Shielding wall optimization for FAIR

A. Senger[1], *G. Fehrenbacher*[1], *and T. Radon*[1]

[1]GSI, Darmstadt, Germany

FLUKA [1, 2] calculations have been carried out for the construction permission of the FAIR buildings and tunnels, in particular for the optimization of shielding walls between tunnels and caves. Free access to a certain cave while beam operations including regular beam losses take place in a neighbouring cave or tunnel can only be granted if the dose rate does not exceed 0.5 µSv/h. Moreover, often shielding walls have to be designed as a labyrinth in order to have access to the beam line components.

The planned concrete shielding wall between tunnel T113 and cave G050 is shown in Figure 1, blue line. Concerning radiation protection the wall is thick enough to reduce the dose rate in the cave down to 0.5 µSv/h in case of a beam loss in the tunnel, but the access to the beam line magnets is difficult.

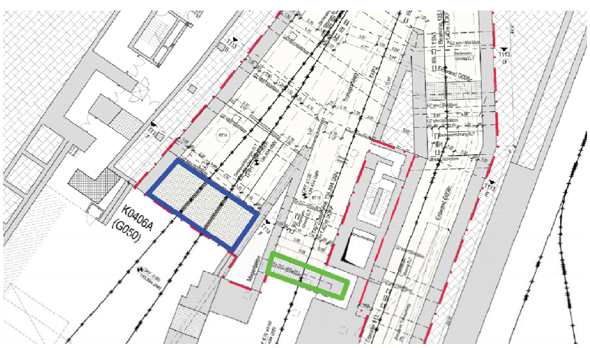

Figure 1: Architect plan of tunnel T113. Blue line – planned shielding wall for G050, green line – for G006c.

The new labyrinth was designed using FLUKA calculations. The dose rate in tunnel T113 and in cave G050 in case of a 2% beam loss of a proton beam at 29 GeV energy with an intensity 5×10^{11} p/s is shown in Figure 2. The black cross indicates the assumed point of beam loss. This scenario is possible during experiments in G006c.

Another scenario is the beam loss while G050 experiments are performed. The shielding wall for G006c was not optimized for such a situation (see green line in Figure 1). The FLUKA calculations allowed optimizing the thickness and structure of the concrete shielding wall for G006c. The dose rate in tunnel T113 and in cave G050 in case of a 3% beam loss of uranium beam at 2 GeV/u energy with an intensity 10^{10} particles per second is shown in Figure 3. The black cross indicates the point of beam loss. The level of 0.5 µSv/h will be reached with a total concrete thickness of 5 m. The labyrinth structure of the shielding wall allows the access to the beam line magnets.

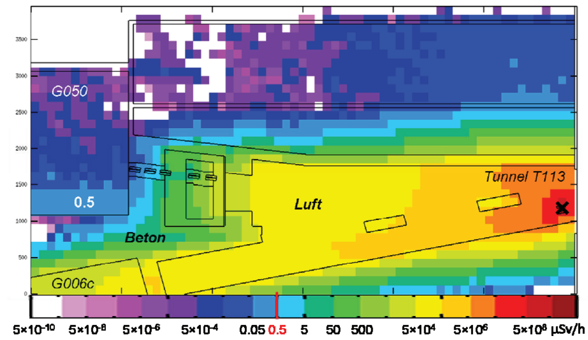

Figure 2: Dose rate in tunnel T113 and cave G050 for a 2% beam loss of proton beams at 29 GeV energy with intensities of 5×10^{11} p/s. The black cross indicates the beam loss position.

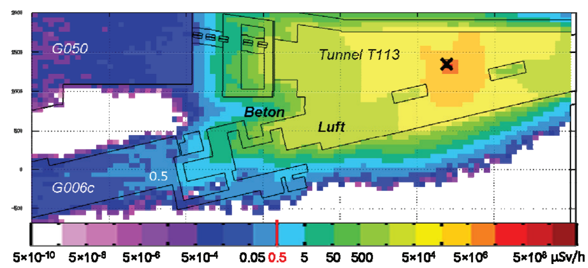

Figure 3: Dose rate in tunnel T113 and cave G006c for a 3% beam loss of uranium beam at 2 GeV/u energy with intensities of 10^{10} particles per second . The black cross indicates the beam loss position.

The final design of the concrete shielding walls between tunnel T113 and caves G050 and G006c together with FLUKA results will be included into the application for the construction permission of the tunnel and both caves.

References

[1] "The FLUKA code: Description and benchmarking", G. Battistoni, S. Muraro, P.R. Sala, F. Cerutti, A. Ferrari, S. Roesler, A. Fasso`, J. Ranft, Proceedings of the Hadronic Shower Simulation Workshop 2006, Fermilab 6-8 September 2006, M. Albrow, R. Raja eds., AIP Conference Proceeding 896, 31-49, (2007)

[2] "FLUKA: a multi-particle transport code", A. Fasso`, A. Ferrari, J. Ranft, and P.R. Sala, CERN-2005-10 (2005), INFN/TC_05/11, SLAC-R-773