PID after TOF, HTTC & RICH

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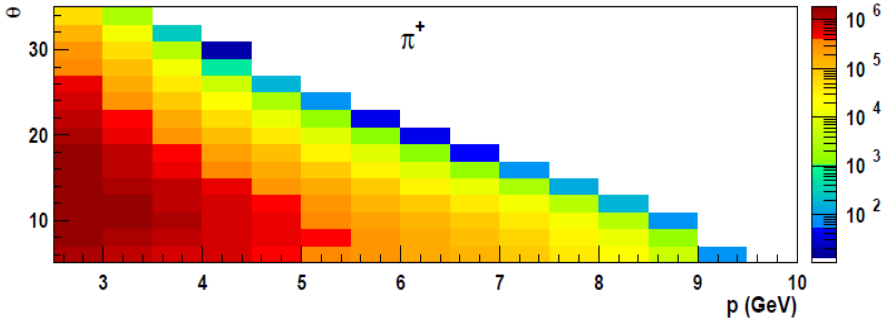
The procedure (1)

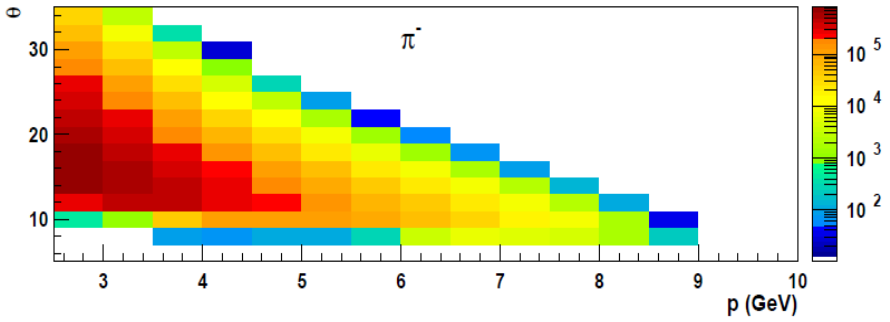
- Make use of the huge statistics of CLASDIS events generated for the proposals to PAC39

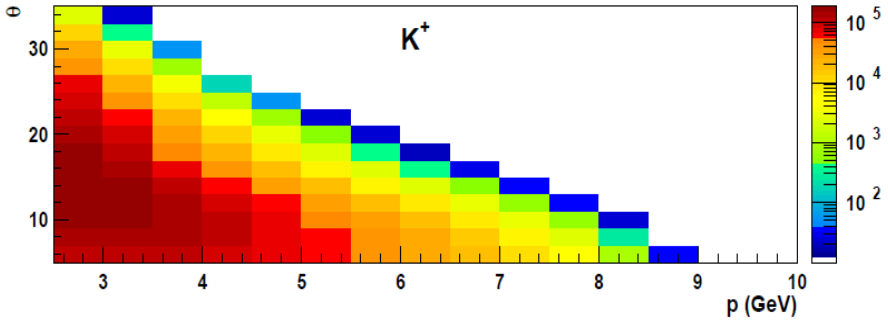
Hadron	# evts (in 4π)
π^+	$1.7 \cdot 10^9$
π^-	$1.2 \cdot 10^9$
K^+	$106 \cdot 10^6$
K^-	$52 \cdot 10^6$
p	$806 \cdot 10^6$
$\bar{p}$	$6.4 \cdot 10^6$

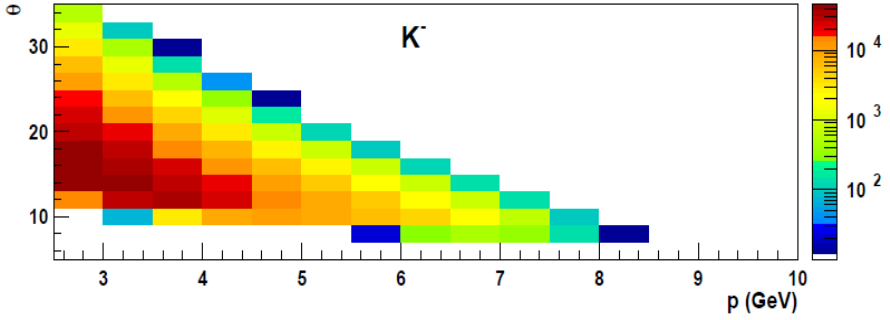
- Split events in a 2dim binning in p and ϑ
  - 15 p-bins from 2.5 to 10 GeV
  - 15 ϑ-bins from $5°$ to $35°$
- Apply DIS/SIDIS cuts:
  - $Q^2 > 1\ GeV^2$
  - $W^2 > 4\ GeV^2$
  - $0.1 < y < 0.85$
  - $z > 0.3$

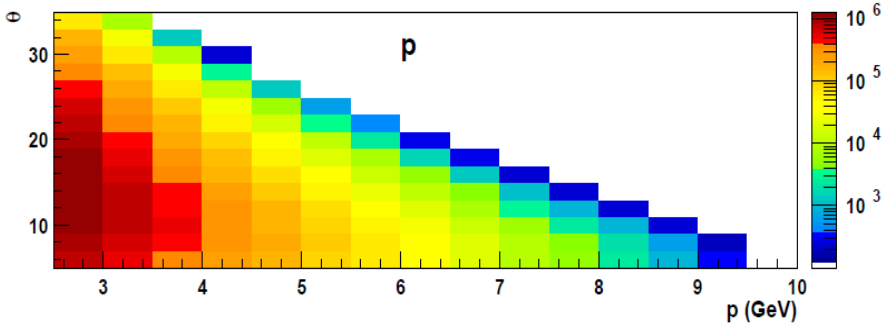
hadron yields

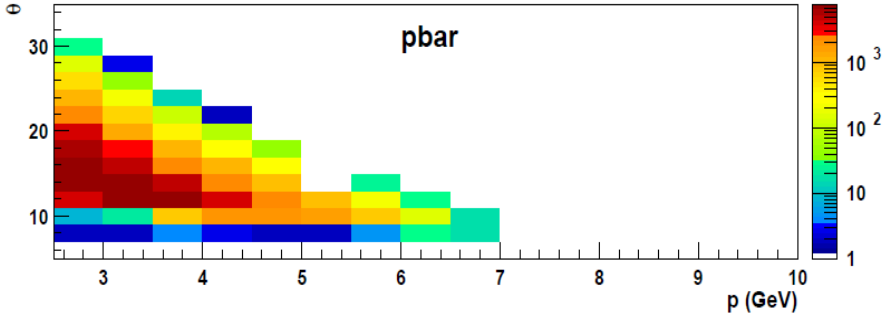












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- Run on GEMC a subsample of events for each hadron and for each 2dim bin to extract:
  - fraction of (4π generated) events that reach the forward TOF $\rightarrow$ detector acceptance
  - TOF time (ns) for each hadron type $\rightarrow \Delta T_{K-\pi}$, ΔT_{p-K} , $\Delta T_{p-\pi}$
  - TOF slab $\rightarrow$ TOF resolution: $\sigma_{TOF}(i_{slab}) = \frac{80-42}{N_{slab}}(i_{slab} - 1) + 42$

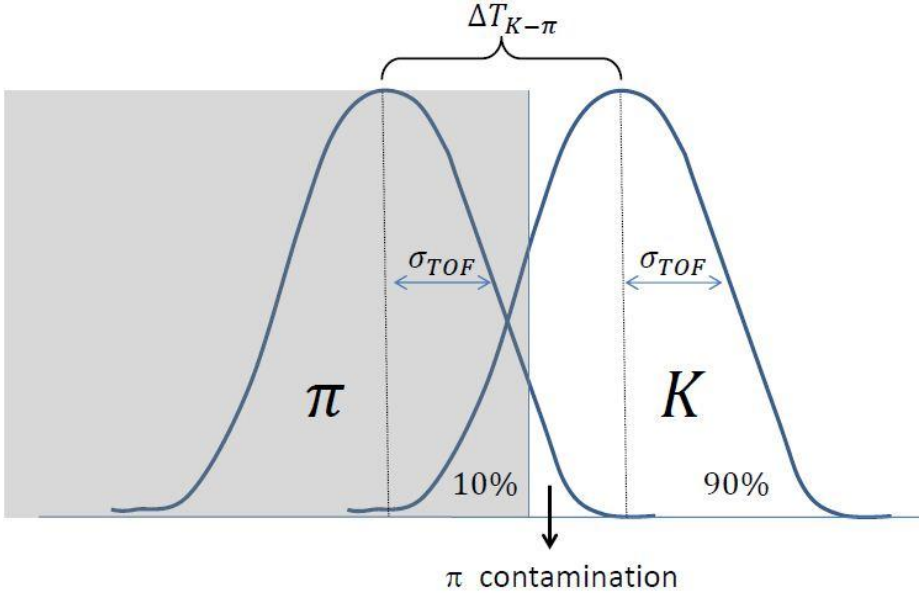
The procedure (2)

- Using ΔT_{TOF} and σ_{TOF} and assuming:

- 90% efficiency
- all hadron types in a given 2dim bin

have the same σ_{TOF} (reasonable)
calculate **contaminations** of

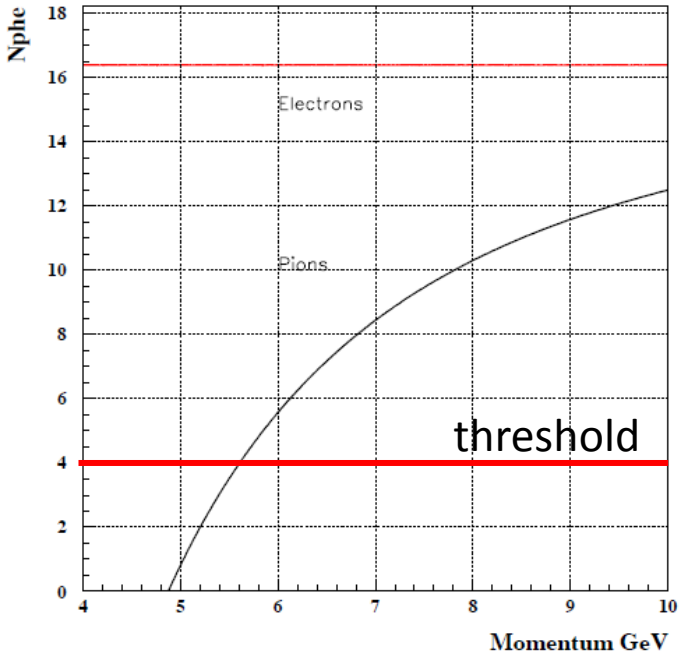
- pions into kaons
- kaons into protons
- pions into protons



- Extract $\langle N_{p.e.} \rangle$ in each mom. bin from HTTC plot and calculate contamination of pions into kaons due to failure in pion reconstruction from HTTC

$$cont_{HTTC} = \begin{cases} 100\% \quad (p_\pi < 5\ GeV) \\ \sum_{i=0,3} P_\mu(\nu) = \sum_{N_{p.e.}=0,3} P_{\langle N_{p.e.} \rangle}(N_{p.e.}) \end{cases}$$

Poisson distribution $$P_\mu(\nu) = e^{-\mu}\frac{\mu^\nu}{\nu!} = e^{-\langle N_{p.e.} \rangle}\frac{\langle N_{p.e.} \rangle^{N_{p.e.}}}{N_{p.e.}!}$$



The procedure (3) (NEW)

- From Marco's Likelihood routine + GEMC extract:
  - RICHC pion and proton contaminations into kaons
  - RICH efficiency for kaons (required to be > 30%)

- Construct three ratios:

$$r_1 = \frac{\pi_{yields}}{K_{yields}}$$

$$r_2 = \frac{\pi_{yields} \cdot [\pi_{contam(TOF)} \cdot \pi_{contam(HTTC)}]}{K_{yields} \cdot K_{eff}(90\%)} = r_1 \frac{[\pi_{contam(TOF)} \cdot \pi_{contam(HTTC)}]}{K_{eff}(90\%)}$$

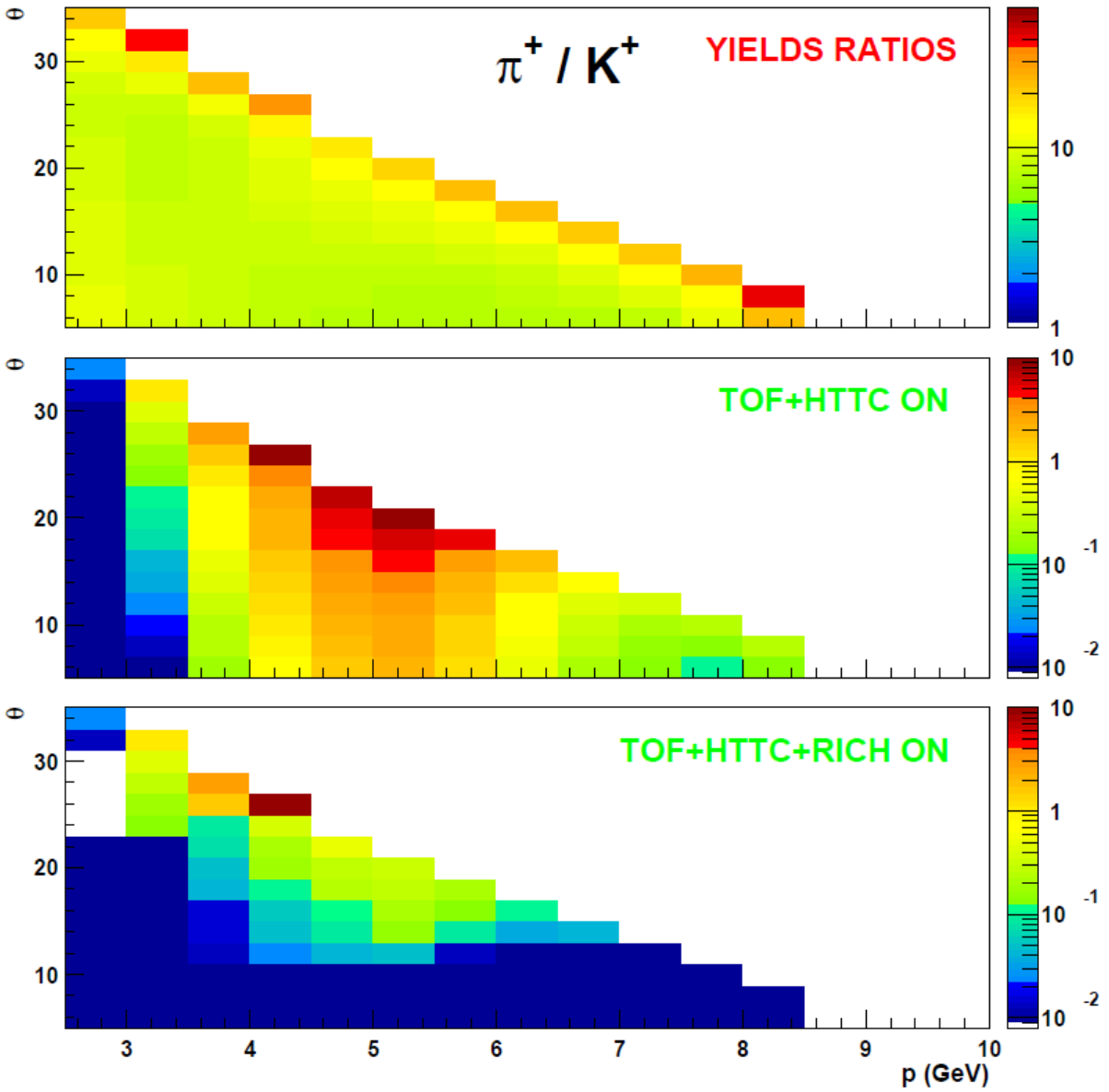
$$r_3 = \frac{\pi_{yields} \cdot [\pi_{contam(TOF)} \cdot \pi_{contam(HTTC)} \cdot \pi_{contam(RICH)}]}{K_{yields} \cdot K_{eff}(90\%) \cdot K_{efficiency(RICH)}} = r_2 \cdot \frac{\pi_{contam(RICH)}}{K_{efficiency(RICH)}}$$

Results (2): π^+/K^+ PID

r_1

r_2

r_3

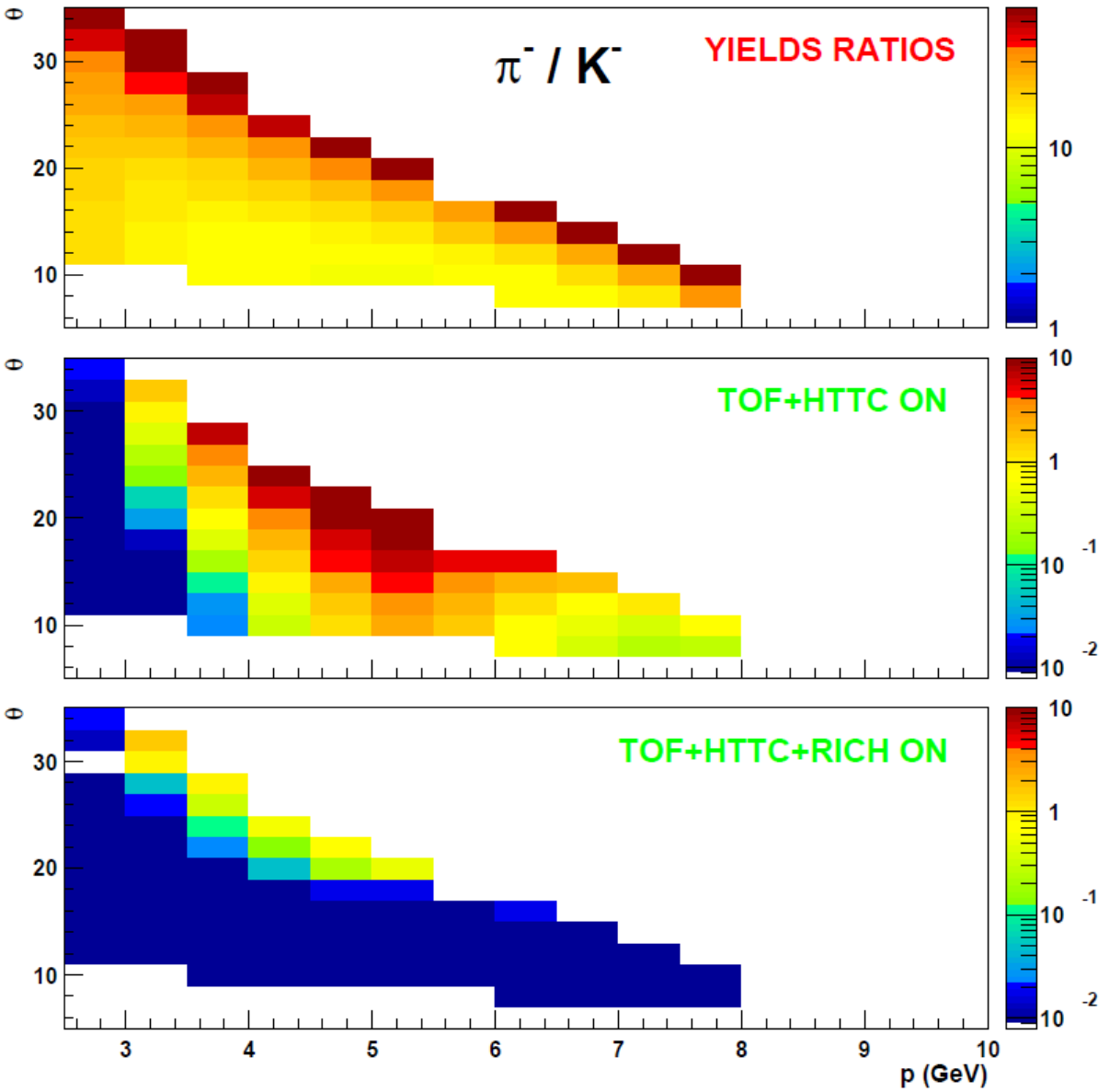


Results (2): π^-/K^- PID

r_1

r_2

r_3



Results (2): π^-/K^- PID

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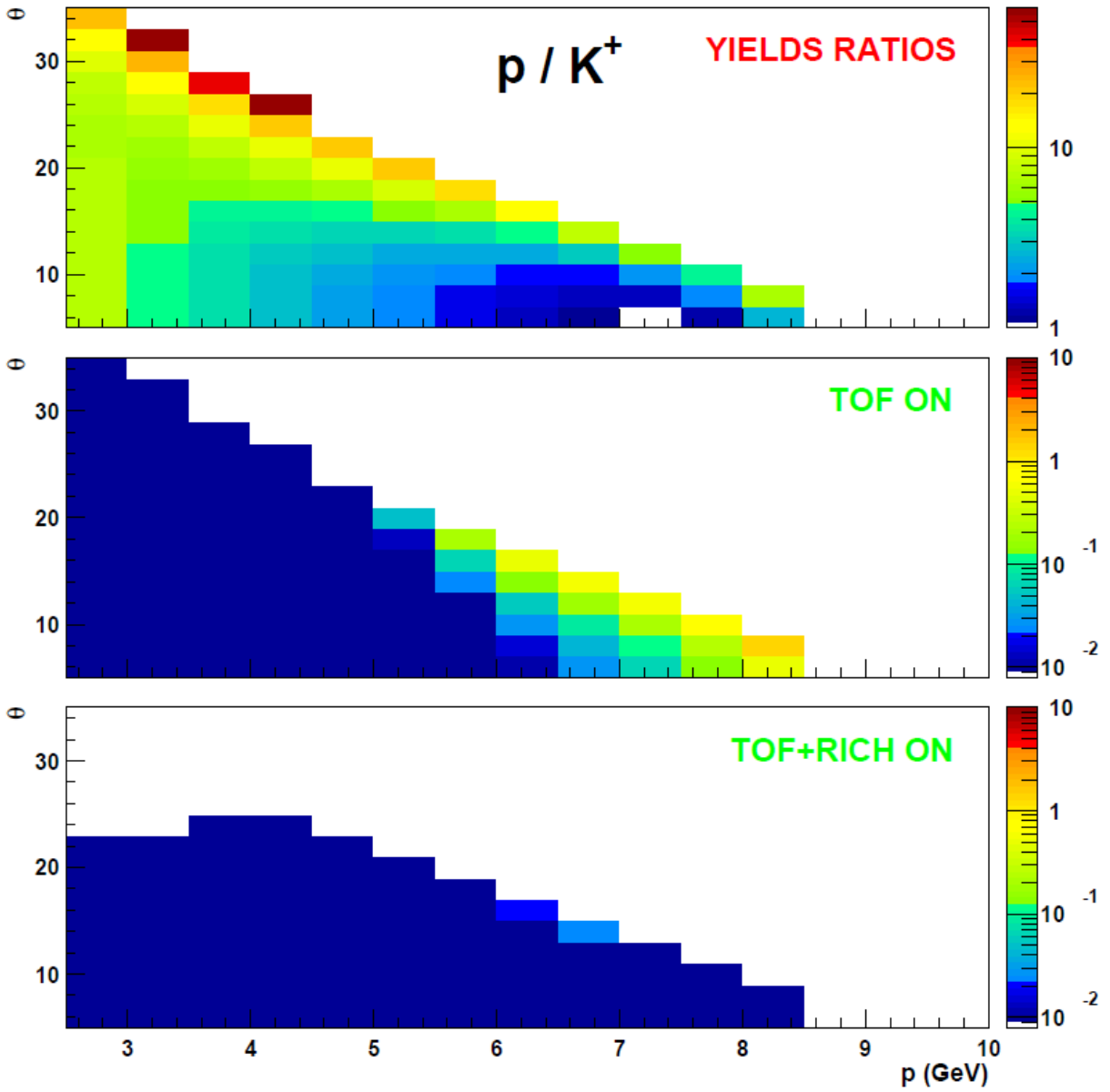
r_2

r_3

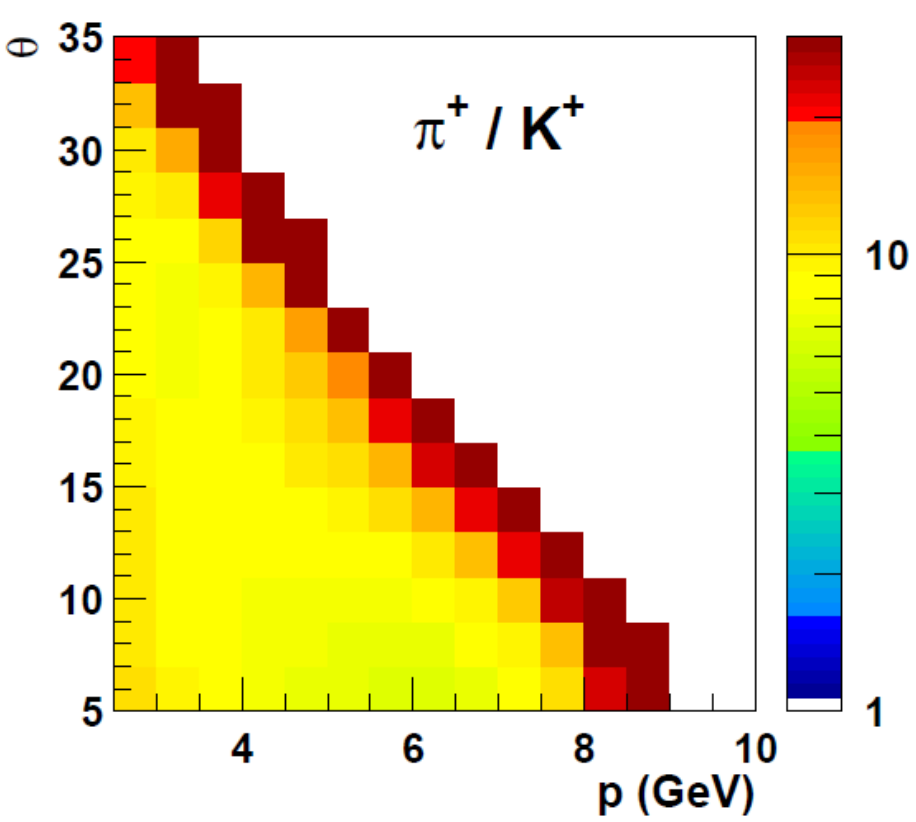


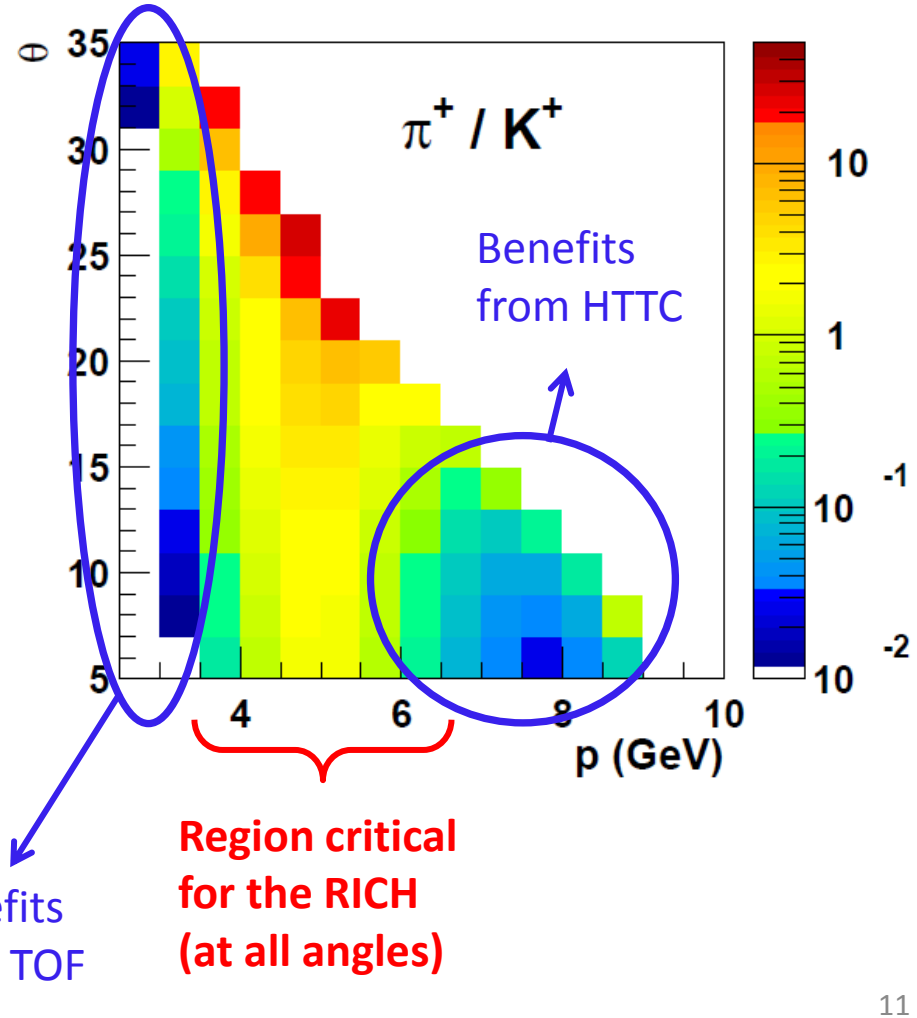
Backup

Results

$$r = \frac{pion\_yields}{kaon\_yields}$$

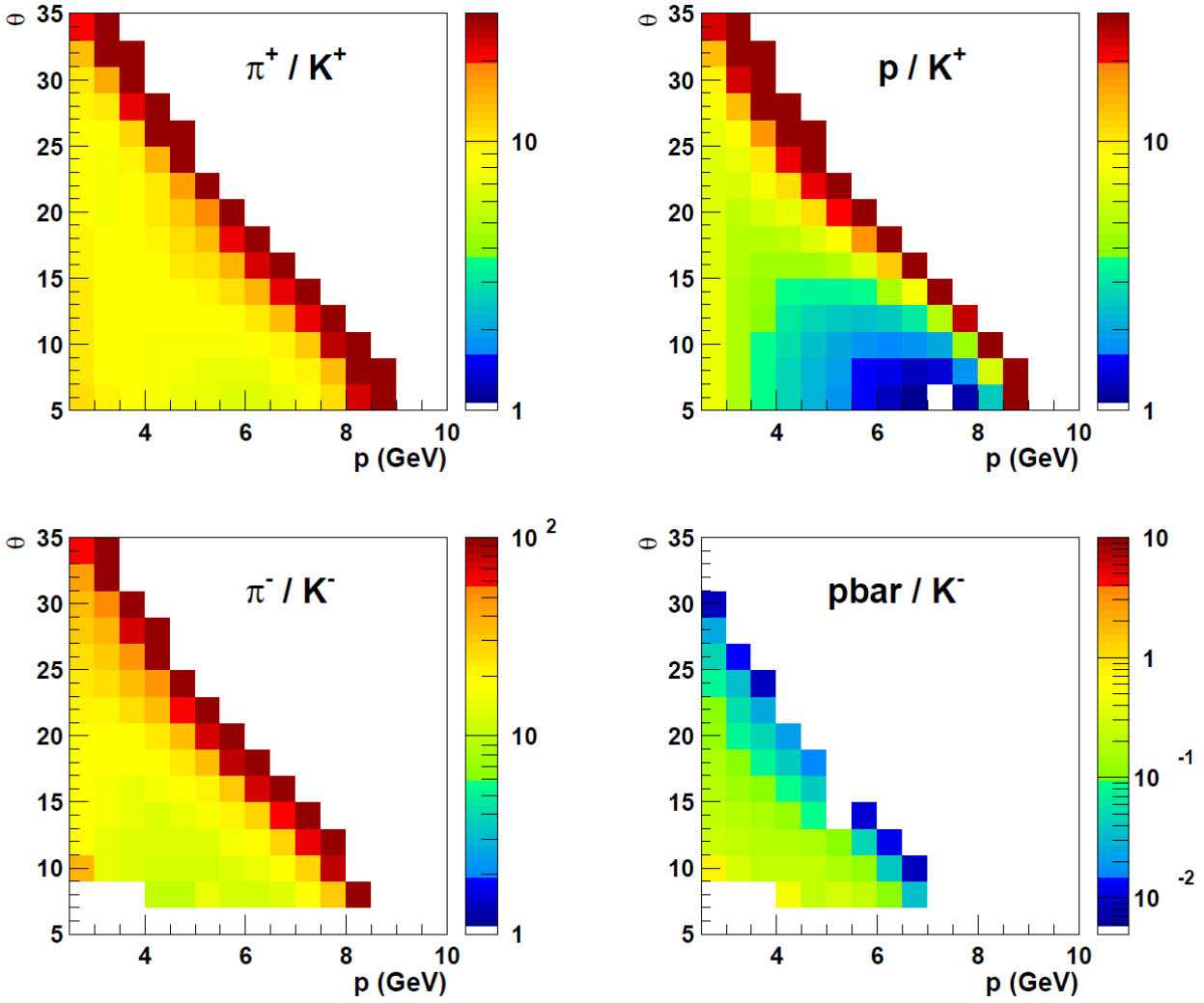
$$r = \frac{pion\_contam(TOF) \cdot pion\_contam(HTTC)}{kaon\_yields \cdot 90\%\ efficiency}$$





Results: full picture (1)

$$r = \frac{pion\_yields}{kaon\_yields}$$



Results: full picture (2)

$$r = \frac{pion\_contam(TOF) \cdot pion\_contam(HTTC)}{kaon_{yields} \cdot 90\%\, efficiency}$$