SUSY and UED in like-sign dimuon

Status for Runlla and Runllb

Mar, 18th 2010

Ângelo Santos (IFT-UNESP)

LS di-muon team: Pedro Mercadante, Andrey Shchukin, Jason Mansur, A.S., Alexey Popov, Leo Bellantoni, Carsten Hensel, Vladimir Goryachev

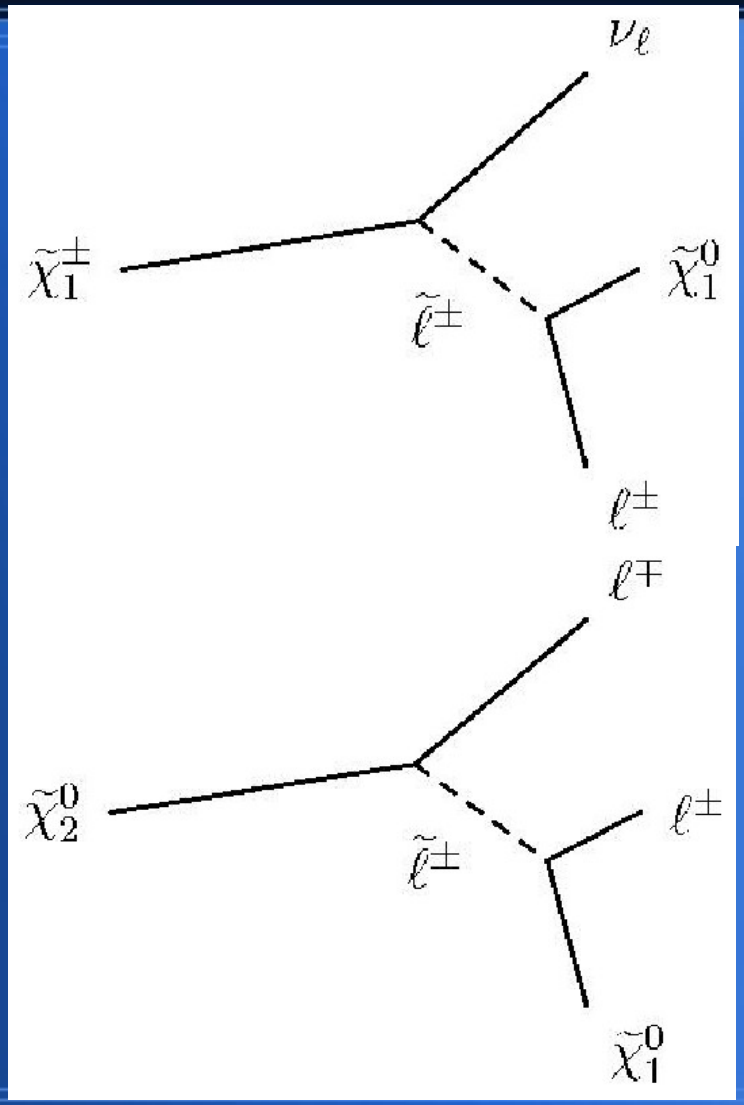
Outline

- Susy and UED common final states
- Data sets and Pre- selections using *np_lsdimuon* package
- Modeling QCD background from Data
- MC normalization factor from $Z/\gamma^* \rightarrow \mu^+\mu^-$ mass peak region
- Data- MC distributions after scale factor
- RunIIb: Distributions in pre- selection level after all corrections
- RunIIa: Distributions in pre- selection level after all corrections
- RunIIa: Old optimization cuts
- Conclusion and Plans

Susy and UED common final states

- Susy (mSUGRA) models predicts tri-lepton final states from chargino and neutralino decays.
- For UED, those final states decay from Z_1/W_1.

- However, if the mass difference between slepton and neutralino is small, the third lepton can be very soft.
- Thus this analysis has 2 same-sign muons and missing transverse energy in the final states.



Data sets and Pre- selections using *np_lsdimuon* package

- We have been using vjets_cafe package in the most part of the code to make small skims.
- **Data Set:**
  - **RunIIa CSG_CAF_MUinclusive_PASS3_p18.13.01 data sample**
  - **RunIIb 4 fb^{-1} (Summer 2009 DataSet)**
- **Pre-selections:**
  - 2 loose muons with same sign
  - χ^2/ndf < 4
  - dca < 0.2 (no SMT hits) and < 0.02 (with SMT hits)
  - anti-cosmic cut
  - ΔZ < 1cm and Primary Vertex < 1cm
- **Isolation cut:**
  - **Tight muon: etHalo < 2.5 GeV and etTrkCone < 2.5 GeV**
  - **Loose muon: etHalo < 4.0 GeV and etTrkCone < 4.0 GeV**

Modeling QCD background from Data

- We have 2 samples:
  - S sample: 1 muon tight isolated and 1 loose (can also be tight) isolated of same sign.
  - Q sample: 1 muon tight isolated and 1 one non isolated of same sign.
- Sample Q is used to model background from Monte Carlo using the non isolated muon pT.
  - Take the momentum distribution in range 5 GeV < p_T < 8 GeV
  - And make the distribution ratio between sample S and Q considering different numbers of jets:

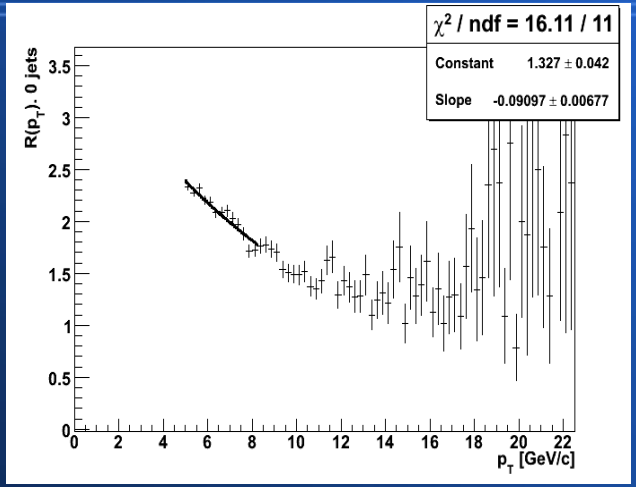
$$R(p_T) = \frac{N(p_T)^S}{2N(p_T)^Q}$$

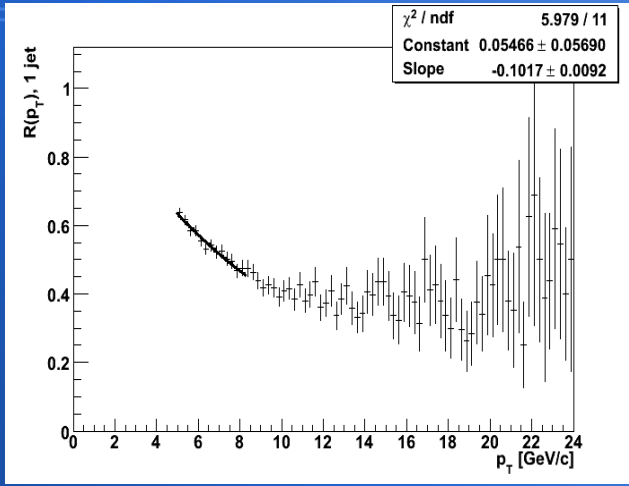
- Apply this ratio in momentum of non isolated muon with pT > 8 GeV.
- QCD background is the subtraction between sample Q_{DATA} and sample Q_{MC} (both with $R(p_T)$ correction).

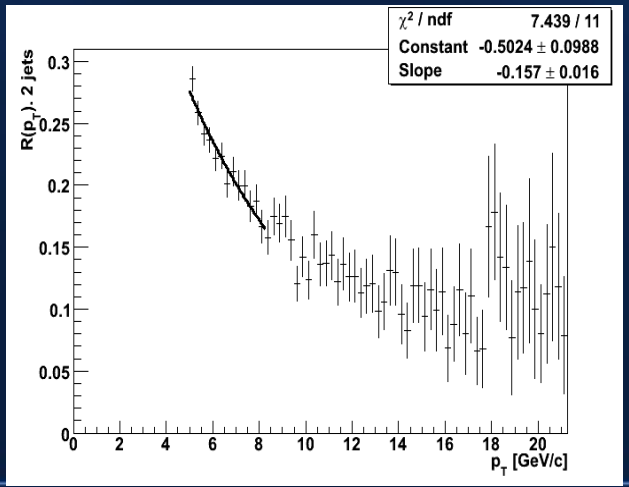
Modeling QCD background from Data

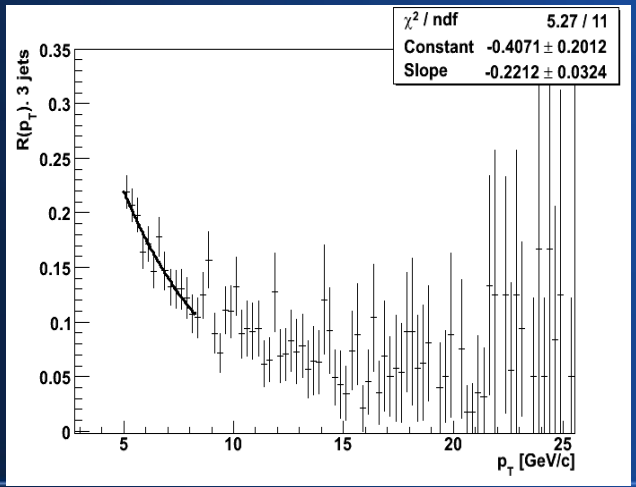
R(pT) from different number of jets

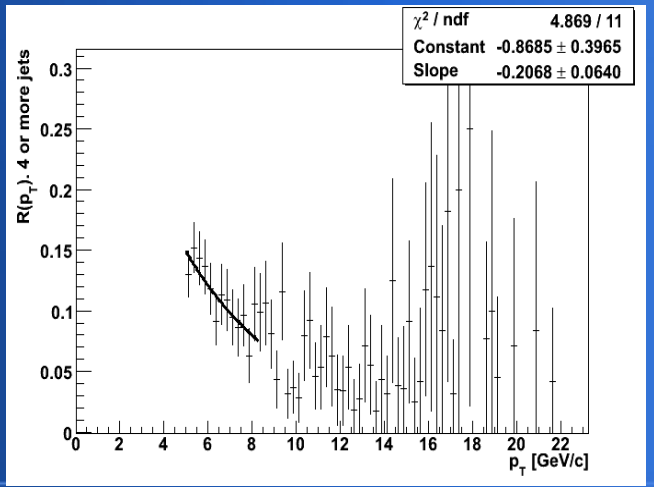
$$R(p_T) = \frac{N(p_T)^S}{2N(p_T)^Q}$$





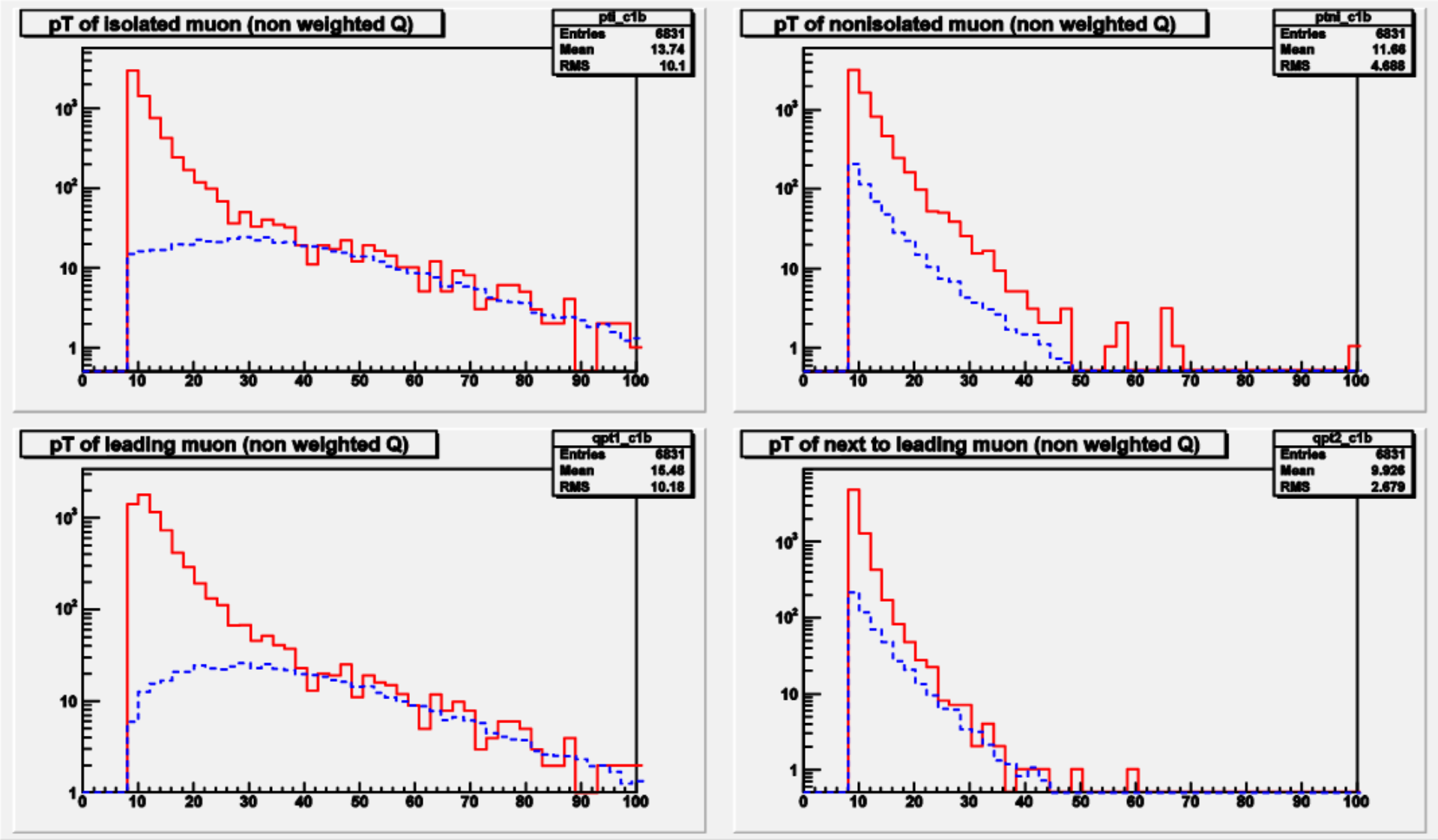






Modeling QCD background from Data

Comparison between Q_{DATA} sample and Q_{MC} sample

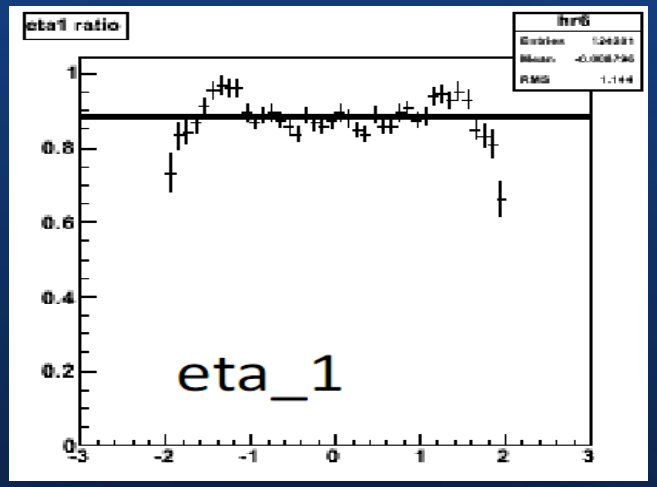


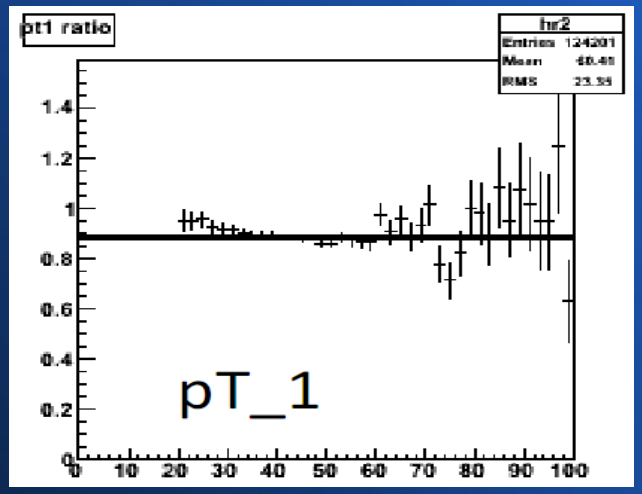
MC normalization factor from $Z/\gamma^* \rightarrow \mu^+\mu^-$ mass peak region

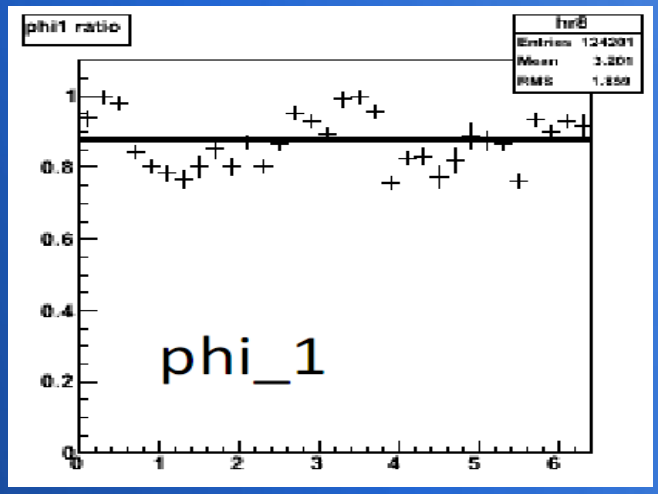
Muon MegaOR Triggers Data / MC

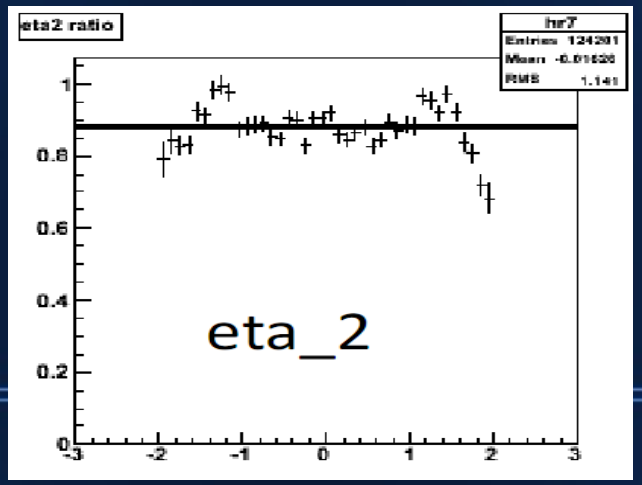
- Opposite sign muons
- Same pre-selection like same sign
- S sample

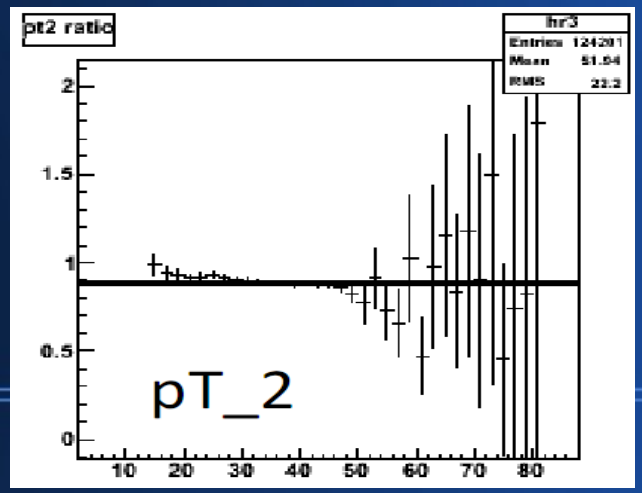
- $p_T^{leading} > 15$ GeV
- $p_T^{second} > 10$ GeV
- 80 GeV < Invariant mass < 100 GeV

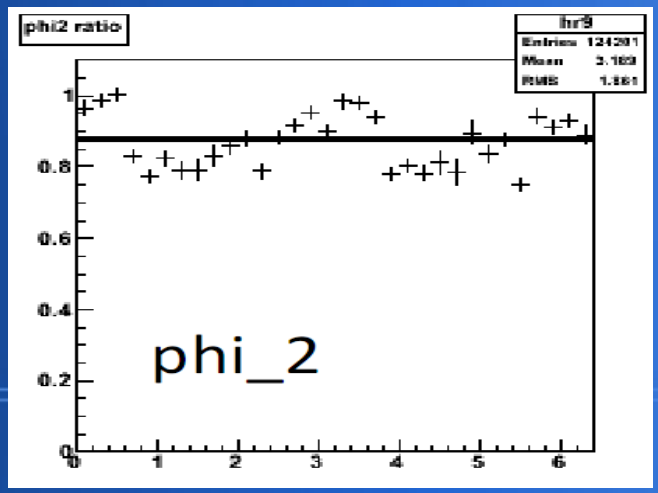








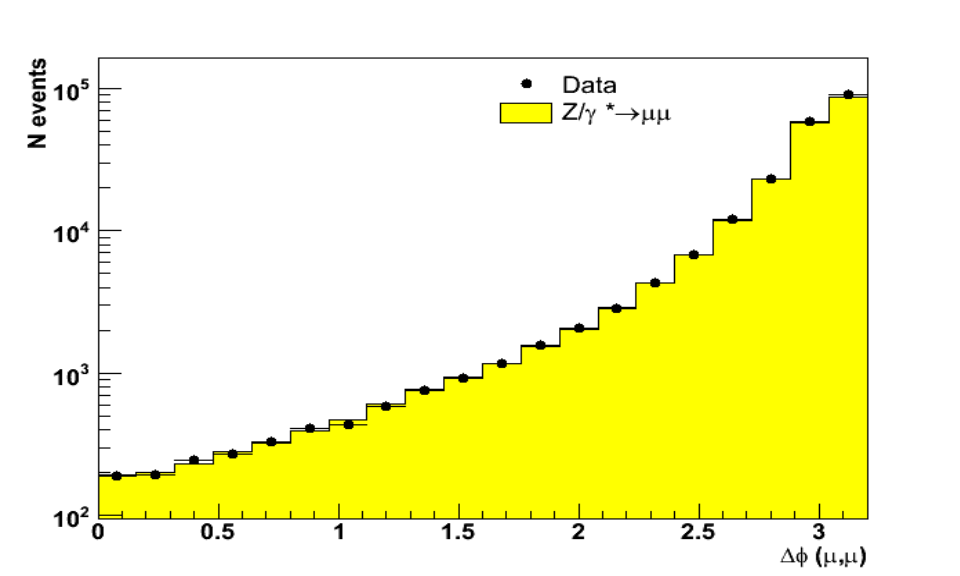


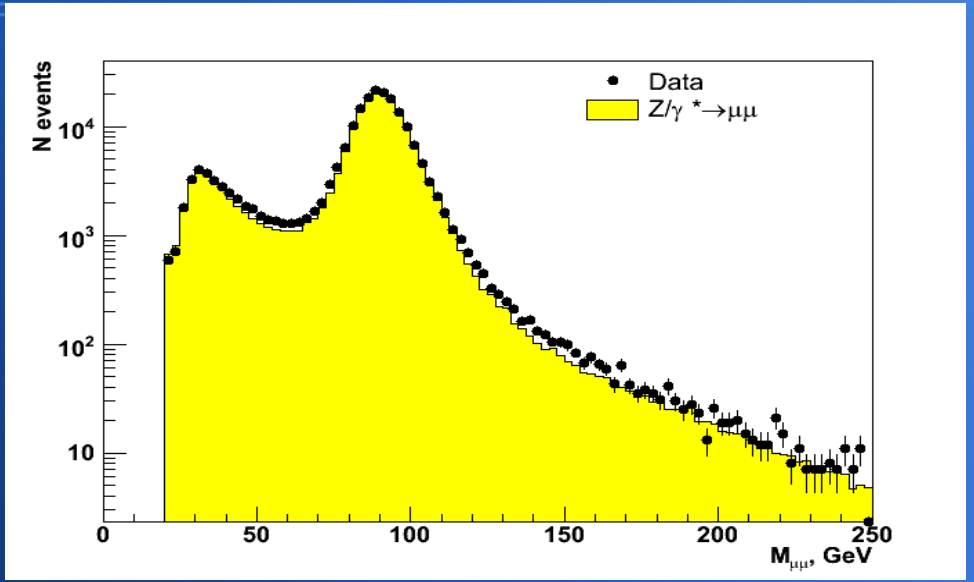


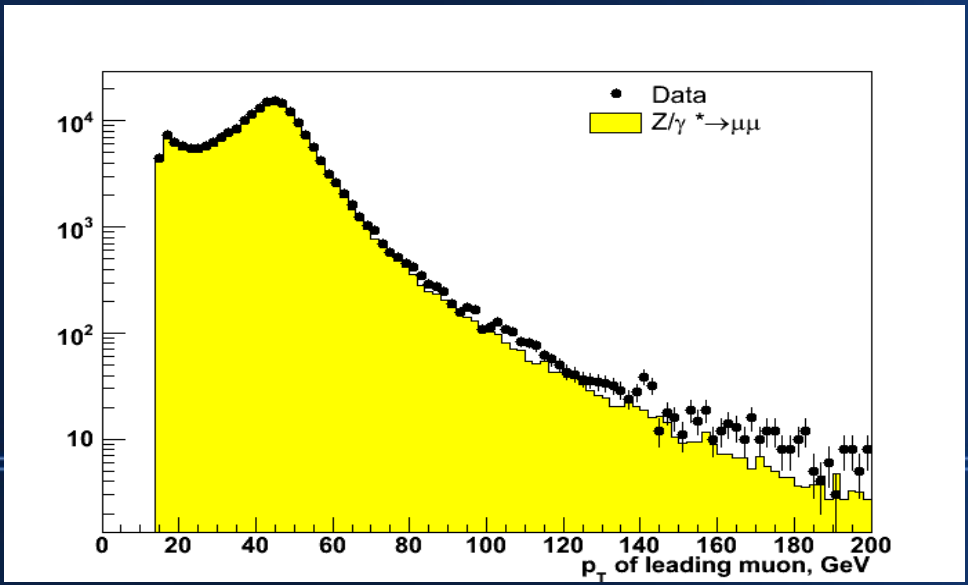
MC is normalized from data

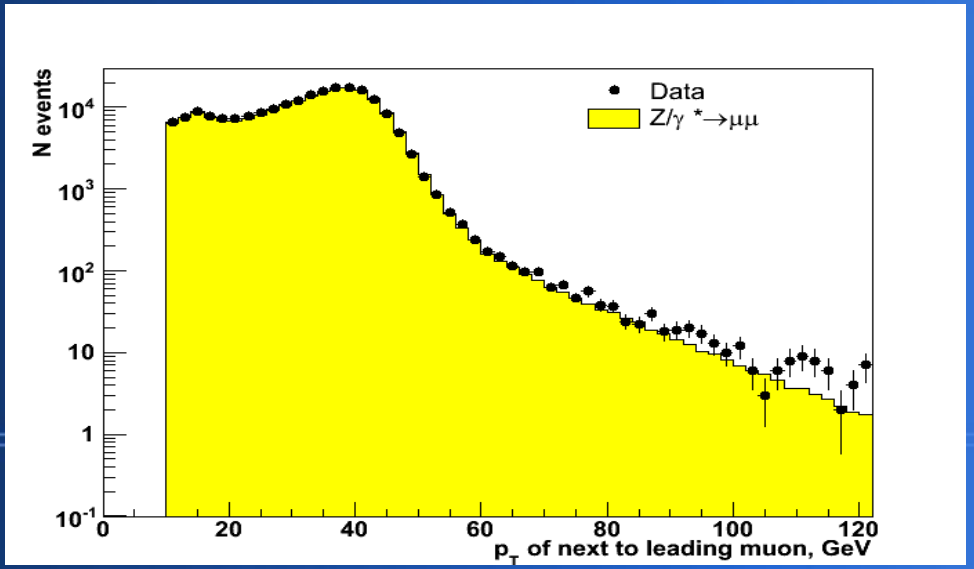
(with new trigger scale factor = 0.9)

Data-MC opposite-sign distributions after scale factor



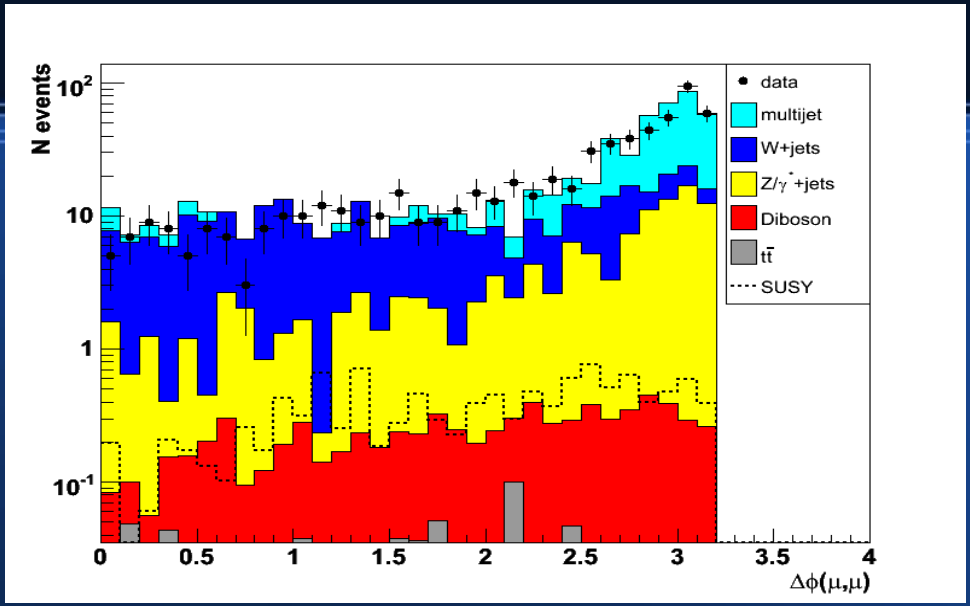


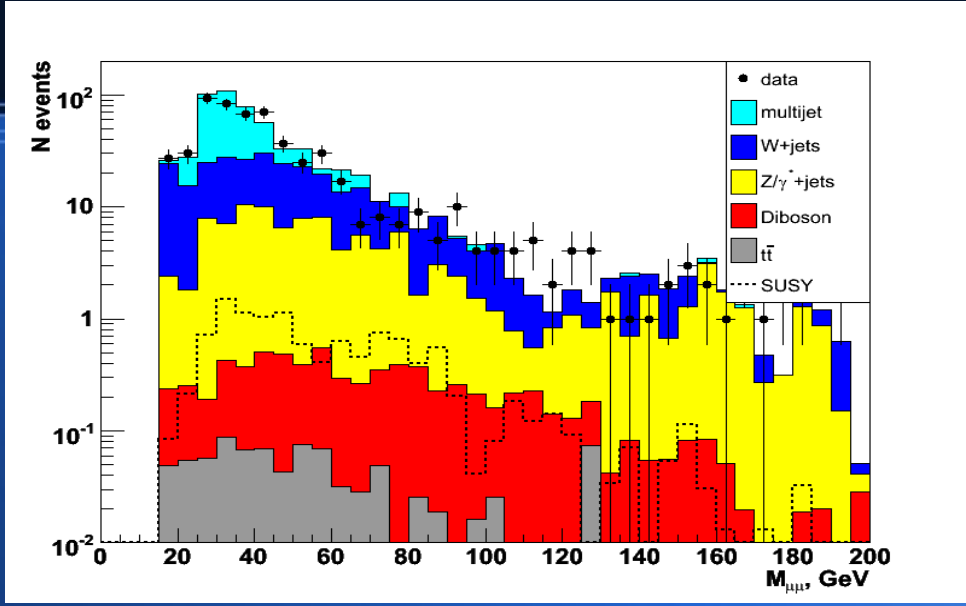


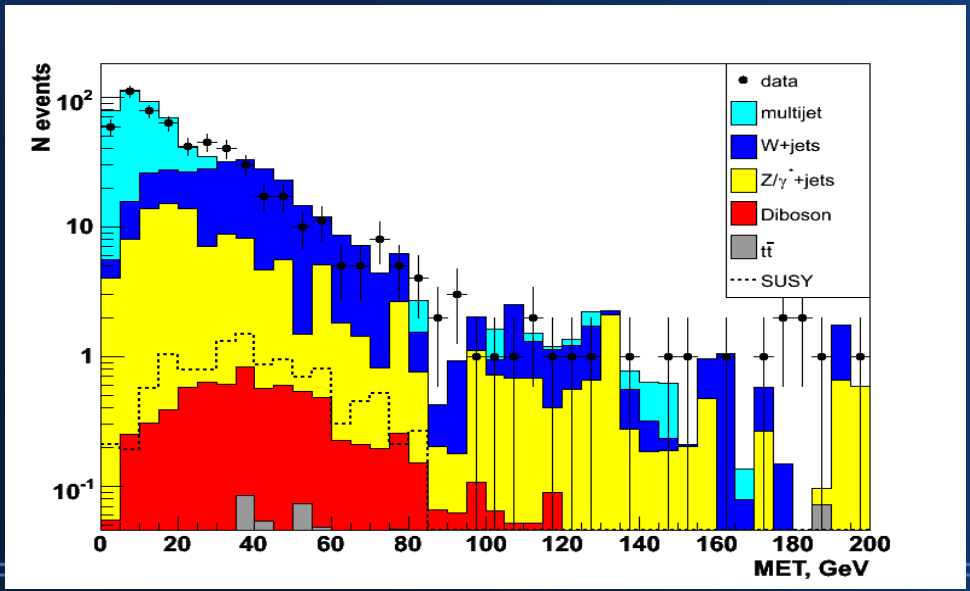


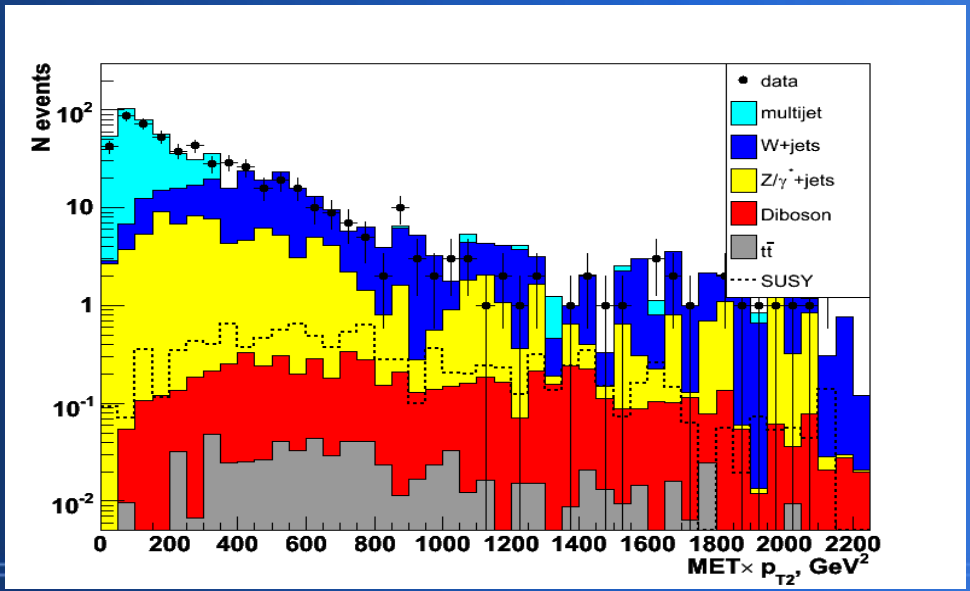
RunIIb - Distributions in pre-selection levelafter all corrections and

$pT^{leading}$ > 15 GeV; pT^{second} > 10 GeV; M_{pair} > 15 GeV

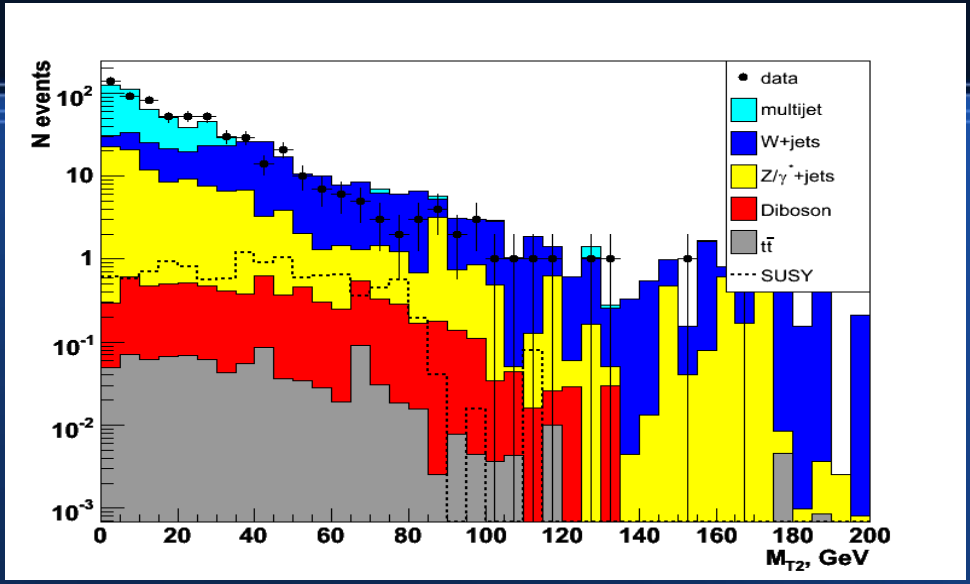


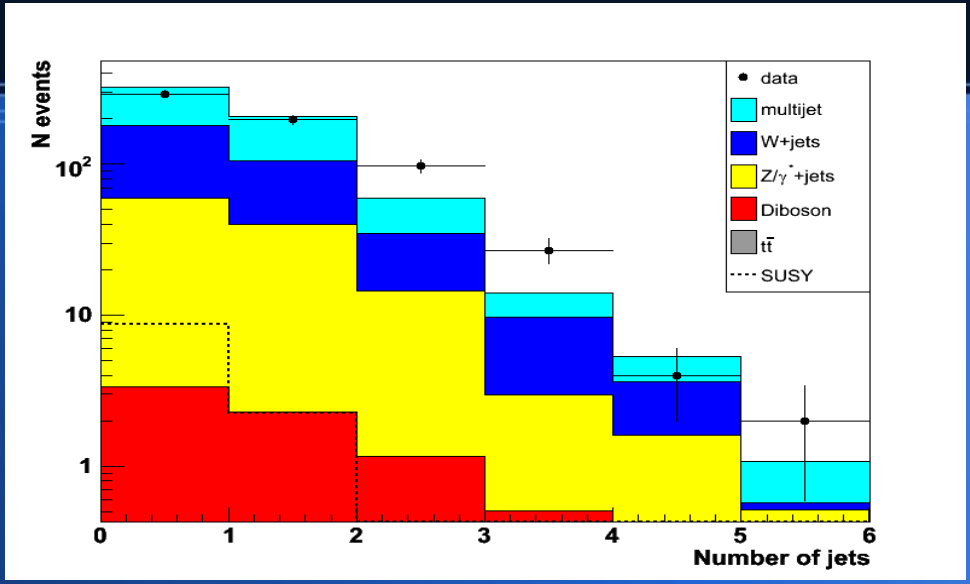


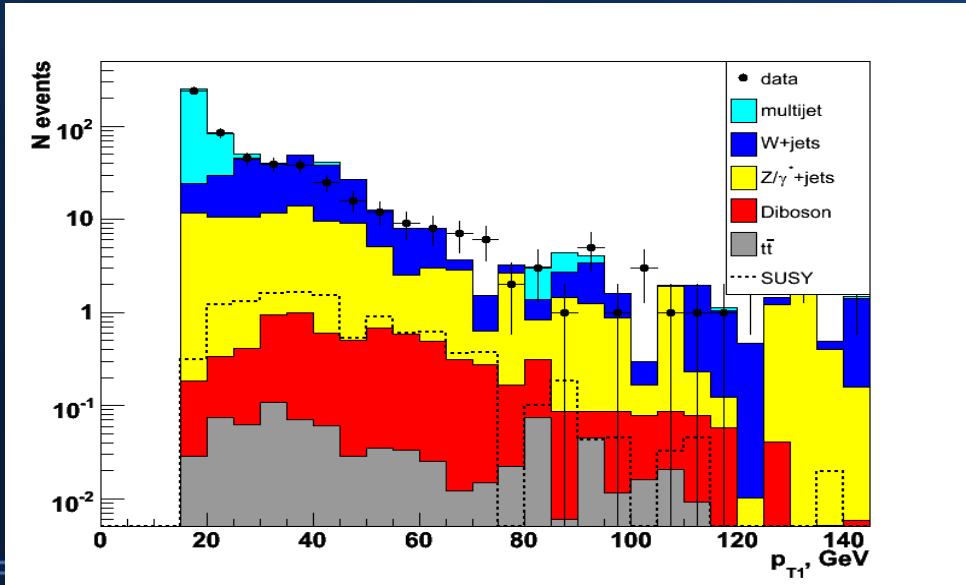


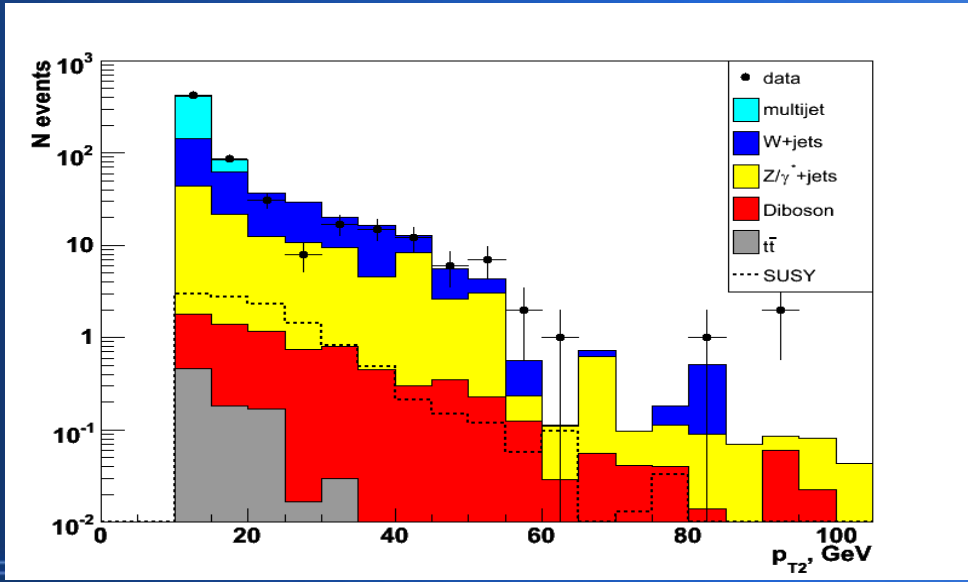


RunIIb - Distributions in pre-selection level after all corrections and $pT^{leading} > 15$ GeV; $pT^{second} > 10$ GeV; $M_{pair} > 15$ GeV

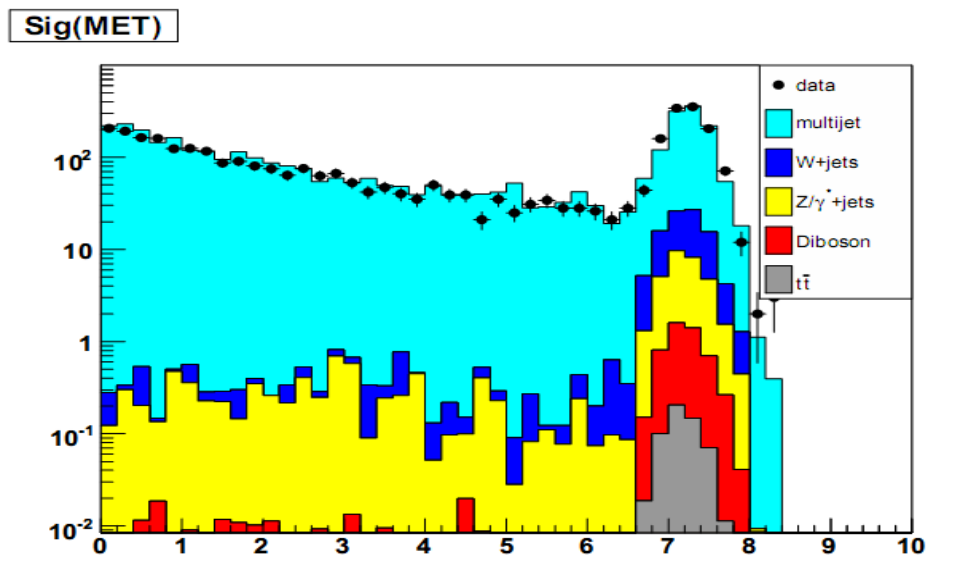


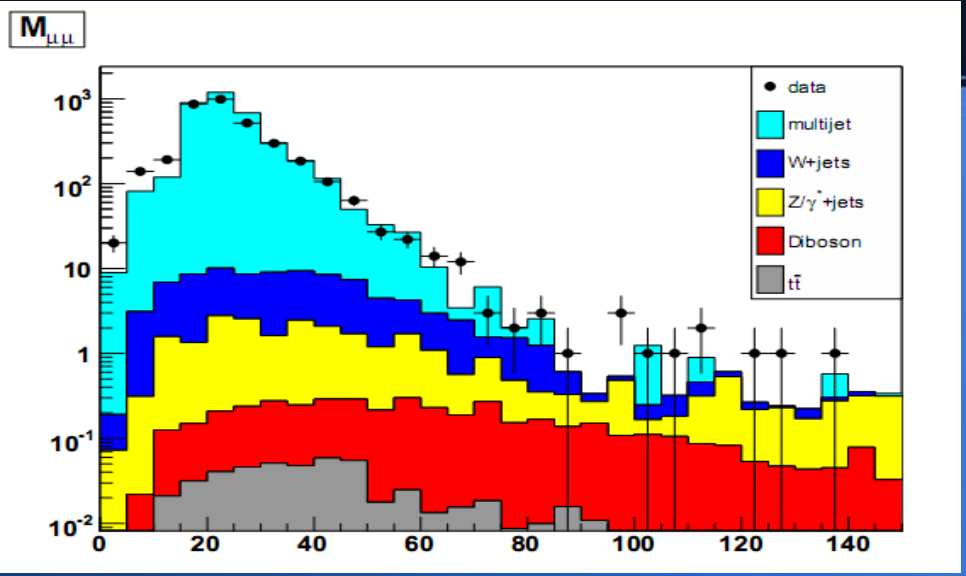


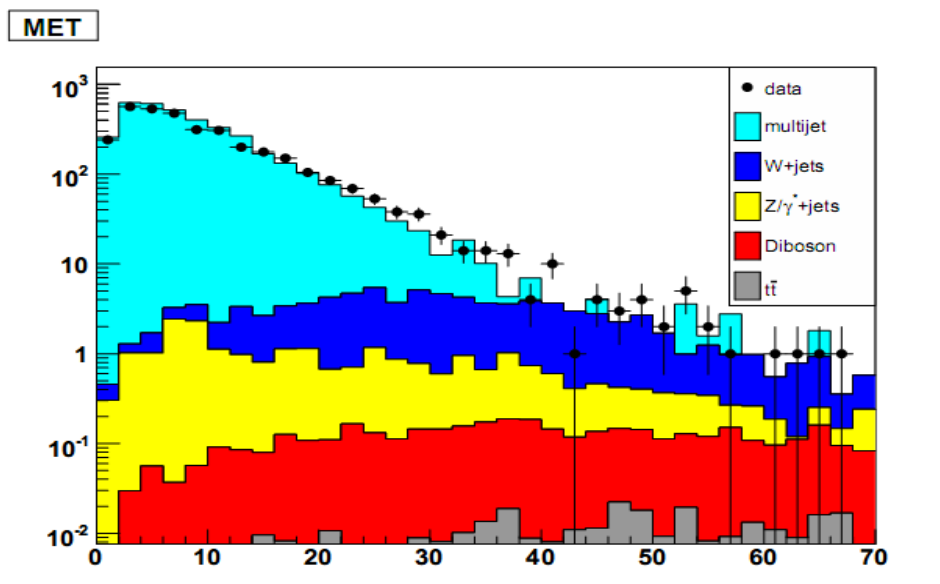


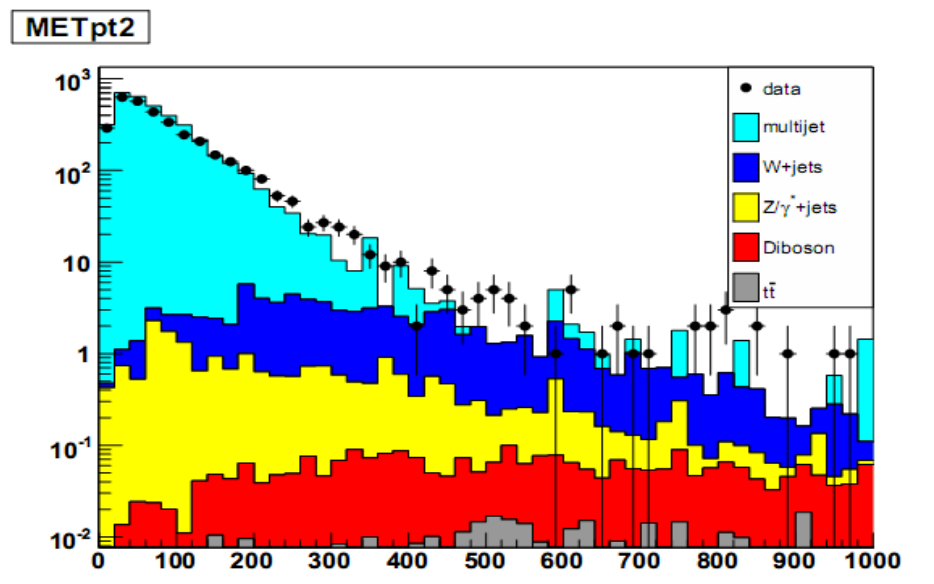


RunIIa - Distributions in pre-selection level after all corrections and MC scale factor = 1.0; $pT^{leading} > 8$ GeV; $pT^{second} > 8$ GeV

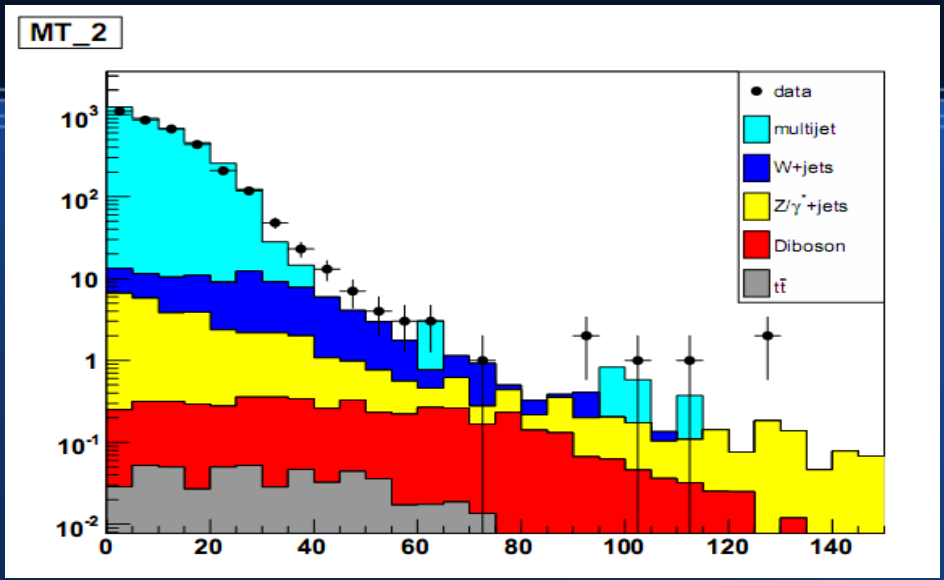


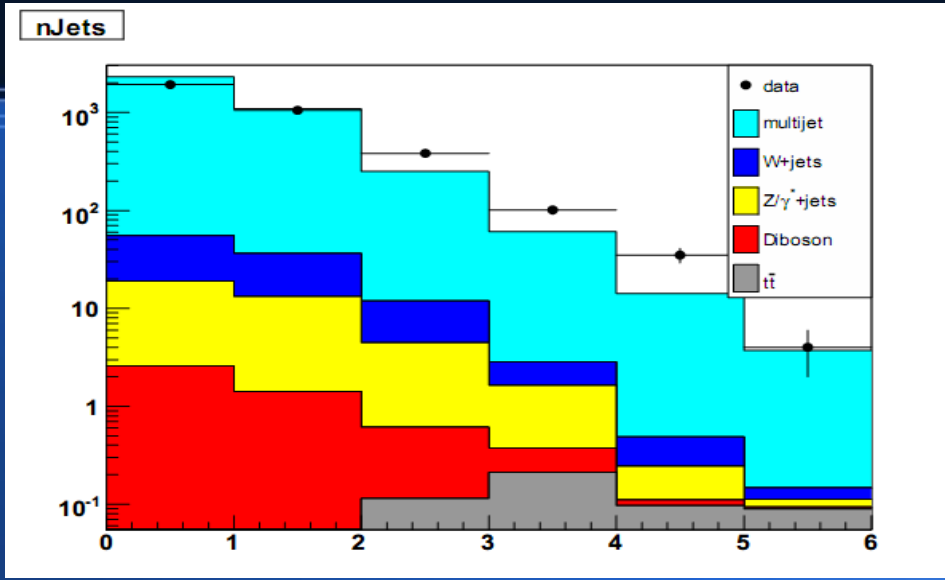


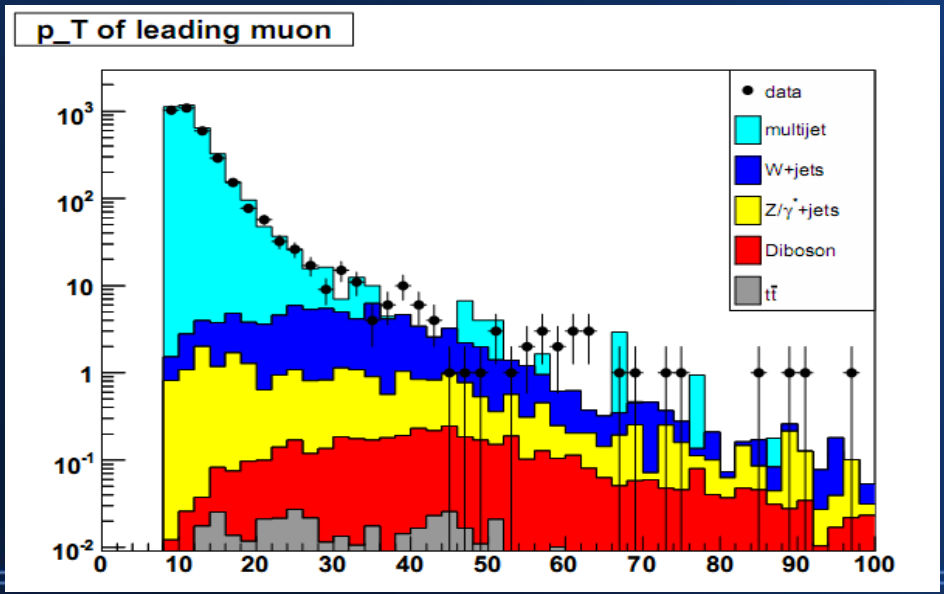


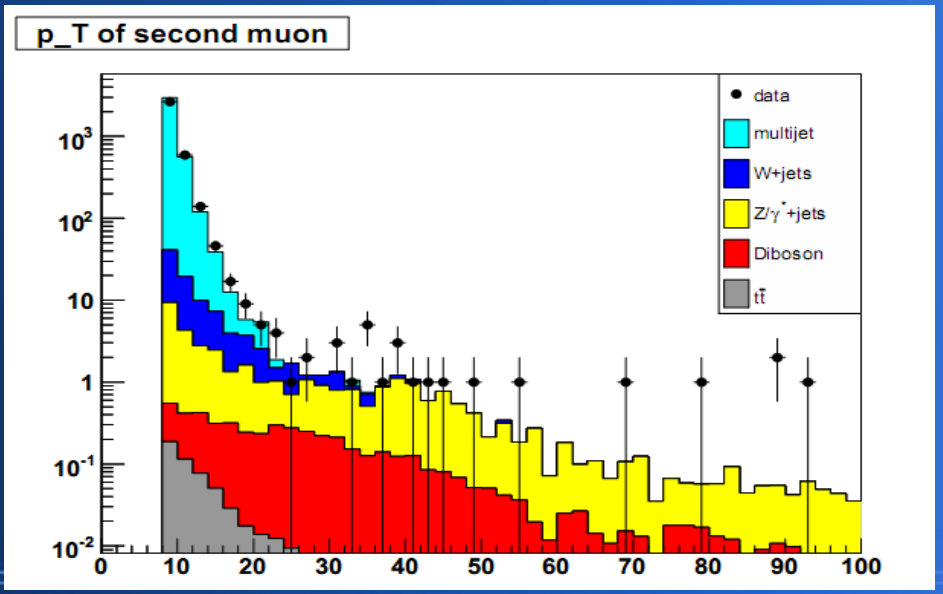


RunIIa - Distributions in pre-selection level after all corrections and MC scale factor = 1.0; $pT^{leading} > 8$ GeV; $pT^{second} > 8$ GeV









RunIIa analysis with np_lsdimuon package

Old cuts

- $\Delta\phi < 2.9$
- $pT_1 > 21$ GeV
- 17 GeV $< pT_2 <$ 44 GeV
- 10 GeV $< M\mu\mu <$ 100 GeV
- 20 GeV $<$ MT2 $<$ 115 GeV
- MET $>$ 27 GeV
- SigMEt > 6 GeV$^{-1/2}$
- METx$pT_2 > 550$ GeV^2

	Z+jets	W+jets	Diboson	tt	QCD	All Bg.	Data
Presel.	33.47	68.62	4.64	0.57	3615.17	3722.47	3506
$\Delta\phi$	19.81	60.92	4.03	0.52	2077.41	2162.69	2312
pT_2	5.76	7.10	2.32	0.09	1.66	16.92	23
pT_1	5.69	6.83	2.30	0.09	0.47	15.37	21
$M_{\mu\mu}$	1.65	6.44	1.70	0.07	0.69	10.54	11
MT_2	1.21	5.74	1.53	0.06	0	8.54	8
MET	0.59	3.96	1.27	0.04	0	5.87	4
SigMET	0.59	3.96	1.27	0.04	0	5.87	4
METpT2	0.58	3.90	1.26	0.04	0	5.78	3

Conclusion

- Expanding the parametrization in low pT region, as well as subtracting the **electro-weak backgrounds** (with non isolated muons) from the **QCD background** (also with non isolated muons) , allows us to model the QCD background very well.
- **The MC normalization factor of 0.9** (from $Z/\gamma^* \rightarrow \mu^+\mu^-$ mass peak region) looks to lead to a good agreement between **Data and all electro-weak backgrounds**.
- We have to make a double check in optimization cuts for RunIIa due some difference between Data and background.

Plans

- ✓ Make optimization cuts.
- ✓ Push this analysis with TMVA
- ✓ Finalize the D0 note.