IP-BPMs as the IP jitter monitor

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AQD0FF for IP-BSM and IP-BPM

The mover AQD0FF kicks the beam to a different trajectory.
The kick magnitude depends on the QD0FF strength. During the Dec/2014 run IP-BSM and IP-BPM had **different AQD0FF** settings.

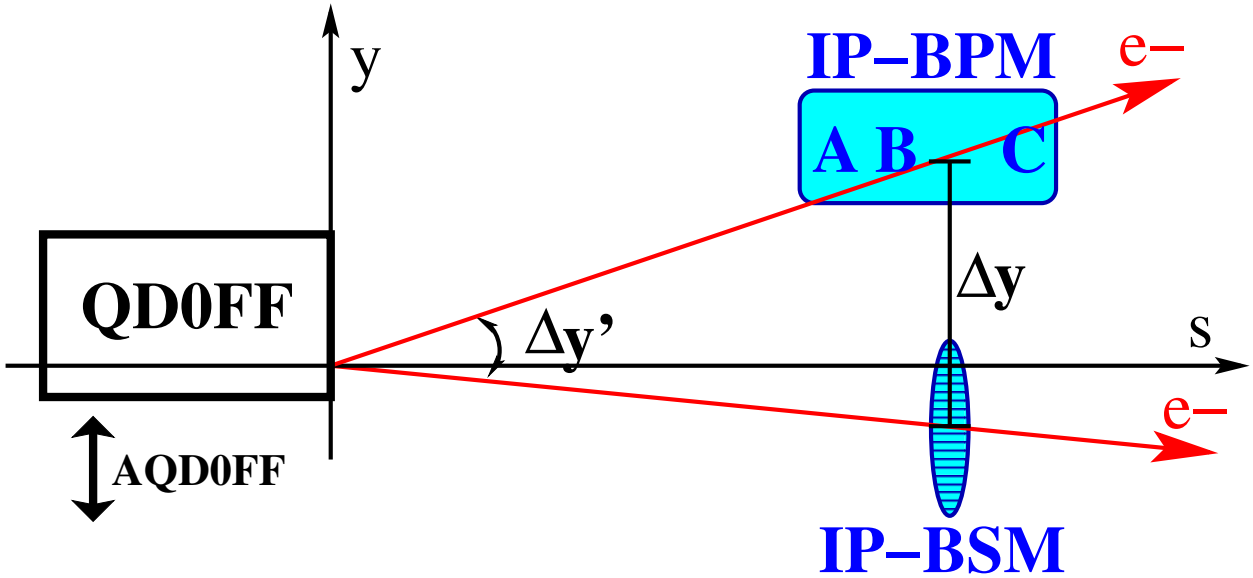
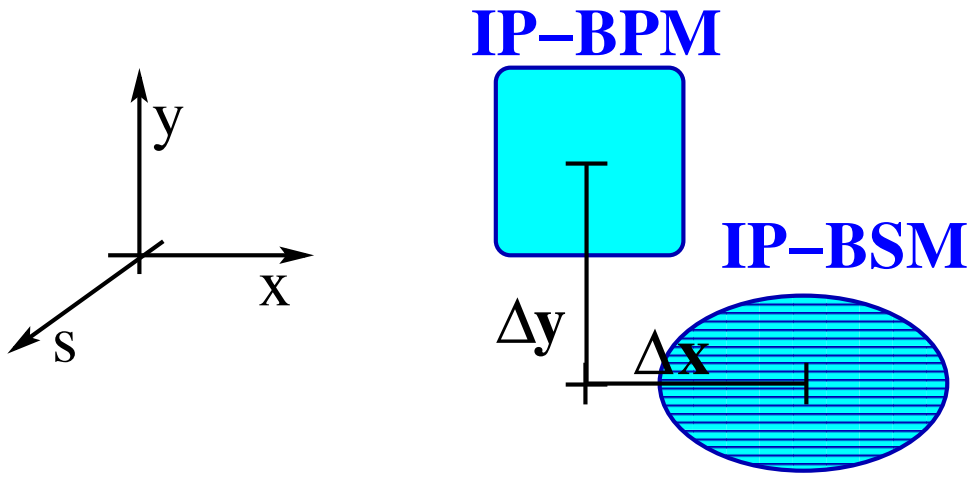


Figure valid for x,y

AQD0FF	X (μm)	Y (μm)
IP-BPM‡	-70	150
IP-BSM†	-450	-200
IP-BPM - IP-BSM	380	350

†Low beta shift 2014/12/20, ‡IP-BPM shift 2014/12/18. Typical values around ± 20

Distance between IP-BPM and IP-BSM at IP



$$\begin{aligned}
\Delta x_{IP} &\approx -700\mu\text{m} \\
\Delta y_{IP} &\approx 570\mu\text{m} \\
\Delta x'_{IP} &\approx -0.56\text{mrad} \\
\Delta y'_{IP} &\approx 0.42\text{mrad}
\end{aligned}$$

Values from simulations of QD0FF displacement in MAD-X. Lattice v5.2

When looking downstream, the IP-BPM is half a mm up and to the right of the IP-BSM/Low-β orbit settings.

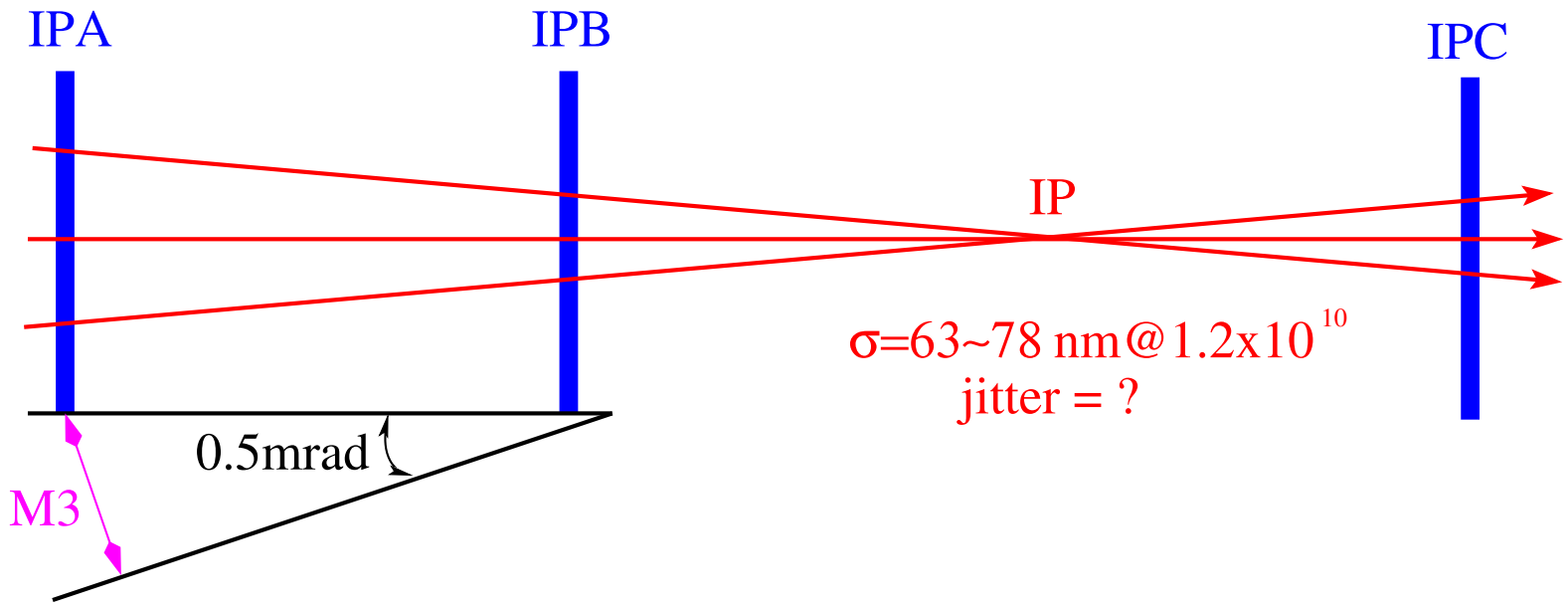
The offset is beyond the IP-BPMs movers range ($\pm 150\mu$m).

The angle is OK in any of the two configurations ($\pm$1mrad).

How big is the IP-BSM transversal dynamic range ?

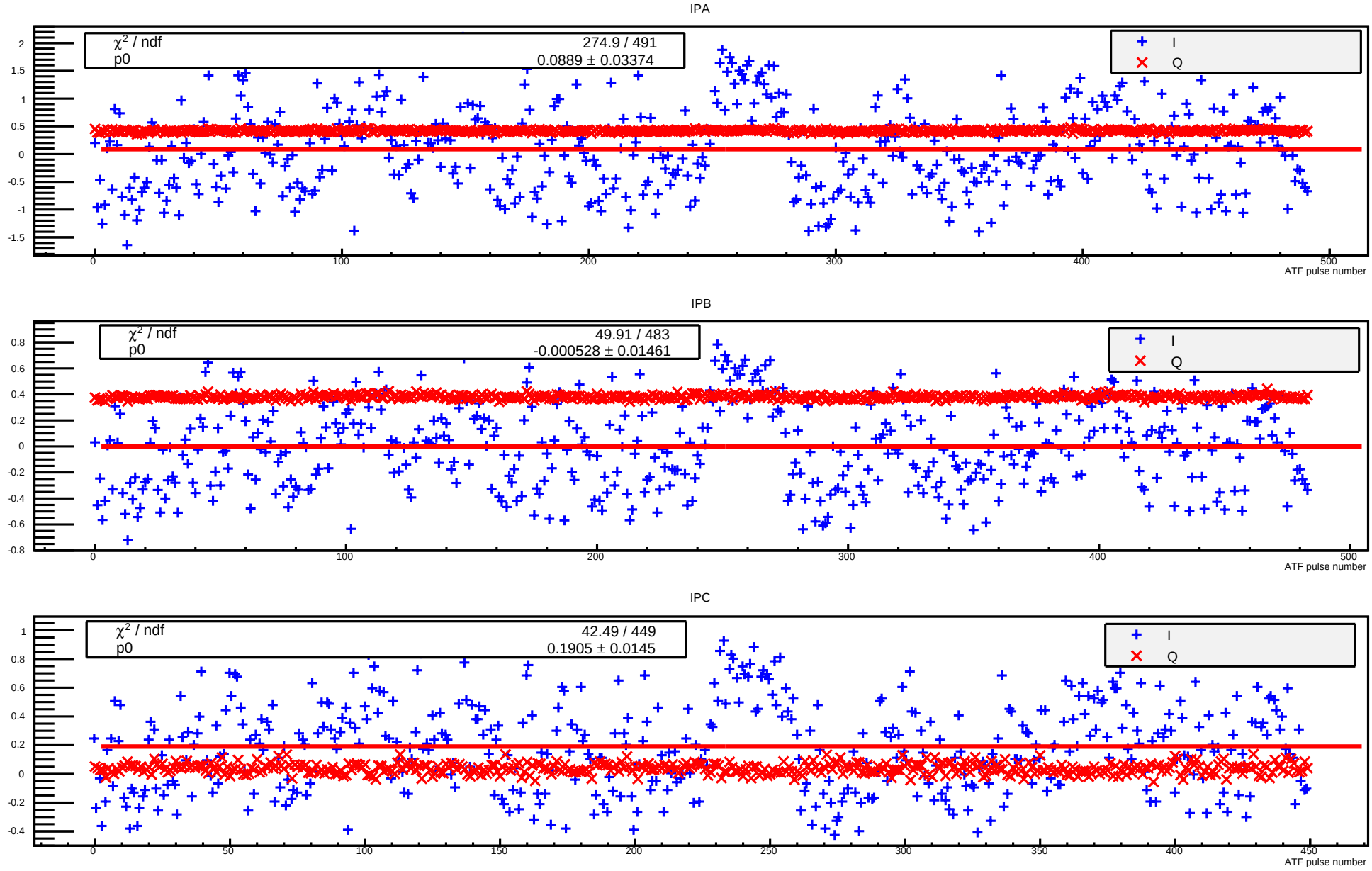
IPBSM Small beam(low beta*)
(IPBPM Parasitic shift in 2014/12/09)

AQD0FF	X (μm)	Y (μm)
IP-BPM	*	150+10
IP-BSM	-450+50	*

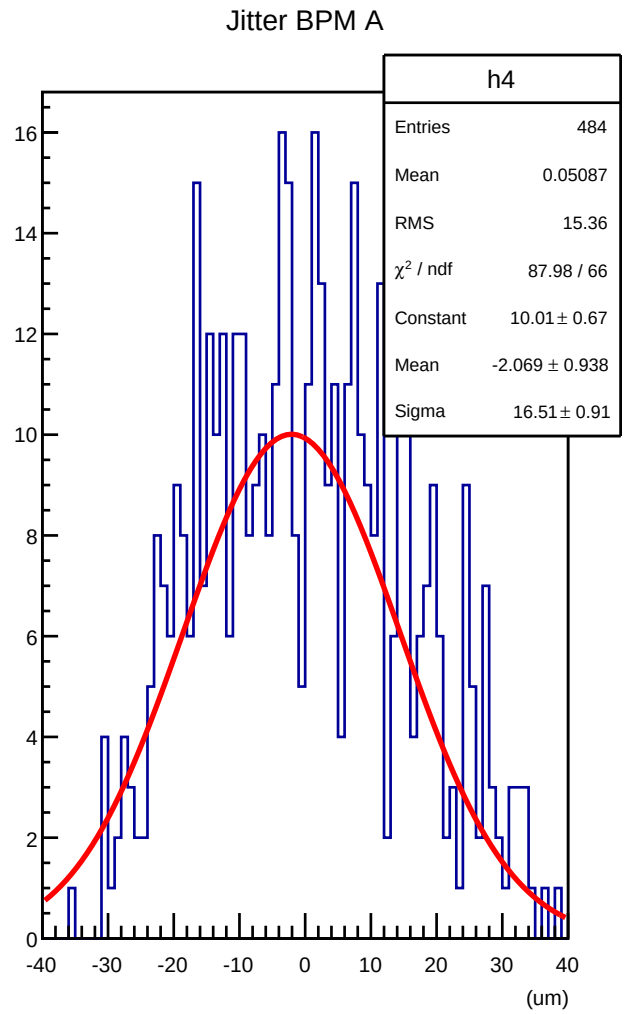


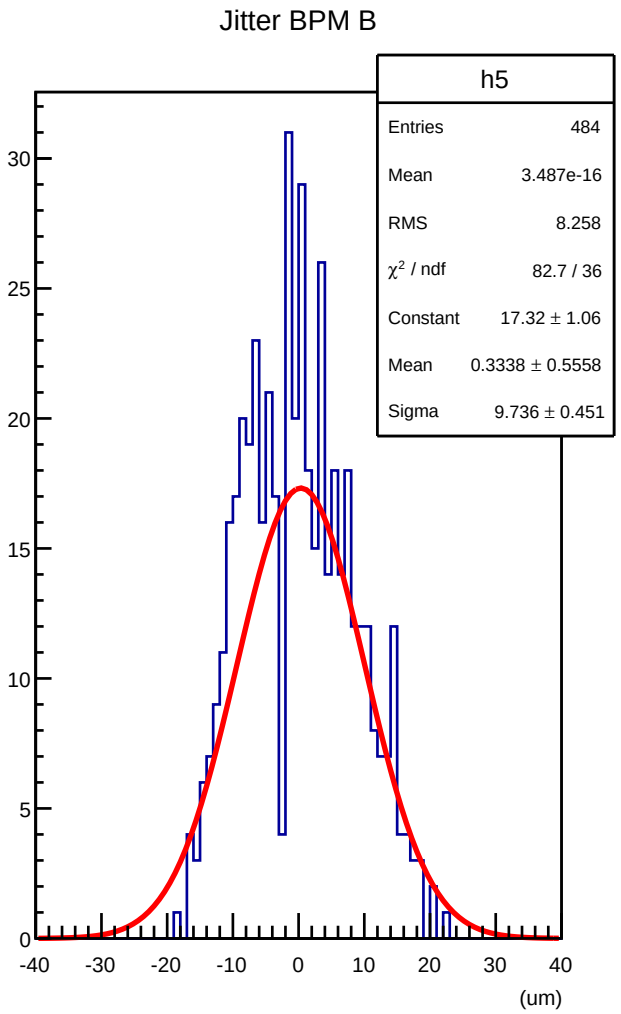
ϵ_N=30nm, γ =2544	IPA	IPB	IP	IPC
s (mm)	-167.9	-87.1	0	87.1
$\sigma_y(\mu m)$	29	15	~0.071	15
β_y(mm)	7.05×10^4	1.9×10^4	0.4	1.9×10^4

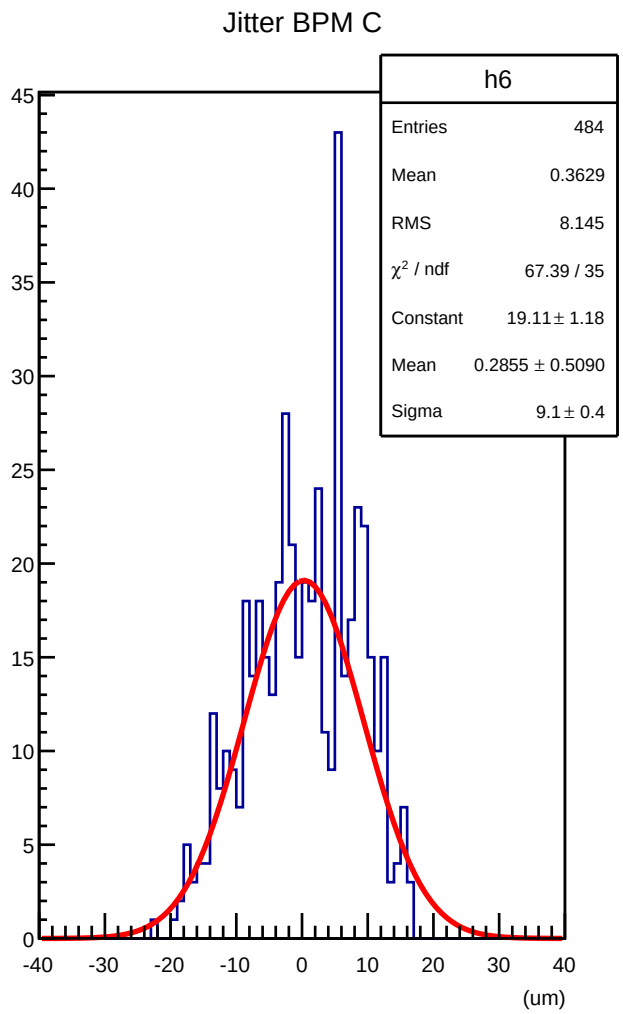
JItter of 10~20% of σ_y is expected.



Jitter at 20dB att. ($\sim 80\mu$m dynamic range) for 500 pulses ($\sim$3min).







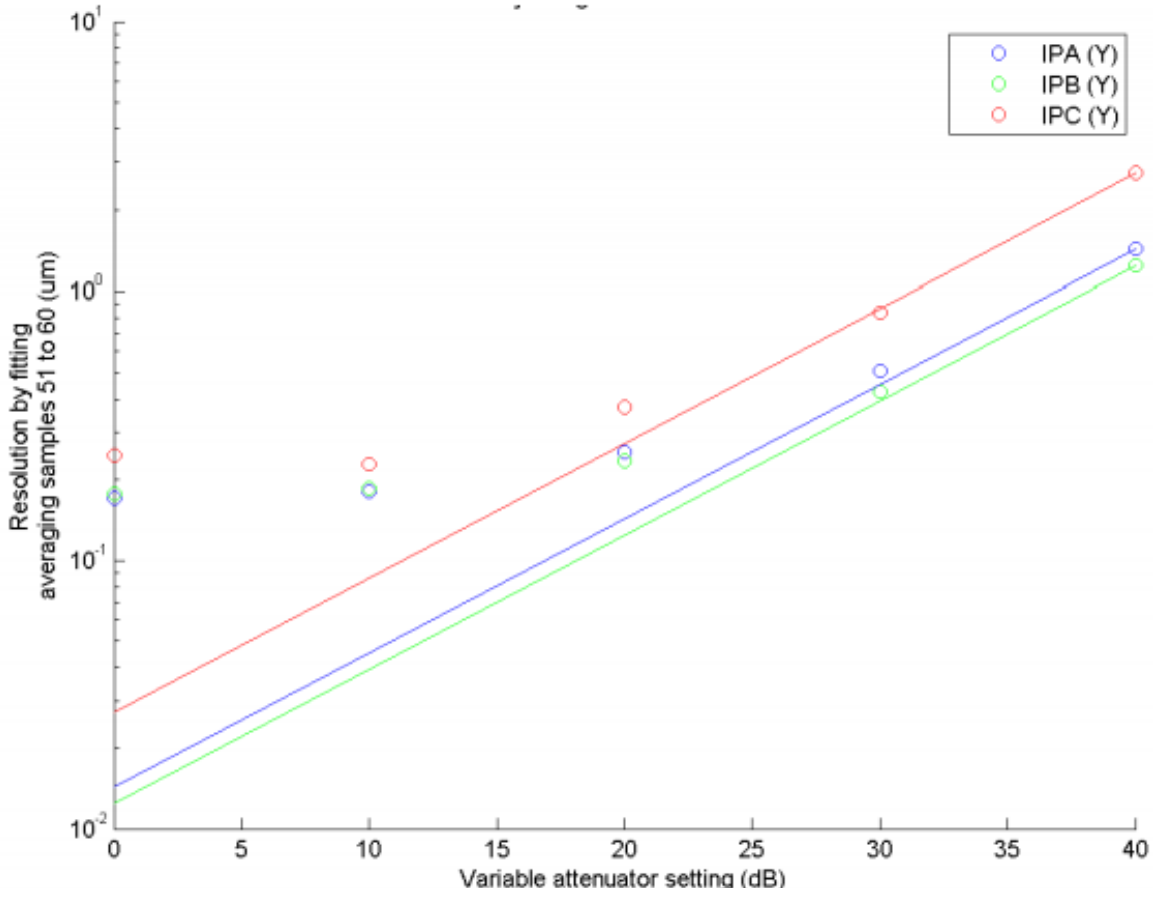
Jitters are 16μm, 9μm and 9μm for IPA, IPB and IPC
($\sim$ 50% of extrapolated beam size)

Resolution and dynamic range at 0.5×10^{10}

If we continue using the current electronics configuration ...

For the normal operation with 0.5×10^{10} particles :

- It is 5 times the charge used for the previous jitter acq. Then, 30dB seems to be safe to avoid saturation, implying 1μm resolution.



Shown by FONT (Bunch-bunch feedback and IP beam stabilization, 18th ATF2 Project Meeting)

Comments on the current IPBPMs operation

- It is possible to analyse only one plane each time (x or y)
- Raw waveforms from the cavities are published through EPICS.
- Calibration software in Vertical and Horizontal plane have been done by ATF staff.
- Jitter software analysis is also available.
- However, most data is reanalyzed off-line, due to changes in parameters (gains, phase settings, hardware electr., ...)

In order to allow the systematic use of IPBPMs data :

- Tests with the electronics could continue but we must define a common electronics setup (and analysis method ?).
- Position data needs to be integrated with the upstream BPMs info. This implyes synchronization issues (because of network ??? currently IPBPMs connected at ip-server, and upstream BPMs are connected to atf-server ?) Also, common trigger
- How interesting is horizontal plane for tuning at the moment ? If both planes are required, it is necessary to install extra hardware.