π^0 radiative width extraction

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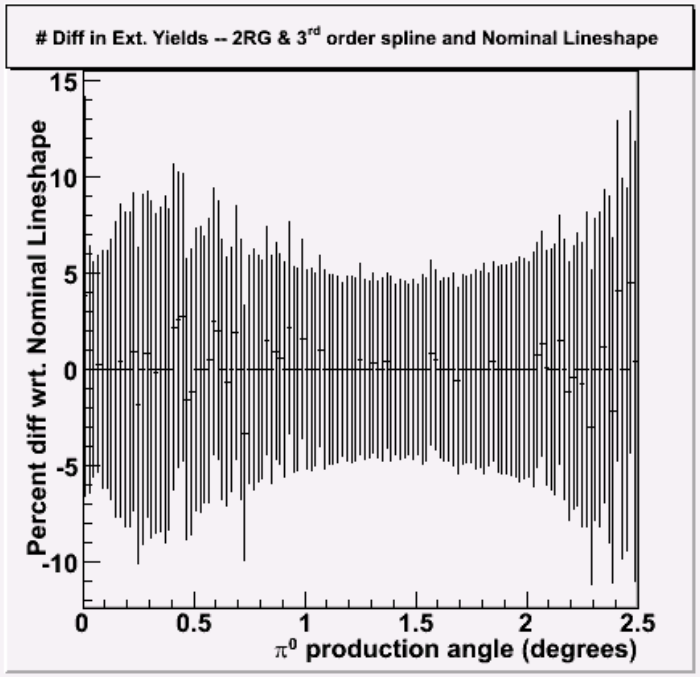
PrimEx Collaboration

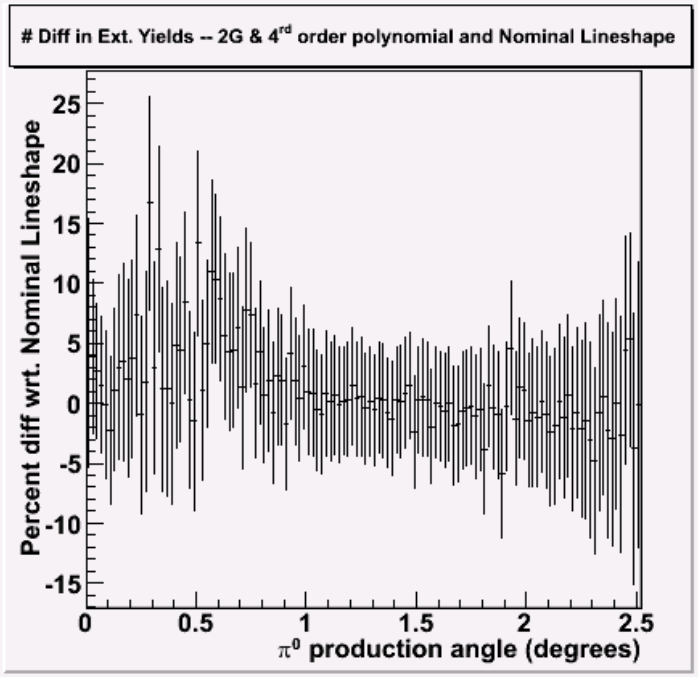
Changes/Improvements

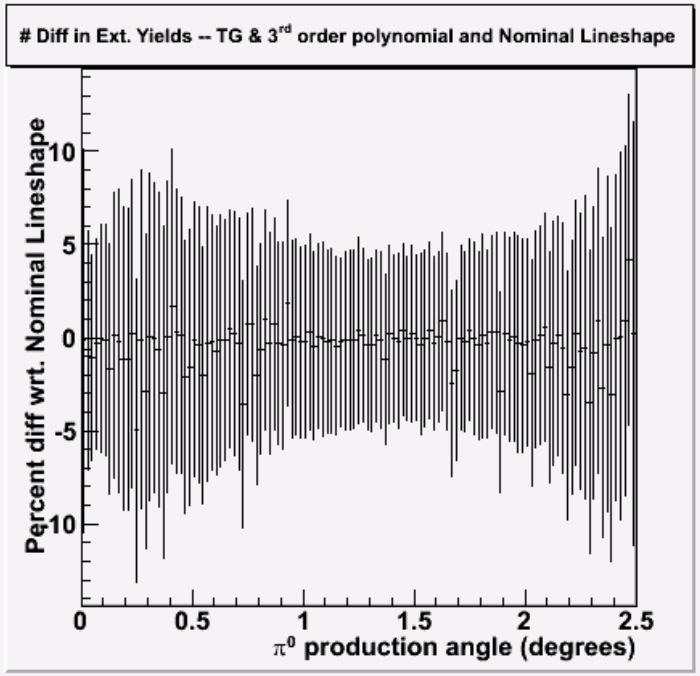
Since Dec. collaboration meeting

- Updated run list
  - Previous list had runs with “suspicious flux”
    - Flux was “off-scale” from the bulk average
- Significant change in extracted width
  - Will briefly run through yield extraction and stability
- Veto Counter double photon conversion efficiency
  - Things look a lot more consistent
- Still in the works
  - Simulation cross sections/MC response functions weighted by non-overlapping E Channel photon flux bins (instead of T Chan).

Comparing Lineshapes







2G = Double Normal Gaussians

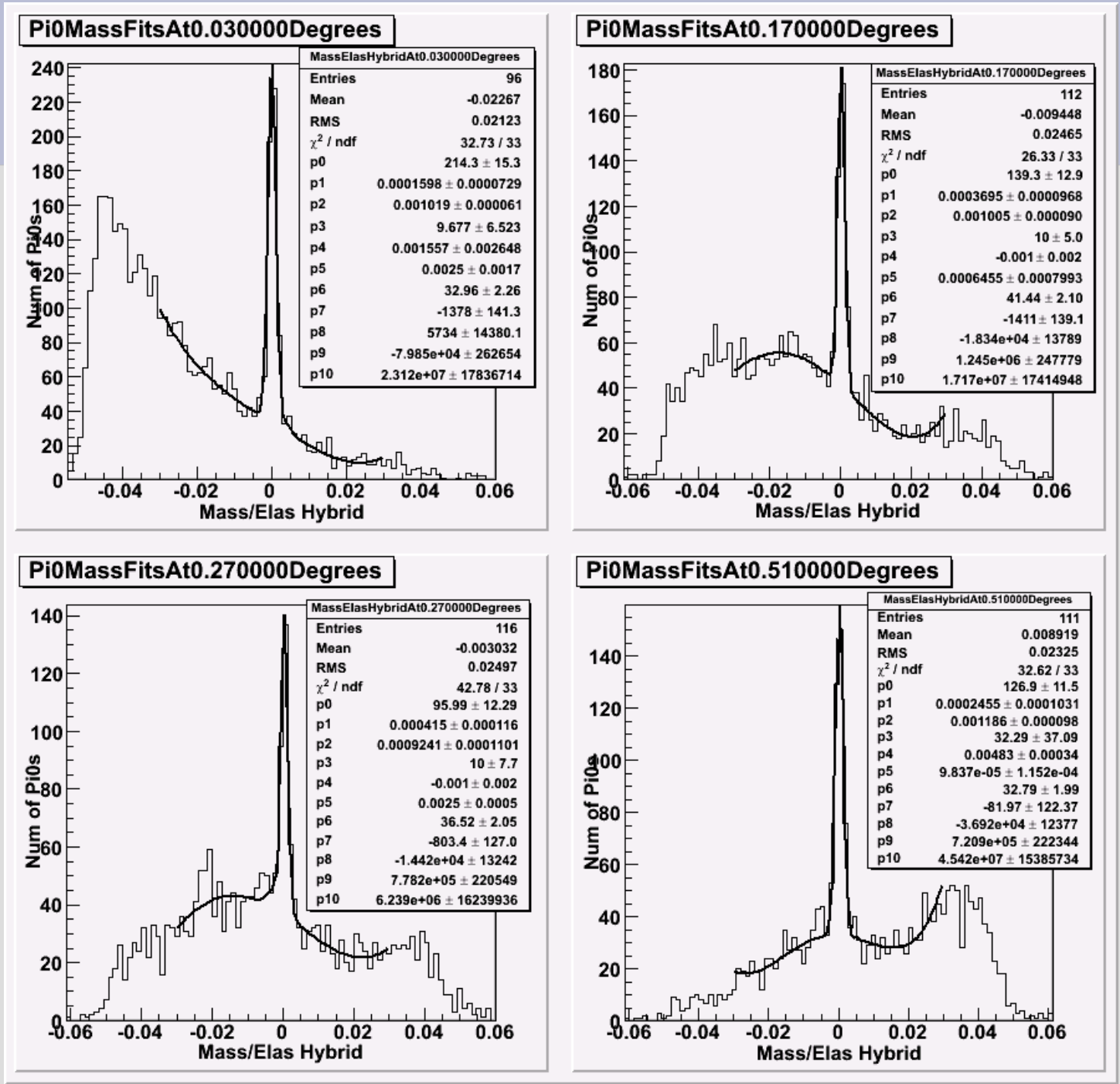
3G = Triple Normal Gaussians

$$\% \text{ Diff} = \frac{\text{Nominal - Variation}}{\text{Nominal}} \times 100$$

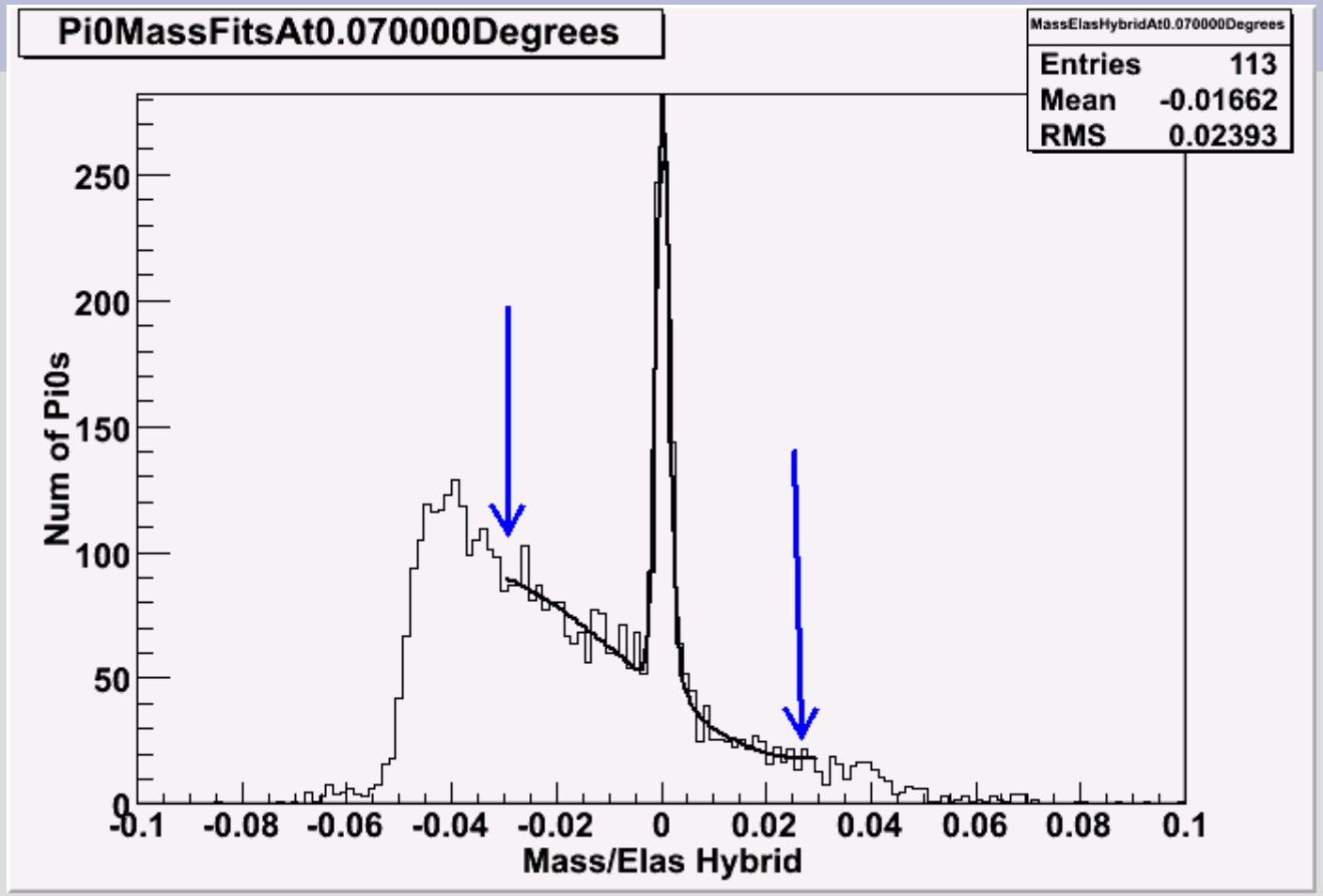
Nominal lineshape =
Double gaussians with 3rd order polynomial

Fourth order polynomial too much?

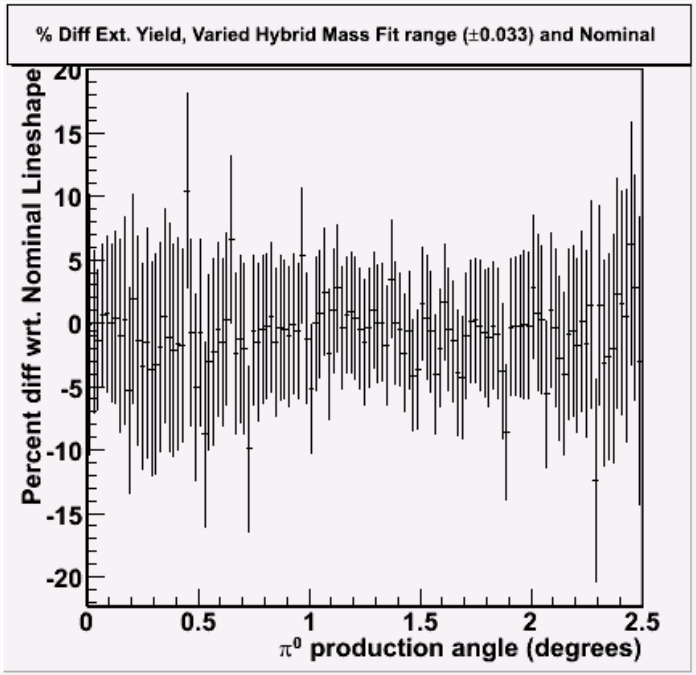
Tungstate only

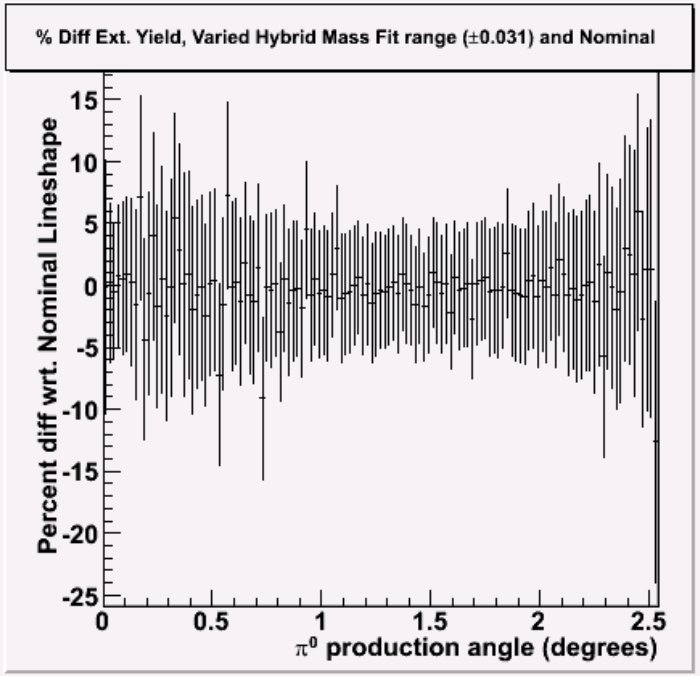


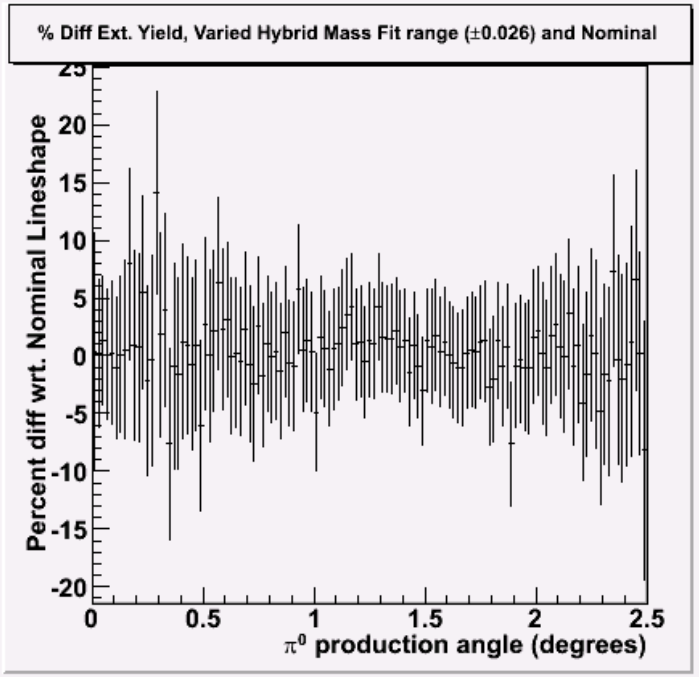
Hybrid Mass Fit Range



Tungstate only, vary Fit range





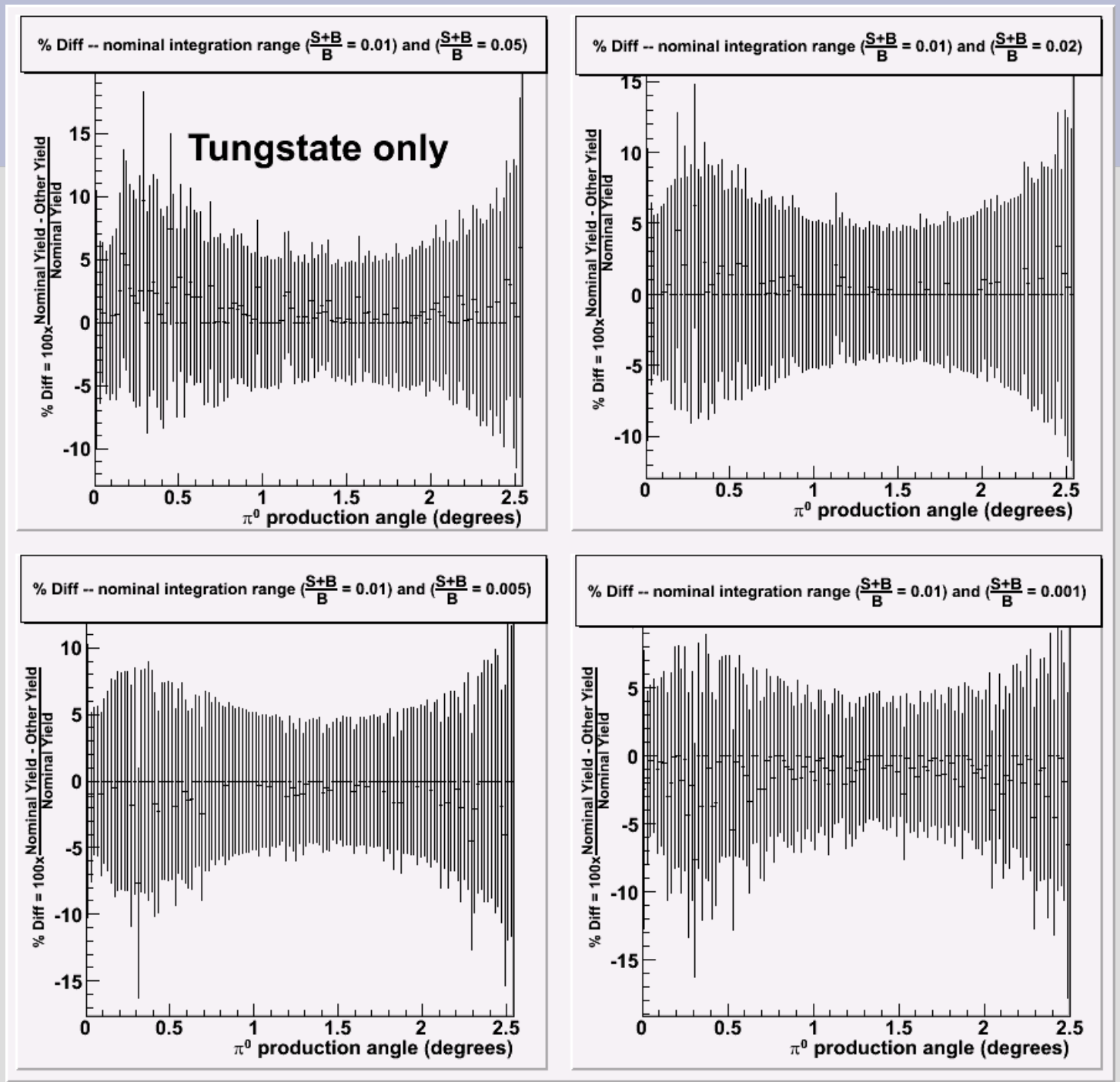


Nominal Fit Range = ± 0.030

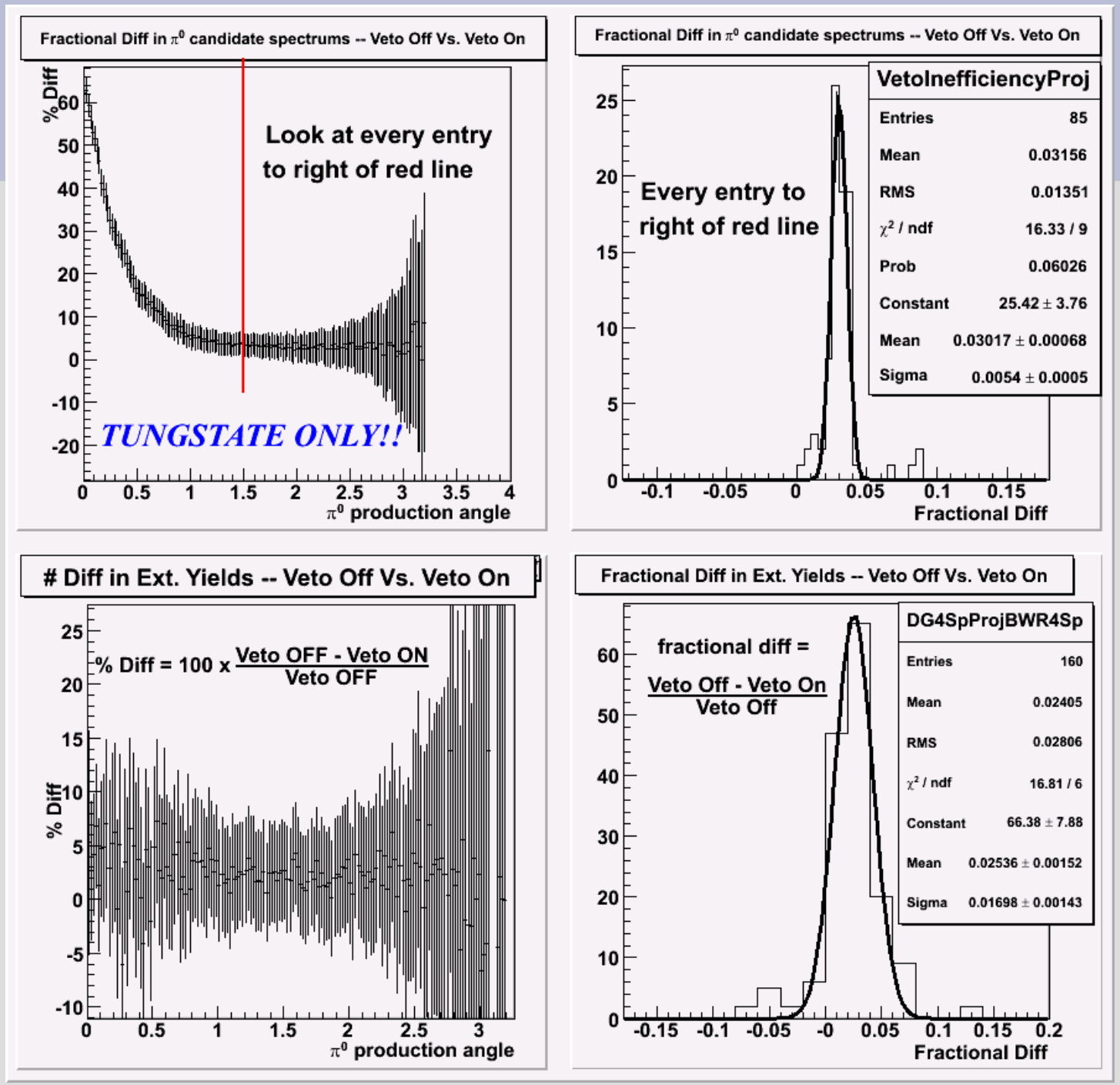
Using Double gaussians with 3rd order polynomial lineshape

Free floating cut/ Integration range

Tungstate

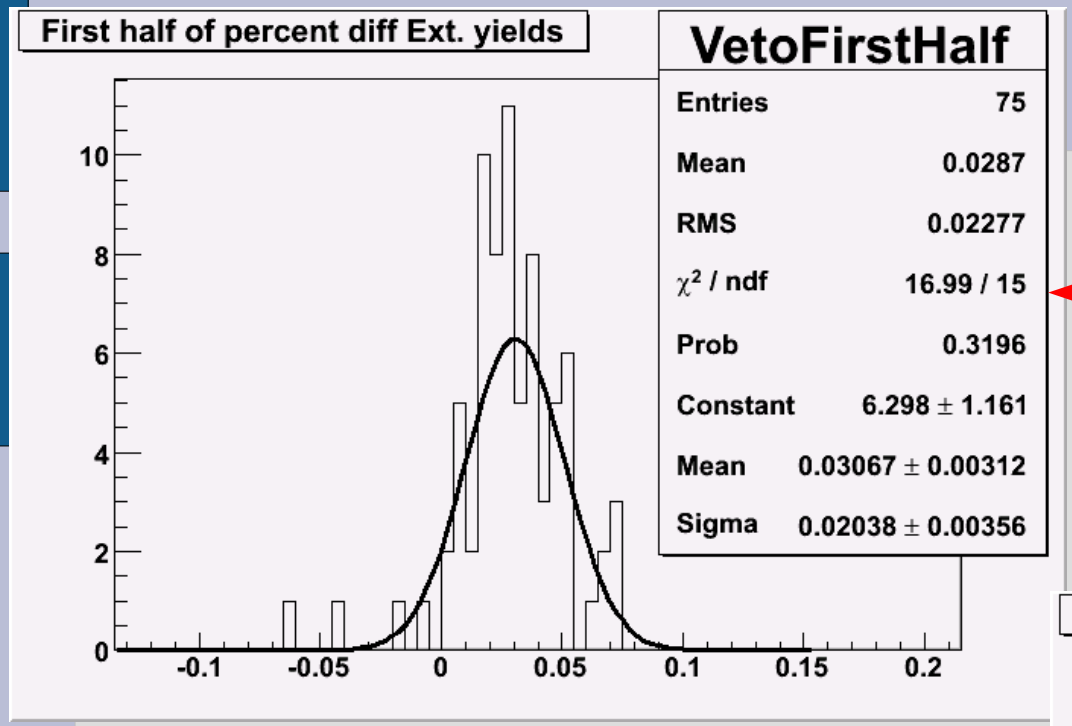


Apply Veto. Tungstate only



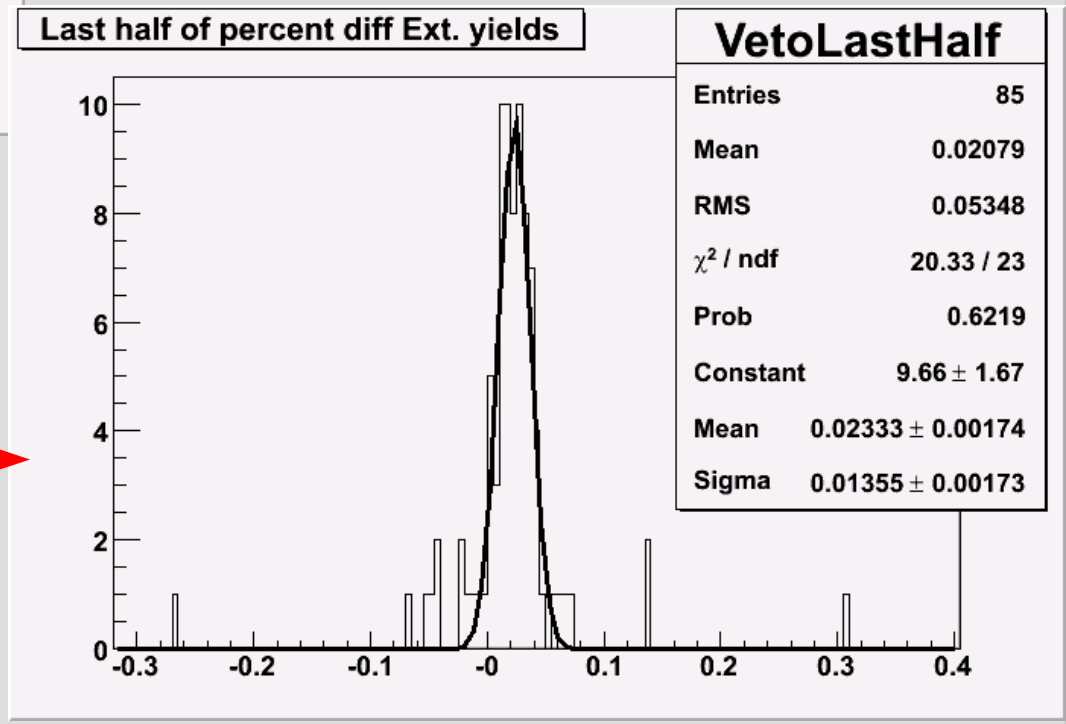
Veto with the Tungstate

π^0 production angle broken up

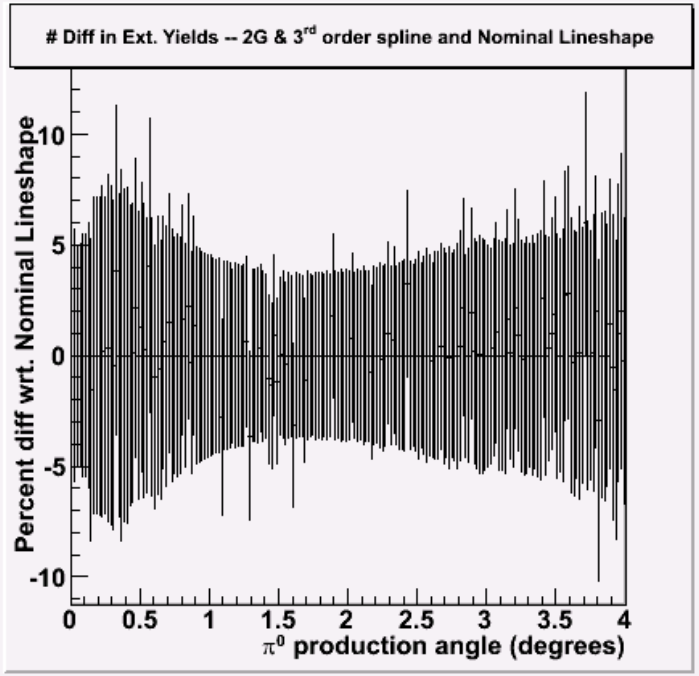


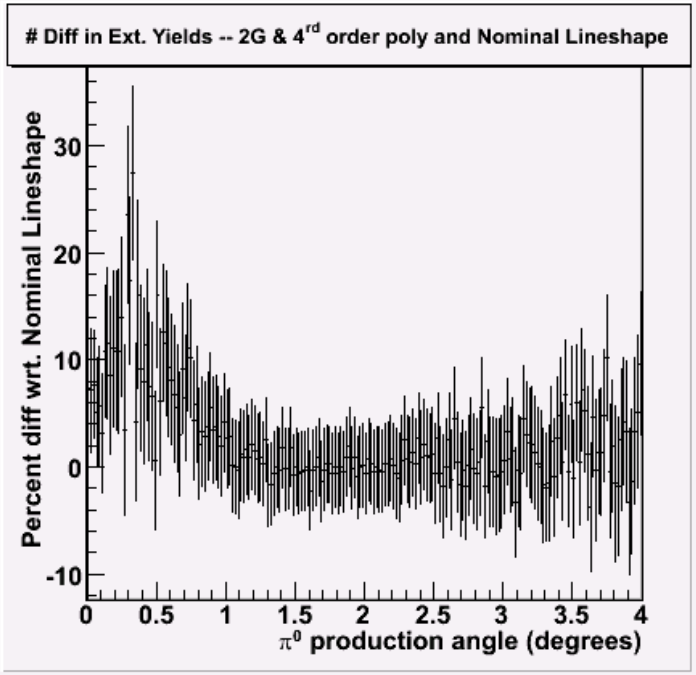
Entries in Extracted Yield differences, π^0 prod. angle <1.5° from previous page

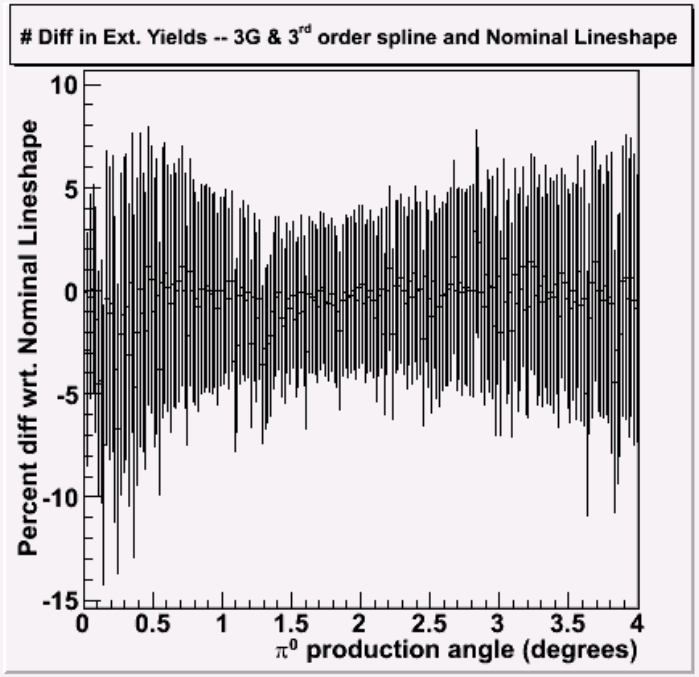
Entries in Extracted Yield differences, π^0 prod. angle >1.5° from previous page



Full HyCal—Vary the Lineshape







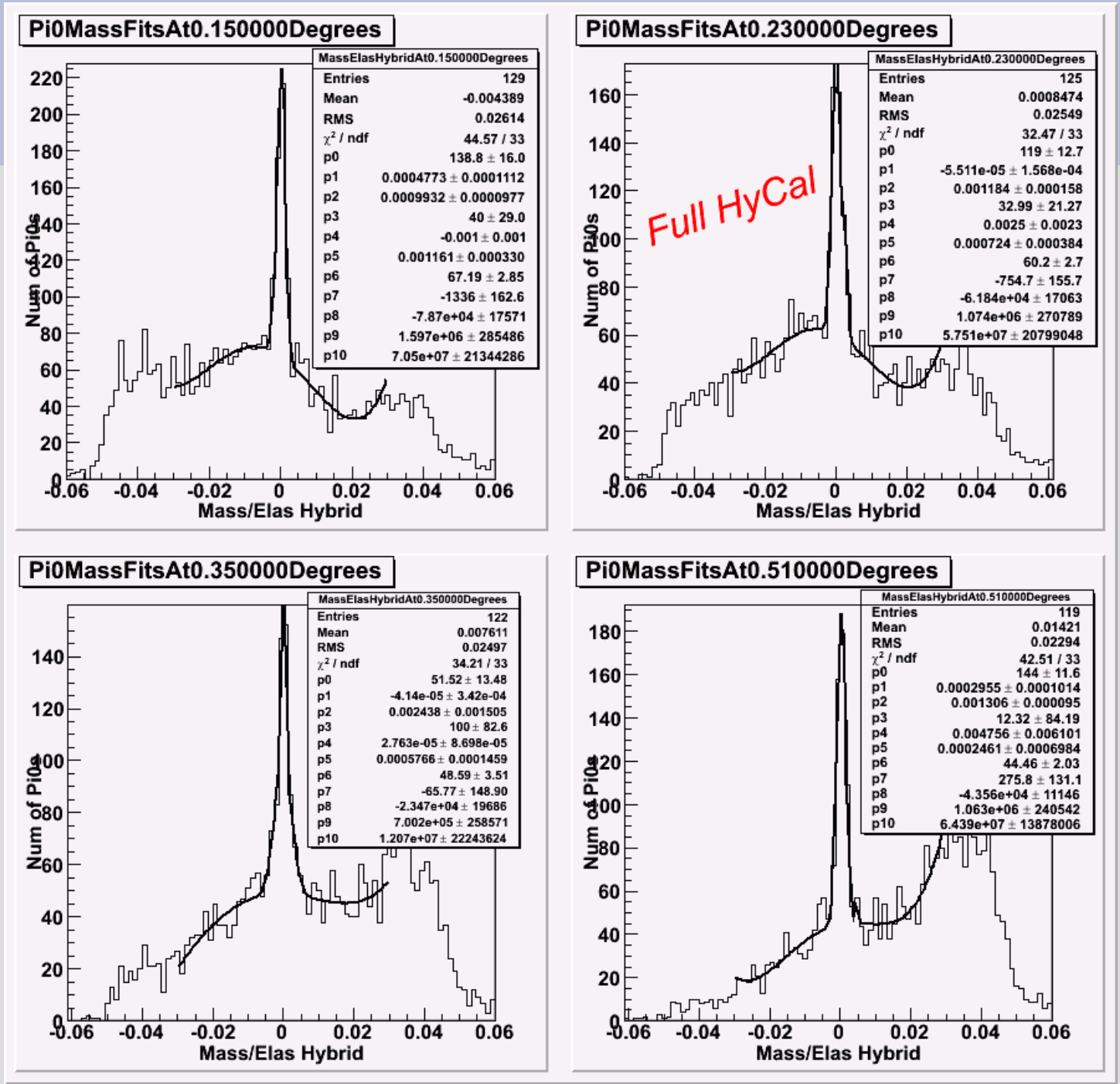
Nominal Lineshape = Double gaussians with 3rd order polynomial

2G = Double gaussains
3G = Triple gaussians

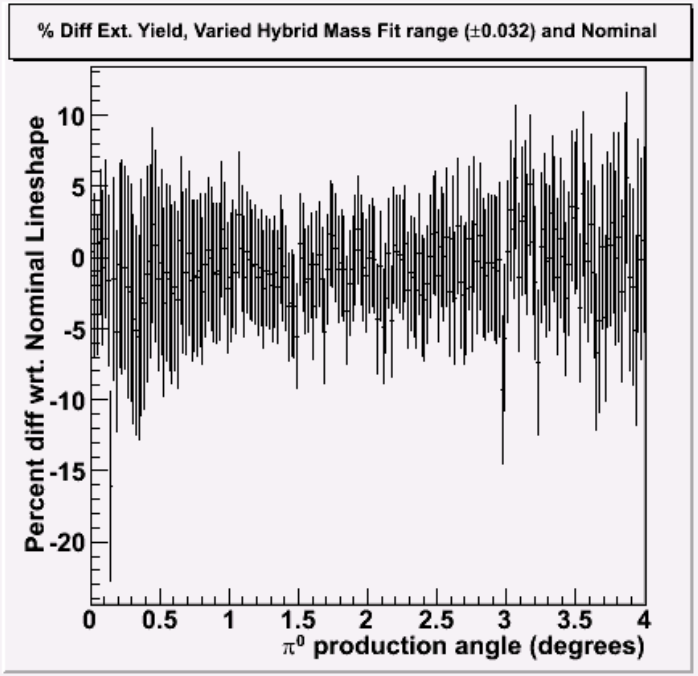
$$\% \text{ Diff} = 100 \times \frac{\text{Nominal - Variation}}{\text{Nominal}}$$

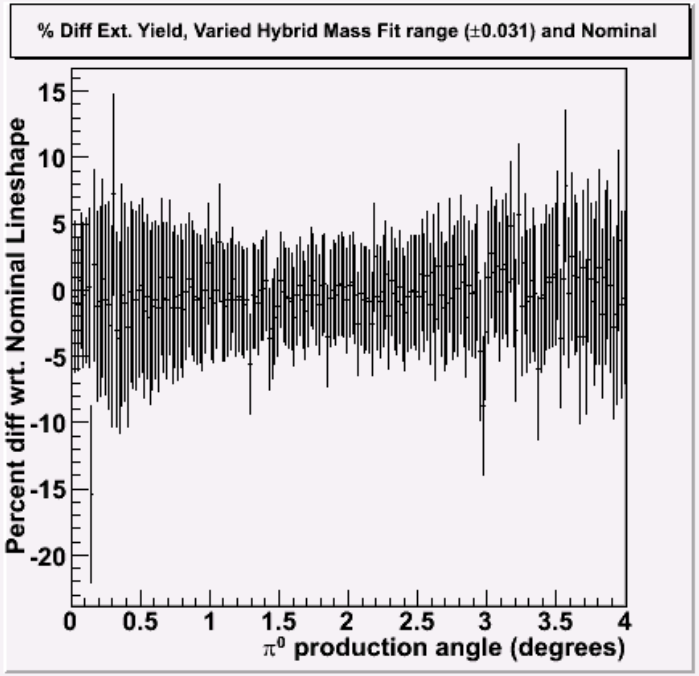
FULL HYCAL HERE

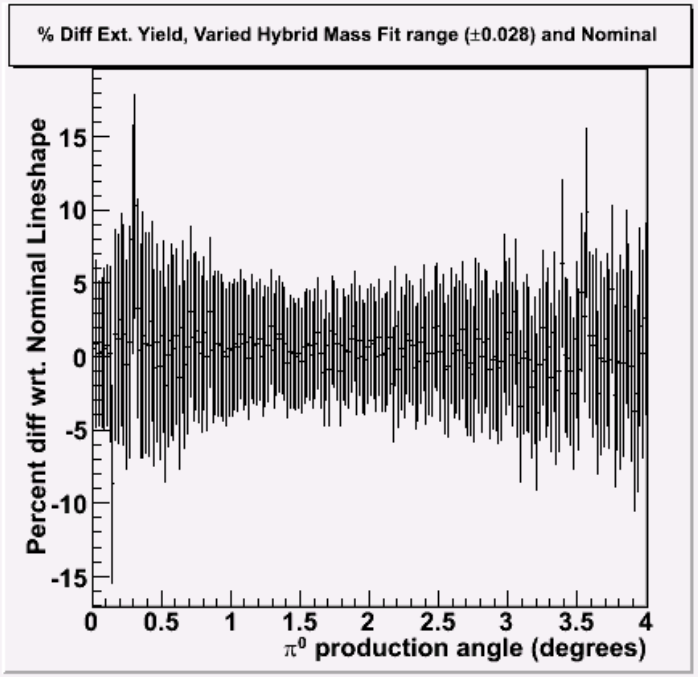
Full HyCal
Too many DOF's in 4th ord. poly?



Full HyCal--Vary the Fit range





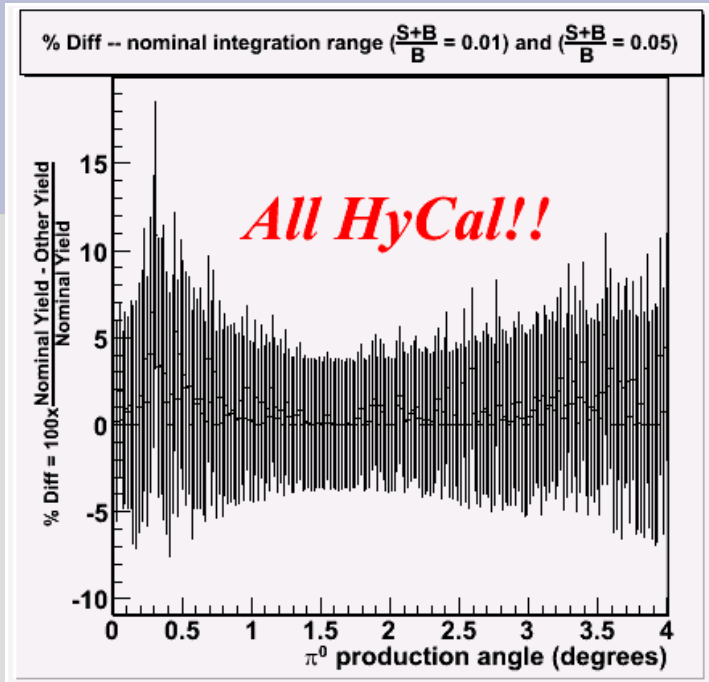


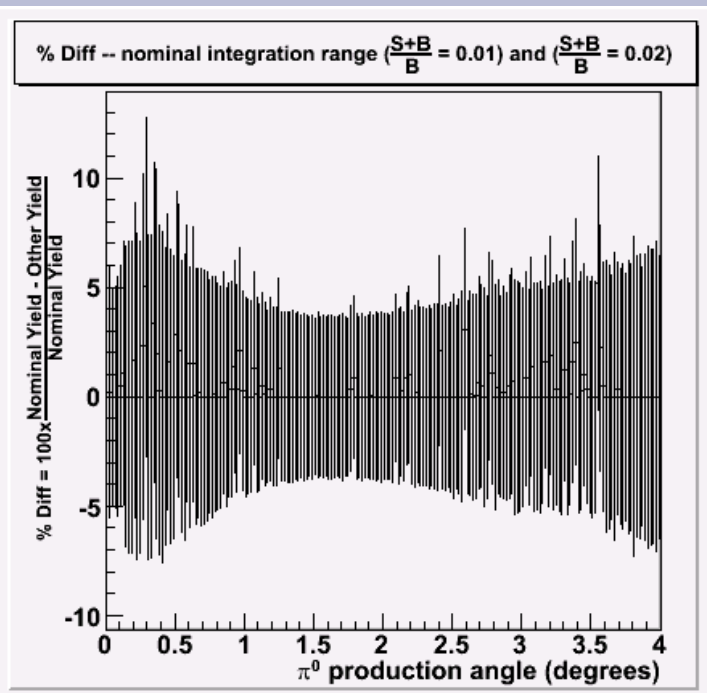
Nominal Fit Range = ± 0.030

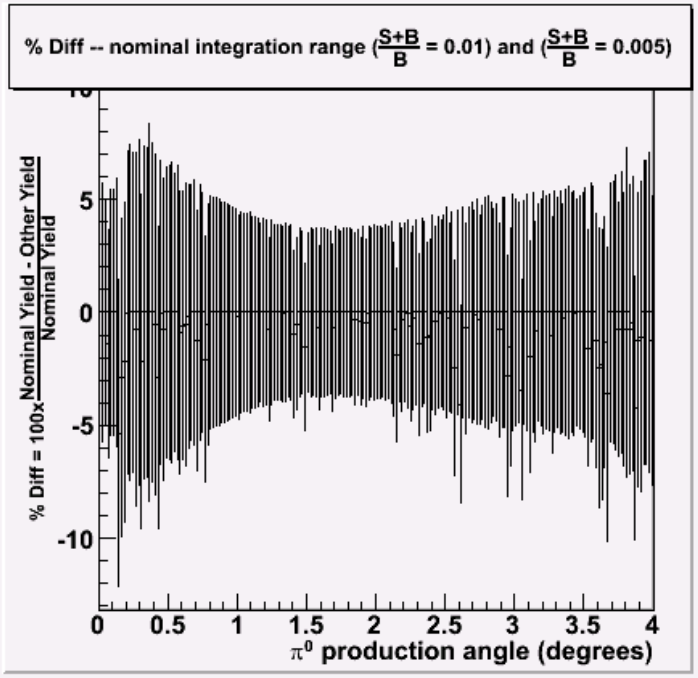
Using Double gaussians with
3rd order polynomial lineshape

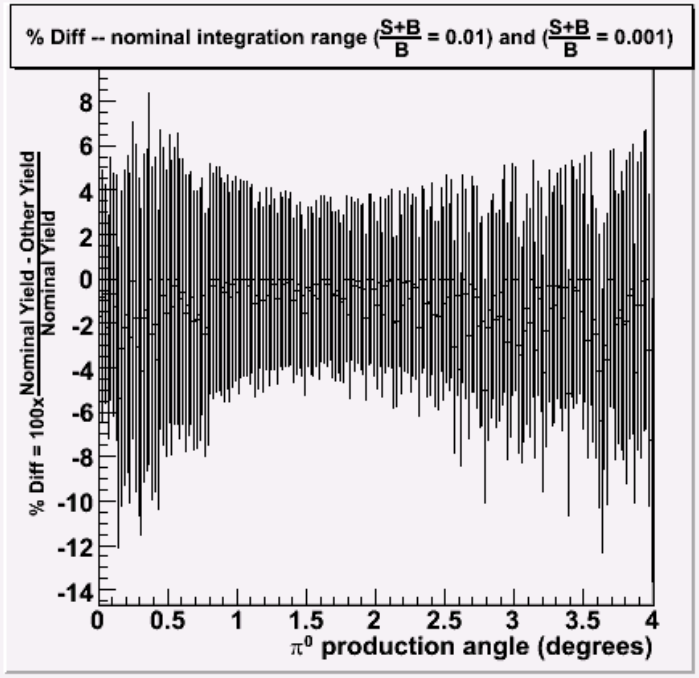
Free floating cut/Integration range

All HyCal

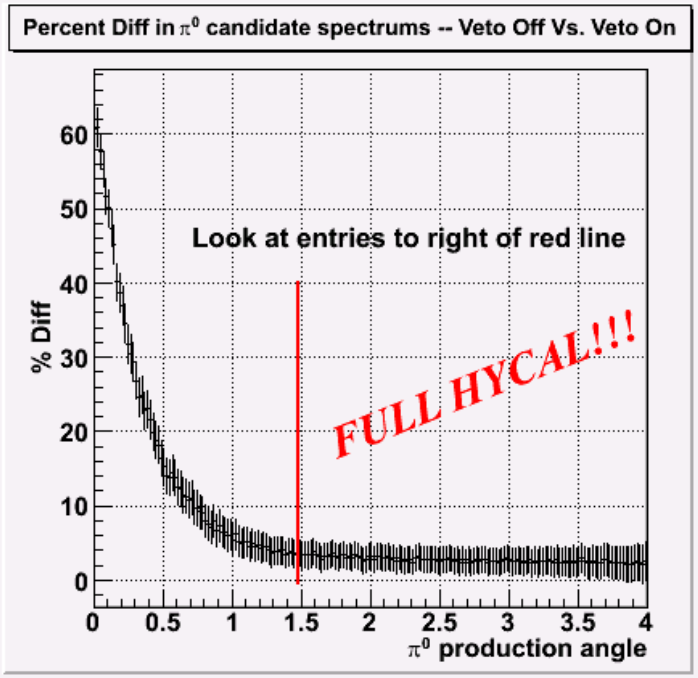


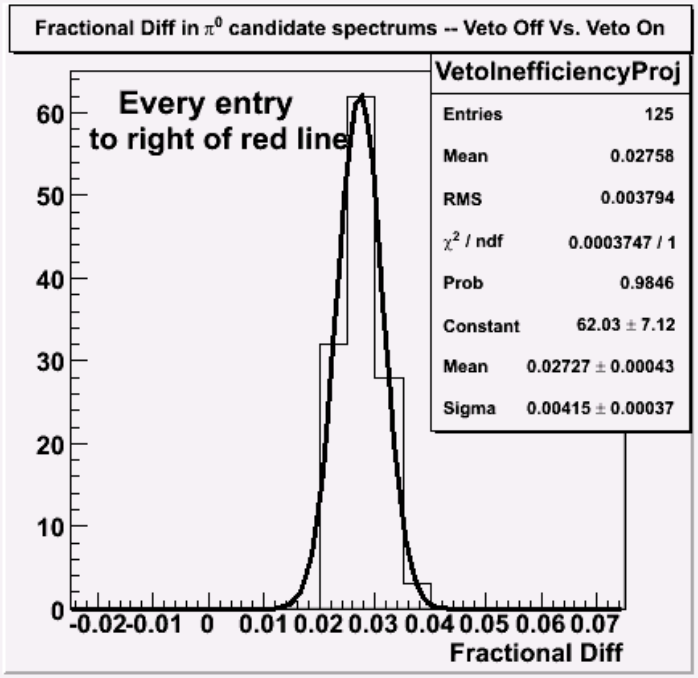


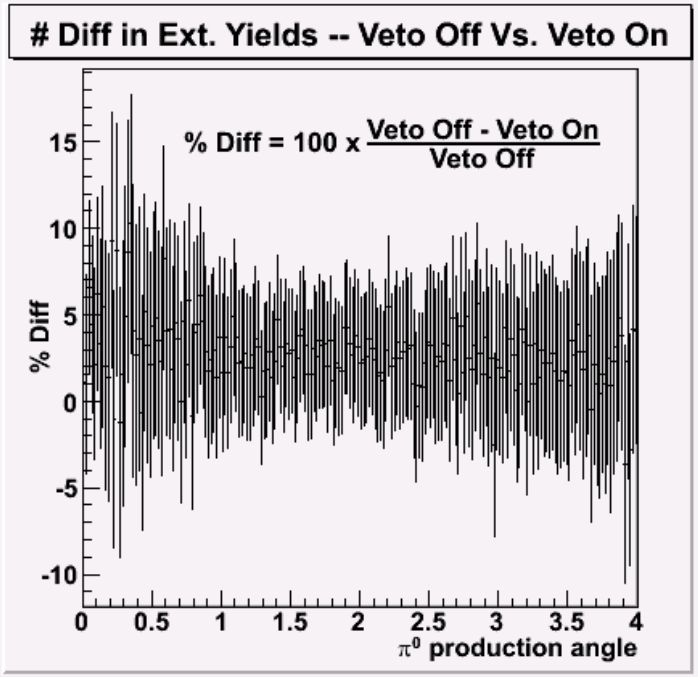


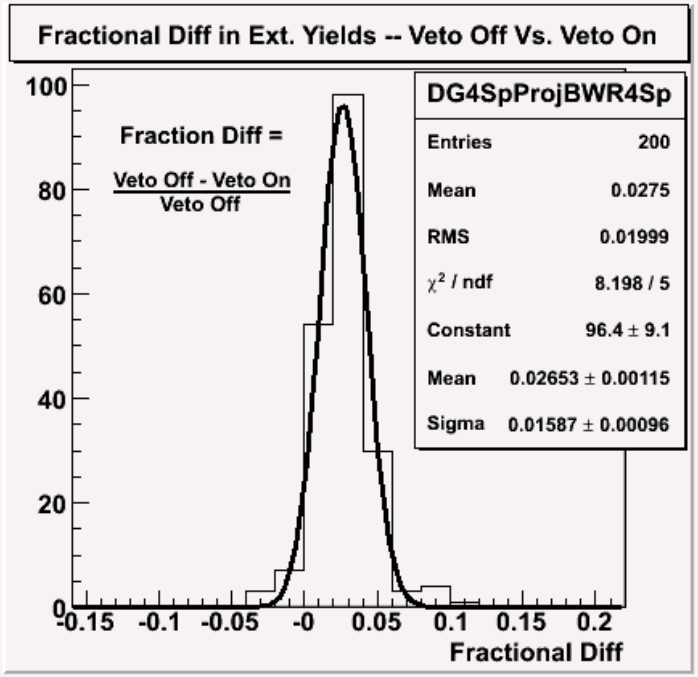


Full HyCal – Veto Study



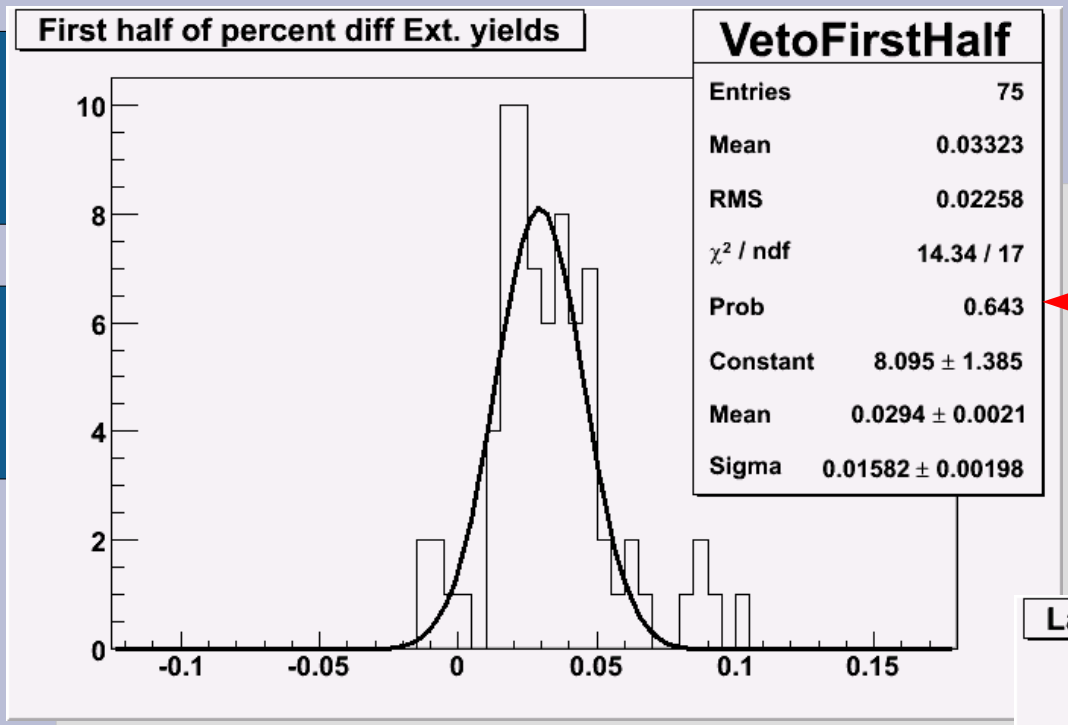






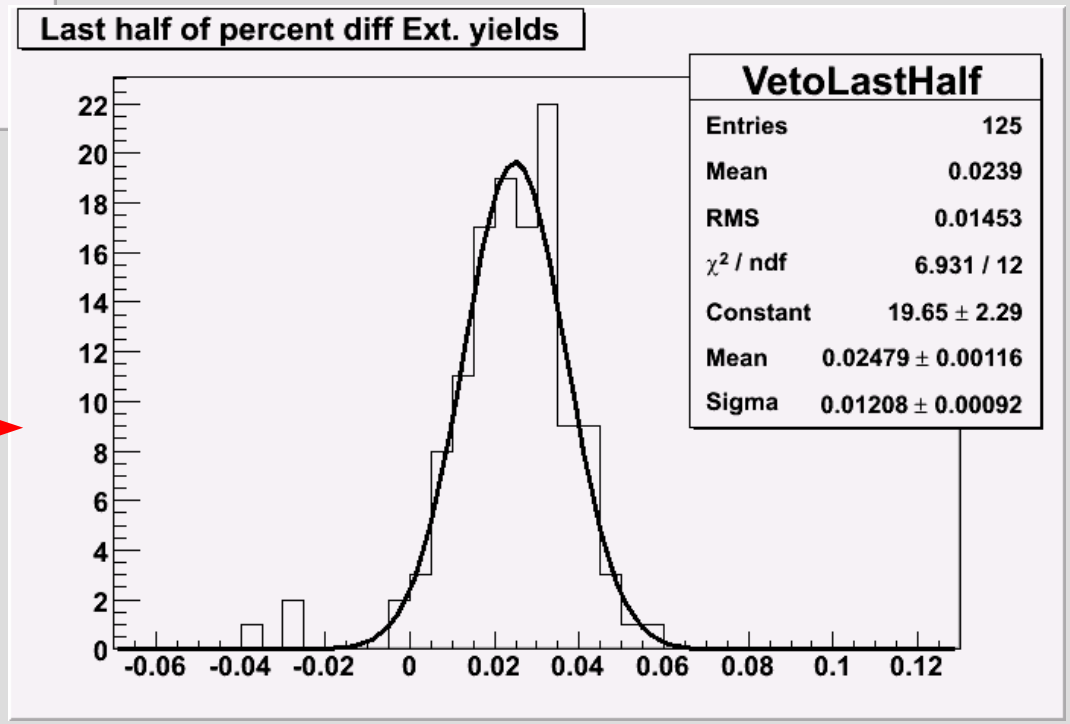
Veto with the All HyCal

π^0 production angle broken up

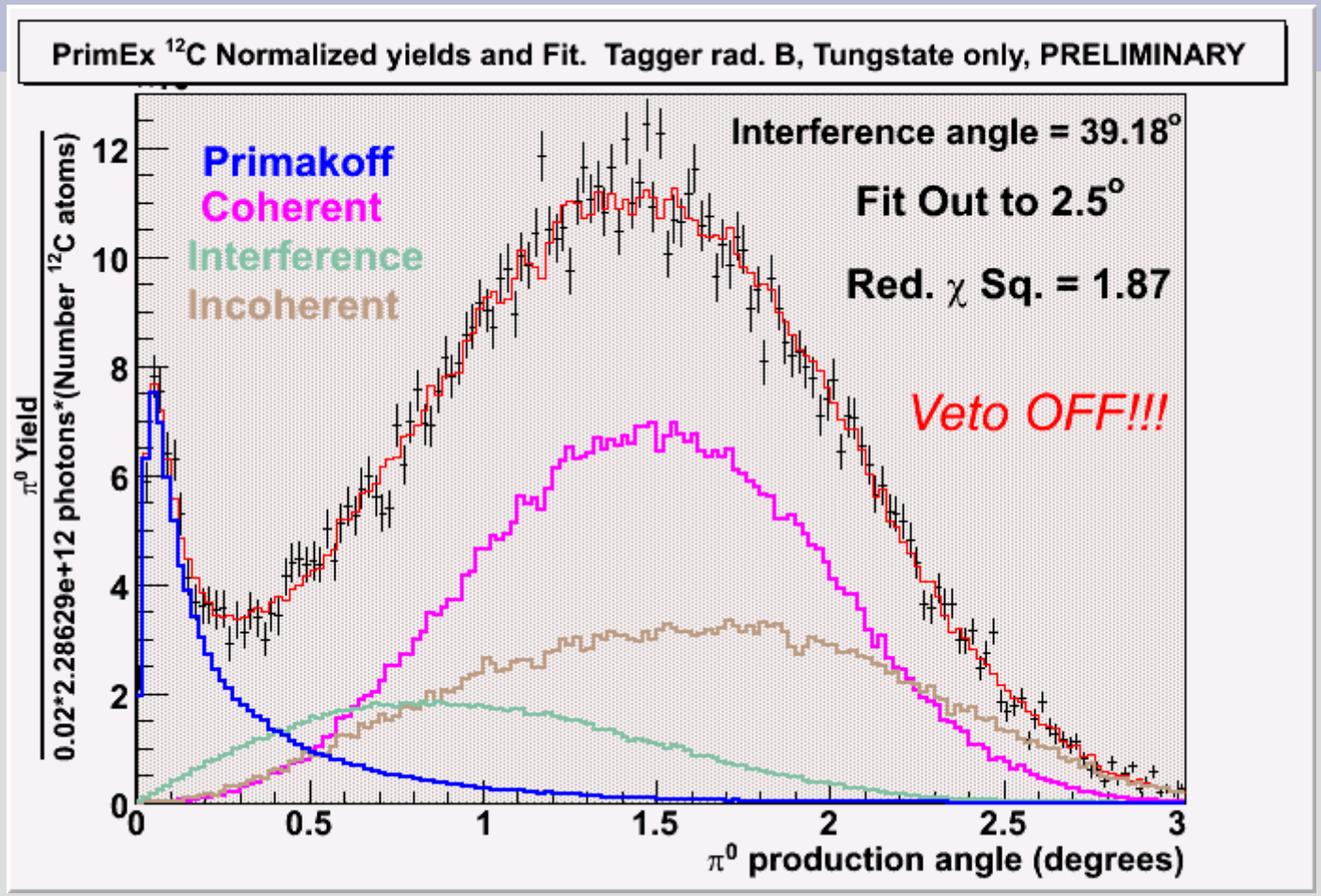


Entries in Extracted Yield differences, π^0 prod. angle <1.5° from previous page

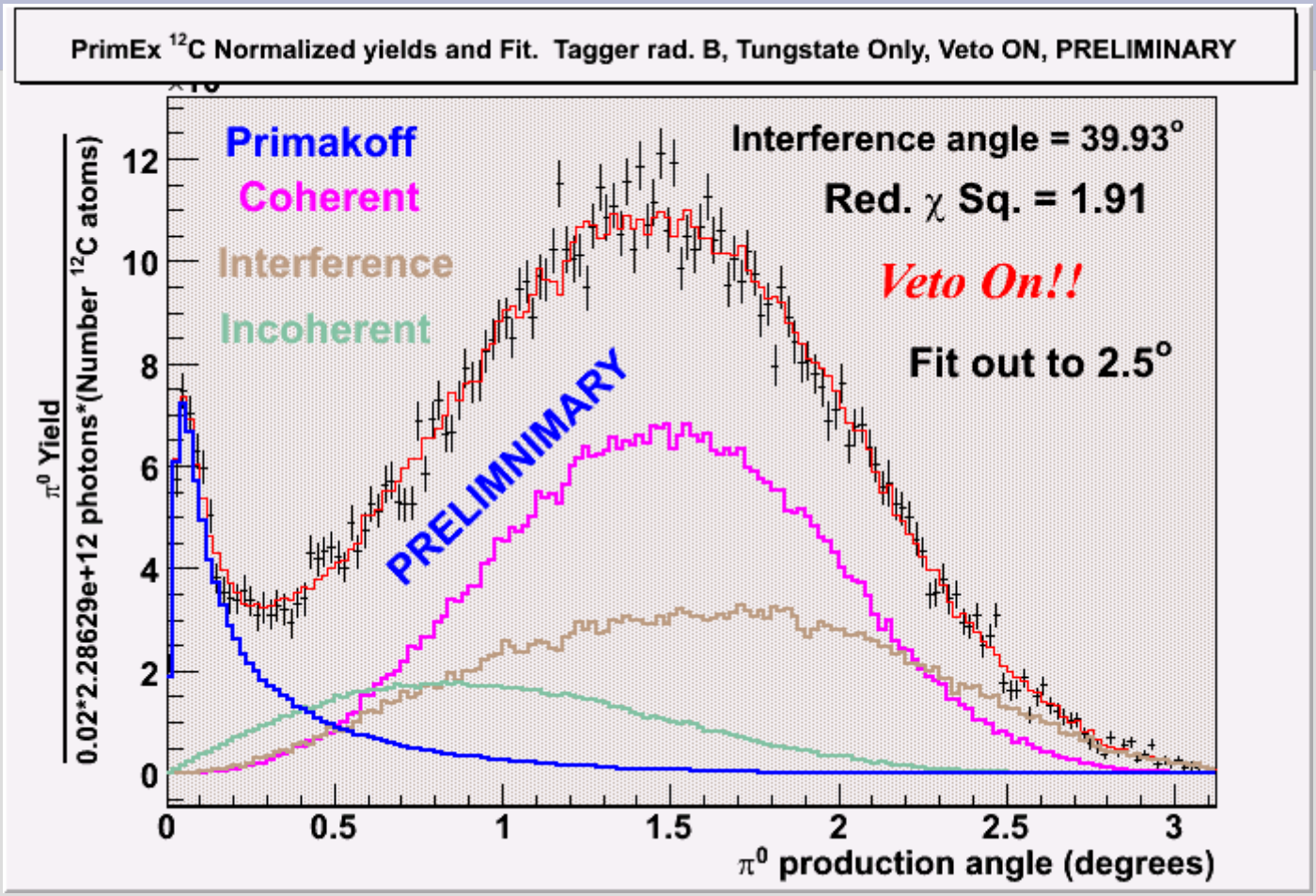
Entries in Extracted Yield differences, π^0 prod. angle >1.5° from previous page



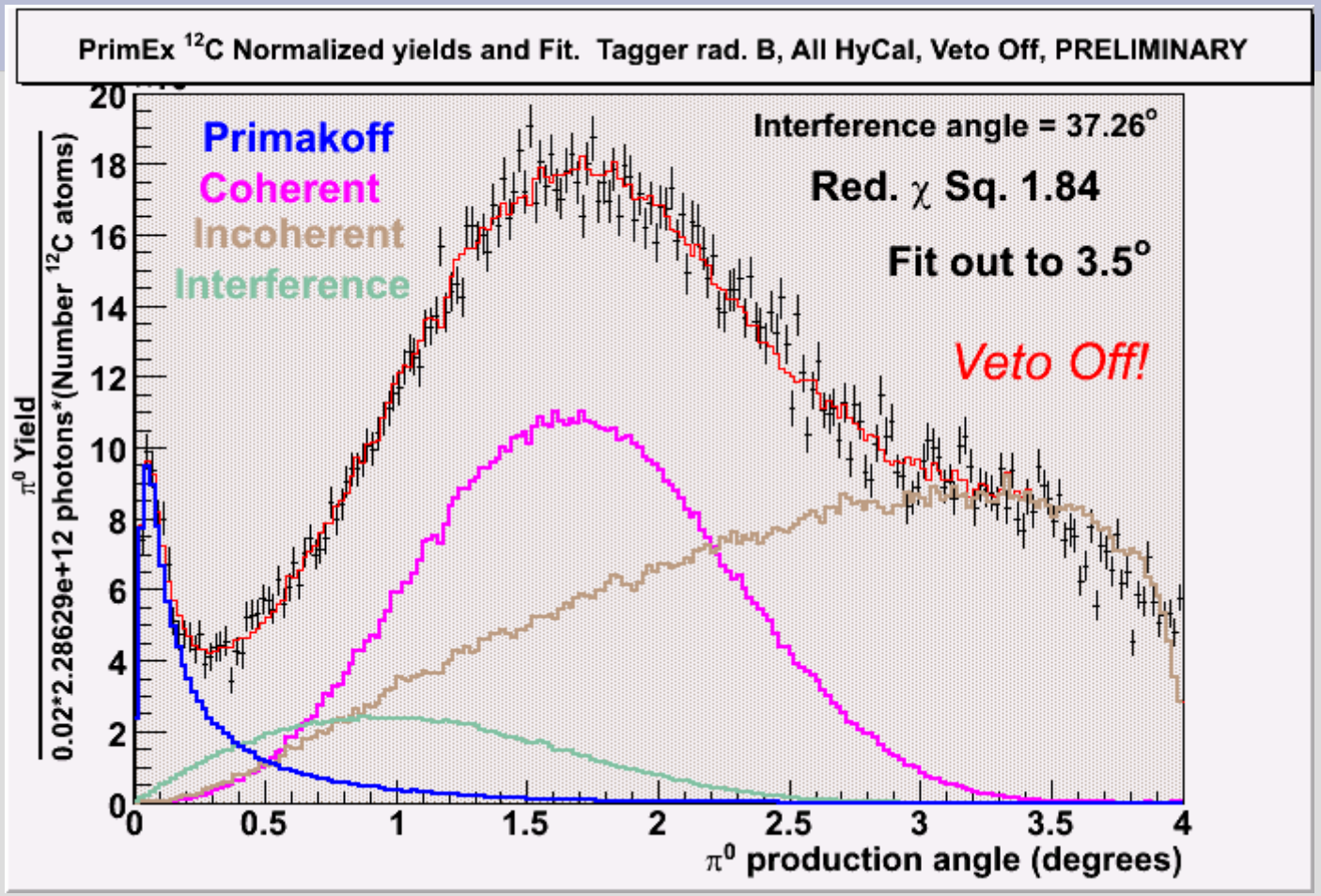
Fit with tungstate only, Veto Off



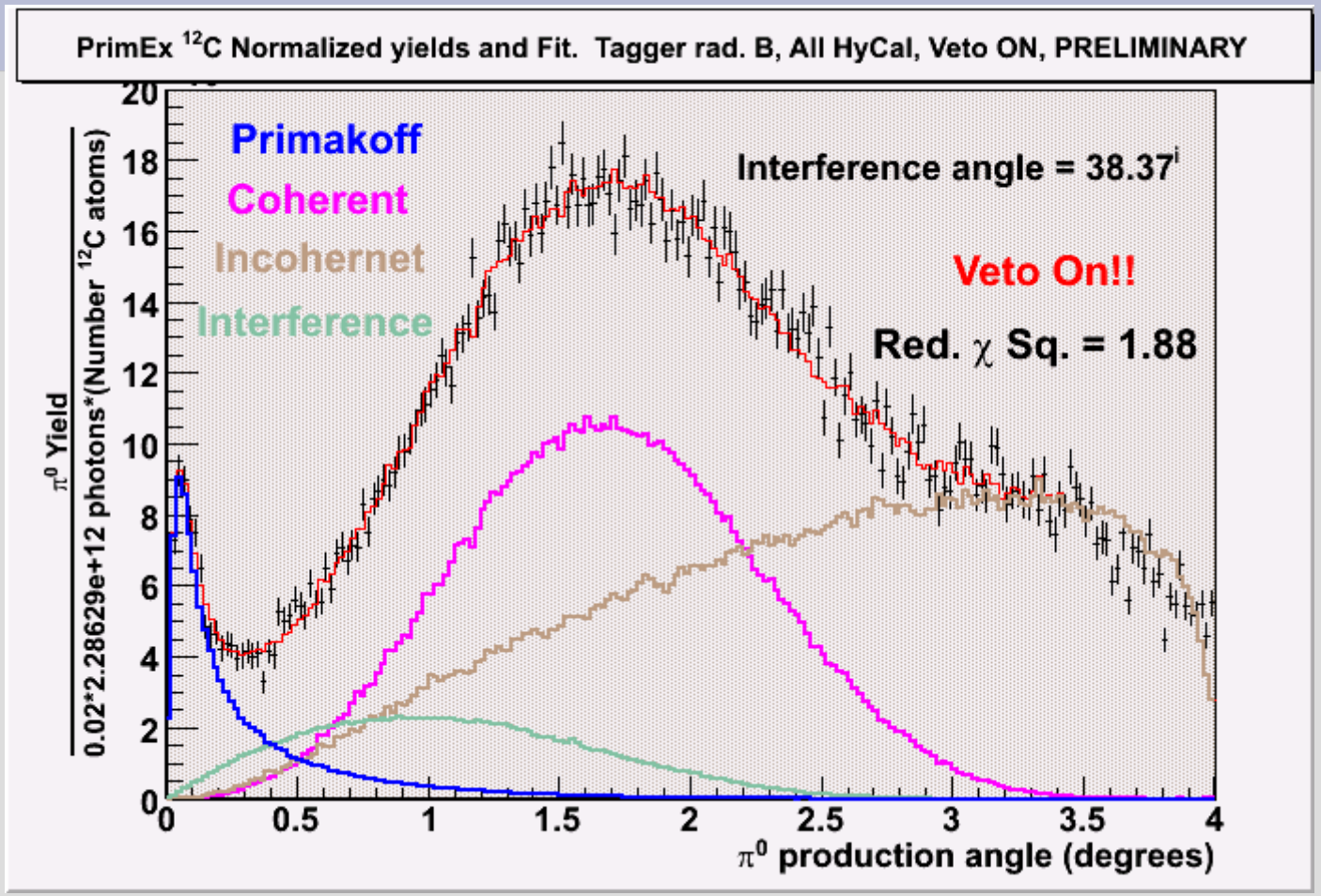
Fit With Tungstate – Veto On



Fit with Full HyCal – Veto Off



Full HyCal – Veto On



Vary the Fit -- Tungstate

Variation	***Width***	***% Diff Nominal***
Nominal	7.864 ± 0.17 eV	NA
Lineshape (2RG-3Poly)		
2RG-3Spline	7.859	-0.07
2RG-4Poly	7.786	1.00 ***
3RG-3Poly	7.932	0.86
Integration Range (Nominal = 1.0%)		
5.0%	7.770	-1.12
2.0%	7.843	-0.27
0.5%	7.948	1.06 ***
0.1%	7.906	0.53
Cluster Position Finding Method Nom. =3		
Cluster Method 0	7.702	-2.06
Cluster Method 1	7.838	-0.33 ***
Cluster Method 2	7.859	-0.07
Cluster Method 4	7.843	-0.27
Veto On	7.763 ± 0.15 eV	-1.28

*** -- Used for systematic error estimation

Cluster Position Fit Parameters...

Method	Primakoff	Coherent	Interference	Incoherent	Red. Chi Sq.
0	0.1474E-02	0.1118E-01	0.2210E-02	0.1753E-01	2.41
1	0.1500E-02	0.1137E-01	0.2305E-02	0.1680E-01	1.81
2	0.1505E-02	0.1123E-01	0.2331E-02	0.1728E-01	1.80
3	0.1504E-02	0.1127E-01	0.2355E-02	0.1705E-01	1.87
4	0.1501E-02	0.1102E-01	0.2354E-02	0.1779E-01	1.86

Vary the Fit – All HyCal

Variation	***Width***	***% Diff Tung.***	***%Diff All HyCal***
Nominal –(2RG-3Poly)	7.770 ± 0.16 eV	-1.47	NA
Lineshape			
2RG-3Spline	7.780	-1.06	0.135
2RG-4Poly	7.2216	-8.2	-7.13
3RG-3Poly	7.958	1.19	2.42
Integration Range			
5.0%	7.692	-2.19	-1.00
2.0%	7.744	-1.53	-0.33
0.5%	7.843	-0.27	0.94
0.1%	7.90	0.47	1.68
Cluster Position Method			
Cluster Method 0	In Progress		
Cluster Method 1	In Progress -- Use Tung. for Sys. Error...		
Cluster Method 2	In Progress		
Cluster Method 4	In Progress		
Veto On	7.656 ± 0.14 eV		

Estimate Error – Tungstate Only

Statistical

Veto OFF	2.20%
Veto ON	1.93%

Systematic

Photon Flux	1.10%
Lineshape	1.00%
Signal Integration Cut-off	1.06%
Cluster Position Finding	0.33%
Target Thickness	0.04%
Branching Ratio	0.03%
Incoherent Background	In progress.
Veto	0.25%

Sys. Total (without Incoherent) 1.86%

Estimate Error – All HyCal

Statistical

Veto OFF	2.06%
Veto ON	1.83%

Systematic

Photon Flux	**
Lineshape	**
Signal Integration Cut-off	**
Cluster Position Finding	**
Target Thickness	**
Branching Ratio	**
Incoherent Background	In progress.
Veto	0.25%

Sys. Total (without Incoherent) **

Preliminary Results

Results:	Width ± Stat Err. ± Sys. Err.
No Veto	
Tungstate Only:	7.864 eV ± 2.20% ± 1.86% [1]
All HyCal:	7.763 eV ± 2.06% ± 1.86% [1]
Veto On	
Tungstate Only:	7.770 eV ± 1.93% ± 1.88% [1,2]
All HyCal:	7.656 eV ± 1.83% ± 1.88% [1,2]

[1] Systematic Error doesn't include Incoherent theory cross section uncertainty

[2] Final systematic error analysis not done for All HyCal