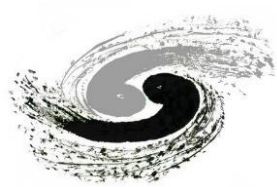


Crystal ECAL with Arbor PFA: a first glance at PFA performance

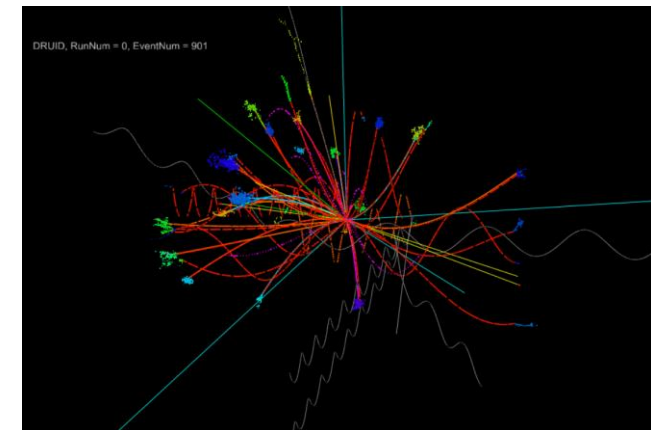
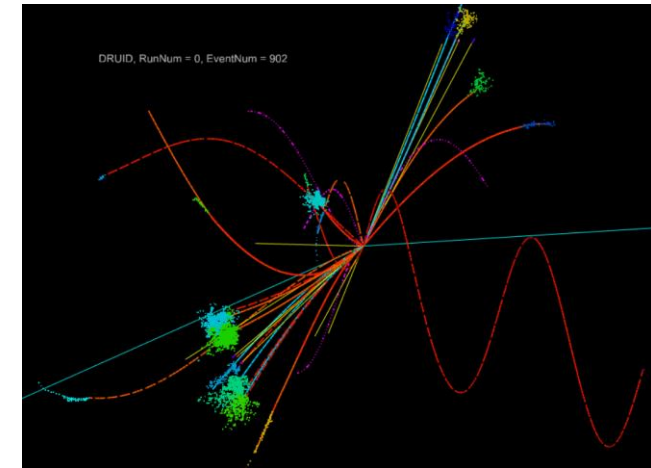
Yong Liu, Dan Yu

Mar. 31, 2021

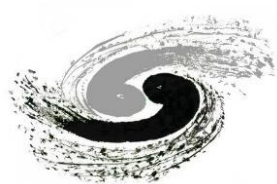


Crystal ECAL: clustering

- Motivation
 - Check the PFA performance with a crystal calorimeter
- Physics benchmark
 - $ZH(Z \rightarrow \nu\nu, H \rightarrow gg)$ at 240 GeV
- In CEPCsoft
 - CEPC_v4 geometry: replace SiW ECAL with crystal ECAL
 - ECAL geometry: crystal cubes (1 cm^3)
 - Digitiser for crystals
 - Calibration constant = 1.0 for EM showers, not finely tuned, estimated ~ 1.1
 - Photon statistics, time windows, etc. not yet included
- Parameters in ArborPFA
 - “Default” paras tuned for SiW ECAL

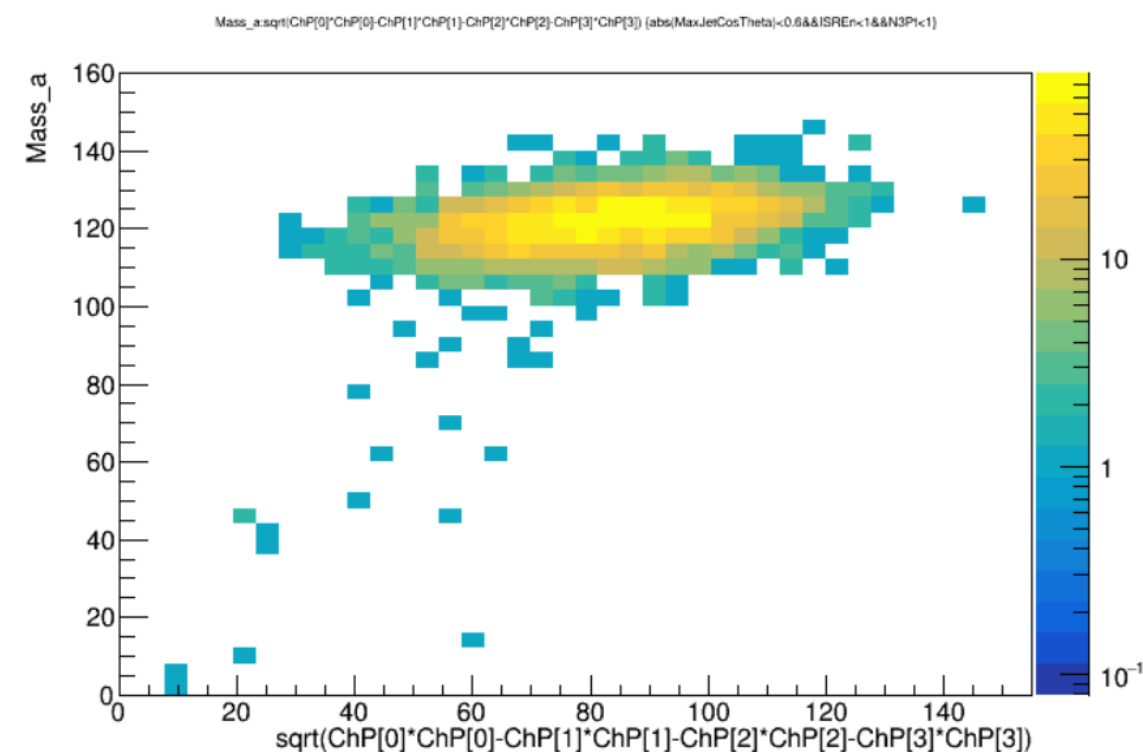
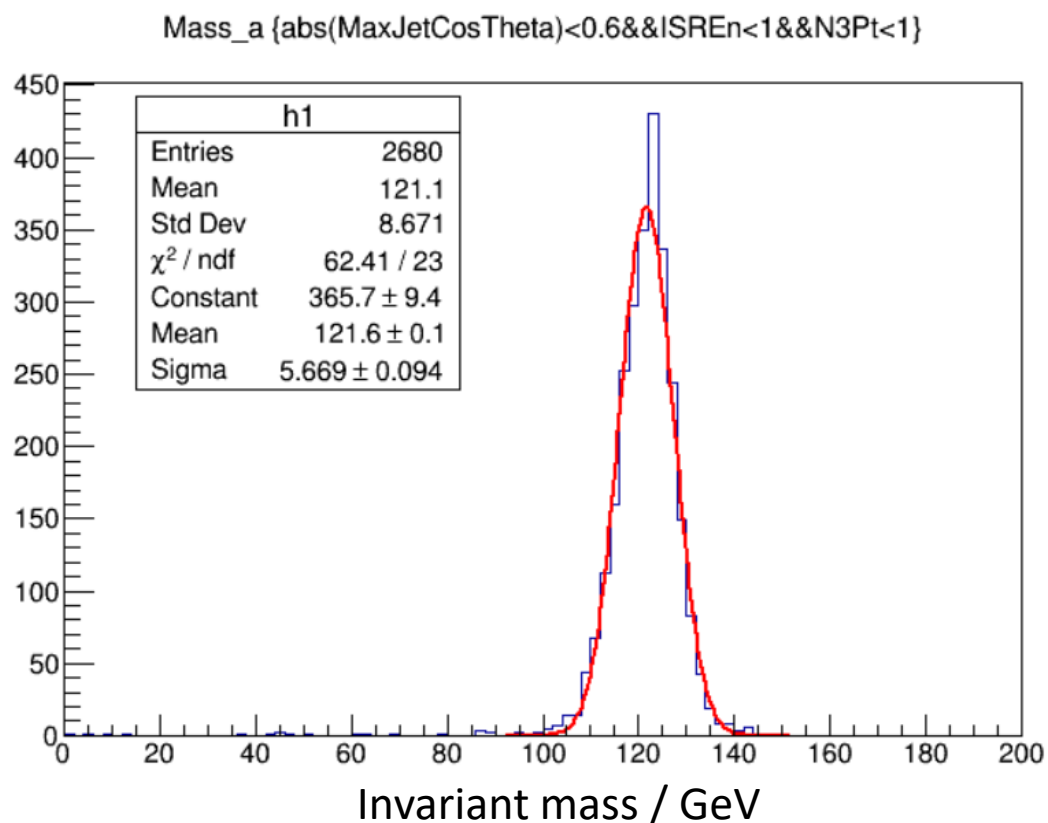


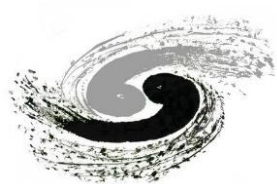
2 gluon-jets in $ZH(Z \rightarrow \nu\nu, H \rightarrow gg)$:
event display with Druid



PFA performance: a first look at BMR

- Invariant mass in $ZH(Z \rightarrow \nu\nu, H \rightarrow gg)$
 - Preliminary results: BMR $\sim 4.7\%$, definitely requires further investigations

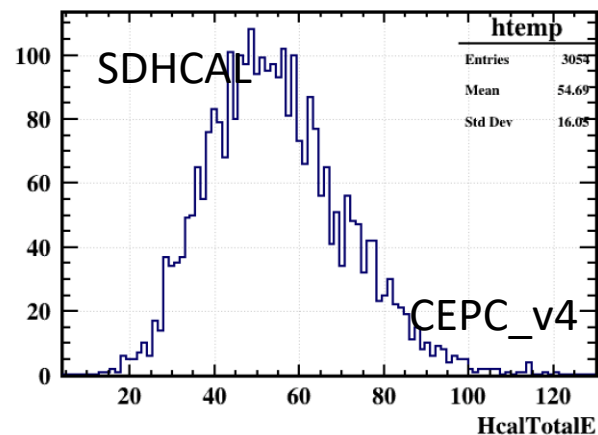
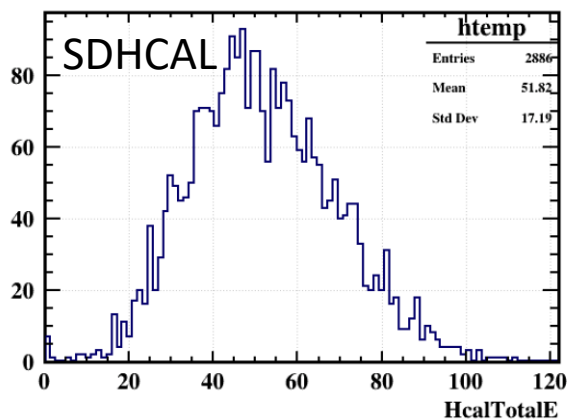
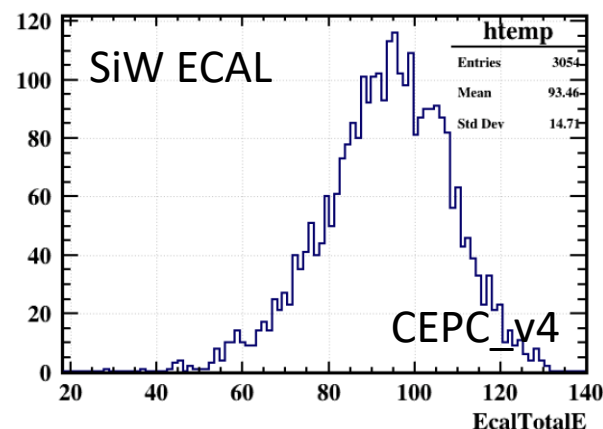
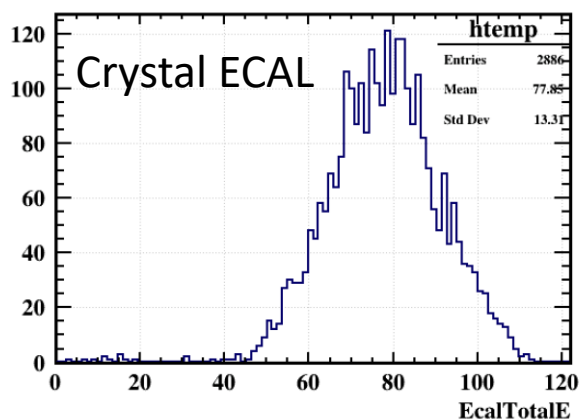




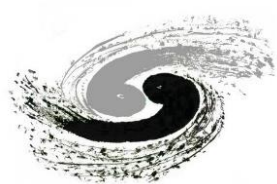
Total energy depositions

Dan Yu

- Energy depositions (reconstructed) in calorimeters: crystal vs. SiW

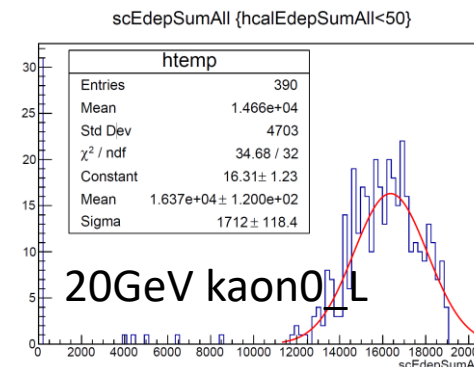
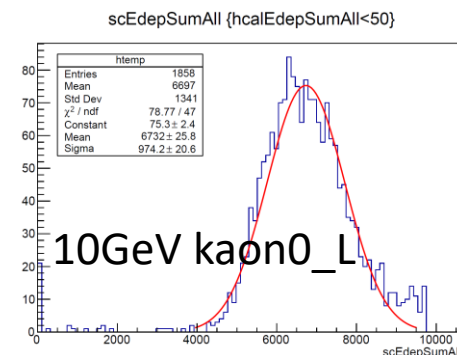
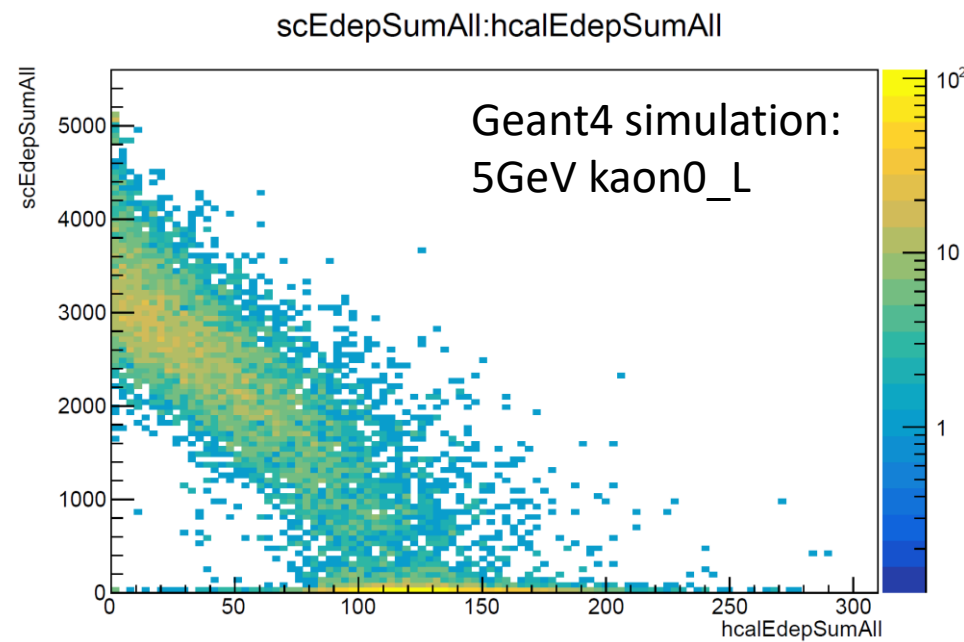
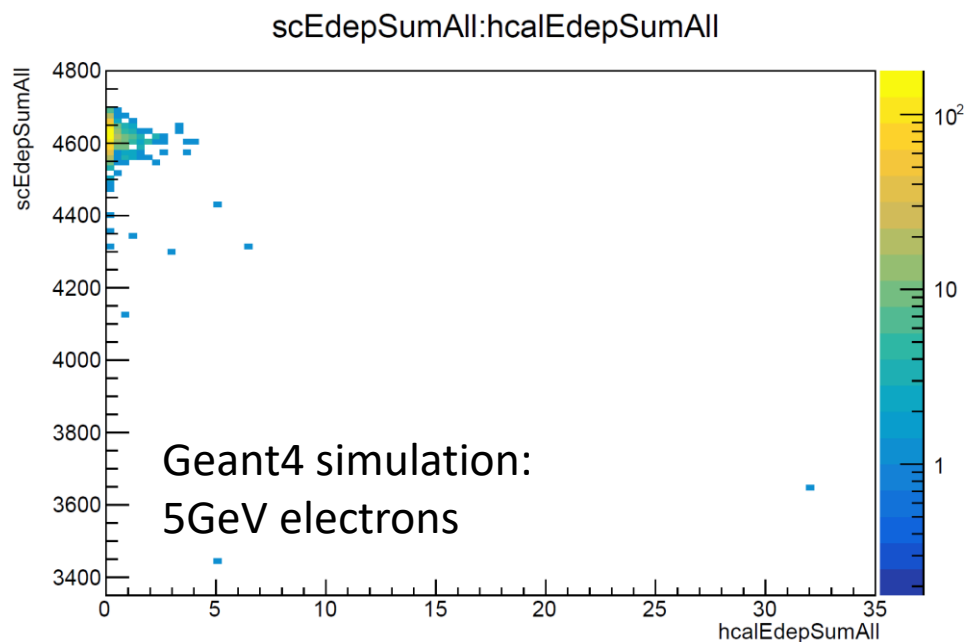


Considerably lower response
in crystals for hadronic showers

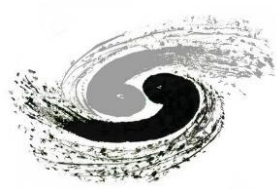


Further look into G4 simulation

- Crystal ECAL: significantly different response to EM and hadronic showers
 - 28cm BGO ECAL + 48 layers AHCAL

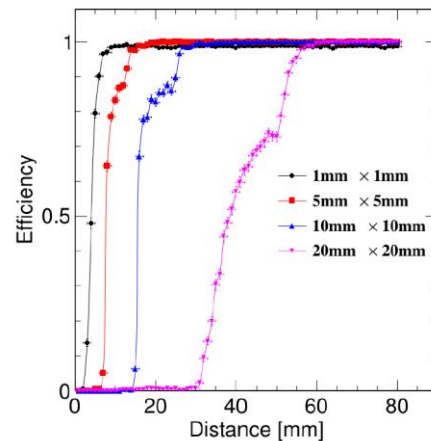


Selected early hadronic showers in crystal ECAL



Other studies: separation power

- Separation power
 - To use two photons, varying incident positions
- Issue with the “Overlay” processor
 - “Overlay” after “Digitisation” will result in one merged (larger) cluster of two photons
 - Solution: generate simulation samples with different incident positions (done), then do “Overlay”-> “Digitisation” (TBD)
- Goal: balance between clustering efficiency and separation power



Plot in CEPC CDR:
illustration only

Figure 3: Reconstruction efficiency of di-photon samples at different cell size. The distance of the photons is scanned from 1 to 80 mm.