Shower shape analysis for pi0 - photon separation

Vanniarajan S, Johan Messchendorp, M.Babai, Christian Geldmann, Elwin Dijck

KVI

university of groningen

p̄anda

Outline

- High momentum pi0 - photon separation

- Zernike moments - z20

- Shower parameter - E4

- MVA Analysis

- Summary

pi0 - Opening angle
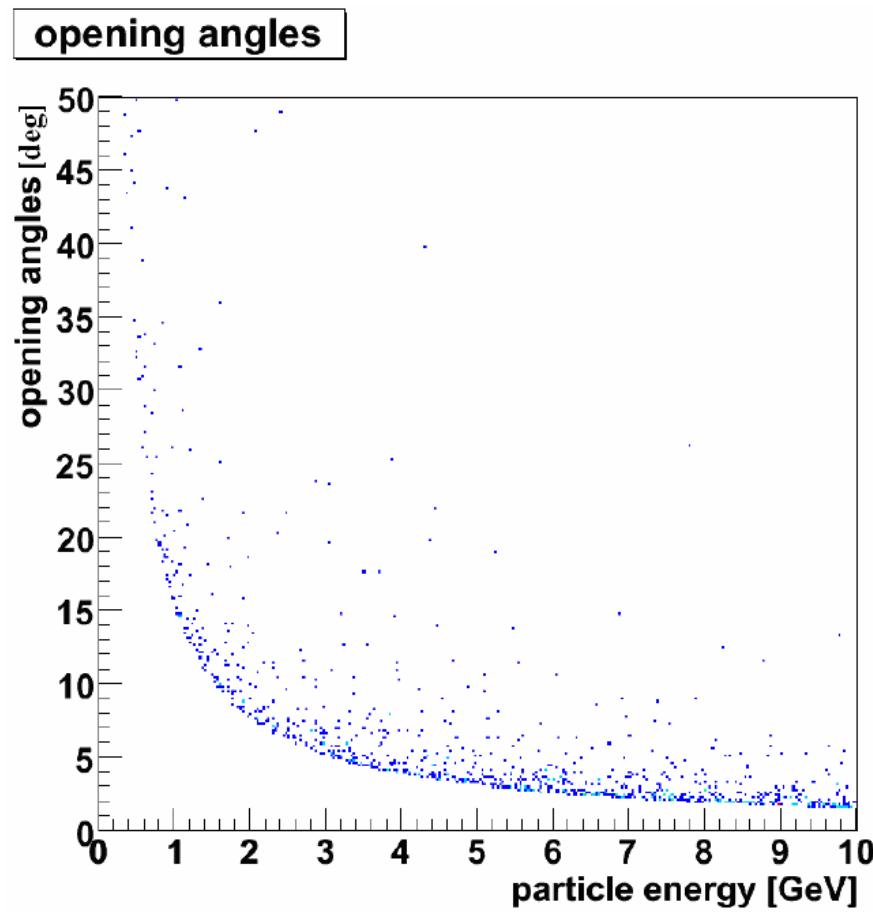
pi0 patterns

1 GeV
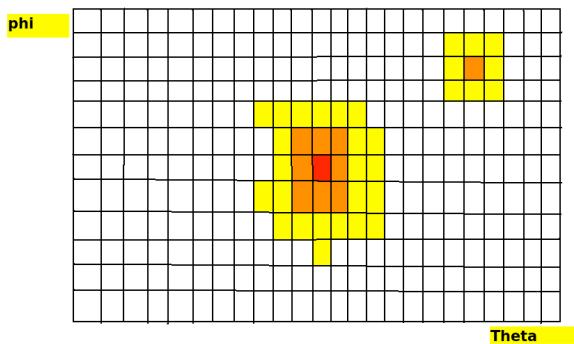
2 GeV
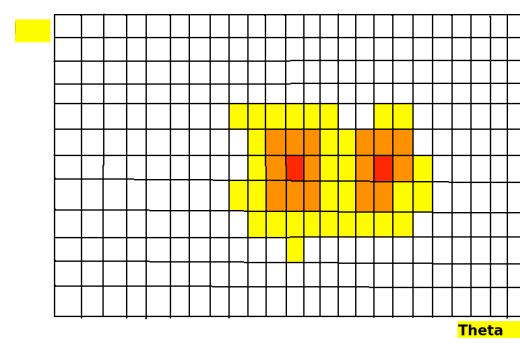
## 3 GeV
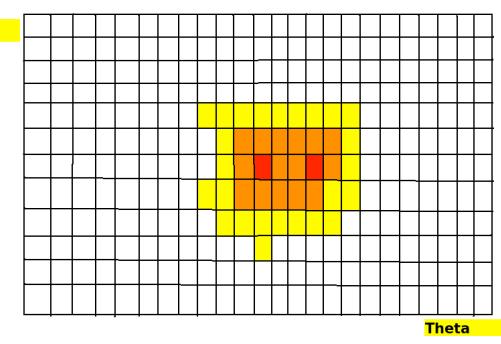
4 GeV
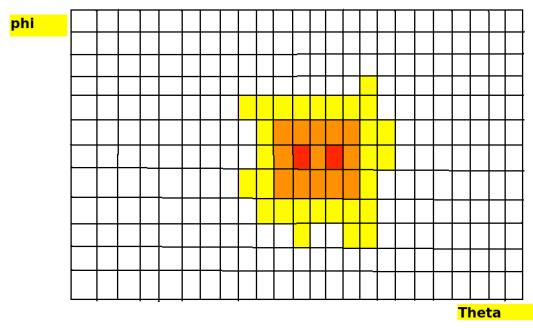
> 5 GeV
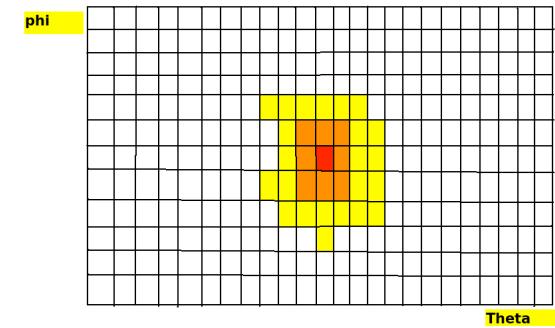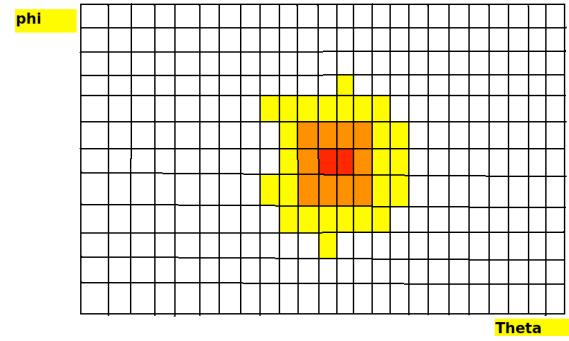
Zernike - moments

Frits Zernike
(1888-1966)

- Zernike polynomials are the complex polynomials defined on unit disk

- Describes the wave front aberrations, tilt, defocus, spherical aberration, coma, astigmatism and many more...

- Zernike moments are the discrete form of Zernike polynomials

Zernike polynomials
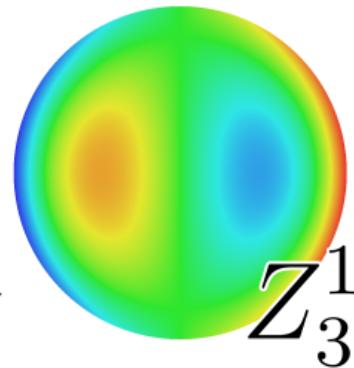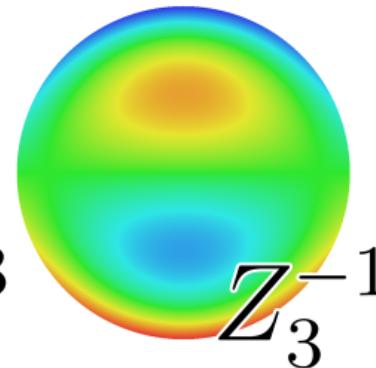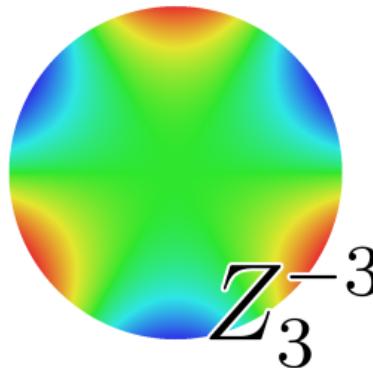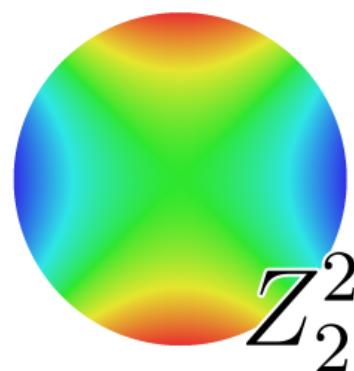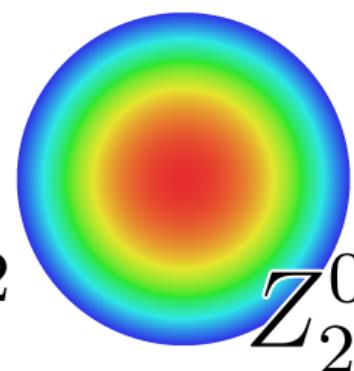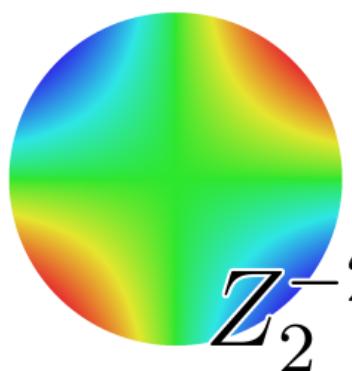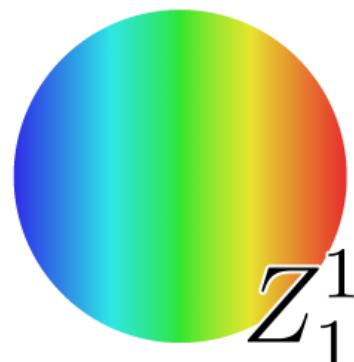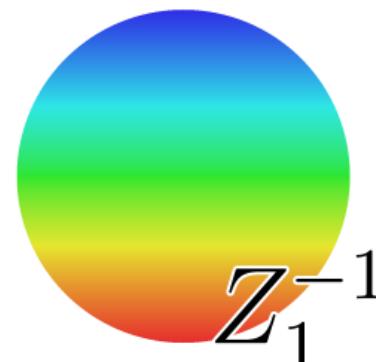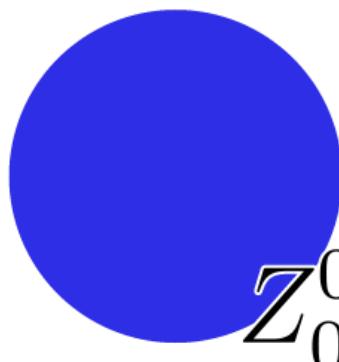
pi0 patterns

## 1 GeV
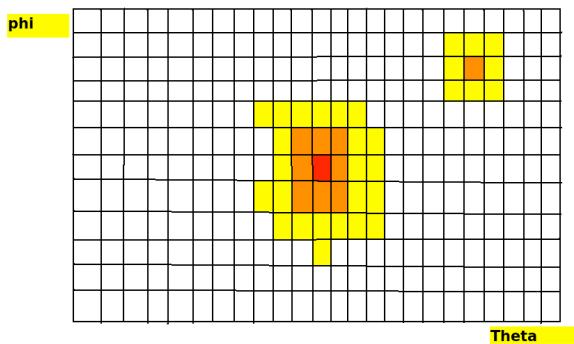
2 GeV
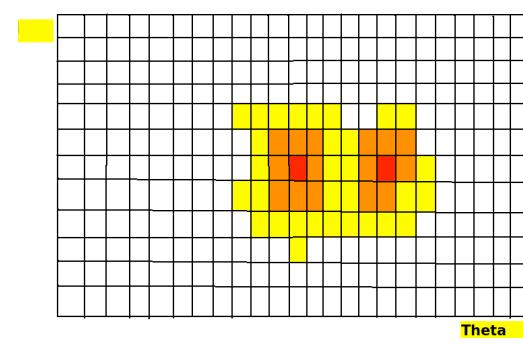
3 GeV
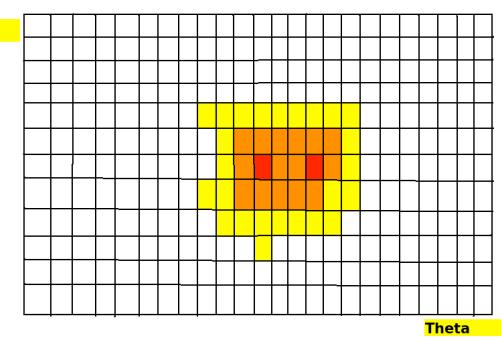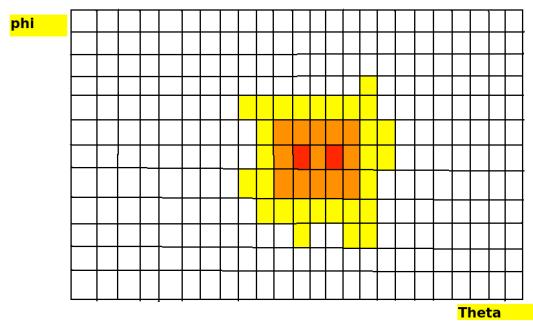
4 GeV

> 5 GeV
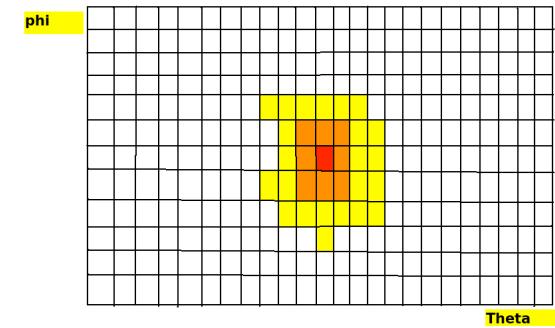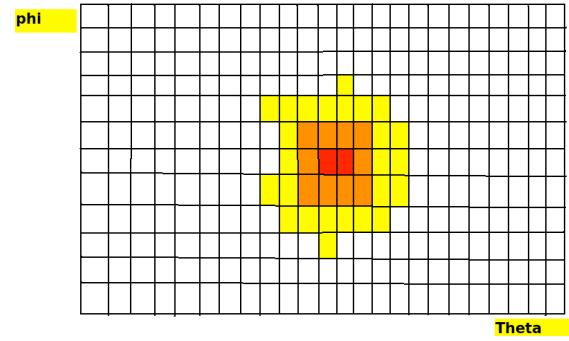
Data description

- pi0 and photon - 10^5 4 GeV, 6 GeV, 8 GeV, 10 GeV

- Phi 0 - 360 deg and Theta 50 - 150 deg

- Pandaroot - EMC

- KVI - Cluster

Z20 for pi0 - photon
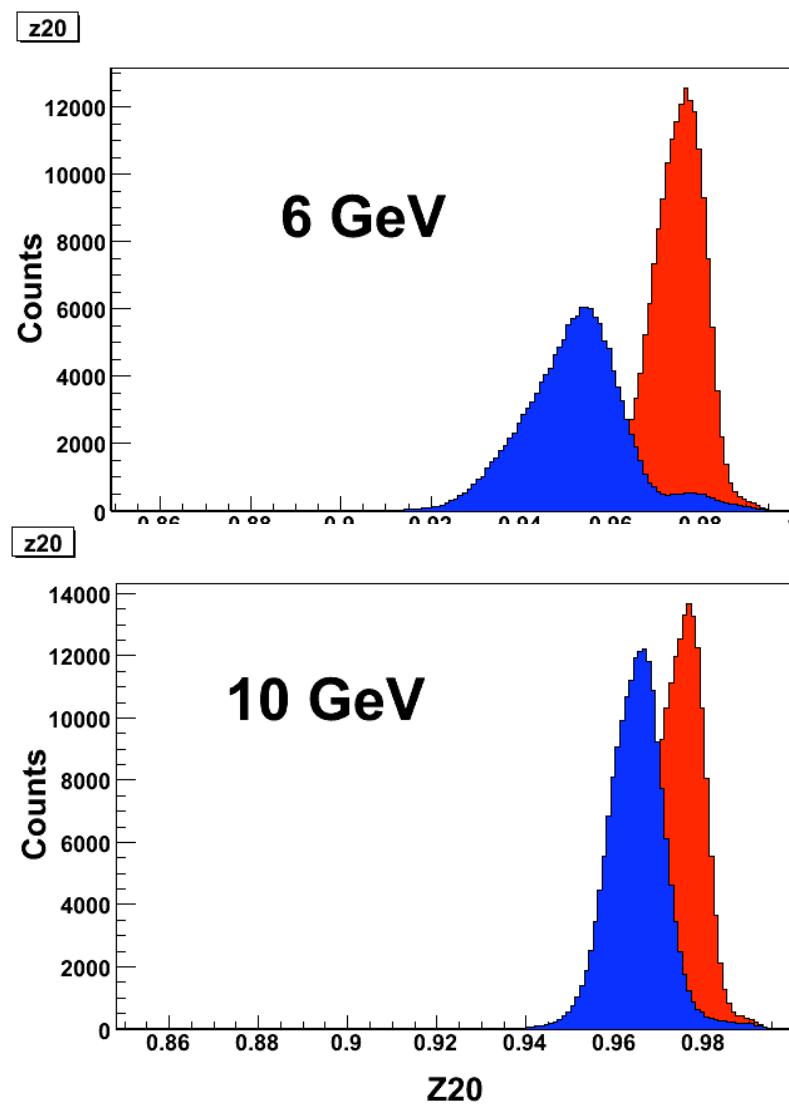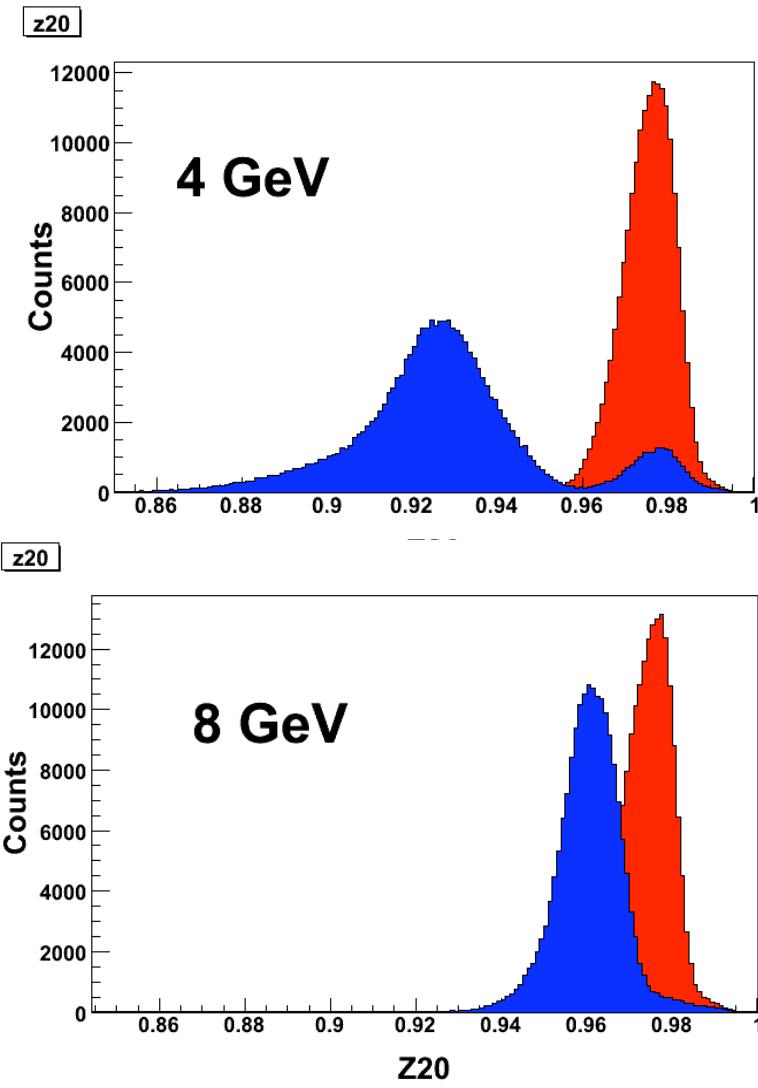
photon efficiency vs pion acceptance
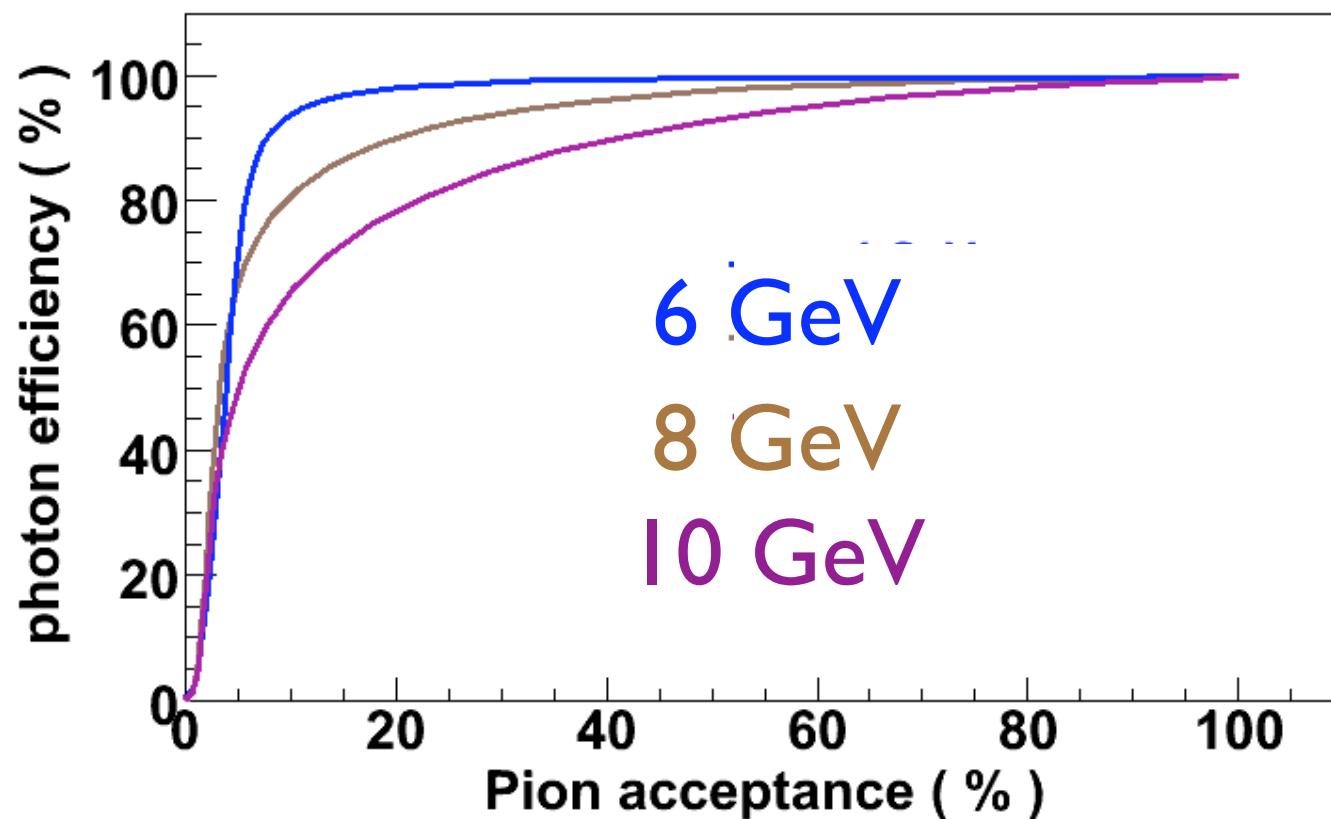
Shower spread - E4

Christian Geldmann
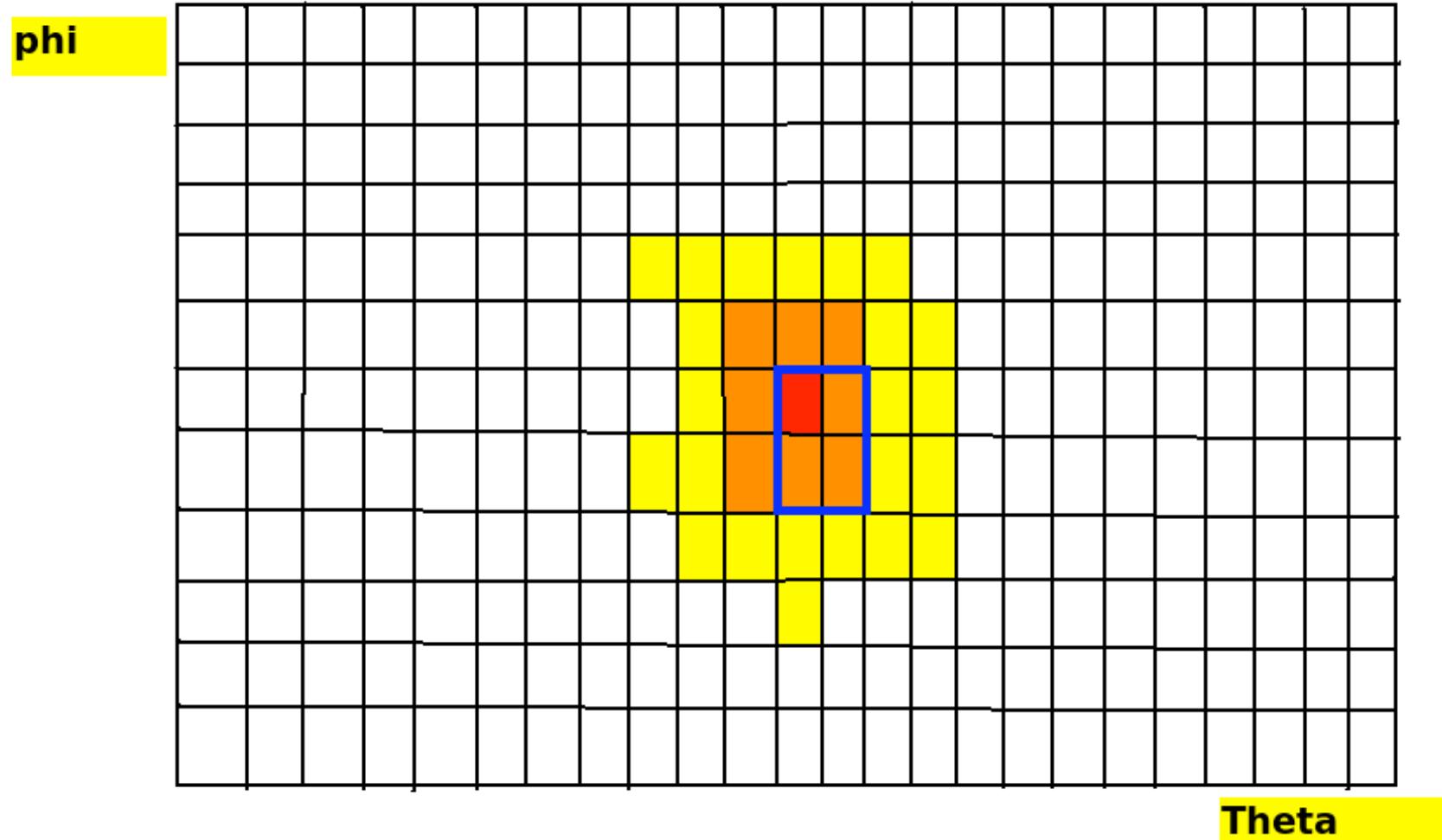
E4 - Measure of shower spread
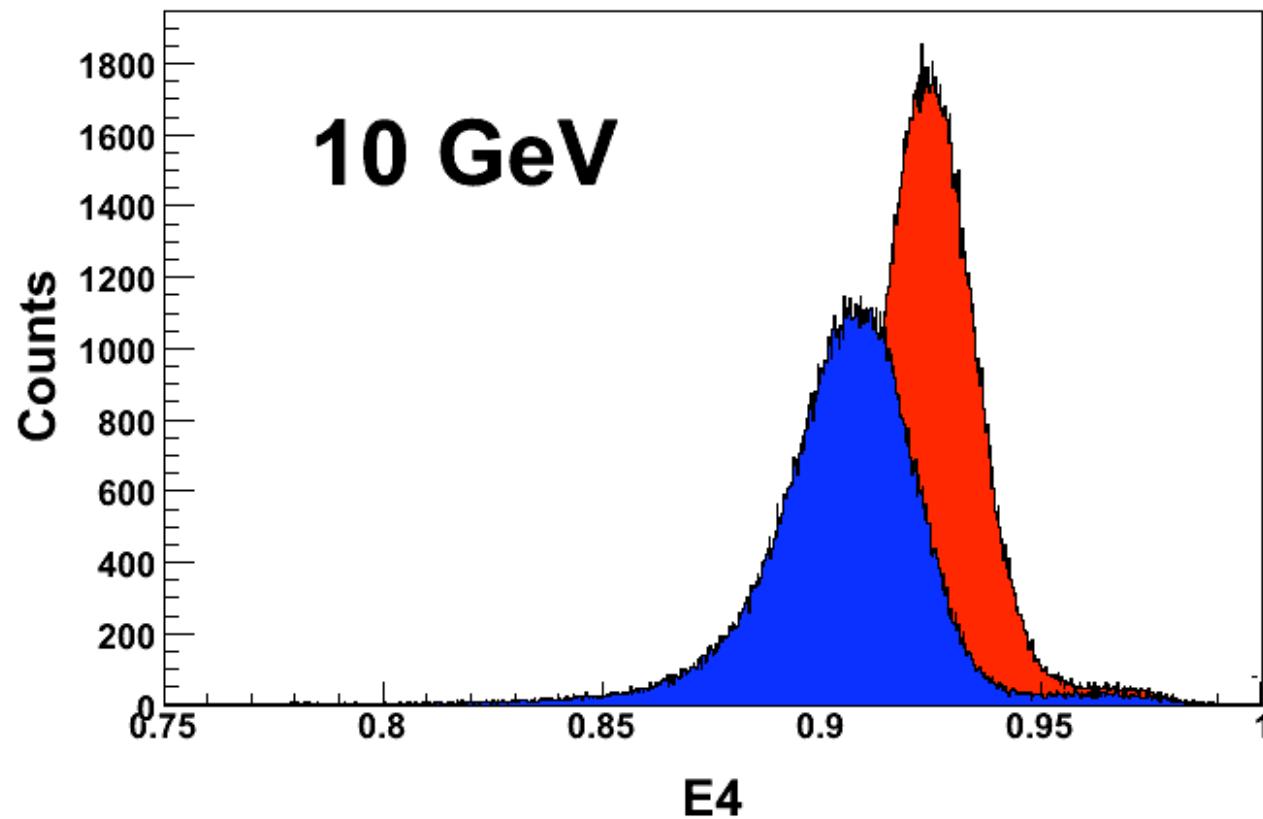
Z20 - E4 correlation
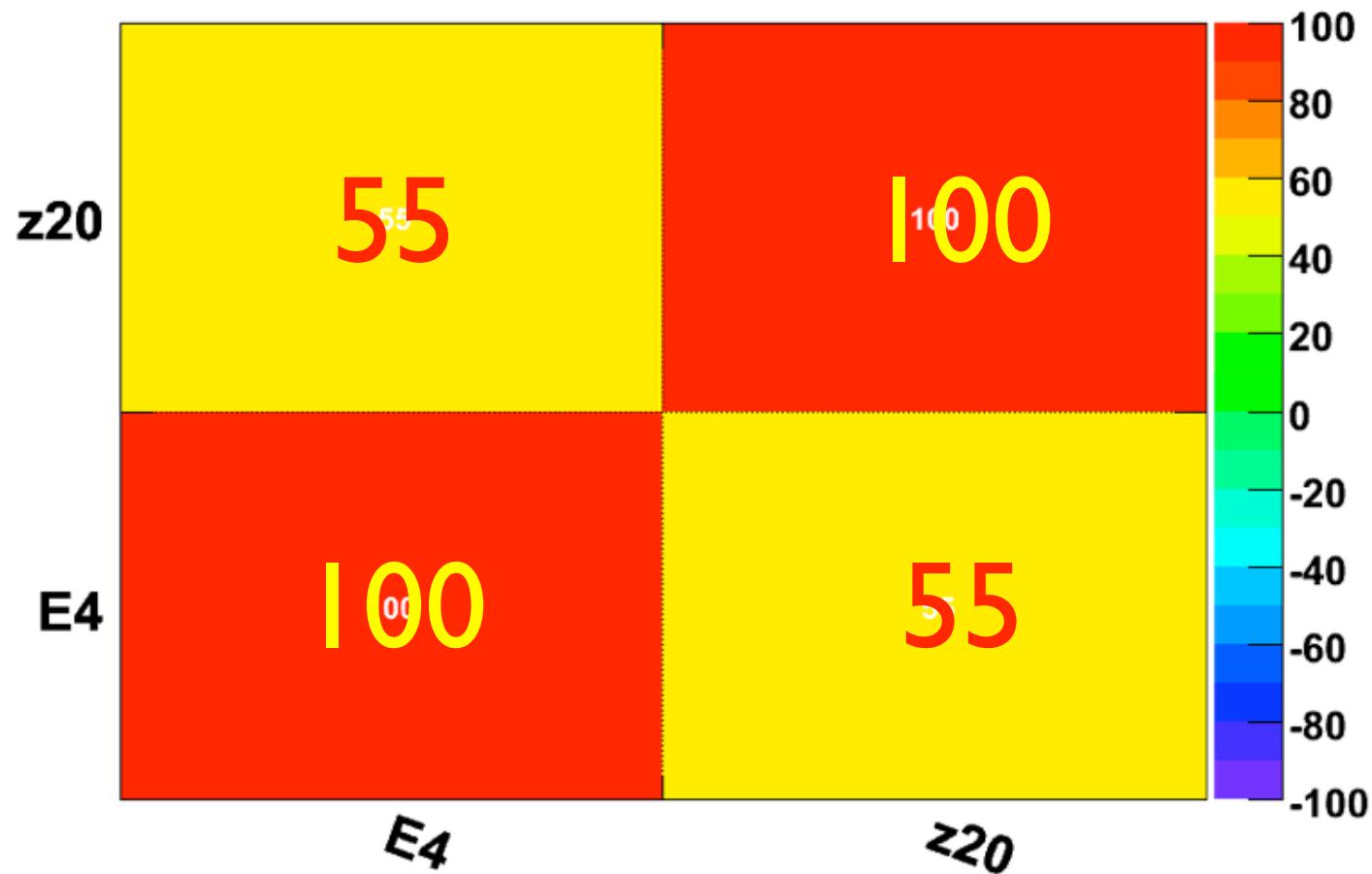
Multi dimensional density estimator
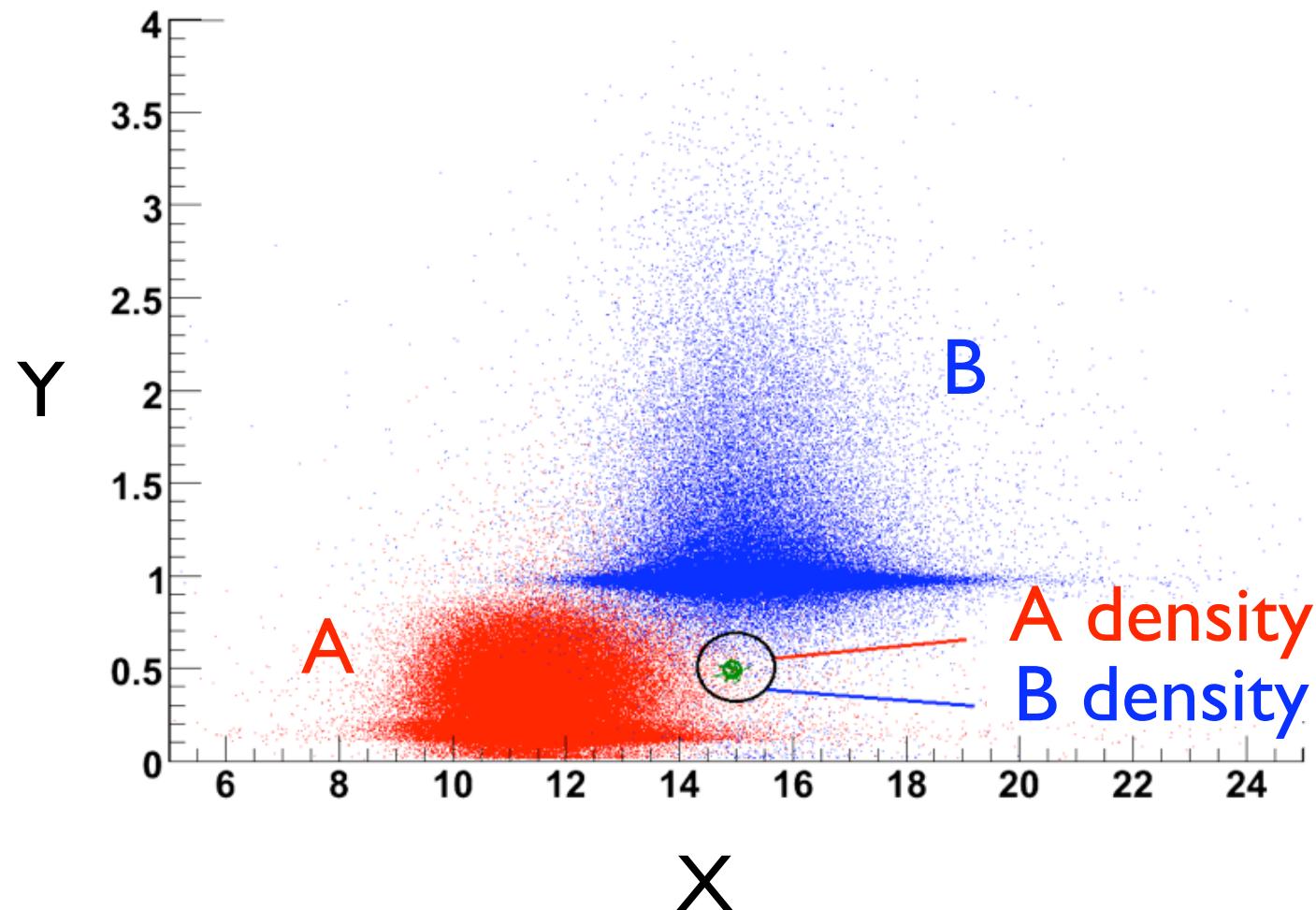
MVA extracts de correlated information
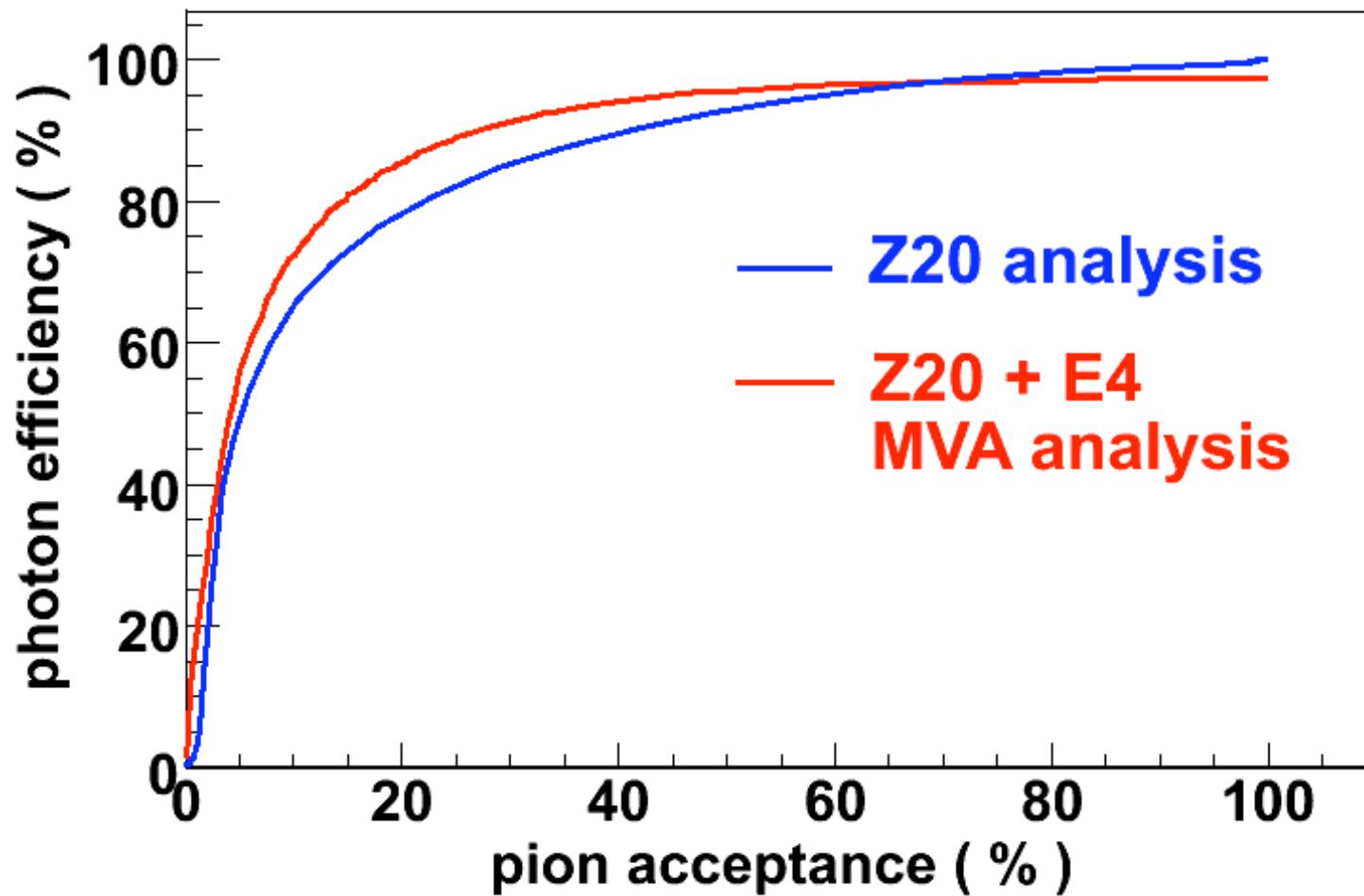
Summary

- Zernike moment - z20 distinguishes symmetric photon from asymmetric pion

- E4 - distinguishes shower spread of photon and pion

- Multivariate analysis are must for extraction of de correlated information from the parameters

- 80 % photon efficiency with 15% pion contamination

- Shower shape of off target photons are interesting aspects

Regression:
"when you fix one bug, you introduce several newer bugs."