Study of interplay of PANDA TOF detectors

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Motivation

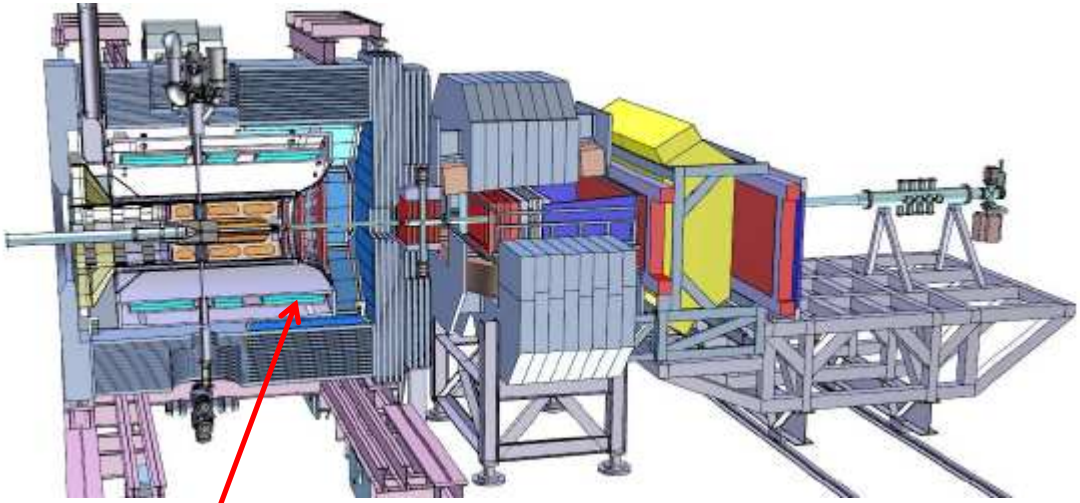
Continuation of Monte Carlo simulation within PANDAroot framework to estimate inclusive and coincidence rates for projected PANDA time-of-line detectors:

Forward TOF walls. Barrel TOF and Dipole TOF (for the first time)

Simulation with PANDAroot

- *Generation: DPM generator, 80K events , p_{beam} = 10 GeV*
- *Simulation with solenoid and dipole magnet field*
- *Registration by Barrel TOF Dipole TOF and Forward TOF detectors*
- *Digitization was done in a simple way: “hit” means particle touch the detector surface*
- *All charged hadrons (p,p-bar, K^+,K^-,π^+, π^-, Λ-bar) were analyzed*

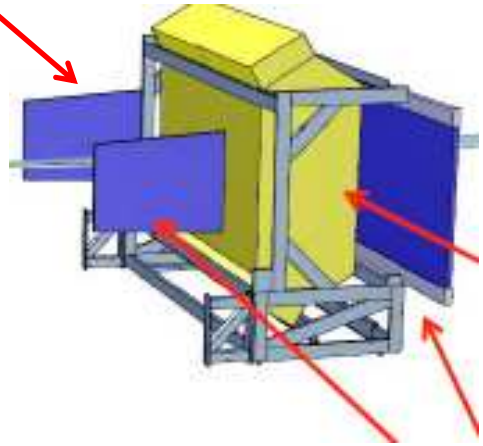
Time-of-Flight PANDA detectors



Barrel TOF
SciTil

FS TOF

Left Side
DipoleTOF

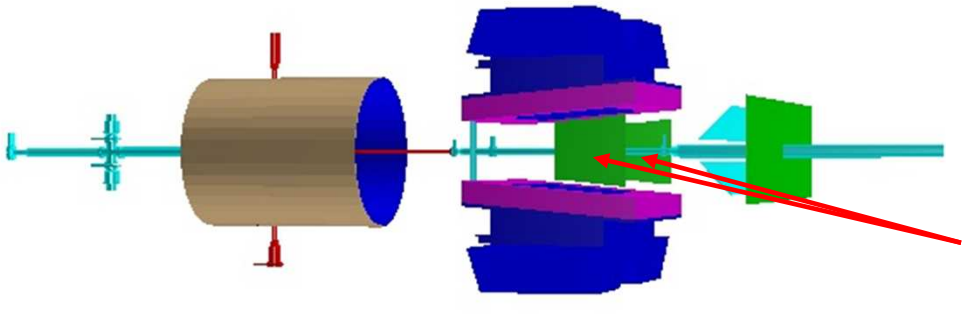


RICH

Right Side
Dipole TOF

FTOF
wall

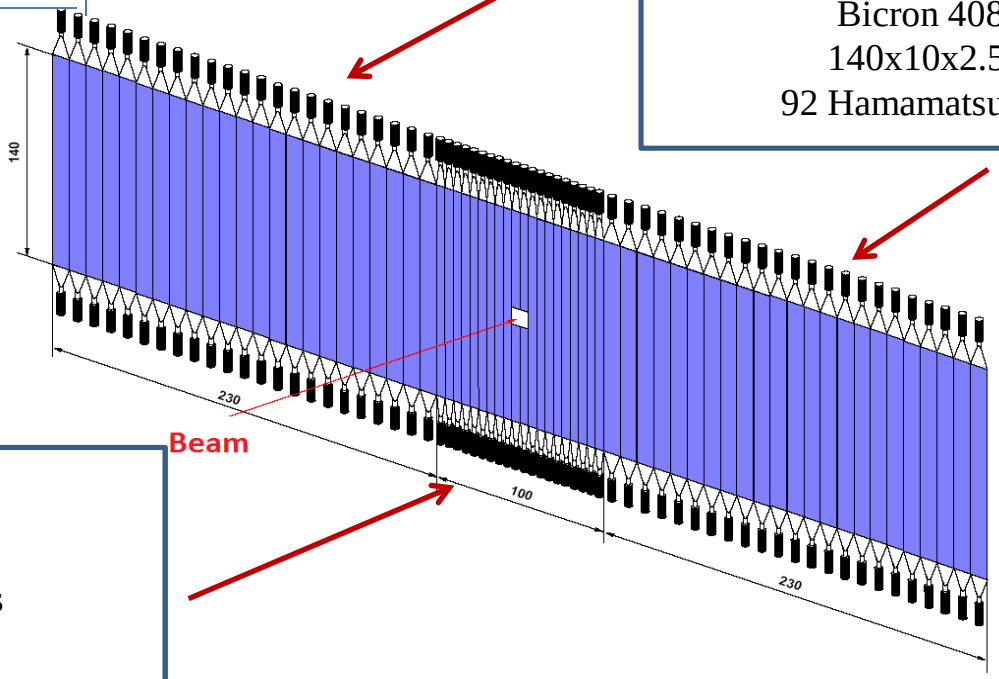
Dipole TOF walls in PANDAroot



10 bars each side
Thickness: 2.5 cm
Width: 10 cm
Height: 80-98 cm

FTOF wall

positioned at 7.5 m
from the IP



Side parts
2x23 counters
46 plastic scintillators
Bicron 408
140x10x2.5 cm
92 Hamamatsu R2083 (2")

Central part
20 counters
20 plastic scintillators
Bicron 408
140x5x2.5 cm
40 Hamamatsu R4998 (1")

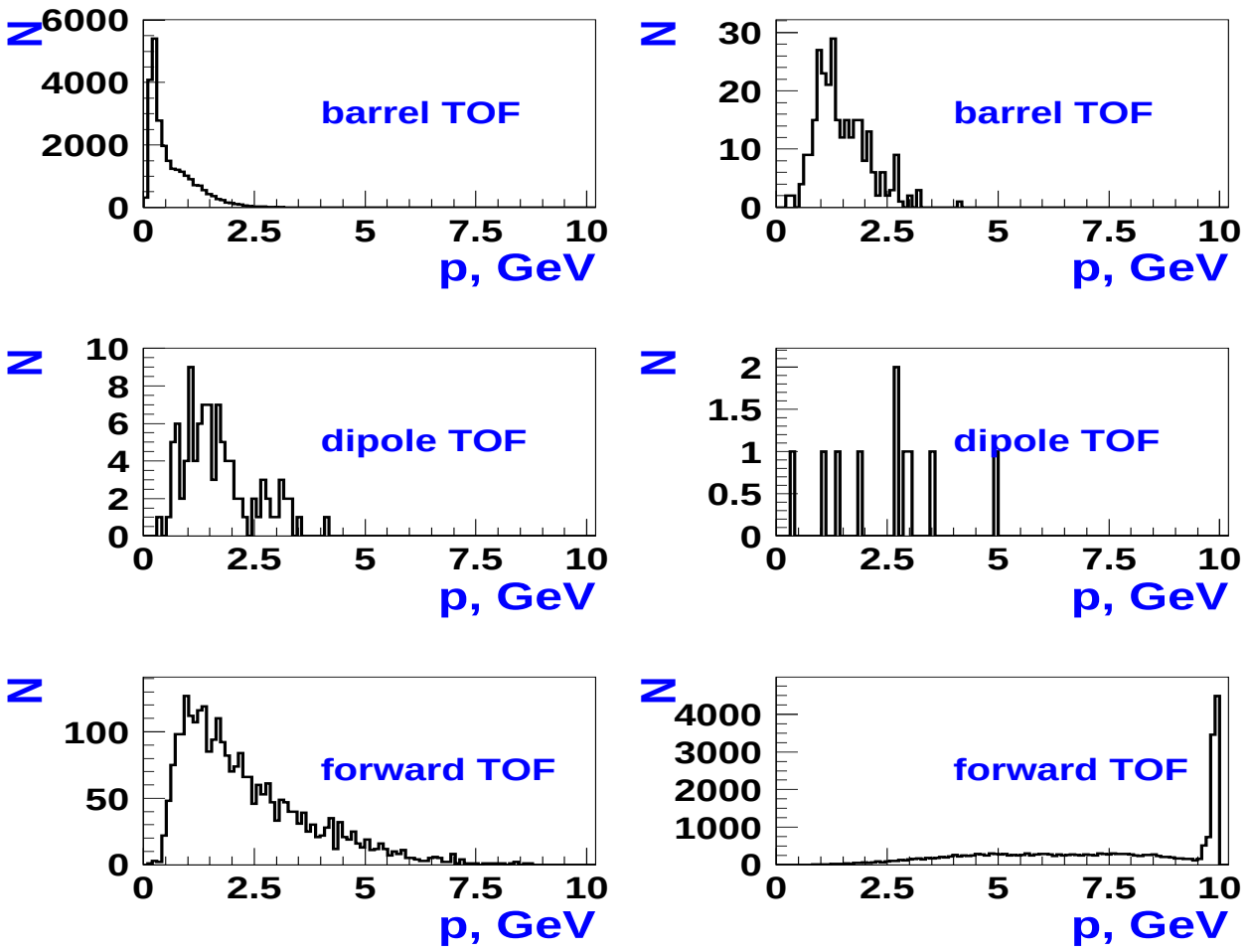
Detection efficiency and count rates of charged hadrons

Count rates scaled to 10^7 interactions in target

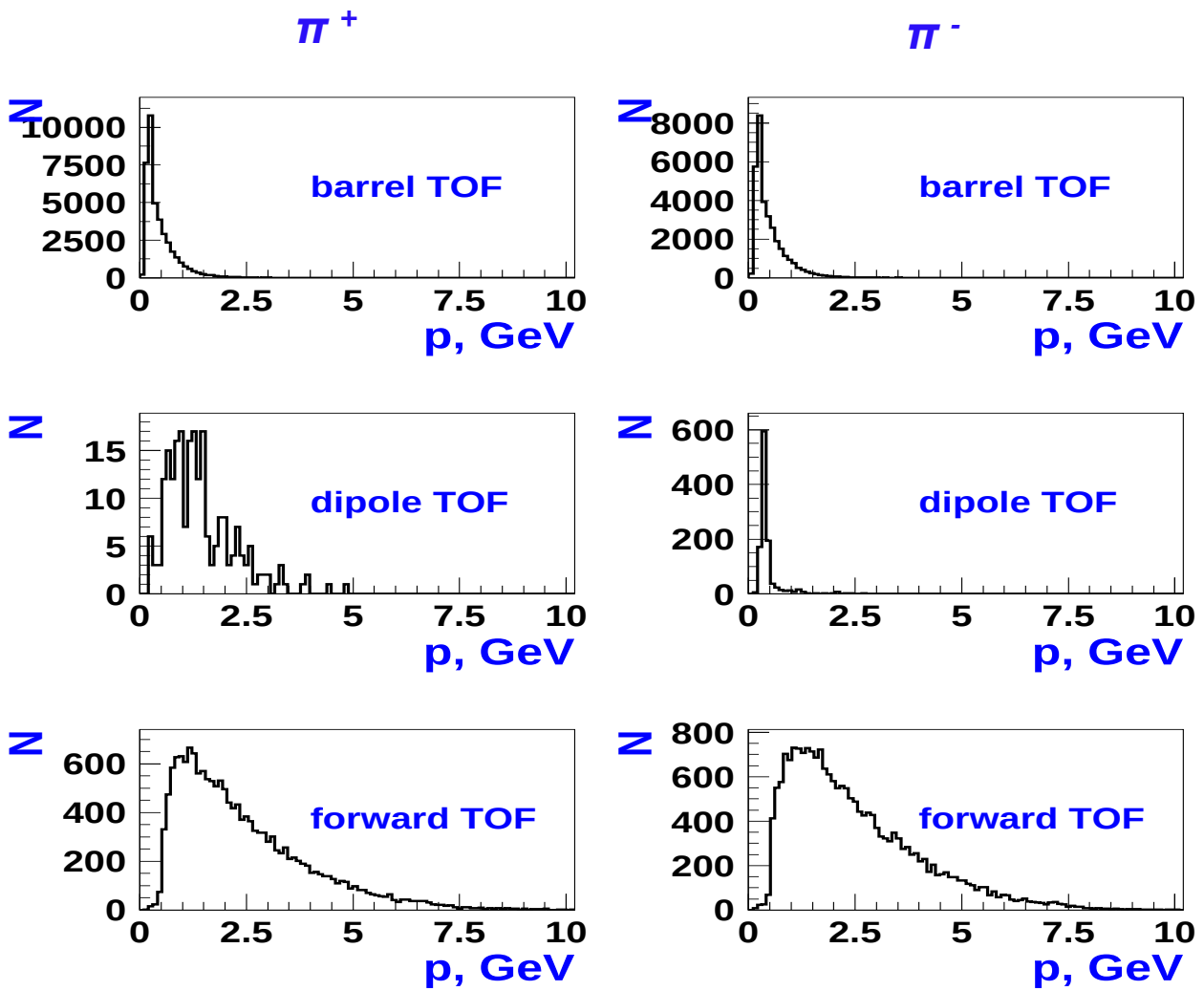
	Generated by DPM (80K events)	Detected by BTOF (eff / N per sec)	Detected by DTOF (eff / N per sec)	Detected by FTOF (eff / N per sec)
π^-	90693	$0.36 / 4.08 \cdot 10^6$	$0.01 / 0.14 \cdot 10^6$	$0.23 / 2.59 \cdot 10^6$
π^+	90725	$0.44 / 5.03 \cdot 10^6$	$0.002 / 0.03 \cdot 10^6$	$0.18 / 2.07 \cdot 10^6$
K^-	3022	$0.09 / 0.03 \cdot 10^6$	$0.001 / 0.0004 \cdot 10^6$	$0.26 / 0.1 \cdot 10^6$
K^+	3082	$0.25 / 0.09 \cdot 10^6$	$0.003 / 0.001 \cdot 10^6$	$0.12 / 0.046 \cdot 10^6$
p-bar	42095	$0.007/ 0.04 \cdot 10^6$	$0.0002 / 0.001 \cdot 10^6$	$0.62 / 3.24 \cdot 10^6$
p	42003	$0.61 / 3.19 \cdot 10^6$	$0.002 / 0.012 \cdot 10^6$	$0.07 / 0.35 \cdot 10^6$

Momentum distributions of p and p-bar registered inclusively by BTOF, DTOF, FTOF

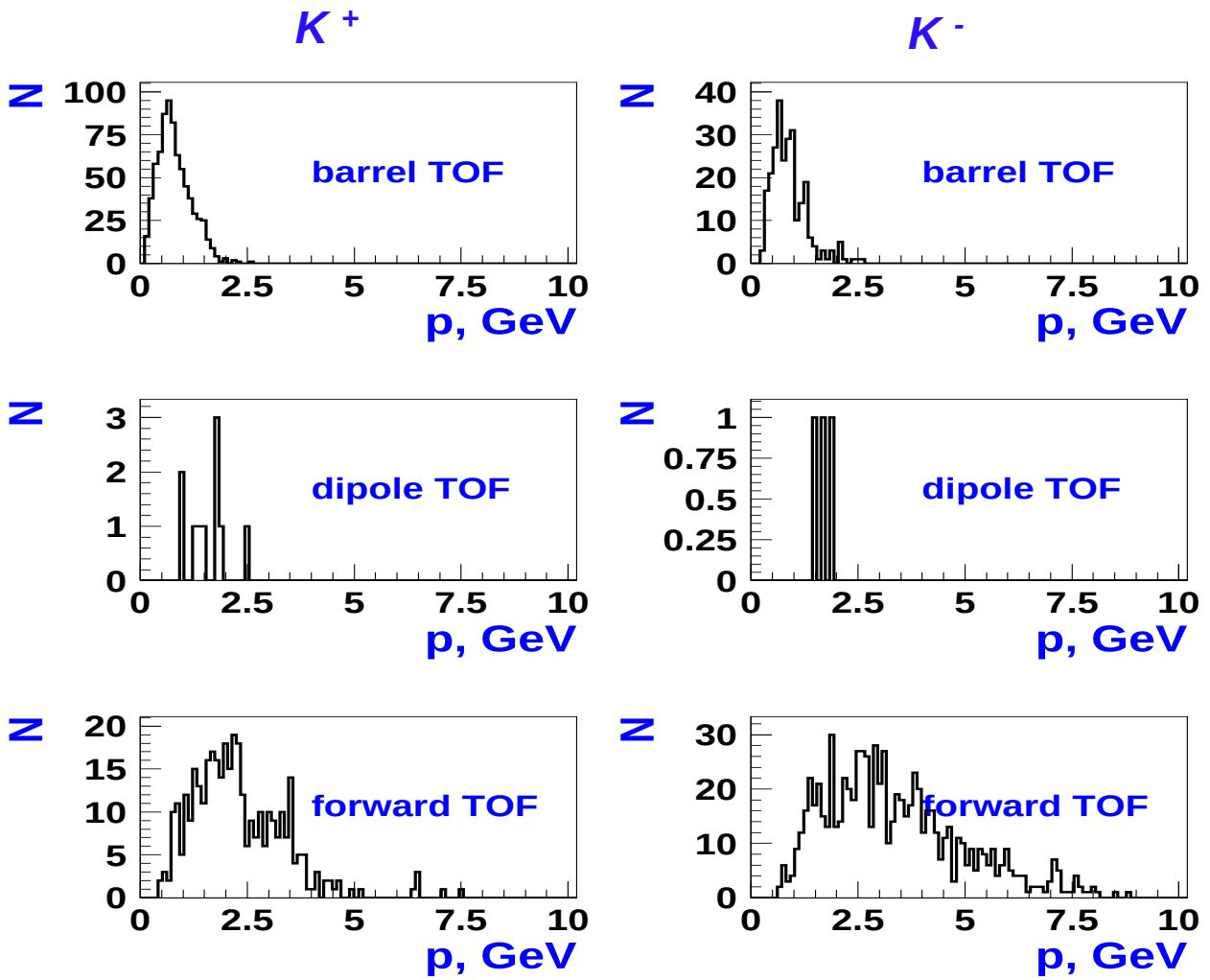
proton *anti-proton*



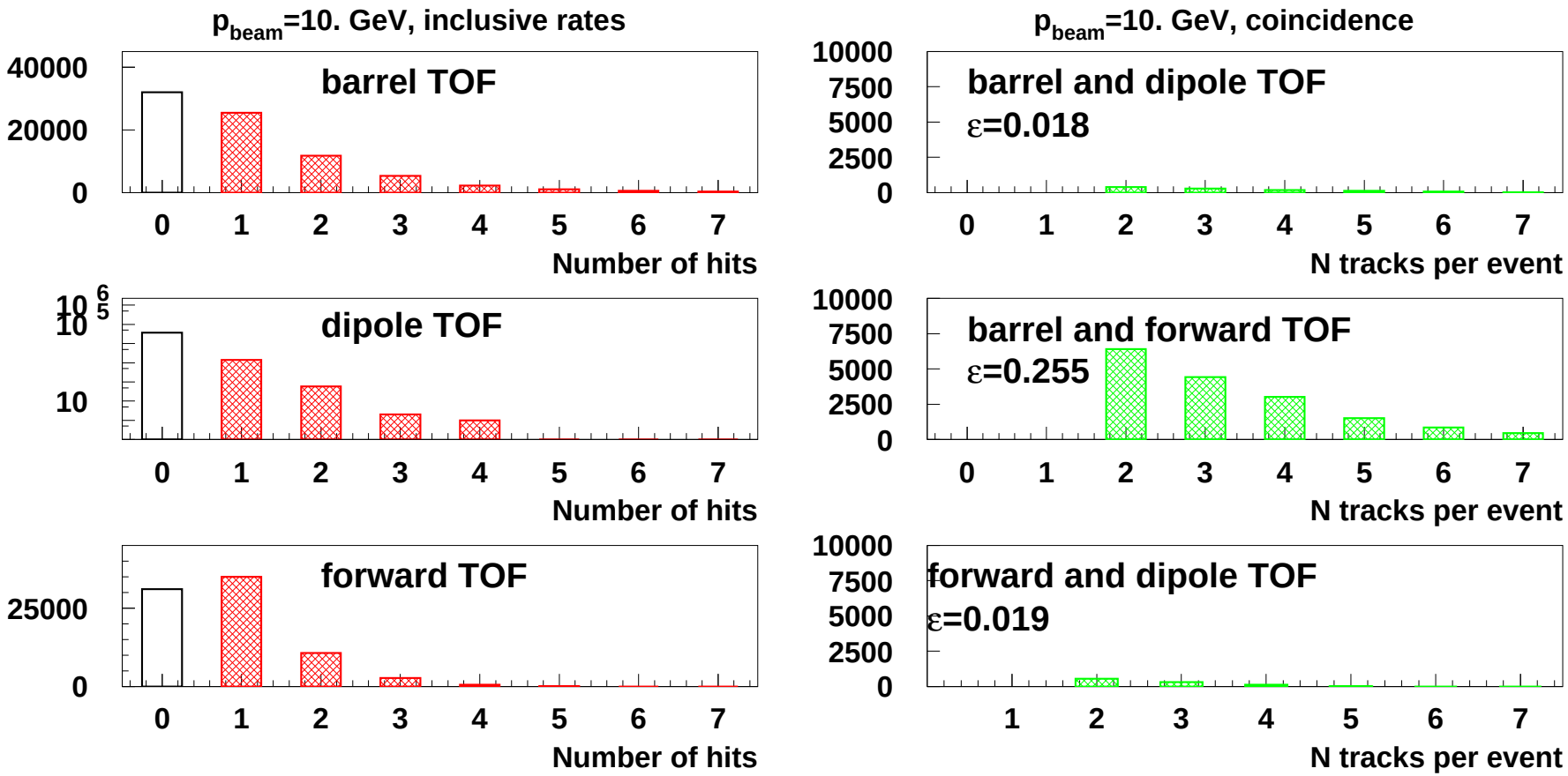
Momentum distributions of π^+ and π^- registered by inclusively BTOF, DTOF, FTOF



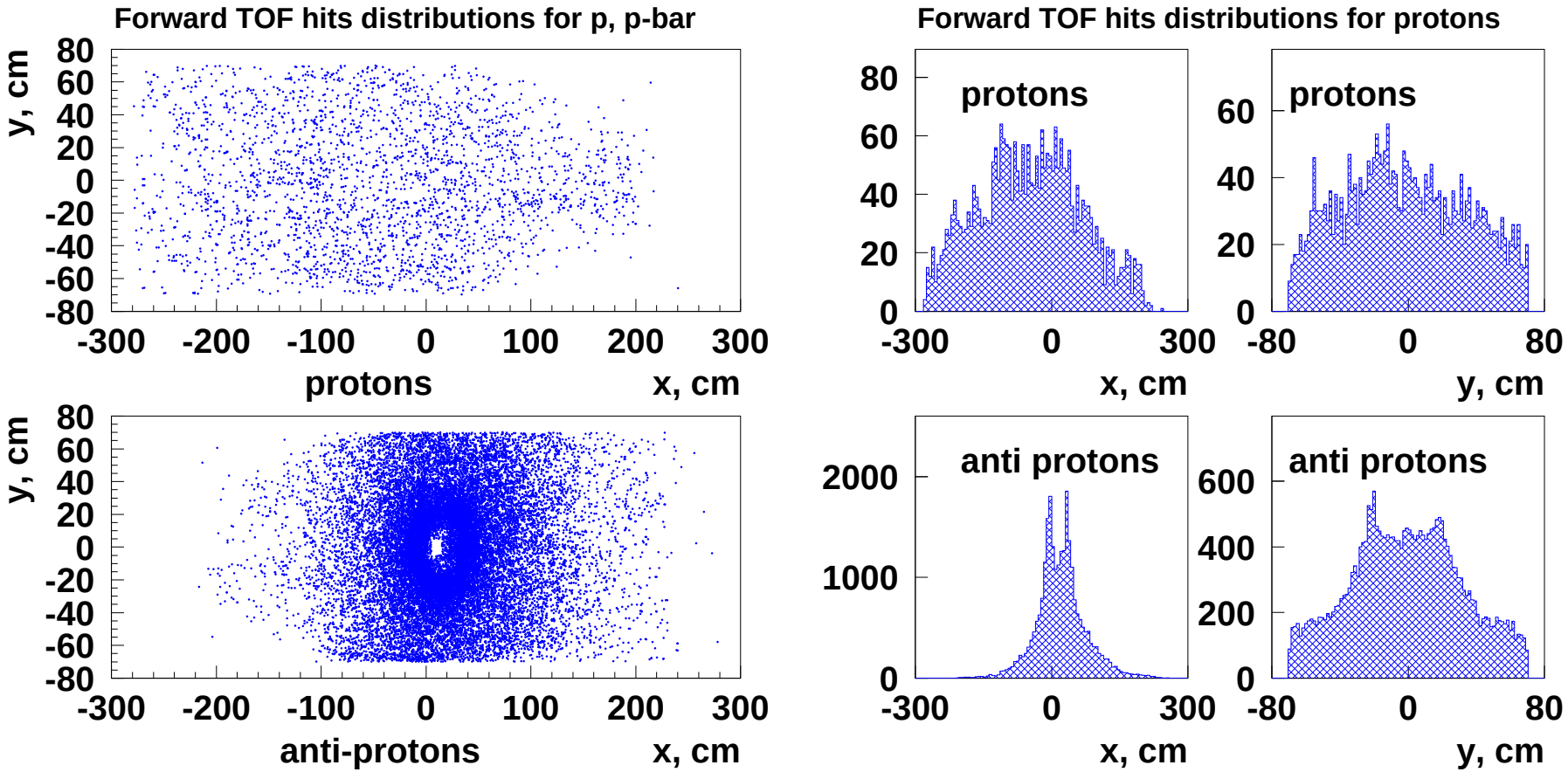
Momentum distributions of K^+ and K^- registered by inclusively BTOF, DTOF, FTOF



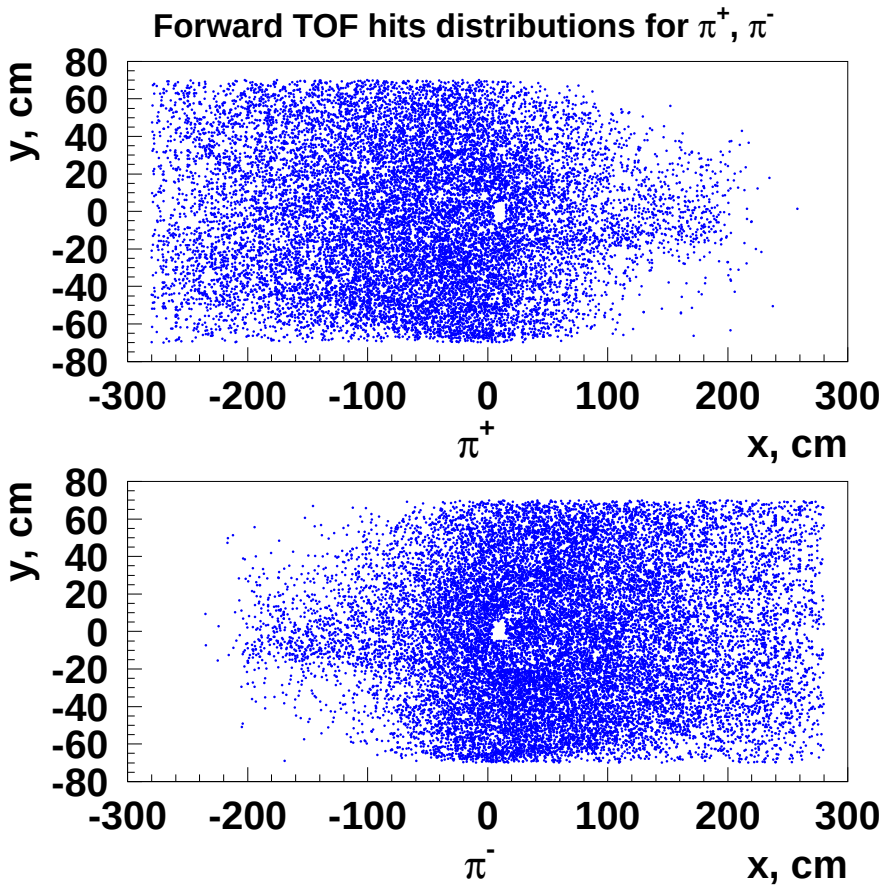
Track multiplicity distributions of charged hadrons for BTOF, DTOF and FTOF

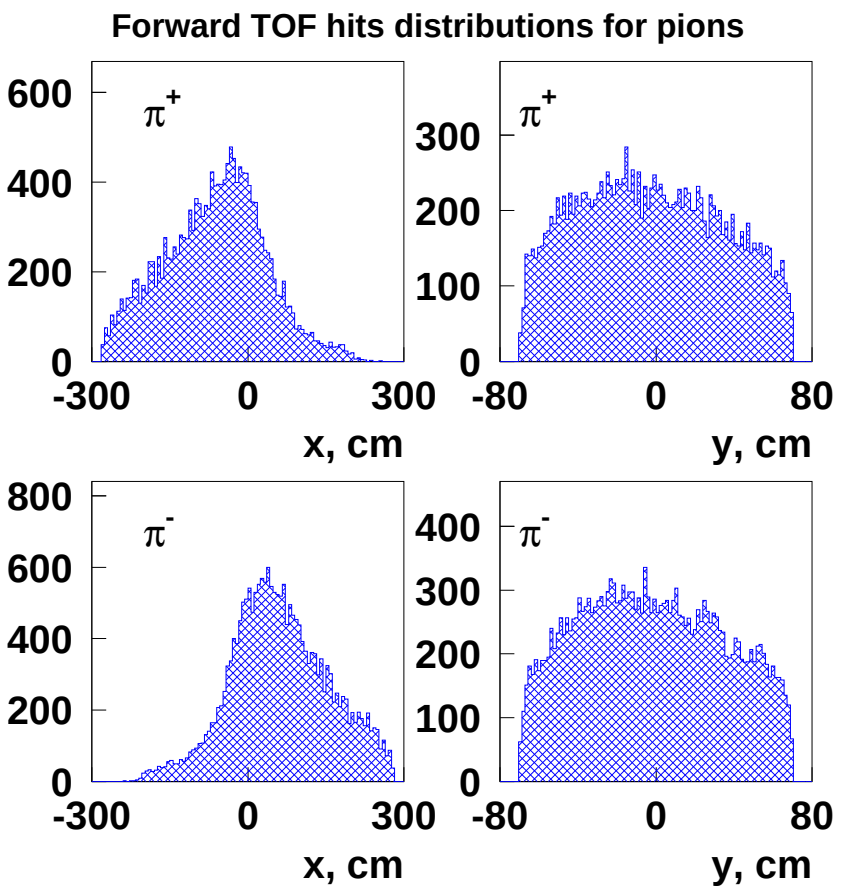


Proton hit distributions for Forward TOF

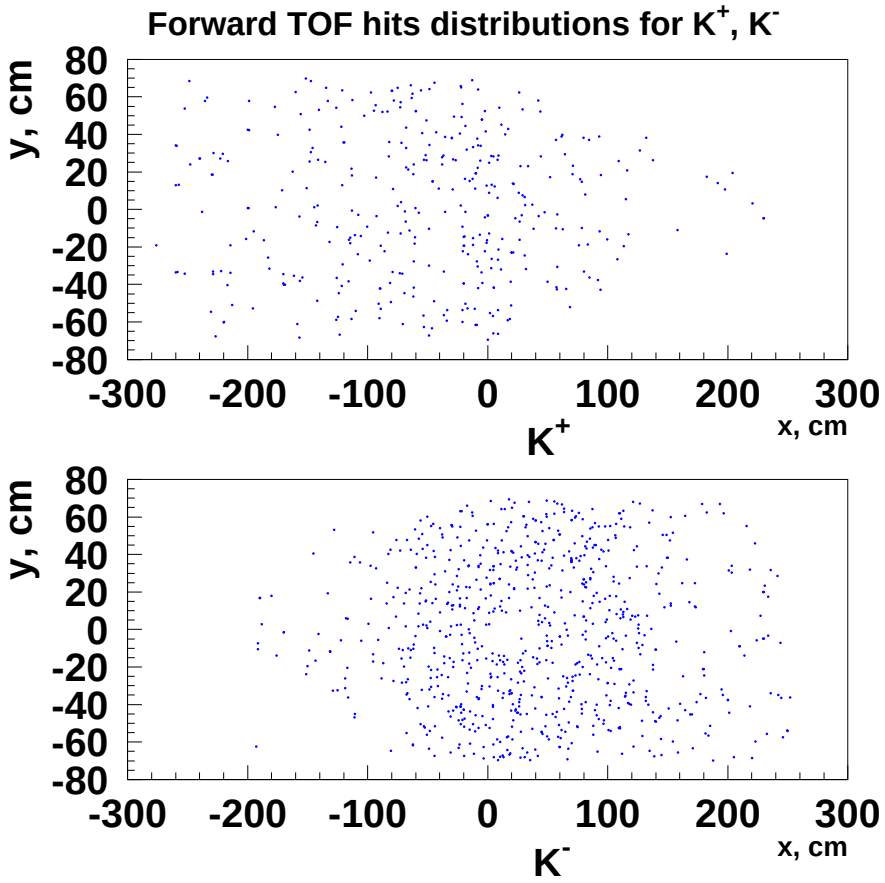


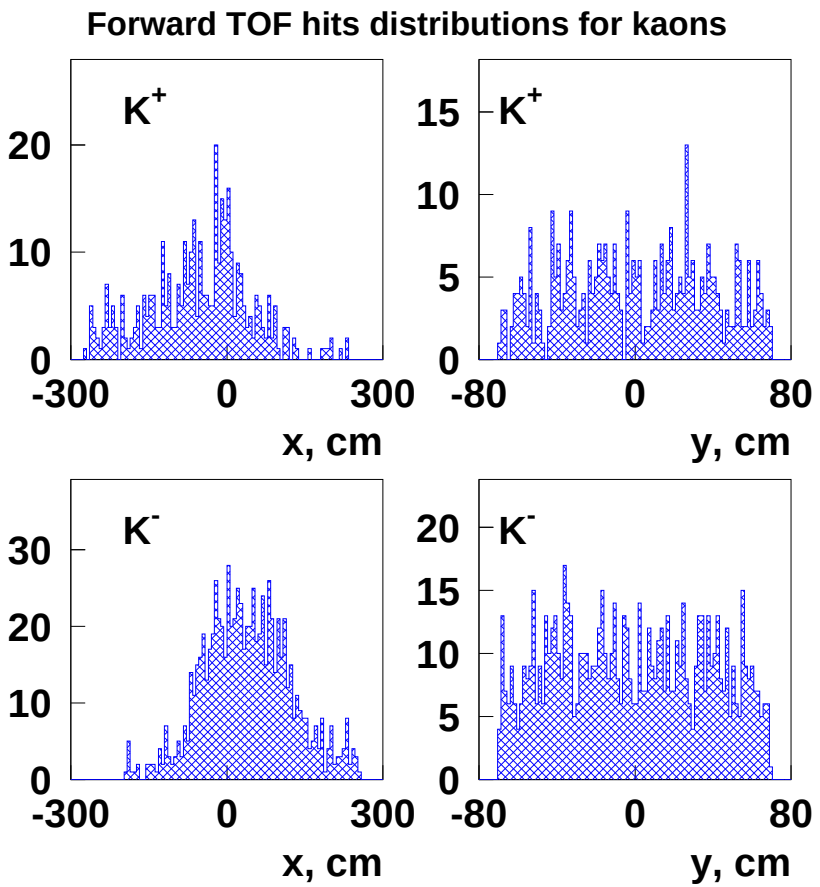
Charged pion hit distributions for Forward TOF



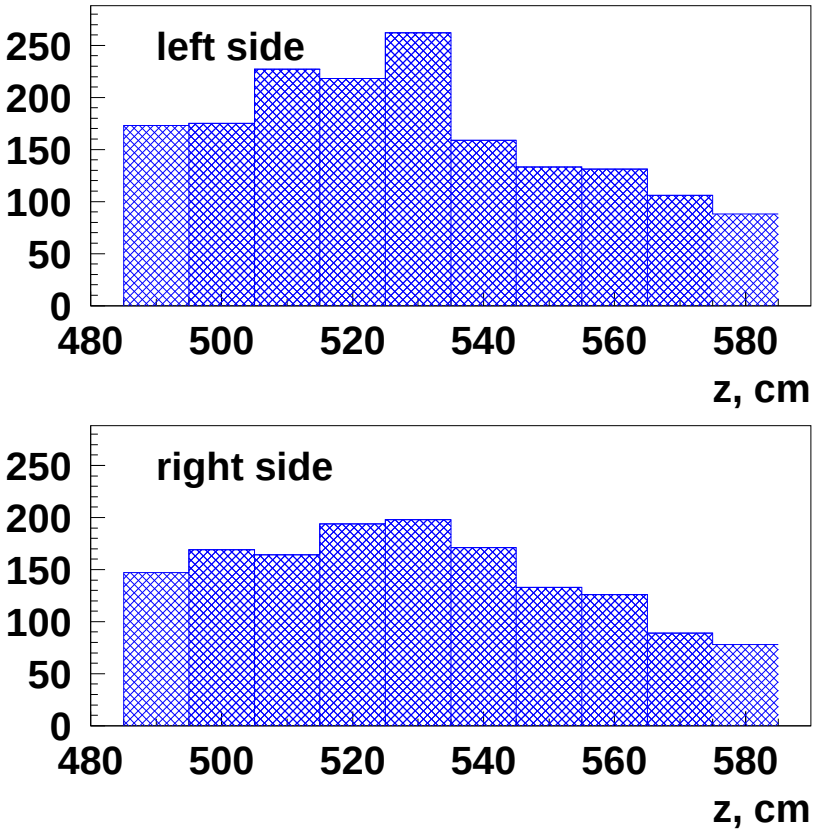


Charged kaon hit distributions for Forward TOF



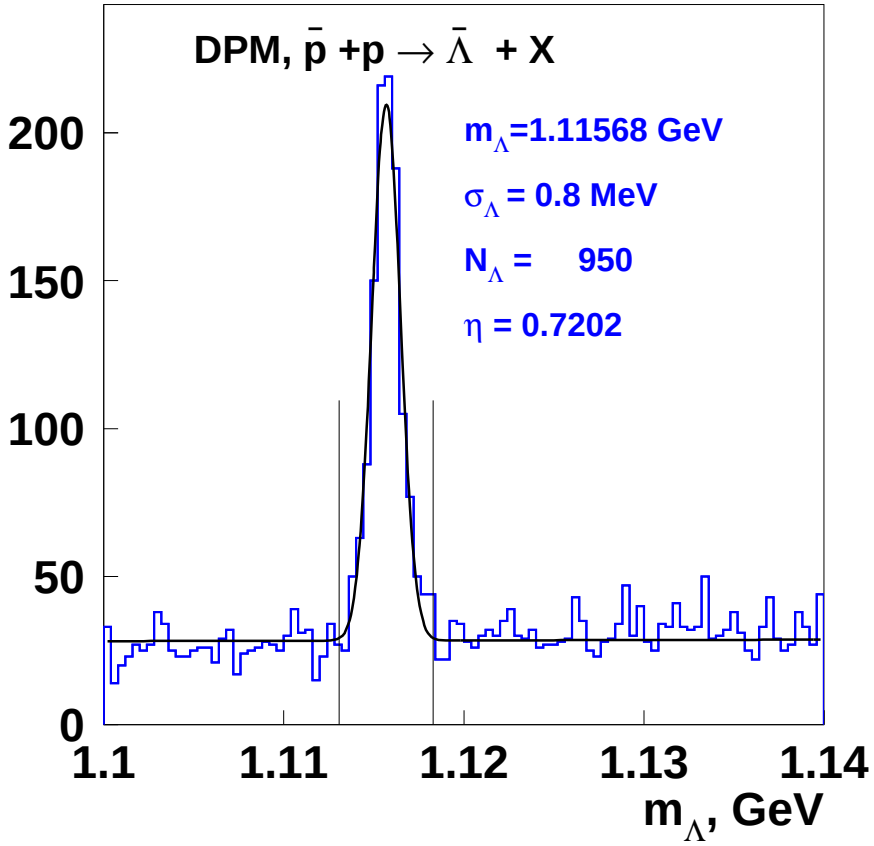


Hit distributions for Dipole TOF



Reconstructed Λ-bar mass

FTOF



Have to analyze different variants of antiproton and pion from Λ-bar decay registration e.g.:

proton	*pion*
FTOF	*BTOF*
FTOF	*DTOF*
DTOF	*BTOF*
…	

N_Λ = 119 K per sec.

Hadron-hadron pairs of opposite charge were analyzed

To do list

- ***Improve statistics***
- ***Repeat analysis for several beam momenta***
- ***According to simulation with DPM generator Dipole TOF contribution is small, it needs simulations for specific benchmark channels where DTOF information could be crucial***
- ***Consider a possibility detector calibration using***

  $\bar{p} + p \rightarrow \bar{\Lambda} + X$ ***reaction***

Detection Efficiency of FTOF

	Generated by DPM	Detected by BTOF (eff / N per sec)	Detected by DTOF (eff / N per sec)	Detected by FTOF (eff / N per sec)
π^-	90693	0.36 / 32682	0.01 / 1121	0.23 / 20681
π^+	90725	0.44 / 40201	0.002 / 226	0.18 / 16594
K^-	3022	0.09 / 260	0.001 / 3	0.26 / 800
K^+	3082	0.25 / 757	0.003 / 10	0.12 / 367
p-bar	42095	0.007/281	0.0002 / 10	0.62 / 25918
p	42003	0.61 / 25511	0.002 / 99	0.07 / 2768