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Top Mass Measurement in the Lepton+Jets Channel Using Soft Muon Tagging

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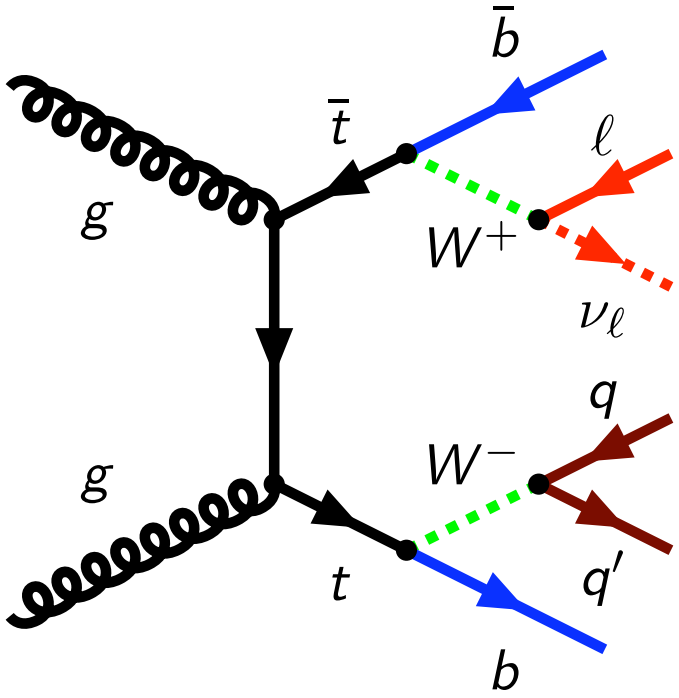
Event Selection



- 1 isolated lepton e / μ > 25 *GeV/c*
- Veto on events with 2 high pT leptons
- 3 or more jets with pT > 40 *GeV/c*
- MET > 20 *GeV*
- Scaler HT > 200 *GeV*
- One or more b-jet with a Soft Lepton Tag (SLT)
- Pass EF e25i and mu20i triggers

Event Selection
Definitions

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good electron

- e-gamma (author !=2)
- 'medium' (0x3FF)
- pT > 25 *GeV/c*
- |eta| < 2.5
- No Isolation

good muon

- STACO muid
- algo == 1
- pT > 20 *GeV/c*
- |eta| < 2.5
- eT cone20 < 6 *GeV*

good jet

- cone 0.4 (tower)
- pT > 25 *GeV/c*
- |eta| < 2.5
- no e in delta R < 0.4

triggers

- e25i (EM25i)
- mu20i (MU20 || MU40)

https://twiki.cern.ch/twiki/bin/view/Atlas/TopGroupCSCObjectSelection

MC Samples

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ttbar:

5200: semi-leptonic, dileptonic, M_{top} = 175 GeV/c^2

6203,4: semi-leptonic, dileptonic, M_{top} = 160, 190 GeV/c^2

W + Jets:

8440-8443: AlpgenJimmyWenu, Np = 2,3,4,5

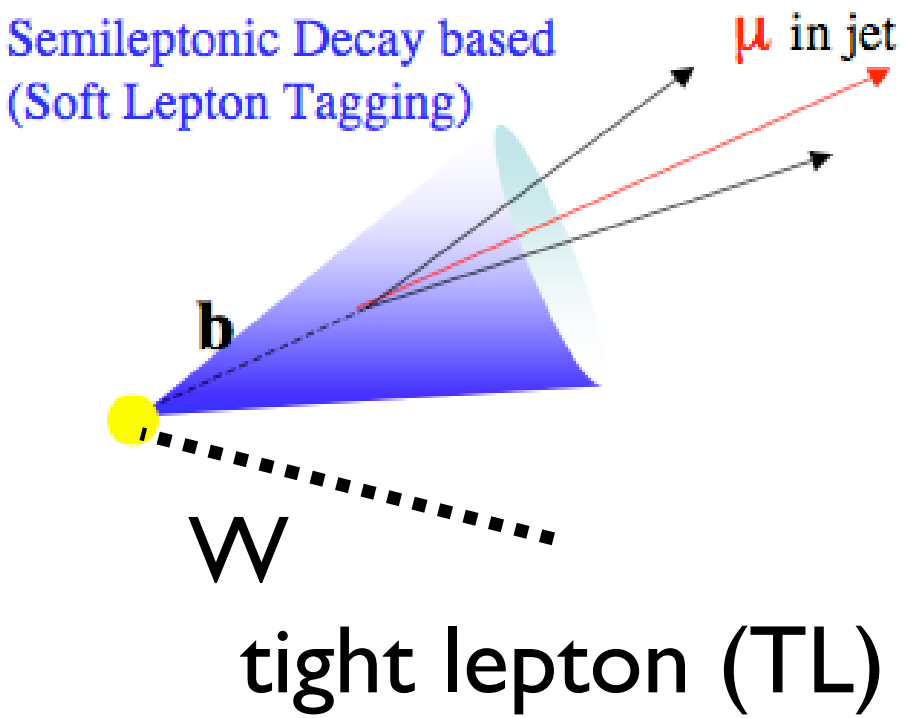
8444-8447: AlpgenJimmyWmunu, Np = 2,3,4,5

QCD:

still working on this bit...

v12.0.6

What is the SLT?



In ~20% of the b-jets a soft muon will come from the decay of the b quark or from $b \rightarrow c \rightarrow \mu$.

Candidate muons within jets are assigned a likelihood that indicates which jet is the most likely source.

The impact parameter significance, the transverse momentum relative to the jet axis and the muon energy fraction relative to the jet energy can be taken as discriminating variables.

SLT Likelihood Ratio

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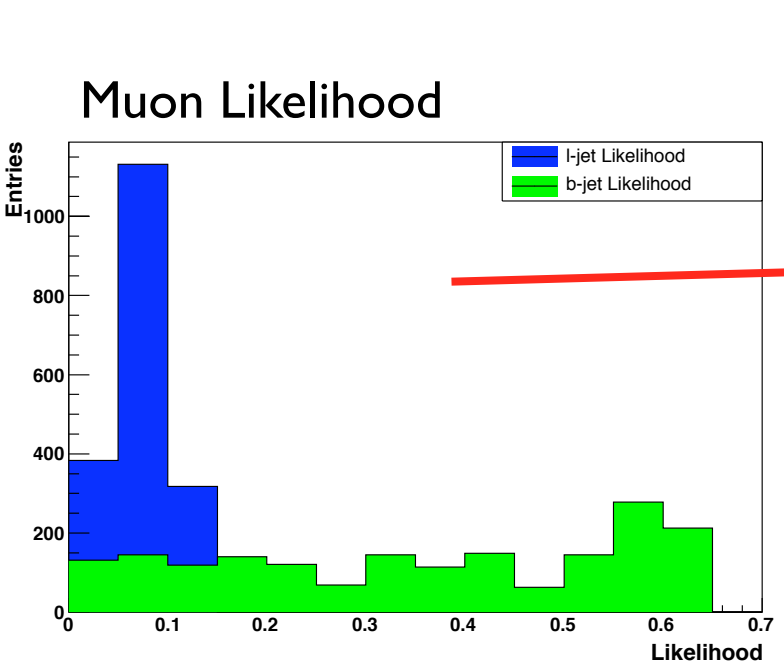
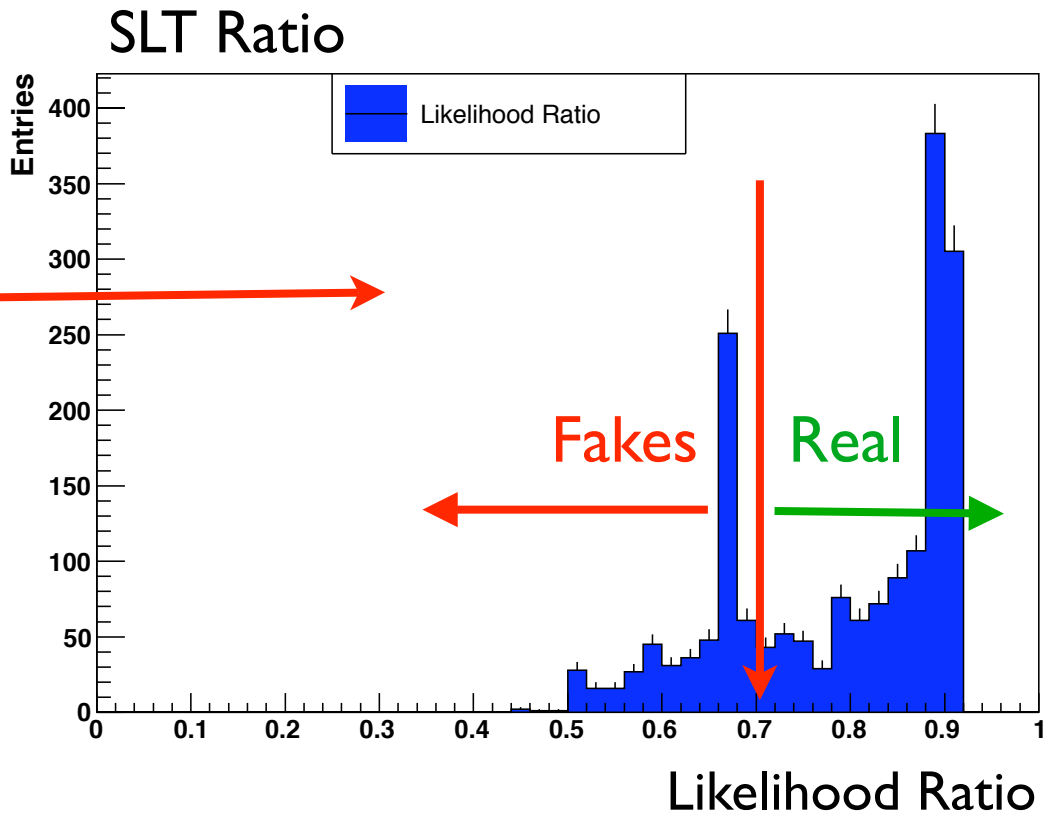


$$\frac{b}{b+l}$$



Currently using the above formula to get a likelihood ratio of the muon likelihood with that of the light quark jet to help distinguish between them.

Event Selection
electron channel

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$\int \mathcal{L}\, dt \approx 100\ pb^{-1}$

Signal

Cut	Total	Acceptance
Initial	48000	100%
Passed EFe25i	23339	49%
"Good" Electron	18925	39%
Nelectron==1	15953	33%
MeT > 20 GeV	14517	23%
HT > 200 GeV	11469	23%
1 or more SLT Jet	2408	5.0%
SLT Ratio > 0.7	482	1.0%
Njets ≥ 3	424	0.88%

Background

Initial	81250	100%
W+jets	23	0.03%

Event Selection
muon channel

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$$\int \mathcal{L}\, dt \approx 100\ pb^{-1}$$

Signal

Cut	Total	Acceptance
Initial	48000	100%
Passed EFmu20i	27205	57%
"Good" Muon	22046	48%
Nmuon==1	21385	46%
MeT > 20 GeV	19460	42%
HT > 200 GeV	14790	32%
1 or more SLT Jet	3254	7.0%
SLT Ratio > 0.7	618	1.3%
Njets ≥ 3	468	0.98%

Background

Initial	81250	100%
W+jets	25	0.03%

Measuring the Top Mass

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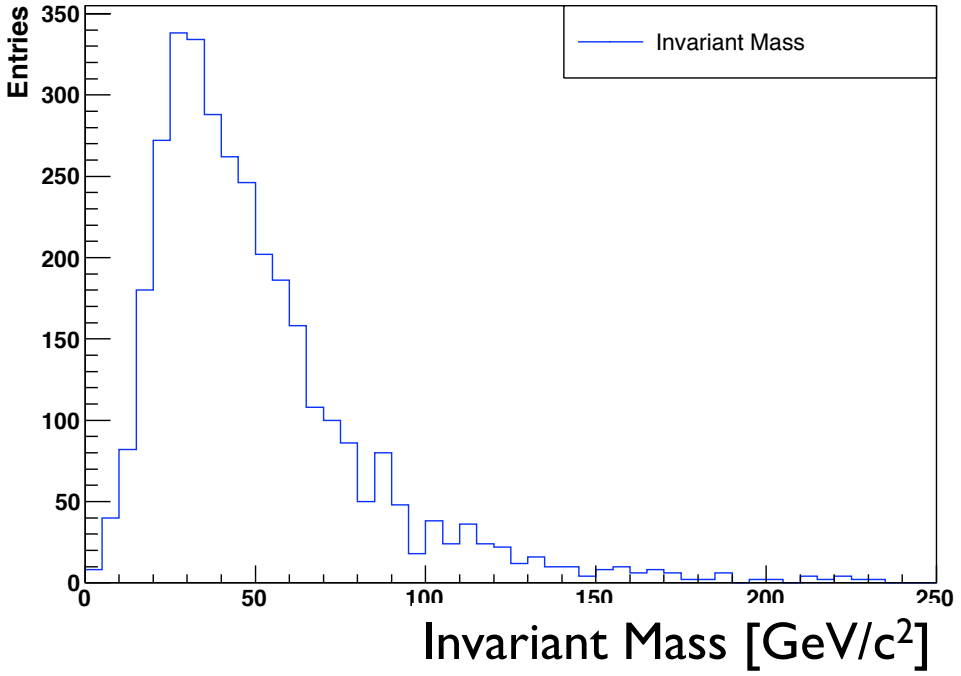
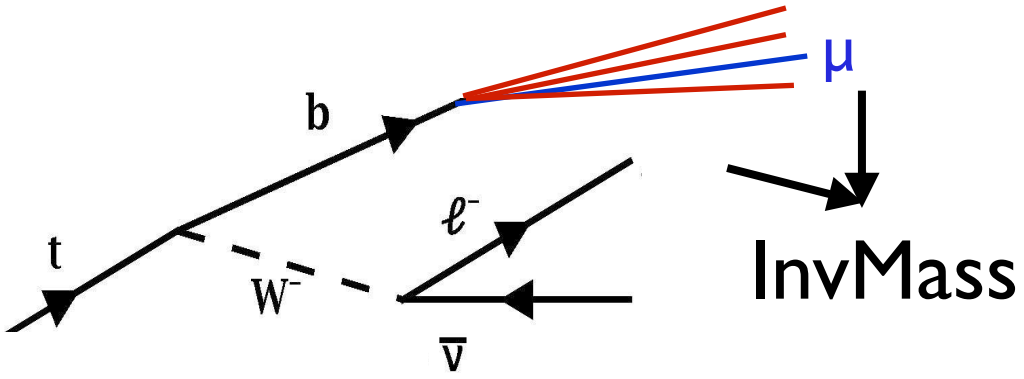
Invariant Mass of the lepton from W decay and the soft muon within the b-jet.

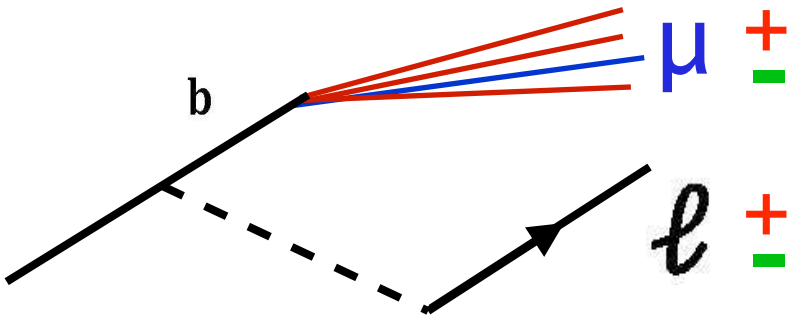




There is a correlation between the mass of the top quark and the invariant mass of its decay products. Its not possible to get a handle on the neutrino but the hard lepton from W decay and the soft muon are accessible.

These decay products will carry a significant fraction of the original Top mass with them and from this it is possible to get a handle on the Top mass.

Invariant Mass
Different Measurement Methods



Using different combinations of the hard lepton from W decay and the soft muon that are dependent on the sign of each yields differing accuracy on the invariant mass.

Method	Sign	Constituents
SS TL-SLT	++ or −−	soft muon and tight lepton
OS TL-SLT	+−	soft muon and tight lepton
TL pT	+ or −	tight lepton only
All TL-SLT	++ +− −−	soft muon and tight lepton

Invariant Mass
No Backgrounds

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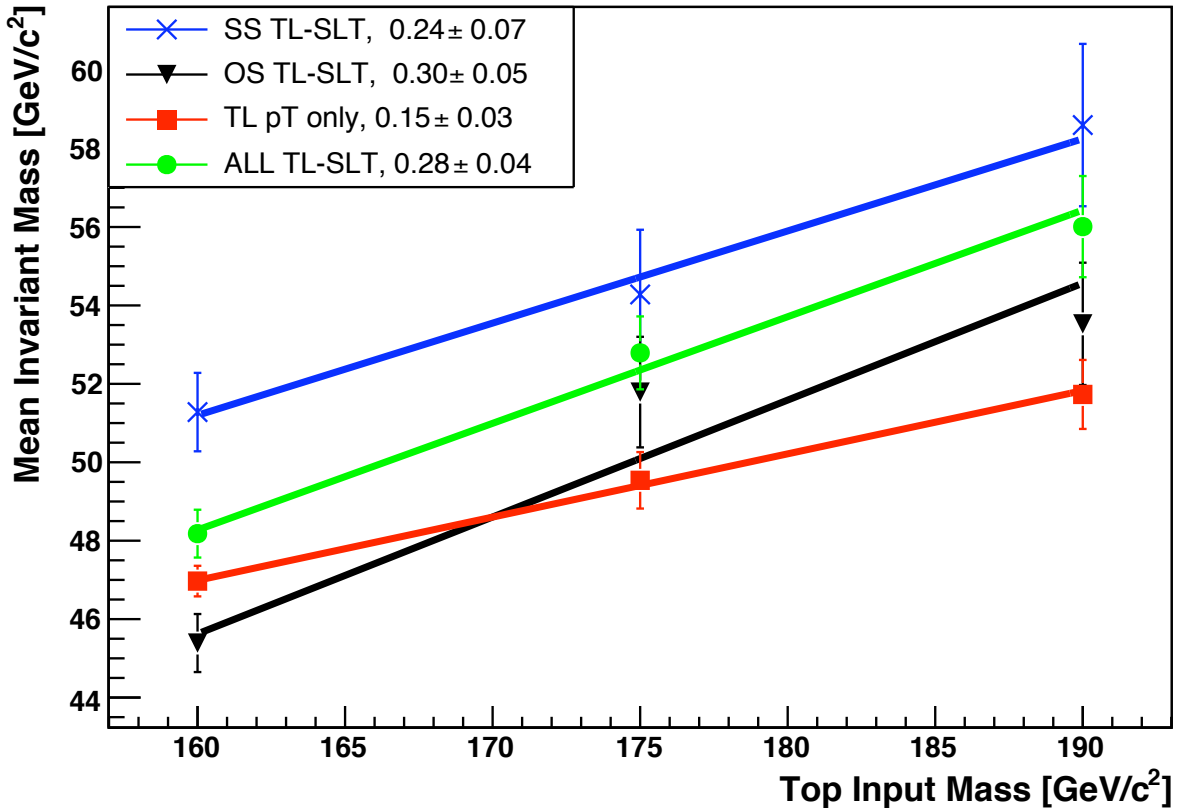
Variation of the mean invariant mass with different top input masses.



Different methods can give better or worse precision but can lose statistics.

Invariant Mass
With W+Jet Backgrounds

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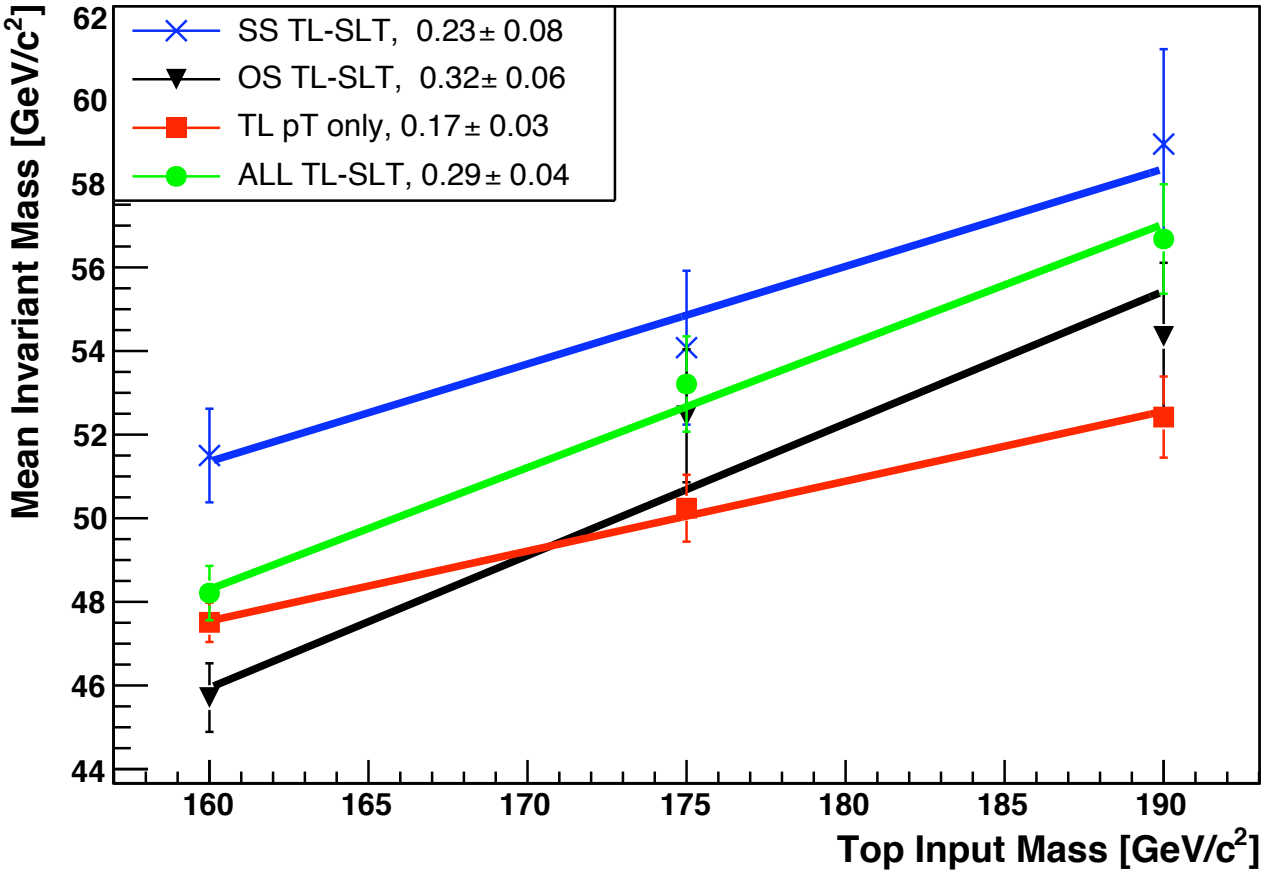
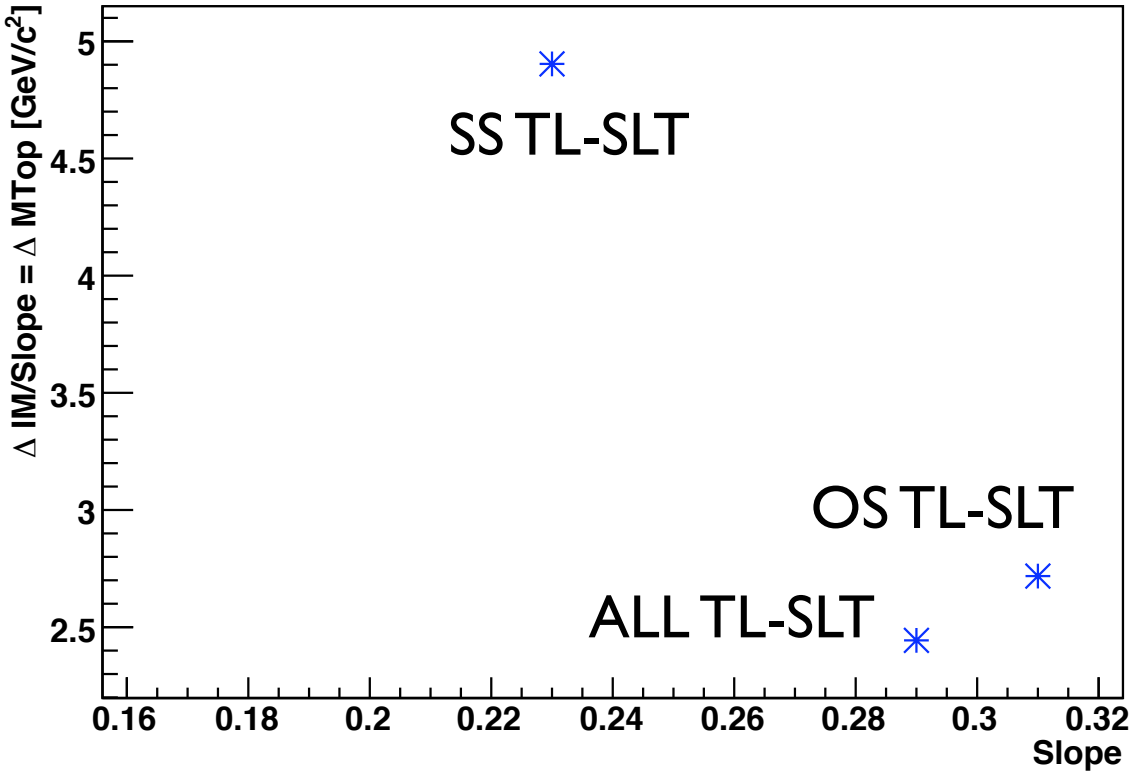
Variation of the mean invariant mass with different top input masses.



Small change in slopes with the addition of background with a slight increase in errors.

Precision on Top Mass



Running the different methods over ≈ 160 pb^{-1} of ttbar events.

Opposite sign method offers the best precision but with reduced number of statistics. All TL-SLT looks to be a good combination.

Precision on Top Mass

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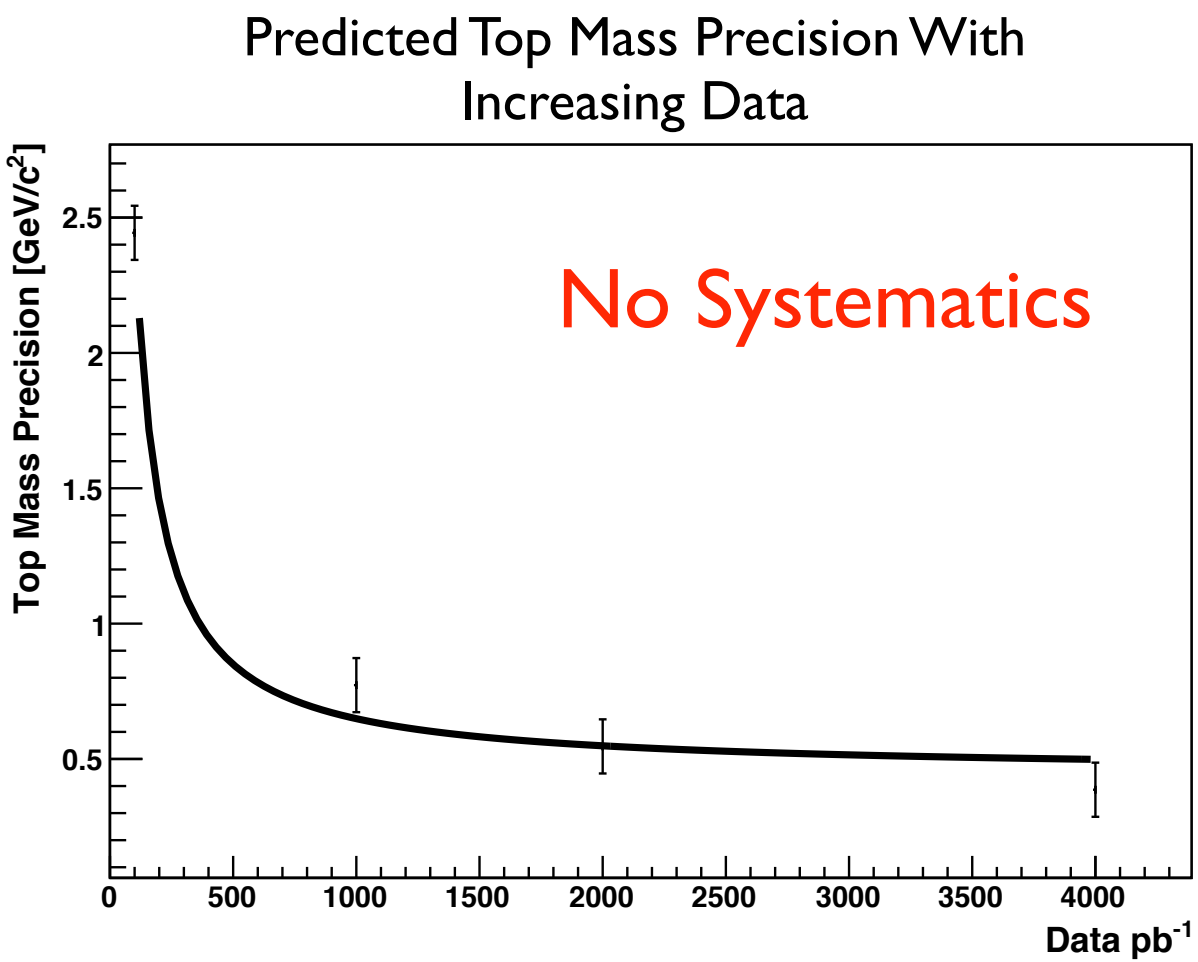

Using the ALL TL-SLT method the expected precision on the top mass measurement looks promising.

Conclusion

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Systematic Errors

- Need to be included...

Outlook

- Study on systematics
- b-quark fragmentation study
- Finish QCD study
- TopView...