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Latest Progress in Geant4 Simulation of HCAL

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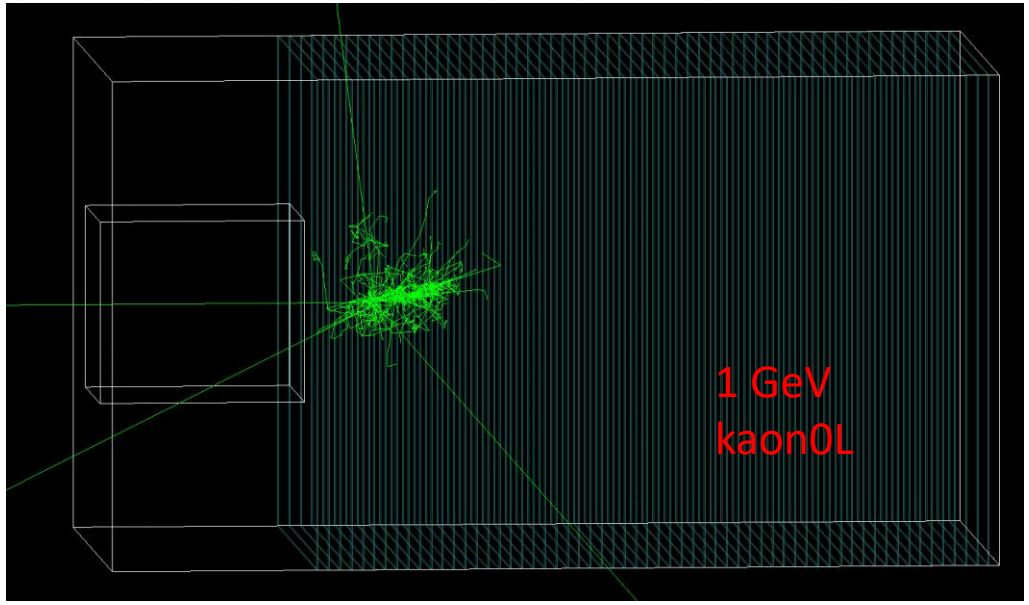
Scintillator HCAL: setup in Geant4 simulation

HCAL geometry

- Transverse plane: $108 \times 108 cm^2$
- 60 longitudinal layers, each with
  - Scintillator: 3mm
  - PCB: 2.1mm
  - Absorber (steel): 20mm



Scintillator materials

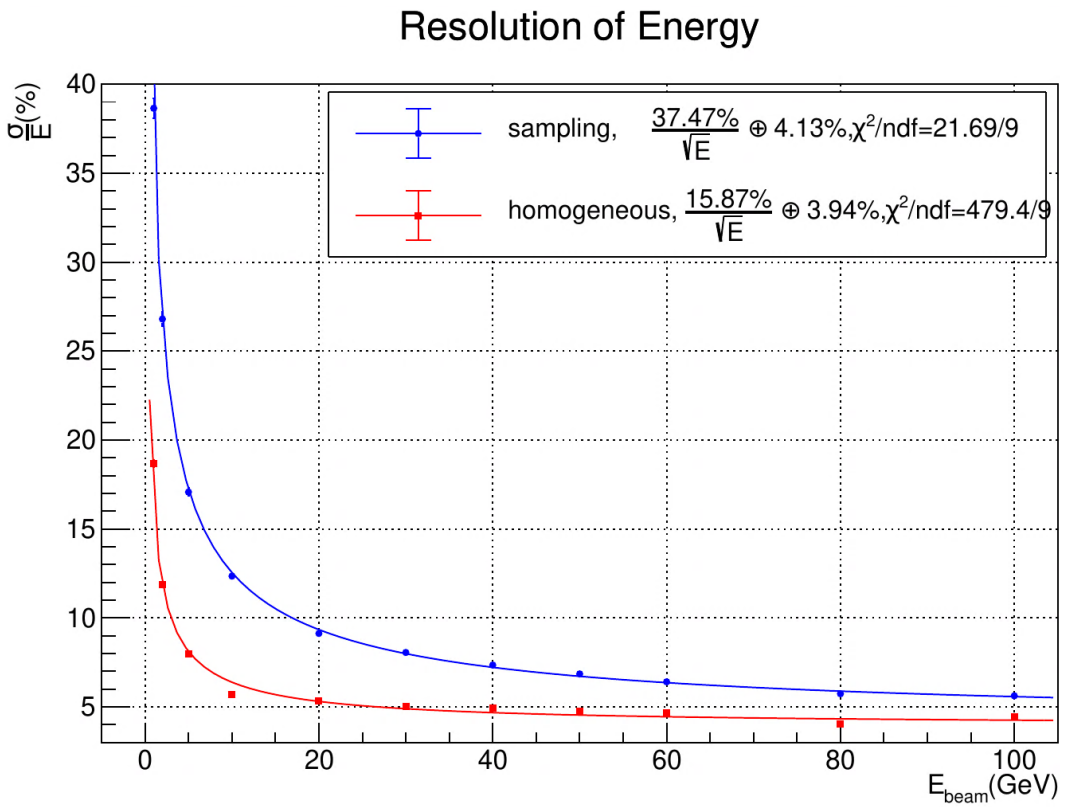
- Plastic scintillator (polystyrene) as baseline reference
- Scintillating glass: $42SiO_2$-$5Al_2O_3$-$22BaF_2$-$9NaF$-$3CaF_2$-$3Gd_2O_3$-$9GdF_3$-$7TbF_3$

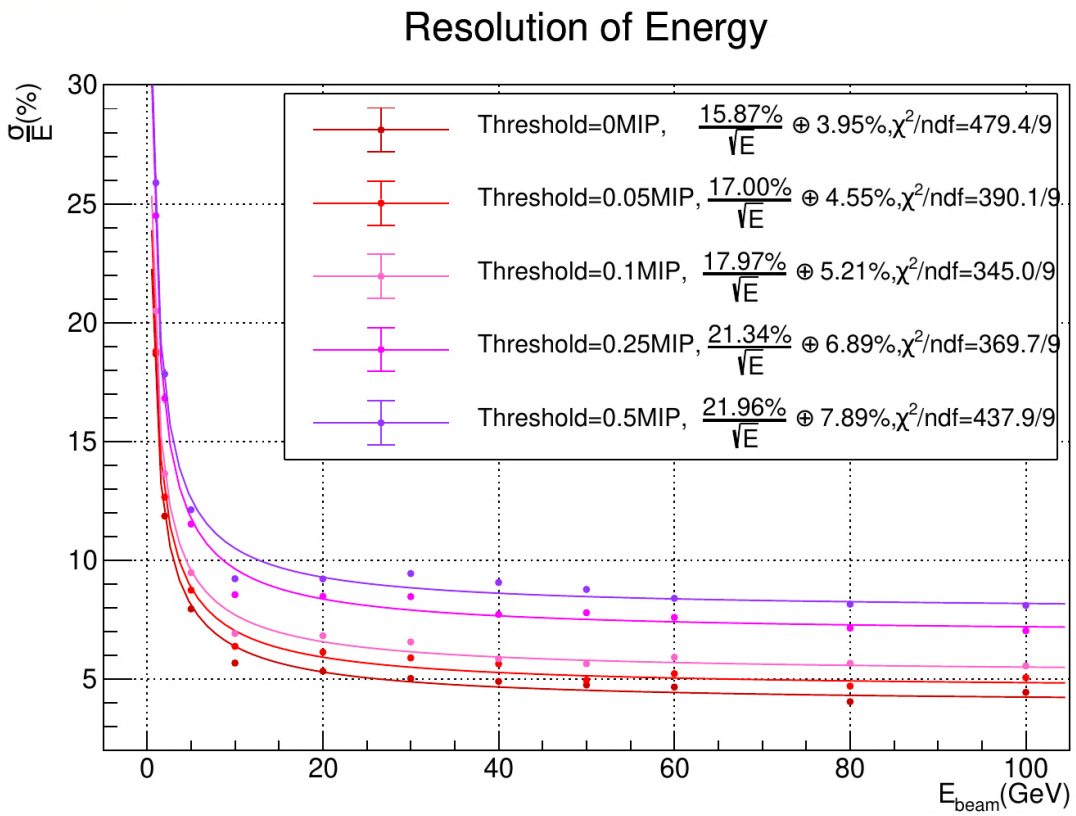
References: https://doi.org/10.1016/j.jeurceramsoc.2021.05.064

Note: HCAL with 40 layers in CEPC CDR as baseline.
Hereby use 60 layers to evaluate leakage effects

HCAL with scintillating glass: sampling vs homogeneous

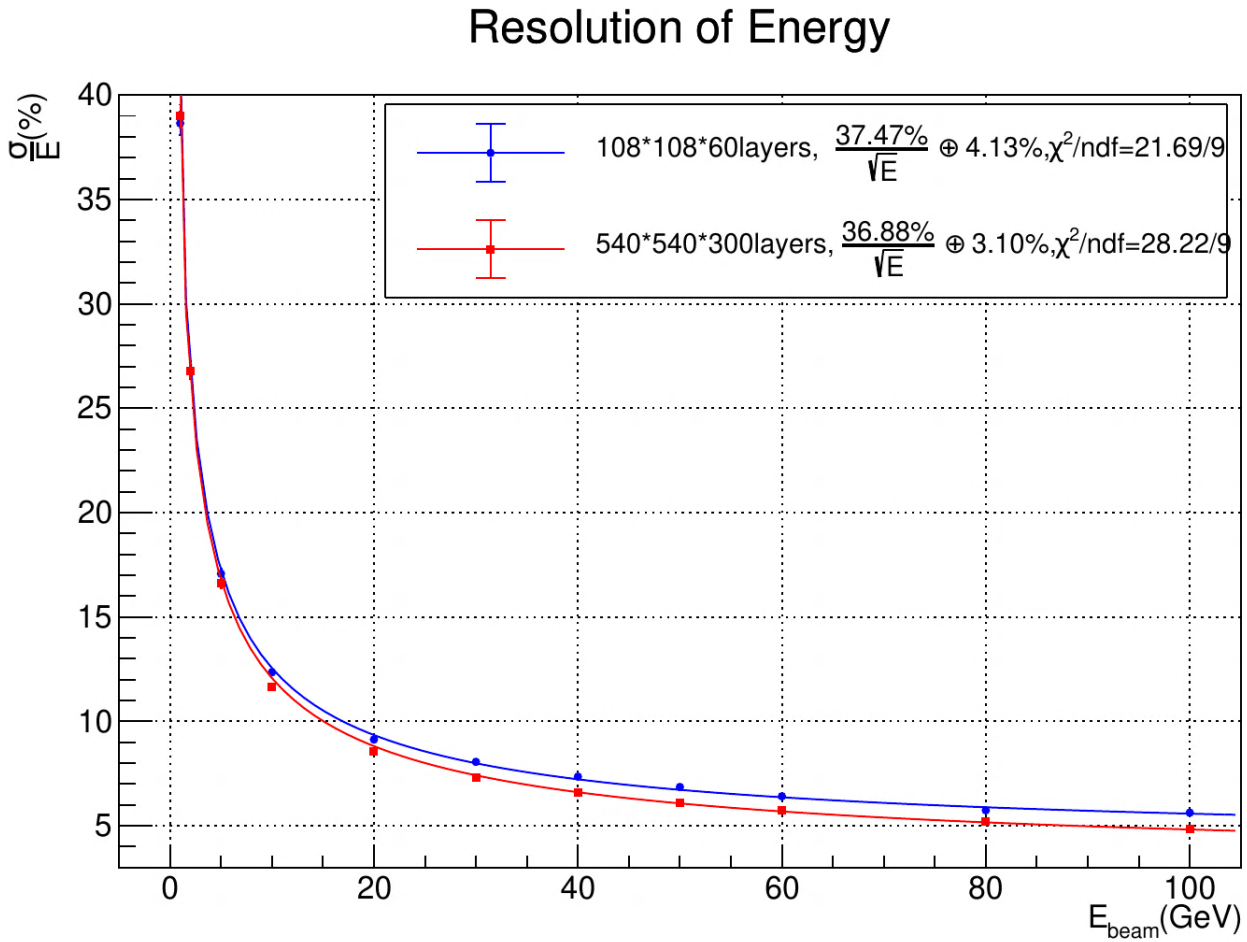
- Birks' constant not included
- Incident particle: kaon0L (1-100GeV)



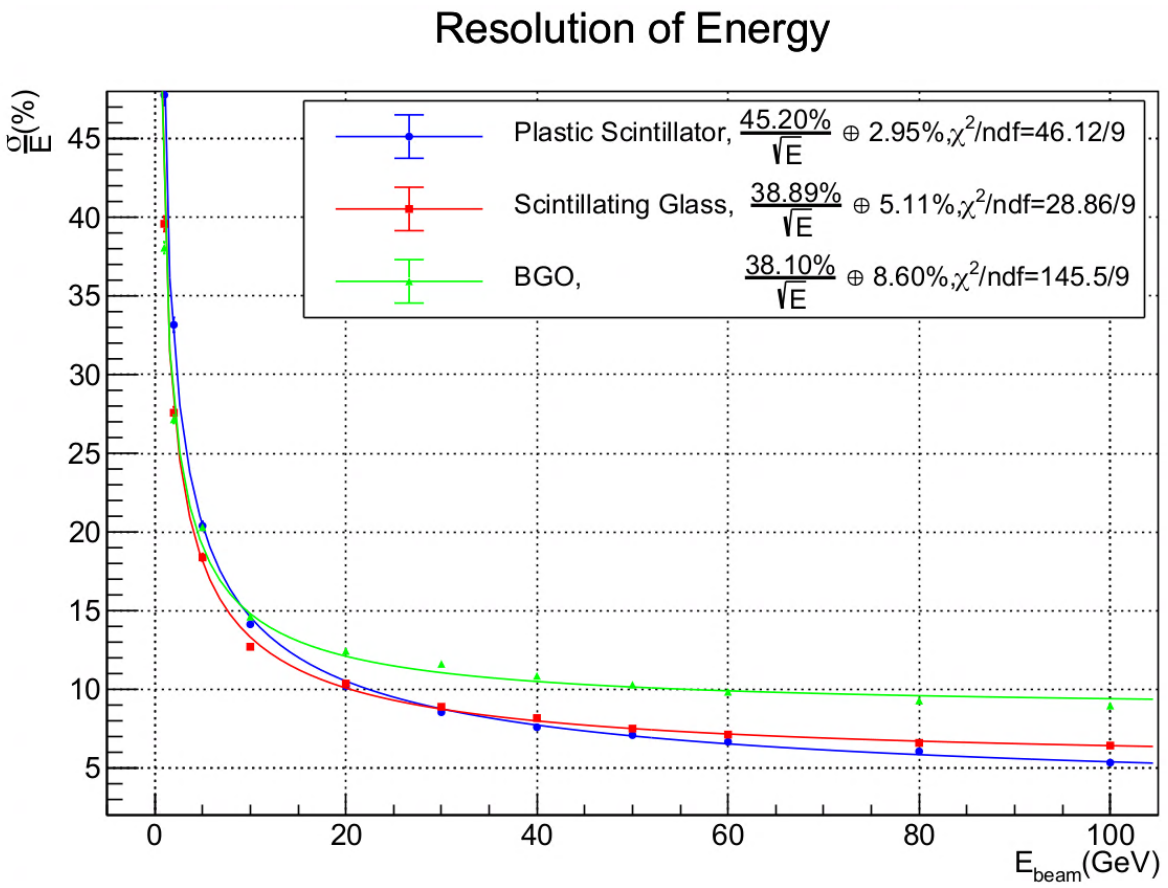


HCAL with scintillating glass: 1m vs 5m

- Birks' constant not included
- Incident particle: kaon0L (1-100GeV)



HCAL: plastic scintillator vs scintillating glass vs BGO

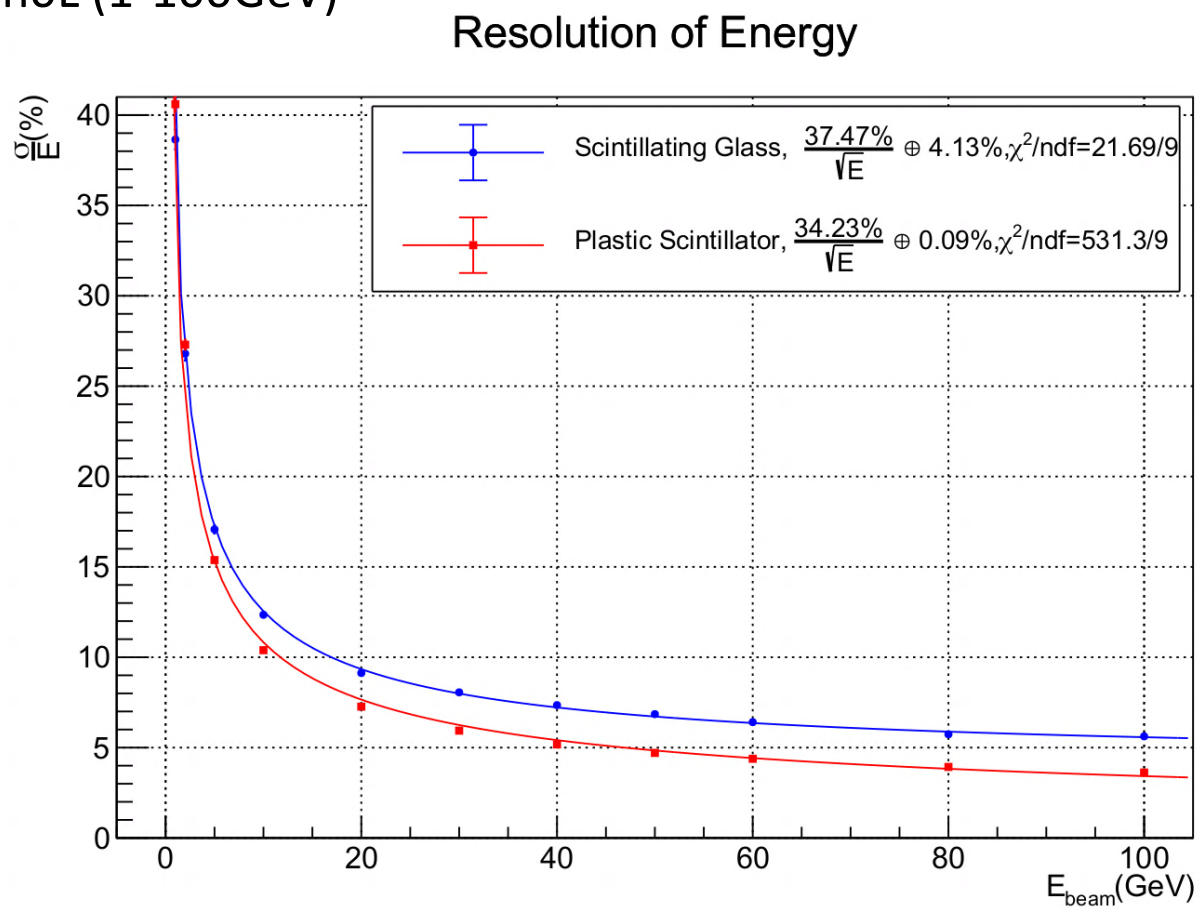


- Preliminary performance comparison
- Scintillating glass: better hadronic energy resolution in low energy region (<20GeV)
  - Note that majority of hadrons in jets at CEPC are with low energy
- Further issue: constant term
  - To be further understood
  - Could be due to the “non-compensation” effects
  - “Software compensation” technique is ready to be applied

HCAL: plastic scintillator vs scintillating glass

At the same density (7 g/cm3)

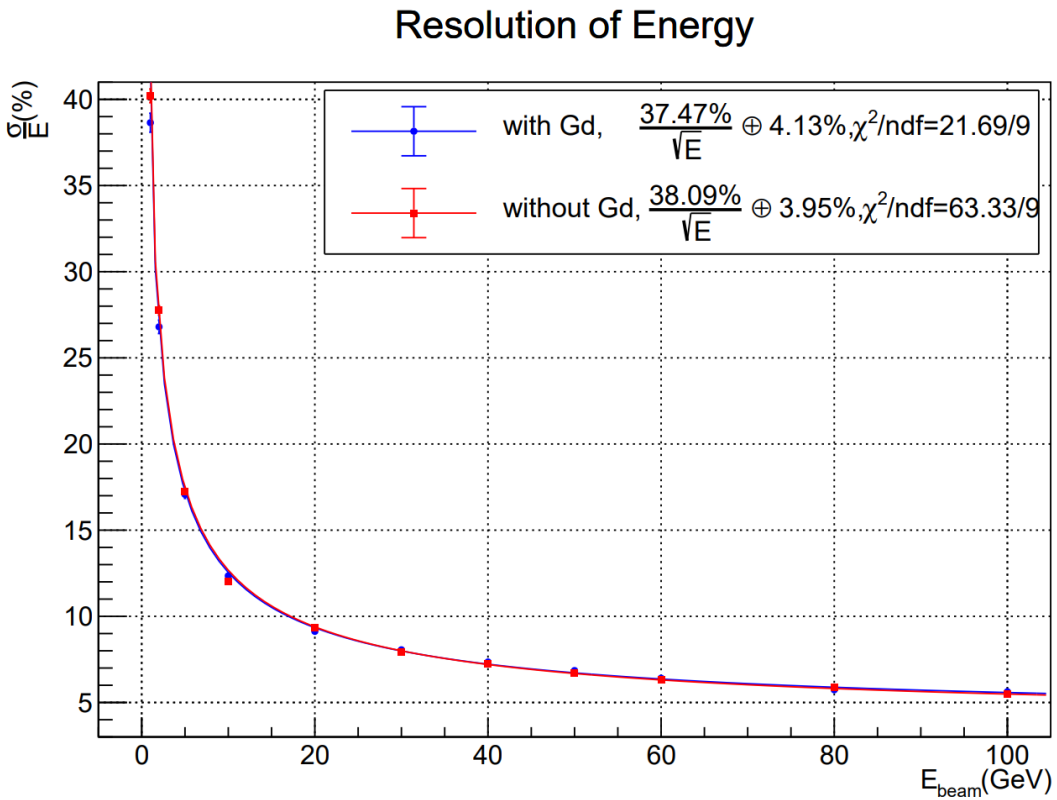
- Birks' constant not included
- Incident particle: kaon0L (1-100GeV)

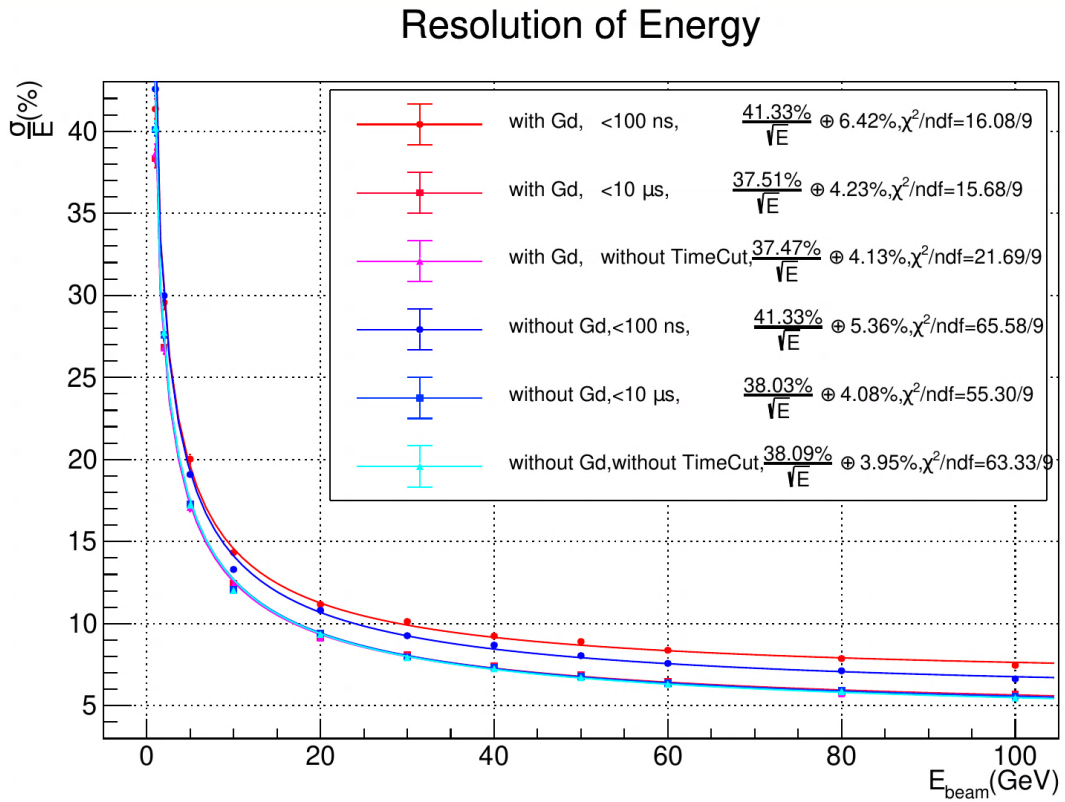


HCAL with scintillating glass

Impact of Gd for energy resolution

- Birks' constant not included
- Incident particle: kaon0L (1-100GeV)



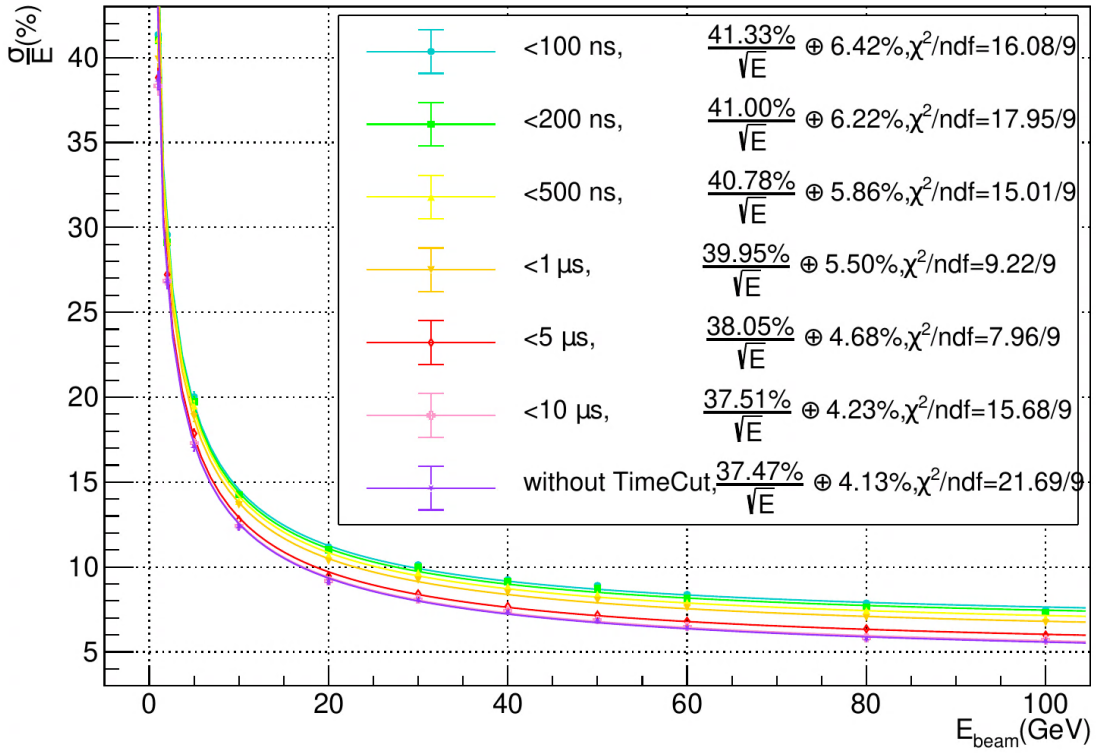


HCAL with scintillating glass

Impact of timing cut for energy resolution

- Birks' constant not included
- Incident particle: kaon0L (1-100GeV)

Scintillating Glass



Plastic Scintillator