Update on LET Benchmarking

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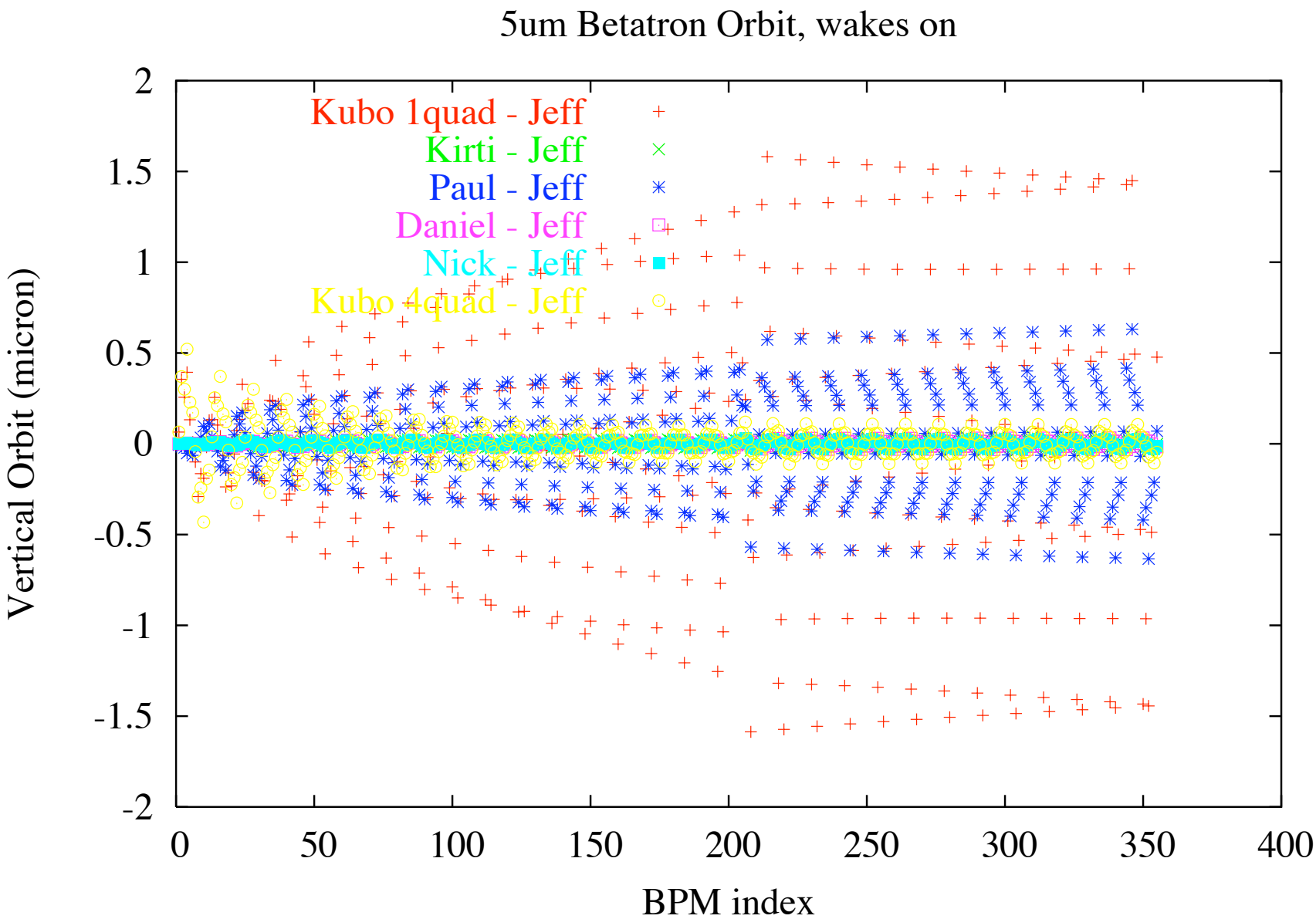
February 25, 2006

- We need to understand subtle differences between our alignment algorithms
- Right now there are significant differences in performance (on the order of the emittance budget of 10 nm)
- Should start with a detailed comparison between simulations programs.
  - The Primary Suspects:
    - Kiyoshi Kubo: SLEPT
    - Paul Lebrun, Nick Walker: Merlin (separately)
    - Kirti Ranjan, Peter Tenenbaum: MatLiar
    - Daniel Schulte: PLACET
    - Jeff Smith: BMAD/TAO

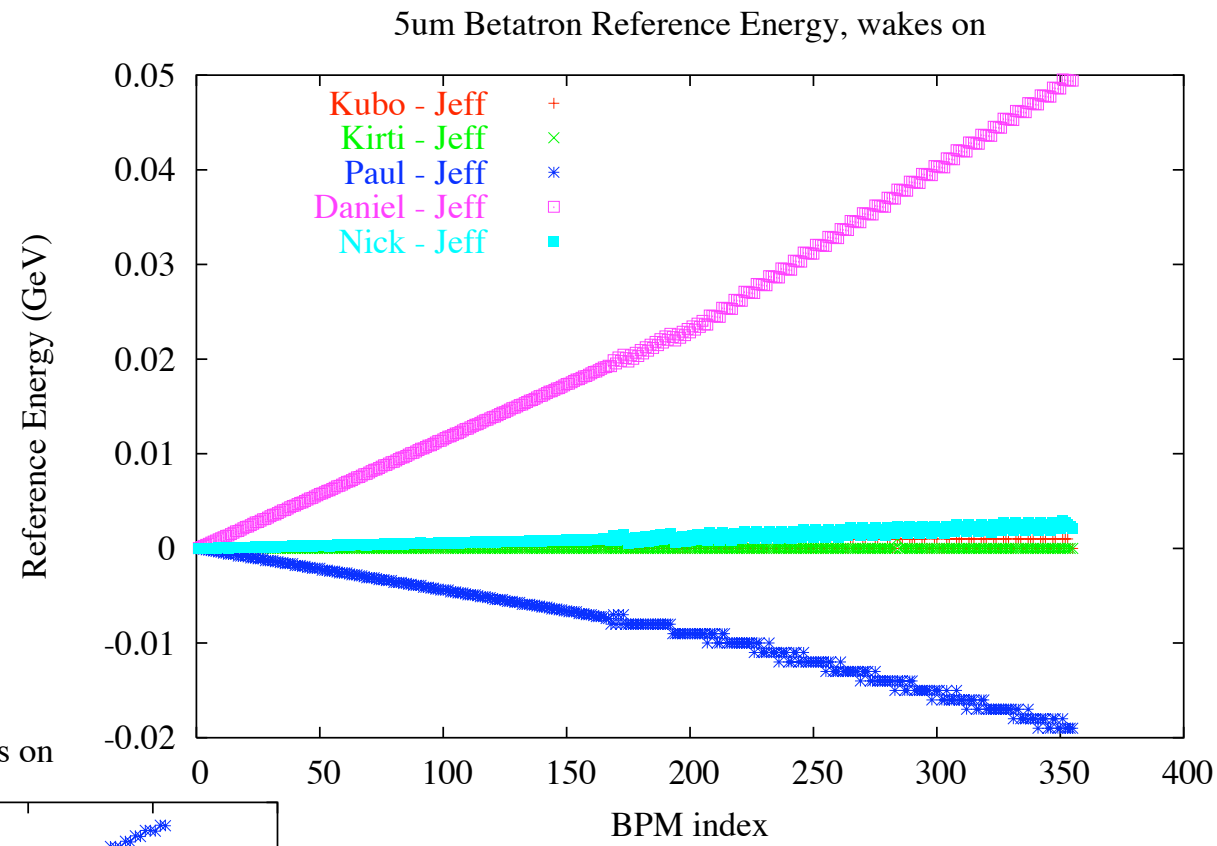
- Exercise #1: Offset beam by 5 microns and pass down perfectly aligned main linac.
  - Arbitrarily using TESLA TDR lattice and wakes

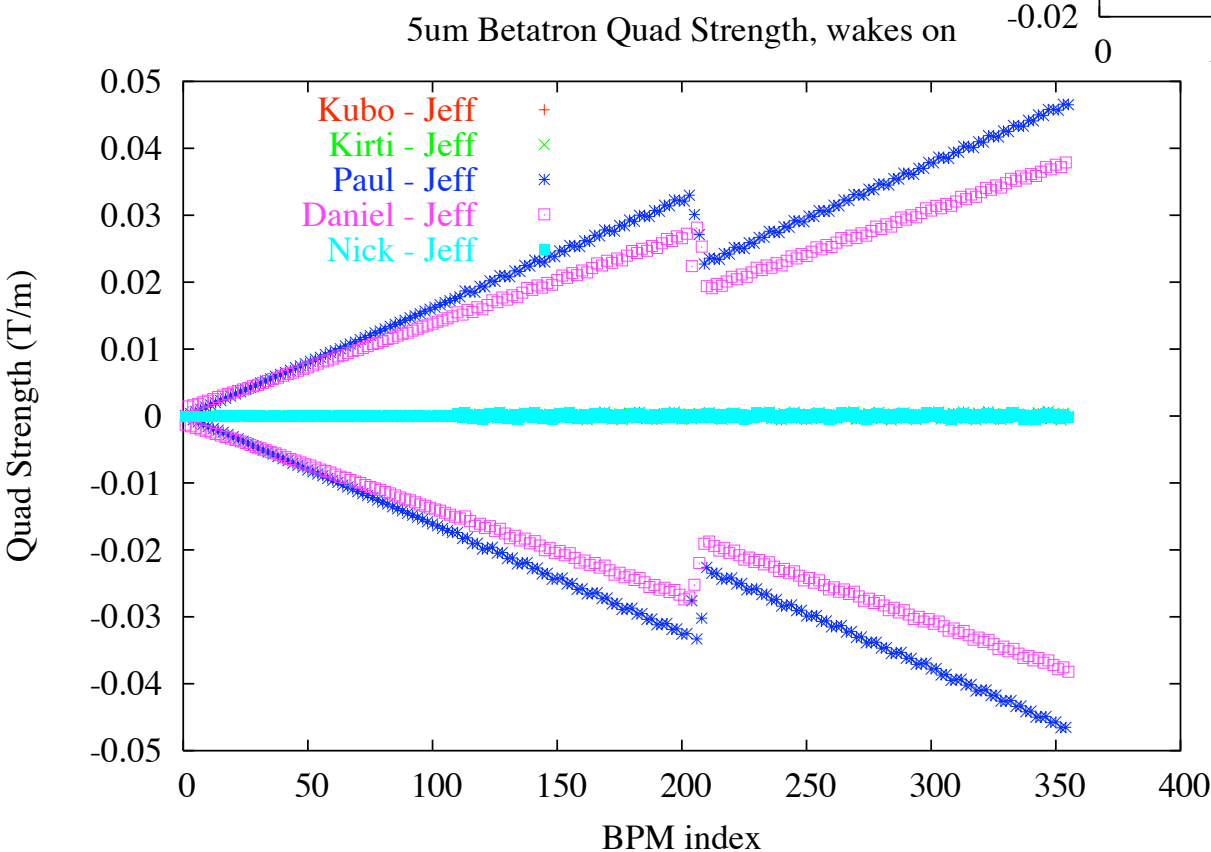
- Several iterations while attempting to converge the orbits, here are the current results (relative to my results)



- Our reference energies are different and hence, our quadrupole strengths are different.

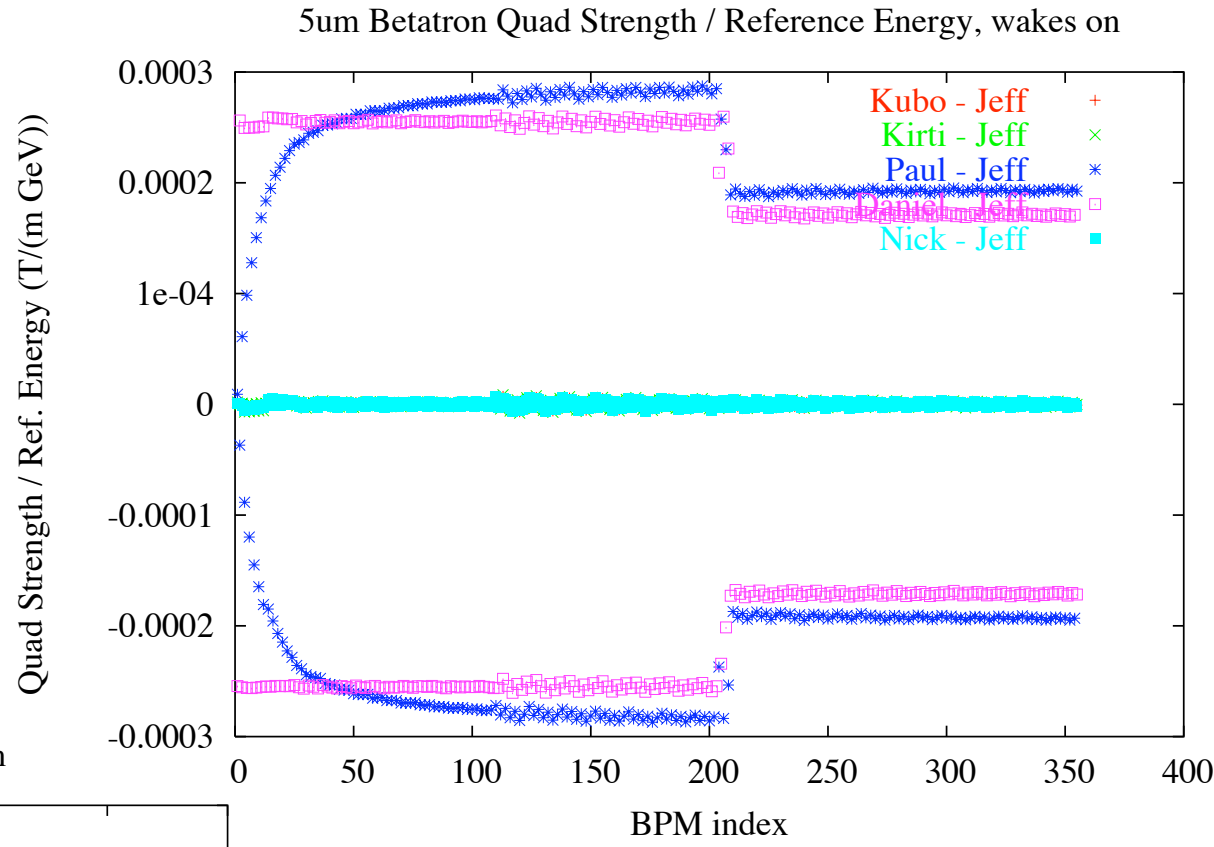
- This is mainly due to how we interpret the energy loss due to beam loading (ELOSS parameter)

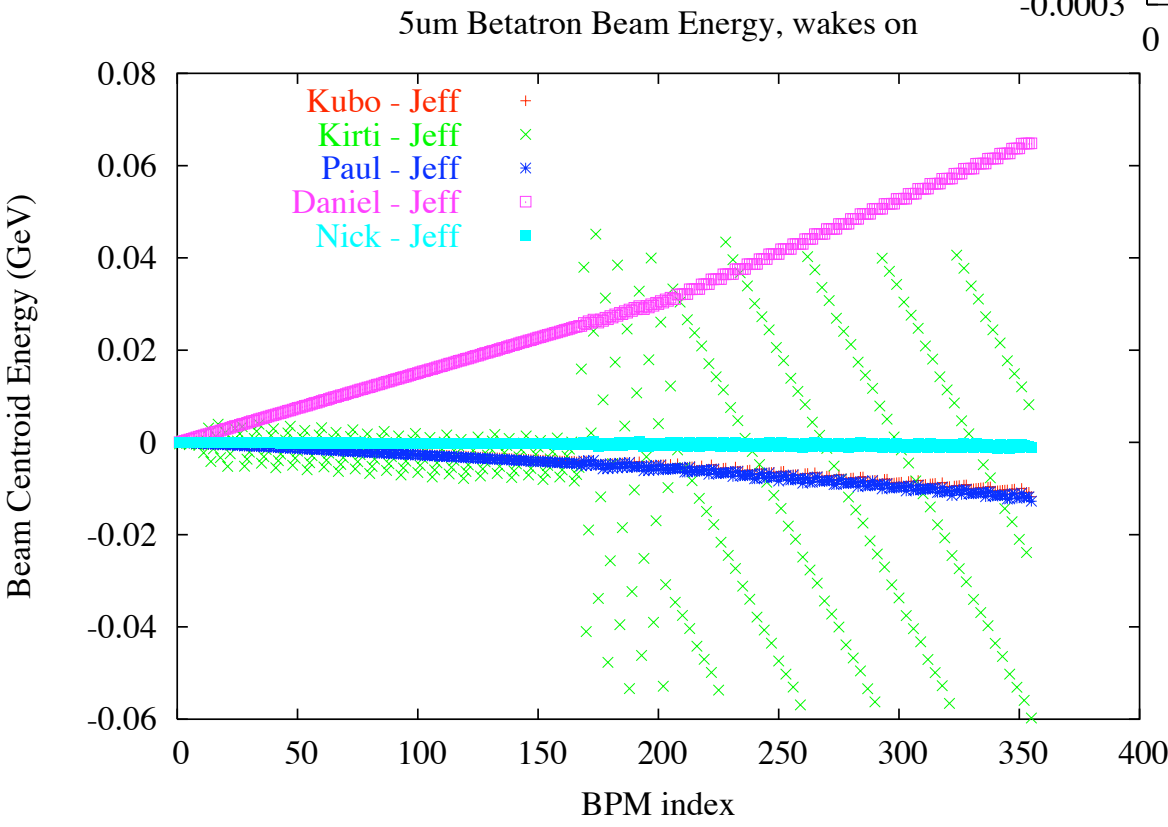




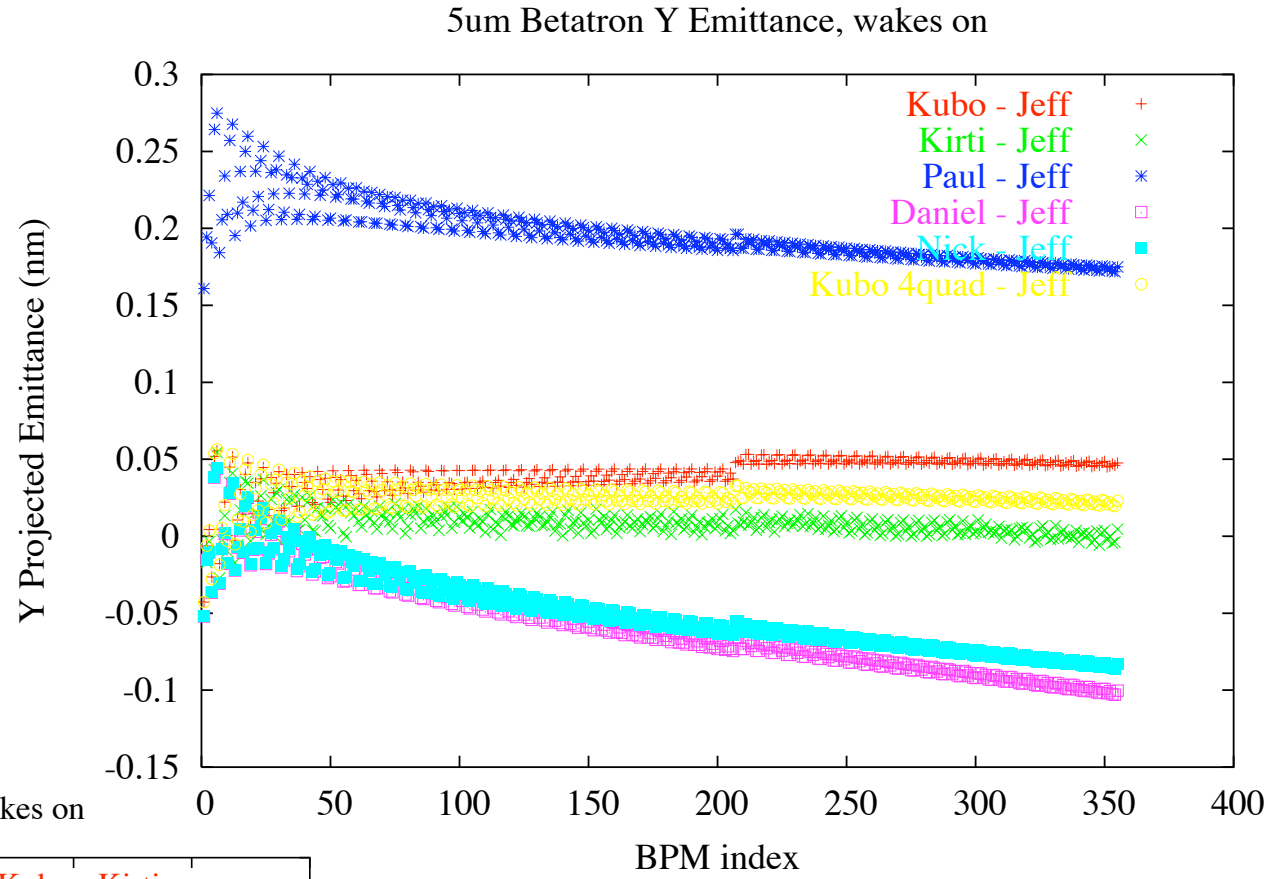
- A more useful quantity to plot is quad stength / reference energy. This also shows some differences. However Daniel's and my orbits are nearly identical, so this doesn't give the whole truth.

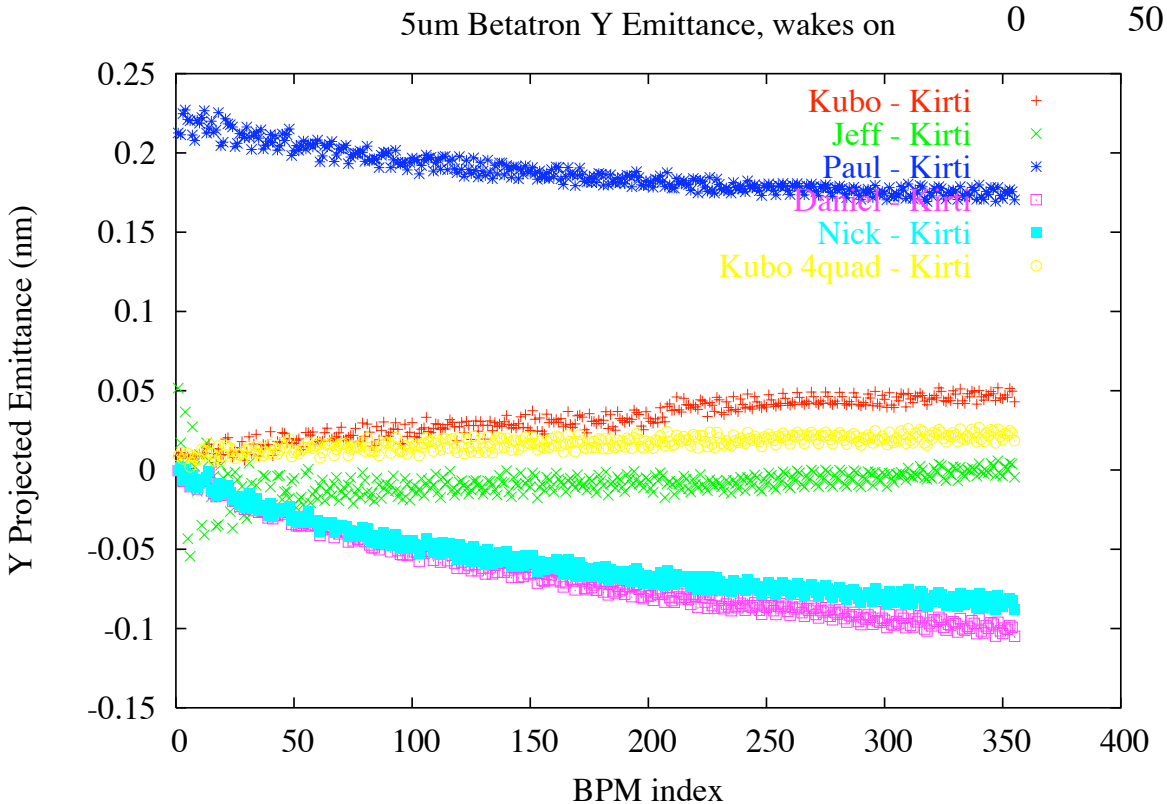
- But also looking at the centroid beam energy, perhaps his slightly heavier beam is compensating for his stronger quads.





- What about emittance?
- There's two camps, Jeff, Kubo Kirti in one corner and Paul, Daniel and Nick in the other (ignoring the DC offset).
- I'm causing the fish tail at the beginning.





Plotting w.r.t. Kirti eliminates the fish tail. Are we close enough here?

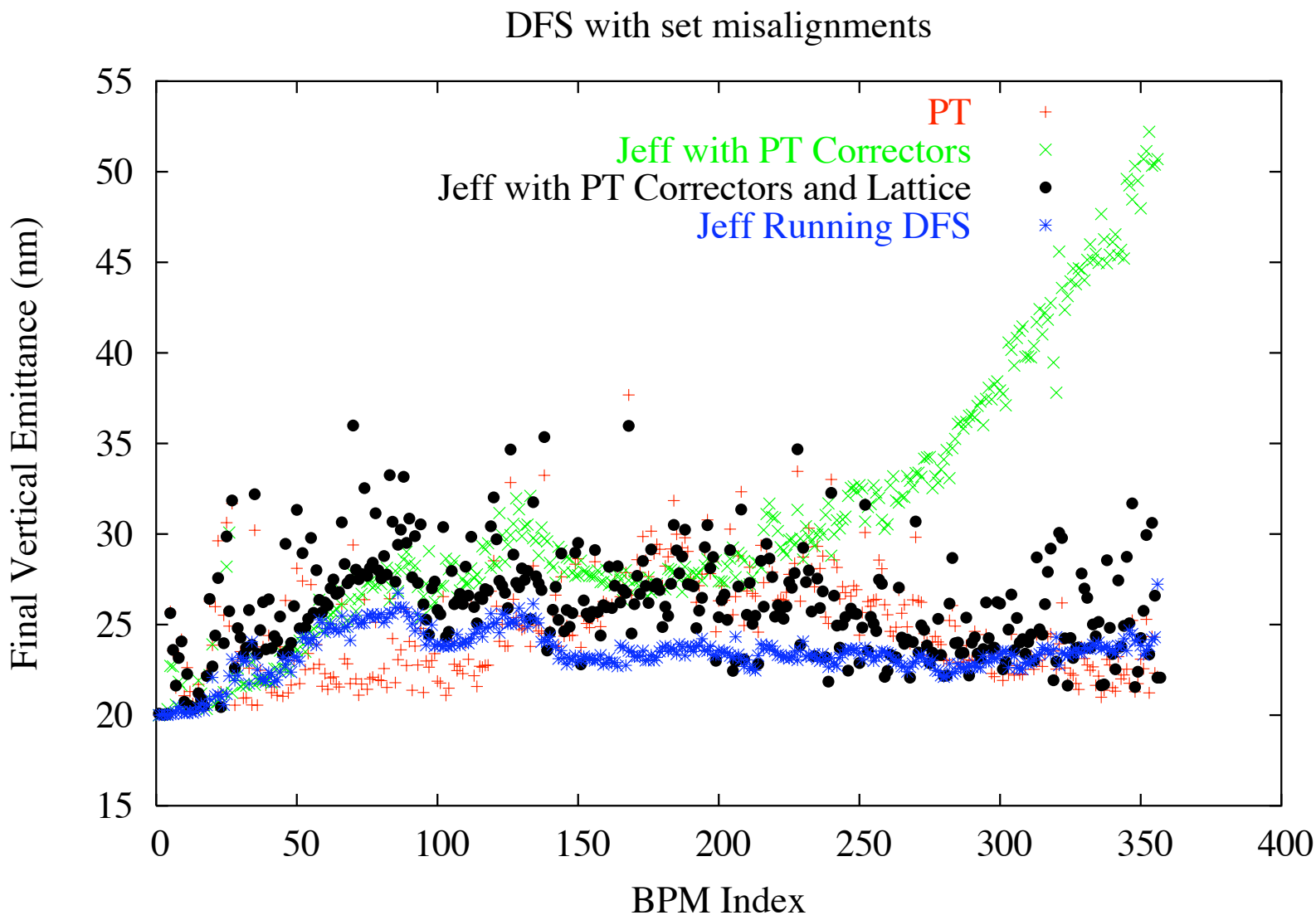
- Exercise #2: Everyone load in a pre-defined set of misalignments. One of us (PT) ran DFS on his code and then sent the rest of us the corrector settings.

- What do we get when we load these in?

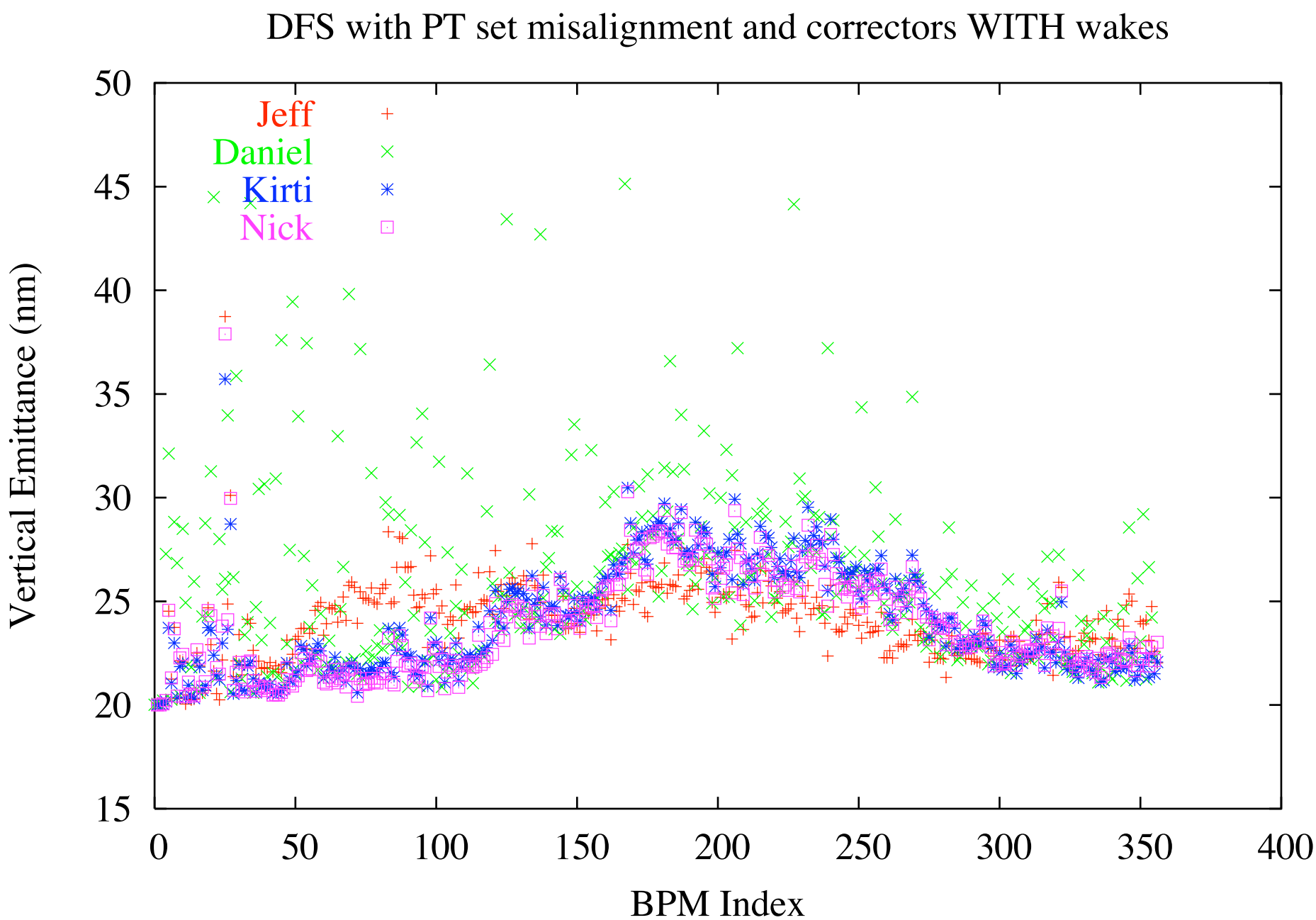
- Our representation of the quadrupoles appears matter! We need to be using very similar lattice.

- Here, PT first sent me a set of corrector settings for his lattice, which had the vkickers in the middle of the quads, I placed half the kick at the entrance half at the exit, his corrector settings do not work for me.

- I had to switch to his precise lattice before they would work for me.

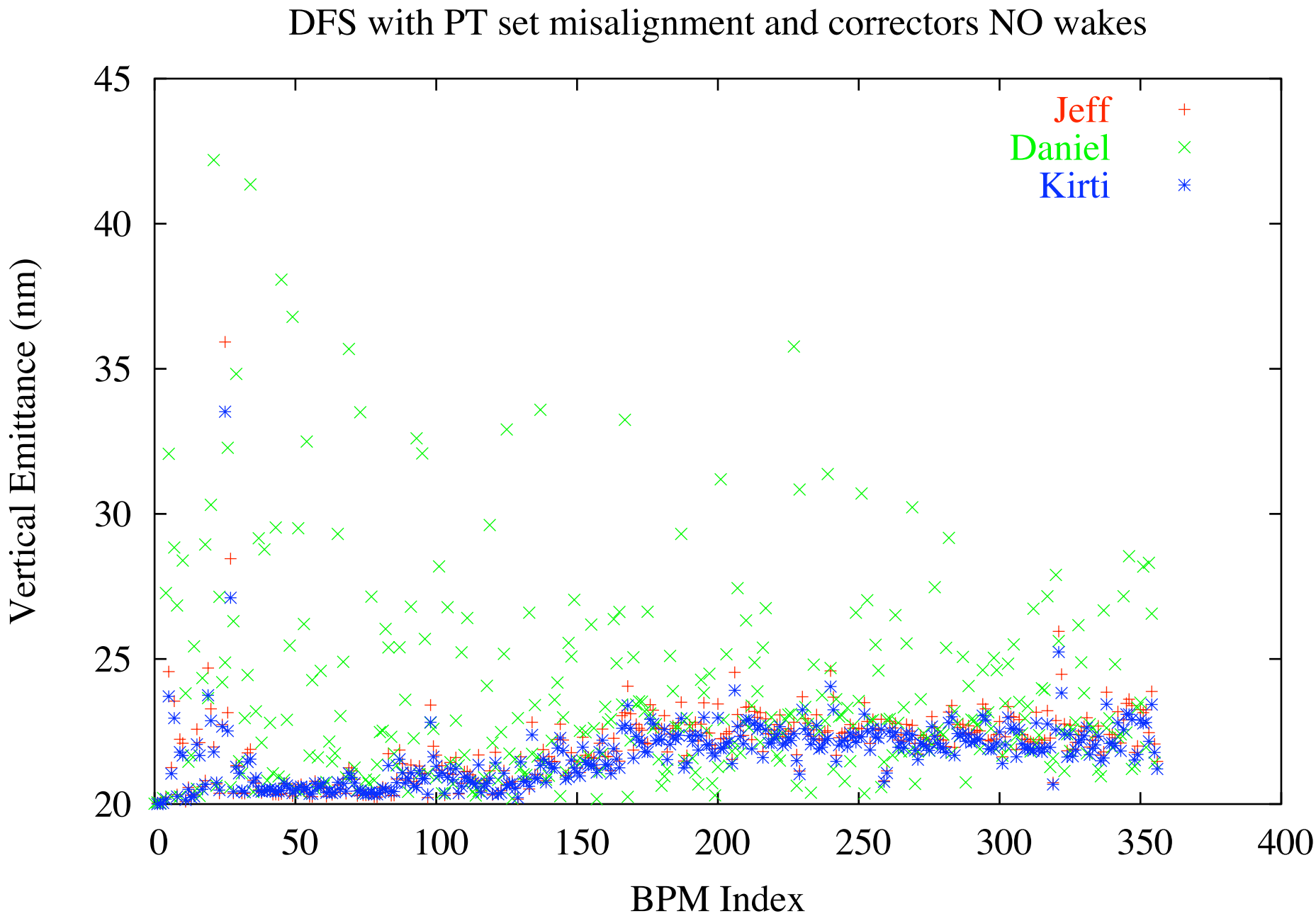


- Now, with everyone using the same lattice:



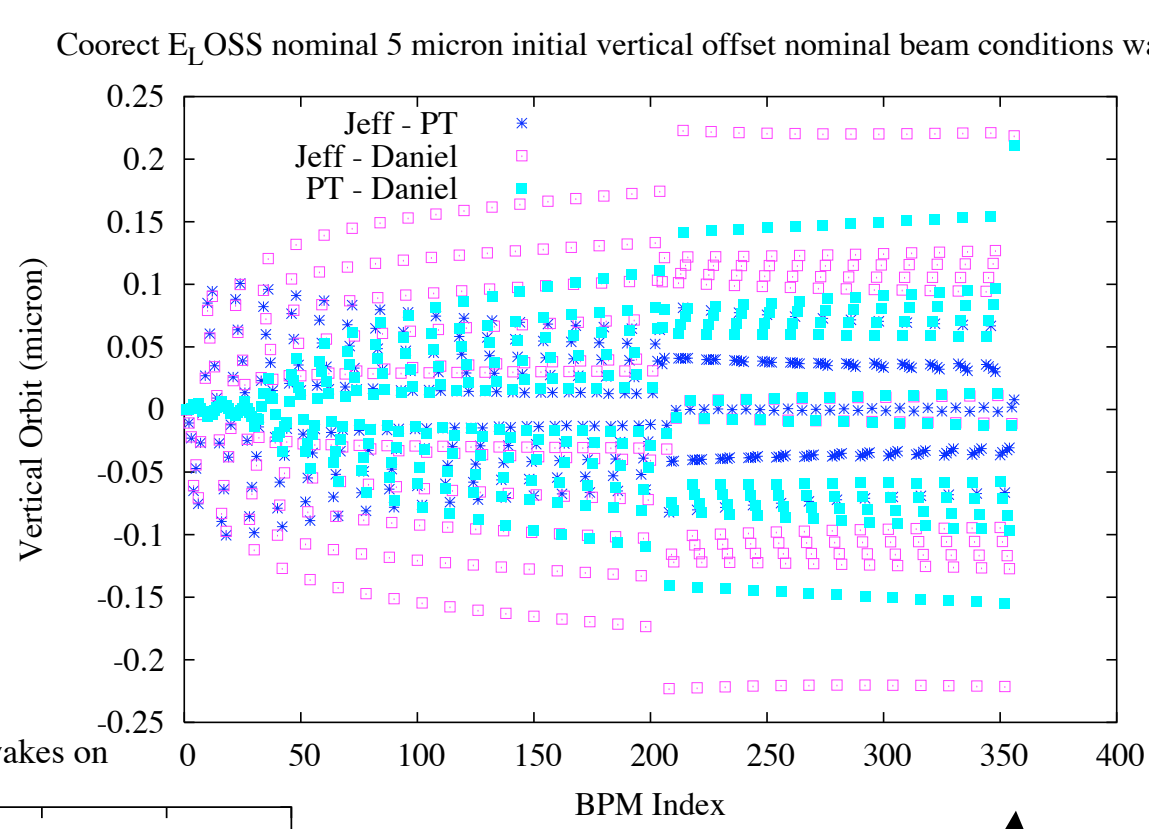
- I'm (Jeff) handling wakes differently than Nick and Kirti.

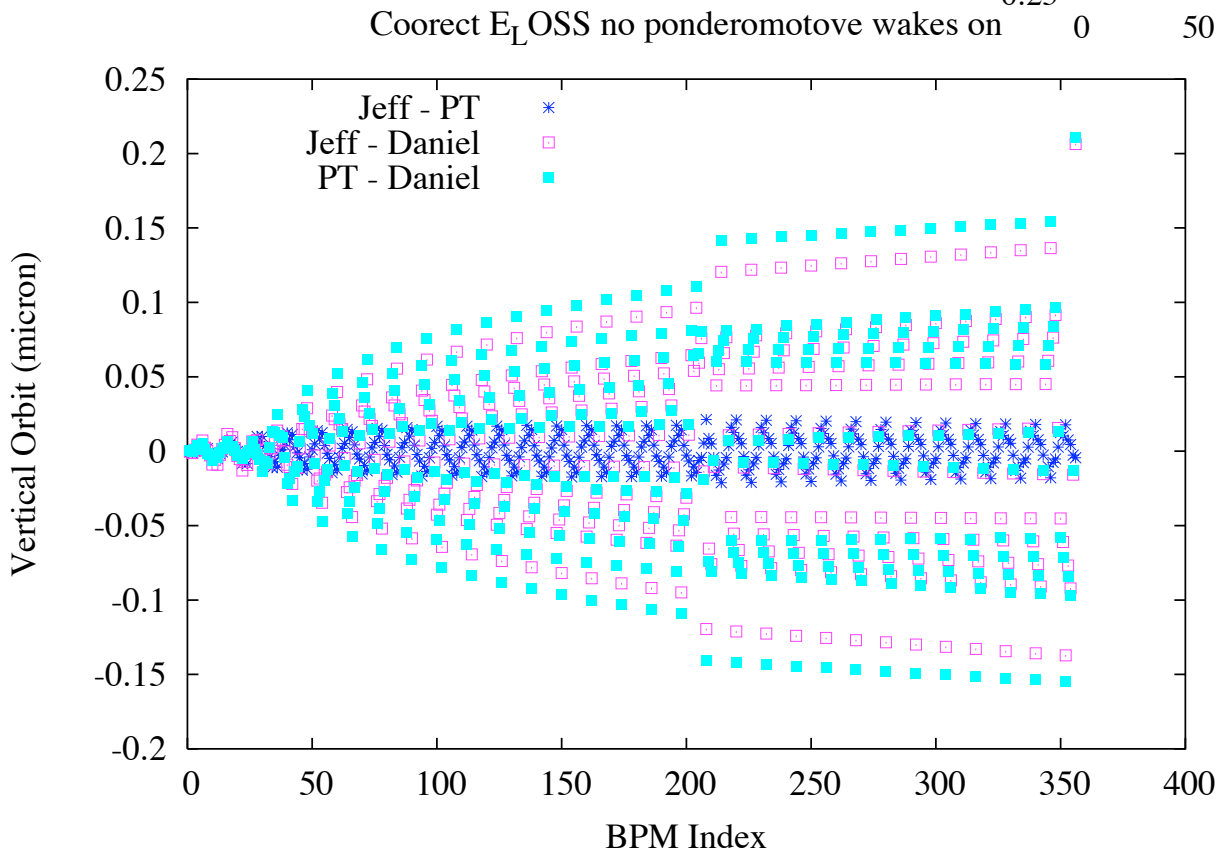
- Here wakes are off and I agree much more closely with Kirti (but there's still differences.



- Ponderomotive Force does make a difference on the orbit.

- There is edge focusing due to the first and last cell in the structure, however, every cell in between also focusses the beam, this is the ponderomotive force.





Me using ponderomotive

Me NOT using ponderomotive

- Factors so far noted that effect our results:
    - Location of corrector magnets
    - representation of quadrupoles
    - reference energy and quad strength
        - ELOSS parameter
    - Ponderomotive Force
    - Representation of the beam
    - Have to be careful to use the EXACT same lattice
- In summary: almost everything effects our results!

- Still plenty more to do
  - Still need to get our our orbits to converge.
  - How close is close enough?
    - Especially for emittance calculation
  - Right now we're just comparing tracking codes. Eventually we'd like to actually look at the alignment algorithms.
  - If we want our emittance results to agree to within a fraction of a nanometer then we have a lot of work to do!