Period 28 High PT Lepton Efficiencies and SF -Peliminary

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Tufts

Electrons ID: Samples

Dataset bhelmm: Runs 287294-289197(P28)
MC sample : zektek (Feb 2009)
GRL :GRL for P28 Prelim
(goodrun_em_si_v34.list, goodrun_em_nosi_v34.list)

P28 skim leptons
MC dataset zektek (P25 and onward) on SAM

Electron ID: Cuts

CEM Selection Cuts

Variable	Tight (CEM)
Region	== CEM
Fiducial	Fiducial == 1
E_T	$\geq$ 20 GeV
Track Z_0	$\leq$ 60 cm
Track p_T	$\geq$ 10 GeV/c
COT Ax. Seg.	$\geq$ 3
COT St. Seg.	$\geq$ 2
Conversion	$\neq$ 1
Had/em	$\leq (0.055 + (0.00045 \times E))$
Isolation	$\leq$ 0.1
LshrTrk	$\leq$ 0.2
E/P	$\leq$ 2.0 unless $p_T \geq$ 50GeV/c
CES ΔZ	$\leq$ 3.0 cm
Signed CES ΔX	$-3.0 \leq q \times \Delta X \leq 1.5$
CES StripChi2	$\leq$ 10.0

Z candidates are used to calculate the efficiencies

Plug Selection Cuts

Variable	PHX	PEM
E_T	$\geq$ 20GeV	$\geq$ 20GeV
Pes2dEta	$1.2 \leq \lvert\eta\rvert \leq 2.8$	$1.2 \leq \lvert\eta\rvert \leq 2.8$
Had/Em	$\leq$ 0.05	$\leq$ 0.05
Pem3x3FitTow	$\neq$ 0	$\neq$ 0
Pem3x3Chisq	$\leq$ 10	$\leq$ 10
Pes5by9U	$\geq$ 0.65	$\geq$ 0.65
Pes5by9V	$\geq$ 0.65	$\geq$ 0.65
Isolation	$\leq$ 0.1	$\leq$ 0.1
ΔR	$\leq$ 3.0 cm	$\leq$ 3.0 cm
PhxMatch	TRUE	-
N_{hits}^{Si}	$\geq$ 3	-
$\lvert z_0^{PHX}\rvert$	$\leq$ 60 cm	-

We calculate efficiencies using a set of very loose, or "probe" electrons as the denominator. For each tight electron in the event which passes the trigger, we look for probe electrons which have the opposite sign and which, paired with the tight electron, have an invariant mass in the Z window 76 GeV/c^2 < M < 106 GeV/c^2. (Central-Central)

We calculate Phoenix electron efficiencies using central-plug Z candidates in the mass window 81 GeV/c^2 < M < 101 GeV/c^2. Due to the non-negligible, and η-dependent, Phoenix charge fake rate, there is no opposite-sign requirement.

P26 numbers vs P25

	Period 27		Period 27	
	bhelmm	zektek	bhelmm	zektek
CEM Eff	0.779+\-0.004	0.793 +\-0.003	0.771+\-0.004	0.793 +\-0.003
CEM SF	0.981 +\-0.006	N/A	0.972 +\-0.006	N/A
nisoCEM Eff	0.814 +\-0.003	0.825 +\-0.003	0.808 +\-0.004	0.825 +\-0.003
nisoCEM SF	0.986 +\-0.005	N/A	0.979 +\-0.006	N/A
LooseCEM Eff	0.907 +/- 0.002	0.901 +\-0.003	0.902 +/- 0.003	0.901 +\-0.003
LooseCEM SF	1.007 +\-0.004	N/A	1.002 +\-0.004	N/A
nisolooseCEM Eff	0.948+\-0.002	0.940 +\-0.003	0.943+\-0.002	0.940 +\-0.003
nisoloostCEM SF	1.009 +\-0.004	N/A	1.004 +\-0.004	N/A

	PHX		PHX	
Eff |Eta| < 2.0	0.671+\-0.006	0.746+\-0.004	0.669+\-0.006	0.746+\-0.004
SF |Eta| < 2.0	0.899+\-0.009	NA	0.897+\-0.009	NA
	PHX		PHX	
Eff |Eta| < 2.8	0.578+\-0.005	0.644+\-0.004	0.585+\-0.005	0.644+\-0.004
SF |Eta| < 2.8	0.897+\-0.009	NA	0.908+\-0.010	NA

CEM-PEM

P25 / P26

	P25 PEM		P26 PEM	
Eff |Eta| < 2.0	0.739+\-0.006	0.843+\-0.003	0.781+\-0.006	0.843+\-0.003
SF |Eta| < 2.0	0.876+\-0.008	NA	0.927+\-0.009	NA

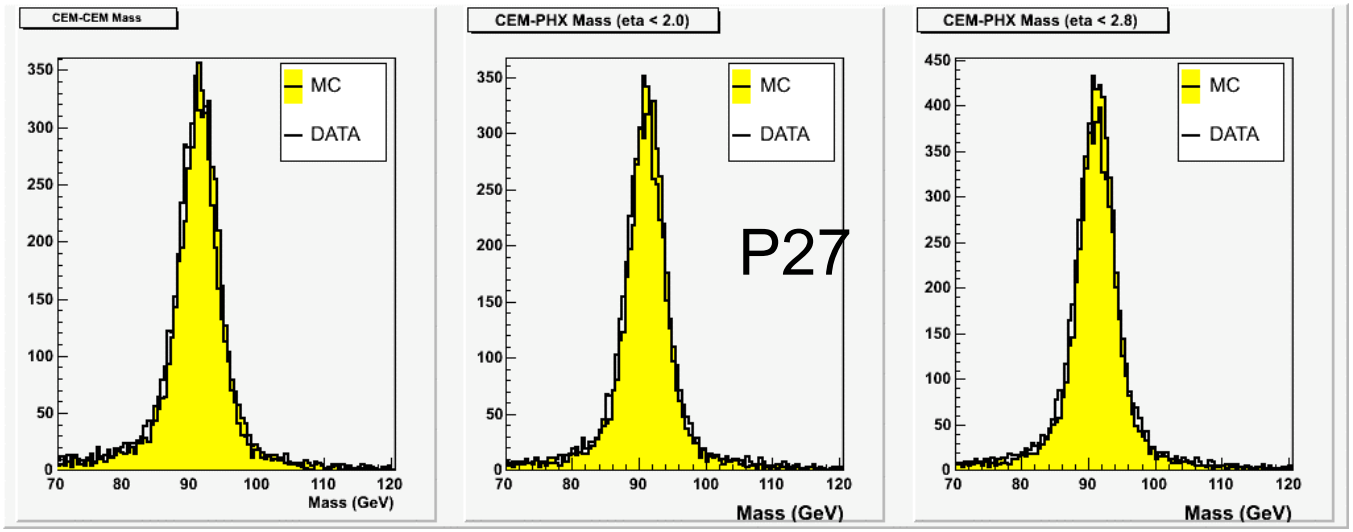
	P25 PEM		P26 PEM	
Eff |Eta| < 2.8	0.697+\-0.006	0.803+\-0.003	0.739+\-0.006	0.803+\-0.003
SF |Eta| < 2.8	0.867+\-0.008	NA	0.920+\-0.008	NA

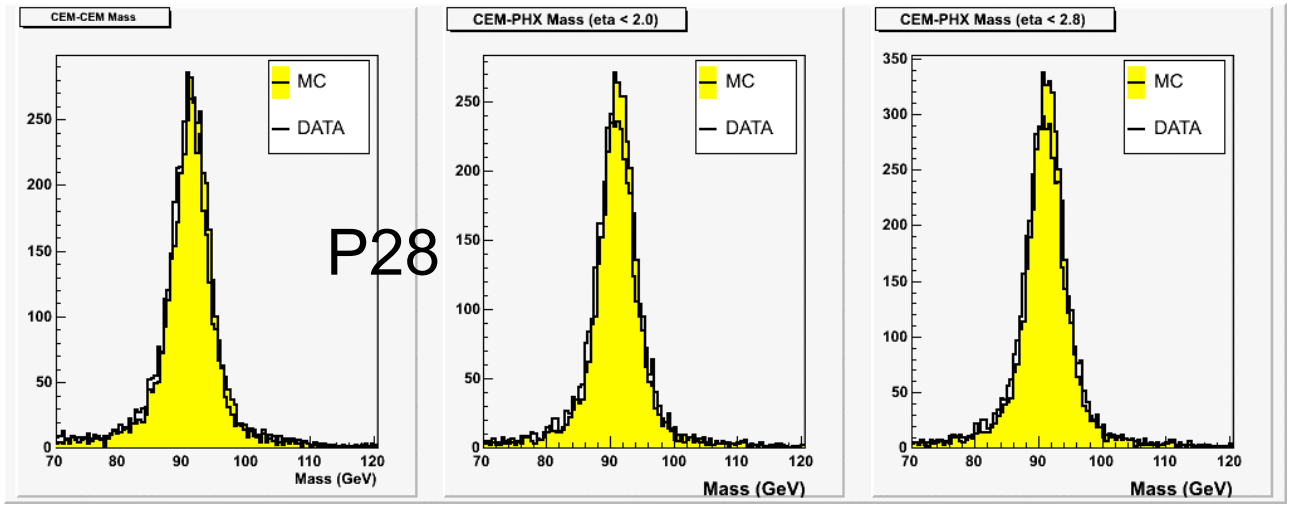
P27 / P28

	P27 PEM		P28 PEM	
Eff |Eta| < 2.0	0.768+\-0.005	0.843+\-0.003	0.762+\-0.006	0.843+\-0.003
SF |Eta| < 2.0	0.911+\-0.007	NA	0.904+\-0.008	NA

	P27 PEM		P28 PEM	
Eff |Eta| < 2.8	0.723+\-0.004	0.803+\-0.003	0.723+\-0.005	0.803+\-0.003
SF |Eta| < 2.8	0.900+\-0.006	NA	0.901+\-0.007	NA

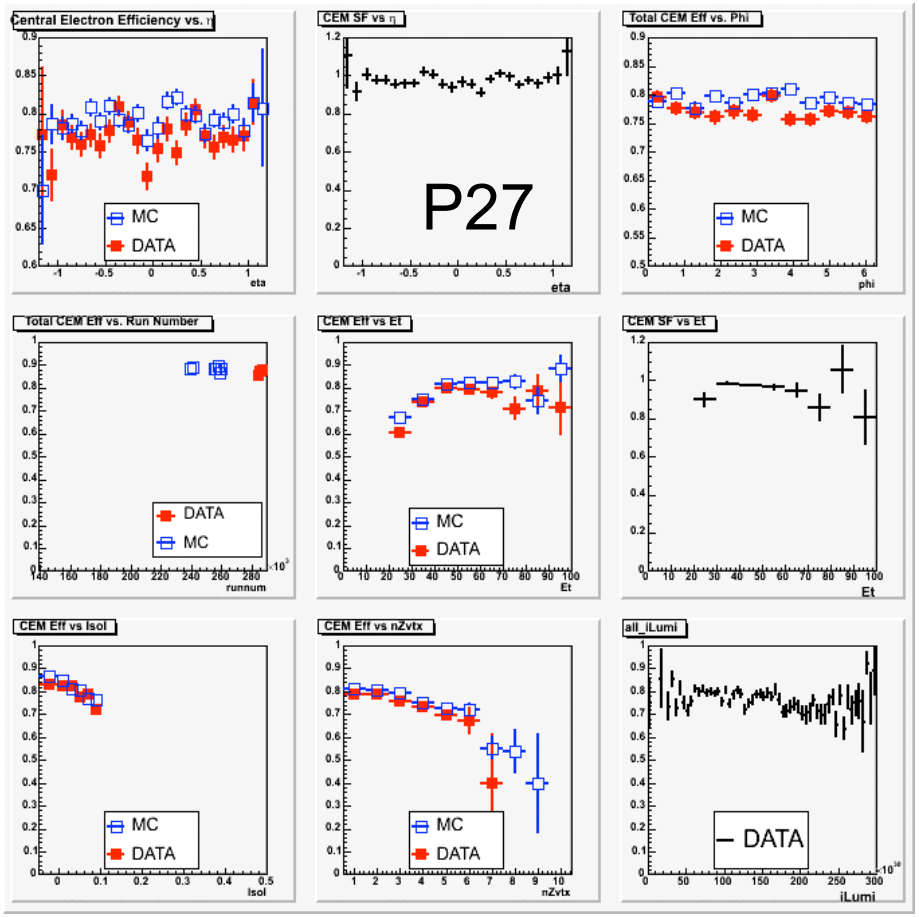
EleID Plots

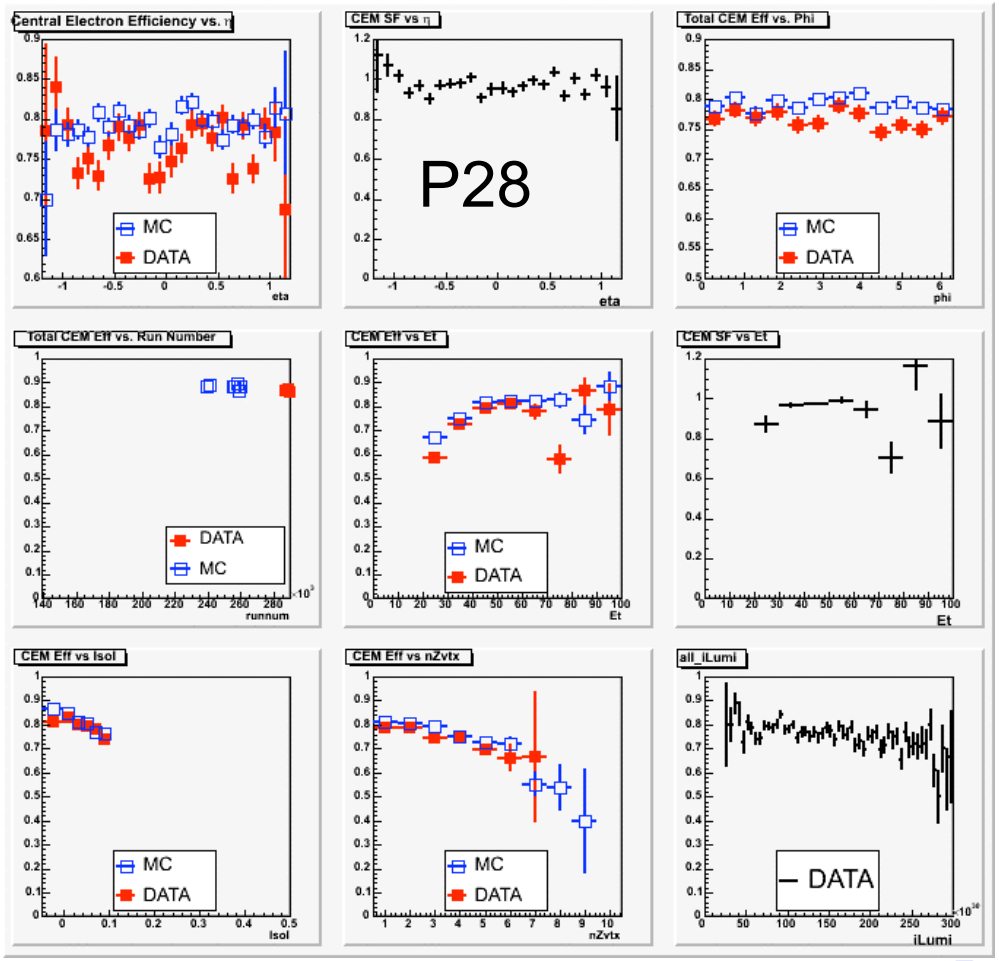

CEM-CEM Mass
CEM-PHX Mass (eta < 2.0)
CEM-PHX Mass (eta < 2.8)
MC
DATA
Mass (GeV)
P27


CEM-CEM Mass
CEM-PHX Mass (eta < 2.0)
CEM-PHX Mass (eta < 2.8)
MC
DATA
Mass (GeV)
P28

EleID Plots 1

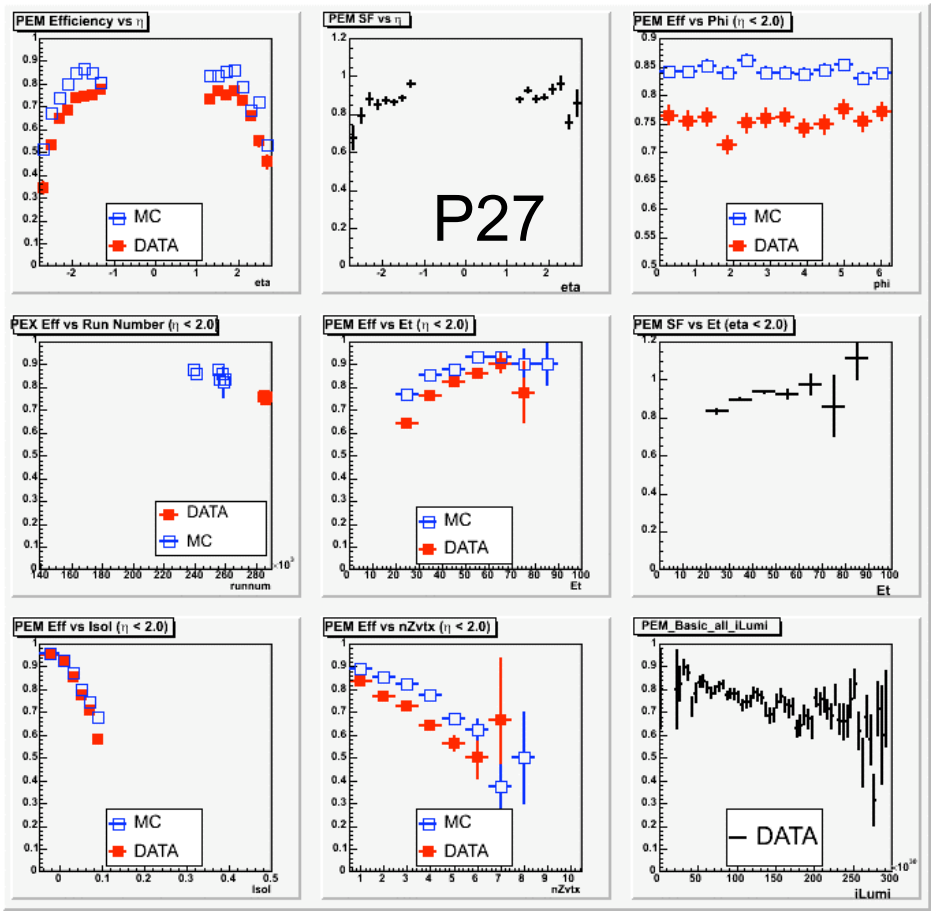
CEM Efficiencies

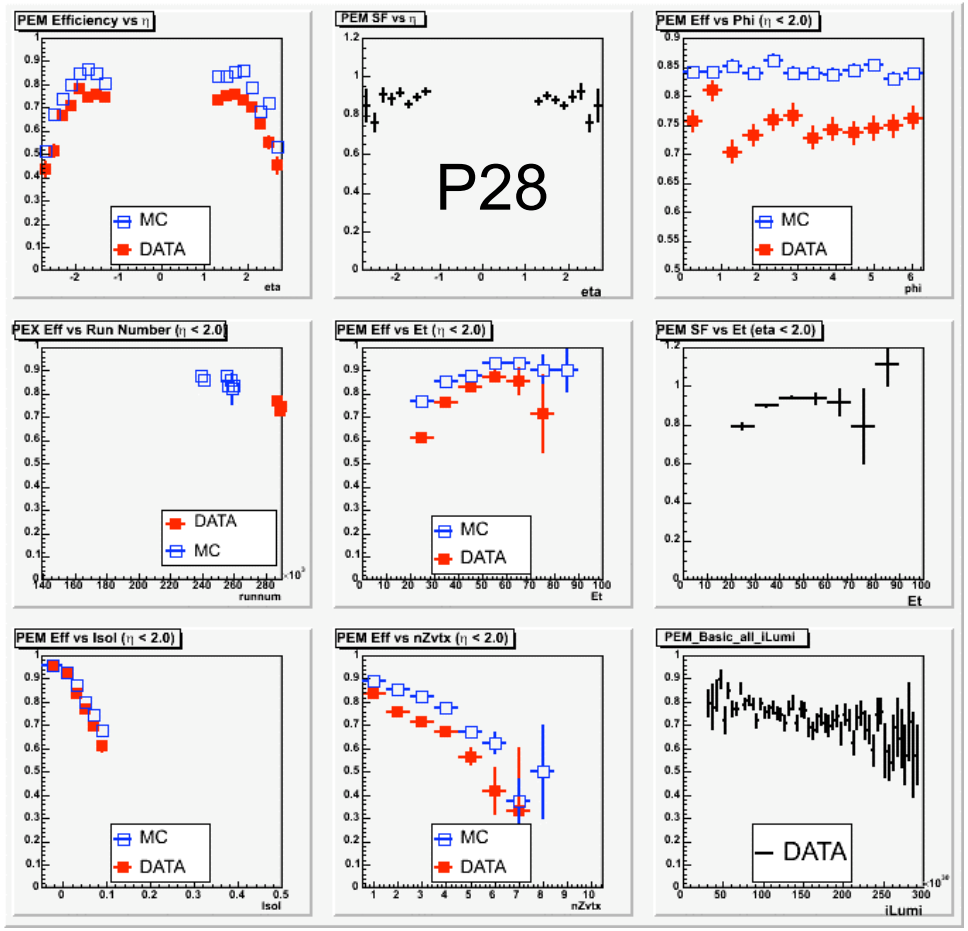




EleID Plots 2

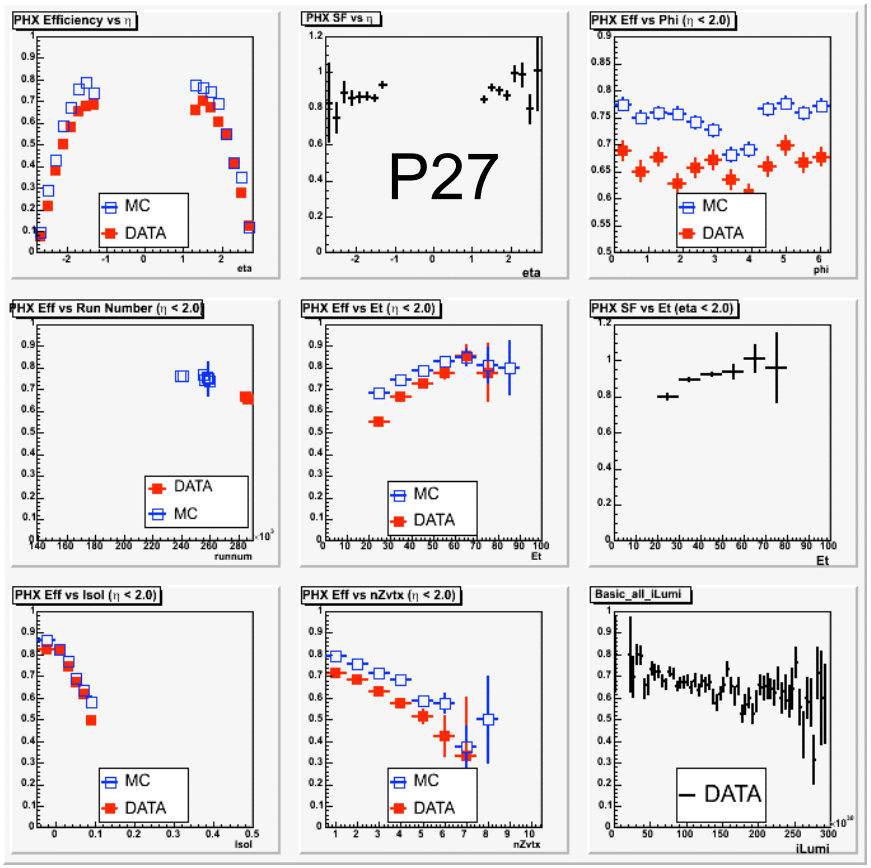
PEM Efficiencies

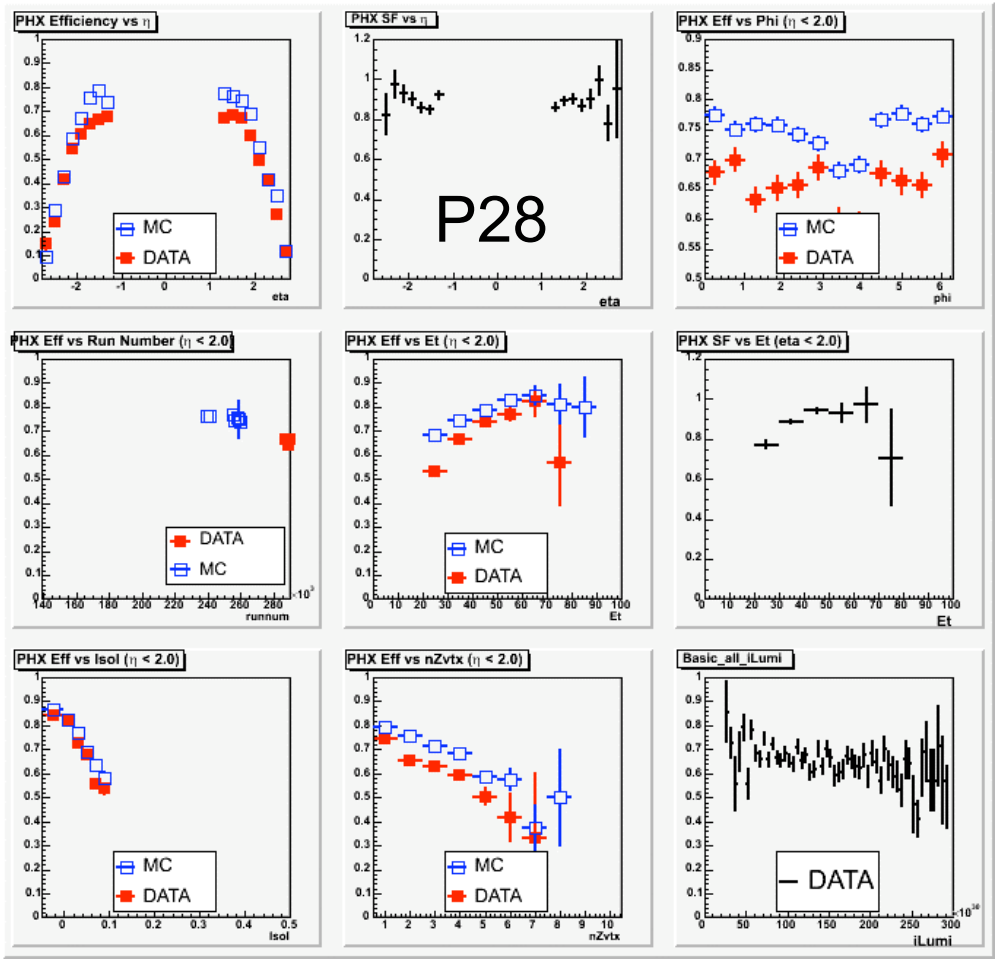




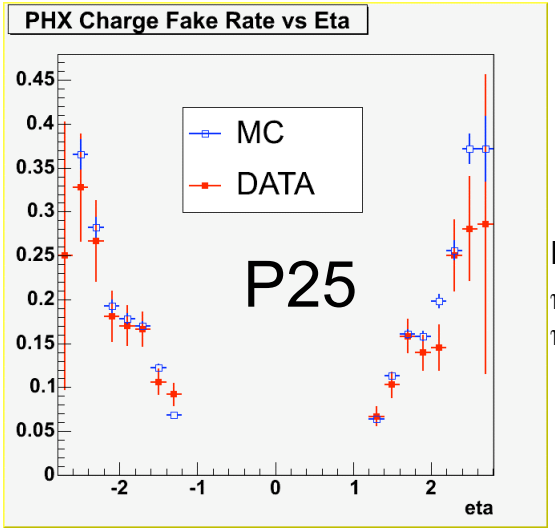
EleID Plots 3

PHX Efficiencies

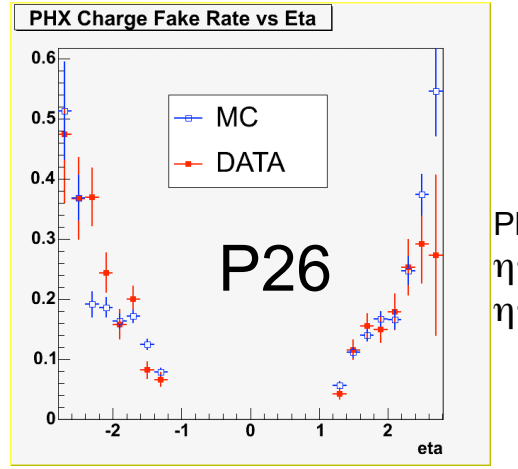




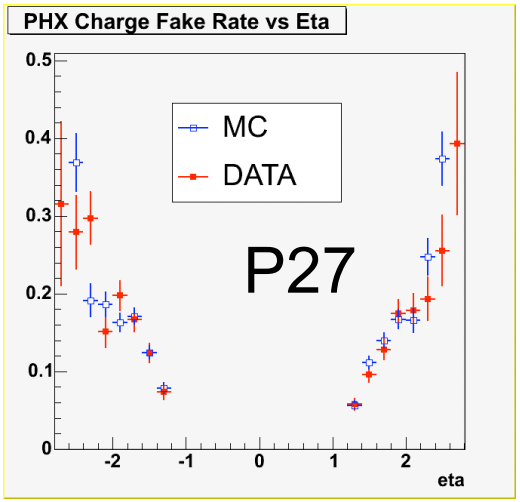
PHX Fake Charge Rate



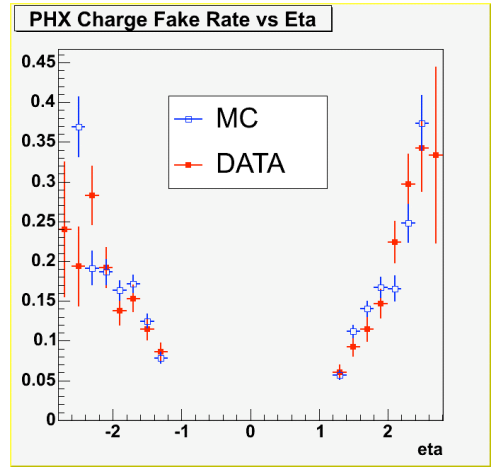
Phoenix charge fake rate
η< 2.0 0.119 +/- 0.006
η < 2.8 0.137 +/- 0.006



Phoenix charge Fake rate
η< 2.0: 0.113 +/- 0.006
η< 2.8: 0.144 +/- 0.006



Phoenix charge fake rate
η < 2.0 0.118 +/- 0.005
η < 2.8 0.137 +/- 0.005



Phoenix charge Fake rate
η< 2.0: 0.108 +/- 0.005
η< 2.8: 0.136 +/- 0.005

Electron ID Conclusions

- P28 are in good agreement with previous periods

Electron Trigger: Tracking

1 electron with $E_T > 25GeV$
$\not{E}_T > 25GeV$
reject cosmic events

Table: Offline *W* selection.

Electron Variables	Current baseline cuts
E_T	> 20 GeV
p_T	> 10 GeV/c
N_{SL}^{axial} with 5 hits	≥ 3
N_{SL}^{stereo} with 5 hits	≥ 2
Fiducial	1
Had/Em	$< 0.055 + 0.00045E$
L_{shr}	< 0.2
E/p	< 2 (for $p_T < 50GeV$)
$\lvert Z_{vertex} \rvert$	< 60 cm
$\lvert \Delta X \rvert$	$-3.0 < Q_{trk}\Delta X < 1.5$ cm
$\lvert \Delta Z \rvert$	< 3 cm
χ^2_{strip}	< 10
Conversion	$\neq 1$ (not)

Table: Offline baseline cuts for central electrons.

L1 Tracking Efficiency

$$\epsilon(\text{L1_XFT_PT8}) = \frac{\text{numW \& passed L1_CEM8_PT8}}{\text{numW}}$$

numW means the number of *W* candidates that passed the W_NOTRACK path.

L2 Tracking Efficiency

At L2, there is no additional tracking done except for receiving the XFT information from L1.

$$\epsilon(\text{L2_XFT_PT8}) = \frac{\text{numW \& passed L1_CEM8_PT8 \& passed L2_CEM16_PT8}}{\text{numW \& passed L1_CEM8_PT8}}$$

L3 Tracking Efficiency

$$\epsilon(\text{L3_PT9}) = \frac{\text{numW \& passed L1_CEM8_PT8 \& L2_CEM16_PT8 \& L3_CEM18_PT9}}{\text{numW \& passed L1_CEM8_PT8 \& L2_CEM16_PT8}}$$

Electron Trigger: Calorimeter

L2 Calorimeter Efficiency

- Require at least 1 electron satisfying the baseline cuts and $E_T >$ 18GeV.
- Use ELECTRON_CENTRAL_18_NO_L2 path.
- Efficiency reaches 100% at about 25 GeV.

$$\epsilon(\text{L2_CEM16}) = \frac{\text{numEl \& passed L1_CEM8_PT8 \& L2_PS \& L2_CEM16}}{\text{numEl \& passed L1_CEM8_PT8 \& L2_PS}}$$

L3 Calorimeter Efficiency

- Use the calibration dataset(blpc).
- Use ELECTRON_CENTRAL_8_NO_L2 path.
- Efficiency reaches 100% at about 20 GeV.

$$\epsilon(\text{L3_CEM18}) = \frac{\text{numEl \& passed EL_CENT_8_NO_L2 \& L2_CEM16 \& L3_CEM18}}{\text{numEl \& passed EL_CENT_8_NO_L2 \& L2_CEM16}}$$

Electron Trigger Results

NofflW	131985
NcemL1	126616
NcemL2	126544
NcemL3	125539

Trigger	Period 17	Period 18	Period 19	Period 20
L1_XFT_PT8	0.9694 ± 0.003	0.9697 ± 0.003	0.9674 ± 0.003	0.9686 ± 0.003
L2_XFT_PT8	0.9995 ± 0.003	0.9995 ± 0.003	0.9993 ± 0.003	0.9995 ± 0.003
L3 tracking	0.9929 ± 0.003	0.9919 ± 0.003	0.9909 ± 0.003	0.9911 ± 0.003
Total Tracking	0.9622 ± 0.003	0.9615 ± 0.003	0.9615 ± 0.003	0.9594 ± 0.003

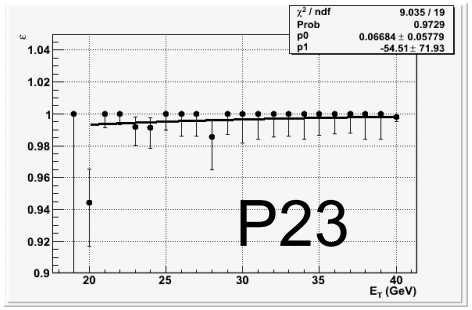
Period 21	Period 22	Period 23	Period 24	Period 25
0.9681 ± 0.002	0.9704 ± 0.003	0.9705 ± 0.003	0.9698 ± 0.003	0.9695 ± 0.003
0.9993 ± 0.002	0.9995 ± 0.003	0.9995 ± 0.003	0.9995 ± 0.003	0.9995 ± 0.003
0.9903 ± 0.002	0.9901 ± 0.003	0.9892 ± 0.003	0.9899 ± 0.003	0.9906 ± 0.003
0.9580± 0.002	0.9580± 0.003	0.9596± 0.003	0.9596± 0.003	0.9599± 0.003

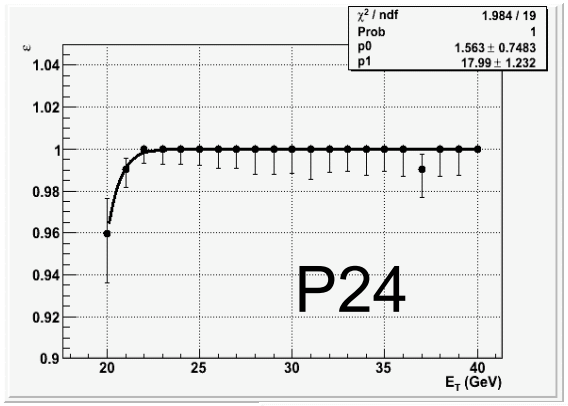
Period 26	Period 27	Period 28
0.9595 ± 0.003	0.9596 ± 0.003	0.9593 ± 0.003
0.9995 ± 0.003	0.9995 ± 0.003	0.9994 ± 0.003
0.9931 ± 0.003	0.9926 ± 0.003	0.9926 ± 0.003
0.9525± 0.003	0.9521± 0.003	0.9521± 0.003

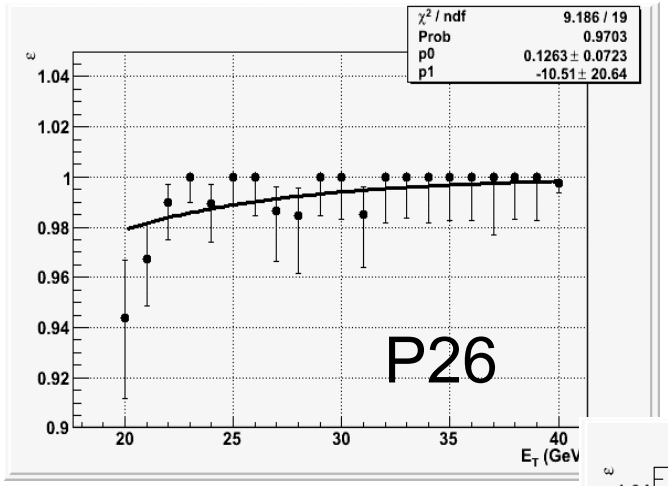
L2 Calo Efficiency

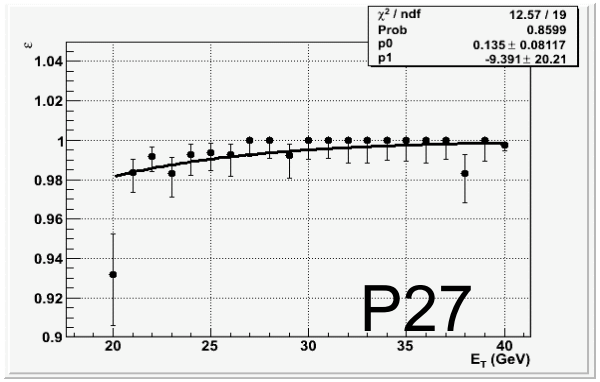
$$\epsilon = \frac{1}{1 + e^{-\beta(E_T - \alpha)}}.$$

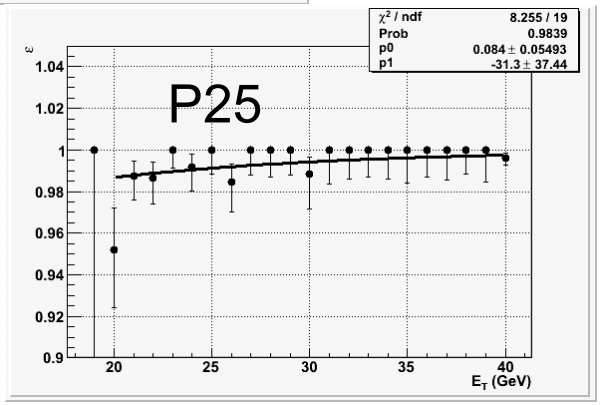
L2_CEM16 calorimeter efficiency

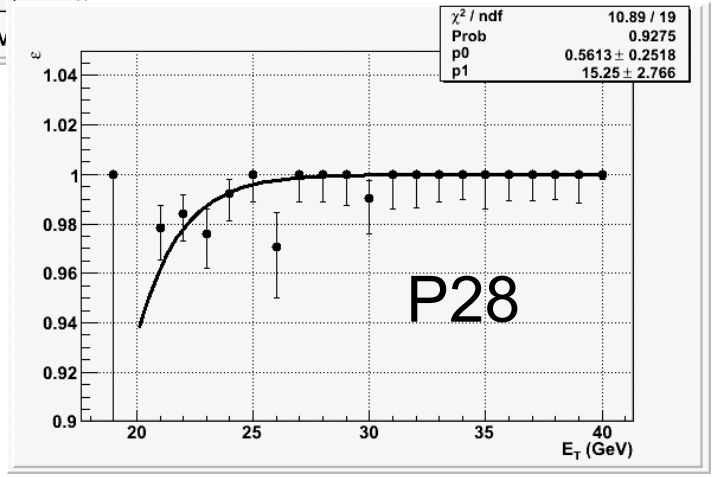












MET_PEM Trigger

Dataset bhelmm: Runs 287294-289197 (P28)
Dataset bpelmm (and high eta PHX): Runs 287294-289197 (P28)

GRL :GRL Prelim for P28

P26 dataset :bpelmm, bhelmm, skim leptons, goodrun_em_si_v34Prelim.list

MET_PEM Trigger: Evt Selection

Event Selection: $W \rightarrow e\nu$ and $Z \rightarrow e^+e^-$ (CP) candidates.

- Plug electrons selected according to the Phoenix Objects standard cuts,
- Central electrons are *UltraTight CEM* Objects
- Electron ID cuts: notes 8614 and 8274

Variable	UltraTight CEM	Variable	PHX
Region	== Central	Region	== plug
Fiducial	TrkFiducial == 1	*Pes2dEta*	$1.2 \leq \lvert\eta\rvert \leq 2.8$
E_T	$\geq$ 20 GeV	E_T	$\geq$ 20 GeV
Track Z_0	$\leq$ 60 cm	Had/Em	$\leq$ 0.05
Track p_T	$\geq$ 10 Gev	Pem3x3FitTow	$\neq$ 0
COT Ax. Seg.	$\geq$ 3	Pem3x3χ^2	$\leq$ 10
COT St. Seg.	$\geq$ 2	Pes5by9U	$\geq$ 0.65
Conversion	$\neq$ 1	Pes5by9V	$\geq$ 0.65
Had/Em	$\leq (0.055 + (0.00045 \times E))$	Isolation	$\leq$ 0.1
Isolation	$\leq$ 0.05 ($\leq$ 0.1 in TCEM)	ΔR	$\leq$ 3.0 cm
LshrTrk	$\leq$ 0.1 ($\leq$ 0.2 in TCEM)	PhxMatch	True
E/p	$\leq$ 2.0 unless $p_T \geq$ 50 GeV/c	$N^{siliconhits}$	$\geq$ 3
CES ΔZ	$\leq$ 3.0 cm	Z_0^{PHX}	$\leq$ 60 cm
Single CES ΔX	$-3.0 \leq q \times \Delta X \leq 1.5$		
CES Stripχ^2	$\leq$ 10.0		

MET_PEM:L1 and L3 MET15 Eff

MET_PEM		PLUG_ELECTRON_20	
L1	L1_EM8_MET15	L1	L1_EM8
L2	L2_PEM20_L1_EM8_MET15	L2	L2_PEM20_PS10 (PS25)
L3	L3_PEM20_MET15	L3	L3_PEM20

L1, L3 MET15 and L2, L3 PEM20 components of MET_PEM are separated thanks to PLUG_ELECTRON_20 back-up trigger.

- MET15: $W \to e\nu$ candidate searched in the bpel dataset:

$$\epsilon(\texttt{L1_MET15_L3_MET15}) = \frac{\texttt{PLUG_ELECTRON_20 \&\& MET_PEM}}{\texttt{PLUG_ELECTRON_20}} \quad (1)$$

- PEM20: $Z \to e^+e^-$ CP candidate searched in the bhel dataset:

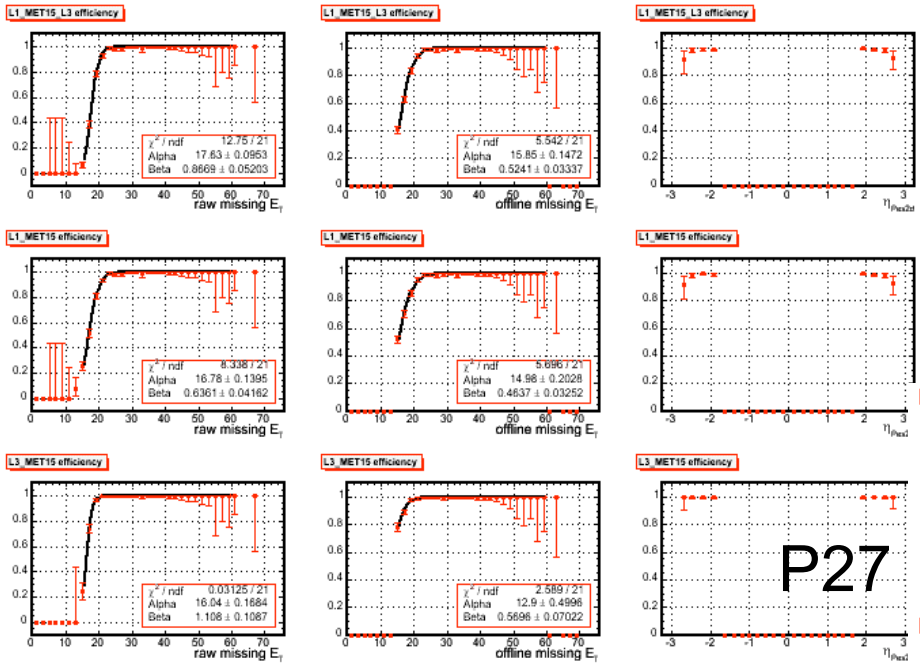
$$\epsilon(\texttt{L2_PEM20}) = \frac{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}}{Z \to e^+e^-(CP)} \quad (2)$$

$$\epsilon(\texttt{L3_PEM20}) = \frac{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}\ \&\&\ \texttt{L3_PEM20}(L3Obj)}{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}} \quad (3)$$

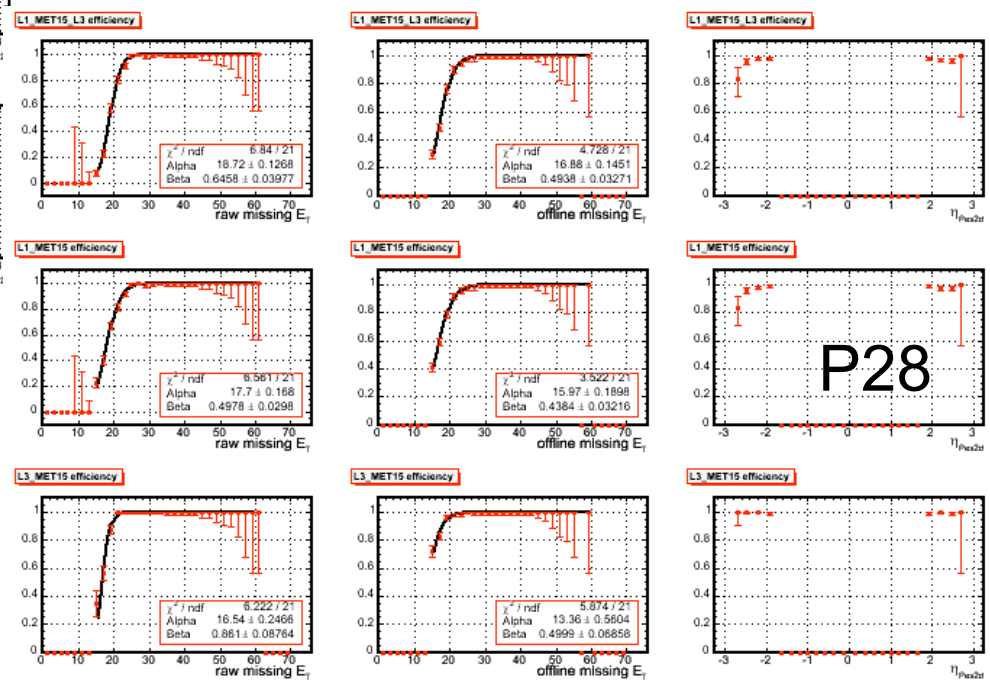
Turn-on fit function

$$\epsilon(x) = \frac{1}{1 + e^{-\beta(x-\alpha)}}$$

MET15 Results



P27



P28

MET15 Fit Results

$1.2 \leq |\eta| \leq 2.8$

L1_MET15_L3_MET15 Fit Values (electron $1.2 \leq |\eta| \leq 2.8$)

period	ϵ ($\not{E}_T > 20$ GeV)	α	β
$p00$	$98.52^{+0.20}_{-0.22}$	14.20 ± 0.24	0.35 ± 0.02
$[p01, p04]$	$97.89^{+0.26}_{-0.28}$	14.80 ± 0.22	0.34 ± 0.02
$[p05, p07]$	$98.64^{+0.09}_{-0.10}$	14.74 ± 0.10	0.35 ± 0.01
$p08$	$98.85^{+0.12}_{-0.12}$	14.38 ± 0.14	0.37 ± 0.01
$p09$	$98.92^{+0.14}_{-0.15}$	13.78 ± 0.20	0.37 ± 0.02
$p10$	$98.54^{+0.17}_{-0.19}$	14.62 ± 0.18	0.37 ± 0.02
$p11$	$98.47^{+0.18}_{-0.19}$	14.67 ± 0.18	0.38 ± 0.02
$p12$	$98.20^{+0.24}_{-0.26}$	15.15 ± 0.19	0.38 ± 0.02
$p13$	$98.36^{+0.18}_{-0.20}$	14.51 ± 0.18	0.37 ± 0.02
$p14$	$98.96^{+0.33}_{-0.41}$	13.57 ± 0.50	0.41 ± 0.05
$p15$	$98.44^{+0.21}_{-0.23}$	14.81 ± 0.19	0.39 ± 0.02
$p16$	$98.20^{+0.28}_{-0.32}$	15.34 ± 0.21	0.39 ± 0.03
$p17$	$98.23^{+0.22}_{-0.24}$	14.52 ± 0.21	0.39 ± 0.02

MET15 Fit Results $1.2 \leq |\eta| \leq 2.8$

P18	$98.46^{+0.15}_{-0.16}$	15.05 ± 0.12	0.387 ±0.014 (1.2 ≤ |η| ≤ 2.8)
P19	$98.48^{+0.18}_{-0.20}$	14.92+/-0.16	0.382+/-0.018 (1.2 ≤ |η| ≤ 2.8)
P20	$97.63^{+0.25}_{-0.26}$	15.05+/-0.17	0.361+/-0.017 (1.2 ≤ |η| ≤ 2.8)
P21	$98.52^{+0.12}_{-0.12}$	12.113+/-0.40	0.688+/-0.067 (1.2 ≤ |η| ≤ 2.8)
P22	$98.33^{+0.29}_{-0.132}$	14.01+/-0.427	0.569+/-0.012 (1.2 ≤ |η| ≤ 2.8)
P23	$99.63^{+00.18}_{-00.27}$	14.16+/-0.27	0.601+/-0.064
P24	$99.60^{+00.17}_{-00.24}$	14.89+/-0.17	0.627+/-0.044
P25	$99.11^{+00.30}_{-00.38}$	13.95+/-0.31	0.527+/-0.054
P26	$99.71^{+00.17}_{-00.27}$	14.18+/-0.28	0.591+/-0.064
P27	$99.82^{+00.10}_{-00.17}$	12.90+/-0.50	0.570+/-0.070
P28	$99.45^{+00.21}_{-00.29}$	13.36+/-0.56	0.500+/-0.070

PEM_20: L3 Results

$1.2 \leq |\eta| \leq 2.8$

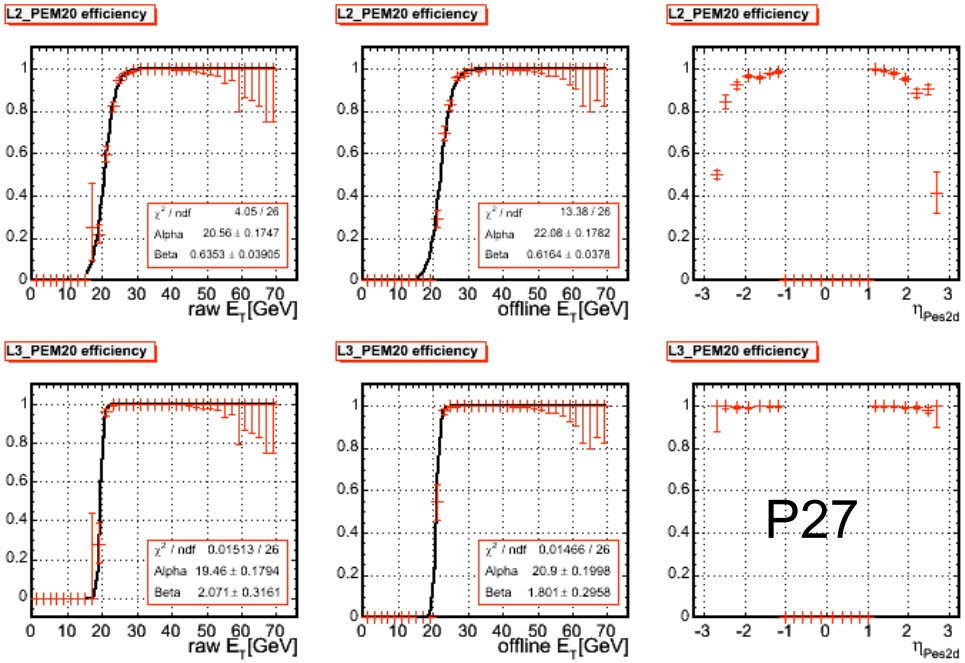
period	ϵ	α	β
$p00$	$99.65^{+0.06}_{-0.07}$	20.68 ± 0.23	1.38 ± 0.20
$[p01, p04]$	$99.67^{+0.06}_{-0.06}$	20.42 ± 0.21	1.53 ± 0.24
$[p05, p07]$	$99.67^{+0.06}_{-0.06}$	20.80 ± 0.22	1.40 ± 0.20
$p08$	$99.47^{+0.11}_{-0.13}$	21.03 ± 0.17	1.95 ± 0.33
$p09$	$99.59^{+0.10}_{-0.12}$	21.48 ± 0.21	1.94 ± 0.35
$p10$	$99.45^{+0.10}_{-0.11}$	20.95 ± 0.18	1.58 ± 0.24
$p11$	$99.69^{+0.08}_{-0.09}$	20.75 ± 0.23	1.88 ± 0.68
$p12$	$99.66^{+0.09}_{-0.11}$	20.73 ± 0.26	1.75 ± 0.42
$p13$	$99.59^{+0.08}_{-0.09}$	20.69 ± 0.23	1.49 ± 0.25
$p14$	$99.32^{+0.24}_{-0.32}$	21.00 ± 0.07	1.67 ± 0.37
$p15$	$99.59^{+0.10}_{-0.12}$	20.43 ± 0.30	1.55 ± 0.33
$p16$	$99.52^{+0.13}_{-0.16}$	20.62 ± 0.34	1.49 ± 0.35
$p17$	$99.51^{+0.11}_{-0.13}$	20.53 ± 0.34	1.21 ± 0.24

PEM_20: L3 Results

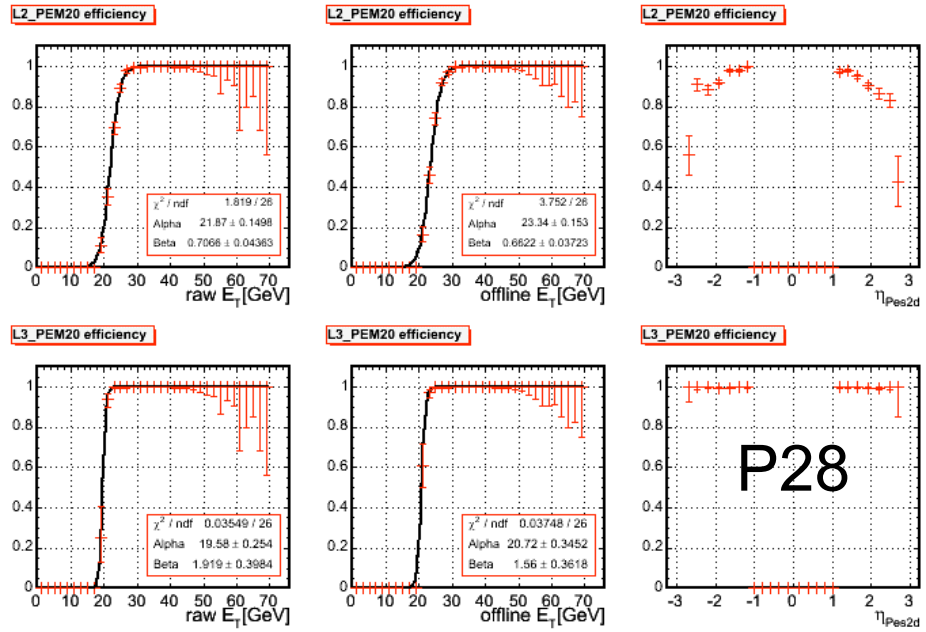
$1.2 \leq |\eta| \leq 2.8$

P18	$99.48^{+0.08}_{-0.09}$	20.91+/-0.18	1.45+/-0.18
P19	$99.49^{+0.10}_{-0.11}$	21.15+/-0.14	2.17+/-0.33
P20	$99.55^{+0.10}_{-0.12}$	20.85+/-0.23	1.73+/-0.34
P21	$99.61^{+0.07}_{-0.08}$	20.71+/-0.17	1.74+/-0.25
P22	$99.64^{+0.08}_{-0.10}$	20.68+/-0.21	1.97+/-0.40
P23	$99.62^{+00.10}_{-00.11}$	20.51+/-0.37	1.37+/-0.30
P24	$99.60^{+00.09}_{-00.11}$	20.73+/-0.18	2.03+/-0.40
P25	$99.64^{+00.09}_{-00.11}$	20.16+/-0.44	1.18+/-0.27
P26	$99.58^{+00.11}_{-00.13}$	20.46+/-0.41	1.17+/-0.26
P27	$99.64^{+00.08}_{-00.09}$	20.90+/-0.20	1.80+/-0.30
P28	$99.79^{+00.06}_{-00.08}$	20.72+/-0.36	1.56+/-0.36

PEM_20 Plots

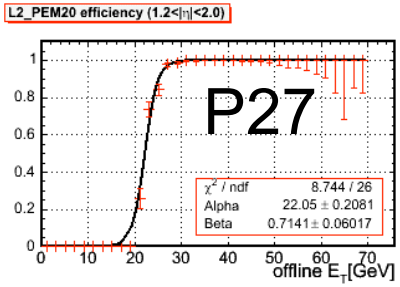


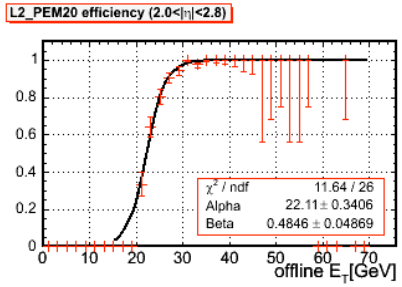
P27

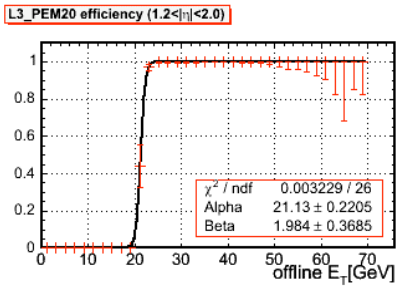


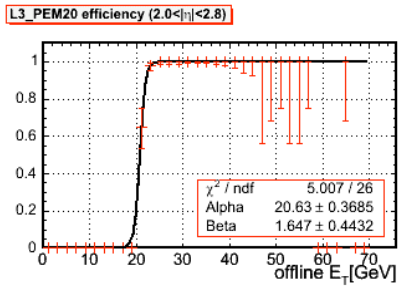
P28

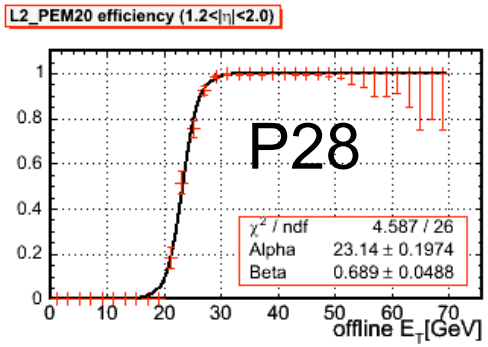
PEM_20 Plots

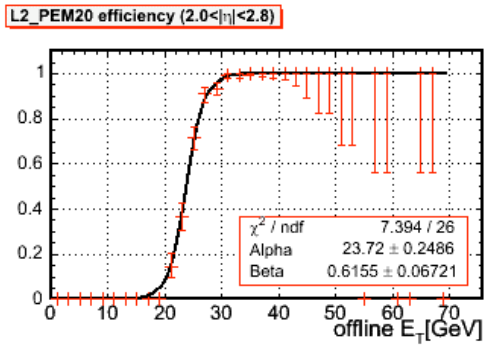

L2_PEM20 efficiency (1.2<|η|<2.0)
P27
χ² / ndf 8.744 / 26
Alpha 22.05 ± 0.2081
Beta 0.7141 ± 0.06017
offline E_T[GeV]

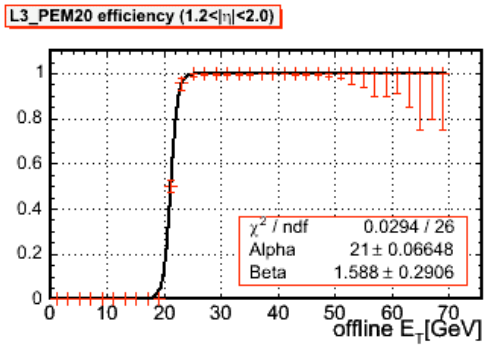

L2_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 11.64 / 26
Alpha 22.11 ± 0.3406
Beta 0.4846 ± 0.04869
offline E_T[GeV]

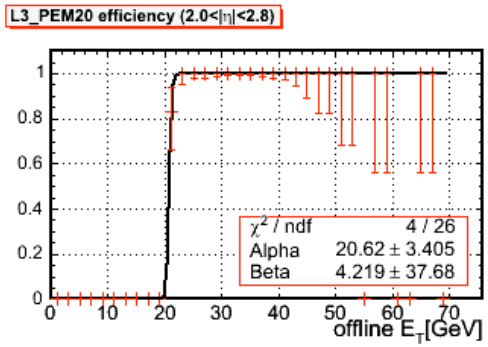

L3_PEM20 efficiency (1.2<|η|<2.0)
χ² / ndf 0.003229 / 26
Alpha 21.13 ± 0.2205
Beta 1.984 ± 0.3685
offline E_T[GeV]


L3_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 5.007 / 26
Alpha 20.63 ± 0.3685
Beta 1.647 ± 0.4432
offline E_T[GeV]


L2_PEM20 efficiency (1.2<|η|<2.0)
P28
χ² / ndf 4.587 / 26
Alpha 23.14 ± 0.1974
Beta 0.689 ± 0.0488
offline E_T[GeV]


L2_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 7.394 / 26
Alpha 23.72 ± 0.2486
Beta 0.6155 ± 0.06721
offline E_T[GeV]


L3_PEM20 efficiency (1.2<|η|<2.0)
χ² / ndf 0.0294 / 26
Alpha 21 ± 0.06648
Beta 1.588 ± 0.2906
offline E_T[GeV]


L3_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 4 / 26
Alpha 20.62 ± 3.405
Beta 4.219 ± 37.68
offline E_T[GeV]

Muons

Dataset bhmumm: Runs 287294-289197 (P28)
MC sample : zemtjm (Feb 2009)
GRL : GRL for P28 v34 prelim
goodrun_em_mu_nosi_cmxignored_v34.list,
goodrun_em_mu_si_cmxignored_v34.list

Data: P28 Data skim Leptons : bhmumm
MC: dataset zemtjm on SAM

Muon ID Efficiency: ID Cuts

For all events:

No cosmic tag.

For all muon types (including stubless muons):

P_T	$>$	20 GeV/c
E_{EM}	$<$	2+max(0, $(p-100)\cdot 0.0115$) GeV
E_{HAD}	$<$	6+max(0, $(p-100)\cdot 0.028$) GeV
$E_T^{isol.}/P_T$	$<$	0.1
Number of axial SL with $\geq$ 5 hits	$\geq$	3
Number of stereo SL with $\geq$ 5 hits	$\geq$	2
$\lvert z_0 \rvert$	$<$	60 cm
Tracks w/ no silicon hits: $\lvert d_0 \rvert$	$<$	0.2 cm
Tracks w/ silicon hits: $\lvert d_0 \rvert$	$<$	0.02 cm

Additionally for tight CMUP muons:

$\lvert \Delta x_{CMU} \rvert$	$<$	7 cm
$\lvert \Delta x_{CMP} \rvert$	$<$	5 cm
No bluebeam muons, run	$<$	154449

Additionally for tight CMX muons:

$\lvert \Delta x_{CMX} \rvert$	$<$	6 cm
Run	$>$	150144
No miniskirt or keystone muons, run	$<$	190697
No muons in wedge 14 west, runs	$\geq$	190697 and $\leq$ 209760

Table 1: Standard muon ID cuts for 6.1.4 data MC.

Fiducial cuts

For CMUP muons:

Fiducial distance from CMU:		
x-fid	$<$	0 cm
z-fid	$<$	0 cm
Fiducial distance from CMP:		
x-fid	$<$	0 cm
z-fid	$<$	-3 cm
No muons from bluebeam region for run $<$ 154449		

For CMX muons:

ρ_{COT}	$>$	140 cm
Fiducial distance from CMX:		
x-fid	$<$	0 cm
z-fid	$<$	-3 cm
No muons from keystone region for run $<$ 190697		
No muons from miniskirt region for run $<$ 190697		
No muons wedge 14 west for runs $\geq$ 190697 and $\leq$ 209760		

Table 2: Suggested muon fiducial cuts for tight muons in release 6.1.4.

Arches:
$0^\circ \leq \phi \leq 75^\circ$ or $105^\circ \leq \phi \leq 225^\circ$ or $315^\circ \leq \phi < 360^\circ$
Additionally, for runs 190697 - 209760, remove:
$210^\circ < \phi \leq 225^\circ$ if $\eta < 0$
Keystone:
$75^\circ < \phi < 105^\circ$ and $\eta < 0$
Miniskirt:
$225^\circ < \phi < 315^\circ$

Table 3: Cuts on ϕ for distinguishing parts of the CMX detector when determining reconstruction efficiencies.

ID Efficiency Calculation

- A first leg must be a CMUP or CMX muon passing all the cuts given in Tables 1 and 2.
- A second leg must be a muon with a CMUP or CMX stub and satisfy:
  - $P_T > 20$ GeV.
  - fiducial requirements in Table 2.
- The event must not have a cosmic tag.
- The z_0 of the two legs must pass: $|z_0^{(1)} - z_0^{(2)}| < 4$ cm.
- The invariant mass of the two tracks must pass: $81 < m(\mu^+\mu^-)$ GeV/$c^2 < 101$.

We then test the second leg to determine if it passes each of the muon ID cuts given in Table 1.

CMUP ID Efficiency

P27

Cut	Count	Efficiency (%)
No cut	4285	
E_{EM} cut	4156	$96.99^{+0.25}_{-0.29}$
E_{HAD} cut	4198	$97.97^{+0.21}_{-0.23}$
COT hits cut	4283	$99.95^{+0.03}_{-0.06}$
d_0 cut	4262	$99.46^{+0.12}_{-0.14}$
Isolation cut	4103	$95.75^{+0.32}_{-0.32}$
Δx_{CMU} cut	4266	$99.56^{+0.10}_{-0.12}$
Δx_{CMP} cut	4206	$98.16^{+0.20}_{-0.22}$
All above cuts	3812	$88.96^{+0.47}_{-0.51}$
All cuts excl. isol.	3970	$92.65^{+0.39}_{-0.44}$
Sliding isol. cut	4159	$97.06^{+0.28}_{-0.26}$
All cuts (sliding isol.)	3862	$90.13^{+0.47}_{-0.46}$
χ^2 cut	4285	$100.00^{+0.00}_{-0.04}$
All cuts (χ^2)	3812	$88.96^{+0.47}_{-0.51}$
All track cuts	3894	$90.88^{+0.46}_{-0.47}$
All trk cuts excl. isol.	4055	$94.63^{+0.36}_{-0.37}$

: Dataset bhmummP27: Muon ID efficiencies for CMUP

P28

Cut	Count	Efficiency (%)
No cut	3255	
E_{EM} cut	3162	$97.14^{+0.29}_{-0.34}$
E_{HAD} cut	3190	$98.00^{+0.25}_{-0.29}$
COT hits cut	3255	$100.00^{+0.00}_{-0.06}$
d_0 cut	3239	$99.51^{+0.11}_{-0.16}$
Isolation cut	3075	$94.47^{+0.38}_{-0.45}$
Δx_{CMU} cut	3246	$99.72^{+0.09}_{-0.12}$
Δx_{CMP} cut	3187	$97.91^{+0.26}_{-0.28}$
All above cuts	2860	$87.86^{+0.56}_{-0.61}$
All cuts excl. isol.	3015	$92.63^{+0.46}_{-0.46}$
Sliding isol. cut	3137	$96.37^{+0.33}_{-0.35}$
All cuts (sliding isol.)	2916	$89.59^{+0.53}_{-0.55}$
χ^2 cut	3255	$100.00^{+0.00}_{-0.06}$
All cuts (χ^2)	2860	$87.86^{+0.56}_{-0.61}$
All track cuts	2925	$89.86^{+0.54}_{-0.58}$
All trk cuts excl. isol.	3086	$94.81^{+0.38}_{-0.40}$

: Dataset bhmummP28: Muon ID efficiencies for CMUP

CMUP ID SF

P27

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0070^{+0.0026}_{-0.0030}$
E_{HAD} cut	$0.9960^{+0.0022}_{-0.0023}$
COT hits cut	$0.9996^{+0.0003}_{-0.0006}$
d_0 cut	$0.9960^{+0.0012}_{-0.0014}$
Isolation cut	$0.9827^{+0.0033}_{-0.0033}$
Δx_{CMU} cut	$0.9956^{+0.0010}_{-0.0012}$
Δx_{CMP} cut	$0.9869^{+0.0020}_{-0.0022}$
All above cuts	$0.9688^{+0.0051}_{-0.0056}$
All cuts excl. isol.	$0.9846^{+0.0042}_{-0.0047}$
Sliding isol. cut	$0.9919^{+0.0029}_{-0.0027}$
All cuts (sliding isol.)	$0.9776^{+0.0052}_{-0.0050}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0004}$
All cuts (χ^2)	$0.9688^{+0.0051}_{-0.0056}$
All track cuts	$0.9844^{+0.0050}_{-0.0051}$
All trk cuts excl. isol.	$1.0003^{+0.0039}_{-0.0039}$

bhmummP27_zemtjm_1: Muon ID Scale Factors for CMUP

P28

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0086^{+0.0031}_{-0.0036}$
E_{HAD} cut	$0.9964^{+0.0026}_{-0.0029}$
COT hits cut	$1.0001^{+0.0000}_{-0.0006}$
d_0 cut	$0.9965^{+0.0011}_{-0.0016}$
Isolation cut	$0.9695^{+0.0039}_{-0.0046}$
Δx_{CMU} cut	$0.9973^{+0.0009}_{-0.0012}$
Δx_{CMP} cut	$0.9844^{+0.0026}_{-0.0028}$
All above cuts	$0.9569^{+0.0062}_{-0.0067}$
All cuts excl. isol.	$0.9844^{+0.0050}_{-0.0050}$
Sliding isol. cut	$0.9849^{+0.0034}_{-0.0036}$
All cuts (sliding isol.)	$0.9717^{+0.0058}_{-0.0060}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0006}$
All cuts (χ^2)	$0.9569^{+0.0062}_{-0.0067}$
All track cuts	$0.9734^{+0.0059}_{-0.0063}$
All trk cuts excl. isol.	$1.0022^{+0.0041}_{-0.0042}$

bhmummP28_zemtjm_1: Muon ID Scale Factors for CMUP

CMX ID Efficiencies

P27

Cut	Count	Efficiency (%)
No cut	2754	
E_{EM} cut	2669	$96.91^{+0.33}_{-0.36}$
E_{HAD} cut	2688	$97.60^{+0.27}_{-0.31}$
COT hits cut	2753	$99.96^{+0.03}_{-0.08}$
d_0 cut	2746	$99.71^{+0.10}_{-0.14}$
Isolation cut	2645	$96.04^{+0.37}_{-0.41}$
Δx_{CMX} cut	2743	$99.60^{+0.11}_{-0.16}$
All above cuts	2498	$90.70^{+0.56}_{-0.62}$
All cuts excl. isol.	2593	$94.15^{+0.45}_{-0.48}$
Sliding isol. cut	2675	$97.13^{+0.31}_{-0.38}$
All cuts (sliding isol.)	2522	$91.58^{+0.54}_{-0.58}$
χ^2 cut	2754	$100.00^{+0.00}_{-0.07}$
All cuts (χ^2)	2498	$90.70^{+0.56}_{-0.62}$
All track cuts	2506	$90.99^{+0.56}_{-0.61}$
All trk cuts excl. isol.	2601	$94.44^{+0.45}_{-0.47}$

I: Dataset bhmummP27: Muon ID efficiencies for CMX

P28

Cut	Count	Efficiency (%)
No cut	2199	
E_{EM} cut	2114	$96.13^{+0.42}_{-0.46}$
E_{HAD} cut	2161	$98.27^{+0.29}_{-0.35}$
COT hits cut	2198	$99.95^{+0.04}_{-0.10}$
d_0 cut	2191	$99.64^{+0.13}_{-0.19}$
Isolation cut	2088	$94.95^{+0.48}_{-0.49}$
Δx_{CMX} cut	2195	$99.82^{+0.09}_{-0.14}$
All above cuts	1966	$89.40^{+0.68}_{-0.68}$
All cuts excl. isol.	2065	$93.91^{+0.50}_{-0.57}$
Sliding isol. cut	2132	$96.95^{+0.39}_{-0.40}$
All cuts (sliding isol.)	2009	$91.36^{+0.58}_{-0.69}$
χ^2 cut	2199	$100.00^{+0.00}_{-0.08}$
All cuts (χ^2)	1966	$89.40^{+0.68}_{-0.68}$
All track cuts	1969	$89.54^{+0.64}_{-0.72}$
All trk cuts excl. isol.	2069	$94.09^{+0.52}_{-0.56}$

I: Dataset bhmummP28: Muon ID efficiencies for CMX

CMX ID SF

P27

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0056^{+0.0034}_{-0.0037}$
E_{HAD} cut	$0.9988^{+0.0028}_{-0.0032}$
COT hits cut	$0.9997^{+0.0003}_{-0.0008}$
d_0 cut	$0.9979^{+0.0010}_{-0.0014}$
Isolation cut	$0.9852^{+0.0038}_{-0.0043}$
Δx_{CMX} cut	$0.9975^{+0.0011}_{-0.0016}$
All above cuts	$0.9890^{+0.0061}_{-0.0068}$
All cuts excl. isol.	$1.0020^{+0.0049}_{-0.0051}$
Sliding isol. cut	$0.9923^{+0.0031}_{-0.0039}$
All cuts (sliding isol.)	$0.9945^{+0.0059}_{-0.0064}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0007}$
All cuts (χ^2)	$0.9890^{+0.0061}_{-0.0068}$
All track cuts	$0.9907^{+0.0061}_{-0.0067}$
All trk cuts excl. isol.	$1.0036^{+0.0049}_{-0.0051}$

bhmummP27_zemtjm_1: Muon ID Scale Factors for CMX

P28

Cut	Scale Factor
No cut	
E_{EM} cut	$0.9976^{+0.0044}_{-0.0048}$
E_{HAD} cut	$1.0056^{+0.0030}_{-0.0036}$
COT hits cut	$0.9996^{+0.0004}_{-0.0010}$
d_0 cut	$0.9972^{+0.0013}_{-0.0019}$
Isolation cut	$0.9740^{+0.0050}_{-0.0051}$
Δx_{CMX} cut	$0.9997^{+0.0009}_{-0.0014}$
All above cuts	$0.9748^{+0.0075}_{-0.0075}$
All cuts excl. isol.	$0.9994^{+0.0054}_{-0.0061}$
Sliding isol. cut	$0.9905^{+0.0040}_{-0.0041}$
All cuts (sliding isol.)	$0.9922^{+0.0064}_{-0.0075}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0008}$
All cuts (χ^2)	$0.9748^{+0.0075}_{-0.0075}$
All track cuts	$0.9749^{+0.0071}_{-0.0079}$
All trk cuts excl. isol.	$0.9998^{+0.0055}_{-0.0060}$

bhmummP28_zemtjm_1: Muon ID Scale Factors for CMX

Reconstruction Efficiency

The reconstruction efficiency is defined as the probability to find a muon stub and link it to a track. First, to know whether we should find a stub or not we have to know that the muon is fiducial in any of the muon chambers. We use the **MuonFiducialTool** class for this purpose. We define a track as being fiducial in a given muon system if it passes the cuts defined in Tables 2 and 3 for that system.

Events Selection
No cosmic tag and 2 tracks passing the following:

- Oppositely charged.
- $|z_0^{(1)} - z_0^{(2)}| < 4$ cm.
- $81\ \mathrm{GeV}/c^2 < m(\mu^+\mu^-) < 101\ \mathrm{GeV}/c^2$
- The first leg must be a reconstructed **CdfMuon** passing all the ID and fiducial cuts given in Tables 1 and 2. It must also match to the level 1 trigger information.
- The second leg must be fiducial in both the CMU and CMP sub-detectors (or the CMX sub-detector) and satisfy:
  - $P_T > 20$ GeV.
  - $E_{EM} < 1.5 \cdot (2+\max(0, (p-100) \cdot 0.0115))$ GeV
  - $E_{HAD} < 1.5 \cdot (6+\max(0, (p-100) \cdot 0.028)$ GeV

$$\varepsilon_{Reco} = \frac{\#\text{tracks fiducial and linked to a stub}}{\#\text{ tracks fiducial}}$$

Reconstruction Efficiency

The first leg must pass all the ID and Fid. cuts and must match to the level 1 trigger information. If the second leg is Fiducial, and pass "P_T, E_{EM}, E_{HAD}" cuts, we examine this track to see if is linked to a muon stub or not.

P25

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	3427	2961	$86.40^{+0.56}_{-0.61}$
CMX	1978	1863	$94.19^{+0.49}_{-0.58}$
CMX Arches	1561	1506	$96.48^{+0.47}_{-0.55}$
CMX Miniskirt	343	289	$84.26^{+1.97}_{-2.13}$
CMX Keystone	74	68	$91.89^{+3.23}_{-4.59}$
CMU-only	822	722	$87.83^{+1.13}_{-1.21}$
CMP-only	948	821	$86.60^{+1.14}_{-1.20}$
CMX MiniKey	417	357	$85.61^{+1.79}_{-1.92}$

P26

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	2432	2118	$87.09^{+0.66}_{-0.71}$
CMX	1551	1480	$95.42^{+0.52}_{-0.55}$
CMX Arches	1233	1206	$97.81^{+0.41}_{-0.52}$
CMX Miniskirt	254	216	$85.04^{+2.36}_{-2.52}$
CMX Keystone	64	58	$90.62^{+3.71}_{-5.27}$
CMU-only	620	535	$86.29^{+1.31}_{-1.43}$
CMP-only	687	613	$89.23^{+1.10}_{-1.24}$
CMX MiniKey	318	274	$86.16^{+2.02}_{-2.28}$

P27

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	4718	4158	$88.13^{+0.47}_{-0.51}$
CMX	2813	2664	$94.70^{+0.44}_{-0.44}$
CMX Arches	2192	2134	$97.35^{+0.33}_{-0.41}$
CMX Miniskirt	511	435	$85.13^{+1.69}_{-1.83}$
CMX Keystone	110	95	$86.36^{+3.28}_{-4.14}$
CMU-only	1071	947	$88.42^{+0.98}_{-1.07}$
CMP-only	1260	1099	$87.22^{+0.91}_{-1.04}$
CMX MiniKey	621	530	$85.35^{+1.47}_{-1.65}$

P28

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	3676	3169	$86.21^{+0.56}_{-0.59}$
CMX	2246	2136	$95.10^{+0.48}_{-0.50}$
CMX Arches	1742	1691	$97.07^{+0.41}_{-0.47}$
CMX Miniskirt	421	369	$87.65^{+1.71}_{-1.81}$
CMX Keystone	83	76	$91.57^{+3.16}_{-4.26}$
CMU-only	886	769	$86.79^{+1.19}_{-1.20}$
CMP-only	1000	877	$87.70^{+1.02}_{-1.13}$
CMX MiniKey	504	445	$88.29^{+1.45}_{-1.67}$

Reconstruction SF

P25

Category	Scale Factor
CMUP	$0.8867^{+0.0058}_{-0.0063}$
CMX	$0.9456^{+0.0049}_{-0.0059}$
CMX Arches	$0.9668^{+0.0047}_{-0.0056}$
CMX Miniskirt	$0.8505^{+0.0199}_{-0.0215}$
CMX Keystone	$0.9306^{+0.0327}_{-0.0465}$
CMU-only	$0.9003^{+0.0116}_{-0.0125}$
CMP-only	$0.8813^{+0.0116}_{-0.0122}$
CMX MiniKey	$0.8647^{+0.0181}_{-0.0181}$

P26

Category	Scale Factor
CMUP	$0.8927^{+0.0067}_{-0.0073}$
CMX	$0.9573^{+0.0053}_{-0.0055}$
CMX Arches	$0.9800^{+0.0041}_{-0.0052}$
CMX Miniskirt	$0.8588^{+0.0239}_{-0.0255}$
CMX Keystone	$0.9125^{+0.0374}_{-0.0531}$
CMU-only	$0.8840^{+0.0134}_{-0.0146}$
CMP-only	$0.9089^{+0.0113}_{-0.0126}$
CMX MiniKey	$0.8696^{+0.0204}_{-0.0204}$

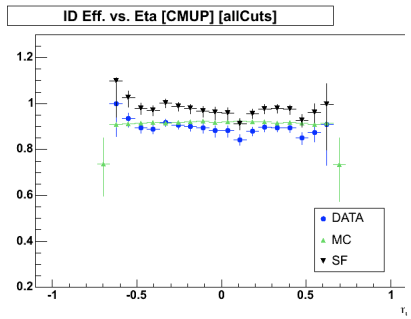
P27

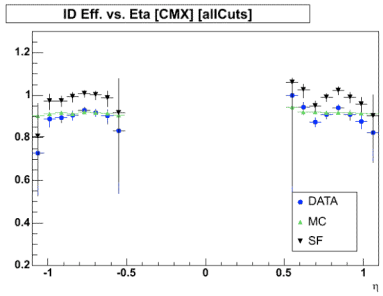
Category	Scale Factor
CMUP	$0.9034^{+0.0048}_{-0.0052}$
CMX	$0.9501^{+0.0044}_{-0.0044}$
CMX Arches	$0.9754^{+0.0033}_{-0.0041}$
CMX Miniskirt	$0.8596^{+0.0171}_{-0.0185}$
CMX Keystone	$0.8696^{+0.0331}_{-0.0417}$
CMU-only	$0.9059^{+0.0101}_{-0.0110}$
CMP-only	$0.8885^{+0.0093}_{-0.0106}$
CMX MiniKey	$0.8614^{+0.0149}_{-0.0149}$

P28

Category	Scale Factor
CMUP	$0.8837^{+0.0057}_{-0.0060}$
CMX	$0.9541^{+0.0048}_{-0.0050}$
CMX Arches	$0.9726^{+0.0041}_{-0.0047}$
CMX Miniskirt	$0.8851^{+0.0173}_{-0.0183}$
CMX Keystone	$0.9220^{+0.0318}_{-0.0429}$
CMU-only	$0.8892^{+0.0122}_{-0.0123}$
CMP-only	$0.8934^{+0.0104}_{-0.0115}$
CMX MiniKey	$0.8911^{+0.0147}_{-0.0147}$

Reco and ID Plots





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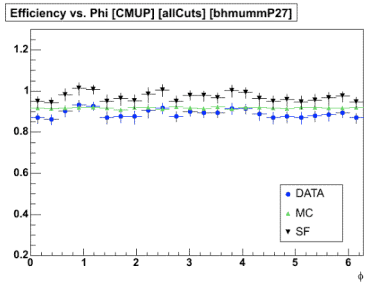

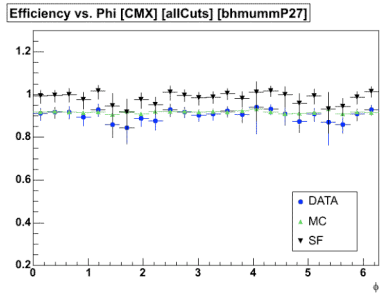

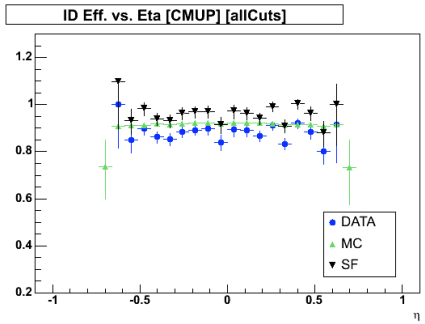

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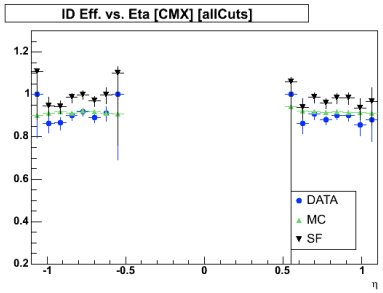
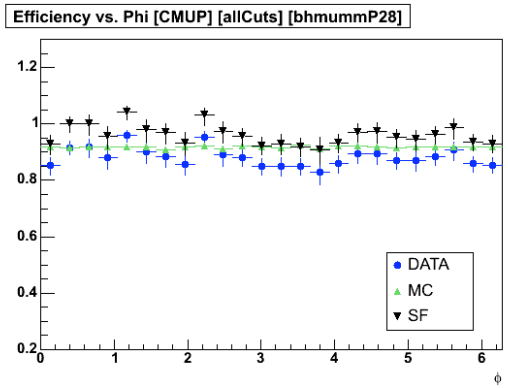
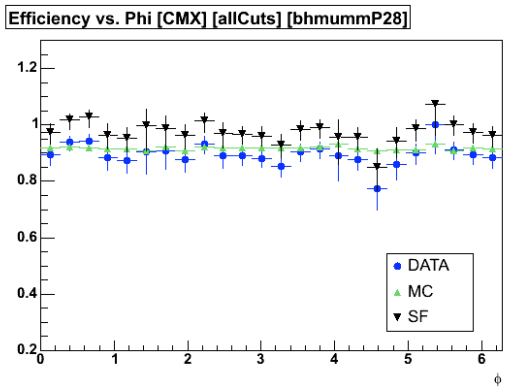
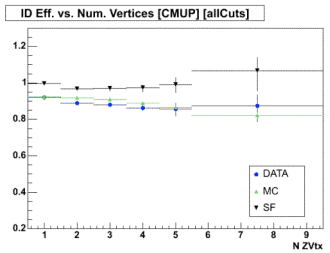
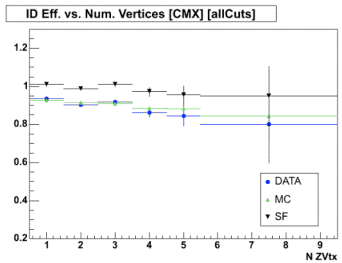






Reco and ID Plots





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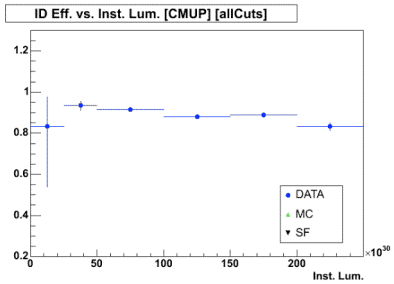

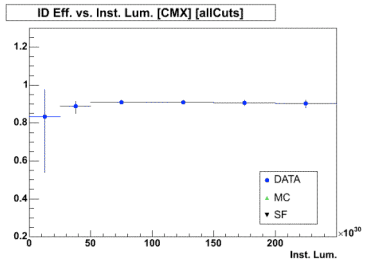

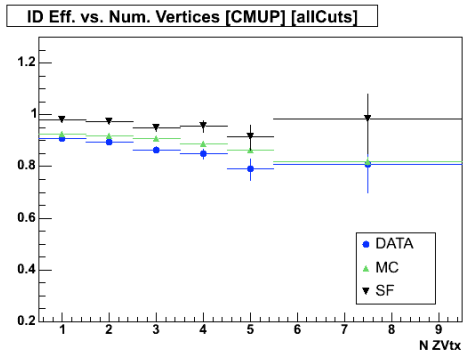

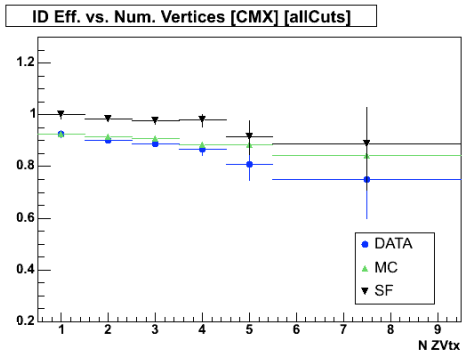

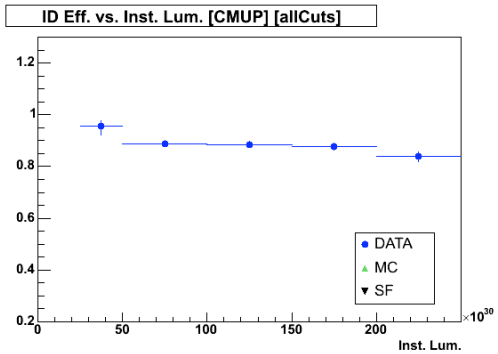

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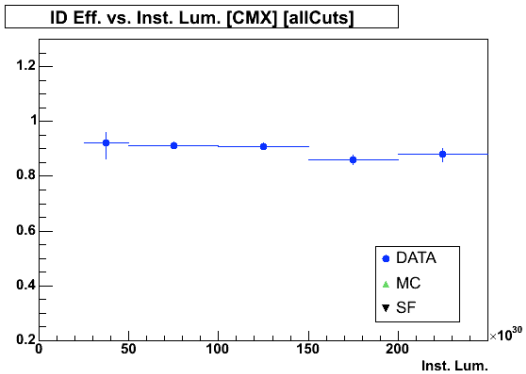
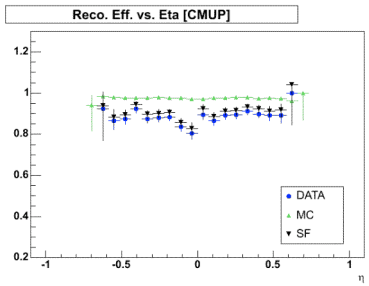
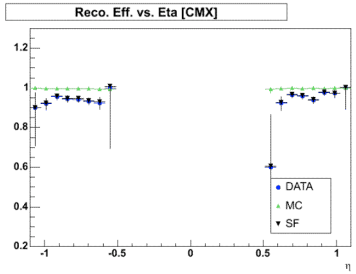


Reco and ID Plots





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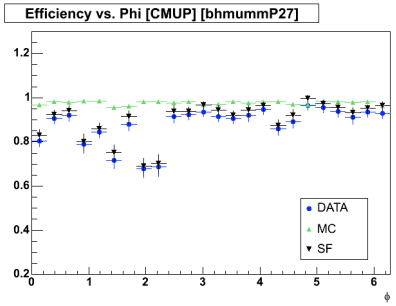
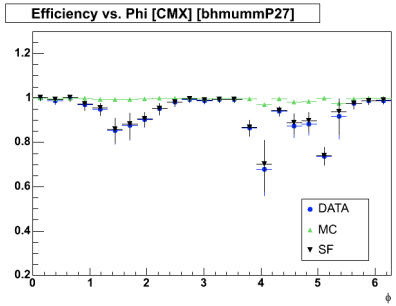
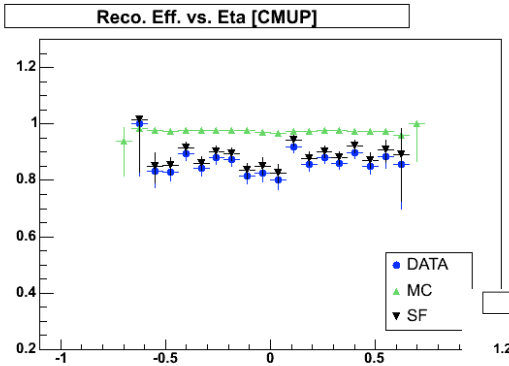
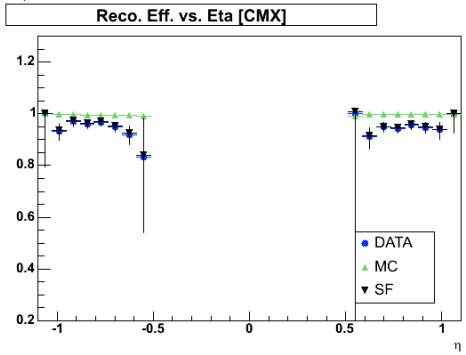
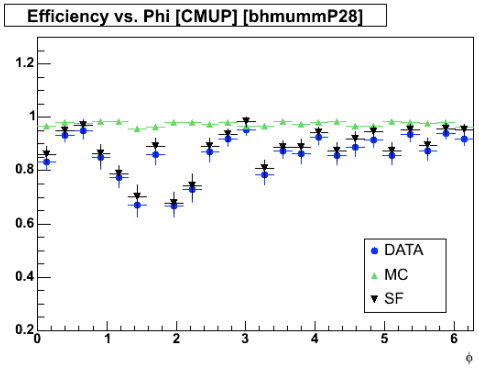


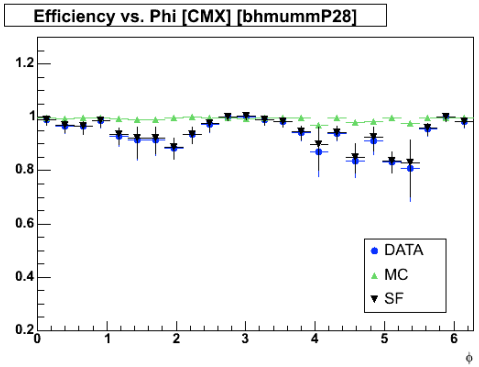








P28



Trigger Efficiencies

Use the two legs from the reconstructed Z (both legs pass muon ID and fiducial cuts)

Level 1:

ε^{L1}_{CMUP} is calculated from 2 independent samples, using CMUP-CMUP and CMUP-CMX samples:

$$\varepsilon^{L1(A)}_{CMUP} = \frac{\#\text{ of events with both legs triggered}}{\#\text{ of events with 1 CMX leg triggered}}$$

$$\varepsilon^{L1(B)}_{CMUP} = \frac{2R}{1+R}$$

$$R = \frac{\#\text{ of events with both legs triggered}}{\#\text{ of events with} \geq 1\text{ CMUP leg triggered}}$$

The final efficiency is an average of $\varepsilon^{L1(A)}_{CMUP}$ and $\varepsilon^{L1(B)}_{CMUP}$ weighted by the errors.

Level 2: (both leg pass L1)

$$\varepsilon^{L2}_{CMUP} = \frac{\#\text{ of events pass both L2 triggers}}{\#\text{ of events pass L2 CMX trigger}}$$

P22

Level 3: (both leg pass L2)

$$\varepsilon^{L3}_{CMUP} = \frac{\#\text{ of events pass both L3 triggers}}{\#\text{ of events pass L3 CMX trigger}}$$

CMX trigger efficiency is calculated in similar way.

Efficiency calculation

$$\varepsilon(\text{CMUP})^{2D} = \frac{(\text{\# of events passing CMUP \& CMX})}{\text{\# of events passing CMUX}}$$

$$\varepsilon(\text{CMUP})^{3D} = \frac{(\text{\# of events passing 2D-CMUP \& 2D-CMX \& 3-D CMUP})}{(\text{\# of events passing 2D-CMUP \&\& 2D-CMX})} \times \text{2D-CMUP eff}$$

$$\varepsilon(\text{CMX})^{2D} = \frac{(\text{\# of events passing CMUP \& CMX})}{\text{\# of events passing CMUP}}$$

These ones increases for the bad runs

$$\varepsilon(\text{CMX})^{3D} = \frac{(\text{\# of events passing 2D-CMUP \& 2D-CMX \& 3-D CMX})}{(\text{\# of events passing 2D-CMUP \&\& 2D-CMX})} \times \text{2D-CMX eff}$$

Raw efficiencies vs P24 through P27

Category	Efficiency (%)
CMUP	$93.02^{+0.62}_{-0.70}$
CMX	$76.58^{+1.26}_{-1.27}$
ARCH	$80.94^{+1.36}_{-1.33}$
MK	$66.74^{+2.94}_{-3.37}$
$CMUP_S$	$87.76^{+0.92}_{-1.02}$
CMX_S	$72.34^{+1.34}_{-1.41}$
$ARCH_S$	$76.66^{+1.40}_{-1.59}$
MK_S	$62.09^{+3.08}_{-3.54}$

bhmummP25_SAM: Muon combined trigger efficiencies

Category	Efficiency (%)
CMUP	$90.68^{+0.80}_{-0.98}$
CMX	$80.29^{+1.24}_{-1.35}$
ARCH	$84.04^{+1.33}_{-1.38}$
MK	$69.57^{+3.10}_{-3.49}$
$CMUP_S$	$85.02^{+1.13}_{-1.34}$
CMX_S	$76.03^{+1.33}_{-1.45}$
$ARCH_S$	$79.49^{+1.55}_{-1.54}$
MK_S	$66.29^{+3.39}_{-3.72}$

bhmummP26: Muon combined trigger efficiencies

Category	Efficiency (%)
CMUP	$91.12^{+0.56}_{-0.62}$
CMX	$79.51^{+0.88}_{-0.92}$
CMX A	$84.88^{+0.92}_{-1.01}$
CMX MK	$66.98^{+2.36}_{-2.48}$
CMUP SLAM	$86.65^{+0.79}_{-0.82}$
CMX SLAM	$74.76^{+1.00}_{-1.07}$
CMX SLAM A	$79.43^{+1.07}_{-1.11}$
CMX SLAM MK	$64.64^{+2.44}_{-2.57}$

bhmummP27-1: Muon combined trigger efficiencies

Category	Efficiency (%)
CMUP	$90.68^{+0.66}_{-0.73}$
CMX	$78.17^{+1.04}_{-1.11}$
ARCH	$84.10^{+1.11}_{-1.18}$
MK	$66.92^{+2.64}_{-3.00}$
$CMUP_S$	$84.67^{+0.94}_{-1.04}$
CMX_S	$73.15^{+1.15}_{-1.20}$
$ARCH_S$	$78.82^{+1.28}_{-1.35}$
MK_S	$62.11^{+2.87}_{-3.19}$

bhmummP28: Muon combined trigger efficiencies

Comparison with previous periods

Combined (L1+L2+L3) CMUP 2-D Trigger efficiencies

Period	Measured (SR)	Livetime Corr.	Corr. Efficiency
12	0.9241(78)	1.0	0.9241(78)
13	0.9090(61)	1.0	0.9090(61)
14	0.9197(2.22)	1.0	0.9197 (2.22)
15	0.9163(77)	1.0	0.9163 (77)
16	0.9172(116)	1.0	0.9172(116)
17	0.9203(76)	1.0	0.9203(76)
18	0.9210(56)	1.0	0.9210(56)
19	0.9177 (75)	1.0	0.9177 (75)
20	0.9074 (75)	1.0	0.9074 (75)
21	0.9134 (65)	1.0	0.9134 (65)
22	0.9022 (73)	1.0	0.9022 (73)
23	0.9034 (81)	1.0	0.9034 (81)
24	0.9068 (85)	1.0	0.9058 (85)
25	0.9302 (66)	1.0	0.9302 (66)
26	0.9068 (89)	1.0	0.9068 (89)
27	0.9112 (58)	1.0	0.9112(58)
28	0.9068 (70)	1.0	0.9068 (70)

CMUP

CMUP 3-D

Combined (L1+L2+L3) CMUP 3-D Trigger efficiencies

Period	2-D Efficiency	2-D+3-D/2-D (SR)	3-D Efficiency
12	0.9241(78)	0.9108(105)	0.8417(120)
13	0.9090(61)		0.8284 (91)
14	0.9197(2.22)		0.8943 (2.22)
15	0.9163(77)		0.8790 (100)
16	0.9172(116)		0.8939(137)
17	0.9203 (76)		0.8885 (97)
18	0.9210(56)		0.8864(75)
19	0.9177(75)		0.8866 (95)
20	0.9074(75)		0.8852 (90)
21	0.9134 (65)		0.8802 (82)
22	0.9022 (73)		0.8484 (100)
23	0.9034 (83)		0.8606 (83)
24	0.9068 (85)		0.8504 (107)
25	0.9302 (66)		0.8776 (96)
26	0.9068 (89)		0.8502 (123)
27	0.9112(58)		0.8665 (80)
28	0.9068(70)		0.8410 (114)

Comparison with previous periods

Combined (L1+L2+L3) CMX 2-D Trigger efficiencies

Arches-only:

Period	Measured (SR)	Livetime Corr.	Corr. Efficiency
13	0.8915 (85)	0.9601	0.9285 (85)
14	0.9123 (239)	0.99	0.9215 (239)
15	0.9013 (117)	0.95	0.9487 (117)
16	0.8439 (204)	0.915	0.9223 (223)
17	0.8532 (127)	0.9128	0.9345 (127)
18	0.8522(96)	0.9031	0.9437 (96)
19	0.8174	0.871	0.9384
20	0.8336	0.9030	0.9231
21	0.8351	0.858	0.9733
22	0.8362	0.9077	0.9212
23	0.8337	0.8739	0.9539
24	0.8335	0.8849	0.9419 ……
25	0.8094 (130)	0.8765	0.9234
26	0.8404 (135)	0.9431	0.8911
27	0.8488 (100)	0.9241	0.9185

CMX

CMX 3-D

Combined (L1+L2+L3) CMX 3-D Trigger efficiencies

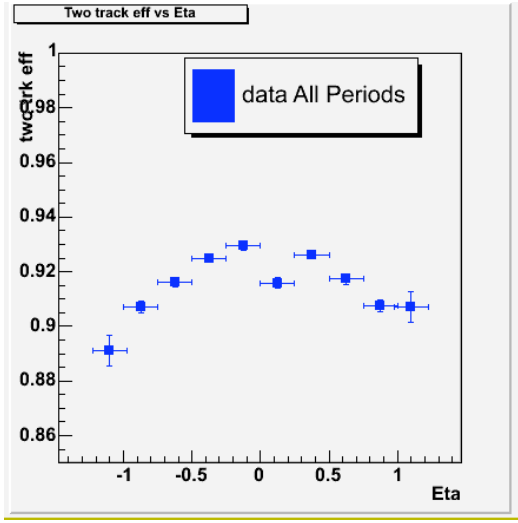
Arches-only

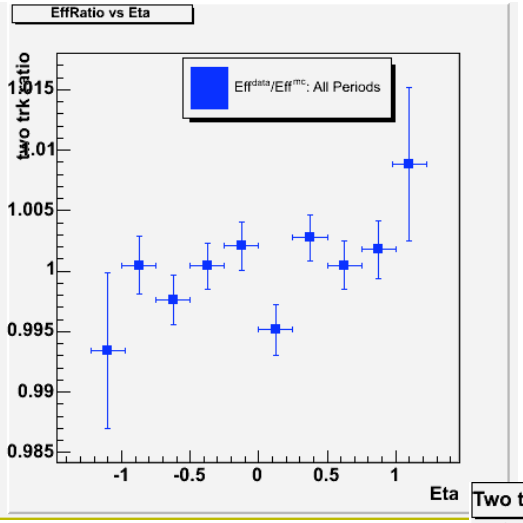
Period	2-D Efficiency	3-D Efficiency
13	0.8915/0.9601=0.93 (85)	0.8569 / 0.9601 = 0.8926 (9)
14	0.9123/0.99= 0.9215 (2.39)	0.8815/0.99 = 0.8904 (2.7)
15	0.9013/0.95= 0.9487 (117)	0.8765/0.95 = 0.9226 (128)
16	0.8439/0.915= 0.9223 (223)	0.8183/0.915 = 0.8943 (235)
17	0.8532/0.913= 0.9345 (127)	0.8195/0.913 = 0.8975 (142)
18	0.8522/0.9031=0.9437 (96)	0.8192/0.903 = 0.9072 (112)
19	0.8174/0.871=0.9384 (129)	0.7874/0.871 = 0.9040 (140)
20	0.8336/0.9030=0.9231 (129)	0.8143/0.9030 = 0.9018 (120)
21	0.8351/0.858 = 0.9733	0.8009/0.858 = 0.9334
22	0.8362/0.9077 = 0.9212	0.8085/0.9077 = 0.8907
23	0.8337/0.8739 = 0.9539	0.7853/0.8739 = 0.8986
24	0.8355/0.9704 = 0.85	0.7853/0.8849 = 0.8874
25	0.8094/0.8765 = 0.92	0.7666/0.8765 = 0.8746
26	0.8404/0.9431 = 0.89	0.7949/0.9431 = 0.8428 (130)
27	0.8488/0.9242 = 0.92	0.7943/0.9242 = 0.8594 (109)

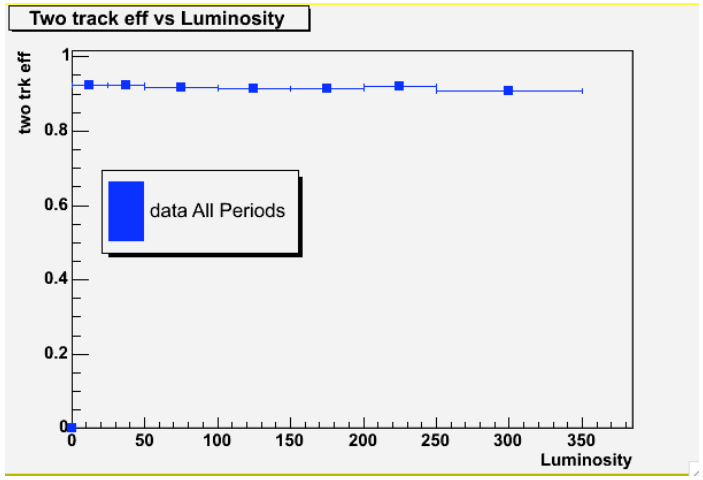
Conclusions

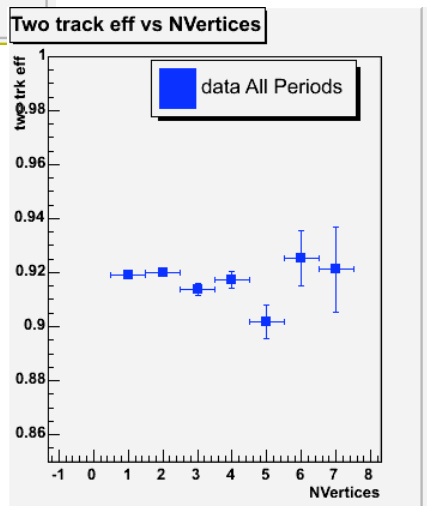
- P28 high PT electrons and muons analyzed:
  - Electron ID - ok
  - Ele Trigger - in agreement with previous periods
  - Muon ID and Reco : ok
  - Muon Trigger: ok
  - MET_PEM trigger ok
  - COT Eff : in progress

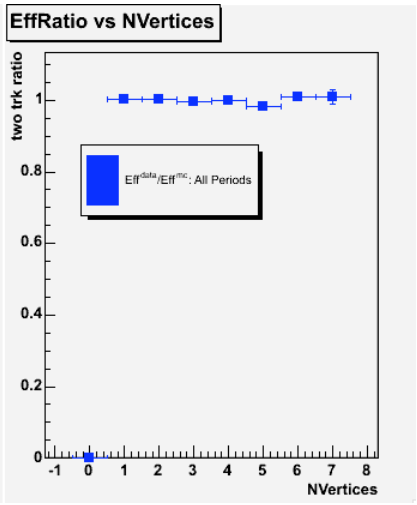
More plots


Two track eff vs Eta
two trk eff
data All Periods
Eta


EffRatio vs Eta
two trk ratio
Eff^data/Eff^mc: All Periods
Eta


Two track eff vs Luminosity
two trk eff
data All Periods
Luminosity


Two track eff vs NVertices
two trk eff
data All Periods
NVertices


EffRatio vs NVertices
two trk ratio
Eff^data/Eff^mc: All Periods
NVertices

Electron Trigger: Results Past Periods

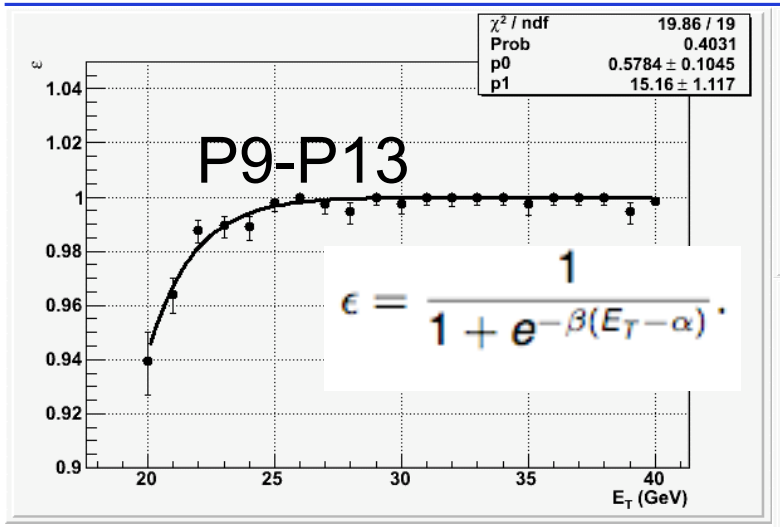
Analyzed all data

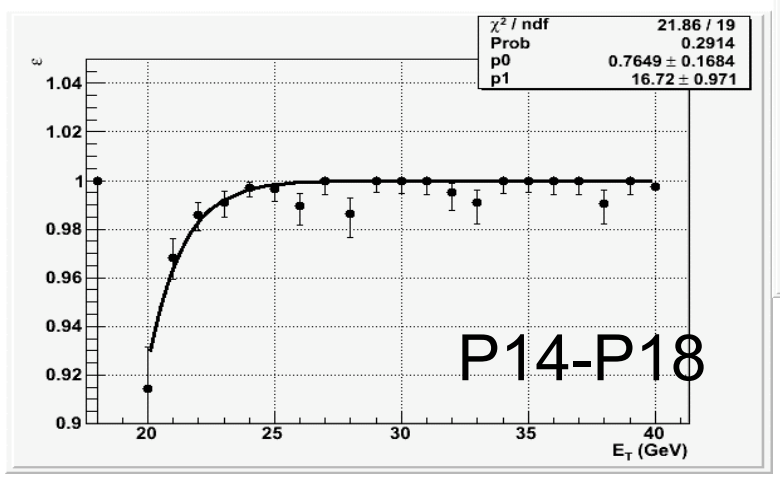
Trigger	Period 9	Period 10A	Period 10B
L1_XFT_PT8	0.9651(6)	0.9673(7)	0.9650(29)
L2_XFT_PT8	0.9992(1)	0.9993(1)	0.9992(5)
L3 tracking	0.9954(2)	0.9932(3)	0.9968(9)
Total Tracking	0.9598(7)	0.9600(8)	0.9611(31)

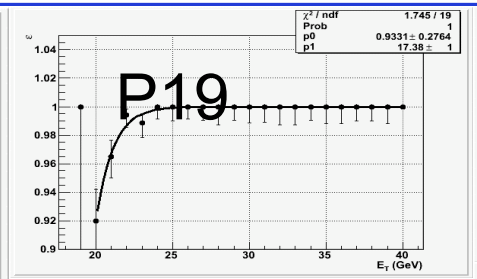
Trigger	Period 11	Period 12	Period 13	Period 14
L1_XFT_PT8	0.9688(4)	0.96857 ± 0.003	0.963922 ± 0.003	0.964755 ± 0.03
L2_XFT_PT8	0.9988(4)	0.9990 ± 0.003	0.998003 ± 0.003	0.999569 ± 0.03
L3 tracking	0.9935(4)	0.9940 ± 0.003	0.994608 ± 0.003	0.996055 ± 0.03
Total Tracking	0.9614(4)	0.9600 ± 0.003	0.95681 ± 0.003	0.960535 ± 0.03

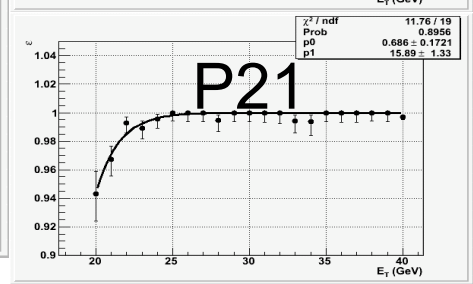
Trigger	Period 15	Period 16	Period 17	Period 18
L1_XFT_PT8	0.9695 ± 0.005	0.9684 ± 0.005	0.9694 ± 0.003	0.9697 ± 0.003
L2_XFT_PT8	0.9994 ± 0.005	0.9994 ± 0.005	0.9995 ± 0.003	0.9995 ± 0.003
L3 tracking	0.9940 ± 0.005	0.9927 ± 0.005	0.9929 ± 0.003	0.9919 ± 0.003
Total Tracking	0.9633 ± 0.005	0.9609 ± 0.005	0.9622 ± 0.003	0.9615 ± 0.003

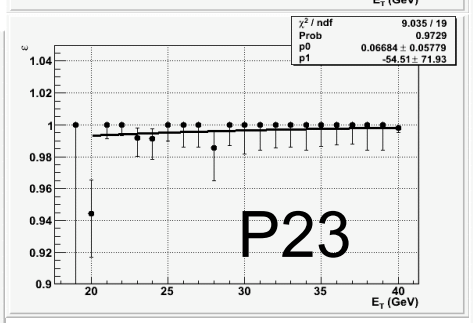
L2 Calo Eff: past periods

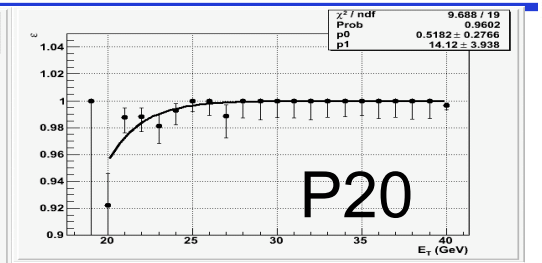


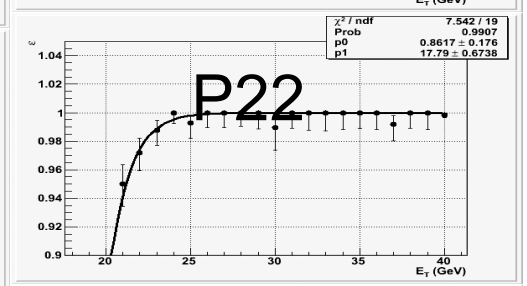


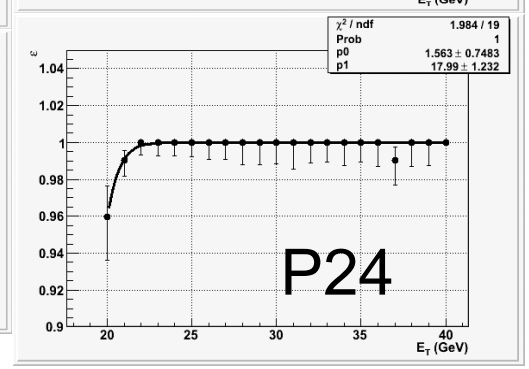












COT Efficiencies

Events are selected with Z_NOTRACK trigger
Z→ee events are selected using:
Calorimeter cuts only to select electrons

- Et > 25 GeV
- Fiduciality →fiducial_track or fiducial_smx
- Had/Em < 0.055 + 0.00045 x E
- IsoRatio < 0.1
- $\chi^2_{strip} < 10$
- $L_{shr} < 0.2$

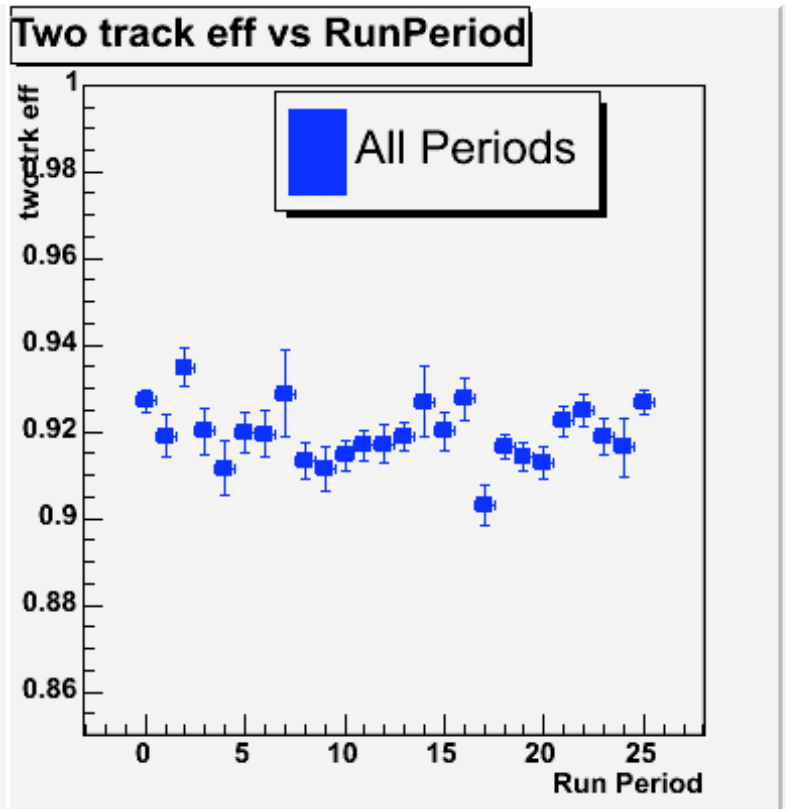
Calorimeter + tracking cuts

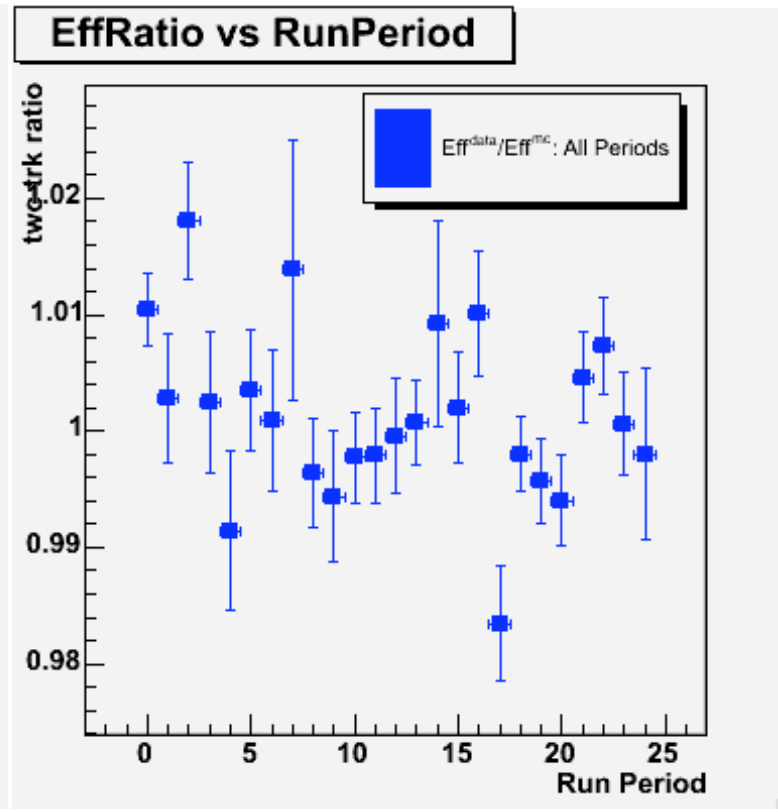
- trkPt > 10 GeV

$$e_{2trk} = \frac{\#\ Z(cc) \text{ with } TrkP_T > 10 \text{ GeV on both electrons}}{\#\ Z(cc) \text{ with two electrons}}$$

- 2 central electrons
- 82 < M(ee) < 102 GeV/c^2

COT Efficiencies: Run Number





$$e_{2trk}^{DATA} = 0.9190 \quad 0.0008$$

0.9185 ± 0.0008 up to P24

COT Efficiencies vs Periods

Period	Ncc	Ncc + 2trk	Efficiency	Error
0	9117	8452	0.927059	0.00272341
1	3013	2769	0.919018	0.00497001
2	3112	2909	0.934769	0.0044265
3	2492	2293	0.920144	0.00543008
4	2094	1909	0.911652	0.00620189
5	3351	3083	0.920024	0.00468589
6	2547	2342	0.919513	0.00539047
7	661	614	0.928896	0.00999611
8	4514	4122	0.913159	0.00419136
9	3089	2816	0.911622	0.00510706
10	6321	5781	0.91457	0.00351576
11	5566	5103	0.916816	0.00370159
12	3922	3597	0.917134	0.004402
13	6930	6368	0.918903	0.00327921
14	1025	950	0.926829	0.00813405
15	3908	3596	0.920164	0.00433566
16	2777	2576	0.92762	0.00491708
17	4284	3869	0.903128	0.00451907
18	9172	8406	0.916485	0.00288877
19	7199	6583	0.914433	0.00329681
20	6254	5709	0.912856	0.00356649
21	5836	5384	0.92255	0.00349904
22	4906	4538	0.92499	0.00376067
23	4535	4167	0.918853	0.0040548
24	1665	1526	0.916517	0.00677896
25	7985	7400	0. 926738	0.00291596