PID with the EMC

- First Electron ID studies with the EMC
  - e/p and shower shape
  - neuronal network

- Some thoughts on Kaon ID with the EMC
  - momentum range <0.8 GeV/c

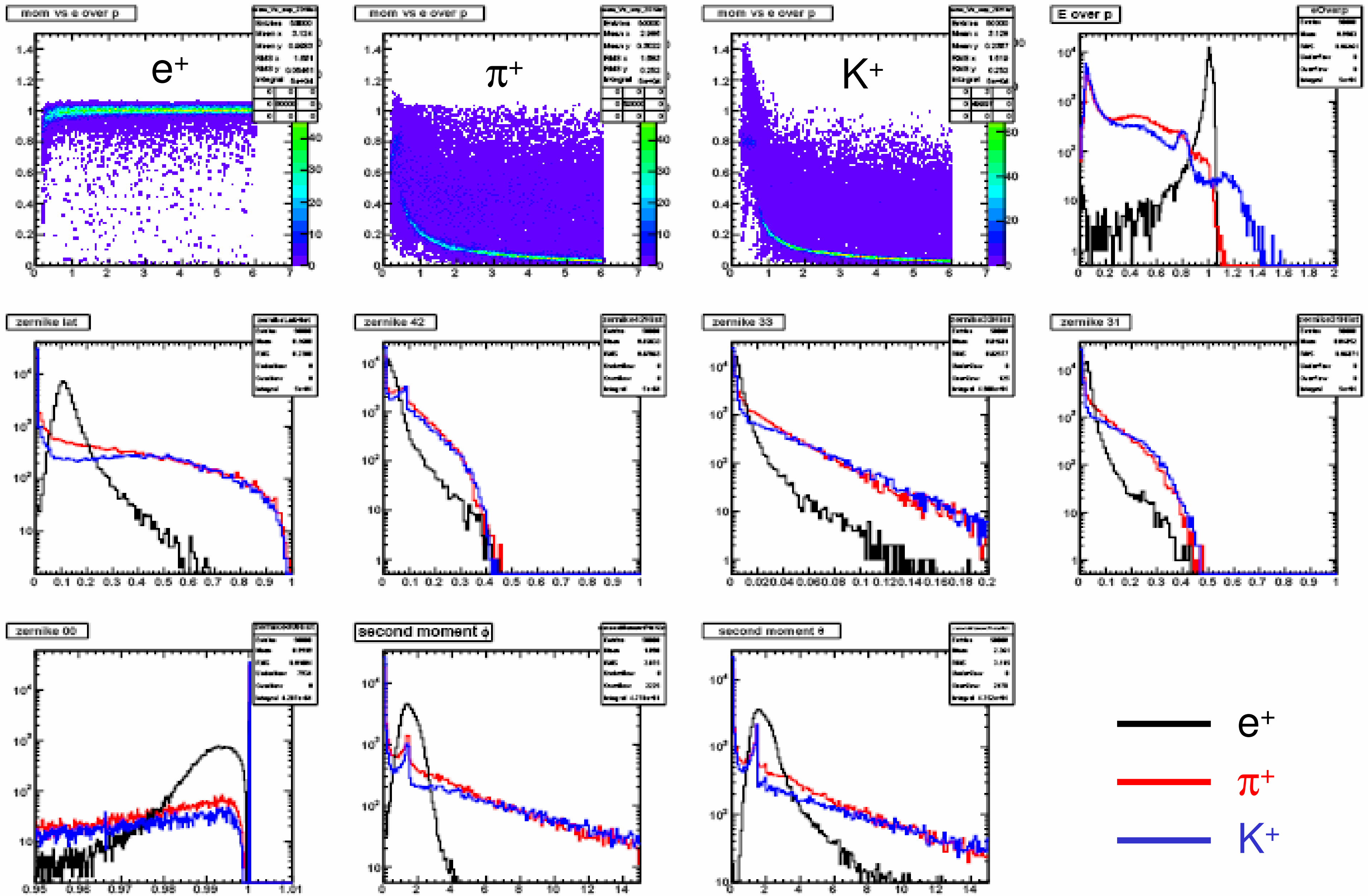
Electron ID with the EMC

- Full simulation chain in BaBar like software
  - G4 simulation with the complete detector, digitization, full reconstruction for the EMC
  - single particles between 0.2 … 6.0 GeV/c and cos(Θ) = -0.7 … 0.7
    - appr. 100k e^+ , π^+ , K^+ each

- 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 momenta)
    - 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



Electron ID with the EMC

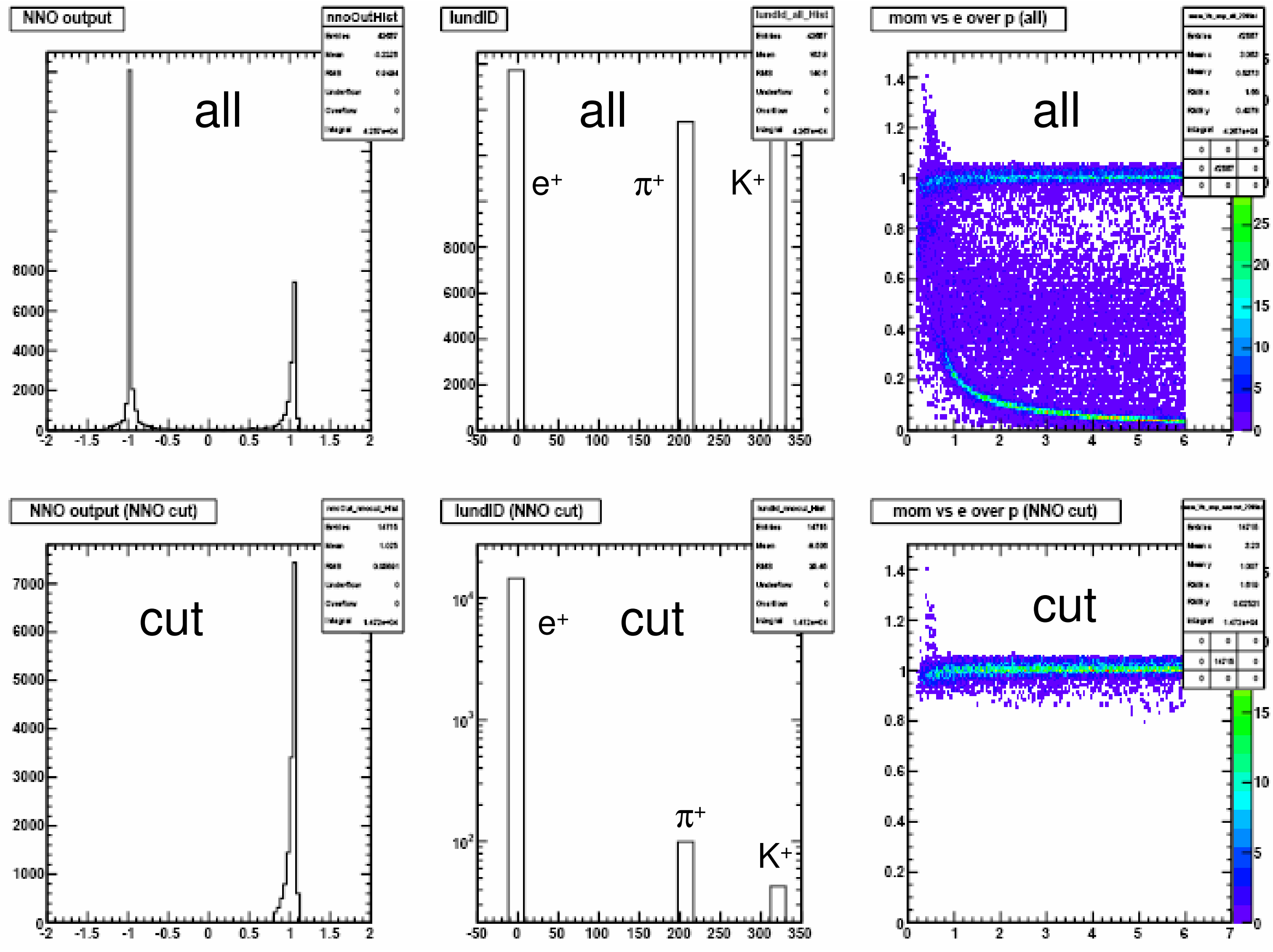
- Suitable properties for electron ID
  - e/p, p, Zernike momenta of the cluster

- 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: ~90k for e^+, π^+, K^+ each
    - test files: ~15k for e^+, π^+, K^+ each
    - 9 input parameters: e/p, p, Zernike00, 31, 33, 42 and Zernike lateral, 2. momentum Φ, 2. momentum Θ

Electron ID with the EMC

Test sample (all)



cut: net output > 0.8

	all	identif. as e+
# e^+	15731	14573 92,6%
# π^+	13484	99 0,73%
# K+	13452	43 0,31%

Electron ID with the EMC

all

	all	identif. as e+
# e^+	15731	14573 92,6%
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# K+	13452	43 0,31%

$p < 0.8$ GeV/c

	all	identif. as e+
# e^+	1499	982 65,5%
# π^+	1523	23 1,5%
# K^+	1030	40 3,9%

$p > 0.8$ GeV/c

	all	identif. as e+
# e^+	14232	13591 95,5%
# π^+	11961	76 0,64%
# K^+	12422	3 ~0,02%

Conclusion and outlook

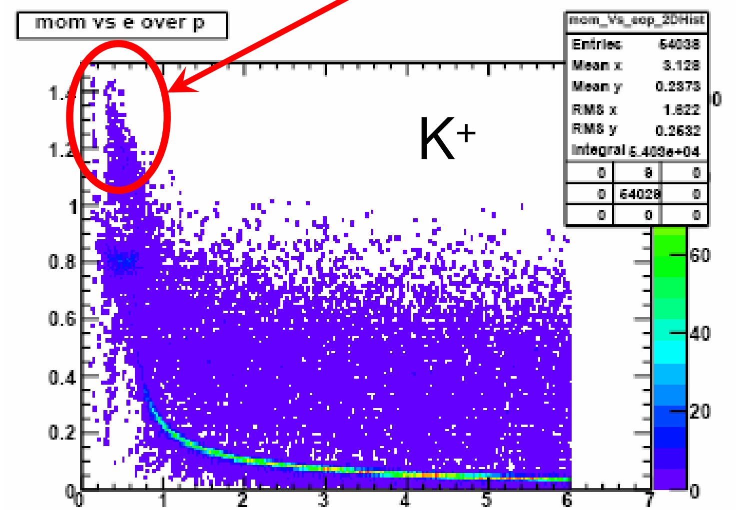
- Electron ID via e/p and shower shape seems to work
- p < 0.8 GeV/c: background >1% for the same fluxes
- p > 0.8 GeV/c: background <1% for the same fluxes
- improvements possible
  - also p and μ should be taken into account
  - complete tracking and track matching should be included
  - combination with other detectors (e.g. dE/dx, tof, cherenkov)
- studies with different crystal sizes

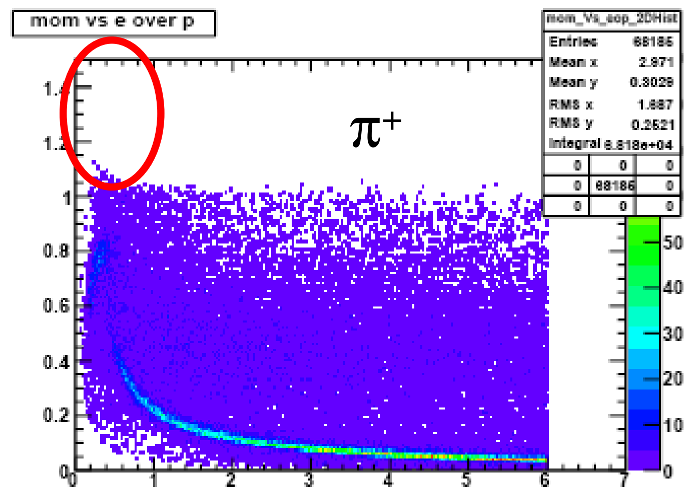
Kaon ID with the EMC for p < 0.8 GeV/c

- p<0.8 GeV/c: K+ and π+ stop in crystals and decay afterwards

- Decay modes:
  - π^+ via $\mu^+ \nu_\mu$ (~100%)
  - K^+ via $\mu^+ \nu_\mu$ (~64%) and via $\pi^+\pi^0$ (~22%)

K^+ should deposit more energy via this decay mode!





Kaon ID with the EMC for p < 0.8 GeV/c

Cross check

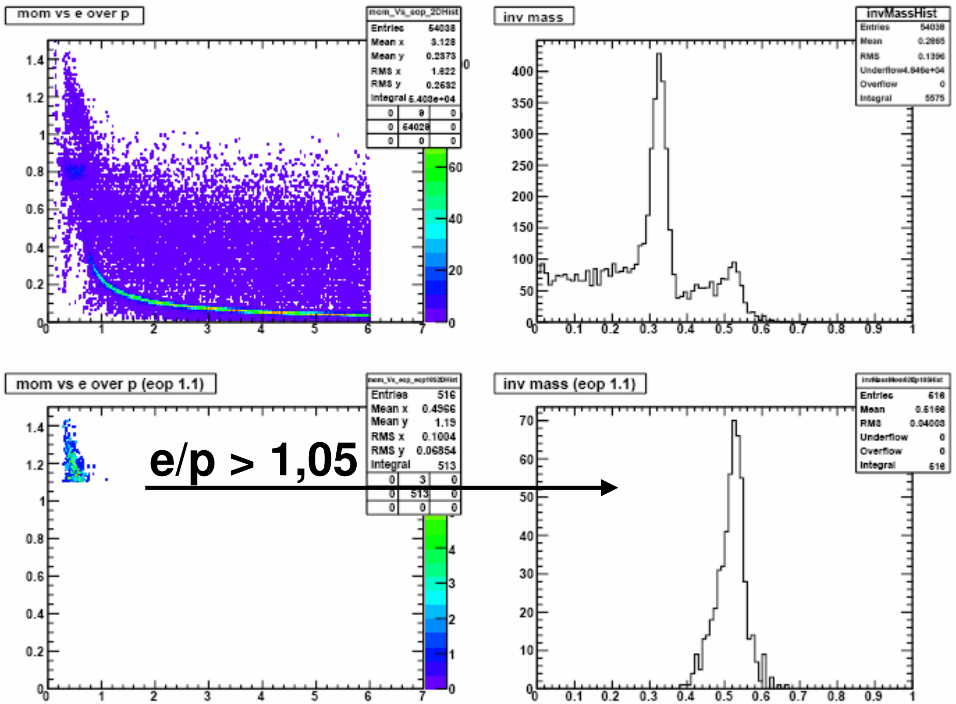
- With hypothesis $K^+ \rightarrow \pi^+\pi^0$ calculation of invariant mass possible
  $\rightarrow$ appr. $E_{Cluster} - E(K+)_{kin} + M(\pi^+)$

measured with EMC

measured via tracking

known

K^+



π^+