

# Feed forward with GM sensors

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# Concept of Feed Forward with GM Sensors

Feed forward  
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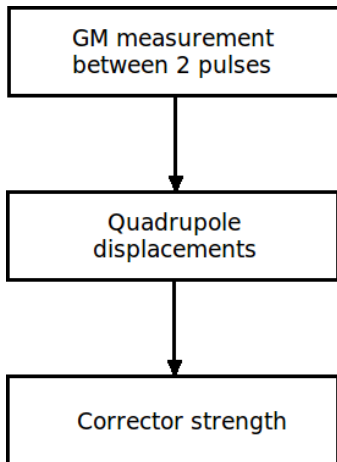
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# Goal and motivation of the ATF2 experiment

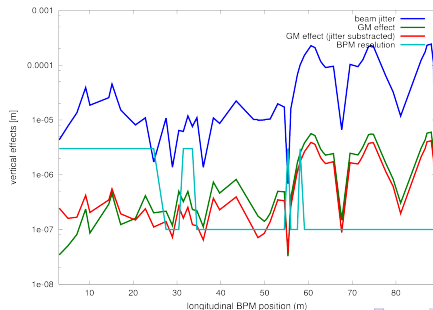
## Goal

- ▶ 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)

- ▶ 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.



## Conditions

- ▶ ATF2 nominal lattice (sextupoles off).
- ▶ Elements misaligned initially (RMS=100 $\mu$ m).
- ▶ Trajectory is then steered.
- ▶ Ground Motion (GM) model based on measurements.
- ▶ Elements are displaced by the amount of relative motion compared with the 1<sup>st</sup> 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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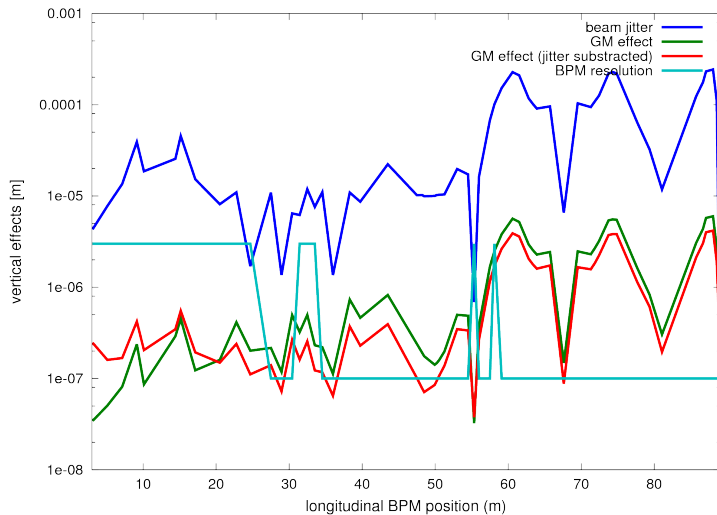
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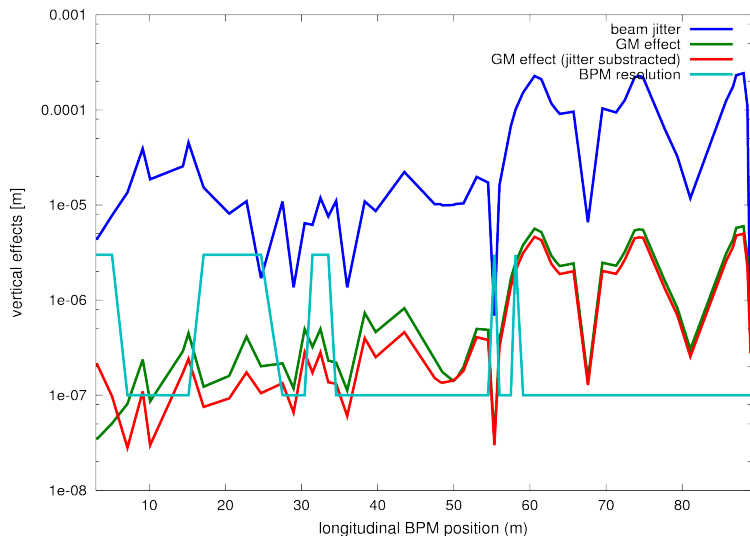
# Nominal Lattice



# Nominal Lattice with 5 Improved BPMs

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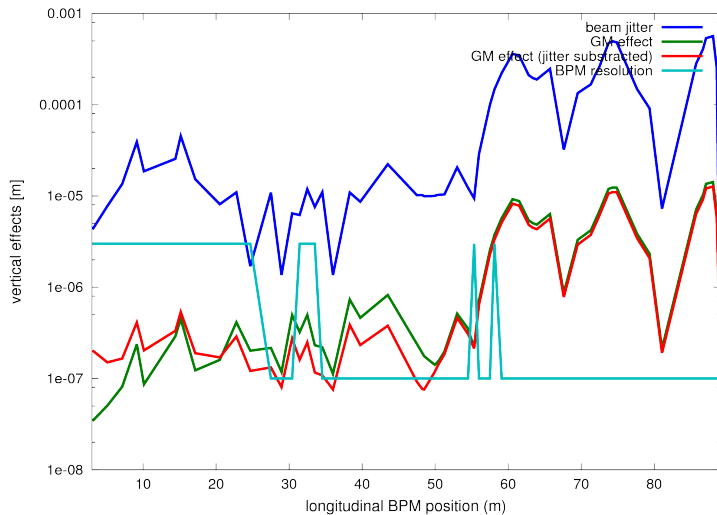
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# Ultra Low $\beta$ Lattice

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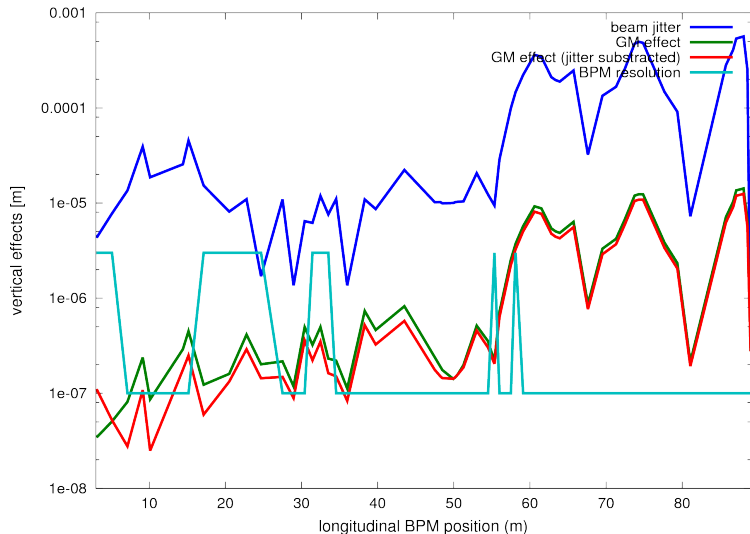
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- ▶  $R_1$  is the GM effect obtained from GM sensors.
- ▶  $R_2$  is the GM effect obtained from BPMs.

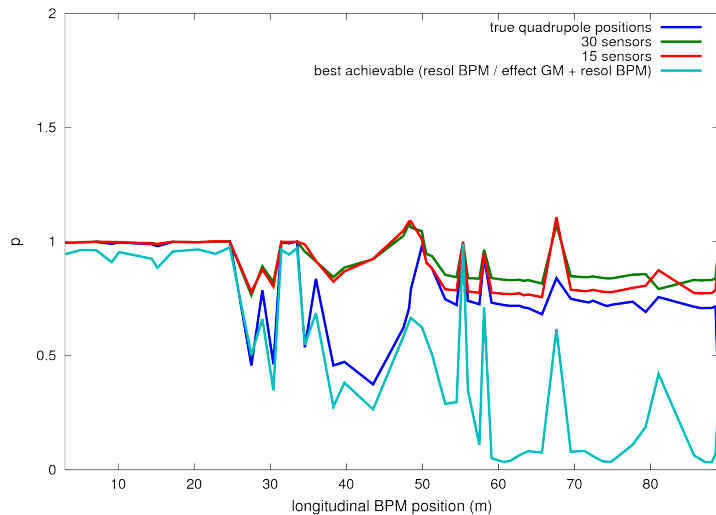
$$\rho = \frac{\|R_1 - R_2\|_2}{\|R_1 + R_2\|_2}$$

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

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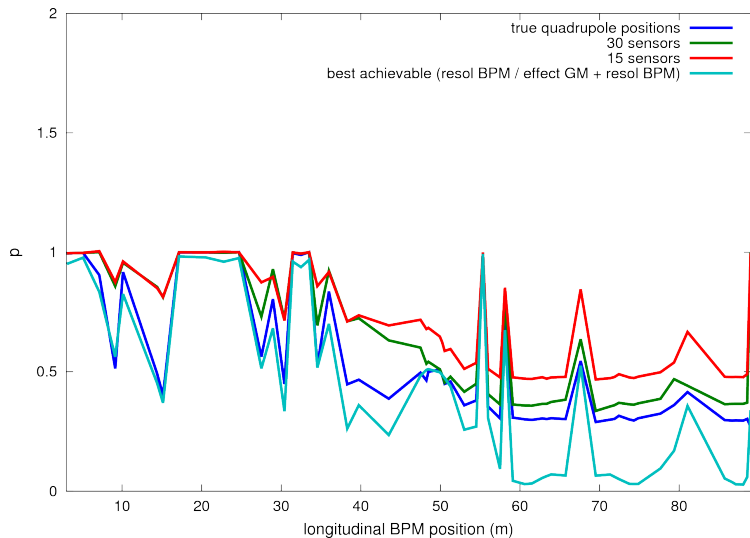
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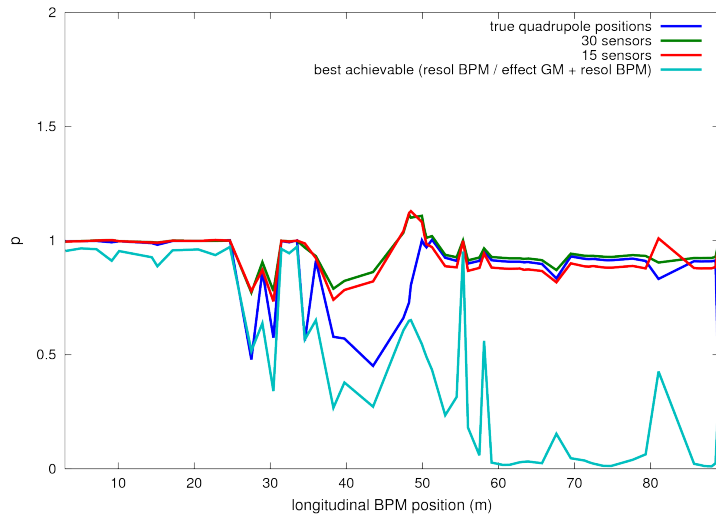
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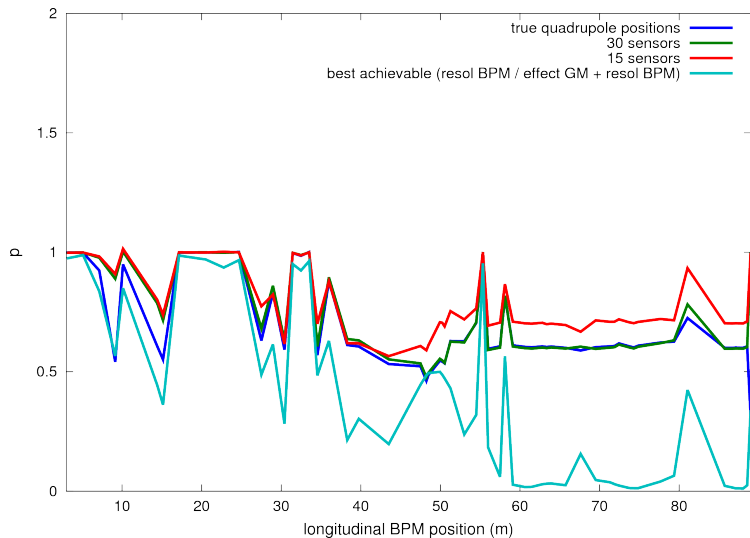
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# Results Summary

	p in Matching Quads	p in FF
Nominal	0.8	0.75
Ultra Low	0.75	0.9
Nominal (good BPMs)	0.75	0.5
Ultra Low (good BPMs)	0.6	0.7

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## 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  $\beta$  do not really help (higher sensitivity to errors)

## Plan

- ▶ 15 sensors available and acquisition system is ready.
- ▶ Testing early November at LAPP.
- ▶ Then ship everything to ATF.
- ▶ Hope for first measurements at ATF in December.