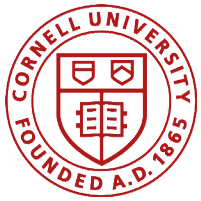
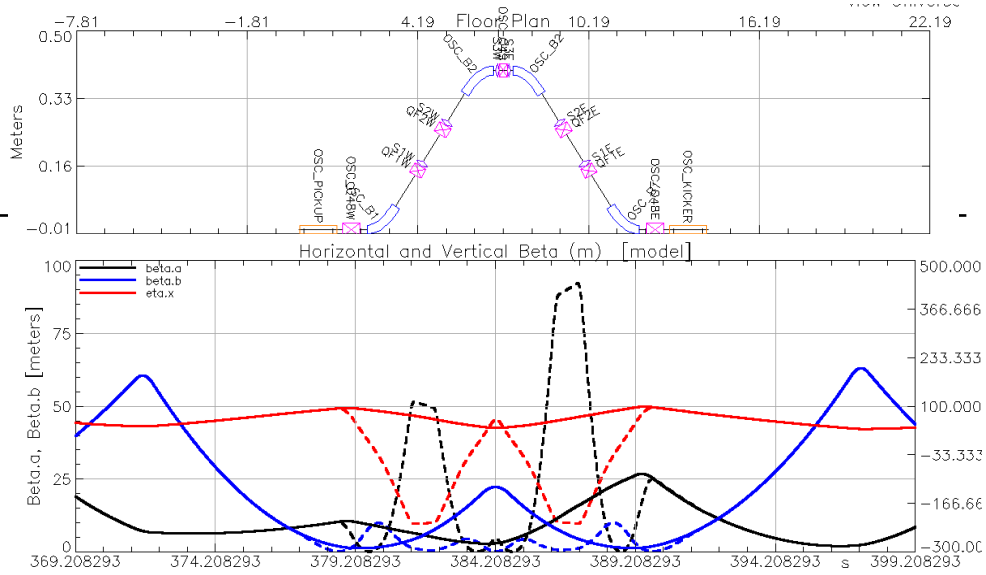


Cornell Laboratory for
Accelerator-Based Sciences
and Education (CLASSE)

40 cm TTOSC bypass matched into CESR: ring optics

Michael Ehrlichman

Introduction



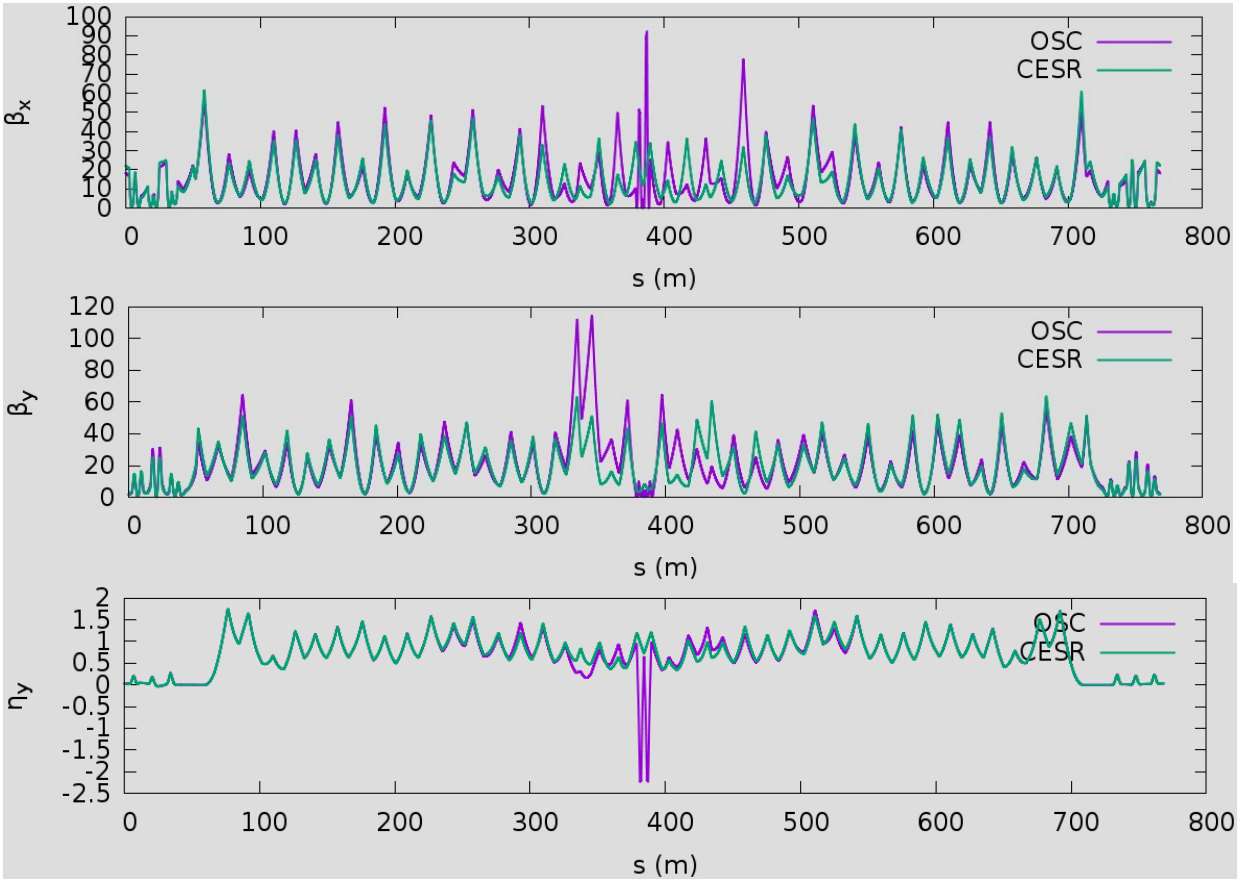
- Presented last week: bypass with good TTOSC parameters, matched to CESR with good storage ring parameters.

Bypass

- $\tilde{\tilde{J}} = 2.6\ 10^{-6}$
- $\tilde{\tilde{M}}_{56} = 9.0\ 10^{-7}$
- $M_{56} = 5.0\ 10^{-4}$

CESR

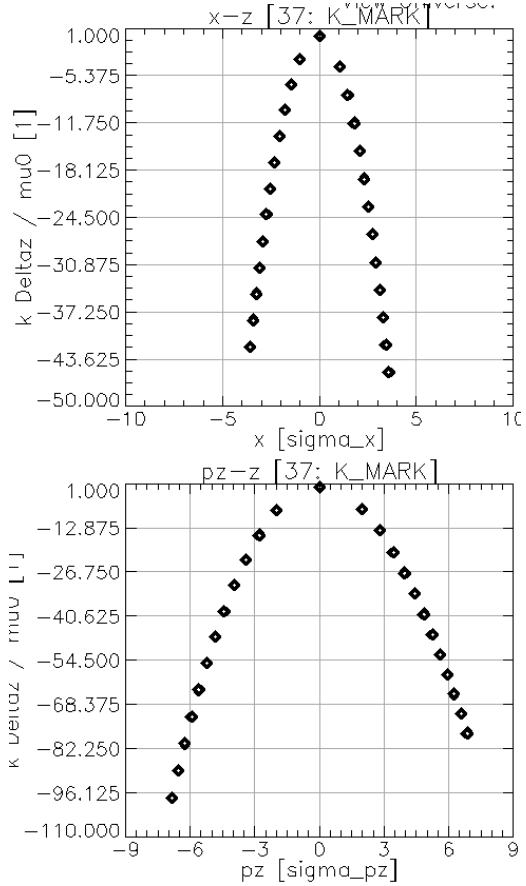
- Matched using quads North of Q30E and Q30W
  - Wigglers off
  - KYMA Std Und
- 22.5 pm rad. int. emittance
- 2.9 10^{-4} energy spread



Challenge 1: Nonlinear TOF

- Linear TOF dependence on J & pz well corrected.
- Nonlinear dependence very strong
- Optimize 6 sextupoles independently, objective is σz at kicker.

No OSC sextupole moments:



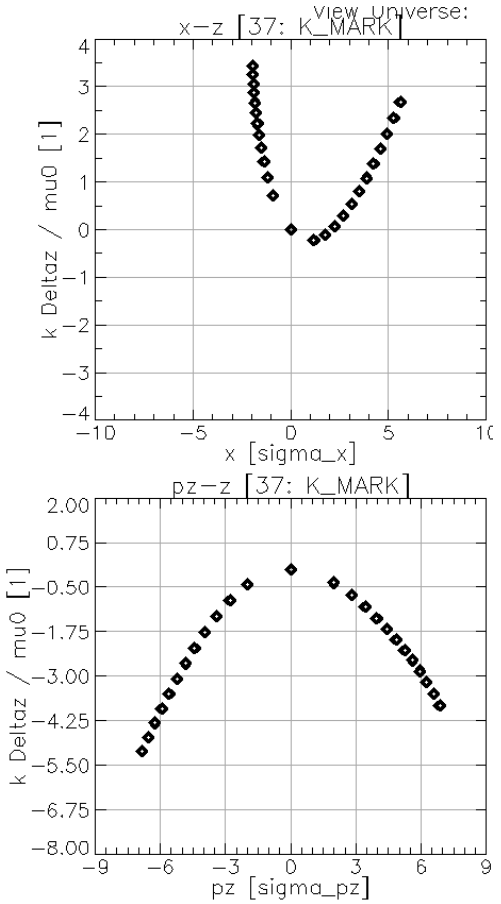
Recall dependence of path length on bend angle:

$$\Delta L = \int \left(\theta^2(s) / 2 \right) ds$$

Optimized k_2, capped at 200 m^{-3}*

```
S1W[K2]=  5.1801E+01
S2W[K2]= -2.0000E+02
S3W[K2]=  2.0000E+02
S1E[K2]=  4.3407E+01
S2E[K2]= -2.0000E+02
S3E[K2]=  2.0000E+02
```

*Yes, absurdly huge. But let's carry on and see what we learn.



Challenge 1 con't: Chromaticity

- Natural Chromaticity is: $\xi x = 214.8$
  $\xi y = -11.8$

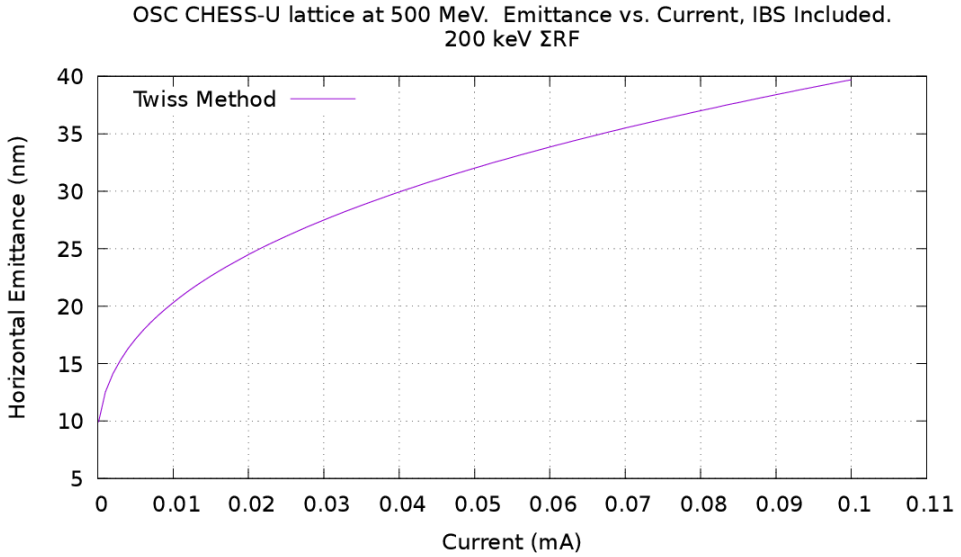
- Correcting to +1, +1 requires strong sextupole scheme.
  - DA seems to be absurdly small.
  - Currently optimizing this in tao.

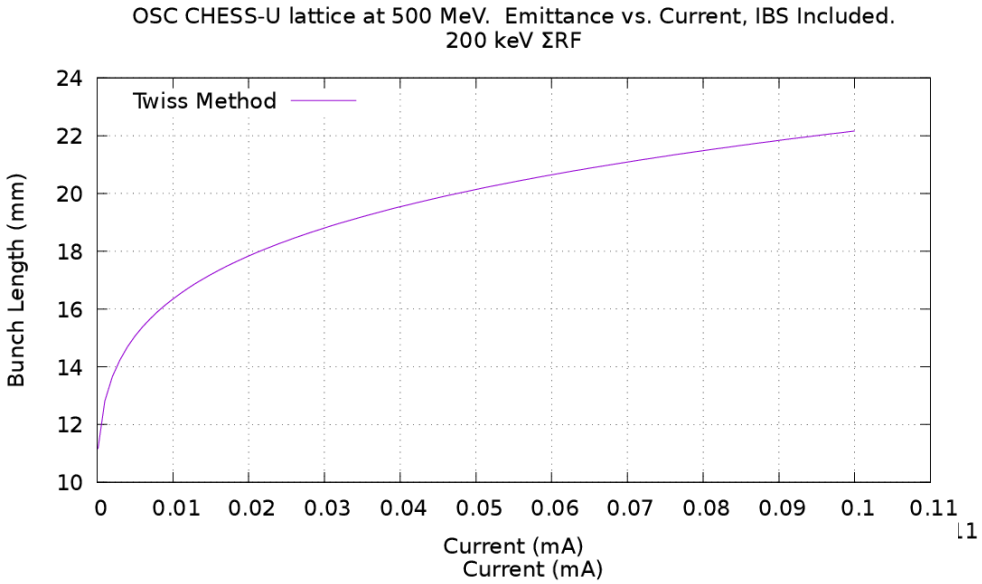
Challenge 2: Radiation Integrals

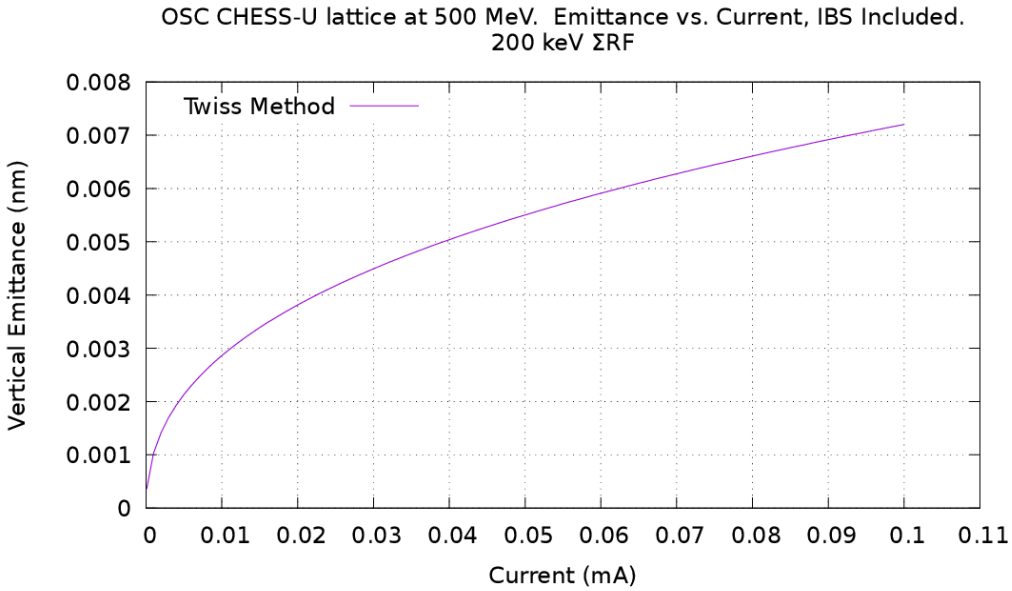
- For matched CESR, excluding OSC bypass contribution
  - ε_x = 22.5 pm
  - Energy Loss = 2.2 keV/turn
- Including OSC contribution
  - ε_x = 9.3 nm
  - Energy Loss = 3.4 keV/turn
- The four bypass bends radiate as much energy as half of CESR.
  - Bigger problem at 1 GeV
    - 18 nm @ 0 mA, 36 nm @ 0.1 mA (IBS)

IBS w/ low RF voltage

- 200 keV RF
  - Gives 1 cm bunch @ 0 mA
- ~ 4x εx blowup to 0.1 mA
- Ideal, uncoupled lattice
- Vertical blowup is direct momentum transfer from horizontal and longitudinal







Conclusion

- CESR with good optics & radiation integrals matched to bypass that has excellent linear TOF properties.
- TOF nonlinearity due to bend angle requires huge k_2 moments to compensate.
  - Not sure if there is a way around this.
  - Might push us to 30 cm or 20 cm bypass
- Ring chromaticity large, requires strong sextupole scheme. Sufficient DA might be tough to achieve.
- 500 MeV IBS emittance with 1 cm still too large.