<u>Update on the SuperBeam Simulation:</u> <u>radiation, activity issues</u>

Talk's Layout:

Material quantities for the SuperBeam Layout

Activities for target and Dose rates for a single target/horn for different cooling times at storage area

Ahorn layout: dose rates in target/horn station and preliminary activity study in the rock (molasse) surround it

Conclusions/Future

Material for SuperBeam



1st order SuperBeam layout beam (based on T2K design) : no service/power supply galleries and collimators, no proton beam tunnel.

Requirements:

concrete to confine all/most of the energy deposited by secondary particles

- minimize the activation in the rock (molasse) and the dose rotes of other galleries
- minimum activation at the edge of the concrete

Tables for different Material

	concrete shields	Fe: vessels, shields	graphite
Downstream	1.95		
target/horn gallery	3.4	0.2	
Decay Tunnel	11	0.04	
Beam Dump	5	.8	3
Total in kt	21.35	1.04	3

Target Activity at Storage Area

study set up:

- packed Ti target, 66%d_{Ti}
- > 1.3MW beam, 200days of irradiation
- no other activation at storage area



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Dose Rates for target/horn at Storage Area, I

radiation limits as in CNGS notes:

	Limits per 12-months period (mSv)		
	Public	Workers	
France	< 1	< 20	
Switzerland	< 1	< 20	
CERN	< 0.3	< 20, if .gt. 2mSv/month report to Swiss authorities	

rates (e.g.):

 \triangleright at 60cm distance from the outer conductor (calculation of the rates using 20cmx20cmx20cm grid binning through out the layout -> choose a slice of x-axis with 20cm thickness and 60cm away)



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Dose Rates target/horn at Storage Area, II



high effective dose rates for the target/horn system makes them inaccessible for humans for years -> remote handling mandatory

horn to be studied separately from the target

 \succ results in agreement with older CERN's 4MW beam studies, NIM A 545 (2005) 813-822

Activation in the rock around the SuperBeam layout

(full 4horn simulation, medium stats: 10⁶ protons, 20% error)

study set up:

➤ packed Ti target, 66%d_{Ti}

▶4MW beam, 4horns, 200days of irradiation

aim:

➢ to confine the energy using concrete around the apparatus -> minimize the activation of the rock (molasse)

minimum activation leads to minimum water contamination

concrete thickness will determine the activation of the molasse

➢ of all the radionuclide's created ²² Na, tritium could represent a hazard by contaminating the ground water. Limits in activity after 1y=200days of beam:

CERN annual radionuclide release to water constraints (achieve 0.3mSv for the public)		SuperBeam, (preliminary)
²² Na	4.2 x 10 ¹¹ Bq	- (to be investigated)
tritium	3.1 x 10 ¹⁵ Bq	6x10 ⁸ Bq



activation plots

Activation and Energy Plots



- energy is confined from concrete thickness
 minimum activation of molasse rock
- > minimum/none effective dose to humans in other galleries
- detailed tables of the radionuclides
- water contamination from tritium is well kept under safety levels





Dose Rates in Target Horn Gallery

study set up:

4MW beam, packed Ti target, 66%d_{Ti}

4horns, 200days of irradiation



rates :

- A. at the start of the decay tunnel using a slice of beam/z-axis with 10cm thickness
- B. average dose rates along the beam/z-axis and x-axis

(volume binning of 10cmx10cmx10cm on both cases)

shown from 1day to 6months, more cooling times and the effective dose along the layout are being simulated



Dose at the start of the Decay Tunnel in transversal x-y plane



<Doses> in transversal and longitudinal planes for Target/Horn Gallery for target/Horn Gallery

effective dose in mSv/h x-y plane 10000 200 150 100 100 1 50 1month 0 0.01 -50 0.0001 -100 -150> 10 Sv/h 1e-06 -200 1e-08 150 200 -200 -150-100 -5(50 100 palette in mSv/h effective dose in mSv/h







remote handling mandatory

<doses> in longitudinal plane along beam axis



<doses> in longitudinal plane along beam axis



conclusions

minimum activation in molasse rock for current secondary beam layout

➢ tritium does not present any hazard related to ground water, ²² Na to be investigated (preliminary)

high dose rates in Storage Gallery -> remote handling for repairs mandatory

high dose rates along SuperBeam layout -> carefully design of shielding for the apparatus, remote handling for any part of the 4horn system

future:

EUROnu note and others + any additional calc necessary

Thanks