Interpolated jitter at the IP waist

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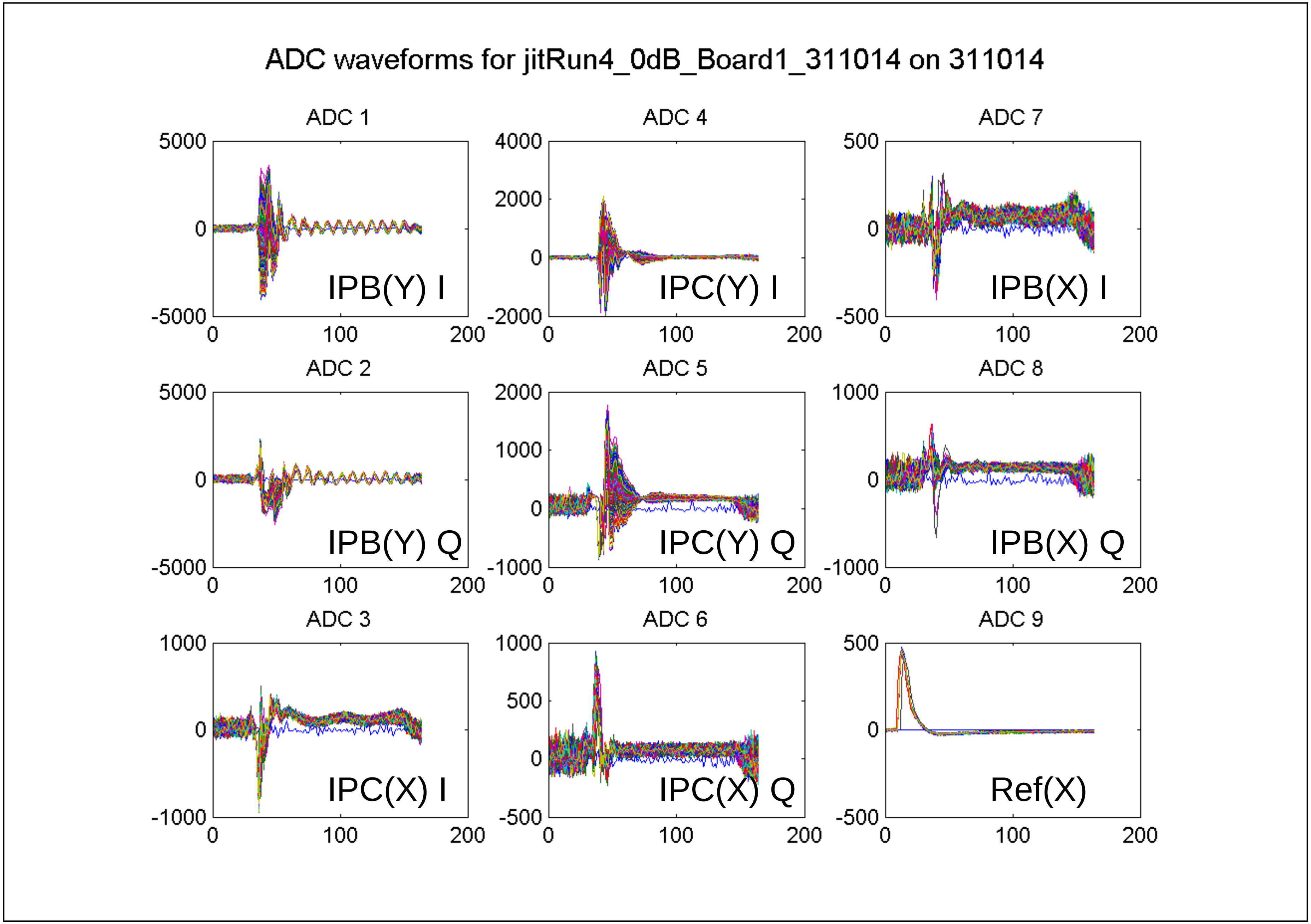
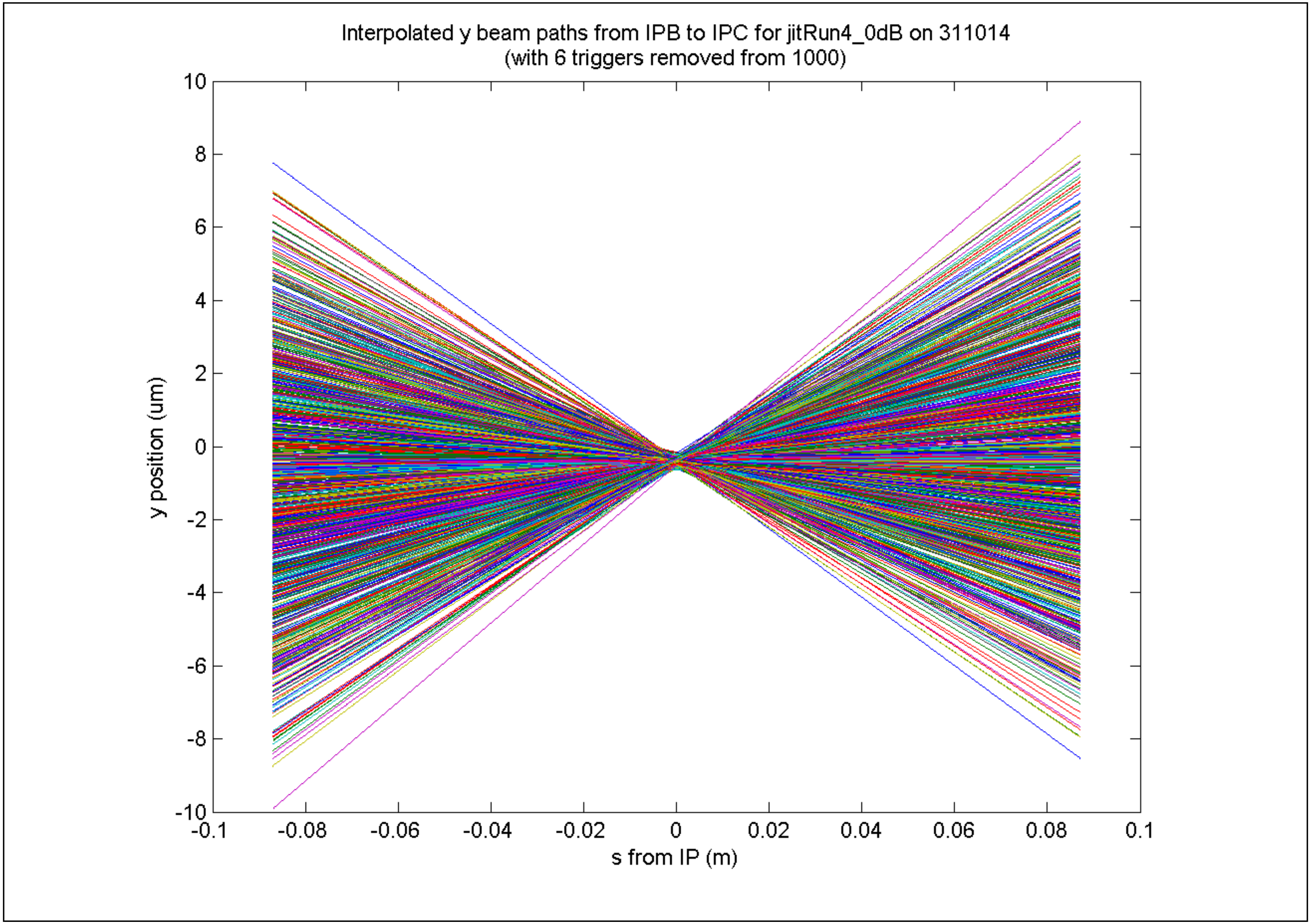
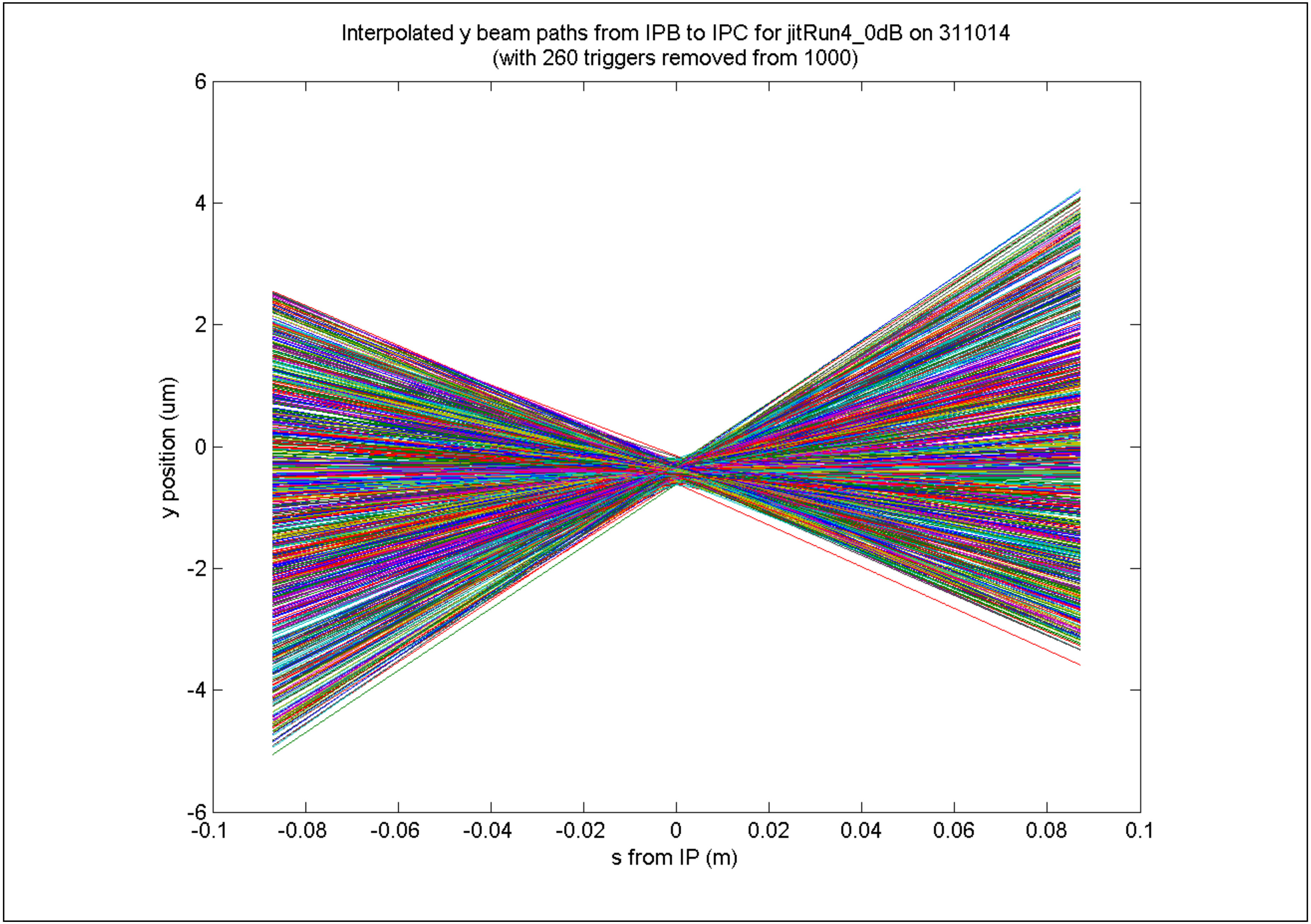
- Place cuts on $\sqrt{I^2 + Q^2}$ to eliminate triggers that may be saturating electronics
- Break up 1000 trigger data run into smaller sets to assess beam drift

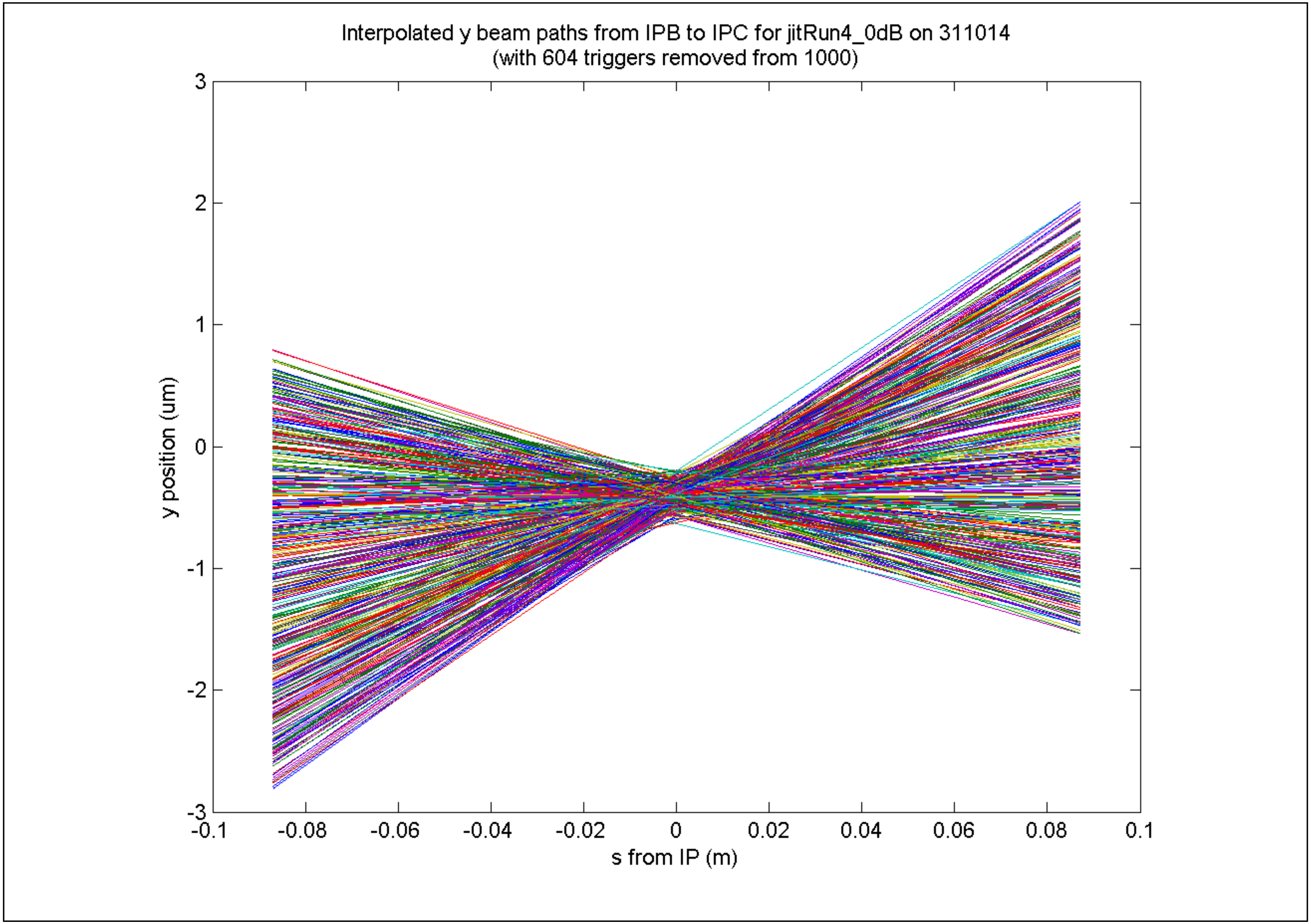

ADC waveforms for jitRun4_0dB_Board1_311014 on 311014
ADC 1
IPB(Y) I
ADC 4
IPC(Y) I
ADC 7
IPB(X) I
ADC 2
IPB(Y) Q
ADC 5
IPC(Y) Q
ADC 8
IPB(X) Q
ADC 3
IPC(X) I
ADC 6
IPC(X) Q
ADC 9
Ref(X)

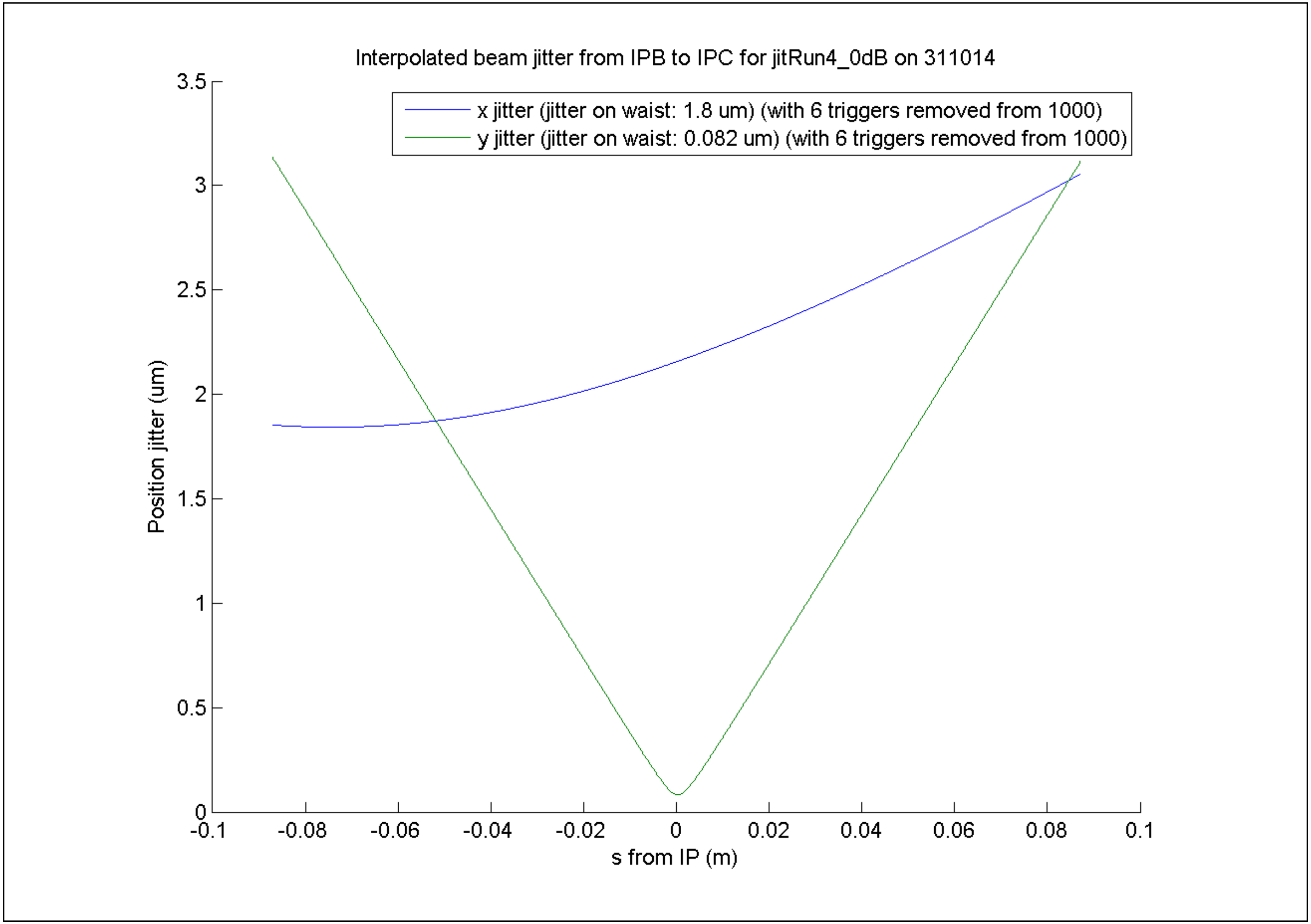
Saturation cut

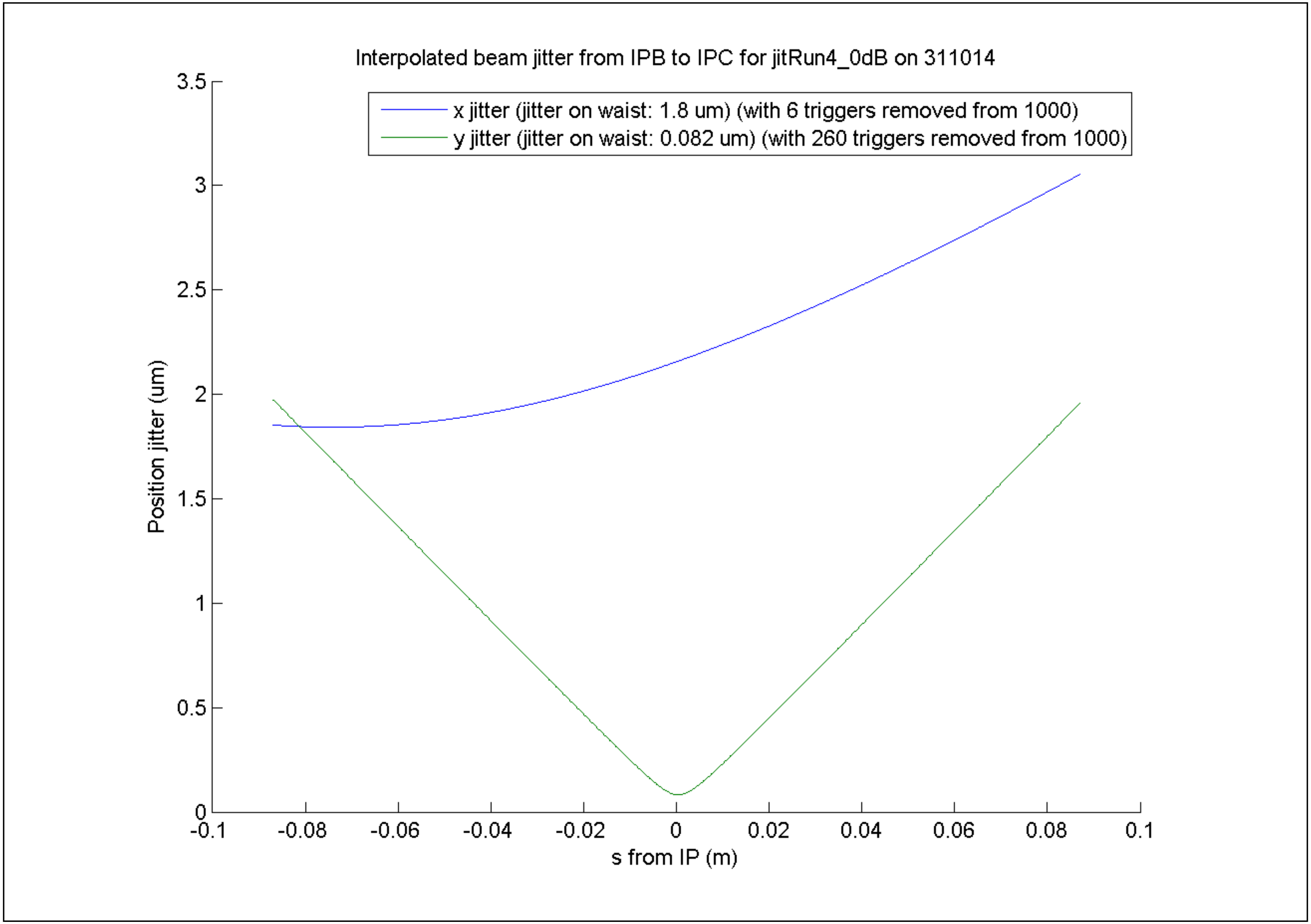
- Place cuts on $\sqrt{I^2 + Q^2}$ of:
  - 6000 ADC counts (6 triggers cut from 1000)
  - 3000 ADC counts (260 triggers cut from 1000)
  - 2500 ADC counts (604 triggers cut from 1000)
- For each:
  - Interpolate y trajectory from IPB to IPC
  - Measure interpolated jitter from IPB to IPC

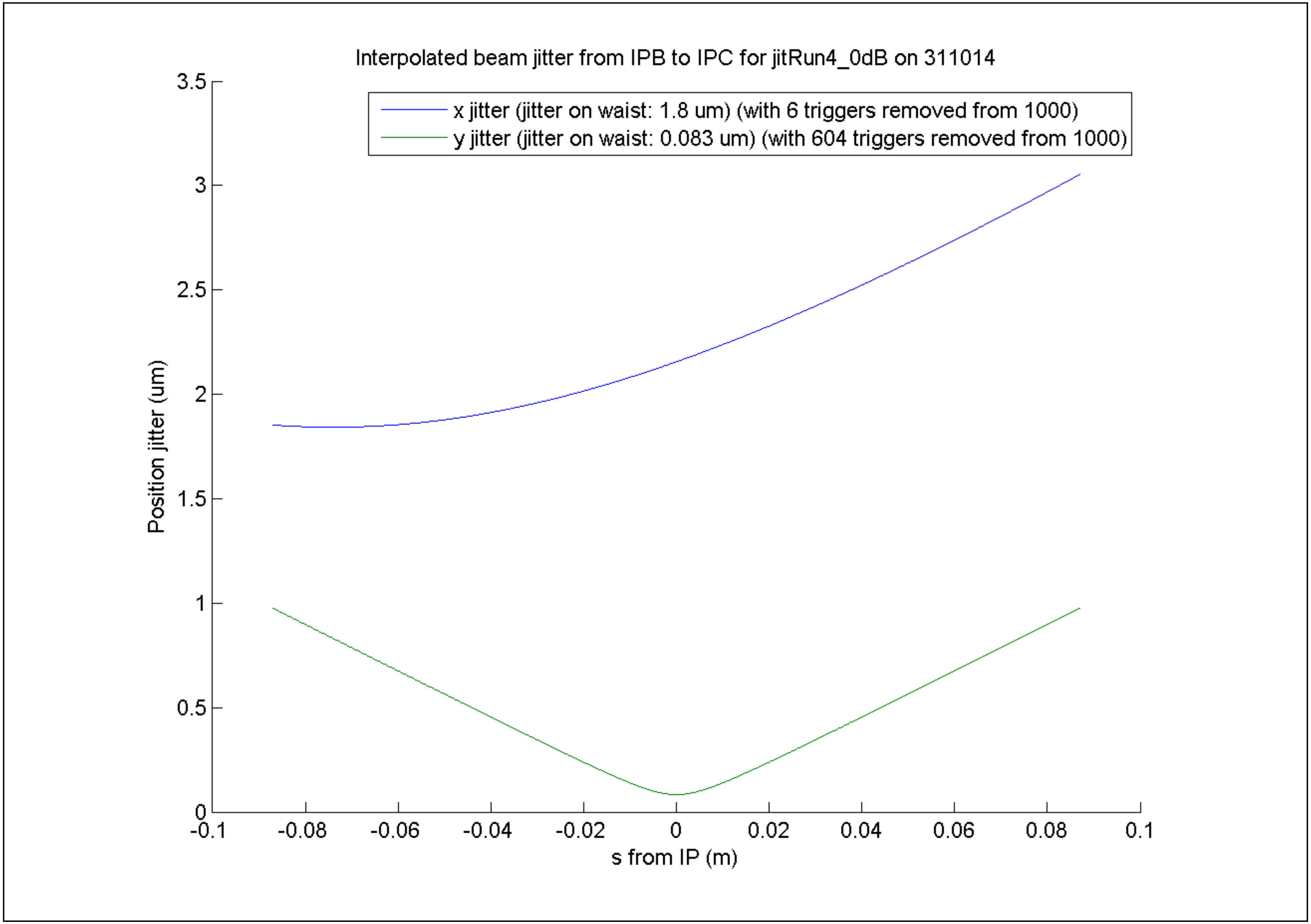

Interpolated y beam paths from IPB to IPC for jitRun4_0dB on 311014
(with 6 triggers removed from 1000)
y position (um)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
s from IP (m)


Interpolated y beam paths from IPB to IPC for jitRun4_0dB on 311014
(with 260 triggers removed from 1000)
y position (um)
s from IP (m)
6
4
2
0
-2
-4
-6
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated y beam paths from IPB to IPC for jitRun4_0dB on 311014
(with 604 triggers removed from 1000)
y position (um)
s from IP (m)
3
2
1
0
-1
-2
-3
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated beam jitter from IPB to IPC for jitRun4_0dB on 311014
x jitter (jitter on waist: 1.8 um) (with 6 triggers removed from 1000)
y jitter (jitter on waist: 0.082 um) (with 6 triggers removed from 1000)
Position jitter (um)
s from IP (m)
3.5
3
2.5
2
1.5
1
0.5
0
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated beam jitter from IPB to IPC for jitRun4_0dB on 311014
x jitter (jitter on waist: 1.8 um) (with 6 triggers removed from 1000)
y jitter (jitter on waist: 0.082 um) (with 260 triggers removed from 1000)
Position jitter (um)
s from IP (m)
3.5
3
2.5
2
1.5
1
0.5
0
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated beam jitter from IPB to IPC for jitRun4_0dB on 311014
x jitter (jitter on waist: 1.8 um) (with 6 triggers removed from 1000)
y jitter (jitter on waist: 0.083 um) (with 604 triggers removed from 1000)
Position jitter (um)
s from IP (m)
3.5
3
2.5
2
1.5
1
0.5
0
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1

Saturation cut

- Saturation cut leaves interpolated jitter unchanged (82 nm)
- As expected* if the BPM is not resolution limited with jitters of ~3 um at the BPMs

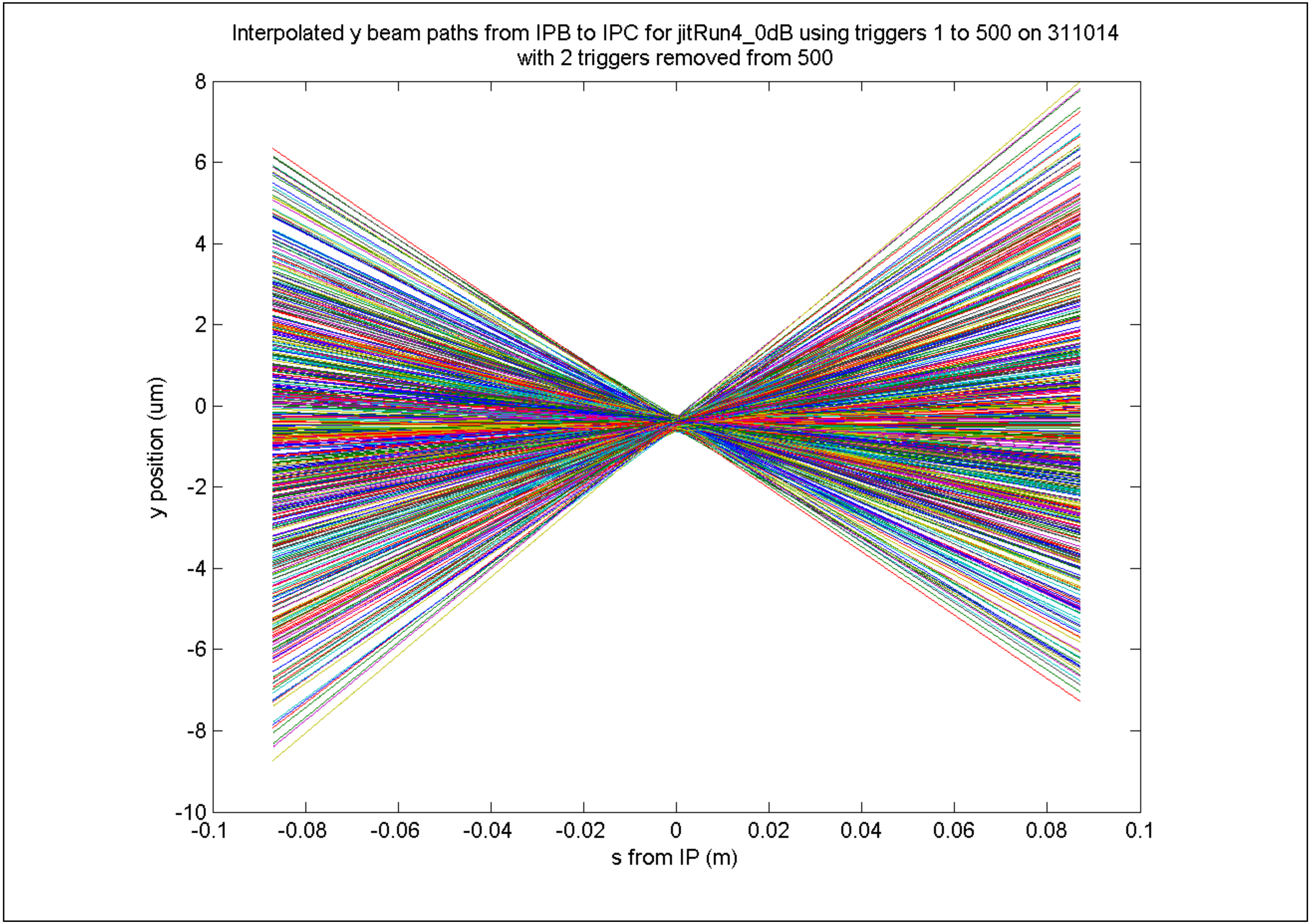
* Model says that there will be no y position correlation between locations on-waist and off-waist, so cutting on positions off-waist will not reduce jitter on-waist

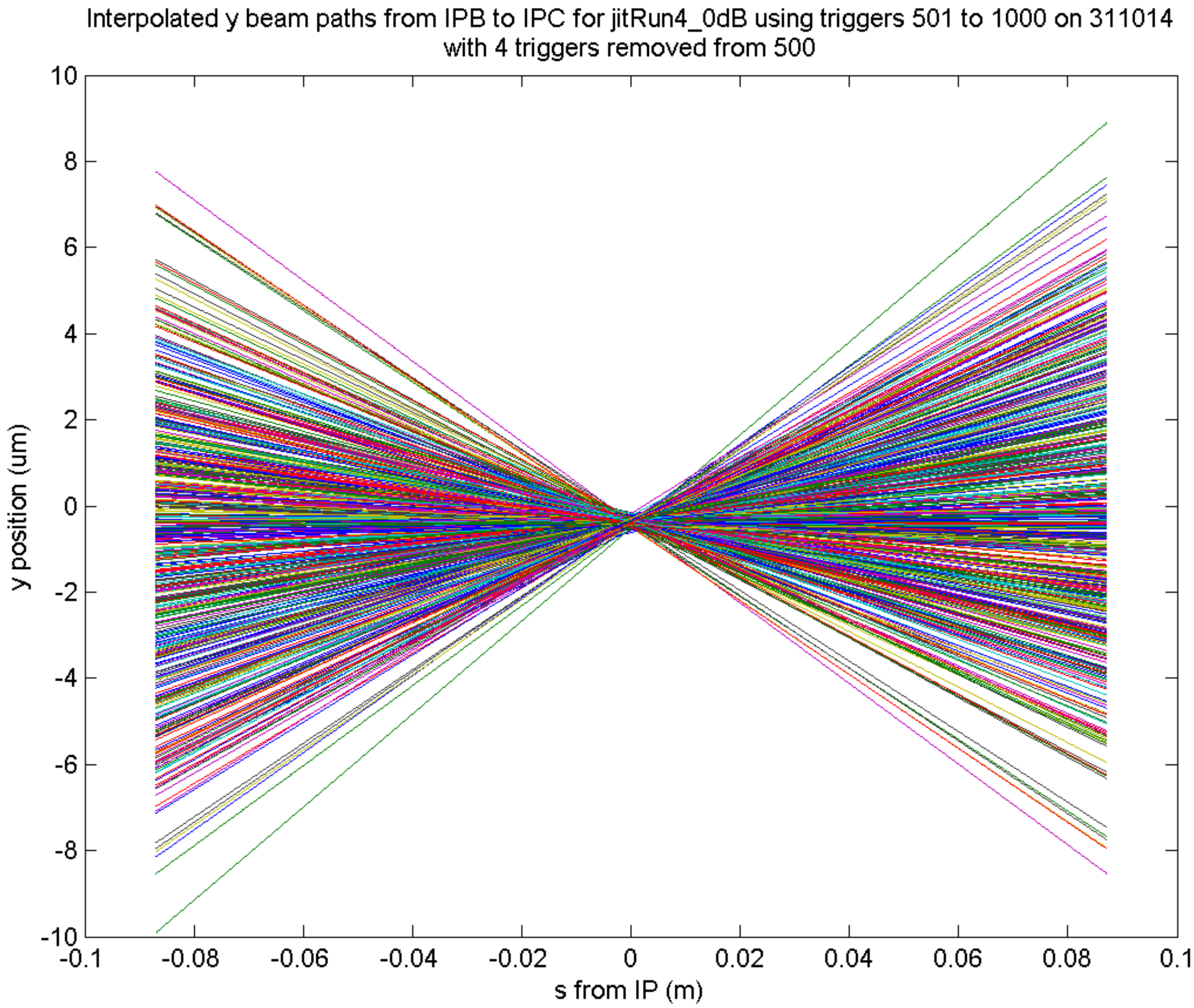
Consideration

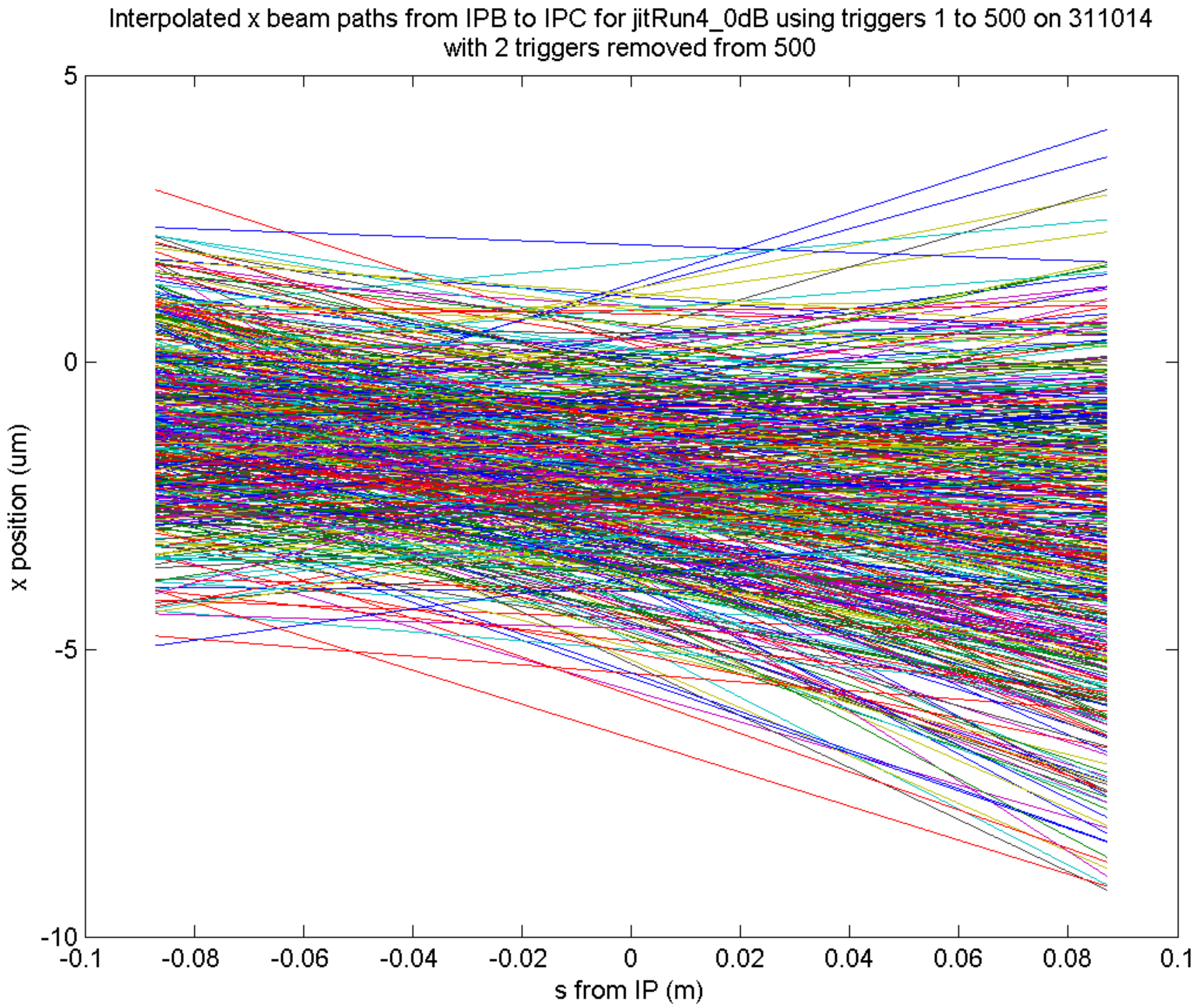
- We measure an interpolated jitter of 73 nm at 10 dB but a jitter of 82 nm at 0 dBm
- This is inconsistent with the idea of the system not being resolution limited at 0 dB
- However, the 10 dB data run has only 500 triggers whilst the 0 dB one has 1000
- Is it possible that beam drift increases the measured interpolated jitter at 0 dB?

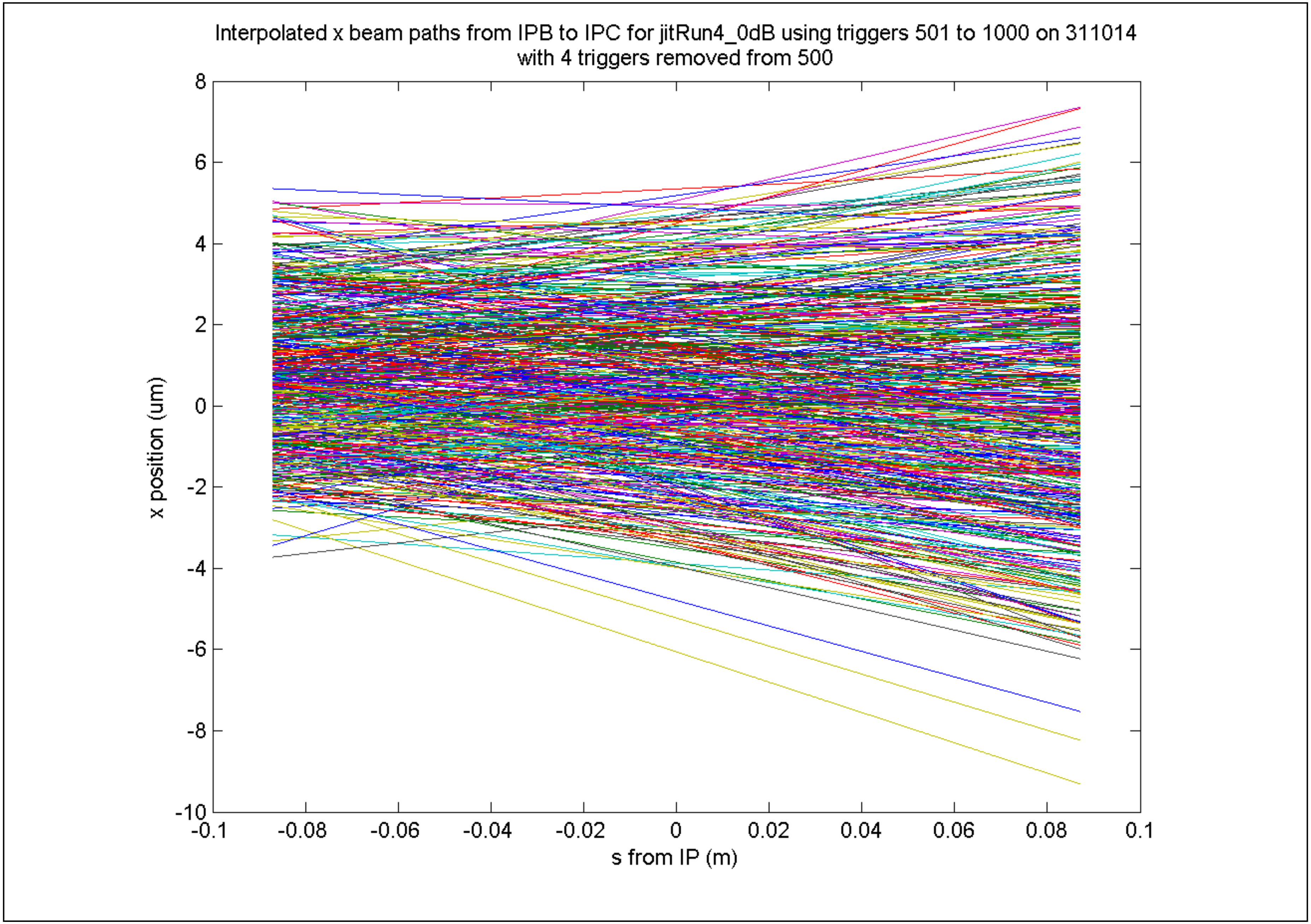
Binning data

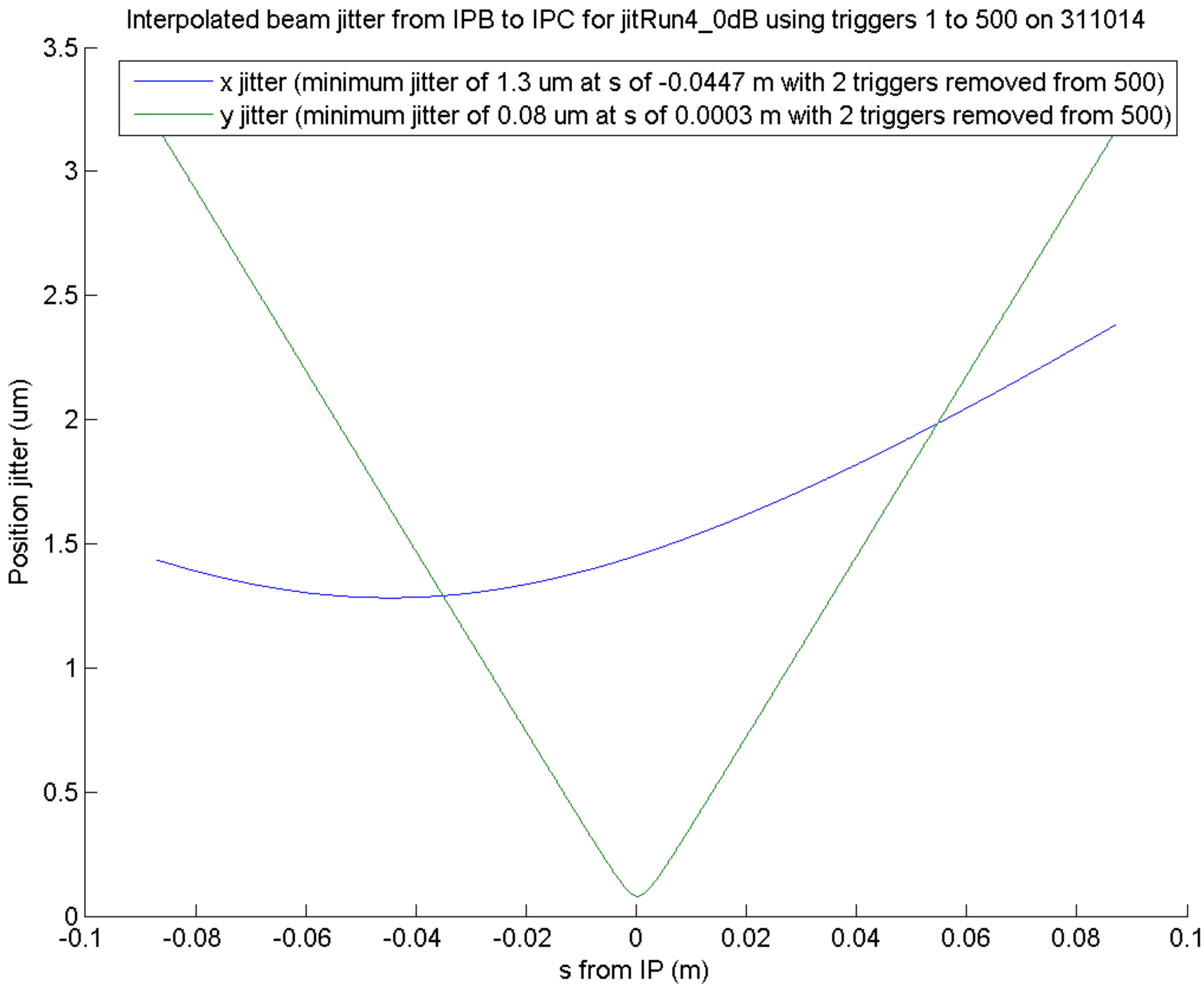
- Break up 1000 trigger data run into smaller sets to assess beam drift
- For first 500 triggers and last 500 triggers:
  - Interpolate y trajectory from IPB to IPC
  - Interpolate x trajectory from IPB to IPC
  - Measure interpolated jitter from IPB to IPC

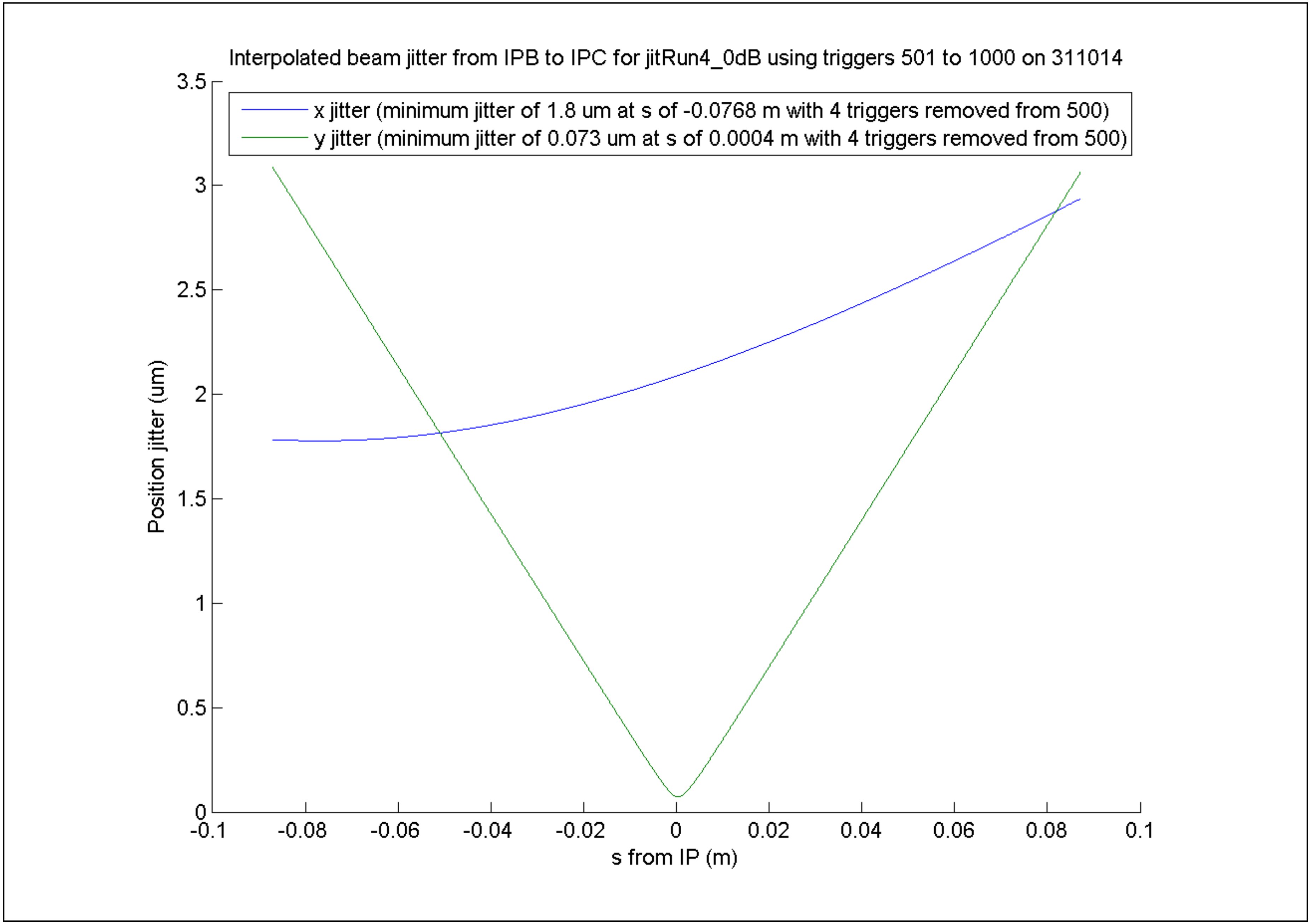

Interpolated y beam paths from IPB to IPC for jitRun4_0dB using triggers 1 to 500 on 311014
with 2 triggers removed from 500
y position (um)
s from IP (m)
8
6
4
2
0
-2
-4
-6
-8
-10
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated y beam paths from IPB to IPC for jitRun4_0dB using triggers 501 to 1000 on 311014
with 4 triggers removed from 500
y position (um)
s from IP (m)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated x beam paths from IPB to IPC for jitRun4_0dB using triggers 1 to 500 on 311014
with 2 triggers removed from 500
5
0
-5
-10
x position (um)
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
s from IP (m)


Interpolated x beam paths from IPB to IPC for jitRun4_0dB using triggers 501 to 1000 on 311014
with 4 triggers removed from 500
x position (um)
s from IP (m)
8
6
4
2
0
-2
-4
-6
-8
-10
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1


Interpolated beam jitter from IPB to IPC for jitRun4_0dB using triggers 1 to 500 on 311014
x jitter (minimum jitter of 1.3 um at s of -0.0447 m with 2 triggers removed from 500)
y jitter (minimum jitter of 0.08 um at s of 0.0003 m with 2 triggers removed from 500)
Position jitter (um)
s from IP (m)
0
0.5
1
1.5
2
2.5
3
3.5
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1



Interpolated beam jitter from IPB to IPC for jitRun4_0dB using triggers 501 to 1000 on 311014
x jitter (minimum jitter of 1.8 um at s of -0.0768 m with 4 triggers removed from 500)
y jitter (minimum jitter of 0.073 um at s of 0.0004 m with 4 triggers removed from 500)
Position jitter (um)
s from IP (m)
3.5
3
2.5
2
1.5
1
0.5
0
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1

Binning data

- First 500 triggers give an interpolated jitter of 80 nm; last 500 triggers report 73 nm
- The 73 nm interpolated jitter at 10 dB may be consistent with the interpolated jitter measured at 0 dB
- Beam drift in x seems concerning!