

High Precision Time-of-Flight for the CMS Phase II Upgrade Test Stand Analysis



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Caltech



Introduction

- **All plots have been inverted to be positive and x-axis have been scaled to be in ns.**

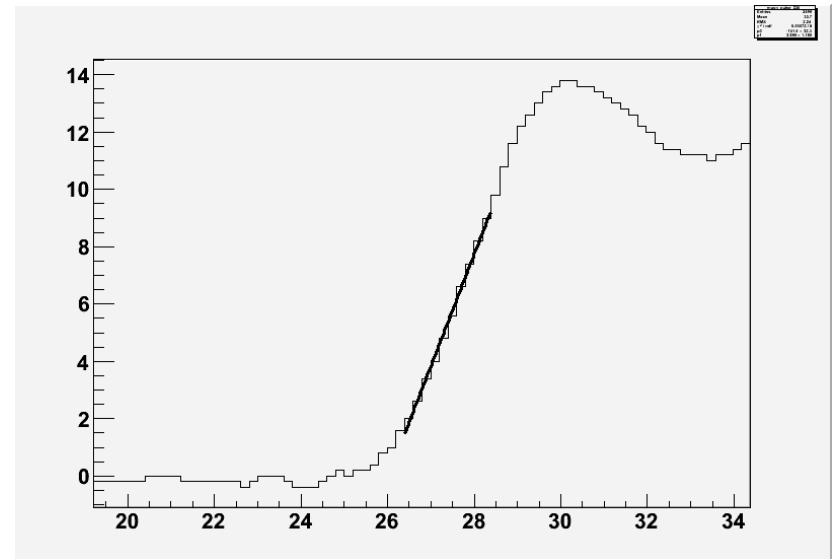
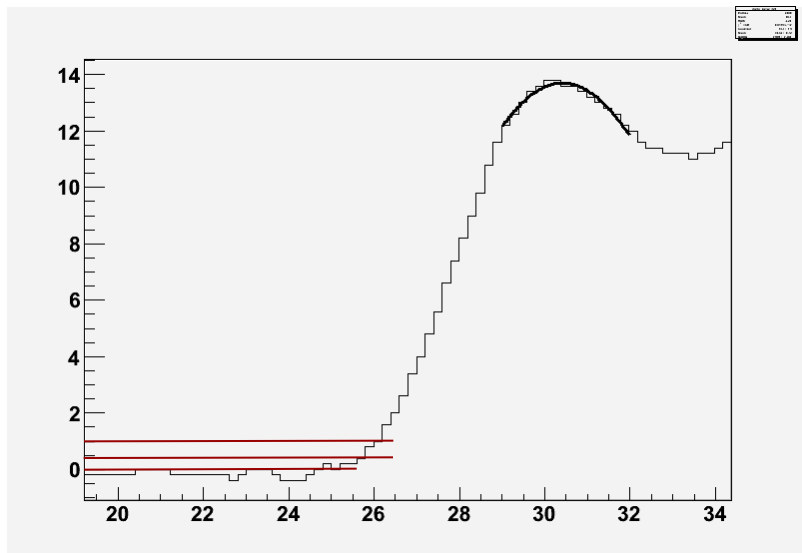


Chapter One

First data taking with a single side readout 10 cm LYSO crystal.



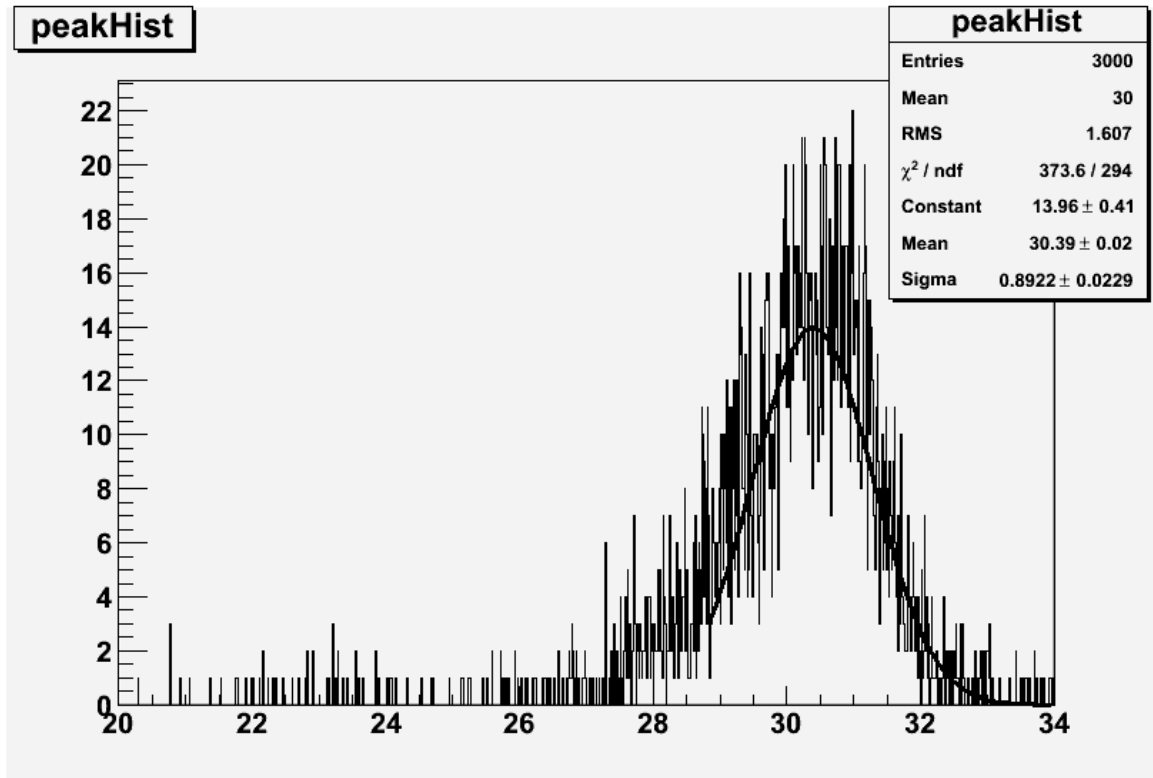
Peak Fit and Rise Time Fit



- Fit a gaus around the first peak of the pusle shape.
- Fit a 1st order polynomial to the rising edge.

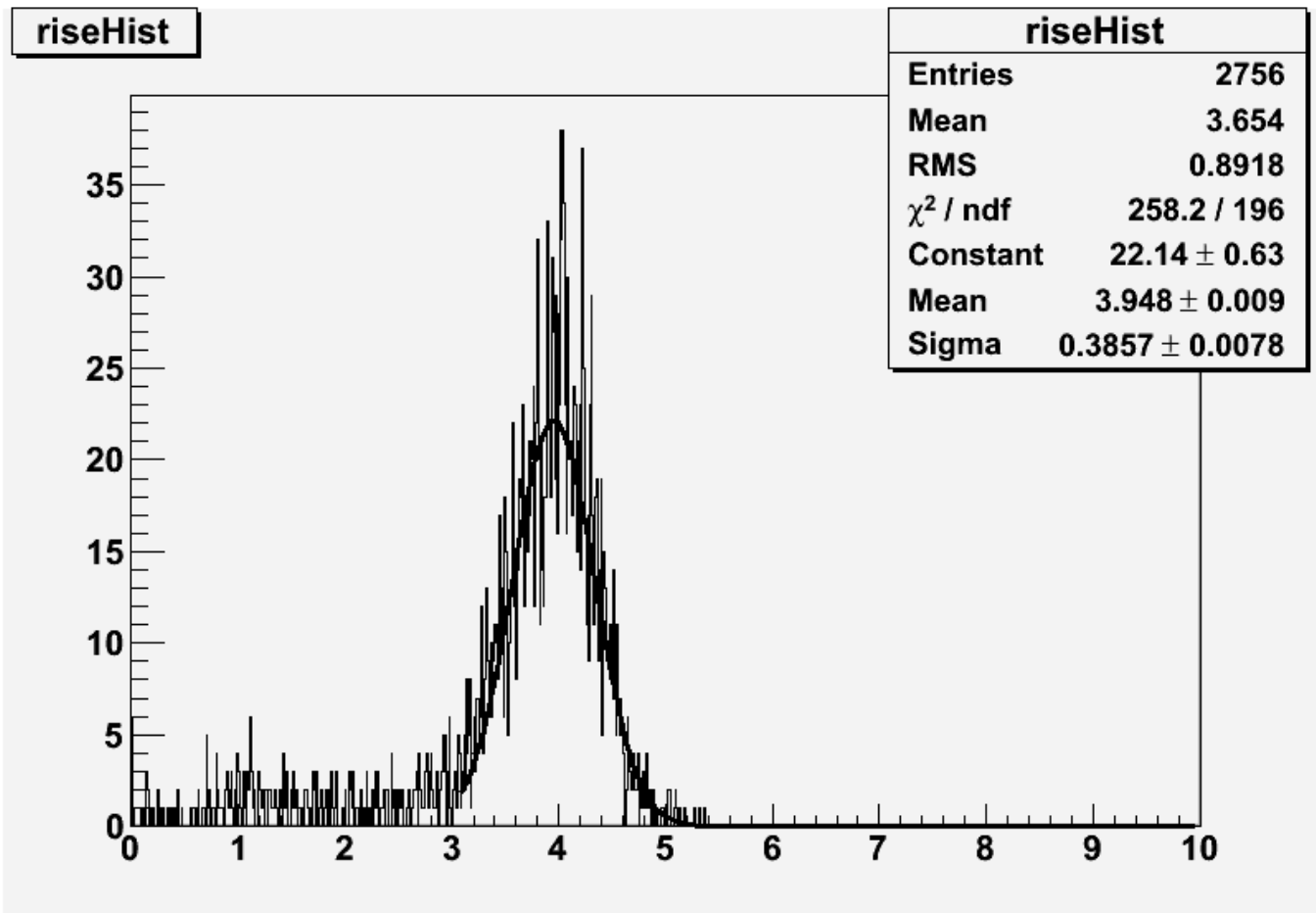


Peak Timing Jitter



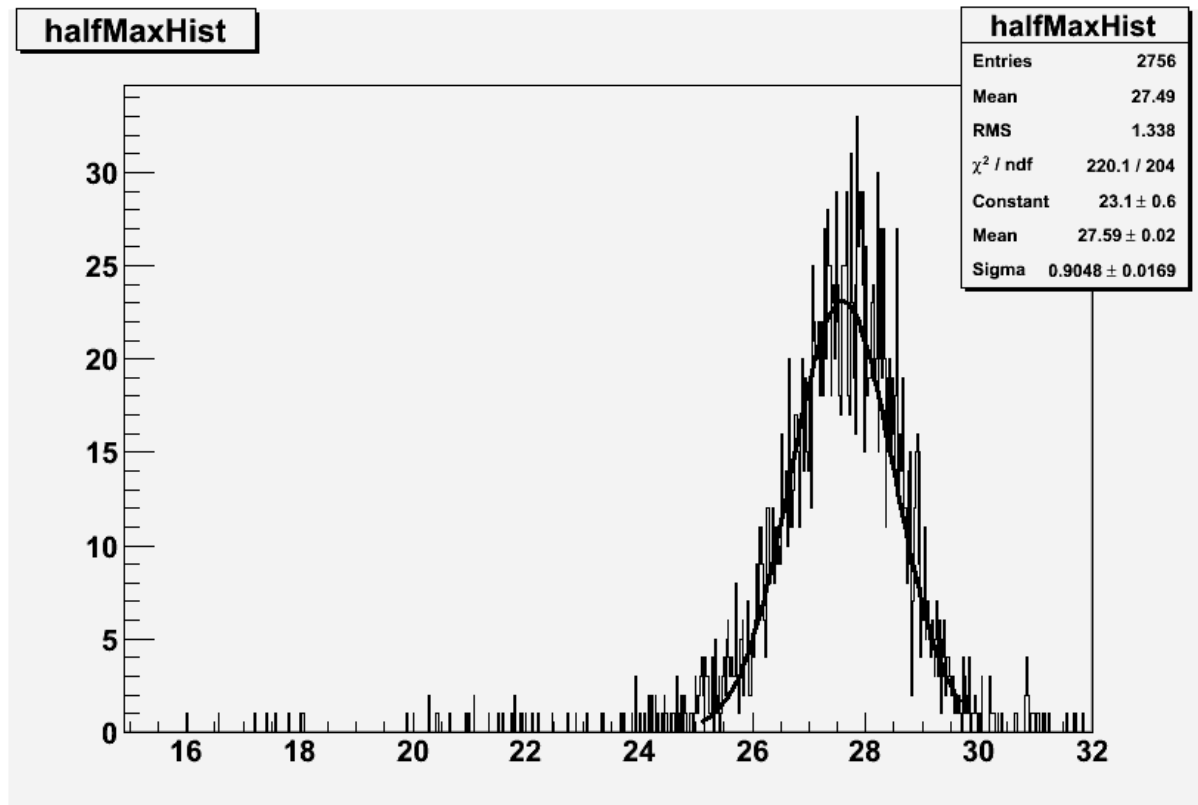


Rise Time Fit



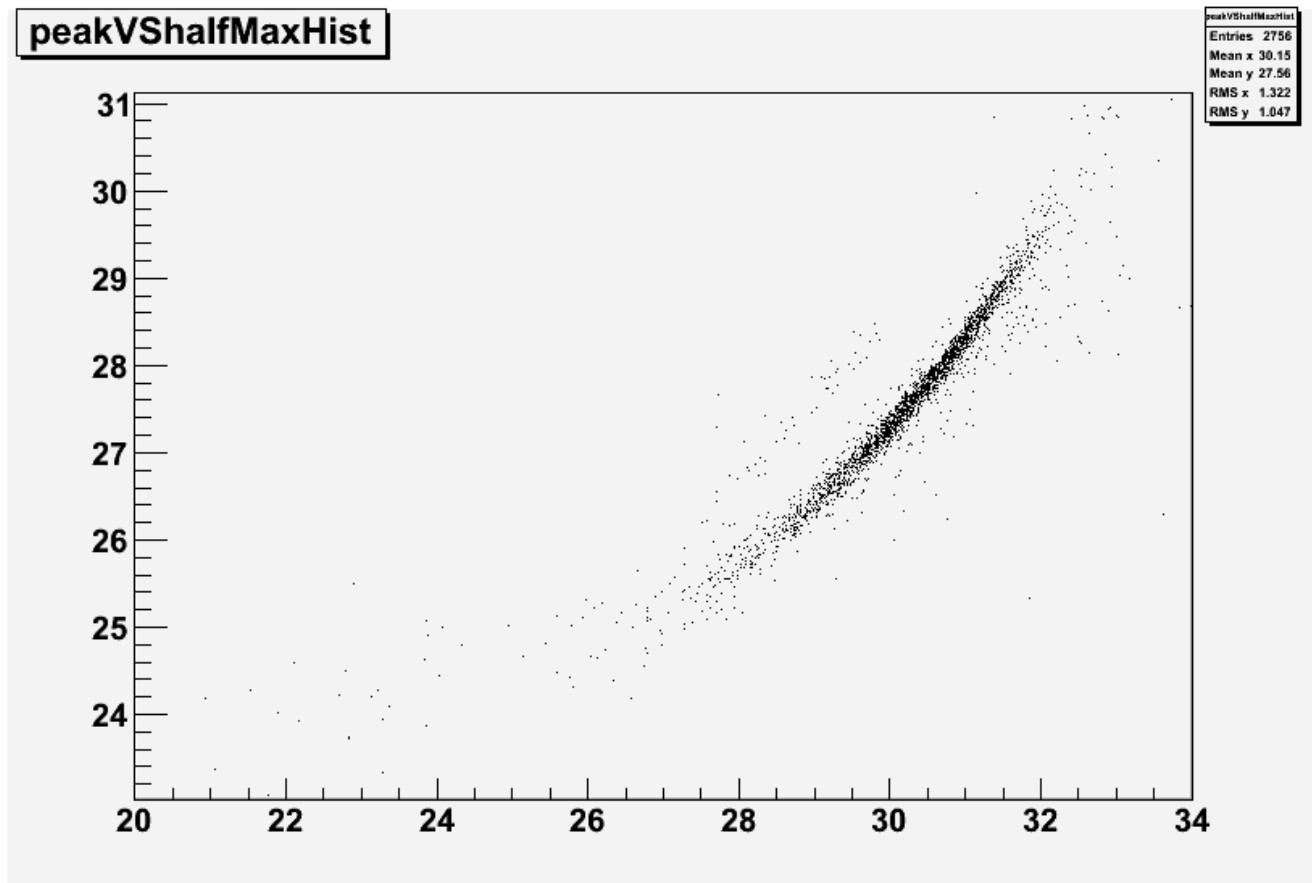


Half Max Time





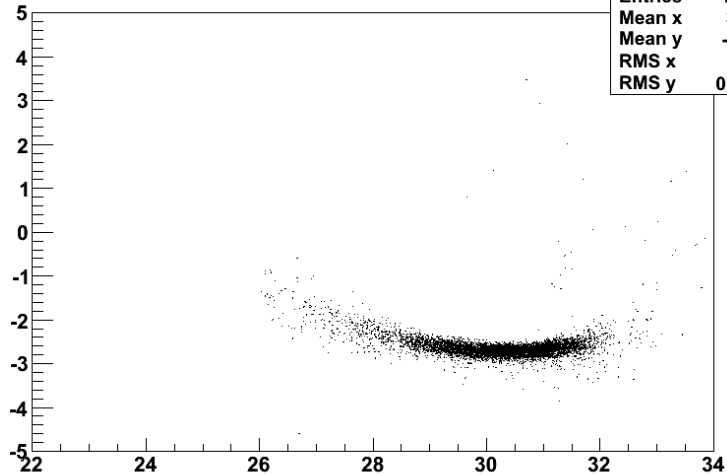
Peak vs Half Max Time





Correcting DeltaT

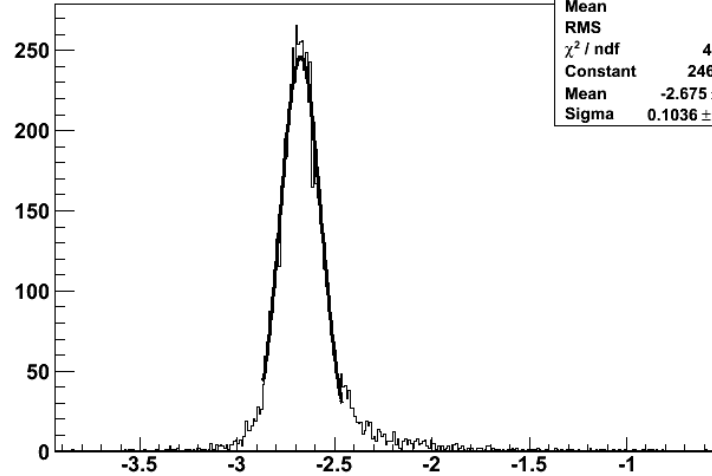
peakVSDeltahalfMaxHist



peakVSDeltahalfMaxHist

Entries	14314
Mean x	30.26
Mean y	-2.631
RMS x	1.003
RMS y	0.2822

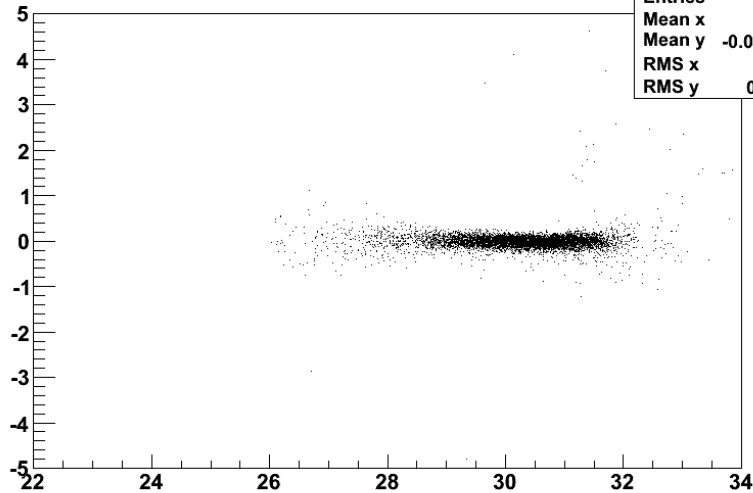
DeltahalfMaxHist



DeltahalfMaxHist

Entries	7157
Mean	-2.641
RMS	0.2
χ^2 / ndf	43.5 / 38
Constant	246.1 ± 4.2
Mean	-2.675 ± 0.002
Sigma	0.1036 ± 0.0015

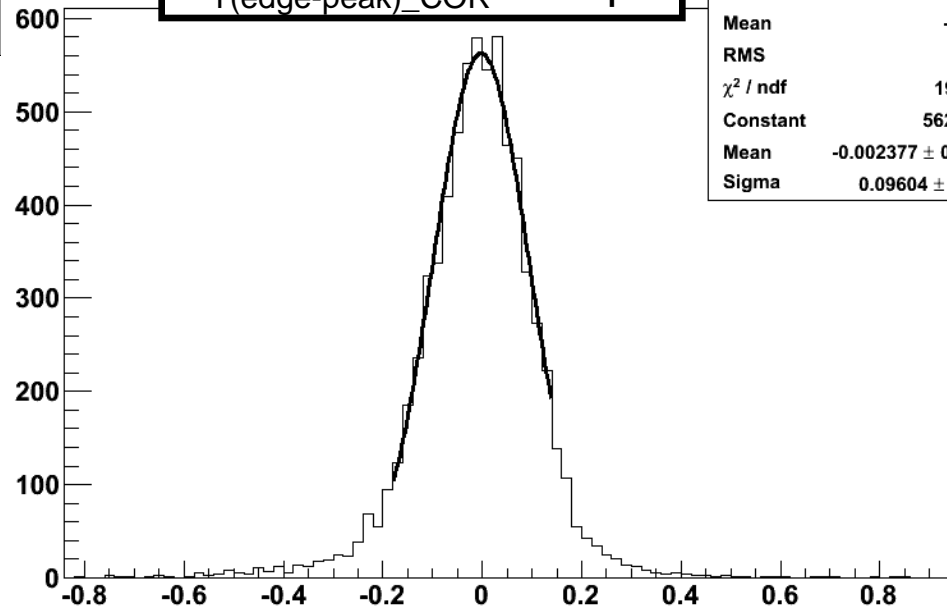
peakVSDeltahalfMaxCORHist



Entries	7157
Mean x	30.26
Mean y	-0.004851
RMS x	1.003
RMS y	0.2068

DeltahalfMaxCORHist

$\Delta_{T(\text{edge-peak})_COR} = 96 \text{ ps}$



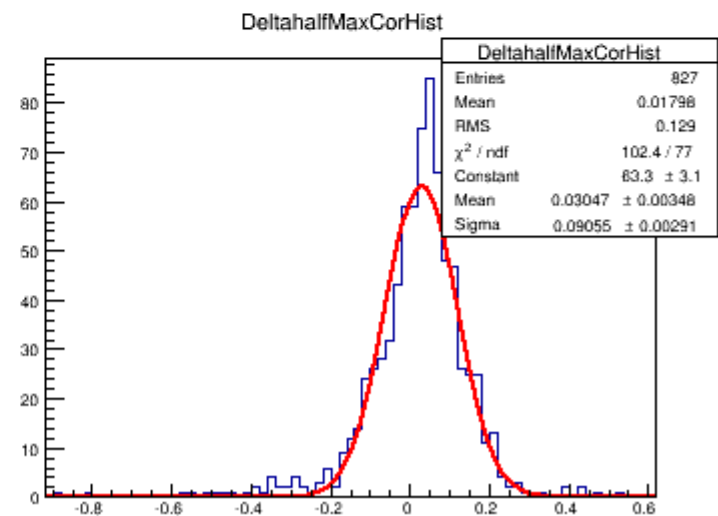
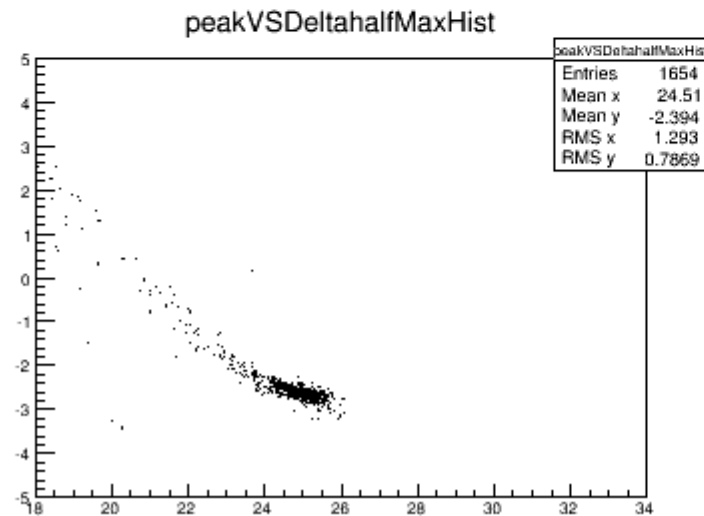
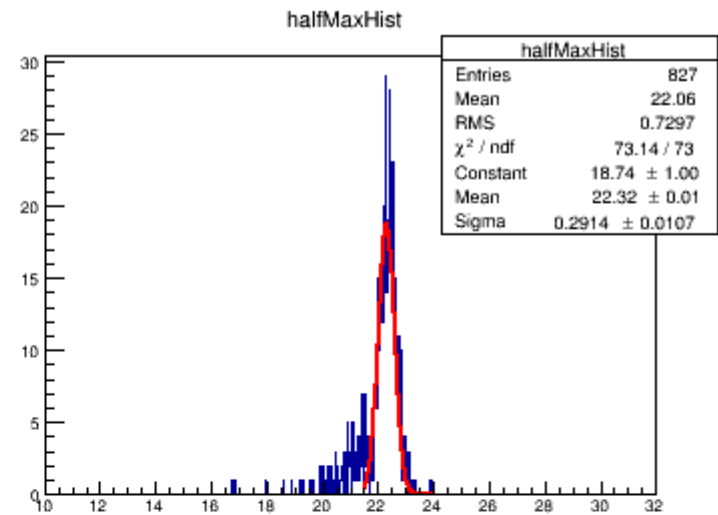
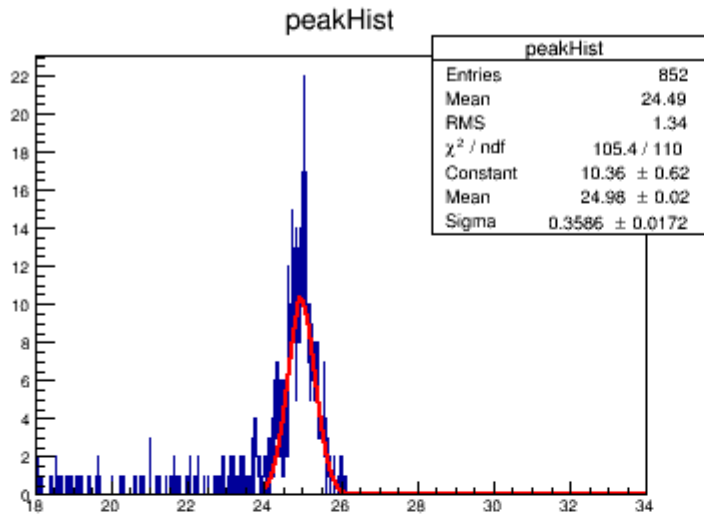
DeltahalfMaxCORHist

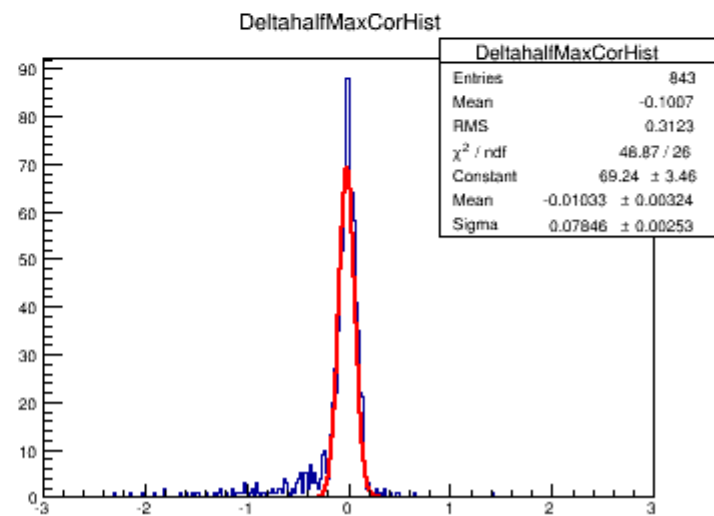
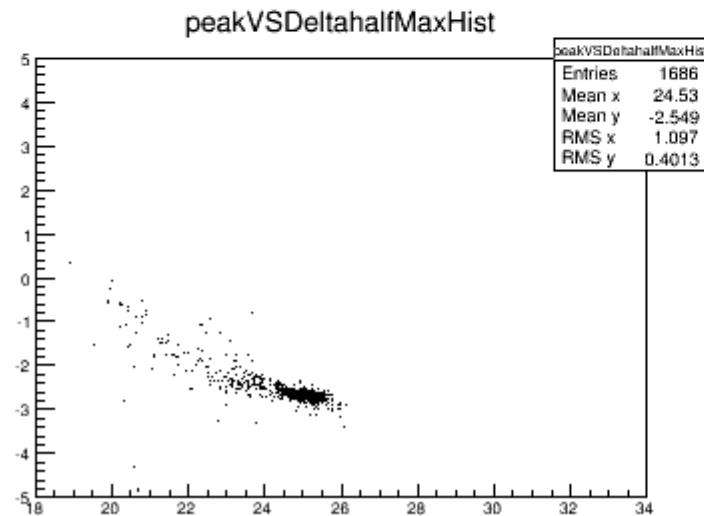
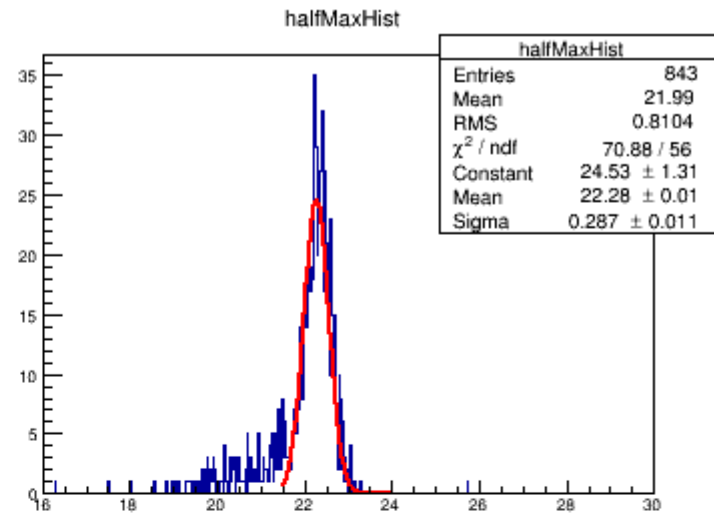
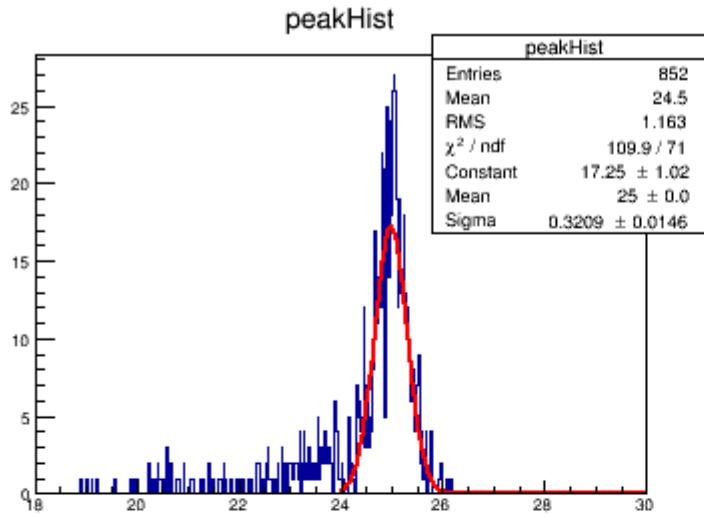
Entries	7157
Mean	-0.01074
RMS	0.1253
χ^2 / ndf	19.57 / 13
Constant	562.5 ± 9.7
Mean	-0.002377 ± 0.001612
Sigma	0.09604 ± 0.00180

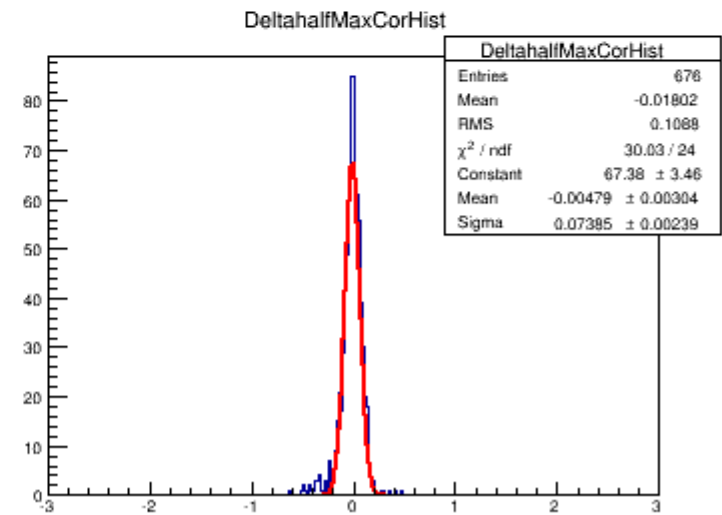
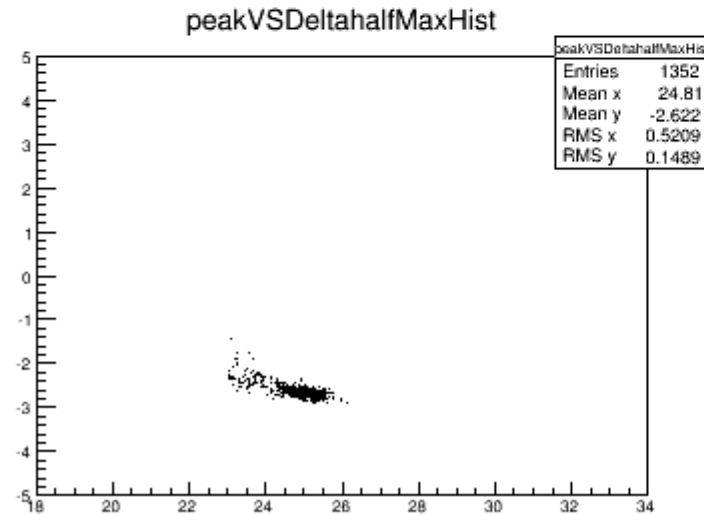
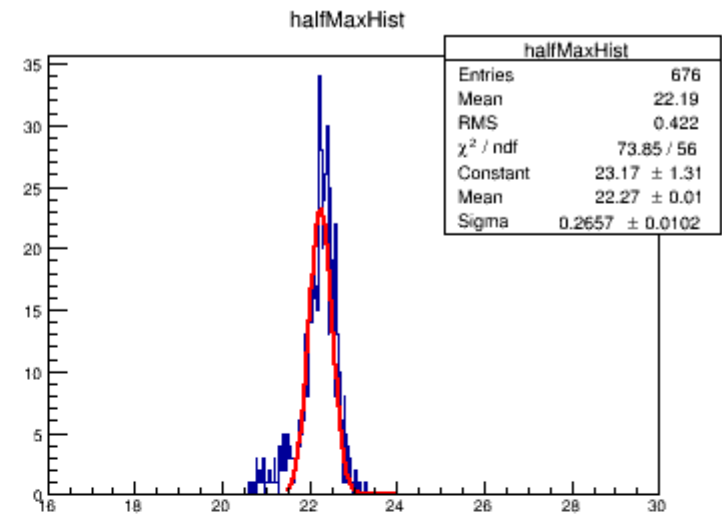
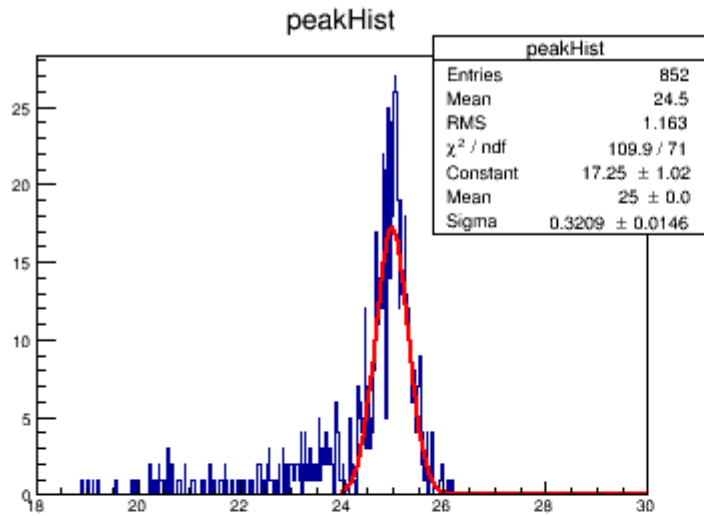


Chapter Two

Second data taking with a single side readout 1.7 cm LYSO crystal.

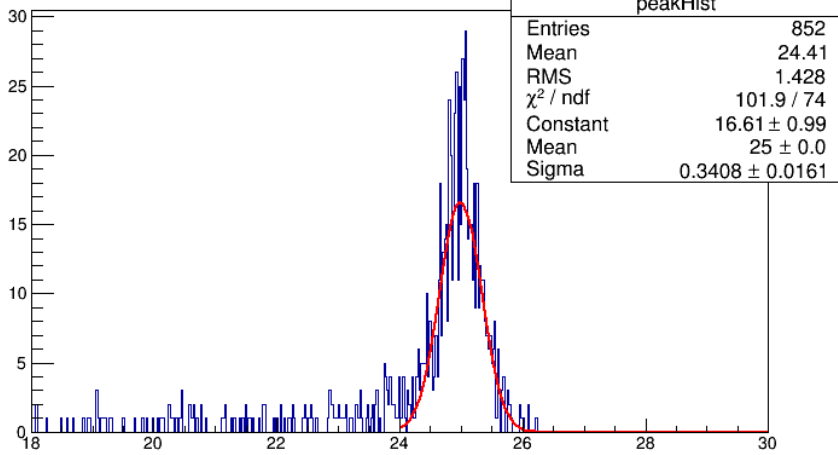




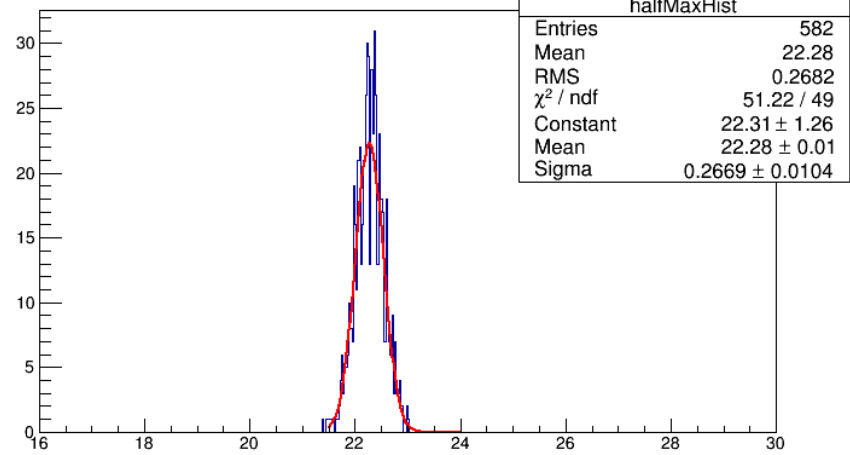




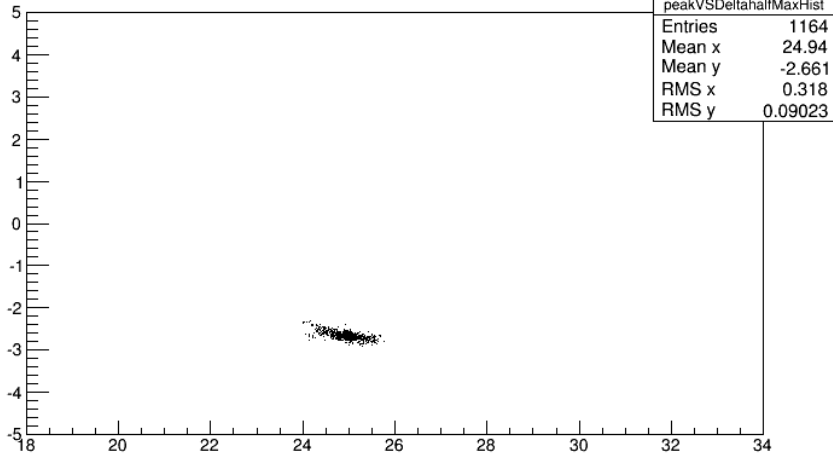
peakHist



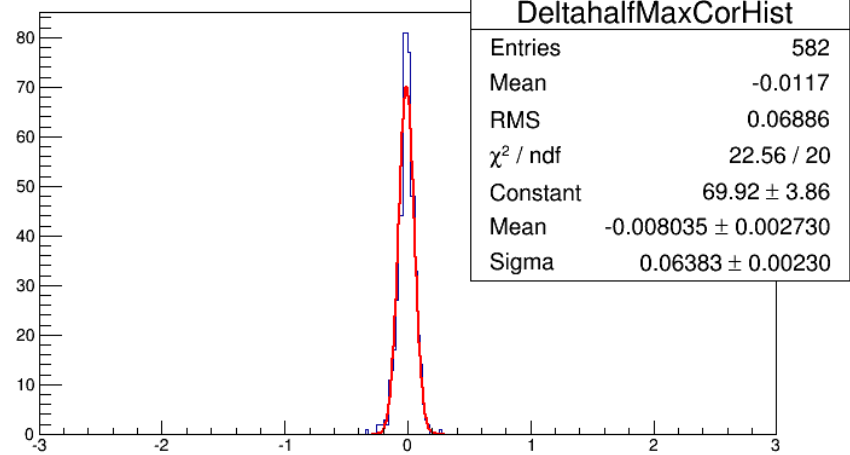
halfMaxHist



peakVSDeltahalfMaxHist



DeltahalfMaxCorHist

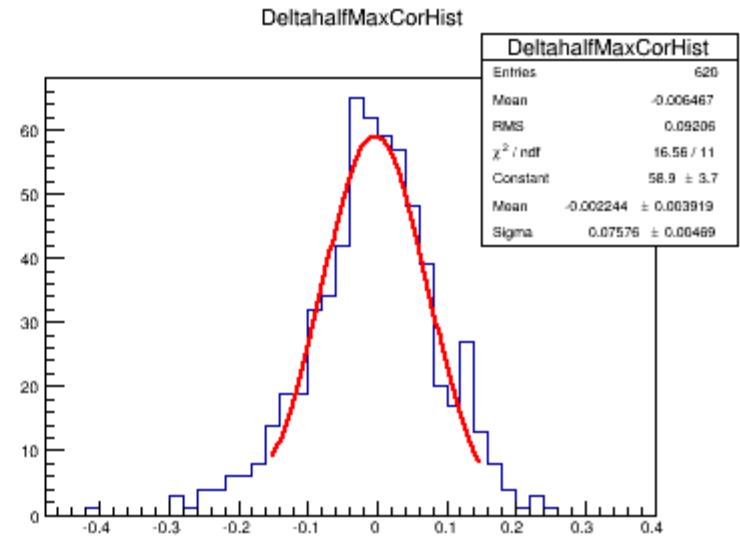
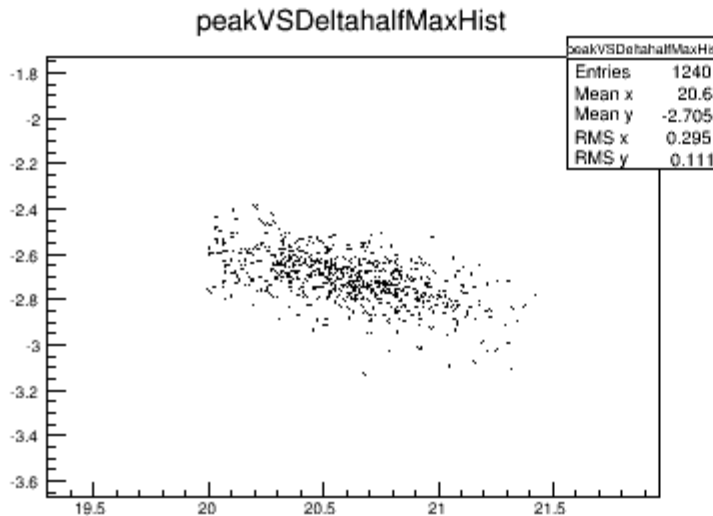
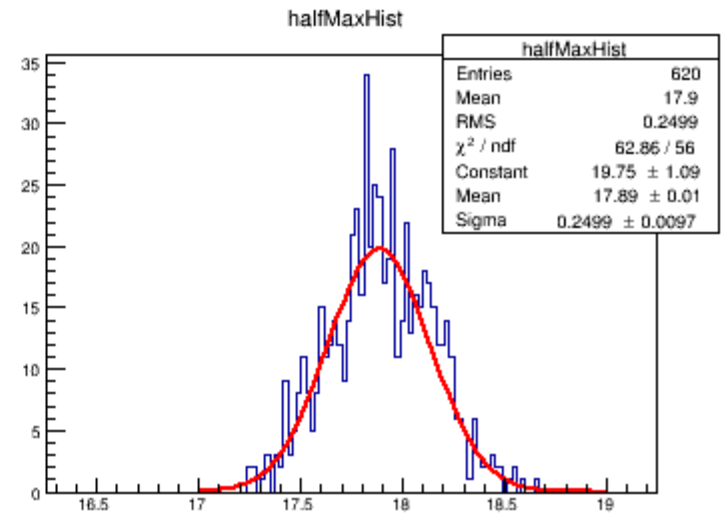
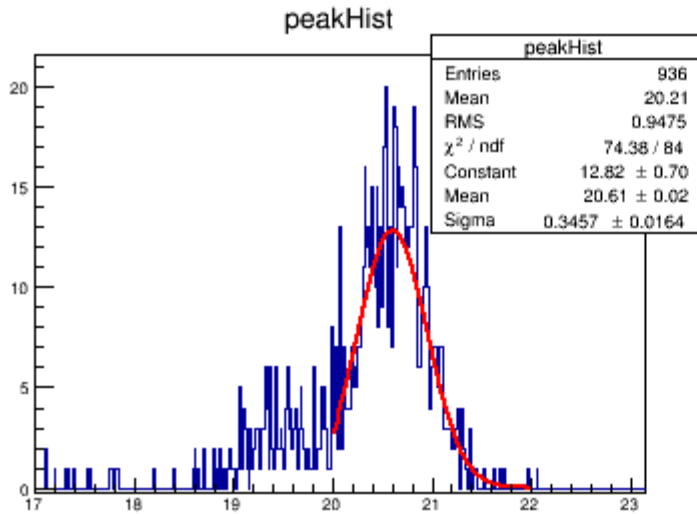


Peak fit : -1.0 to 1.5
Slope fit : -2.0 to -1.5



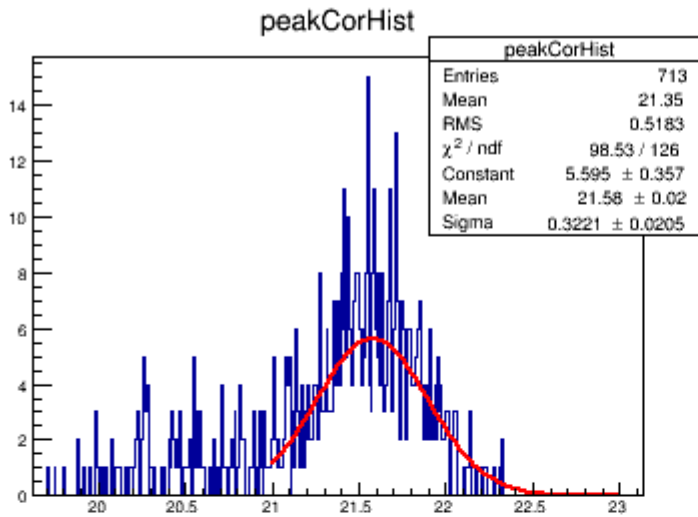
Chapter Three

**Third data taking with a single side readout 1.7 cm LYSO crystal
with a new faster scope.**

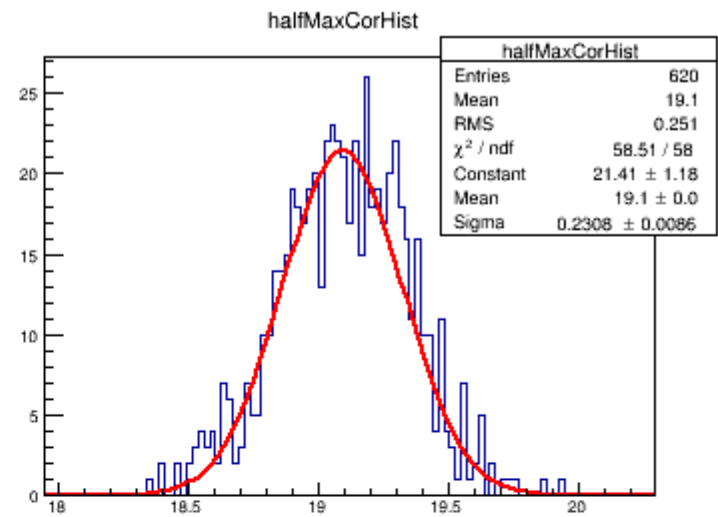


$$\text{DeltaTCor} = \text{DeltaT} - 1.784 + 0.2176 * \text{peak};$$

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$$\text{peakCor} = \text{peak} + 1.097 * \text{amp};$$

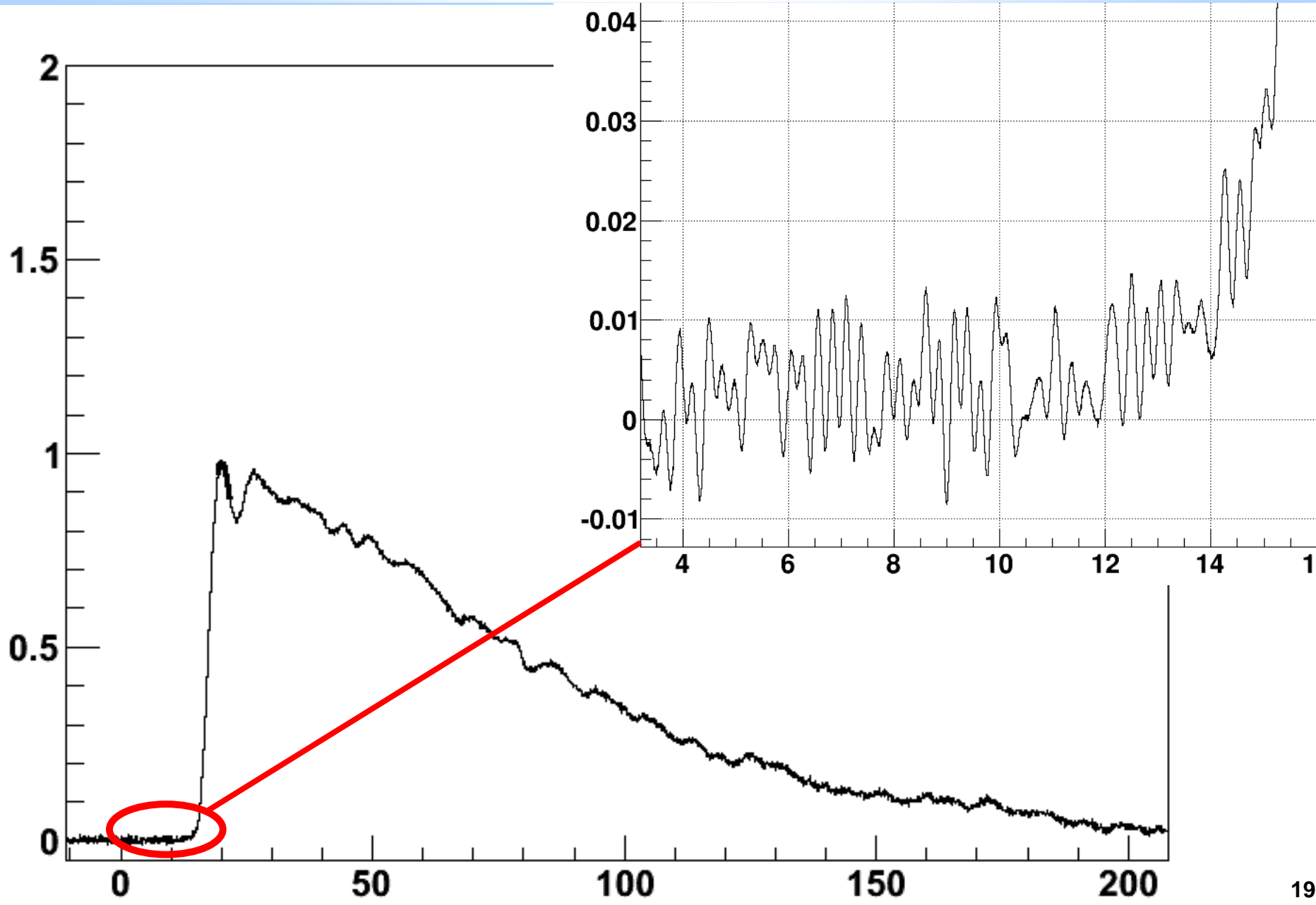


$$\text{halfMaxCor} = \text{halfMax} + 3.95 * \text{slopeFit};$$



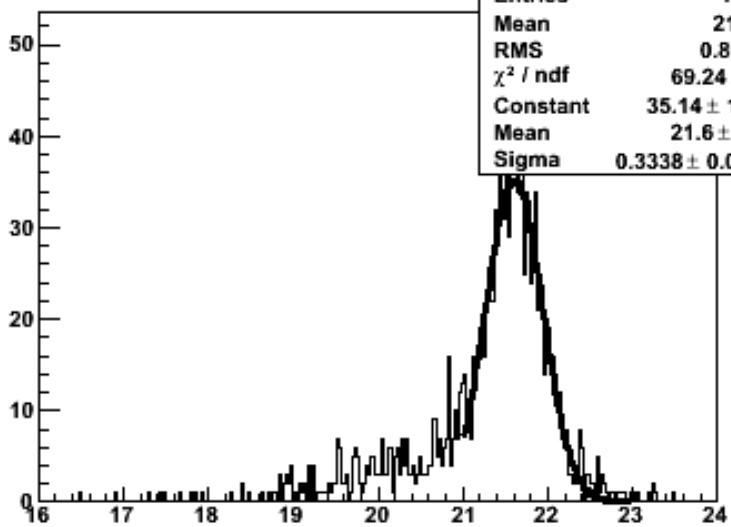
Chapter Four

**Fourth data taking with a single side readout 1.7 cm LYSO crystal
with a new Agilent scope.**



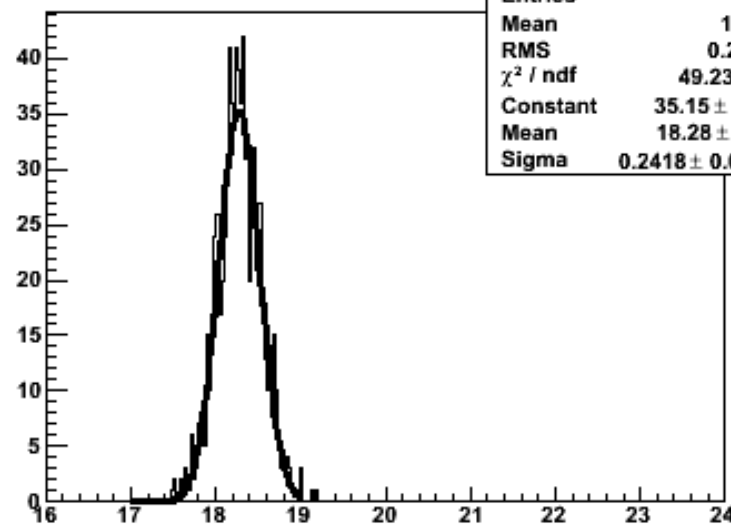


peakHist



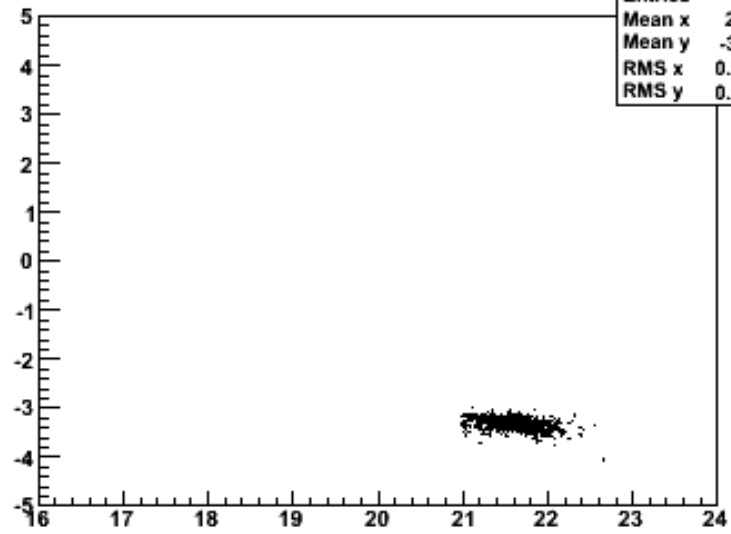
peakHist	
Entries	1500
Mean	21.32
RMS	0.8066
χ^2 / ndf	69.24 / 67
Constant	35.14 ± 1.45
Mean	21.6 ± 0.0
Sigma	0.3338 ± 0.0111

halfMaxHist



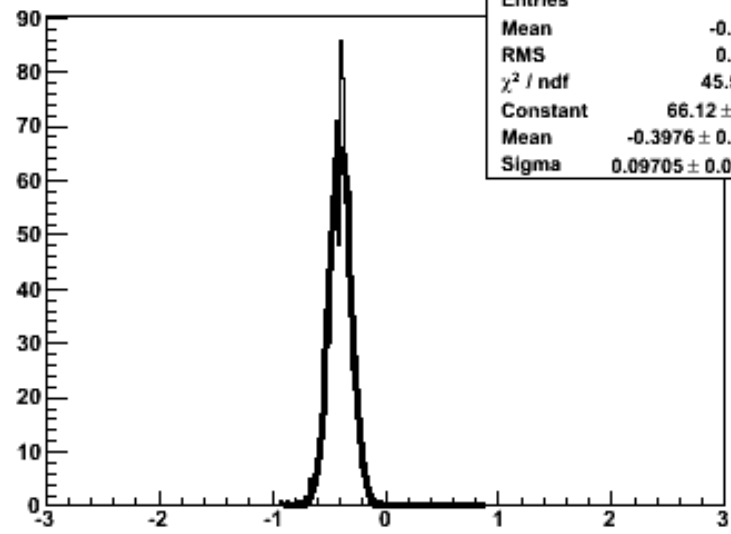
halfMaxHist	
Entries	848
Mean	18.27
RMS	0.2554
χ^2 / ndf	49.23 / 53
Constant	35.15 ± 1.59
Mean	18.28 ± 0.01
Sigma	0.2418 ± 0.0070

peakVSDeltahalfMaxHist



peakVSDeltahalfMaxHist	
Entries	1696
Mean x	21.59
Mean y	-3.315
RMS x	0.2777
RMS y	0.1102

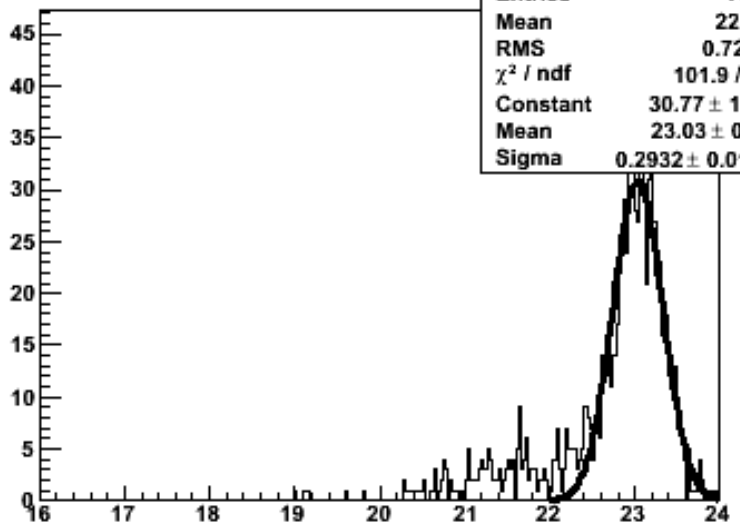
DeltahalfMaxCorHist



DeltahalfMaxCorHist	
Entries	848
Mean	-0.4013
RMS	0.1028
χ^2 / ndf	45.5 / 31
Constant	66.12 ± 3.12
Mean	-0.3976 ± 0.0035
Sigma	0.09705 ± 0.00310

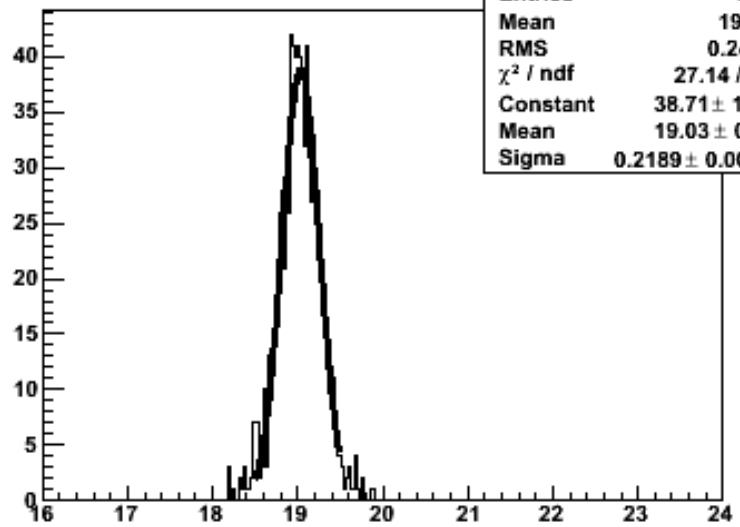


peakCorHist



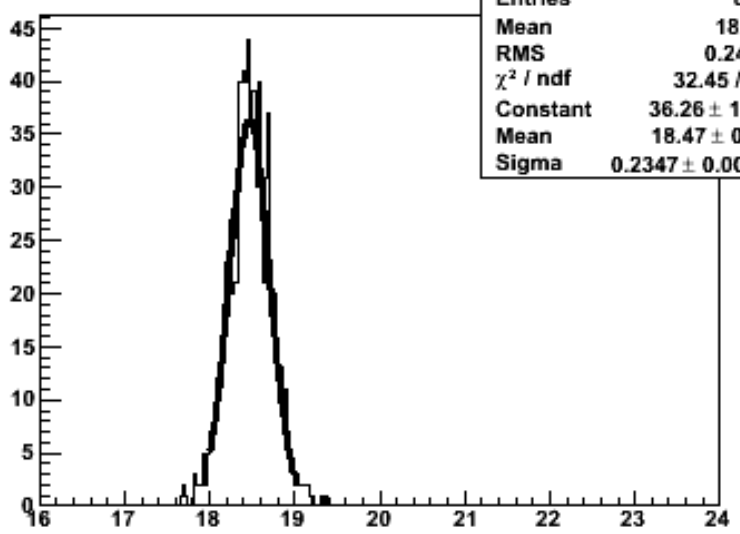
peakCorHist	
Entries	1120
Mean	22.75
RMS	0.7205
χ^2 / ndf	101.9 / 68
Constant	30.77 ± 1.48
Mean	23.03 ± 0.01
Sigma	0.2932 ± 0.0101

halfMaxCorHist



halfMaxCorHist	
Entries	848
Mean	19.02
RMS	0.2492
χ^2 / ndf	27.14 / 34
Constant	38.71 ± 1.79
Mean	19.03 ± 0.01
Sigma	0.2189 ± 0.0075

halfMaxCor2Hist



halfMaxCor2Hist	
Entries	848
Mean	18.47
RMS	0.2498
χ^2 / ndf	32.45 / 35
Constant	36.26 ± 1.70
Mean	18.47 ± 0.01
Sigma	0.2347 ± 0.0086