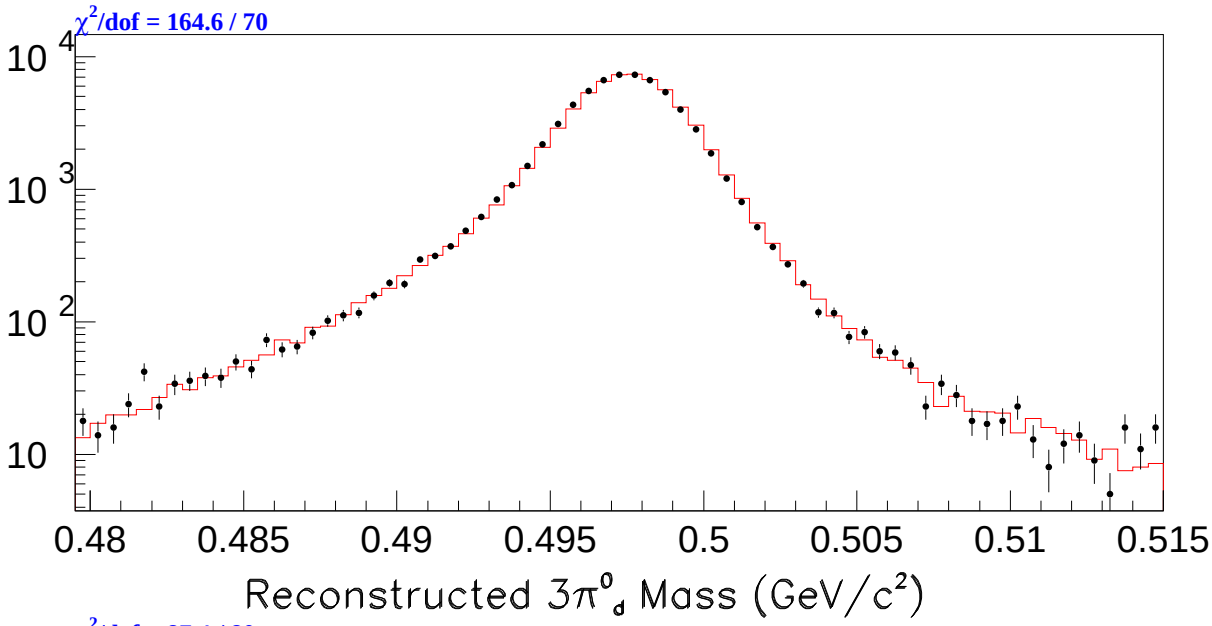
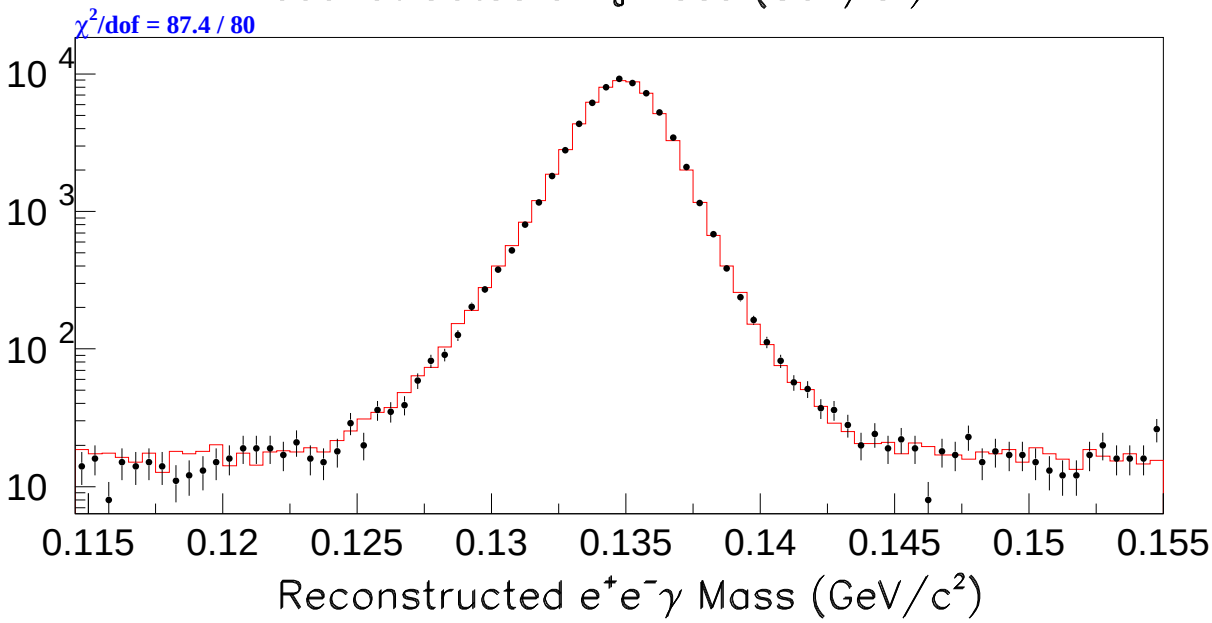
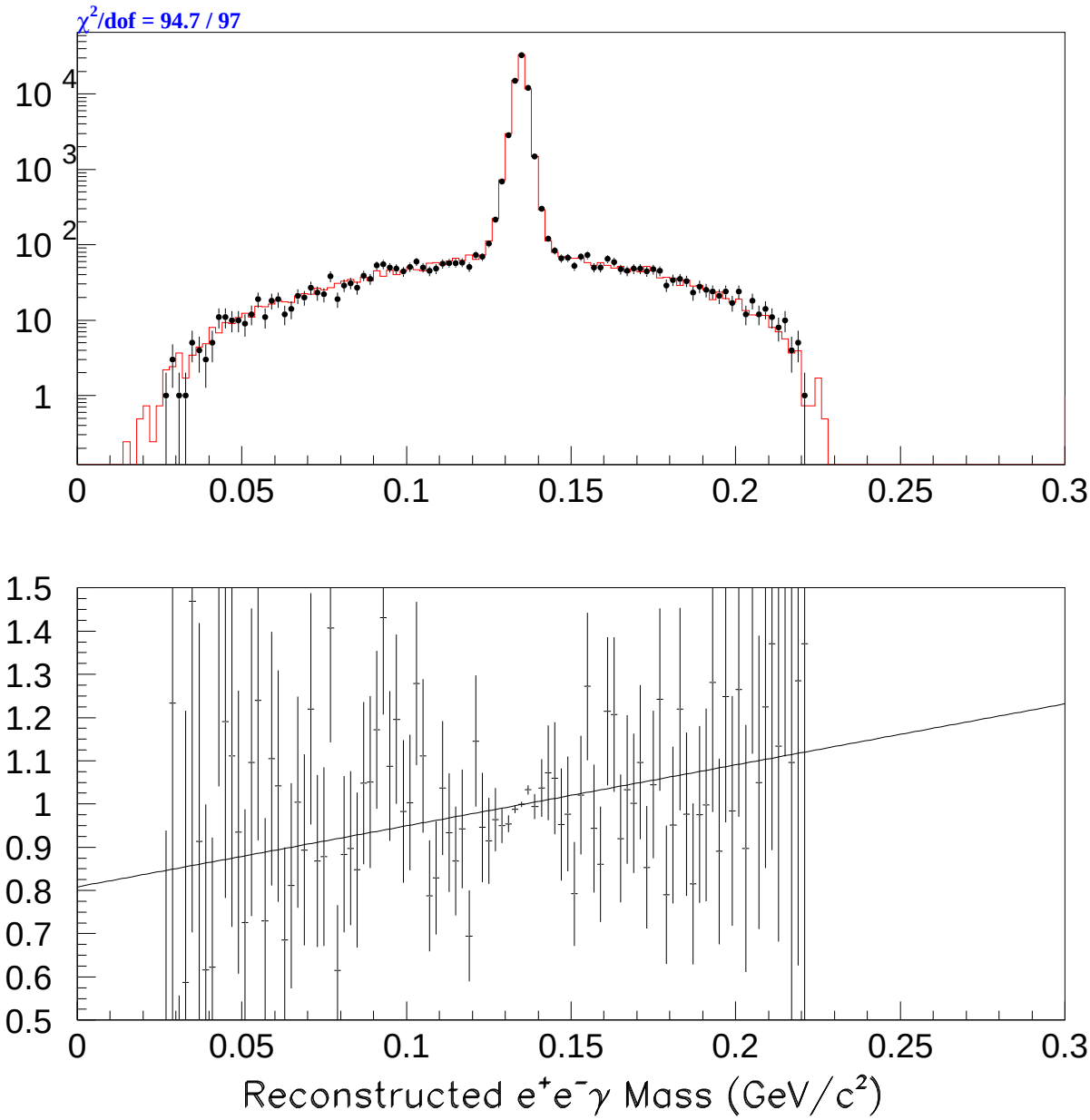
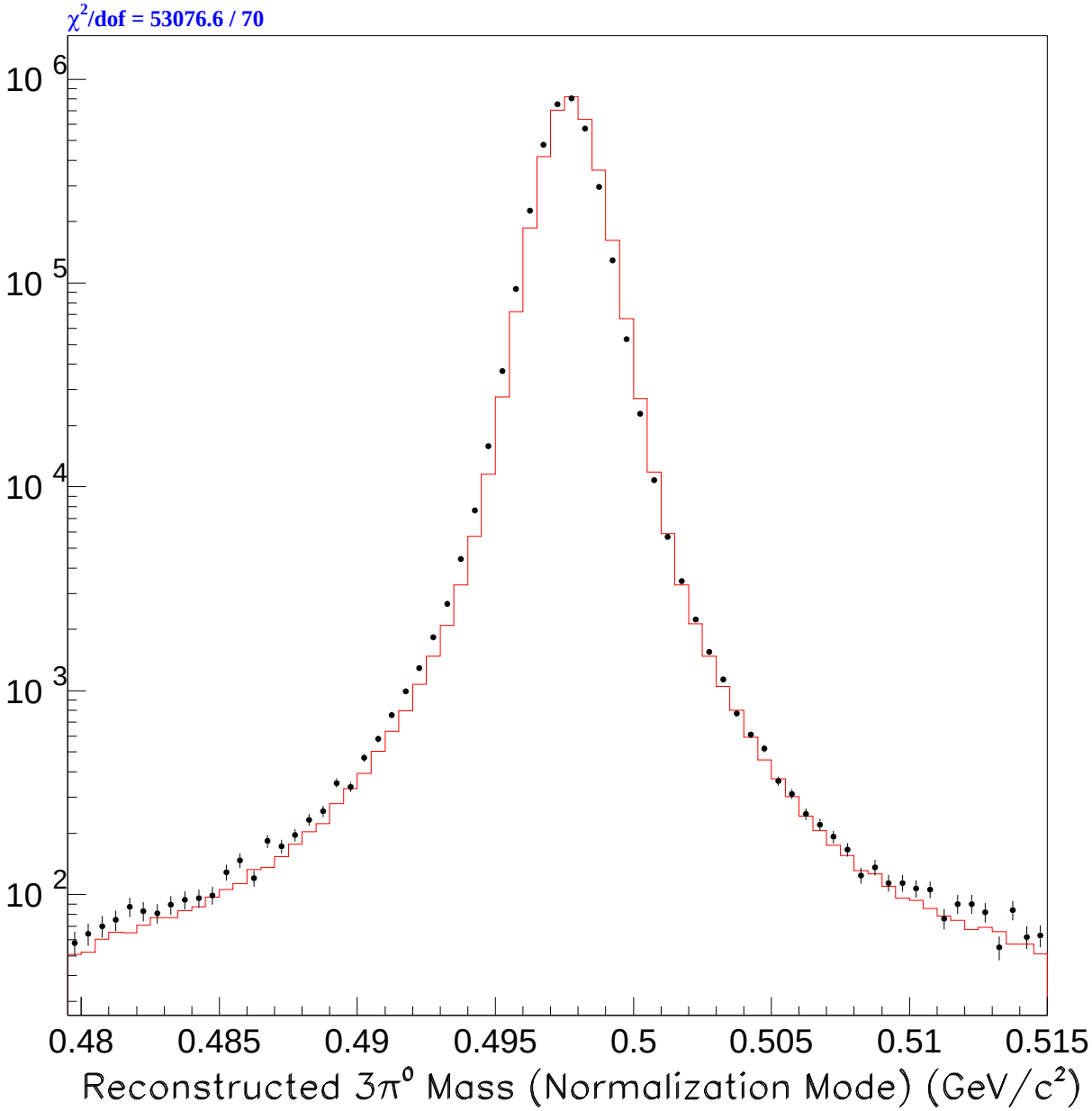
$B(\pi^0 \to e^+e^-\gamma)/B(\pi^0 \to \gamma\gamma)$ using $K_L \to 3\pi^0$

Erin Abouzaid 23 October 2006



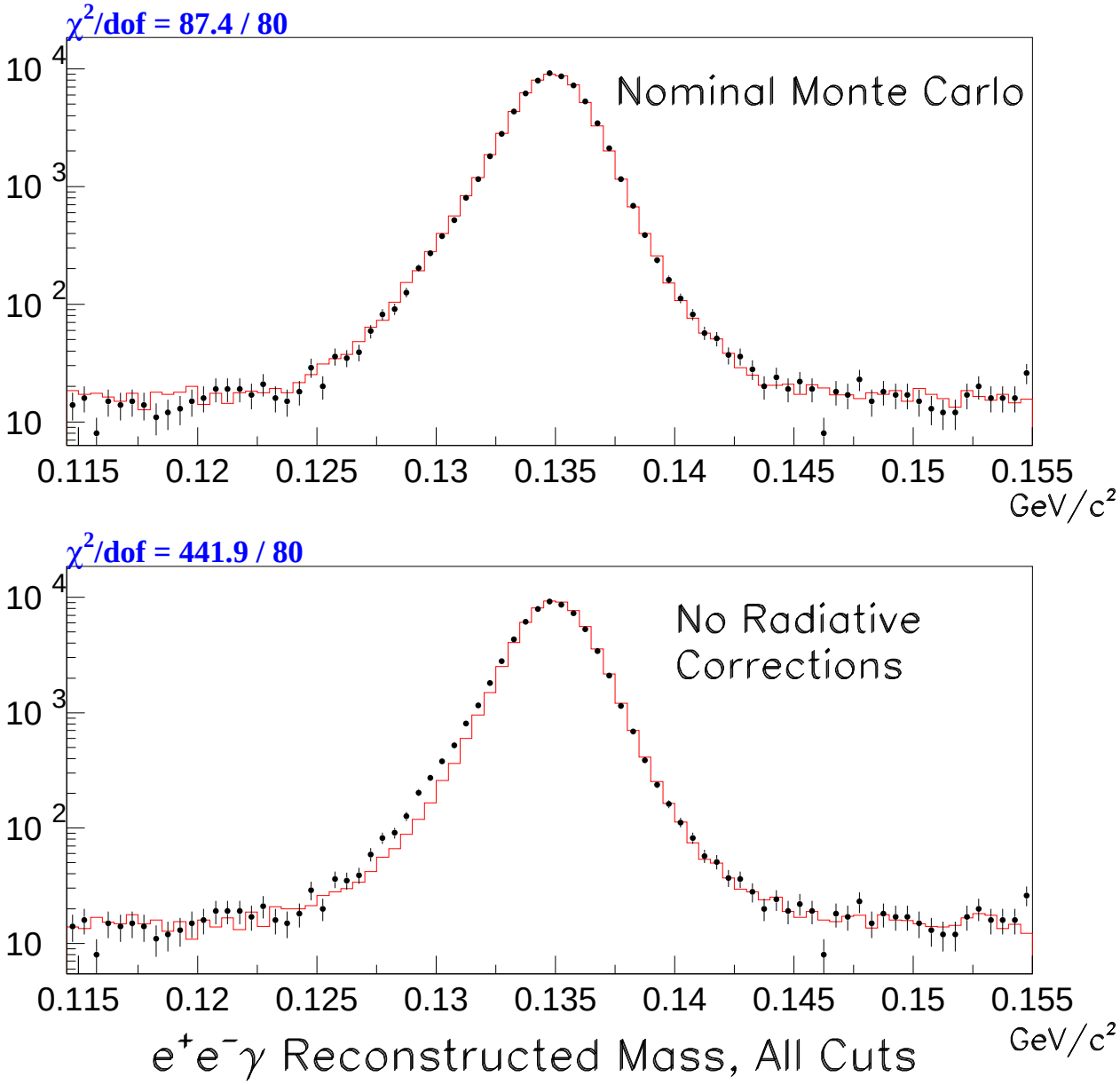



χ^2/dof = 94.7 / 97
10^4
10^3
10^2
10
1
0
0.05
0.1
0.15
0.2
0.25
0.3
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
Reconstructed $e^+e^-\gamma$ Mass (GeV/c^2)


χ^2/dof = 53076.6 / 70
10^6
10^5
10^4
10^3
10^2
0.48
0.485
0.49
0.495
0.5
0.505
0.51
0.515
Reconstructed $3\pi^0$ Mass (Normalization Mode) (GeV/c^2)

Source of Systematic Error	Level of Uncertainty
Radiative Corrections	1.02%
Tracking Inefficiency	0.68%
Detector Material	0.37%
Accidentals	0.1%
Trigger Inefficiency	0.14%
Trigger 6 pre-scale	$< 0.1\%$
Form Factor	0.07%
Photon Inefficiency	0.01%
Background	$< 0.1\%$
Cut Variations	$< 0.1\%$
Monte Carlo Statistics	0.19%
Total Systematic Error	1.32%

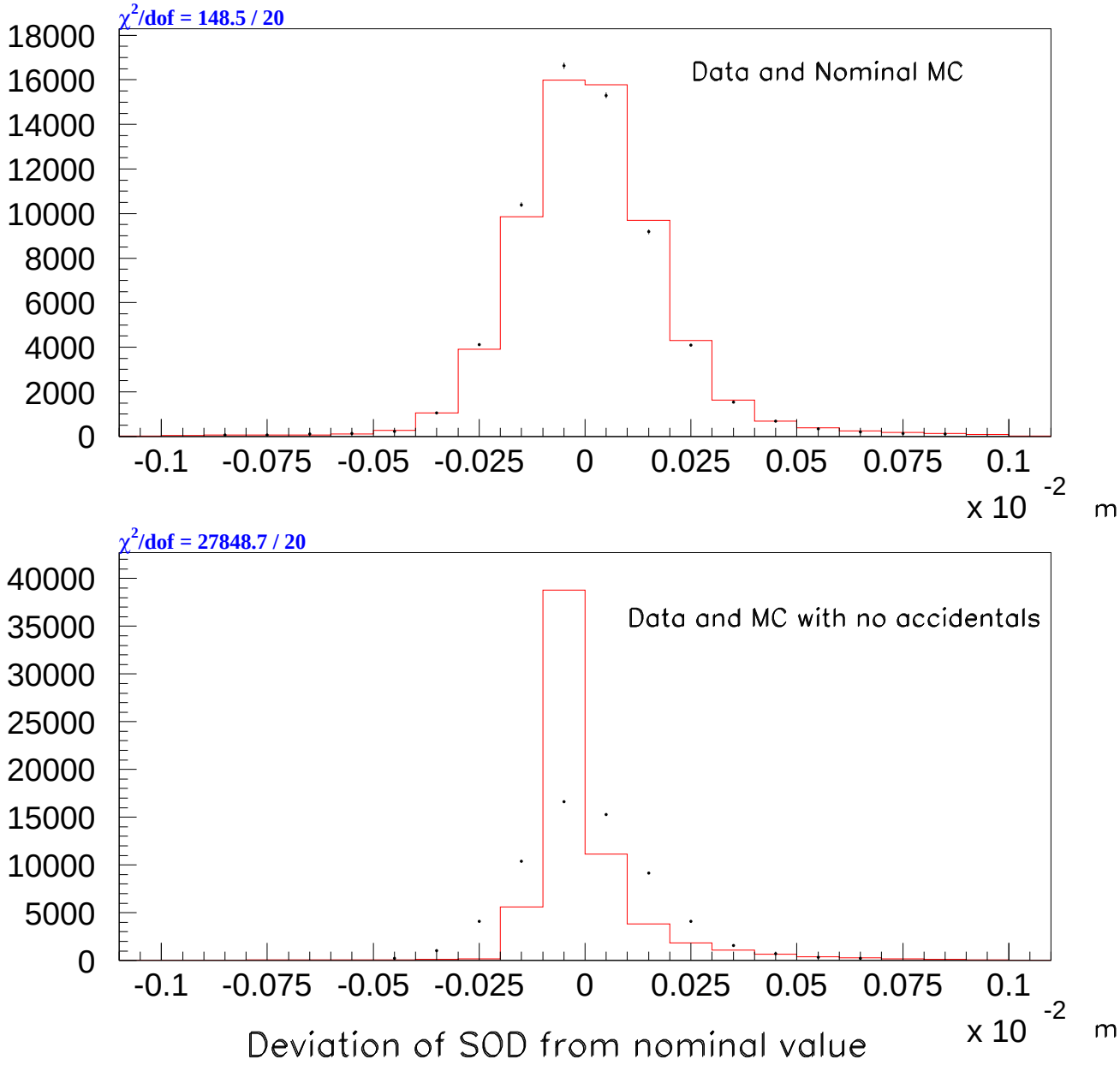
Radiative Corrections



Tracking Inefficiency

	Tracking Inefficiency Medium Intensity	Tracking Inefficiency High Intensity
Data		
$2\eta_1$	3.48%	4.90%
η_0	0.19%	0.21%
Total	3.67%	5.11%
Monte Carlo		
$2\eta_1$	2.97%	4.31%
η_0	0.05%	0.09%
Total	3.02%	4.40%
Correction	0.65%	0.72%
MC no accidentals		
$2\eta_1$	0.41%	0.41%
η_0	0.00%	0.00%
Total	0.41%	0.41%

Accidentals

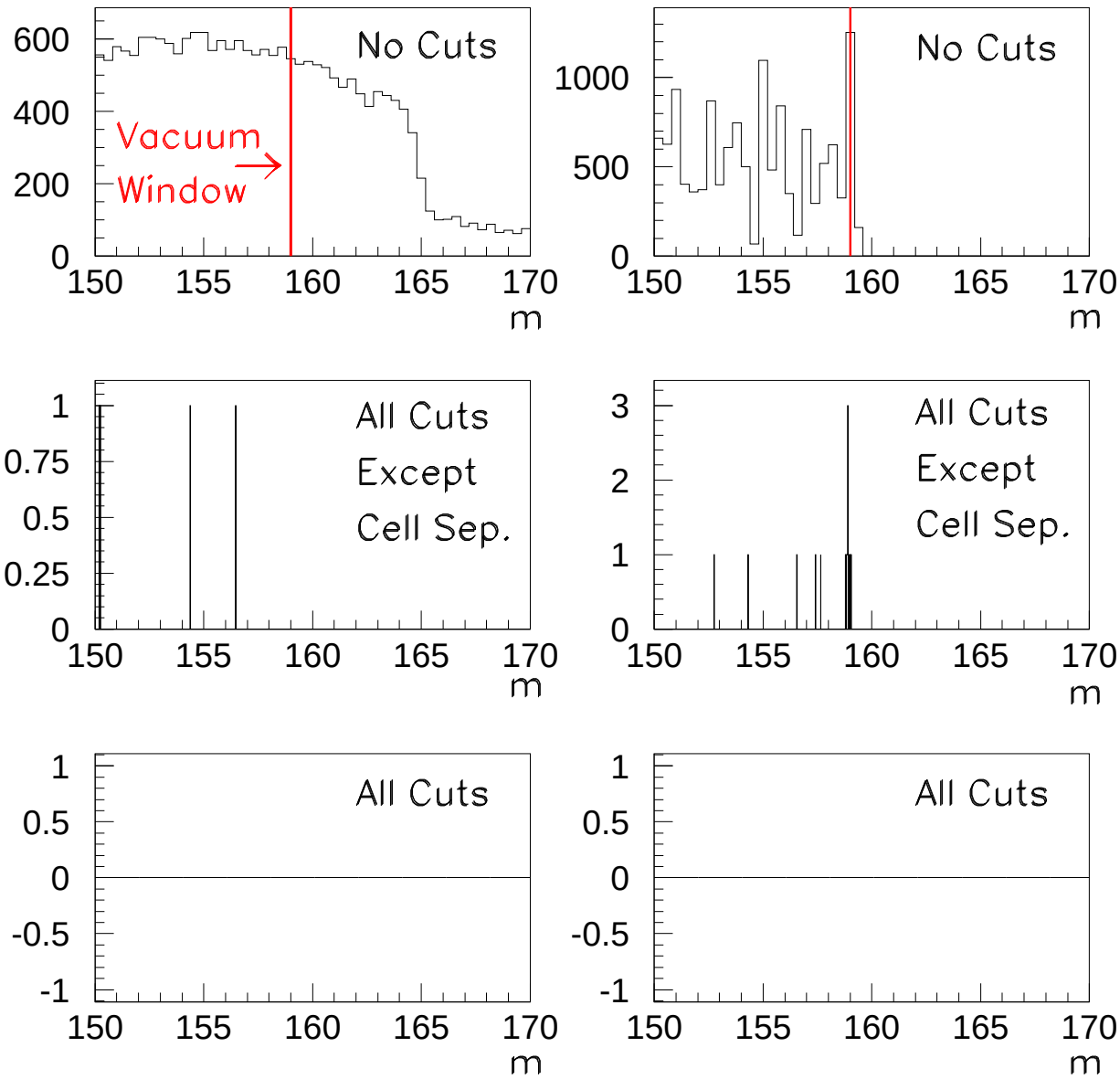


Sample	Frac. Dev Sod $< -.2$mm	Error	Sigma Diff From Data
Data	0.1169	0.0012	-
Nominal MC	0.1156	0.0006	0.90
MC no accid.	0.0282	0.0004	67.99
MC: 97.5% nom and 2.5% no accid.	0.1126	0.0006	3.06

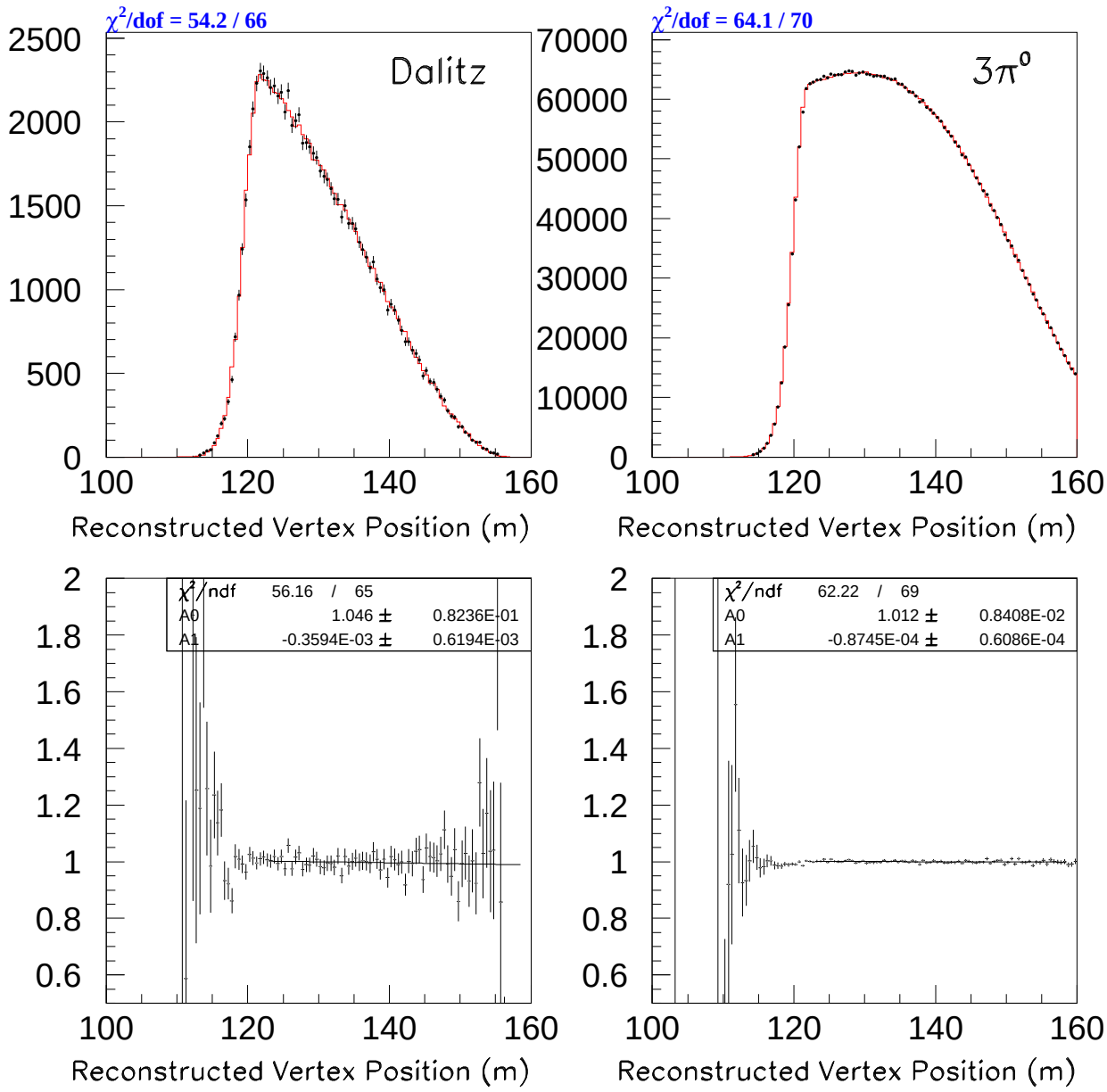
One-photon difference between signal and normalization $\rightarrow$ also sensitive to accidentals in the neutral parts of the two decays. Used distribution of number of software clusters to estimate this part of uncertainty due to accidentals.

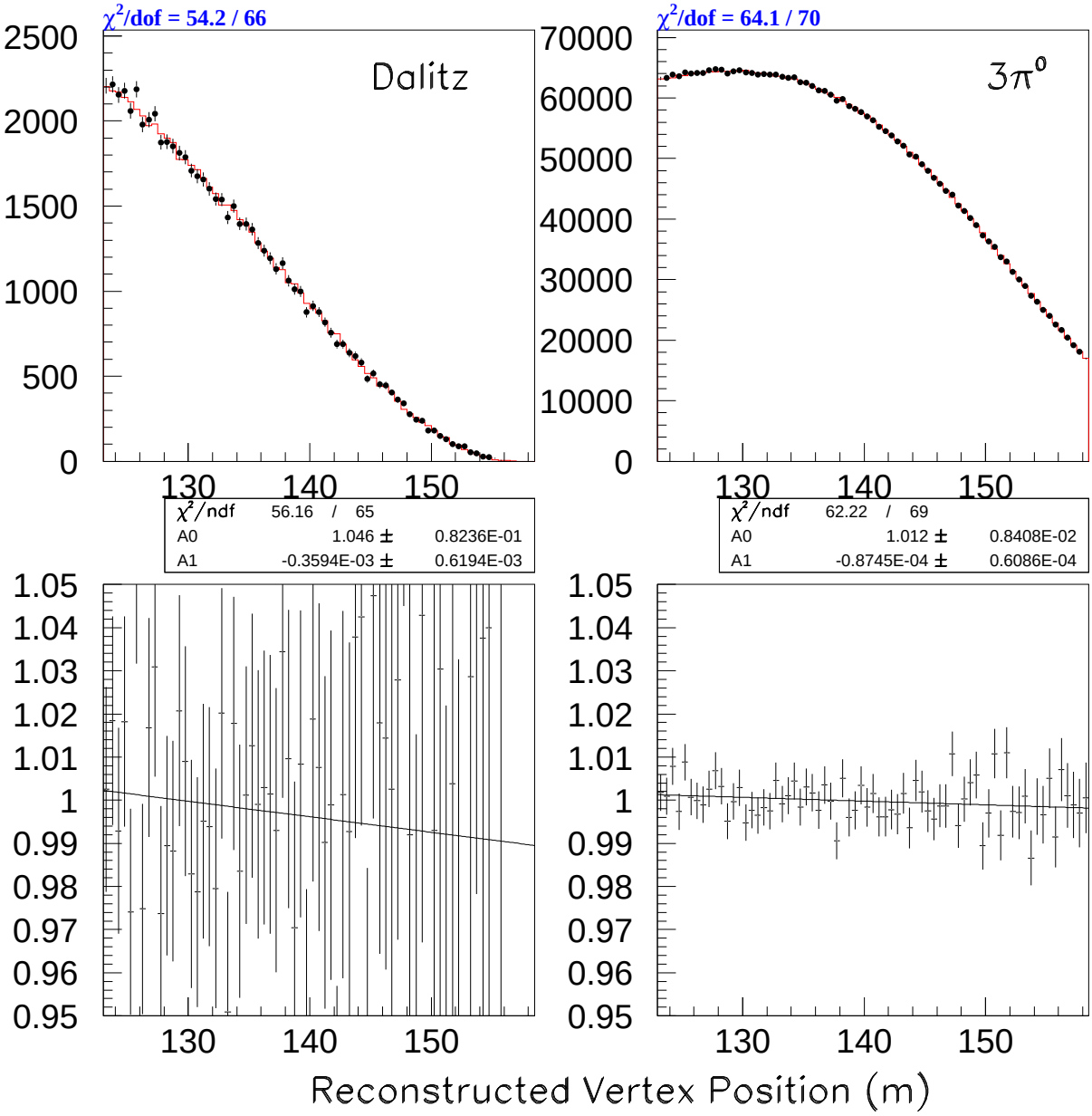
Background Estimate – 2 events/66432

Left Side is the Z Reconstructed from Photons
Rigth Side is the Z Reconstructed from Tracks



Z Overlays


χ^2/dof = 54.2 / 66
Dalitz
Reconstructed Vertex Position (m)
χ^2/dof = 64.1 / 70
$3\pi^0$
Reconstructed Vertex Position (m)
χ^2/ndf 56.16 / 65
A0 1.046 ± 0.8236E-01
A1 -0.3594E-03 ± 0.6194E-03
Reconstructed Vertex Position (m)
χ^2/ndf 62.22 / 69
A0 1.012 ± 0.8408E-02
A1 -0.8745E-04 ± 0.6086E-04
Reconstructed Vertex Position (m)


χ²/dof = 54.2 / 66
Dalitz
χ²/ndf 56.16 / 65
A0 1.046 ± 0.8236E-01
A1 -0.3594E-03 ± 0.6194E-03
χ²/dof = 64.1 / 70
3π⁰
χ²/ndf 62.22 / 69
A0 1.012 ± 0.8408E-02
A1 -0.8745E-04 ± 0.6086E-04
Reconstructed Vertex Position (m)

Result

PDG $(1.213 \pm .030)\%$

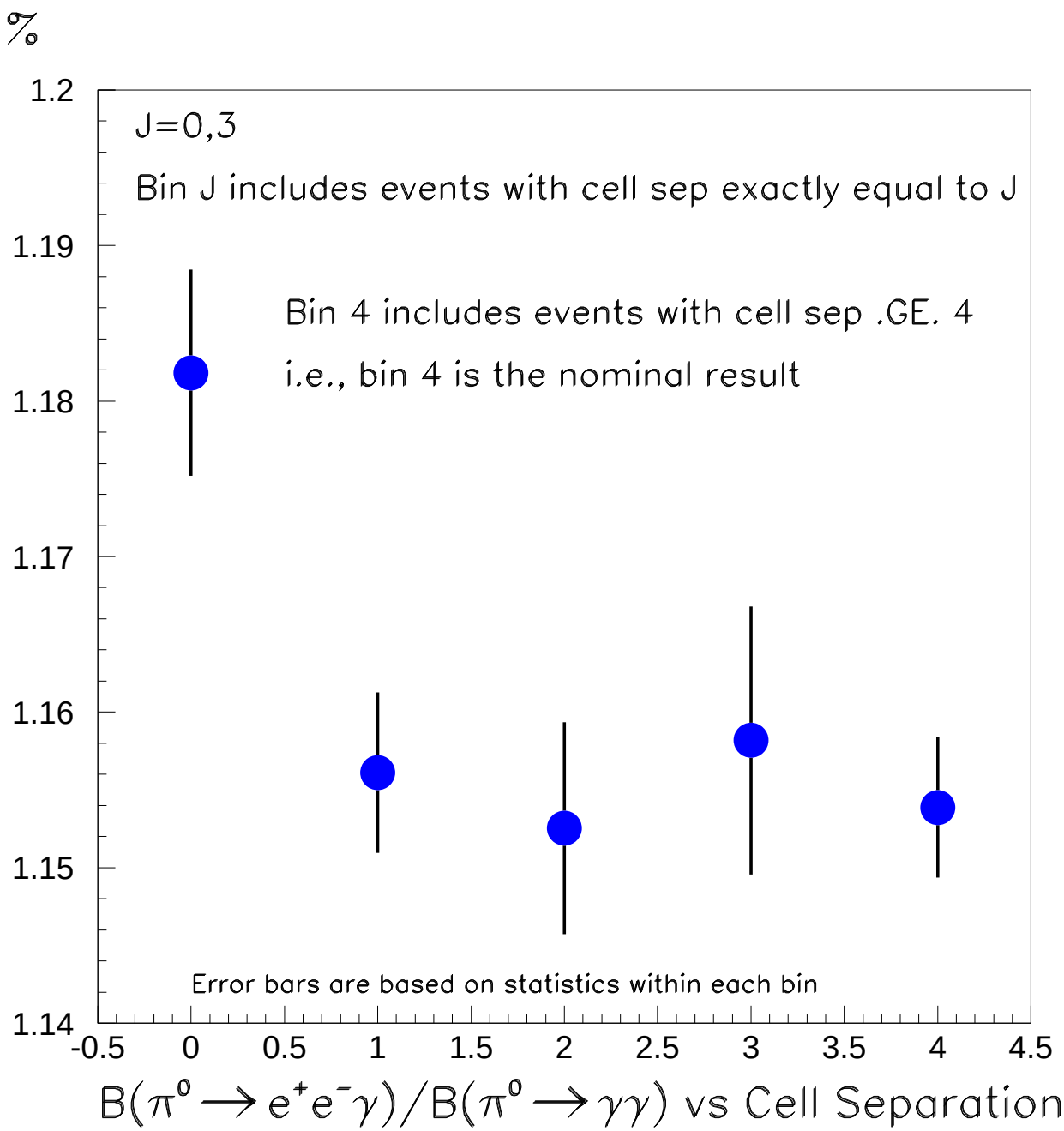
2.5% uncertainty

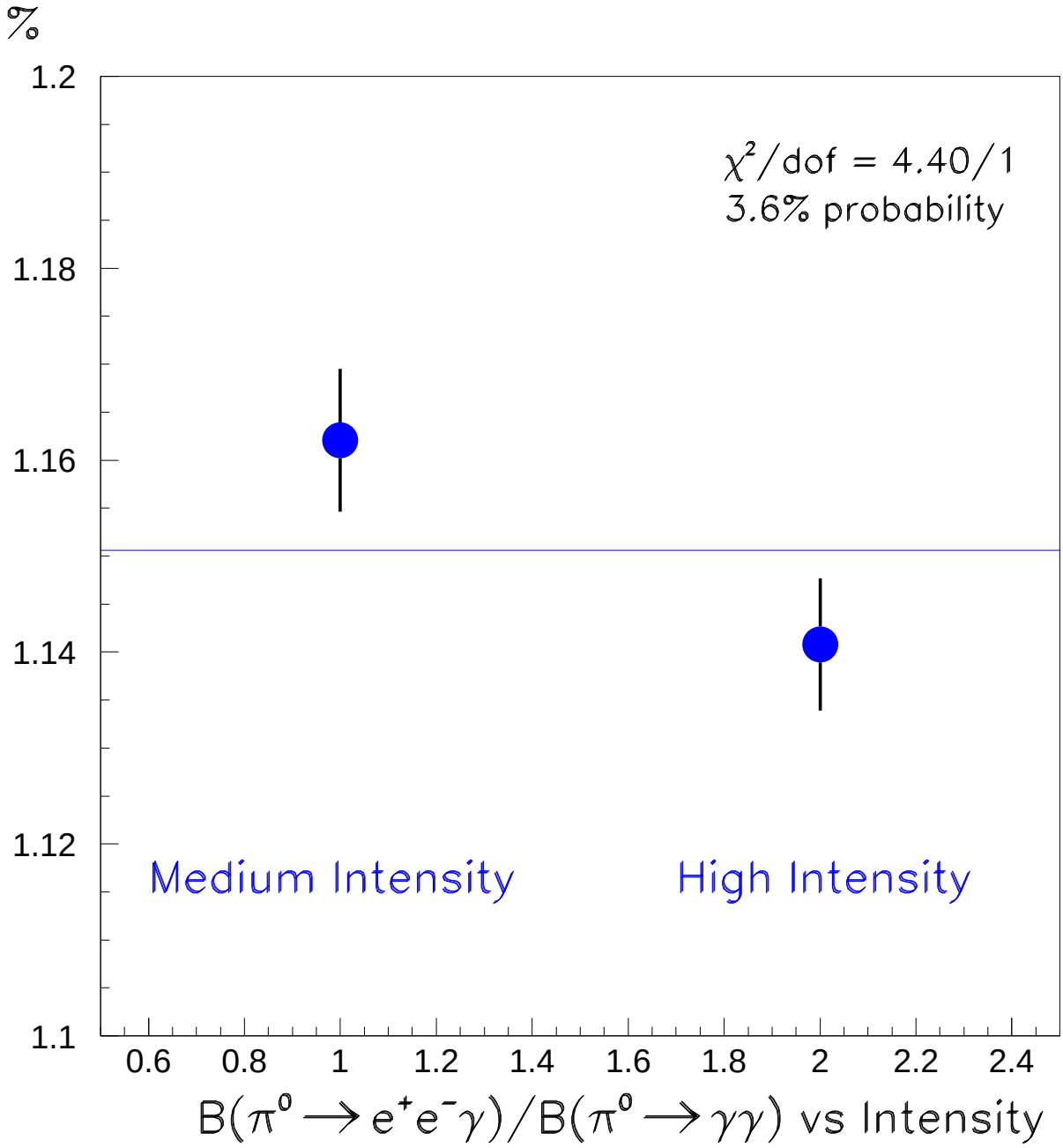
KTeV 2006 (prel)

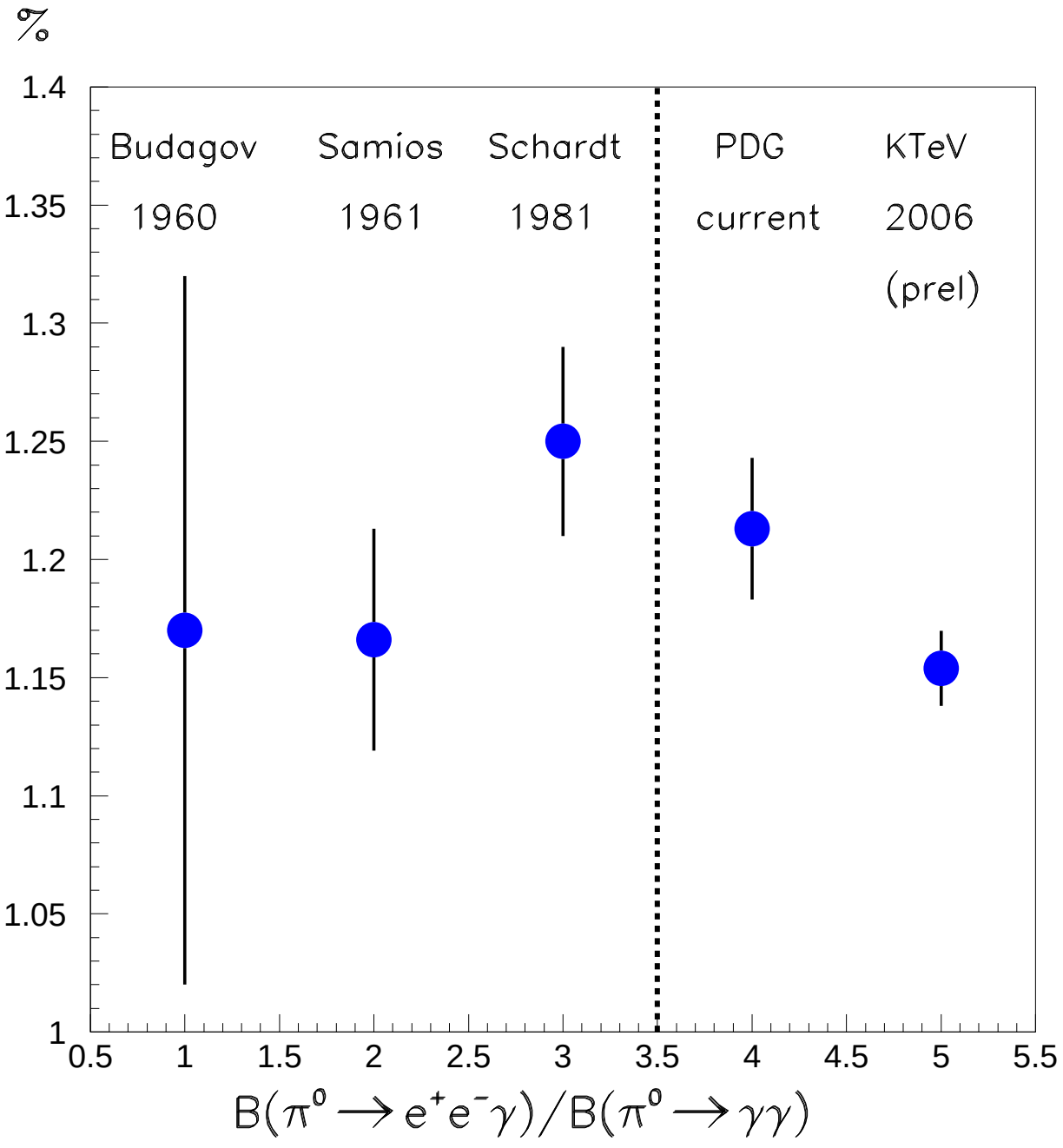
$(1.1539 \pm 0.0045 \pm 0.0152)\%$

1.38% uncertainty (0.39% stat., 1.32% syst.)

Some Cross Checks




%
1.2
1.18
1.16
1.14
1.12
1.1
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
χ^2/dof = 4.40/1
3.6% probability
Medium Intensity
High Intensity
$B(\pi^0 \to e^+e^-\gamma)/B(\pi^0 \to \gamma\gamma)$ vs Intensity


%
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
Budagov
1960
Samios
1961
Schardt
1981
PDG
current
KTeV
2006
(prel)
$B(\pi^0 \to e^+e^-\gamma)/B(\pi^0 \to \gamma\gamma)$