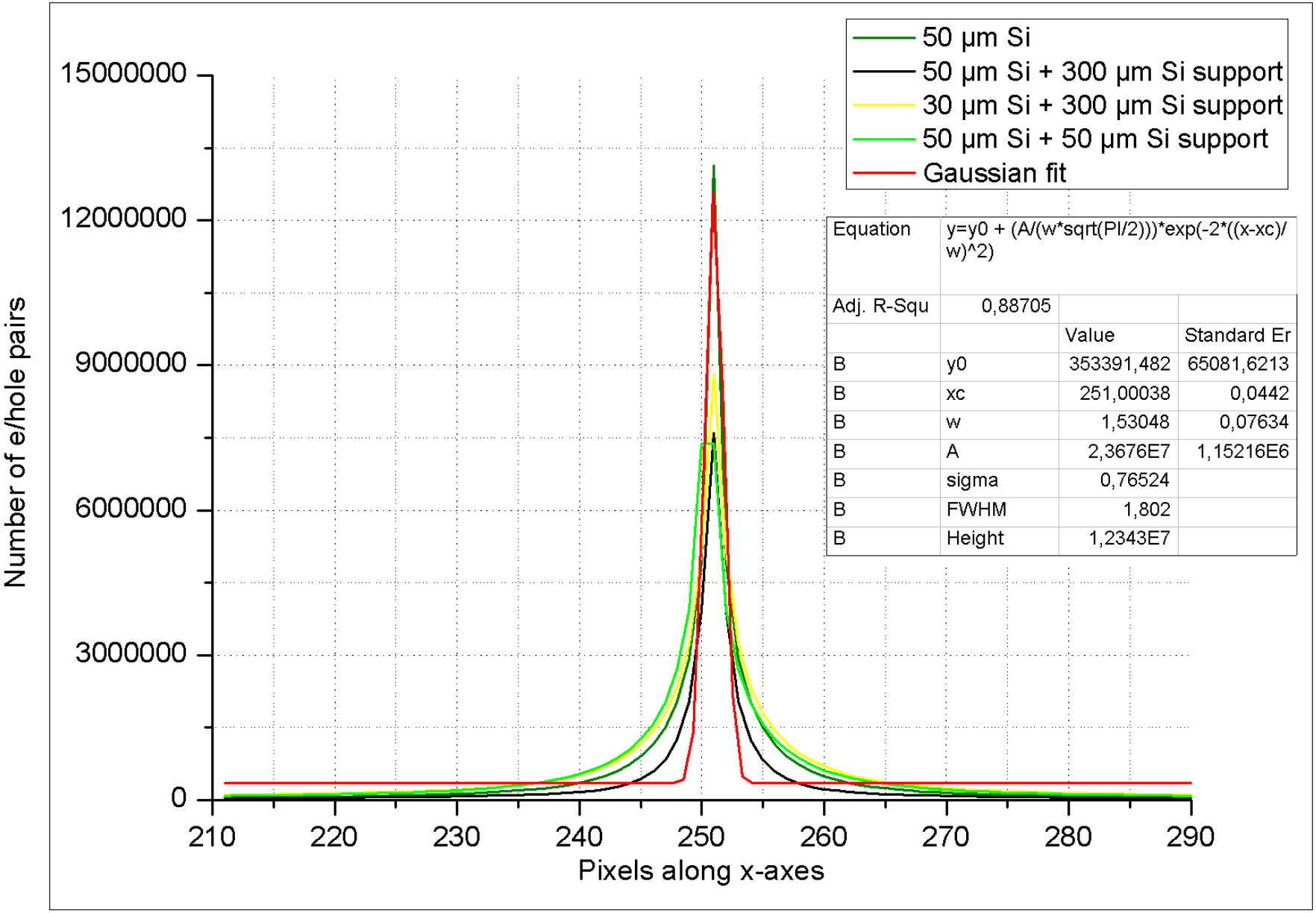

1.2
1.0
0.8
0.6
0.4
0.2
Ratio
0
20
40
60
80
100
multi primary electron events
4s/m 50 µm
4s/m 30 µm
Divided by G on G


Means 30 mu
Means 50 mu
Poisson
statistical mean on basis of 1000 samples
RMS
multi primary electron events
0
20
40
60
80
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80

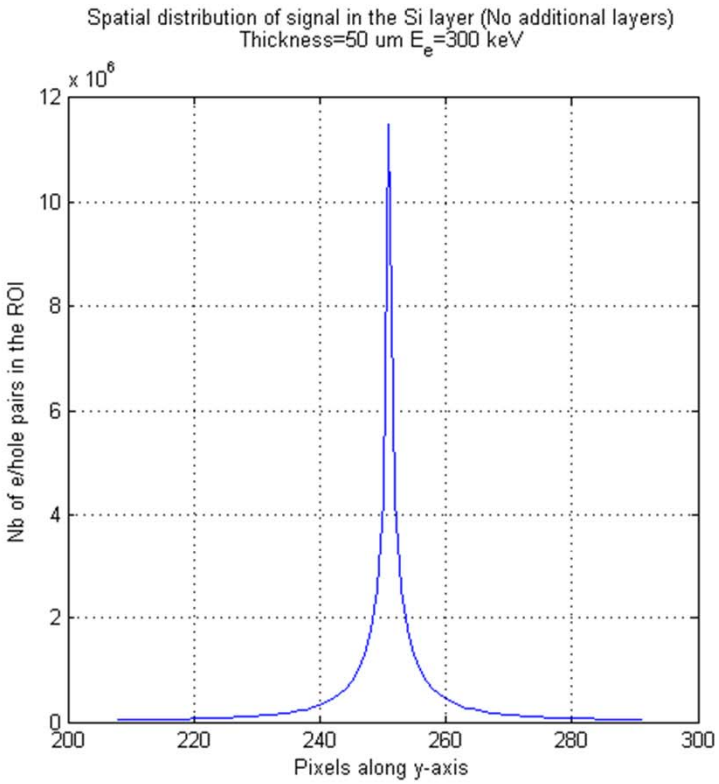
1. Which sensitive layer thickness? 30 or 50 µm?
    - From a statistical point: No indication that 30 µm is worse than 50 µm!

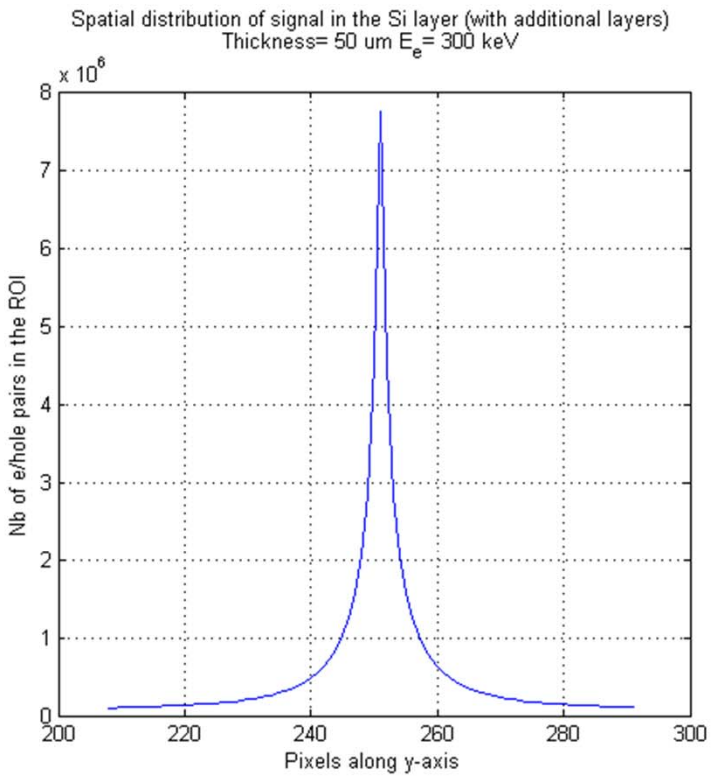
2. Can we allow a support layer to the thin sensitive layer?
    - From a statistical point: Probably….


viewer-0 (OpenGLImmediateWin32)
Cu: 100 nm
TiW: 100 nm
BCB: 3000 nm
SiO2: 1000 nm
Al: 1000 nm
SiO2: 300 nm
Si3N4: 50 nm
SiO2: 200 nm
Si: 400 nm
SiO2: 100 nm
Si: 50 µm
Si: 30 µm



Equation	y=y0 + (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Adj. R-Squ	0,88705		
		Value	Standard Er
B	y0	353391,482	65081,6213
B	xc	251,00038	0,0442
B	w	1,53048	0,07634
B	A	2,3676E7	1,15216E6
B	sigma	0,76524	
B	FWHM	1,802	
B	Height	1,2343E7	


Spatial distribution of signal in the Si layer (No additional layers)
Thickness=50 um E_e=300 keV
x 10^6
Nb of e/hole pairs in the ROI
Pixels along y-axis
0
2
4
6
8
10
12
200
220
240
260
280
300


Spatial distribution of signal in the Si layer (with additional layers)
Thickness= 50 um E_e= 300 keV
x 10^6
Nb of e/hole pairs in the ROI
Pixels along y-axis
0
1
2
3
4
5
6
7
8
200
220
240
260
280
300

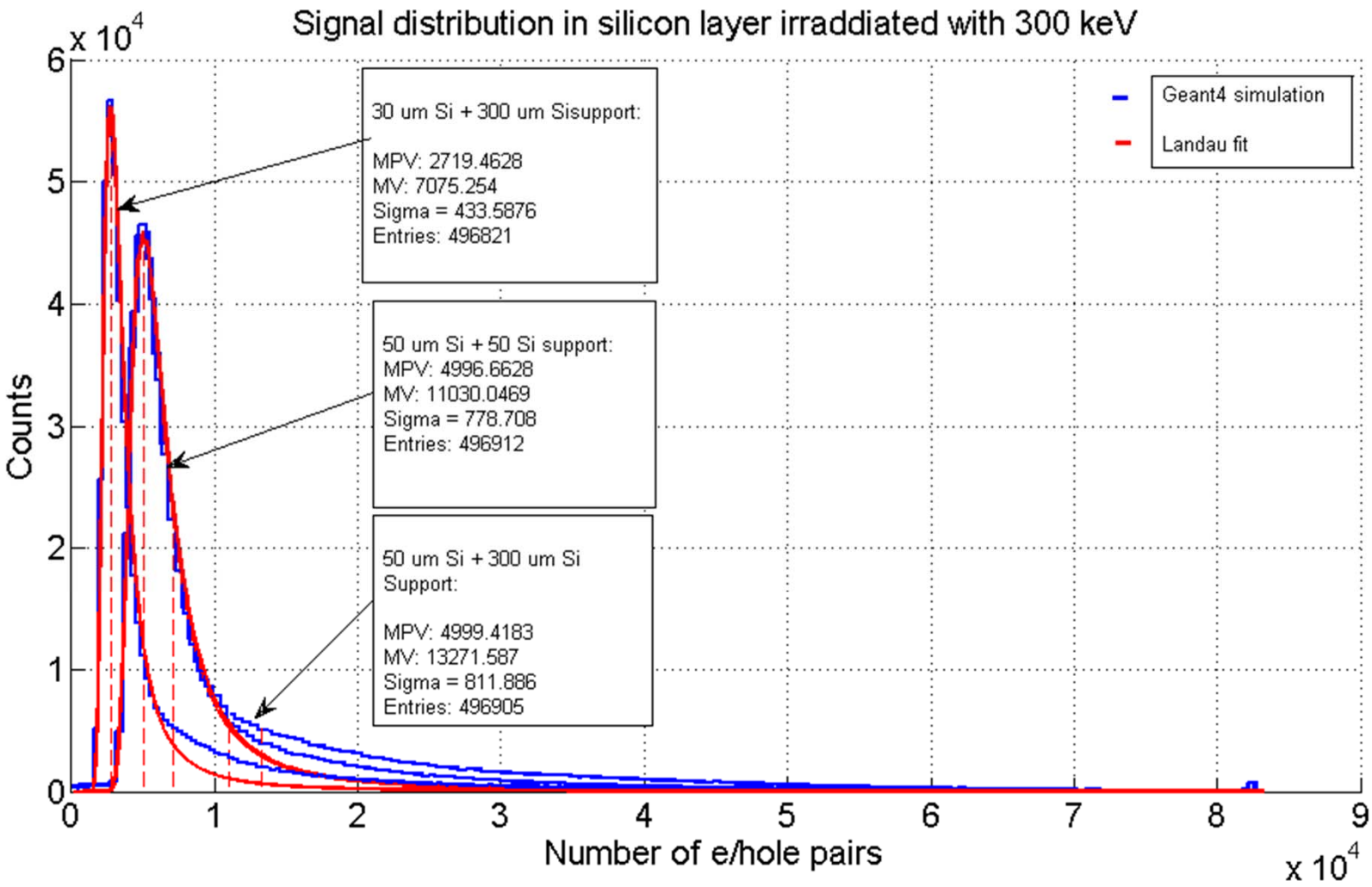
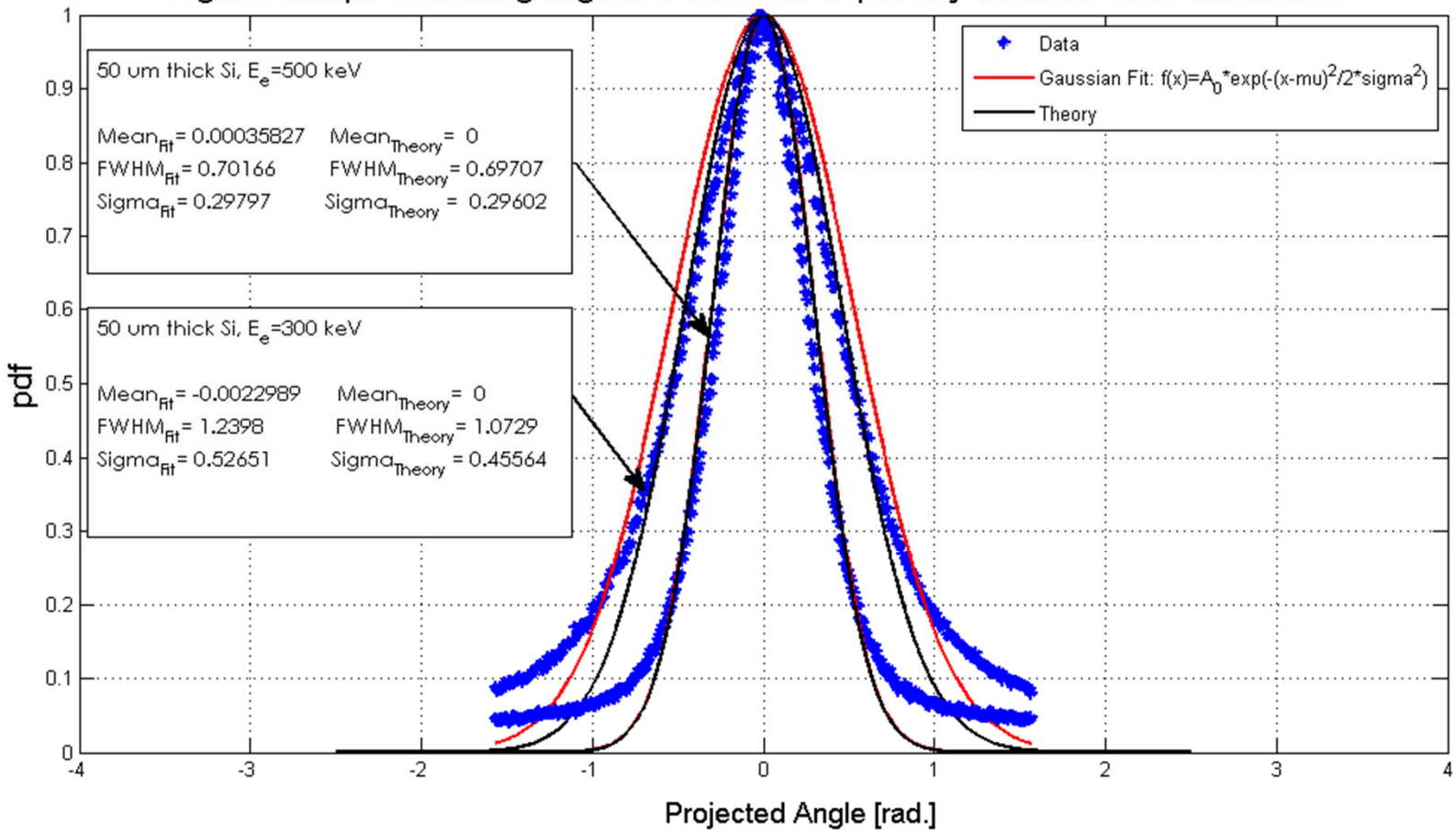
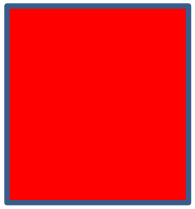
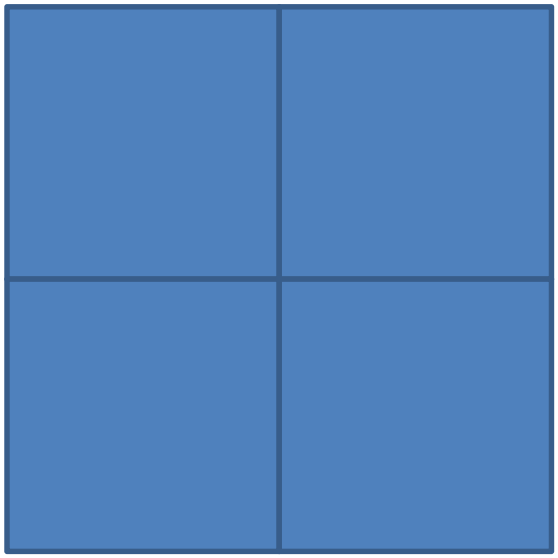

Signal distribution in silicon layer irraddiated with 300 keV
x 10^4
Counts
Number of e/hole pairs
x 10^4
0
1
2
3
4
5
6
7
8
9
Geant4 simulation
Landau fit
30 um Si + 300 um Sisupport:
MPV: 2719.4628
MV: 7075.254
Sigma = 433.5876
Entries: 496821
50 um Si + 50 Si support:
MPV: 4996.6628
MV: 11030.0469
Sigma = 778.708
Entries: 496912
50 um Si + 300 um Si
Support:
MPV: 4999.4183
MV: 13271.587
Sigma = 811.886
Entries: 496905

Figure: Multiple scattering angular distribution of primary electrons in 50 um thick Si

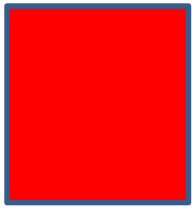




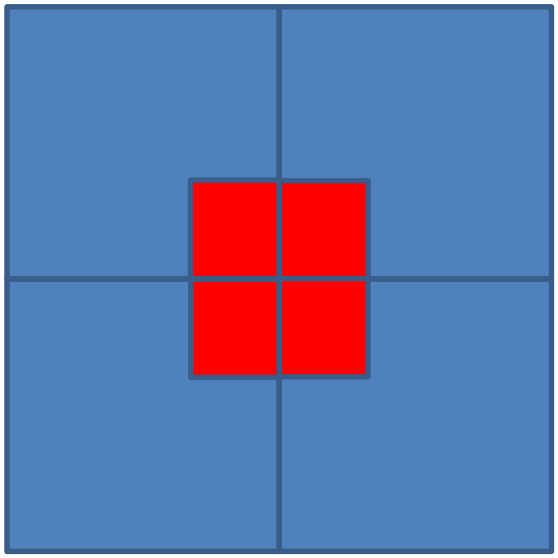
e-h pairs



4 pixel…..25% each split



e-h pairs



4 pixel.....25% each split