Period 22 High PT Lepton Efficiencies and SF -Blessing Period 23 Preliminary

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Tufts

Electrons ID: Samples

Dataset bhelmm: Runs 271072-272214 (P22)
Runs 272470-274055 (P23)

MC sample : zektei (Feb 2008)

GRL :GRL for P22 v28 and GRL for P23 Prelim

(goodrun_em_si_v28.list, goodrun_em_nosi_v28.list)

P22/23 skim leptons

MC dataset zektei (P14 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.

P22 numbers vs P21

	Period 21		Period 22	
	bhelmm	zektei	bhelmm	zektei
CEM Eff	0.769+\-0.003	0.795 +\-0.001	0.779+\-0.004	0.795 +\-0.001
CEM SF	0.967 +\-0.004	N/A	0.980 +\-0.005	N/A
nisoCEM Eff	0.809 +\-0.003	0.825 +\-0.001	0.817 +\-0.004	0.825 +\-0.001
nisoCEM SF	0.981 +\-0.004	N/A	0.991 +\-0.004	N/A
LooseCEM Eff	0.897 +/- 0.002	0.907 +\-0.001	0.906 +/- 0.003	0.907 +\-0.001
LooseCEM SF	0.989 +\-0.003	N/A	0.999 +\-0.003	N/A
nisolooseCEM Eff	0.943+\-0.002	0.943 +\-0.001	0.950+\-0.002	0.943 +\-0.001
nisoloostCEM SF	1.000 +\-0.002	N/A	1.008 +\-0.002	N/A

	PHX		PHX	
Eff |Eta| < 2.0	0.672+\-0.005	0.744+\-0.002	0.671+\-0.006	0.744+\-0.002
SF |Eta| < 2.0	0.903+\-0.007	NA	0.902+\-0.009	NA
	PHX		PHX	
Eff |Eta| < 2.8	0.582+\-0.004	0.645+\-0.002	0.578+\-0.005	0.645+\-0.002
SF |Eta| < 2.8	0.902+\-0.007	NA	0.895+\-0.009	NA

P23 numbers vs P22

	Period 22		Period 23	
	bhelmm	zektei	bhelmm	zektei
CEM Eff	0.779+\-0.004	0.795 +\-0.001	0.770+\-0.005	0.795 +\-0.001
CEM SF	0.980 +\-0.005	N/A	0.968 +\-0.006	N/A
nisoCEM Eff	0.817 +\-0.004	0.825 +\-0.001	0.807 +\-0.004	0.825 +\-0.001
nisoCEM SF	0.991 +\-0.004	N/A	0.979 +\-0.005	N/A
LooseCEM Eff	0.906 +/- 0.003	0.907 +\-0.001	0.895 +/- 0.003	0.907 +\-0.001
LooseCEM SF	0.999 +\-0.003	N/A	0.987 +\-0.004	N/A
nisolooseCEM Eff	0.950+\-0.002	0.943 +\-0.001	0.941+\-0.003	0.943 +\-0.001
nisoloostCEM SF	1.008 +\-0.002	N/A	0.998 +\-0.003	N/A

	PHX		PHX	
Eff |Eta| < 2.0	0.671+\-0.006	0.744+\-0.002	0.678+\-0.007	0.744+\-0.002
SF |Eta| < 2.0	0.902+\-0.009	NA	0.911+\-0.010	NA
	PHX		PHX	
Eff |Eta| < 2.8	0.578+\-0.005	0.645+\-0.002	0.591+\-0.006	0.645+\-0.002
SF |Eta| < 2.8	0.895+\-0.009	NA	0.915+\-0.010	NA

CEM-PEM

P22

	PEM	
Eff |Eta| < 2.0	0.758+\-0.006	0.847+\-0.002
SF |Eta| < 2.0	0.895+\-0.007	NA

	PEM	
Eff |Eta| < 2.8	0.711+\-0.005	0.810+\-0.001
SF |Eta| < 2.8	0.878+\-0.006	NA

P23

	PEM	
Eff |Eta| < 2.0	0.761+\-0.007	0.847+\-0.002
SF |Eta| < 2.0	0.898+\-0.008	NA

	PEM	
Eff |Eta| < 2.8	0.717+\-0.006	0.810+\-0.001
SF |Eta| < 2.8	0.885+\-0.007	NA

P20

	PEM	
Eff |Eta| < 2.0	0.777+\-0.006	0.847+\-0.002
SF |Eta| < 2.0	0.917+\-0.007	NA

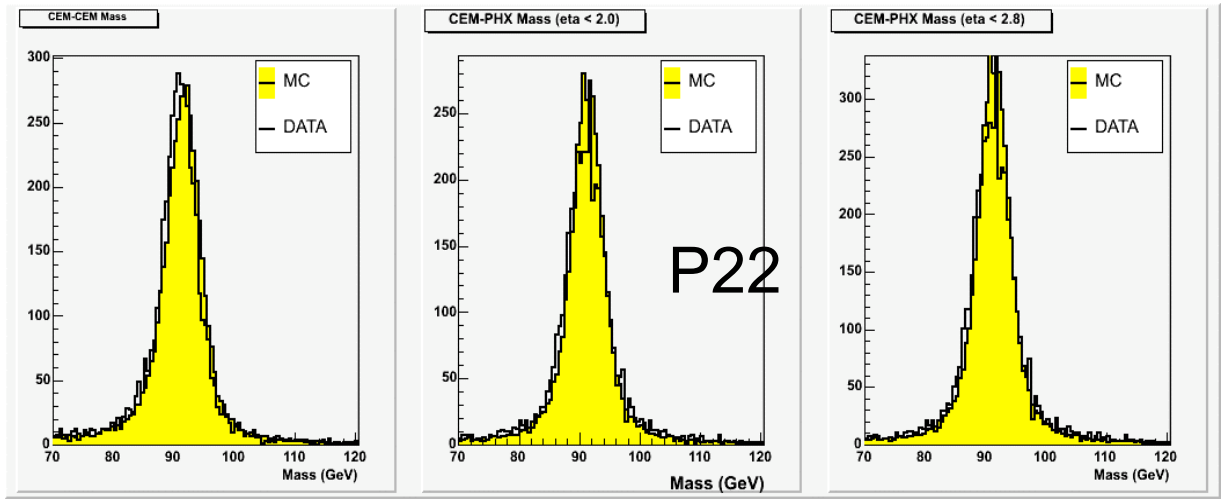
	PEM	
Eff |Eta| < 2.8	0.730+\-0.005	0.810+\-0.001
SF |Eta| < 2.8	0.901+\-0.007	NA

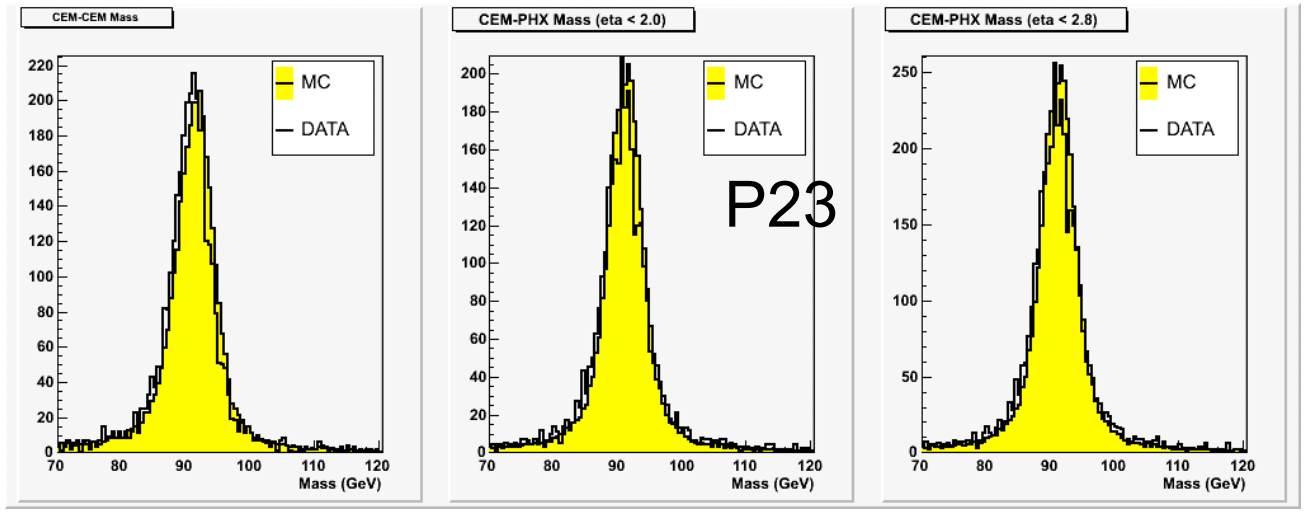
P21

	PEM	
Eff |Eta| < 2.0	0.756+\-0.004	0.847+\-0.002
SF |Eta| < 2.0	0.893+\-0.005	NA

	PEM	
Eff |Eta| < 2.8	0.707+\-0.004	0.810+\-0.001
SF |Eta| < 2.8	0.873+\-0.005	NA

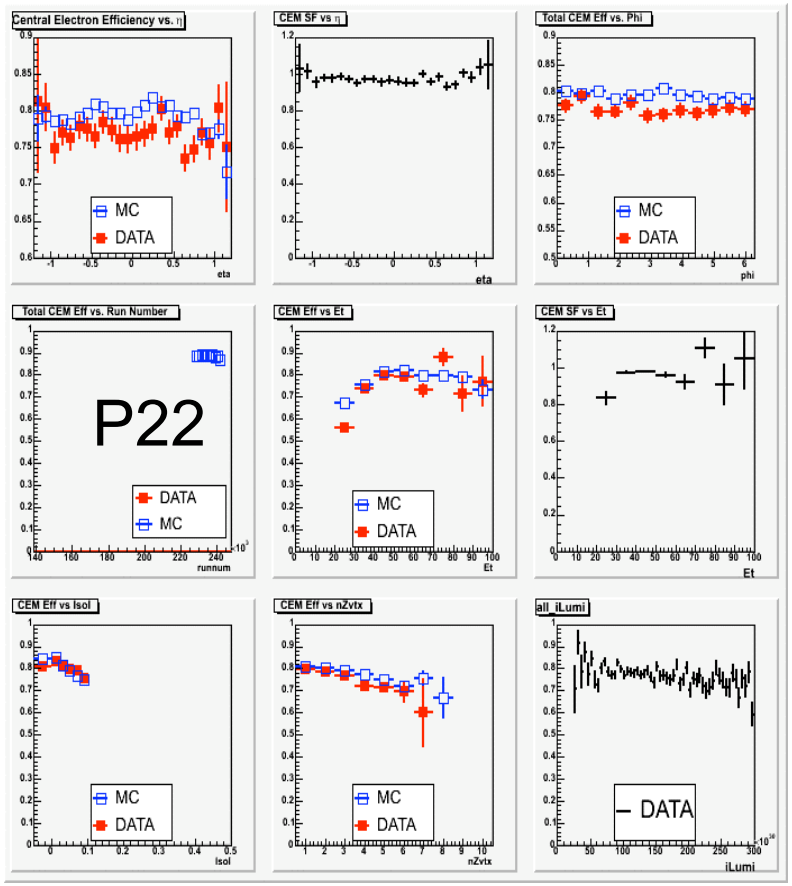
EleID Plots

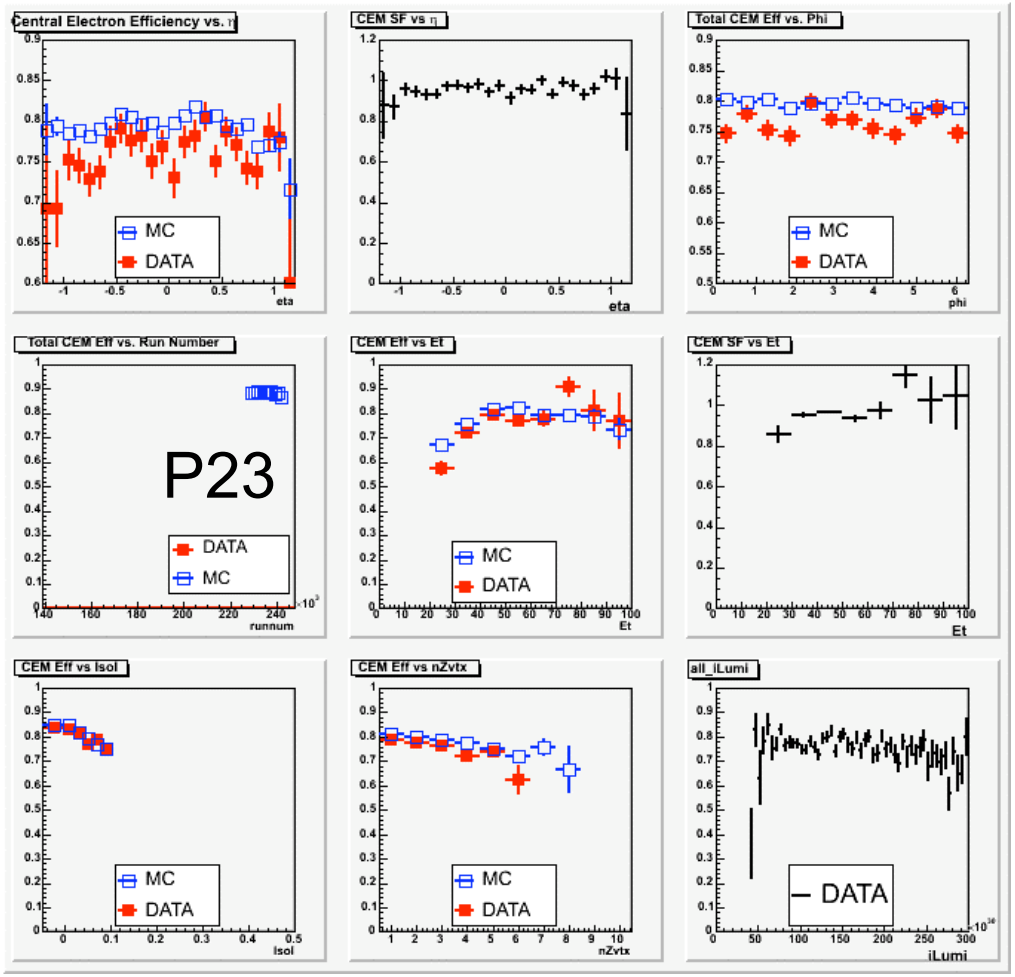

CEM-CEM Mass
CEM-PHX Mass (eta < 2.0)
CEM-PHX Mass (eta < 2.8)
MC
DATA
P22
Mass (GeV)


CEM-CEM Mass
CEM-PHX Mass (eta < 2.0)
CEM-PHX Mass (eta < 2.8)
MC
DATA
P23
Mass (GeV)

EleID Plots 1

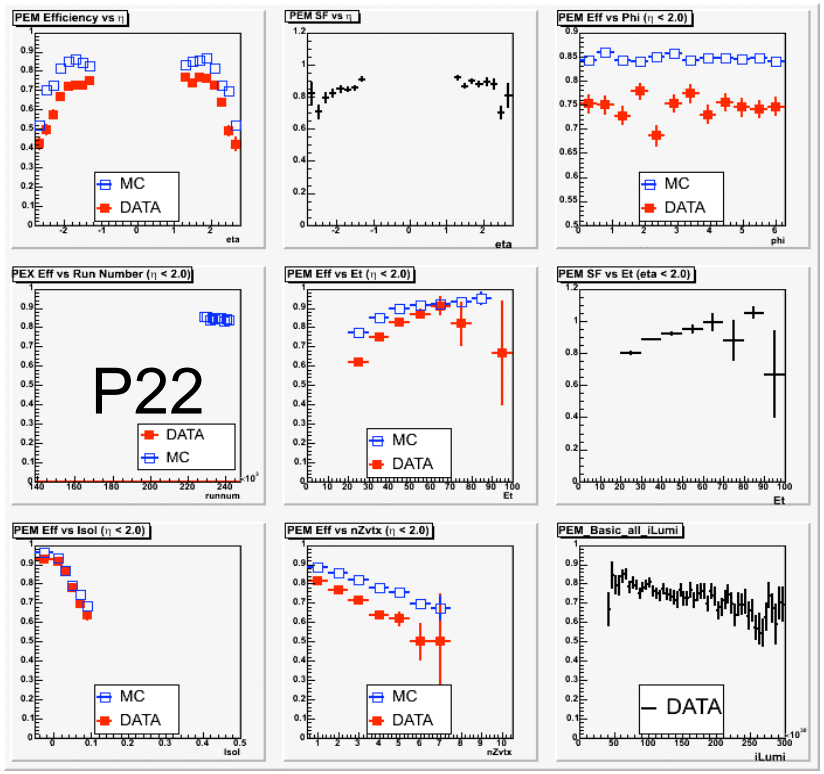
CEM Efficiencies

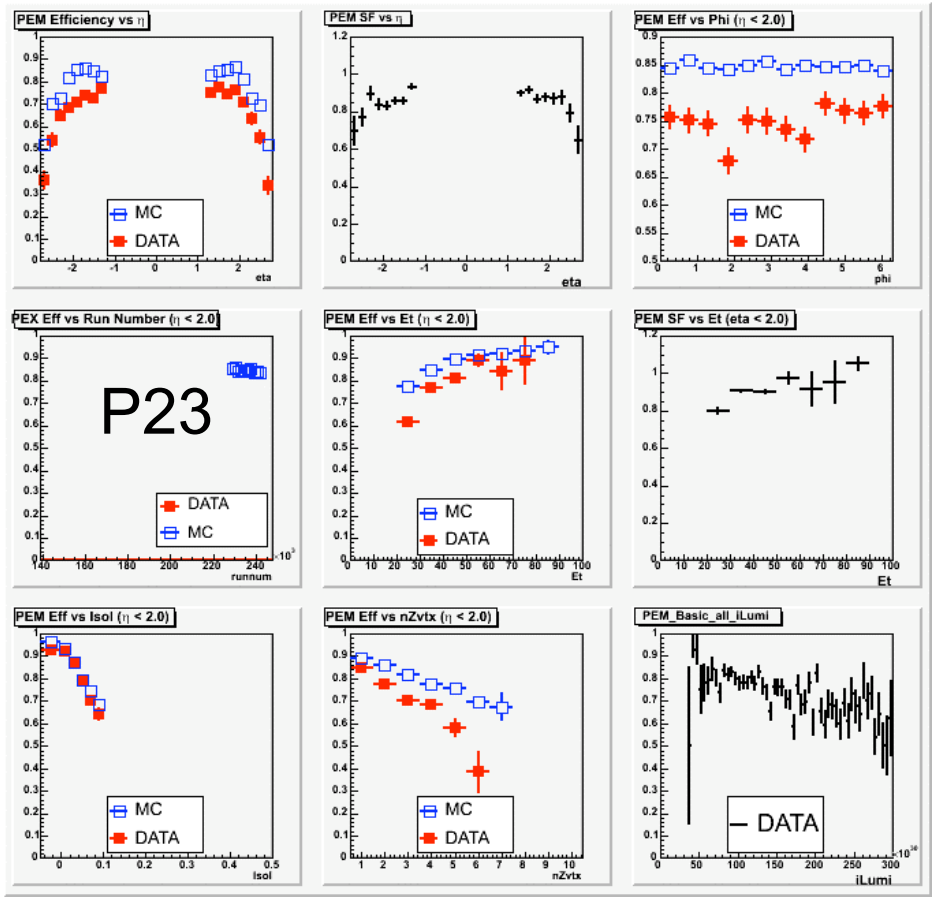




EleID Plots 2

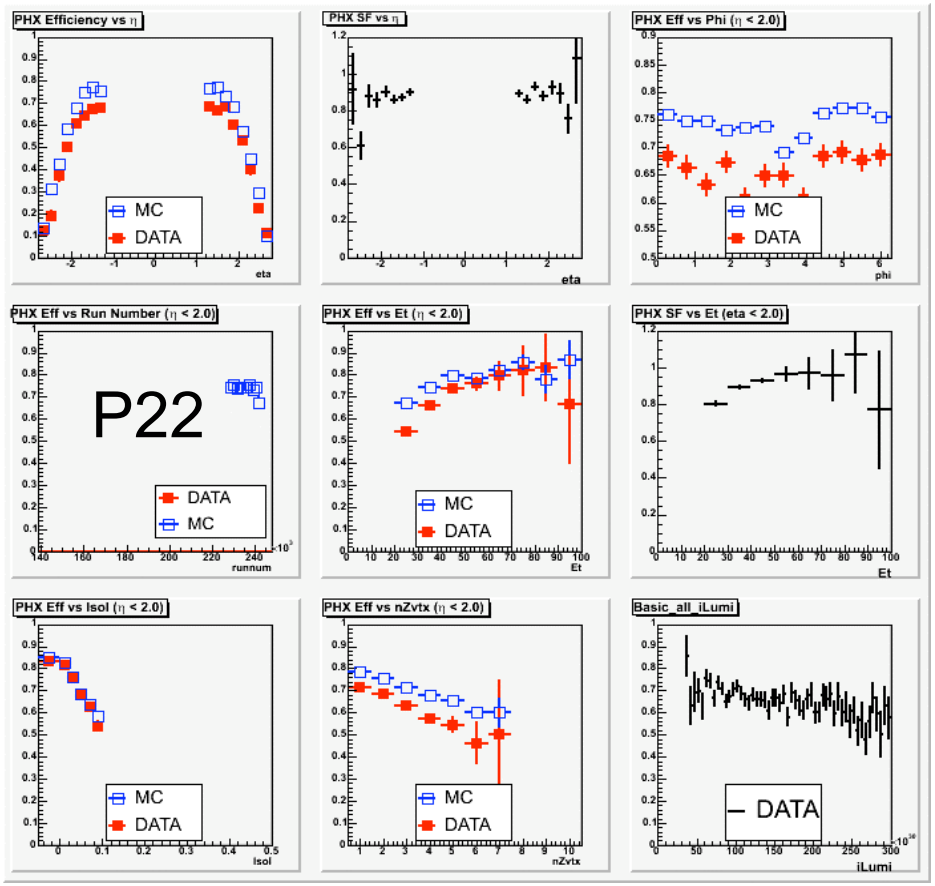
PEM Efficiencies

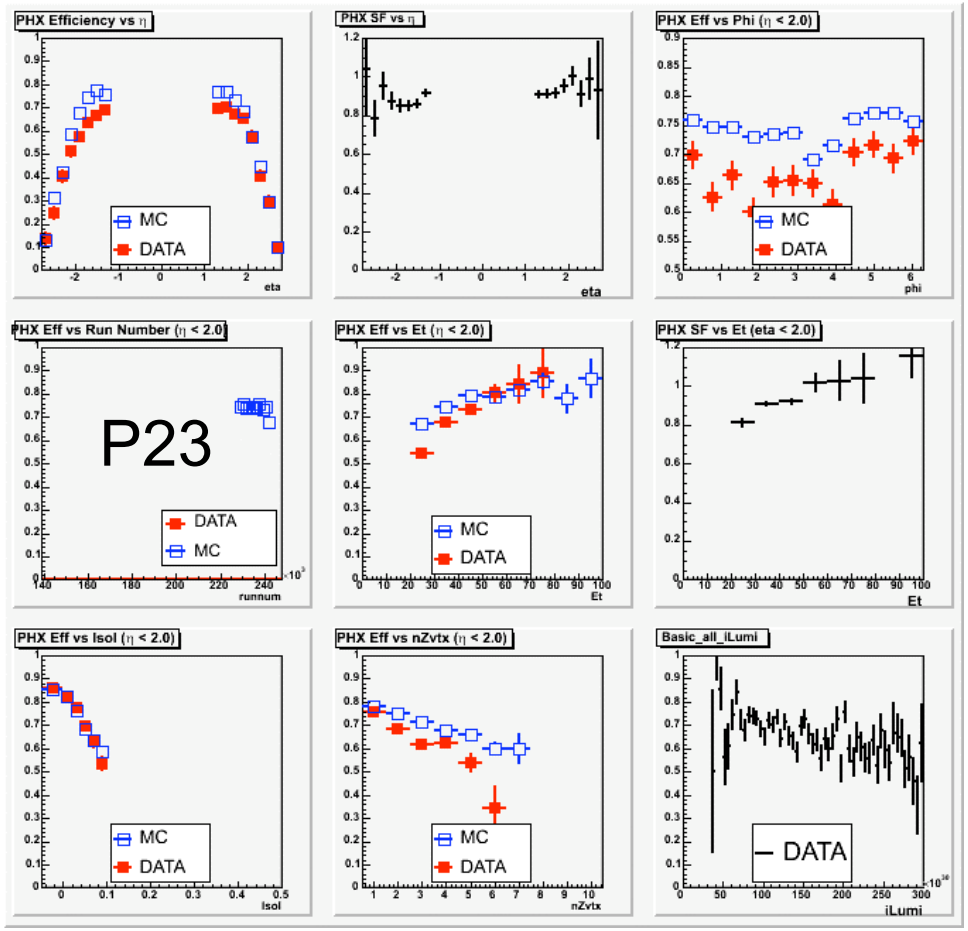




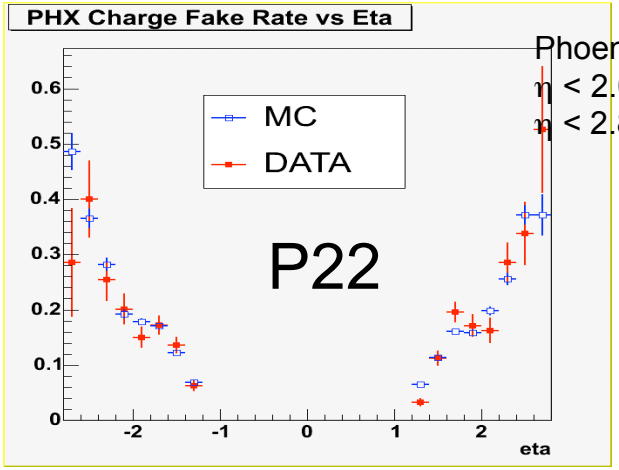
EleID Plots 3

PHX Efficiencies

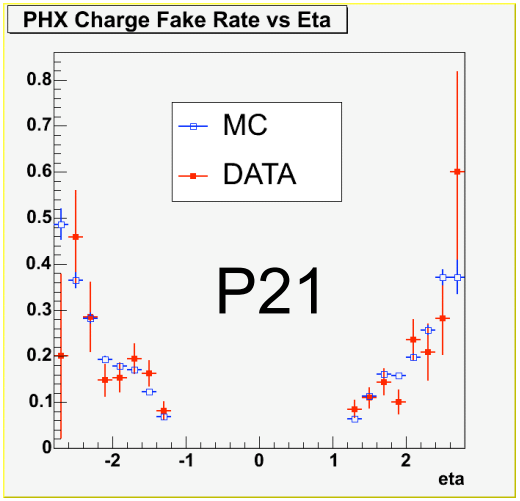




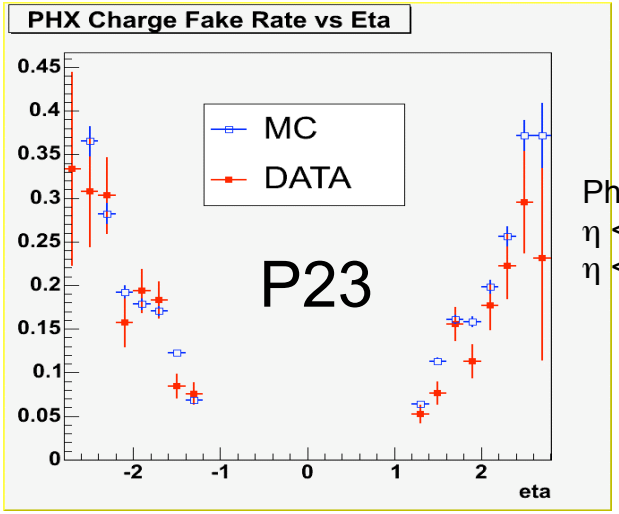
PHX Fake Charge Rate



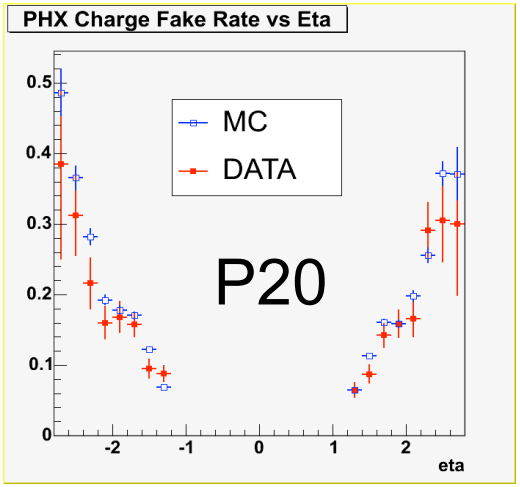
Phoenix charge fake rate
$\eta < 2.0$ 0.121 +/- 0.005
$\eta < 2.8$ 0.145 +/- 0.005



Phoenix charge fake rate
$\eta < 2.0$ 0.120 +/- 0.004
$\eta < 2.8$ 0.142 +/- 0.004



Phoenix charge fake rate
$\eta < 2.0$ 0.109 +/- 0.006
$\eta < 2.8$ 0.132 +/- 0.006



Phenix charge fake rate
$\eta < 2.0$ 0.1139 +/- 0.0055
$\eta < 2.8$ 0.1352 +/- 0.0053

Electron ID Conclusions

- Slight drop observed in P21 has disappeared
- I've rerun P21 with the revised GRL (excluding some bad plug runs) but I find no difference with P21 results already blessed.
- P23 looks in 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	104997
NcemL1	101902
NcemL2	101850
NcemL3	100754

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
0.9681 ± 0.002	0.9704 ± 0.003	0.9705 ± 0.003
0.9993 ± 0.002	0.9995 ± 0.003	0.9995 ± 0.003
0.9903 ± 0.002	0.9901 ± 0.003	0.9892 ± 0.003
0.9580± 0.002	0.9580± 0.003	0.9596± 0.003

Electron Trigger: Results Past Periods

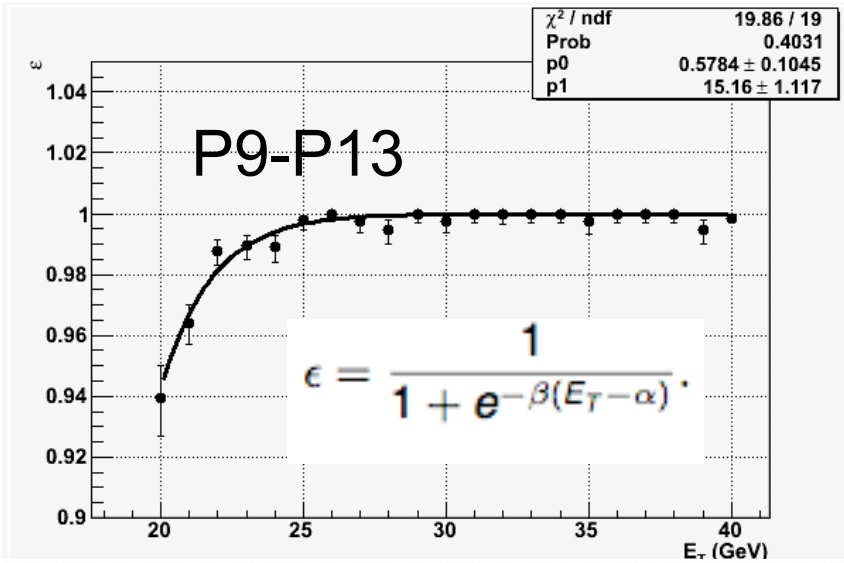
Analyzed all data

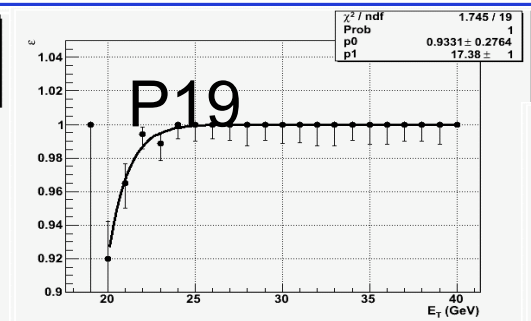
Trigger	Period 9	Period 10A	Period 10B
L1_XFT_PT8	0.9651(6)	0.9673(7)	0.9650(29)
L2_XFT_PT8	0.9992(1)	0.9993(1)	0.9992(5)
L3 tracking	0.9954(2)	0.9932(3)	0.9968(9)
Total Tracking	0.9598(7)	0.9600(8)	0.9611(31)

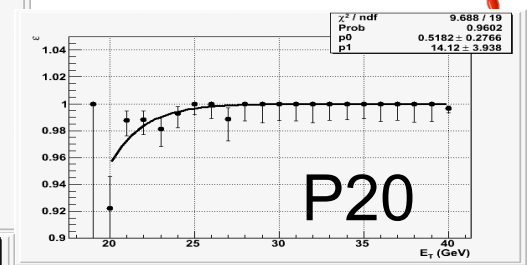
Trigger	Period 11	Period 12	Period 13	Period 14
L1_XFT_PT8	0.9688(4)	0.96857 ± 0.003	0.963922 ± 0.003	0.964755 ± 0.03
L2_XFT_PT8	0.9988(4)	0.9990 ± 0.003	0.998003 ± 0.003	0.999569 ± 0.03
L3 tracking	0.9935(4)	0.9940 ± 0.003	0.994608 ± 0.003	0.996055 ± 0.03
Total Tracking	0.9614(4)	0.9600 ± 0.003	0.95681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

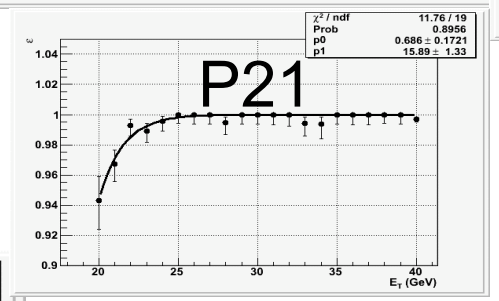
Trigger	Period 15	Period 16	Period 17	Period 18
L1_XFT_PT8	0.9695 ± 0.005	0.9684 ± 0.005	0.9694 ± 0.003	0.9697 ± 0.003
L2_XFT_PT8	0.9994 ± 0.005	0.9994 ± 0.005	0.9995 ± 0.003	0.9995 ± 0.003
L3 tracking	0.9940 ± 0.005	0.9927 ± 0.005	0.9929 ± 0.003	0.9919 ± 0.003
Total Tracking	0.9633 ± 0.005	0.9609 ±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

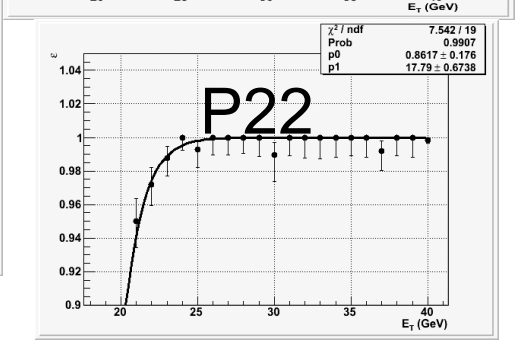
CEM Electron Trigger Results

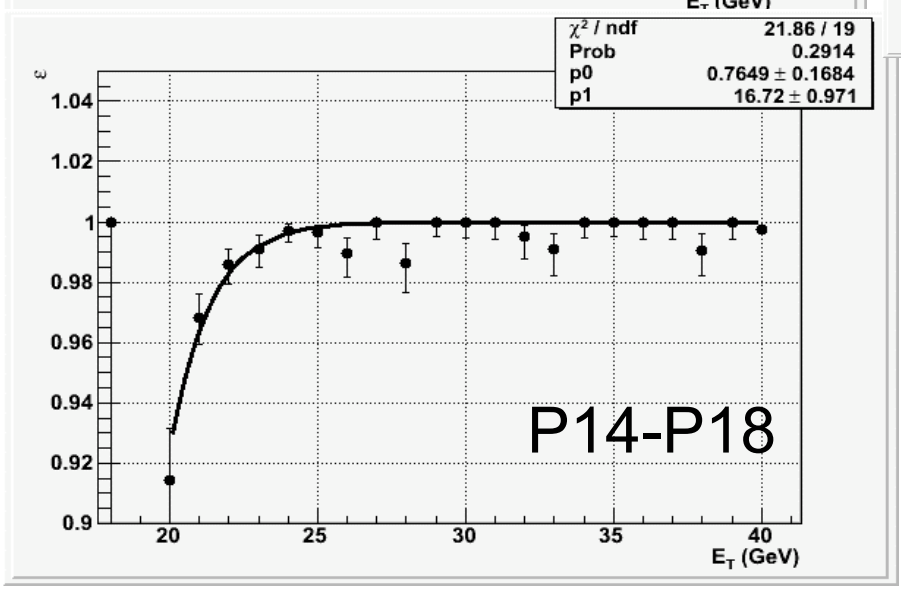


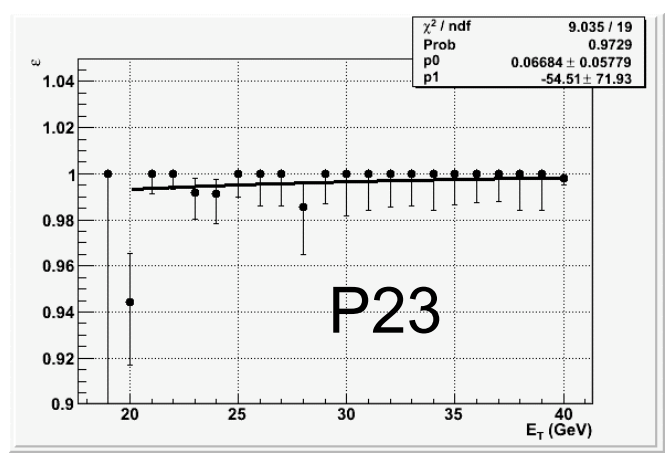








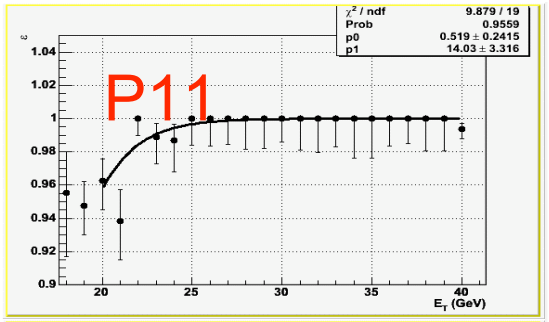


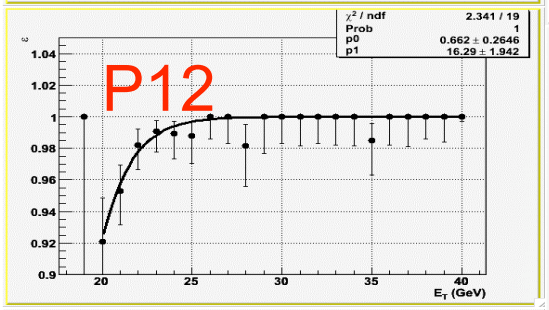


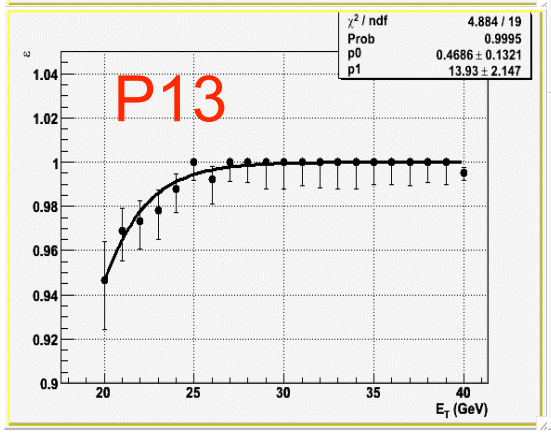
Electron Trigger :Past Periods

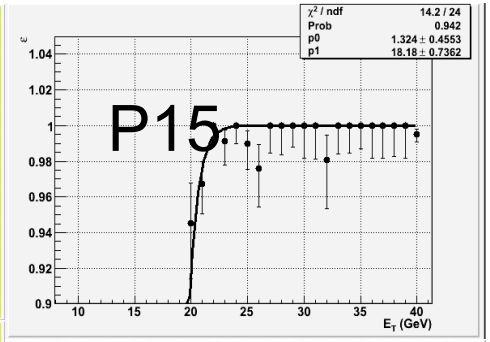
$$\epsilon = \frac{1}{1 + e^{-\beta(E_T - \alpha)}}.$$

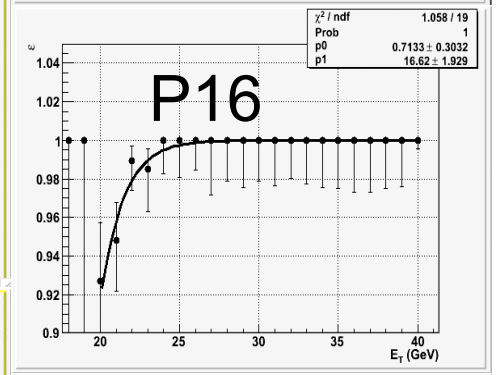
L2_CEM16 calorimeter efficiency

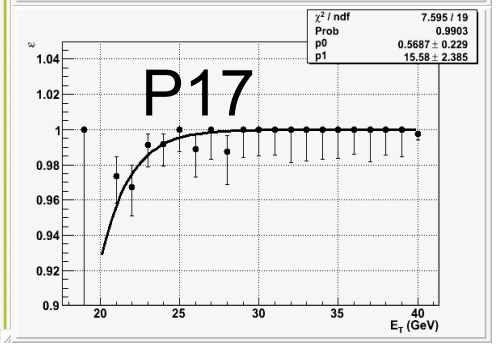


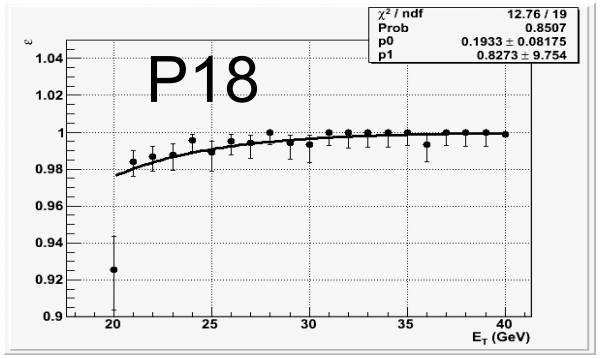


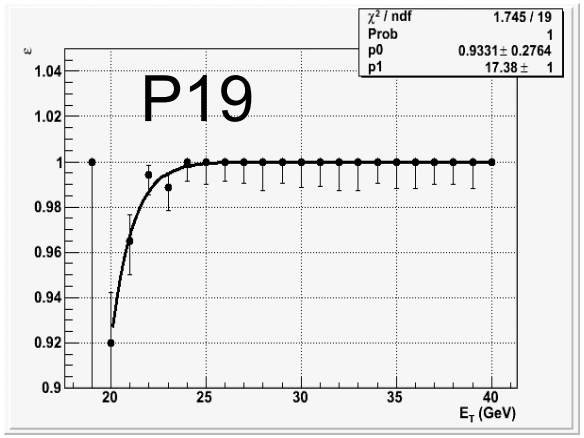












MET_PEM Trigger

Dataset bhelmm: Runs 271072-272214 (P22)
Runs 272470-274055 (P23)

Dataset bpelmm (and high eta PHX): Runs 271072-272214
Runs 272470-274055

GRL :GRL for P22 v28, Prelim for P23

P20 dataset :bpelmm, bhelmm, skim leptons, goodrun_em_si_v28.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:

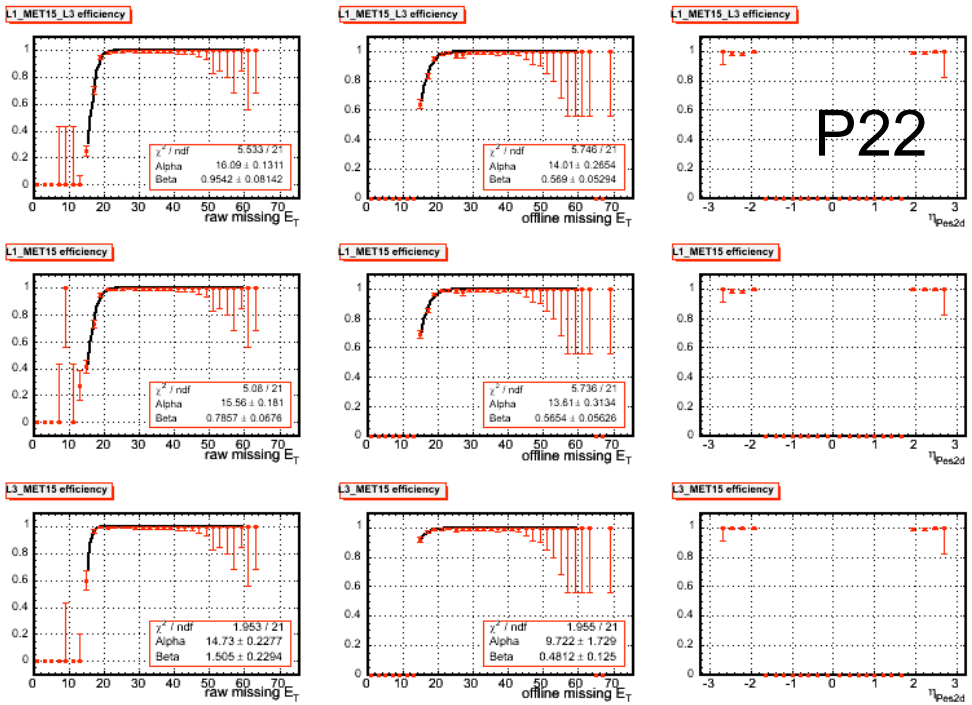
$$\epsilon(\texttt{L2_PEM20}) = \frac{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}}{Z \to e^+e^-(CP)} \quad (2)$$

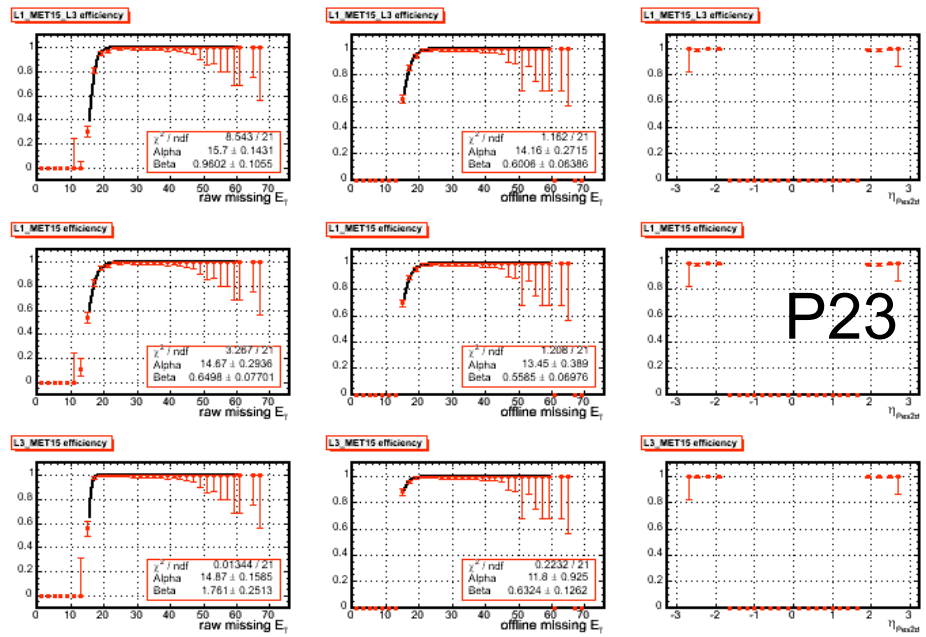
$$\epsilon(\texttt{L3_PEM20}) = \frac{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}\ \&\&\ \texttt{L3_PEM20}(L3Obj)}{Z \to e^+e^-(CP)\ \&\&\ \texttt{L2_PEM20_NoPS}} \quad (3)$$

Turn-on fit function

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

MET15 Results





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

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

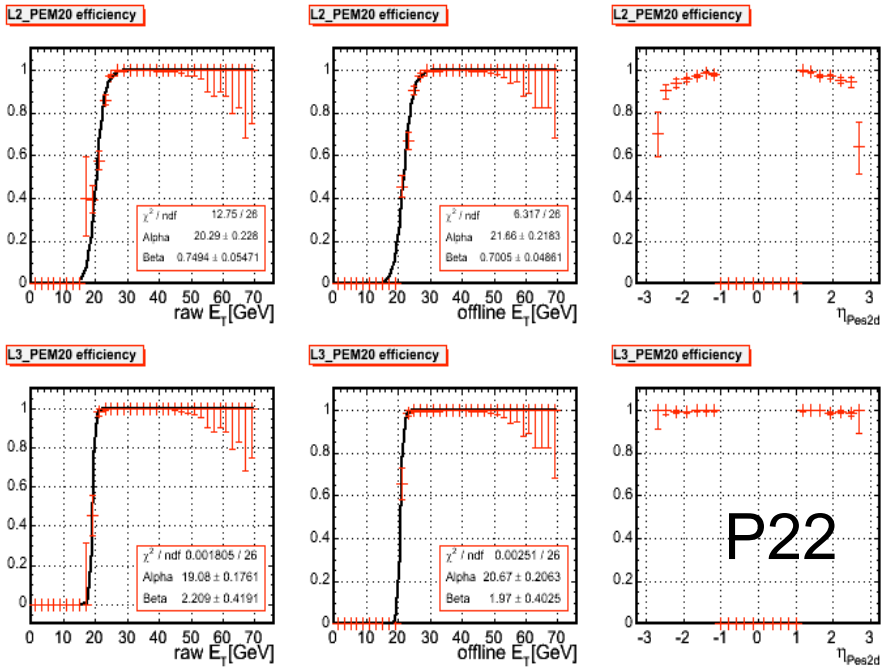
period	ϵ ($\not{E}_T > 20$ GeV)	α	β
$p00$	$98.52^{+0.20}_{-0.22}$	14.20 ± 0.24	0.35 ± 0.02
$[p01, p04]$	$97.89^{+0.26}_{-0.28}$	14.80 ± 0.22	0.34 ± 0.02
$[p05, p07]$	$98.64^{+0.09}_{-0.10}$	14.74 ± 0.10	0.35 ± 0.01
$p08$	$98.85^{+0.12}_{-0.12}$	14.38 ± 0.14	0.37 ± 0.01
$p09$	$98.92^{+0.14}_{-0.15}$	13.78 ± 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
P18	$98.46^{+0.15}_{-0.16}$	15.05 ± 0.12	0.387 ± 0.014 ($1.2 \leq \lvert\eta\rvert \leq 2.8$)
P19	$98.48^{+0.18}_{-0.20}$	14.92+/-0.16	0.382+/-0.018 ($1.2 \leq \lvert\eta\rvert \leq 2.8$)
P20	$97.63^{+0.25}_{-0.26}$	15.05+/-0.17	0.361+/-0.017 ($1.2 \leq \lvert\eta\rvert \leq 2.8$)
P21	$98.52^{+0.12}_{-0.12}$	12.113+/-0.40	0.688+/-0.067 ($1.2 \leq \lvert\eta\rvert \leq 2.8$)
P22	$98.33^{+0.29}_{-0.132}$	14.01+/-0.427	0.569+/-0.012 ($1.2 \leq \lvert\eta\rvert \leq 2.8$)
P23	$99.63^{+00.18}_{-00.27}$	14.16+/-0.27	0.601+/-0.064

PEM_20: L3 Results

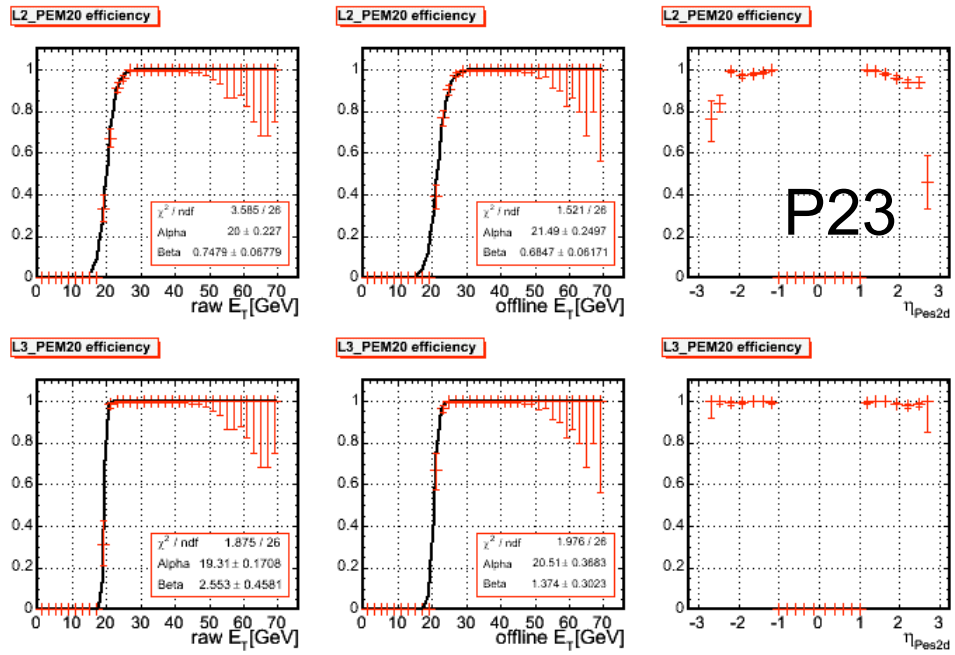
$1.2 \leq |\eta| \leq 2.8$

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
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

PEM_20 Plots

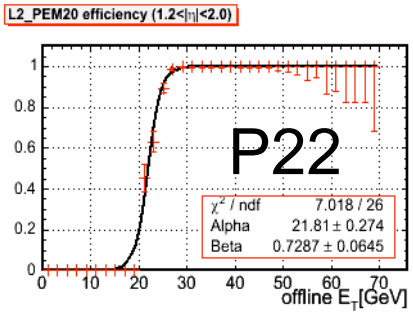


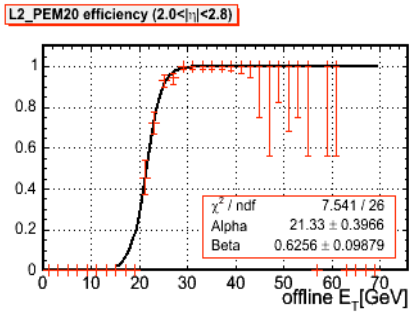
P22

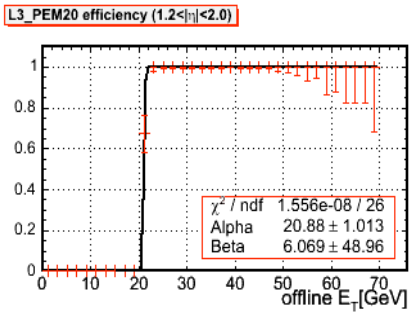


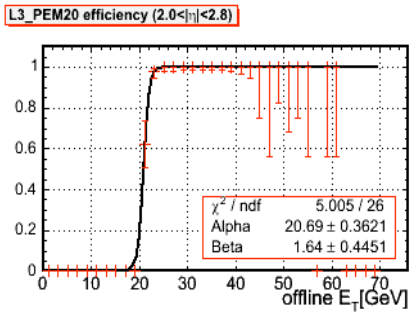
P23

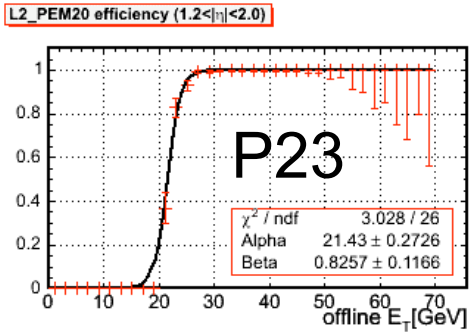
PEM_20 Plots

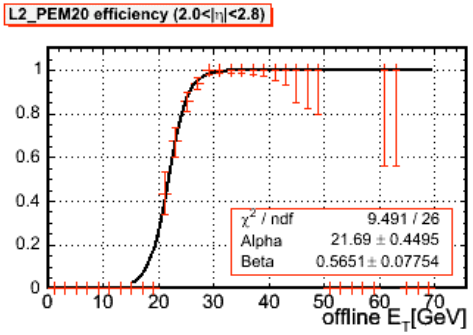

L2_PEM20 efficiency (1.2<|η|<2.0)
P22
χ² / ndf 7.018 / 26
Alpha 21.81 ± 0.274
Beta 0.7287 ± 0.0645
offline E_T[GeV]

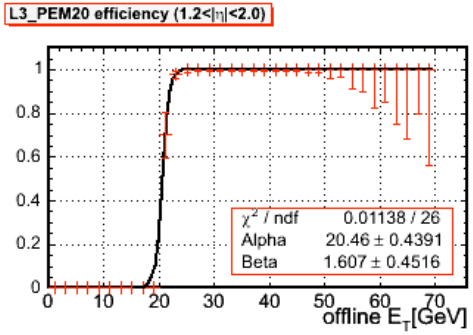

L2_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 7.541 / 26
Alpha 21.33 ± 0.3966
Beta 0.6256 ± 0.09879
offline E_T[GeV]

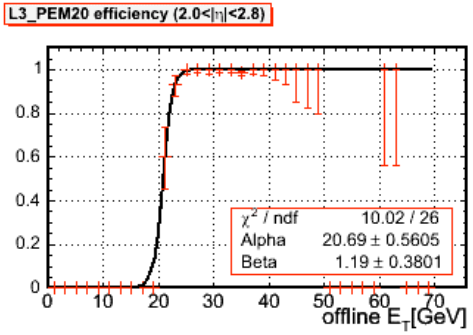

L3_PEM20 efficiency (1.2<|η|<2.0)
χ² / ndf 1.556e-08 / 26
Alpha 20.88 ± 1.013
Beta 6.069 ± 48.96
offline E_T[GeV]


L3_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 5.005 / 26
Alpha 20.69 ± 0.3621
Beta 1.64 ± 0.4451
offline E_T[GeV]


L2_PEM20 efficiency (1.2<|η|<2.0)
P23
χ² / ndf 3.028 / 26
Alpha 21.43 ± 0.2726
Beta 0.8257 ± 0.1166
offline E_T[GeV]


L2_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 9.491 / 26
Alpha 21.69 ± 0.4495
Beta 0.5651 ± 0.07754
offline E_T[GeV]


L3_PEM20 efficiency (1.2<|η|<2.0)
χ² / ndf 0.01138 / 26
Alpha 20.46 ± 0.4391
Beta 1.607 ± 0.4516
offline E_T[GeV]


L3_PEM20 efficiency (2.0<|η|<2.8)
χ² / ndf 10.02 / 26
Alpha 20.69 ± 0.5605
Beta 1.19 ± 0.3801
offline E_T[GeV]

Muons

Dataset bhmumm: Runs 271072-272214 (P22)
Runs 272470-274055 (P23)

MC sample : zektim (Feb 2008)

GRL : GRL for P22 v28 and prelim for P23

goodrun_em_mu_nosi_cmxignored_v28.list,
goodrun_em_mu_si_cmxignored_v28.list

Data: P22/23 Data on SAM : bhmumm

MC: dataset zektim on SAM

No dps accounting yet for P23

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

P22

Cut	Count	Efficiency (%)
No cut	3641	
E_{EM} cut	3541	$97.25^{+0.28}_{-0.31}$
E_{HAD} cut	3562	$97.83^{+0.25}_{-0.26}$
COT hits cut	3640	$99.97^{+0.02}_{-0.06}$
d_0 cut	3616	$99.31^{+0.14}_{-0.16}$
Isolation cut	3443	$94.56^{+0.38}_{-0.40}$
Δx_{CMU} cut	3628	$99.64^{+0.09}_{-0.13}$
Δx_{CMP} cut	3575	$98.19^{+0.21}_{-0.25}$
All above cuts	3192	$87.67^{+0.54}_{-0.58}$
All cuts excl. isol.	3368	$92.50^{+0.44}_{-0.49}$
Sliding isol. cut	3518	$96.62^{+0.28}_{-0.31}$
All cuts (sliding isol.)	3259	$89.51^{+0.51}_{-0.52}$
χ^2 cut	3641	$100.00^{+0.00}_{-0.05}$
All cuts (χ^2)	3192	$87.67^{+0.54}_{-0.58}$
All track cuts	3262	$89.59^{+0.52}_{-0.55}$
All trk cuts excl. isol.	3442	$94.53^{+0.36}_{-0.42}$

TABLE I: Dataset bhmumm22_SAM: Muon ID efficiencies for CMUP

P23

Cut	Count	Efficiency (%)
No cut	2611	
E_{EM} cut	2535	$97.09^{+0.35}_{-0.39}$
E_{HAD} cut	2558	$97.97^{+0.30}_{-0.34}$
COT hits cut	2610	$99.96^{+0.03}_{-0.09}$
d_0 cut	2590	$99.20^{+0.18}_{-0.21}$
Isolation cut	2481	$95.02^{+0.41}_{-0.47}$
Δx_{CMU} cut	2601	$99.62^{+0.12}_{-0.16}$
Δx_{CMP} cut	2565	$98.24^{+0.27}_{-0.31}$
All above cuts	2304	$88.24^{+0.67}_{-0.69}$
All cuts excl. isol.	2416	$92.53^{+0.51}_{-0.56}$
Sliding isol. cut	2525	$96.71^{+0.34}_{-0.39}$
All cuts (sliding isol.)	2343	$89.74^{+0.65}_{-0.62}$
χ^2 cut	2611	$100.00^{+0.00}_{-0.07}$
All cuts (χ^2)	2304	$88.24^{+0.67}_{-0.69}$
All track cuts	2349	$89.97^{+0.61}_{-0.66}$
All trk cuts excl. isol.	2465	$94.41^{+0.44}_{-0.49}$

TABLE I: Dataset bhmummP23_SAM: Muon ID efficiencies for CMUP

CMUP ID SF

P22

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0110^{+0.0029}_{-0.0032}$
E_{HAD} cut	$0.9948^{+0.0026}_{-0.0026}$
COT hits cut	$0.9999^{+0.0002}_{-0.0006}$
d_0 cut	$0.9958^{+0.0014}_{-0.0016}$
Isolation cut	$0.9784^{+0.0040}_{-0.0041}$
Δx_{CMU} cut	$0.9965^{+0.0009}_{-0.0013}$
Δx_{CMP} cut	$0.9872^{+0.0022}_{-0.0025}$
All above cuts	$0.9648^{+0.0060}_{-0.0064}$
All cuts excl. isol.	$0.9857^{+0.0047}_{-0.0052}$
Sliding isol. cut	$0.9905^{+0.0029}_{-0.0032}$
All cuts (sliding isol.)	$0.9763^{+0.0055}_{-0.0057}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0005}$
All cuts (χ^2)	$0.9648^{+0.0060}_{-0.0064}$
All track cuts	$0.9806^{+0.0057}_{-0.0061}$
All trk cuts excl. isol.	$1.0019^{+0.0039}_{-0.0045}$

TABLE I: Dataset bhmumm22_SAM_zektim: Muon ID Scale Factors for CMUP

P23

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0093^{+0.0036}_{-0.0040}$
E_{HAD} cut	$0.9962^{+0.0030}_{-0.0034}$
COT hits cut	$0.9997^{+0.0003}_{-0.0009}$
d_0 cut	$0.9946^{+0.0018}_{-0.0021}$
Isolation cut	$0.9832^{+0.0043}_{-0.0048}$
Δx_{CMU} cut	$0.9963^{+0.0012}_{-0.0016}$
Δx_{CMP} cut	$0.9877^{+0.0027}_{-0.0032}$
All above cuts	$0.9711^{+0.0074}_{-0.0076}$
All cuts excl. isol.	$0.9860^{+0.0055}_{-0.0060}$
Sliding isol. cut	$0.9913^{+0.0035}_{-0.0040}$
All cuts (sliding isol.)	$0.9788^{+0.0071}_{-0.0068}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0007}$
All cuts (χ^2)	$0.9711^{+0.0074}_{-0.0076}$
All track cuts	$0.9847^{+0.0067}_{-0.0072}$
All trk cuts excl. isol.	$1.0006^{+0.0047}_{-0.0052}$

TABLE I: Dataset bhmummP23_SAM_zektim: Muon ID Scale Factors for CMUP

CMX ID Efficiencies

P22

Cut	Count	Efficiency (%)
No cut	2432	
E_{EM} cut	2348	$96.55^{+0.35}_{-0.43}$
E_{HAD} cut	2382	$97.94^{+0.27}_{-0.31}$
COT hits cut	2431	$99.96^{+0.03}_{-0.10}$
d_0 cut	2419	$99.47^{+0.16}_{-0.19}$
Isolation cut	2321	$95.44^{+0.44}_{-0.44}$
Δx_{CMX} cut	2418	$99.42^{+0.15}_{-0.19}$
All above cuts	2189	$90.01^{+0.57}_{-0.60}$
All cuts excl. isol.	2281	$93.79^{+0.47}_{-0.50}$
Sliding isol. cut	2357	$96.92^{+0.37}_{-0.41}$
All cuts (sliding isol.)	2222	$91.37^{+0.58}_{-0.59}$
χ^2 cut	2432	$100.00^{+0.00}_{-0.08}$
All cuts (χ^2)	2189	$90.01^{+0.57}_{-0.60}$
All track cuts	2198	$90.38^{+0.59}_{-0.68}$
All trk cuts excl. isol.	2290	$94.16^{+0.49}_{-0.53}$

TABLE II: Dataset bhmumm22_SAM: Muon ID efficiencies for CMX

P23

Cut	Count	Efficiency (%)
No cut	1779	
E_{EM} cut	1714	$96.35^{+0.46}_{-0.52}$
E_{HAD} cut	1743	$97.98^{+0.34}_{-0.39}$
COT hits cut	1776	$99.83^{+0.09}_{-0.17}$
d_0 cut	1768	$99.38^{+0.19}_{-0.25}$
Isolation cut	1697	$95.39^{+0.48}_{-0.54}$
Δx_{CMX} cut	1765	$99.21^{+0.21}_{-0.28}$
All above cuts	1586	$89.15^{+0.74}_{-0.82}$
All cuts excl. isol.	1658	$93.20^{+0.60}_{-0.67}$
Sliding isol. cut	1729	$97.19^{+0.39}_{-0.44}$
All cuts (sliding isol.)	1615	$90.78^{+0.67}_{-0.69}$
χ^2 cut	1779	$100.00^{+0.00}_{-0.10}$
All cuts (χ^2)	1586	$89.15^{+0.74}_{-0.82}$
All track cuts	1597	$89.77^{+0.71}_{-0.76}$
All trk cuts excl. isol.	1669	$93.82^{+0.57}_{-0.60}$

TABLE II: Dataset bhmummP23_SAM: Muon ID efficiencies for CMX

CMX ID SF

P22

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0034^{+0.0037}_{-0.0045}$
E_{HAD} cut	$1.0011^{+0.0028}_{-0.0032}$
COT hits cut	$0.9997^{+0.0003}_{-0.0010}$
d_0 cut	$0.9968^{+0.0016}_{-0.0019}$
Isolation cut	$0.9850^{+0.0045}_{-0.0046}$
Δx_{CMX} cut	$0.9958^{+0.0015}_{-0.0019}$
All above cuts	$0.9885^{+0.0063}_{-0.0067}$
All cuts excl. isol.	$1.0000^{+0.0051}_{-0.0054}$
Sliding isol. cut	$0.9916^{+0.0038}_{-0.0042}$
All cuts (sliding isol.)	$0.9950^{+0.0063}_{-0.0065}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0008}$
All cuts (χ^2)	$0.9885^{+0.0063}_{-0.0067}$
All track cuts	$0.9910^{+0.0065}_{-0.0075}$
All trk cuts excl. isol.	$1.0023^{+0.0053}_{-0.0057}$

TABLE II: Dataset bhmumm22_SAM_zektim: Muon ID Scale Factors for CMX

P23

Cut	Scale Factor
No cut	
E_{EM} cut	$1.0013^{+0.0048}_{-0.0054}$
E_{HAD} cut	$1.0014^{+0.0035}_{-0.0040}$
COT hits cut	$0.9985^{+0.0009}_{-0.0017}$
d_0 cut	$0.9960^{+0.0019}_{-0.0025}$
Isolation cut	$0.9846^{+0.0050}_{-0.0056}$
Δx_{CMX} cut	$0.9937^{+0.0021}_{-0.0028}$
All above cuts	$0.9791^{+0.0082}_{-0.0091}$
All cuts excl. isol.	$0.9936^{+0.0064}_{-0.0072}$
Sliding isol. cut	$0.9944^{+0.0040}_{-0.0045}$
All cuts (sliding isol.)	$0.9886^{+0.0074}_{-0.0076}$
χ^2 cut	$1.0000^{+0.0000}_{-0.0010}$
All cuts (χ^2)	$0.9791^{+0.0082}_{-0.0091}$
All track cuts	$0.9843^{+0.0078}_{-0.0083}$
All trk cuts excl. isol.	$0.9987^{+0.0061}_{-0.0065}$

TABLE II: Dataset bhmummP23_SAM_zektim: 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.

P20

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	3284	2845	$86.63^{+0.62}_{-0.65}$
CMX	2030	1929	$95.02^{+0.51}_{-0.52}$
CMX Arches	1568	1528	$97.45^{+0.38}_{-0.45}$
CMX Miniskirt	368	322	$87.50^{+1.66}_{-2.05}$
CMX Keystone	94	79	$84.04^{+4.04}_{-4.55}$
CMU-only	785	699	$89.04^{+1.09}_{-1.25}$
CMP-only	854	742	$86.89^{+1.10}_{-1.24}$
CMX MiniKey	462	401	$86.80^{+1.58}_{-1.74}$

P21

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	4474	3926	$87.75^{+0.51}_{-0.52}$
CMX	2852	2711	$95.06^{+0.43}_{-0.45}$
CMX Arches	2235	2165	$96.87^{+0.37}_{-0.41}$
CMX Miniskirt	491	430	$87.58^{+1.58}_{-1.74}$
CMX Keystone	126	116	$92.06^{+2.27}_{-3.20}$
CMU-only	1127	1002	$88.91^{+0.98}_{-0.97}$
CMP-only	1266	1089	$86.02^{+0.94}_{-1.01}$
CMX MiniKey	617	546	$88.49^{+1.25}_{-1.48}$

P22

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	4074	3545	$87.02^{+0.51}_{-0.57}$
CMX	2473	2351	$95.07^{+0.42}_{-0.46}$
CMX Arches	1970	1902	$96.55^{+0.40}_{-0.48}$
CMX Miniskirt	409	362	$88.51^{+1.63}_{-1.89}$
CMX Keystone	94	87	$92.55^{+2.56}_{-3.69}$
CMU-only	940	827	$87.98^{+1.03}_{-1.11}$
CMP-only	1110	967	$87.12^{+1.02}_{-1.13}$
CMX MiniKey	503	449	$89.26^{+1.46}_{-1.47}$

P23

Category	Fiducial	w/ Stub	Efficiency (%)
CMUP	2969	2543	$85.65^{+0.63}_{-0.64}$
CMX	1819	1720	$94.56^{+0.51}_{-0.56}$
CMX Arches	1436	1392	$96.94^{+0.45}_{-0.52}$
CMX Miniskirt	317	274	$86.44^{+1.94}_{-2.16}$
CMX Keystone	66	54	$81.82^{+5.29}_{-5.84}$
CMU-only	739	637	$86.20^{+1.20}_{-1.33}$
CMP-only	873	755	$86.48^{+1.11}_{-1.23}$
CMX MiniKey	383	328	$85.64^{+1.76}_{-1.95}$

Reconstruction SF

P18

Category	Scale Factor
CMUP	$0.9144^{+0.0044}_{-0.0046}$
CMX	$0.9516^{+0.0041}_{-0.0048}$
CMX Arches	$0.9668^{+0.0038}_{-0.0046}$
CMX Miniskirt	$0.8883^{+0.0157}_{-0.0179}$
CMX Keystone	$0.9020^{+0.0297}_{-0.0337}$
CMU-only	$0.9015^{+0.0098}_{-0.0102}$
CMP-only	$0.9112^{+0.0085}_{-0.0094}$
CMX MiniKey	$0.8912^{+0.0133}_{-0.0133}$

P19

Category	Scale Factor
CMUP	$0.8979^{+0.0066}_{-0.0065}$
CMX	$0.9575^{+0.0051}_{-0.0052}$
CMX Arches	$0.9753^{+0.0040}_{-0.0048}$
CMX Miniskirt	$0.8878^{+0.0182}_{-0.0213}$
CMX Keystone	$0.8752^{+0.0406}_{-0.0504}$
CMU-only	$0.8950^{+0.0129}_{-0.0132}$
CMP-only	$0.9005^{+0.0109}_{-0.0125}$
CMX MiniKey	$0.8851^{+0.0174}_{-0.0174}$

P20

Category	Scale Factor
CMUP	$0.8891^{+0.0064}_{-0.0066}$
CMX	$0.9540^{+0.0051}_{-0.0052}$
CMX Arches	$0.9765^{+0.0038}_{-0.0045}$
CMX Miniskirt	$0.8832^{+0.0168}_{-0.0207}$
CMX Keystone	$0.8511^{+0.0410}_{-0.0461}$
CMU-only	$0.9127^{+0.0112}_{-0.0128}$
CMP-only	$0.8842^{+0.0112}_{-0.0126}$
CMX MiniKey	$0.8767^{+0.0160}_{-0.0160}$

P21

Category	Scale Factor
CMUP	$0.9005^{+0.0052}_{-0.0053}$
CMX	$0.9543^{+0.0043}_{-0.0045}$
CMX Arches	$0.9707^{+0.0037}_{-0.0041}$
CMX Miniskirt	$0.8840^{+0.0160}_{-0.0175}$
CMX Keystone	$0.9324^{+0.0230}_{-0.0324}$
CMU-only	$0.9113^{+0.0101}_{-0.0100}$
CMP-only	$0.8754^{+0.0096}_{-0.0103}$
CMX MiniKey	$0.8938^{+0.0127}_{-0.0127}$

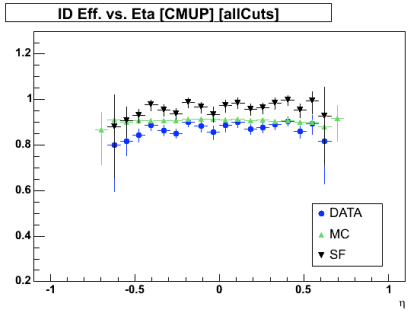
P22

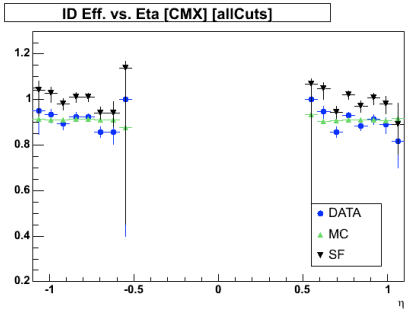
Category	Scale Factor
CMUP	$0.8930^{+0.0052}_{-0.0058}$
CMX	$0.9544^{+0.0042}_{-0.0046}$
CMX Arches	$0.9675^{+0.0040}_{-0.0048}$
CMX Miniskirt	$0.8934^{+0.0164}_{-0.0191}$
CMX Keystone	$0.9373^{+0.0260}_{-0.0374}$
CMU-only	$0.9017^{+0.0106}_{-0.0114}$
CMP-only	$0.8866^{+0.0104}_{-0.0115}$
CMX MiniKey	$0.9016^{+0.0147}_{-0.0147}$

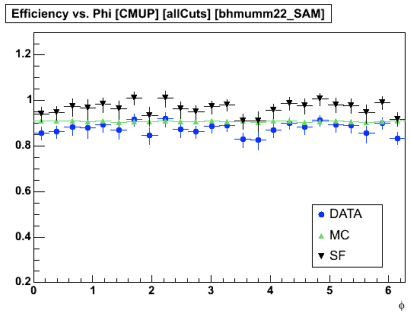
P23

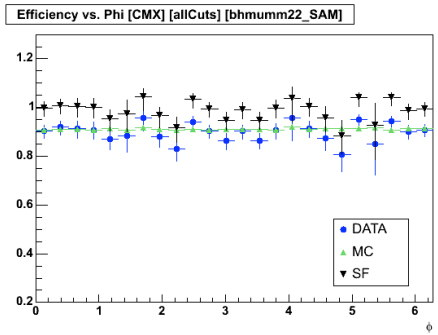
Category	Scale Factor
CMUP	$0.8790^{+0.0064}_{-0.0066}$
CMX	$0.9493^{+0.0051}_{-0.0057}$
CMX Arches	$0.9714^{+0.0045}_{-0.0053}$
CMX Miniskirt	$0.8725^{+0.0196}_{-0.0218}$
CMX Keystone	$0.8286^{+0.0536}_{-0.0592}$
CMU-only	$0.8835^{+0.0124}_{-0.0137}$
CMP-only	$0.8801^{+0.0113}_{-0.0125}$
CMX MiniKey	$0.8650^{+0.0178}_{-0.0178}$

Reco and ID Plots

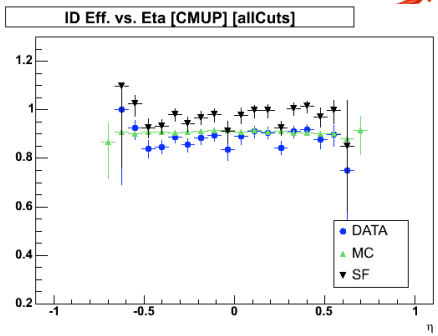


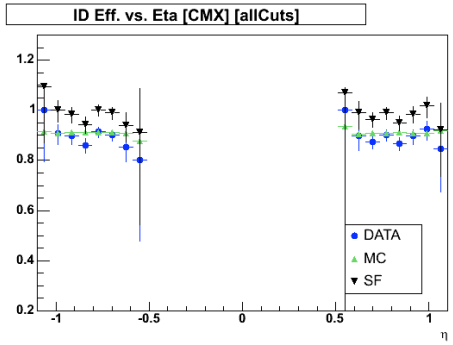






P22





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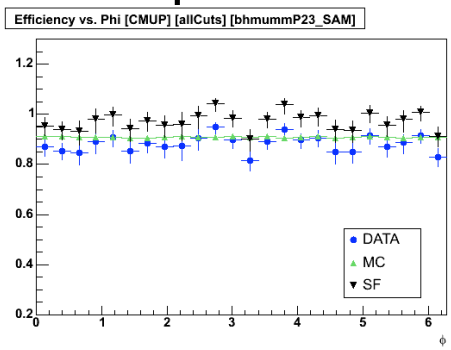
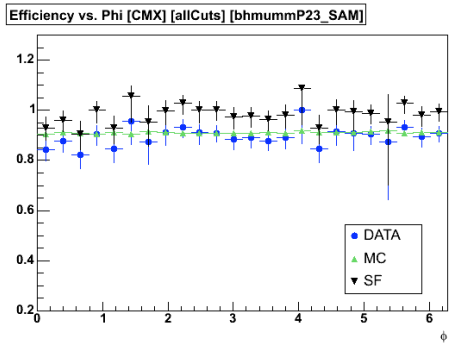
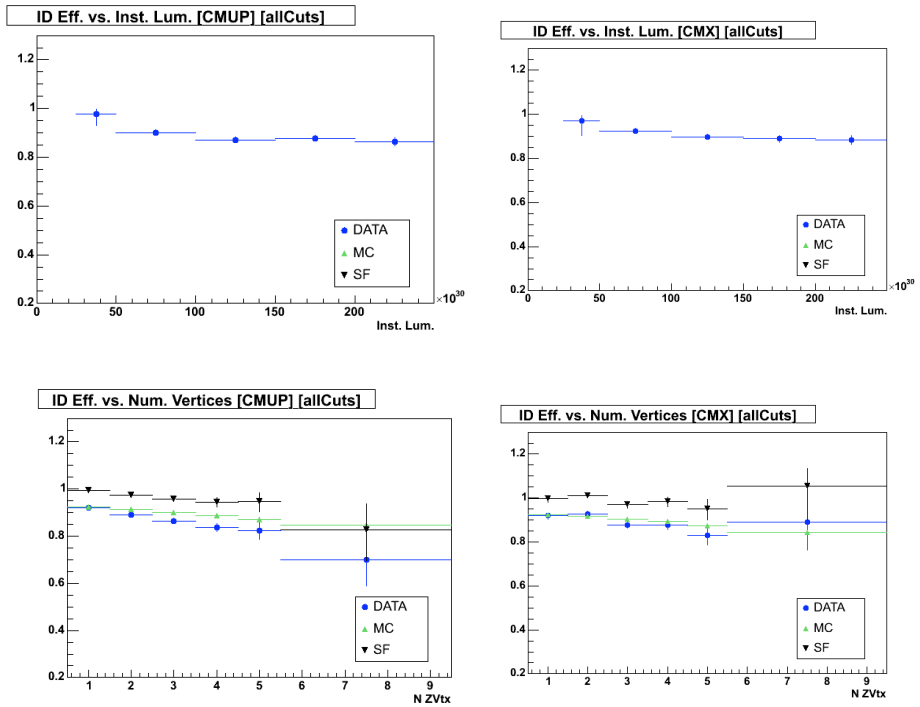
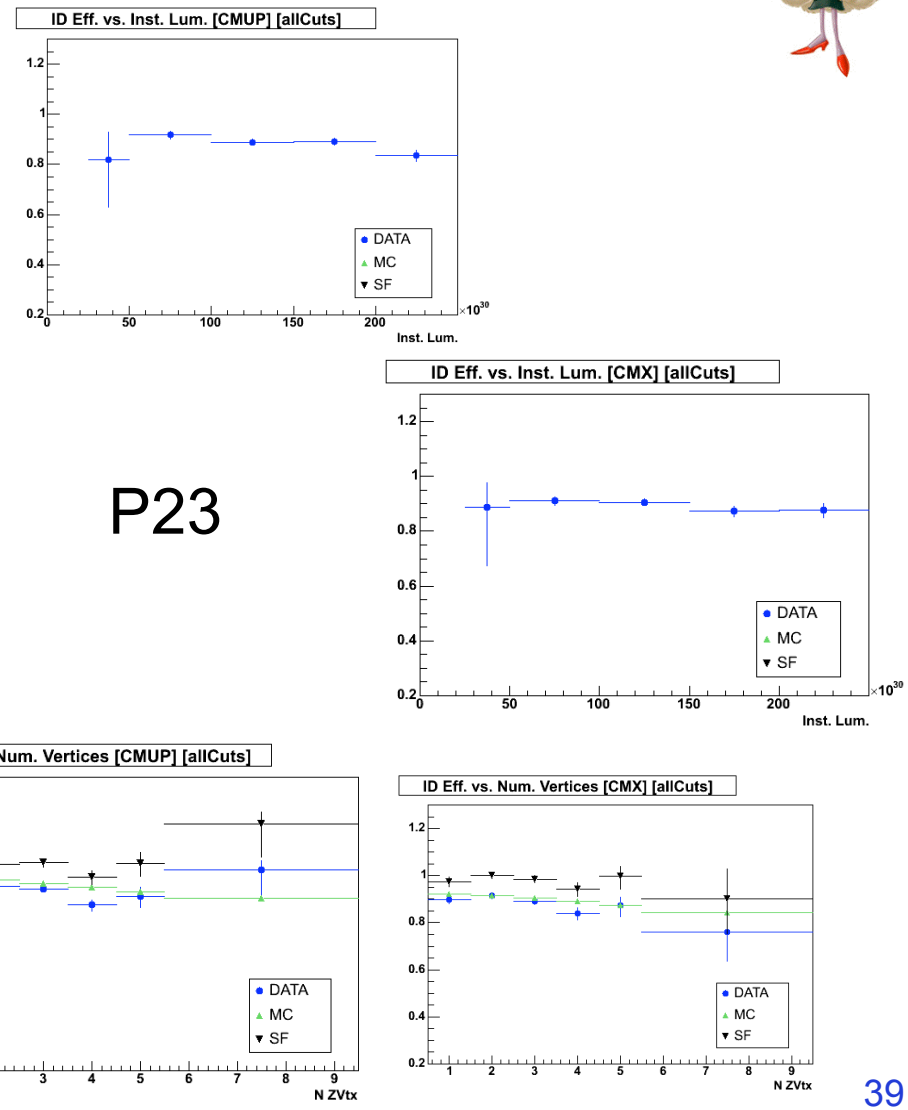




Reco and ID Plots

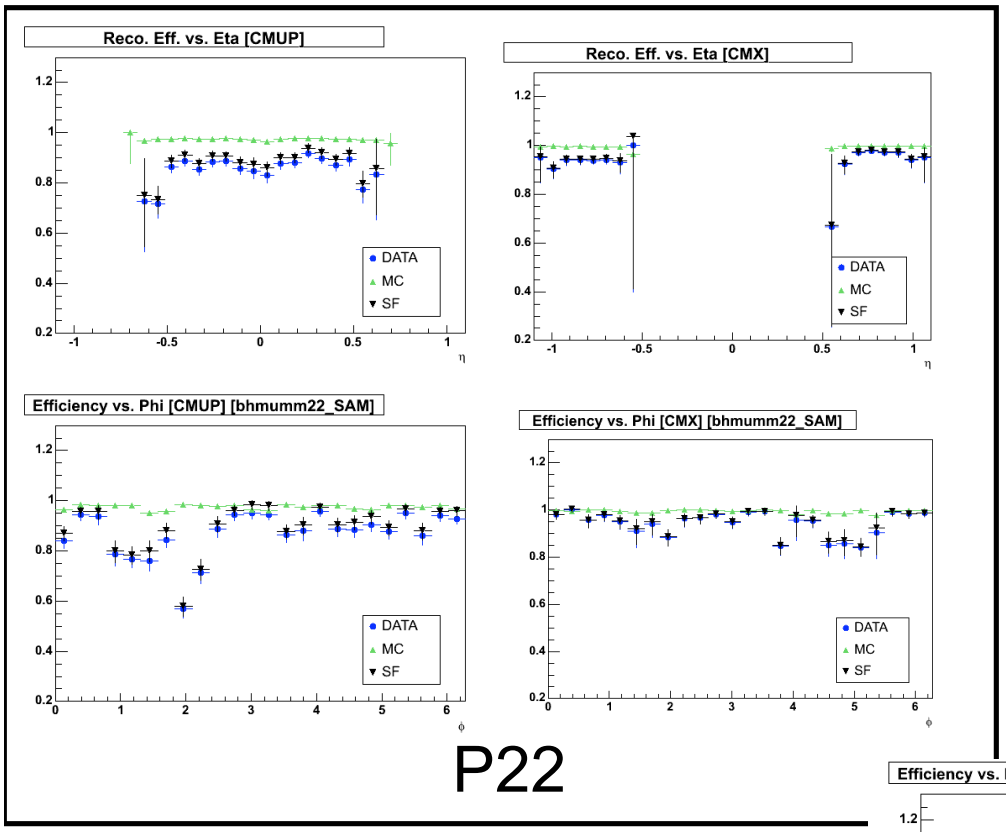


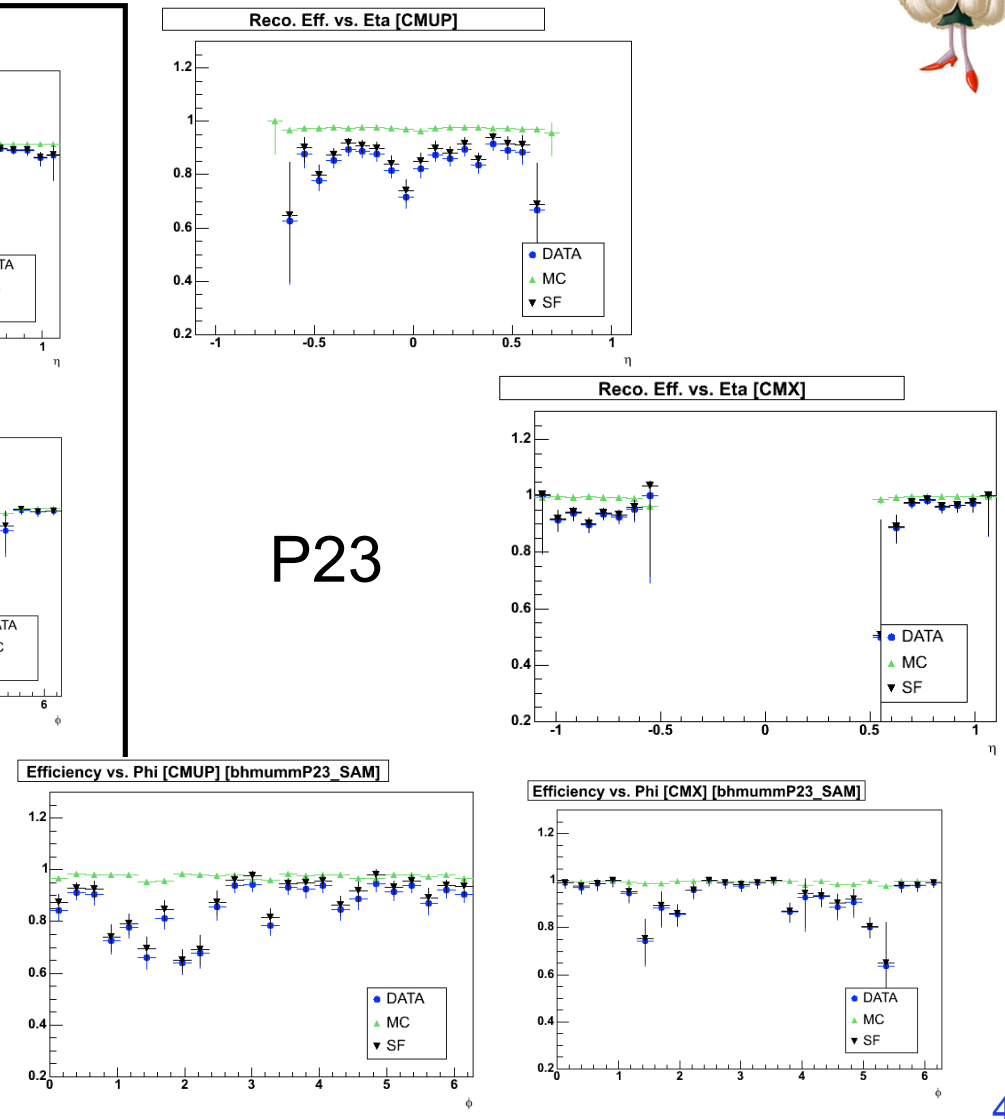
P22



P23

Reco and ID Plots





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:

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

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

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

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)

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

Level 3: (both leg pass L2)

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

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 P21 and P22

Category	Efficiency (%)
CMUP	$90.23^{+0.69}_{-0.77}$
CMX	$77.16^{+1.10}_{-1.17}$
CMX A	$83.35^{+1.20}_{-1.26}$
CMX MK	$61.26^{+2.96}_{-3.18}$
CMUP SLAM	$72.09^{+1.37}_{-1.29}$
CMX SLAM	$61.65^{+1.37}_{-1.38}$
CMX SLAM A	$65.98^{+1.56}_{-1.53}$
CMX SLAM MK	$51.47^{+3.16}_{-3.17}$

TABLE V: Dataset bhmumm22_SAM-1: Muon combined trigger efficiencies

Category	Efficiency (%)
CMUP	$91.34^{+0.60}_{-0.65}$
CMX	$78.04^{+1.01}_{-1.09}$
CMX A	$83.51^{+1.04}_{-1.15}$
CMX MK	$64.38^{+2.60}_{-2.81}$
CMUP SLAM	$88.02^{+0.78}_{-0.86}$
CMX SLAM	$75.20^{+1.07}_{-1.14}$
CMX SLAM A	$80.09^{+1.14}_{-1.19}$
CMX SLAM MK	$63.61^{+2.51}_{-2.87}$

TABLE V: Dataset bhmummP21_SAM-1: Muon combined trigger efficiencies

Category	Efficiency (%)
CMUP	$90.34^{+0.76}_{-0.93}$
CMX	$78.95^{+1.31}_{-1.39}$
CMX A	$83.37^{+1.31}_{-1.54}$
CMX MK	$68.86^{+3.11}_{-3.59}$
CMUP SLAM	$1.01^{+0.50}_{-0.35}$
CMX SLAM	$0.88^{+0.43}_{-0.30}$
CMX SLAM A	$1.14^{+0.56}_{-0.39}$
CMX SLAM MK	$0.00^{+0.00}_{-0.00}$

!!!!

Comparison with previous periods

CMUP

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	0.9023 (73)	1.0	0.9023 (73)

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	0.9023 (73)		0.7209 (133)

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	0.7716	0.9077	0.8500

CMX

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	0.7716/0.9077 = 0.8500	0.6598/0.9077 = 0.7268

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
- $\chi^2_{strip} < 10$
- $L_{shr} < 0.2$

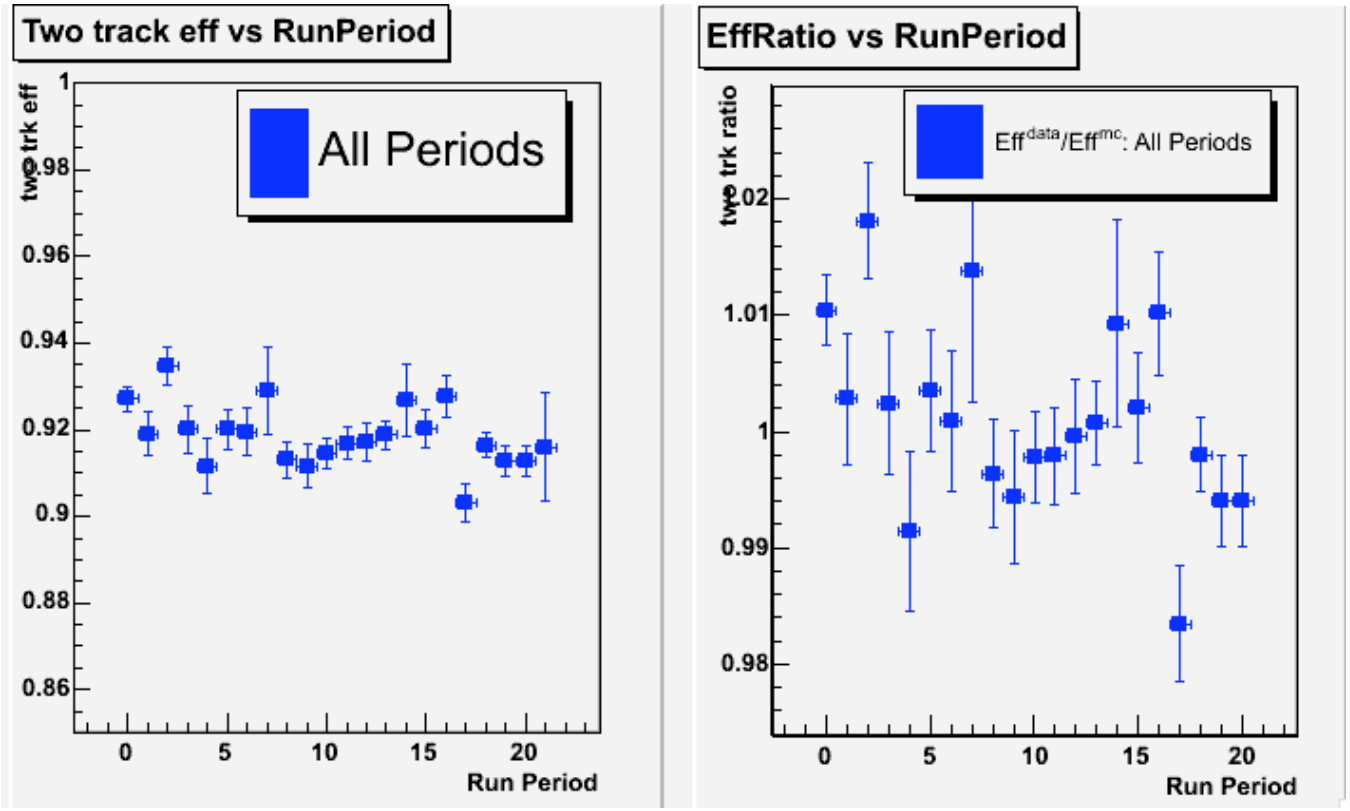
Calorimeter + tracking cuts

- 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



Preliminary
1/10 data sample

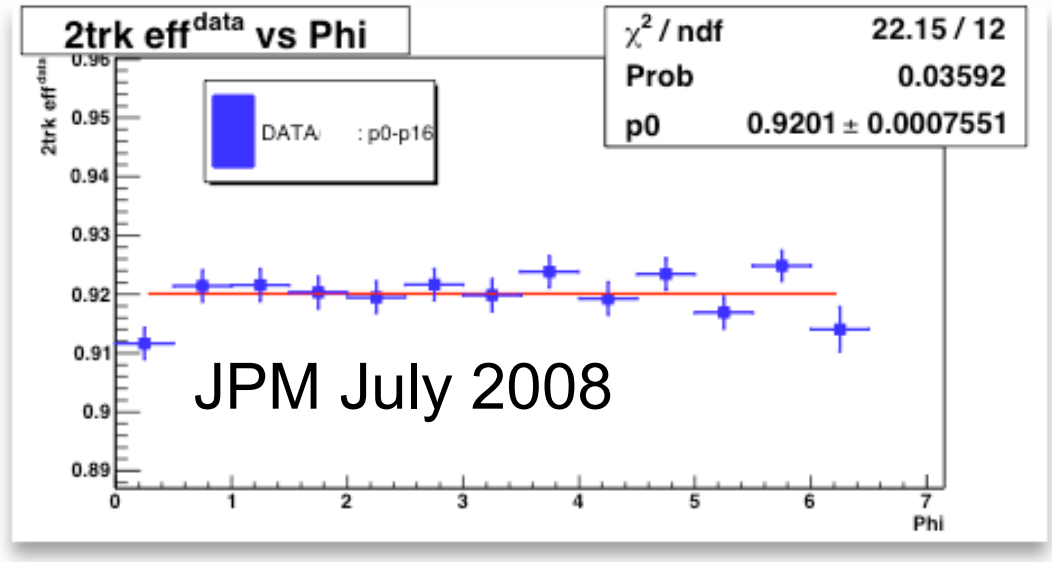
$$e_{2trk}^{DATA} = 0.9180 \quad 0.0009$$

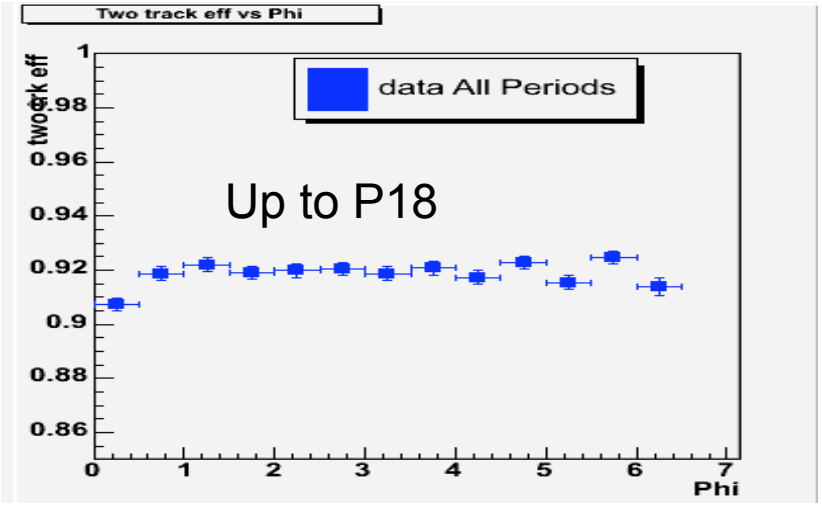
0.9180 ± 0.0009 up to P20

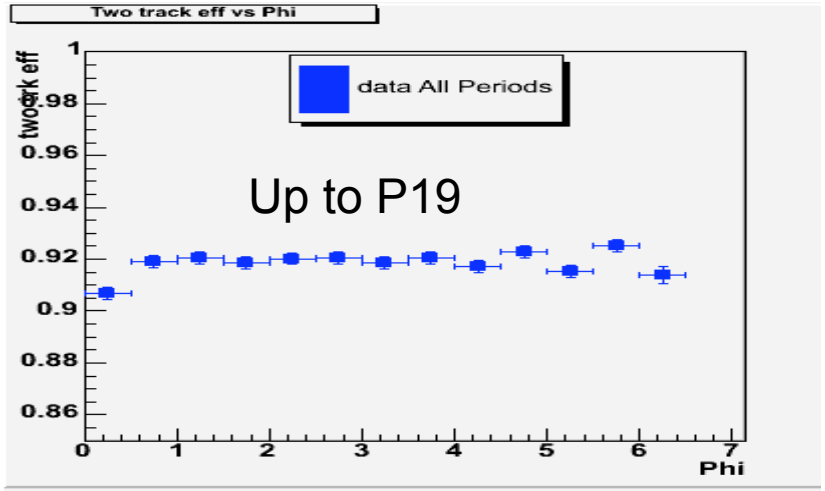
COT Efficiencies vs Periods

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	6203	5662	0.912784	0.00358246
20	6254	5709	0.912856	0.00356649
21	500	458	0.916	0.0124052

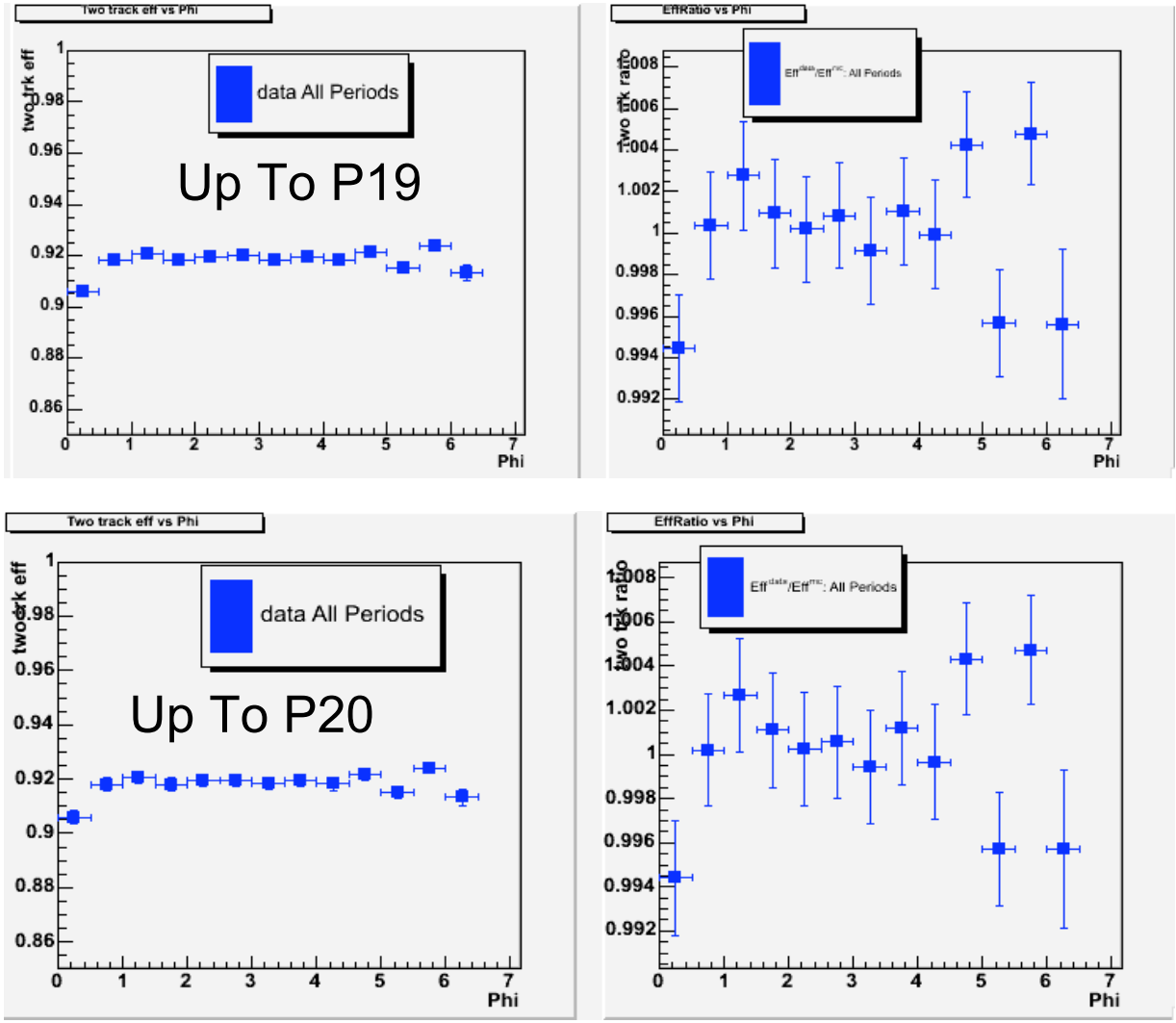
COT Efficiencies: phi distributions







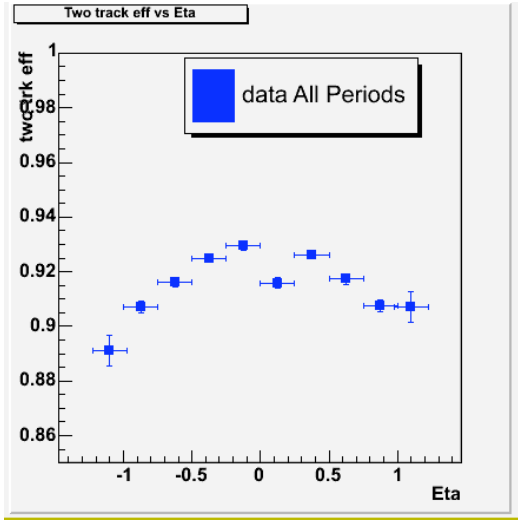
COT Efficiencies:Phi

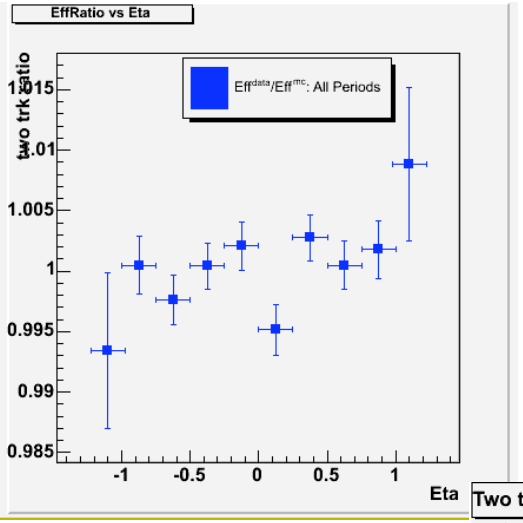


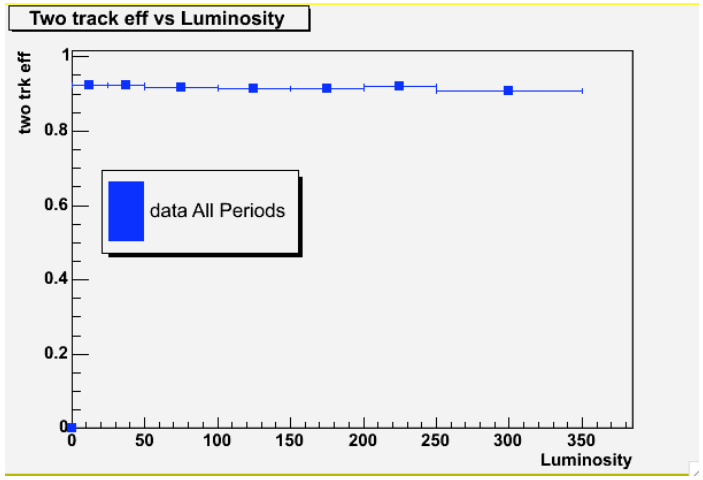
Conclusions

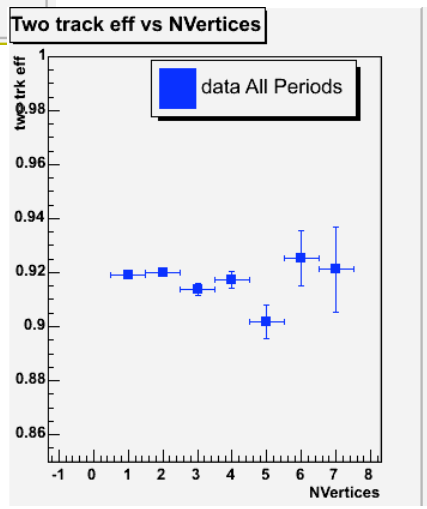
- P22/23 high PT electrons and muons analyzed:
  - Electron ID - P22 and P23 look ok, drop observed in P21 disappeared. P21 re-analyzed with new GRL, no effect.
  - Ele Trigger - in agreement with previous periods
  - Muon ID and Reco : ok
  - Muon Trigger: not good…
  - MET_PEM trigger ok
  - To be continued……
    - COT Eff : preliminary looks ok..

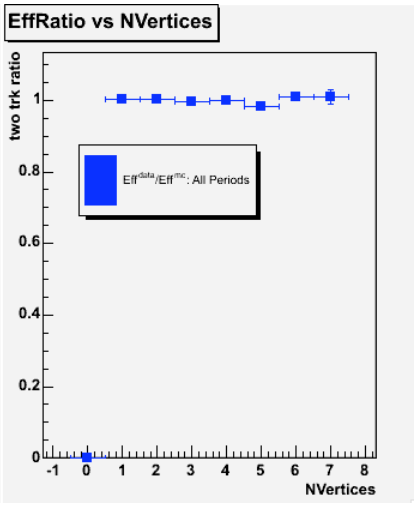
More plots


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