DESY Summerstudent Program 2007

# Muon Efficiency Corrections in ZEUS

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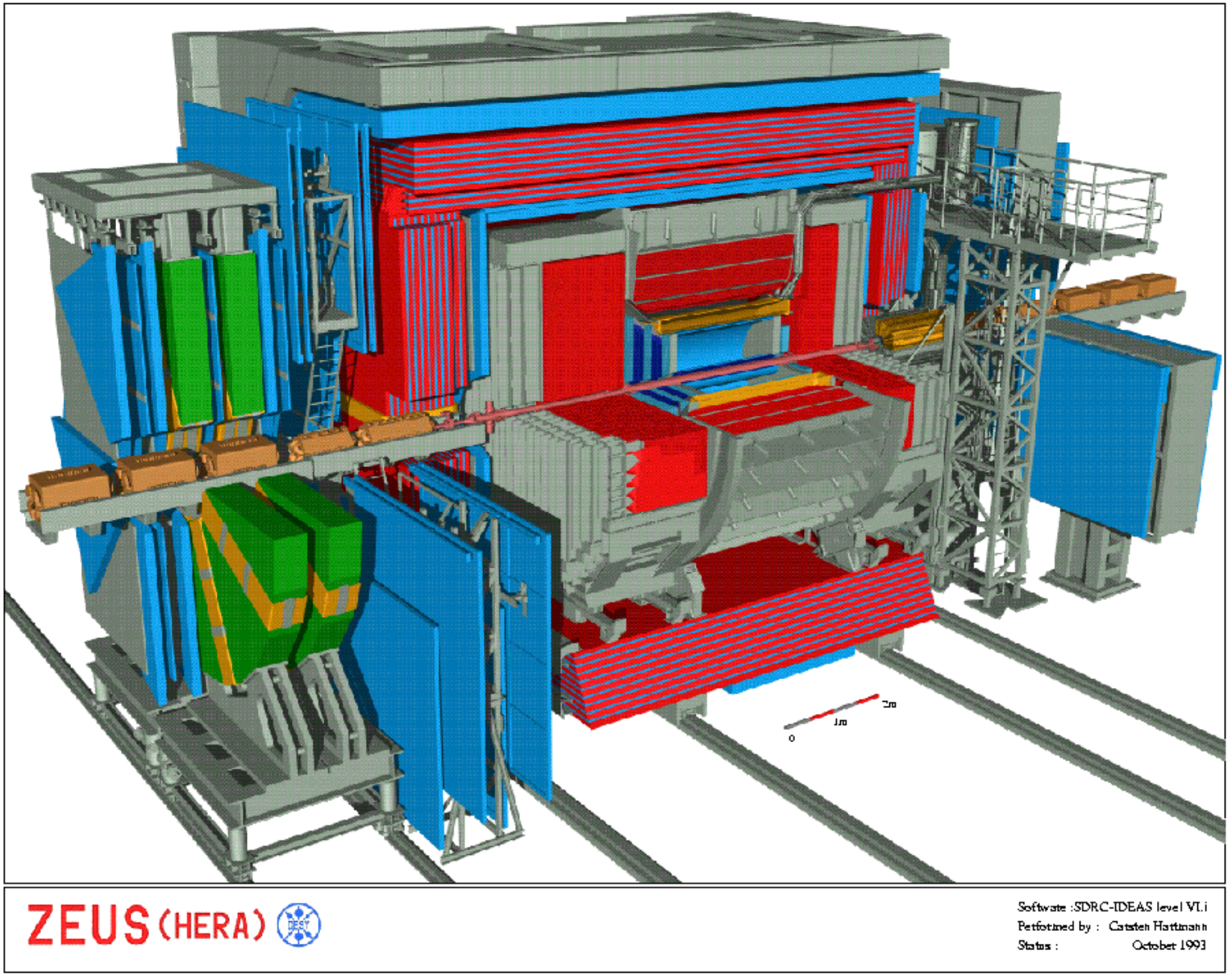
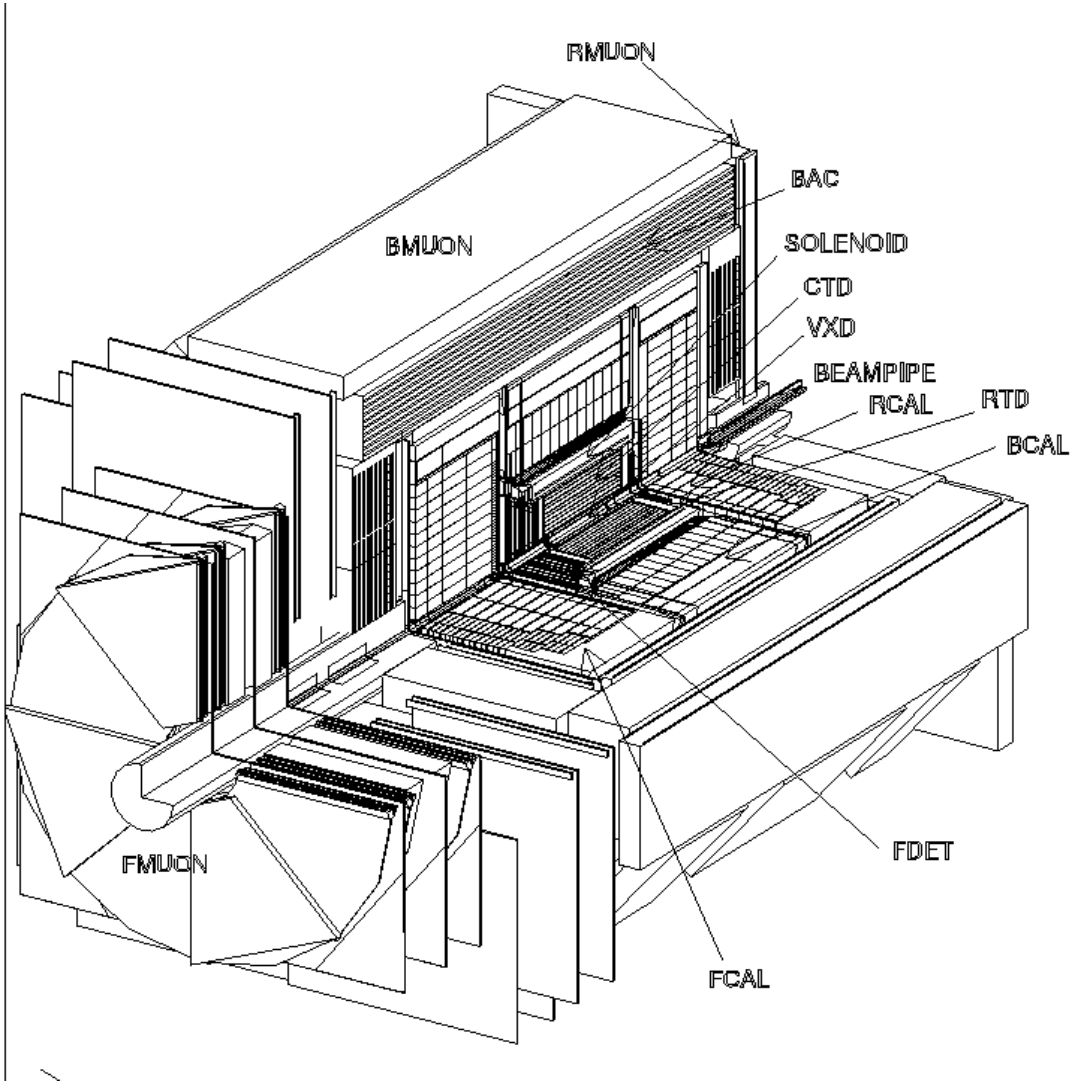
# The ZEUS Detector



# Muons in ZEUS




- Muons, as charged particles, yield tracks in the ZEUS inner tracking detectors.
- Muons, as minimum ionizing particles, loose a well defined amount of energy in the calorimeter along their trajectory
- Muons, due to their high penetration power, are usually the only particles which can reach the different element of the dedicated muon detection system.

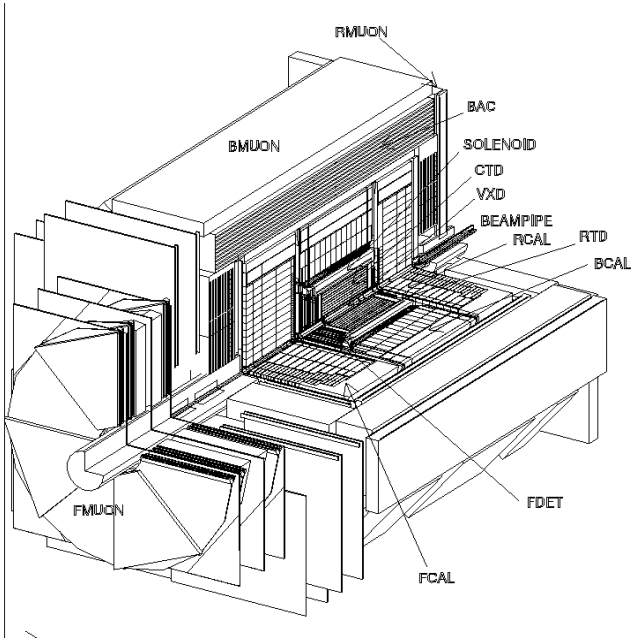
# Muon efficiency

- Not every time when a muon hits a muon detector, we get a signal (finite efficiency of the detector)
- Due to their energy lost, not every muon reachs the detector
- Both is not fully correctly implemented in Monte Carlo => efficiency is too high in MC
- => We need efficiency corrections for MC

# Muon finders in ZEUS

- There are different muon reconstruction algorithms which uses different detector components (calorimeter, muon chambers ...)
- MV: uses calorimeter MIP information
- MPMATCH: uses forward muon detector
- BREMAT: uses barrel and rear muon detector
- MUBAC: uses backing calorimeter

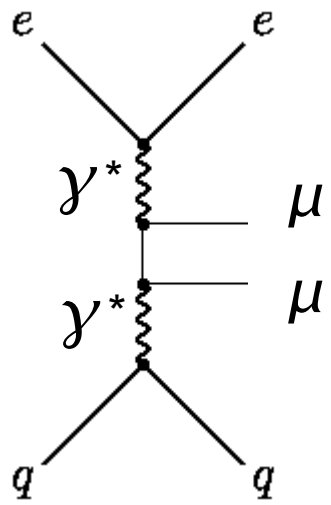
We start from muons identified by MV and use this information to determine the efficiency of the other detectors



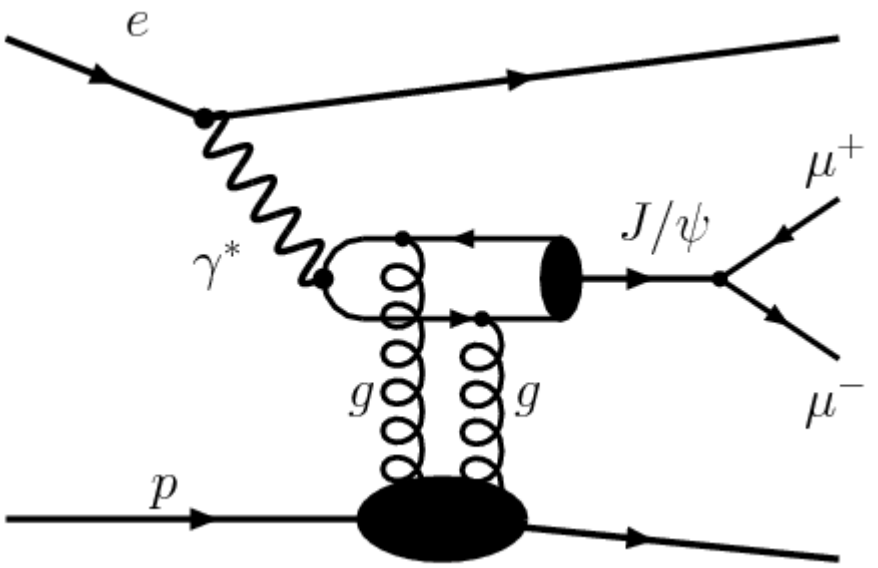
# dimuon events

• We are using dimuon events because they have a very clean signature (low background)

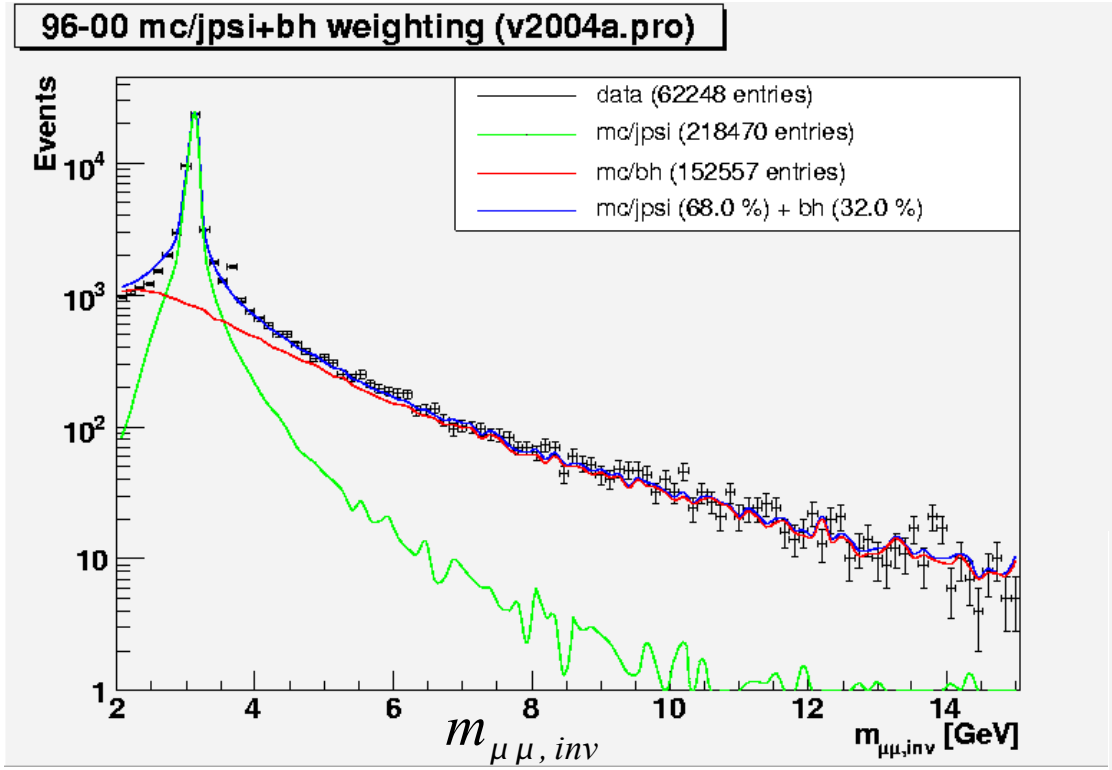
Bethe-Heidler




$J/\Psi$



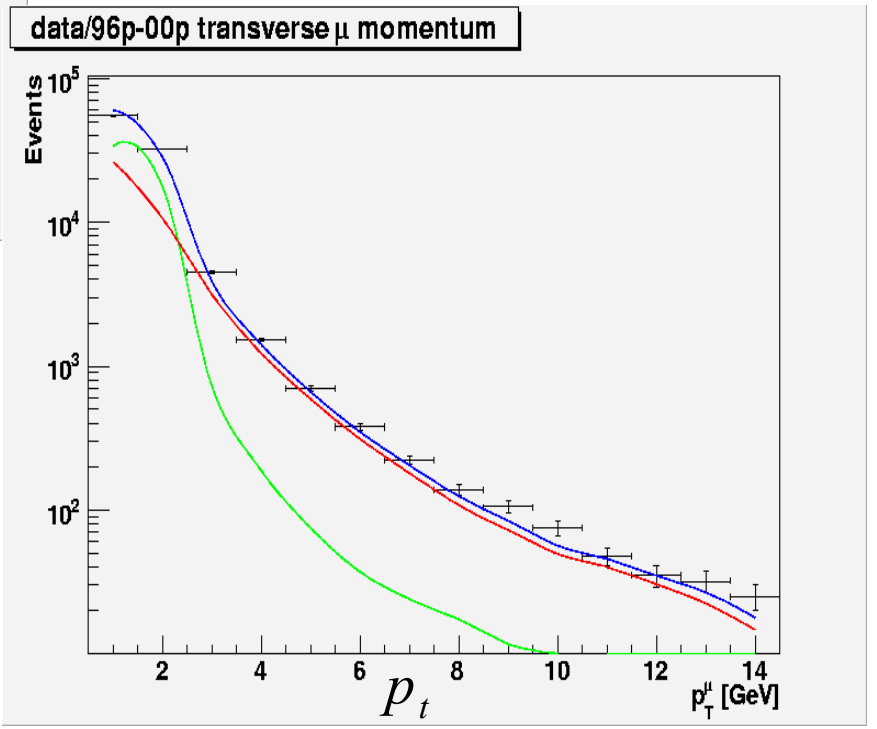
# Weighting of BH and $J/\psi$




- The invariant mass of the dimuon system is used to find the right mixture of jpsi and bh

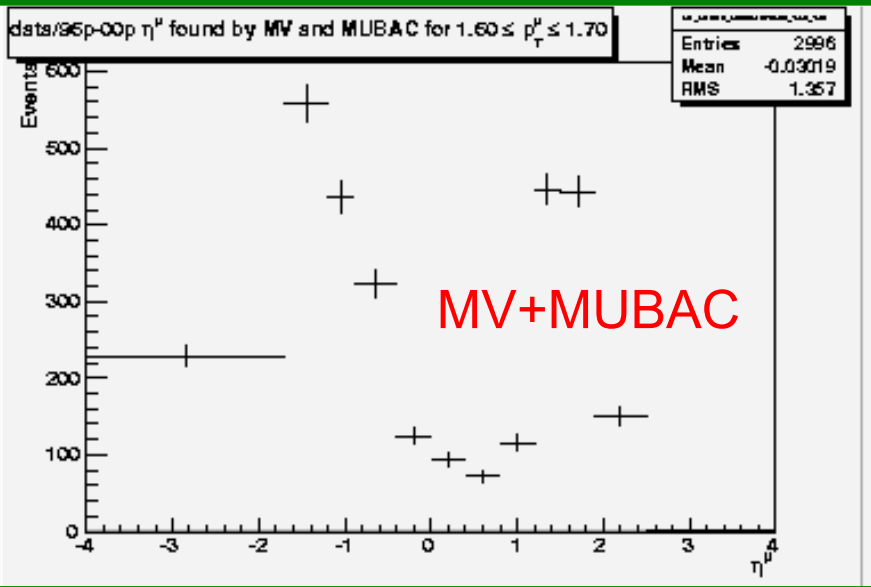
$$m_{\mu\mu,inv} = \sqrt{(E_{\mu_1} + E_{\mu_2})^2 - (p_{\mu_1} + p_{\mu_2})^2}$$

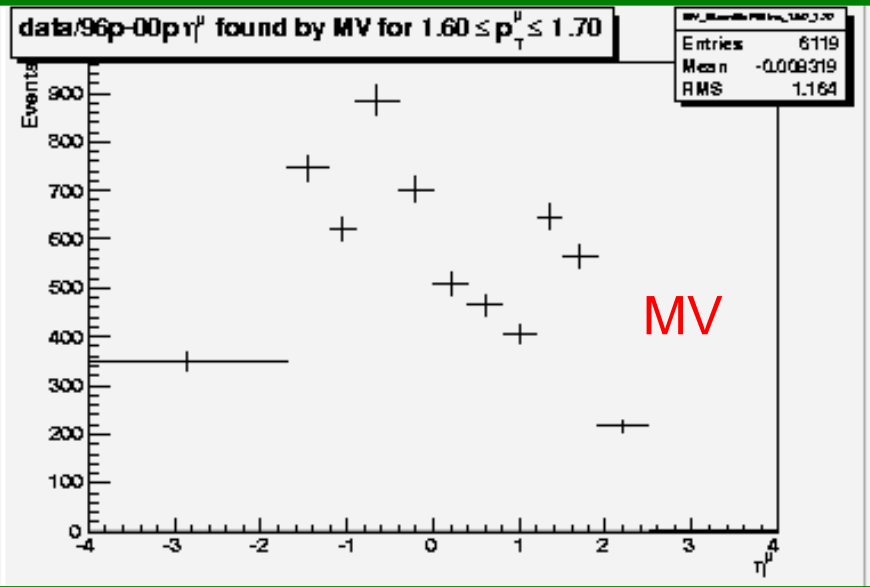
$$E_\mu = \sqrt{p_\mu^2 + m_\mu^2}$$



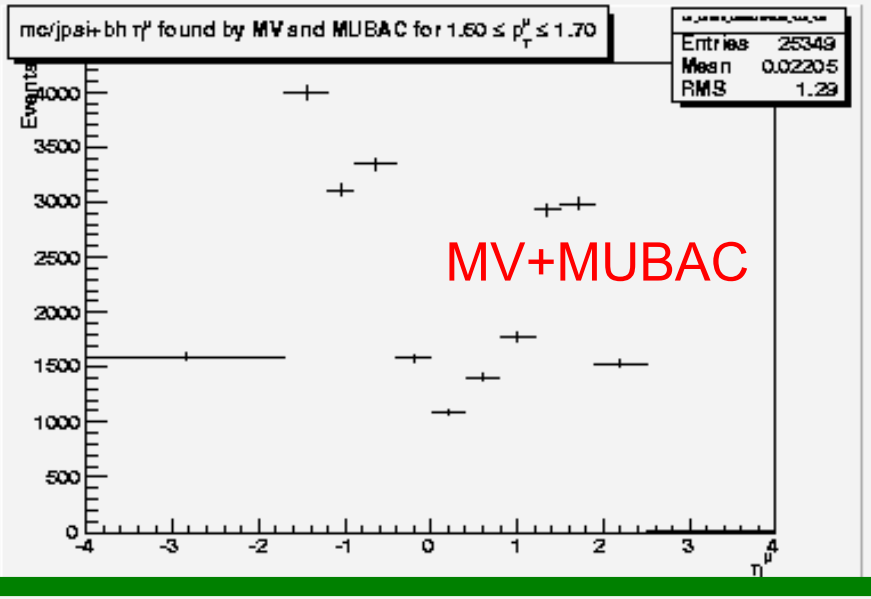

The efficiency depends on the transverse momentum
=> it's important to have the same spectrum in data and MC

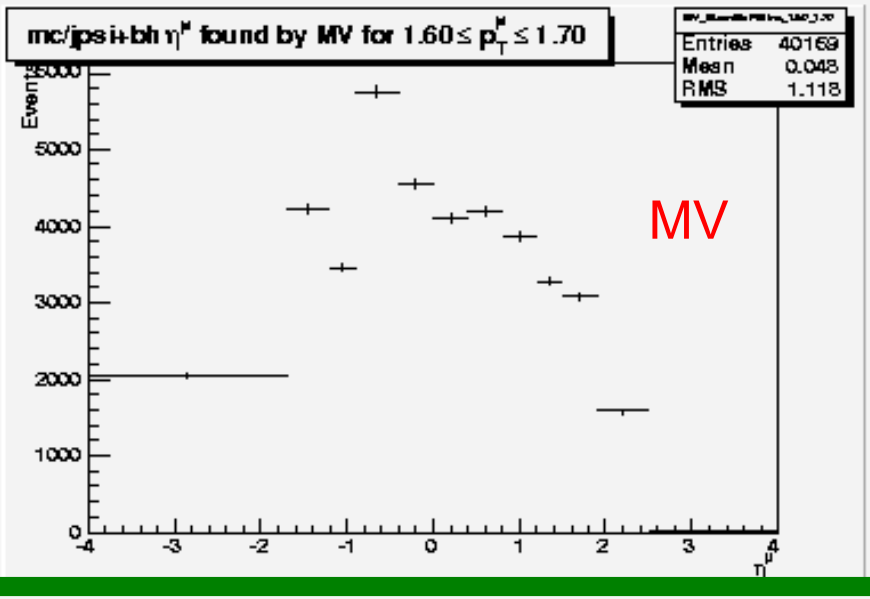
# Counting muons ...




data




MC

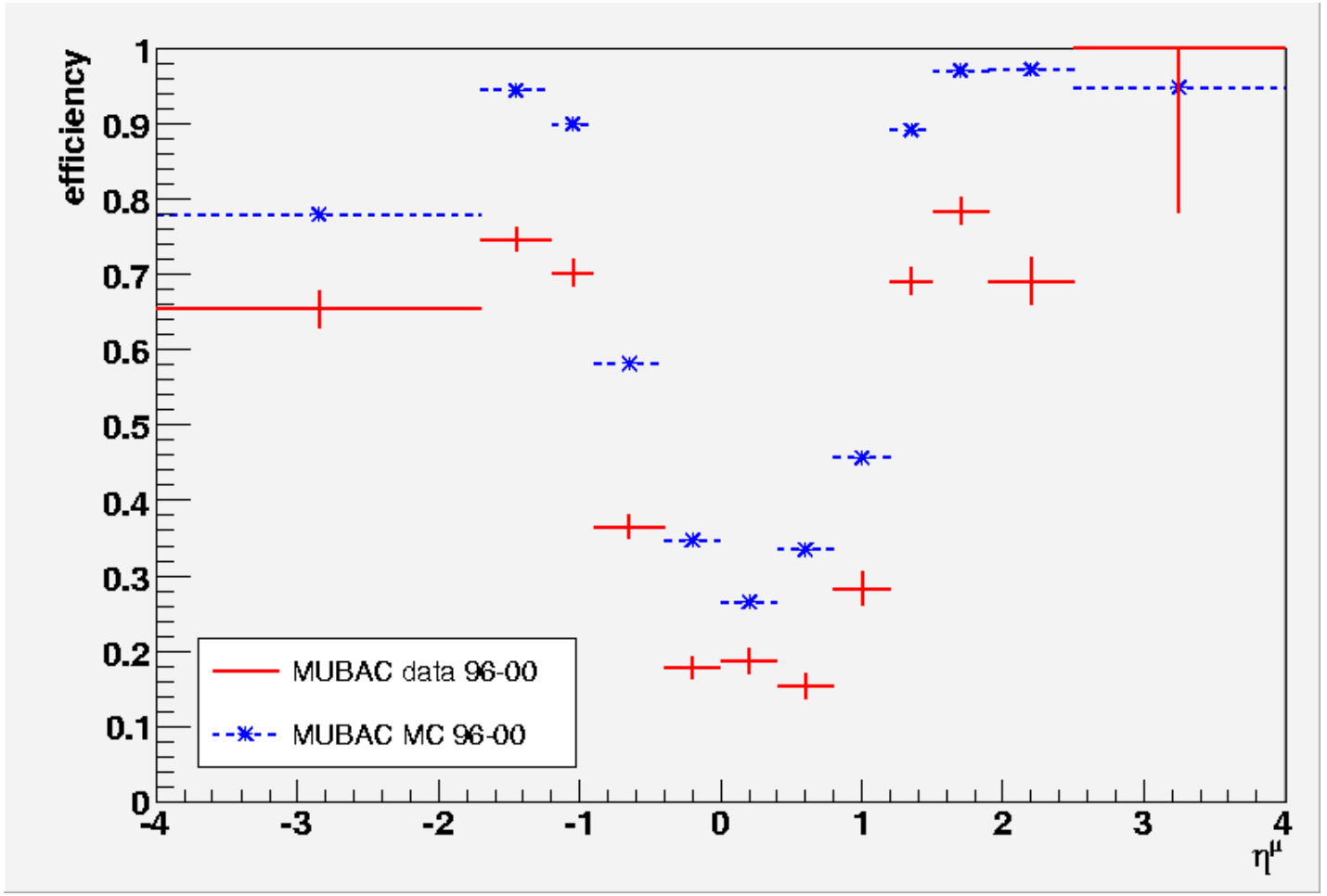
pseudo-rapidity $\eta = -\ln \tan \theta/2$

$1.60\,GeV \le p_t \le 1.70\,GeV$

# Efficiency in data and Monte Carlo

$$\text{Efficiency} = \frac{\text{number of muons seen by a finder}}{\text{total number of muons}}$$

$$\frac{N(MV+MUBAC)}{N(MV)}$$

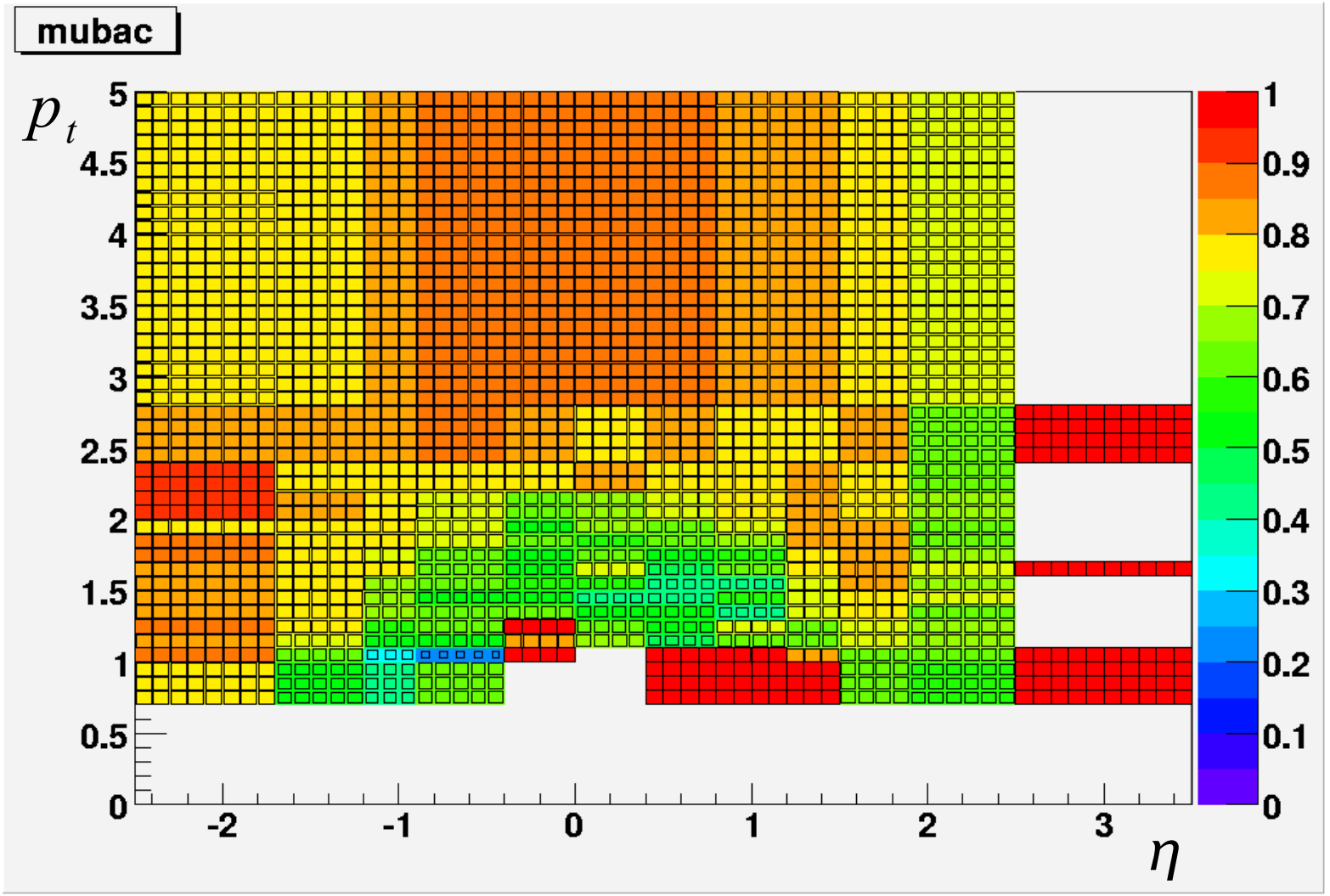



red: data
blue: MC

$$1.60\,GeV \le p_t \le 1.70\,GeV$$

# Efficiency Correction

$$\text{Efficiency correction} = \frac{\text{data efficiency}}{\text{Monte Carlo efficiency}}$$



# Conclusions / Summary

- The efficiency corrections are calculated and are ready for use
- It works
- They are needed for some upcoming papers
- They will be used in many future analysis
- A ZEUS note about it will be published soon