IP FB Tests Status

Feedback On Nanosecond Timescales (FONT):

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John Adams Institute

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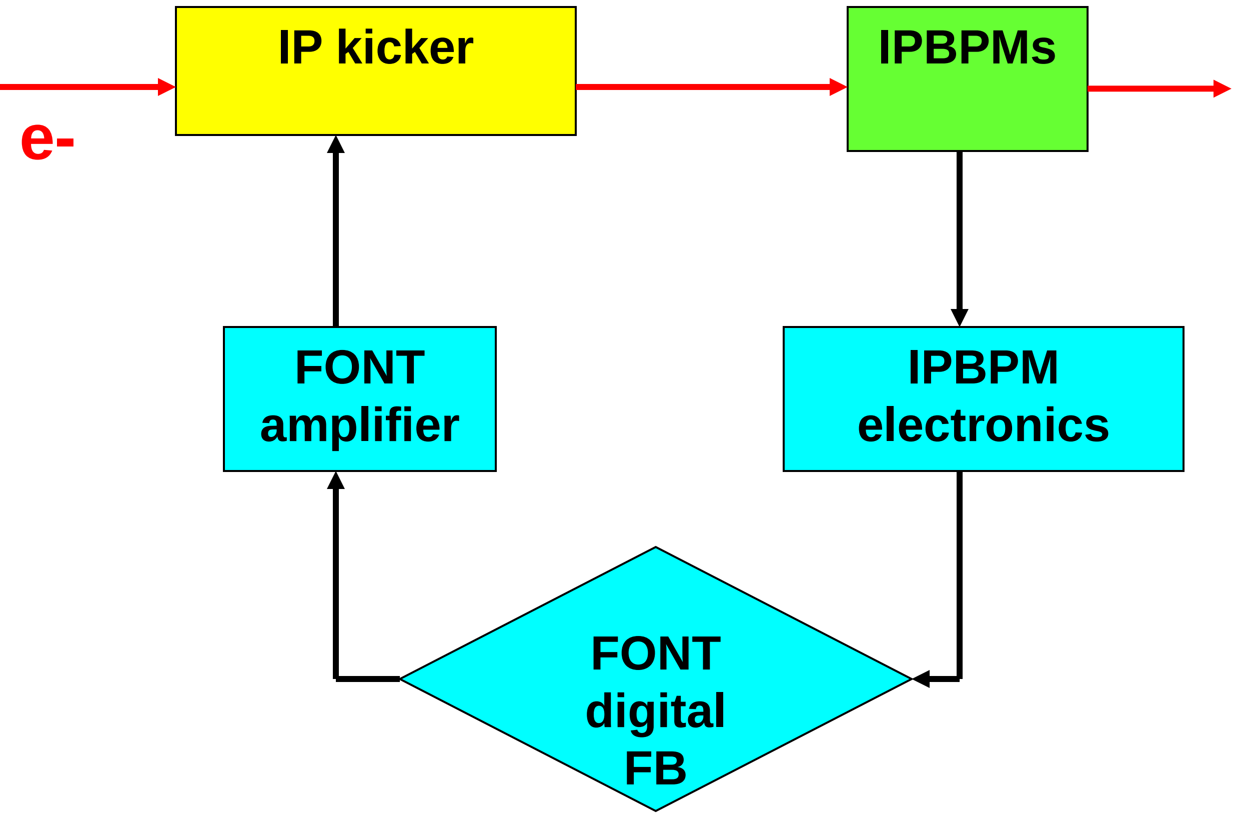
Outline

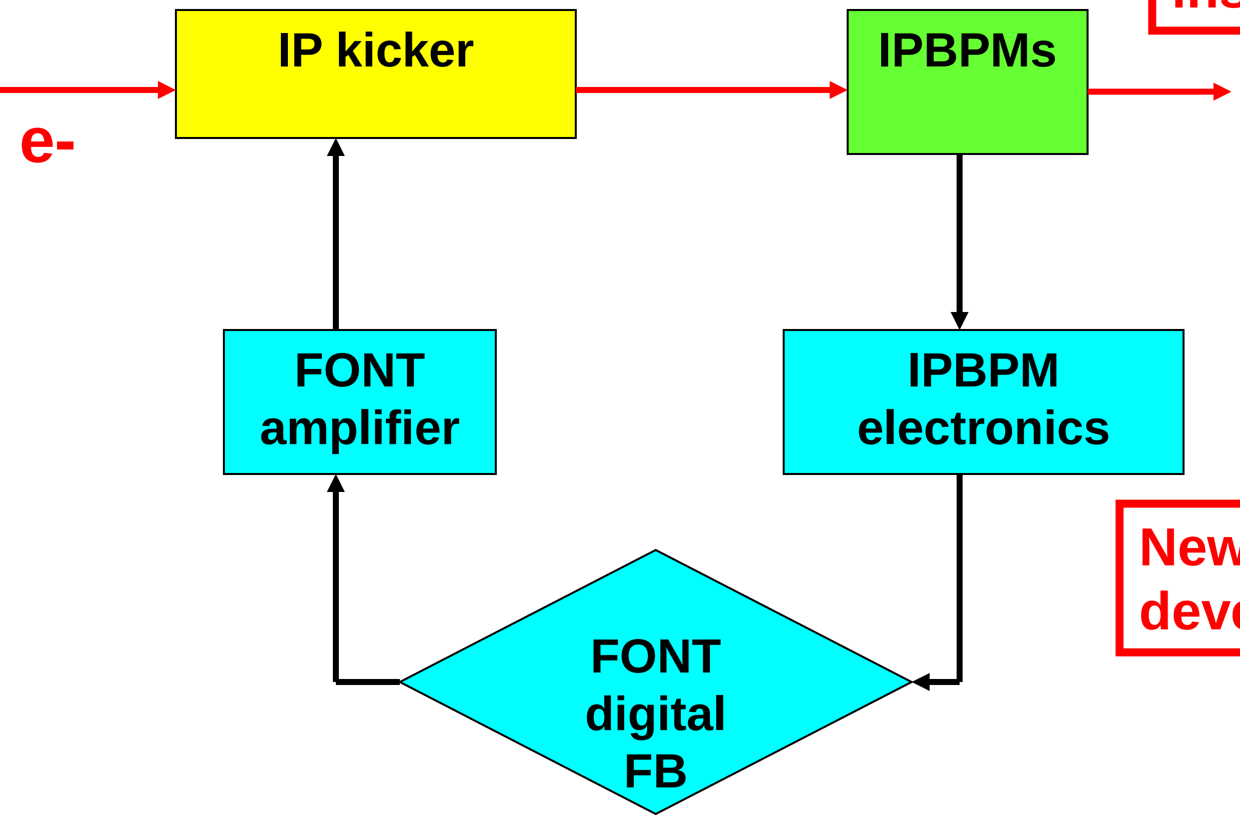
- Reminder of ATF2 IP FB concept
- Preliminary results of June beam runs
- Summary
- Speculations

ATF2 IP FB loop scheme



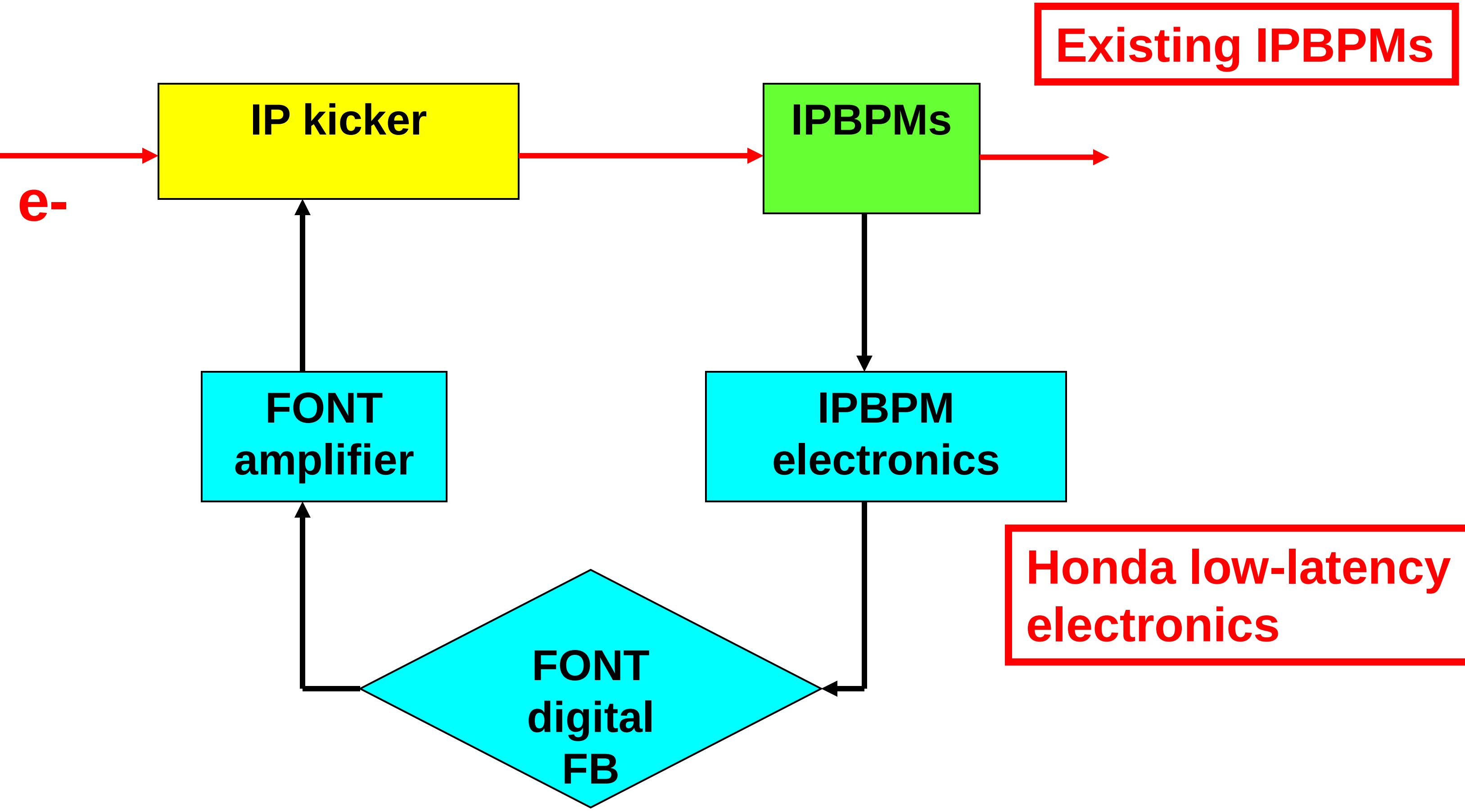
Tests > October 2013

New IP chamber
installed Summer 2013



New IPBPM electronics
developed by KNU

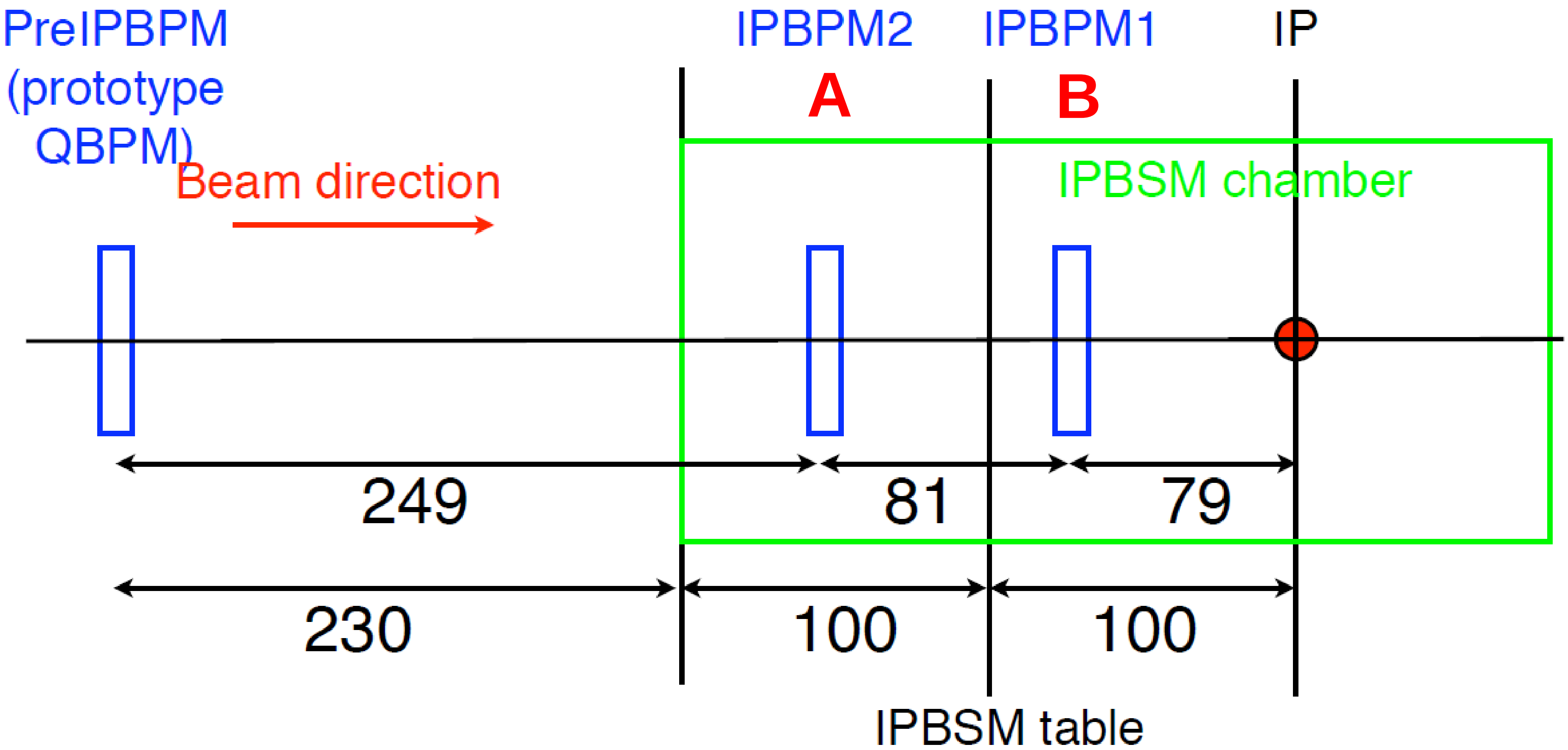
Tests < July 2013



Existing IP-BPM geometry

2011.6.29 Y.Honda

- Relative location of IP and two IPBPMs in BSM chamber and PreIPBPM.
- Accuracy of the number should be a few mm.

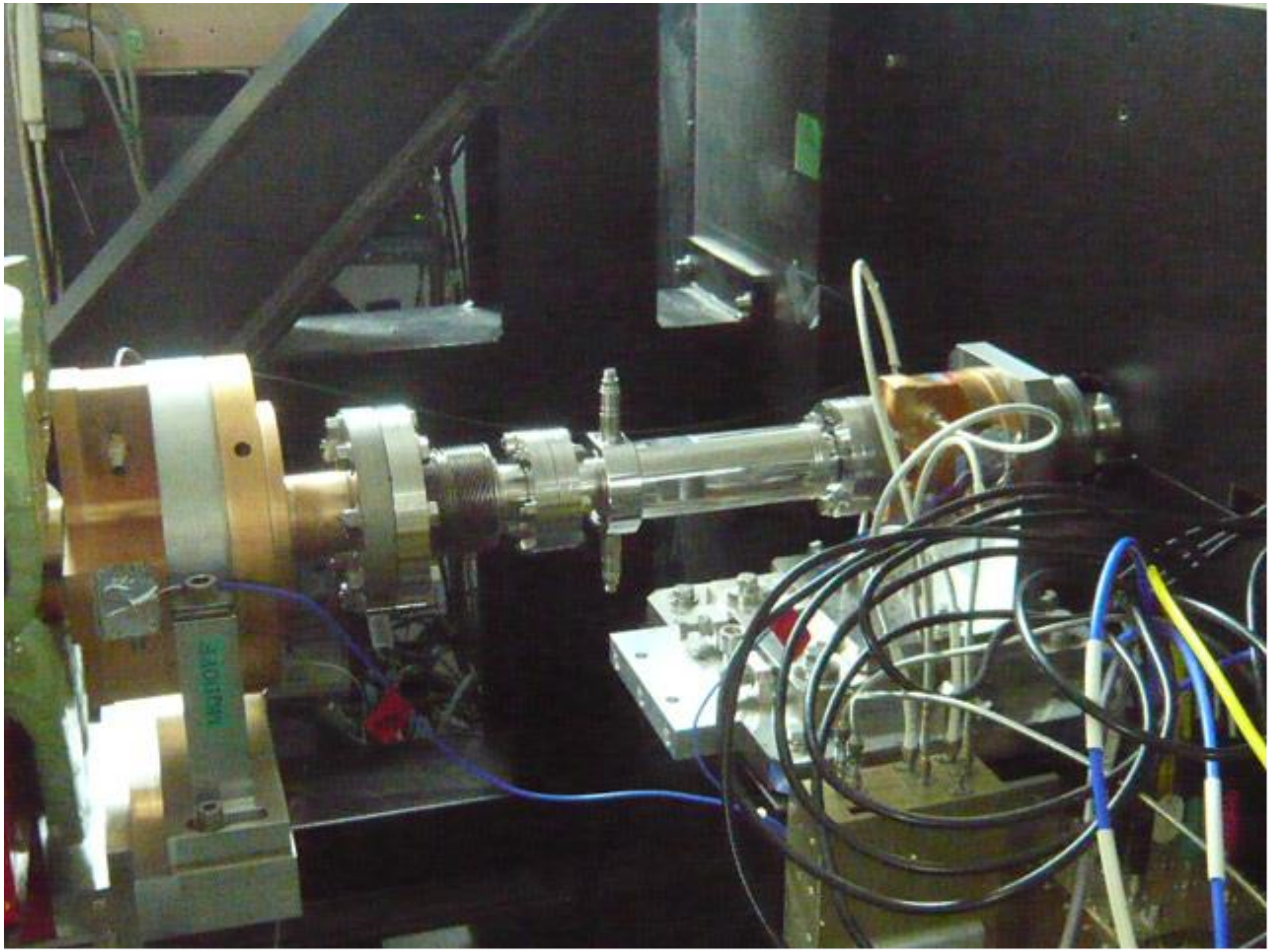


Layout with new IP kicker

Designed by Oxford

Fabrication arranged by KEK

Installed May 2012



Test programme

Preparations for beam stability in IP region with

2-bunch beam, bunch separation 270ns:

1. Readout of IPBPMs with 2-bunch beam

2. Upstream FONT FB: record beam in IPBPMs

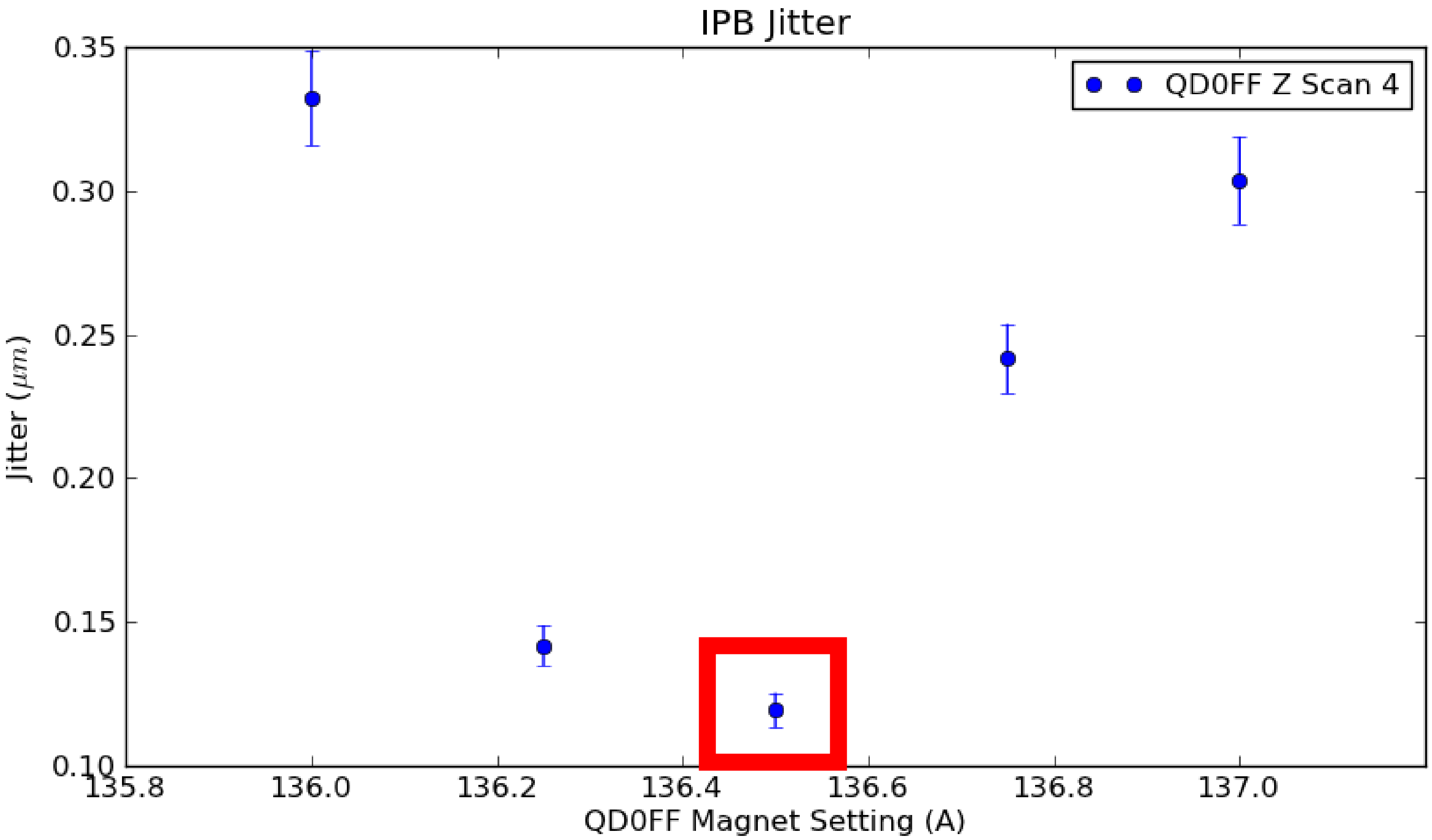
3. Feed-forward from upstream FONT BPMs → IP kicker: record beam in IPBPMs

4. IP FB using IPBPM signal and IP kicker

Standard procedure is to correct beam in y at IPB

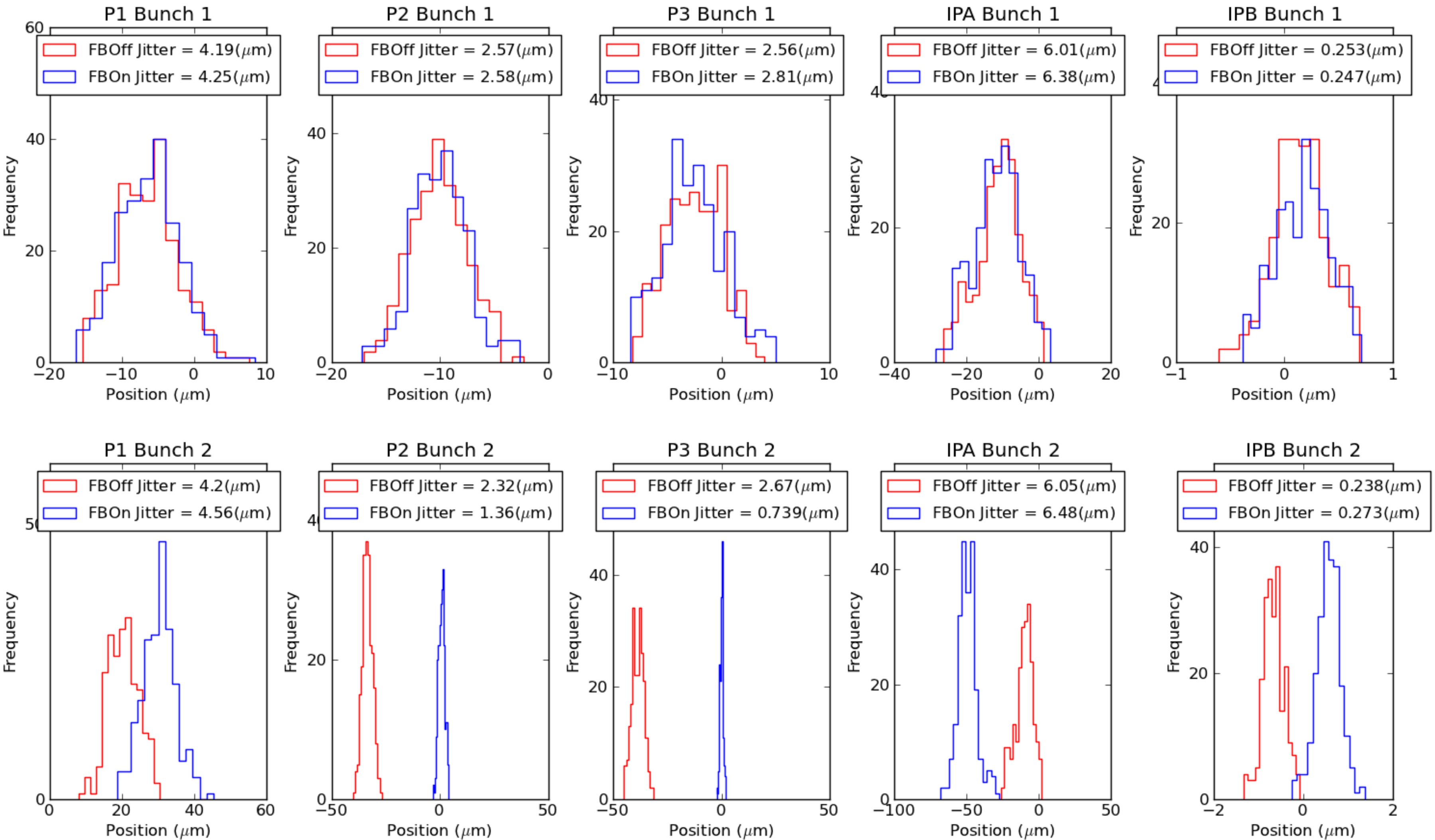
Resolution of IPBPMs

Single-bunch mode, scan of y-waist to minimise jitter in IPB: minimum ~ 120nm → resolution < 120nm



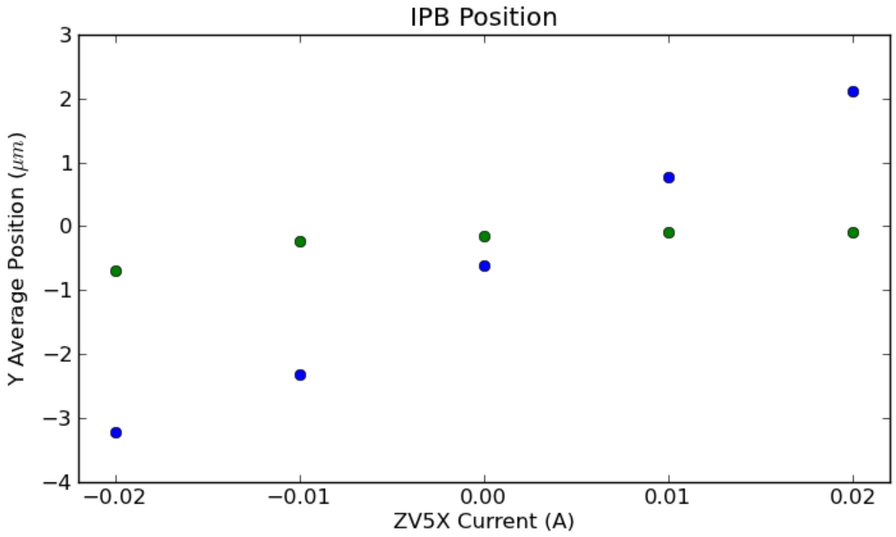
Upstream FB: example

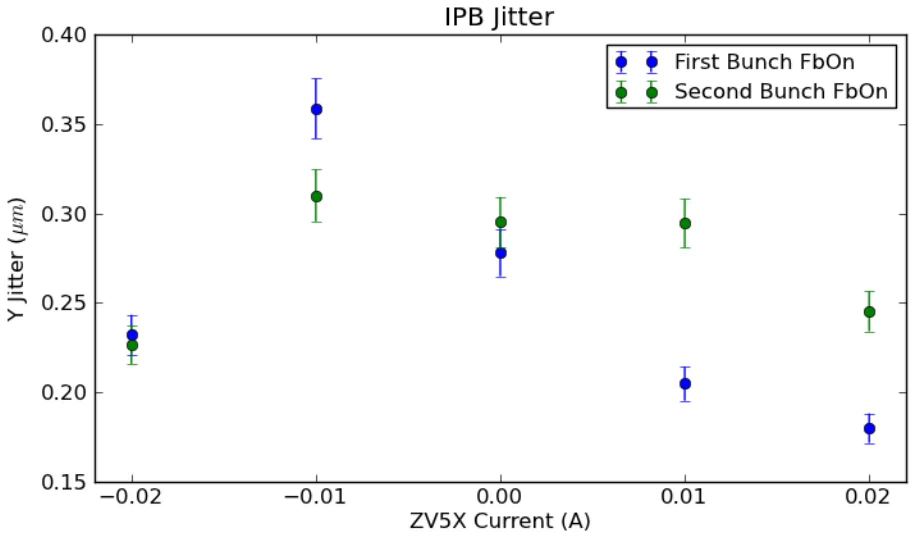
Observe effect of upstream FB at IP



Upstream FB: position scan

- FB gain nominal for correction in FONT region
- Scan ZV5X (upstream of FONT region)
- Monitor beam position and jitter at IPB

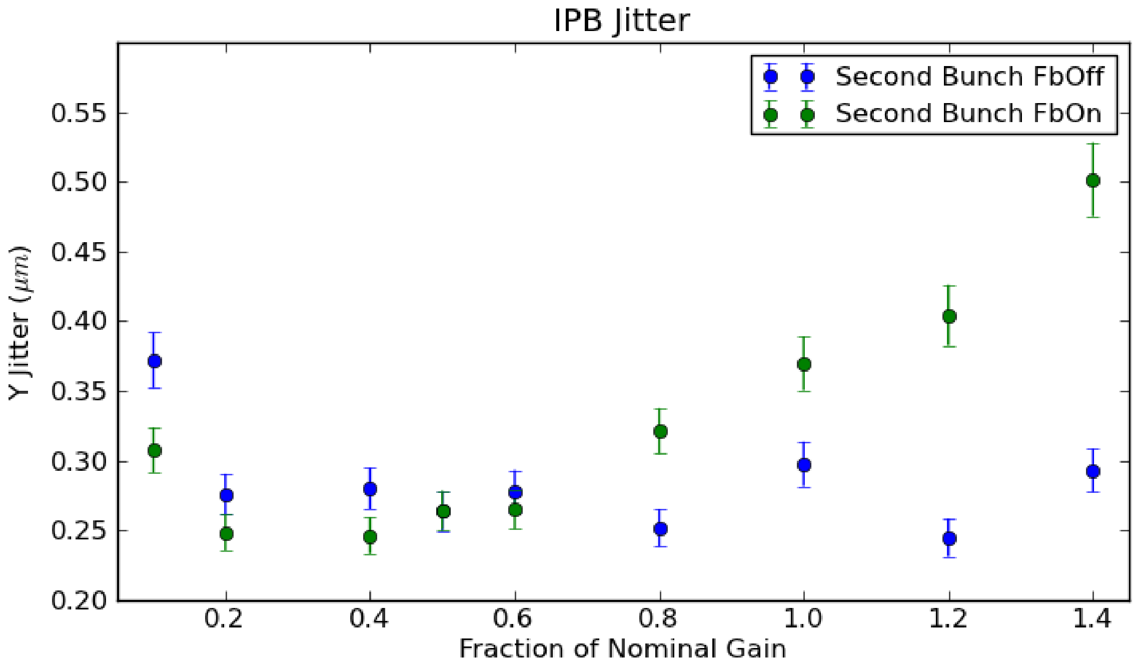




Upstream FB centres beam, but increases jitter

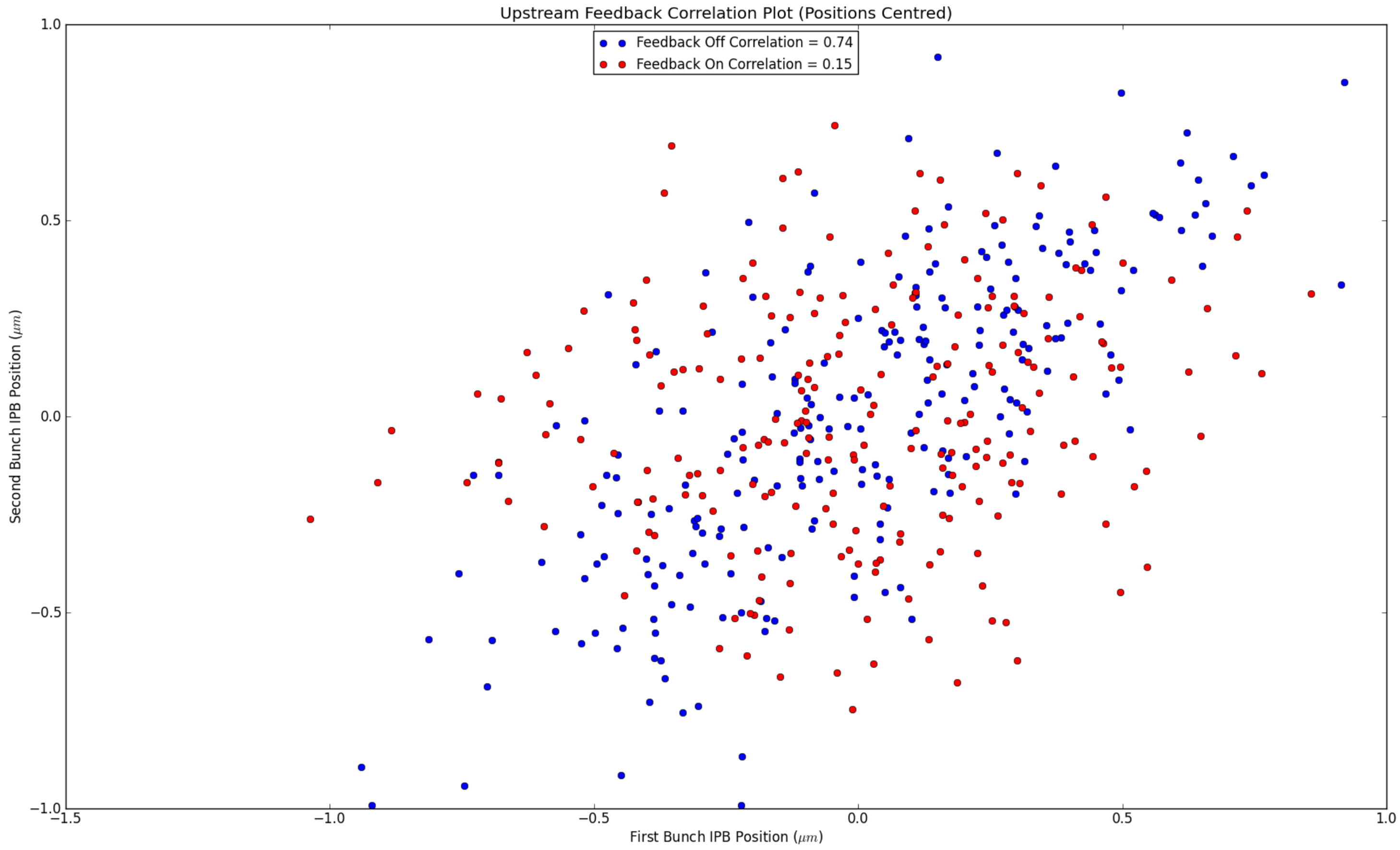
Upstream FB: gain scan

- **FB gain scan**
- **Monitor beam position and jitter at IPB**



Some jitter decrease at low gain

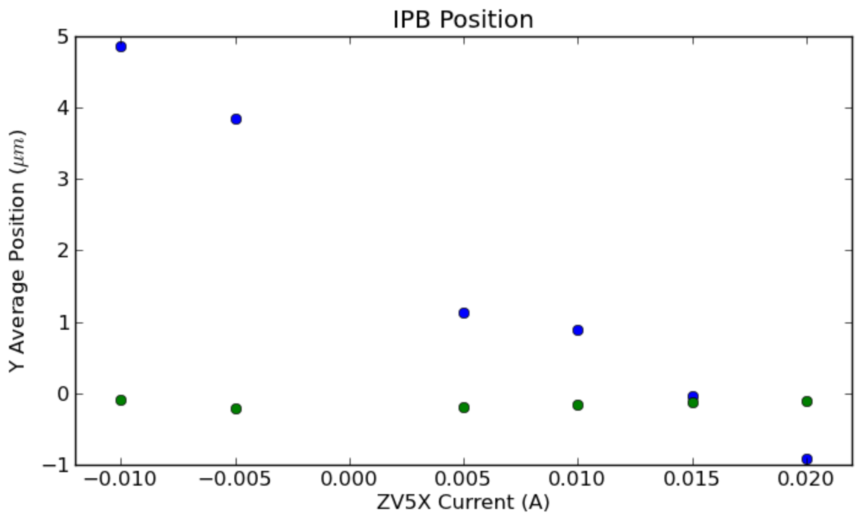
Upstream FB: bunch correlations

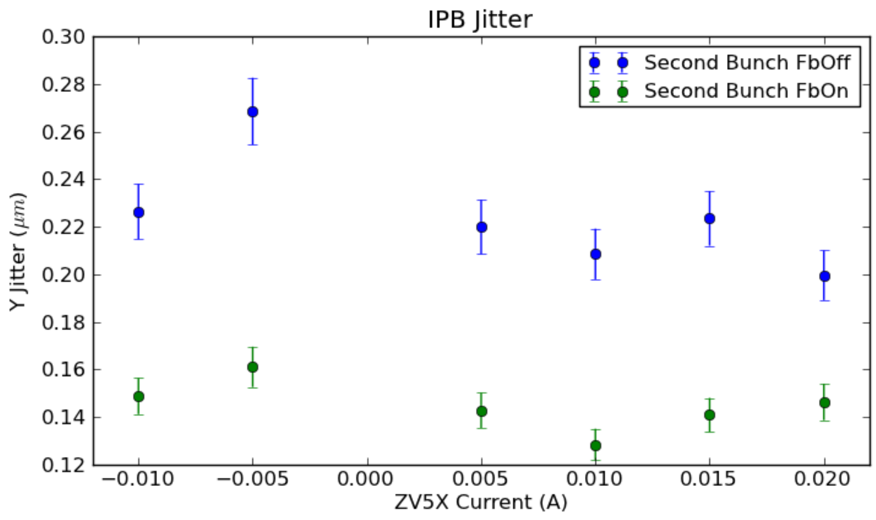


FB does remove correlated jitter component, but dominated by white noise

Feed-forward mode

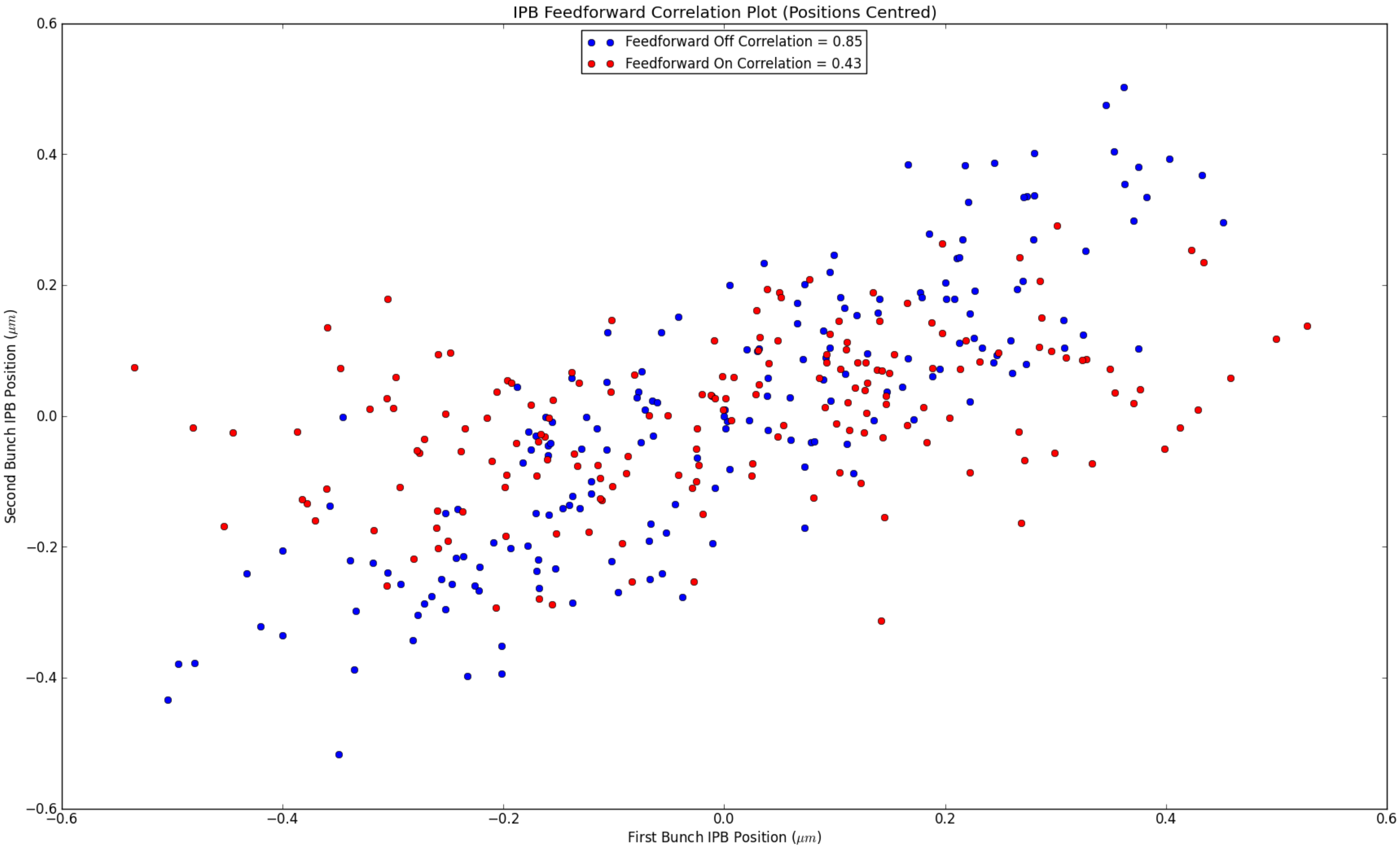
- FF gain optimised for best correction @ IP
- Scan ZV5X (upstream of FONT region)
- Monitor beam position and jitter at IPB





FF centres beam, and reduces jitter x 2

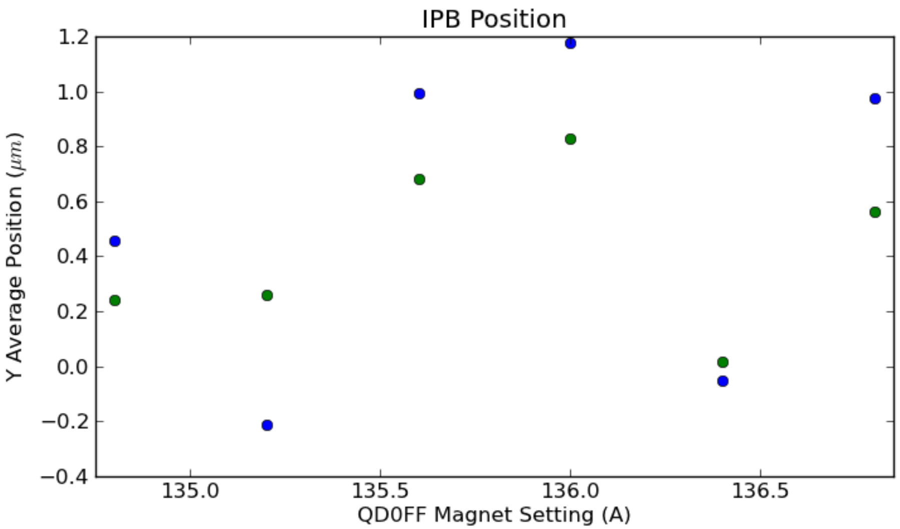
FF: bunch correlations

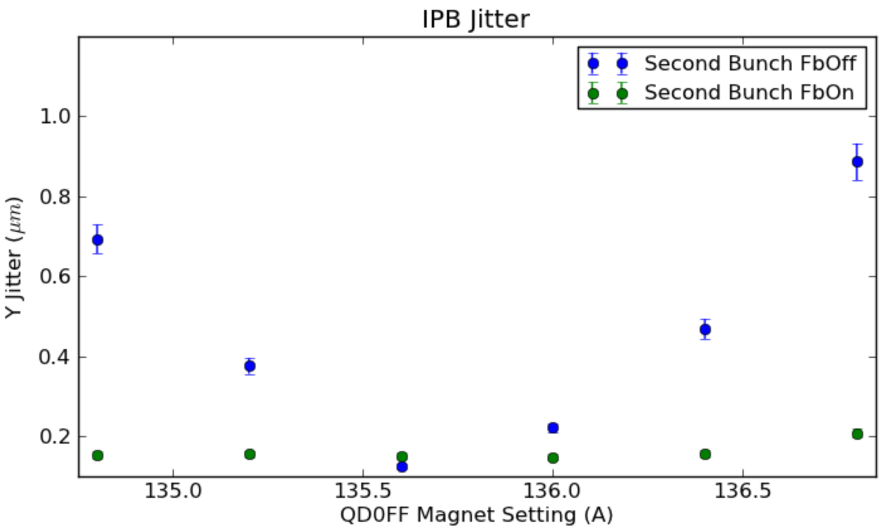


FF removes correlated jitter component, not white noise dominated

IP FB

- Nominal IP FB gain
- Scan QD0FF to move waist (increases jitter)
- Monitor beam position and jitter at IPB

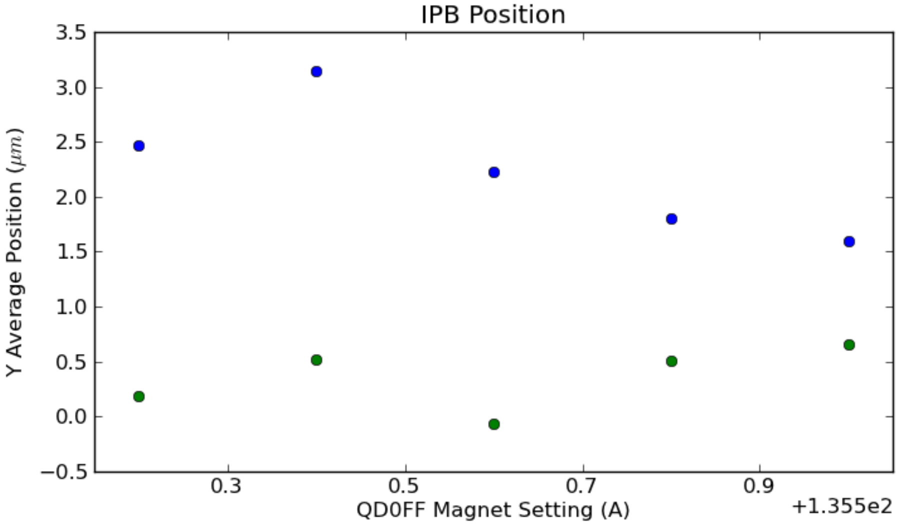


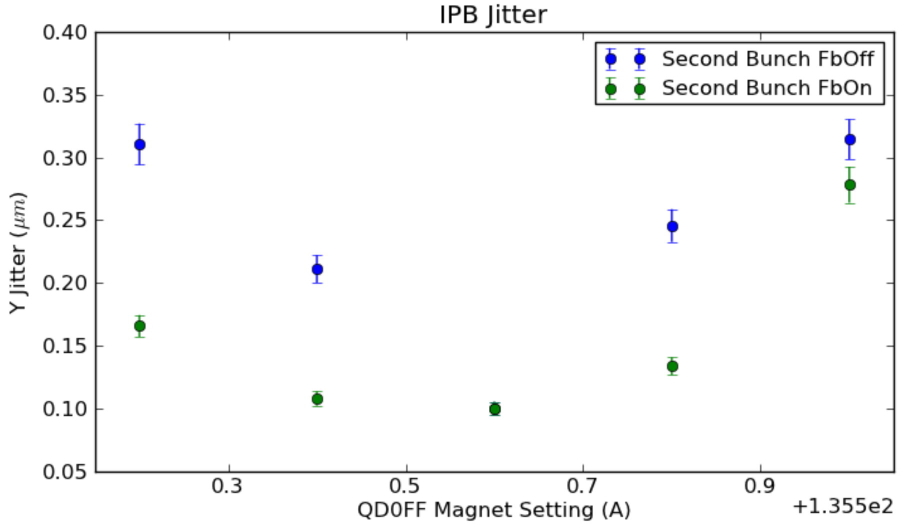


IPFB reduces jitter as waist is scanned across IPB

Optimised IP FB

- IP FB gain optimised empirically
- Scan QD0FF to move waist (increases jitter)
- Monitor beam position and jitter at IPB





IPFB reduces jitter to minimum of ~ 100nm

Optimised IP FB

- IP FB gain optimised empirically
- Scan QD0FF to move waist (increases jitter)
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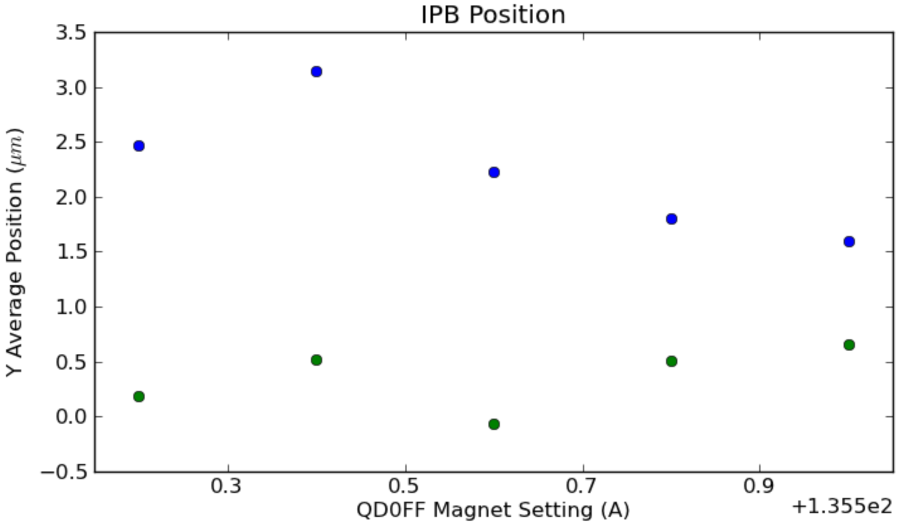
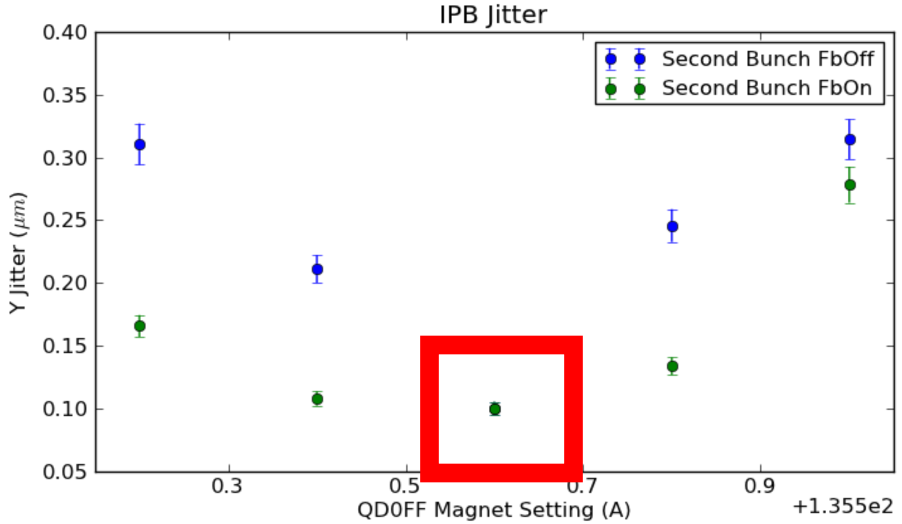
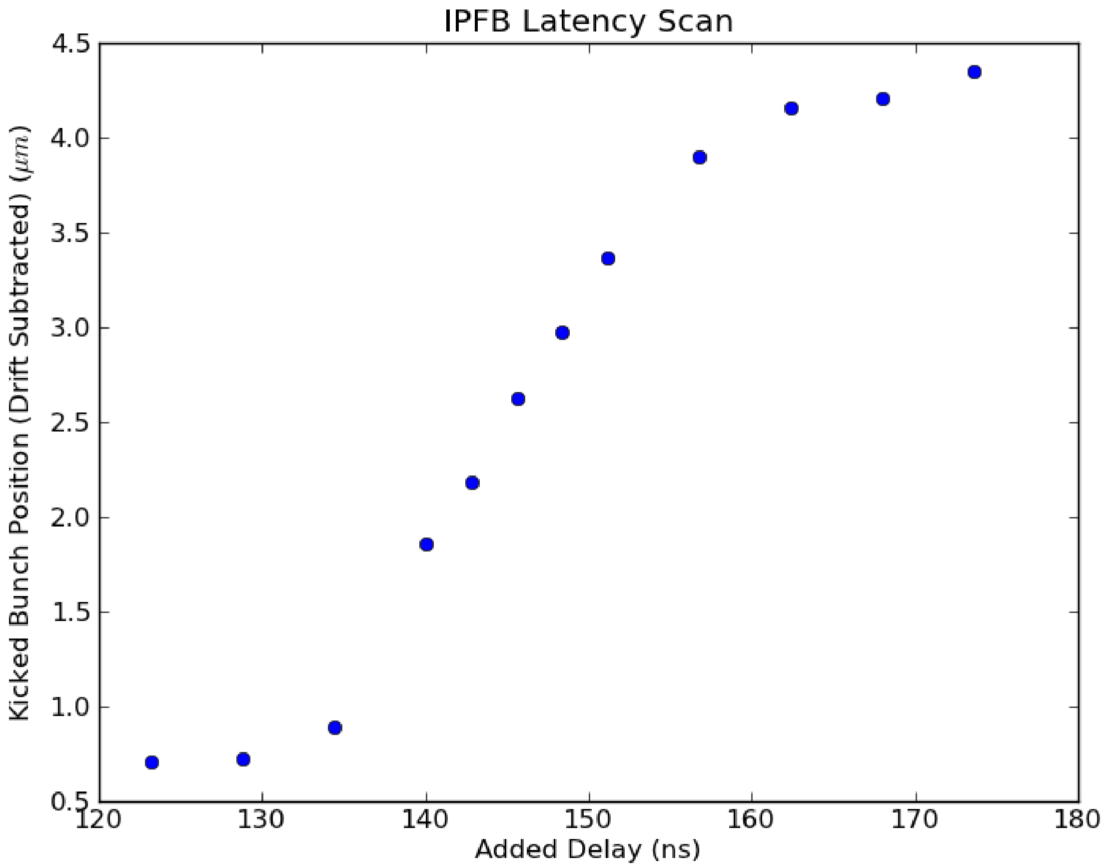




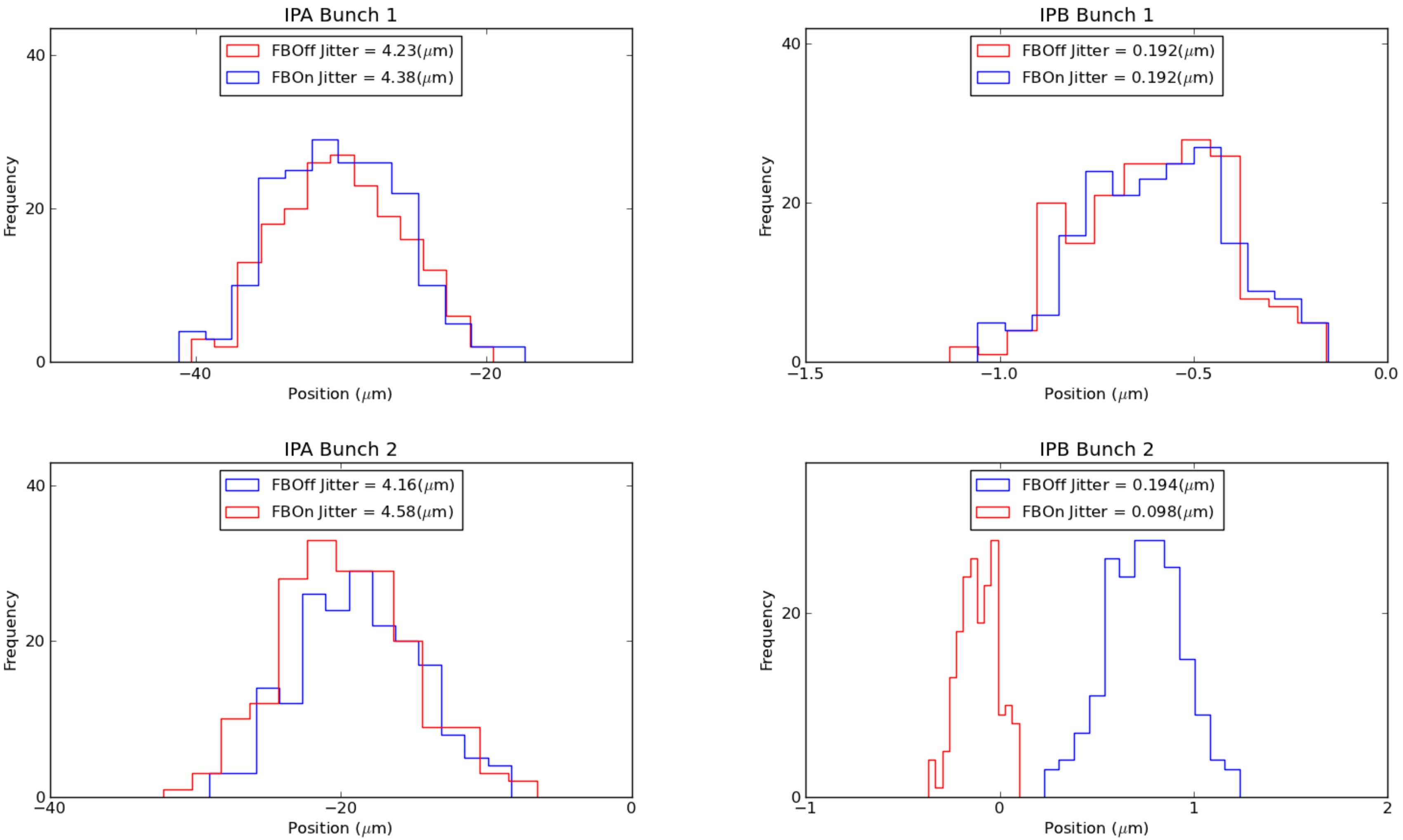
IPFB reduces jitter to minimum of ~ 100nm
Minimum jitter (waist at IPB) 100nm!

IP FB latency measurement

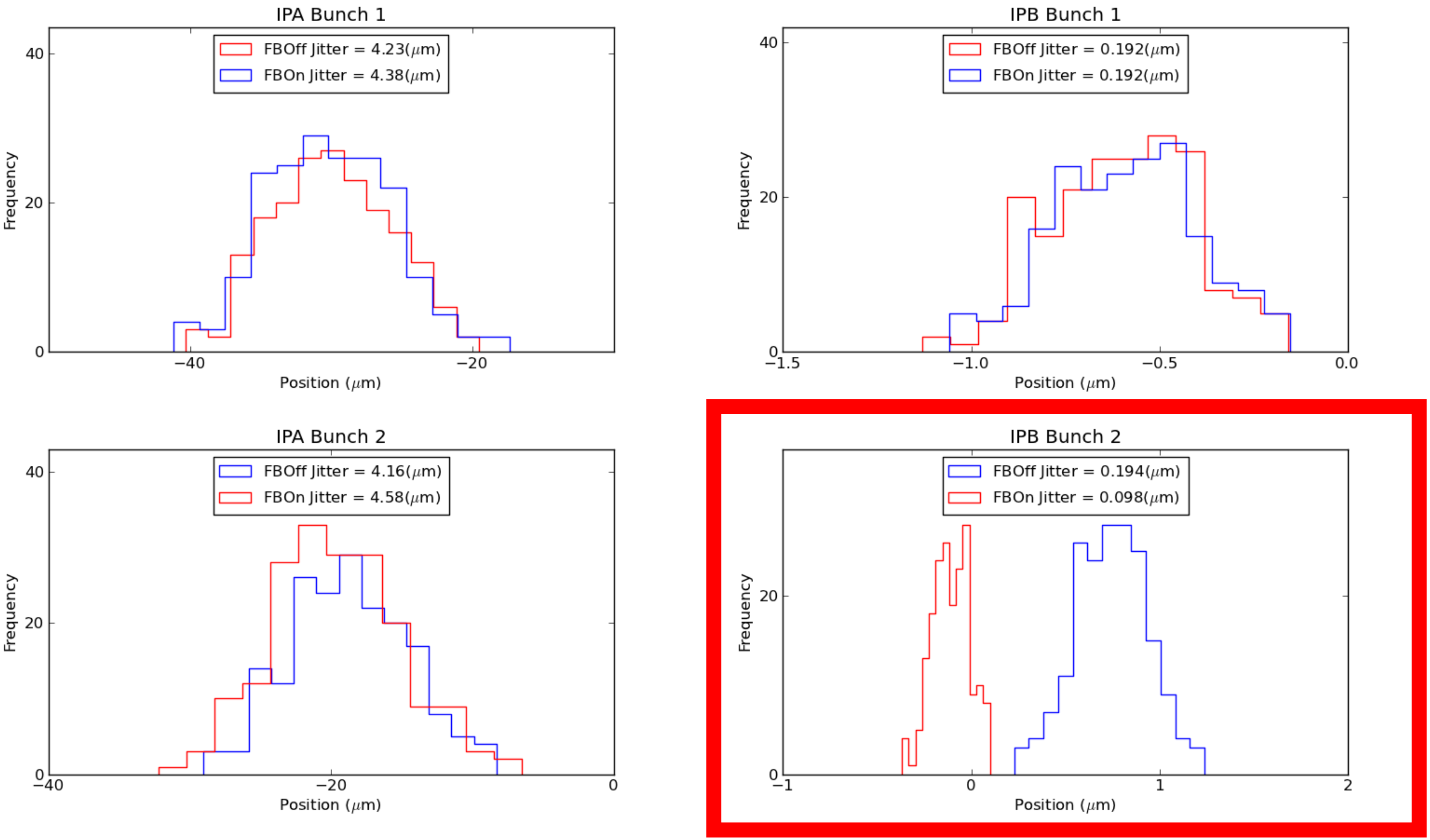


Latency ~ 160ns

Example of best IP FB

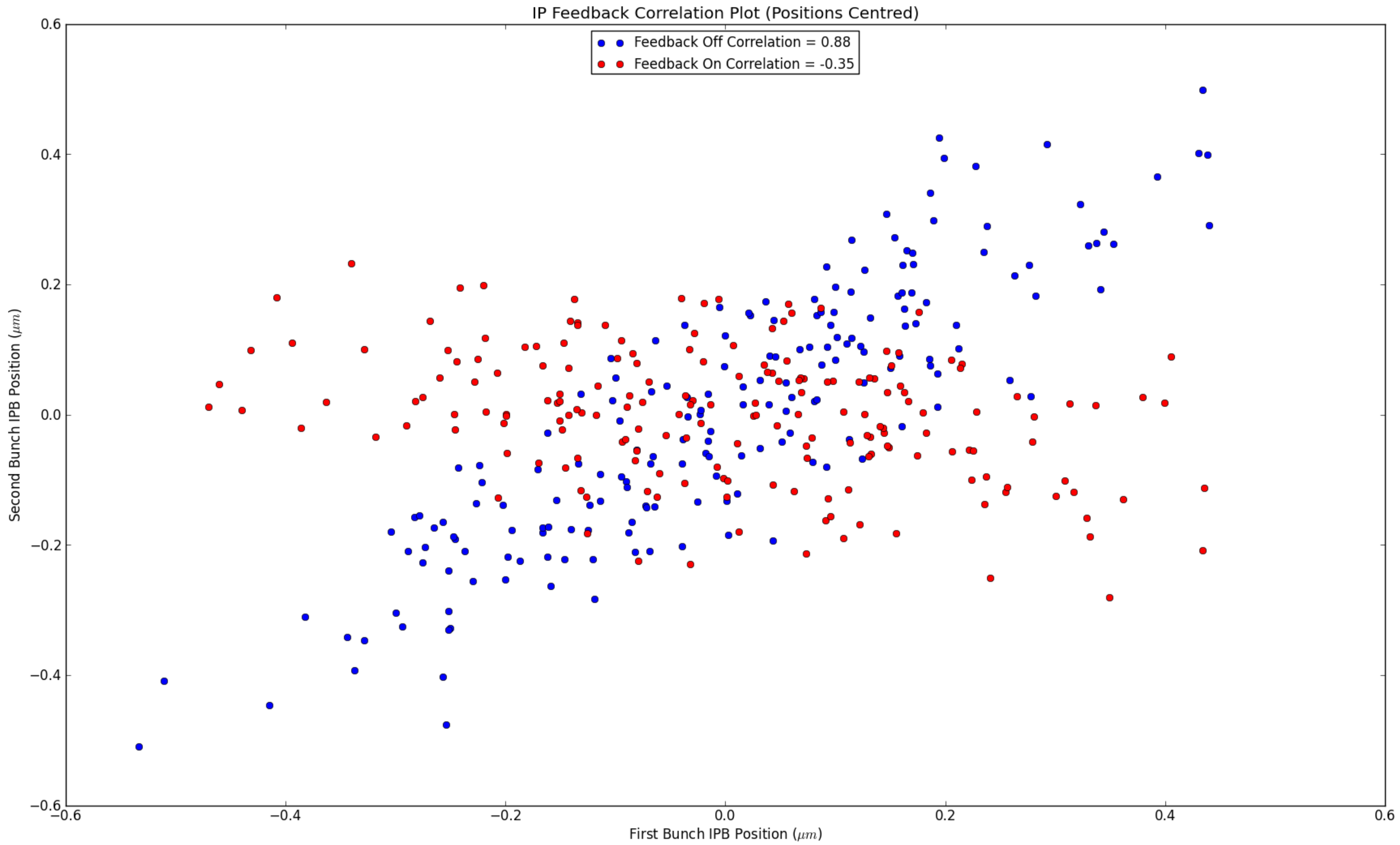


Example of best IP FB



→ Resolution ~ 70nm (?)

IP FB: bunch correlations



IP FB removes correlated jitter component, not white noise dominated

IP correction test programme

Preparations for beam stability in IP region with 2-bunch beam:

1. Readout of IPBPMs with 2-bunch beam ✓

2. Upstream FONT FB: record beam in IPBPMs ✓

3. Feed-forward from upstream FONT BPMs → IP kicker: record beam in IPBPMs ✓

4. IP FB using IPBPM signal and IP kicker ✓

Summary of June 2013 runs

Beam correction and jitter reduction observed at IP:

Upstream FB gives marginal jitter improvement, but only at low gain (< 0.5 * nominal).

Upstream FF gives clear factor 2 jitter reduction.

IPFB works well, reduces locally incoming jitter:

best performance is jitter reduced to 100nm

probably limited by IPBPM resolution

Data analysis preliminary, studies ongoing

Speculations

In order of performance:

1. Local IPFB works best to reduce jitter

2. Upstream FF correction applied locally at IP OK

3. Upstream FB works poorly, only at low gain

→ Not a surprise (to me at least)

→ Jitter sources between FONT region and IP

eg. x jitter coupling into y?

more investigation needed