IP-BPM NOV. BEAM TEST RESULTS

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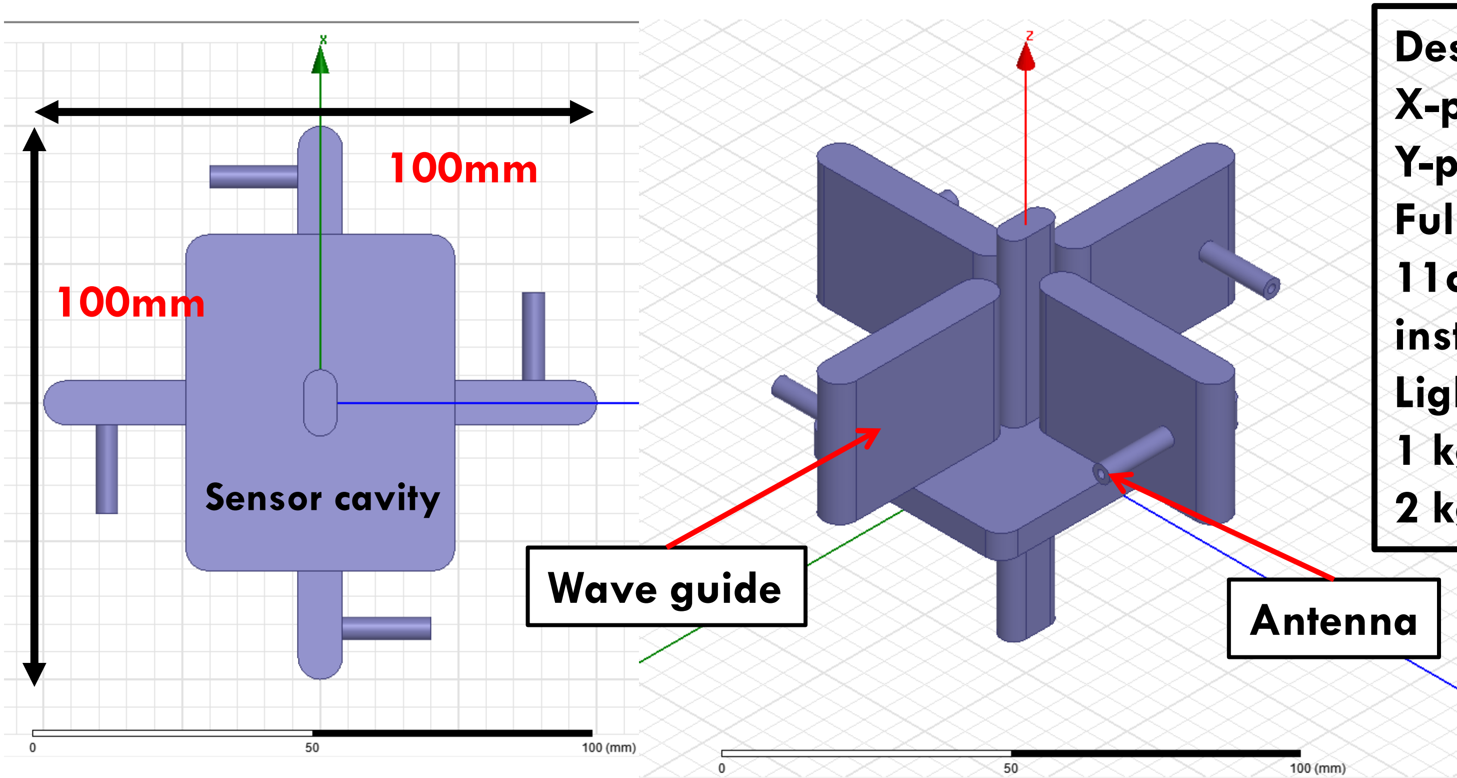
11cm Low-Q IP-BPM design

- 11cm Low-Q IP-BPM drawings of HFSS



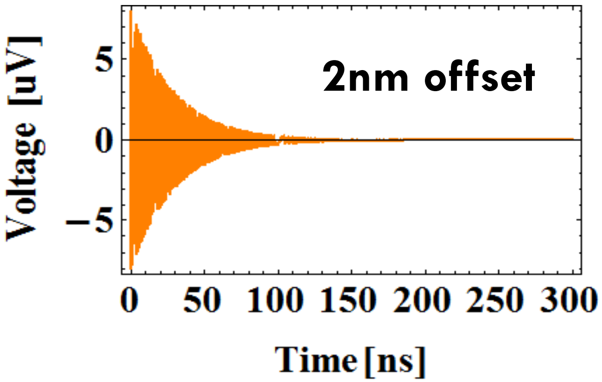
Designed frequency
X-port: 5.712 GHz
Y-port: 6.426 GHz
Full size :
11cmx11cm (to install IP-Chamber)
Light weight:
1 kg (Single cavity)
2 kg (Double cavity)

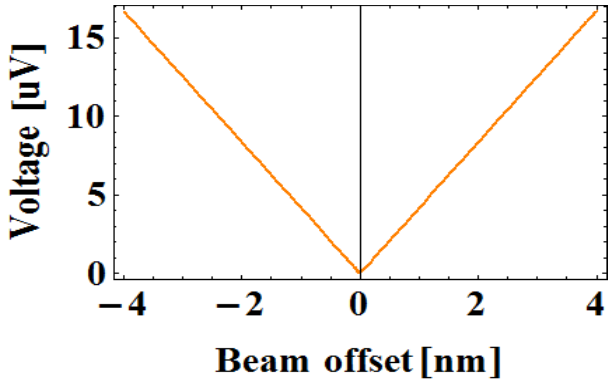
Results of HFSS simulation

11cm AL ver.

Port	f_0 (GHz)	β	Q_0	Q_{ext}	Q_L	τ (ns)
X-port	5.7127	5.684	4959.29	872.42	741.91	18.72
Y-port	6.4280	5.684	4670.43	821.61	698.70	17.23

Output signal for Y-port (11cm AL ver.)





Parameter	Value	Unit
q (charge)	~ 1.6	nC
Beam energy	1.3	GeV
Bunch length	8	mm

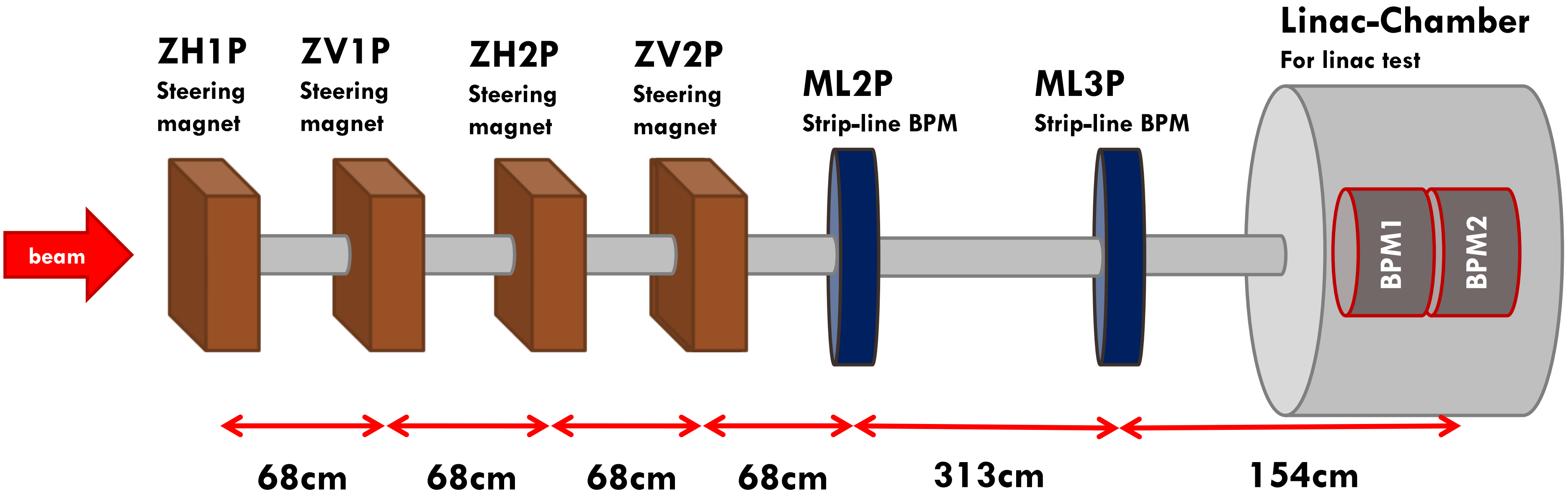
RF measurement data

	Port	f_0 (GHz)	β	Q_0	Q_{ext}	Q_L	τ (ns)	V_out (uV/2nm)
Designed	X-port	5.7127	5.684	4959.29	872.42	741.91	18.72	7.739
Designed	Y-port	6.4280	5.684	4670.43	821.61	698.70	17.23	7.448
Double_1	X-port	5.6968	0.656	362.34	552.14	218.77	6.112	9.740
Double_1	Y-port	6.4099	0.668	845.66	1266.7	507.11	12.59	6.010
Double_2	X-port	5.6975	0.817	483.38	591.45	265.99	7.430	9.410
Double_2	Y-port	6.4097	0.641	834.70	1302.5	508.70	12.63	5.927
Single_1	X-port	5.6991	[illegible]	[illegible]	[illegible]	[illegible]	7.55[illegible]	9.444
Single_2	Y-port	6.4089	[illegible]	[illegible]	[illegible]	[illegible]	15.48	6.037

The double block of IP-BPM was used for November beam test at the end of Linac.

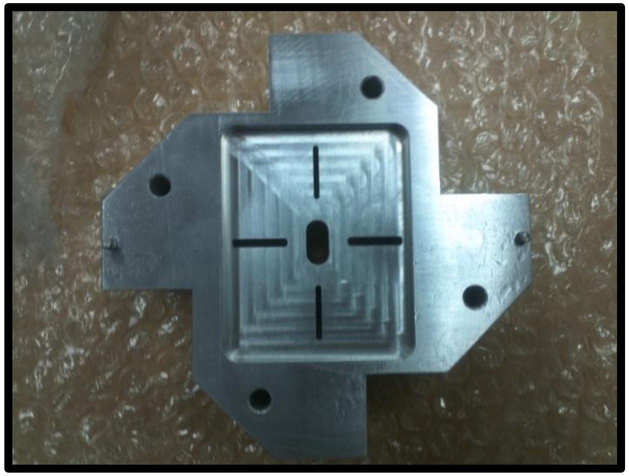
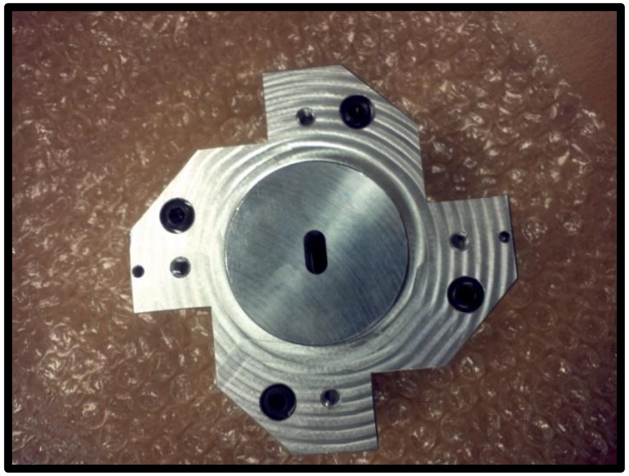
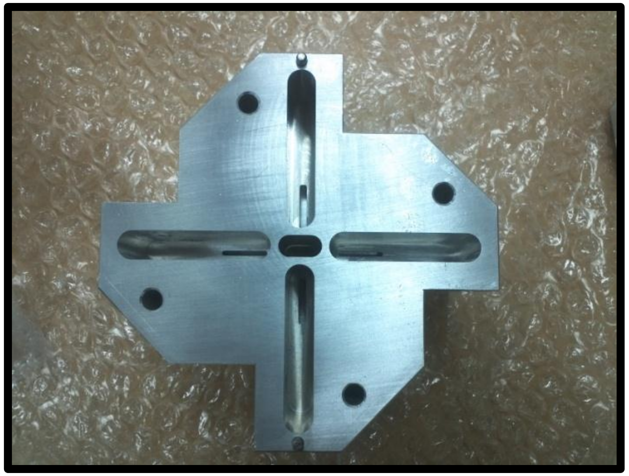
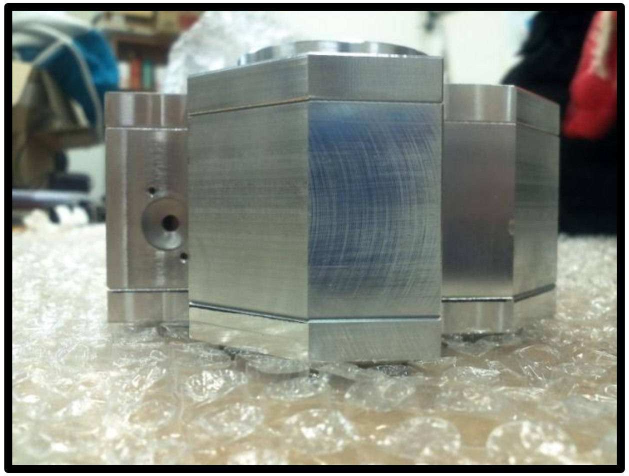
Test scheme @ end of Linac

- **Distance between each elements**
  - **In this test, we used two BPMs (Double block).**
  - **Beam test performed during two shift**
  - **The beam position at Low-Q IP-BPM was estimated by using two strip-line BPMs.**

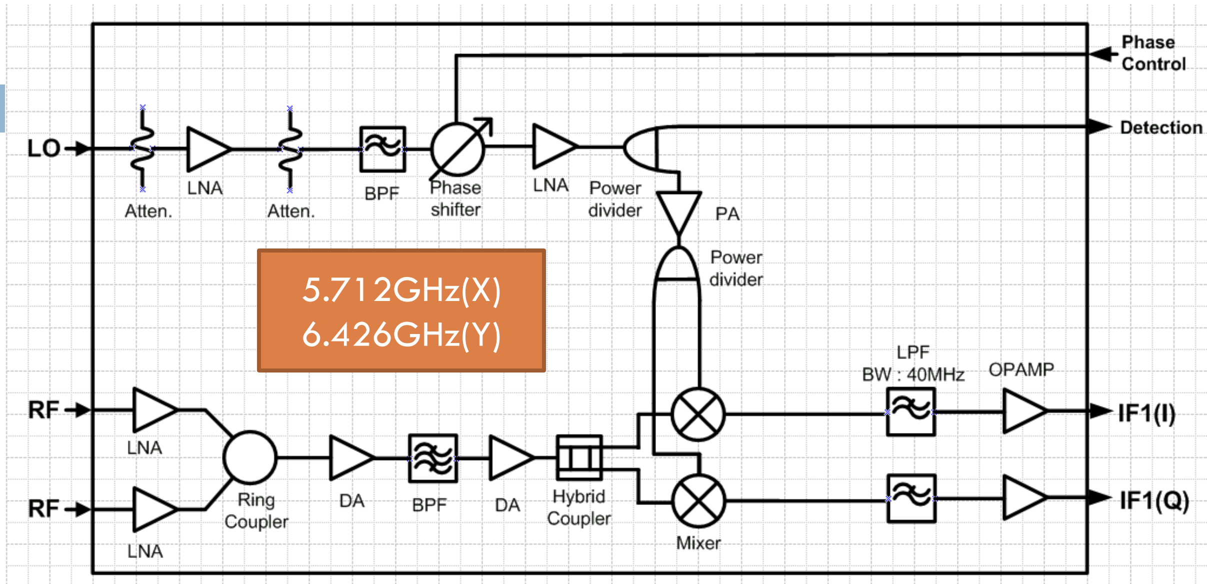


Tested Double block IP-BPM

- **Made by Aluminum** (2kg for double block)

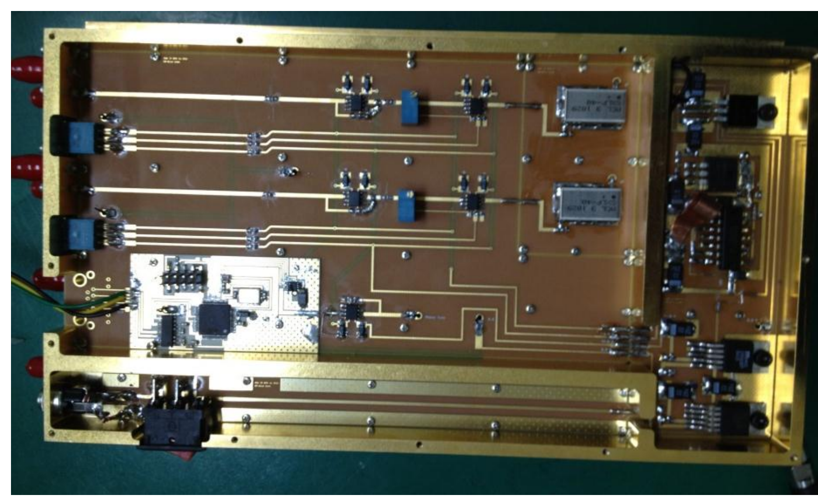
Simplified schematic of new electronics



Total conversion Gain: 54dB->35dB

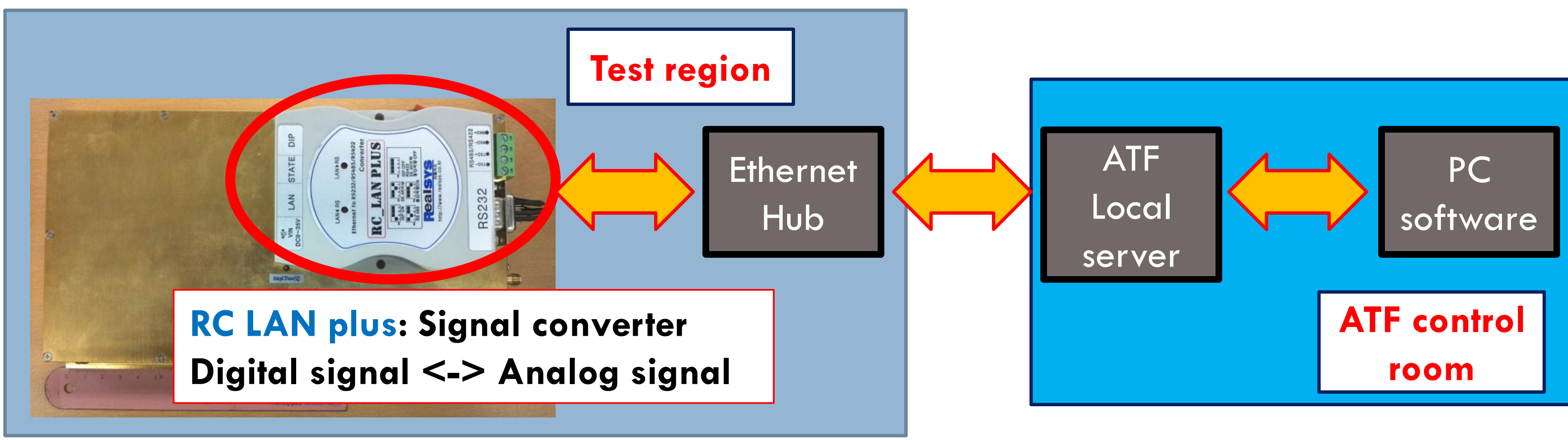
To get the more wide Dynamic range at the IP-region

Simplified schematic of the IP-BPM signal processing electronics.



Phase shifter remote control

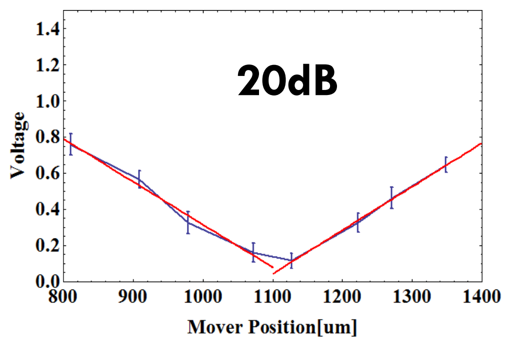
- In November beam test, the phase shifter was controlled remotely at the ATF control room.
- The phase shifter was connected to RC LAN plus to control due to digital signal. The LO signal phase was controlled from 0 degree to more than 360 degree.

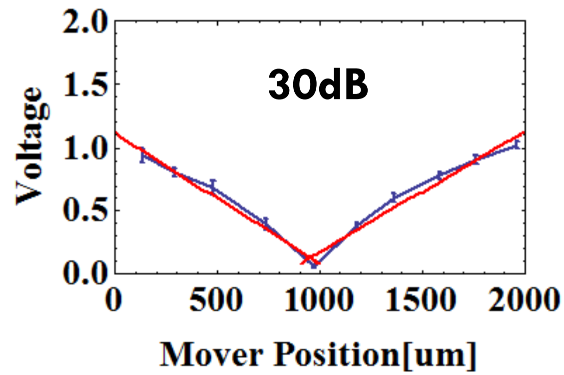


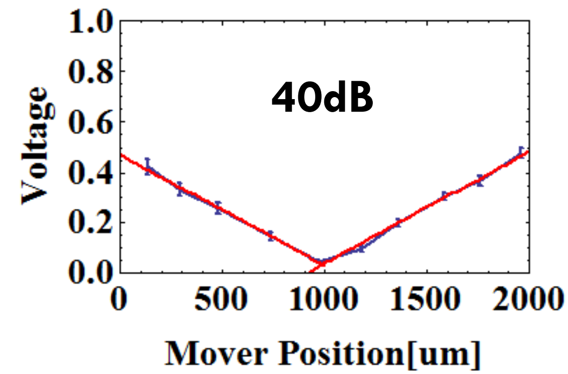
Results of Nov. beam test

- Calibration Run was made under 40 dB, 30 dB, 20 dB attenuation cases. This is to enlarge dynamic range of the electronics, in order not to saturate while sweeping the beam.

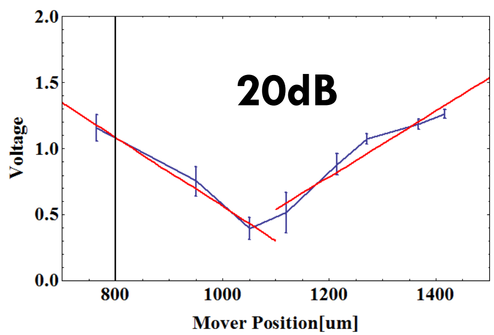
BPM1 Y-port

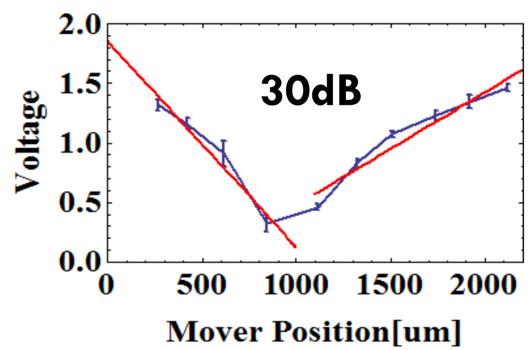


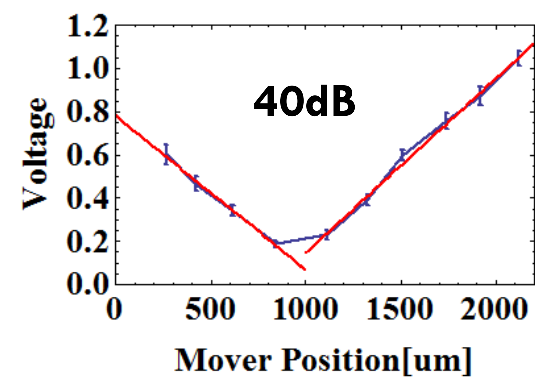




BPM2 Y-port







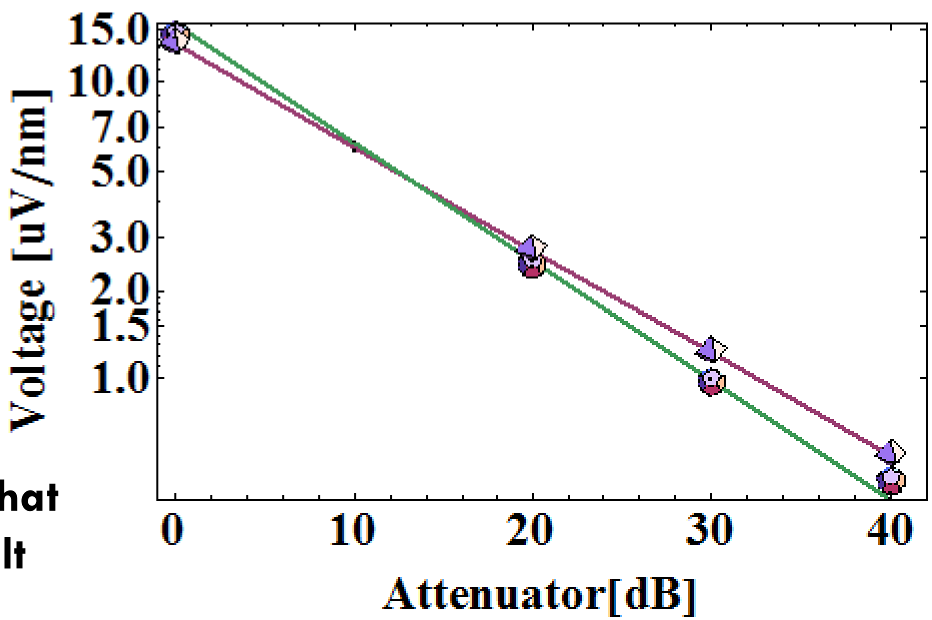
Results of Electronics sensitivity

- **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).



The reason of Nov. beam test results

1/10 = reference cavity cal. factor

[mV/nm]	w/o	20dB	30dB	40dB
Y-port	4.509	0.721	0.218	0.077
Ex. Y-port	2.632	0.416	0.163	0.063

The Jan. (2012) beam test results

[mV/nm]	w/o	20dB	30dB	40dB
Y-port	**0.451**	**0.072**	**0.022**	**0.008**
Ex. Y-port	**0.263**	**0.042**	**0.016**	**0.006**

The Jan. (2012) beam test results after re-analysis

- **For the Jan. beam test, the electronics total conversion gain was 54dB. In the Jan. beam test, the wrong value of reference cavity calibration factor was used. It make higher sensitivity results.**
- **The actual sensitivity results was 450~270uV/nm. It means we can get the 2nm beam position resolution with wide dynamic range.**
- **Therefore, current total conversion gain of the electronics (35dB) will be modified to 54dB, again.**

Results of IP-BPM y-port sensitivity At November beam test

- **IP-BPM sensitivity**

(For y-port)

= **2.2558**[mV/um]

(one-port measurements of BPM1)

= **2.22996**[mV/um]

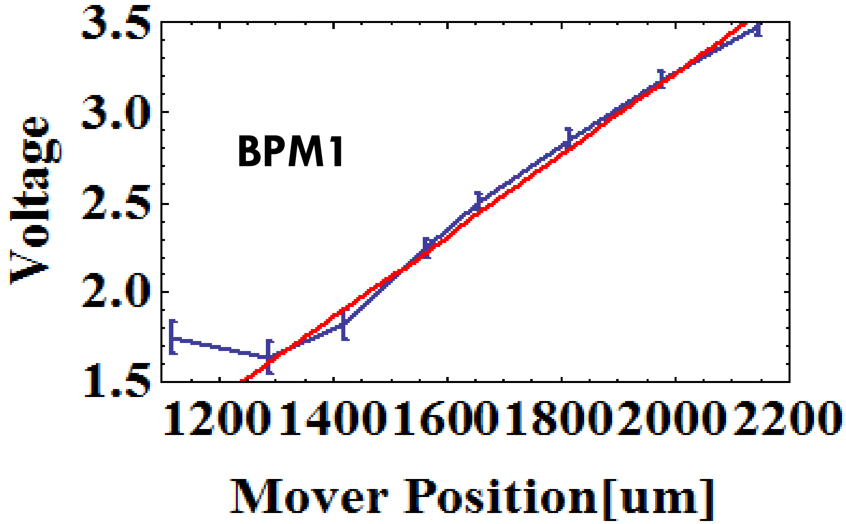
(one-port measurements of BPM2)

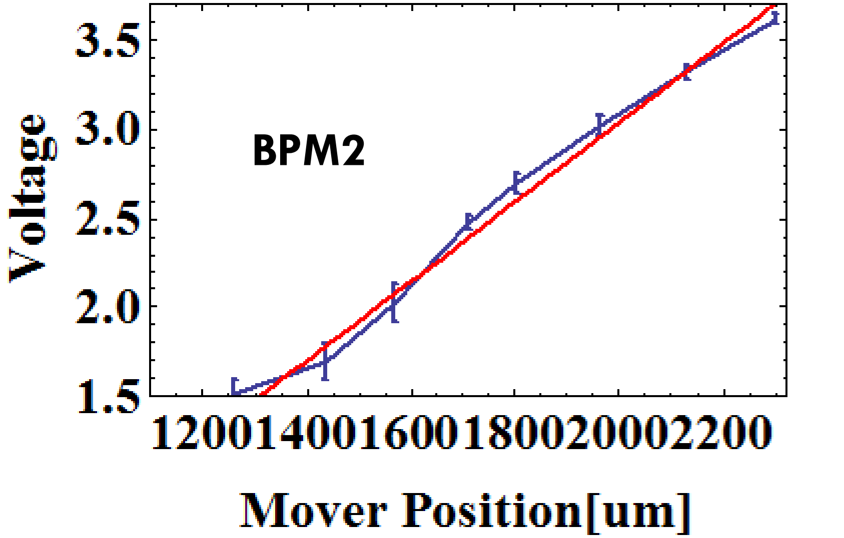
- **Designed sensitivity**

= **3.005** [mV/um] (BPM1)

= **2.964** [mV/um] (BPM2)

ICT monitor: 0.36~0.38 *10^10 (at LNE)



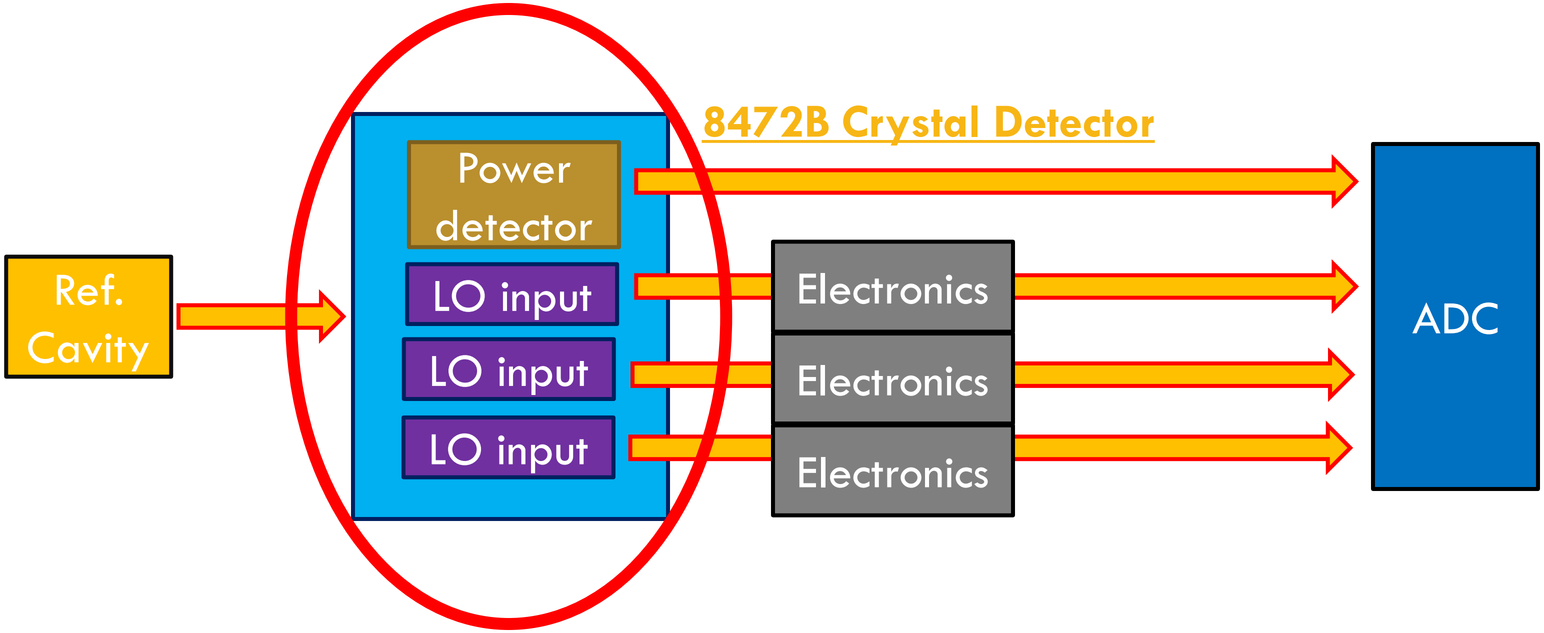


Further more works

- Preparation list until Apr. install
  - RF test of reference cavity
  - Electronics modify
    - Conversion gain should be more higher as before case.
    - Ref. signal detecting system modify
  - Crystal diode detector calibration check
    - 8472B Crystal Detector - Agilent Technologies

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.

Apr. beam test plan

- IP-chamber install at the IP-region
- Reference cavity sensitivity calibration
- Electronics sensitivity check again with IP-chamber
  - Total conversion gain will be changed to 54dB, again.
- BPM sensitivity check at the IP-region with piezo-mover.