

Update on Multiple GM sensors at ATF2

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CERN

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- ▶ GM sensors are usually only compared to other GM sensors
- ▶ Objective : detect Ground Motion (GM) effect on beam trajectory.
- ▶ Such a correlation would demonstrate possibility to make a feed forward.
- ▶ Feed forward would allow trajectory correction based on GM measurements in CLIC.
- ▶ Feed forward would allow big saving (avoid quadrupole stabilization in CLIC)

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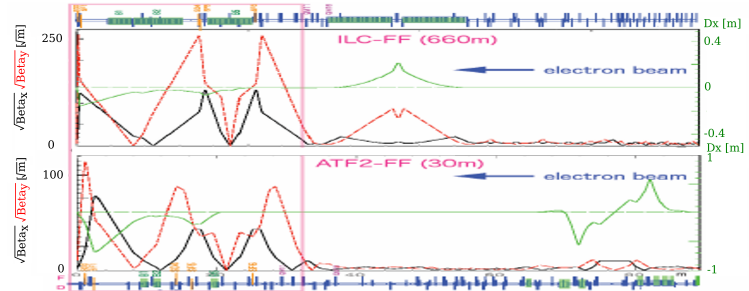
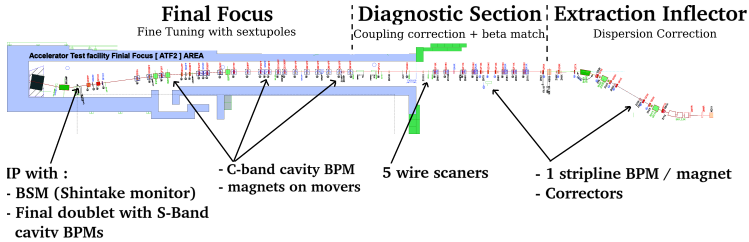
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Conditions

- ▶ ATF2 nominal lattice (sextupoles off).
- ▶ Elements misaligned initially (RMS=100 μ m).
- ▶ Trajectory is then steered.
- ▶ Ground Motion (GM) model based on measurements (10 seeds).
- ▶ Elements are displaced by the amount of relative motion compared with the 1st 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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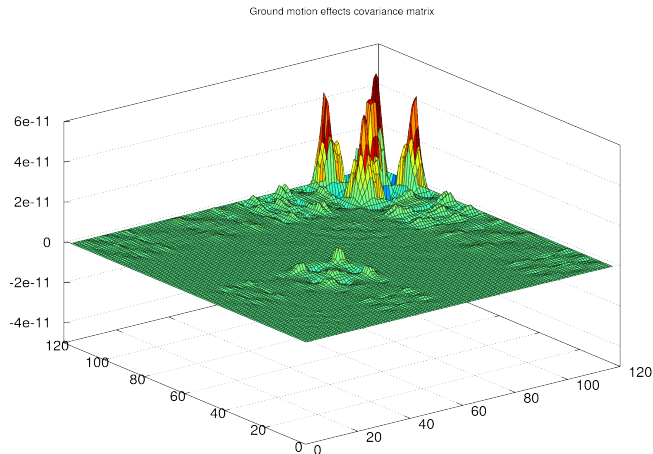
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Algorithm

Initialization

- ▶ Measure transfer matrix from first 5 SVD modes.
- ▶ GM effects covariance matrix from model.



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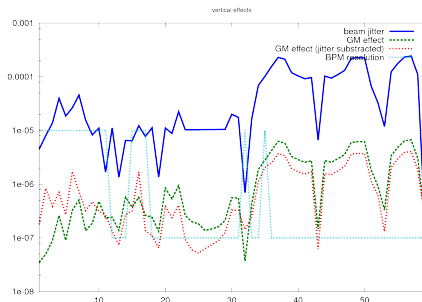
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Algorithm - Each Pulse

- ▶ Remove jitter with generalized least square from BPM measurements.
- ▶ Evaluate GM effect on BPM readings and removed the part reconstructed as jitter.
- ▶ Compare these residuals.



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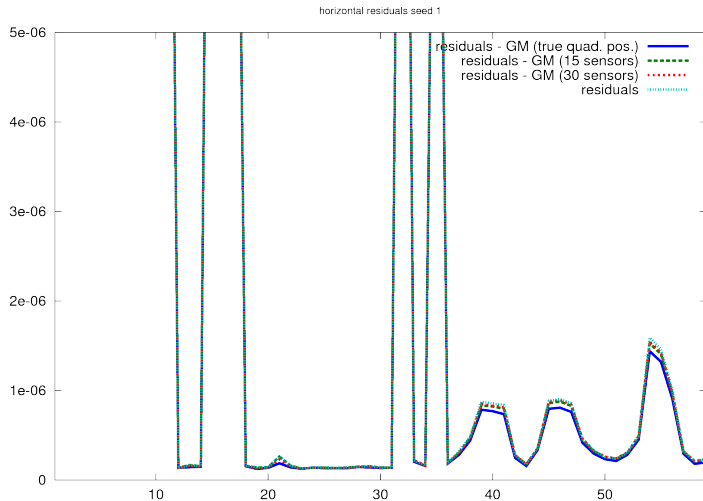
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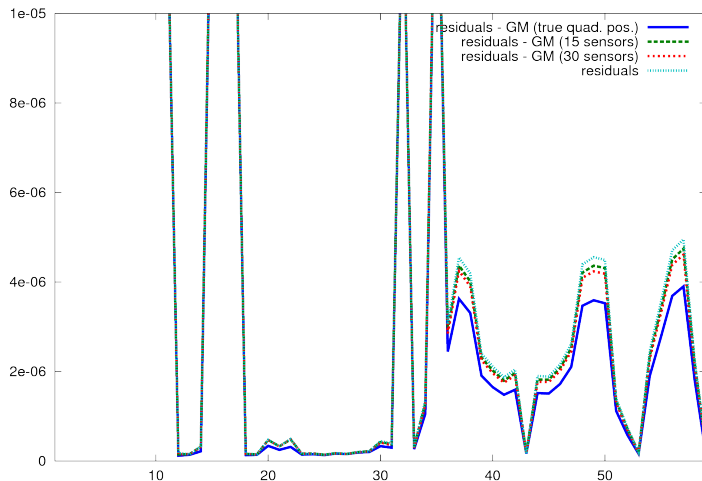
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vertical residuals GM subtracted seed 1



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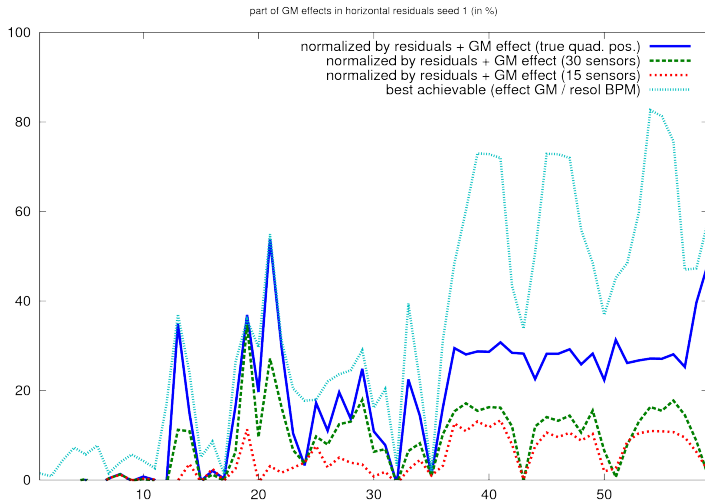
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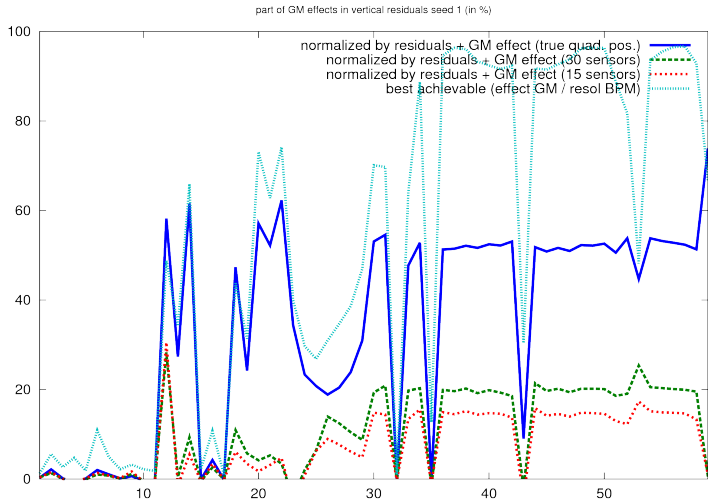
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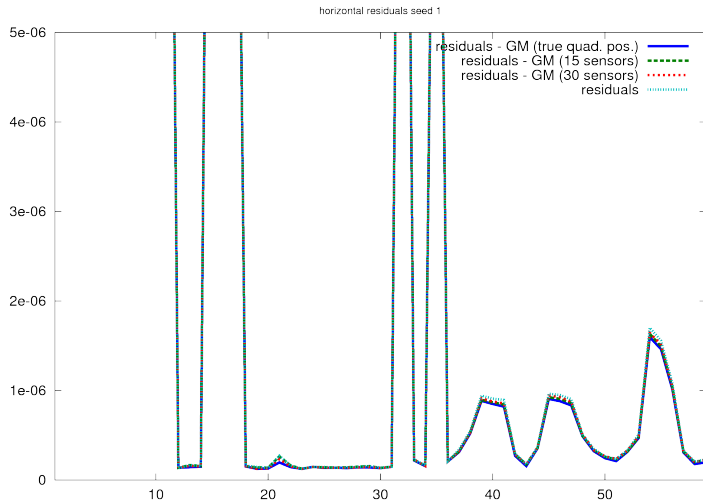
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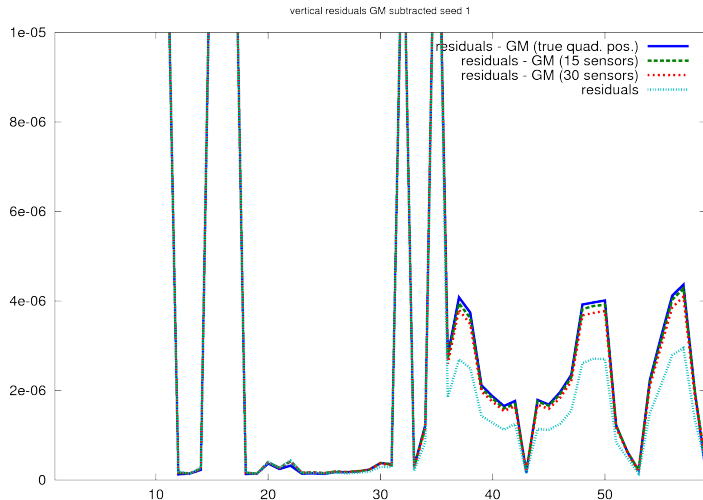
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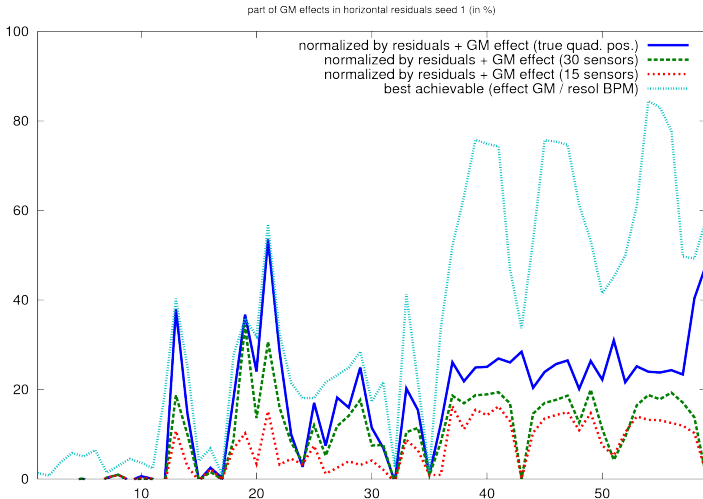
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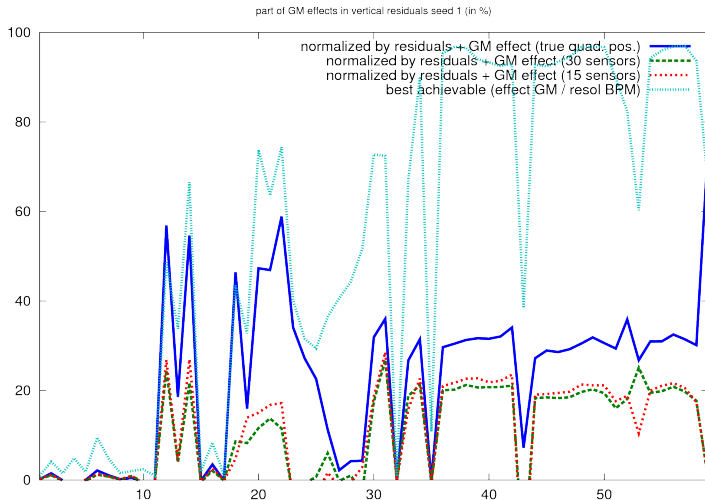
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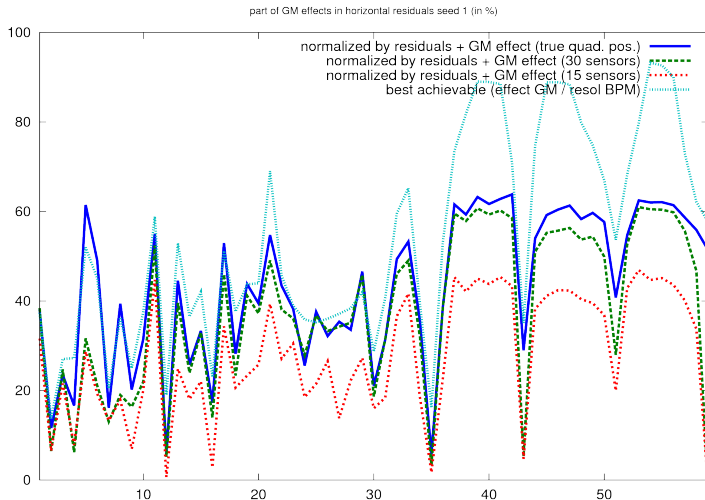
Place of sensors

- ▶ Large difference from true quad. pos. and meas.
- ▶ TF of sensor has little influence.
- ▶ Interpolation between sensors is the issue.
- ▶ Optimize sensors position should improve the results!

BPM resolution

- ▶ As an upgrade first BPMs could be replaced.
- ▶ 100nm resolution of cavity BPMs are obtained with attenuators.
- ▶ 30 nm should be achievable without attenuators.

All BPM 100nm resolution



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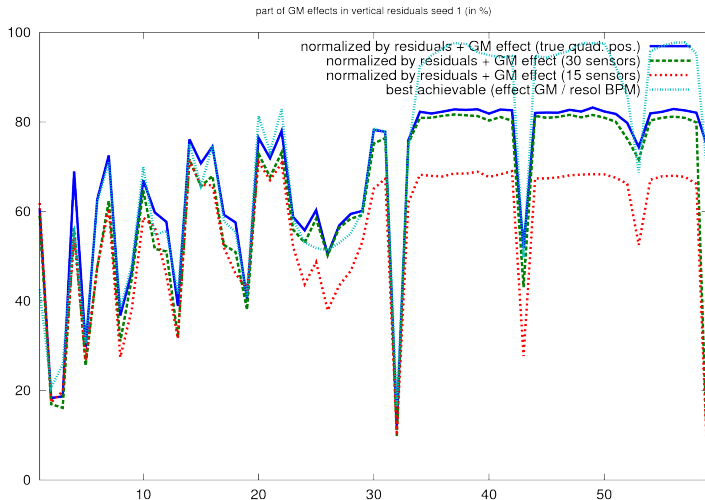
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All BPM 100nm resolution

GM sensors at ATF2

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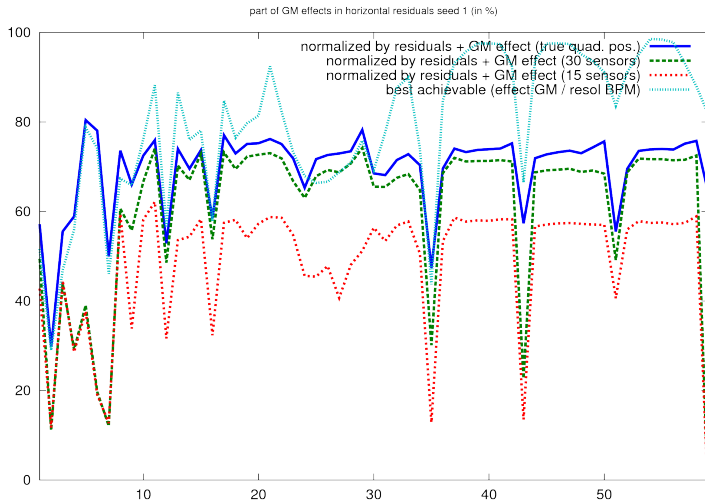
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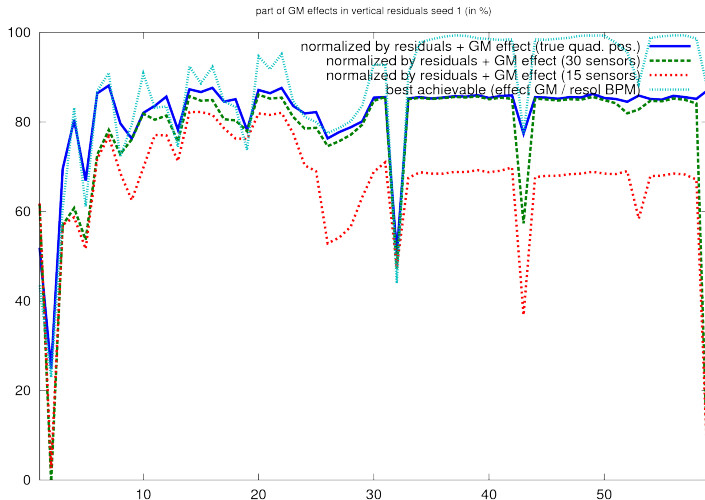
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- ▶ Try to determine jitter source from correlations using reconstruction.
- ▶ Compare jitter level in extraction line and in the ring.
- ▶ Look at the spectra of the jitter.

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Conclusion

- ▶ Beam jitter subtraction is critical.
- ▶ But it reduce the GM signal as well.
- ▶ Analyse robust to lattice errors
- ▶ Still place for improvement.

Prospects

- ▶ Analyze jitter.
- ▶ Try to optimize sensor positions.

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