

CBPM work

Antoine

CESR acc group meeting

Jan 18, 2023

Outline

- x CBPM3 mock DAQ → chasing an eluding memory leak
- x update to injection transient code → added safety check for faulty metadata
- x support Suntao for Online DA MS → wrote python code for magnet control
- x CBPM gain calibration → first gain extraction from MS study data
- x raw button distribution fit → first attempt on real data (**slides today!**)

CBPM raw button distribution fit

Data collected as part of Suntao's online DA shift:

https://cesrwww.lepp.cornell.edu/logs/CHESS_MS/2182

t1b1 coasting at 0.7 mA:

x 90760/90761, 90762/90763, 90764/90765

beam dumped, collecting pedestal:

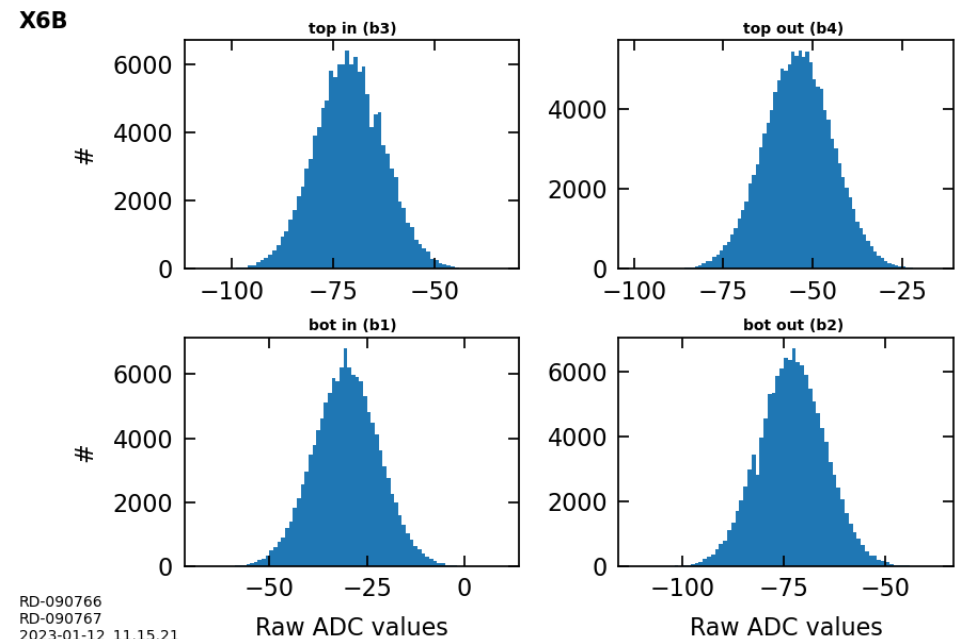
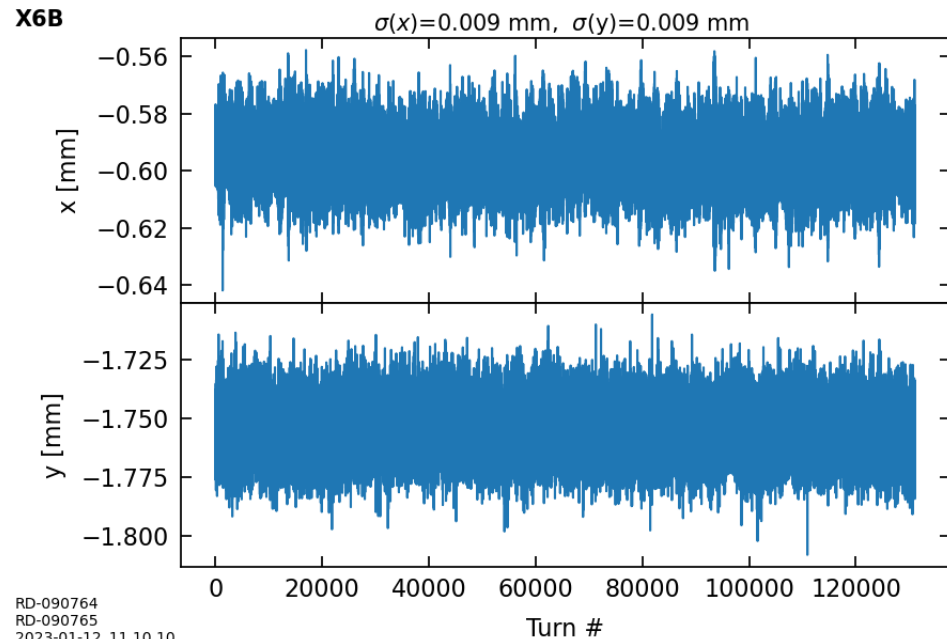
x 90766/90767, 90768/90769

re-inject t1b1 coasting at 0.7 mA:

x 90770/90771, 90772/90773

X6B

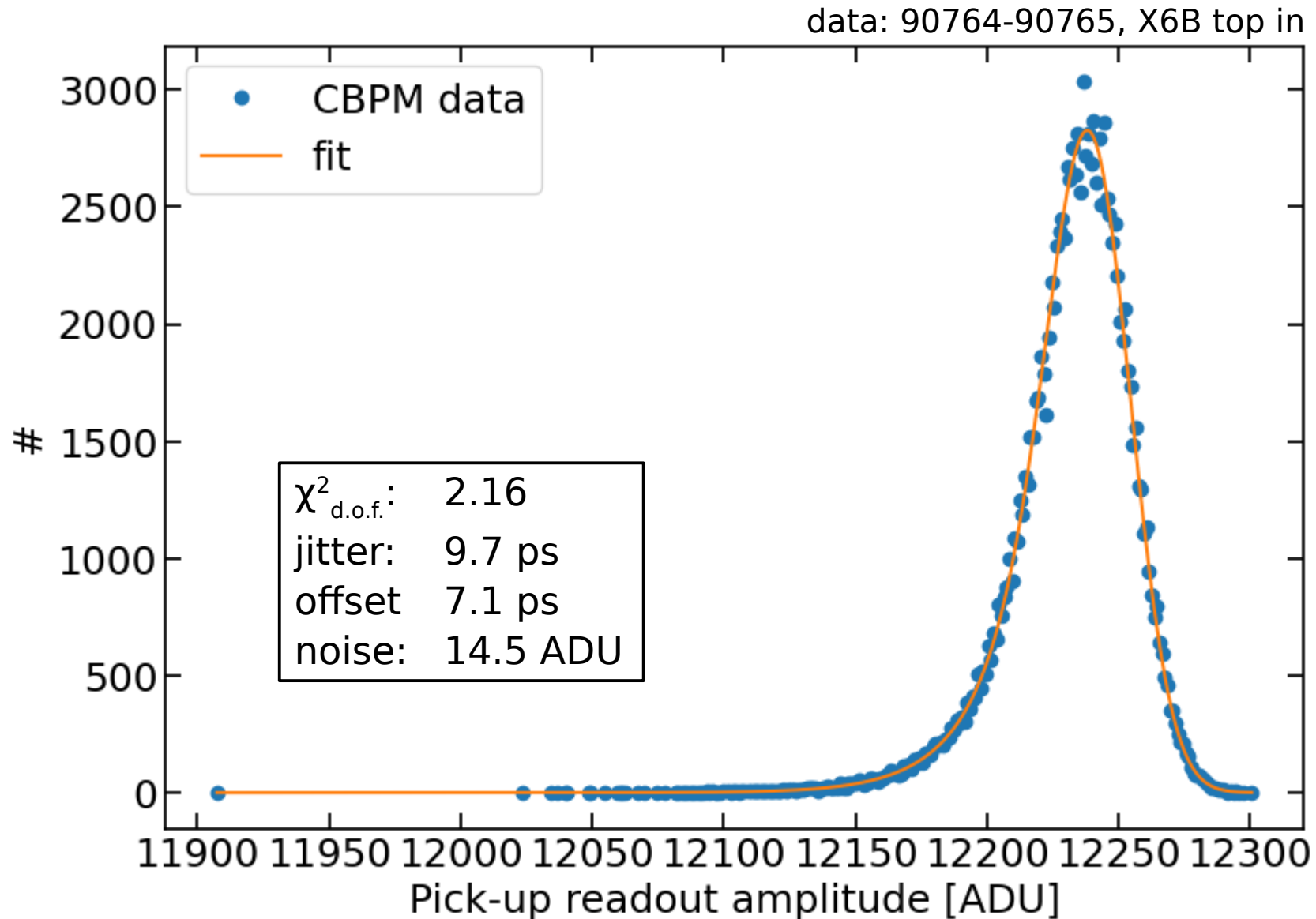
Chose X6B since beam motion (real or not) is small and pedestal noise resembles nicely a Gaussian distribution



Focused on top in (b3) button out of convenience from using analysis code

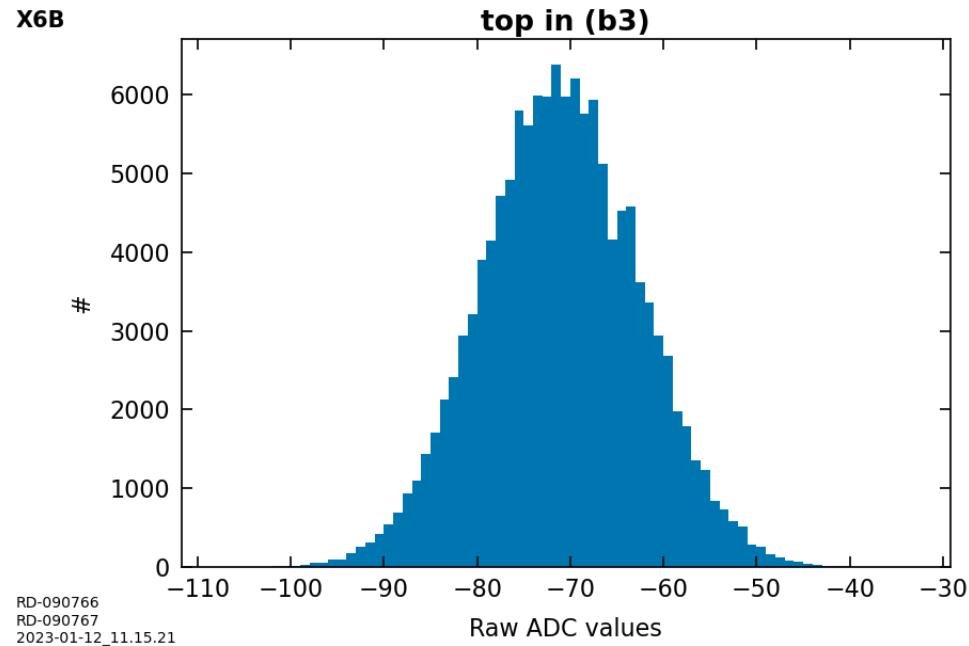
Fitting real data

Fit bounds are generically loose to account for all realistic values



Noise mismatch: 8.4 vs 14.5 ADU

Noise was measured dumping the beam after collecting 90764-90765 → from 90766-90767 and 90768-90769, noise for X6B top in is: **8.4 ADU**

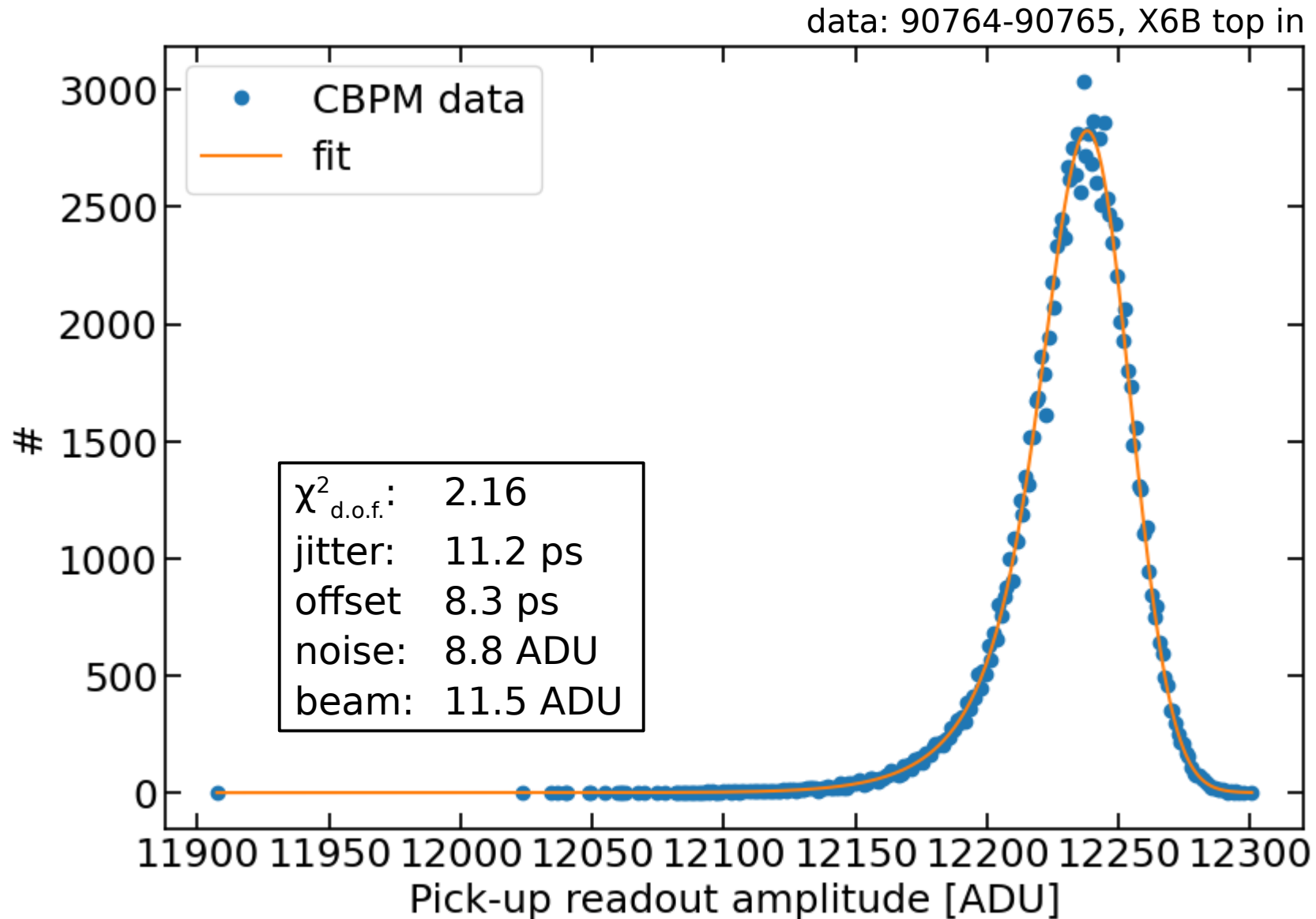


Jitter was measured as expected (~ 10 ps) and offset is within a realistic range

Culprit: beam centroid motion? Let's add an extra fit parameter: the standard deviation of the beam centroid motion (added in quadrature to the noise standard deviation given a bivariate Gaussian distribution with uncorrelated variables)

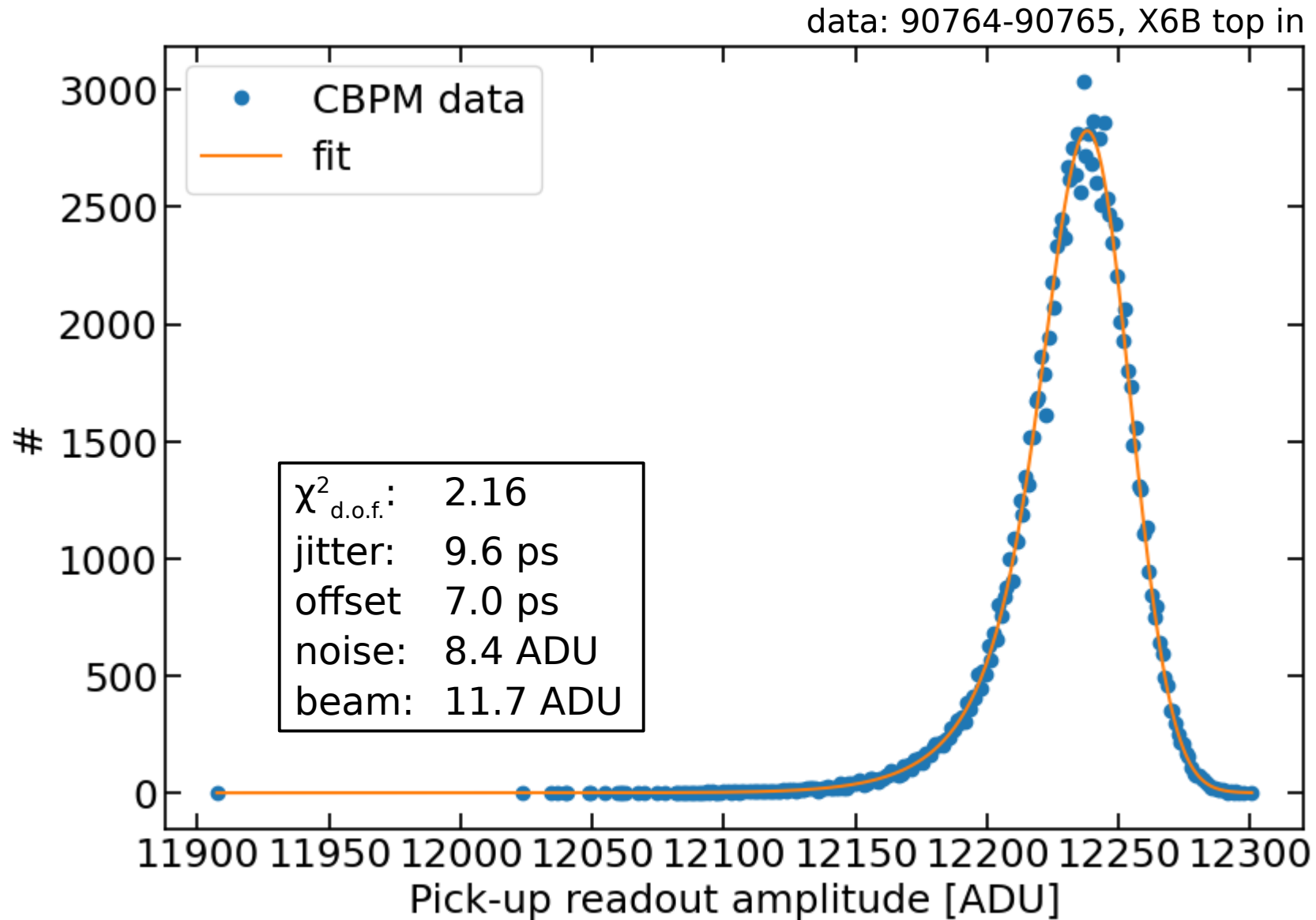
Fitting real data

Fit bounds are generically loose to account for all realistic values



Fitting real data

Noise parameter is fixed to the measured value



More work needed

Getting a good fit/reduced χ^2 value: **check**

Making sure the fitted parameters are meaningful: **not check...**

Path forward:

- x plug fitted error values for 4 buttons into MC simulation to see what beam motion we expect (fitting w/ and w/o beam motion) → compare with data
- x MC simulation studies to see if we can reliably fit for beam motion, alongside error parameters, in simulated data
- x understand if pedestal noise is same as “signal” noise

Group feedback/discussion

- x look at fit residual → anything of interest?
- x use v/h shaker to
 - change beam motion → can method track the change?
- x vary Beta to simultaneously:
 - change beam size → impact on gain reconstruction from change in spatial charge distribution?
 - change beam motion → can method track the change?
- x fit 4-button sum → effective module error extraction minimizing beam motion?

Additional materials

Numbers

accuracy/precision numbers:

Jitter	Accuracy	+ -	Precision	[ps]	:	0.066	+ -	0.351
Offset	Accuracy	+ -	Precision	[ps]	:	-0.163	+ -	0.889
Noise	Accuracy	+ -	Precision	[ADU]	:	0.026	+ -	0.455
Frequency	Accuracy	+ -	Precision	[MHz]	:	1.08	+ -	15.485
Amplitude	Accuracy	+ -	Precision	[ADU]	:	-0.322	+ -	1.259