Updates: EMTF and CSCTF pT Resolution & Track Build

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pT Resolution Study

- Run #274440 - 274443
- Plot the relative residual

$$(\text{Relative residual} = \frac{EMTF\ pT - RECO\ pT}{RECO\ pT} = \frac{EMTF\ pT}{RECO\ pT} - 1)$$

- Only look at tracks with trkBx (or leg_trkBx) = 0
- Apply $\Delta R < 0.25$ cut for EMTF and CSCTF as before (see backup)

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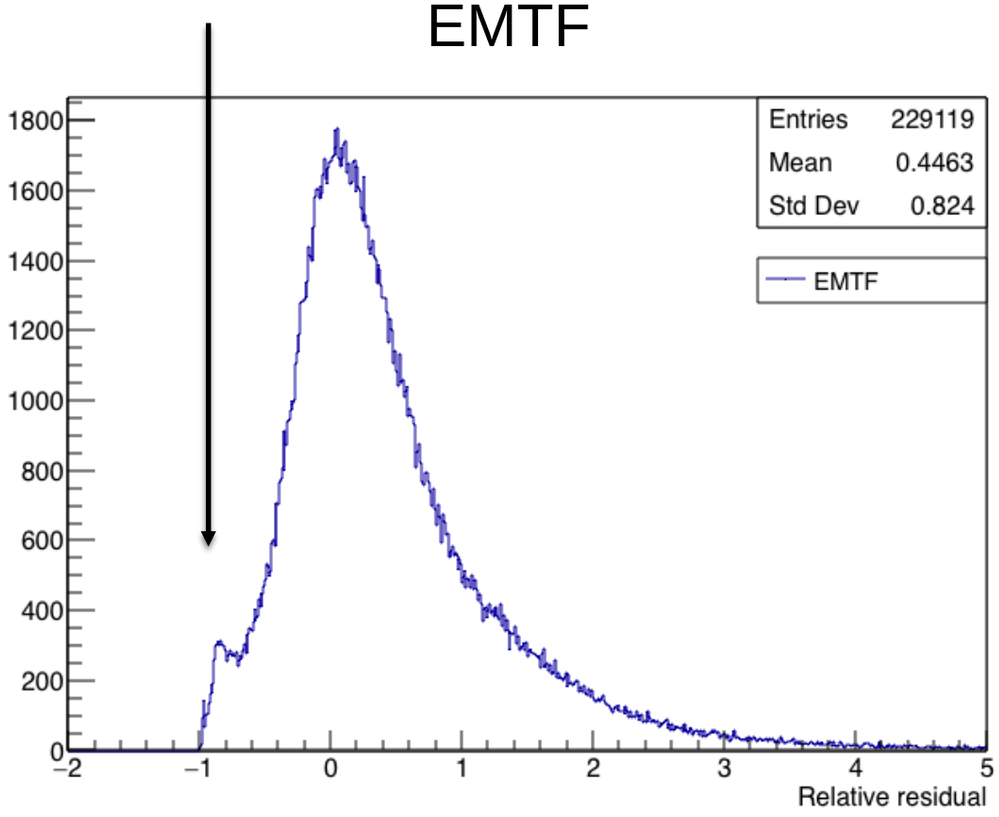
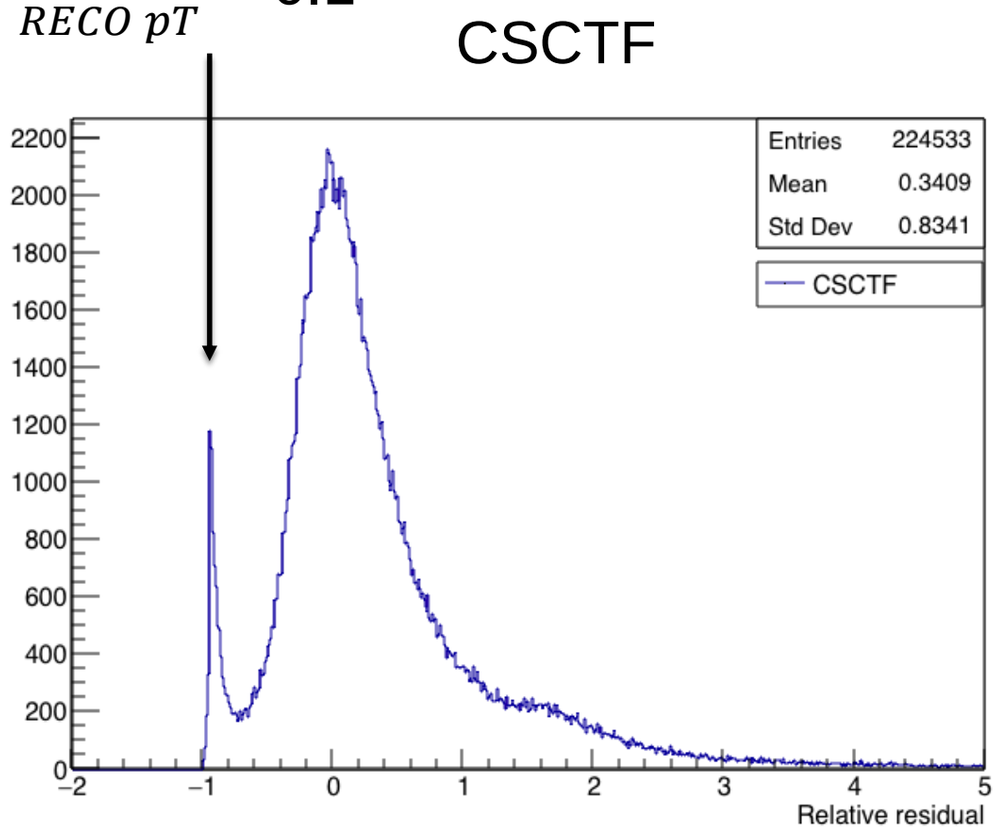
$$\text{Relative residual} = \frac{EMTF\ pT}{RECO\ pT} - 1$$

$\frac{EMTF\ pT}{RECO\ pT} \sim 0.1$



$\frac{EMTF\ pT}{RECO\ pT} \sim 0.1$



- Unexpected peak at relative residual ~ -0.9 (especially CSCTF)

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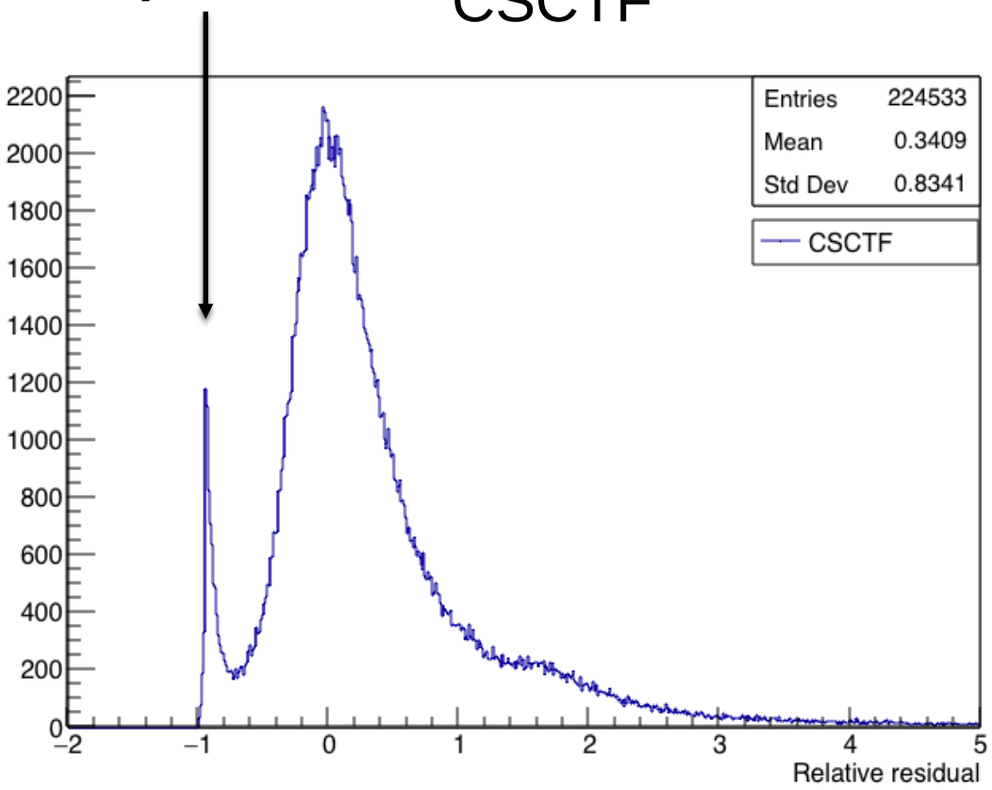
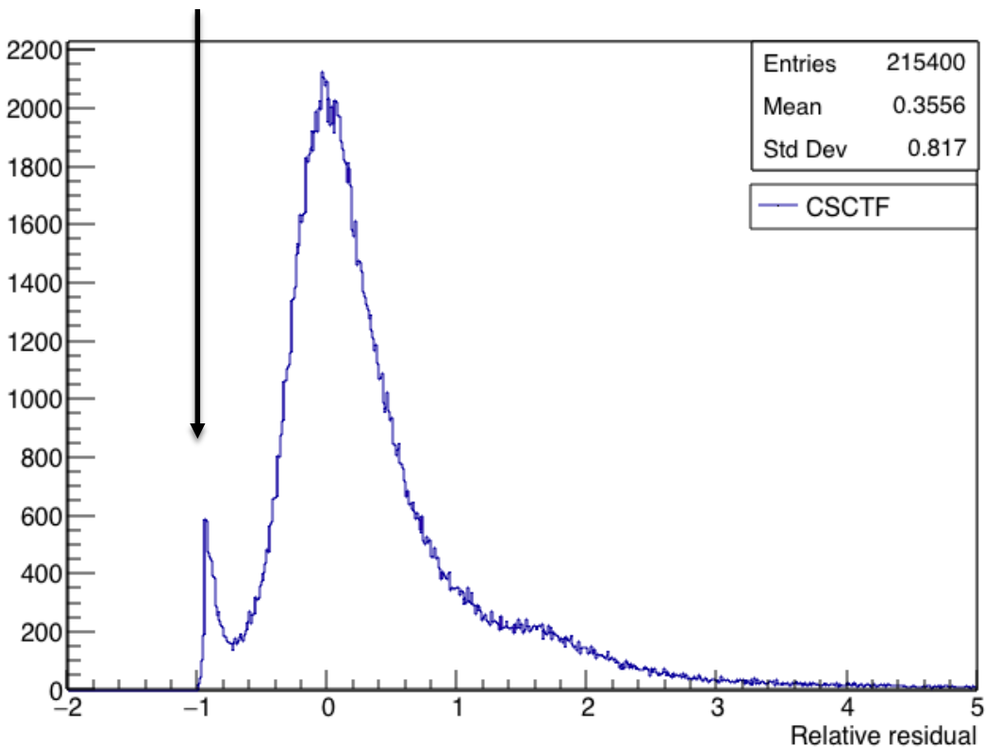
Require both EMTF/CSCTF match to same RECO(right plot)

$\frac{EMTF\ pT}{RECO\ pT} \sim 0.1$



$\frac{EMTF\ pT}{RECO\ pT} \sim 0.1$



- The unexpected peak at relative residual ~ -0.9 is significantly reduced for CSCTF, not for EMTF

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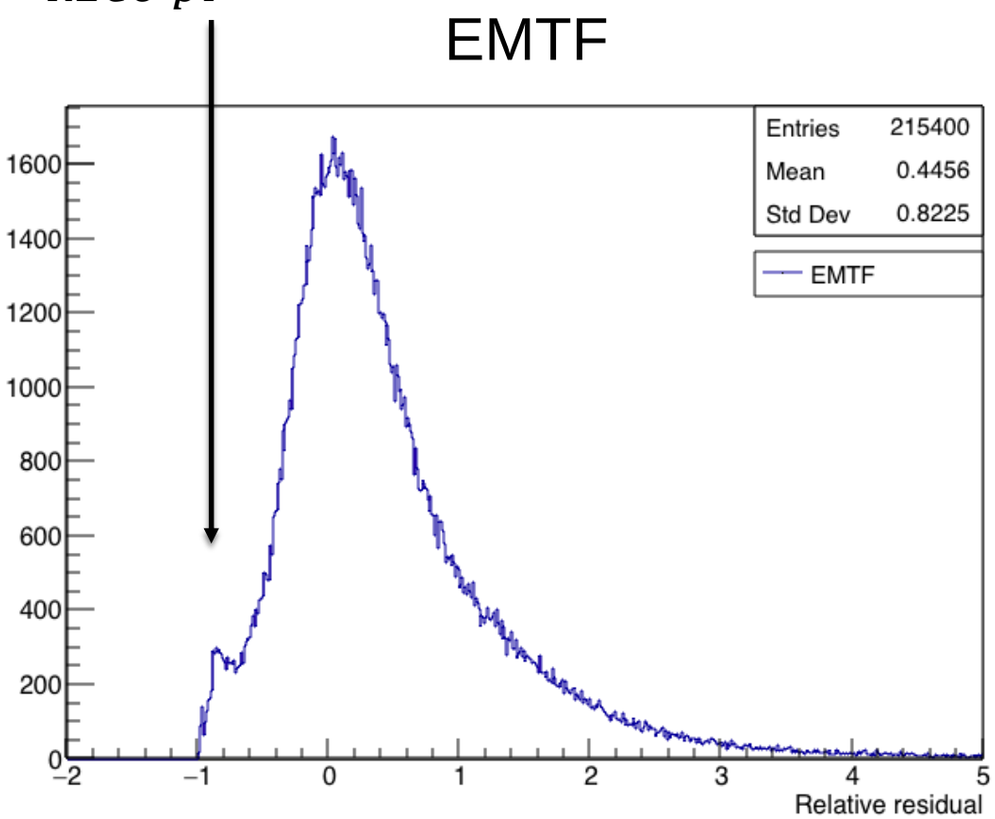
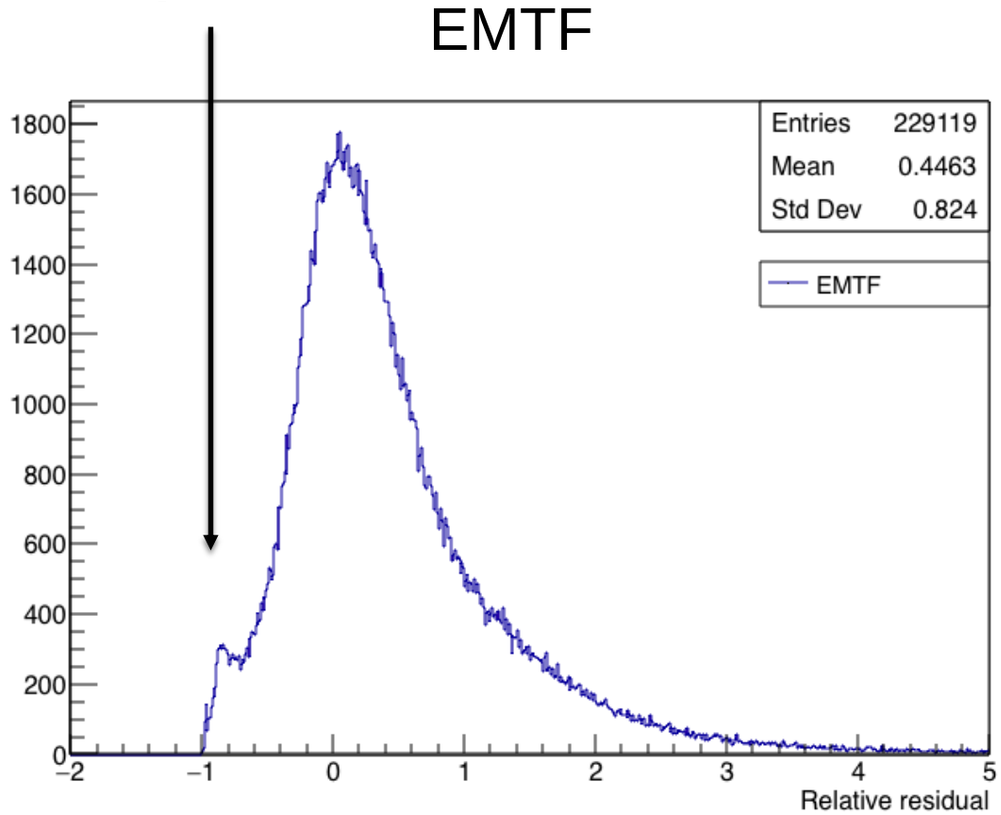
Require both EMTF/CSCTF match to same RECO(right plot)

$\frac{EMTF\ pT}{RECO\ pT}$ ~ 0.1



$\frac{EMTF\ pT}{RECO\ pT}$ ~ 0.1



- The unexpected peak at relative residual ~ -0.9 is significantly reduced for CSCTF, not for EMTF

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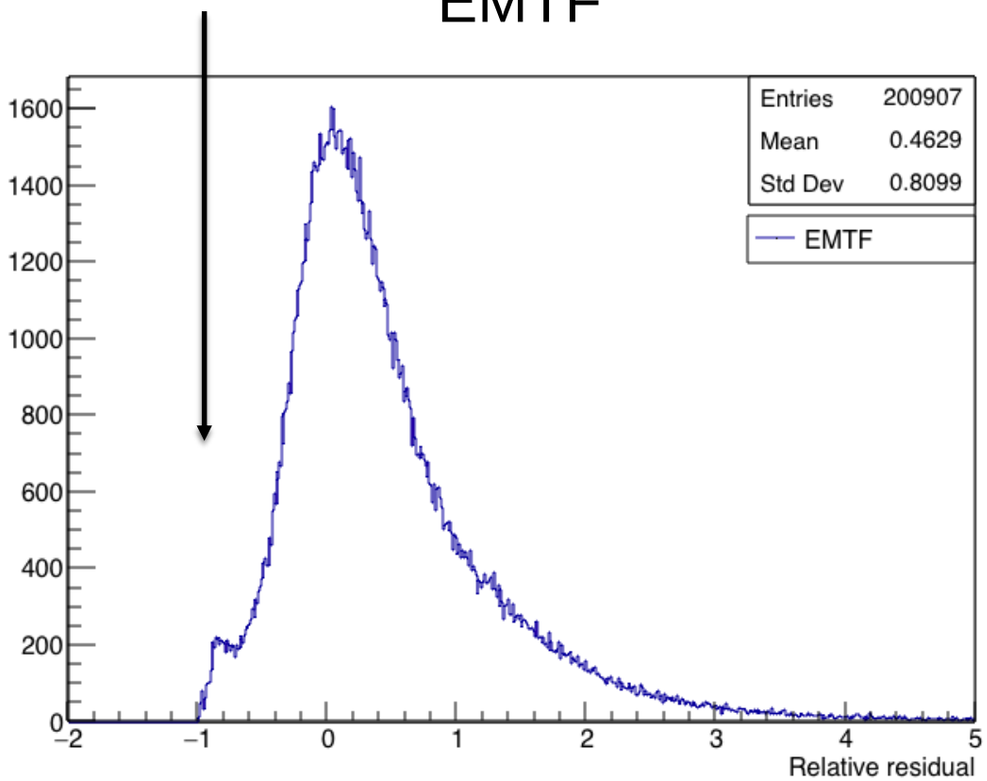
Further requirement: only look at agree modes
(‘agree’ means EMTF shows same mode as CSCTF)

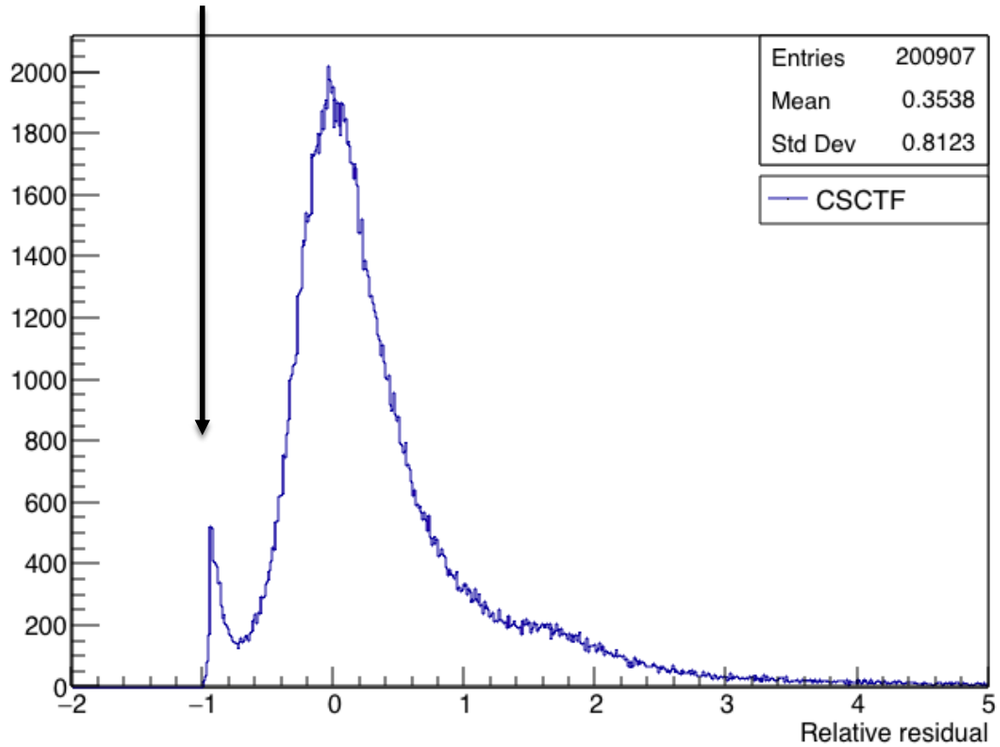
$\frac{EMTF\ pT}{RECO\ pT}$ ~ 0.1

EMTF



$\frac{EMTF\ pT}{RECO\ pT}$ ~ 0.1

CSCTF



- The unexpected peak at relative residual ~ -0.9 is slightly reduced both for EMTF and CSCTF

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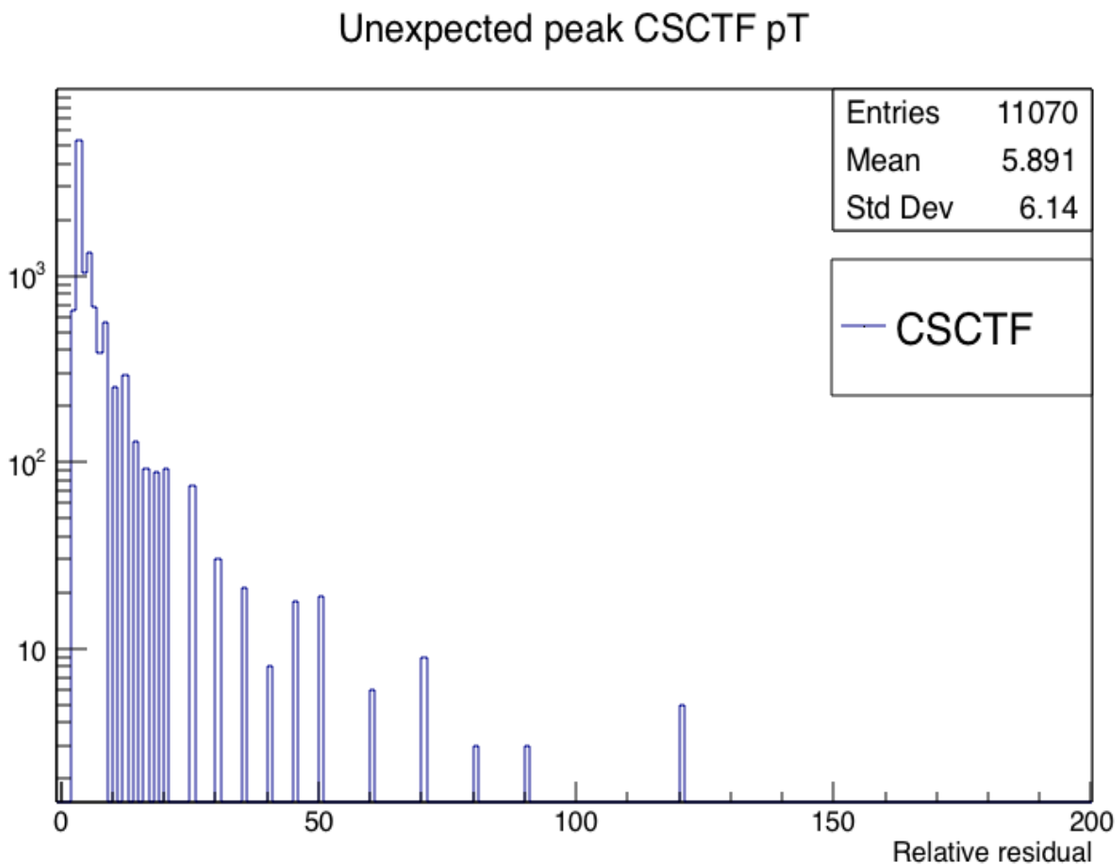
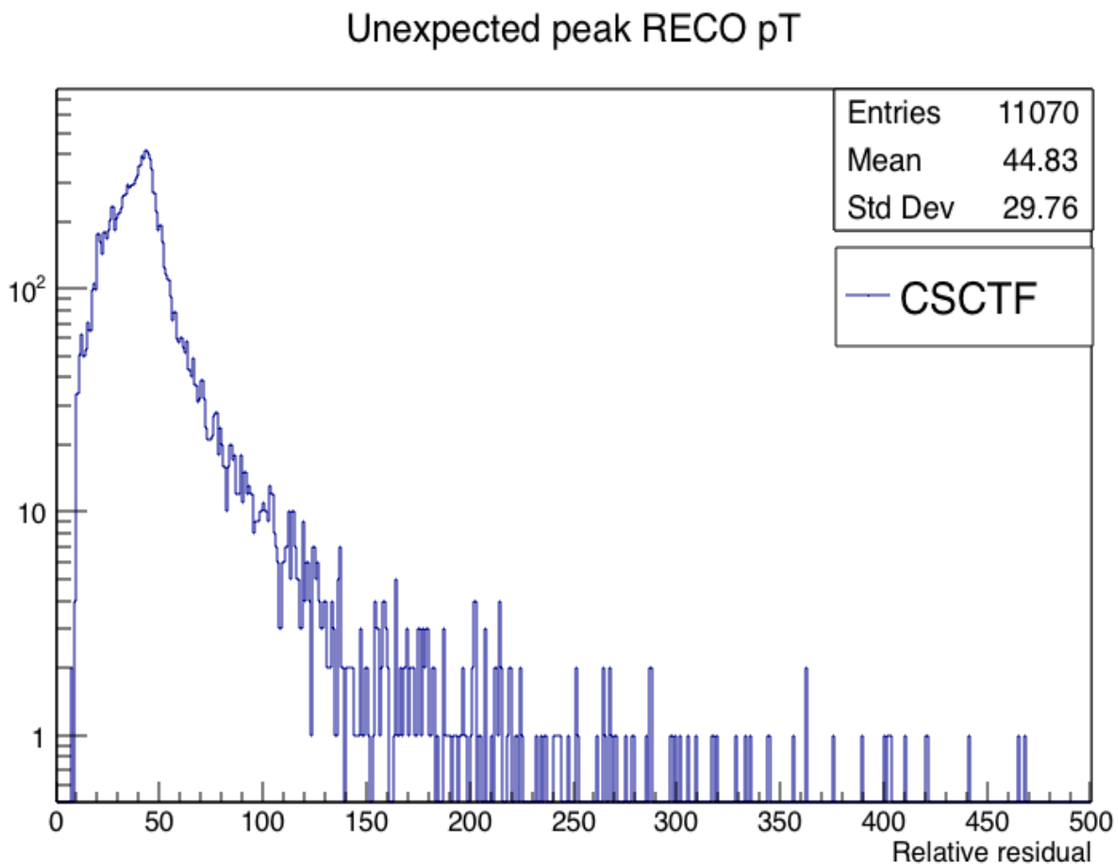
Look into unexpected peak with $\frac{CSCTF\ pT}{RECO\ pT}$ range 0 ~ 0.3





- Mainly come from low pT estimate of CSCTF, while RECO muon with pT range 20 ~100 GeV

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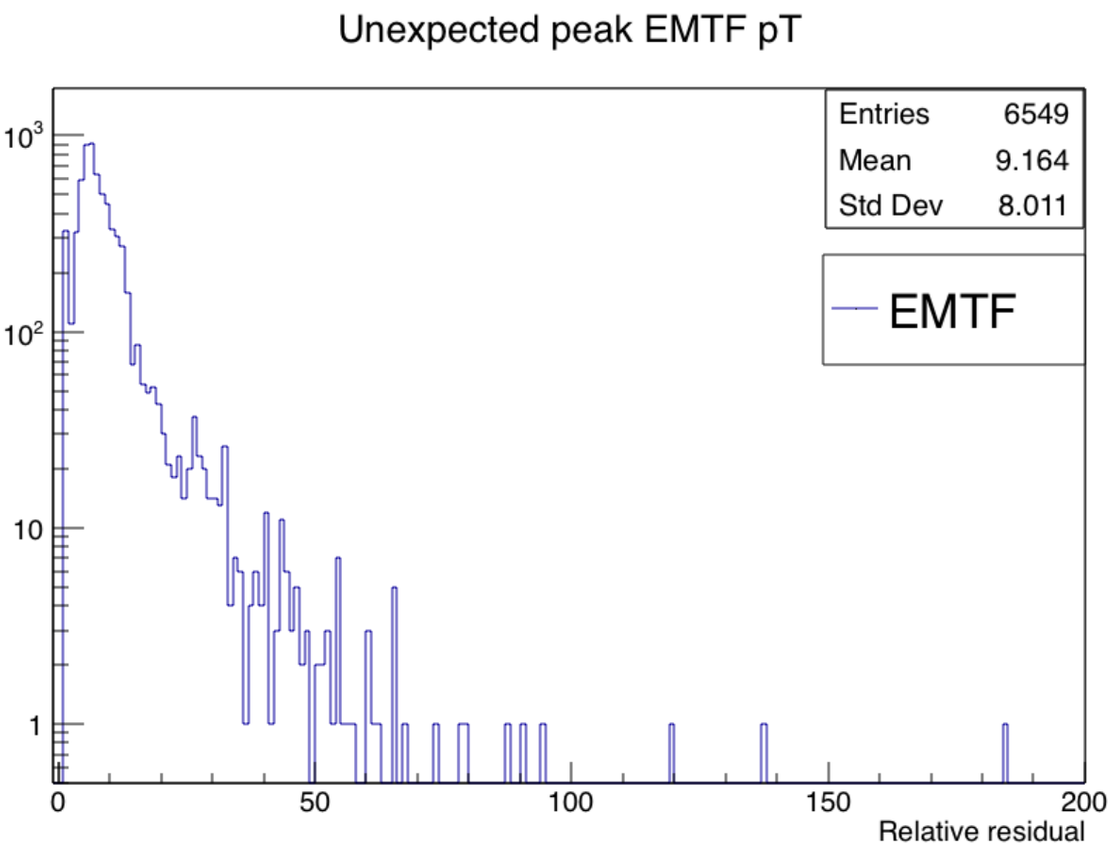
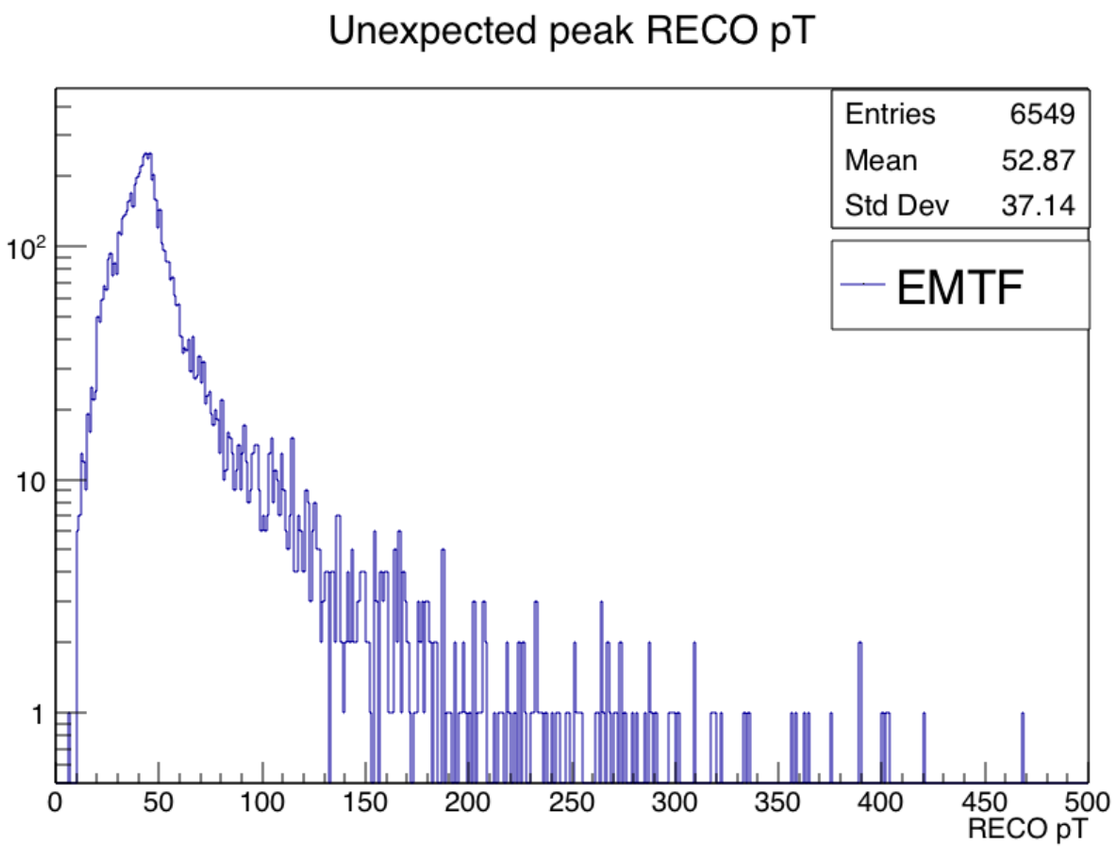
Unexpected peak in EMTF with $\frac{EMTF\ pT}{RECO\ pT}$ range 0 ~ 0.3





- Mainly come from low pT estimate of EMTF, while RECO muon with pT range 20 ~ 100 GeV

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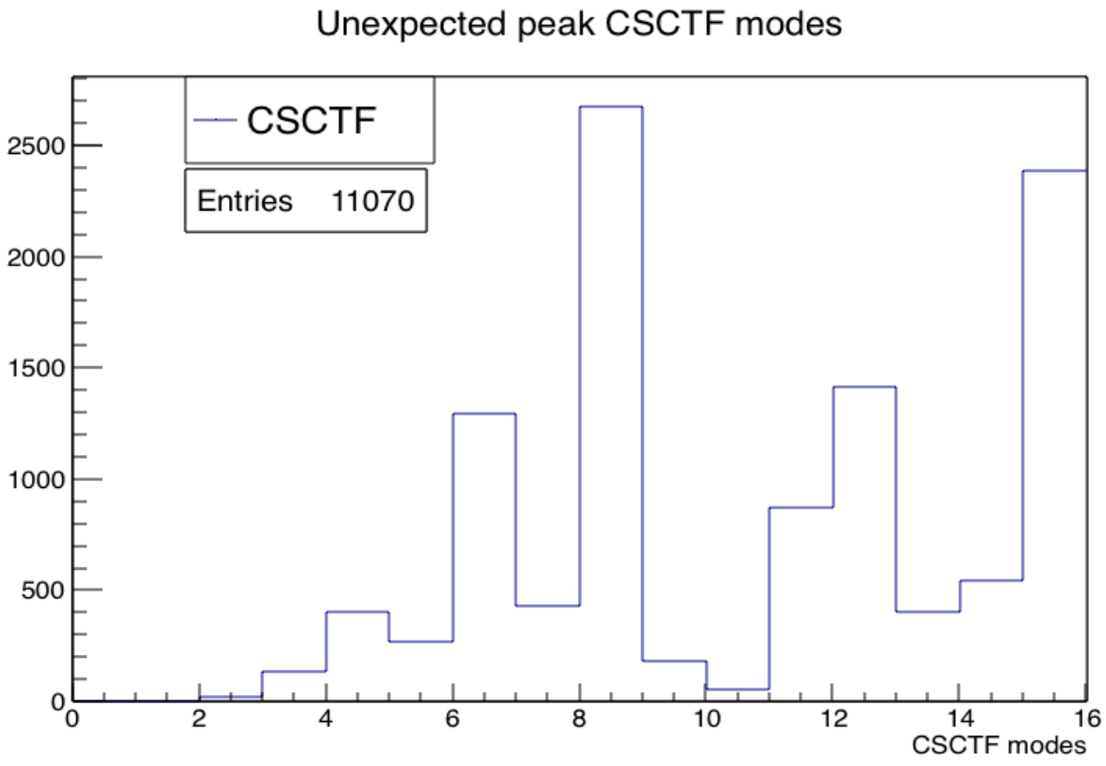
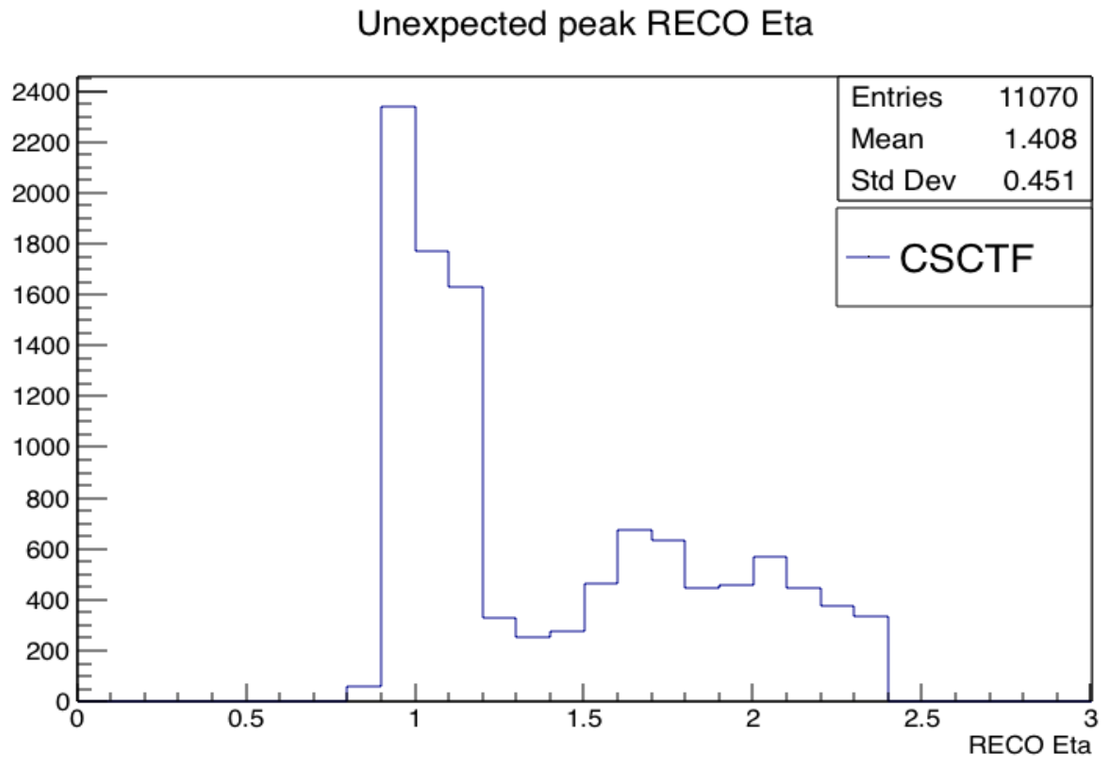
Unexpected peak in CSCTF: modes and eta





- A lot come from mode #8(station 1), #15 (4-station mode)
- Most tracks are from CSC overlap region(0.9-1.2)

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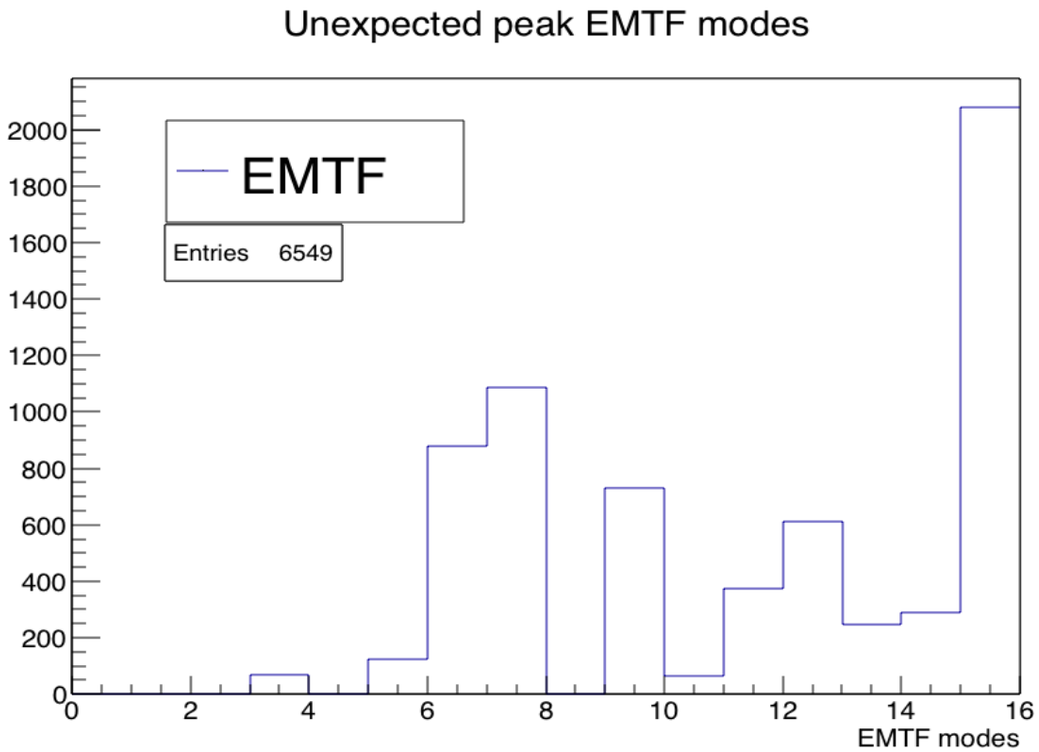
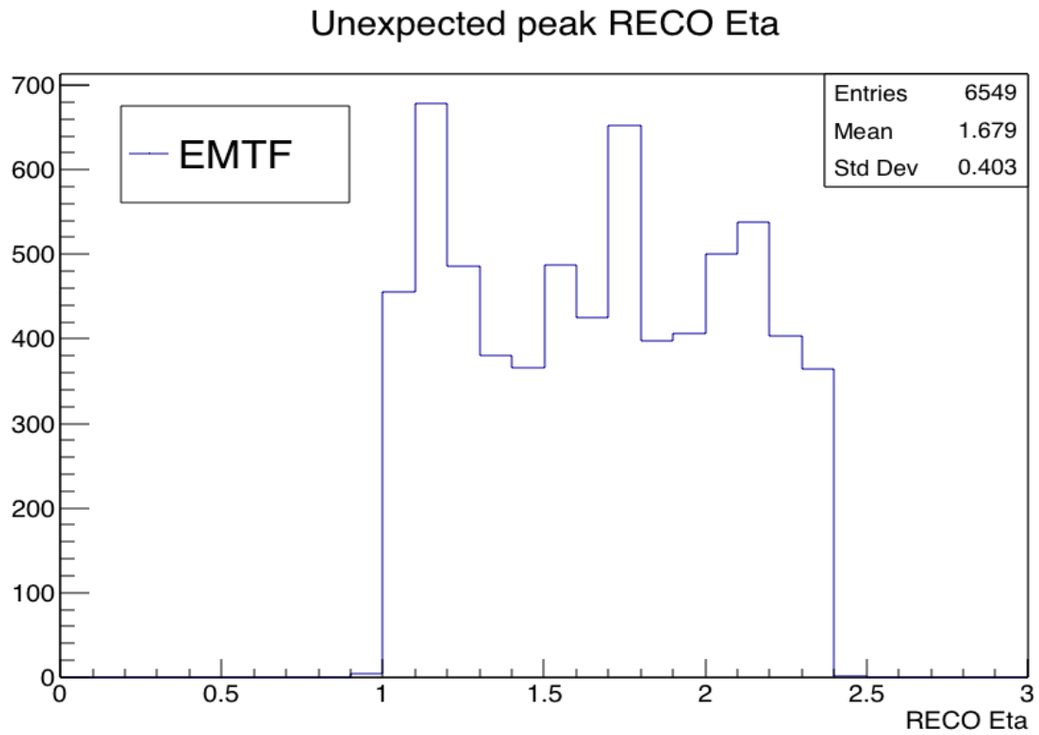
Unexpected peak in EMTF with $\frac{EMTF\ pT}{RECO\ pT}$ range 0 ~ 0.3





- Mainly come from mode #15(similar to CSCTF in track numbers)
- Eta distribution is more average than CSCTF

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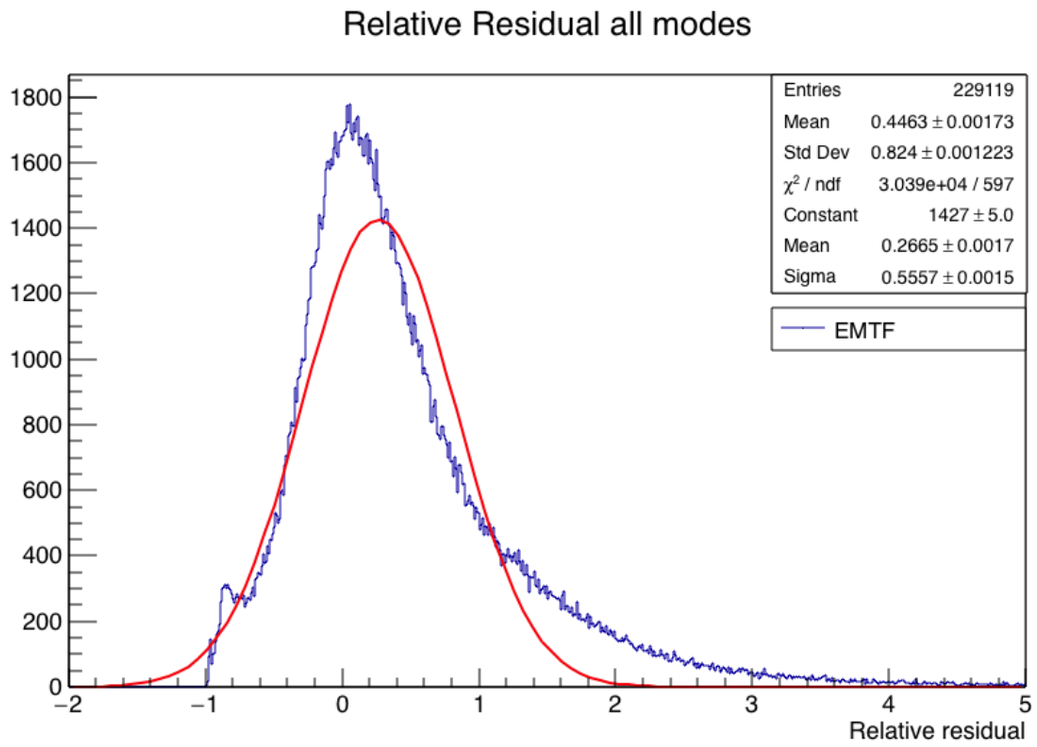
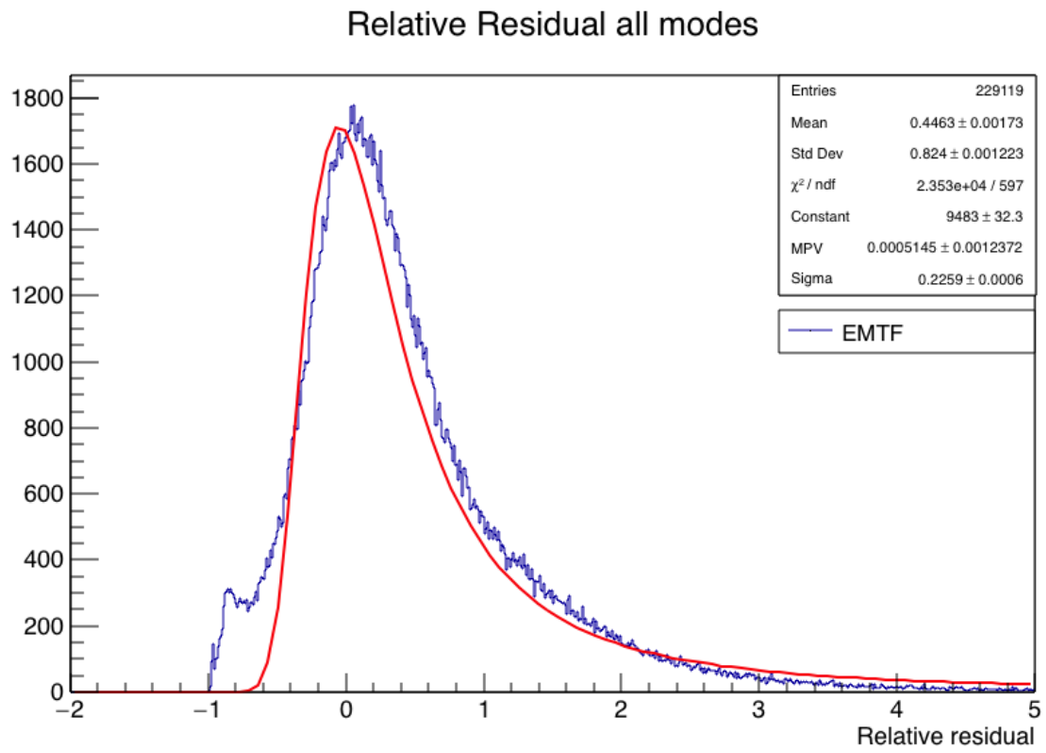
pT resolution: fit problem

Gaussian fit



Landau fit



- Overall, Landau fit seems better, but not good as well
- Expect to use FWHM of Gaussian fit to decide the pT resolution
- Same problem applies to CSCTF

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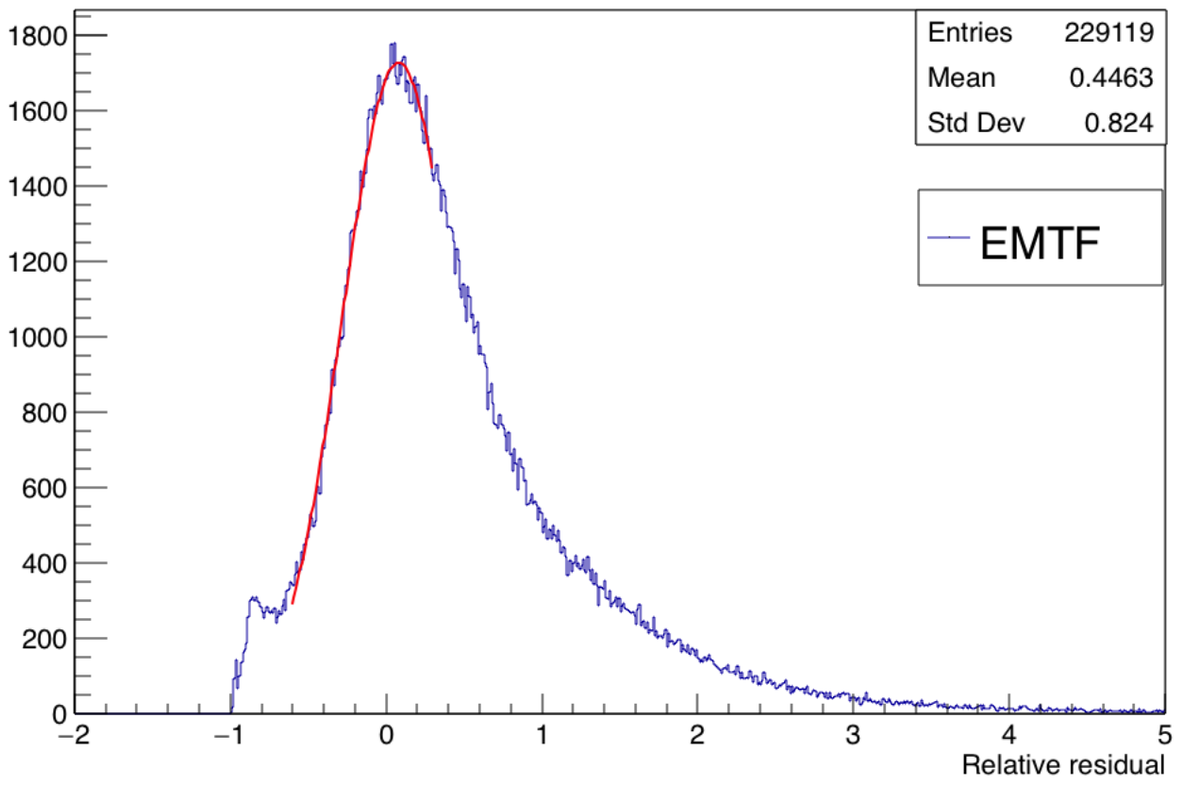
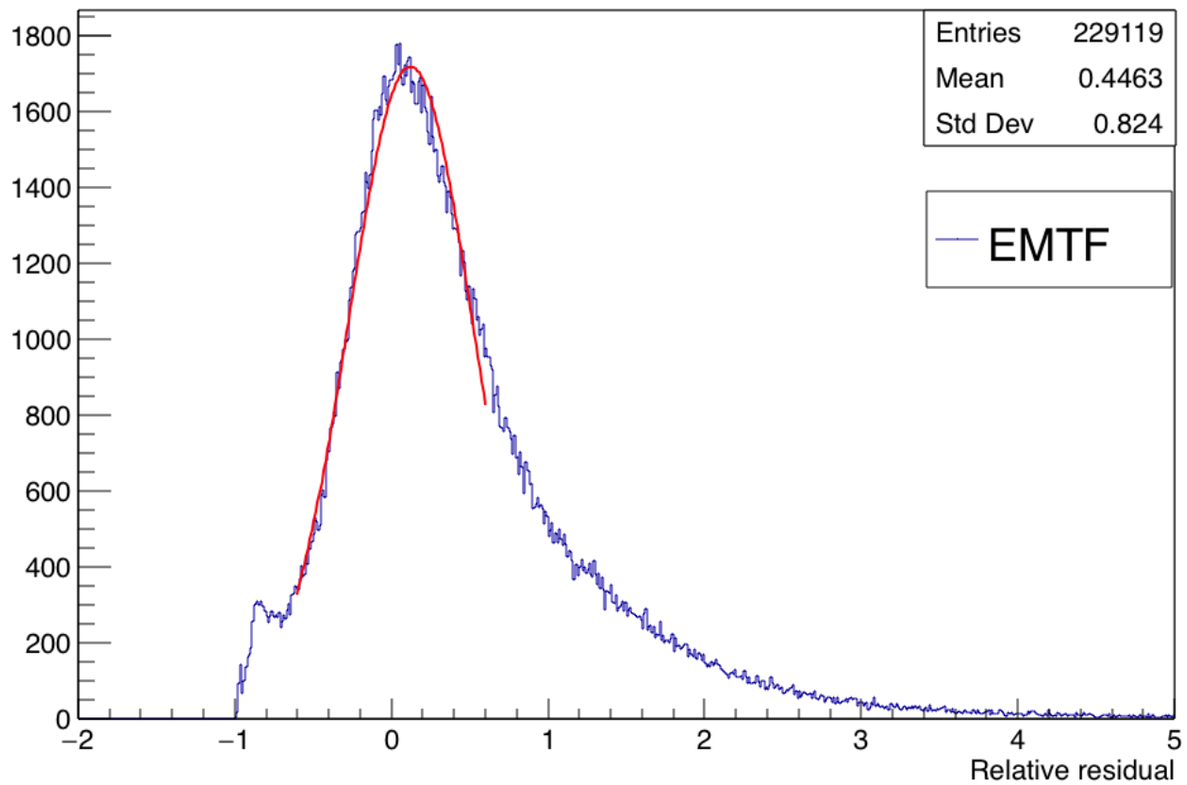
Fit problem: Gaussian fit

EMTF with fit range (-0.6, 0.3)



EMTF with fit range (-0.6, 0.6)



- Gaussian fits well in (-0.6, 0.3), goes worse if include more from the long tail side
- Same problem applies to CSCTF

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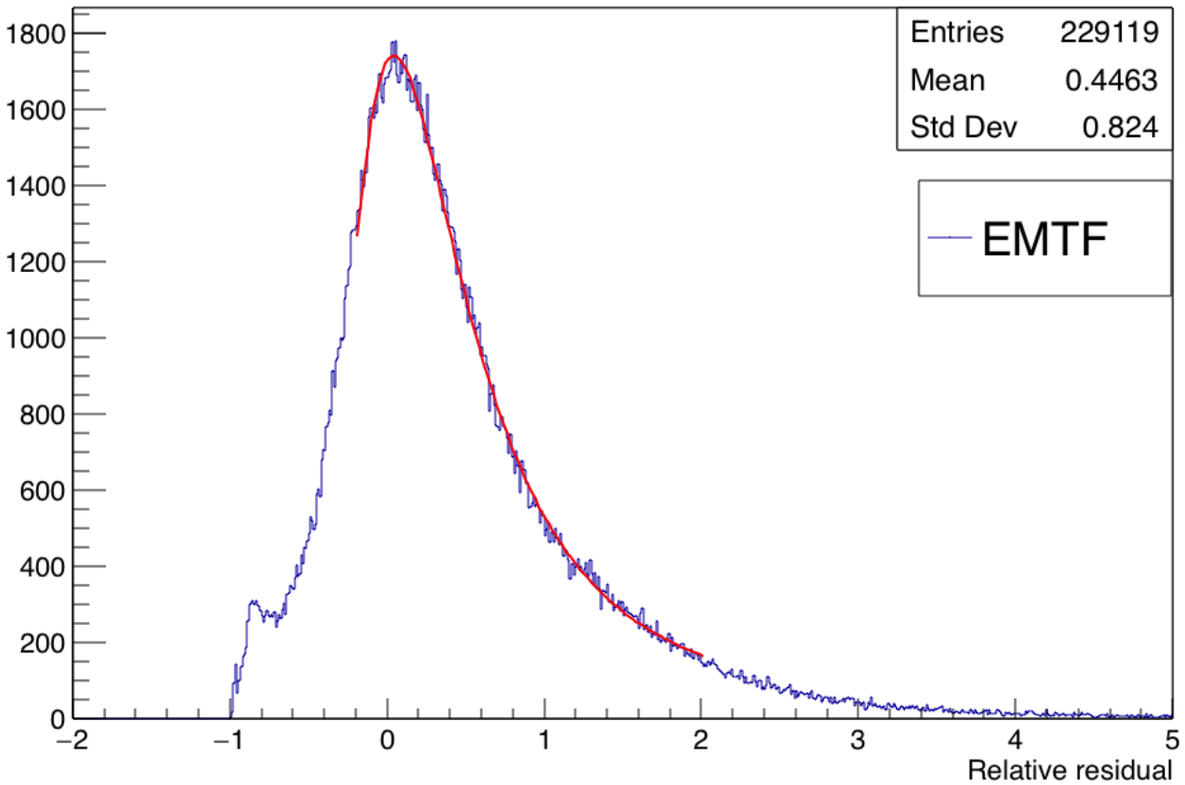
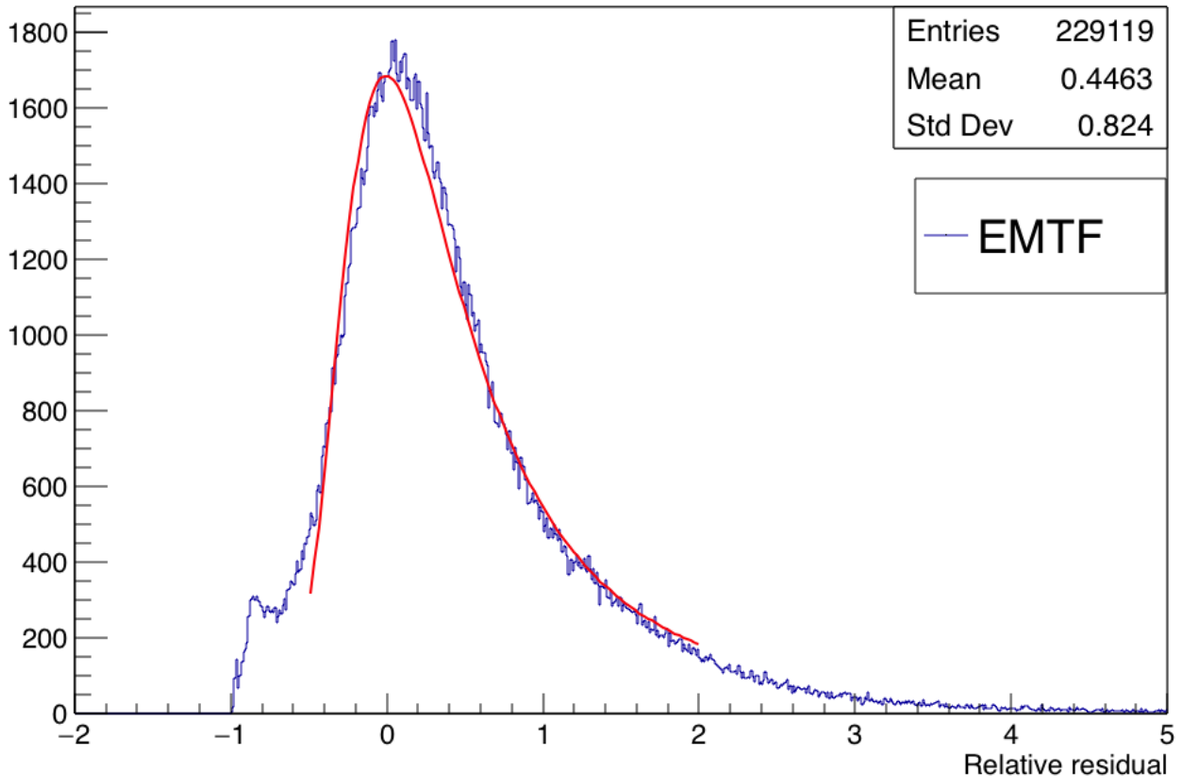
Fit problem: Landau fit

EMTF with fit range (-0.2, 2)



EMTF with fit range (-0.5, 2)



- Landau fits well for (-0.2, 2), goes worse if include more from short tail side
- Same problem applies to CSCTF

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Track build study

Only change w.r.t. pT assignment study

- Require EMTF/CSCTF match to the same muon

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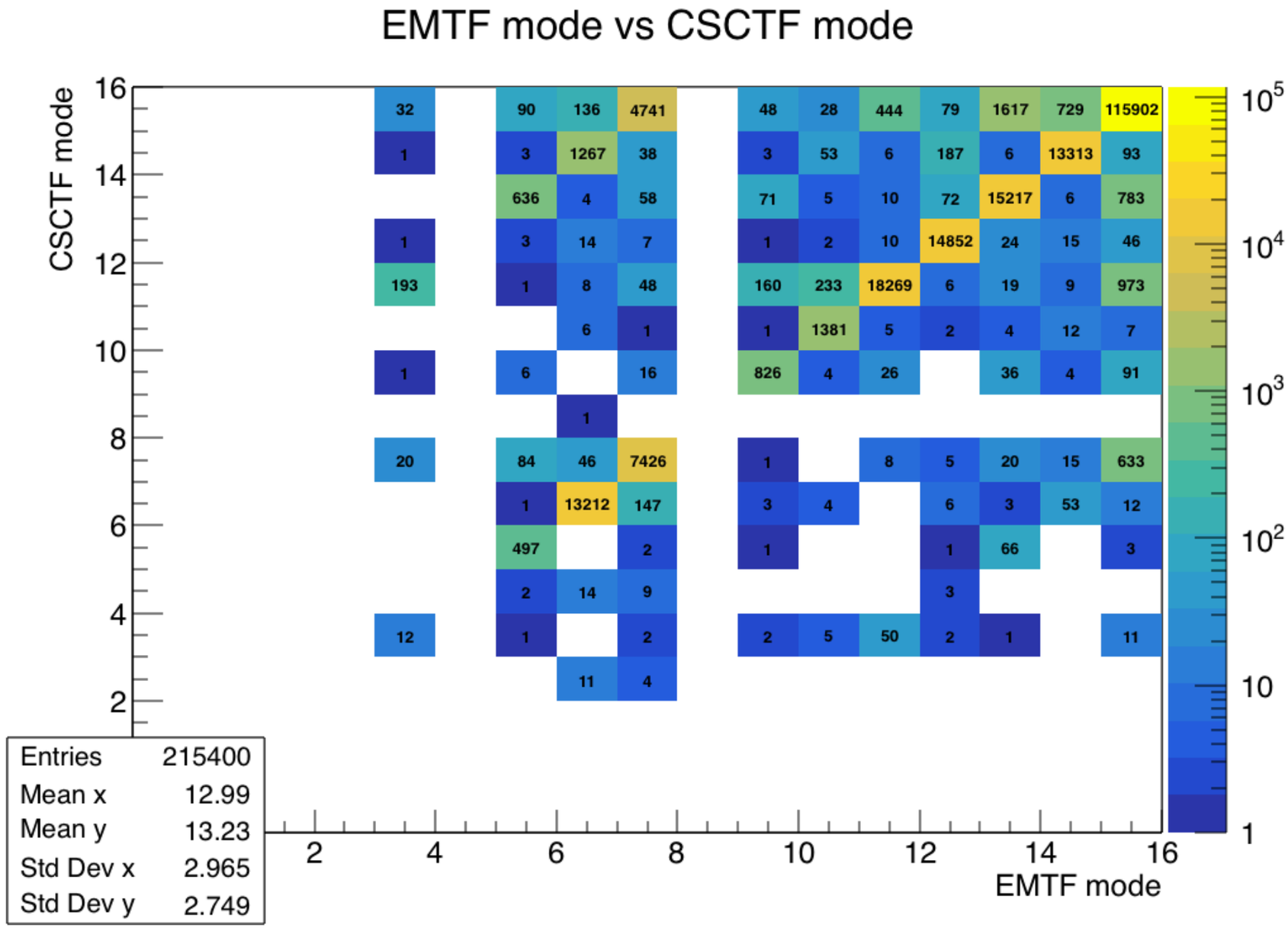
Track Build



Only look at EMTF and CSCTF tracks matched to the same RECO muon

- ~ 93.3% tracks EMTF and CSCTF agree

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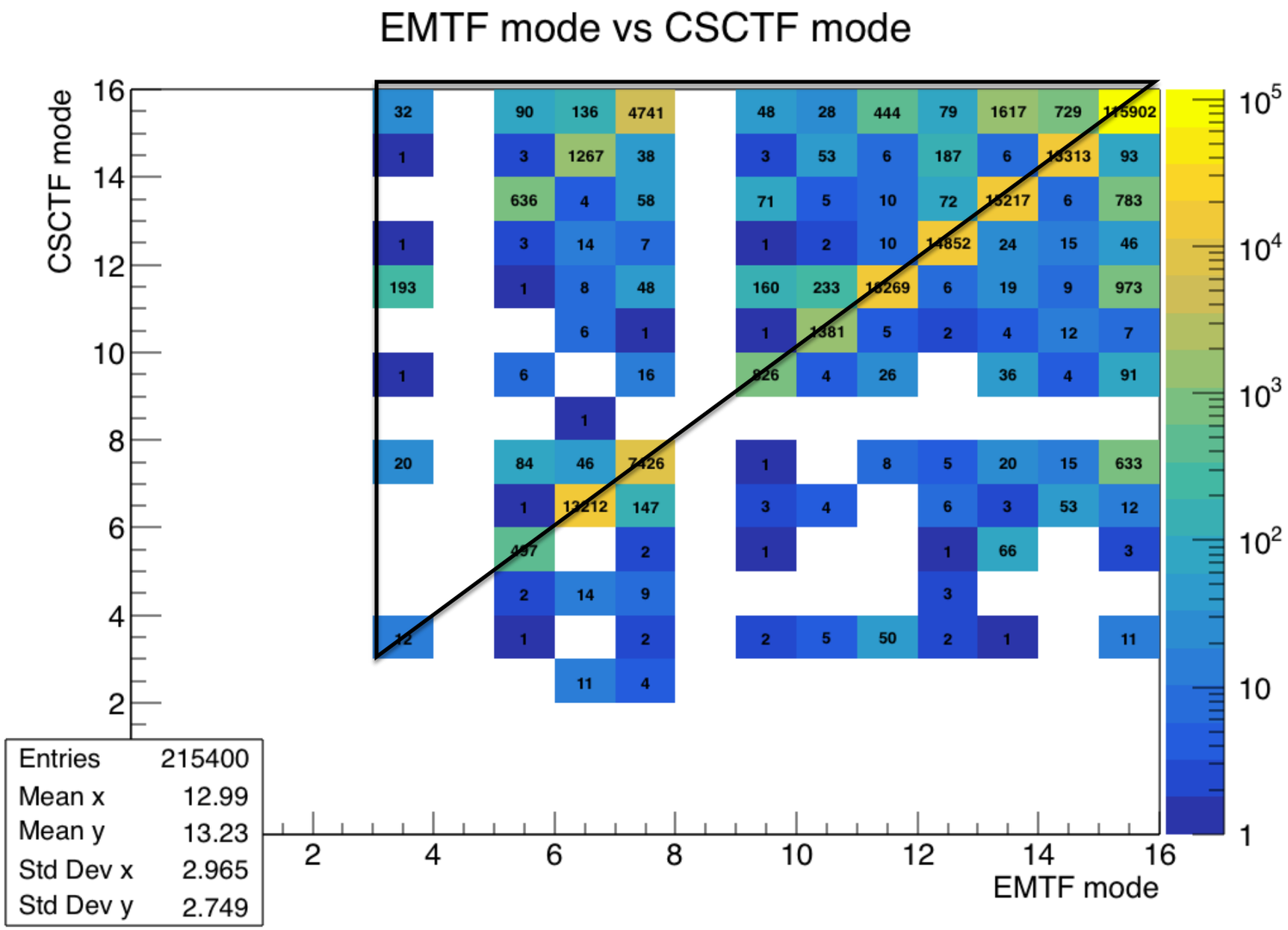
Track Build



- EMTF and CSCTF disagree more often in upper diagonal, CSCTF includes more stations than EMTF more often

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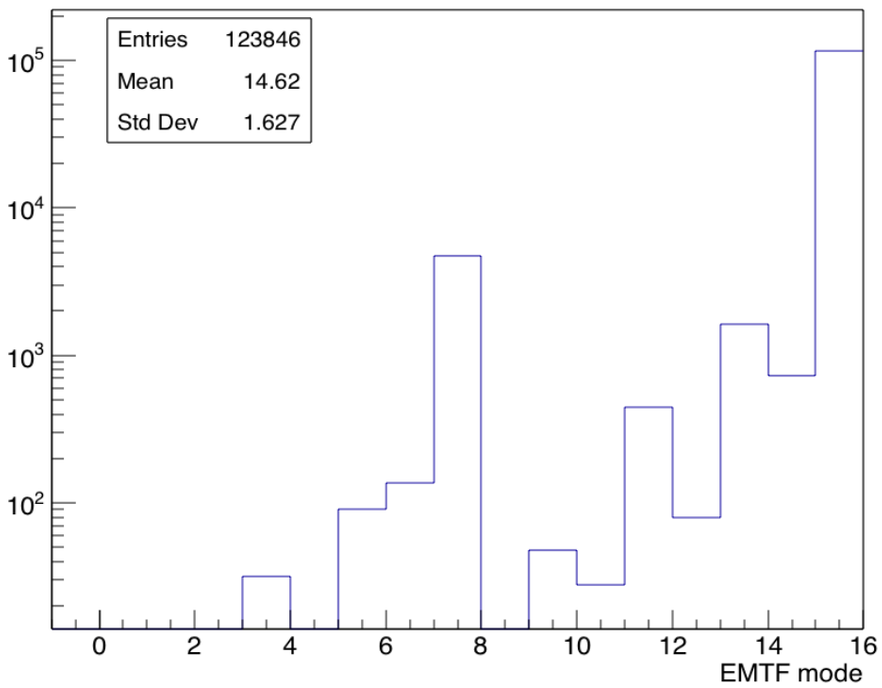
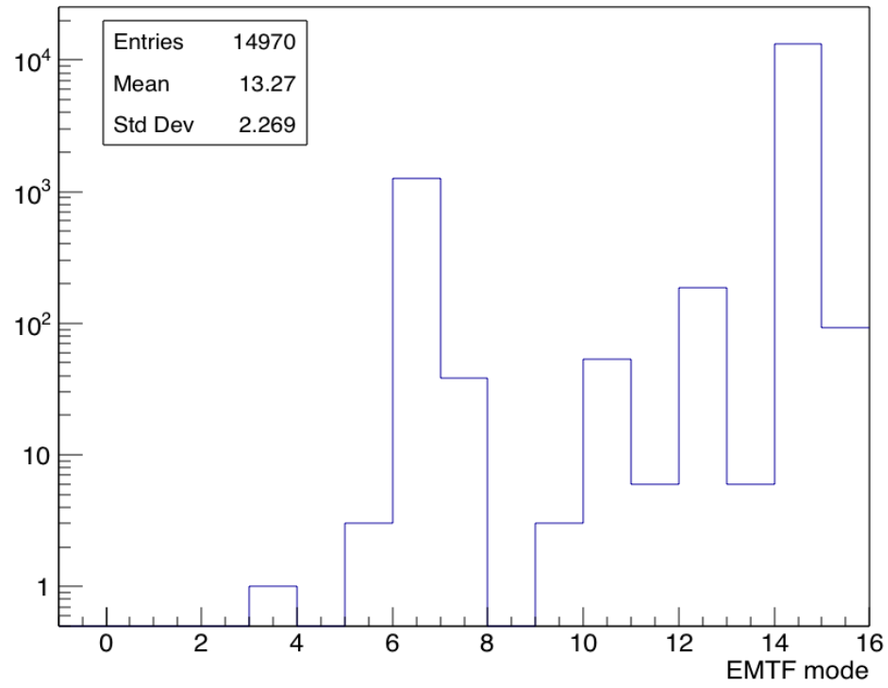
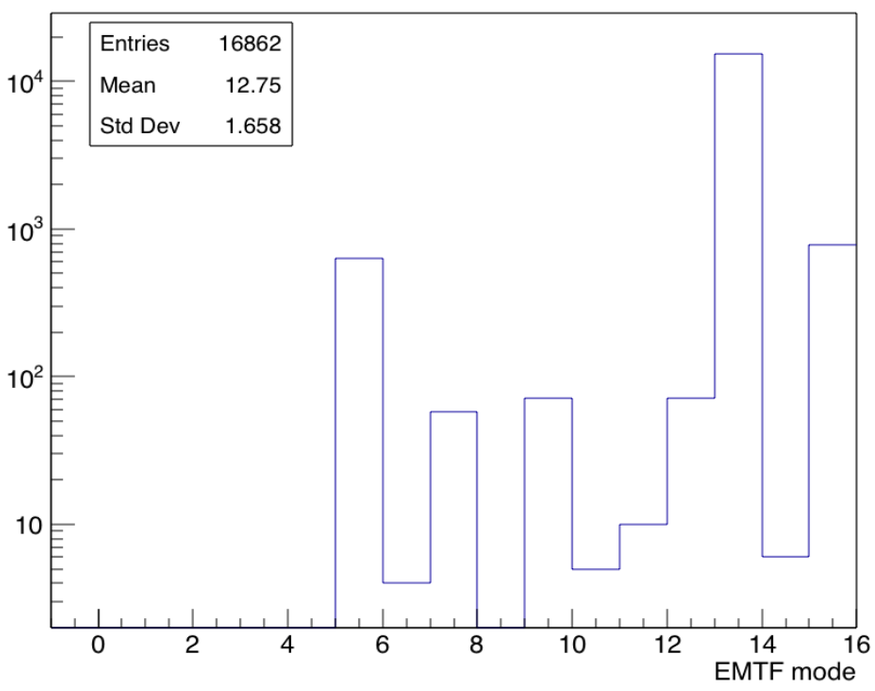
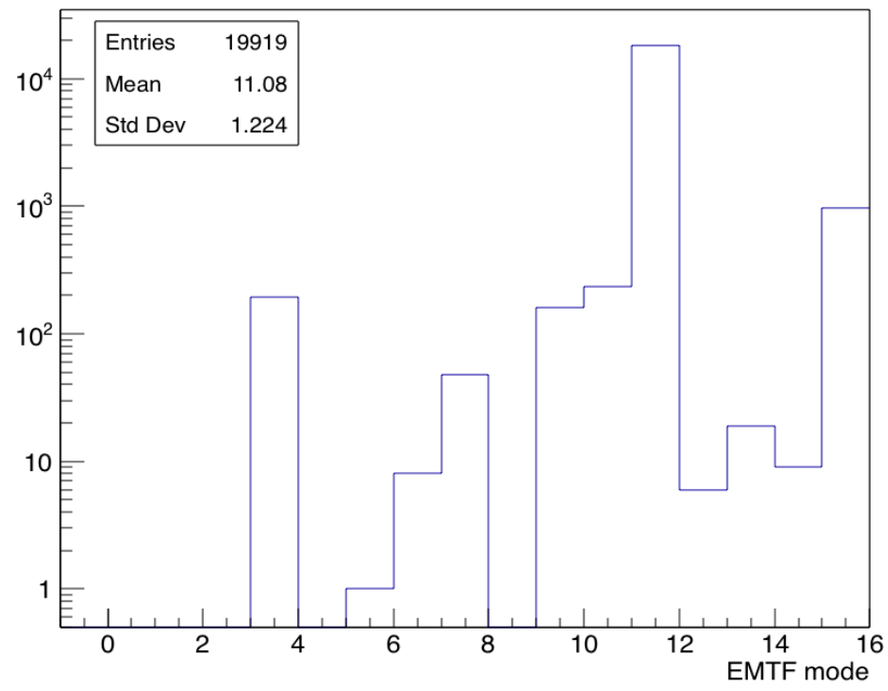
Track Build: separate plot









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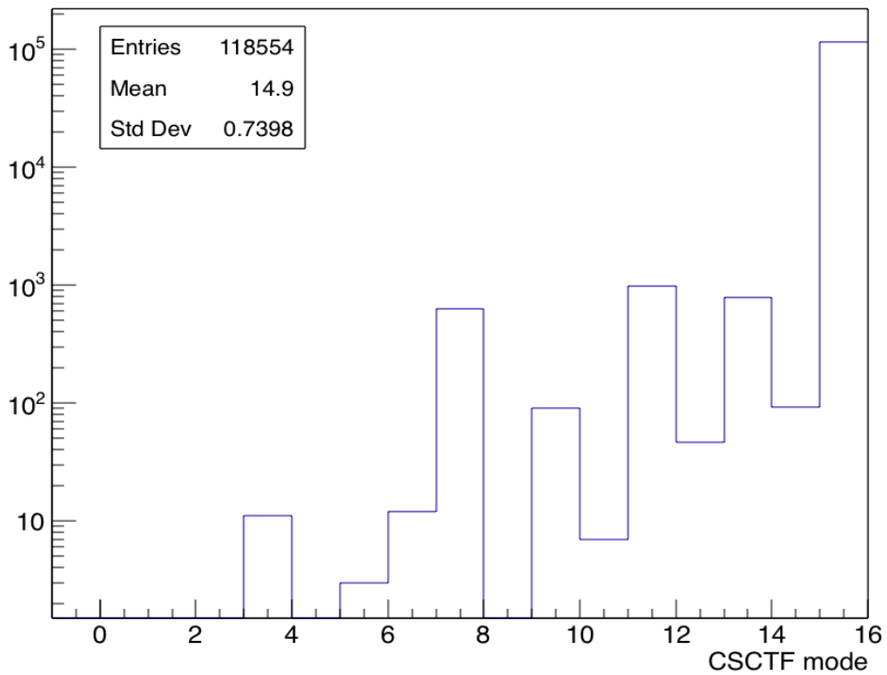
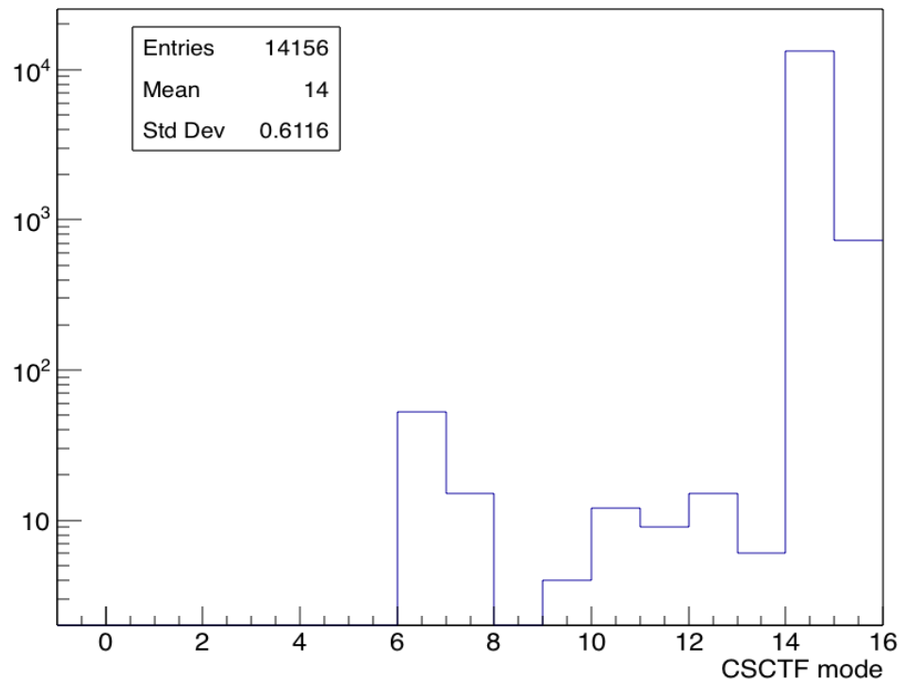
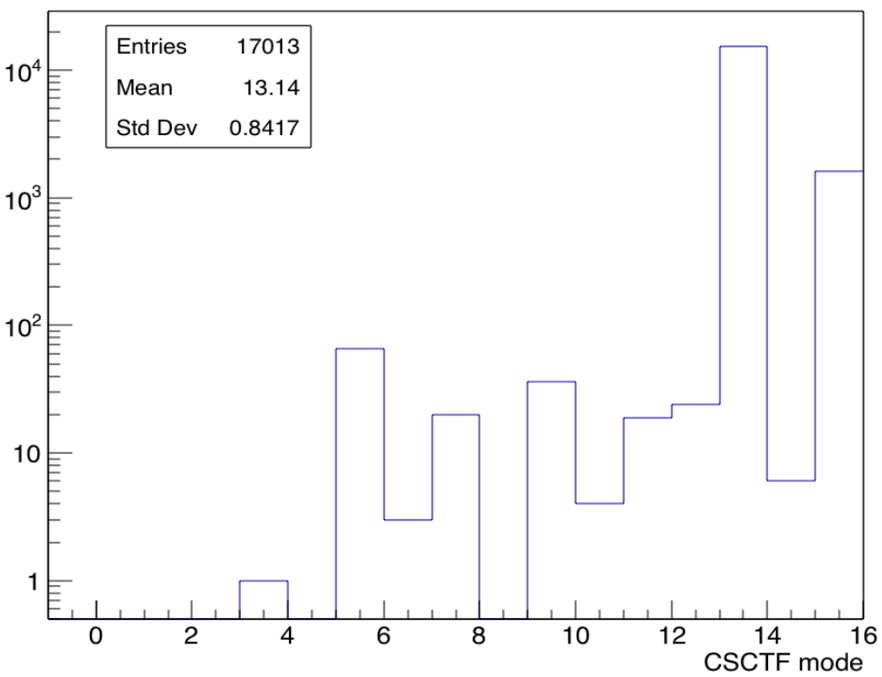
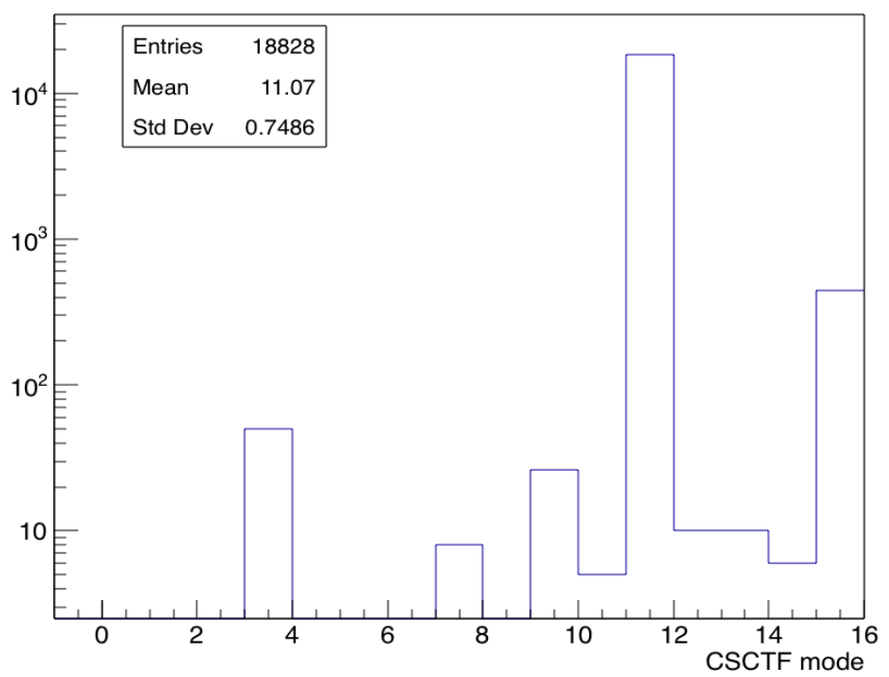
Track Build: separate plot









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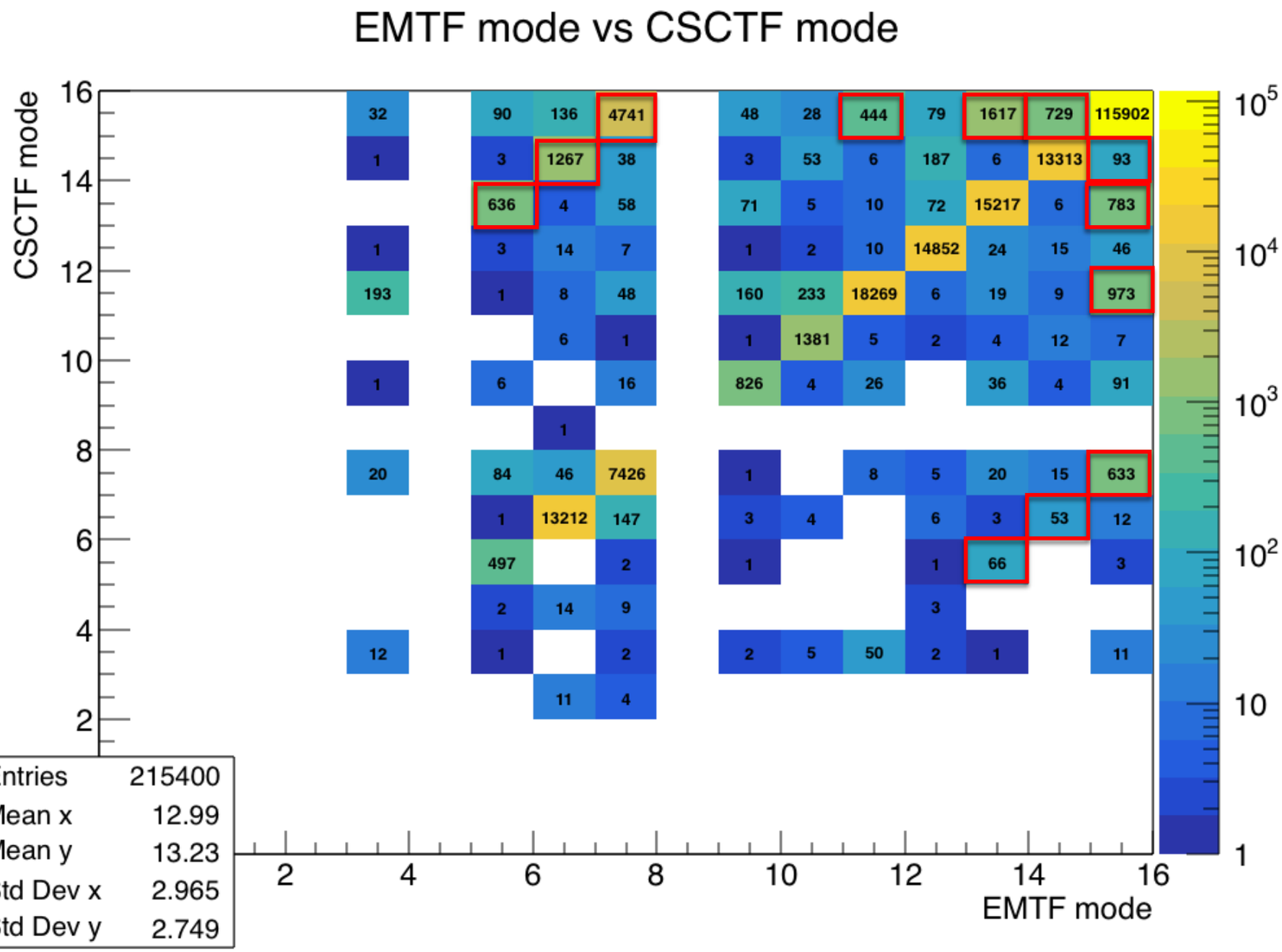
Track Build



- Only choose to look into red highlighted modes

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Look into track number in stations

Disagree on station #1(see other modes in backup)

(EMTF, CSCTF) mode	Stations	1	2	3	4
(15,7)	RECO	457	537	539	530
	EMTF	633	633	633	633
	CSCTF	0	633	633	633
(7,15)	RECO	4197	4269	4239	4210
	EMTF	0	4741	4741	4741
	CSCTF	4741	4741	4741	4741

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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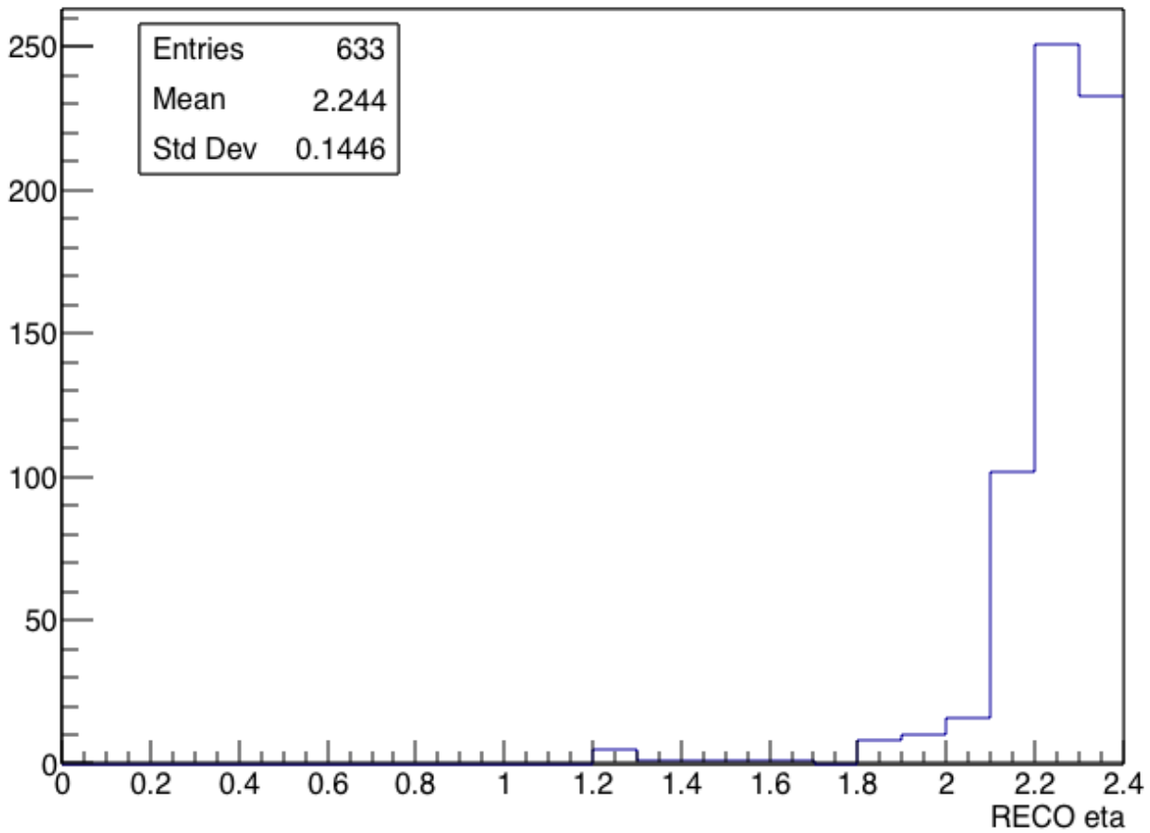
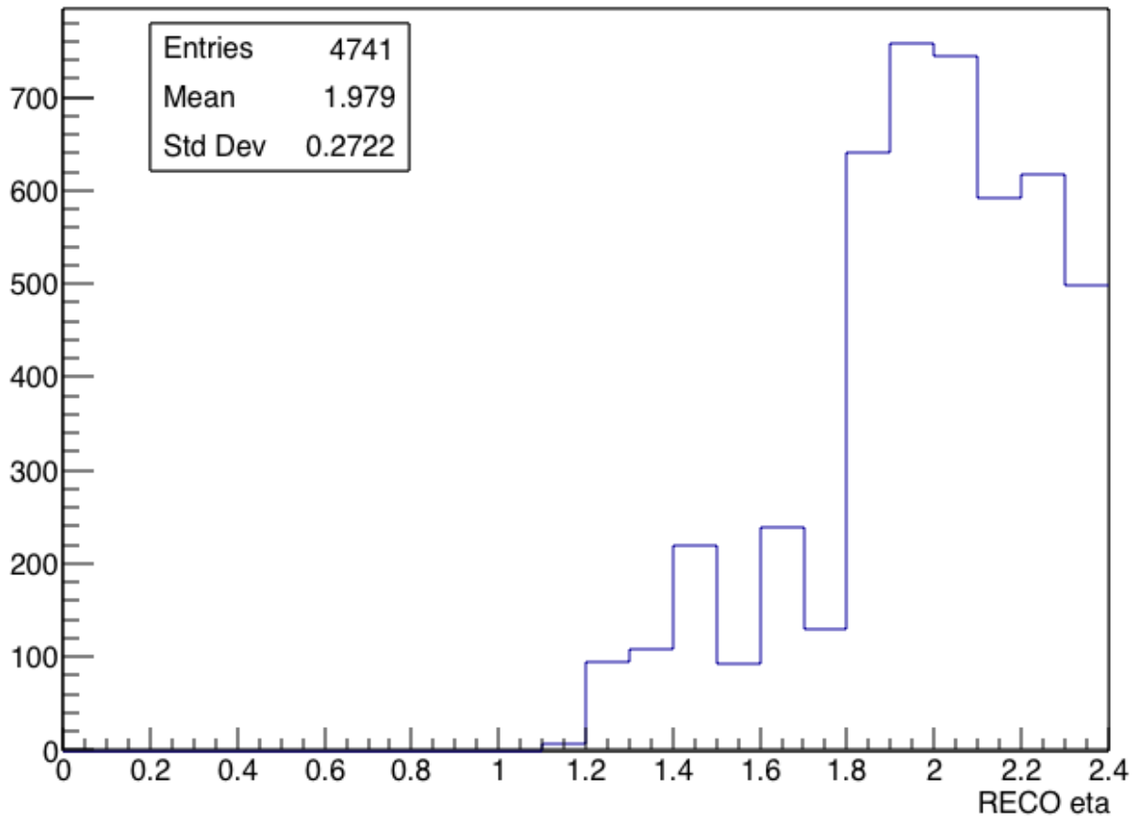
Disagree on station #1

RECO eta when EMTF mode=15,CSCTF mode=7



RECO eta when EMTF mode=7,CSCTF mode=15



- Mainly distributed in high eta 1.8-2.4 since ME1/1 is in this region
- EMTF and CSCTF disagreement on other stations see backup

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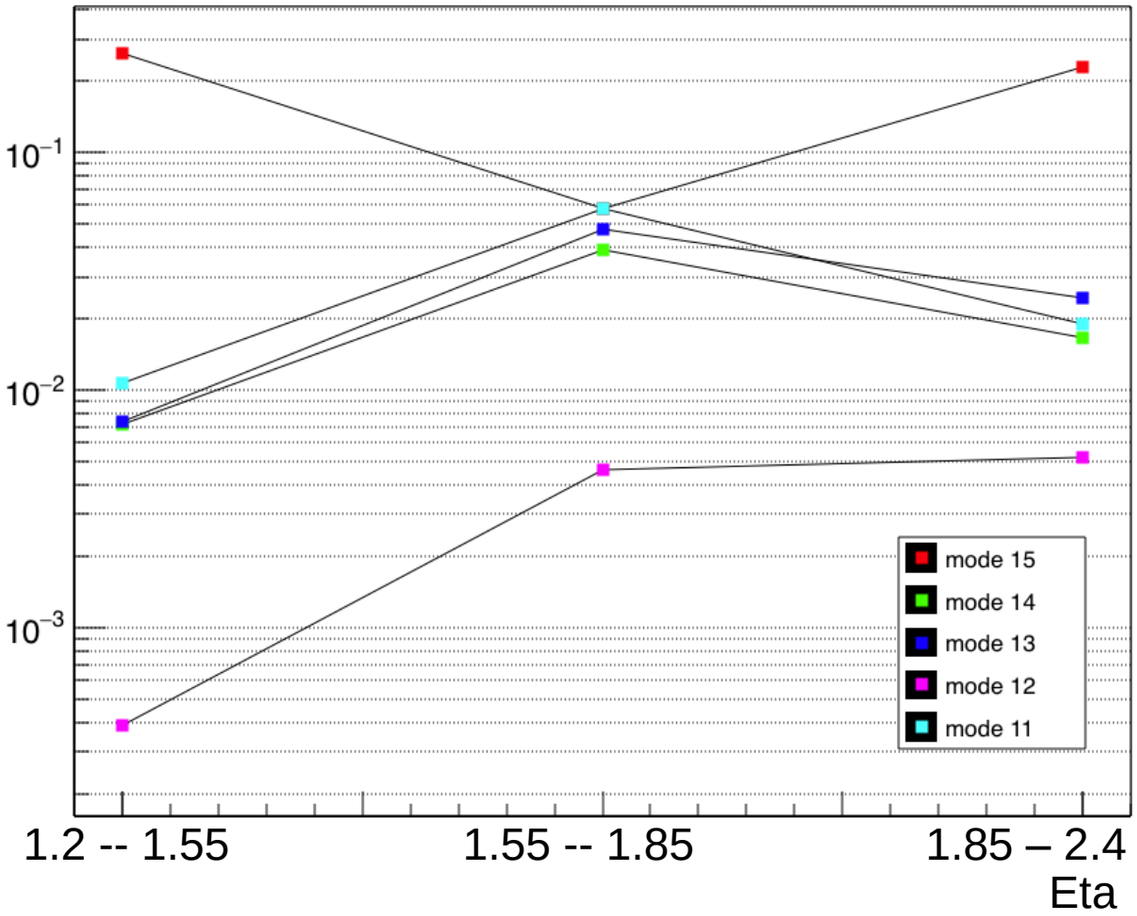
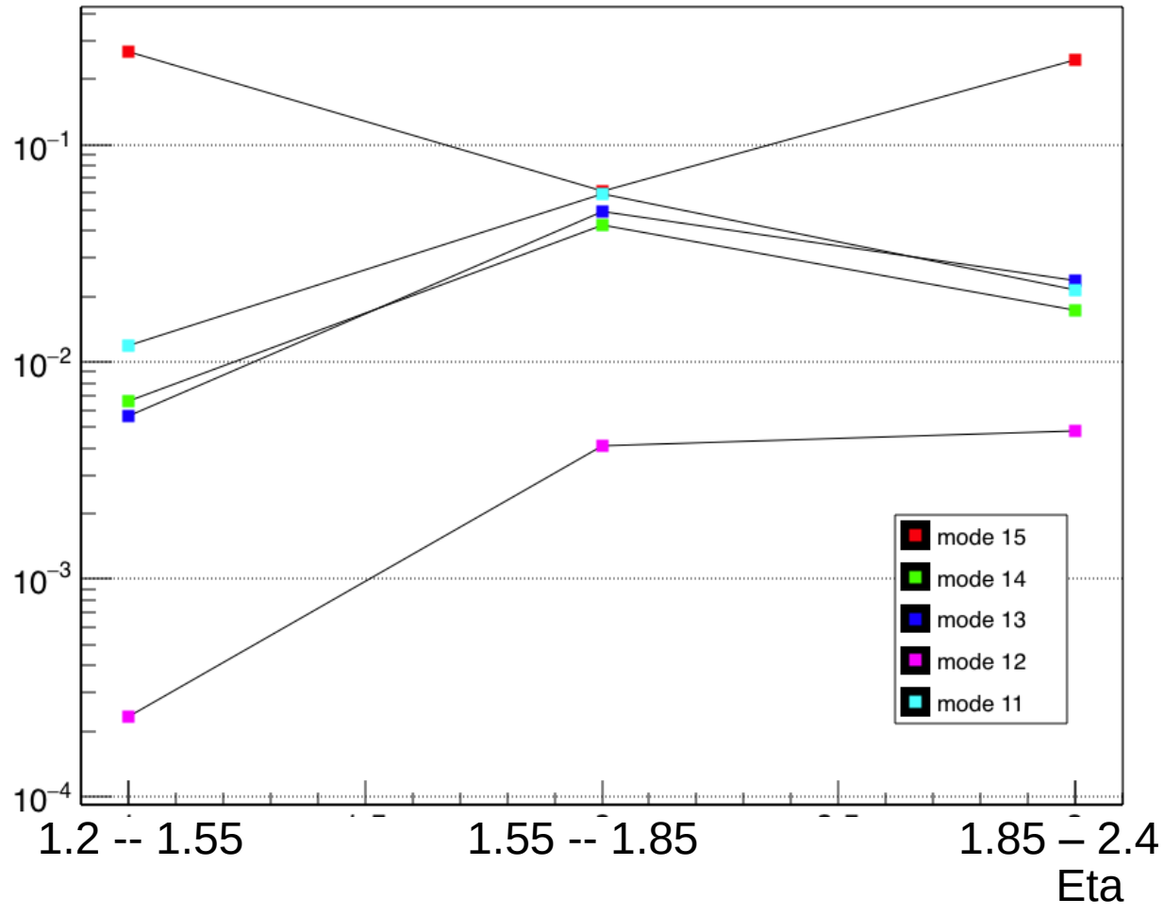
Track Build Study

Fraction of RECO muons matched to different modes and eta

EMTF



CSCTF



- EMTF and CSCTF show similar match behavior in mode and eta
- Fraction differs by order of magnitude for 4-station mode(~10^{-1}), 3-station mode(~10^{-2}) and 2-station mode #12(~10^{-3})

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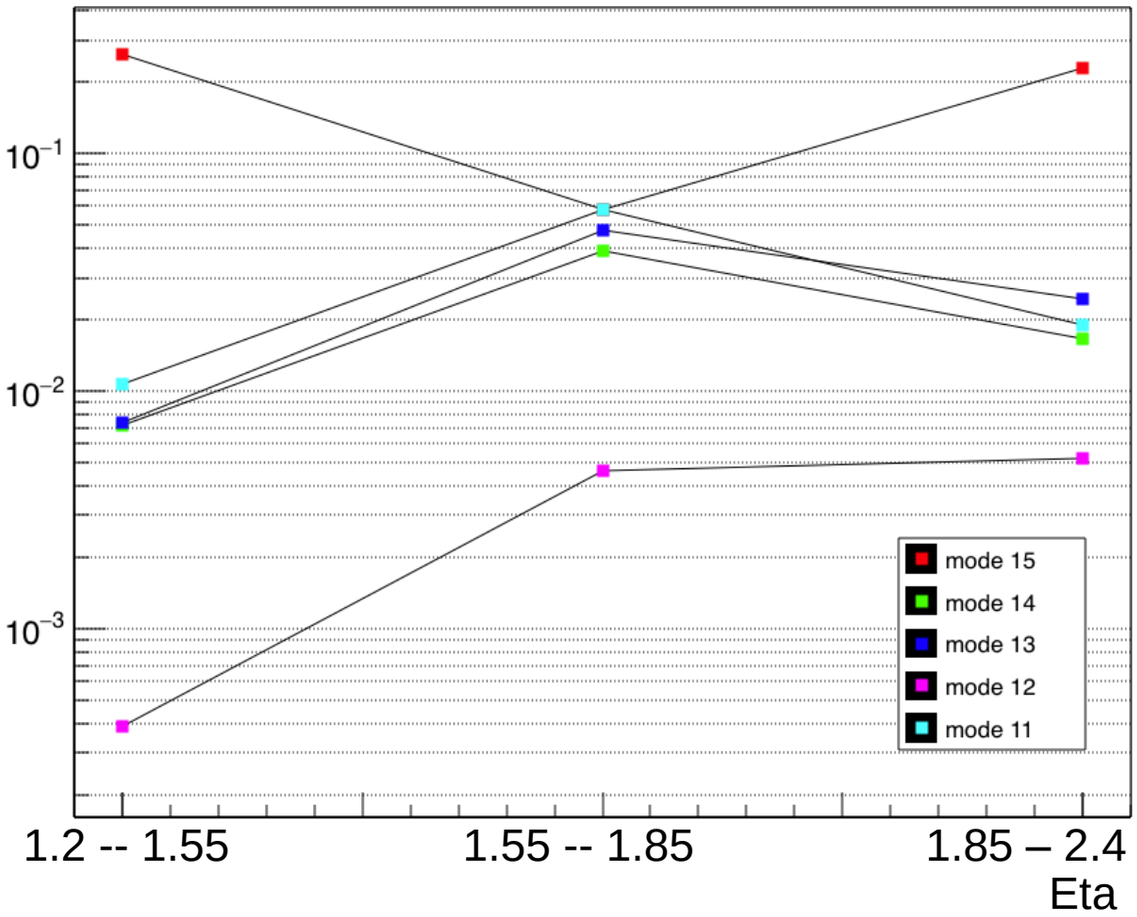
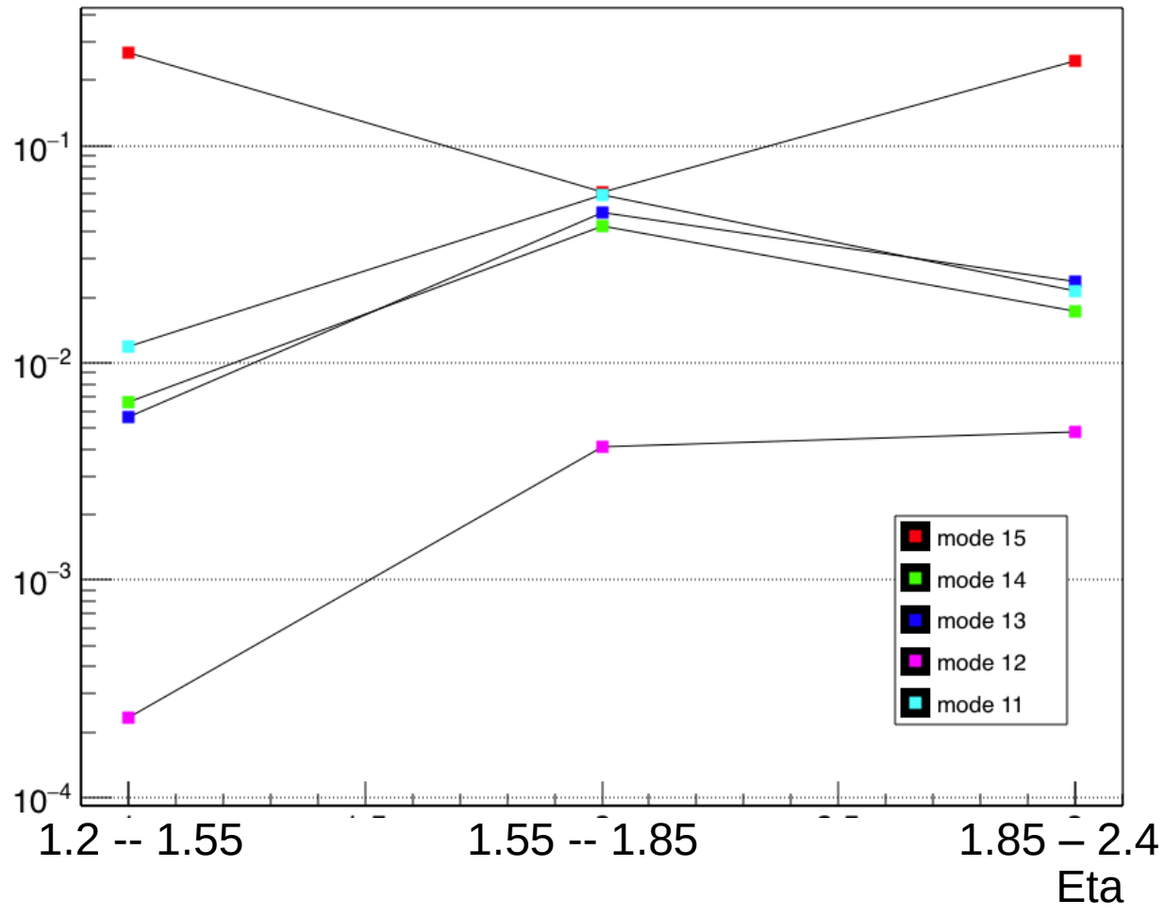
Track Build Study

Fraction of RECO muons matched to different modes and eta

EMTF



CSCTF



- 4-hit(mode #15) tracks mostly in 1.2<eta<1.55 and 1.85<eta<2.4, possibly because of gaps b/t ring 1 and ring 2 of stations 2, 3, 4
- Mostly 3-hit tracks(mode #14, #13, #11) in 1.55<eta<1.85
- 2-hit tracks always in small fraction in modes and eta

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Summary: Track Build Study

- EMTF modes vs CSCTF modes
  1) 93.3% tracks in same mode
  2) EMTF/CSCTF can both be wrong in mode
  3) Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

- Fraction of RECO muons matched to mode and eta
  1) Fraction differs by order of magnitude for 4-station mode(10^{-1}), 3-station mode(10^{-2}) and 2-station mode(10^{-3})
  2) 4-hit(mode #15) tracks mostly in 1.2<eta<1.55 and 1.85<eta<2.4
  3) Mostly 3-hit tracks(mode #14, #13, #11) in 1.55<eta<1.85
  4) 2-hit tracks always in small fraction in modes and eta

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Summary: pT resolution study

- Unexpected peak at relative residual ~ -0.9
  1) Most come from RECO pT 20 - 100 GeV with low pT estimation of EMTF/CSCTF
  2) For CSCTF, most unexpected tracks are in CSC overlap region with eta 0.9 -1.2; EMTF distribution in eta is more average
  3) For CSCTF, single station mode #8 contributes a lot to unexpected peak; #15 contributes similarly to EMTF/CSCTF
- Fit problem: suggestions?

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Back Up

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Analysis purpose

Study pT reconstruction performance of EMTF

- Match EMTF-RECO tracks using ΔR cut
- Look into different modes and eta ranges

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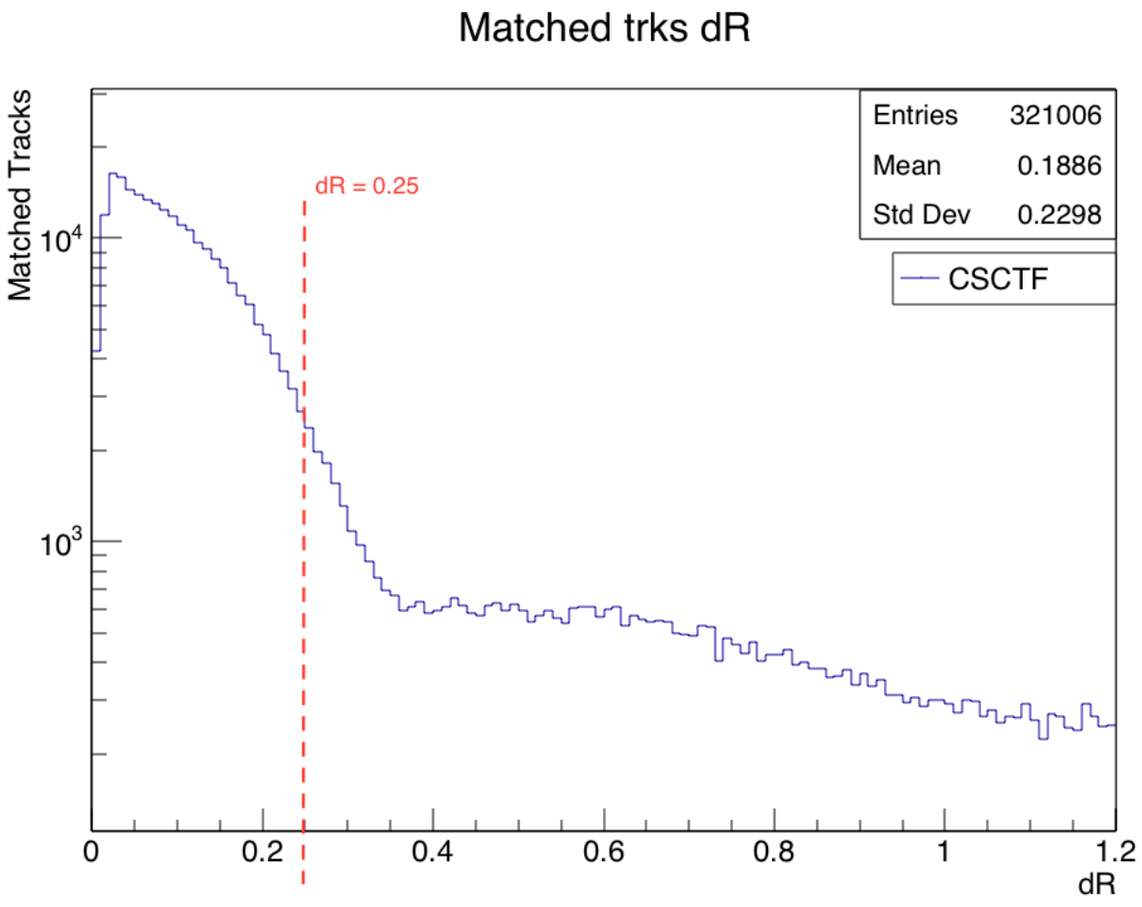
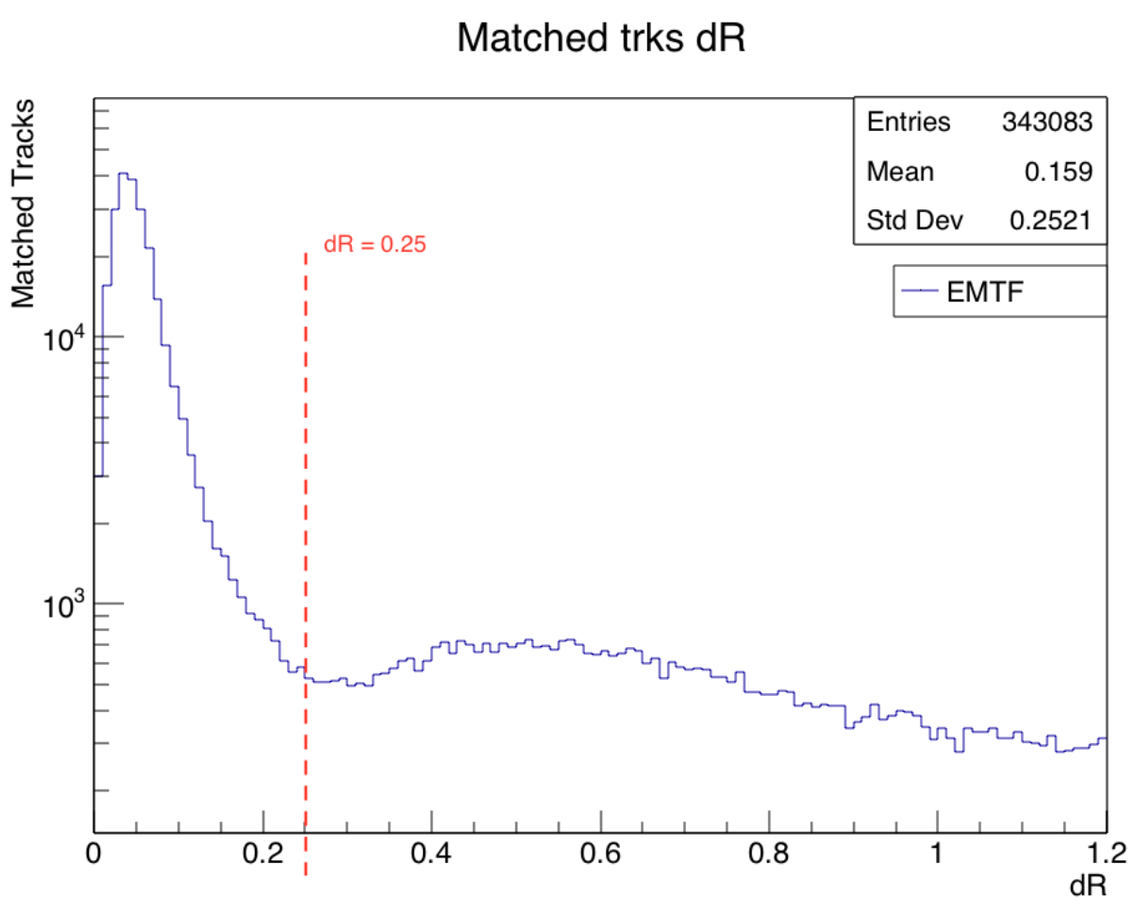
dR cut





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Mode

The modes describe which stations have been hit, the mode numbering is as follows...

- Definition in code:

```
int mode = 0;
if(lt->first.me1ID())
  mode |= 8;
if(lt->first.me2ID())
  mode |= 4;
if(lt->first.me3ID())
  mode |= 2;
if(lt->first.me4ID())
  mode |= 1;
```

Mode #	Definiition in code	Stations
15	1+2+4+8	1,2,3,4
14	2+4+8	1,2,3
13	1+4+8	1,2,4
12	4+8	1,2
11	1+2+8	1,3,4
10	2+8	1,3
9	1+8	1,4
8	8	1
7	1+2+4	2,3,4
6	2+4	2,3
5	1+4	2,4
4	4	2
3	1+2	3,4
2	2	3
1	1	4

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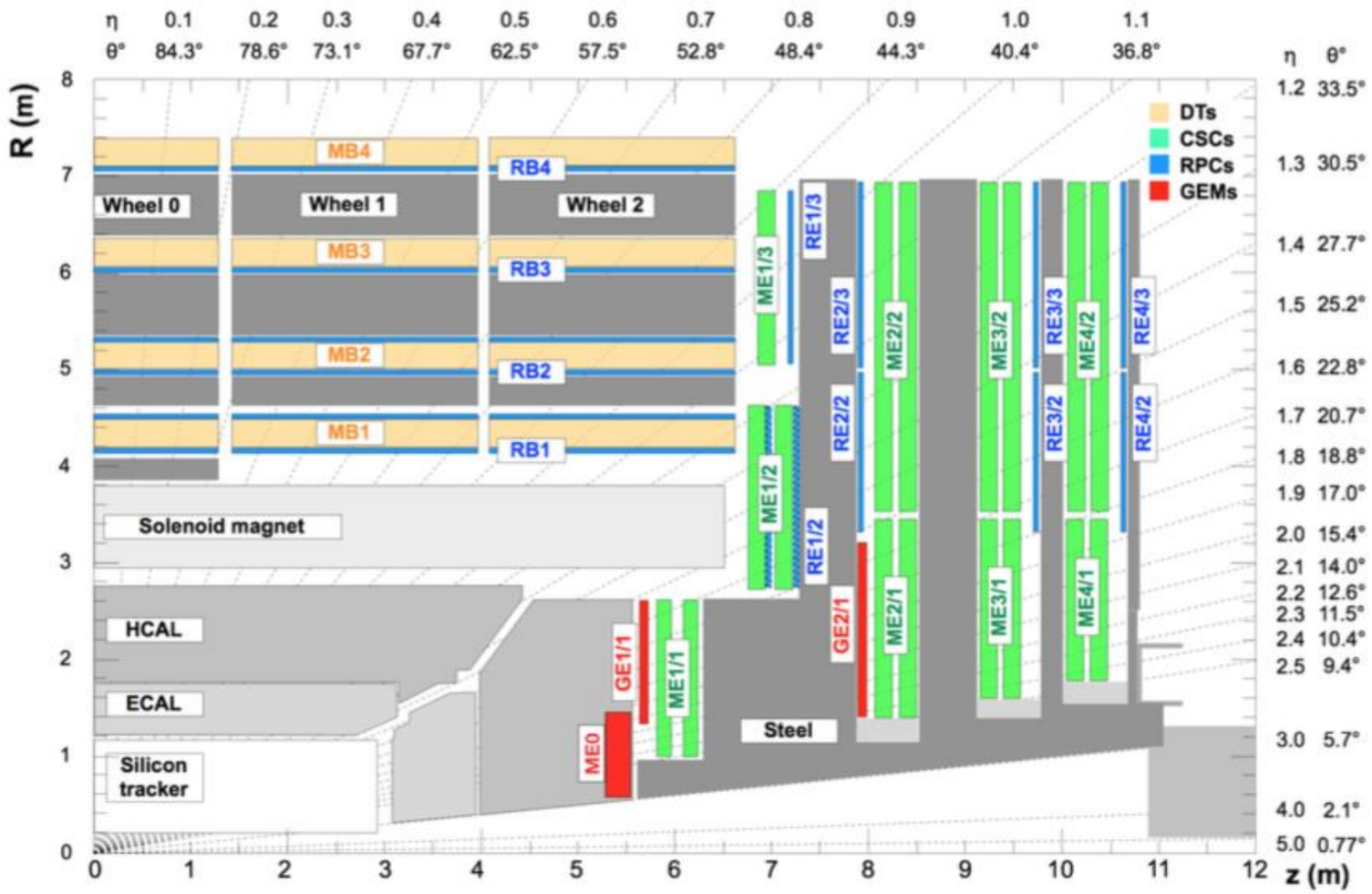
Eta



CSC Eta range: 0.9 — 2.4

Overlap region (CSC, DT, RPC)

- 0.9-1.2(full ME1/3)

Endcap (CSC, RPC)

- 1.2-1.5 (part of ME1/2)
- 1.5-2.4 (full ME1/1)

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Track build

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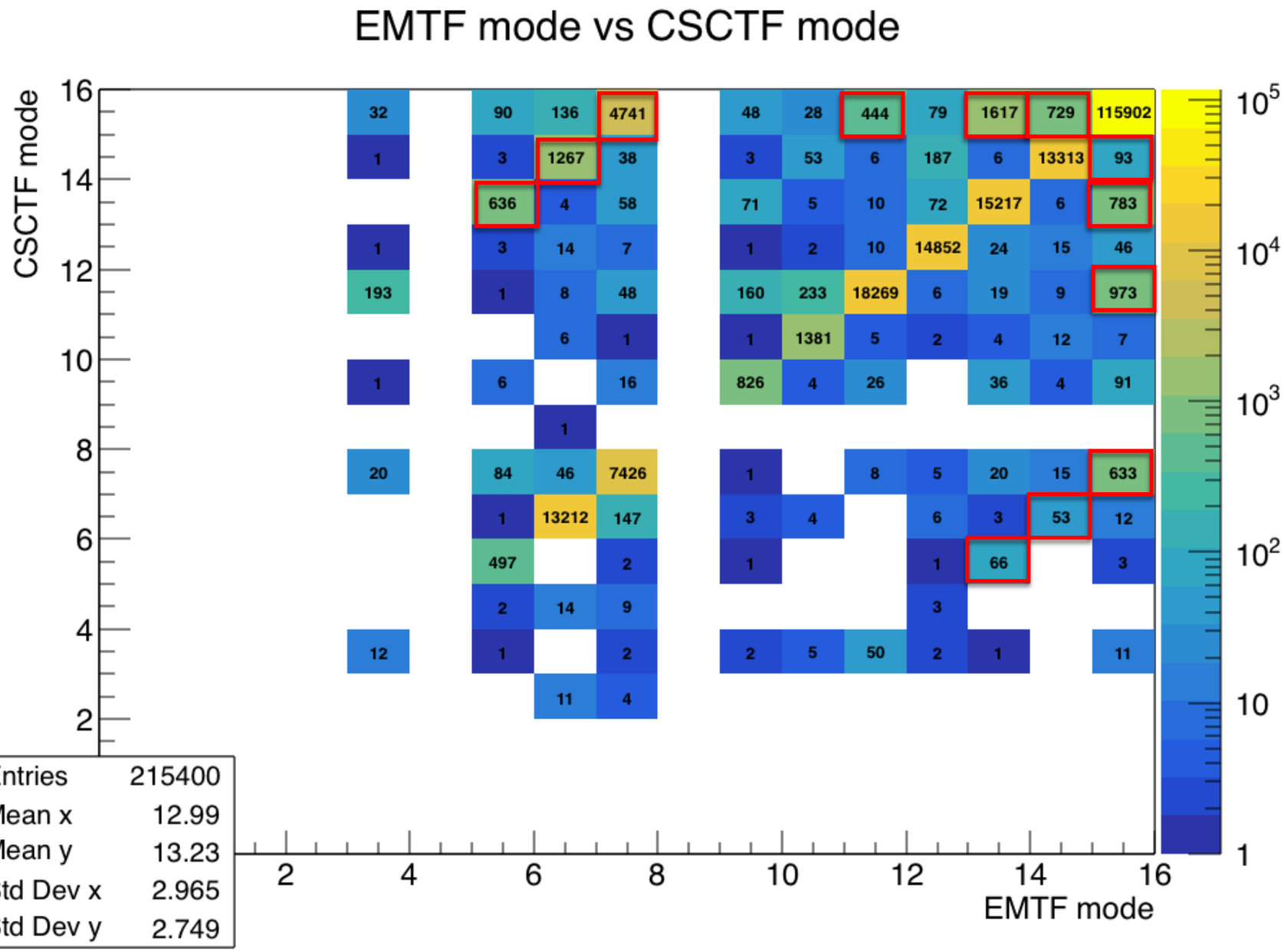
Track Build



- EMTF and CSCTF disagree more often in upper diagonal, CSCTF tend to include more stations than EMTF(see Table in next slides)

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Table: Disagreed modes in pairs

(EMTF, CSCTF)	[number of tracks]	Agree
(14, 1):(1, 14)	[0 +/- 0 : 0 +/- 0]	YES
(14, 2):(2, 14)	[0 +/- 0 : 0 +/- 0]	YES
(14, 3):(3, 14)	[0 +/- 0 : 1 +/- 1]	YES
(14, 4):(4, 14)	[0 +/- 0 : 0 +/- 0]	YES
(14, 5):(5, 14)	[0 +/- 0 : 3 +/- 1]	NO
(14, 6):(6, 14)	[53 +/- 7 : 1267 +/- 35]	NO
(14, 7):(7, 14)	[15 +/- 3 : 38 +/- 6]	NO
(14, 8):(8, 14)	[0 +/- 0 : 0 +/- 0]	YES
(14, 9):(9, 14)	[4 +/- 2 : 3 +/- 1]	YES
(14, 10):(10, 14)	[12 +/- 3 : 53 +/- 7]	NO
(14, 11):(11, 14)	[9 +/- 3 : 6 +/- 2]	YES
(14, 12):(12, 14)	[15 +/- 3 : 187 +/- 13]	NO
(14, 13):(13, 14)	[6 +/- 2 : 6 +/- 2]	YES
(15, 1):(1, 15)	[0 +/- 0 : 0 +/- 0]	YES
(15, 2):(2, 15)	[0 +/- 0 : 0 +/- 0]	YES
(15, 3):(3, 15)	[11 +/- 3 : 32 +/- 5]	NO
(15, 4):(4, 15)	[0 +/- 0 : 0 +/- 0]	YES
(15, 5):(5, 15)	[3 +/- 1 : 90 +/- 9]	NO
(15, 6):(6, 15)	[12 +/- 3 : 136 +/- 11]	NO
(15, 7):(7, 15)	[633 +/- 25 : 4741 +/- 68]	NO
(15, 8):(8, 15)	[0 +/- 0 : 0 +/- 0]	YES
(15, 9):(9, 15)	[91 +/- 9 : 48 +/- 6]	NO
(15, 10):(10, 15)	[7 +/- 2 : 28 +/- 5]	NO
(15, 11):(11, 15)	[973 +/- 31 : 444 +/- 21]	NO
(15, 12):(12, 15)	[46 +/- 6 : 79 +/- 8]	NO
(15, 13):(13, 15)	[783 +/- 27 : 1617 +/- 40]	NO
(15, 14):(14, 15)	[93 +/- 9 : 729 +/- 27]	NO

- Map the 2D mode plot into a table
- Include error estimate ~ $\sqrt{\#\ of\ tracks}$
- Examinate the unsymmetry in number of tracks

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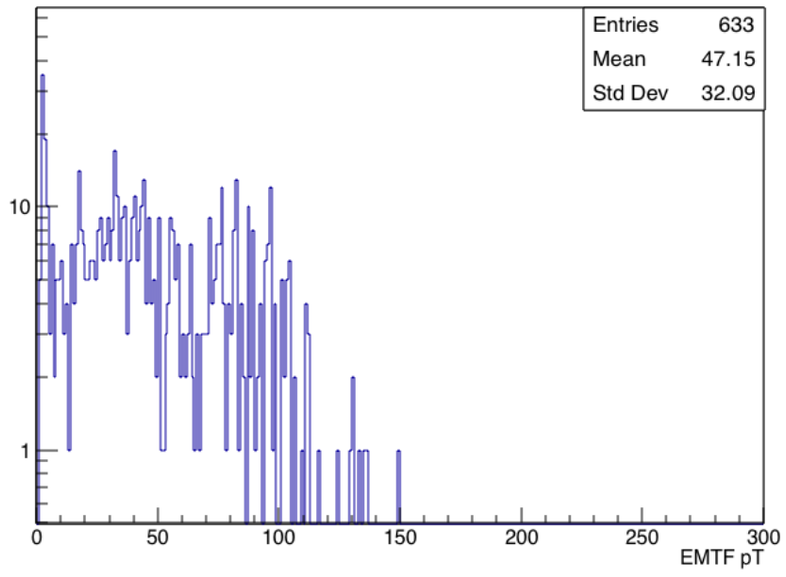
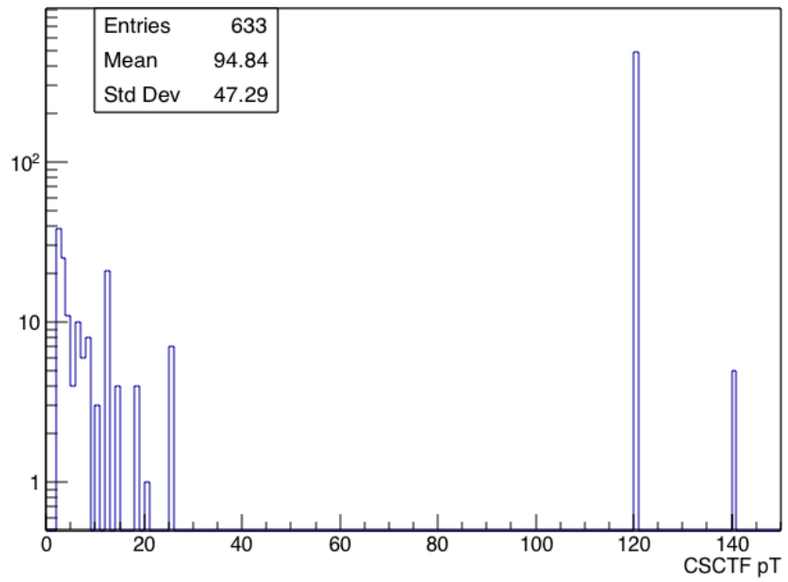
Disagree on station #1: pT

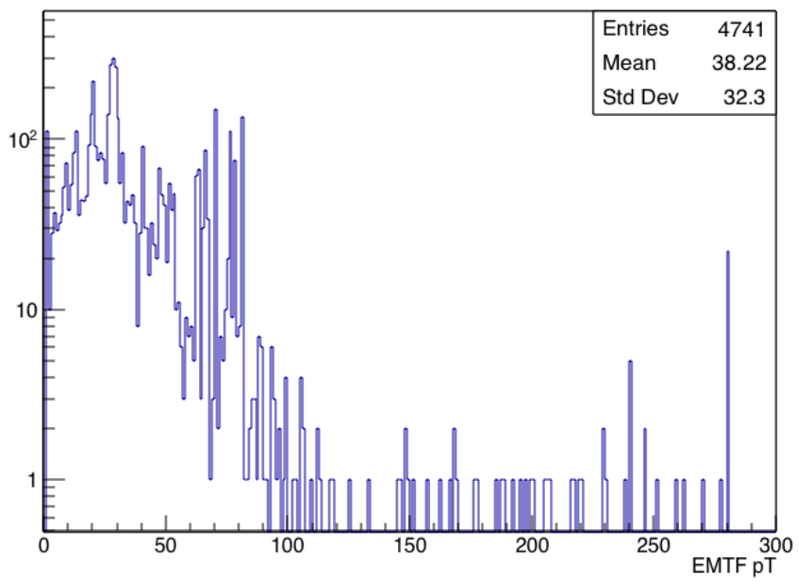
EMTF pT when EMTF mode=15, CSCTF mode=7



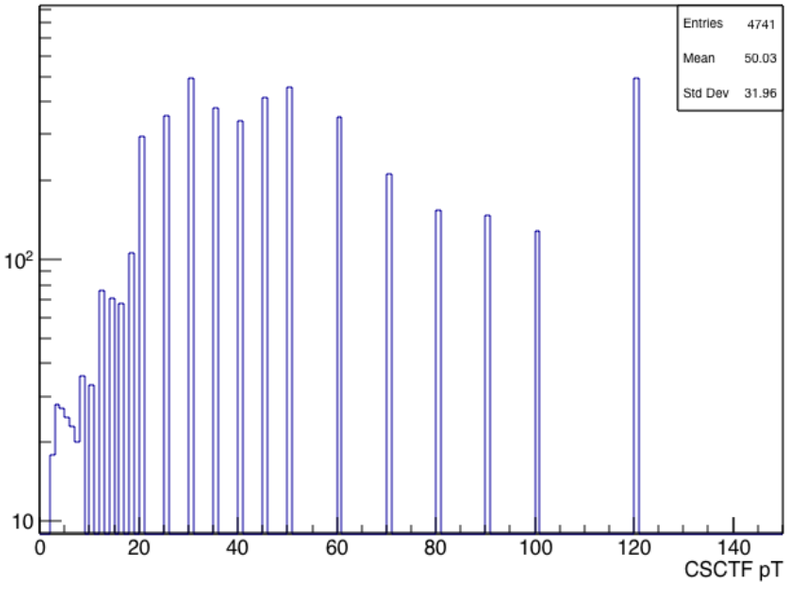
CSCTF pT when EMTF mode=15, CSCTF mode=7



EMTF pT when EMTF mode=7, CSCTF mode=15



CSCTF pT when EMTF mode=7, CSCTF mode=15



- No obvious features found in pT distribution(All other disagreed modes pT distrbution in backup)

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Look into track number in stations

Disagree on station #2

(EMTF, CSCTF) mode	Stations	1	2	3	4
(15,11)	RECO	897	451	853	887
	EMTF	973	973	973	973
	CSCTF	973	0	973	973
(11,15)	RECO	406	306	400	397
	EMTF	444	0	444	444
	CSCTF	444	444	444	444

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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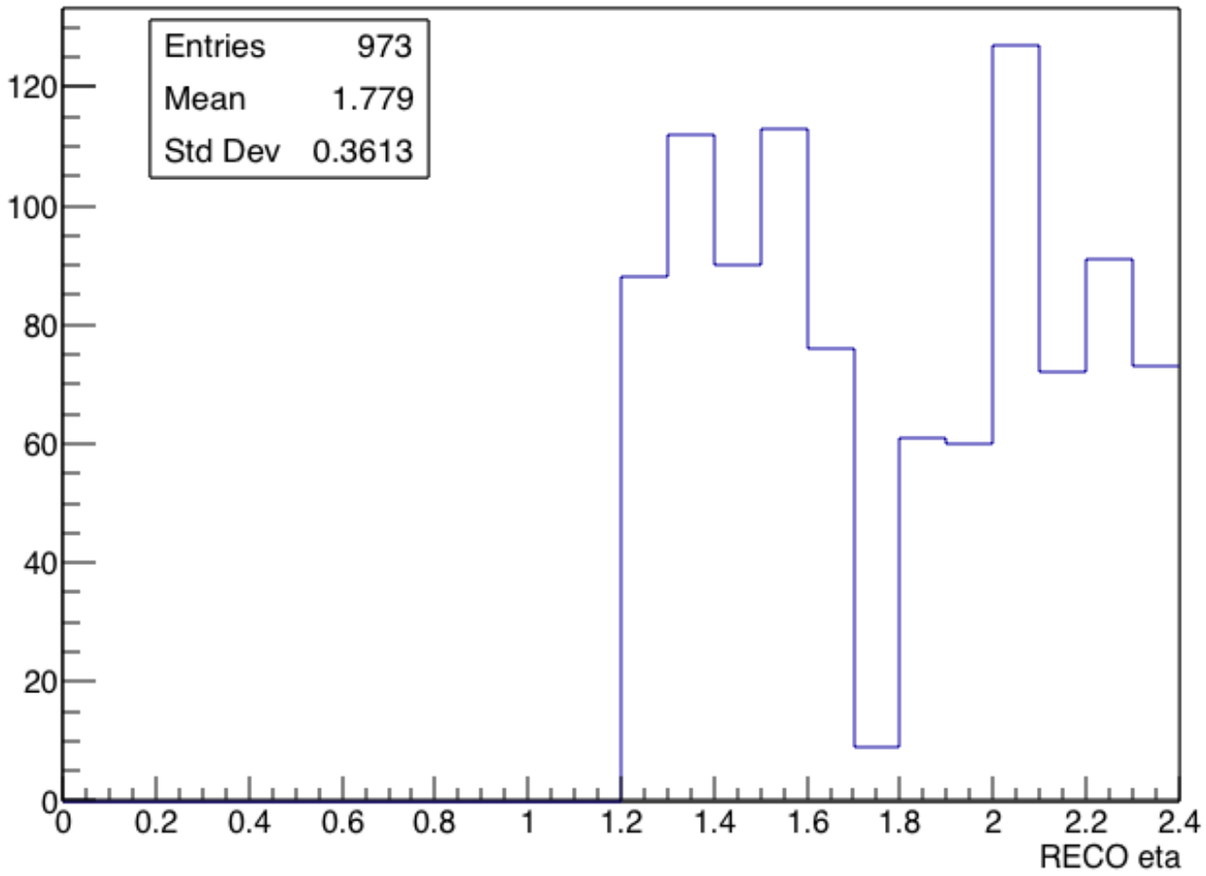
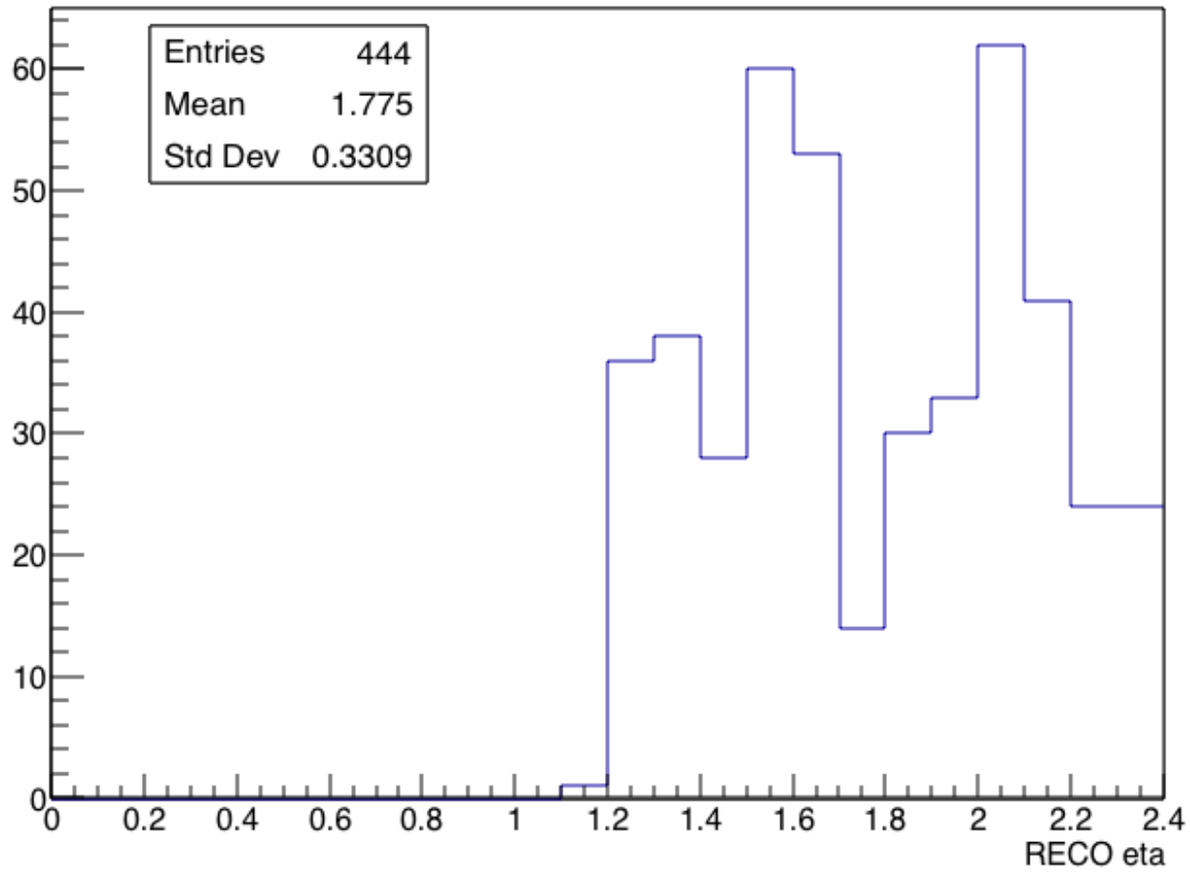
Disagree on station #2

RECO eta when EMTF mode=15,CSCTF mode=11



RECO eta when EMTF mode=11,CSCTF mode=15



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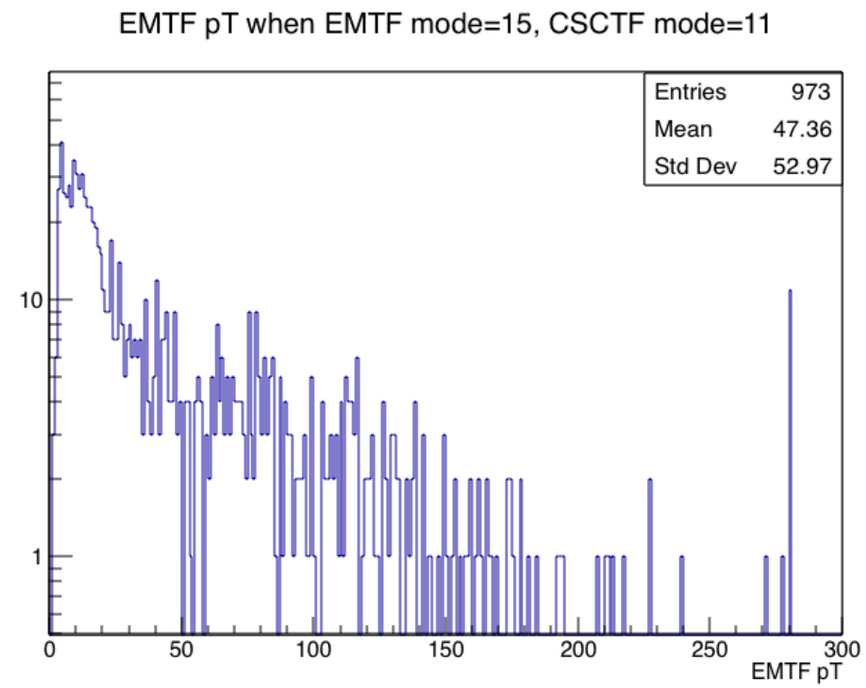
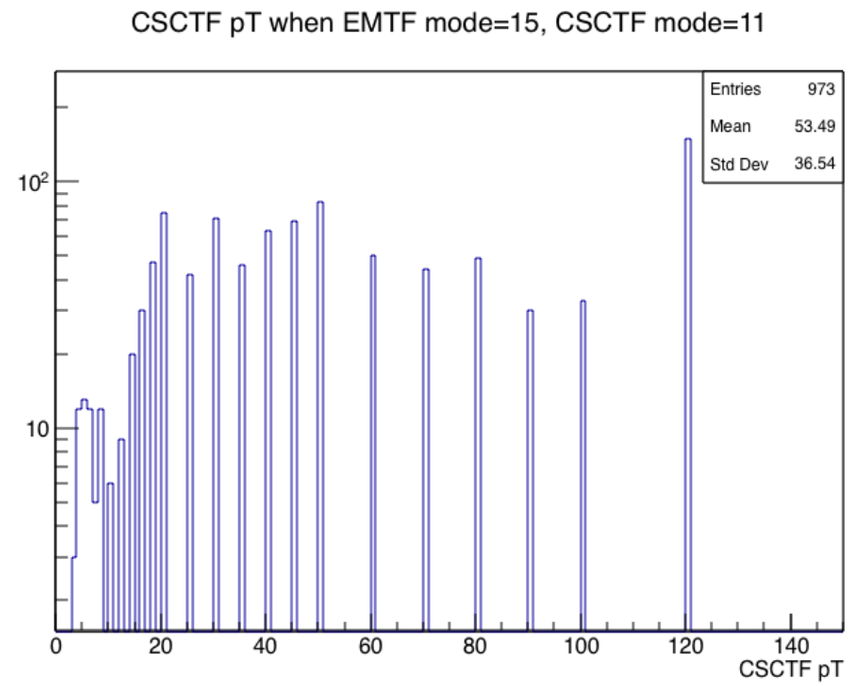
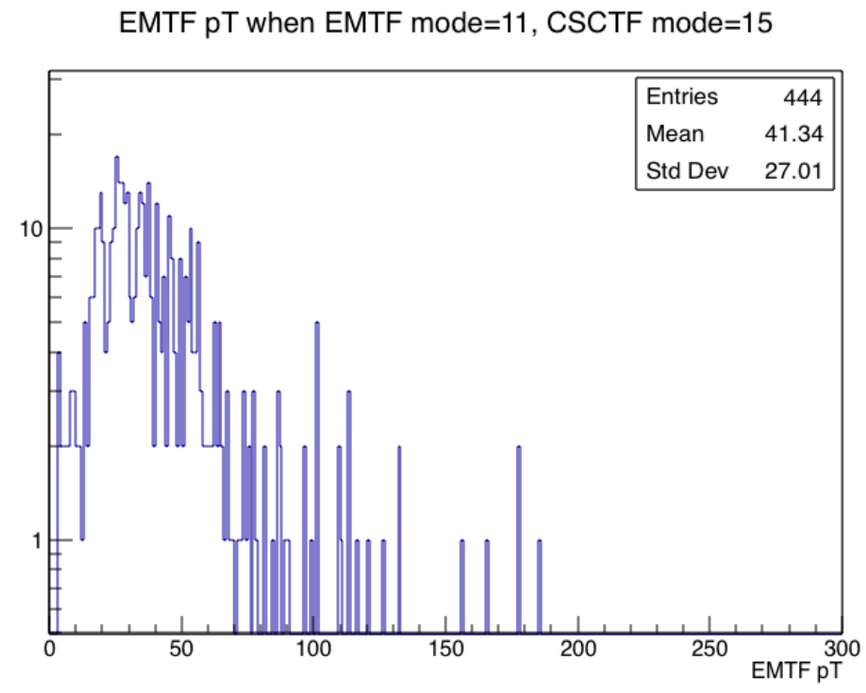
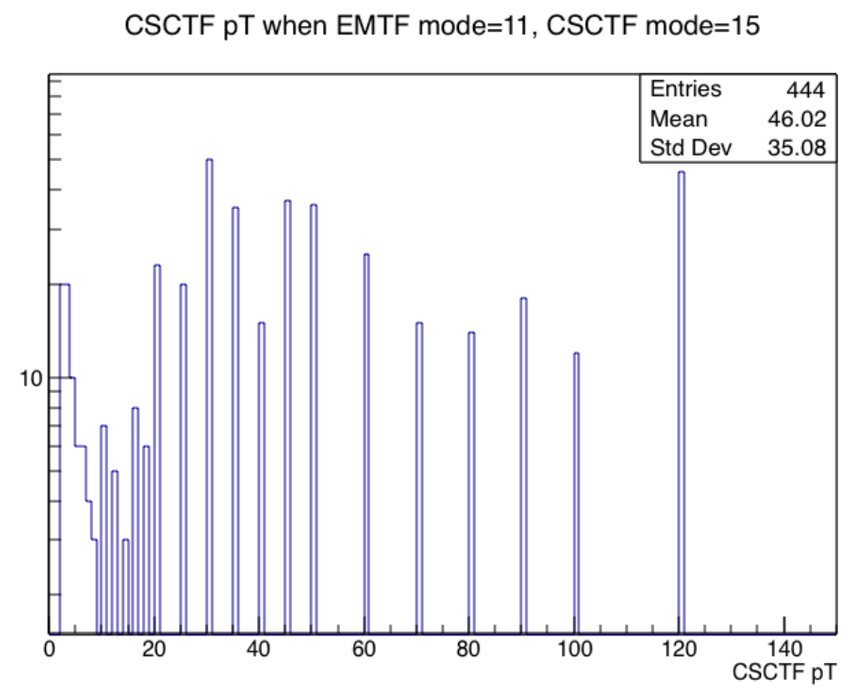
Disagree on station #2









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Look into track number in stations

Disagree on station #3

(EMTF, CSCTF) mode	Stations	1	2	3	4
(15,13)	RECO	720	686	366	677
	EMTF	783	783	783	783
	CSCTF	783	783	0	783
(13,15)	RECO	1508	1468	1432	1444
	EMTF	1617	1617	0	1617
	CSCTF	1617	1617	1617	1617

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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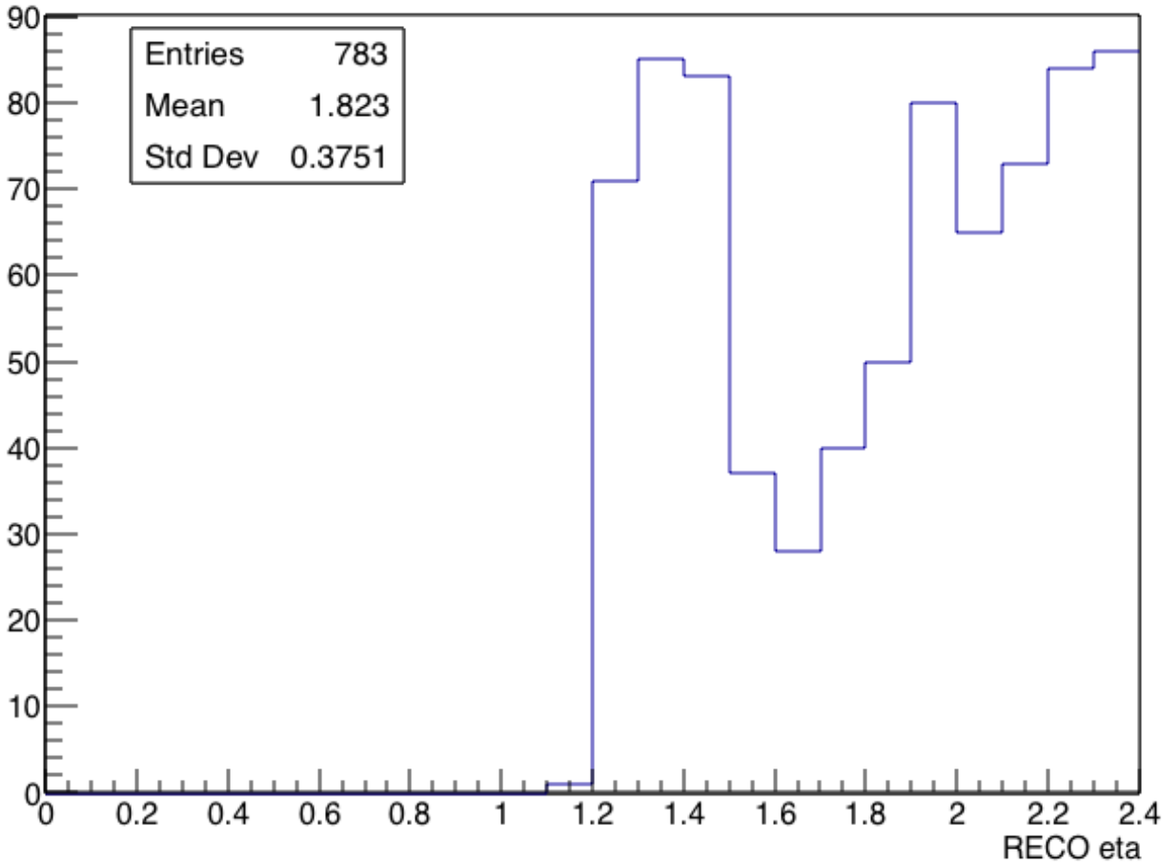
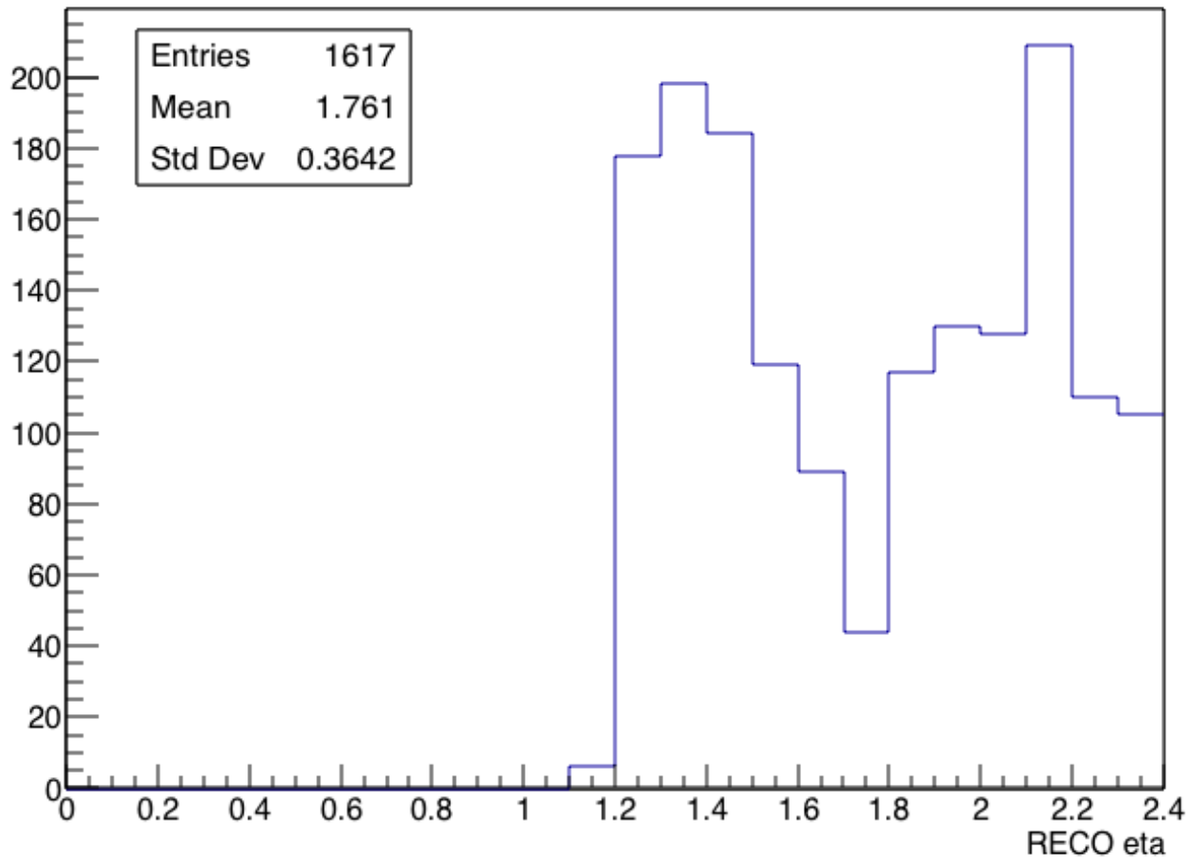
Disagree on station #3

RECO eta when EMTF mode=15,CSCTF mode=13



RECO eta when EMTF mode=13,CSCTF mode=15



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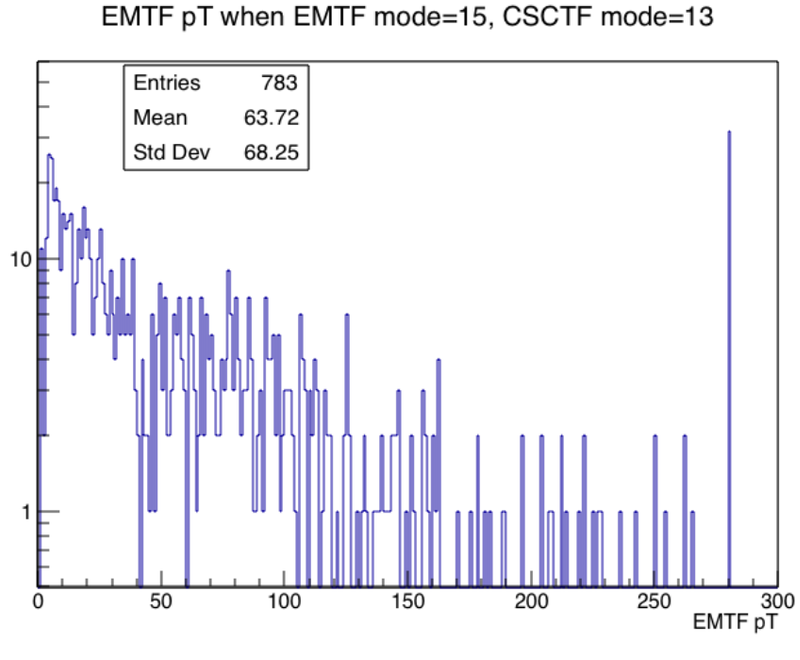
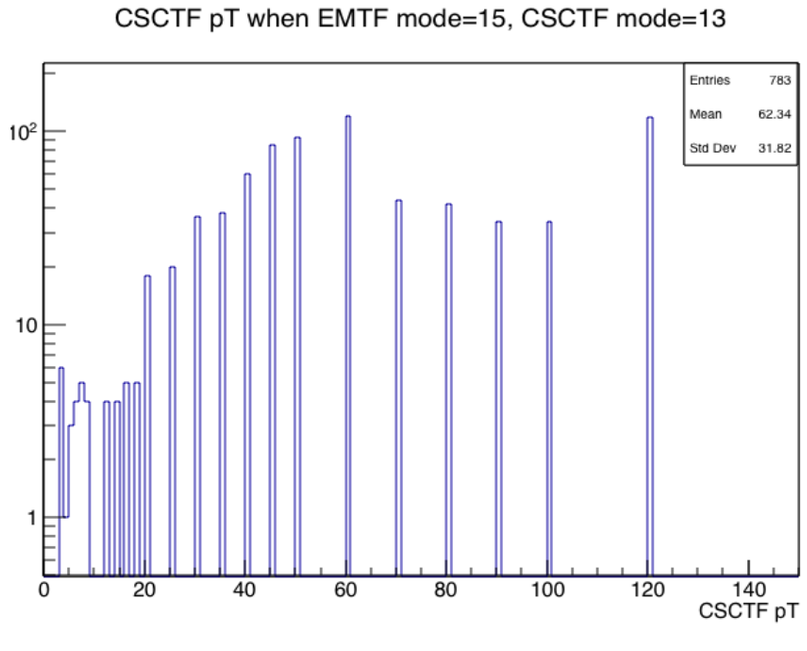
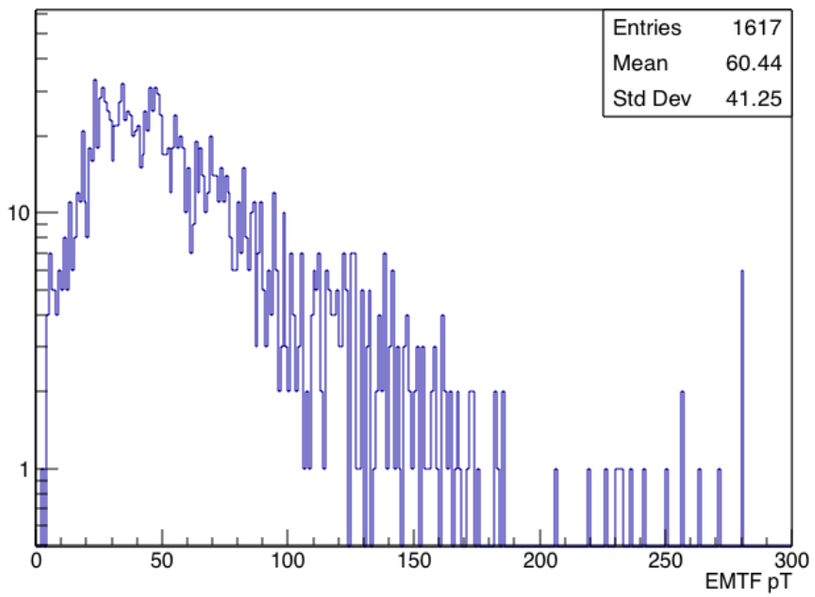
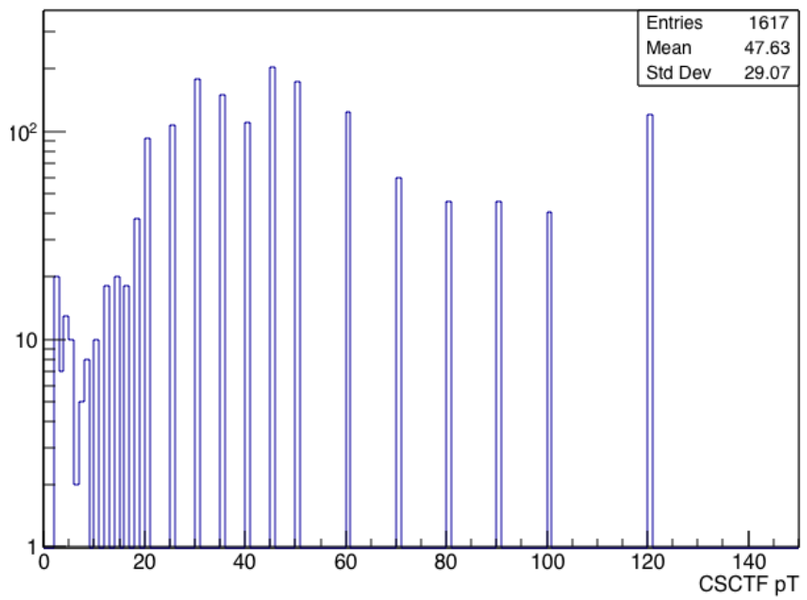
Disagree on station #3









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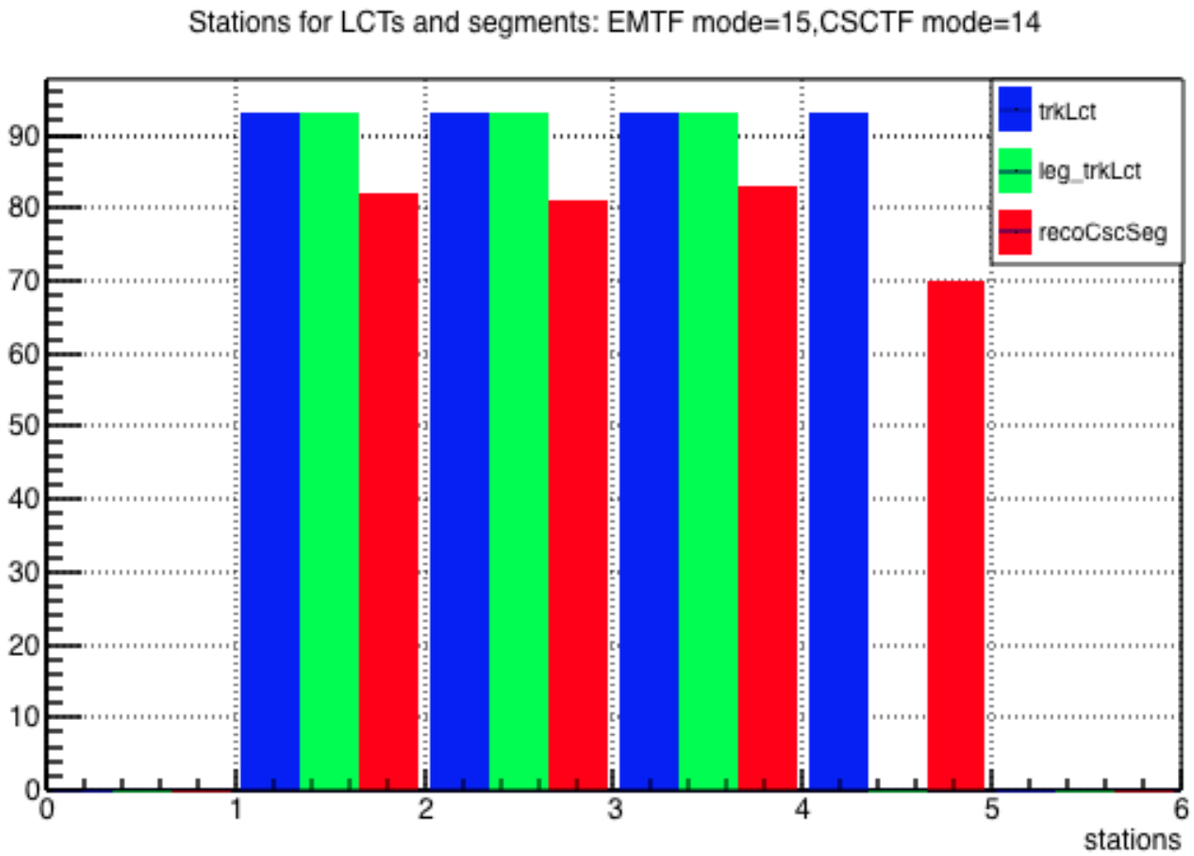
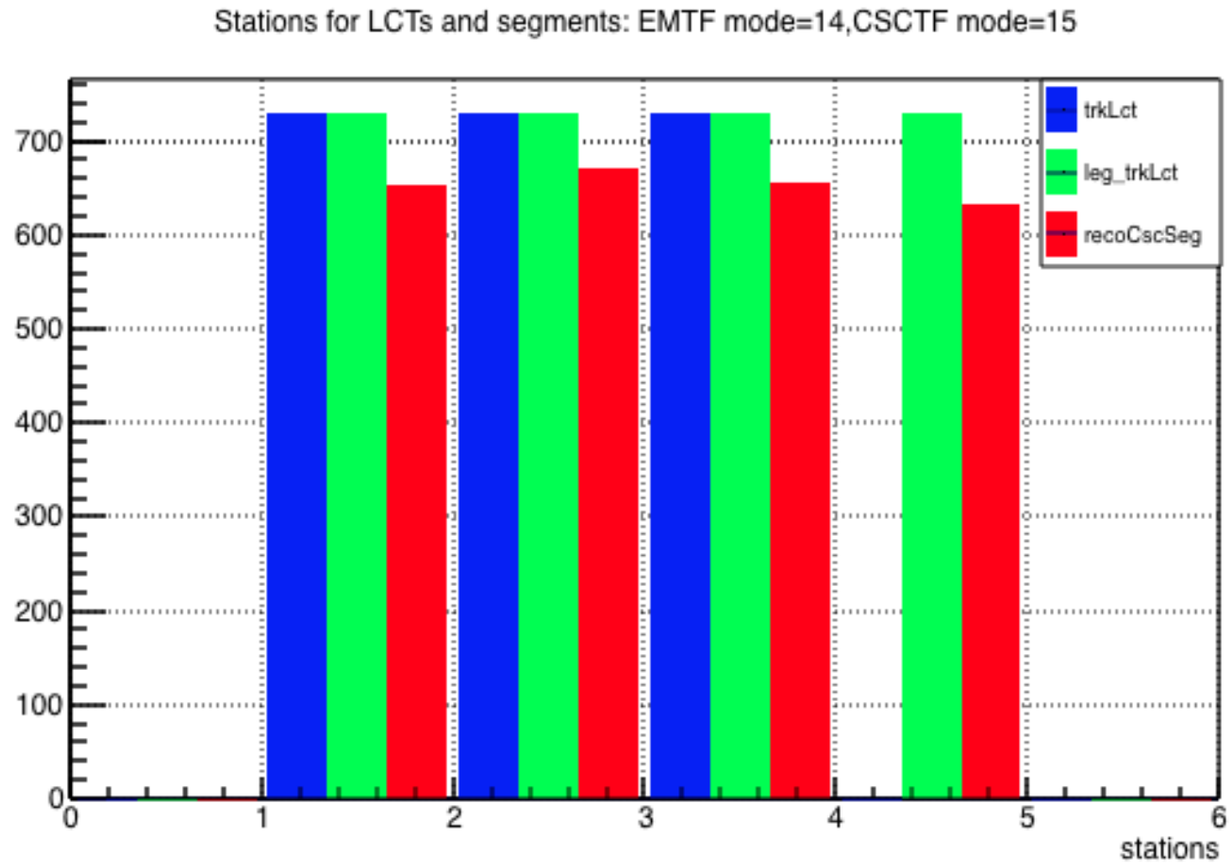
Disagree on station #4

****
(EMTF, CSCTF) * [number of tracks] * Agree
****
(15, 14):(14, 15) * [93 +/- 9 : 729 +/- 27] * NO
****





- RECO muon includes more stations than EMTF and CSCTF when reconstructing the same track(see other disagreed modes in backup)

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Look into track number in stations

Disagree on station #4

(EMTF, CSCTF) mode	Stations	1	2	3	4
(15,14)	RECO	82	81	83	70
	EMTF	93	93	93	93
	CSCTF	93	93	93	0
(14,15)	RECO	654	671	657	633
	EMTF	729	729	729	0
	CSCTF	729	729	729	729

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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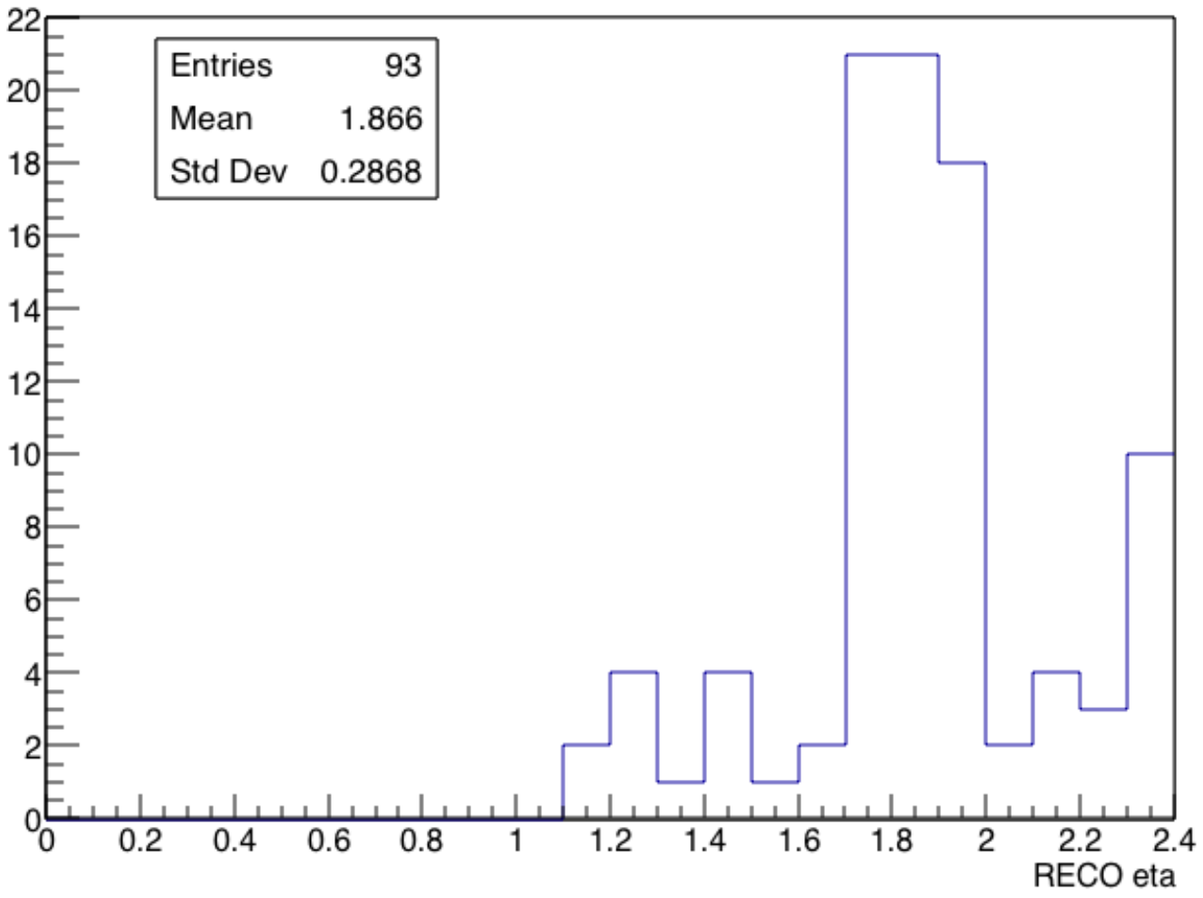
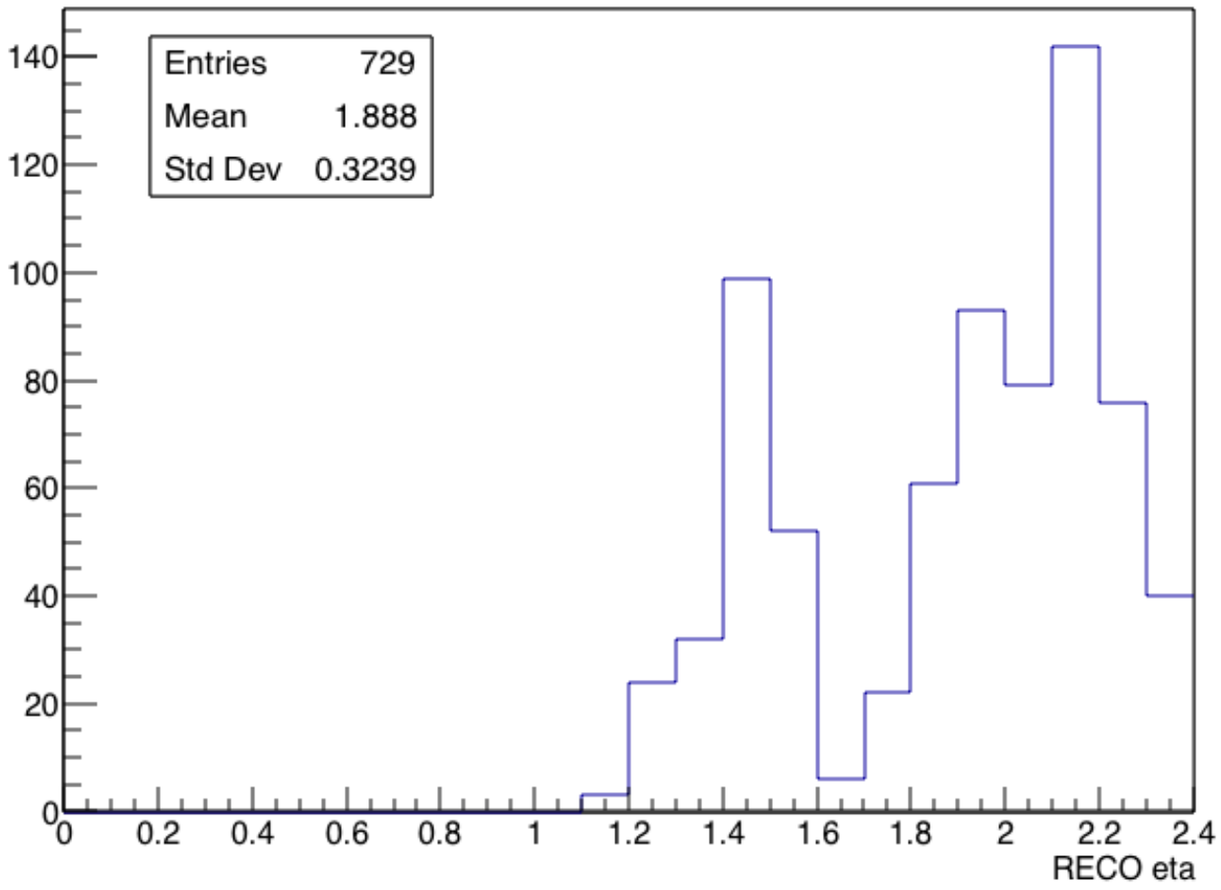
Disagree on station #4

RECO eta when EMTF mode=15,CSCTF mode=14



RECO eta when EMTF mode=14,CSCTF mode=15



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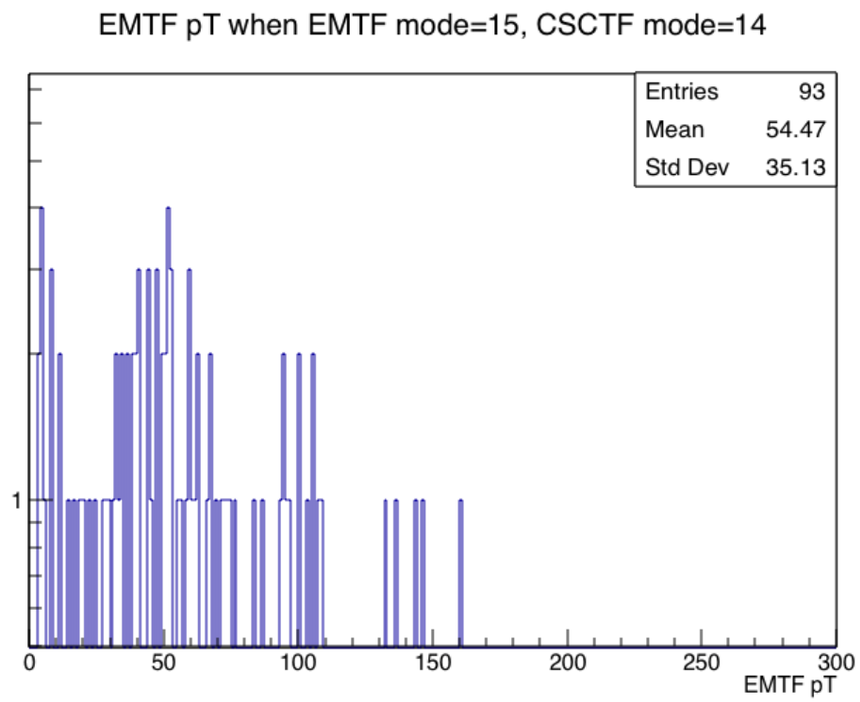
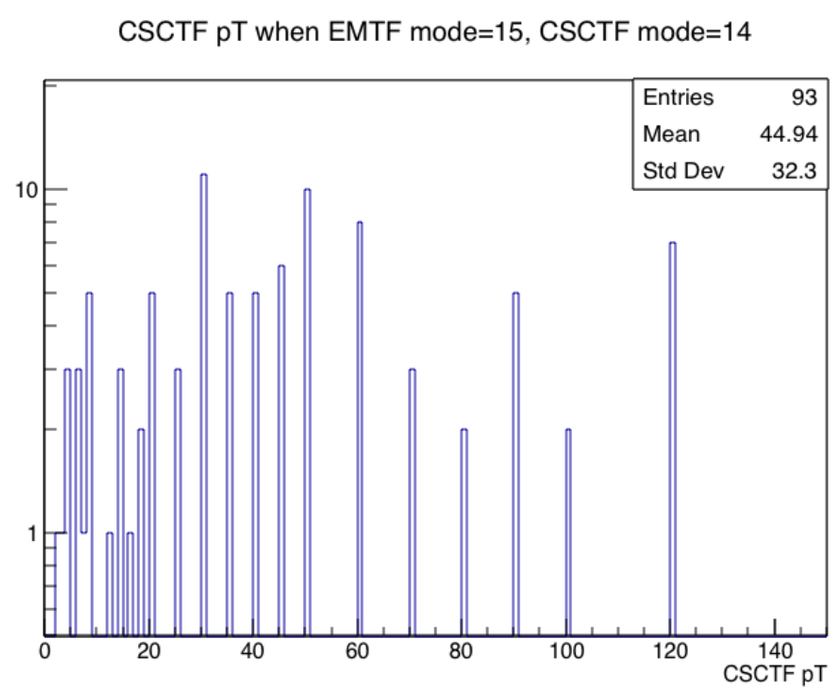
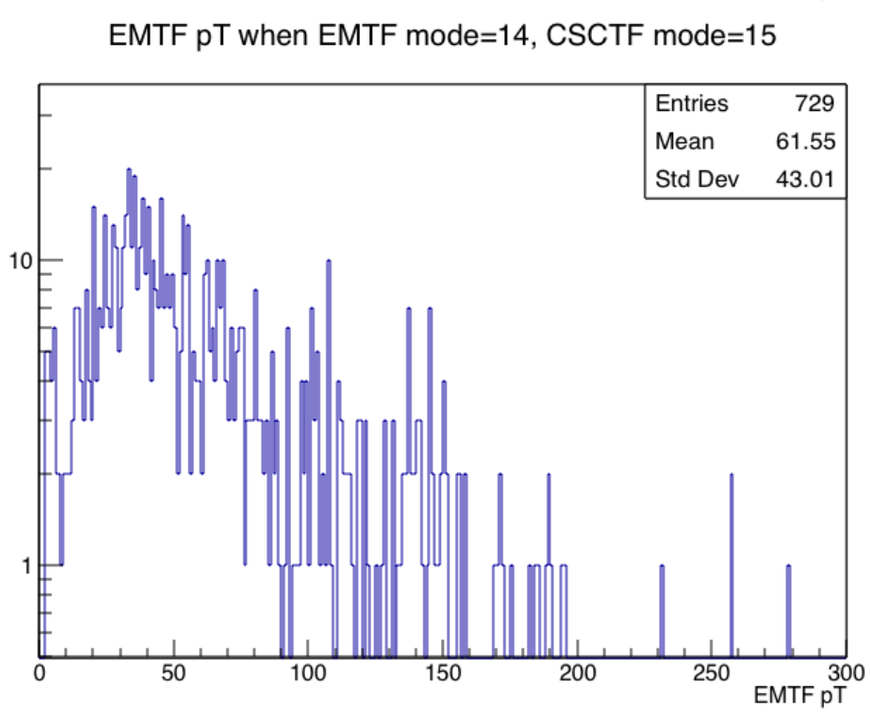
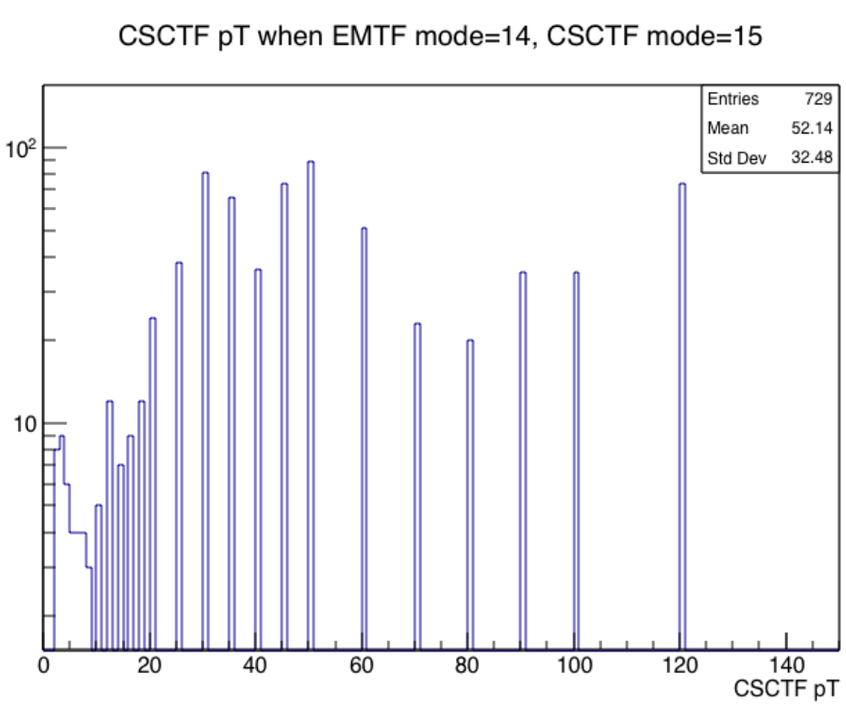
Disagree on station #4









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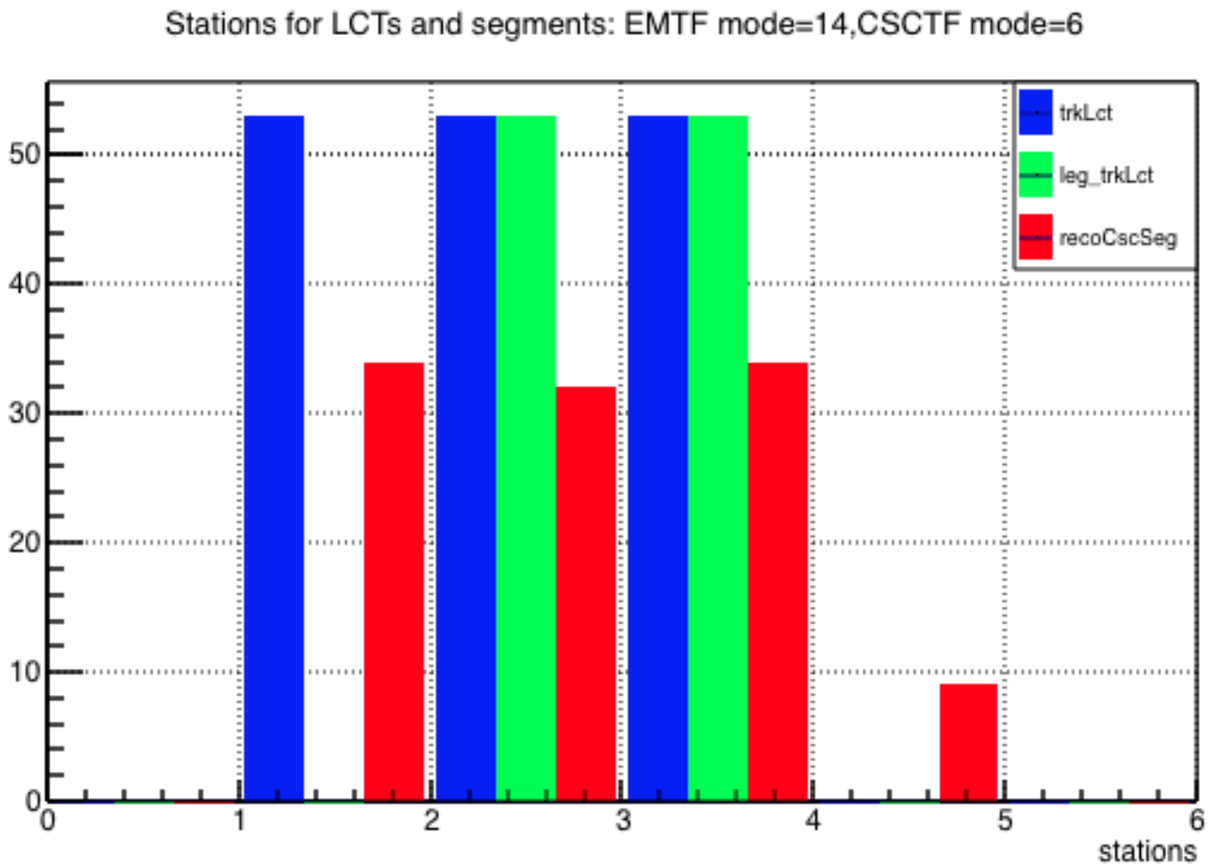
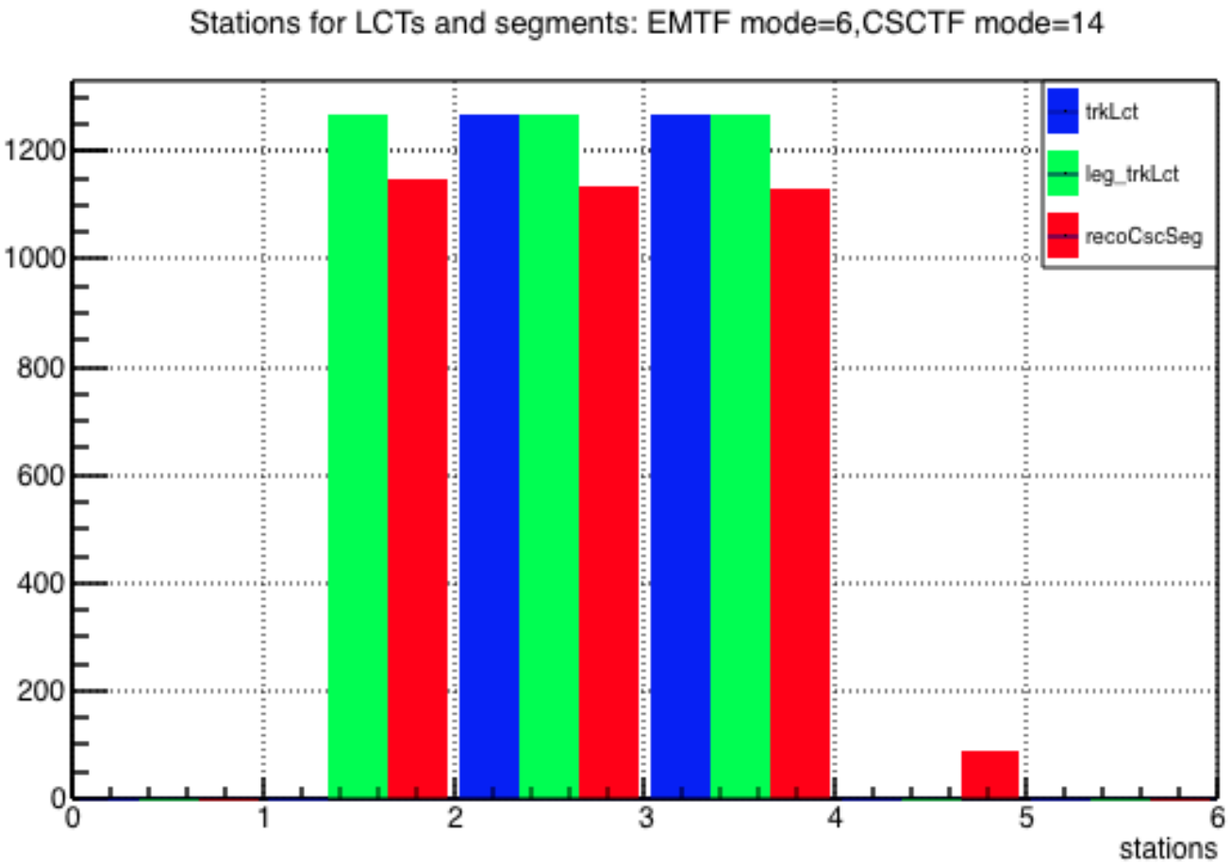
Disagree on station #1

****
(EMTF, CSCTF) * [number of tracks] * Agree
****
(14, 6):(6, 14) * [53 +/- 7 : 1267 +/- 35] * NO
****





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Look into track number in stations

Disagree on station #1

(EMTF, CSCTF) mode	Stations	1	2	3	4
(14,6)	RECO	34	32	34	9
	EMTF	53	53	53	0
	CSCTF	0	53	53	0
(6,14)	RECO	1150	1136	1132	88
	EMTF	0	1267	1267	0
	CSCTF	1267	1267	1267	0

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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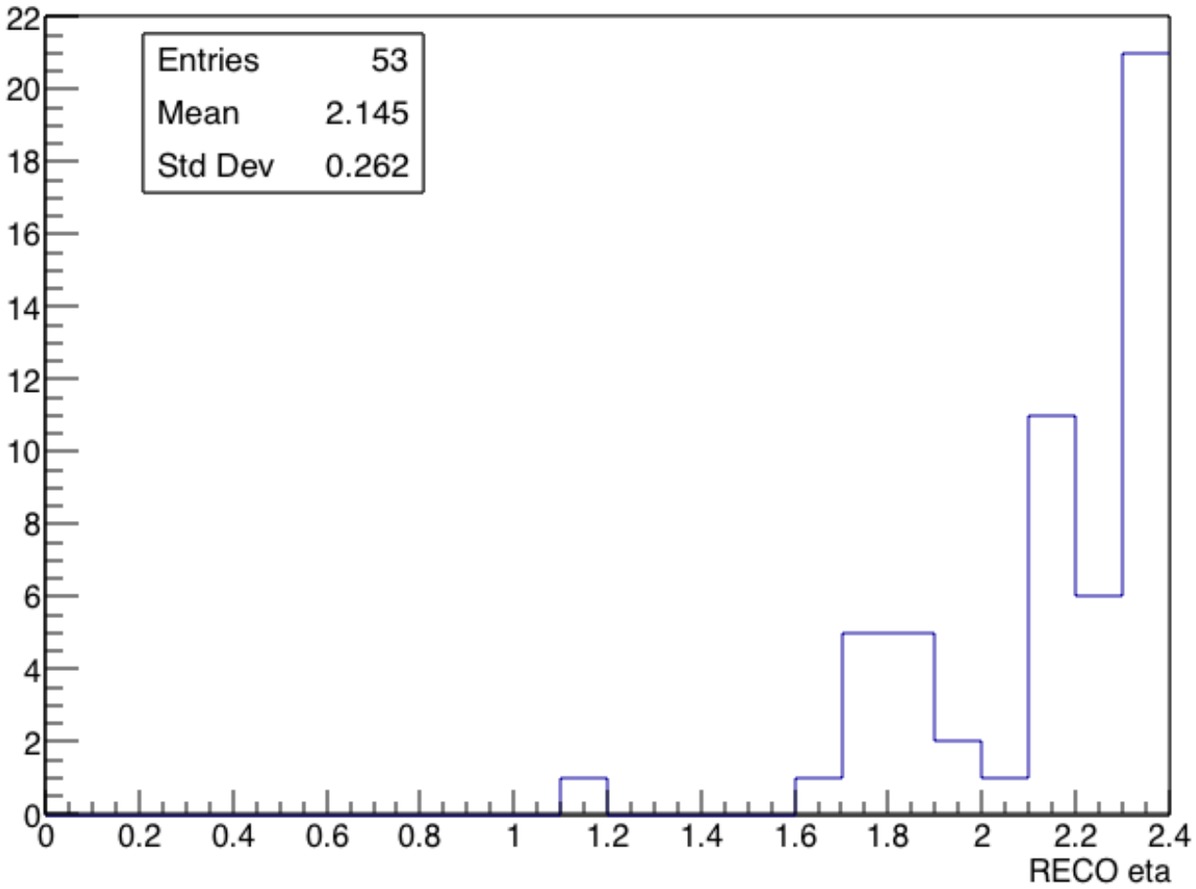
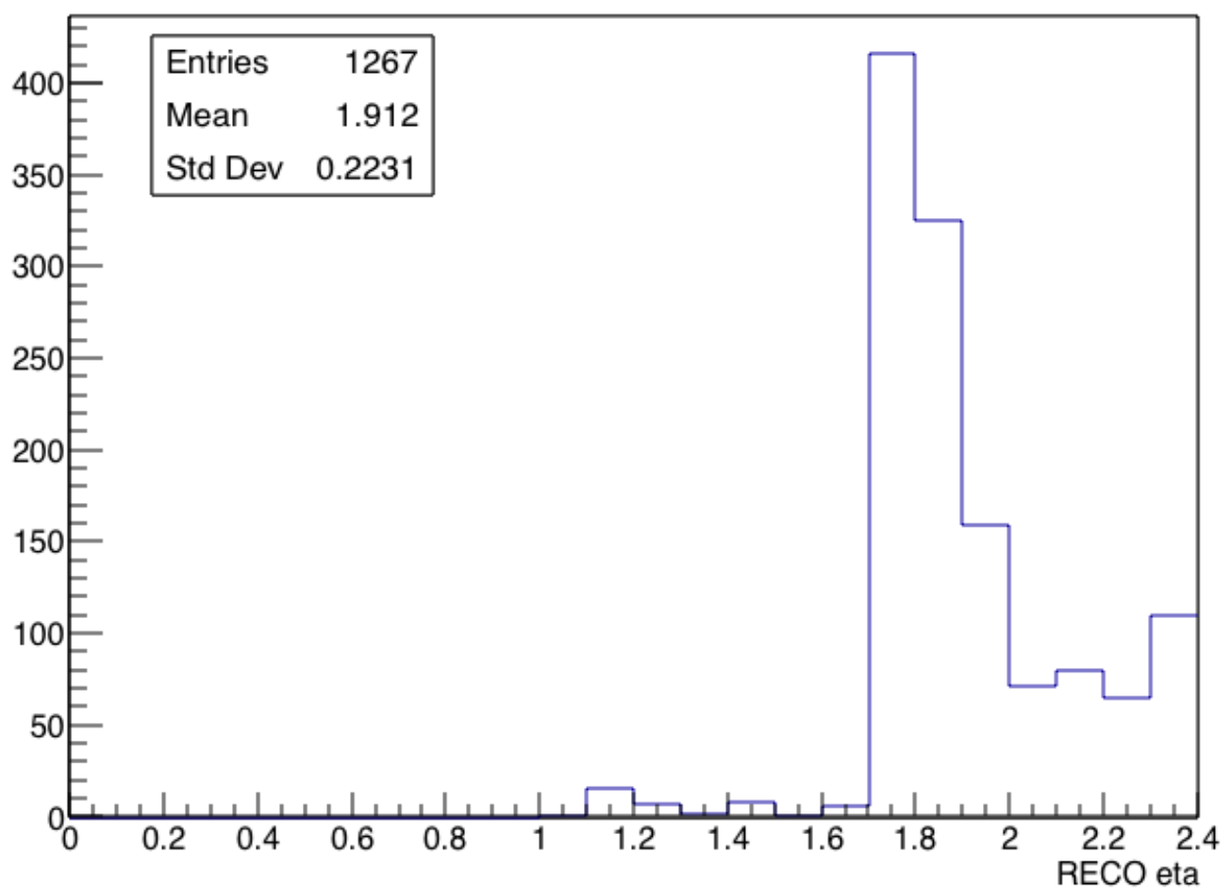
Disagree on station #1

RECO eta when EMTF mode=14,CSCTF mode=6



RECO eta when EMTF mode=6,CSCTF mode=14



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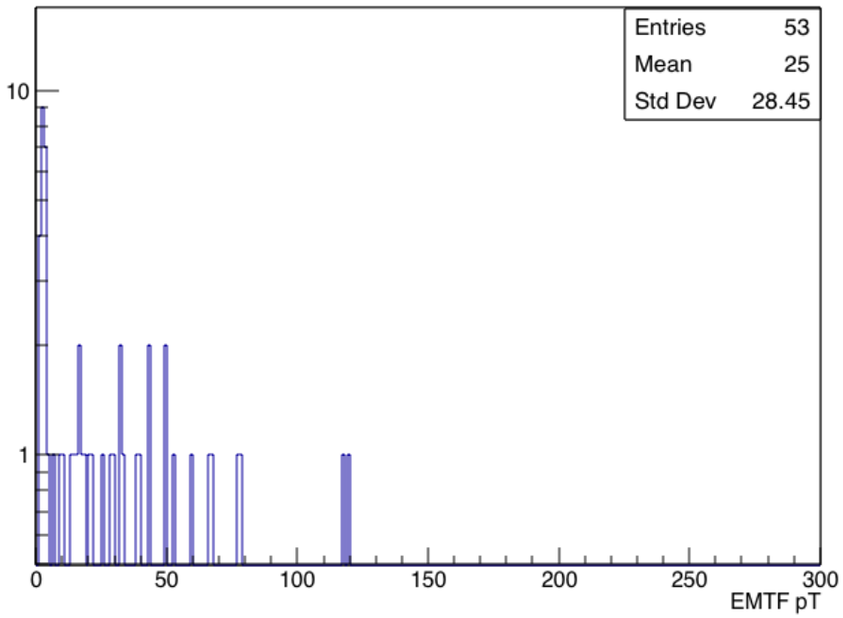
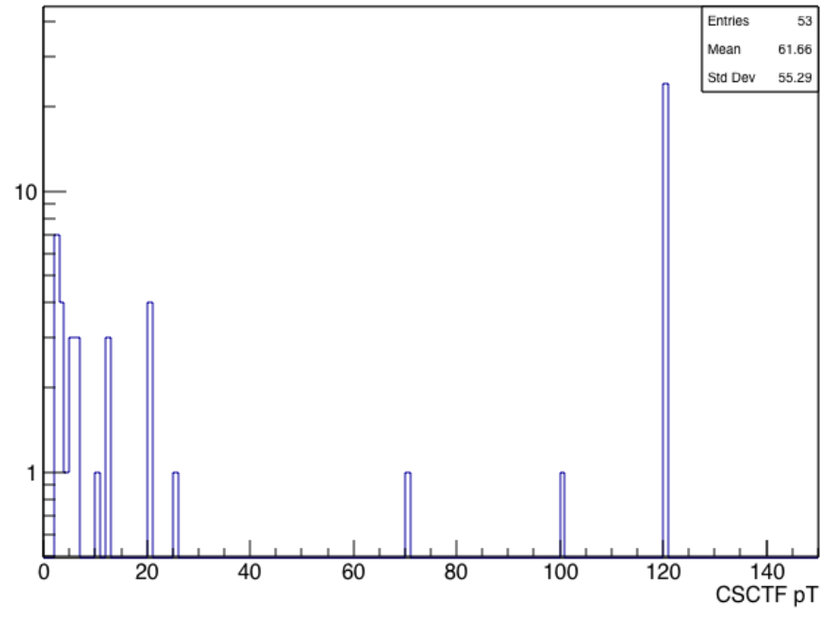
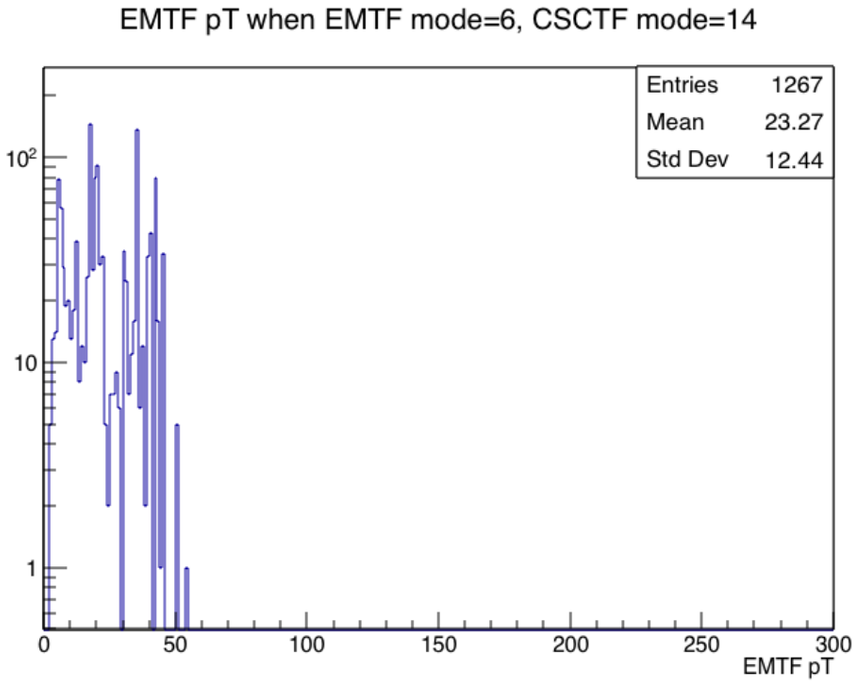
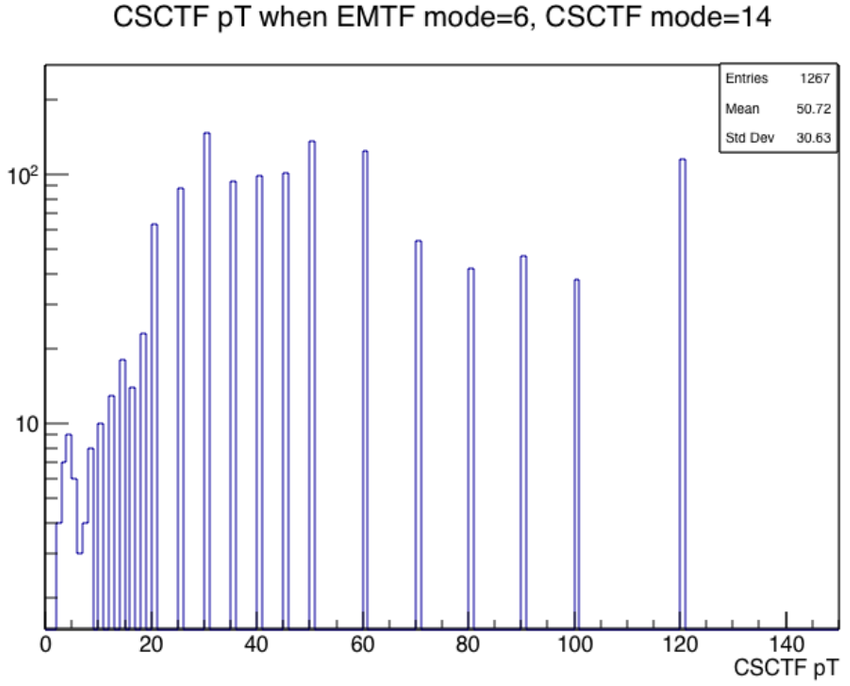
Disagree on station #1









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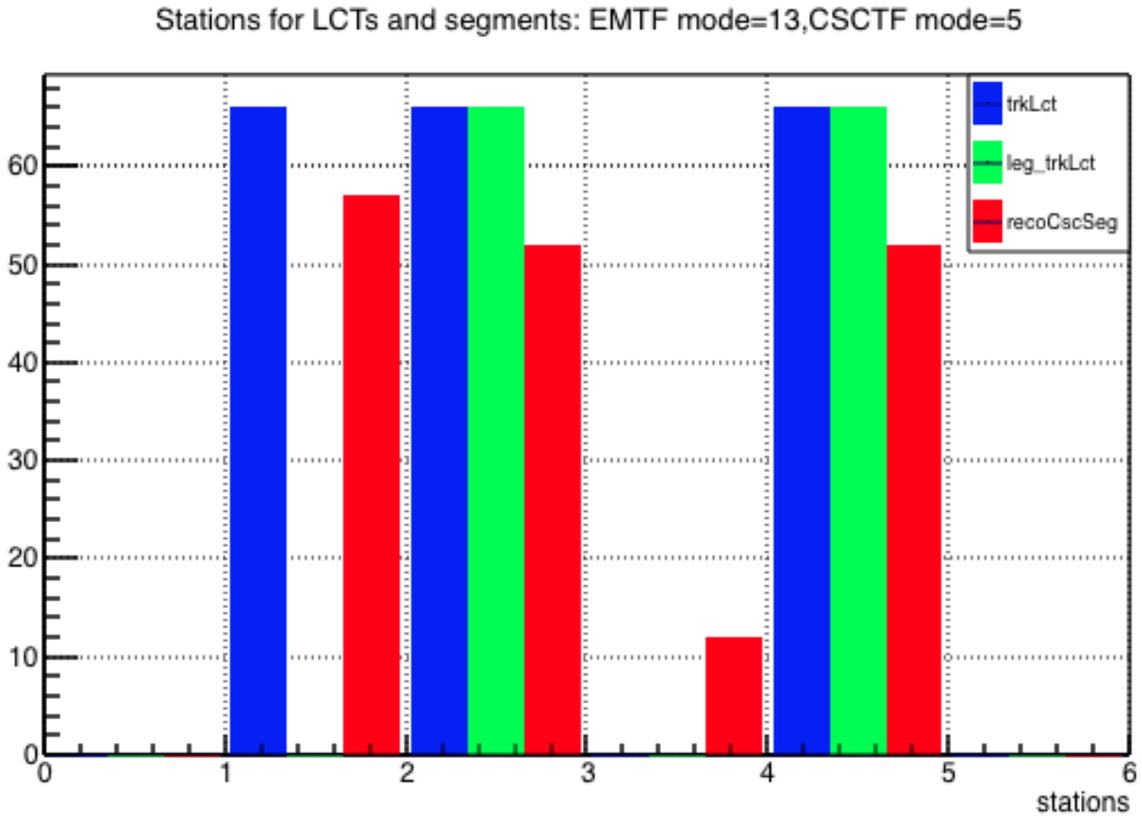
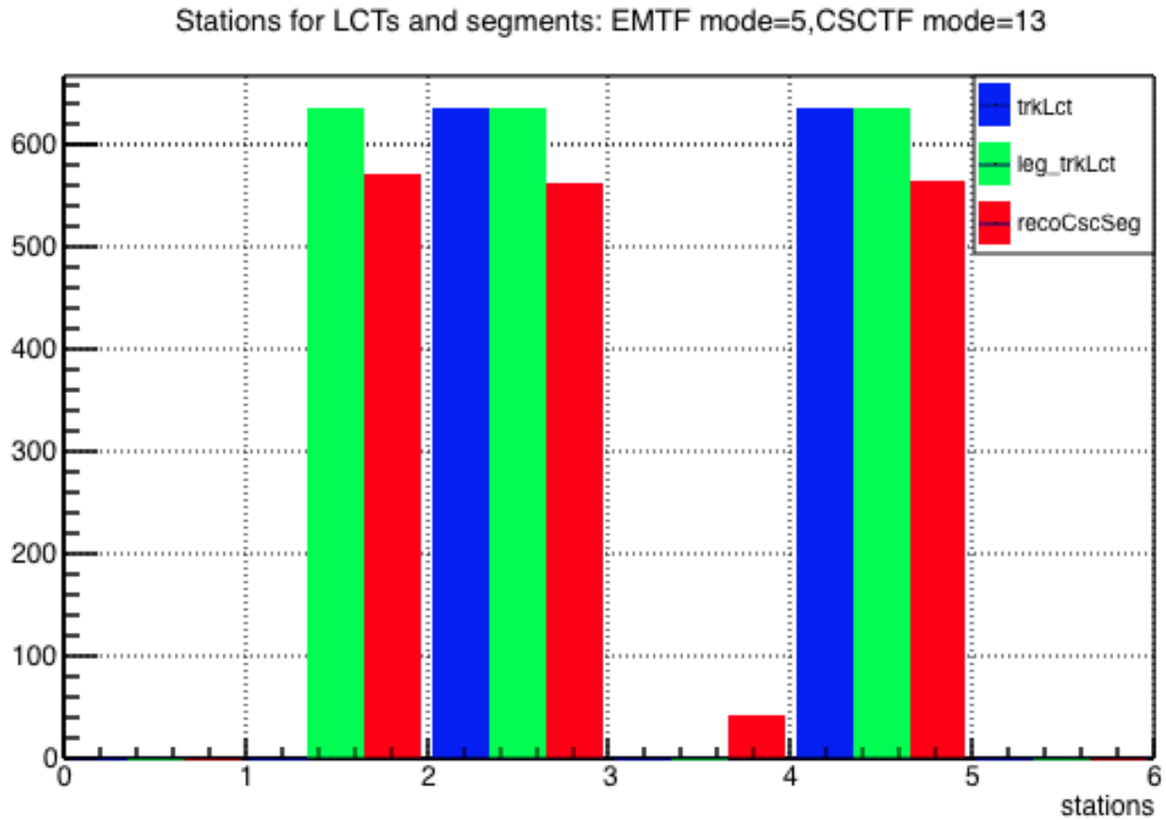
Disagree on station #1

****
(EMTF, CSCTF) * [number of tracks] * Agree
****
(13, 5):(5, 13) * [66 +/- 8 : 636 +/- 25] * NO
****





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Look into track number in stations

Disagree on station #1

(EMTF, CSCTF) mode	Stations	1	2	3	4
(13, 5)	RECO	57	52	12	52
	EMTF	66	66	0	66
	CSCTF	0	66	0	66
(5, 13)	RECO	572	563	43	565
	EMTF	0	636	0	636
	CSCTF	636	636	0	636

- EMTF/CSCTF can both be wrong in mode
- Overall, RECO muon is more probable to include more stations than EMTF or CSCTF

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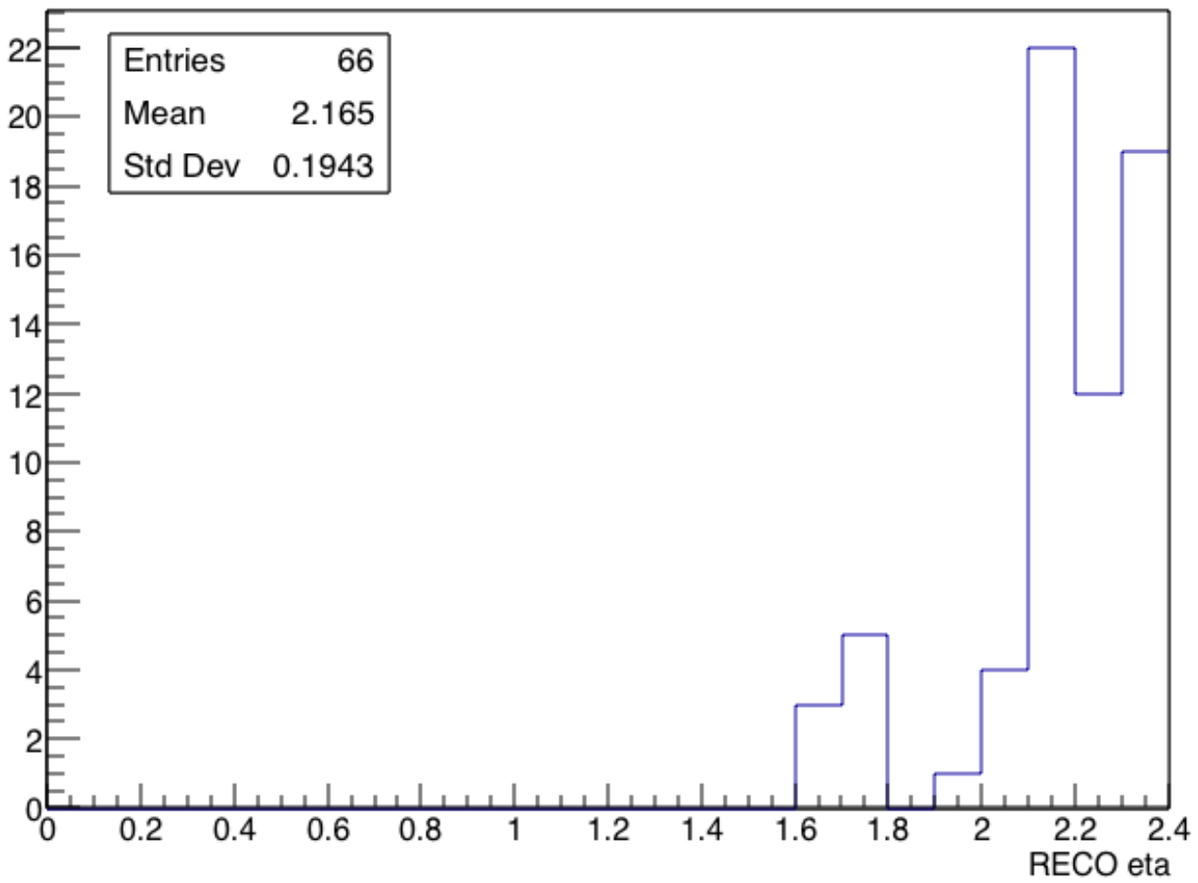
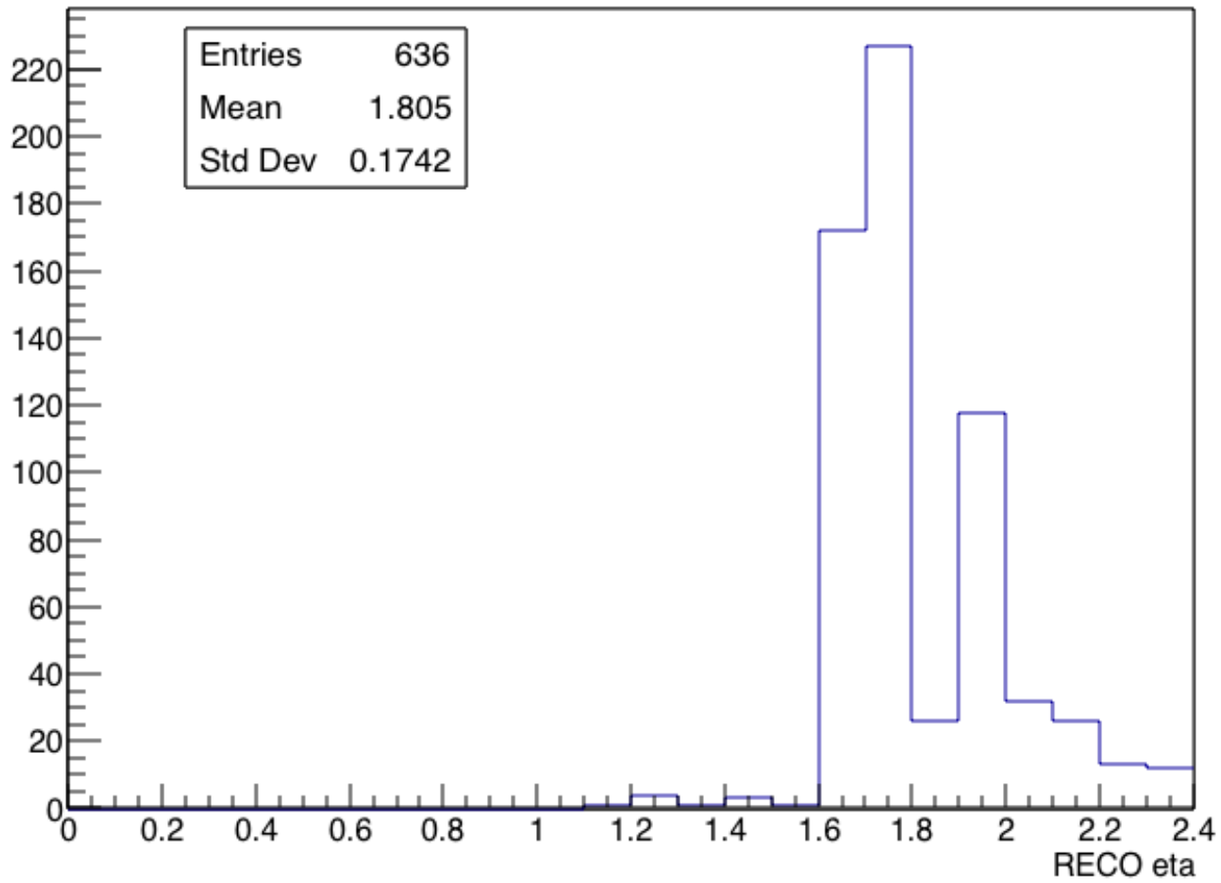
Disagree on station #1

RECO eta when EMTF mode=13,CSCTF mode=5



RECO eta when EMTF mode=5,CSCTF mode=13



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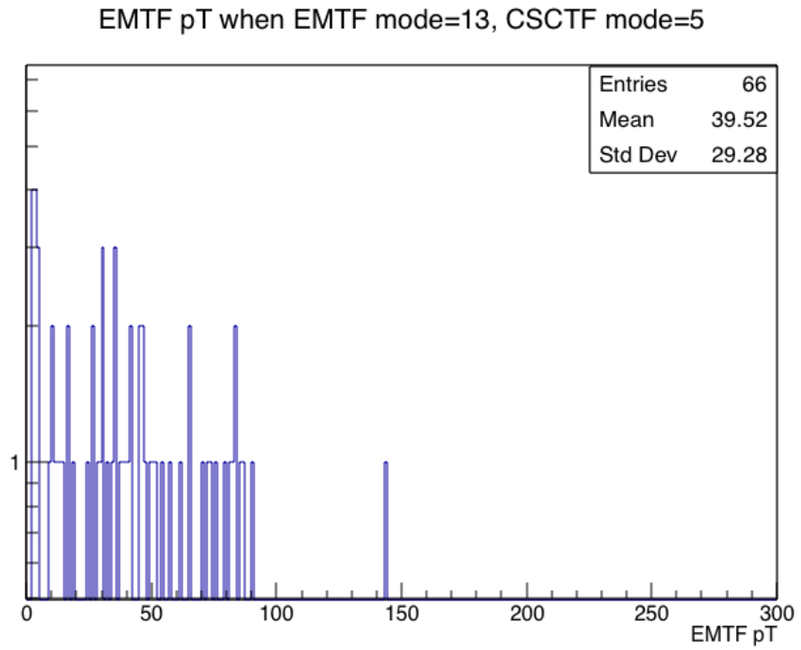
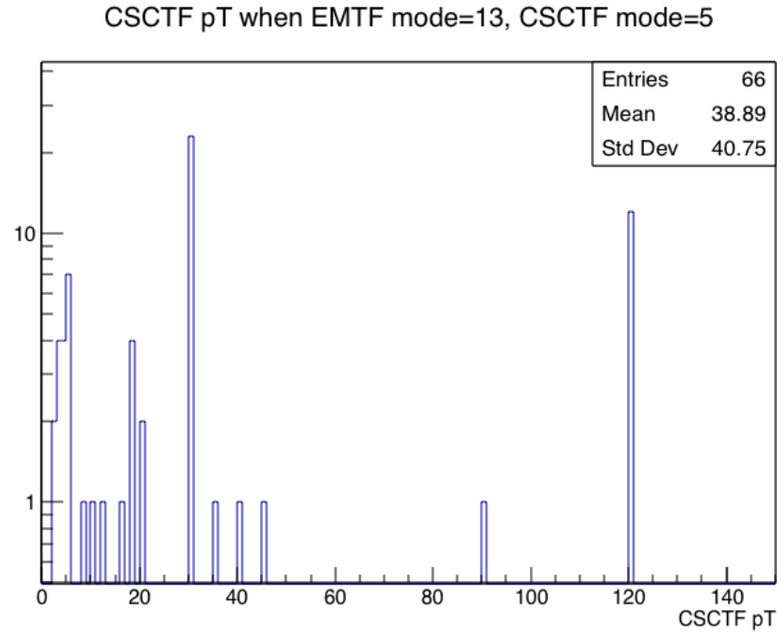
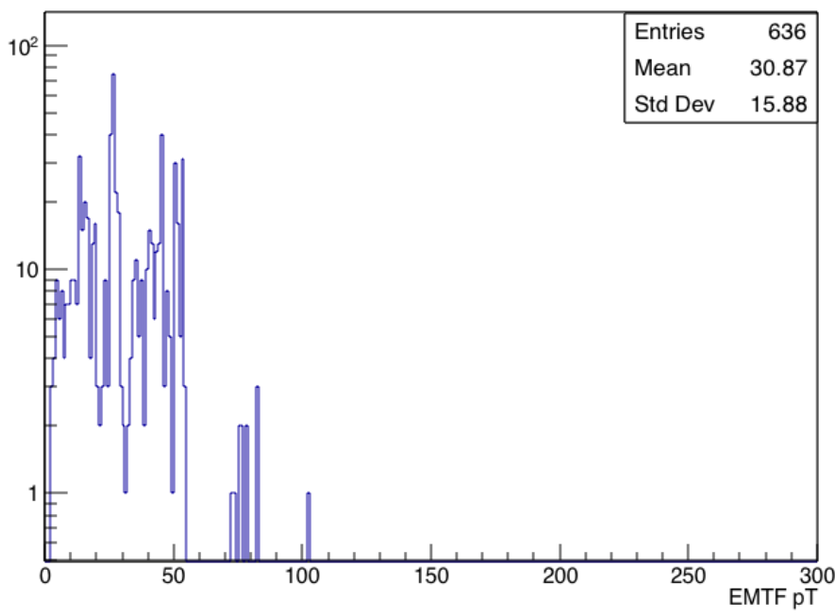
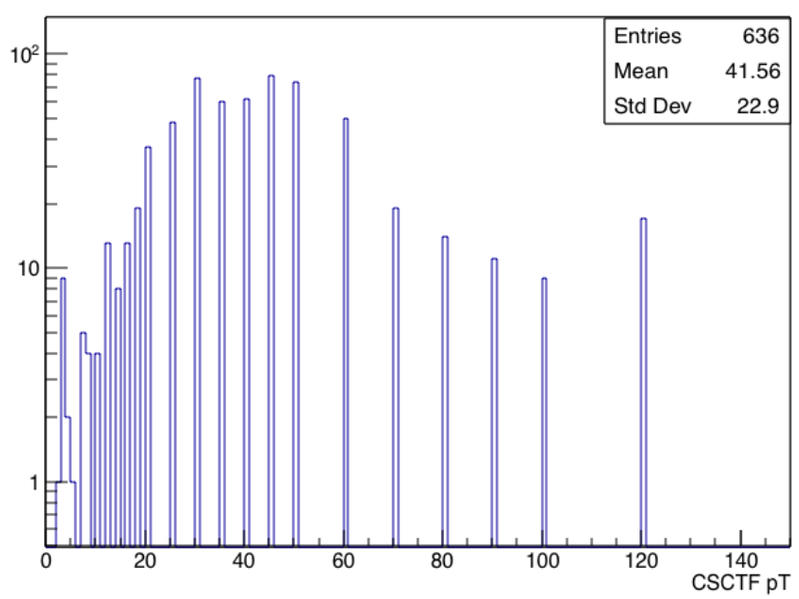
Disagree on station #1









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EMTF mode vs CSCTF mode

```
*****************************************************************
(EMTF, CSCTF)    *     [number of tracks]        *   Agree
*****************************************************************
( 2,  1):( 1,  2) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 3,  1):( 1,  3) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 3,  2):( 2,  3) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 4,  1):( 1,  4) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 4,  2):( 2,  4) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 4,  3):( 3,  4) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 5,  1):( 1,  5) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 5,  2):( 2,  5) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 5,  3):( 3,  5) *   [  1 +/-  1 :   0 +/-  0]  *   YES
( 5,  4):( 4,  5) *   [  2 +/-  1 :   0 +/-  0]  *   NO
( 6,  1):( 1,  6) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 6,  2):( 2,  6) *   [ 11 +/-  3 :   0 +/-  0]  *   NO
( 6,  3):( 3,  6) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 6,  4):( 4,  6) *   [ 14 +/-  3 :   0 +/-  0]  *   NO
( 6,  5):( 5,  6) *   [  0 +/-  0 :   1 +/-  1]  *   YES
( 7,  1):( 1,  7) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 7,  2):( 2,  7) *   [  4 +/-  2 :   0 +/-  0]  *   NO
( 7,  3):( 3,  7) *   [  2 +/-  1 :  20 +/-  4]  *   NO
( 7,  4):( 4,  7) *   [  9 +/-  3 :   0 +/-  0]  *   NO
( 7,  5):( 5,  7) *   [  2 +/-  1 :  84 +/-  9]  *   NO
( 7,  6):( 6,  7) *   [147 +/- 12 :  46 +/-  6]  *   NO
( 8,  1):( 1,  8) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 8,  2):( 2,  8) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 8,  3):( 3,  8) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 8,  4):( 4,  8) *   [  0 +/-  0 :   0 +/-  0]  *   YES
( 8,  5):( 5,  8) *   [  0 +/-  0 :   0 +/-  0]  *   YES
*****************************************************************
```


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EMTF mode vs CSCTF mode

```
****************************************************************
(EMTF, CSCTF)     *      [number of tracks]          *   Agree
****************************************************************
( 8,  6):( 6,  8) *    [   0 +/-  0 :    1 +/-  1]   *   YES
( 8,  7):( 7,  8) *    [   0 +/-  0 :    0 +/-  0]   *   YES
( 9,  1):( 1,  9) *    [   0 +/-  0 :    0 +/-  0]   *   YES
( 9,  2):( 2,  9) *    [   0 +/-  0 :    0 +/-  0]   *   YES
( 9,  3):( 3,  9) *    [   2 +/-  1 :    1 +/-  1]   *   YES
( 9,  4):( 4,  9) *    [   0 +/-  0 :    0 +/-  0]   *   YES
( 9,  5):( 5,  9) *    [   1 +/-  1 :    6 +/-  2]   *   NO
( 9,  6):( 6,  9) *    [   3 +/-  1 :    0 +/-  0]   *   NO
( 9,  7):( 7,  9) *    [   1 +/-  1 :   16 +/-  4]   *   NO
( 9,  8):( 8,  9) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  1):( 1, 10) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  2):( 2, 10) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  3):( 3, 10) *    [   5 +/-  2 :    0 +/-  0]   *   NO
(10,  4):( 4, 10) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  5):( 5, 10) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  6):( 6, 10) *    [   4 +/-  2 :    6 +/-  2]   *   YES
(10,  7):( 7, 10) *    [   0 +/-  0 :    1 +/-  1]   *   YES
(10,  8):( 8, 10) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(10,  9):( 9, 10) *    [   4 +/-  2 :    1 +/-  1]   *   YES
(11,  1):( 1, 11) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(11,  2):( 2, 11) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(11,  3):( 3, 11) *    [  50 +/-  7 :  193 +/- 13]   *   NO
(11,  4):( 4, 11) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(11,  5):( 5, 11) *    [   0 +/-  0 :    1 +/-  1]   *   YES
(11,  6):( 6, 11) *    [   0 +/-  0 :    8 +/-  2]   *   NO
(11,  7):( 7, 11) *    [   8 +/-  2 :   48 +/-  6]   *   NO
****************************************************************
```


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EMTF mode vs CSCTF mode

```
*************************************************************
(EMTF, CSCTF)     *      [number of tracks]         *   Agree
*************************************************************
(11,  8):( 8, 11) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(11,  9):( 9, 11) *    [  26 +/-  5 :  160 +/- 12]   *   NO
(11, 10):(10, 11) *    [   5 +/-  2 :  233 +/- 15]   *   NO
(12,  1):( 1, 12) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(12,  2):( 2, 12) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(12,  3):( 3, 12) *    [   2 +/-  1 :    1 +/-  1]   *   YES
(12,  4):( 4, 12) *    [   3 +/-  1 :    0 +/-  0]   *   NO
(12,  5):( 5, 12) *    [   1 +/-  1 :    3 +/-  1]   *   YES
(12,  6):( 6, 12) *    [   6 +/-  2 :   14 +/-  3]   *   NO
(12,  7):( 7, 12) *    [   5 +/-  2 :    7 +/-  2]   *   YES
(12,  8):( 8, 12) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(12,  9):( 9, 12) *    [   0 +/-  0 :    1 +/-  1]   *   YES
(12, 10):(10, 12) *    [   2 +/-  1 :    2 +/-  1]   *   YES
(12, 11):(11, 12) *    [   6 +/-  2 :   10 +/-  3]   *   YES
(13,  1):( 1, 13) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(13,  2):( 2, 13) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(13,  3):( 3, 13) *    [   1 +/-  1 :    0 +/-  0]   *   YES
(13,  4):( 4, 13) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(13,  5):( 5, 13) *    [  66 +/-  8 :  636 +/- 25]   *   NO
(13,  6):( 6, 13) *    [   3 +/-  1 :    4 +/-  2]   *   YES
(13,  7):( 7, 13) *    [  20 +/-  4 :   58 +/-  7]   *   NO
(13,  8):( 8, 13) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(13,  9):( 9, 13) *    [  36 +/-  6 :   71 +/-  8]   *   NO
(13, 10):(10, 13) *    [   4 +/-  2 :    5 +/-  2]   *   YES
(13, 11):(11, 13) *    [  19 +/-  4 :   10 +/-  3]   *   NO
(13, 12):(12, 13) *    [  24 +/-  4 :   72 +/-  8]   *   NO
*************************************************************
```


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EMTF mode vs CSCTF mode

```
****************************************************************
(EMTF, CSCTF)     *      [number of tracks]          *   Agree
****************************************************************
(14,  1):( 1, 14) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(14,  2):( 2, 14) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(14,  3):( 3, 14) *    [   0 +/-  0 :    1 +/-  1]   *   YES
(14,  4):( 4, 14) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(14,  5):( 5, 14) *    [   0 +/-  0 :    3 +/-  1]   *   NO
(14,  6):( 6, 14) *    [  53 +/-  7 : 1267 +/- 35]   *   NO
(14,  7):( 7, 14) *    [  15 +/-  3 :   38 +/-  6]   *   NO
(14,  8):( 8, 14) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(14,  9):( 9, 14) *    [   4 +/-  2 :    3 +/-  1]   *   YES
(14, 10):(10, 14) *    [  12 +/-  3 :   53 +/-  7]   *   NO
(14, 11):(11, 14) *    [   9 +/-  3 :    6 +/-  2]   *   YES
(14, 12):(12, 14) *    [  15 +/-  3 :  187 +/- 13]   *   NO
(14, 13):(13, 14) *    [   6 +/-  2 :    6 +/-  2]   *   YES
(15,  1):( 1, 15) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(15,  2):( 2, 15) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(15,  3):( 3, 15) *    [  11 +/-  3 :   32 +/-  5]   *   NO
(15,  4):( 4, 15) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(15,  5):( 5, 15) *    [   3 +/-  1 :   90 +/-  9]   *   NO
(15,  6):( 6, 15) *    [  12 +/-  3 :  136 +/- 11]   *   NO
(15,  7):( 7, 15) *    [ 633 +/- 25 : 4741 +/- 68]   *   NO
(15,  8):( 8, 15) *    [   0 +/-  0 :    0 +/-  0]   *   YES
(15,  9):( 9, 15) *    [  91 +/-  9 :   48 +/-  6]   *   NO
(15, 10):(10, 15) *    [   7 +/-  2 :   28 +/-  5]   *   NO
(15, 11):(11, 15) *    [ 973 +/- 31 :  444 +/- 21]   *   NO
(15, 12):(12, 15) *    [  46 +/-  6 :   79 +/-  8]   *   NO
(15, 13):(13, 15) *    [ 783 +/- 27 :  +/- 40]   *   NO
(15, 14):(14, 15) *    [  93 +/-  9 :  729 +/- 27]   *   NO
****************************************************************
```


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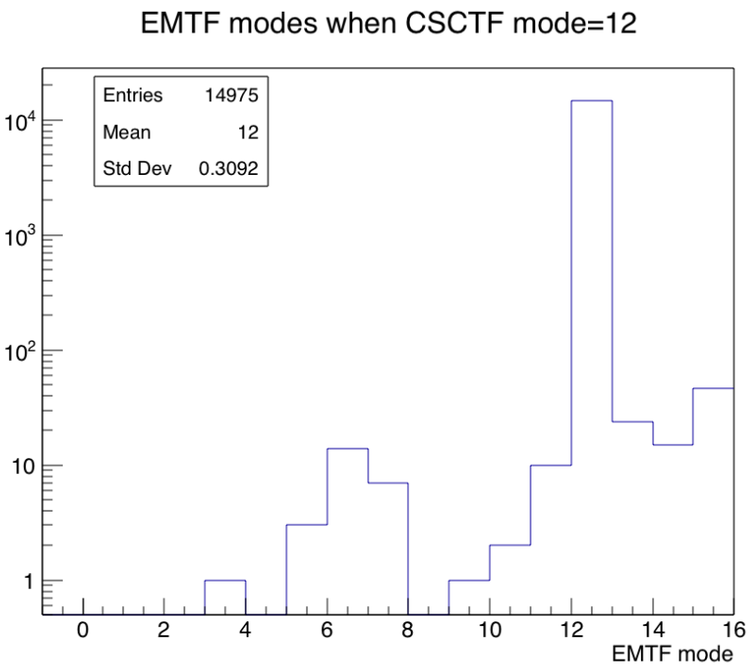
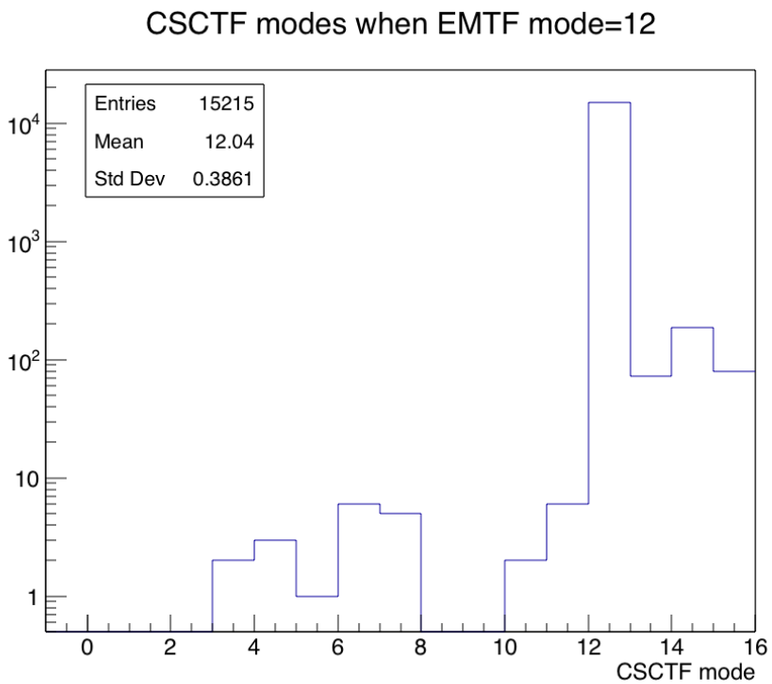
Track Build: separate plot





- EMTF and CSCTF disagree more often in upper diagonal, CSCTF includes more stations than EMTF more often

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