Integration Ideas for the Central Region

Some old some new

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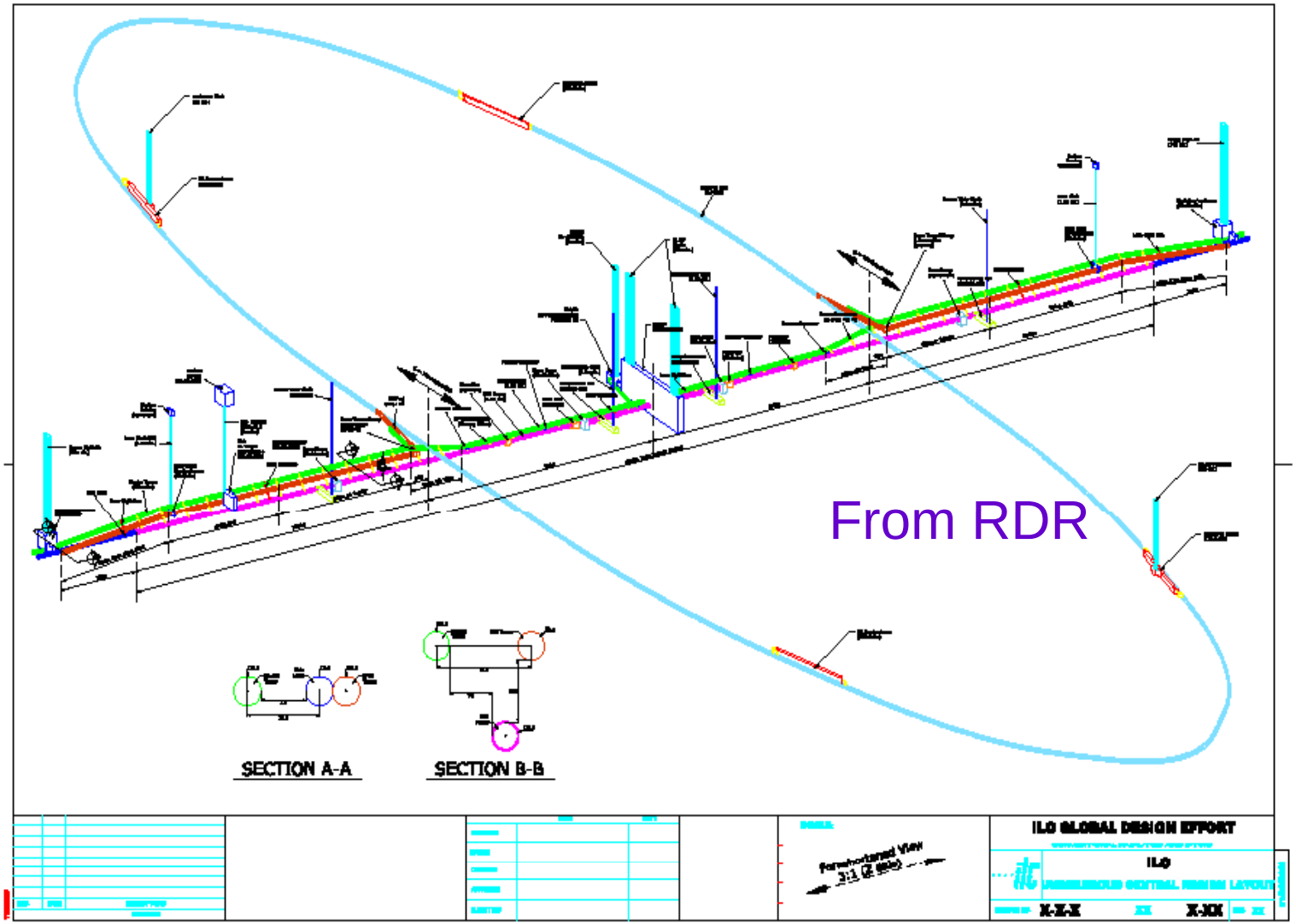
GDE

Can we design more into less in the Central Region



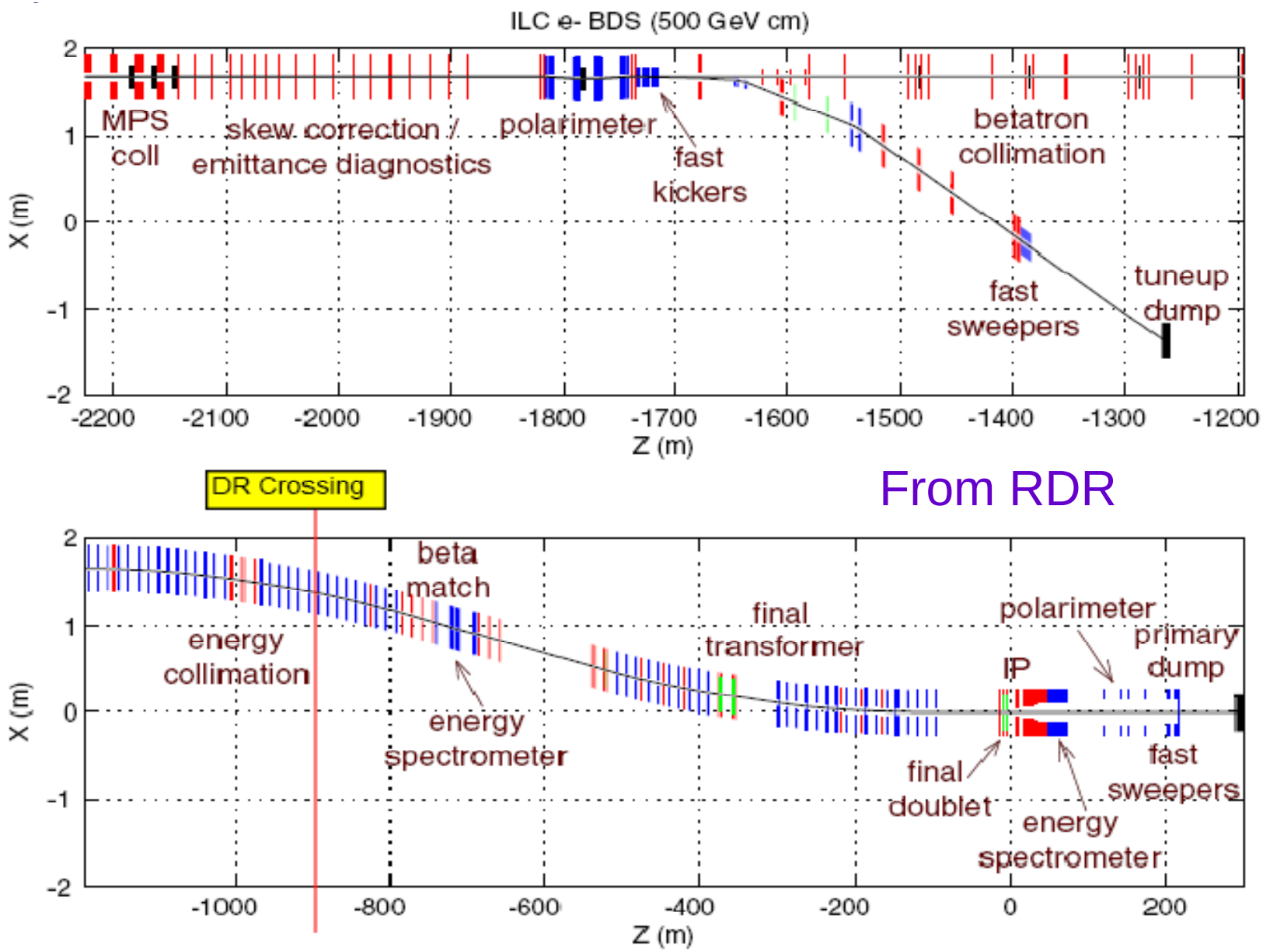


FIGURE 2.7-2. BDS layout showing functional subsystems, starting from the linac exit; X – horizontal position of elements, Z – distance measured from the IP.

Accelerator Design Change Ideas

- Assumption:- Reduce the underground footprint of any design lowers the “capital” cost. These ideas would work with 1 or 2 tunnels, shallow or deep but the cost differentials would change.
- In the central region the different elevations of the Injectors and DR’s enabled independent operation of these systems with open access to the BDS, the IR and linacs.
- Let us assume that with tunnel shielding walls and creativity we can do the same but with larger “access control” zones.
- Put everything in the same plane and put the Injectors in the same shared tunnel with the BDS!

IS THERE ENOUGH SPACE?

- In the Z (beam) direction the answer is YES

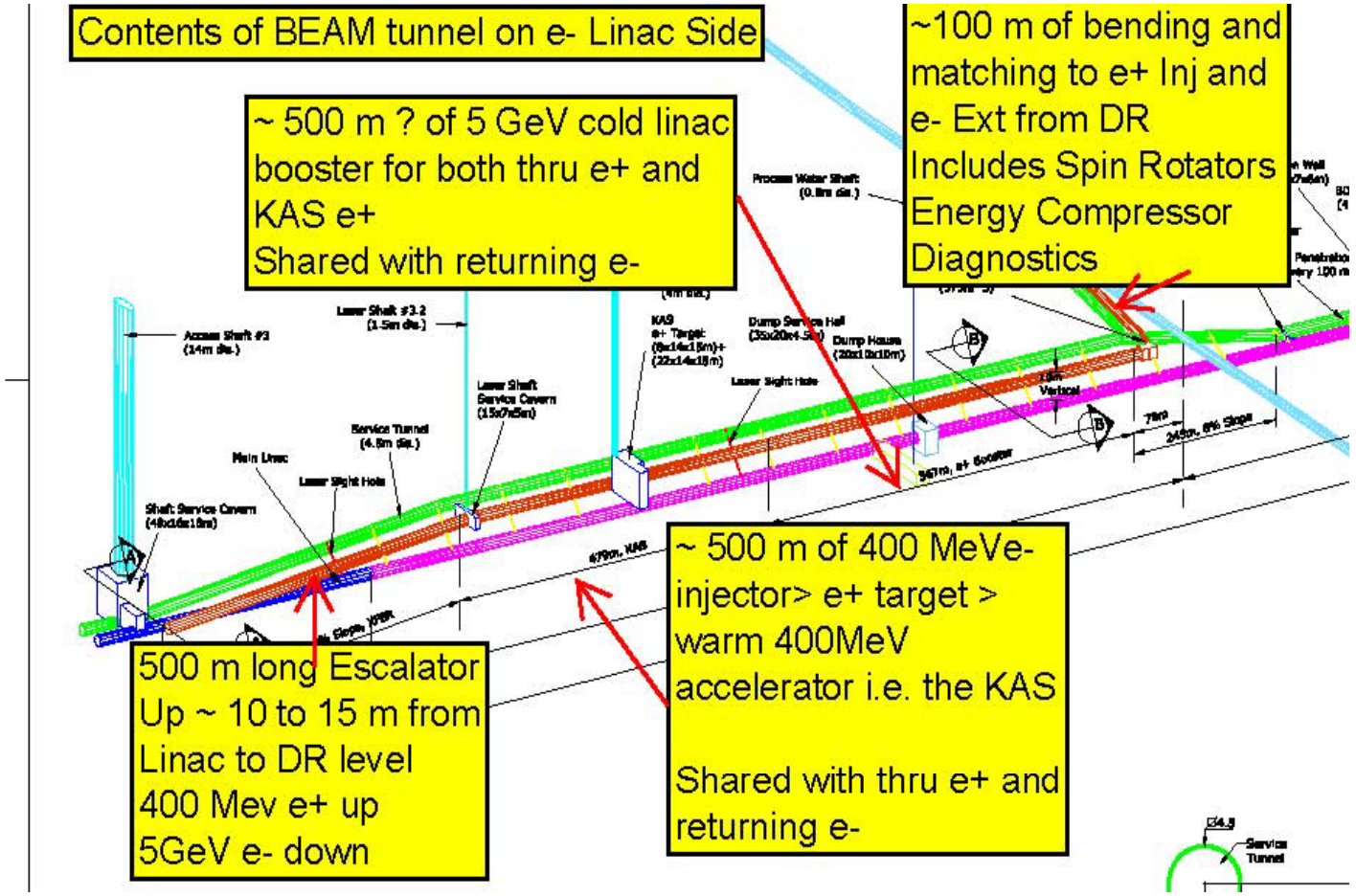
  see next slide 6

In the transverse direction, the answer is less obvious. What are the largest components that share transverse space? (over any extended Z). Looking at slide 7, one might conclude that a 4.5 m tunnel could be difficult.

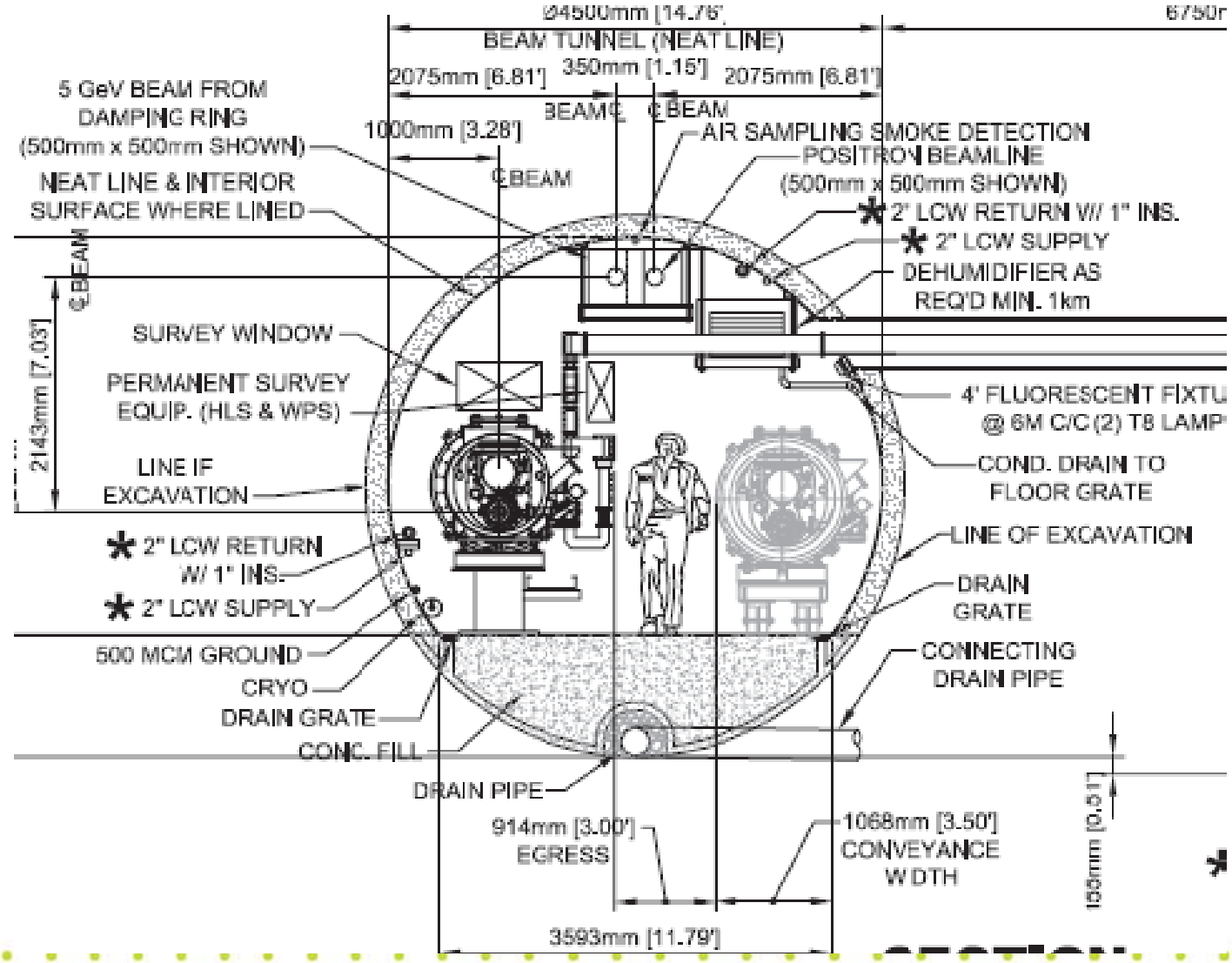
But in a 5.5 m tunnel it should be possible. 22% in radius and 50% in area! Only over a few km's ?

This would remove 2X1.5 = 3km of beam tunnel with some small cost in operating flexibility but no change in scope.

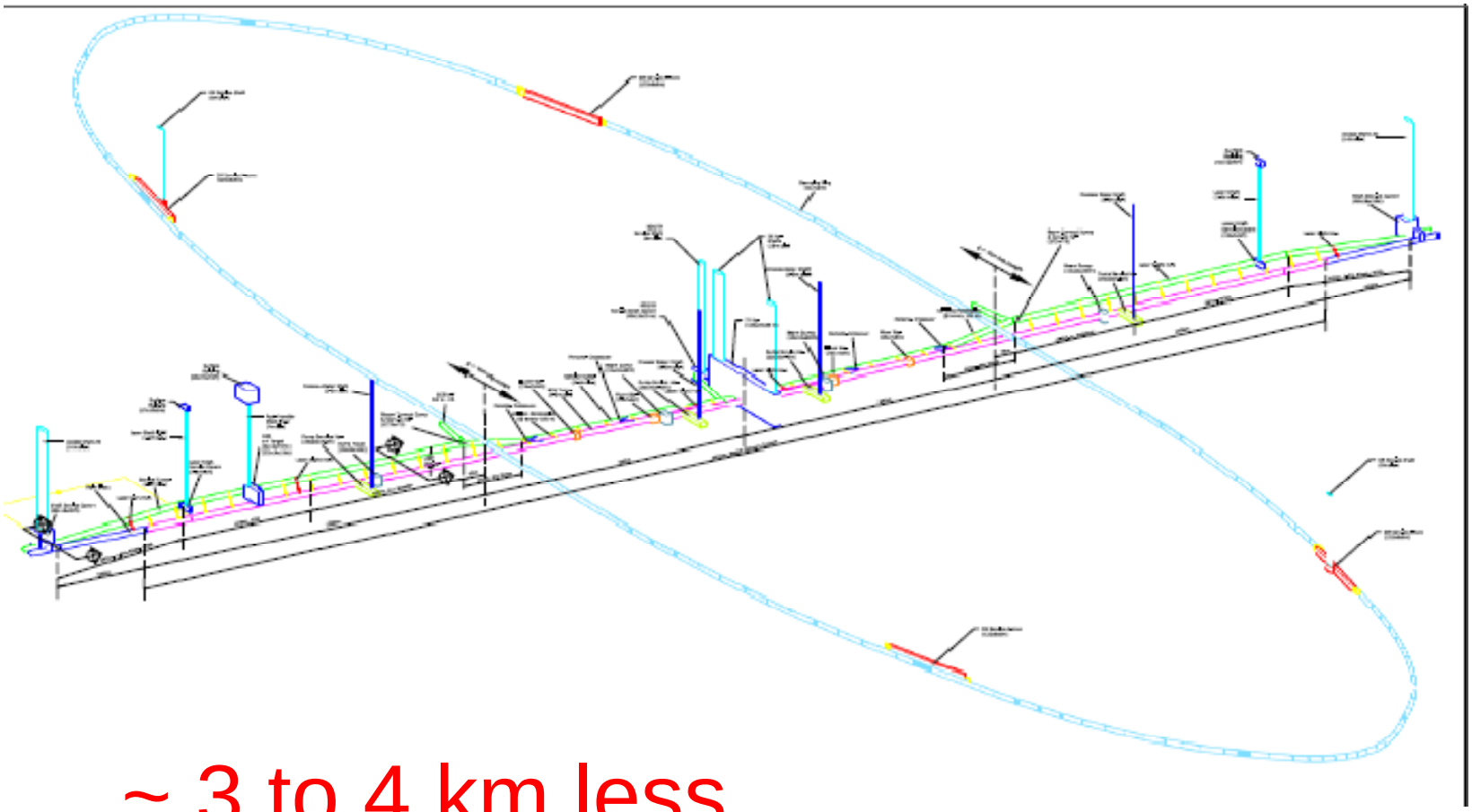
RDR KAS + BOOSTER



4.5m Tunnel with 2 Cryostats and both 5.0 and 0.5 GeV beamlines during installation



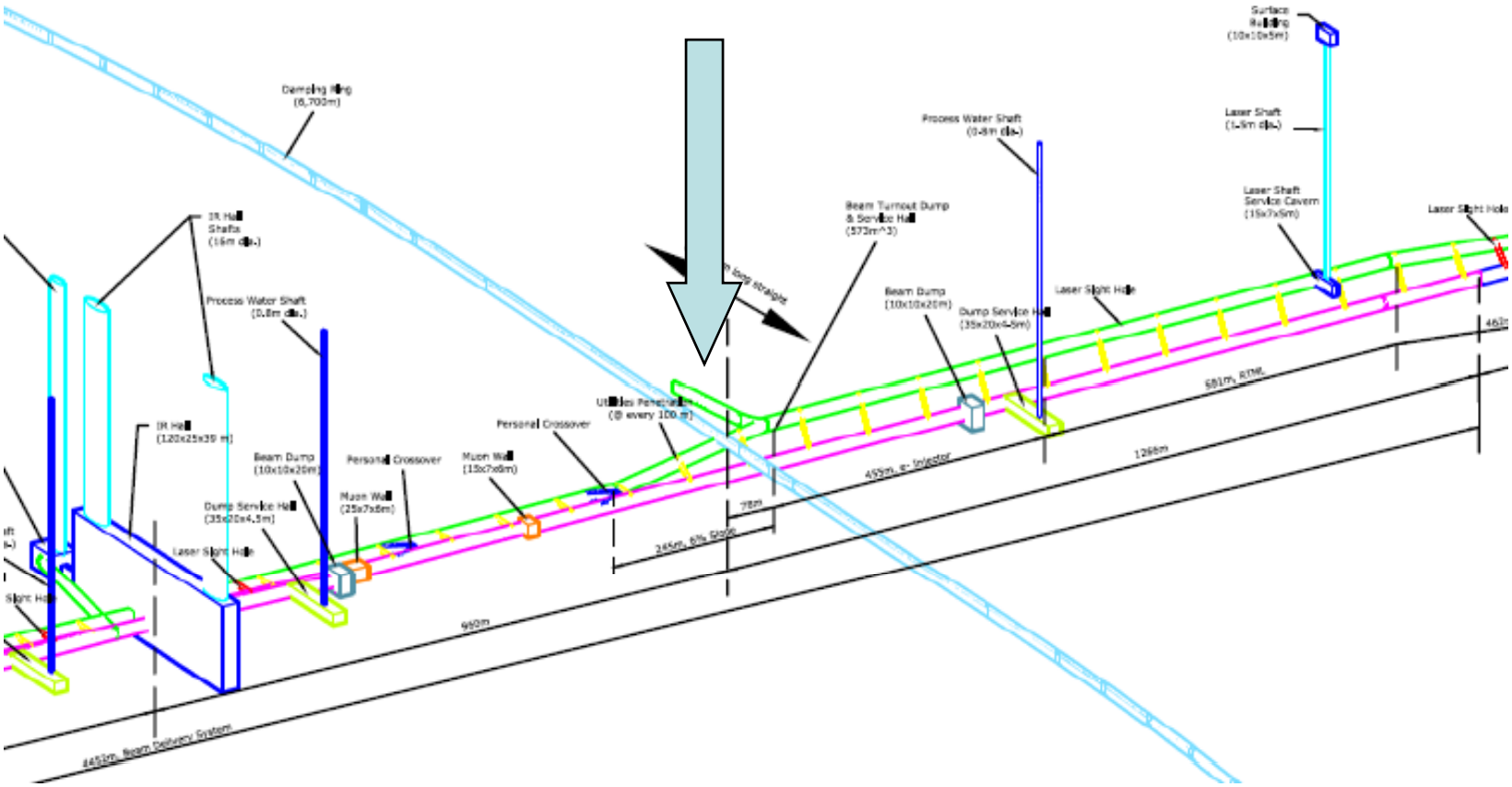
The result is Only One Beam Housing on each side



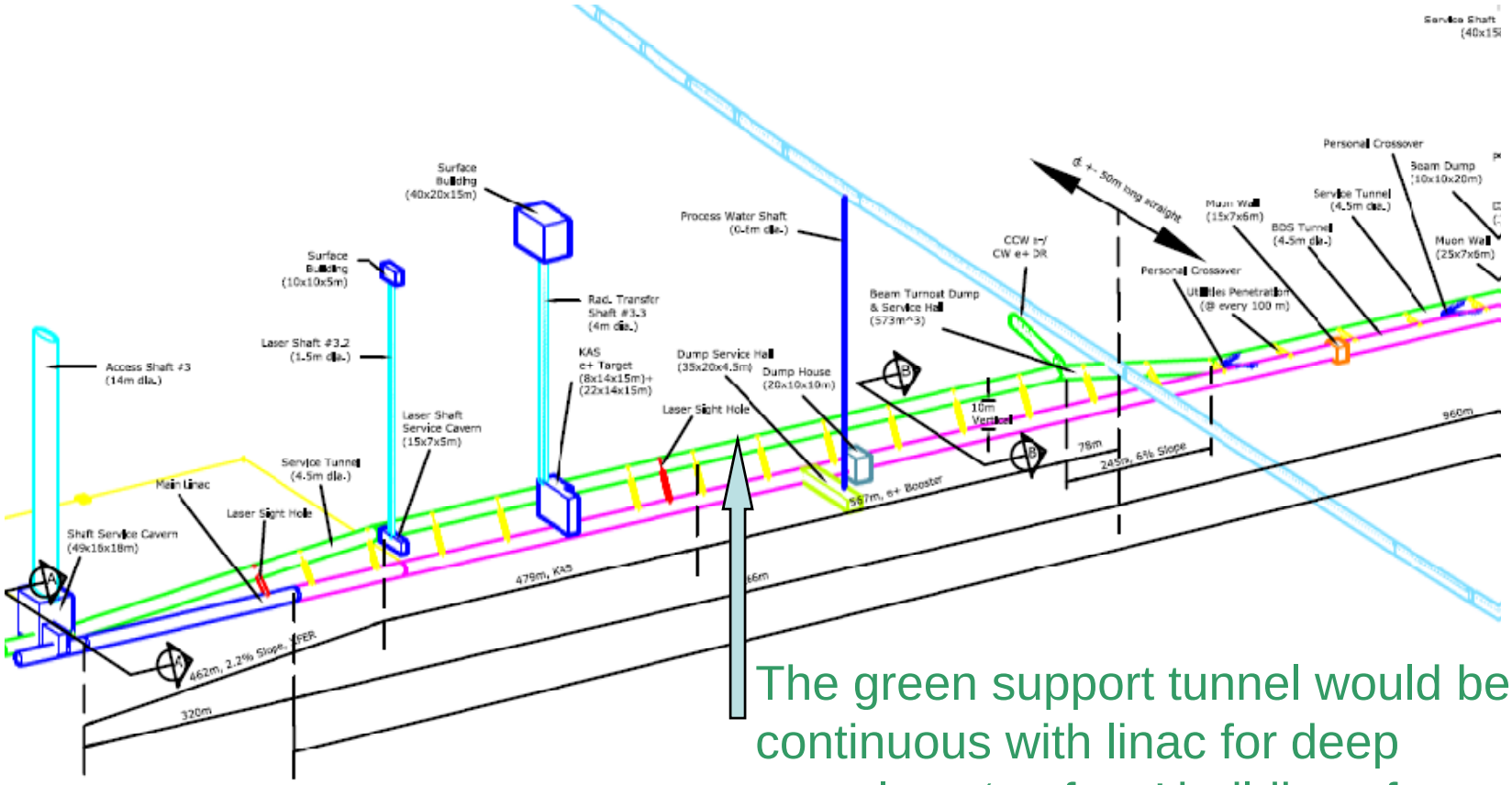
~ 3 to 4 km less beam tunnel

Enlarged E- Injection Side

150 m Inj tunnel accidentally removed



E+ Injection side which has KAS, Booster, Injection/Extraction and RTML



The green support tunnel would be continuous with linac for deep tunnels or ‘surface’ buildings for shallow case.

The KAS

- The KAS is a candidate for deletion. Impact is on commissioning and availability and it includes a lot of expensive high power hardware. (Both electrical and radiation power)
- In the ‘new’ layout removal of the KAS would ‘free up’ 600m of tunnel between the end of the e- linac and the booster.
- It is tempting to make better use of this section which already includes a full power ‘tune up’ dump. So let us review some positron production options.

RDR E+ SOURCES (Undulator)

- The RDR E+ source is based on an Helical Undulator design at 150 GeV (~10MeV photons on tgt) which meets design goals for intensity and produces ~30% polarized beam. E+/- timing not addressed!
- A Keep Alive Source (conventional e- on tgt) produces ~10% e+ current and is situated near the DR
- Best update on technical issues with this design, the R&D programs and open questions, can be found at the ILC Positron Collaboration Meeting (07-09 April 2008). See

  "http://ilcagenda.linearcollider.org/conferenceTimeTable.py?confId=2639&showDate=all&showSession=all&detailLevel=contribution&viewMode=session"

Conventional E+ Source

- Could be alternative to Undulator source
- Would have zero polarization
- Less costly…….how much?
- No timing problems
- Replaces KAS, use for Z-calib running and maybe GigaZ or E-E- but without polarization!
- BUT
- More R&D required on high power on thick target (see KAS comment). Increased costs in target capture section…is this properly accounted in comparison?
- Upgrade path to 60% polarized beam is still unclear and involves some backscattered laser system or Undulator scheme.

Undulator E+ Source Systems

- Need ~ 100 m of undulator to cover all operating range of ILC…. Modular design.
- Helical undulator is practical and easily gives 30% polarization from total source
- Planar undulator might be cheaper but how much? Certainly not XFEL or LCLS style!
- Whether undulator has a chicane, dogleg or other geometry, the 'drift' to target from the end of undulator must be > 400 m ! See later
- Growing consensus that undulator or beam offset could be between ~ 1 m and 2.5 m.
- After several oscillations, my present opinion is that it still looks like the best overall solution! But is it in the best location in the middle of the linac?

Consider E+ Source Layout(1)

- Approx lengths in the RDR design in meters

Undulator	Drift&Dogleg	Target+ Capture	Pre-accelerator	TOTAL
100(200)	400	100	500	1200

Move the source system to the end of the E- linac…..>

The Target/Capture section would now be close to the MPS collimators at the beginning of the BDS.

While on access into the IR all systems operate and the main e- drive beam would go to the tune up dump, a shared dump.

We save ½ , 600m, of the positron insert! But we also shorten the low energy e+ transport by several kilometers and open up several possible scenarios for starting the machine at lower energies and simple upgrades to “full” energy.

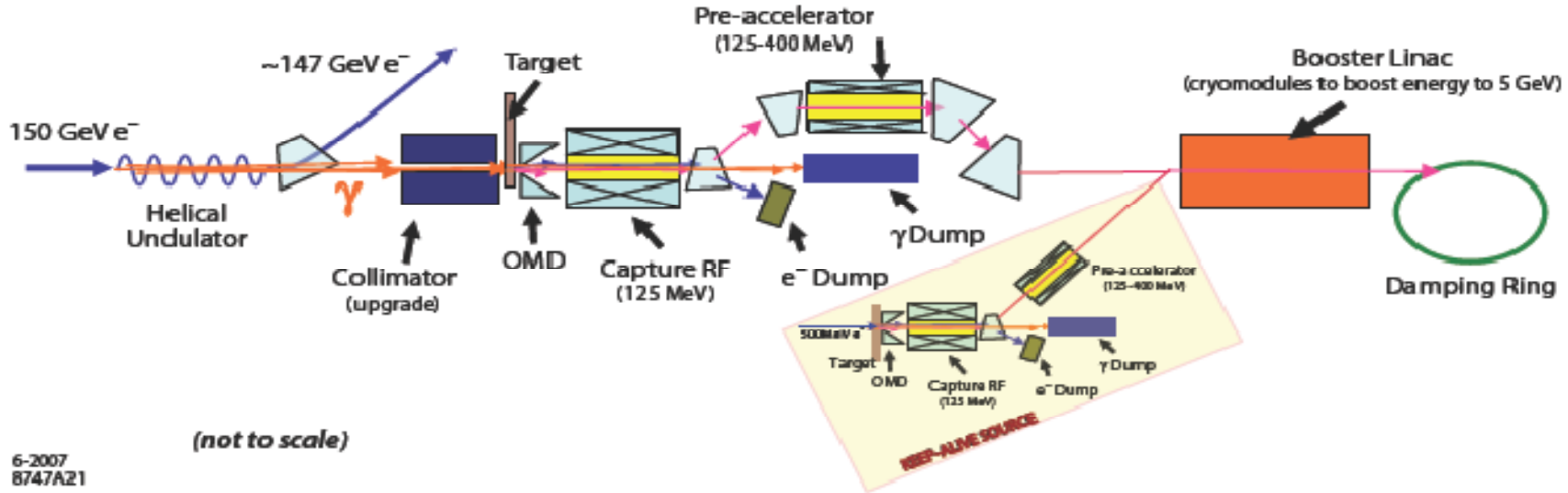
All systems except the linac are now within +/- 2.5 km of the IR.

A Central Campus

Consider E+ Source Layout (2)

- Lengths of the RDR e+ systems in meters

Undulator	**Drift&Dogleg**	Target+ Capture	Pre-accelerator	TOTAL
100(200)	**400**	100	500	1200



Q? Can we insert a warm 400 MeV E-accelerator in the drift/dogleg section and use the same target/capture, preaccelerator as a new type of "*KAS*" YES, WHY NOT?

KAS or *KAS*

- We need to review the design ***requirements*** for a KAS and its cost/benefits to overall ILC operation.
- RDR design has everything (except polarization) at 10% intensity…Injector, L-band linac, tgt/capture section and pre-accelerator. *Large and expensive!*
- An extreme alternate ***KAS*** could be a compact S-band single bunch linac whose e- beam uses the photon E+ tgt, capture and pre-accelerator, producing single bunches at a few % intensity.
- *Inexpensive, compact and could fit between the undulator and target alongside the photon and high energy e beam!*

Summary (1)

Really three ideas that could (should) be considered together…….or separately?

a) Co-planar DR and BDS. i.e 3 to 2 tunnels

b) Remove KAS and move e+ source to end of the linac partially sharing source and BDS tunnel at end of the linac.

c) Add back a special compact ***KAS*** which shares many e+ source systems.

We need a representative group to evaluate these ideas and options before doing detail design work.

Sources, Damping Rings, BDS, RTML, CF&S, and why not Linac!

Later we will need some working decision to go ahead before investing effort in design changes to everything from optics to CF&S in almost all systems. This second stage will be major effort.

SUMMARY (2)

These changes could deliver considerable cost savings in both CF&S and Technical Systems

They can apply for deep or shallow sites and one or two tunnel approaches. However, in addition there are many potential benefits in having all the area systems except the repetitive linac systems within a 5 X 3 km central campus.

For example, this could also work in a mountainous region where this central campus is shallow beneath the floor of a valley while the linacs are deep under the mountains!

A CHALLENGE

From slide 18

"We need a representative group to evaluate these ideas and options before doing detail design work.

Sources, Damping Rings, BDS, RTML, CF&S, and why not Linac!"

Could we start tomorrow morning?

Listing pro's and con's, problems, things that need more careful consideration, and other ideas that should be incorporated into the same study.