Update on RTML Coupling Correction

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Answer a couple questions

- Reinvestigate using upstream coupling correction
  - ★ Could tuning horizontal dispersion help?
- Do I need to tune off the <xy> measurment?
  - ★ Can <yy> be used instead?

Alignment tolerances used

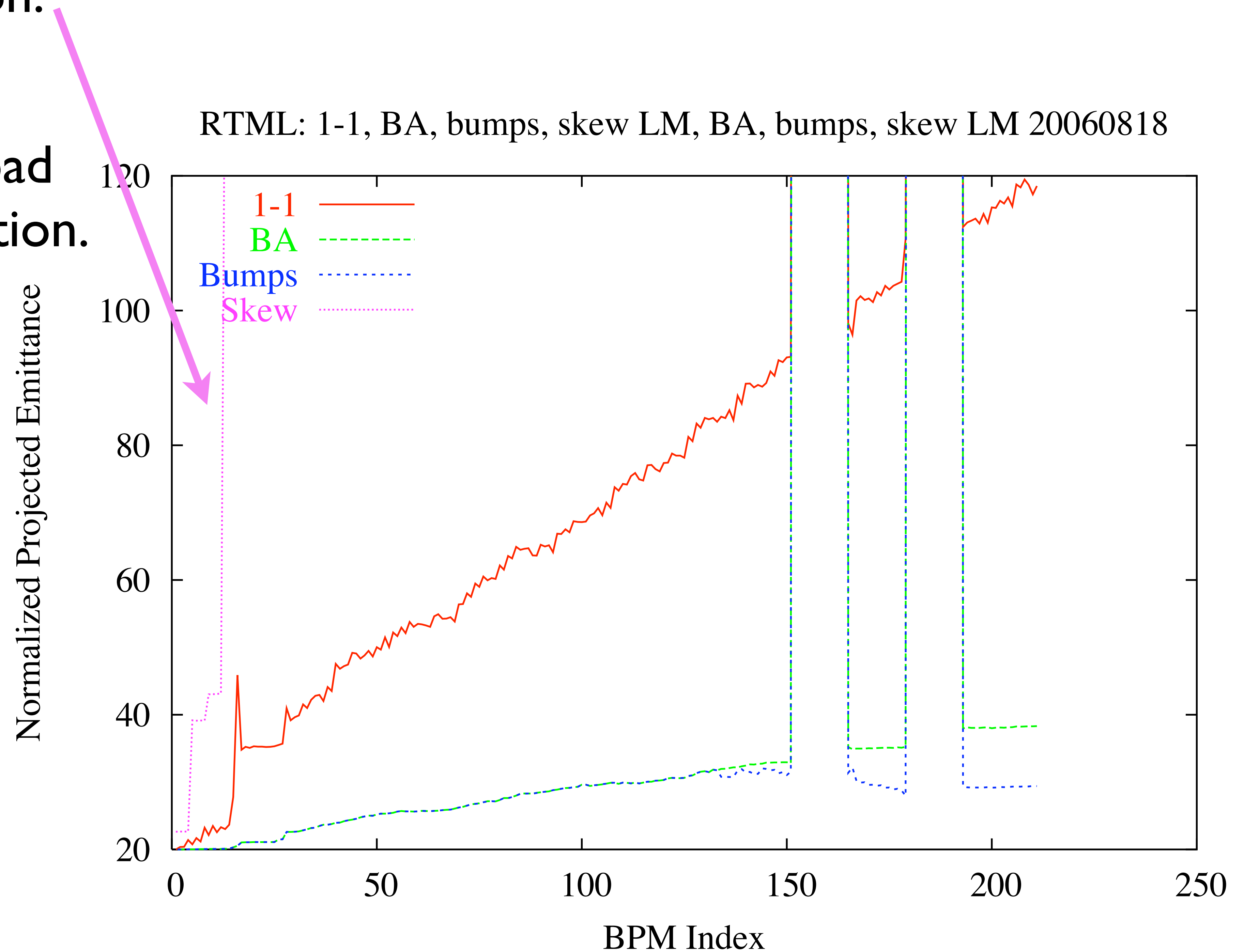
- Misalignments used (Same as Kubo-san and PT):
  - ★ **Quads:**
    - ✤ 150 μm RMS offsets in x and y
    - ✤ 0.25% strength errors
    - ✤ 300 μrad rotation errors
  - ★ **Bends:**
    - ✤ 0.5% strength errors
    - ✤ 300 μrad rotation errors
  - ★ **Solenoids**
    - ✤ 1% strength error
  - ★ **BPMs:**
    - ✤ 0 um resolution (for starters)
    - ✤ 7 μm RMS offsets x and y to nearest quad
    - ✤ No rotations or scale errors
  - ★ **Laser Wire Scanners:**
    - ✤ 0% error on measurement on each wire
    - ✤ 0 degree angle error on skewed wire
    - ✤ I can place errors on these whenever I want

Upstream correctors

- Noticed that in certain cases the horizontal dispersion increases by 30% or so. This would cause the vertical emittance to grow via coupling and appearently "confuse" the coupling correction.

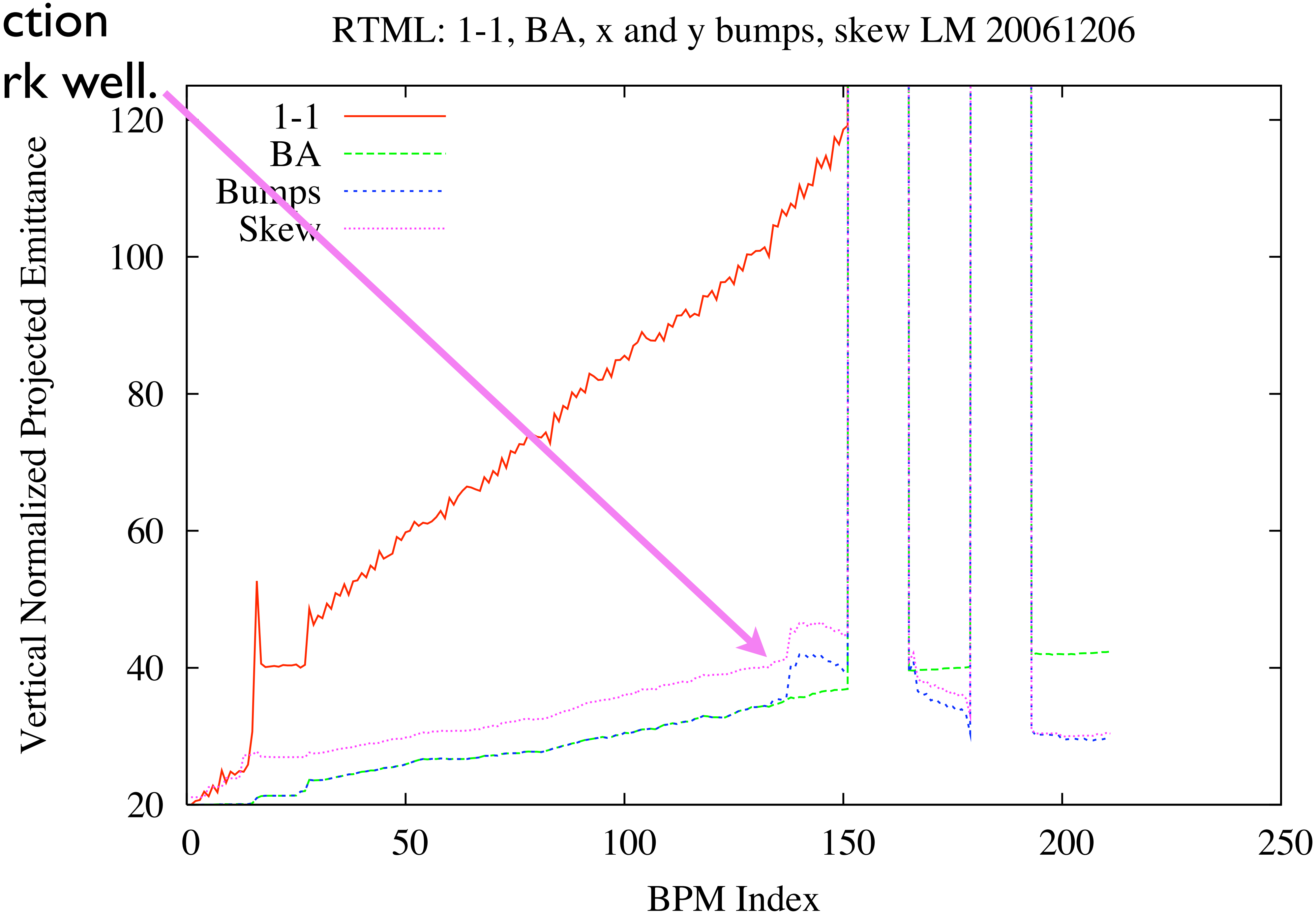
- Most seeds were only moderately bad after skew correction.

- The really bad seeds were screwing with the statistics



The fix

- Used horizontal dispersion bumps to recover horizontal dispersion.
- This seemed to eliminate the really bad seeds
- Coupling correction still doesn't work well.



Need to watch horizontal dispersion

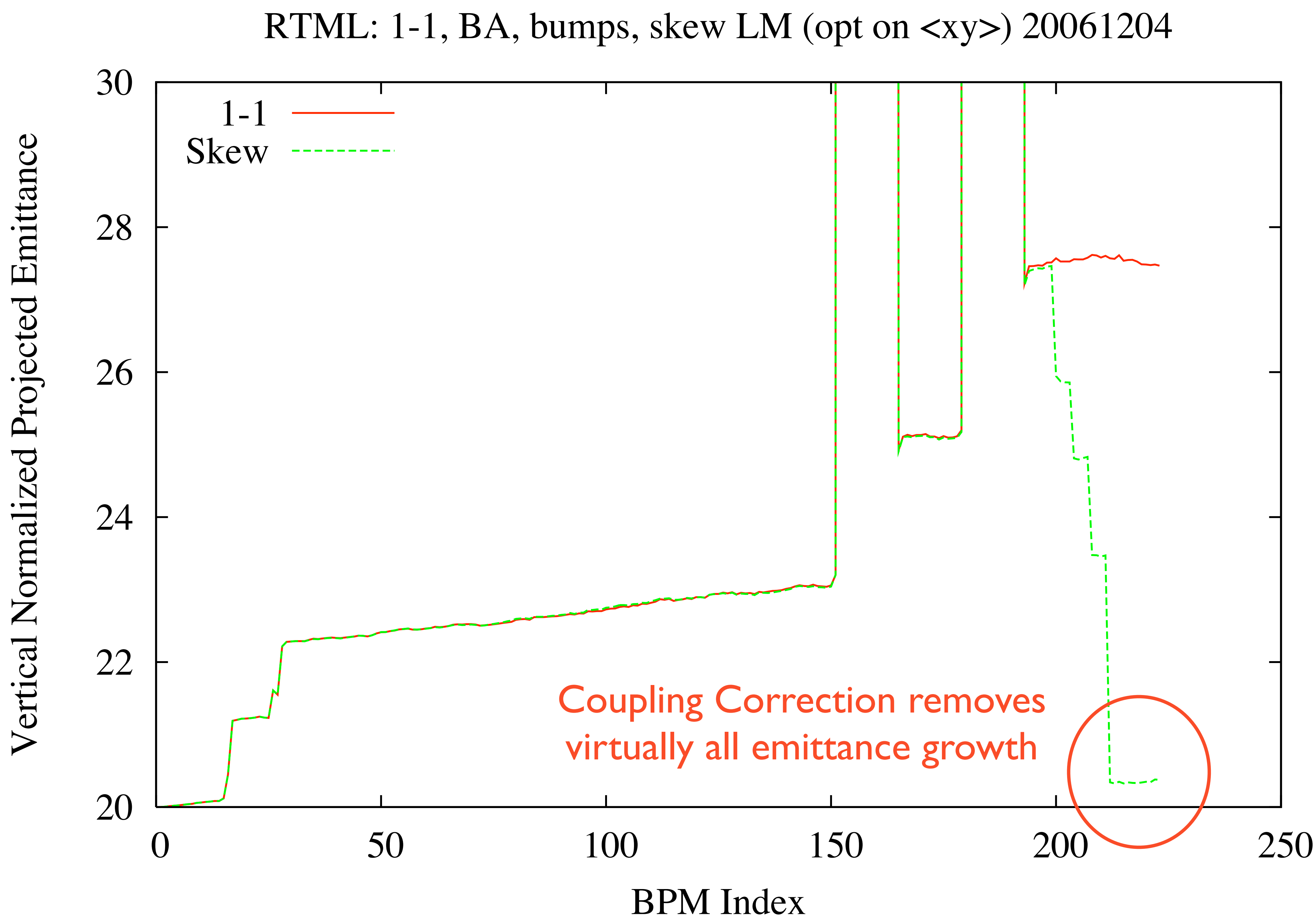
- The horizontal emittance growth effects the vertical when there's coupling
  - ★ This isn't really surprising, but the degree that it effects the vertical in certain seeds is surprising to me.
- Correcting the horizontal dispersion still doesn't allow the upstream skew correctors to properly decouple the beam and I still think my previous argument is valid
  - ★ Performing two different global corrections that effects emittance in two different ways over the same transport line
  - ★ Correcting the chromatic emittance growth in the turnaround matching sections may help but even so, I believe the best solution is still to have the skews right next to the measurement.

Tuning off of <yy>

- The current design has fewer wire scanners and cannot measure all four coupling parameters. The thought being we can tune coupling off of the <yy> measurements.
- Will this work? I tried this earlier and it didn't work well. But my algorithm has changed since then, so maybe it'll work now.
- For this test I first zeroed the energy spread to eliminate all sources of emittance other than coupling. Then I ran my coupling correction after inserting all errors.

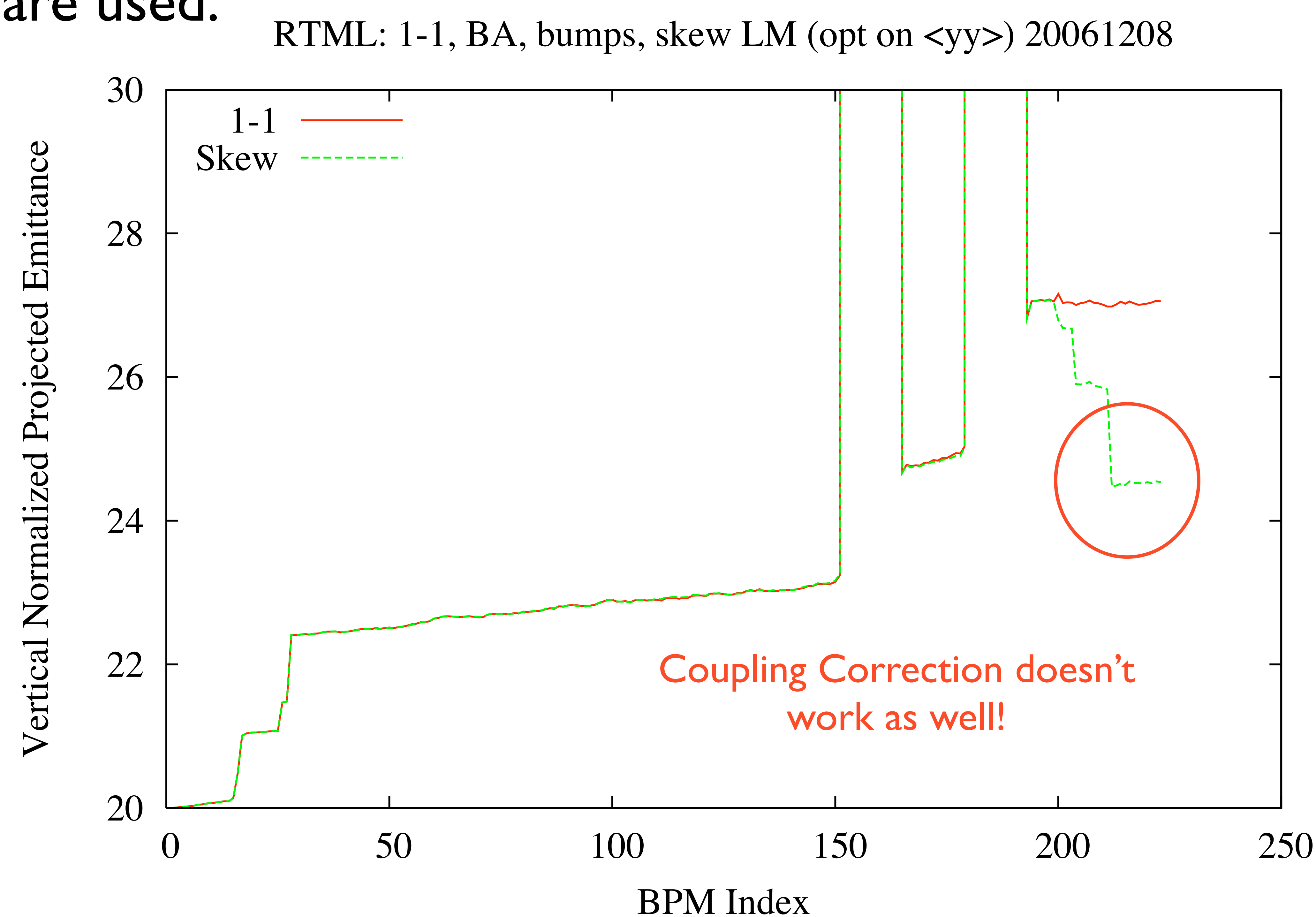
First the control

- This is optimizing off the normalized coupling terms like I always do: <xy>/sqrt(<xx><yy>)



Now try <yy>

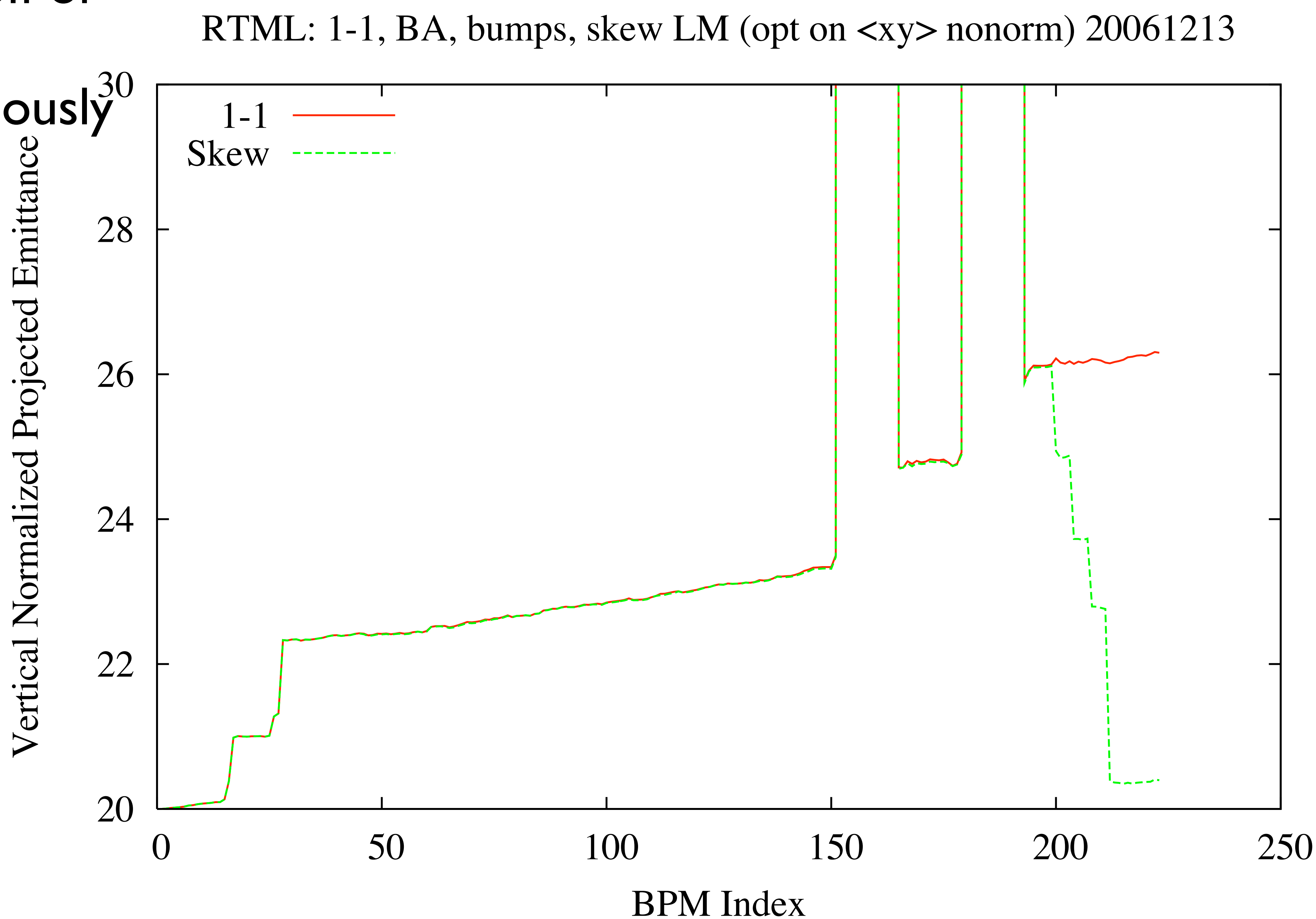
- Exact same test except optimizing off of <yy>. To keep everything else constant, the same four wire scanners are used.



Is it the normalization?

- I normally use <xy>/sqrt(<xx><yy>) which normalizes the coupling measurement and removes the sensitivity to changes in emittance. What if I use <xy>?

- If I optimize off of <xy> it still works marvelously



<xy> is better

- Using the <xy> measurement appears to work better
- This is in the absence of measurement errors and other sources of emittance.
- If those were added in, I would guess the situation would only be worse.

Conclusions

- Using upstream coupling correction still doesn’t work well for me.
- Using <xy> is far better than using <yy> even in an ideal situation.