Global Search for New Physics in 2 fb^{-1} at CDF

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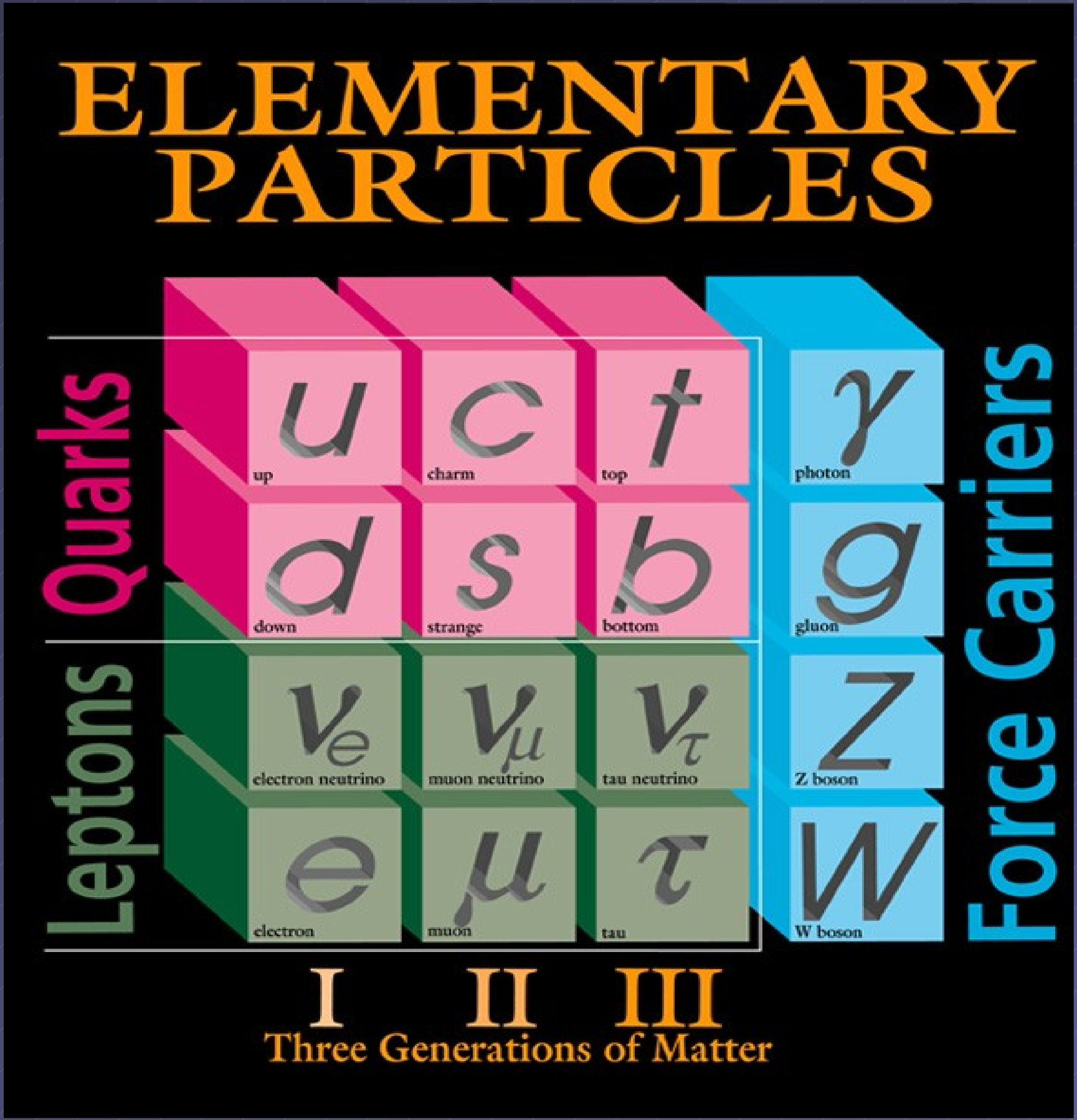
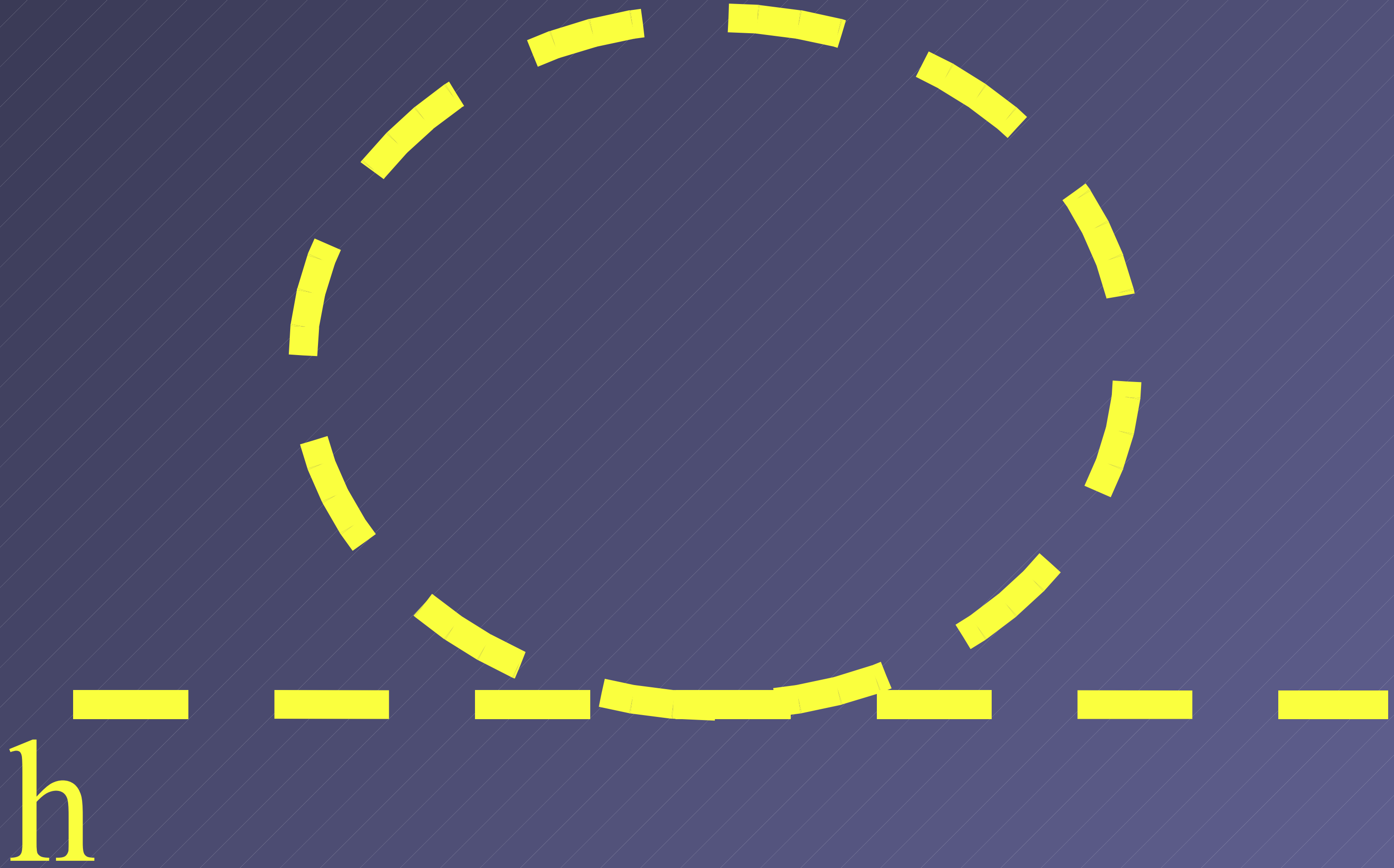
PHENO 08
April 29 , 2008

Standard Model Works Very Well

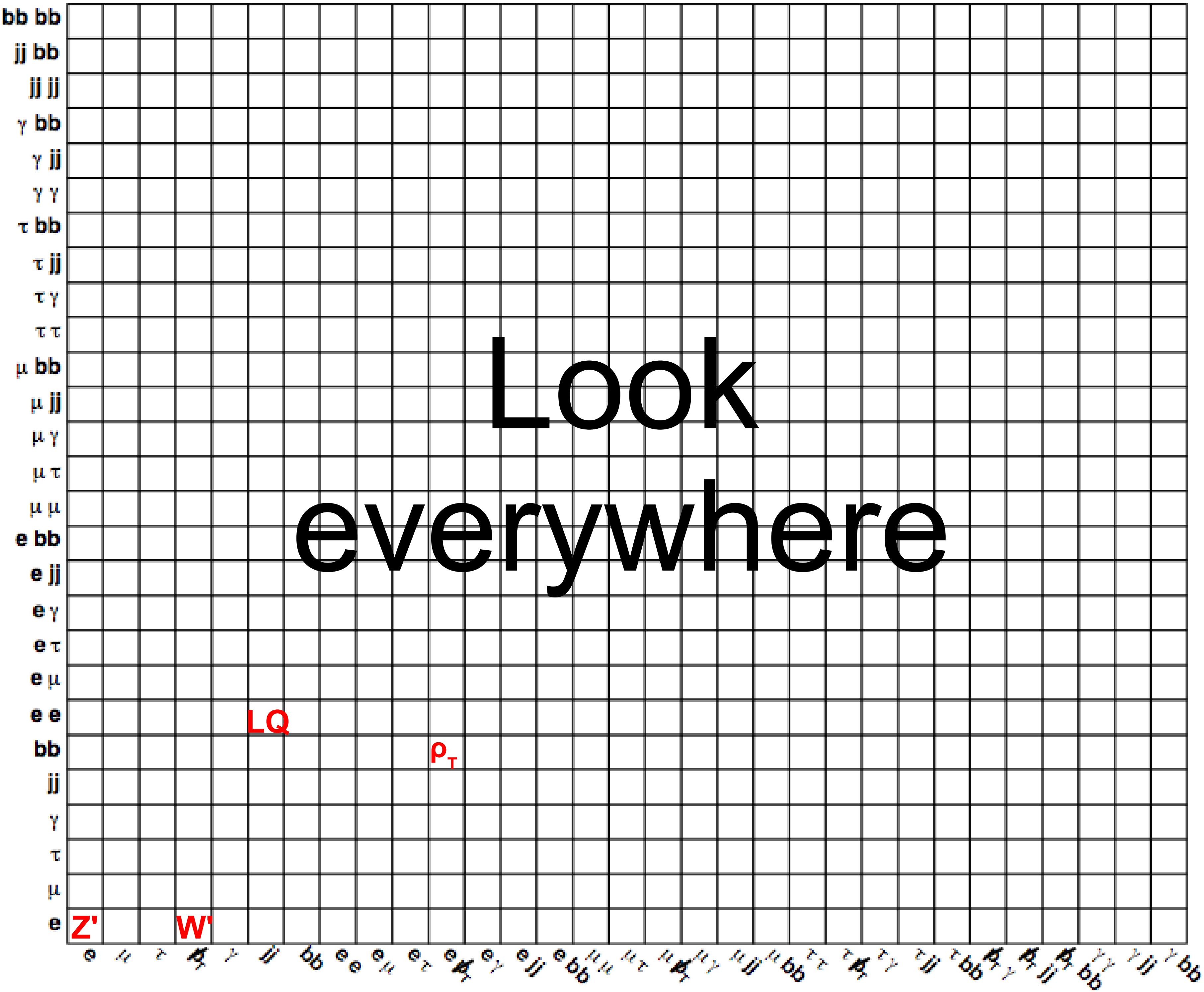


We expect something new !




bosonic TC
composite Higgs
TC-TC
hypercolor
supercolor
techni-GIM
extended TC
pseudo NGB
NOT YET THOUGHT OF
THOUGHT OF
NOT YET
6th gen
5th gen
4th gen
S,T,U
vector-like family
lepto quark
sterile ν
heavy Majorana ν
fractionally charged
effective SUSY
NMSSM
nMSSM
MSSM +νR
unified S
Z'ψ
Z'I
W'
Z'SM
Z'χ
X
Z'η
milli-charged
shadow matter
mirror symmetry
NOT THOUGHT
triplet Higgs
Type 2
Type II
doubly charged Higgs
general 2HDSM
spontaneous CP
superweak
milli-weak
Weinberg's 3HD
Majoron
axion
saxion
axino
familon
NGB
quintessence
k-ssence
4x λ
composite W,Z
contact int.
strings
IIB
IIA
Extra dim
worm-hole

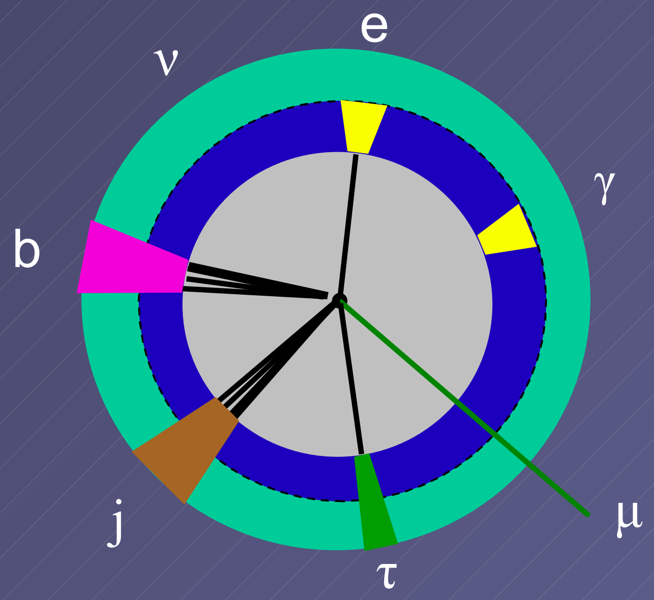
Look everywhere



Identify Objects and Select Events

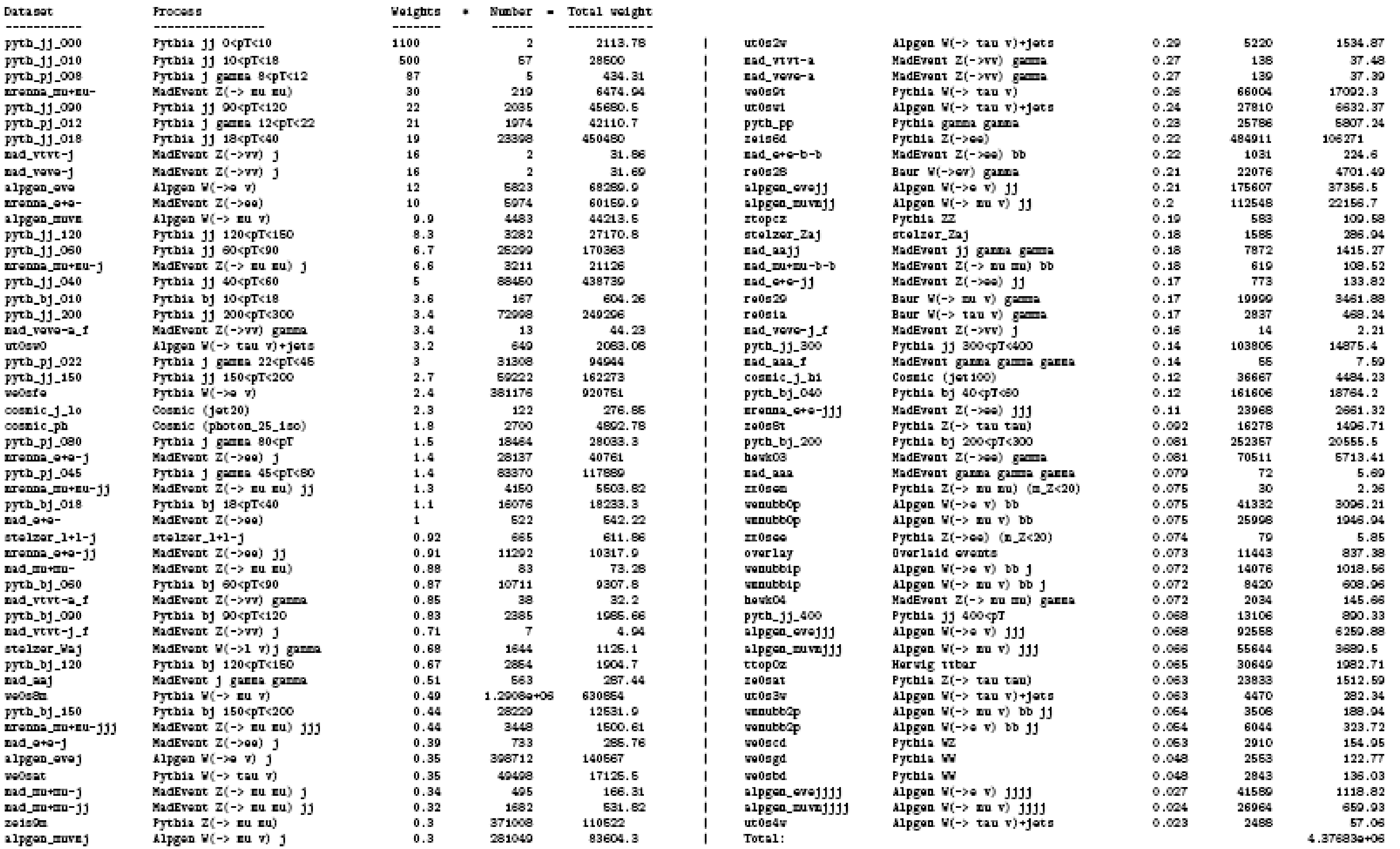
- Identify Physics Objects

$p_T > 17\text{GeV}$



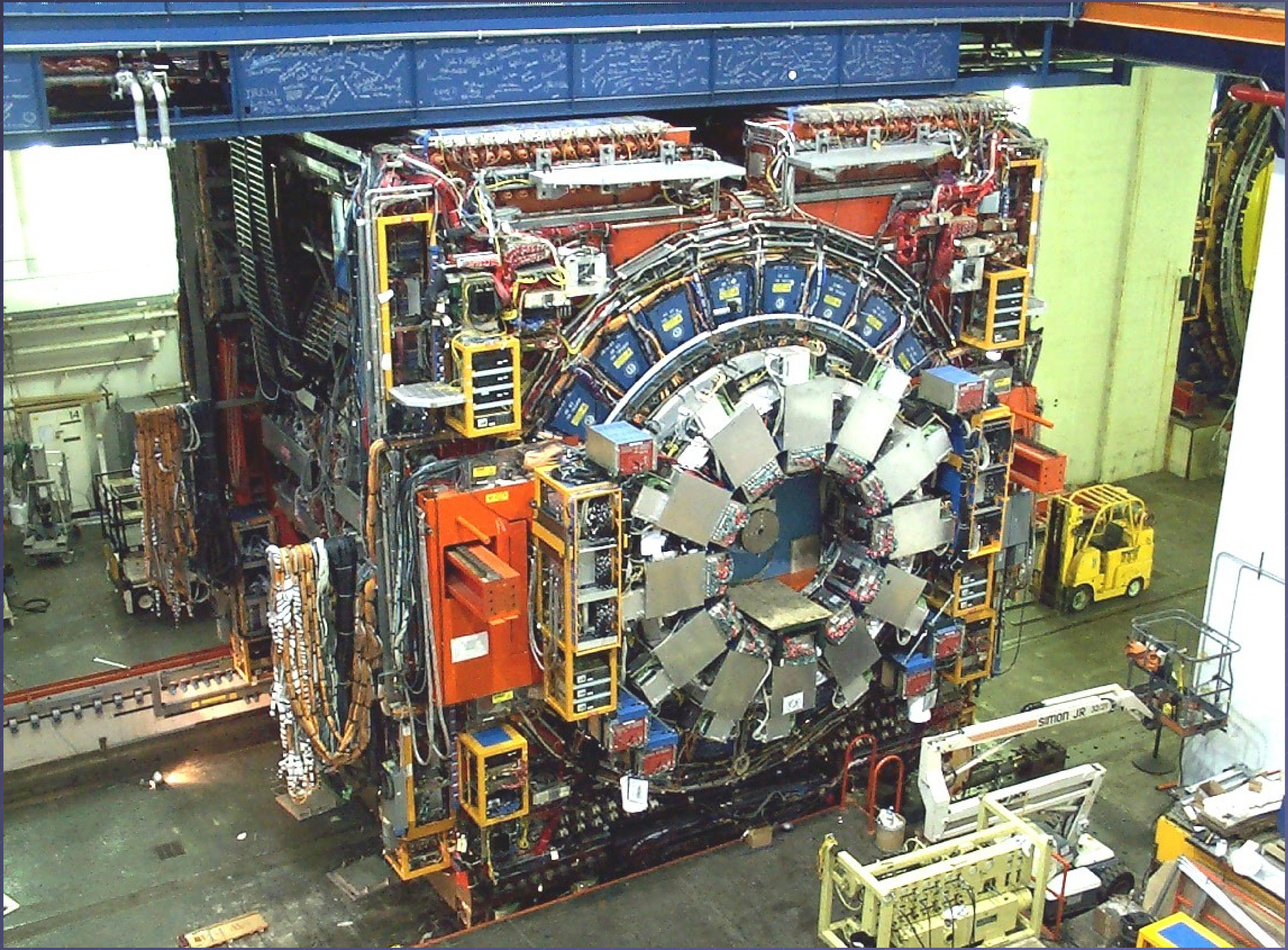
- Select Events of Interest
  - Select events containing high-p_T objects, diobjects, multi-objects
  - Total Selection of ~4 million events

Full Tevatron Standard Model Monte Carlo Set



Dataset	Process	Weights *	Number =	Total weight
pyth_jj_000	Pythia jj 0<pT<10	1100	2	2113.78
pyth_jj_010	Pythia jj 10<pT<18	500	57	28500
pyth_pj_008	Pythia j gamma 8<pT<12	87	5	434.31
mrenna_mu+mu-	MadEvent Z(-> mu mu)	30	219	6474.94
pyth_jj_090	Pythia jj 90<pT<120	22	2035	45680.5
pyth_pj_012	Pythia j gamma 12<pT<22	21	1974	42110.7
pyth_jj_018	Pythia jj 18<pT<40	19	23398	450480
mad_vtvt-j	MadEvent Z(->vv) j	16	2	31.86
mad_veve-j	MadEvent Z(->vv) j	16	2	31.69
alpgen_eve	Alpgen W(->e v)	12	5823	68289.9
mrenna_e+e-	MadEvent Z(->ee)	10	5974	60159.9
alpgen_muvm	Alpgen W(-> mu v)	9.9	4483	44213.5
pyth_jj_120	Pythia jj 120<pT<150	8.3	3282	27170.8
pyth_jj_060	Pythia jj 60<pT<90	6.7	25299	170363
mrenna_mu+mu-j	MadEvent Z(-> mu mu) j	6.6	3211	21126
pyth_jj_040	Pythia jj 40<pT<60	5	88450	438739
pyth_bj_010	Pythia bj 10<pT<18	3.6	167	604.26
pyth_jj_200	Pythia jj 200<pT<300	3.4	72998	249296
mad_veve-a_f	MadEvent Z(->vv) gamma	3.4	13	44.23
ut0sw0	Alpgen W(-> tau v)+jets	3.2	649	2063.06
pyth_pj_022	Pythia j gamma 22<pT<45	3	31308	94944
pyth_jj_150	Pythia jj 150<pT<200	2.7	59222	162273
we0sfe	Pythia W(->e v)	2.4	381176	920751
cosmic_j_lo	Cosmic (jet20)	2.3	122	276.85
cosmic_ph	Cosmic (photon_25_iso)	1.8	2700	4892.78
pyth_pj_080	Pythia j gamma 80<pT	1.5	18464	28033.3
mrenna_e+e-j	MadEvent Z(->ee) j	1.4	28137	40761
pyth_pj_045	Pythia j gamma 45<pT<80	1.4	83370	117889
mrenna_mu+mu-jj	MadEvent Z(-> mu mu) jj	1.3	4150	5503.82
pyth_bj_018	Pythia bj 18<pT<40	1.1	16076	18233.3
mad_e+e-	MadEvent Z(->ee)	1	522	542.22
stelzer_l+l-j	stelzer_l+l-j	0.92	665	611.86
mrenna_e+e-jj	MadEvent Z(->ee) jj	0.91	11292	10317.9
mad_mu+mu-	MadEvent Z(-> mu mu)	0.88	83	73.28
pyth_bj_060	Pythia bj 60<pT<90	0.87	10711	9307.8
mad_vtvt-a_f	MadEvent Z(->vv) gamma	0.85	38	32.2
pyth_bj_090	Pythia bj 90<pT<120	0.83	2385	1985.66
mad_vtvt-j_f	MadEvent Z(->vv) j	0.71	7	4.94
stelzer_Waj	MadEvent W(->l v)j gamma	0.68	1644	1125.1
pyth_bj_120	Pythia bj 120<pT<150	0.67	2854	1904.7
mad_aaj	MadEvent j gamma gamma	0.51	563	287.44
we0s8m	Pythia W(-> mu v)	0.49	1.2908e+06	630854
pyth_bj_150	Pythia bj 150<pT<200	0.44	28229	12531.9
mrenna_mu+mu-jjj	MadEvent Z(-> mu mu) jjj	0.44	3448	1500.61
mad_e+e-j	MadEvent Z(->ee) j	0.39	733	285.76
alpgen_evej	Alpgen W(->e v) j	0.35	398712	140567
we0sat	Pythia W(-> tau v)	0.35	49498	17125.5
mad_mu+mu-j	MadEvent Z(-> mu mu) j	0.34	495	166.31
mad_mu+mu-jj	MadEvent Z(-> mu mu) jj	0.32	1682	531.82
zeis0m	Pythia Z(-> mu mu)	0.3	371008	110522
alpgen_muvmj	Alpgen W(-> mu v) j	0.3	281049	83604.3
ut0s2w	Alpgen W(-> tau v)+jets	0.29	5220	1534.87
mad_vtvt-a	MadEvent Z(->vv) gamma	0.27	138	37.48
mad_veve-a	MadEvent Z(->vv) gamma	0.27	139	37.39
we0s9t	Pythia W(-> tau v)	0.26	66004	17092.3
ut0swi	Alpgen W(-> tau v)+jets	0.24	27810	6632.37
pyth_pp	Pythia gamma gamma	0.23	25786	5807.24
zeis6d	Pythia Z(->ee)	0.22	484911	106271
mad_e+e-b-b	MadEvent Z(->ee) bb	0.22	1031	224.6
re0s28	Baur W(->ev) gamma	0.21	22076	4701.49
alpgen_evejj	Alpgen W(->e v) jj	0.21	175607	37356.5
alpgen_muvmjj	Alpgen W(-> mu v) jj	0.2	112548	22156.7
stopcz	Pythia ZZ	0.19	583	109.58
stelzer_Zaj	stelzer_Zaj	0.18	1585	286.94
mad_aajj	MadEvent jj gamma gamma	0.18	7872	1415.27
mad_mu+mu-b-b	MadEvent Z(-> mu mu) bb	0.18	619	108.52
mad_e+e-jj	MadEvent Z(->ee) jj	0.17	773	133.82
re0s29	Baur W(-> mu v) gamma	0.17	19999	3461.88
re0sia	Baur W(-> tau v) gamma	0.17	2837	468.24
mad_veve-j_f	MadEvent Z(->vv) j	0.16	14	2.21
pyth_jj_300	Pythia jj 300<pT<400	0.14	103806	14875.4
mad_aaa_f	MadEvent gamma gamma gamma	0.14	55	7.59
cosmic_j_hi	Cosmic (jet100)	0.12	36667	4484.23
pyth_bj_040	Pythia bj 40<pT<60	0.12	161606	18764.2
mrenna_e+e-jjj	MadEvent Z(->ee) jjj	0.11	23968	2661.32
ze0s8t	Pythia Z(-> tau tau)	0.092	16278	1496.71
pyth_bj_200	Pythia bj 200<pT<300	0.081	252367	20555.5
hewk03	MadEvent Z(->ee) gamma	0.081	70511	5713.41
mad_aaa	MadEvent gamma gamma gamma	0.079	72	5.69
zx0sem	Pythia Z(-> mu mu) (m_Z<20)	0.075	30	2.26
wenubb0p	Alpgen W(->e v) bb	0.075	41332	3096.21
wmnubb0p	Alpgen W(-> mu v) bb	0.075	25998	1946.94
zx0see	Pythia Z(->ee) (m_Z<20)	0.074	79	5.85
overlay	Overlaid events	0.073	11443	837.38
wenubb1p	Alpgen W(->e v) bb j	0.072	14076	1018.56
wmnubb1p	Alpgen W(-> mu v) bb j	0.072	8420	608.96
hewk04	MadEvent Z(-> mu mu) gamma	0.072	2034	145.66
pyth_jj_400	Pythia jj 400<pT	0.068	13106	890.33
alpgen_evejjj	Alpgen W(->e v) jjj	0.068	92568	6259.88
alpgen_muvmjjj	Alpgen W(-> mu v) jjj	0.066	55644	3689.5
ttop0z	Herwig ttbar	0.065	30649	1982.71
ze0sat	Pythia Z(-> tau tau)	0.063	23833	1512.59
ut0s3w	Alpgen W(-> tau v)+jets	0.063	4470	282.34
wmnubb2p	Alpgen W(-> mu v) bb jj	0.054	3506	188.94
wenubb2p	Alpgen W(->e v) bb jj	0.054	6044	323.72
we0scd	Pythia WZ	0.053	2910	154.95
we0sgd	Pythia WW	0.048	2563	122.77
we0sbd	Pythia WW	0.048	2843	136.03
alpgen_evejjjj	Alpgen W(->e v) jjjj	0.027	41589	1118.82
alpgen_muvmjjjj	Alpgen W(-> mu v) jjjj	0.024	26964	659.93
ut0s4w	Alpgen W(-> tau v)+jets	0.023	2488	57.06
Total:				4.37683e+06

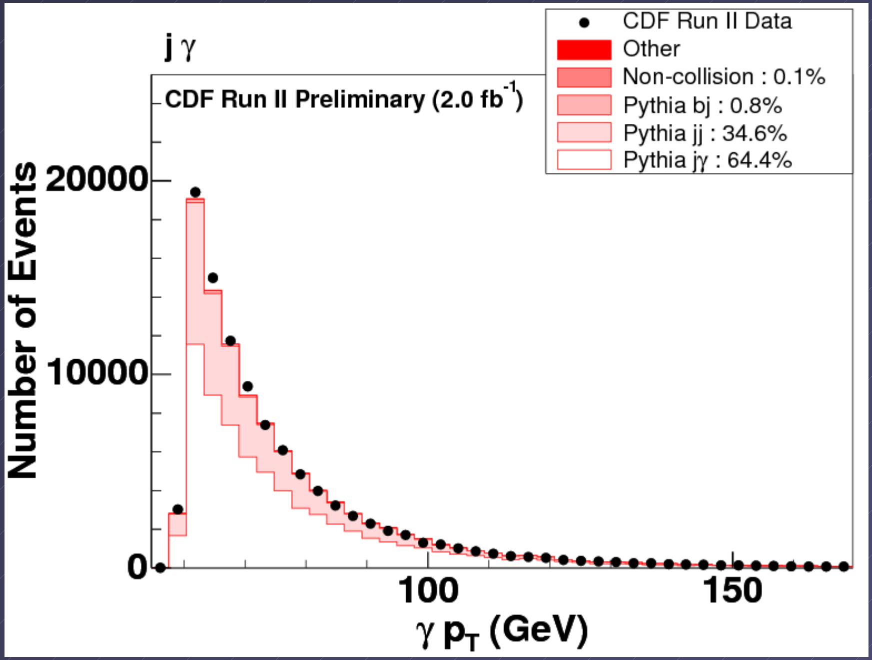
Simulate detector response

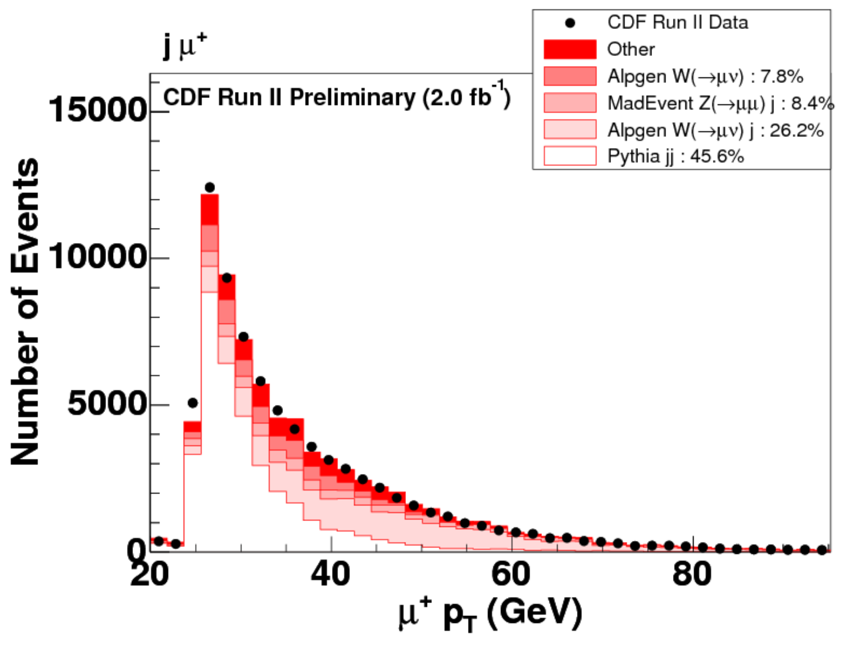


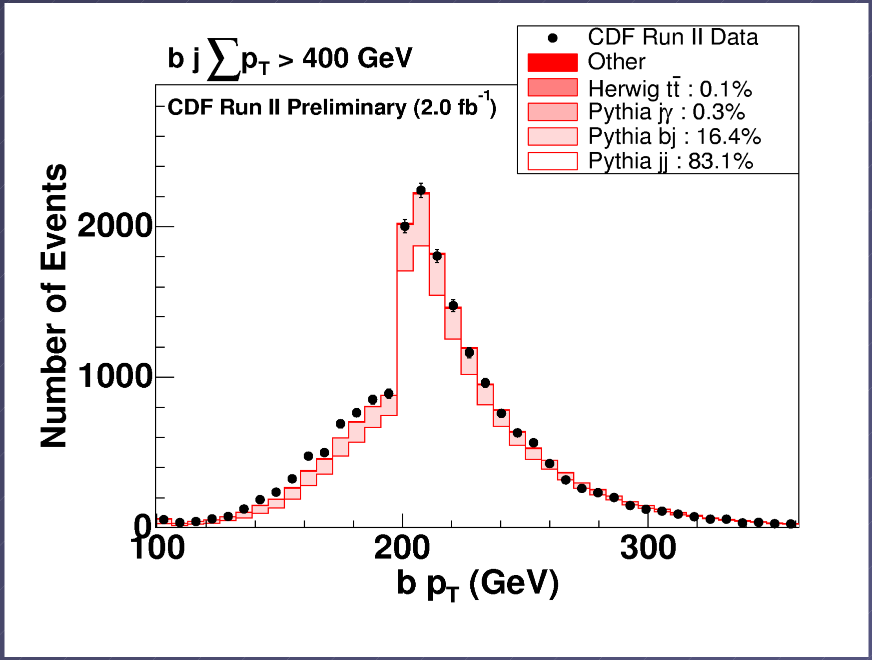
Correction Model

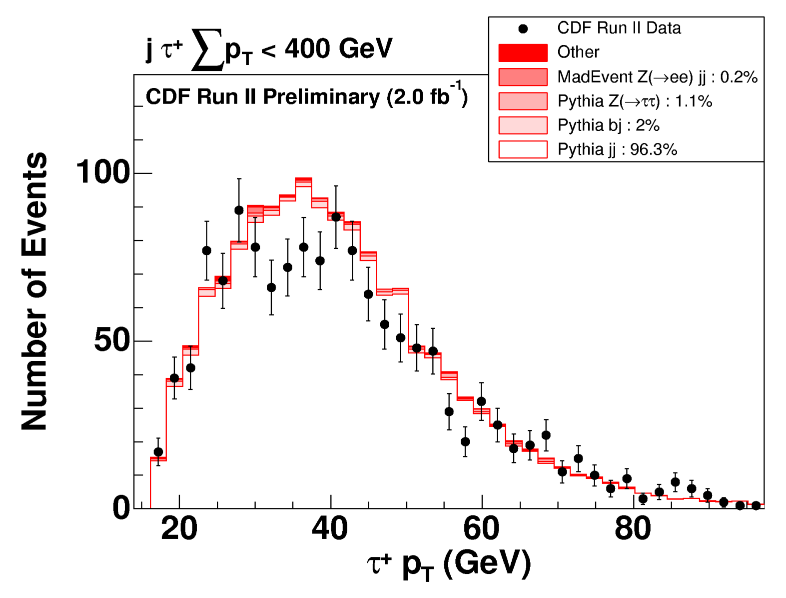
- Attempts to accurately reflect the limit to our systematic understanding of the detector and the standard model
- Correction factors include: integrated luminosity, k-factors, trigger efficiencies, reconstruction efficiencies, fake rates
- Values are obtained by a global fit of data to background yielding a set of values maximizing global agreement

A few typical control distributions

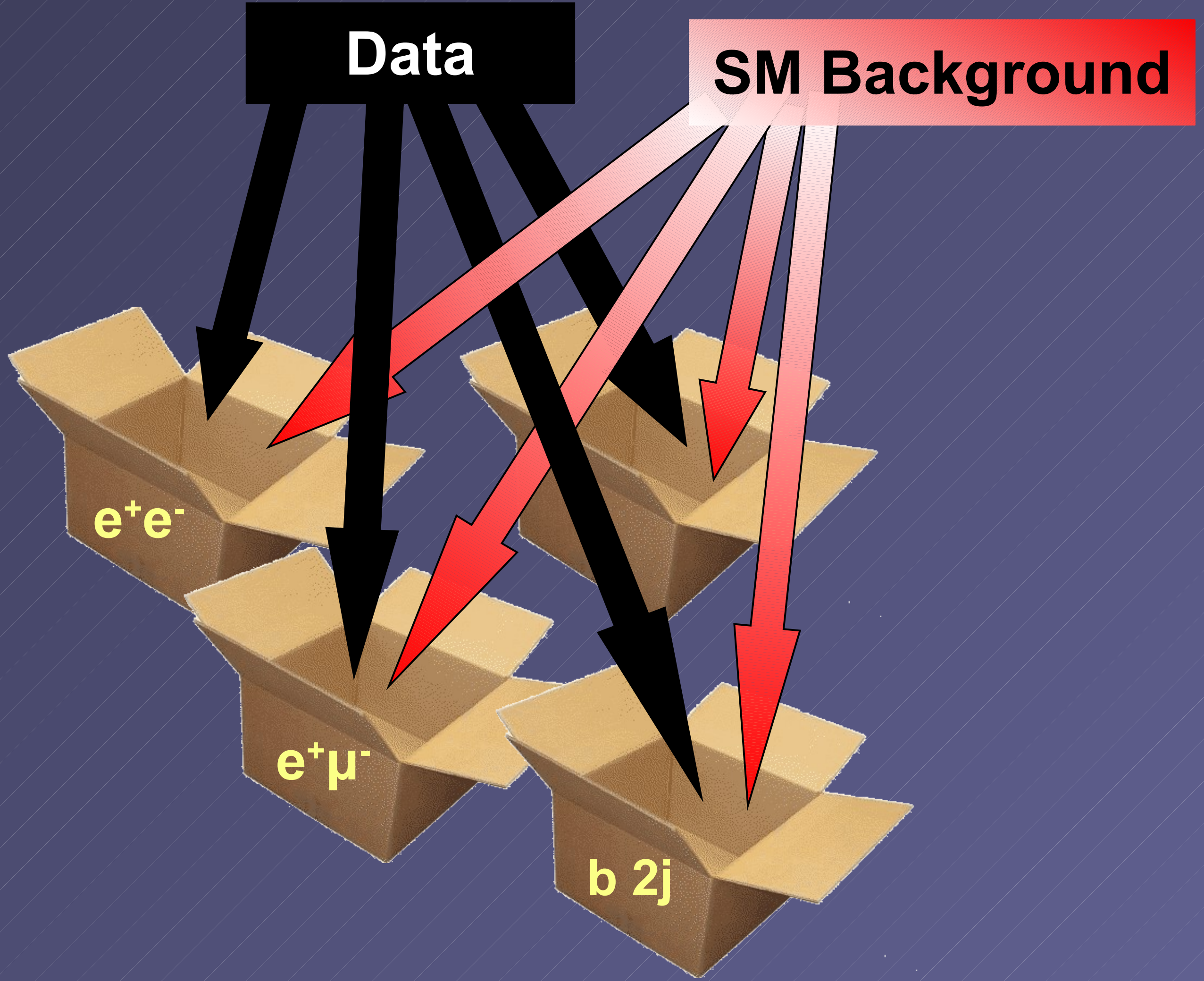






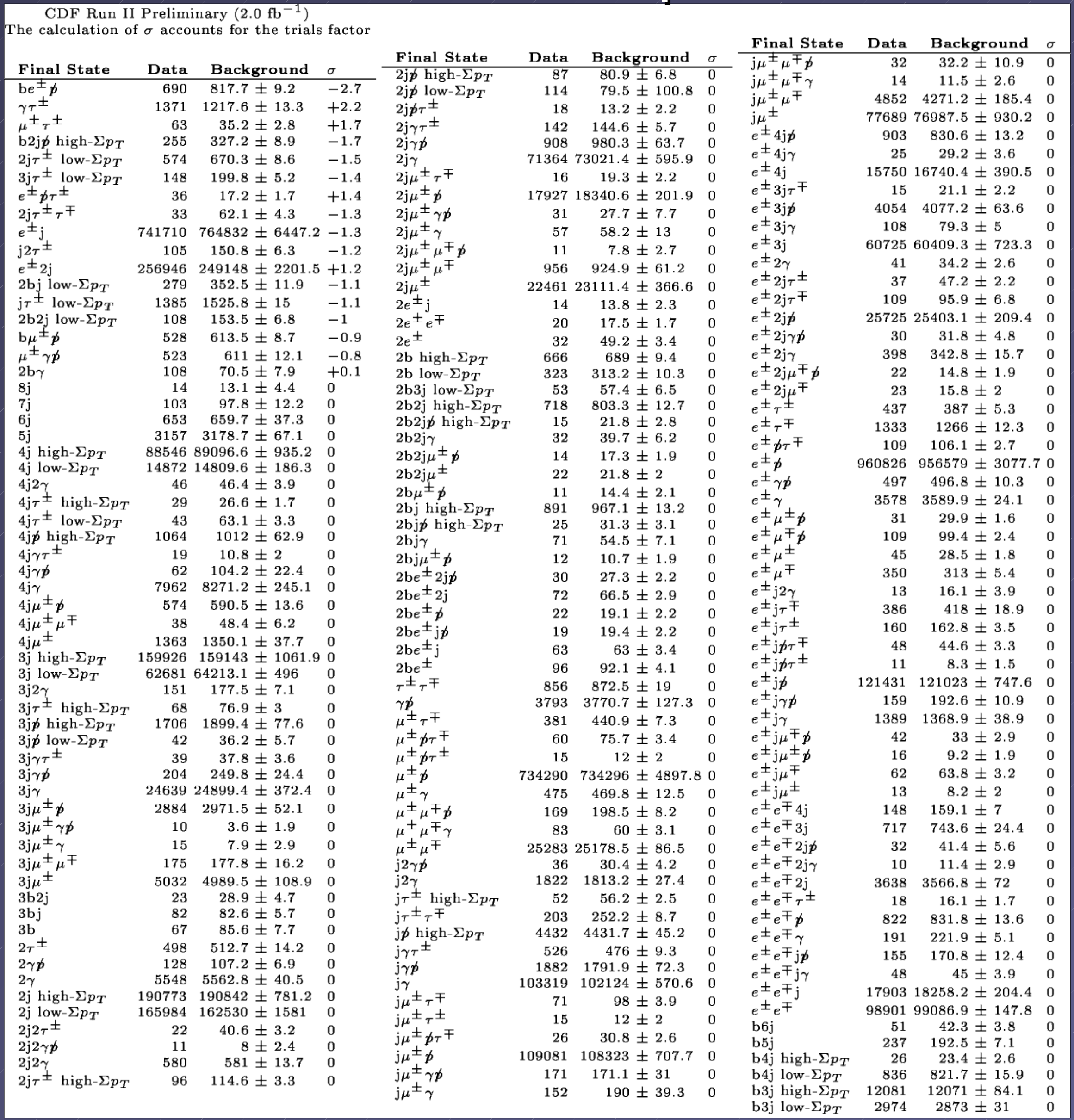


Partition Events into **exclusive final states**



Global Comparison

399 Final State Populations

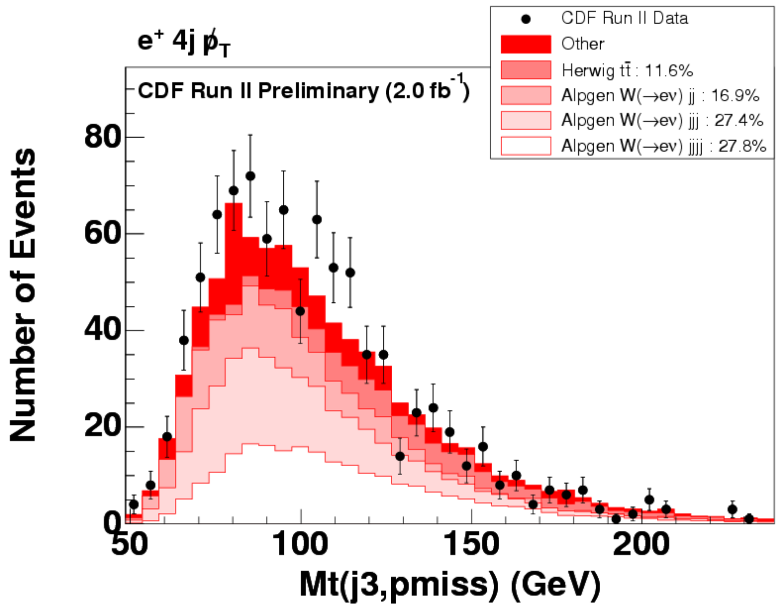


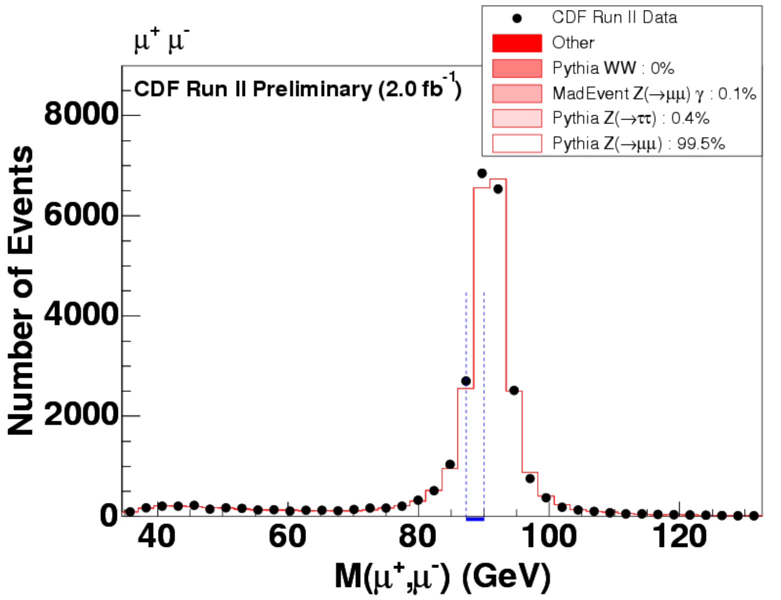
CDF Run II Preliminary (2.0 fb^{-1})
The calculation of σ accounts for the trials factor

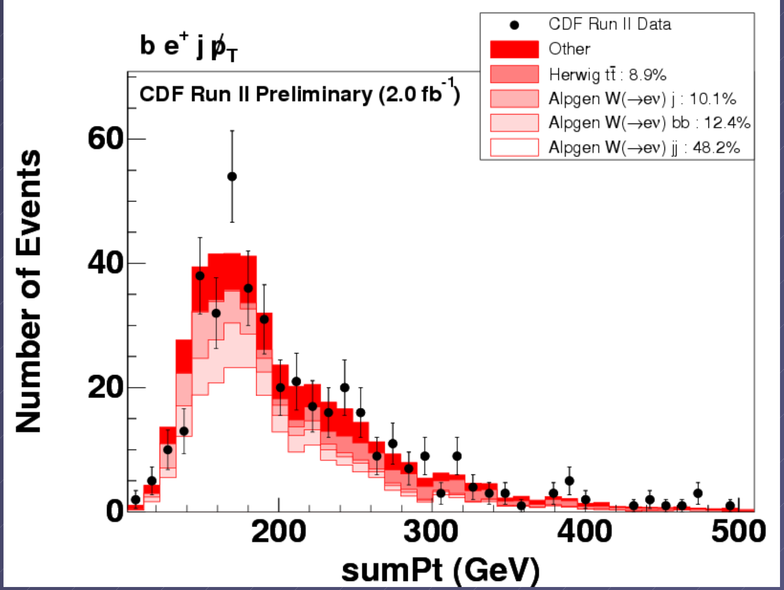
Final State	Data	Background	σ
$\mathrm{b}e^{\pm}\not{p}$	690	817.7 ± 9.2	−2.7
$\gamma\tau^{\pm}$	1371	1217.6 ± 13.3	+2.2
$\mu^{\pm}\tau^{\pm}$	63	35.2 ± 2.8	+1.7
$\mathrm{b2j}\not{p}$ high-Σp_T	255	327.2 ± 8.9	−1.7
$\mathrm{2j}\tau^{\pm}$ low-Σp_T	574	670.3 ± 8.6	−1.5
$\mathrm{3j}\tau^{\pm}$ low-Σp_T	148	199.8 ± 5.2	−1.4
$e^{\pm}\not{p}\tau^{\pm}$	36	17.2 ± 1.7	+1.4
$\mathrm{2j}\tau^{\pm}\tau^{\mp}$	33	62.1 ± 4.3	−1.3
$e^{\pm}\mathrm{j}$	741710	764832 ± 6447.2	−1.3
$\mathrm{j2}\tau^{\pm}$	105	150.8 ± 6.3	−1.2
$e^{\pm}\mathrm{2j}$	256946	249148 ± 2201.5	+1.2
2bj low-Σp_T	279	352.5 ± 11.9	−1.1
$\mathrm{j}\tau^{\pm}$ low-Σp_T	1385	1525.8 ± 15	−1.1
2b2j low-Σp_T	108	153.5 ± 6.8	−1
$\mathrm{b}\mu^{\pm}\not{p}$	528	613.5 ± 8.7	−0.9
$\mu^{\pm}\gamma\not{p}$	523	611 ± 12.1	−0.8
$\mathrm{2b}\gamma$	108	70.5 ± 7.9	+0.1
8j	14	13.1 ± 4.4	0
7j	103	97.8 ± 12.2	0
6j	653	659.7 ± 37.3	0
5j	3157	3178.7 ± 67.1	0
4j high-Σp_T	88546	89096.6 ± 935.2	0
4j low-Σp_T	14872	14809.6 ± 186.3	0
$\mathrm{4j2}\gamma$	46	46.4 ± 3.9	0
$\mathrm{4j}\tau^{\pm}$ high-Σp_T	29	26.6 ± 1.7	0
$\mathrm{4j}\tau^{\pm}$ low-Σp_T	43	63.1 ± 3.3	0
$\mathrm{4j}\not{p}$ high-Σp_T	1064	1012 ± 62.9	0
$\mathrm{4j}\gamma\tau^{\pm}$	19	10.8 ± 2	0
$\mathrm{4j}\gamma\not{p}$	62	104.2 ± 22.4	0
$\mathrm{4j}\gamma$	7962	8271.2 ± 245.1	0
$\mathrm{4j}\mu^{\pm}\not{p}$	574	590.5 ± 13.6	0
$\mathrm{4j}\mu^{\pm}\mu^{\mp}$	38	48.4 ± 6.2	0
$\mathrm{4j}\mu^{\pm}$	1363	1350.1 ± 37.7	0
3j high-Σp_T	159926	159143 ± 1061.9	0
3j low-Σp_T	62681	64213.1 ± 496	0
$\mathrm{3j2}\gamma$	151	177.5 ± 7.1	0
$\mathrm{3j}\tau^{\pm}$ high-Σp_T	68	76.9 ± 3	0
$\mathrm{3j}\not{p}$ high-Σp_T	1706	1899.4 ± 77.6	0
$\mathrm{3j}\not{p}$ low-Σp_T	42	36.2 ± 5.7	0
$\mathrm{3j}\gamma\tau^{\pm}$	39	37.8 ± 3.6	0
$\mathrm{3j}\gamma\not{p}$	204	249.8 ± 24.4	0
$\mathrm{3j}\gamma$	24639	24899.4 ± 372.4	0
$\mathrm{3j}\mu^{\pm}\not{p}$	2884	2971.5 ± 52.1	0
$\mathrm{3j}\mu^{\pm}\gamma\not{p}$	10	3.6 ± 1.9	0
$\mathrm{3j}\mu^{\pm}\gamma$	15	7.9 ± 2.9	0
$\mathrm{3j}\mu^{\pm}\mu^{\mp}$	175	177.8 ± 16.2	0
$\mathrm{3j}\mu^{\pm}$	5032	4989.5 ± 108.9	0
3b2j	23	28.9 ± 4.7	0
3bj	82	82.6 ± 5.7	0
3b	67	85.6 ± 7.7	0
$2\tau^{\pm}$	498	512.7 ± 14.2	0
$2\gamma\not{p}$	128	107.2 ± 6.9	0
2γ	5548	5562.8 ± 40.5	0
2j high-Σp_T	190773	190842 ± 781.2	0
2j low-Σp_T	165984	162530 ± 1581	0
$\mathrm{2j2}\tau^{\pm}$	22	40.6 ± 3.2	0
$\mathrm{2j2}\gamma\not{p}$	11	8 ± 2.4	0
$\mathrm{2j2}\gamma$	580	581 ± 13.7	0
$\mathrm{2j}\tau^{\pm}$ high-Σp_T	96	114.6 ± 3.3	0
$\mathrm{2j}\not{p}$ high-Σp_T	87	80.9 ± 6.8	0
$\mathrm{2j}\not{p}$ low-Σp_T	114	79.5 ± 100.8	0
$\mathrm{2j}\not{p}\tau^{\pm}$	18	13.2 ± 2.2	0
$\mathrm{2j}\gamma\tau^{\pm}$	142	144.6 ± 5.7	0
$\mathrm{2j}\gamma\not{p}$	908	980.3 ± 63.7	0
$\mathrm{2j}\gamma$	71364	73021.4 ± 595.9	0
$\mathrm{2j}\mu^{\pm}\tau^{\mp}$	16	19.3 ± 2.2	0
$\mathrm{2j}\mu^{\pm}\not{p}$	17927	18340.6 ± 201.9	0
$\mathrm{2j}\mu^{\pm}\gamma\not{p}$	31	27.7 ± 7.7	0
$\mathrm{2j}\mu^{\pm}\gamma$	57	58.2 ± 13	0
$\mathrm{2j}\mu^{\pm}\mu^{\mp}\not{p}$	11	7.8 ± 2.7	0
$\mathrm{2j}\mu^{\pm}\mu^{\mp}$	956	924.9 ± 61.2	0
$\mathrm{2j}\mu^{\pm}$	22461	23111.4 ± 366.6	0
$2e^{\pm}\mathrm{j}$	14	13.8 ± 2.3	0
$2e^{\pm}e^{\mp}$	20	17.5 ± 1.7	0
$2e^{\pm}$	32	49.2 ± 3.4	0
2b high-Σp_T	666	689 ± 9.4	0
2b low-Σp_T	323	313.2 ± 10.3	0
2b3j low-Σp_T	53	57.4 ± 6.5	0
2b2j high-Σp_T	718	803.3 ± 12.7	0
$\mathrm{2b2j}\not{p}$ high-Σp_T	15	21.8 ± 2.8	0
$\mathrm{2b2j}\gamma$	32	39.7 ± 6.2	0
$\mathrm{2b2j}\mu^{\pm}\not{p}$	14	17.3 ± 1.9	0
$\mathrm{2b2j}\mu^{\pm}$	22	21.8 ± 2	0
$\mathrm{2b}\mu^{\pm}\not{p}$	11	14.4 ± 2.1	0
2bj high-Σp_T	891	967.1 ± 13.2	0
$\mathrm{2bj}\not{p}$ high-Σp_T	25	31.3 ± 3.1	0
$\mathrm{2bj}\gamma$	71	54.5 ± 7.1	0
$\mathrm{2bj}\mu^{\pm}\not{p}$	12	10.7 ± 1.9	0
$\mathrm{2b}e^{\pm}\mathrm{2j}\not{p}$	30	27.3 ± 2.2	0
$\mathrm{2b}e^{\pm}\mathrm{2j}$	72	66.5 ± 2.9	0
$\mathrm{2b}e^{\pm}\not{p}$	22	19.1 ± 2.2	0
$\mathrm{2b}e^{\pm}\mathrm{j}\not{p}$	19	19.4 ± 2.2	0
$\mathrm{2b}e^{\pm}\mathrm{j}$	63	63 ± 3.4	0
$\mathrm{2b}e^{\pm}$	96	92.1 ± 4.1	0
$\tau^{\pm}\tau^{\mp}$	856	872.5 ± 19	0
$\gamma\not{p}$	3793	3770.7 ± 127.3	0
$\mu^{\pm}\tau^{\mp}$	381	440.9 ± 7.3	0
$\mu^{\pm}\not{p}\tau^{\mp}$	60	75.7 ± 3.4	0
$\mu^{\pm}\not{p}\tau^{\pm}$	15	12 ± 2	0
$\mu^{\pm}\not{p}$	734290	734296 ± 4897.8	0
$\mu^{\pm}\gamma$	475	469.8 ± 12.5	0
$\mu^{\pm}\mu^{\mp}\not{p}$	169	198.5 ± 8.2	0
$\mu^{\pm}\mu^{\mp}\gamma$	83	60 ± 3.1	0
$\mu^{\pm}\mu^{\mp}$	25283	25178.5 ± 86.5	0
$\mathrm{j2}\gamma\not{p}$	36	30.4 ± 4.2	0
$\mathrm{j2}\gamma$	1822	1813.2 ± 27.4	0
$\mathrm{j}\tau^{\pm}$ high-Σp_T	52	56.2 ± 2.5	0
$\mathrm{j}\tau^{\pm}\tau^{\mp}$	203	252.2 ± 8.7	0
$\mathrm{j}\not{p}$ high-Σp_T	4432	4431.7 ± 45.2	0
$\mathrm{j}\gamma\tau^{\pm}$	526	476 ± 9.3	0
$\mathrm{j}\gamma\not{p}$	1882	1791.9 ± 72.3	0
$\mathrm{j}\gamma$	103319	102124 ± 570.6	0
$\mathrm{j}\mu^{\pm}\tau^{\mp}$	71	98 ± 3.9	0
$\mathrm{j}\mu^{\pm}\tau^{\pm}$	15	12 ± 2	0
$\mathrm{j}\mu^{\pm}\not{p}\tau^{\mp}$	26	30.8 ± 2.6	0
$\mathrm{j}\mu^{\pm}\not{p}$	109081	108323 ± 707.7	0
$\mathrm{j}\mu^{\pm}\gamma\not{p}$	171	171.1 ± 31	0
$\mathrm{j}\mu^{\pm}\gamma$	152	190 ± 39.3	0
$\mathrm{j}\mu^{\pm}\mu^{\mp}\not{p}$	32	32.2 ± 10.9	0
$\mathrm{j}\mu^{\pm}\mu^{\mp}\gamma$	14	11.5 ± 2.6	0
$\mathrm{j}\mu^{\pm}\mu^{\mp}$	4852	4271.2 ± 185.4	0
$\mathrm{j}\mu^{\pm}$	77689	76987.5 ± 930.2	0
$e^{\pm}\mathrm{4j}\not{p}$	903	830.6 ± 13.2	0
$e^{\pm}\mathrm{4j}\gamma$	25	29.2 ± 3.6	0
$e^{\pm}\mathrm{4j}$	15750	16740.4 ± 390.5	0
$e^{\pm}\mathrm{3j}\tau^{\mp}$	15	21.1 ± 2.2	0
$e^{\pm}\mathrm{3j}\not{p}$	4054	4077.2 ± 63.6	0
$e^{\pm}\mathrm{3j}\gamma$	108	79.3 ± 5	0
$e^{\pm}\mathrm{3j}$	60725	60409.3 ± 723.3	0
$e^{\pm}2\gamma$	41	34.2 ± 2.6	0
$e^{\pm}\mathrm{2j}\tau^{\pm}$	37	47.2 ± 2.2	0
$e^{\pm}\mathrm{2j}\tau^{\mp}$	109	95.9 ± 6.8	0
$e^{\pm}\mathrm{2j}\not{p}$	25725	25403.1 ± 209.4	0
$e^{\pm}\mathrm{2j}\gamma\not{p}$	30	31.8 ± 4.8	0
$e^{\pm}\mathrm{2j}\gamma$	398	342.8 ± 15.7	0
$e^{\pm}\mathrm{2j}\mu^{\mp}\not{p}$	22	14.8 ± 1.9	0
$e^{\pm}\mathrm{2j}\mu^{\mp}$	23	15.8 ± 2	0
$e^{\pm}\tau^{\pm}$	437	387 ± 5.3	0
$e^{\pm}\tau^{\mp}$	1333	1266 ± 12.3	0
$e^{\pm}\not{p}\tau^{\mp}$	109	106.1 ± 2.7	0
$e^{\pm}\not{p}$	960826	956579 ± 3077.7	0
$e^{\pm}\gamma\not{p}$	497	496.8 ± 10.3	0
$e^{\pm}\gamma$	3578	3589.9 ± 24.1	0
$e^{\pm}\mu^{\pm}\not{p}$	31	29.9 ± 1.6	0
$e^{\pm}\mu^{\mp}\not{p}$	109	99.4 ± 2.4	0
$e^{\pm}\mu^{\pm}$	45	28.5 ± 1.8	0
$e^{\pm}\mu^{\mp}$	350	313 ± 5.4	0
$e^{\pm}\mathrm{j2}\gamma$	13	16.1 ± 3.9	0
$e^{\pm}\mathrm{j}\tau^{\mp}$	386	418 ± 18.9	0
$e^{\pm}\mathrm{j}\tau^{\pm}$	160	162.8 ± 3.5	0
$e^{\pm}\mathrm{j}\not{p}\tau^{\mp}$	48	44.6 ± 3.3	0
$e^{\pm}\mathrm{j}\not{p}\tau^{\pm}$	11	8.3 ± 1.5	0
$e^{\pm}\mathrm{j}\not{p}$	121431	121023 ± 747.6	0
$e^{\pm}\mathrm{j}\gamma\not{p}$	159	192.6 ± 10.9	0
$e^{\pm}\mathrm{j}\gamma$	1389	1368.9 ± 38.9	0
$e^{\pm}\mathrm{j}\mu^{\mp}\not{p}$	42	33 ± 2.9	0
$e^{\pm}\mathrm{j}\mu^{\pm}\not{p}$	16	9.2 ± 1.9	0
$e^{\pm}\mathrm{j}\mu^{\mp}$	62	63.8 ± 3.2	0
$e^{\pm}\mathrm{j}\mu^{\pm}$	13	8.2 ± 2	0
$e^{\pm}e^{\mp}\mathrm{4j}$	148	159.1 ± 7	0
$e^{\pm}e^{\mp}\mathrm{3j}$	717	743.6 ± 24.4	0
$e^{\pm}e^{\mp}\mathrm{2j}\not{p}$	32	41.4 ± 5.6	0
$e^{\pm}e^{\mp}\mathrm{2j}\gamma$	10	11.4 ± 2.9	0
$e^{\pm}e^{\mp}\mathrm{2j}$	3638	3566.8 ± 72	0
$e^{\pm}e^{\mp}\tau^{\pm}$	18	16.1 ± 1.7	0
$e^{\pm}e^{\mp}\not{p}$	822	831.8 ± 13.6	0
$e^{\pm}e^{\mp}\gamma$	191	221.9 ± 5.1	0
$e^{\pm}e^{\mp}\mathrm{j}\not{p}$	155	170.8 ± 12.4	0
$e^{\pm}e^{\mp}\mathrm{j}\gamma$	48	45 ± 3.9	0
$e^{\pm}e^{\mp}\mathrm{j}$	17903	18258.2 ± 204.4	0
$e^{\pm}e^{\mp}$	98901	99086.9 ± 147.8	0
b6j	51	42.3 ± 3.8	0
b5j	237	192.5 ± 7.1	0
b4j high-Σp_T	26	23.4 ± 2.6	0
b4j low-Σp_T	836	821.7 ± 15.9	0
b3j high-Σp_T	12081	12071 ± 84.1	0
b3j low-Σp_T	2974	2873 ± 31	0

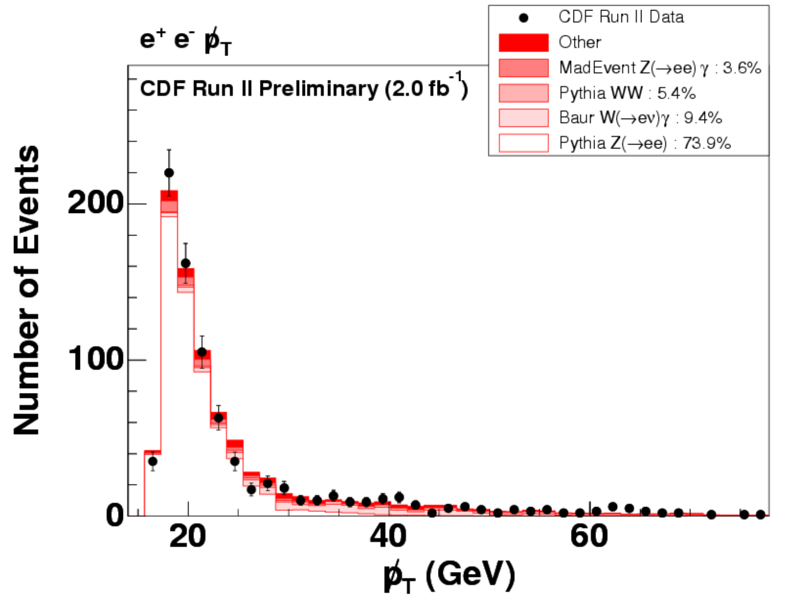
Global Comparison

19650 Kinematic Distributions







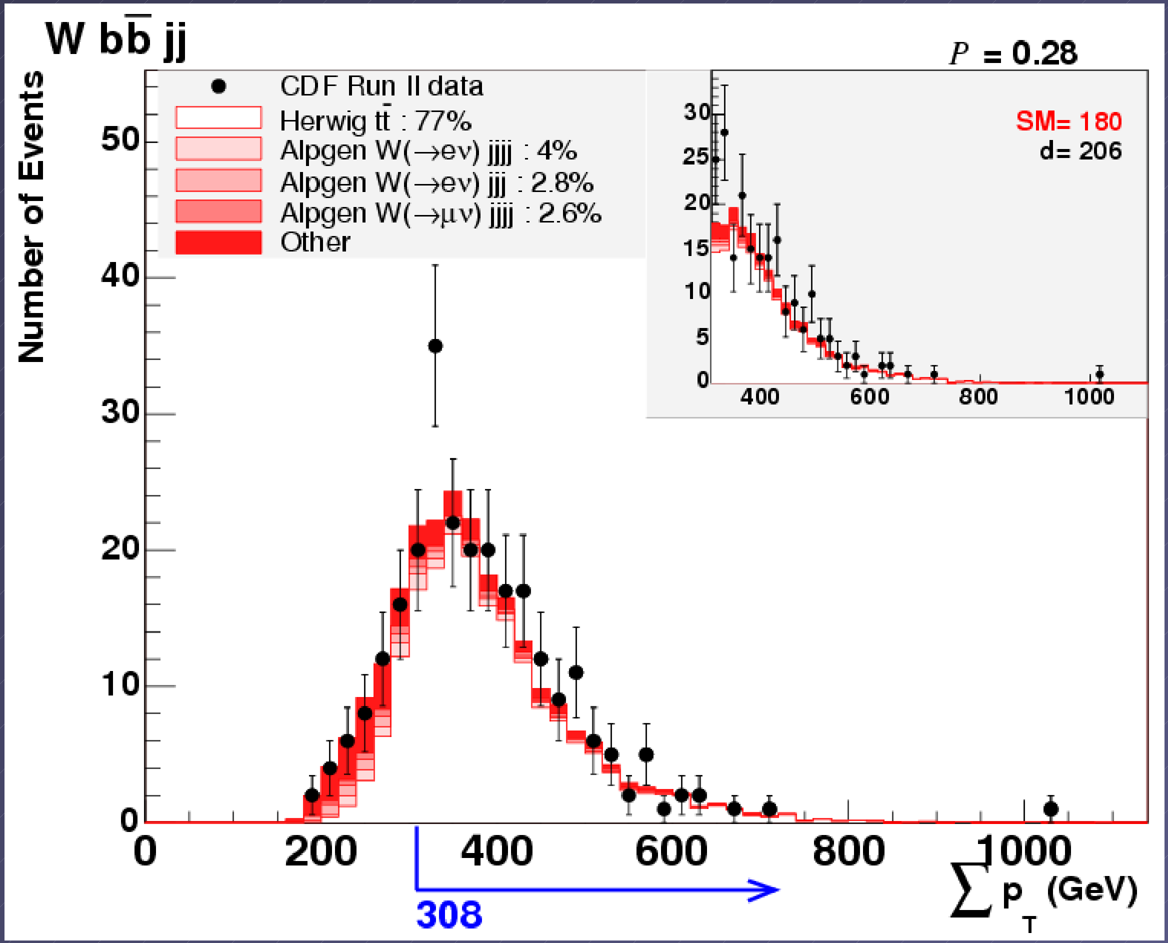


Global Comparison

Sleuth Final States : 87

Sleuth variable:

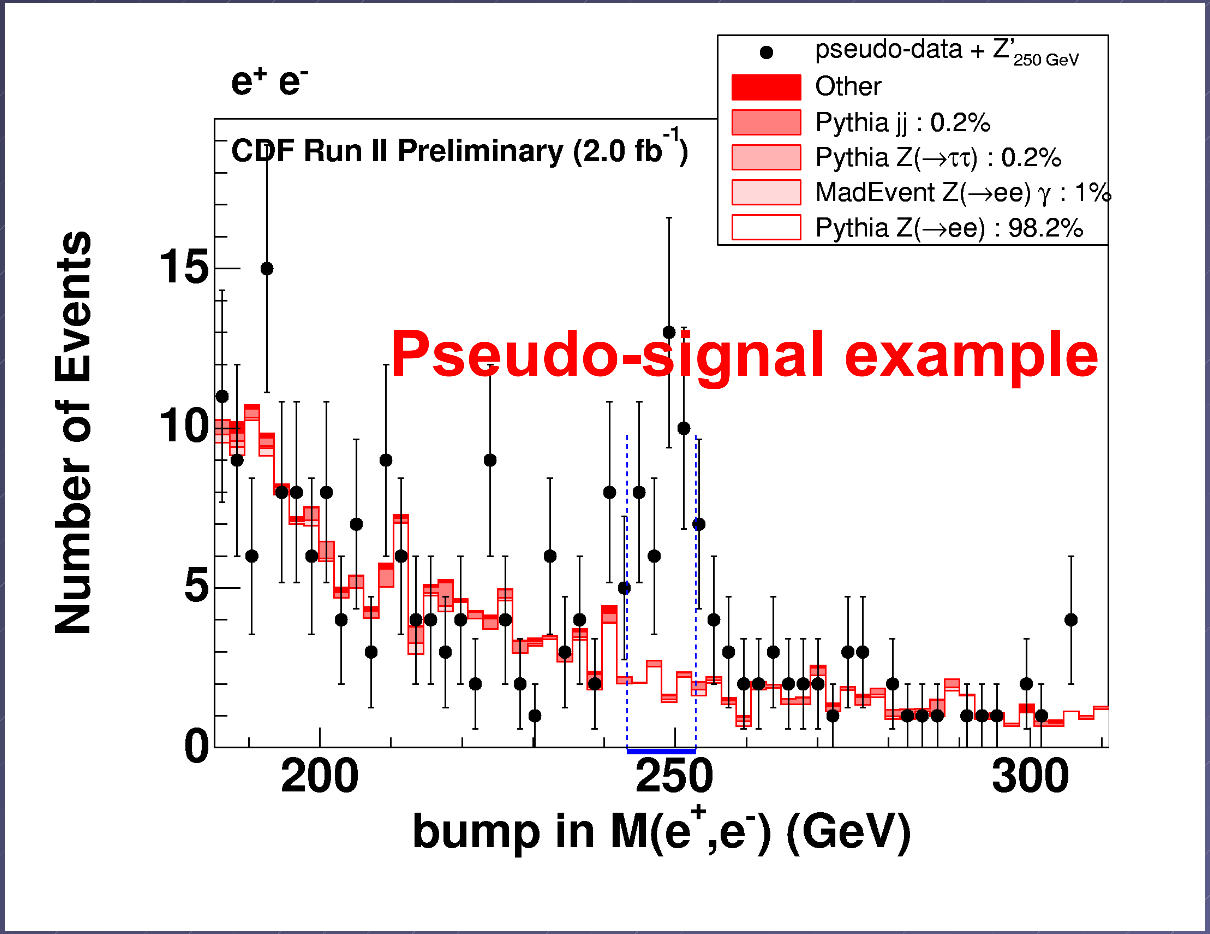
$$\sum p_T \equiv \sum_i |\vec{p}_i| + \left|\overrightarrow{\text{uncl}}\right| + \left|\vec{\not{p}}\right| ,$$



- Scan the ΣP_T spectrum
- Look for semi-infinite region with the most significant excess of data
- Excesses at Large ΣP_T are expected by a wide spectrum of new physics scenarios.
- Perform pseudo-experiments to evaluate significance

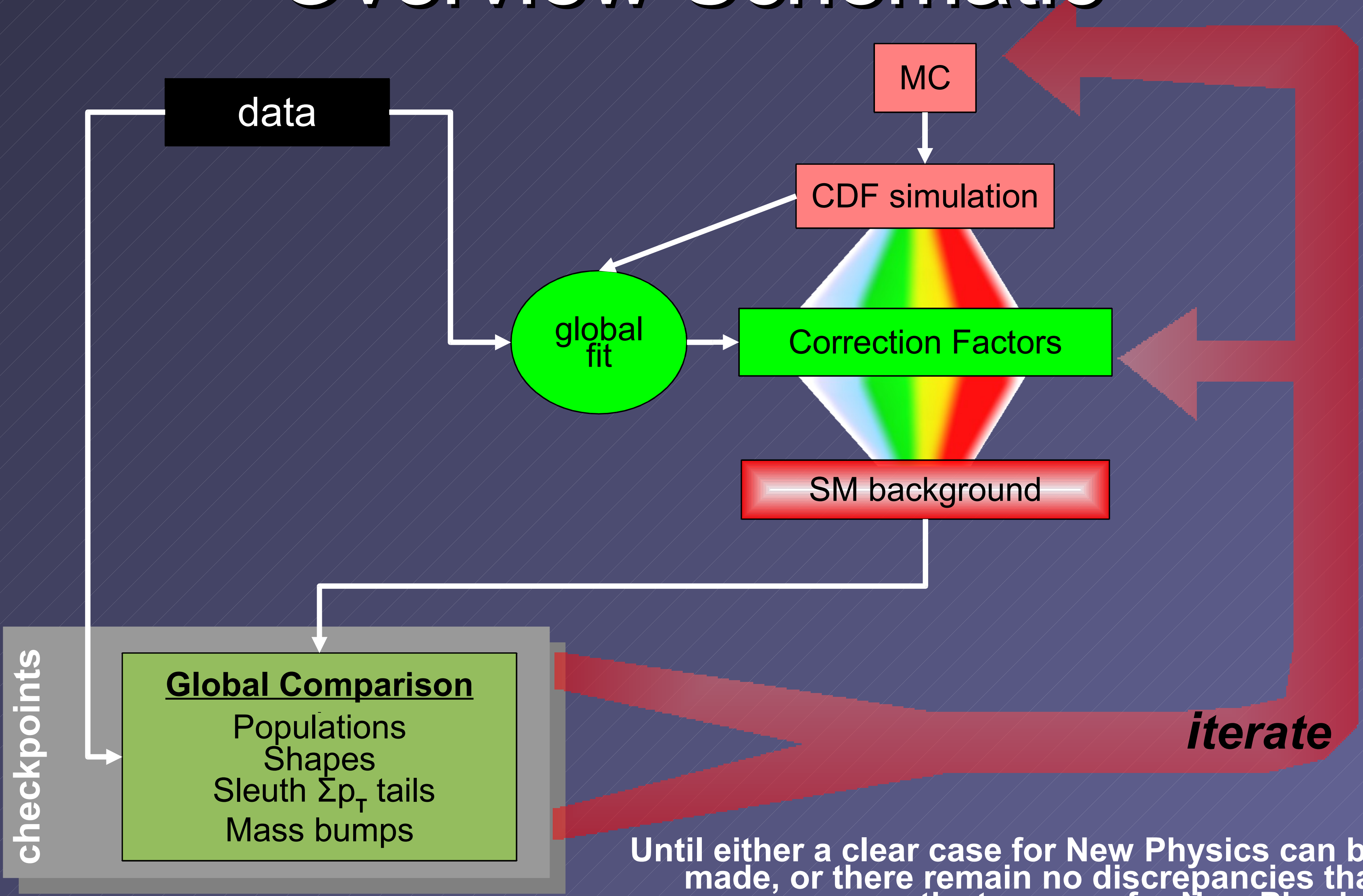
Global Comparison

Bump Hunter: 5036 Mass variables

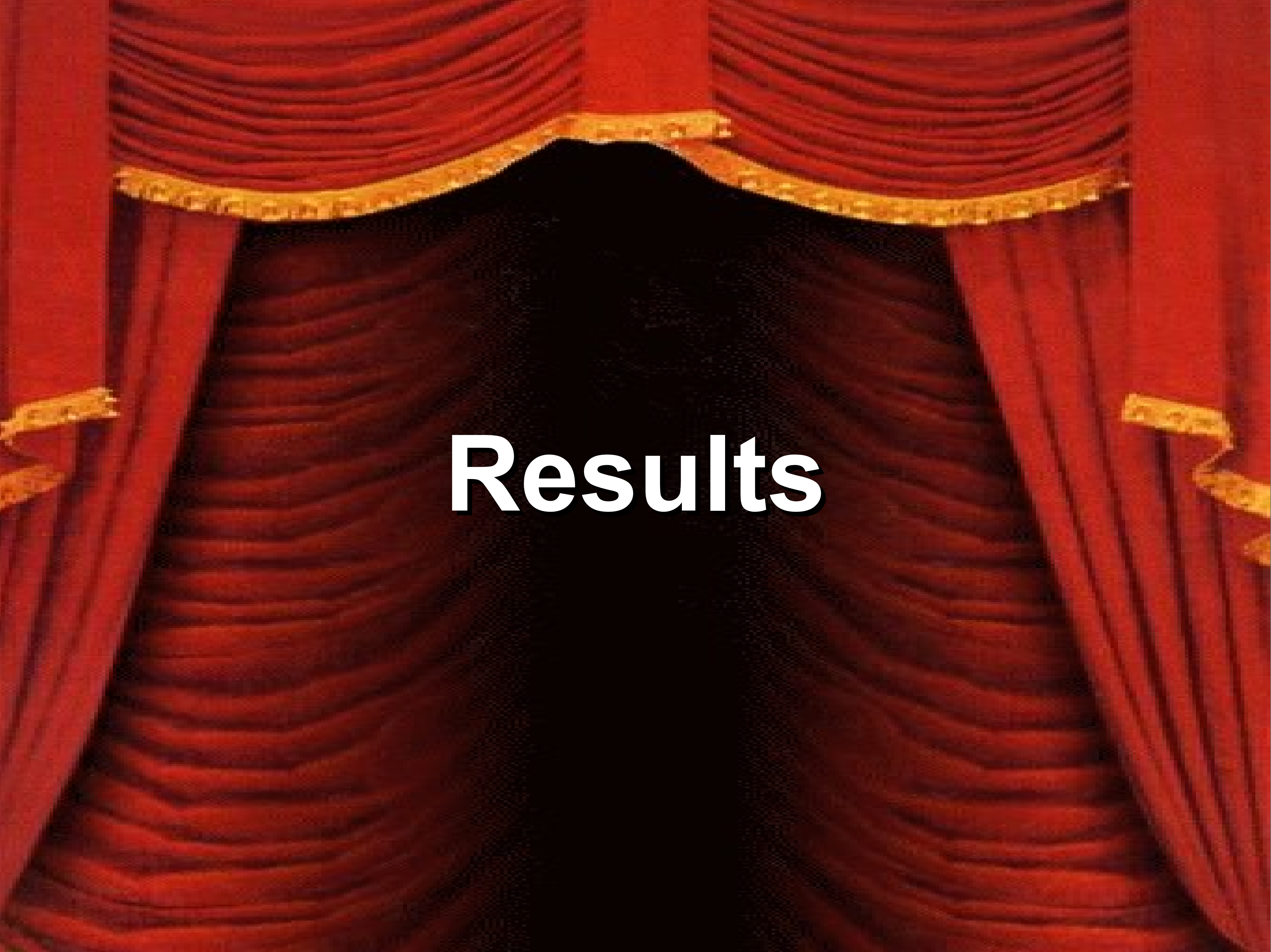


For details see the talk by Georgios Choudalakis
in the Resonances and New Colored Particles Session

Overview Schematic



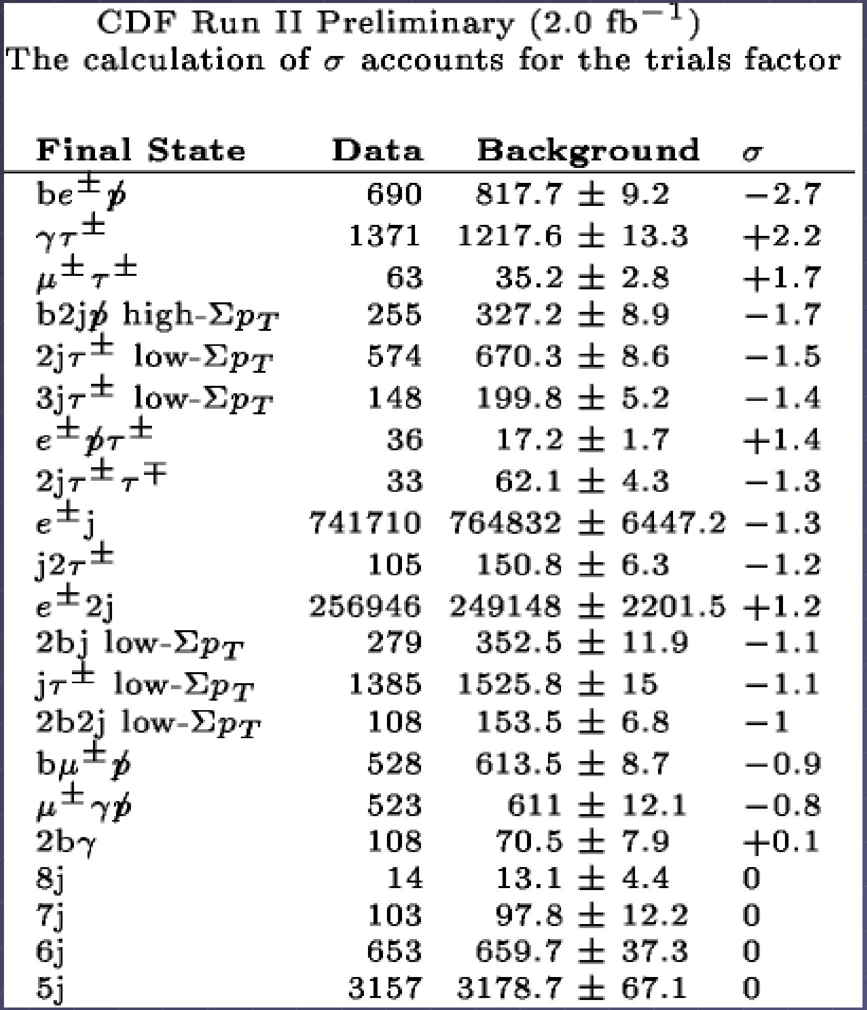
Until either a clear case for New Physics can be made, or there remain no discrepancies that motivate a case for New Physics



Results

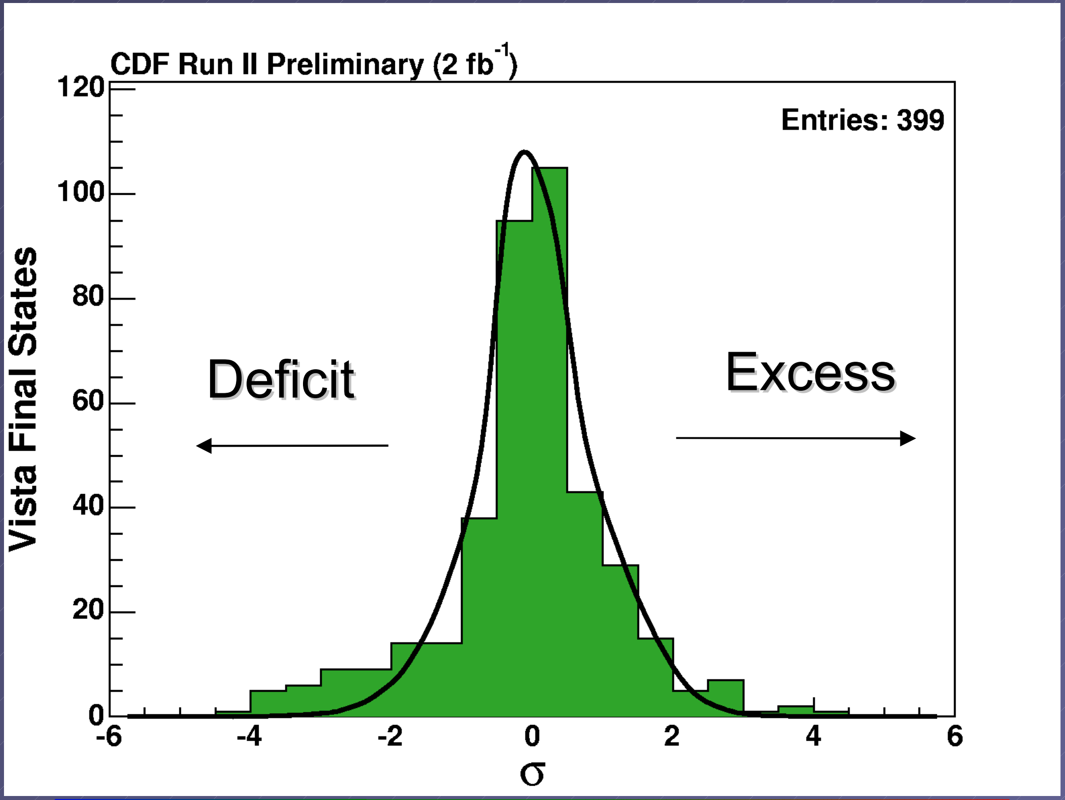
Final State Populations

List of Top Population Discrepancies



CDF Run II Preliminary (2.0 fb^{-1})
The calculation of σ accounts for the trials factor

Final State	Data	Background	σ
$be^{\pm}\not{p}$	690	817.7 ± 9.2	−2.7
$\gamma\tau^{\pm}$	1371	1217.6 ± 13.3	+2.2
$\mu^{\pm}\tau^{\pm}$	63	35.2 ± 2.8	+1.7
$b2j\not{p}$ high-Σp_T	255	327.2 ± 8.9	−1.7
$2j\tau^{\pm}$ low-Σp_T	574	670.3 ± 8.6	−1.5
$3j\tau^{\pm}$ low-Σp_T	148	199.8 ± 5.2	−1.4
$e^{\pm}\not{p}\tau^{\pm}$	36	17.2 ± 1.7	+1.4
$2j\tau^{\pm}\tau^{\mp}$	33	62.1 ± 4.3	−1.3
$e^{\pm}j$	741710	764832 ± 6447.2	−1.3
$j2\tau^{\pm}$	105	150.8 ± 6.3	−1.2
$e^{\pm}2j$	256946	249148 ± 2201.5	+1.2
$2bj$ low-Σp_T	279	352.5 ± 11.9	−1.1
$j\tau^{\pm}$ low-Σp_T	1385	1525.8 ± 15	−1.1
$2b2j$ low-Σp_T	108	153.5 ± 6.8	−1
$b\mu^{\pm}\not{p}$	528	613.5 ± 8.7	−0.9
$\mu^{\pm}\gamma\not{p}$	523	611 ± 12.1	−0.8
$2b\gamma$	108	70.5 ± 7.9	+0.1
8j	14	13.1 ± 4.4	0
7j	103	97.8 ± 12.2	0
6j	653	659.7 ± 37.3	0
5j	3157	3178.7 ± 67.1	0



Large deficit

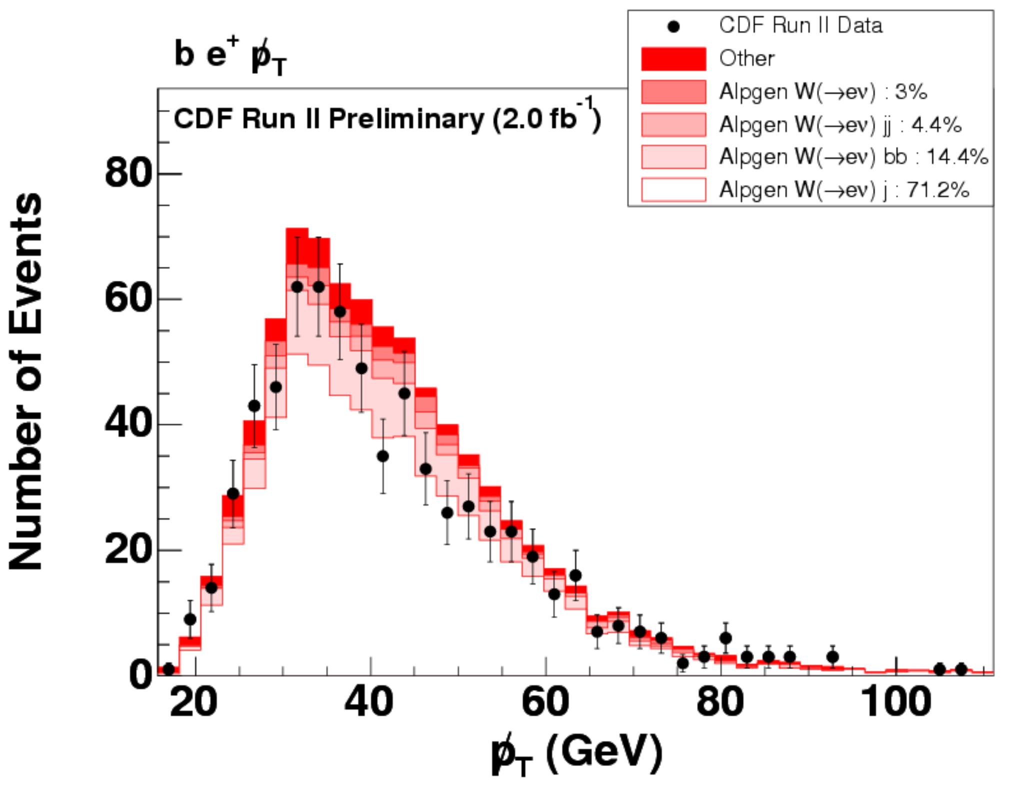
agreement

Large excess

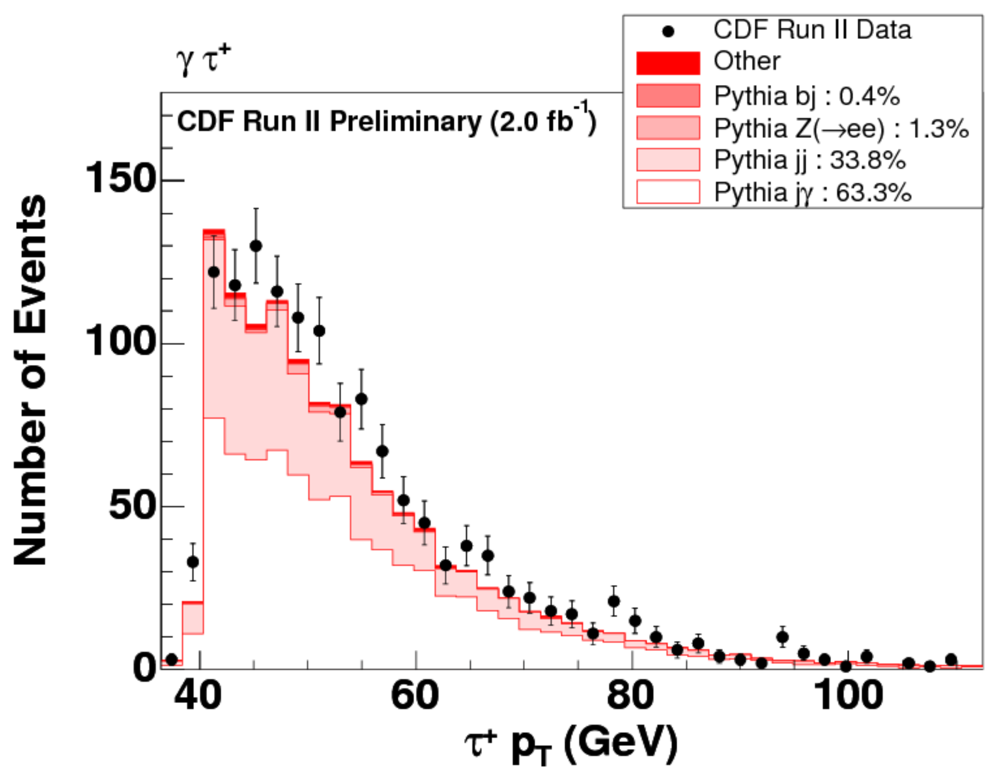
No Significant Discrepancy in Populations!

A few example distributions

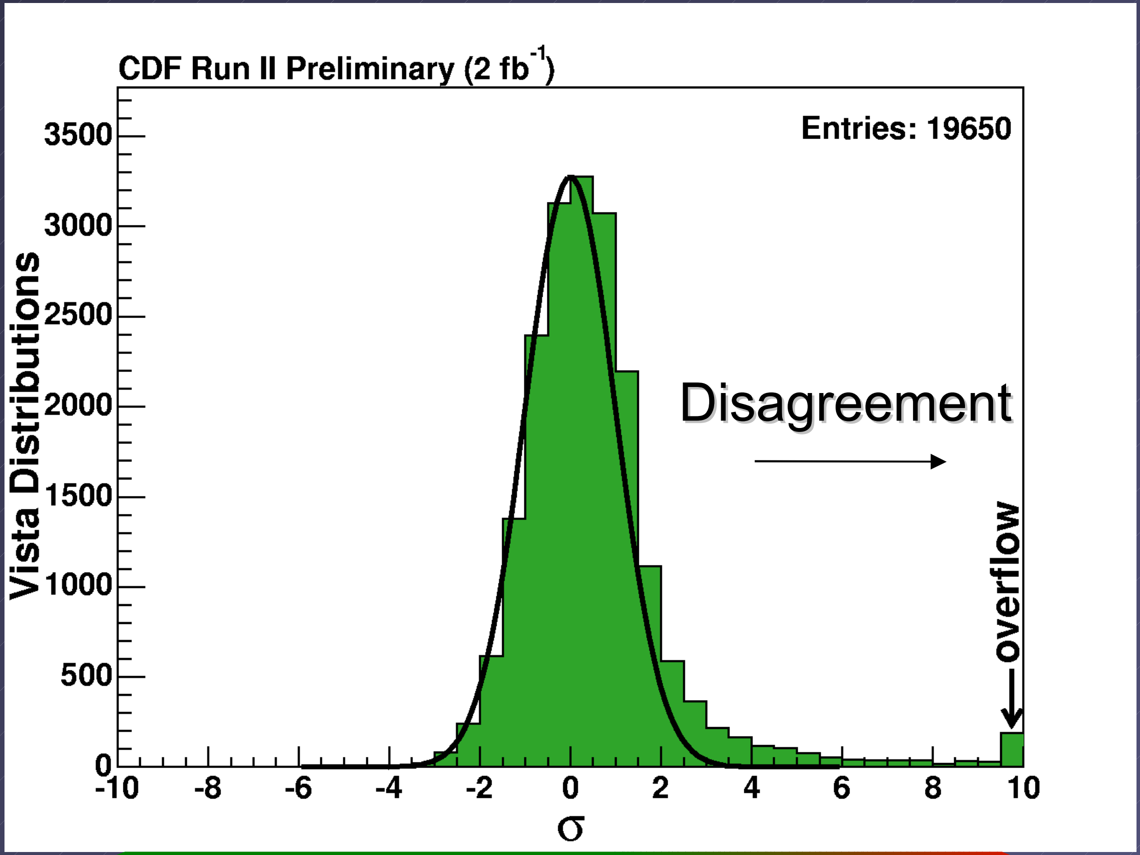
From
Most significant deficit

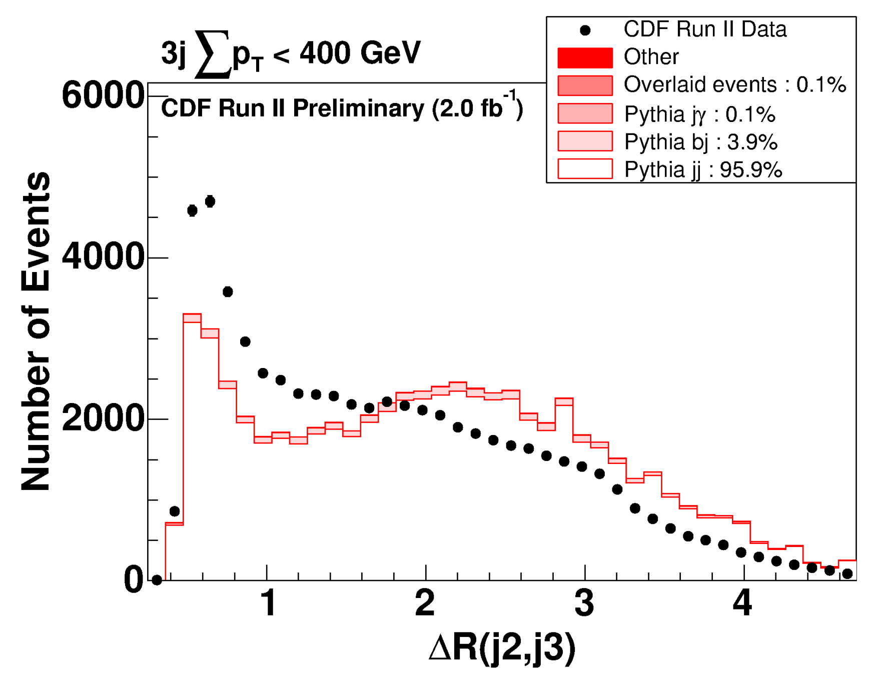


From
Most significant excess



Kinematic Shapes



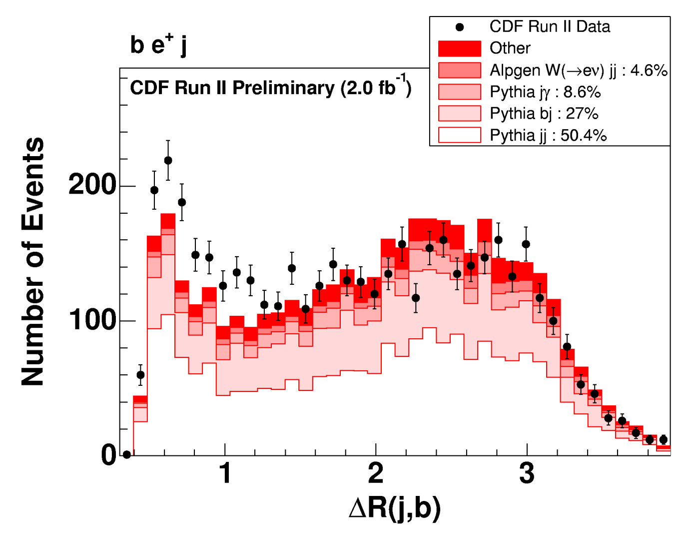


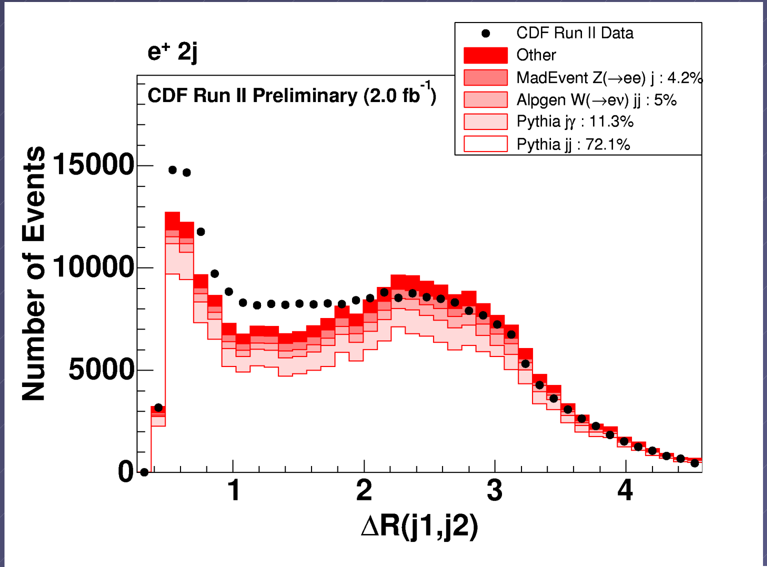
agree disagree

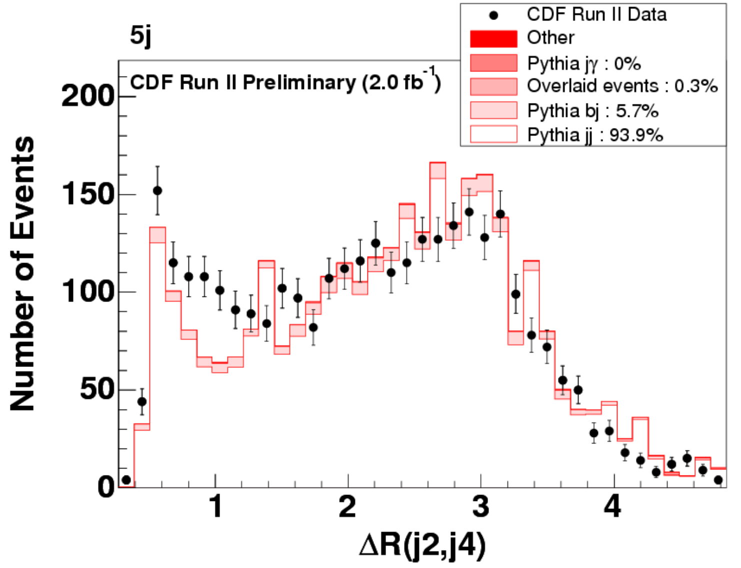
This analysis brought this issue ("3 jet effect") to attention and is currently being investigated by experimental and theoretical colleagues.

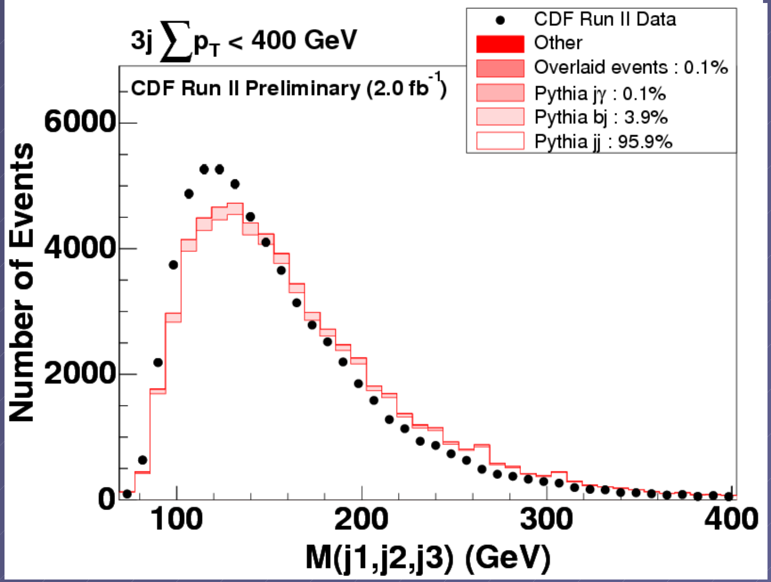
This is a major limiting factor in our ability to see mass resonances in multijet final states.

3 jet effect





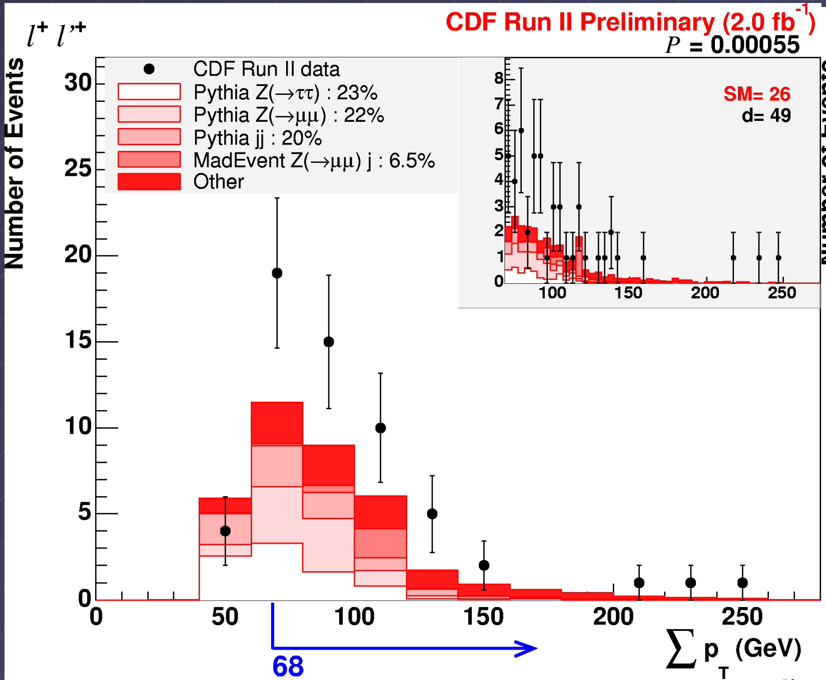




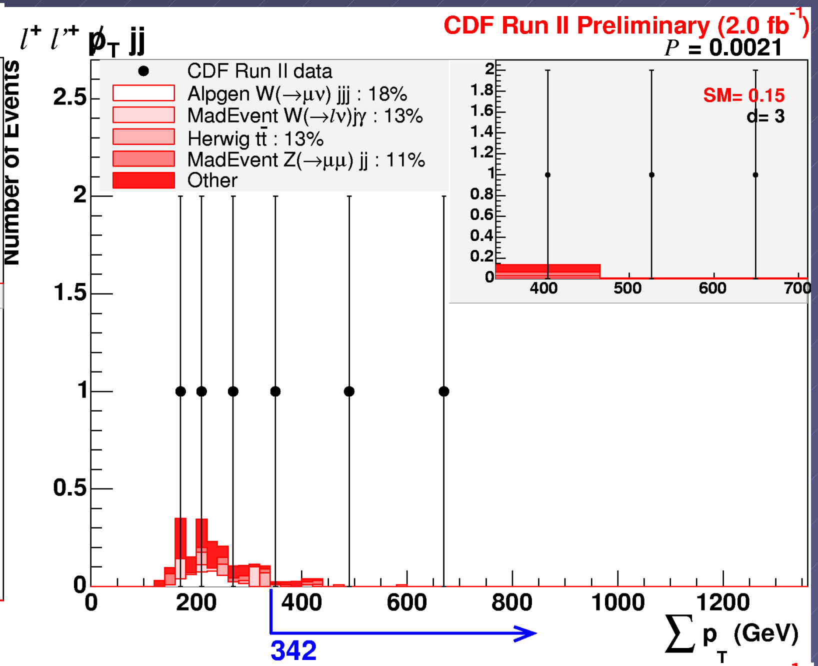
Conclusion: No discrepancies to motivate a new physics claim

Sleuth Results

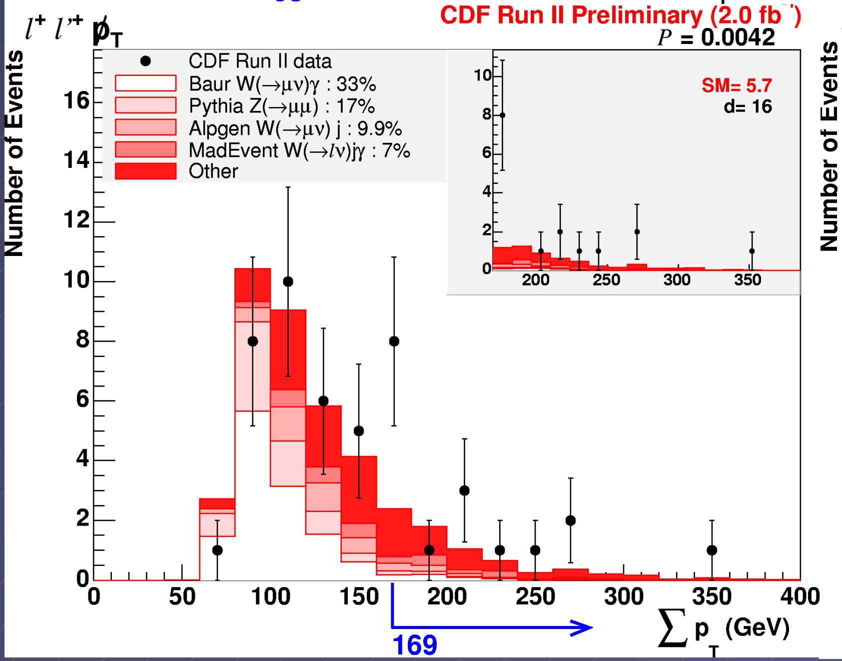
$e^+\mu^+$



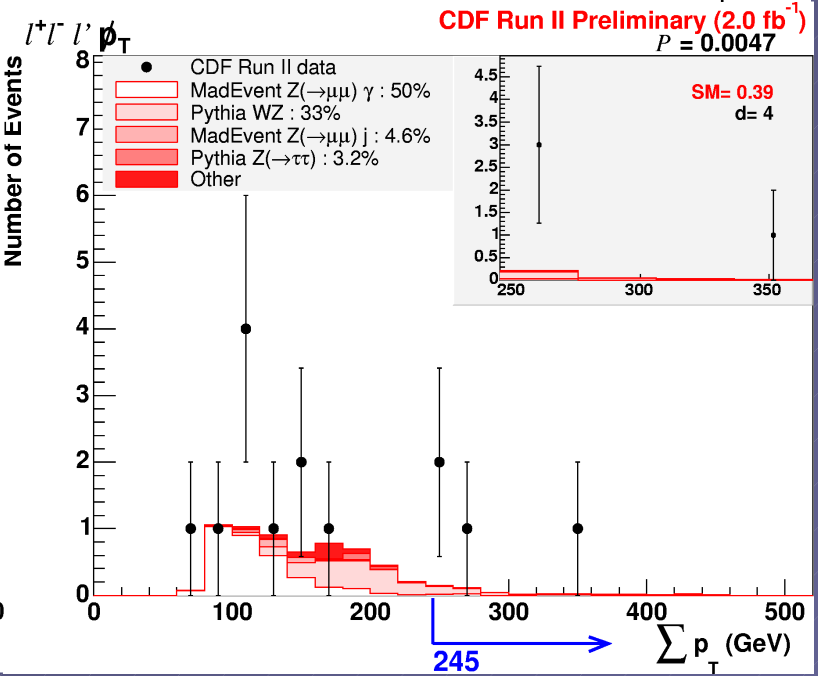
$e^+\mu^+ \not\!E_T jj$



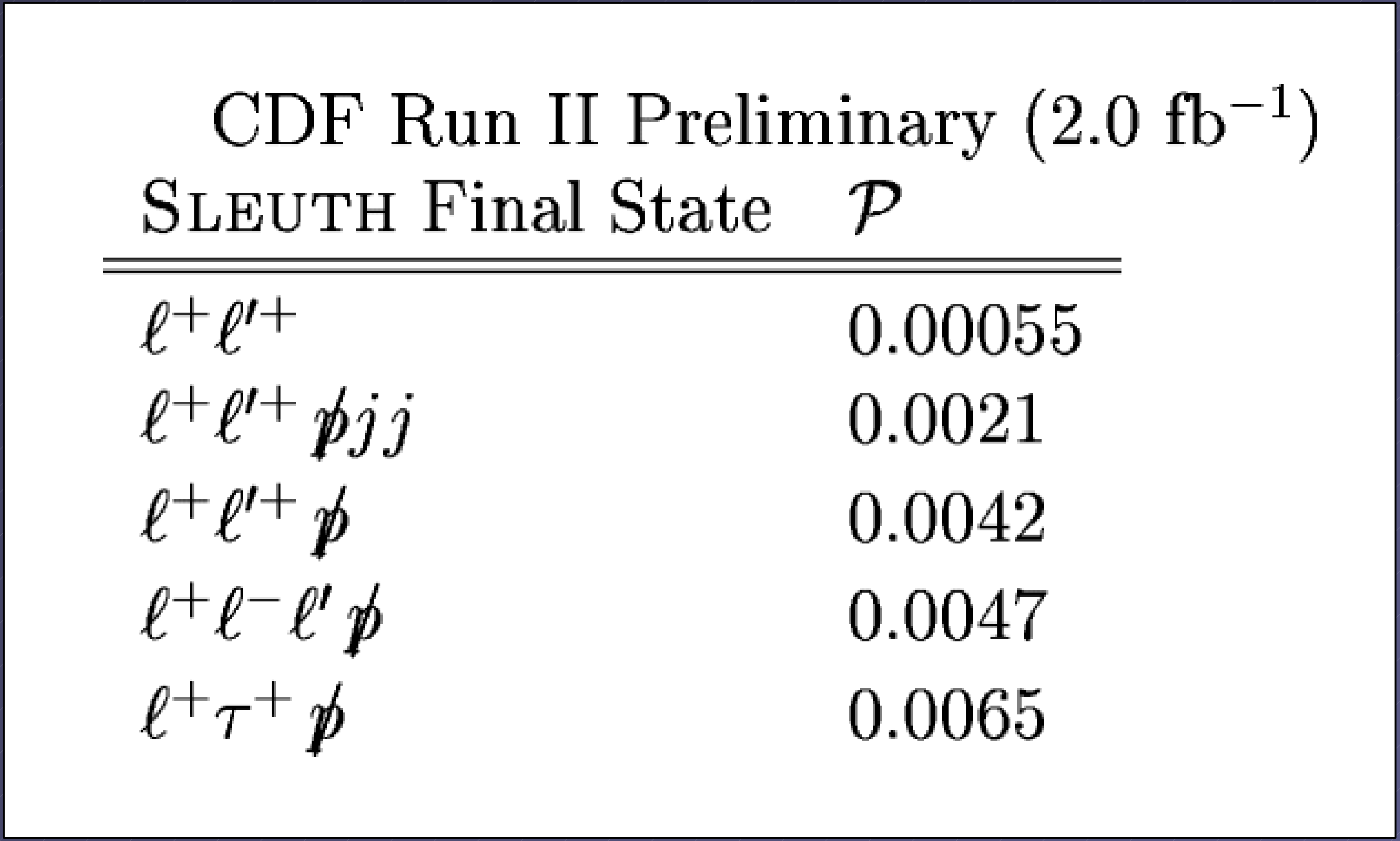
$e^+\mu^+ \not\!E_T$



$e^+e^-\mu^+ \not\!E_T$



Sleuth Results Summary



CDF Run II Preliminary (2.0 fb^{-1})

SLEUTH Final State	$\mathcal{P}$
$\ell^+\ell'^+$	0.00055
$\ell^+\ell'^+\not{p}jj$	0.0021
$\ell^+\ell'^+\not{p}$	0.0042
$\ell^+\ell^-\ell'\not{p}$	0.0047
$\ell^+\tau^+\not{p}$	0.0065

The most discrepant Sleuth final state has a probability of 8% after accounting for trials factor

Conclusion

- Completed the global search for new physics in $2fb^{-1}$ at CDF
- This analysis finds...
  - No significant final state population discrepancies.
  - No shape discrepancies motivating new physics
  - No statistically significant Sleuth Σp_T excess.
  - Bump Hunter results will be presented in another talk
- The search continues...

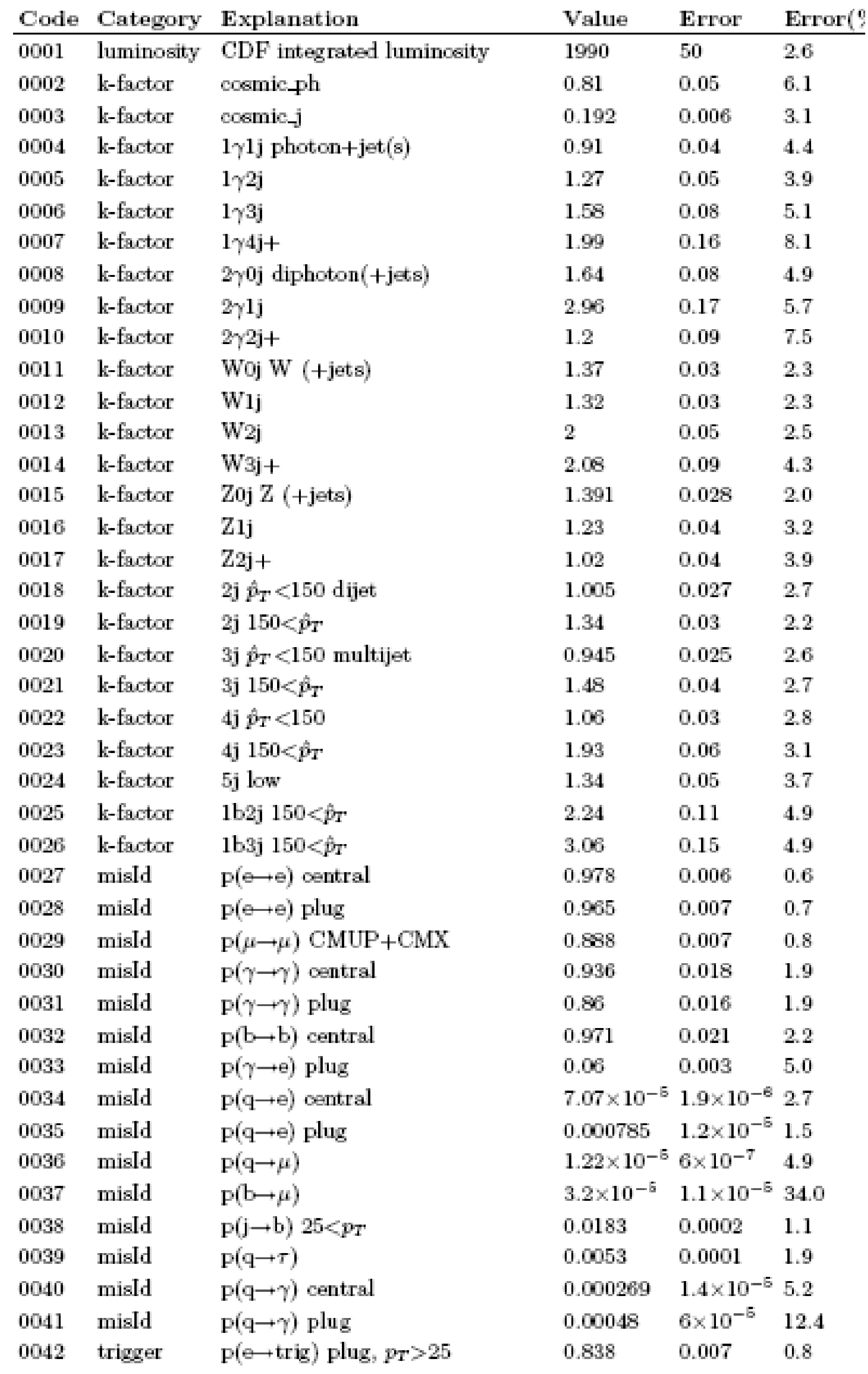
BACKUP

Global Fit

$$\chi^2(\vec{s}) = \left(\sum_{k \in \mathrm{bins}} \chi_k^2(\vec{s}) \right) + \chi^2_{\mathrm{constraints}}(\vec{s})$$

$$\chi_k^2(\vec{s}) = \frac{(\mathrm{Data}[k] - \mathrm{SM}[k])^2}{\delta \mathrm{SM}[k]^2 + \sqrt{\mathrm{SM}[k]}^2}$$

Correction Factors



Code	Category	Explanation	Value	Error	Error(
0001	luminosity	CDF integrated luminosity	1990	50	2.6
0002	k-factor	cosmic_ph	0.81	0.05	6.1
0003	k-factor	cosmic_j	0.192	0.006	3.1
0004	k-factor	$1\gamma1j$ photon+jet(s)	0.91	0.04	4.4
0005	k-factor	$1\gamma2j$	1.27	0.05	3.9
0006	k-factor	$1\gamma3j$	1.58	0.08	5.1
0007	k-factor	$1\gamma4j+$	1.99	0.16	8.1
0008	k-factor	$2\gamma0j$ diphoton(+jets)	1.64	0.08	4.9
0009	k-factor	$2\gamma1j$	2.96	0.17	5.7
0010	k-factor	$2\gamma2j+$	1.2	0.09	7.5
0011	k-factor	W0j W (+jets)	1.37	0.03	2.3
0012	k-factor	W1j	1.32	0.03	2.3
0013	k-factor	W2j	2	0.05	2.5
0014	k-factor	W3j+	2.08	0.09	4.3
0015	k-factor	Z0j Z (+jets)	1.391	0.028	2.0
0016	k-factor	Z1j	1.23	0.04	3.2
0017	k-factor	Z2j+	1.02	0.04	3.9
0018	k-factor	2j $\hat{p}_T<150$ dijet	1.005	0.027	2.7
0019	k-factor	2j $150<\hat{p}_T$	1.34	0.03	2.2
0020	k-factor	3j $\hat{p}_T<150$ multijet	0.945	0.025	2.6
0021	k-factor	3j $150<\hat{p}_T$	1.48	0.04	2.7
0022	k-factor	4j $\hat{p}_T<150$	1.06	0.03	2.8
0023	k-factor	4j $150<\hat{p}_T$	1.93	0.06	3.1
0024	k-factor	5j low	1.34	0.05	3.7
0025	k-factor	1b2j $150<\hat{p}_T$	2.24	0.11	4.9
0026	k-factor	1b3j $150<\hat{p}_T$	3.06	0.15	4.9
0027	misId	$p(e\rightarrow e)$ central	0.978	0.006	0.6
0028	misId	$p(e\rightarrow e)$ plug	0.965	0.007	0.7
0029	misId	$p(\mu\rightarrow\mu)$ CMUP+CMX	0.888	0.007	0.8
0030	misId	$p(\gamma\rightarrow\gamma)$ central	0.936	0.018	1.9
0031	misId	$p(\gamma\rightarrow\gamma)$ plug	0.86	0.016	1.9
0032	misId	$p(b\rightarrow b)$ central	0.971	0.021	2.2
0033	misId	$p(\gamma\rightarrow e)$ plug	0.06	0.003	5.0
0034	misId	$p(q\rightarrow e)$ central	7.07×10^{-5}	1.9×10^{-6}	2.7
0035	misId	$p(q\rightarrow e)$ plug	0.000785	1.2×10^{-5}	1.5
0036	misId	$p(q\rightarrow\mu)$	1.22×10^{-5}	6×10^{-7}	4.9
0037	misId	$p(b\rightarrow\mu)$	3.2×10^{-5}	1.1×10^{-5}	34.0
0038	misId	$p(j\rightarrow b)$ $25<p_T$	0.0183	0.0002	1.1
0039	misId	$p(q\rightarrow\tau)$	0.0053	0.0001	1.9
0040	misId	$p(q\rightarrow\gamma)$ central	0.000269	1.4×10^{-5}	5.2
0041	misId	$p(q\rightarrow\gamma)$ plug	0.00048	6×10^{-5}	12.4
0042	trigger	$p(e\rightarrow trig)$ plug, $p_T>25$	0.838	0.007	0.8
0043	trigger	$p(\mu\rightarrow trig)$ CMUP+CMX, $p_T>25$	0.92	0.004	0.4

Sleuth Algorithm

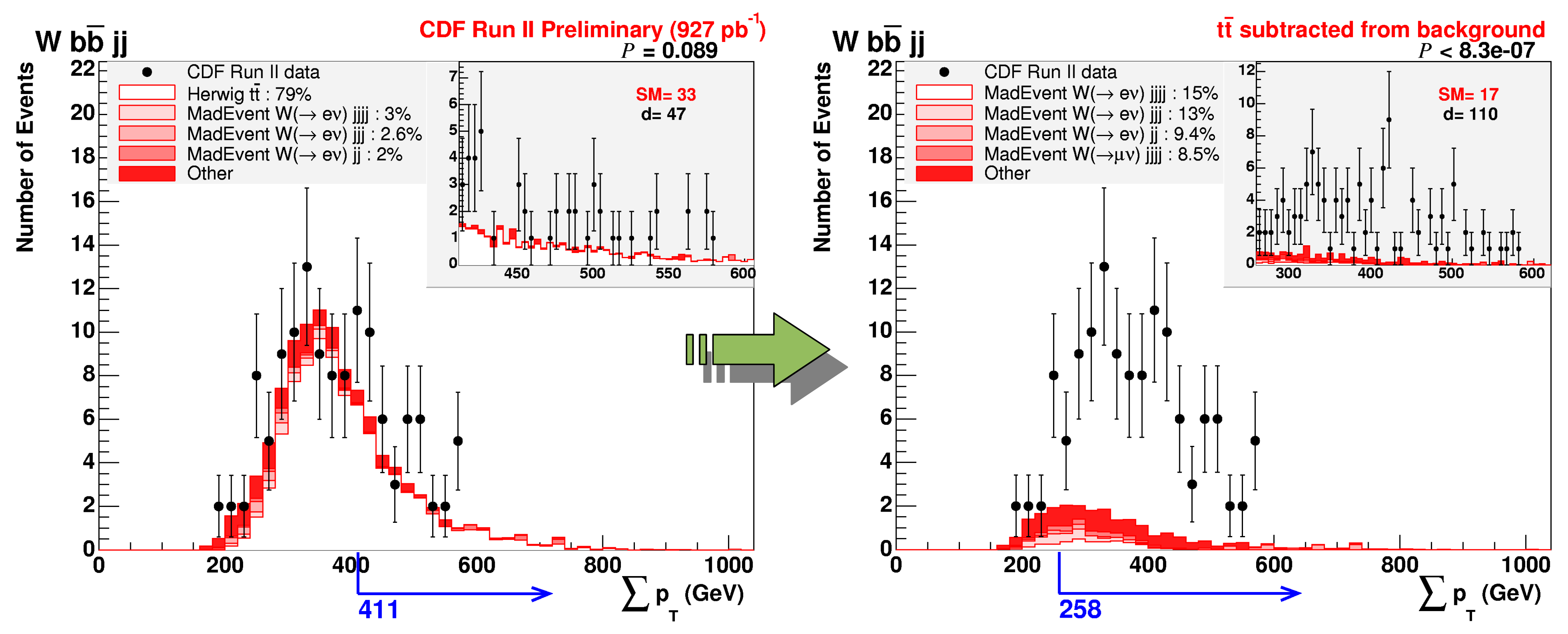
Sleuth variable:

$$\sum p_T \equiv \sum_i |\vec{p}_i| + \left|\overrightarrow{\mathrm{uncl}}\right| + \left|\vec{\not{p}}\right| ,$$

- Scan the sumPt spectrum in all final states and find the region with the most significant excess of data over SM.
- Perform pseudo-experiments to determine the probability that a statistical fluctuation of the background would yield an excess as significant as the one observed
- Takes into account the trials factor for looking at many places
- Discovery level significance set at 0.001 = 5σ effect

Sensitivity: Top Discovery?

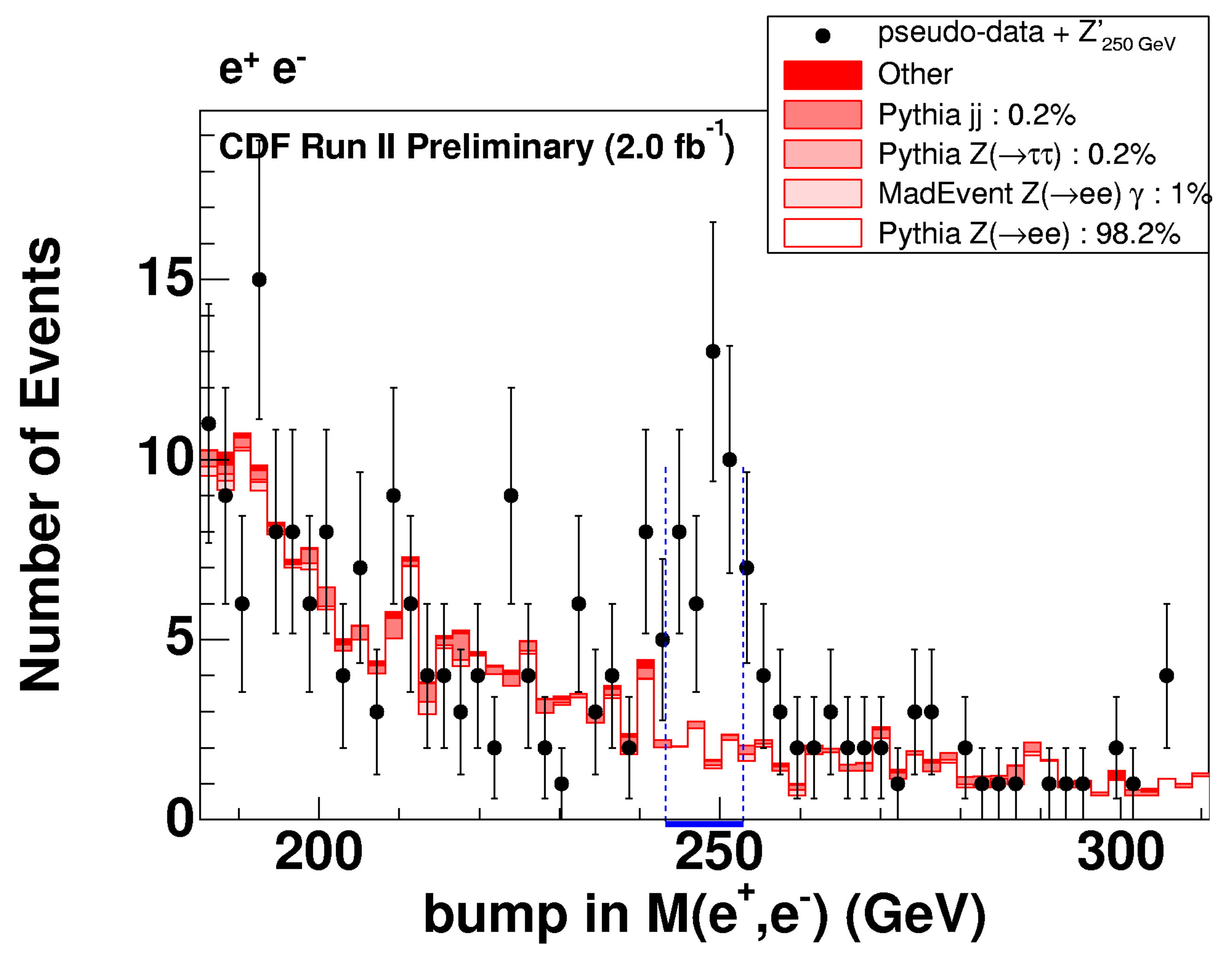
Remove top quark from Standard Model, refit correction factors, search!



Easily finding top in 1 fb^{-1}

Approximate Luminosity Needed ~ O (Run1 Discovery)

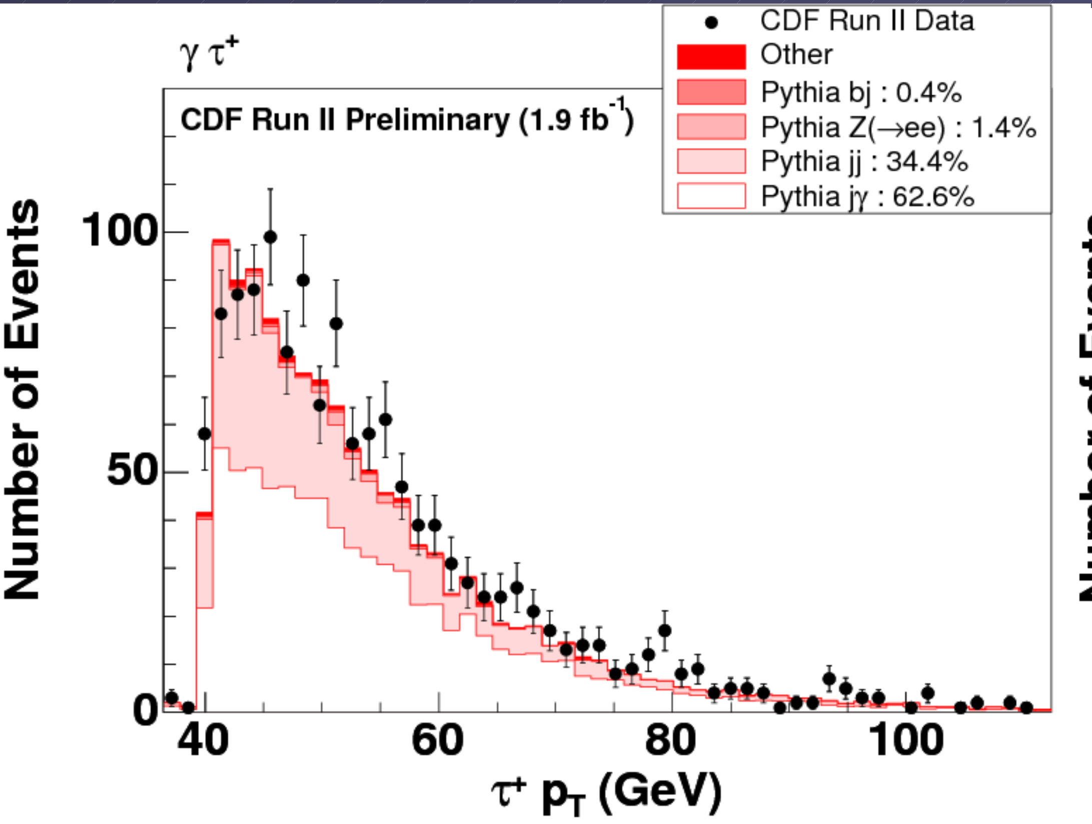
Sensitivity: Z' mass bump ?

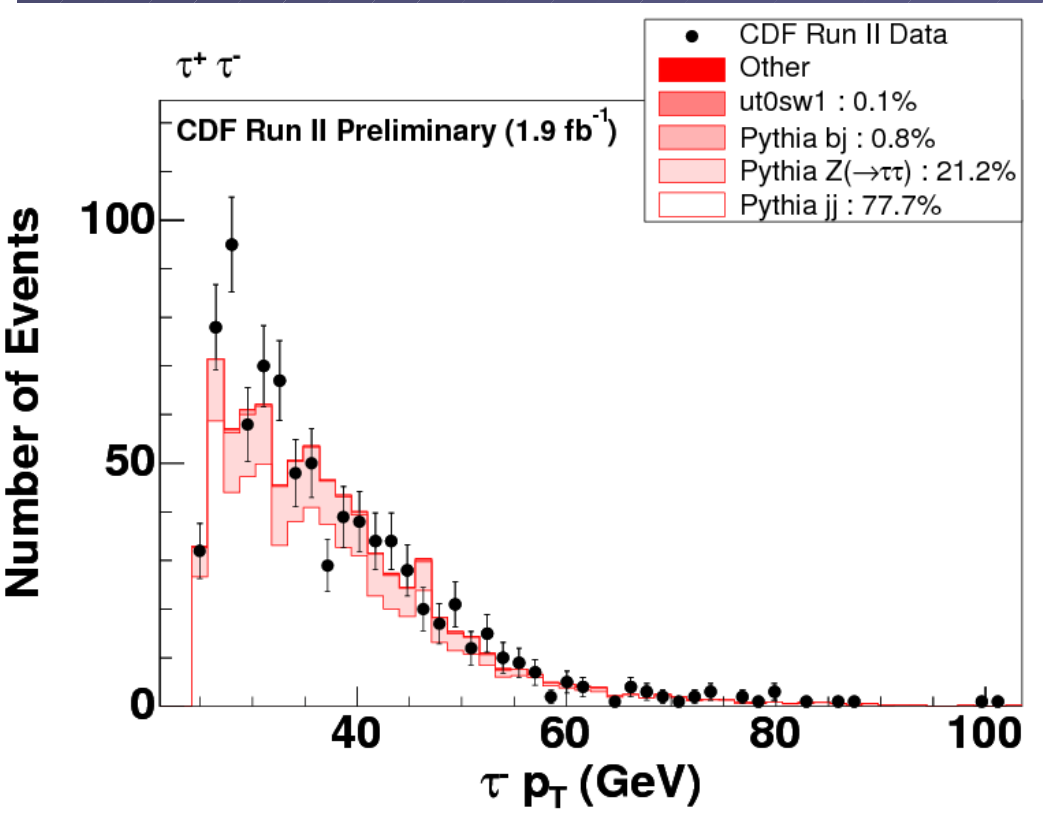


$Z'_{250} \rightarrow$ charged leptons
5σ discovery if $\sigma \times BR \approx 0.325$ pb.

Jet -> Tau Fakes

Correction Factor p(q->tau) = 5.2E-3

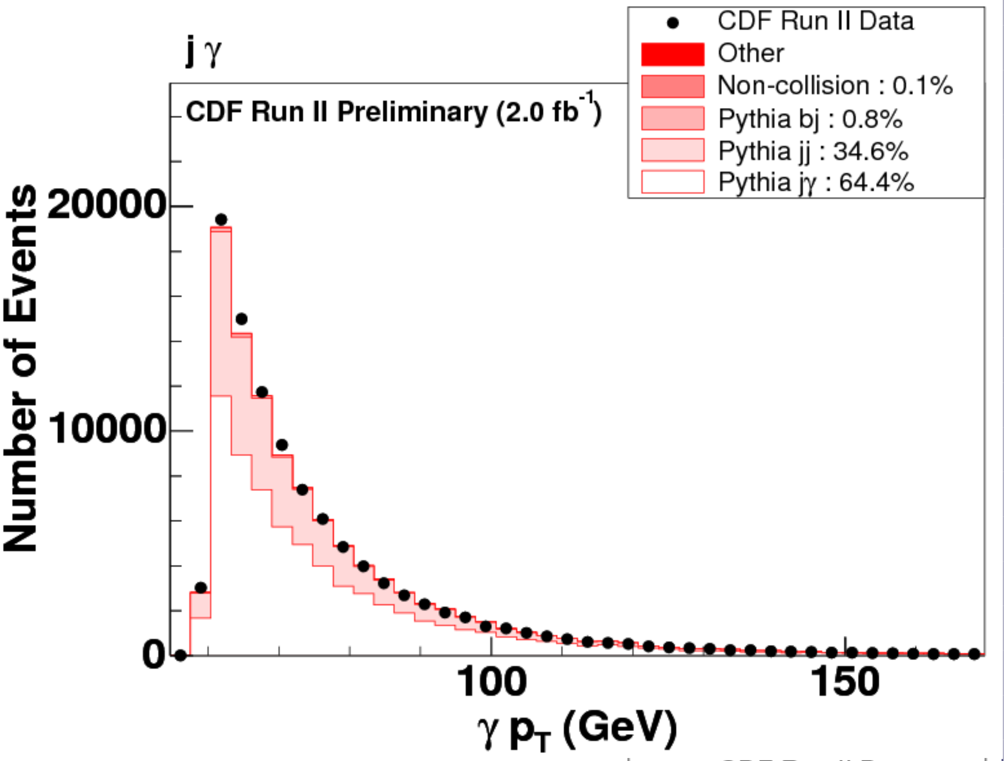


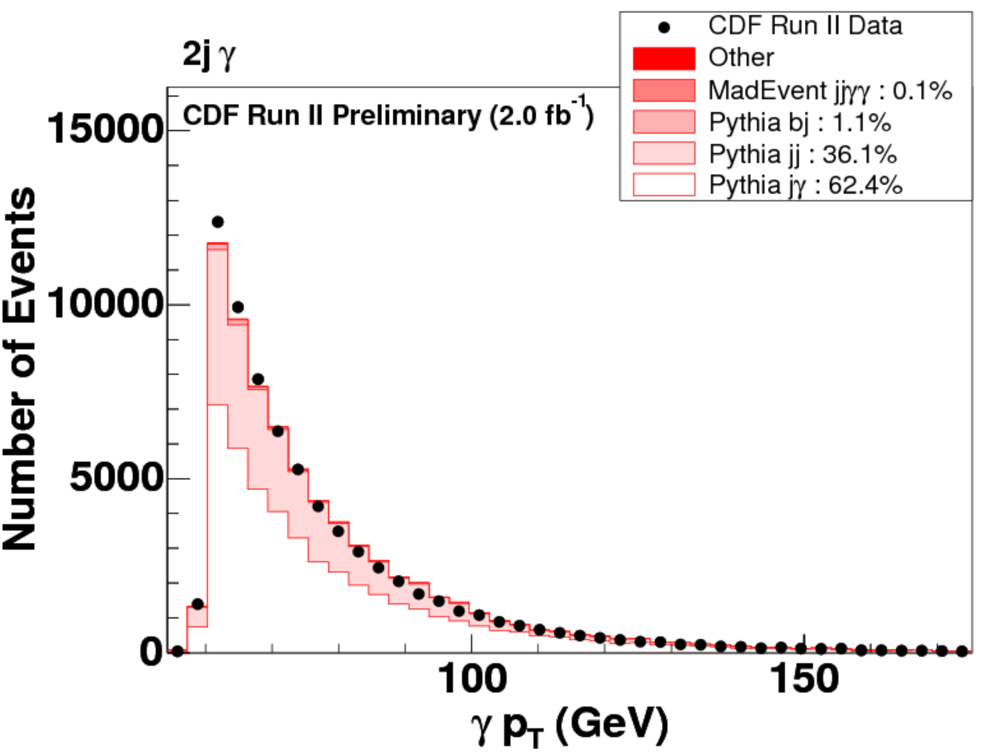


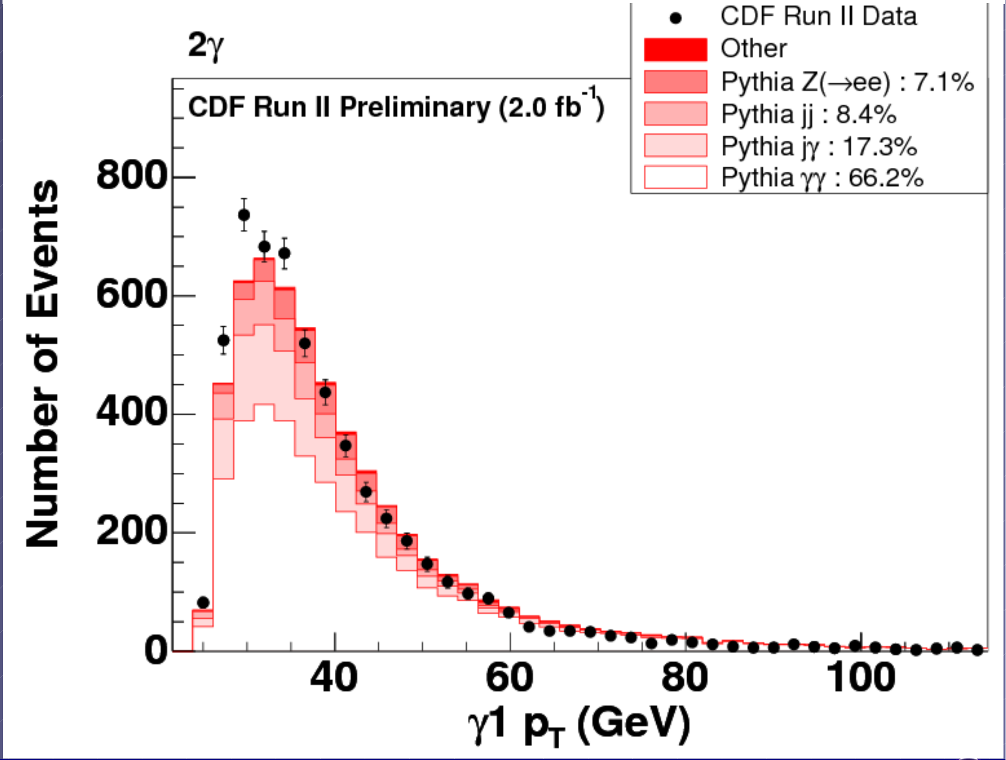
jet -> photon fake

Correction Factor p(q->ph) central = 2.66E-4

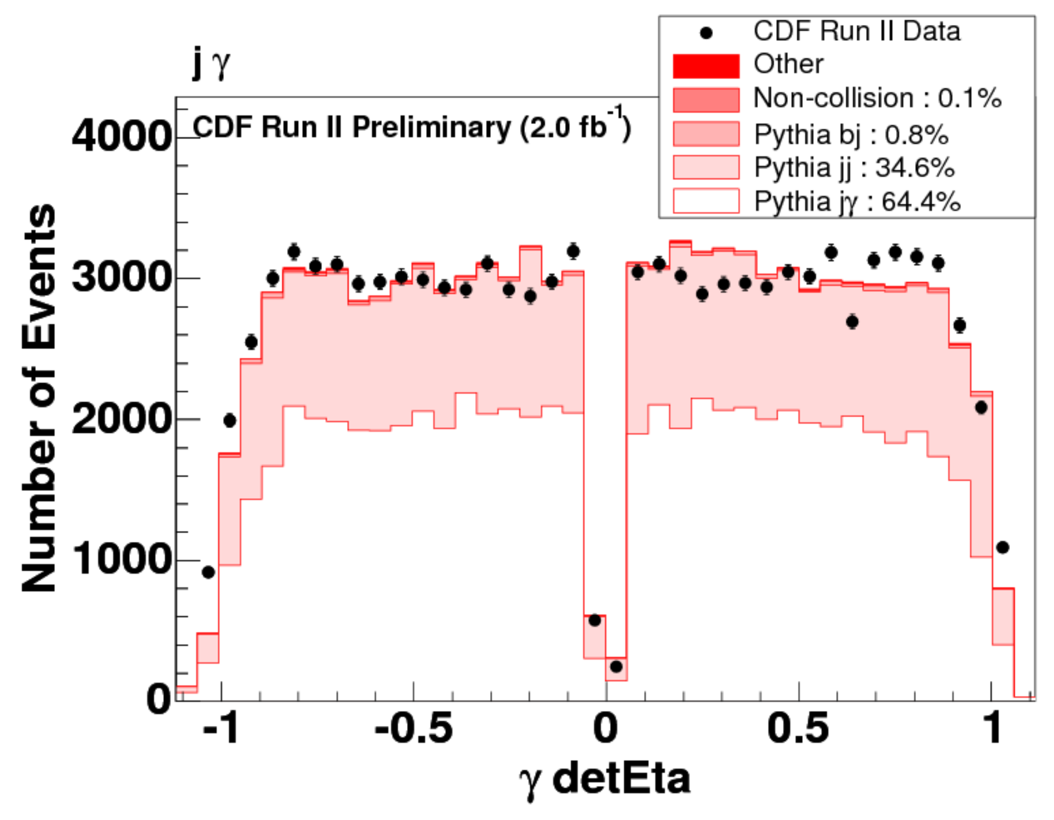
Correction Factor p(q->ph) plug = 5.1E-4

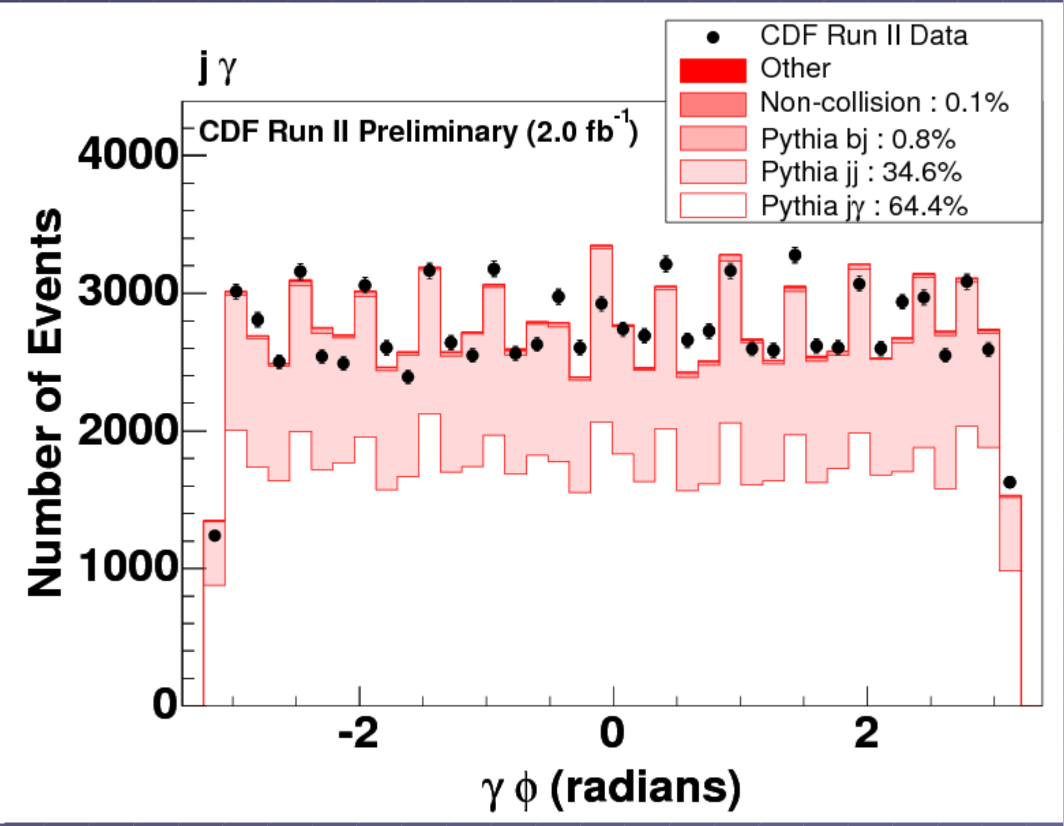






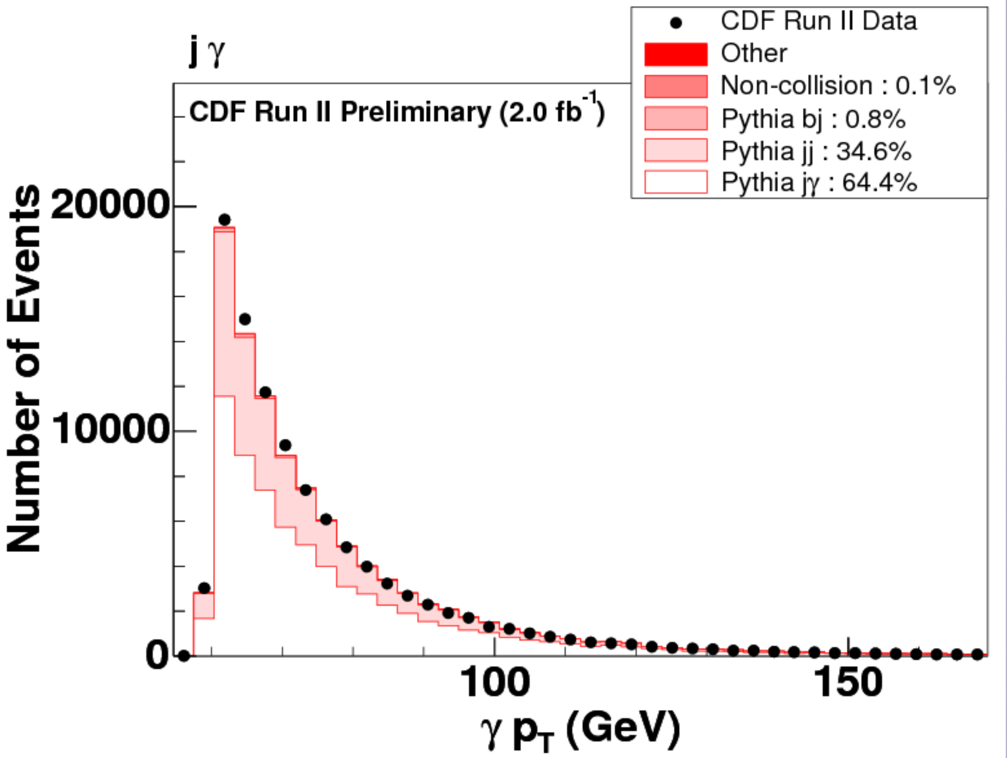
jet -> photon fake

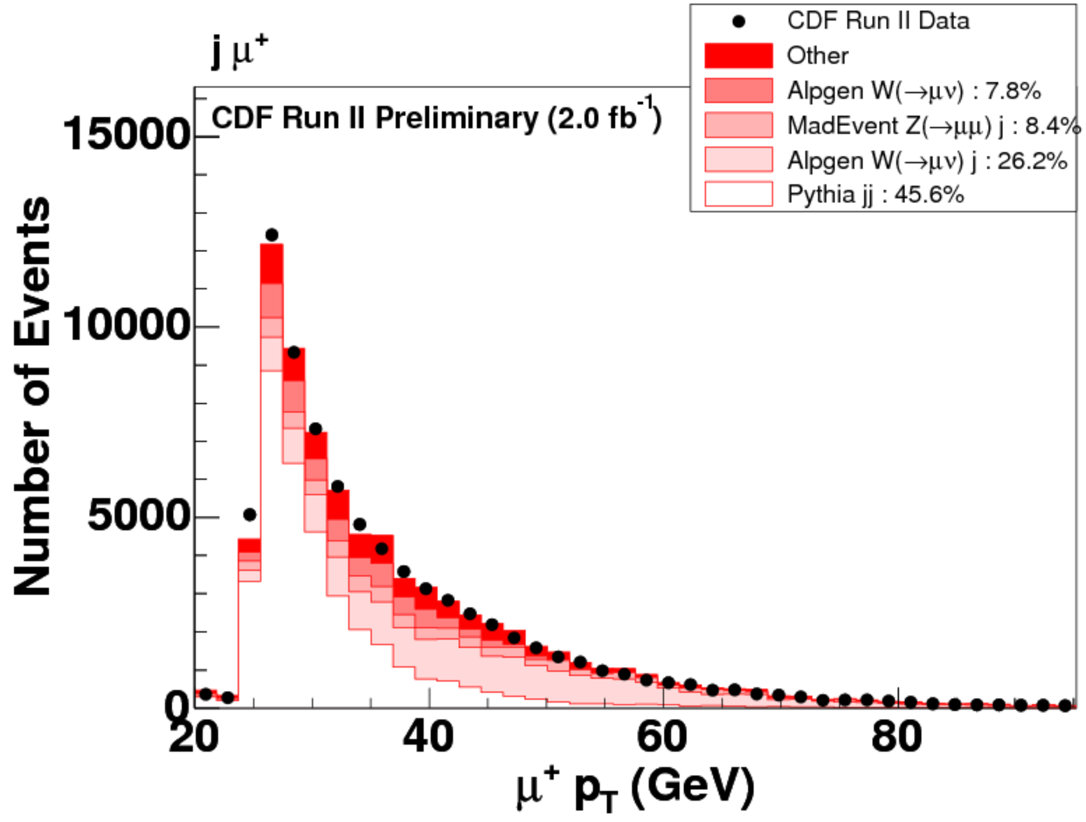




jet -> muon fake

Correction Factor p(q->mu) = 1.18E-5





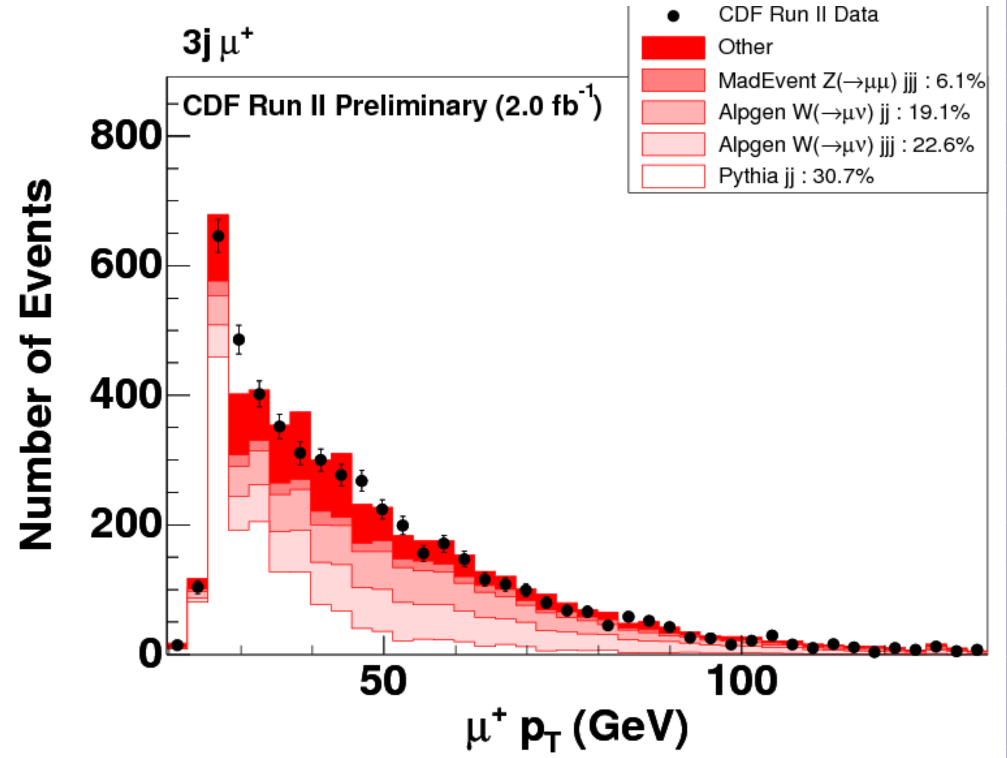
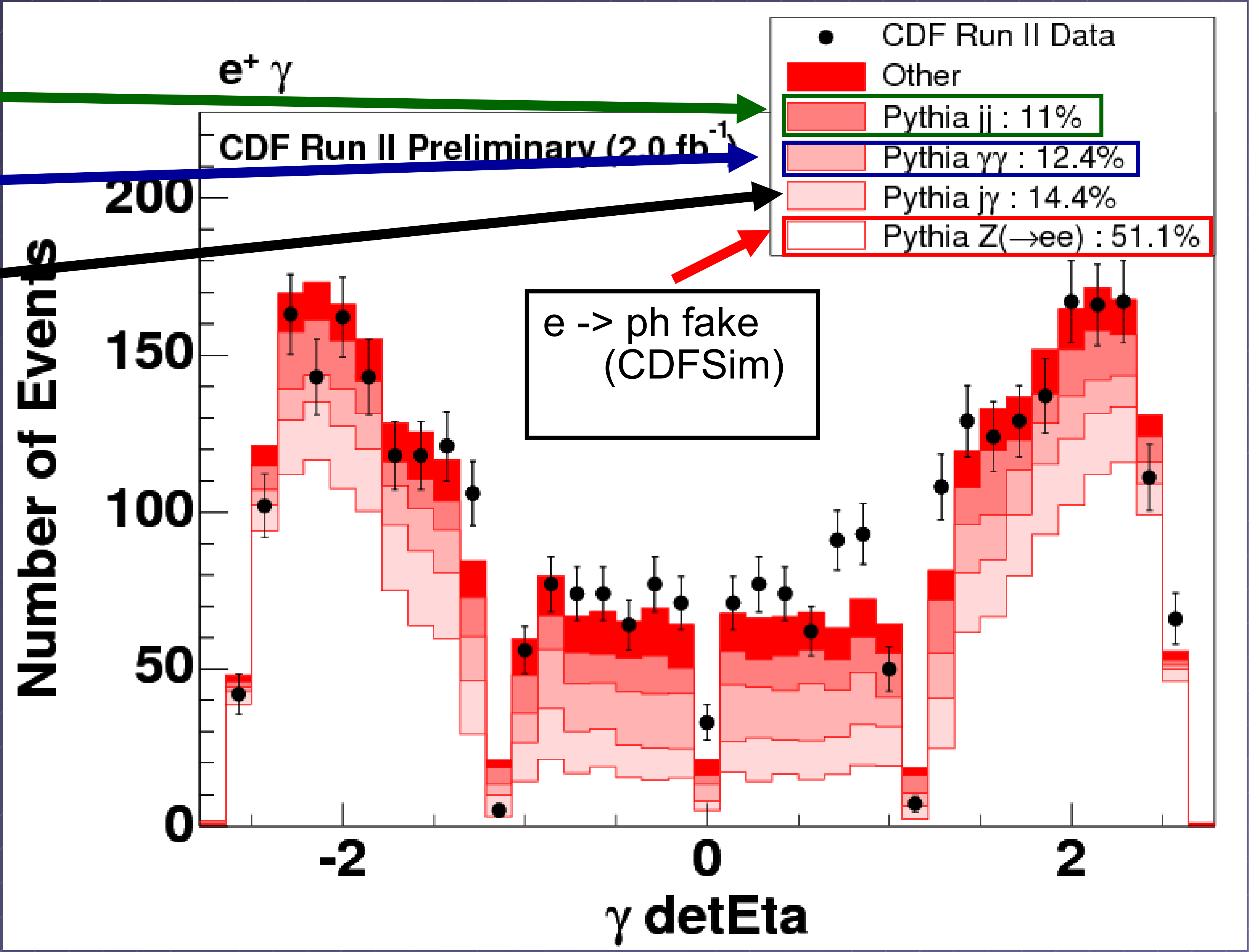


Illustration of Fakes

jet -> ph fake

ph -> e fake

real photon



e -> ph fake
(CDFSim)