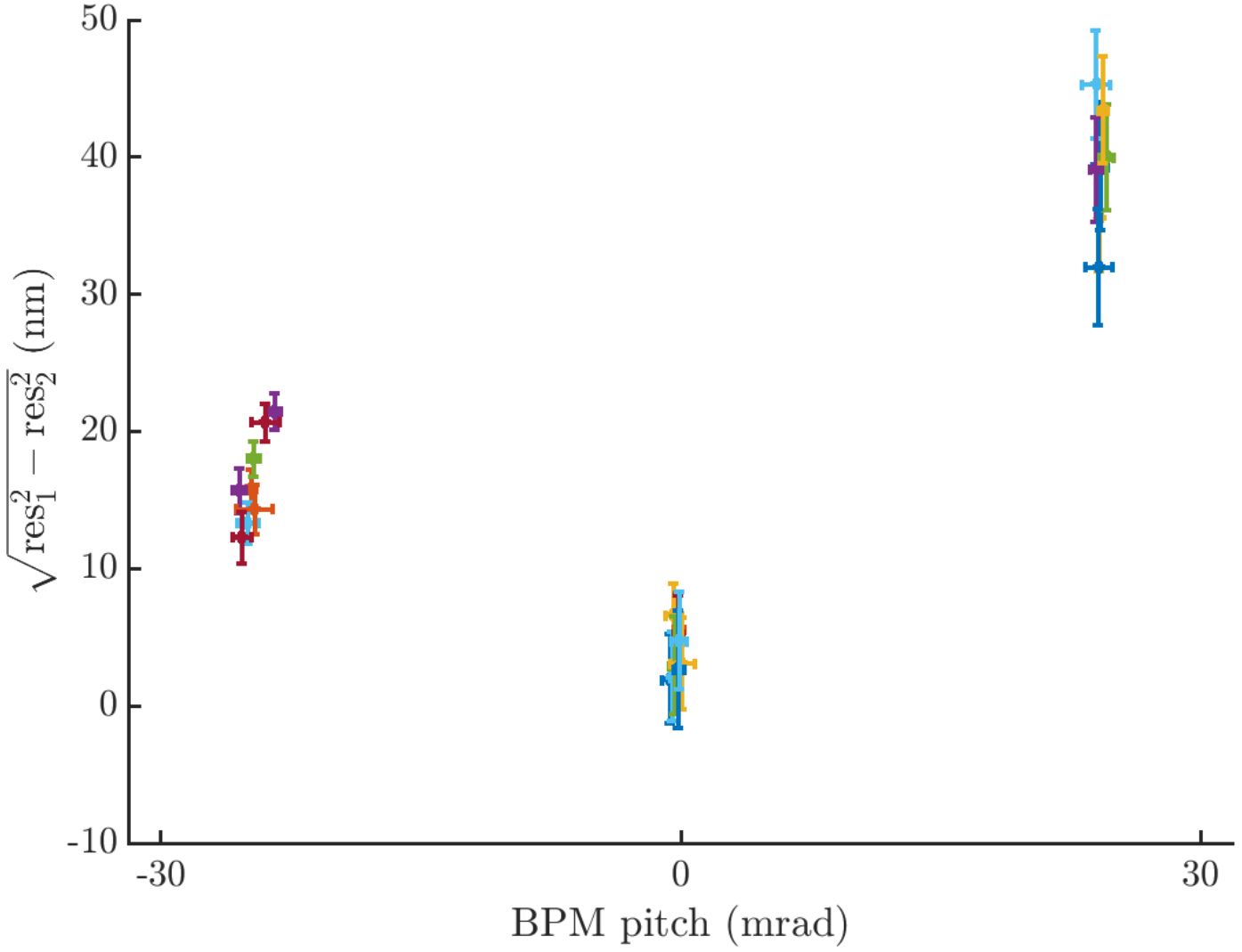
ATF2 June Shifts 3

R. Ramjiawan

Friday, 13th July 2018

Follow up from last meeting

Improvement from adding limiter phase



- Difference from last presentation: resolution terms are squared and summed and the pitch is in mrad not ADC counts.
- Fitting to position compared with fitting to position and limiter phase.
  Res1=fitting to position.
- Res2=fitting to position and limiter phase. As expected from:

$$y = \frac{I'}{q} + \frac{Q'}{q} \times \delta\theta_{IQ}$$

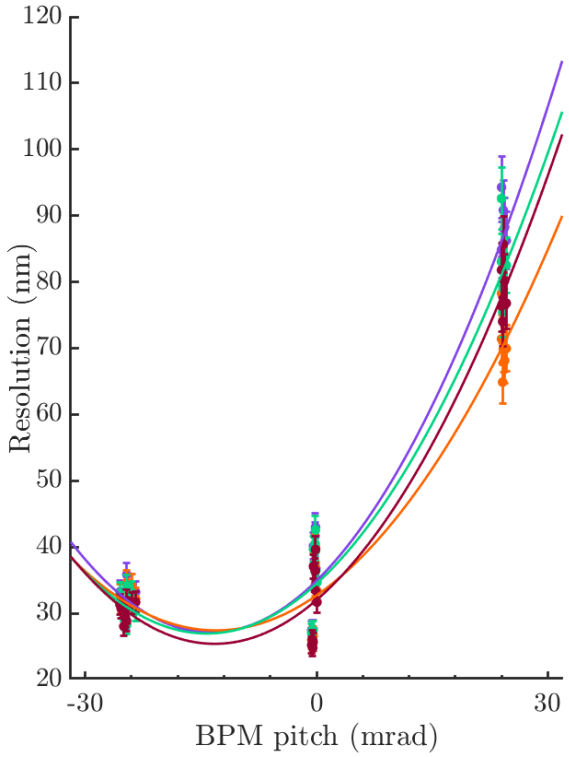
Error on the resolution

Covariance of the two vectors of residuals

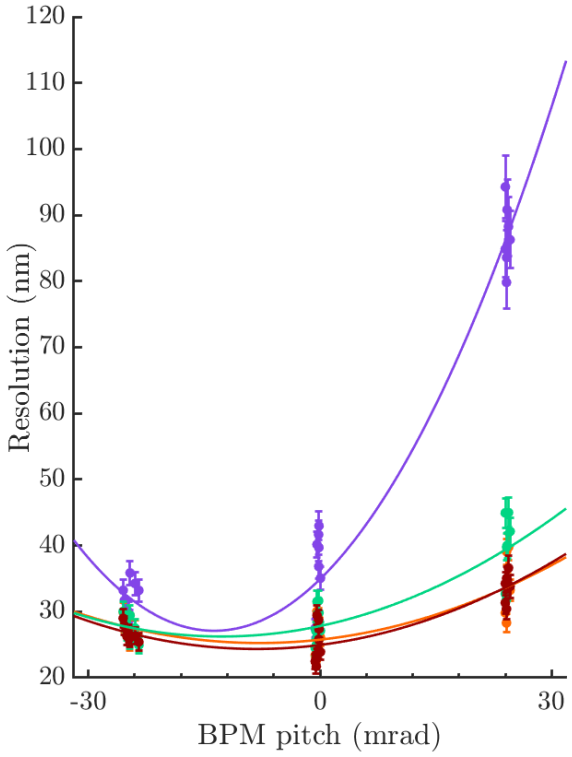
$$\sigma_f \approx |f| \sqrt{\left(\frac{\sigma_A}{A}\right)^2 + \left(\frac{\sigma_B}{B}\right)^2 - 2\frac{\sigma_{AB}}{AB}}$$

Fitted resolution with limiter phase

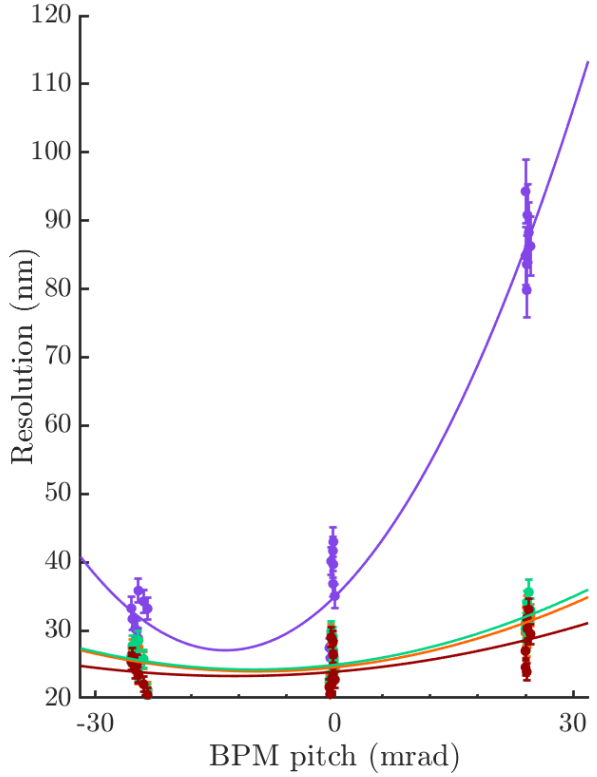
Geometric resolution and fitting to I’/q



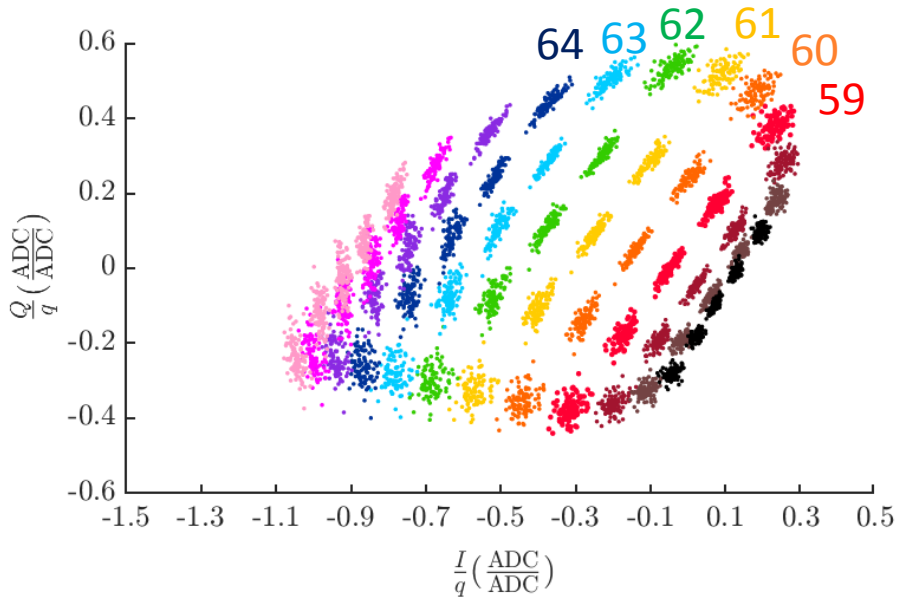
Geometric resolution and fitting to I’/q, Q’/q



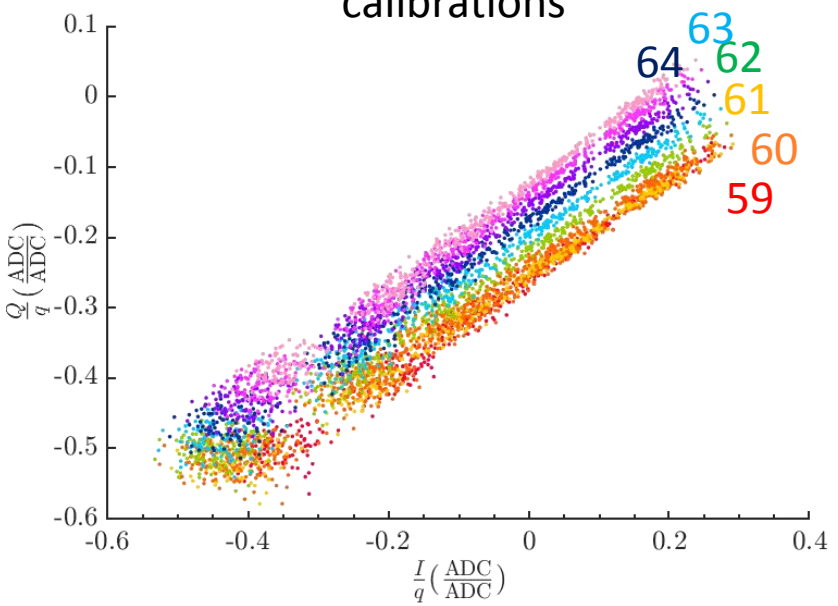
Geometric resolution and fitting to I’/q, Q’/q, limiter phase.



Single sample calibrations

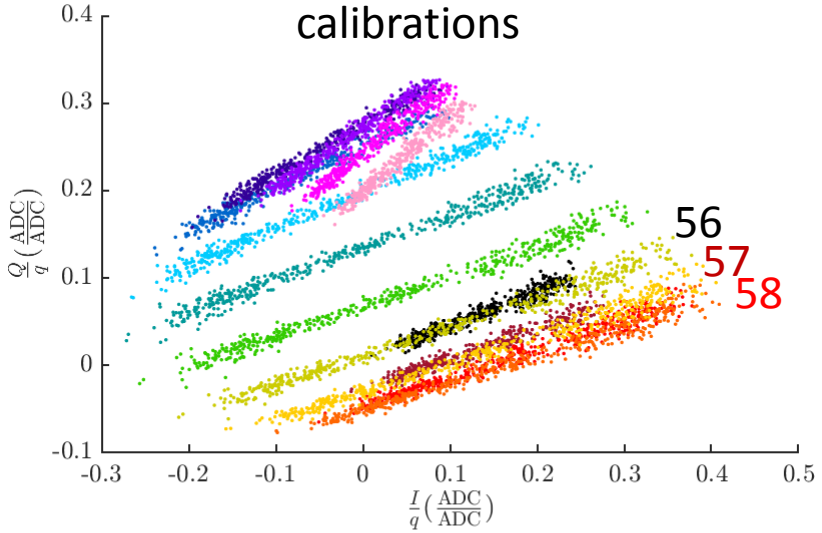


Integrated sample calibrations

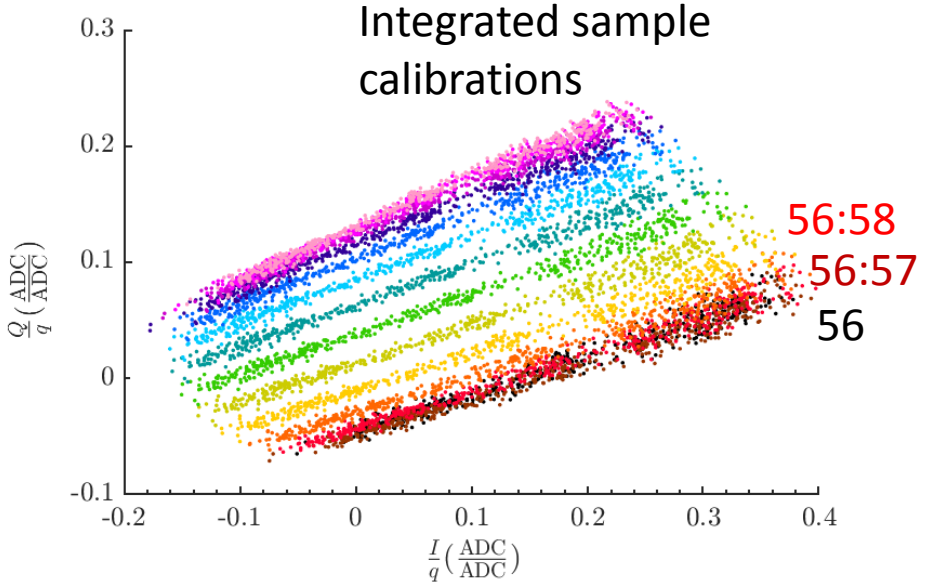


AQD0FFyScan4 15/06/18
Where 6 sample integration is optimal.
Samples 59:64
June 2018

Single sample calibrations



Integrated sample calibrations

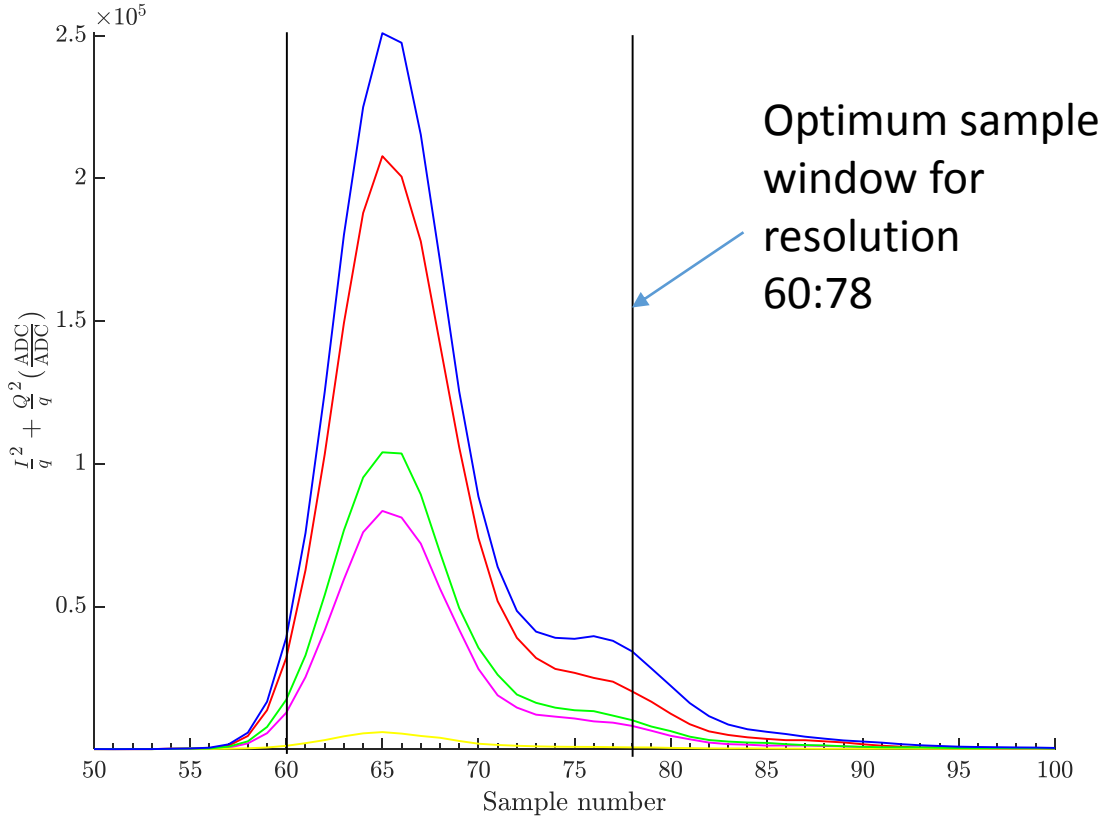


IPyCal1 19/04/18
Where 12 sample integration is optimal.
Samples 56:68
APRIL 2018

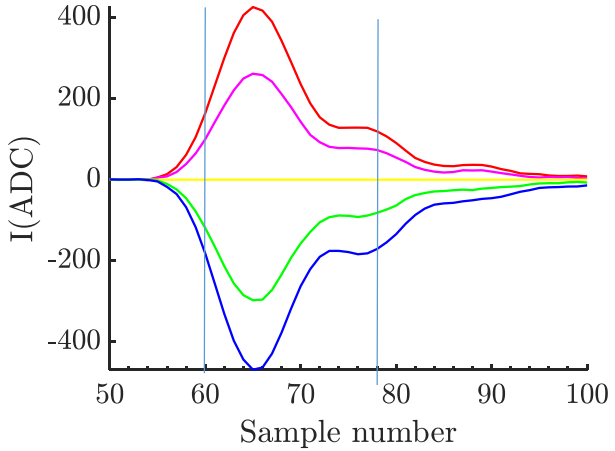
Waveforms (I^2+Q^2, I, Q)

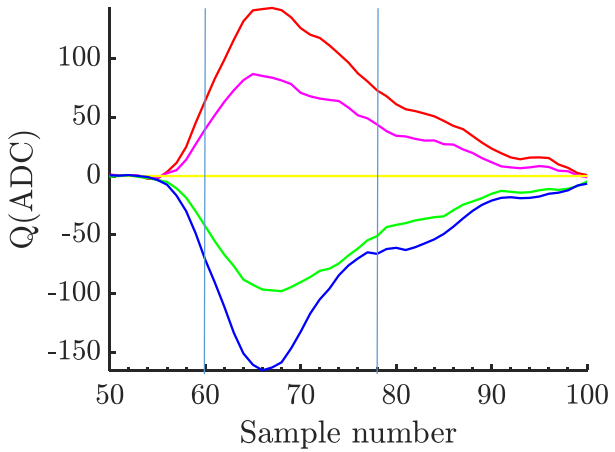
19/04/2018 – IPyCal1-10dB

- Mean waveforms with subtraction of central mover setting (yellow).
- From a day when the optimum resolution was achieved by integrating 19 samples and not significantly degraded by integrating more than that.



Optimum sample window for resolution 60:78





Phase changed between calibrations

JUNE WAVEFORMS

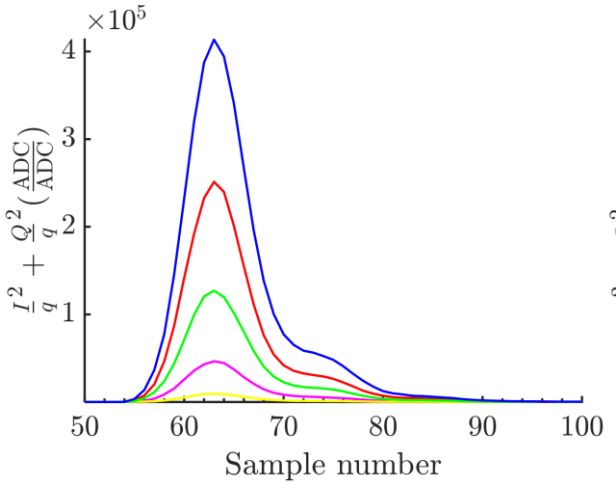
AQD0FF_41: charge upstream (sample 80) = 1142

AQD0FF_44: charge upstream (sample 80) = 1172

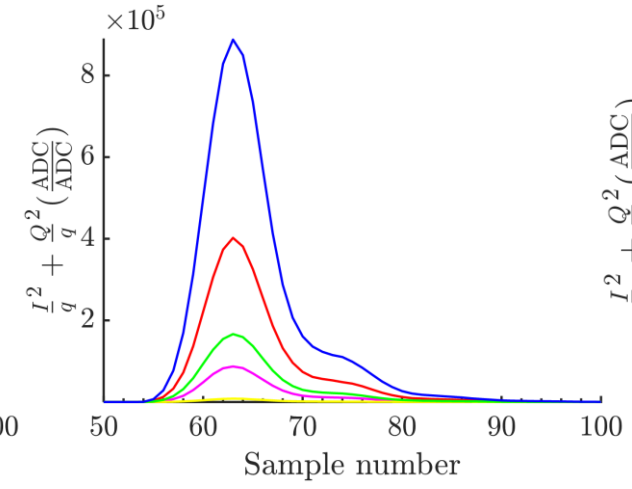
All at 10dB

Mean subtracted with yellow line as mean and centre setting of calibration.

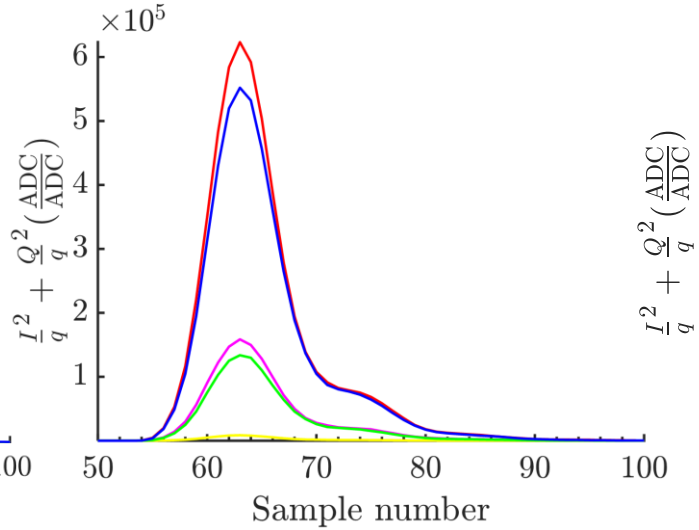
AQ44



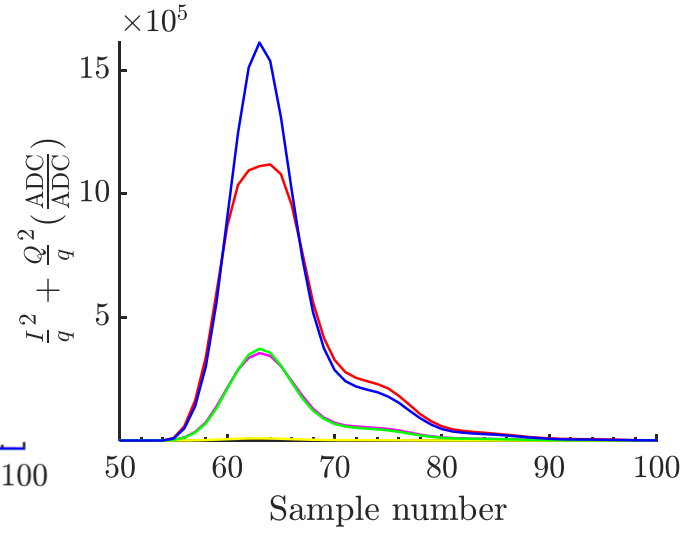
AQ43



AQ42

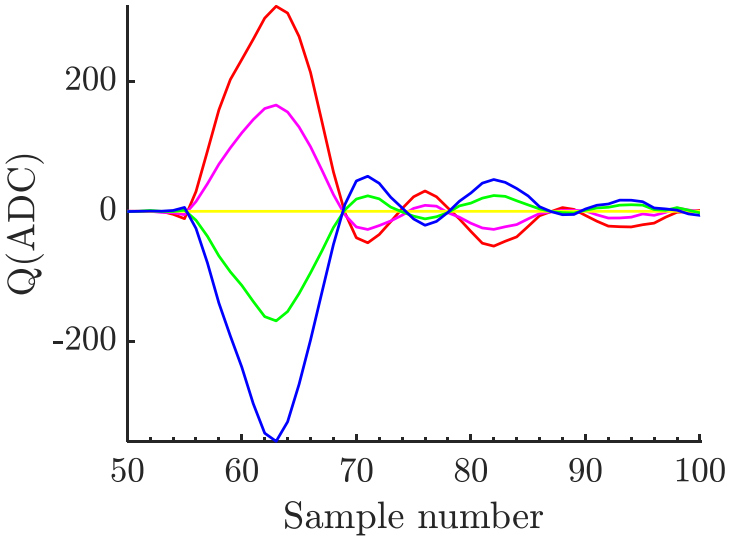


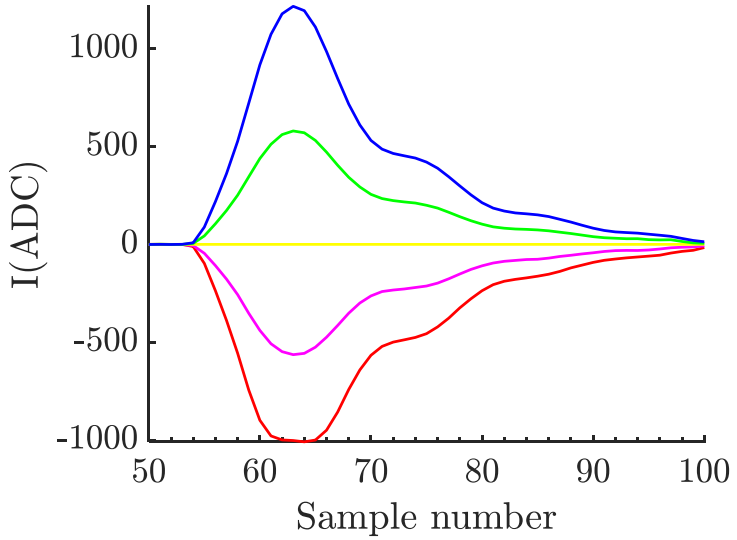
AQ41

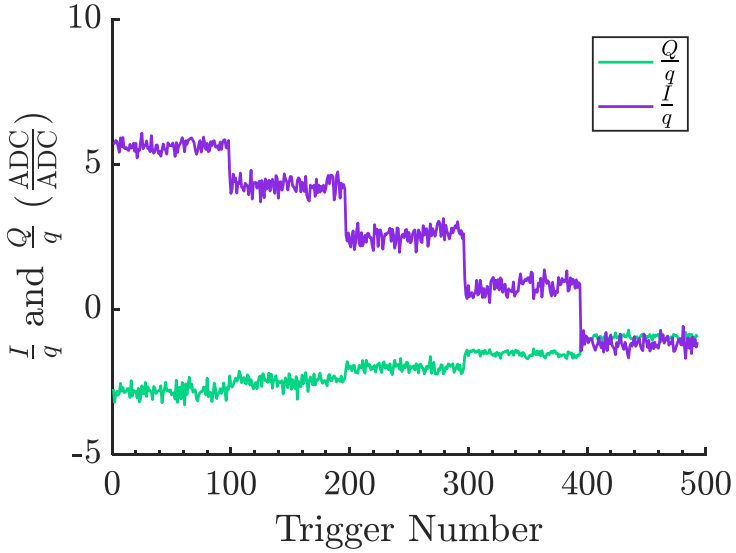


AQD0FF 41 (IPC)

This calibration is phased such that the position signal is almost entirely in the I signal.

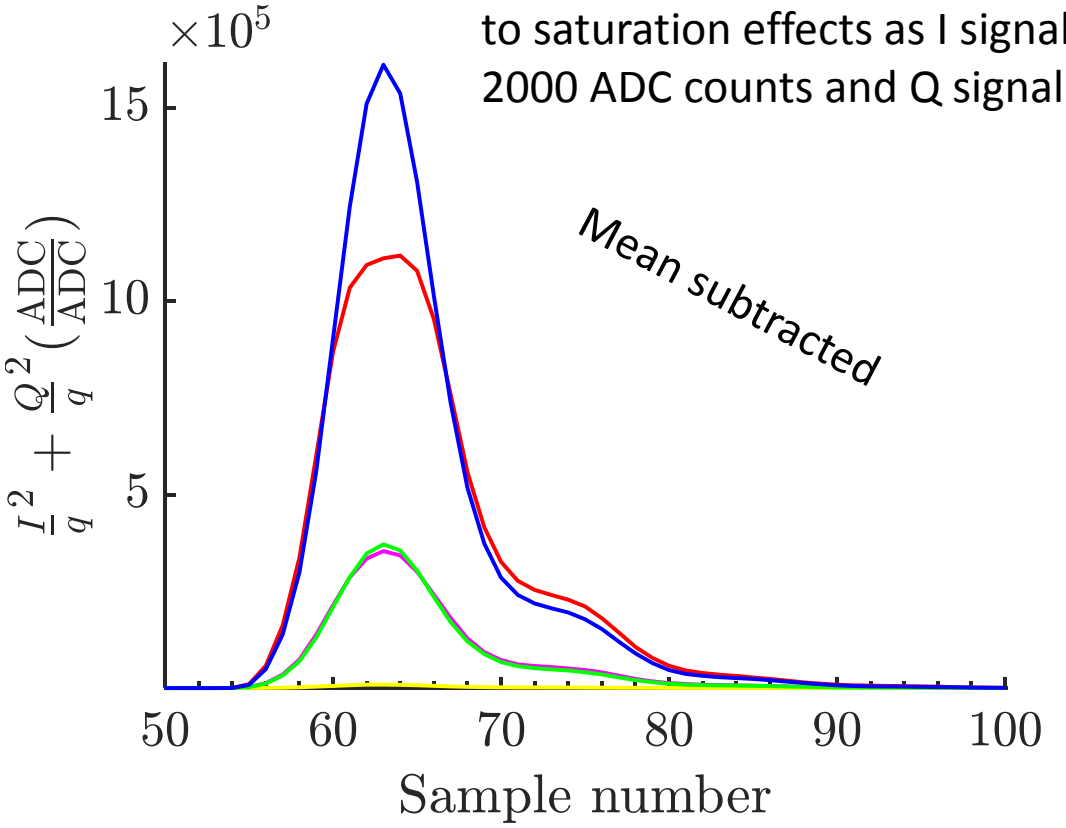


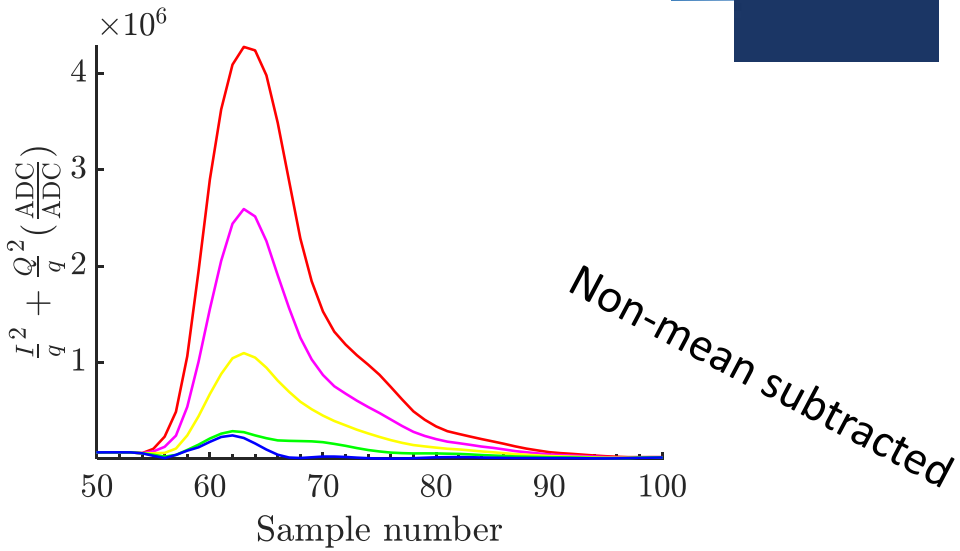


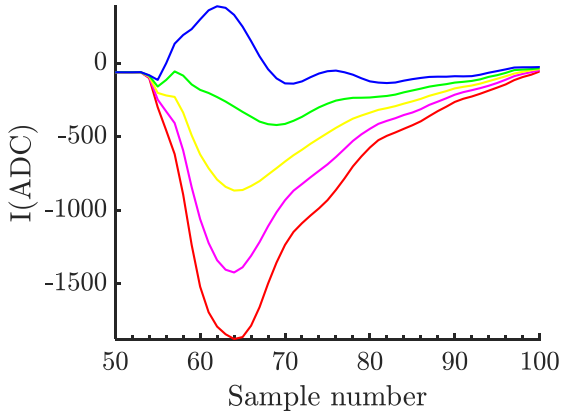


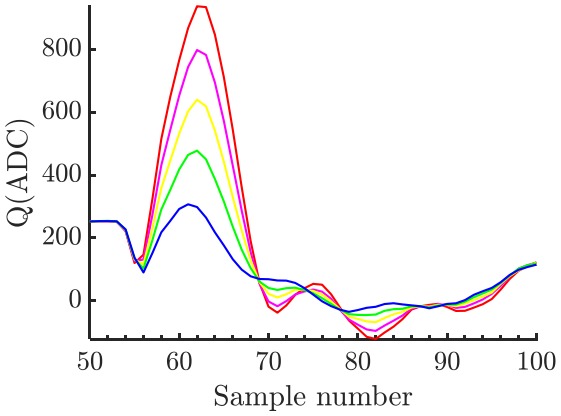
Asymmetric calibration (IPC) (AQD0FF 41)

Asymmetric calibration – particularly visible when subtracting the mean waveform for the central setting of the calibration. Possibly due to saturation effects as I signal approaches 2000 ADC counts and Q signal also large?

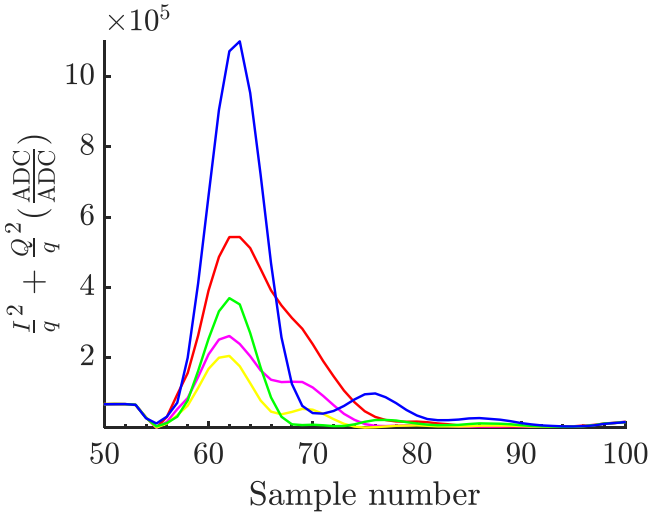


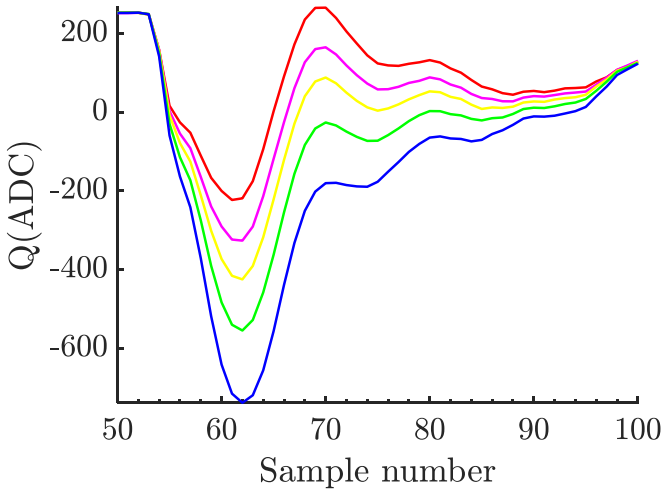


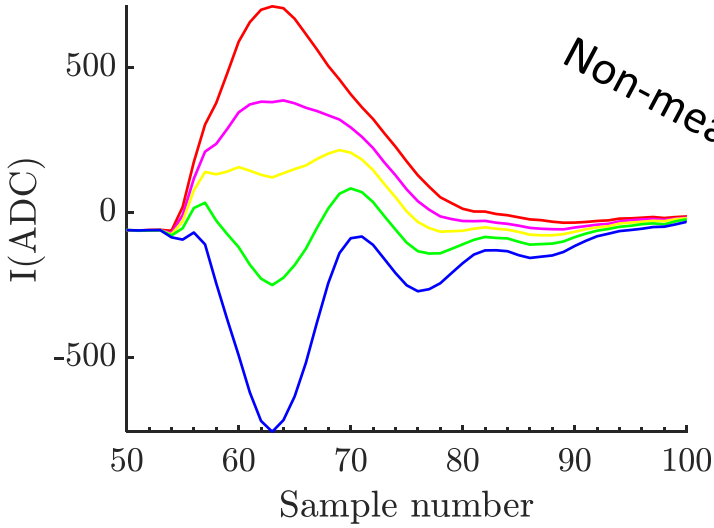




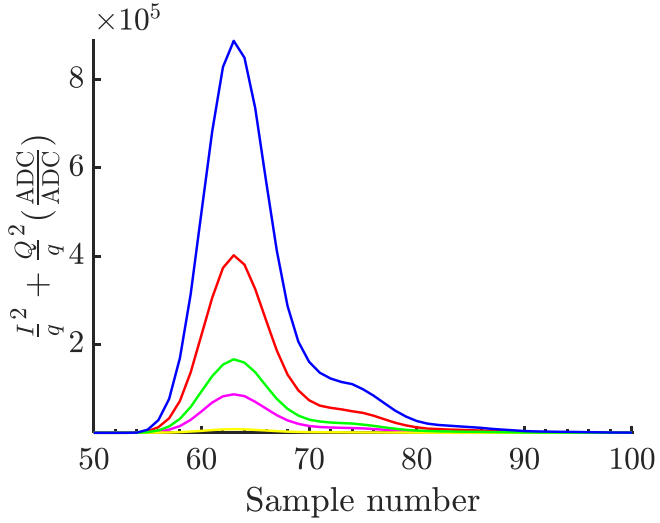
AQD0FFyScan 43

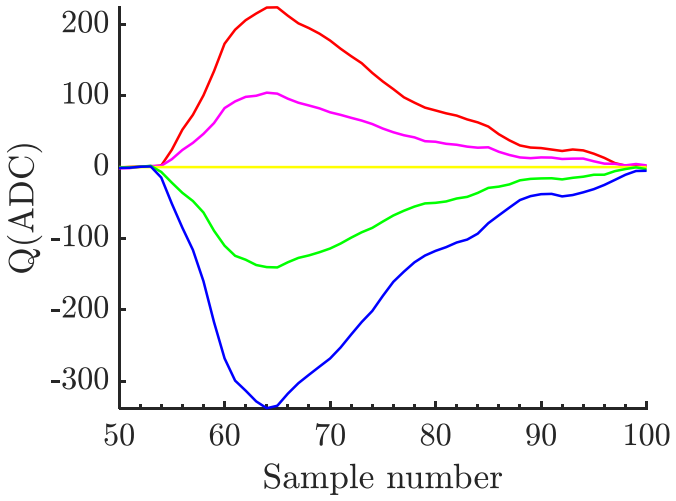


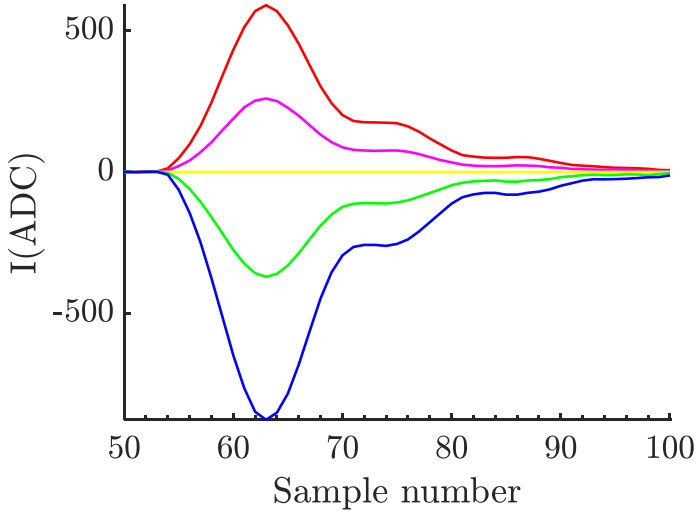




Non-mean subtracted



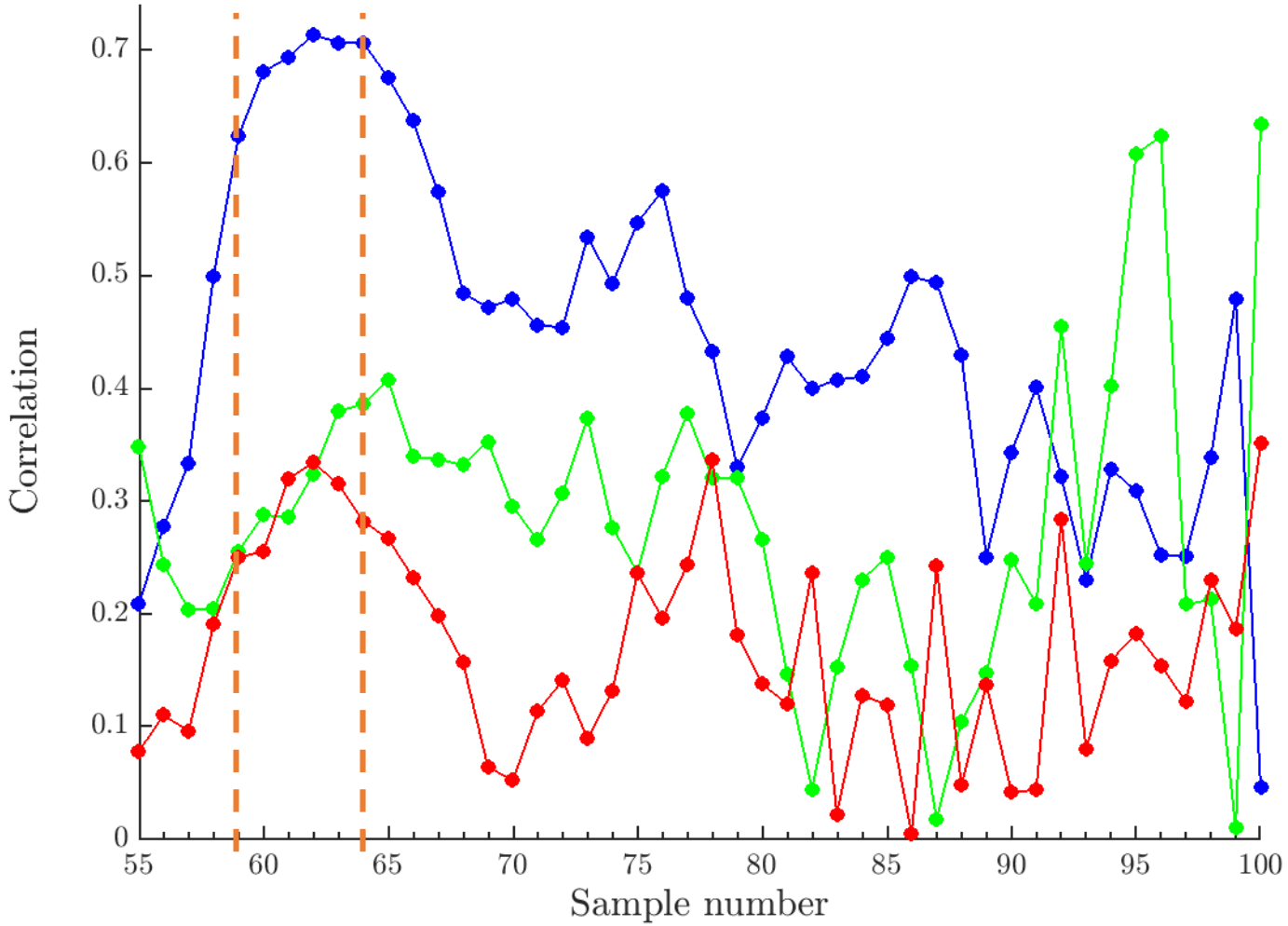




Mean subtracted

Study of why 5 or 6 sample integration is optimal

Correlation between position signals



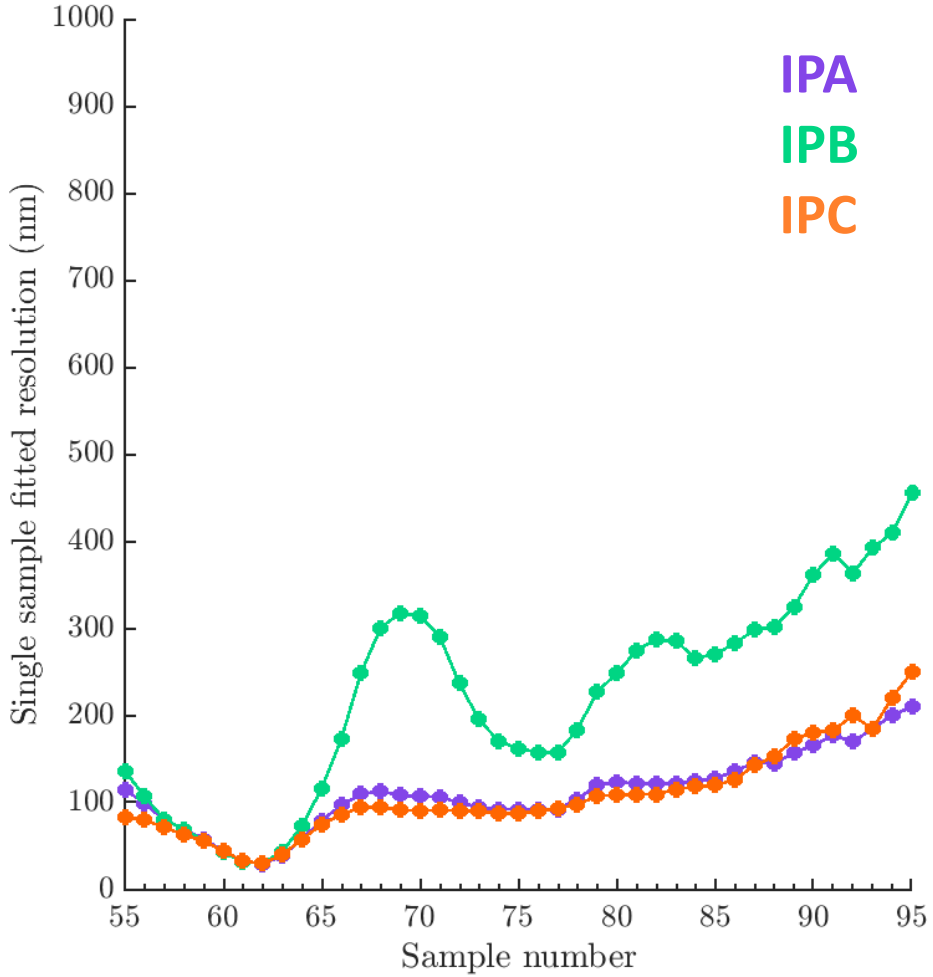
Optimum samples for resolution are 59:64

Correlation between IPA and IPB
Correlation between IPA and IPC
Correlation between IPB and IPC

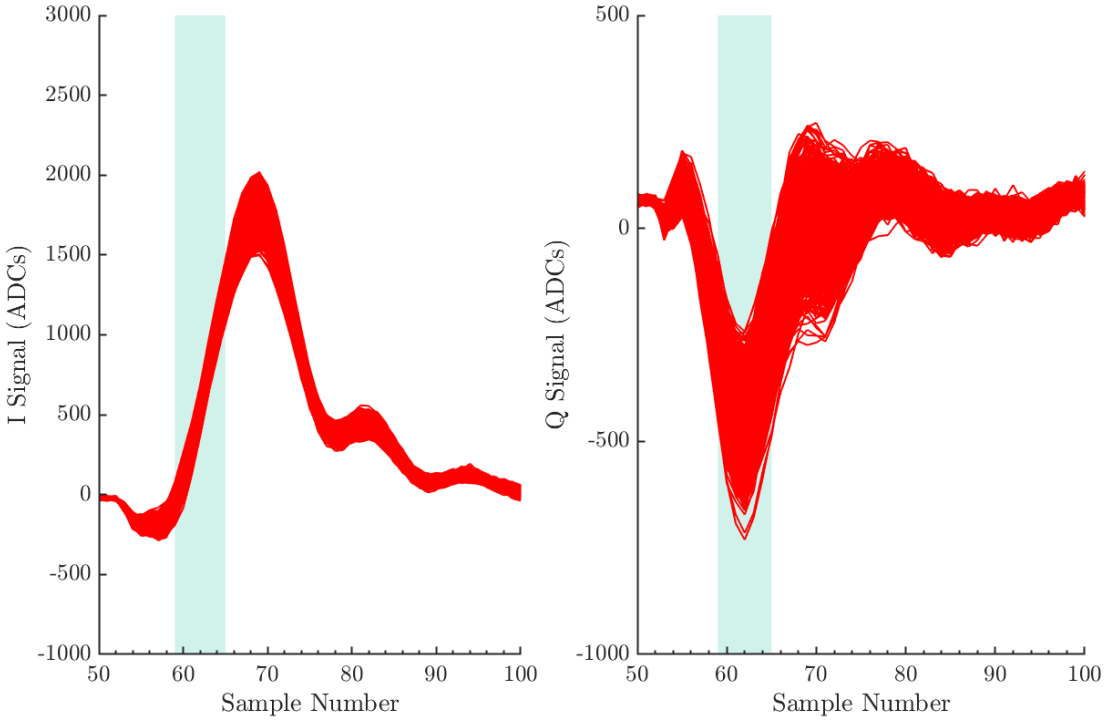
Charge: 0.6e10.
Ref att: 40dB
Dip att: 10dB

Both the correlations involving IPB drop after samples 62-64.

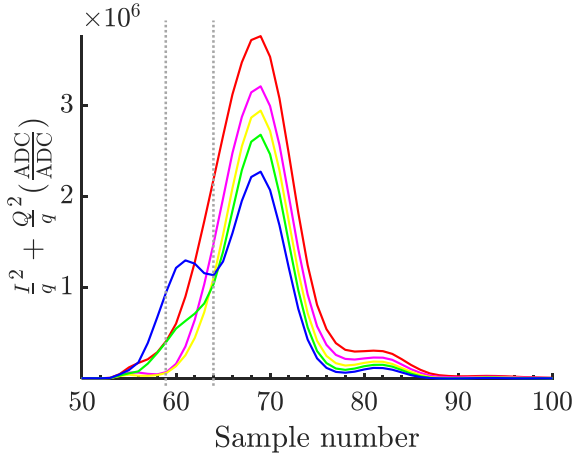
Single Sample Resolution

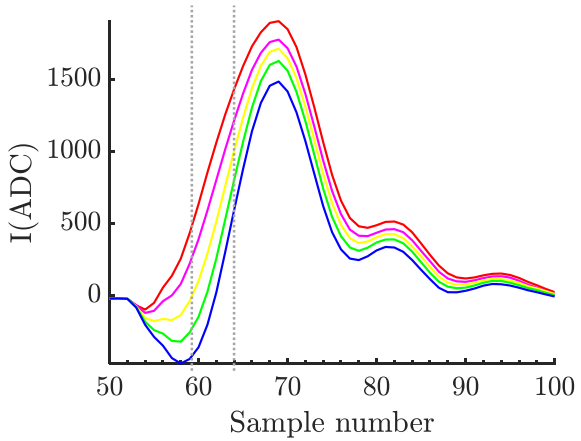


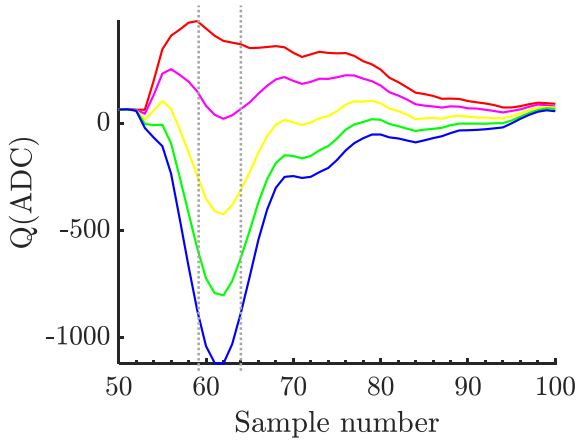
IPB waveforms with samples 59:64 highlighted.
N.B IPB(I) was the signal that we were unable to minimise using the quad movers or BPM movers.



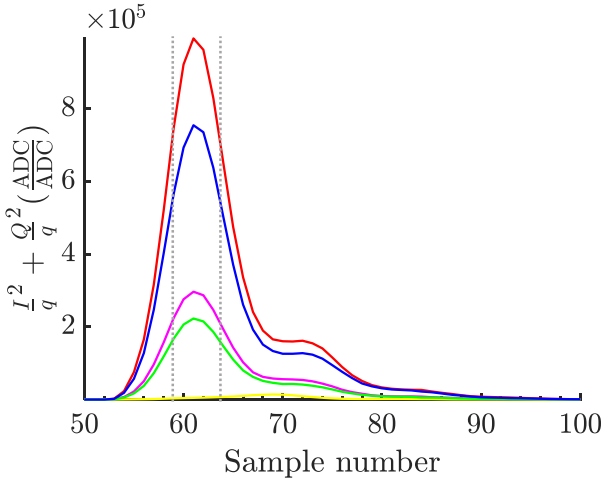
IPB – jitRun7

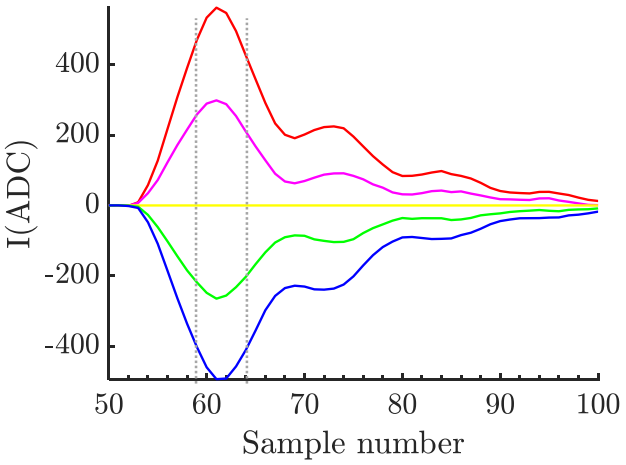


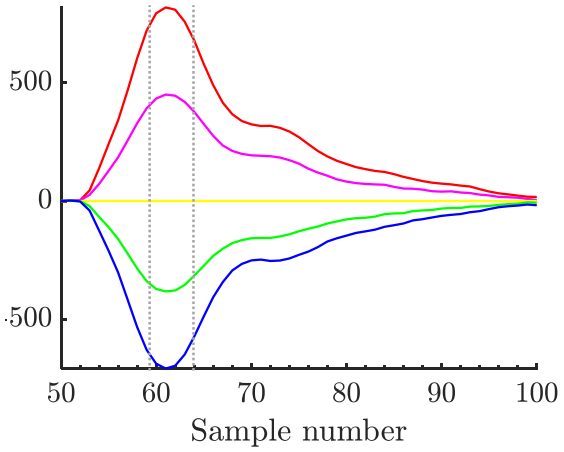




Non-mean subtracted



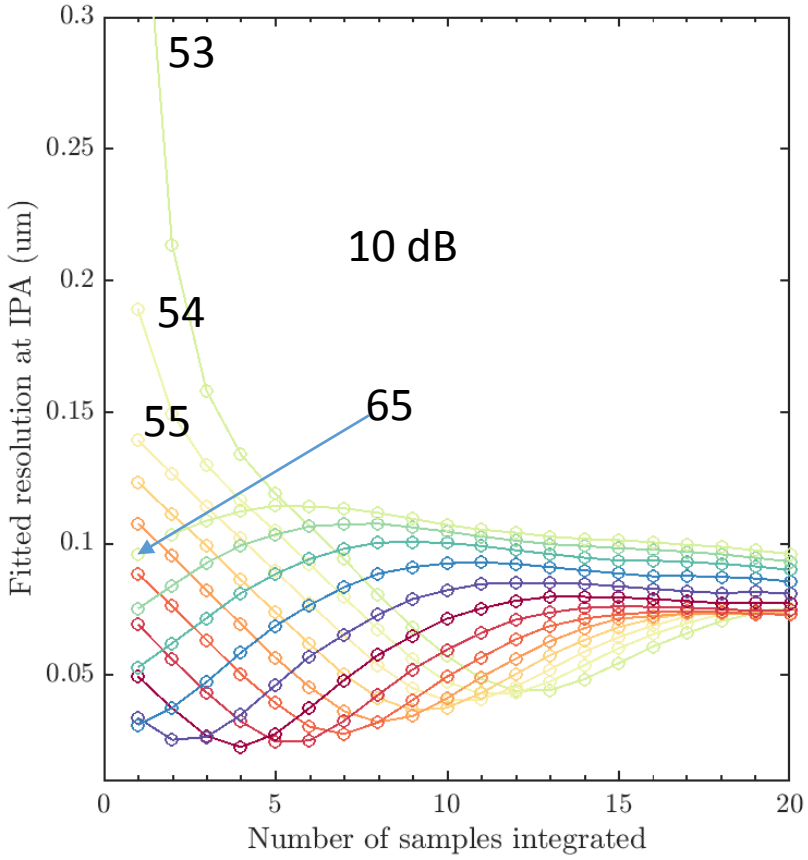


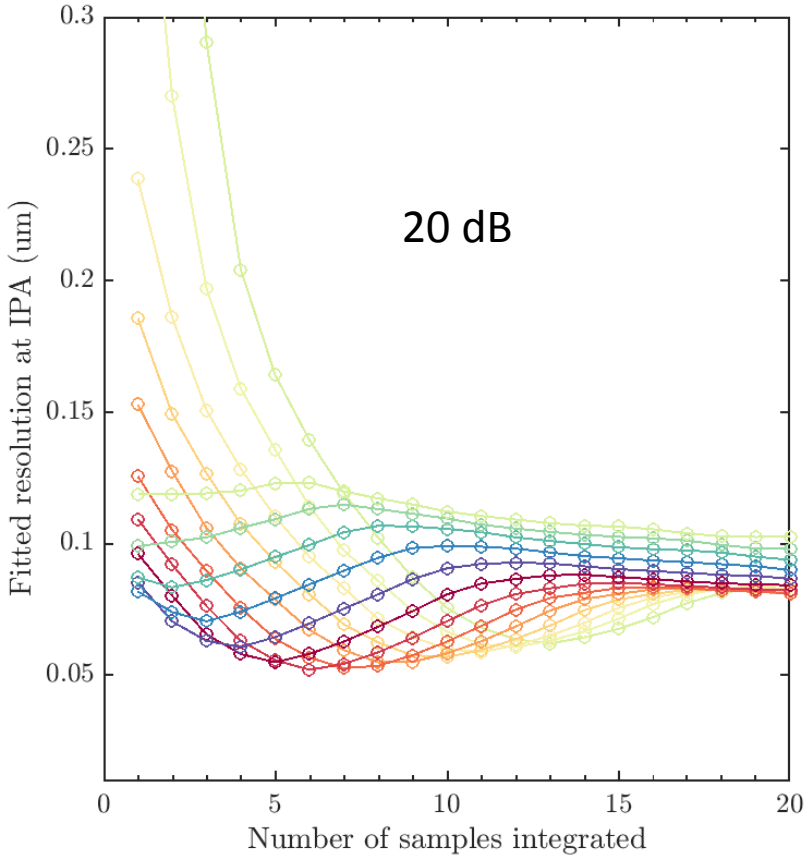


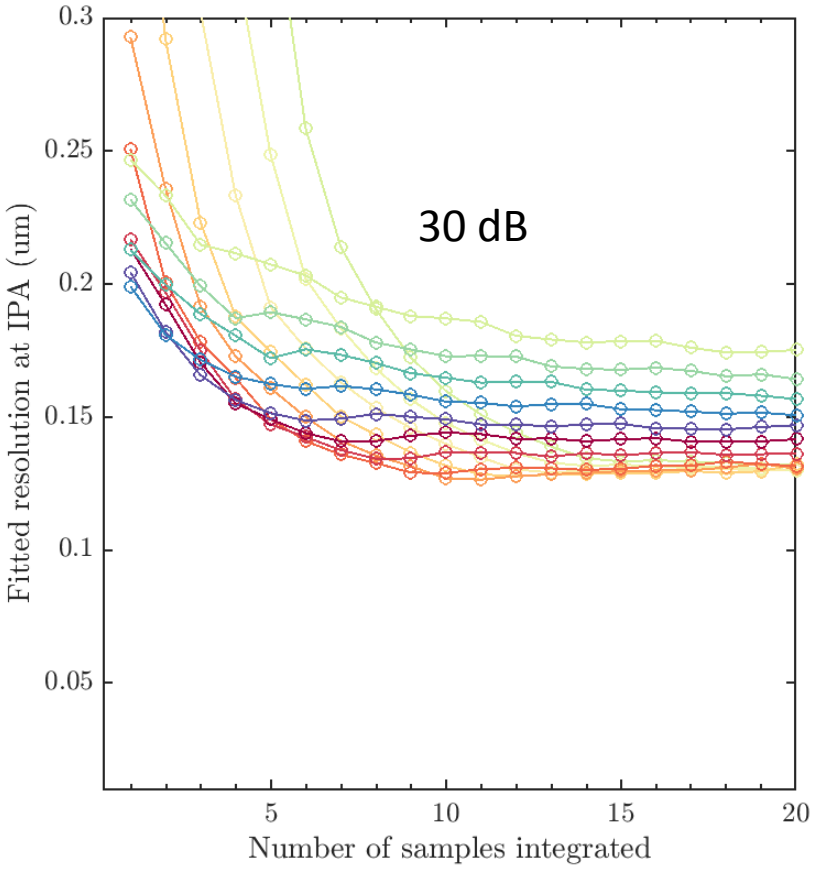
Mean subtracted

Resolution as function of number of samples integrated

Sample number at the start of window denoted by the colour with samples between 53:65.
If noise is uncorrelated between sample numbers should not degrade the resolution by integrating more sample numbers – this seems to be the case for 30dB, 40dB and 50dB. Saturation effect?

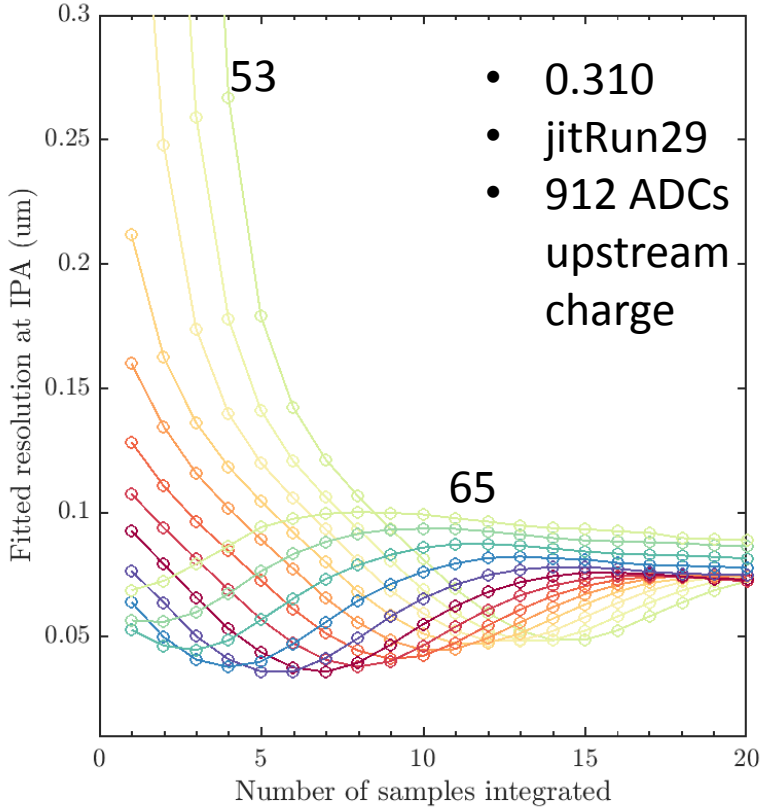


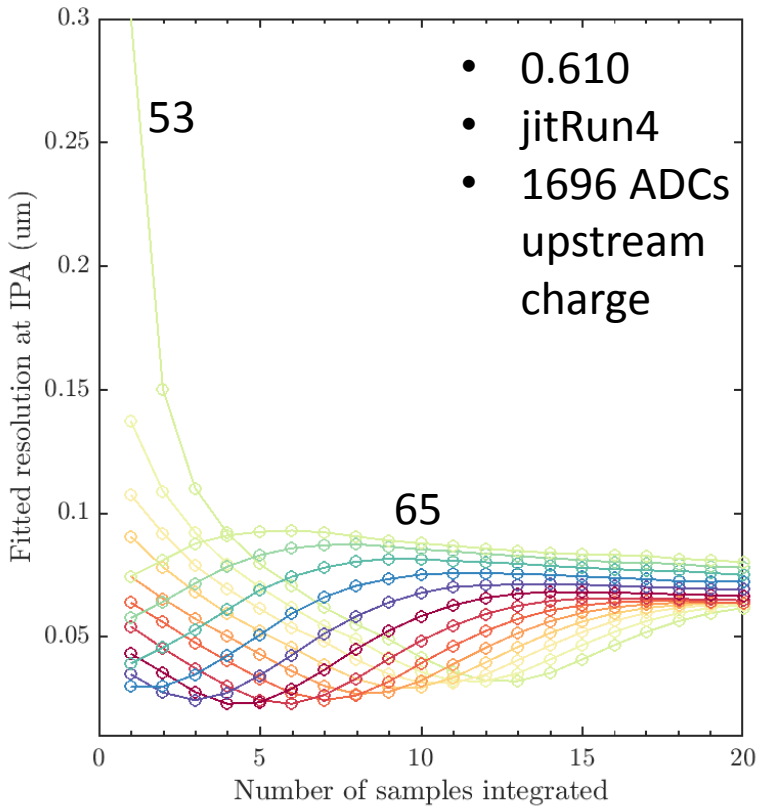


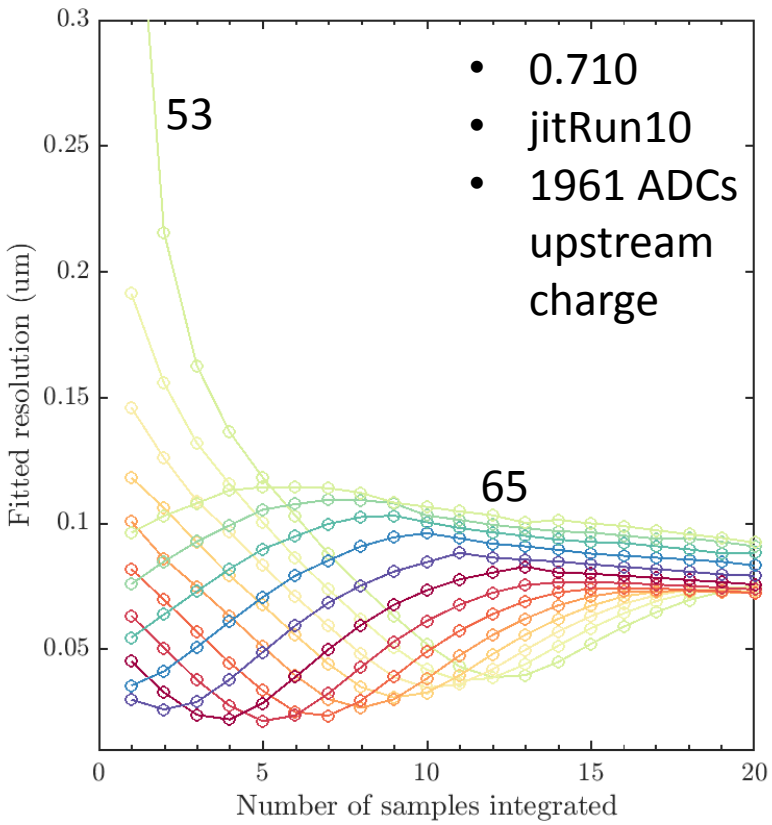


Resolution as function of number of samples integrated

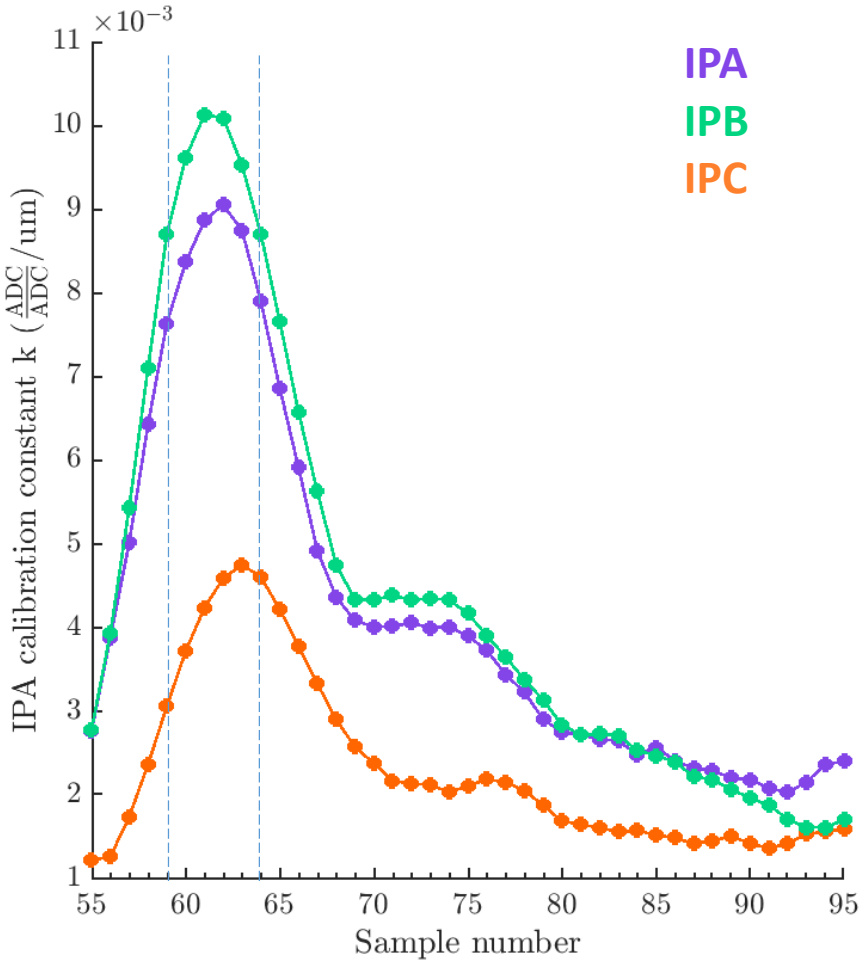
Sample number at the start of window denoted by the colour with samples between 53:65.
If noise is uncorrelated between sample numbers should not degrade the resolution by integrating more sample numbers – this seems to be more true for lower charge. Saturation effect?

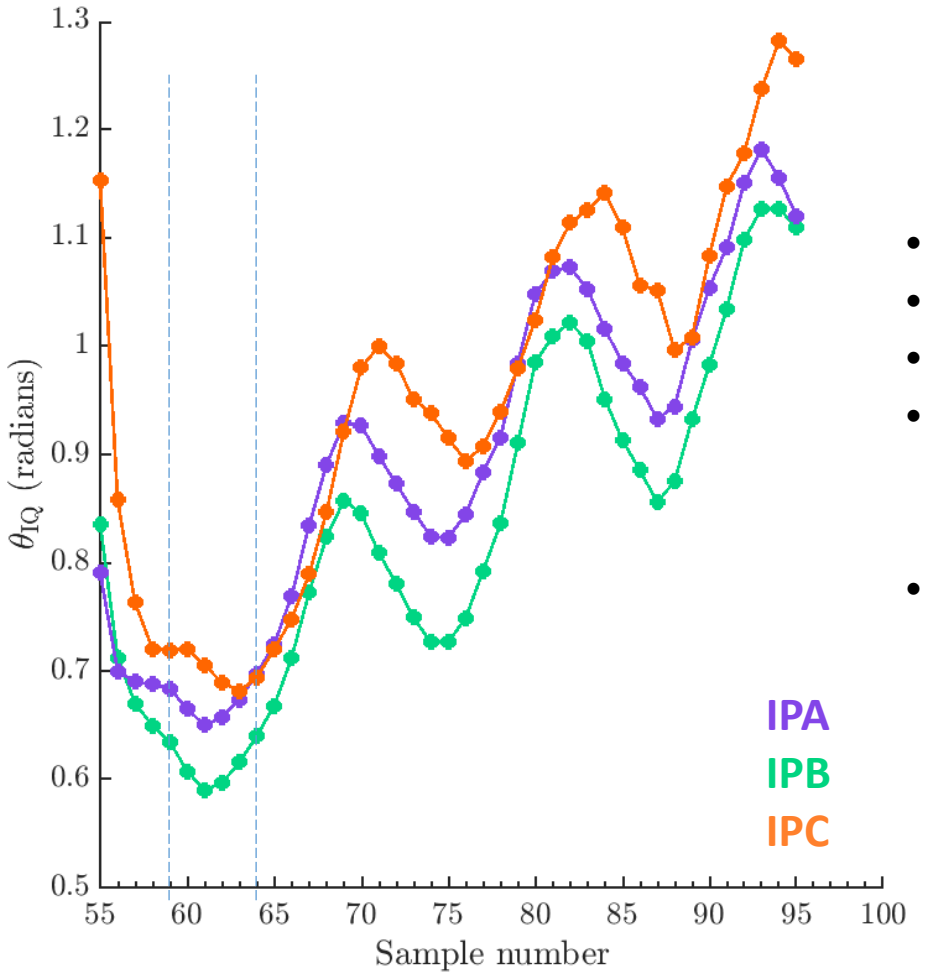






K and theta vs. sample number



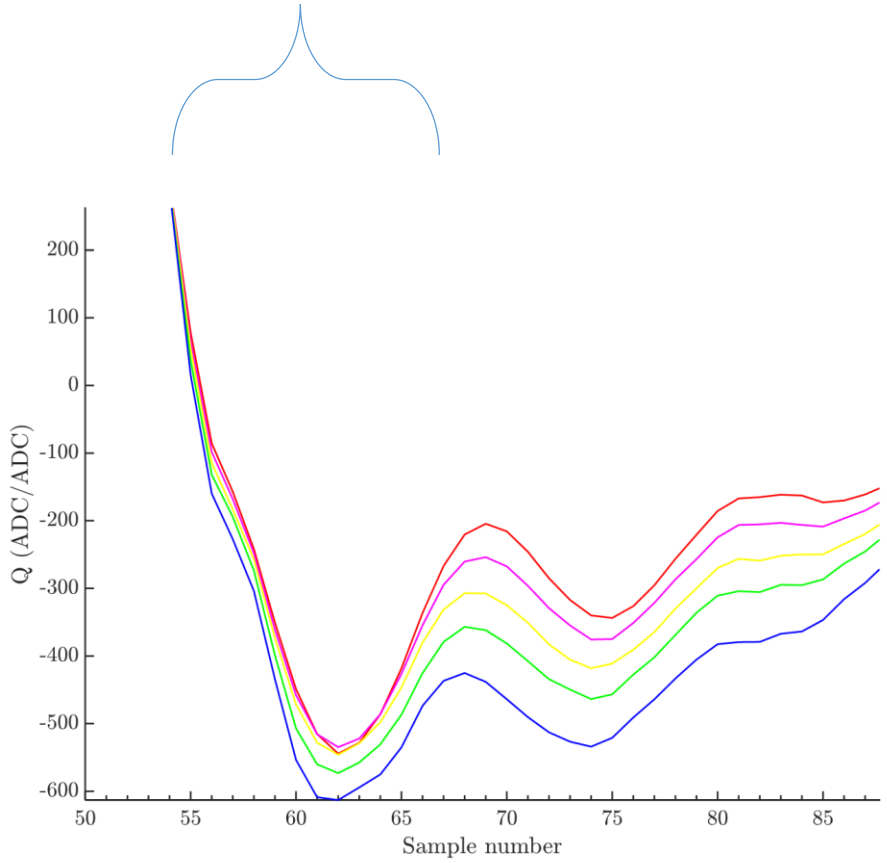


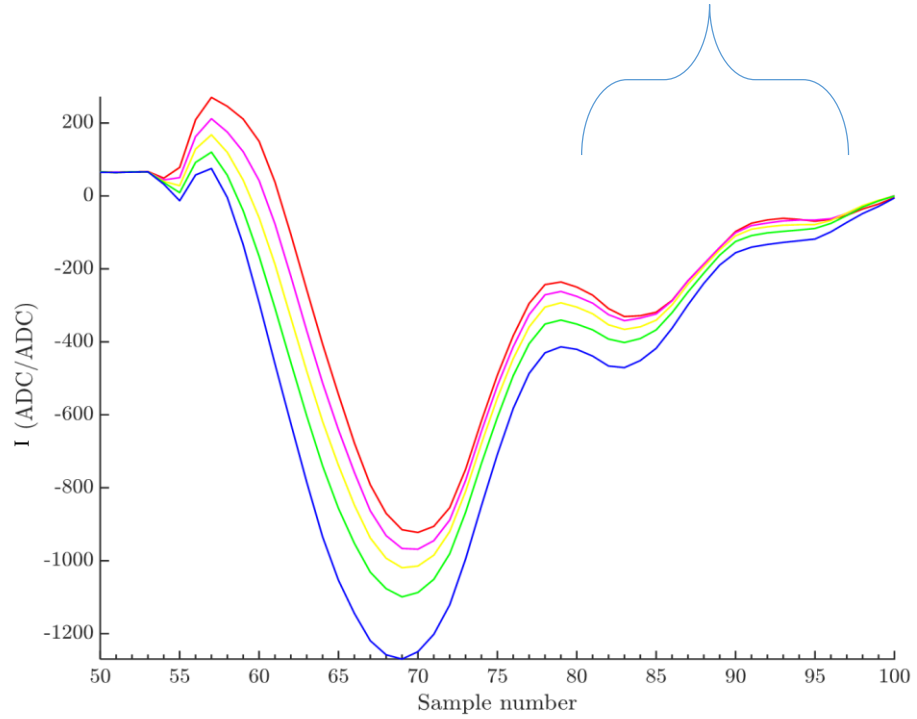
- Low: 912 ADCs
- Mid: 1696 ADCs
- High: 1961 ADCs
- All values measured as peak of upstream charge signal.
- Reference samples used: 62, 68, 70 for low, medium and high charge respectively.

Charge/attenuation studies

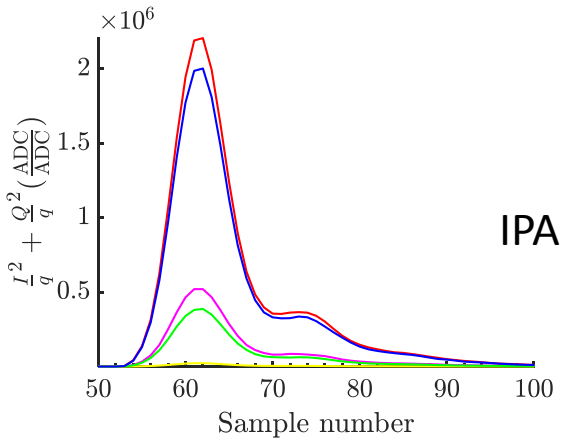
Waveforms overlapping

Red and magenta lines overlap – only seen in the regions of waveforms at low signal levels.
Suspect waveforms for calibration.

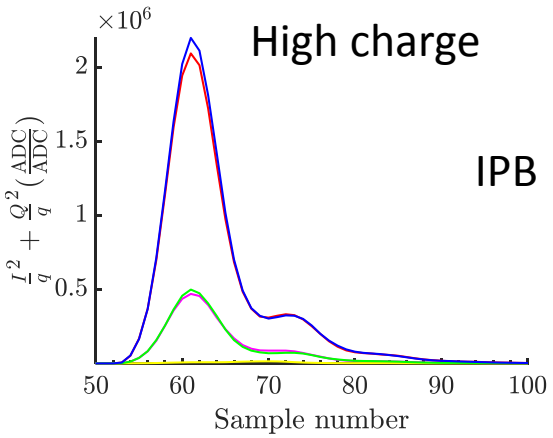




High charge vs low charge

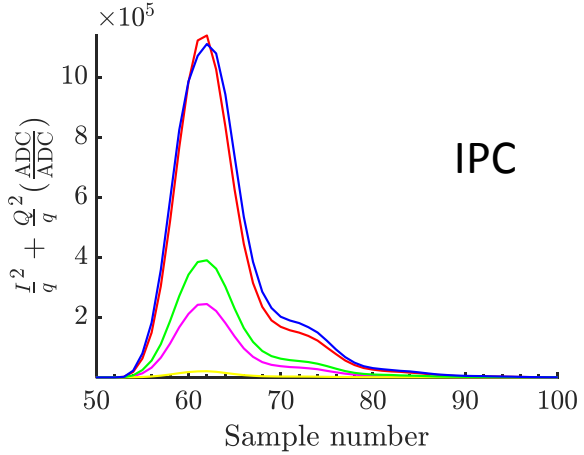


IPA

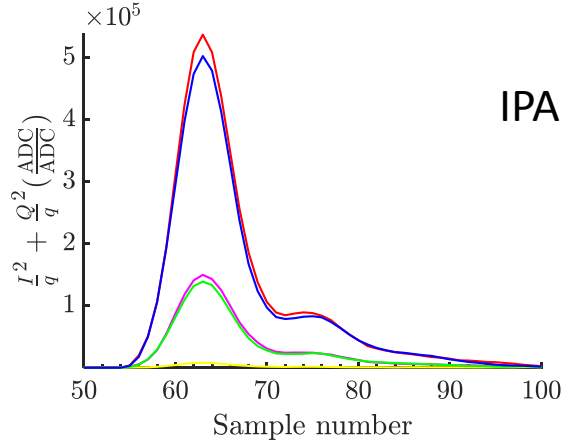


High charge

IPB

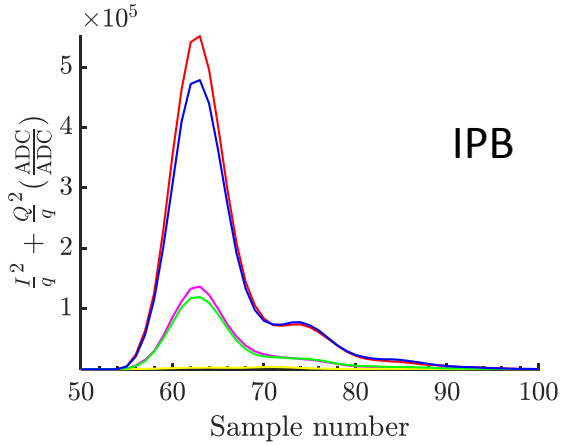


IPC

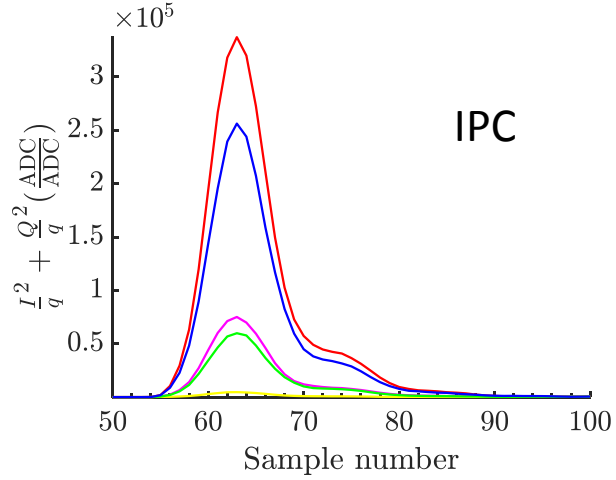


IPA

Low charge

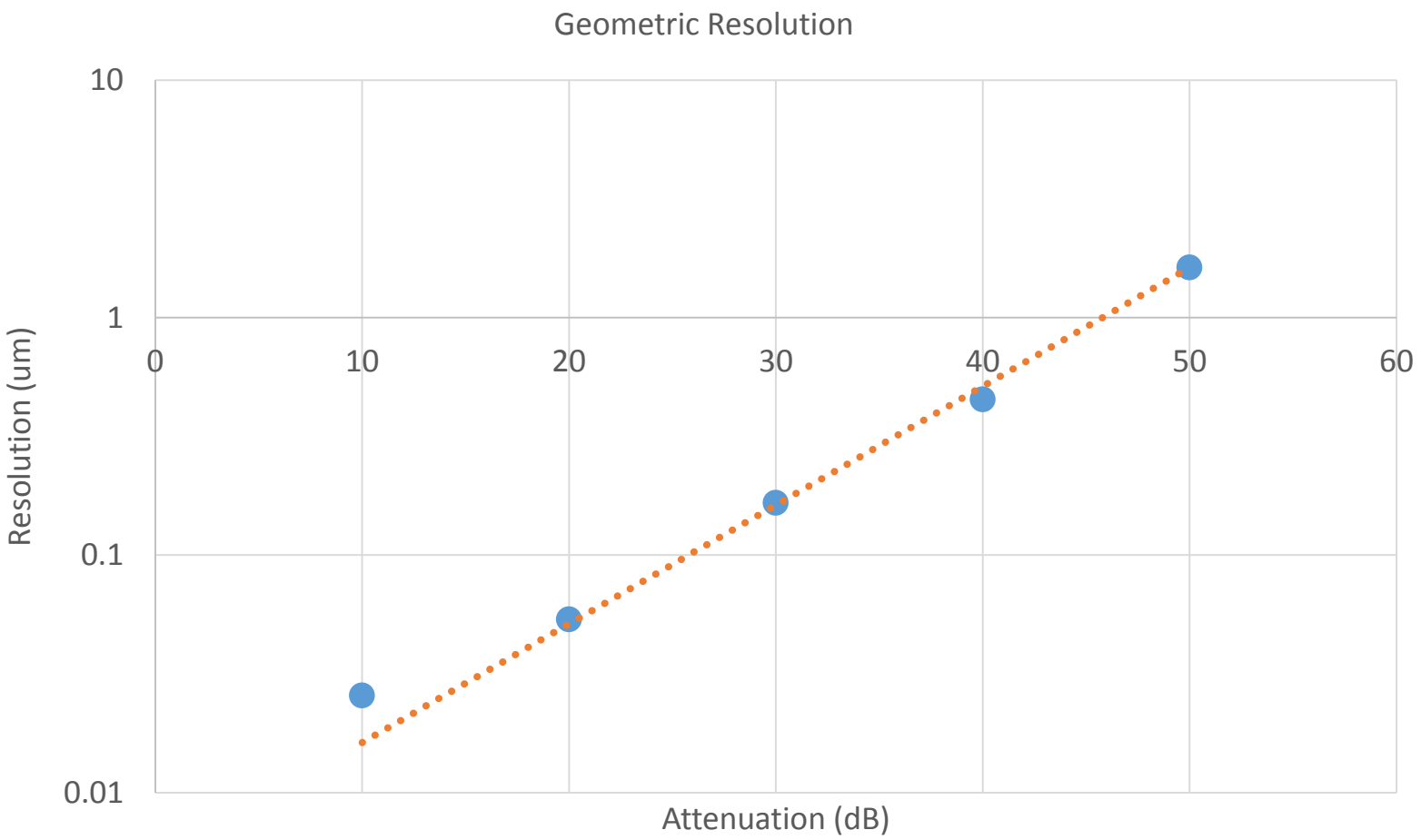


IPB



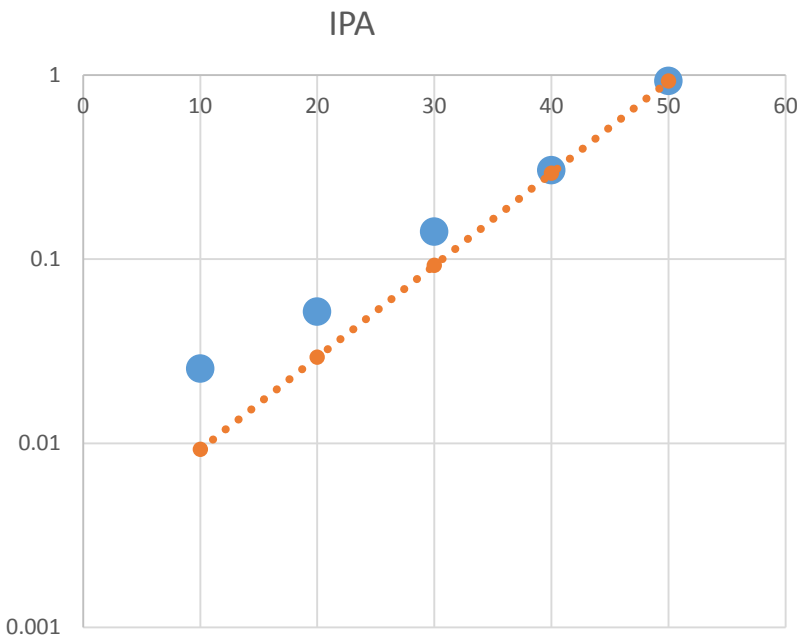
IPC

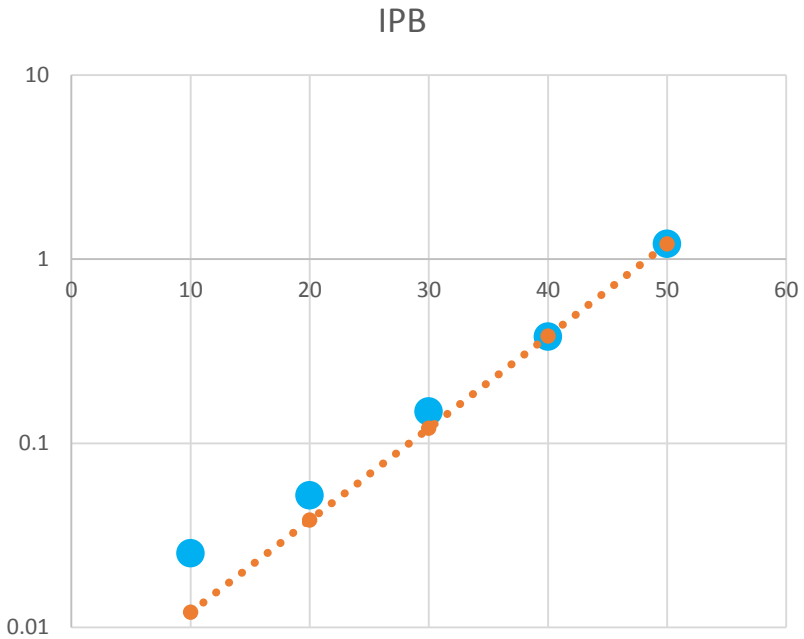
Resolution as Function of Attenuation

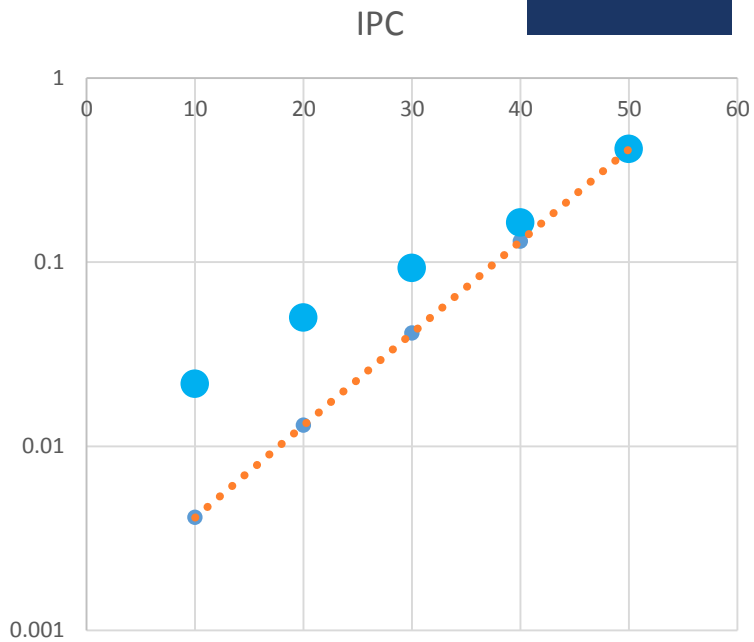


Good agreement scaling resolution from 50dB down to 20dB.

Resolution fitted to position







Plots:
Y-axis – resolution
X-axis – attenuation
Blue dots –measured resolution
Orange line – resolution scaled from 50 dB

Fitted resolutions for IPA/IPB and IPC start to differ at 30, 40 and 50 dB.

	IPA	IPB	IPC
10 dB	0.025371	0.025204	0.023882
20 dB	0.051696	0.052071	0.051644
30 dB	0.140681	0.148417	0.097798
40 dB	0.303347	0.378687	0.1703
50 dB	0.925061	1.207213	0.416695

Conclusions

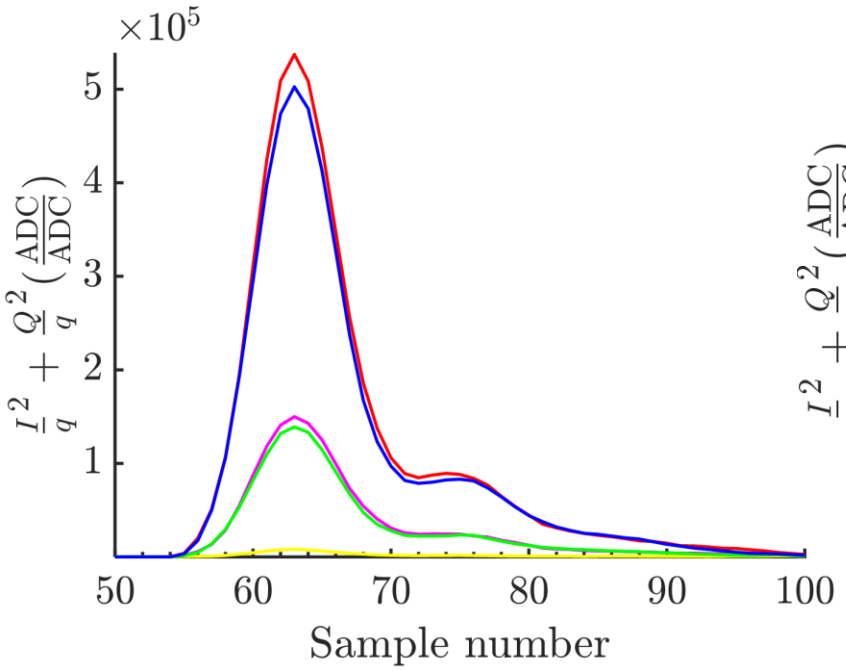
- Geometric resolution scales well with attenuation but fitted resolution does not. Additionally, at higher attenuations the fitted resolutions for IPA, IPB and IPC do not agree with one another.
- Resolution might be being degraded by large IPB(I) signal exceeding dynamic range.
- Some suspect waveforms – particularly at lower charge.
- Resolution degraded for later sample numbers especially for higher charge/lower attenuation files.

Extra Slides

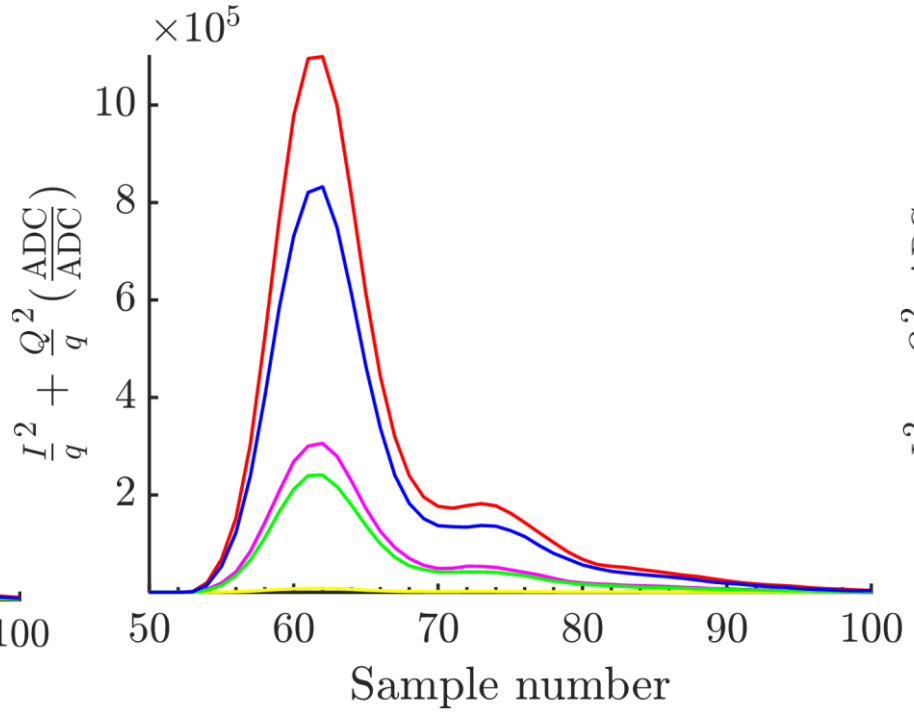
June Waveforms (IPA)

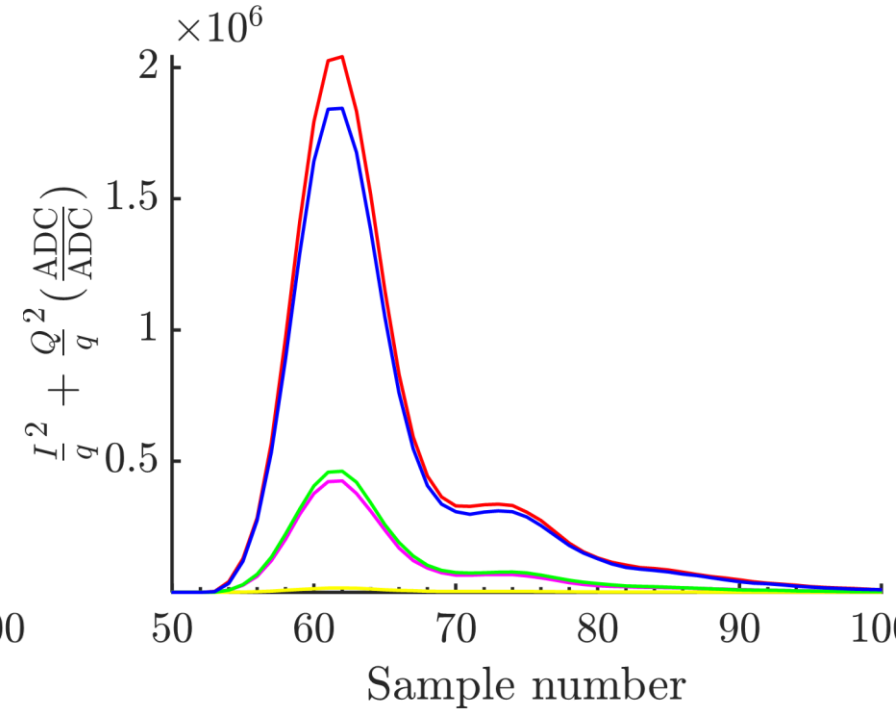
Shape similar for lower and higher charge.

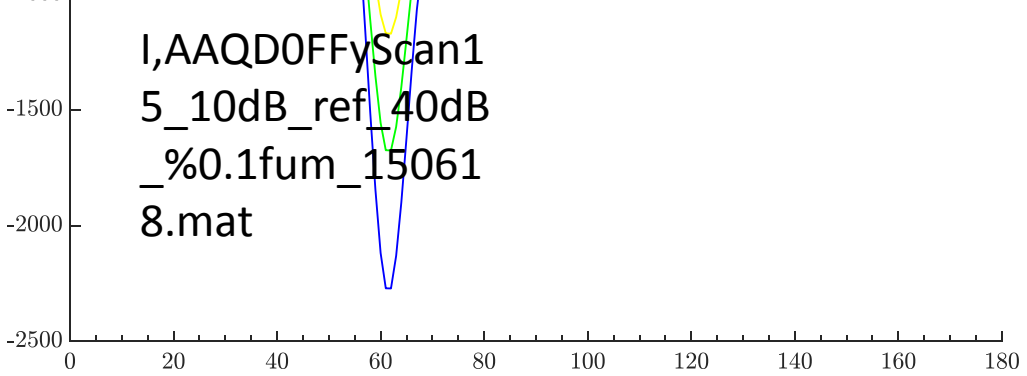
~0.3e10 charge

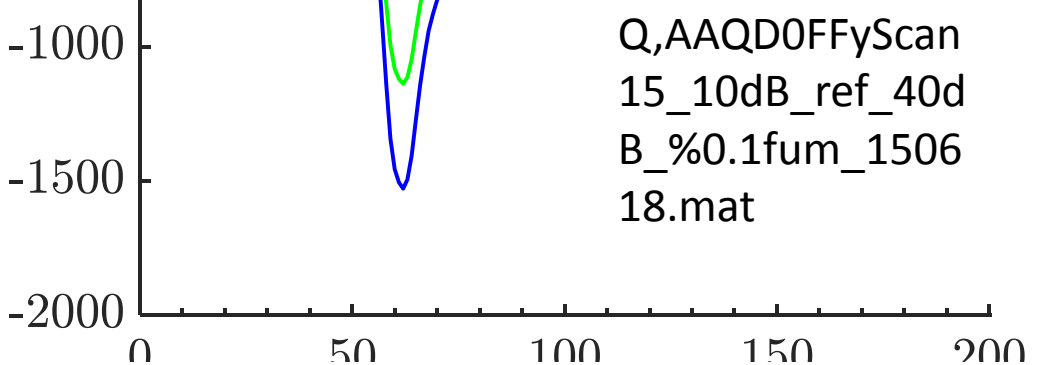


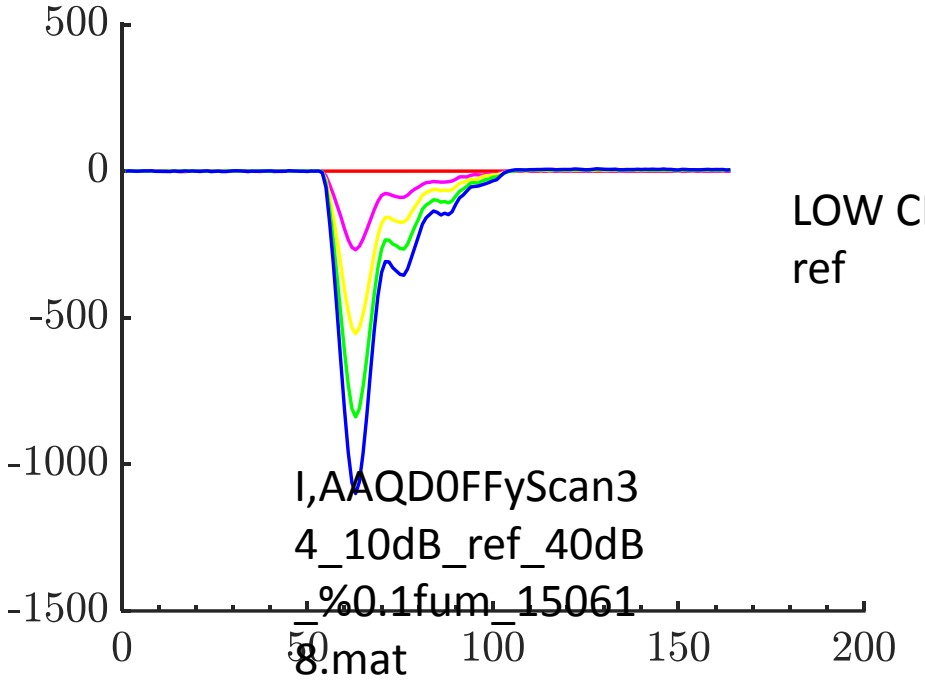
~0.5e10 charge



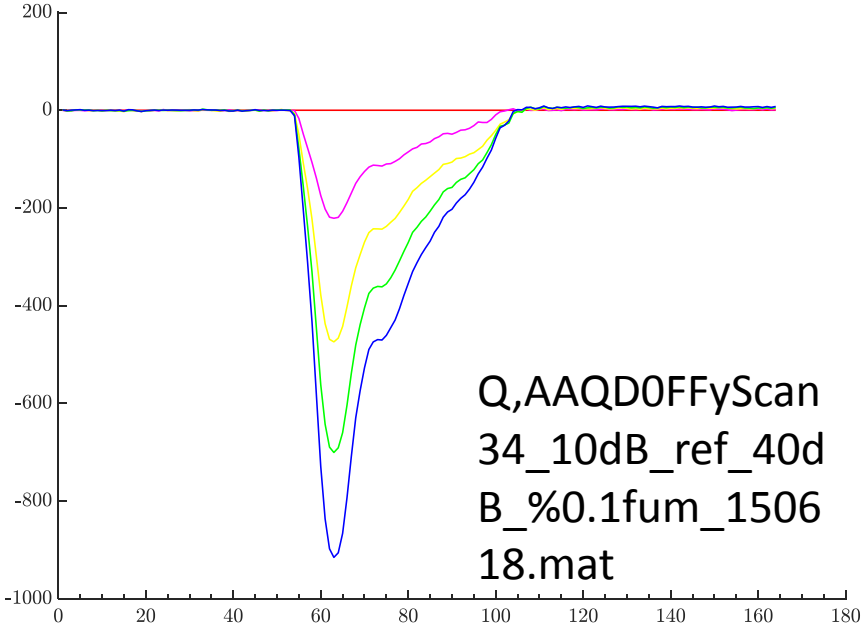


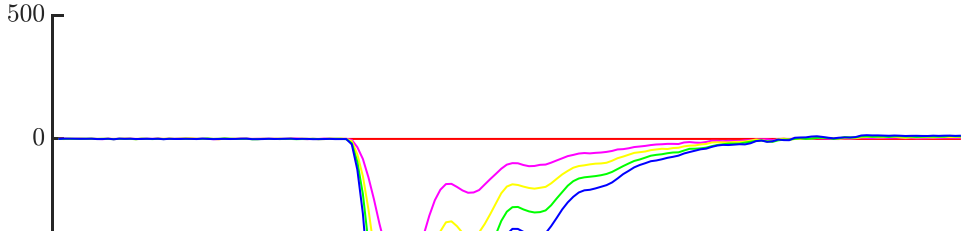


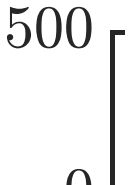




LOW CHARGE 40dB ref

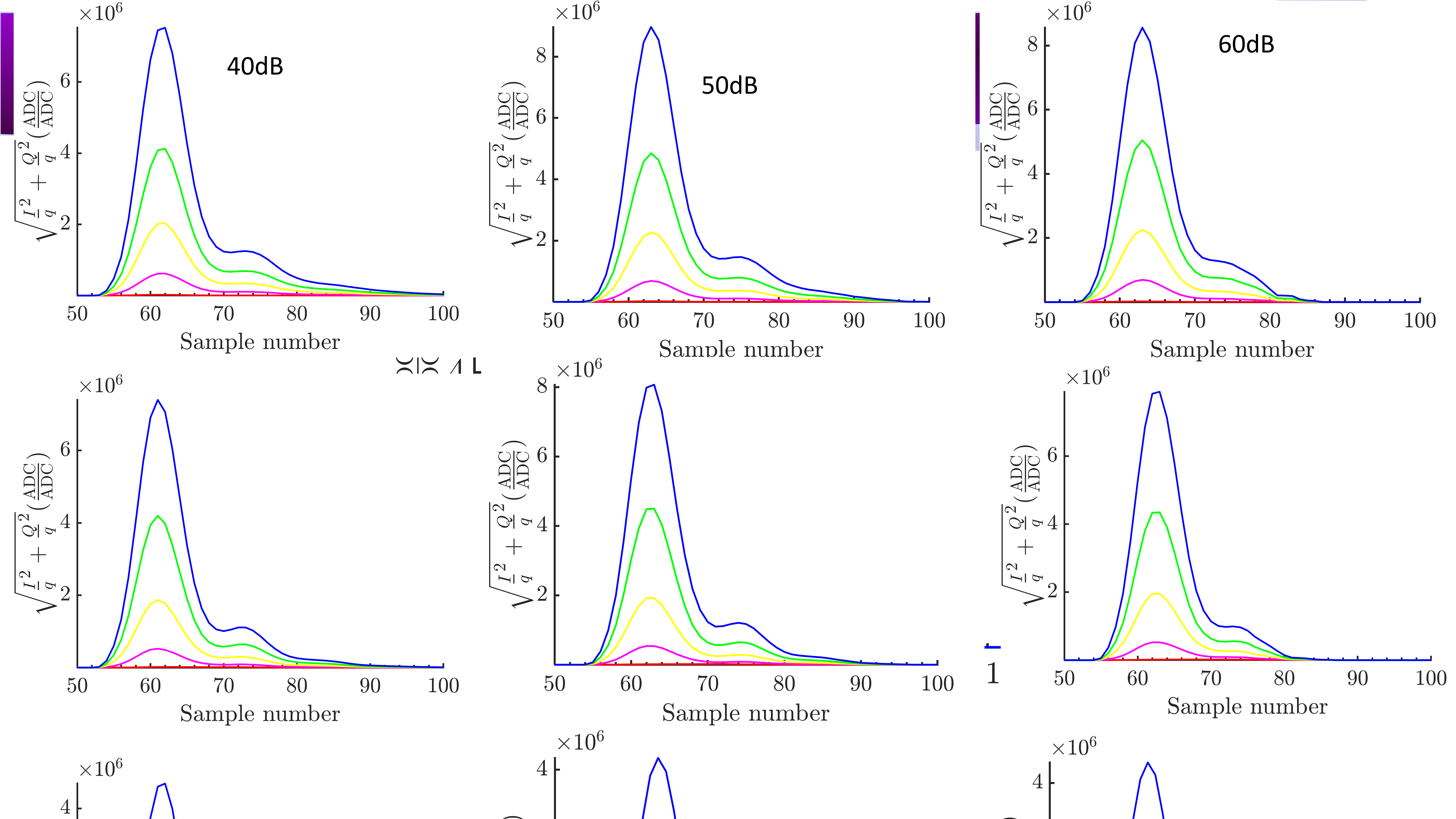


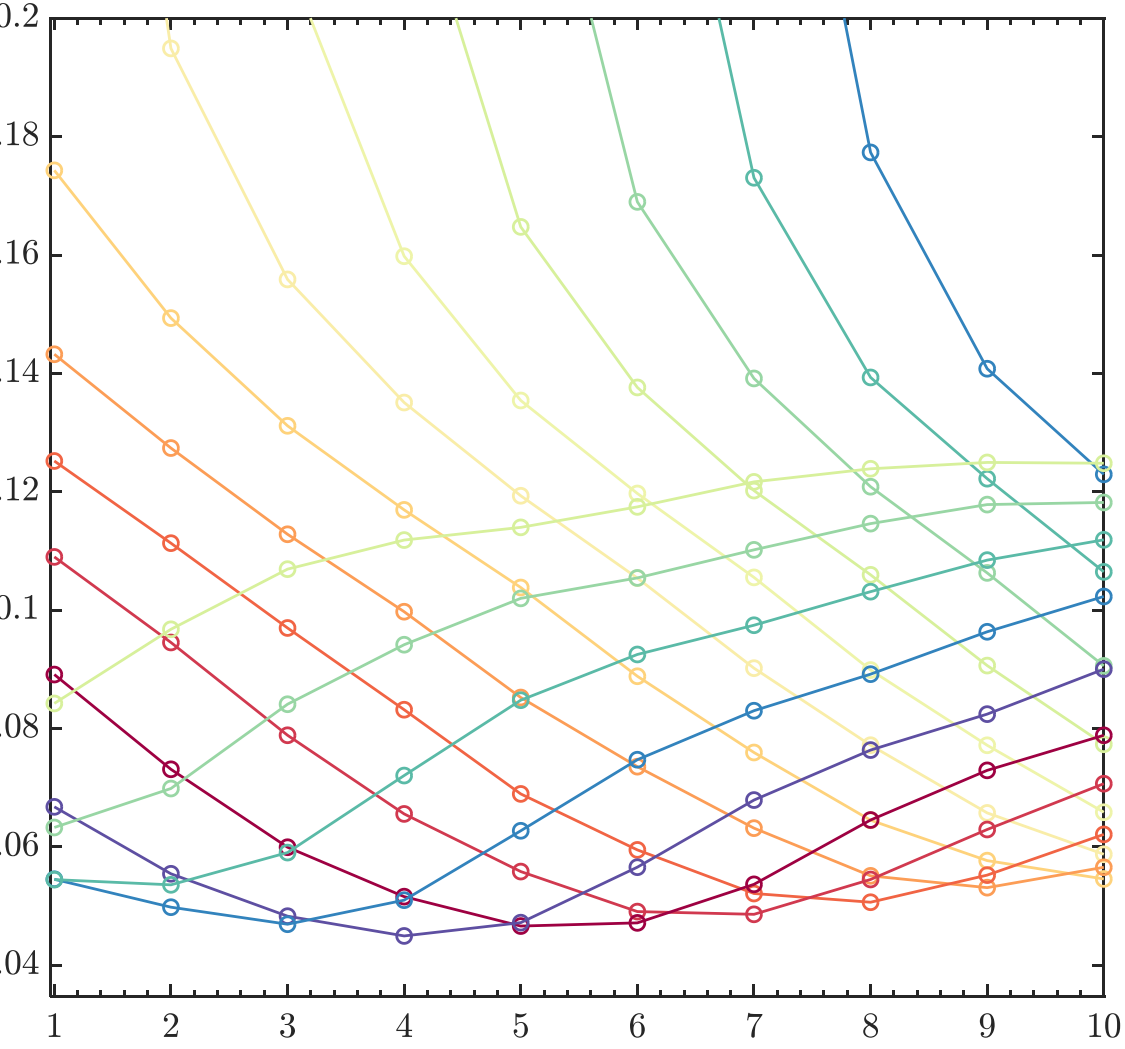


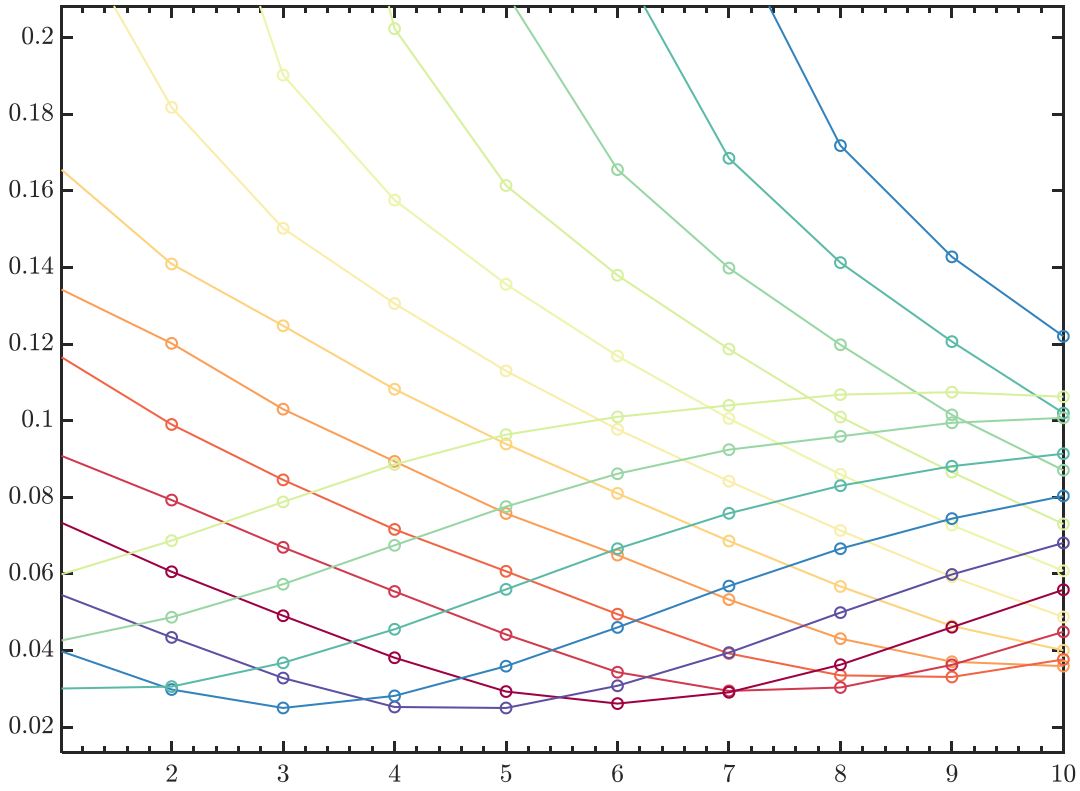



JAI
John Adams Institute
for Accelerator Science


50
200


40dB
50dB
60dB
×10^6
$\sqrt{\frac{I}{q}^2 + \frac{Q}{q}^2}(\frac{ADC}{ADC})$
Sample number
50
60
70
80
90
100


0.2
.18
.16
.14
.12
0.1
.08
.06
.04
1
2
3
4
5
6
7
8
9
10


0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
2
3
4
5
6
7
8
9
10

10dB ref