SUSY and UED LS di-muon Status

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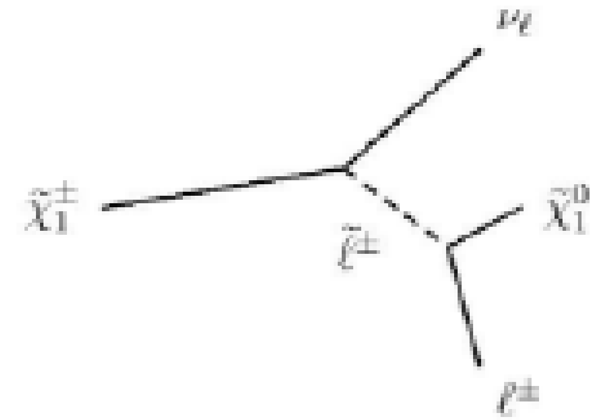
Summary

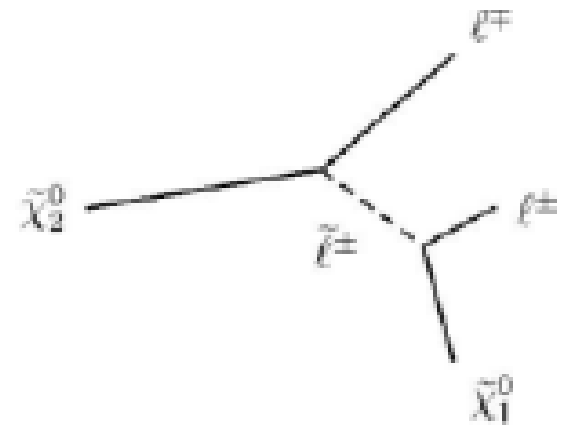
- Like Sign Signal
- QCD modelling
- Triggers
- Charge flip
- Cut optimization

Like sign Muon signal at Tevatron

- Trilepton Signal
  - 3 leptons from neutralino/chargino decay
  - Similar for UED. Just change neutralino/chargino to Z_1 W_1



- 2 SS lepton
  - If mass diference from chargino/neutralino to slepton is very small lepton could be very soft
  - Not all leptons are reconstructed
  - 2SS leptons might be a good signal



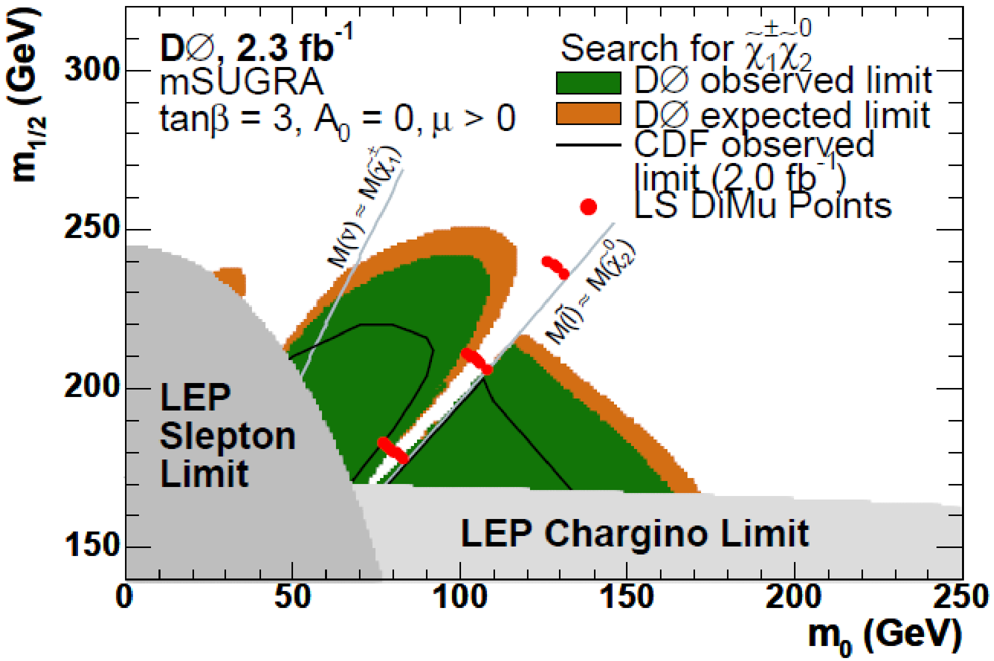


FIG. 3: Simulated signal points in the $m_0 \times m_{1/2}$ plane

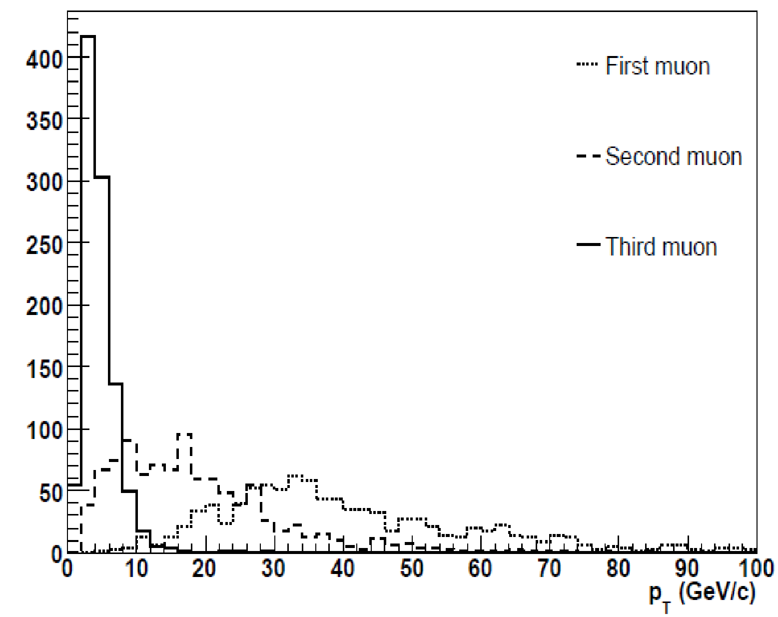


FIG. 4: p_T of the third, second and leading muon for the signal in SUGRA point 1

Data set and preselection

- Data set
  - Run IIb 4 fb^{-1} (Summer 2009 dataset)
  - Run IIa CSG_CAF_MUinclusive_PASS3_p18.13.01 data sample
- Pre selection
  - Events with at least 2 loose SS muons; Track reconstruction χ^2 /ndf < 4, dca < 0.2 or <0.02 (SMT hit), anti-cosmic cut, Δ z muon and primary vertex < 1cm
  - Pt > 8 GeV
- Isolation
  - Tight : Et calo (R=0.4) < 2.5 GeV; Et Track (R=0.5) < 2.5 GeV
  - Loose: 2.5 < Et calo < 4.0 GeV; 2.5 < Et Track < 4.0 GeV

Triggers

– Very low rate for single_OR
– Proposal:
  - MuMegaOr trigger list
  - Normalize MC/Data by normalization in the Z-peak region (ex. D0 note 5932)
  - Pt1 > 15 GeV and Pt2 > 10 GeV cut (need to cut the QCD bg)
  - MC normalized using known cross section and data Luminosity
  - Ratio of data and MC Z-peak integrals used as an additional flat scale factor
  - Factor of .835 introduced in the RunIIb plots

QCD background (from data)

- Divide data in two samples:
  - Sample S (signal): 1 tight isolated muon and 1 loose SS isolated muon
  - Sample Q (QCD bg): 1 tight isolated muon and one non loose isolated SS muon.
  - Pre selection criteria but 5 GeV < p_T < 8 GeV
- Normalization
  - Normalize sample Q extrapolating in the high p_T region with weight given by the non isolated muon on sample Q and both muon on sample S:

$$R(p_T) = \frac{N(p_T)^S}{2N(p_T)^Q}$$

  - Different R for different number of jets: 0,1,2,3 and > 3

Fit

- RunIIb

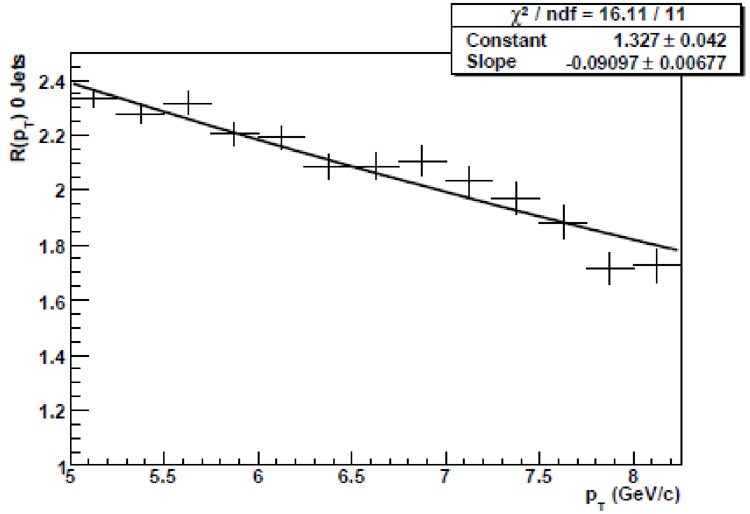


FIG. 10: Normalization function $R(p_T)_{0_J}$ for RunIIb data

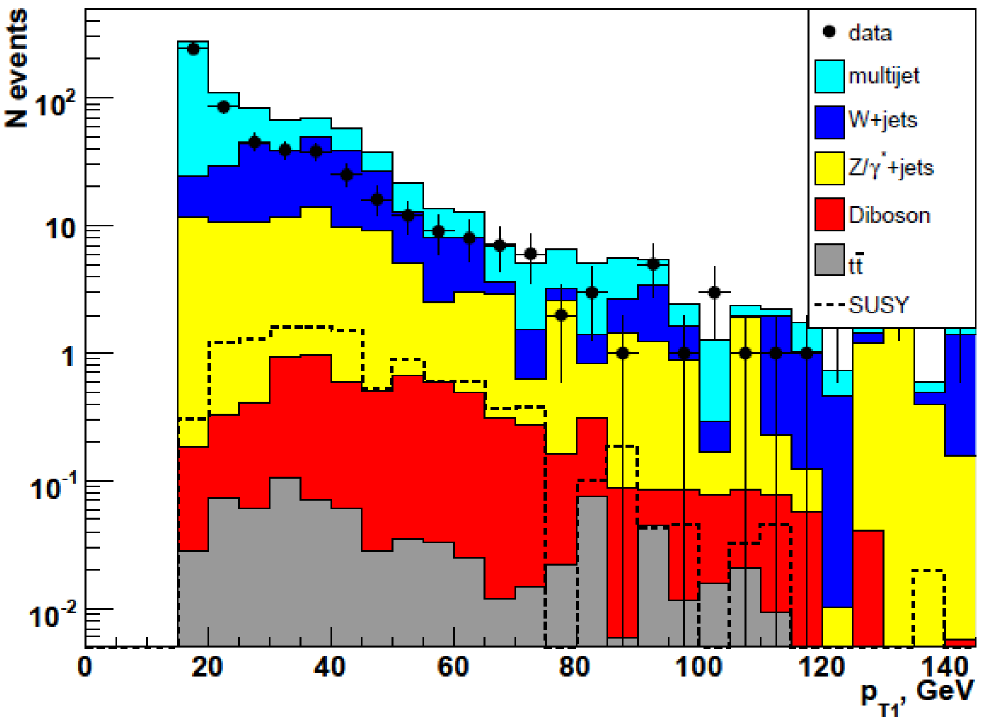
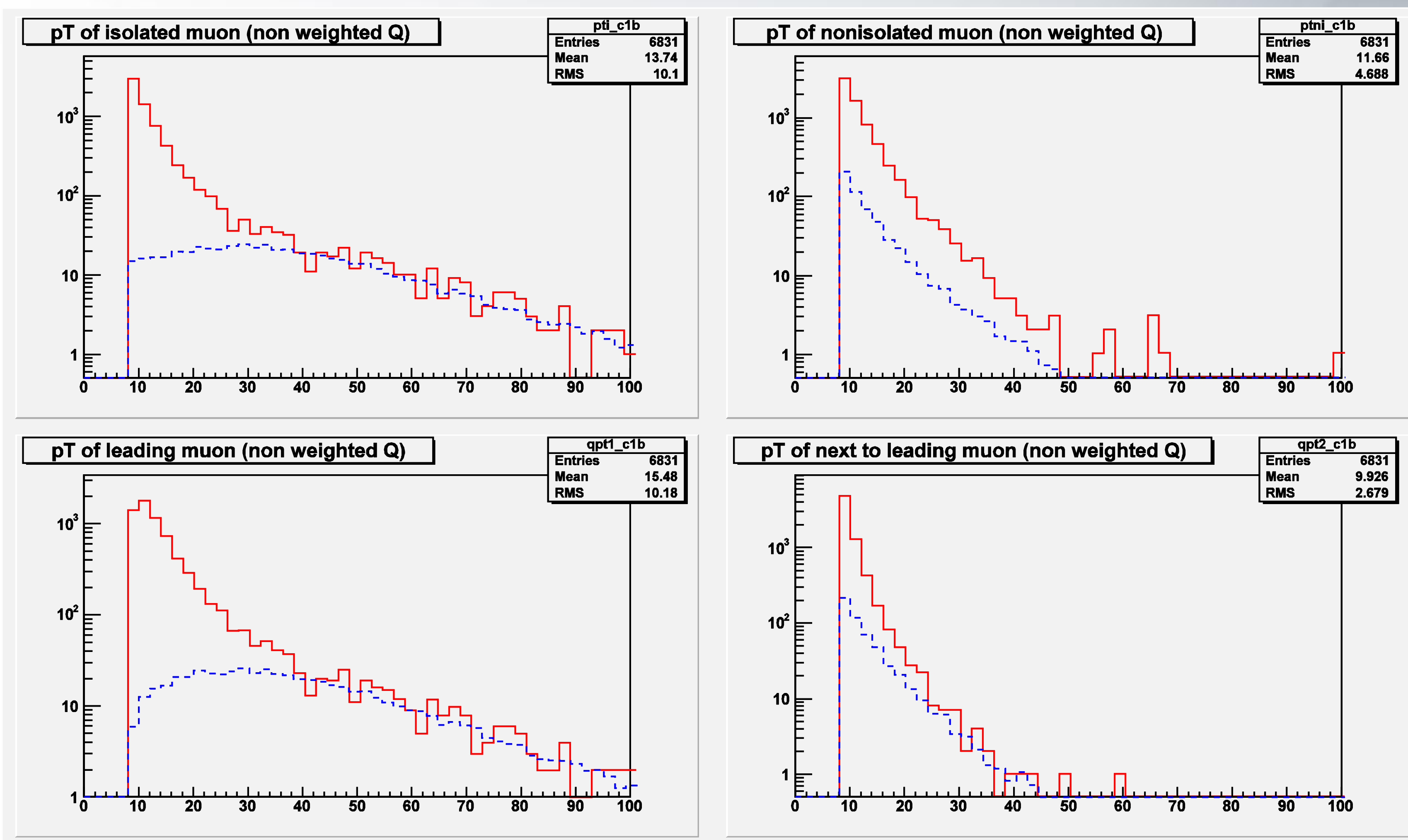


FIG. 18: Leading muon p_T distributions including all EW backgrounds for RunIIb.

EW contamination for sample Q

Sample Q from data vs Sample Q from MC

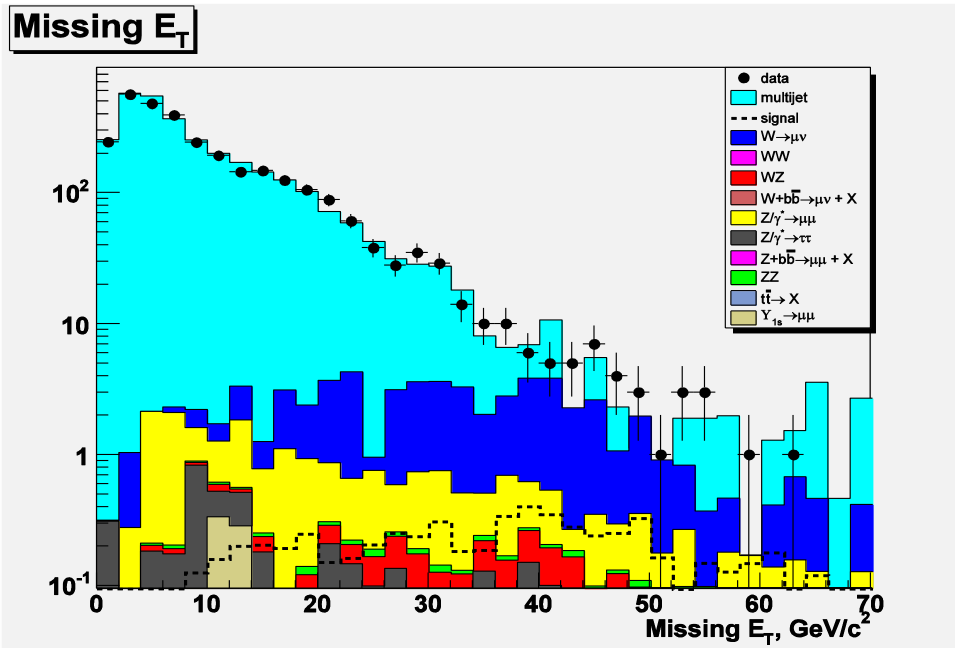


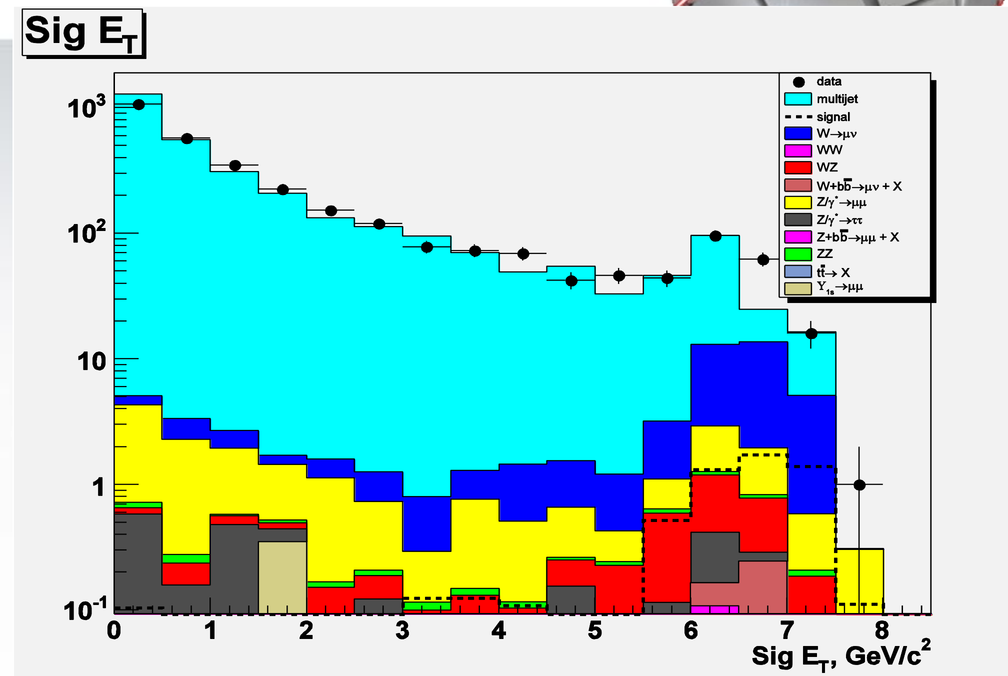
Subtraction of EW contamination

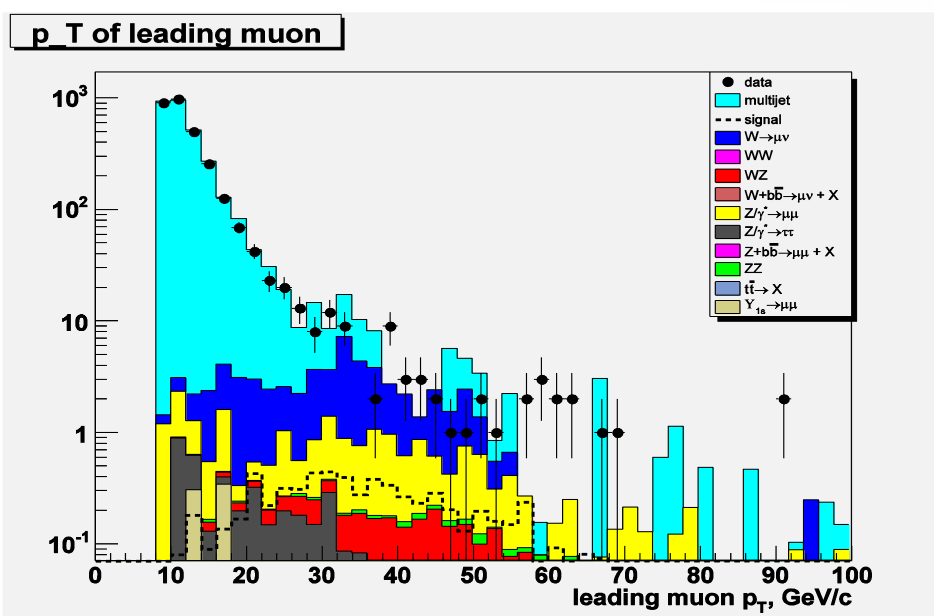
- Idea:
  - Sample Q multi-jet estimation is sample Q_{data} – sample Q_{MC}
  - Sample S estimation is Sample Q*R(pt)
  - Introduce a new weigth for each event or subtract bin by bin? Second aproach choosed.
  - Subtratc Q_{MC}*R(pt) for each histogram in sample S. In this way we do not introduce bias for fiting in one variable.

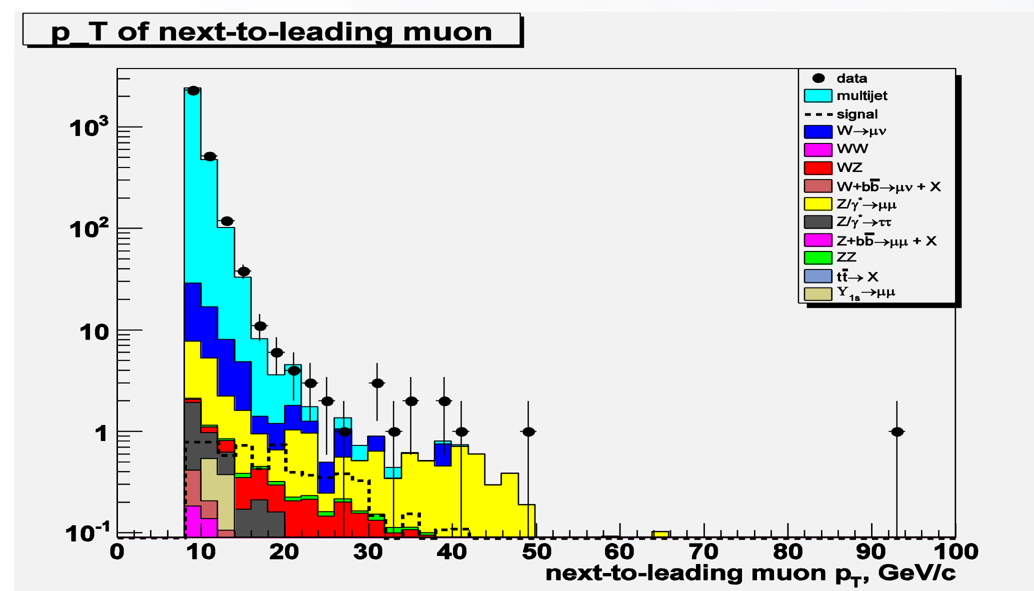
Results (Run IIa)

Data 3013 events,
QCD 2992.4 events



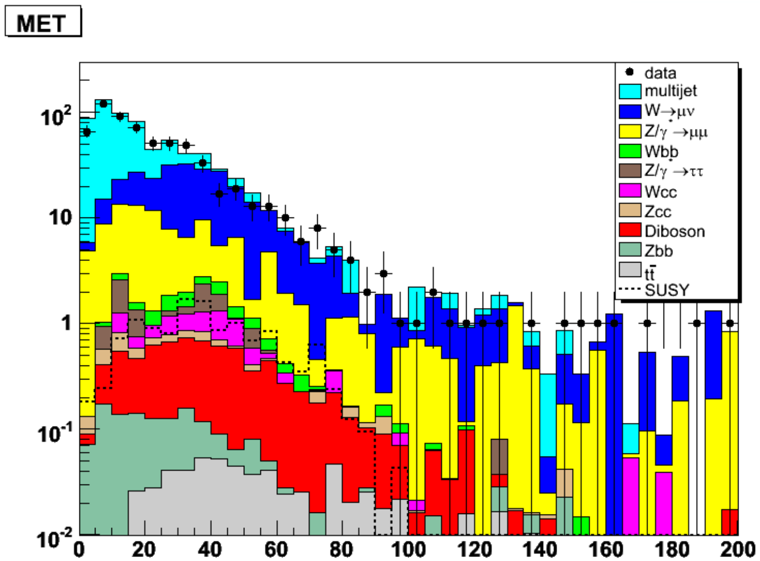


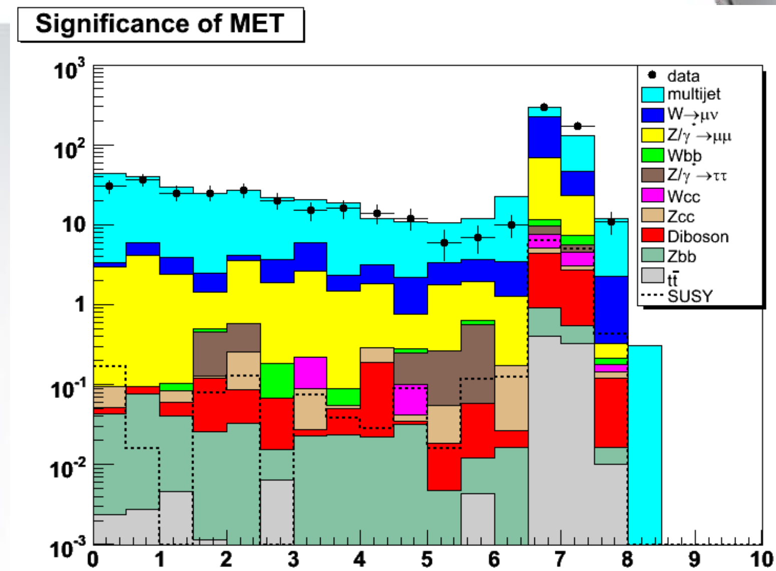


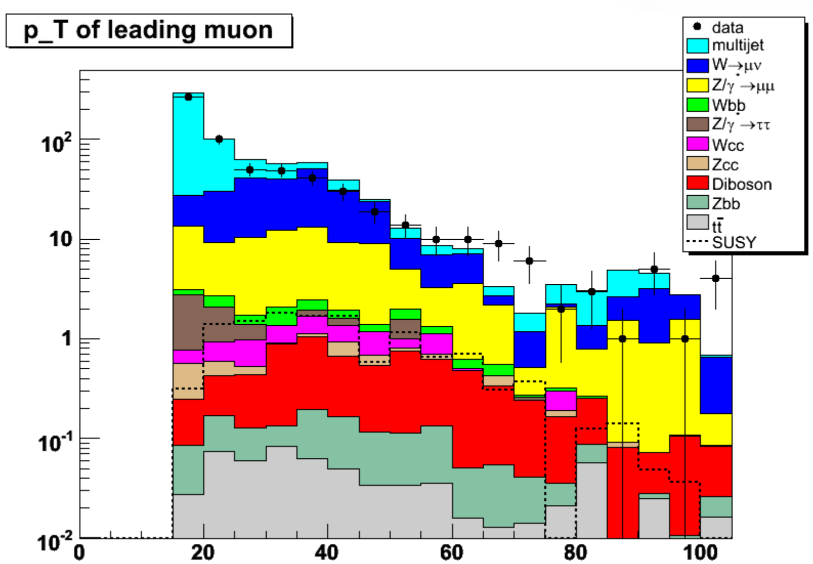


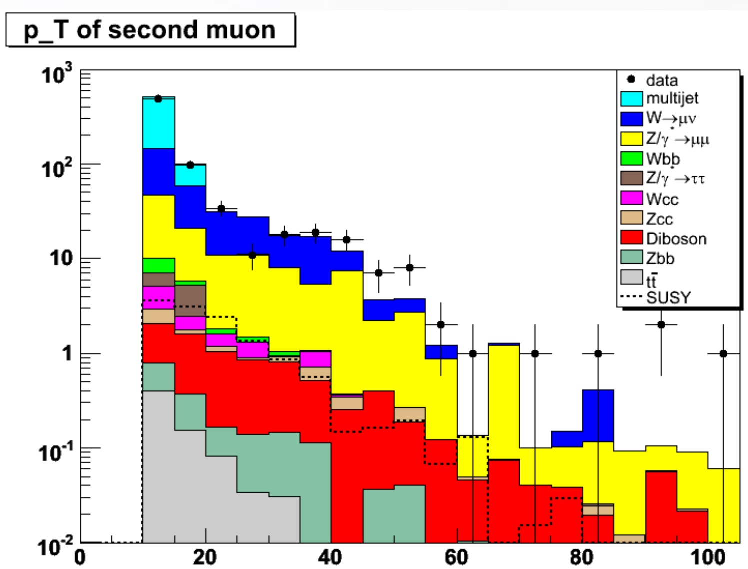
Results (Run IIb)

Data 642 events,
Total bg 708 events









Cut on Pt1 > 15 GeV
Pt2 > 10 GeV

Results

TABLE IX: RunIIb cutflow

Cut	W	QCD	Z	Diboson	$t\bar{t}$	Total BG	Data	Signal
Pre-selection	213.7±9.6	319.6±19.2	108.6±7.4	6.7±0.36	0.87±0.10	649.5±22.6	606	11.5±0.83
$p_{T1} > 31$	145.2±8.0	13.1±8.9	75.2±6.1	5.8±0.34	0.67±0.10	240.0±13.5	230	8.4±0.72
$p_{T2} > 17$	73.4±5.7	0	46.6±4.7	4.5±0.29	0.26±0.08	124.8±7.4	108	5.9±0.61
$\not{E}_T > 14$	68.2±5.4	0	40.8±4.4	4.2±0.28	0.26±0.08	113.5±7.0	96	5.7±0.61
$\not{E}_T \times p_{T2} > 500$	63.0±5.2	0	37.1±4.2	4.0±0.28	0.26±0.08	104.4±6.7	86	5.5±0.59
$Sig(\not{E}_T) > 6.8$	27.6±3.2	0	13.3±2.3	3.1±0.24	0.22±0.08	44.1±3.9	52	4.5±0.53
$16 < M_{\not{E}_T,p_{T2}} < 80$	14.5±2.2	0	3.9±1.1	2.2±0.19	0.18±0.08	20.7±2.5	27	3.8±0.49
$M_{\mu\mu} < 90$	12.2±2.0	0	2.2±0.97	1.12±0.14	0.10±0.02	15.6±2.2	10	3.4±0.47
$\chi_g^2 lob < 10$	4.1±1.2	0	0.81±0.52	0.93±0.13	0.06±0.02	5.9±1.3	3	3.0±0.45

TABLE X: RunIIb cutflow

Cut	1	2	3	4	5	6	7	8	9
Pre-selection	6.46±0.70	9.17±0.80	9.95±0.83	11.50±0.83	15.42±0.96	18.24±0.99	16.52±0.87	3.93±0.30	4.42±0.31
$p_{T1} > 31$	4.05±0.56	5.53±0.604	6.44±0.66	8.42±0.72	11.30±0.82	12.32±0.81	11.93±0.76	3.21±0.28	3.42±0.27
$p_{T2} > 17$	2.42±0.44	3.63±0.49	4.78±0.56	5.87±0.61	8.56±0.71	9.02±0.69	8.18±0.62	2.11±0.22	2.21±0.22
$\not{E}_T > 14$	2.29±0.43	3.19±0.46	4.46±0.54	5.69±0.61	7.96±0.68	8.52±0.68	7.81±0.61	1.97±0.21	2.04±0.21
$\not{E}_T \times p_{T2} > 500$	2.19±0.43	3.09±0.45	4.33±0.53	5.45±0.59	7.46±0.65	8.03±0.65	7.26±0.59	1.85±0.21	2.01±0.21
$Sig(\not{E}_T) > 6.8$	1.64±0.36	2.33±0.37	3.42±0.47	4.47±0.53	6.65±0.61	6.58±0.59	6.28±0.54	1.49±0.18	1.61±0.18
$16 < M_{\not{E}_T,p_{T2}} < 80$	1.47±0.35	1.89±0.33	2.78±0.42	3.82±0.49	5.30±0.55	5.05±0.51	4.82±0.47	1.01±0.15	1.12±0.15
$M_{\mu\mu} < 90$	1.03±0.28	1.34±0.28	2.10±0.36	3.36±0.47	3.46±0.42	4.16±0.46	3.82±0.42	0.86±0.14	0.73±0.12
$\chi^2_{glob} < 10$	0.84±0.26	1.23±0.27	1.70±0.33	2.99±0.45	2.99±0.40	3.65±0.44	3.41±0.40	0.77±0.13	0.62±0.11
Cut	10	11	12	13	14	15	16	17	
Pre-selection	4.54±0.30	5.93±0.37	6.71±0.33	1.02±0.06	1.54±0.11	2.20±0.14	2.27±0.13	1.79±0.08	
$p_{T1} > 31$	3.62±0.27	4.90±0.33	5.56±0.30	0.73±0.05	1.31±0.10	1.87±0.12	1.95±0.12	1.57±0.08	
$p_{T2} > 17$	2.67±0.23	3.96±0.30	4.24±0.26	0.53±0.04	1.01±0.09	1.52±0.11	1.53±0.10	1.29±0.07	
$\not{E}_T > 14$	2.42±0.22	3.67±0.29	4.03±0.25	0.51±0.04	0.96±0.09	1.47±0.11	1.47±0.10	1.23±0.07	
$\not{E}_T \times p_{T2} > 500$	2.27±0.21	3.45±0.28	3.92±0.25	0.47±0.04	0.94±0.08	1.41±0.11	1.45±0.10	1.21±0.07	
$Sig(\not{E}_T) > 6.8$	1.89±0.19	3.00±0.26	3.37±0.23	0.36±0.03	0.69±0.07	1.14±0.10	1.21±0.09	0.98±0.06	
$16 < M_{\not{E}_T,p_{T2}} < 80$	1.30±0.16	2.26±0.22	2.25±0.18	0.27±0.03	0.37±0.05	0.68±0.07	0.82±0.07	0.58±0.05	
$M_{\mu\mu} < 90$	0.99±0.14	1.37±0.17	1.33±0.14	0.18±0.02	0.19±0.04	0.36±0.05	0.49±0.06	0.34±0.04	
$\chi^2_{glob} < 10$	0.84±0.13	1.06±0.15	1.11±0.13	0.16±0.02	0.17±0.03	0.33±0.05	0.45±0.06	0.28±0.03	

Results

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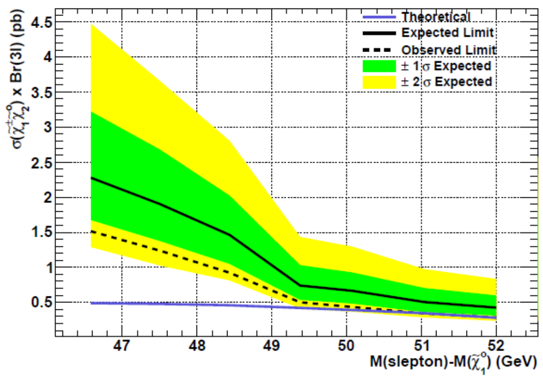

FIG. 33: Observed (dash line) and expected (solid line) limits on $\sigma(p\bar{p} \to \tilde{\chi}_1^{\pm}\tilde{\chi}_2^0) \times BR(3l)$ as a function of the slepton and the lightest neutralino mass difference. Also shown is the expected SUSY cross section.

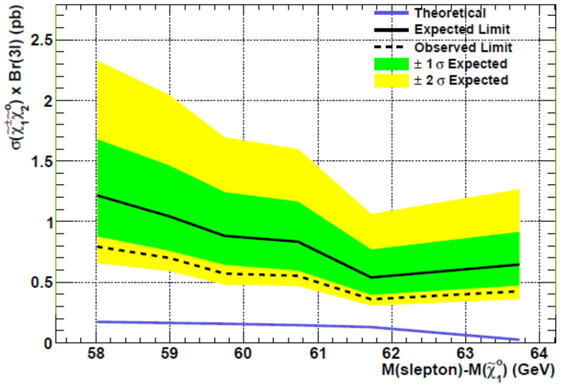

FIG. 34: Observed (dash line) and expected (solid line) limits on $\sigma(p\bar{p} \to \tilde{\chi}_1^{\pm}\tilde{\chi}_2^0) \times BR(3l)$ as a function of the slepton and the lightest neutralino mass difference. Also shown is the expected SUSY cross section.

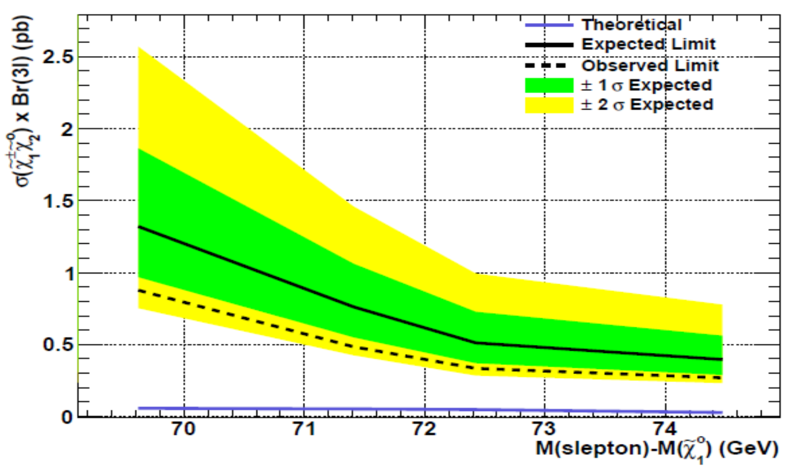

FIG. 35: Observed (dash line) and expected (solid line) limits on $\sigma(p\bar{p} \to \tilde{\chi}_1^{\pm}\tilde{\chi}_2^0) \times BR(3l)$ as a function of the slepton and the lightest neutralino mass difference. Also shown is the expected SUSY cross section.

Multi Variate Approach- Work in progress

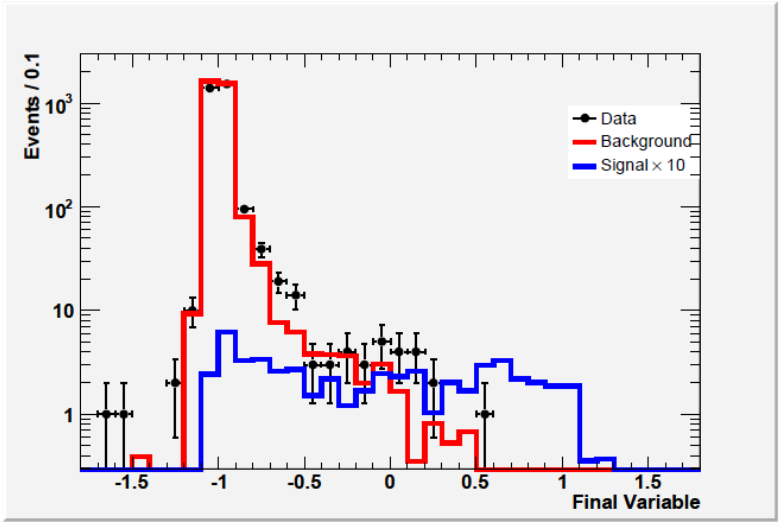

FIG. 31: Output of TMVA classifier for RunIIa.

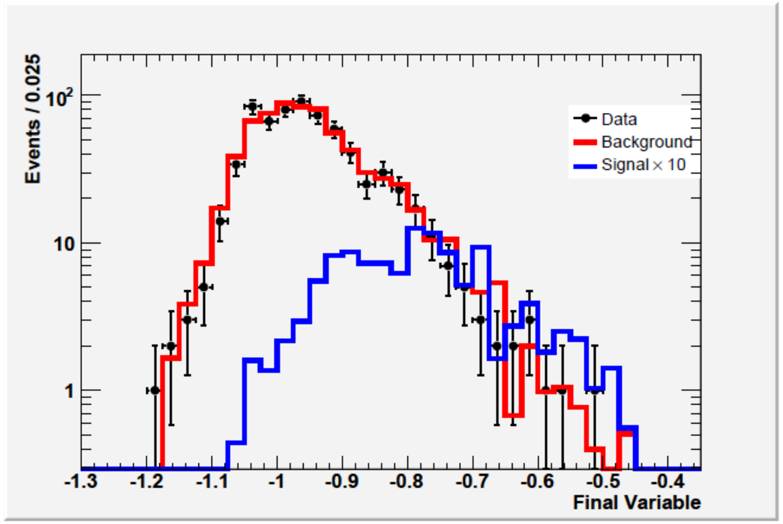

FIG. 32: Output of TMVA classifier for RunIIb.