Few issues for New IP BPM system

Young-Im Kim
John Adams Institute – University of Oxford
FONT group

Issues

- Cavity
- Electronics
- Signal processing
- Reference cavity : low-q?
  - Single bunch : no problem
  - Multi bunch ??

Cavity

Si-Won Jang – 14th ATF2 project meeting

RF measurement data

	Port	f_0 (GHz)	β	Q_0	Q_{ext}	Q_L	τ (ns)	V_{out} [mV/um]
Designed	X-port	5.7127	5.684	4959.29	872.42	741.91	18.72	3.870
Designed	Y-port	6.4280	5.684	4670.43	821.61	698.70	17.23	3.724
Double_1	X-port	5.6968	0.656	362.34	552.14	218.77	6.112	4.870
Double_1	Y-port	6.4099	0.668	845.66	1266.7	507.11	12.59	3.005
Double_2	X-port	5.6975	0.817	483.38	591.45	265.99	7.430	4.705
Double_2	Y-port	6.4097	0.641	834.70	1302.5	508.70	12.63	2.964
Single_1	X-port	5.6991	0.855	502.05	587.04	270.61	7.557	4.722
Single_2	Y-port	6.4089	0.986	1238.0	1255.9	623.43	15.48	3.019

- Measured Q0 value shows too low for both x-port & y-port.
- Measured X-port data shows too strange, but output voltage shows little bit good.
- If possible I want to make one more set of Al IP-BPMs except volt type.

Cavity

Si-Won Jang – 14th ATF2 project meeting

- Center frequency?
- Any plan to tune?
- Reference cavity frequencies?

RF measurement data

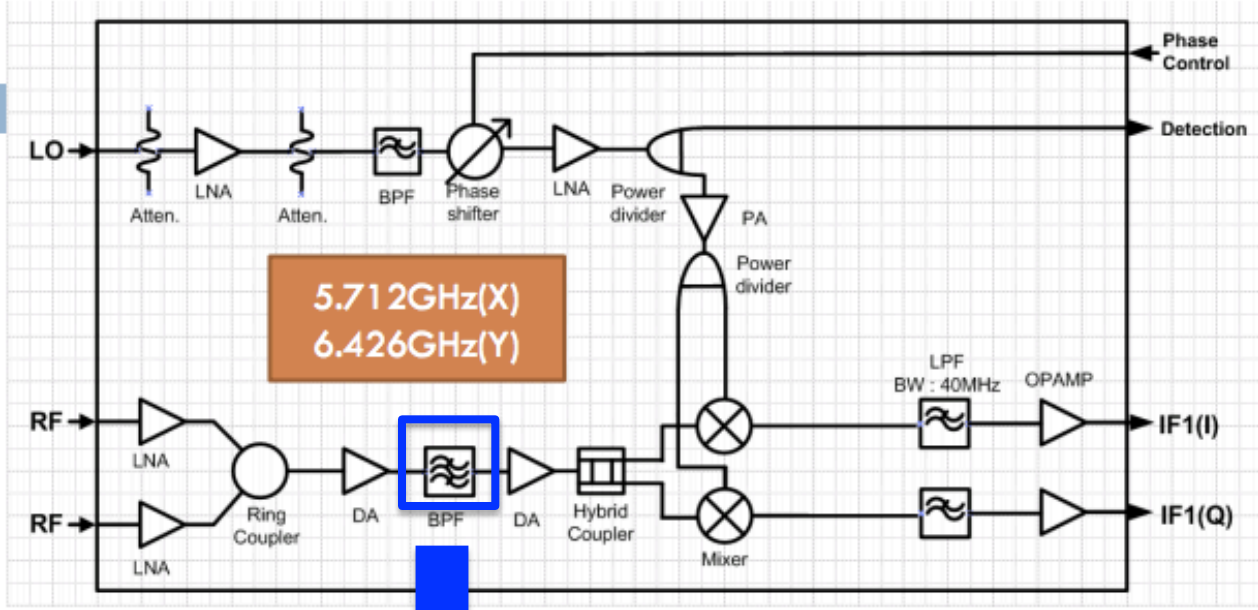
	Port	f_0 (GHz)	β	Q_0	Q_{ext}	Q_L	τ (ns)	V_{out} [mV/um]
Designed	X-port	5.7127	5.684	4959.29	872.42	741.91	18.72	3.870
Designed	Y-port	6.4280	5.684	4670.43	821.61	698.70	17.23	3.724
Double_1	X-port	5.6968	0.656	362.34	552.14	218.77	6.112	4.870
Double_1	Y-port	6.4099	0.668	845.66	1266.7	507.11	12.59	3.005
Double_2	X-port	5.6975	0.817	483.38	591.45	265.99	7.430	4.705
Double_2	Y-port	6.4097	0.641	834.70	1302.5	508.70	12.63	2.964
Single_1	X-port	5.6991	0.855	502.05	587.04	270.61	7.557	4.722
Single_2	Y-port	6.4089	0.986	1238.0	1255.9	623.43	15.48	3.019

- Measured Q0 value shows too low for both x-port & y-port.
- Measured X-port data shows too strange, but output voltage shows little bit good.
- If possible I want to make one more set of Al IP-BPMs except volt type.

Electronics

Si-Won Jang – 15th ATF2 project meeting

Simplified schematic of new electronics



Total conversion Gain: 54dB->35dB

To get the more wide Dynamic range at the IP-region

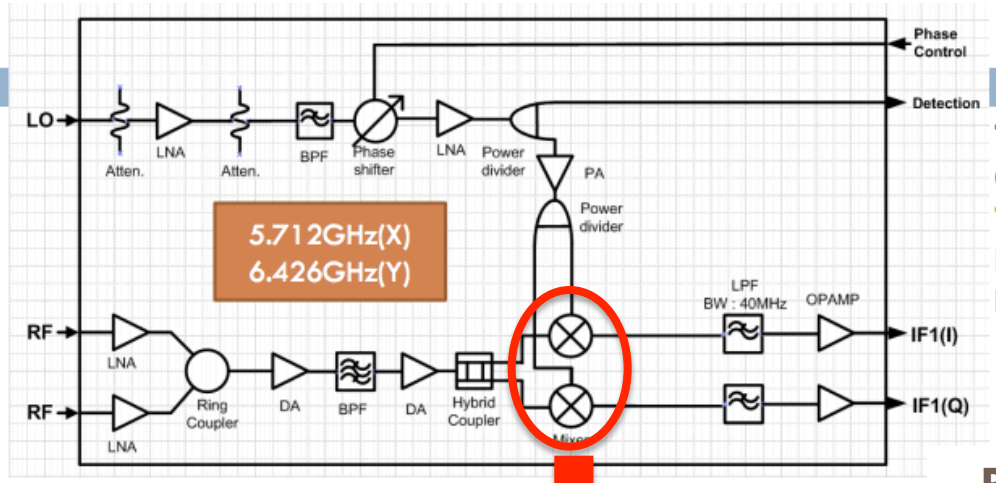
Simplified schematic of the IP-BPM signal processing electronics.

BPF center frequency? Bandwidth?

Electronics

Si-Won Jang – 15th ATF2 project meeting

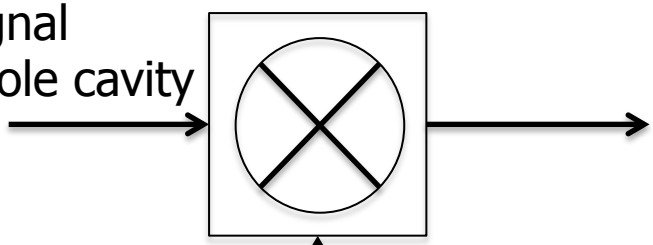
Simplified schematic of new electronics



Simplified schematic of the IP-BPM signal processing electronics.

Total conversion
Gain: 54dB->35dB
To get the more wide Dynamic range at the IP-region

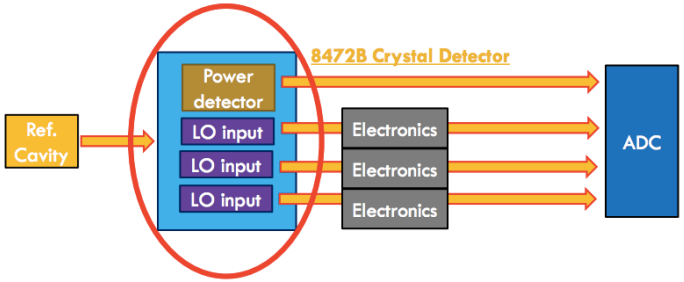
Input signal from dipole cavity



LO from Ref. cavity

Power divider for Ref. signals

- **The ref. cavity output is just one port, therefore the output signal should be split to connect LO signal port of each electronics and power detector.**

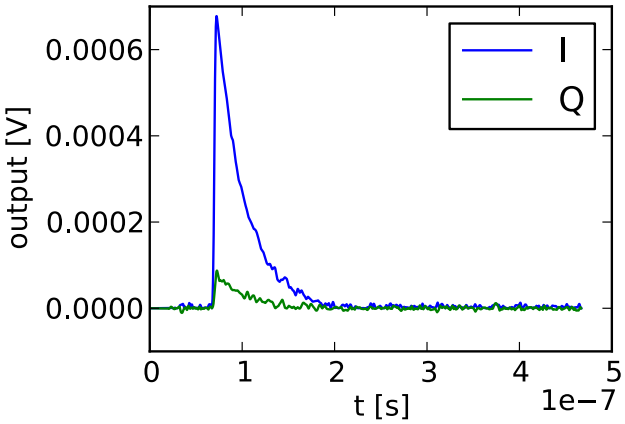


Will be fabricated.

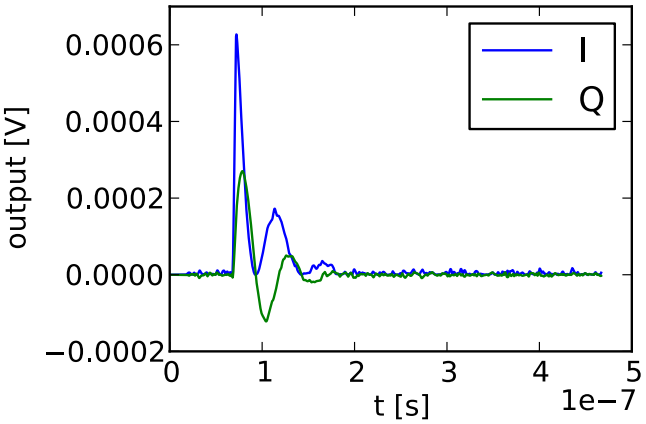
Simulation
Frequency mismatch @ mixer

Different LO frequency distribution

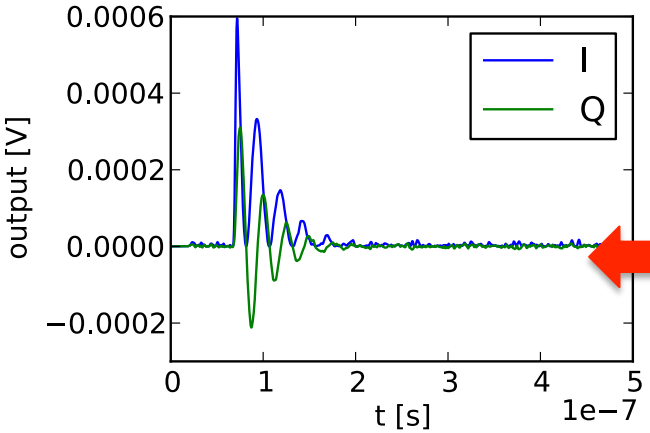
LO : 100 % same frequency



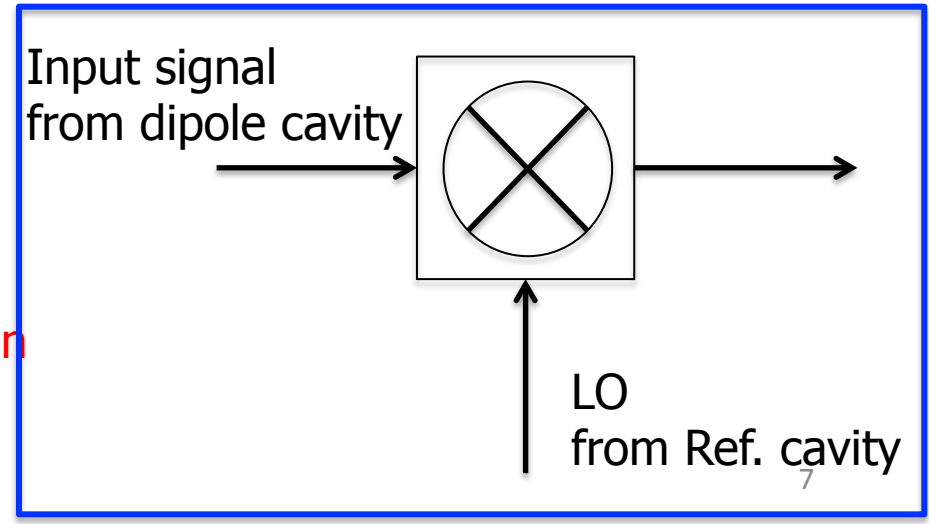
LO : 0.15 % different frequency



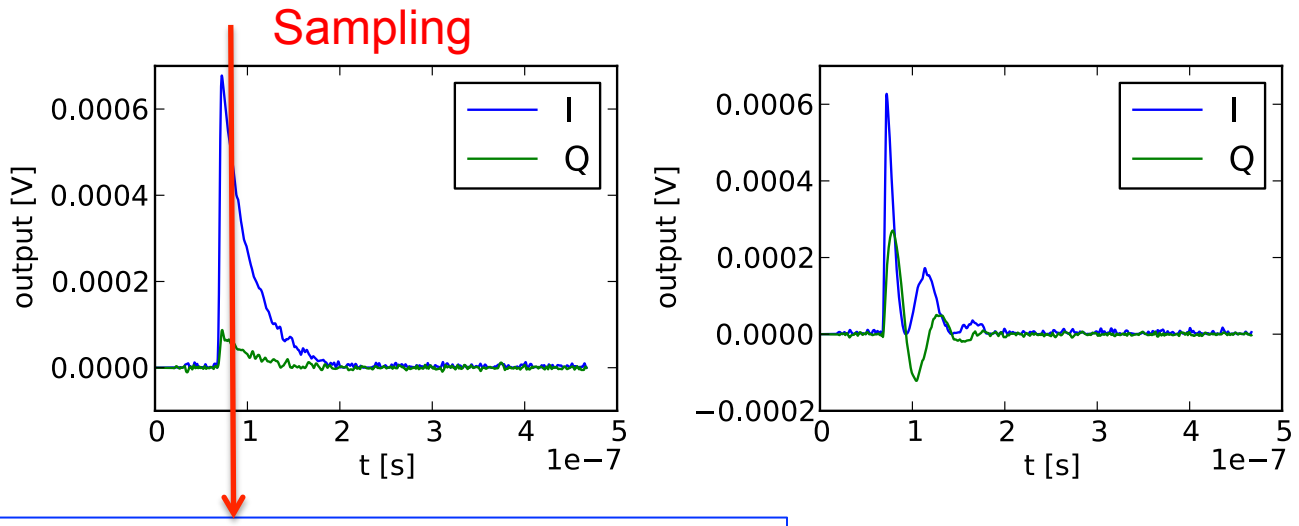
20 MHz IF

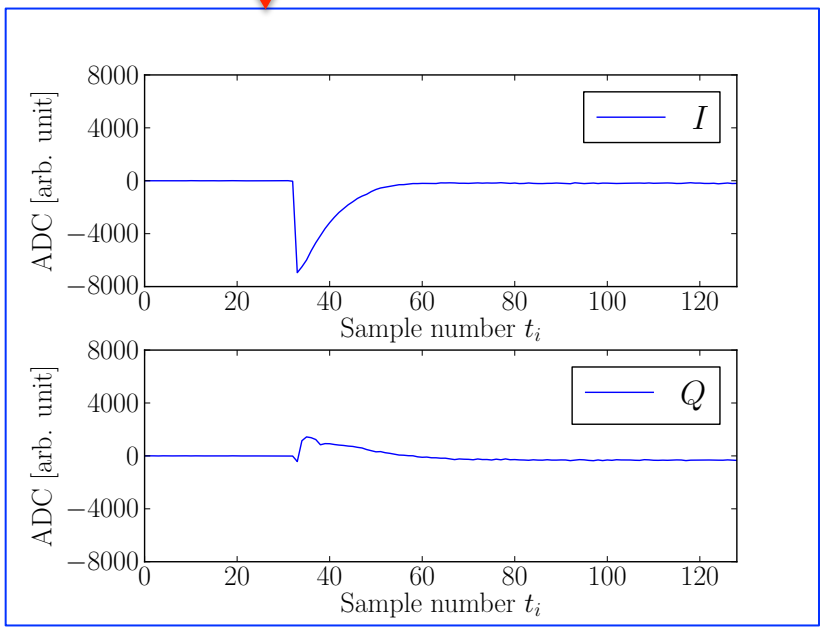


Digital Down Conversation (DDC)



Frequency mismatch @ mixer



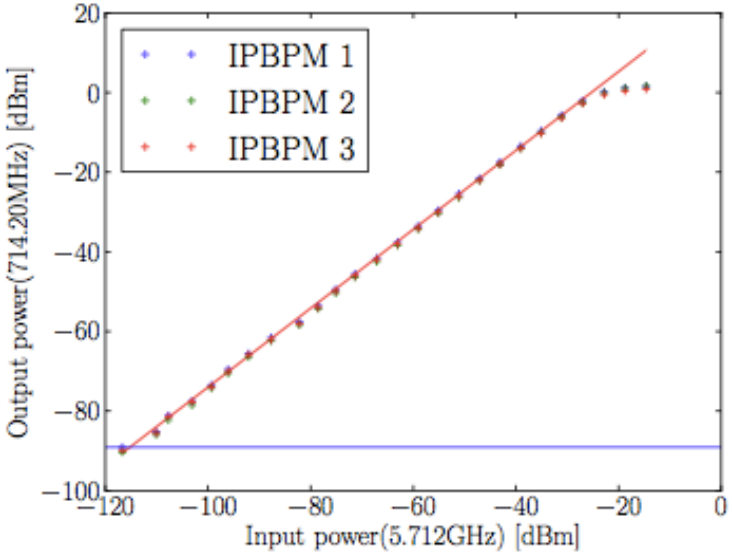


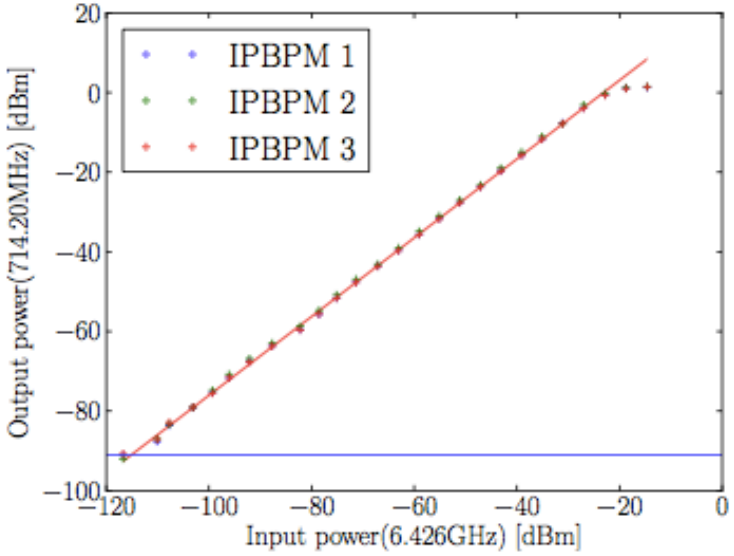
IPBPM @ Upstream (Nov. – Dec. 2011)

Homodyne :
Additional signal processing is not needed so it is good for using feedback

Electronics

- Electronics measurement without cavity and beam
  - Simple measurement with signal generator and spectrum analyser/Digital oscilloscope
  - Linearity/non-linearity
  - System noise





Attenuator – linear component

Si-Won Jang – 15th ATF2 project meeting

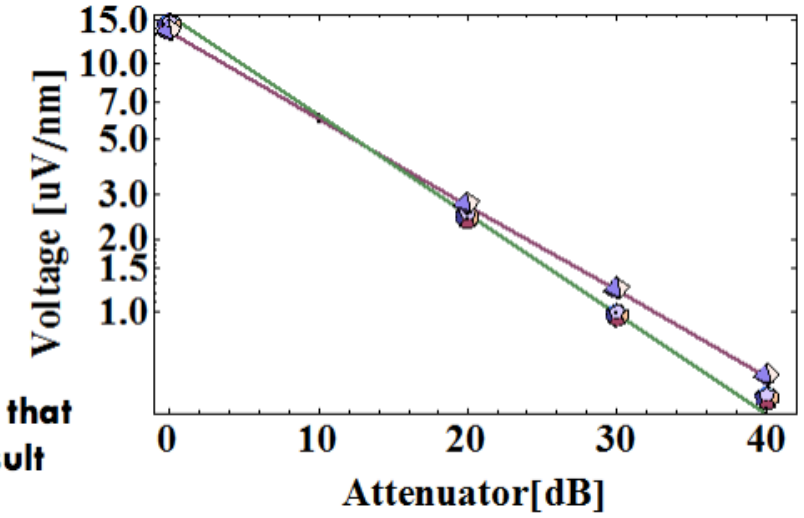
Results of Electronics sensitivity

- Calibration slope for calibrating the I signal to actual beam position is summarized in Table.
- Operation condition: 1.1GeV
- ICT monitor 0.2~0.4*10^10 (during beam shift)

[uV/nm]	w/o	20dB	30dB	40dB
BPM 1	14.12	2.411	0.961	0.448
BPM 2	13.72	2.614	1.724	0.712

(14bit ADC noise = 366uV)
14uV/nm= 0.1count/nm
366uV/(14uV/nm) = 26 nm (Limit of Elec.)

Even though the beam orbit was unstable at that time and beam current also unstable, the result values of calibration slope shows too small. (0.17~0.38 during data taking).



More…

- Reference cavity
  - Center frequency?
  - Low-Q?
    - If not, problem for the multi bunch operation?
    - How to charge normalise?
    - Mixer for the second bunch?
- Which signals to FONT? – need to be discussed in next session?
  - I ? Or I and Q ?
  - Phase stability?