Slow Extraction with Octupoles at CERN PS to improve Extraction Efficiency

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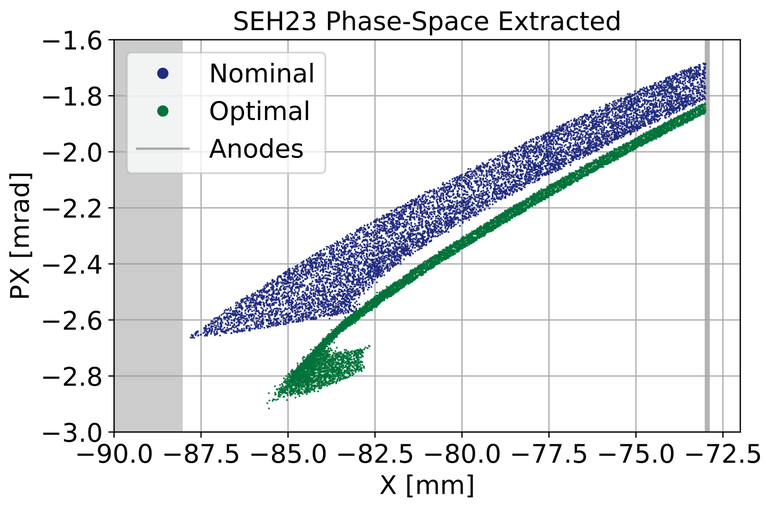
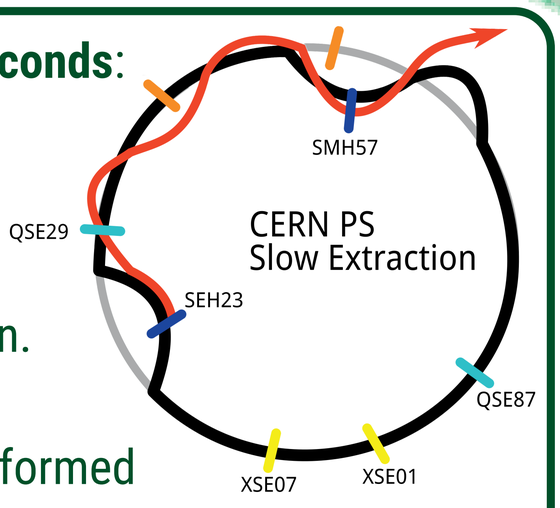
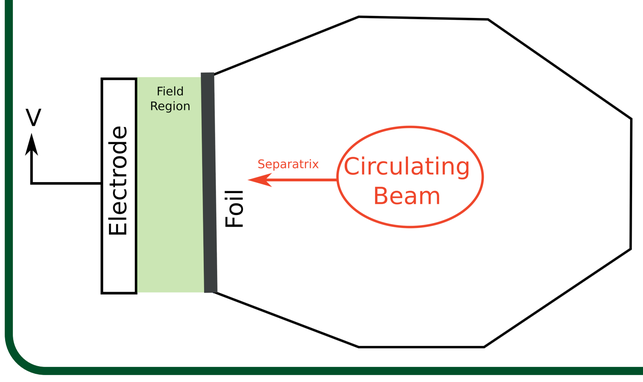
Octupoles are used during extraction to increase the **beam density** and reduce the particles hitting **septa apertures**.



- Slow extraction provides **continuous beam over seconds**: Used in PS East Area for electronic irradiation tests.
- Applying technique from SLAWG to reduce septum losses during extraction by **'folding' separatrices.**
- Increasing number of particles in **SEH23 field**-region.

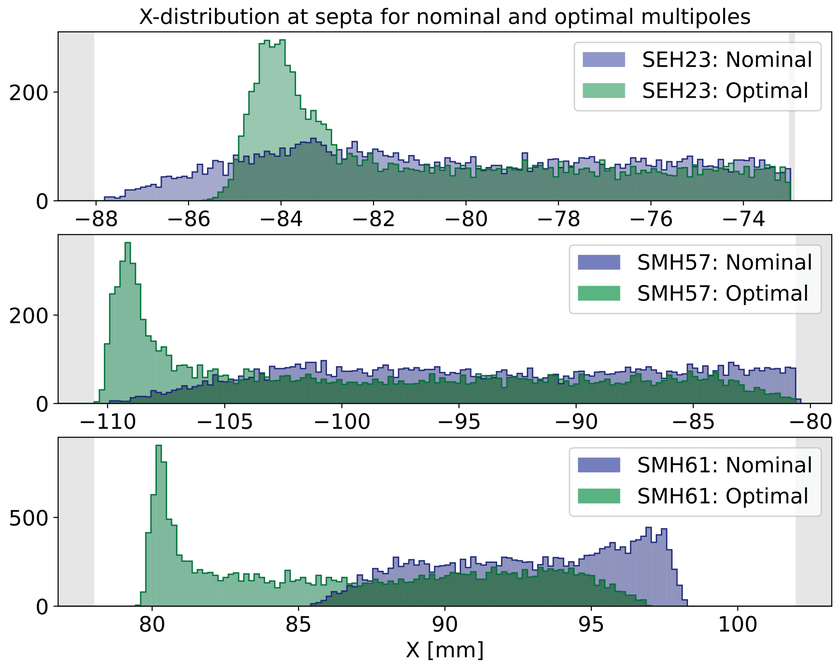




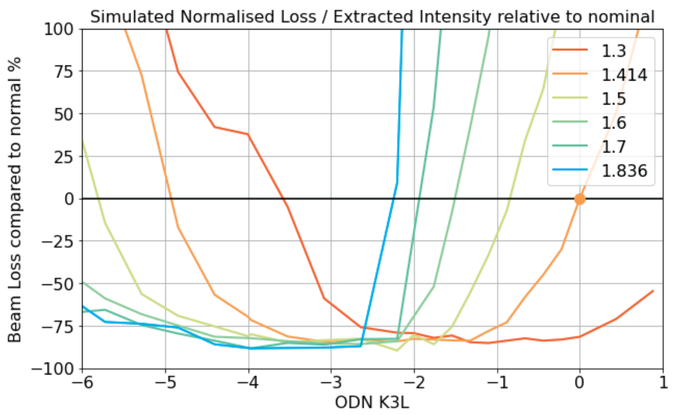
- Slow extraction performed by putting beam near Qx=19/3 resonance excited with XSE sextupoles.
- Controlling extraction rate with COSE.

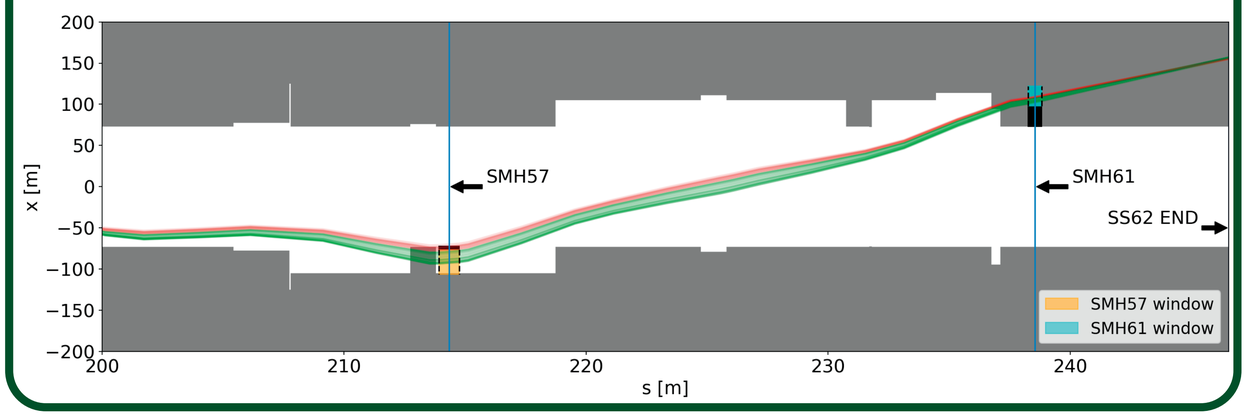
Prelim Simulations

- **MADX-PTC** for 10,000 particles, 500 turns on resonance.
- Plotted phase-space at SEH23, counted losses at electrodes. Applied septum kick, repeated for SMH51/61.



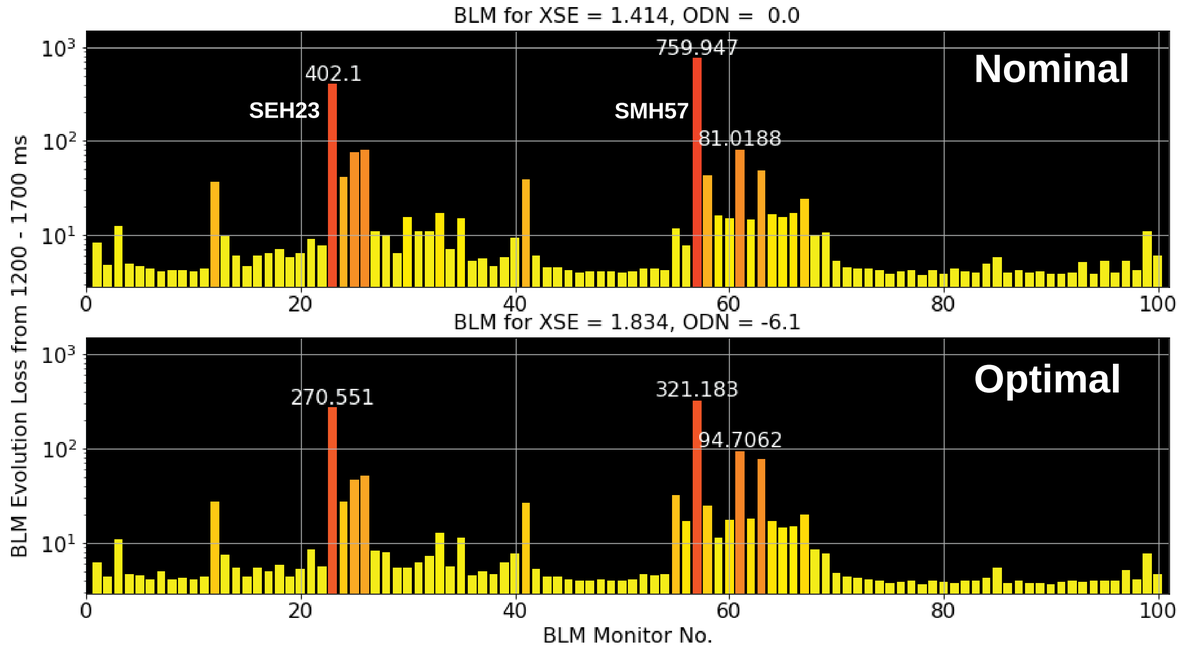
- Changed XSE and ODN variables and repeated.
- Tracked extracted beam from to F61 line through strong MU61 fringes.



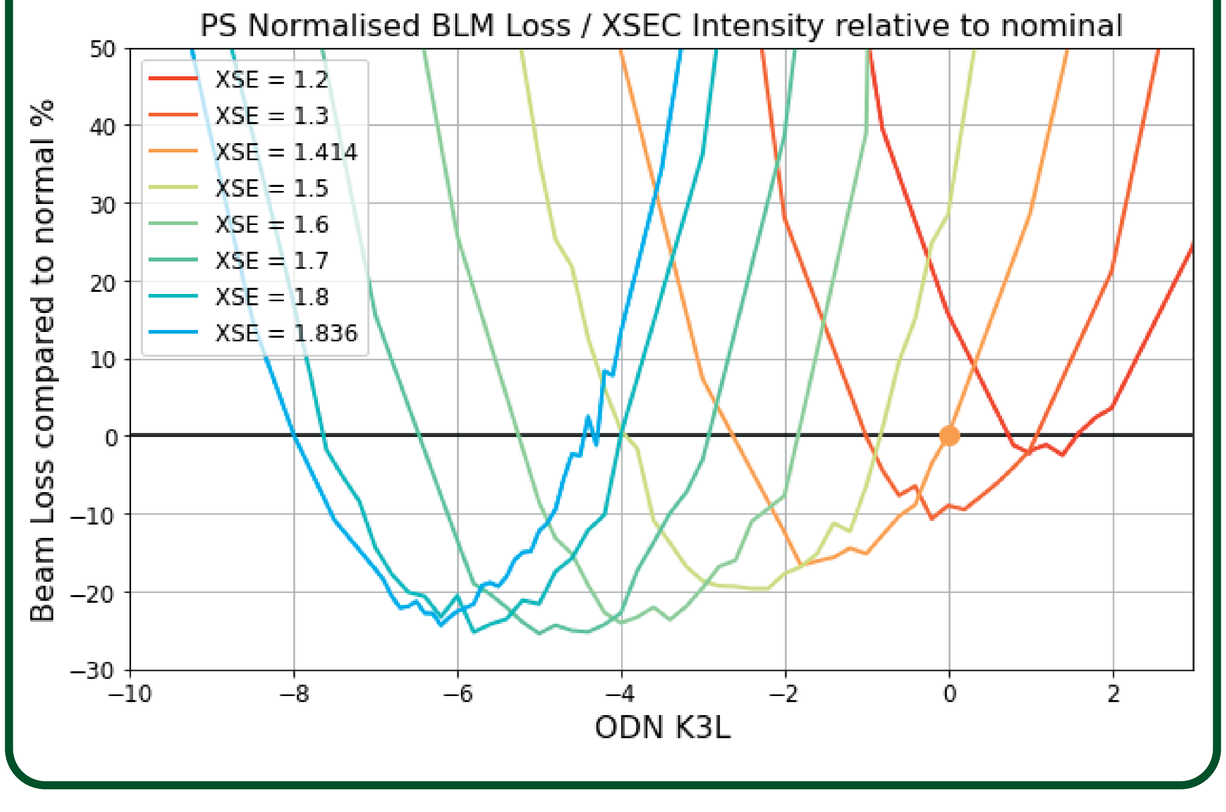


Measurements

- **24 GeV proton beam** extracted to East Area via F61 line.
- Obtained Beam Loss Monitors (BLMs) during extraction.



- Measured **relative extracted intensity** via Secondary Emission Chambers (XSEC) after extraction.
- Multipoles causing **tune shift**, meaning incomparable rates of extraction. Normalised beam loss by XSEC.
- Selected two points of comparison, operational **nominal** setting beam (XSE k2 = **1.414**, ODN k3L = **0.0**) and an **optimal** setting (XSE k2 = **1.836**, ODN k3L = **-6.0**).
- Found an **improved relative extraction efficiency of 25%.**



Conclusion

- Demonstrated an **improved beam loss per proton** of 25%.
- For constant XSE strength, octupoles can reduce losses.
- Simulated beam density changes with **octupole folding**.
- Tracked simulated beam through PS magnets to F61 lines.

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