Benefits from TOF and HTTC

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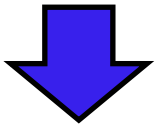
The goal

Estimate the impact of TOF and HTTC PID on RICH working range (based on last Valery's presentation)



localize the regions where the RICH has to perform at best and the regions where the RICH performances can be relaxed (in a 2dim binning in p and ϑ)

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Procedure (1)

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

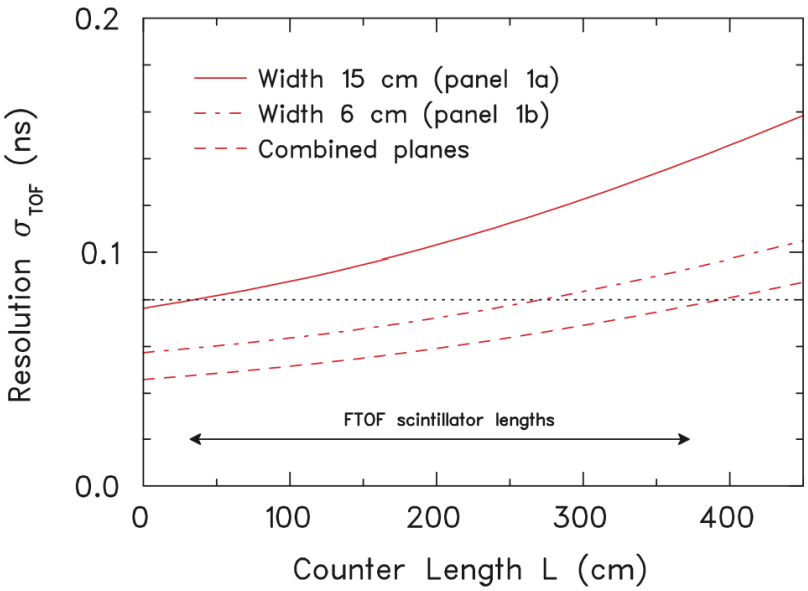
Hadron	# evts (in 4π)
π^+	$1.7 \cdot 10^9$
π^-	$1.2 \cdot 10^9$
K^+	$106 \cdot 10^6$
K^-	$52 \cdot 10^6$
p	$806 \cdot 10^6$
$\bar{p}$	$6.4 \cdot 10^6$

- 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:
  - $Q^2 > 1\ GeV^2$
  - $W^2 > 4\ GeV^2$
  - $0.1 < y < 0.85$
  - $z > 0.3$

The procedure (2)

- 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
  - # of TOF slab
  - TOF time (ns) for each hadron type $\rightarrow \Delta T_{K-\pi}$, ΔT_{p-K} , $\Delta T_{p-\pi}$

- Exctract TOF resolution in each 2dim bin using
  - # of TOF slab hit
  - plot from Valery's presentation

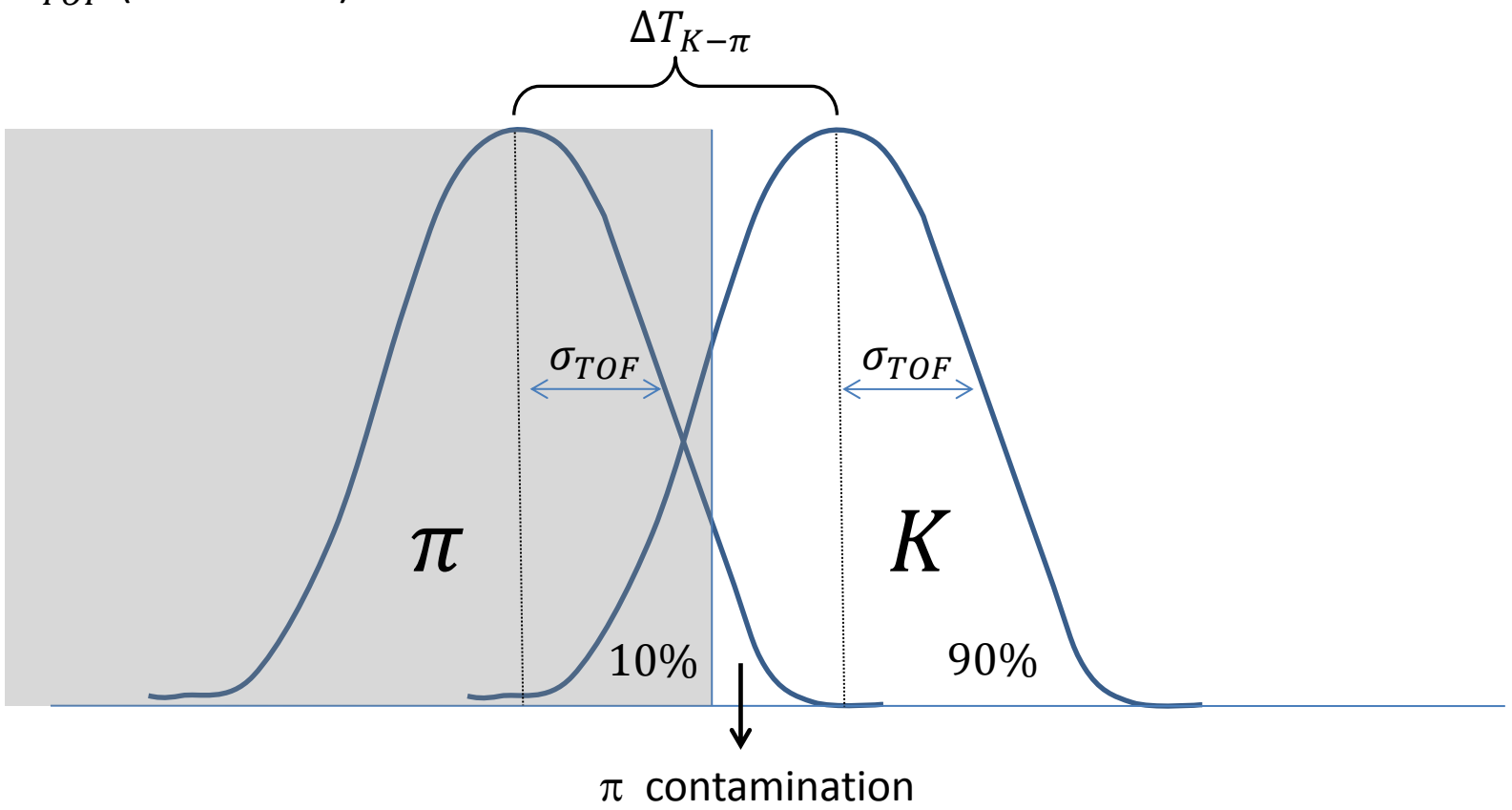


$$\sigma_{TOF}(i_{slab}) = \frac{80-42}{N_{slab}}(i_{slab}-1)+42 \qquad (ps)$$

The procedure (3)

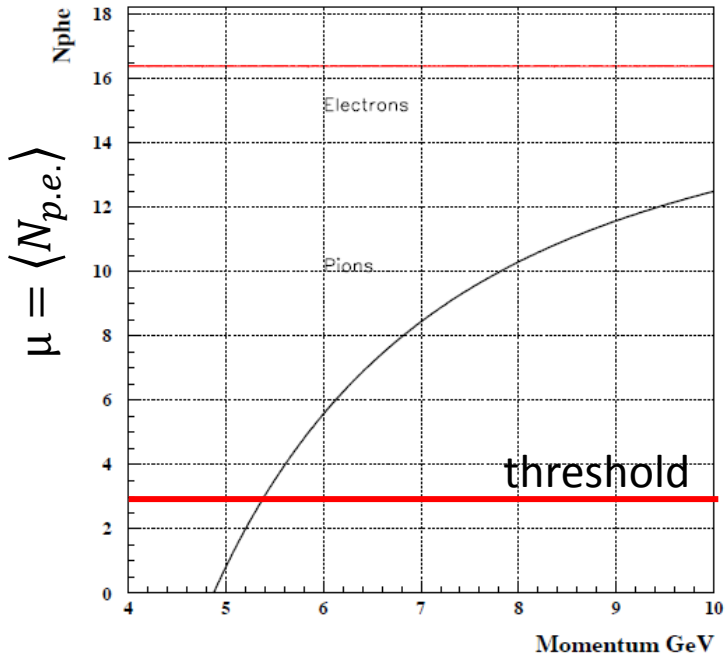
- Using ΔT_{TOF} and σ_{TOF} calculate contaminations of
  - pions into kaons
  - kaons into protons
  - pions into protons

using efficiency of 90% and assuming that all hadron types in a given 2dim bin have the same σ_{TOF} (reasonable)



The procedure (4)

- Extract $\langle N_{p.e.} \rangle$ in each momentum bin from plot presented by Valery (HTTC)



- Calculate contamination of into kaons due to failure in pion reconstruction from HTTC using Poisson distribution:

$$cont_{HTTC} = \begin{cases} 100\% \quad (p_\pi < 5\ GeV) \\ \sum_{i=0,2} P_\mu(\nu) = \sum_{N_{p.e.}=0,2} P_{\langle N_{p.e.} \rangle}(N_{p.e.}) \end{cases}$$

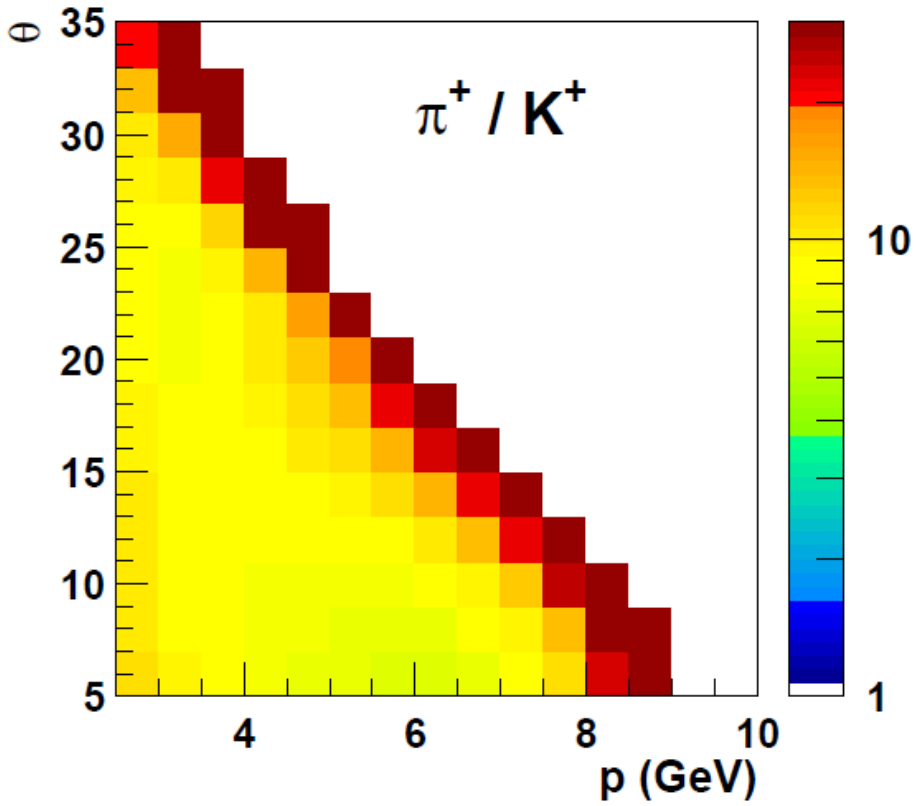
$$P_\mu(\nu) = e^{-\mu} \frac{\mu^\nu}{\nu!} = e^{-\langle N_{p.e.} \rangle} \frac{\langle N_{p.e.} \rangle^{N_{p.e.}}}{N_{p.e.}!}$$

- Evaluate π/K and p/K flux ratios in 2dim bins taking into account fiducial volume and DIS/SIDIS cuts

- Evaluate global contaminations in each 2dim bin
  - of pions on kaons (using joint info from TOF and HTTC)
  - of protons on kaons (using info from TOF)

Results

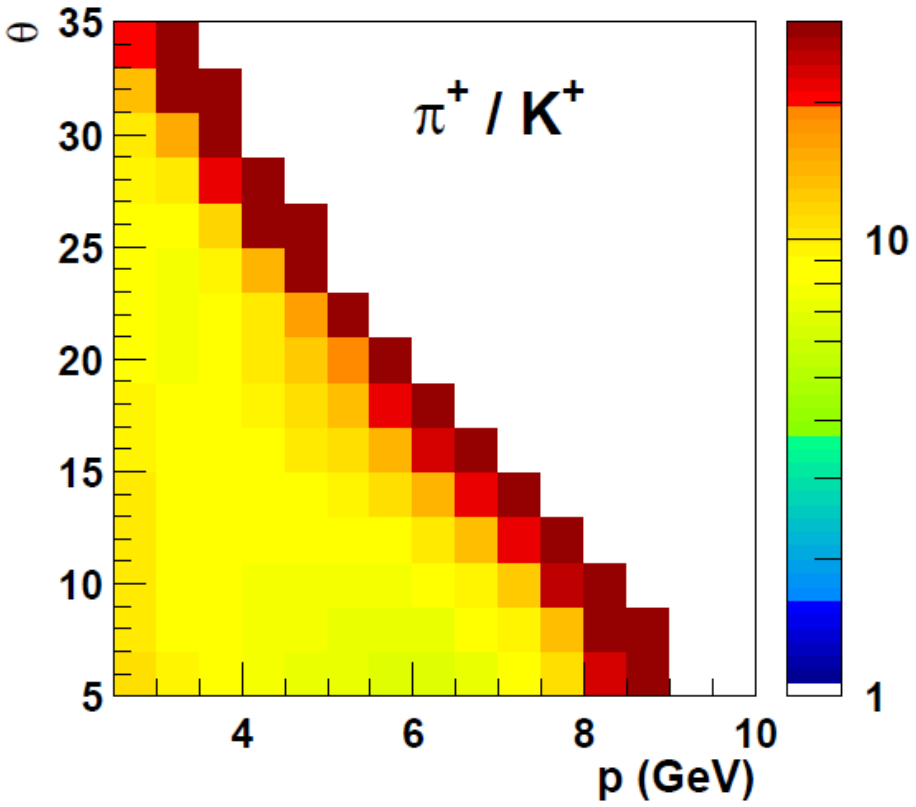
$$r = \frac{pion\_yields}{kaon\_yields}$$

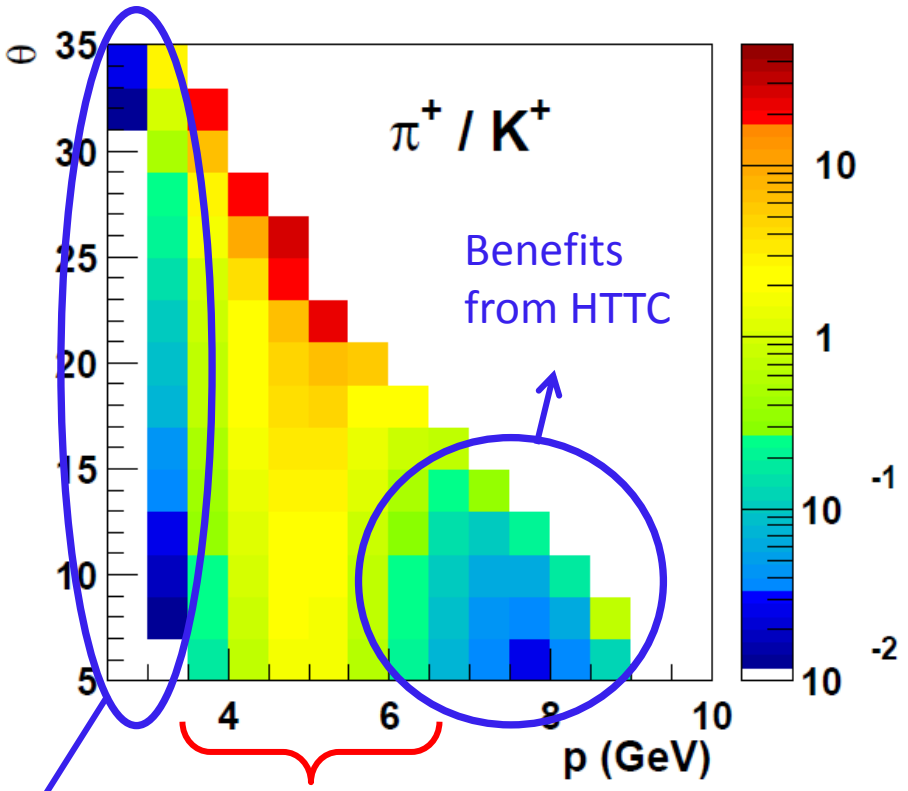


Results

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

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



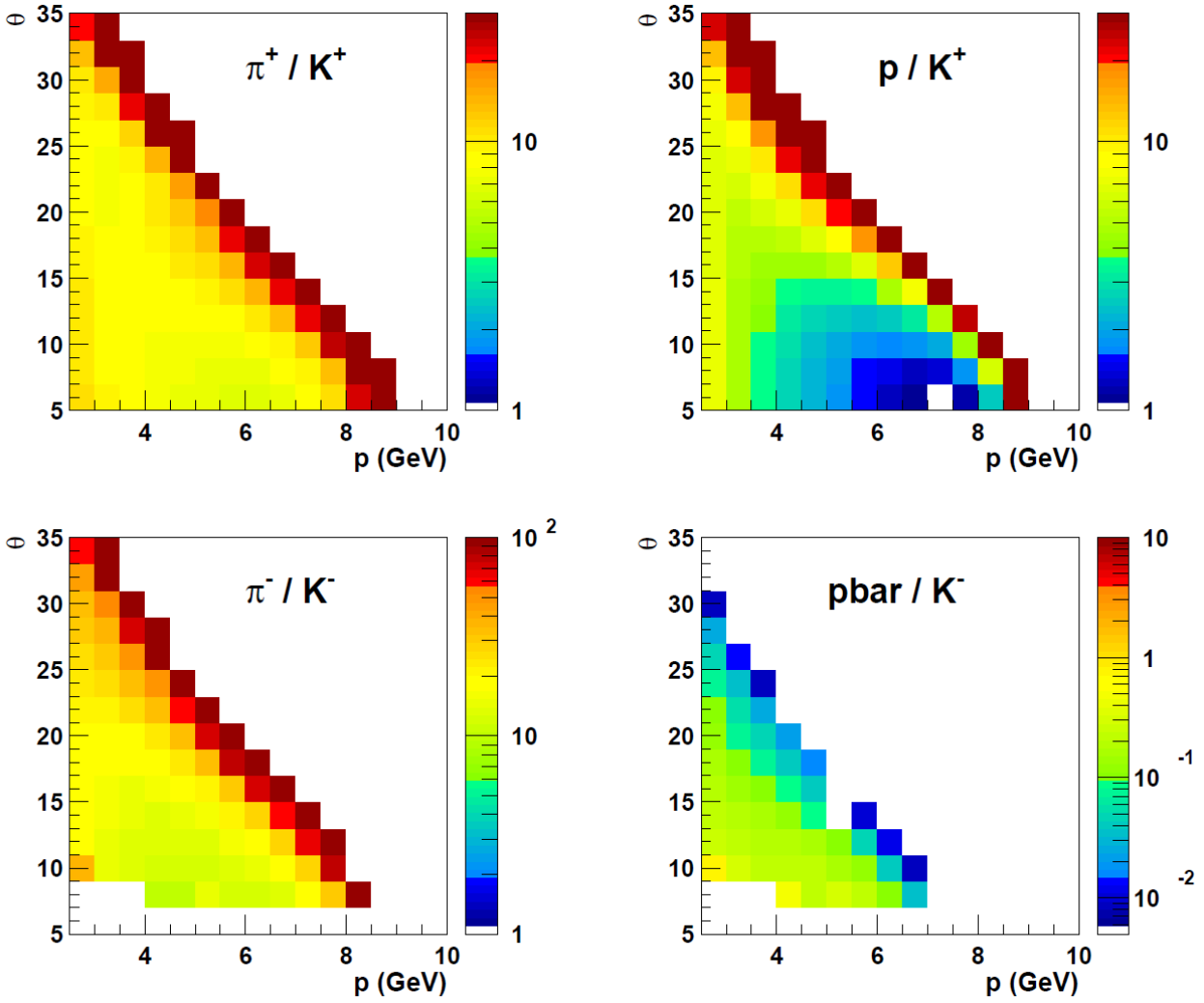


Benefits from TOF

Region critical for the RICH (at all angles)

Results: full picture (1)

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



Results: full picture (2)

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