



PS Injection Bump Tune Swing Simulations

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Injection Bump: Motivation

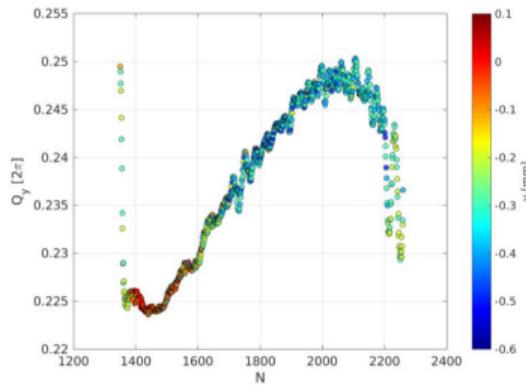
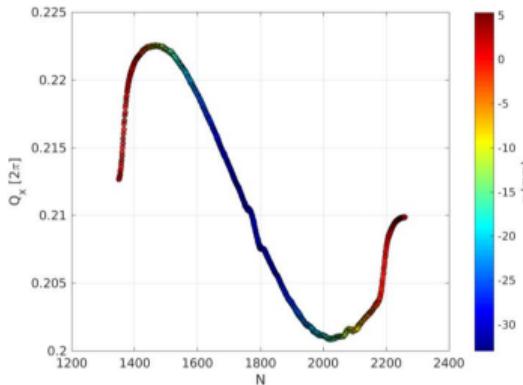
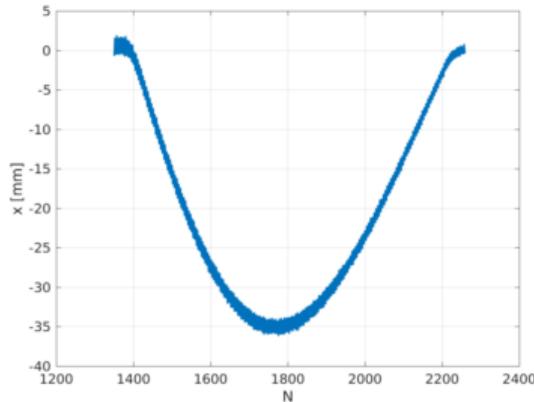


Figure: Measured closed orbit horizontal bump (left), horizontal tune (middle), and vertical tune (right), in 2018. **Measurements show tune swing caused by sextupolar components in BSW magnets.** Implement in MAD-X/PTC and thus create tables for PTC in PyORBIT.

PS: Measurements for the Linear Optics Model, P. Zisopoulos et. al., 2nd Space Charge Collaboration Meeting, 12.03.18.

Injection Bump Closure: Implementation

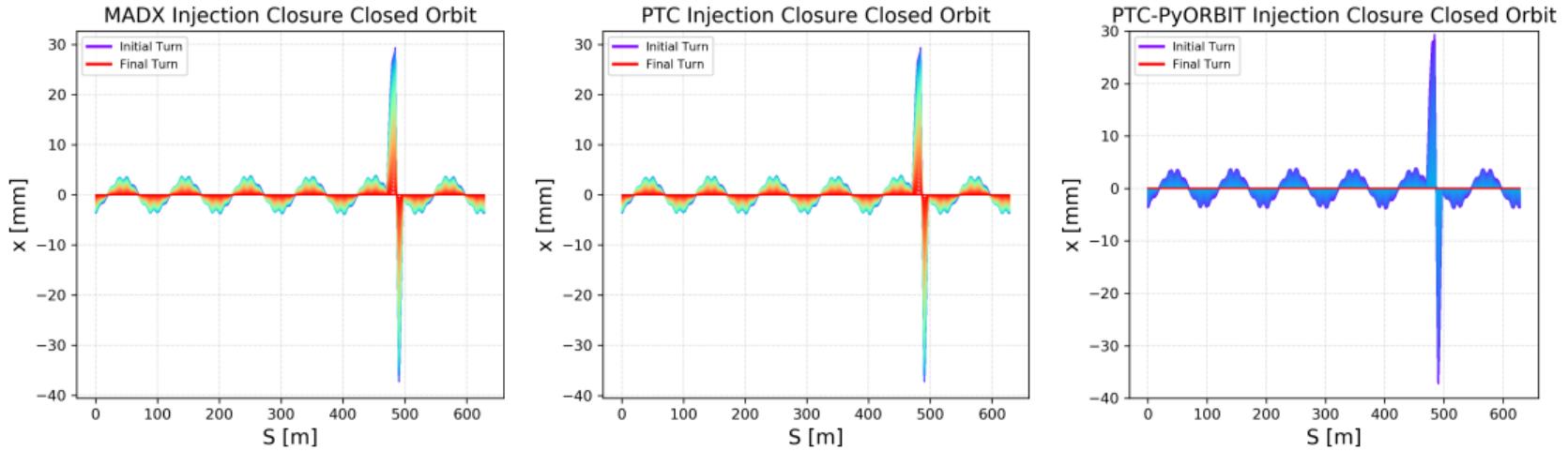


Figure: Closed orbit for injection bump closure comparing MAD-X (left), PTC (middle), and PTC-PyORBIT (right).

Injection Bump Closure: Implementation

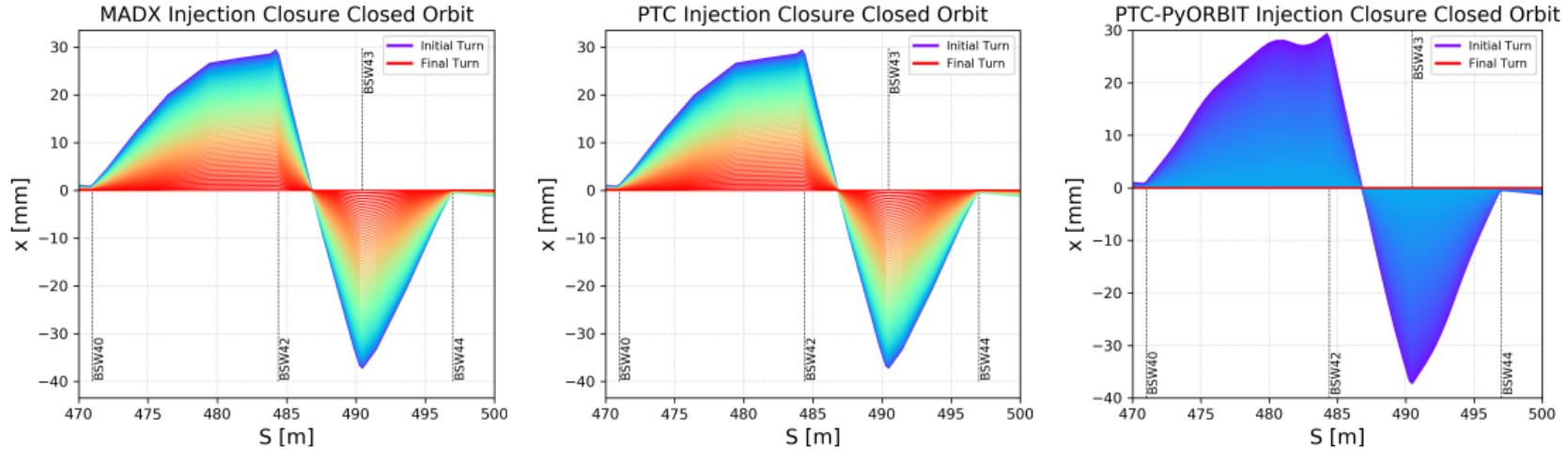


Figure: Closed orbit for injection bump closure comparing MAD-X (left), PTC (middle), and PTC-PyORBIT (right).

Injection Bump Closure: Implementation

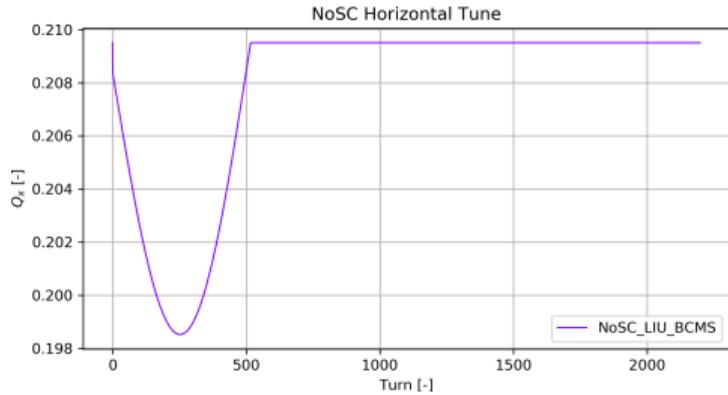
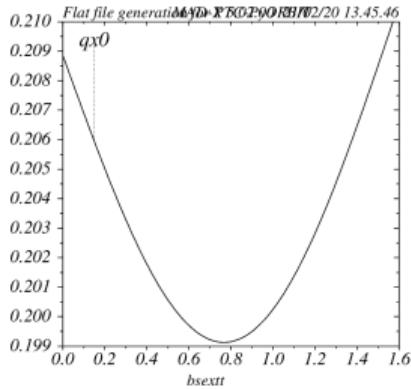
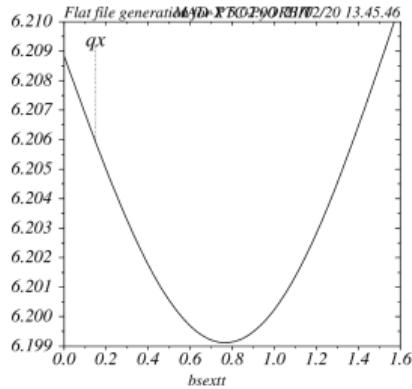


Figure: Horizontal tune Q_x for injection bump closure comparing MAD-X (left), PTC (middle), and PTC-PyORBIT (right).

Injection Bump Closure: Implementation

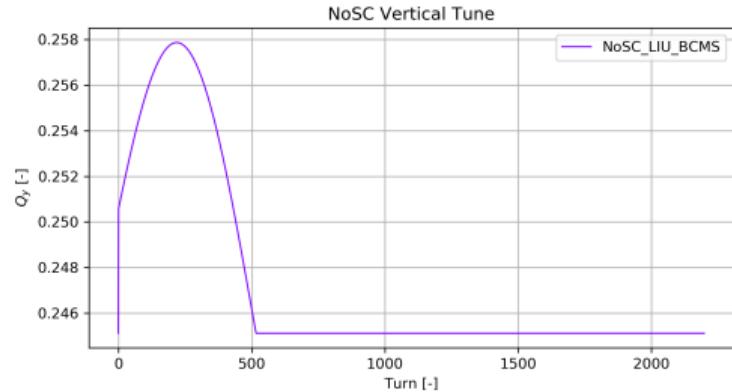
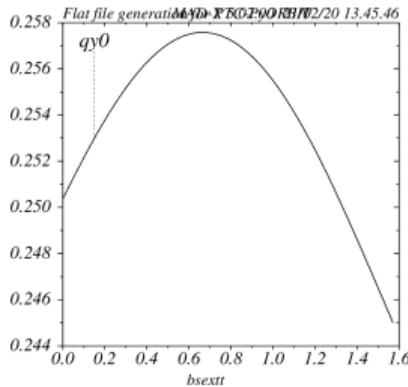
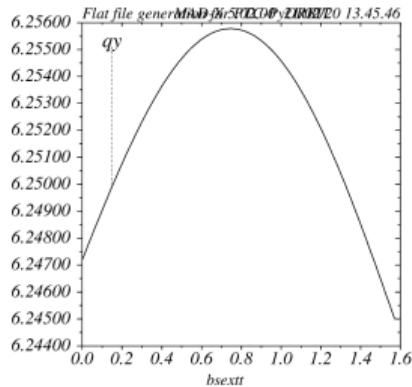


Figure: Vertical tune Q_y for injection bump closure comparing MAD-X (left), PTC (middle), and PTC-PyORBIT (right).

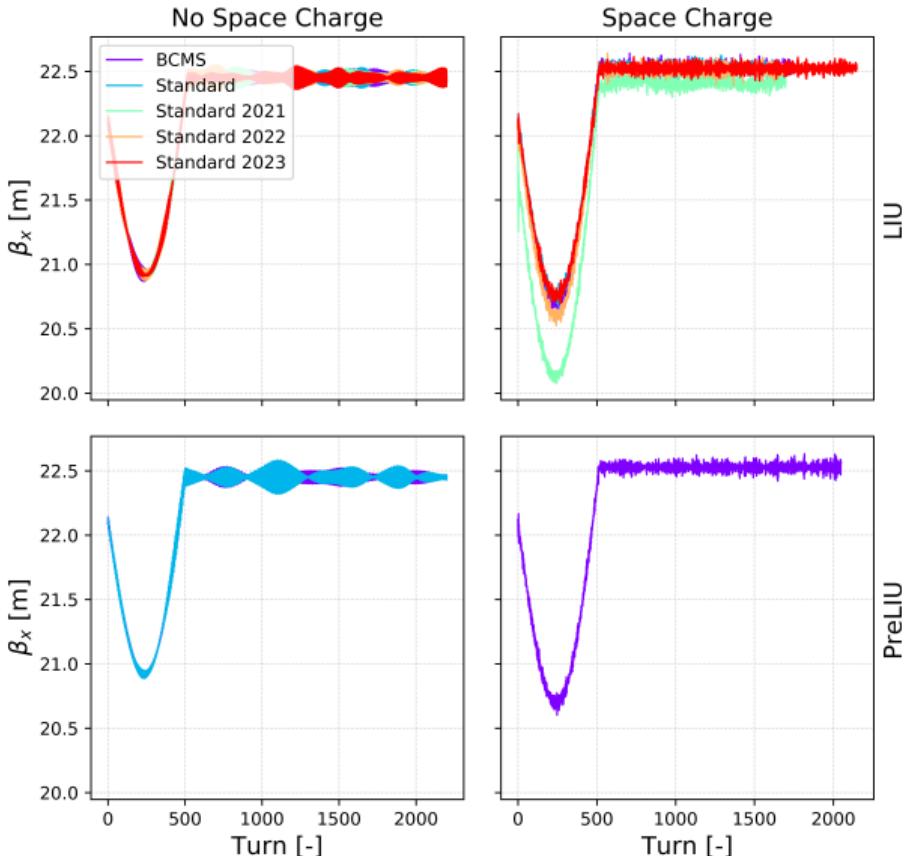


Figure: Horizontal beta function β_x as calculated from the bunch in PyORBIT.

Left column using no space charge, right column using slice-by-slice PIC space charge. Top row for LIU beams, bottom row for PreLIU beams.

The effect of the injection bump is evident from turn 0 - 500.

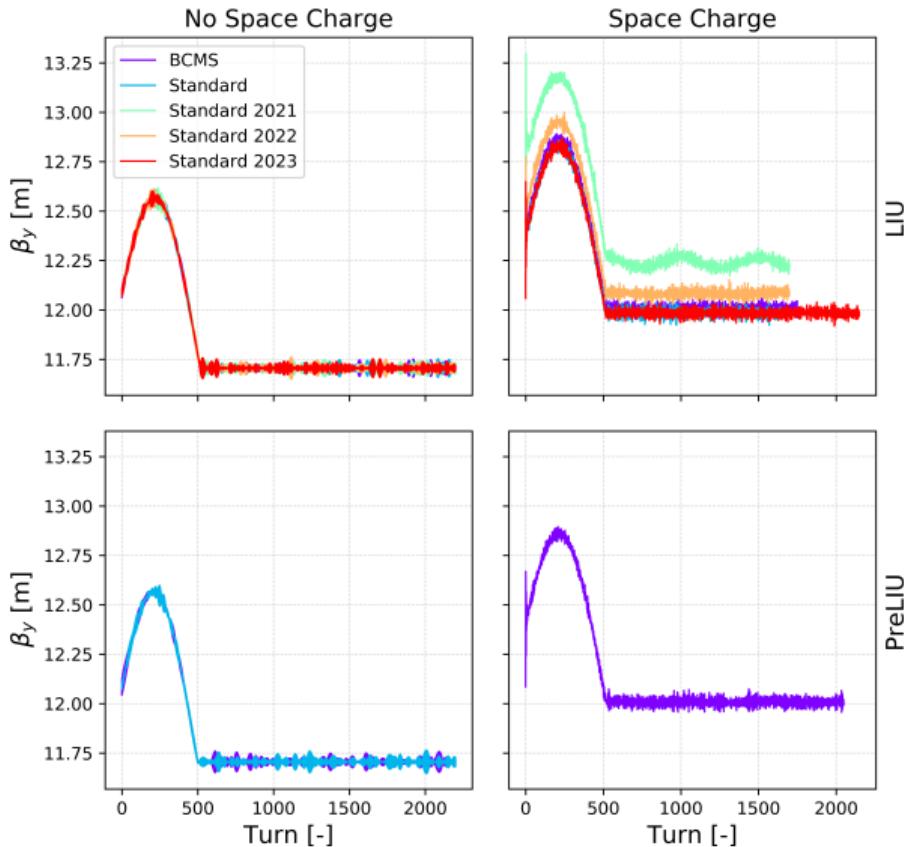


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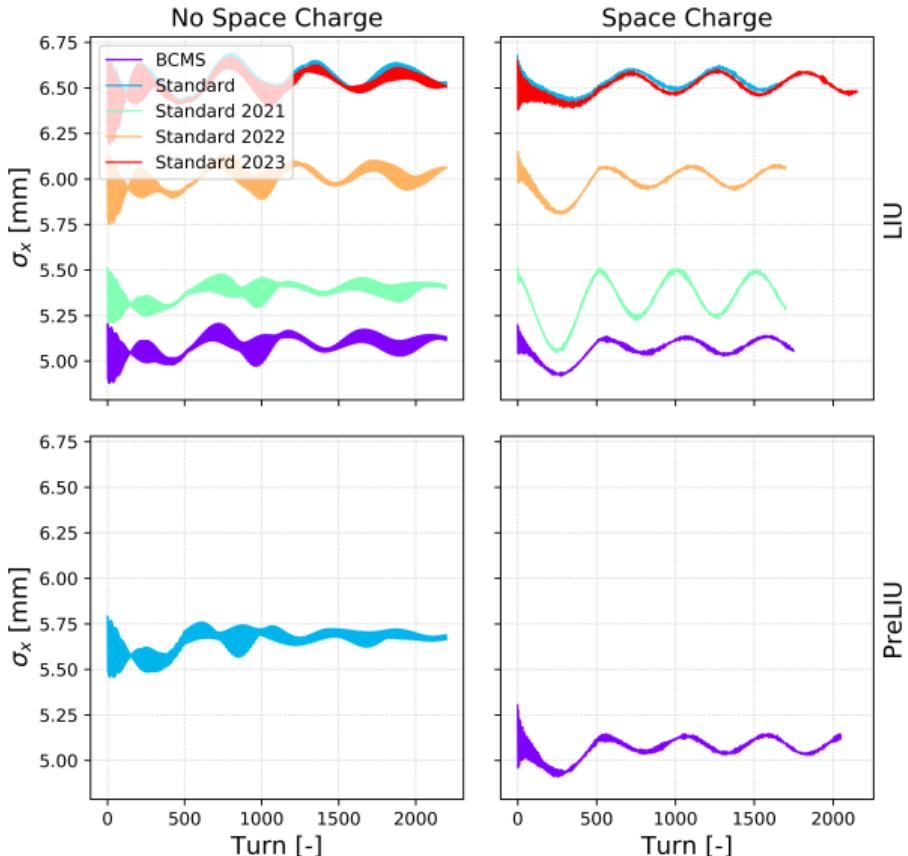


Figure: Horizontal Beam size σ_x as calculated from the bunch in PyORBIT.

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The effect of the injection bump is evident from turn 0 - 500.

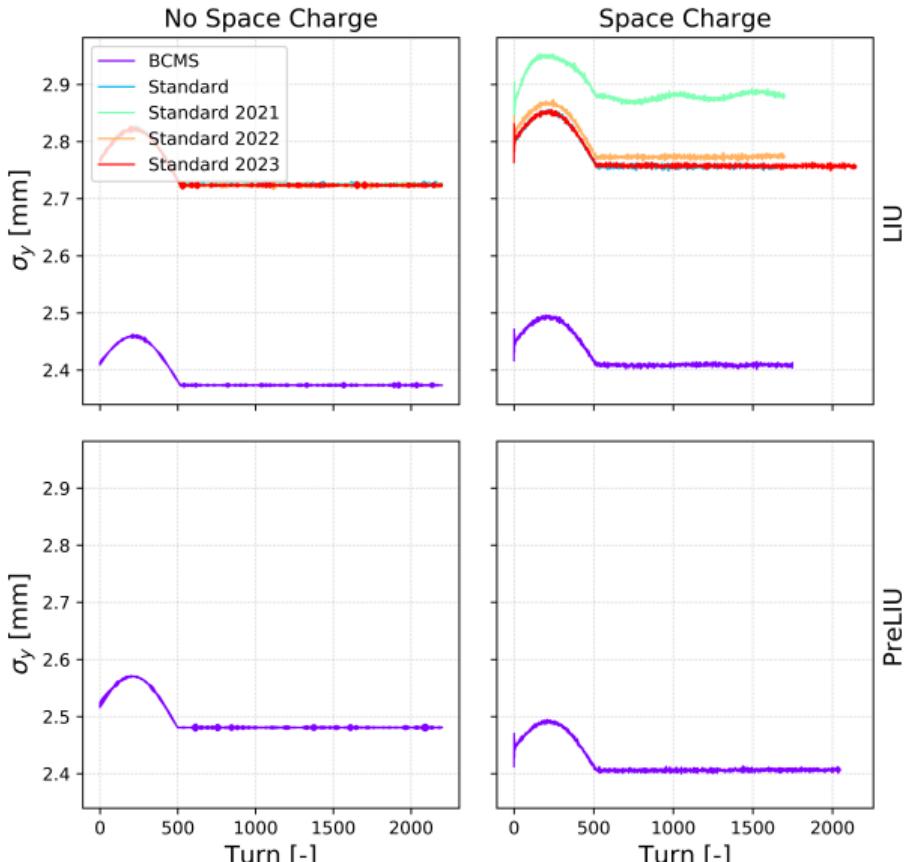


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Left column using no space charge, right column using slice-by-slice PIC space charge. Top row for LIU beams, bottom row for PreLIU beams.

The effect of the injection bump is evident from turn 0 - 500. Only LIU Standard 2021 shows beam size growth.

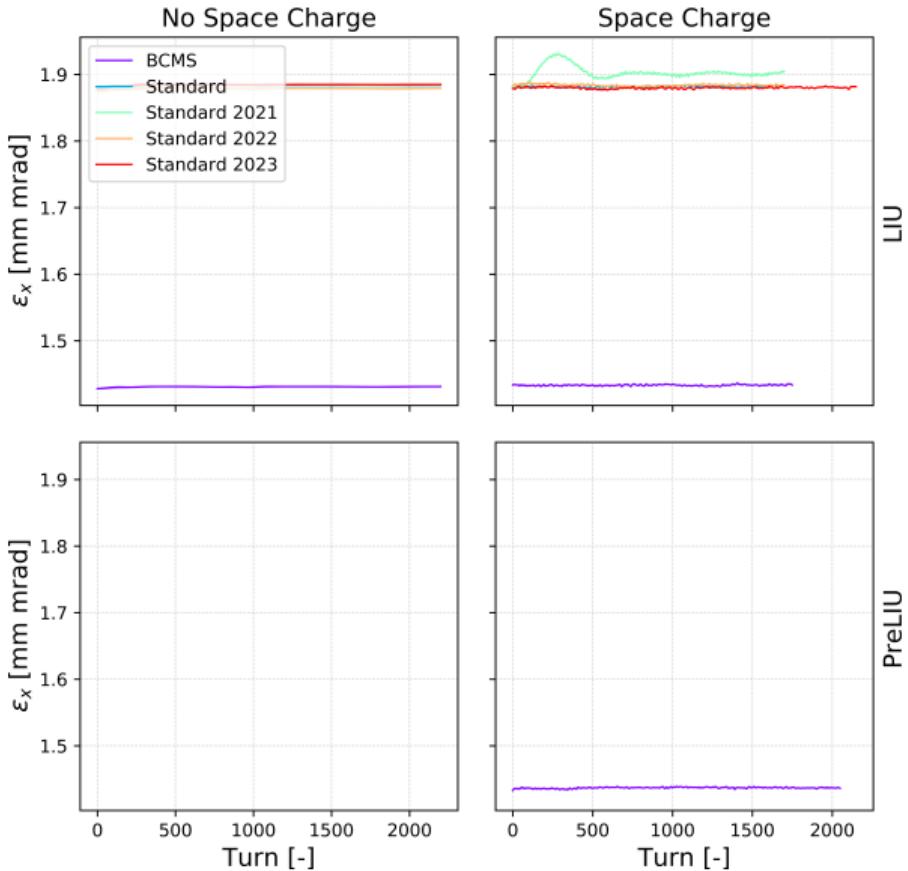


Figure: Horizontal normalised RMS emittance ϵ_x as calculated from the bunch in PyORBIT.

Left column using no space charge, right column using slice-by-slice PIC space charge. Top row for LIU beams, bottom row for PreLIU beams.

The injection bump tune swing causes horizontal emittance growth in LIU Standard 2021 only.

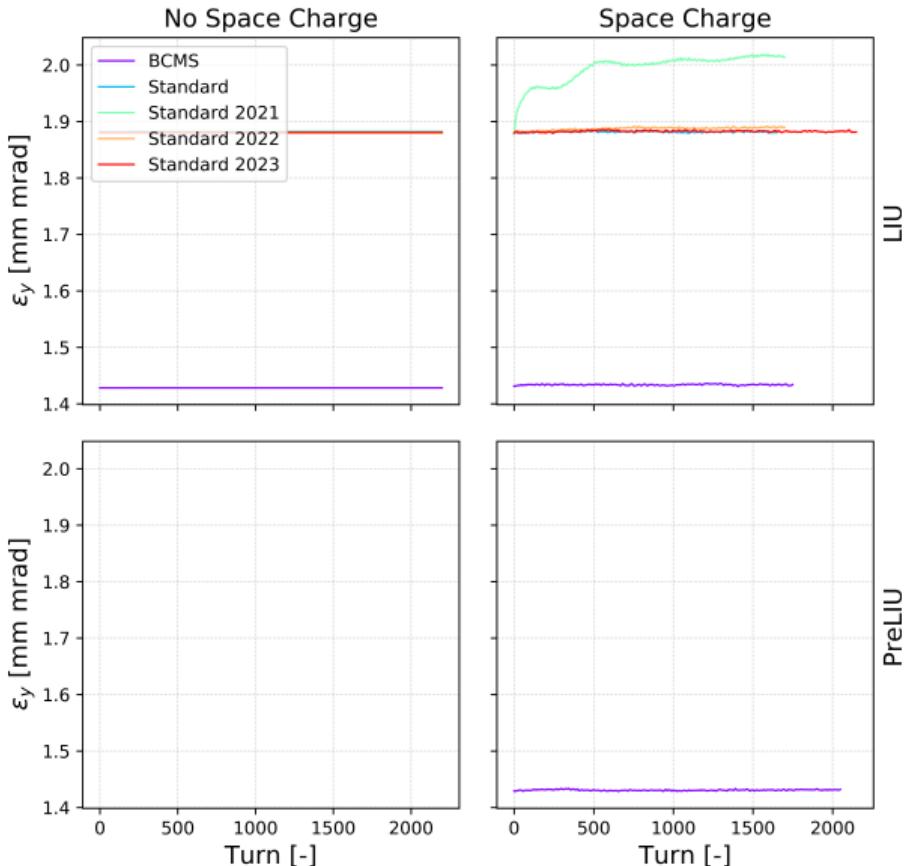


Figure: Vertical normalised RMS emittance ϵ_y as calculated from the bunch in PyORBIT.

Left column using no space charge, right column using slice-by-slice PIC space charge. Top row for LIU beams, bottom row for PreLIU beams.

The injection bump tune swing causes vertical emittance growth in LIU Standard 2021 only.

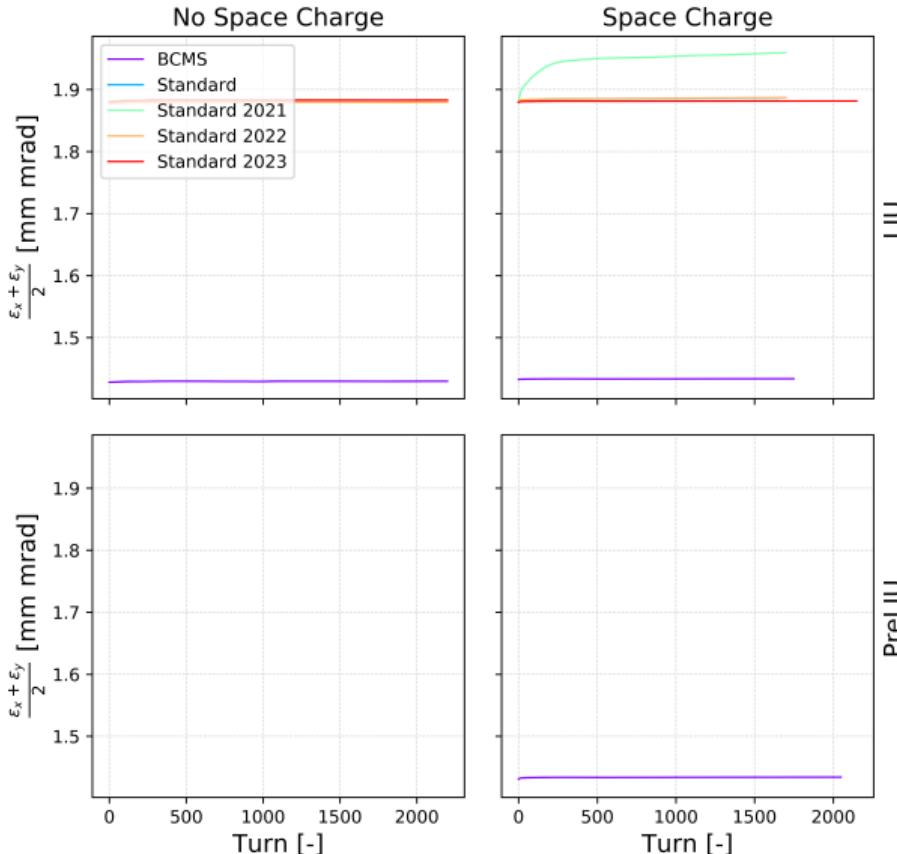


Figure: Average normalised RMS emittance $\frac{\epsilon_y + \epsilon_x}{2}$ as calculated from the bunch in PyORBIT.

Left column using no space charge, right column using slice-by-slice PIC space charge. Top row for LIU beams, bottom row for PreLIU beams.

The injection bump tune swing causes average emittance growth in LIU Standard 2021 only.

Conclusion

Acknowledgements

Conclusion

What have we learnt?

- ▶ Injection bump tune swing modelled in MAD-X, PTC, PTC-PyORBIT by applying Sextupole field as an error on the BSW bumpers.
- ▶ The effect of the bump on the beam is evident, yet in all previously stable cases, the beam remains stable.
- ▶ Only the 2021 LIU Standard beam parameters show emittance growth - this is present without the bump also.
- ▶ We conclude that the injection bump and resulting tune swing has negligible effect on the beam for the simulated cases.

Conclusion

Acknowledgements

Acknowledgements

“If I have seen further it is by standing on the shoulders of Giants” - Newton

- ▶ E. Senes: Original MAD-X tune swing work.



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