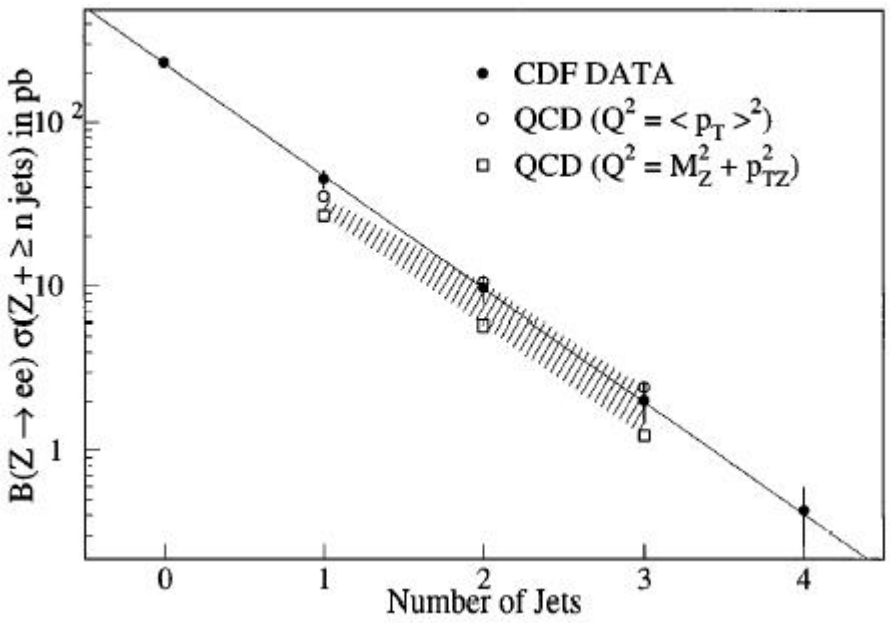
Z(ee)+Jets: Analysis overview

- Cross Section for Z(ee) + n Jets (n=0,1,2)
- Comparison to MCFM
- Z(ee)+X cross section as a crosscheck



CDF Run1
PRL 77 (448)

Dataset

- Moriond 04 dataset: 221 pb^{-1} of delivered lumi (04/19/02 - 09/07/03 runrange: 151816 - 180956)
- EM1TRK skim:
  - EM: (ID=10 OR |ID|=11) AND (pT>8.0GeV)
  - TRK: pT>5.0GeV within Δphi=.1 of EM object
- ATHENA v01-04-02 root tuple
- Good event selection:
  - Jet/MET v5.0 list of bad LBNs (no T42)
  - CAL, SMT, CFT based on runquality database
  - Bad LBNs for lumi calculation
- Checking for event duplication
- DiEM triggers:
  - 2EM_HI = CEM(2,10) L3(loose, 1, 20) for triggerlist $\leqq$ v11 (<= run 178721)
  - E1_2L20 = CEM(1,11) L3(loose, 2, 20) for triggerlist v12 (>= run 178722)
- Luminosity:

	2EM_HI	E1_2L20	Sum
delivered	**174pb-1**	**47pb-1**	**221pb-1**
recorded	**145pb-1**	**44pb-1**	**189pb-1**
recorded w/o bad LBNs	**127.91pb-1**	**42.39pb-1**	**170.3pb-1**
reco'd w/o bad LBNs	**127.63pb-1**	**42.38pb-1**	**170.01pb-1**

Electron and Jet selection

- Electrons:
- EMF>.9
- Iso<.15
- HMx7<12.
- pT>20GeV
- Including phi cracks
- CC-CC: |eta|<1.1
- Cut on chi2 of track match based on E/p & distance
- 80 GeV < M_{ee} < 100 GeV

- Jets:
- .05<EMF<.95
- Chfrac<.4
- HotFrac<10.
- N90>1
- L1confirmation
- pT>20GeV
- d0correct removes all jets overlapping with <u>any</u> EM object within dR=.4

Z(ee) + X Cross Section

$$\sigma \cdot BR = \frac{N - B}{Lumi \cdot Trigger \cdot Accept \cdot Trk \cdot EM}$$

N-B = # of Z candidate events after QCD background substraction

Lumi = 170.01pb-1

Trigger = coming up next ...

Accept = $\frac{N_{pass}}{N_{total}} * \frac{1}{\epsilon_{EMreco}^{MC\ 2}}$

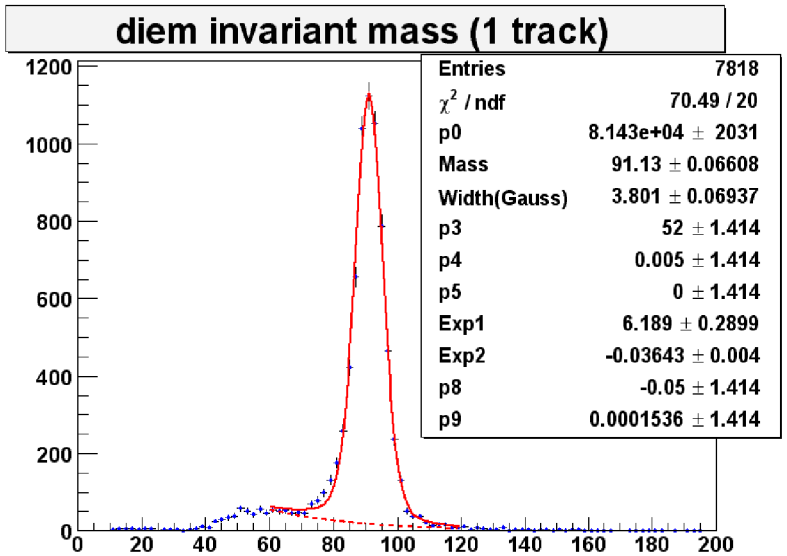
Trk = $2 * \epsilon_{trk}^{data} - \epsilon_{trk}^{data\ 2}$

EM = $\epsilon_{EM}^{data\ 2}$

Number of signal events (N-B)

Substracting QCD background from Z and DY using fitting
(Following WZ group's method gives consistent result!)

- Fitting m_{ee} distribution with Gauss+BW (Z) and Exponential (QCD + DY):
  - Using $\mathbf{Z/\gamma^* \rightarrow e^+e^-}$ Pythia MC (GEANT) to determine fraction of DY (1.99%)
  - Using m_{ee} distribution in data to separate Signal (Z+DY) and Background (QCD)



=> **Signal = Z + DY = 6150 +-81**

Background = QCD = 66 +-18

Acceptance

$$\text{Acceptance} = \frac{N_{pass}}{N_{total}} * \frac{1}{\epsilon_{EMreco}^{MC\ 2}}$$

Using $Z/\gamma^* \rightarrow e^+e^-$ Pythia Monte Carlo (GEANT)

N_{pass}: Number of events with 2 electrons passing pT>20GeV, |det_eta|>1.1, 80GeV < m_{ee} < 100GeV

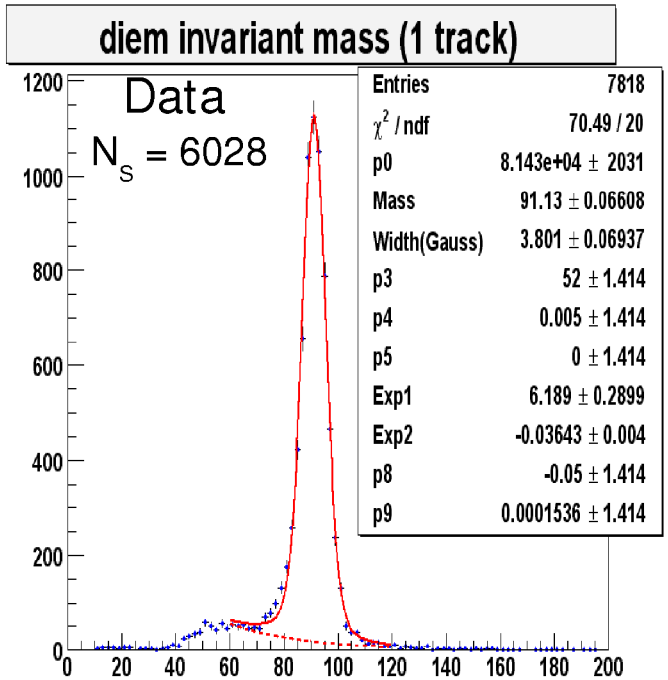
N_{tot}: Number of all events in the MC sample

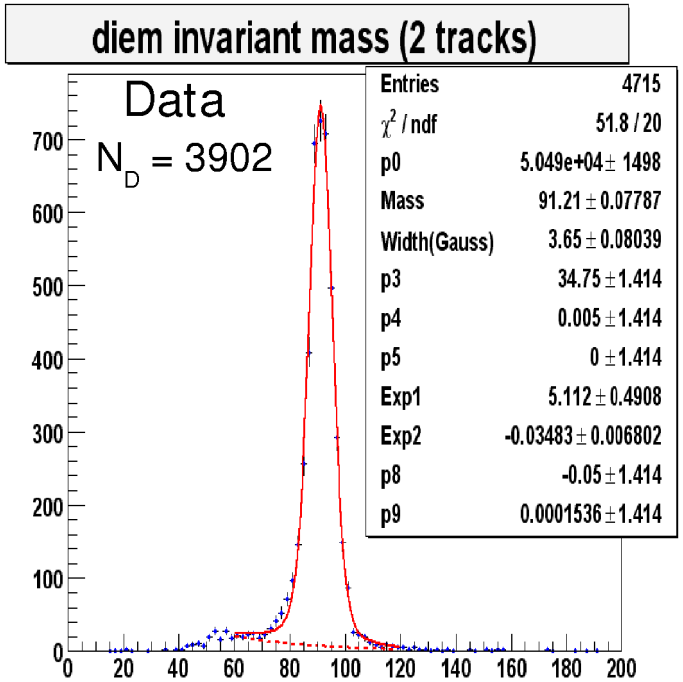
$\varepsilon_{EMreco}^{MC}$: MC efficiency to find an electron with |ID|=10,11

Acceptance = 20.7%+-.1%

Track efficiency

- N_S = # of events with 2 trk matches
- N_D = # of events with at least 1 trk match
- Efficiency = $2N_D/N_D + N_S$
- Fit: Gaussian+BW for signal and exponential for background

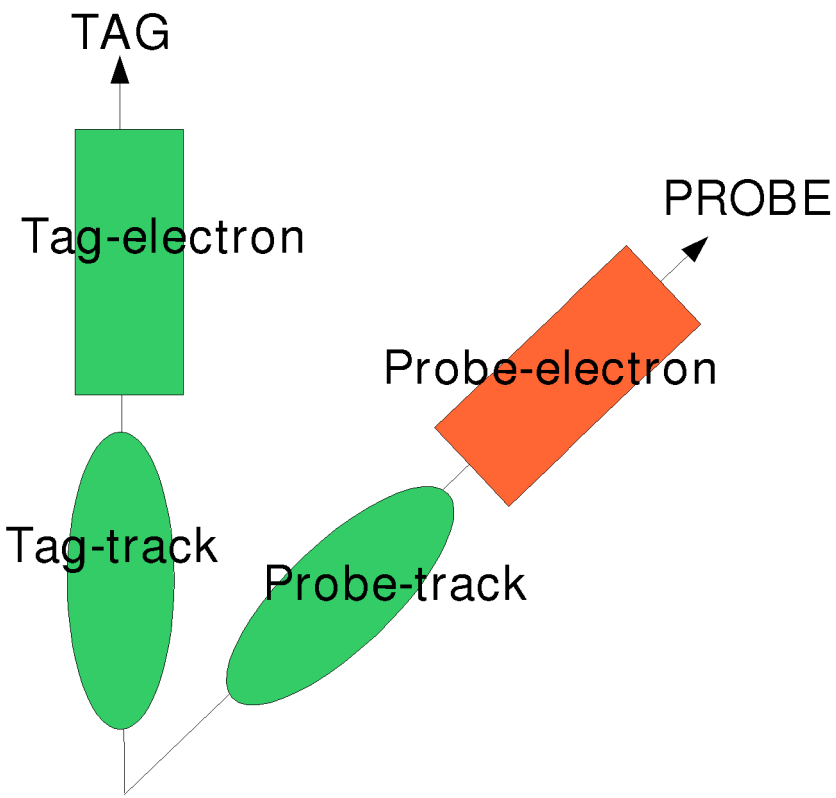




ε_{trk}^{data} = 78.6%+.41%

EM efficiency

Tag and probe method:



Tag electron:
EMF>.9, Iso<.15, HMx7<12.,
pT>20GeV, |det_eta|<1.1

Tag/Probe tracks:
20GeV<pT<80GeV, |eta|<1.1,
Chi^2<8., DCA wrt r-phi <.3,
DCA wrt best vtx<4.cm,
del_phi<2.

Invariant tag-electron probe-track
mass m: 70GeV < m < 110GeV

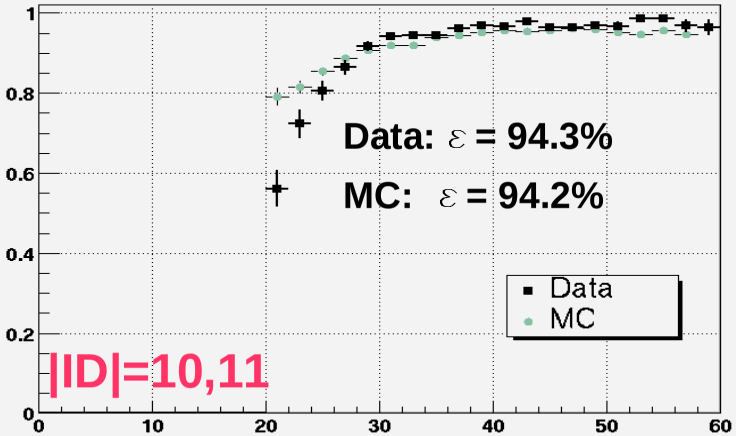
Probe electron:
ID, EMF>.9, Iso<.15, HMx7<12.

$\varepsilon_{EM}^{data} = \varepsilon_{EMreco}^{data} \times \varepsilon_{EMF,Iso}^{data} \times \varepsilon_{HMx7}^{data}$ = 94.3% x 98.8% x 89.6% = **84.2%**+-0.4%

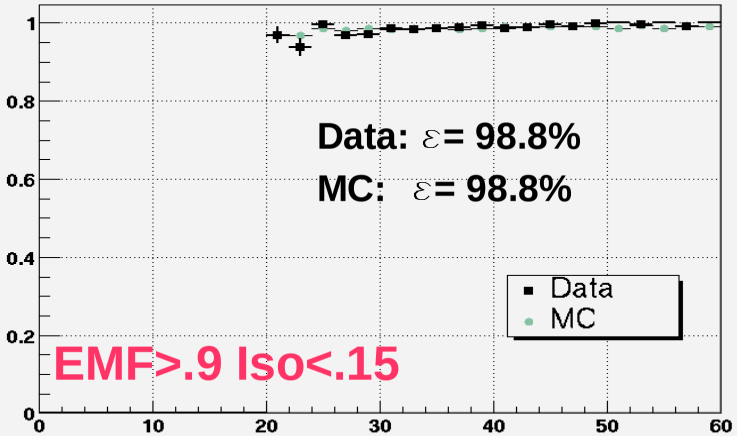
$\varepsilon_{EM}^{MC} = \varepsilon_{EMreco}^{MC} \times \varepsilon_{EMF,Iso}^{MC} \times \varepsilon_{HMx7}^{MC}$ = **94.2%**+-.1% x 98.8% x 94.1% = 88.3%+-0.3%

EM efficiency vs pT

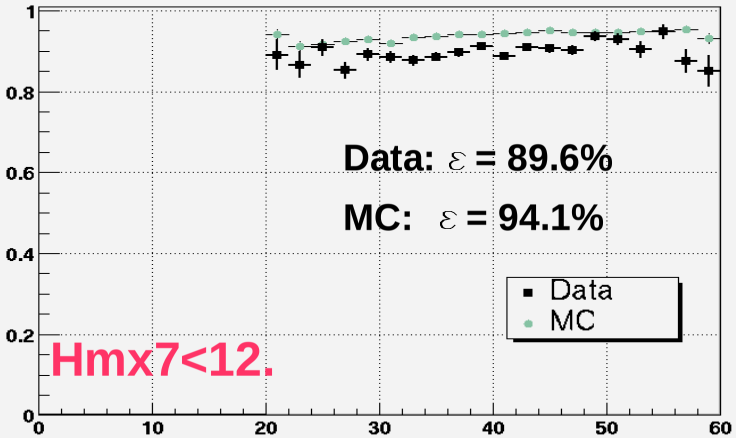
- EMreco efficiency vs probe-track pT



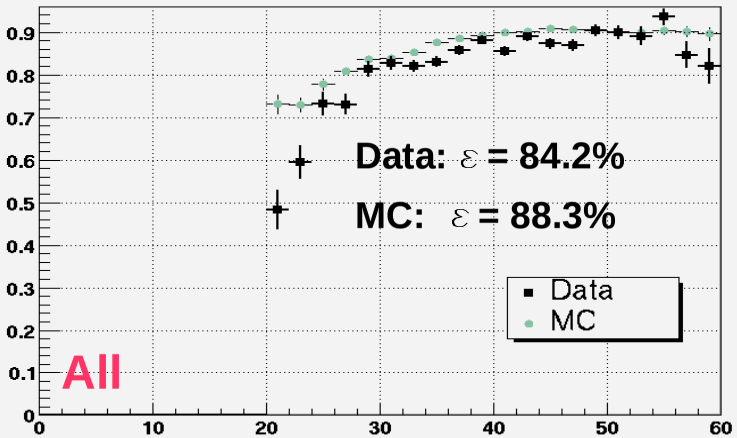
- EMF/Iso efficiency vs probe-track pT



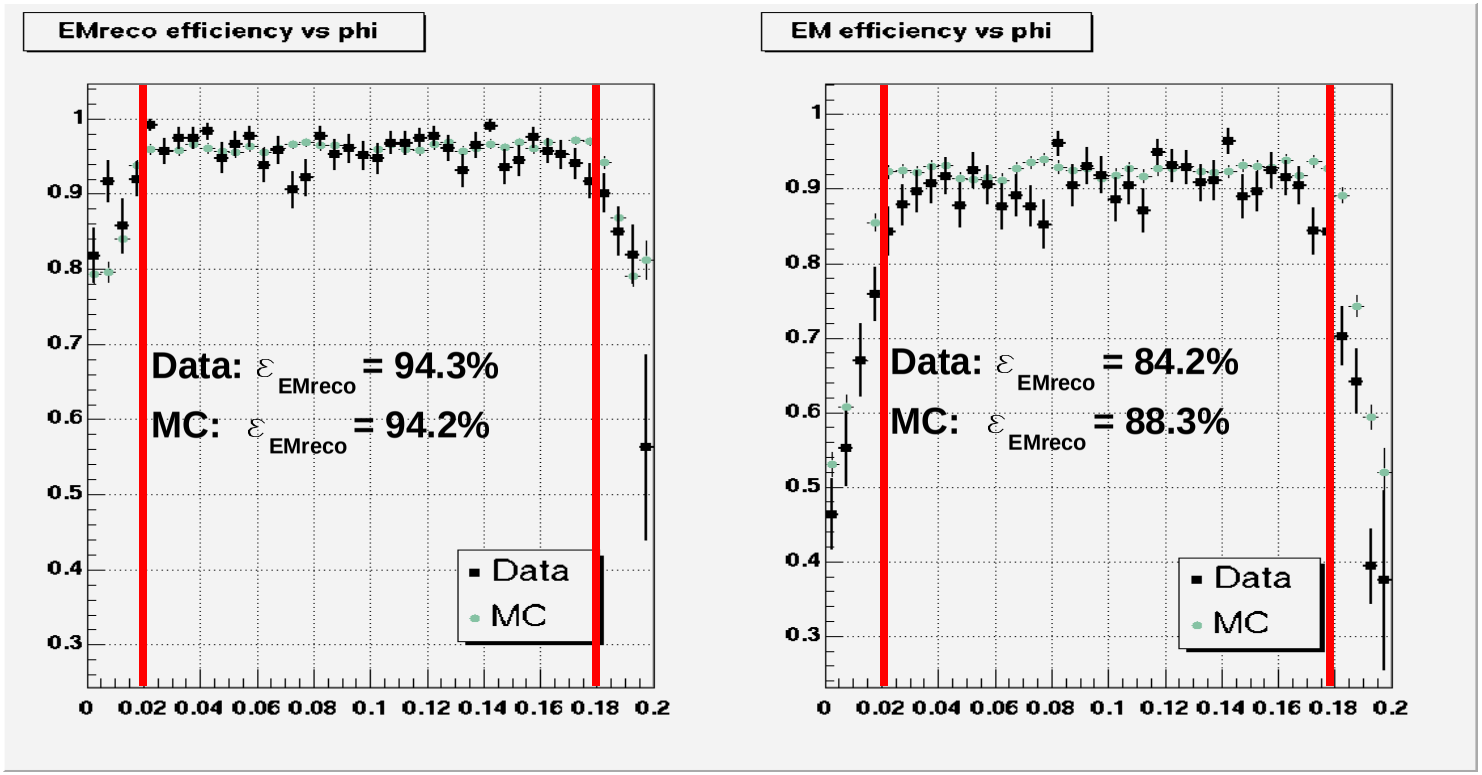
- HMx7 efficiency vs probe-track pT



- EM efficiency vs probe-track pT



EM efficiency vs phi



EMreco and EM ID (EMF>.9, Iso<.15, Hmx7<12.) efficiencies vs mod(probe-track phi,2π/32)

Summary table

Jet multiplicity	n≥0	n≥1	n≥2
N-B(QCD)	6150+-81	946+-32	154+-13
Lumi	170.01pb+-11.05	170.01pb+-11.05	170.01pb+-11.05
N_{pass}/N_{tot}	18.4%+-.1% **(P)**	16.3%+-.1% **(A)**	15.8%+-.1% **(A)**
$\varepsilon_{EMreco}^{MC}$	94.2%+-.1% **(P)**	84.9%+-.3% **(A)**	77.6%+-.4% **(A)**
ε_{trk}^{data}	78.6%+-.4%	75.3%+-1.1%	76.5%+-2.7%
ε_{EM}^{data}	84.2%+-.4%	60.6%+-1.2%	42.9%+-2.8%
$\varepsilon_{trigger}$	-	-	-
Xsection x BR	**257.9pb+-4.5pb**	**71.4pb+-3.8**	**19.9pb+-3.1**

(P) = PYTHIA
(A) = ALPGEN

to do

- Φ cracks in or out?
- Include post-shutdown data (250pb^{-1} !)
- Calculate Trigger efficiencies
- Calculate Jet ID/Reco efficiencies (James Heinmiller)