EIC Detector Barrel EMCal Requirements

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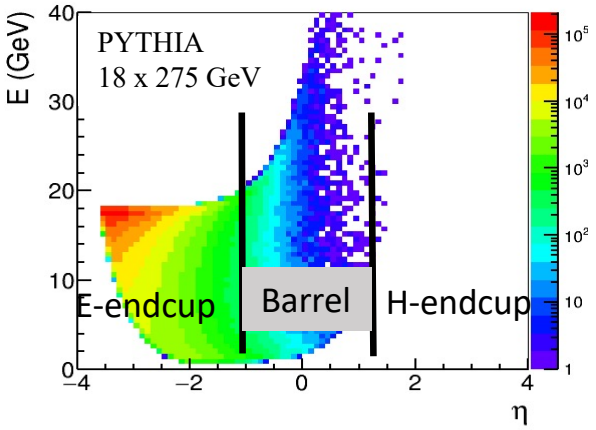
EMCal goals

- DIS kinematics
  (through scattered electron)
- Decay electrons
  (e.g. from vector mesons and HF)
- Photons
  (e.g. from DVCS)
- $\pi 0$
  (e.g. from SIDIS or exclusive DIS)

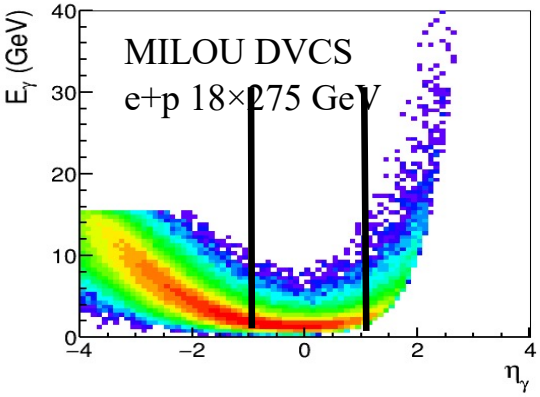
- Dynamic range
- Resolution
- Charged hadron suppression for eID
- $\gamma/\pi 0$ discrimination

Dynamic ranges

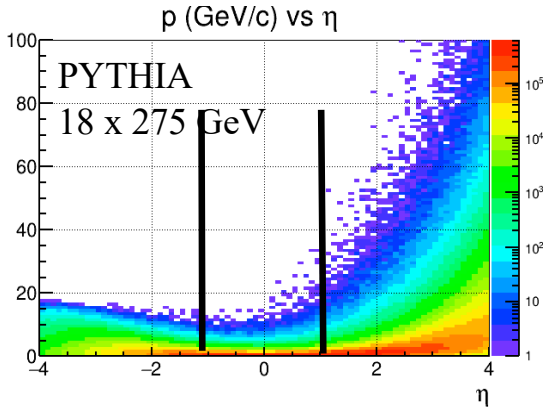
DIS e



DVCS photons



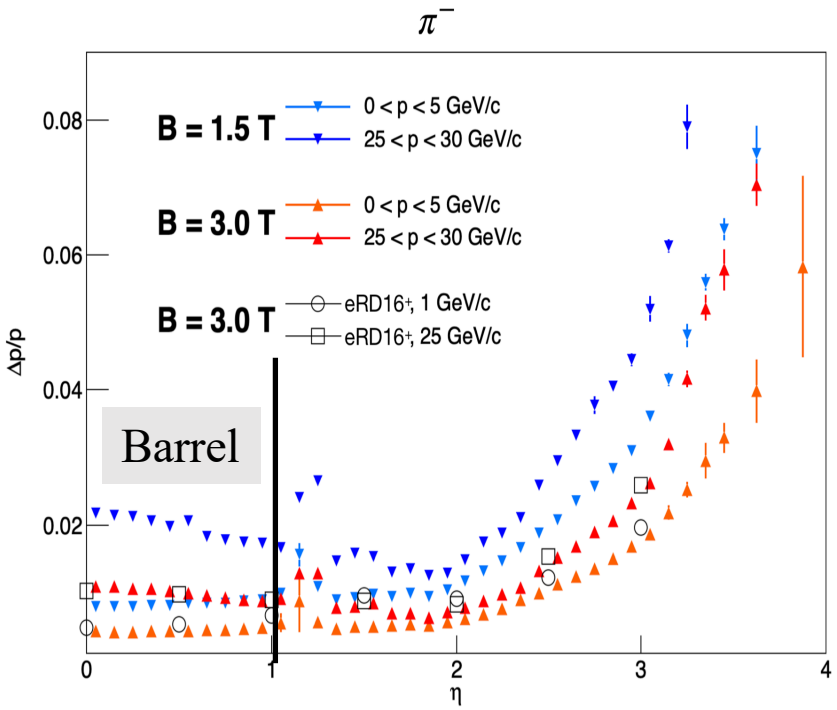
SIDIS π0



DIS electrons in barrel:
Up to 40-50 GeV/c

Photons, pi0 in barrel:
Up to 10-15 GeV/c

Electron Kinematics and Resolutions

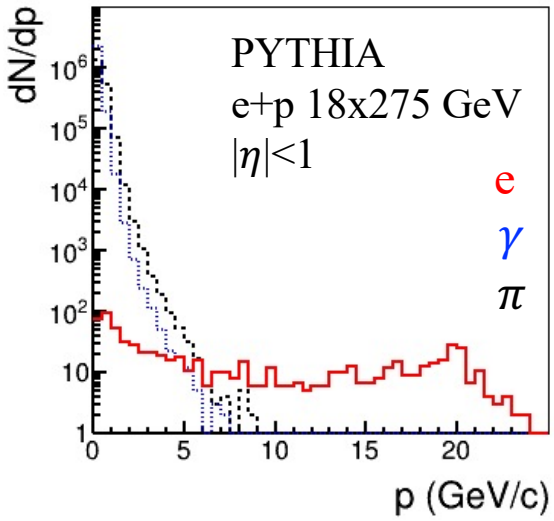


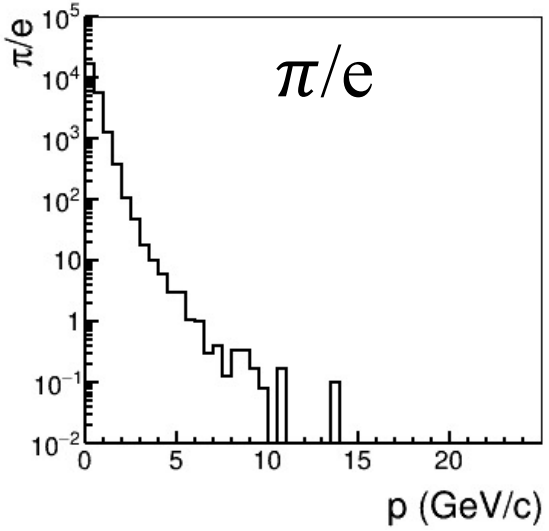
Tracking resolution <1% (<2%)
for 3 T (1.5 T) field

⇒ Electron kinematics reconstruction
will be provided by tracking

⇒ EMCal role mainly for eID

eID and background





From YR:

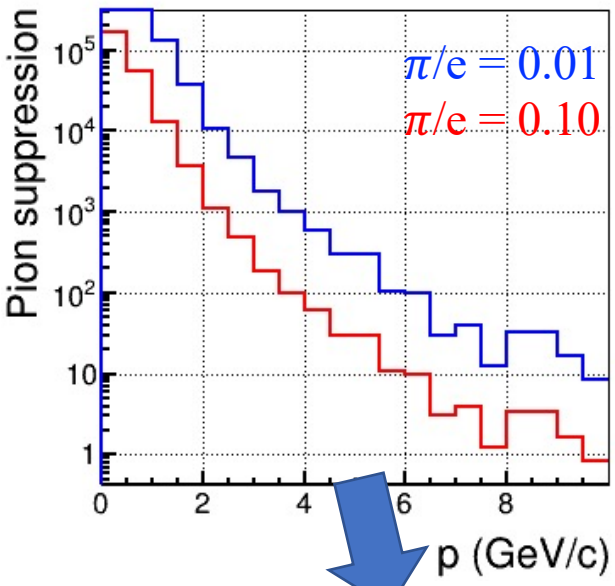
$E^{e^-}_{beam}$ (GeV)	η bin	$p^{e^-}_{min}$ (GeV)	Max π^-/e^-	final π^-/e^- ratio
18	(-3.5,-2)	0.9	200	0.02
18	(-2,-1)	0.9	800	0.08
18	(-1, 0)	1.0	1000	0.1
18	(0, 1)	1.8	100	0.01
10	(-3.5,-2)	1.4	10	0.001
10	(-2,-1)	0.5	400	0.04
10	(-1, 0)	0.6	800	0.08
10	(0, 1)	1.0	1000	0.1
5	(-3.5,-2)	2.8	0.1	0.00001
5	(-2,-1)	0.4	100	0.01
5	(-1, 0)	0.3	500	0.05
5	(0, 1)	0.5	1000	0.1

Table 8.1: The minimum detected e^- momentum (column 3), the maximum π^-/e^- ratio for electrons with $p^{e^-} > p^{e^-}_{min}$ (column 4) and the detector level π^- suppression (column 5) for each e^- beam energy and scattered e^- η bin. The calculation of $p^{e^-}_{min}$ includes a $Q^2 > 1$ GeV^2 and $y < 0.95$ requirement.

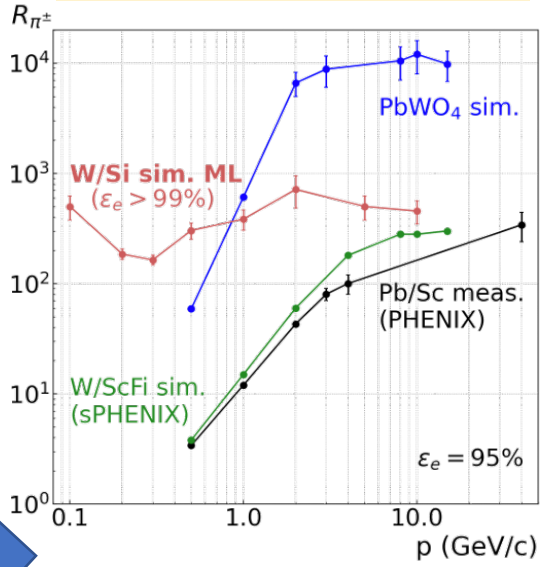
eID and hadron suppression

e+p 18x275 GeV
$|\eta|<1$

Required pion suppression:



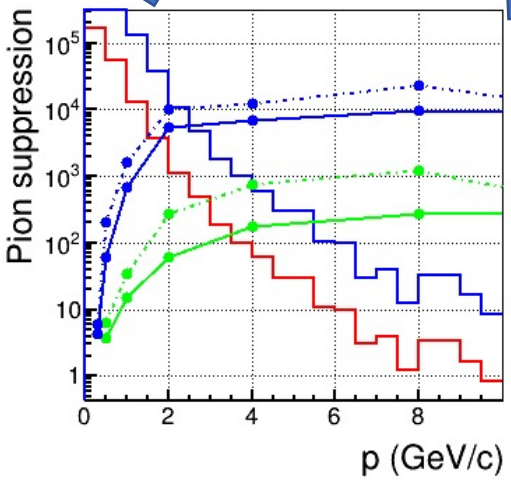
Suppression capability



Only E/p matching included

Shower profile will give additional x(2-4) suppression

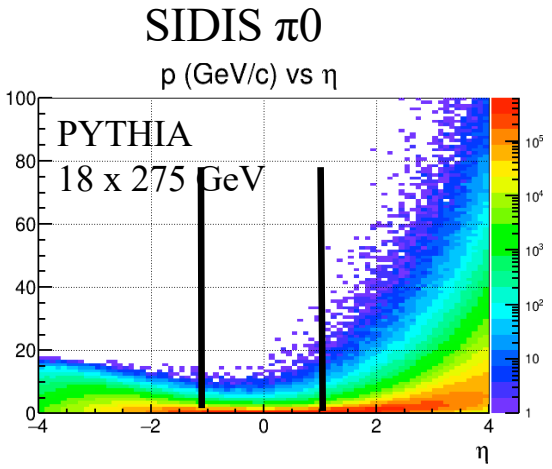
Solid: E/p
Dashed : E/p+Prof

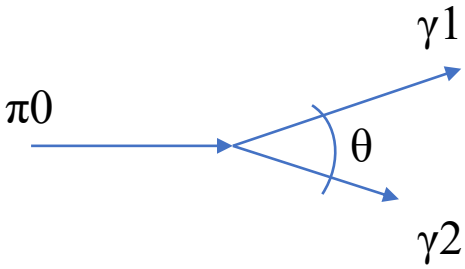


- W/SciFi satisfies requirements down to ~4 GeV/c
- PWO satisfies requirements down to 2 (3) GeV/c in optimistic (realistic) scenario
- No any EMCal (alone) can satisfy requirements <2 GeV/c

π0/γ Discrimination

Capability to separate two nearby photons





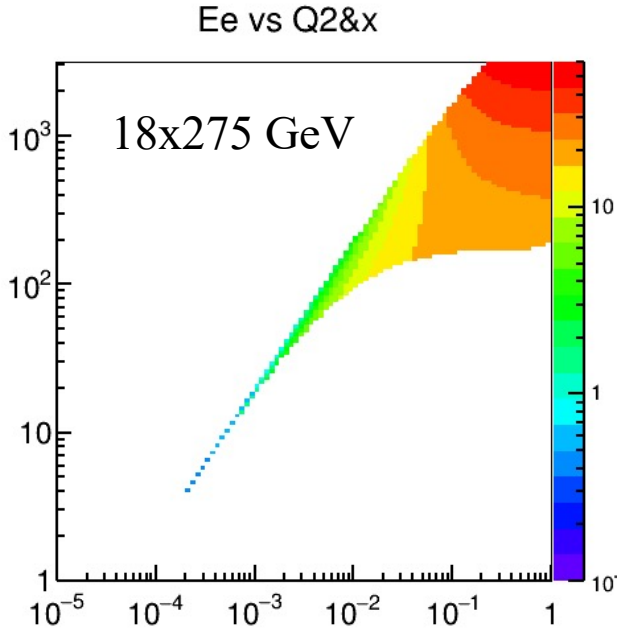
$$\theta = \frac{2m_{\pi 0}}{E_{\pi 0}\sqrt{1-\alpha^2}} \qquad \alpha = \frac{E_{\gamma 1} - E_{\gamma 2}}{E_{\gamma 1} + E_{\gamma 2}}$$

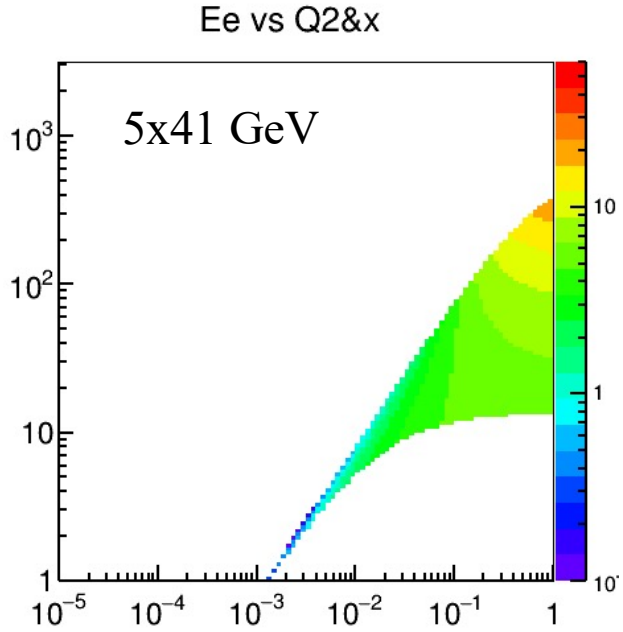
$$\theta_{min} = \frac{2m_{\pi 0}}{E_{\pi 0}}$$

$E_{\pi 0} \sim 15$ GeV => $\Theta_{min} \sim 0.02$ (2 cm at 1m)

Backup

DIS electron energy vs (Q2,x)



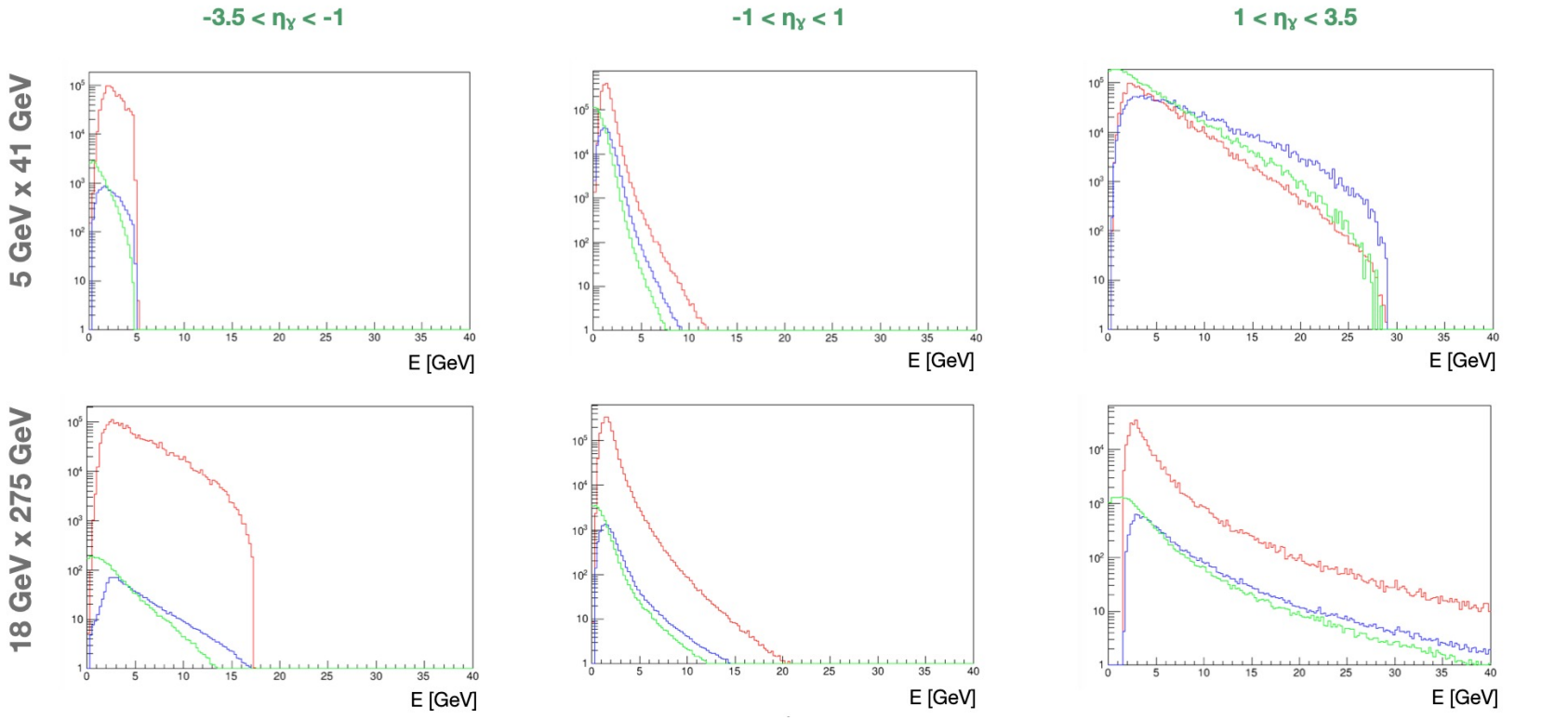


Exclusive

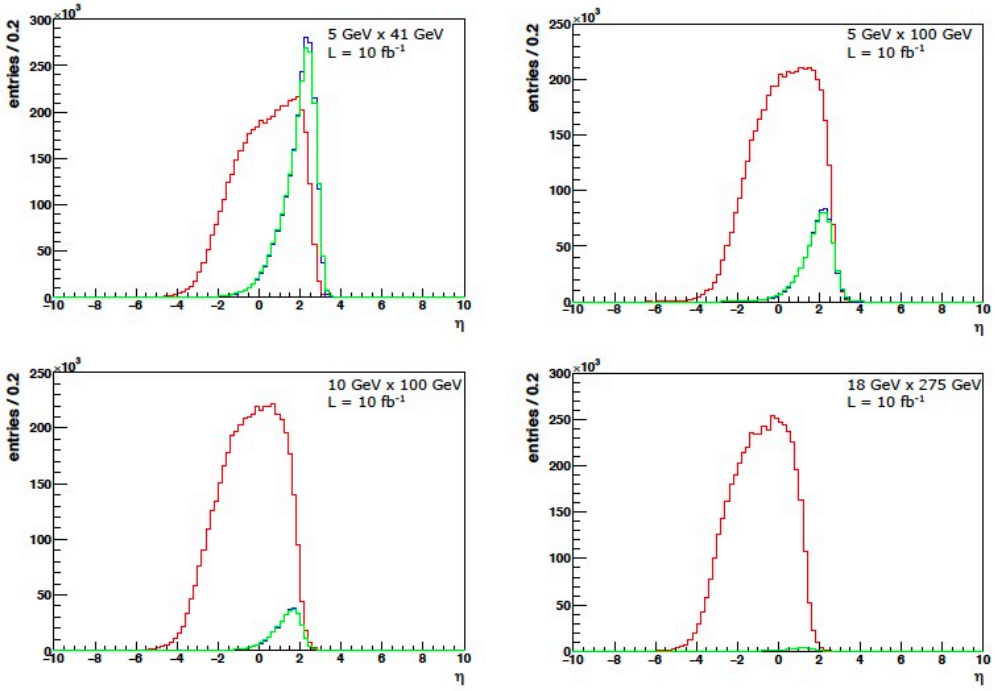
distributions of energy for two beam energies and various ranges of eta

$Q^2 > 1$ GeV^2
$0.01 < y < 0.95$
$|\eta_{e^-}| < 3.5$
$L = 10$ fb^{-1}

- DVCS: γ
- DVMP π^0: π^0
- DVMP π^0: $\pi^0 \to \gamma\gamma$



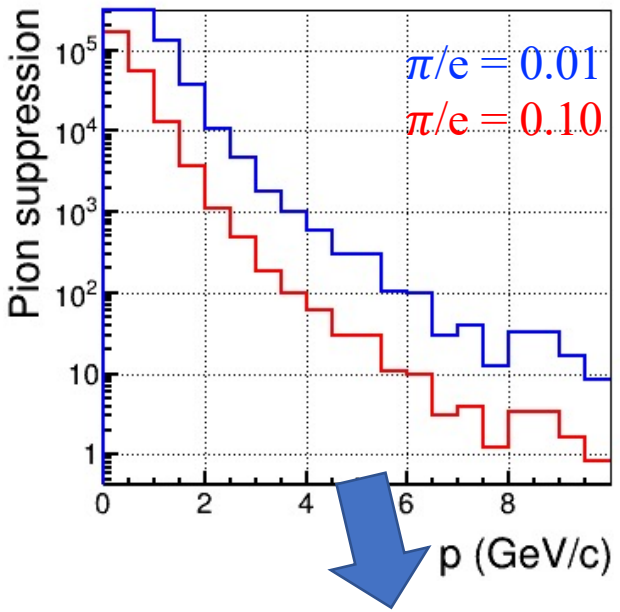
Exclusive


5 GeV x 41 GeV
L = 10 fb-1
5 GeV x 100 GeV
L = 10 fb-1
10 GeV x 100 GeV
L = 10 fb-1
18 GeV x 275 GeV
L = 10 fb-1
entries / 0.2
η

eID and hadron suppression

e+p 10x100 GeV
$|\eta|<1$

Required pion suppression:



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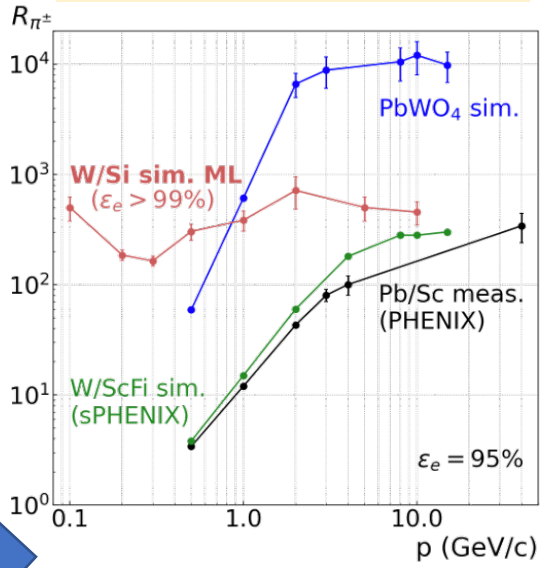

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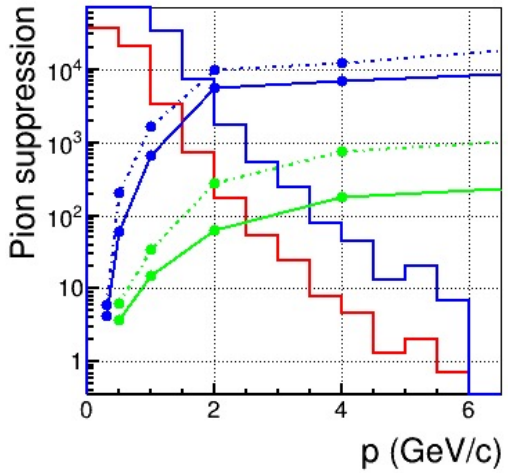

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- PWO satisfies requirements down to 2 (2.5) GeV/c in optimistic (realistic) scenario
- No any EMCal (alone) can satisfy requirements <1.5 GeV/c