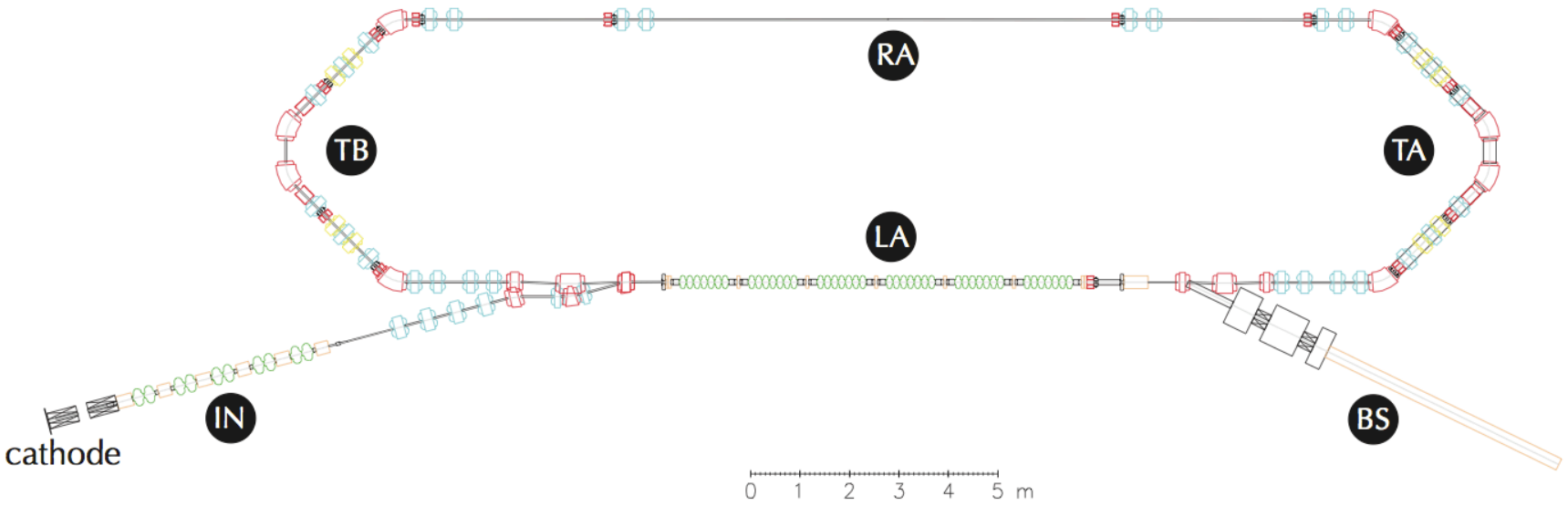
Cornell High-Power Recirculation Loop



Cornell ERL Timeline

A Possible Apparatus for Electron Clashing-Beam Experiments (*).

M. TIGNER

Laboratory of Nuclear Studies, Cornell University - Ithaca, N. Y.

(ricevuto il 2 Febbraio 1965)

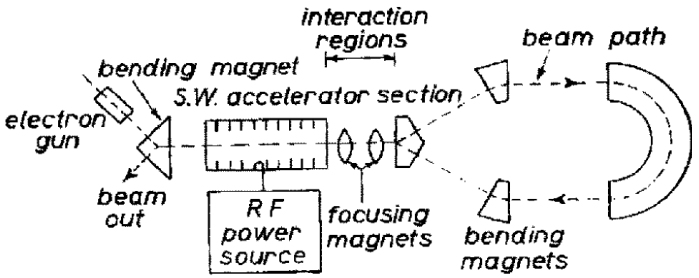
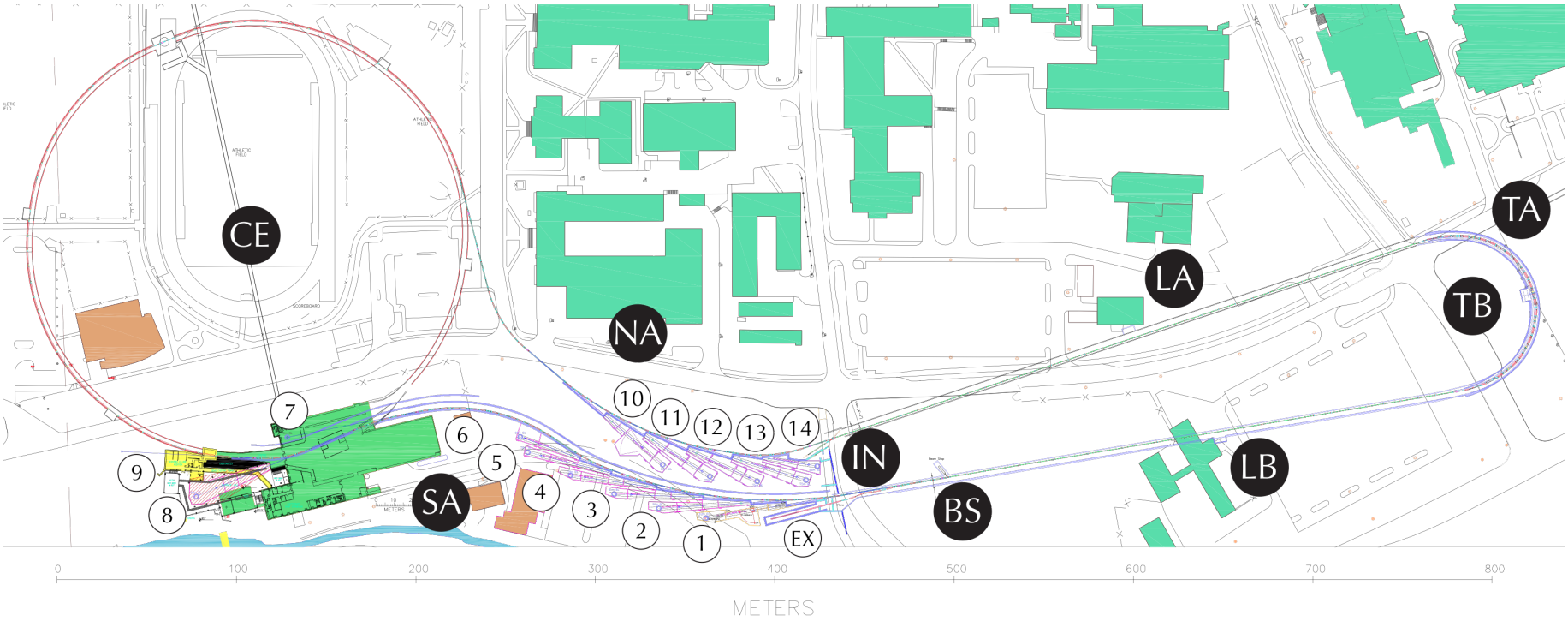


Fig. 3.

1999: Tigner suggests a coherent hard x-ray ERL light source is feasible.
2000: First x-ray Science Workshop for an ERL at Cornell
NSF encourages proposal
2001: Cornell & JLab ERL `white' paper. Phase 1a proposed.
2005: NSF funds Phase1a: 5-yr R&D on injector, linac modules, machine issues.
2006: Six x-ray Science Workshops for an Energy Recovery Linac at Cornell
2006: Conceptual engineering studies for Phase II (NY State + CU support)
2008: NSF Light Source Panel recommends that the NSF
should build & steward a coherent light source.
2010: NSF funds Phase 1b: 4 year continued R&D).
ERL civil construction design study completed.
2011: XDL-2011 Workshops completed.
ERL technical design report (PDDR) completed, reviewed.
ERL draft Environmental Impact Statement ready for submission.
2012: Critical ERL Phase 1b milestones achieved

Cornell ERL


CE
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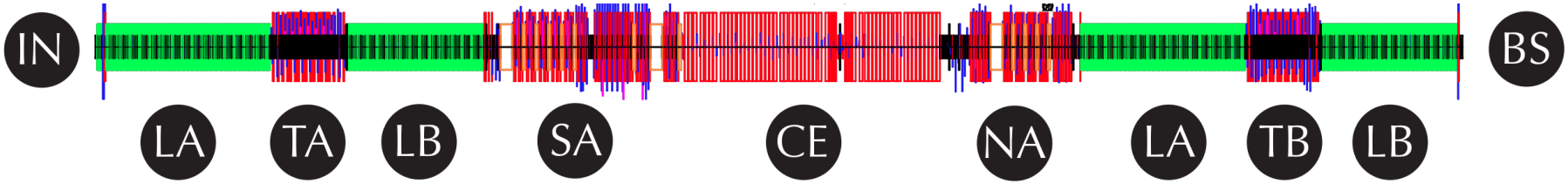
METERS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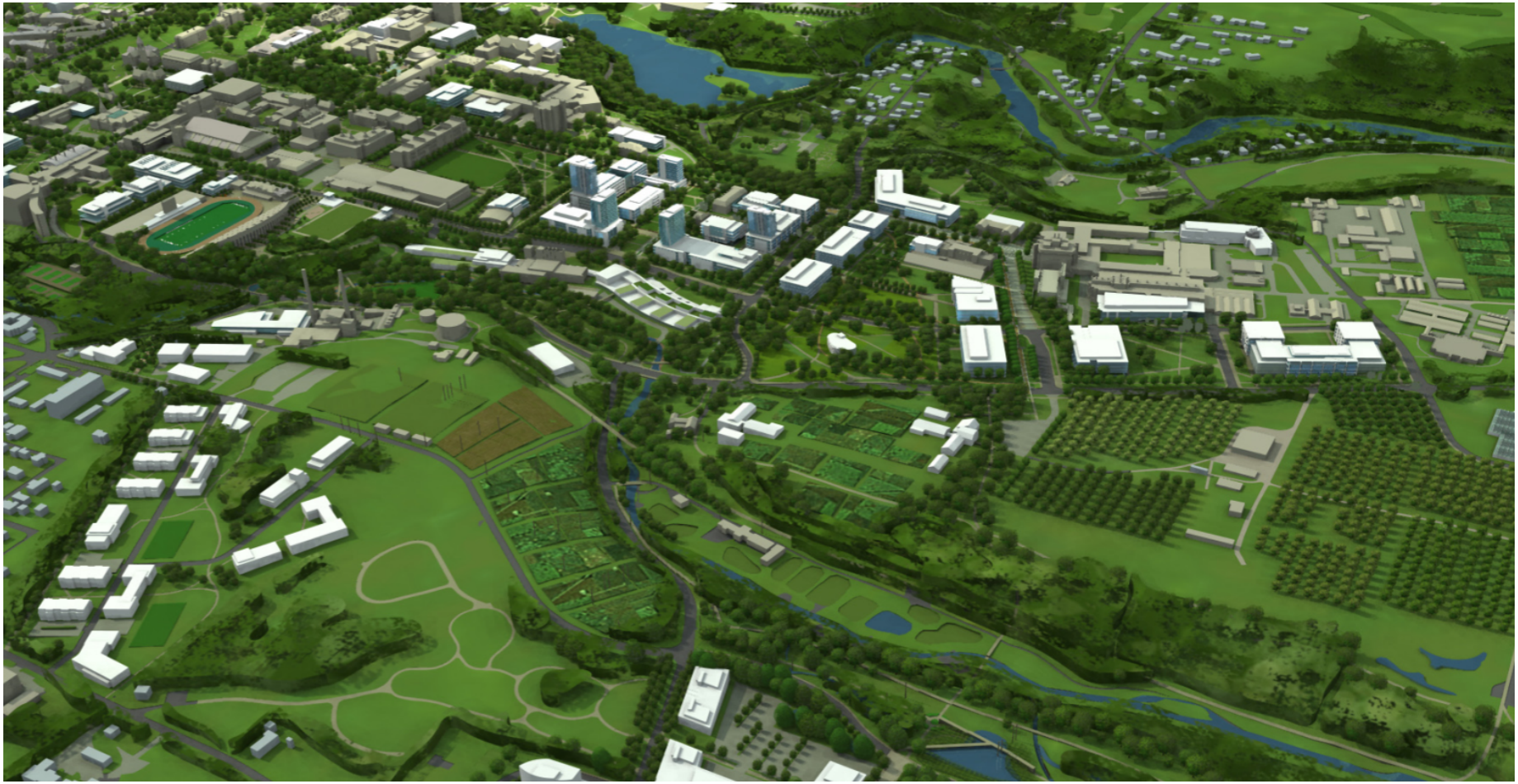
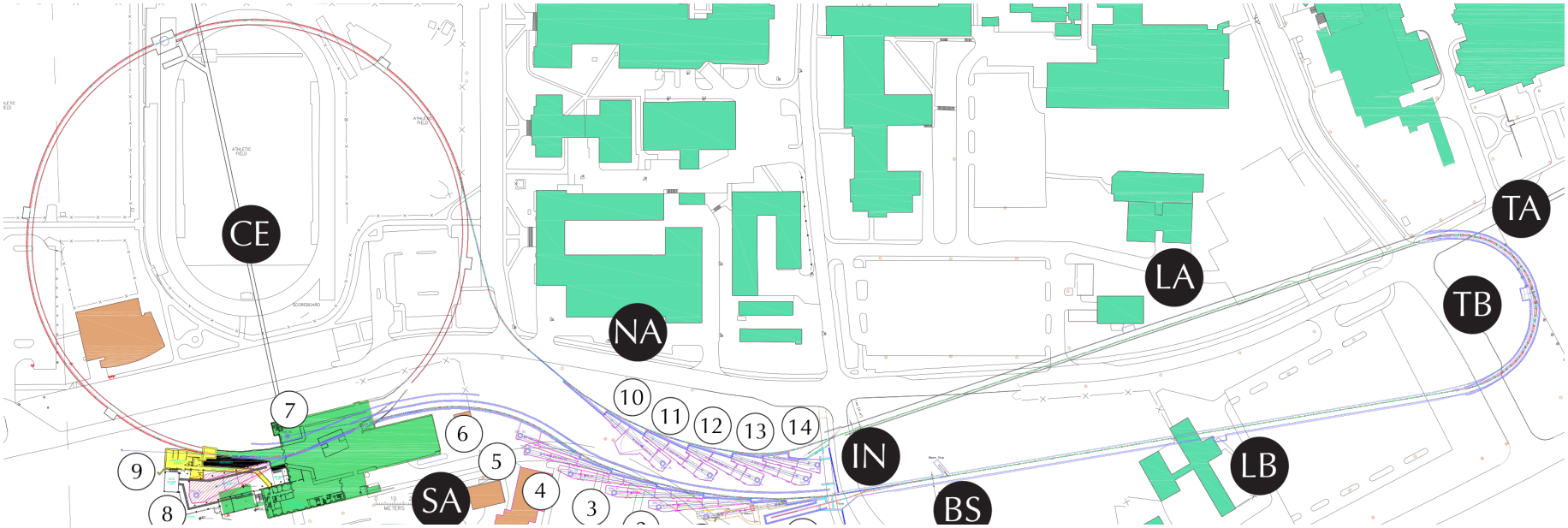
Cornell Master Plan



[www.masterplan.cornell.edu]

Cornell ERL Parameters



Operating Modes	A *High Flux*	B *High Coherence*	C *Short Bunch*	Unit
Energy	5	5	5	GeV
Current	100	25	25	mA
Bunch Charge	77	19	19	pC
Repetition Rate	1.3	1.3	1.3	GHz
ϵ_x (SA/NA)	31/52	13/34	21/66	pm
ϵ_y (SA/NA)	25/26	10/10	14/14	pm
σ_z/c (SA/NA)	2.1/2.1	1.5/1.5	1.0/0.1	ps
σ_δ (SA/NA)	1.9/1.9	0.9/1.0	9.1/9.3	10^{-4}

Cornell ERL PDDR

www.classe.cornell.edu/ERL/

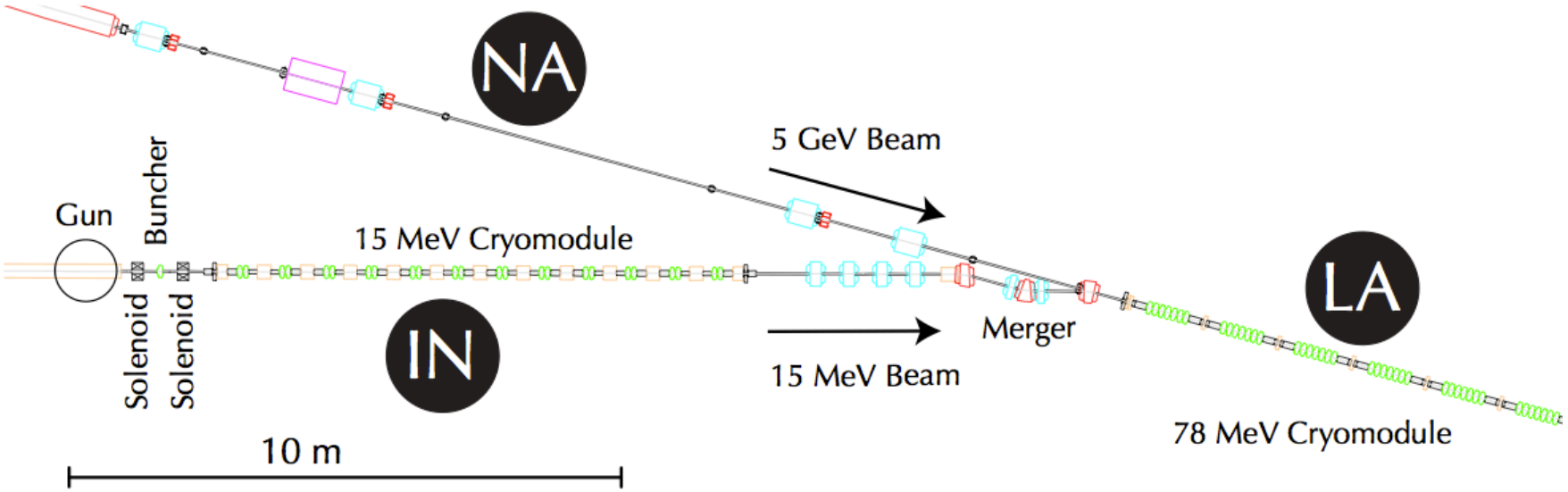
Cornell Energy Recovery Linac

Project Definition Design Report

Editors: Georg H. Hoffstaetter, Sol M. Gruner, Maury Tigner

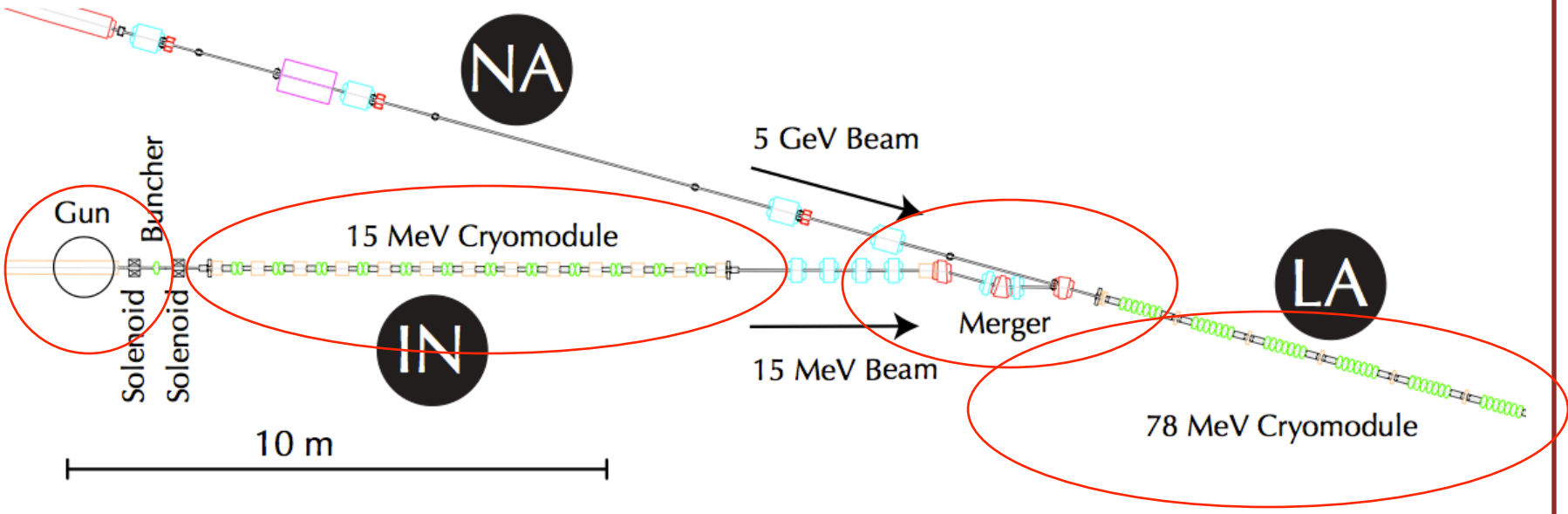
Contributors: A. Bartnik, I. V. Bazarov, D. H. Bilderback, M. G. Billing, J. D. Brock, J. A. Crittenden, L. Cultrera, D. Dale, J. A. Dobbins, B. M. Dunham, R. D. Ehrlich, M. P. Ehrlichman, R. Eichhorn, K. D. Finkelstein, E. Fontes, M. J. Forster, S. Full, F. Furuta, D. Gonnella, S. W. Gray, S. M. Gruner, C. Gulliford, D. L. Hartill, Y. He, R. G. Helmke, V. Ho, R. P. Kaplan, S. S. Karkare, V. O. Kostroun, H. A. Lee, Y. Li, X. Liu, M. U. Liepe, C. E. Mayes, J. M. Maxson, A. A. Mikhailichenko, H. S. Padamsee, J. R. Patterson, S. B. Peck, S. E. Posen, P. G. Quigley, P. Revesz, D. H. Rice, D. C. Sagan, J. O. Sears, V. D. Shemelin, D. M. Smilgies, E. N. Smith, K. W. Smolenski, A. B. Temnykh, M. Tigner, N. R. A. Valles, V. G. Veshcherevich, A. R. Woll, Y. Xie, Z. Zhao

Critical components

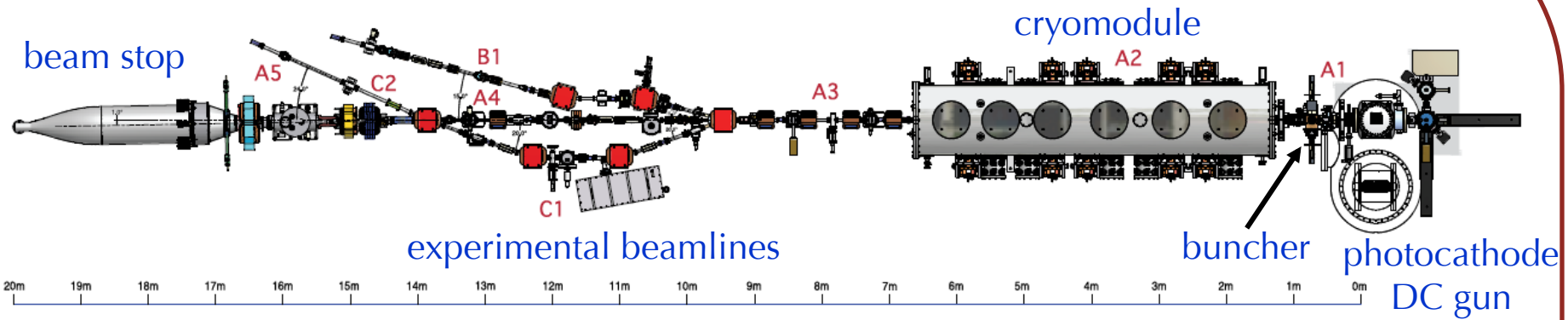


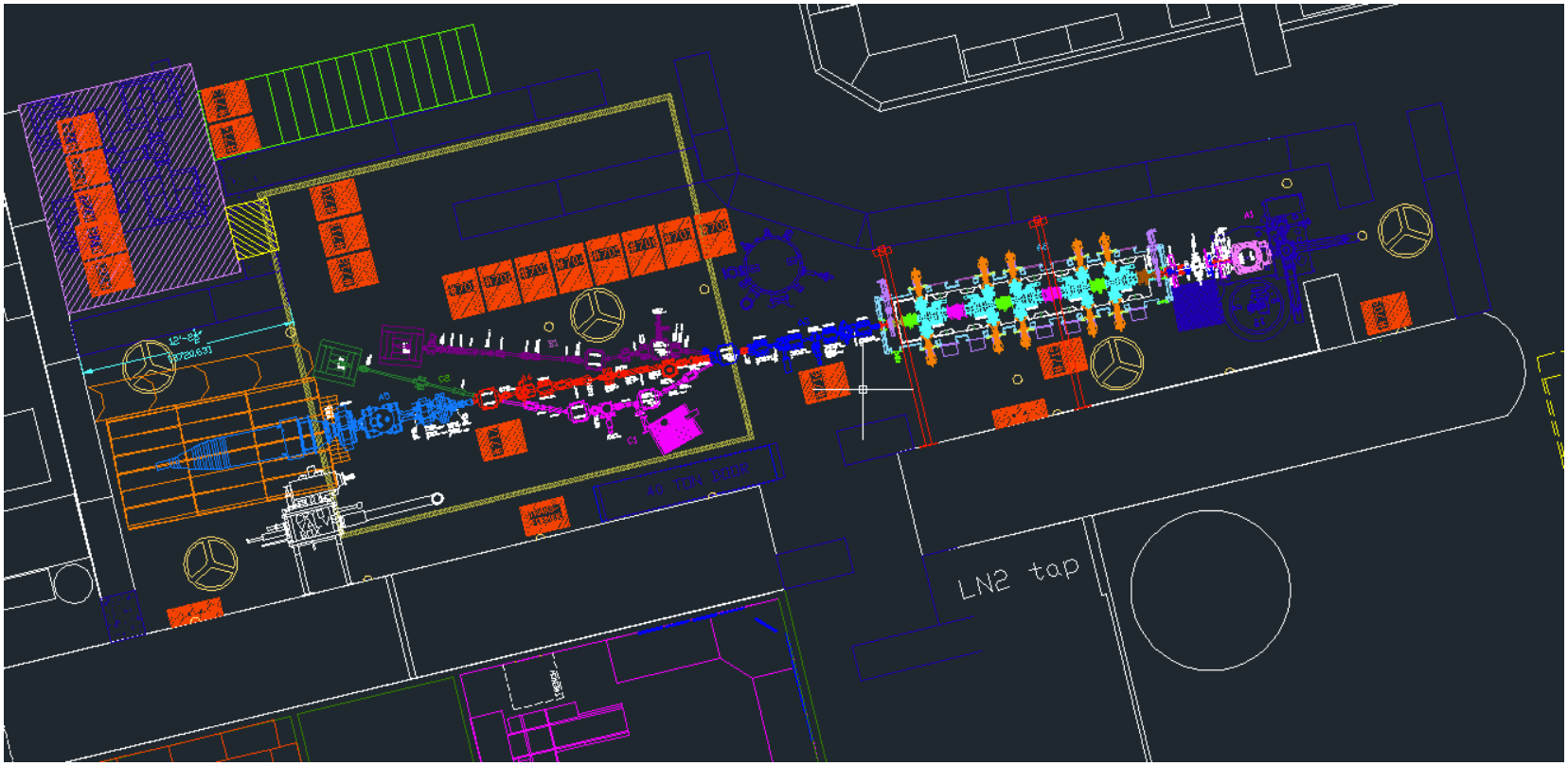
Critical components

Phase 1a & 1b

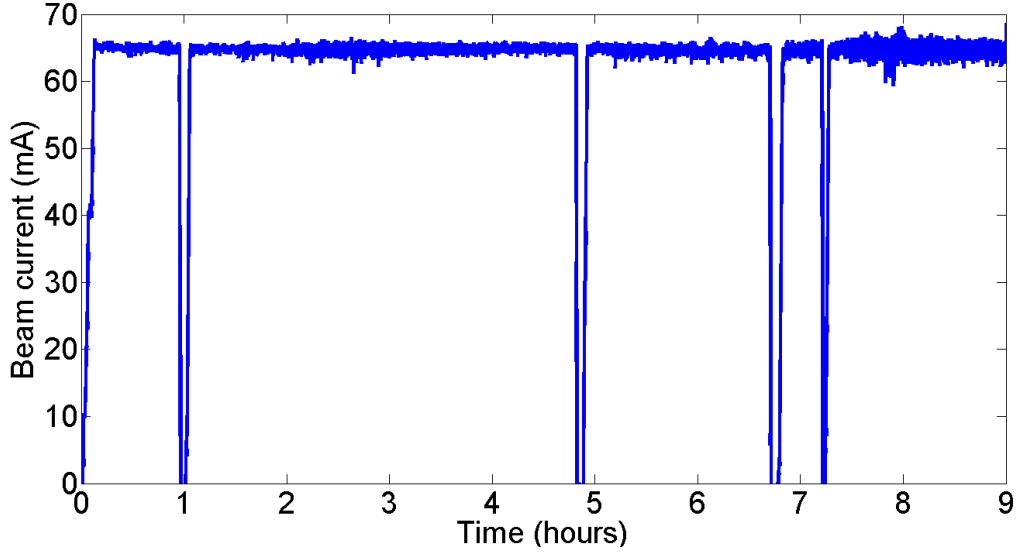


Prototype ERL injector

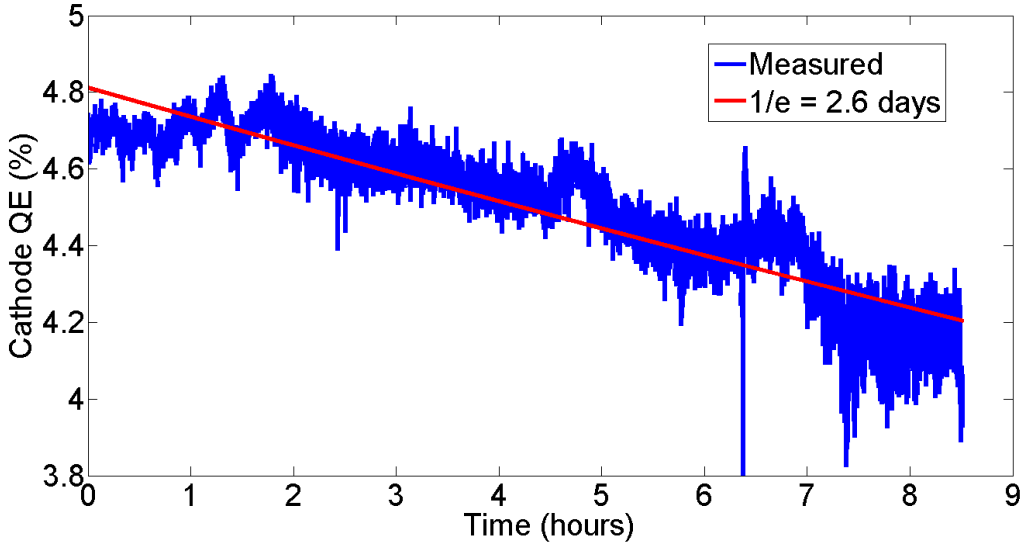




Highest current ever NaK_2Sb Cathode: 75 mA, 65 mA sustained



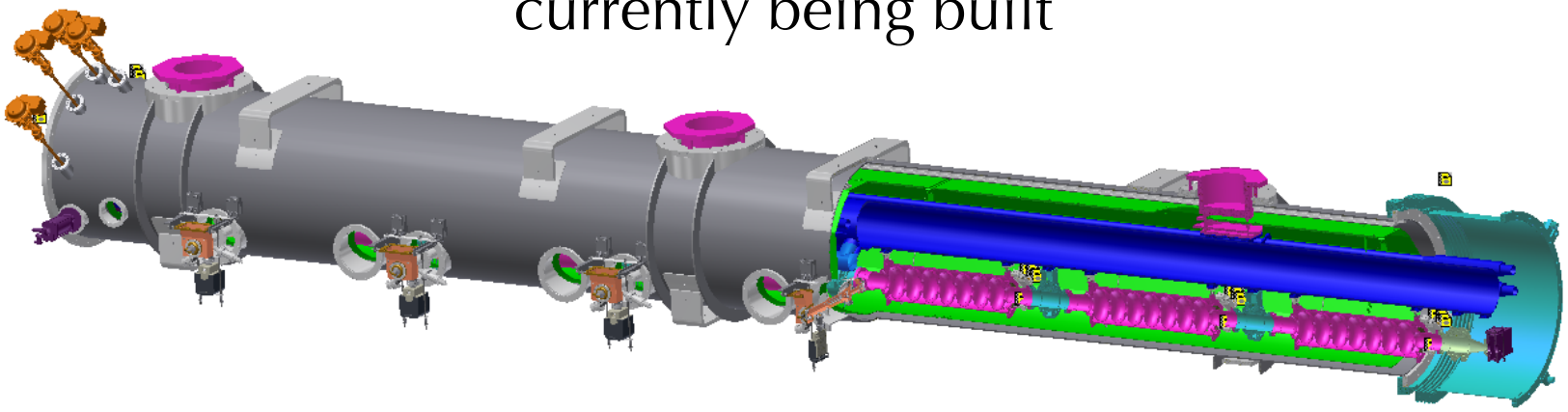
May 24, 2013



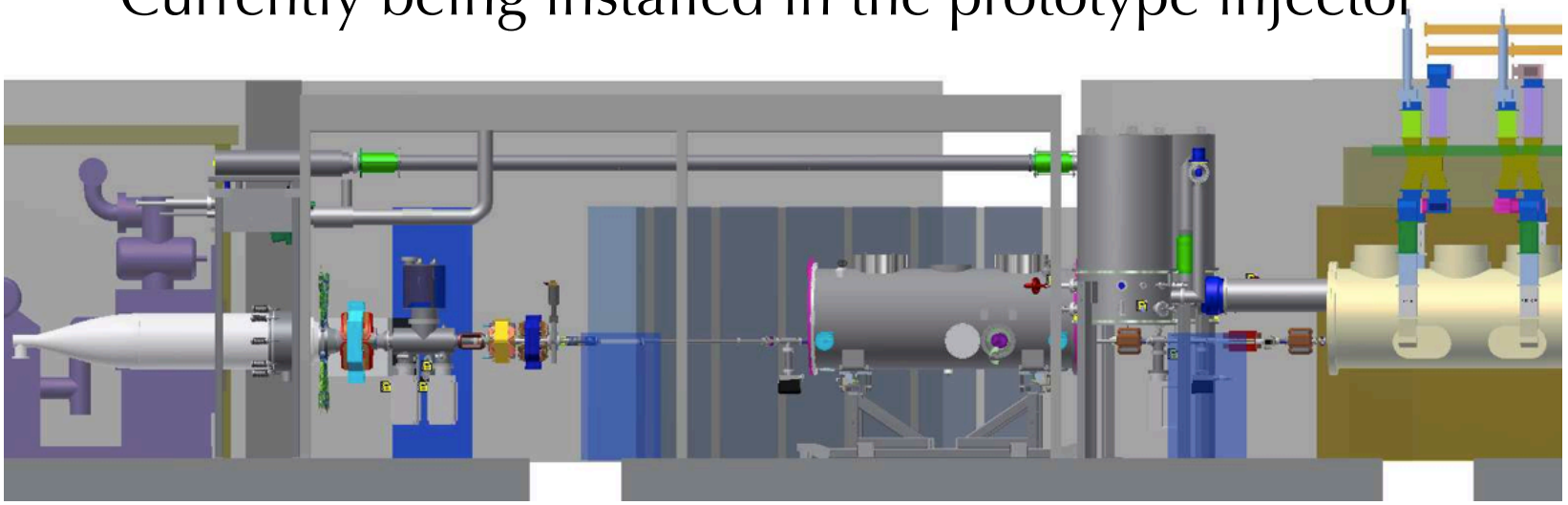
L. Cultrera, *et al.*, *Appl. Phys. Lett.*, in publication
B. Dunham, *et al.*, *Appl. Phys. Lett.*, 102, 034105 (2013)

Phase 1b Cryomodules

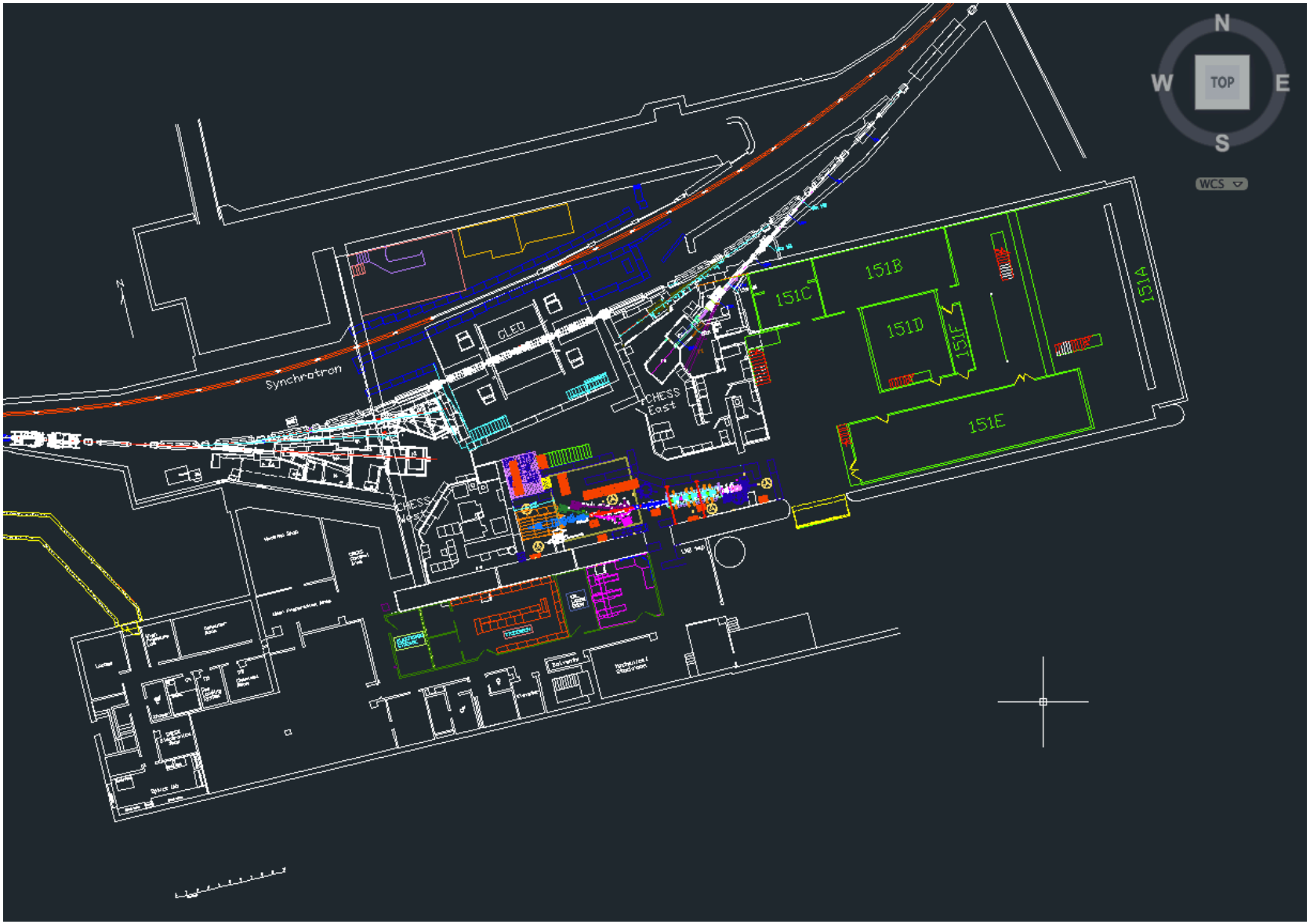
Main Linac Cryomodule (MLC) currently being built



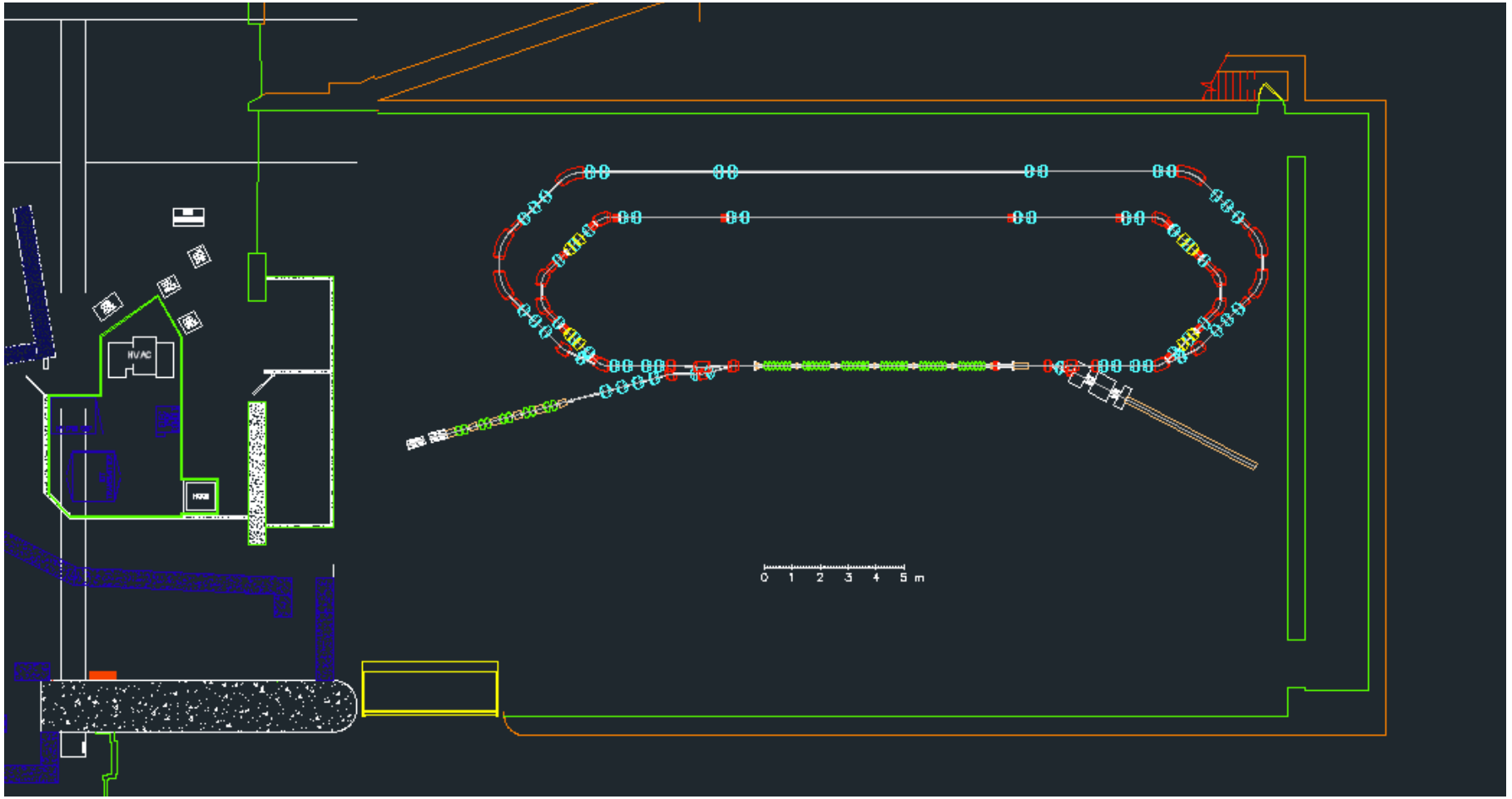
Horizontal Test Cryomodule (HTC) Currently being installed in the prototype injector



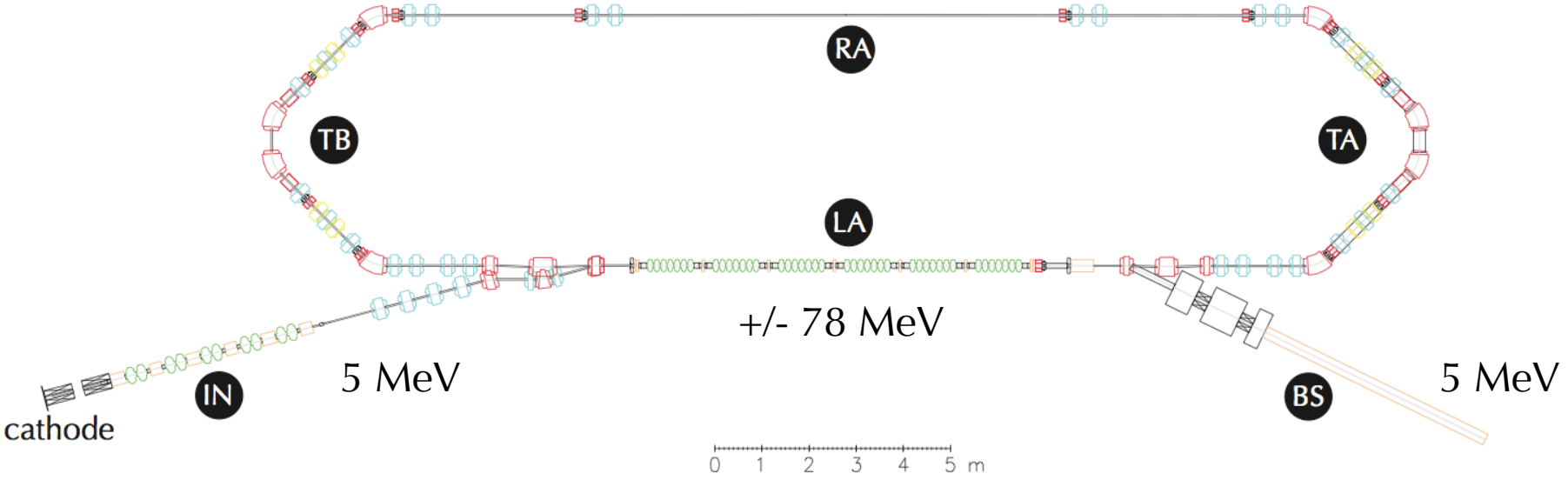
Cornell High-power recirculation loop



Cornell High-power recirculation loop



Cornell High-power recirculation loop (preliminary design)



Energy	83	MeV
Current	100	mA
Emittance x, y	0.3	mm-mrad
Frequency	1.3	GHz
Bunch charge	77	pC

Studies

High current

- Halo sources in high-power beams
- Halo development in high-power beams
- Particle-Loss mechanisms
- Collimation of beam halos
- Detection of beam halos
- Particle-loss detection for machine and personnel safety
- Radiation background, material damage, and demagnetization under particle loss

Studies

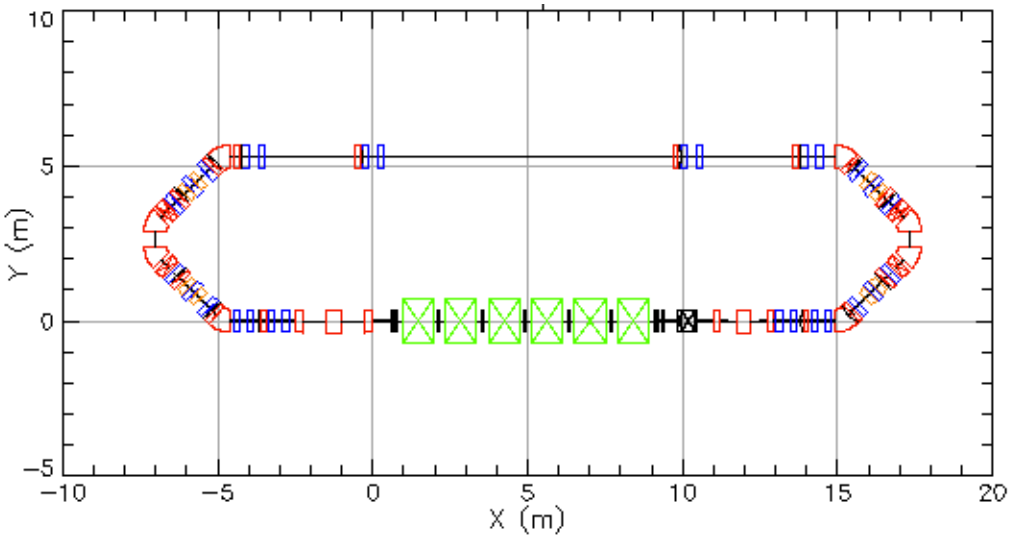
CW operation

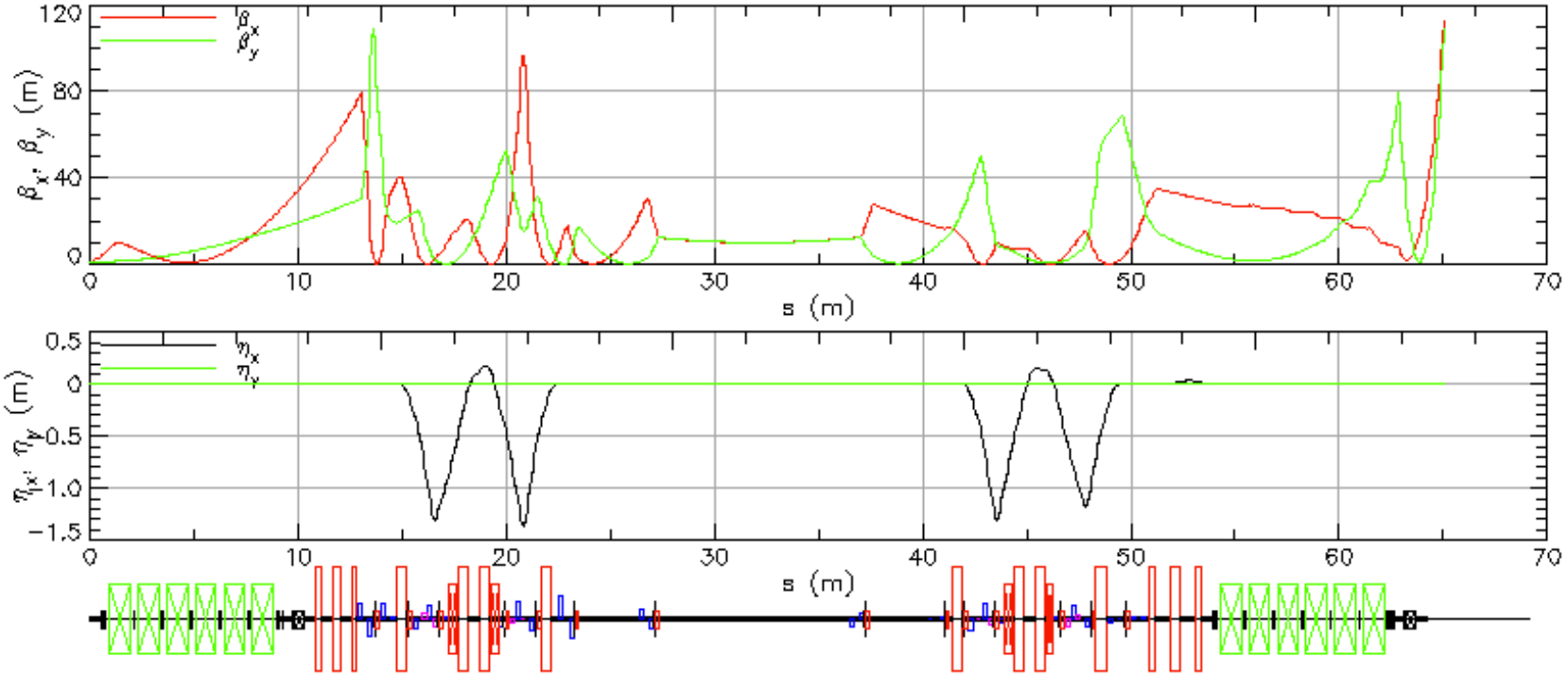
- SRF operation dominated by dynamic heat load
- SRF field control at highest precision
- Active and passive microphonics control in SRF cryostats
- Evaluation of high-precision cavity production, incl. Q0, Q and R/Q of HOMs, coupler kicks, alignments, and straightness.

Low emittance

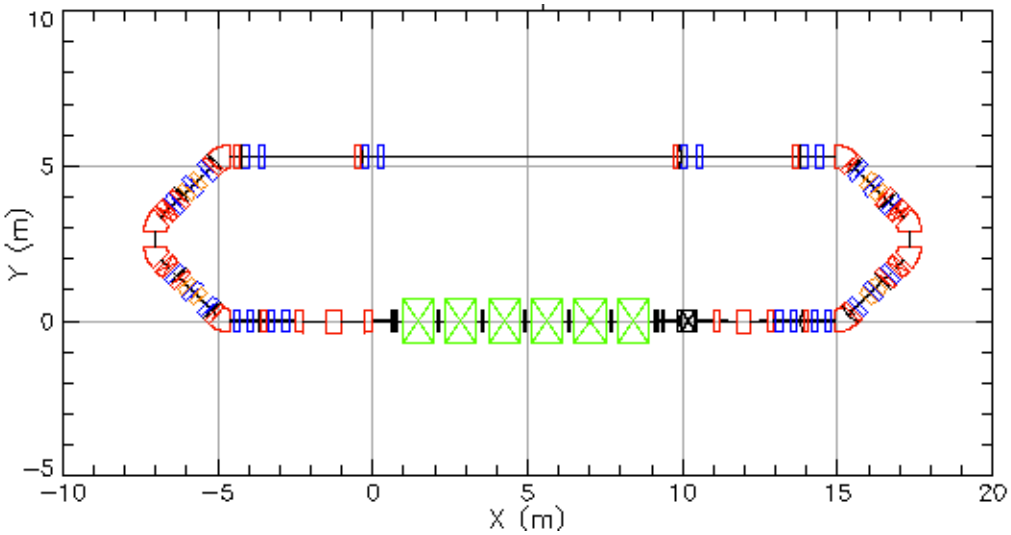
- Space-charge dominated beams (in the injector region)
- High-density beams in high-energy accelerators (emittance preservation, error fields, element alignments and imperfections)
- High-brightness beam diagnostics

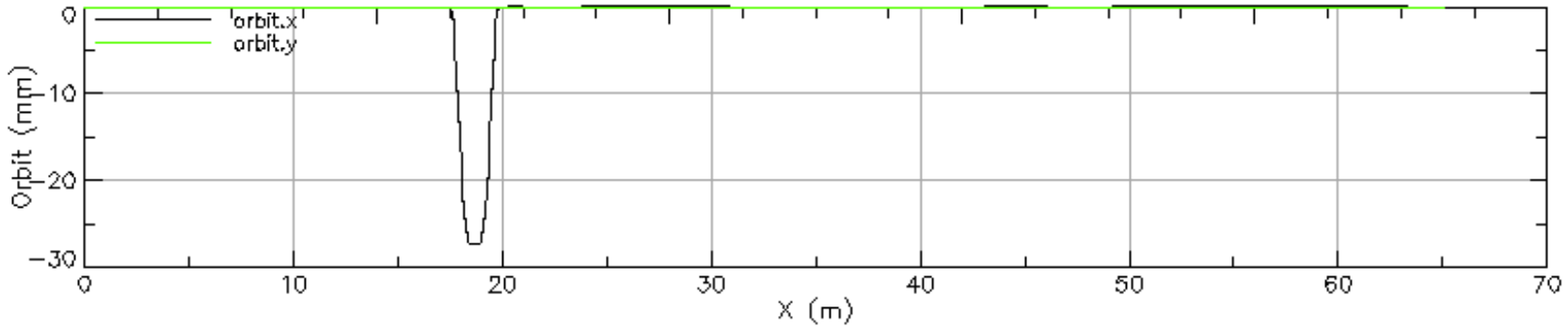
Lattice

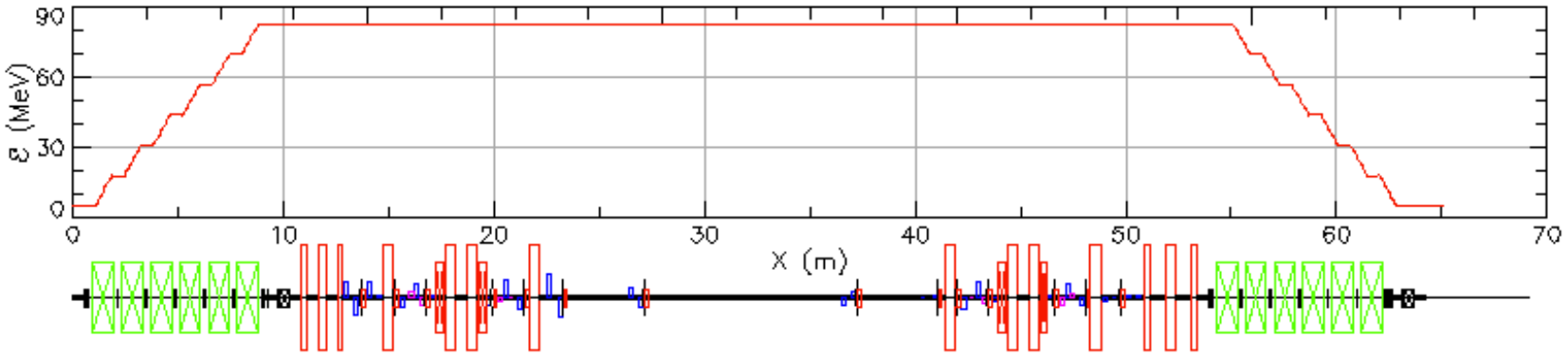




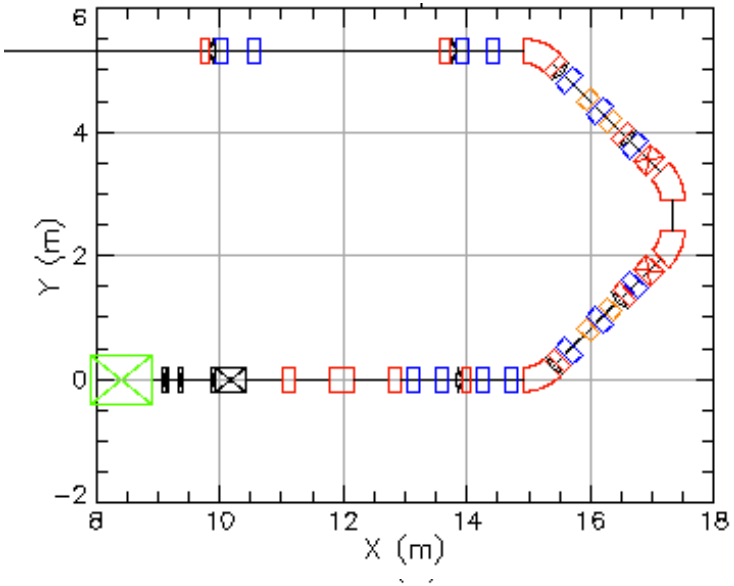
Lattice

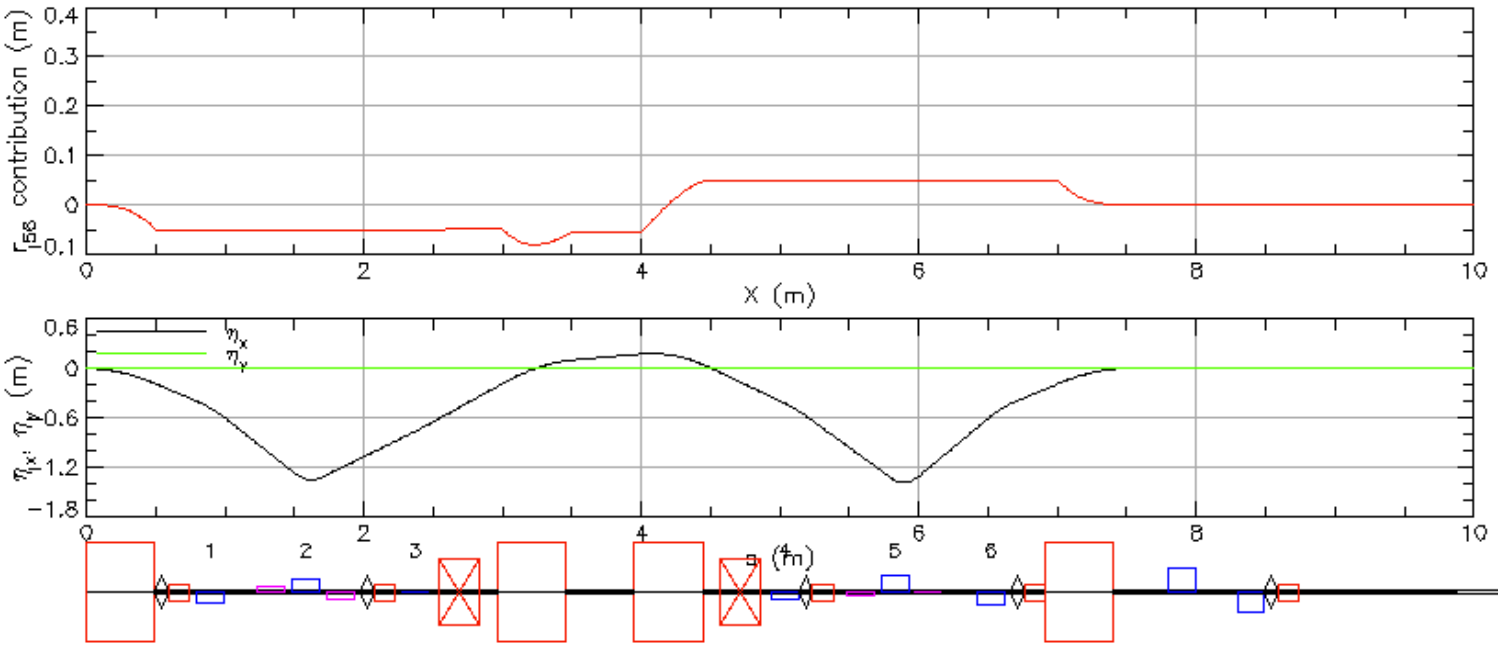




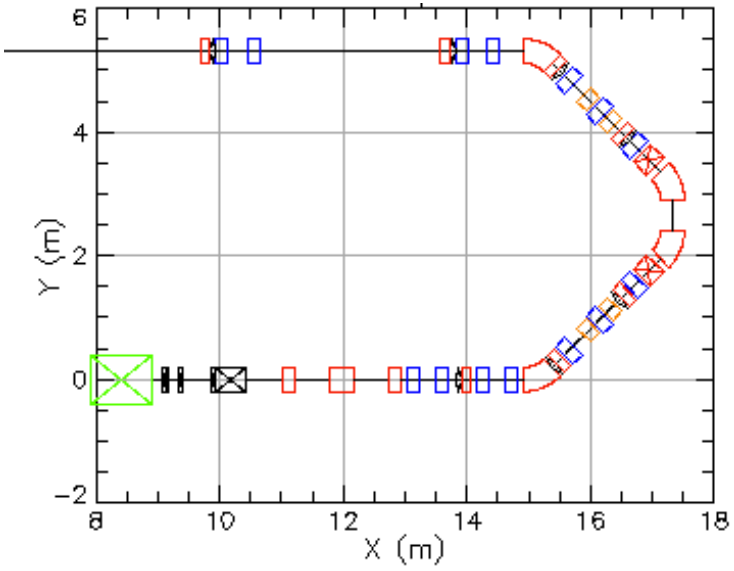


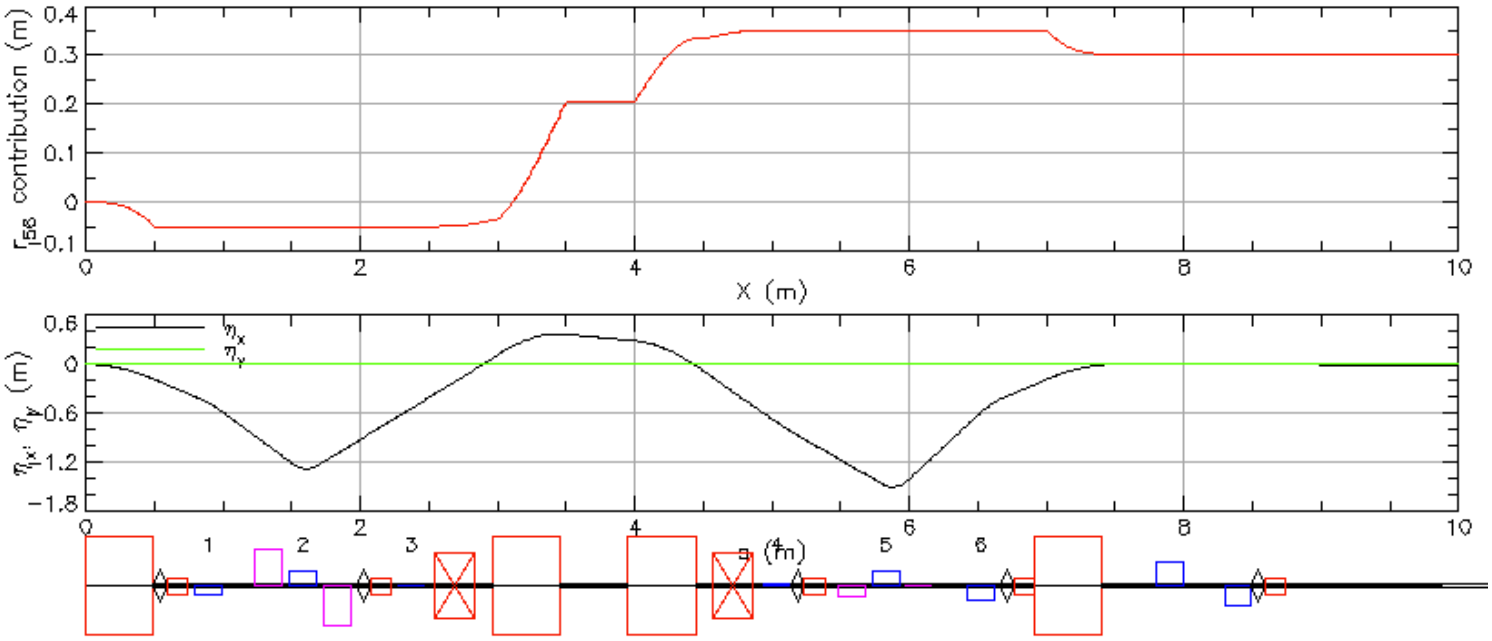
Arc – on crest operation





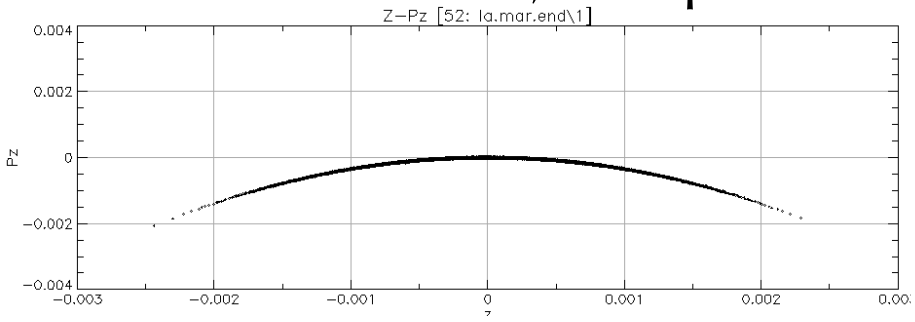
Arc – bunch compression operation



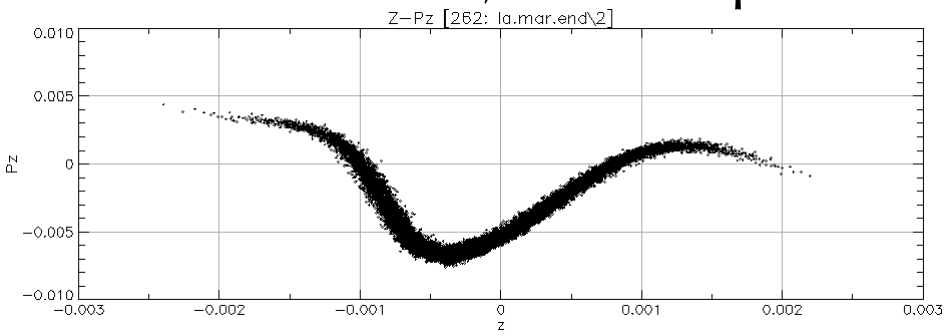


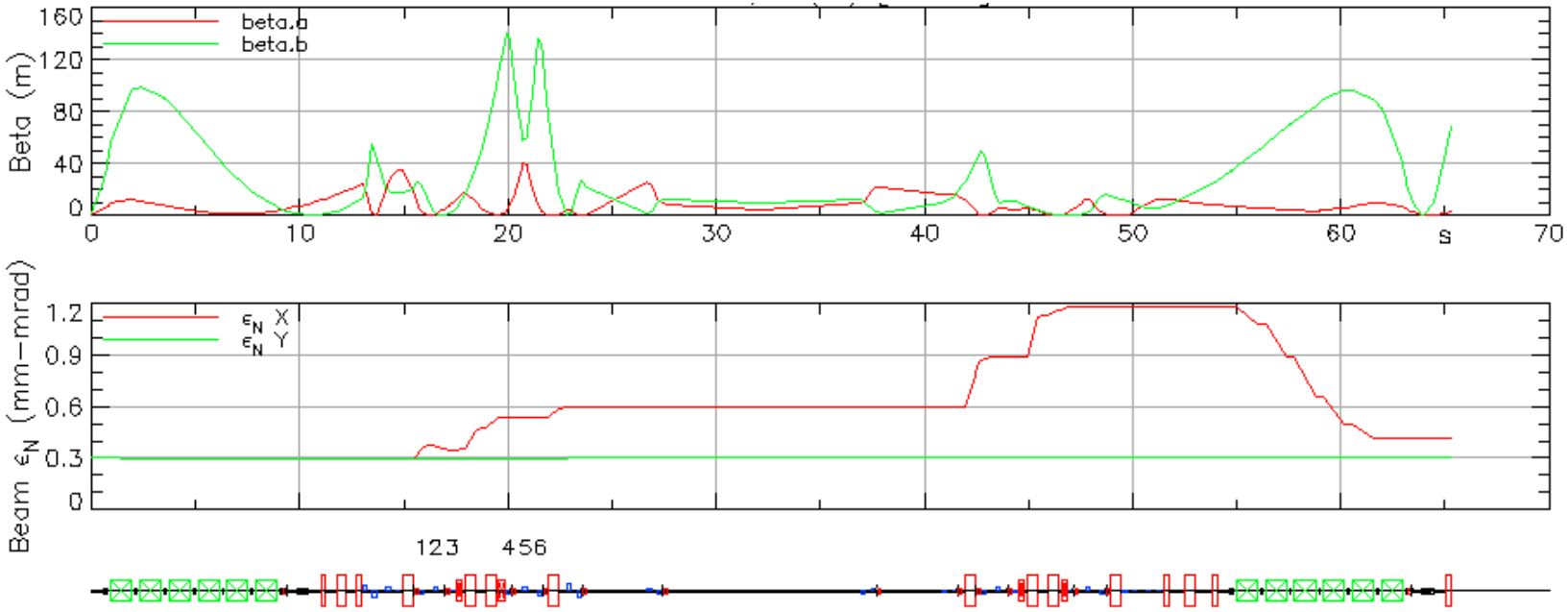
CSR (shielding included), 77 pC

End of linac, first pass



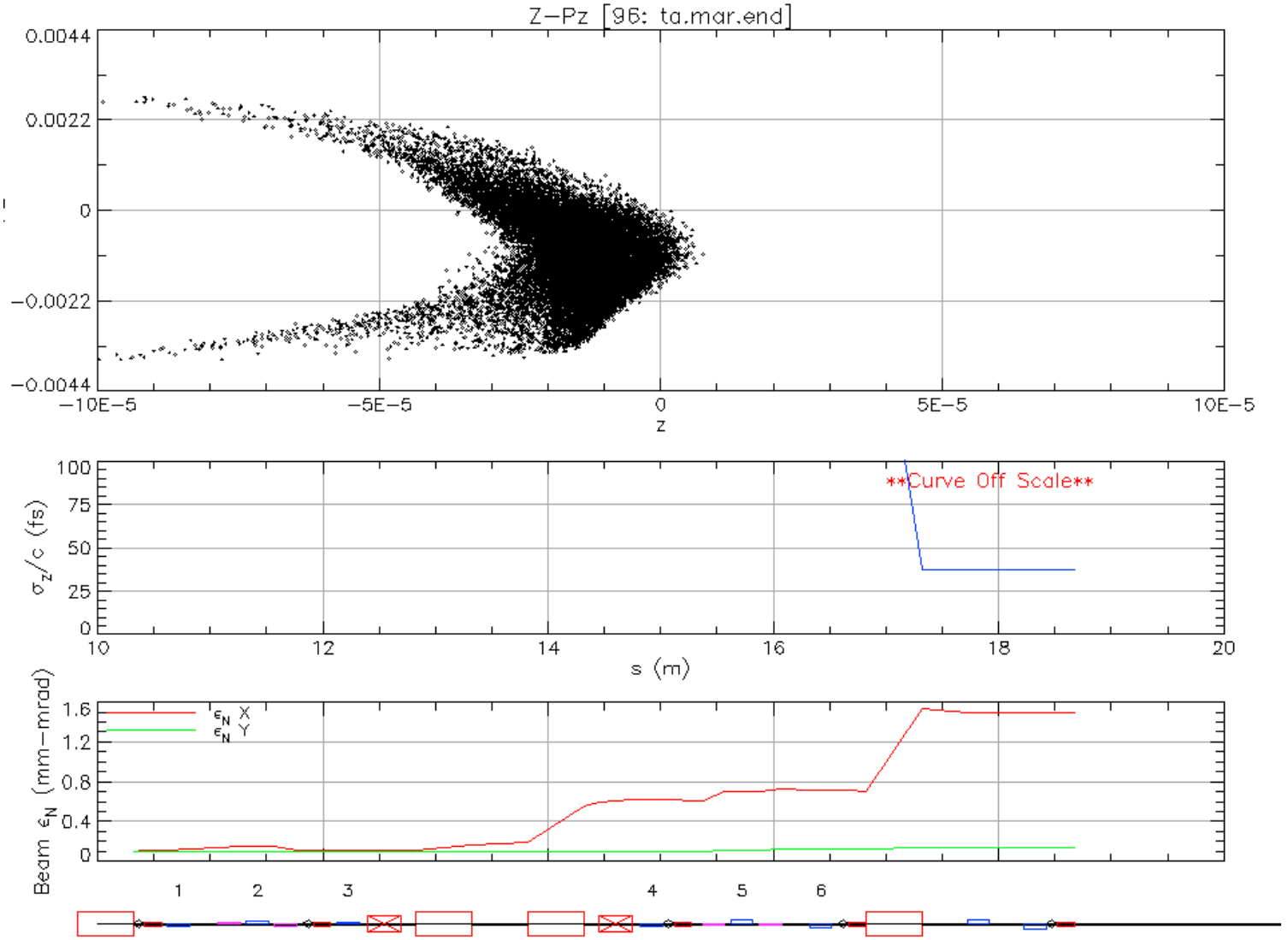
End of linac, second pass





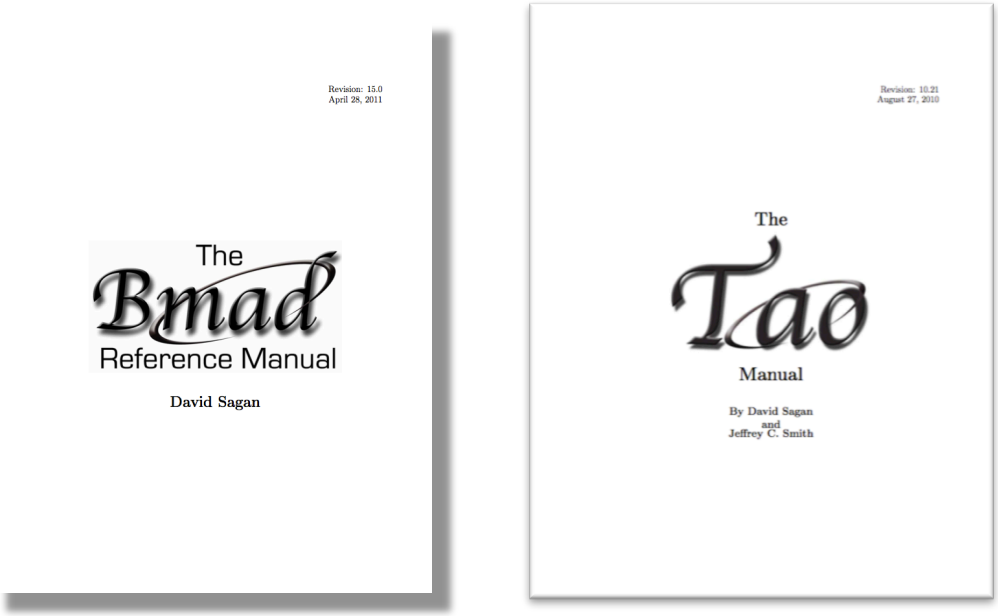
CSR (shielding included), 19 pC

End of first arc



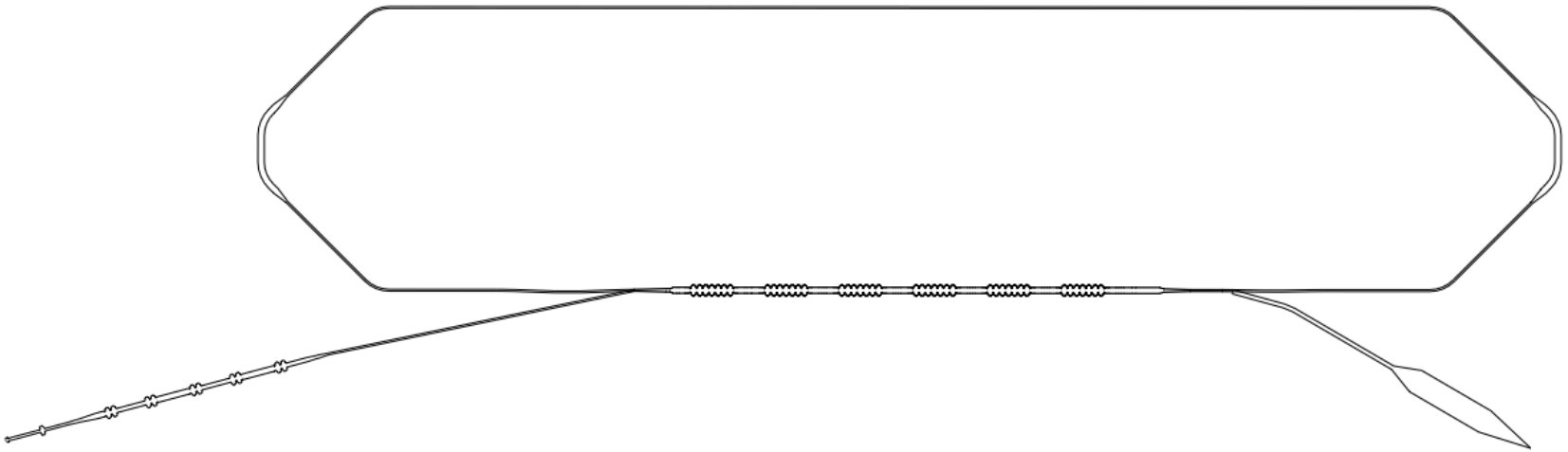
Simulation Software

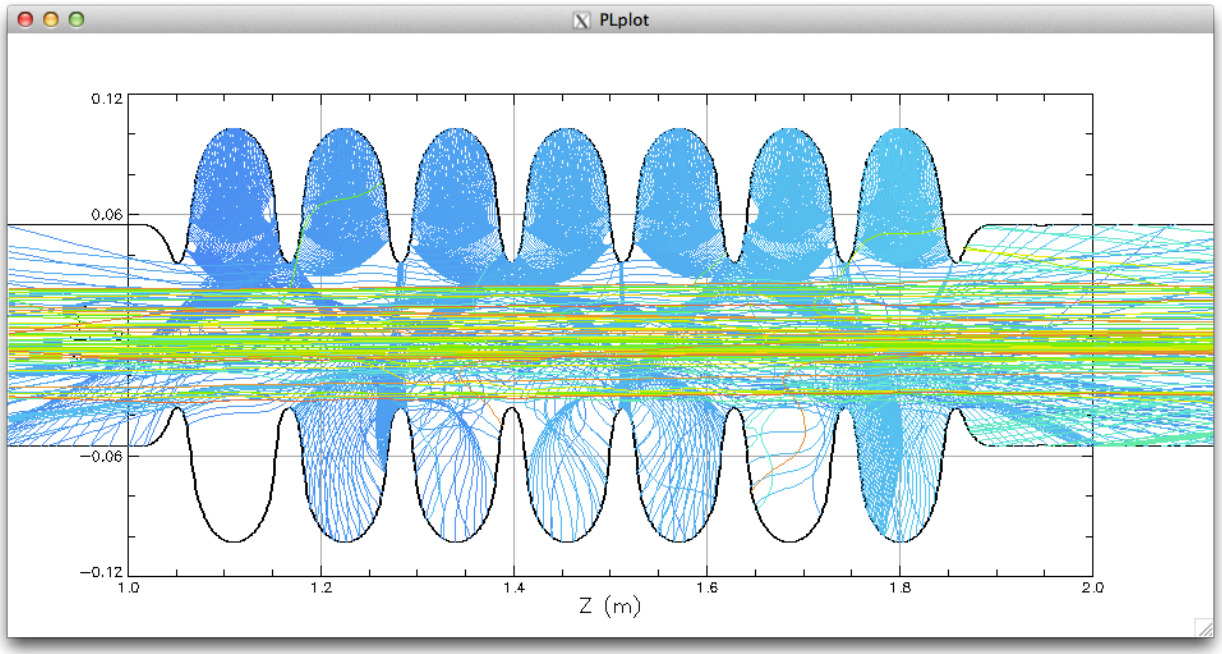
Bmad & Tao (Cornell)



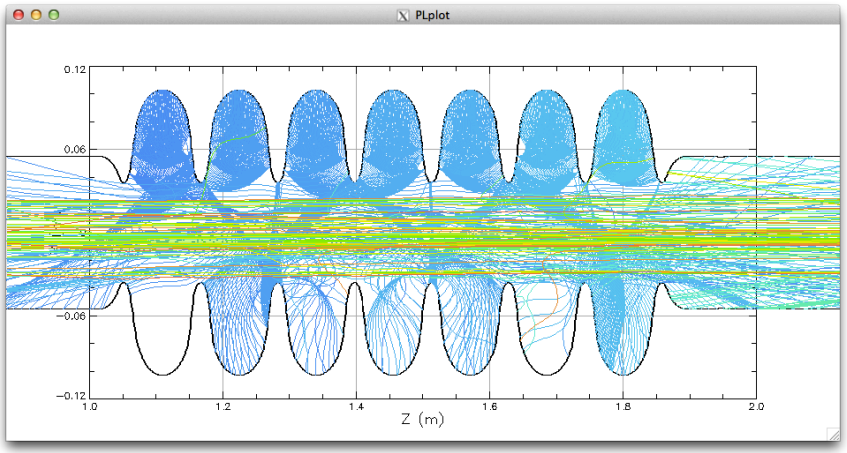
www.lns.cornell.edu/~dcs/bmad

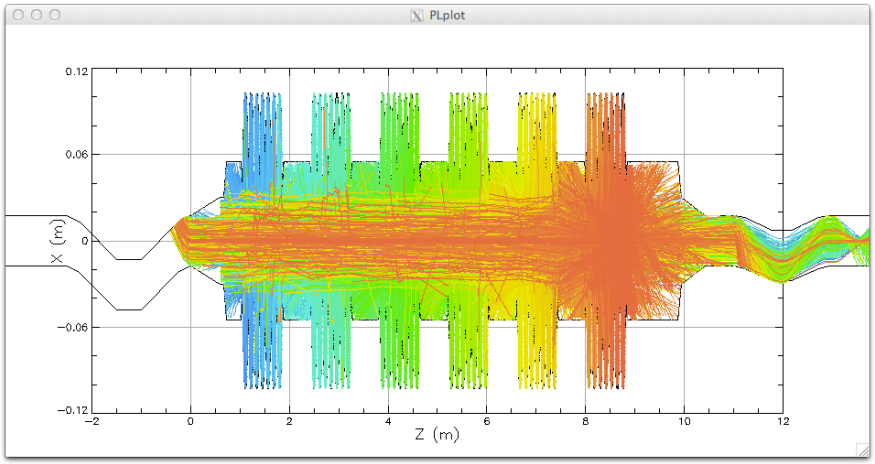
Dark current tracking

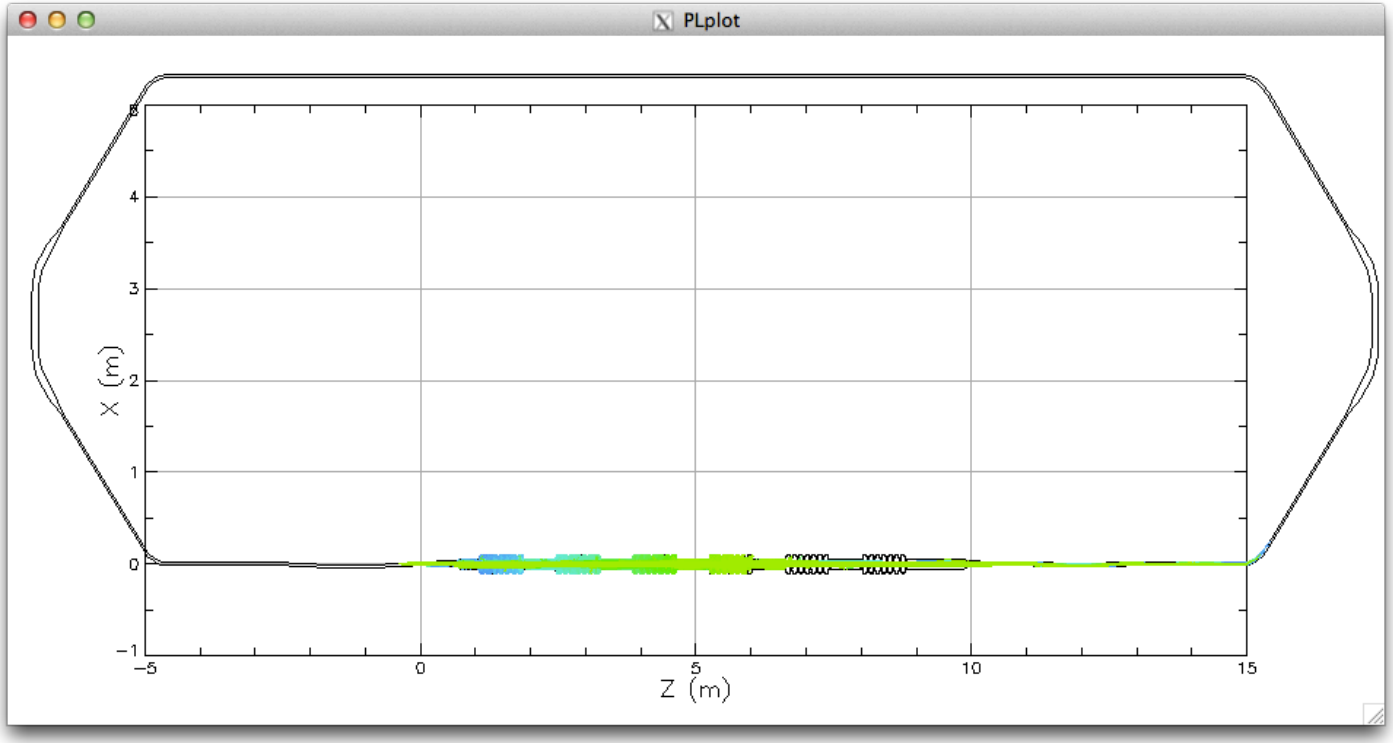




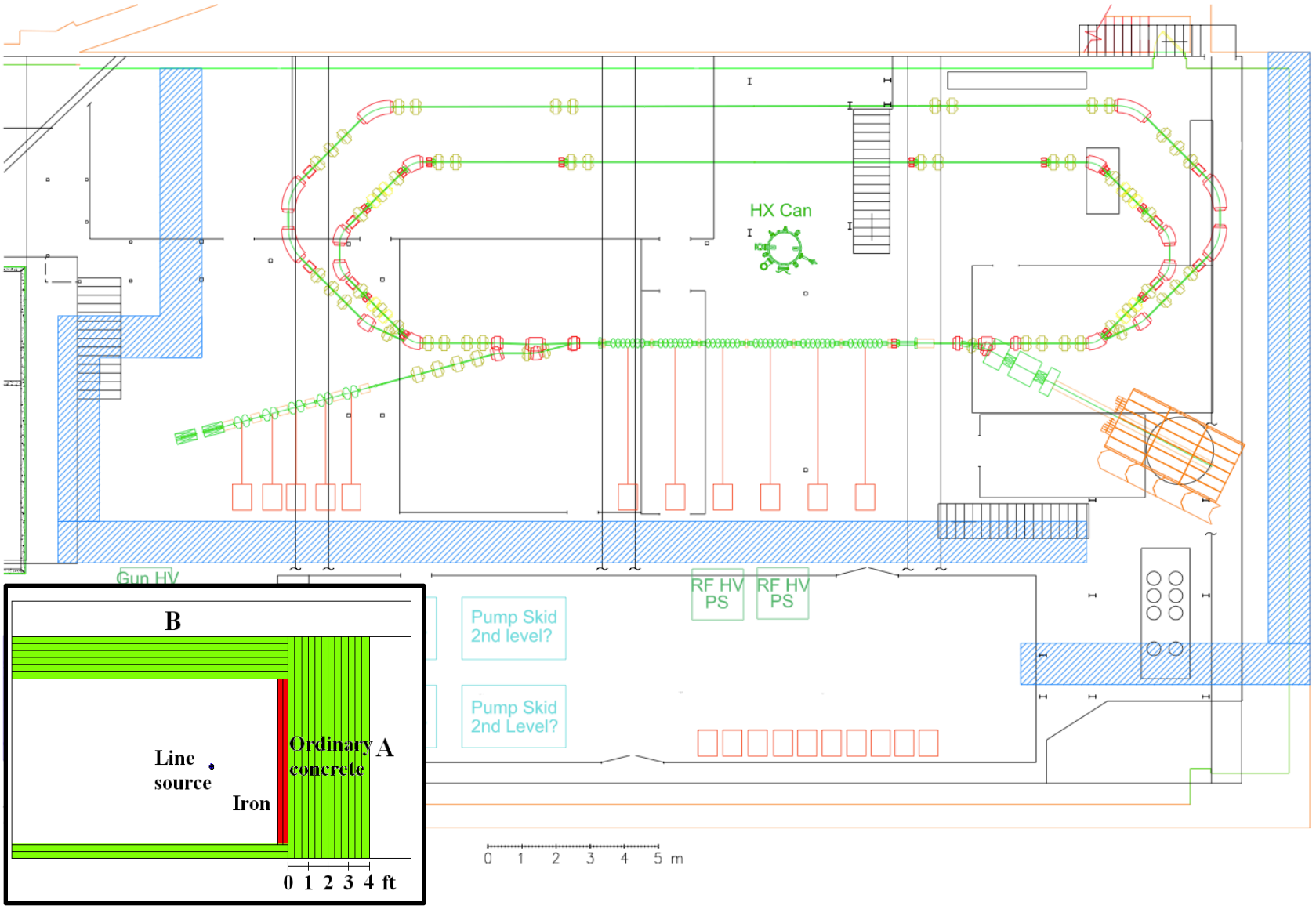
Dark current tracking







Shielding Wall



Cornell ERL PDDR

www.classe.cornell.edu/ERL/

Cornell Energy Recovery Linac

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This work is supported by the National Science Foundation grant DMR-0807731