# Calculation of probability for B=0 data

L. J. Broussard

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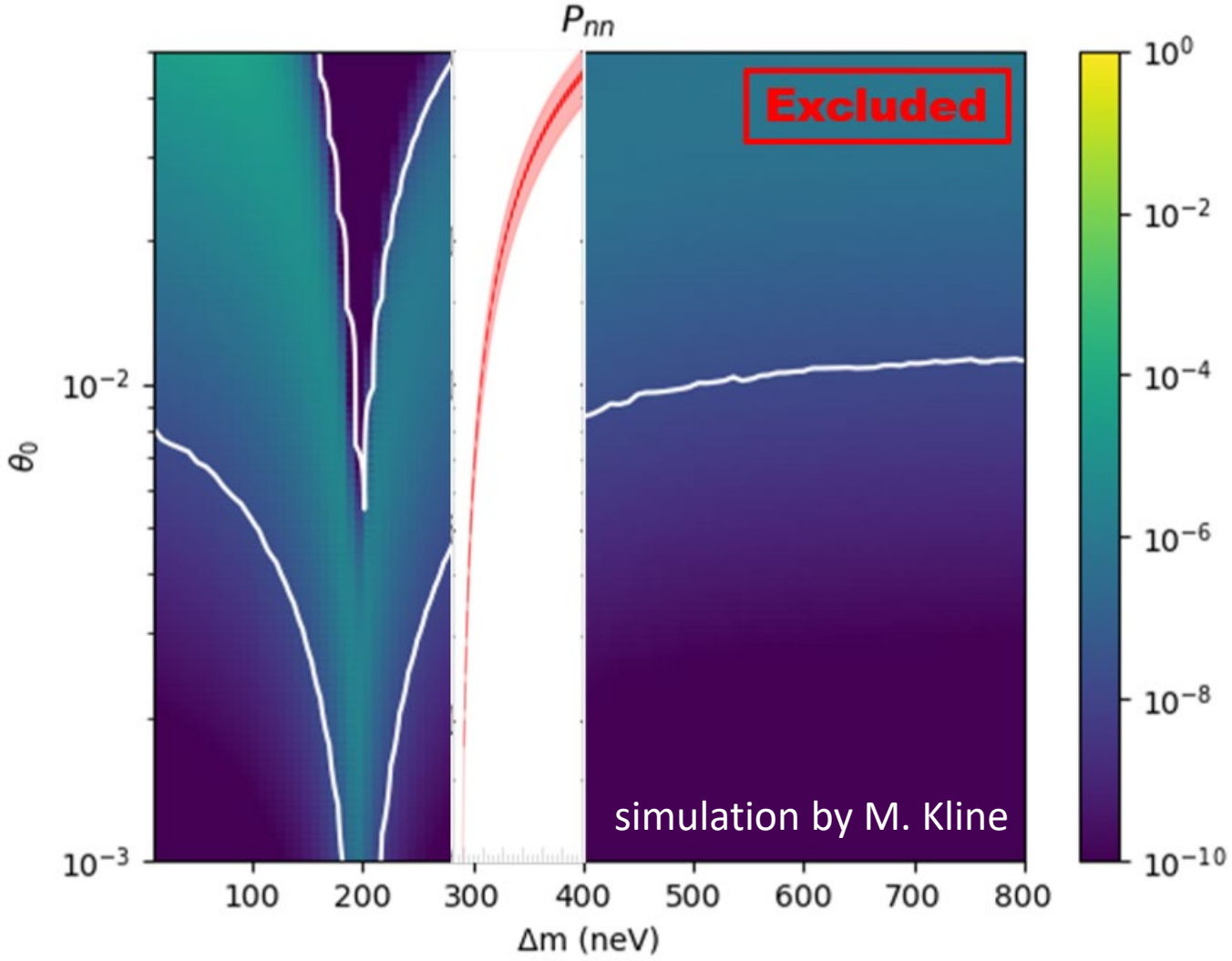
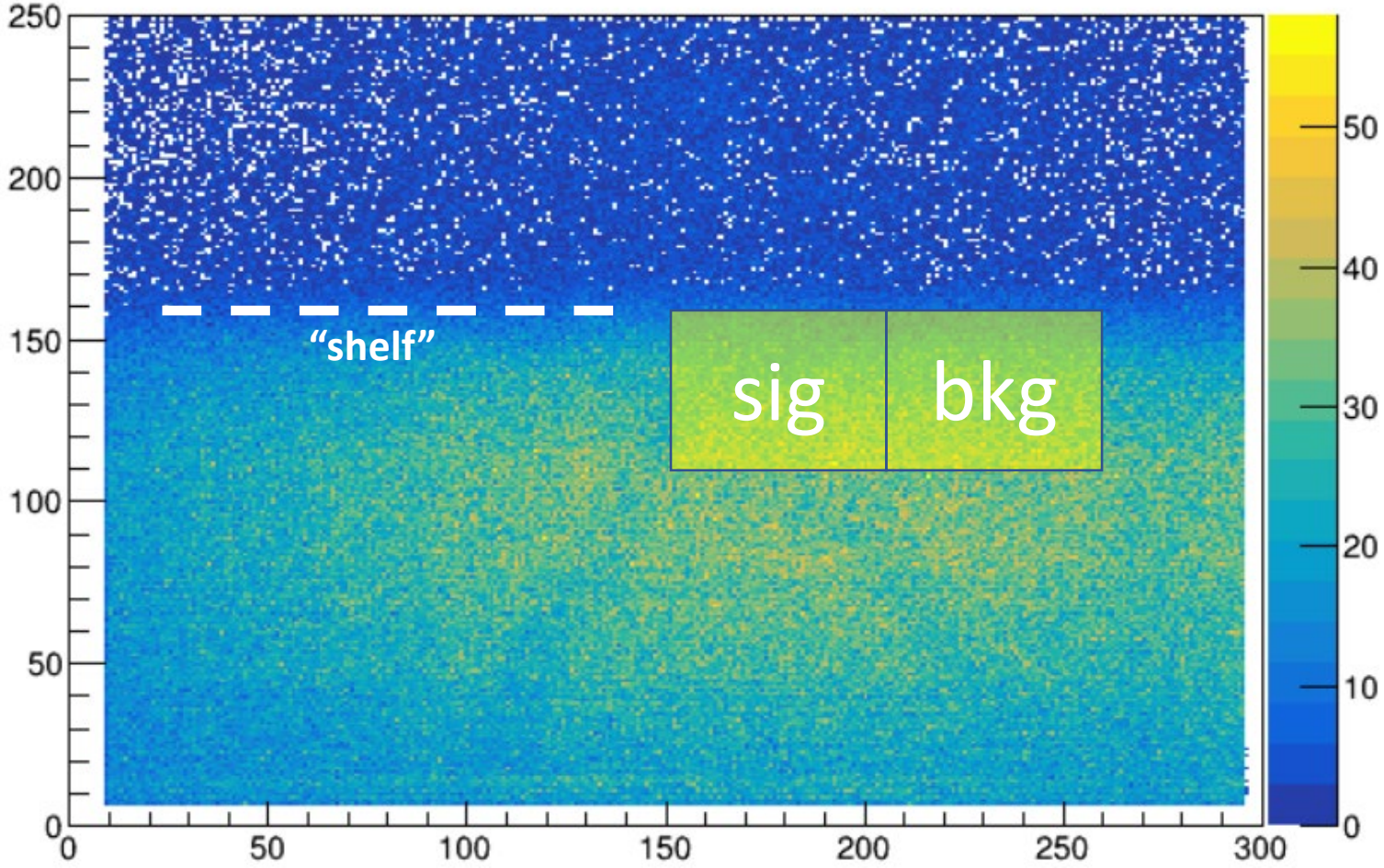
# Reminder of Goals

- Determine exclusion limit for Δm > 400 neV
- Michael estimated: P < 3.73e-8
- Not sure what ROI's assumed
- Want to cross-check limit



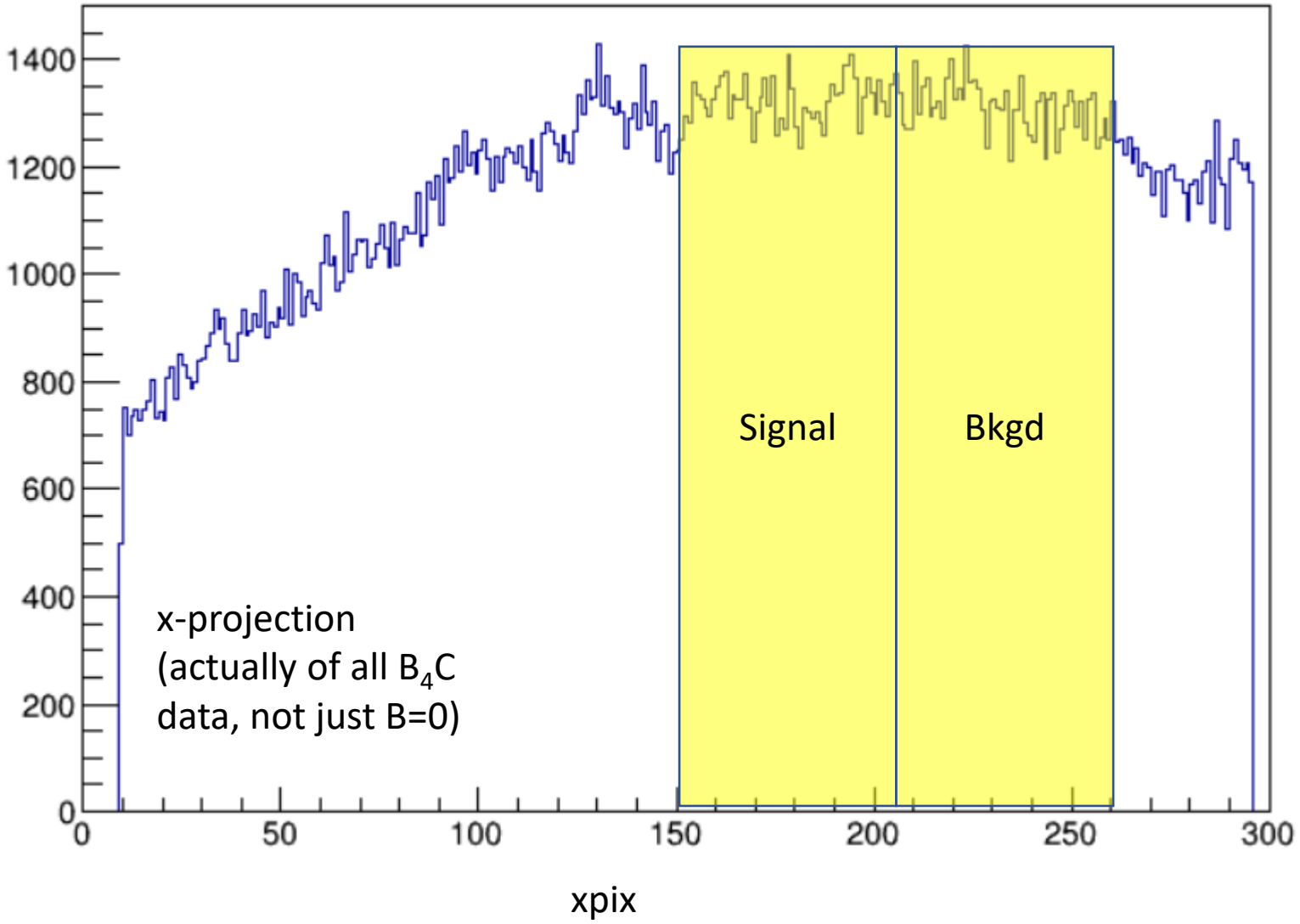
# Detector Uniformity 2019

- Sum of all runs with $B_4C$ – assume no nn’
- Large y-dependence in background – too severe
- Smaller x-dependence in background; different above and below “shelf”
- Use total dataset to choose 2nd ROI with nearly identical rate
- Signal: x(150,207) y(107,156)
- Background: x(207,264) y(107,156)



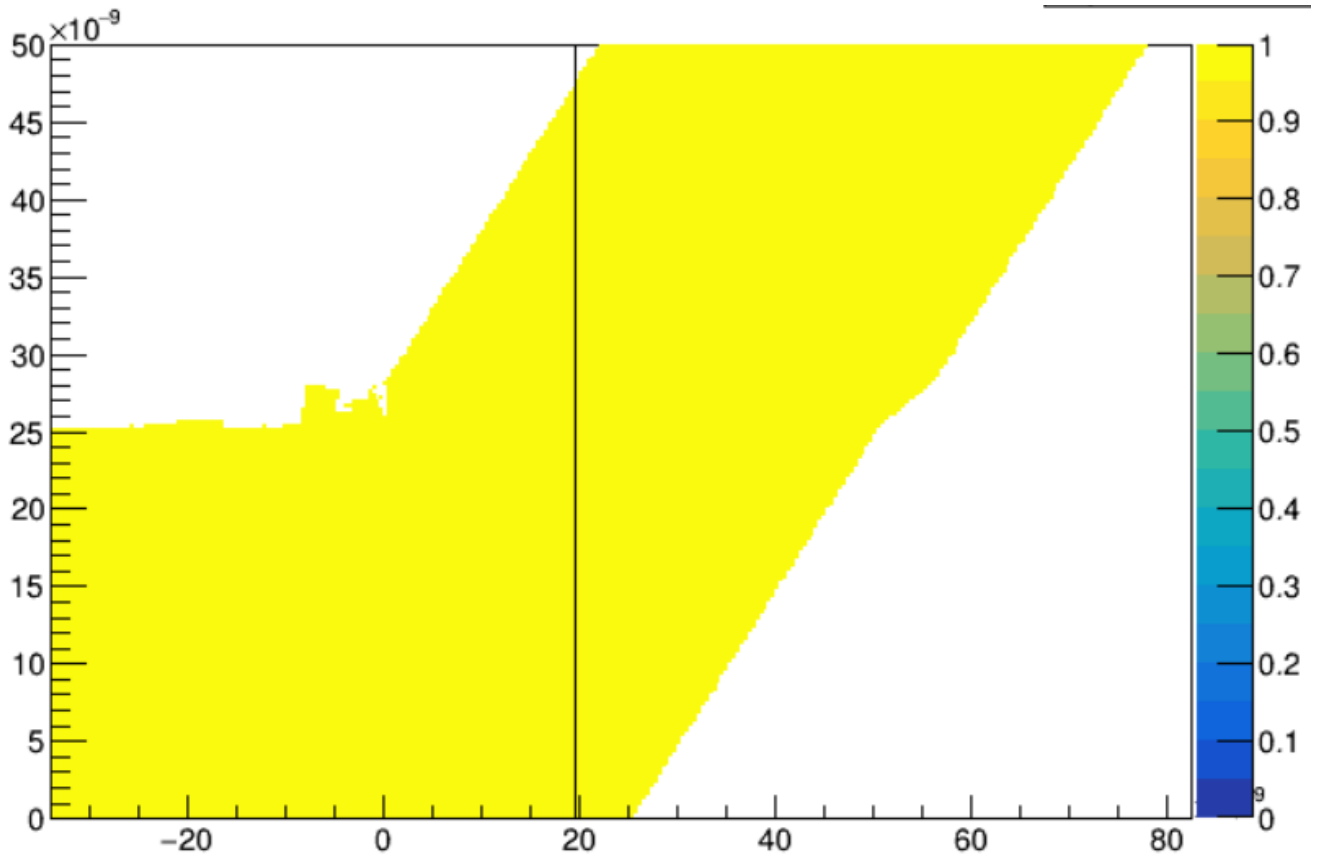
# Comparison of ROI's for B=0 data

- Plotting X-Projection within Y ROI: (107,156)
- signal:
  X ROI = (150,207)
  558.2±6.9 cts/C
- background:
  X ROI = (207,264)
  537.7±6.7 cts/C
- (4% higher in Signal ROI)



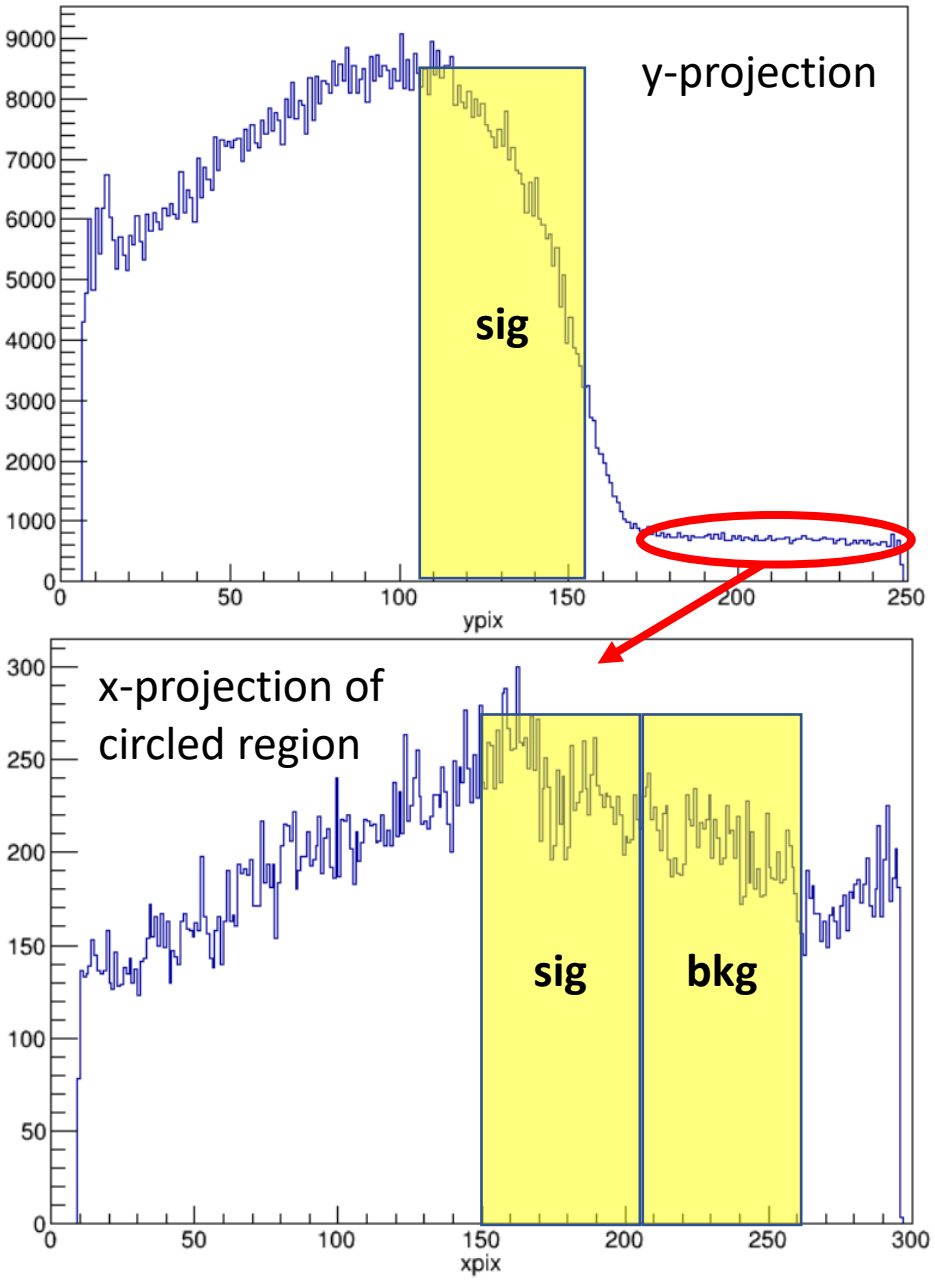
# Naive confidence limit

- Assume only statistical errors
- Feldman Cousins method of inverting confidence belt
- Signal – Bkgd = 20.5±9.6 cts/C
- Corresponds to p < 4.8e-8
- (Slightly worse than Michael's limits, p<3.7e-8)



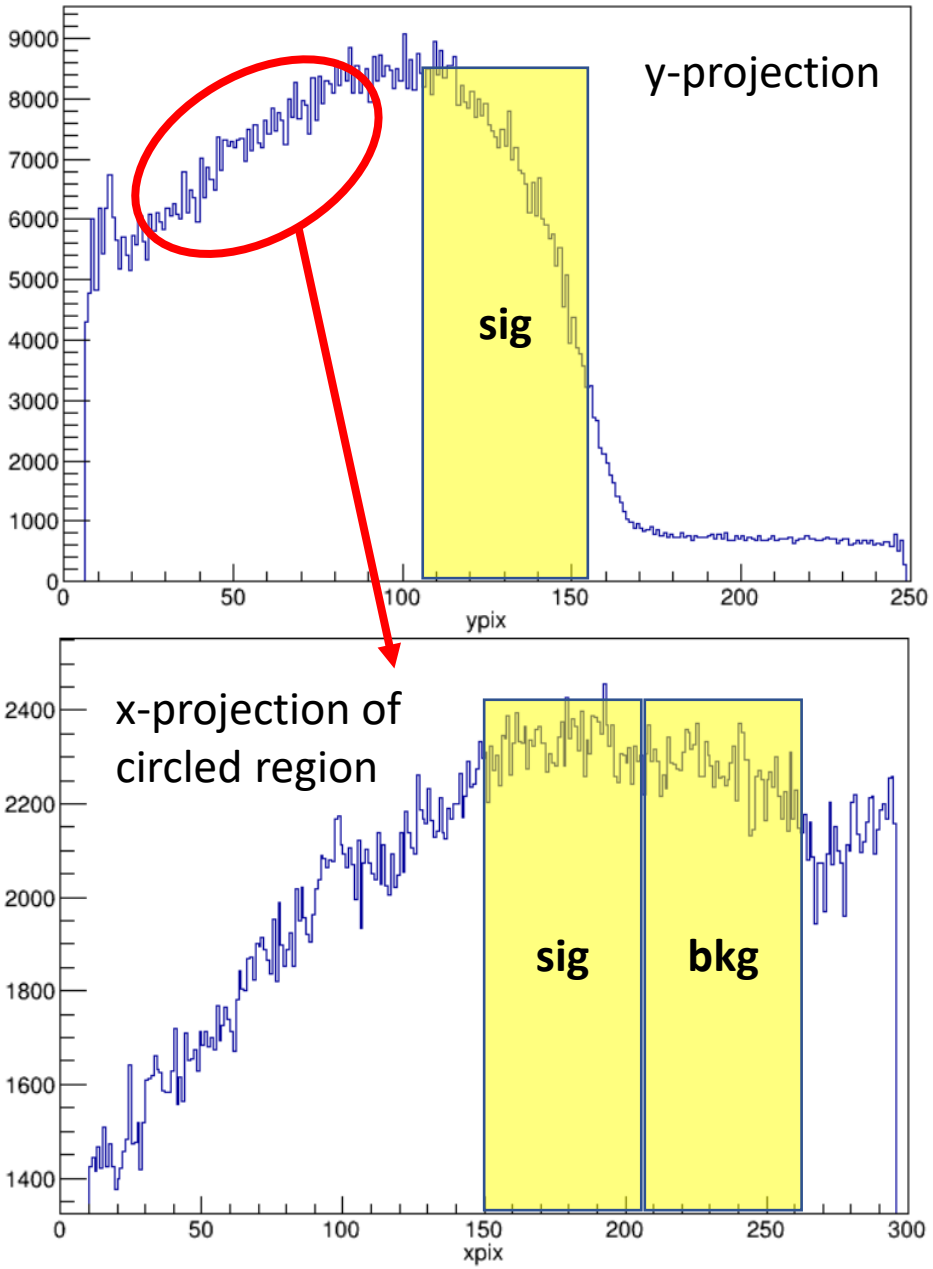
# How bad is the position dependence?

- Our signal ROI composed of 11-13% “above shelf” background + additional “below shelf” background
- Study y>170:  some x-dependence
  - Signal ROI =13809±118
  - Background ROI = 11703±108
- 18% higher rate in sig ROI than bkg ROI in “below shelf” background



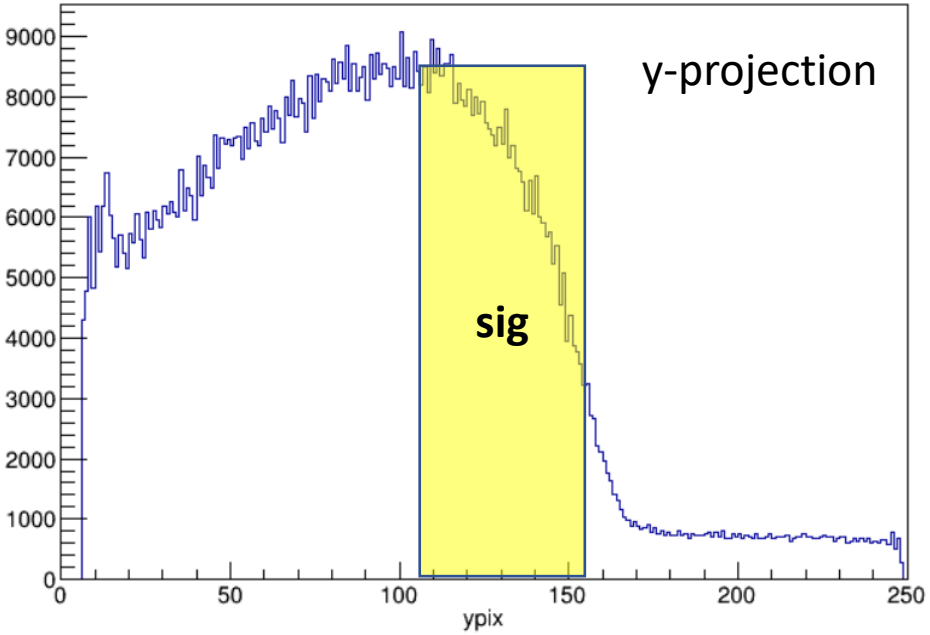
# How bad is the position dependence?

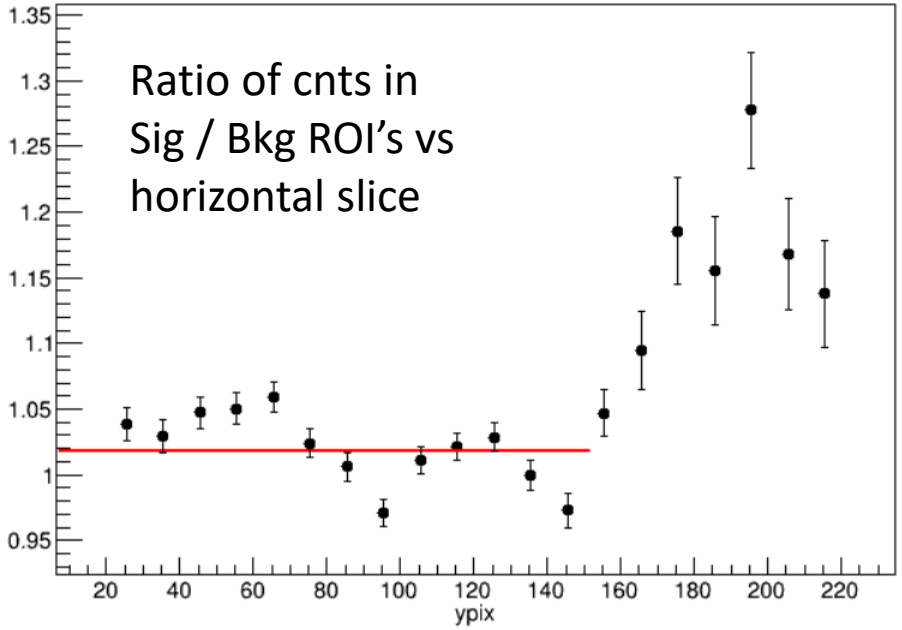
- Study below ROI (20<y<100): Some x-dependence
  - Signal ROI =134744±367
  - Background ROI = 131307±362
- 2.6% total higher rate in Signal ROI



# How bad is the position dependence?

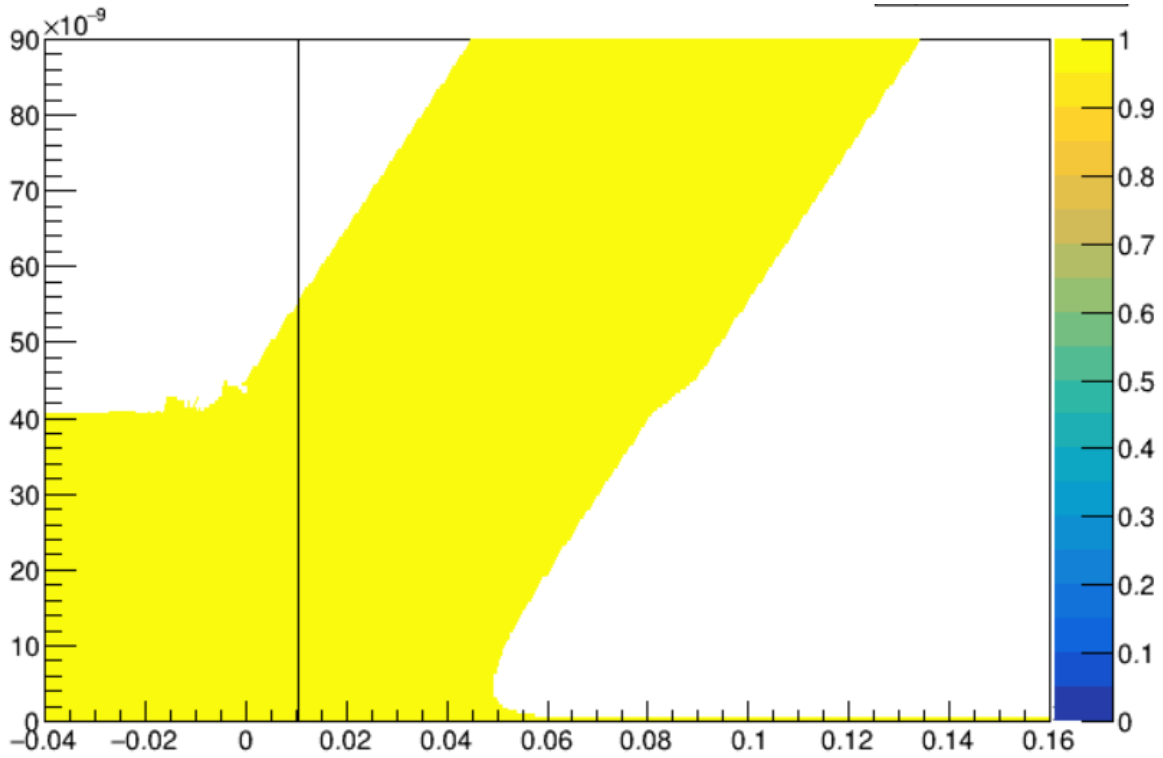
- Compare ratio in signal ROI to background ROI for horizontal pixel slices with height = 10 pixels
- Ratio nearly 1, but with non-statistical fluctuation
- Use standard deviation as systematic uncertainty in position dependence of background
  - Sig/Bkg ROIs = (1.8±2.8)%



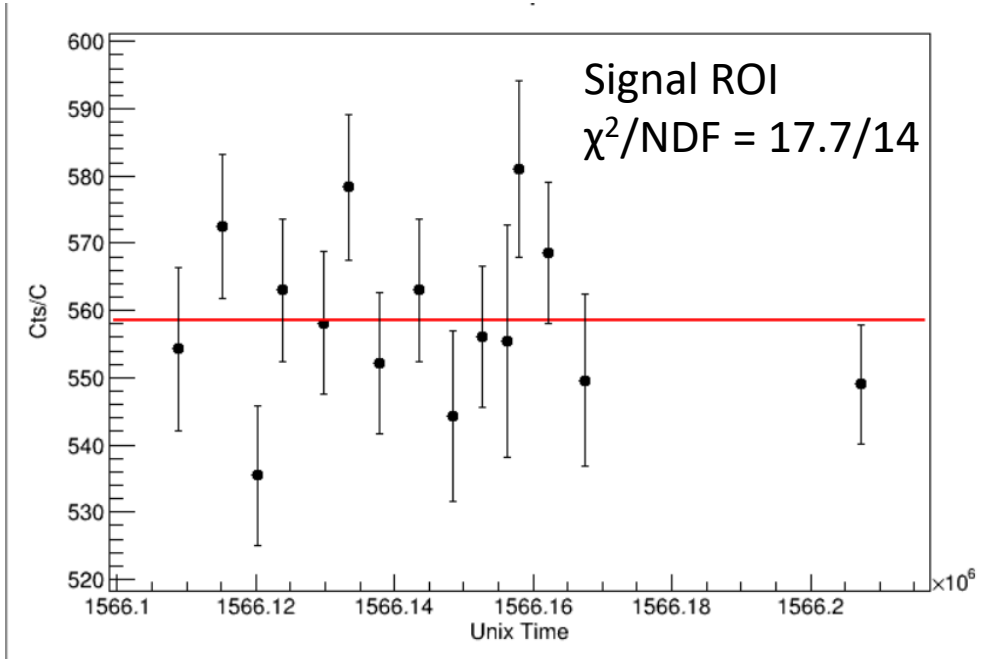
# Comparison of ROI's for B=0 data

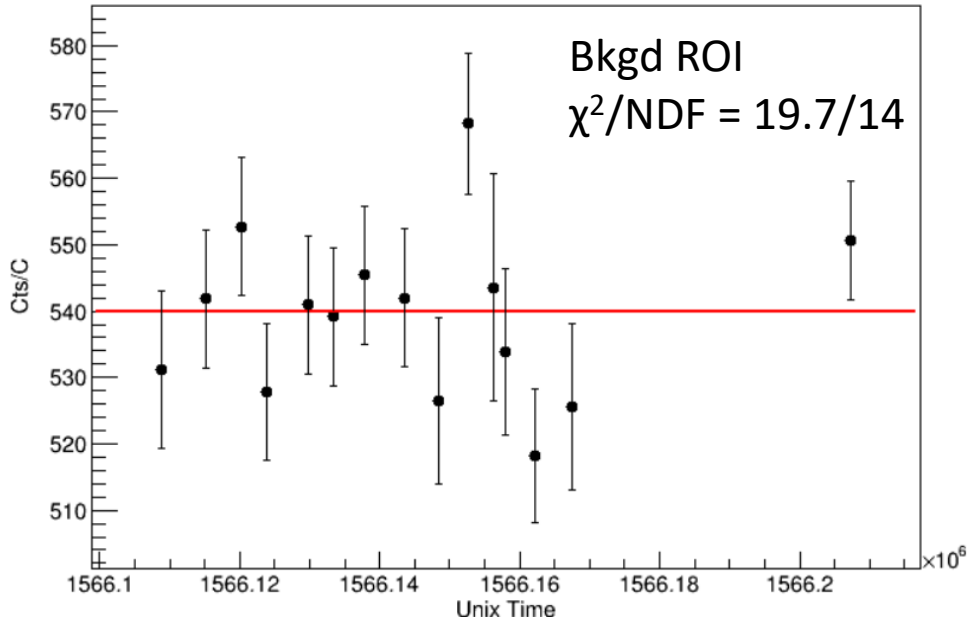
- Raw counts:
  - signal: X ROI = (150,207)
    558.2±6.9 cts/C
  - background: X ROI = (207,264)
    537.7±6.7 cts/C
- Increase background by ratio
  (1.8±2.8)%
  - background = 547.4±16.5 cts/C
  - sig – bkg difference = 10±18 cts/C
- p < 5.5e-8



# Time Dependence

- Fit background rate vs. time to check if constant
- 2-parameter fits consistent with zero slope
- 1-parameter fits:
  - $\chi^2$/NDF = 1.25 in signal ROI
  - $\chi^2$/NDF = 1.41 in background ROI
- Good enough?



# When is $\chi^2$/NDF good enough

- $\chi^2$/NDF = 1.25 in signal ROI
- $\chi^2$/NDF = 1.41 in background ROI

- Seems okay for us!

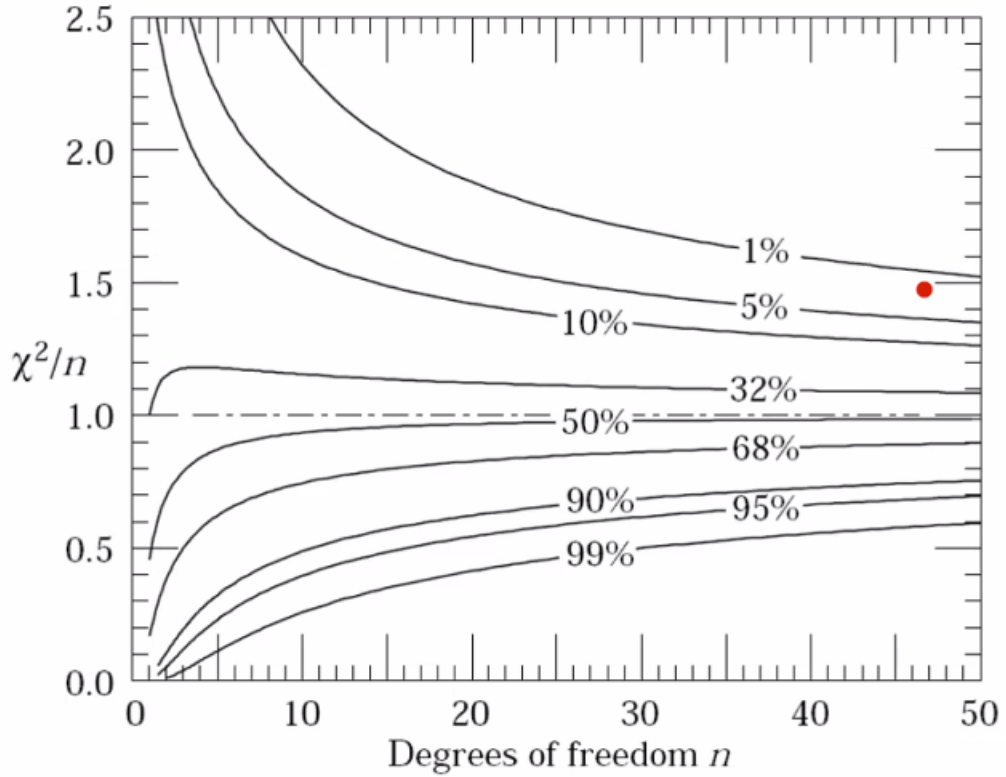



**Figure 32.2:** The 'reduced' $\chi^2$, equal to $\chi^2/n$, for $n$ degrees of freedom. The curves show as a function of $n$ the $\chi^2/n$ that corresponds to a given $p$-value.