The Simulation for the Next-Generation Ultra-High Energy Air Shower Lake Array for SWGO

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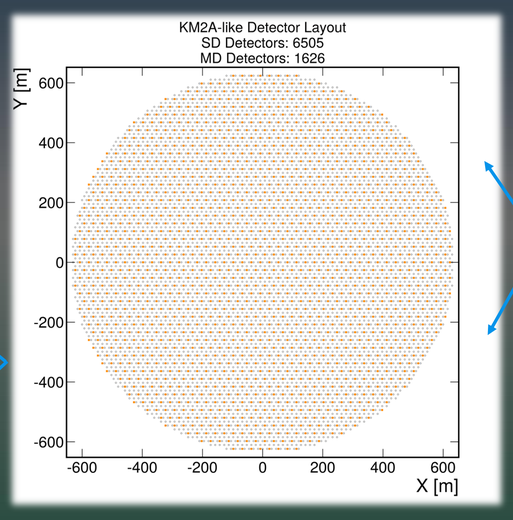
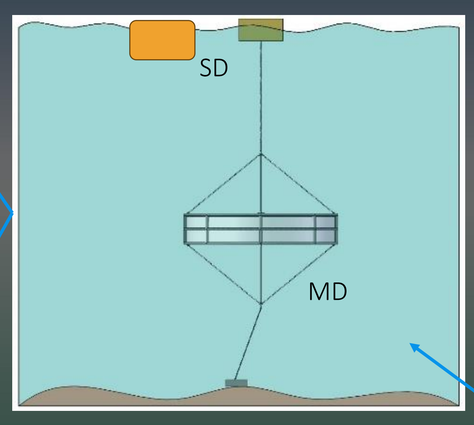
SWGO The Southern Wide-field Gamma-ray Observatory

1. Lake Array Config

Goals → Ultra-high-energy → Low flux → Large area; Strong background → Muon detector

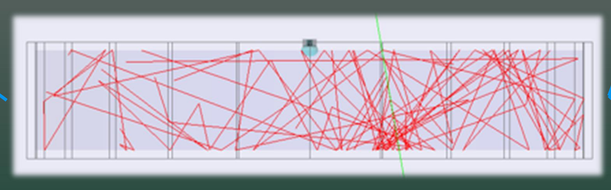




◆ Surface detector

Height: 1 m
Diameter: 1.5 m
PMT: 8 inch

◆ Muon detector



Bag Height: 1.2 m
Diameter: 6.8 m
Depth: 6 m
PMT: 8 inch

2. Fast Simulation Flow

Why simulate the same unit detector again and again for different arrays and showers, if its response can be reused?

LUT construction

Particle List → HAWCSim (GEANT4) → Extract → Particle Info (E, Dir, Pos); Response (nPE, Time, Eff)

Extract → Look-up-table

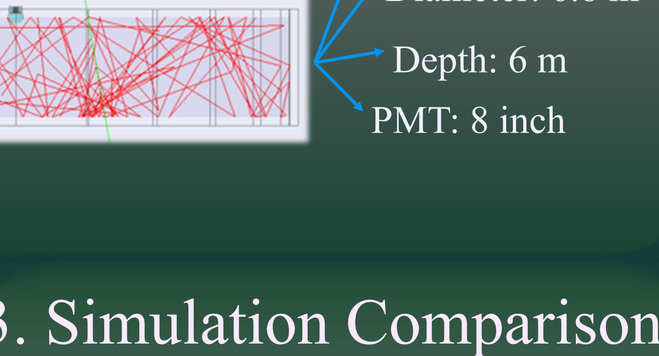
Fast simulation

CORSIKA showers → Select secondary particles → Interpolation → Random Sampling (with efficiency) → Time; nPE

3. Simulation Comparisons

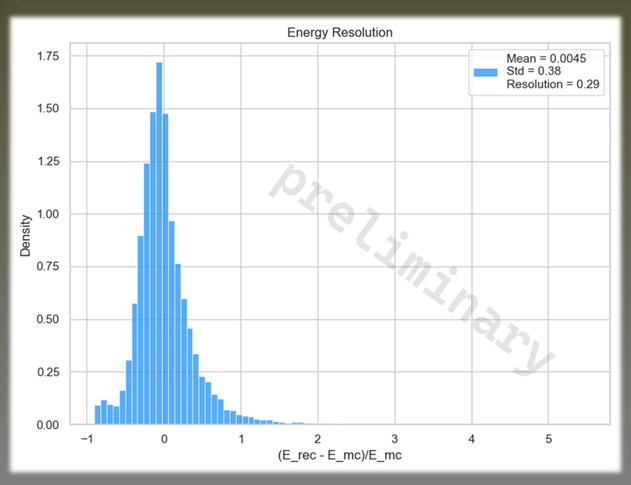
The fast simulation shows consistency with the results from Geant4.

Number of photoelectrons

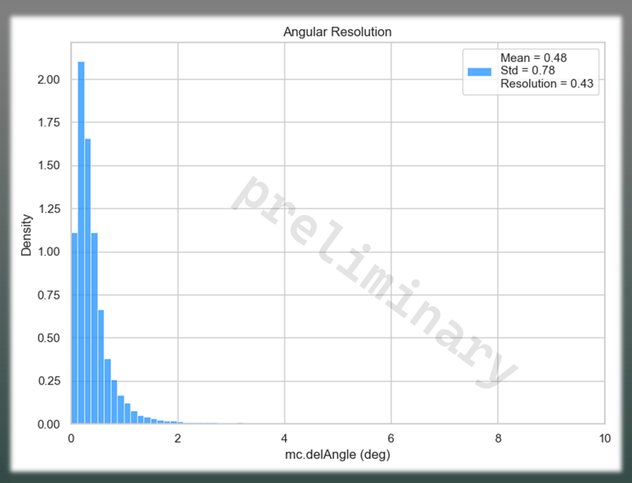


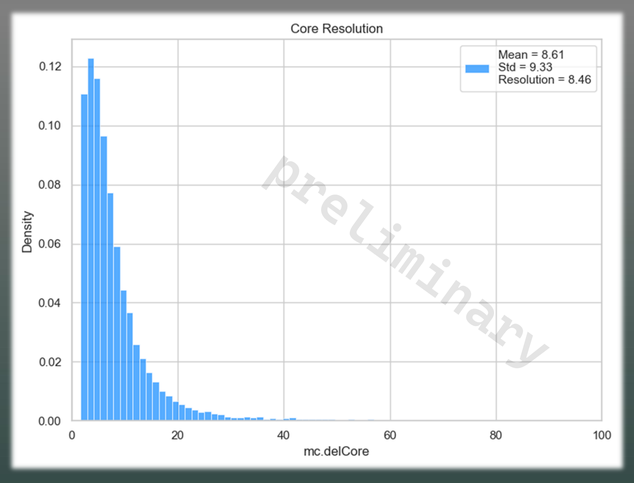
First arrival time distribution

4. Detector Performance



- Range: 10-100 TeV
- Altitude: 4000 m
- Resolutions(@E_med 20 TeV):
  - Core: 8.46 m
  - Direction: 0.43°
  - Energy: 29%





The Lake array performs similar to KM2A at the same energy range.

5. Future

- Extend the energy of gamma ray showers above PeV.
- Simulate proton-initiated showers.
- Optimize the array configuration.
- Evaluate the detector sensitivity.