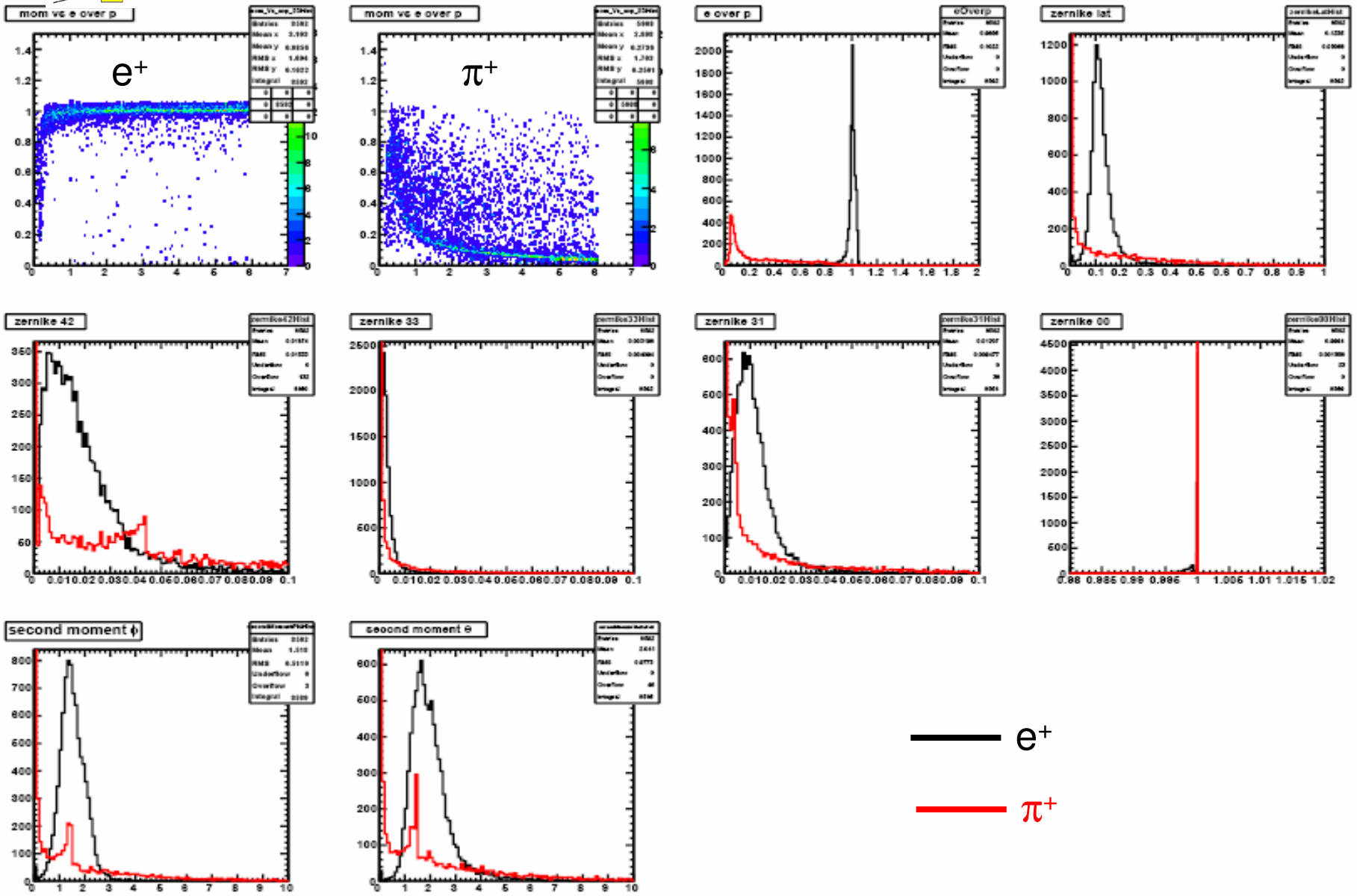
Electron ID with the EMC (barrel)

- Very first electron ID studies with EMC have been started (K. Götzen, B. Kopf)
- Full simulation chain in BaBar like software
  - G4 simulation with the complete detector, digitization, full reconstruction for the EMC
  - single particles between 0.05 … 6.0 GeV/c and cos(Θ) = -0.7 … 0.7
    - 10k e^+
    - 10k π^+
- Electron can be identified via
  - E/p (E: energy deposit of the cluster; p: reconstructed momentum of the track)
  - shower shape of the cluster
- Studies based on
  - complete EMC reconstruction
    - reconstructed energy deposit of the cluster
    - reconstructed shower shape of the cluster (Zernike moments)
    - events with only one cluster
      (no split offs, no e^+ which produces one or more photons via bremsstrahlung, …)
  - tracking not taken into account yet
    - no matching of the charged track with the cluster
    - MC truth momentum

Electron ID with the EMC (barrel)

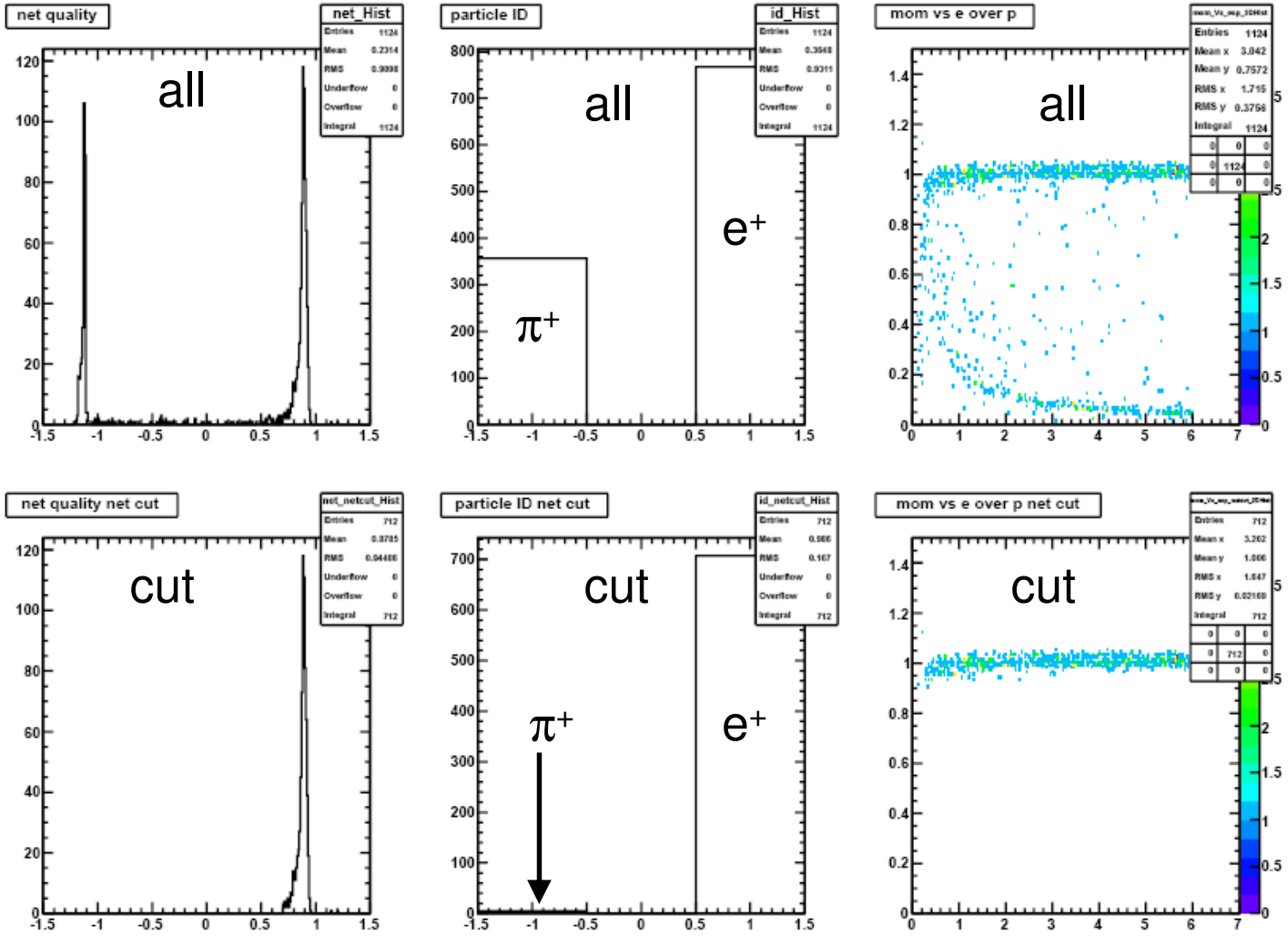


Electron ID with the EMC (barrel)

- Suitable properties for electron ID
  - e/p, p, Zernike moments of the cluster
- Problem
  - how to find the optimal cut parameters in the multi-dimensional space
  - possible solution: usage of neuronal networks
- BaBar like software
  - 8 different (supervised and non supervised) neuronal networks available
  - first training of a multi layer perceptron (MLP) already started by splitting the data sample in
    - training files: 9k for e^+ and π^+ each
    - test files: 1k for e^+ and π^+ each
    - 7 input parameters: e/p, p, Zernike00, 31, 33, 42 and Zernike lateral

Electron ID with the EMC (barrel)

Test sample (all)

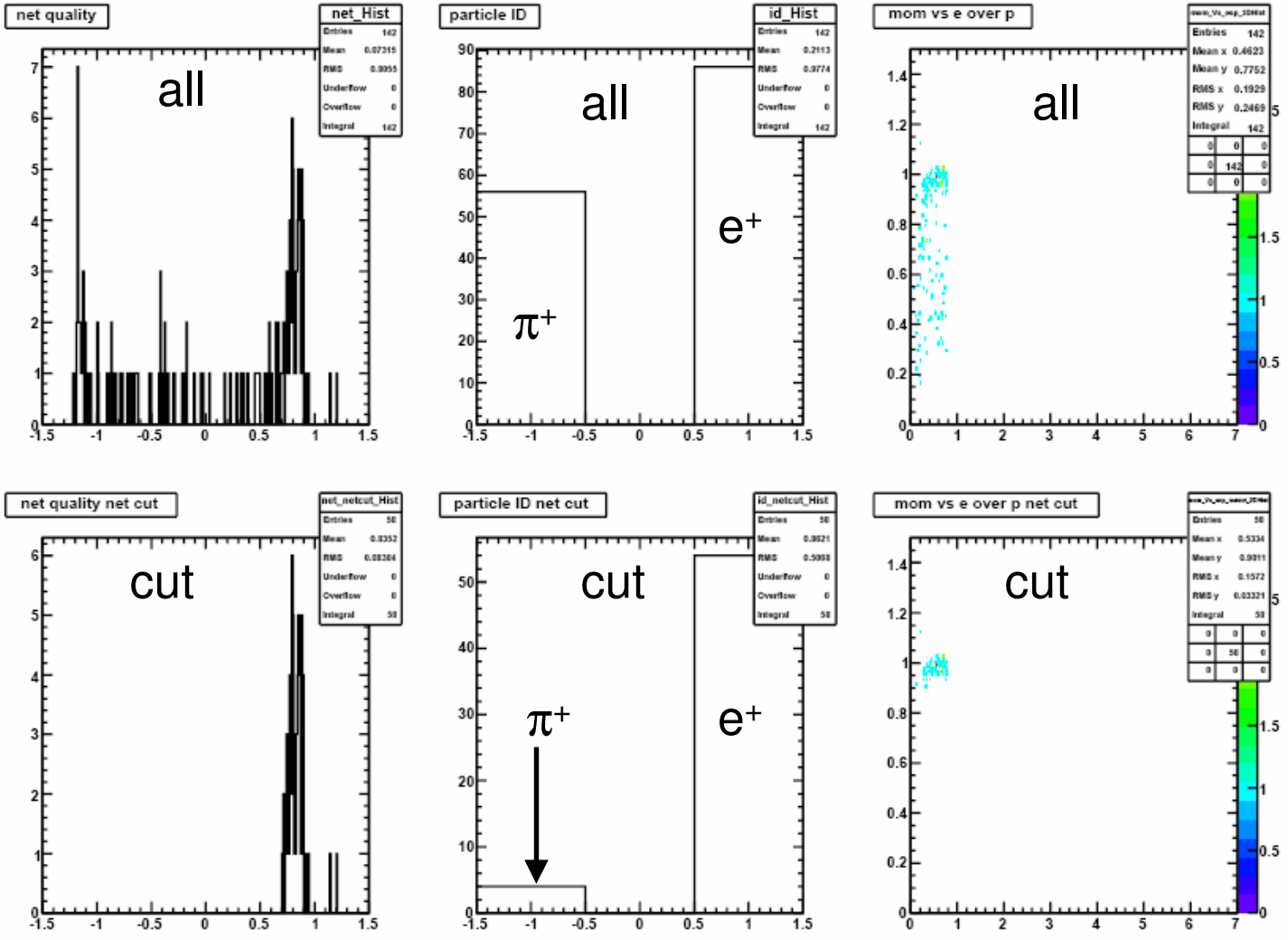


cut: net output > 0.7

	# e^+	# π^+
all	**767**	**357**
identified as e+	**707 (92,2%)**	**5 (~1,4%)**

Electron ID with the EMC (barrel)

Test sample (momentum < 0.8 GeV/c)

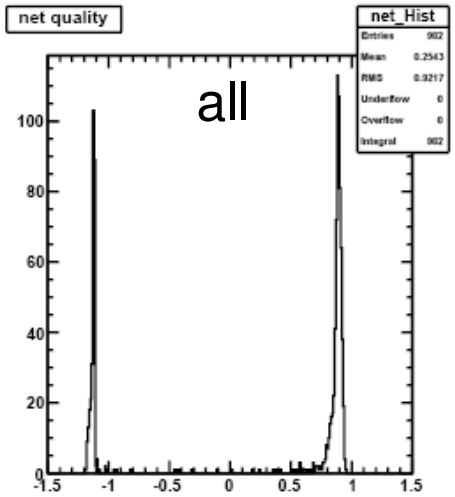


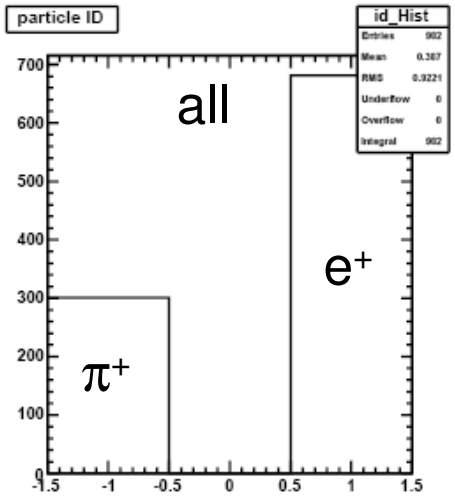
cut: net output > 0.7

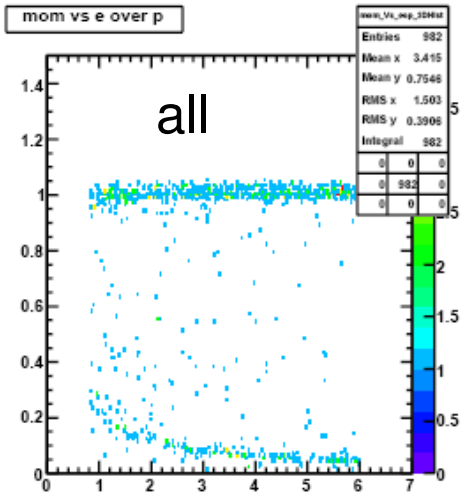
	# e^+	# π^+
all	**86**	**56**
identified as e+	**54 (62,8%)**	**4 (~7,4%)**

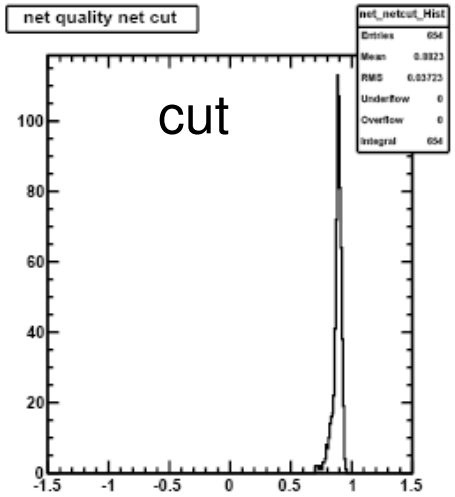
Electron ID with the EMC (barrel)

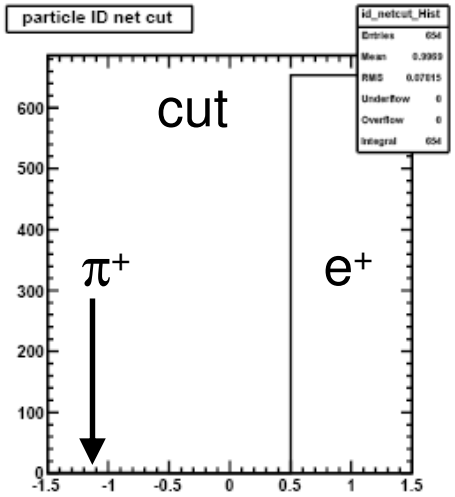
Test sample (momentum > 0.8 GeV/c)

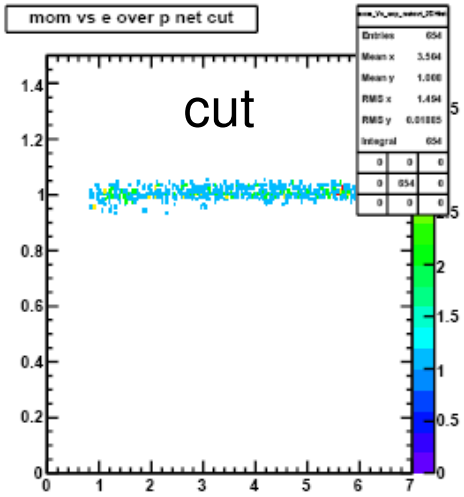












cut: net output > 0.7

	# e^+	# π^+
all	**681**	**301**
identified as e+	**653 (95,5%)**	**1 (~0,33%)**

Electron ID with the EMC (barrel)

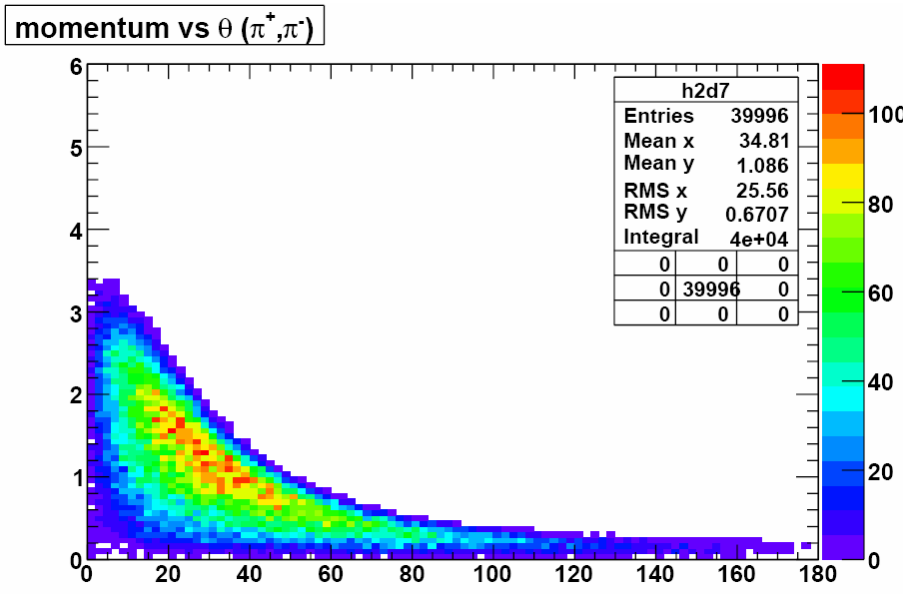
Conclusion and outlook

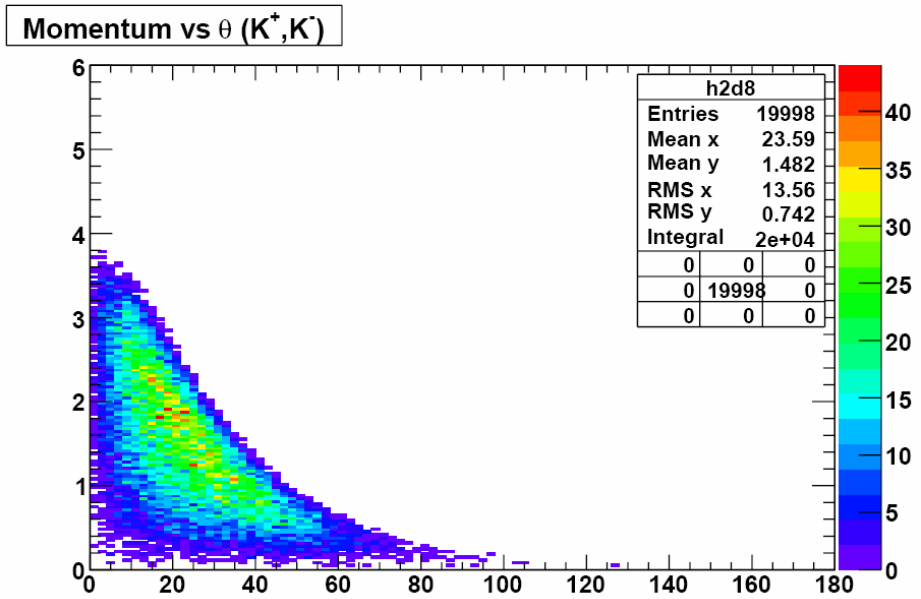
- Electron ID via e/p and shower shape seems to work
- PID for p < 0.8 GeV/c still not sufficient
- improvements for the training of the neuronal network necessary
  - more statistics needed (for training and testing)
  - also K, p and μ should be taken into account
  - other/further input parameters ?
  - complete tracking and track matching should be included
  - handle p > 0.7 GeV/c and p < 0.8 GeV/c seperately
  - combination with other detectors (e.g. dE/dx, tof, cherenkov)
- studies with different crystal sizes

Kinematics of the benchmark channels

- Already available
  - DPM @ 1.5 GeV/c and @ 15 GeV/c
  - $\bar{p}p \rightarrow \Psi(4040) \rightarrow D^* \bar{D}^*$

$\bar{p}p \rightarrow \Psi(3770) \rightarrow D^+ D^- \rightarrow 2K\,4\pi$ @ 6.57 GeV/c

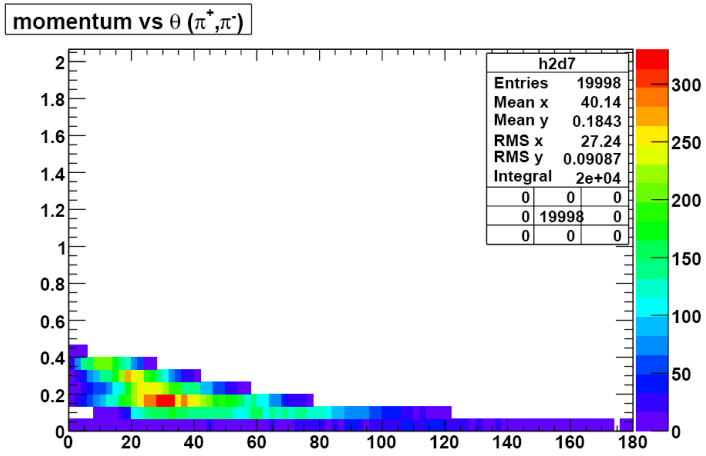


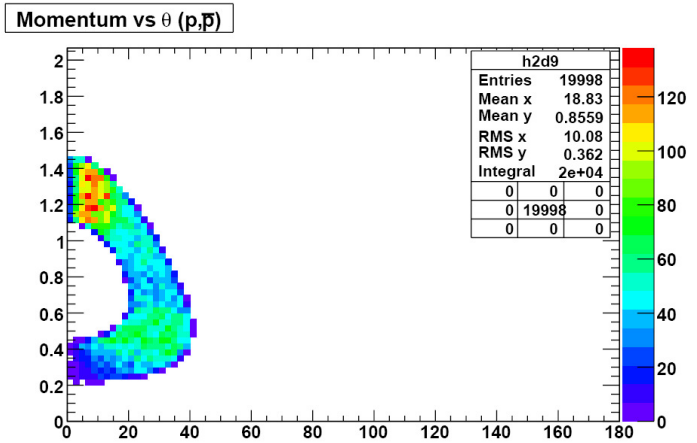


Kinematics of the benchmark channels

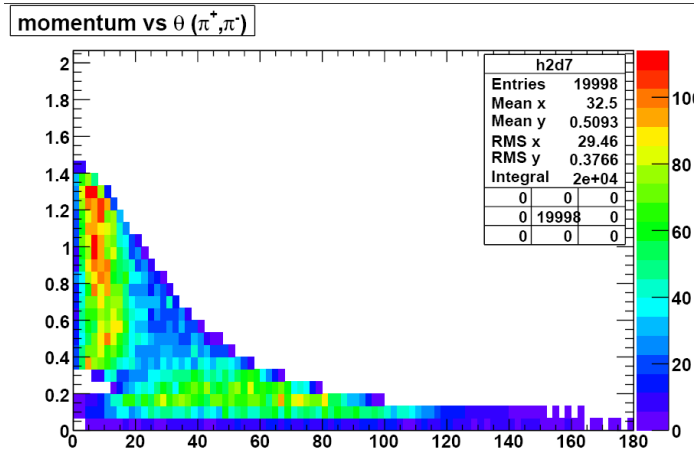
$\bar{p}p \rightarrow \Lambda \bar{\Lambda} \rightarrow p\,\pi^-\ \bar{p}\,\pi^+$

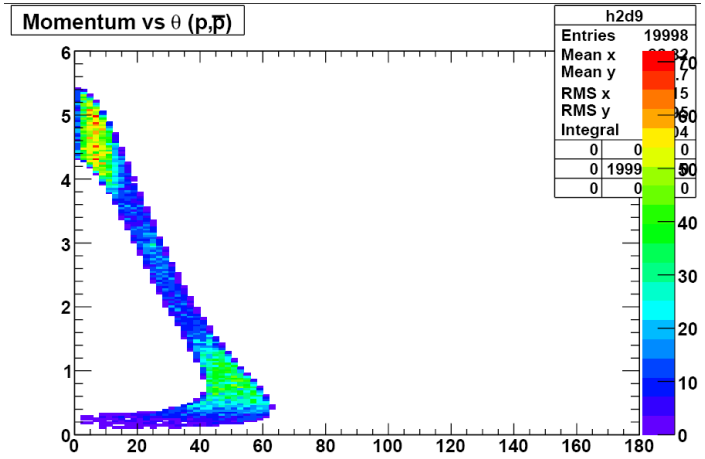
@ 1.92 GeV/c





@ 6.0 GeV/c

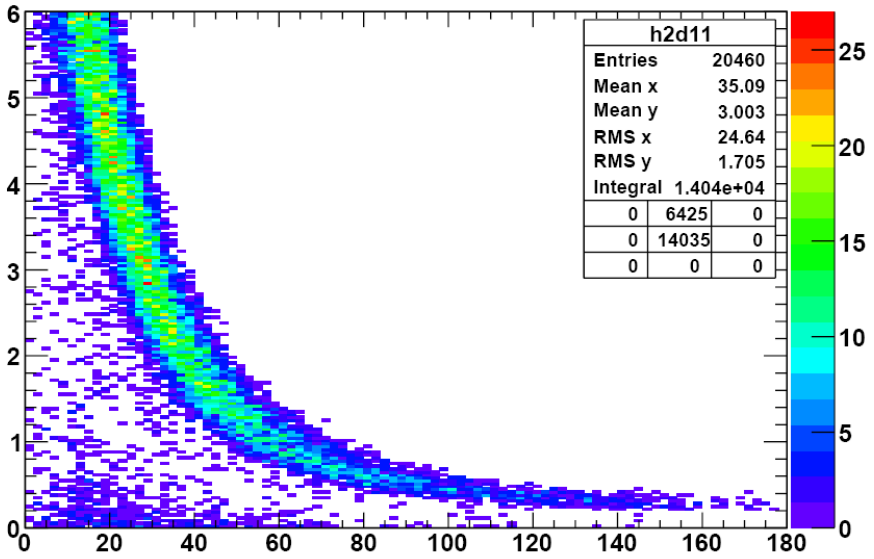




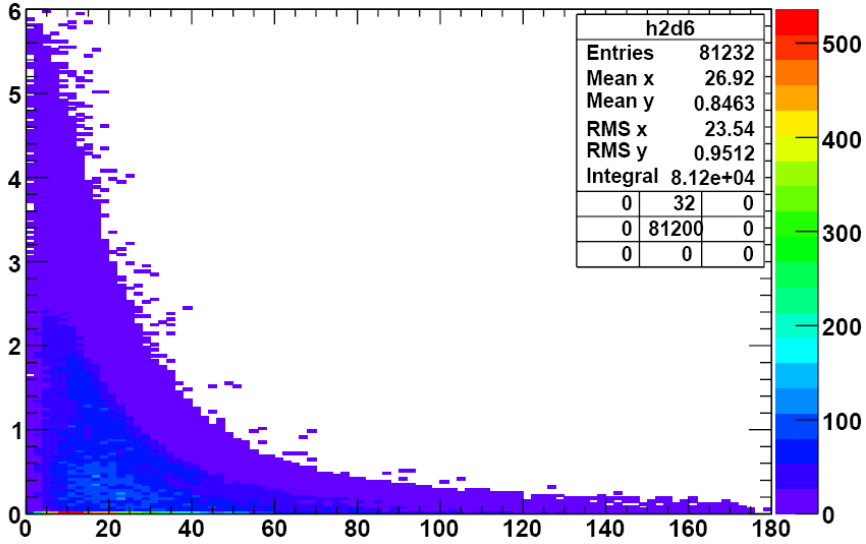
Kinematics of the benchmark channels

$\bar{p}p \rightarrow \Psi_g \eta \rightarrow \chi_{c1} (\pi^0\pi^0)_S \eta \rightarrow J/\Psi \gamma (\pi^0\pi^0)_S \eta \rightarrow e^+ e^- 7\gamma$ @ 15 GeV/c

Momentum vs θ (e^-,e^+)



Momentum vs θ (γ)



- Still not available
  - $\bar{p}p \rightarrow \Phi\Phi \rightarrow 4K$ @ 3.68 GeV/c
  - $\bar{p}p \rightarrow K_S K \pi$ @ 3.68 GeV/c
  - $\bar{p}p \rightarrow \gamma\gamma$ (important for PID?)
  - $\bar{p}p \rightarrow \pi^0 \pi^0 \eta \rightarrow 6\gamma$ (important for PID?)