



Contribution ID: 1251 Contribution code: TUPB091

Type: **Poster Presentation**

Dose calculations for warm quadrupoles in the LHC off-momentum cleaning insertion

Tuesday 3 June 2025 16:00 (2 hours)

Interaction Region 3 (IR3) of the Large Hadron Collider (LHC) houses the off-momentum collimation system, designed to remove particles with significant energy deviations. The interaction of the beam with this multi-stage collimation system generates particle showers that impact various elements, including quadrupole magnets in the straight section. Radiation exposure to magnet coils and spacers raises concerns about potential damage. The upcoming High-Luminosity (HL) LHC upgrade will significantly increase radiation doses, necessitating further assessments. While shielding inserts were added to the quadrupoles during a previous shutdown, further shielding may be required, prompting dose predictions through the HL-LHC era in the 2040s. This paper presents FLUKA simulations where the off-momentum proton and heavy ion losses in LHC Run 2 (2014-2018) and Run 3 (2022-2026) is estimated from Beam Loss Monitors. These estimates serve as normalization factor for calculating the dose deposited in the quadrupoles. These results are then extrapolated to HL-LHC operational parameters, offering unprecedented insight into the future IR3 radiation environment

Footnotes

Paper preparation format

LaTeX

Region represented

Europe

Funding Agency

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Session Classification: Tuesday Poster Session

