

Updated results of the radiological study for HST @ L4

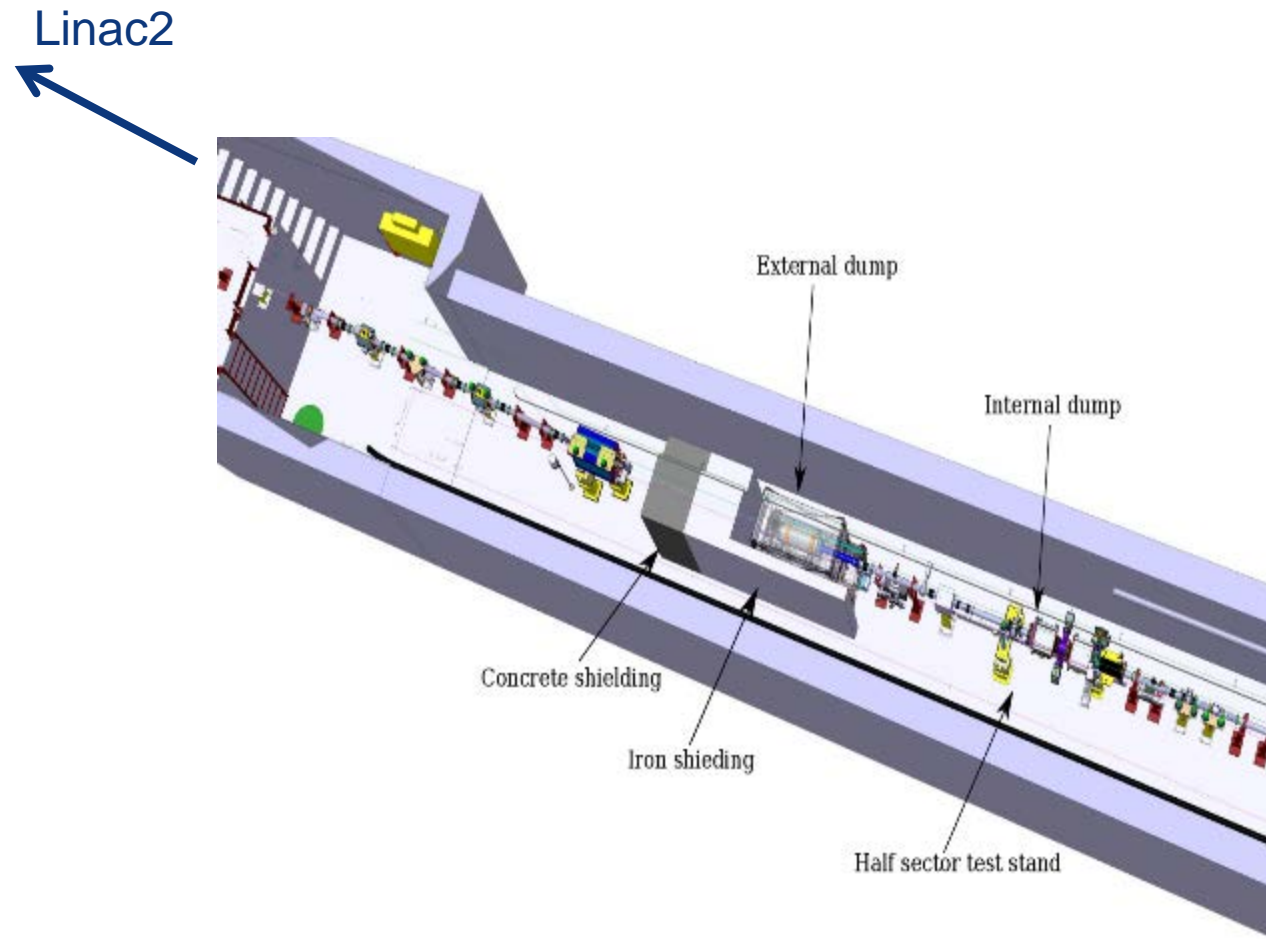
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DGS-RP-AS
LIU-PSB meeting
- August 6th, 2015 -



Introduction

- Updates w.r.t. presentation of June 18th
 - Updated shielding and dump materials (thanks to D. Grenier)
 - Minor changes in the simulation
 - Study of accidental case of foil break (should this be considered?)
 - Design objectives:
 - **53.31 W** beam power
 - **95% striping efficiency** (i.e. 5% of beam dumped in internal dump)
- Aim:
 - Study radiological assessment for HST to fulfil safety requirements
 - Prompt and residual dose rate maps for updated shielding
 - **Determine the maximum intensity that can be delivered to the beam dump**

Reminder: Outline of HSTS



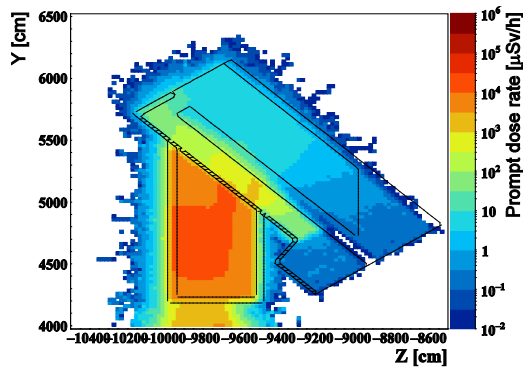
Reminder: The Linac2 / Linac4 interface

- Linac2 Classification:
 - interlocked primary beam area (no access during operation)
 - Limited Stay Area due to residual dose rate levels (access during TS, YETS....)
- Building 363 (Linac2 racks, amplifiers, Linac2 control room....) is classified as a Simple Controlled Radiation Area. During L2 operation period it can be considered as a low occupancy area
 - Might not be the case during TS

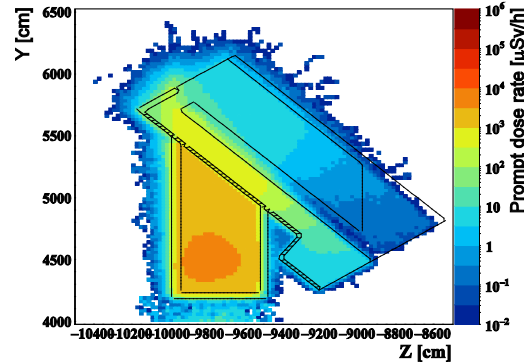


Prompt dose rate maps

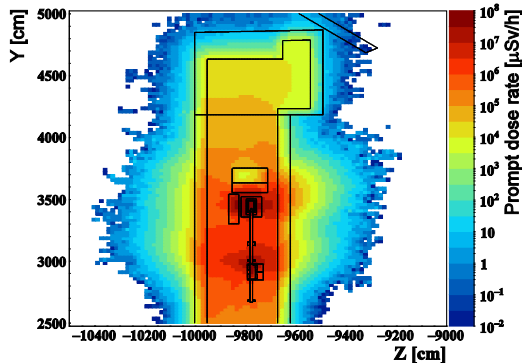
Linac4/Linac2 junction



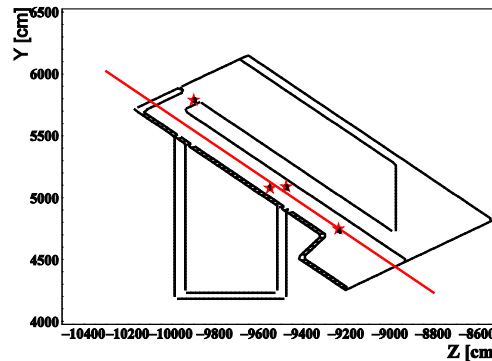
@Linac2 level



@Linac2 amplifier gallery



Linac4 tunnel



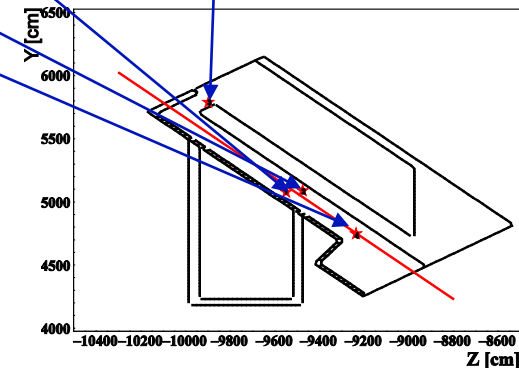
- Linac2 tunnel accessible during Linac4 operation
- Prompt dose rate seems similar to previous study
- Prompt dose rates shown **not** for design objective, but
 - 325 W and 95% striping efficiency
 - see next slide

Prompt dose rates

- During L2 operation current dose rate @ PAXLN202 is about 10 $\mu\text{Sv/h}$
 - Close to current warning level threshold corresponding to Permanent Workplace Simple Controlled Radiation Area
- Classify area outside fenced area as Low Occupancy Simple Controlled Radiation Area (EDMS 1376031)
 - Warning/Action threshold: 50/100 $\mu\text{Sv/h}$
- With this design objective, i.e. assuming low occupancy and 95% striping efficiency, the maximum beam power can be increased to **325 W**

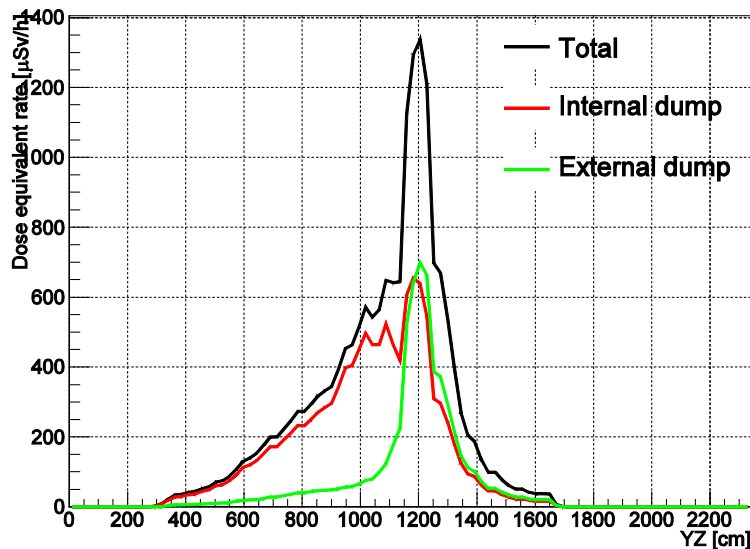
Area classification		Permanent workplaces		Low-occupancy		
		Warning	Action	Warning	Action	
Non-designated Area		Guideline EMDS 788938				
Radiation Area	Supervised Radiation Area	3 $\mu\text{Sv/h}$	6 $\mu\text{Sv/h}$	15 $\mu\text{Sv/h}$	30 $\mu\text{Sv/h}$	
	Controlled Radiation Area	Simple Controlled Radiation Area	10 $\mu\text{Sv/h}$	20 $\mu\text{Sv/h}$	50 $\mu\text{Sv/h}$	100 $\mu\text{Sv/h}$
		Limited Stay Area	-	-	not predefined	
		High Radiation Area	-	-	not predefined	
		Prohibited Area	-	-	not predefined	

	ARCON monitor	Fenced area L2	Fenced area Bldg. 363
Prompt dose [$\mu\text{Sv/h}$]	309.11 25.0 (fence)	380.01	10.41

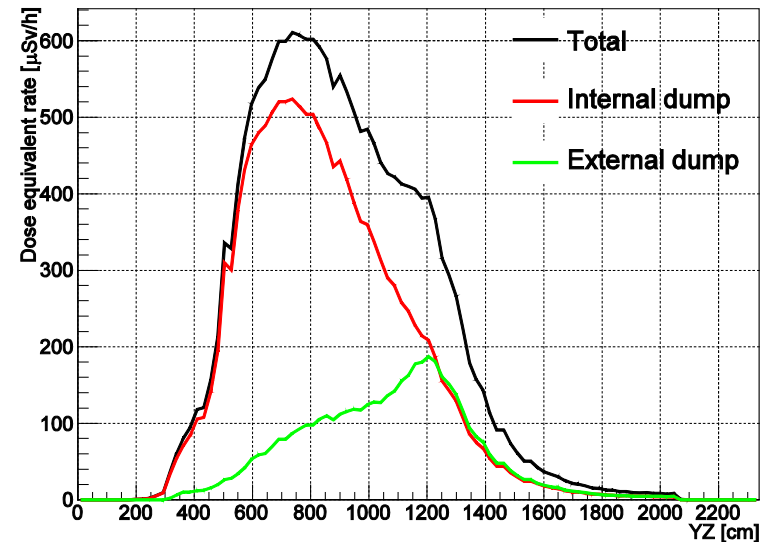


Prompt dose rate profiles

- Profile prompt dose rate along imaginary plane indicated by red line on previous slide
- At L2 level contribution comes roughly by same amount from internal and main beam dump, while at amplifier gallery level the prompt dose is dominated from internal dump contribution



@Linac2 level



@Linac2 amplifier gallery

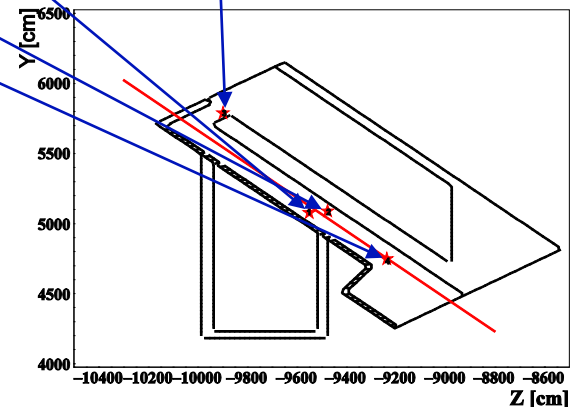
325 W and 95% stripping efficiency



Accident case: striping foil break

- In case of a break of the striping foil the entire beam will be dumped in the internal dump
- Calculate prompt dose at different radiation monitors for this case

	ARCON monitor	Fenced area L2	Fenced area Bldg. 363
Prompt dose [$\mu\text{Sv/h}$]	3073 237.59 (fence)	4042	185

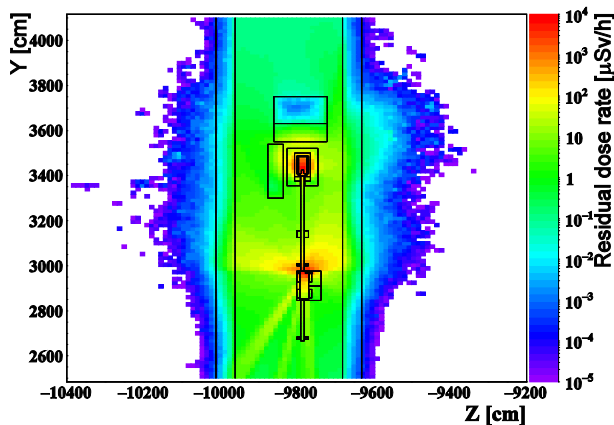


325 W and 95% striping efficiency

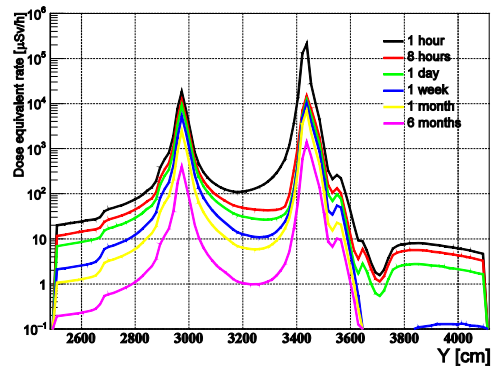


Residual dose rate profiles

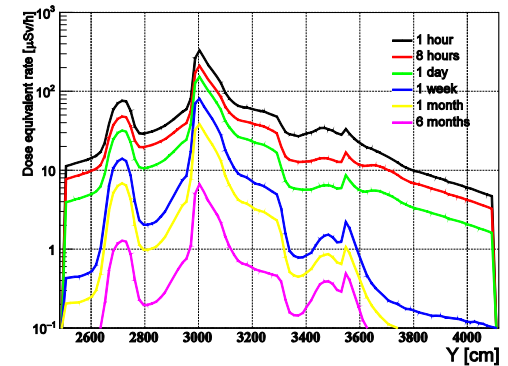
- Profile residual dose rate for all cooling times along the beam line (and in 1m distance) as well as transverse to the beamline at the dump positions
- Residual dose rates are calculated with design objectives, i.e. **53.31 W and 95% stripping efficiency**
- Need to work out new irradiation profile



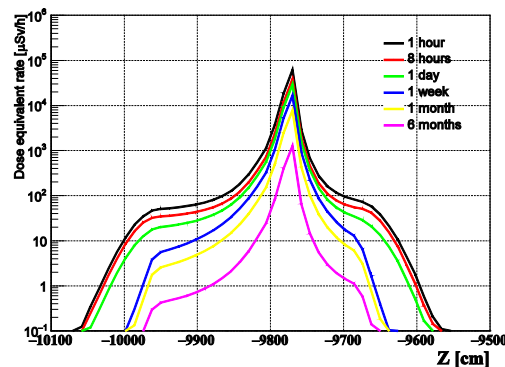
1w cooling time



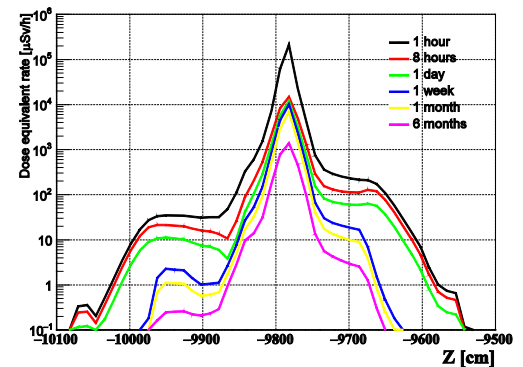
Along beamline



Along beamline @ 1m distance



Internal dump



Main dump

Conclusion/Outlook

- Study has been updated including updates on the shielding materials
- Prompt and residual dose rates have been evaluated
 - Including profiles
 - Considered accident case of striping foil break
- According to design objective (low occupancy area and 95% striping efficiency) the maximum beam power can be increased to 325 W
- 95% striping efficiency is very conservative, could be repeated with 98% or even higher
- 325 W beam power might not be feasible for the entire operation period (leads to high residual dose rates and thus long cooling time)
 - Should discuss alternative operation pattern
- Documentation (Engineering specification) under internal review