IPBPM Plans

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Motivation

- First goal of ATF2
  - Verification with achievement of σ^*_y = 37 nm
    - where σ^*_y is the vertical beam size at focal point (IP)
- Second goal of ATF2
  - Stabilize the beam focal point at a few nano meter level for long period in order to assure the high luminosity

- FONT and IPBPM are essential for two goals

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NANO BPM

- 2 nm resolution low-Q BPM is extremely challenging
- Previous (large-Q systems) best resolution 10 nm, Honda-san 5 nm but not directly measured

- Achieving thermal limit difficult. Not observed in any BPM system. But this is required for Feedback low-Q IPBPM

- The goals
  - Understand the physical limit to resolution either KEK IPBPM or KNU IPBPM. Then determine the additional difficulties due to low-Q
  - A sensible early goal would be 10-20 nm resolution with a low-Q BPM which could be used for feedback for my thesis.
  - Understand the limiting factors for achieving below 10 nm. Remove the problems

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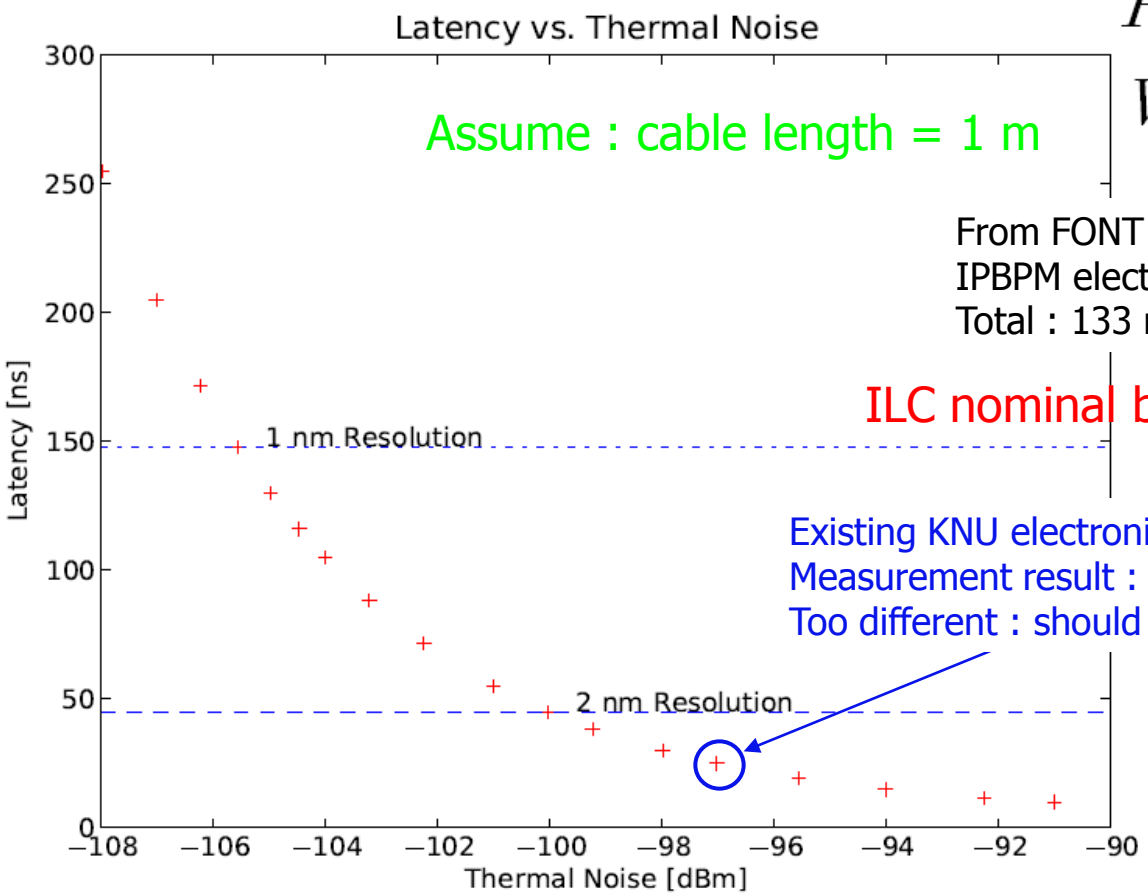
Latency vs. Thermal Noise



$$P_{TN}[W] \approx kTf_{BW}$$

$$V_{TN}[V] \approx \sqrt{4kTZf_{BW}}$$

From FONT
IPBPM electronics : 40 ns ?
Total : 133 ns

ILC nominal bunch space : 300 ns

Existing KNU electronics BW : 50 MHz ~ -97 dBm
Measurement result : -83 dBm (expected resolution : 10 nm)
Too different : should be fixed or understood

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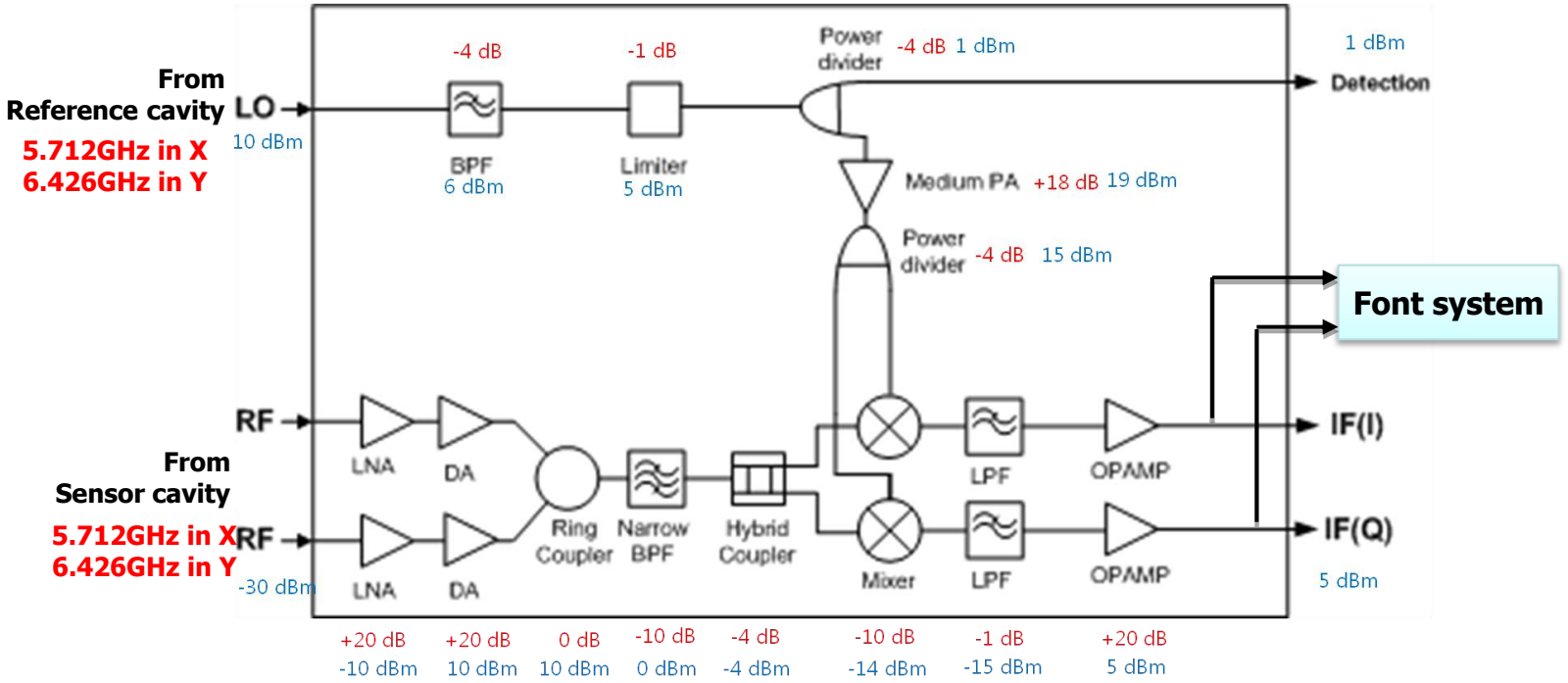
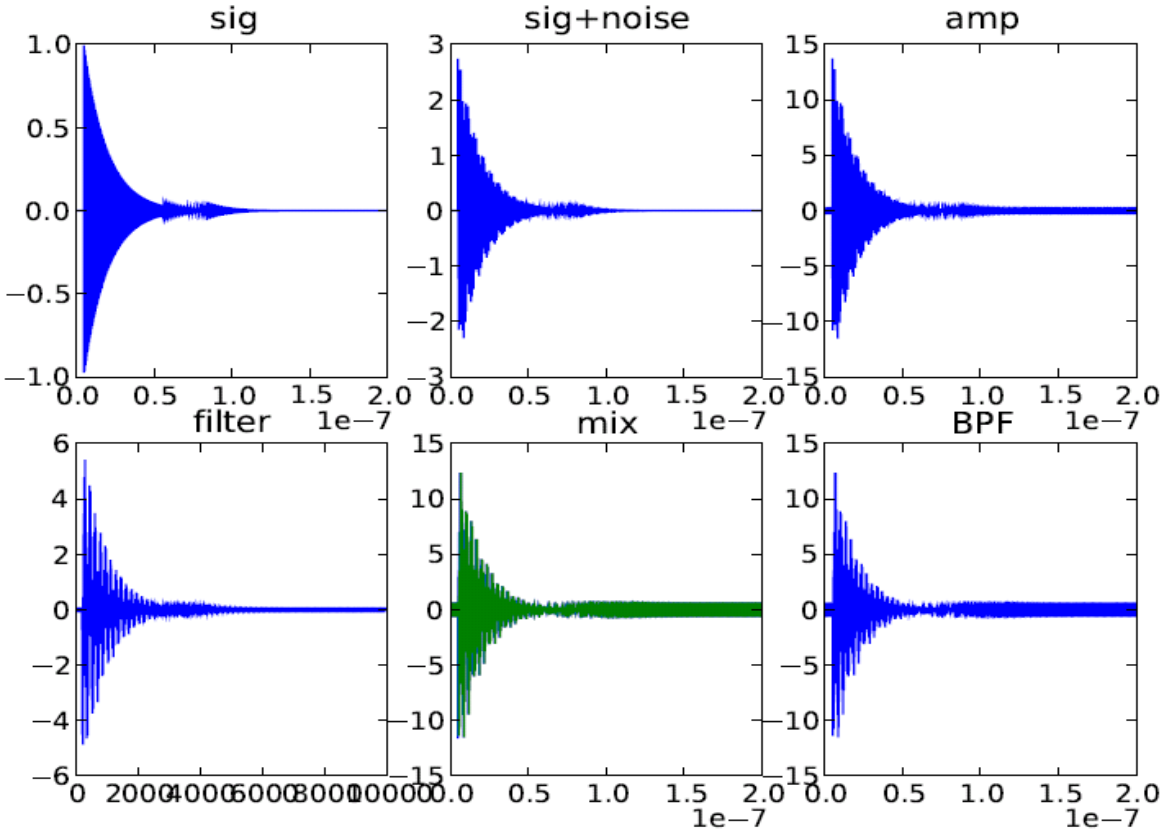
Electronics Design



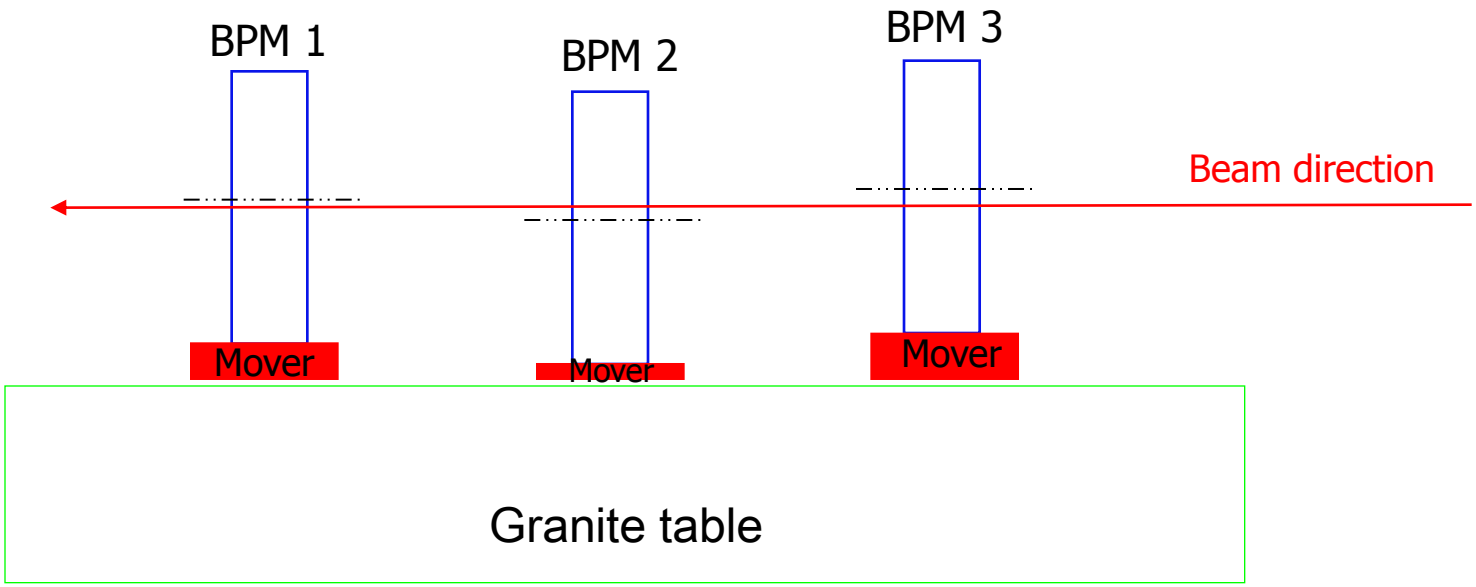
- The electronics design is being considered (discuss with EMWise company)
  - Conversion gain : 10 dB -> 35 dB
  - Narrow bandwidth of filter
  - Noise figure : 4.0 -> 2.55
  - Latency : 17 ns -> ??

Electronics Simulation



Low-Q allows us to make simple time domain simulation of the signal processing
This will allow understanding of some simple systematic effects

Proposed BPM Installation



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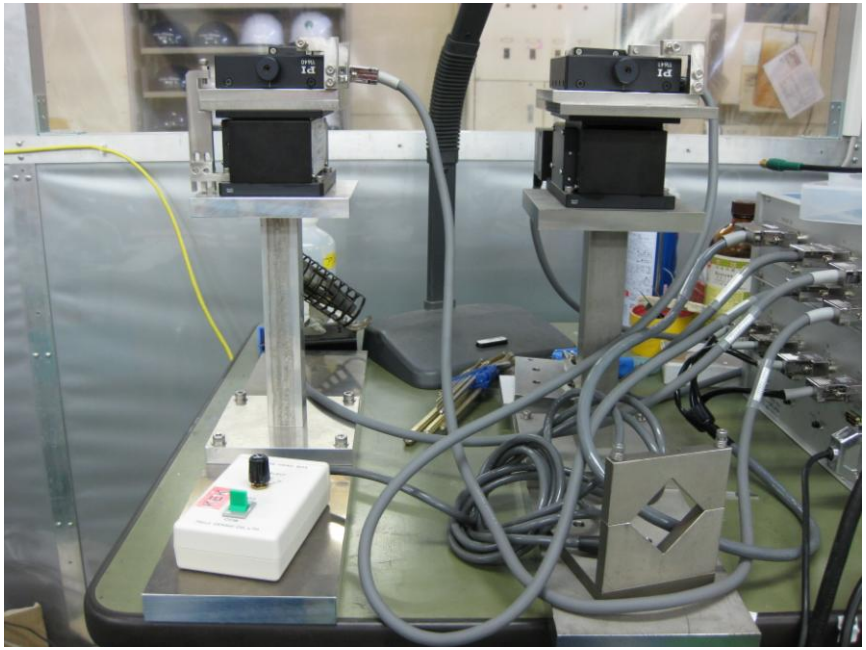
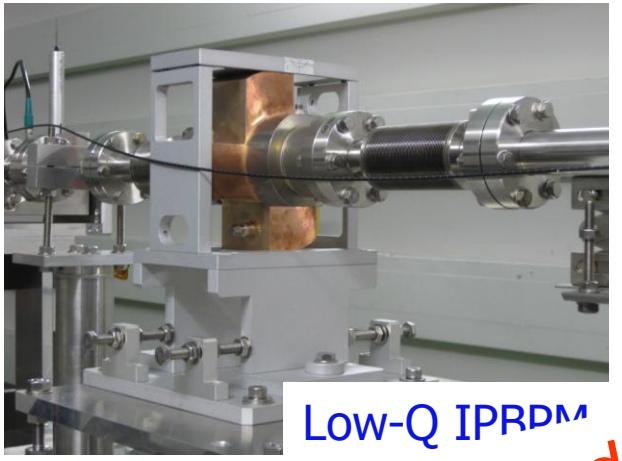
Mover systems

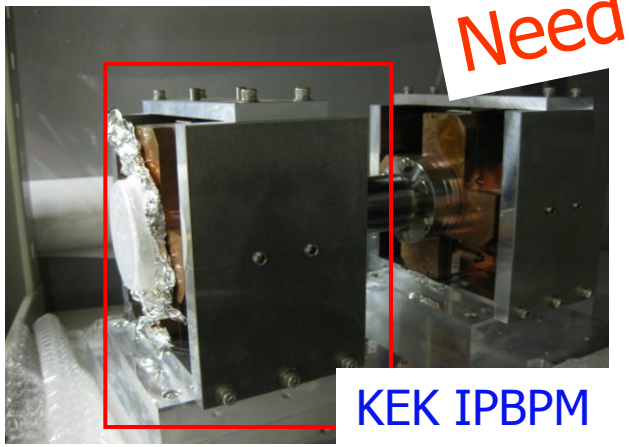


- Two mover
  - Vertical and horizontal direction in each
  - One for low-Q IPBPM, one for KEK IPBPM
- Thanks to Hayano-san & Naito-san for lending these to the IPBPM project

Installation Plan



Low-Q IPBPM

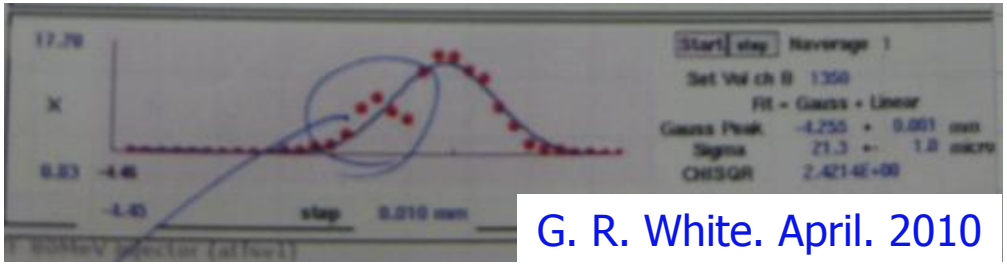


KEK IPBPM

KEK IP BPM : 2 blocks
consisting of two cavities in each block

Need good alignment !!

Granite table



G. R. White. April. 2010

Shoulders observed in Horizontal PIP scan
After centering beam, no further shoulder seen

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Plan

- Summer
  - Revise design of IPBPM electronics
  - Finalize physical IPBPM installation
    - Cables
    - Mechanical installation (movers etc)
    - Test readout and controls
  - Develop analysis codes
    - SVD (monitor systematics)
- October
  - Alignment of 3 BPMs on beam line
  - 1st generation electronics test – one week
  - Decision on fabrication of new IPBPM electronics
- November/December
  - Test of new electronics
  - Systematics studies

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Other considerations

- What about BPM calibration in situ (at IP)
- What is the stability requirement
  - How often calibration?
  - What calibration systems, like C/S-band

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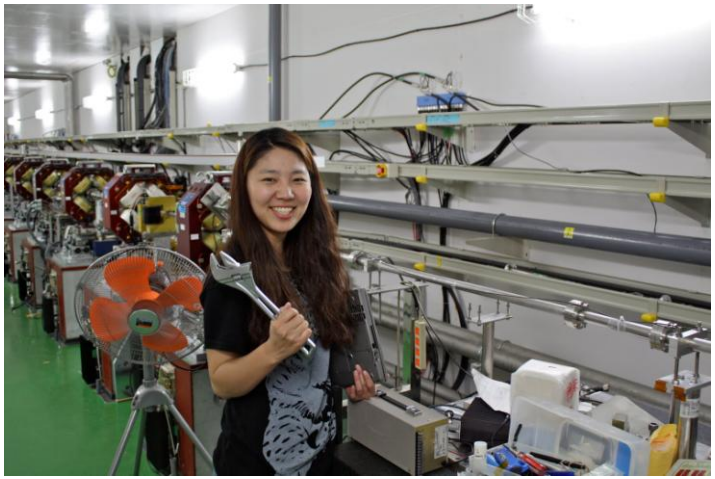
Summary

- 2 nm possible but effectively the thermal limit
- Early operation in ATF2 will explain the technical limitations of 2 nm low-Q BPM
- Integration with feedback systems should be started



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Back up Slides

KEK IP BPM Resolution

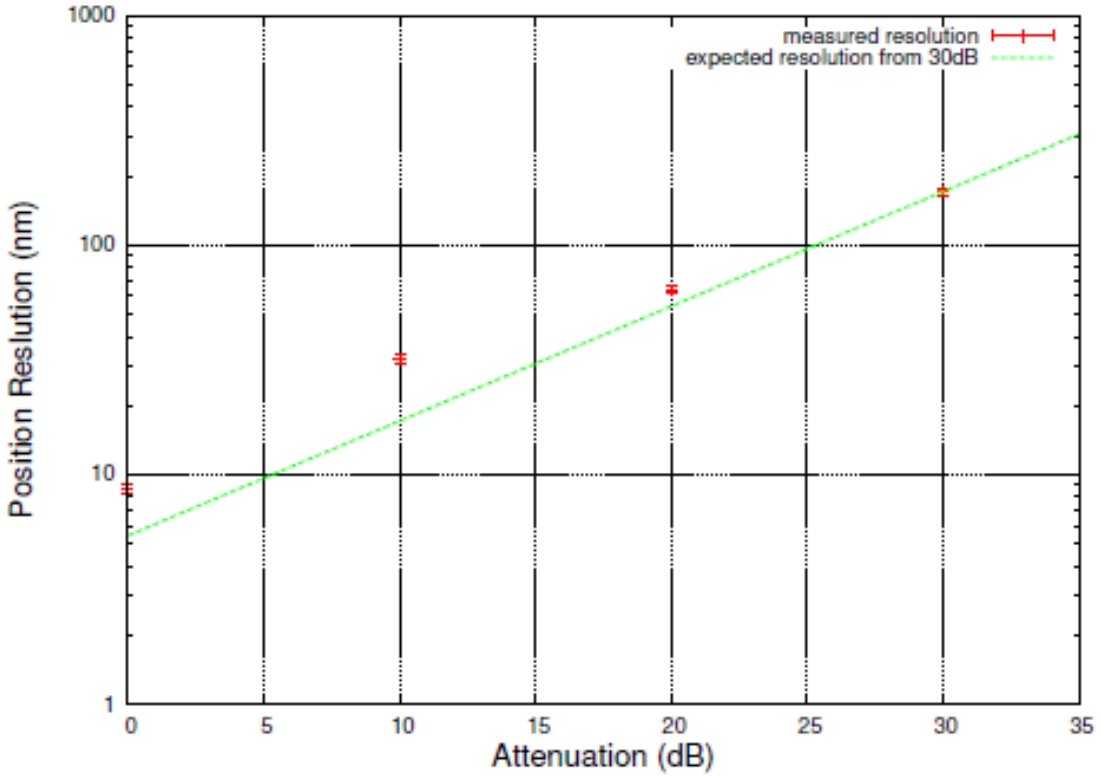

Figure 10.11: Measured position resolution under various attenuations

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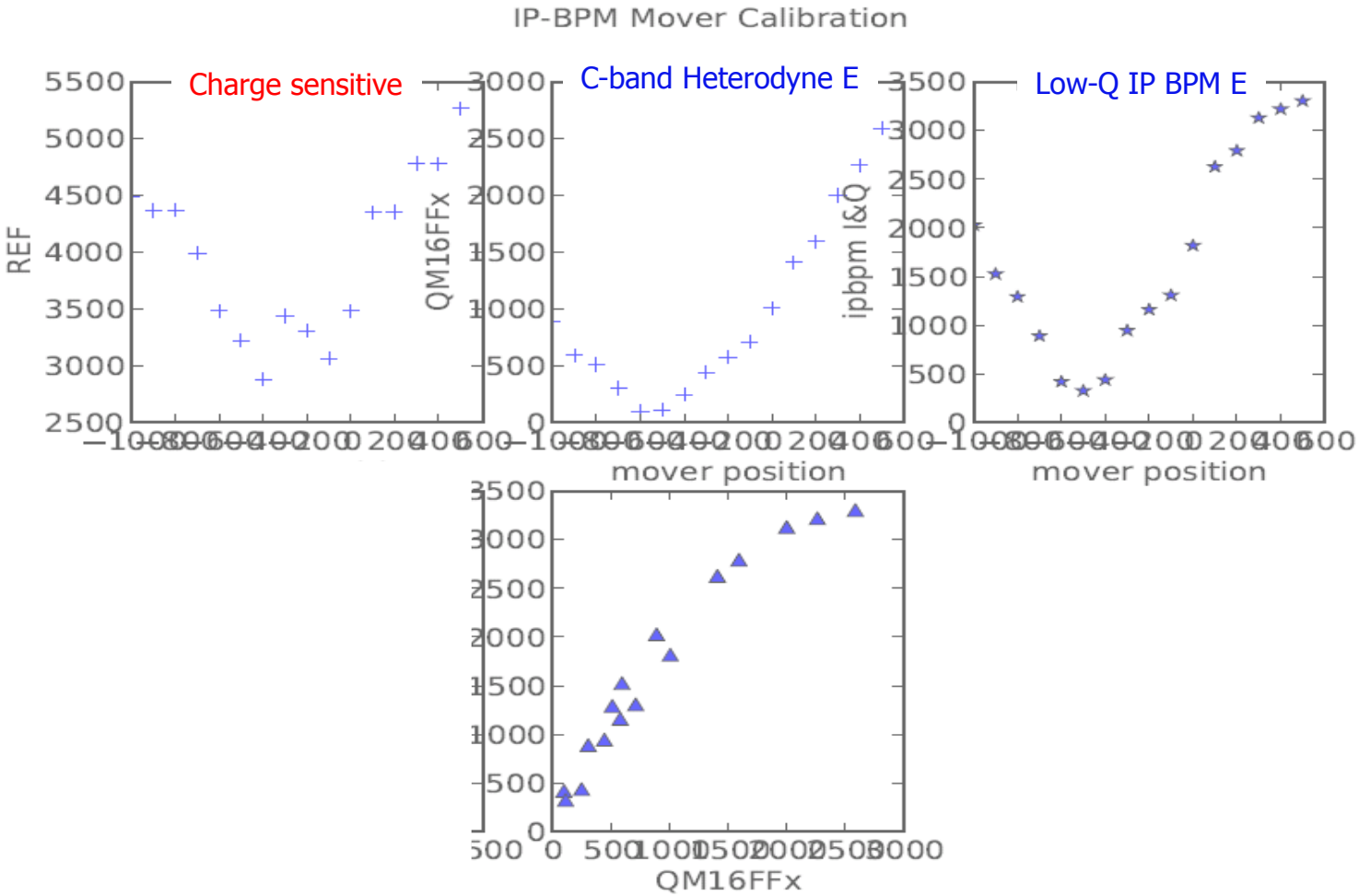
Analysis of calibration data



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KEK IPBPM Electronics

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