



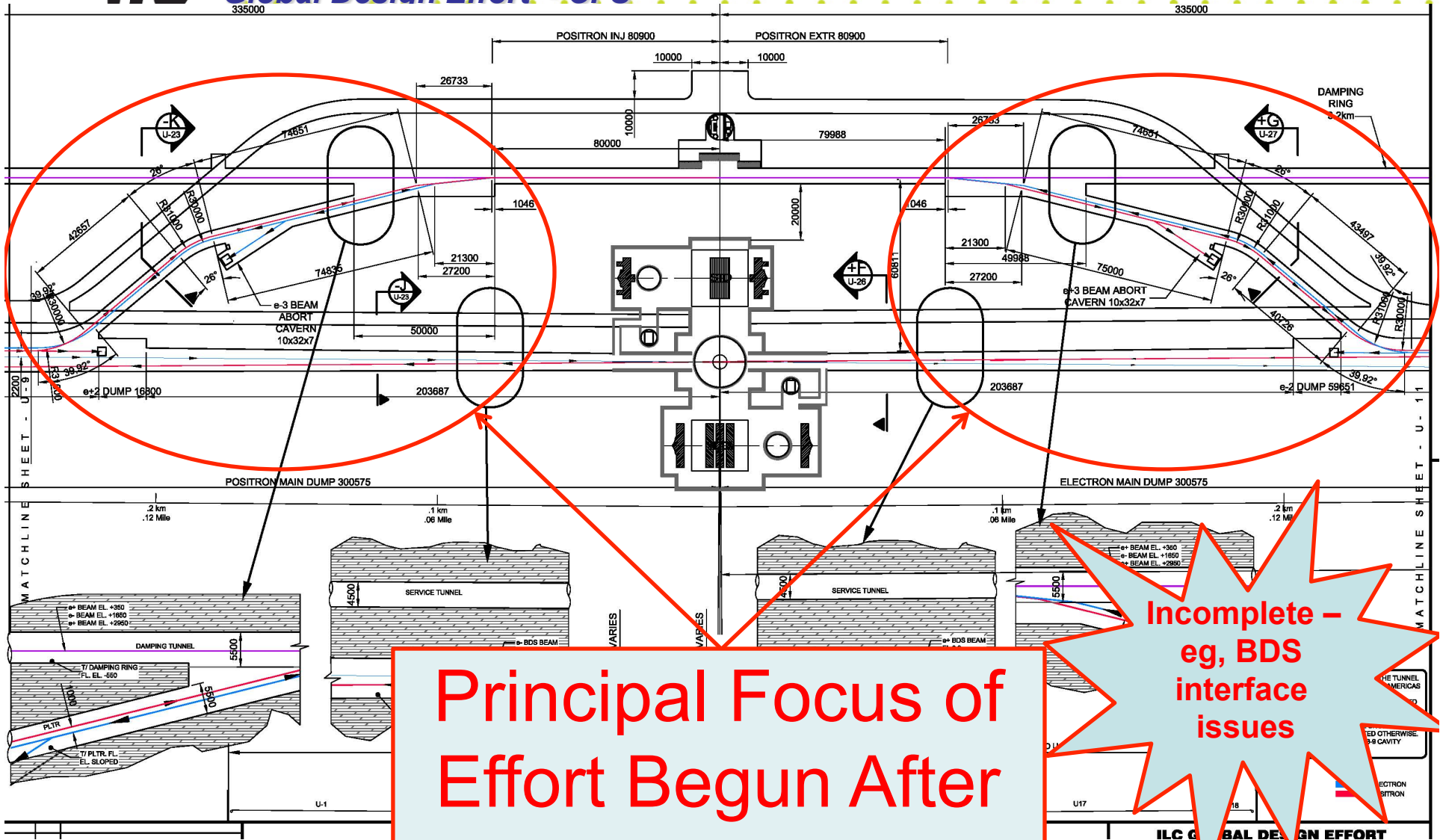
Central Region Integration Issues

Mark Palmer
Cornell University



Central Region Layout – Latest Version

Global Design Effort - CFS



Principal Focus of Effort Begun After Damping Ring TBR

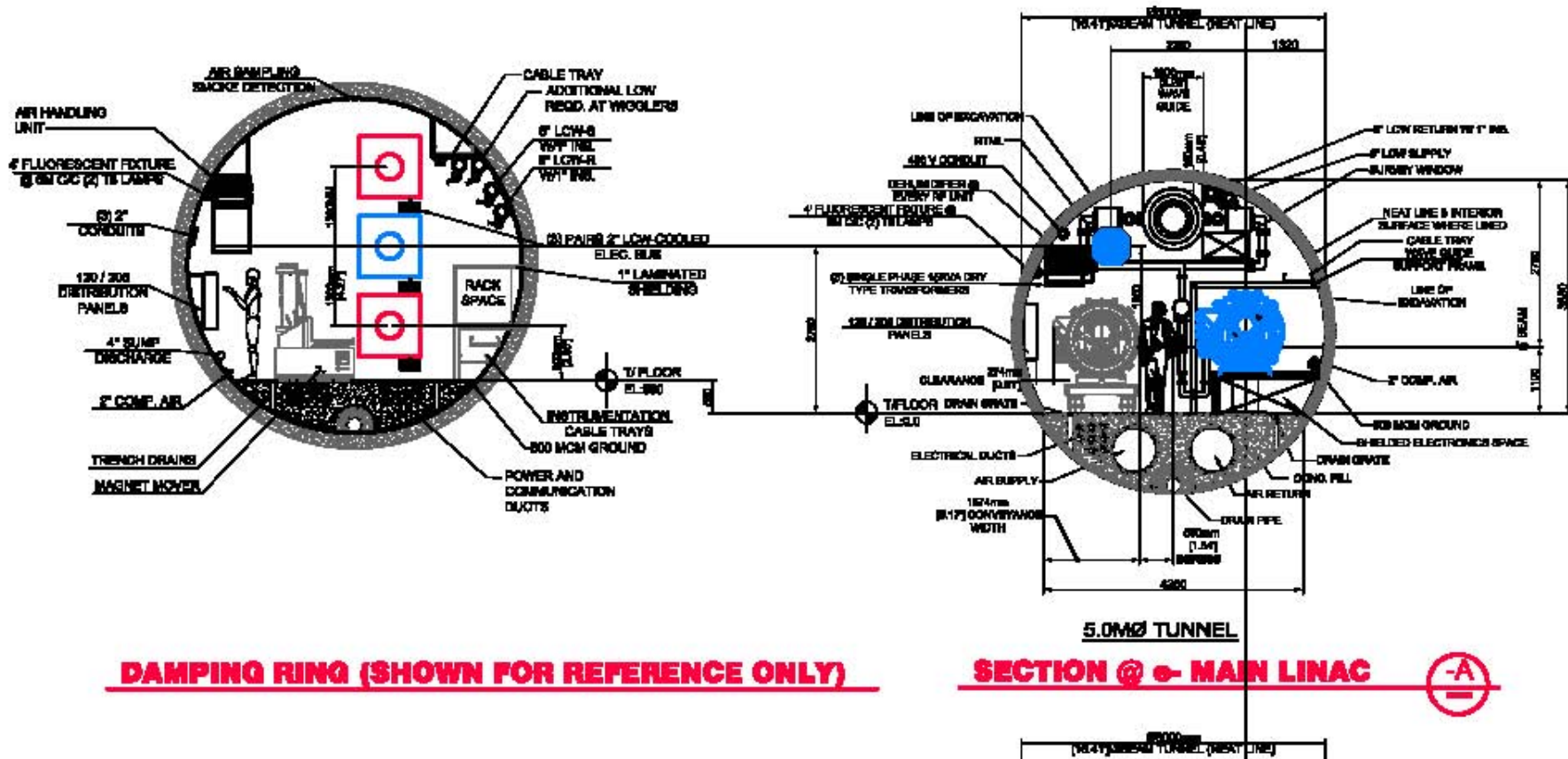
Incomplete - eg, BDS interface issues



Main Linac Facing IR

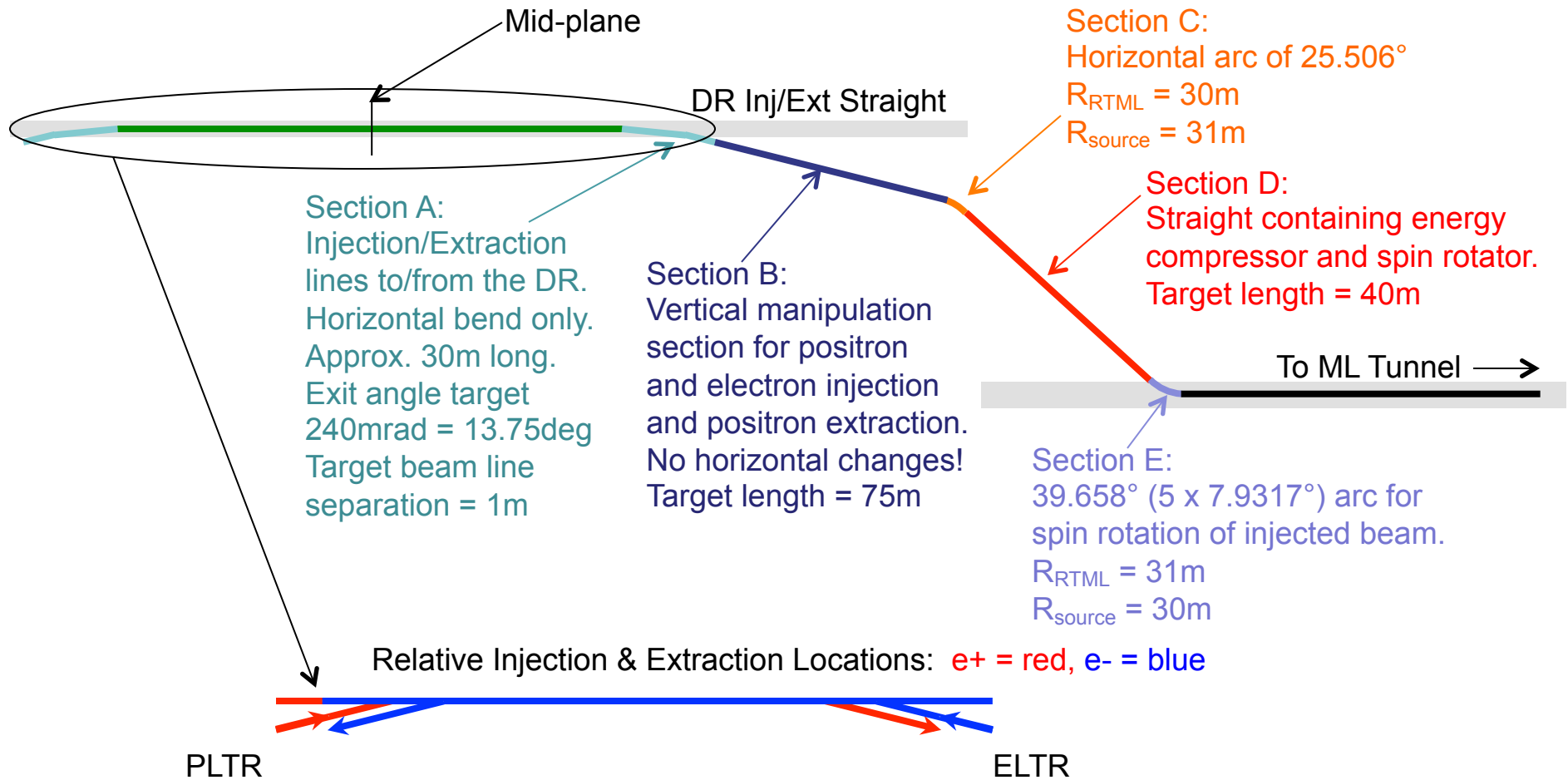
Lackowski

e- MAIN LINAC





Central Region - Transition





Where Do We Stand? Part I

- Agreement on basic layout elements
 - Integrated effort with CF&S group to define target beam line tunnel layout ✓
 - Function of each section defined ✓
- Section lattices
 - Section A: ✓
 - DR Injection/Extraction line lattices complete (Rubin) ✓
 - Section A – Section B interface: ✓
 - New DR-Source treaty points (Palmer) ✓
 - New DR-RTML treaty points (Palmer) ✓
 - Section B: Nom. 75m straight ○
 - Vertical elevator for e+ ring splitter/merger function defined (Kapin/Solyak) ✓
 - Pulsed element specifications largely in hand (LCWS11) ✓
 - Need to validate pulsed element concept for high power upgrade ○
 - Need to confirm longitudinal space requirements for pulsed elements ○
 - RTML lattice defined (Kapin/Solyak) ✓
 - e+ Source lattice up to splitter defined (Liu/Gai) ✓
 - Need to connect to splitter, complete matching, and confirm space requirements ○
 - e- Source lattice to be based on e+ source in this region (???)/Liu ○
 - Will need additional transport section in lieu of splitter section ○
 - Need to match ALL lengths ○

○=open item
✓=completed



Where Do We Stand? Part II

- **Section C: Short arc (25.506°)** ✓
 - Source lattice sections defined (Liu/Gai) ✓
 - RTML lattice sections defined (Kapin/Solyak) ✓
- **Section D: Nom. 40m straight**
 - Source and RTML lattice sections defined (Gai/Kapin/Liu/Solyak) ✓
 - Need to match ALL lengths ○
 - DR Dump lines are in place (Kapin/Solyak) ✓
 - Need to confirm transverse space requirements for specialized elements ○
 - Need to study power and cryogenic distribution issues ○
- **Section E: “Spin rotation” arc (39.658°)**
 - Source and RTML lattice sections defined (Gai/Kapin/Liu/Solyak) ✓
 - Nominal matching into main tunnel lines, including crossing angle (Gai/Kapin/Liu/Solyak) ✓
- **General Lattice and Layout Issues**
 - **Lattice Naming Conventions Available (List)** ✓
 - **Must verify point to point connections of all lattice sections and consistency with targeted (or updated) layout!** ○
 - **Service tunnel issues (layout, population, and personnel egress constraints) have not been fully evaluated** ○
 - **Trapped regions (eg, A-B section) must be evaluated for hardware and personnel access** ○
 - **Timing requirements** ○

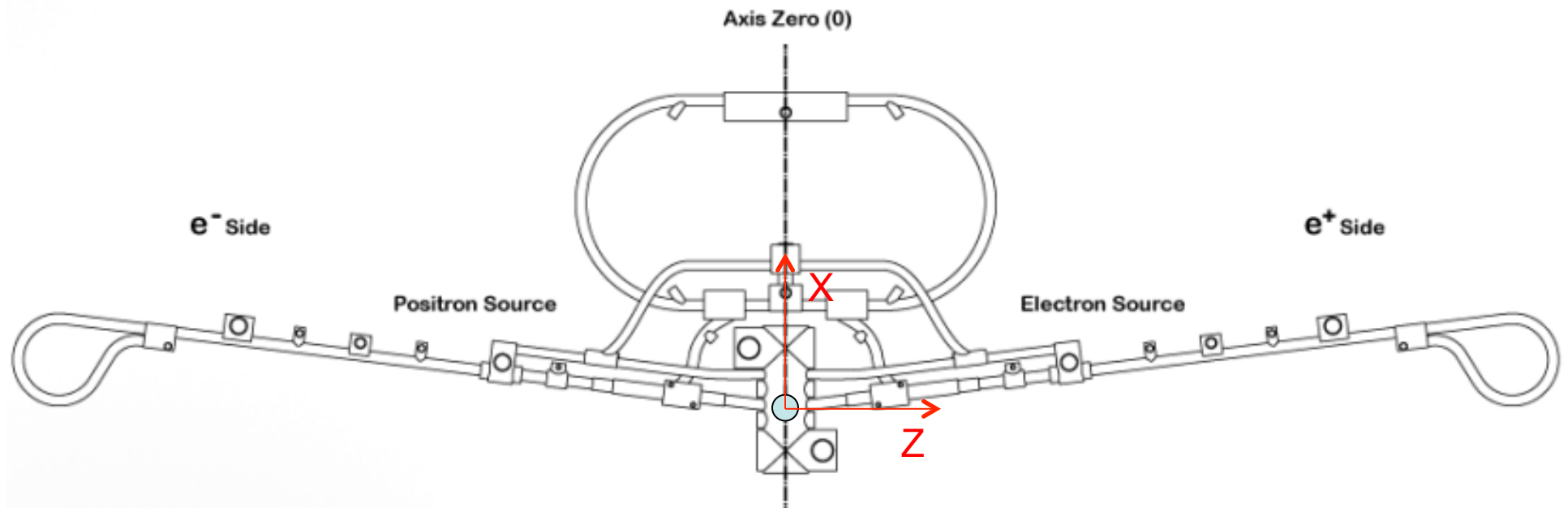


Where Do We Stand? Part III

- Global Coordinate System (List - see following slides)
 - **Major issue is offset between IP and DR**
 - Interaction between DR and detector cavern ○
 - Determines offset between DR and global coordinates
 - Preliminary offset and working global coordinate system chosen ✓
 - Discussions ongoing about options for optimally choosing offset ○
 - **Lattice and layout checks are slowed unless we can independently constrain the IP-DR spacing ○**



Coordinate System I



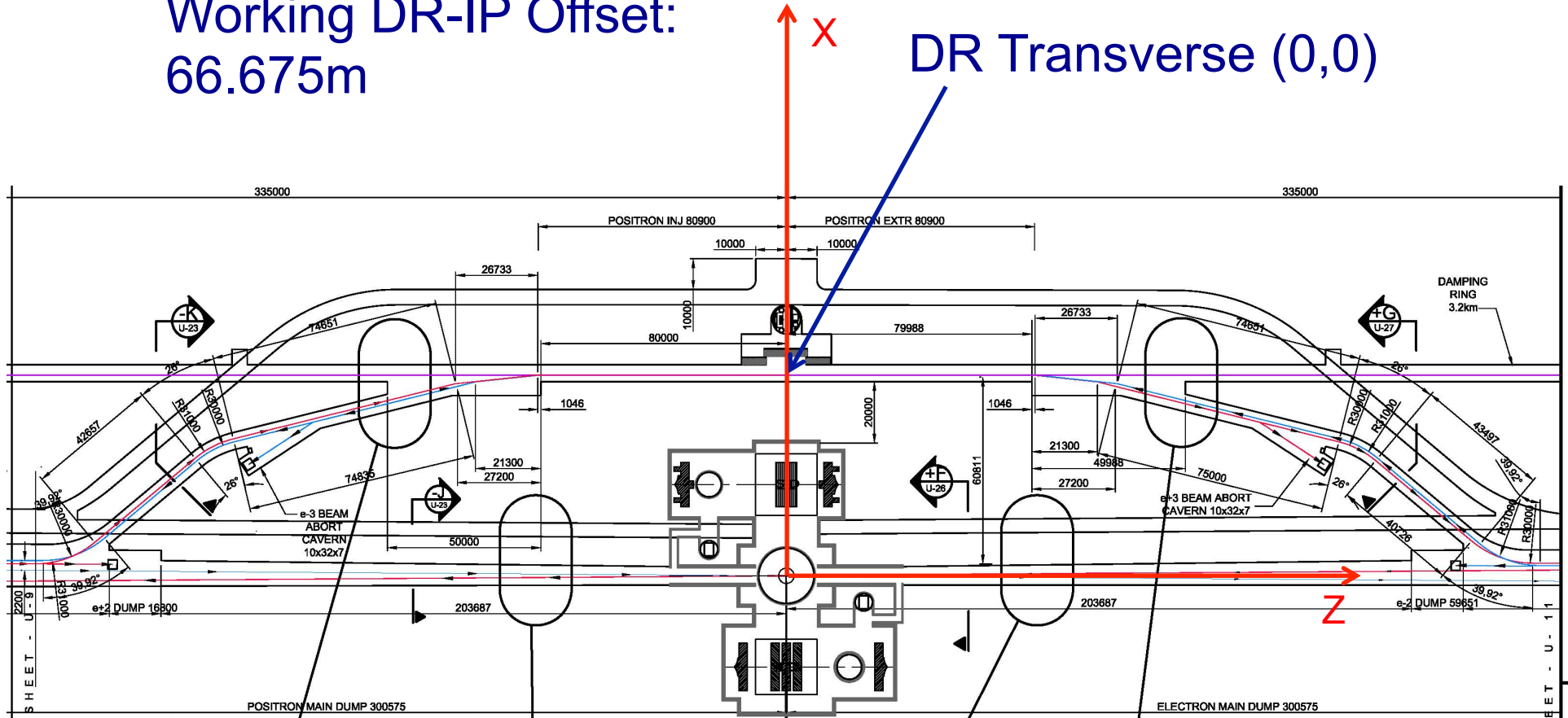
Y direction is up – out of page



Coordinate System II

Working DR-IP Offset:
66.675m

DR Transverse (0,0)



Global Y direction is up – out of page



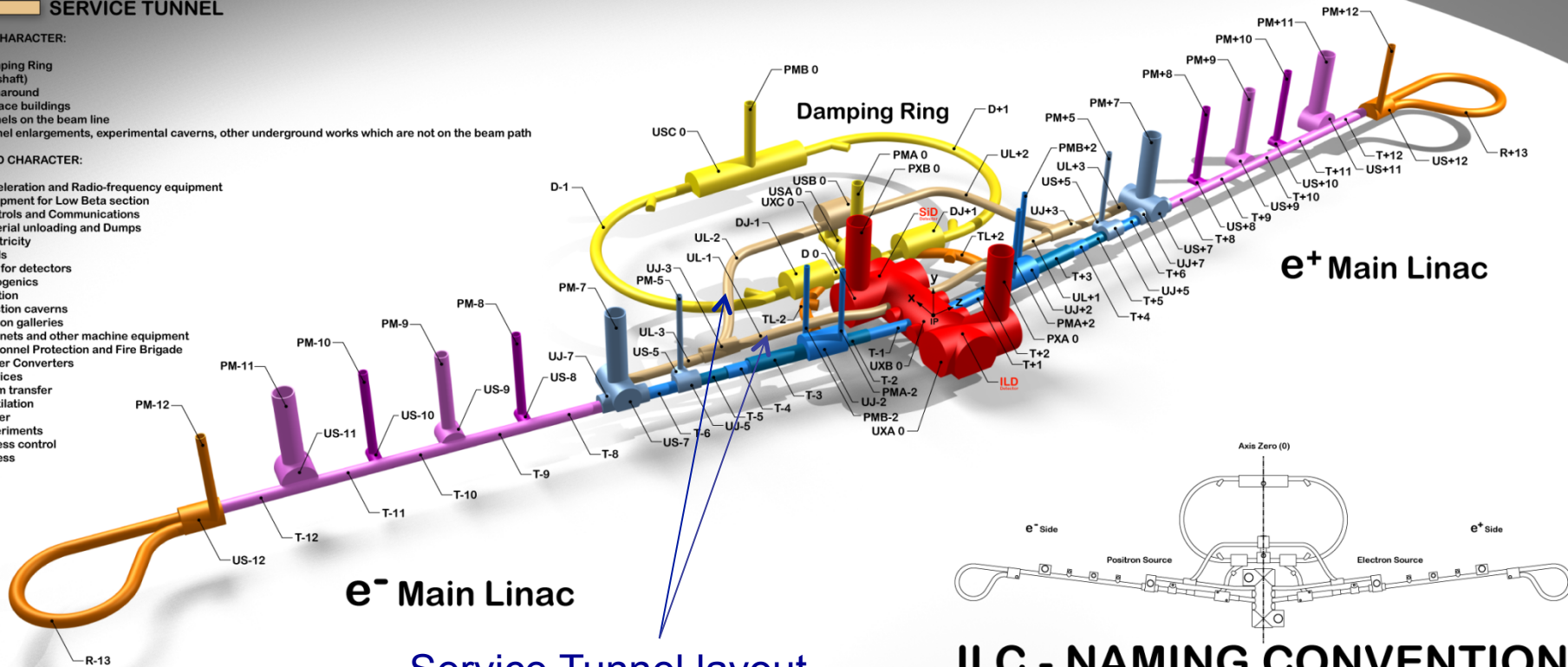
- RTML
- ML
- SOURCES & BDS
- DR
- DETECTOR AREA
- SERVICE TUNNEL

FIRST CHARACTER:

- D = Damping Ring
- P = Pit (shaft)
- R = Turnaround
- S = Surface buildings
- T = Tunnels on the beam line
- U = Tunnel enlargements, experimental caverns, other underground works which are not on the beam path

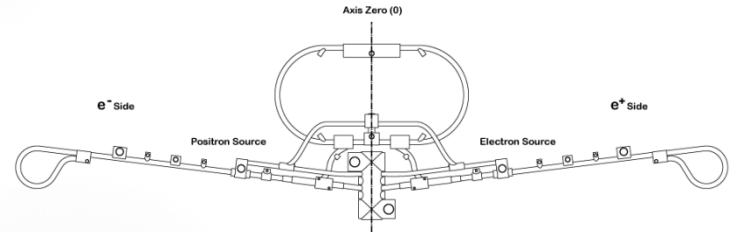
SECOND CHARACTER:

- A = Acceleration and Radio-frequency equipment
- B = Equipment for Low Beta section
- C = Controls and Communications
- D = Material unloading and Dumps
- E = Electricity
- F = Fluids
- G = Gas for detectors
- H = Cryogenics
- I = Injection
- J = Junction caverns
- L = Liaison galleries
- M = Magnets and other machine equipment
- P = Personnel Protection and Fire Brigade
- R = Power Converters
- S = Services
- T = Beam transfer
- U = Ventilation
- W = Water
- X = Experiments
- Y = Access control
- Z = Access



e⁻ Main Linac

e⁺ Main Linac



Service Tunnel layout
and needs to be discussed
tomorrow

**ILC - NAMING CONVENTION
KLYCLUSTER (Europe / CERN)**

Schematic 3D - 20111021 / John Osborne - Antoine Kosmicki
View in 3D on your iphone, ipad or ipod touch, download the 3dvia app then search ILC



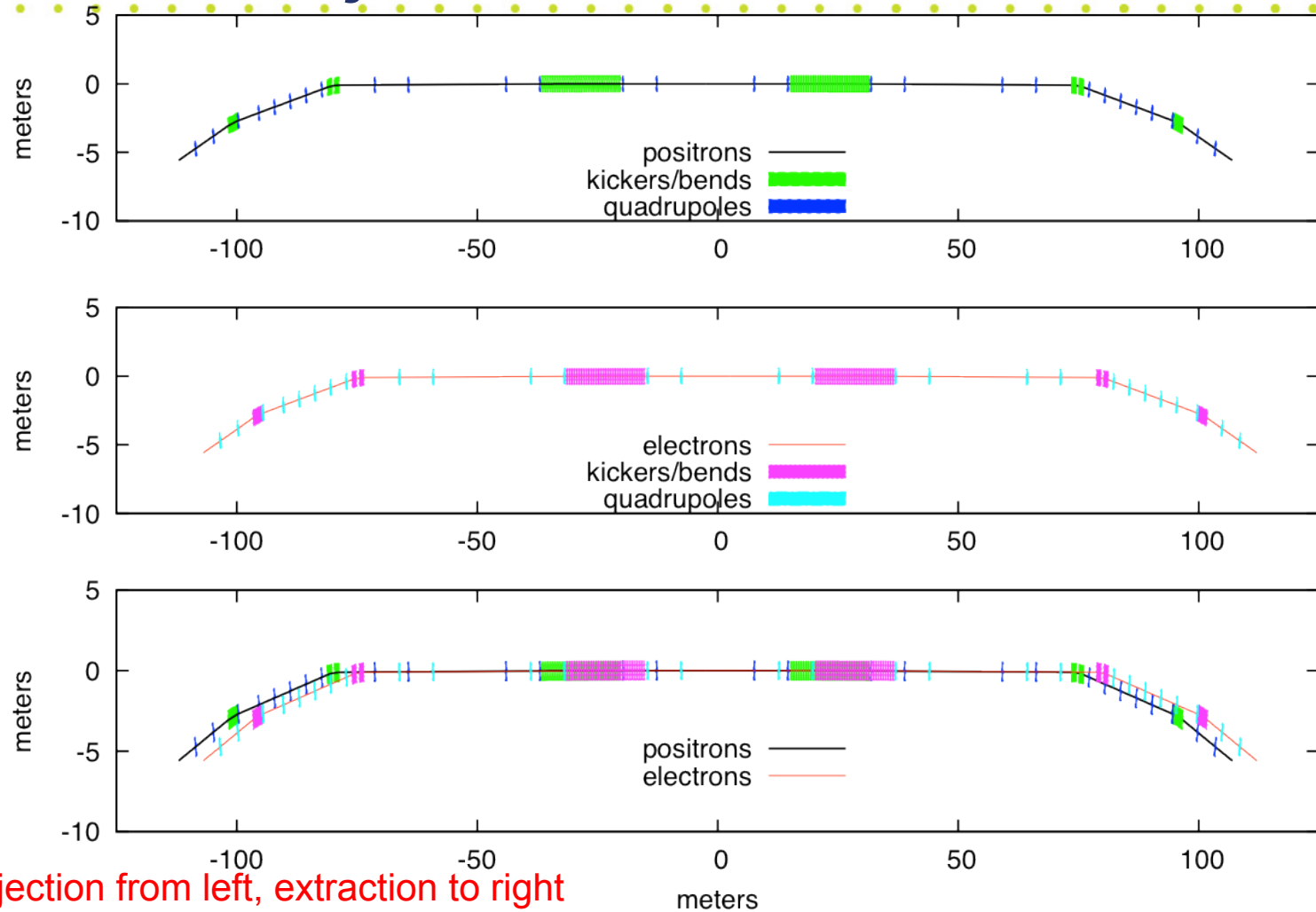
Version
Date
Author
Revised
Revised

2.3
13/10/2011
Benno List
Mark Palmer
Benno List

	injection	extraction	unit
Distance IP – DR	66.765		m
x offset		5.590	m
RTML height	1.650		m
y offset between rings	1.300		m
z position		112.610	m
angle		0.240	rad
		13.751	deg
alpha_x		-0.7989	
beta_x		45.00	m
alpha_y		1.5752	
beta_y		29.96	m
DR Energy	5		GeV
90 spin rotation angle	0.138433786		rad
	7.9317		deg
Total spin rotation angle in Arc	450		deg
ML angle	0.007		rad
Length of Elevator section ("section B")		75.000	80.021 m
Angle in Arc "section C"		0.44517	0.44517 rad
		25.506	25.506 deg
Length of "section C"		13.8002369	13.35506794 m
Radius of section C		31	30 m
Sagitta of section C		13.686566	13.2450639 m
Length of SR+EC ("section D")		40.317	40.000 m
Arc Angle section "E"	0.69217	0.69217	0.69217 rad
	39.658	39.658	39.658 deg
Length of "section E"		20.7650679	21.45723688 m
Radius of section E		30	31 m
Sagitta of section E		20.3530225	21.03145662 m



Injection/Extraction



Positrons – injection from left, extraction to right

Electrons – injection from right, extraction to left

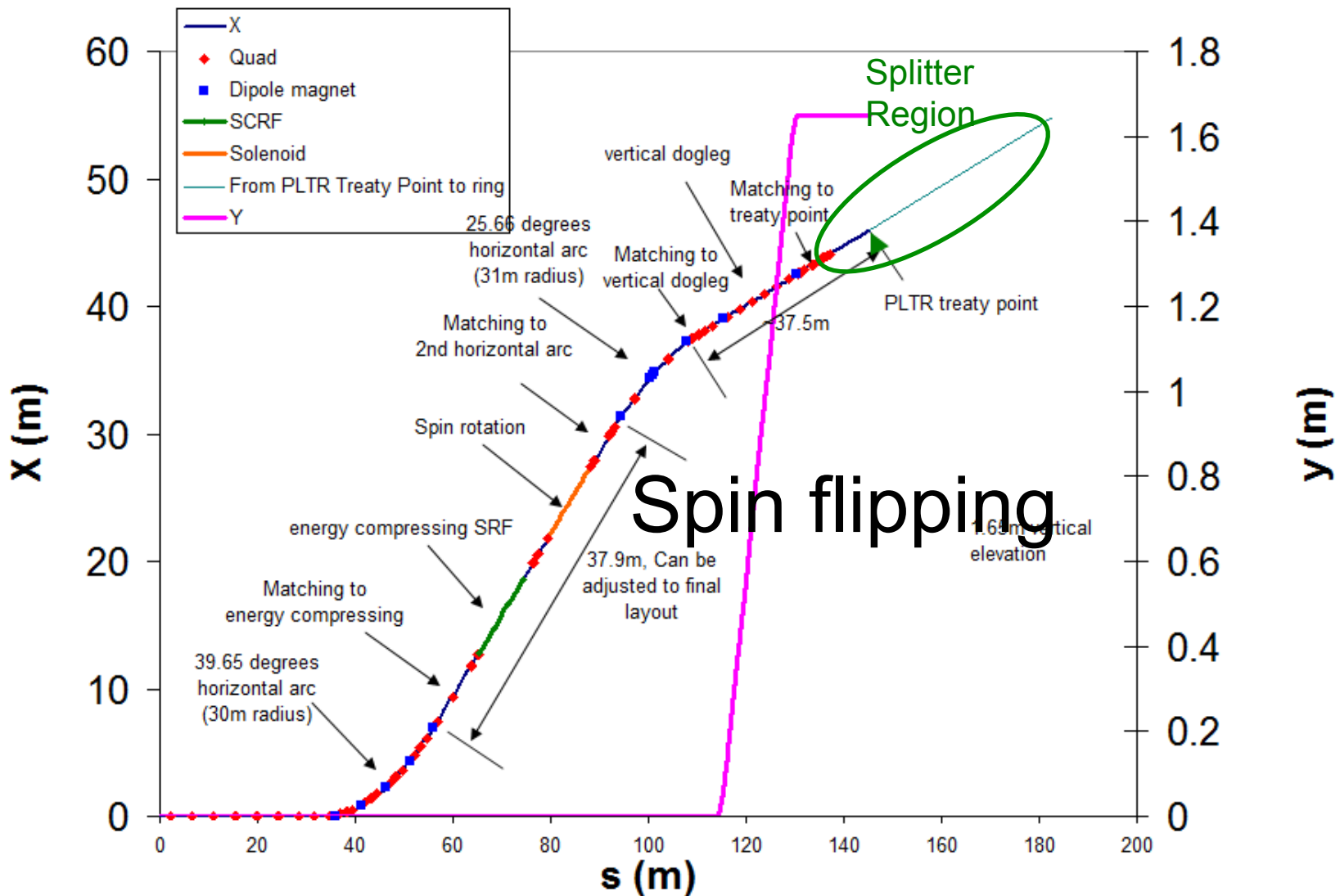
Midpoint between injection and extraction kickers is 2.56m from center of straight

Angle at entrance/exit of transfer lines with respect to storage ring straight = 240mrad



PLTR Floor Map

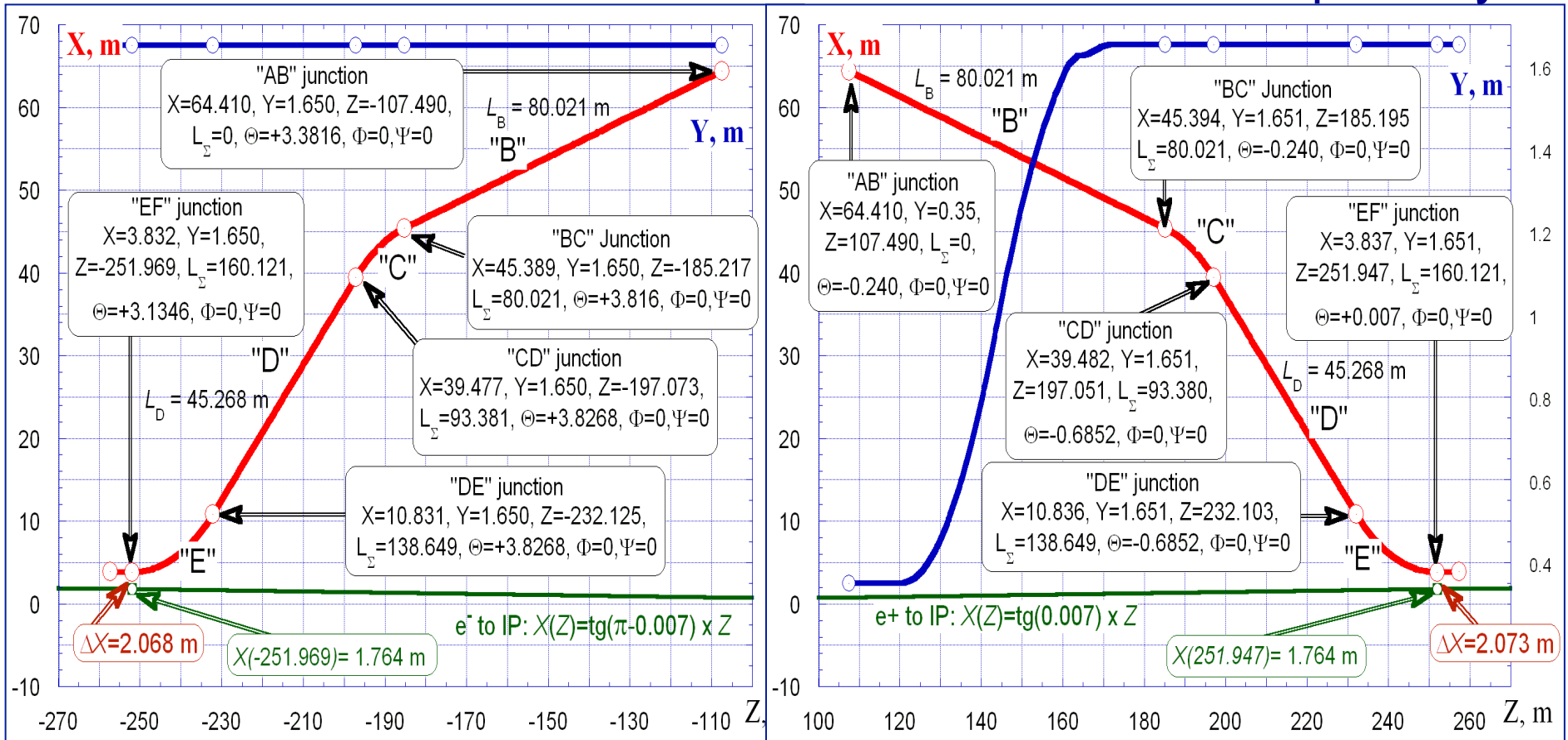
Liu/Gai





ERTL/ PRTL survey results (MAD8)

Kapin/Solyak



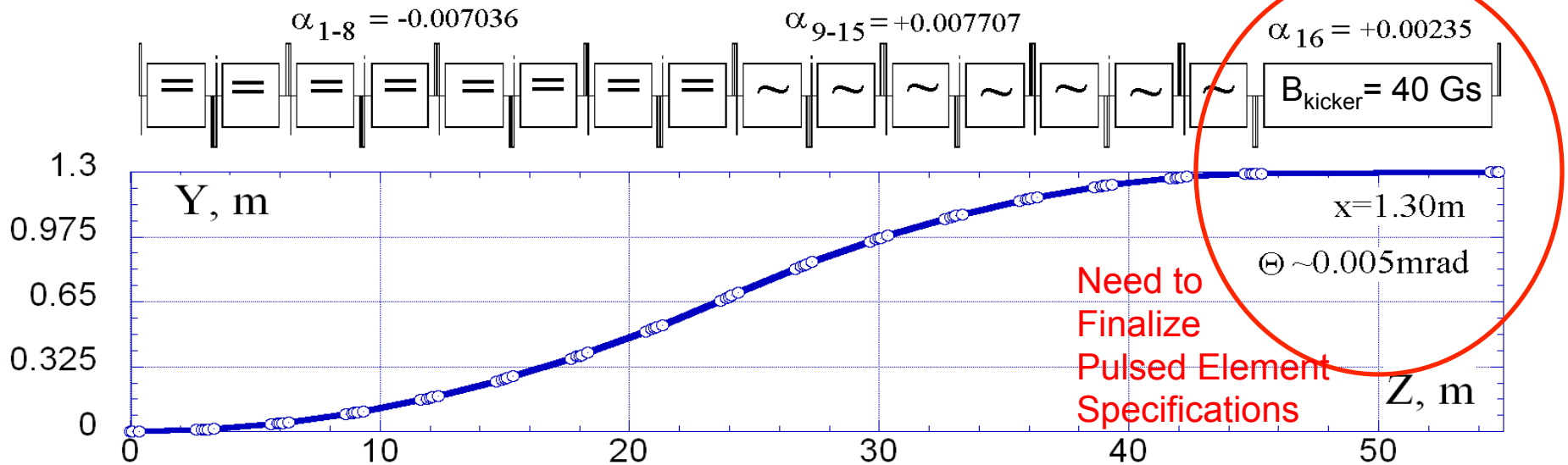
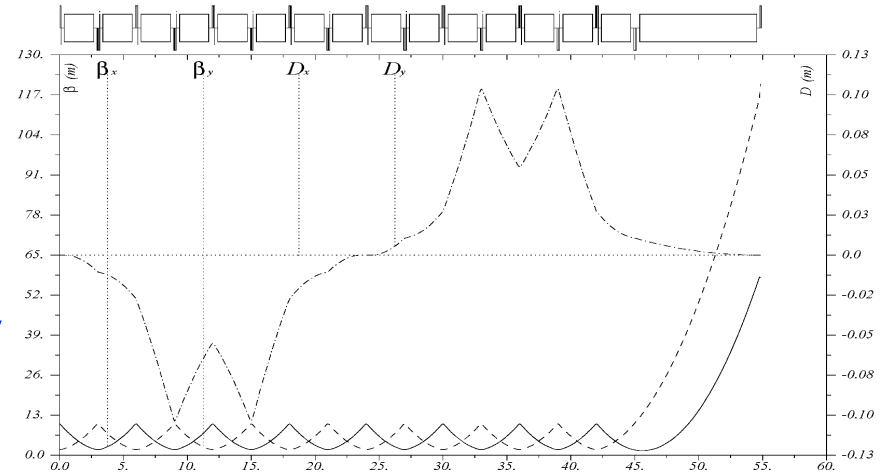
Good symmetry in X0Z plane between PRTL and ERTL (while the same L_{Σ})
Good coincidence between the "ideal" layout and the lattice survey



Example of the Merger design:

(tune Θ and $d=1.3\text{m}$)

- Total azimuth angle is tuned to 0 by changing bend angles in the 9-15th cells
- The distance d is also re-adjusted by scaling of bending angles a
- Both must be done simultaneously



Need to Finalize Pulsed Element Specifications

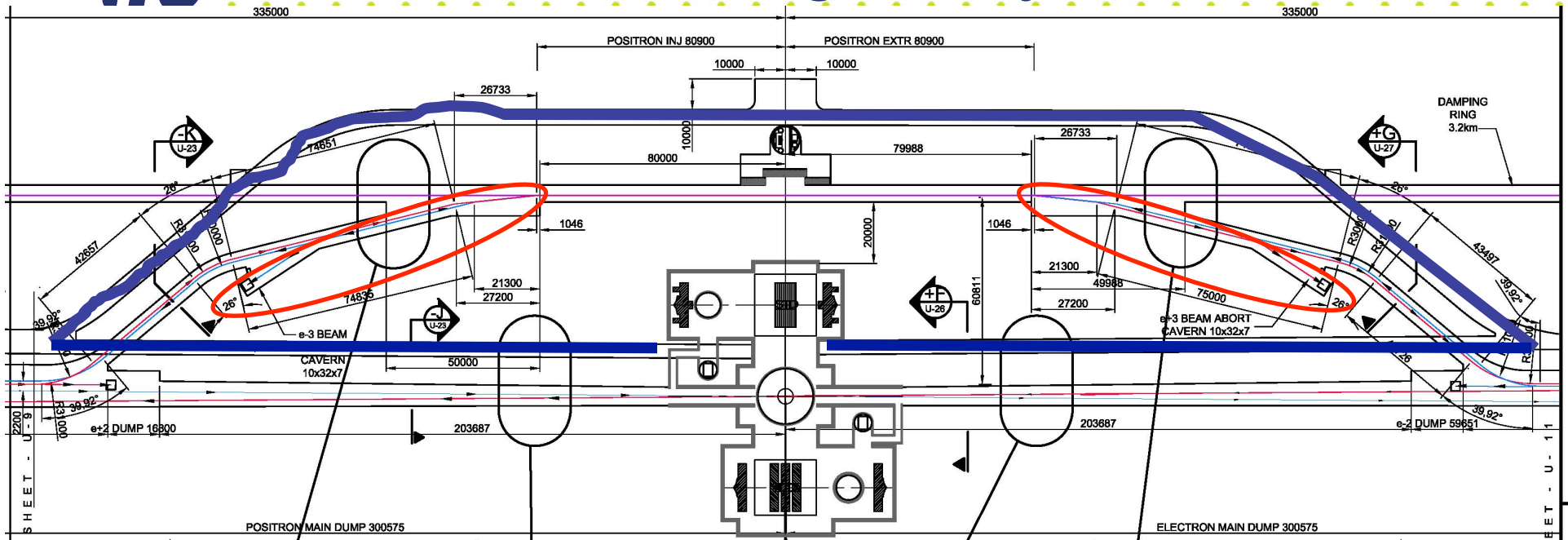


Alternate Layouts

- May be desirable to:
 - **Leave space for “fast spin flip” option**
 - Dual spin rotator lines
 - Requires additional 10’s of meters to split and merge incoming beams from sources
 - **Move the connection to the Main Linac Tunnel beyond the Main Beam Dump**
 - Minimizes interference between dump/BDS region and Source/RTML lines
 - May be nearly neutral with respect to total tunnel volume (drill & blast) required
 - Trade-off between D&B widening of main tunnel and similar length, discrete tunnel (also D&B)
 - Transport sections formerly in ML tunnel now migrate into ELTR/PLTR tunnels



CFS Target Layout



- Some key questions:
 - “Trapped” regions
 - Service tunnel layout

Relative Injection & Extraction Locations: e+ = red, e- = blue



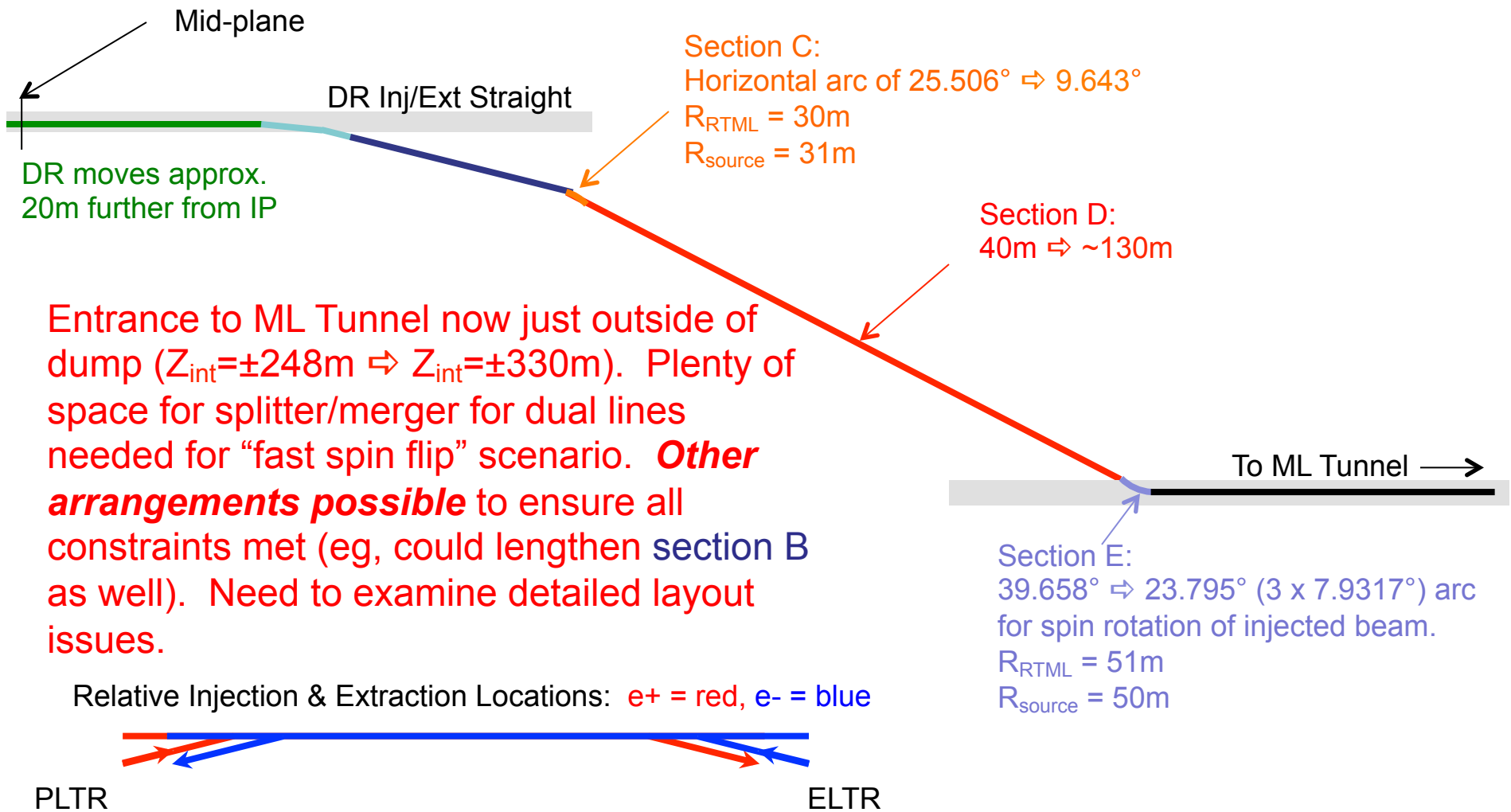
PLTR

ELTR



One Possible Change to Accommodate “Fast Spin Flip” and Move ML Tunnel Intercept Beyond Main Dump

Instead of using 450° spin rotation, use 270°





Move ML Tunnel Intercept Outboard of Main Dump

Version 3.1
 Date 26/10/11
 Author Benno List
 Revised Mark Palmer
 Revised Benno List
 Revised Mark Palmer

End of Section E Arc
 at Z ~ 330m (vs 248m)

	injection	extraction	unit
Distance IP – DR	86.534		m
x offset	5.590	5.590	m
Line Lengths (B-E, inclusive)	231.482	236.251	m
RTML height	1.650		m
y offset between rings	1.300		m
z position	112.610	107.490	m
angle	0.240	0.240	rad
	13.751	13.751	deg
alpha_x	-0.7989	-0.7989	
beta_x	45.00	45.00	m
alpha_y	1.5752	1.5752	
beta_y	29.96	29.96	m
DR Energy	5		GeV
90 spin rotation angle	0.138433786		rad
	7.9317		deg
Total spin rotation angle in Arc	270		deg
ML angle	0.007		rad
Length of Elevator section (“section B”)	75.000	80.021	m
Angle in Arc “section C”	0.16830	0.16830	rad
	9.643	9.643	deg
Length of “section C”	5.21734213	5.049040767	m
Radius of section C	31	30	m
Chord length of section C	5.21118668	5.04083883	m
Length of SR+EC (“section D”)	130.500	130.000	m
Arc Angle section “E”	0.41530	0.41530	rad
	23.795	23.795	deg
Length of “section E”	20.7650679	21.1803693	m
Radius of section E	50	51	m
Chord length of section E	20.6161619	21.02848509	m



Overall Layouts

End of E- Linac to End of E+ Linac

- **CFS Tunnel Cross Sections** Drafts exist for the whole region (including DR's) showing tunnel sizes, cross sections and beam-line locations based on best available info as of late August 2011
- **Beam-line Optics Designs** Many pieces of systems exist, some as old as RDR, but they need updating to be compatible with the present baseline designs and a hard look at components they intersect or overlap and share tunnels
- **Component sizes** Probably well enough known for next iteration of above bullets unless major conflicts immediately surface! Exception may be kept as a source technical design choice. I suggest a warm S-band linac for the time being?

Nominal cross sections reasonably understood. Need final placement.

Pieces in place and most interferences looked at. Need to finalize layout.

Needs further examination.

Ewan – Sept 14



NEXT STEPS?

- We need to have enough new or updated info to have (complete) reviews of issues or questions on previous slide, during the parallel/joint sessions at LCWS followed by one more iteration? before the BTR at DESY.
- This is a very tight schedule but a necessary one to make sufficient progress at the BTR, where these will not be final complete systems designs ready for the TDR but rather designs with no show stoppers arising from interferences between optics, system layouts and CFS.

Ewan – Sept 14



Conclusions and Summary

- We need a decision on the CR layout goal
 - **Extend “arms” so that intercept with ML tunnel is beyond main dump?**
 - Cost implications seem modest
 - Addresses space issues for proposed spin rotation options
 - Appears to minimize conflicts between different areas
 - **Otherwise need to fine-tune present layout and bring everything into full consistency**
- Beyond layout decision, need to focus on 3 main items:
 - **Step-by-step review through CR tunnels to confirm line matching, absence of line-to-line interference, absence of line-tunnel interference**
 - **Review access and utility issues**
 - Service tunnel layout
 - Trapped regions
 - Power, cooling, cryo distribution
 - Service tunnel layout
 - **Confirm pulsed element conceptual design and space requirements for high power (2 e⁺ ring) upgrade**

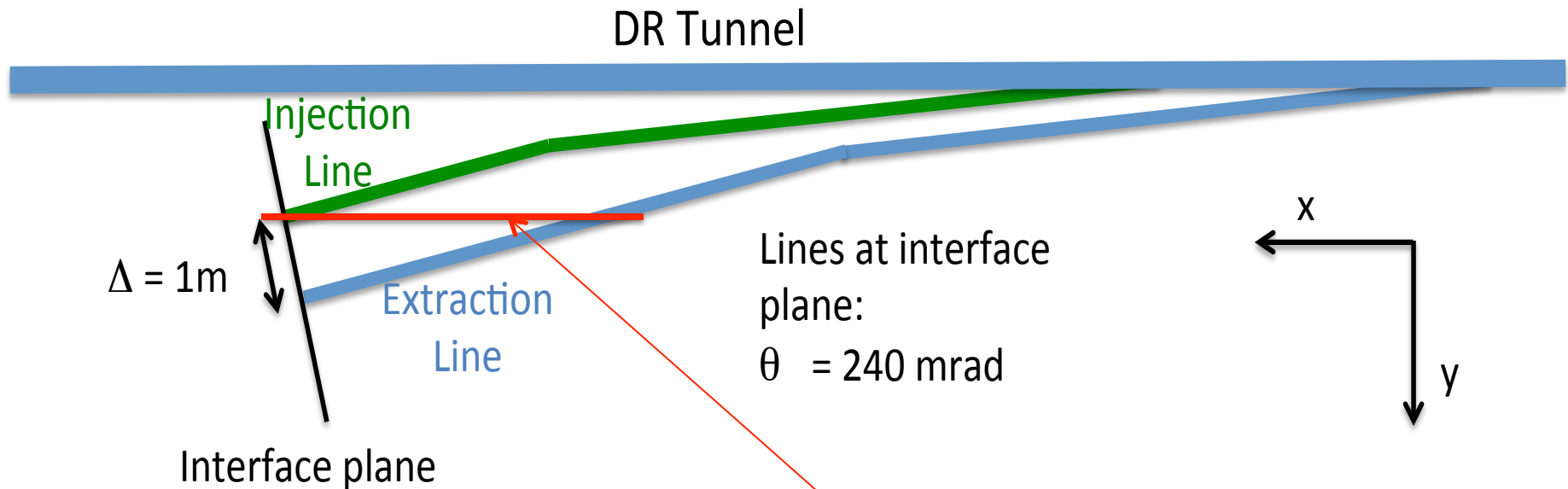


- Extra Slides...



Injection/Extraction Treaty Point Update

- As of last week we have an updated design for the injection and extraction lines which is integrated with the DTC02 Lattice



Proposed new interface plane



Injection Line

Table 1: Injection Line target parameters at the treaty point as sketched in Figure 2. Nominal x and y positions are in the coordinate system shown in Figure 2 where (0,0) is the center point of the damping ring injection-extraction straight. z=0 is considered the height of the RTML beam line and the electron ring in the DR tunnel. Note that this is a right-handed coordinate system. The red values correspond to using the red line in Figure 2 as the treaty point.

Parameter	x-value (target)	y-value (target)	z-value (height)
Positron Injection Lines:			Ring1 / Ring2
Treaty point position	108.66m ⇔ 112.61m	3.75m ⇔ 5.59m	-1.3m / +1.3m
Treaty point angle	240mrad	0.0mrad	0.0mrad / 0.0mrad
Inj septum position	78.66m ⇔ 80.71m	0.0m	-1.3m / +1.3m
η and η'	0.0	0.0	---
α	0.093 ⇔ -0.7989	-0.22 ⇔ 1.5752	---
β	20.2m ⇔ 45.0m	11.7m ⇔ 29.96m	---
Electron Injection Line:			Ring1
Treaty point position	-108.66m ⇔ -112.61m	3.75m ⇔ 5.59m	0.0m
Treaty point angle	240mrad	0.0mrad	0.0mrad
Inj septum position	-78.66m ⇔ -80.71m	0.0m	0.0m
η and η'	0.0	0.0	---
α	0.093 ⇔ -0.7989	-0.22 ⇔ 1.5752	---
β	20.2m ⇔ 45.0m	11.7m ⇔ 29.96m	---



Extraction Line

Table 2: Extraction Line target parameters at the treaty point as sketched in Figure 2. Nominal x and y positions are in the coordinate system shown in Figure 2 where (0,0) is the center point of the damping ring injection-extraction straight. z=0 is considered the height of the RTML beam line and the electron ring in the DR tunnel. Note that this is a right-handed coordinate system. The red values correspond to using the red line in Figure 2 as the treaty point.

Parameter	x-value (target)	y-value (target)	z-value (height)
Positron Extraction Lines:			Ring1 / Ring2
Treaty point position	108.42m ⇔ 107.49m	4.72m ⇔ 5.59m	-1.3m / +1.3m
Treaty point angle	($\pi - 0.240$) rad	0.0mrad	0.0mrad / 0.0mrad
Ext septum position	77.64m ⇔ 75.59m	0.0m	-1.3m / +1.3m
η and η'	0.0	0.0	---
α	0.098 ⇔ -0.7989	-0.74 ⇔ 1.5752	---
β	20.5m ⇔ 45.0m	7.5m ⇔ 29.96m	---
Electron Extraction Line:			Ring1
Treaty point position	-108.42m ⇔ -107.49m	4.72m ⇔ 5.59m	0.0m
Treaty point angle	($\pi - 0.240$) rad	0.0mrad	0.0mrad
Ext septum position	-77.64m ⇔ -75.59m	0.0m	0.0m
η and η'	0.0	0.0	---
α	0.098 ⇔ -0.7989	-0.74 ⇔ 1.5752	---
β	20.5m ⇔ 45.0m	7.5m ⇔ 29.96m	---