

Resolution Study

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Outline

Look at different files from the May/June run and attempt to identify common conditions for achieving good resolution results.

So far ...

- Study 1: Comparing repeat resolution runs with no changes.
- Study 2: Comparing many different runs across a shift.

Study 1

Three consecutive data runs combined to give 17 x 200-trigger data sets.

jitRun13_10dB_Board1_260517 (400 triggers)

jitRun14_10dB_Board1_260517 (2000 triggers)

jitRun15_10dB_Board1_260517 (1000 triggers)

Same calibration files and noise baseline subtraction:

noiseFloor8_70dB_Board1_260517

AQD0FFyScan13_10dB_Board1_260517

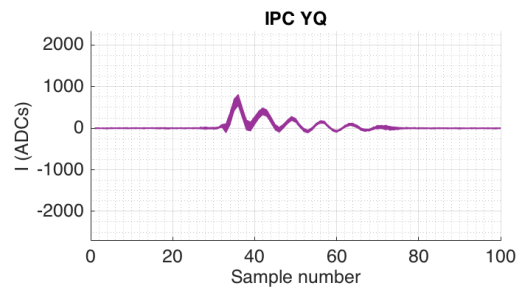
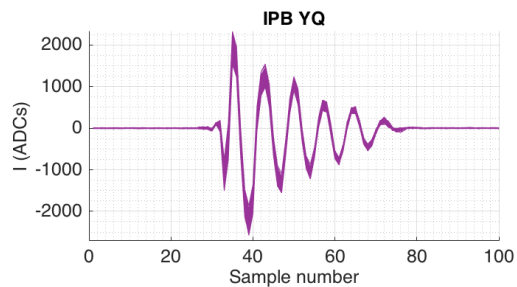
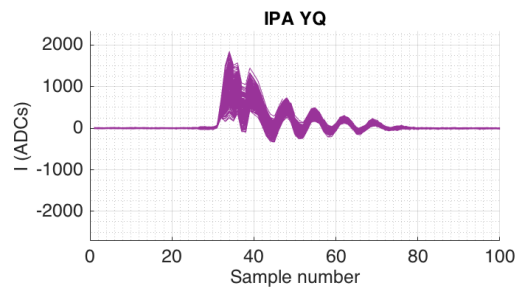
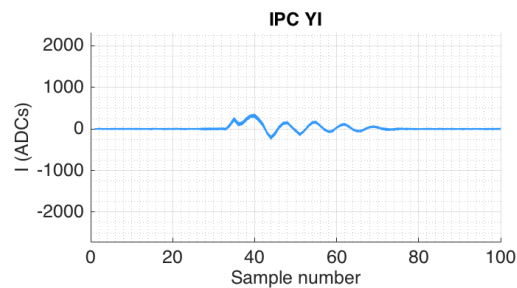
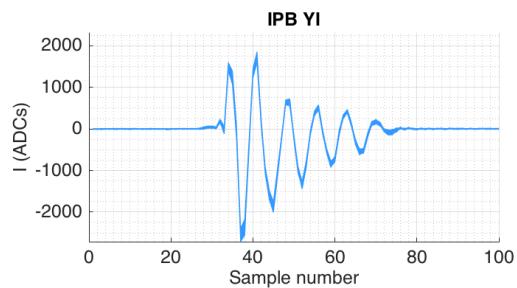
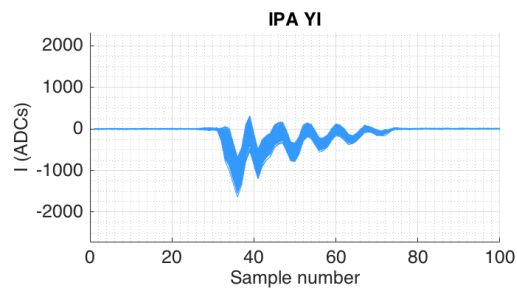
No band pass filters were used for this shift.

The charge was $\sim 0.5 \times 10^{10}$.

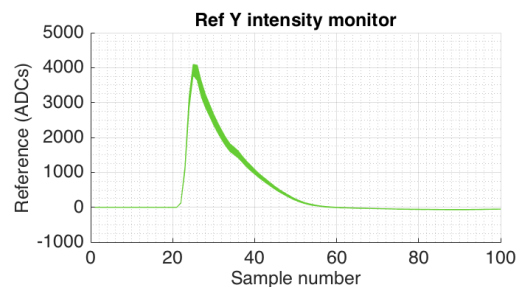
This was the shift where the best resolution results were achieved.

Integrate over 10 samples.

Study 1: Example Y waveforms

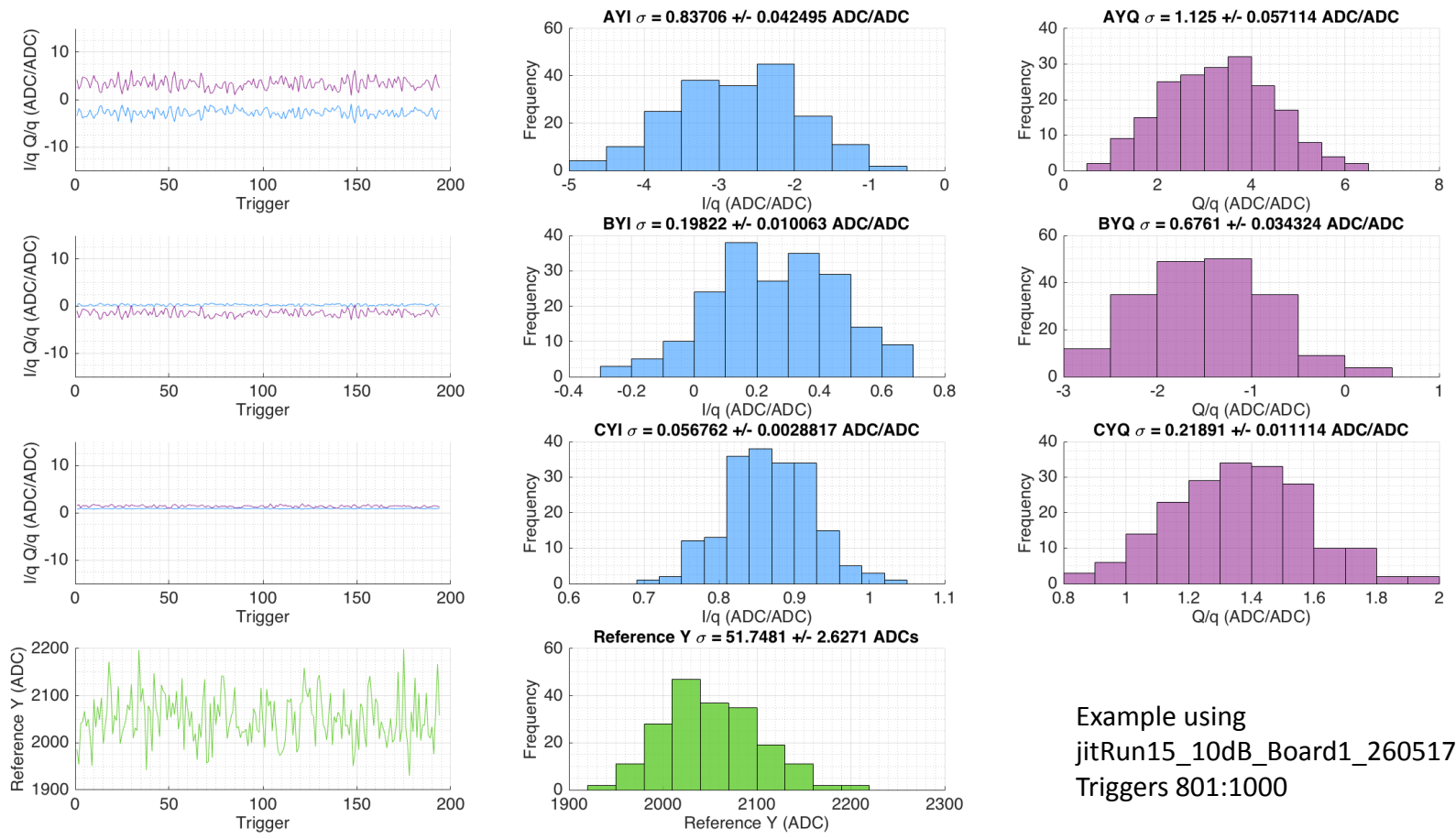


Example using
jitRun15_10dB_Board1_260517
Triggers 801:1000



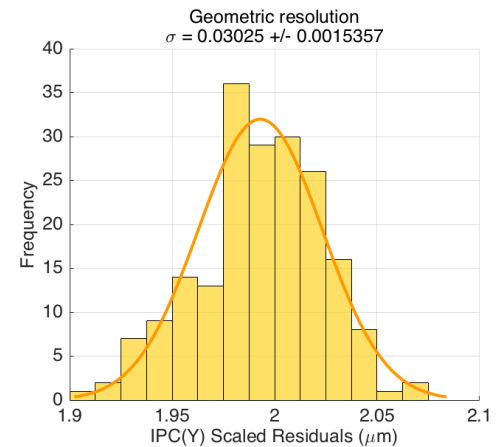
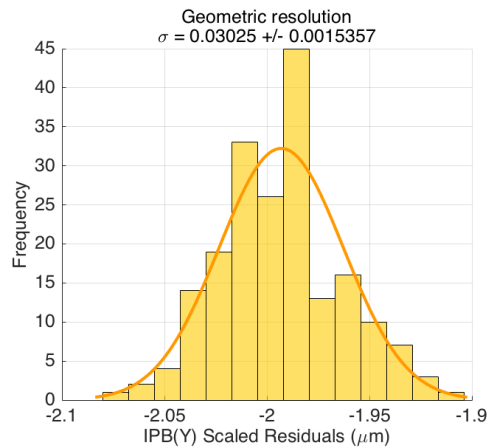
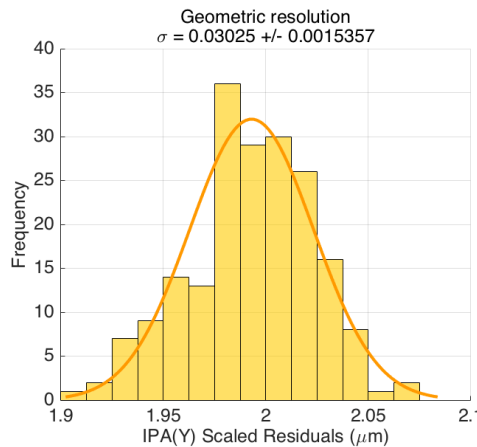
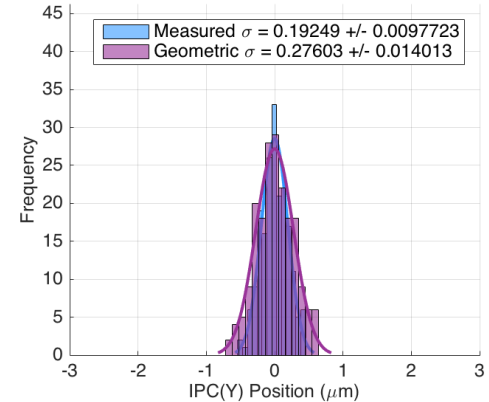
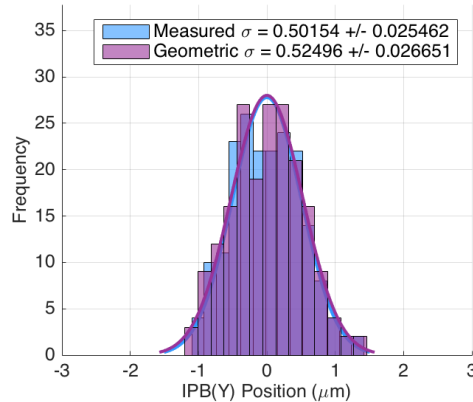
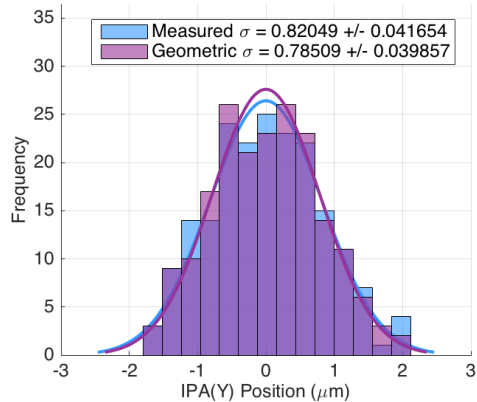
Study 1: sampling of I, Q, Ref

Sample by integrating across 10 samples in I and Q. Use the same ref, and sample numbers to compare data sets.



Example using
jitRun15_10dB_Board1_260517
Triggers 801:1000

Study 1: position/residuals



Example using – jitRun15_10dB_Board1_260517 – Triggers 801:1000

Study 1: results

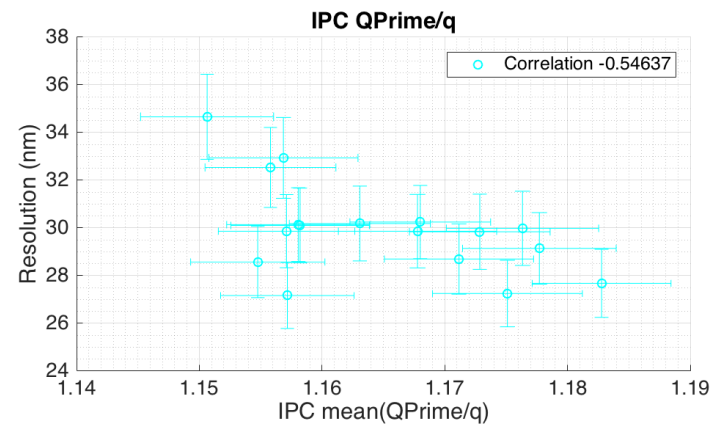
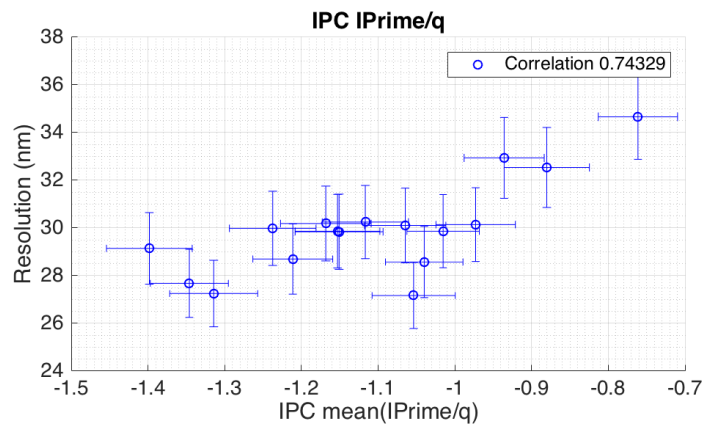
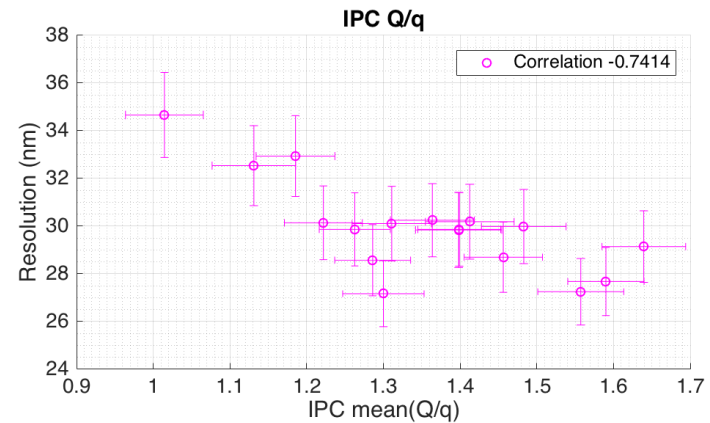
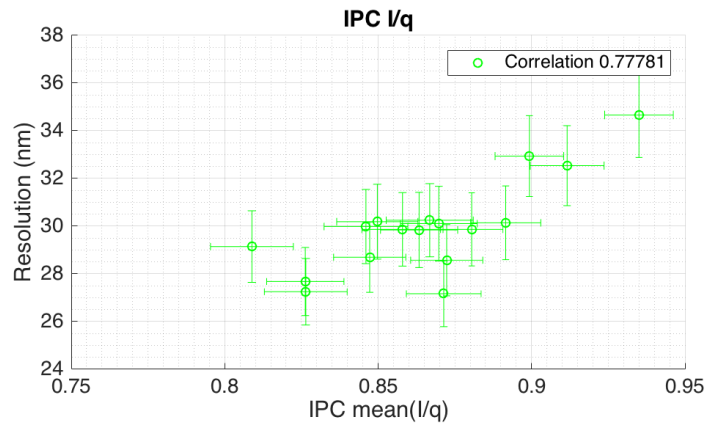
- Calculate standard deviation and mean of: IPA, IPB, IPC I/q, Q/q, I'/q, Q'/q, RefY.
- Look for significant correlations between all of these things and the geometric resolution.
- > 50% correlation >70% correlation

Standard Deviation	Parameter	Correlation with res
	A I'/q	-0.03
	A Q'/q	-0.59
	B I'/q	-0.19
	B Q'/q	-0.22
	C I'/q	-0.08
	C Q'/q	-0.19
	Ref Y	-0.27
	A I/q	-0.13
	A Q/q	0.02
	B I/q	-0.26
	B Q/q	-0.18
	C I/q	-0.34
	C Q/q	-0.06

Mean	Parameter	Correlation with res
	A I'/q	0.56
	A Q'/q	0.55
	B I'/q	0.33
	B Q'/q	0.00
	C I'/q	0.74
	C Q'/q	-0.55
	Ref Y	0.52
	A I/q	0.60
	A Q/q	-0.54
	B I/q	0.27
	B Q/q	-0.33
	C I/q	0.78
	C Q/q	-0.74

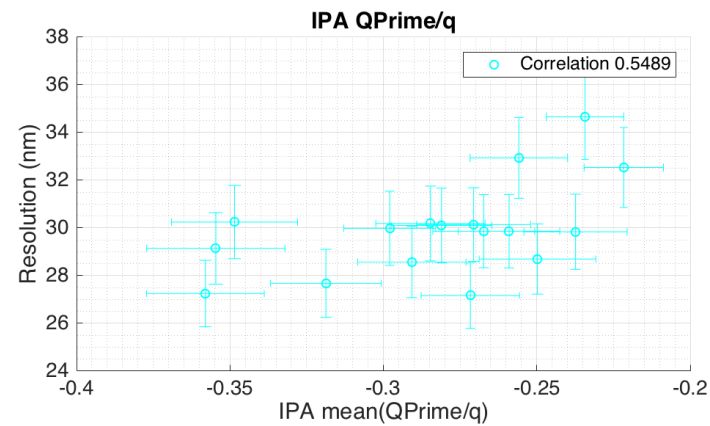
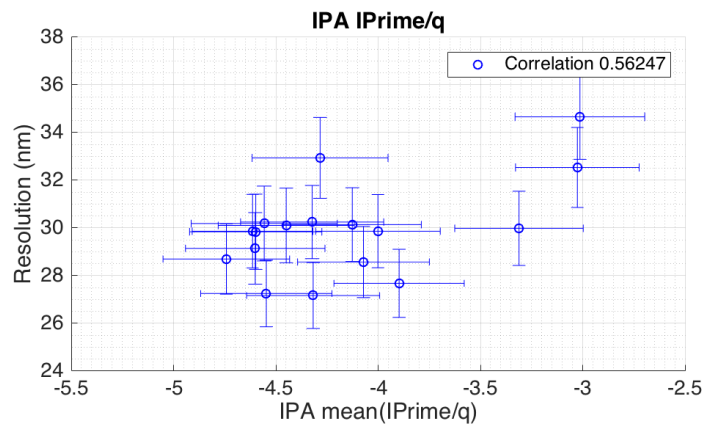
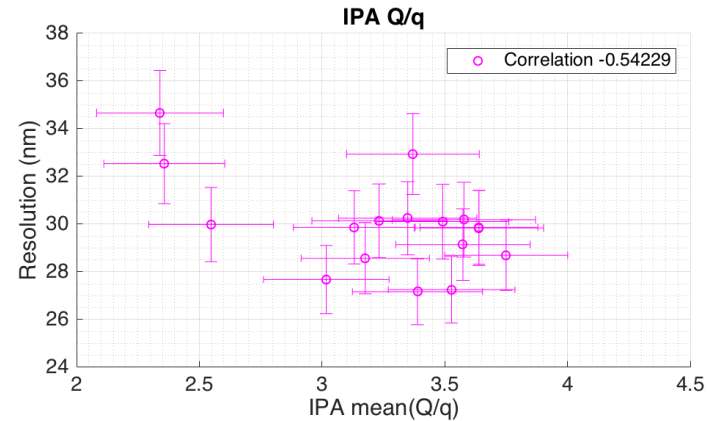
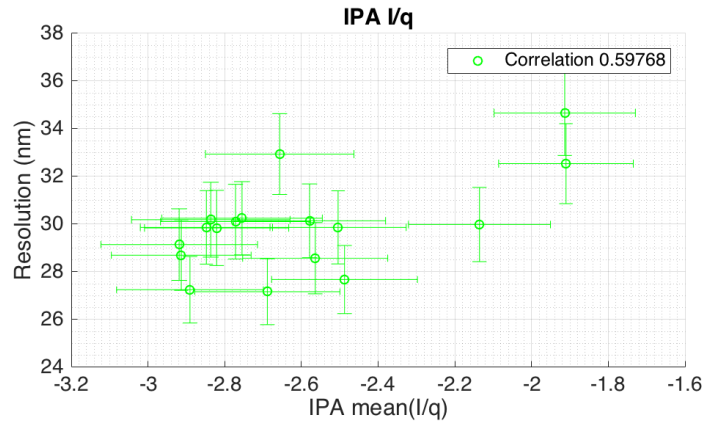
Study 1: >70% correlation

- Correlation between mean IPC I/q, Q/q, I'/q, Q'/q levels and the geometric resolution.



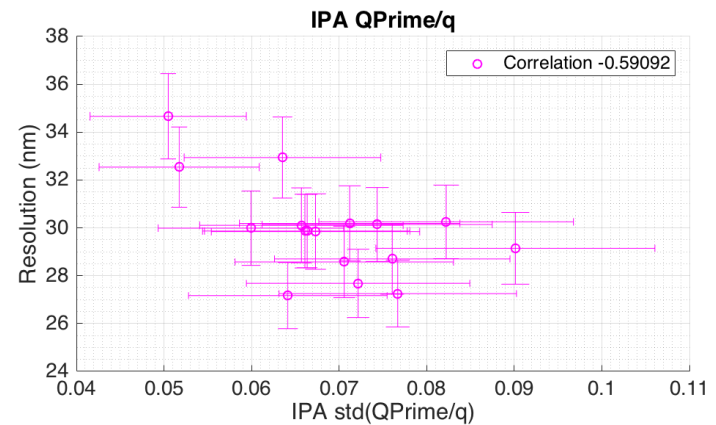
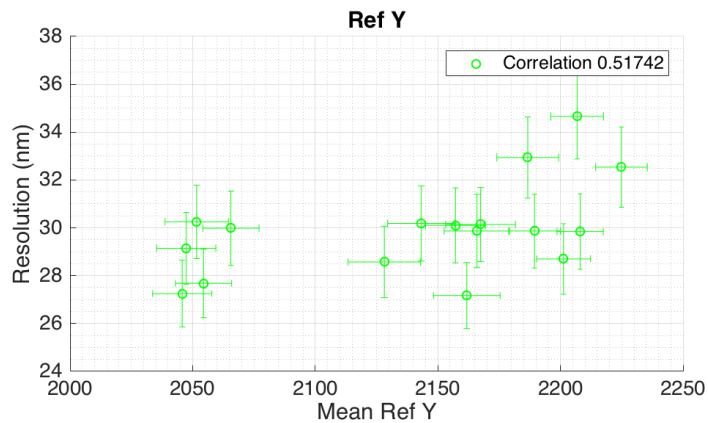
Study 1: >50% correlation

- Correlation between mean IPA I/q, Q/q, I'/q, Q'/q levels and the geometric resolution.



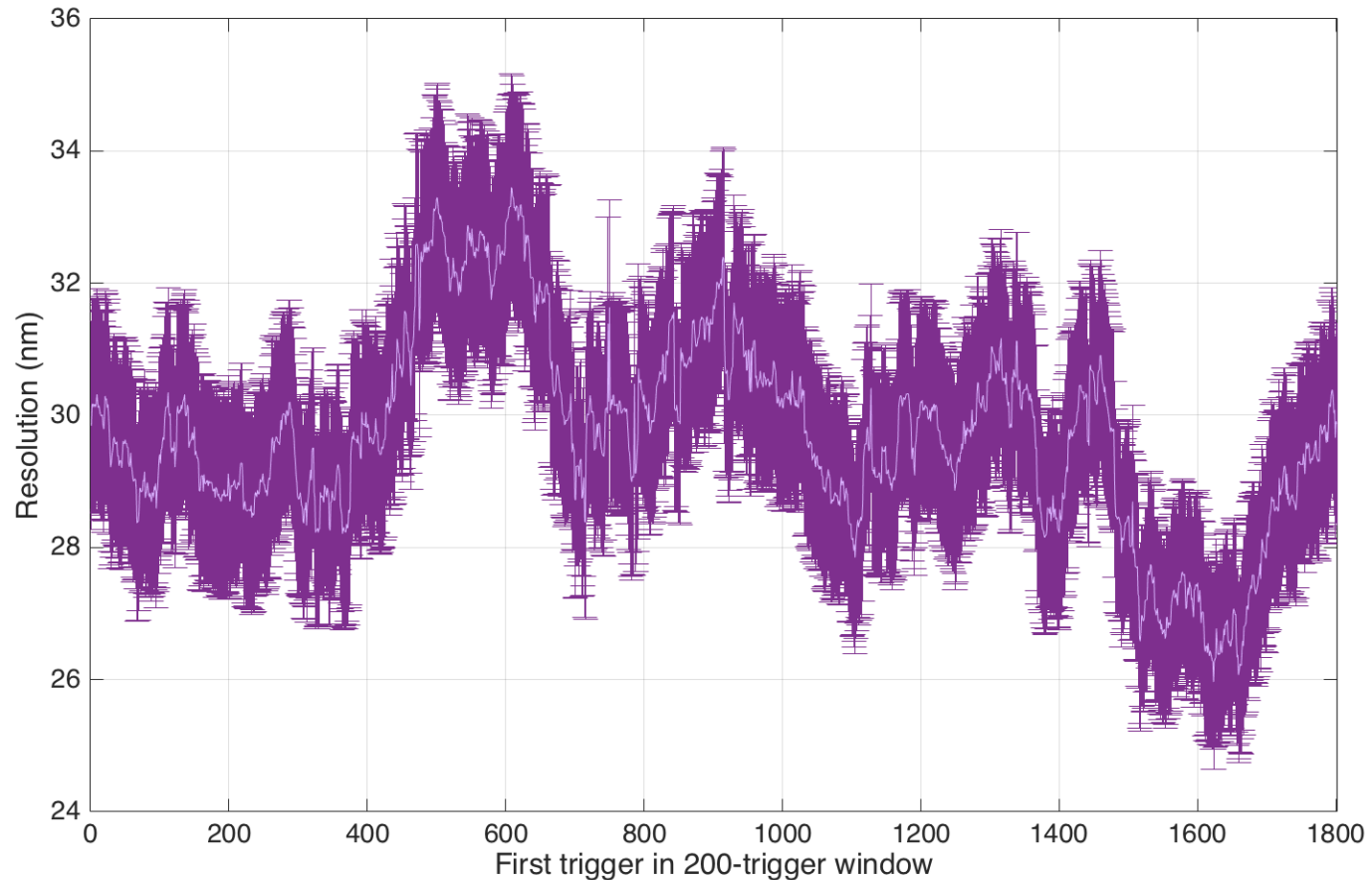
Study 1: >50% correlation

- Correlation between standard deviation of IPA I/q and the geometric resolution.
- Correlation between the mean Y Reference signal and the geometric resolution.



Study 1: rolling resolution

- Break the 2000 trigger data set up into 200 triggers i.e. 1:200, 2:201, 3:202, 4:203 to see what the geometric resolution does over time.



Study 1: rolling correlation

- No clear correlation found with the standard deviation or mean levels of IPA, IPB and IPC, I/q , Q/q , I'/q , I''/q or reference Y.

	Parameter	Correlation with res
Standard Deviation	A I'/q	0.40
	A Q'/q	-0.14
	B I'/q	0.35
	B Q'/q	0.23
	C I'/q	0.21
	C Q'/q	0.25
	Ref Y	-0.06
	A I/q	0.41
	A Q/q	0.39
	B I/q	0.41
	B Q/q	0.35
	C I/q	0.08
	C Q/q	0.22

	Parameter	Correlation with res
Mean	A I'/q	0.07
	A Q'/q	0.15
	B I'/q	-0.08
	B Q'/q	0.04
	C I'/q	0.37
	C Q'/q	-0.09
	Ref Y	0.16
	A I/q	0.09
	A Q/q	-0.06
	B I/q	-0.08
	B Q/q	0.08
	C I/q	0.44
	C Q/q	-0.37

Study 2

All data runs across the first shift, using single-sample.

jitRun7_10dB_Board1_260517	54 nm
jitRun8_10dB_Board1_260517	47 nm
jitRun9_10dB_Board1_260517	87 nm
jitRun10_10dB_Board1_260517	60 nm
jitRun11_10dB_Board1_260517	56 nm
jitRun13_10dB_Board1_260517	60 nm
jitRun14_10dB_Board1_260517	53 nm
jitRun15_10dB_Board1_260517	56 nm

The changes between these data sets involved slight adjustments of the reference attenuation, slight adjustments in the BPM positions to re-centre the beam, new calibrations etc.

Slight change in the attenuation on the reference signal are accounted for by scaling the diode reference signal to 50dB to make all comparable.

Study 2: results single-sample

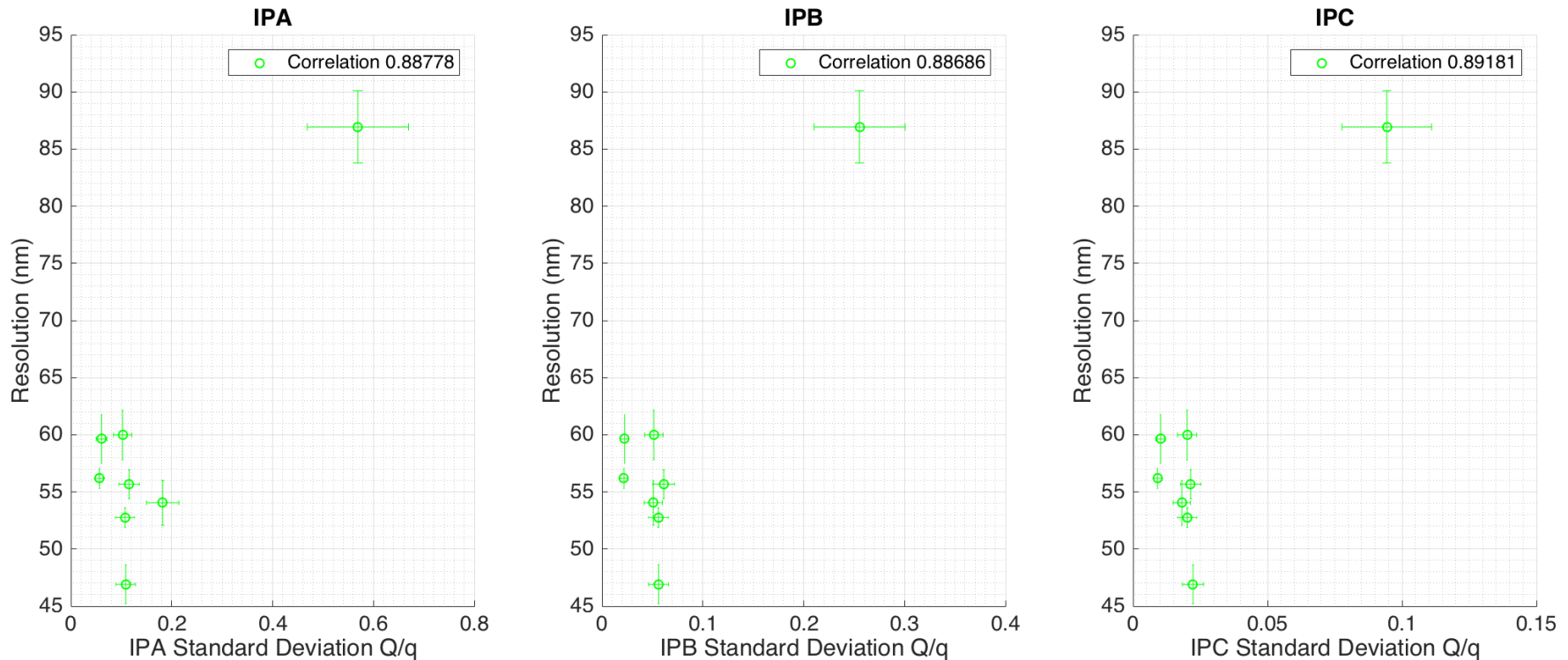
Most significant correlations to geometric resolution was the standard deviation of the Q/q.

std	A I'/q	0.85
	A Q'/q	0.86
	B I'/q	0.85
	B Q'/q	0.81
	C I'/q	0.85
	C Q'/q	0.83
	Ref Y	-0.37
	A pos	0.77
	B pos	0.34
	C pos	0.05
	A I/q	0.10
	A Q/q	0.89
	B I/q	0.24
	B Q/q	0.89
C I/q	0.44	
C Q/q	0.89	

mean	A I'/q	-0.76
	A Q'/q	0.71
	B I'/q	-0.68
	B Q'/q	-0.80
	C I'/q	-0.82
	C Q'/q	-0.80
	Ref Y	-0.38
	A pos	0.17
	B pos	0.07
	C pos	0.17
	A I/q	0.08
	A Q/q	0.88
	B I/q	0.87
	B Q/q	-0.56
C I/q	0.11	
C Q/q	-0.79	

Study 2: results single sample

Most correlation due to the single bad performance resolution file.



Study 2

All data runs across the first shift, using 10-sample integration.

jitRun7_10dB_Board1_260517	28 nm
jitRun8_10dB_Board1_260517	20 nm
jitRun9_10dB_Board1_260517	40 nm
jitRun10_10dB_Board1_260517	30 nm
jitRun11_10dB_Board1_260517	29 nm
jitRun13_10dB_Board1_260517	34 nm
jitRun14_10dB_Board1_260517	30 nm
jitRun15_10dB_Board1_260517	30 nm

The changes between these data sets involved slight adjustments of the reference attenuation, slight adjustments in the BPM positions to re-centre the beam, new calibrations etc.

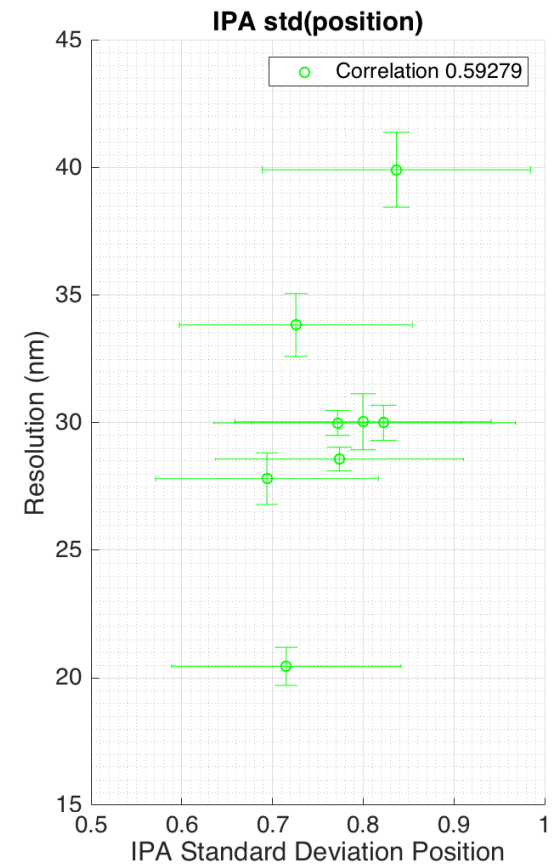
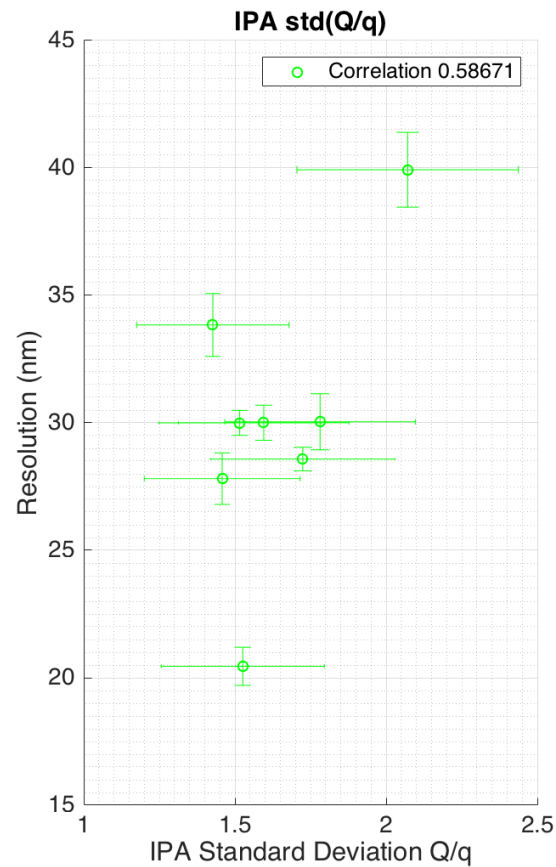
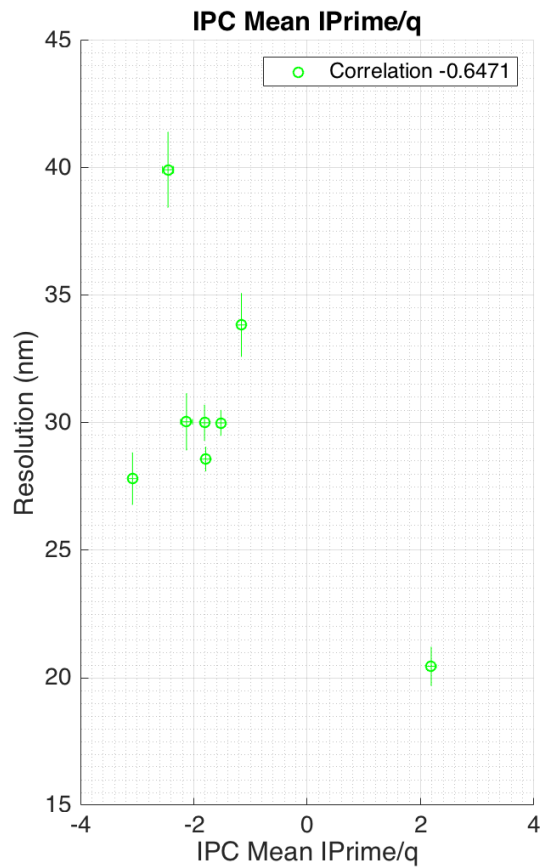
Slight change in the attenuation on the reference signal are accounted for by scaling the diode reference signal to 50dB to make all comparable.

Study 2: results 10-sample

Most significant correlations to geometric resolution was the standard deviation of the IPA position and IPA Q/q, and the mean IPC I'/q.

Parameter	std	mean
A I'/q	0.49	-0.15
A Q'/q	-0.04	-0.19
B I'/q	0.41	0.15
B Q'/q	0.47	0.32
C I'/q	0.10	-0.65
C Q'/q	0.12	-0.31
Ref Y	-0.09	-0.48
A pos	0.59	-0.01
B pos	0.32	-0.26
C pos	-0.21	-0.17
A I/q	-0.36	0.06
A Q/q	0.59	0.11
B I/q	-0.36	0.18
B Q/q	0.34	-0.30
C I/q	-0.20	0.06
C Q/q	0.26	0.07

Study 2: results 10-sample



Study 2: Qualitative approach

Compare the two most extreme cases:

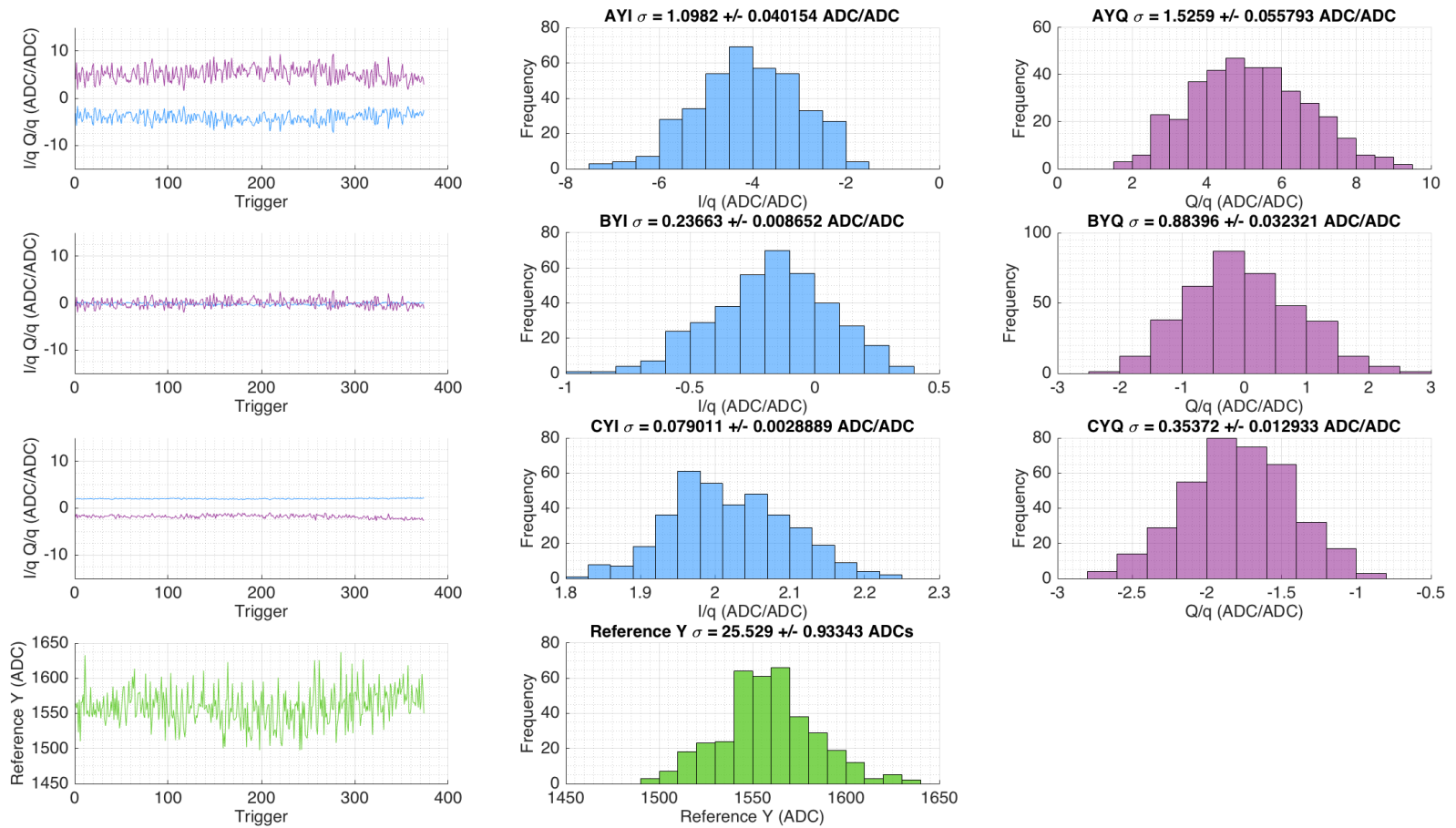
jitRun8_10dB_Board1_260517	20 nm
jitRun9_10dB_Board1_260517	40 nm

Differences between these two files:

- Slight change in the attenuation on the reference signal (6dB) are accounted for by scaling the diode reference signal to 50dB to make all comparable.
- New calibrations. New background subtractions.

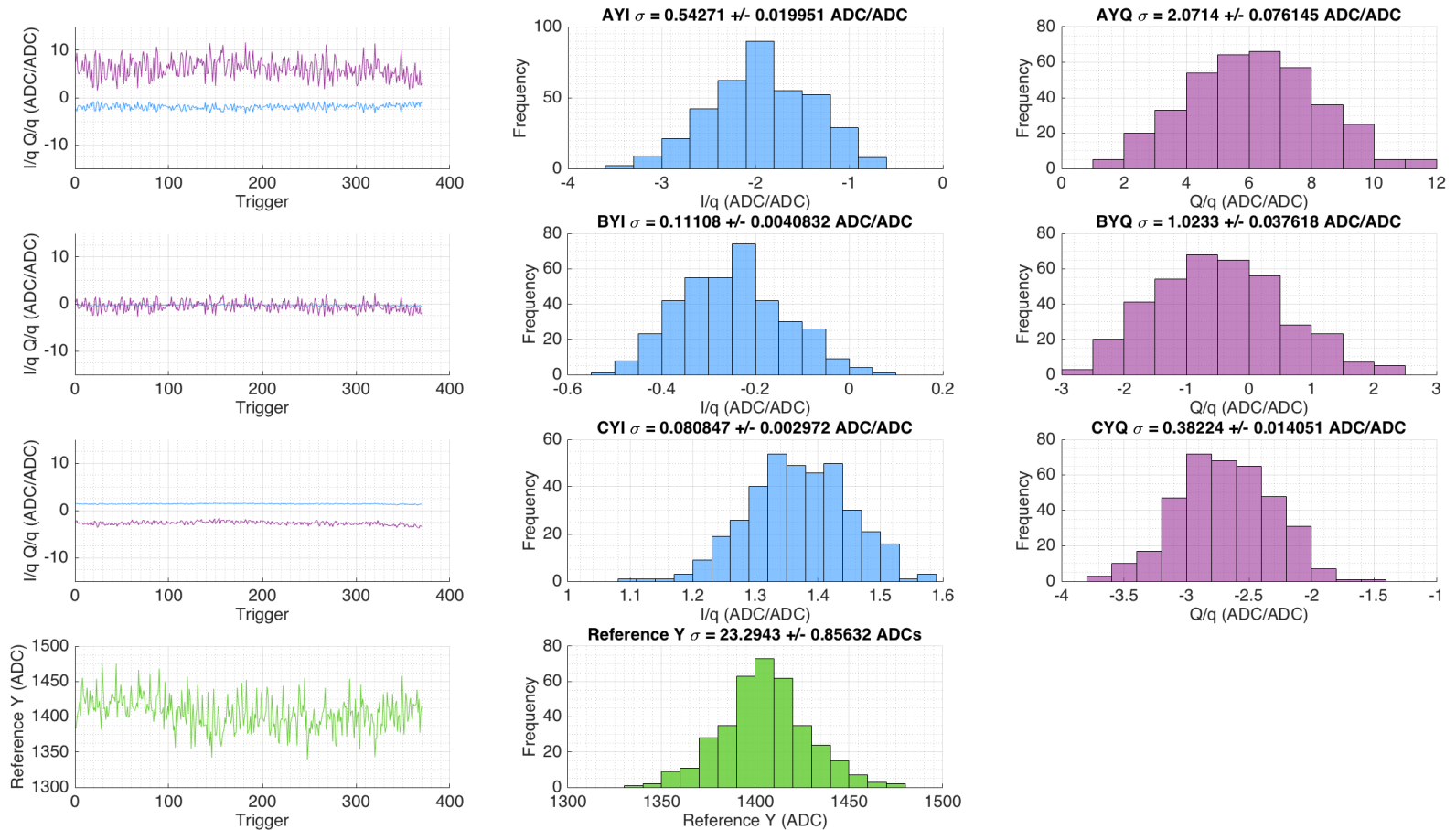
Study 2: Signal distributions

jitRun8: 20nm



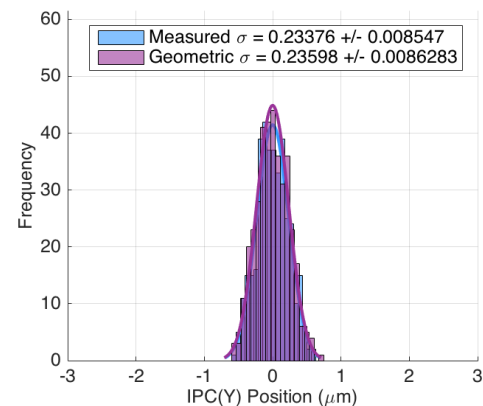
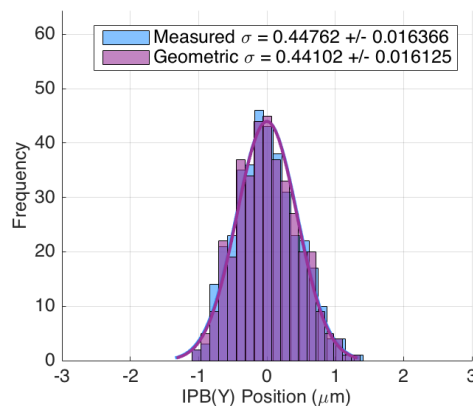
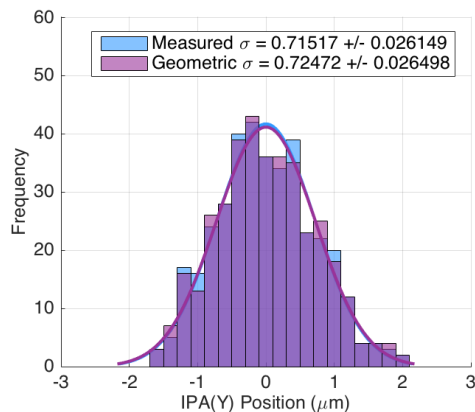
Study 2: Signal distributions

jitRun9: 40nm

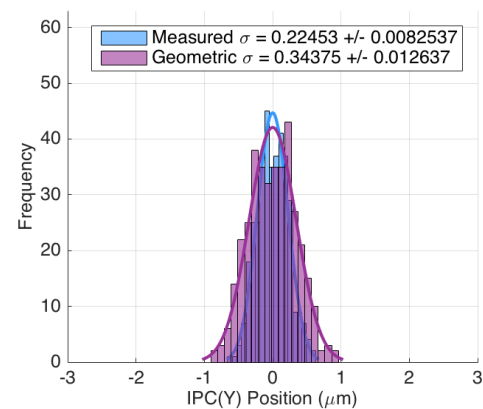
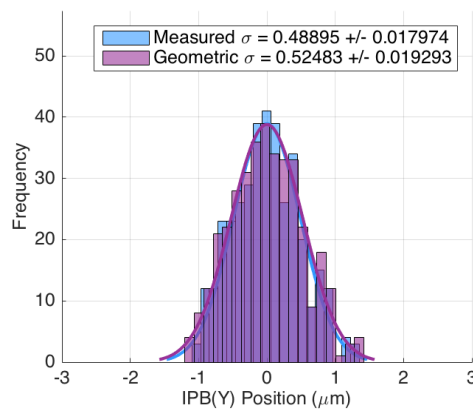
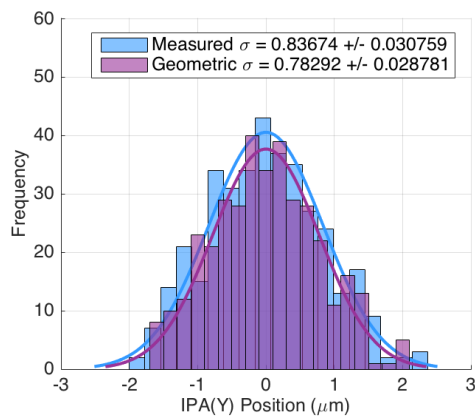


Study 2: Position distributions

jitRun8: 20nm

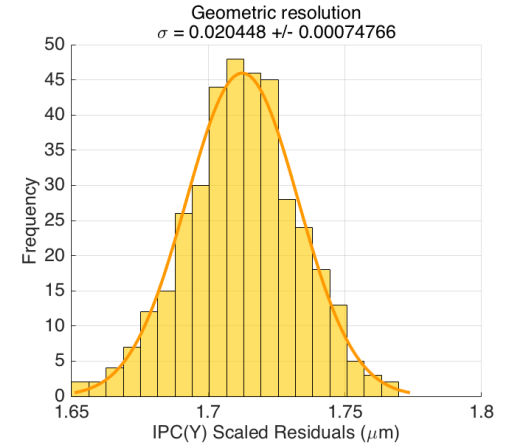
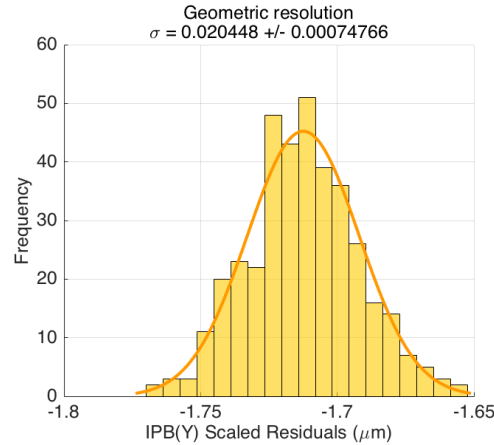
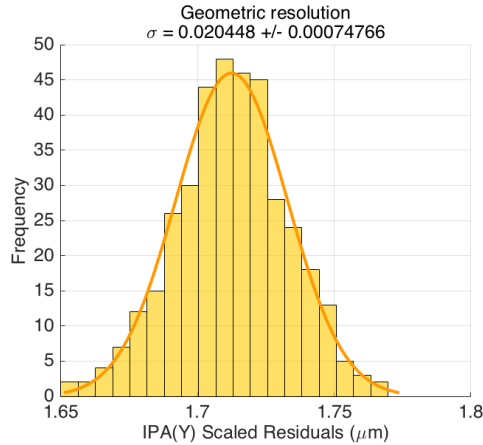


jitRun9: 40nm

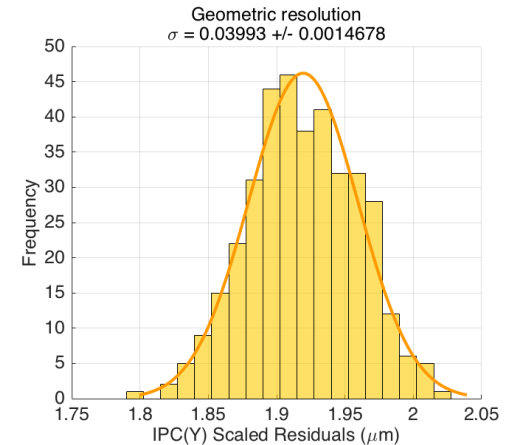
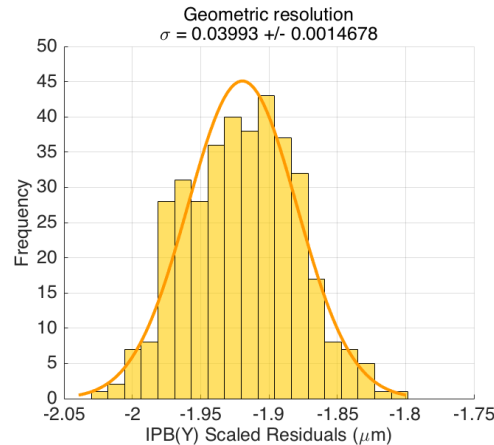
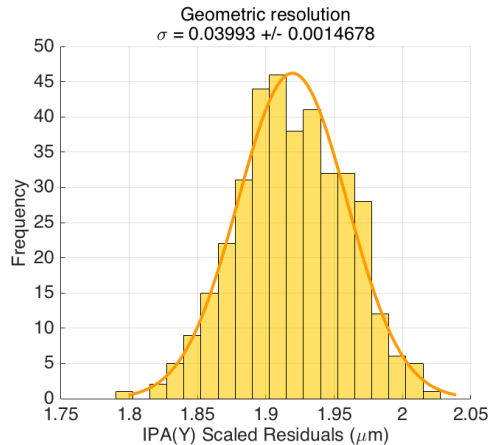


Study 2: Residual distributions

jitRun8: 20nm



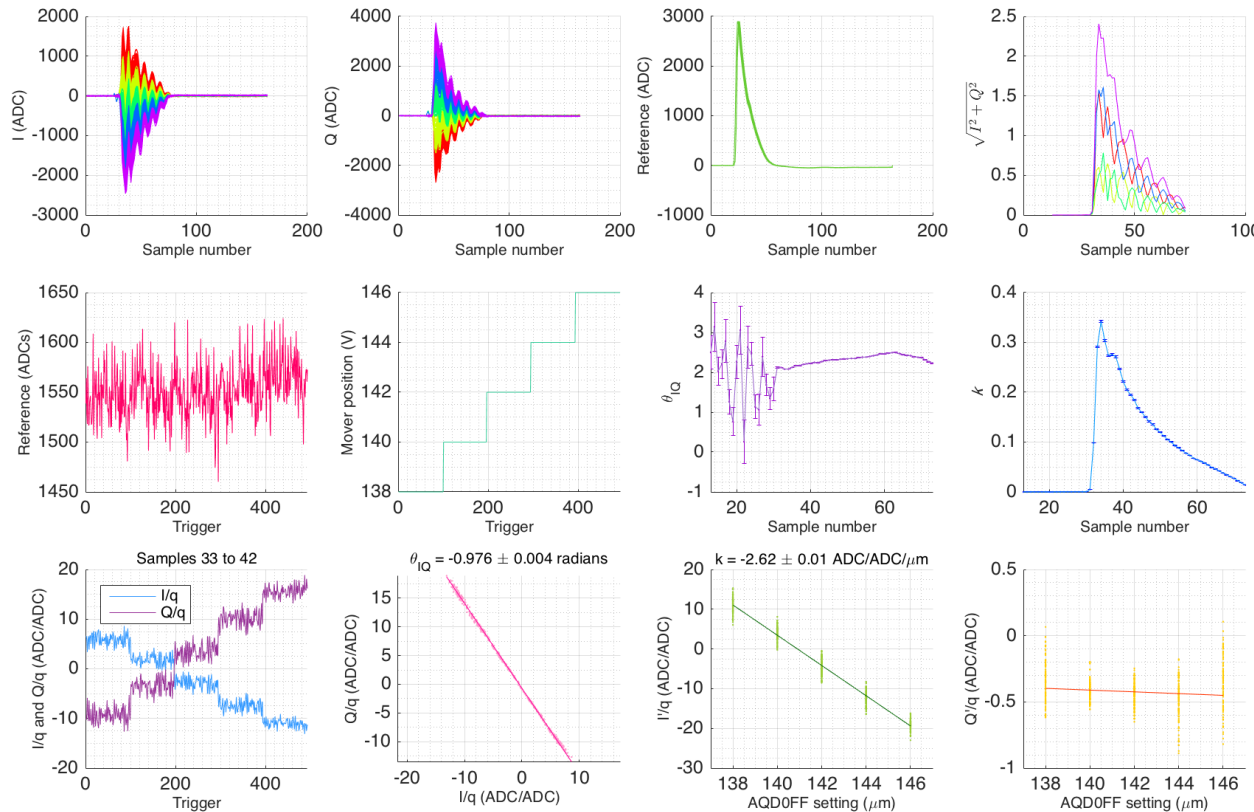
jitRun9: 40nm



Study 2: Calibrations

jitRun8: 20nm (AQD0FFScan9)

IPBPM Calibration



AQD0FFyScan9_10dB_
{138:146}um_Board1_260517

IPAY

Number of triggers: 500
Number of samples: 164
IPBPM analysed: AY
Waveform starts at sample: 33
Reference maximum at sample: 25
IQ amplitude maximum at sample: 36

CHARGE
 1550 ± 1 ADCs

MOVERS
Number of steps: 5
Triggers per step:
100 100 100 100 100
Steps used: 1: 5

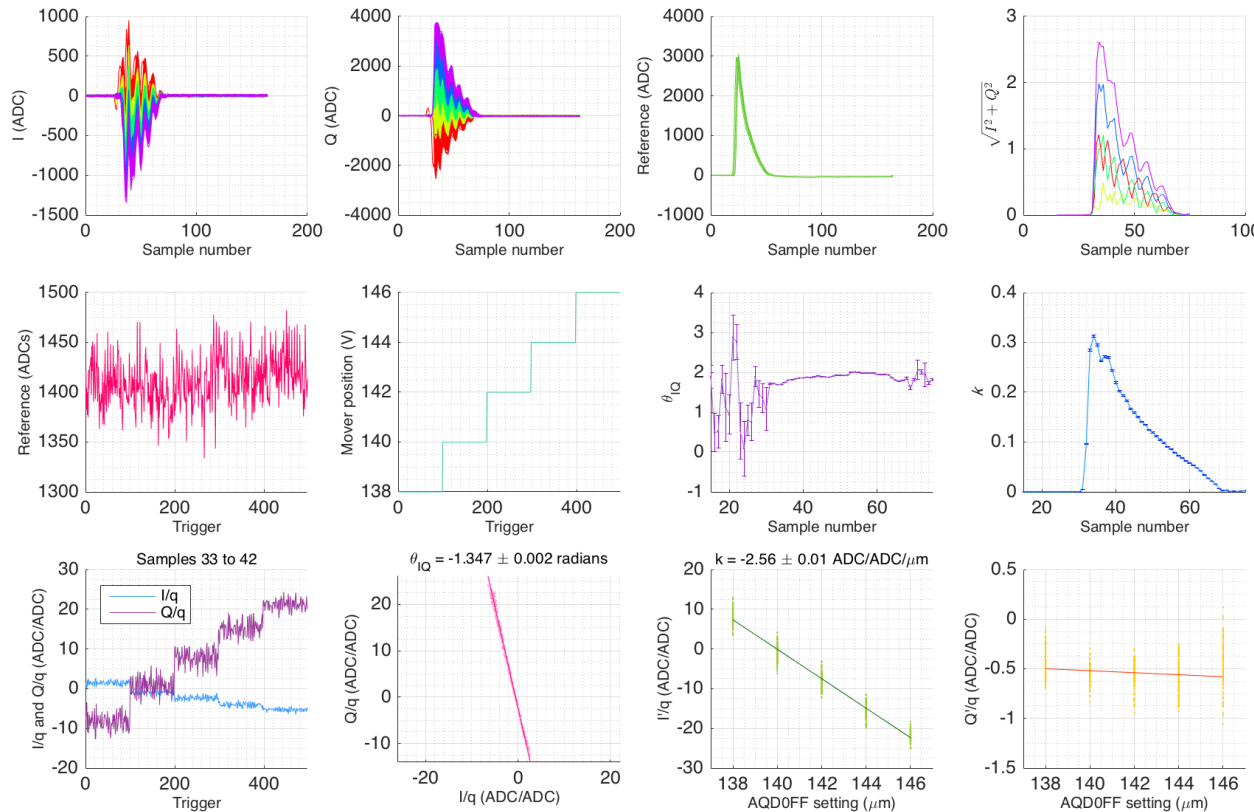
CUTS
Saturated samples: 0
Reference threshold cuts: 0
3-sigma reference cuts: 7
Total triggers cut: 7
Triggers remaining: 493

CALIBRATION
Samples 33 to 42
Integration
Reference sample number: 32
IQ rotation angle θ : -0.976 ± 0.004 radians
Scale factor k : -2.62 ± 0.01 ADC/ADC/ μm

Study 2: Calibrations

jitRun9: 40nm (AQD0FFScan10)

IPBPM Calibration



AQD0FFyScan10_10dB_
{138:146}um_Board1_260517

IPAY

Number of triggers: 500
Number of samples: 164
IPBPM analysed: AY
Waveform starts at sample: 35
Reference maximum at sample: 25
IQ amplitude maximum at sample: 35

CHARGE
 1410 ± 1 ADCs

MOVERS
Number of steps: 5
Triggers per step:
100 100 100 100 100
Steps used: 1: 5

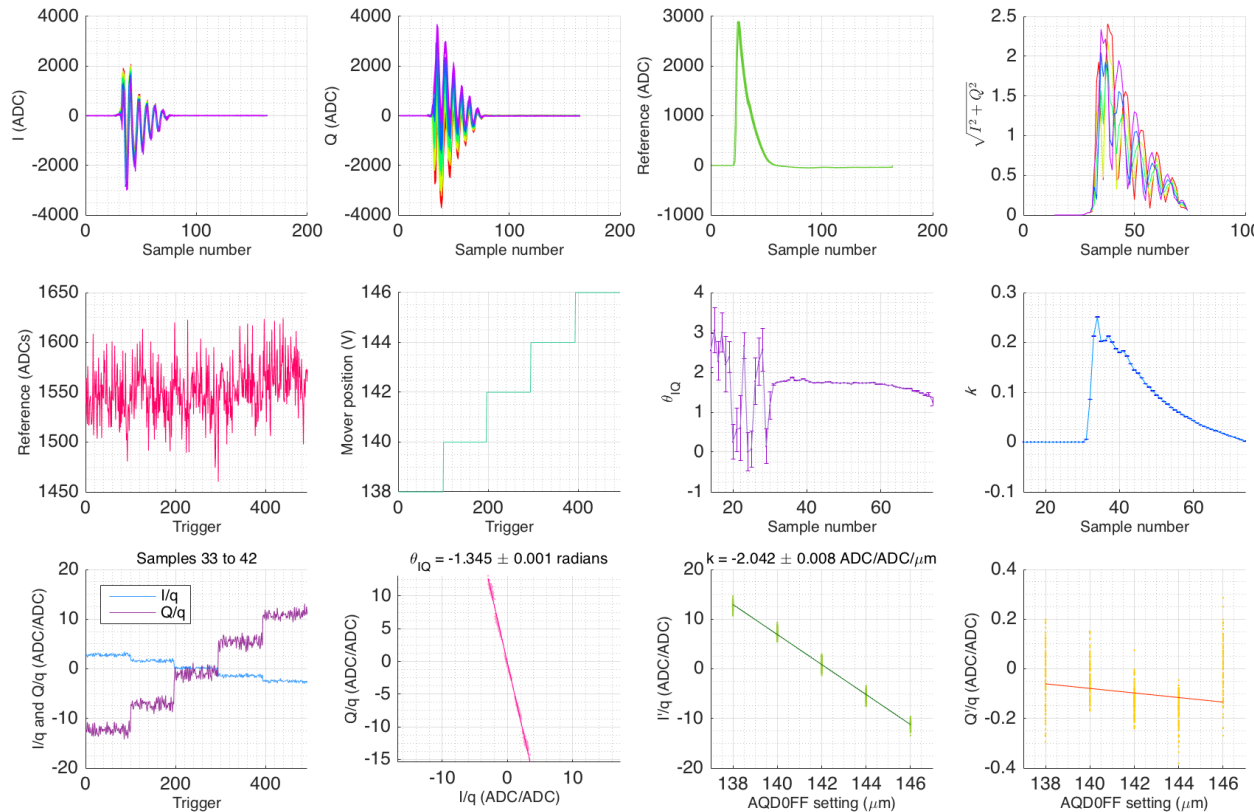
CUTS
Saturated samples: 0
Reference threshold cuts: 0
3-sigma reference cuts: 3
Total triggers cut: 3
Triggers remaining: 497

CALIBRATION
Samples 33 to 42
Integration
Reference sample number: 32
IQ rotation angle θ : -1.347 ± 0.002 radians
Scale factor κ : -2.56 ± 0.01 ADC/ADC/ μm

Study 2: Calibrations

jitRun8: 20nm (AQD0FFScan9)

IPBPM Calibration



AQD0FFyScan9_10dB_
{138:146}um_Board1_260517

IPBY

Number of triggers: 500
Number of samples: 164
IPBPM analysed: BY
Waveform starts at sample: 34
Reference maximum at sample: 25
IQ amplitude maximum at sample: 37

CHARGE
 1550 ± 1 ADCs

MOVERS
Number of steps: 5
Triggers per step:
100 100 100 100 100
Steps used: 1: 5

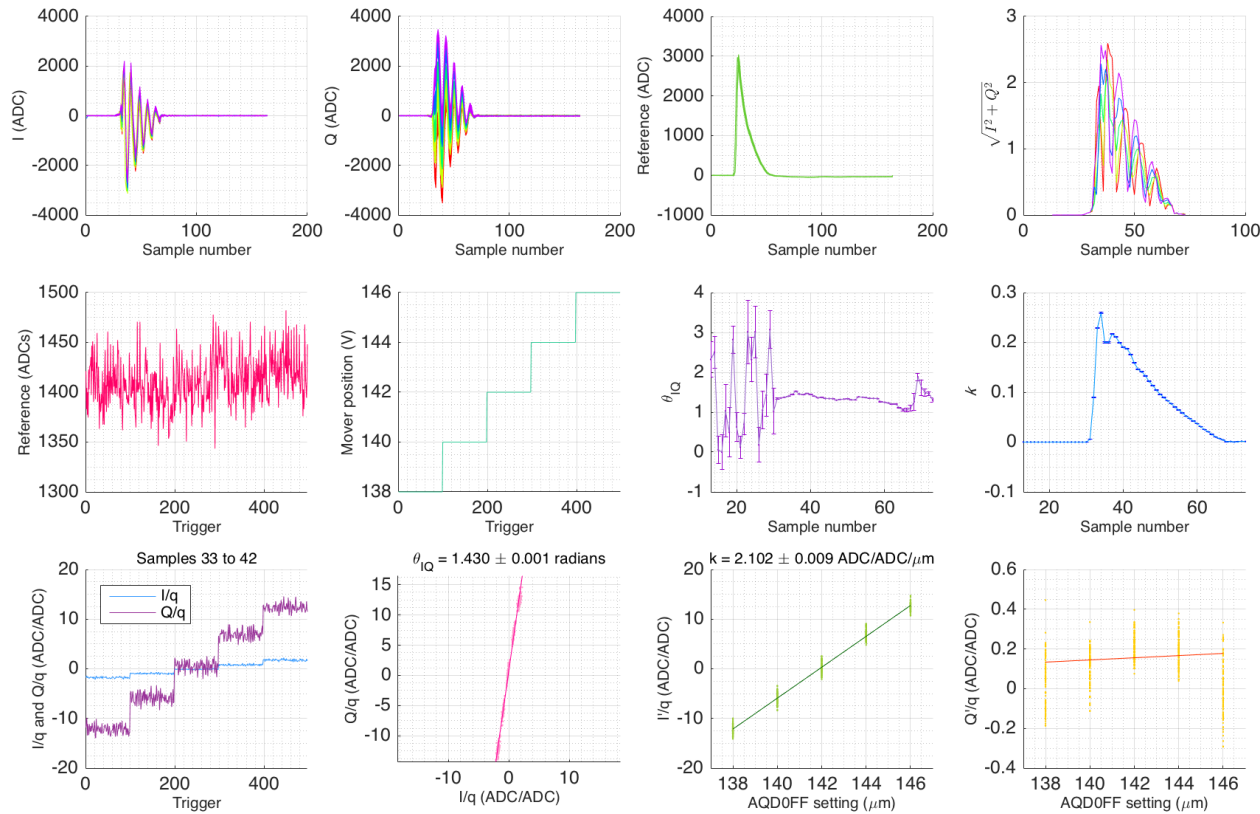
CUTS
Saturated samples: 0
Reference threshold cuts: 0
3-sigma reference cuts: 7
Total triggers cut: 7
Triggers remaining: 493

CALIBRATION
Samples 33 to 42
Integration
Reference sample number: 32
IQ rotation angle θ : -1.345 ± 0.001 radians
Scale factor k : -2.042 ± 0.008 ADC/ADC/ μm

Study 2: Calibrations

jitRun9: 40nm (AQD0FFScan10)

IPBPM Calibration



AQD0FFyScan10_10dB_
{138:146}um_Board1_260517

IPBY

Number of triggers: 500
Number of samples: 164
IPBPM analysed: BY
Waveform starts at sample: 33
Reference maximum at sample: 25
IQ amplitude maximum at sample: 37

CHARGE
1410 ± 1 ADCs

MOVERS
Number of steps: 5
Triggers per step:
100 100 100 100 100
Steps used: 1: 5

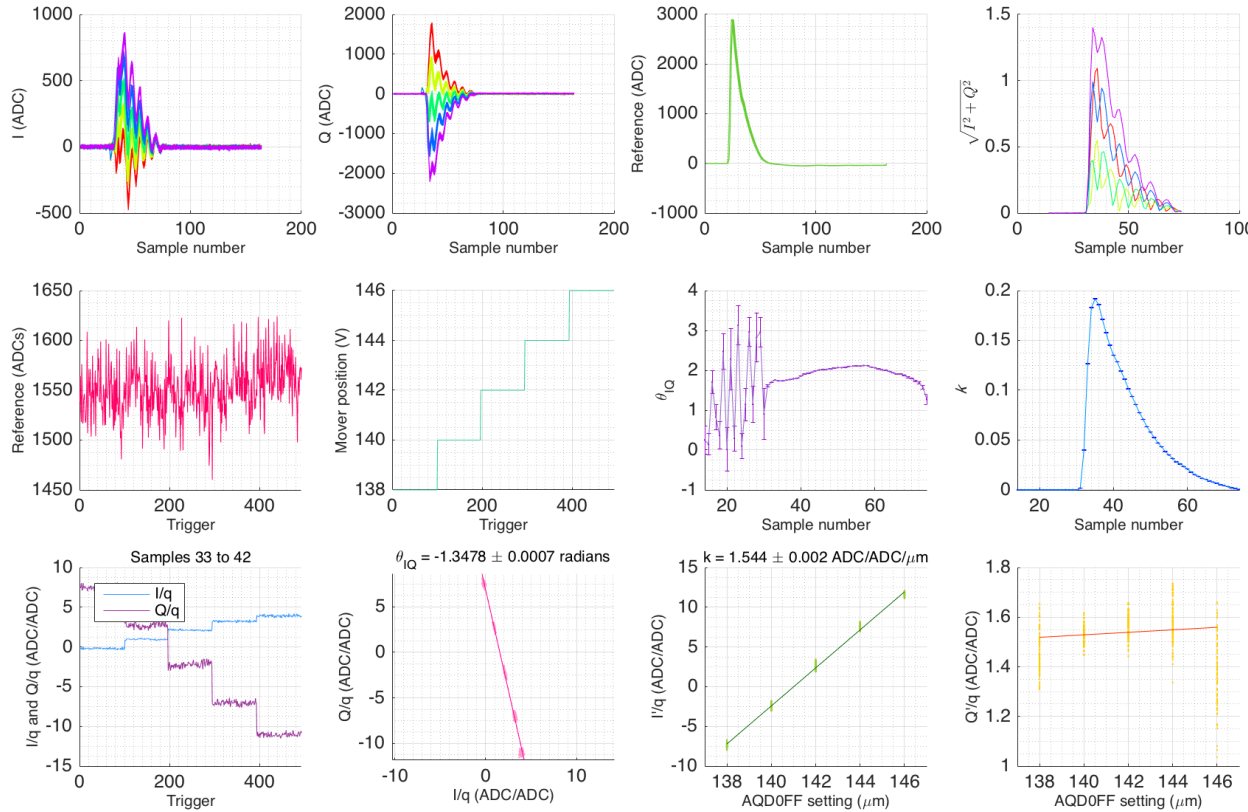
CUTS
Saturated samples: 1
Reference threshold cuts: 0
3-sigma reference cuts: 2
Total triggers cut: 3
Triggers remaining: 497

CALIBRATION
Samples 33 to 42
Integration
Reference sample number: 32
IQ rotation angle θ : 1.430 ± 0.001 radians
Scale factor k : 2.102 ± 0.009 ADC/ADC/μm

Study 2: Calibrations

jitRun8: 20nm (AQD0FFScan9)

IPBPM Calibration



AQD0FFyScan9_10dB_
{138:146}um_Board1_260517

IPCY

Number of triggers: 500
 Number of samples: 164
 IPBPM analysed: CY
 Waveform starts at sample: 34
 Reference maximum at sample: 25
 IQ amplitude maximum at sample: 36

CHARGE
 1550 ± 1 ADCs

MOVERS
 Number of steps: 5
 Triggers per step:
 100 100 100 100 100
 Steps used: 1: 5

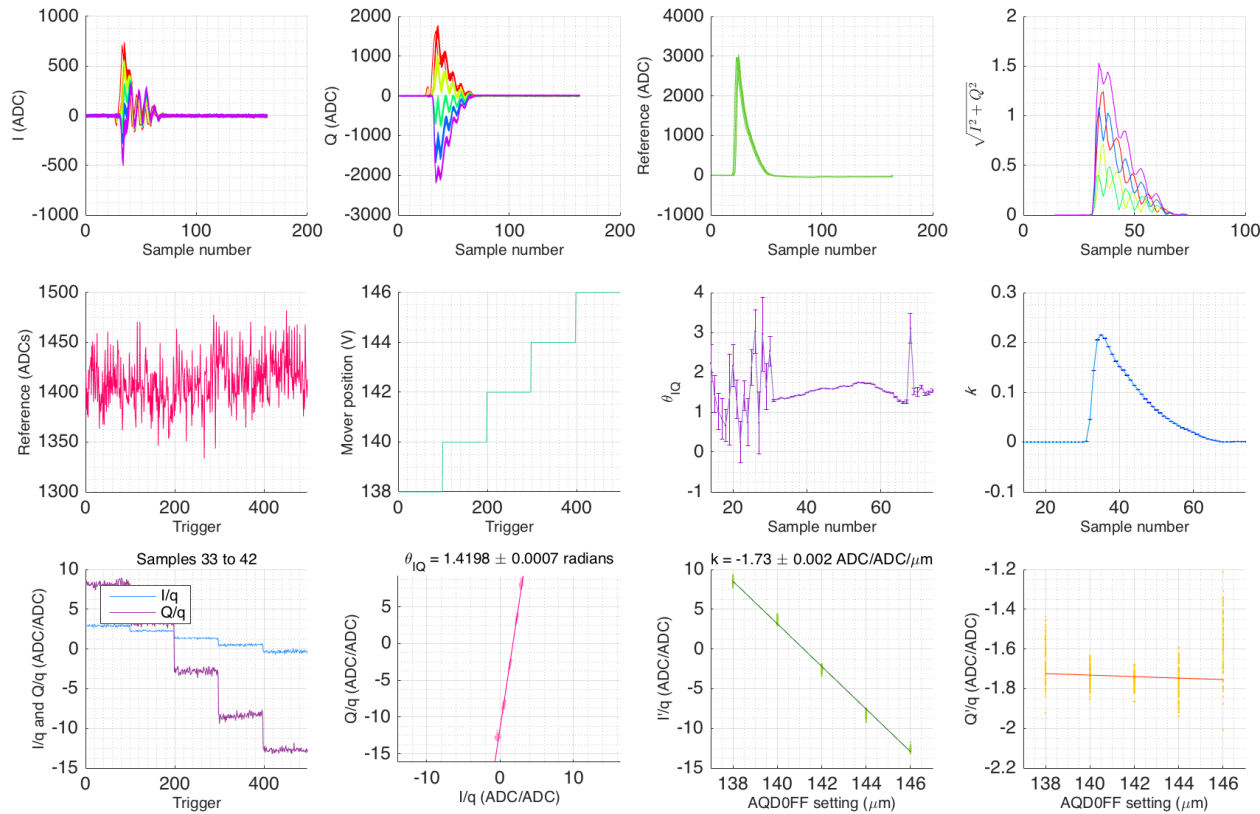
CUTS
 Saturated samples: 0
 Reference threshold cuts: 0
 3-sigma reference cuts: 7
 Total triggers cut: 7
 Triggers remaining: 493

CALIBRATION
 Samples 33 to 42
 Integration
 Reference sample number: 32
 IQ rotation angle θ : -1.3478 ± 0.0007 radians
 Scale factor k : 1.544 ± 0.002 ADC/ADC/ μm

Study 2: Calibrations

jitRun9: 40nm (AQD0FFScan10)

IPBPM Calibration



AQD0FFyScan10_10dB_
{138:146}um_Board1_260517

IPCY

Number of triggers: 500
Number of samples: 164
IPBPM analysed: CY
Waveform starts at sample: 34
Reference maximum at sample: 25
IQ amplitude maximum at sample: 36

CHARGE
 1410 ± 1 ADCs

MOVERS
Number of steps: 5
Triggers per step:
100 100 100 100 100
Steps used: 1: 5

CUTS
Saturated samples: 0
Reference threshold cuts: 0
3-sigma reference cuts: 3
Total triggers cut: 3
Triggers remaining: 497

CALIBRATION
Samples 33 to 42
Integration
Reference sample number: 32
IQ rotation angle θ : 1.4198 ± 0.0007 radians
Scale factor k : -1.73 ± 0.002 ADC/ADC/ μm