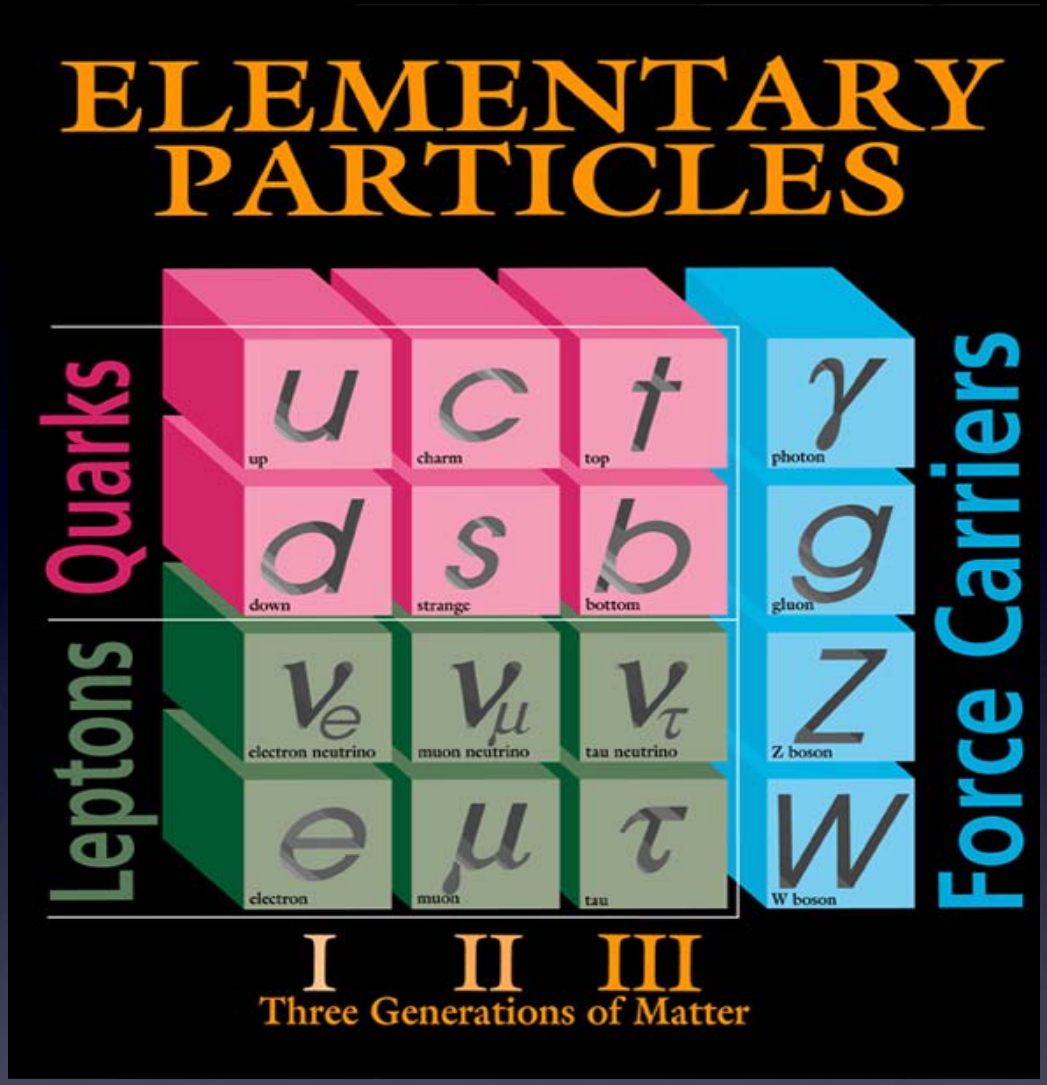
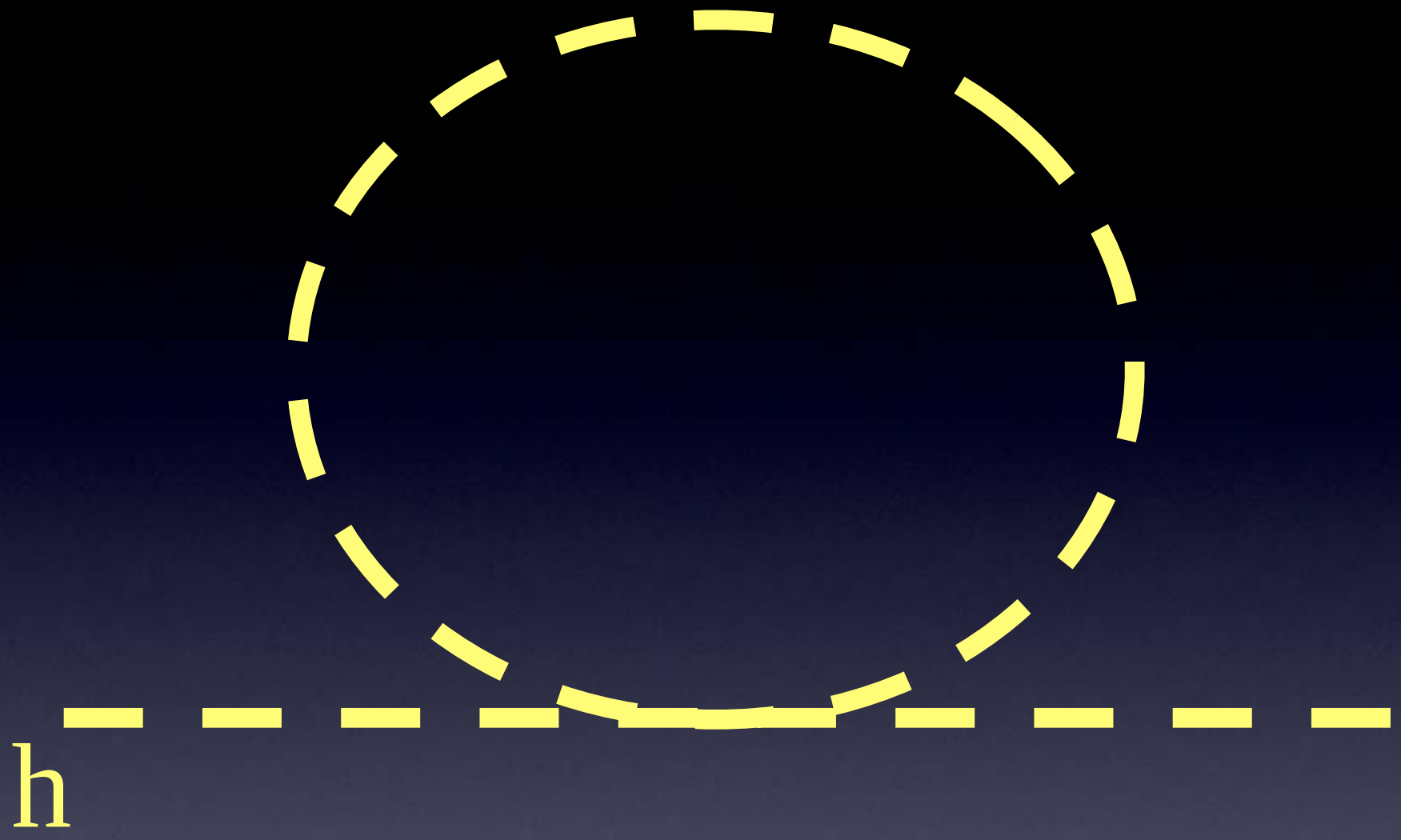
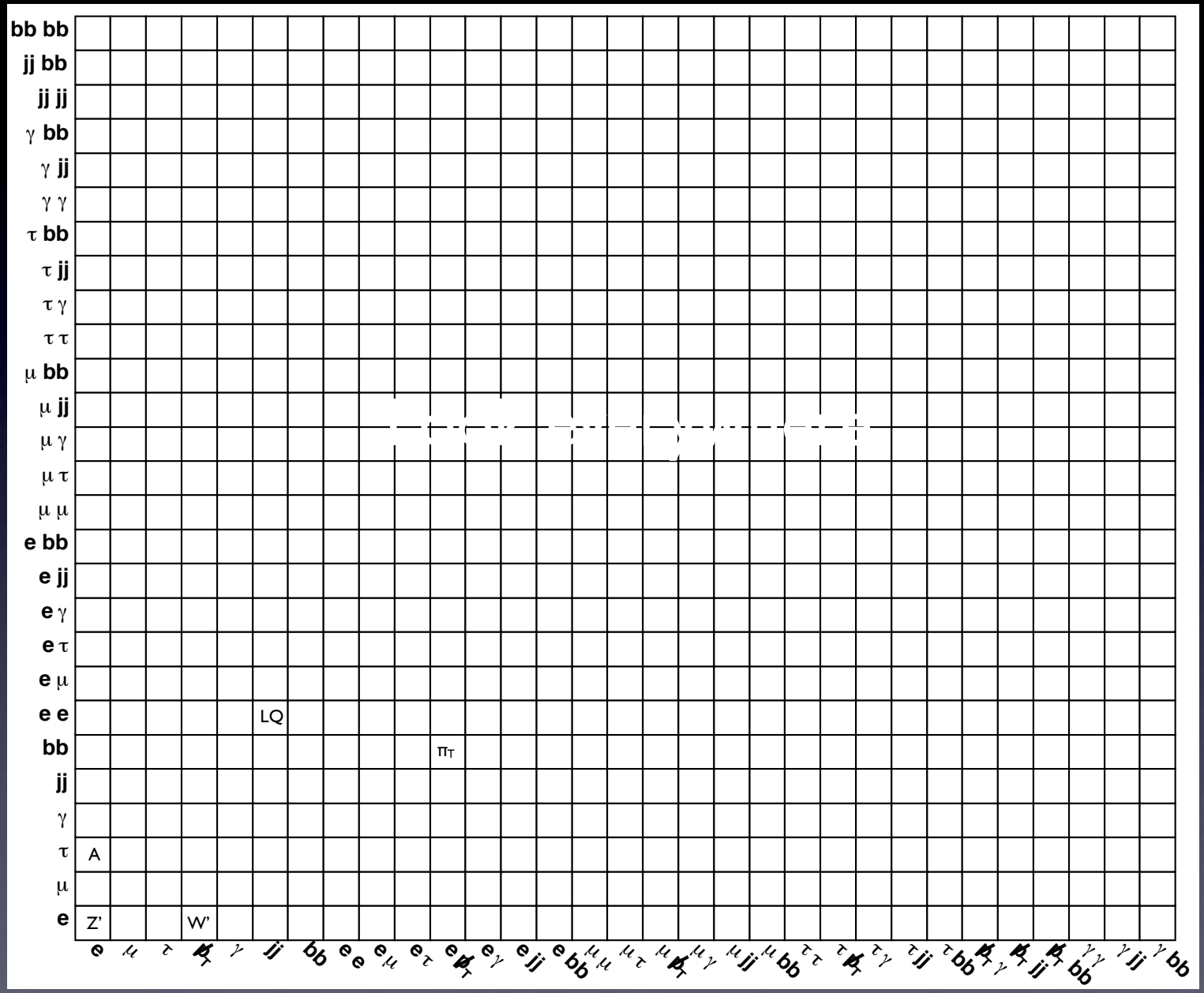
Global analysis of CDF high-p_T data



The Standard Model works pretty well

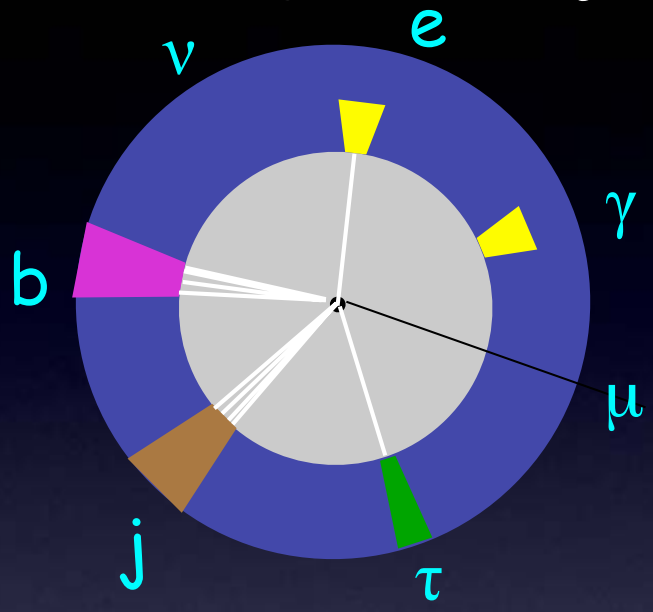


We expect something new

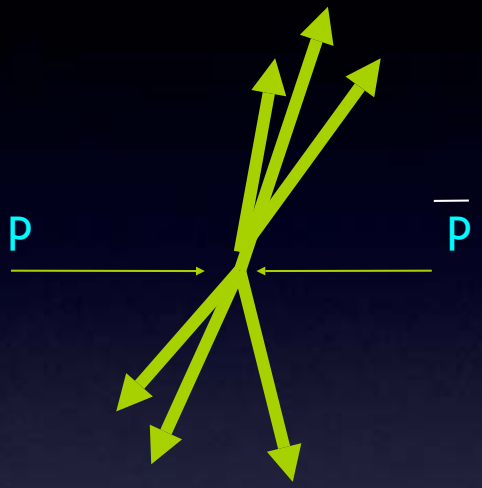

bb bb
jj bb
jj jj
γ bb
γ jj
γ γ
τ bb
τ jj
τ γ
τ τ
μ bb
μ jj
μ γ
μ τ
μ μ
e bb
e jj
e γ
e τ
e μ
e e
bb
jj
γ
τ
μ
e
A
Z'
W'
LQ
π_T
e μ τ $\not{p}_T$ γ jj bb ee eμ eτ e$\not{p}_T$ eγ ejj ebb μμ μτ μ$\not{p}_T$ μγ μjj μbb ττ τ$\not{p}_T$ τγ τjj τbb $\not{p}_T$γ $\not{p}_T$jj $\not{p}_T$bb γγ γjj γbb

VISTA ALGORITHM

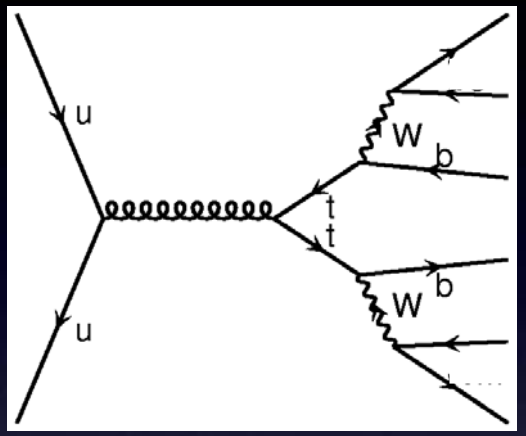
Define physics objects



Filter events of interest

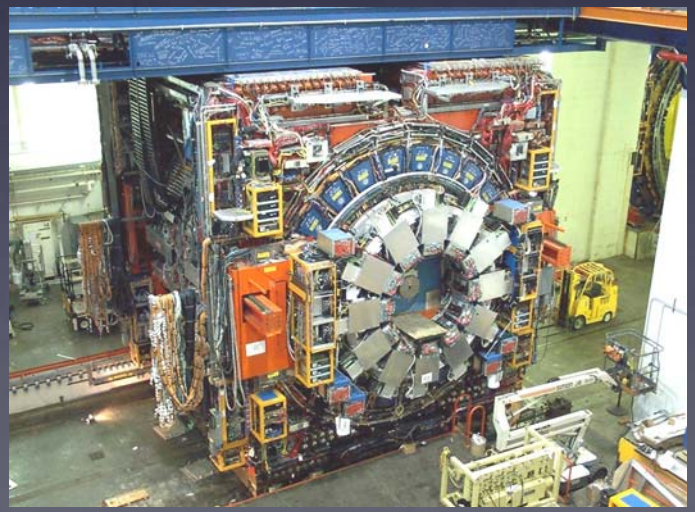


Estimate backgrounds



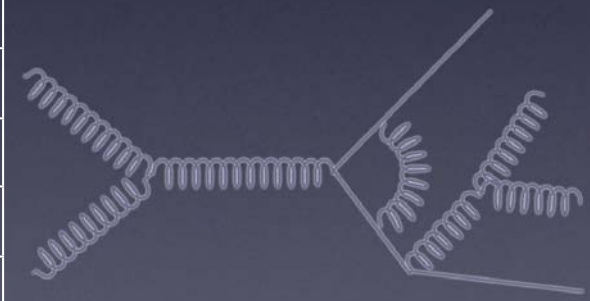
Fit for experimental & theoretical factors

Simulate detector response



(mis)Id **reconstructed**

true	e	μ	τ	γ	j	b
e	0.62		2e-3	0.02	0.28	
μ		0.51				
τ	0.02	0.01	0.04		0.90	6e-3
γ	0.03			0.68	0.21	
j	1e-4	1e-5	3e-3	3e-4	1	2e-2
b	1e-4	1e-4	1e-4	5e-5	0.65	0.35



Data used: 927 pb^{-1}

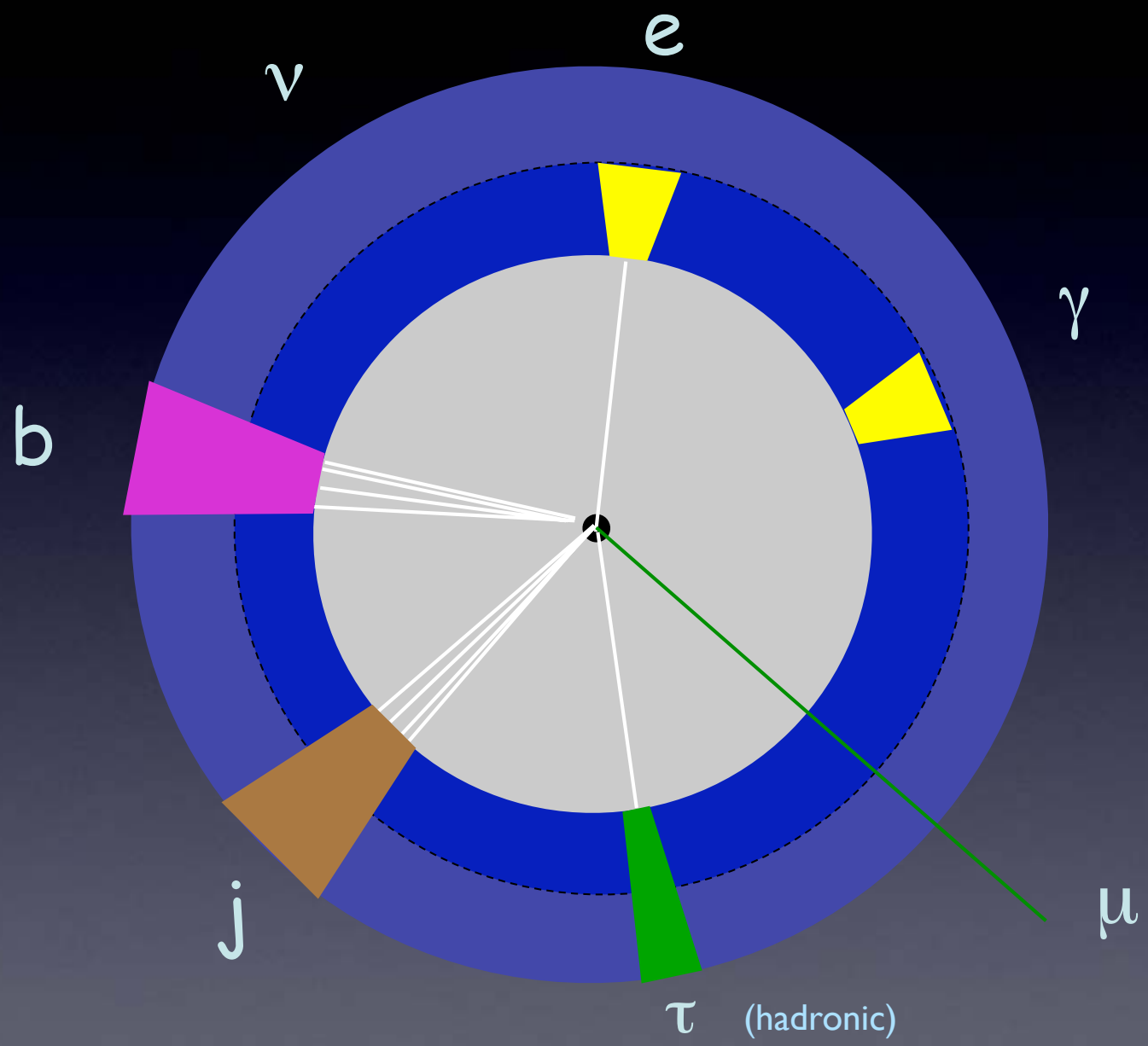
2.5 fb^{-1} already in hand, 3.0 fb^{-1} by shutdown

Equal luminosity accumulated at DØ

Total Tevatron luminosity available is *already* x 5

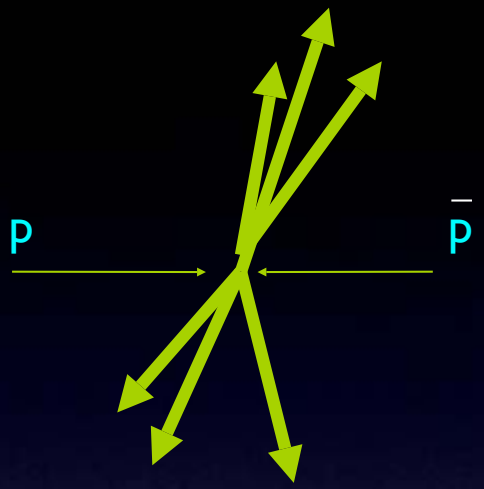
Big thanks to the Accelerator Division

"Objects" seen in the detector



p_T > 17 GeV

Filter events of interest



Recall: objects are *identified* with p_T > 17 GeV

e with p_T > 25 GeV or

μ with p_T > 25 GeV or

γ with p_T > 60 GeV or

b or j with p_T > 200 GeV or

one of a number of di-object triggers

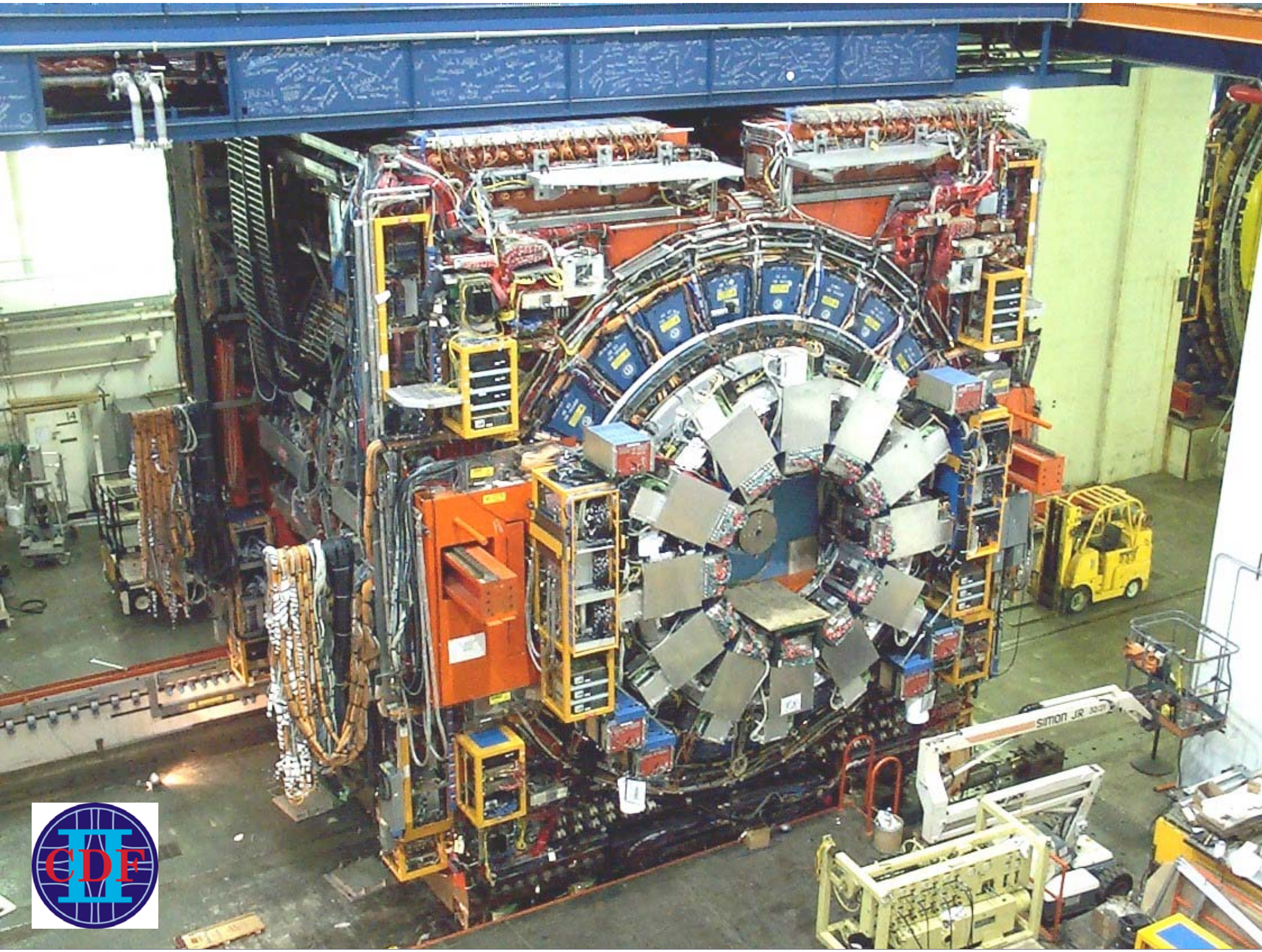
keep ~2 million events

Standard Model prediction

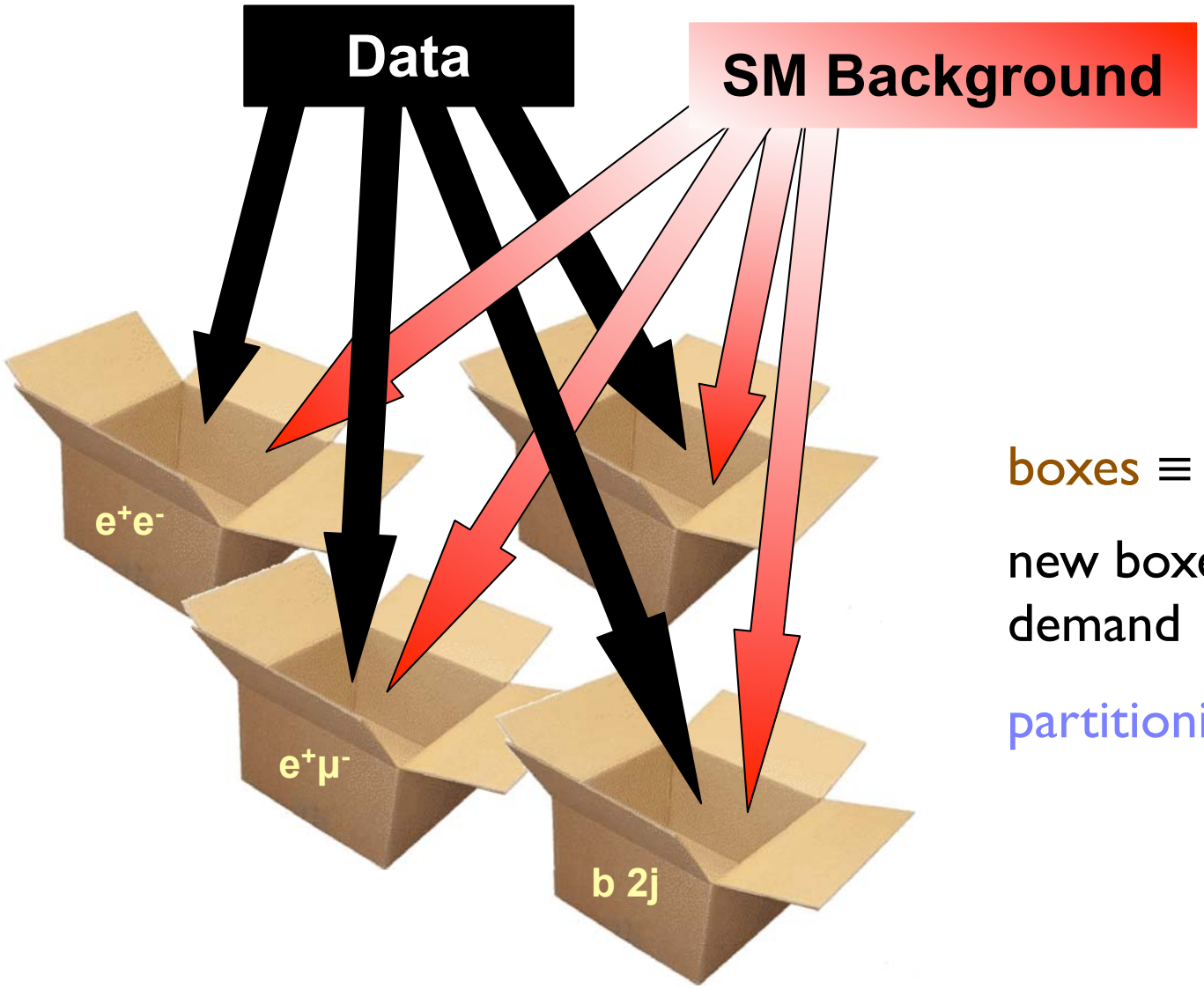
Process	Source
Non-collision	data events with < 3 reconstructed tracks
Minimum bias	additional unclustered energy
Overlapping events	event mixing
QCD jets	Pythia (ranges in $\hat{p}_T$)
γ+jets	Pythia (ranges in $\hat{p}_T$)
$\gamma\gamma$+jets	Pythia
W+jets	MadEvent+Pythia with CKKW matching
Z+jets	MadEvent+Pythia with CKKW matching
WW,WZ,ZZ	Pythia
Wγ,Zγ + jets	MadEvent+Pythia
W($\rightarrow\tau\nu$) + jets	Pythia
Z($\rightarrow\tau\tau$) + jets	Pythia
$t\bar{t}$	Herwig
other	MadEvent+Pythia with MLM matching

Standard Model prediction

Dataset	Process	Weights	*	Number	=	Total weight
pyth_jj_000	Pythia jj 0<pT<10	740		1		744.3
pyth_pj_008	Pythia gamma j 8<pT<12	350		3		1044.35
pyth_bj_010	Pythia bj 10<pT<10	210		4		846
pyth_jj_010	Pythia jj 10<pT<10	80		158		12563.3
mrenna_e+ve	MadEvent W(->ev)	15		399		5880.94
mrenna_e-ve-	MadEvent W(->ev)	15		420		6190.27
mrenna_mu-vm-	MadEvent W(->muv)	13		294		3889.71
mrenna_mu+vm	MadEvent W(->muv)	13		286		3774.45
pyth_jj_090	Pythia jj 90<pT<120	12		1723		20694.6
pyth_jj_018	Pythia jj 18<pT<40	11		22020		246916
pyth_pj_012	Pythia gamma j 12<pT<22	8.7		2512		21949.4
mad_veve-j	MadEvent Z(->vv) j	7.1		4		28.22
mad_e+ve	MadEvent W(->ev)	6.5		34		220.57
mrenna_mu+mu-	MadEvent Z(->mumu)	6.2		581		3625.87
mad_vtvt-j	MadEvent Z(->vv) j	6		5		30.08
mad_mu+vm	MadEvent W(->muv)	5.9		19		111.92
mad_e-ve-	MadEvent W(->ev)	5.7		46		261.99
mrenna_e+e-	MadEvent Z(->ee)	5.4		4831		25991.8
mad_mu-vm-	MadEvent W(->muv)	5.3		20		106.11
pyth_jj_120	Pythia jj 120<pT<150	5.1		2713		13917.7
pyth_bj_018	Pythia bj 18<pT<40	4.9		2012		9945.3
cosmic_j_lo	Cosmic (jet20)	3.3		120		400.42
pyth_jj_060	Pythia jj 60<pT<90	3.1		23749		74560.4
pyth_bj_040	Pythia bj 40<pT<60	2.4		4040		9558.81
pyth_bj_060	Pythia bj 60<pT<90	2.3		1601		3740.66
mrenna_mu+vmj	MadEvent W(->muv) j	2.3		8033		18297.6
mrenna_mu-vm-j	MadEvent W(->muv) j	2.3		8000		18194.6
cosmic_ph	Cosmic (photon_25_iso)	2.2		1134		2491.2
mrenna_mu+mu-j	MadEvent Z(->mumu) j	2.2		4938		10804.7
pyth_jj_040	Pythia jj 40<pT<60	2.1		107930		222982
pyth_pj_022	Pythia gamma j 22<pT<45	1.9		21663		41389.2
pyth_jj_200	Pythia jj 200<pT<300	1.7		72348		120708
sewkad	Pythia W(->ev)	1.5		300974		451690
mrenna_e+vej	MadEvent W(->ev) j	1.4		25106		35338.8
mrenna_e-ve-j	MadEvent W(->ev) j	1.4		25078		35289.8
pyth_jj_150	Pythia jj 150<pT<200	1.3		63296		79160.4
pyth_pj_080	Pythia gamma j 80<pT	0.92		16152		14928.7
mad_e+e-jj	MadEvent Z(->ee) jj	0.9		521		468.4
mrenna_e+vejj	MadEvent W(->ev) jj	0.77		17144		13254.9
mrenna_e-ve-jj	MadEvent W(->ev) jj	0.77		17145		13254.2
pyth_pj_045	Pythia gamma j 45<pT<80	0.75		70674		52735
mrenna_mu-vm-jj	MadEvent W(->muv) jj	0.67		9936		6703.19
mrenna_mu+vmjj	MadEvent W(->muv) jj	0.67		9930		6692.87
mad_vtvt-j_f	MadEvent Z(->vv) j	0.66		12		7.95
mad_e-ve-jj	MadEvent W(->ev) jj	0.57		291		165.28
pyth_bj_090	Pythia bj 90<pT<120	0.54		1228		664.52
mrenna_e+e-j	MadEvent Z(->ee) j	0.52		34478		17935.4
mad_e-ve-j	MadEvent W(->ev) j	0.51		308		157.78
mad_mu-vm-jj	MadEvent W(->muv) jj	0.51		241		121.94
mad_e+e-	MadEvent Z(->ee)	0.5		1075		533.43
mad_mu-vm-j	MadEvent W(->muv) j	0.47		194		91.39
mad_veve-j_f	MadEvent Z(->vv) j	0.47		11		5.14
mrenna_e+e-jj	MadEvent Z(->ee) jj	0.44		11185		4939.41
mad_mu+mu-	MadEvent Z(->mumu)	0.44		603		263.65
tewkie	Pythia Z(->ee)	0.41		147184		61002.3
cosmic_j_hi	Cosmic (jet100)	0.4		10422		4164.38
mrenna_mu+mu-jj	MadEvent Z(->mumu) jj	0.39		5963		2343.41
mad_veve-a_f	MadEvent Z(->vv) gamma	0.39		36		13.92
mad_vtvt-a_f	MadEvent Z(->vv) gamma	0.38		39		14.99
pyth_bj_120	Pythia bj 120<pT<150	0.35		2532		874.45
wewk9t	Pythia W(->tau v)	0.31		74911		23172
wewk7m	Pythia W(->mu v)	0.27		318983		87183.8
mad_aaj	MadEvent gamma gamma j	0.25		603		153.32
wexo0m	Pythia W(->mu v)	0.25		349241		86024.1
mad_e+vej	MadEvent W(->ev) j	0.22		757		167.43
mad_mu+vmj	MadEvent W(->muv) j	0.19		539		102.46
hewk09	MadEvent W(->ev) gamma	0.18		16088		2903.95
mad_e+e-j	MadEvent Z(->ee) j	0.17		761		130.43
mad_e+vejj	MadEvent W(->ev) jj	0.17		969		163.61
mad_mu+mu-jj	MadEvent Z(->mumu) jj	0.16		1784		280.63
hewk0a	MadEvent W(->muv) gamma	0.16		9732		1527.35
mad_mu+vmjj	MadEvent W(->muv) jj	0.15		770		118.33
mad_mu+mu-j	MadEvent Z(->mumu) j	0.15		502		75.2
pyth_bj_150	Pythia bj 150<pT<200	0.14		30067		4280.97
we0s8n	Pythia W(->mu v)	0.14		692822		95672.8
mad_veve-a	MadEvent Z(->vv) gamma	0.13		119		16.05
mad_vtvt-a	MadEvent Z(->vv) gamma	0.13		122		16.4
mrenna_e+vejjj	MadEvent W(->ev) jjj	0.13		15305		1992.12
mrenna_e-ve-jjj	MadEvent W(->ev) jjj	0.13		15341		1995.7
ztopcz	Pythia ZZ	0.13		592		75.03
mrenna_mu-vm-jjj	MadEvent W(->muv) jjj	0.12		8345		996.33
mrenna_mu+vmjjj	MadEvent W(->muv) jjj	0.12		8325		993.91
mad_e+e-b-b	MadEvent Z(->ee) bb	0.11		1000		113.67
pyth_pp	Pythia gamma gamma	0.1		35170		3622.08
mad_mu+mu-b-b	MadEvent Z(->mumu) bb	0.099		486		48.15
wenubb0p	Alpgen W(->ev) bb	0.099		5289		521.95
mad_aaa_f	MadEvent gamma gamma gamma	0.083		47		3.91
zewk9t	Pythia Z(->tau tau)	0.078		13740		1069.49
pyth_jj_300	Pythia jj 300<pT<400	0.077		92870		7175.72
tewk1n	Pythia Z(->mu mu)	0.077		626816		48416.8
wmnubb0p	Alpgen W(->mu v) bb	0.077		3281		251.57
hewk04	MadEvent Z(->mumu) gamma	0.075		759		57.12
mad_aaa	MadEvent gamma gamma gamma	0.075		40		3
pyth_bj_200	Pythia bj 200<pT<300	0.075		98800		7406.03
pyth_jj_400	Pythia jj 400<pT	0.075		5737		429.92
mad_aajj	MadEvent gamma gamma jj	0.074		6598		489.27
hewk03	MadEvent Z(->ee) gamma	0.074		41733		3090.04
wmnubb1p	Alpgen W(->mu v) bb j	0.073		1638		120.33
overlay	Overlaid events	0.073		4748		345.52
wenubb1p	Alpgen W(->ev) bb j	0.072		3469		251.32
mrenna_mu+mu-jjj	MadEvent Z(->mumu) jjj	0.067		9998		672.33
wmnubb2p	Alpgen W(->mu v) bb jj	0.065		502		32.65
wenubb2p	Alpgen W(->ev) bb jj	0.064		1053		67.61
mrenna_e+e-jjj	MadEvent Z(->ee) jjj	0.063		22149		1390.08
wewk6d	Pythia WZ	0.056		2794		157.84
mrenna_e-ve-jjjj	MadEvent W(->ev) jjjj	0.054		7127		381.39
mrenna_e+vejjjj	MadEvent W(->ev) jjjj	0.053		7131		381.42
mrenna_mu-vm-jjjj	MadEvent W(->muv) jjjj	0.052		3659		192.01
mrenna_mu+vmjjjj	MadEvent W(->muv) jjjj	0.052		3624		190.01
ttop0z	Herwig ttbar	0.05		17902		899.9
sewkcd	Pythia WW	0.049		2115		103.57
Total:						2.0906e+06


CDF II

Vista partitioning of events



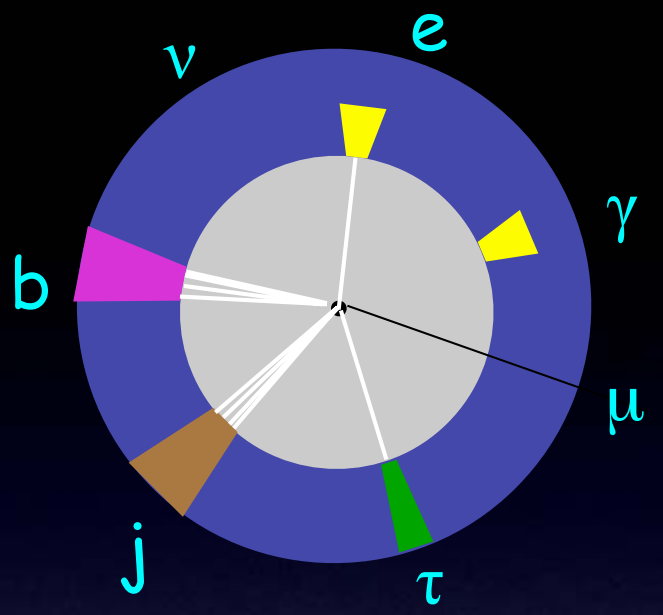
boxes ≡ exclusive final states

new boxes are created as data demand

partitioning is orthogonal

Kinematic distributions

(from 4-vectors)

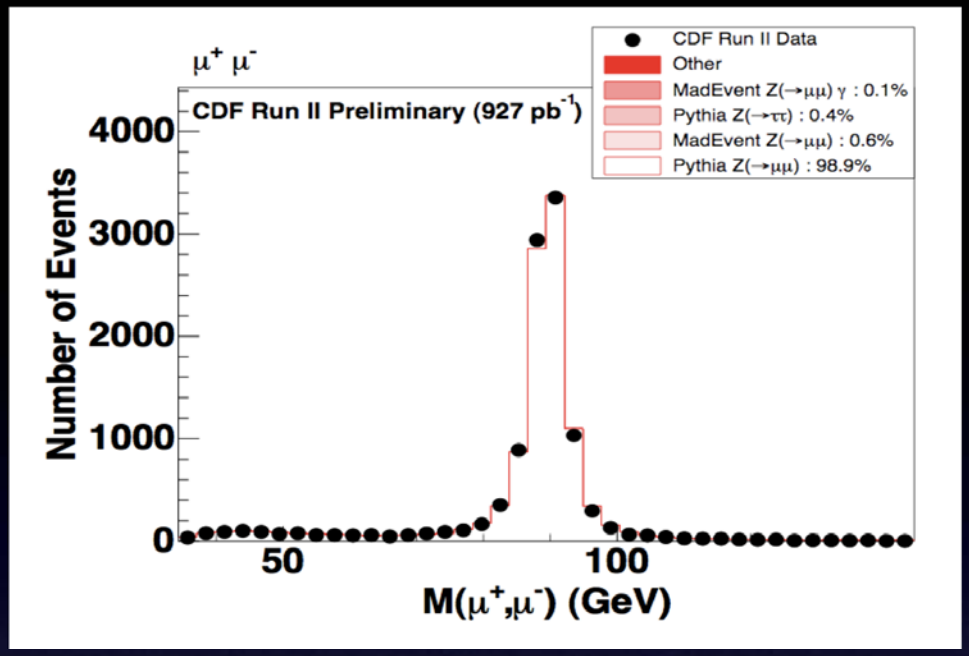


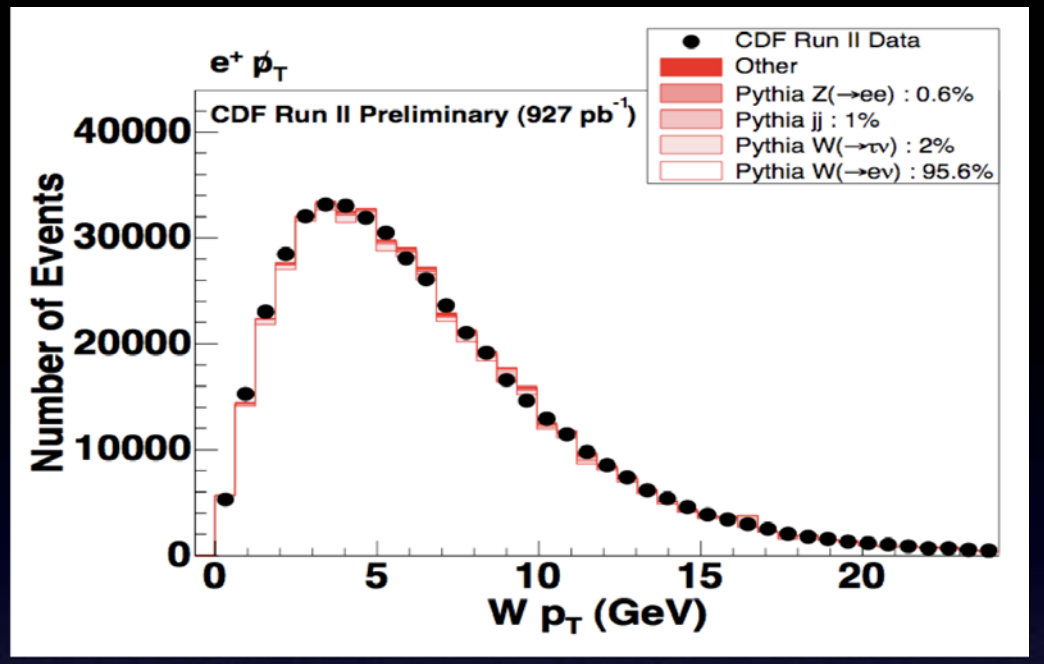
- object p_T, η, φ
- invariant masses of all object combinations
- $\Delta\varphi$, ΔR of all object pairs
- additional specialized variables

Usual approach

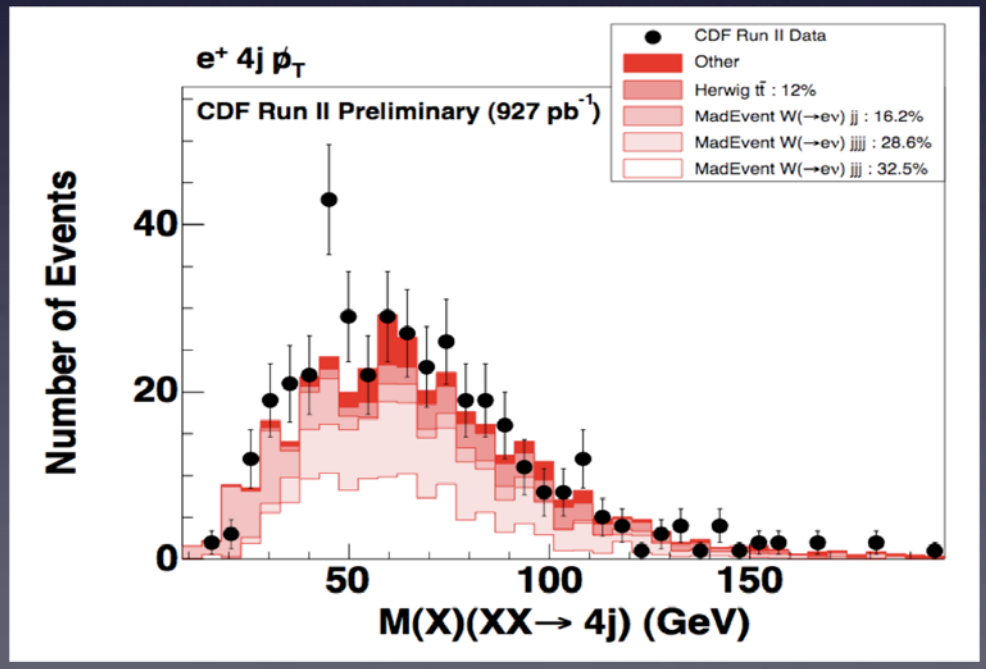
measure correction factors in a control region

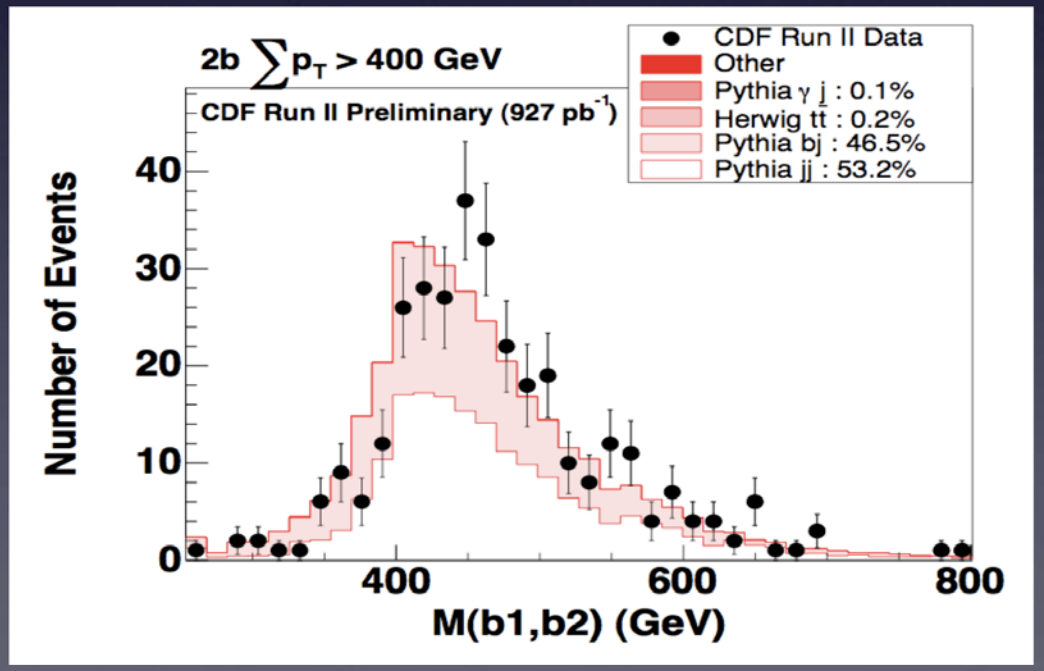
search in a signal region





One physicist's control region is another physicist's signal region





Correction Model

- All data are treated as both signal and control
- Goal
  - Identify a discrepancy on which we can base a new physics claim
  - NOT obtain a "good" description of data
- Systematic iterative improvement of understanding
- Focus on discrepancies
- Mundane explanation?
  - Explicitly work out consequences
  - Policy: Nothing gets cut away

Vista correction factors

$\vec{S}$

systematics

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation
5001	luminosity	CDF integrated luminosity
5102	k-factor	cosmic_ph
5103	k-factor	cosmic_j
5121	k-factor	1γ1j photon+jet(s)
5122	k-factor	1γ2j
5123	k-factor	1γ3j
5124	k-factor	1γ4j+
5130	k-factor	2γ0j diphoton(+jets)
5131	k-factor	2γ1j
5132	k-factor	2γ2j+
5141	k-factor	W0j W (+jets)
5142	k-factor	W1j
5143	k-factor	W2j
5144	k-factor	W3j+
5151	k-factor	Z0j Z (+jets)
5152	k-factor	Z1j
5153	k-factor	Z2j+
5161	k-factor	2j $\hat{p}_T$<150 dijet
5162	k-factor	2j 150<$\hat{p}_T$
5164	k-factor	3j $\hat{p}_T$<150 multijet
5165	k-factor	3j 150<$\hat{p}_T$
5167	k-factor	4j $\hat{p}_T$<150
5168	k-factor	4j 150<$\hat{p}_T$
5169	k-factor	5j+ low
5211	misId	p(e→e) central
5212	misId	p(e→e) plug
5213	misId	p(μ→μ) CMUP
5214	misId	p(μ→μ) CMX
5216	misId	p(γ→γ) central
5217	misId	p(γ→γ) plug
5219	misId	p(b→b) central
5245	misId	p(e→γ) plug
5256	misId	p(q→e) central
5257	misId	p(q→e) plug
5261	misId	p(q→μ)
5273	misId	p(j→b) 25<p_T
5285	misId	p(q→τ) 15<p_T<60
5286	misId	p(q→τ) 60<p_T<200
5292	misId	p(q→γ) central
5293	misId	p(q→γ) plug
5401	trigger	p(e→trig) central, p_T>25
5402	trigger	p(e→trig) plug, p_T>25
5403	trigger	p(μ→trig) CMUP, p_T>25
5404	trigger	p(μ→trig) CMX, p_T>25

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

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

$$\chi^2_{\text{constraints}}(\vec{s}) = \frac{(s_{5001} - 902\ \text{pb}^{-1})^2}{(6\% \times 902\ \text{pb}^{-1})^2} + \ldots$$

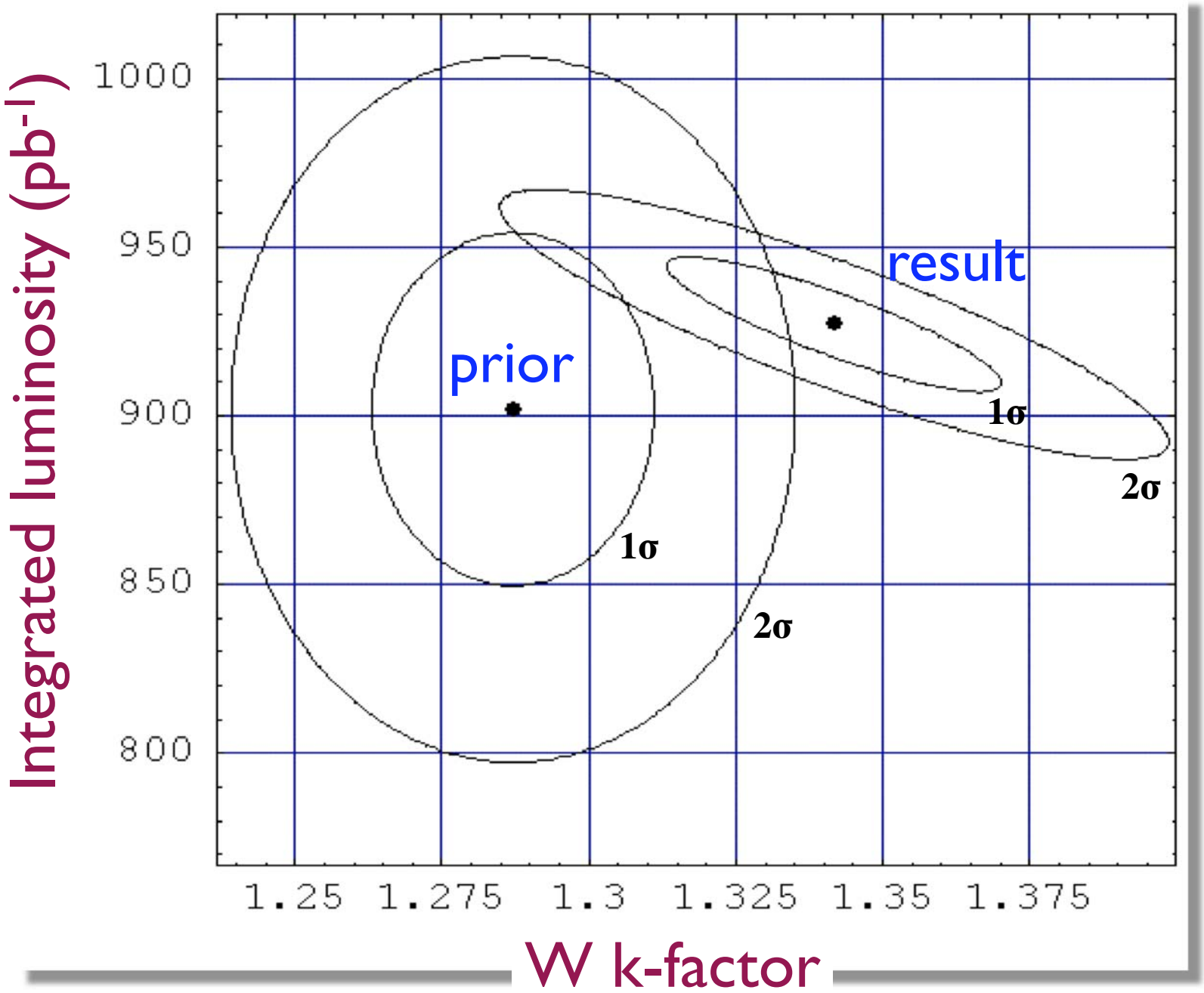
Vista correction factor values

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)
5001	luminosity	CDF integrated luminosity	927.1	20	2.2
5102	k-factor	cosmic_ph	0.686	0.05	7.3
5103	k-factor	cosmic_j	0.4464	0.014	3.1
5121	k-factor	1γ1j photon+jet(s)	0.9492	0.04	4.2
5122	k-factor	1γ2j	1.205	0.05	4.1
5123	k-factor	1γ3j	1.483	0.07	4.7
5124	k-factor	1γ4j+	1.968	0.16	8.1
5130	k-factor	2γ0j diphoton(+jets)	1.809	0.08	4.4
5131	k-factor	2γ1j	3.417	0.24	7.0
5132	k-factor	2γ2j+	1.305	0.16	12.3
5141	k-factor	W0j W (+jets)	1.453	0.027	1.9
5142	k-factor	W1j	1.059	0.03	2.8
5143	k-factor	W2j	1.021	0.03	2.9
5144	k-factor	W3j+	0.7582	0.05	6.6
5151	k-factor	Z0j Z (+jets)	1.419	0.024	1.7
5152	k-factor	Z1j	1.177	0.04	3.4
5153	k-factor	Z2j+	1.035	0.05	4.8
5161	k-factor	2j $\hat{p}_T$<150 dijet	0.9599	0.022	2.3
5162	k-factor	2j 150<$\hat{p}_T$	1.256	0.028	2.2
5164	k-factor	3j $\hat{p}_T$<150 multijet	0.9206	0.021	2.3
5165	k-factor	3j 150<$\hat{p}_T$	1.36	0.032	2.4
5167	k-factor	4j $\hat{p}_T$<150	0.9893	0.025	2.5
5168	k-factor	4j 150<$\hat{p}_T$	1.705	0.04	2.3
5169	k-factor	5j+ low	1.252	0.05	4.0
5211	misId	p(e→e) central	0.9864	0.006	0.6
5212	misId	p(e→e) plug	0.9334	0.009	1.0
5213	misId	p(μ→μ) CMUP	0.8451	0.008	0.9
5214	misId	p(μ→μ) CMX	0.915	0.011	1.2
5216	misId	p(γ→γ) central	0.9738	0.018	1.8
5217	misId	p(γ→γ) plug	0.9131	0.018	2.0
5219	misId	p(b→b) central	0.9969	0.04	4.0
5245	misId	p(e→γ) plug	0.04452	0.012	27.0
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2
5401	trigger	p(e→trig) central, p_T>25	0.9758	0.007	0.7
5402	trigger	p(e→trig) plug, p_T>25	0.835	0.015	1.8
5403	trigger	p(μ→trig) CMUP, p_T>25	0.9166	0.007	0.8
5404	trigger	p(μ→trig) CMX, p_T>25	0.9613	0.01	1.0

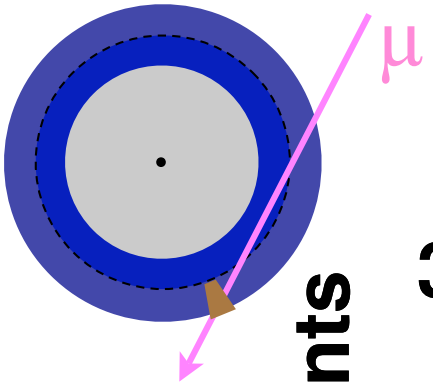
CDF Run II Preliminary (927 pb^{-1})

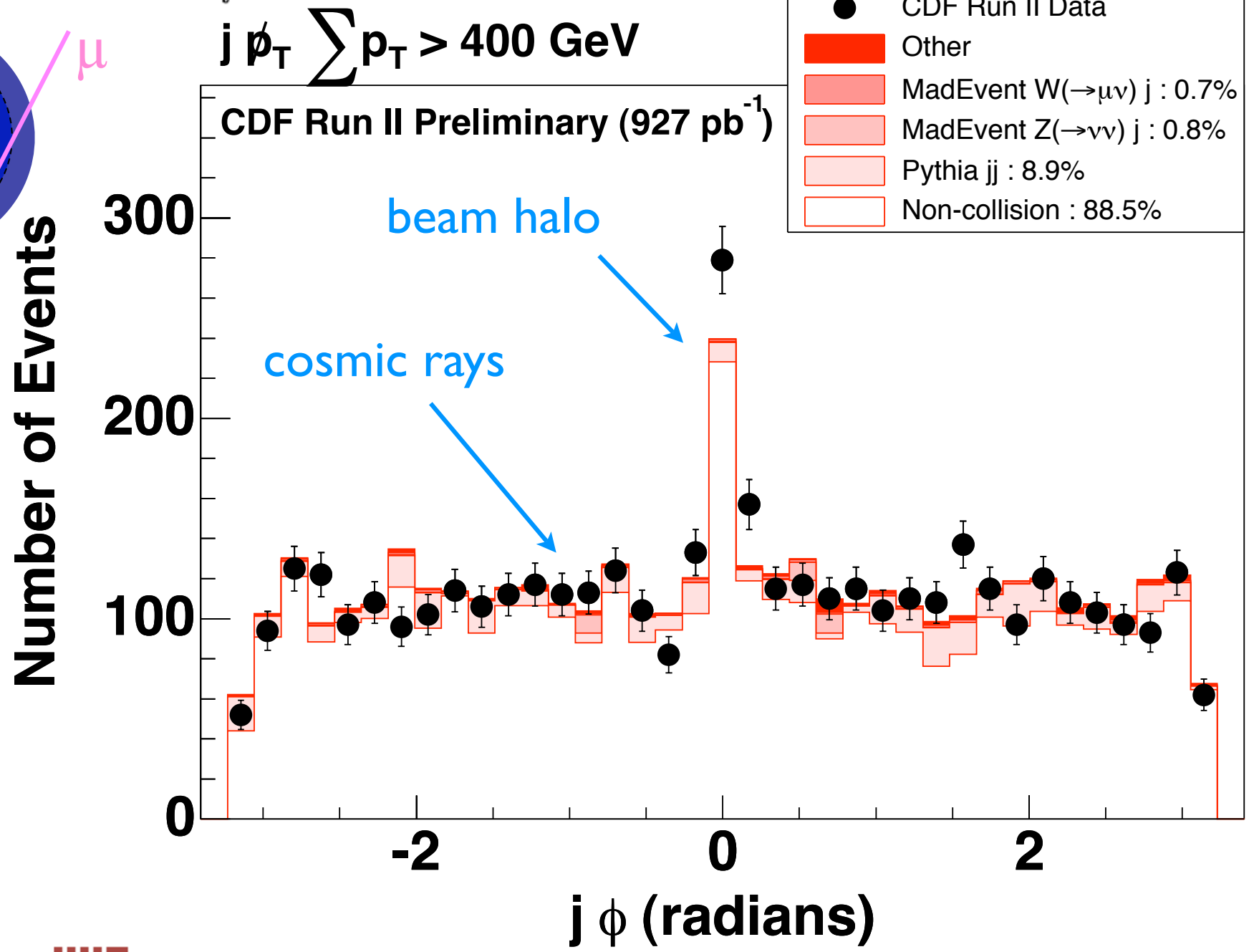
Code	Category	Explanation	Value	Error	Error(%)
5001	luminosity	CDF integrated luminosity	927.1	20	2.2



CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation
5001	luminosity	CDF integrated luminosity
5102	k-factor	cosmic_ph
5103	k-factor	cosmic_j

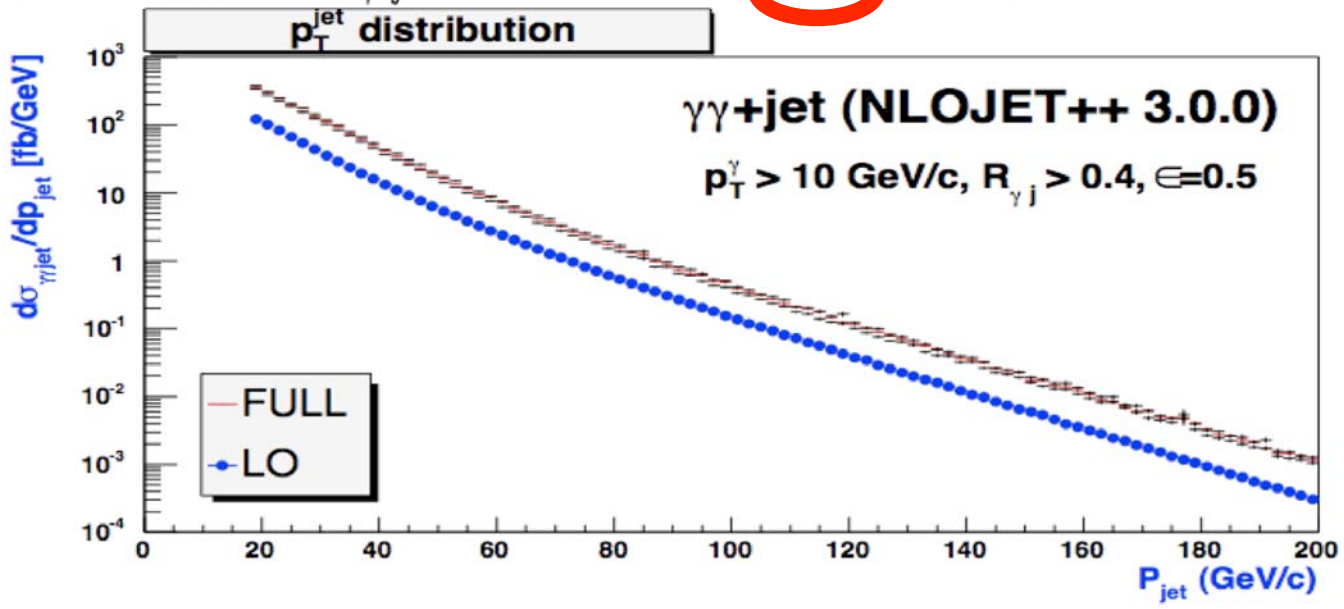


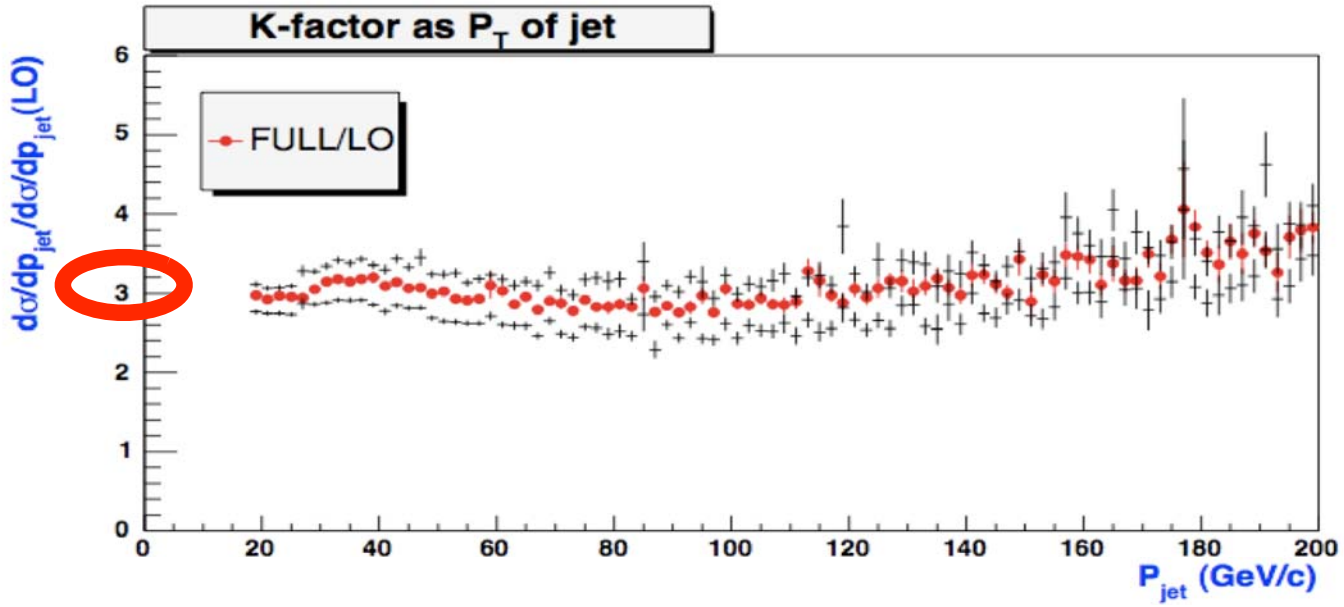


Comparisons to NLO calculations are performed where possible

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)
5001	luminosity	CDF integrated luminosity	927.1	20	2.2
5102	k-factor	cosmic_ph	0.686	0.05	7.3
5103	k-factor	cosmic_j	0.4464	0.014	3.1
5121	k-factor	1γ1j photon+jet(s)	0.9492	0.04	4.2
5122	k-factor	1γ2j	1.205	0.05	4.1
5123	k-factor	1γ3j	1.483	0.07	4.7
5124	k-factor	1γ4j+	1.968	0.16	8.1
5130	k-factor	2γ0j diphoton(+jets)	[illegible]	0.08	4.4
5131	k-factor	2γ1j	3.417	0.24	7.0





Fake rates

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)	
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0	
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1	
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3	
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6	} p_T dependence imposed
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5	
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5	
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7	
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2	

Electroweak physics at the Tevatron is possible because

$$\frac{\sigma(p\bar{p}\to W)\ p(e\to e)}{\sigma(p\bar{p}\to jj)\ p(j\to e)} \gtrsim 1$$

We need to obtain a Monte Carlo based modeling of fake objects

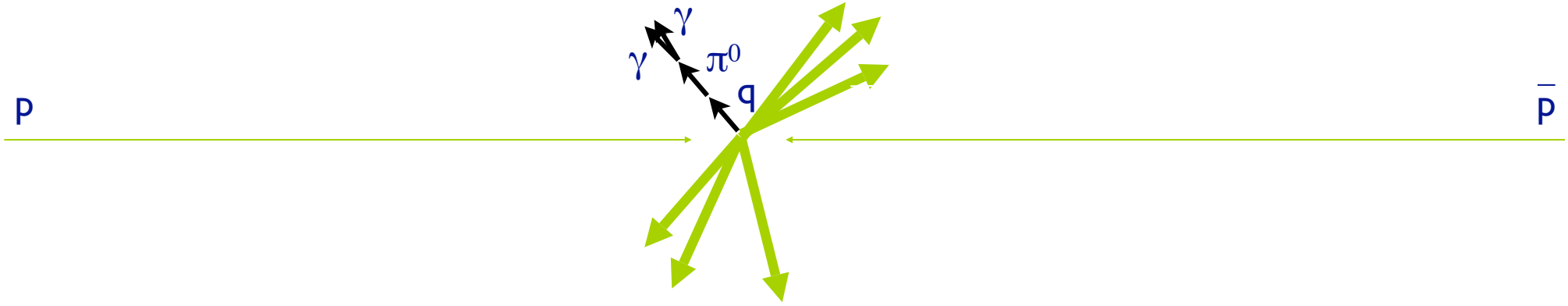
Fake rates

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)	
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0	
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1	
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3	
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6	} p_T dependence imposed
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5	
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5	
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7	
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2	

Understanding the underlying physical mechanism is crucial

p(j→γ)



Fake rates

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)	
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0	
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1	
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3	
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6	} p_T dependence imposed
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5	
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5	
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7	
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2	

The primary physical mechanism behind p(j→e) is:

75%	single π^0
20%	single π^+
<5%	heavy flavor
<1%	$\pi^0\pi^\pm$ overlap

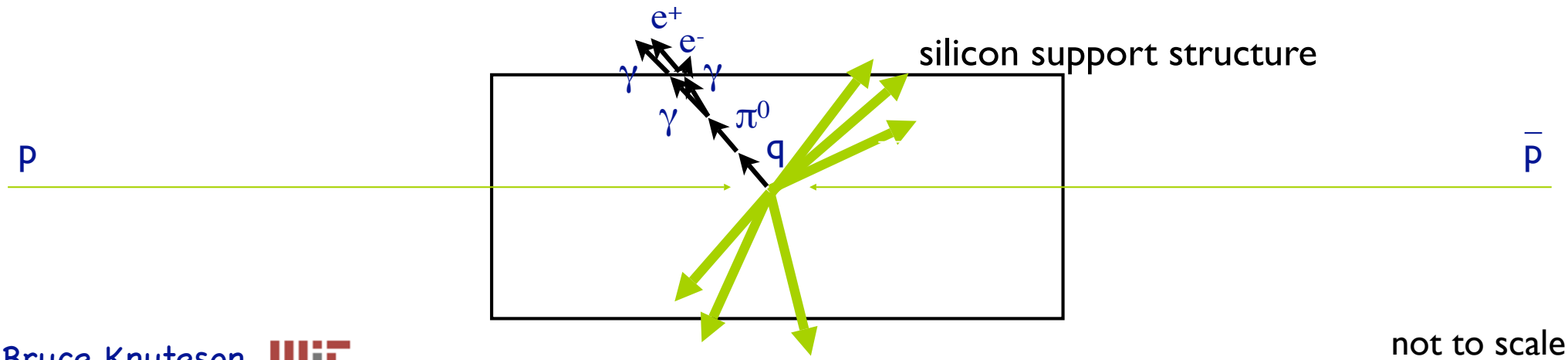
Fake rates

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)	
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0	
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1	
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3	
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6	} p_T dependence imposed
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5	
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5	
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7	
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2	

The primary physical mechanism behind p(j→e) is:

75% single π^0



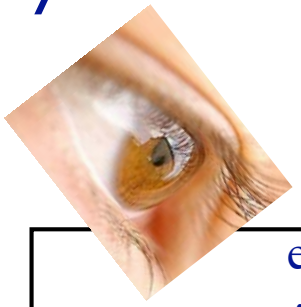
not to scale

Fake rates

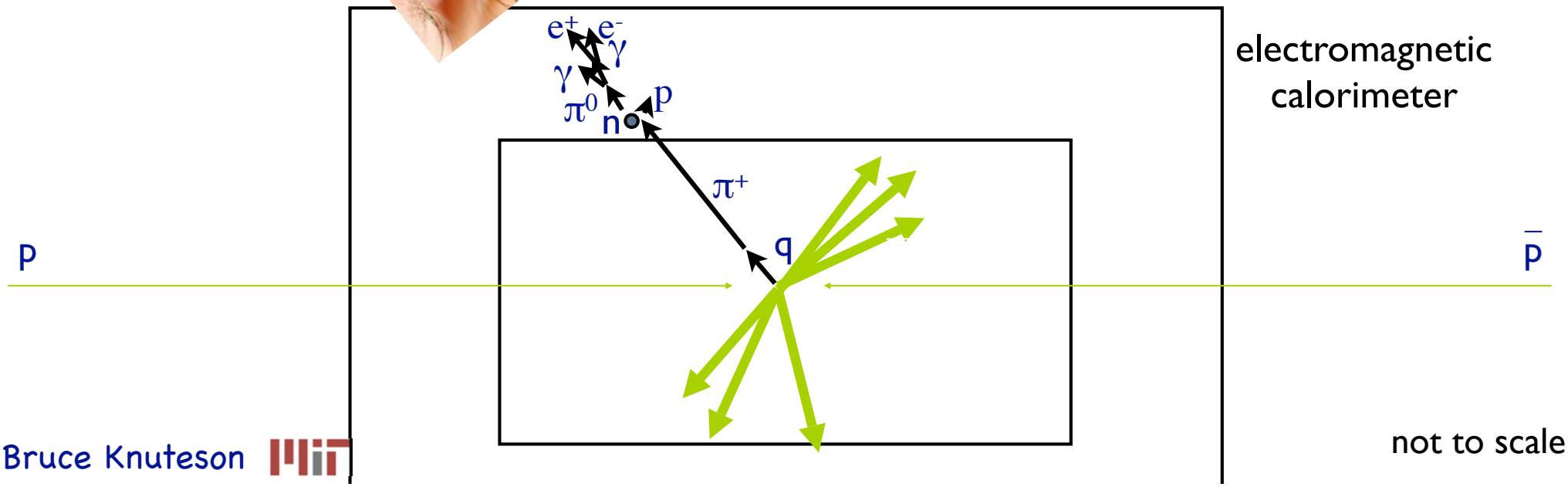
CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)	
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0	
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1	
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3	
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6	} p_T dependence imposed
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5	} p_T dependence imposed
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5	} p_T dependence imposed
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7	
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2	

The primary physical mechanism behind p(j→e) is:



20% single π^+



Single particle gun

p_T = 25 GeV
central

Reconstructed

Shot

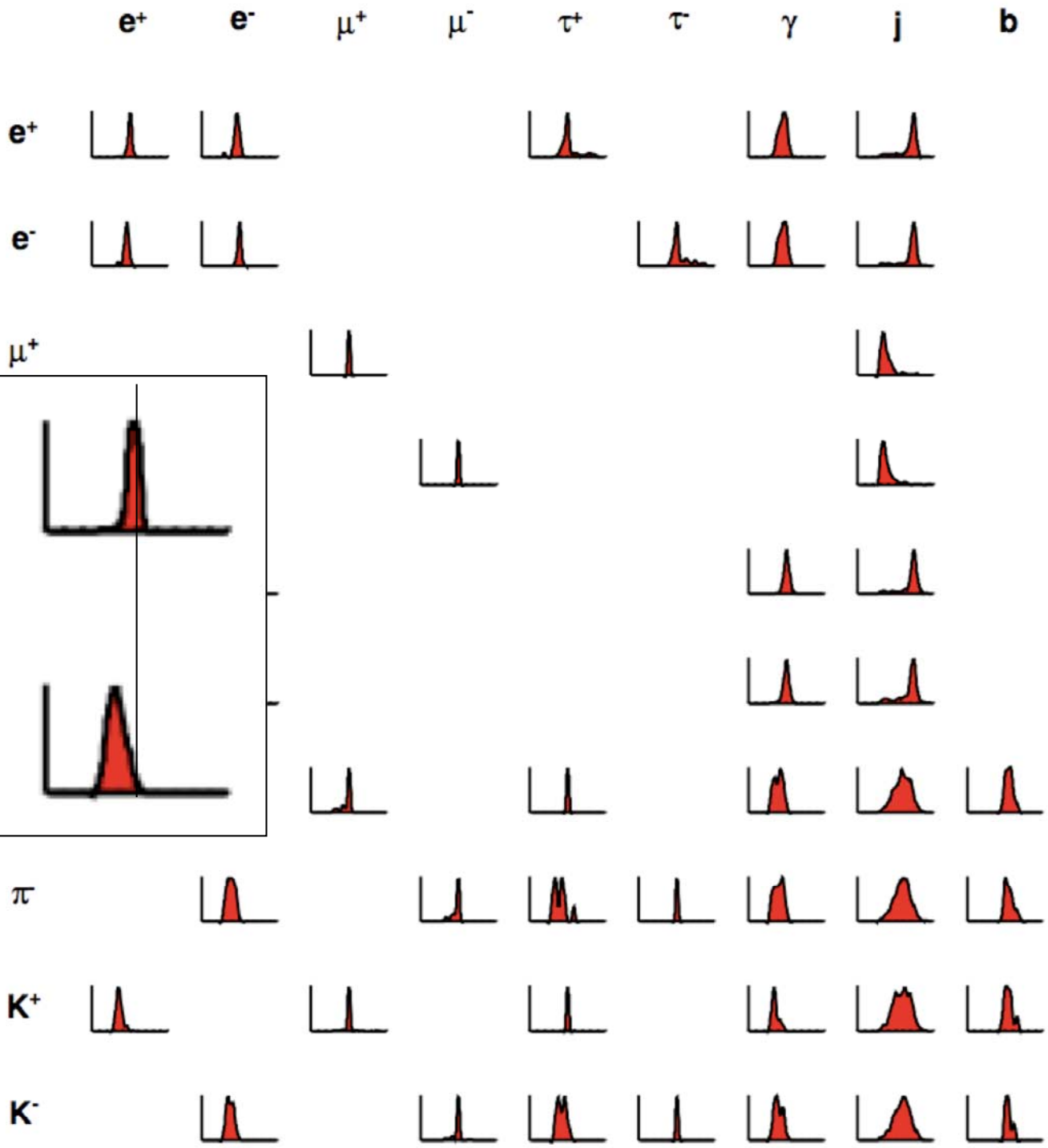
	e^+	e^-	μ^+	μ^-	τ^+	τ^-	γ	j	b
e^+	62228	33	0	0	182	0	2435	28140	0
e^-	24	62324	0	0	0	192	2455	28023	1
μ^+	0	0	50491	0	6	0	0	606	0
μ^-	0	1	0	50294	0	6	0	577	0
γ	1393	1327	0	0	1	1	67679	21468	0
π^0	1204	1228	0	0	5	8	58010	33370	0
π^+	266	0	115	0	41887	6	95	54189	37
π^-	1	361	0	88	13	41355	148	54692	44
K^+	156	1	273	0	42725	7	37	52317	24
K^-	1	248	0	165	28	41562	115	53917	22
B^+	100	0	77	1	100	10	40	66062	25861
B^-	2	85	3	68	11	99	45	66414	25621
B^0	88	27	87	17	77	32	21	65866	25046
$\bar{B}^0$	17	79	11	71	41	77	21	66034	25103
D^+	126	6	62	0	1485	67	207	79596	11620
D^-	4	134	3	74	64	1400	234	79977	11554
D^0	60	13	27	2	312	1053	248	88821	5487
$\bar{D}^0$	15	46	5	28	1027	253	237	89025	5480
K_L^0	1	4	0	0	71	60	202	96089	26
K_S^0	26	31	2	1	170	525	9715	76196	0
τ^+	1711	13	1449	0	4167	2	673	50866	607
τ^-	12	1716	0	1474	6	3940	621	51125	580
u	8	10	1	0	446	31	247	94074	26
d	3	4	0	0	64	308	191	94322	22
g	2	0	0	0	17	14	12	81865	99

/10^5

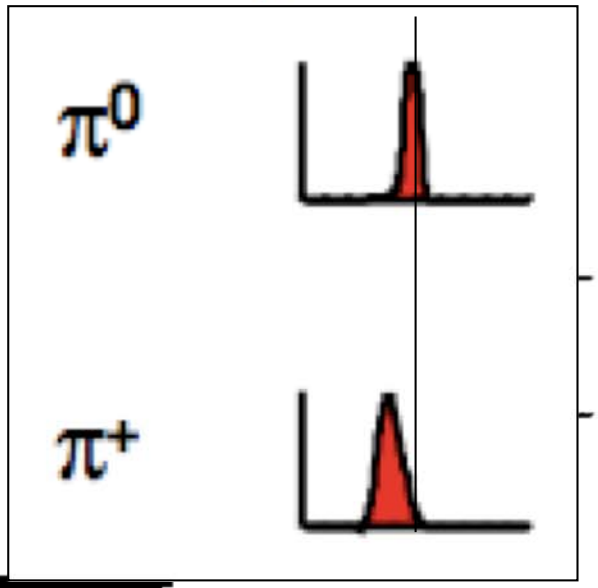
Single particle gun

p_T = 25 GeV
central

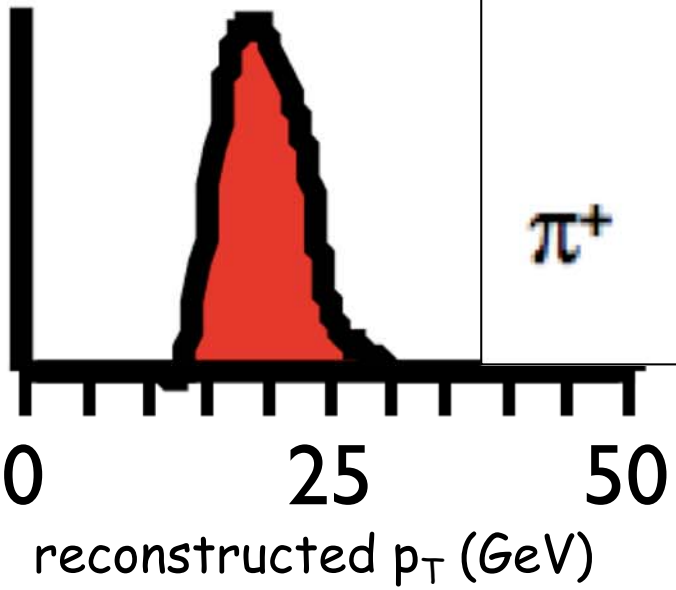
Reconstructed



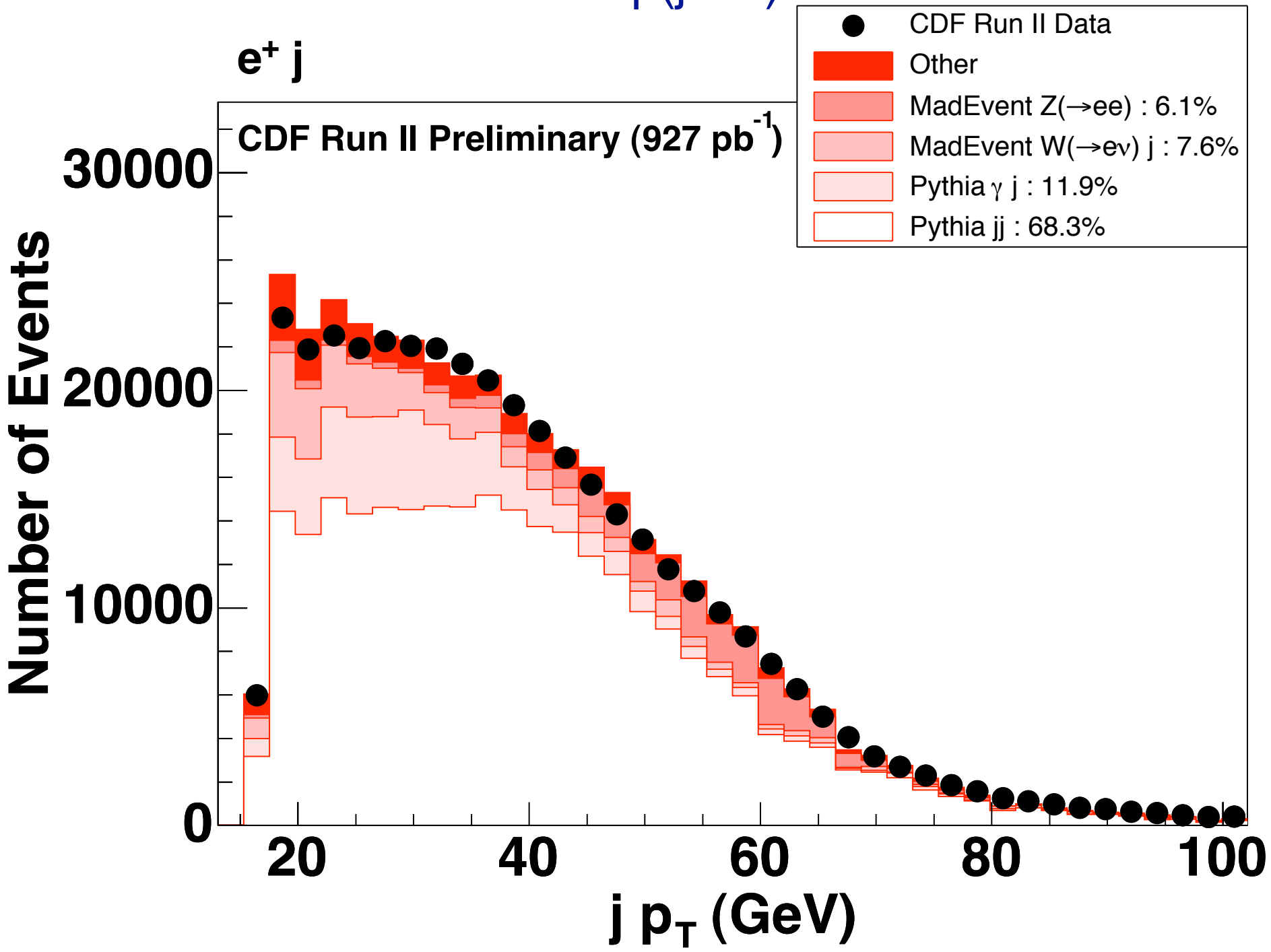
Shot



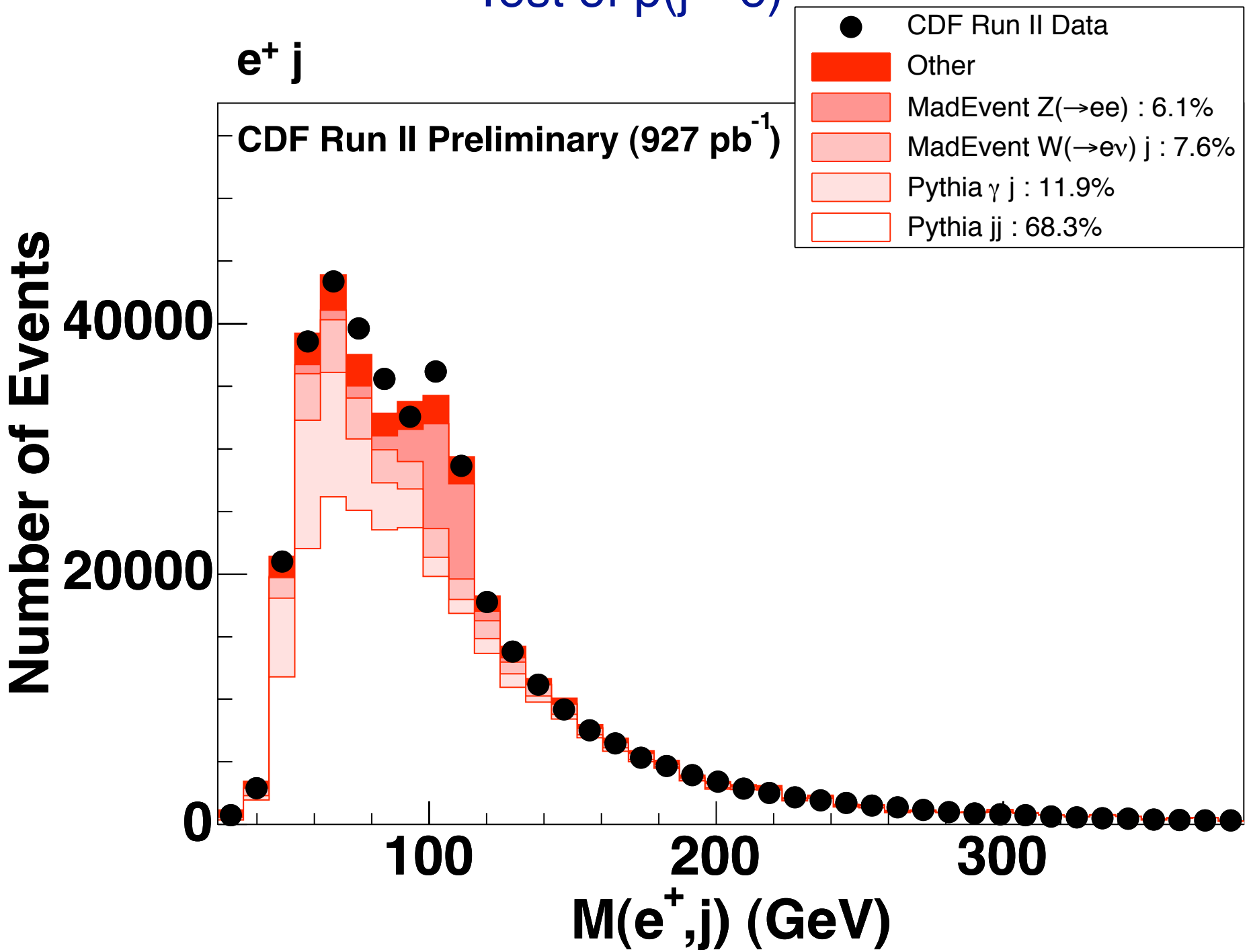
Legend



Test of p(j→e)


e+ j
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent Z(→ee) : 6.1%
MadEvent W(→eν) j : 7.6%
Pythia γ j : 11.9%
Pythia jj : 68.3%
Number of Events
0
10000
20000
30000
20
40
60
80
100
j pT (GeV)

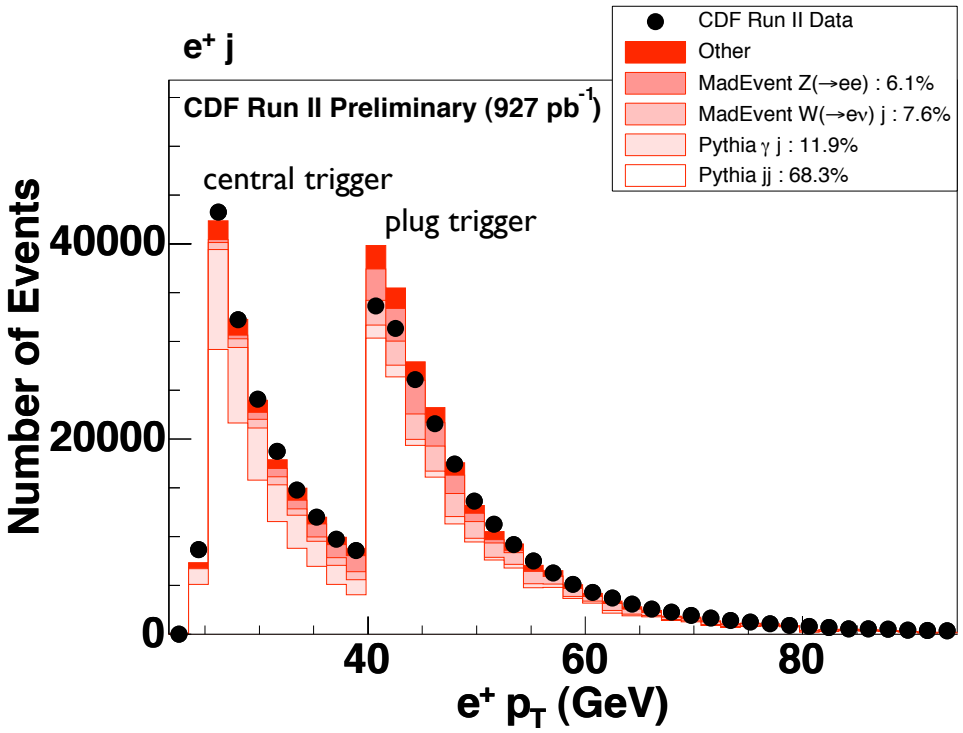
Test of p(j→e)

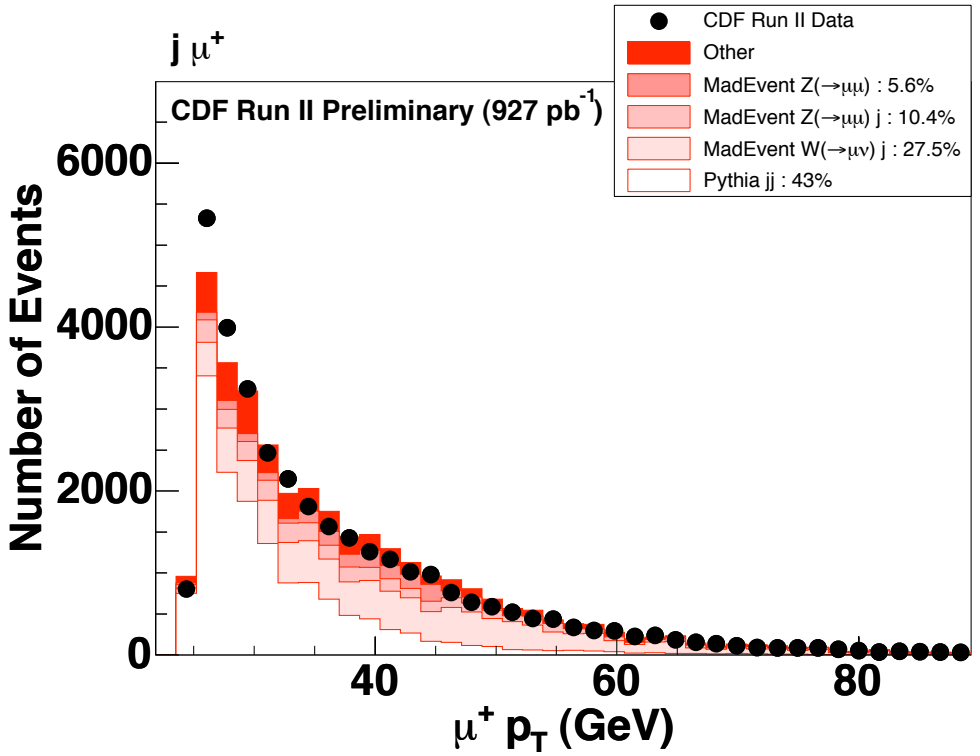

e+ j
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent Z(→ee) : 6.1%
MadEvent W(→eν) j : 7.6%
Pythia γ j : 11.9%
Pythia jj : 68.3%
Number of Events
40000
20000
0
100
200
300
M(e+,j) (GeV)

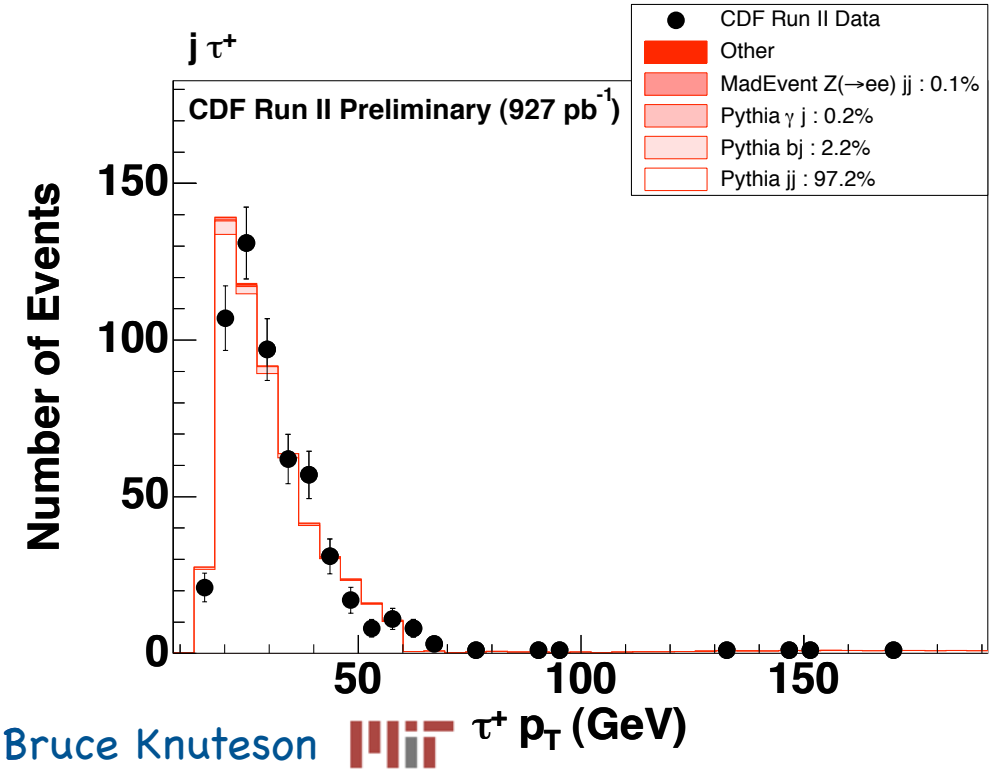
Fake rate physics

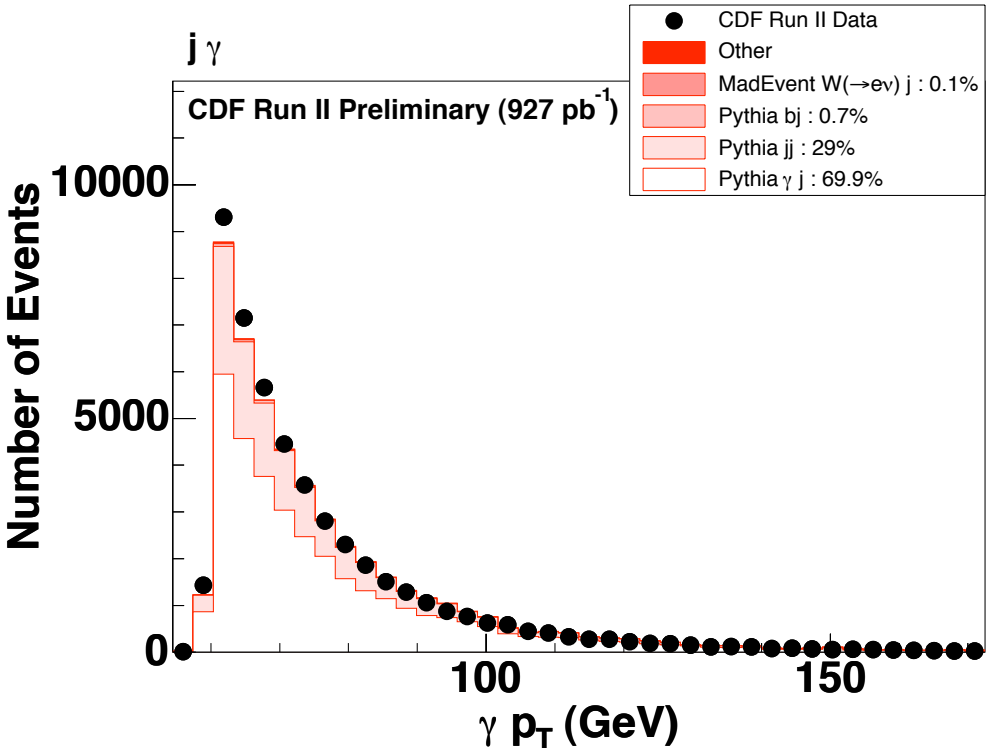
$p(j \to e)$	$p(j \to \mu)$
$\pi^0 \to \gamma\gamma \to \gamma ee \to$ "e"	$\pi^+ \to \mu\nu_\mu \to$ "μ"
$p(j \to \tau)$	$p(j \to \gamma)$
$\pi^+ \to$ "τ"	$\pi^0 \to \gamma\gamma \to$ "γ"

$p(q \to \pi)$


e+ j
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent Z(→ee) : 6.1%
MadEvent W(→eν) j : 7.6%
Pythia γ j : 11.9%
Pythia jj : 68.3%
central trigger
plug trigger
Number of Events
e+ pT (GeV)


j μ+
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent Z(→μμ) : 5.6%
MadEvent Z(→μμ) j : 10.4%
MadEvent W(→μν) j : 27.5%
Pythia jj : 43%
Number of Events
μ+ pT (GeV)


j τ+
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent Z(→ee) jj : 0.1%
Pythia γ j : 0.2%
Pythia bj : 2.2%
Pythia jj : 97.2%
Number of Events
τ+ pT (GeV)


j γ
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent W(→eν) j : 0.1%
Pythia bj : 0.7%
Pythia jj : 29%
Pythia γ j : 69.9%
Number of Events
γ pT (GeV)

Vista correction factor values

A number of additional checks have been performed:

- comparisons with numbers from other CDF studies
- re-fitting on data subsamples
- leaving Standard Model processes out of the background estimate and seeing whether they can be fit away
- introducing additional correction factors to check behavior
- checking PullApart and Influence

CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)
5001	luminosity	CDF integrated luminosity	927.1	20	2.2
5102	k-factor	cosmic_ph	0.686	0.05	7.3
5103	k-factor	cosmic_j	0.4464	0.014	3.1
5121	k-factor	1γ1j photon+jet(s)	0.9492	0.04	4.2
5122	k-factor	1γ2j	1.205	0.05	4.1
5123	k-factor	1γ3j	1.483	0.07	4.7
5124	k-factor	1γ4j+	1.968	0.16	8.1
5130	k-factor	2γ0j diphoton(+jets)	1.809	0.08	4.4
5131	k-factor	2γ1j	3.417	0.24	7.0
5132	k-factor	2γ2j+	1.305	0.16	12.3
5141	k-factor	W0j W (+jets)	1.453	0.027	1.9
5142	k-factor	W1j	1.059	0.03	2.8
5143	k-factor	W2j	1.021	0.03	2.9
5144	k-factor	W3j+	0.7582	0.05	6.6
5151	k-factor	Z0j Z (+jets)	1.419	0.024	1.7
5152	k-factor	Z1j	1.177	0.04	3.4
5153	k-factor	Z2j+	1.035	0.05	4.8
5161	k-factor	2j $\hat{p}_T$<150 dijet	0.9599	0.022	2.3
5162	k-factor	2j 150<$\hat{p}_T$	1.256	0.028	2.2
5164	k-factor	3j $\hat{p}_T$<150 multijet	0.9206	0.021	2.3
5165	k-factor	3j 150<$\hat{p}_T$	1.36	0.032	2.4
5167	k-factor	4j $\hat{p}_T$<150	0.9893	0.025	2.5
5168	k-factor	4j 150<$\hat{p}_T$	1.705	0.04	2.3
5169	k-factor	5j+ low	1.252	0.05	4.0
5211	misId	p(e→e) central	0.9864	0.006	0.6
5212	misId	p(e→e) plug	0.9334	0.009	1.0
5213	misId	p(μ→μ) CMUP	0.8451	0.008	0.9
5214	misId	p(μ→μ) CMX	0.915	0.011	1.2
5216	misId	p(γ→γ) central	0.9738	0.018	1.8
5217	misId	p(γ→γ) plug	0.9131	0.018	2.0
5219	misId	p(b→b) central	0.9969	0.04	4.0
5245	misId	p(e→γ) plug	0.04452	0.012	27.0
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2
5401	trigger	p(e→trig) central, p_T>25	0.9758	0.007	0.7
5402	trigger	p(e→trig) plug, p_T>25	0.835	0.015	1.8
5403	trigger	p(μ→trig) CMUP, p_T>25	0.9166	0.007	0.8
5404	trigger	p(μ→trig) CMX, p_T>25	0.9613	0.01	1.0

A complete correlation matrix is obtained

CDF Run II Preliminary (927 pb^{-1})

	5001	5102	5103	5121	5122	5123	5124	5130	5131	5132	5141	5142	5143	5144	5151	5152	5153	5161	5162	5164	5165	5167	5168	5169	5211	5212	5213	5214	5216	5217	5219	5245	5256	5257	5261	5273	5285	5286	5292	5293	5401	5402	5403	5404
5001	1	-.32	-.7	-.56	-.53	-.45	-.26	-.36	-.21	-.14	-.87	-.77	-.51	-.28	-.82	-.55	-.31	-.95	-.96	-.94	-.94	-.88	-.88	-.62	-.54	-.17	-.46	-.37	-.09	-.1	0	-.24	+.08	+.17	+.08	-.01	-.04	+.01	+.02	-.02	-.22	-.21	-.13	-.11
5102	-.32	1	+.21	+.37	+.38	+.33	+.2	+.34	+.18	+.12	+.28	+.25	+.17	+.09	+.27	+.18	+.1	+.3	+.31	+.31	+.3	+.28	+.28	+.2	+.18	+.06	+.15	+.12	-.31	+.02	0	+.08	-.14	-.06	-.03	0	+.01	-.03	-.07	-.07	+.07	+.07	+.04	+.04
5103	-.7	+.21	1	+.39	+.37	+.31	+.18	+.25	+.14	+.1	+.61	+.53	+.35	+.2	+.57	+.38	+.21	+.66	+.66	+.66	+.65	+.61	+.61	+.43	+.38	+.12	+.32	+.26	+.06	+.07	-.01	+.17	-.05	-.12	-.06	+.01	+.03	-.01	-.01	+.01	+.15	+.14	+.09	+.08
5121	-.56	+.37	+.39	1	+.9	+.77	+.48	+.61	+.33	+.23	+.49	+.43	+.29	+.16	+.46	+.32	+.18	+.5	+.53	+.53	+.52	+.49	+.49	+.35	+.3	+.1	+.25	+.2	-.46	+.03	0	+.13	-.44	-.09	-.03	-.01	+.02	-.32	-.62	-.17	+.11	+.11	+.07	+.06
5122	-.53	+.38	+.37	+.9	1	+.75	+.46	+.62	+.31	+.21	+.46	+.41	+.27	+.15	+.44	+.3	+.17	+.5	+.51	+.48	+.5	+.47	+.46	+.33	+.29	+.1	+.24	+.19	-.49	+.03	-.02	+.12	-.43	-.09	-.04	0	+.02	-.29	-.57	-.16	+.11	+.1	+.07	+.06
5123	-.45	+.33	+.31	+.77	+.75	1	+.4	+.54	+.29	+.13	+.4	+.35	+.24	+.13	+.38	+.26	+.14	+.43	+.44	+.42	+.42	+.35	+.4	+.28	+.25	+.09	+.2	+.16	-.45	+.02	-.01	+.1	-.36	-.07	-.04	0	+.01	-.24	-.46	-.14	+.09	+.09	+.06	+.05
5124	-.26	+.2	+.18	+.48	+.46	+.4	1	+.34	+.18	+.09	+.23	+.2	+.13	+.08	+.22	+.15	+.08	+.24	+.25	+.25	+.24	+.21	+.22	+.02	+.14	+.05	+.12	+.09	-.29	+.01	-.02	+.06	-.23	-.04	-.02	+.01	+.01	-.15	-.3	-.09	+.05	+.05	+.03	+.03
5130	-.36	+.34	+.25	+.61	+.62	+.54	+.34	1	+.37	+.28	+.32	+.28	+.19	+.1	+.3	+.22	+.12	+.34	+.34	+.34	+.33	+.31	+.31	+.22	+.18	+.06	+.16	+.12	-.61	-.03	0	+.11	-.29	-.06	-.03	0	+.01	-.09	-.17	-.28	+.07	+.07	+.04	+.04
5131	-.21	+.18	+.14	+.33	+.31	+.29	+.18	+.37	1	+.06	+.19	+.17	+.11	+.06	+.2	+.06	+.11	+.2	+.2	+.19	+.19	+.18	+.18	+.13	+.08	+.03	+.07	+.06	-.31	+.05	0	+.06	-.15	-.03	-.01	0	+.01	-.04	-.08	-.29	+.04	+.04	+.03	+.02
5132	-.14	+.12	+.1	+.23	+.21	+.13	+.09	+.28	+.06	1	+.13	+.11	+.08	+.06	+.13	+.11	-.03	+.13	+.14	+.13	+.13	+.12	+.12	+.09	+.05	-.01	+.05	+.04	-.19	+.06	0	+.07	-.1	-.03	-.01	0	+.01	-.04	-.07	-.26	+.03	+.04	+.01	+.01
5141	-.87	+.28	+.61	+.49	+.46	+.4	+.23	+.32	+.19	+.13	1	+.85	+.58	+.32	+.89	+.61	+.33	+.83	+.84	+.82	+.82	+.76	+.77	+.54	+.25	+.09	+.16	+.15	+.07	+.07	0	+.12	+.1	+.04	+.02	0	+.01	-.01	-.02	+.01	-.13	-.04	-.11	-.09
5142	-.77	+.25	+.53	+.43	+.41	+.35	+.2	+.28	+.17	+.11	+.85	1	+.33	+.35	+.79	+.49	+.33	+.72	+.74	+.74	+.72	+.68	+.67	+.47	+.21	+.08	+.15	+.13	+.06	+.06	+.01	+.11	+.1	-.02	-.09	-.01	+.01	-.01	-.01	+.01	-.14	+.01	-.06	-.05
5143	-.51	+.17	+.35	+.29	+.27	+.24	+.13	+.19	+.11	+.08	+.58	+.33	1	-.21	+.52	+.35	+.15	+.5	+.49	+.46	+.48	+.46	+.45	+.36	+.15	+.06	+.1	+.09	+.04	+.04	-.01	+.07	+.05	+.07	-.07	0	0	-.01	-.01	+.01	-.1	-.07	-.06	-.05
5144	-.28	+.09	+.2	+.16	+.15	+.13	+.08	+.1	+.06	+.06	+.32	+.35	-.21	1	+.29	+.26	-.04	+.28	+.27	+.28	+.26	+.21	+.26	+.09	+.08	+.03	+.05	+.05	+.02	+.02	0	+.03	+.01	0	-.07	0	0	-.01	-.01	+.01	-.05	-.01	-.03	-.02
5151	-.82	+.27	+.57	+.46	+.44	+.38	+.22	+.3	+.2	+.13	+.89	+.79	+.52	+.29	1	+.58	+.35	+.77	+.78	+.77	+.76	+.71	+.71	+.5	+.09	+.04	+.06	+.05	+.05	+.02	0	+.03	-.02	-.03	-.06	0	0	-.01	-.02	+.03	+.04	+.03	+.04	+.03
5152	-.55	+.18	+.38	+.32	+.3	+.26	+.15	+.22	+.06	+.11	+.61	+.49	+.35	+.26	+.58	1	-.09	+.52	+.53	+.52	+.52	+.49	+.48	+.35	+.1	+.03	+.08	+.07	+.03	+.02	0	+.04	-.03	-.01	-.1	0	+.01	-.01	-.02	+.02	0	+.01	-.02	-.01
5153	-.31	+.1	+.21	+.18	+.17	+.14	+.08	+.12	+.11	-.03	+.33	+.33	+.15	-.04	+.35	-.09	1	+.3	+.3	+.29	+.29	+.25	+.28	+.16	+.03	-.02	+.04	+.04	+.02	+.04	0	+.04	-.03	-.06	-.06	0	+.01	-.01	-.01	-.02	+.03	+.05	+.01	+.01
5161	-.95	+.3	+.66	+.5	+.5	+.43	+.24	+.34	+.2	+.13	+.83	+.72	+.5	+.28	+.77	+.52	+.3	1	+.91	+.92	+.89	+.85	+.83	+.6	+.51	+.16	+.43	+.35	+.09	+.1	-.07	+.23	-.16	-.23	-.16	+.02	0	-.01	-.03	+.01	+.21	+.18	+.12	+.1
5162	-.96	+.31	+.66	+.53	+.51	+.44	+.25	+.34	+.2	+.14	+.84	+.74	+.49	+.27	+.78	+.53	+.3	+.91	1	+.91	+.91	+.84	+.85	+.59	+.52	+.16	+.44	+.36	+.09	+.1	+.03	+.23	-.07	-.17	-.08	-.06	+.04	-.01	-.02	+.02	+.21	+.2	+.12	+.11
5164	-.94	+.31	+.66	+.53	+.48	+.42	+.25	+.34	+.19	+.13	+.82	+.74	+.46	+.28	+.77	+.52	+.29	+.92	+.91	1	+.87	+.84	+.83	+.6	+.51	+.16	+.43	+.35	+.08	+.1	-.05	+.23	-.13	-.24	-.13	+.01	+.01	-.02	-.03	+.01	+.21	+.2	+.12	+.11
5165	-.94	+.3	+.65	+.52	+.5	+.42	+.24	+.33	+.19	+.13	+.82	+.72	+.48	+.26	+.76	+.52	+.29	+.89	+.91	+.87	1	+.82	+.83	+.57	+.51	+.16	+.43	+.35	+.08	+.1	+.04	+.23	-.07	-.16	-.07	-.08	+.04	-.01	-.02	+.02	+.2	+.19	+.12	+.1
5167	-.88	+.28	+.61	+.49	+.47	+.35	+.21	+.31	+.18	+.12	+.76	+.68	+.46	+.21	+.71	+.49	+.25	+.85	+.84	+.84	+.82	1	+.73	+.55	+.47	+.15	+.4	+.33	+.08	+.09	-.04	+.21	-.1	-.21	-.1	+.01	+.02	-.01	-.03	+.02	+.19	+.18	+.11	+.1
5168	-.88	+.28	+.61	+.49	+.46	+.4	+.22	+.31	+.18	+.12	+.77	+.67	+.45	+.26	+.71	+.48	+.28	+.83	+.85	+.83	+.83	+.73	1	+.53	+.48	+.15	+.4	+.33	+.08	+.09	+.01	+.21	-.06	-.15	-.07	-.04	+.03	-.01	-.02	+.02	+.19	+.18	+.11	+.1
5169	-.62	+.2	+.43	+.35	+.33	+.28	+.02	+.22	+.13	+.09	+.54	+.47	+.36	+.09	+.5	+.35	+.16	+.6	+.59	+.6	+.57	+.55	+.53	1	+.33	+.11	+.28	+.23	+.05	+.06	-.01	+.15	-.09	-.16	-.07	+.01	+.02	-.01	-.02	+.01	+.13	+.13	+.08	+.07
5211	-.54	+.18	+.38	+.3	+.29	+.25	+.14	+.18	+.08	+.05	+.25	+.21	+.15	+.08	+.09	+.1	+.03	+.51	+.52	+.51	+.51	+.47	+.48	+.33	1	+.23	+.6	+.49	+.05	+.04	-.01	+.25	-.03	-.23	-.05	+.01	+.04	-.01	-.02	+.09	+.12	+.28	+.19	+.17
5212	-.17	+.06	+.12	+.1	+.1	+.09	+.05	+.06	+.03	-.01	+.09	+.08	+.06	+.03	+.04	+.03	-.02	+.16	+.16	+.16	+.16	+.15	+.15	+.11	+.23	1	+.18	+.15	+.01	+.01	0	-.66	-.03	+.37	-.01	0	-.02	0	-.01	+.19	+.07	-.44	+.05	+.04
5213	-.46	+.15	+.32	+.25	+.24	+.2	+.12	+.16	+.07	+.05	+.16	+.15	+.1	+.05	+.06	+.08	+.04	+.43	+.44	+.43	+.43	+.4	+.4	+.28	+.6	+.18	1	+.29	+.05	+.1	0	+.27	-.15	-.25	0	0	+.05	-.01	-.01	0	+.35	+.3	-.33	+.33
5214	-.37	+.12	+.26	+.2	+.19	+.16	+.09	+.12	+.06	+.04	+.15	+.13	+.09	+.05	+.05	+.07	+.04	+.35	+.36	+.35	+.35	+.33	+.33	+.23	+.49	+.15	+.29	1	+.05	+.08	0	+.23	-.1	-.19	+.03	0	+.04	-.01	-.01	0	+.26	+.23	+.32	-.54
5216	-.09	-.31	+.06	-.46	-.49	-.45	-.29	-.61	-.31	-.19	+.07	+.06	+.04	+.02	+.05	+.03	+.02	+.09	+.09	+.08	+.08	+.08	+.08	+.05	+.05	+.01	+.05	+.05	1	+.06	0	+.03	+.31	-.02	0	+.01	+.01	+.01	+.01	+.21	+.03	+.03	+.01	+.01
5217	-.1	+.02	+.07	+.03	+.03	+.02	+.01	-.03	+.05	+.06	+.07	+.06	+.04	+.02	+.02	+.02	+.04	+.1	+.1	+.1	+.1	+.09	+.09	+.06	+.04	+.01	+.1	+.08	+.06	1	0	-.13	-.02	-.03	0	0	+.03	0	0	-.76	+.08	+.05	+.01	+.01
5219	0	0	-.01	0	-.02	-.01	-.02	0	0	0	0	+.01	-.01	0	0	0	0	-.07	+.03	-.05	+.04	-.04	+.01	-.01	-.01	0	0	0	0	0	1	0	+.07	+.04	+.07	-.83	+.03	+.01	+.03	+.01	-.01	0	-.01	-.01
5245	-.24	+.08	+.17	+.13	+.12	+.1	+.06	+.11	+.06	+.07	+.12	+.11	+.07	+.03	+.03	+.04	+.04	+.23	+.23	+.23	+.23	+.21	+.21	+.15	+.25	-.66	+.27	+.23	+.03	-.13	0	1	-.06	-.48	-.02	0	+.05	0	0	-.08	+.17	+.57	+.06	+.05
5256	+.08	-.14	-.05	-.44	-.43	-.36	-.23	-.29	-.15	-.1	+.1	+.1	+.05	+.01	-.02	-.03	-.03	-.16	-.07	-.13	-.07	-.1	-.06	-.09	-.03	-.03	-.15	-.1	+.31	-.02	+.07	-.06	1	+.23	+.17	-.02	-.01	+.2	+.39	+.14	-.55	-.18	-.21	-.18
5257	+.17	-.06	-.12	-.09	-.09	-.07	-.04	-.06	-.03	-.03	+.04	-.02	+.07	0	-.03	-.01	-.06	-.23	-.17	-.24	-.16	-.21	-.15	-.16	-.23	+.37	-.25	-.19	-.02	-.03	+.04	-.48	+.23	1	+.16	-.01	-.04	+.01	+.02	+.09	-.31	-.89	-.22	-.19
5261	+.08	-.03	-.06	-.03	-.04	-.04	-.02	-.03	-.01	-.01	+.02	-.09	-.07	-.07	-.06	-.1	-.06	-.16	-.08	-.13	-.07	-.1	-.07	-.07	-.05	-.01	0	+.03	0	0	+.07	-.02	+.17	+.16	1	-.02	+.02	+.01	+.01	0	-.12	-.1	-.26	-.23
5273	-.01	0	+.01	-.01	0	0	+.01	0	0	0	0	-.01	0	0	0	0	0	+.02	-.06	+.01	-.08	+.01	-.04	+.01	+.01	0	0	0	+.01	0	-.83	0	-.02	-.01	-.02	1	0	0	+.01	0	+.01	+.01	+.02	+.01
5285	-.04	+.01	+.03	+.02	+.02	+.01	+.01	+.01	+.01	+.01	+.01	+.01	0	0	0	+.01	+.01	0	+.04	+.01	+.04	+.02	+.03	+.02	+.04	-.02	+.05	+.04	+.01	+.03	+.03	+.05	-.01	-.04	+.02	0	1	+.01	+.01	-.03	+.06	+.07	+.03	+.02
5286	+.01	-.03	-.01	-.32	-.29	-.24	-.15	-.09	-.04	-.04	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.02	-.01	-.01	-.01	-.01	-.01	0	-.01	-.01	+.01	0	+.01	0	+.2	+.01	+.01	0	+.01	1	+.51	+.06	0	0	0	0
5292	+.02	-.07	-.01	-.62	-.57	-.46	-.3	-.17	-.08	-.07	-.02	-.01	-.01	-.01	-.02	-.02	-.01	-.03	-.02	-.03	-.02	-.03	-.02	-.02	-.02	-.01	-.01	-.01	+.01	0	+.03	0	+.39	+.02	+.01	+.01	+.01	+.51	1	+.12	0	-.01	0	0
5293	-.02	-.07	+.01	-.17	-.16	-.14	-.09	-.28	-.29	-.26	+.01	+.01	+.01	+.01	+.03	+.02	-.02	+.01	+.02	+.01	+.02	+.02	+.02	+.01	+.09	+.19	0	0	+.21	-.76	+.01	-.08	+.14	+.09	0	0	-.03	+.06	+.12	1	-.04	-.11	+.01	+.01
5401	-.22	+.07	+.15	+.11	+.11	+.09	+.05	+.07	+.04	+.03	-.13	-.14	-.1	-.05	+.04	0	+.03	+.21	+.21	+.21	+.2	+.19	+.19	+.13	+.12	+.07	+.35	+.26	+.03	+.08	-.01	+.17	-.55	-.31	-.12	+.01	+.06	0	0	-.04	1	+.37	+.39	+.33
5402	-.21	+.07	+.14	+.11	+.1	+.09	+.05	+.07	+.04	+.04	-.04	+.01	-.07	-.01	+.03	+.01	+.05	+.18	+.2	+.2	+.19	+.18	+.18	+.13	+.28	-.44	+.3	+.23	+.03	+.05	0	+.57	-.18	-.89	-.1	+.01	+.07	0	-.01	-.11	+.37	1	+.25	+.22
5403	-.13	+.04	+.09	+.07	+.07	+.06	+.03	+.04	+.03	+.01	-.11	-.06	-.06	-.03	+.04	-.02	+.01	+.12	+.12	+.12	+.12	+.11	+.11	+.08	+.19	+.05	-.33	+.32	+.01	+.01	-.01	+.06	-.21	-.22	-.26	+.02	+.03	0	0	+.01	+.39	+.25	1	+.07
5404	-.11	+.04	+.08	+.06	+.06	+.05	+.03	+.04	+.02	+.01	-.09	-.05	-.05	-.02	+.03	-.01	+.01	+.1	+.11	+.11	+.1	+.1	+.1	+.07	+.17	+.04	+.33	-.54	+.01	+.01	-.01	+.05	-.18	-.19	-.23	+.01	+.02	0	0	+.01	+.33	+.22	+.07	1

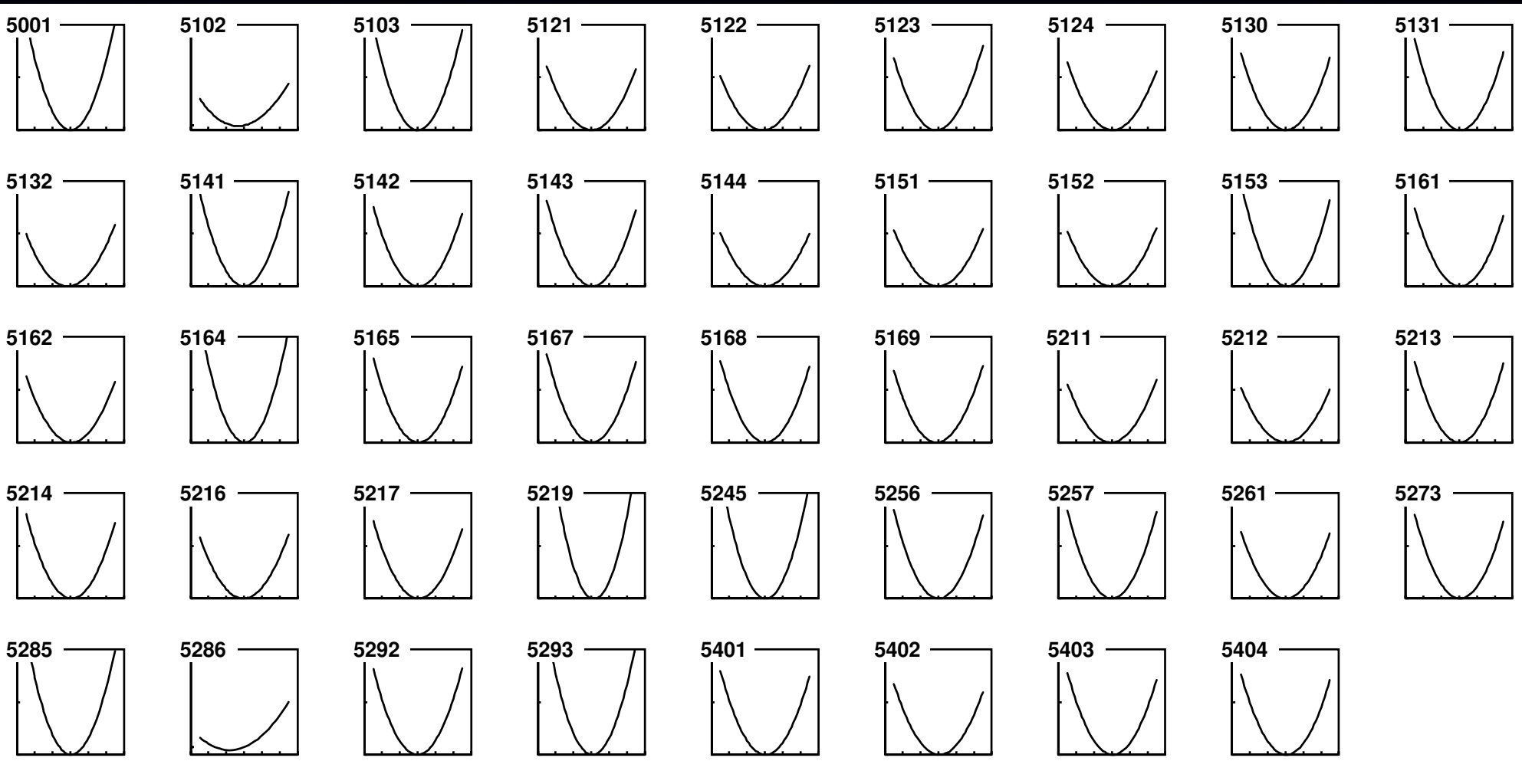
(no other procedure provides a complete correlation matrix)

$\chi^2(\vec{s})$

near minimum

$\Delta\chi^2$

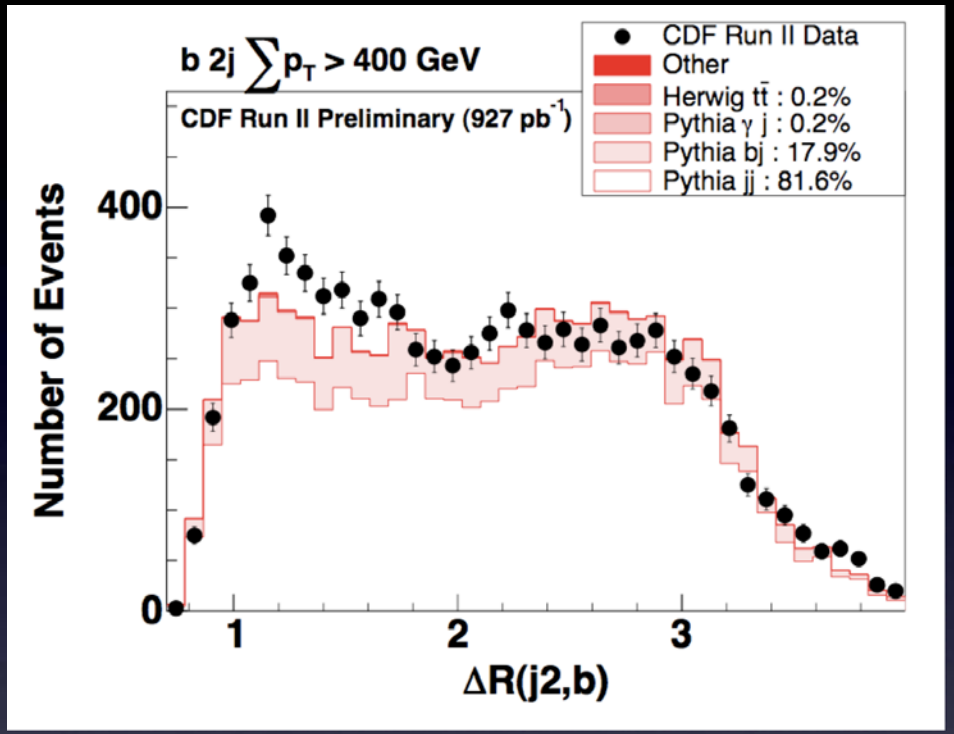
CDF Run II Preliminary (927 pb^{-1})



horizontal axes provided in previous table
(correction factor values and errors)

systematically improving understanding

continual iteration



- convincing new physics claim
- no discrepancy left that motivates a new physics claim

The Vista result

Vista output

Table of final states

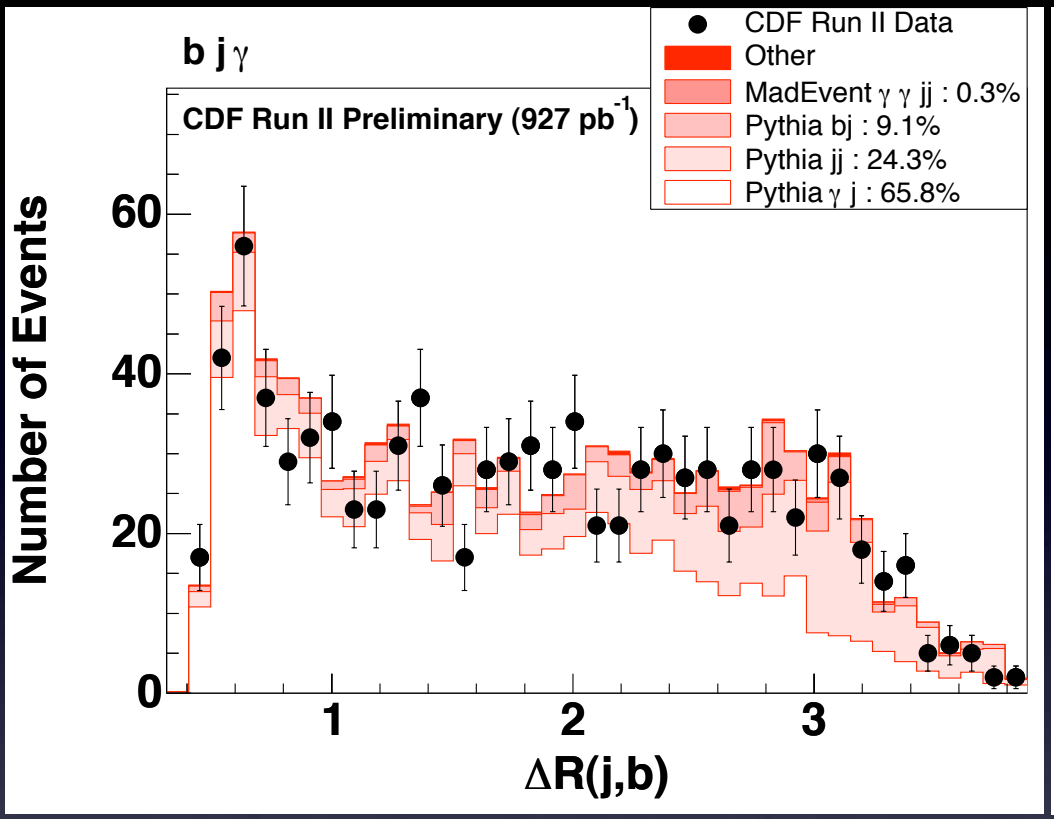
CDF Run II preliminary (927 pb^{-1})

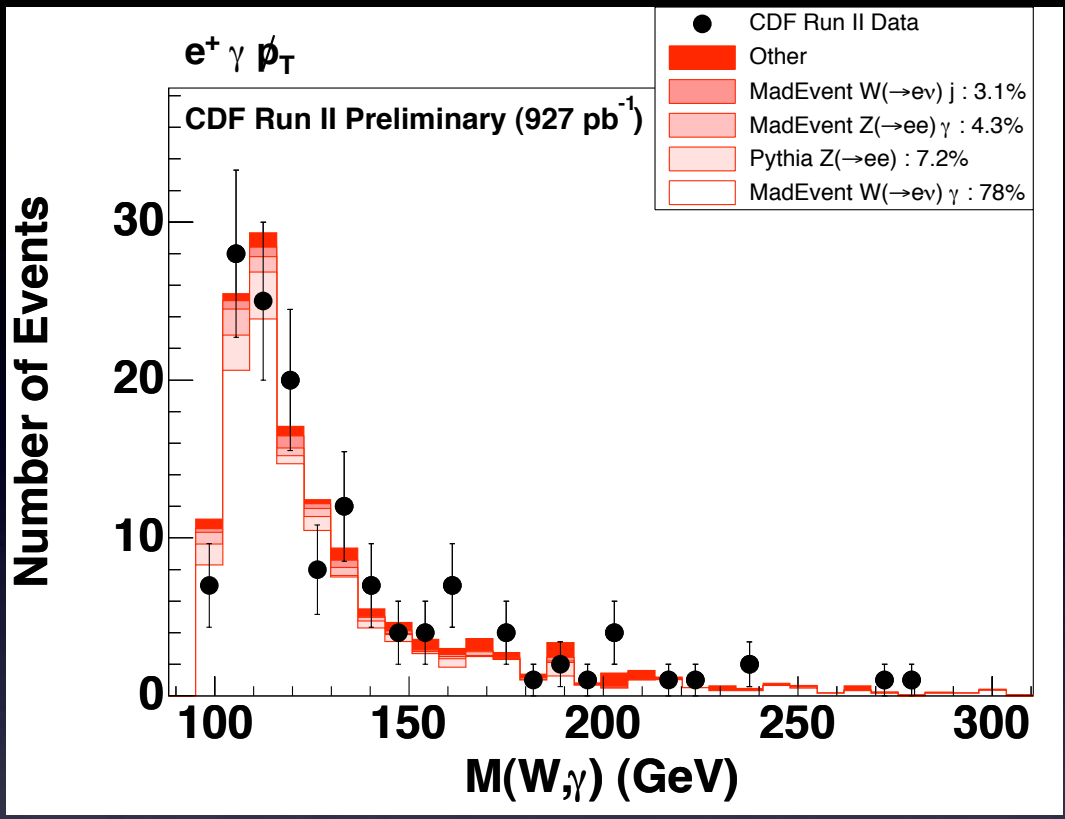
Final State	Plots	Observed	Expected (stat. uncertainty only)	Discrepancy (σ)	SM composition	Discrepant Distributions (σ)
3j1tau+	[plots]	71	113.7 +- 3.6	-2.3	Pythia jj 40 < pT < 60 = 27.5, Pythia jj 60 < pT < 90 = 18.2, Pythia jj 18 < pT < 40 = 17.8, Pythia jj 200 < pT < 300 = 17.7, Pythia jj 150 < pT < 200 = 15.7, Pythia jj 90 < pT < 120 = 6.8, Pythia jj 120 < pT < 150 = 3.8, Pythia bj 40 < pT < 60 = 1.4, Pythia jj 300 < pT < 400 = 1.3, Pythia bj 60 < pT < 90 = 1, Pythia bj 200 < pT < 300 = 0.7, Pythia bj 150 < pT < 200 = 0.4, Pythia bj 18 < pT < 40 = 0.3, Pythia gamma j 80 < pT = 0.2, Pythia bj 120 < pT < 150 = 0.2, Pythia bj 90 < pT < 120 = 0.1, Pythia gamma j 22 < pT < 45 = 0.1	
5j	[plots]	1661	1902.9 +- 50.8	-1.7	Pythia jj 40 < pT < 60 = 685.8, Pythia jj 18 < pT < 40 = 553.4, Pythia jj 60 < pT < 90 = 429.9, Pythia jj 90 < pT < 120 = 98.8, Pythia bj 40 < pT < 60 = 41.2, Pythia bj 60 < pT < 90 = 28.2, Pythia bj 18 < pT < 40 = 27, Pythia jj 120 < pT < 150 = 17.4, Pythia jj 150 < pT < 200 = 6.4, Pythia bj 90 < pT < 120 = 6.1, Overlaid events = 5.5, Pythia bj 120 < pT < 150 = 1.2, Pythia bj 150 < pT < 200 = 0.7, MadEvent W(→ev) jjjj = 0.5, Pythia jj 200 < pT < 300 = 0.5, Herwig ttbar = 0.2	mass(j2)/j2_pt 7.1 mass(j1) 6.7 mass(j3)/j3_pt 6.2 mass(j2,j3) 4.4 mass(j2,j3,j4) 4.2 mass(j1)/j1_pt 3.9 mass(j2,j3,j5) 3.5 deltaR(j2,j3) 3.4 mass(j2,j3,j4,j5) 3.3 mass(j2) 2.8 mass(j4)/j4_pt 2.5
2j1tau+	[plots]	233	296.5 +- 5.6	-1.6	Pythia jj 40 < pT < 60 = 95.9, Pythia jj 18 < pT < 40 = 67.3, Pythia jj 60 < pT < 90 = 54.3, Pythia jj 200 < pT < 300 = 30.9, Pythia jj 150 < pT < 200 = 19.6, Pythia jj 90 < pT < 120 = 10.8, Pythia jj 120 < pT < 150 = 5.4, Pythia bj 40 < pT < 60 = 4, Pythia jj 300 < pT < 400 = 2, Pythia bj 18 < pT < 40 = 1.6, Pythia bj 60 < pT < 90 = 1.5, Pythia bj 200 < pT < 300 = 0.8, Pythia bj 150 < pT < 200 = 0.5, Pythia bj 90 < pT < 120 = 0.4, Pythia Z(→τ τ) = 0.3, Pythia gamma j 80 < pT = 0.3, MadEvent Z(→ee) j = 0.1, Pythia gamma j 22 < pT < 45 = 0.1, Pythia bj 120 < pT < 150 = 0.1	mass(tau+,j1,j2) 3.7 sumPt 3.5 mass(tau+,j2) 3 mass(tau+,j1) 2.7 clusteredObjectsRecoil_pt 2.6 j1_pt 2.5
2j2tau+	[plots]	6	27 +- 4.6	-1.4	Pythia jj 18 < pT < 40 = 11.7, Pythia jj 40 < pT < 60 = 9.5, Pythia jj 60 < pT < 90 = 4.1, Pythia bj 40 < pT < 60 = 0.8, Pythia jj 90 < pT < 120 = 0.7, Pythia bj 18 < pT < 40 = 0.1	
1b1e+1j	[plots]	2207	2015.4 +- 28.7	+1.4	Pythia jj 40 < pT < 60 = 411.6, Pythia bj 40 < pT < 60 = 295.7, Pythia jj 60 < pT < 90 = 233.5, Pythia jj 18 < pT < 40 = 225.5, Pythia bj 18 < pT < 40 = 162.8, Pythia bj 60 < pT < 90 = 155.8, MadEvent W(→ev) jj = 91.4, Pythia gamma j 22 < pT < 45 = 79.7, MadEvent Z(→ee) j = 74.4, Pythia jj 90 < pT < 120 = 55.5, Pythia gamma j 45 < pT < 80 = 27.5, Pythia bj 90 < pT < 120 = 26.6, Pythia gamma j 12 < pT < 22 = 26.5, MadEvent Z(→ee) jj = 23.4, Alpgen W(→ev) bb = 13.3, MadEvent W(→ev) j = 12.4, Pythia jj 120 < pT < 150 = 11.6, Pythia gamma j 80 < pT = 10.4, MadEvent W(→ev) jjj = 10.4, MadEvent Z(→ee) = 9.6, Alpgen W(→ev) bb j = 8.8, Pythia W(→τ ν) = 8.8, Pythia jj 150 < pT < 200 = 7.5, Herwig ttbar = 5.1, MadEvent Z(→ee) gamma = 4.8, Pythia bj 120 < pT < 150 = 4.5, MadEvent Z(→ee) bb = 4.1, MadEvent Z(→ee) jjj = 2.9, Alpgen W(→ev) bb jj = 2.1, Pythia bj 150 < pT < 200 = 1.8, Pythia jj 200 < pT < 300 = 1.5, MadEvent W(→ev) jjjj = 1.1, MadEvent W(→ev) gamma = 0.8, Overlaid events = 0.8, MadEvent W(→ev) = 0.6, Pythia bj 10 < pT < 18 = 0.6, Pythia ZZ = 0.5, MadEvent gamma gamma jj = 0.3, Pythia bj 200 < pT < 300 = 0.3, Pythia Z(→τ τ) = 0.3, Pythia WZ = 0.2	mass(b)/b_pt 9.9 mass(b) 7.2 mass(j)/j_pt 4.3 deltaR(j,b) 4.1 minMass(j) 3.9 mass(j,b) 3.6 uncl_pt 3.5
3j_sumPt0-400	[plots]	35436	37294.6 +- 524.3	-1.1	Pythia jj 18 < pT < 40 = 18129.1, Pythia jj 40 < pT < 60 = 12273.7, Pythia jj 60 < pT < 90 = 3950.7, Pythia bj 18 < pT < 40 = 751.6, Pythia jj 10 < pT < 18 = 749, Pythia bj 40 < pT < 60 = 540.5, Pythia jj 90 < pT < 120 = 520.8, Pythia bj 60 < pT < 90 = 179.5, Pythia jj 120 < pT < 150 = 96.7, Pythia jj 150 < pT < 200 = 27.6, Pythia bj 90 < pT < 120 = 19.7, Pythia gamma j 22 < pT < 45 = 13.8, Pythia bj 10 < pT < 18 = 13.8, Overlaid events = 7.9, Pythia gamma j 12 < pT < 22 = 7.9, MadEvent Z(→ee) jj = 3.9, Pythia gamma j 8 < pT < 12 = 2, Pythia bj 120 < pT < 150 = 2, MadEvent W(→ev) jjj = 2, MadEvent W(→ev) jjjj = 2	minDeltaR(j,j) 9.9 mass(j2,j3) 9.9 deltaR(j2,j3) 9.9 deltaEta(j2,j3) 9.9 mass(j2)/j2_pt 9.9
1e+3j1pmiss	[plots]	1954	1751.6 +- 42	+1.1	MadEvent W(→ev) jj = 705.6, MadEvent W(→ev) jjj = 595.3, MadEvent W(→ev) j = 132.6, MadEvent W(→ev) jjjj = 85, Pythia W(→τ ν) = 56.4, MadEvent W(→ev) = 45.8, Herwig ttbar = 26.7, MadEvent Z(→ee) jj = 25.9, Alpgen W(→ev) bb j = 10.3, MadEvent Z(→ee) jjj = 9.2, MadEvent W(→ev) gamma = 8.1, MadEvent Z(→ee) j = 7.7, Alpgen W(→ev) bb = 6.8, Pythia jj 60 < pT < 90 = 5.8, Alpgen W(→ev) bb jj = 5.1, Pythia jj 90 < pT < 120 = 4.4, Overlaid events = 3.6, Pythia jj 40 < pT < 60 = 2.2, Pythia gamma j 80 < pT = 1.9, Pythia jj 150 < pT < 200 = 1.5, Pythia jj 120 < pT < 150 = 1.5, Pythia jj 200 < pT < 300 = 1.3, Pythia bj 60 < pT < 90 = 1.3, Pythia gamma j 45 < pT < 80 = 1.2, MadEvent Z(→ee) bb = 0.7, Pythia bj 40 < pT < 60 = 0.7, MadEvent Z(→ee) gamma = 0.6, Pythia WZ = 0.6, Pythia Z(→τ τ) = 0.5, MadEvent gamma gamma jj = 0.5, Pythia bj 90 < pT < 120 = 0.4, Pythia bj 150 < pT < 200 = 0.4, Cosmic (photon_25_iso) = 0.4, Pythia bj 18 < pT < 40 = 0.4, Pythia ZZ = 0.3, MadEvent W(→μν) gamma = 0.3, MadEvent Z(→νν) gamma = 0.2, MadEvent W(→μν) jjj = 0.2	mass(j2)/j2_pt 3.4

Vista output

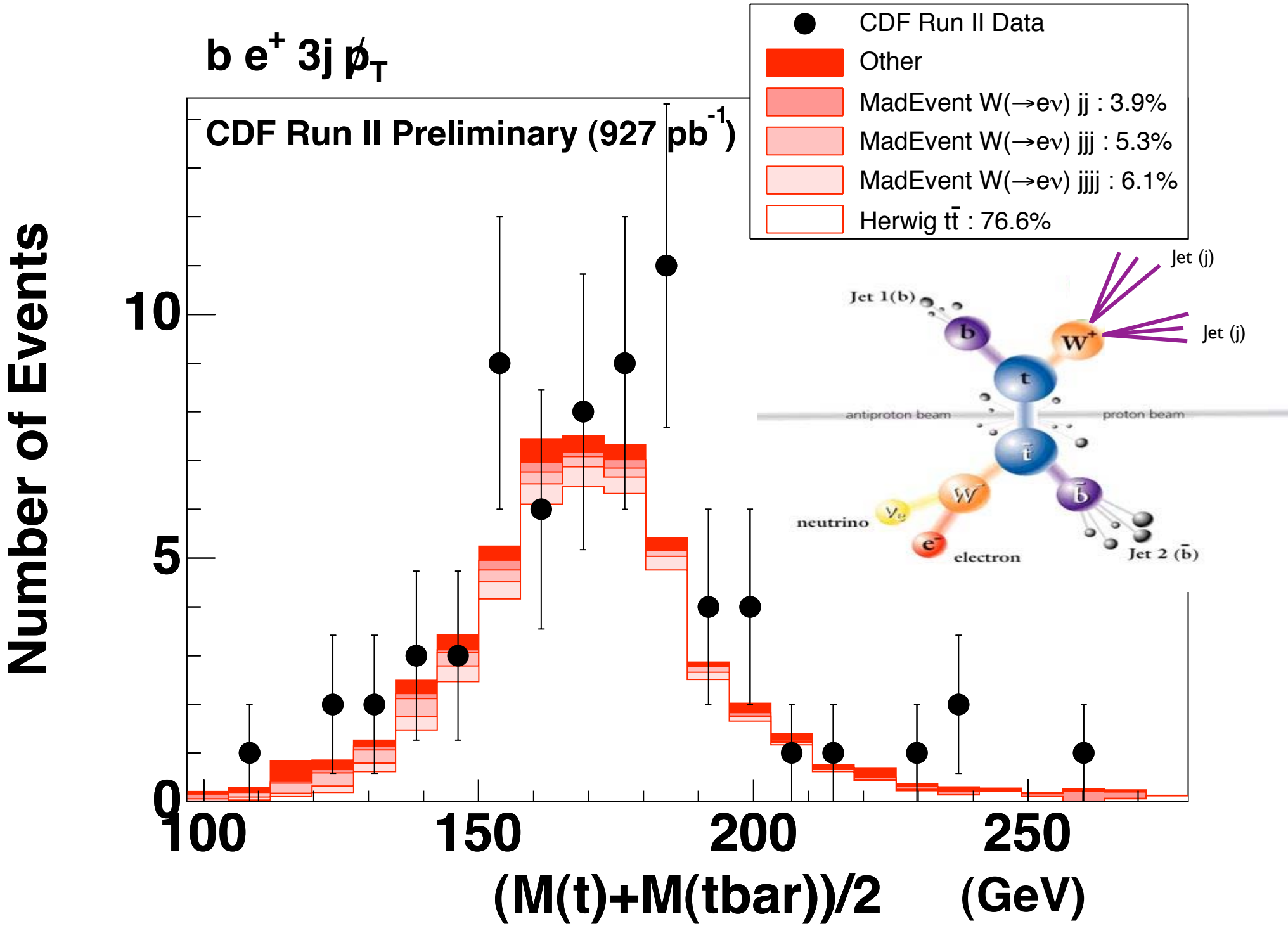
CDF Run II preliminary (927 pb^{-1})

Final State	Data	Background
3jτ+	71	113.7 ± 3.6
5j	1661	1902.9 ± 50.8
2jτ+	233	296.5 ± 5.6
be+j	2207	2015.4 ± 28.7
3j Σp_T < 400 GeV	35436	37294.6 ± 524.3
e+3jp	1954	1751.6 ± 42
be+2j	798	695.3 ± 13.3
3jp Σp_T > 400 GeV	811	967.5 ± 38.4
e+μ+	26	11.6 ± 1.5
e+γ	636	551.2 ± 11.2
e+3j	28656	27281.5 ± 405.2
b5j	131	95 ± 4.7
j2τ+	50	85.6 ± 8.2
jτ+τ-	74	125 ± 13.6
bp Σp_T > 400 GeV	10	29.5 ± 4.6
e+jγ	286	369.4 ± 21.1
e+jpτ-	29	14.2 ± 1.8
2j Σp_T < 400 GeV	96502	92437.3 ± 1354.5
be+3j	356	298.6 ± 7.7
8j	11	6.1 ± 2.5
7j	57	35.6 ± 4.9
6j	335	298.4 ± 14.7
4j Σp_T > 400 GeV	39665	40898.8 ± 649.2
4j Σp_T < 400 GeV	8241	8403.7 ± 144.7
4j2γ	38	57.5 ± 11
4jτ+	20	36.9 ± 2.4
4jp Σp_T > 400 GeV	516	525.2 ± 34.5
4jγp	28	53.8 ± 11
4jγ	3693	3827.2 ± 112.1
4jμ+	576	568.2 ± 26.1
4jμ+p	232	224.7 ± 8.5
4jμ+μ-	17	20.1 ± 2.5
3γ	13	24.2 ± 3
3j Σp_T > 400 GeV	75894	75939.2 ± 1043.9
3j2γ	145	178.1 ± 7.4
3jp Σp_T < 400 GeV	20	30.9 ± 14.4
3jγτ+	13	11 ± 2
3jγp	83	102.9 ± 11.1
3jγ	11424	11506.4 ± 190.6
3jμ+p	1114	1118.7 ± 27.1
3jμ+μ-	61	84.5 ± 9.2
3jμ+	2132	2168.7 ± 64.2
3bj Σp_T > 400 GeV	14	9.3 ± 1.9
2τ+	316	290.8 ± 24.2
2γp	161	176 ± 9.1
2γ	8482	8349.1 ± 84.1
2j Σp_T > 400 GeV	93408	92789.5 ± 1138.2
2j2γ	645	612.6 ± 18.8
2jτ+τ-	15	25 ± 3.5
2jp Σp_T > 400 GeV	74	106 ± 7.8
2jp Σp_T < 400 GeV	43	37.7 ± 100.2
2jγ	33684	33259.9 ± 397.6
2jγτ+	48	41.4 ± 3.4
2jγp	403	425.2 ± 29.7
2jμ+p	7287	7320.5 ± 118.9
2jμ+γp	13	12.6 ± 2.7
2jμ+γ	41	35.7 ± 6.1
[illegible]μ+μ-	374	394.2 ± 24.8
2jμ+	9513	9362.3 ± 166.8
2e+j	13	9.8 ± 2.2
2e+e-	12	4.8 ± 1.2
2e+	23	36.1 ± 3.8
2b Σp_T > 400 GeV	327	335.8 ± 7
2b Σp_T < 400 GeV	187	173.1 ± 7.1
2b3j Σp_T < 400 GeV	28	33.5 ± 5.5
2b2j Σp_T > 400 GeV	355	326.3 ± 8.4
2b2j Σp_T < 400 GeV	56	80.2 ± 5
2b2jγ	16	15.4 ± 3.6
2bγ	37	31.7 ± 4.8
2bj Σp_T > 400 GeV	415	393.8 ± 9.1
2bj Σp_T < 400 GeV	161	195.8 ± 8.3
2bjp Σp_T > 400 GeV	28	23.2 ± 2.6
2bjγ	25	24.7 ± 4.3
2be+2jp	15	12.3 ± 1.6
2be+2j	30	30.5 ± 2.5
2be+j	28	29.1 ± 2.8
2be+	48	45.2 ± 3.7
τ+τ-	498	428.5 ± 22.7
γτ+	177	204.4 ± 5.4
γp	1952	1945.8 ± 77.1
μ+τ+	18	19.8 ± 2.3
μ+τ-	151	179.1 ± 4.7
μ+p	321351	320500 ± 3475.5
μ+pτ-	22	25.8 ± 2.7
μ+γ	269	285.5 ± 5.9
μ+γp	269	282.2 ± 6.6
μ+μ-p	49	61.4 ± 3.5
μ+μ-γ	32	29.9 ± 2.6
μ+μ-	10648	10845.6 ± 96
j2γ	2196	2200.3 ± 35.2
j2γp	38	27.3 ± 3.2
jτ+	563	585.7 ± 10.2
jp Σp_T > 400 GeV	4183	4209.1 ± 56.1
jγ	49052	48743 ± 546.3
jγτ+	106	104 ± 4.1
jγp	913	965.2 ± 41.5
jμ+	33462	34026.7 ± 510.1
jμ+τ-	29	37.5 ± 4.5
jμ+pτ-	10	9.6 ± 2.1
jμ+p	45728	46316.4 ± 568.2
jμ+γp	78	69.8 ± 9.9
jμ+γ	70	98.4 ± 12.1
jμ+μ-	1977	2093.3 ± 74.7
e+4j	7144	6661.9 ± 147.2
e+4jp	403	363 ± 9.9
e+3jτ-	11	7.6 ± 1.6
e+3jγ	27	21.7 ± 3.4
e+2γ	47	74.5 ± 5
e+2j	126665	122457 ± 1672.6
e+2jτ-	53	37.3 ± 3.9
e+2jτ+	20	24.7 ± 2.3
e+2jp	12451	12130.1 ± 159.4
e+2jγ	101	88.9 ± 6.1
e+τ-	609	555.9 ± 10.2
e+τ+	225	211.2 ± 4.7
e+p	476424	479572 ± 5361.2
e+pτ-	48	35 ± 2.7
e+pτ+	20	18.7 ± 1.9
e+γp	141	144.2 ± 6
e+μ-p	54	42.6 ± 2.7
e+μ+p	13	10.9 ± 1.3
e+μ-	153	127.6 ± 4.2
e+j	386880	392614 ± 5031.8
e+j2γ	14	15.9 ± 2.9
e+jτ+	79	79.3 ± 2.9
e+jτ-	162	148.8 ± 7.6
e+jp	58648	57391.7 ± 661.6
e+jγp	52	76.2 ± 9
e+jμ-p	22	13.1 ± 1.7
e+jμ-	28	26.8 ± 2.3
e+e-4j	103	113.5 ± 5.9
e+e-3j	456	473 ± 14.6
e+e-2jp	30	39 ± 4.6
e+e-2j	2149	2152 ± 40.1
e+e-τ+	14	11.1 ± 2
e+e-p	491	487.9 ± 12
e+e-γ	127	132.3 ± 4.2
e+e-j	10726	10669.3 ± 123.5
e+e-jp	157	144 ± 11.2
e+e-jγ	26	45.6 ± 4.7
e+e-	58344	58575.6 ± 603.9
b6j	24	15.5 ± 2.3
b4j Σp_T > 400 GeV	13	9.2 ± 1.8
b4j Σp_T < 400 GeV	464	499.2 ± 12.4
b3j Σp_T > 400 GeV	5354	5285 ± 72.4
b3j Σp_T < 400 GeV	1639	1558.9 ± 24.1
b3jp Σp_T > 400 GeV	111	116.8 ± 11.2
b3jγ	182	194.1 ± 8.8
b3jμ+p	37	34.1 ± 2
b3jμ+	47	52.2 ± 3
b2γ	15	14.6 ± 2.1
b2j Σp_T > 400 GeV	8812	8576.2 ± 97.9
b2j Σp_T < 400 GeV	4691	4646.2 ± 57.7
b2jp Σp_T > 400 GeV	198	209.2 ± 8.3
b2jγ	429	425.1 ± 13.1
b2jμ+p	46	40.1 ± 2.7
b2jμ+	56	60.6 ± 3.4
bτ+	19	19.9 ± 2.2
bγ	976	1034.8 ± 15.6
bγp	18	16.7 ± 3.1
bμ+	303	263.5 ± 7.9
bμ+p	204	218.1 ± 6.4
bj Σp_T > 400 GeV	9060	9275.7 ± 87.8
bj Σp_T < 400 GeV	7236	7030.8 ± 74
bj2γ	13	17.6 ± 3.3
bjτ+	13	12.9 ± 1.8
bjp Σp_T > 400 GeV	53	60.4 ± 19.9
bjγ	937	989.4 ± 20.6
bjγp	34	30.5 ± 4
bjμ+p	104	112.6 ± 4.4
bjμ+	173	141.4 ± 4.8
be+3jp	68	52.2 ± 2.2
be+2jp	87	65 ± 3.3
be+p	330	347.2 ± 6.9
be+jp	211	176.6 ± 5
be+e-j	22	34.6 ± 2.6
be+e-	62	55 ± 3.1

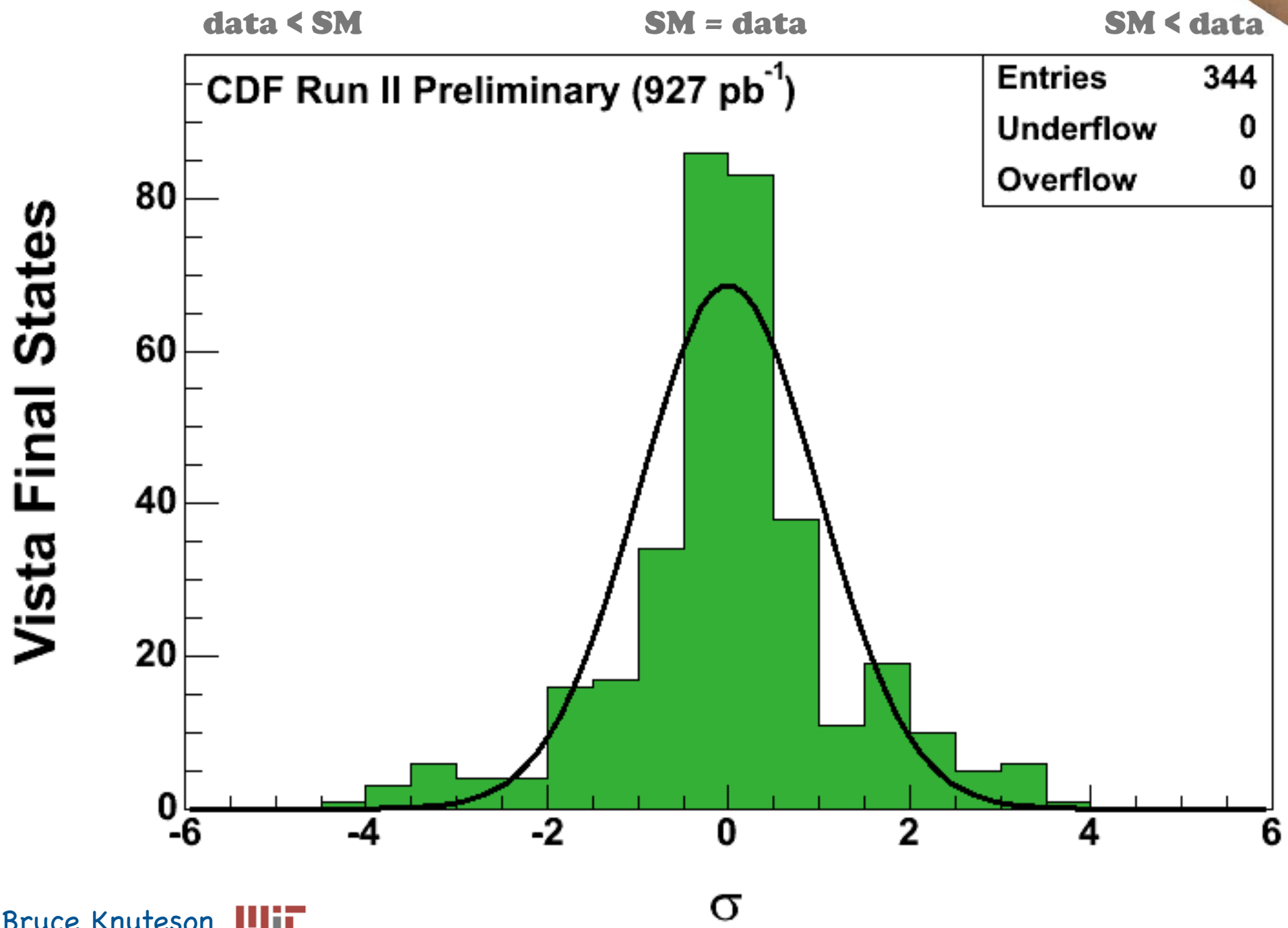




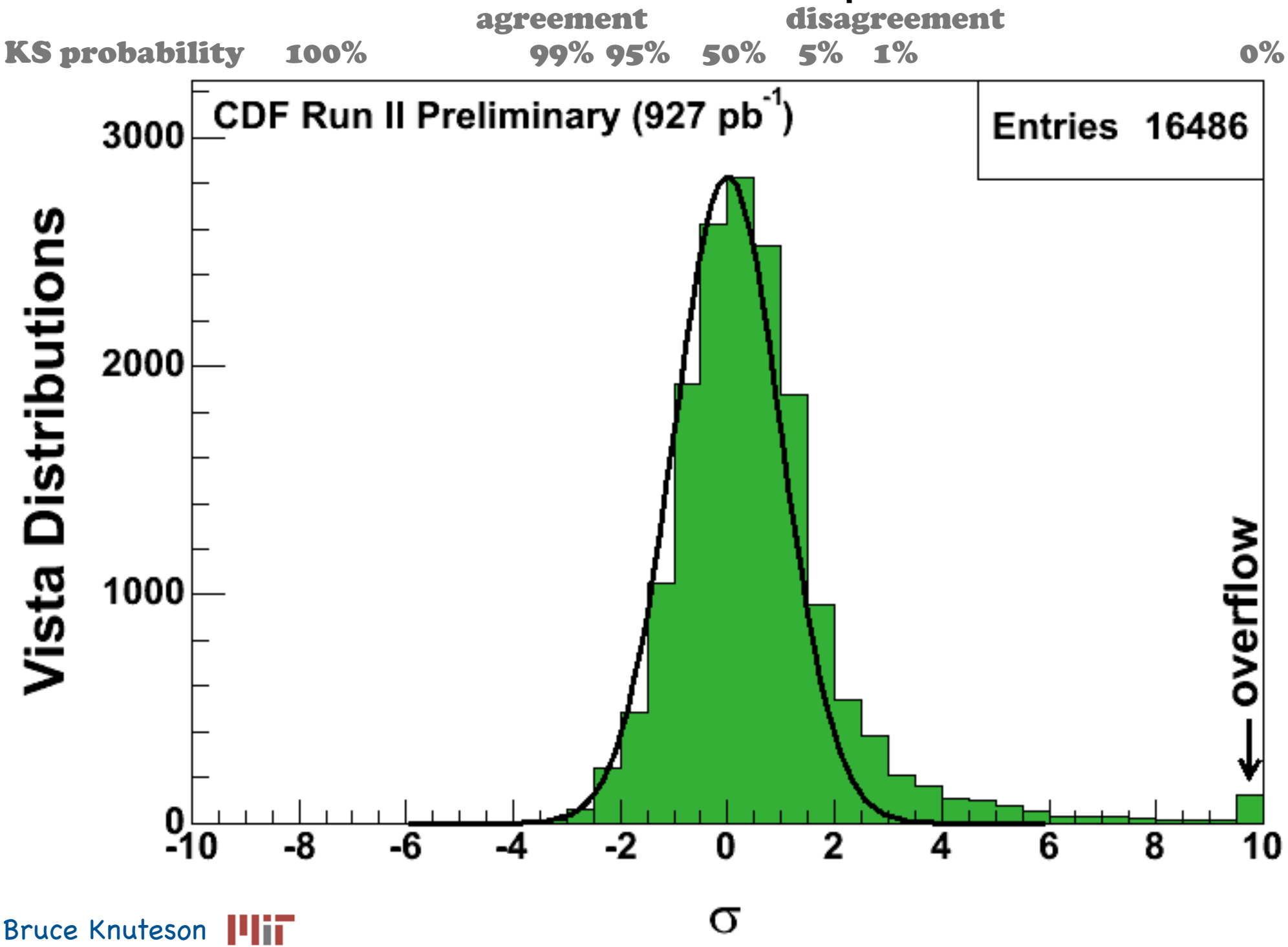
Many final state background estimates are dead reckoned, with no degrees of freedom


b e+ 3j ∅T
CDF Run II Preliminary (927 pb-1)
CDF Run II Data
Other
MadEvent W(→eν) jj : 3.9%
MadEvent W(→eν) jjj : 5.3%
MadEvent W(→eν) jjjj : 6.1%
Herwig tt̄ : 76.6%
Number of Events
0
5
10
100
150
200
250
(M(t)+M(tbar))/2 (GeV)
Jet 1(b)
Jet (j)
Jet (j)
antiproton beam
proton beam
neutrino
electron
Jet 2 (b̄)

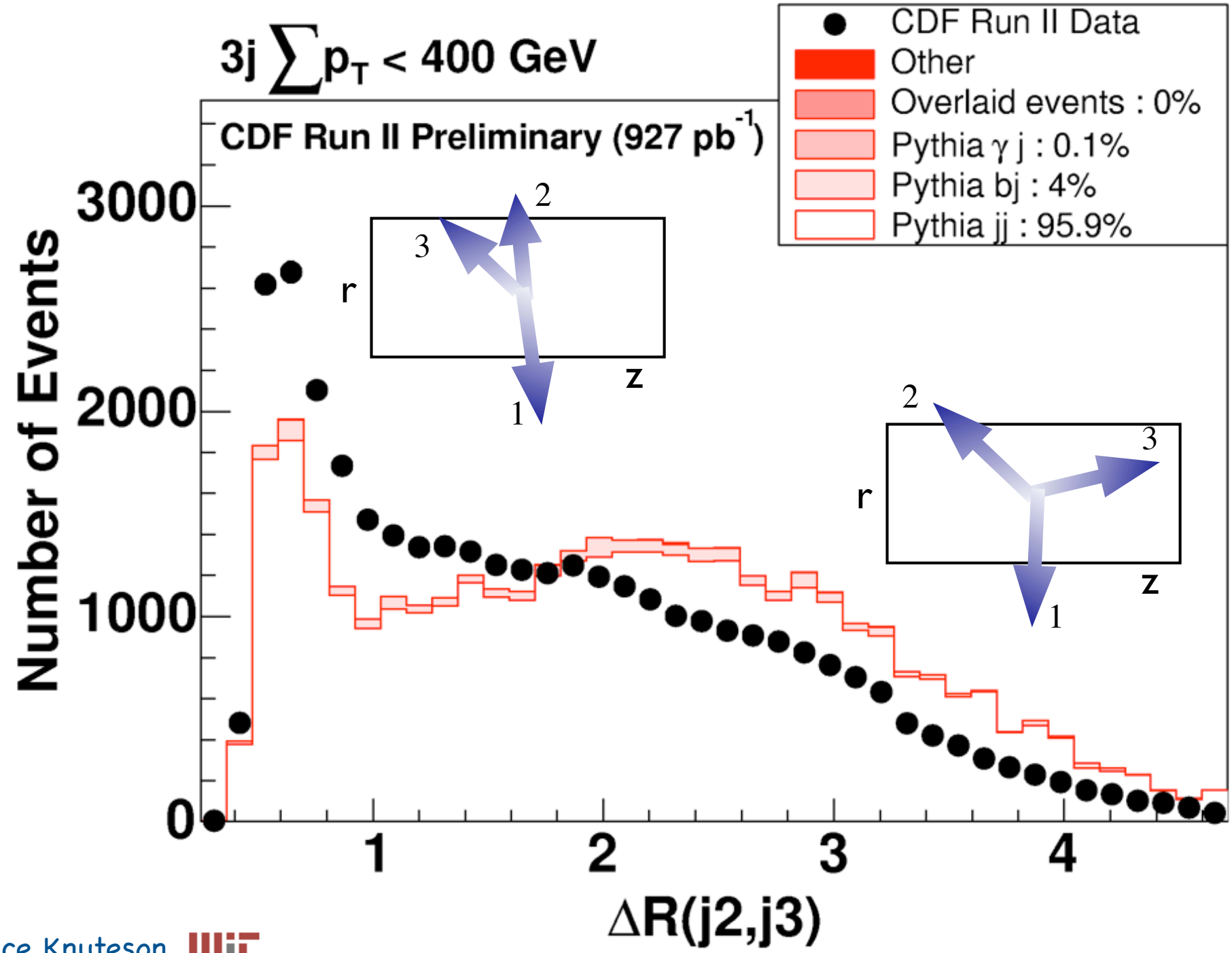
Vista final state normalizations



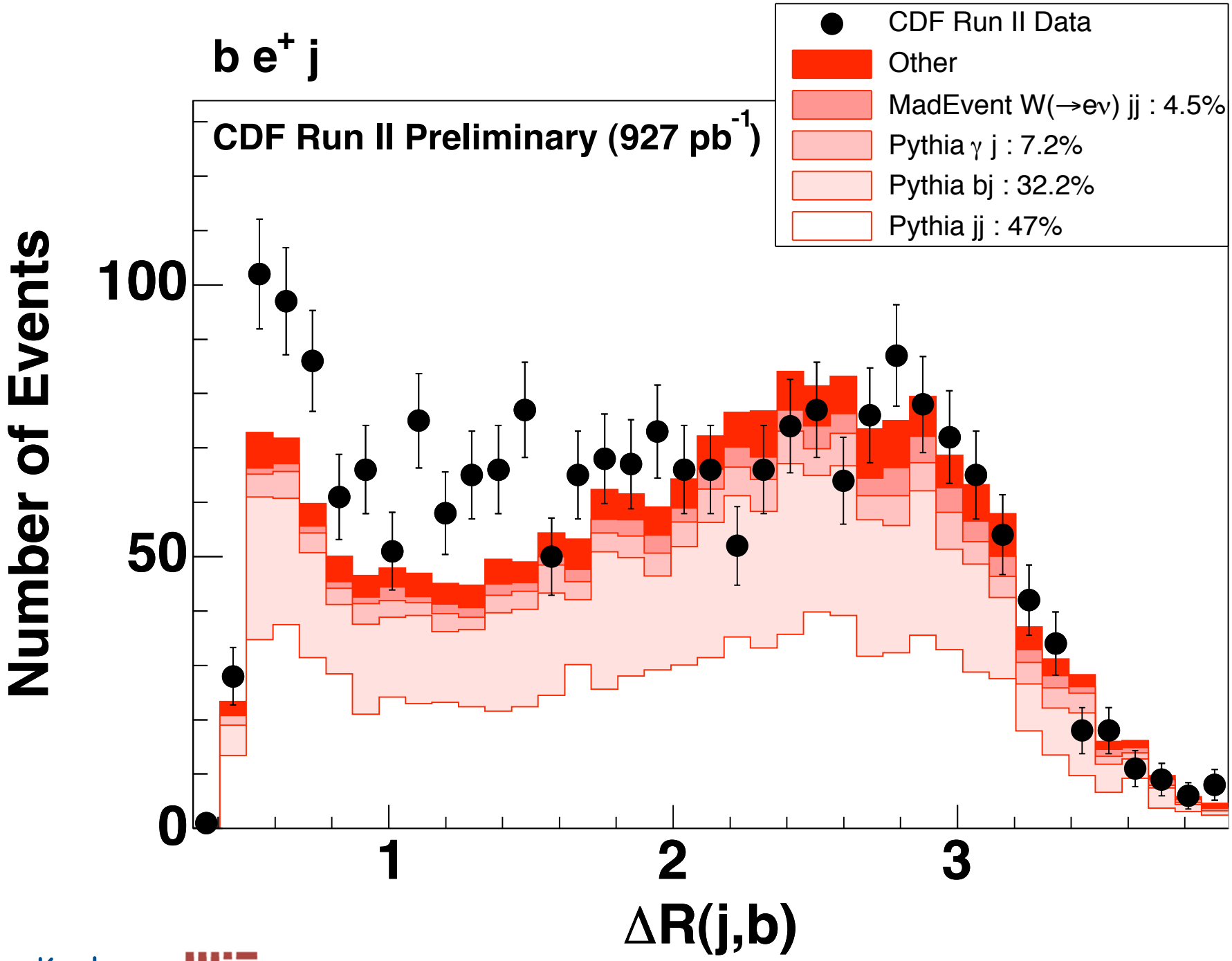
Vista kinematic shapes



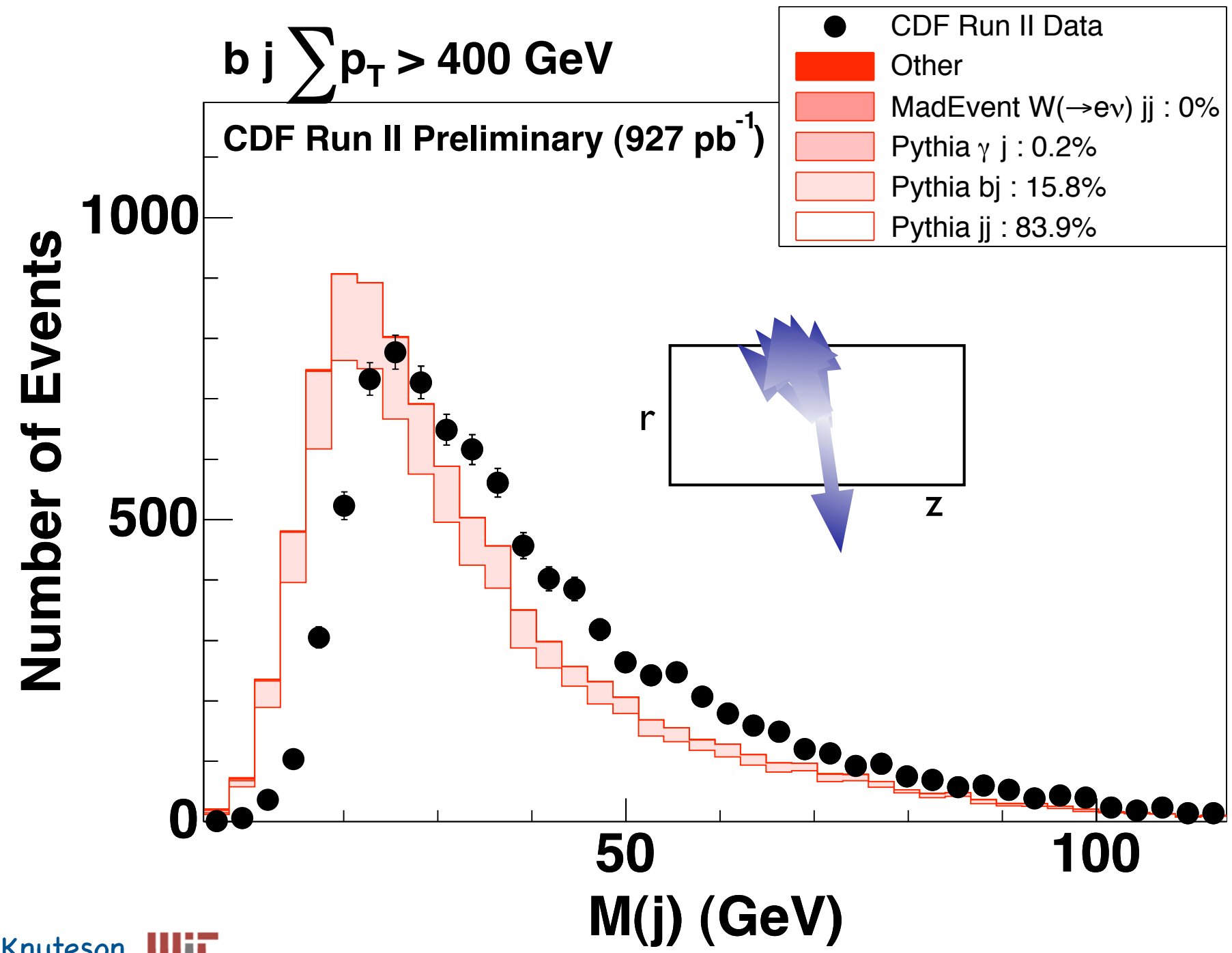
Sample discrepant distribution

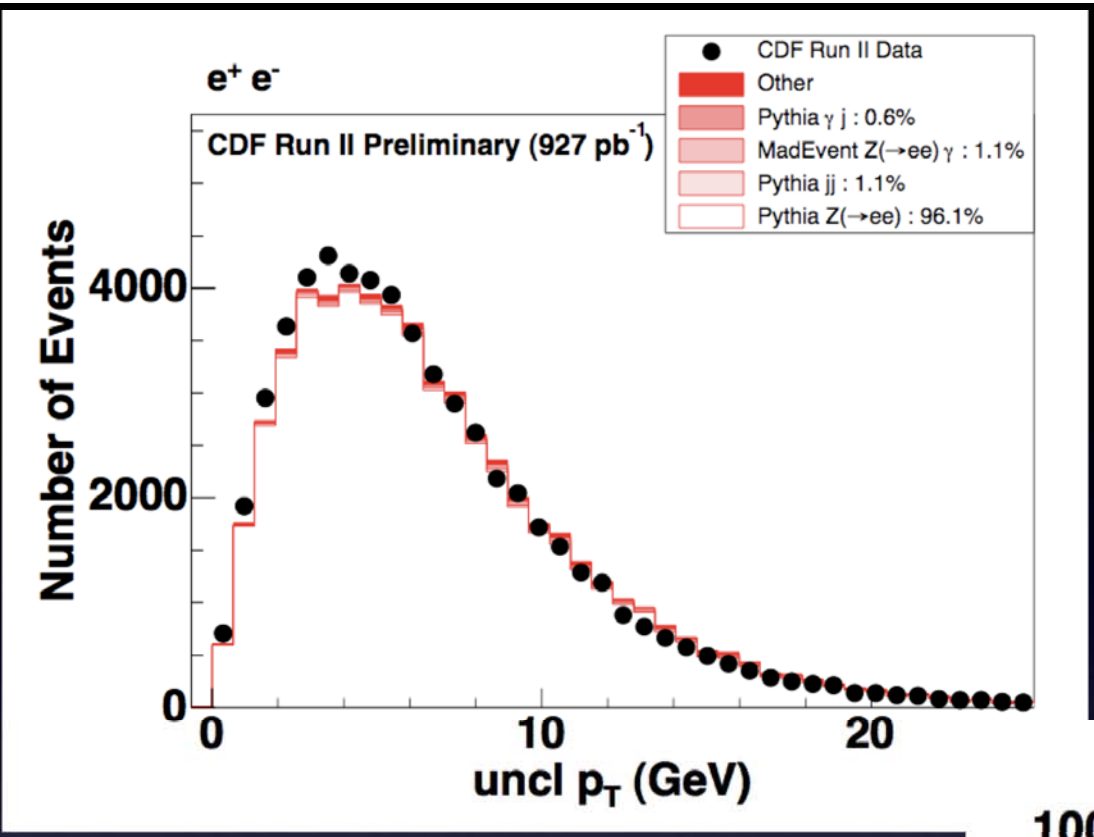


Related discrepant distribution



Related discrepant distribution



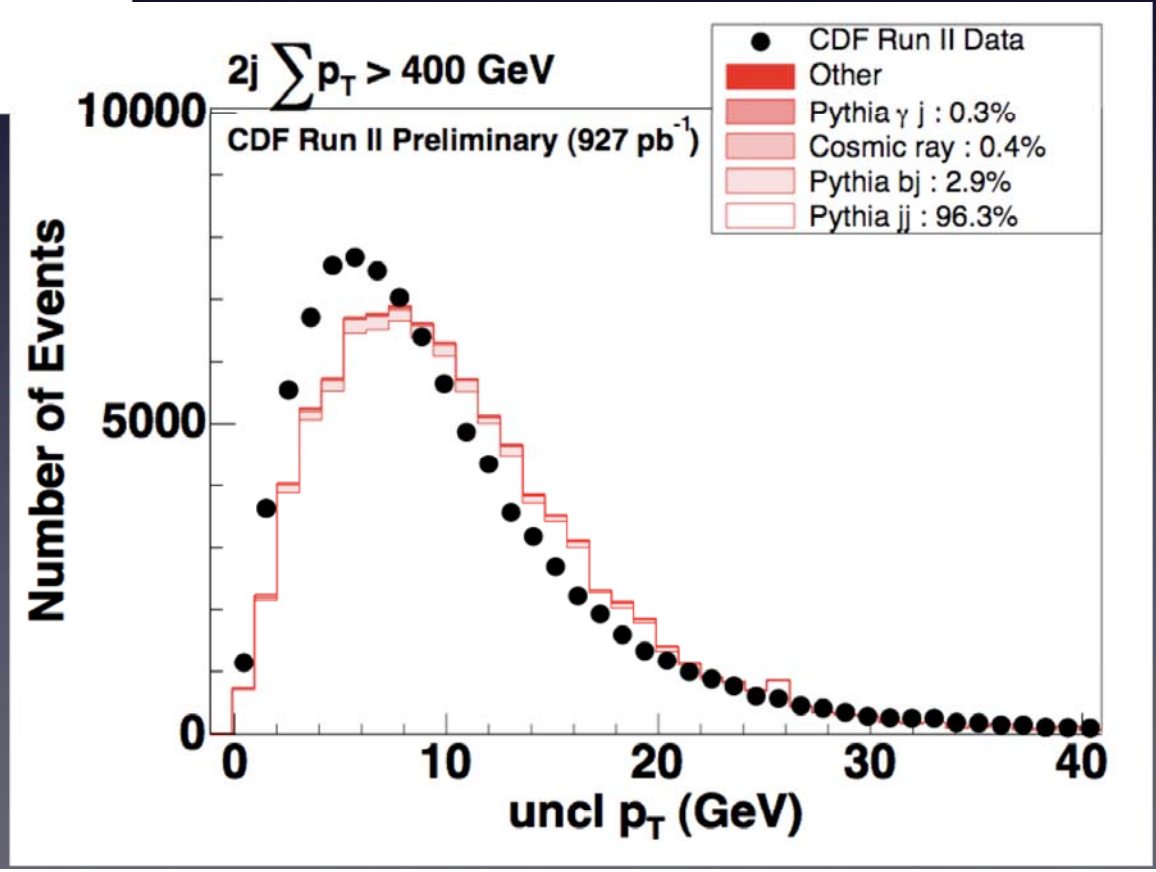


Overall boost
("intrinsic k_T")
not well described

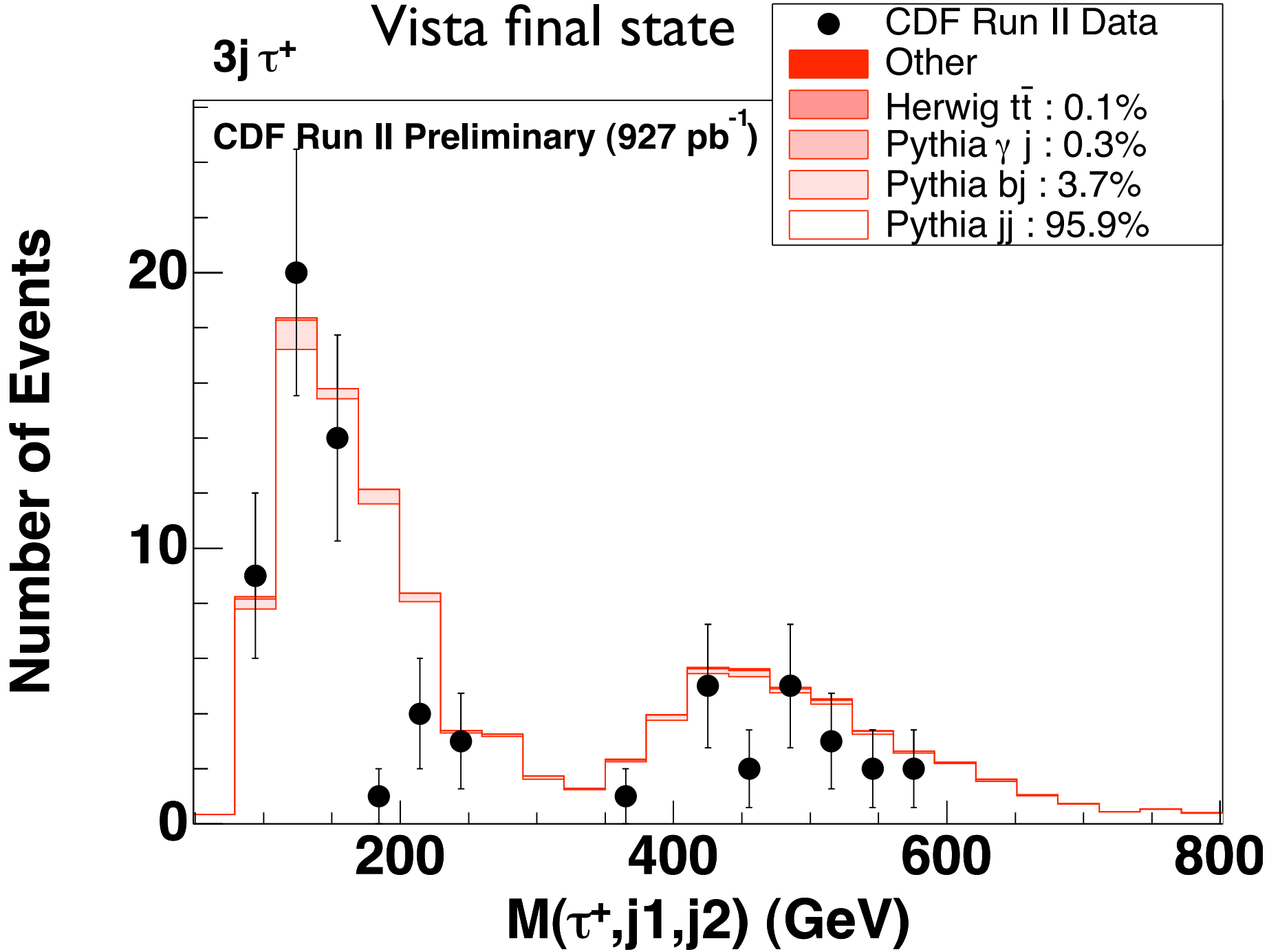
unclustered energy

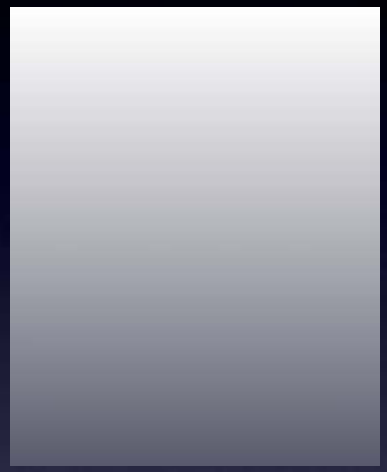
$$\sum_i \vec{p}_i + \overrightarrow{\text{uncl}} + \vec{\not{p}} = \vec{0}$$

(x,y)

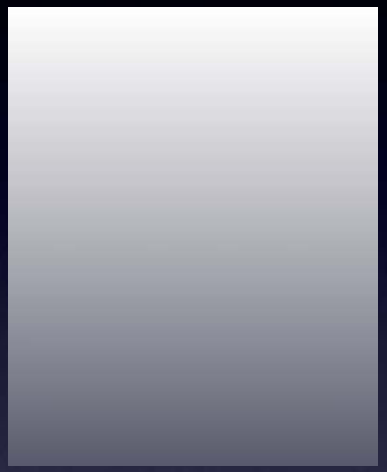


Most discrepant distribution in the most discrepant Vista final state

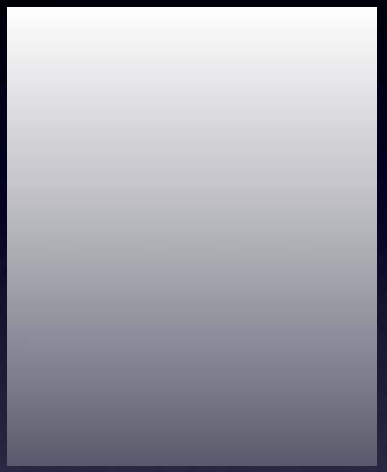




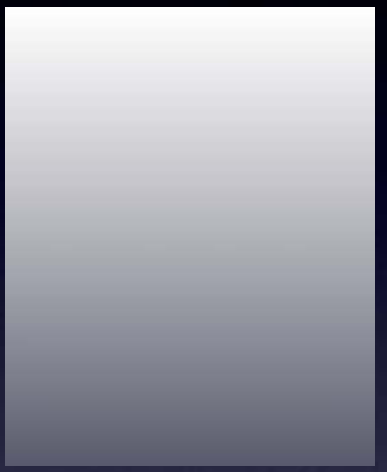
Statistical fluctuation



Detector effect



Poor prediction



Plausible interpretation

Statistics defined so far:

Normalization (final state populations)
Shape (quantified by a KS test)

Add one more:

$\sum p_T$ (for historical reasons called Sleuth)

$\sum p_T$ statistic

Sleuth

a quasi-model-independent search strategy for new physics

Assumptions:

1. Exclusive final state
2. Large $\sum p_T$
3. An excess

DØ Run I

Phys.Rev.D 62:092004,2000
Phys.Rev.D 64:012004,2001
Phys.Rev.Lett.86:3712,2001

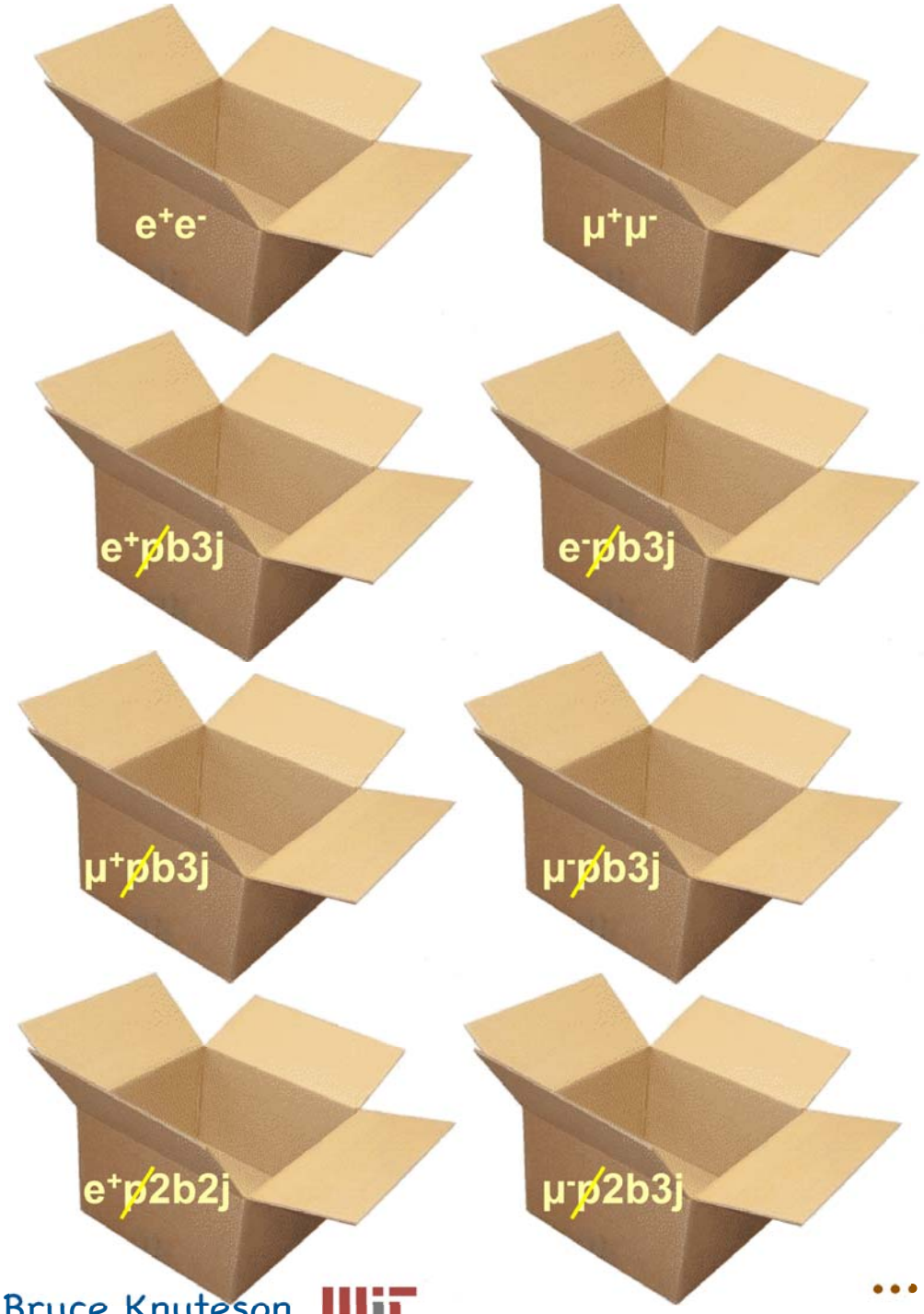
H1 General Search

Phys.Lett.B 602:14-30,2004
arXiv:0705.3721 (last month)

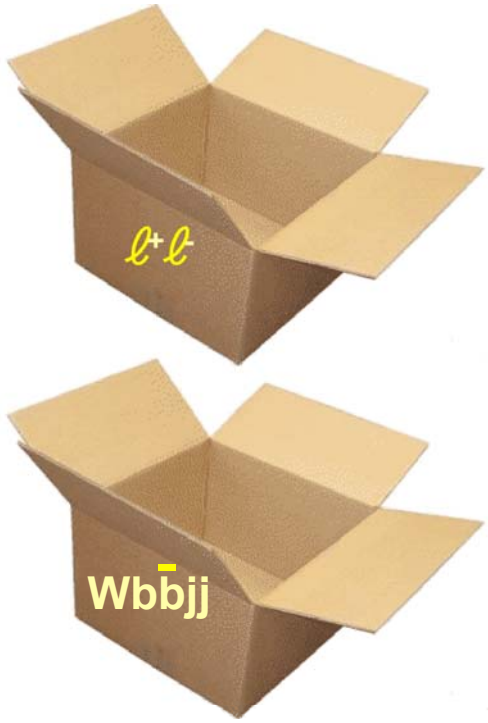
$$\int_{0001001}^{\text{present}} (\text{prediction})\, d(\text{hep-ph})$$

Rigorously compute the trials factor associated with looking everywhere

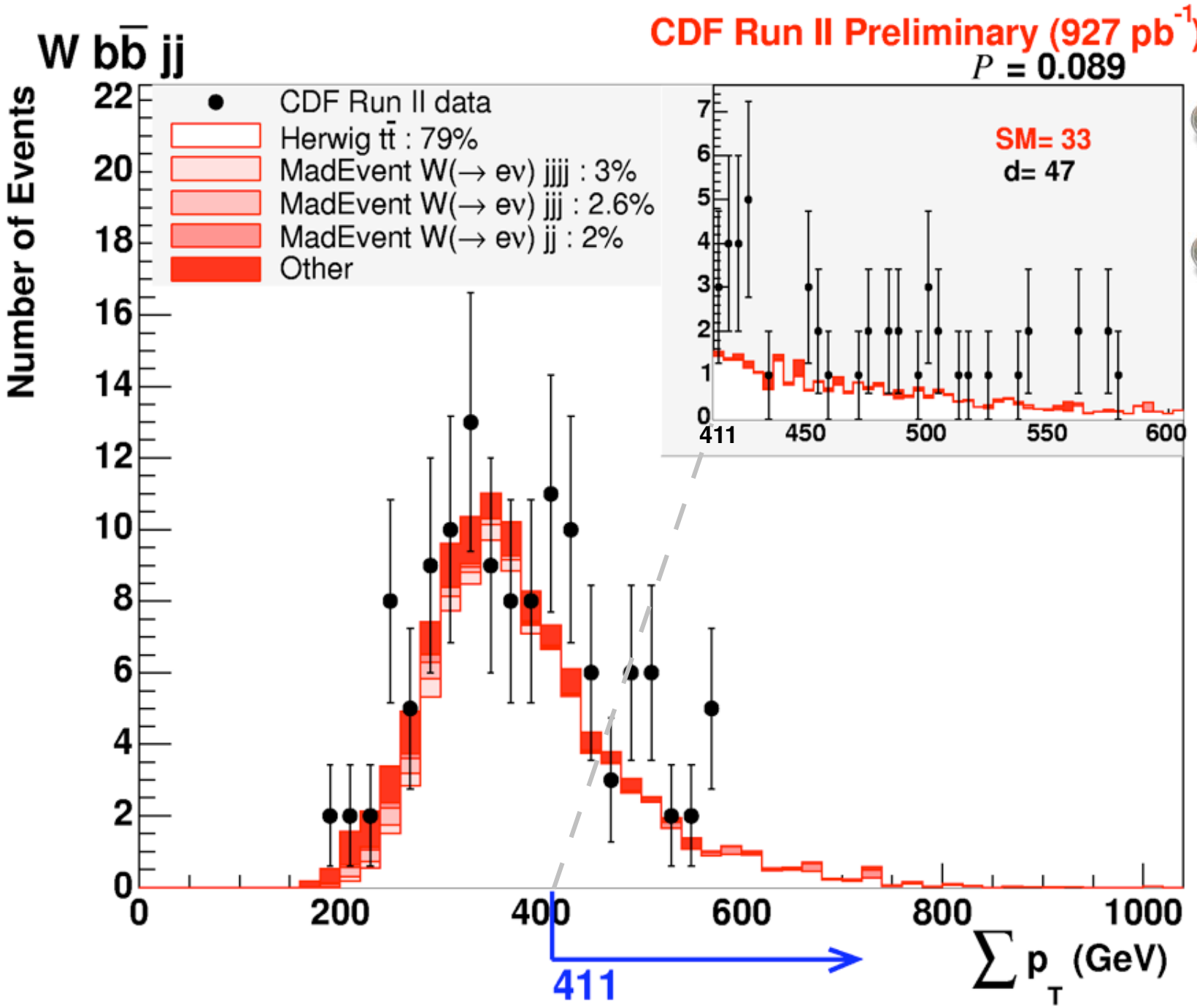
Vista partitioning of events



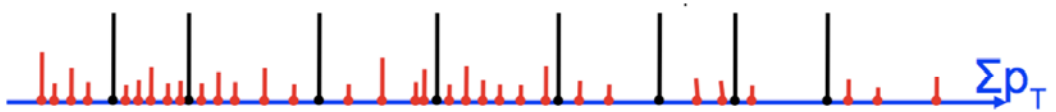
Sleuth partitioning of events



- Global charge conjugation equivalence
  $e^+e^+ \equiv e^-e^-$
- Lesser generation equivalence
  $e^+\not{p} \equiv \mu^+\not{p}$
- Quark jets come in pairs
  $2j \equiv 3j$
  $4j \equiv 5j$
  $bj \equiv bb \equiv bjj \equiv bbj$



- Find the most interesting tail
- Produce pseudo experiments to assess significance



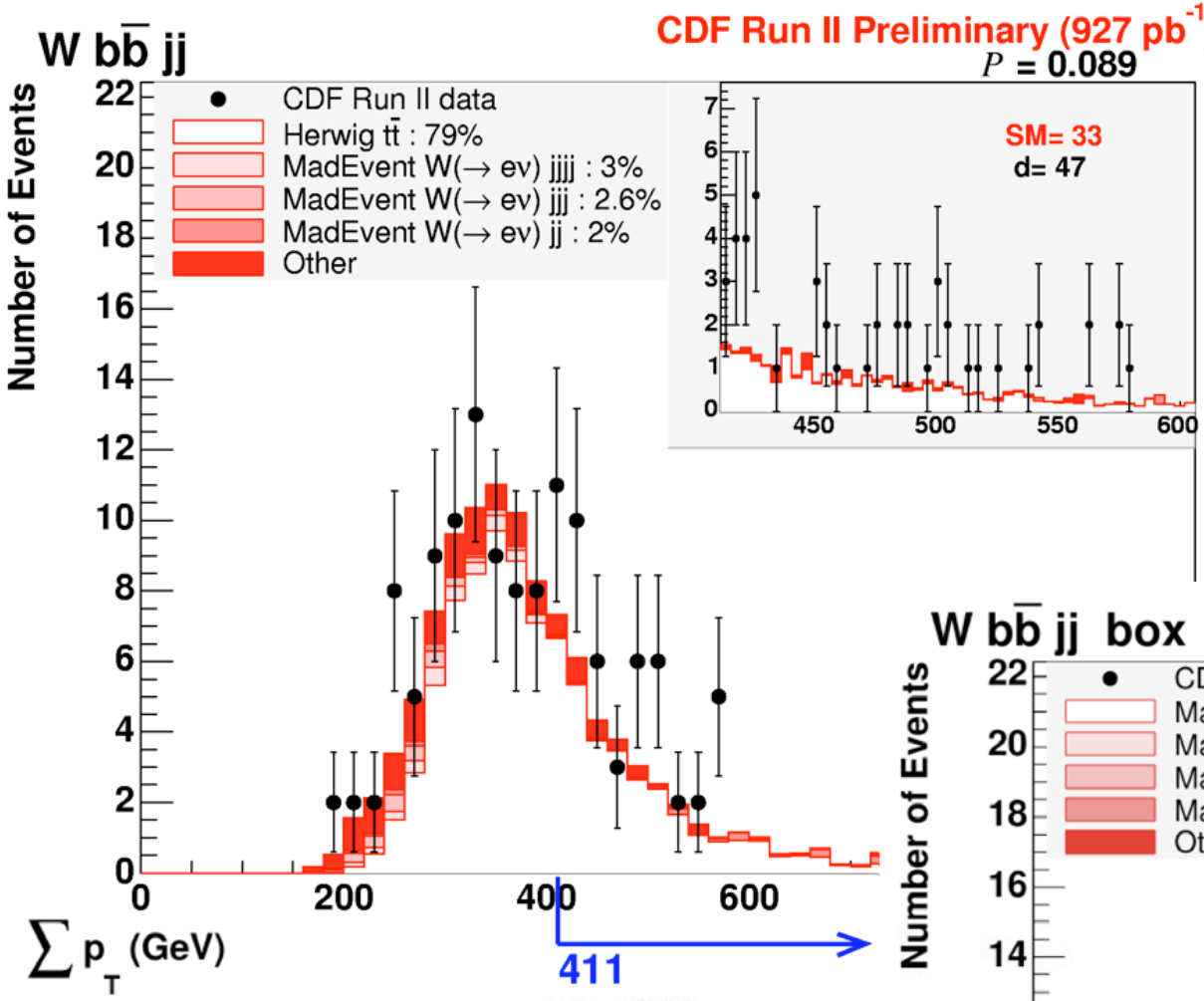
Sleuth Sensitivity

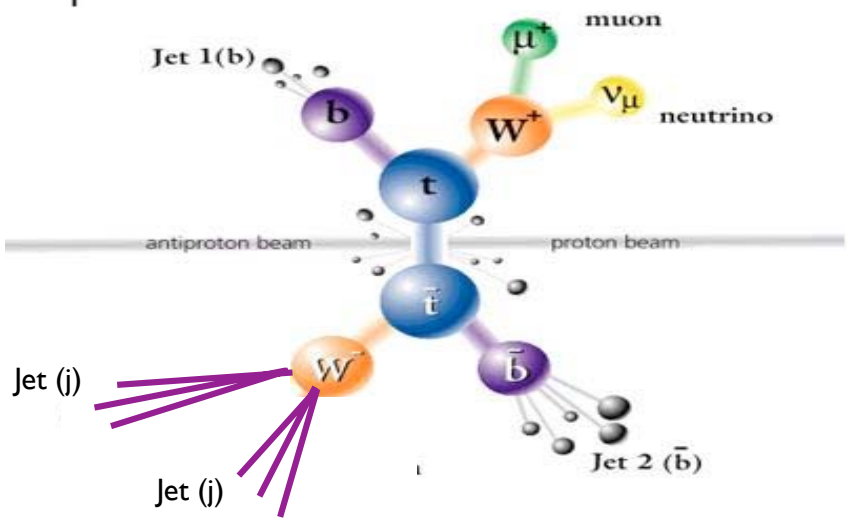
Q: Would Sleuth have found the top quark?

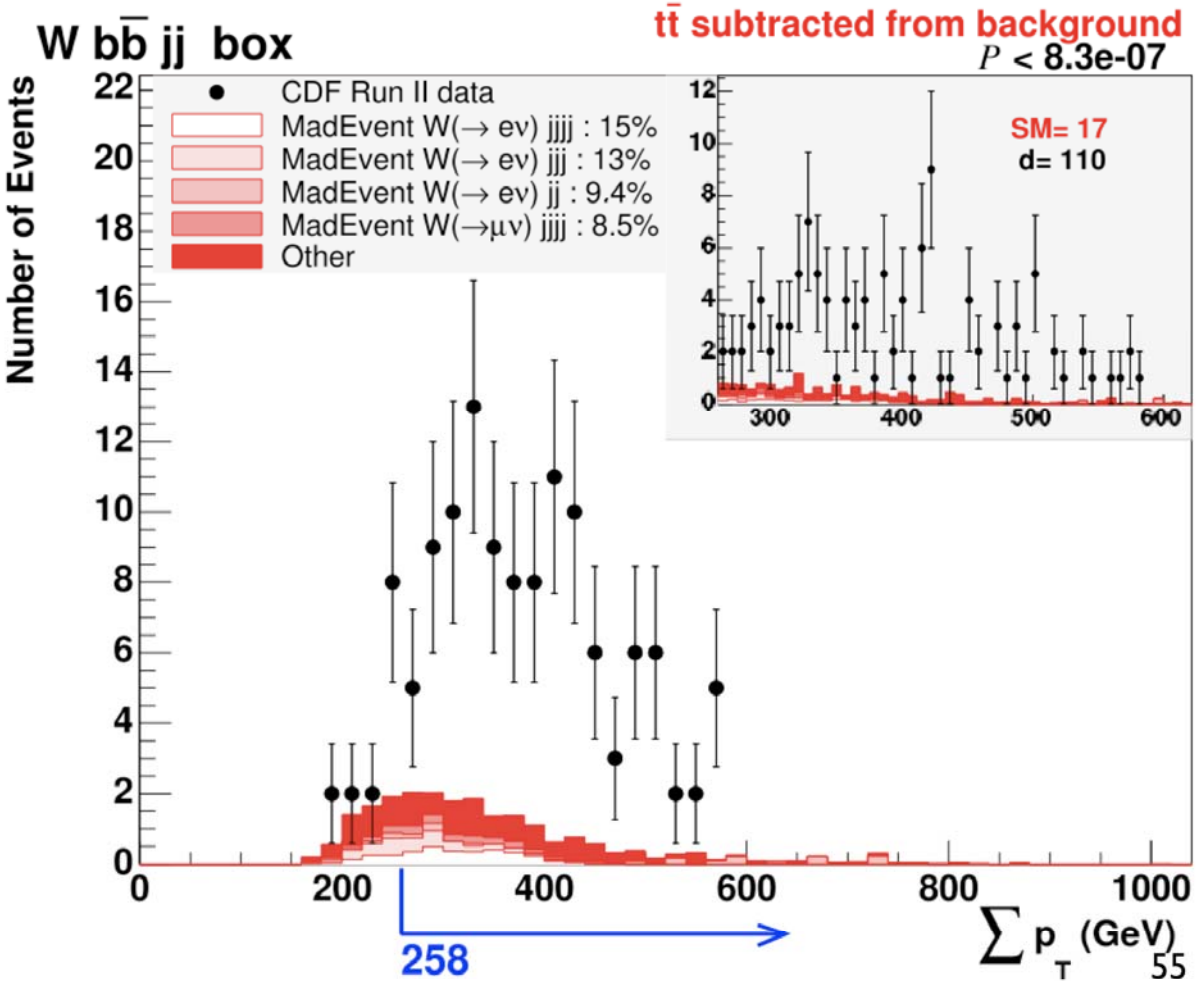
A: Yes.

Expected Run II discovery luminosity ~80 pb^{-1}

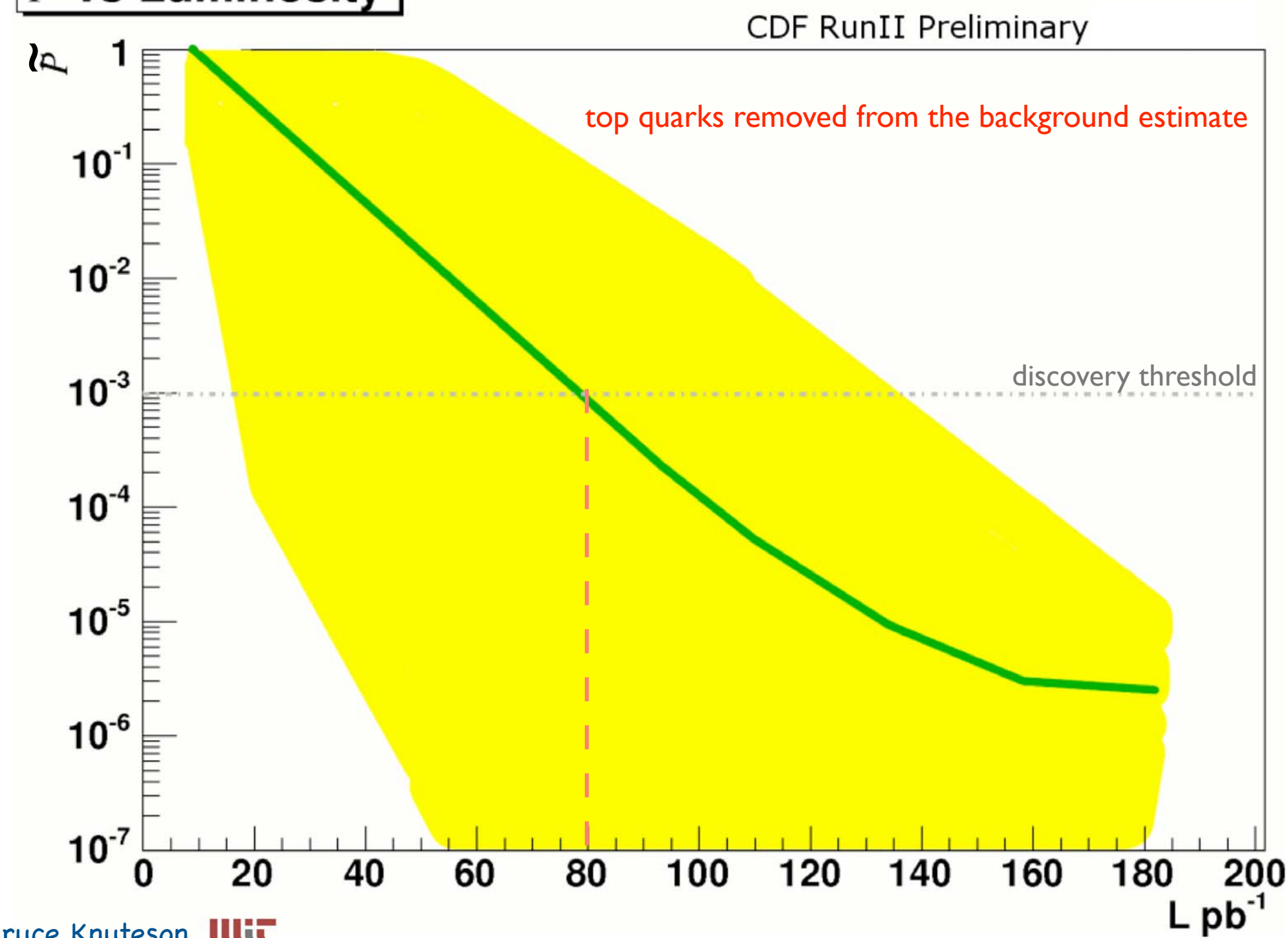
(Run I discovery 67 pb^{-1})







$\tilde{P}$ vs Luminosity



Sleuth systematics

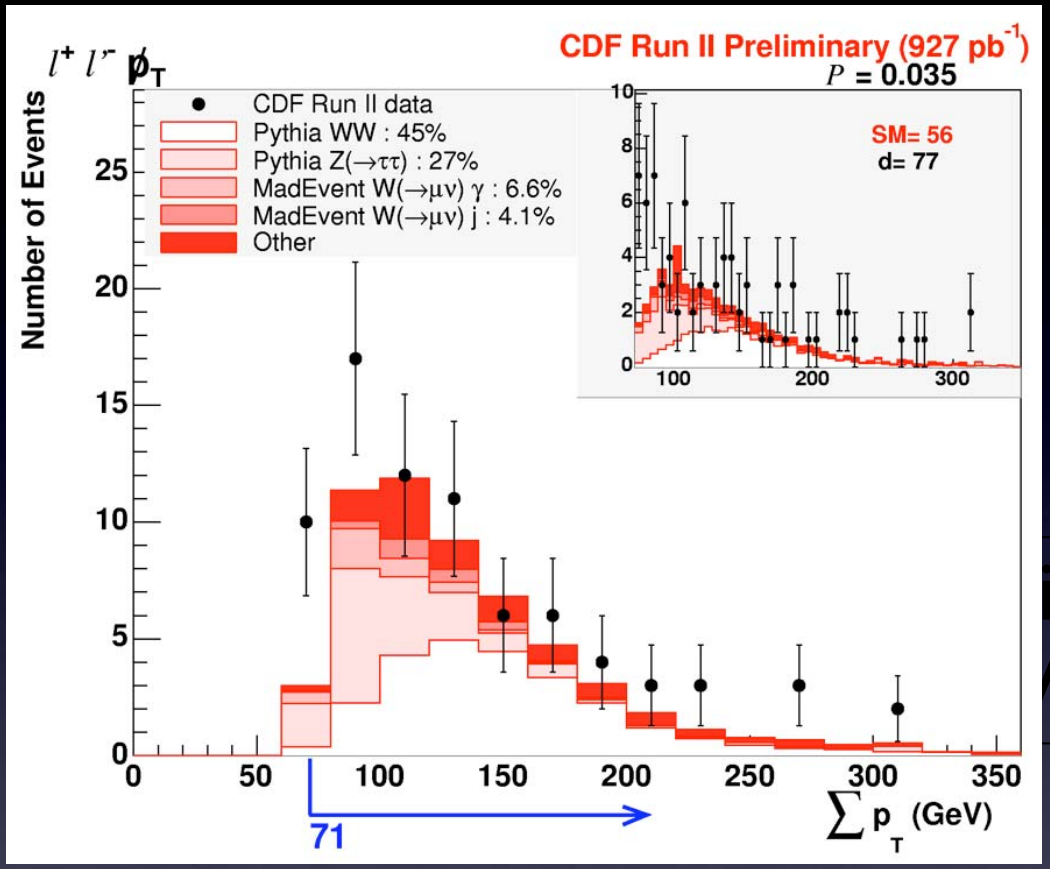
- There is no sense in which Sleuth comes *after* Vista (except pedagogically)
- A Sleuth discrepancy is pursued and debugged just like a Vista discrepancy
- A mundane, specific hypothesis to explain a Sleuth discrepancy feeds back into the Vista correction model, and is tested for consistency with the CDF data
- Systematic uncertainties are incorporated into Sleuth in the form of this correction flexibility
- Systematic errors are not integrated over as nuisance parameters

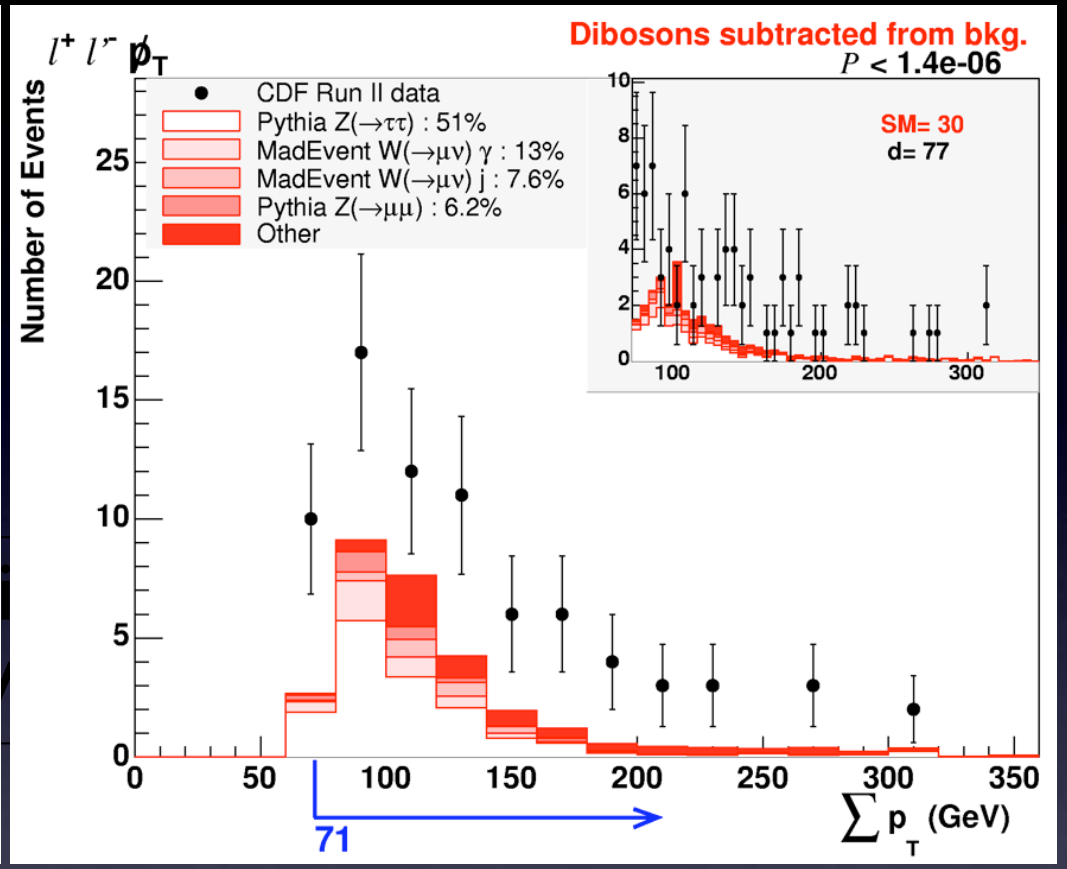
CDF Run II Preliminary (927 pb^{-1})

Code	Category	Explanation	Value	Error	Error(%)
5001	luminosity	CDF integrated luminosity	927.1	20	2.2
5102	k-factor	cosmic_ph	0.686	0.05	7.3
5103	k-factor	cosmic_j	0.4464	0.014	3.1
5121	k-factor	1γ1j photon+jet(s)	0.9492	0.04	4.2
5122	k-factor	1γ2j	1.205	0.05	4.1
5123	k-factor	1γ3j	1.483	0.07	4.7
5124	k-factor	1γ4j+	1.968	0.16	8.1
5130	k-factor	2γ0j diphoton(+jets)	1.809	0.08	4.4
5131	k-factor	2γ1j	3.417	0.24	7.0
5132	k-factor	2γ2j+	1.305	0.16	12.3
5141	k-factor	W0j W (+jets)	1.453	0.027	1.9
5142	k-factor	W1j	1.059	0.03	2.8
5143	k-factor	W2j	1.021	0.03	2.9
5144	k-factor	W3j+	0.7582	0.05	6.6
5151	k-factor	Z0j Z (+jets)	1.419	0.024	1.7
5152	k-factor	Z1j	1.177	0.04	3.4
5153	k-factor	Z2j+	1.035	0.05	4.8
5161	k-factor	2j $\hat{p}_T$<150 dijet	0.9599	0.022	2.3
5162	k-factor	2j 150<$\hat{p}_T$	1.256	0.028	2.2
5164	k-factor	3j $\hat{p}_T$<150 multijet	0.9206	0.021	2.3
5165	k-factor	3j 150<$\hat{p}_T$	1.36	0.032	2.4
5167	k-factor	4j $\hat{p}_T$<150	0.9893	0.025	2.5
5168	k-factor	4j 150<$\hat{p}_T$	1.705	0.04	2.3
5169	k-factor	5j+ low	1.252	0.05	4.0
5211	misId	p(e→e) central	0.9864	0.006	0.6
5212	misId	p(e→e) plug	0.9334	0.009	1.0
5213	misId	p(μ→μ) CMUP	0.8451	0.008	0.9
5214	misId	p(μ→μ) CMX	0.915	0.011	1.2
5216	misId	p(γ→γ) central	0.9738	0.018	1.8
5217	misId	p(γ→γ) plug	0.9131	0.018	2.0
5219	misId	p(b→b) central	0.9969	0.04	4.0
5245	misId	p(e→γ) plug	0.04452	0.012	27.0
5256	misId	p(q→e) central	9.71×10^{-5}	1.9×10^{-6}	2.0
5257	misId	p(q→e) plug	0.0008761	1.8×10^{-5}	2.1
5261	misId	p(q→μ)	1.157×10^{-5}	2.7×10^{-7}	2.3
5273	misId	p(j→b) 25<p_T	0.01684	0.00027	1.6
5285	misId	p(q→τ) 15<p_T<60	0.003414	0.00012	3.5
5286	misId	p(q→τ) 60<p_T<200	0.000381	4×10^{-5}	10.5
5292	misId	p(q→γ) central	0.0002651	1.5×10^{-5}	5.7
5293	misId	p(q→γ) plug	0.001591	0.00013	8.2
5401	trigger	p(e→trig) central, p_T>25	0.9758	0.007	0.7
5402	trigger	p(e→trig) plug, p_T>25	0.835	0.015	1.8
5403	trigger	p(μ→trig) CMUP, p_T>25	0.9166	0.007	0.8
5404	trigger	p(μ→trig) CMX, p_T>25	0.9613	0.01	1.0

- Effect of adjusting correction factors is ~10% x Standard Model prediction
- Effect of outright mistakes (not thought of until discovered and fixed) is often larger (focusing on pathologies)

Sleuth's sensitivity to other Standard Model processes





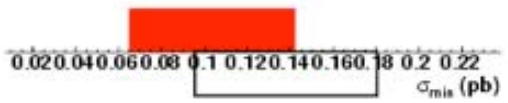
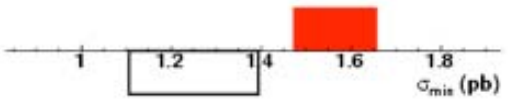
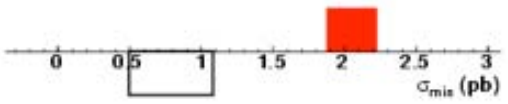
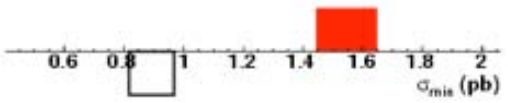
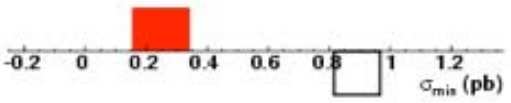
- WW: discovery if removed from Standard Model background
- Single top: somewhat less sensitive than targeted search
- Light Higgs (m_h < ~150 GeV): significantly less sensitive than targeted search
- Heavy Higgs (m_h > ~160 GeV): performance similar to WW production

Sample comparison of **Sleuth** to targeted searches

Sleuth

targeted search

CDF Run II Preliminary (927 pb^{-1})

Name	Description	Sensitivity
Model 01	GMSB, $\Lambda = 82.6$ GeV, $\tan\beta = 15$, $\mu > 0$, 1 messenger of $M = 2\Lambda$	
Model 02	$Z'_{(250\,\mathrm{GeV}/c^2)} \to \ell\bar{\ell}$, with $\ell \neq \nu$	
Model 03	$Z'_{(700\,\mathrm{GeV}/c^2)} \to q\bar{q}$	
Model 04	$Z'_{(1\,\mathrm{TeV}/c^2)} \to q\bar{q}$	
Model 05	mSUGRA, $M_0 = 100$ GeV, $M_{1/2} = 180$ GeV, $A_0 = 0$, $\tan\beta = 5$, $\mu > 0$	
Model 06	mSUGRA, $M_0 = 284$ GeV, $M_{1/2} = 100$ GeV, $A_0 = 0$, $\tan\beta = 5$, $\mu < 0$	
Model 07	mSUGRA, $M_0 = 300$ GeV, $M_{1/2} = 200$ GeV, $A_0 = 0$, $\tan\beta = 5$, $\mu < 0$	

better ⟷ worse

$\sigma_{discovery}$ (pb)

The Sleuth result

$\sum p_T$ statistic

Sleuth@CDFII result

(top 5)

fraction of pseudo experiments in this final state as interesting as CDF data

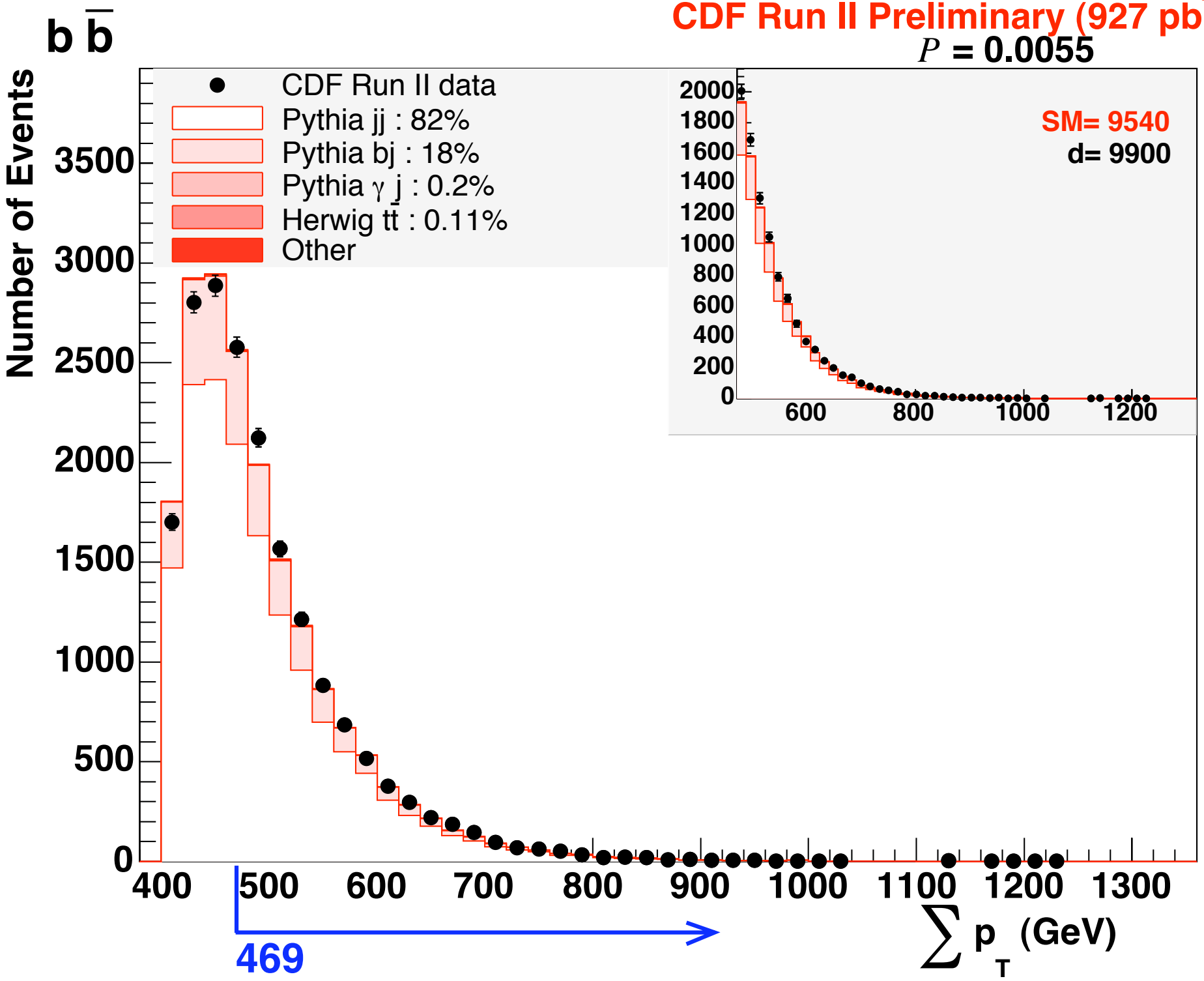
fraction of pseudo experiments in any final state as interesting as CDF data

$$\tilde{\mathcal{P}} = 0.46$$

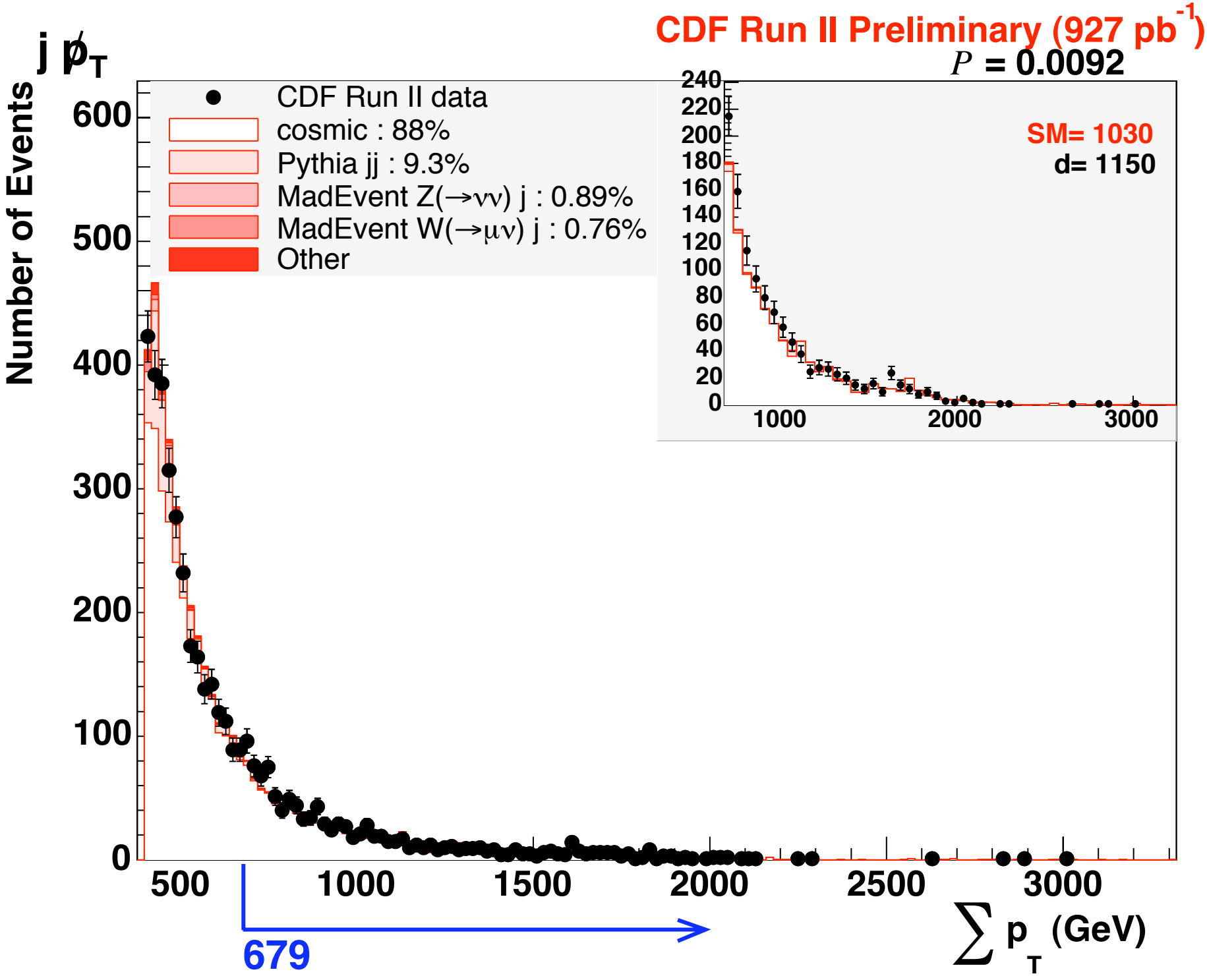
SLEUTH Final State	$\mathcal{P}$
$b\bar{b}$	0.0055
$j \not{p}$	0.0092
$\ell^+\ell'^+ \not{p} jj$	0.011
$\ell^+\ell'^+ \not{p}$	0.016
$\tau \not{p}$	0.016

- 46% of pseudo experiments are expected to be as interesting
- Sleuth finds no significant excess in CDF Run II high-p_T data
- This does not prove there is no new physics present

#1

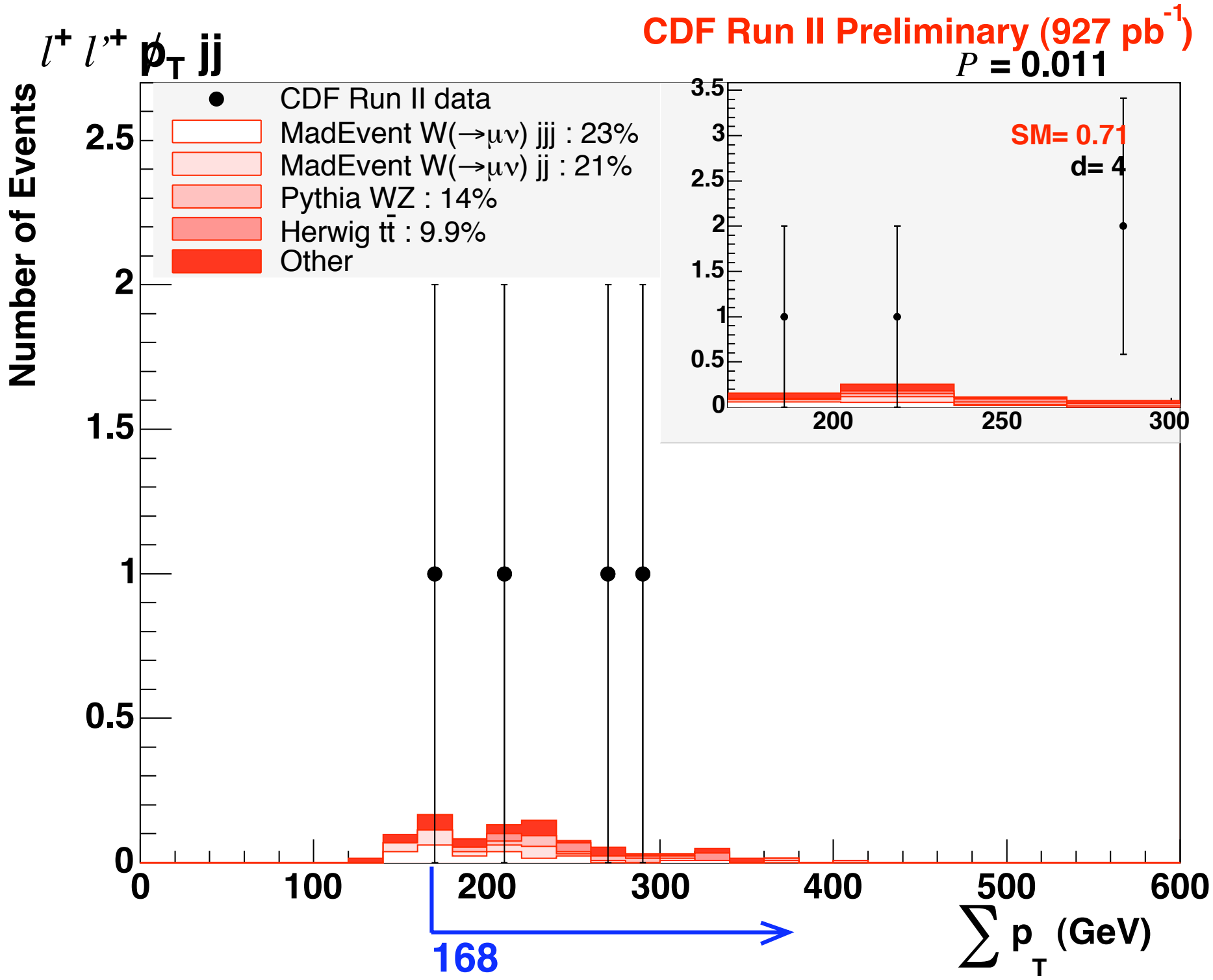

b b̄
CDF Run II Preliminary (927 pb⁻¹)
P = 0.0055
CDF Run II data
Pythia jj : 82%
Pythia bj : 18%
Pythia γ j : 0.2%
Herwig tt̄ : 0.11%
Other
SM= 9540
d= 9900
Number of Events
0
500
1000
1500
2000
2500
3000
400
500
600
700
800
900
1000
1100
1200
1300
469
∑ p_T (GeV)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
600
800
1000
1200

#2

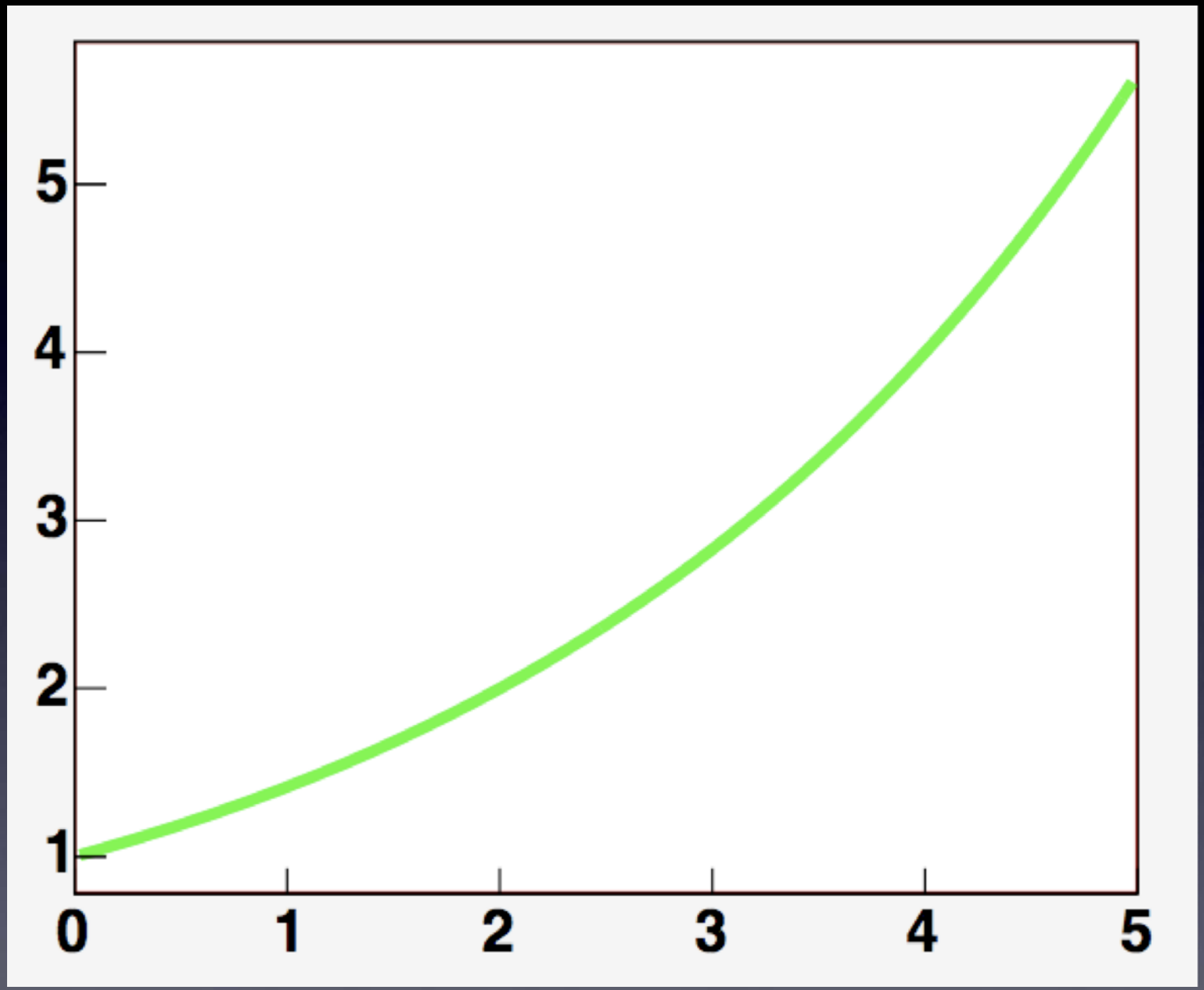


Bruce Knuteson

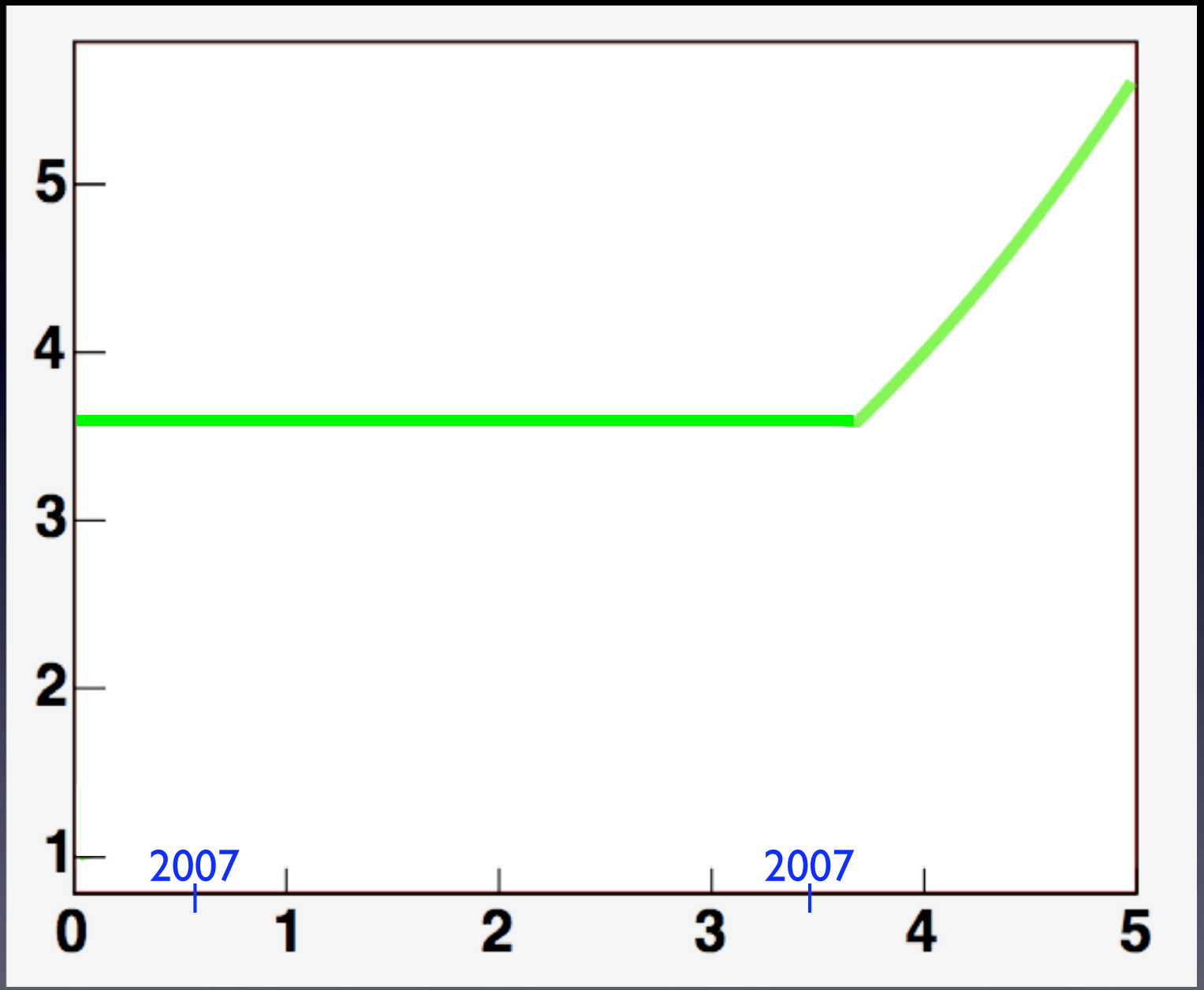
#3


CDF Run II Preliminary (927 pb-1)
l+ l'+ p̸T jj
P = 0.011
CDF Run II data
MadEvent W(→μν) jjj : 23%
MadEvent W(→μν) jj : 21%
Pythia WZ : 14%
Herwig tt̄ : 9.9%
Other
SM= 0.71
d= 4
Number of Events
∑ pT (GeV)
168

Can we still discover something new?



Yes



Summary

A global analysis of 927 pb^{-1} of CDF Run II data has been performed

Vista

model-independent
searches the bulk of distributions

Sleuth

quasi-model-independent
searches the high-Σp_T tails

This global analysis has revealed no new physics in 927 pb^{-1}
Tevatron Run II will provide 10x more data yet to be searched