Calorimeters - What's in the Decadal Plan?

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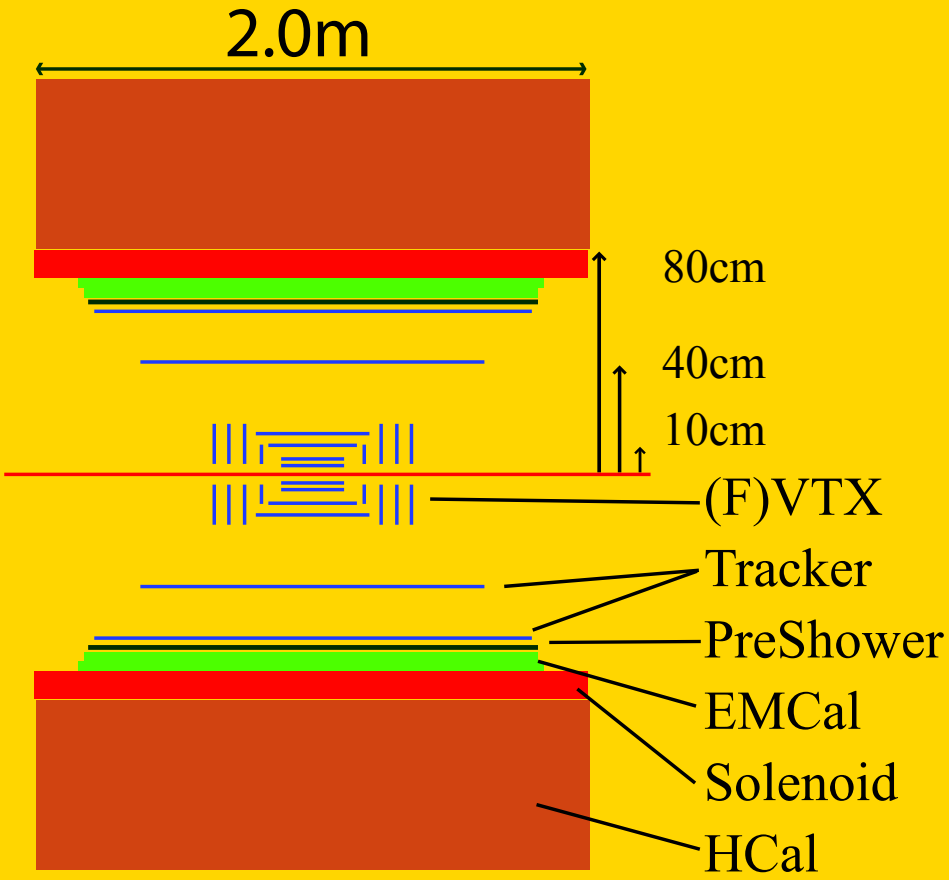
The Strawman Calorimeters



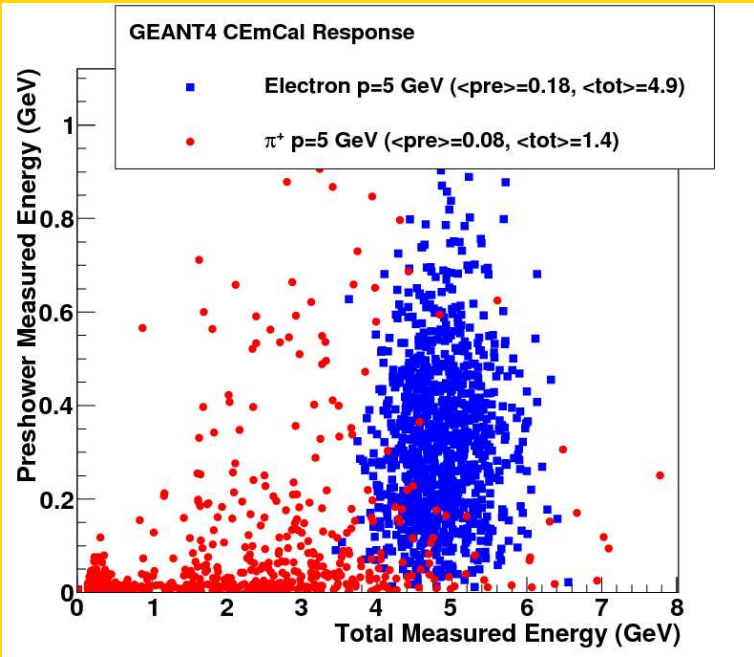
- What is in the GEANT4 and decadal plan for
  - Preshower
  - Two compartments of the compact EMCal
  - Hadronic calorimeter

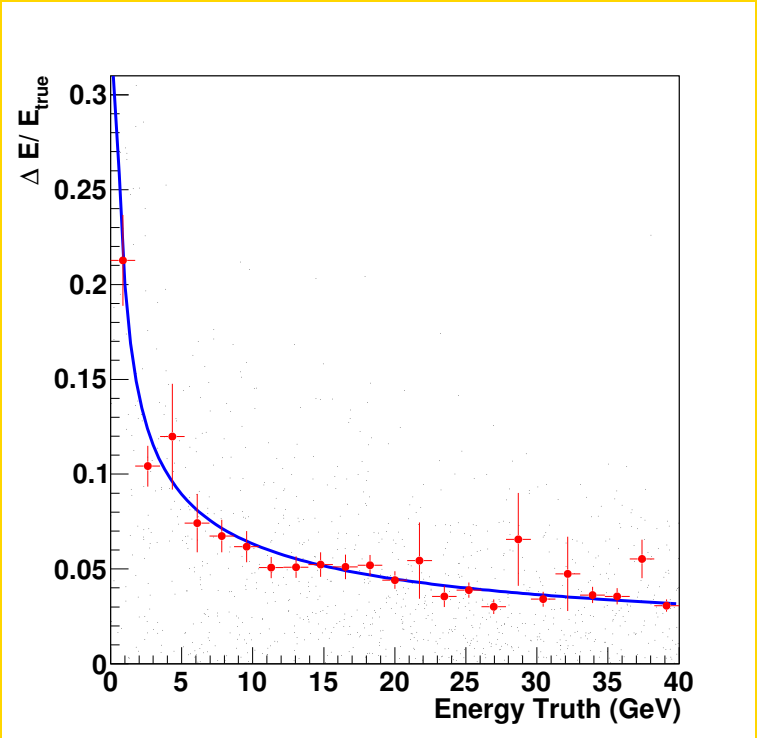
Calorimeter Requirements

- Physics requirements
  - Measure single photons separated from π^0s up to some reasonable p_T for γ-jet physics.
  - Measure electrons for heavy flavor physics.
  - Meausre jets calorimetrically (without relying on tracking).
  - All in central Au+Au collisions at RHIC energies.
- Yields design requirements
  - Compact design ($\sim$60 cm front face) means highly segmented EMCal.
  - Hermetic for jet measurments.
  - Energy resolution
    - EMCal: $\sim 15\%/\sqrt{E}$
    - HCal: $\sim 50\%/\sqrt{E}$

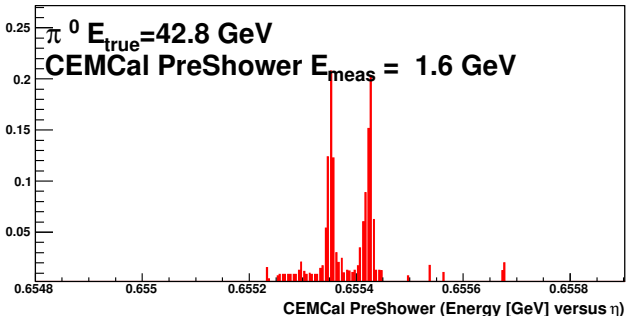
Compact EMCal in GEANT4

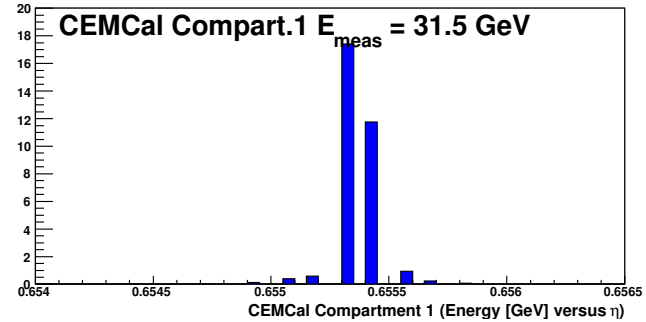
- Si-W sampling calorimeter with projective $\eta - \phi$ segmentation and 3 longitudinal layers
  - Preshower: 1 layer of Si-W with 0.005x0.1 (300μm x 6 cm).
  - 1st compartment: 7 Si-W layers with 0.05x0.05 (0.75cm x 0.75 cm).
  - 2nd compartment: 8 Si-W layers with 0.1x0.1 (1.5cm x 1.5 cm).

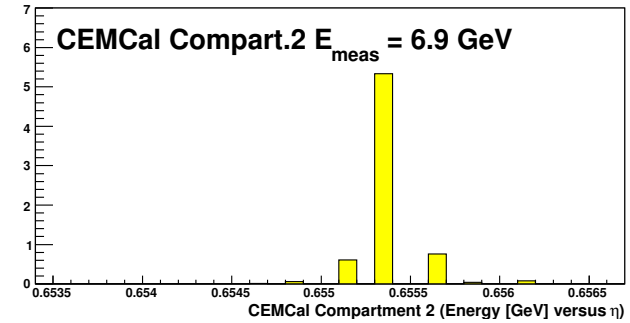




Compact EMCal in GEANT4





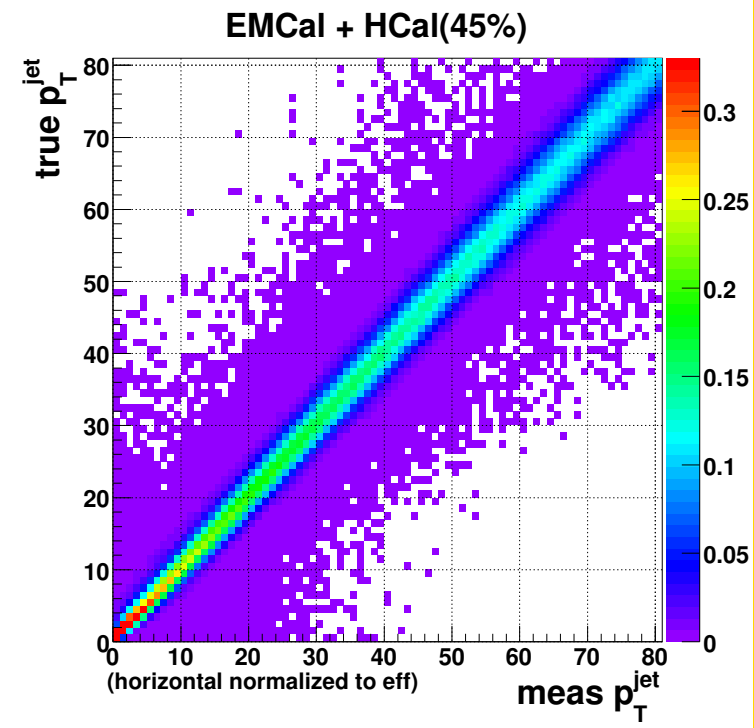


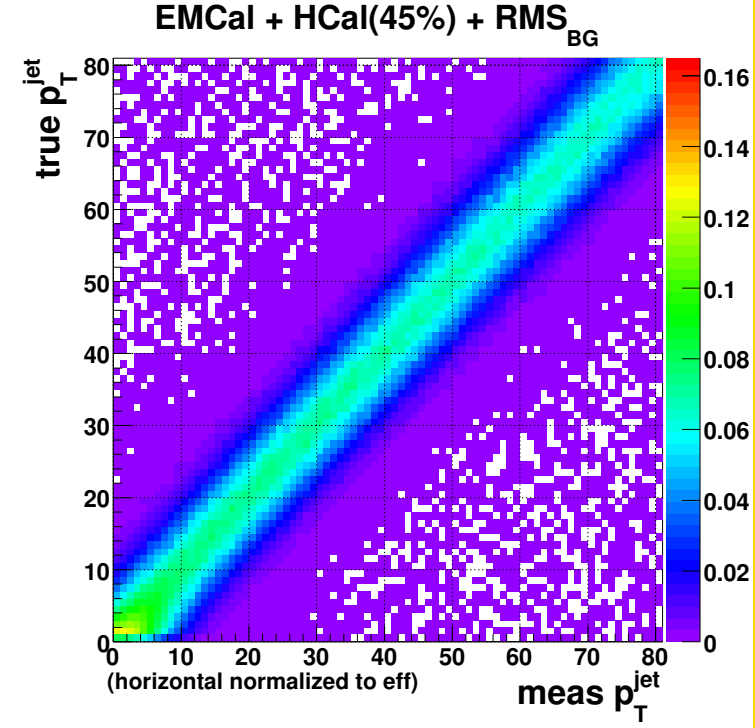
- Strips allow two photons from π^0 decay to be separated.
- Small occupancy and energy deposition by underlying event.
- Separation up to and beyond 50 GeV.

HCal in GEANT4

- 62 cm (with 50 layers) of steel and scintillator with 0.1x0.1 segmentation
- But nothing substantial done with this yet.

Jet Energy Resolution





- Left: Fast simulation by smearing generator particles (M. McCumber)
- Right: Same with additional smearing due to underlying event.
- We would like better energy resolution but can MC it. Underlying event is harder.

Review

- Based on physics we would like to have a hermetic calorimeter system for calorimetric jet reconstruction that can still separate photons at high-p_T.
  - Energy resolution is not a primary limitation on the design.
  - Will need a preshower layer - likely silicon strips.
- But there are questions.
  - How do we design for hermeticity?
  - How do we handle the large occupancy?
  - Do we care about PID (timing) in the EMCal?