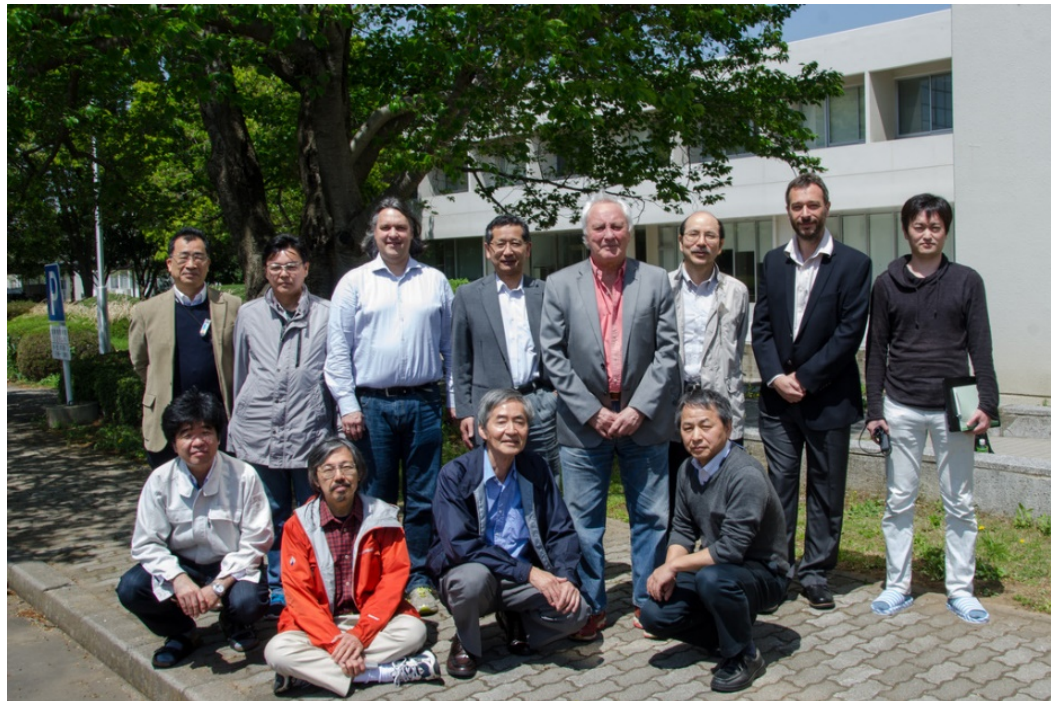


Summary of CRWG+CFS +Positron Mini-WS

Workshop indico: <https://agenda.linearcollider.org/event/7062/>

K. Yokoya

Plus ~ 10 by online



2016/4/28 MiniWS summary
for ADI mtg

19 (Tue)			
10 00–12 00	Summary of the discussion in CRWG till now		Kaoru Yokoya
	PPS issues for CRWG		Ewan Paterson
	MPS issues for CRWG		Ewan Paterson
13 30–15 30	10Hz		
	Requirements for 10Hz operation		Nick Waker
	Beam line geometry of spent electron		Toshiyuki Okugi
	Beam dump : Requirements to CFS		Benno List
	BDS issues for CRWG (incl muon wall)		Glenn White
16 00–18 00	Positron (photon/electron dumps, shielding, target)		Masao Kurki
	Radiation shielding in target region		Andriy Ushakov
	Layout of target region (1)		Peter Sievers (presented by KY)
	Layout of target region (2)		Toshiyuki Okugi
	Photon Dump Design		Masao Kurki
22 00–23 00	CRWG Regular Meeting		
	Summary of Tuesday		
	Plan for Santander		
20 (Wed)			
9 00–12 30	CFS		
	Review of BDS tunnel in TDR (tw in tunnel)		Masanobu Miyahara
	Tunnel in the Central Region		Toshiyuki Okugi

PPS (Ewan)

PPS and Central Region Design, Summary

- To make progress we need to encourage freezing the accelerator and access tunnels ASAP.
- Decide whether we are going to change Central Region to Kamaboko tunnels.
- **Decide whether we want 3.5 m shield wall or 1.5 m and more restricted operation with e- beams to DR and restricted access to service tunnel.**
- Review present CFS plans for personnel safety, installation, and ventilation for the chosen tunnel configuration.
- Then iterate with CFS and CRWG to clarify the remaining questions in Central Region Design.

MPS (Ewan)

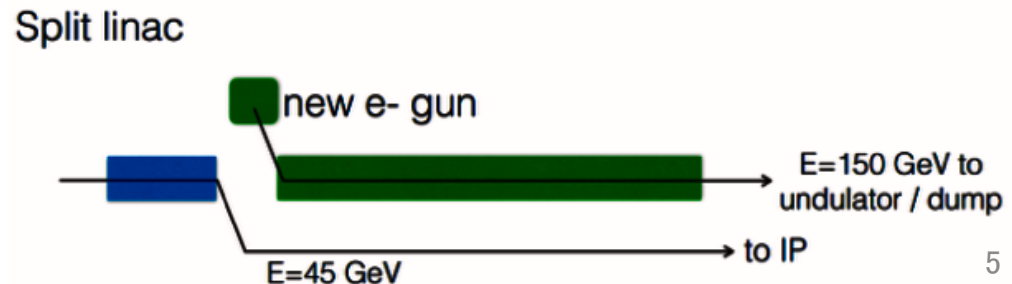
IMPACT OF MPS ON CRWG/CFS STUDIES

- **The MPS is a complex and critical system!**
- **There is a lot of detail design work required in the future but the impact on the CRWG studies is limited today to :-**
- **Ensuring that the design lattice includes adequate space for kickers that are part of the MPS and share the tune-up dumps in this region.**
- **The inclusion of the tune-up dumps, there services and shielding of residual radiation,as required, in the CFS layouts.**
- **A review to check that the E- Gun, Injectors, and DR's have adequate flexibility to satisfy the MPS requirements.**

10Hz Requirements

Summary from Nick walker

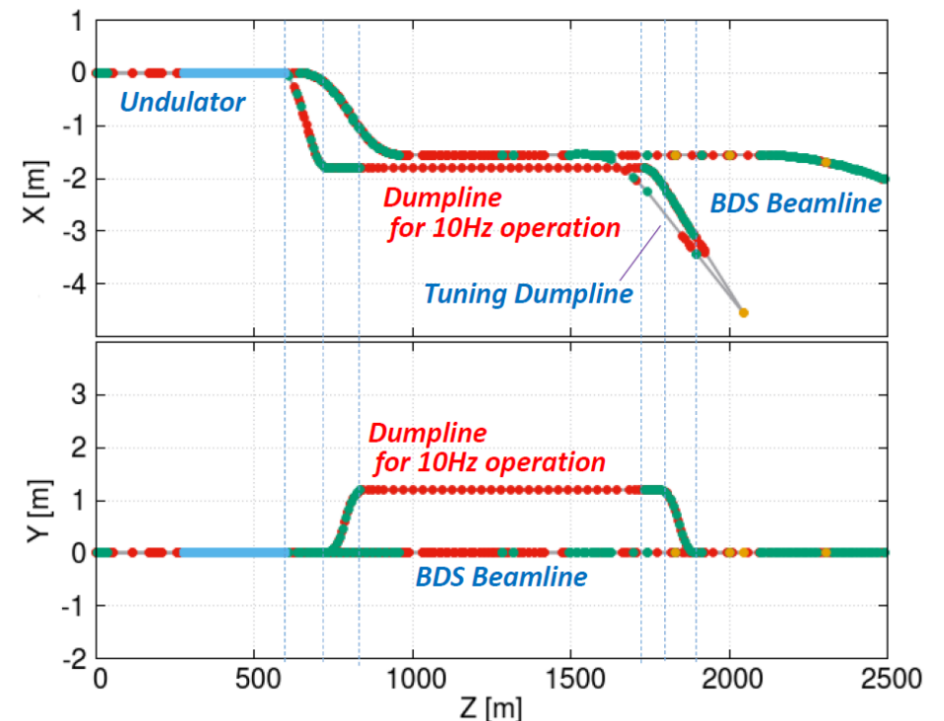
- 10Hz positron production mode (TDR baseline)
 - Additional beam lines and pulsed magnets
 - Impact on DR, electron source, BC...
 - (No need for e-driven case)
- 10Hz collision at $E_{cm}=250\text{GeV}$
 - 2625 bunches : a challenge for DR (higher SR, hence RF). Also for positron production?
 - (Can raise rep rate only a little for e0driven case)
- Z-pole
 - Alternating e-linac operation (125GeV & 46GeV) challenging
 - Alternative scheme



Beam Line of Spent Electron for 10Hz

- First version of the layout and optics created by Okugi san
- From undulator end to tune-up dump
- Should be put into EDMS later on
- Includes horizontal and vertical dogleg after undulator.
- It turned out possible to accommodate the beamline with only some 10m longitudinal extension (pulsed magnets and some matching quads)

Geometry of the beam transport line from undulator to tuning dump



Auxiliary Positron Source --- no time, skipped

- Roles of APS
 - Commissioning
 - Keep Alive Source
 - Detector calibration at Z-pole (without 10Hz)
- TDR mentions about APS with single bunch per pulse with 1% bunch intensity
- Is this useful at all?
- CRWG made questions to ADI team
- Conclusion within CRWG is
 - 1% is still useful if accumulated in a single bucket in DR
 - So, retain TDR specs
 - Must check if there is a sufficient space

BDS Issues (Glen White)

- Background suppression scheme
 - Muons, PPS, shield design
- Design details for MPS beam extraction system
 - Abort kicker <554ns rise must be revisited
 - Okugi san's suggestion in ALCW
 - Ewan presented design of short rise and infinite flattop
- Tune-up & abort dump

- Main beam dump design by CCLRC
 - Can combine tune-up and main dumps?
 - Access to surface, Or, to IR.
- Diagnostics etc.
 - Laserwire (locations & laser source areas),

Question by Benno

- Is the tune-up dump really needed?
- It may be a historical relic from 2IP era?
- Detector work during linac commissioning ?
 - At least one detector can be at work if the other one is sitting at IP

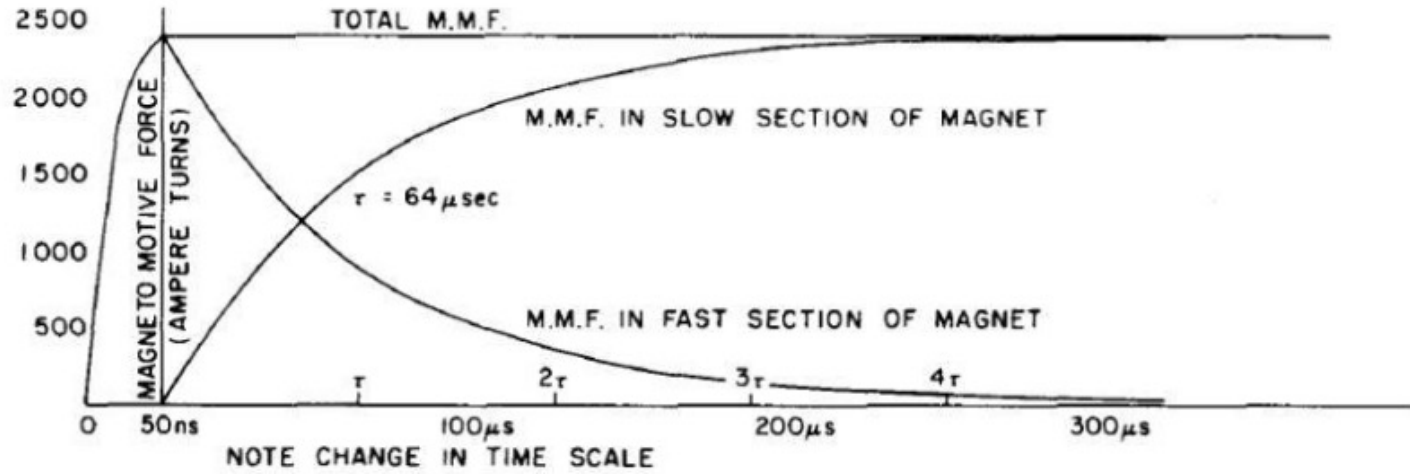


FIGURE 1
WAVEFORMS IN ULTRAFLECTOR CURRENT SWITCH

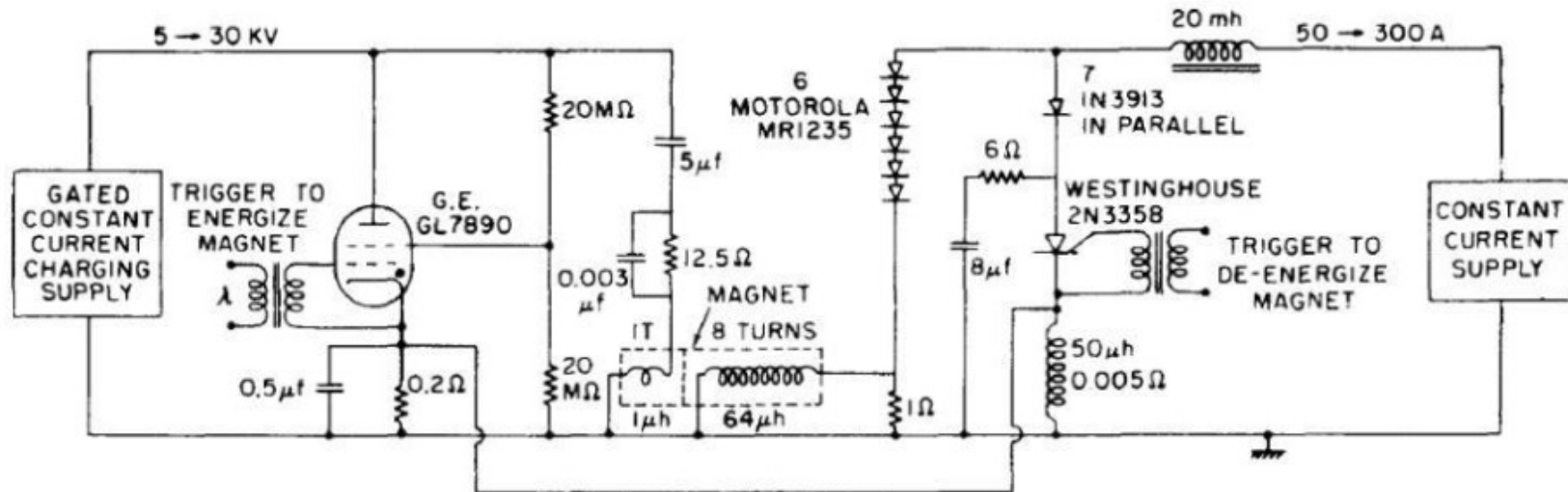


FIGURE 2
ULTRAFLECTOR CURRENT SWITCH

E. Paterson

Beam Dump: Requirements on CFS (Benno)

- Water dump needs shielded cavern
- Cooling: Need 18MW cooling power (obviously)
- Activation:
 - Assume closed primary system that contains radioactivity
 - Secondary cooling water not activated much
 - Showers cannot be fully contained within dump water volume
 - > continuous production of radioactive isotopes in air
 - > needs ventilation to prevent accumulation
- Dump cavern needs separate ventilation channel to outside
 - > could be direct surface access, or ventilation duct in tunnel
- Exhaust air is slightly radioactive. In Germany (very strict laws!) this would require ~100m high exhaust chimney. Then it would be OK even close to inhabited areas
- Framatome calculation: 9TBq H3 production in water tank per year. Chimney would allow to exhaust complete Tritium production (even from primary water)

Risks: Window rupture

- Biggest risk: Window breaks
-> releases 10atm radioactive water
- Design includes double window
-> water would be contained (could leak into beam pipe though)
- Needs emergency expansion vessel for radioactive water, but then it is probably OK
- Second risk: Water boils, dump water becomes transparent
-> beam penetrates rear wall
- How many bunches are needed to puncture the vessel?
- Needs to be prevented by MPS: detect excess radiation behind dump and switch of machine
- Can we assume that MPS takes care of this? Probably yes
- Other Risks: Radioactivity escapes during maintenance (e.g. exchange of filters) -> need water and air tight seals between dump cavern and main tunnels to contain any radioactivity; dump hall needs to be **underpressurized**

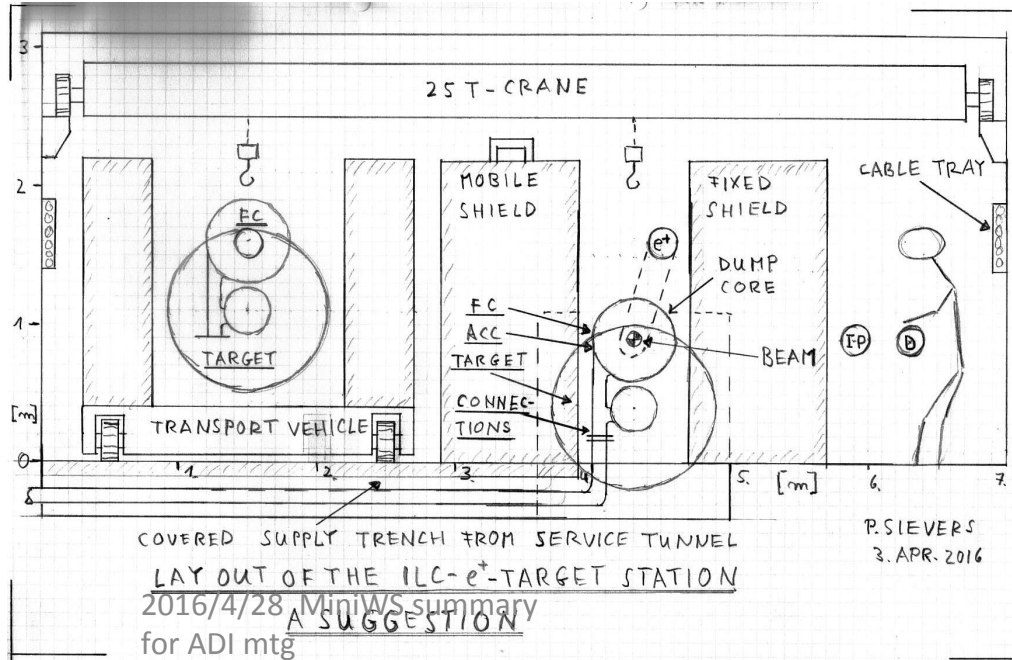
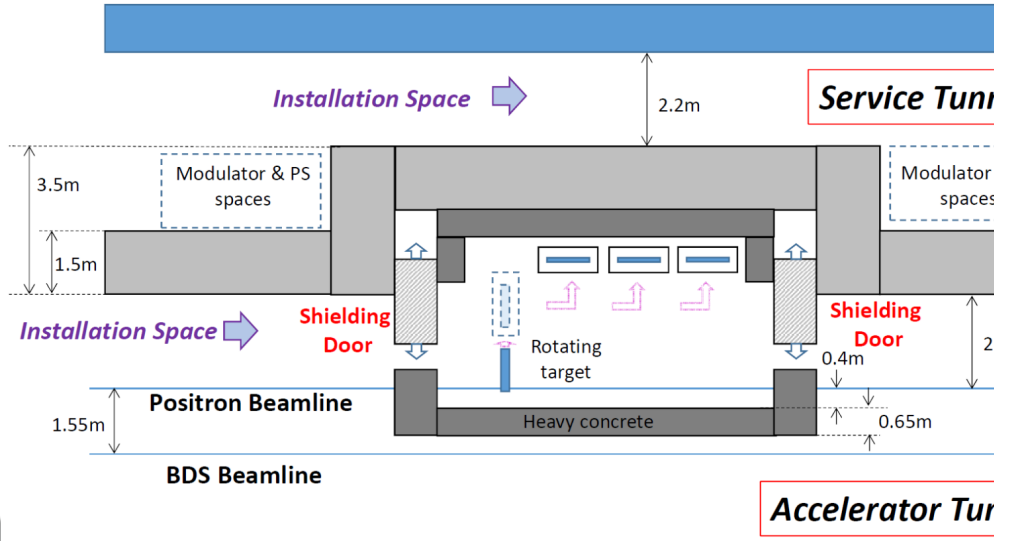
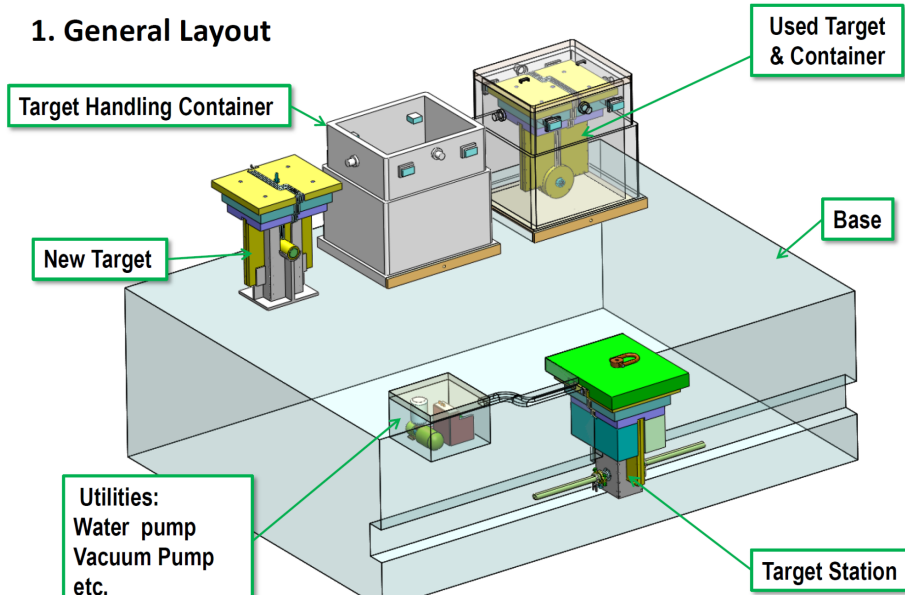
Lots of info good for Nomura Survey

Positron Target Region Layout

- 4 possible layouts
 - TDR remote handling by Jia Xuejun
 - Remote handling replacement
 - Take out used target vertical, store it while
 - Peter Sievers
 - Beam line shielded by fixed and mobile wall
 - Replacement by crane horizontally
 - Take out immediately from the tunnel
 - Okugi san
 - Storage of used targets in working target region
 - Ewan Paterson's suggestion
 - Storage of used targets in nearby cavern (?)



1. General Layout



Store here (perhaps) by Ewan

Consensus on the Target Region

- The region near the working target is full of high radiation even after beam stop (drops only factor 3-5 in the first 1000 hours, by Jia and Ushakov). Accessible ($\sim 1\text{mSv/h}$) only after ~ 2 years.
- Human access in this region is always prohibited except just after new target installation before its first operation. Maintenance only by remote handling.
- Region outside $\sim 1\text{m}$ shield and inside accelerator tunnel (colliding beamline, RTML, positron line after e/γ dumps, etc) should be accessible after a few hours since beam stop.
- Service tunnel should be accessible right after beam stop

Key Issues

- Can the used target be carried out from tunnel immediately after replacement?
 - Very hot. Transportation over kilometers in the tunnel, through access tunnel to the surface.
 - How large a space (width) needed for the vehicle?
- If not, used targets must (at least temporarily) be stored somewhere in the tunnel (> 2 years). Where?
 - Near the working target (with ~6cm lead shield) (Okugi)
 - This does not require big crane (other 3 require mobile shield, hence big crane)
 - But does this allow human work even just after new target installed?
 - Upper floor (Jia)
 - Cavern on the other side of colliding beamline (Paterson)
 - Lower floor (trench)
- Route to take them out from tunnel after appropriate cooling

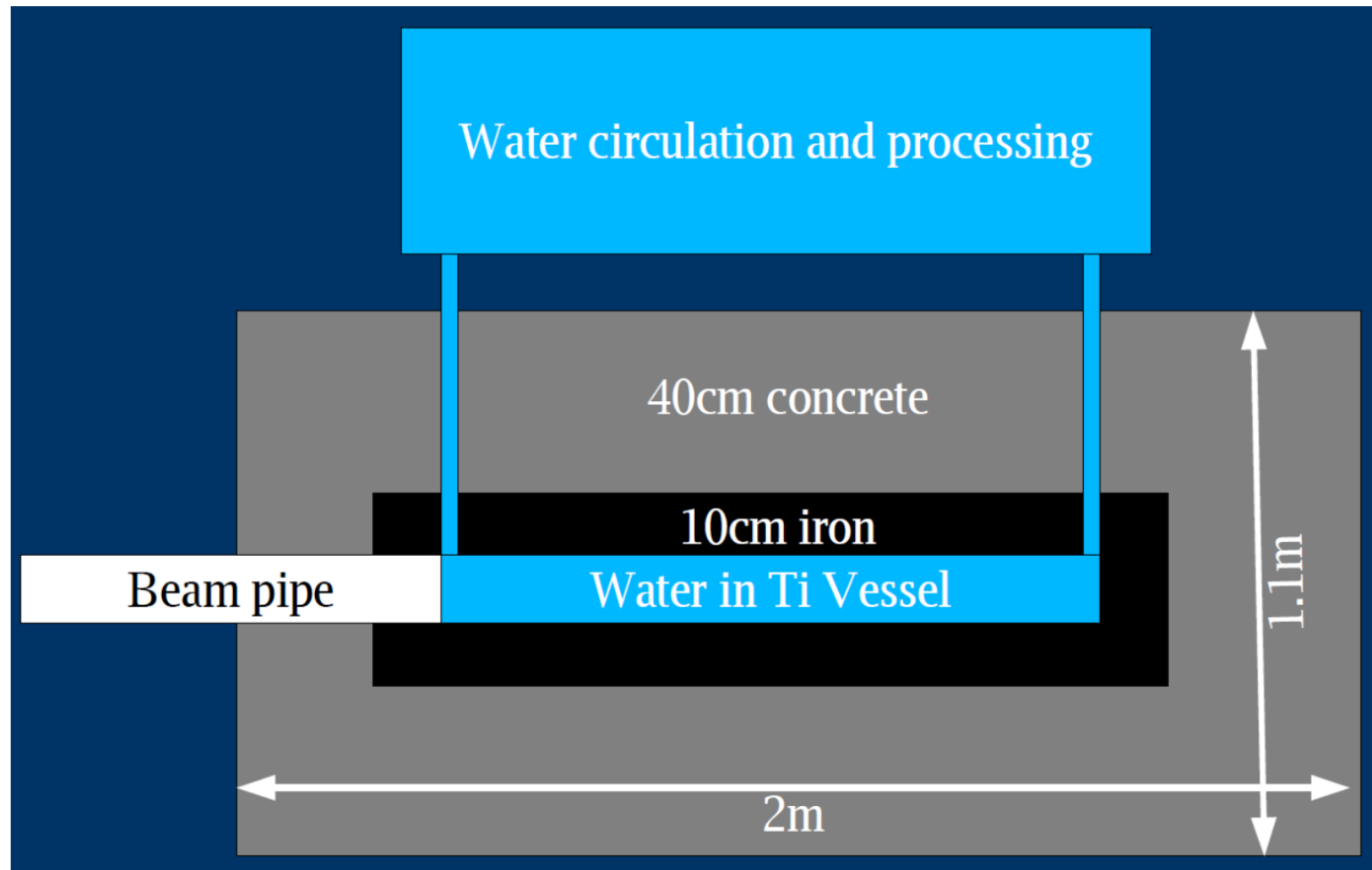
Conclusions on Target Region Layout

- Beyond this level the layout issue must be attacked by Positron+CFS.
- Contact with CRWG.
- Will have 1 to 1.5 hour in CRWG session at Santander (pm 31st)
- More detail should be discussed in Positron parallel session

Photon Dump

- Max photon power $\sim 300\text{kW}$
 - Needs official parameter lists of various cases
 - In particular, 10Hz collision at $E_{\text{cm}}=250\text{GeV}$ ($E_e=125\text{GeV}$) necessary?
- TDR
 - Photon intensity 2×10^{17} photons/sec, 10MeV average, angular spread $3\mu\text{rad}$.
 - Distance 500m from middle of undulator to target, plus 150m (?) from target to dump
 - $\rightarrow 0.5\text{kW}/\text{cm}^2$ on window
 - $\diamond \Delta T=425$ deg on window after one bunch train, $\Delta T=190$ deg in water.
 - Dump: 10cm diameter, 1m long water vessel (12 bar) with 1mm Ti window

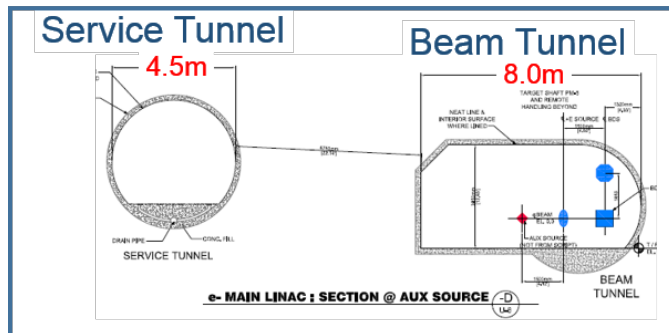
- Based on TDR, suggested by Kuriki
- Water processing system needed
- Should this be further shielded by ~1m shield?



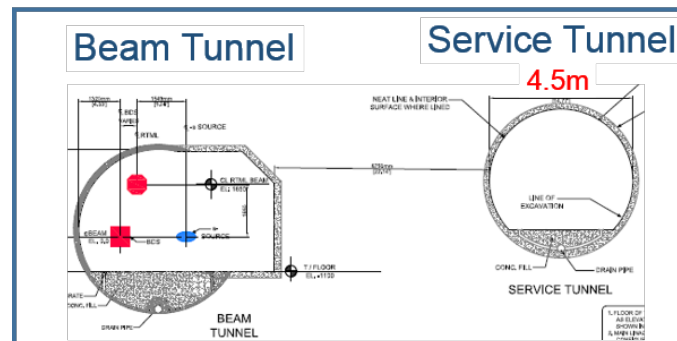
Tunnel Design in TDR (review by Miyahara)

BDS Tunnel Constitution (Electron side)

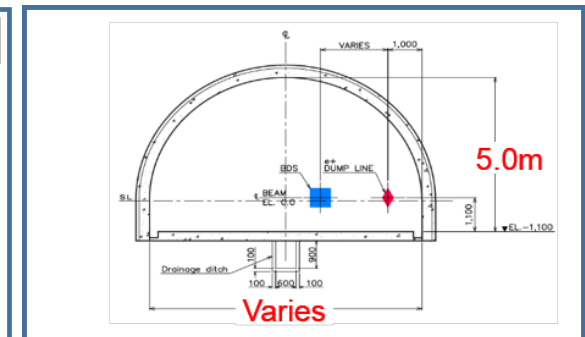
Section	Length		Structure	Main Component
Beam Diagnostics	550 m	1,650 m	Twin Tunnel	Electron Dogleg Collimation System Positron Source Tune-up Dump
Beam collimation	500 m			
Energy Collimation	600 m			
Final Transport Final Focus	600 m	250 m	Twin Tunnel	Muon Wall
		350 m	Single Tunnel	Muon Spoiler Main Dump
Total	2,250 m	2,250 m		



e- side twin tunnel



e+ side twin tunnel



Single tunnel

BDS Tunnel

- Okugi san suggested twin tunnel in the second half of BDS (kamamoko in positron region to the first half of BDS)
 - No wave-guide penetration. Cables only.
 - Tunnel crossection smaller (better for muon wall problem)
 - Can access service tunnel during operation
 - Cost may be comparable (or cheaper?)

