

# Updated results of the radiological study for HST @ L4

Marcus M. Morgenstern  
DGS-RP-AS  
LIU-PSB meeting  
- August 6<sup>th</sup>, 2015 -

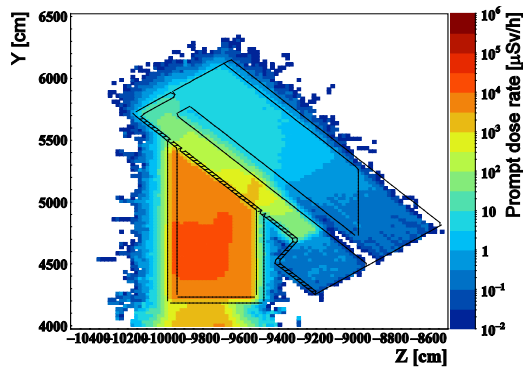


# Introduction

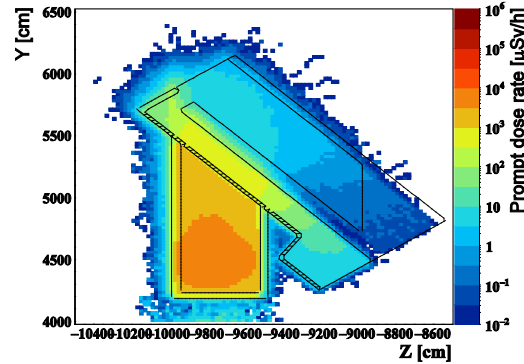
- **Performed calculation assuming 98% striping efficiency**
- Updates w.r.t. presentation of June 18<sup>th</sup>
  - Updated shielding and dump materials (thanks to D. Grenier)
  - Minor changes in the simulation
  - Study of accidental case of foil break (should this be considered?)
  - Design objectives:
    - **53.31 W** beam power
    - **98% striping efficiency** (i.e. **2%** 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**

# Prompt dose rate maps

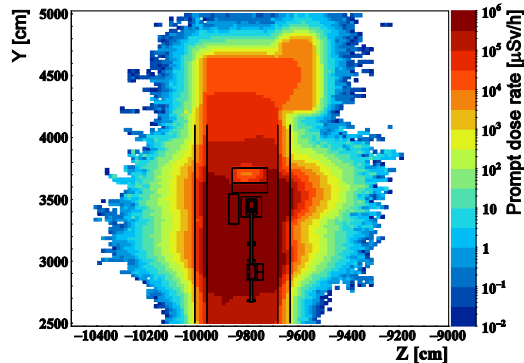
## Linac4/Linac2 junction



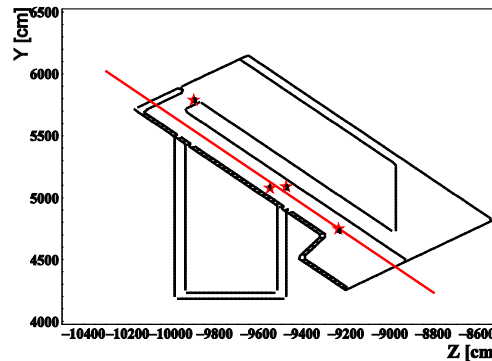
@Linac2 level



@Linac2 amplifier gallery



Linac4 tunnel



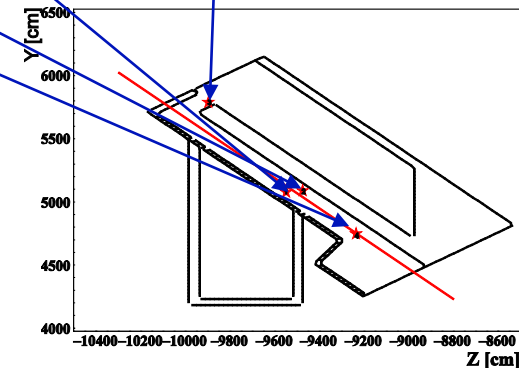
- Linac2 tunnel accessible during Linac4 operation
- Prompt dose rate seems similar to previous study
- Prompt dose rates shown **not** for design objective, but
  - **445 W** and **98%** striping efficiency
  - see next slide

# 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 **98%** stripping efficiency, the maximum beam power can be increased to **445 W**

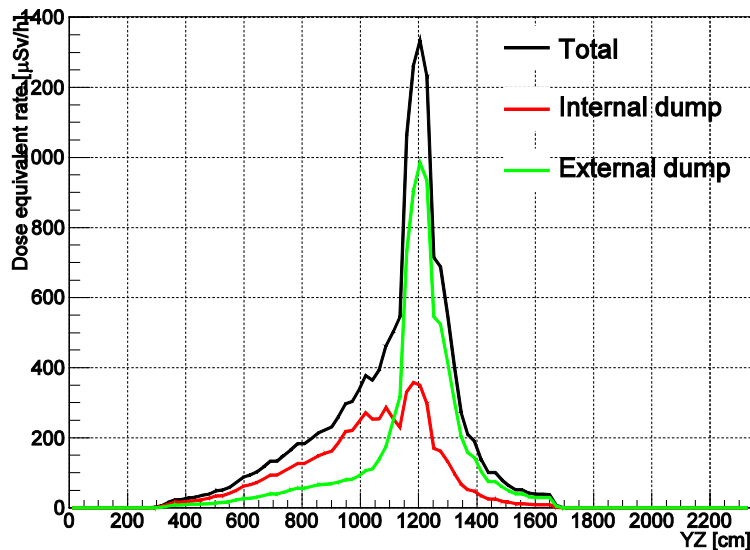
Area classification		Permanent workplaces		Low-occupancy		
		Warning	Action	Warning	Action	
Non-designated Area		Guideline EMDS 788938				
Radiation Area	Supervised Radiation Area	3 $\mu\text{Sv/h}$	6 $\mu\text{Sv/h}$	15 $\mu\text{Sv/h}$	30 $\mu\text{Sv/h}$	
	Controlled Radiation Area	Simple Controlled 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 [ $\mu\text{Sv/h}$ ]	303.27 25.0 (fence)	361.4	6.69

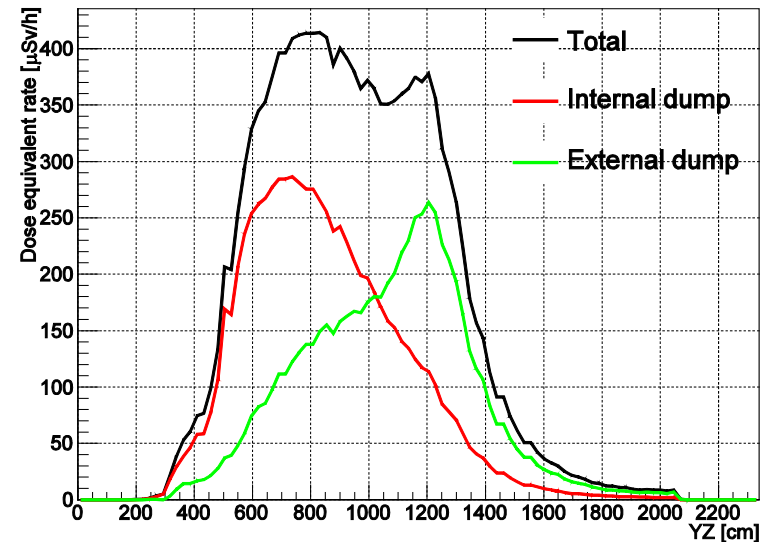


# Prompt dose rate profiles

- 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

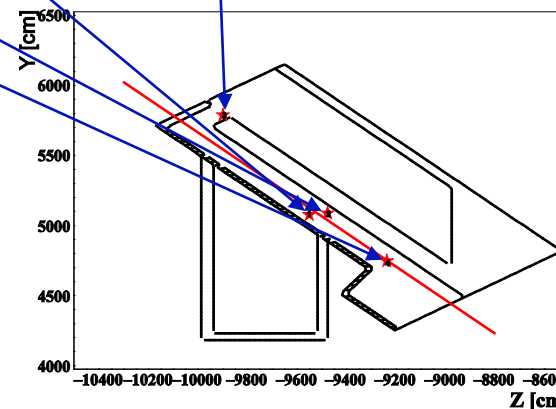
**445 W and 98% stripping efficiency**



# 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 [ $\mu\text{Sv/h}$ ]	4201 324.81 (fence)	5526	253

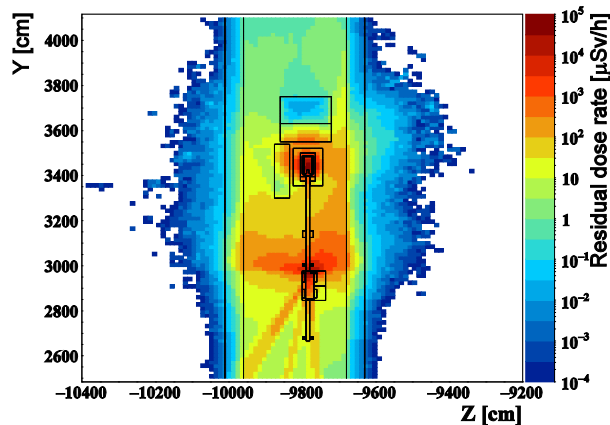


**445 W and 95% striping efficiency**

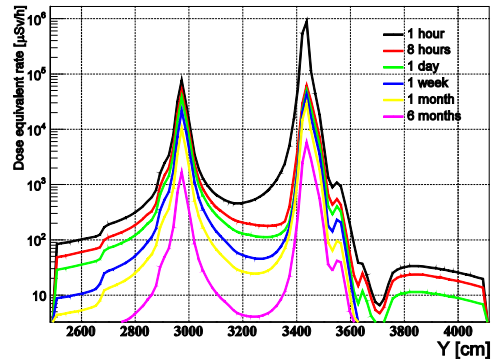


# Residual dose rate profiles

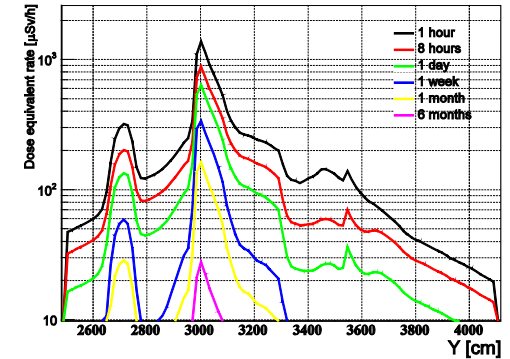
- Profile residual dose rate for all cooling times along the beam line (and in 1m distance) as well as transverse to the beamline at the dump positions
- Residual dose rates are calculated with the following design objectives:
  - **445 W** and **98%** striping efficiency
  - **2 month low intensity run (5.33 W)** followed by **2 month high intensity run (445 W)**
- Need to work out new irradiation profile



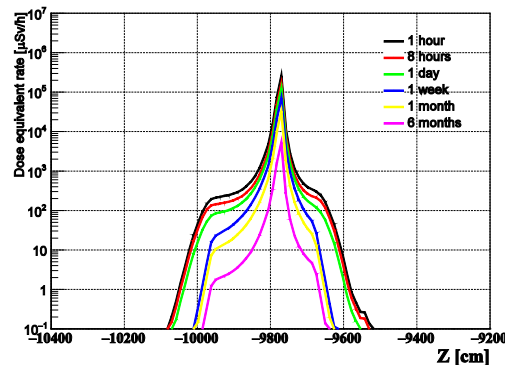
1w cooling time



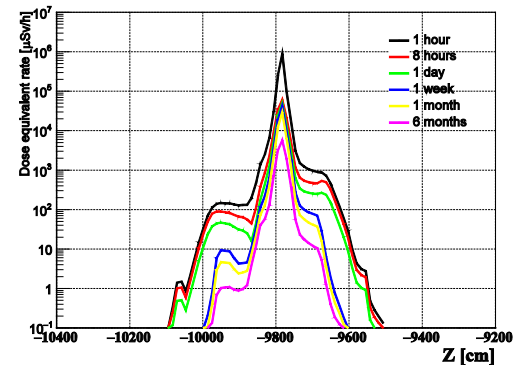
Along beamline



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 98% striping efficiency) the maximum beam power can be increased to 445 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