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Shielding calculations for the Swiss Light Source upgrade

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The Swiss Light Source (SLS) has been in operation since 2001. Renovations are now ongoing for a major upgrade project, named SLS 2.0.

Key changes for the SLS 2.0 are the increase of the electron beam energy from 2.4 GeV to 2.7 GeV and a significant reduction of the beam emittance. In addition to this, the new lattice foresees the presence of two sets of collimators and of a dedicated beam dump. Beam losses will be concentrated at these three locations, posing new challenges to shielding design.

Simulations have been performed using the FLUKA.CERN Monte Carlo code and the results will be presented in this work.

The energy density on the beam intercepting devices could be very high, because of the small beam emittance. In particular, the expected energy density on the dump is challenging. To avoid damages, a strategy to distribute the bunches on the dump has been developed. The resulting energy density on the dump is calculated for different filling patterns.

Furthermore, there will be permanent magnets in the same straight sections as those of the intercepting devices. Notably, undulators will be located downstream of the collimators. These magnets are characterized by lower aperture compared to other machine components, so they are more exposed to radiation. The load on these components is evaluated and shielding strategies conceived.

The expected dose maps outside the SLS 2.0 bunker have also been calculated. Openings are foreseen in both collimation regions to host wave guides for the radiofrequency cavities, cooling pipes and cables. The expected dose in correspondence to these weak points has been evaluated and shielding reinforcements have been studied.

Finally, an accidental beam loss scenario will be discussed to assess the maximum possible dose in a gallery below the SLS 2.0 bunker, accessible during operations.

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Scientific Topic 2

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