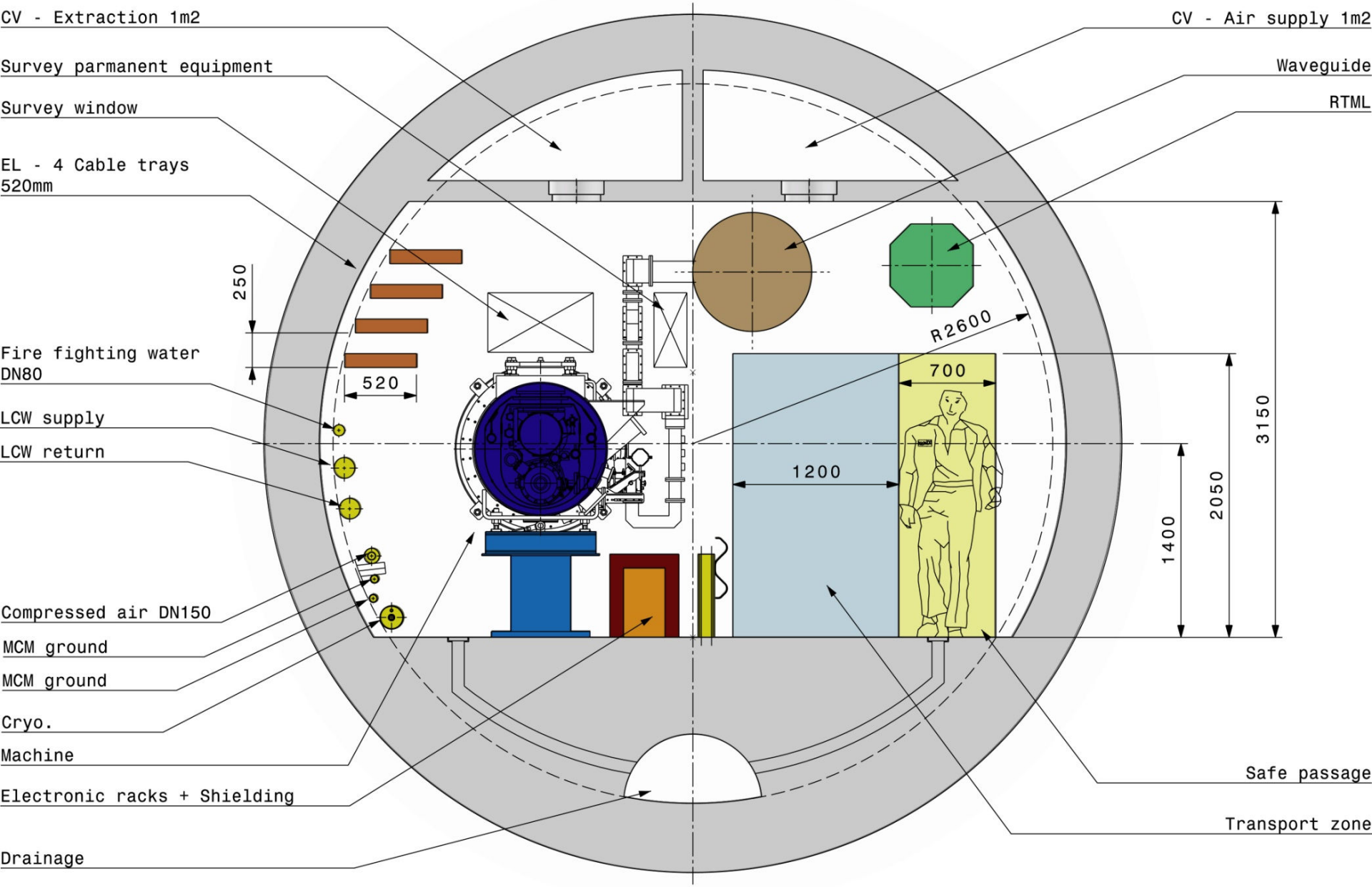
ILC

CFS update for Europe (CERN):

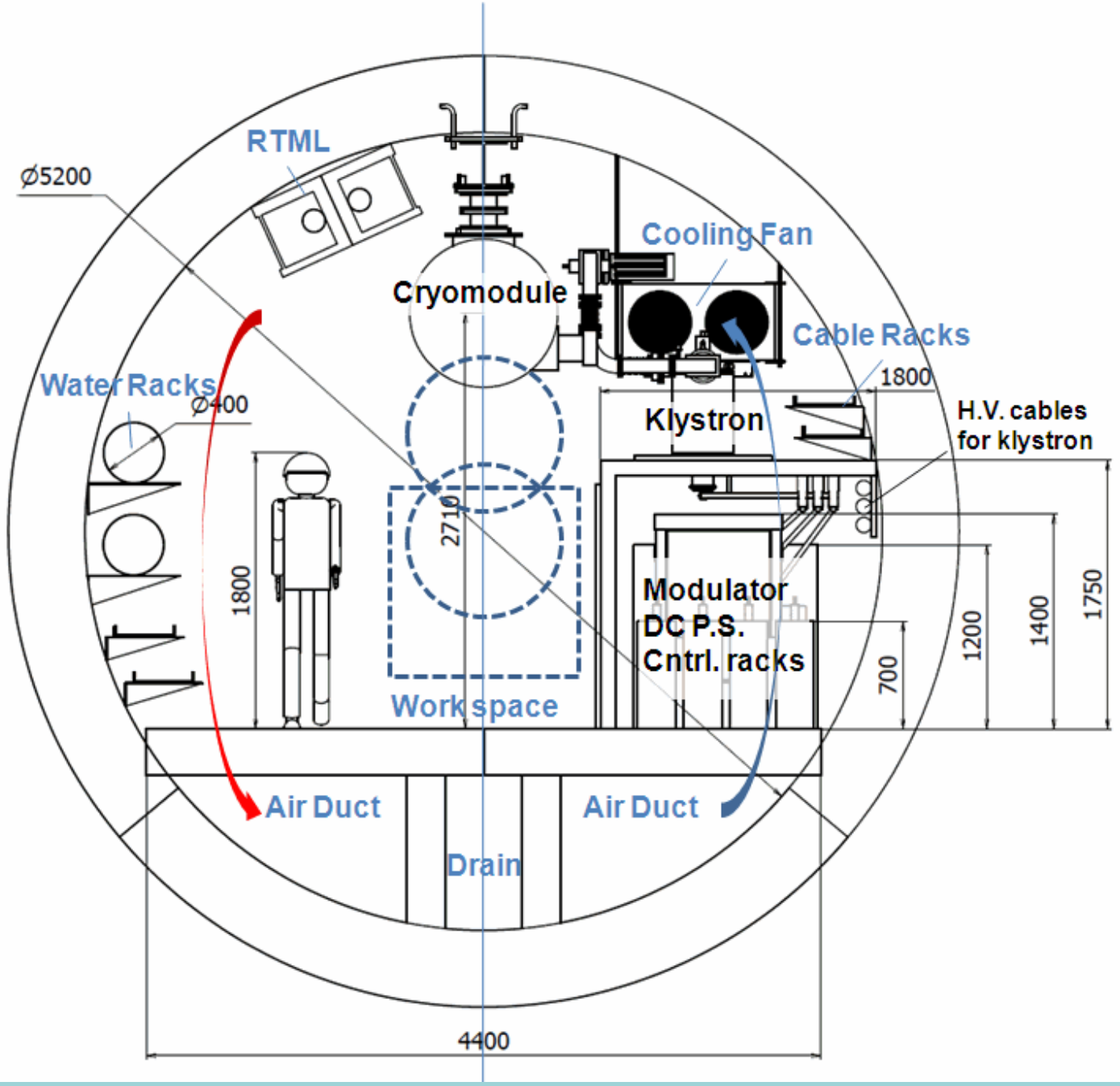
- Cross Sections
- 3d Layout and BDS tunnel diameters
- CERN Resources

John Osborne – March 2010



ILC - Typical Cross Section - Diameter 5200mm - Scale 1:25 (A3)
KLY CLUSTER EUROPE - J.Osborne / A.Kosmicki -November 6th 2009

Cross section for Europe (CERN) 5.2m diameter for Kly Cluster



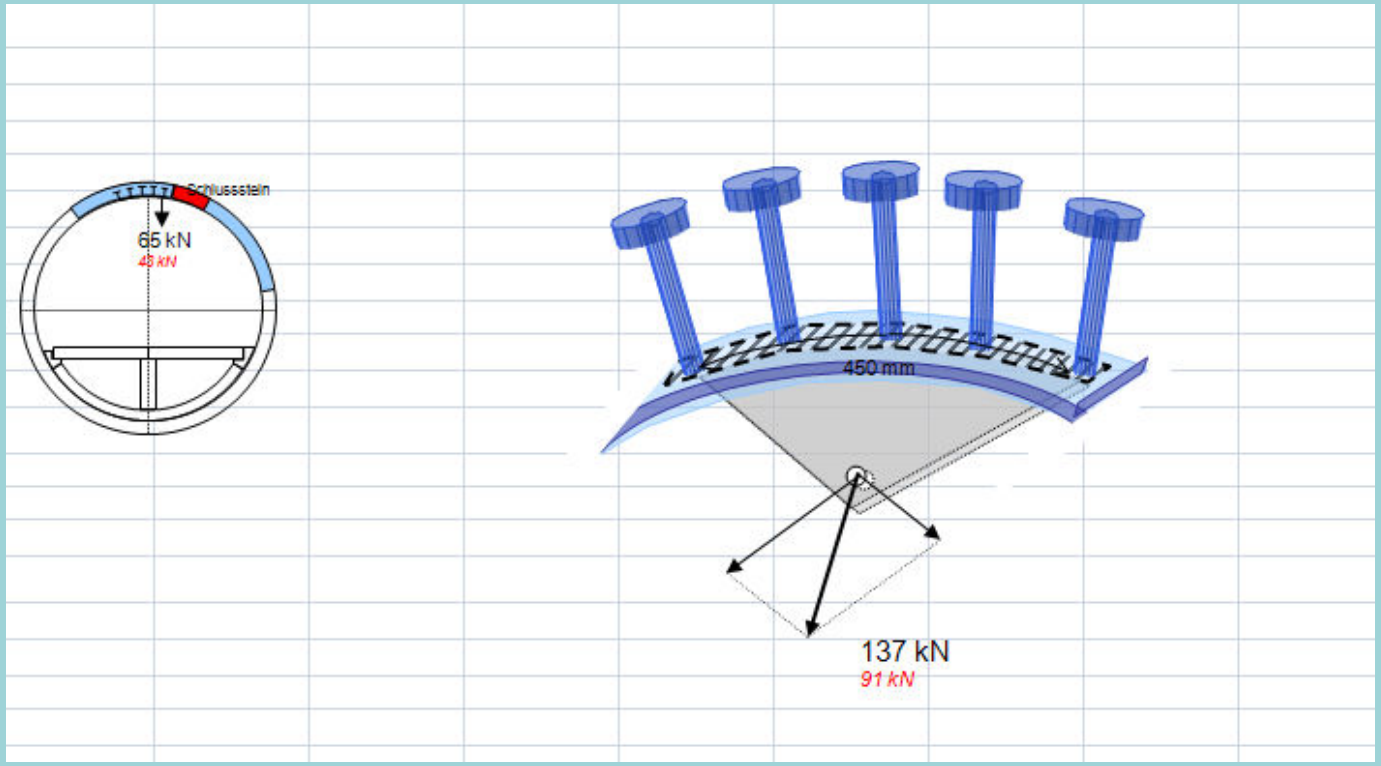
Cross section for Asia 5.2m diameter for DRFS

Disadvantages of suspending the cryo-modules from tunnel crown at CERN :

- Solution not compatible with CERN safety concept of transversal ventilation
- Transversal ventilation has advantage that overhead ducts could help remove Helium from tunnel in the event of an incident
- CERN geology not conducive, likely to induce ground movements which implies regular re-alignment of machine
- Additional safety risks associated with installation / access for maintenance
- CE construction tolerances significantly greater for segmental lining as opposed to 2nd phase tunnel invert concrete (may impact on costs for cryo supports ?)
- Difficult to transfer horizontal forces into segmental lining (up to 20tons at LHC ??)
- This is assuming ILC-type cryomodule approx. 7.4tons (data from J.Leibfritz FNAL). LHC 33tons.
- This idea was rejected for LHC (see report from Ph. Lebrun, C. Hauviller etc March 1990)

However, suspending cryomodules has major advantage due to more tunnel space available for machine & services, therefore potential to reduce diameter.

XFEL Solution for suspending Cryo-modules

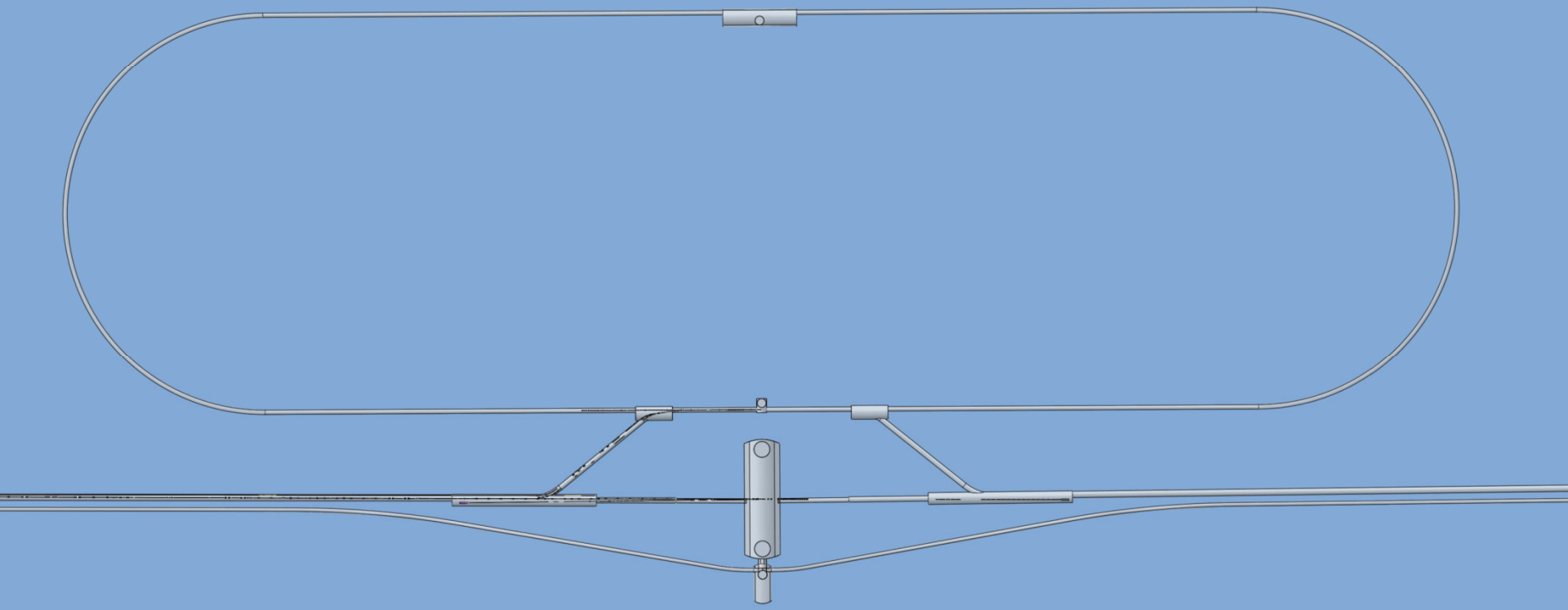


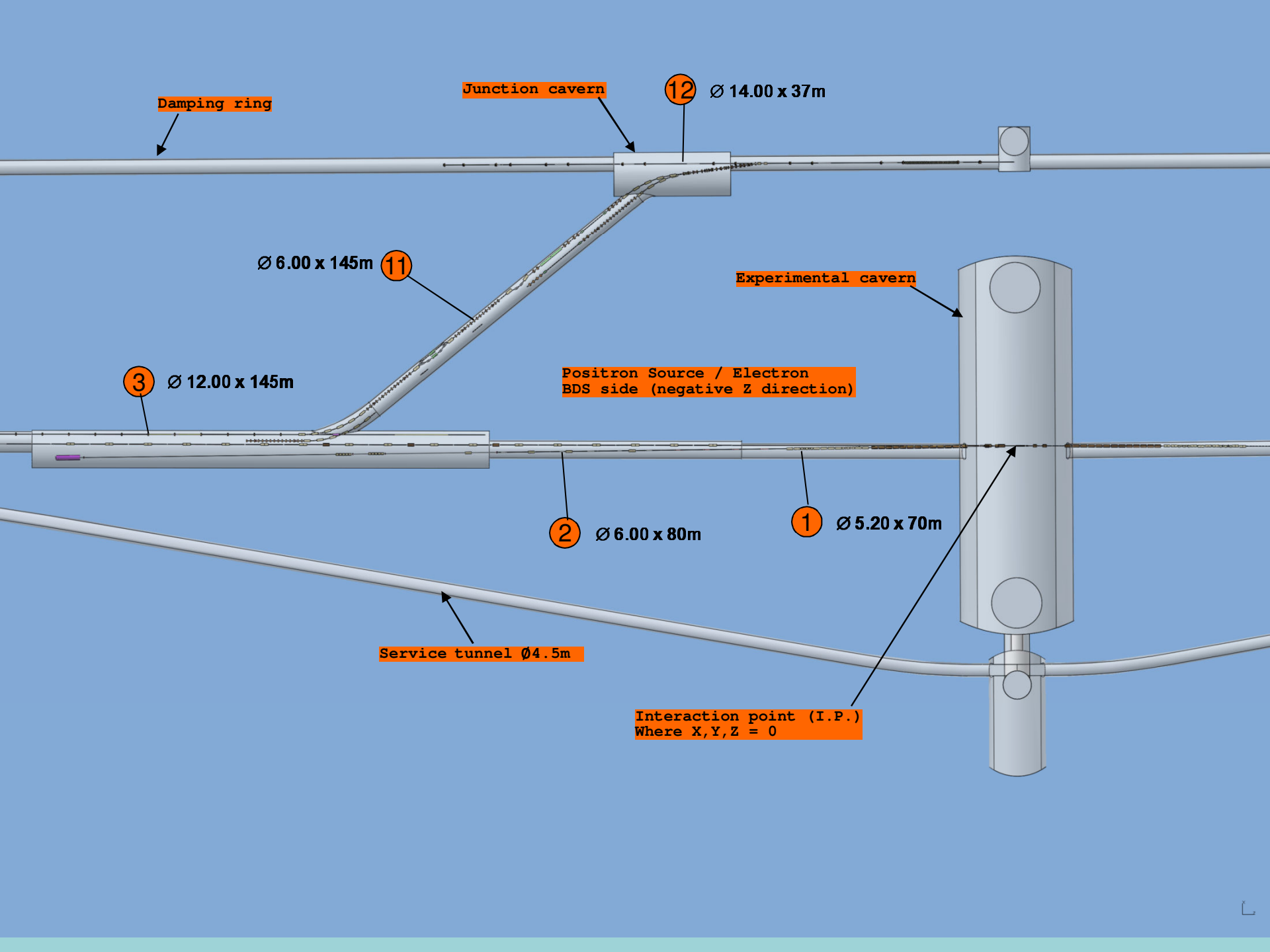
Steel plates with tangs cast into tunnel segments. Approximate maximum longitudinal load 10tons.

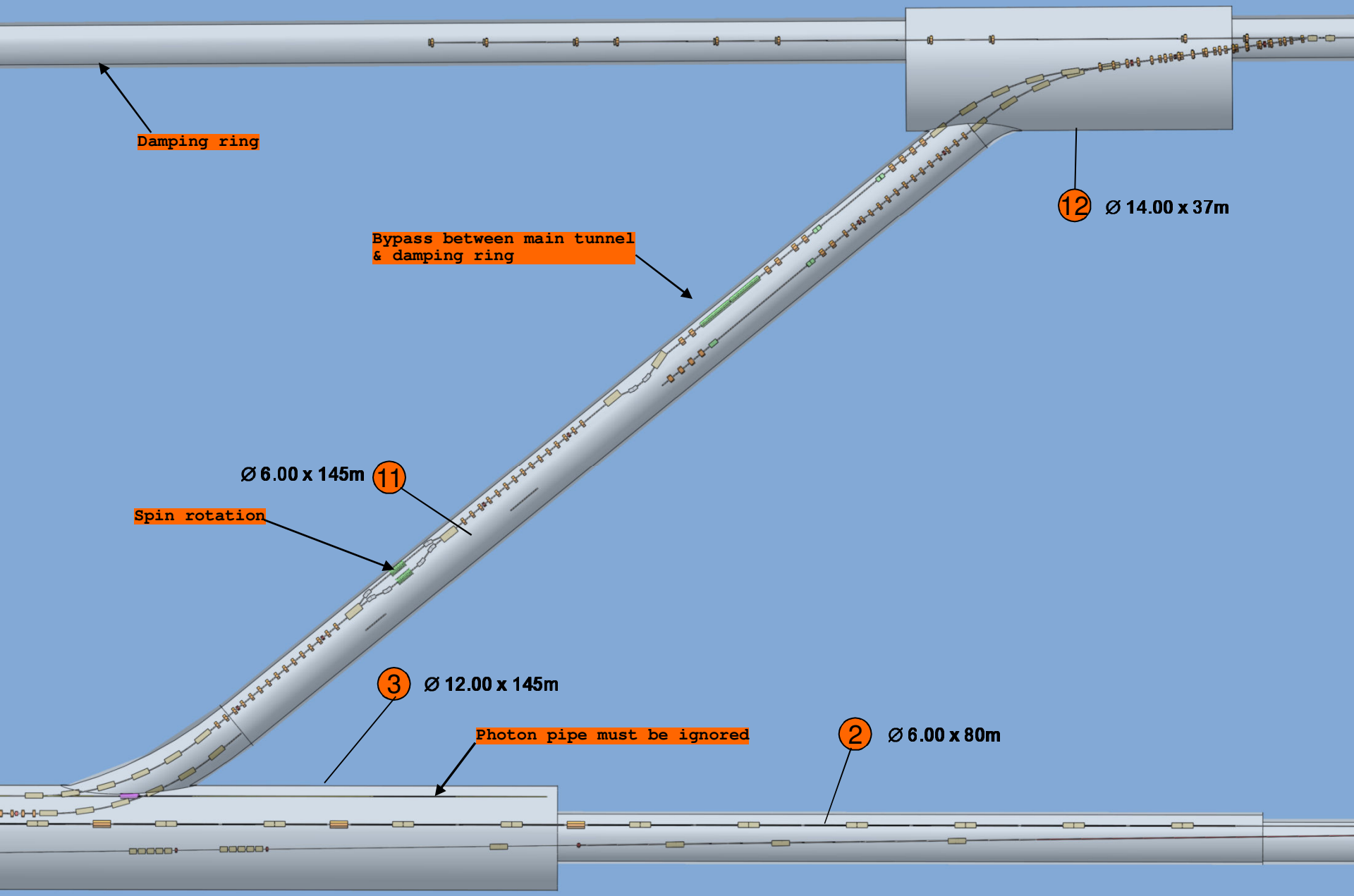
ILC

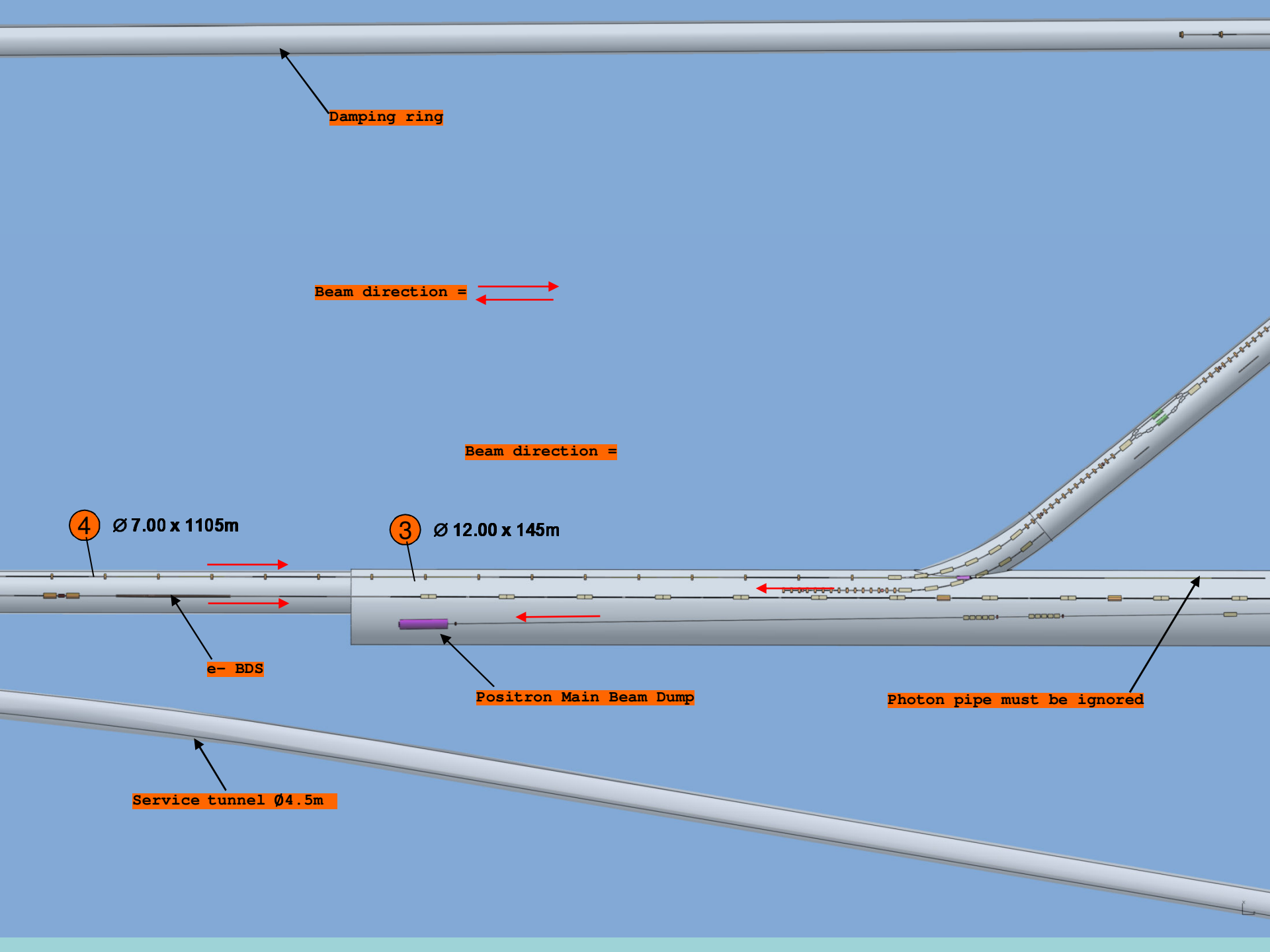
The following 3d models have been created using Lattice files produced by N.Collomb at Daresbury in Feb/Mar 2010

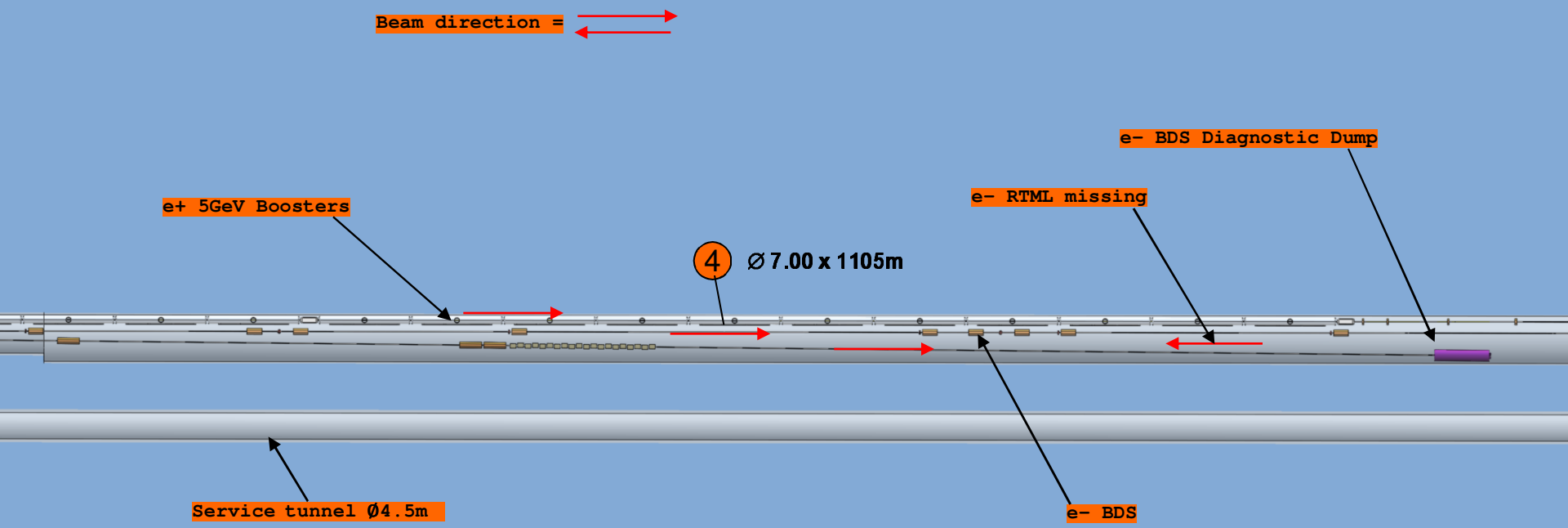
Damping ring

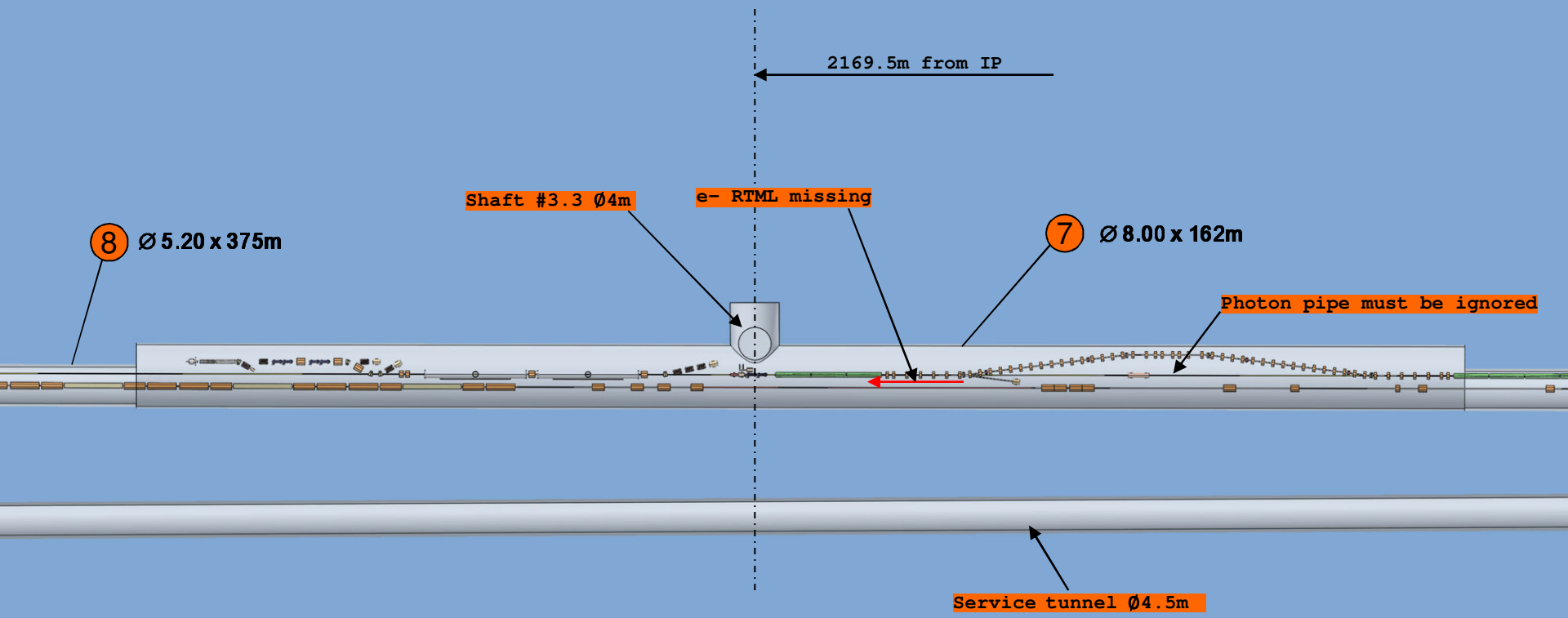


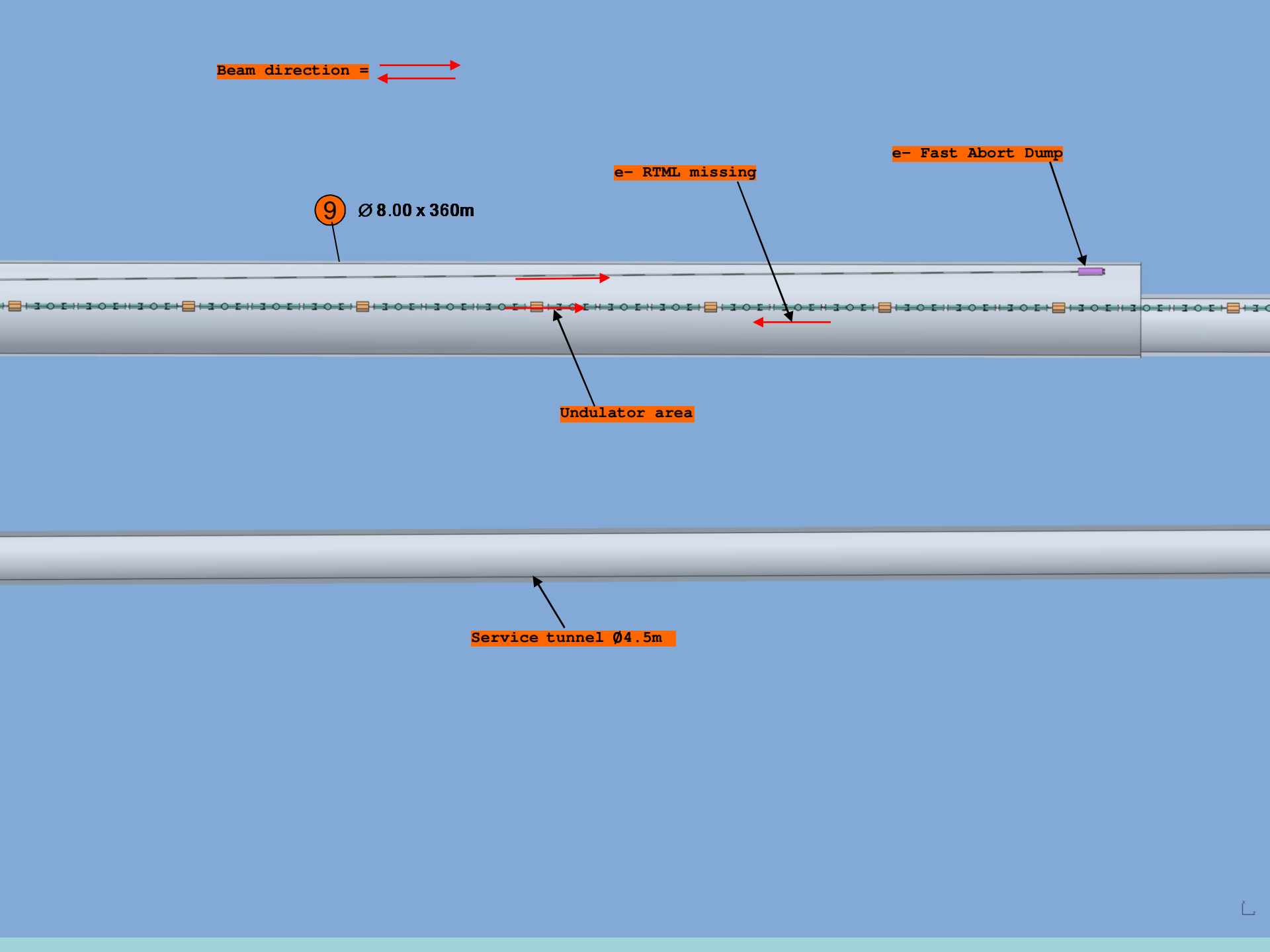

Damping ring
Junction cavern
12
Ø 14.00 x 37m
Ø 6.00 x 145m
11
Experimental cavern
3
Ø 12.00 x 145m
Positron Source / Electron
BDS side (negative Z direction)
2
Ø 6.00 x 80m
1
Ø 5.20 x 70m
Service tunnel Ø4.5m
Interaction point (I.P.)
Where X,Y,Z = 0

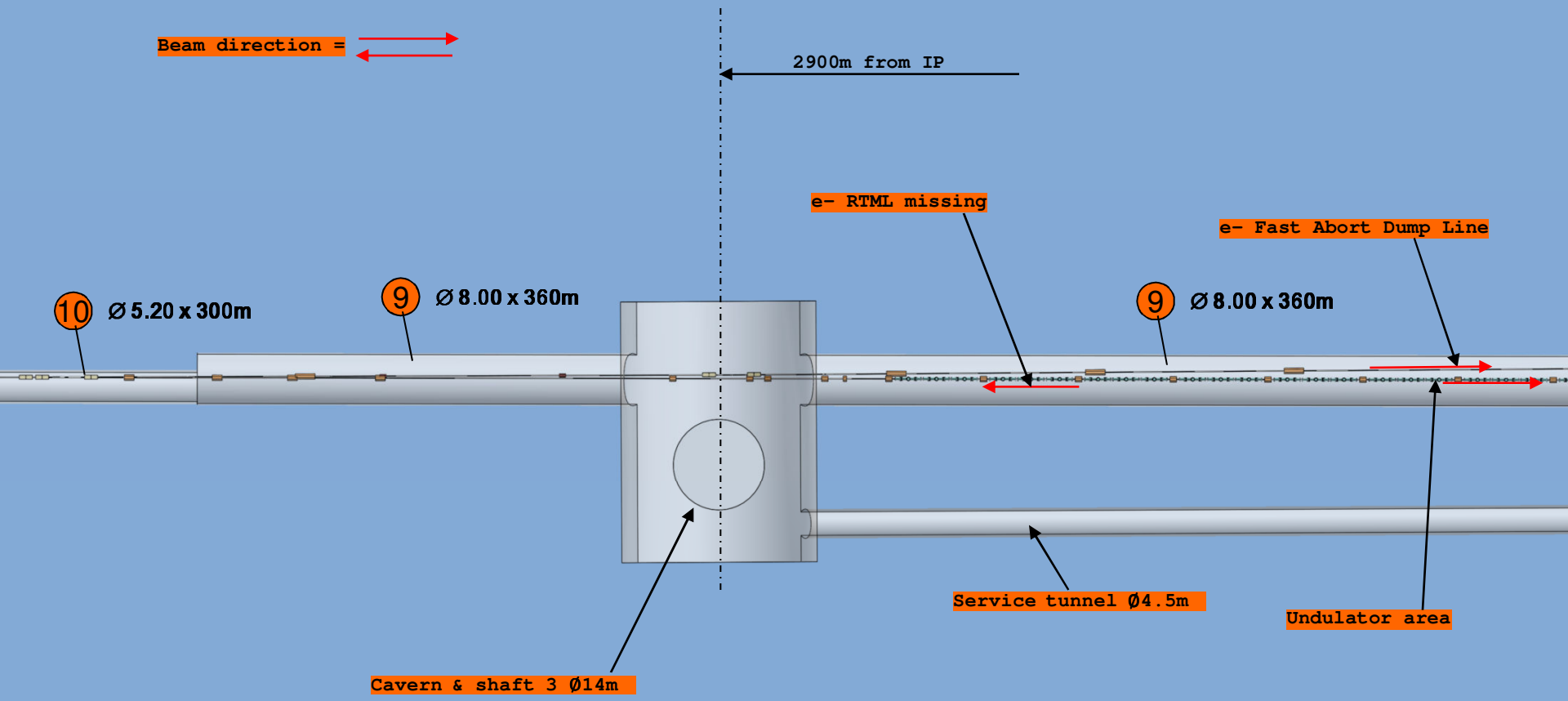

Damping ring
12
Ø 14.00 x 37m
Bypass between main tunnel
& damping ring
Ø 6.00 x 145m
11
Spin rotation
3
Ø 12.00 x 145m
Photon pipe must be ignored
2
Ø 6.00 x 80m


Damping ring
Beam direction =
Beam direction =
4
Ø 7.00 x 1105m
3
Ø 12.00 x 145m
e- BDS
Positron Main Beam Dump
Photon pipe must be ignored
Service tunnel Ø4.5m


Beam direction =
e- BDS Diagnostic Dump
e+ 5GeV Boosters
e- RTML missing
4
Ø 7.00 x 1105m
Service tunnel Ø4.5m
e- BDS

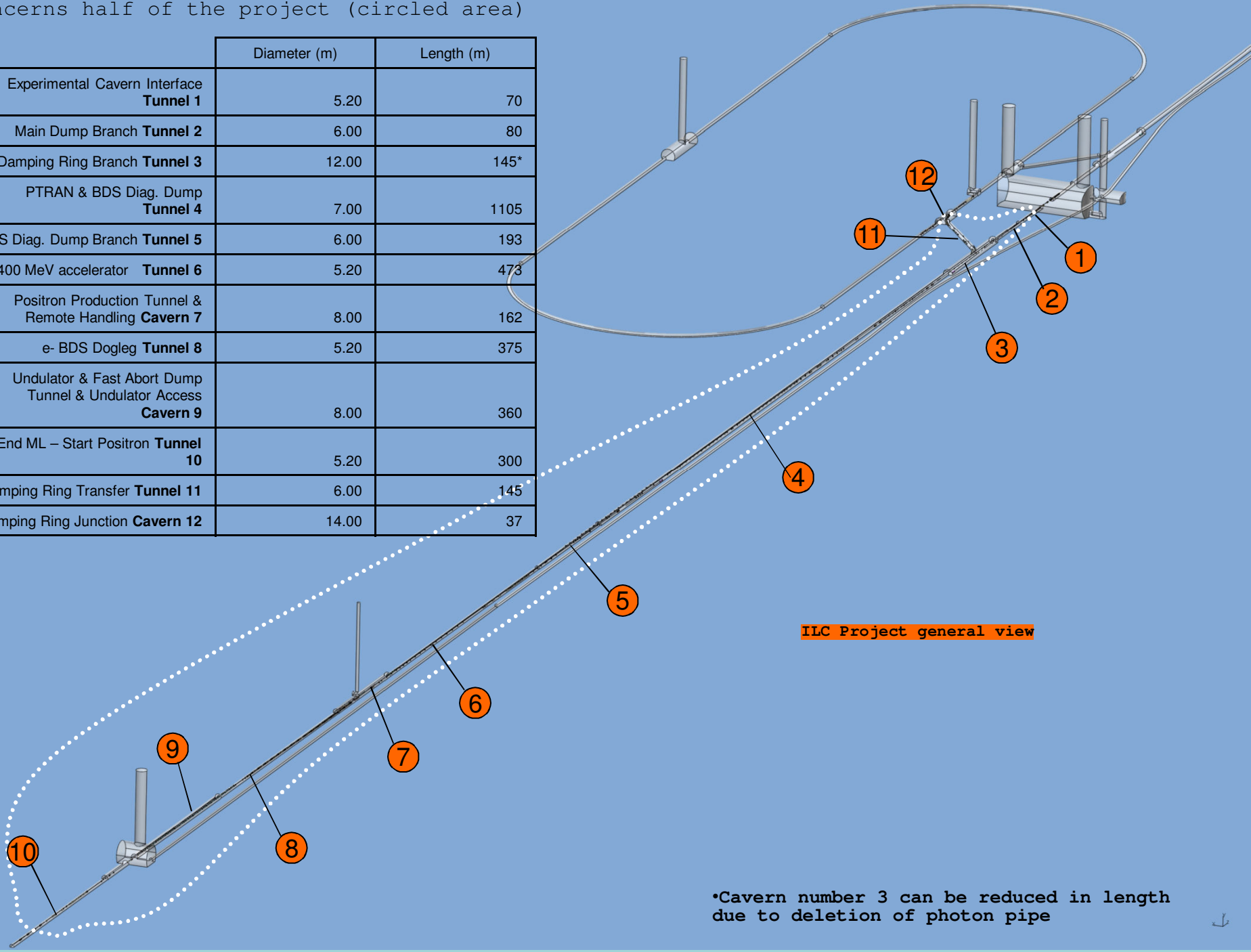

2169.5m from IP
Shaft #3.3 Ø4m
e- RTML missing
8
Ø 5.20 x 375m
7
Ø 8.00 x 162m
Photon pipe must be ignored
Service tunnel Ø4.5m


Beam direction =
e- Fast Abort Dump
e- RTML missing
9
Ø 8.00 x 360m
Undulator area
Service tunnel Ø4.5m


Beam direction =
2900m from IP
e- RTML missing
e- Fast Abort Dump Line
10
Ø 5.20 x 300m
9
Ø 8.00 x 360m
9
Ø 8.00 x 360m
Service tunnel Ø4.5m
Undulator area
Cavern & shaft 3 Ø14m

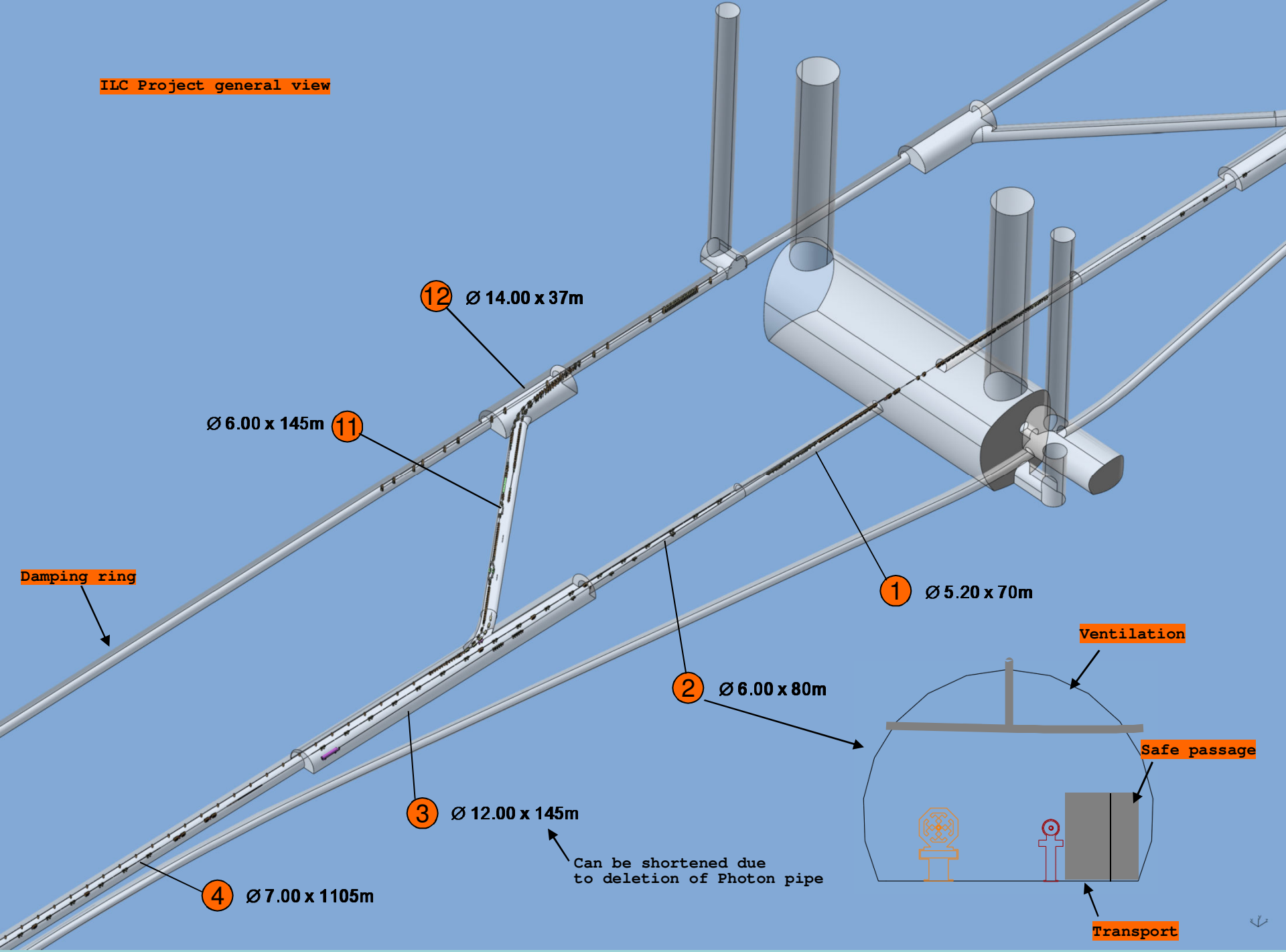
Concerns half of the project (circled area)

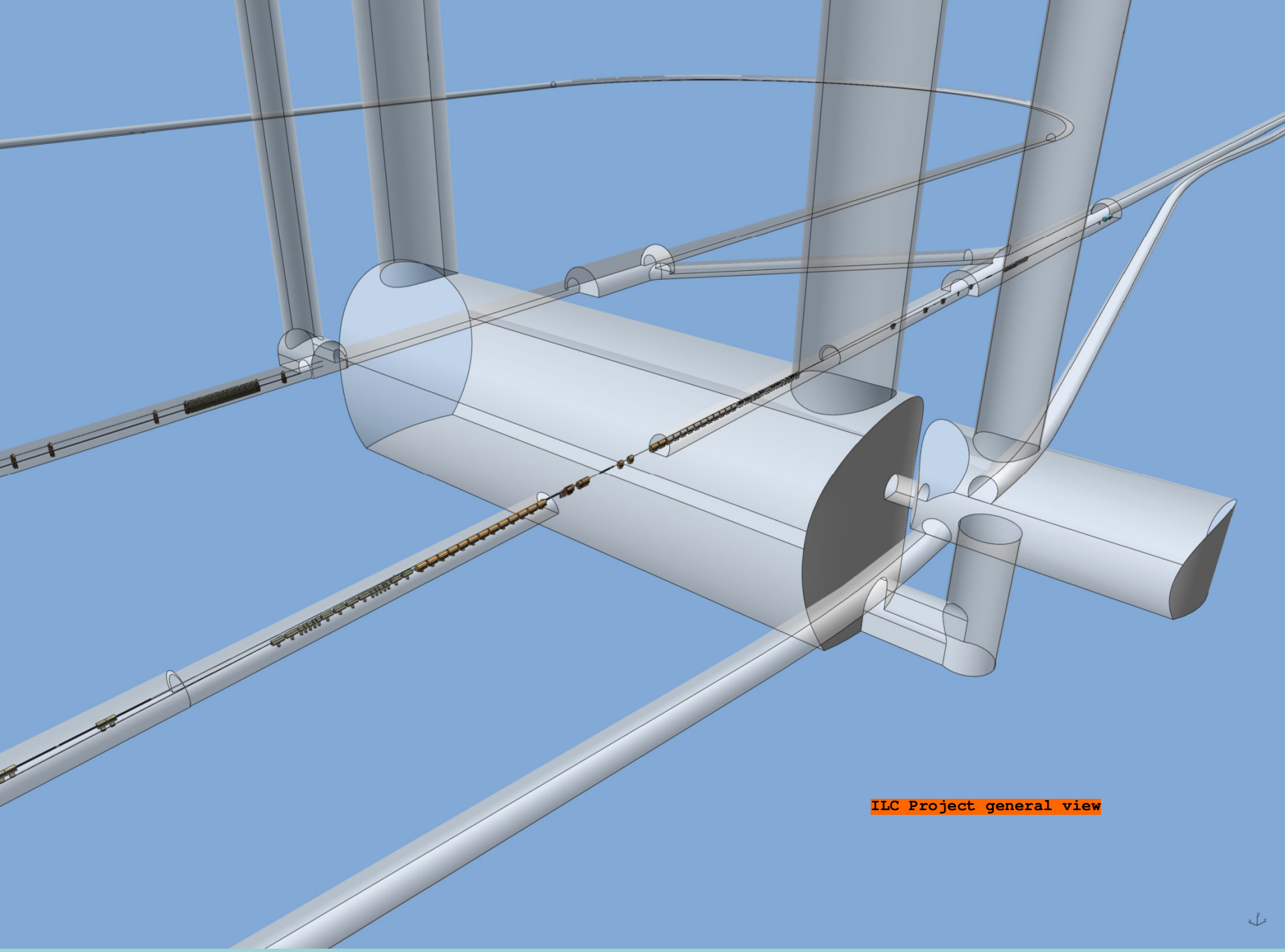
	Diameter (m)	Length (m)
Experimental Cavern Interface **Tunnel 1**	5.20	70
Main Dump Branch **Tunnel 2**	6.00	80
Damping Ring Branch **Tunnel 3**	12.00	145*
PTRAN & BDS Diag. Dump **Tunnel 4**	7.00	1105
BDS Diag. Dump Branch **Tunnel 5**	6.00	193
400 MeV accelerator **Tunnel 6**	5.20	473
Positron Production Tunnel & Remote Handling **Cavern 7**	8.00	162
e- BDS Dogleg **Tunnel 8**	5.20	375
Undulator & Fast Abort Dump Tunnel & Undulator Access **Cavern 9**	8.00	360
End ML – Start Positron **Tunnel 10**	5.20	300
Damping Ring Transfer **Tunnel 11**	6.00	145
Damping Ring Junction **Cavern 12**	14.00	37

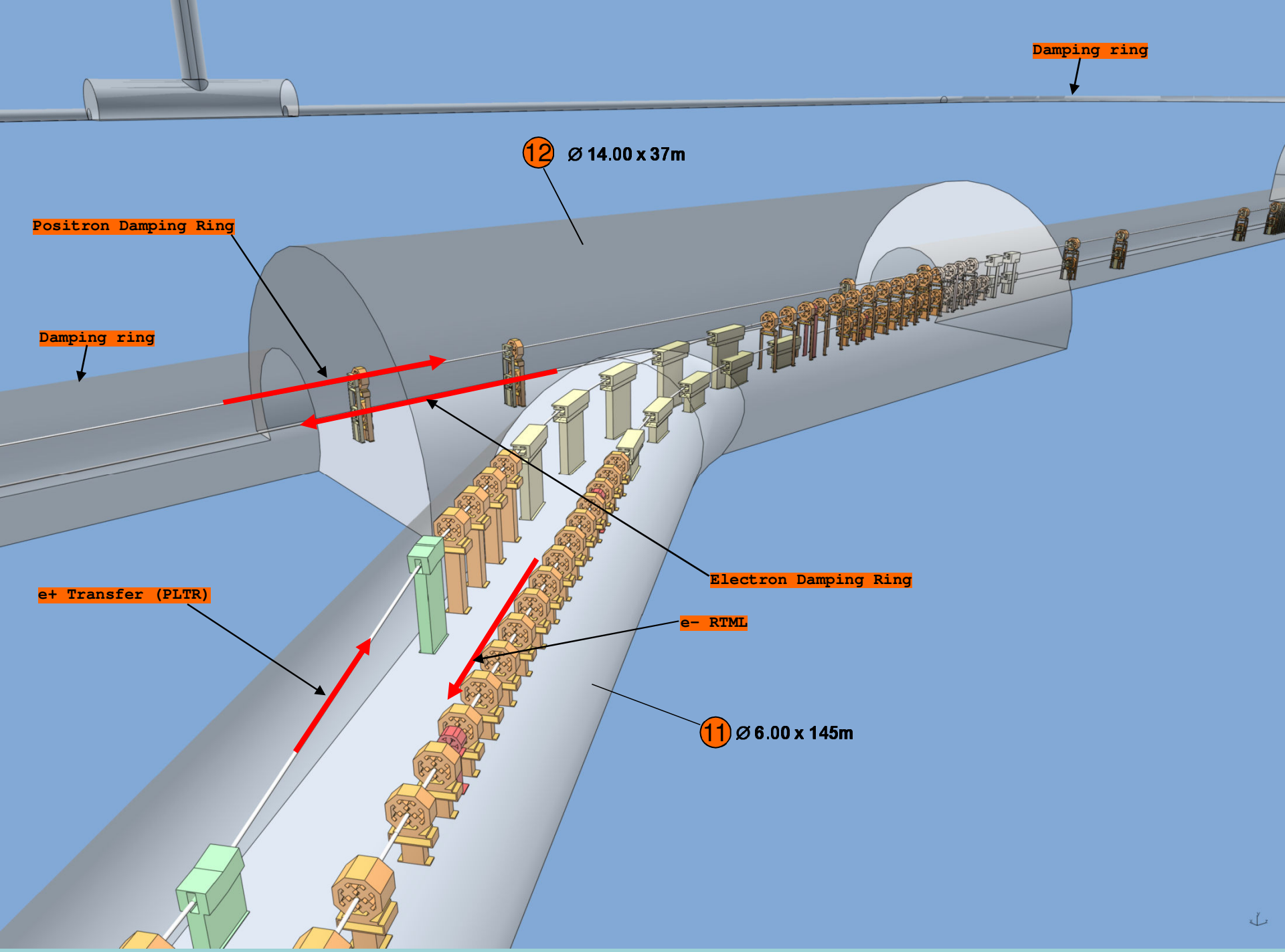


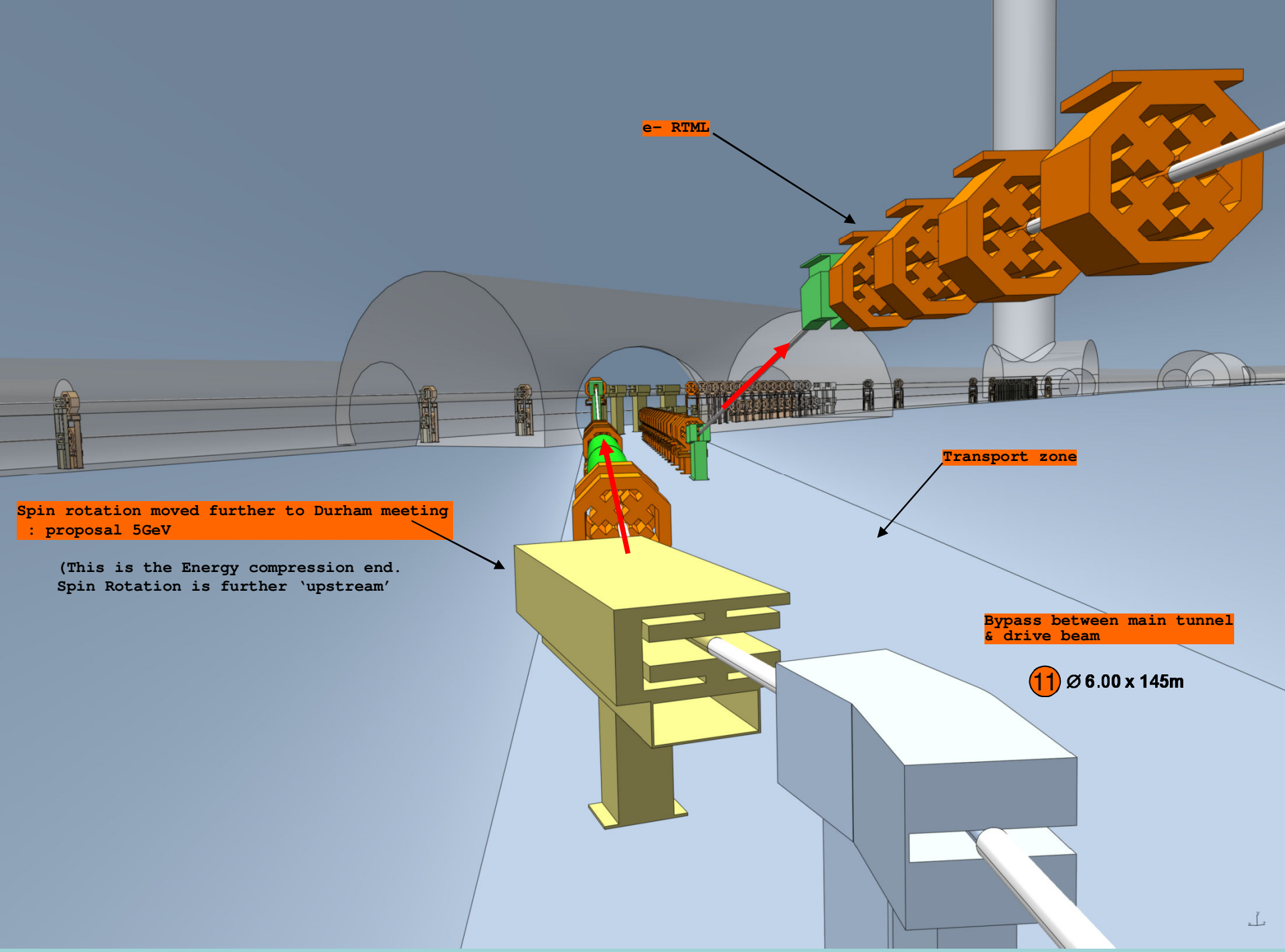
ILC Project general view

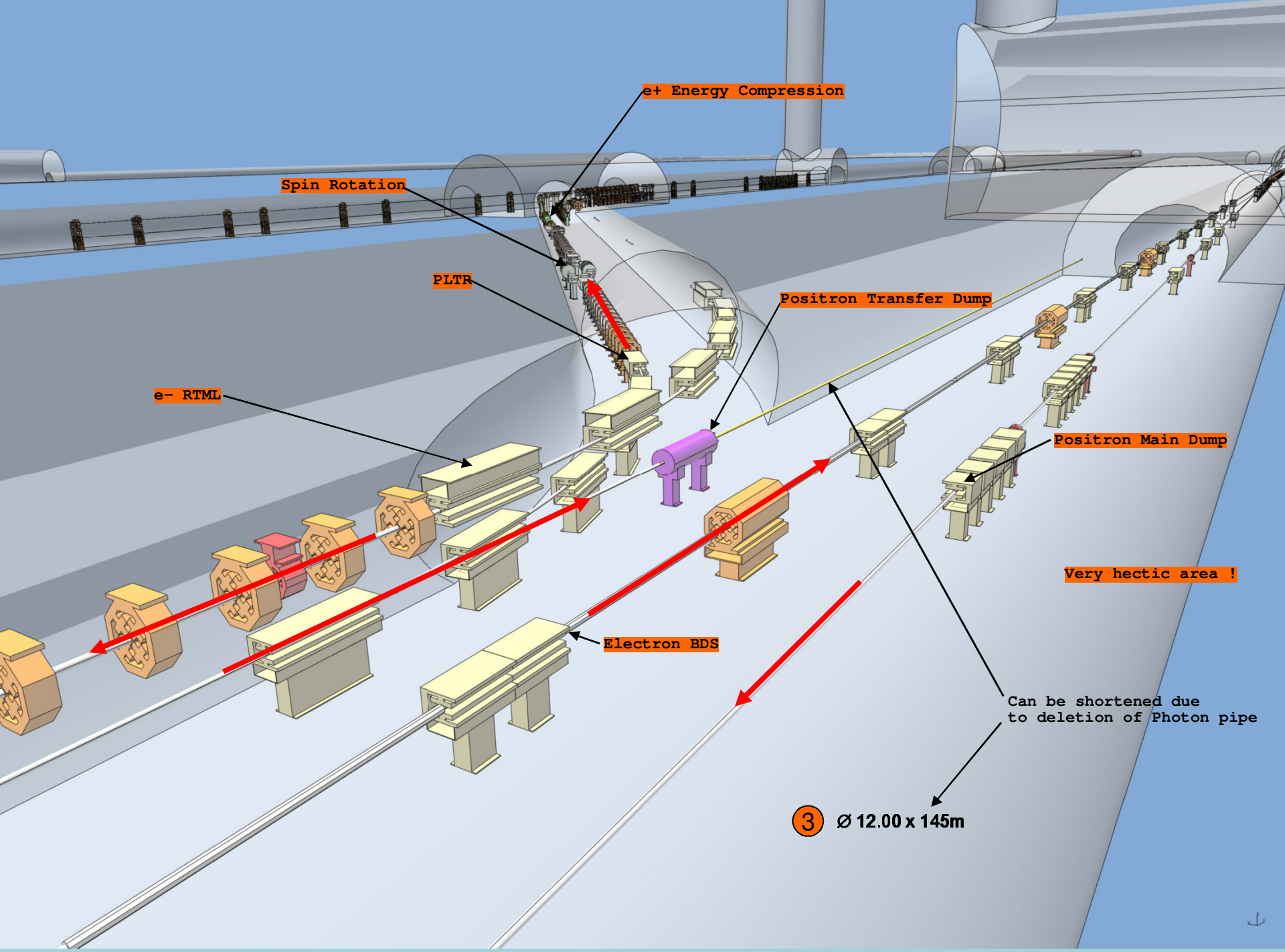
•Cavern number 3 can be reduced in length due to deletion of photon pipe

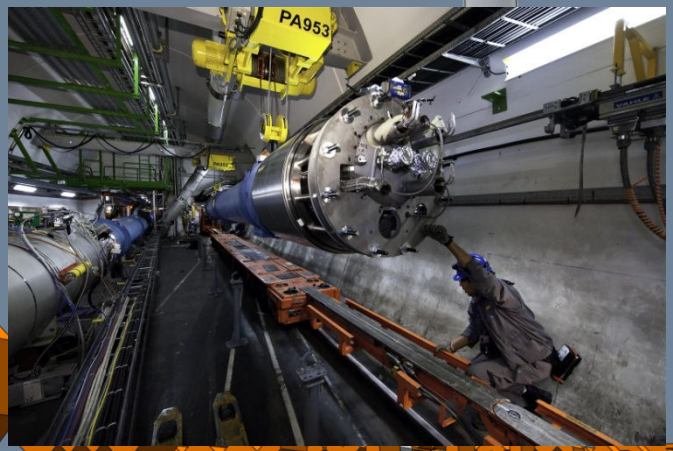

ILC Project general view
12
Ø 14.00 x 37m
Ø 6.00 x 145m
11
Damping ring
1
Ø 5.20 x 70m
Ventilation
2
Ø 6.00 x 80m
Safe passage
3
Ø 12.00 x 145m
Can be shortened due
to deletion of Photon pipe
4
Ø 7.00 x 1105m
Transport

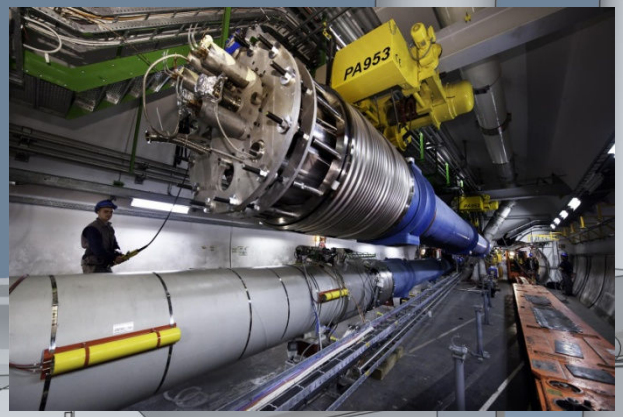

ILC Project general view

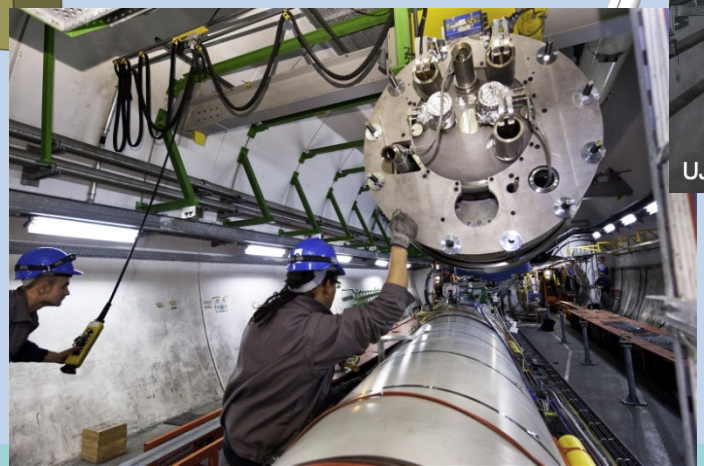

Damping ring
12 Ø 14.00 x 37m
Positron Damping Ring
Damping ring
Electron Damping Ring
e+ Transfer (PLTR)
e- RTML
11 Ø 6.00 x 145m


e- RTML
Transport zone
Spin rotation moved further to Durham meeting
: proposal 5GeV
(This is the Energy compression end.
Spin Rotation is further 'upstream'
Bypass between main tunnel
& drive beam
11 Ø 6.00 x 145m


e+ Energy Compression
Spin Rotation
PLTR
Positron Transfer Dump
e- RTML
Positron Main Dump
Very hectic area !
Electron BDS
Can be shortened due
to deletion of Photon pipe
3
Ø 12.00 x 145m

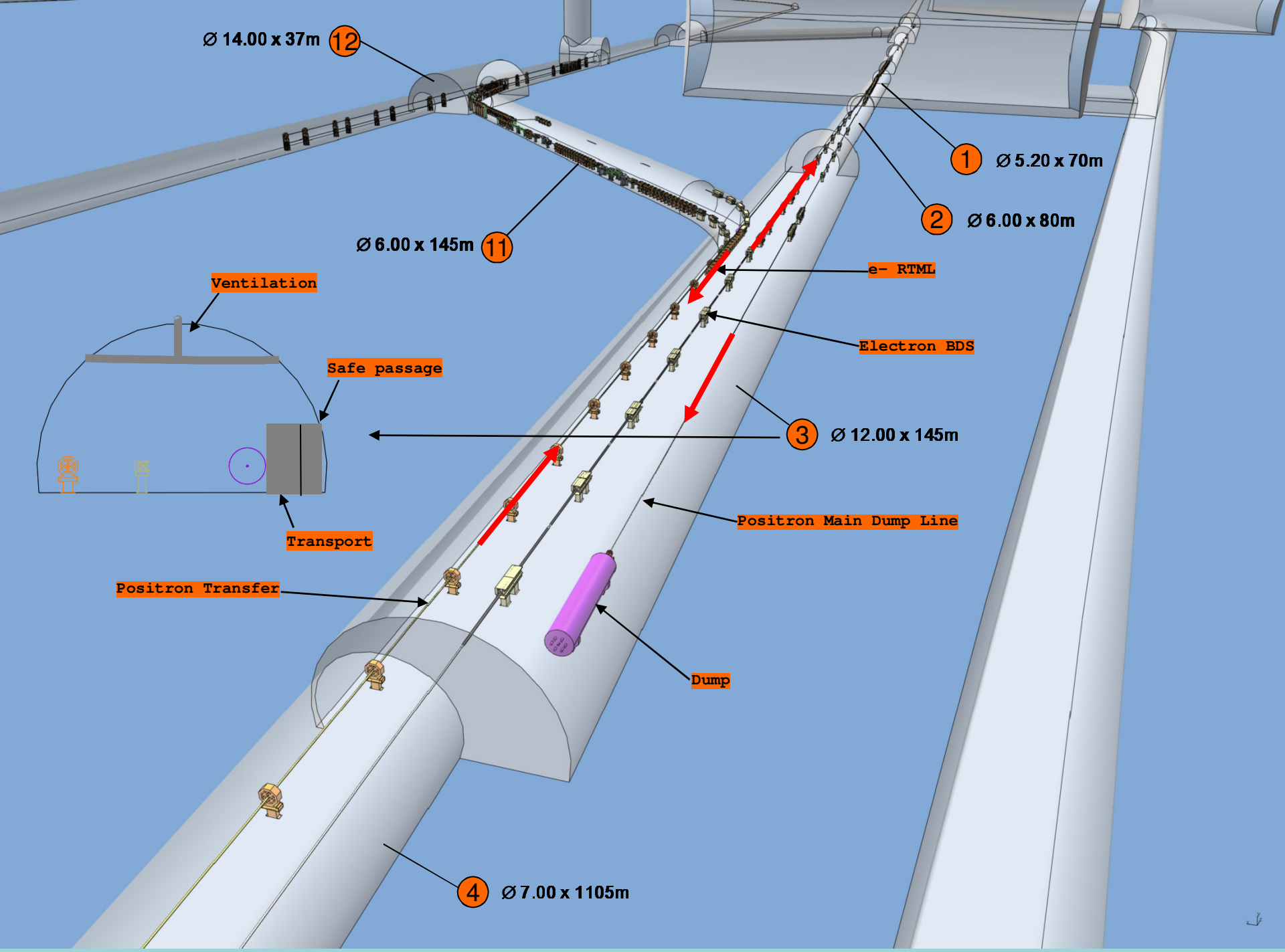


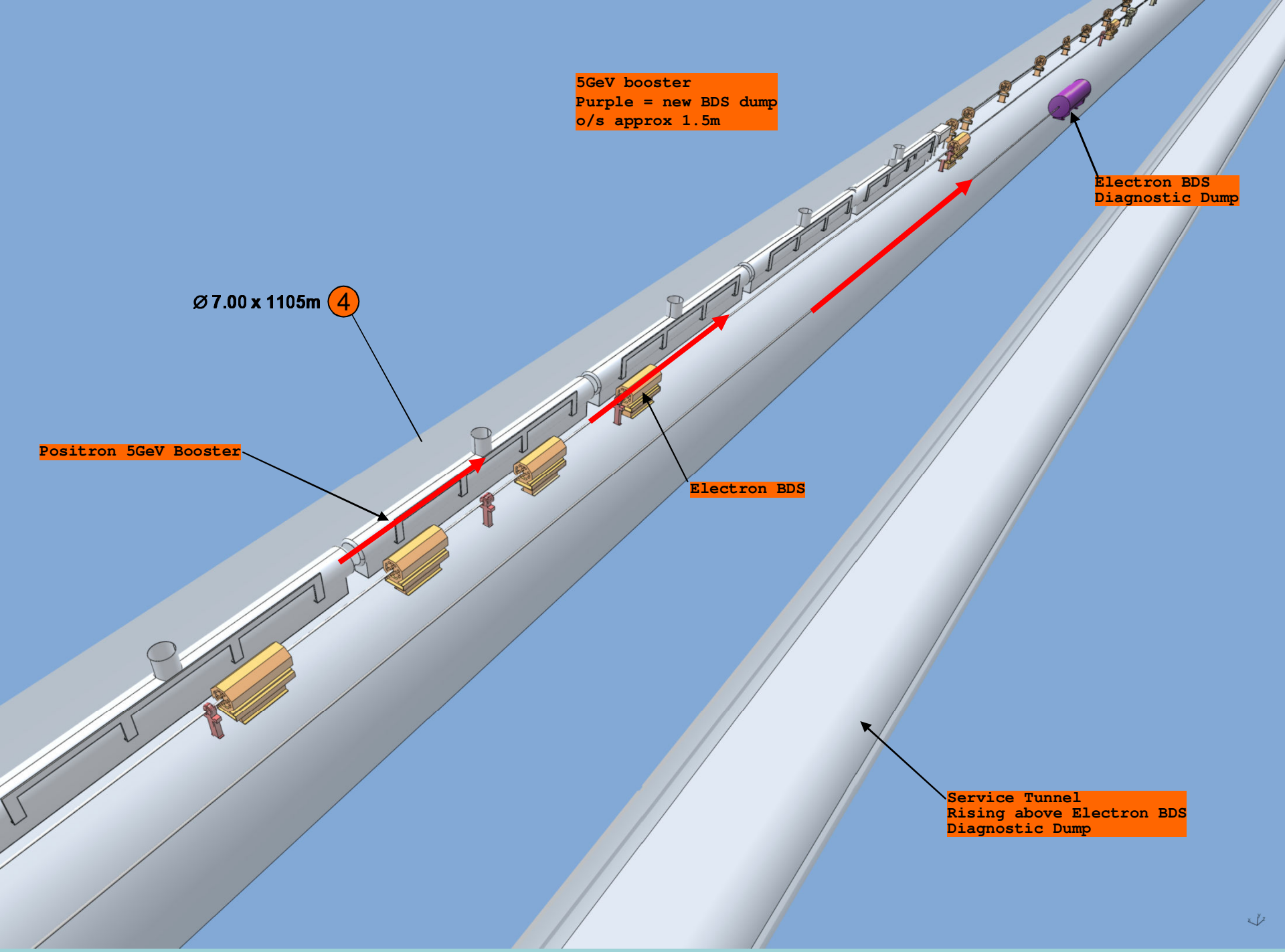


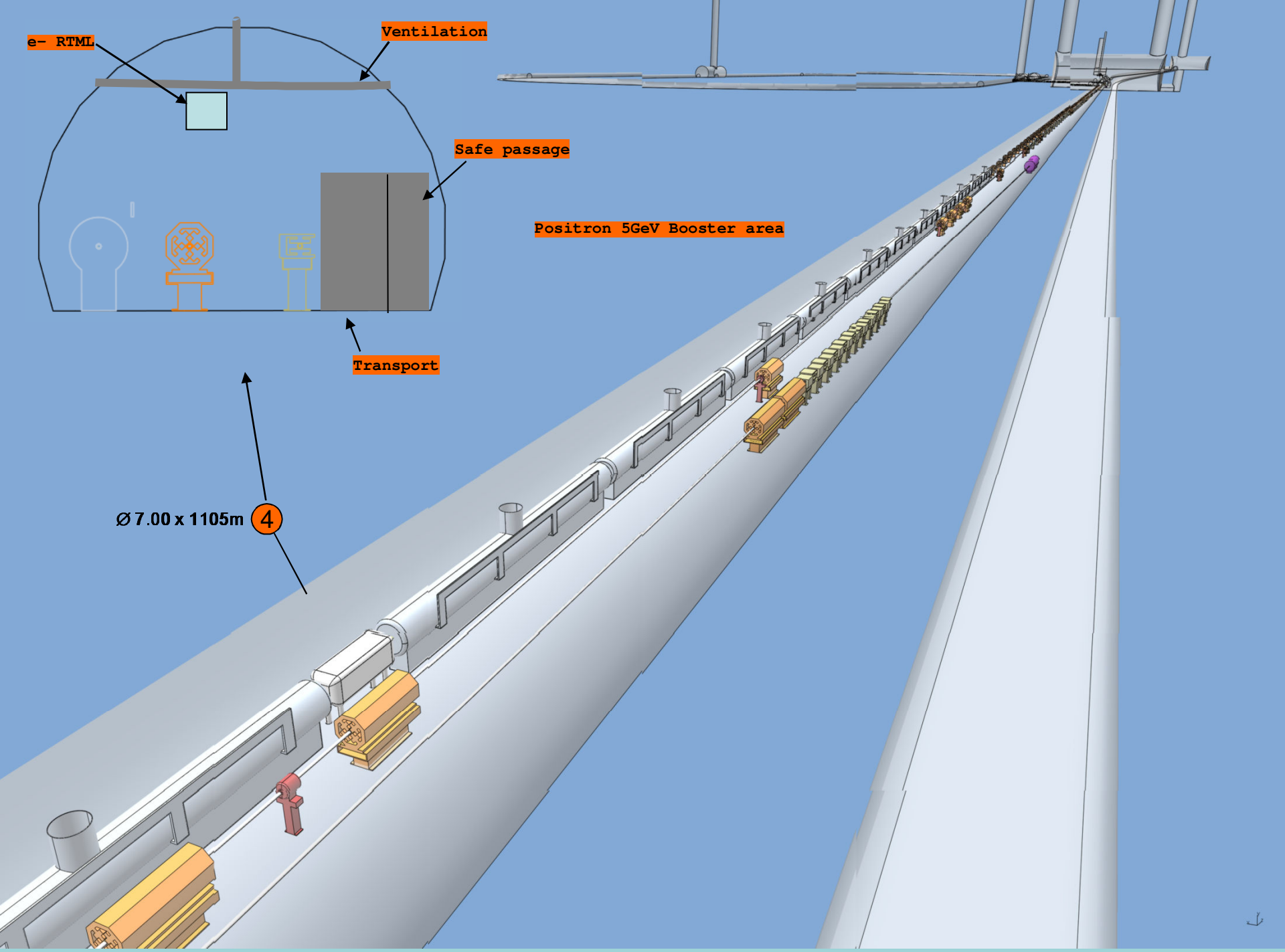


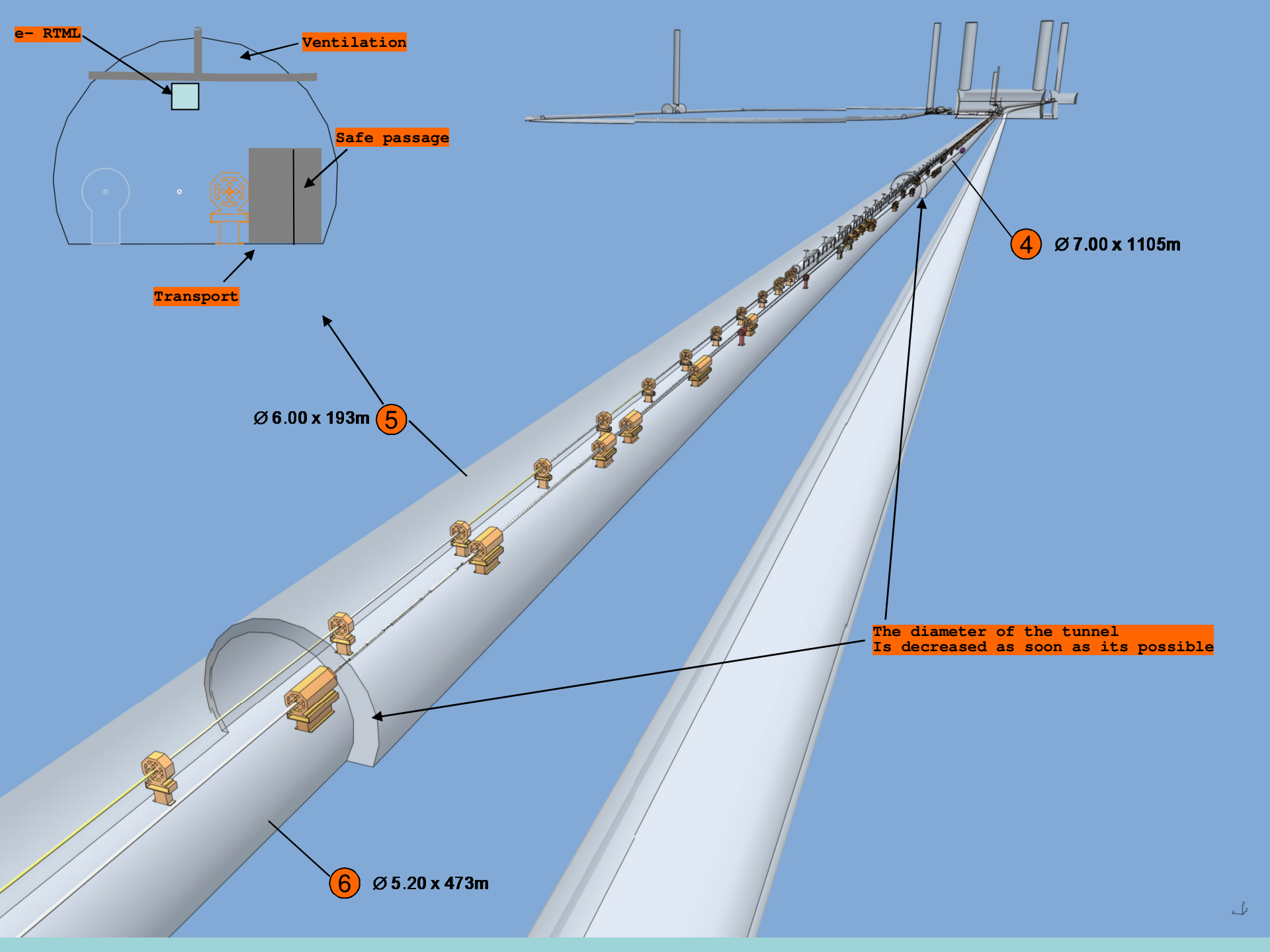
3 Ø 12.00 x 145m

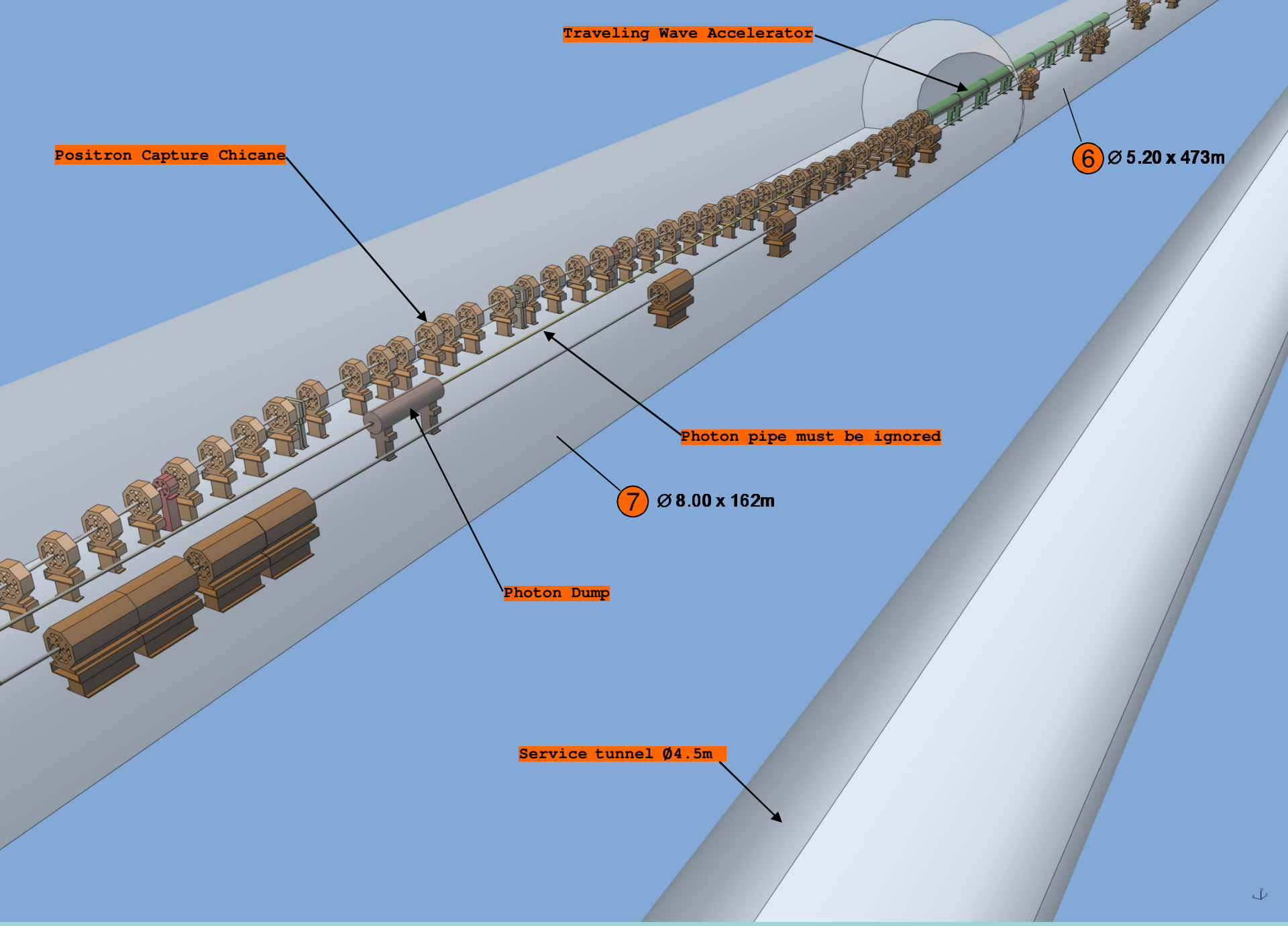
Just like in the UJ22 LHC cavern,
The magnets will have to be lifted
Over the beam lines

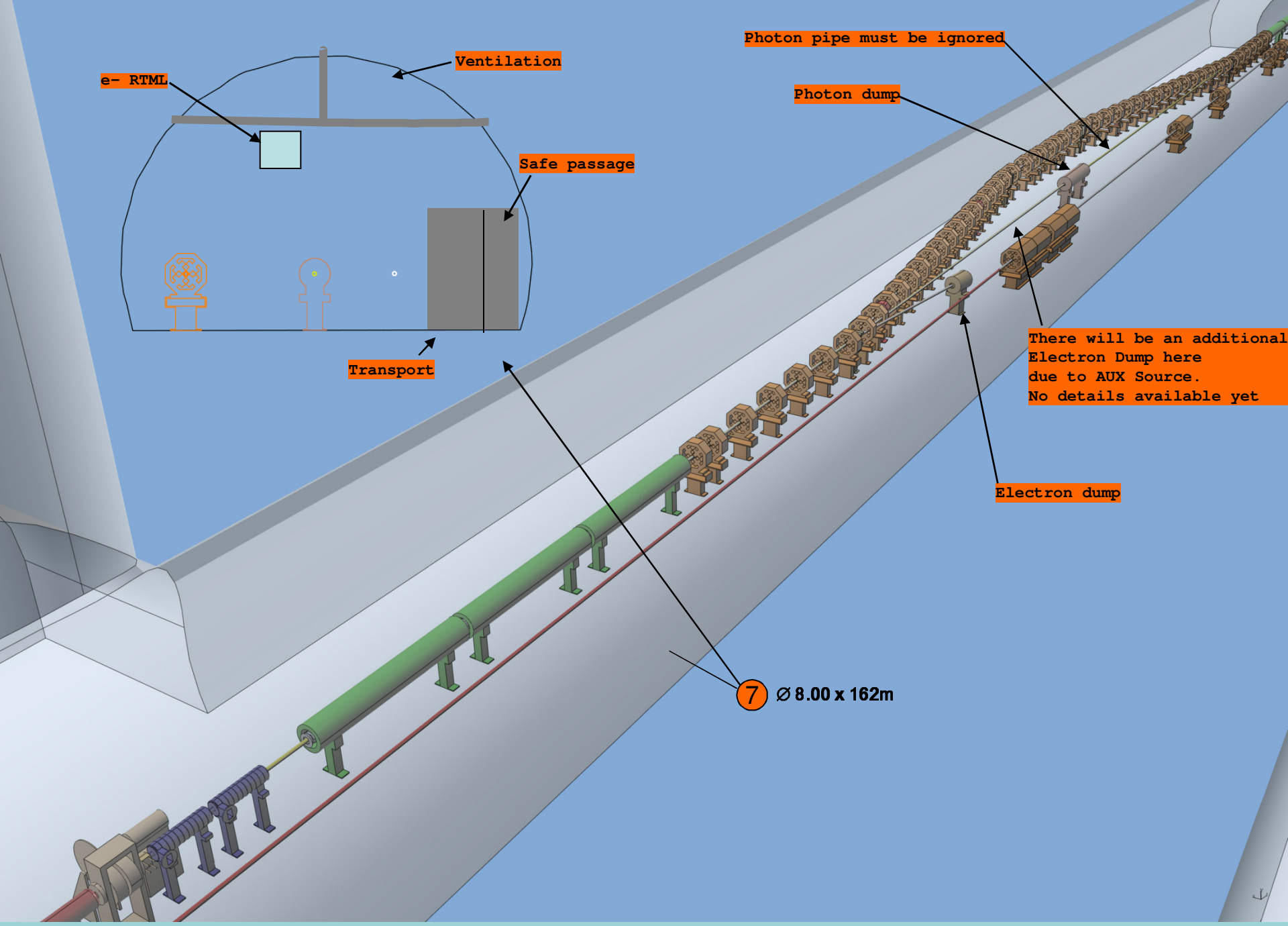

Ø 14.00 x 37m
12
1
Ø 5.20 x 70m
2
Ø 6.00 x 80m
Ø 6.00 x 145m
11
e- RTML
Ventilation
Electron BDS
Safe passage
3
Ø 12.00 x 145m
Positron Main Dump Line
Transport
Positron Transfer
Dump
4
Ø 7.00 x 1105m

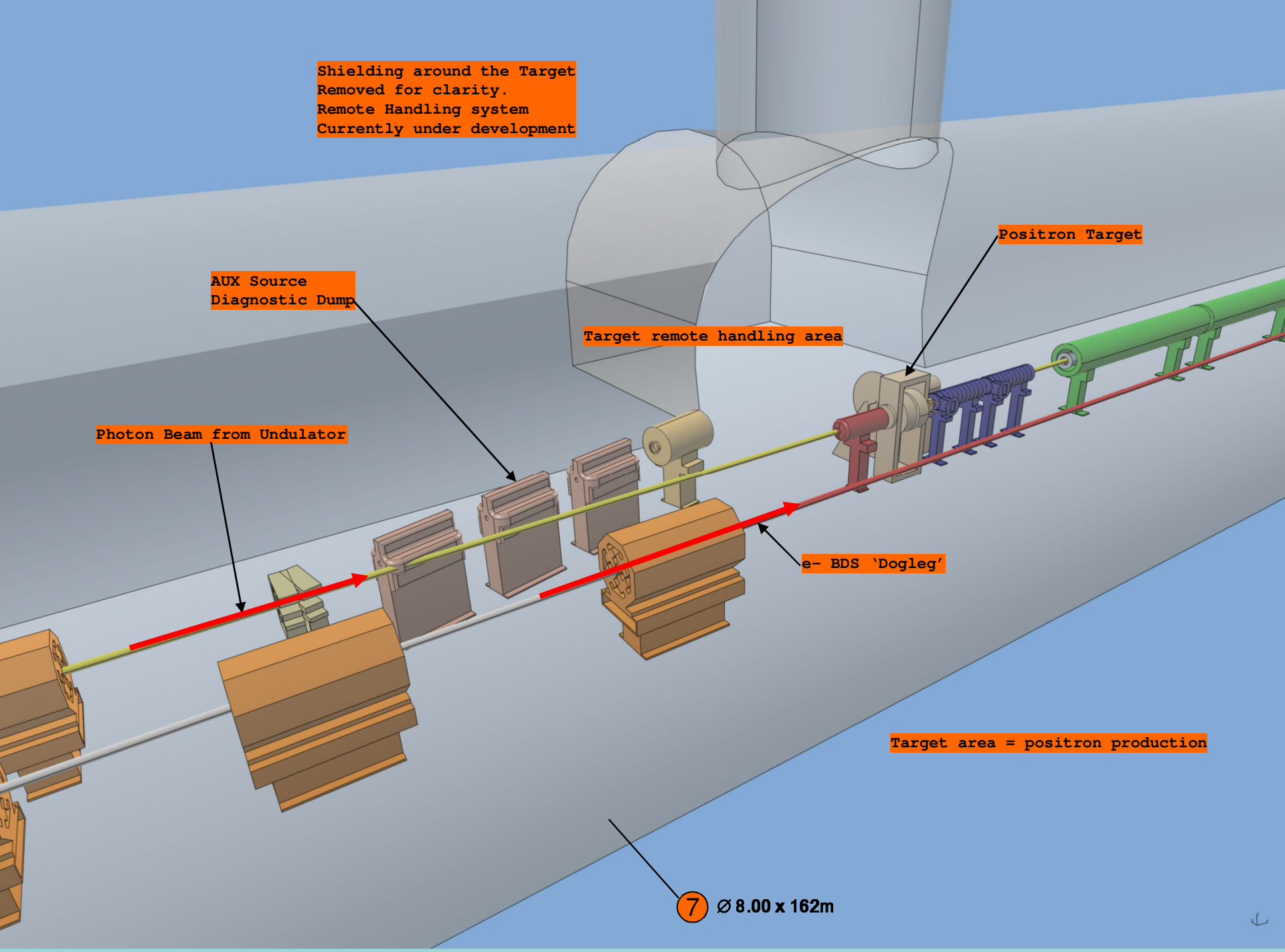

5GeV booster
Purple = new BDS dump
o/s approx 1.5m
Electron BDS
Diagnostic Dump
Ø 7.00 x 1105m
4
Positron 5GeV Booster
Electron BDS
Service Tunnel
Rising above Electron BDS
Diagnostic Dump

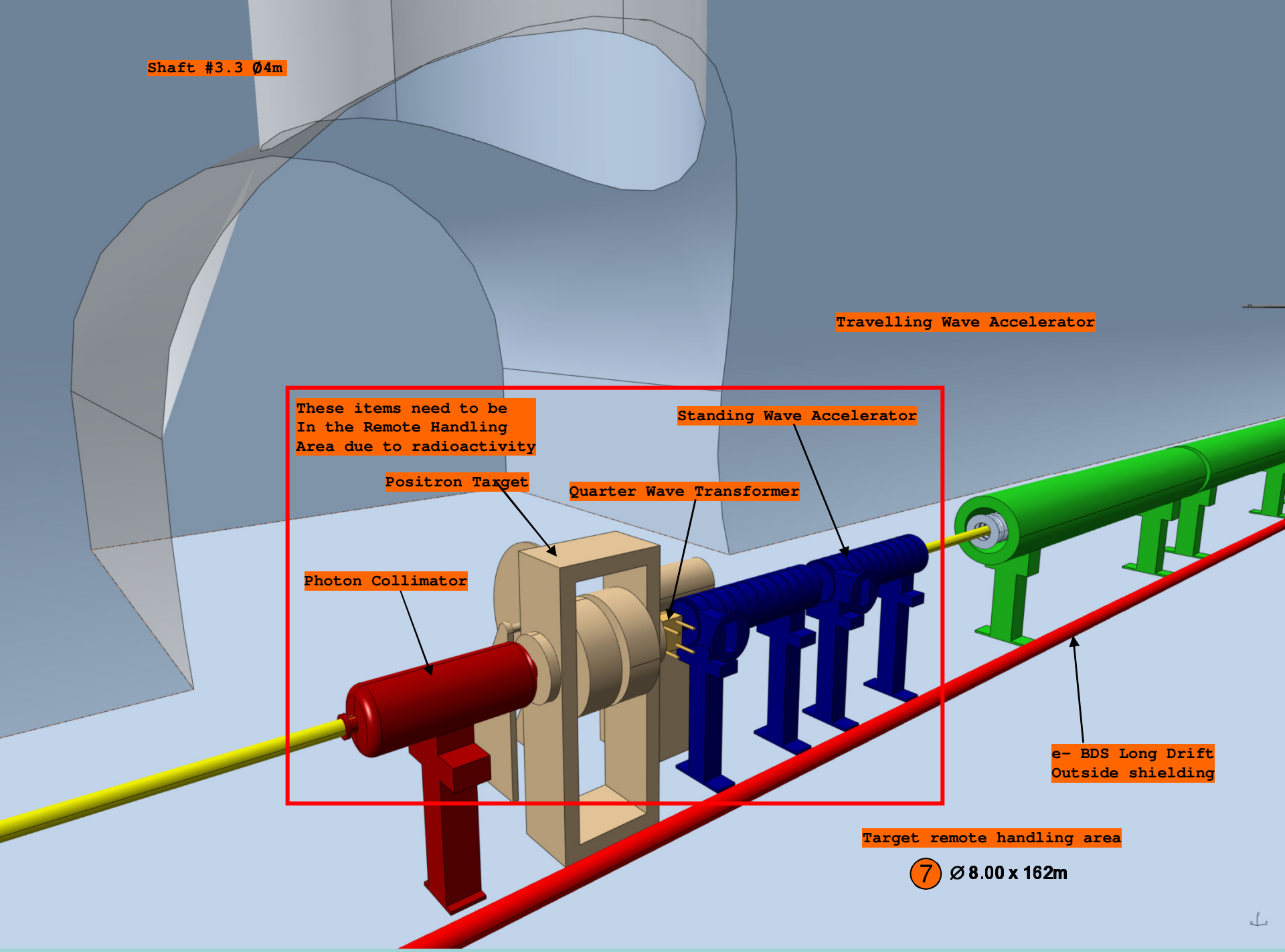

e- RTML
Ventilation
Safe passage
Positron 5GeV Booster area
Transport
Ø 7.00 x 1105m
4

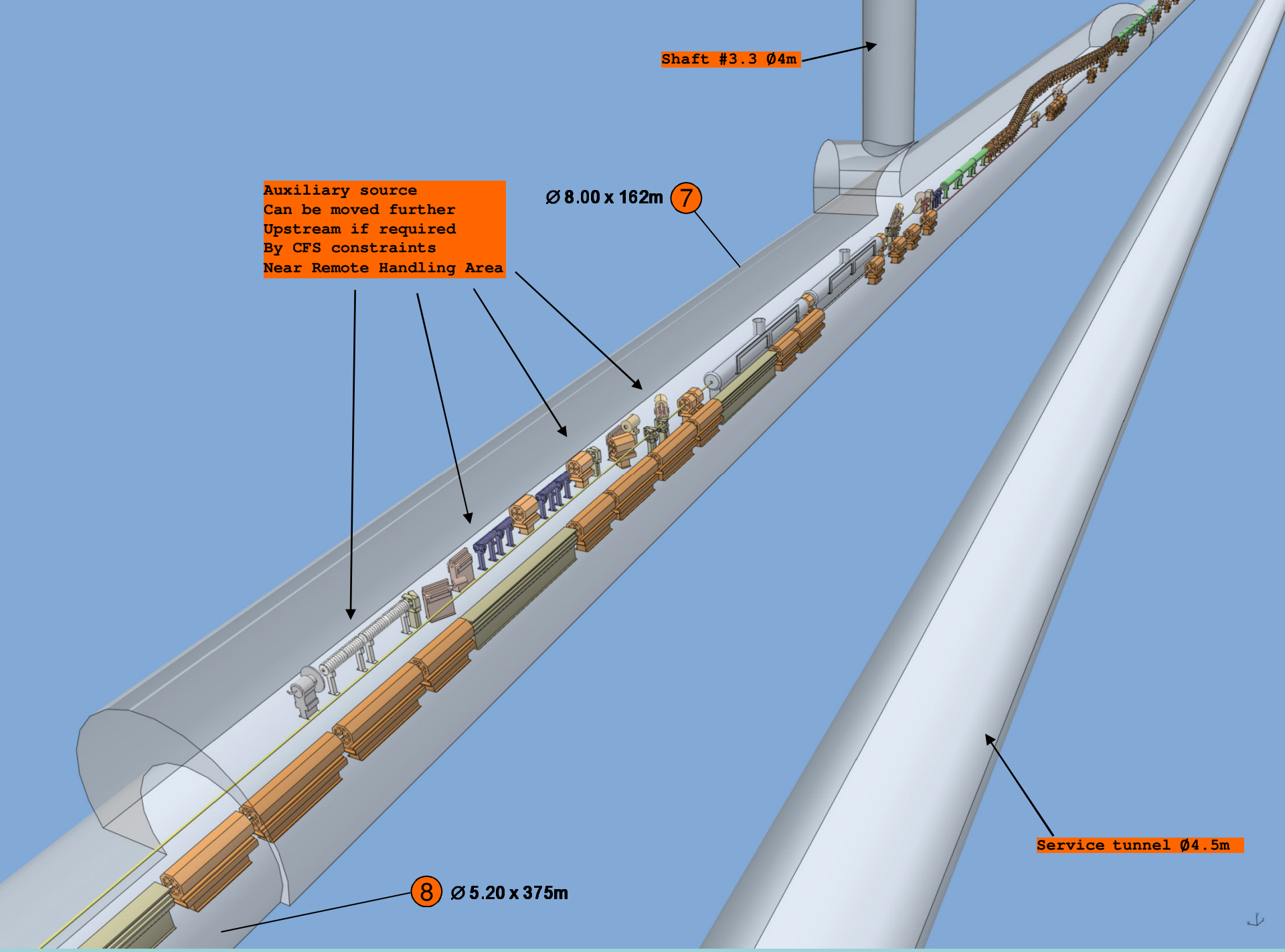

e- RTML
Ventilation
Safe passage
Transport
4
Ø 7.00 x 1105m
Ø 6.00 x 193m
5
The diameter of the tunnel
Is decreased as soon as its possible
6
Ø 5.20 x 473m

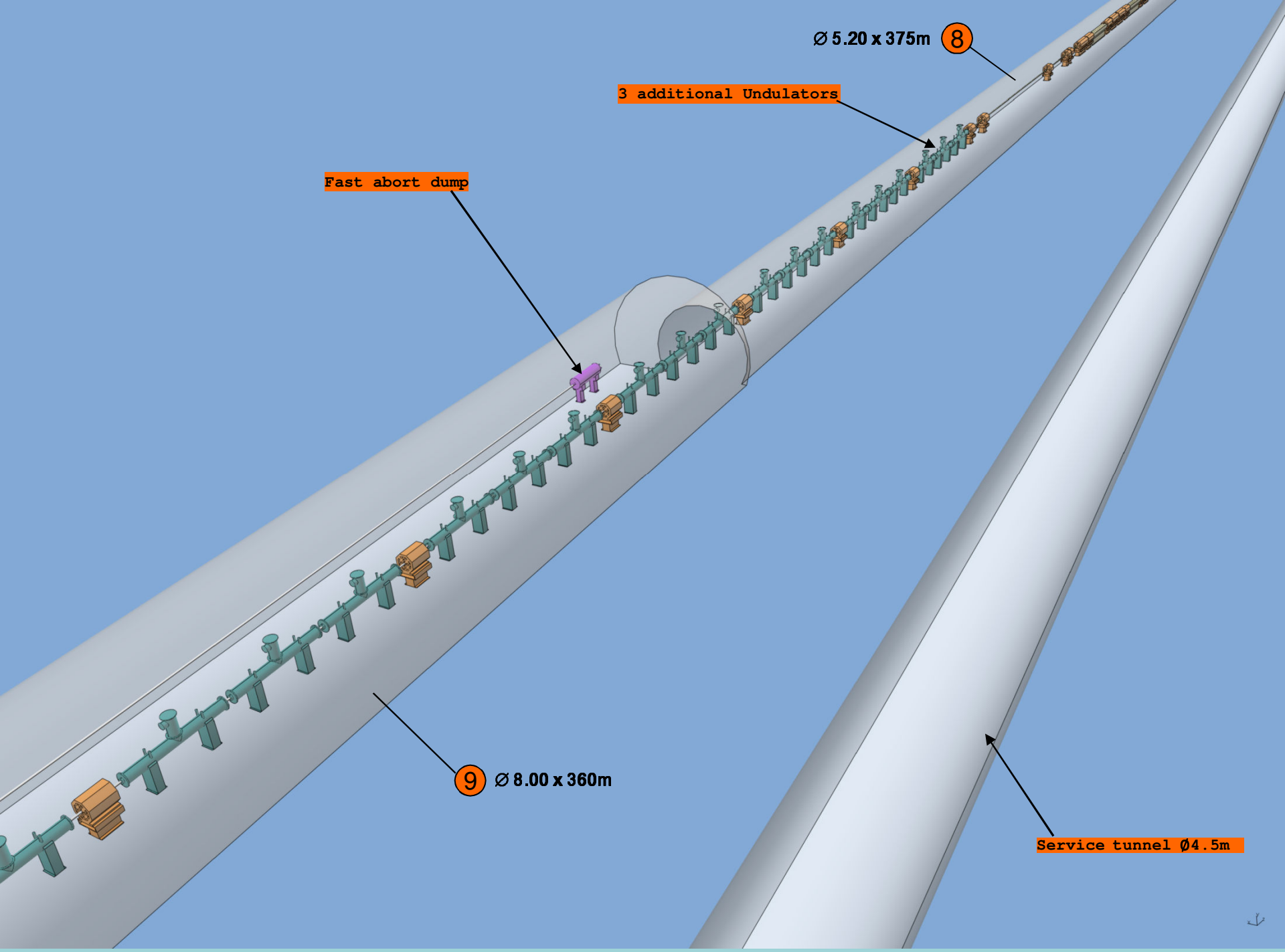

Traveling Wave Accelerator
Positron Capture Chicane
6
Ø 5.20 x 473m
Photon pipe must be ignored
7
Ø 8.00 x 162m
Photon Dump
Service tunnel Ø4.5m

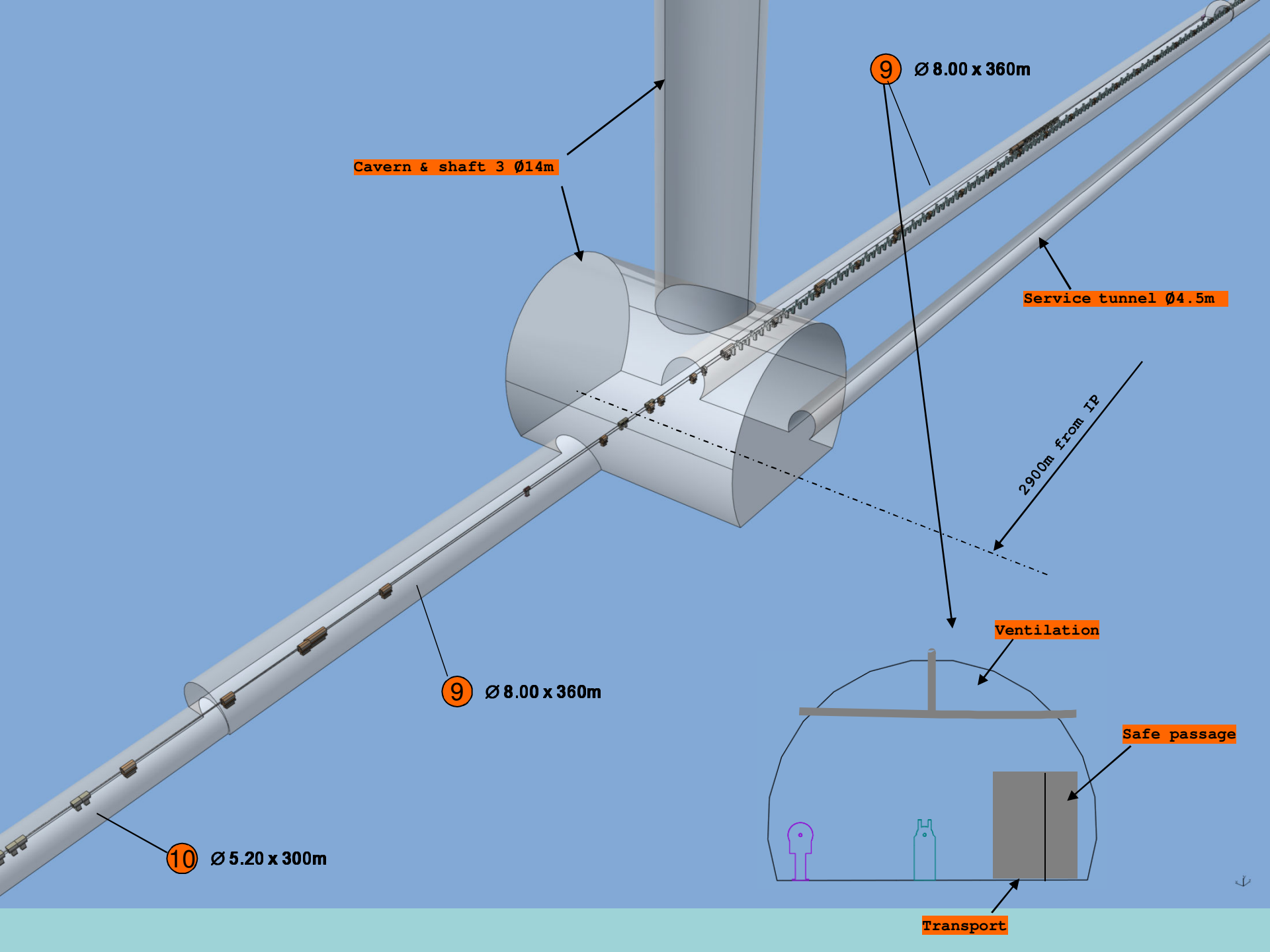

e- RTML
Ventilation
Safe passage
Transport
Photon pipe must be ignored
Photon dump
There will be an additional
Electron Dump here
due to AUX Source.
No details available yet
Electron dump
7
Ø 8.00 x 162m


Shielding around the Target
Removed for clarity.
Remote Handling system
Currently under development
Positron Target
AUX Source
Diagnostic Dump
Target remote handling area
Photon Beam from Undulator
e- BDS 'Dogleg'
Target area = positron production
7
Ø 8.00 x 162m


Shaft #3.3 Ø4m
Travelling Wave Accelerator
These items need to be
In the Remote Handling
Area due to radioactivity
Standing Wave Accelerator
Positron Target
Quarter Wave Transformer
Photon Collimator
e- BDS Long Drift
Outside shielding
Target remote handling area
7
Ø 8.00 x 162m


Shaft #3.3 Ø4m
Auxiliary source
Can be moved further
Upstream if required
By CFS constraints
Near Remote Handling Area
Ø 8.00 x 162m
7
Service tunnel Ø4.5m
8
Ø 5.20 x 375m


Ø 5.20 x 375m
8
3 additional Undulators
Fast abort dump
9
Ø 8.00 x 360m
Service tunnel Ø4.5m


9 Ø 8.00 x 360m
Cavern & shaft 3 Ø14m
Service tunnel Ø4.5m
2900m from IP
Ventilation
9 Ø 8.00 x 360m
Safe passage
10 Ø 5.20 x 300m
Transport


6.8m tunnel : image courtesy of Gautrain Project (ZA)

For costing purposes, CERN have adopted a TBM with pre-cast segmental lining. This makes it 'difficult' to locally enlarge the tunnel

Cost comparison for BDS area tunnel :

- **4.5m** BDS tunnel costed for RDR

- **5.2m** single tunnel solution (with pre-cast segments) proposed for Europe Kyl-Cluster with **major** local enlargements as indicated on previous slide

- **8.0m** single tunnel with **minor** local enlargements (for only 12m and 14m caverns) is **8% cheaper** than 5.2m tunnel. (This is a common diameter for single track railway tunnels).

Conclusion : Adopt 8m BDS tunnel for CERN geology ?

CERN Resources 2010 for ILC CFS items :

•Civil Engineer	John Osborne	15%
•Draughtsman	Antoine Kosmicki	5%
•Installation / Transport Studies	Ingo Ruehl	5%
•HVAC, EL	Ad-hoc requests……	

•External consultant for civil engineering studies 10KEuro