Jitter minimisation at BPM on waist

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- Results:
  - Jitter on waist vs. averaging sample window
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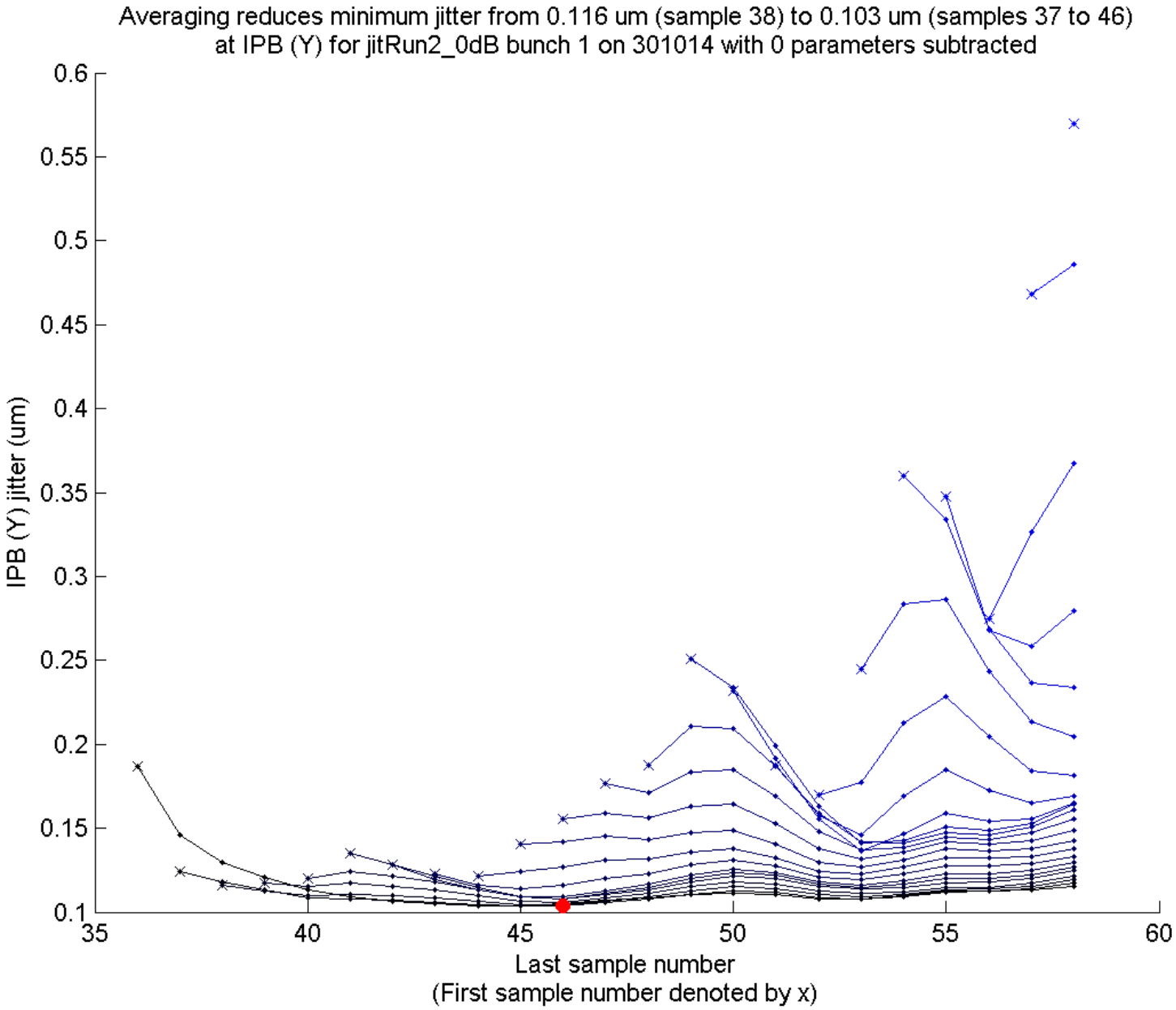
  - Remove correlated components and average

Averaging window

- Averaging samples 37 to 46 gives smallest jitter
- This averaging window is used for all plots
- Results quoted in tables on slides 13 & 20 use specific averaging window to minimise each quoted jitter

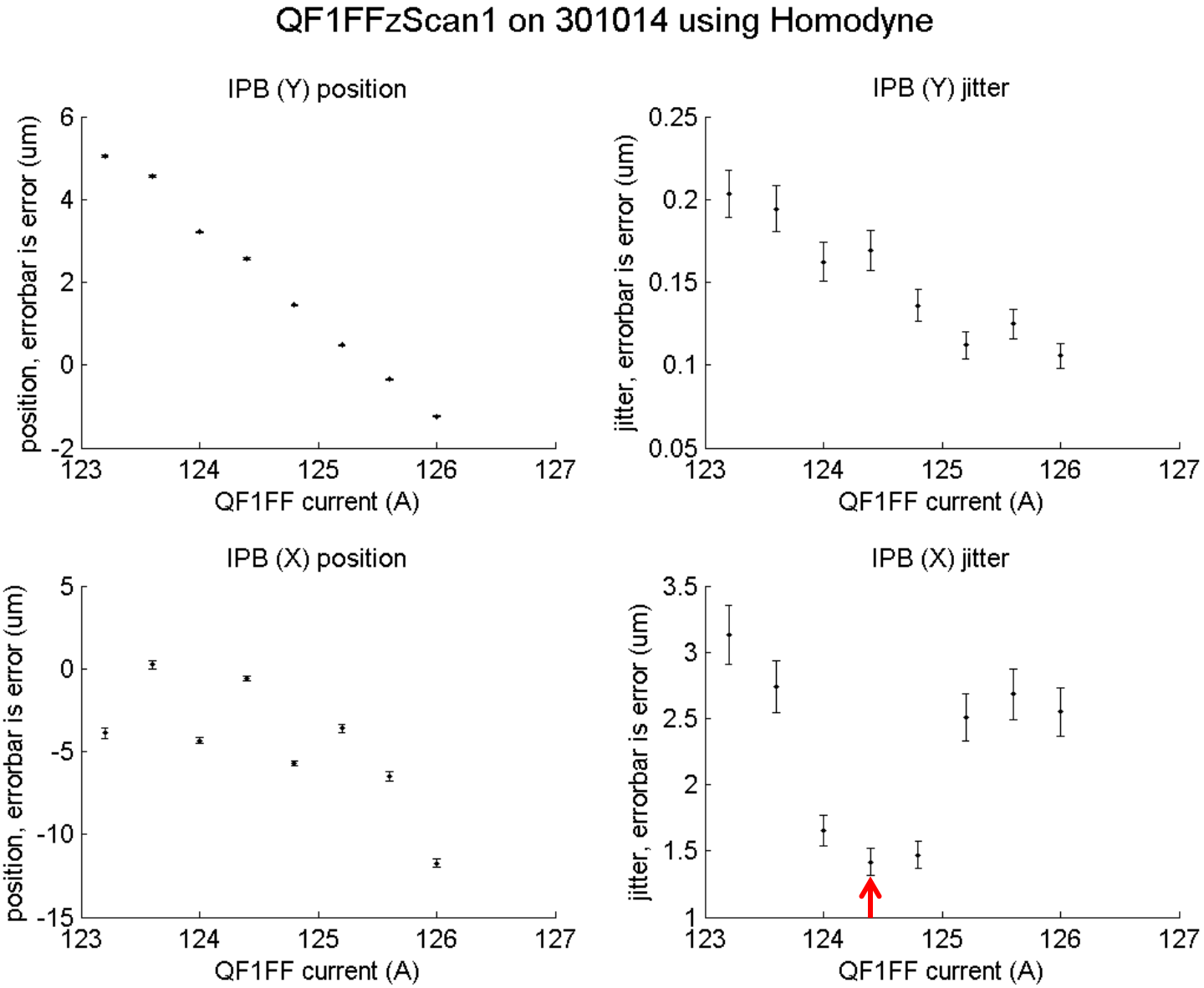

Averaging reduces minimum jitter from 0.116 um (sample 38) to 0.103 um (samples 37 to 46)
at IPB (Y) for jitRun2_0dB bunch 1 on 301014 with 0 parameters subtracted
IPB (Y) jitter (um)
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
35
40
45
50
55
60
Last sample number
(First sample number denoted by x)

QF1FF and QD0FF scans

- x jitter minimised with QF1FF at 124.4 A
- y jitter minimised with QD0FF at 137.35 A

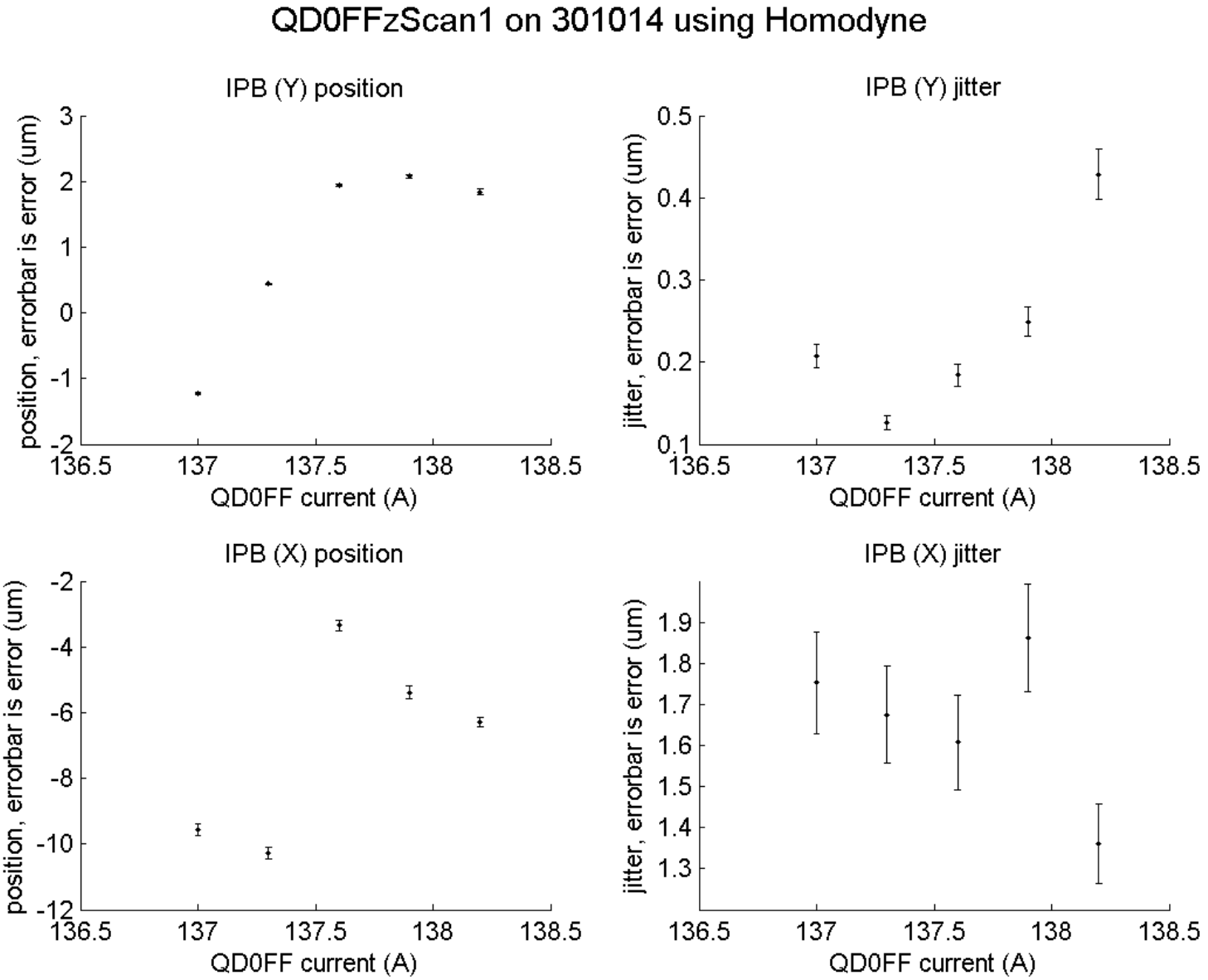
y: 10 dB

x: 20 dB


QF1FFzScan1 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
QF1FF current (A)
IPB (Y) jitter
jitter, errorbar is error (um)
QF1FF current (A)
IPB (X) position
position, errorbar is error (um)
QF1FF current (A)
IPB (X) jitter
jitter, errorbar is error (um)
QF1FF current (A)

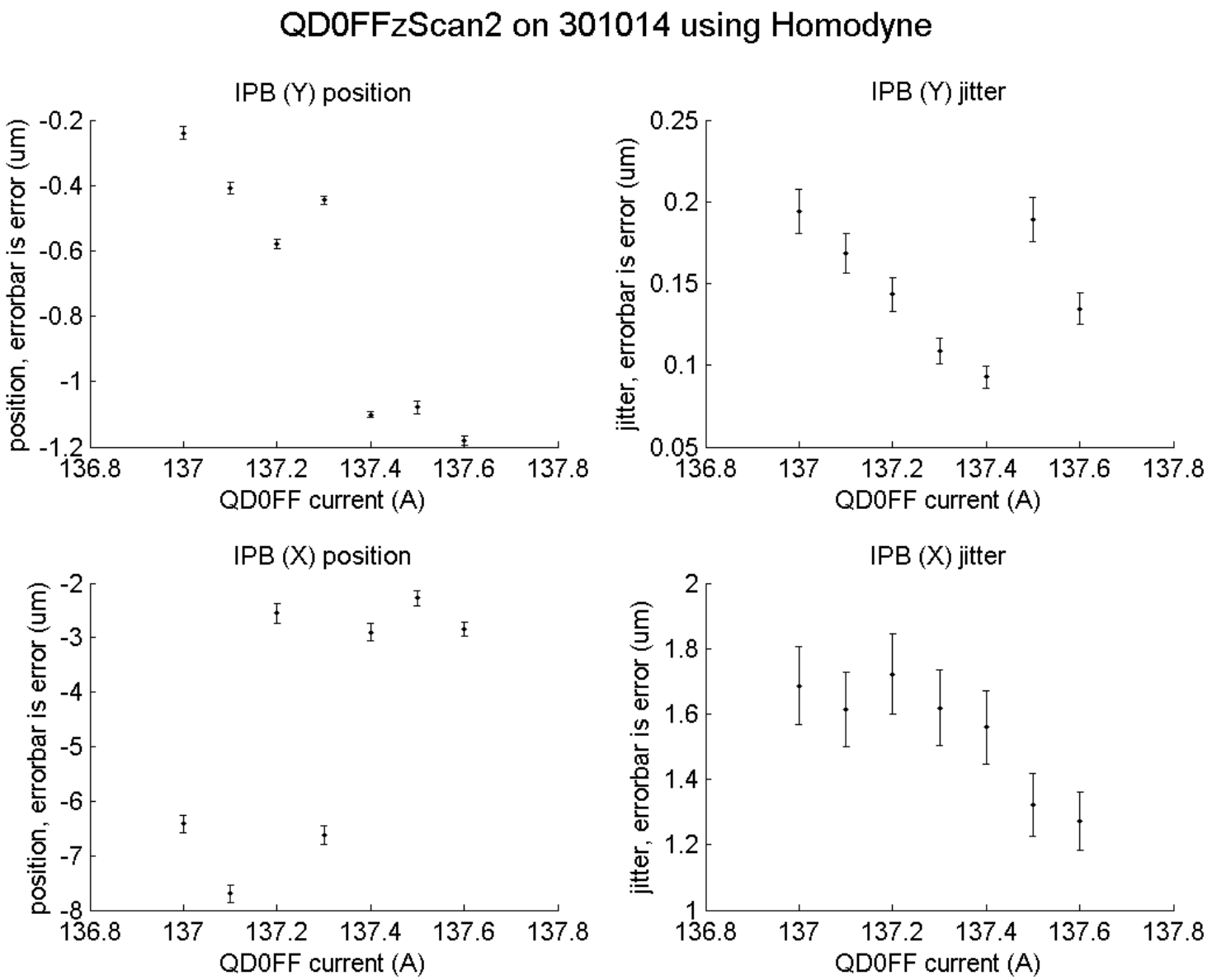
y: 10 dB

x: 20 dB


QD0FFzScan1 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
QD0FF current (A)
IPB (Y) jitter
jitter, errorbar is error (um)
QD0FF current (A)
IPB (X) position
position, errorbar is error (um)
QD0FF current (A)
IPB (X) jitter
jitter, errorbar is error (um)
QD0FF current (A)

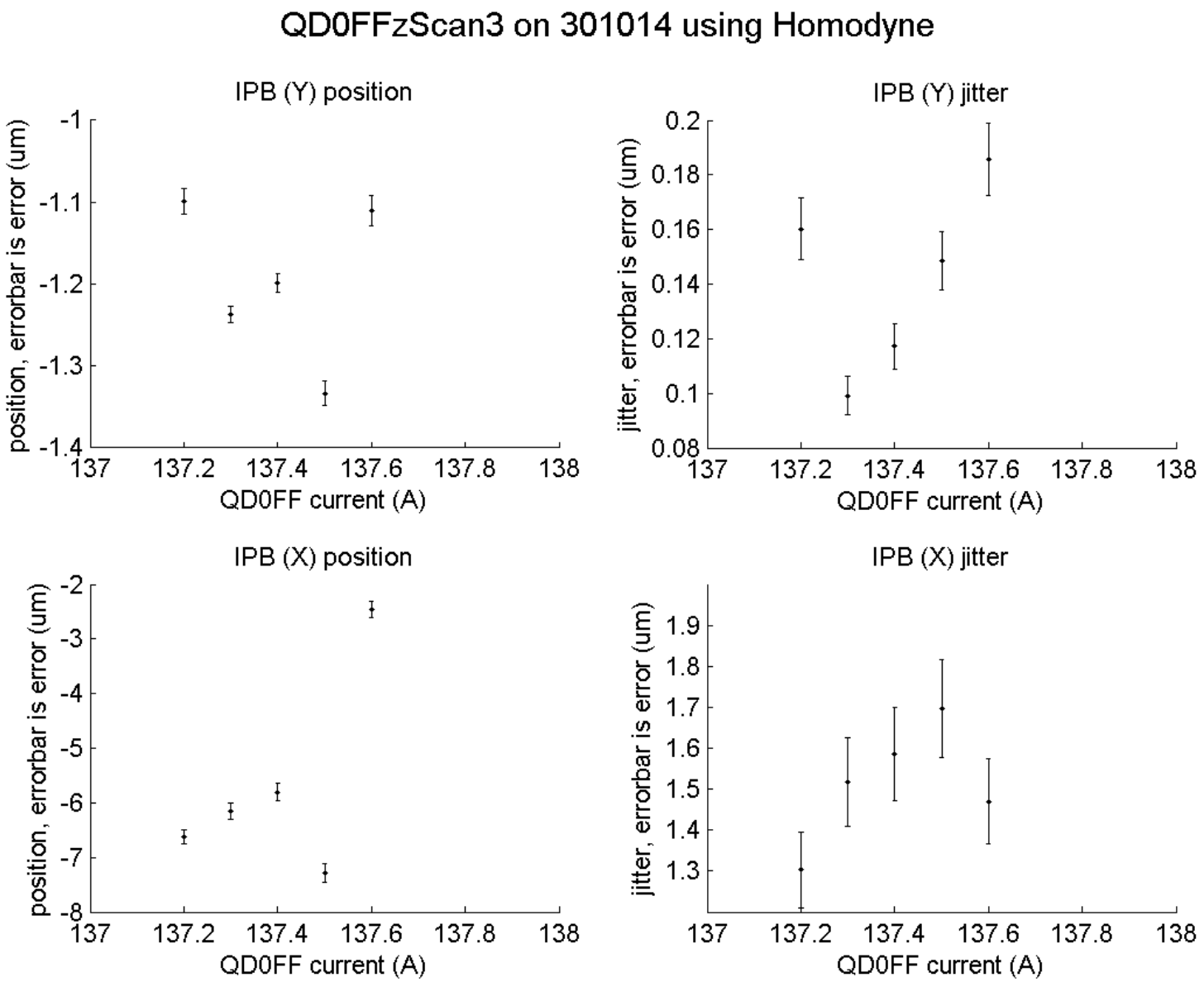
y: 0 dB

x: 20 dB


QD0FFzScan2 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
136.8
137
137.2
137.4
137.6
137.8
QD0FF current (A)
IPB (Y) jitter
jitter, errorbar is error (um)
0.25
0.2
0.15
0.1
0.05
136.8
137
137.2
137.4
137.6
137.8
QD0FF current (A)
IPB (X) position
position, errorbar is error (um)
-2
-3
-4
-5
-6
-7
-8
136.8
137
137.2
137.4
137.6
137.8
QD0FF current (A)
IPB (X) jitter
jitter, errorbar is error (um)
2
1.8
1.6
1.4
1.2
1
136.8
137
137.2
137.4
137.6
137.8
QD0FF current (A)

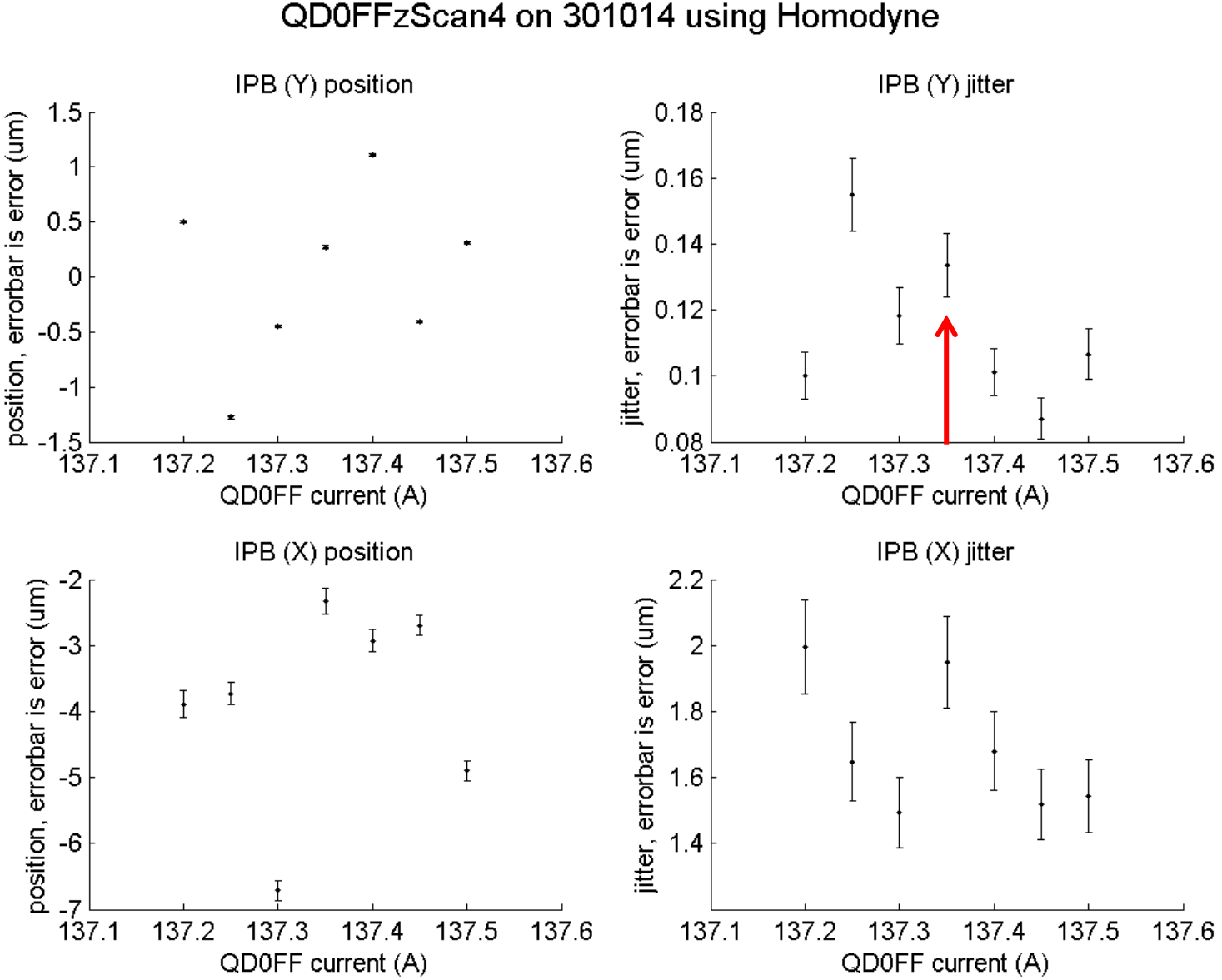
y: 0 dB

x: 20 dB


QD0FFzScan3 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
-1
-1.1
-1.2
-1.3
-1.4
137
137.2
137.4
137.6
137.8
138
QD0FF current (A)
IPB (Y) jitter
jitter, errorbar is error (um)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
137
137.2
137.4
137.6
137.8
138
QD0FF current (A)
IPB (X) position
position, errorbar is error (um)
-2
-3
-4
-5
-6
-7
-8
137
137.2
137.4
137.6
137.8
138
QD0FF current (A)
IPB (X) jitter
jitter, errorbar is error (um)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
137
137.2
137.4
137.6
137.8
138
QD0FF current (A)

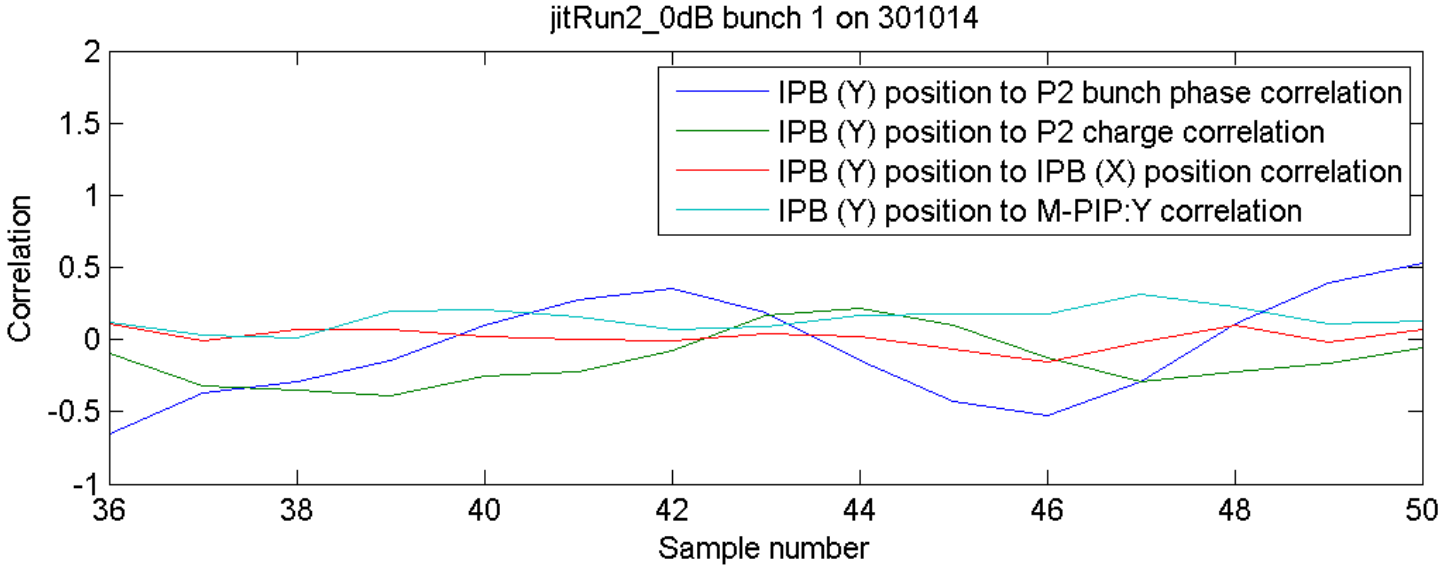
y: 0 dB

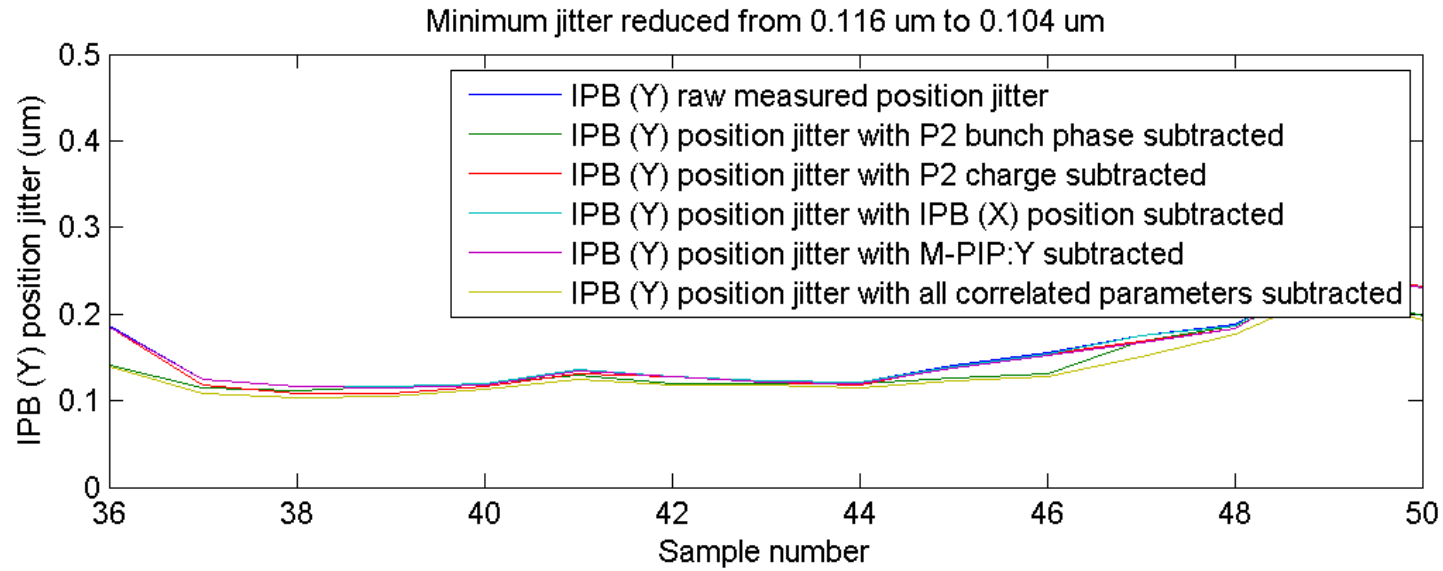
x: 20 dB


QD0FFzScan4 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
QD0FF current (A)
IPB (Y) jitter
jitter, errorbar is error (um)
QD0FF current (A)
IPB (X) position
position, errorbar is error (um)
QD0FF current (A)
IPB (X) jitter
jitter, errorbar is error (um)
QD0FF current (A)

Correlated components

- At each sample number, find correlation of IPB (Y) with:
  - P2 bunch phase
  - P2 charge
  - IPB (X) position
  - PIP (Y) position
- Remove correlation with each component at each sample number
- Then, perform multi-sample averaging


jitRun2_0dB bunch 1 on 301014
IPB (Y) position to P2 bunch phase correlation
IPB (Y) position to P2 charge correlation
IPB (Y) position to IPB (X) position correlation
IPB (Y) position to M-PIP:Y correlation
Correlation
Sample number


Minimum jitter reduced from 0.116 um to 0.104 um
IPB (Y) raw measured position jitter
IPB (Y) position jitter with P2 bunch phase subtracted
IPB (Y) position jitter with P2 charge subtracted
IPB (Y) position jitter with IPB (X) position subtracted
IPB (Y) position jitter with M-PIP:Y subtracted
IPB (Y) position jitter with all correlated parameters subtracted
IPB (Y) position jitter (um)
Sample number

Jitter on waist

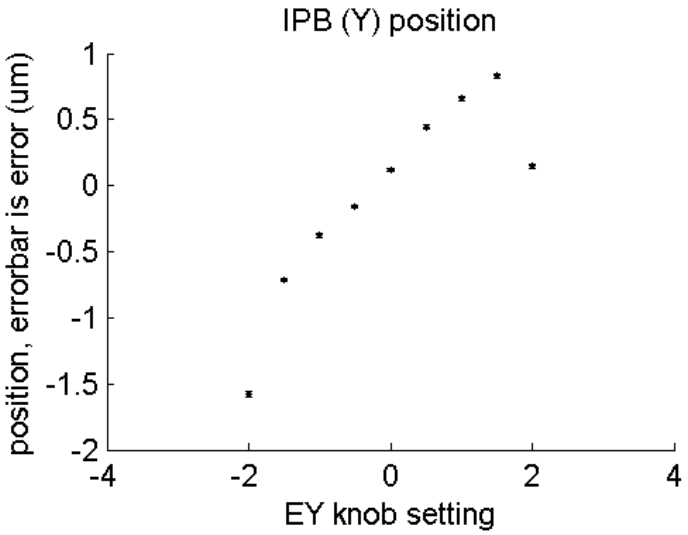
Remove correlation with	Jitter at IPB (Y) (nm)	
	Single-sample	Multi-sample
Nothing	116	103
P2 charge	108	102
P2 phase	111	103
PIP (Y) position	115	102
IPB (X) position	116	103
All of the above	104	100

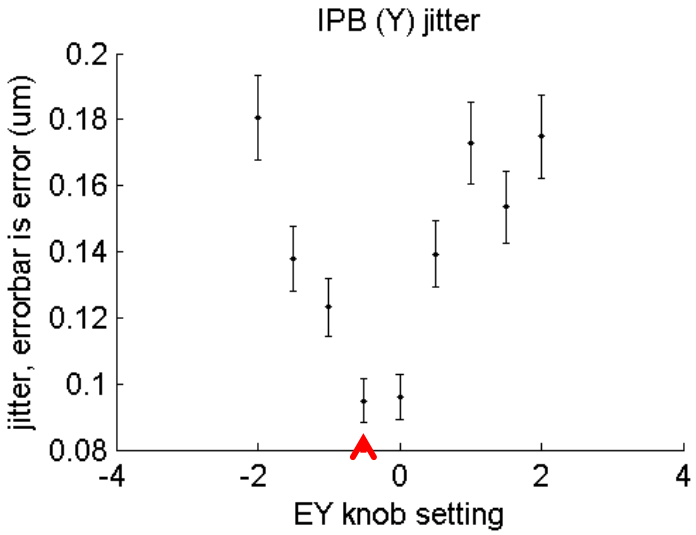
Linear knob scans

- Perform multiple iterations of linear knob scans (EY, AY, Coup2)
- Knob setting set after scan marked with red arrow

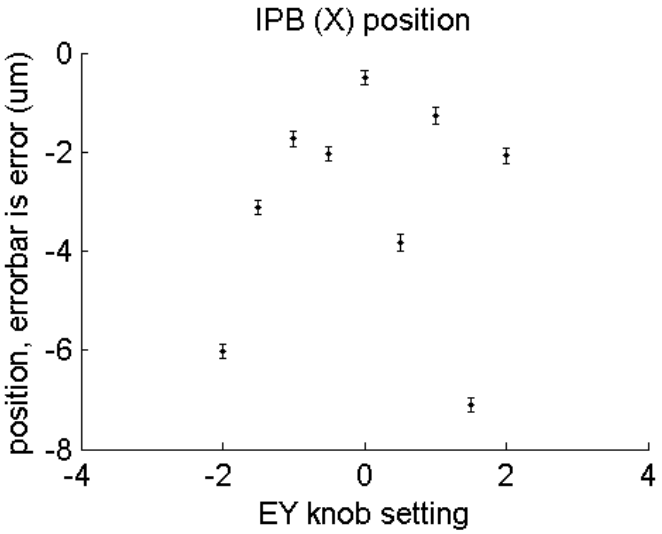
EYscan2 on 301014 using Homodyne

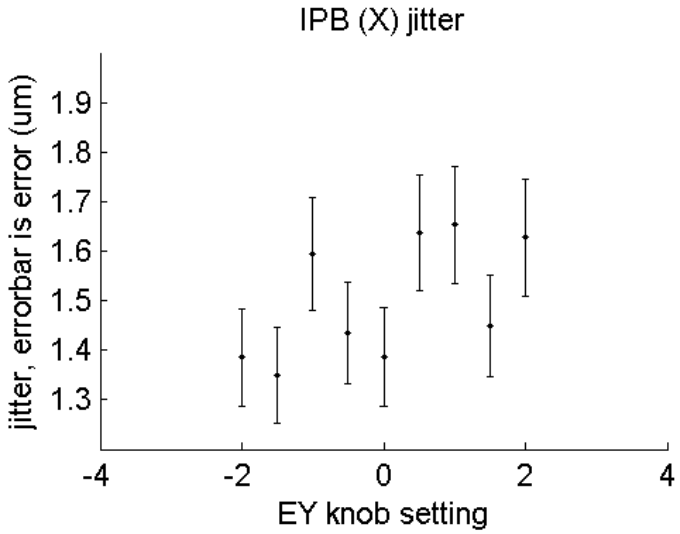
y: 0 dB





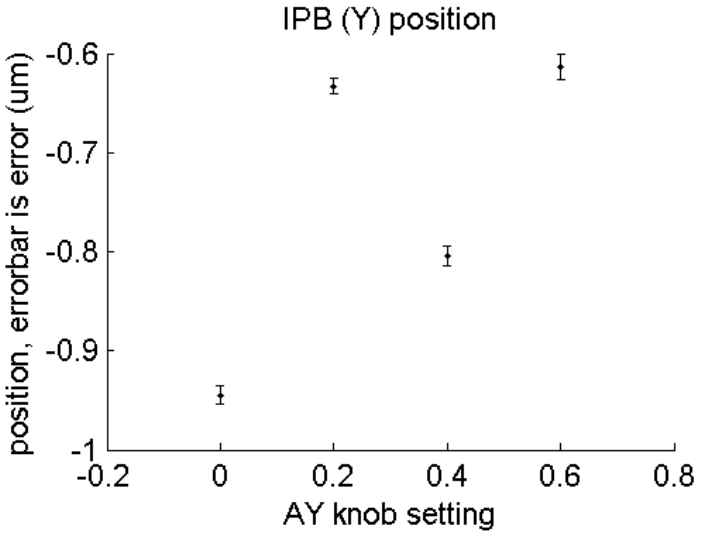
x: 20 dB

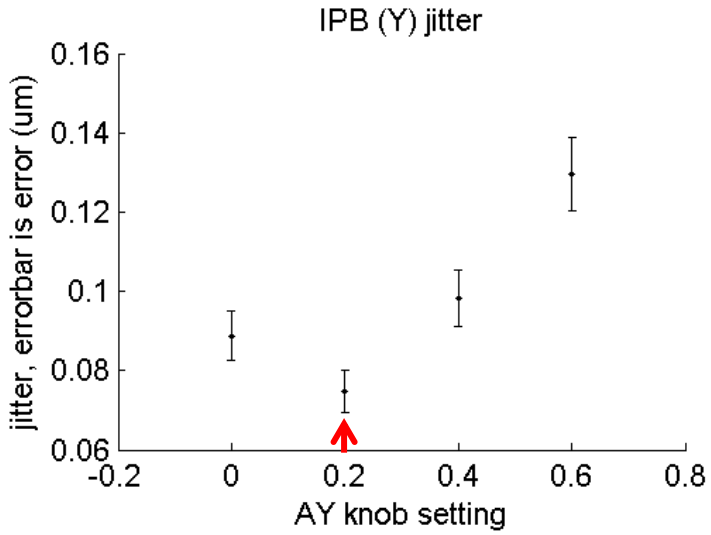




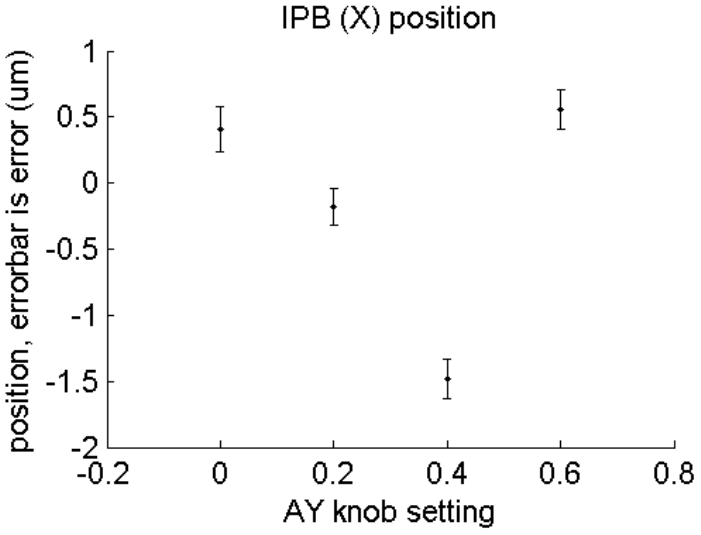
AYscan3 on 301014 using Homodyne

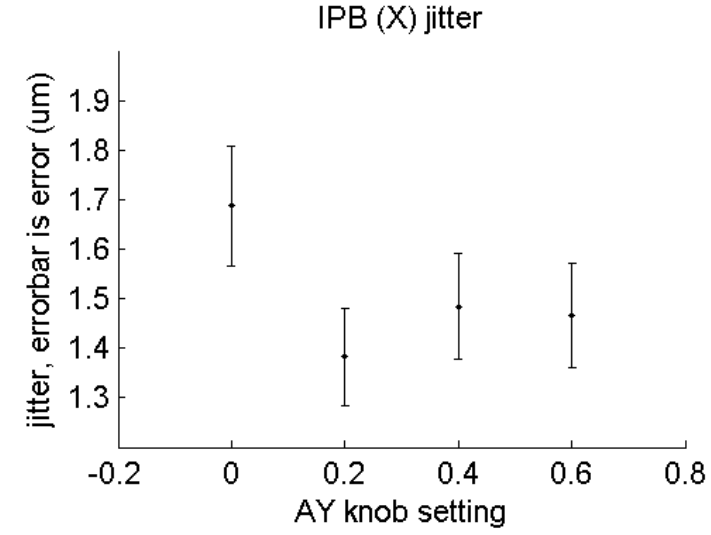
y: 0 dB





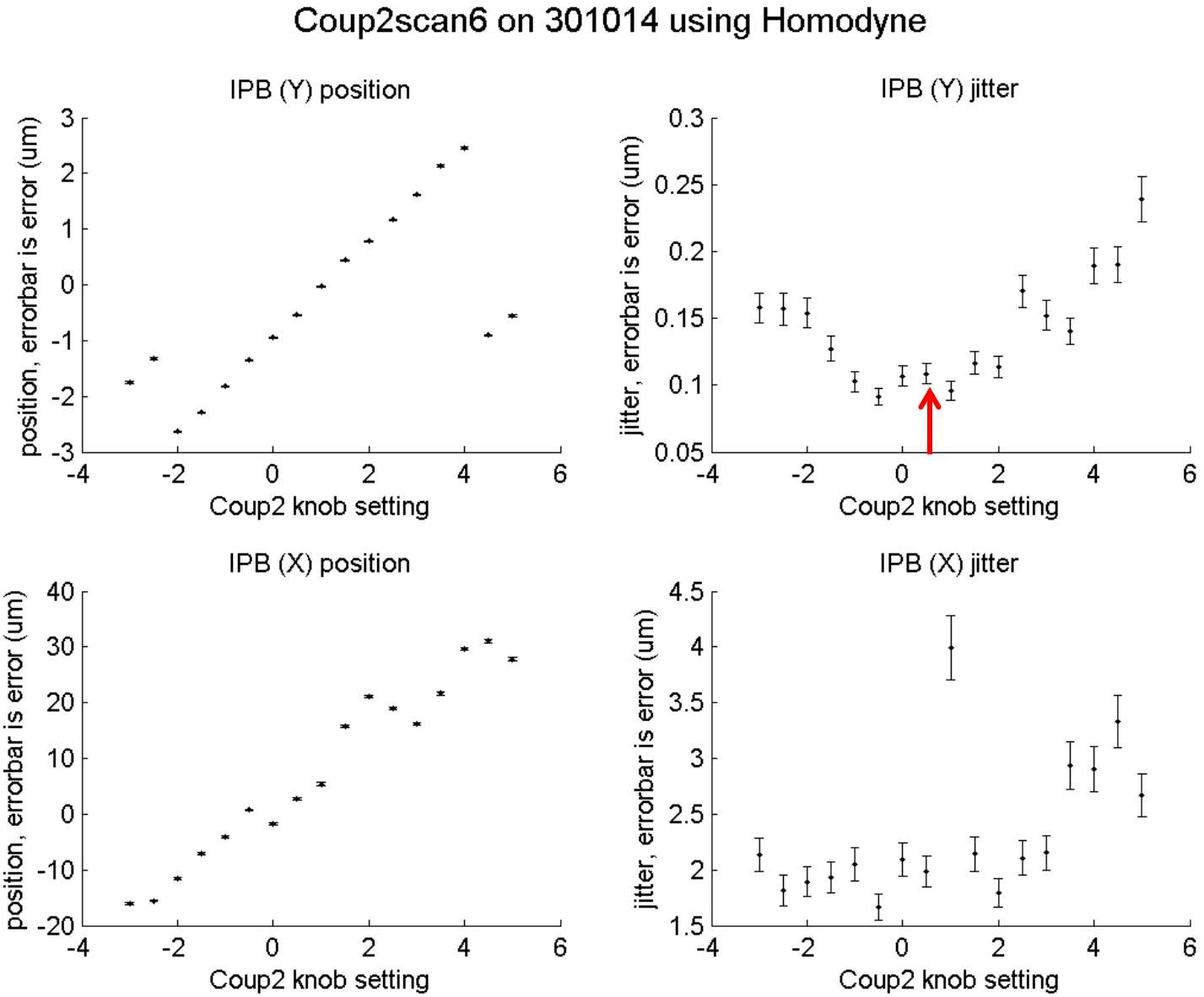
x: 20 dB





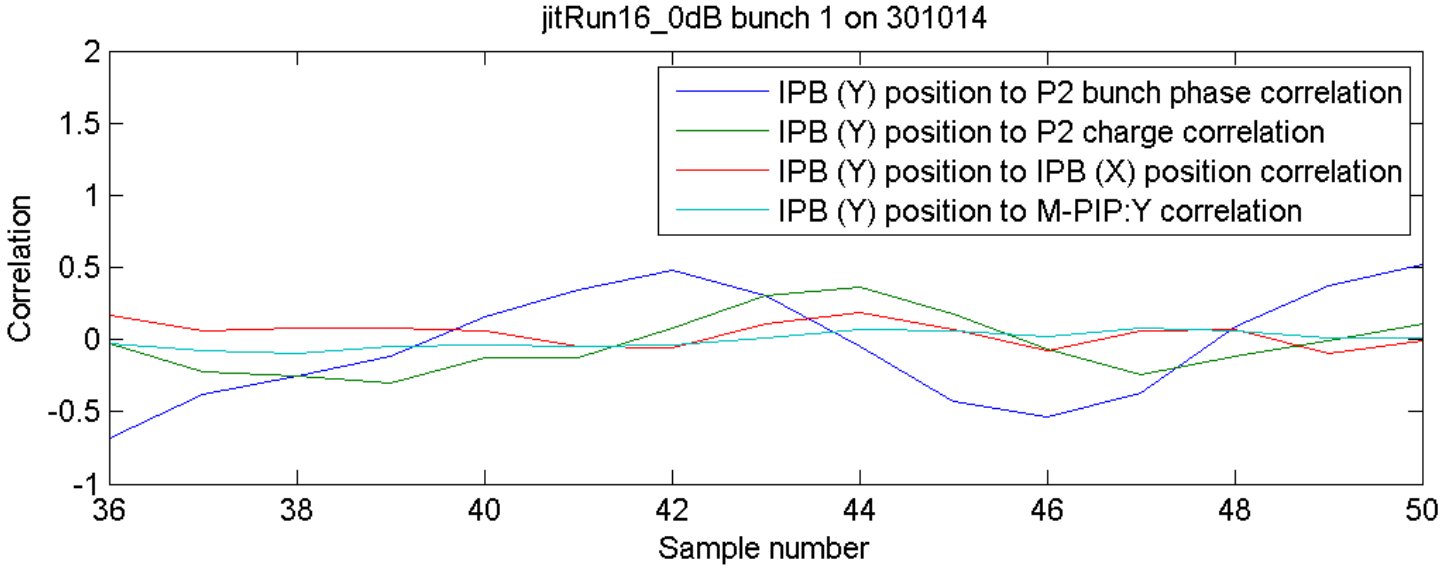
y: 0 dB

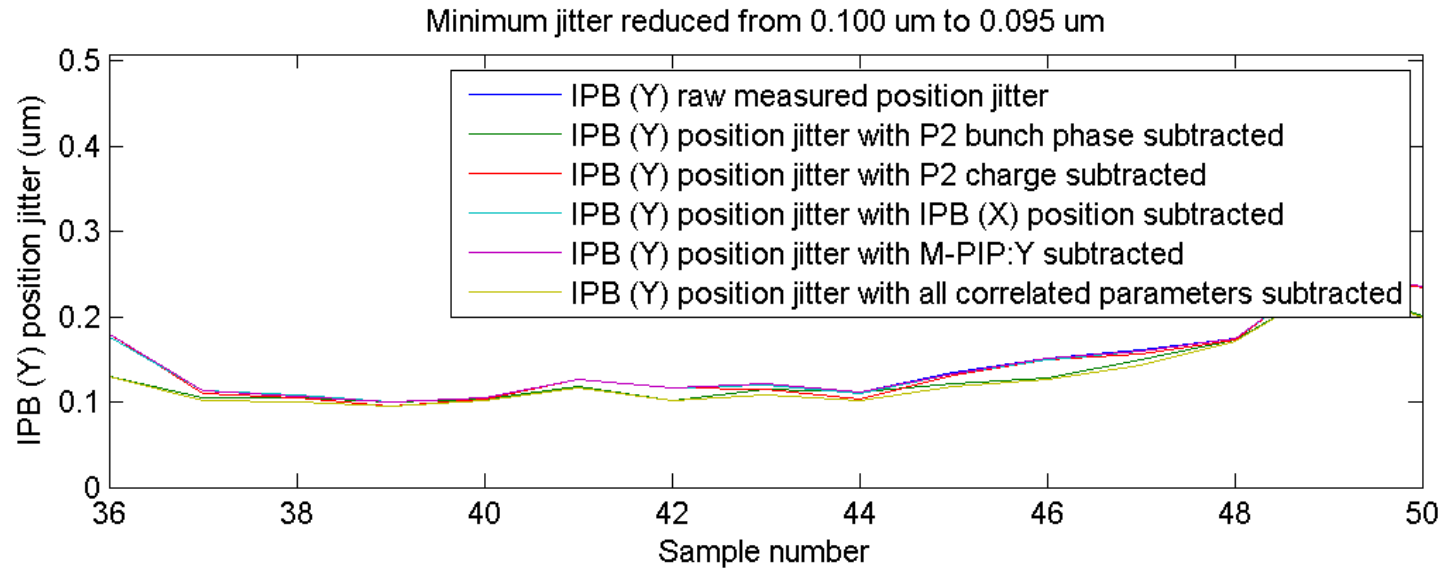
x: 20 dB


Coup2scan6 on 301014 using Homodyne
IPB (Y) position
position, errorbar is error (um)
Coup2 knob setting
IPB (Y) jitter
jitter, errorbar is error (um)
Coup2 knob setting
IPB (X) position
position, errorbar is error (um)
Coup2 knob setting
IPB (X) jitter
jitter, errorbar is error (um)
Coup2 knob setting

Correlated components

- Perform correlated component subtraction on jitter run taken after linear knob scans


jitRun16_0dB bunch 1 on 301014
IPB (Y) position to P2 bunch phase correlation
IPB (Y) position to P2 charge correlation
IPB (Y) position to IPB (X) position correlation
IPB (Y) position to M-PIP:Y correlation
Correlation
Sample number


Minimum jitter reduced from 0.100 um to 0.095 um
IPB (Y) raw measured position jitter
IPB (Y) position jitter with P2 bunch phase subtracted
IPB (Y) position jitter with P2 charge subtracted
IPB (Y) position jitter with IPB (X) position subtracted
IPB (Y) position jitter with M-PIP:Y subtracted
IPB (Y) position jitter with all correlated parameters subtracted
IPB (Y) position jitter (um)
Sample number

Jitter on waist

Remove correlation with	Jitter at IPB (Y) (nm)	
	Single-sample	Multi-sample
Nothing	100	86
P2 charge	96	86
P2 phase	100	85
PIP (Y) position	100	86
IPB (X) position	100	85
All of the above	95	84

Summary

- Negligible correlation of IPB (Y) position with PIP (Y) or IPB (X)
- Jitter after QF1FF & QD0FF current scans:
  - 115 nm (single point)
  - 100 nm (multi-point averaging)
- Jitter after EY, AY & Coup2 scans:
  - 100 nm (single point)
  - 85 nm (multi-point averaging)