First look at photon efficiency and purity

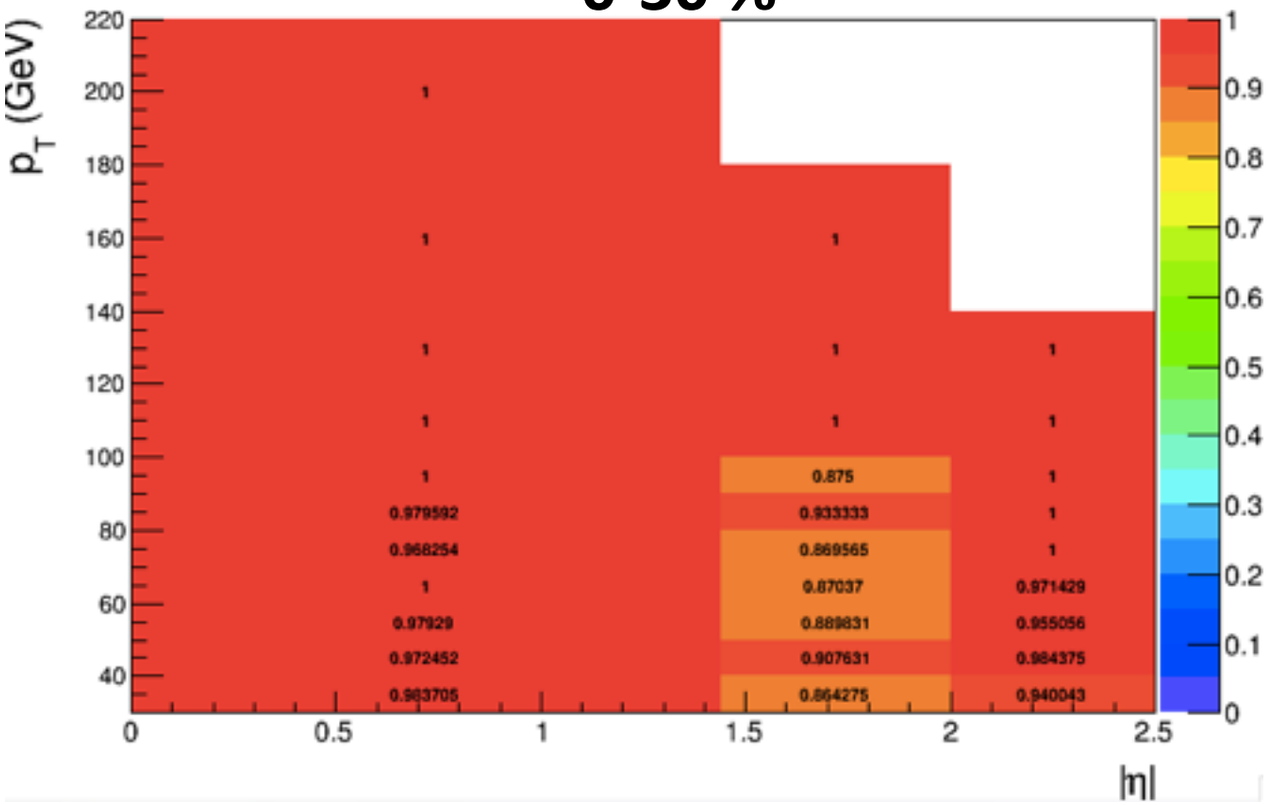
29 Jan 2016

Yeonju Go

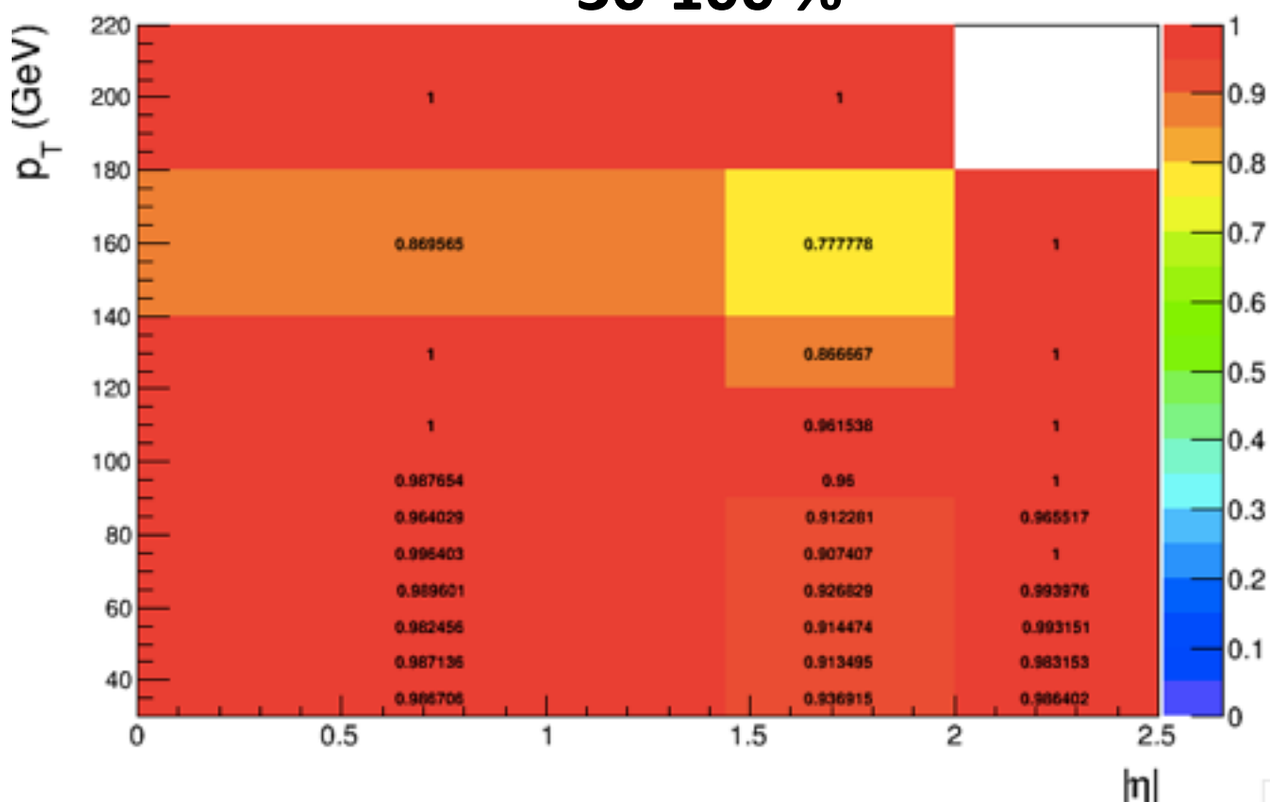
Reconstruction Efficiency

$$\epsilon_{Reco+ID} = \frac{\#\ recoMatched\ generated\ photons}{\#\ generated\ isolated\ photons\ (genIso < 5\ GeV)}$$

0-30 %



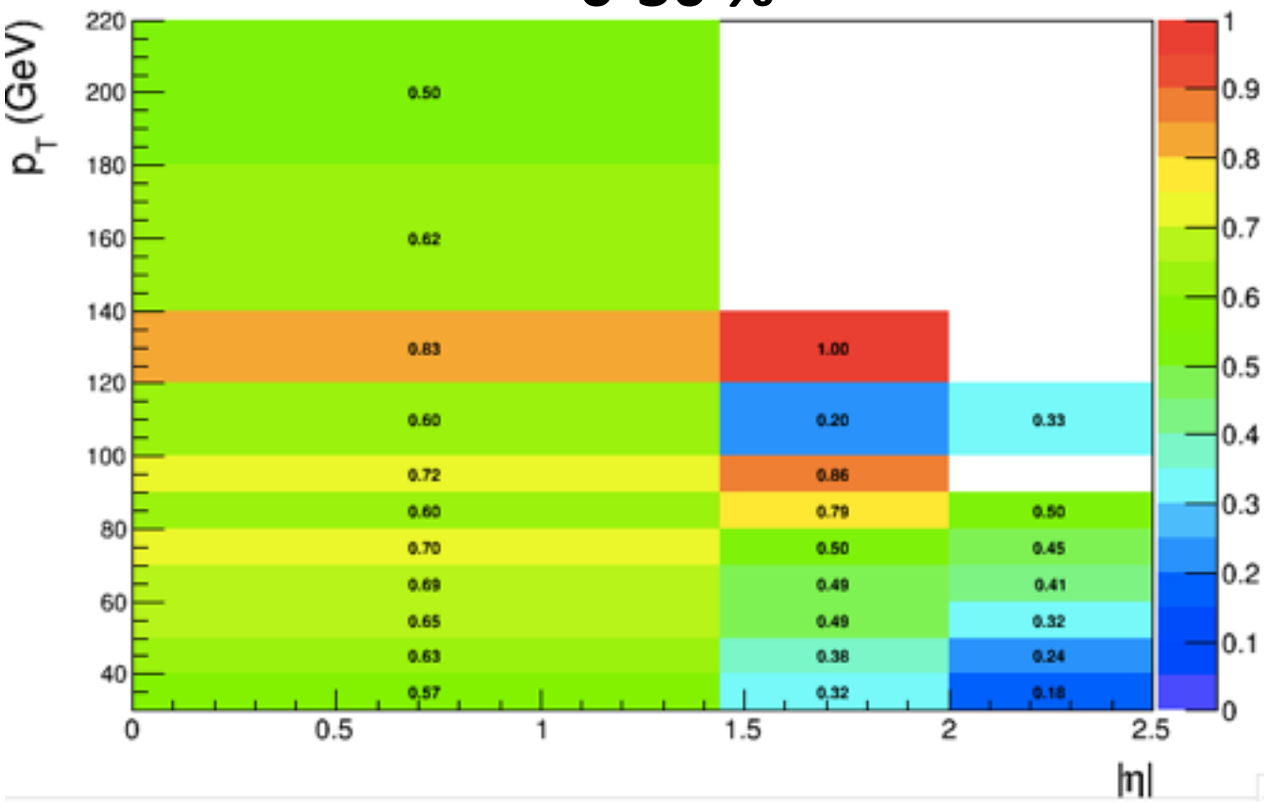
30-100 %



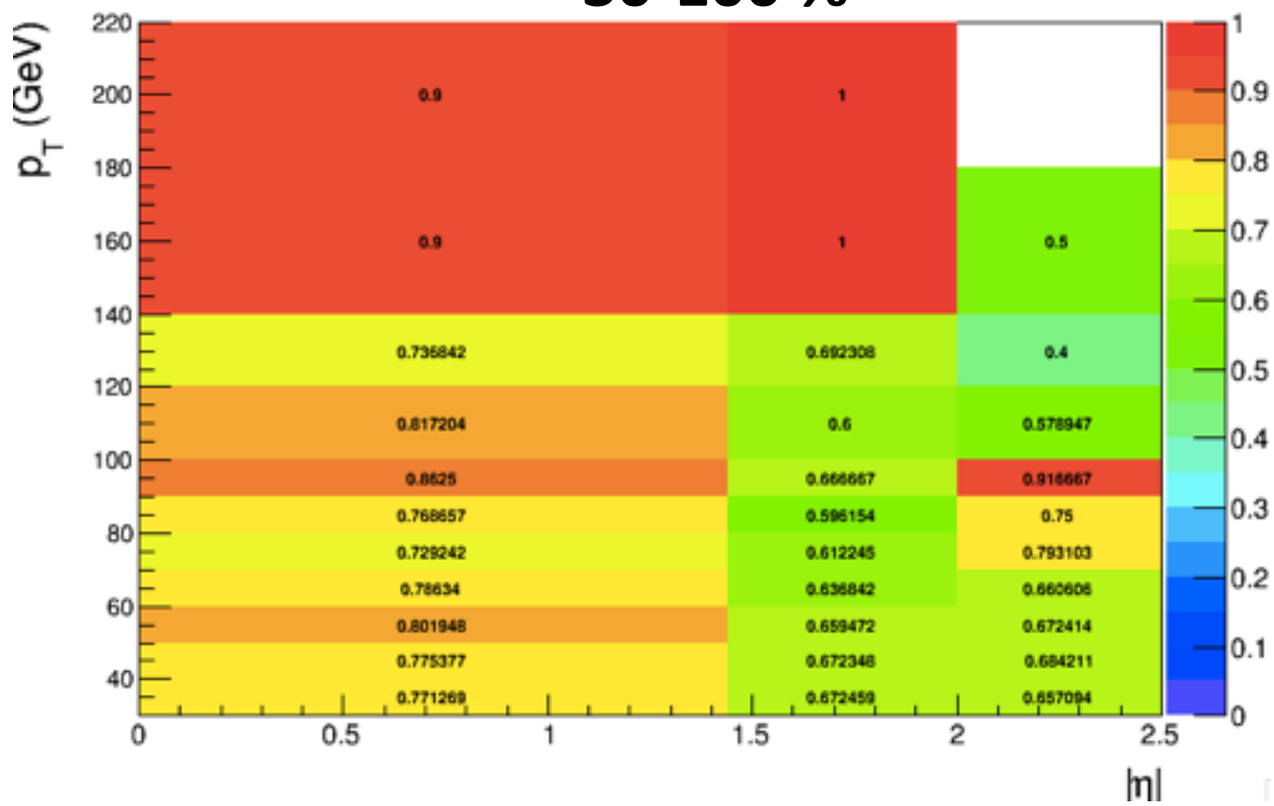
Isolaion Efficiency

$$\epsilon_{Iso} = \frac{\#\ recoMatched\ isolated\ generated\ photons\ (sumIso < 1\ GeV)}{\#\ recoMatched\ generated\ photons}$$

0-30 %



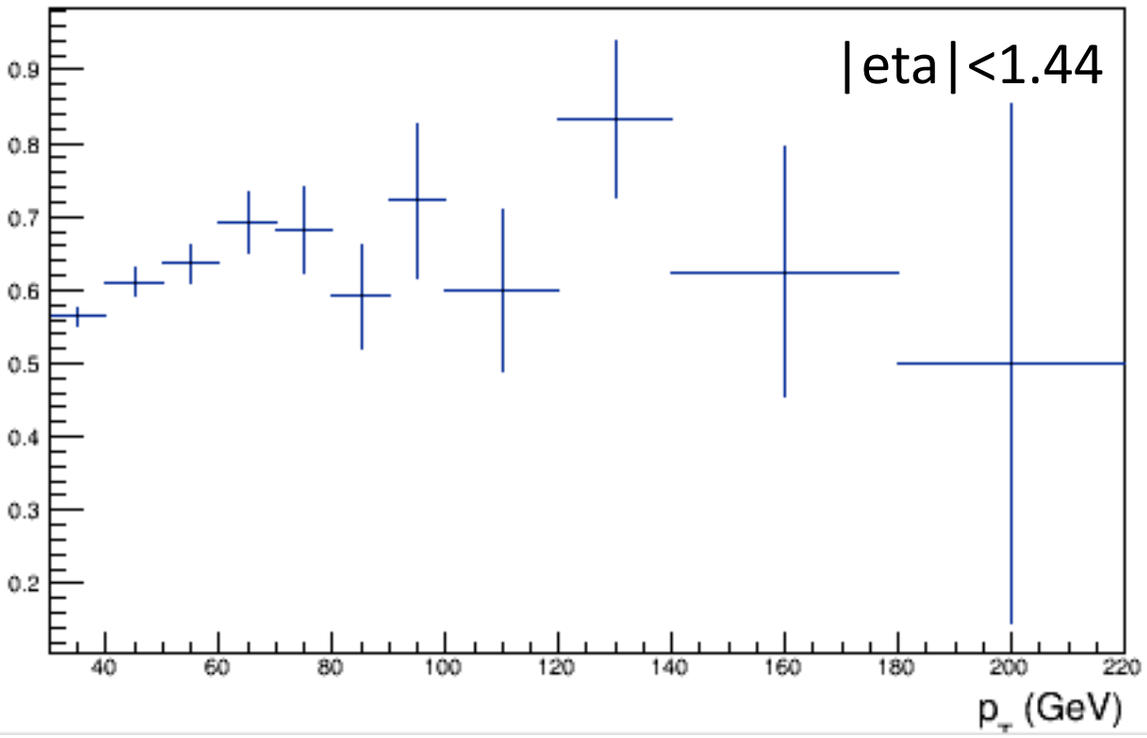
30-100 %



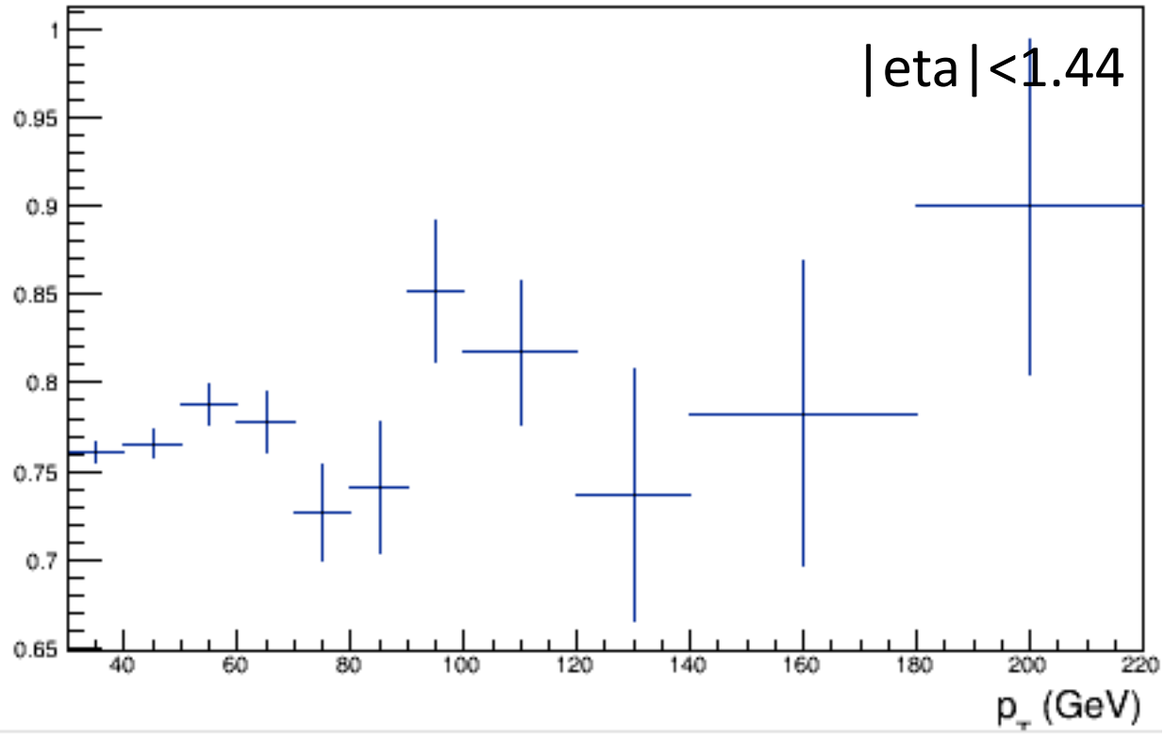
Total Efficiency

$$\epsilon_{total} = \epsilon_{Reco+ID} \times \epsilon_{Iso}$$

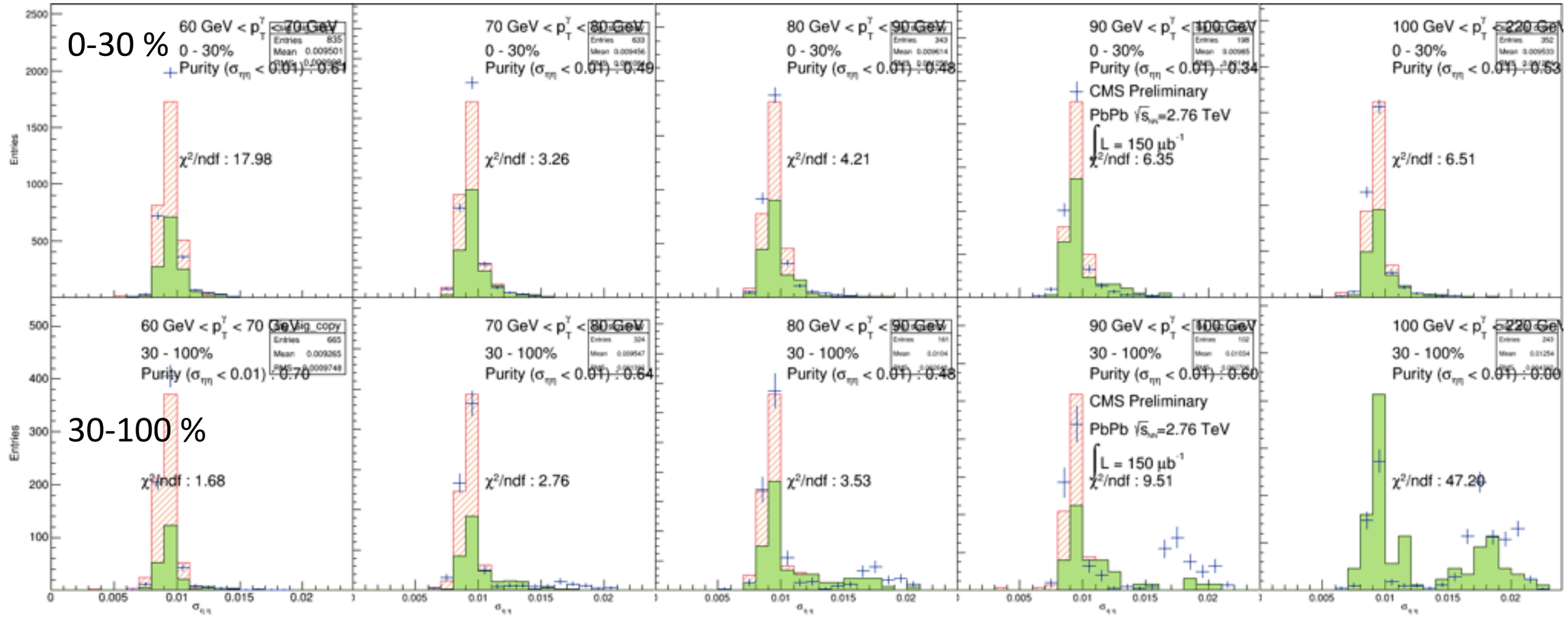
0-30 %



30-100 %



first look at purity (PbPb)



Centrality calibration by # of tower method

29 Jan 2016

Yeonju Go

HF tower firing event fraction (E>3 GeV)

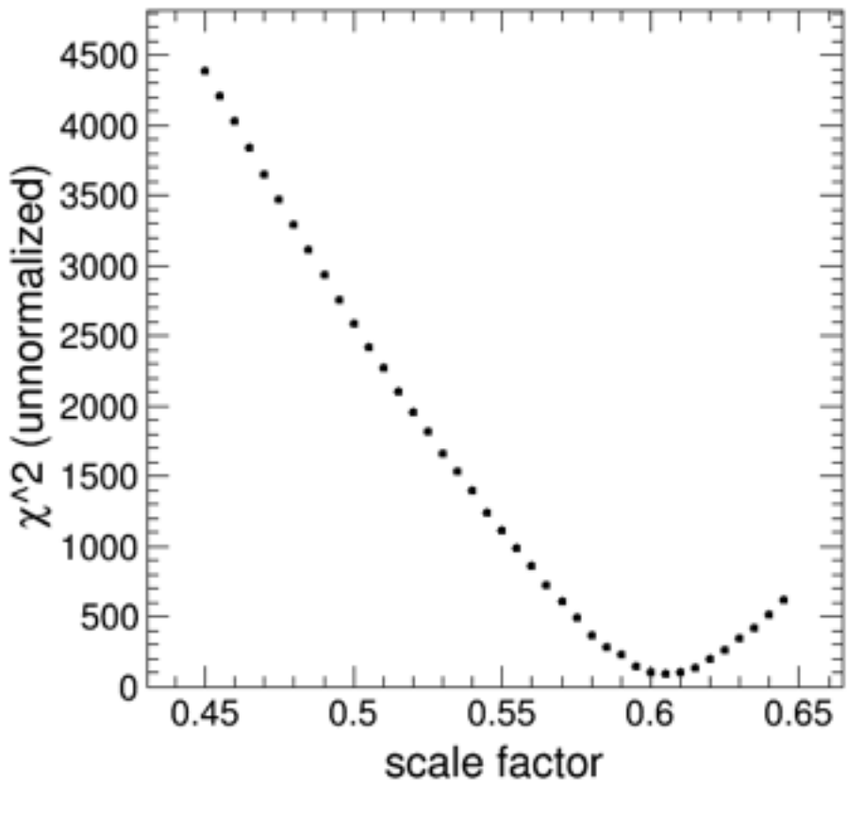
Event Fraction (%)

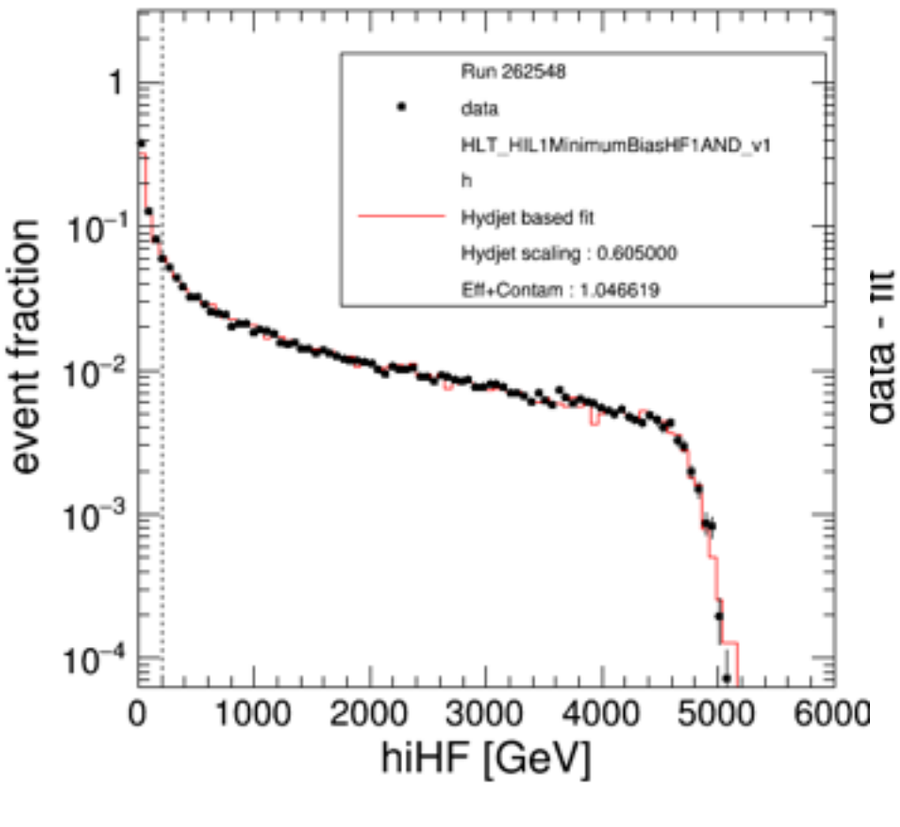
Cuts		STARLIGHT		HYDJET	
		GEN	RECO	GEN	RECO
E > 3 GeV, # of towers : 1	HF AND	2.94%	2.34%	99.00%	98.93%
	HF OR	75.15%	75.12%	99.78%	99.75%
	HF XOR	72.21%	72.78%	0.78%	0.82%
E > 3 GeV, # of towers : 2	HF AND	1.40%	1.30%	98.33%	98.51%
	HF OR	62.03%	66.79%	99.40%	99.57%
	HF XOR	60.63%	65.49%	1.07%	1.06%
E > 3 GeV, # of towers : 3	HF AND	0.70%	0.79%	97.72%	98.17%
	HF OR	52.93%	59.50%	99.00%	99.37%
	HF XOR	52.23%	58.71%	1.28%	1.19%
E > 3 GeV, # of towers : 4	HF AND	0.34%	0.46%	97.09%	97.82%
	HF OR	46.27%	53.49%	98.57%	99.15%
	HF XOR	45.92%	53.03%	1.48%	1.33%
E > 3 GeV, # of towers : 5	HF AND	0.15%	0.25%	96.51%	97.43%
	HF OR	40.30%	48.01%	98.15%	98.93%
	HF XOR	40.15%	47.75%	1.64%	1.50%

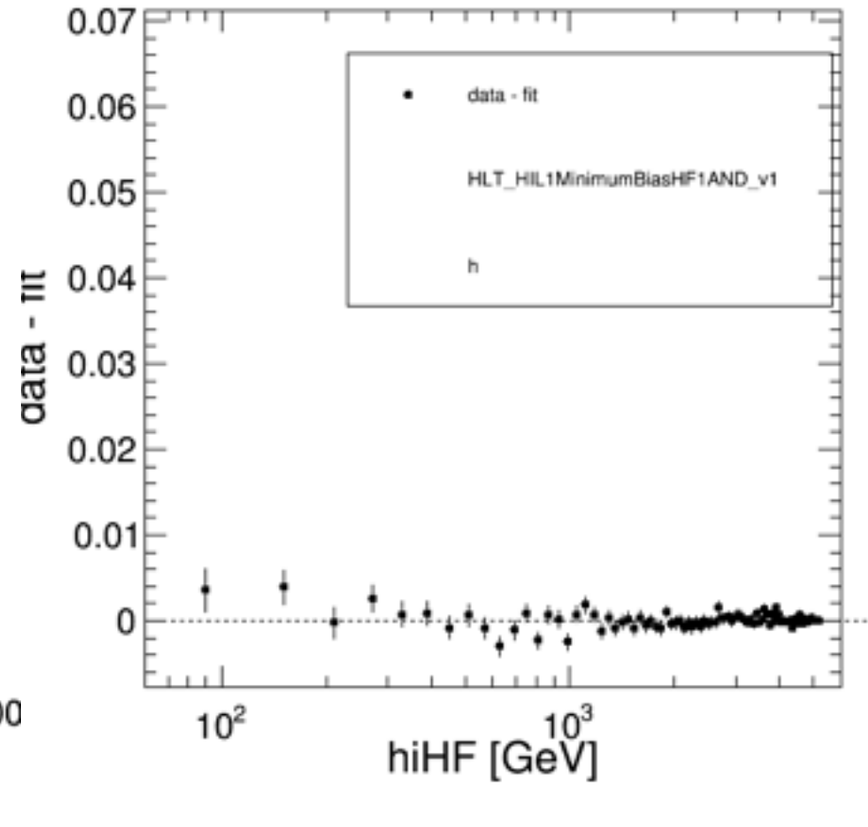
Datasets

- **PbPb Prompt Reco (12 Jan 2016 ver.)**
  - /eos/cms//store/group/phys_heavyions/velicanu/forest/HIRun2015/HIMinimumBias2/Merged/
  - (run 262)694, 695, 703, 726, 735, 811, 816
  - Trigger : HLT_HIL1MinimumBiasHF1AND_v1
- **MC**
  - /eos/cms/store/cmst3/user/mverweij/jetsPbPb/Run2Prep/Hydjet_Quenched_MinBias_5020GeV_750/crab_Run2_HydjetMB/151109_130226/HiForestMerged.root
    - has no rechitanalyzer tree.

centrality calibration : Fitting method



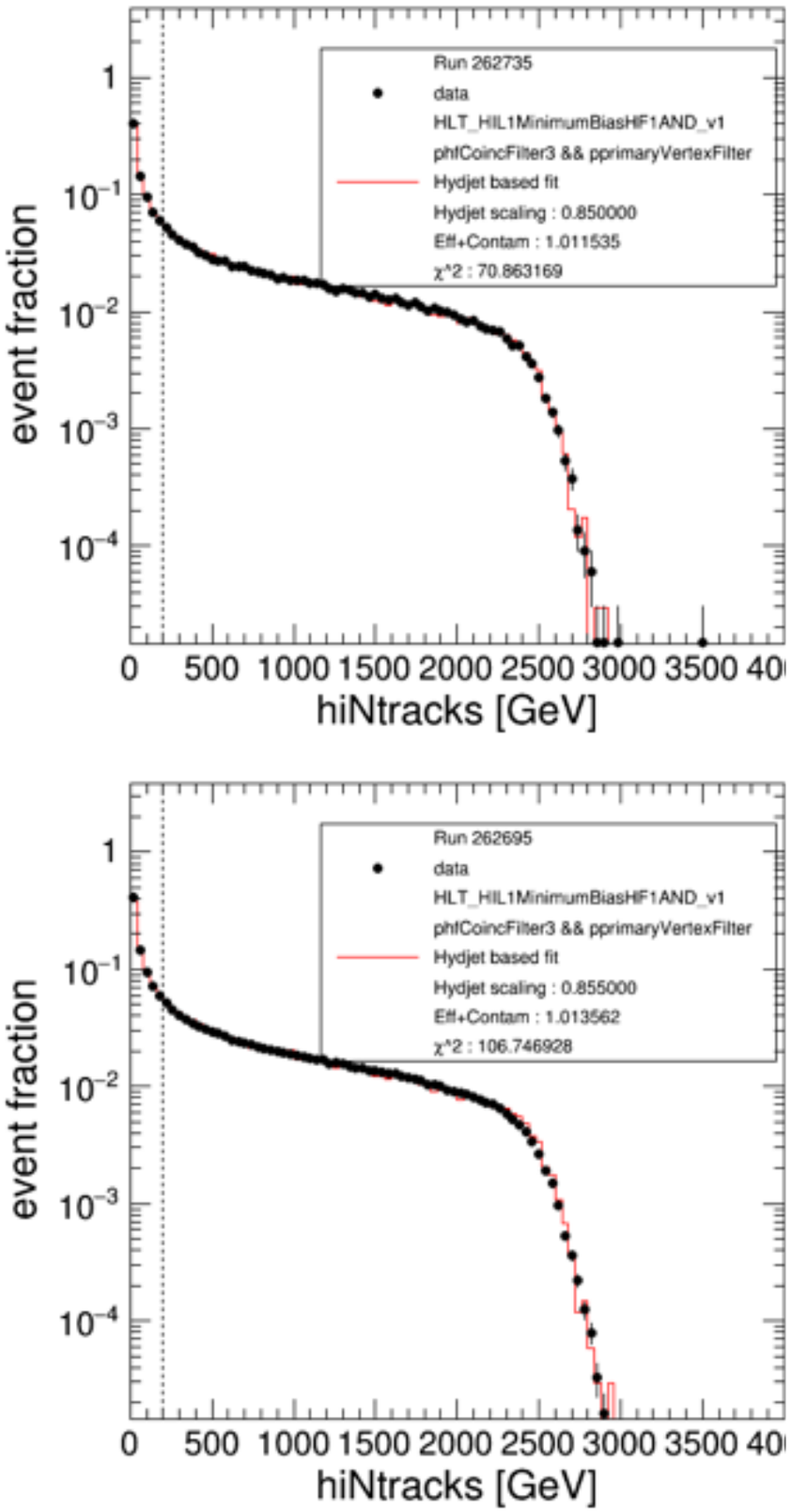


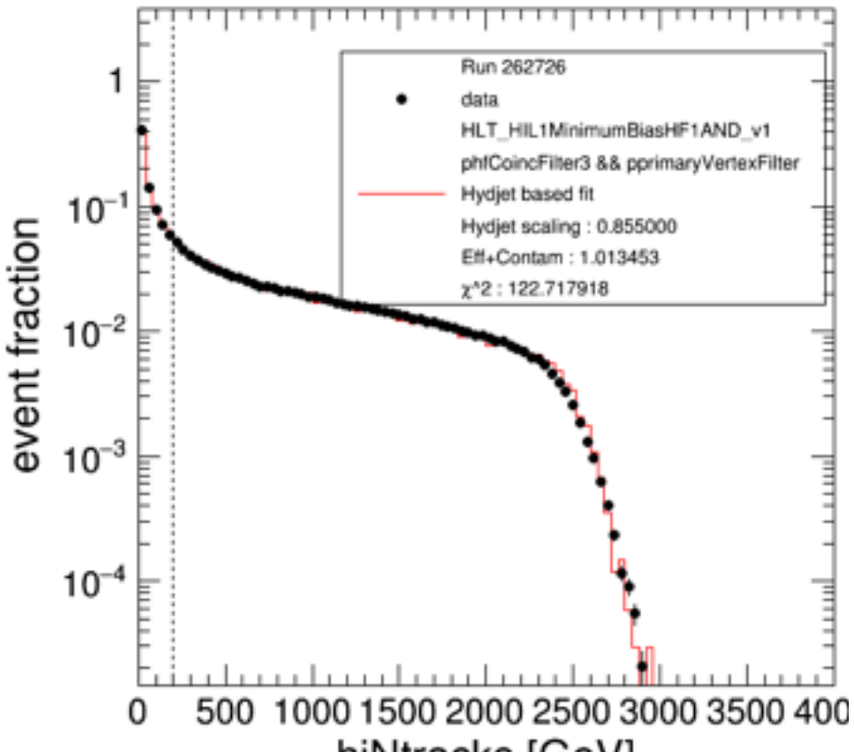


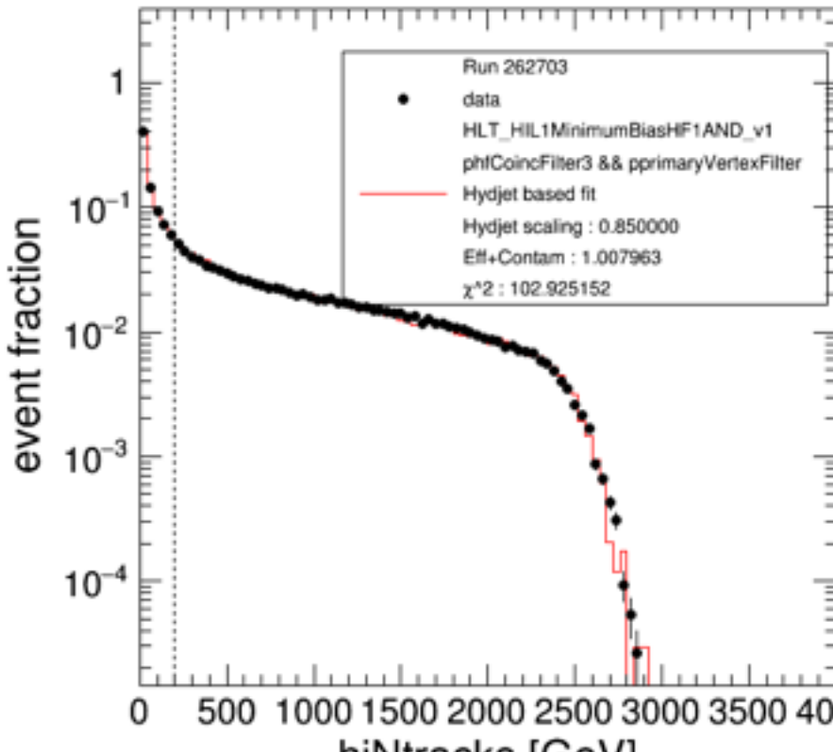
- **MC(with no selection) was scaled by best chi2 value**
  - chi2 is considered in high multiplicity region (over the dotted line in the plot)
- **DATA selection**
  - Trigger : HLT_HIL1MinimumBiasHF1AND_v1
  - with (hfCoincFilter3 , primaryVertexFilter)
- **Divide the integrals (DATA/MC) to estimate (efficiency + contamination)**
- **Repeated for different parts of the detector: HF, EB, EE, Npix, Ntracks, HFhit…**

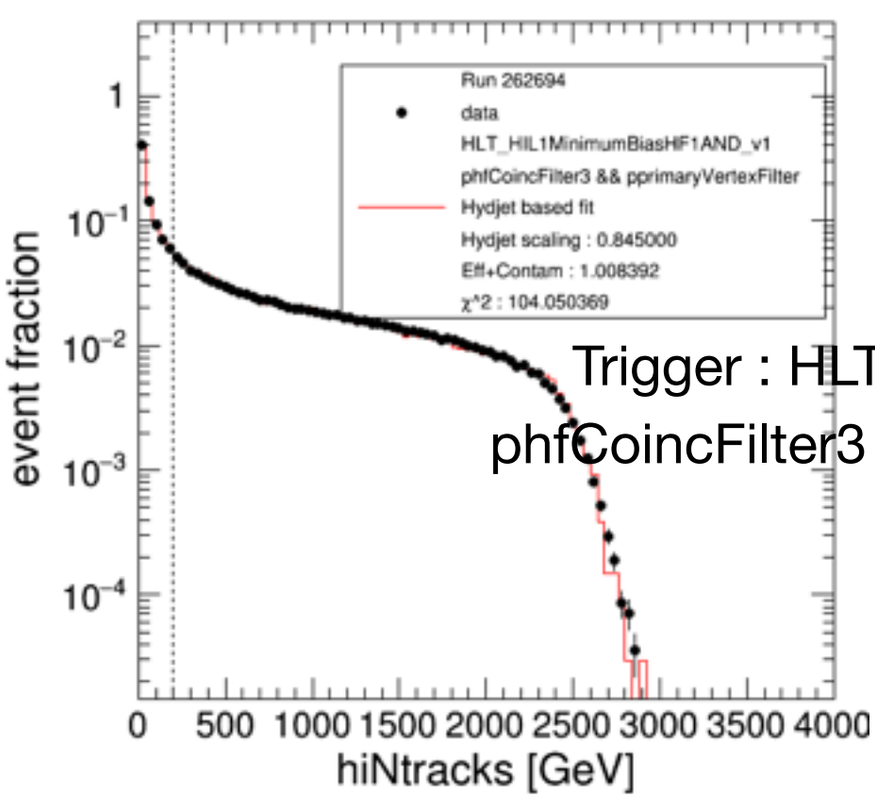
- **you can find all the plots here :**
  - https://www.dropbox.com/sh/wppz6x21wd909ea/AADg6p_AlmEvnIXEEkDWIFpAa?dl=0

DATA dist. with MC fitting



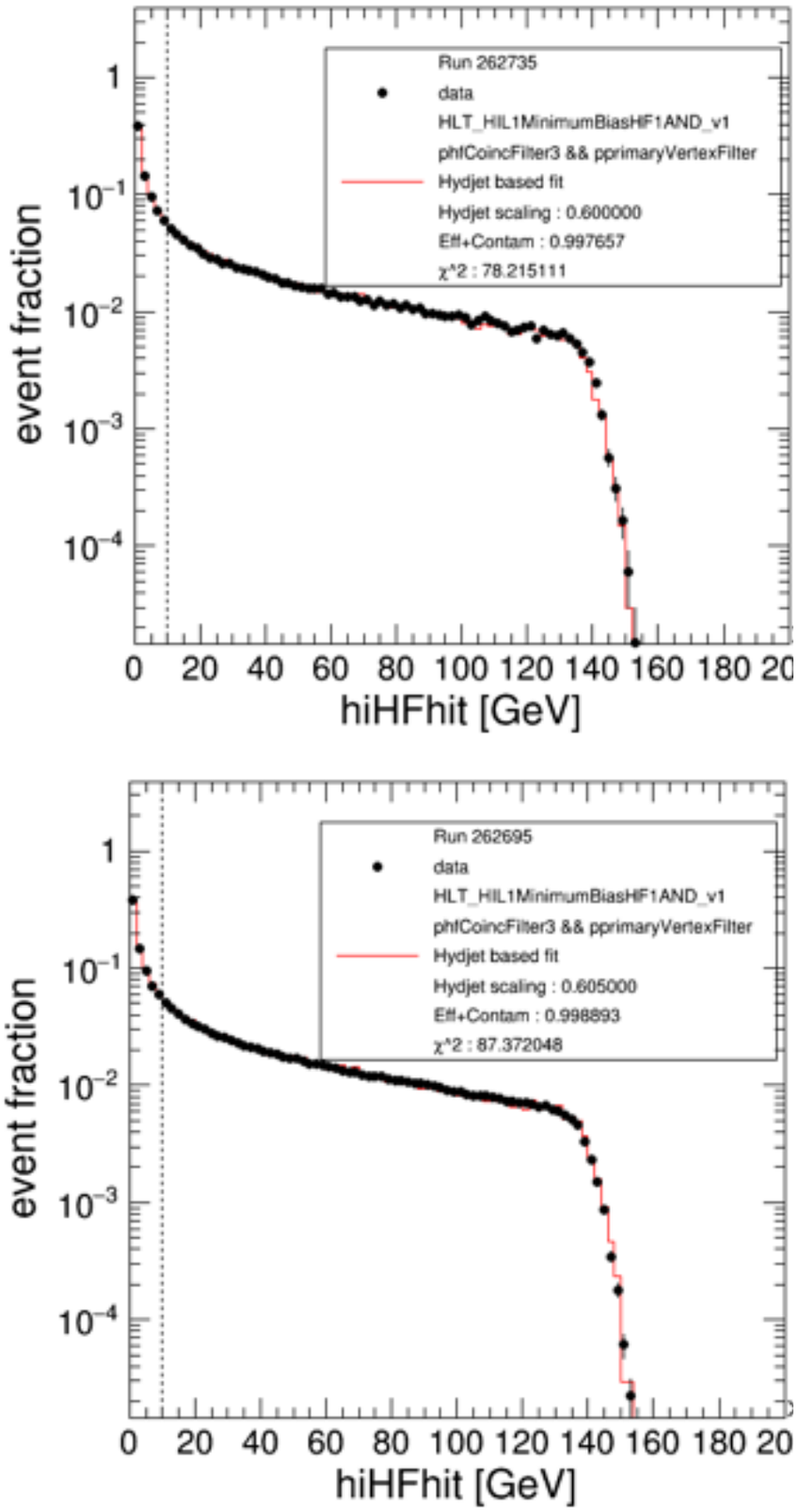


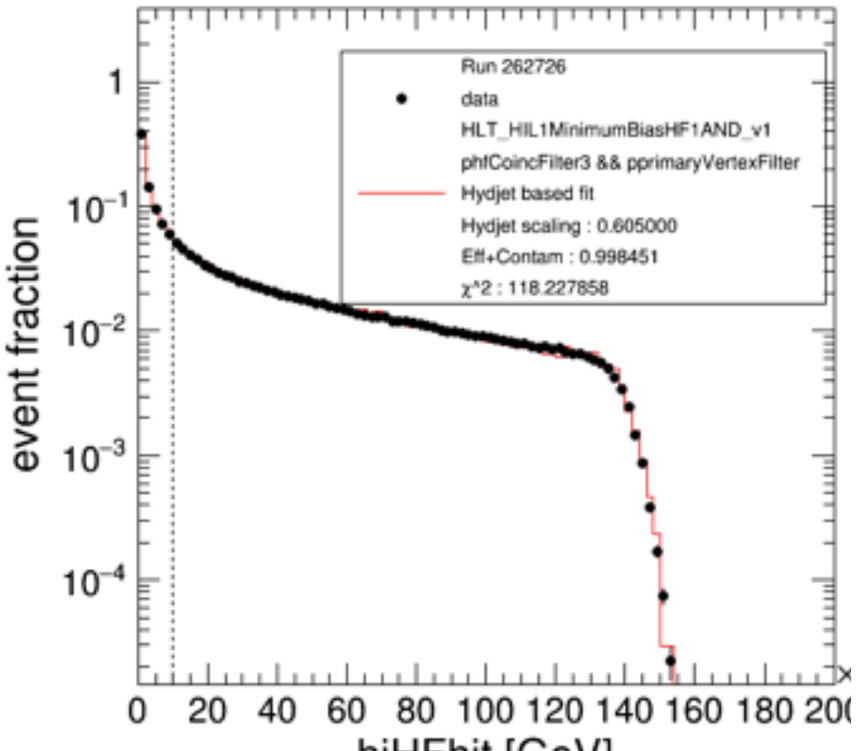


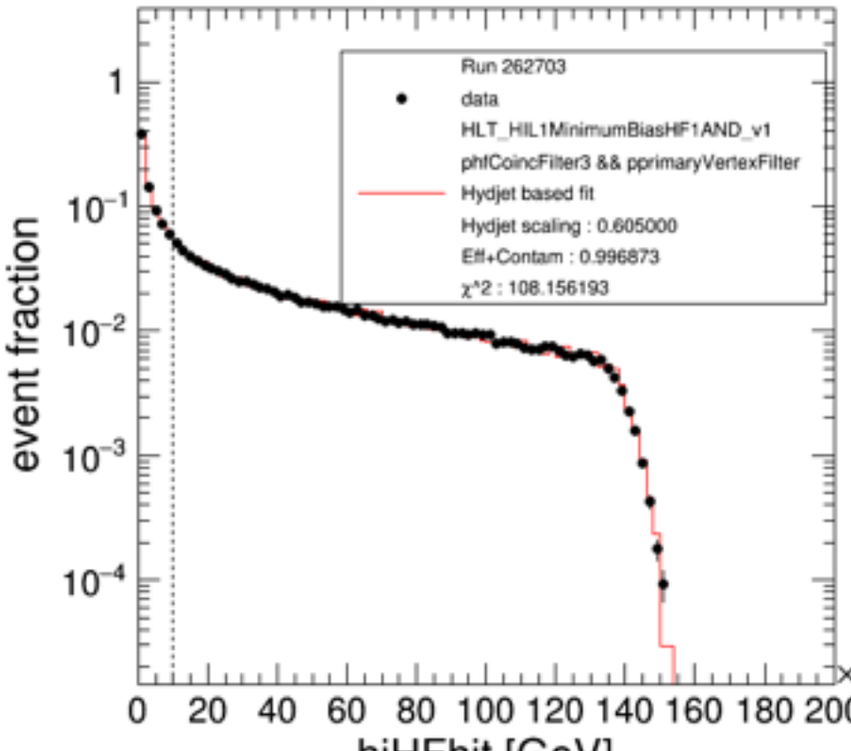


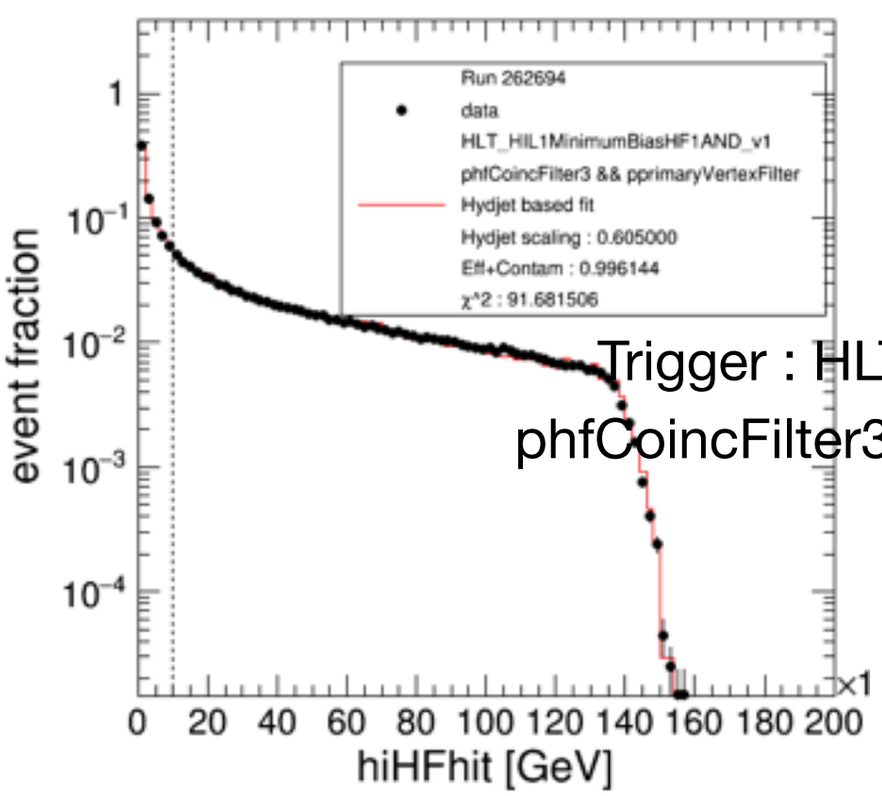
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

DATA dist. with MC fitting









Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

Efficiency+Contamination values

Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

Run #	262694	262695	262703	262726	262735	262811	262816	mean	sigma
hiHF	99.45%	99.75%	99.49%	99.64%	99.57%	99.60%	99.70%	99.60%	0.11%
hiHFhit	99.61%	99.89%	99.69%	99.84%	99.77%	100.11%	100.06%	99.85%	0.18%
hiNtracks	100.83%	101.36%	100.80%	101.34%	101.15%	101.41%	101.37%	101.18%	0.26%
hiNpix	98.07%	98.35%	98.06%	98.49%	98.29%	98.26%	98.29%	98.26%	0.15%
hiET	101.01%	101.41%	100.80%	101.38%	101.76%	101.44%	101.32%	101.30%	0.31%
hiEB	99.48%	99.78%	99.25%	99.70%	99.79%	99.57%	99.56%	99.59%	0.19%
hiEE	102.93%	103.39%	102.96%	103.27%	103.98%			103.31%	0.43%
								100.32%	1.46%

- **(Eff+Contamination) values are relatively consistent between different runs.**
- **Various centrality obj. has different Eff+Cont. values.**

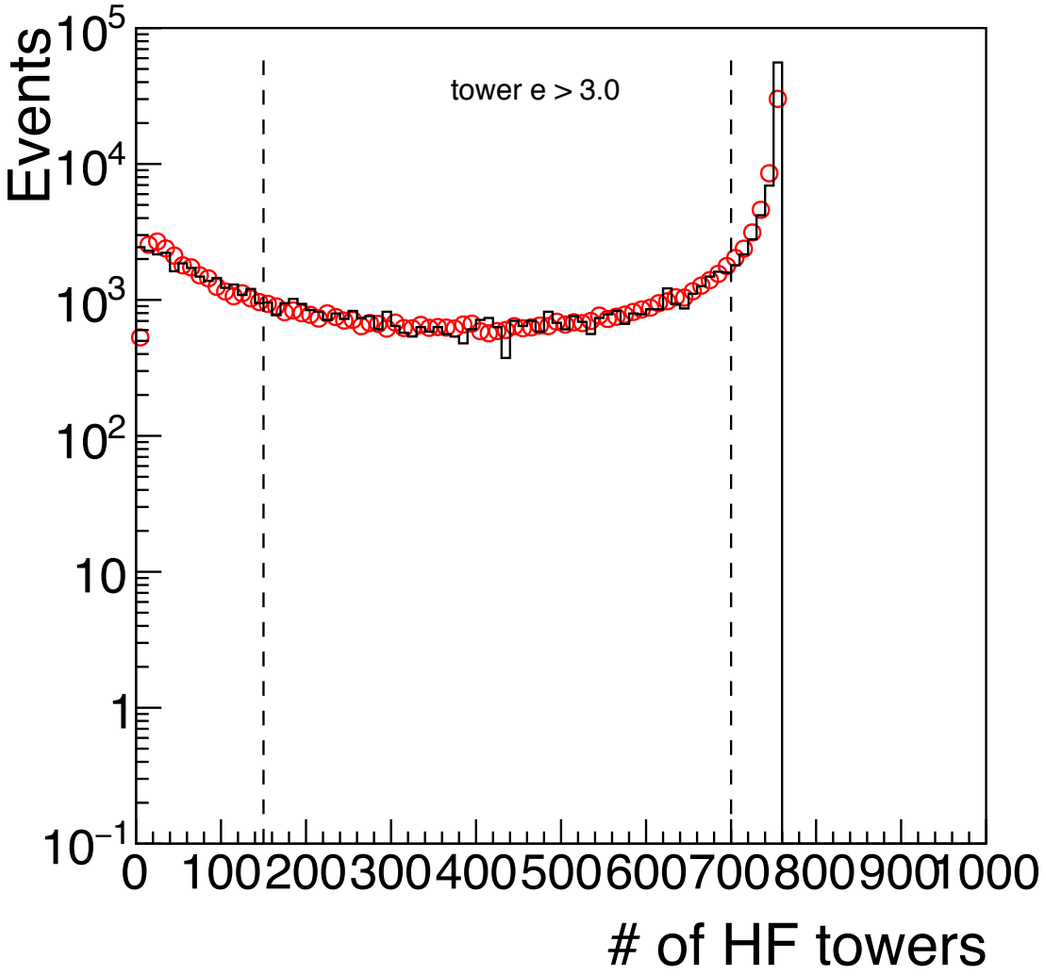
chi2/ndf

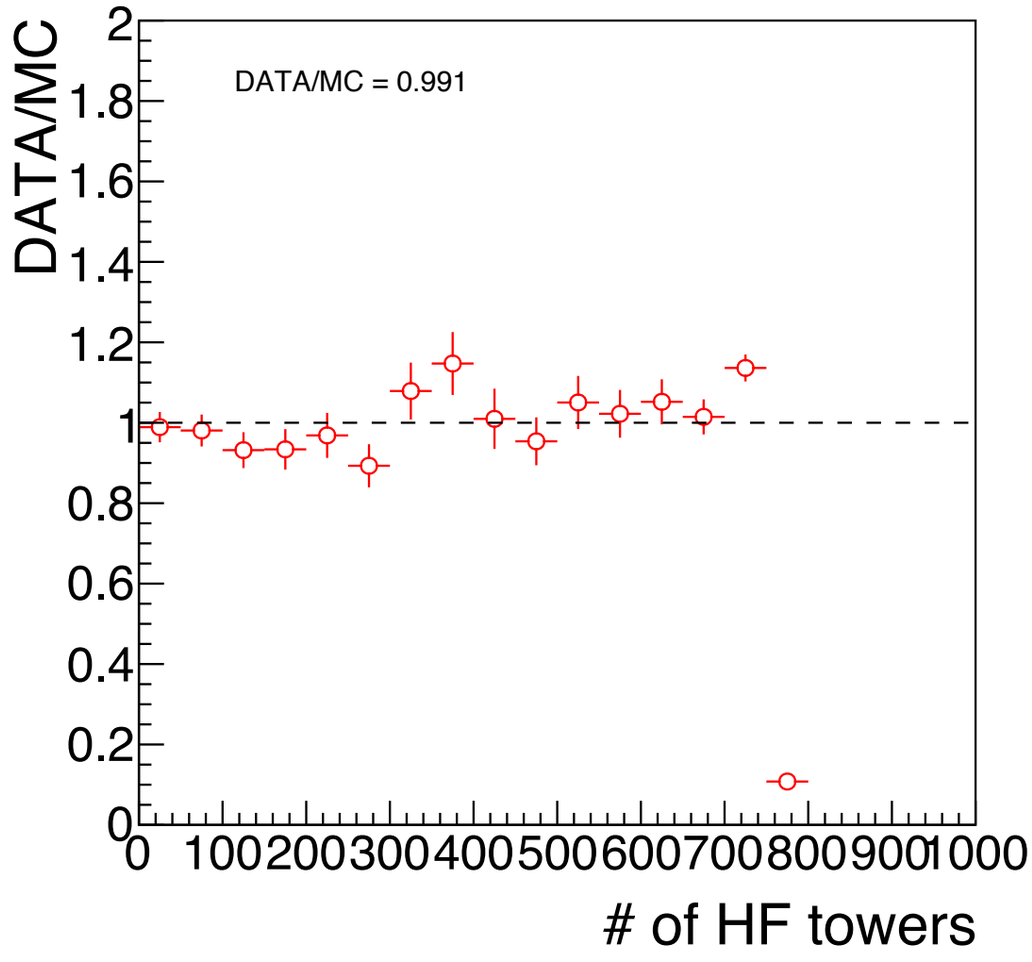
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

Run #	262694	262695	262703	262726	262735	262811	262816	mean	sigma
hiHF	1.27	1.35	1.46	1.52	1.21	1.18	1.08	1.30	0.16
hiHFhit	1.13	1.04	1.38	1.34	1.09	1.11	1.14	1.18	0.13
hiNtracks	1.41	1.52	1.47	1.66	1.01	1.17	1.30	1.36	0.22
hiNpix	1.44	1.59	1.57	1.68	1.55	1.44	1.52	1.54	0.09
hiET	1.77	1.92	1.60	2.04	1.40	1.54	1.90	1.74	0.23
hiEB	1.66	1.98	1.44	2.51	1.16	1.26	1.53	1.65	0.47
hiEE	1.38	1.51	1.43	1.85	1.33			1.50	0.21
								1.46	0.30

- **chi2/ndf (reduced chi2) has the lowest value for hiHFhit**
- **Fittings for hiET, hiEB, hiEE and hiNpix are relatively bad compared to HF**

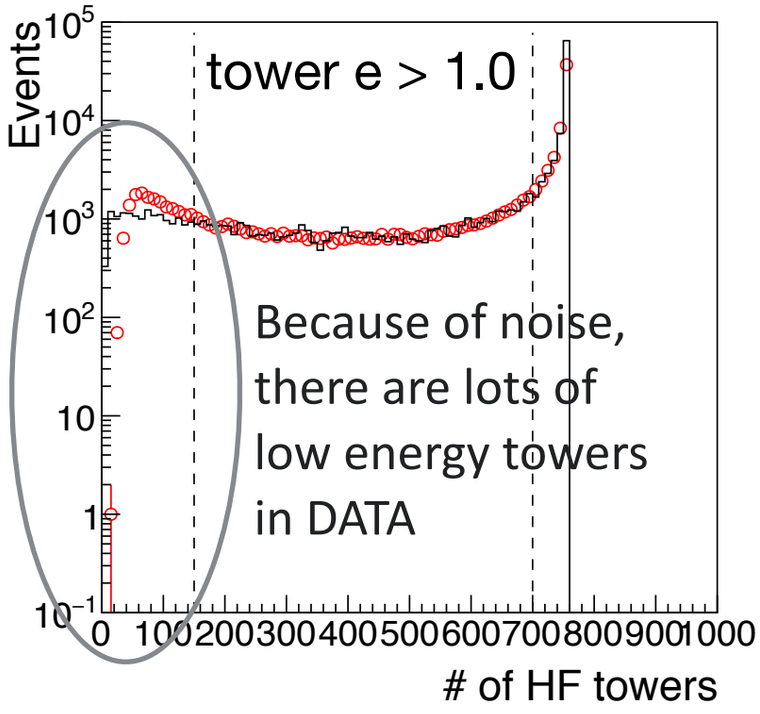
Centrality calibration : # of towers method

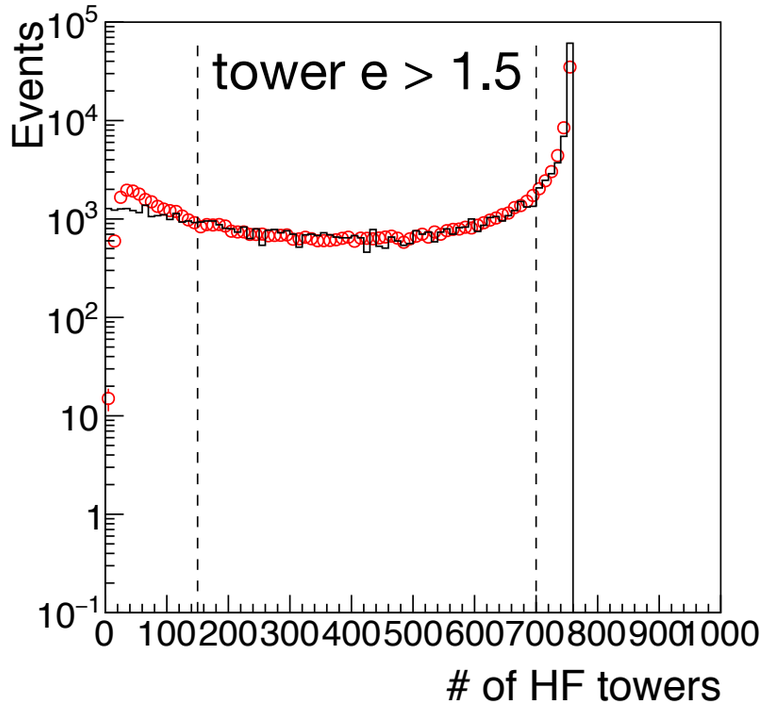


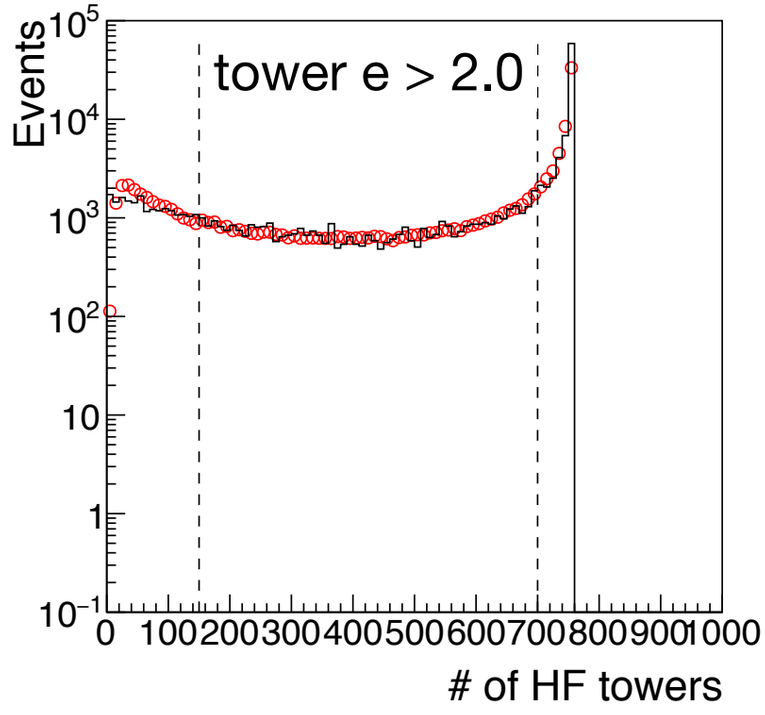


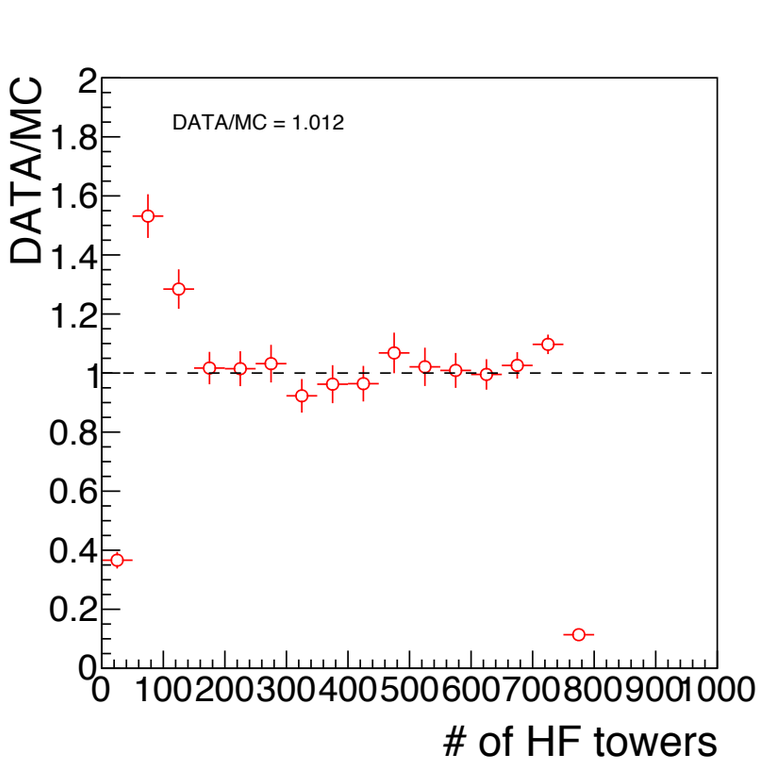
- **Number of towers(tower energy above some threshold) distributions for DATA and MC are plotted.**
- **MC was normalised by DATA in the middle range (between the dashed lines in the left)**
- **Divide the integrals (DATA/MC) to estimate (efficiency + contamination)**
  - to see the effect of low multiplicity region, ignore the difference in high multiplicity region (> ~ 700)
- **Variation :**
  - tower energy threshold (0.5, 1.0, … , 5.0)
  - tower transverse energy threshold (0.1, 0.2, … , 1.0)
  - with/without filters(hfCoinc3, primaryVertex …)

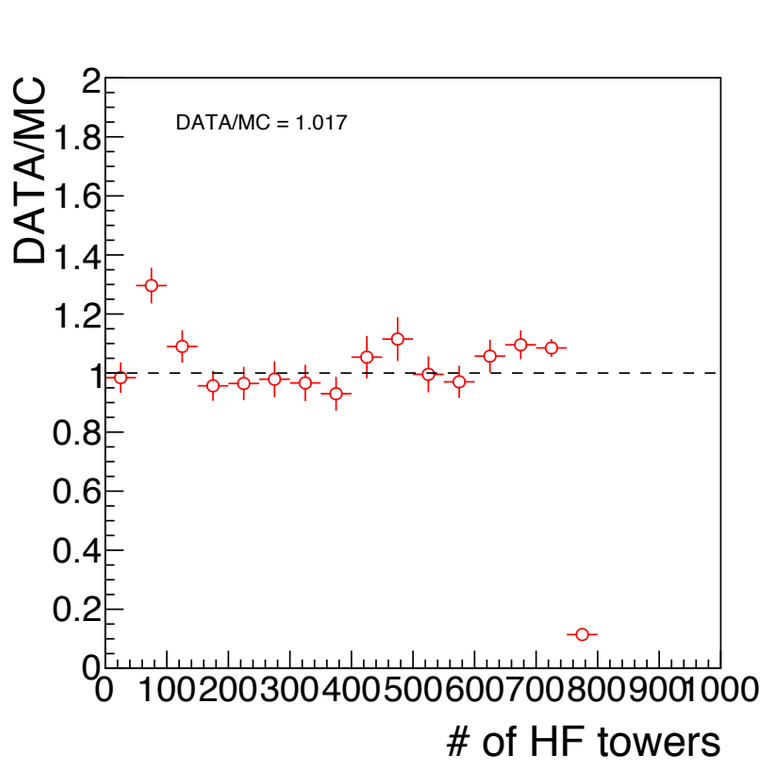
of tower distributions : diff. E thr.

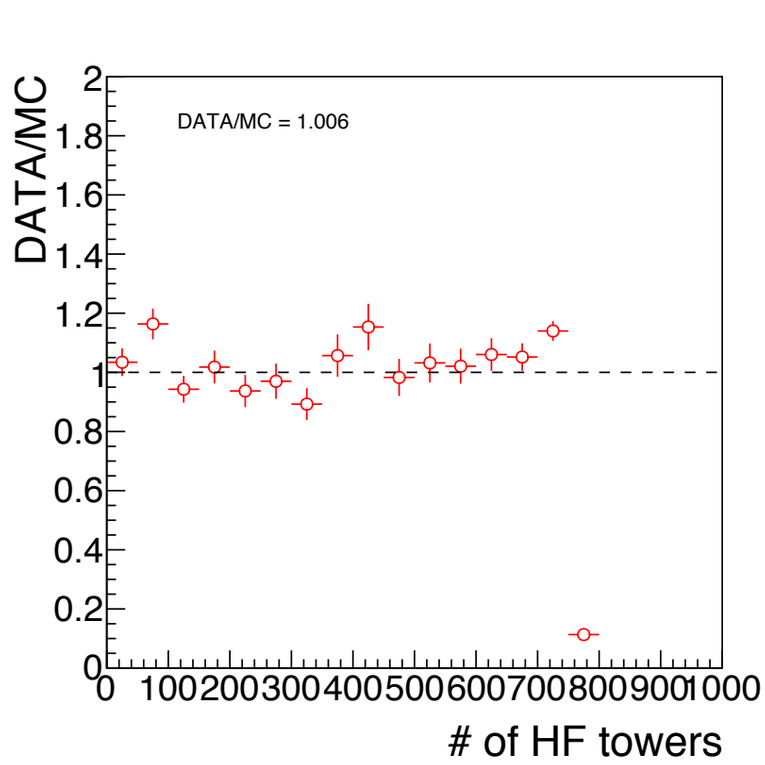








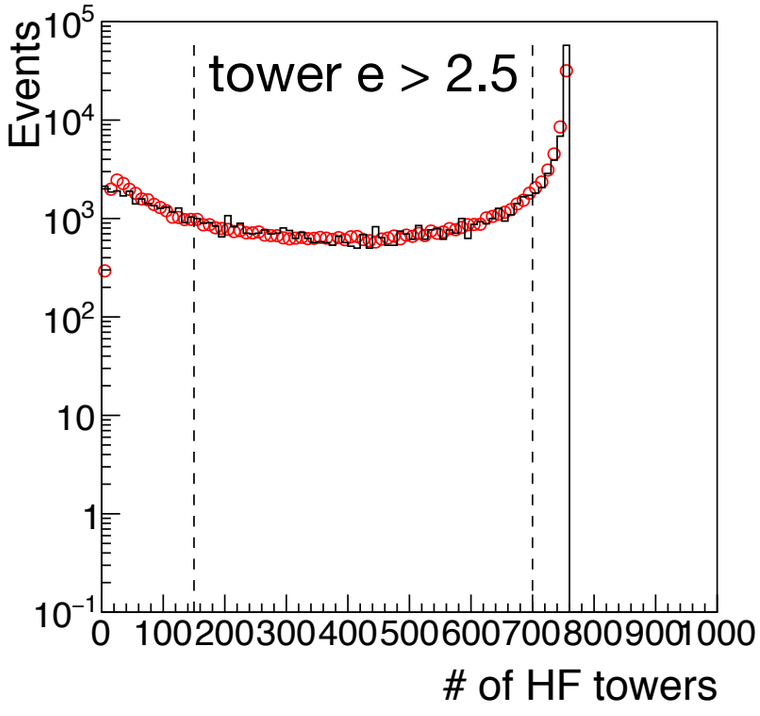


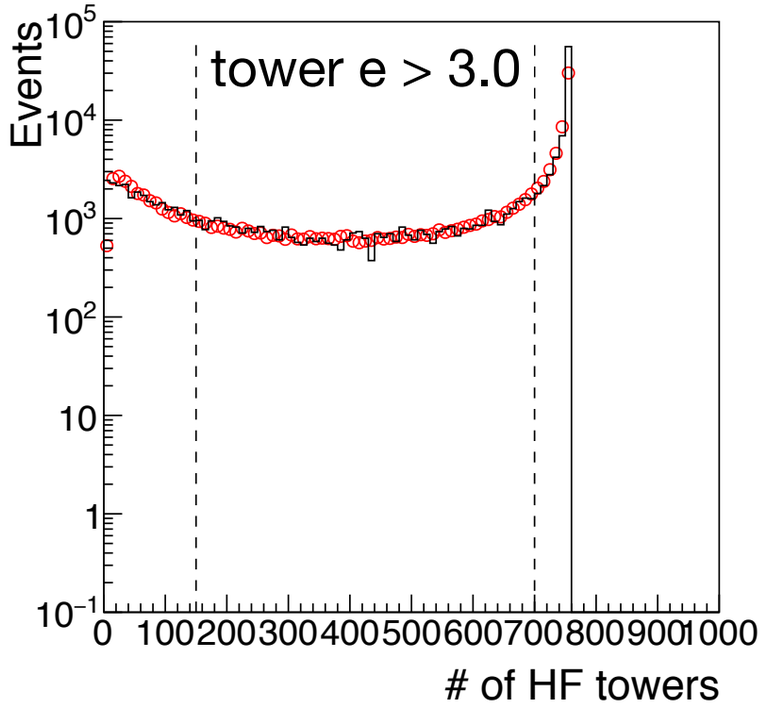


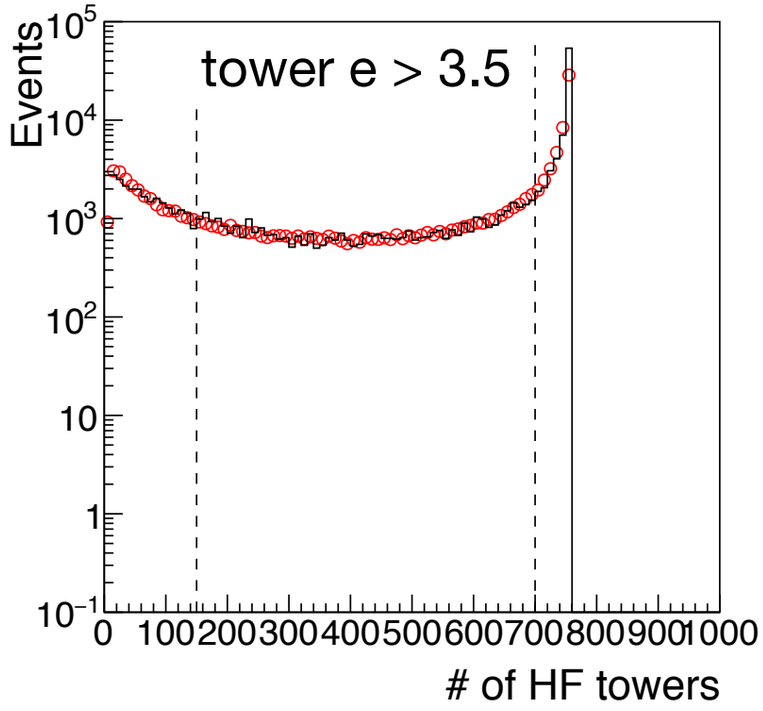
- **have to consider which threshold is adjust for this study.**
  - first, remove noise towers.

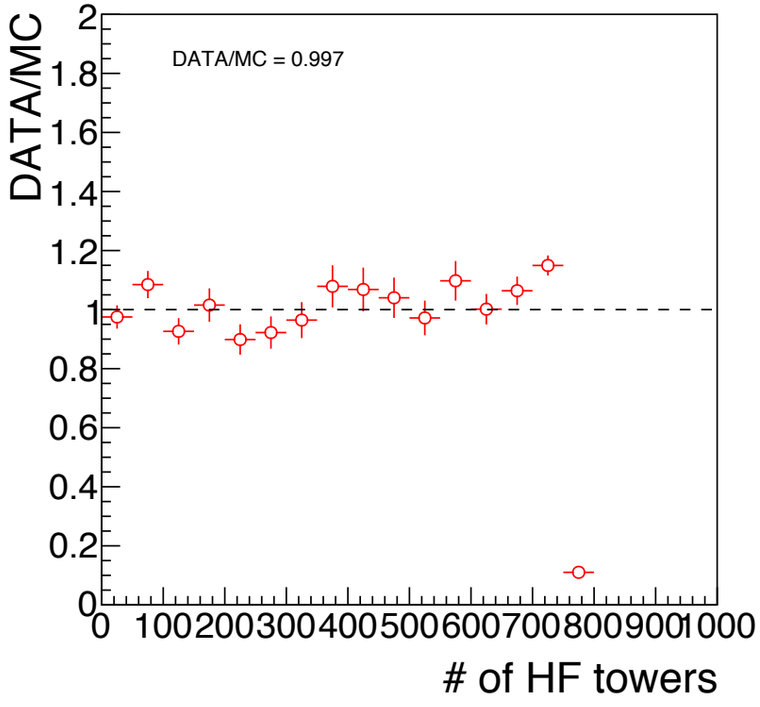
run 262735
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

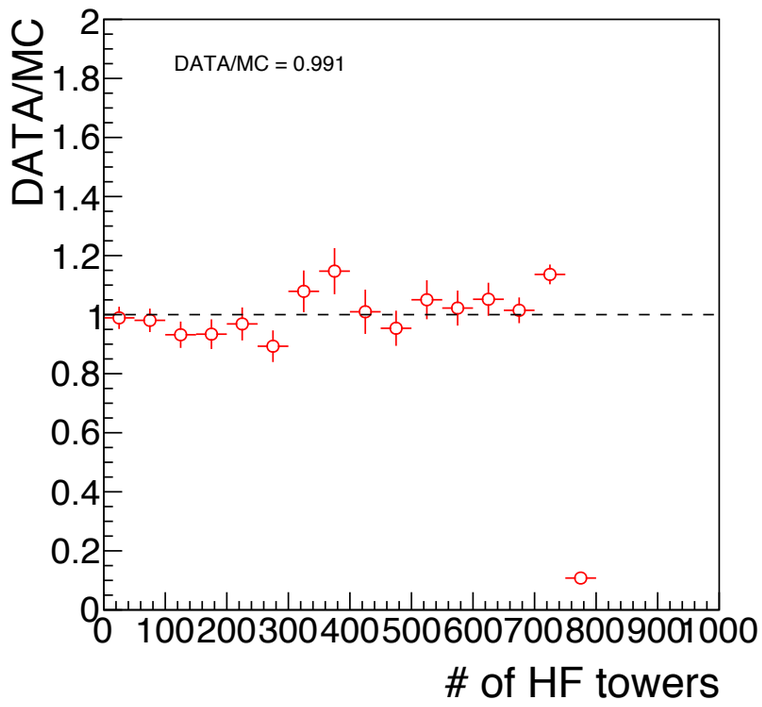
of tower distributions : diff. E thr.

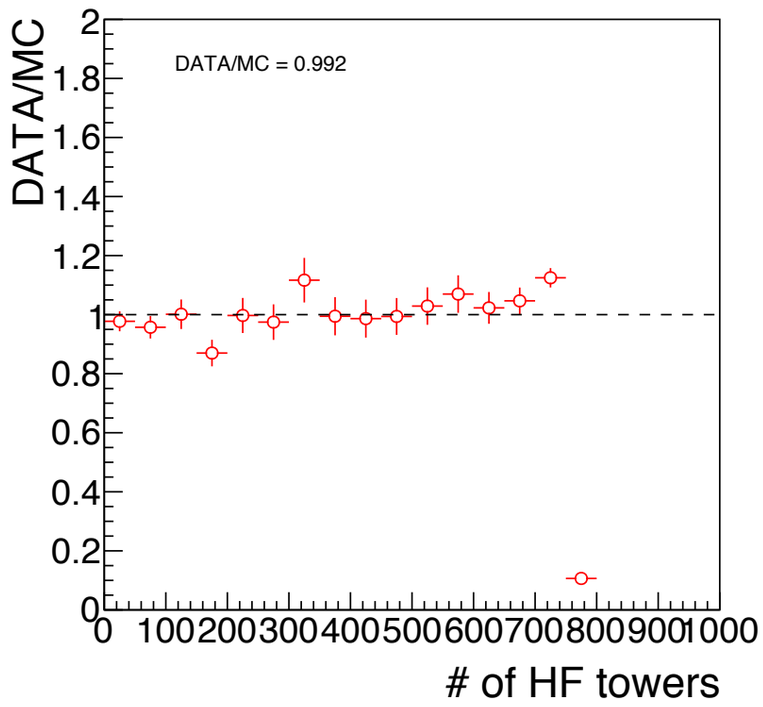






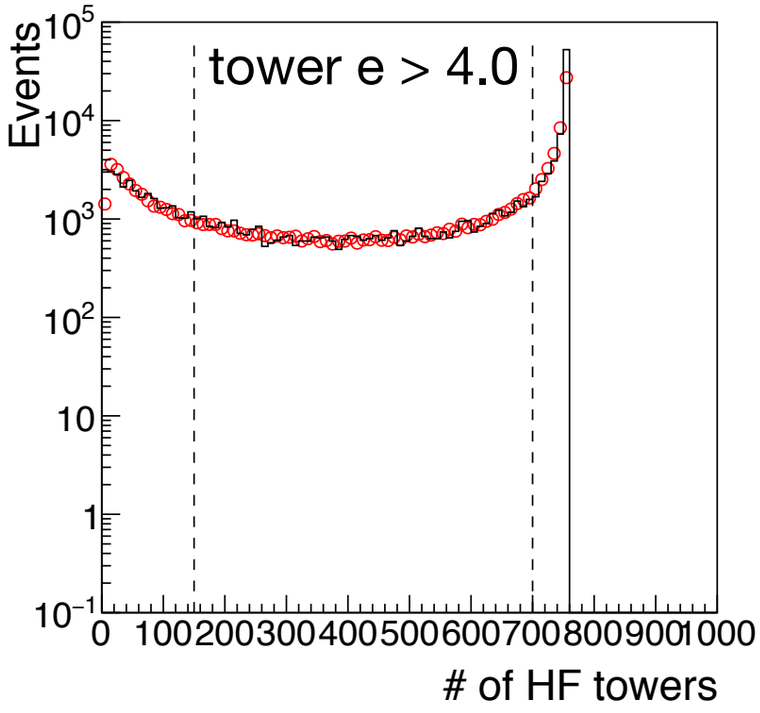


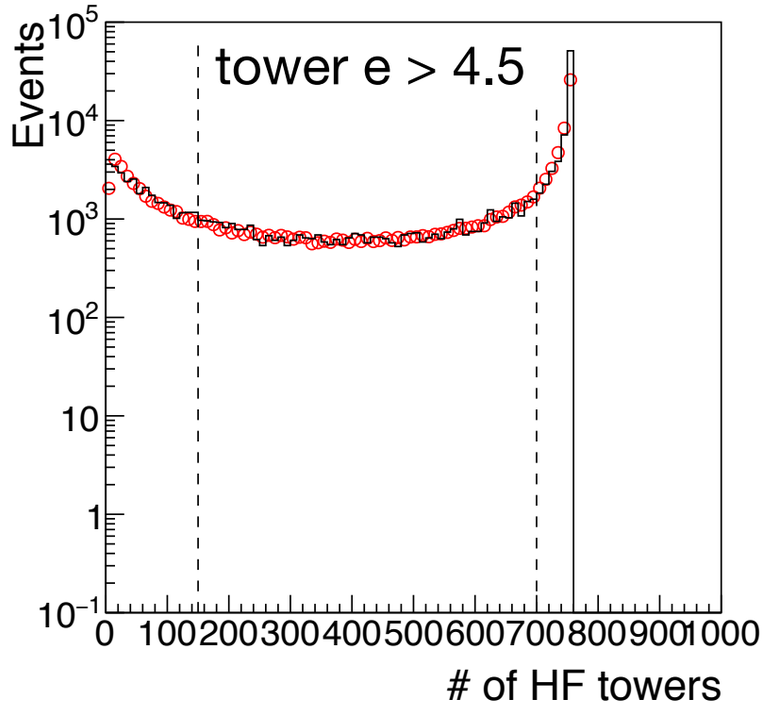


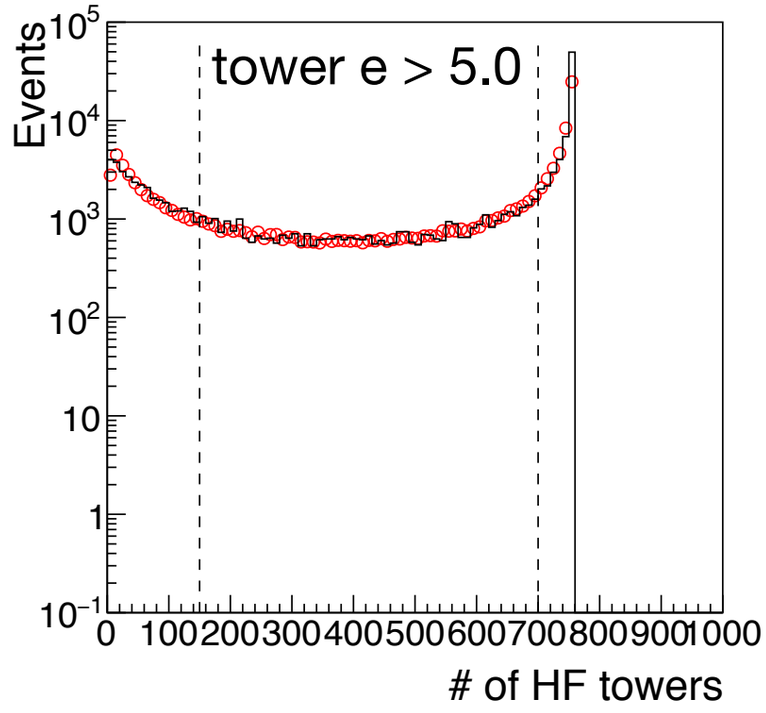


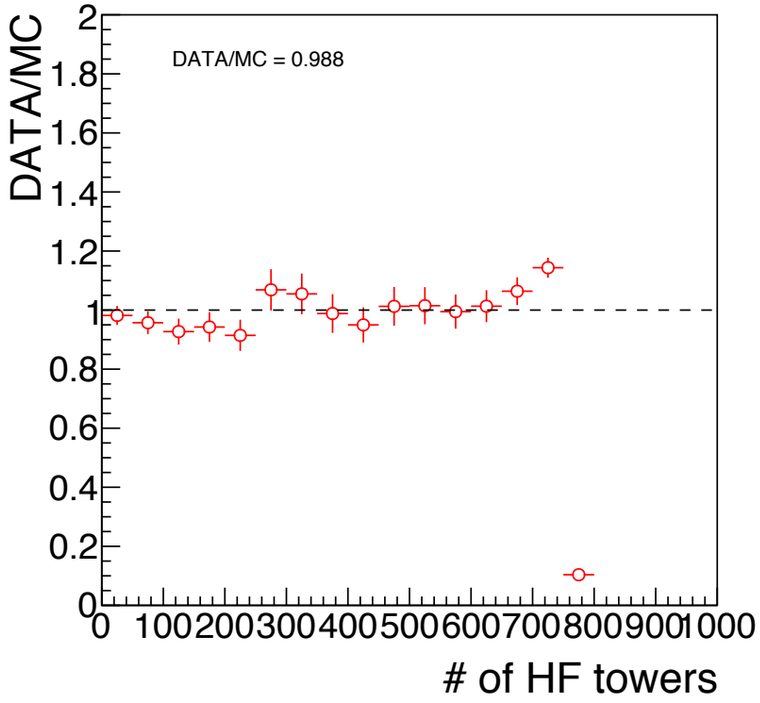
run 262735
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

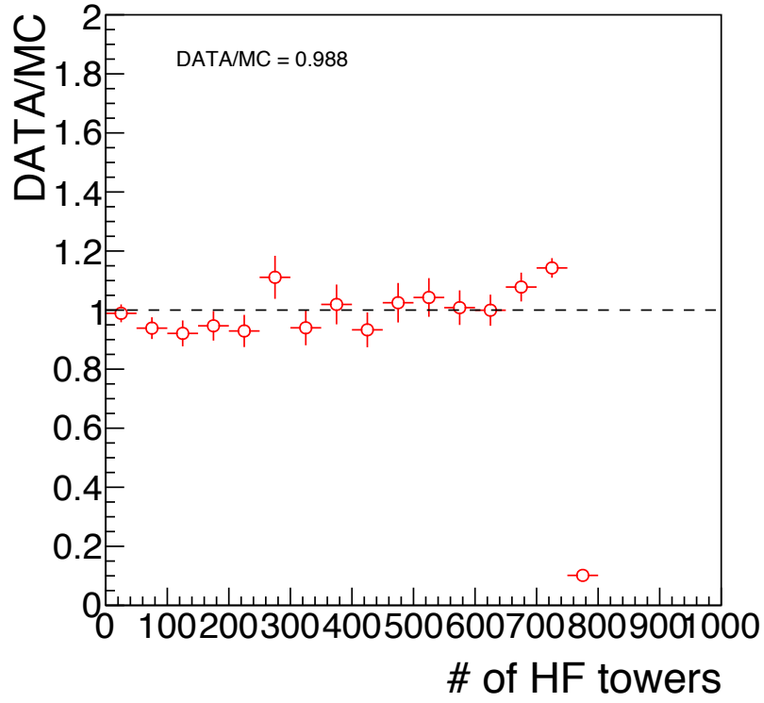
of tower distributions : diff. E thr.

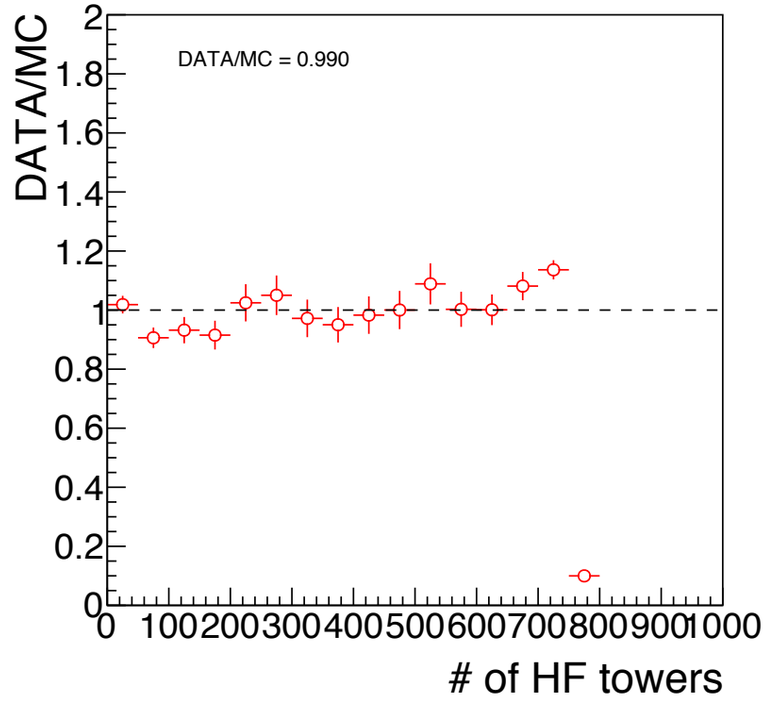






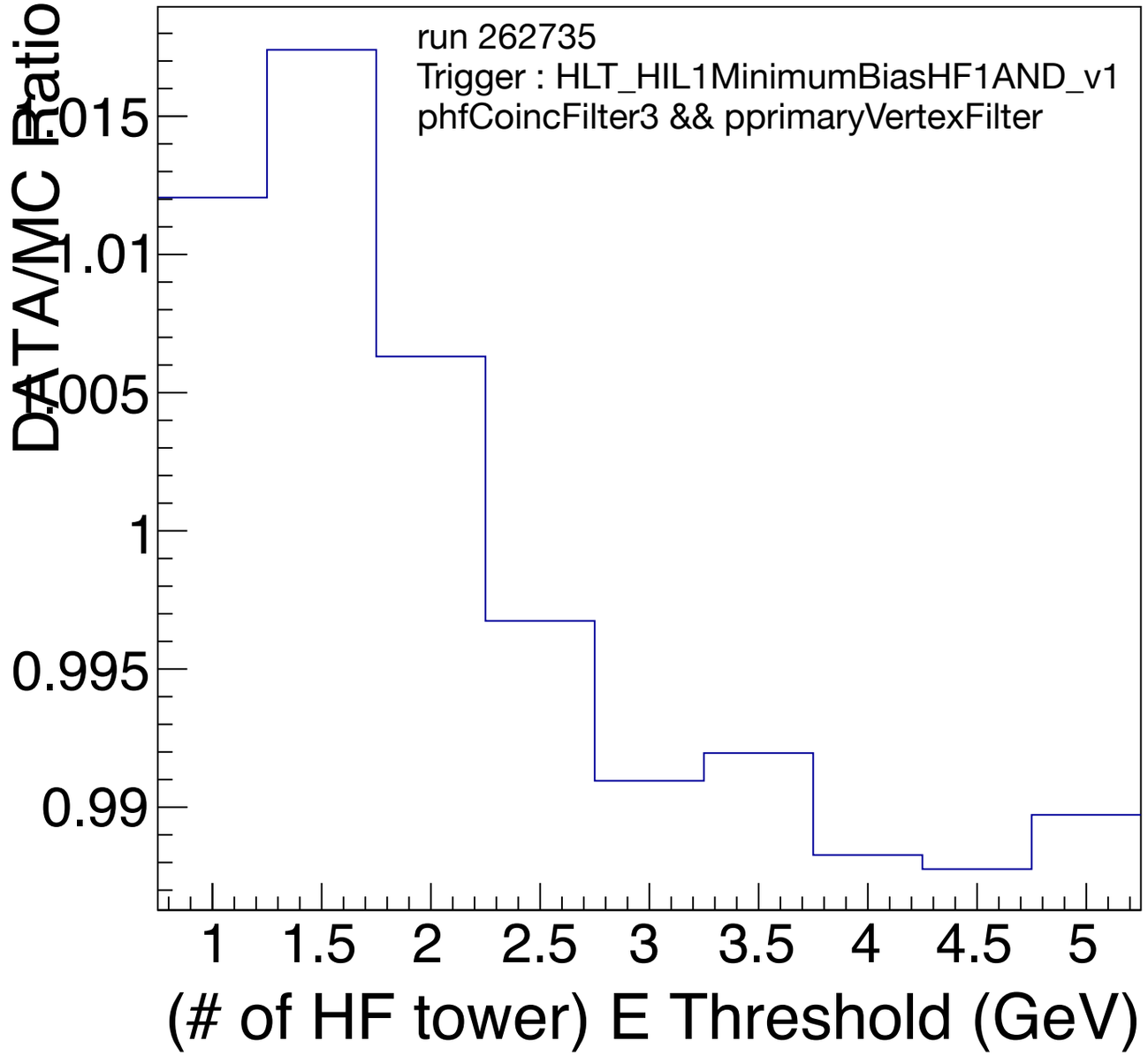




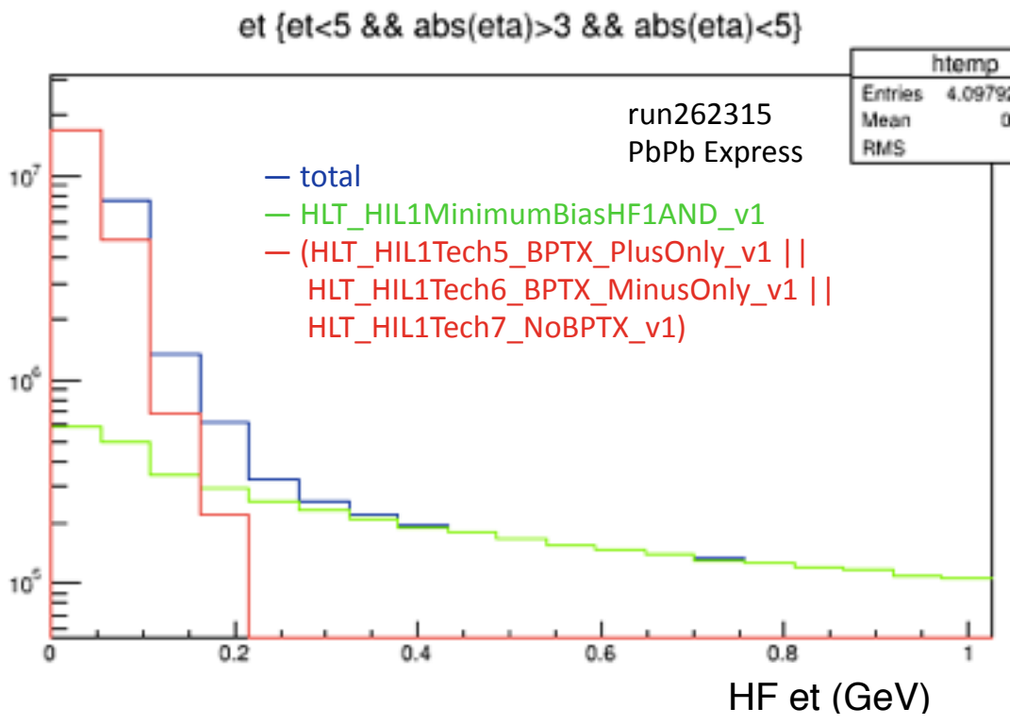


run 262735
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

DATA/MC vs. tower E thr.



- **Over tower e > ~3 GeV, centrality calibration is ~ 99 %.**
- **would be good to check noise level.**



Efficiency+Contamination values

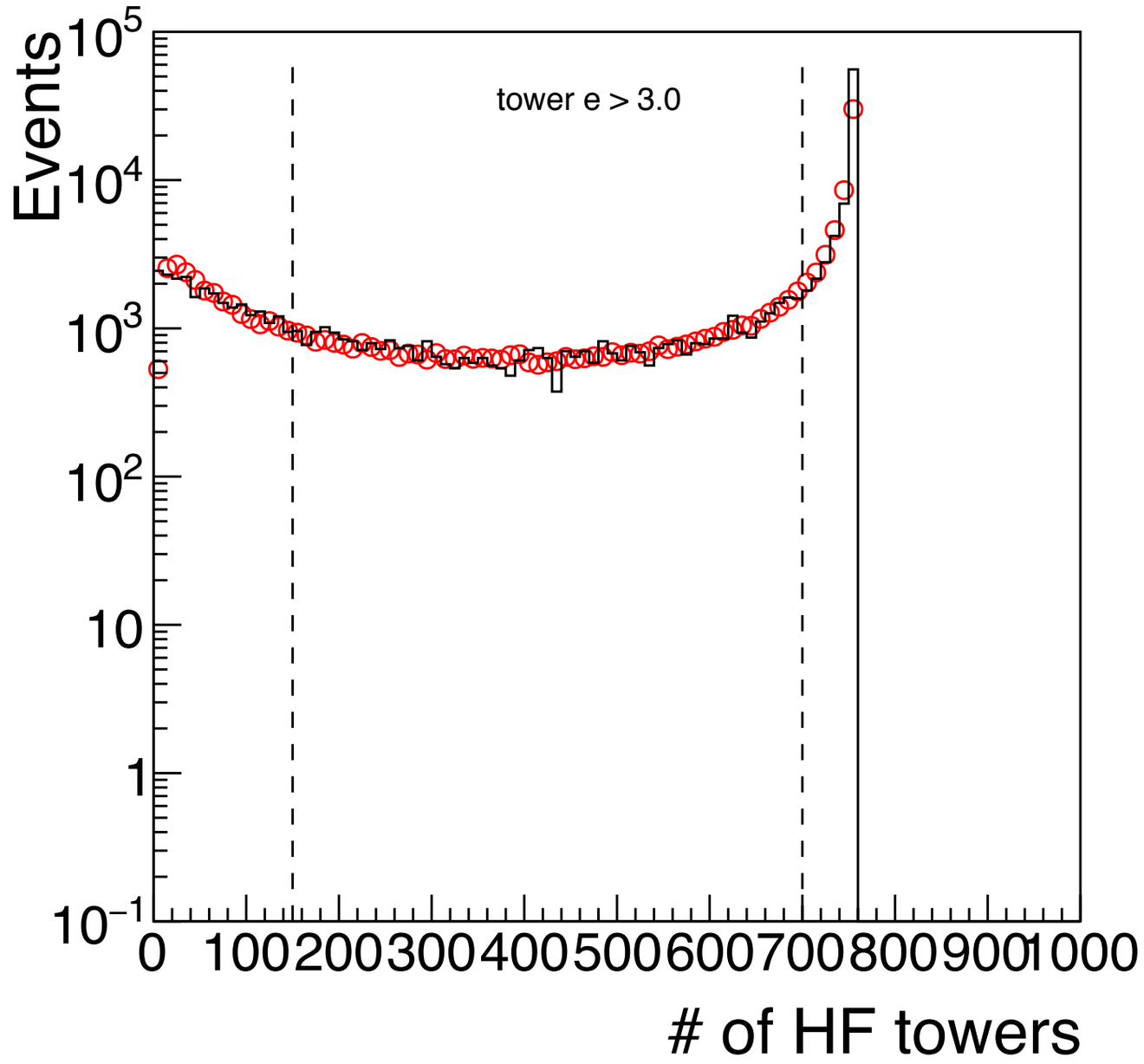
Trigger : HLT_HIL1MinimumBiasHF1AND_v1
phfCoincFilter3 && pprimaryVertexFilter applied

Run #	262694	262695	262703	262726	262735	262811	262816	mean	sigma
1.0	101.3%	101.3%	101.2%	101.3%	101.2%	101.3%	101.3%	101.27%	0.05%
1.5	101.9%	101.9%	101.8%	101.9%	101.7%	101.8%	101.9%	101.84%	0.08%
2.0	101.0%	101.0%	100.9%	100.9%	100.6%	100.9%	100.9%	100.89%	0.13%
2.5	100.0%	100.0%	100.0%	99.9%	99.7%	99.9%	99.9%	99.91%	0.11%
3.0	99.4%	99.4%	99.3%		99.1%	99.3%	99.3%	99.30%	0.11%
3.5	99.5%	99.5%	99.4%		99.2%	99.4%	99.5%	99.42%	0.12%
4.0	99.1%	99.1%	99.0%		98.8%	99.1%	99.1%	99.03%	0.12%
4.5	99.1%	99.1%	99.1%		98.8%	99.0%	99.1%	99.03%	0.12%
5.0	99.3%		99.2%		99.0%	99.1%	99.3%	99.18%	0.13%
								100.07%	1.04%

- **(Eff+Contamination) values are relatively consistent between different runs.**
- **Various ‘energy threshold of tower’ has different Eff+Cont. value.**
- **you can find all the plots here :**
  - https://www.dropbox.com/sh/pcvkh5gvrx30y4s/AAAjqbjI7DvrMI05aqP9yNZza?dl=0

BACK UP

DATA/MC ratio definition

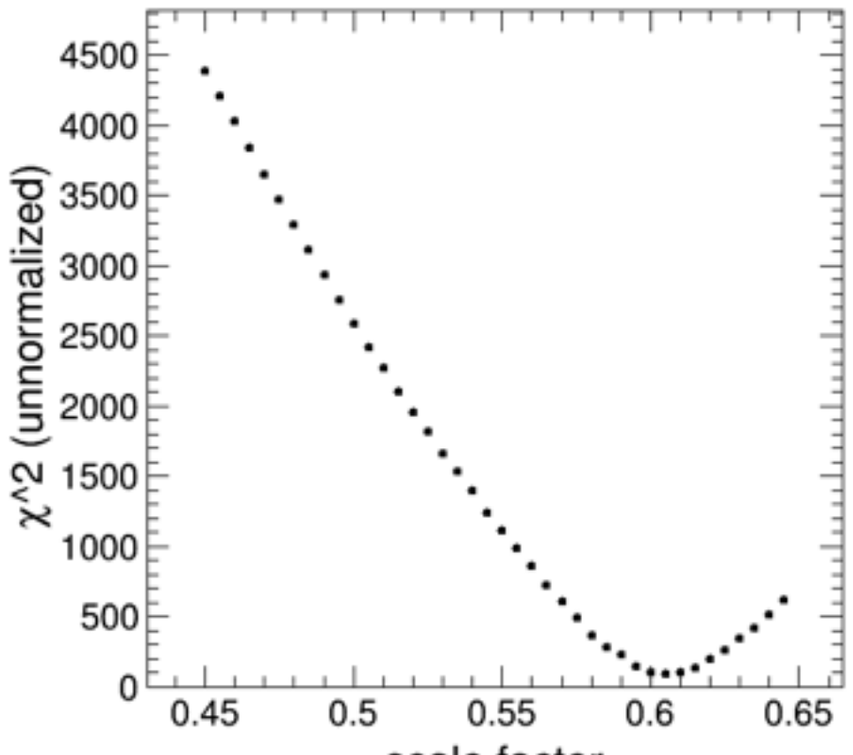


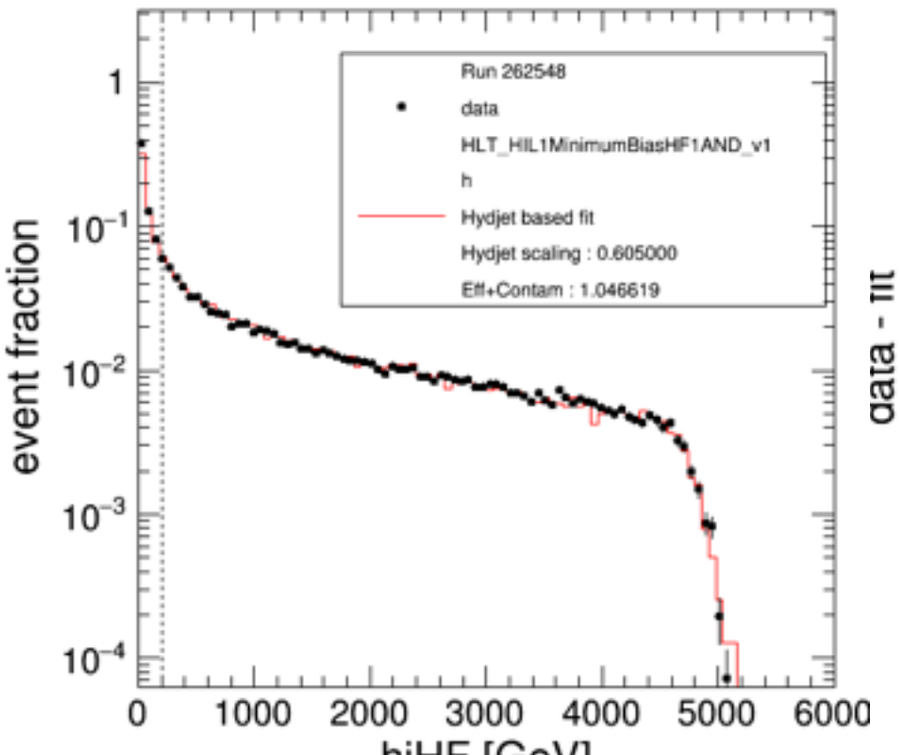
- **DATA/MC = (Integral(0,1000) of DATA) / (Integral(0,700) of MC + Integral(700,1000) of DATA)**

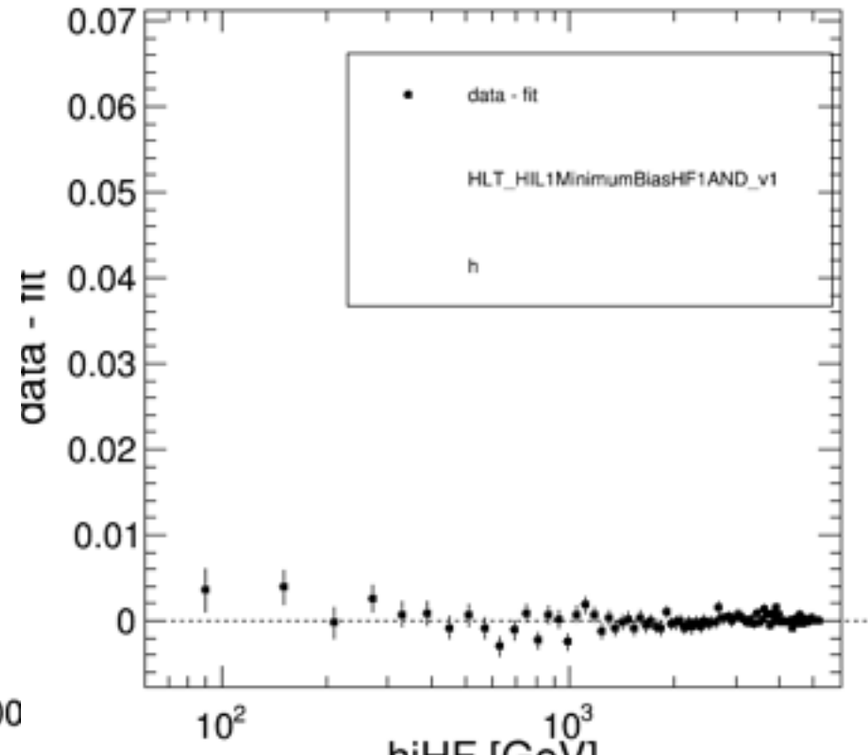
PbPb MinBias Forest : JSON

- **PbPb MinBias Forest Samples from Jian Sun**
  - /afs/cern.ch/work/j/jisun/public/forest2015/lumiSummary_crab_PbPb_HIMinimumBias1_ForestAOD_Track_AK4CaloJet_D0_tkpt0p9eta1p5_01152016.json
  - {"263689": [[1, 146]], "263688": [[1, 1]], "263379": [[82, 916]], "263349": [[60, 402]], "263502": [[74, 256], [258, 493], [495, 512]], "263584": [[78, 959]], "263035": [[1, 334], [336, 609]], "262893": [[33, 108], [110, 111], [116, 118], [120, 122]], "263033": [[1, 6 2]], "263687": [[1, 1]], "263031": [[1, 110]], "263233": [[43, 427], [429, 437], [439, 486], [488, 736]], "262699": [[1, 34], [36, 40]], "262701": [[1, 1]], "263742": [[19, 20], [22, 22], [24, 25], [27, 29], [31, 33], [35, 39], [46, 46], [48, 48], [51, 51], [53, 53], [55, 56], [59, 59], [62, 62], [65, 65], [68, 68], [71, 71], [78, 82], [85, 87]], "262695": [[3, 223]], "262694": [[72, 225]], "262697": [[1, 63]], "262656": [[1, 178]], "263322": [[64, 1238]], "262734": [[1, 1]], "262735": [[1, 69], [71, 71], [105, 105], [117, 118], [121, 121], [127, 127], [131, 131], [139, 139]], "262732": [[1, 2]], "262733": [[1, 83]], "263614": [[80, 1050], [1053, 1092]], "262731": [[1, 2]], "262698": [[1, 11], [15, 15]], "262921": [[9, 887], [889, 1072]], "263729": [[31, 31], [45, 45], [50, 50], [56, 56], [58, 59], [63, 63], [70, 70], [77, 77], [80, 80], [82, 82], [86, 86], [89, 89], [91, 91], [94, 94], [96, 96], [101, 102], [107, 107], [110, 110], [112, 115], [119, 120], [128, 128], [131, 132], [134, 134], [136, 138], [142, 142], [144, 144], [147, 149], [154, 157], [160, 160], [163, 165], [167, 172], [175, 180], [182, 182], [184, 186], [189, 189], [193, 195], [198, 200]], "262777": [[1, 149]], "263718": [[80, 573]], "263007": [[1, 128]], "263511": [[1, 39], [41, 98], [101, 101], [104, 117], [120, 125], [128, 132], [135, 143], [146, 23 7]], "263005": [[63, 654]], "263410": [[78, 306], [309, 664]], "263491": [[52, 410]], "263412": [[1, 240]], "262548": [[100, 107], [109, 112], [115, 127], [129, 135], [138, 150], [152, 187], [189, 213], [215, 257], [267, 270], [272, 295], [297, 307], [309, 318], [320, 325], [327, 328], [330, 342], [344, 355], [357, 365]], "263333": [[78, 227]], "263293": [[1, 373]], "263411": [[1, 1]], "262988": [[1, 689]], "262784": [[1, 374]], "263234": [[1, 695]], "263213": [[1, 8]], "262816": [[1, 449]], "262563": [[1, 79]], "263685": [[83, 91 4]], "262783": [[1, 5]], "263362": [[1, 574]], "262987": [[71, 158], [161, 174]], "263022": [[3, 204]], "262814": [[1, 2], [5, 6]], "262818": [[1, 279]], "263284": [[71, 221], [223, 223]], "263686": [[1, 3]], "263406": [[82, 99]], "262817": [[1, 27]], "262768": [[59, 426]], "262815": [[1, 4], [6, 6]], "262726": [[64, 253], [255, 488], [490, 500]], "262813": [[1, 4], [6, 6]], "263604": [[81, 978]], "262811": [[7, 438]], "263261": [[82, 1357]], "263744": [[1, 91], [93, 93]], "262640": [[87, 232]], "263212": [[1, 17]], "262703": [[1, 123]], "262702": [[1, 1]], "262819": [[1, 118]], "263743": [[1, 67]], "263357": [[1, 2]], "263356": [[1, 1]], "263355": [[1, 117]], "263400": [[63, 904]], "262620": [[99, 423]], "263358": [[1, 3]], "262834": [[73, 214]], "262837": [[1, 777]], "263286": [[1, 603]], "262836": [[1, 99]], "263359": [[1, 2]], "263414": [[1, 1]]}
  - /afs/cern.ch/work/j/jisun/public/forest2015/lumiSummary_crab_PbPb_HIMinimumBias2_ForestAOD_Track_AK4CaloJet_D0_tkpt0p9eta1p5_01142016.json
  - {"263689": [[1, 146]], "263688": [[1, 1]], "263685": [[83, 914]], "263687": [[1, 1]], "263686": [[1, 3]], "262699": [[1, 34], [36, 40]], "262698": [[1, 11], [15, 15]], "262695": [[3, 223]], "262694": [[72, 225]], "262697": [[1, 63]], "263614": [[80, 140], [144, 149], [153, 416], [420, 428], [432, 464], [468, 1050], [1053, 1092]], "263293": [[1, 373]], "263233": [[43, 427], [429, 437], [439, 486], [488, 736]], "263234": [[1, 695]], "262620": [[99, 423]], "263604": [[81, 196], [209, 493], [497, 978]], "263357": [[1, 2]], "263356": [[1, 1]], "263355": [[1, 117]], "263728": [[3, 262], [264, 264]], "263729": [[4, 4], [149, 149], [152, 152], [159, 159], [163, 163], [187, 187], [199, 204]], "262834": [[73, 214]], "262837": [[1, 777]], "263286": [[1, 603]], "263359": [[1, 2]], "263358": [[1, 3]], "263 349": [[60, 402]], "263035": [[1, 609]], "262893": [[33, 108], [110, 111], [116, 118], [120, 122]], "263033": [[1, 62]], "263031": [[1, 110]], "262734": [[1, 1]], "262735": [[1, 69], [71, 71], [105, 105], [117, 118], [121, 121], [127, 127], [131, 131], [139, 139]], "2 62732": [[1, 2]], "262733": [[1, 83]], "262731": [[1, 2]], "262921": [[9, 887], [889, 1072]], "263322": [[64, 1238]], "263511": [[1, 39], [41, 98], [100, 101], [104, 117], [119, 123], [125, 132], [135, 143], [147, 237]], "263022": [[3, 204]], "263284": [[71, 221], [22 3, 223]], "262817": [[1, 27]], "262816": [[1, 449]], "262815": [[1, 4], [6, 6]], "262814": [[1, 2], [5, 6]], "262813": [[1, 4], [6, 6]], "262811": [[7, 438]], "262640": [[87, 232]], "262819": [[1, 118]], "262818": [[1, 279]], "263333": [[78, 227]], "262656": [[1, 178]], "263491": [[52, 410]], "263718": [[80, 571]], "263414": [[1, 1]], "263410": [[78, 632], [634, 664]], "263411": [[1, 1]], "263412": [[1, 240]], "262784": [[1, 374]], "262783": [[1, 5]], "262548": [[100, 255], [269, 365]], "263362": [[1, 574]], "263361": [[3, 3]], "2 62726": [[64, 187], [189, 500]], "262703": [[1, 123]], "262702": [[1, 1]], "262701": [[1, 1]], "263400": [[63, 904]], "263406": [[82, 99]], "263379": [[82, 916]], "263502": [[74, 374], [378, 395], [399, 512]], "262836": [[1, 99]], "262777": [[1, 149]], "263007": [[1, 128]], "263005": [[63, 654]], "262988": [[1, 1], [3, 5], [8, 11], [13, 13], [15, 15], [17, 20], [22, 22], [26, 39], [41, 54], [56, 57], [59, 63], [65, 71], [73, 95], [97, 107], [109, 110], [112, 140], [142, 160], [162, 169], [171, 176], [178, 180], [182, 212], [214, 2 27], [229, 229], [233, 236], [238, 241], [243, 243], [245, 247], [249, 251], [253, 258], [260, 265], [267, 279], [281, 285], [287, 296], [298, 304], [306, 307], [309, 320], [322, 328], [330, 330], [332, 343], [345, 351], [353, 384], [388, 395], [397, 397], [399, 399], [401, 401], [404, 405], [407, 408], [410, 431], [433, 433], [435, 448], [450, 452], [455, 472], [474, 474], [476, 494], [496, 499], [501, 507], [510, 514], [517, 519], [521, 521], [524, 526], [528, 531], [534, 534], [536, 546], [548, 552], [554, 554], [556, 560], [563, 564], [566, 578], [580, 581], [583, 593], [595, 604], [606, 609], [611, 614], [616, 620], [622, 622], [624, 689]], "263212": [[1, 17]], "263213": [[1, 8]], "262563": [[1, 79]], "262987": [[71, 158], [161, 174]], "262768": [[59, 426]], "263584": [[78, 274], [278, 28 31, 287, 959]], "263744": [[1, 93]], "263742": [[19, 21], [23, 23], [25, 26], [28, 29], [31, 34],

centrality calibration : Fitting method







- **MC(with no selection) was scaled by best chi2 value**
  - chi2 is considered in high multiplicity region (over the dotted line in the plot)
- **DATA selection**
  - Trigger : HLT_HIL1MinimumBiasHF1AND_v1
  - with (hfCoincFilter3 , primaryVertexFilter)
- **Divide the integrals (DATA/MC) to estimate (efficiency + contamination)**
- **Repeated for different parts of the detector: HF, EB, EE, Npix, Ntracks, HFhit…**

- **you can find all the plots here :**
  - https://www.dropbox.com/sh/wppz6x21wd909ea/AADg6p_AlmEvnIXEEkDWIFpAa?dl=0