Status Report on Single Detector PID Studies

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Outline

1. Simulations
2. Comparison to Physics Performance Report
3. Problems in the FTOF

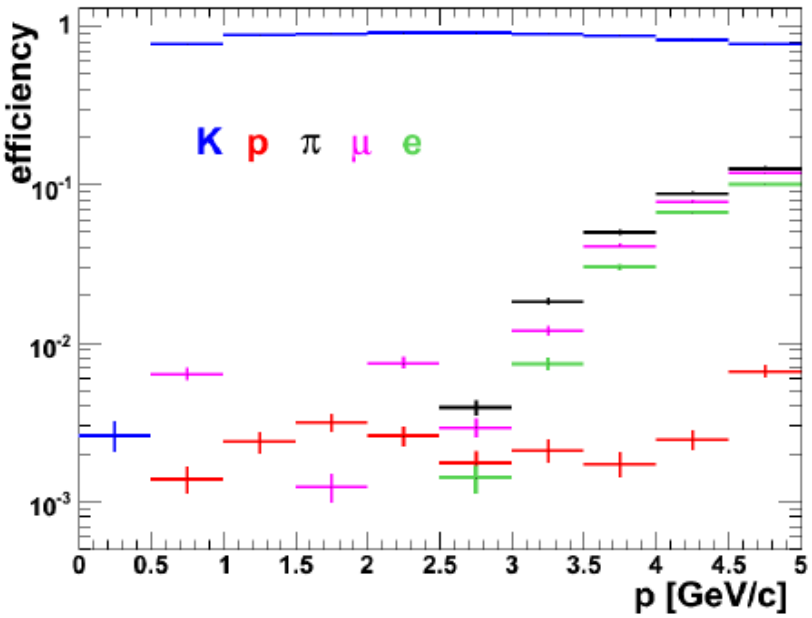
1. Simulations

- Particle generation:
  - Charged final states: e, μ, π, K, p
  - Box generator:
    - θ ranges: 0°-10°, 10°-23°, 25°-90°, 90°-130°
    - Φ: -180° to 180°
    - Momentum: 0-5 GeV
- Tracking:
  - Default algorithm
- Version: FairSoft jun19p2, FairRoot v18.2.0, PandaRoot dev (02.04.2020), Root 6

2. Comparison to Physics Performance Report (PPR, 2009)

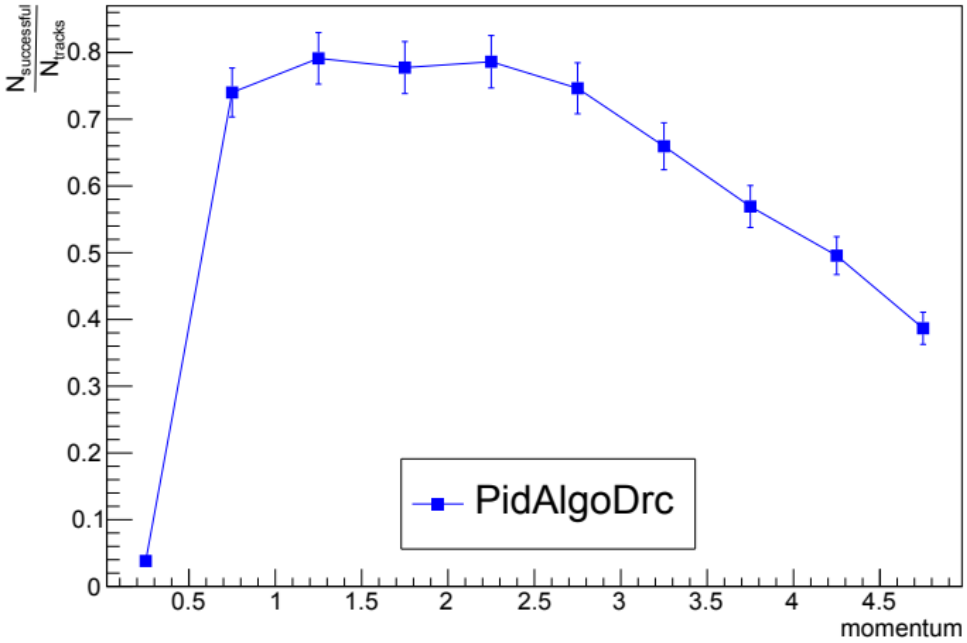
- Criterion for successful PID and efficiency: probability for true particle ≥ 0.3,
  - Why? Used in the PPR

Kaon efficiency (DIRC)



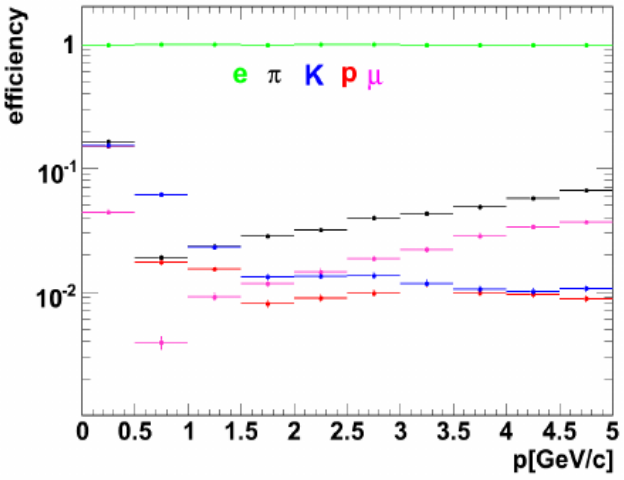
0.8

PPR: DIRC Kaon efficiency and contaminations

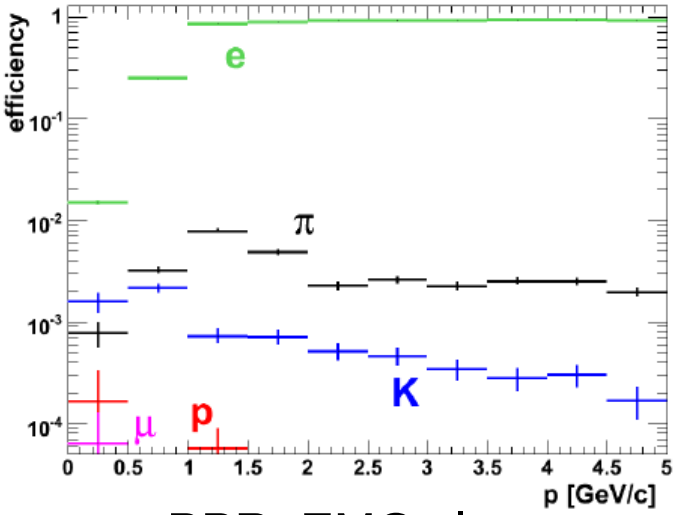


New simulation: DIRC Kaon efficiency, θ:25°-90°

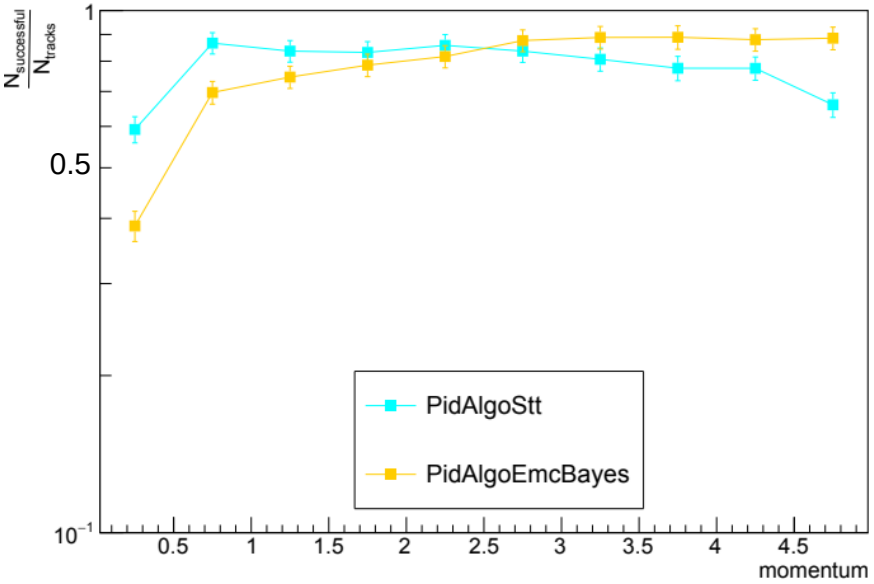
Electron Efficiency (STT/EMC)



PPR, STT electron efficiency
and contamination

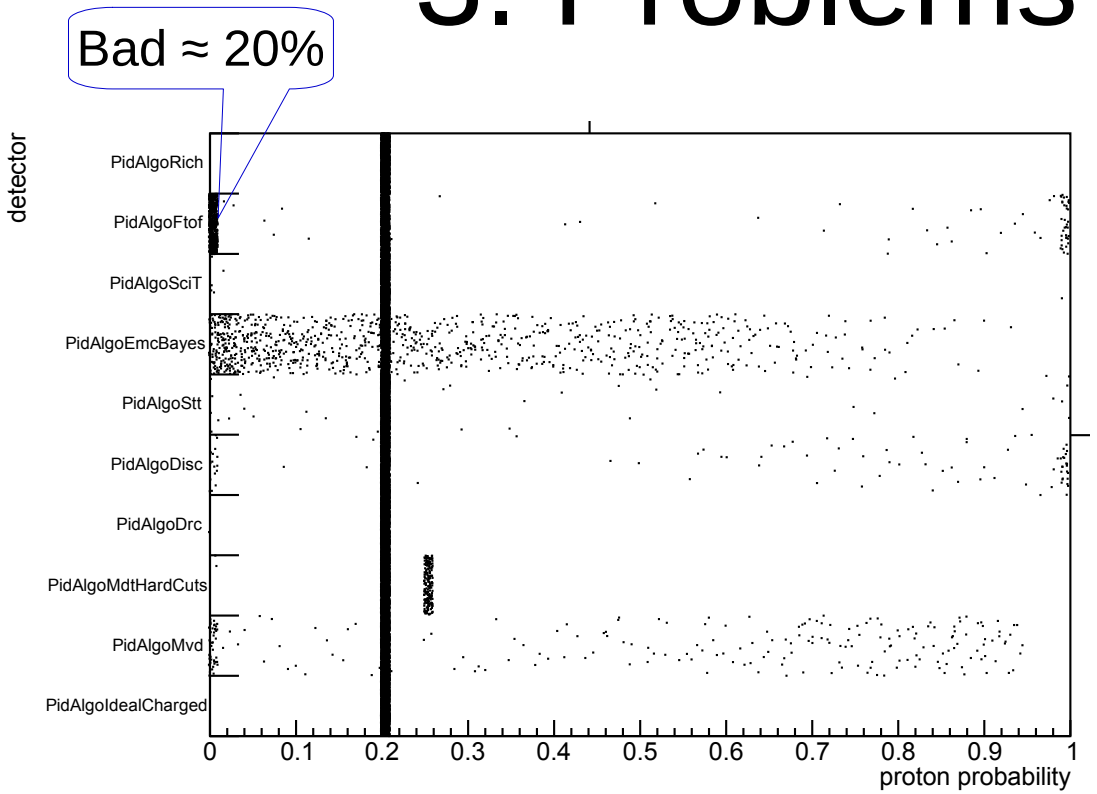


PPR, EMC electron efficiency
and contamination

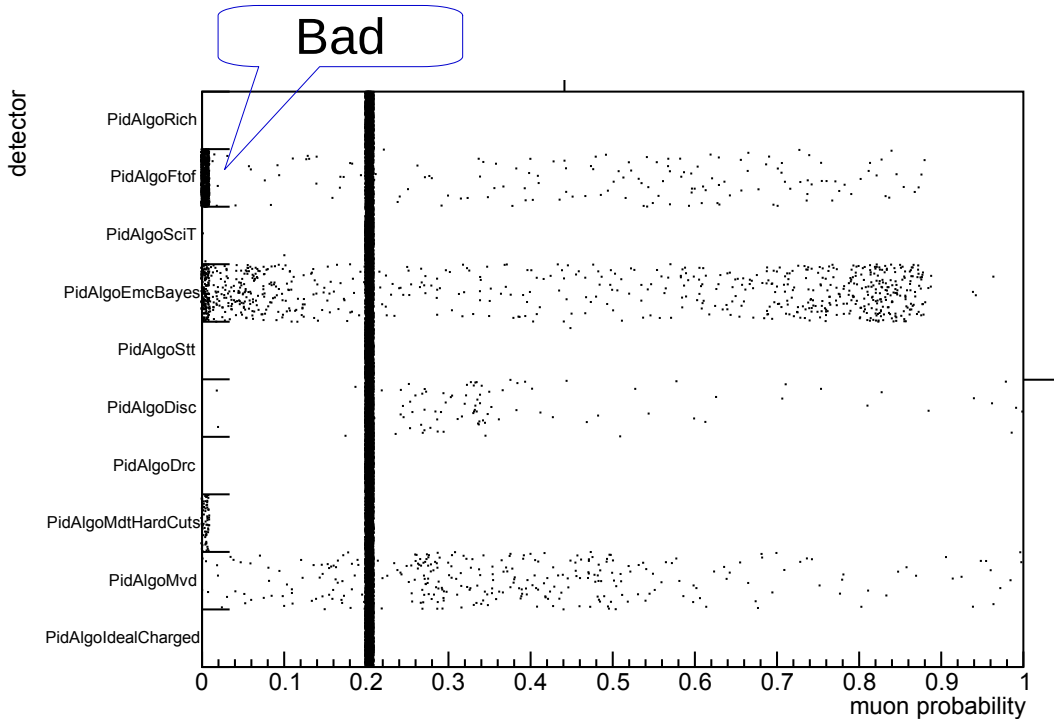


New simulation:
EMC electron efficiency,
θ:25°-90°

3. Problems in the FTOF



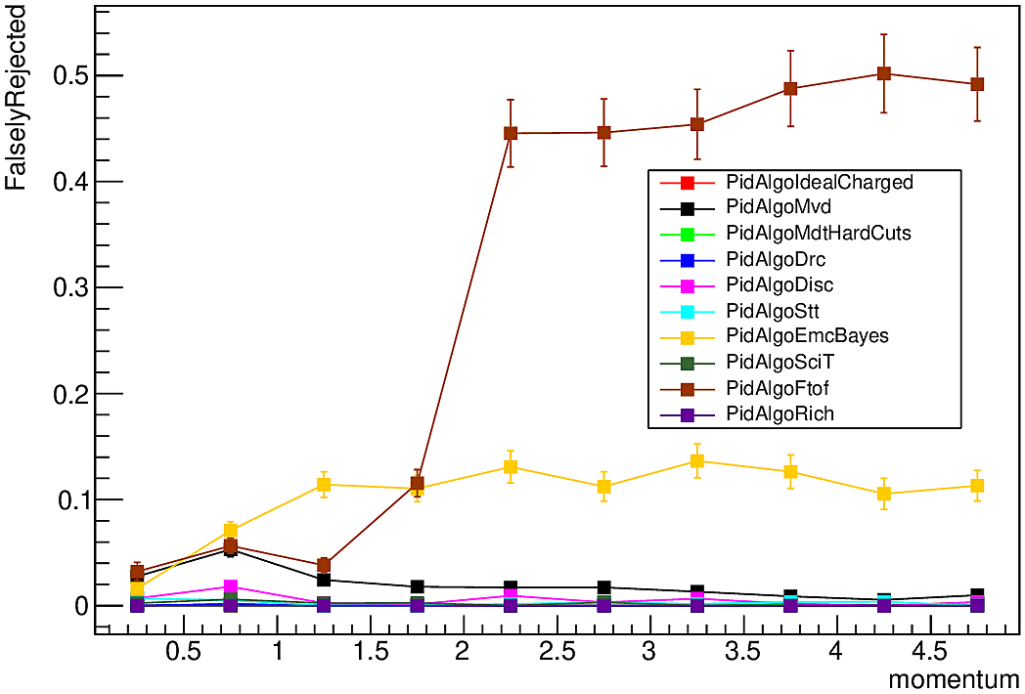
protons, θ: 0°-10°, p: 0-5 GeV

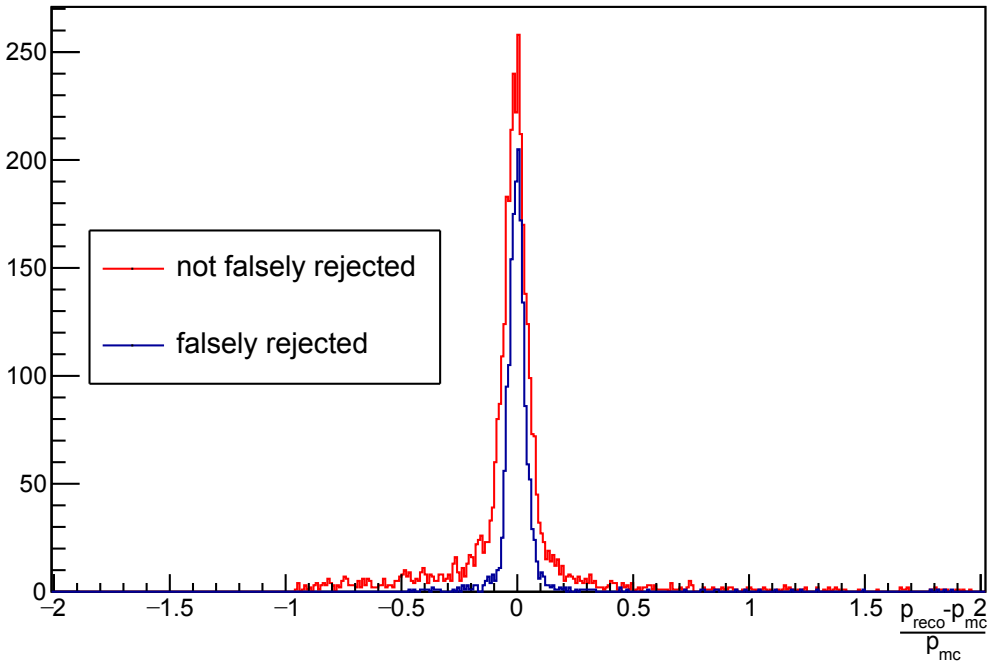


muons, θ: 0°-10°, p: 0-5 GeV

- In many cases the true particle has very low probability
- Cut: P_{true}<5% (falsely rejected)

Momentum Dependence



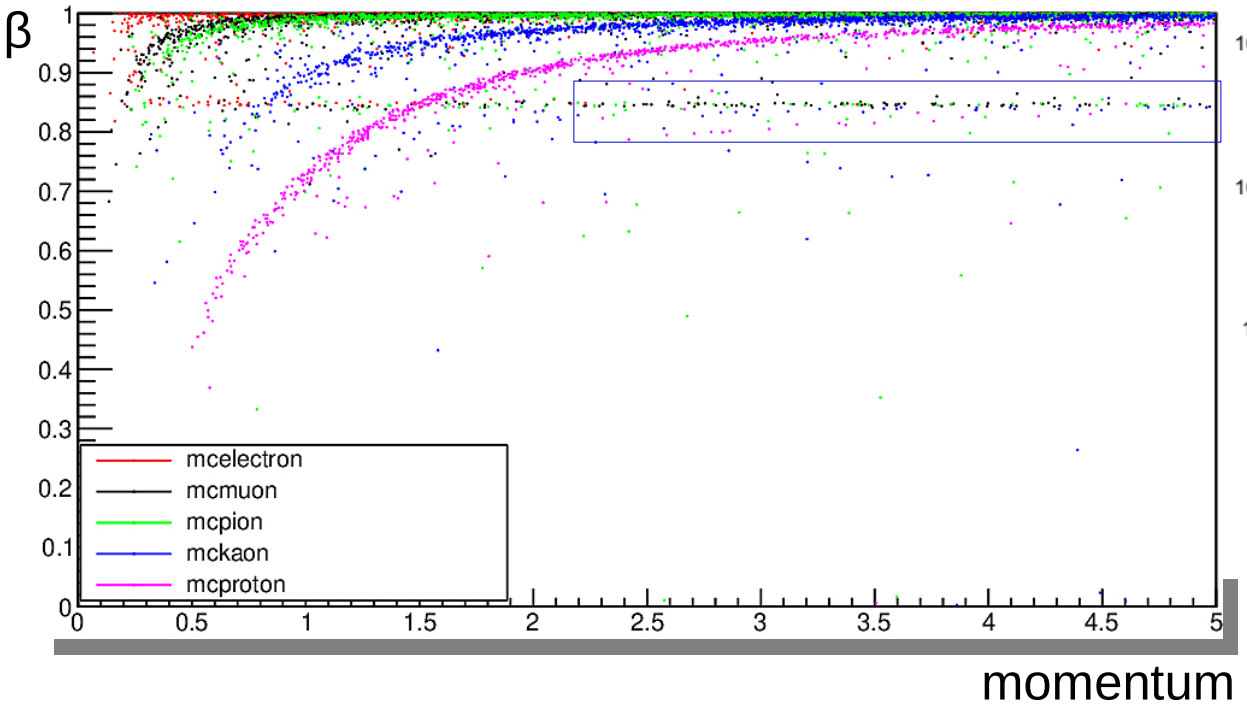


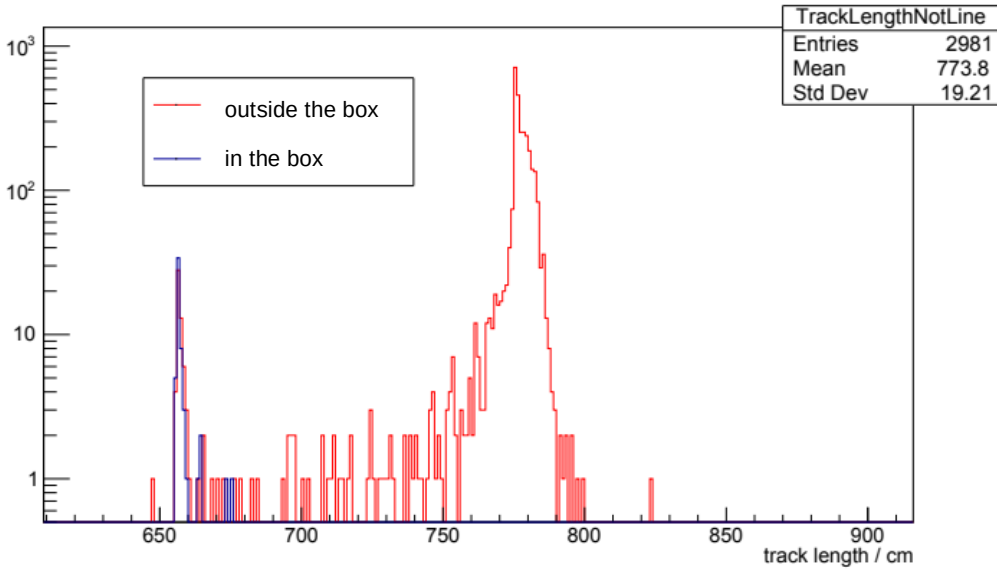
- Proton: performance above 2 GeV is not good, θ=0° to 10°
- FTOF-TDR: up to 4 GeV is reliable
- Other particles similar

- Relative momentum error similar
  → Does not cause the problem

- Problem: at high momentum everything has the same time of flight

Reconstructed Momentum vs β





Track Length, Muons, 0-5 GeV

- Blue peak < distance to FTOF

- All curves have a shifted duplicate, seems to be a bug
- Not enough to explain all problems

Summary

- Efficiency was found to be lower than in Physics Performance Report
- FTOF assigns very low probabilities to true particle

Outlook

- Investigate cause for problems of FTOF
  - tracking?
  - assignment of probabilities?
- Check other detectors with similar problems
  - MDT
  - EMC (cf. Marvin’s talk after the break)