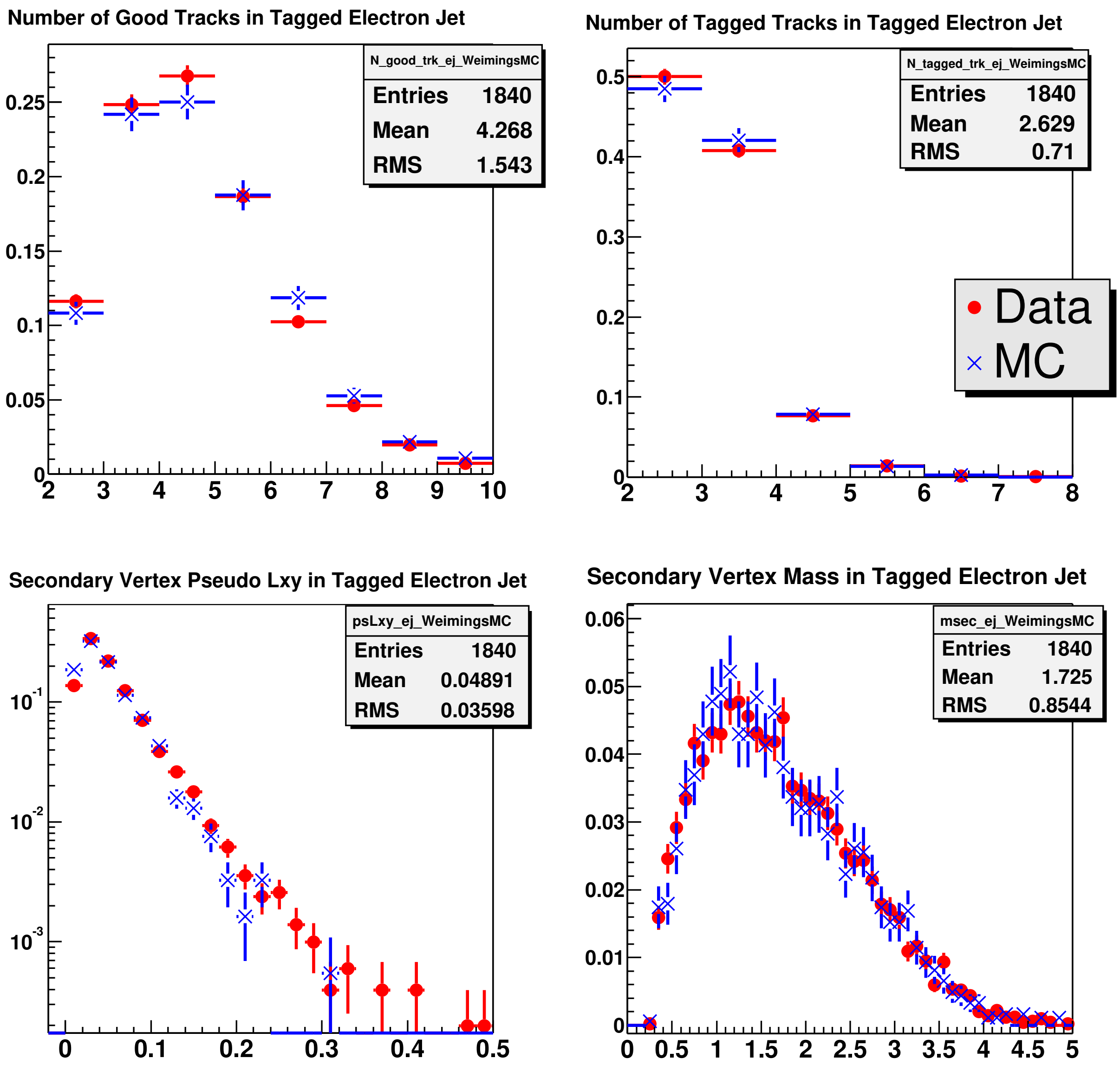
First Look at $b\bar{b}A \rightarrow b\bar{b}b\bar{b}$ Signal Efficiency

- Try to estimate signal efficiency from L1+L2+L3 for $b\bar{b}A \rightarrow b\bar{b}b\bar{b}$ using realistic MC

- Estimate bg and figure out how to do mass recon in another talk

- Start looking at $m_A = 90$ GeV and $\tan(\beta) = 50$ since LEP combined limit is currently 90 GeV at high $\tan(\beta)$.

Realistic MC Not Bad for Tracking



Positively tagged e-jets, data vs MC. Henri Bachacou

PHYSICS_1_03_v-2 HIGGS_MULTI_JET

- L1_JET10_&_SUMET90_v-1: Requires one 10 GeV E_t trigger jet from central or plug in coincidence with 90 GeV total E_t
- L2_TWO_TRK2_D100_L1_JET10_&_SUMET90_v-1: Two tracks each with $25\ \mu\mathrm{m} < d_0 < 1\ \mathrm{mm}$, $\chi^2 < 25$ and $P_t > 2$ GeV from SVT.
- L3_THREE_JET10_SUMET100_TWO_SVT_v-1: Using cone size of 0.4, require three jets of 10 GeV E_t with total $E_t > 100$ GeV
- L3 rate is 0.94 Hz, or 37 nb.
- In $50\ \mathrm{pb}^{-1}$ expect 1.8M triggers

Simulation of Signal

- Generate 1000 $q\bar{q} \rightarrow b\bar{b}A \rightarrow b\bar{b}b\bar{b}$, for $m_A = 90$ GeV and $\tan(\beta) = 50$ GeV. (Width of A is ~ 5 GeV)

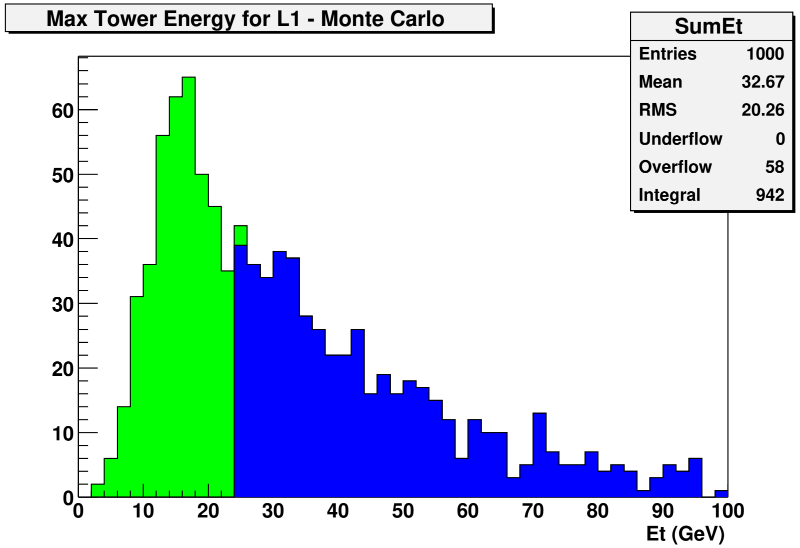
- Using Alex Cerri's `4.9.1` prescription for trigger simulation
  - Simulate L1 trigger with `TRGSim++`
  - L2 trigger with `svtfilter`
  - L3 cuts by hand

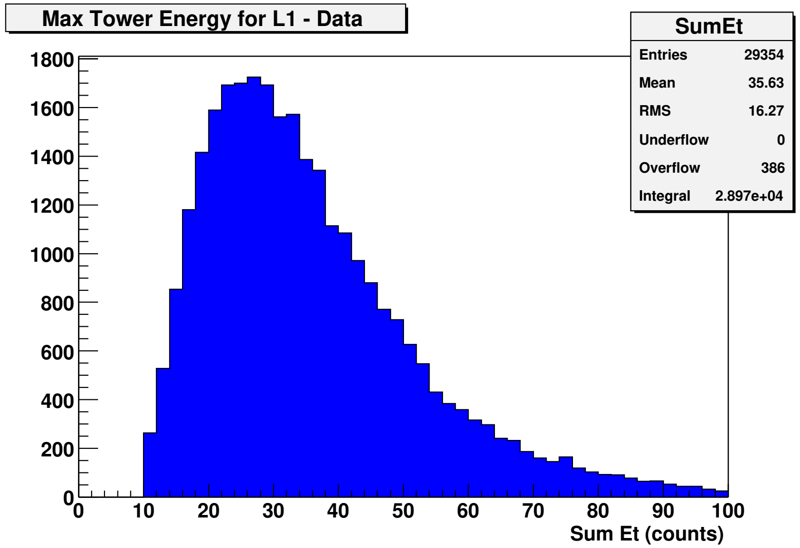
- Make crude analysis by requiring at least 3 `SecVtx` positively tagged jets

Look at L1 eff

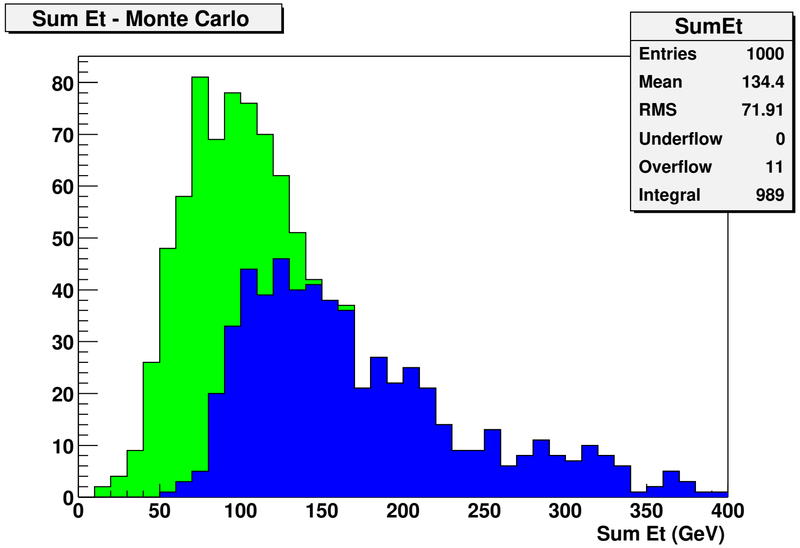
- Apparently a problem with `L1_JET10_&_SUMET90` in `TRGSim++` circa `4.9.1`
- Supposed to require at least one 10 GeV jet and sum $E_t > 90\ \mathrm{GeV}$, but strange cuts at other energies seem to be taking place in simulation
- If use the same code to plot trigger bank quantities in data, the cuts seem OK
- So it looks like unpacking/packing or cut used in trigger sim is wrong for simulation, not the actual trigger table itself.
- No big deal, since the L3 requirements are approximately a super-set of the L1 cuts.

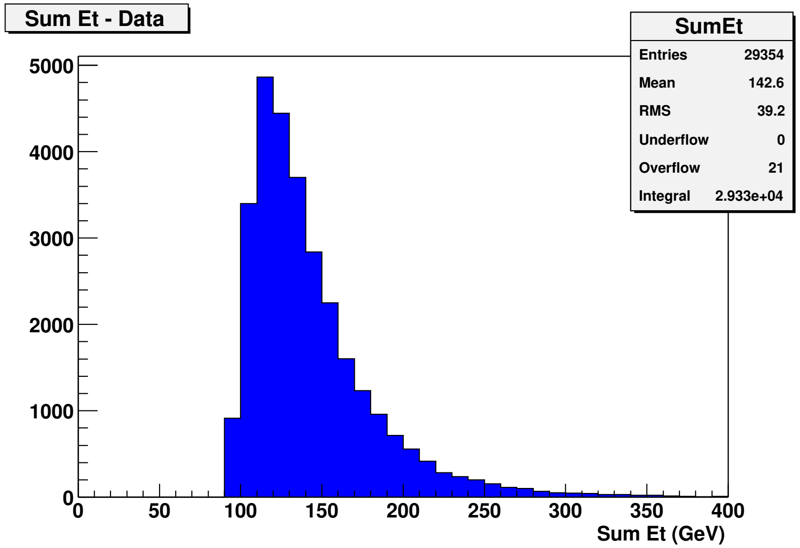
TRGSim++ **Problem with** L1_JET10_&_SUMET90





TRGSim++ Problem with L1_JET10_&_SUMET90



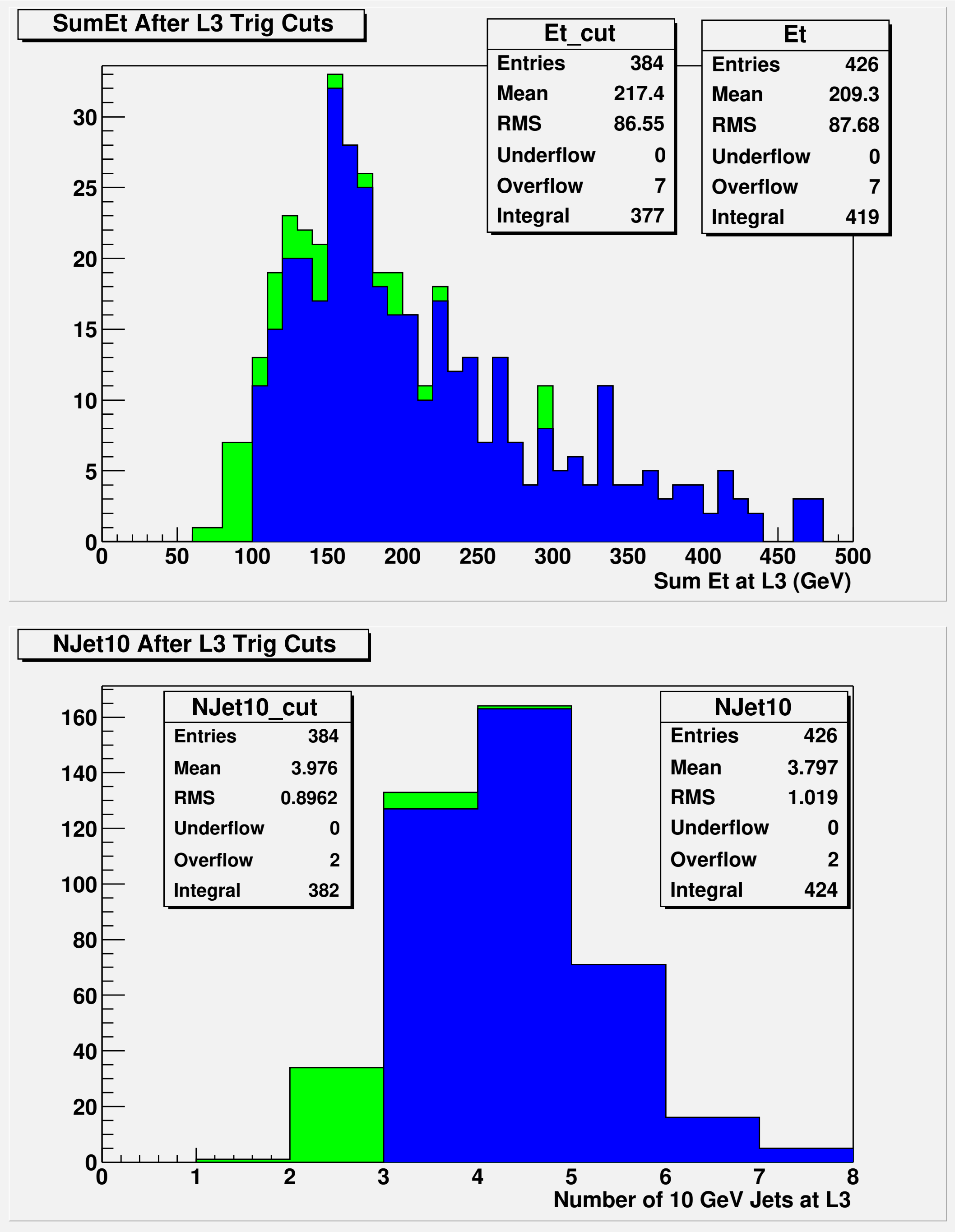


L2 eff

- Input Events: 1000
- > 0 SVT track: 831
- SVT Chi2: 821
- SVT Pt: 775
- SVT d0 Low: 643
- SVT d0 Up: 635
- N SVT tracks: 610
- 2 Tracks SVT Chi2: 607
- 2 Tracks SVT Pt: 589
- 2 Tracks SVT d0 Low: 450
- 2 Tracks SVT d0 Up: 441
- Sum pt: 426 (Maybe this is a mistake)

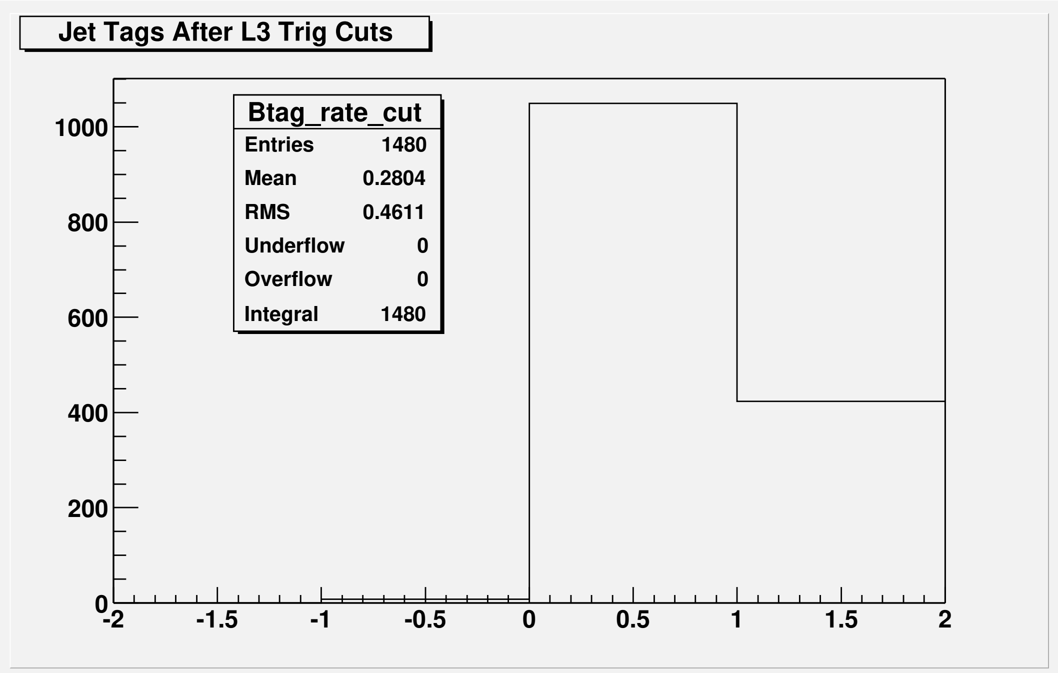
Looks like a 43% eff, not counting the L1 cuts which are actually an upstream requirement

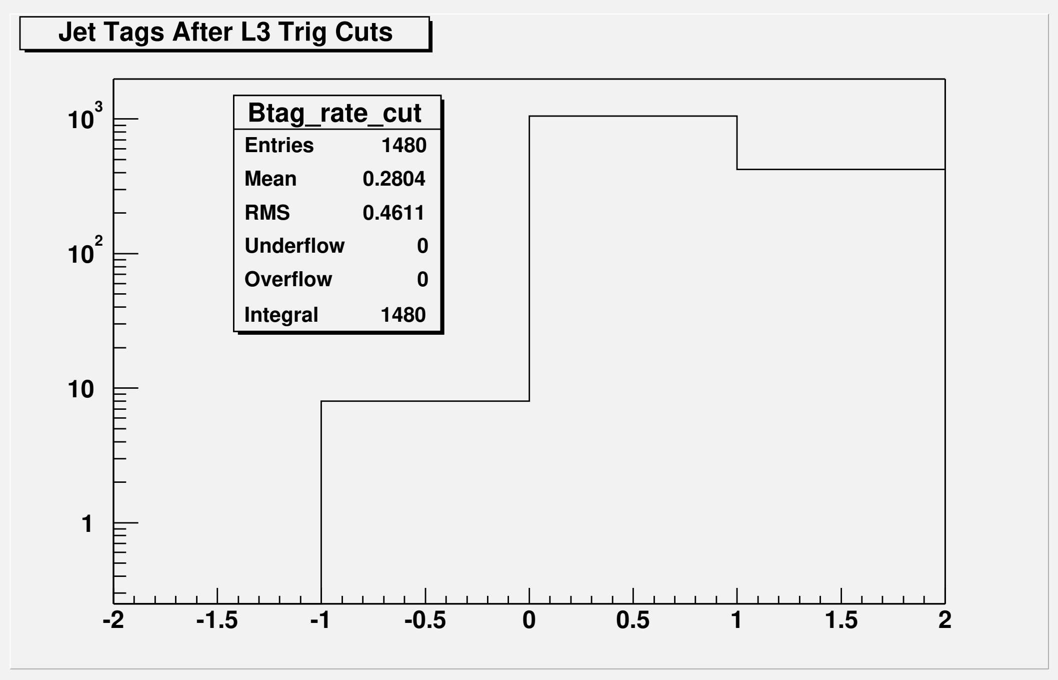
L3 eff



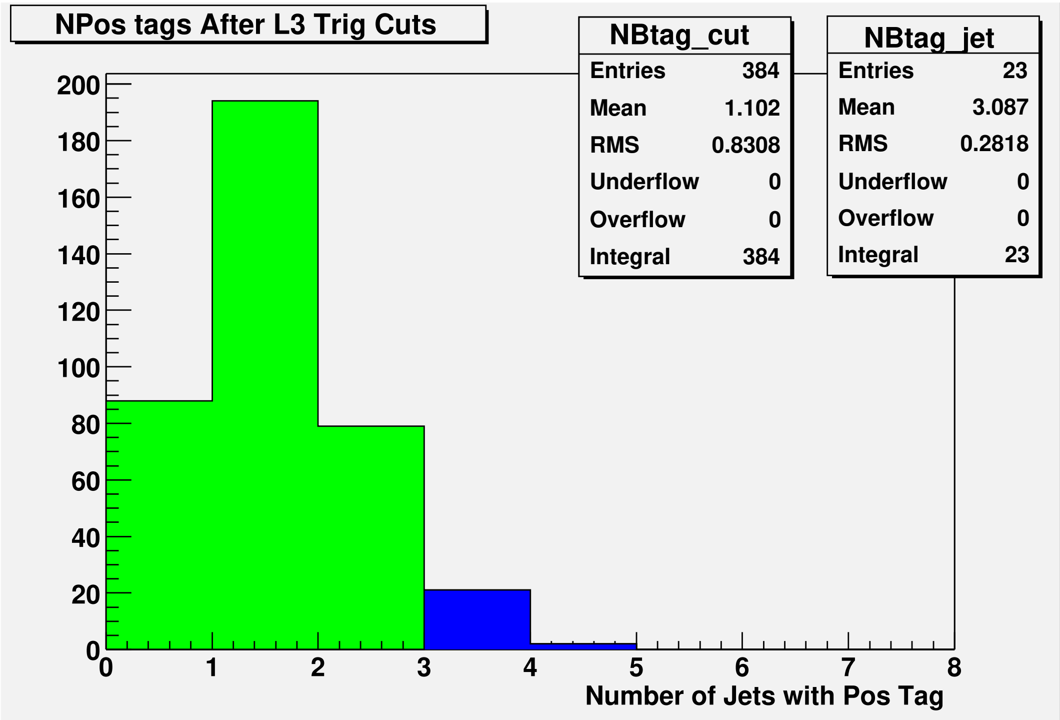
L3 cuts assumed to include L1 cuts, gives 38.4% including L2

Tagging rate after L3





Events with 3+ Positive Tags



With a 10 GeV jet cut for SecVtx, we have 23 events left out of our original 1000.

RunI 4b Results

TABLES

TABLE I. Number of observed and expected background events after the final selection and for the different SM contributions as a function of mass. Last three columns show the total acceptances and expected 95% C.L. upper limits on the number of signal events (N_{signal}) and on $\sigma \times \mathcal{BR}$, respectively.

m_φ (GeV/c^2)	Observed Events	Expected Background	Acceptance (%)	N_{signal} (95% C.L.)	$\sigma \times \mathcal{BR}$ (pb, 95% C.L.)
70	5	4.6 ± 1.4	0.16 ± 0.03	7.9	53.3
80	4	4.6 ± 1.4	0.22 ± 0.04	6.6	31.7
90	3	3.8 ± 1.3	0.23 ± 0.04	5.8	27.1
100	3	3.8 ± 1.3	0.25 ± 0.04	5.9	25.7
110	2	3.7 ± 1.1	0.25 ± 0.04	4.8	20.7
120	2	3.5 ± 1.1	0.28 ± 0.05	4.9	19.2
130	1	2.6 ± 0.9	0.28 ± 0.05	4.1	15.8
140	1	1.7 ± 0.8	0.29 ± 0.05	4.3	16.2
150	0	1.5 ± 0.8	0.30 ± 0.05	3.2	11.5
200	0	1.2 ± 0.7	0.41 ± 0.07	3.2	8.5
250	0	1.0 ± 0.7	0.47 ± 0.08	3.2	7.5
300	0	0.1 ± 0.4	0.59 ± 0.09	3.2	5.8

TABLE II. Expected QCD, fake triple tags, $t\bar{t}$, $Wb\bar{b} + Wc\bar{c}$, $Zb\bar{b} + Zc\bar{c}$, and total number of background events as a function of mass.

m_φ (GeV/c^2)	QCD	Fakes	$t\bar{t}$	$Wb\bar{b} + Wc\bar{c}$	$Zb\bar{b} + Zc\bar{c}$	Total
70	2.97 ± 0.70	0.5 ± 1.2	0.70 ± 0.18	0.09 ± 0.06	0.37 ± 0.02	4.6 ± 1.4
80	2.97 ± 0.70	0.5 ± 1.2	0.70 ± 0.18	0.09 ± 0.06	0.37 ± 0.02	4.6 ± 1.4
90	2.16 ± 0.55	0.5 ± 1.2	0.70 ± 0.18	0.09 ± 0.06	0.37 ± 0.02	3.8 ± 1.3
100	2.16 ± 0.55	0.5 ± 1.2	0.70 ± 0.18	0.09 ± 0.07	0.37 ± 0.02	3.8 ± 1.3
110	2.16 ± 0.55	0.4 ± 0.9	0.68 ± 0.18	0.09 ± 0.07	0.37 ± 0.02	3.7 ± 1.1
120	2.16 ± 0.55	0.3 ± 0.9	0.66 ± 0.17	0.07 ± 0.06	0.29 ± 0.02	3.5 ± 1.1
130	1.44 ± 0.45	0.3 ± 0.8	0.64 ± 0.17	0.05 ± 0.05	0.21 ± 0.02	2.6 ± 0.9
140	0.73 ± 0.40	0.2 ± 0.7	0.60 ± 0.16	0.04 ± 0.05	0.16 ± 0.02	1.7 ± 0.8
150	0.73 ± 0.40	0.1 ± 0.7	0.55 ± 0.15	0.03 ± 0.05	0.12 ± 0.02	1.5 ± 0.8
200	0.73 ± 0.40	0.1 ± 0.6	0.32 ± 0.09	0.00 ± 0.00	0.00 ± 0.00	1.2 ± 0.7
250	0.73 ± 0.40	0.1 ± 0.6	0.17 ± 0.05	0.00 ± 0.00	0.00 ± 0.00	1.0 ± 0.7
300	0.01 ± 0.01	0.1 ± 0.4	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.1 ± 0.4

Summary and What Next?

- `HIGGS_MULTI_JET` trigger plus requirement of 3+ btags, apparently $\sim 2\%$ efficient on 4b signal of $m_{\mathrm{A}} = 90\ \mathrm{GeV}$.

- Seems to compare quite favorably to RunI trigger and selection eff

- Next step is estimate QCD bg with double tag sample in data and ratio of double/triple tags in QCD MC

- Choose mass combo somehow: Mass hypothesis, m_{12} or m_{23}, something better?

- What about jet corrections?

- Need signal cross section ntuple. Soushi has program?