



Rapid Tuning of Synchrotron Surrogate Models at the Recycler Ring

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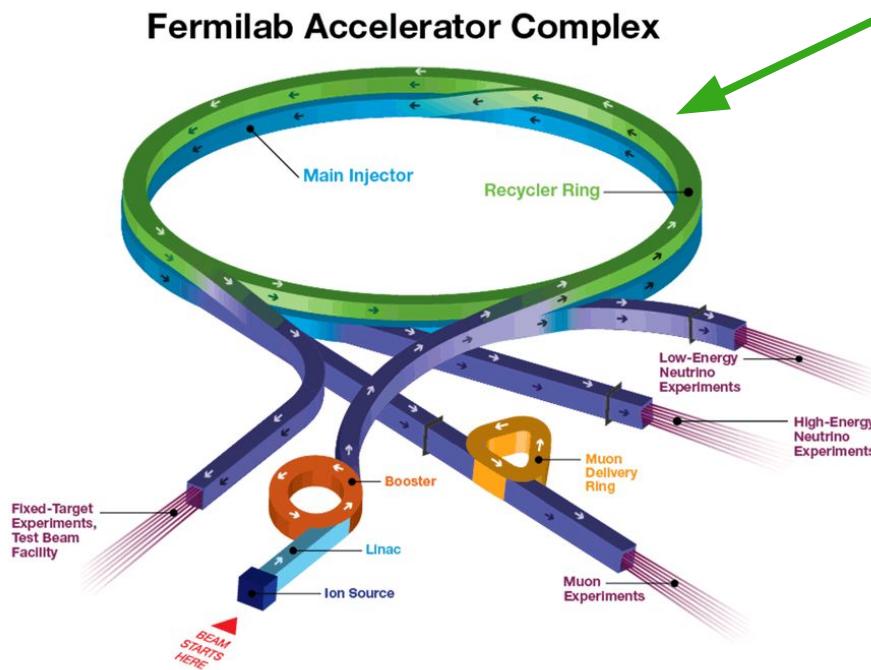
Accelerator Division

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The Fermilab Accelerator Complex



Recycler Ring is essential to Fermilab:
megawatt proton beams → high-intensity neutrino beams

The Recycler Ring

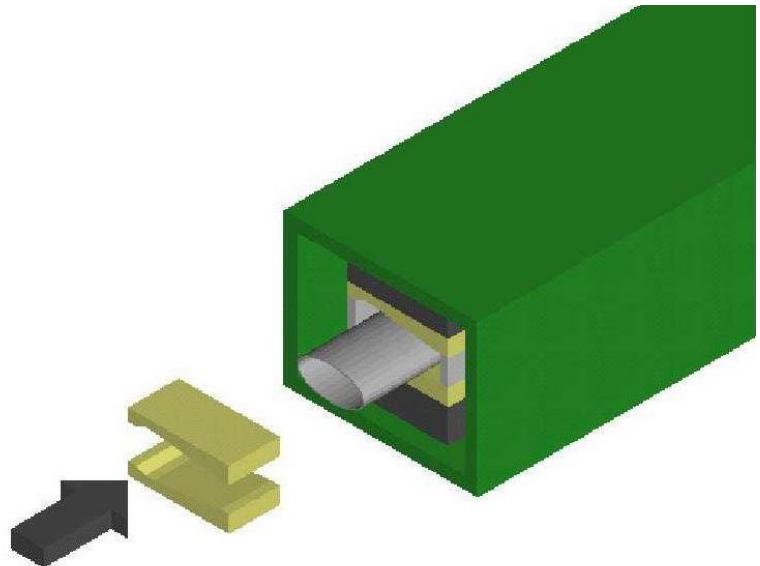
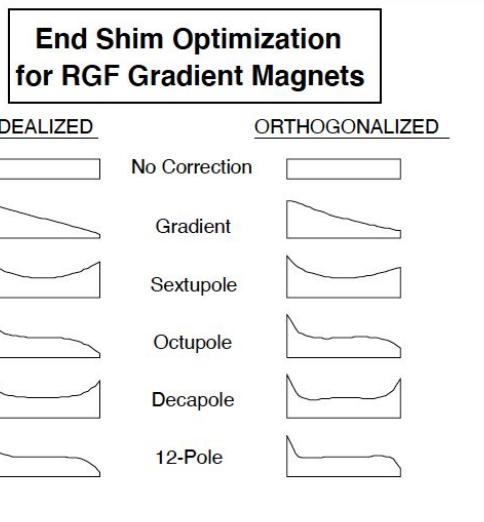
Recycler Ring is a permanent-magnet storage ring

Matched to Main Injector 8 GeV proton KE



The Recycler Ring Multipole Shims

"Computer Generated End Shims for Recycler Ring Magnets" C.N. Brown, G.W. Foster, G. P. Jackson, J. T. Volk, Proceedings of the 1999 Particle Accelerator Conference, New York, 1999

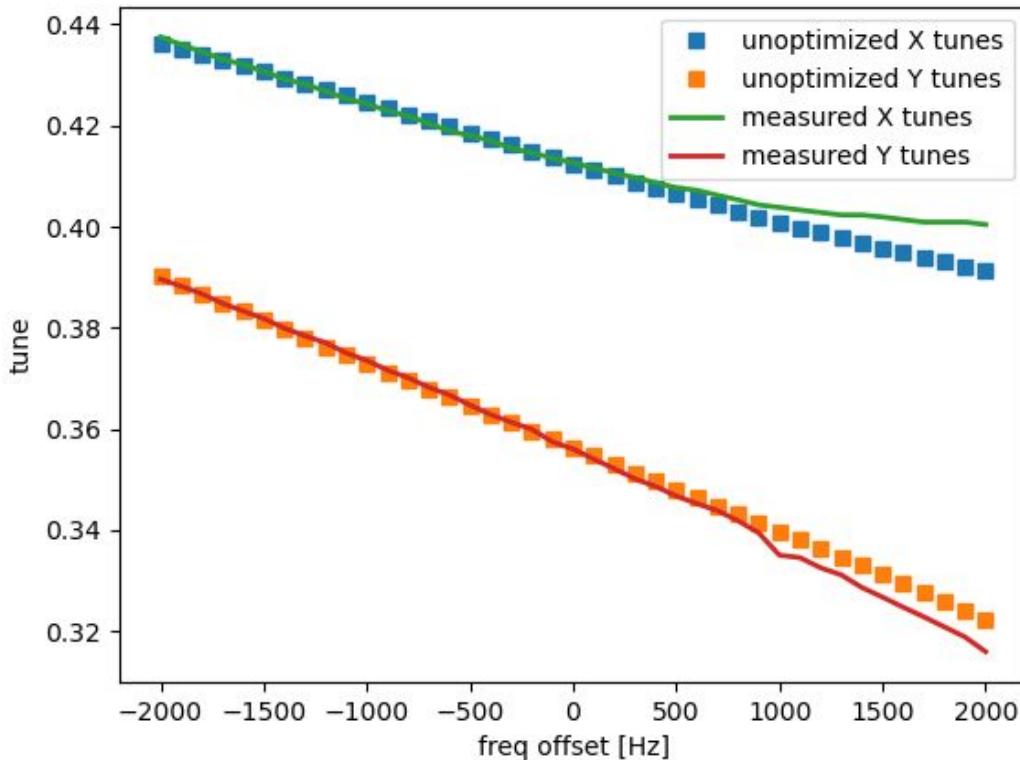


Magnetic shim plates were installed to correct for undesirable multiple moments observed in the Recycler.

Fig. 2 – Elementary monomial Z-shim designs used as a starting point, and shim designs which were found to produce pure multipole shifts after re-orthogonalizing the multipole contributions from the elementary shims.

The Recycler Ring Chromaticity

Challenge:

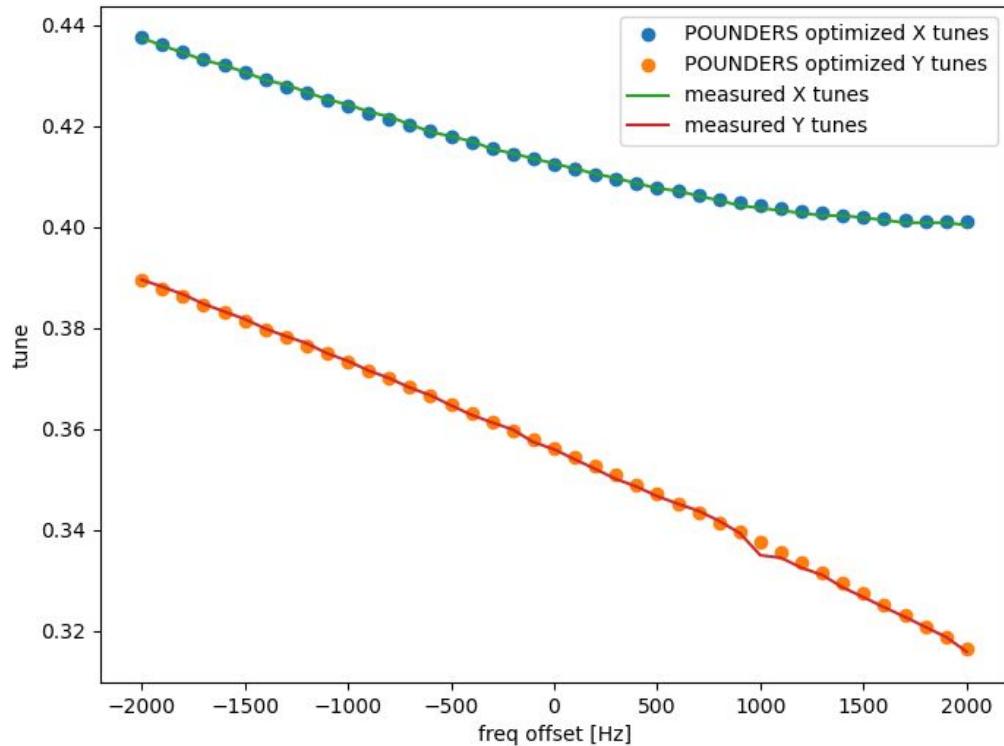


Tune simulated chromaticity to better match observed, using only additive corrections of multipole moments at shims.

Can small errors in shim plate shape account for the observed difference?

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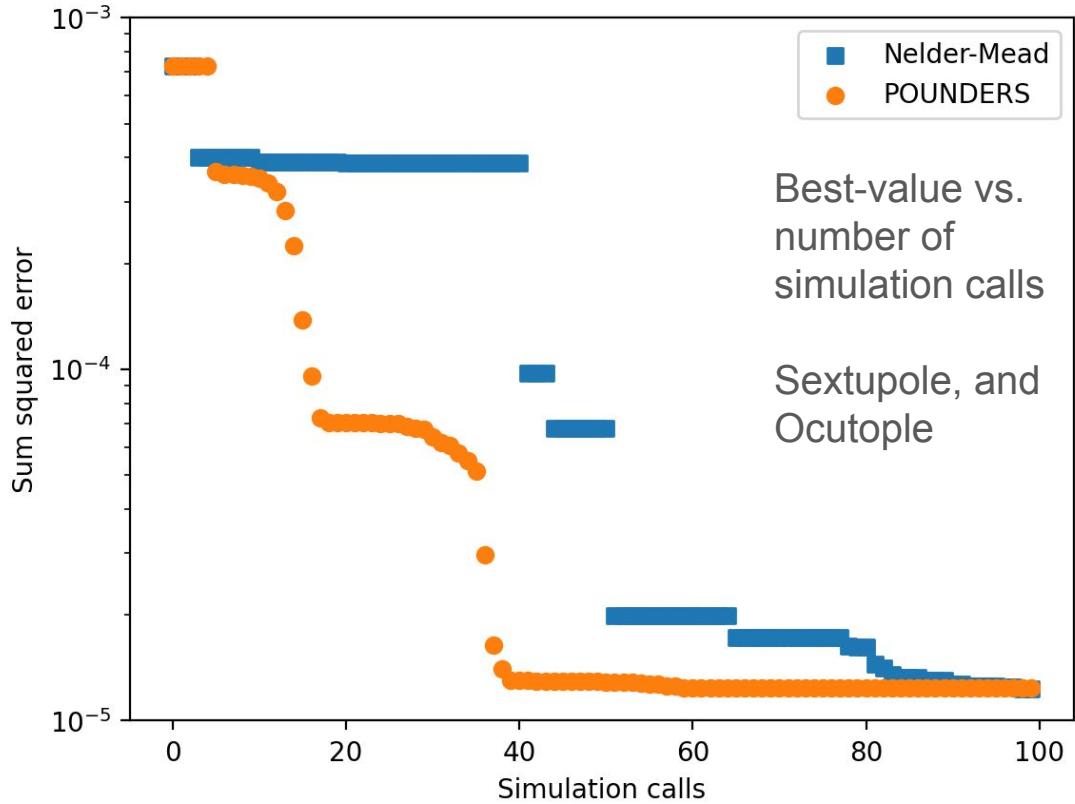
Yep!

Parameter Optimization with POUNDERS

Comparison to Nelder-Mead
downhill simplex method (NM).
Both are set to minimize the
sum of squared errors.

Different inputs:
N-M: sum sq. err's
POUNDERS: vector of sq.
err's

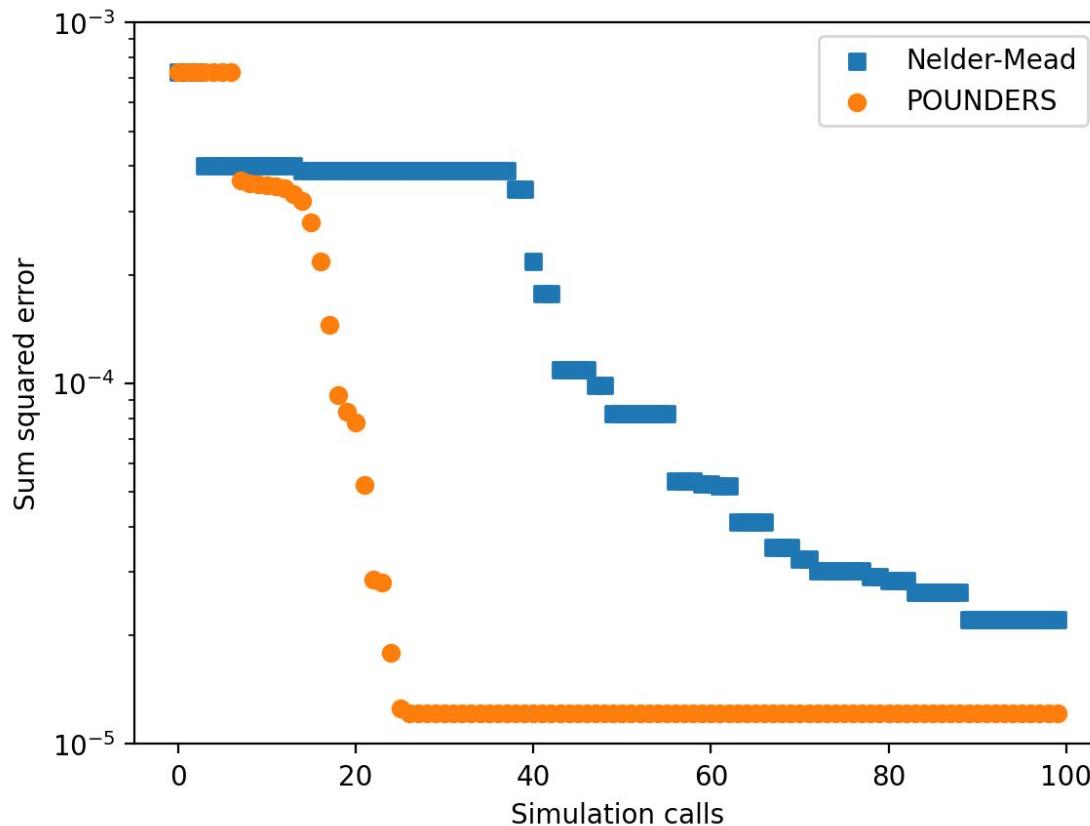
POUNDERS converges faster
(~60 vs ~100 steps)



Final parameter values very close to NM result

	H sext.	V sext.	H octu.	V octu.
POUNDERS	-0.00107	-0.00099	0.37075	0.40921
NM	-0.00108	-0.00097	0.34959	0.45167

A tool for self-updating accelerator models?



Best-value vs.
number of
simulation calls

Sextupole, and
Octupole, and
Decapole