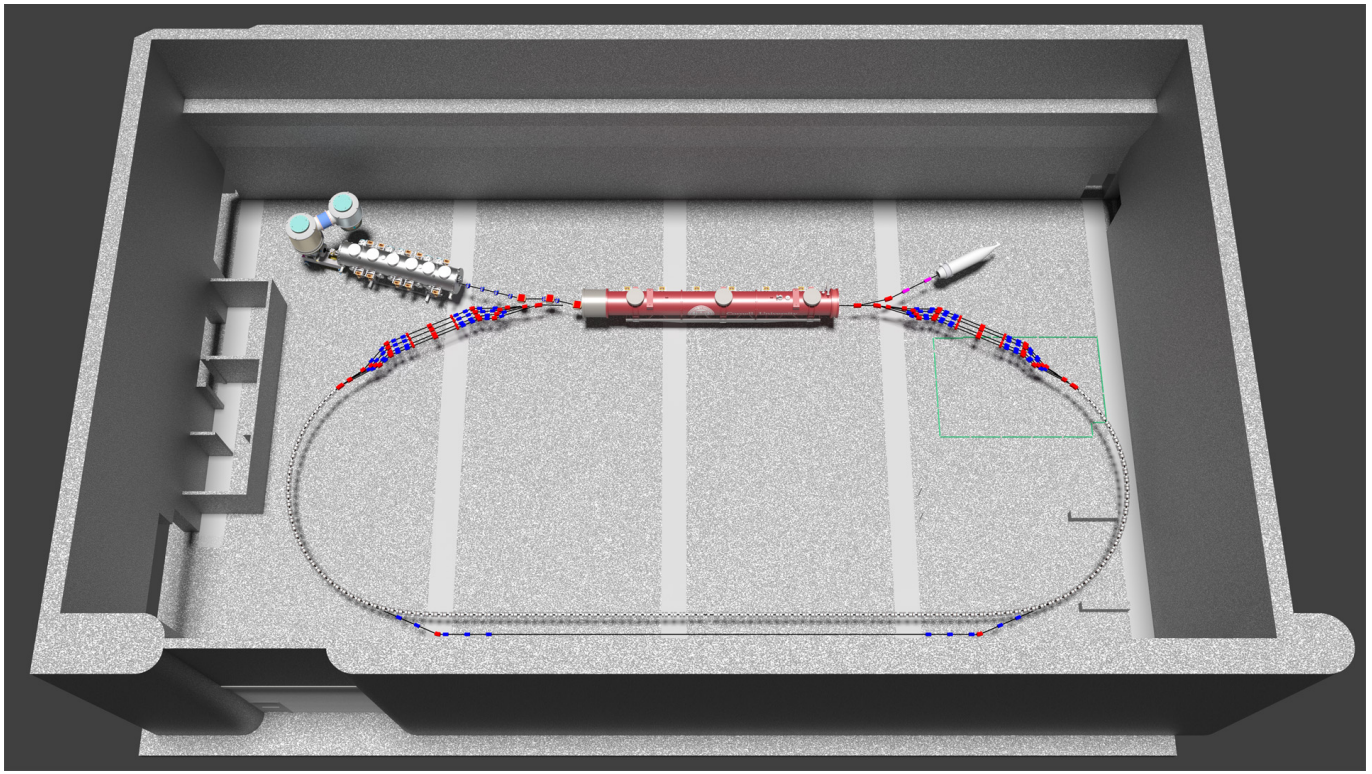
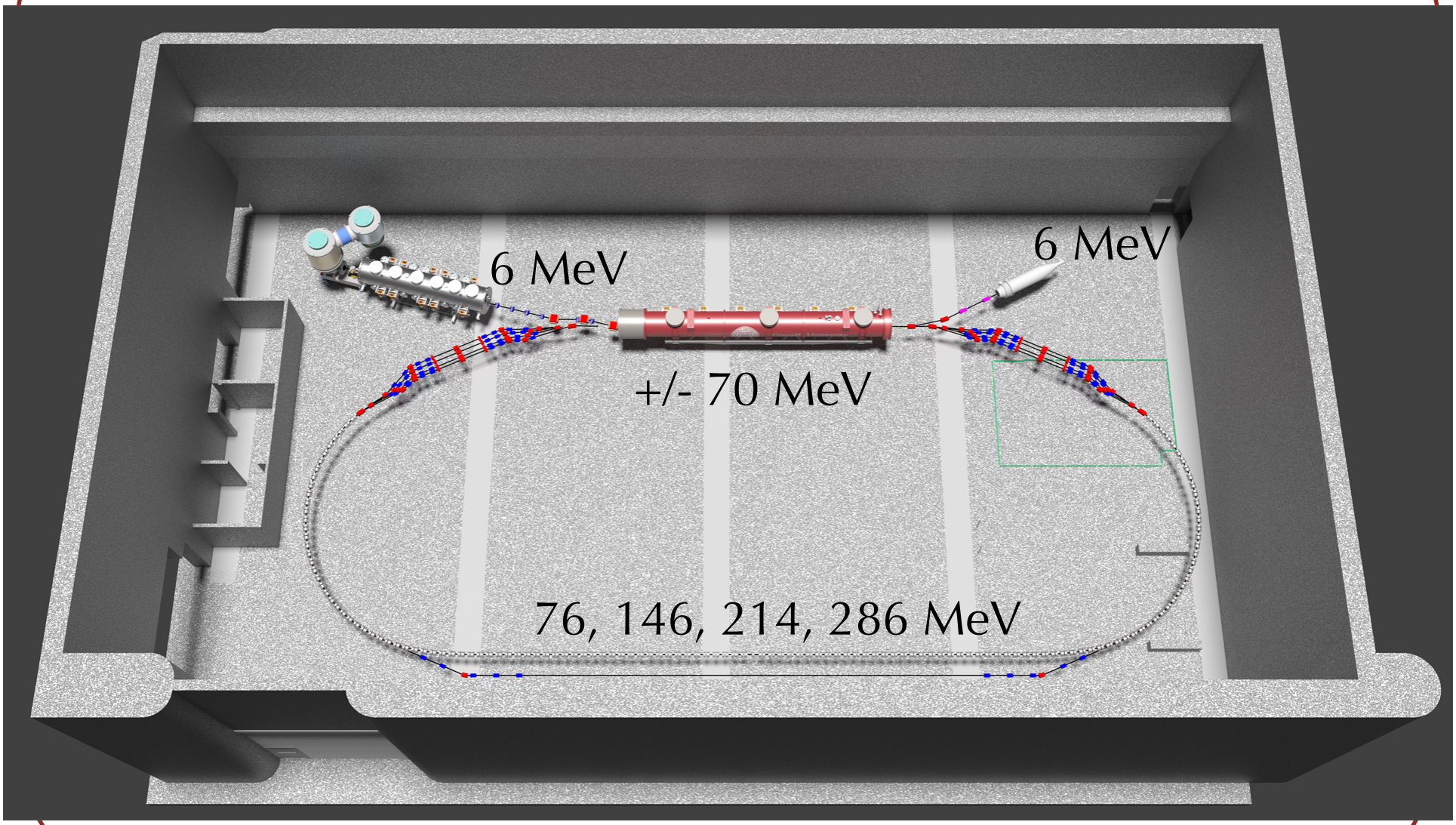
Cβ: Cornell-BNL ERL-FFAG Test Accelerator

Optics considerations

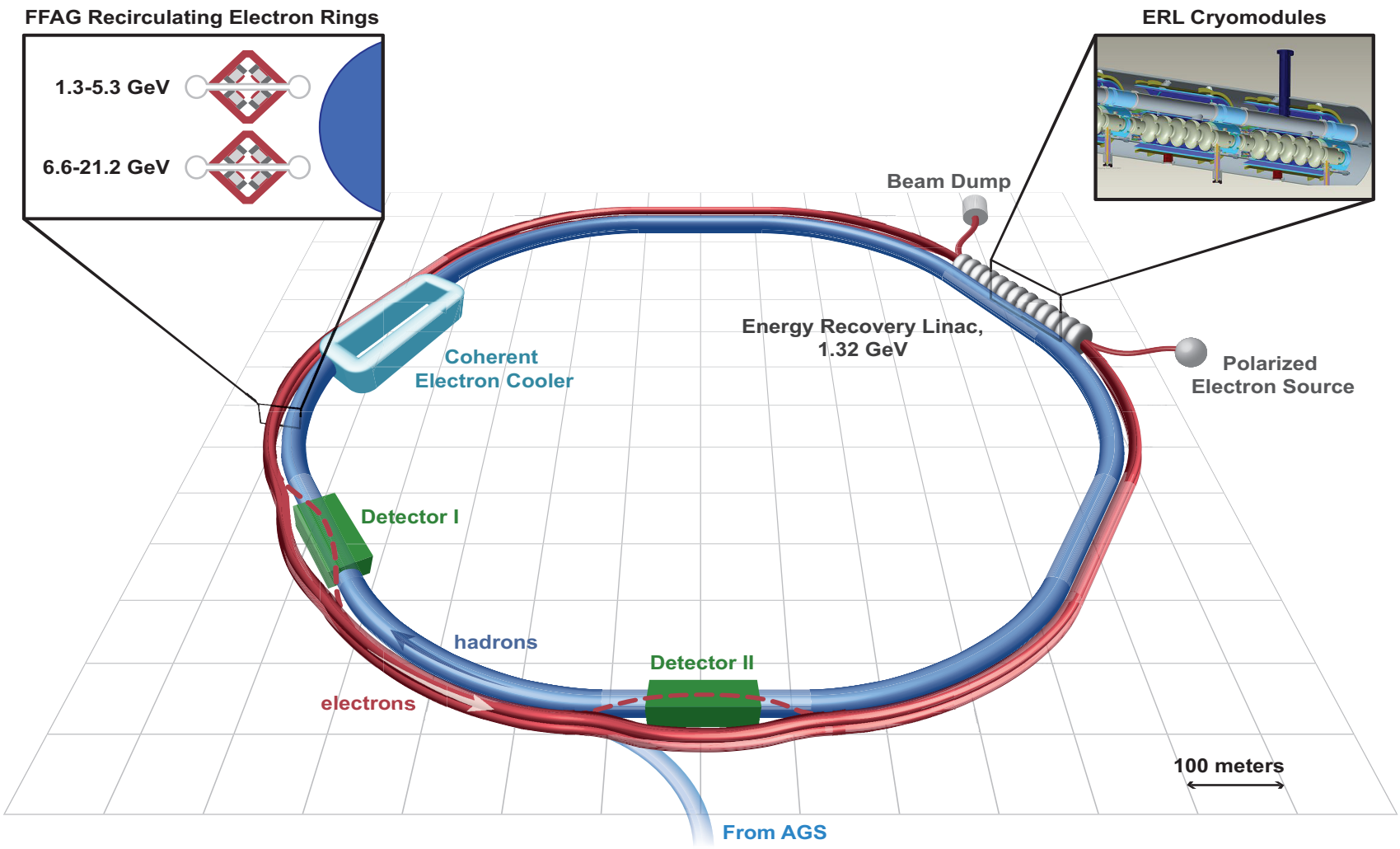


Christopher Mayes – June 10, 2015

Cβ: Cornell-BNL ERL-FFAG Test Accelerator



eRHIC



arxiv.org/abs/1409.1633

Cβ White Paper

The Cornell-BNL FFAG-ERL Test Accelerator

White Paper

Ivan Bazarov, John Dobbins, Bruce Dunham, Georg Hoffstaetter, Christopher Mayes, Ritchie Patterson, David Sagan

Cornell University, Ithaca NY

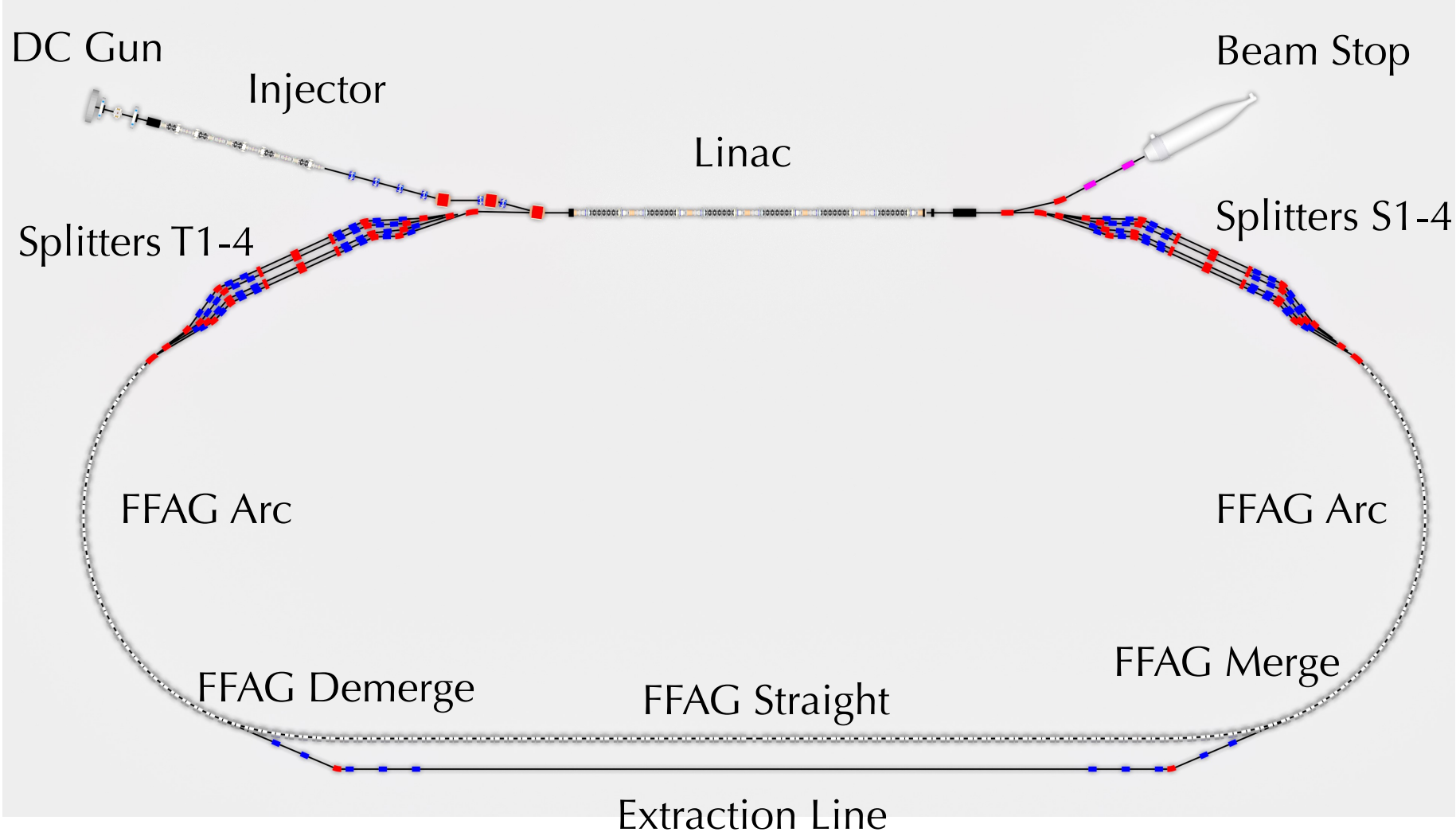
Ilan Ben-Zvi, Scott Berg, Michael Blaskiewicz, Stephen Brooks, Kevin Brown, Wolfram Fischer, Yue Hao, Wuzheng Meng, François Méot, Michiko Minty, Stephen Peggs, Vadim Ptitsin, Thomas Roser, Peter Thieberger, Dejan Trbojevic, Nick Tsoupas.

Brookhaven National Laboratory, Upton NY

December 16, 2014

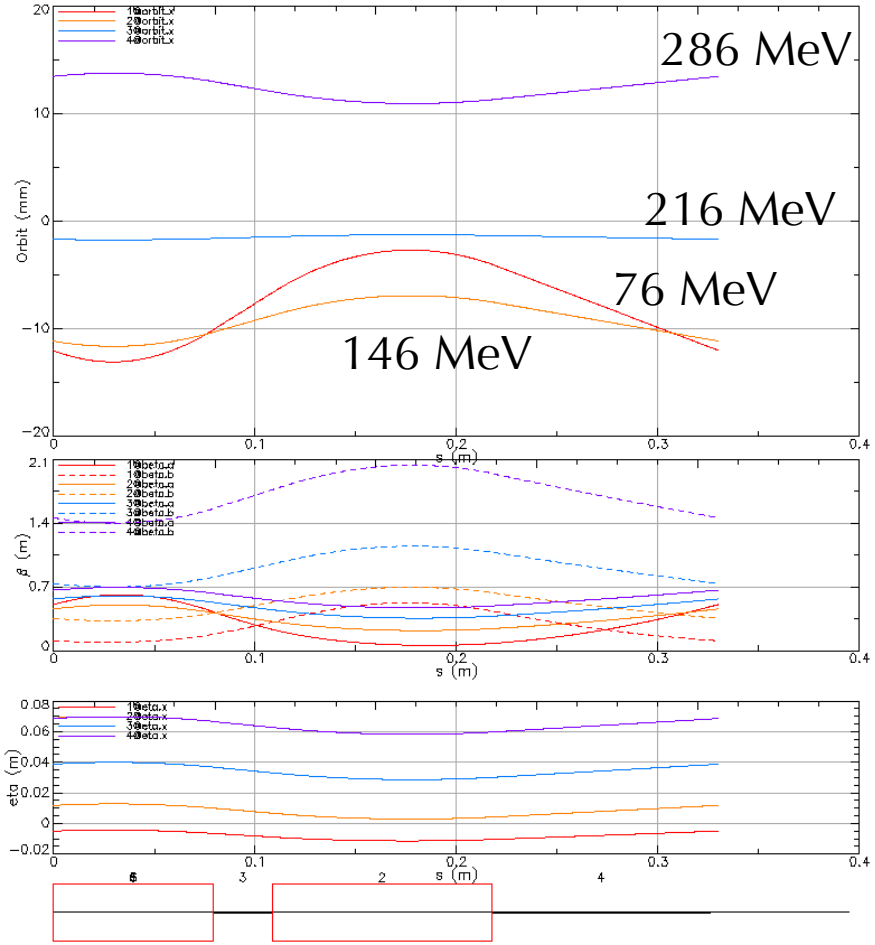
arxiv.org/abs/1504.00588

Layout


DC Gun
Injector
Linac
Beam Stop
Splitters T1-4
Splitters S1-4
FFAG Arc
FFAG Arc
FFAG Demerge
FFAG Straight
FFAG Merge
Extraction Line

FFAG Optics

Cell

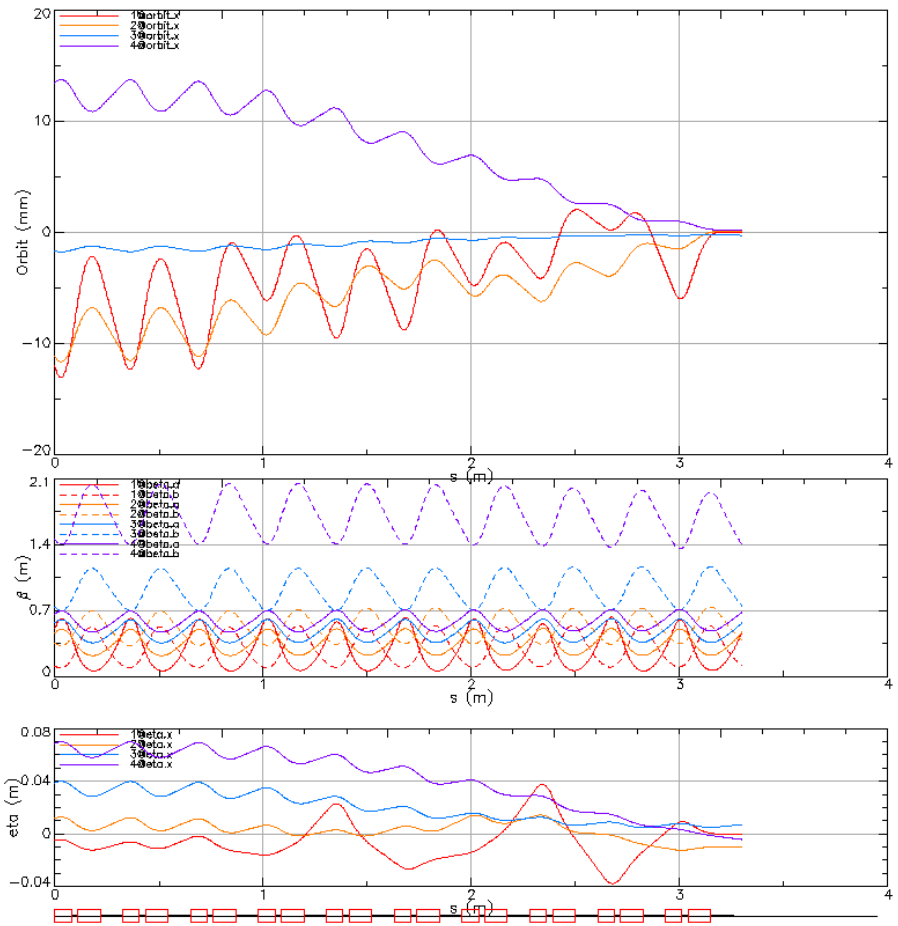


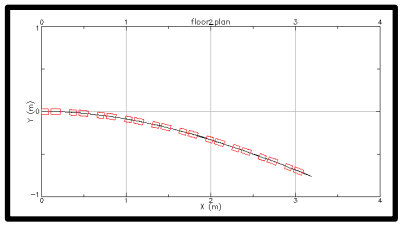
3.6 deg

8 cm
42.5 T/m
-0.104 T

11 cm
-27.5 T/m
0.5044 T

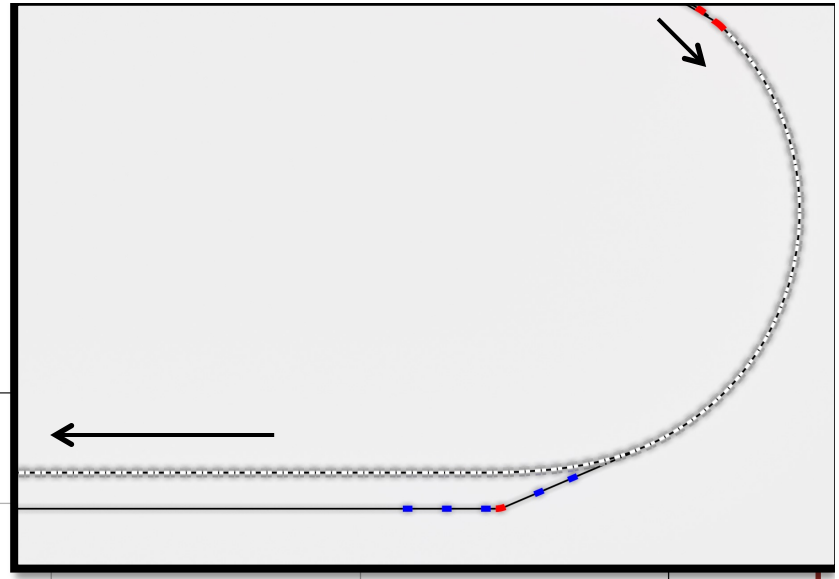
Merge (10 cells)

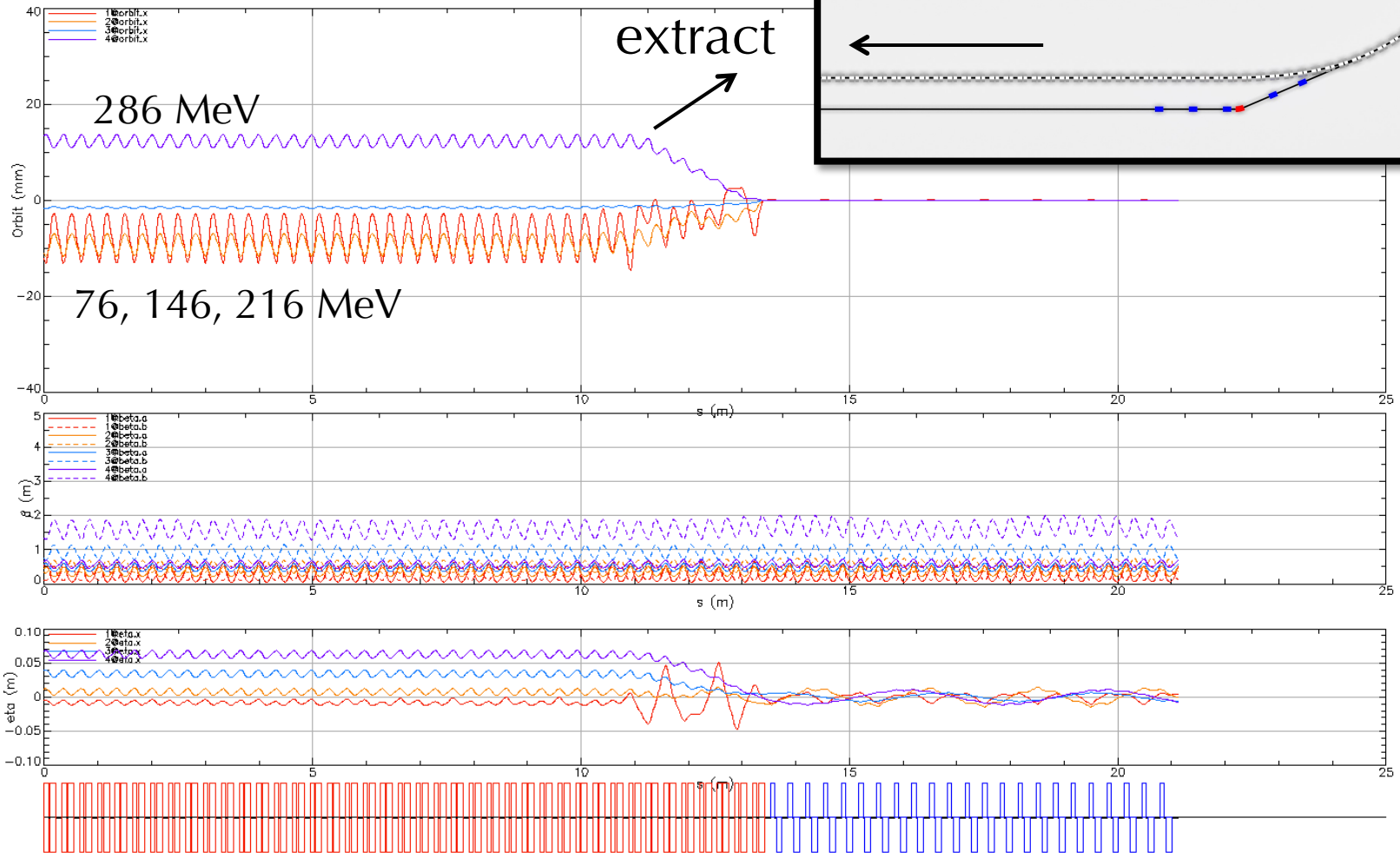




22 deg

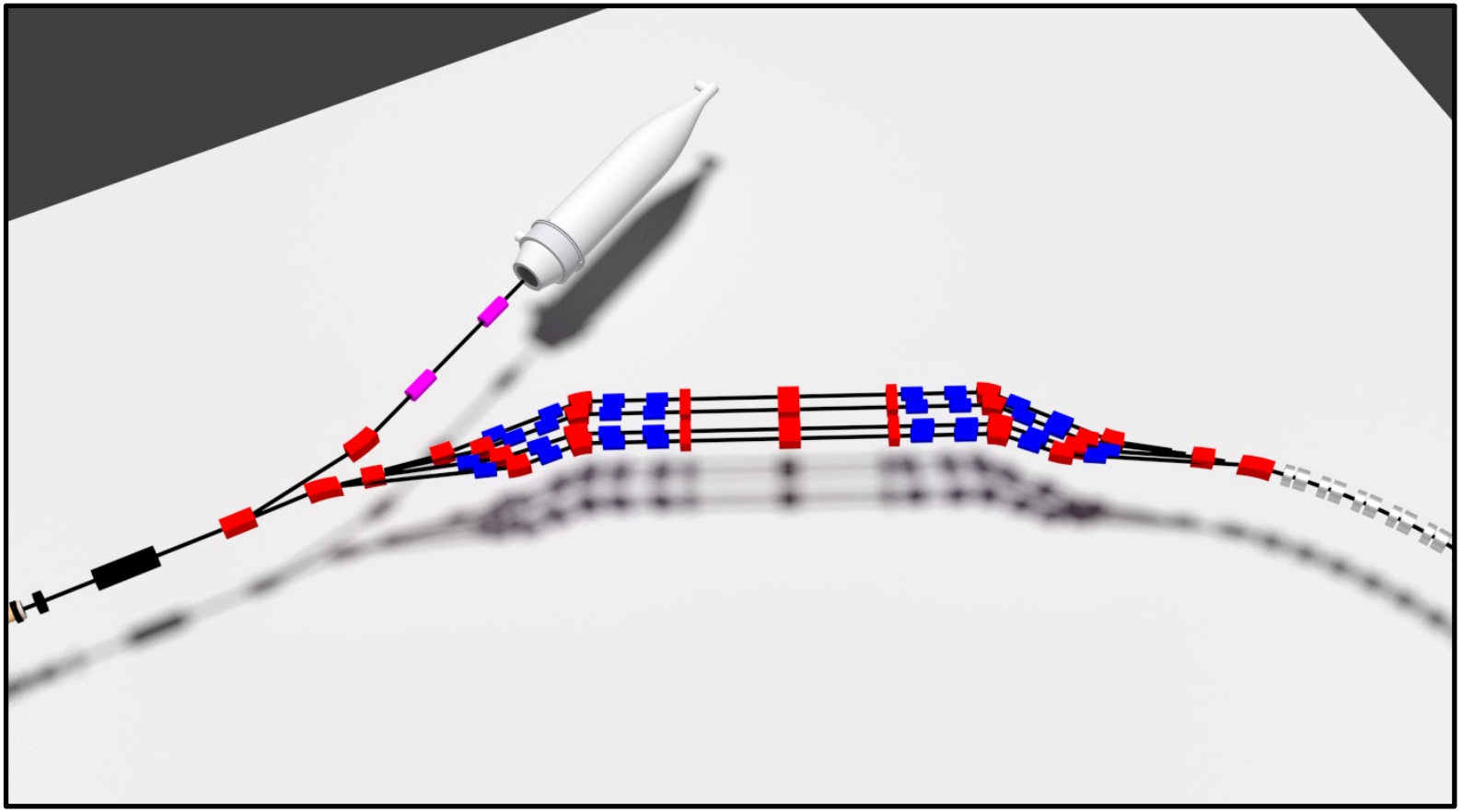
FFAG Arc, Merge, Straight



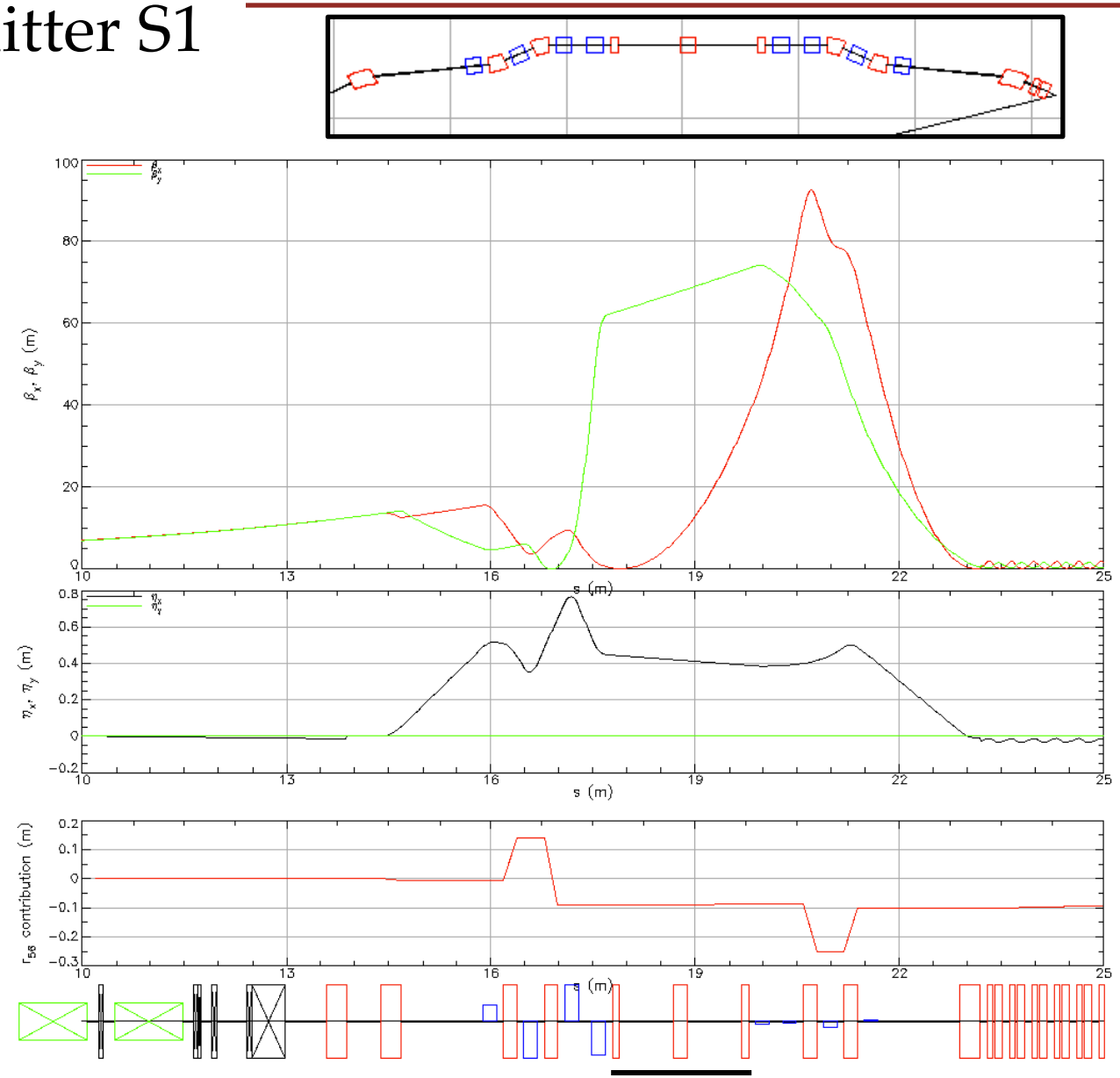


Splitters S1-4

- Accept large beams from Linac
- Steer onto FFAG closed orbits
- Match to FFAG optics
- r_{56} adjustment
- Path length adjustment via vertical chicanes
- Total path lengths close to ideal for ERL operation



Splitter S1



r_{56}

Linac

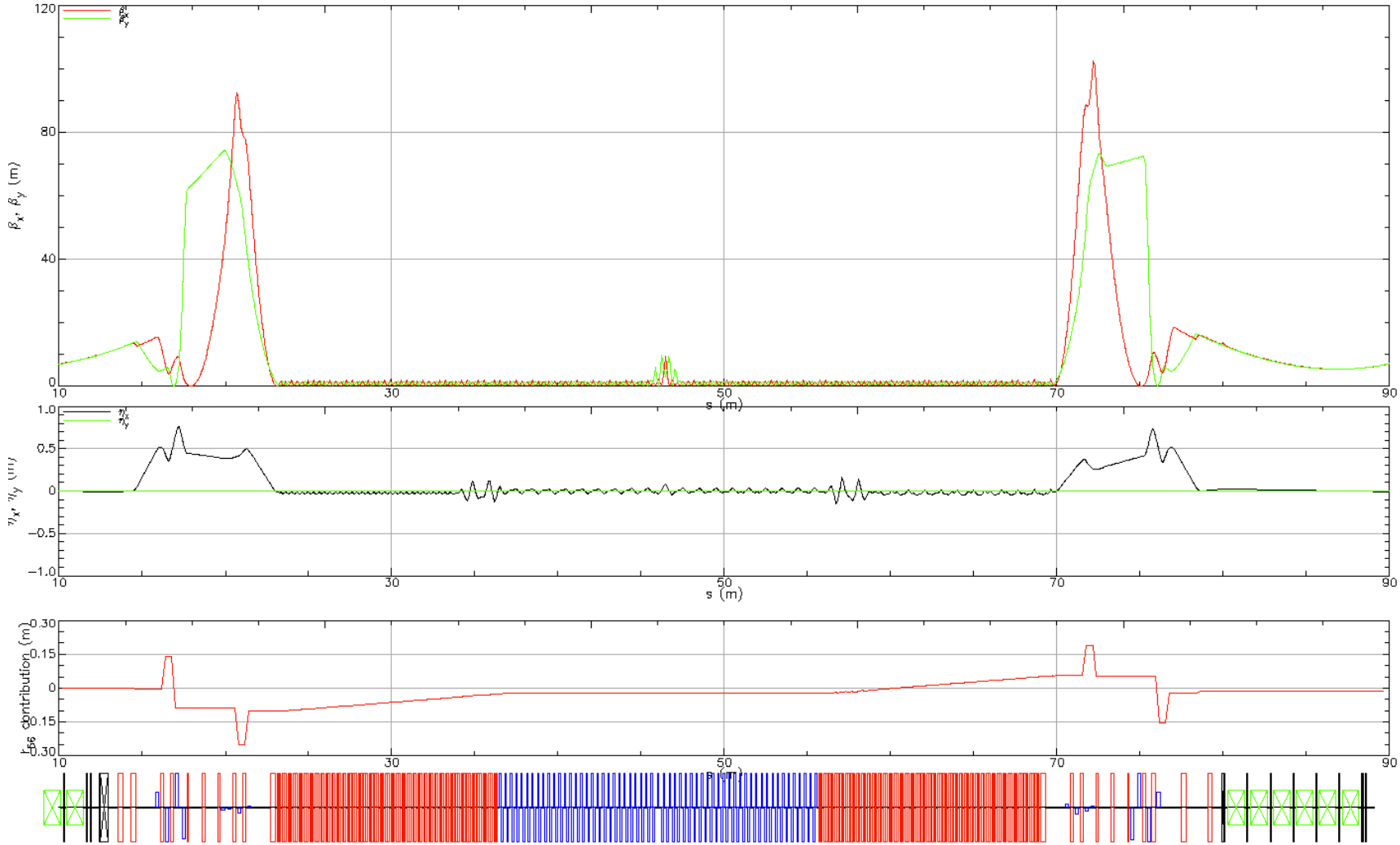
Vertical chicane

FFAG

Pass 1 optics

76 MeV

to 146 MeV

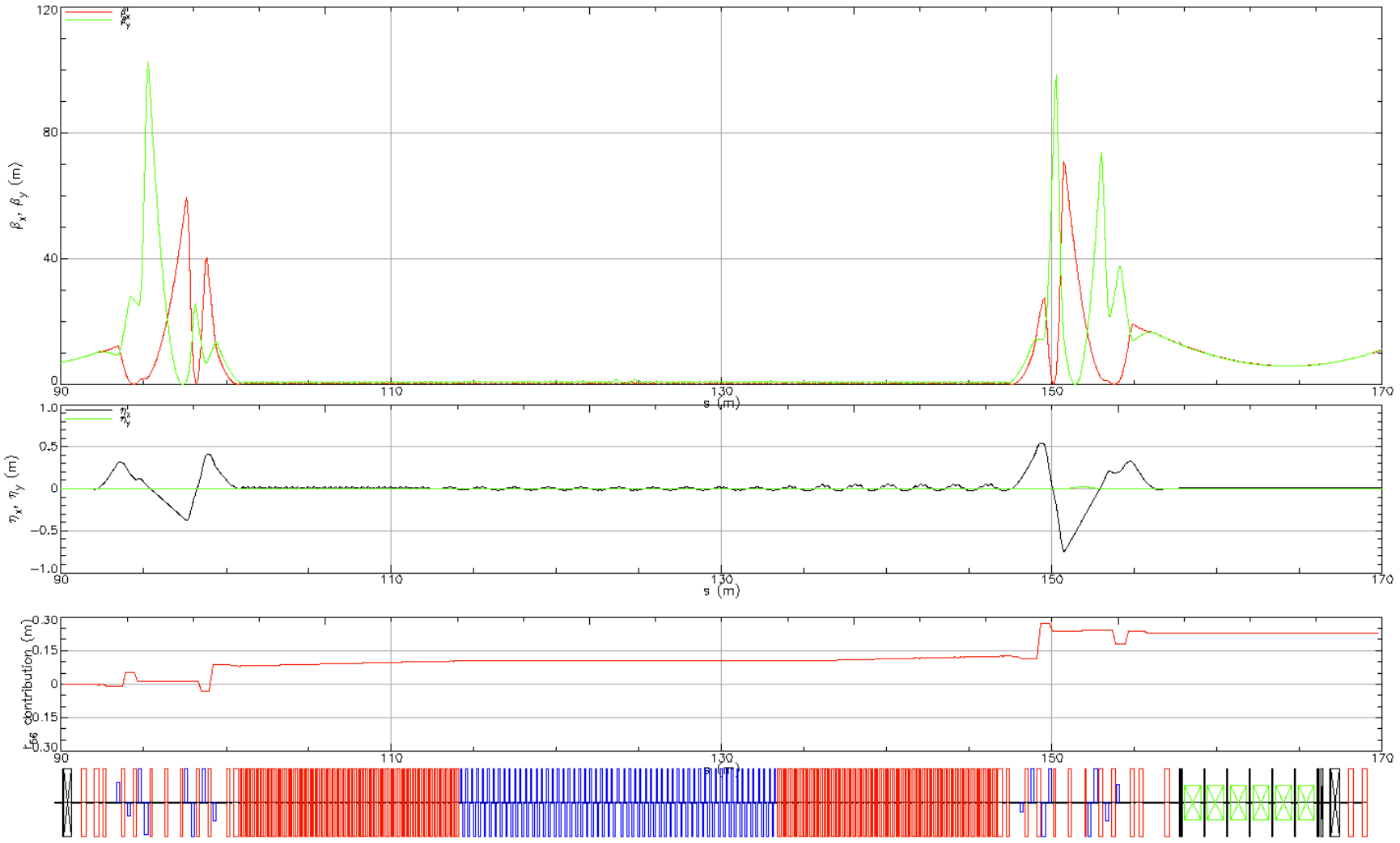


S1 FFAG T1

Pass 2 optics

146 MeV

to 216 MeV

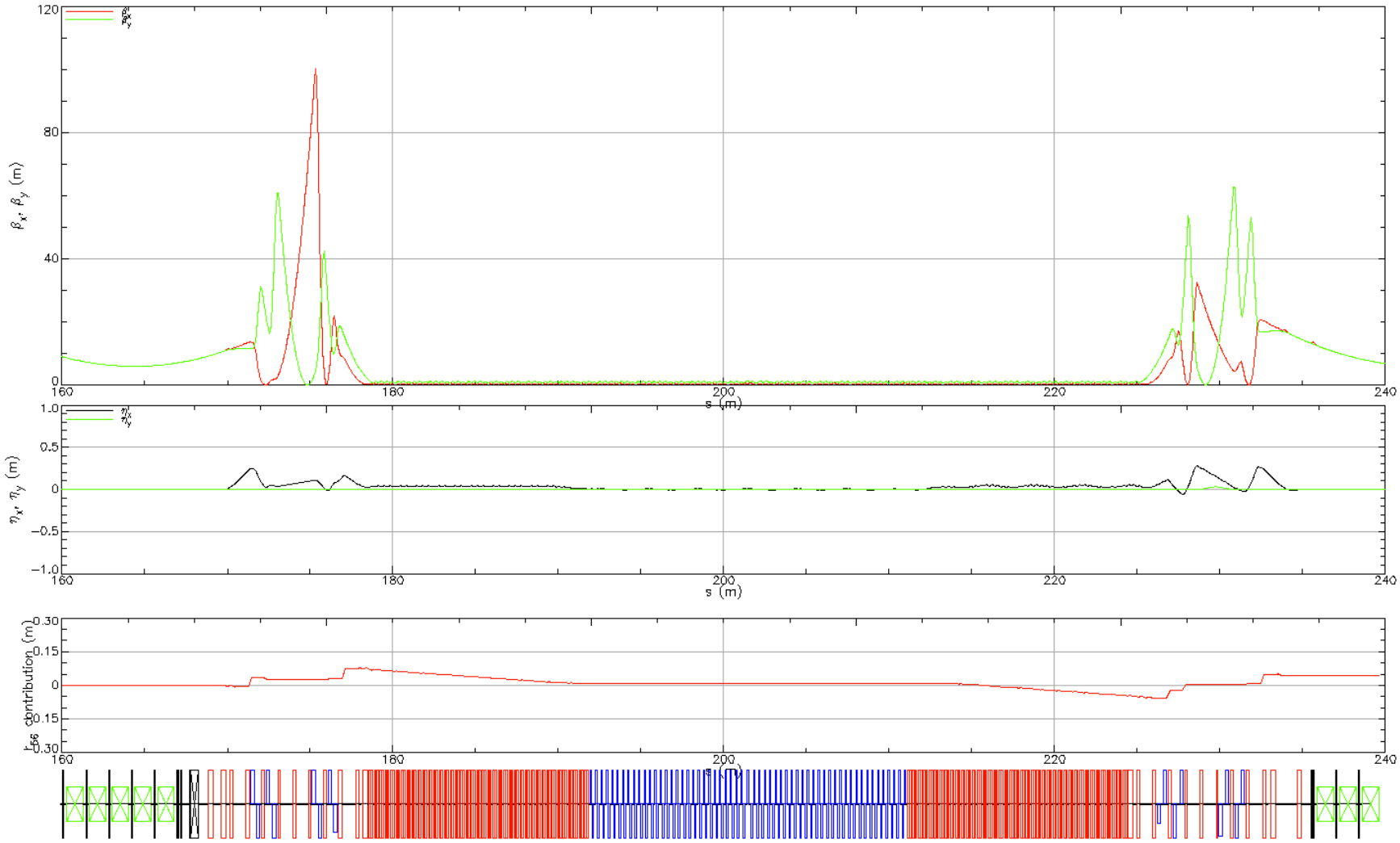


S2 FFAG T2

Pass 3 optics

216 MeV

to 286 MeV

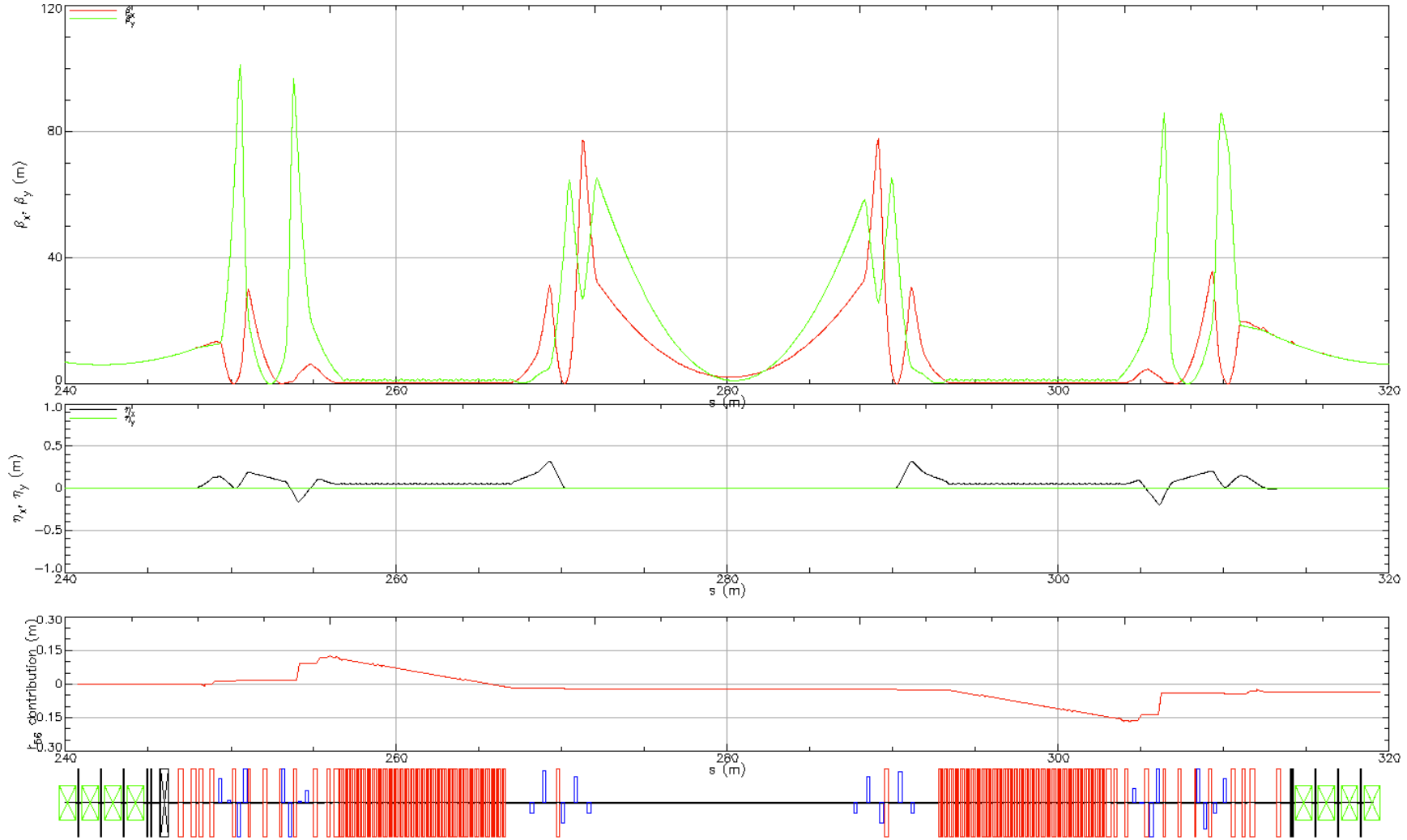


S3 FFAG T3

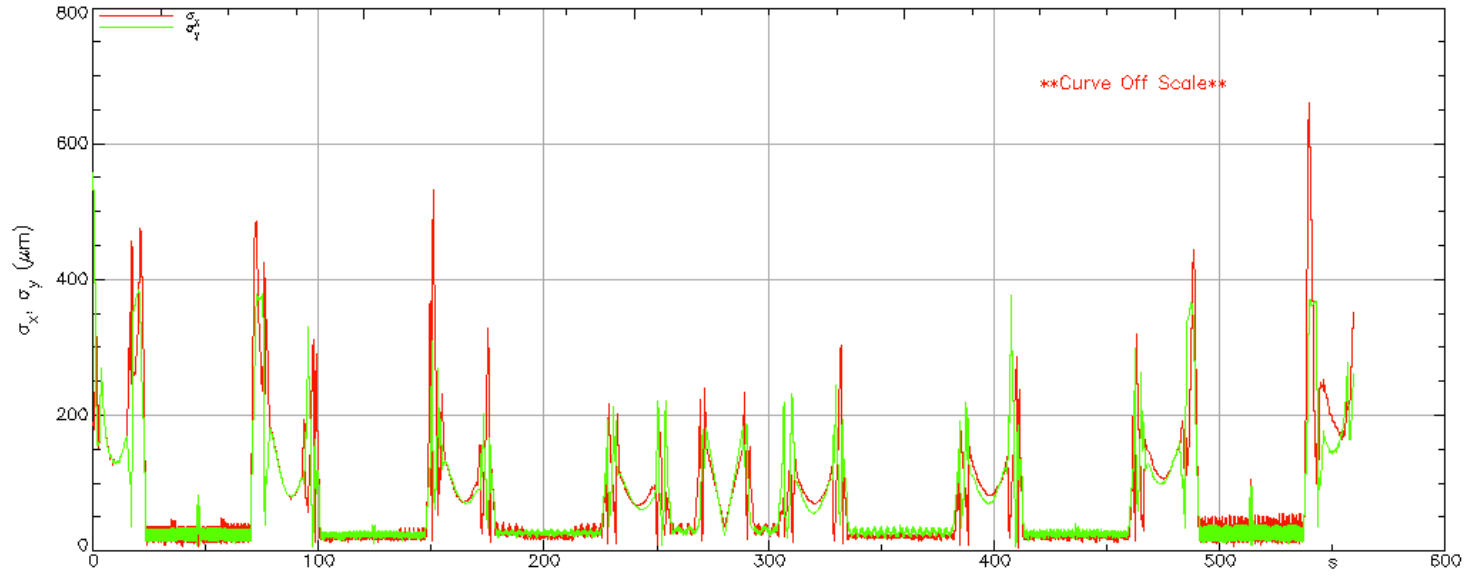
Pass 4 optics

286 MeV

Decelerate to 216 MeV

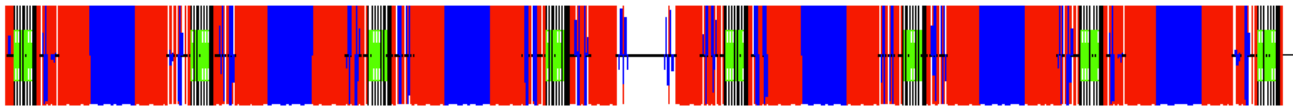


Full ERL bunch tracking



286 MeV

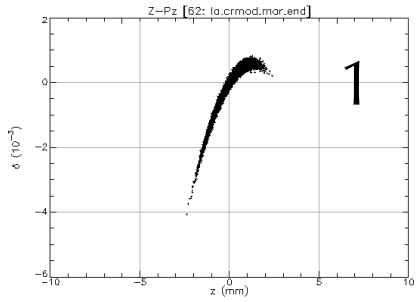
6 MeV

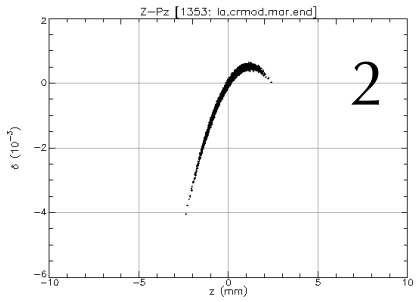


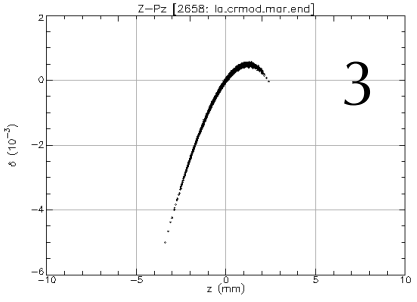
6 MeV

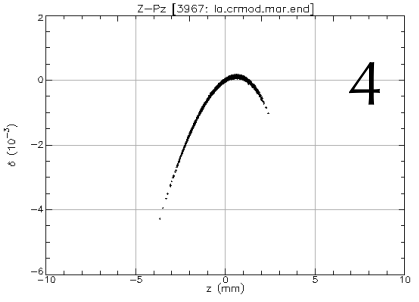
Longitudinal Phase Space

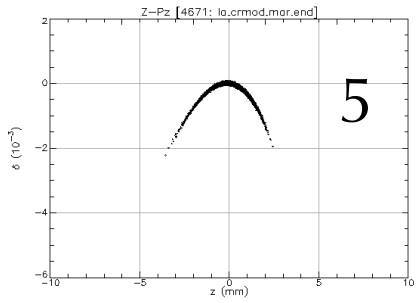
end of the Linac for pass (full scale 8%)

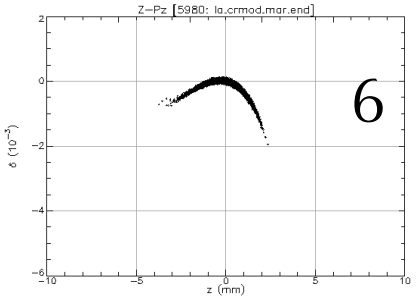


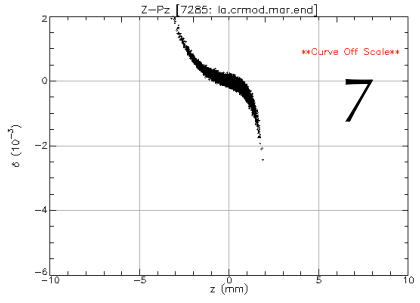


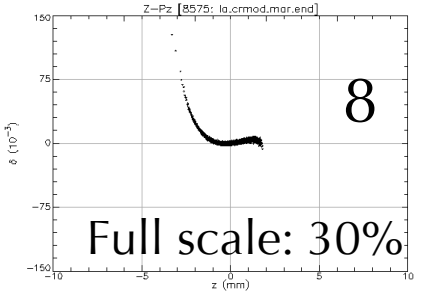






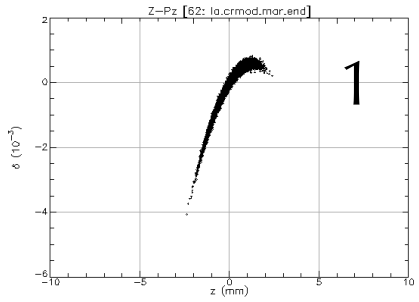


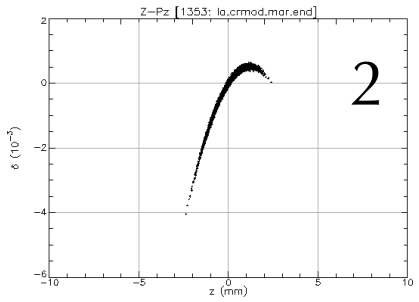


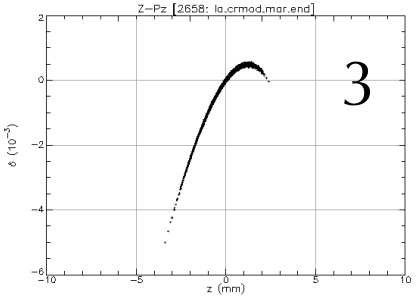


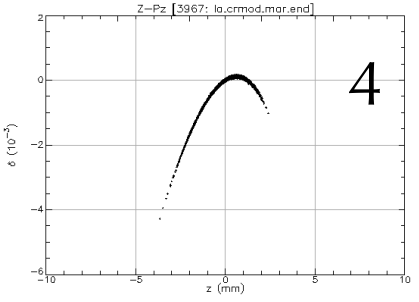
Longitudinal Phase Space

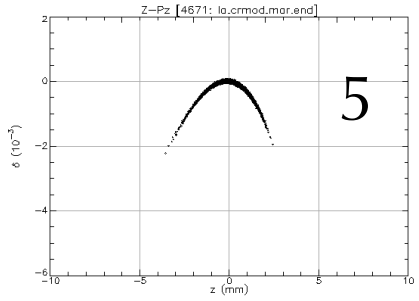
end of the Linac for pass (full scale 8%)

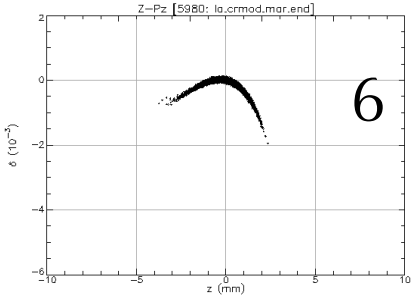


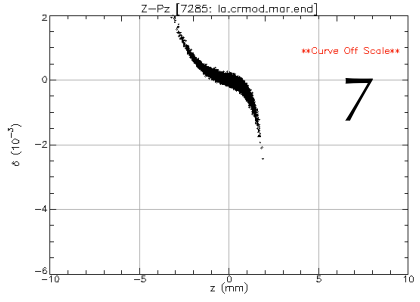


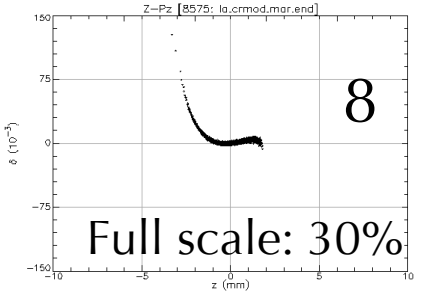


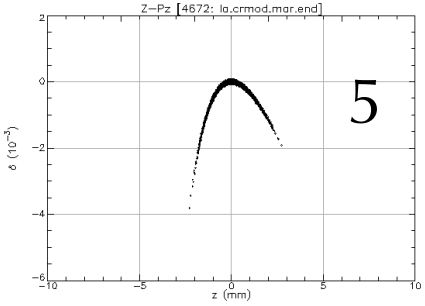


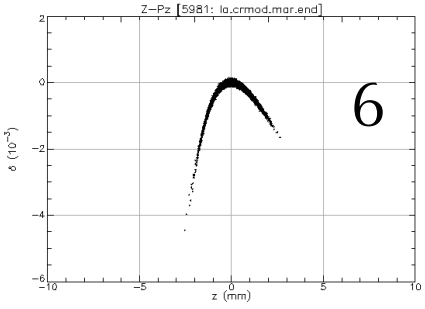


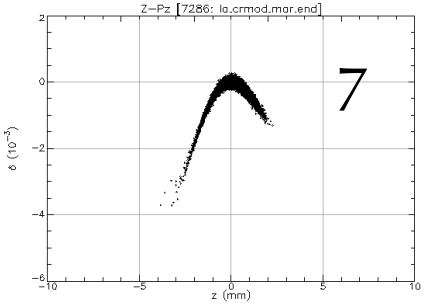


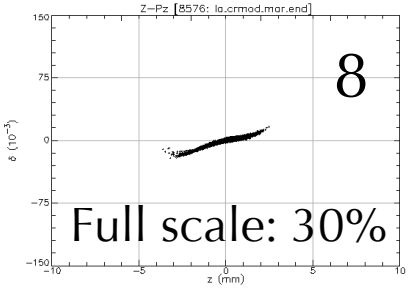








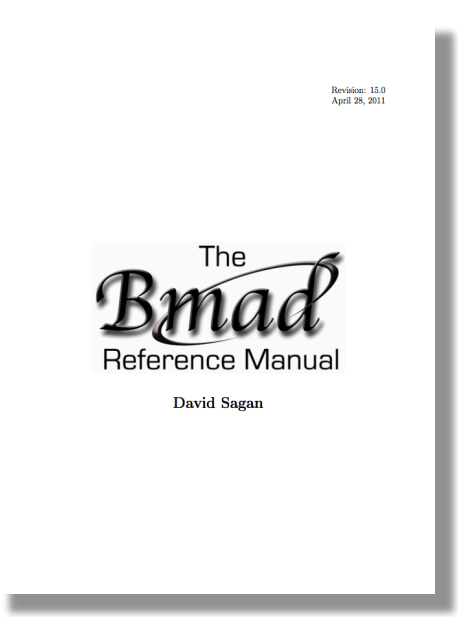


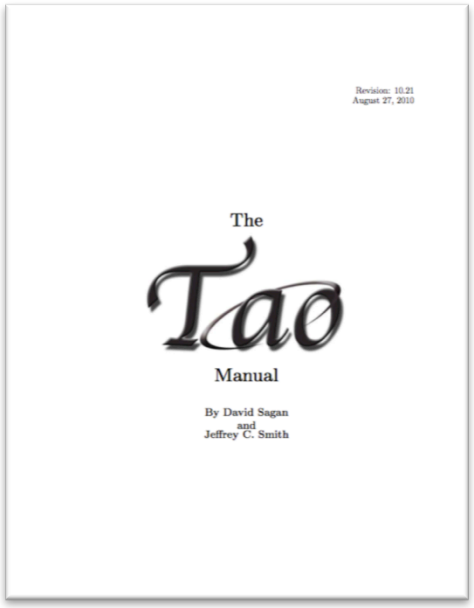


r_{56} adjusted on pass 4

Simulation Software

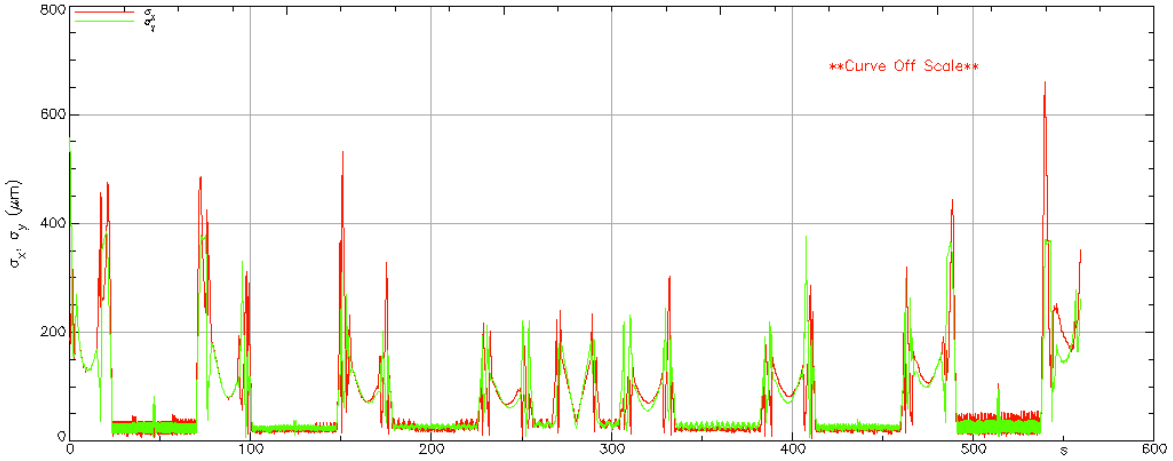
Bmad & Tao (Cornell)





www.lns.cornell.edu/~dcs/bmad

Next steps

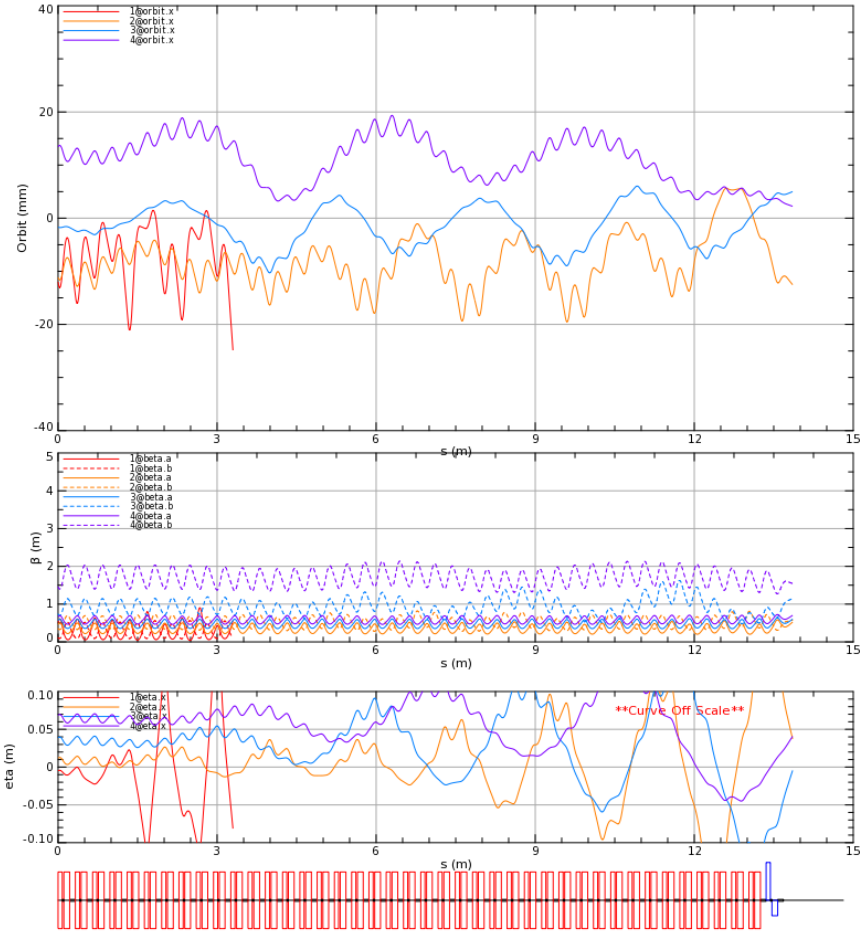


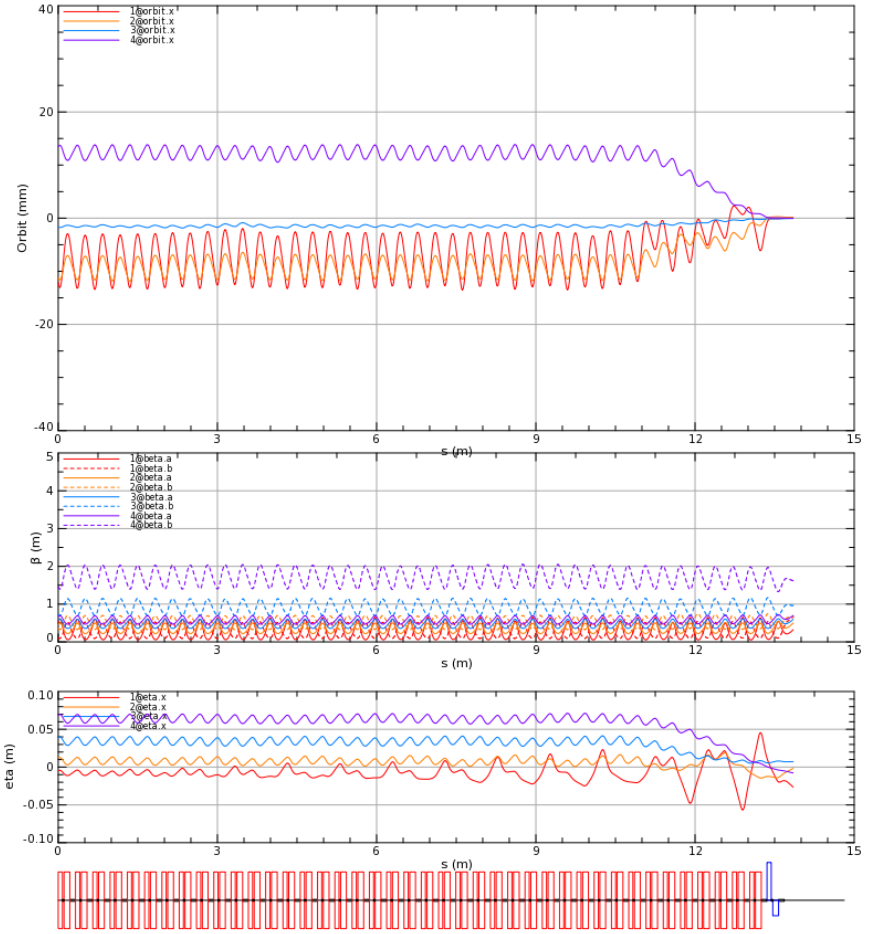
- Real fieldmaps (FFAG magnets, cavities, …)
- Wakefields (CSR, resistive wall, …)
- Injector + Linac space charge optimization
- Touschek scattering
- Dark current tracking & collimation
- BBU
- Ion trapping
- Orbit and optics correction
- Tolerance & stability analysis

FFAG orbit correction simulation

500 um rms x offset errors

SVD correction given BPM readings for separate beams and correction coils on every other dipole



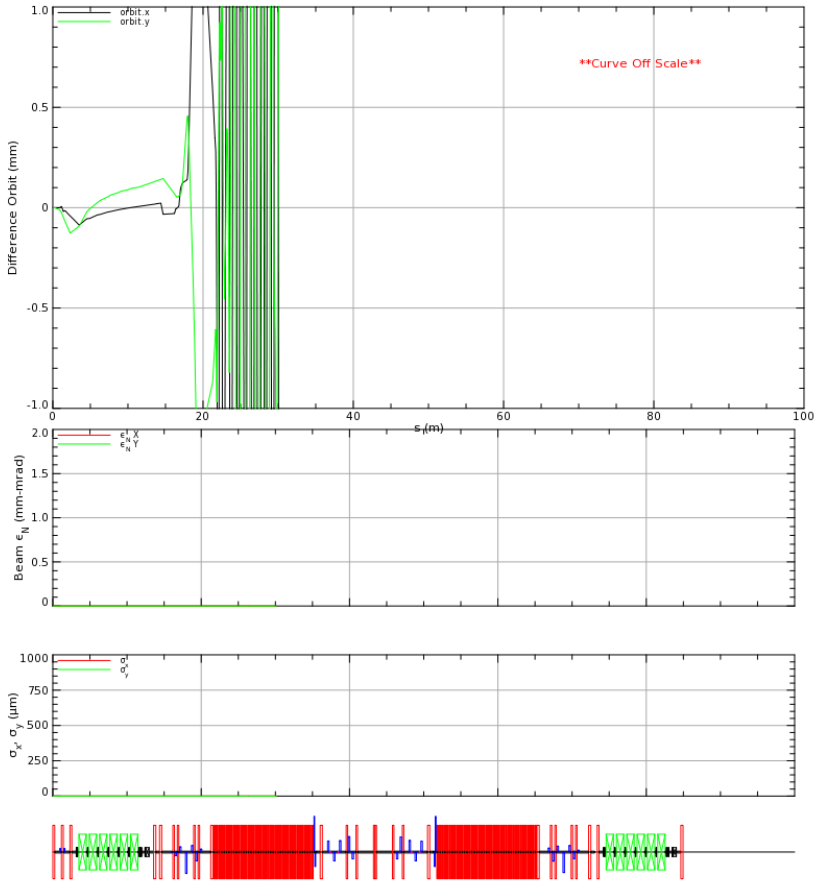


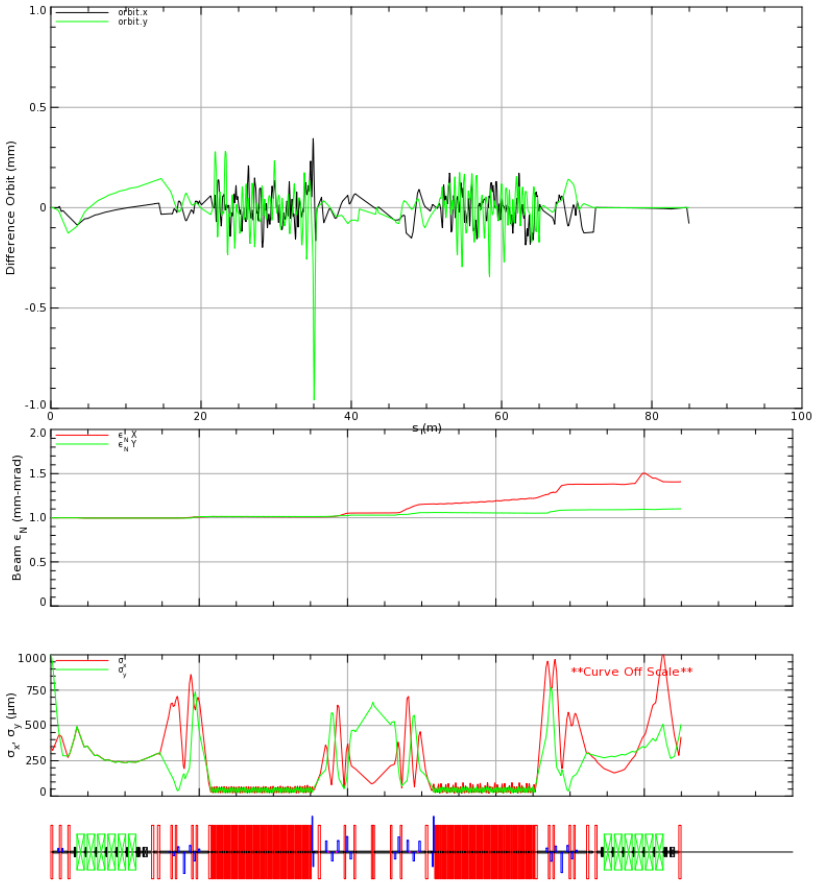
FFAG Arc

Example errors, correction, and bunch tracking

Variety of errors

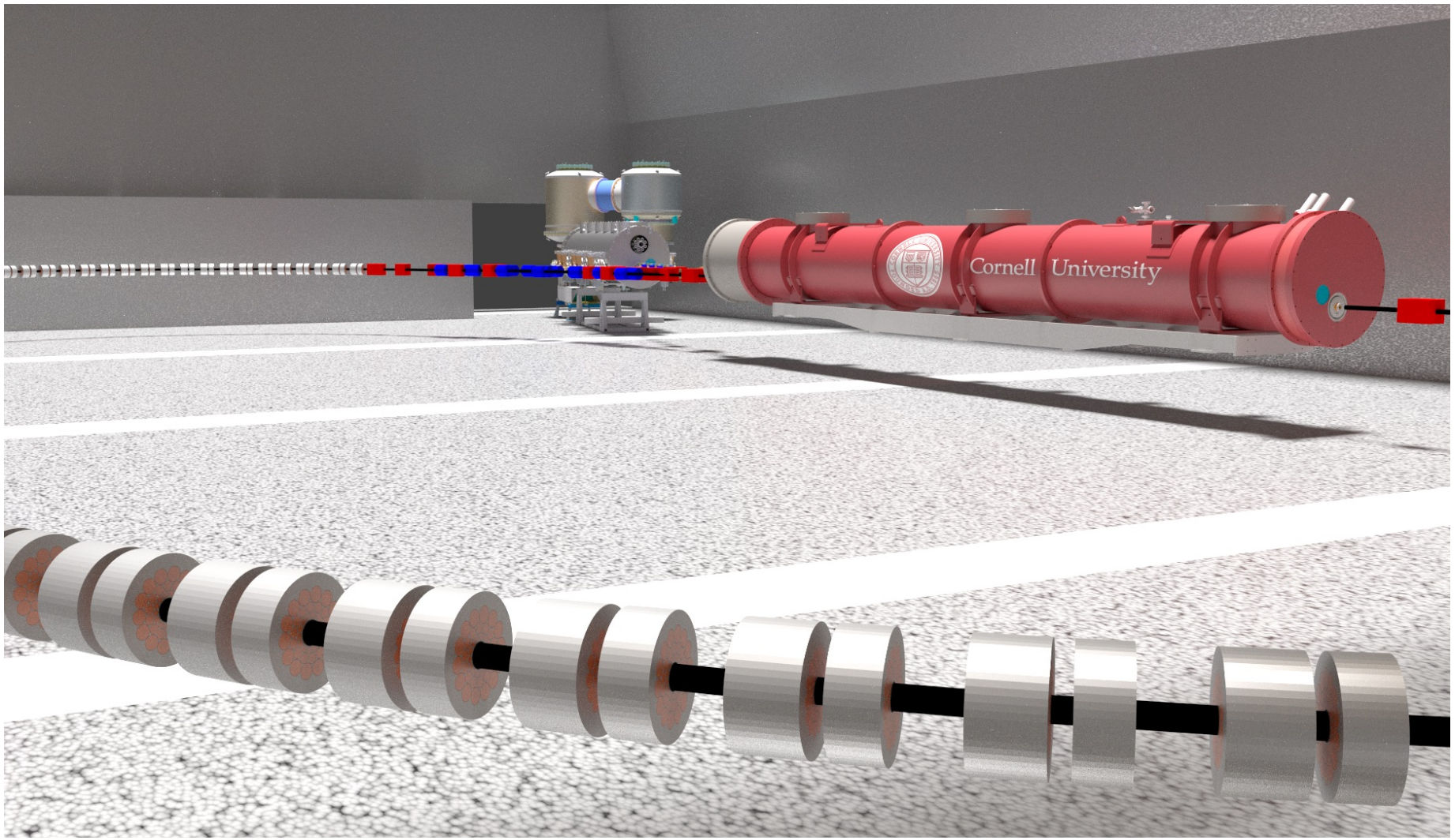
SVD correction given BPM readings for separate beams and correction coils on every other FFAG dipole and all quadrupoles





1-pass ERL-FFAG (early design)

Cβ: Cornell-BNL ERL-FFAG Test Accelerator



End