Vista and Sleuth at CDF and LHC

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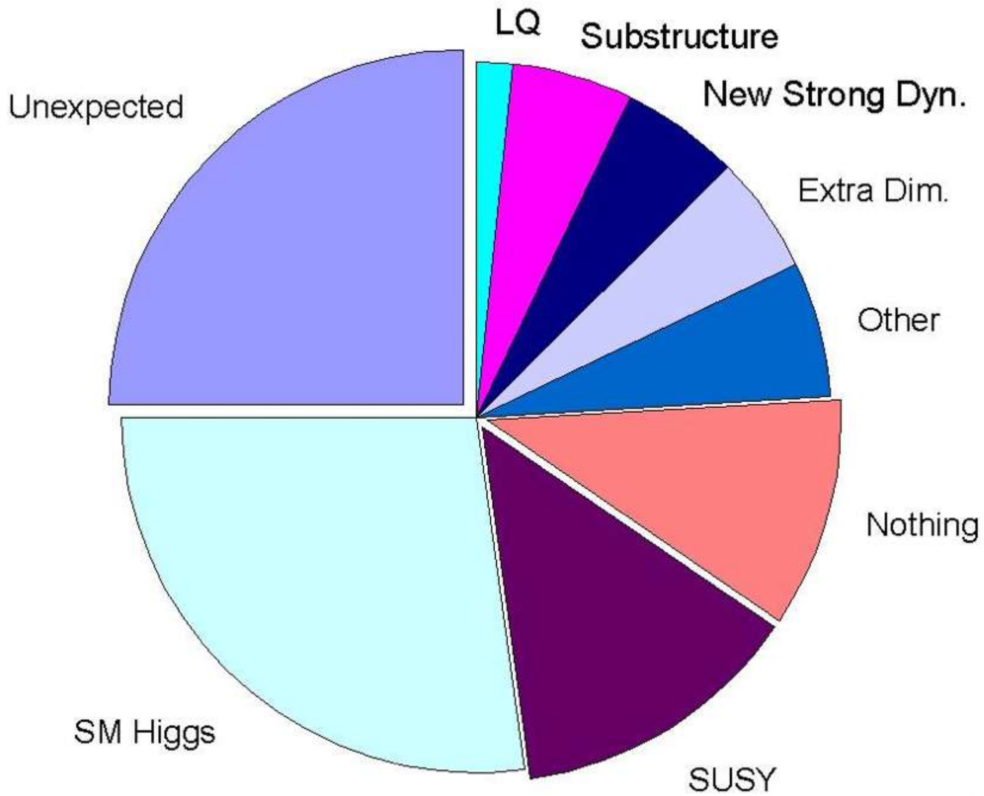
FNAL

Why a Generic Search?

Too much model guidance
- all types, signatures
- many parameters
- basically no data hints
  → try to look everywhere...

Model blindness
- narrow searches
- discrepancies avoided
→ all signatures are not covered

survey of FNAL grad students:
what do you expect next?



Is there a reasonable BG model which describes all high-pt data?

Vista

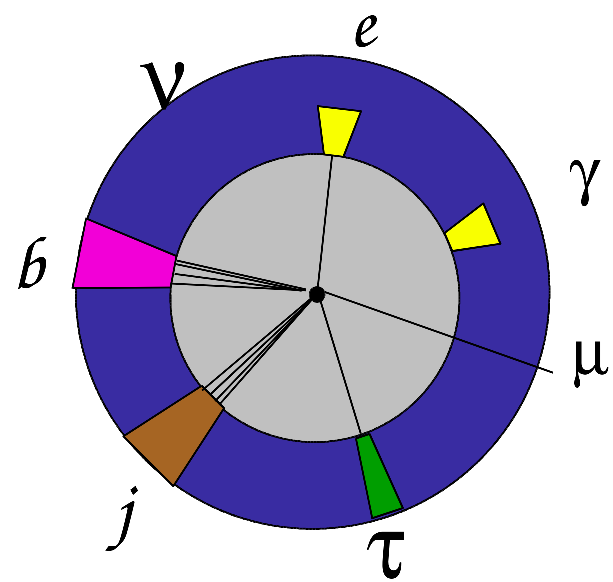
A panoramic view of the bulk of all kinematic distributions of all high-Pt data

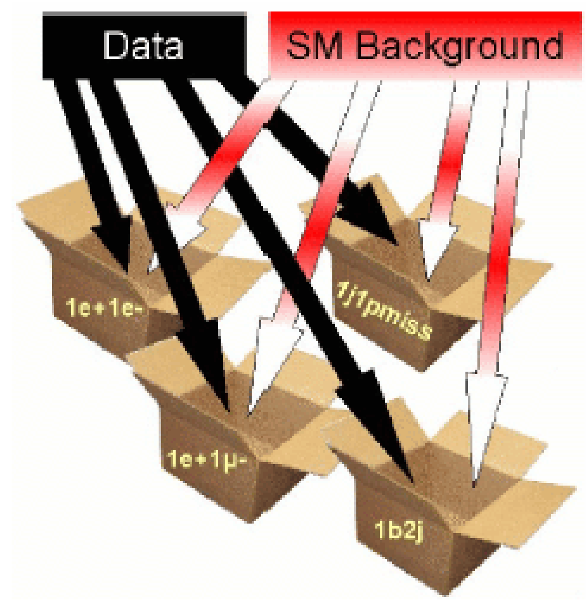
Sleuth

Examine the tails of the SumPt distributions of all high-Pt final states

Select the Data

- Online triggers:
  inclusive e, μ, γ, j
- Identify all high-Pt (Pt>17 GeV) and isolated (<~1 GeV) objects:
  - electron (central and forward)
  - muon (CMU and CMX)
  - tau (1-prong, central)
  - photon (central and forward)
  - jet (|η|<2.5)
  - b-jet (2ndry tag, central)
  - MEt
- Offline, reduce the sample size :
  electron>25 GeV OR photon>60 GeV
  OR two lepton Et>17 GeV, OR jet > 200 GeV, etc





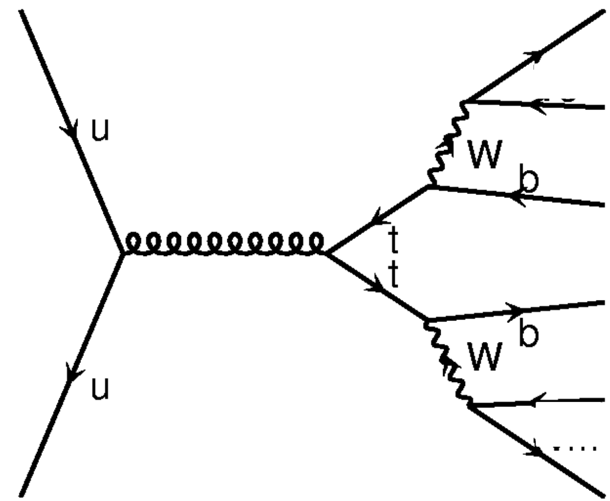
Generate the SM

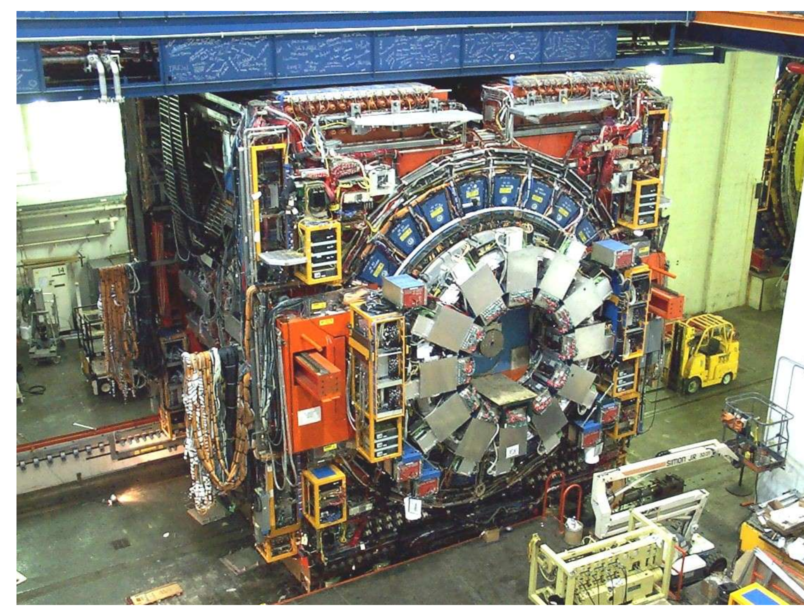
- Sample definitions finely tuned to keep the sizes manageable
- coordinated with offline triggers

- Generate most by MADEVENT plus PYTHIA
- jets, γ, $\gamma\gamma$, VV - PYTHIA
- V+jets from Mrenna-matched MADEVENT plus PYTHIA
- tt - HERWIG

- interactions of cosmic rays model from from data

- Pass all through the full standard CDF GEANT Simulation





Build Correction Model

- Correction categories:
  - fake rates
  - efficiencies
  - k-factors
- Constraints applied when available
  - W NNLO x-sec, etc.
  - CDF b-tag efficiency , etc.
  - charge asymmetries
- Start with none, add as needed
  - physically motivated
  - unlikely to mask new physics
- Fit 44 parameters in all

to wide bins in η, Pt for all final states

(mis)Id

true

	e	μ	τ	γ	j	b
e	0.66		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

The whole dataset is the control region

Vista Final States

-344

-trials factor included

Final State	Data	Background	Final State	Data	Background	Final State	Data	Background
$3j\tau+$	71	113.7 ± 3.6	$2e+j$	13	9.8 ± 2.2	$e+\gamma\not{p}$	141	144.2 ± 6
$5j$	1661	1902.9 ± 50.8	$2e+e-$	12	4.8 ± 1.2	$e+\mu-\not{p}$	54	42.6 ± 2.7
$2j\tau+$	233	296.5 ± 5.6	$2e+$	23	36.1 ± 3.8	$e+\mu+\not{p}$	13	10.9 ± 1.3
$be+j$	2207	2015.4 ± 28.7	$2b\ \Sigma p_T > 400$ GeV	327	335.8 ± 7	$e+\mu-$	153	127.6 ± 4.2
$3j\ \Sigma p_T < 400$ GeV	35436	37294.6 ± 524.3	$2b\ \Sigma p_T < 400$ GeV	187	173.1 ± 7.1	$e+j$	386880	392614 ± 5031.8
$e+3j\not{p}$	1954	1751.6 ± 42	$2b3j\ \Sigma p_T < 400$ GeV	28	33.5 ± 5.5	$e+j2\gamma$	14	15.9 ± 2.9
$be+2j$	798	695.3 ± 13.3	$2b2j\ \Sigma p_T > 400$ GeV	355	326.3 ± 8.4	$e+j\tau+$	79	79.3 ± 2.9
$3j\not{p}\ \Sigma p_T > 400$ GeV	811	967.5 ± 38.4	$2b2j\ \Sigma p_T < 400$ GeV	56	80.2 ± 5	$e+j\tau-$	162	148.8 ± 7.6
$e+\mu+$	26	11.6 ± 1.5	$2b2j\gamma$	16	15.4 ± 3.6	$e+j\not{p}$	58648	57391.7 ± 661.6
$e+\gamma$	636	551.2 ± 11.2	$2b\gamma$	37	31.7 ± 4.8	$e+j\gamma\not{p}$	52	76.2 ± 9
$e+3j$	28656	27281.5 ± 405.2	$2bj\ \Sigma p_T > 400$ GeV	415	393.8 ± 9.1	$e+j\mu-\not{p}$	22	13.1 ± 1.7
$b5j$	131	95 ± 4.7	$2bj\ \Sigma p_T < 400$ GeV	161	195.8 ± 8.3	$e+j\mu-$	28	26.8 ± 2.3
$j2\tau+$	50	85.6 ± 8.2	$2bj\not{p}\ \Sigma p_T > 400$ GeV	28	23.2 ± 2.6	$e+e-4j$	103	113.5 ± 5.9
$j\tau+\tau-$	74	125 ± 13.6	$2bj\gamma$	25	24.7 ± 4.3	$e+e-3j$	456	473 ± 14.6
$b\not{p}\ \Sigma p_T > 400$ GeV	10	29.5 ± 4.6	$2be+2j\not{p}$	15	12.3 ± 1.6	$e+e-2j\not{p}$	30	39 ± 4.6
$e+j\gamma$	286	369.4 ± 21.1	$2be+2j$	30	30.5 ± 2.5	$e+e-2j$	2149	2152 ± 40.1
$e+j\not{p}\tau-$	29	14.2 ± 1.8	$2be+j$	28	29.1 ± 2.8	$e+e-\tau+$	14	11.1 ± 2
$2j\ \Sigma p_T < 400$ GeV	96502	92437.3 ± 1354.5	$2be+$	48	45.2 ± 3.7	$e+e-\not{p}$	491	487.9 ± 12
$be+3j$	356	298.6 ± 7.7	$\tau+\tau-$	498	428.5 ± 22.7	$e+e-\gamma$	127	132.3 ± 4.2
$8j$	11	6.1 ± 2.5	$\gamma\tau+$	177	204.4 ± 5.4	$e+e-j$	10726	10669.3 ± 123.5
$7j$	57	35.6 ± 4.9	$\gamma\not{p}$	1952	1945.8 ± 77.1	$e+e-j\not{p}$	157	144 ± 11.2
$6j$	335	298.4 ± 14.7	$\mu+\tau+$	18	19.8 ± 2.3	$e+e-j\gamma$	26	45.6 ± 4.7
$4j\ \Sigma p_T > 400$ GeV	39665	40898.8 ± 649.2	$\mu+\tau-$	151	179.1 ± 4.7	$e+e-$	58344	58575.6 ± 603.9
$4j\ \Sigma p_T < 400$ GeV	8241	8403.7 ± 144.7	$\mu+\not{p}$	321351	320500 ± 3475.5	$b6j$	24	15.5 ± 2.3
$4j2\gamma$	38	57.5 ± 11	$\mu+\not{p}\tau-$	22	25.8 ± 2.7	$b4j\ \Sigma p_T > 400$ GeV	13	9.2 ± 1.8
$4j\tau+$	20	36.9 ± 2.4	$\mu+\gamma$	269	285.5 ± 5.9	$b4j\ \Sigma p_T < 400$ GeV	464	499.2 ± 12.4
$4j\not{p}\ \Sigma p_T > 400$ GeV	516	525.2 ± 34.5	$\mu+\gamma\not{p}$	269	282.2 ± 6.6	$b3j\ \Sigma p_T > 400$ GeV	5354	5285 ± 72.4
$4j\gamma\not{p}$	28	53.8 ± 11	$\mu+\mu-\not{p}$	49	61.4 ± 3.5	$b3j\ \Sigma p_T < 400$ GeV	1639	1558.9 ± 24.1
$4j\gamma$	3693	3827.2 ± 112.1	$\mu+\mu-\gamma$	32	29.9 ± 2.6	$b3j\not{p}\ \Sigma p_T > 400$ GeV	111	116.8 ± 11.2
$4j\mu+$	576	568.2 ± 26.1	$\mu+\mu-$	10648	10845.6 ± 96	$b3j\gamma$	182	194.1 ± 8.8
$4j\mu+\not{p}$	232	224.7 ± 8.5	$j2\gamma$	2196	2200.3 ± 35.2	$b3j\mu+\not{p}$	37	34.1 ± 2
$4j\mu+\mu-$	17	20.1 ± 2.5	$j2\gamma\not{p}$	38	27.3 ± 3.2	$b3j\mu+$	47	52.2 ± 3
3γ	13	24.2 ± 3	$j\tau+$	563	585.7 ± 10.2	$b2\gamma$	15	14.6 ± 2.1
$3j\ \Sigma p_T > 400$ GeV	75894	75939.2 ± 1043.9	$j\not{p}\ \Sigma p_T > 400$ GeV	4183	4209.1 ± 56.1	$b2j\ \Sigma p_T > 400$ GeV	8812	8576.2 ± 97.9
$3j2\gamma$	145	178.1 ± 7.4	$j\gamma$	49052	48743 ± 546.3	$b2j\ \Sigma p_T < 400$ GeV	4691	4646.2 ± 57.7
$3j\not{p}\ \Sigma p_T < 400$ GeV	20	30.9 ± 14.4	$j\gamma\tau+$	106	104 ± 4.1	$b2j\not{p}\ \Sigma p_T > 400$ GeV	198	209.2 ± 8.3
$3j\gamma\tau+$	13	11 ± 2	$j\gamma\not{p}$	913	965.2 ± 41.5	$b2j\gamma$	429	425.1 ± 13.1
$3j\gamma\not{p}$	83	102.9 ± 11.1	$j\mu+$	33462	34026.7 ± 510.1	$b2j\mu+\not{p}$	46	40.1 ± 2.7
$3j\gamma$	11424	11506.4 ± 190.6	$j\mu+\tau-$	29	37.5 ± 4.5	$b2j\mu+$	56	60.6 ± 3.4
$3j\mu+\not{p}$	1114	1118.7 ± 27.1	$j\mu+\not{p}\tau-$	10	9.6 ± 2.1	$b\tau+$	19	19.9 ± 2.2
$3j\mu+\mu-$	61	84.5 ± 9.2	$j\mu+\not{p}$	45728	46316.4 ± 568.2	$b\gamma$	976	1034.8 ± 15.6
$3j\mu+$	2132	2168.7 ± 64.2	$j\mu+\gamma\not{p}$	78	69.8 ± 9.9	$b\gamma\not{p}$	18	16.7 ± 3.1
$3bj\ \Sigma p_T > 400$ GeV	14	9.3 ± 1.9	$j\mu+\gamma$	70	98.4 ± 12.1	$b\mu+$	303	263.5 ± 7.9
$2\tau+$	316	290.8 ± 24.2	$j\mu+\mu-$	1977	2093.3 ± 74.7	$b\mu+\not{p}$	204	218.1 ± 6.4
$2\gamma\not{p}$	161	176 ± 9.1	$e+4j$	7144	6661.9 ± 147.2	$bj\ \Sigma p_T > 400$ GeV	9060	9275.7 ± 87.8
2γ	8482	8349.1 ± 84.1	$e+4j\not{p}$	403	363 ± 9.9	$bj\ \Sigma p_T < 400$ GeV	7236	7030.8 ± 74
$2j\ \Sigma p_T > 400$ GeV	93408	92789.5 ± 1138.2	$e+3j\tau-$	11	7.6 ± 1.6	$bj2\gamma$	13	17.6 ± 3.3
$2j2\gamma$	645	612.6 ± 18.8	$e+3j\gamma$	27	21.7 ± 3.4	$bj\tau+$	13	12.9 ± 1.8
$2j\tau+\tau-$	15	25 ± 3.5	$e+2\gamma$	47	74.5 ± 5	$bj\not{p}\ \Sigma p_T > 400$ GeV	53	60.4 ± 19.9
$2j\not{p}\ \Sigma p_T > 400$ GeV	74	106 ± 7.8	$e+2j$	126665	122457 ± 1672.6	$bj\gamma$	937	989.4 ± 20.6
$2j\not{p}\ \Sigma p_T < 400$ GeV	43	37.7 ± 100.2	$e+2j\tau-$	53	37.3 ± 3.9	$bj\gamma\not{p}$	34	30.5 ± 4
$2j\gamma$	33684	33259.9 ± 397.6	$e+2j\tau+$	20	24.7 ± 2.3	$bj\mu+\not{p}$	104	112.6 ± 4.4
$2j\gamma\tau+$	48	41.4 ± 3.4	$e+2j\not{p}$	12451	12130.1 ± 159.4	$bj\mu+$	173	141.4 ± 4.8
$2j\gamma\not{p}$	403	425.2 ± 29.7	$e+2j\gamma$	101	88.9 ± 6.1	$be+3j\not{p}$	68	52.2 ± 2.2
$2j\mu+\not{p}$	7287	7320.5 ± 118.9	$e+\tau-$	609	555.9 ± 10.2	$be+2j\not{p}$	87	65 ± 3.3
$2j\mu+\gamma\not{p}$	13	12.6 ± 2.7	$e+\tau+$	225	211.2 ± 4.7	$be+\not{p}$	330	347.2 ± 6.9
$2j\mu+\gamma$	41	35.7 ± 6.1	$e+\not{p}$	476424	479572 ± 5361.2	$be+j\not{p}$	211	176.6 ± 5
$2j\mu+\mu-$	374	394.2 ± 24.8	$e+\not{p}\tau-$	48	35 ± 2.7	$be+e-j$	22	34.6 ± 2.6
$2j\mu+$	9513	9362.3 ± 166.8	$e+\not{p}\tau+$	20	18.7 ± 1.9	$be+e-$	62	55 ± 3.1

Vista

Table of final states

Final State	Plots	Observed	Expected	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(→eν) 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(→ττ) = 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(→eν) 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(→eν) bb = 13.3, MadEvent W(→eν) j = 12.4, Pythia jj 120 < pT < 150 = 11.6, Pythia gamma j 80 < pT = 10.4, MadEvent W(→eν) jjj = 10.4, MadEvent Z(→ee) = 9.6, Alpgen W(→eν) bb j = 8.8, Pythia W(→τν) = 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(→eν) bb jj = 2.1, Pythia bj 150 < pT < 200 = 1.8, Pythia jj 200 < pT < 300 = 1.5, MadEvent W(→eν) jjjj = 1.1, MadEvent W(→eν) gamma = 0.8, Overlaid events = 0.8, MadEvent W(→eν) = 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(→ττ) = 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(→eν) jjj = 2, MadEvent W(→eν) 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(→eν) jj = 705.6, MadEvent W(→eν) jjj = 595.3, MadEvent W(→eν) j = 132.6, MadEvent W(→eν) jjjj = 85, Pythia W(→τν) = 56.4, MadEvent W(→eν) = 45.8, Herwig ttbar = 26.7, MadEvent Z(→ee) jj = 25.9, Alpgen W(→eν) bb j = 10.3, MadEvent Z(→ee) jjj = 9.2, MadEvent W(→eν) gamma = 8.1, MadEvent Z(→ee) j = 7.7, Alpgen W(→eν) bb = 6.8, Pythia jj 60 < pT < 90 = 5.8, Alpgen W(→eν) 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(→ττ) = 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

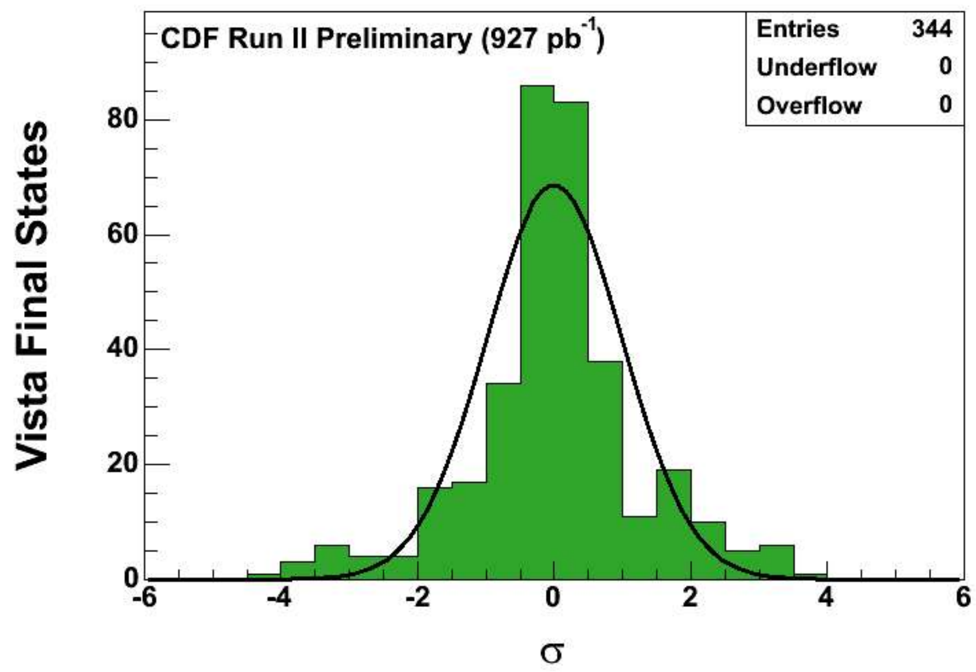
Vista Results

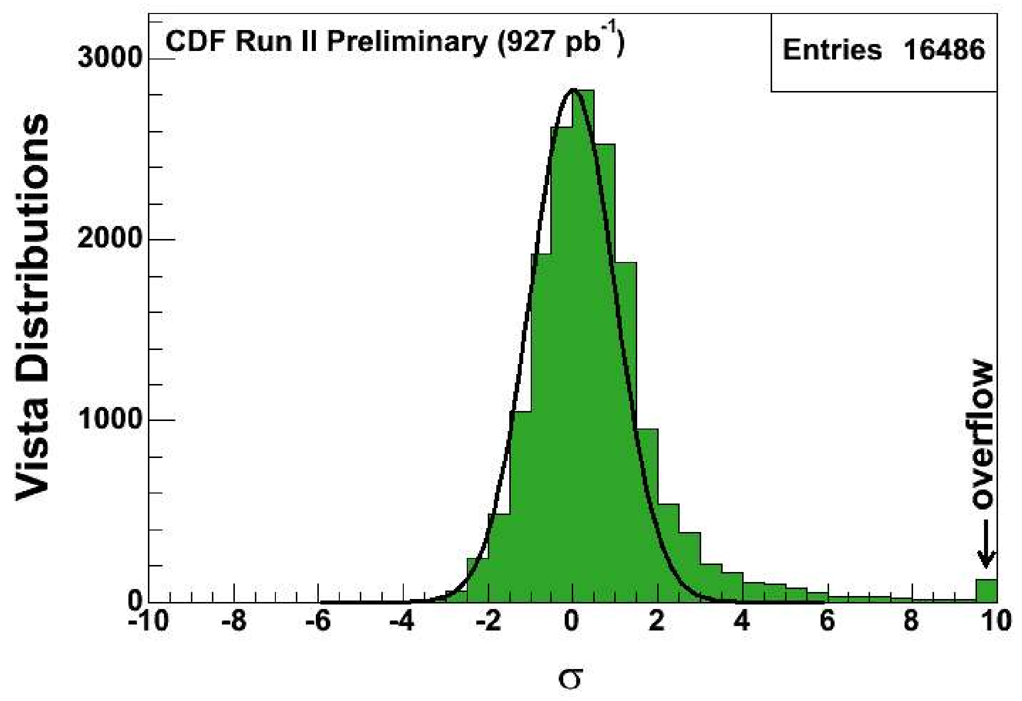
- Vista produces final states normalizations, and 16K kinematic distributions
- sorted by discrepancy

- debugging proceeds by most discrepant
- goal is to understand outliers, not produce the best possible background model

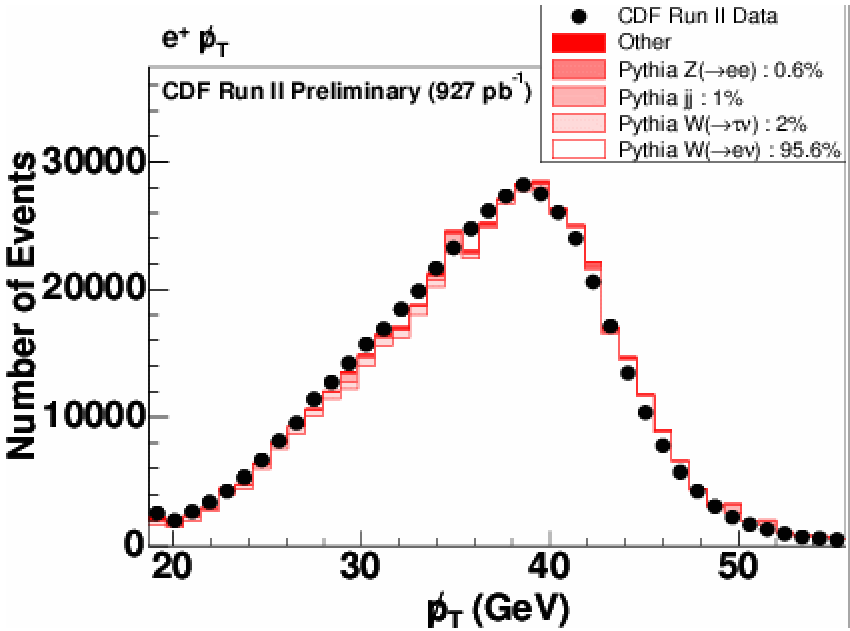
- reasonable agreement virtually everywhere

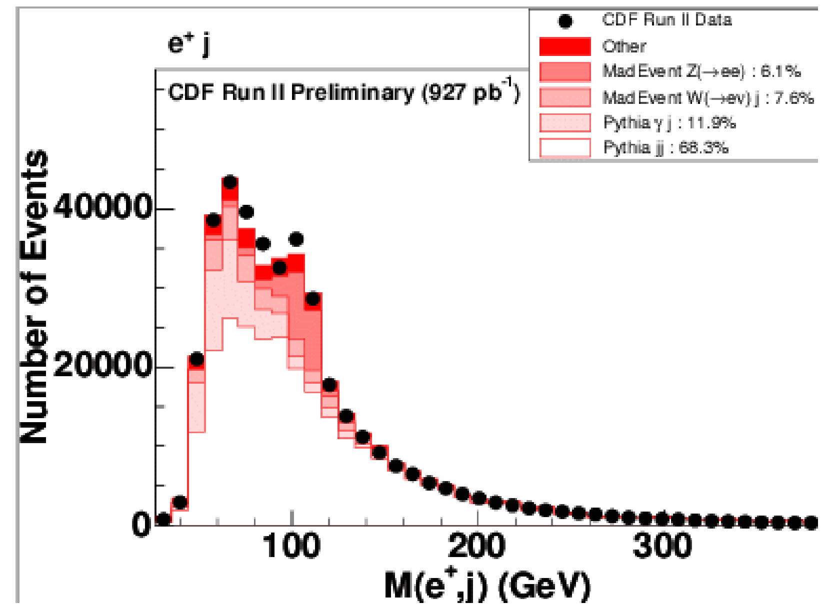
Remaining effects on tails do not hint at new physics





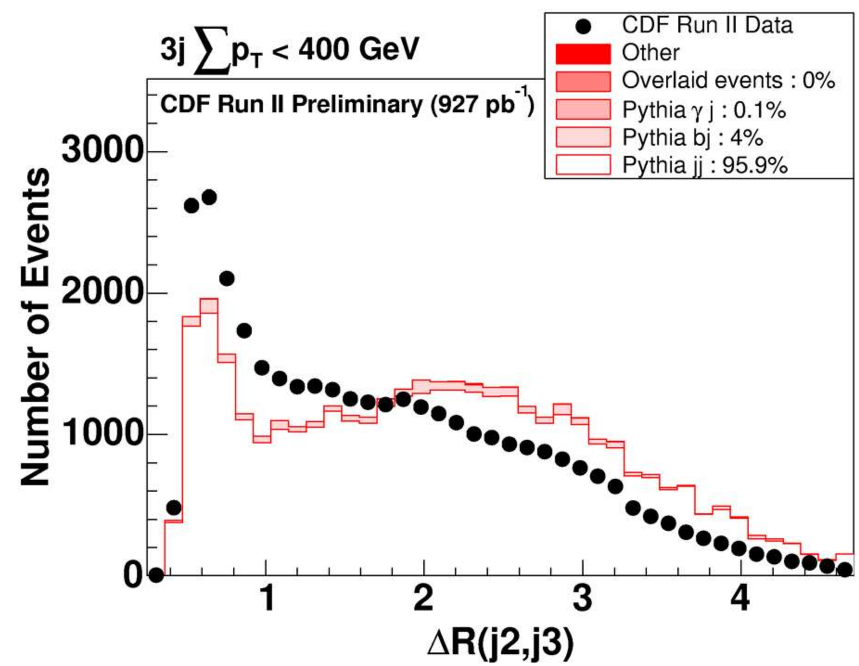
Agreements/Discrepancies





- W high S/N, stats agreement
- ej fakes agreement

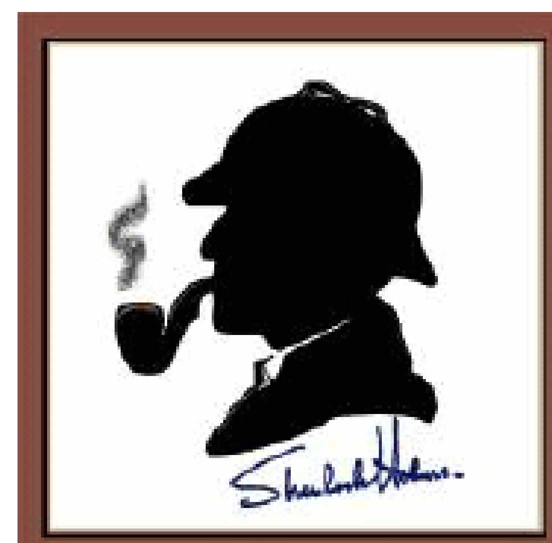
- 3j discrepancies significant, but also difficult to rule out the mundane (under investigation)
- other effects from intrinsic Kt



Vista to Sleuth

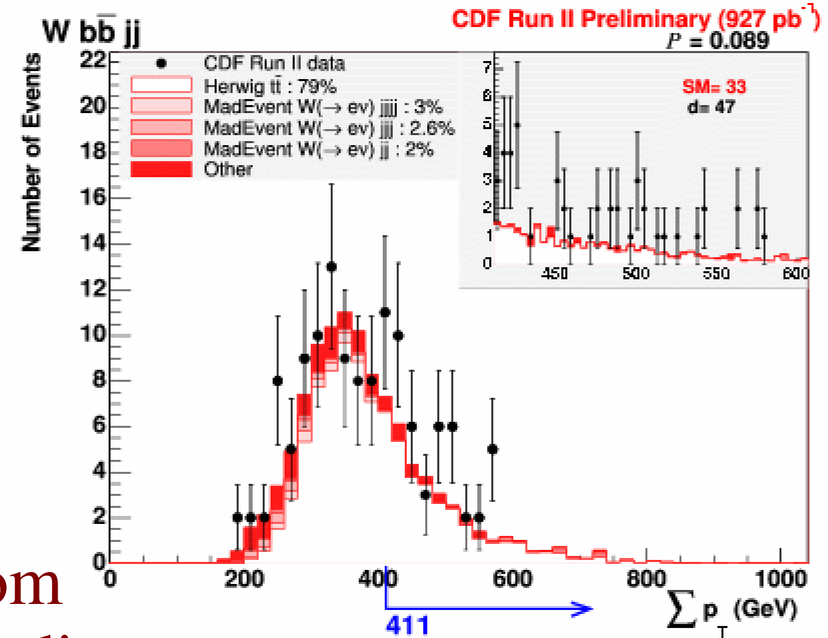
- Overall Vista shows excellent agreement in almost all areas
- few discrepancies unlikely to be due to new physics

Vista:
bulk yields,
kinematics



Sleuth:
high-Pt tails

Sleuth Overview



Method

- re-sort events in fewer final states
  (e-μ democracy, jets in pairs, ...)
- SumPt of objects in final state
- for each event, sum data and BG from this event to infinity - select most discrepant
- correct for trials factor with mini-MC
- find most discrepant final state, compute global discrepancy

Assumptions

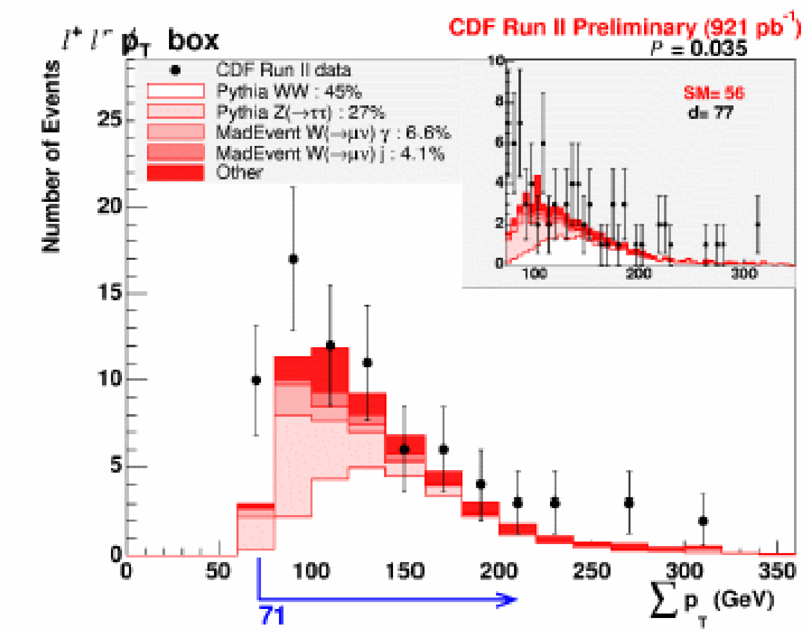
- the new physics appears as excess on the tail - high mass
- the new physics appears mostly in one final state

Limitations

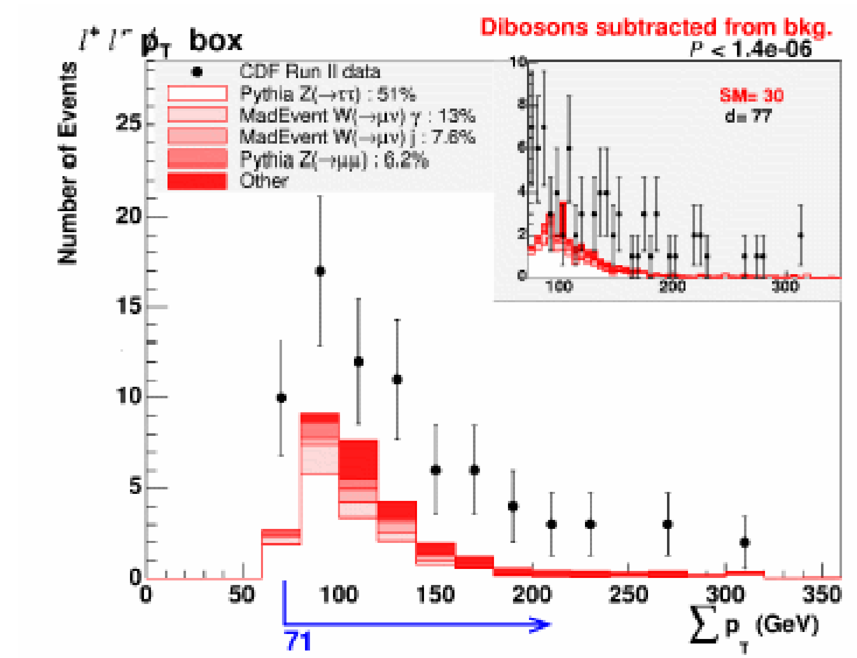
- optimized for a model matching assumptions very well
- not sensitive to small mass peaks like Higgs
- not sensitive to low-pt, like trileptons

Does this work?

WW → ll MEt normally



WW → ll MEt after removing WW



- it would discover WW
- reasonably sensitive to high mass Higgs
- not as sensitive to light Higgs as dedicated analysis
- would discover top in luminosity similar to Run I
- somewhat less sensitive to single top than dedicated analysis
- for 10 tests of new physics, it is similarly sensitive as dedicated analysis, when the model meets Sleuth's assumptions

Sleuth Result

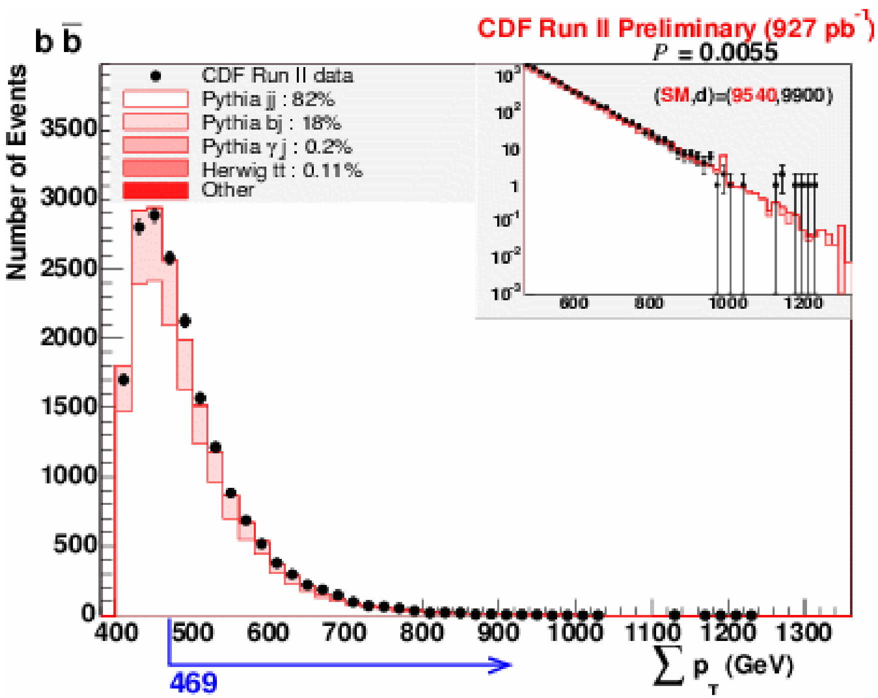
And the answer is ... $\tilde{\mathcal{P}} = 0.46$

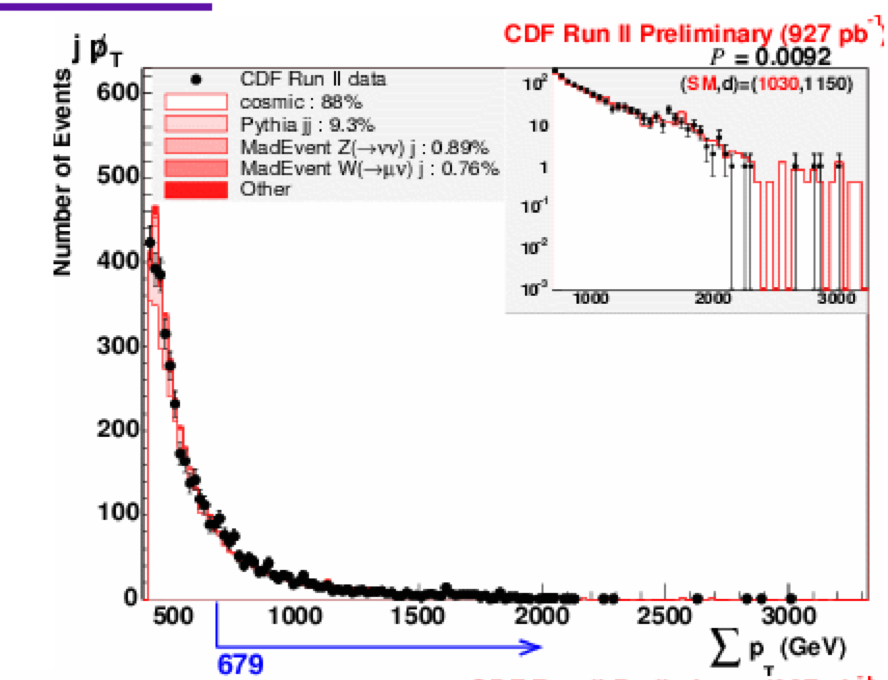
- the probability that the most discrepant final state would be more discrepant is 0.46 - no significant excess
- 927 pb^{-1}
- does not prove no new physics

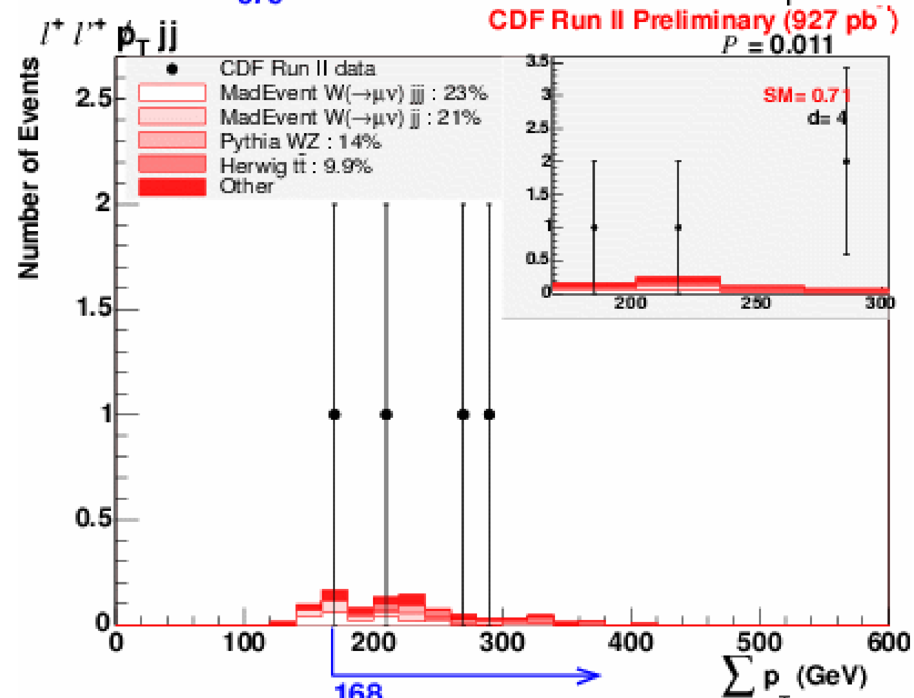
the most discrepant final states →

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

Sleuth Most Discrepant







- Most discrepant final states
- Do not reveal hints of new physics
- are not statistically significant after considering trials factors

CDF Vista/Sleuth Result

Vista

- scans 16K kinematic distributions
- debugging background estimate
- defines a 44 parameter correction model
- finds no discrepancies indicating new physics

Sleuth

- applies background model
- searches high-SumPt tails
- is sensitive to many new physics models
- agreement in 72 final states - 0.46 probability

The search continues

- dedicated searches continue

  a discovery could pop up as soon as 2fb^{-1}
- similar search is underway at DØ
- value to LHC experiments...

Vista/Sleuth Family Tree

D0 Run I
- Phys Rev D 62, 092004, 2000
- Phys Rev D 62, 012004, 2001
- Phys Rev Lett 86, 3712, 2001

Vista@L1
- Performed

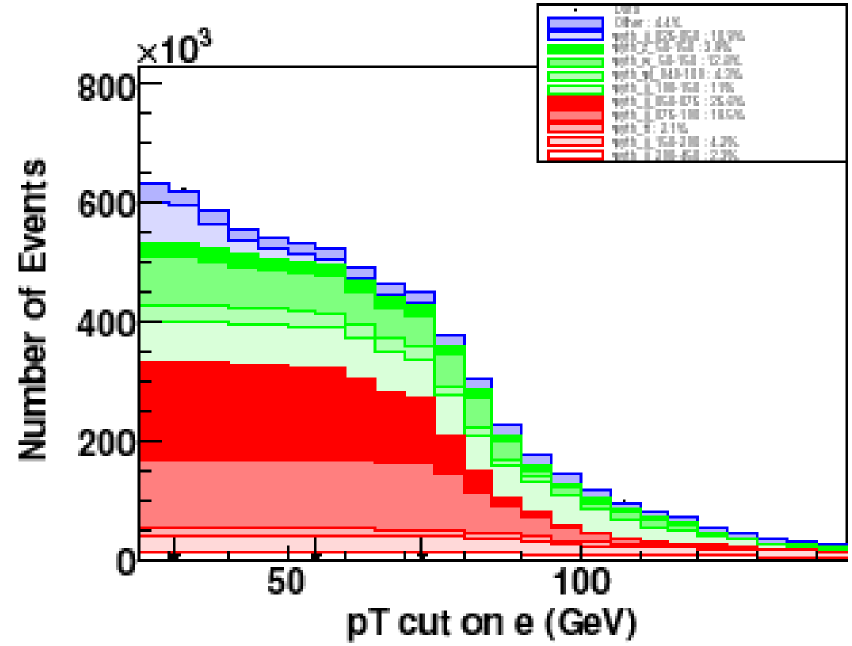
Vista@Aleph
- Performed

Sleuth@H1
- Phys. Lett. B 602: 14-30, 2004
- Quaero performed

CDF Run II
- Just blessed →PRL, PRD

D0 Run II
- Vista/Sleuth underway

The LHC Generation
- Si Xie, Knuteson, Mrenna
- designing offline triggers



Vista/Sleuth @ LHC

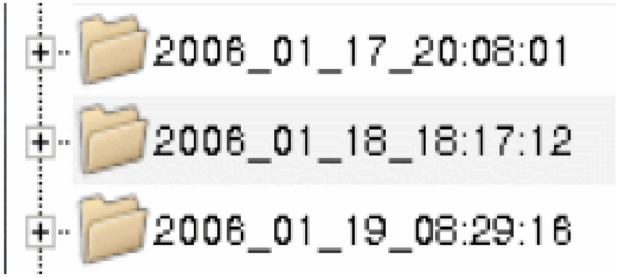
Search tool

- LHC unknowns demand a tool to scan final states
- don't commit to a final state early on
- find the anomalies and attack them

Commissioning tool

- So far, Sleuth has only been an endgame, a final tuning of background and data comparison
- early on all discrepancies will be problems
  - presented in a organized way, ordered
  - complete set - wonder about a plot? we got it.
  - see where the background is coming from
- high-level - compliments low-level work
  Vista shows where the real physics problems are
- flows from commissioning into searching

Commissioning is Debugging



A Very Nice Overview

- can provide daily comparisons,
  a continuous pointer to largest problems
  daily "star count"
- typical problems found:
  - increase granularity in fake rates
  - adjust correction model
  - fix oversights in simulation
  - cosmics/beam halo
- targets physics results, not details

Now, the heavy lifting

- Vista can characterize the problem
- then someone has to drill down,
  or find someone else to drill down ....

Vista is a plotting/stat/organizational tool - needs physicist expertise and a project this size needs a critical mass

Global Studies

Vista gives you a global view of the data -
what is the value of the global aspect?
- extract luminosity
- intrinsic Kt for many final states
- X+jets for all X
- global MC parameters
- comparison of PDF's?
- αs?

Many nice incidental features
- fake rate dependence on
  final state, Et, NJet, time, etc.
- compare Monte Carlo datasets
- compare production passes
- document the current state
- answer random questions quickly
- useful to check/compare to dedicated analyses

TurboSim

Working on this discrepancy

- Likely a showering problem
- little MC tuning since 90's
  much expected for LHC era

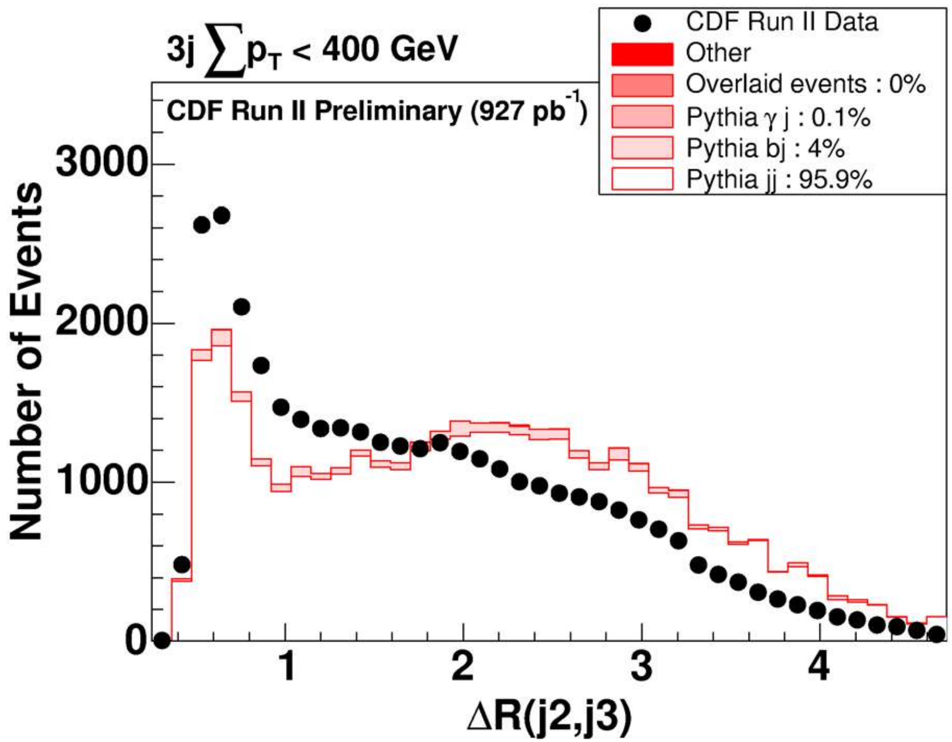
$\rightarrow$ need to test tunes, but simulation time per event is a very real problem

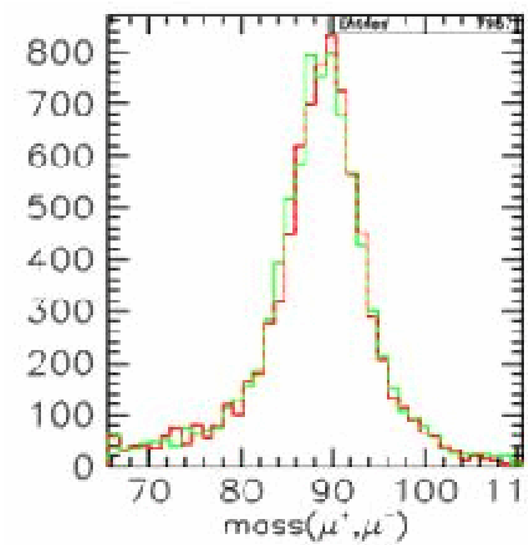
Turbocharge it!

- Examine ~10M of full sim events
- save parton $\rightarrow$ recon

for each particle type, for Pt, η, ϕ

- allow look-up of N $\rightarrow$ M
- result is ~1% precision, plenty for most studies, and fast - 10ms!
- plenty of other uses...





Finally

Vista

- gives a global view of the data
- pinpoints discrepancies in distributions
  - finds problems in data and MC
  - points to where to look for new physics in the bulk
- produces a tremendous amount of info on fakes, effs, background composition

Sleuth

- examines Sum-pt tails
- account for trials factors
- no new physics found in CDF data so far

Vista/Sleuth provide global, organized distributions and comparisons which can be used for studies, commissioning, or searches