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A new framework for synchrotron radiation studies in the EIC experiment

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The Electron-Ion Collider (EIC) is an advanced particle accelerator designed to explore matter's fundamental structure at the subatomic scale. It collides high-energy polarized electron beams with ions, like protons or lead nuclei, enabling scientists to scrutinize quark and gluon interactions. The EIC's unique setup provides a platform to study these interactions within atomic nuclei, shedding light on nuclear matter and extreme conditions in the universe. Collaboration among multiple institutions drives the construction and operation of the EIC, with the overarching goal of advancing our understanding of the fundamental forces and particles.

The EIC plans to operate at high beam currents and luminosities to probe dense gluon systems and unravel the origins of nucleon mass and spin. However, this strategy increases beam-induced background rates in the ePIC spectrometer located at the interaction point. Notably, synchronous radiation (SR) emitted from the electron beam is a significant source that negatively impacts detector longevity and physics analysis performance.

This talk describes the Monte-Carlo simulation method for the SR background in the ePIC setup at the EIC. It introduces a new framework to accurately model X-ray photons' specular and diffuse reflection on vacuum-metal interfaces. In addition, the framework utilizes the extensive functionalities of Geant4 classes for particle-matter interaction studies. Moreover, the talk presents updated estimates of SR rates in various ePIC subsystems and proposes countermeasures to protect sensitive electronics, ensuring a stable detector operation.

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