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Radiation Shielding Design for the MOLLER Spectrometer Coils at Jefferson Lab

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The MOLLER experiment at Jefferson Lab will measure the weak mixing angle with unprecedented precision via parity-violating Møller scattering. A major engineering challenge is mitigating radiation damage to the spectrometer coils and their S2-glass/CTD-403 insulation.

The upstream and downstream regions receive radiation levels beyond acceptable limits, necessitating the implementation of protective shielding. High-statistics, GEANT4-based simulations were performed to iteratively design and optimize shielding geometries within mechanical constraints. These studies achieved significant dose reduction and included analyses of symmetric versus asymmetric magnetic configurations, dominant radiation pathways called as hotspots, and the sensitivity of the design to small coil misalignments.

This work presents the resulting shielding strategy for the MOLLER upstream torus.

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