Status of Electron Lens Efforts

Procurement of McMillan gun parts

We are procuring parts to build an electron gun with a McMillan beam profile. We are sourcing from three different companies:

Description	Company	Price	Status
Parts for ONE TEL01 style electron gun.	Meyer Tool and Manufacturing	$ 88250	Machining in progress. Frequent questions/updates from supplier. Promise date tomorrow!
TWO/THREE cathode/heater assemblies with bell jar measurements.	Heatwave Lab -> 3M Technical Ceramics	$ 42562 -> $21,825?	Heatwave hiked price by 40%. 3M quote almost a factor of 2 cheaper for 3 cathodes! RFP from Fermilab sent to 3M. Waiting for reply.
Ceramic insulator rings.	Morgan Advanced Materials	$ 7398.60	Received!
		$ 138210.60 -> $ 117473.60	

Next steps for the McMillan gun

- We have a few unused vacuum chambers at UChicago which we can use to store the cathodes in UHV or dry nitrogen.
- Assemble a nitrogen backfill system for the test stand for easy swapping of guns. Reduce bake time.
- Start assembly of new gun as soon as parts delivered from Meyer Tools.

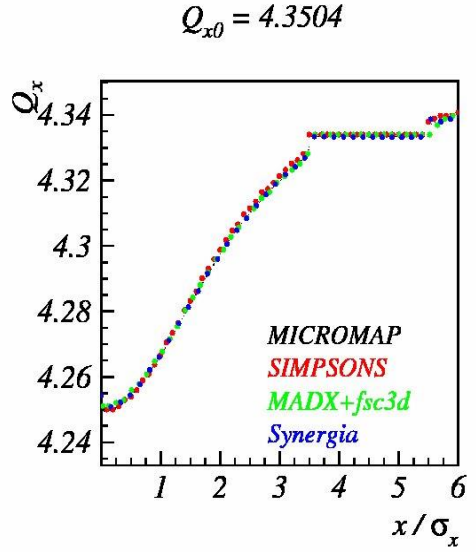
Space-charge simulations of bare IOTA

I have been simulating electron cooling with space-charge for a while, but only in PyORBIT. Is the 2.5D PIC model in PyORBIT accurate?

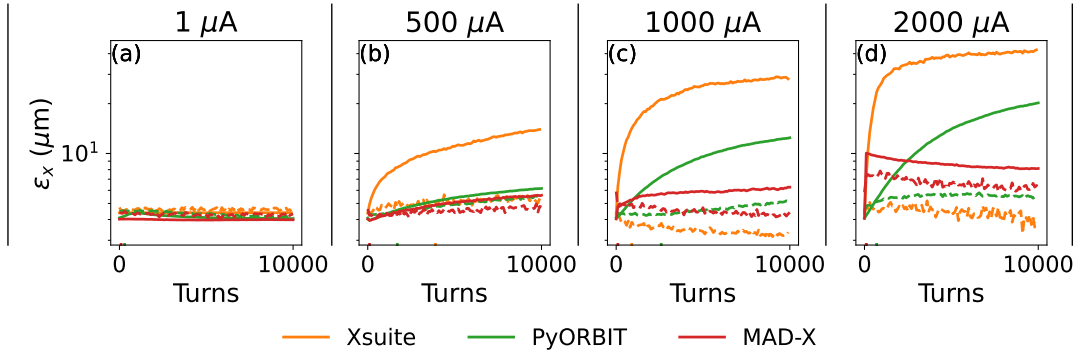
- Major benchmarking effort used the SIS18 synchrotron. Comparable beam parameters with IOTA but with 11-fold symmetry, 10-100 times smaller synchrotron tune.
- Ben Simons, Mike Wallbank, John Wieland and I am comparing space-charge simulations in MAD-X, Xsuite, PyORBIT and IMPACT-X.

Objective: Predict dynamics in bare NIO lattice comparing various codes and models:

1. Identify resonances excited and corresponding emittance growth as function of intensity. – Ongoing.
2. Propose experiment.



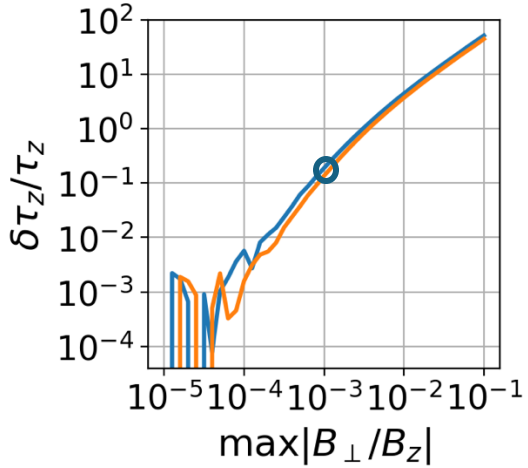
Resonance trapping
http://web-docs.gsi.de/~giuliano/research_activity/trapping_benchmarking/main.html



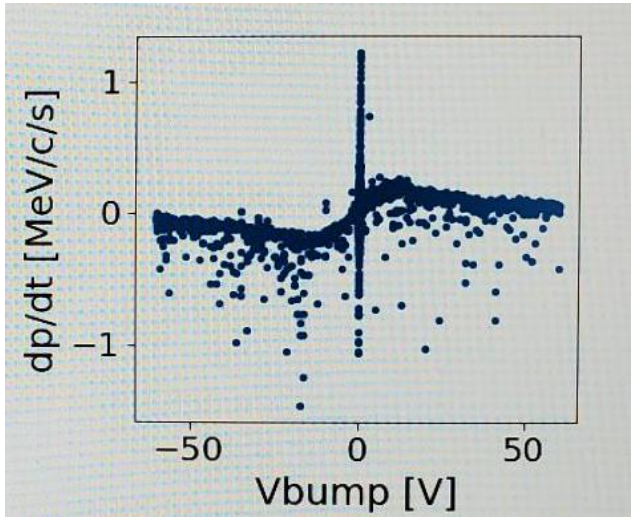
Horizontal emittance growth
N. Banerjee et al., in Proc. IPAC'24, Nashville, TN, May 2024, pp. 3179-3182. doi:10.18429/JACoW-IPAC2024-THPC68

Electron cooler design

- Basic parameters in place for a while. Major part remaining is the magnetic system for the electron beam and a thorough calculation of tolerances.
- I visited CERN in May to participate in longitudinal cooling force measurements at LEIR with Mg7+ ions. Objectives:
  - Experimental benchmarking of cooling dynamics as predicted by PyORBIT and XSuite. – Analysis/report in progress.
  - Gain practical insights into commissioning a magnetized electron cooler. – Major insights include:
    - Minimum required diagnostics: At least 4 BPMs in cooler and longitudinal Schottky monitor in ring. Combining signals from multiple BPMs is challenging in practice.
    - Compensation solenoids located as close to cooler as possible. – We use distributed transverse decoupling in the lattice design, but I haven't thoroughly checked magnet current constraints.
    - Commissioning procedure. – Heavily depends on Schottky monitor.
- Will use the shutdown period to finish draft of electron cooling report.



Degradation of cooling time-scale vs maximum field error



Measured centroid momentum dragging rate as function of cooler voltage bump