LOW-Q IP-BPM STATUS

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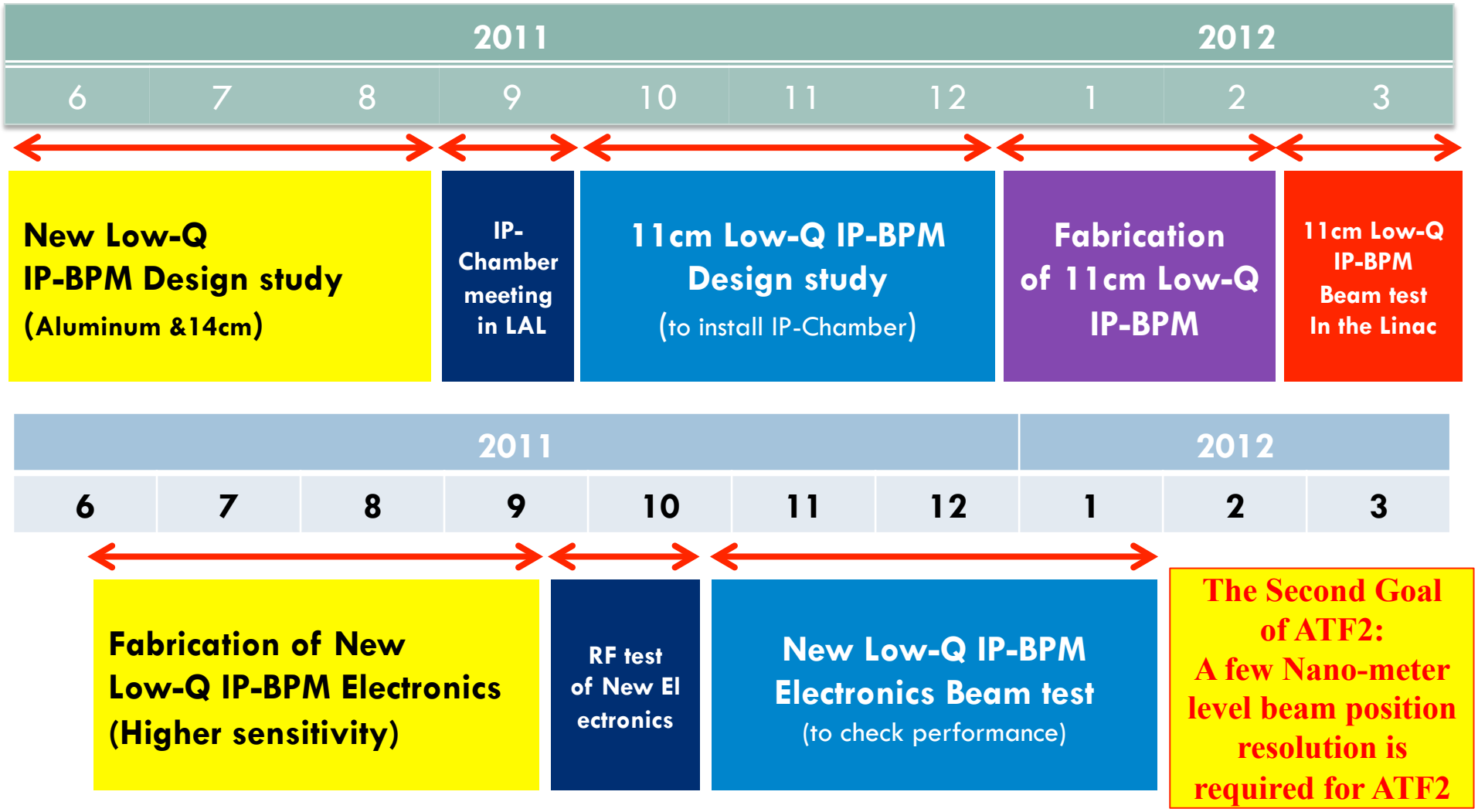
Contents

- Low-Q IP-BPM Progress
  - BPM progress
    - 11cm Al Low-Q IP-BPM design
    - Fabrication of Low-Q IP-BPM
    - RF measurements
    - Sensitivity measurements @ end of linac in ATF2
    - Summary of Low-Q IP-BPM progress
  - Electronics progress
    - Electronics test results
    - Summary of Electronics
- Summary

Low-Q IP-BPM Progress

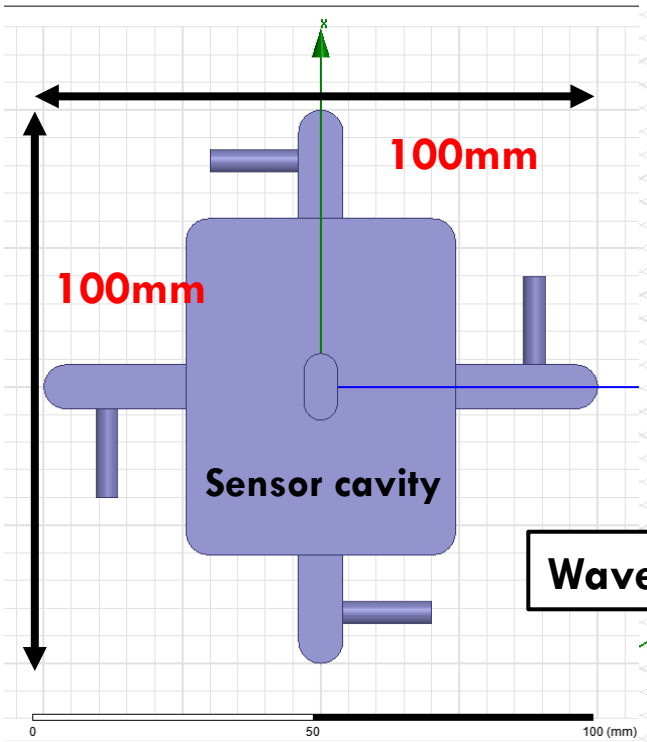


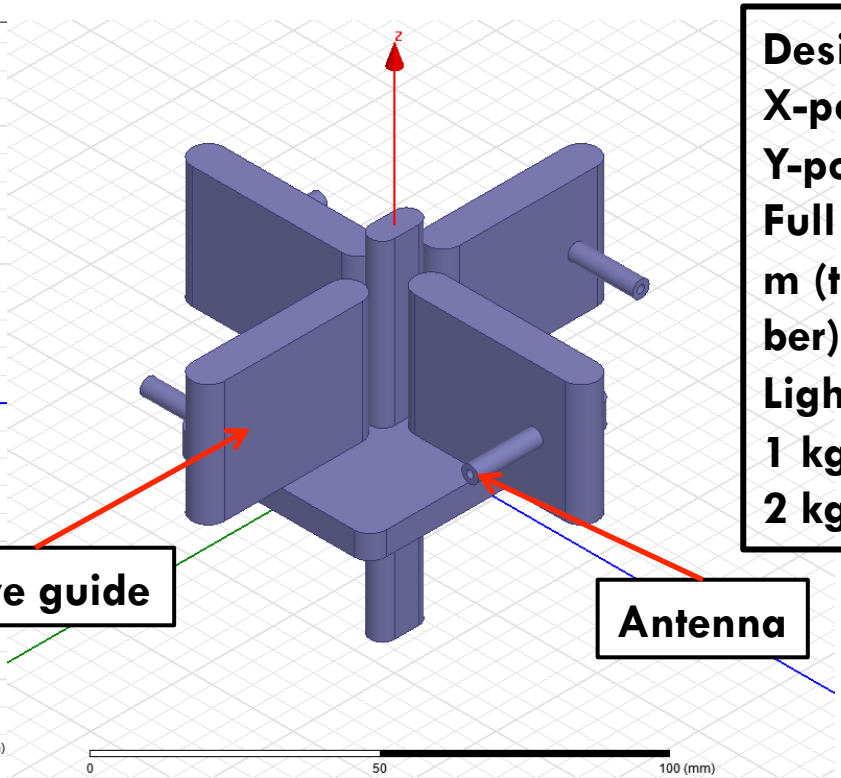
BPM progress

- 11cm Al Low-Q IP-BPM design
- Fabrication of Low-Q IP-BPM
- RF measurements
- Sensitivity measurements @ end of linac in ATF2
- Summary of Low-Q IP-BPM progress

11cm Low-Q IP-BPM design

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





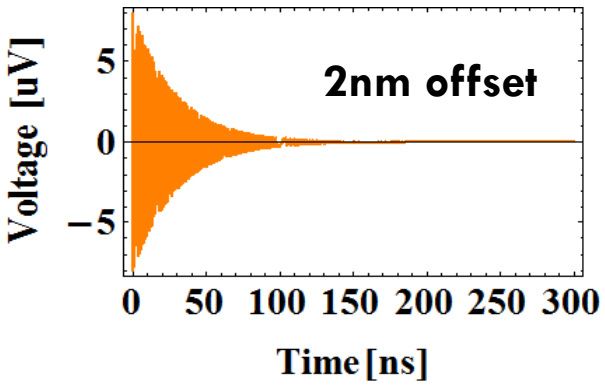
Designed frequency
X-port: 5.712 GHz
Y-port: 6.426 GHz
Full size : 11cmx11cm (to install IP-Chamber)
Light weight:
1 kg (Single cavity)
2 kg (Double cavity)

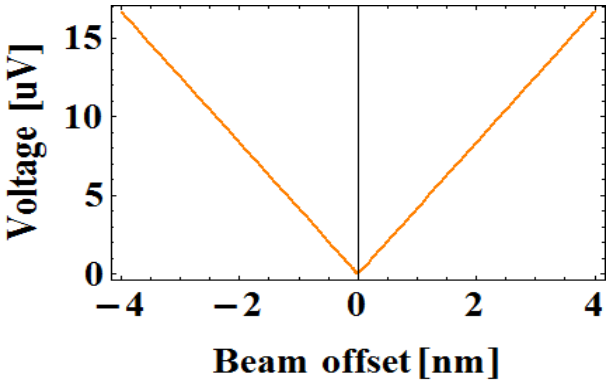
Results of HFSS simulation

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.)

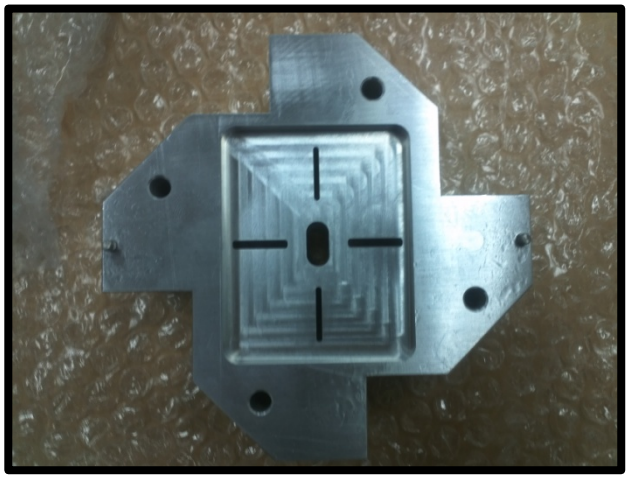
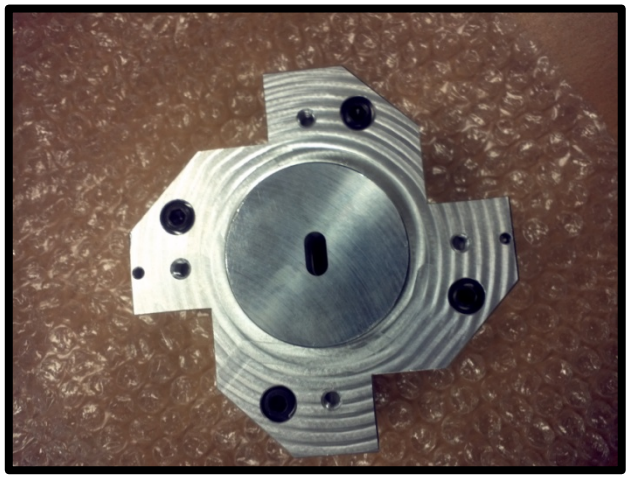
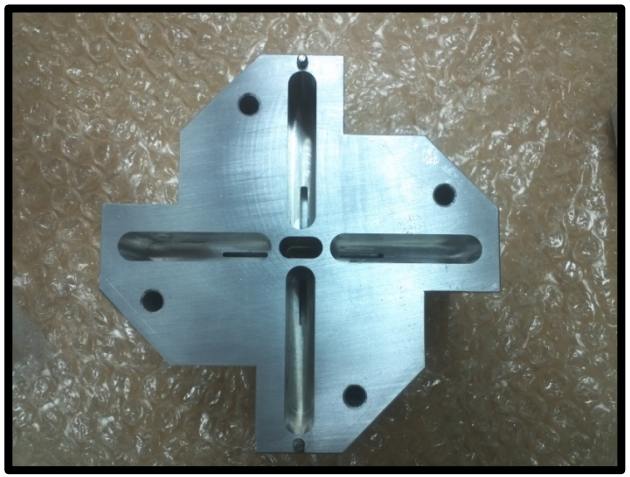
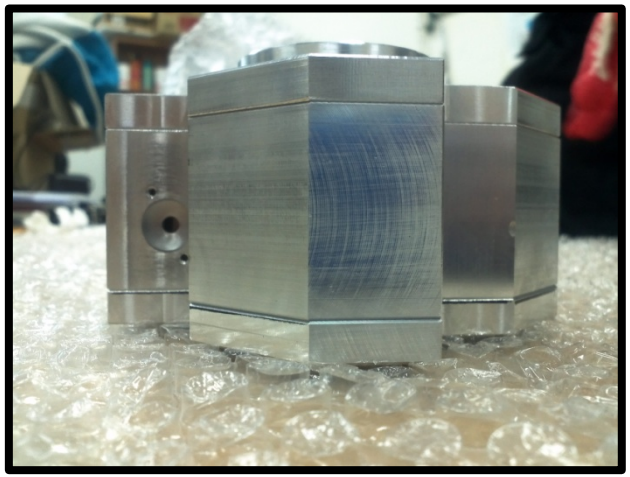




Parameter	Value	Unit
q (charge)	~ 1.6	nC
Beam energy	1.3	GeV
Bunch length	8	mm

Fabrication of 11cm Low-Q IP-BPM

- **Made by Aluminum** (1kg for 1cavity)

RF measurement data

	Port	f_0 (GHz)	β	Q_0	Q_{ext}	Q_L	τ (ns)	V_out (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	0.855	502.05	587.04	270.61	7.557	9.444
Single_2	Y-port	6.4089	0.986	1238.0	1255.9	623.43	15.48	6.037

- **Measured Q0 value shows too low for both x-port & y-port.**

- In my opinion, because it did not measured in a vacuum and caused by bolt type.

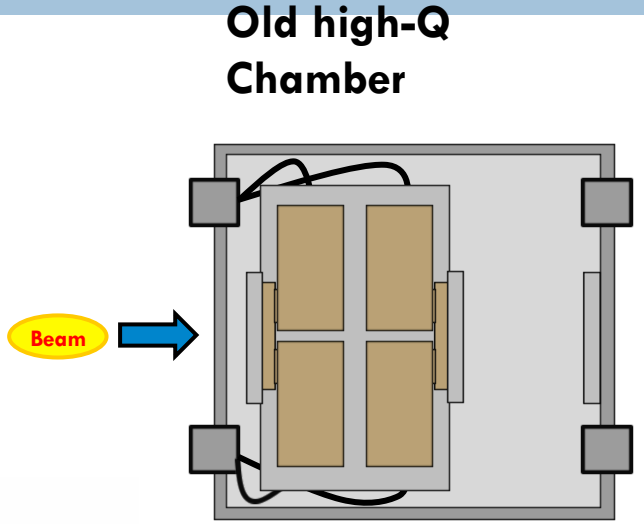
- **Measured X-port data shows too strange, but output voltage shows little bit good.**

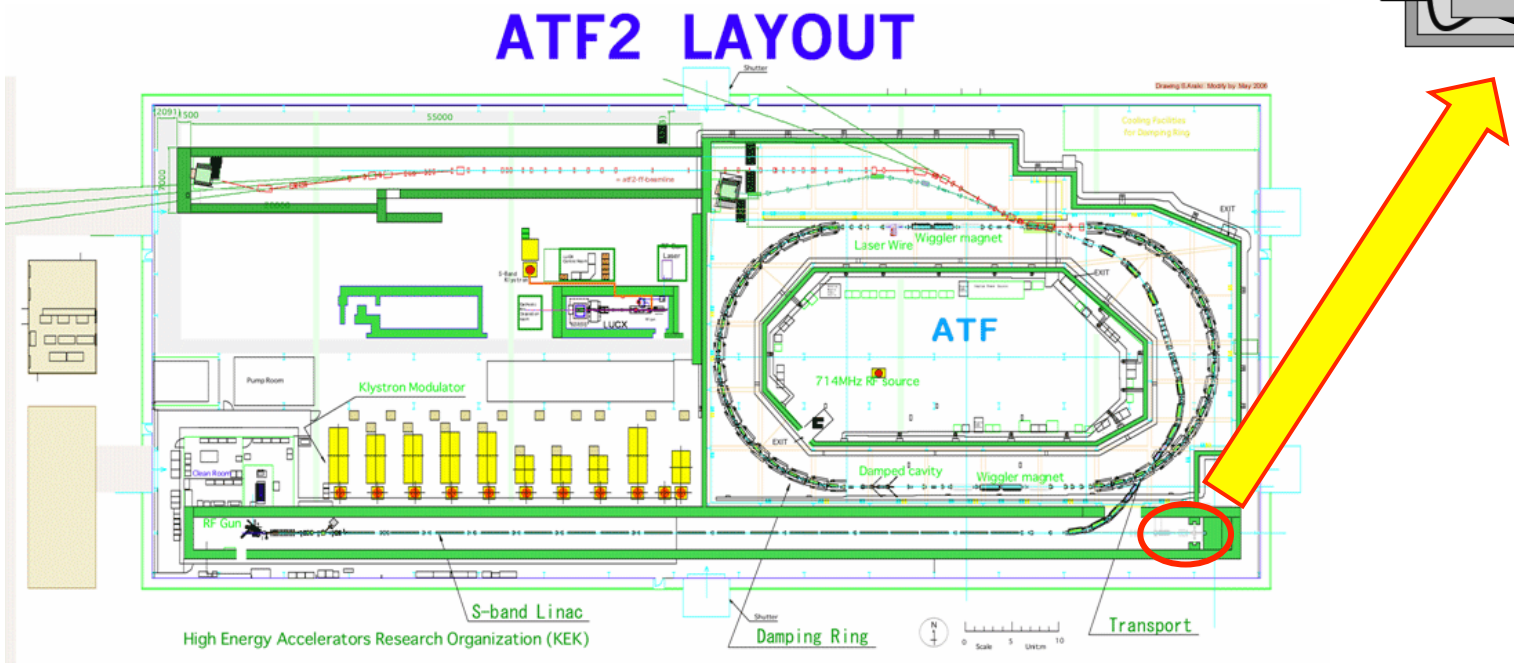
- I will perform HFSS simulation to compare with measured data, again.

- **If possible I want to make one more set of Al IP-BPMs except volt type.**

11cm Low-Q IP-BPM Test plan

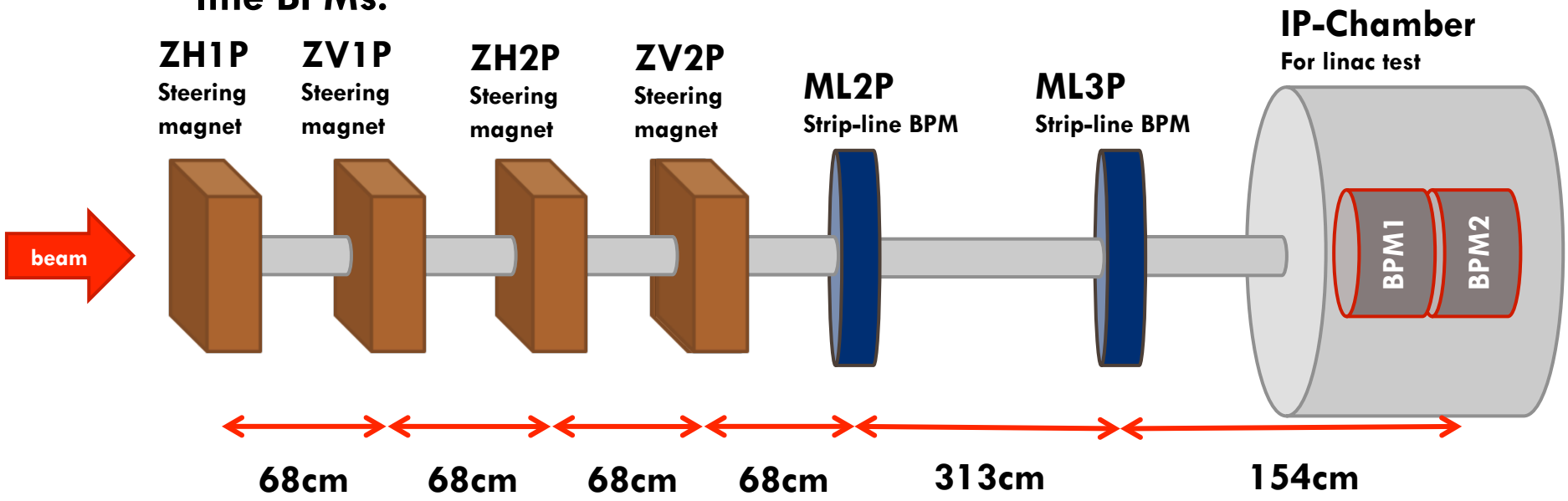
- **New IP-BPMs performance will test at end of linac with old high-Q chamber. (2012/03/12)**





Test scheme @ end of Linac

- **Distance between each elements**
  - In this test, we used just one BPM (BPM2).
  - There is no more cables connect to BPM1.
  - Beam test performed during 4hours. (Not enough to test other BPMs)
  - The beam position at Low-Q IP-BPM was estimated by using two strip-line BPMs.



Results of IP-BPM y-port sensitivity for one-port measurements

- **IP-BPM sensitivity**

  (For y-port)

  = 0.87631 [mV/um]

  (one-port measurements)

*** This results didn't consider the cable loss.**

The main cable loss value is -8.3dB.

Test conditions

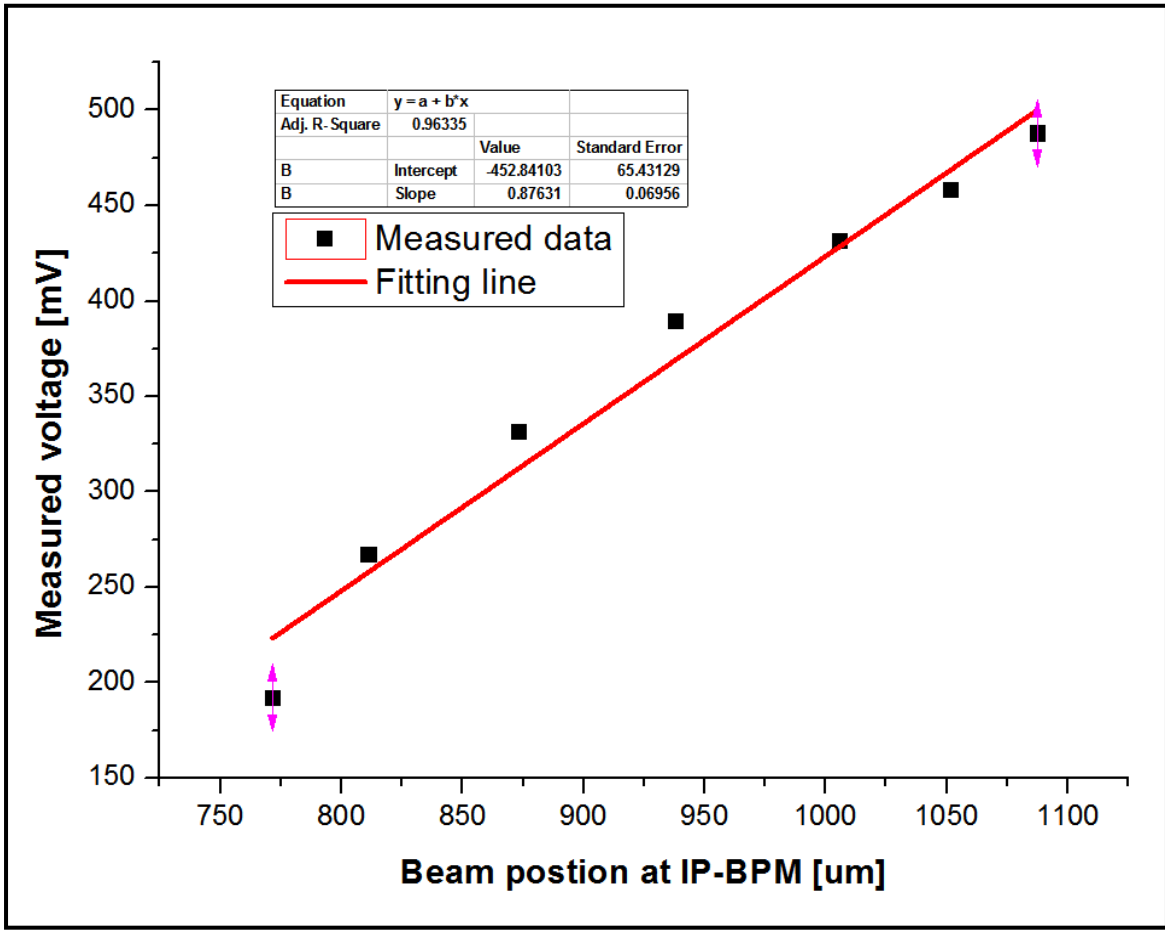
- 4 steering magnet (2 ver. + 2 hor.)

  => ZH1P, ZH2P, ZV1P, ZV2P

- 2 strip-line bpm

  =>ML2P, ML3P

ICT monitor: 0.87 *10^10 (at LNE)



Results of IP-BPM y-port sensitivity for one-port & 8.3dB cable loss

- **IP-BPM sensitivity**

  (For y-port)

  = 2.27855[mV/um]

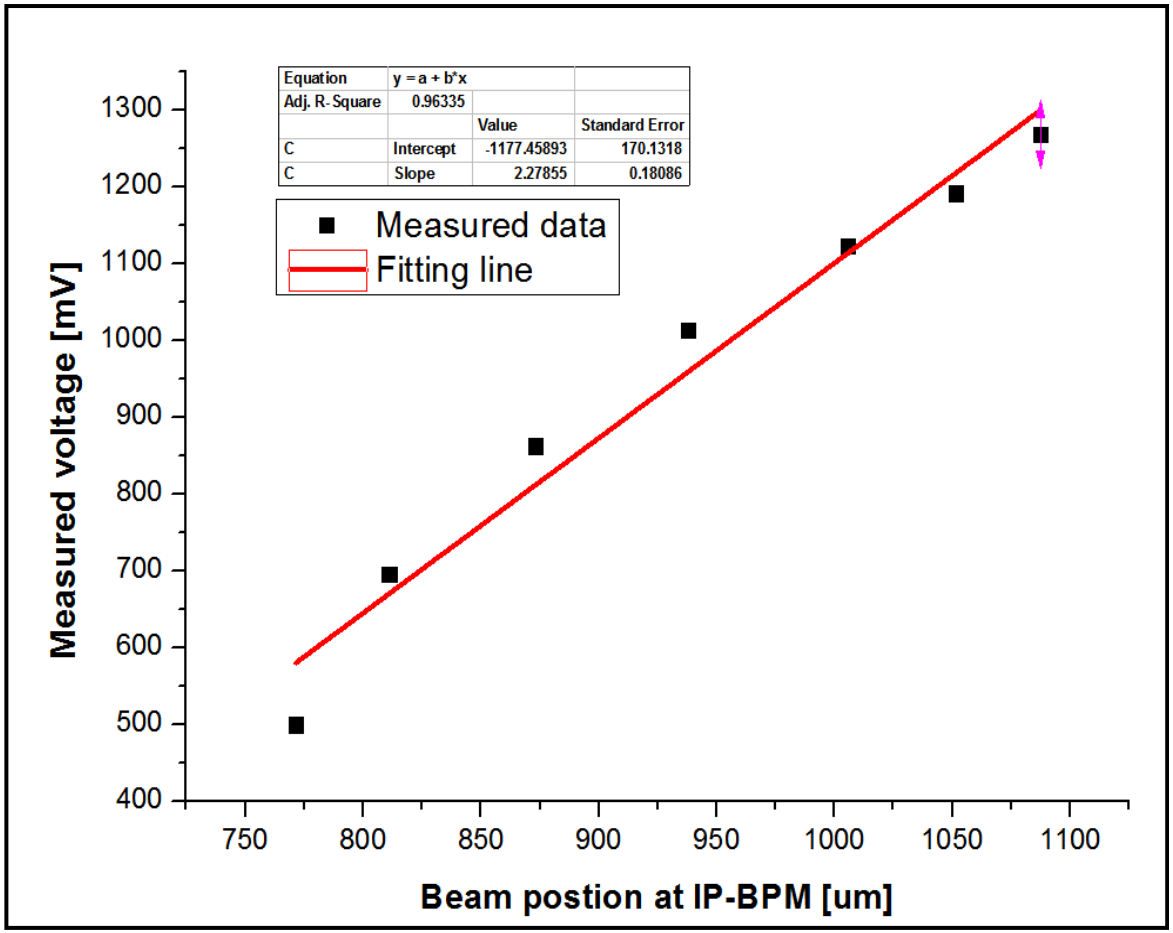
(one-port measurements &
Consider the 8.3dB cable loss)

***if we used two y-port of BPM, we would have the results 4.5571[mV/um].**

- **Designed sensitivity**

  = 3.724[mV/um] for two-port

ICT monitor: 0.87 *10^10 (at LNE)



Results of IP-BPM x-port sensitivity for one-port measurements

- **IP-BPM sensitivity**

  (For x-port)

  = 0.34146[mV/um]

  (one-port measurements)

  = 0.88786[mV/um]

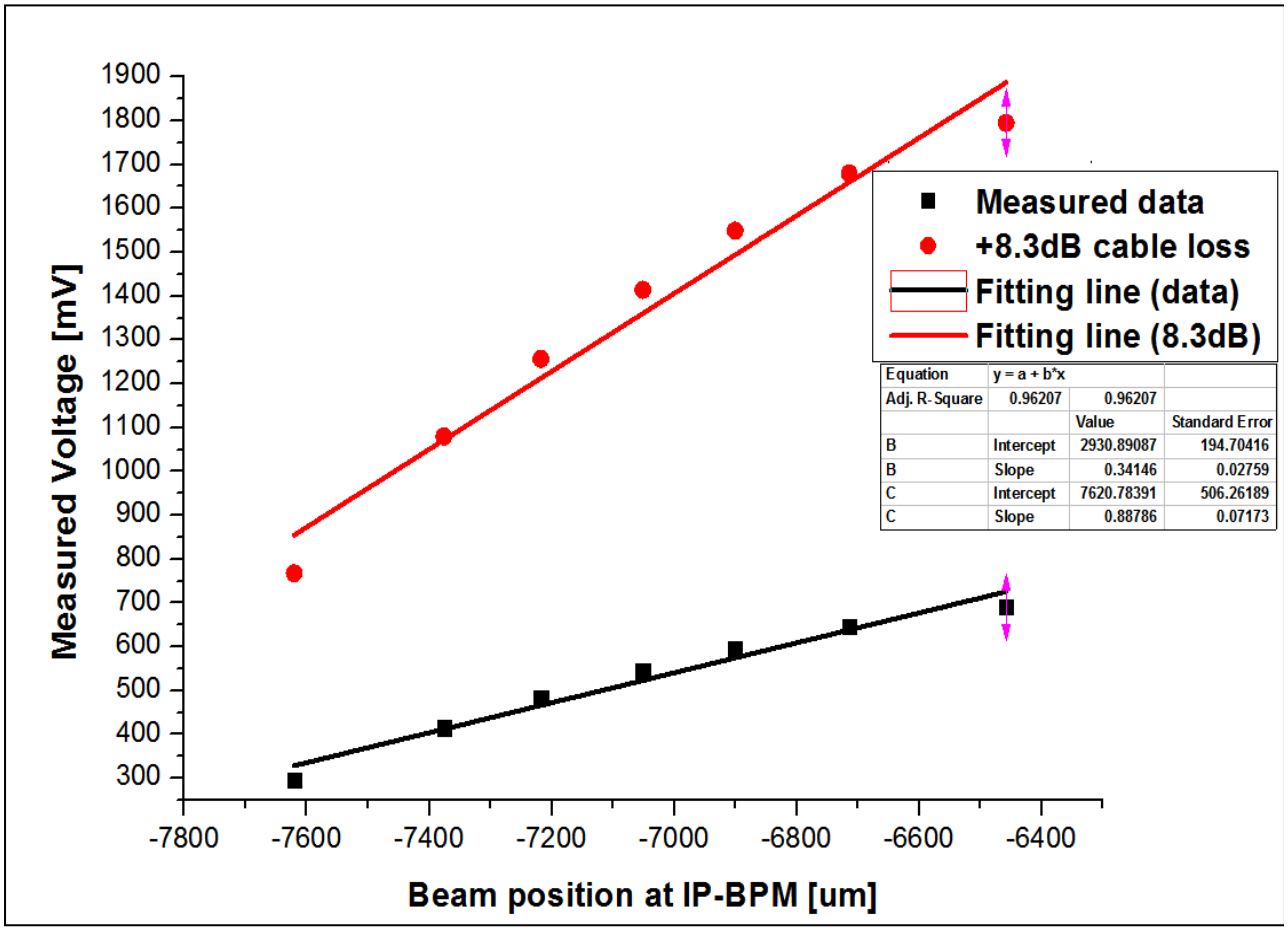
  (one-port measurements &

  Consider the 8.3dB cable loss)

*if we used two x-port of BPM, we would have the results 1.77572[mV/um].

- **Designed sensitivity**

  = 3.865[mV/um] for two-port



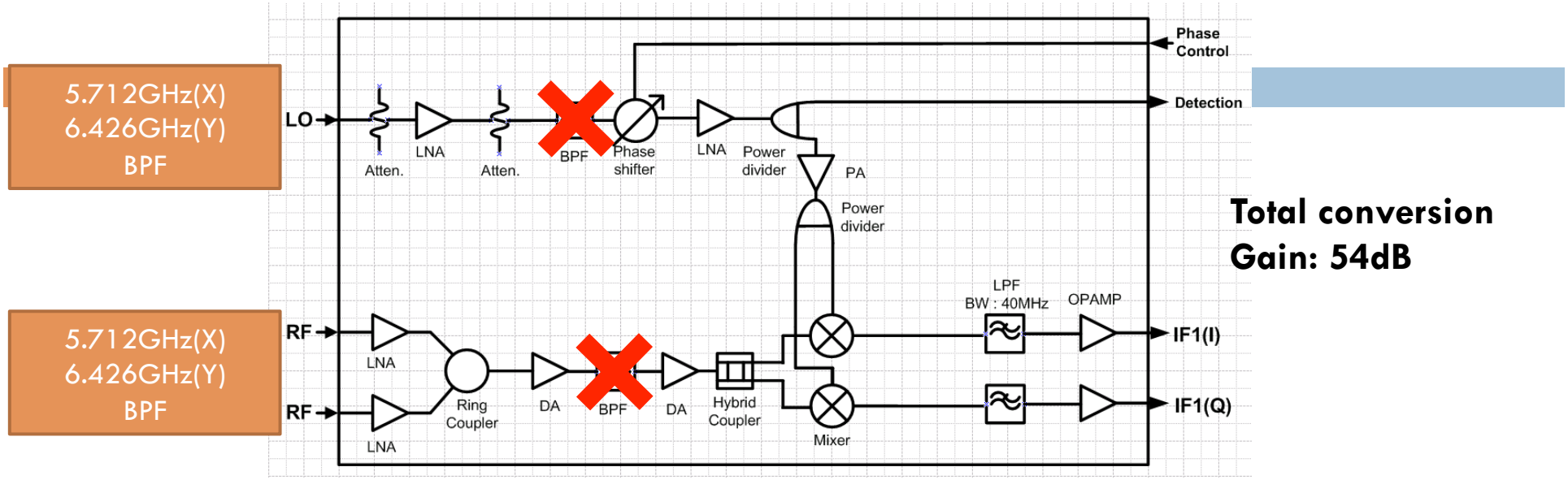
Summary of 11cm Low-Q IP-BPM

- New Low-Q IP-BPM was fabricated and tested at the end of linac in ATF2.
- The RF test results shows bad, but output voltage shows not bad. It's mean that Low-Q IP-BPM can measure a few nano-meter level beam position resolution for Y-port.
- The beam test results shows quite good, Y-port results shows good performance. X-port results shows low performance less than expected value, however which results still satisfy to get the goal of Low-Q IP-BPM for the second goal of ATF2.

Electronics progress

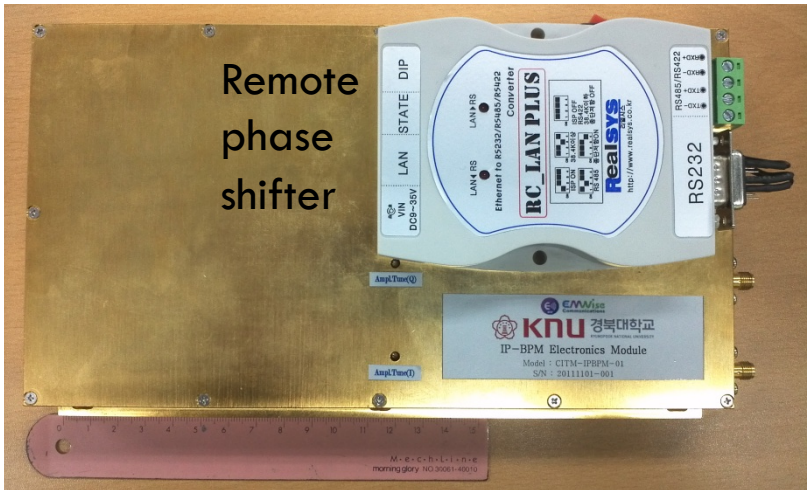
- Simplified schematic of new electronics
- New Y-port electronics test
- Results of Jan. beam test
- Summary of new electronics

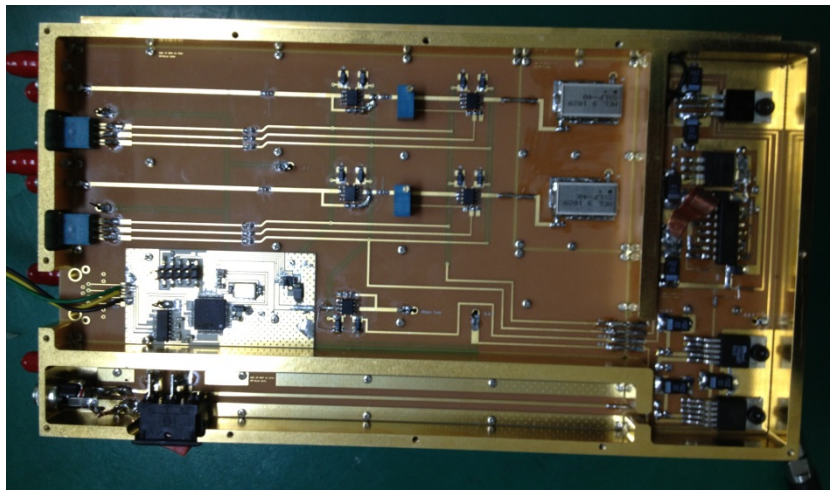
Simplified schematic of new electronics



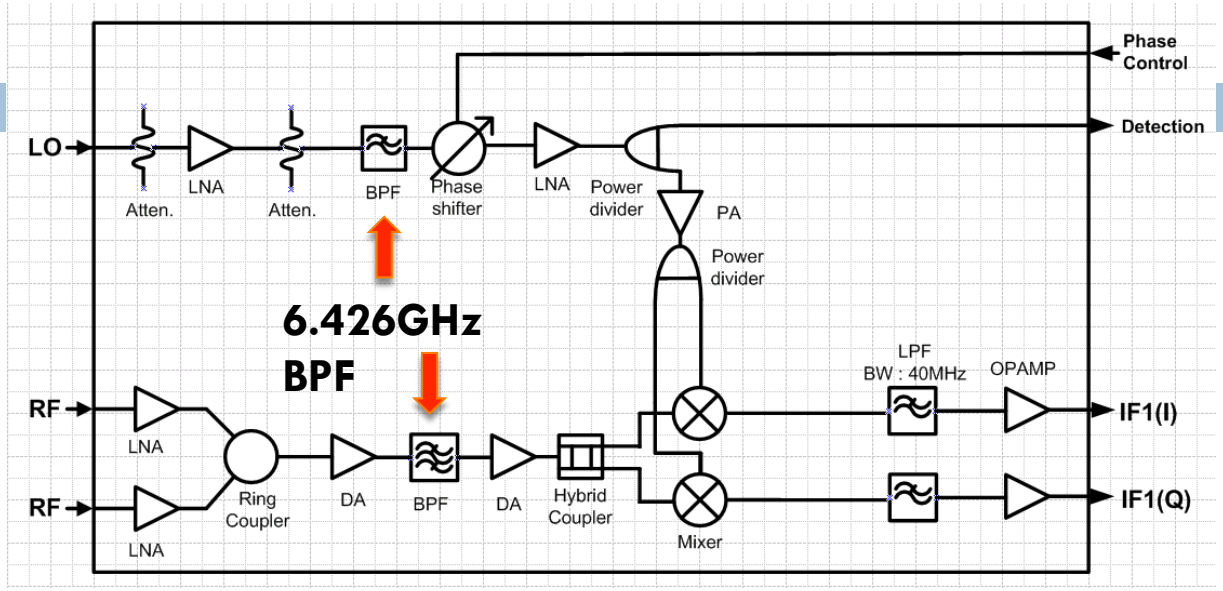
Total conversion Gain: 54dB

Simplified schematic of the IP-BPM signal processing electronics. (For the flexible type)



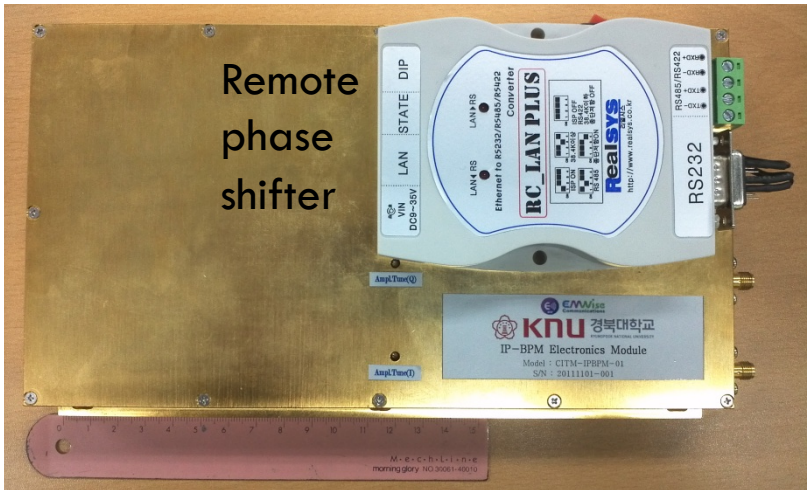


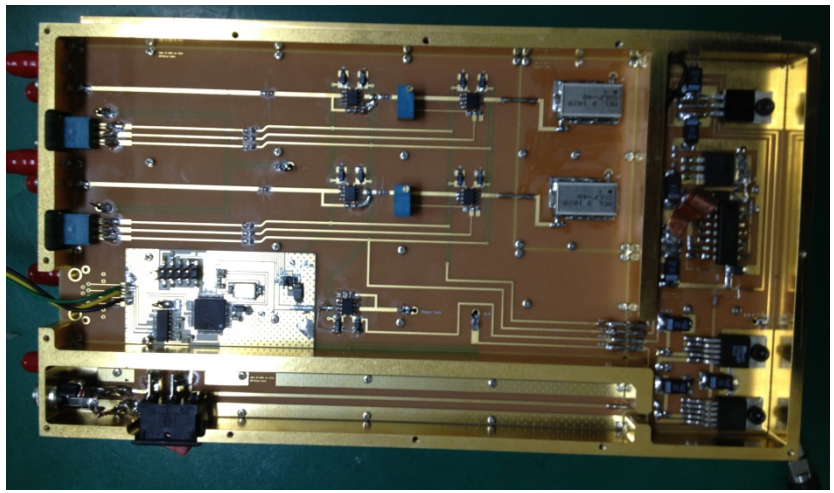
Simplified schematic of new electronics



Total conversion Gain: 54dB

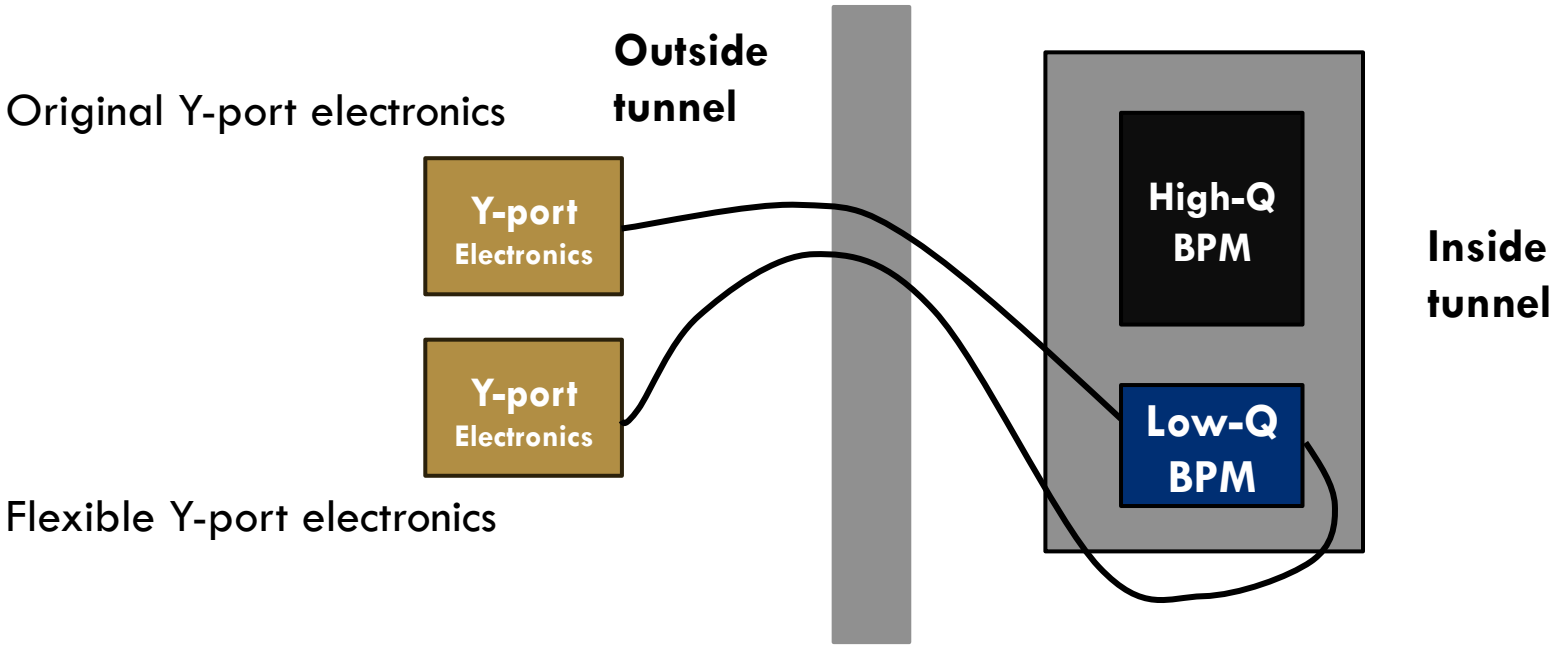
Simplified schematic of the IP-BPM signal processing electronics. (For the original y-port)





New Y-port electronics test (Jan.)

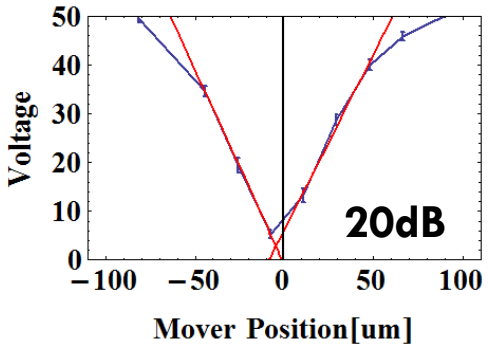
- We tested two Y-port electronics at the same time by using one old Low-Q IP-BPM to check the performance of both electronics.
- Beam test scheme

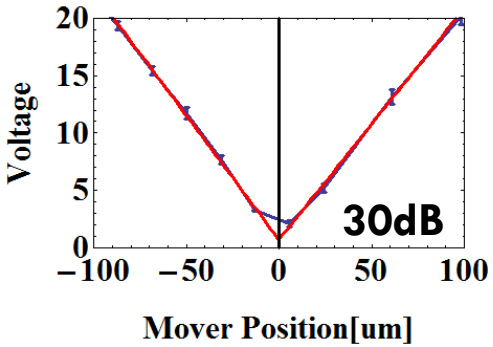


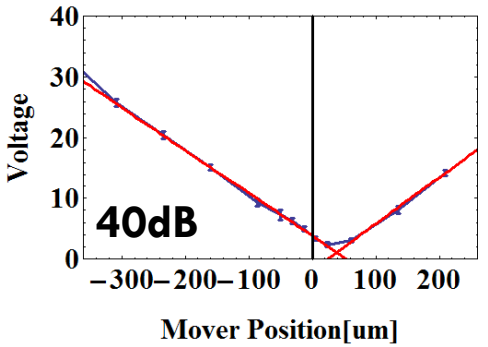
Results of Jan. beam test

- 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.

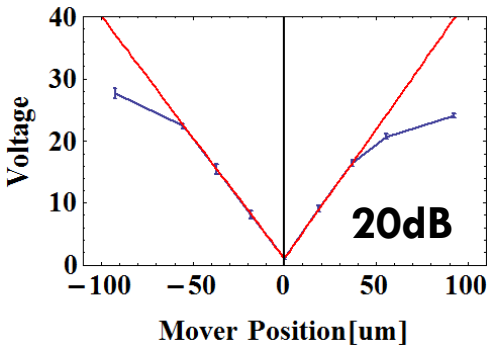
Y-port

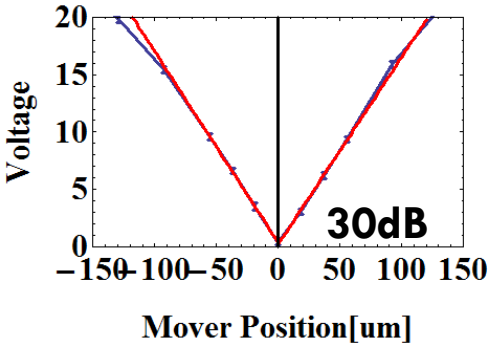


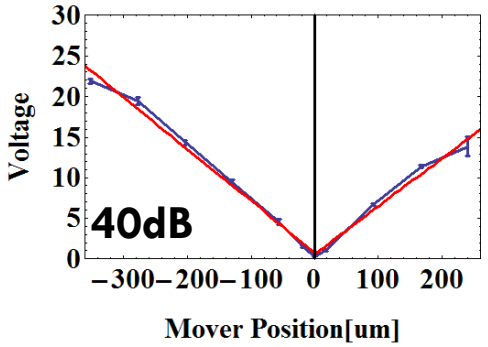




Flexible Y-port





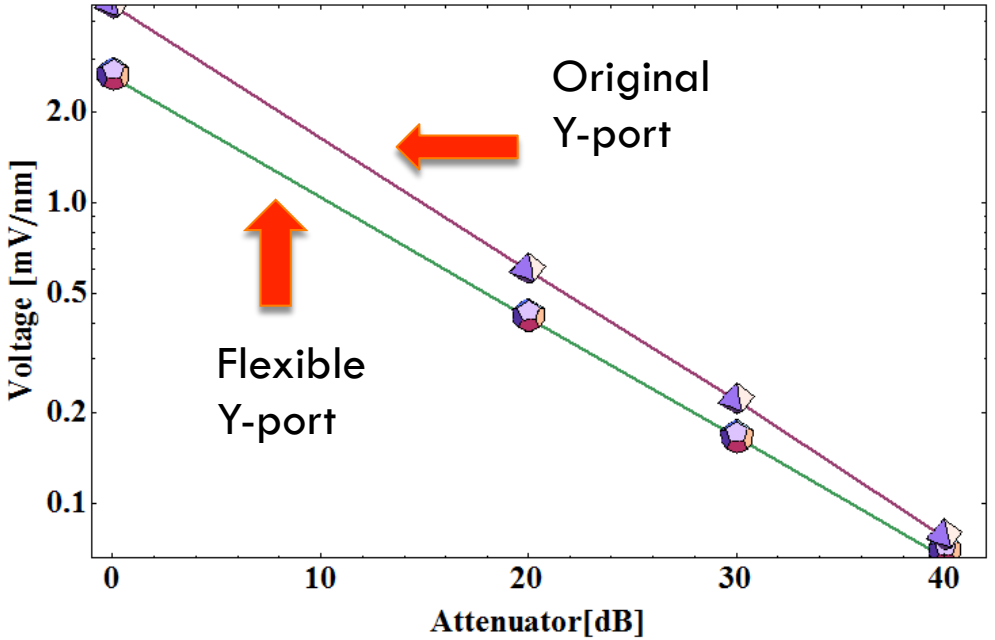


Results of Jan. beam test

- **Calibration slope for calibrating the I signal to actual beam position is summarized in Table.**

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

The results of calibration slope at the w/o att. case shows enough to measure 2nm resolution by using 14bit ADC.
(14bit ADC noise = 366uV)
4509uV/nm= 37count/nm
2632uV/nm=21.6count/nm



Summary of new electronics

- New electronics for the Low-Q IP-BPM were fabricated. (One flexible, one y-port)
- We tested two Y-port electronics at the same time by using one Low-Q IP-BPM to check the performance of both electronics. (2012/01)
- The calibration slope of both electronics shows very good. However, the dynamics range shows too narrow. Therefore, some part of new electronics will be modified.

Summary

- Low-Q IP-BPM was fabricated and tested.
  - Three Low-Q IP-BPM were fabricated by KNU.
  - The test results shows not bad. (still satisfy the goal of Low-Q IP-BPM)
  - It will be install in the IP-Chamber.
- New electronics were fabricated and tested.
  - Two electronics were fabricated.
  - The test results shows very good. However, the dynamic range is too narrow.
  - Some part of new electronics will be modified.