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FLUKA Simulations of Gamma Irradiation Effects on Dynode Materials for the ATLAS TileCal

Understanding the impact of radiation on detector components is essential for ensuring the sustained long-term performance of the ATLAS TileCal, particularly in the high-luminosity phase of the LHC. This study details a variety of FLUKA Monte Carlo simulations investigating the effects
of gamma irradiation on selected materials used in the dynode chain of photomultiplier tubes, a vital detector component of the TileCal. These materials include aluminium oxide, gallium arsenide, thallium-doped caesium iodide, and magnesium oxide. FLUKA's features are used to evaluate both the absorbed dose and the displacement per atom for each material, providing insight into radiation induced structural damage under conditions simulating Co-60 gamma radiation. The average photon
energy of 1.25285 MeV was used to represent the decay spectrum of Co-60, with a beam fluence corresponding to 5 kGy, 50 kGy, and 100 kGy absorbed dose levels. This study aims to support the selection of radiation-hard materials for use in photomultipliers for the high-luminosity upgrade of
the LHC, while also providing predictions to support ongoing experimental measurements.

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