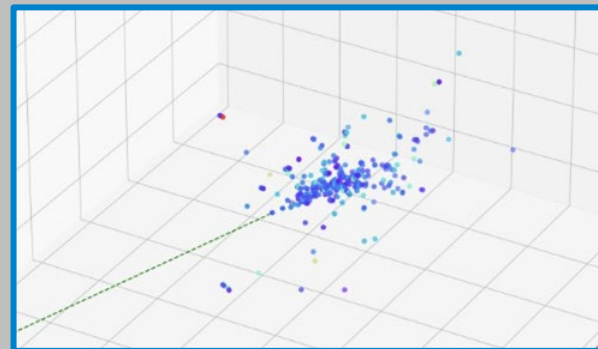# ML PID with 3D Shower Profiles from Calorimetry

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ePIC Barrel ECAL DSC

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ePIC Barrel ECal

EM Calorimetry at EIC is challenging

- Electron scattering machine: inclusive physics program requires up to 10^4 π^- background suppression at low momenta in the barrel

- The exclusive program requires decent energy resolution ($< 7\%/\sqrt{E} \oplus 1\%$) for γ, and fine granularity for π^0/γ separation up to 10 GeV

- The system is very space-constrained inside the solenoid

Hybrid lead/scintillating fiber calorimeter with interleaved silicon trackers
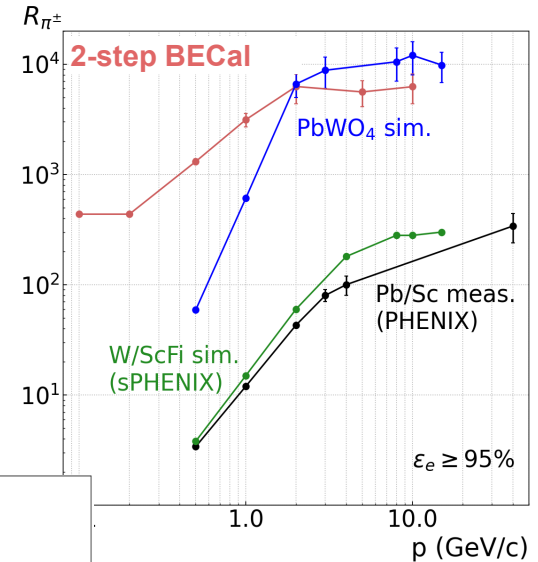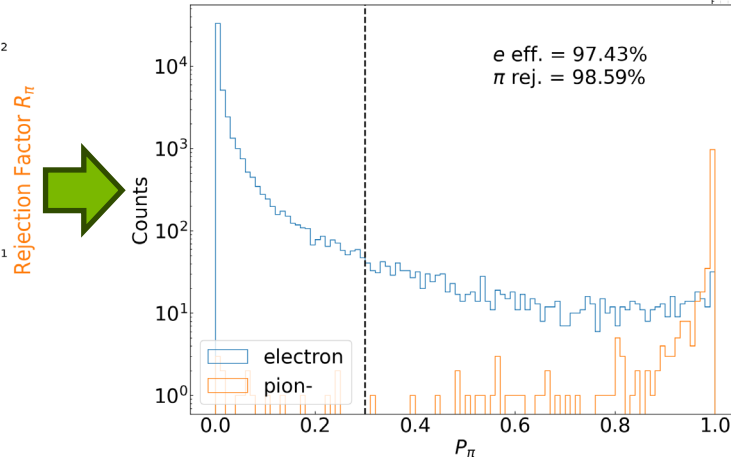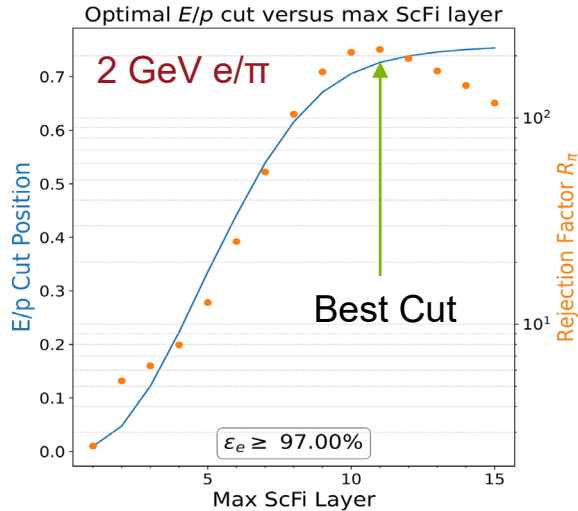
- 3D shower imaging to separate π^- background from electrons

- ML/AI classification to achieve a rejection power of $\sim 10^3$

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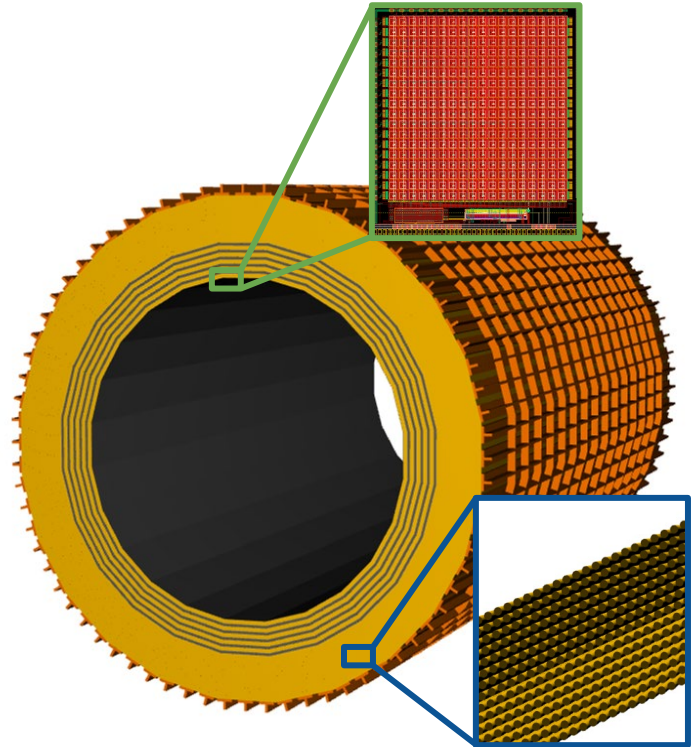
ML Classification for PID

Two-step process

- Conventional E/p cut with dE/dx from Pb/SciFi layers

  Up to ~200:1 rejection

- ML classification for the leftover samples (a shallow VGGNet)

  A factor of >5 boost on top of E/p cut results

Optimal *E/p* cut versus max ScFi layer

2 GeV e/π

Best Cut

$\varepsilon_e \geq 97.00\%$

e eff. = 97.43%
π rej. = 98.59%

$R_{\pi^\pm}$

2-step BECal

$PbWO_4$ sim.

Pb/Sc meas. (PHENIX)

W/ScFi sim. (sPHENIX)

$\varepsilon_e \geq 95\%$

p (GeV/c)

Planned Improvement

- More sophisticated model

- GNN

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