GM feedback and GM effect detection

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CLIC Workshop 2013
30 of January 2013

Headlines

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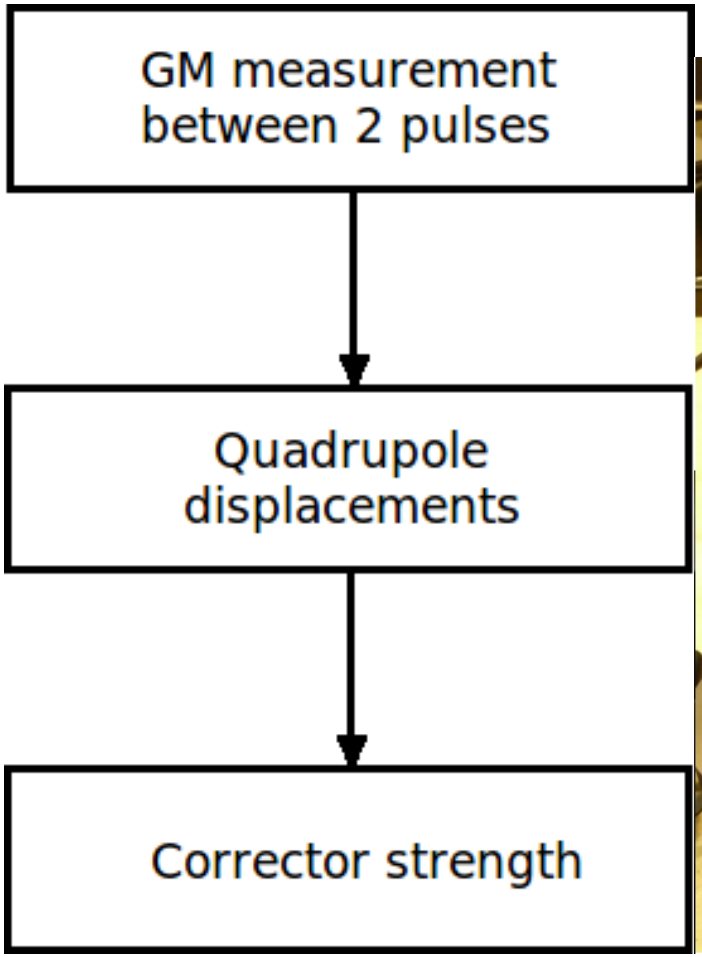
Concept of Feed Forward with GM Sensors



Goal and motivation of the ATF2 experiment

Goal

- Detect Ground Motion (GM) effect on beam trajectory.

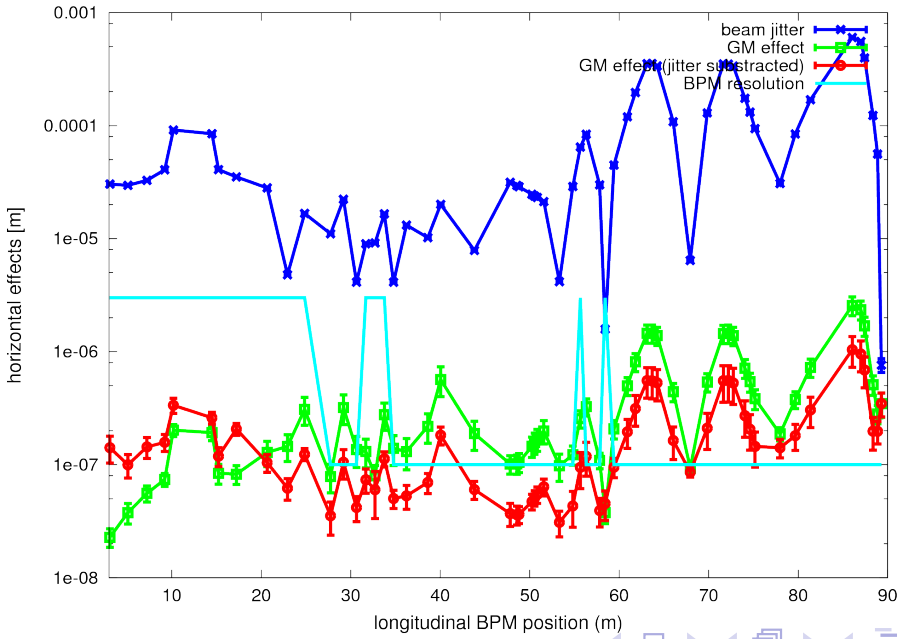
Motivation

- GM sensors are usually only compared to other GM sensors
- It would demonstrate possibility to make a feed forward with GM sensors.
- Feed forward would allow trajectory correction based on GM measurements in CLIC.
- Feed forward would allow big saving (avoid quadrupole stabilization in CLIC)

Algorithm

Algorithm - Each Pulse

- Remove incoming jitter from BPM measurements (first 5 SVD modes).
- Evaluate GM effect on BPM readings from GM sensor measurements (minus the part removed by jitter subtraction).
- Compare these two residuals.



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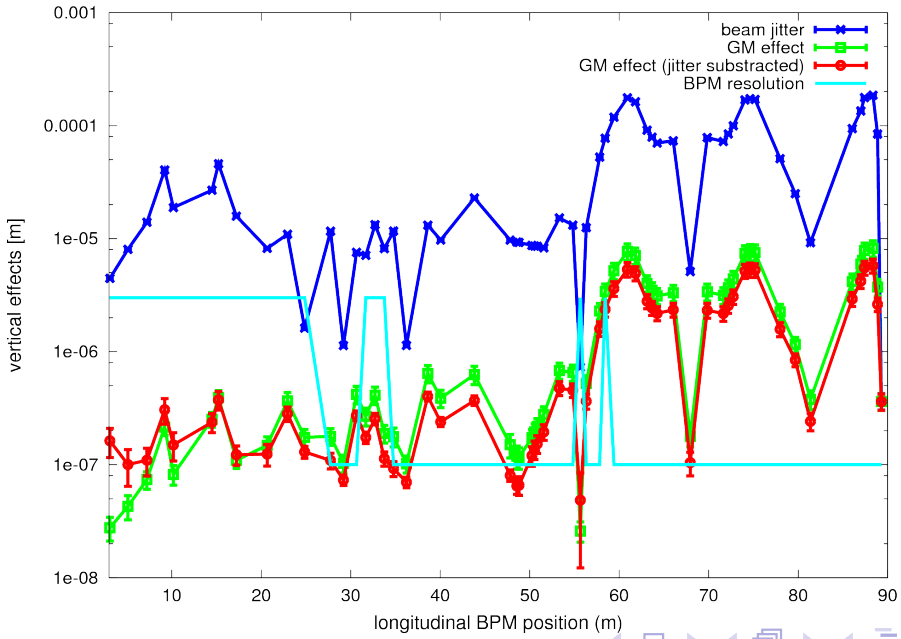

Simulation Parameters

Conditions

- ATF2 nominal lattice (sextupoles off).
- Elements misaligned initially (RMS=100μm).
- Trajectory is then steered.
- Ground Motion (GM) model based on measurements.
- Elements are displaced by the amount of relative motion compared with the 1^{st} element.
- Incoming beam jitter.
- Quadrupoles errors of $\frac{dK}{K} = 10^{-4}$ included.
- BPM resolution included.
- GM measurement included (sensors TF included).

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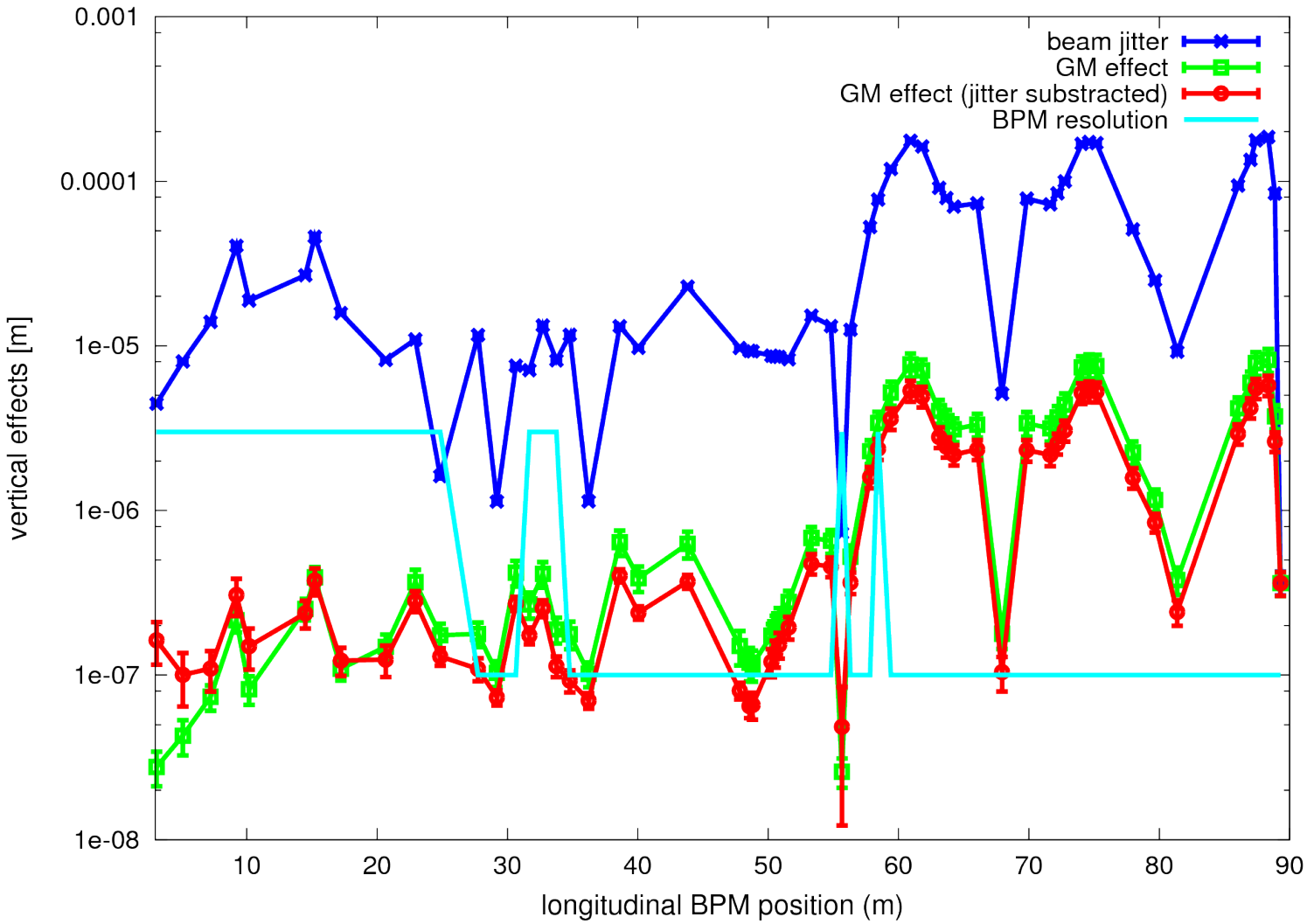
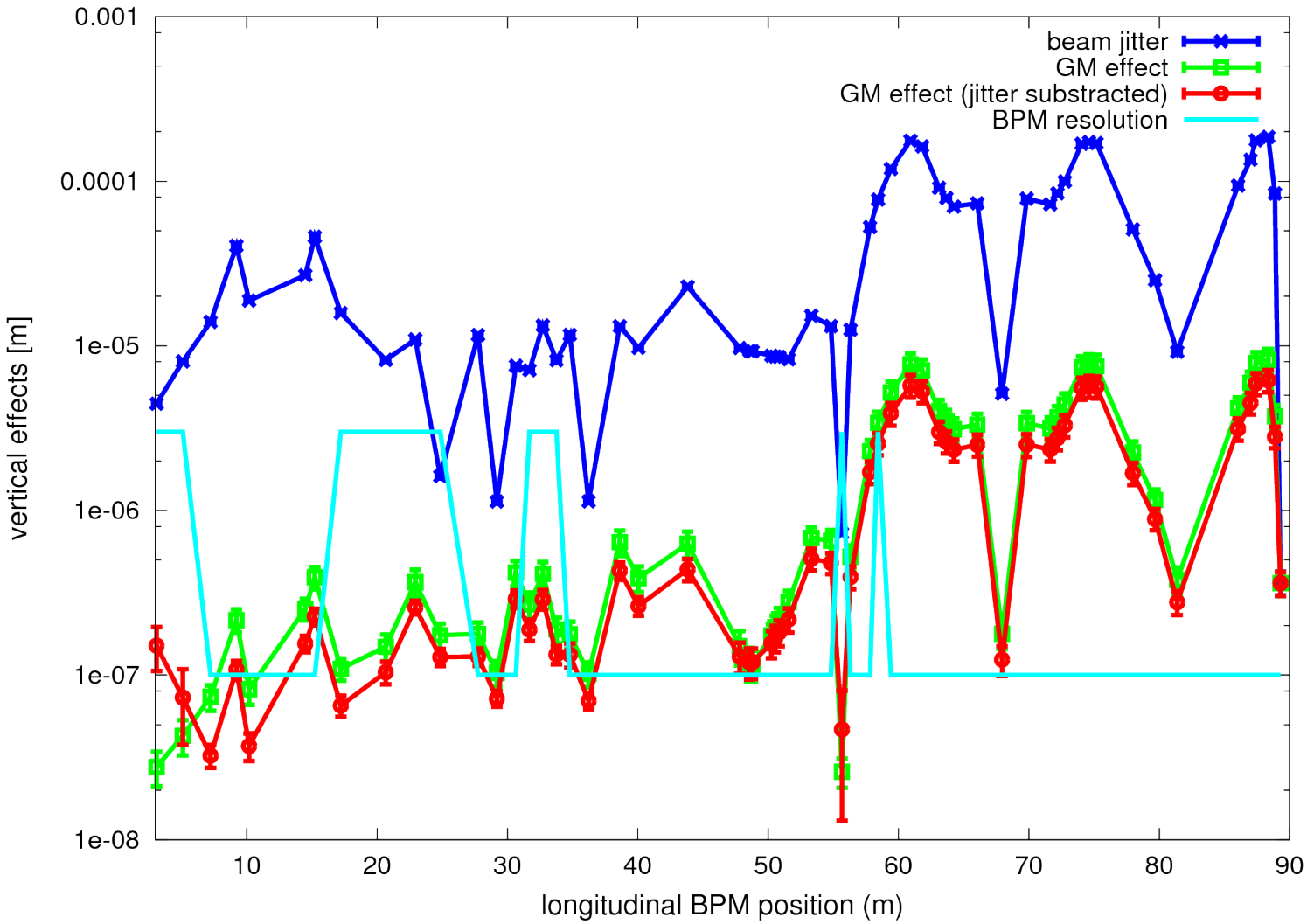
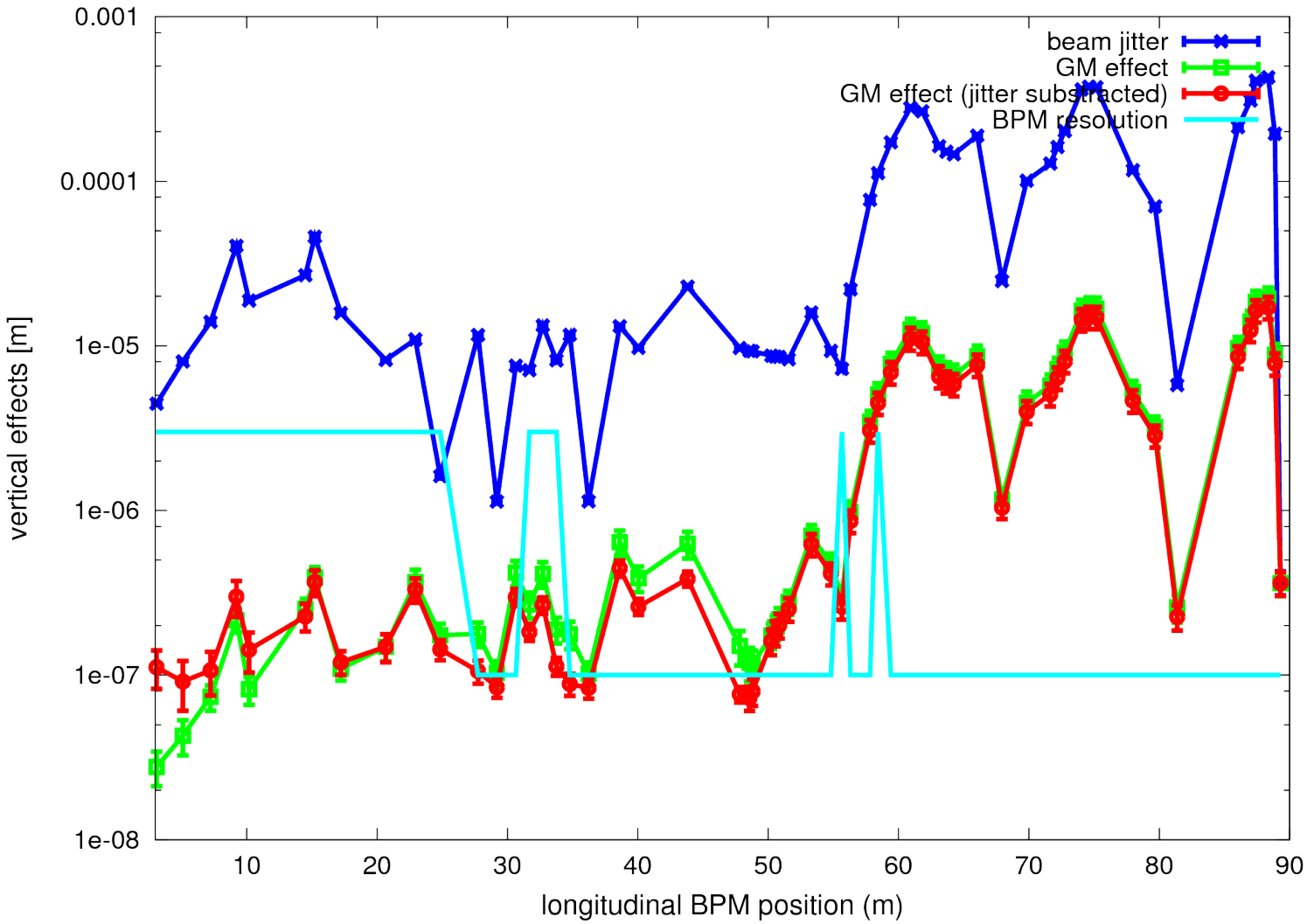
Nominal Lattice



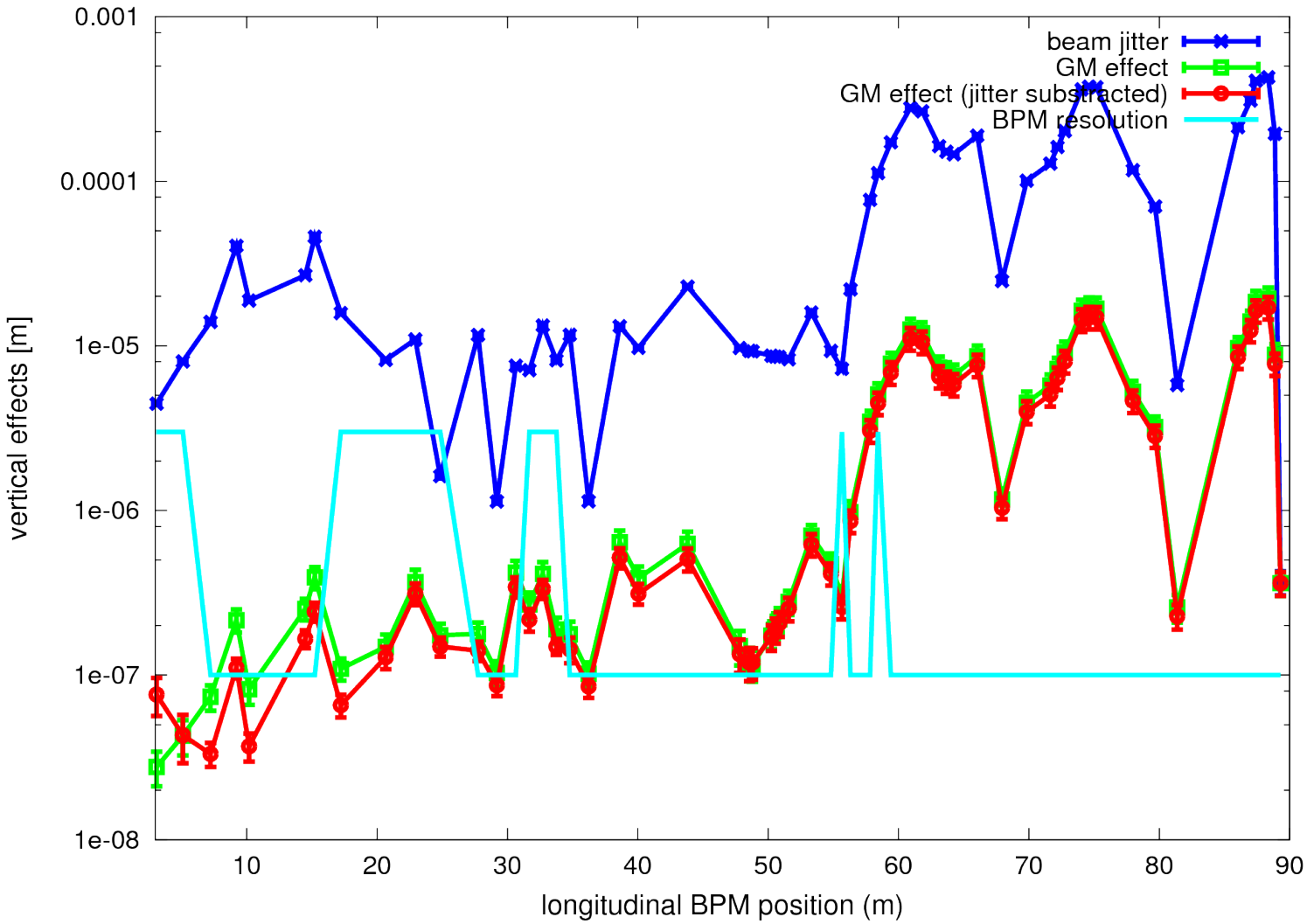
Nominal Lattice with 5 Improved BPMs



Ultra Low β Lattice



Ultra Low β Lattice with 5 Improved BPMs



Headlines

Evaluation of the results

- R_1 is the GM effect obtained from GM sensors.
- R_2 is the GM effect obtained from BPMs.

$$p = \frac{||R_1 - R_2||_2}{||R_1 + R_2||_2}$$

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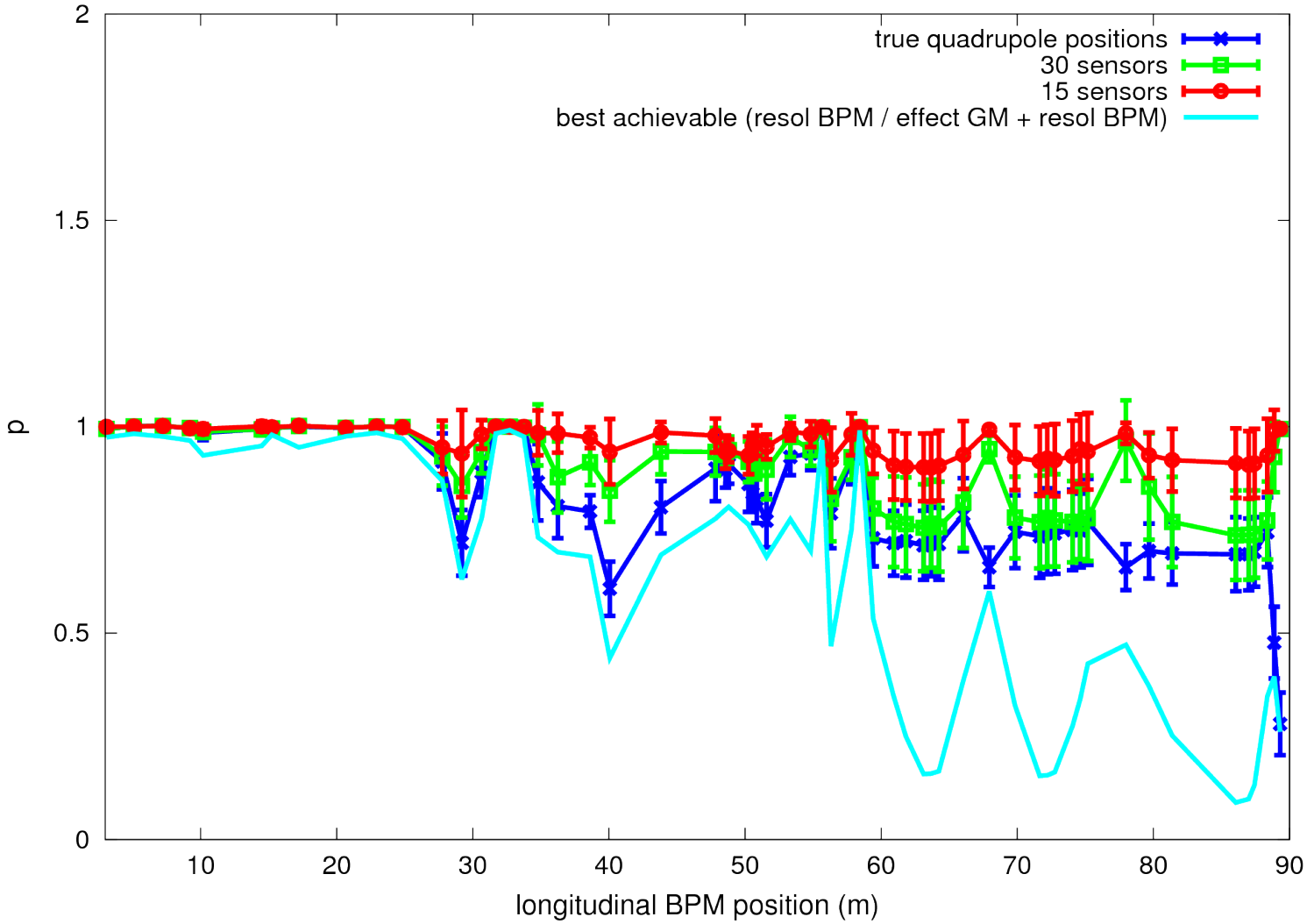
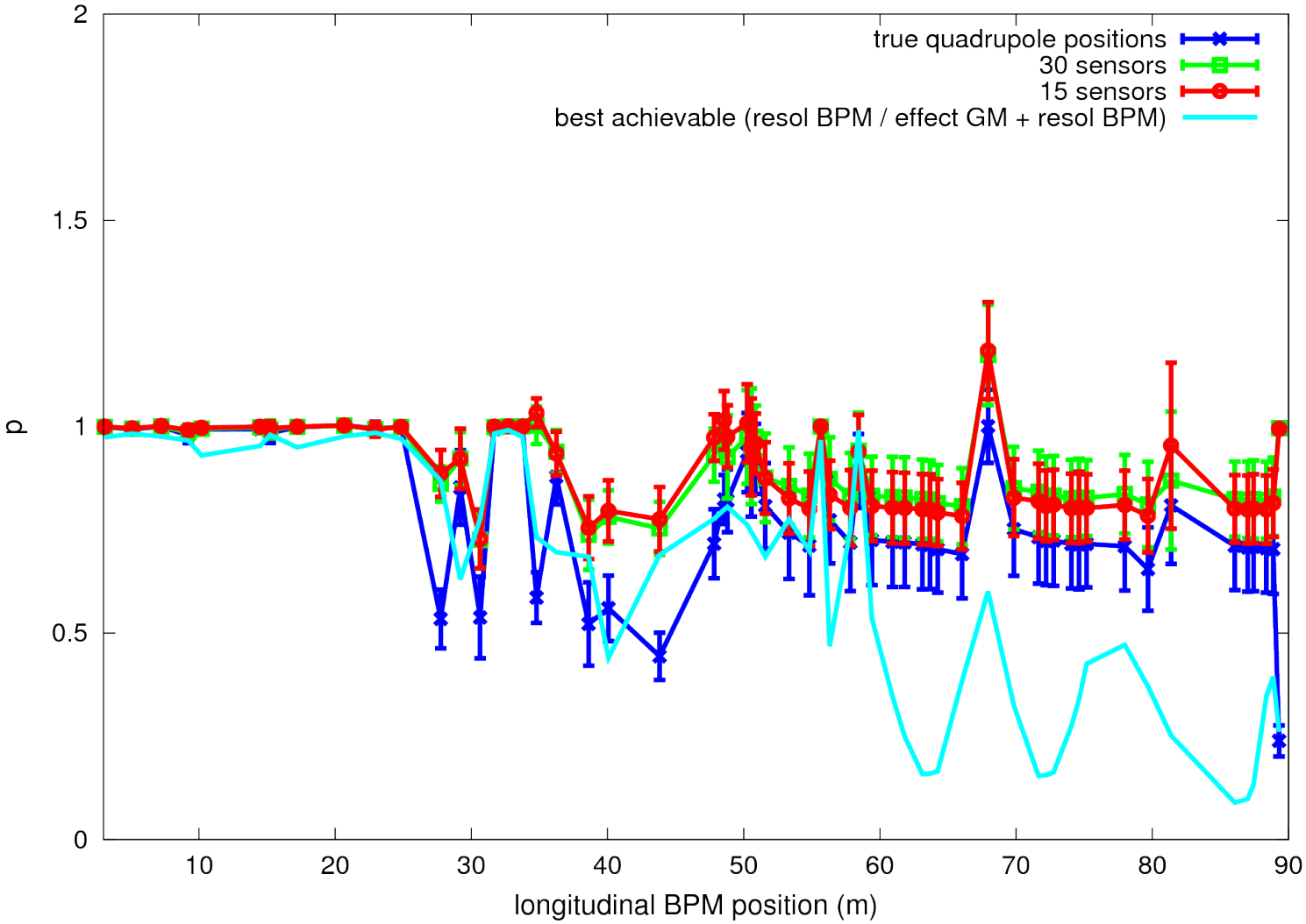
- $p = 1$ if R_1 and R_2 independent.
- $p = 0$ if $R_1 = R_2$ (ideal case).
- The lower p is, the best is the determination from the GM sensors.

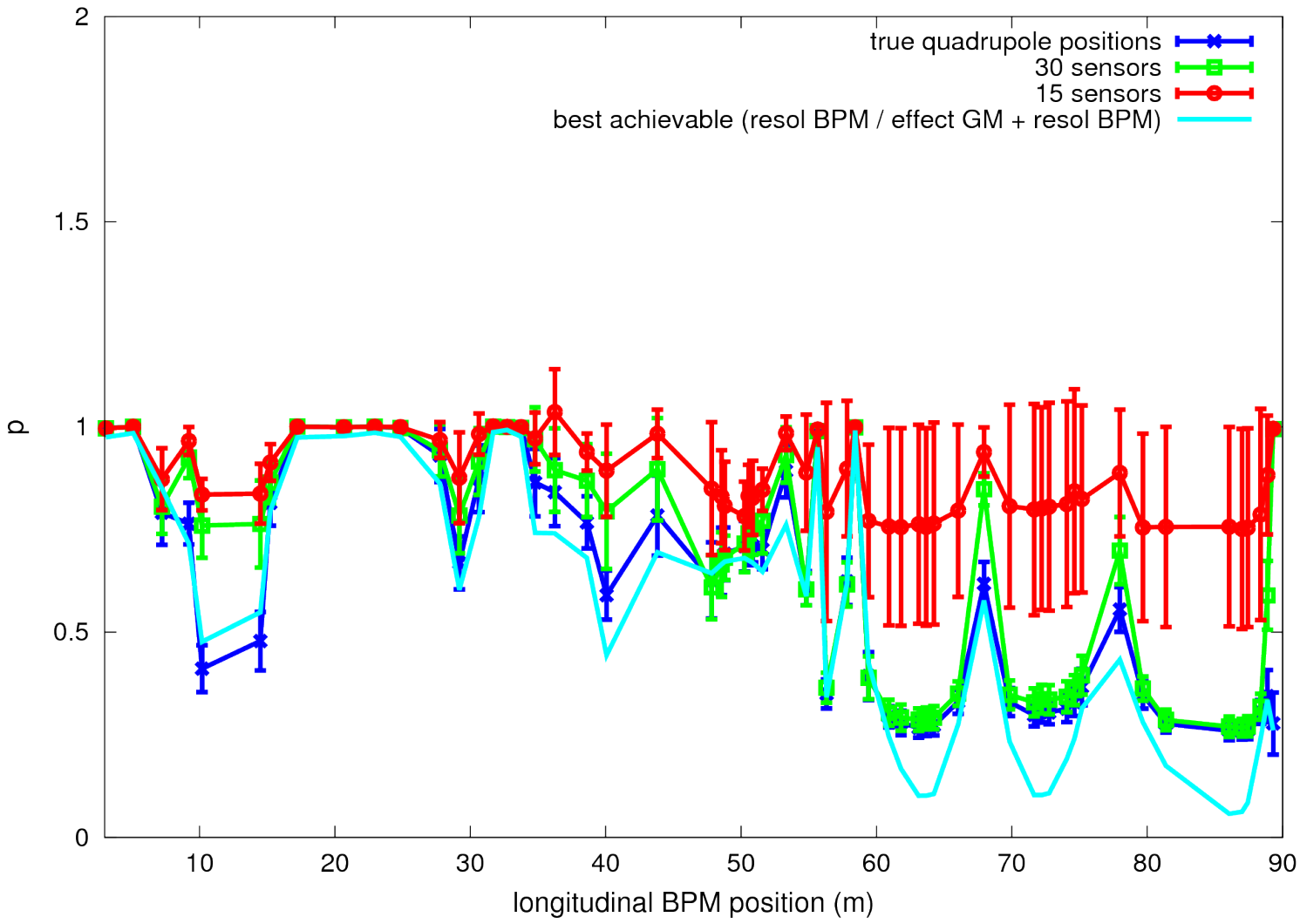
Nominal Lattice (X)



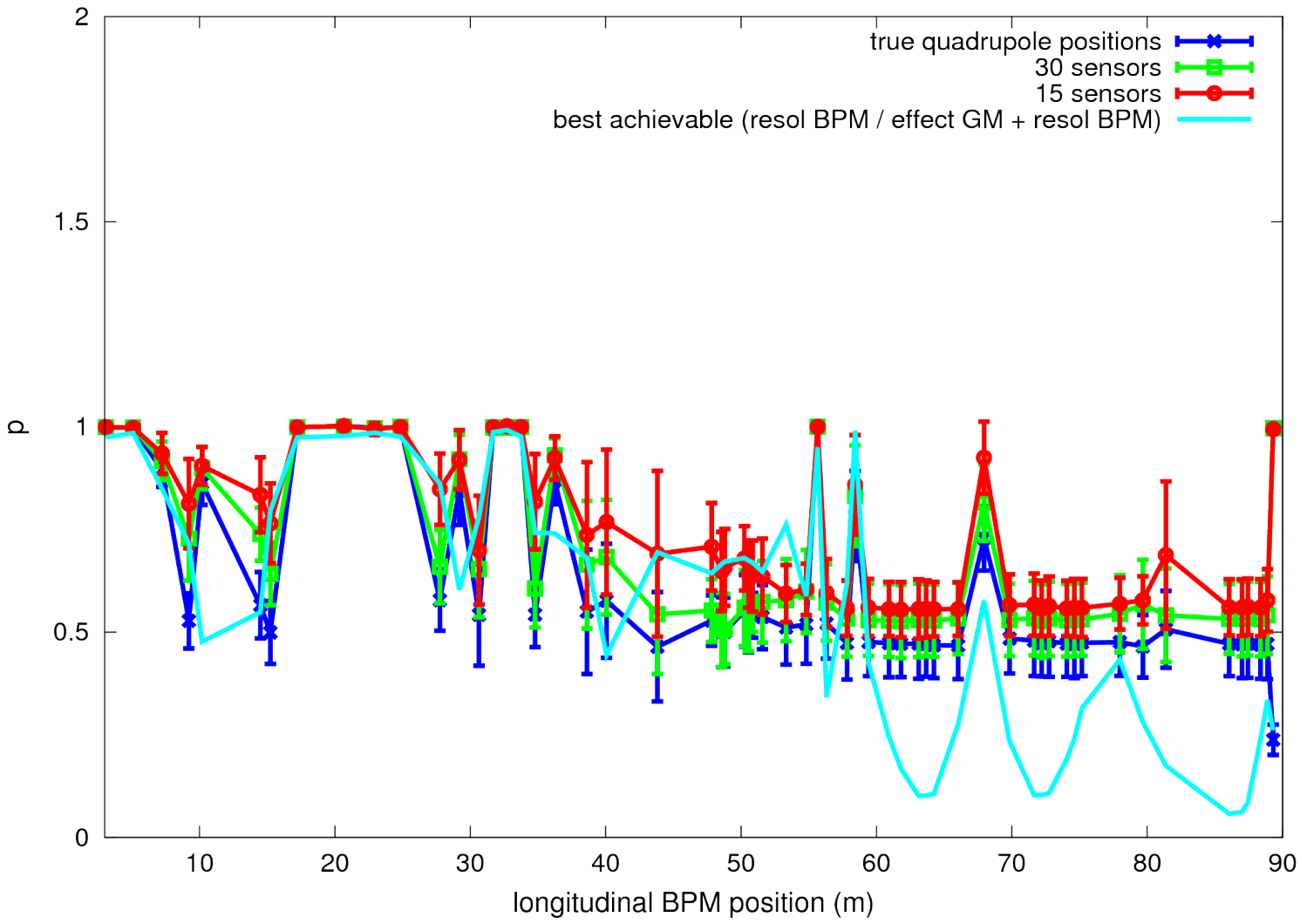
Nominal Lattice (Y)



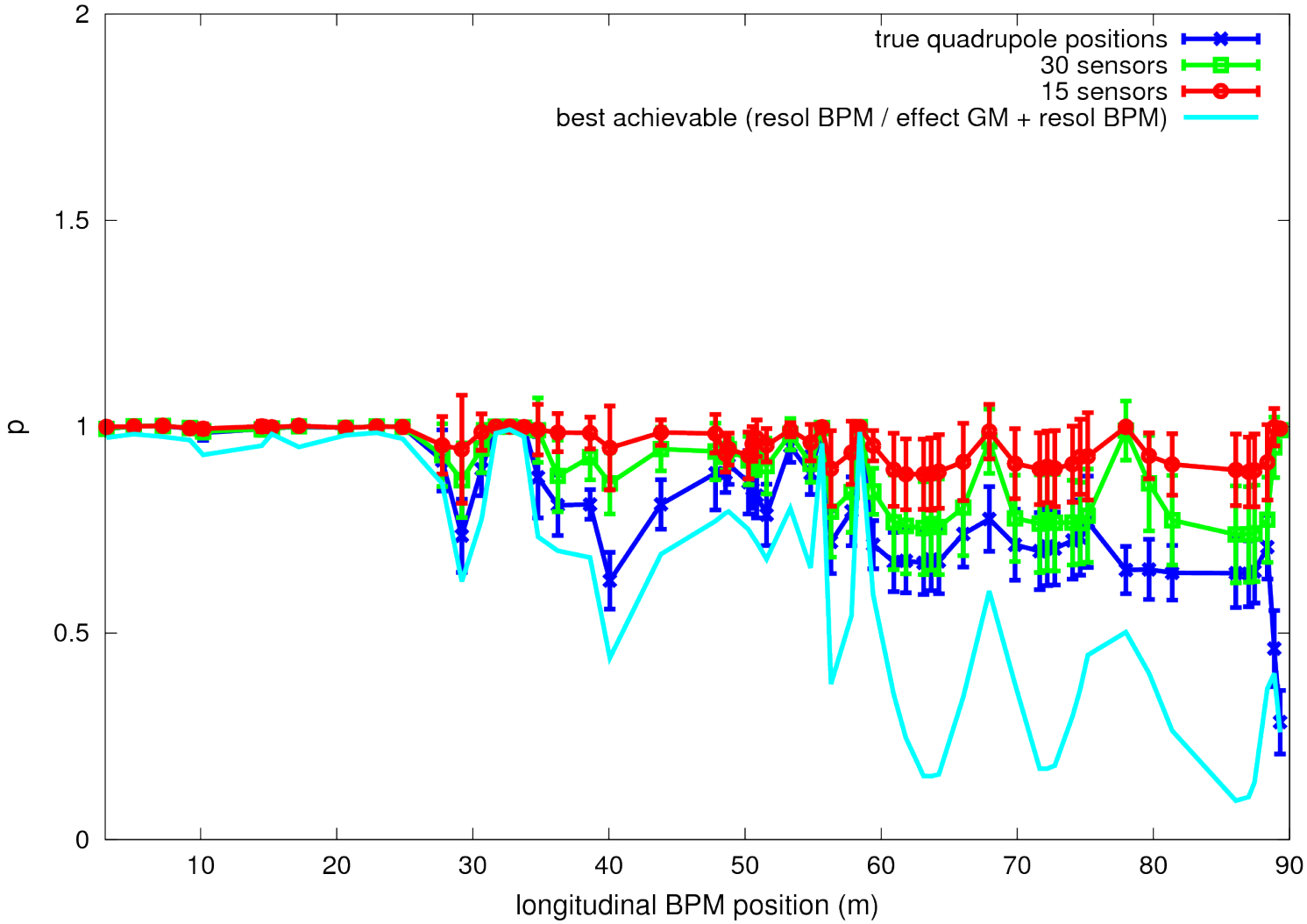
Nominal Lattice with 5 Improved BPMs(X)



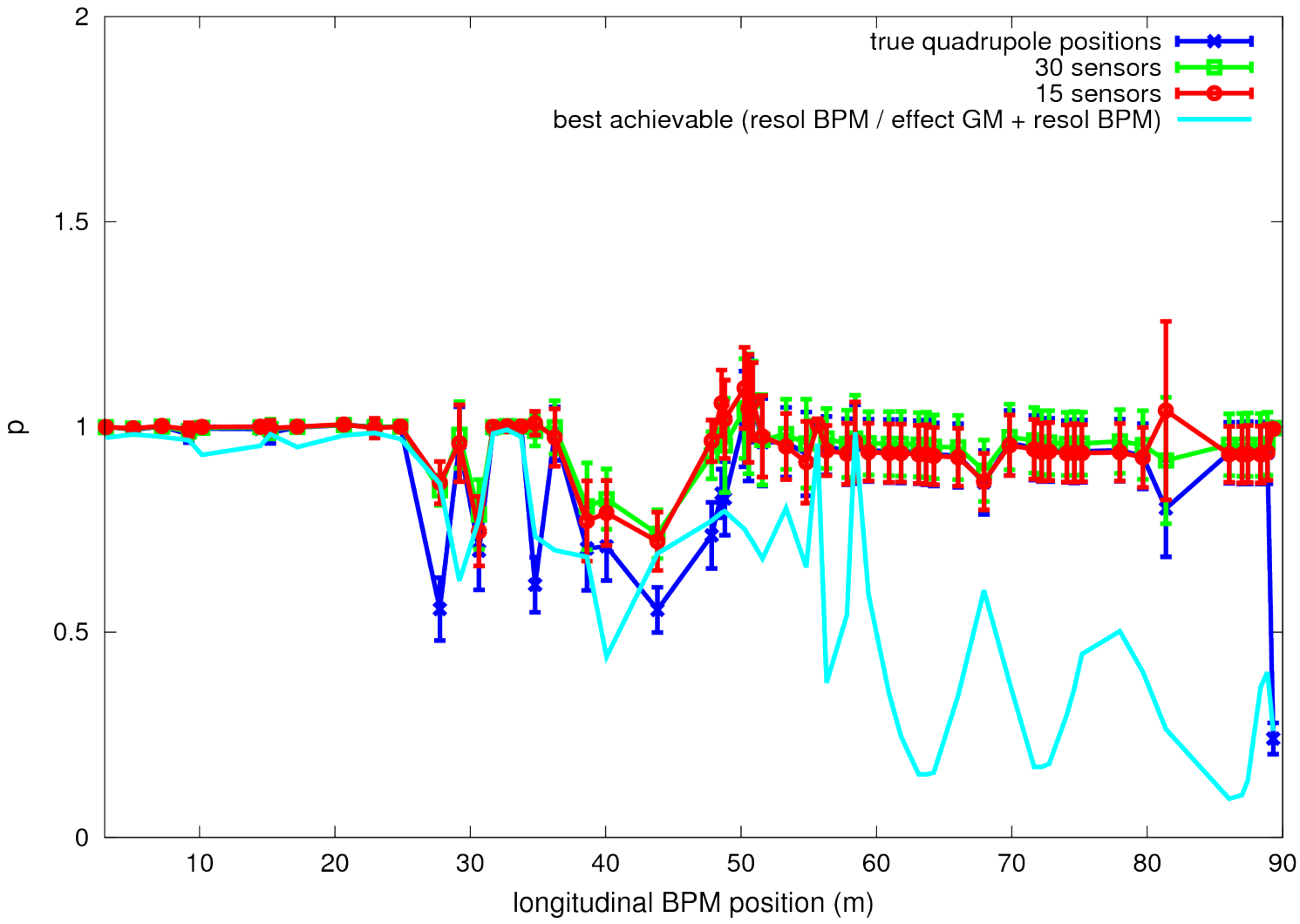
Nominal Lattice with 5 Improved BPMs(Y)



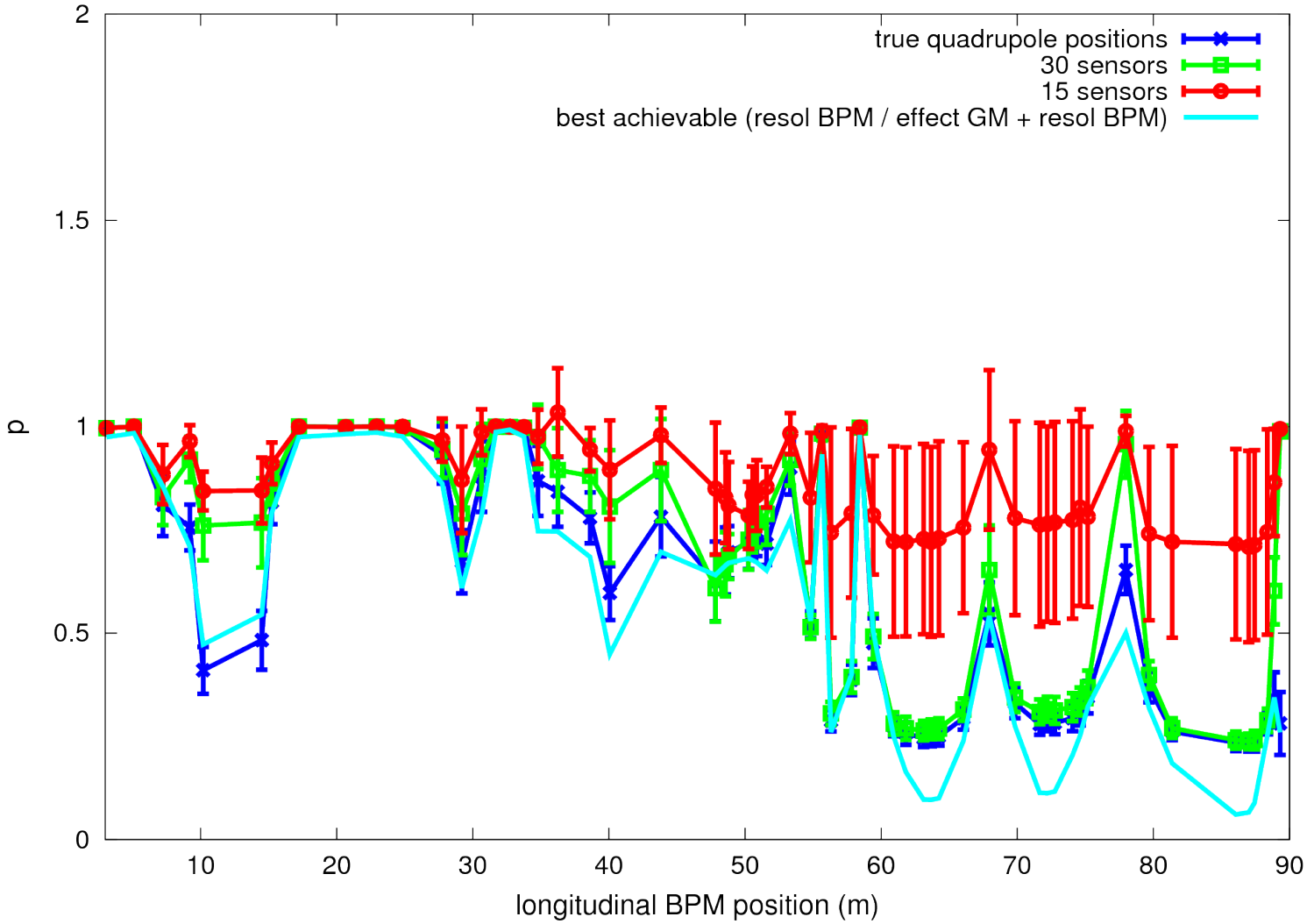
Ultra Low β Lattice(X)



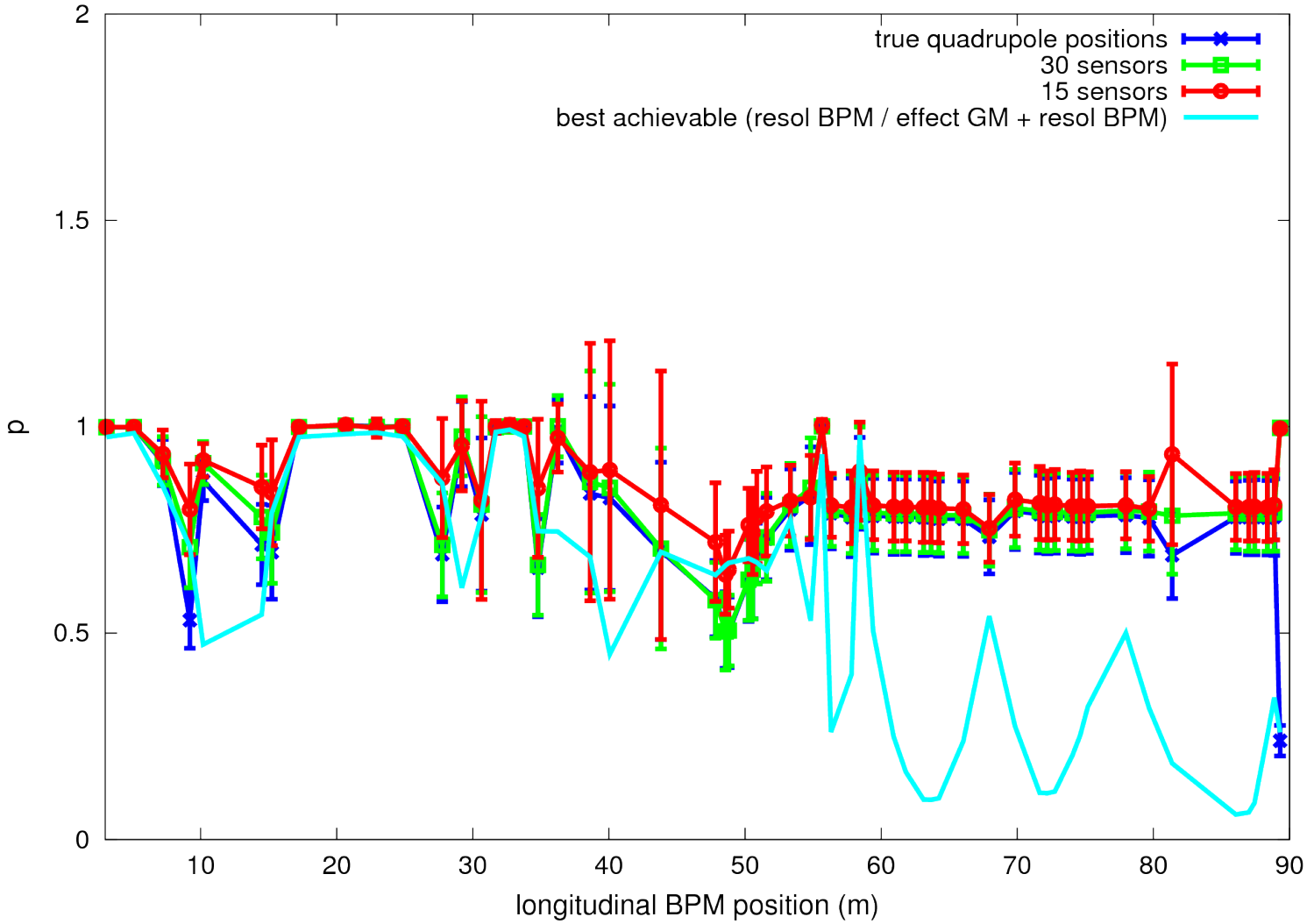
Ultra Low β Lattice(Y)



Ultra Low β Lattice with 5 Improved BPMs (X)



Ultra Low β Lattice with 5 Improved BPMs (Y)



Results Summary

	p_x in MQ	p_x in FF
Nominal	0.9 ± 0.1	0.85 ± 0.1
Ultra Low	0.9 ± 0.1	0.85 ± 0.1
Nominal (good BPMs)	0.8 ± 0.15	0.7 ± 0.2
Ultra Low (good BPMs)	0.8 ± 0.15	0.7 ± 0.2

	p_y in MQ	p_y in FF
Nominal	0.75 ± 0.1	0.8 ± 0.1
Ultra Low	0.75 ± 0.1	0.9 ± 0.1
Nominal (good BPMs)	0.75 ± 0.2	0.55 ± 0.1
Ultra Low (good BPMs)	0.75 ± 0.2	0.7 ± 0.1

MQ = Matching Quadrupoles

Headlines

Conclusion & Plan

Conclusion

- Beam jitter subtraction is critical.
- Detection seems difficult but should be feasible with the current configuration.
- Great improvement with the 5 first BPMs upgraded.
- Ultra Low β does not help (limited by jitter subtraction)

Plan

- 15 sensors available and acquisition system is ready.
- Testing is ongoing.
- Then ship everything to ATF.
- Measurements at ATF2 this year.