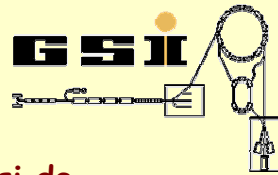
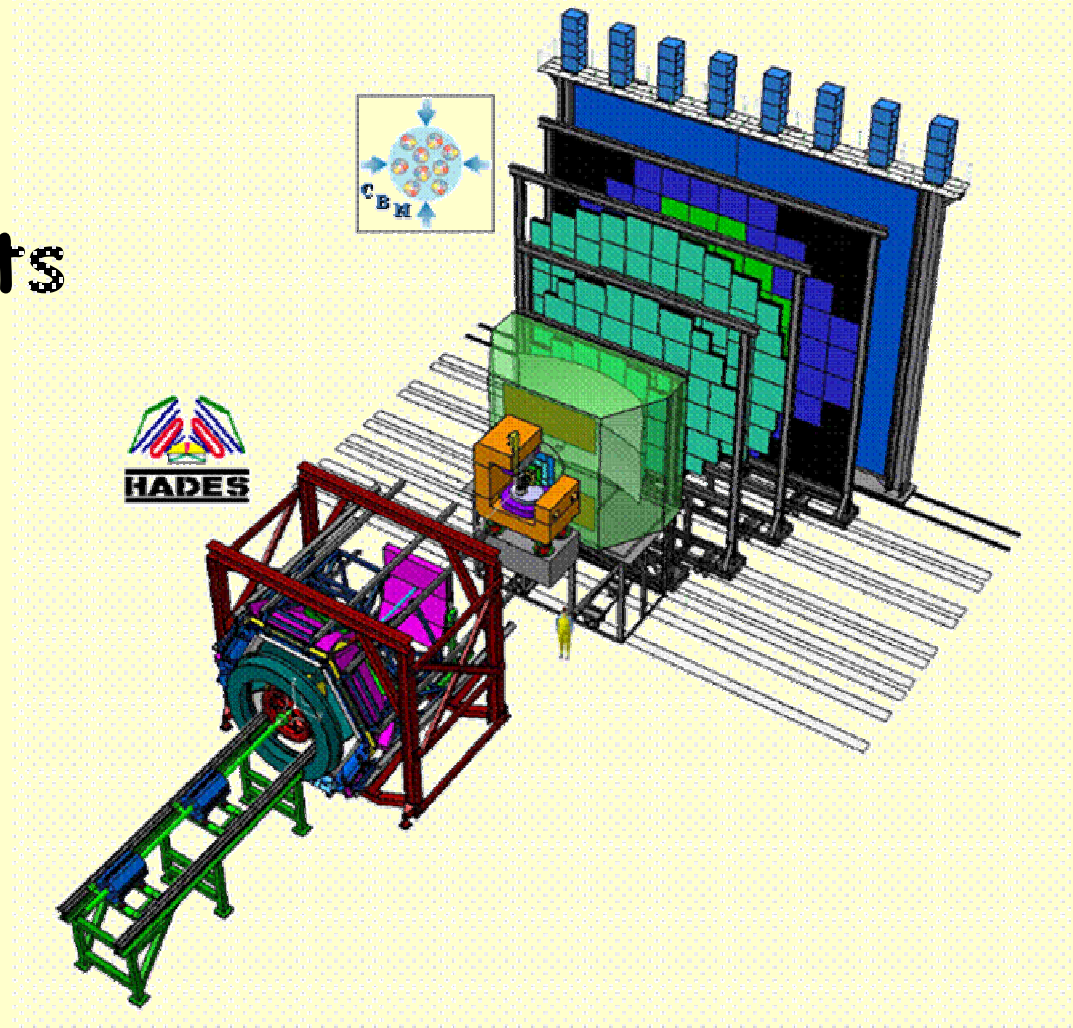


# Dilepton measurements with CBM

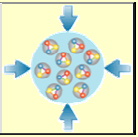
Volker Friese



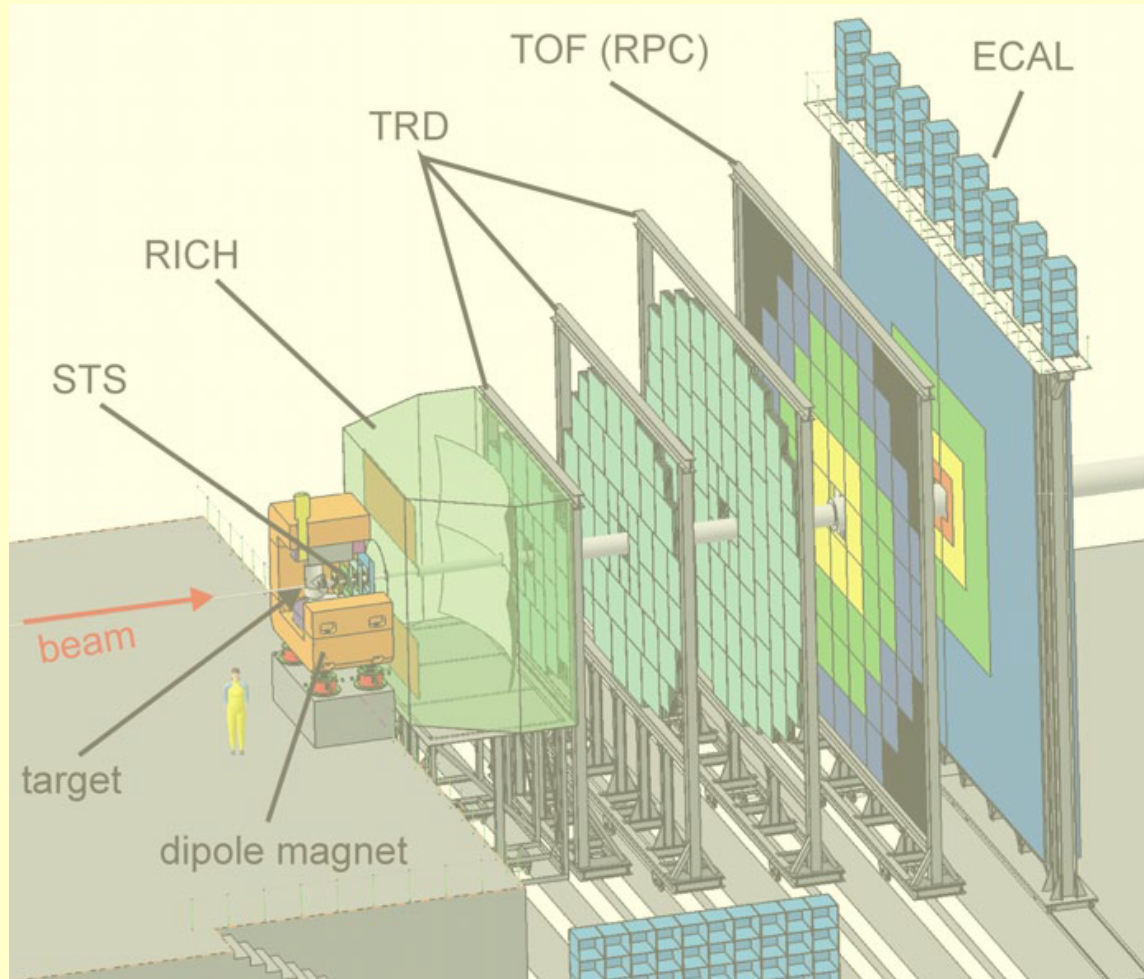
[v.friese@gsi.de](mailto:v.friese@gsi.de)



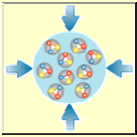
CBM Forum on Dilepton Measurements in Heavy-Ion Collisions  
GSI, February 27, 2007



# The CBM Experiment



"Standard" setup with  
electron detectors

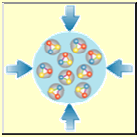


# CBM : Overview of Observables

• Identified hadrons ( $\pi$ , K, p)	STS + TOF	spectra, yields
• Hyperons ( $\Lambda$ , $\Xi$ , $\Omega$ )	STS (+ TOF)	
• Open charm ( $D^0$ , $D^\pm$ )	STS (+ TOF)	flow
• Direct photons	ECAL	
• Charmonium ( $\psi$ , $\psi'$ )	STS + RICH + TRD	fluctuations
• Low-mass vector mesons	STS + RICH (+ TRD + TOF)	
• Charmonium ( $\psi$ , $\psi'$ )	STS + MuCH (+ TRD + TOF)	
• Low-mass vector mesons	STS + MuCH (+ TRD + TOF)	

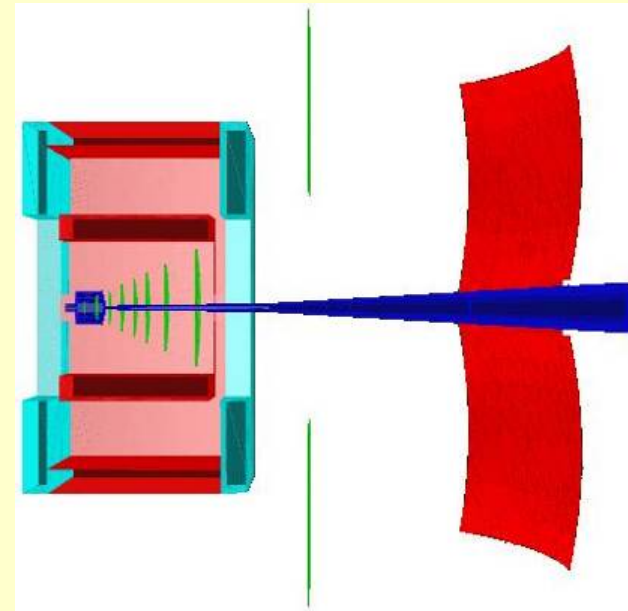
from p+p to Pb+Pb

from 10 AGeV to 35 (45) AGeV



# Measuring Electron Pairs with CBM

- electron identification
  - RICH ( - 12 GeV)
  - TRD (1 GeV - )
- background
  - mis-identified hadrons
  - Dalitz decays
  - $\gamma$  conversion pairs
- no electron identification before the magnetic field

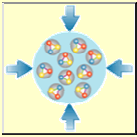


suppression of electronic background

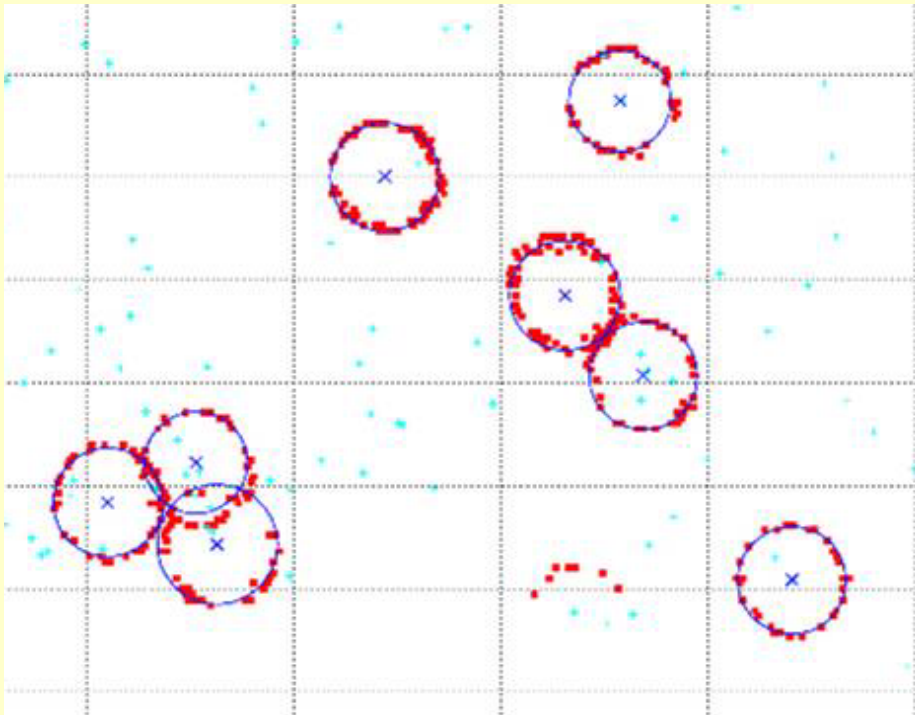
non-vertex: by tracking

for charmonium: single electron  $p_t$

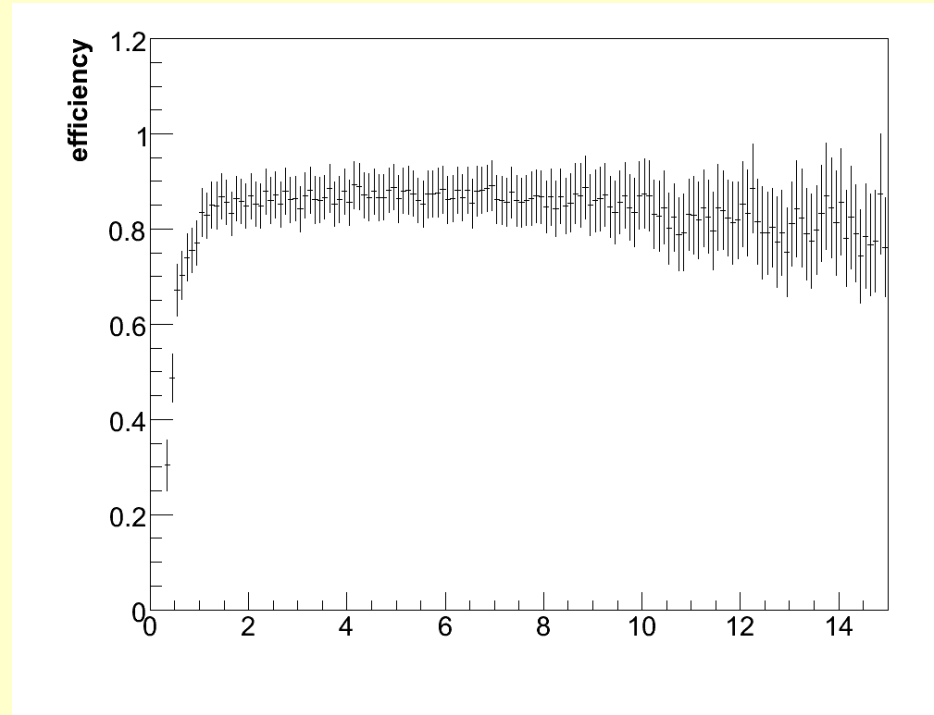
for LVM: dedicated cut strategy for rejection of conversion and Dalitz



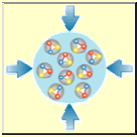
# Electron Identification in RICH



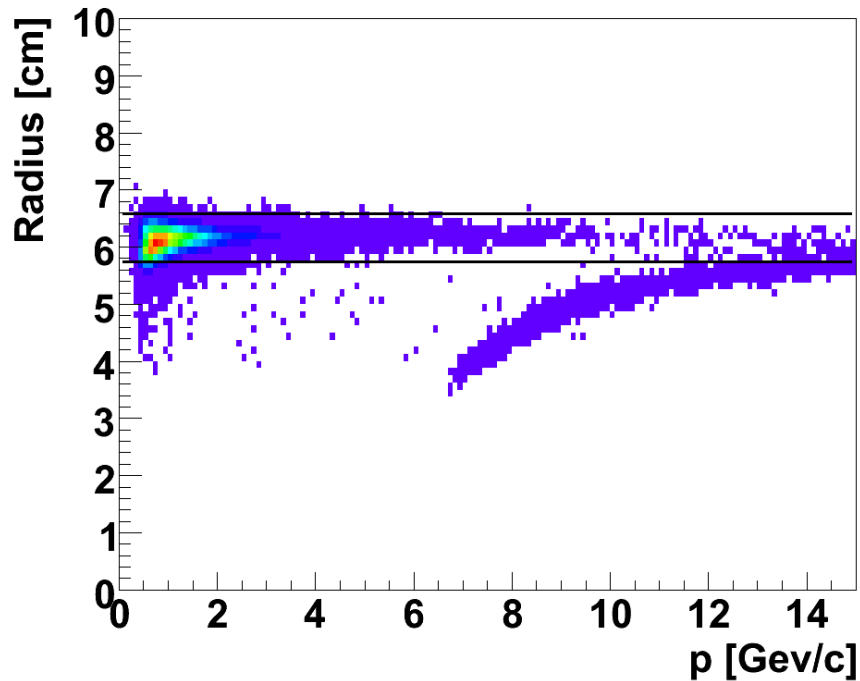
Pattern recognition in the PM plane



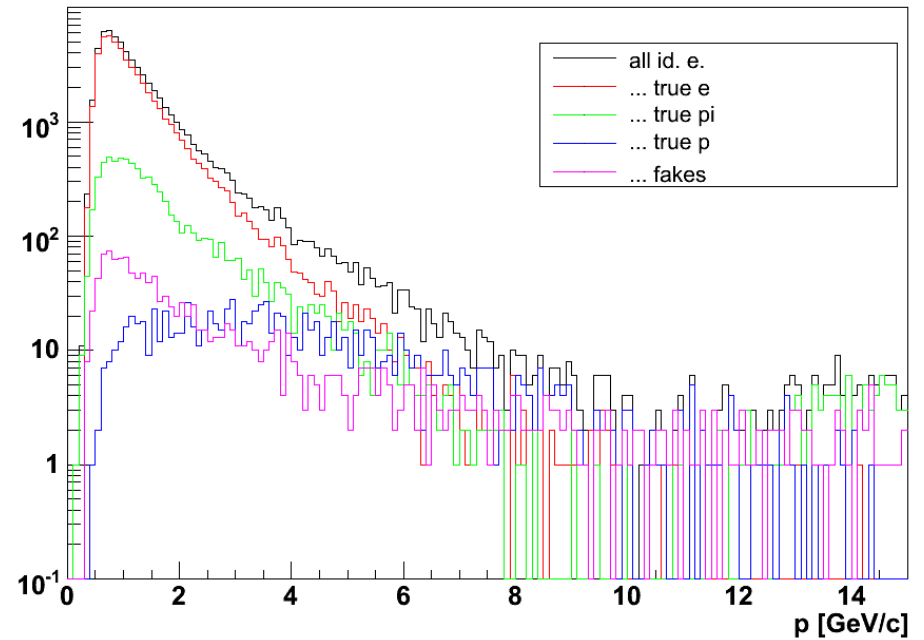
Ring finding efficiency vs. momentum



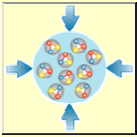
# Electron Identification in RICH



ring radius vs. momentum

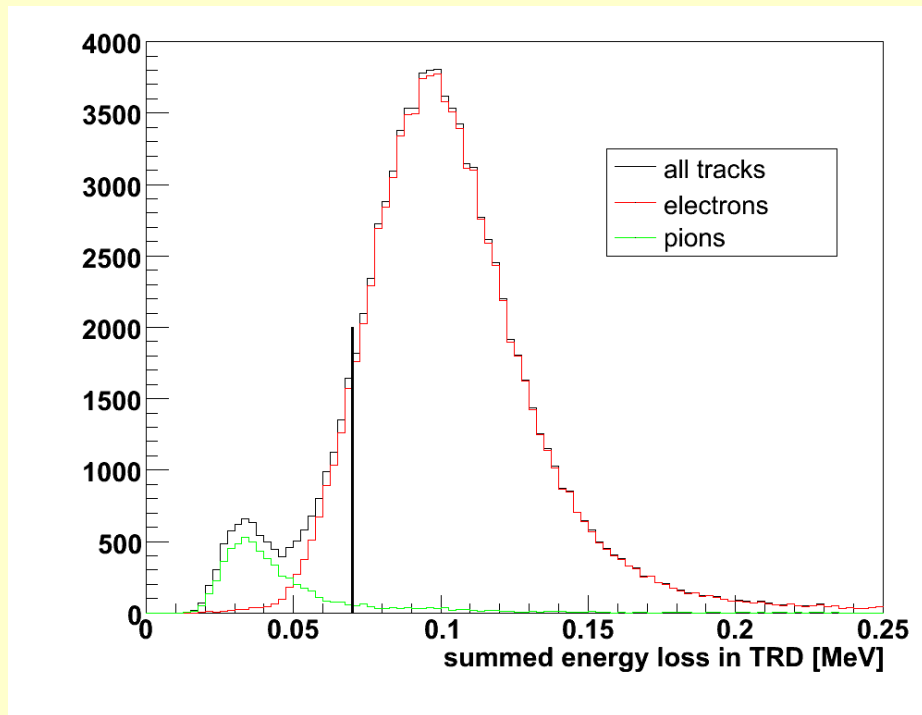


composition of tracks identified as electrons  
(UrQMD events)

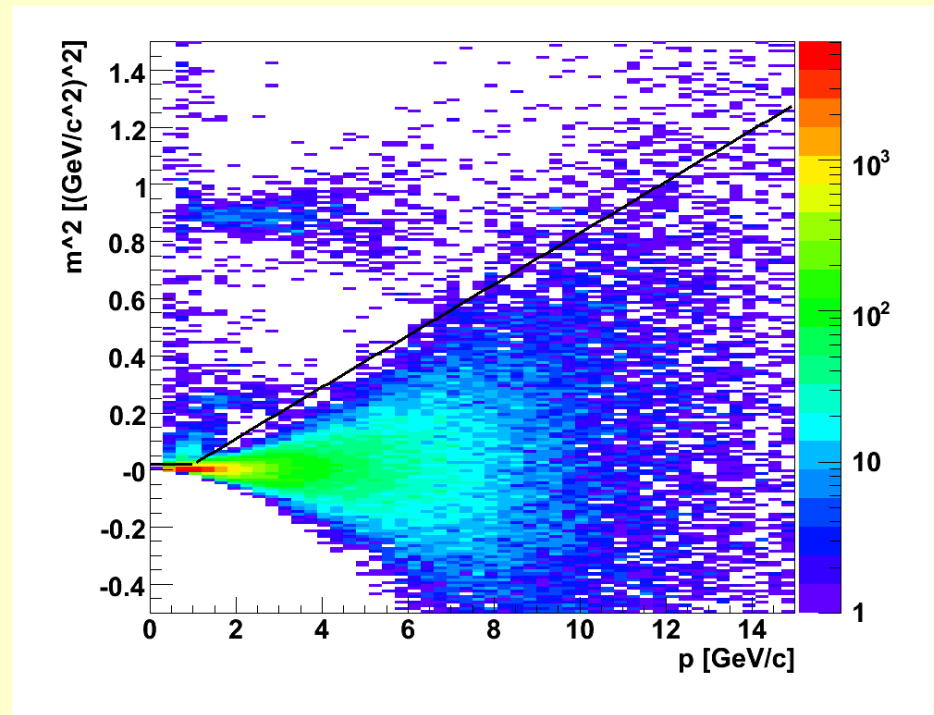


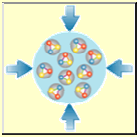
# Improvement of Electron ID by TRD and TOF

RICH-identified electrons

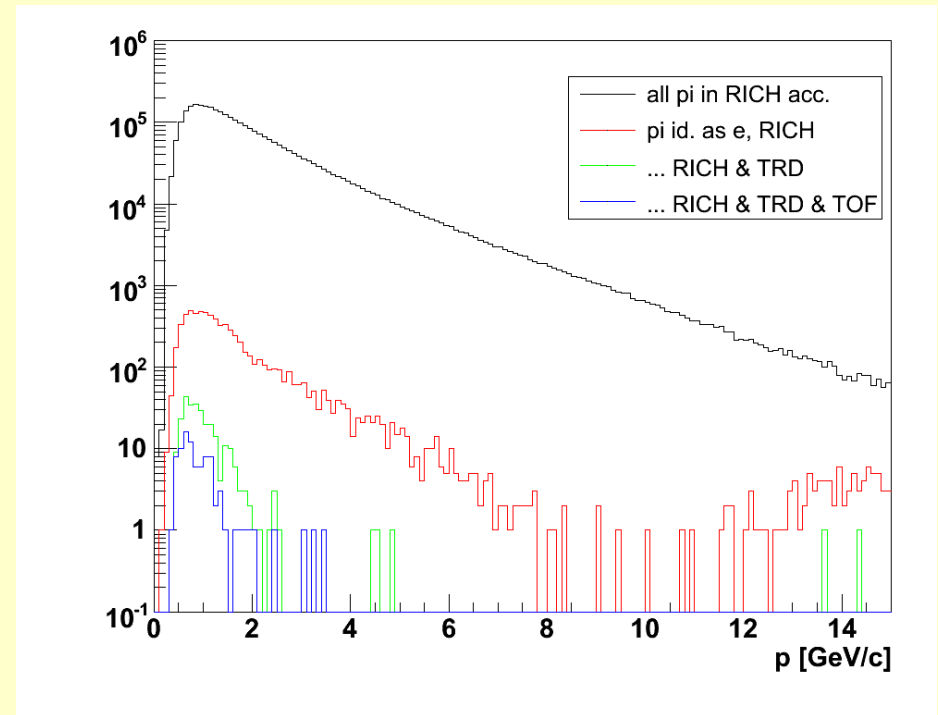
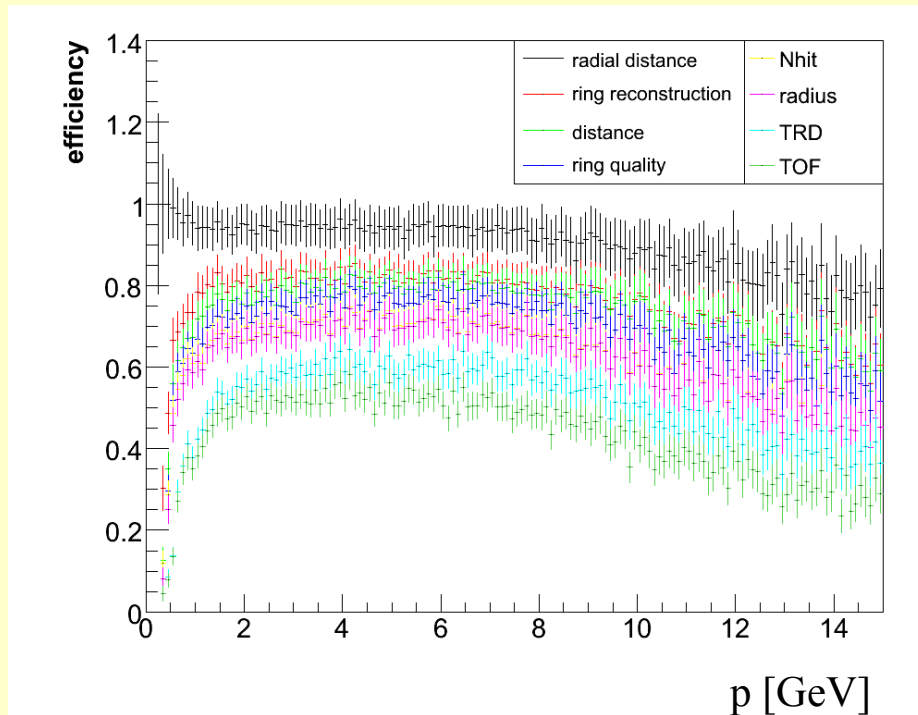


RICH and TRD-identified electrons

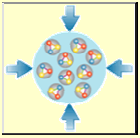




# Pion Suppression and Electron Efficiency

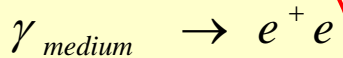
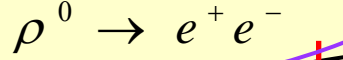
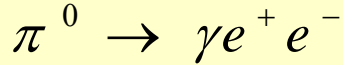






# Background topology for LVM

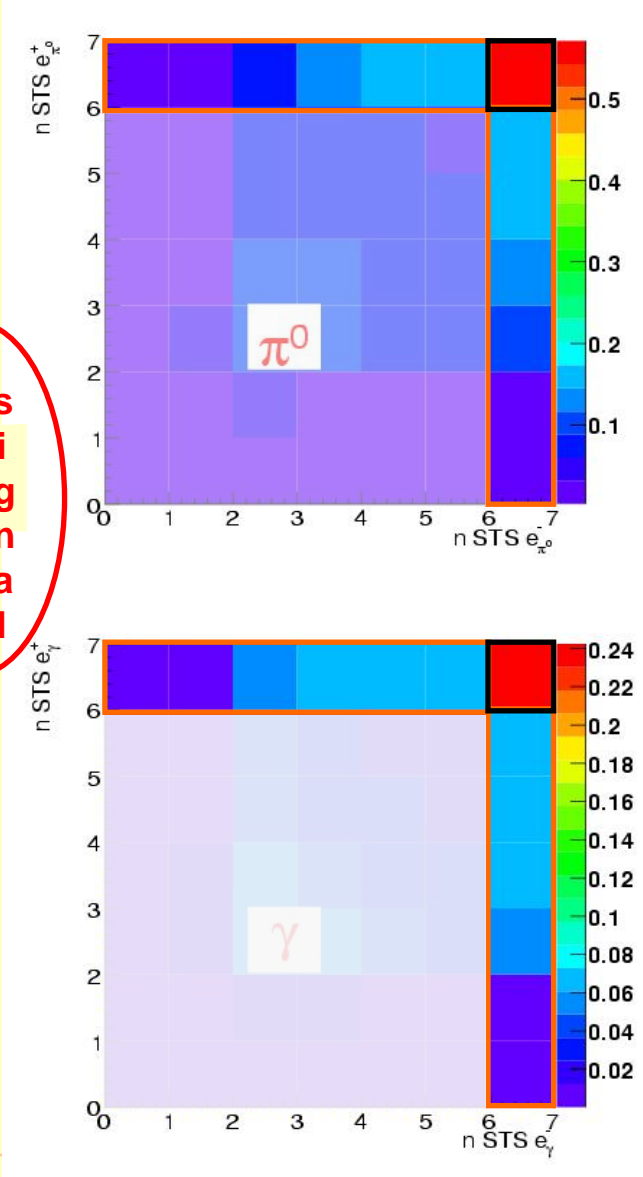
Track Segment



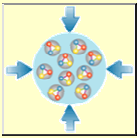
Track Fragment

Global Track

falsch  
signaler  
paar

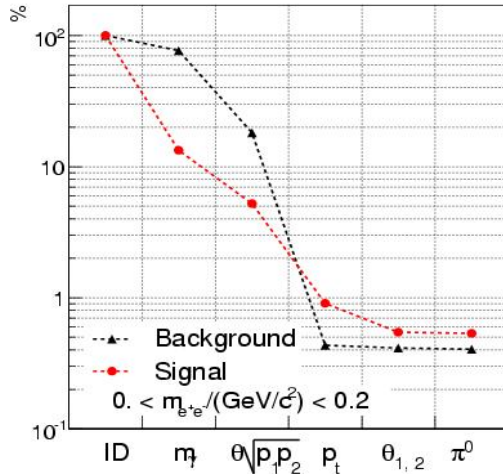


- Track Fragment** - x, y position; no charge information
- Track Segment** - reconstructed track
- Global Track** - identified in RICH

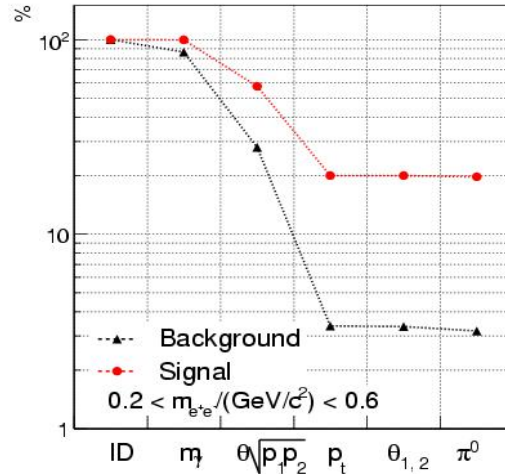


# LVM: Efficiency of cuts, S/B ratio

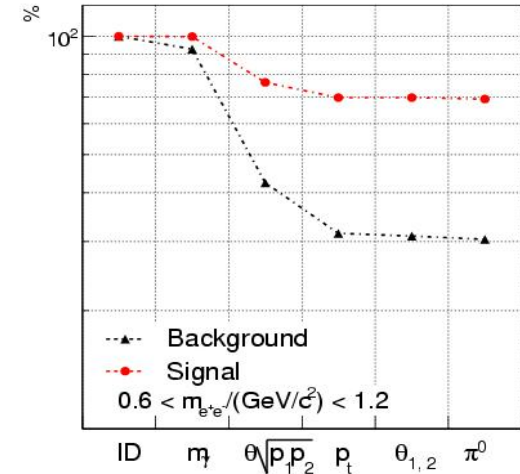
$\pi^0$ -Dalitz region



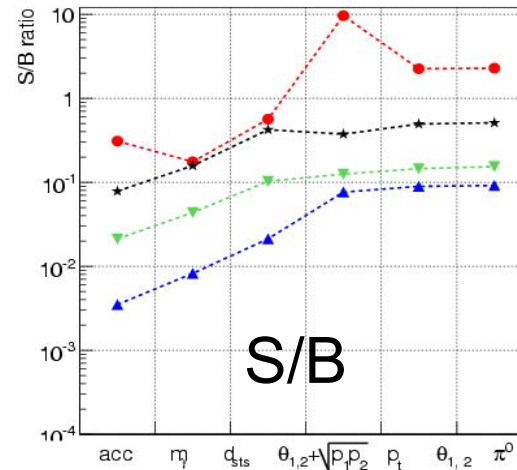
Enhancement region



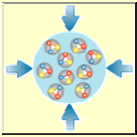
$\omega/\phi$  region



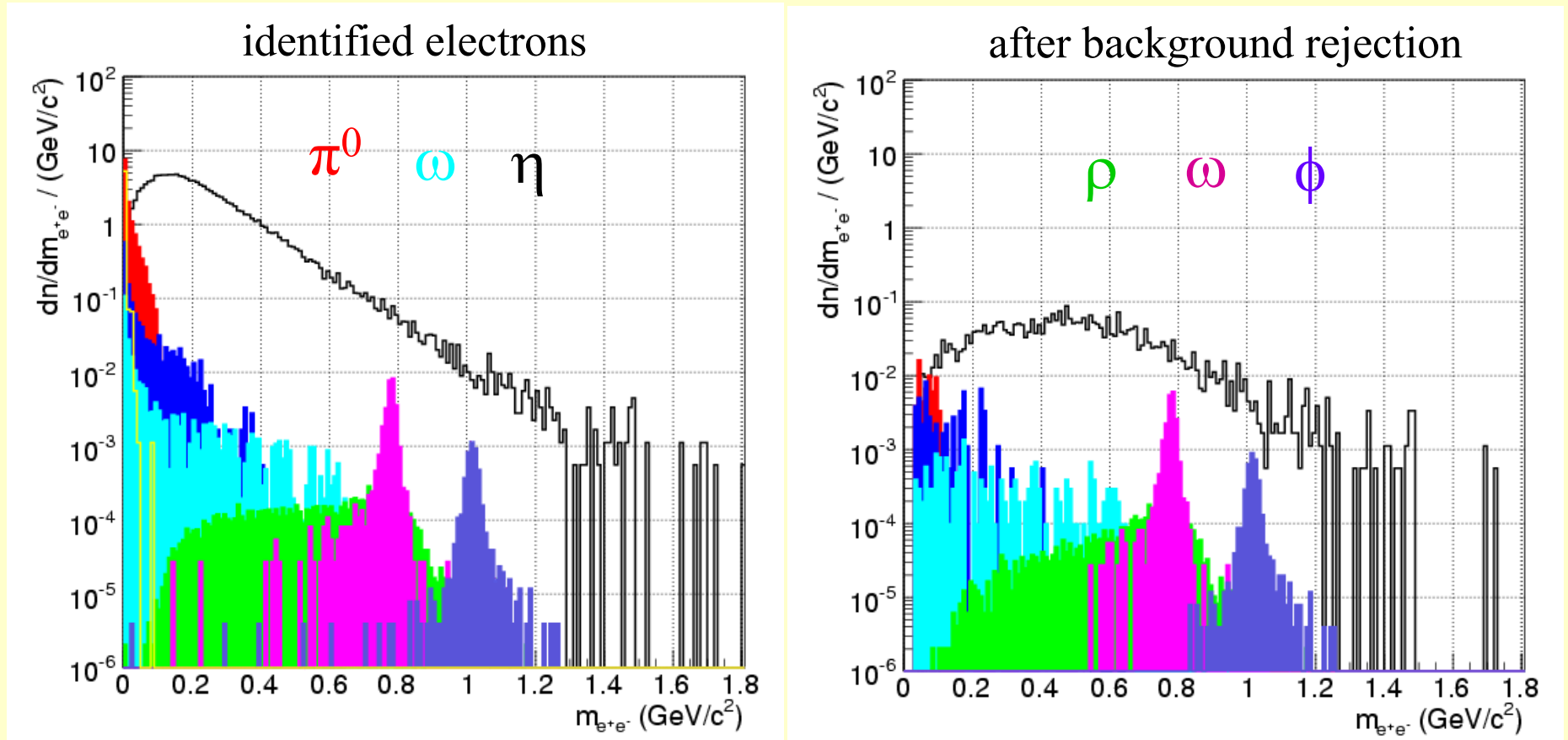
Rejection of background from Dalitz and conversion by cuts on  
 distance to closest neighbour  
 pair opening angle  
 pair invariant mass  
 single electron  $p_t$



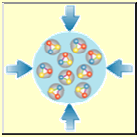
- 0.  $< m_{e^+e^-}/(\text{GeV}/c^2) < 0.2$
- ▲ 0.2  $< m_{e^+e^-}/(\text{GeV}/c^2) < 0.6$
- ▼ 0.6  $< m_{e^+e^-}/(\text{GeV}/c^2) < 1.2$
- ★  $\omega$  (mass region  $\pm 1.4\sigma_m$ )



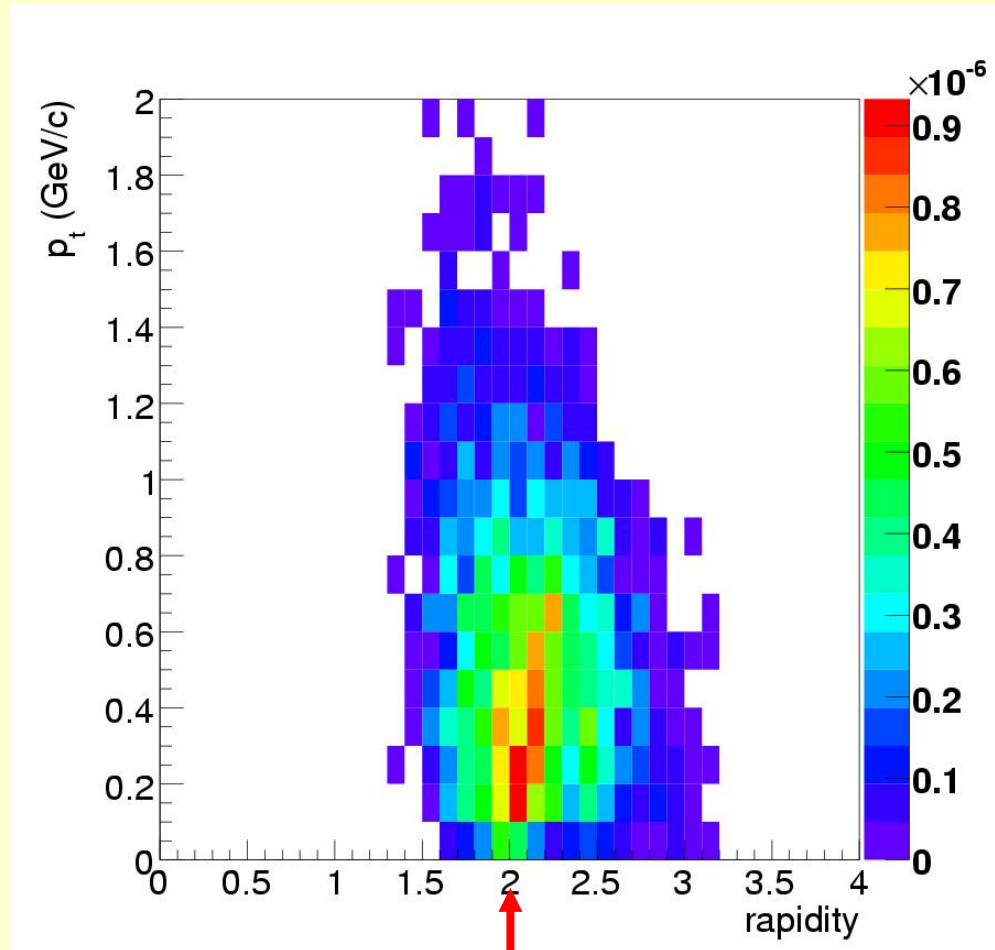
# LVM: Current Status



Results include full event reconstruction and electron identification



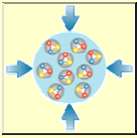
# LVM: Phase Space Coverage



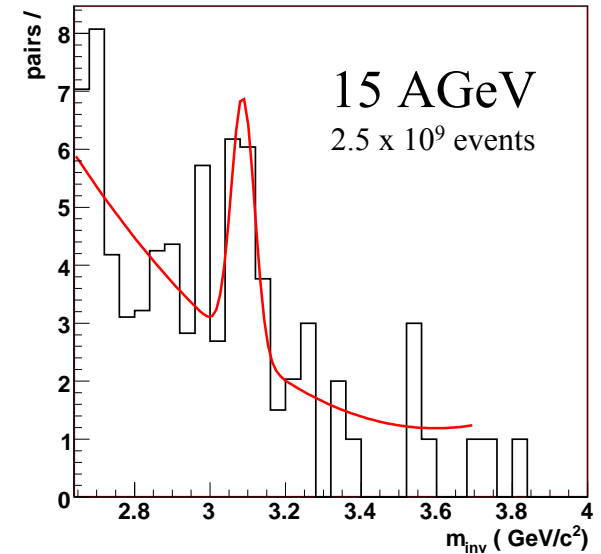
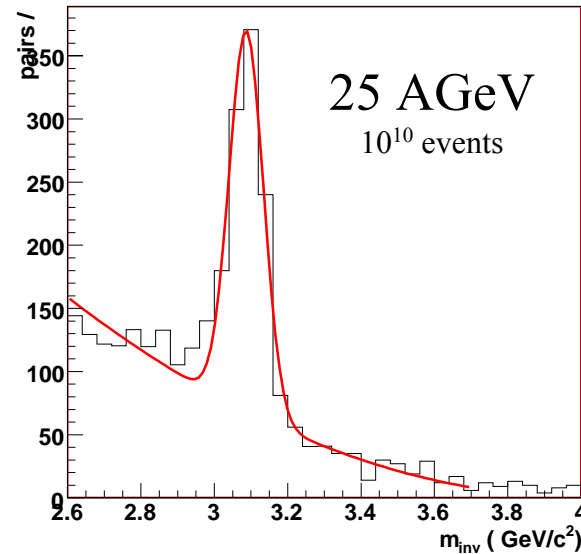
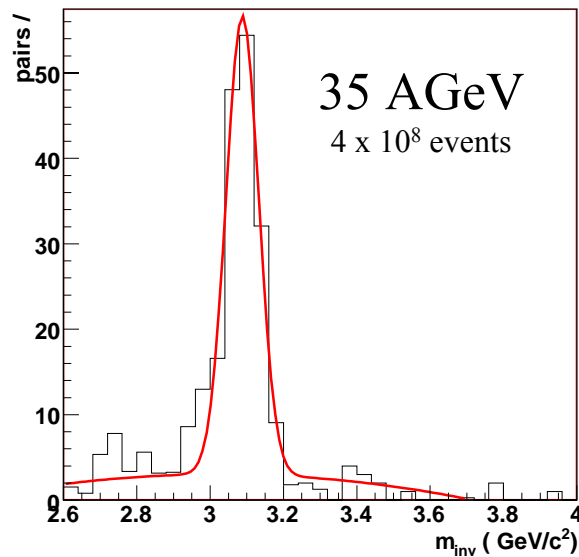
after all cuts

good mid-rapidity coverage

$y_{CM}$



# Charmonium in the Di-electron channel

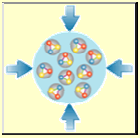


Results for central Au+Au collisions

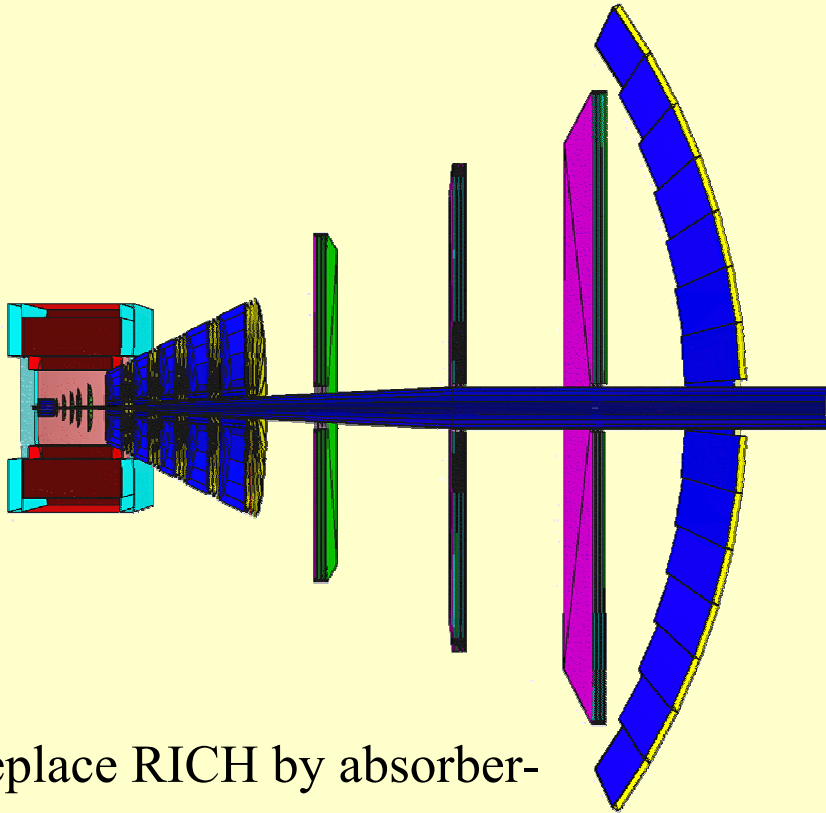
J/ $\psi$  yield from HSD

Full event reconstruction and electron identification in RICH and TRD

Single electron  $p_t > 1.2$  GeV

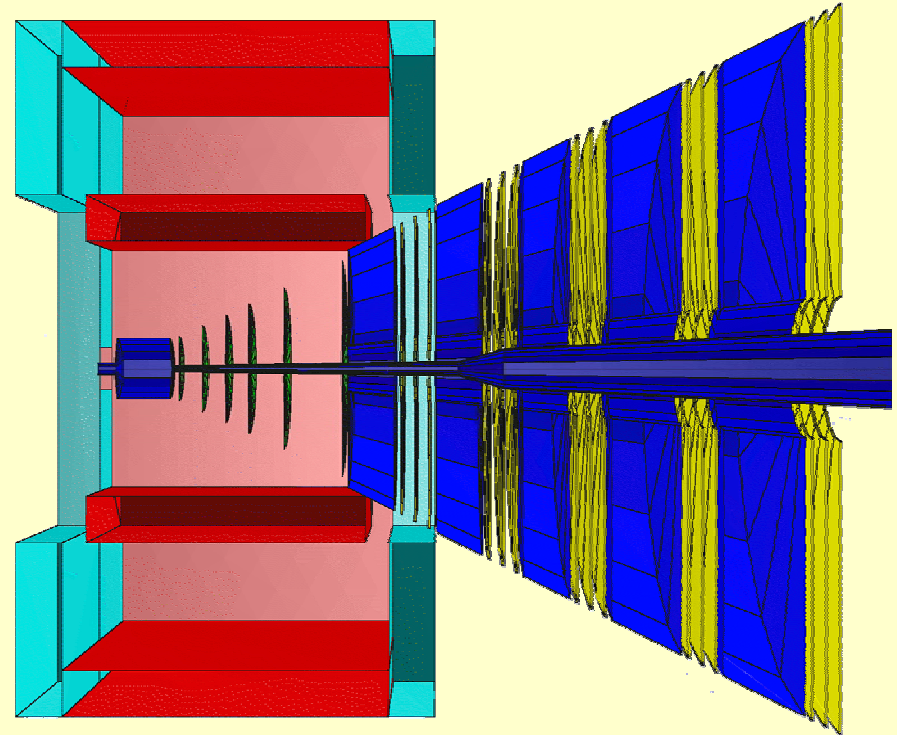


# Measuring Muons with CBM

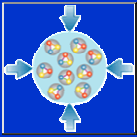


Replace RICH by absorber-detector system

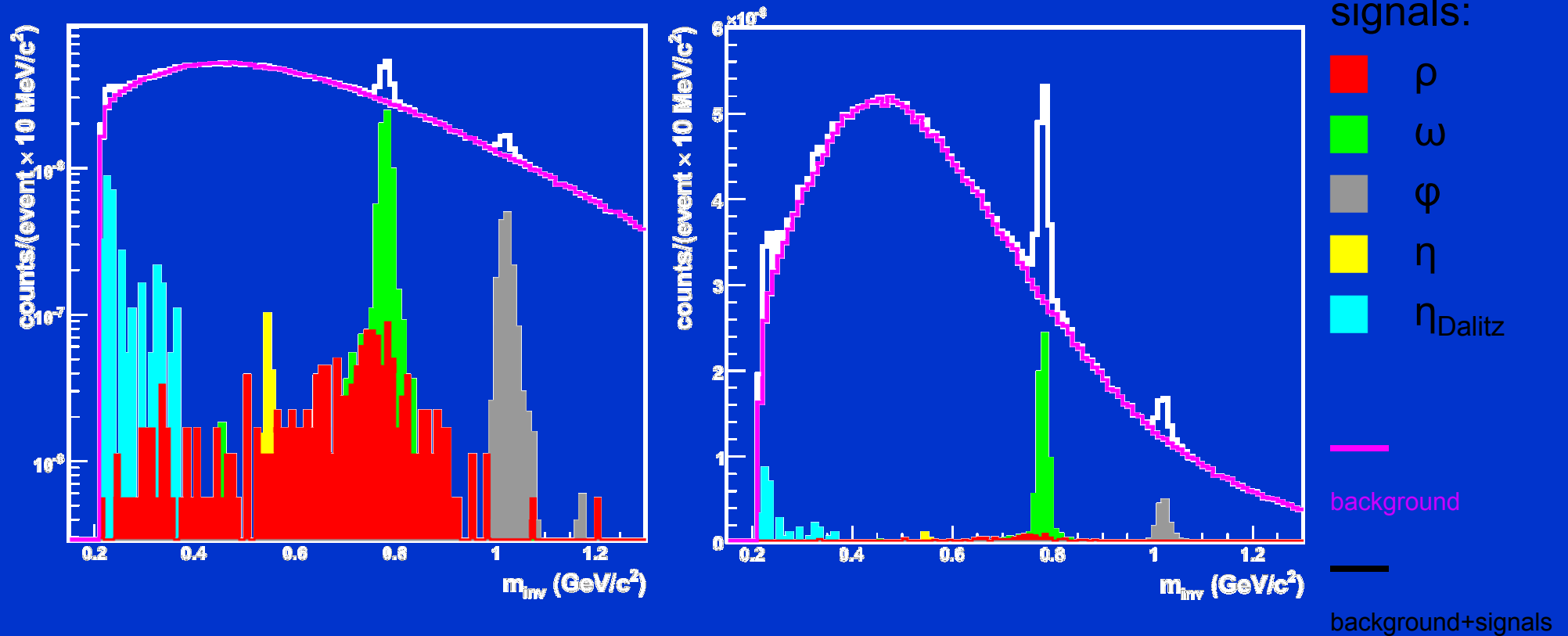
different absorber concepts under study



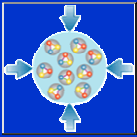
"Compact" design with 5 Fe absorbers and 15 detector layers



# Muon Option: Results for LVM

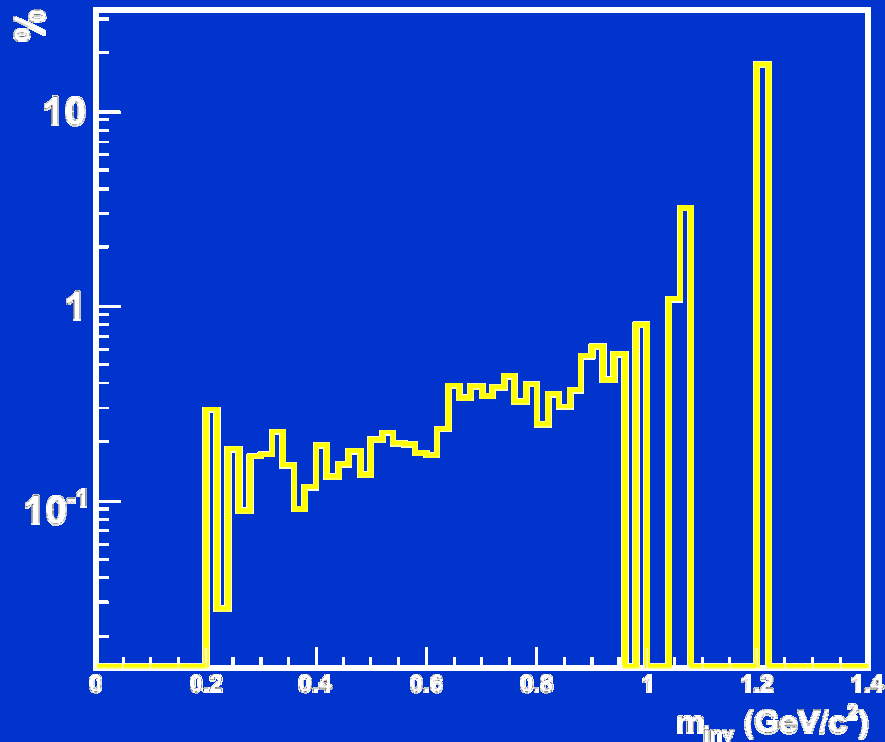


Results include full tracking through STS and absorbers  
Muons are identified after the last absorber

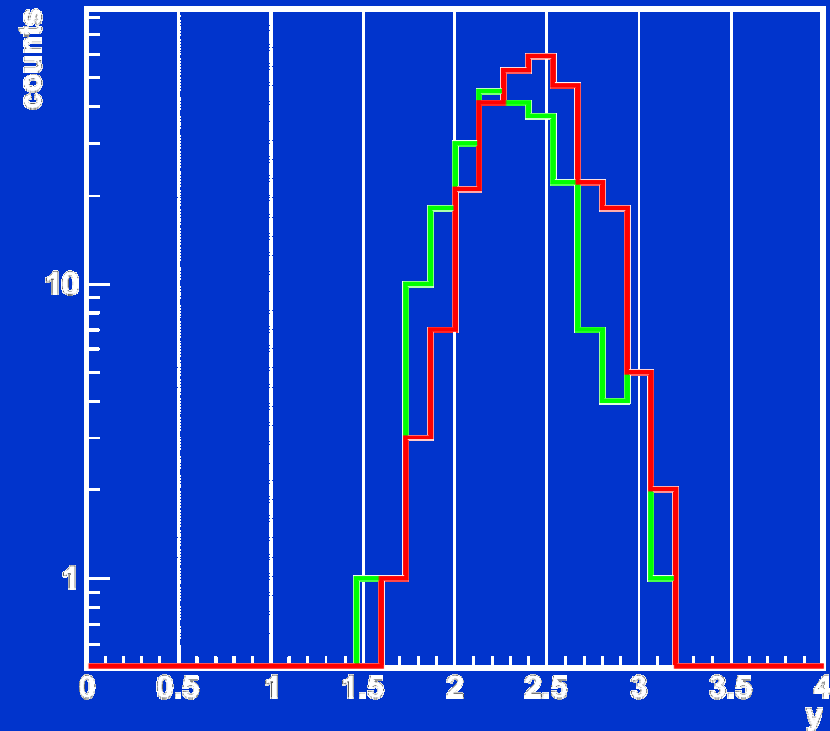


# LVM: Efficiency and Phase Space

Signal efficiency vs. inv. mass

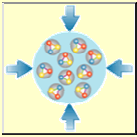


Rapidity coverage

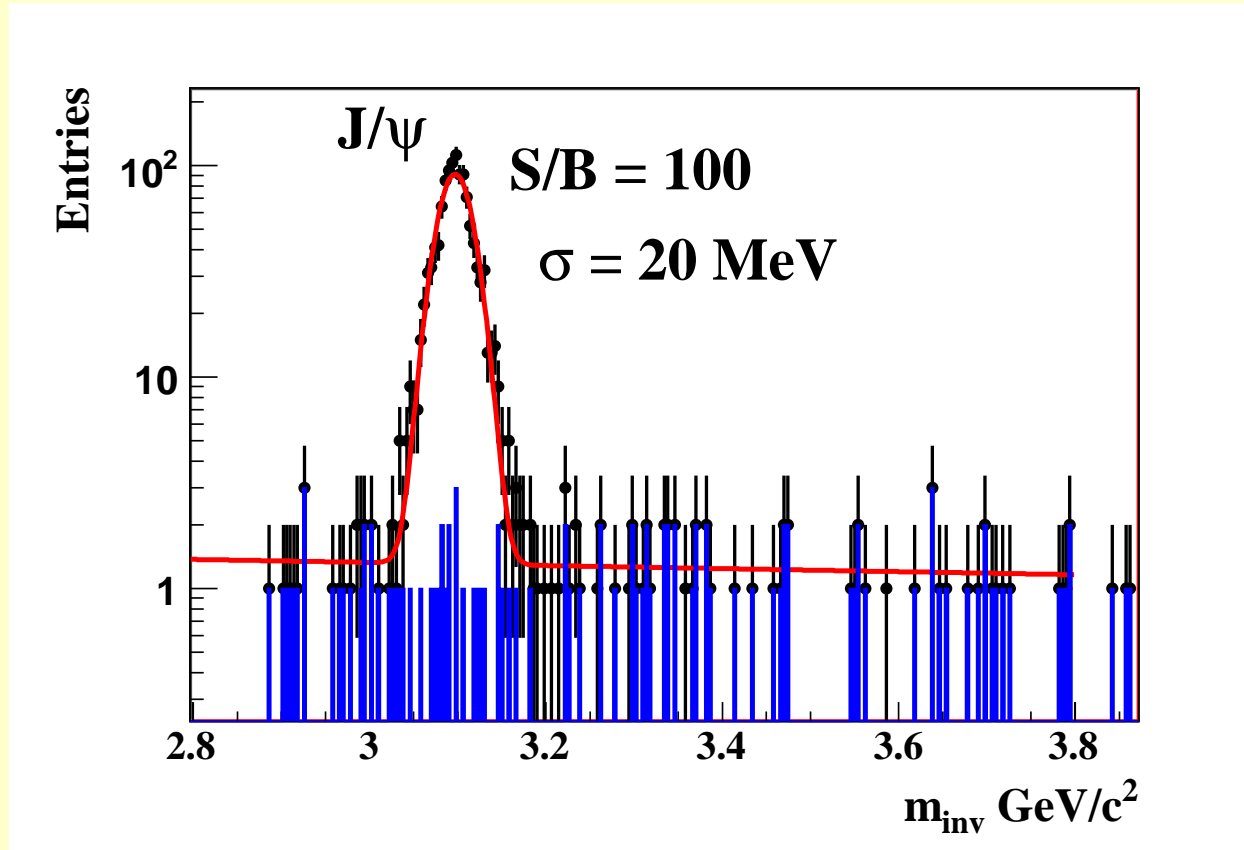


Mid-rapidity coverage can be improved by allowing "soft tracks"  
(crossing 4 of 5 absorbers)

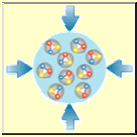




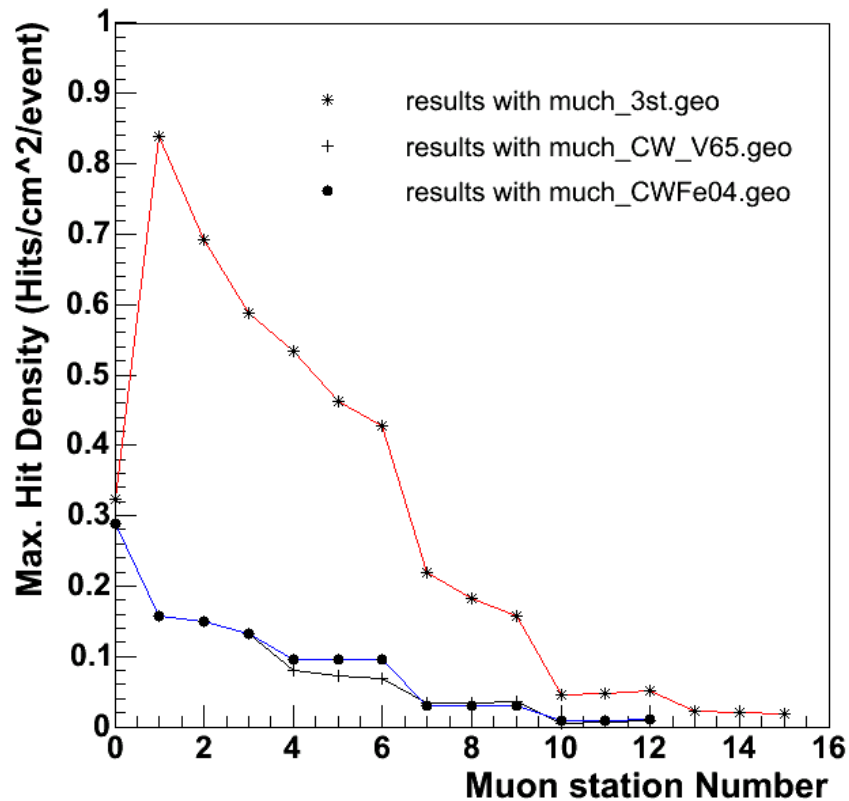
# Charmonium in the Di-Muon Channel



High momentum of charmonium daughters allows a clean identification  
High quality signal expected



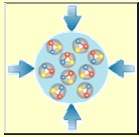
# Muon Measurement: Detector Issues



Very high hit rates after first absorber

Coordinate resolution  $\approx 100 \mu\text{m}$  required for tracking through the absorber system

Possible solutions GEM / micromegas / MWPC depending on station number / distance from beam



# Summary

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- Both electron and muon option give access to low-mass vector mesons and charmonium
- Feasibility studies are based on full event reconstruction and electron / muon identification. They are still subject to further optimisation.
- Performance on low-mass VM is similar for electrons and muons; mid-rapidity coverage is more difficult for muons
- Performance on charmonium is better for muons: higher charmonium states probably not measurable with electrons
- Electron measurements rely on established detector technology (RICH, TRD)
- Detector issues for muon measurements not yet solved