# IPBPM shifts – ATF March Week 2

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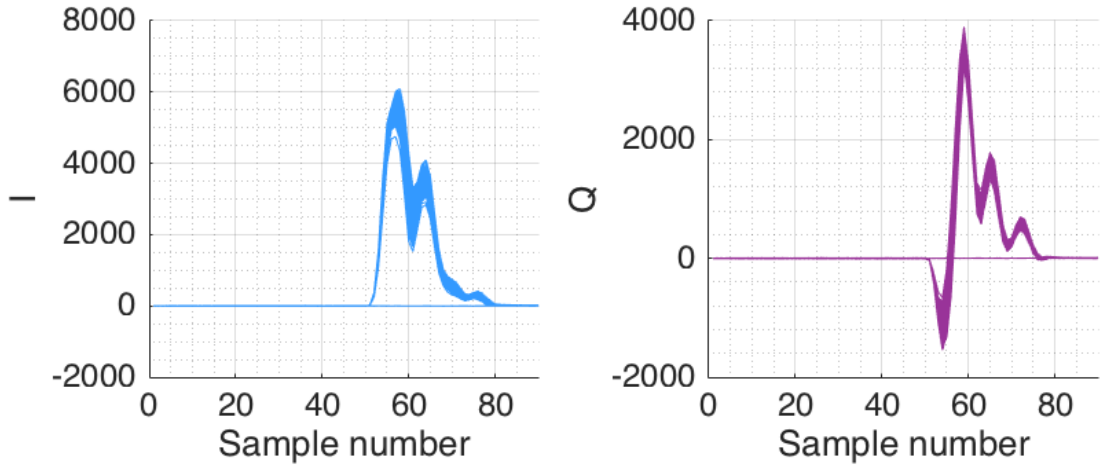
# Outline

- IP BPM electronic noise floor estimates
- Strange waveform shifts observed in calibrations
- Resolution at high charge
- Resolution at different attenuations
- Resolution at different charges
- FFT of new IPC waveforms

# IP BPM electronic noise floor

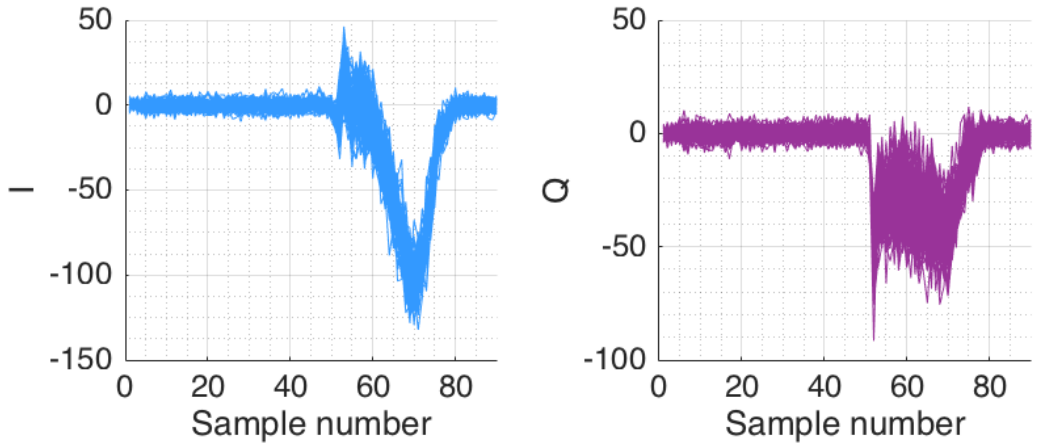
- Perform jitter runs with 70dB attenuation on the dipole signal to observe the electronic noise of the processing system in the absence of the dipole signal, but with the mixer still being driven.
- Calibrate the resultant signal using a 0dB calibration run in the region of the dipole pulse.
- For this data (160315) the 0dB dipole signal starts at sample 52, with peak signal at sample ~ 58.

***0dB on dipole signal***
***(to locate sample region of pulse)***



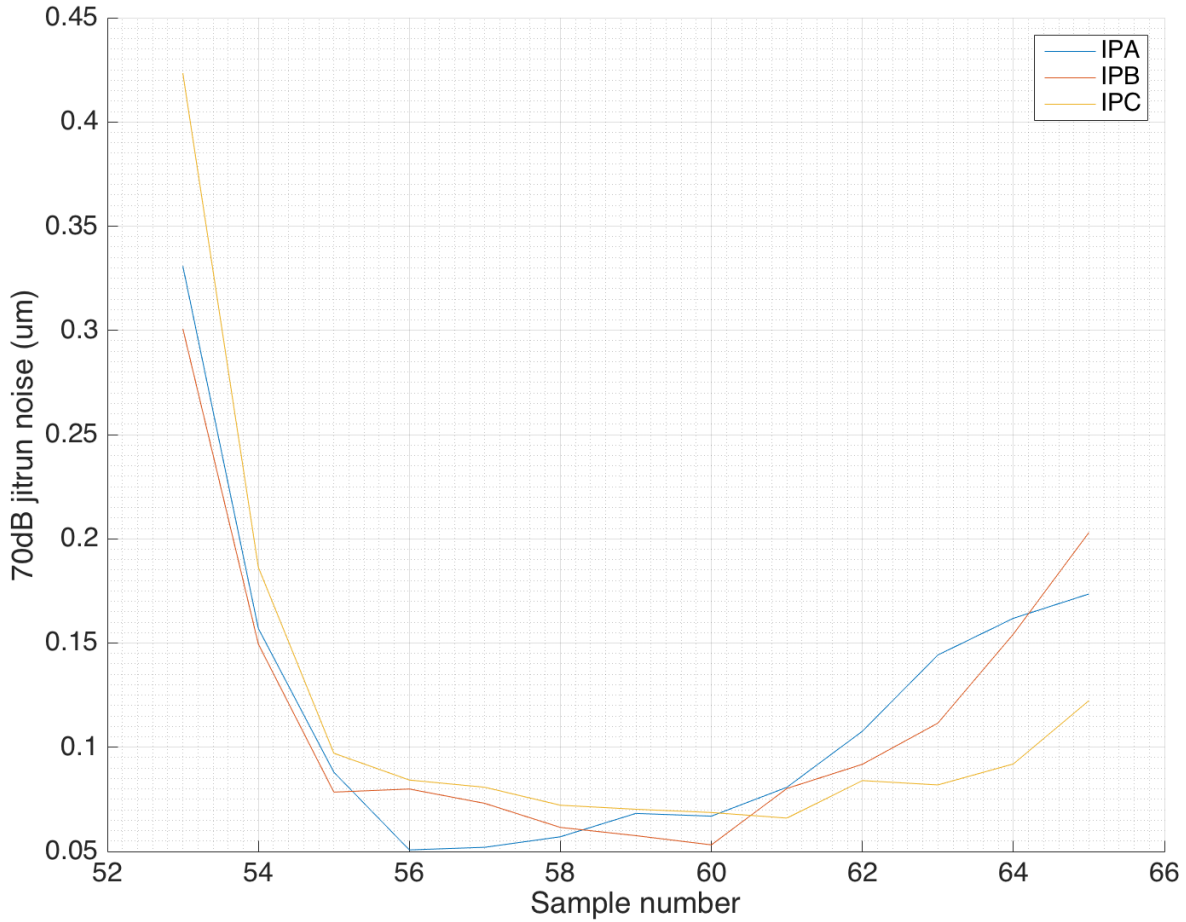

**jitRun20_0dB_0.45_ipbpm_160315**

***70dB on dipole signal***
***(electronic noise in absence of dipole signal)***




**jitRun21_70dB_0.4_ipbpm_160315**

# Where to sample the noise for analysis?




- Analyse 70dB waveforms at each sample number to calculate apparent noise jitter due to electronics.
- Before and after the the location of the dipole signal peak (sample ~ 58), the electronic noise becomes very large.
- Focus analysis on the region where pulse would normally be sampled: i.e. 3 or 4 samples around the peak amplitude of dipole signal.
- Subsequent sample region chosen for this analysis - **samples 57:61**.

# Noise floor results:

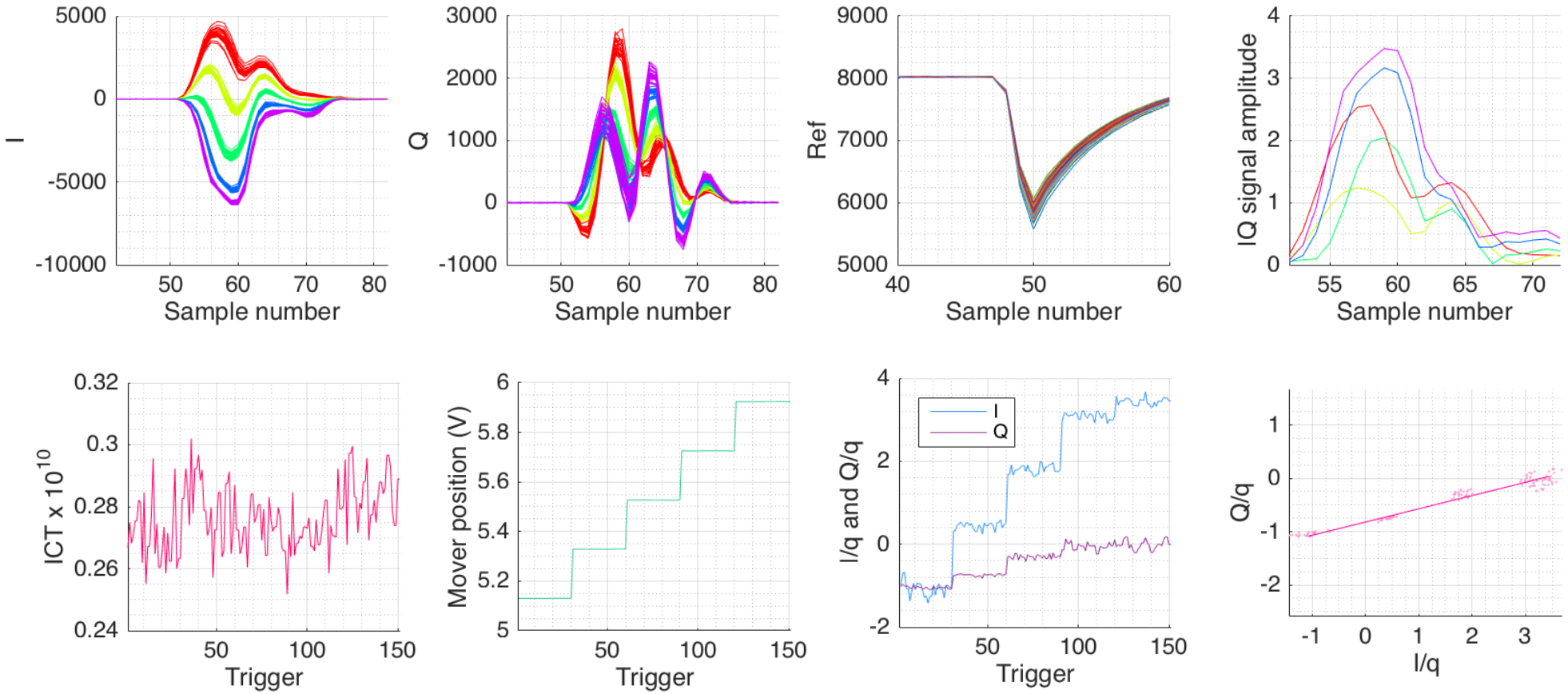
- Repeated 70dB measurements at four different charges.
- Calculated noise jitter at all five sample points, 57 to 61. Results for the estimate of the noise floor shows the mean of these five jitter results, repeated for all three BPMs.
- Note: conversions to nm from ADCs were determined using 0dB calibration runs with a charge as close as possible to the jitter run charge, but we saw a lot of charge drift on shift, so calibration constants may be calculated at a charge approx. +/- 0.15 x $10^{10}$.

| Filename | JitterRun Charge ( x $10^{10}$ ) | IPA Jitter (nm) | σ | IPB jitter (nm) | σ | IPC Jitter (nm) | σ |
|---|---|---|---|---|---|---|---|
| jitRun21_70dB_0.3_ipbpm_160315 | 0.3 | 31 | 3 | 28 | 2 | 32 | 1 |
| jitRun21_70dB_0.4_ipbpm_160315 | 0.4 | 21 | 2 | 21 | 1 | 33 | 1 |
| jitRun21_70dB_0.8_ipbpm_160315 | 0.7 | 14 | 2 | 18 | 1 | 24 | 2 |
| jitRun21_70dB_1_ipbpm_160315 | 0.9 | 13 | 1 | 16 | 2 | 26 | 4 |

*Neven's thesis estimates the noise floor limit on the IPB electronics to be 23.0 ± 0.7 nm by splitting the signal from IPB into two sets of the Honda electronics and comparing their outputs at a charge ~ 0.5 x $10^{10}$.*

# Shifts in I and Q waveforms

Strange waveform shapes repeatedly observed in the I and Q signals across the March IPBPM shifts.



# IPBPM resolution at high charge

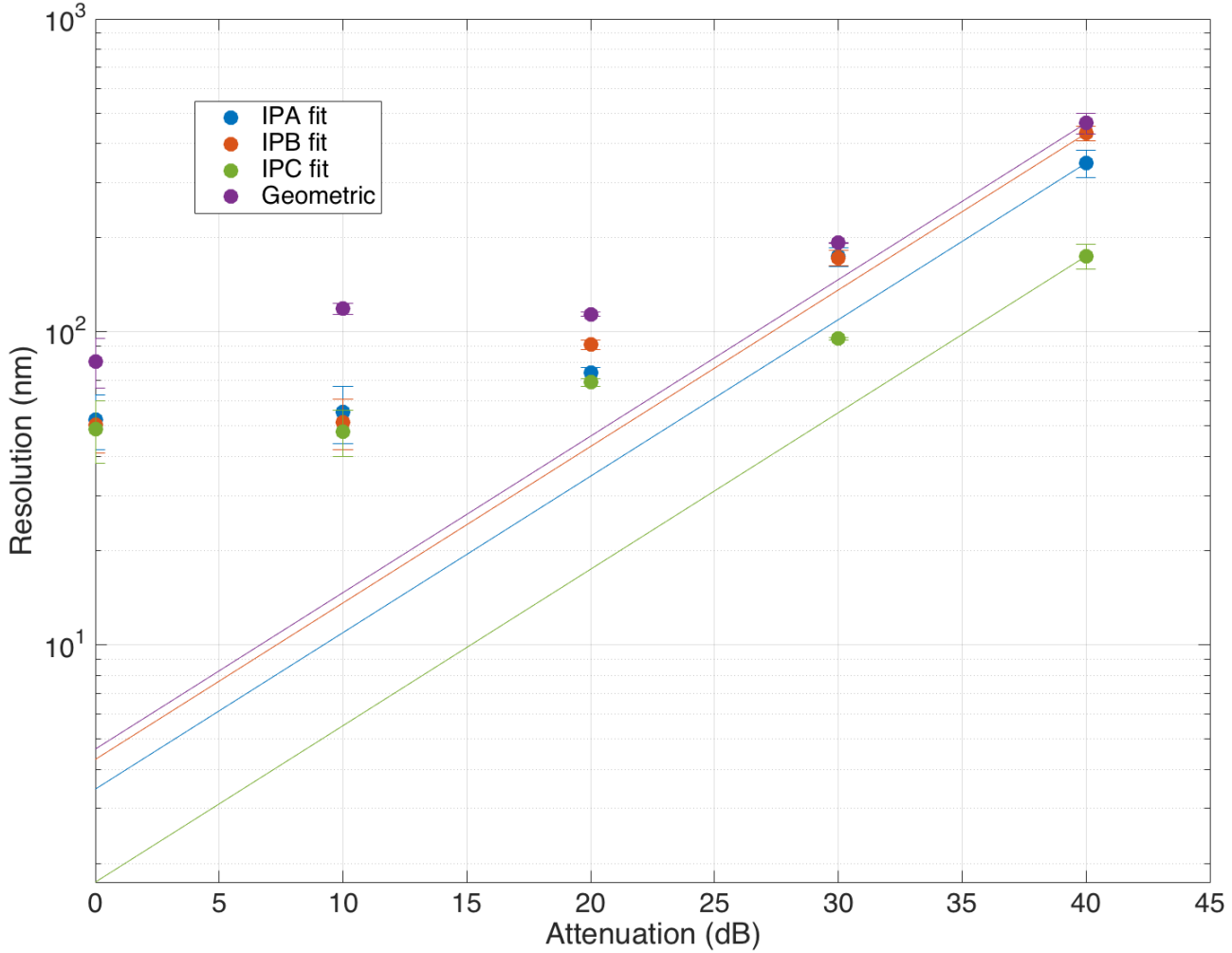
I think this is the data set Siwon is using

Eight repeat resolution measurements taken at a charge of 0.95 x $10^{10}$ with 0dB attenuation.
All analysed integrating sample numbers 57:59.

| Filename | Resolution using IPA and 5-parameter fit (nm) | Resolution using IPB and 5-parameter fit (nm) | Resolution using IPC and 5-parameter fit (nm) | Resolution from average of the three results for a 5-parameter fit (nm) | σ (nm) | Resolution using geometric method (nm) | σ (nm) |
|---|---|---|---|---|---|---|---|
| jitRun26_0dB_0.95 | 113 | 111 | 56 | 93 | 19 | 188 | 2 |
| jitRun27_0dB_0.95 | 41 | 36 | 26 | 34 | 4 | 178 | 2 |
| jitRun28_0dB_0.95 | 24 | 25 | 22 | 24 | 1 | 139 | 2 |
| jitRun29_0dB_0.95 | 25 | 27 | 22 | 25 | 1 | 145 | 3 |
| jitRun30_0dB_0.95 | 100 | 83 | 73 | 85 | 8 | 156 | 3 |
| jitRun31_0dB_0.95 | 98 | 82 | 65 | 82 | 10 | 140 | 2 |
| jitRun32_0dB_0.95 | 25 | 20 | 15 | 20 | 3 | 124 | 3 |
| jitRun33_0dB_0.95 | 22 | 23 | 14 | 19 | 3 | 123 | 3 |

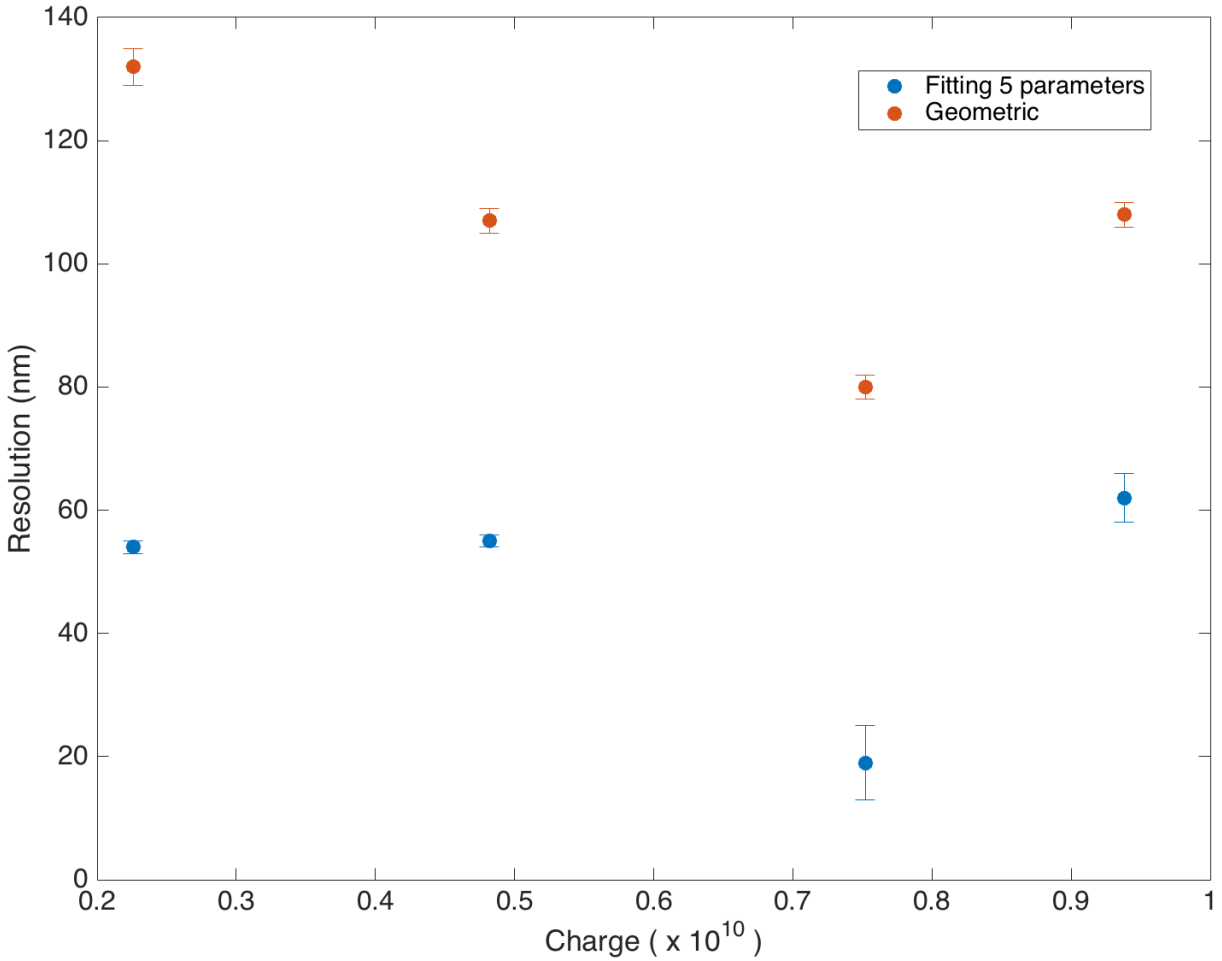
# IPBPM resolution at different attenuations

- All data taken at a charge of 0.95 x $10^{10}$.
- Waveforms sampled using integration over a range optimised for each data set to produce the lowest resolution.
- Plotted data point and associated uncertainty is derived from the average of repeated data sets taken at the same attenuation.
- Plotted line shows 40dB results extrapolated to 0dB.



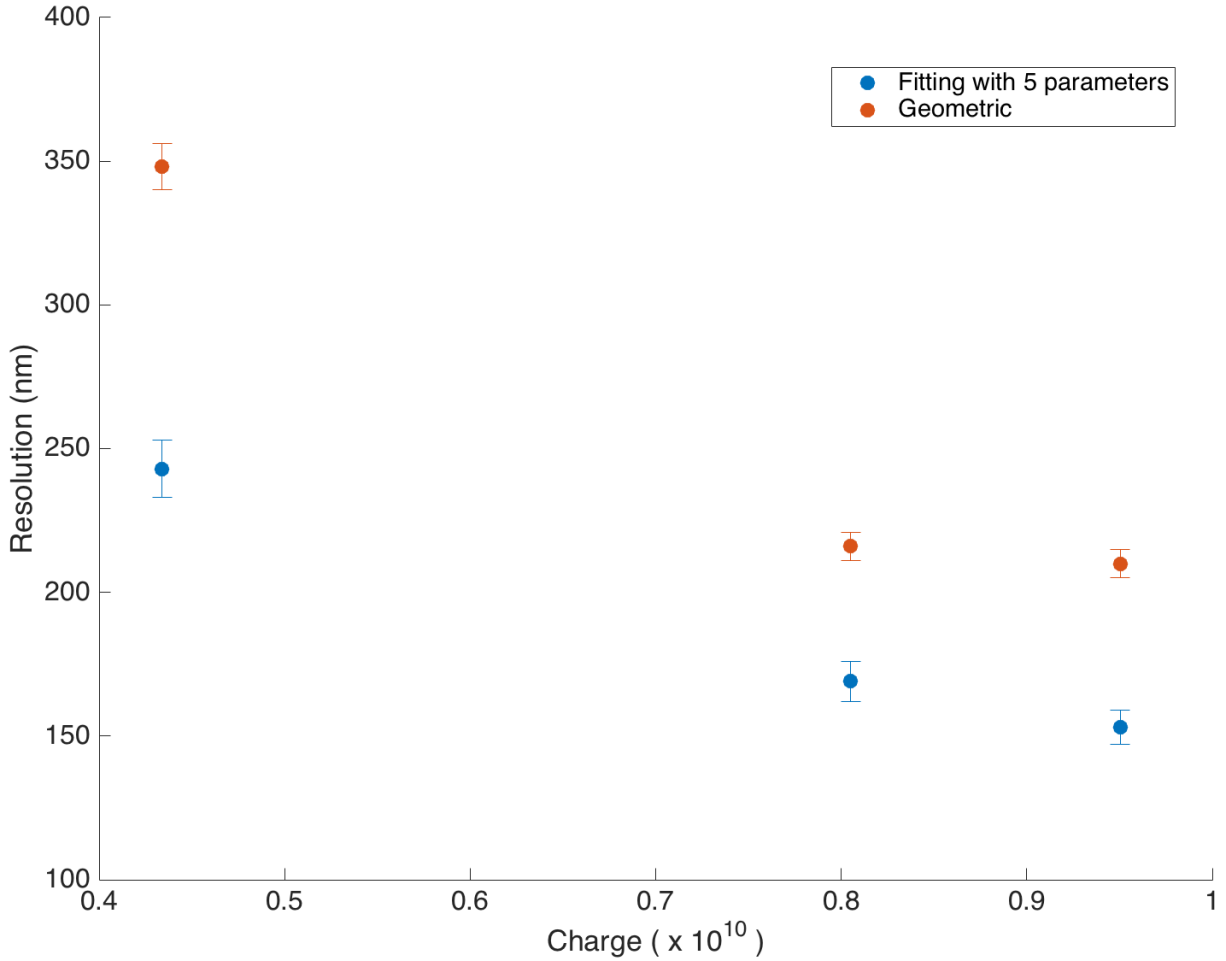
# IPBPM resolution at different charges, 0dB

- All data taken at 0dB.
- Waveforms sampled using integration over a range optimised for each data set to produce the lowest resolution.



# IPBPM resolution at different charges, 30dB

- All data taken at 30dB.
- Waveforms sampled using integration over a range optimised for each data set to produce the lowest resolution.



# New IPC waveforms

- FFT of IPC I and Q signals at 0dB with the waist approximately at IPC.