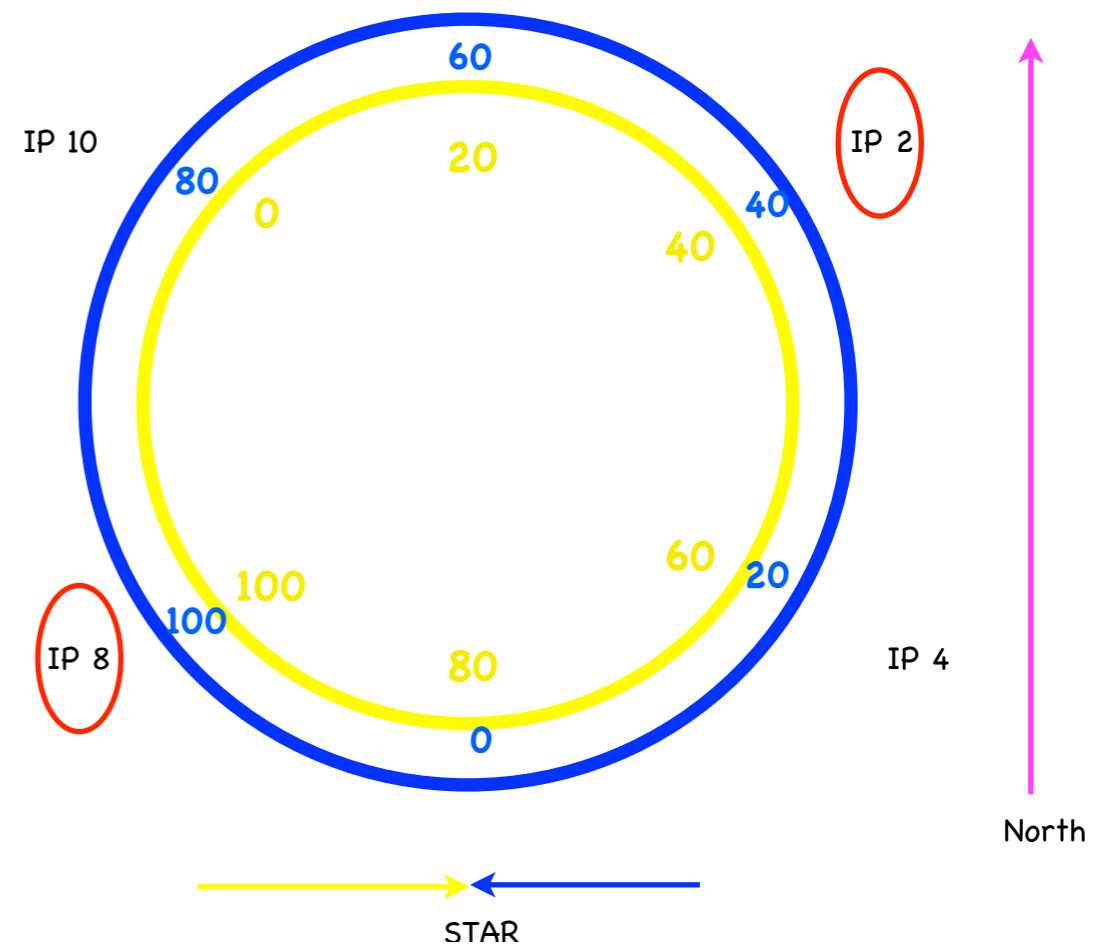


# Beam Crossing QA

Run 13 W Analysis Group

# Introduction

- Once RHIC beams are injected into rings they are clogged meaning beams are set such that the **first bunches collide at specific points.**
- Yellow beam bunch 0 collides with blue beam bunch 0 at **IP 8** and **IP 2**
- 2 beams are shifted by **80** at **STAR collision point.**
- Bunch crossing spectrums reflects this shift.
- This analysis is to confirm this known shift and to further check for **additional offsets.**

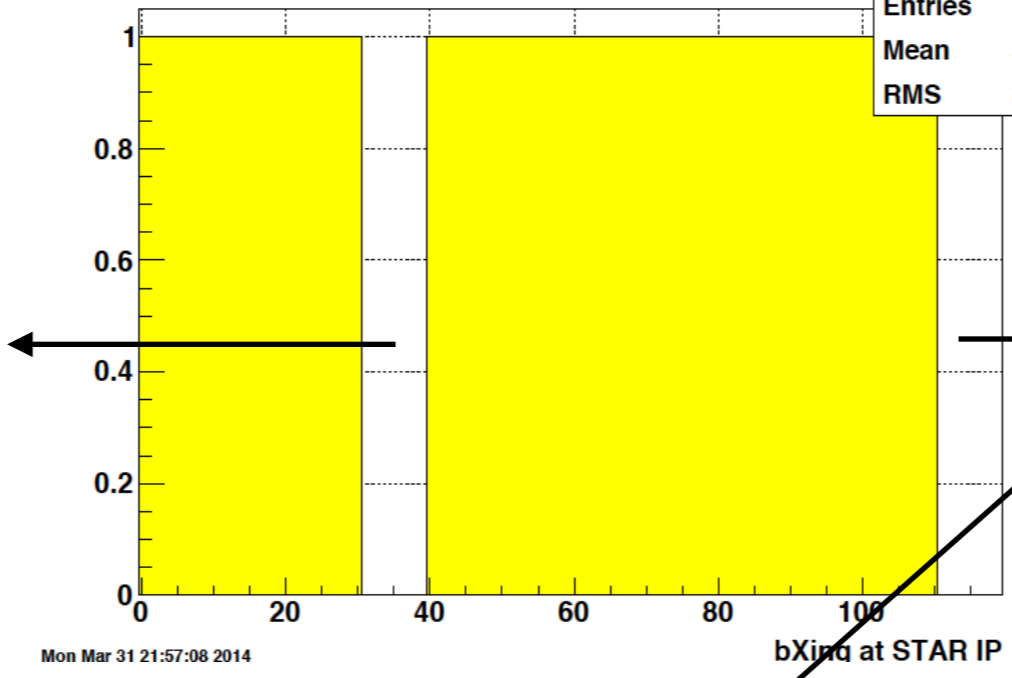


# Bunch crossing spectrums

Intended fill pattern vs. STAR bXing

Ideal

bXI	
Entries	102
Mean	56.76
RMS	32.84



YB abort gap

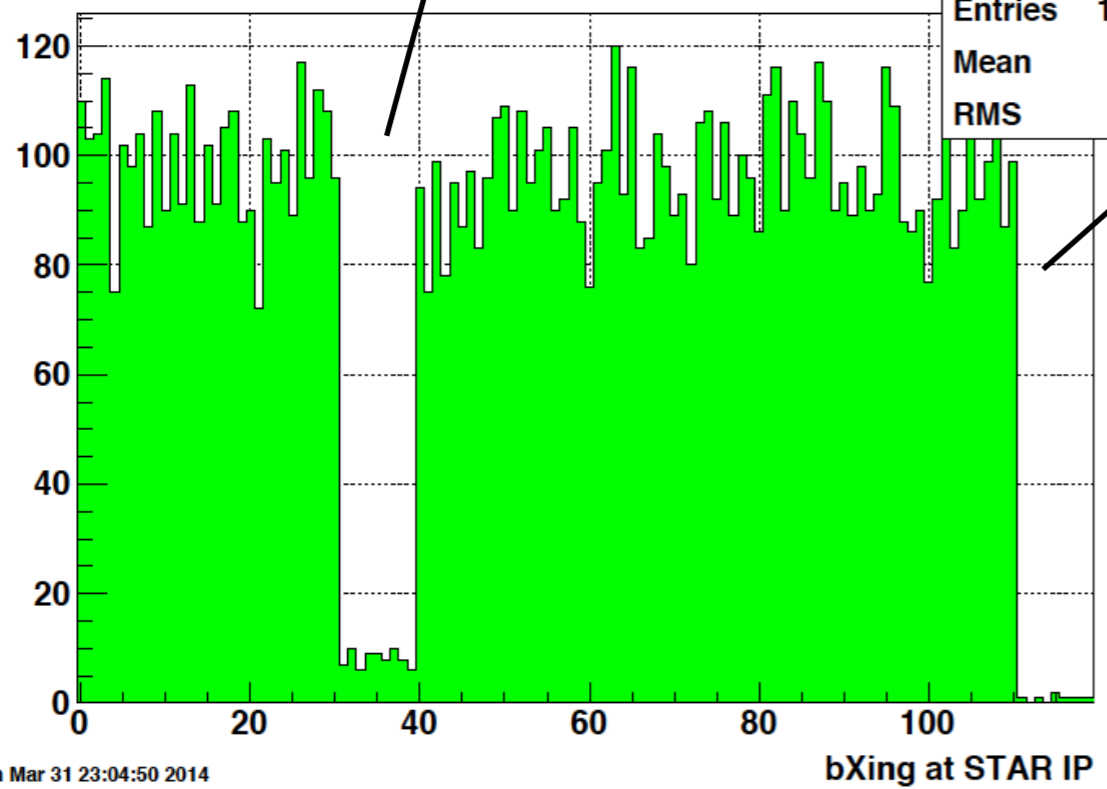
BB abort gap

bX7

Rate vs. true bXing from bx7

bX7

Entries	10000
Mean	56.5
RMS	32.9

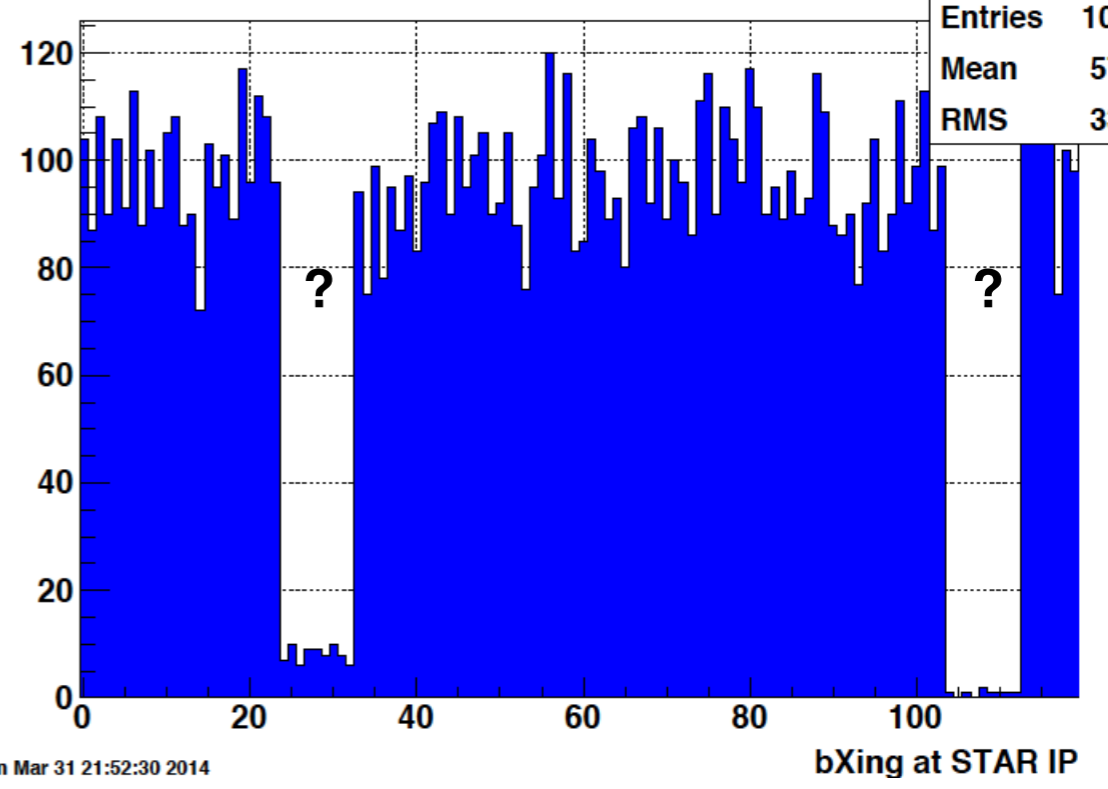


bX48

Rate vs. true bXing from bx48

bX48

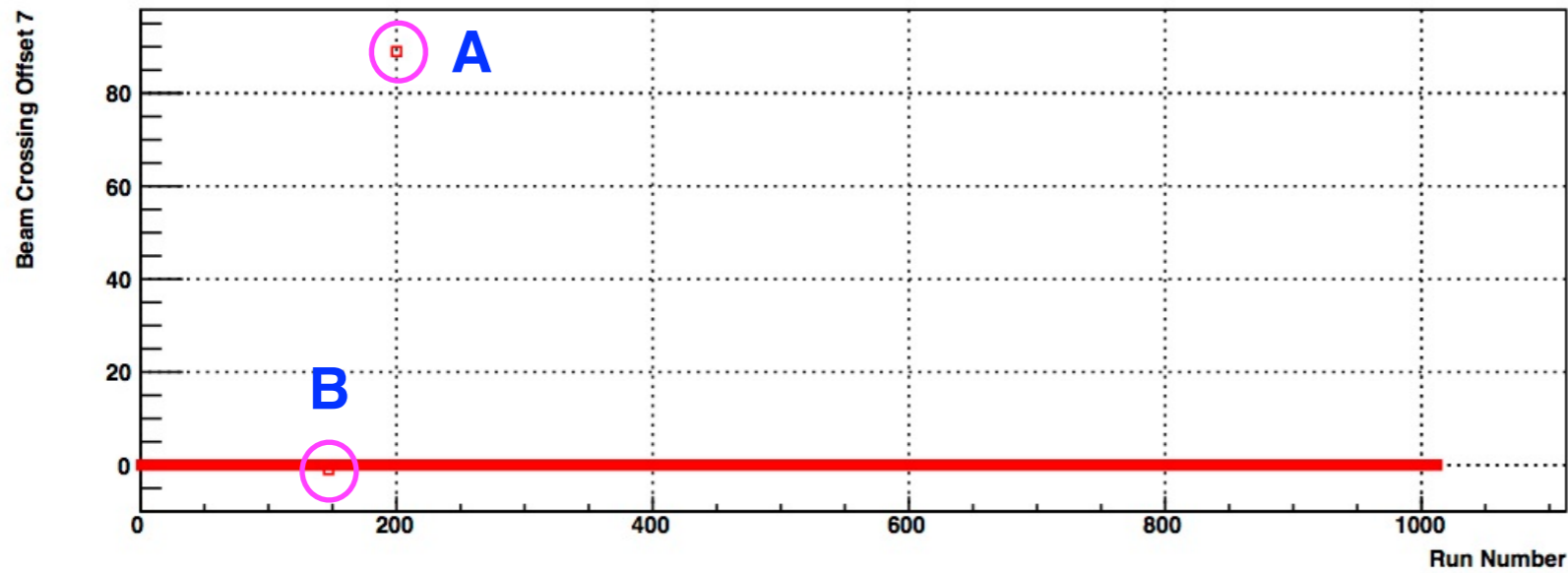
Entries	10000
Mean	57.97
RMS	33.46



# Beam crossing offset

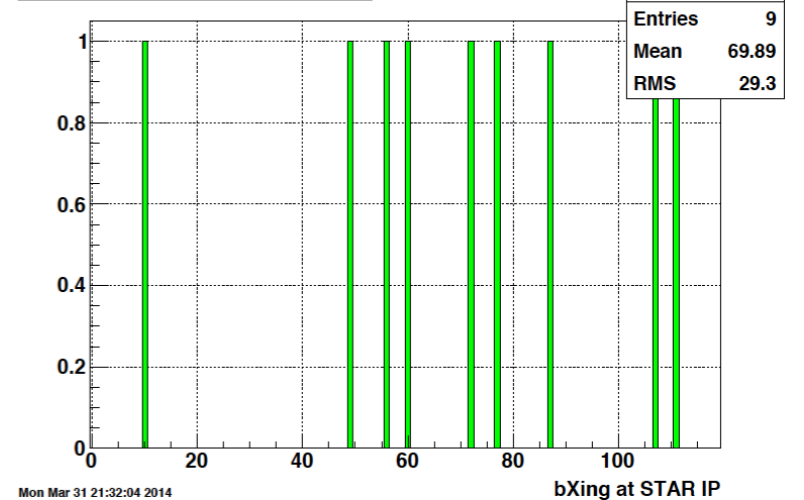
## bx7 offset

Run Number Vs Beam Crossing Offset 7



**A : R14117001** ❌😭

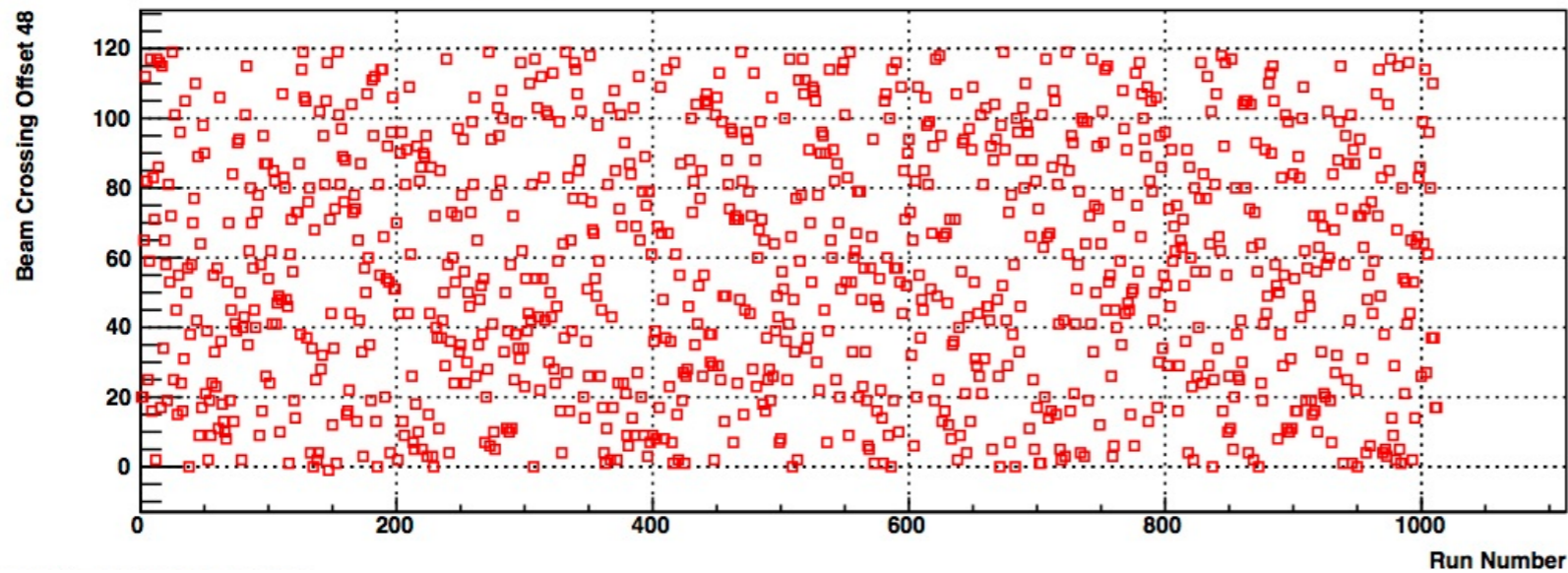
Rate vs. true bXing from bx7



- low lumi. 85 k events

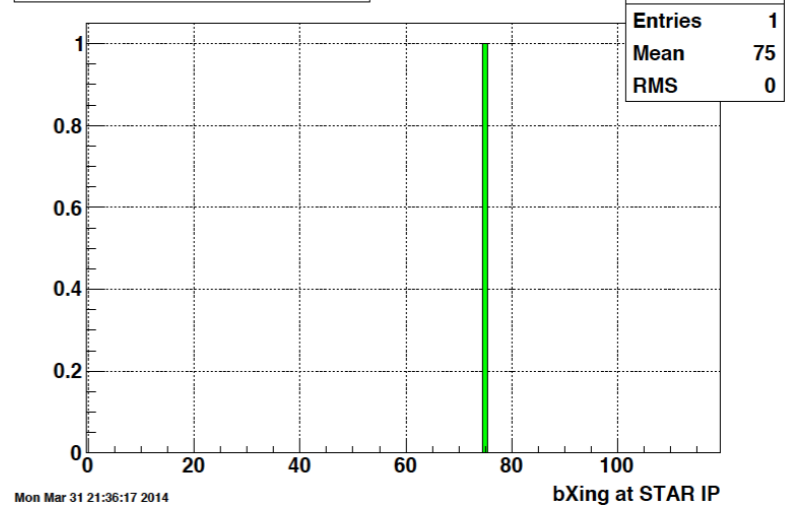
## bx48 offset

Run Number Vs Beam Crossing Offset 48



**B : R14118062** ❌😭

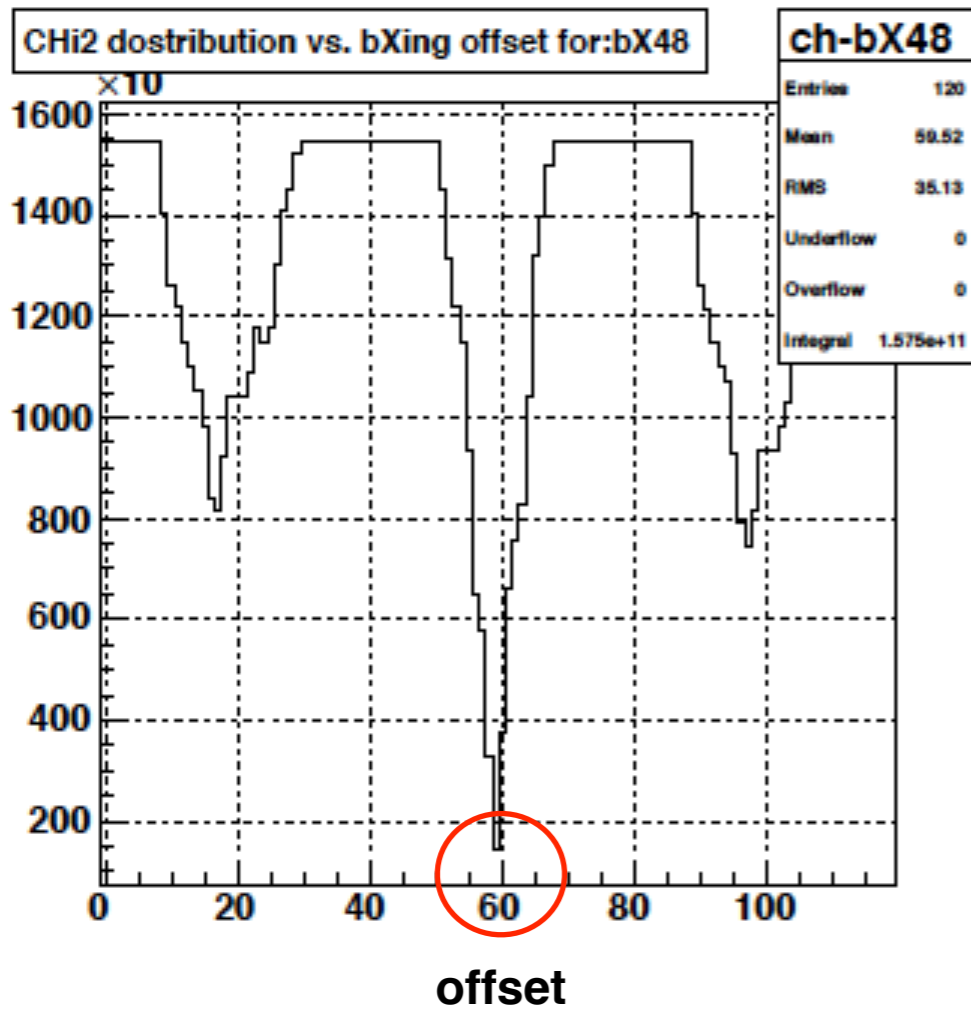
Rate vs. true bXing from bx7



- low lumi. 100 events

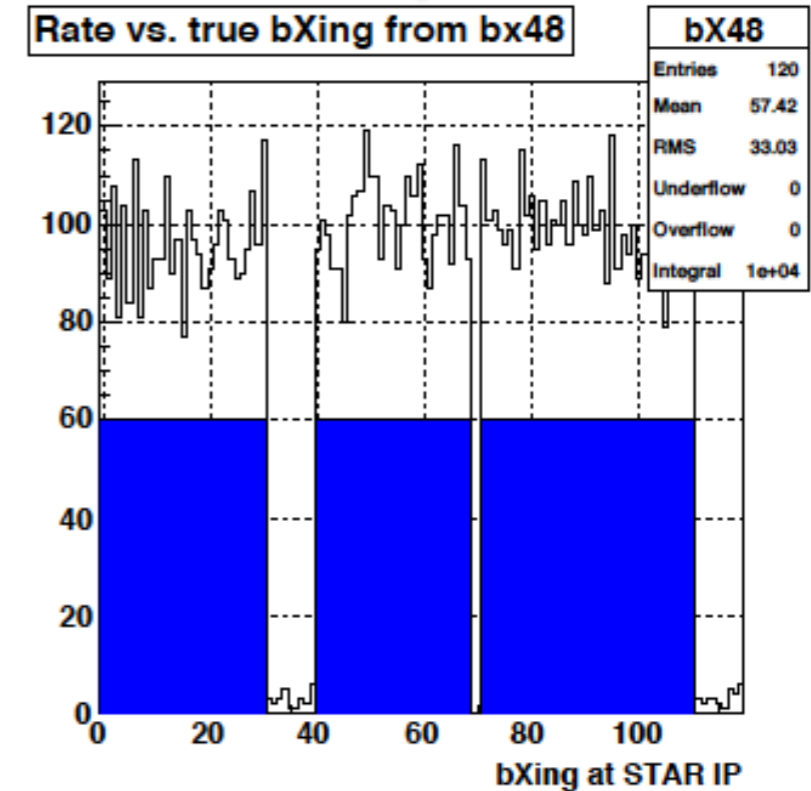
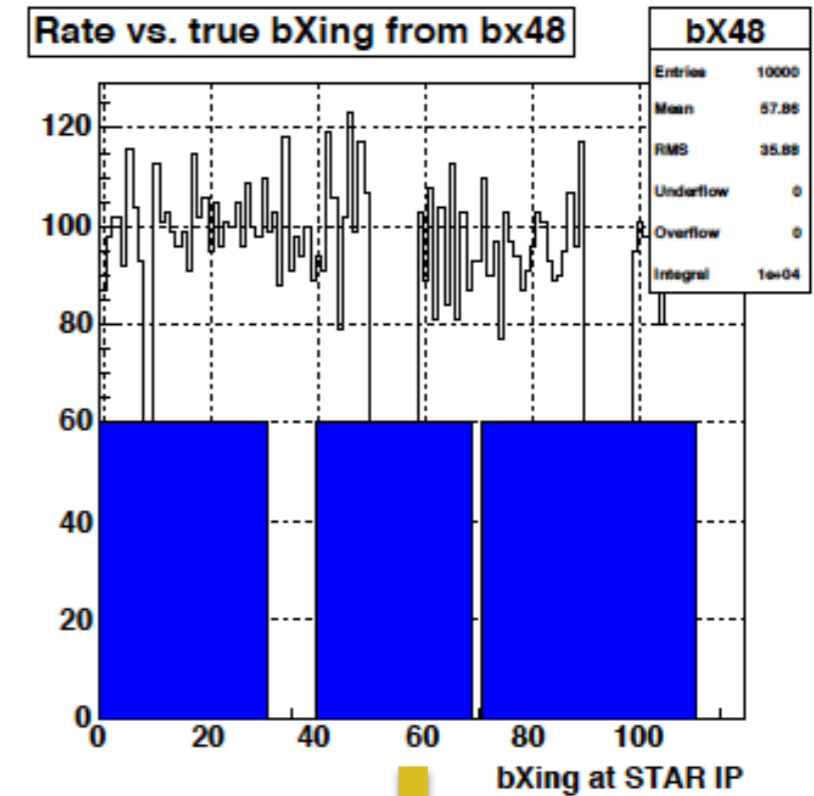
- 1008 runs have 0 offset : BunchX QA Pass ✓😊

# Chi2 method



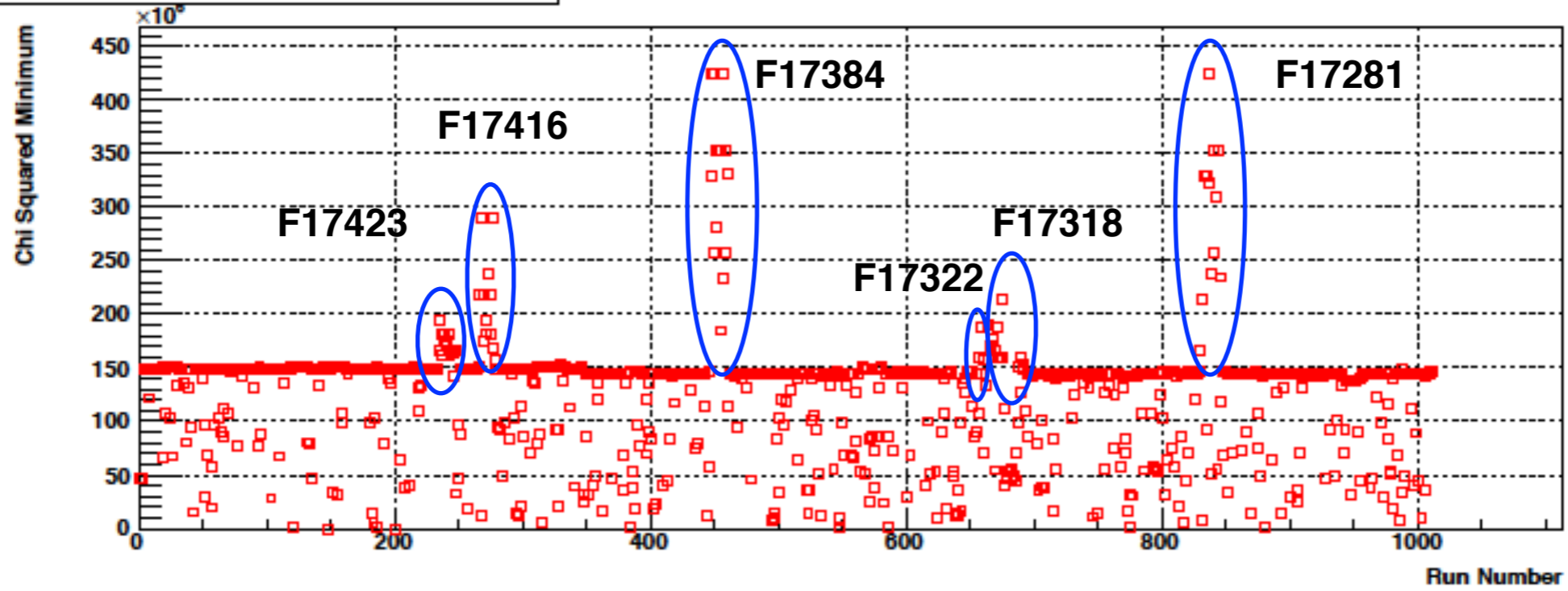
$$\chi^2 = \sum \frac{(N_{\text{bx48}(i+\text{offset})} - N_{\text{bxideal}(i)})^2}{\sigma^2_{\text{bx48}(i+\text{offset})}}$$

loop offset [0,119] and find the position of minimum chi2 where the bx48 spectrum is best fitting with ideal spectrum

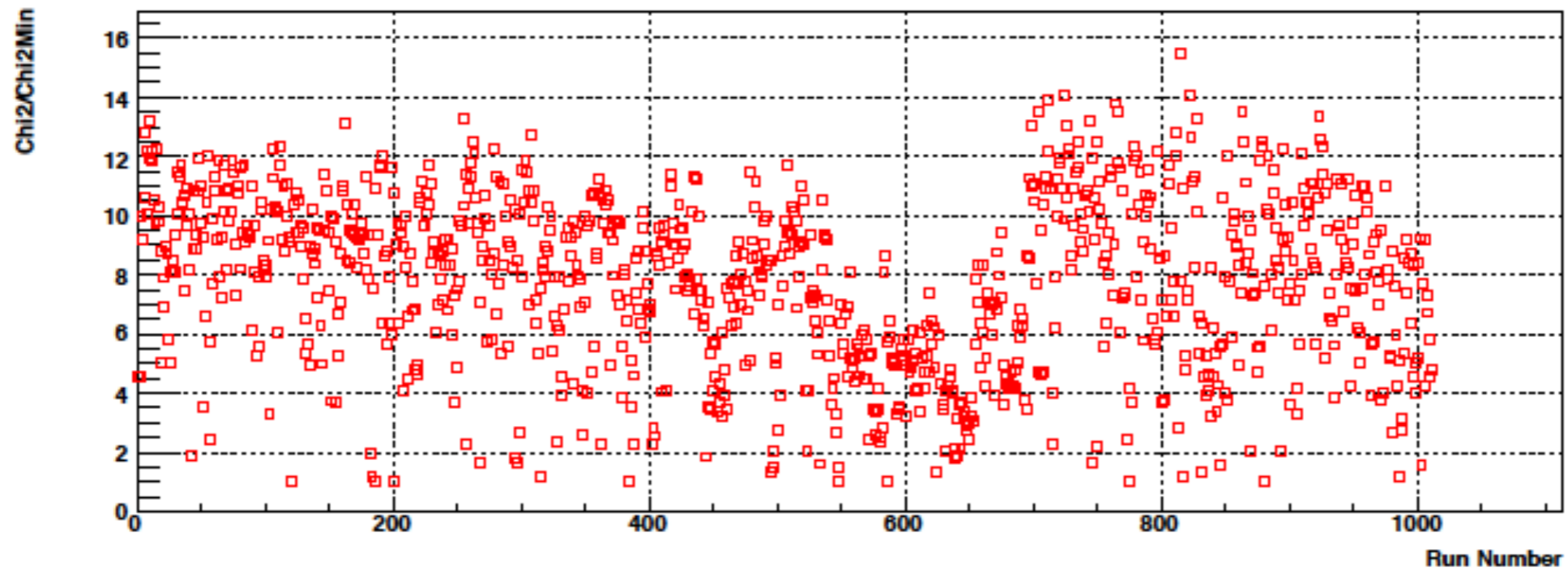


# Chi2 minimum

Run Number Vs Chi Squared Minimum



Run Number Vs Chi2 / Chi2 Minimum



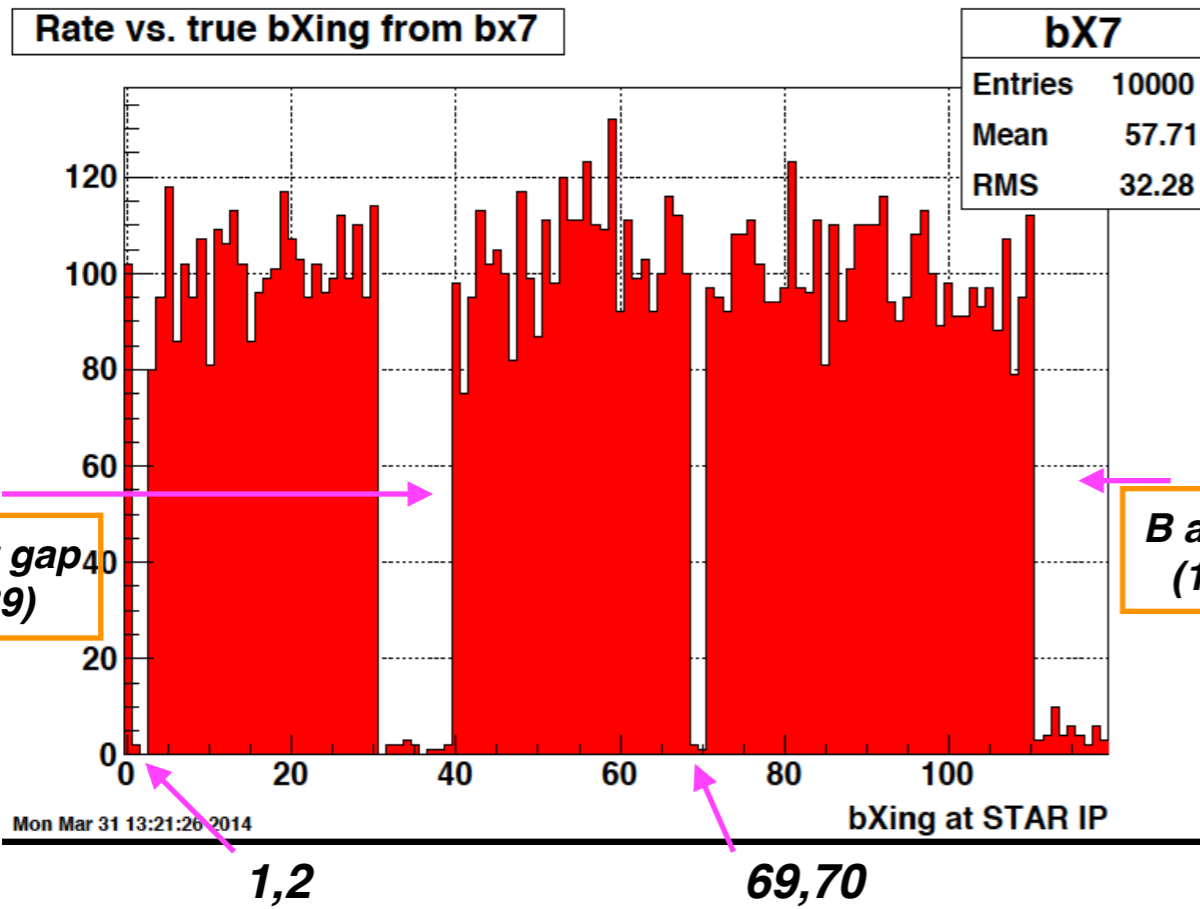
# Search for missing bunches

**F17281**

cdev record of Measured Fill Patterns

**Y**

**B**



100100100100	3	100100100100	3
100100100100	7	100100100100	7
100100100100	11	100100100100	11
100100100100	15	100100100100	15
100100100100	19	100100100100	19
100100100100	23	100100100100	23
100100100100	27	100100100100	27
100000000100	31	100100100100	31
100100100100	35	100100100100	35
100100100100	39	100100100100	39
100100100100	43	100100100100	43
100100100100	47	100100100100	47
100100100100	51	100100100100	51
100100100100	55	100100100100	55
100100100100	59	100100100100	59
100100100100	63	100100100100	63
100100100100	67	100100100100	67
100100100100	71	100000000100	71
100100100100	75	100100100100	75
100100100100	79	100100100100	79
100000000100	83	100100100100	83
100100100100	87	100100100100	87
100100100100	91	100100100100	91
100100100100	96	100100100100	96
100100100100	99	100100100100	99
100100100100	103	100100100100	103
100100100100	107	100100100100	107
100100100000	111	100100100000	111
000000000000	115	000000000000	115
000000000000	119	000000000000	119

**Y** bunches 81,82

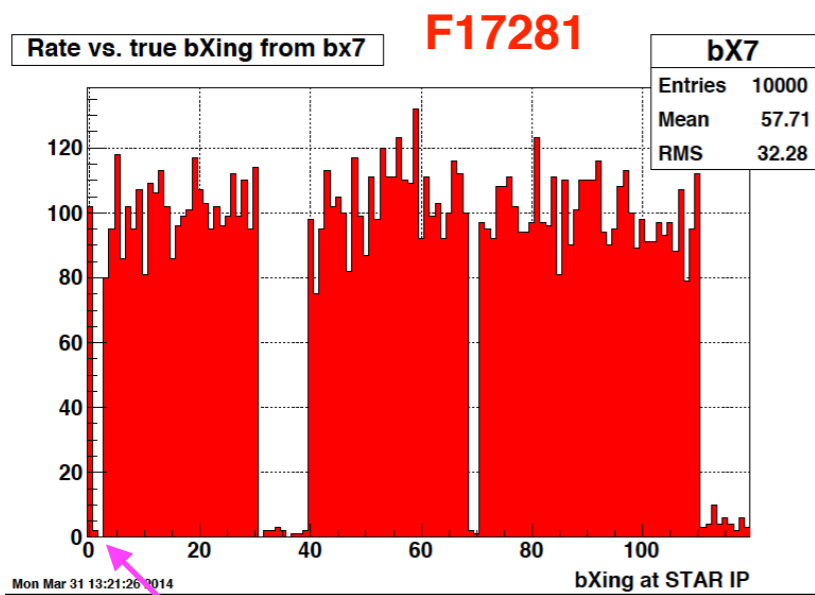
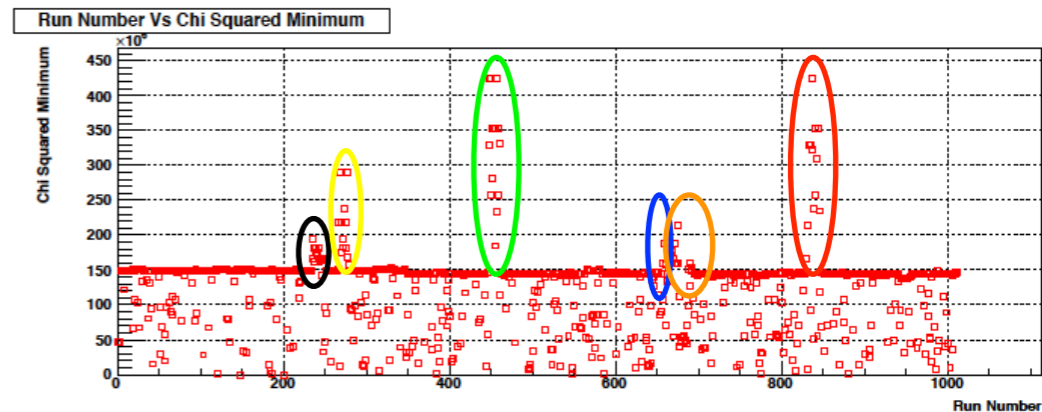
81-80 = 1  
82-80 = 2

**Y** bunches 29,30 and **B** bunches 69,70 intentionally left empty until April 20 (F17407)

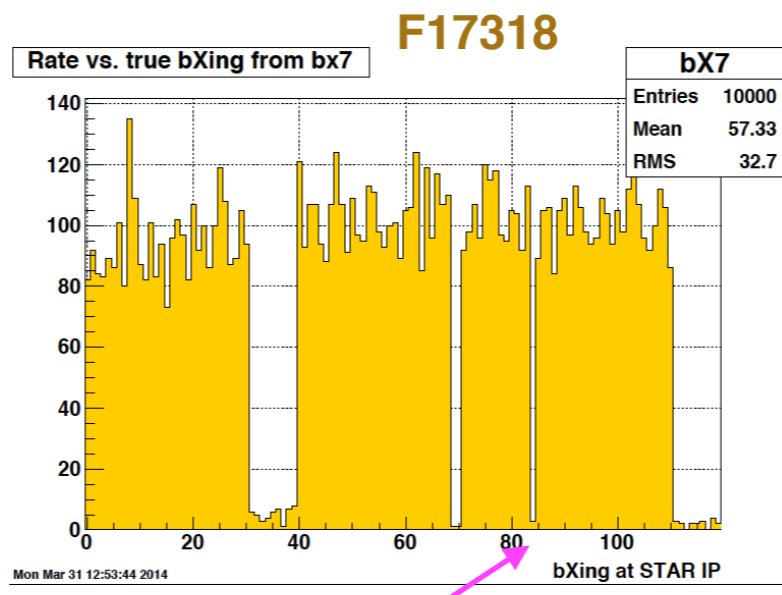
120 - (80-29) = 69  
120 - (80-30) = 70

**F17281 have 2 missing bunches : Y beam bunches 81,82 !!!**

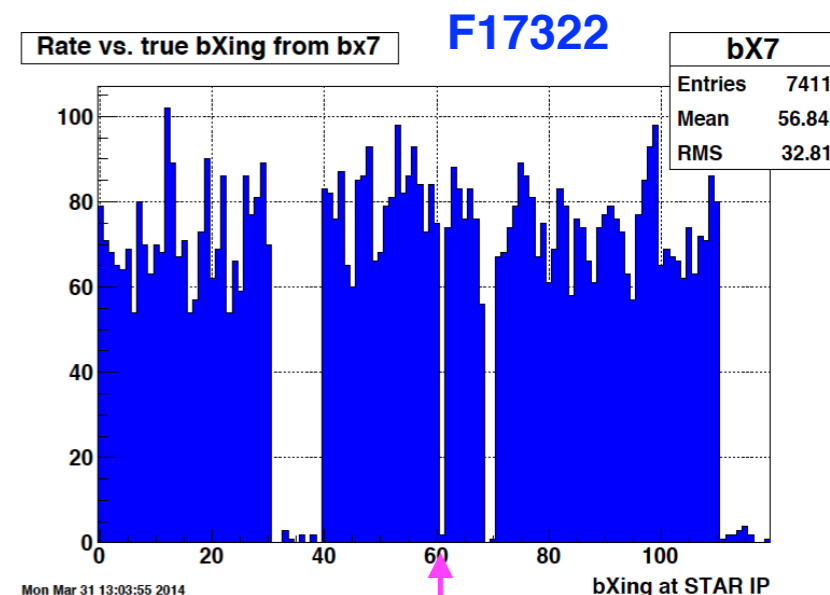
# Fills with unintended Missing Bunches



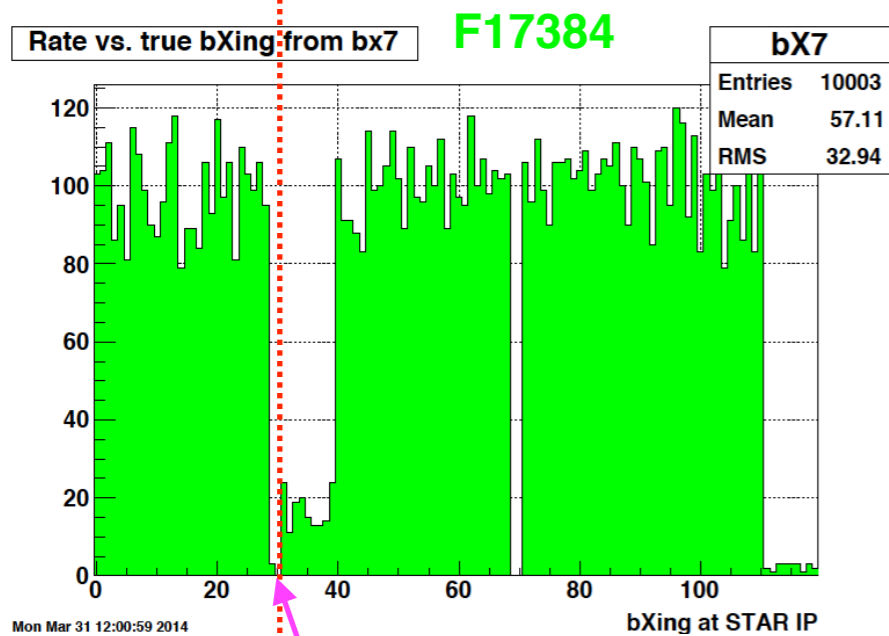
Y bunches 81,82



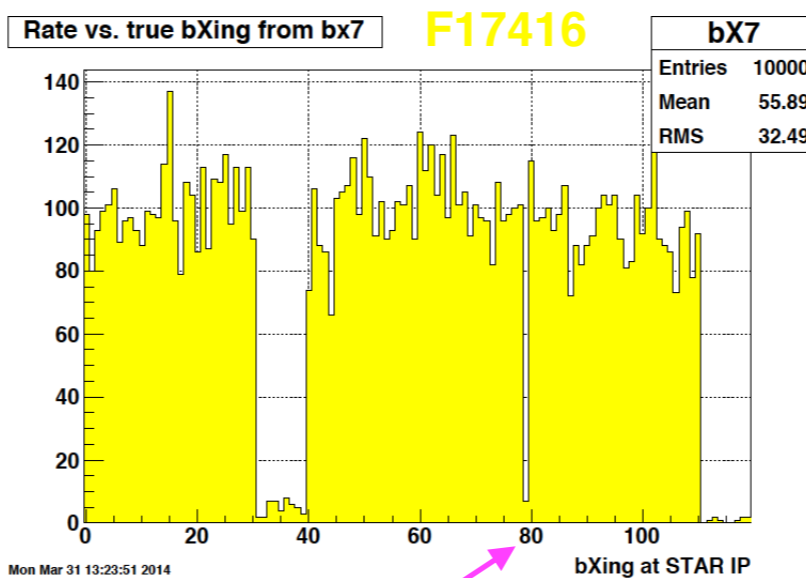
Y bunch 44



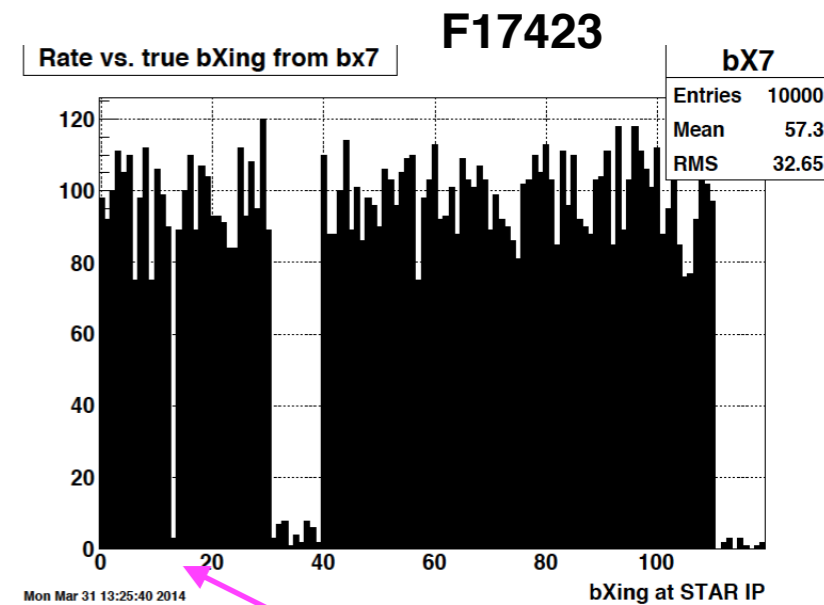
B bunch 61



Y bunches 109,110



Y Bunch 39  
8



Y bunch 93



# Summary

- Out of 1010 ,1008 runs passed the beam crossing QA.
- 6 fills contains unintended missing bunches, should mask them.
- bx7 and bx48 offset table for 1008 runs need to upload to DB.

# back up

## Steps

- Slide ideal histogram in to both bx7 and bx48 spectrum and find **offset** if theres any
- Also calculate the chi2 value and plot chi2 minimum distribution
- Files which upload to data base contain 2 information: bx7 offset and bx48 offset

Ex, R14090036.BXoff

#rhic/spinStar

0 93

**bx7**

**bx48**

