Trigger Efficiencies for High p_T electron

(ELECTRON_CENTRAL_18 : CDFnote 8629)

Bo-Young Han, Véronique Boisvert

University of Rochester

Joint Physics meeting

Dataset, Trigger and Period Definition

1. Dataset Used
   - Period : November 24th 2006 - January 31st 2007
   - RunNumber : 228664 - 233111
   - dataset : bhel, blpc
   - Good run list : v16 (1,0,4,1)
2. Trigger Definitions(PHYSICS_4_01)
   - ELECTRON_CENTRAL_18_v − 9
     - L1_CEM8_PT8
     - L2_CEM16_PT8
     - L3_ELECTRON_CENTRAL_18
3. Period Definition
   - Period 9 : 222529 - 228596
   - Period 10 : 228664 - 233111
     - 10A : 228664 - $<$ 232951
     - 10B : 232951 - 233111 new L3 patch

Summary of central electron trigger efficiency

1. New L3 patch makes an effect on tracking trigger efficiency for period 10.
2. We take into account this effect and background as a systematic.
   - L1 : $\pm 0.03\%$ (background)
   - L3 : $^{+0.28}_{-0.08}\%$ (L3 new patch), $\pm 0.11\%$(background)

Trigger	Period 10
	eff. $\pm$ stat. $\pm$ syst.
L1_XFT_PT8	$96.77 \pm 0.05\ ^{+0.03}_{-0.03}\%$
L2_XFT_PT8	$99.93 \pm 0.01\ ^{+0.00}_{-0.00}\ \%$
L3 tracing	$99.40 \pm 0.04\ ^{+0.30}_{-0.13}\%$
Total tracking	$96.12 \pm 0.06\ ^{+0.30}_{-0.13}\%$
L1_CEM8	100%
L2_CEM16	$1.0/(1 + e^{-1.38(E_T - 17.88)})$
L3_CEM18	100%

Table: Summary of trigger efficiencies for central electrons.

BackUp

$W \rightarrow e\nu$ Event Selection

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.

Definition of Tracking Trigger Efficiencies

Use $W \rightarrow e\nu$ candidate(CEM + $\not{E}_T > 25$ GeV : W_NOTRACK path)

- L1 tracking efficiency

$$\epsilon(\text{L1_XFT_PT8}) = \frac{\text{numW \& passed L1_CEM8_PT8}}{\text{numW}} \tag{1}$$

- L2 tracking efficiency

$$\epsilon(\text{L2_XFT_PT8}) = \frac{\text{numW \& passed L1_CEM8_PT8 \& passed L2_CEM16_PT8}}{\text{numW \& passed L1_CEM8_PT8}} \tag{2}$$

- L3 tracking efficiency

$$\epsilon(\text{L3_PT9}) = \frac{\text{numW \& passed L1_CEM8_PT8 \& L2_CEM16_PT8 \& L3_CEM18_PT9}}{\text{numW \& passed L1_CEM8_PT8 \& L2_CEM16_PT8}} \tag{3}$$

- L1 tracking trigger efficiency dependence on η

$$\epsilon(L1_XFT_PT8) = A - \frac{c}{2\pi\sigma} e^{-\frac{\eta^2}{2\sigma^2}} \tag{4}$$

L3 track trigger efficiency

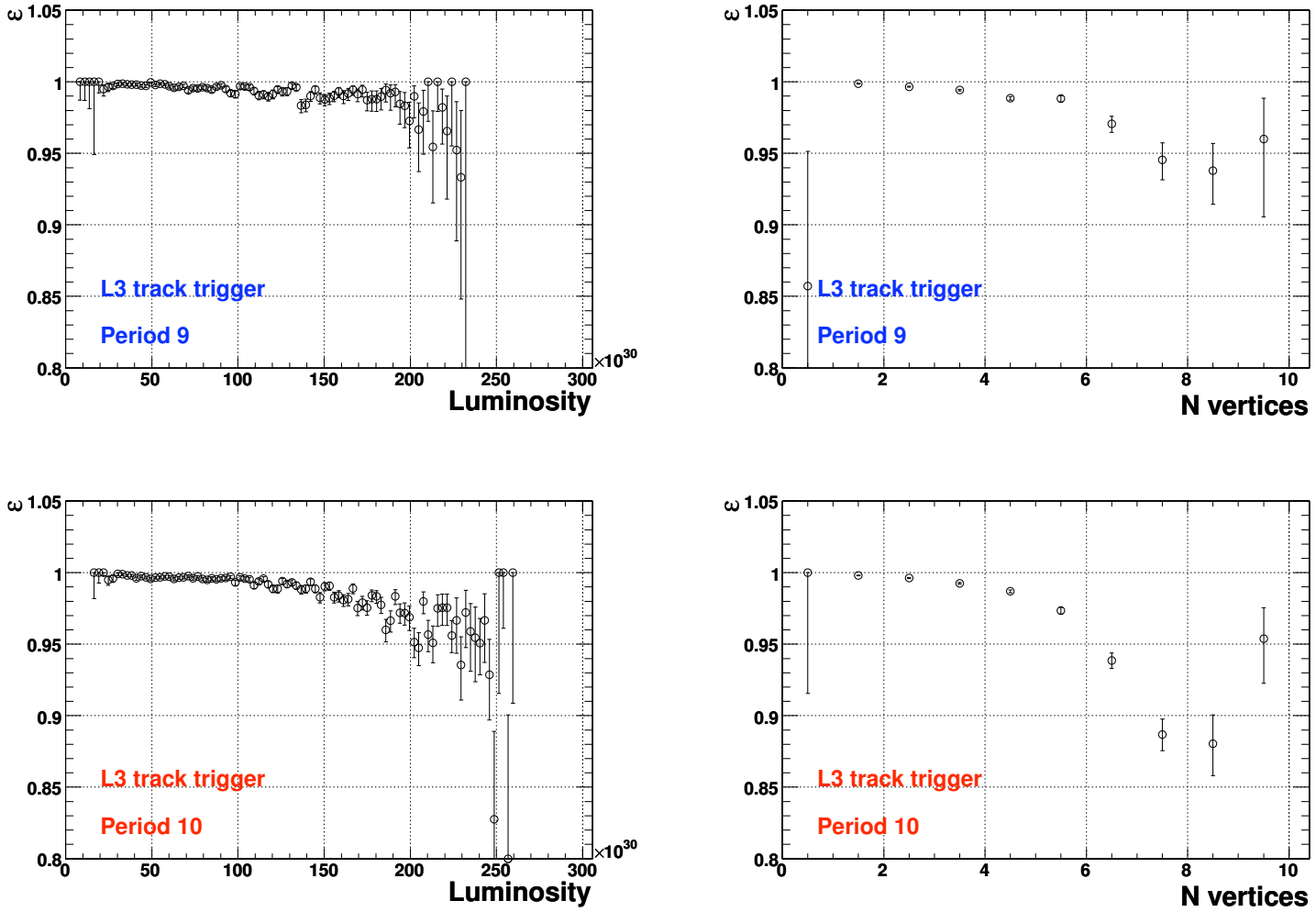


Figure: L3 tracking trigger efficiency as a function of luminosity(left) and number of vertices(right).

looking into L3 track trigger...

we investigate sources which could make the efficiency lower.

1. Offline track cuts → get same result W/O COT hit cuts
2. L3 track selects COT only or OI algorithm → get same result with offline COT only, OI tracks
3. Background → check this effect using tighter cuts → small effect
4. Beam position → small effect
5. L3 new patch(the occupance cut)
   - For offline, the patch was put in starting period 10. (From Elena)
   - For trigger table, started running with the patch around run 232951 (25th January). (From Dave).

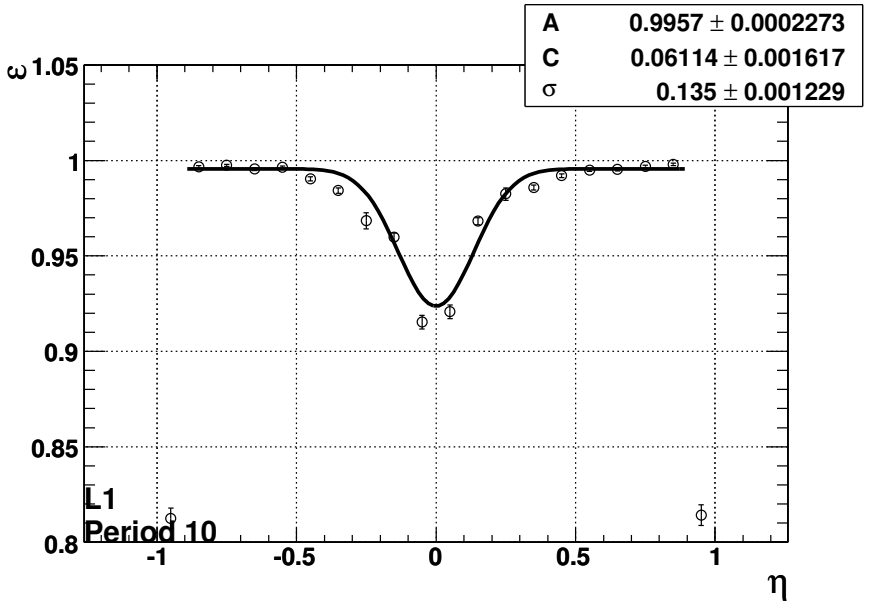
Trigger	Period 9	Period 10($<$232951)	($\geq$232951)
L3 tracking	0.9954(2)	0.9932(3)	0.9968(9)

Measurement of tracking trigger efficiency

1. The averaged tracking efficiency in period 10 & the efficiencies in subperiod 10A and 10B.

Trig.	Period 9	Avg. Period 10	Period 10A	Period 10B
	eff. $\pm$ stat.	eff. $\pm$ stat. $\pm$ syst.	eff. $\pm$ stat.	eff. $\pm$ stat.
L1	96.51 $\pm$ 0.06 %	96.72 $\pm$ 0.07 $^{+0.01}_{-0.22}$ %	96.73 $\pm$ 0.07%	96.50 $\pm$ 0.29%
L2	99.92 $\pm$ 0.01 %	99.93 $\pm$ 0.01 $^{+0.00}_{-0.01}$ %	99.93 $\pm$ 0.01%	99.92 $\pm$ 0.05%
L3	99.54 $\pm$ 0.02 %	99.40 $\pm$ 0.04 $^{+0.28}_{-0.08}$ %	99.32 $\pm$ 0.03%	99.68 $\pm$ 0.09%
Total	95.98 $\pm$ 0.07 %	96.07 $\pm$ 0.08 $^{+0.28}_{-0.23}$ %	96.00 $\pm$ 0.08%	96.11 $\pm$ 0.31%

2. L1 tracking trigger efficiency as a function of η



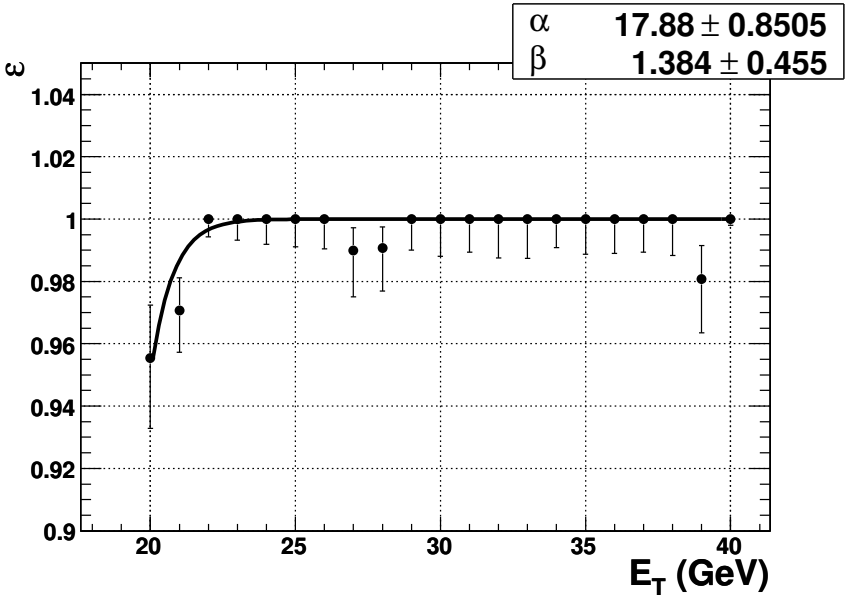
L2 Calorimeter Trigger Efficiency

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

$$\epsilon(\text{L2_CEM16}) = \frac{\text{numEl \& passed L1_CEM8_PT8 \& L2_PS \& L2_CEM16}}{\text{numEl \& passed L1_CEM8_PT8 \& L2_PS}} \tag{5}$$

The turn-on curve :

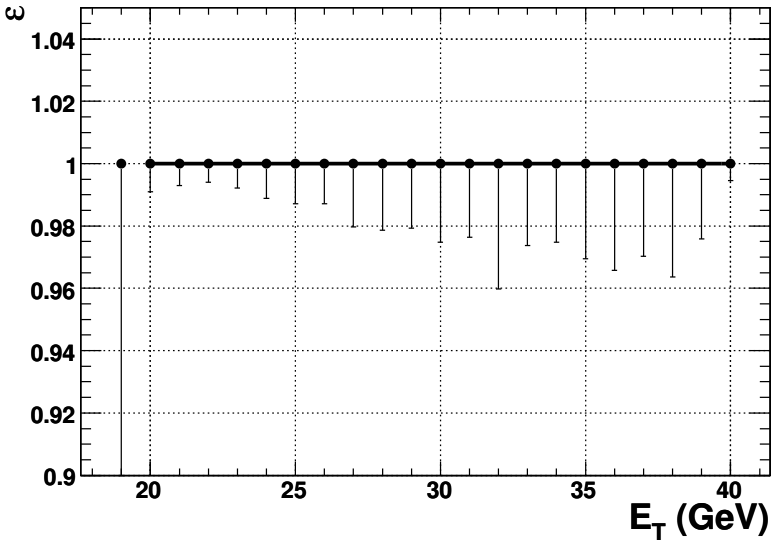
$$\epsilon = \frac{1}{1 + e^{-\beta(E_T - \alpha)}}. \tag{6}$$



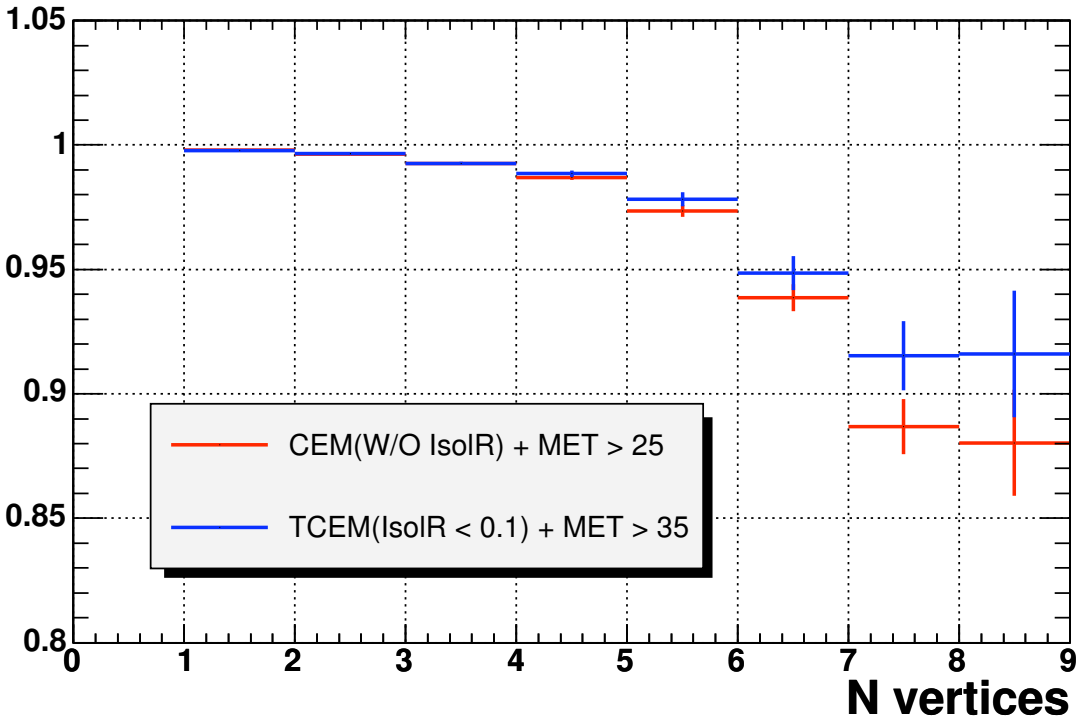
L3 Calorimeter Trigger Efficiency

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

$$\epsilon(\text{L3_CEM18}) = \frac{\text{numEl \& passed EL_CENT_8_NO_L2 \& L2_CEM16 \& L3_CEM18}}{\text{numEl \& passed EL_CENT_8_NO_L2 \& L2_CEM16}} \quad (7)$$

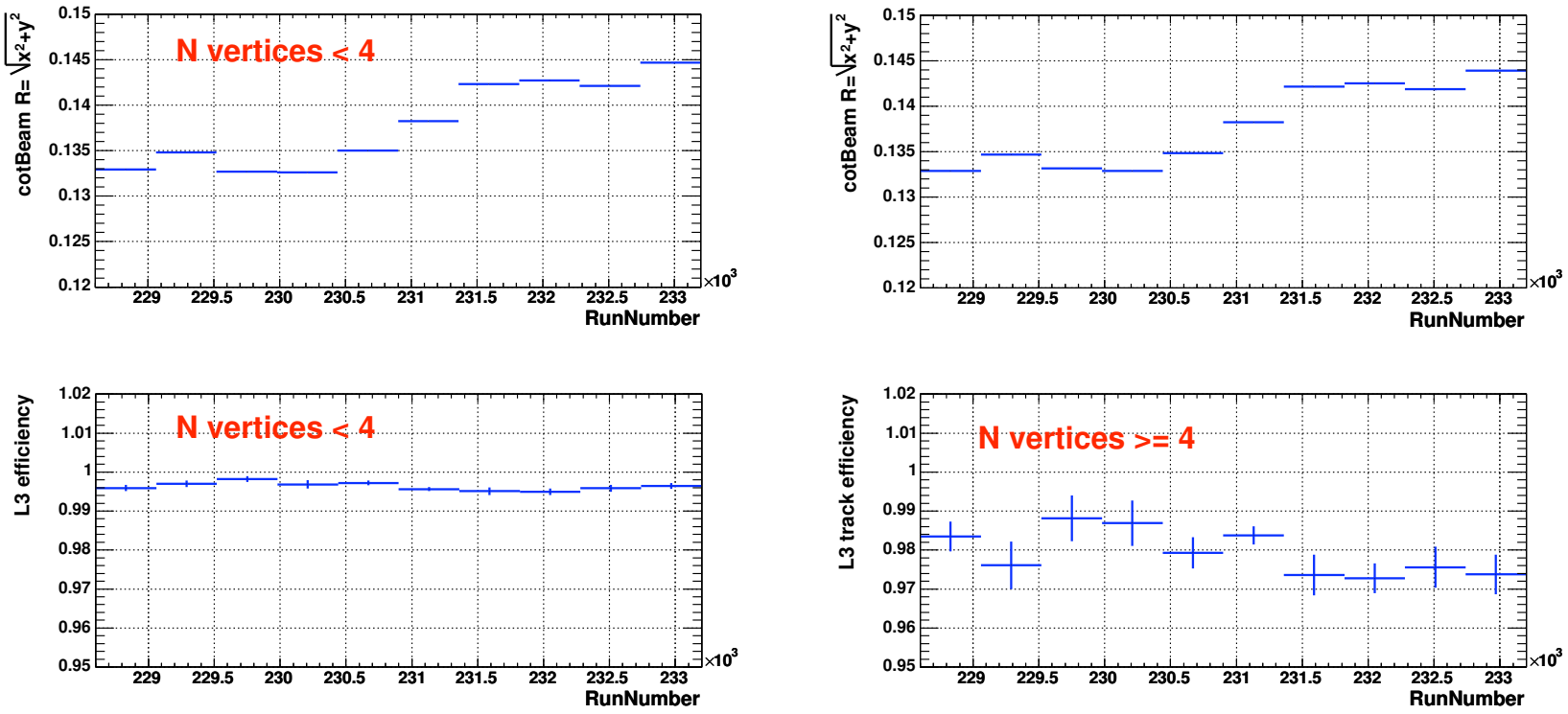


Background Effect



looking into L3 track trigger...

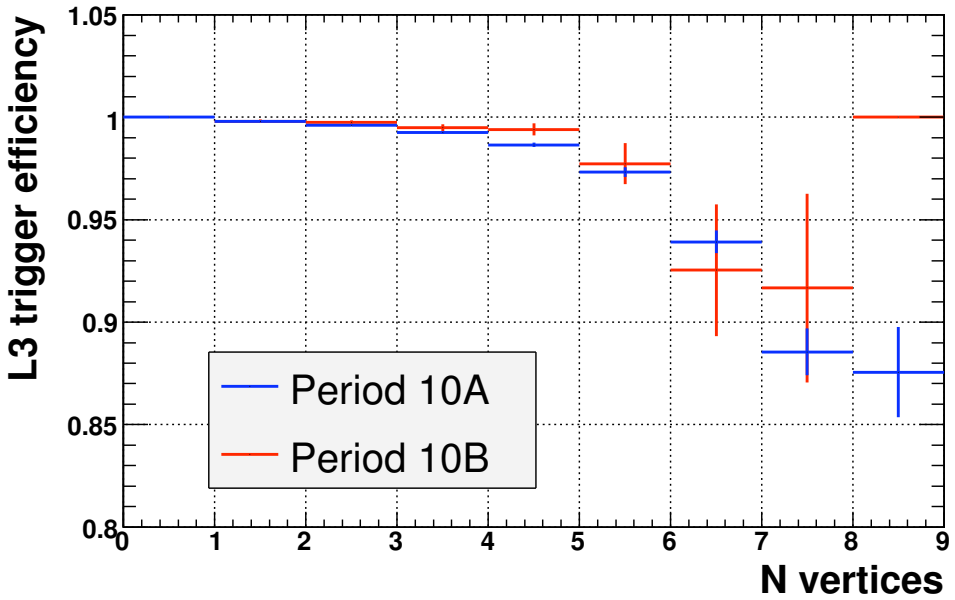
- L3 uses beam position(0,0) → check COT beam position and run dependence.



looking into L3 track trigger...

- L3 new patch(the occupance cut)
  - For offline, the patch was put in starting period 10. (From Elena)
  - For trigger table, started running with the patch around run 232951 (25th January). (From Dave).

Trigger	Period 9	Period 10($<$232951)	($\geqq$232951)
L3 tracking	0.9954(2)	0.9932(3)	0.9968(9)



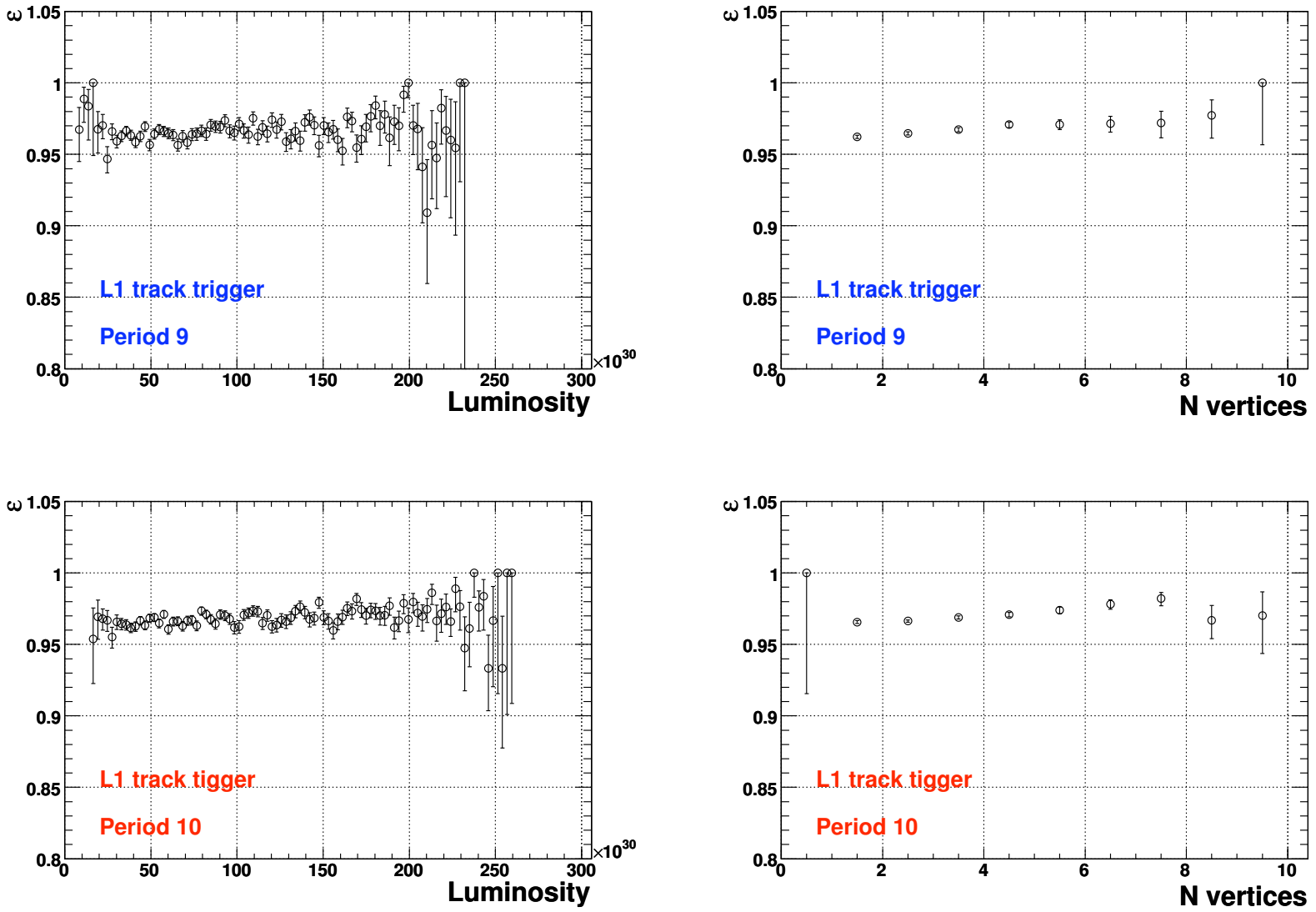


Figure: L1 tracking trigger efficiency as a function luminosity(left) and number of vertices(right).

L3 track trigger efficiecny as N vertices

N vertices	Period 10	($<$232951)	($\geqq$232951)
1	0.9980(2)	0.9980(2)	0.9980(8)
2	0.9963(3)	0.9962(3)	0.9976(9)
3	0.9926(5)	0.9925(6)	0.9948(18)
4	0.9870(10)	0.9865(11)	0.9940(30)
5	0.9735(23)	0.9733(24)	0.9774(100)
6	0.9387(55)	0.9391(55)	0.9254(321)
7	0.8869(110)	0.8855(114)	0.9167(460)
8	0.8803(212)	0.8756(220)	

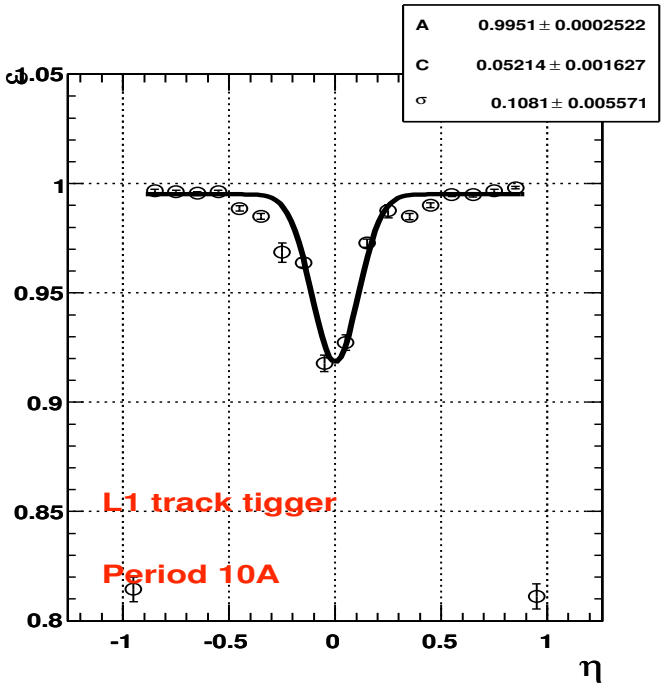
Table: L3 track trigger efficiency as function of N vertices.

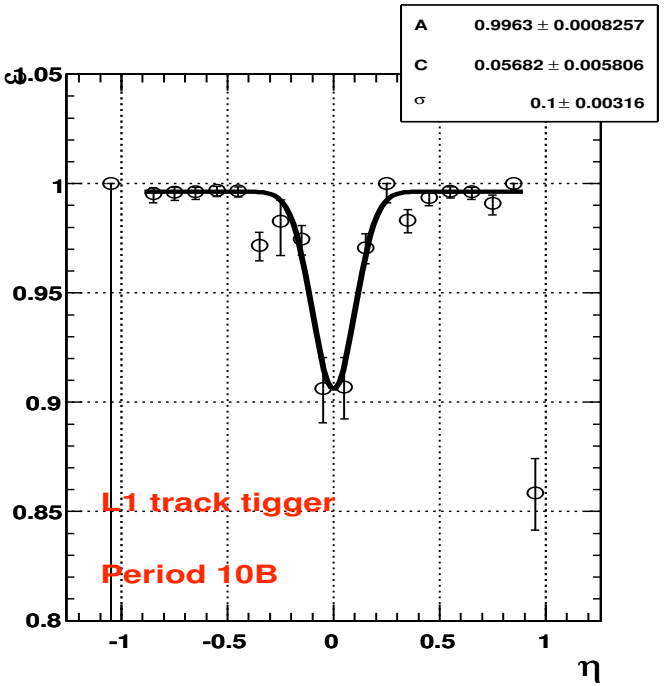
Tracking trigger efficiencies for subperiod

1. The tracking efficiencies in period 10A and 10B.

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)

2. L1 tracking trigger efficiency as a function of η





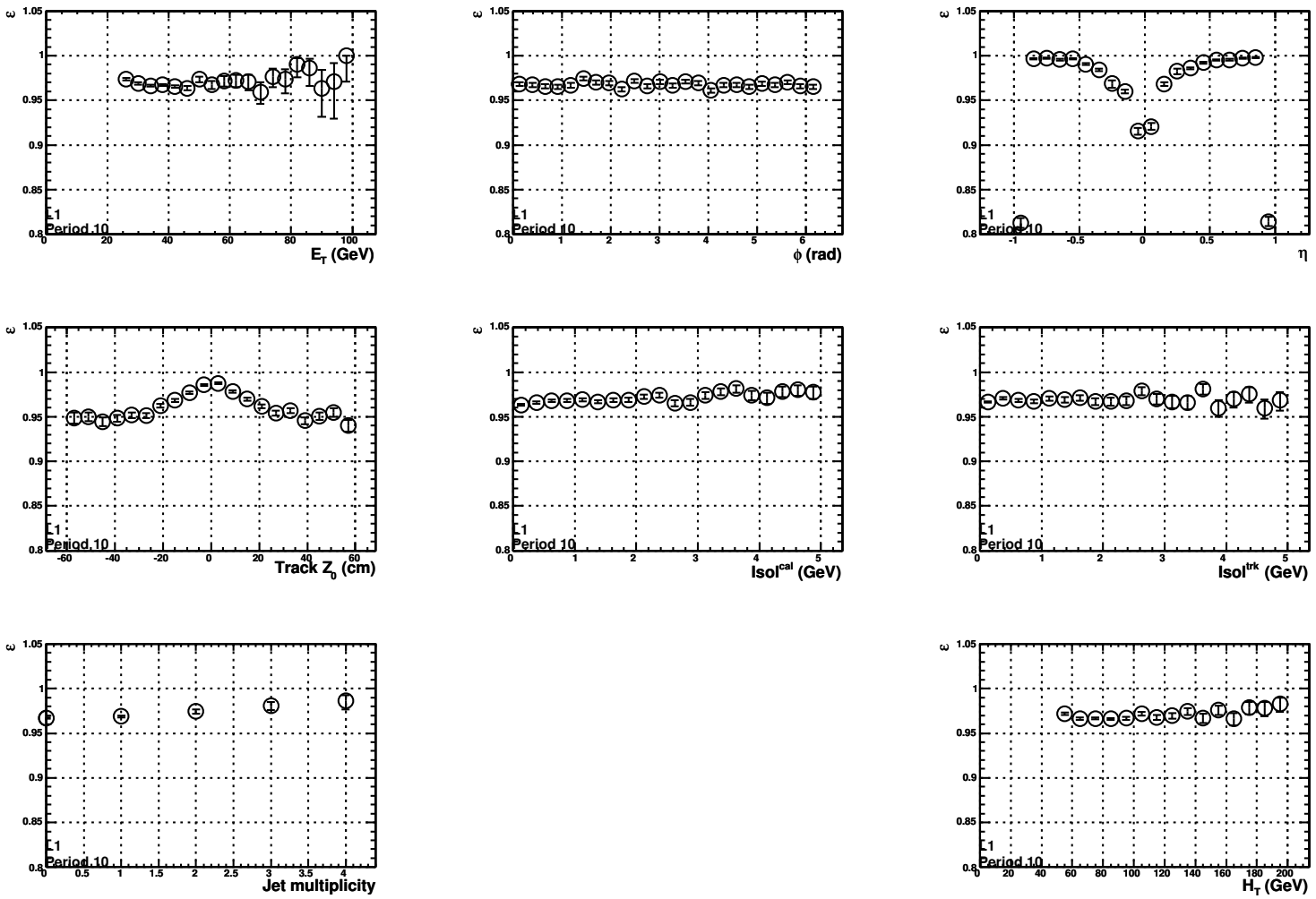


Figure: Period 10 : L1 tracking trigger efficiency dependences on various variables.

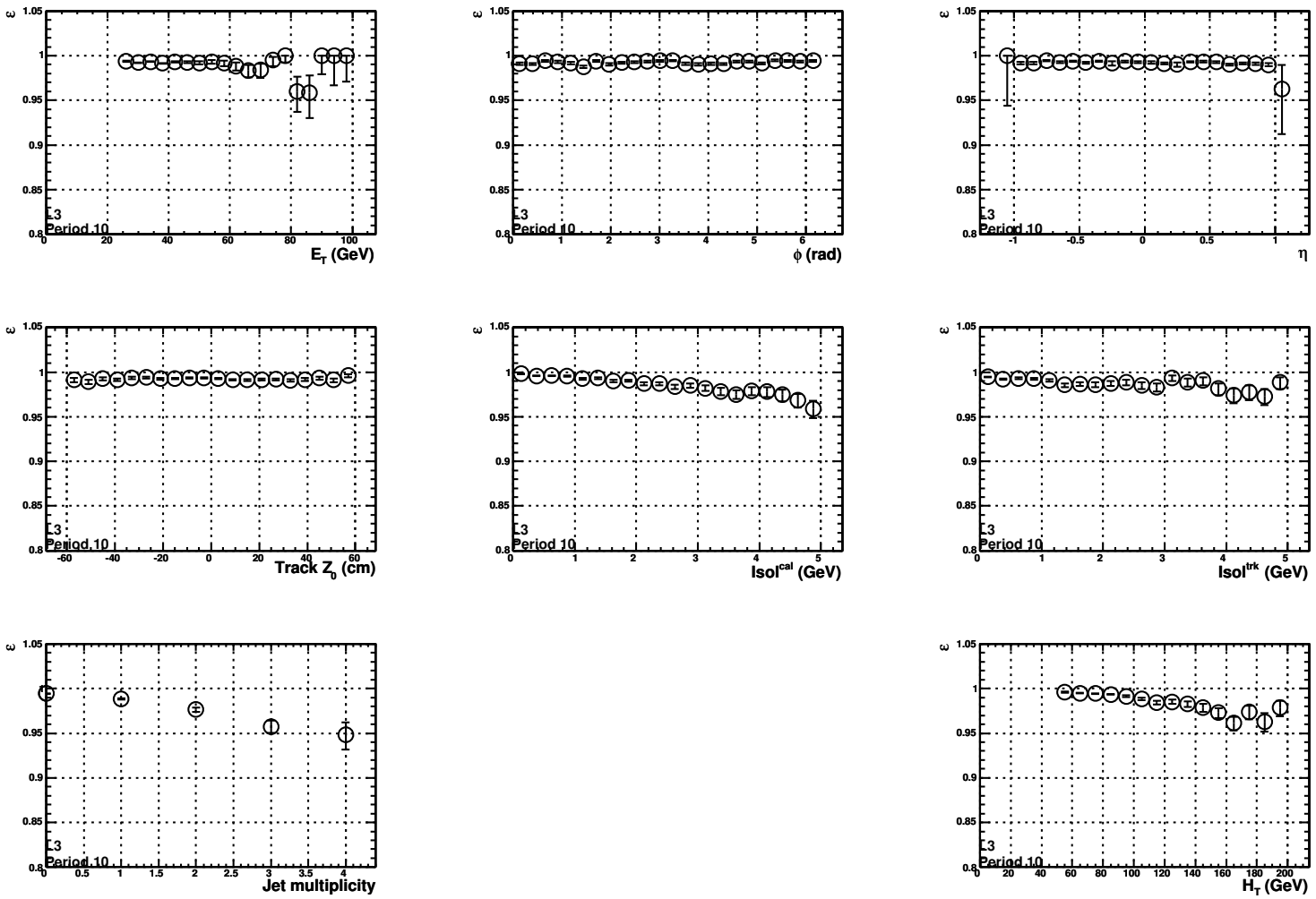
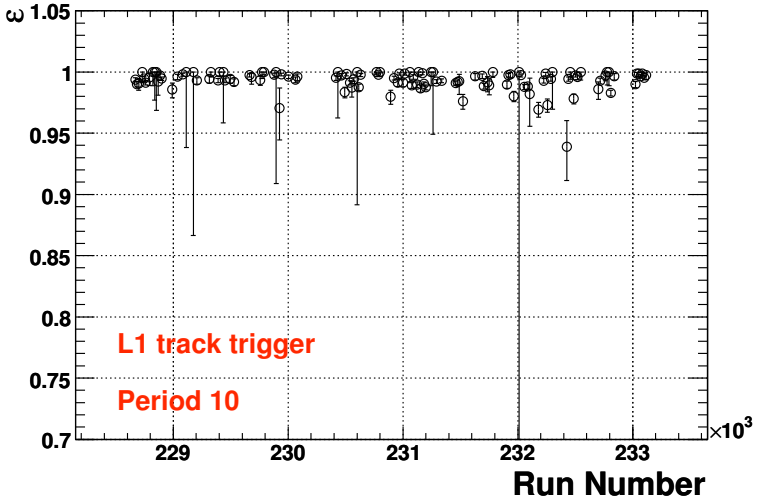


Figure: Period 10 : L3 tracking trigger efficiency dependences on various variables



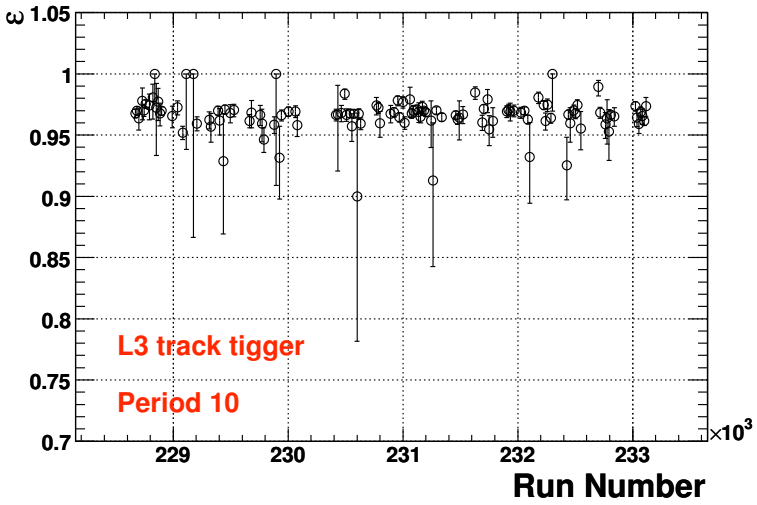
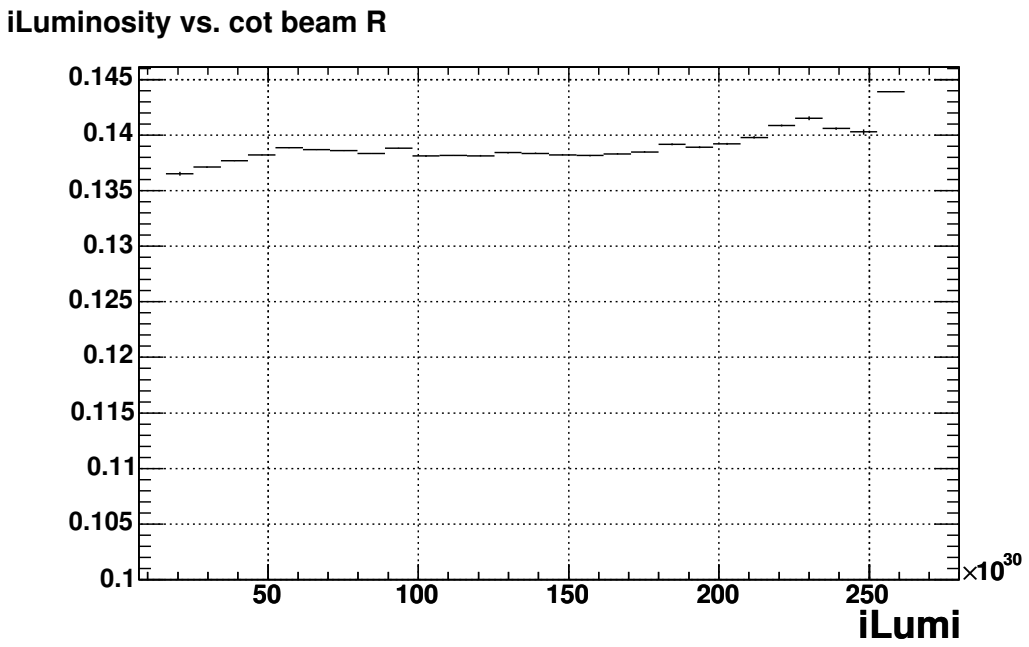
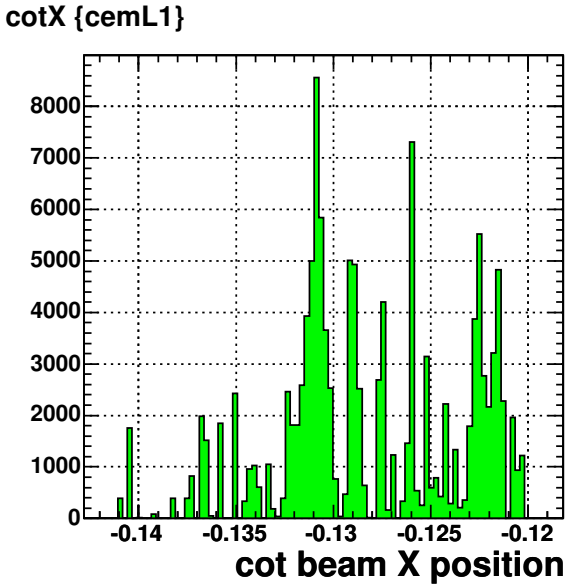
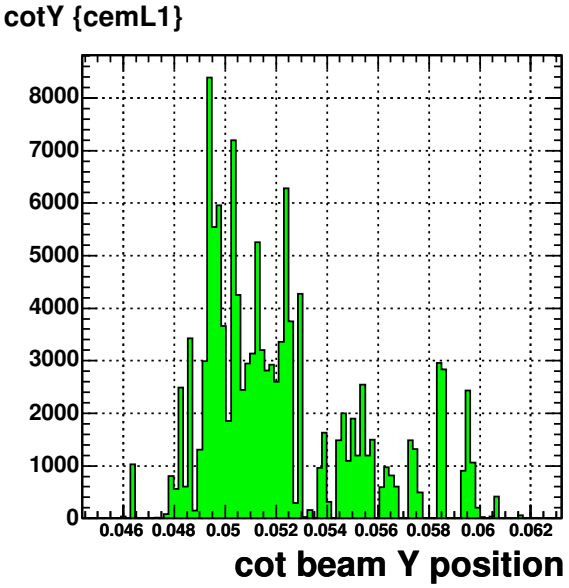
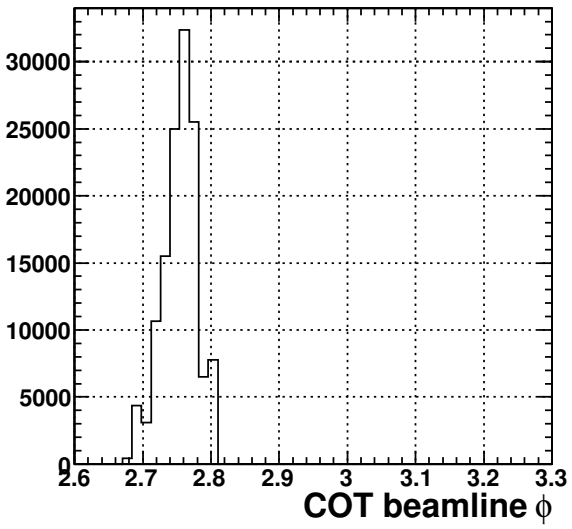


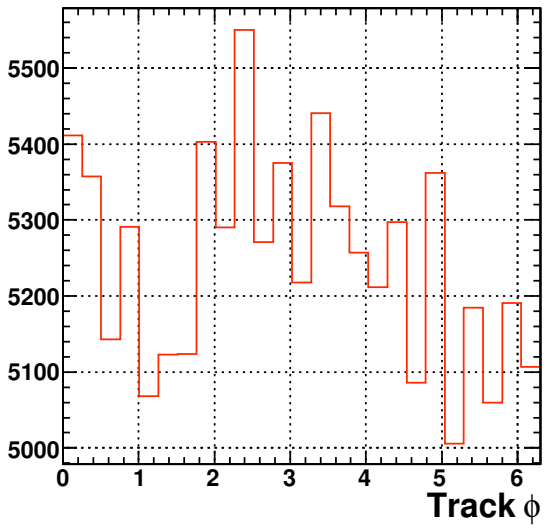
Figure: Period 10 : L1(left) and L3(right) tracking trigger efficiency as a function of run number.

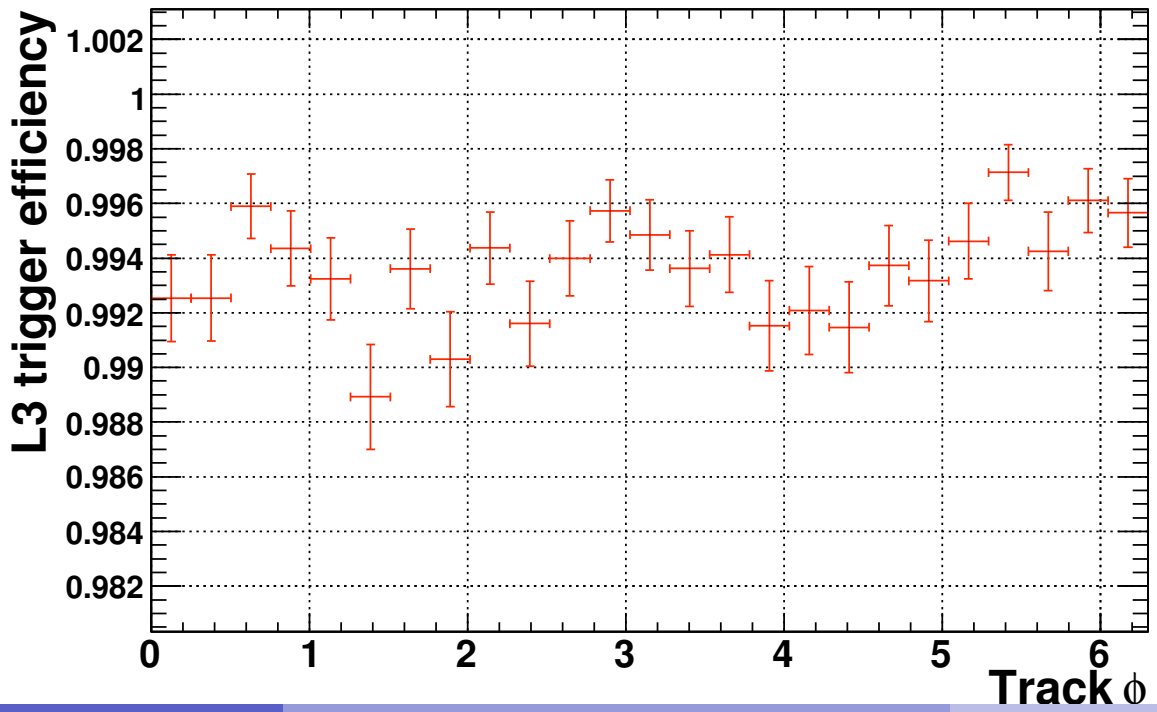

iLuminosity vs. cot beam R
0.145
0.14
0.135
0.13
0.125
0.12
0.115
0.11
0.105
0.1
50
100
150
200
250
×10^30
iLumi


cotX {cemL1}
8000
7000
6000
5000
4000
3000
2000
1000
0
-0.14
-0.135
-0.13
-0.125
-0.12
cot beam X position


cotY {cemL1}
8000
7000
6000
5000
4000
3000
2000
1000
0
0.046
0.048
0.05
0.052
0.054
0.056
0.058
0.06
0.062
cot beam Y position


30000
25000
20000
15000
10000
5000
0
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
COT beamline ϕ


5500
5400
5300
5200
5100
5000
0
1
2
3
4
5
6
Track ϕ


L3 trigger efficiency
1.002
1
0.998
0.996
0.994
0.992
0.99
0.988
0.986
0.984
0.982
0
1
2
3
4
5
6
Track ϕ