Orbit Response Analysis

The method:

- A small kick $\Delta\theta$ is applied in either the horizontal or vertical
- Change in closed orbit is measured at each BPM
- Results summarized in matrix form:

$$\Delta x = M \Delta\theta$$

- Orbit response matrix M has dimensions (horz. + vert. steering eles) x (horiz. + vert. BPMs)

Project outline:

- Simulate the "ideal" Orbit Response Matrix for current CESR lattice
- Introduce BPM misalignments / resolution limits into simulated ORM
- Benchmark: load both matrices into LOCO to find the "misaligned" BPM
- Analyze the ORM data previously collected, using LOCO
- Implement BPM corrections suggested by LOCO?

Simulated Ideal ORM

-Ideal ORM can be calculated using two methods:

1) Directly from the twiss parameters and phase, using

$$M_{ij} = \sqrt{\beta_i \beta_j} * \cos(\pi\nu - |\varphi_i - \varphi_j|) / [2 \sin(\pi\nu)]$$

(ith bpm, jth steering element)

2) Manually apply a kick, and measure the difference in closed orbit:

$$M_{ij} = \Delta x / \Delta\theta$$

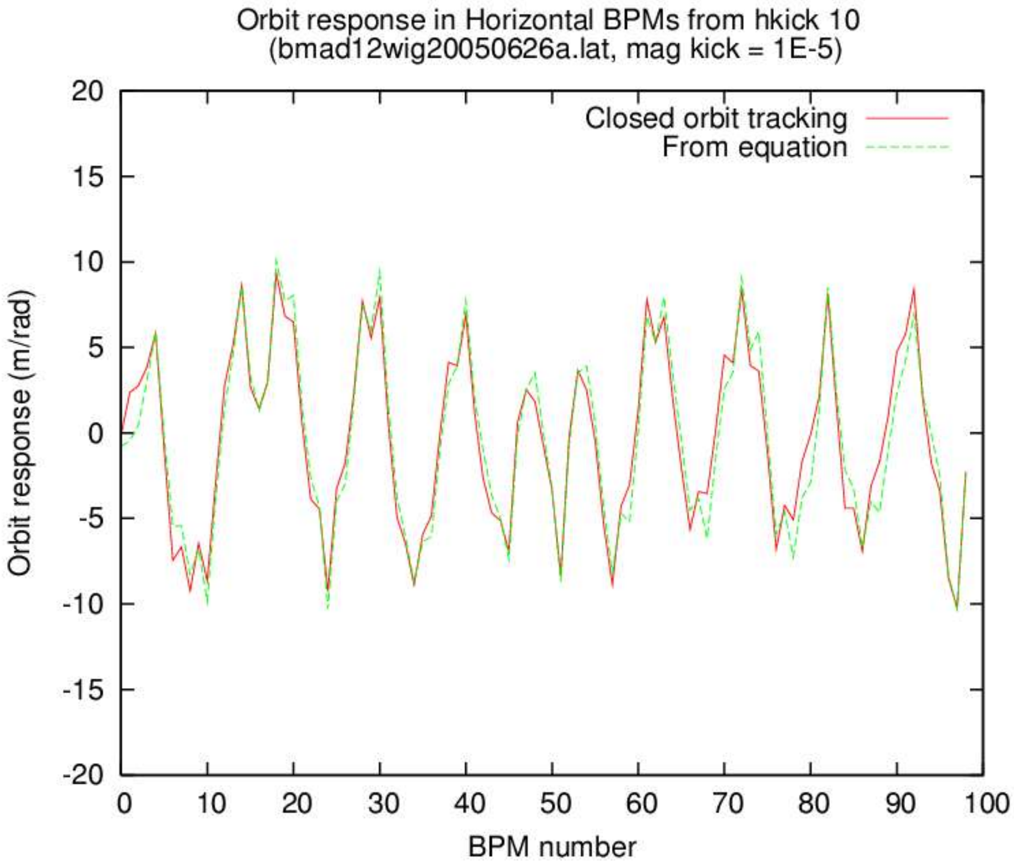
-Both methods have been implemented in parallel, allowing us to compare results

-Results decomposed into four quadrants of the ORM: XX, XY, YX, YY

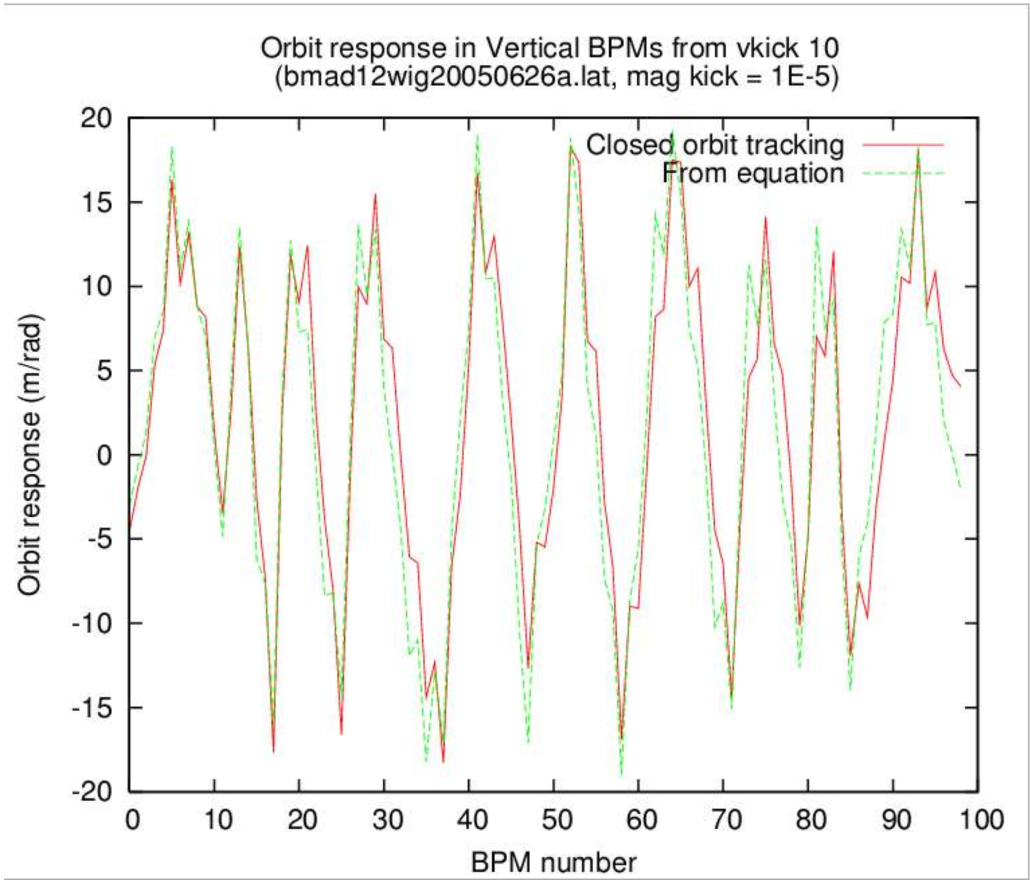
-Ideally, XY, YX terms should all be zero (no coupling)

- -Cannot compute these terms using the first method; only with closed-orbit method

Simulated Ideal ORM – Sample Results

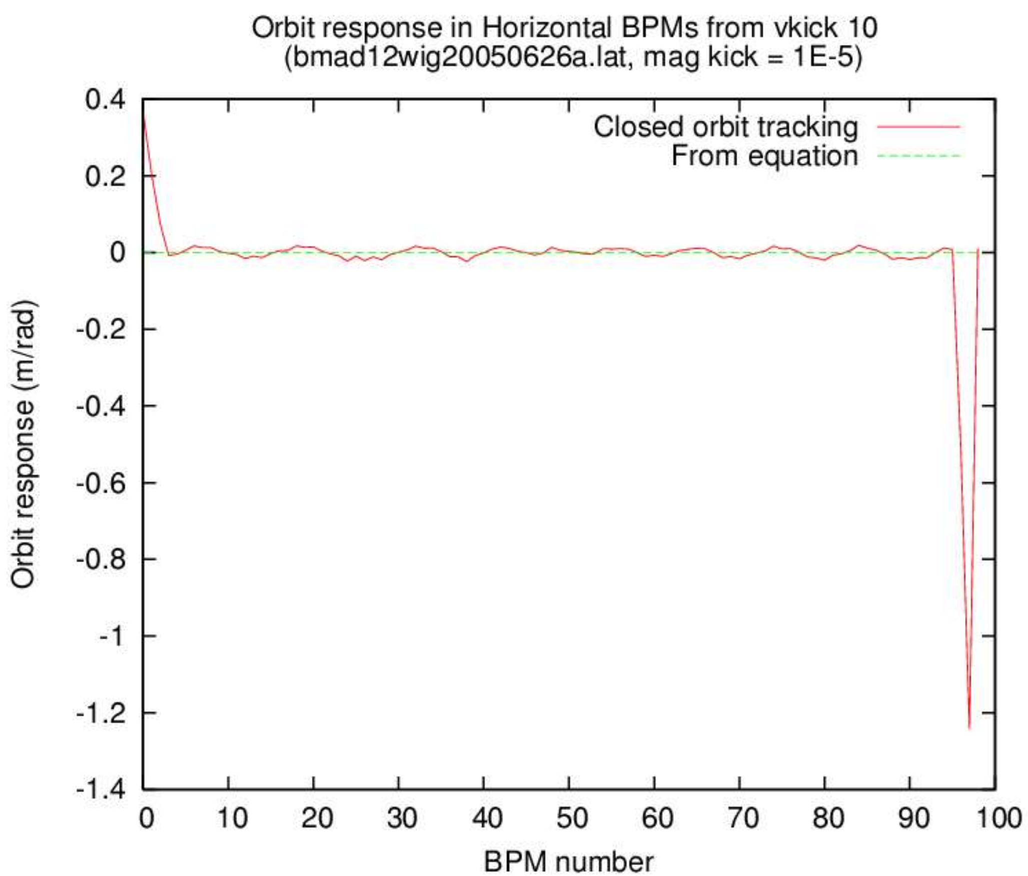


XX, hkick 10, across all BPMs

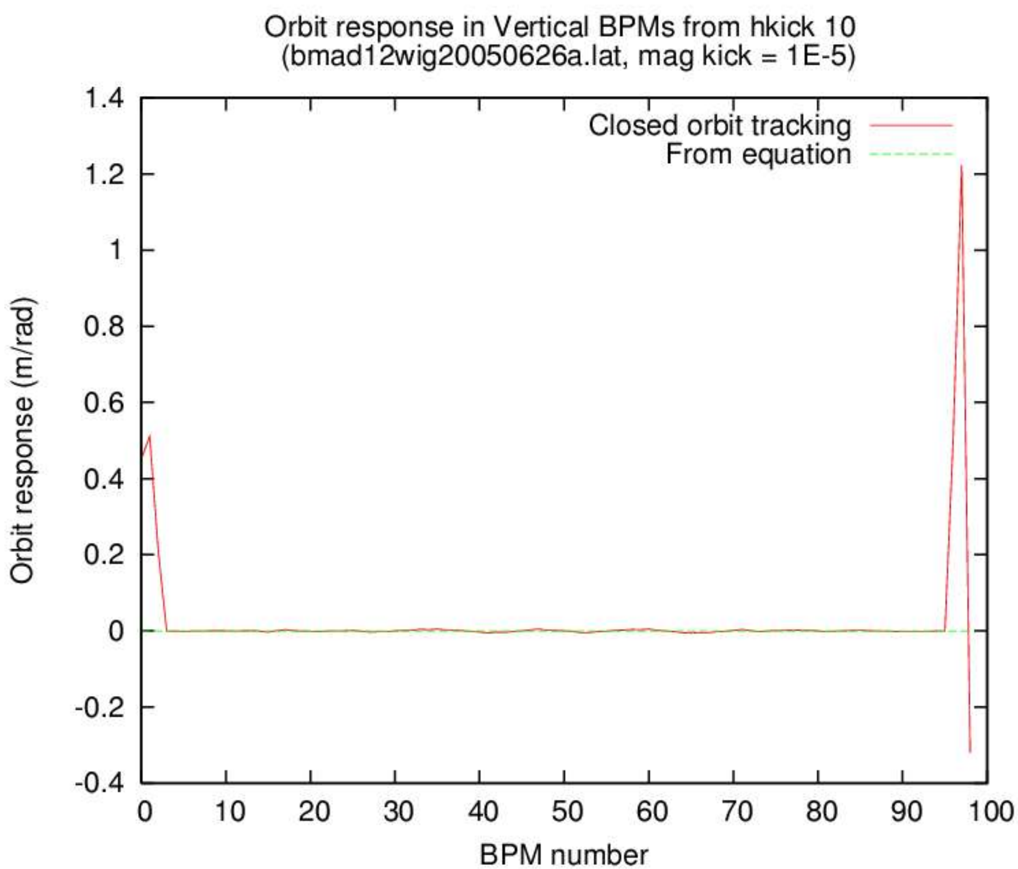


YY, hkick 10, across all BPMs

Simulated Ideal ORM – Sample Results – Coupling Terms



XY, hkick 10, across all BPMs



YX, hkick 10, across all BPMs

-The source of the highly non-zero coupling terms from closed-orbit tracking is possibly due to elements in or near the IR

-Next step:

- -Determine source of these discrepancies
- -Either introduce BPM rotations and gain errors, or begin analyzing previous ORM data