Comparison between BFEM data and G4 simulation

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Overview of this study

• Main purpose of this work is to **construct reliable Cosmic-Ray generator and BFEM simulator**.
• In order to do this, we have been constructing cosmic-ray generators and running Geant4 simulator.
• We regard that major components of cosmic-ray particles are **CR proton, electron, positron, gamma, and muon**, and constructed their generators.
• For proton and electron generator, see LAT-TD-250.1 (and note that electron spectrum are now extrapolated down to 10MeV with E^-1). We are also preparing a description for others.
• We have not reach goal. We need to improve the simulator and generators by **comparing BFEM data and simulation results** (L1T rate, neutron event rate, hit distribution in TKR).
Distribution of Top-most hit layer

BFEM data vs. G4 simulation

Contributions of each component

Calorimeter → Top of TKR

observed L1T rate = ~500Hz

- proton: ~205Hz
- electron: ~95Hz
- positron: ~60Hz
- gamma: ~105Hz
- muon: ~90Hz

simulated L1T rate = ~560Hz

- proton: ~205Hz
- electron: ~95Hz
- positron: ~60Hz
- gamma: ~105Hz
- muon: ~90Hz
Distribution of Hit Frequency

BFEM data vs. G4 simulation

Contribution of each component

Slight deviation is seen in layer 0-5 and 10-15.
Distribution of Hit Frequency for neutral events

BFEM data vs. G4 simulation

Contribution of each component

observed = ~50Hz

simulated = 67Hz

• proton: ~4Hz
• electron: ~12Hz
• positron: ~7Hz
• gamma: ~40Hz
• muon: ~4Hz

gamma-ray is dominant in layer 15 or higher, and in this region, simulation overestimates hit frequency. We may need to adjust gamma-ray flux or angular distribution.
Summary
• We plan to construct reliable CR generators and simulator.
• We have constructed CR proton, electron, positron, gamma, and muon generators.
• Observed data and simulation show good agreement in L1T rate (500Hz vs. 560Hz)
• There exists a slight difference in hit distribution in TKR. Neutral event rate of simulation is larger than that of real data.

Future plan
• Adjust CR generator, especially gamma-ray flux and angular dependence.
• Combine two CR particles and see the effect.
• Update simulator (support structure for BFEM).
• Apply proton/muon cuts to both real data and simulation data, and adjust proton (muon) flux in generator.