Simplified PID for π/K/p in BiBi@9.2 GeV

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Outline

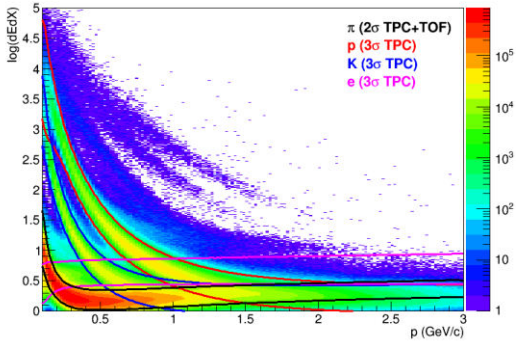
- Need π/K/p results for the second collaboration paper
- Simplified approach based on n-sigma method for TPC/TOF:
  - ✓ limited p_T range at higher momenta
  - ✓ minimization of model-dependent corrections
  - ✓ robust → most appropriate for the first-day analysis & results
- Today:
  - ✓ analysis details for Request 25 mass production (UrQMD, BiBi@9.2, 50M events)

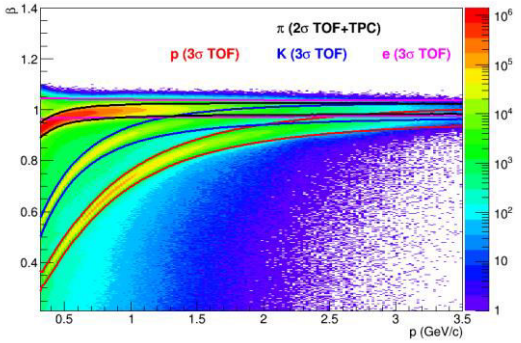
PID strategy

- Event selection: |z-vertex| < 100 cm; centrality 0-92%
- Track selection:
  - ✓ TPC-hits > 24
  - ✓ DCA-to-PV < $2\sigma_{x,y,z}$
  - ✓ |y| < 0.5
- Two quasi-independent measurements for π/K/p:
  - 1st: (**TPC-TOF**)
    - ✓ TPC 2σ-PID selection for a given specie (π/K/p)
    - ✓ If track is 2σ-matched to TOF then TOF 2σ-PID selection for a given specie (π/K/p)
    - ✓ TPC 3σ-veto-PID for other species (for π - e/K/p veto, for K - e/π/p veto, for p - e/π/K veto)
  - 2nd: (**TOF-TPC**)
    - ✓ TOF 2σ-PID selection for a given specie (π/K/p)
    - ✓ TPC 2σ-PID selection for a given specie (π/K/p)
    - ✓ TOF 3σ-veto-PID for other species (for π - e/K/p veto, for K - e/π/p veto, for p - e/π /K veto)
- Spectra are reconstructed while purity > 95%:
  - ✓ spectra are corrected for impurities → impose 50% uncertainty for the correction value = 0.5 * 5% = 2.5% p_T-correlated systematic uncertainty for spectra
- **TPC-TOF** and **TOF-TPC** spectra are combined for final results for minimum total uncertainties

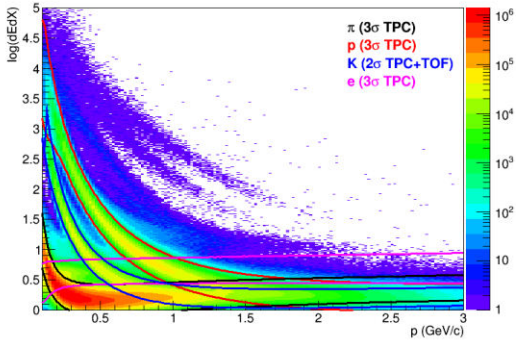
Momentum coverage with veto cuts

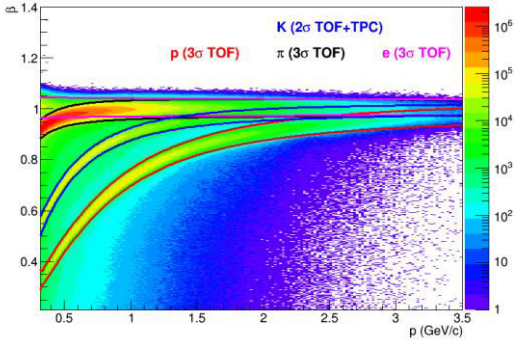
- **Pions: ~ 0-1 GeV/c**



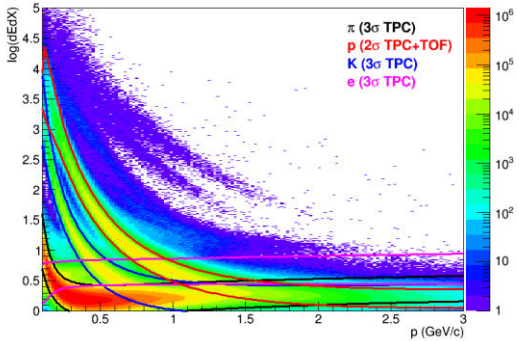


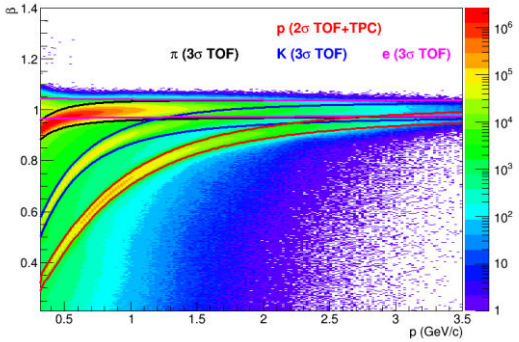
- **Kaons: ~ 0-1.5 GeV/c**





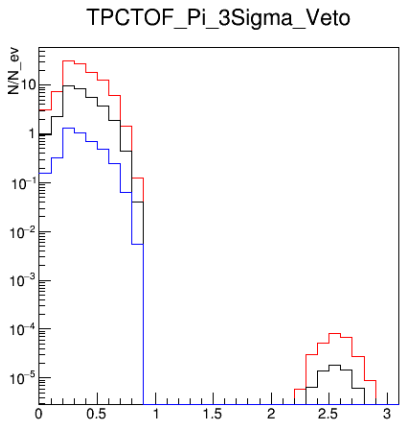
- **Protons: ~ 0-4.5 GeV/c**

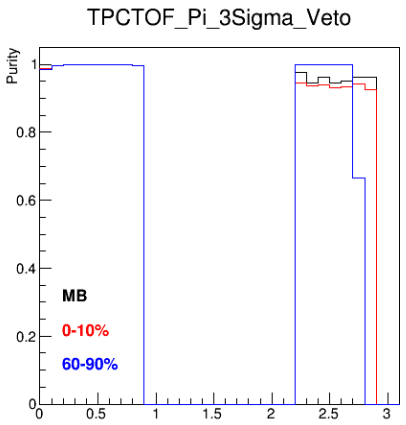


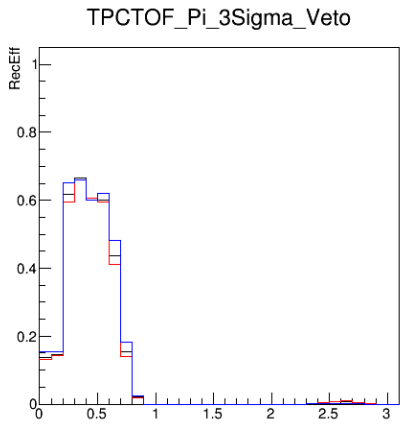


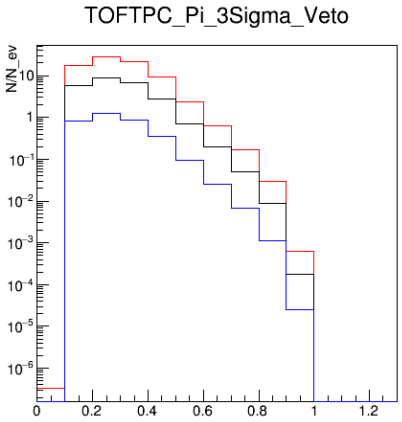
Pions

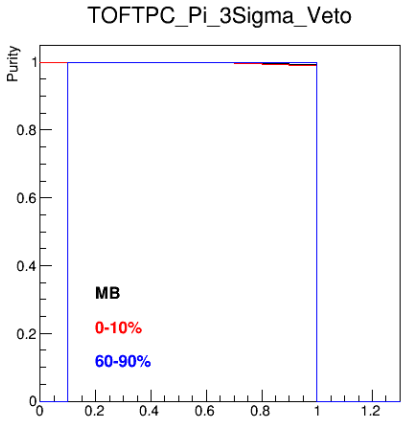
- Accepted p_T range is defined by purity > 95% → whole range is fine

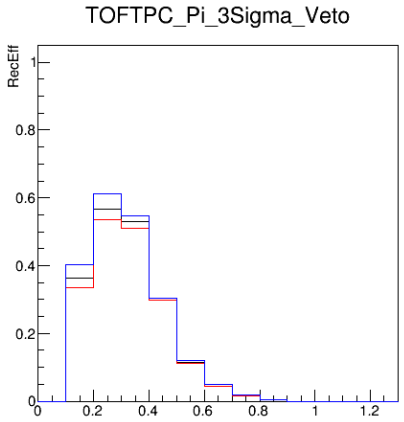






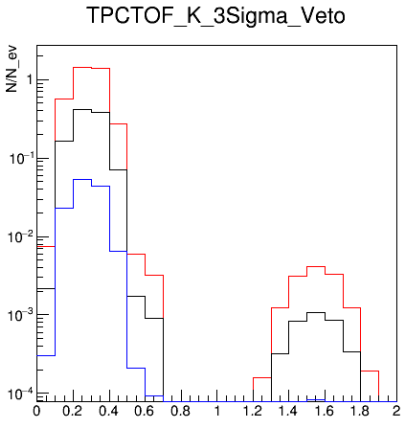


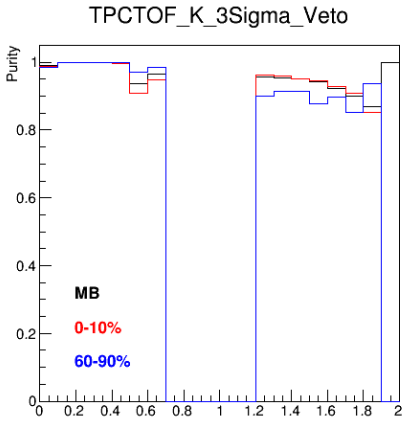


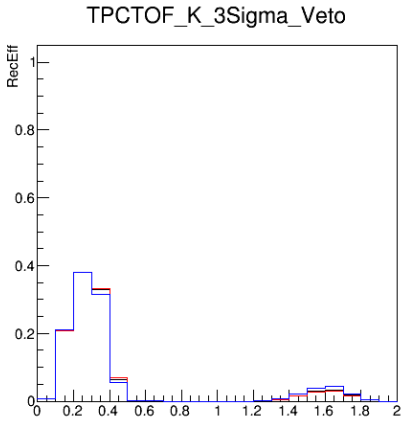


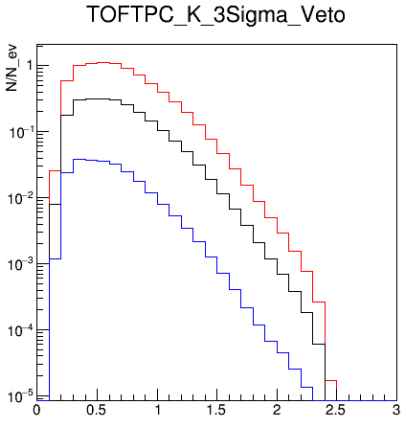
Kaons

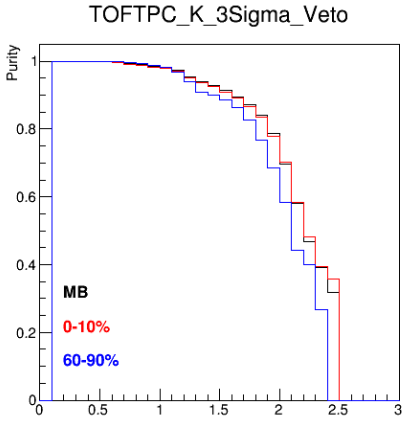
- Accepted p_T range is defined by purity > 95% → limits p_T range to ~ 1.4 GeV/c

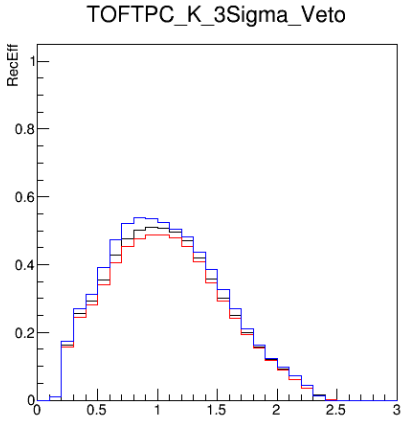






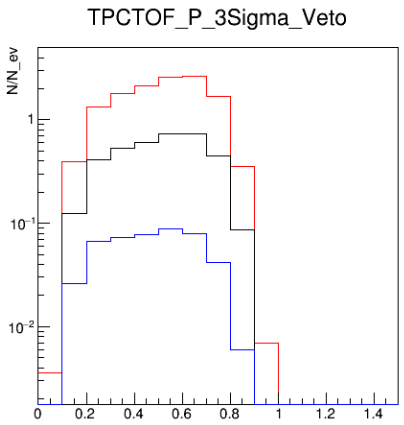


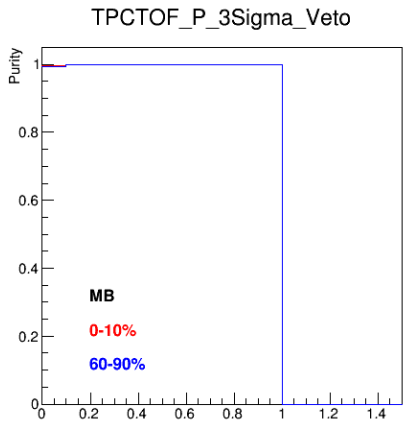


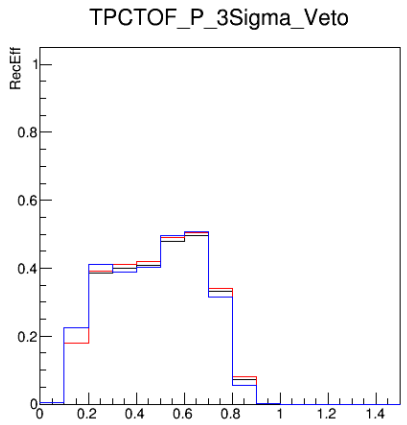


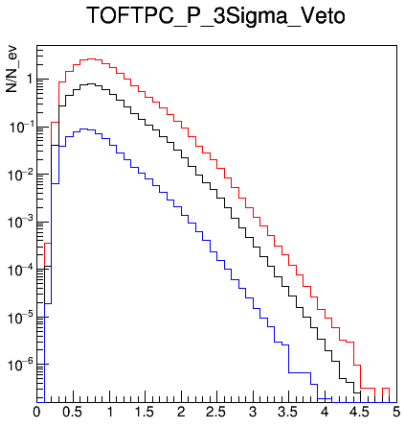
Protons

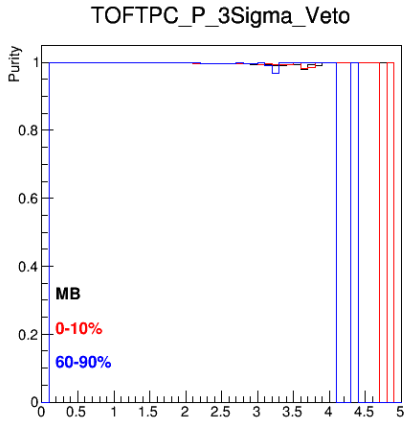
- Accepted p_T range is defined by purity > 95% → whole range is fine

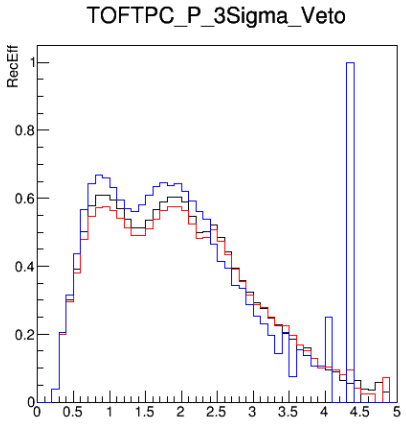








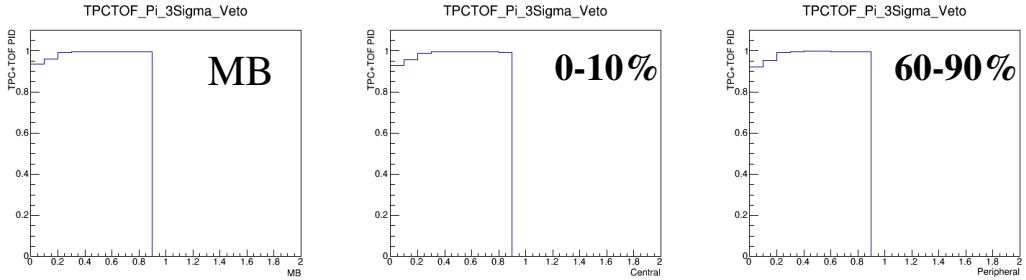




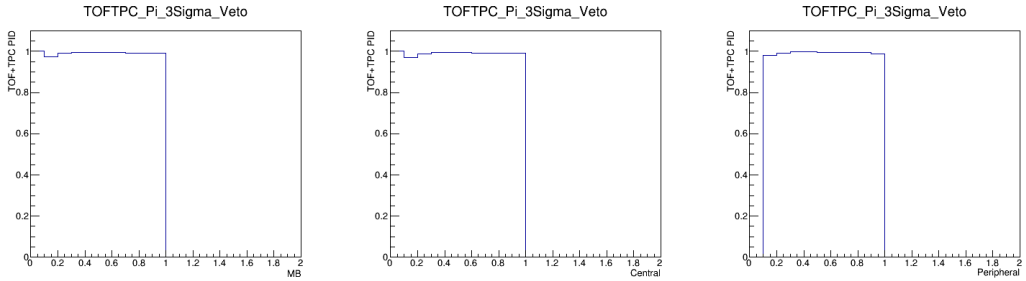
Particle sources - Pions

- Fraction of primaries in the measured spectrum (primaries – produced at a distance < 1 cm from PV)

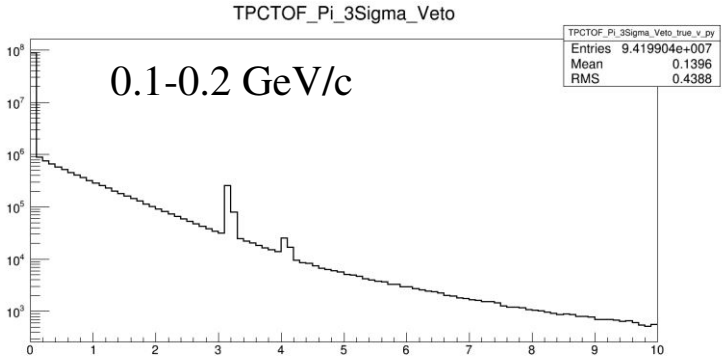
TPC-TOF

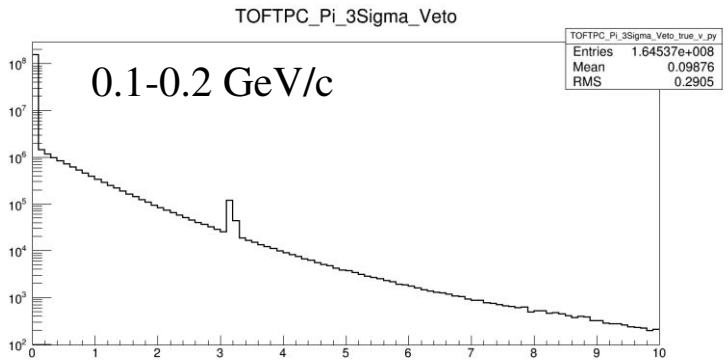


TOF-TPC



- Production radius of soft pions



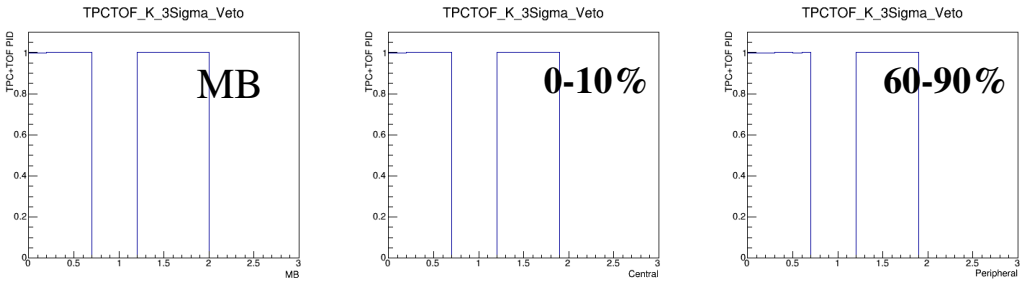


- Most of pions are primary (>95%), small admixture of decay pions and secondary from the beam pipe

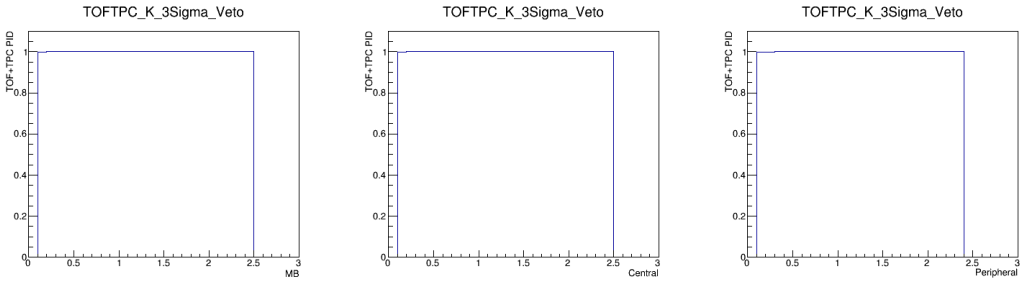
Particle sources - Kaons

- Fraction of primaries in the measured spectrum (primaries – produced at a distance < 1 cm from PV)

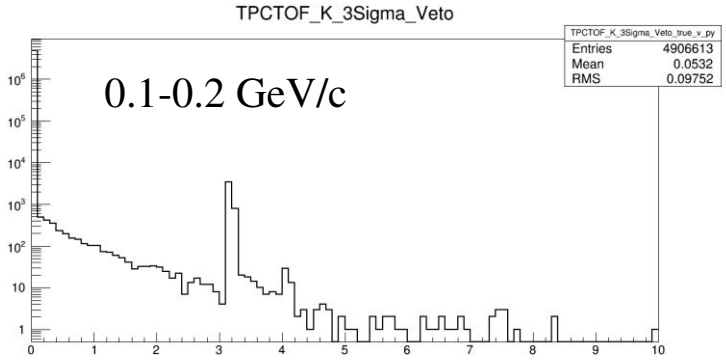
TPC-TOF

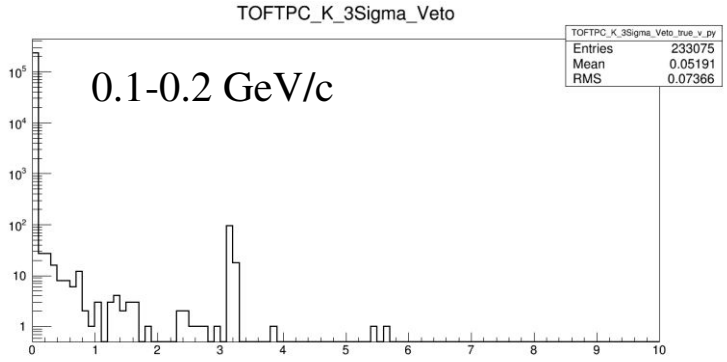


TOF-TPC



- Production radius of soft kaons



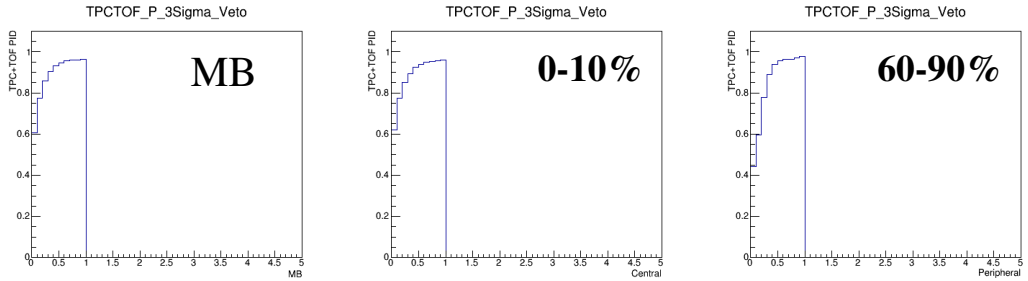


- All kaons are primary (>99%), tiny admixture of secondary particles

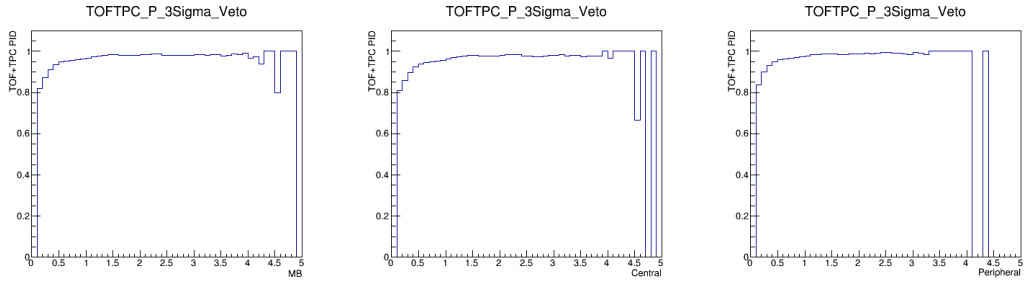
Particle sources - Protons

- Fraction of primaries in the measured spectrum (primaries – produced at a distance < 1 cm from PV)

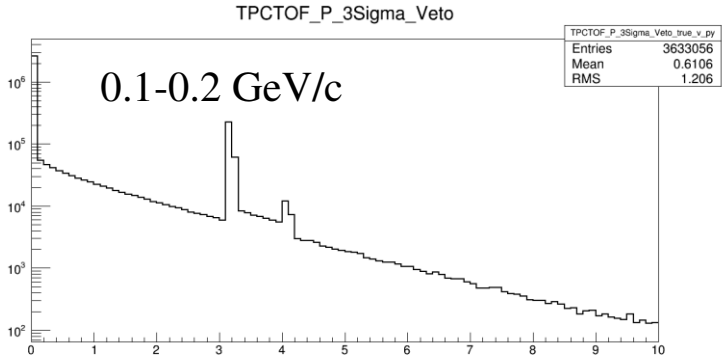
TPC-TOF

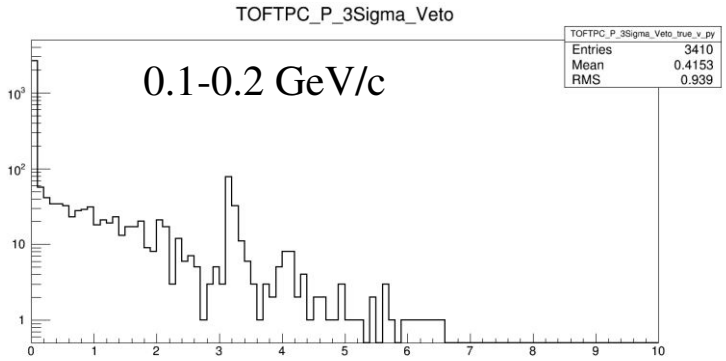


TOF-TPC



- Production radius of soft protons

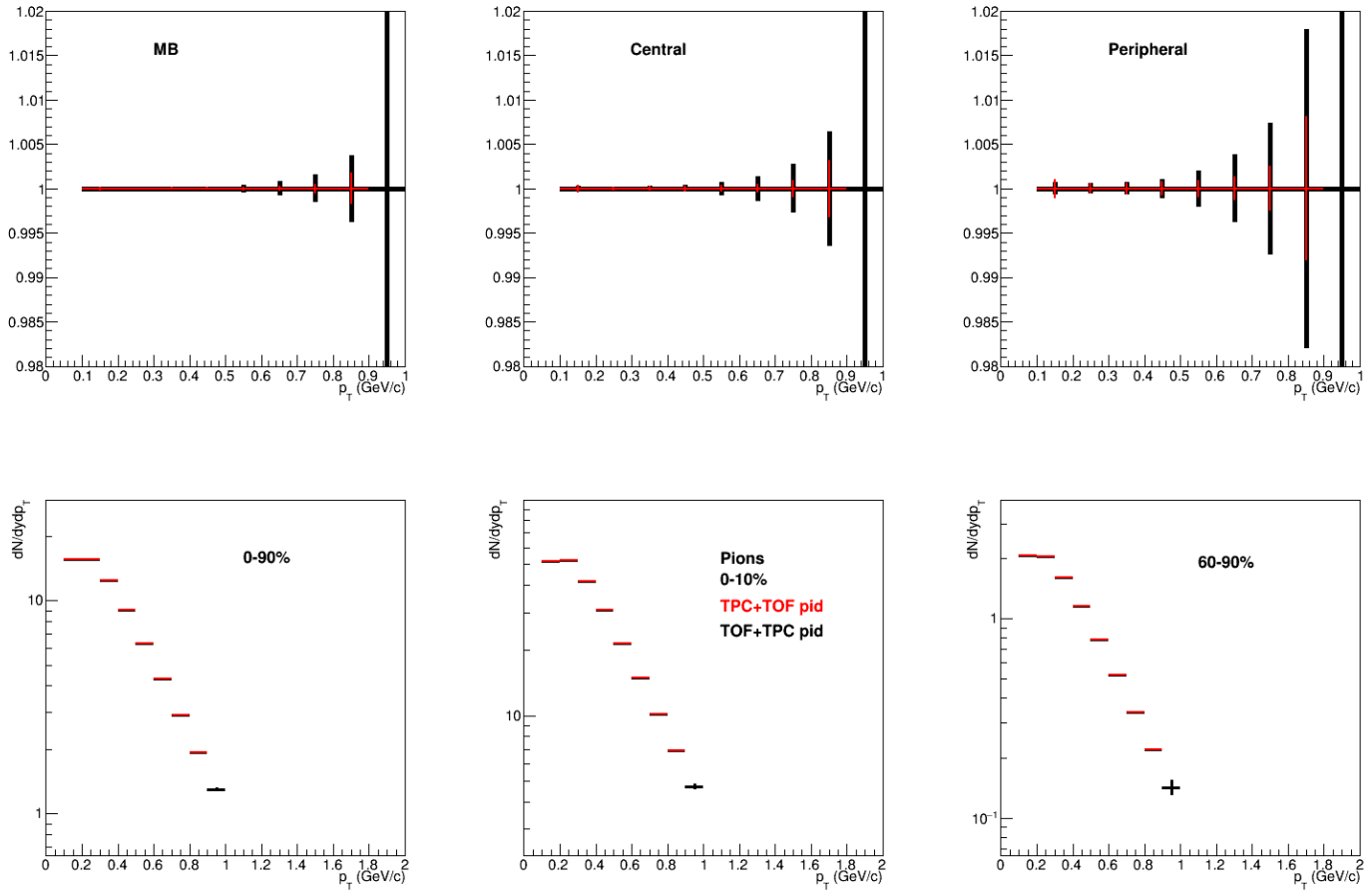




- Significant admixtures at low p_T (~30%), mostly from hyperon decays + up to ~ 5-10% of protons from the beam pipe in the first bin(s)

Combined spectra - Pions

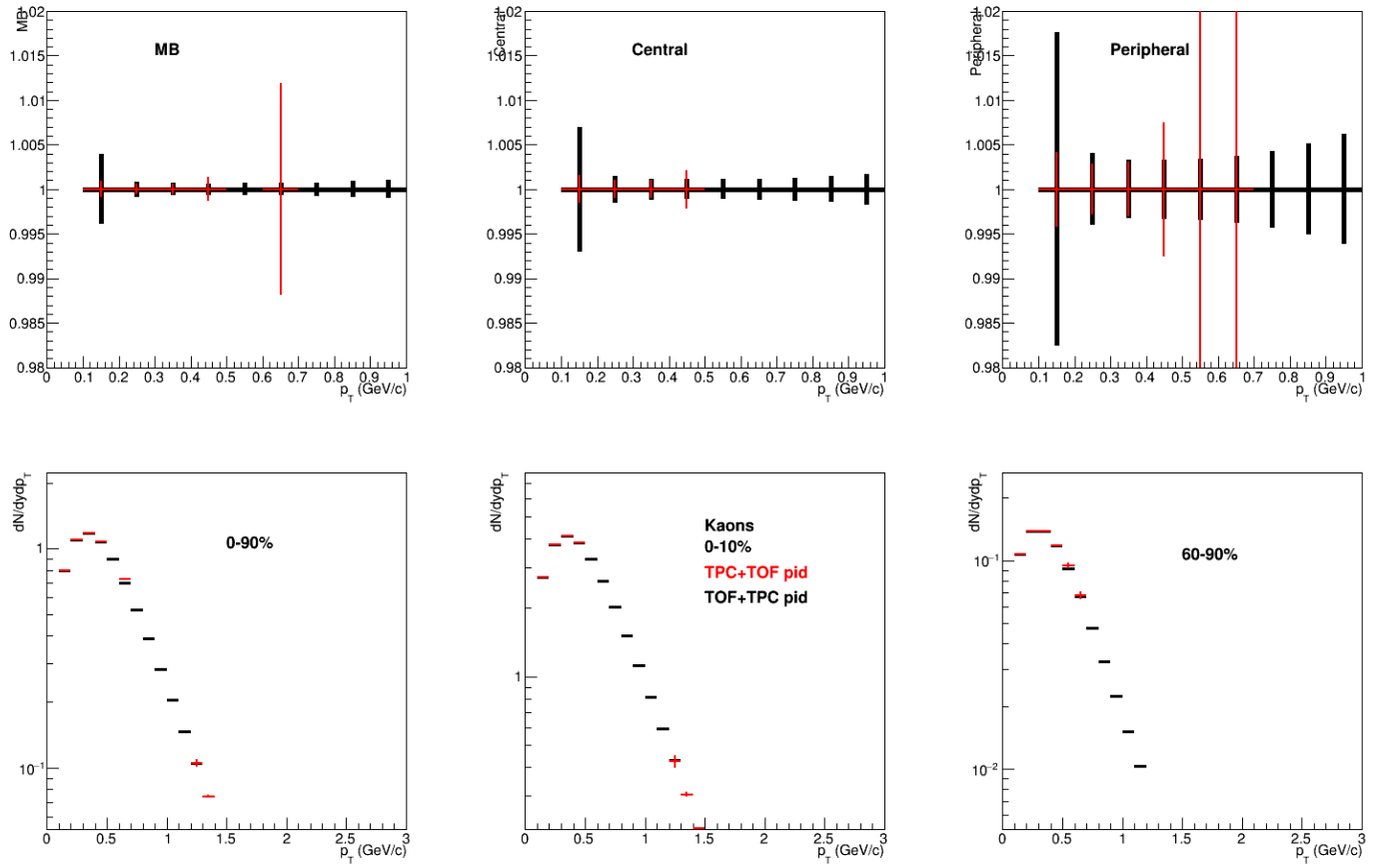
- Relative statistical uncertainties for **TPC-TOF** and **TOF-TPC** spectra



- Set transition point to $p_T = 0.95$ GeV/c

Combined spectra - Kaons

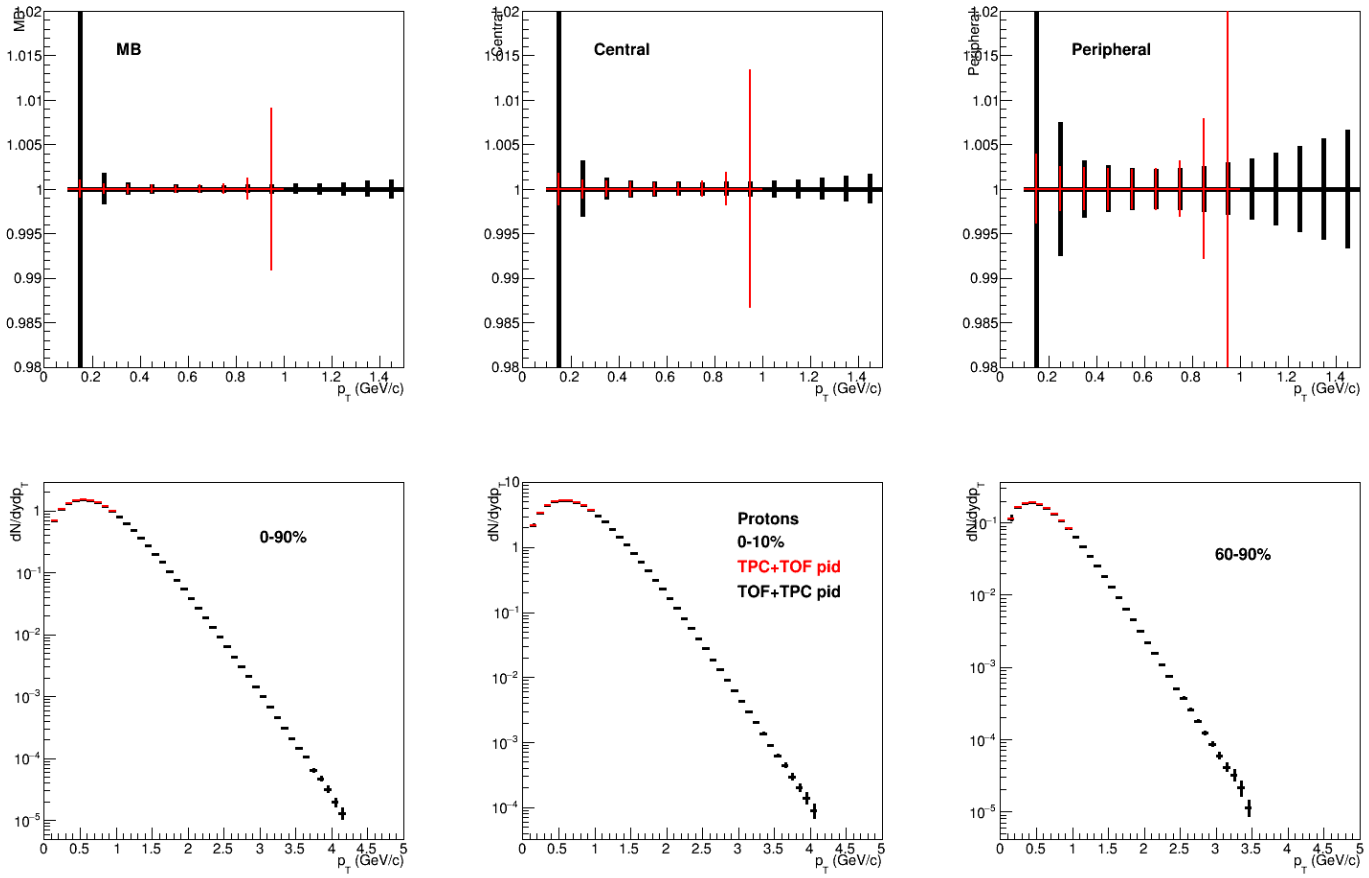
- Relative statistical uncertainties for **TPC-TOF** and **TOF-TPC** spectra



- Set transition point to $p_T = 0.45$ GeV/c

Combined spectra - Protons

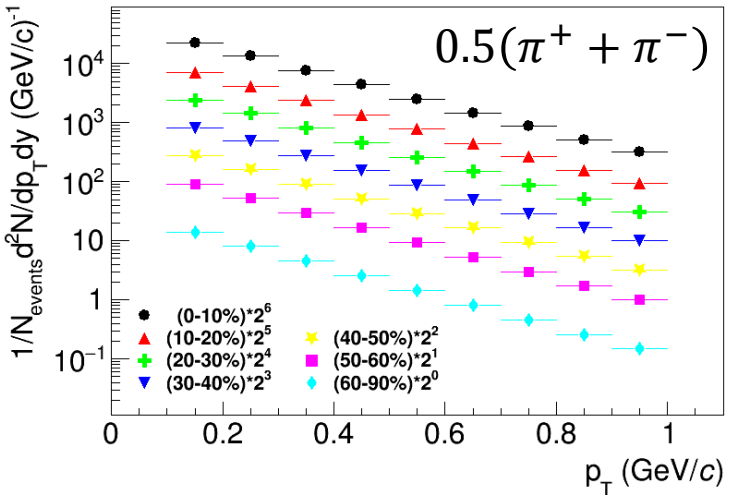
- Relative statistical uncertainties for **TPC-TOF** and **TOF-TPC** spectra

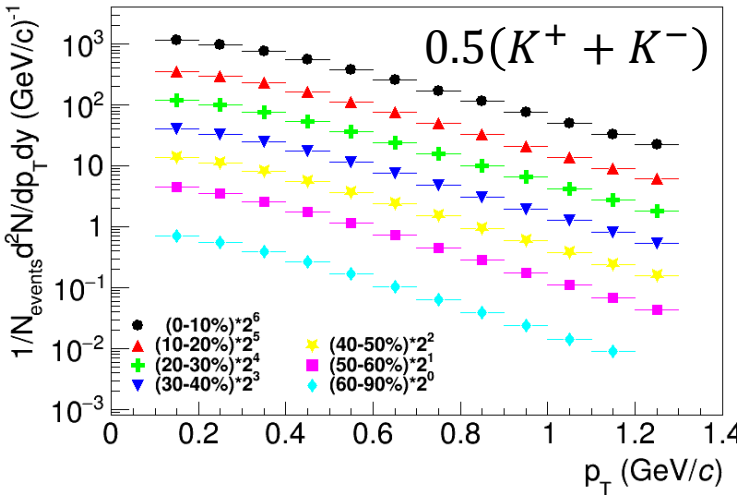


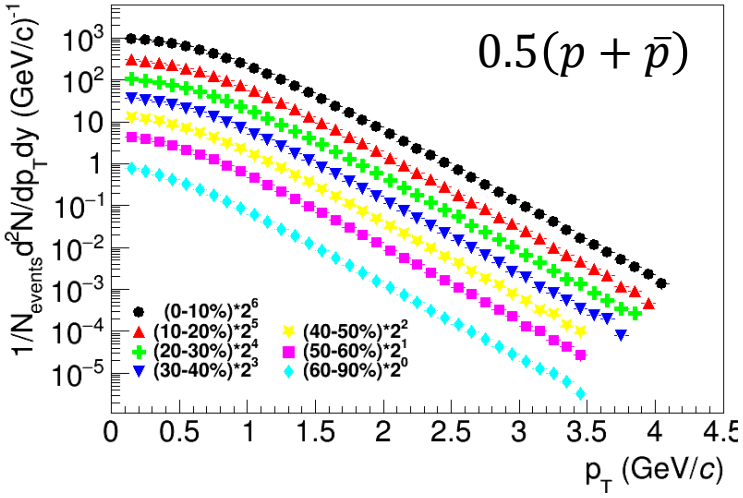
- Set transition point to $p_T = 0.75$ GeV/c

Final spectra, $(h^+ + h^-)/2$

- Combined, centrality-dependent spectra for π/K/p







- Missing high-p_T tails contribute ~ 3.7%, 3.5% and 0% of the total yield for π, K and p, respectively

Summary

- A very straightforward approach for π/K/p measurements is proposed → probably most appropriate approach for the first-day measurements
- Provides good enough coverage for integrated yield measurements, uncovered high-p_T range contributes < 4% of the total yields, uncovered low-p_T range is as small as possible given current track reconstruction techniques & methods
- The approach needs to be extended to charge-dependent case → 1-2 weeks