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FCC-ee radiation environment and shielding

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The secondary radiation fields generated by synchrotron photons pose a significant challenge for equipment in high energy electron and positron storage rings like the Future Circular Collider (FCC-ee) at CERN. The annual ionizing dose can reach MGy-levels in the FCC-ee tunnel and requires the design of a dedicated radiation shielding enclosing the photon stoppers in dipoles. In this paper, we present a first optimization of the shielding design, taking into account different aspects such as shielding efficiency, engineering and integration constraints, raw material costs, and radiological considerations. We demonstrate that the proposed shielding solution can decrease the dose in the tunnel by about two orders of magnitude, which considerably reduces the need of expensive radiation-hard equipment. In addition, we explore the option of housing accelerator electronics in a dedicated bunker near lattice quadrupoles, which can possibly allow for custom-off-the-shelf-based radiation tolerant electronics systems. We quantify the expected radiation levels in this bunker, which are driven by photo-neutron production by the high-energy component of the synchrotron spectrum.

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