



# ILC Lattice Descriptions: The Big Picture

M. Woodley, SLAC

# ILC Lattice Description Files

- all files are MAD (XSIF) decks
- most recent versions for all Area Systems (RDR baseline)
- some tuneup/abort dump lines missing
- decks for each Area System integrated (device naming conflicts resolved, treaty points and break points established (somewhat arbitrarily), etc.)
- earth's curvature following switched off (for first iteration of global layout)
- MAD SURVEY layout generation in "IP" coordinate system
  - IP at  $X=0$ ,  $Y=0$ ,  $Z=0$
  - plan view: horizontal axis is  $Z$ ; vertical axis is  $X$
  - elevation view: horizontal axis is  $Z$ ; vertical axis is  $Y$
  - e- Main Linac at  $Z<0$ , oriented at  $\theta = 0.007$  rad
  - e+ Main Linac at  $Z>0$ , oriented at  $\theta = \pi - 0.007$  rad
  - Damping Rings centered in  $Z$  at  $Z=0$  (not centered in  $X$ )
- some modifications to "zeroth-order" optics (i.e. layout) have been made in order to put IPs at  $X=0$ ,  $Z=0$  and to establish 14 mrad crossing angle
- injection/extraction straight sections for "central injectors" Damping Rings remains incomplete at this point

# The Files: What / Who / Where / When

- ESOURCE
  - from F. Zhou [SLAC] (version of 8 January 2007)
- PSOURCE
  - from Y. Nosochkov and F. Zhou [SLAC] (version of 8 January 2007)
- EDR / PDR
  - from A. Xiao and L. Emery [ANL] (version of 20 June 2006) “OCS6”
    - <https://wiki.lepp.cornell.edu/ilc/pub/Public/DampingRings/WebHome/OCS6.xsif>
- EDRi / EDRx / PDRi / PDRx
  - from I. Reichel [LBL] (version of 4 May 2007)
  - includes kickers, septa, compensating bends, etc.
- ERTML / PRTML
  - from P. Tenenbaum [SLAC] (version of 4 March 2007) “BCD”
    - [http://www.linearcollider.org/wiki/doku.php?id=rdr:rdr\\_as:rml\\_lattice](http://www.linearcollider.org/wiki/doku.php?id=rdr:rdr_as:rml_lattice)
- ELIN
  - from A. Valishev [FNAL] (23 May 2007)
  - corresponds to T. Peterson’s latest cryo layout (Module-9-8-9-4Sep07.xls)
    - [http://lattices.fnal.gov/cgi-bin/listall.pl?whichlist=lattices/ilc\\_linac&whichpath=unofficial/valishev/ILC2006e-989-28dec06#onetogoto](http://lattices.fnal.gov/cgi-bin/listall.pl?whichlist=lattices/ilc_linac&whichpath=unofficial/valishev/ILC2006e-989-28dec06#onetogoto)
- PLIN
  - from A. Valishev [FNAL] (23 May 2007)
  - corresponds to T. Peterson’s latest cryo layout (Module-9-8-9-4Sep07.xls)
    - [http://lattices.fnal.gov/cgi-bin/listall.pl?whichlist=lattices/ilc\\_linac&whichpath=unofficial/valishev/ILC2006p-989-4sep07#onetogoto](http://lattices.fnal.gov/cgi-bin/listall.pl?whichlist=lattices/ilc_linac&whichpath=unofficial/valishev/ILC2006p-989-4sep07#onetogoto)
- EBDS / PBDS
  - from M. Woodley [SLAC] (31 October 2006) “ILC2006e”
    - <http://www.slac.stanford.edu/~mdw/ILC/2006e>

# Systems & Subsystems

- ESOURCE
  - EBSTR, ELTR, EDRI
- PSOURCE
  - pPROD, PCAP, PPA, PPATEL, PTRAN, PBSTR, PLTR, PDRI
- EDR
- PDR
- ERTML
  - EDRx, EGETAWAY, EESCALATOR, ERETURN, ETURN, ESPIN, EBC1, EBC2
- PRTML
  - PDRx, PGETAWAY, PESCALATOR, PRETURN, PTURN, PSPIN, PBC1, PBC2
- ELIN
  - ELIN1, EUND, ELIN2
- PLIN
  - PLIN1, PLIN2
- EBDS
  - EBSY1, EBSY2, EFF, EDL
- PBDS
  - PBSY1, PBSY2, PFF, PDL
  
- ELET (DR extraction to IP)
  - ERTML, ELIN, EBDS (to IP)
- PLET (DR extraction to IP)
  - PRTML, PLIN, PBDS (to IP)

~40-50 MAD decks plus parameters files, configuration files, etc.

# “Zeroth-order” Issues (Big Stuff)

1. both Damping Rings are at the same (incorrect) height above the IR ... they should be separated vertically by 1.444 m
2. after connecting the LETs to the DRs and setting the IR crossing angles, the e- and e+ IPs were ~1.8 km apart (this has been partially fixed ... see below)
3. the 500 m photon transport for e+ production should start at the center of the undulator insert ... it's ~360 m downstream
4. the PSOURCE and ERTML escalators should be side-by-side in the same tunnel ... they're separated in Z by ~300 m
5. need a horizontal jog at the lower end of each of the escalators to get back into the main linac tunnels
6. relative beamline locations in shared tunnels, especially:
  - the undulator and e+ source systems in the e- Main Linac tunnel
  - the PDR injection and EDR extraction lines
  - the PSOURCE and ERTML escalators
7. injection/extraction systems for the Damping Rings incomplete ... working with Ina Reichel (LBL) to get the lattices

From the RTML RDR wiki pages:

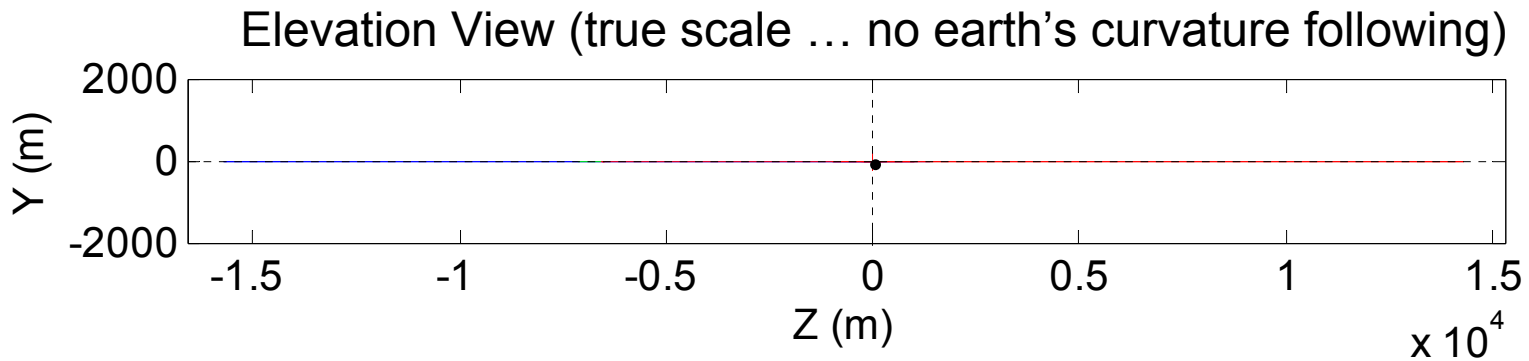
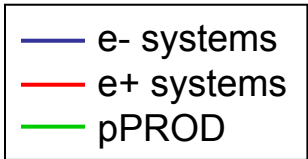
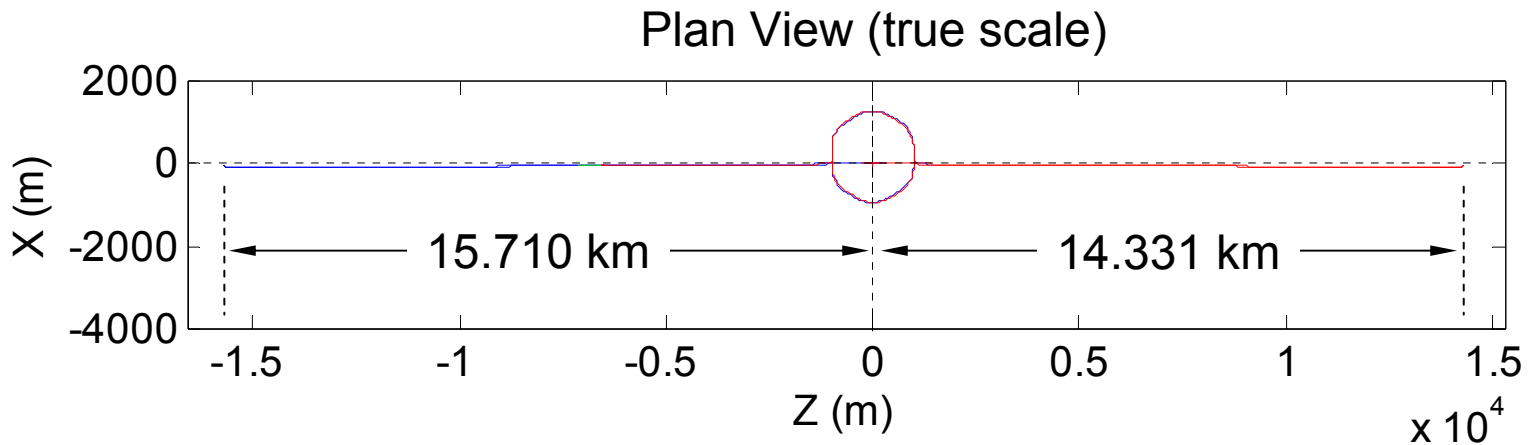
“The geometry is only roughly correct: the bend out of the damping ring is 90 degrees, it should be 90 degrees minus 7 mrad for the crossing angle; the Return and Getaway line lengths are only approximately correct; the electron and positron systems have the same Escalator height when the two should be different, and the bend angles probably need a sign-flip from electron to positron; the geometry of the transition from the linac tunnel to the Escalator tunnel doesn't match the CFS drawings (take a look at the way in which the “injection” and “beam” tunnels match up in the drawings).”

See also the discussions from the DRIX Task Force meeting (3 June 2007 at DESY):

<http://ilcdoc.linearcollider.org/record/8605>

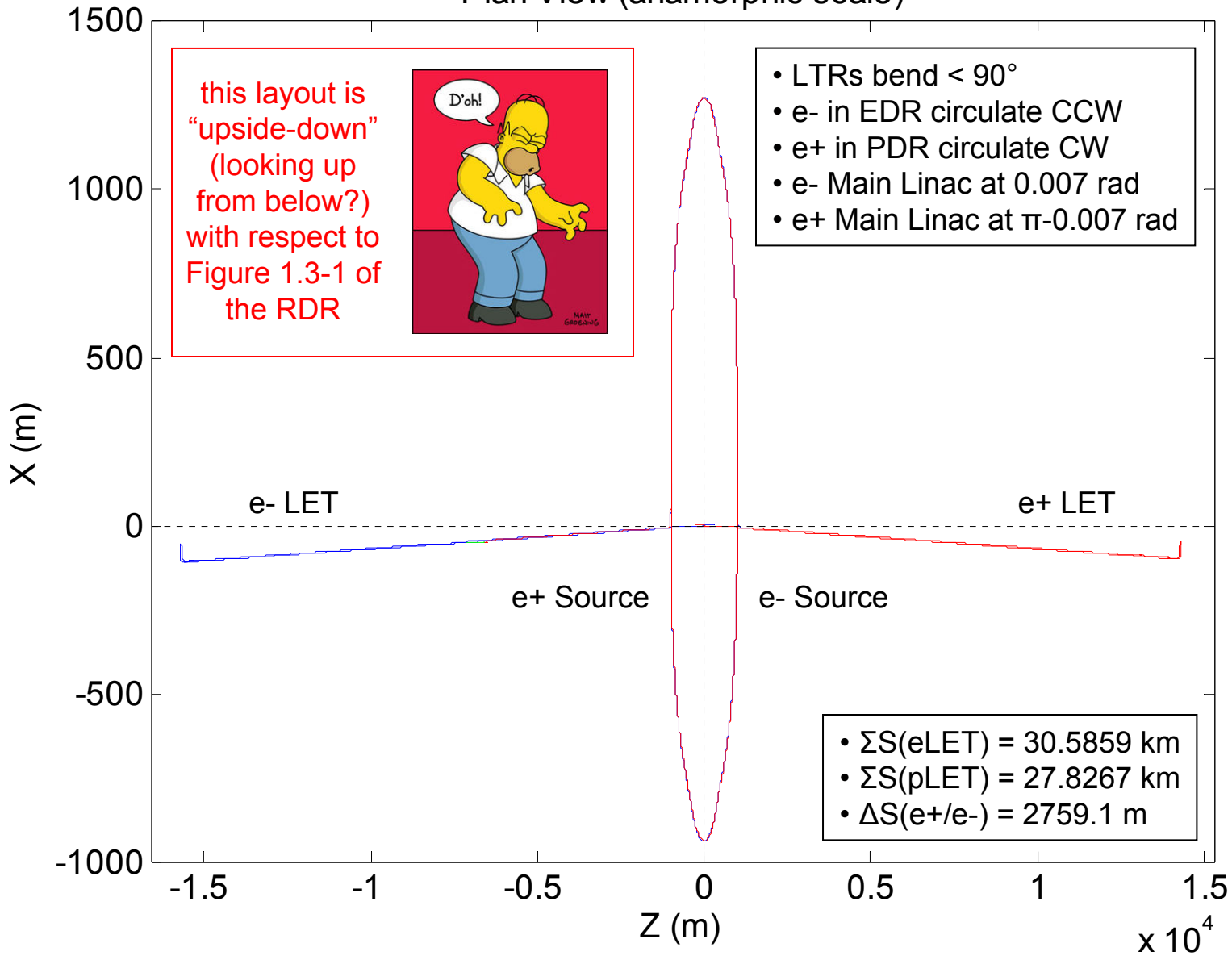
# “Zeroth-order” Modifications (so far ... )

- ESOURCE
  - redefine end of ELTR to be entrance to “B1” bend ... downstream components moved to EDRi
  - adjust bend angle of “B1” (EDRi) to align e- Booster Linac to  $\pi-0.007$  rad
- PSOURCE
  - added 500 m drift for photon transport from center of undulator
  - added 20 m drift for target, OMD, high-gradient acceleration, etc.
  - switch off earth's curvature following (PTRAN)
  - redefine end of PLTR to be entrance to “B1” bend ... downstream components moved to PDRi
  - adjust bend angle of “B1” (PDRi) to align e+ source systems to 0.007 rad
- EDR / PDR
  - copy injection/extraction straight into "idle" straight for opposite side injection/extraction (central DR scheme)
- ERTML
  - adjust TA\_TOTALANGLE (EGETAWAY) to align ERTML axis to  $\pi+0.007$  rad
  - remove 11 RETURNCELLCs and adjust DERFODO[L] (ERETURN) to bring IP to Z=0
- PRTML
  - adjust TA\_TOTALANGLE (PGETAWAY) to align PRTML axis to -0.007 rad
  - remove 14 RETURNCELLCs and adjust DPRFODO[L] (PRETURN) to bring IP to Z=0
- ELIN
  - absorbed "warm drift" at end of cryo unit #3 into DMLI00 drift (ELIN1)
  - adjust DMLI07-11 drift lengths (matching between linac and undulator insert) (EUND)
- EBDS / PBDS
  - latest push-pull dump line from Y. Nosochkov (version of 2 April 2007)

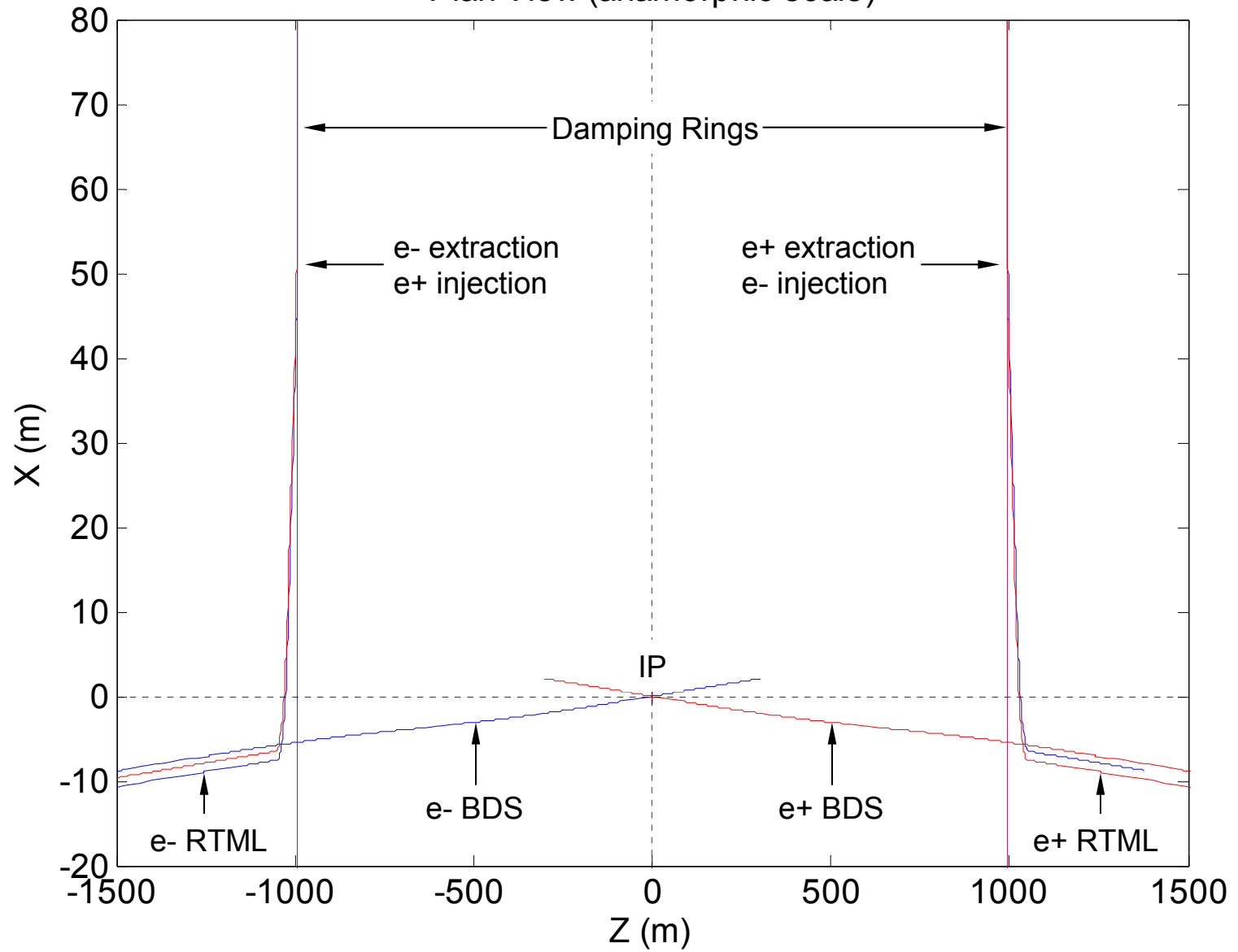


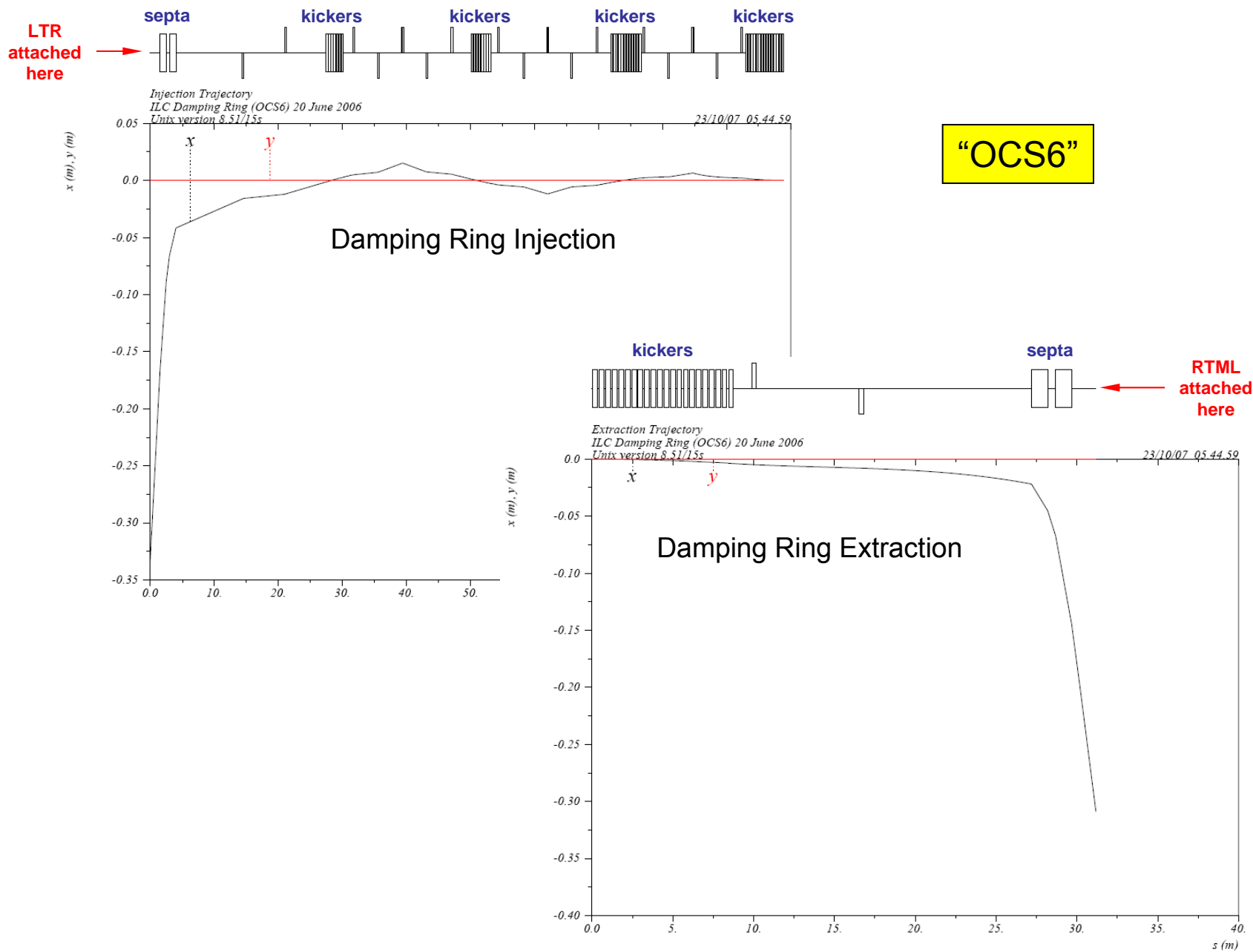


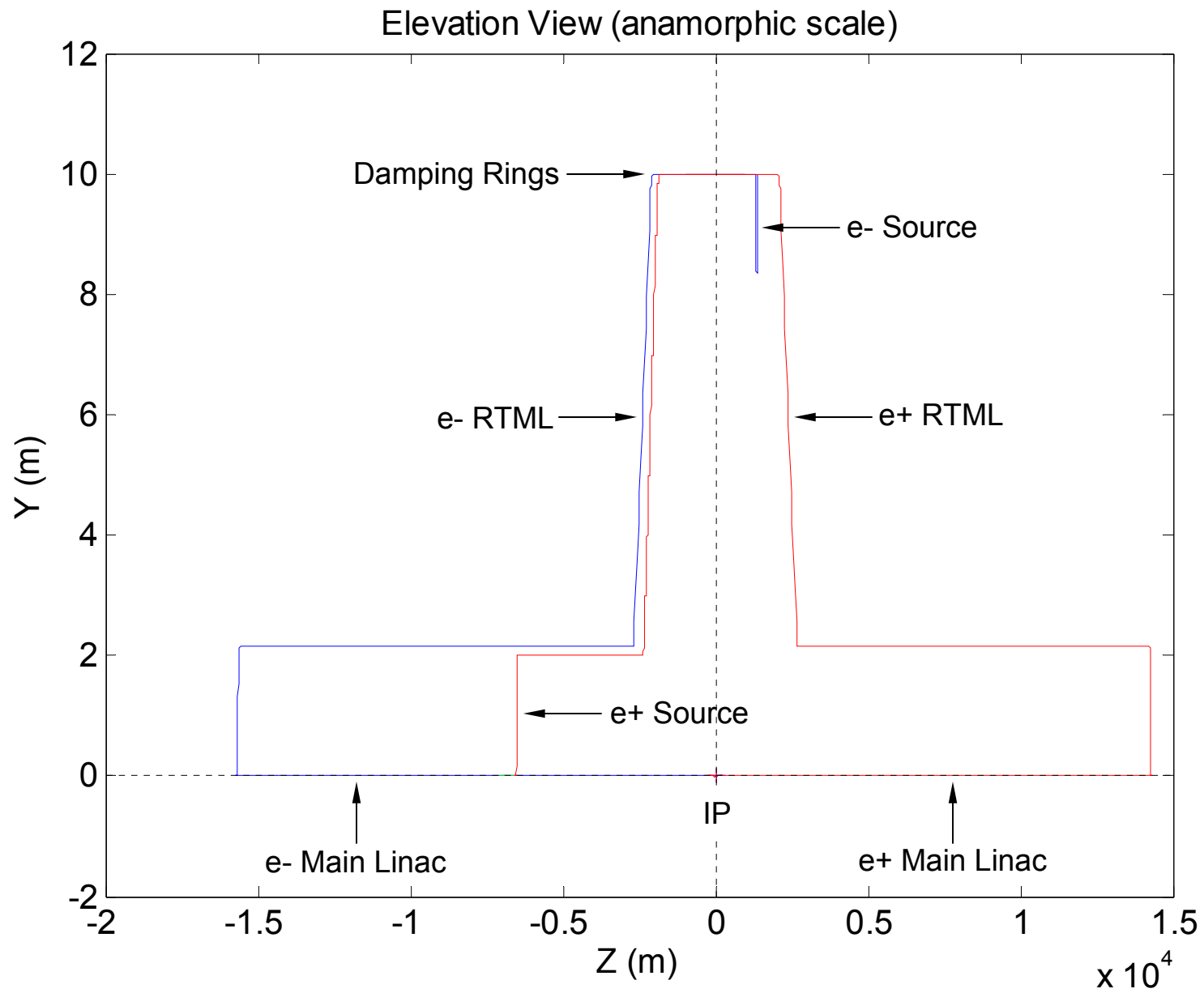
# Plan View (anamorphic scale)



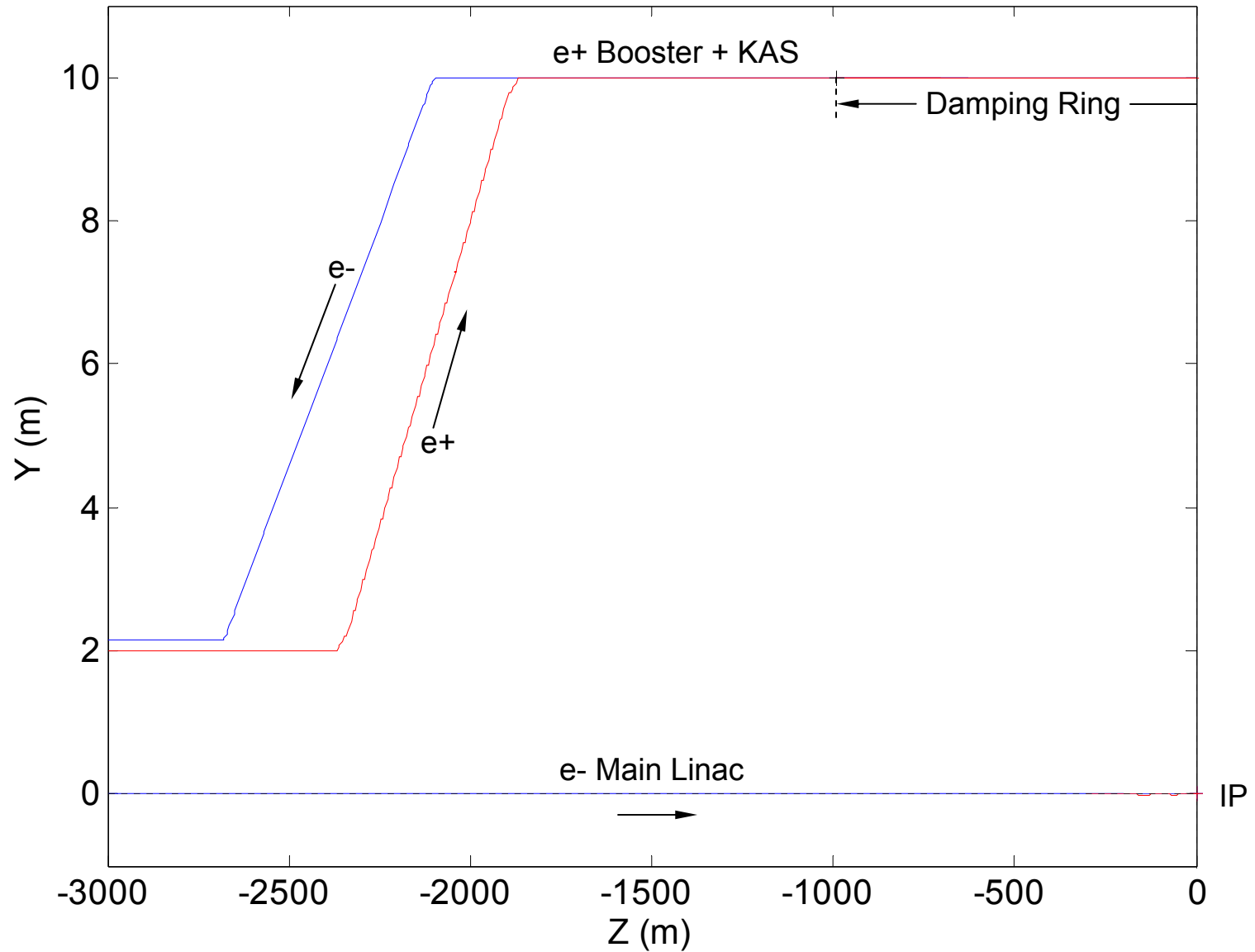
Plan View (anamorphic scale)



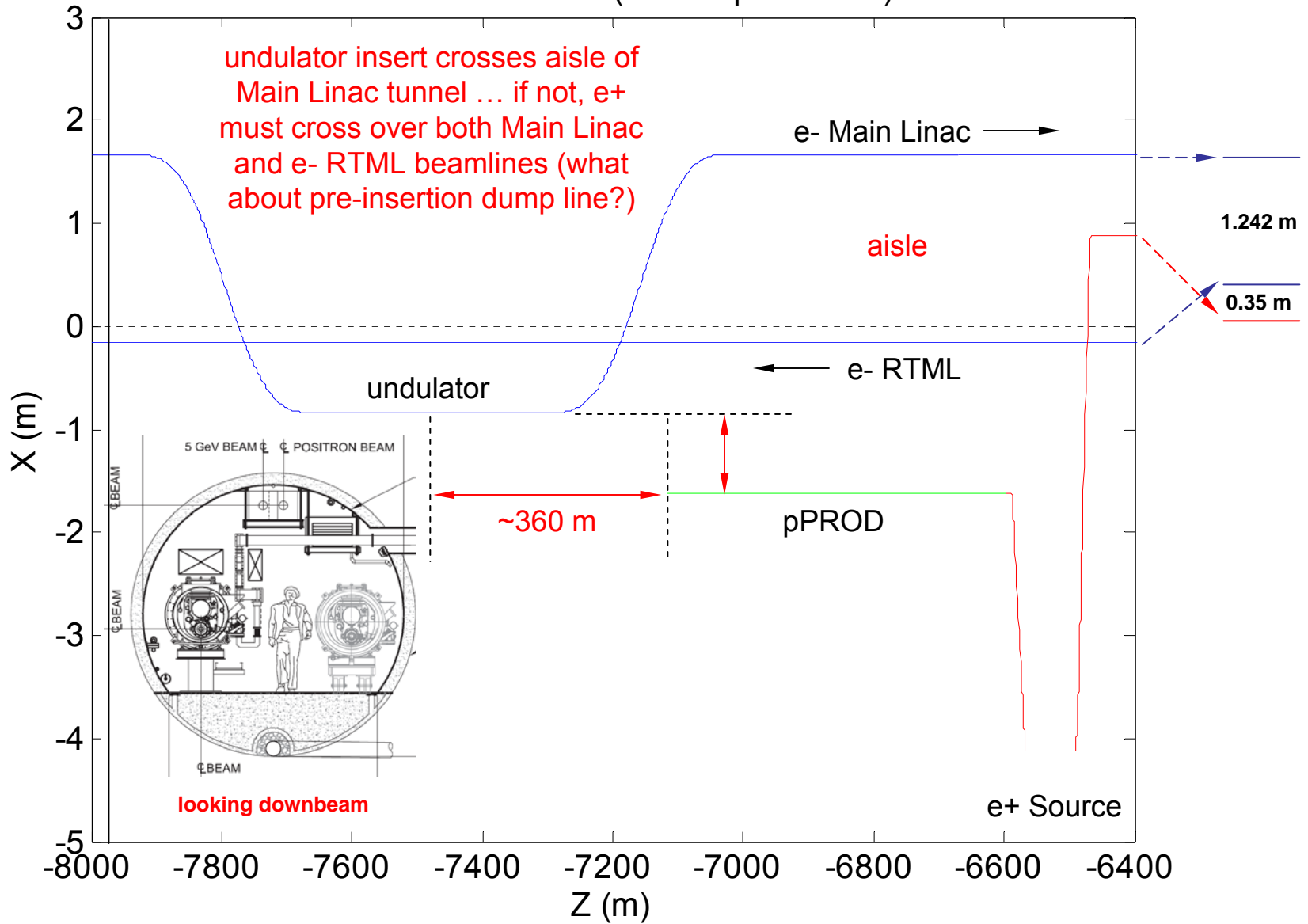




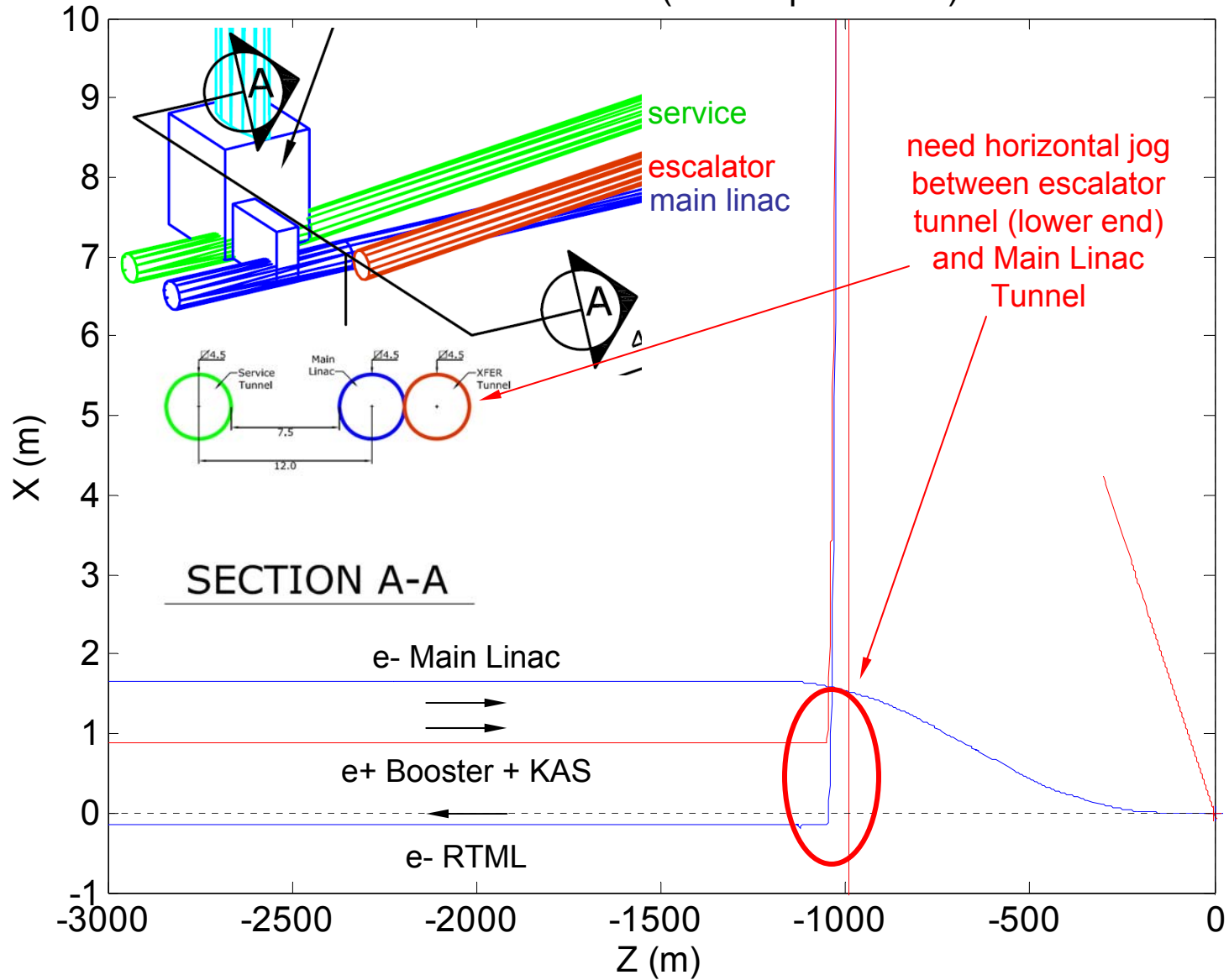
# Elevation View (anamorphic scale)



# Rotated Plan View (anamorphic scale)



Rotated Plan View (anamorphic scale)



# “Zeroth-order” Issues (subsystems )

- PSOURCE
  - height of transport line above Main Linac (2.0 m now ... should be 2.143 m)
  - adjust escalator slope (~1.7% now ... should be 2.2%)
  - adjust escalator length (PDR is 10 m above ML now ... should be ~16 m)
  - missing KAS lattice
- EDR / PDR
  - final locations of kickers and septa?
- ERTML
  - adjust escalator slope (~1.4% now ... should be 2.2%)
  - adjust escalator length (EDR is 10 m above ML now ... should be ~14.6 m)
- PRTML
  - adjust escalator slope (~1.4% now ... should be 2.2%)
  - adjust escalator length (PDR is 10 m above ML now ... should be ~16 m)
- ELIN
  - bending direction in undulator insert and pre-insert dump line
- EBDS / PBDS
  - remove DMLS drift ... there's already a "warm drift" at end of cryo unit #5



# Summary

- a “complete” set of MAD/XSIF files exists for the primary baseline systems
  - Damping Ring injection/extraction systems are incomplete (I have injection upstream of the first septum and extraction downstream of the last septum; I need updated Damping Ring straight sections with kickers and septa in their correct locations)
  - some tuneup/abort lines are not included
  - diagnostic and correction components are not always called out
  - there are some remaining “zeroth-order” disconnects
- “zeroth-order” layout issues need to be addressed first, in cooperation with CF&S group
  - relative locations of beamlines in shared tunnels
  - e+ production system layout: undulator, photon transport, PSOURCE layout
  - DR injection/extraction geometry
  - escalator locations, slopes, etc.
  - connection of escalator tunnels to Main Linac tunnels
- first-order optical rematching will then be needed
  - dispersion correction
  - internal rematching to lengthened/shortened FODO arrays, etc.
  - external matching from system to system

# Observations & Questions

- we need a set of decks that corresponds to the RDR cost estimate, so that we can track revisions as we work to reduce the costs during the EDR
  - try to make an exact correspondence to the RDR?
  - or sneak in changes/updates/fixes that we know about now? (as I've already started doing ... )
  - how about the BCD ... do we need to reconstruct previous incarnations of the lattices for the purpose of tracking changes that have already happened?
- when to “release” the RDR set of lattice decks?
  - release whatever I have now? make it public but not officially “released”?
  - do the “zeroth-order” adjustments and the optical rematching and then return decks to their respective owners for verification and then gather and release?
- what's the best way to work with CF&S to resolve the layout issues?
  - do we try to define the layouts we want, or does CF&S define the tunnels that we have to work with? (I think further CF&S-driven changes to the layout are probably already being discussed ... )
  - is the global coordinate system that I'm using the one that CF&S wants/needs? (I think not ... )
- what format should we use for the lattice files?
  - XSIF? AML? both?
- where should the files be located?
  - EDMS?
  - institutional repositories?