

IP FB tests at ATF2

Philip Burrows

Douglas Bett, Neven Blaskovic,

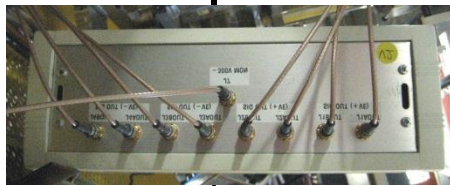
Glenn Christian, Michael Davis, Young Im Kim,

Colin Perry

John Adams Institute

Oxford University

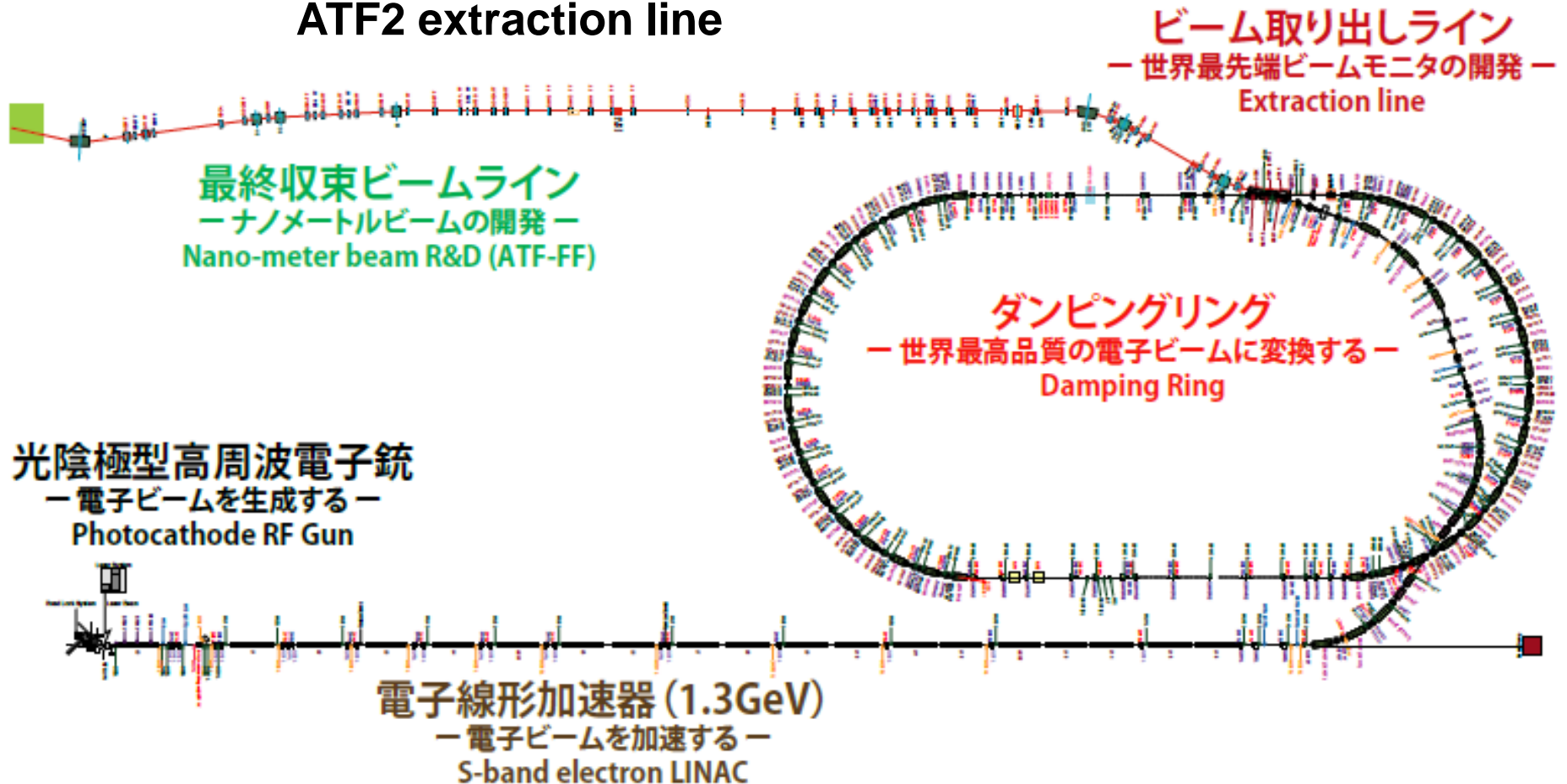
ILC prototype: FONT4 at KEK/ATF



BPM resolution < 1 μ m
Latency ~ 130ns
Drive power > 300nm
@ ILC

ATF2

ATF2 extraction line



ATF2 goals

After small beam (37nm) has been obtained (goal 1), stabilisation of ATF2 beam at the nanometre level (goal 2) will need to be addressed

Key to addressing this challenge is beam position correction near the ATF2 IP

FONT5 location

ATF2 extraction line

ビーム取り出しライン
— 世界最先端ビームモニタの開発 —
Extraction line

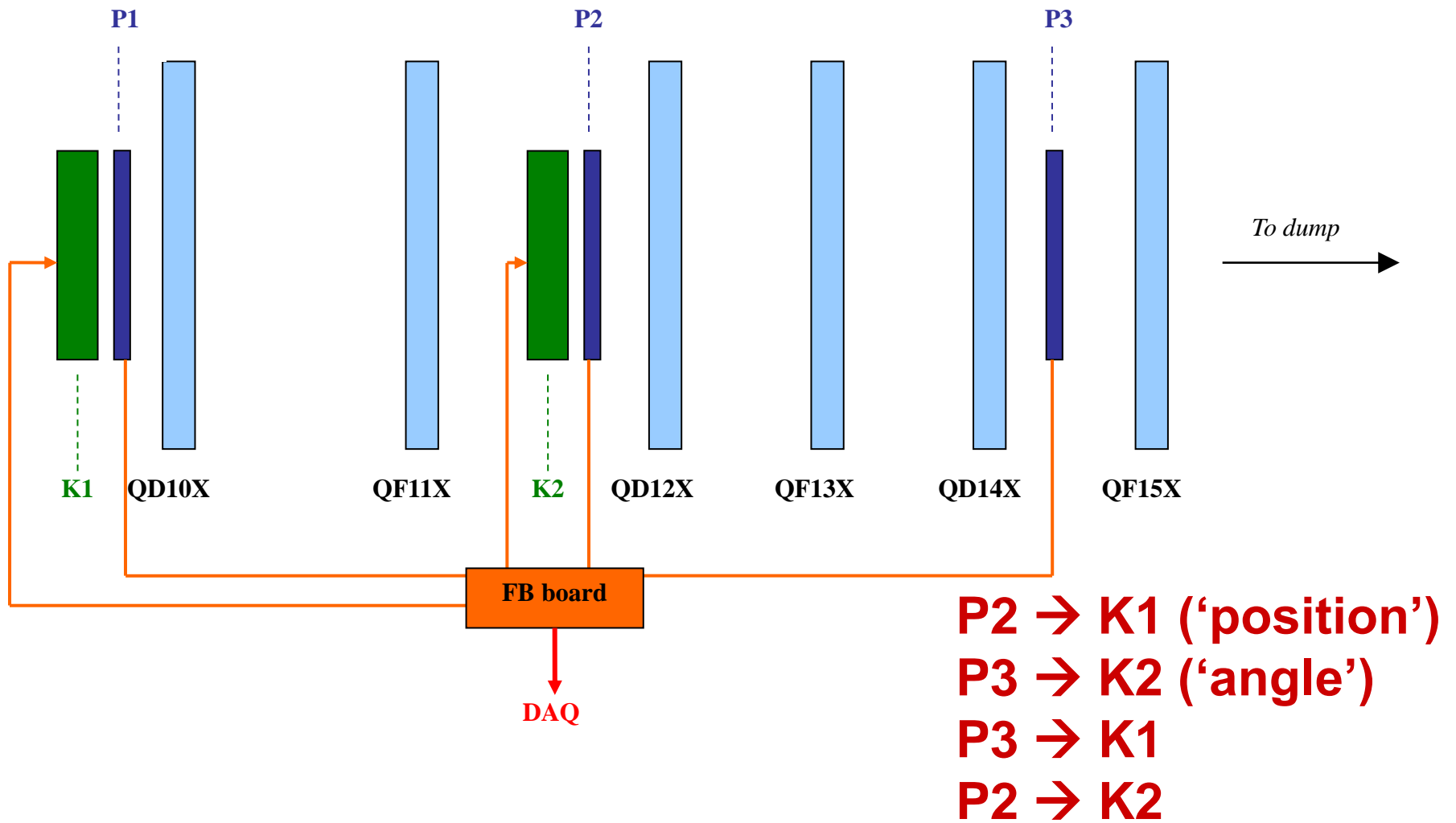
最終収束ビームライン
— ナノメートルビームの開発 —
Nano-meter beam R&D (ATF-FF)

ダンピングリング
— 世界最高品質の電子ビームに変換する —
Damping Ring

光陰極型高周波電子銃
— 電子ビームを生成する —
Photocathode RF Gun

電子線形加速器 (1.3GeV)
— 電子ビームを加速する —
S-band electron LINAC

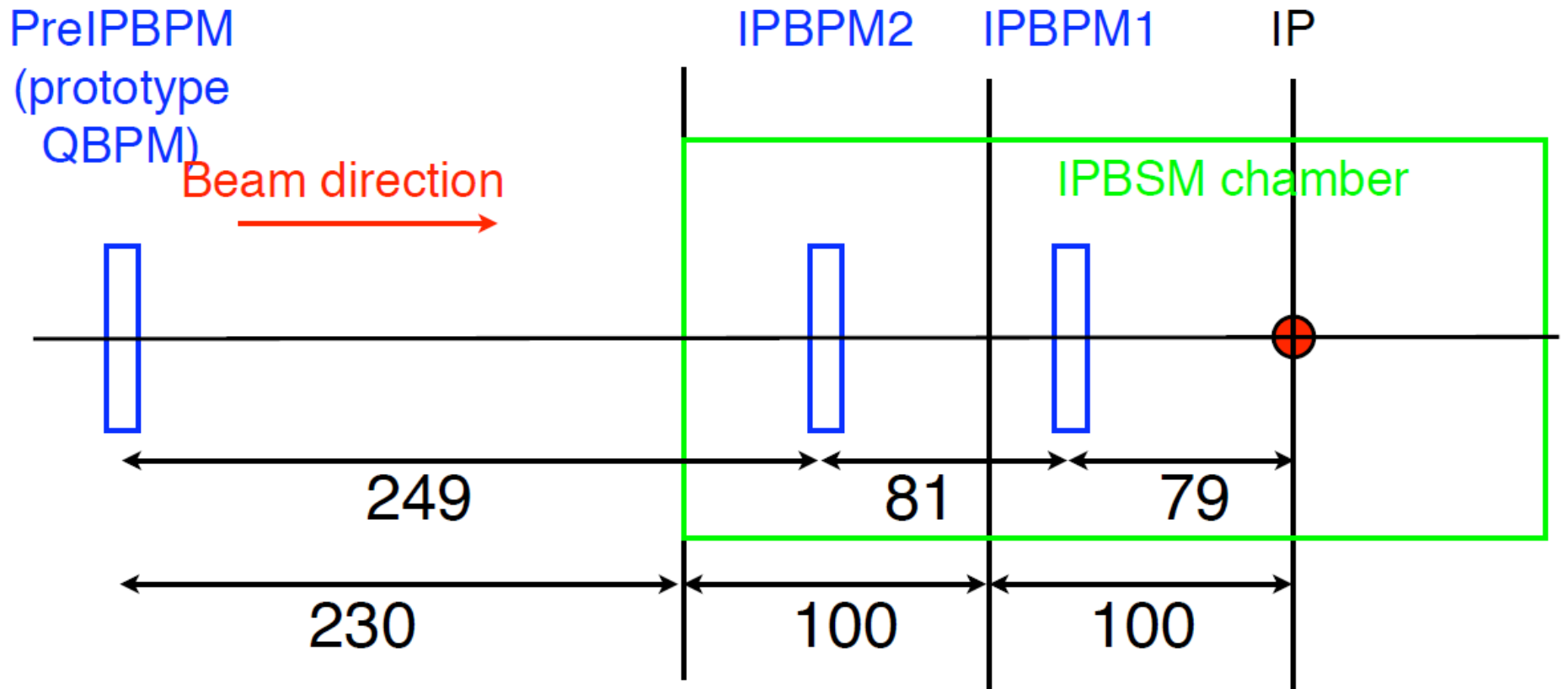
FONT5 setup



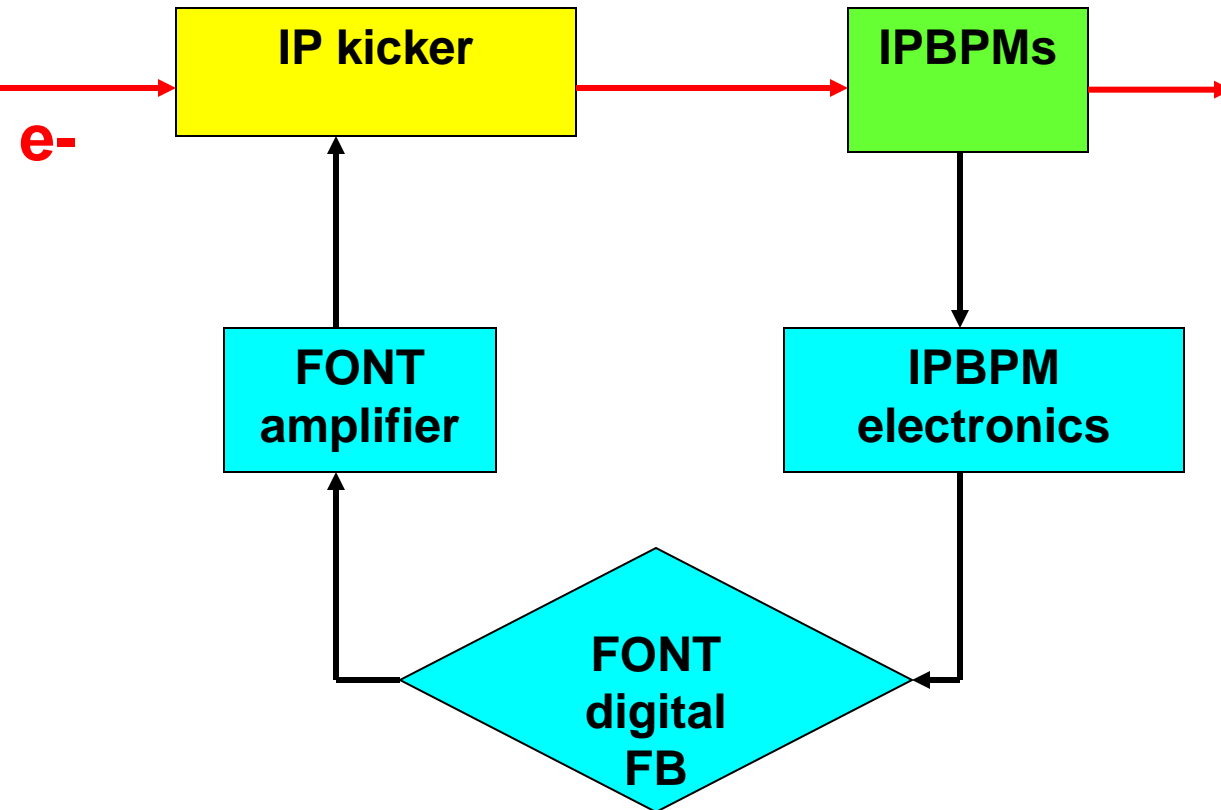
Existing IP-BPM geometry

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.

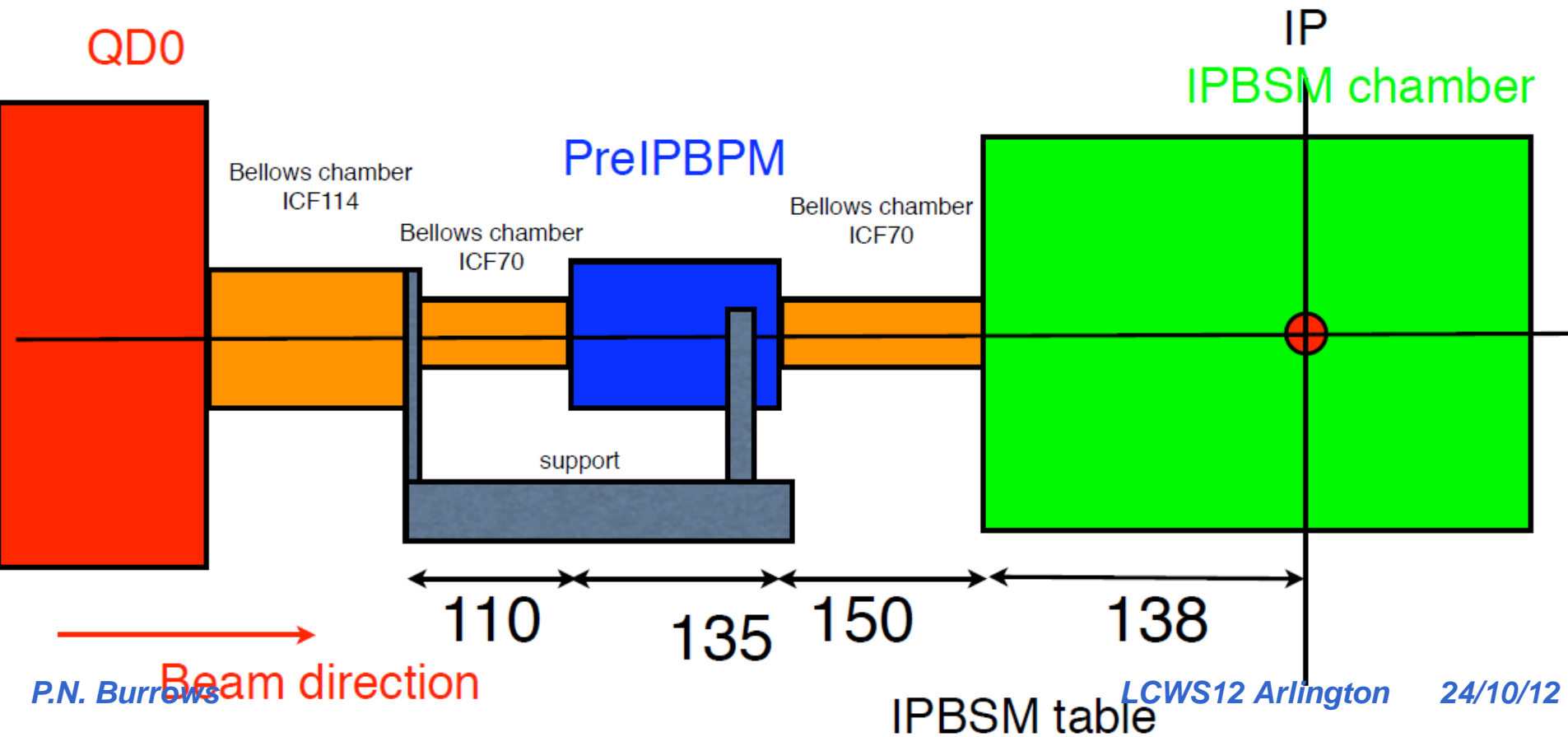


IP FB loop scheme

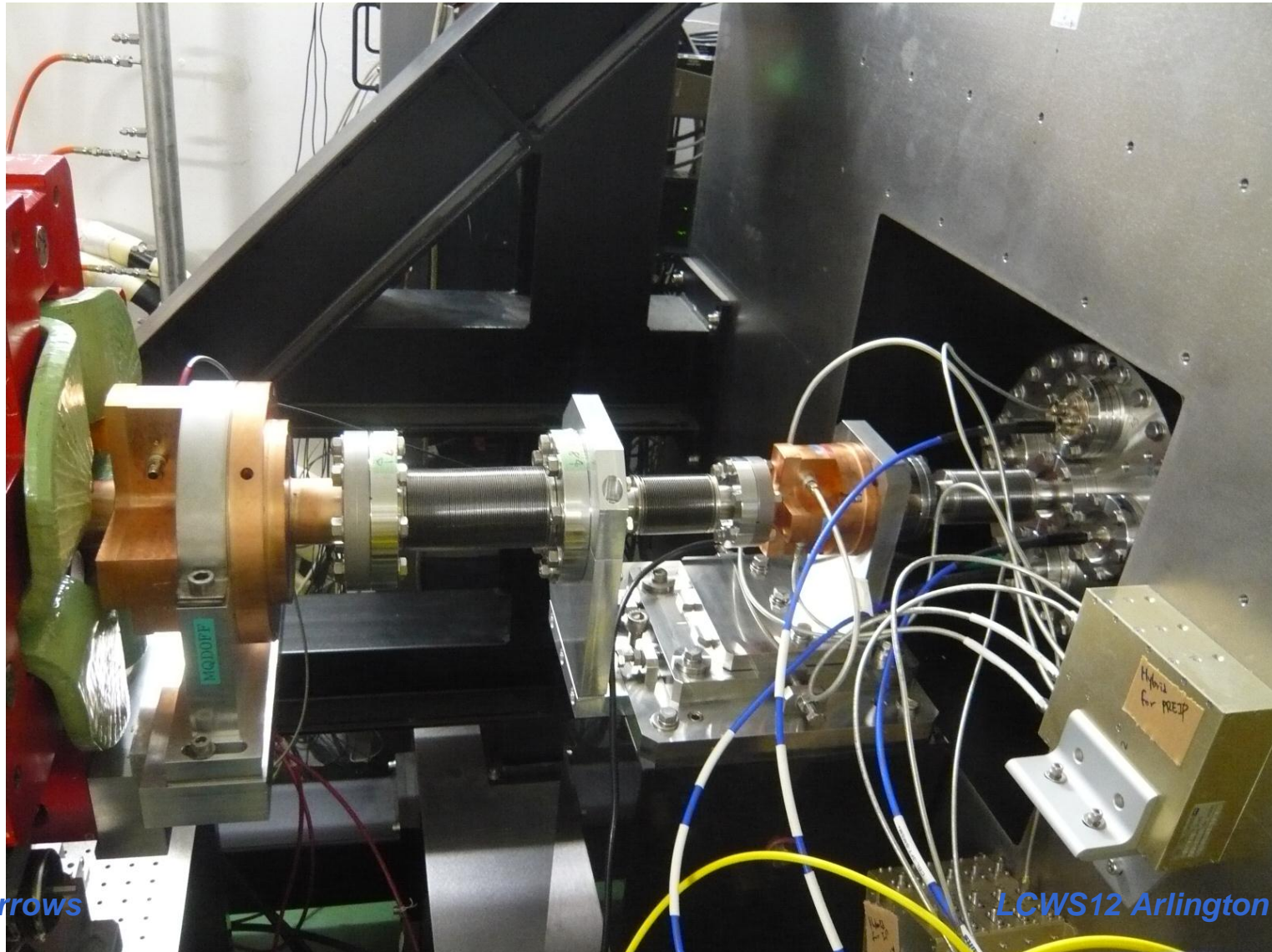


Chamber geometry

- PreIPBPM is connected with ICF70 bellows at both ends for position adjustment.
- QDO is with ICF114 bellows for its position adjustment. (Since it needs to balance vacuum force for both ends, this should be ICF114 size.)
- ICF70-114 bellows joint is supported from PreIPBPM table.



Layout (before May 2012)

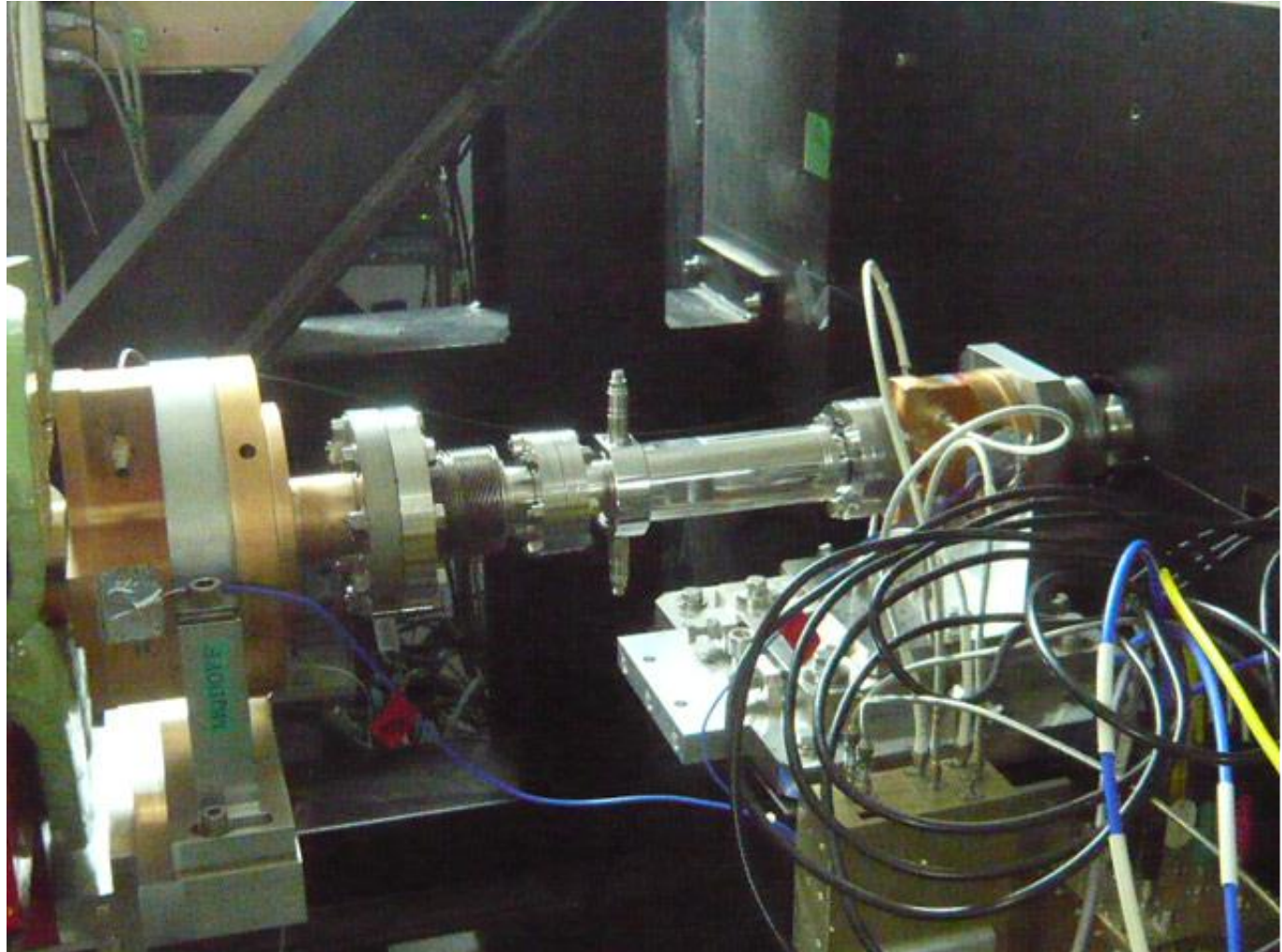


New IP kicker

**Designed
by Oxford**

**Fabrication
arranged
by KEK**

**Installed
May 2012**



FONT drive amplifier

FONT5 amplifier, built by TMD Technologies

Specifications:

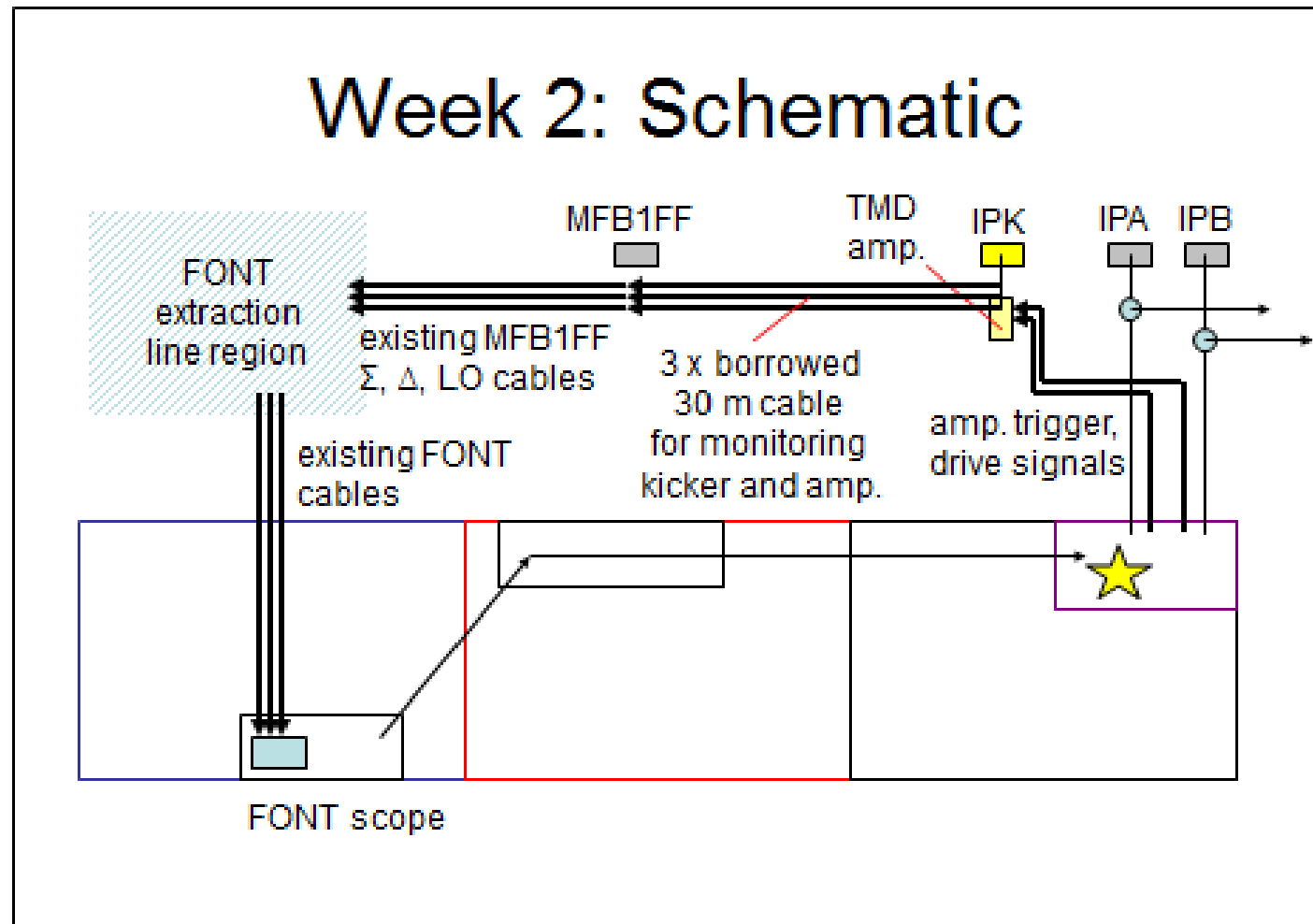
- **+ - 15A (kicker terminated with 50 Ohm)**
- **+ - 30A (kicker shorted at far end)**
- **35ns risetime (to 90%)**
- **pulse length 10 us**
- **repetition rate 10 Hz**



First preparations (June 2012)

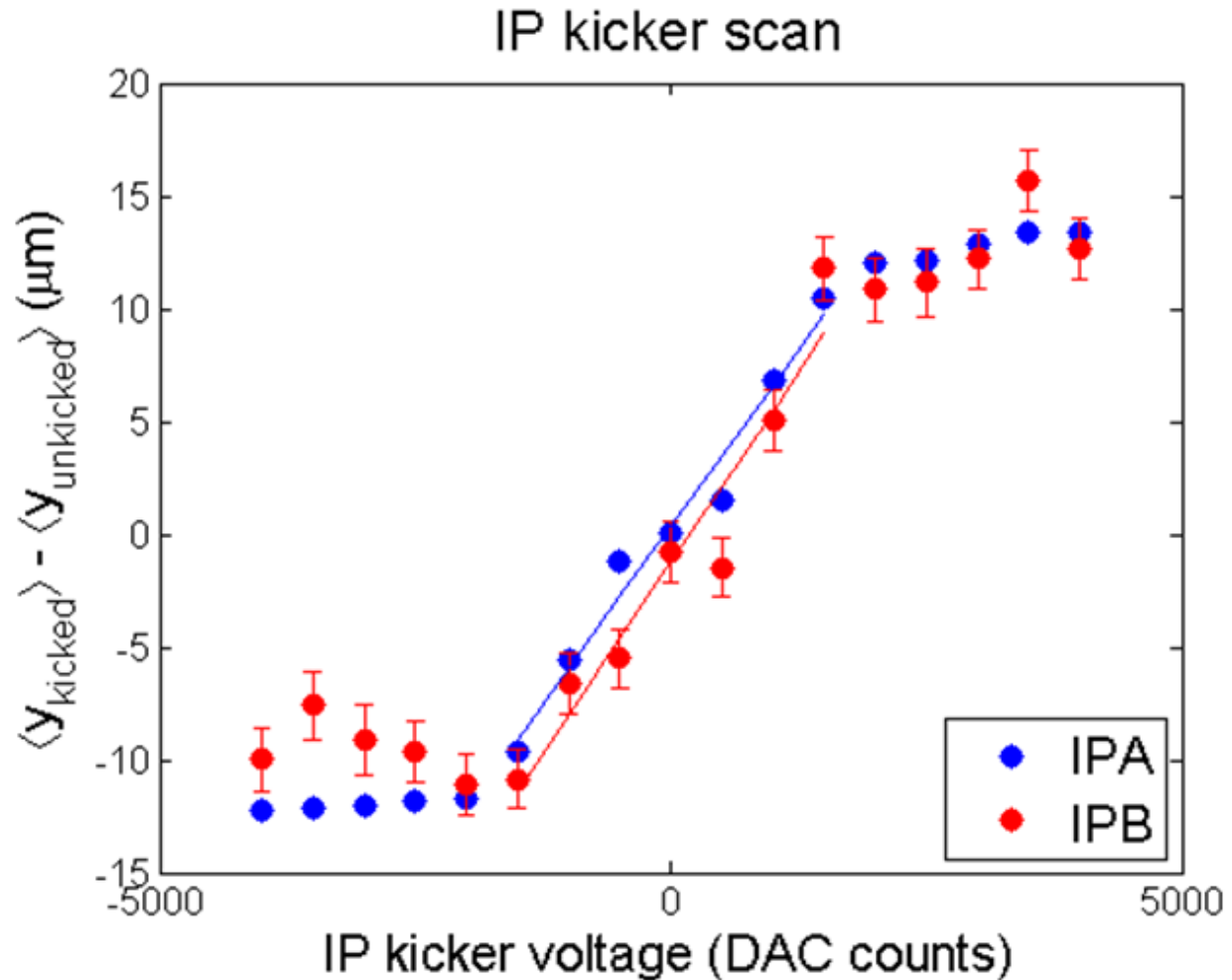
- **Tested new IP kicker with FONT amplifier:**
 - ensure functionality**
 - measure dynamic range of kick**
- **Digitised existing IPBPM signals:**
 - gain experience with cavity BPM signals**
 - exercise FONT5 board in this mode, at IP**

Experimental setup (June 2012)



IP kicker drive scan

EPICS
readout
of IPBPMs



IP kicker conclusions

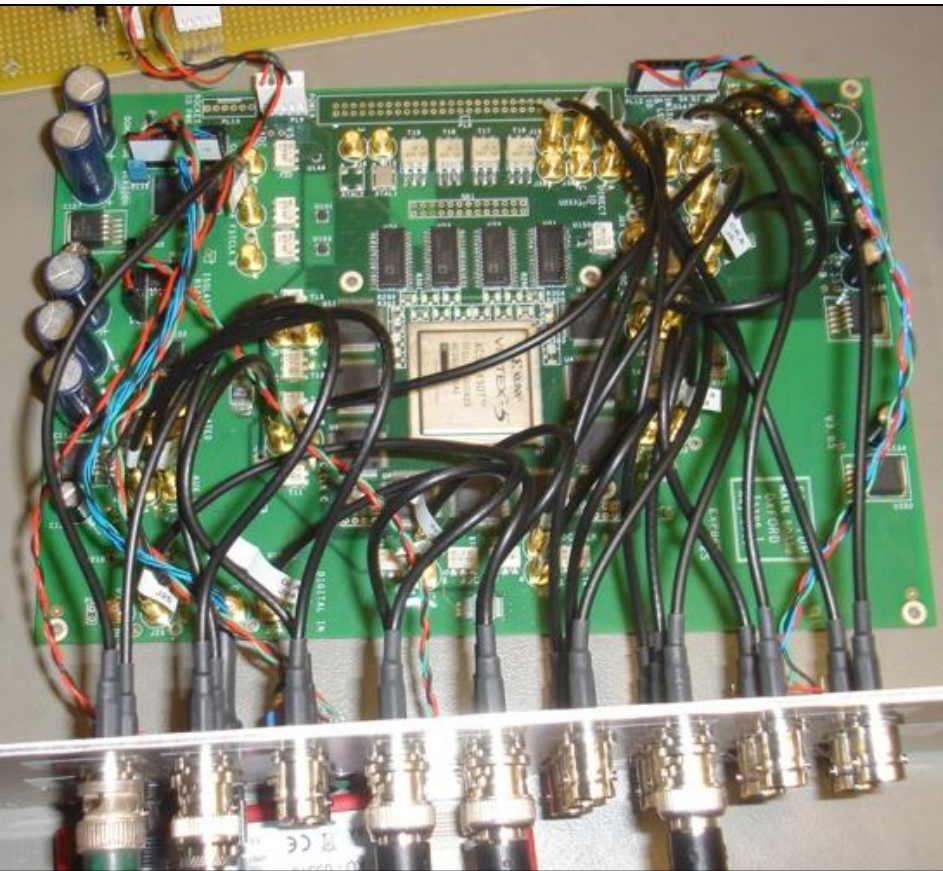
- **Kicker is working well**
 - **FONT amplifier is able to drive kicker**
 - **Dynamic kick range almost $\pm 15 \mu\text{m}$ at IPBPMs**
 - **Linear kick range $> \pm 10 \mu\text{m}$**
- plenty of drive for beam stabilisation @ IP**

IPBPM tests (single bunch)

- **IPBPM A+B signals split:**
 - 1) **SLAC electronics → ATF controls**
 - 2) **Honda-san electronics → FONT5 board**

allowed cross-check of standard electronics and FONT digitised readout
- **Temporary cabling and setup used for tests**

FONT5 digital FB board



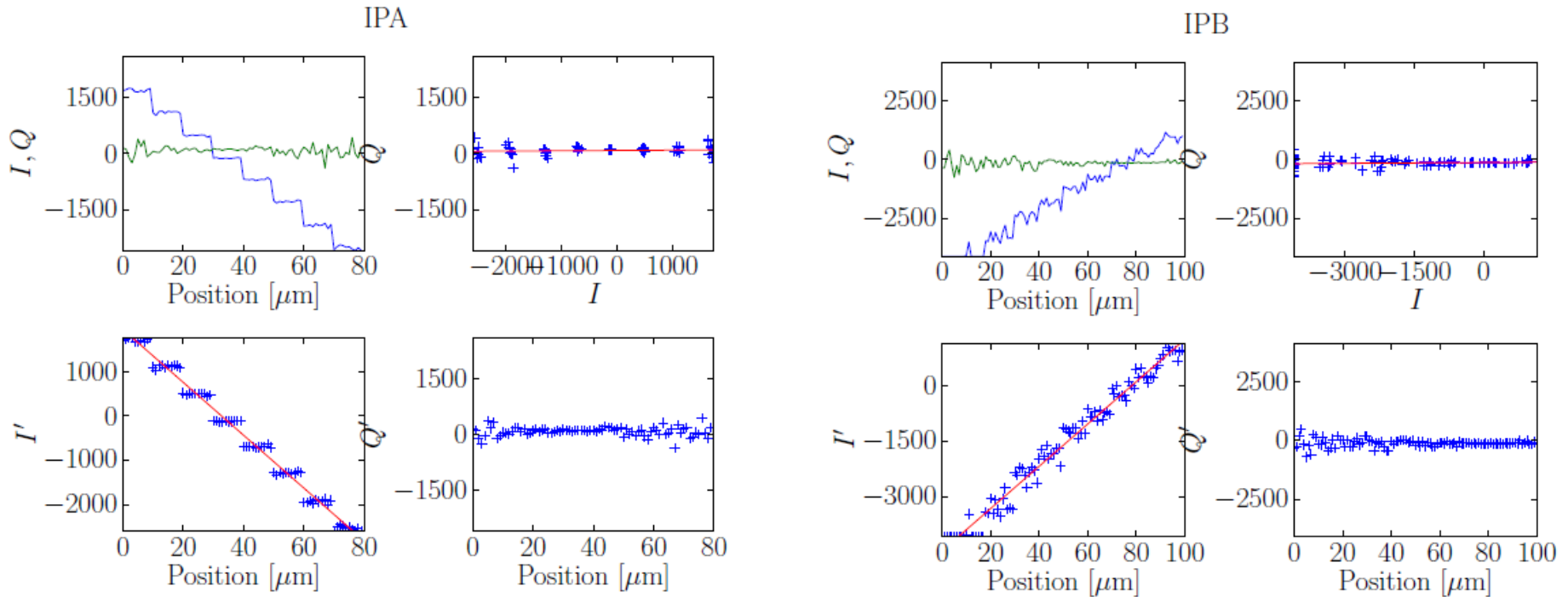
Xilinx Virtex5 FPGA

**9 ADC input channels
(TI ADS5474)**

**4 DAC output channels
(AD9744)**

**Clocked at 357 MHz
phase-locked to beam**

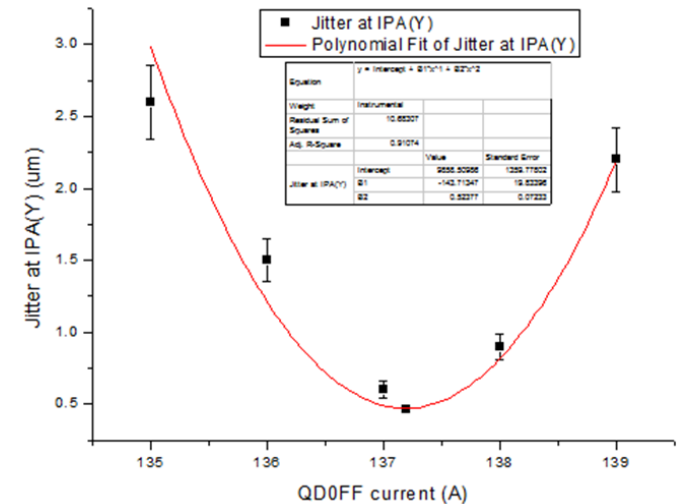
FONT digitisation of IPBPMs



**Digitisation and calibration successful,
with single-bunch beam**

Upstream FONT kicker tests

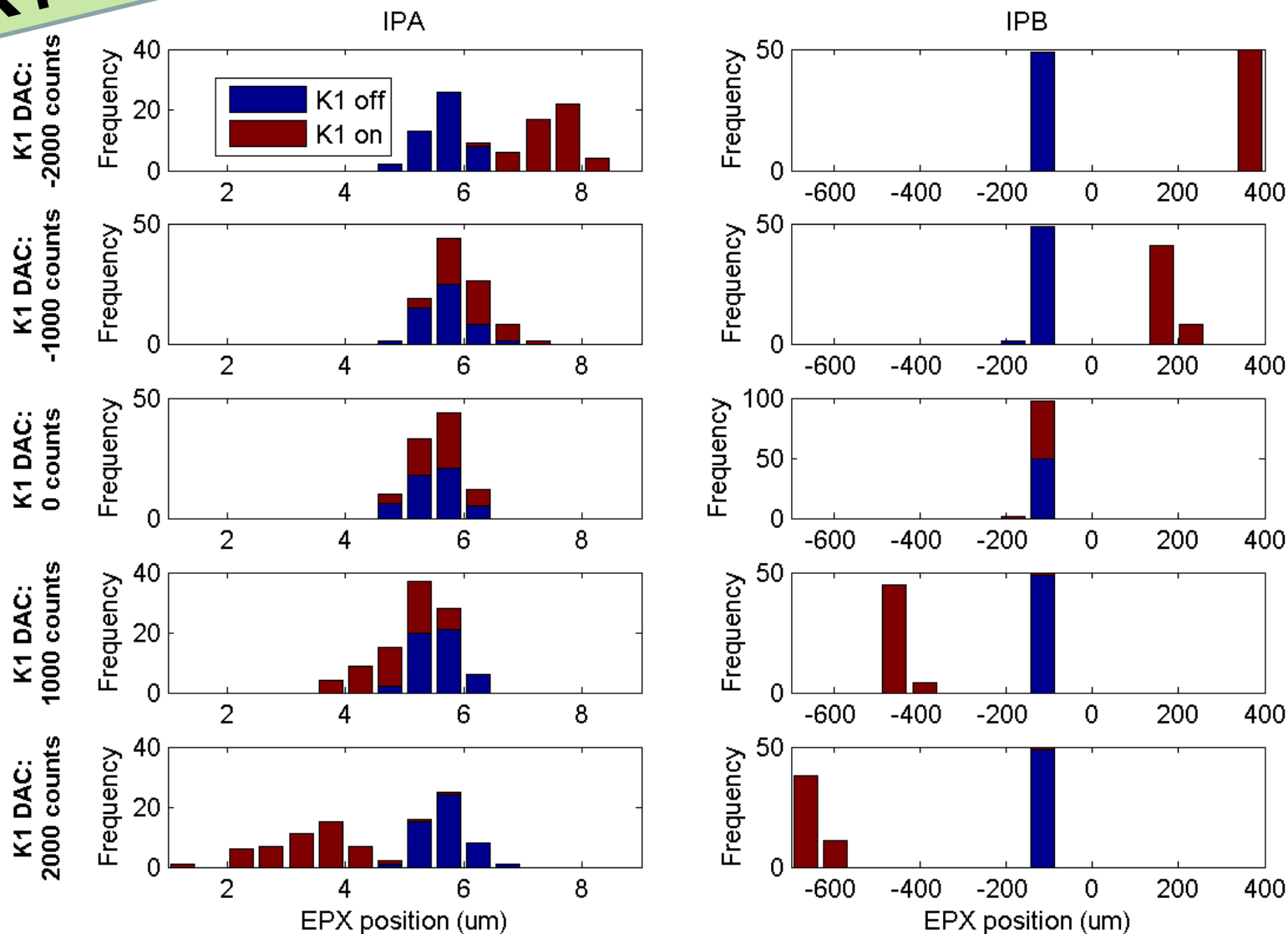
- **Beam waist set to IPBPM A**
- **Jitter minimised**



- **Upstream FONT kickers K1, K2 scanned**
- **Beam position recorded in IPBPMs**

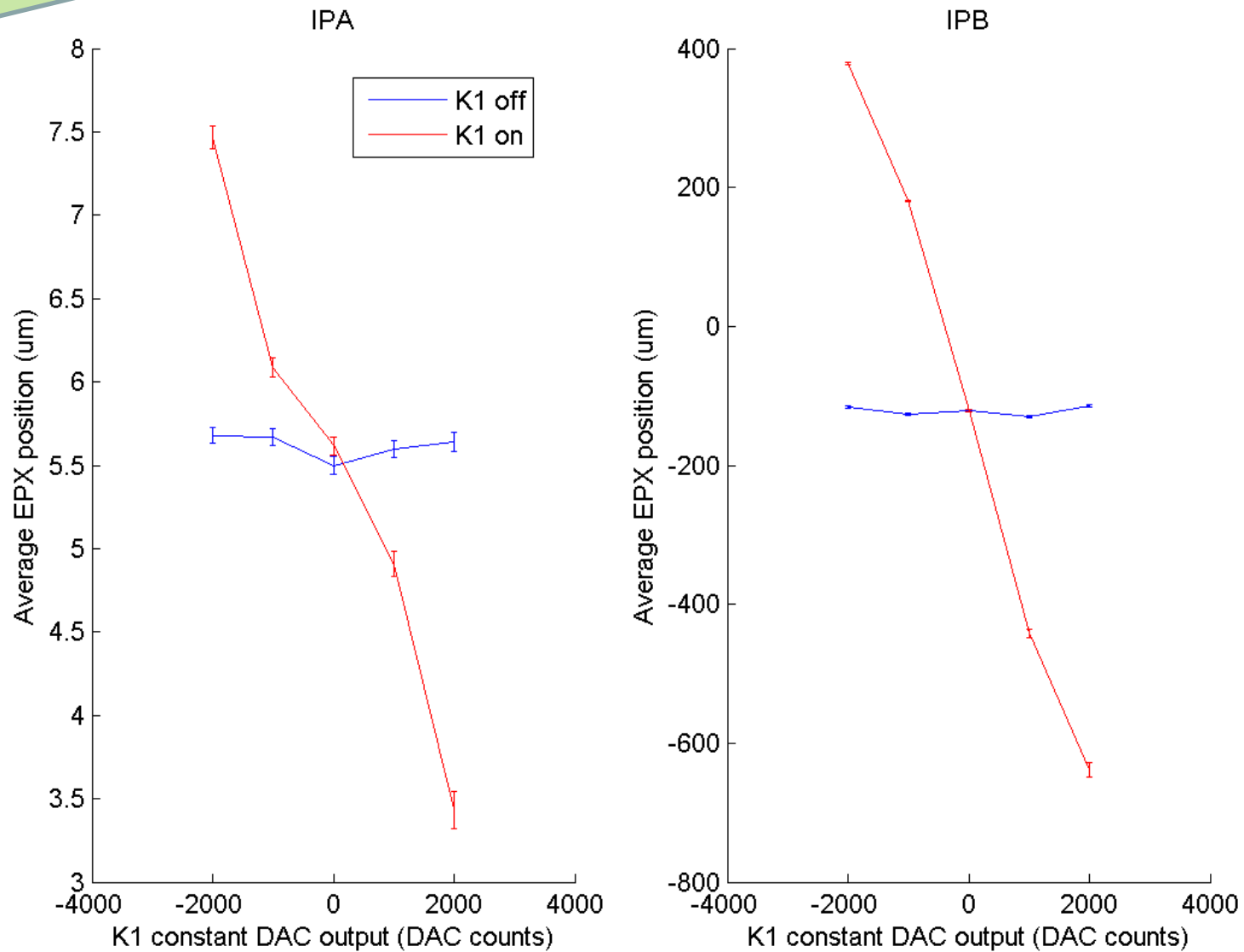
K1 scan

EPX position distributions at IP BPMs over K1 scan



K1 scan

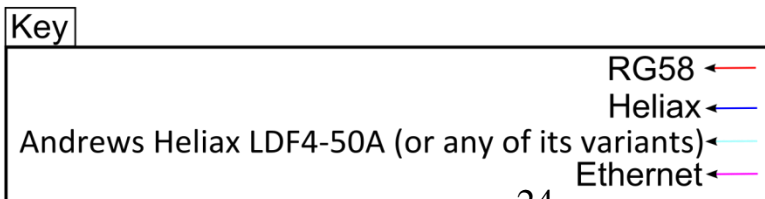
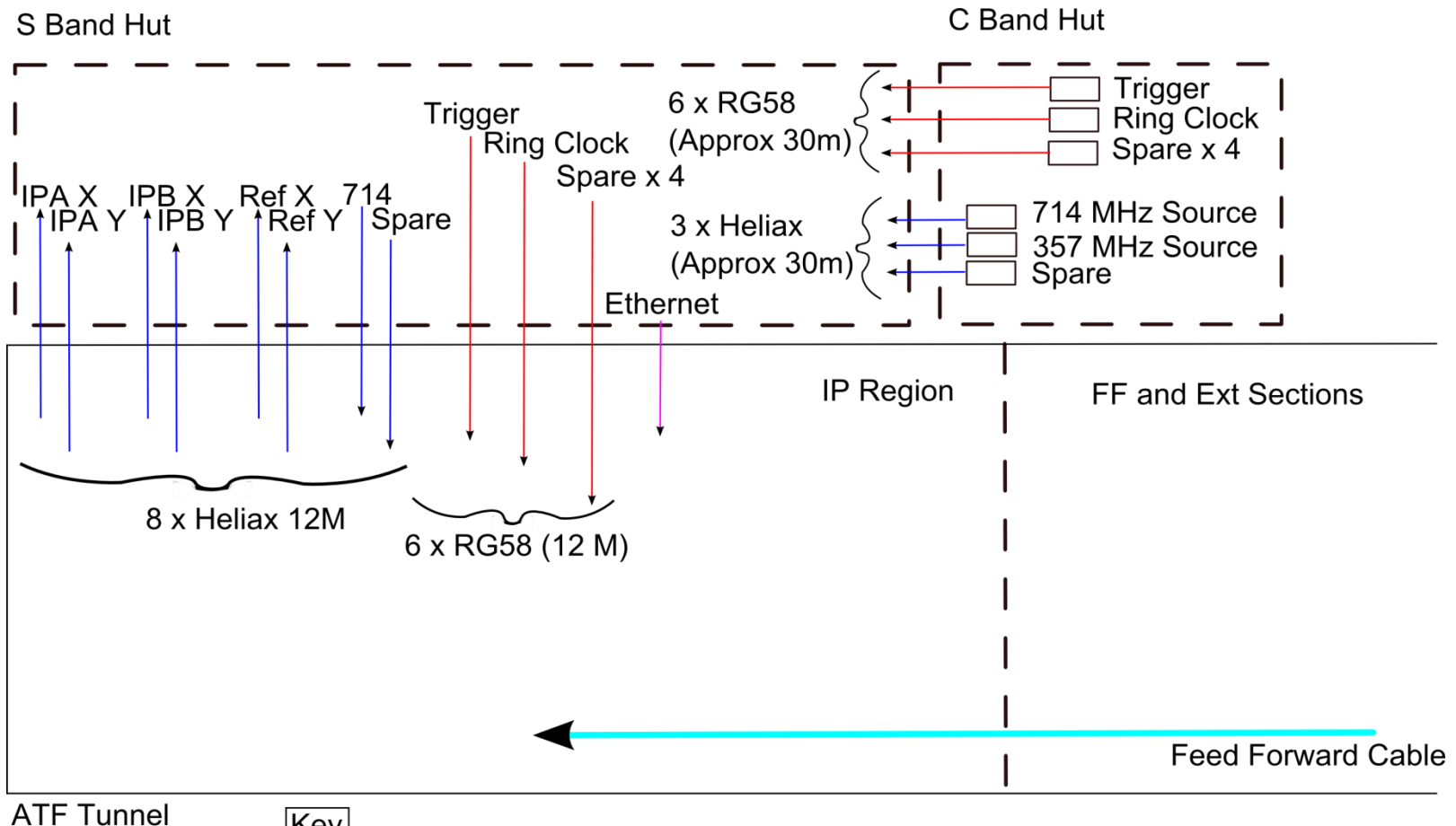
EPX position at IP BPMs over K1 scan



Upstream FONT kicker tests

- **Position change at IPBPMs clearly observed**
 - **upstream FONT FB can stabilise beam @ IP**
 - **may be valuable for achieving GOAL 1!**
 - **setup to allow test in October**

Setup (September)



Tests (Oct – Dec 2012)

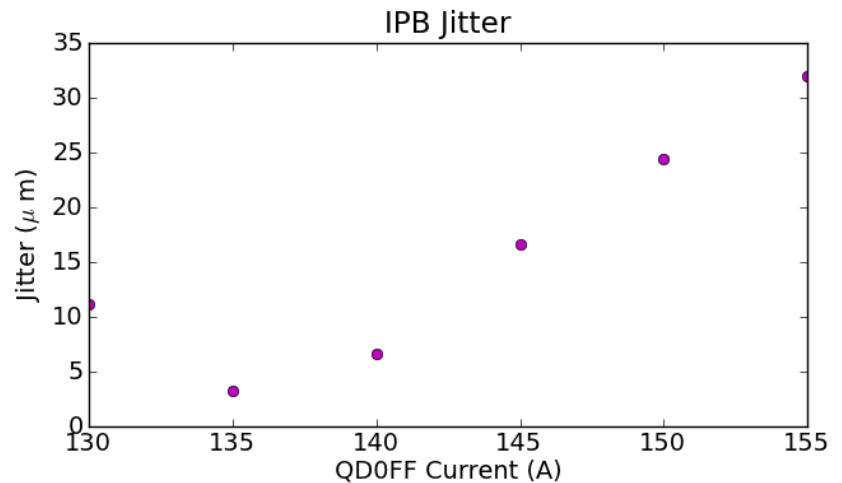
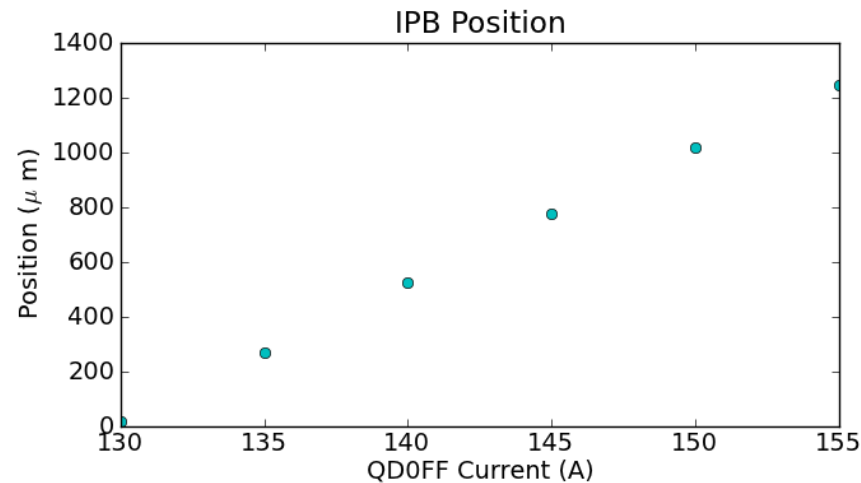
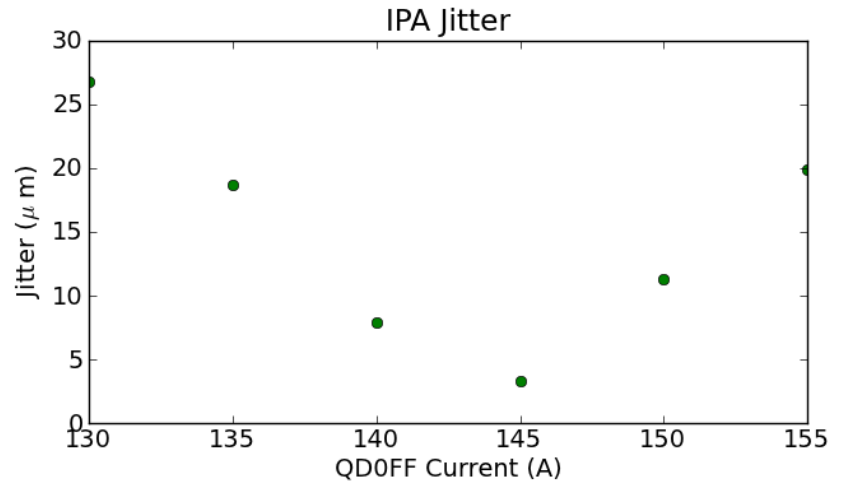
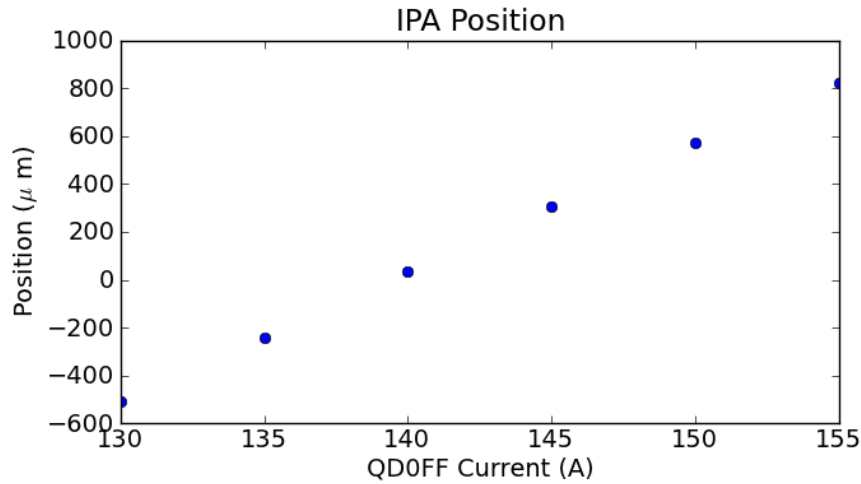
Preparations for beam stability in IP region with

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

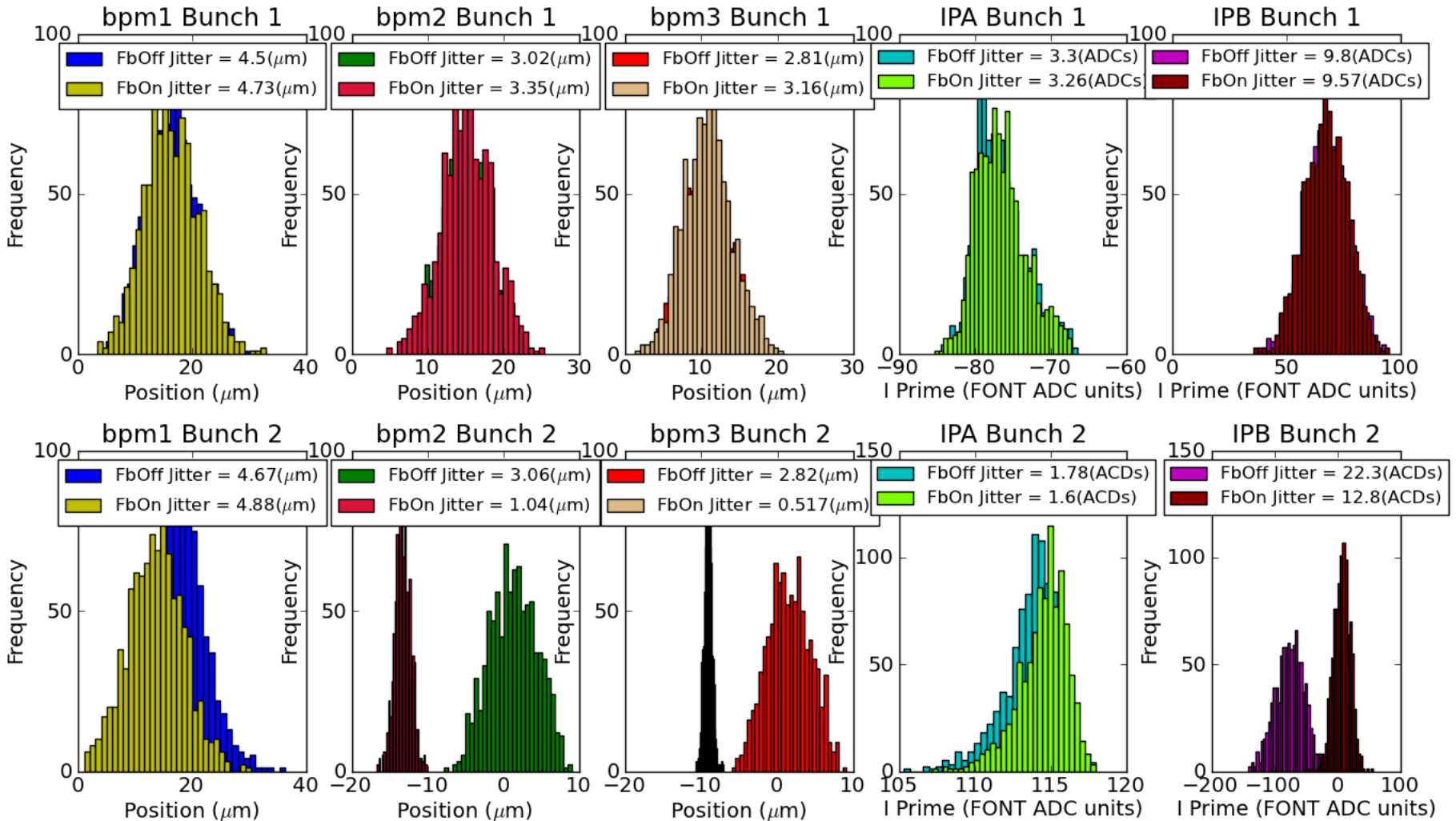
Beam waist scans at IPA, IPB

IP Waist Scan (19/10/12)



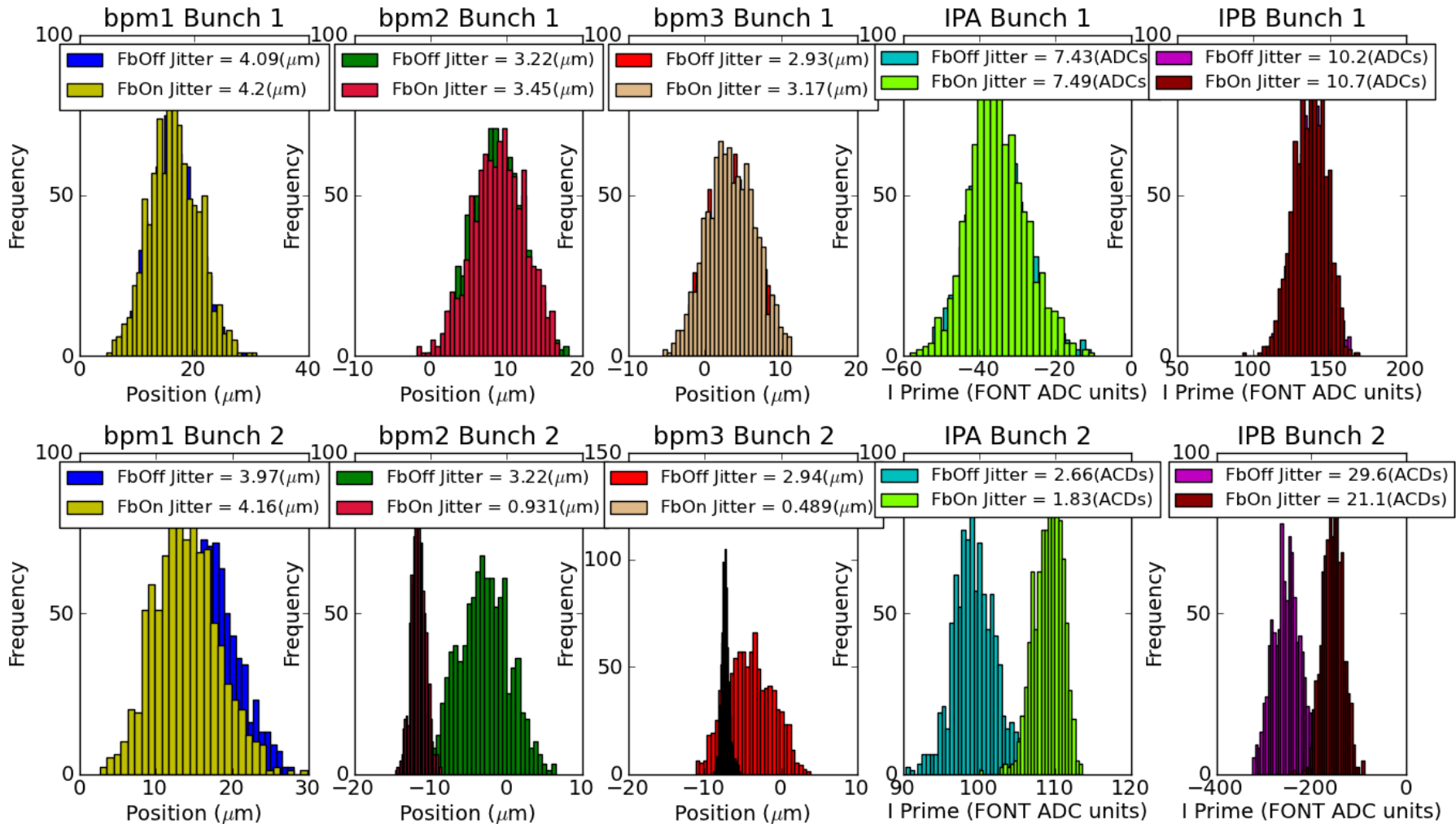
Beam waist at IPB: FB off/on

Jitter Histograms (fbRun10) Waste at IP



Beam waist at IP: FB off/on

Jitter Histograms (fbRun16) Waste at IP



IP tests status

Preparations for beam stability in IP region with


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kicker: record beam in IPBPMs
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IP tests status



Preparations for beam stability in IP region with

2-bunch beam:

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IP tests status

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 

See clear reduction in jitter at IPA + IPB, and by implication at the IP!

IP tests status

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 **THIS WEEK**

4. **IP FB** using IPBPM signal and IP kicker

IP tests status

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 

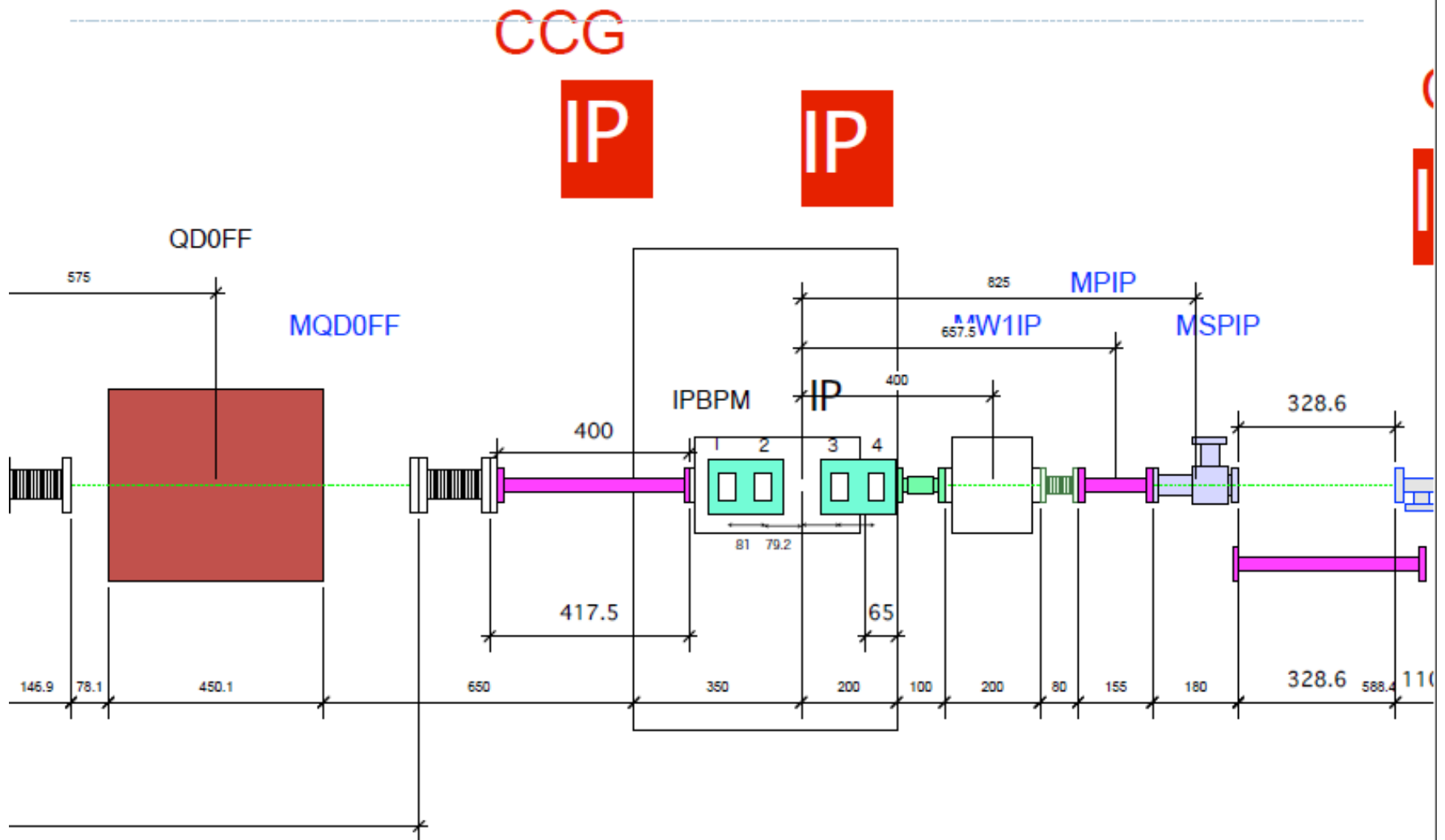
3. **Feed-forward** from upstream FONT BPMs → IP

kicker: record beam in IPBPMs **THIS WEEK**

4. **IP FB** using IPBPM signal and IP kicker

NOV OR DEC, SUBJECT TO BEAMTIME

Eventual ATF2 IP configuration



IP FB loop scheme

