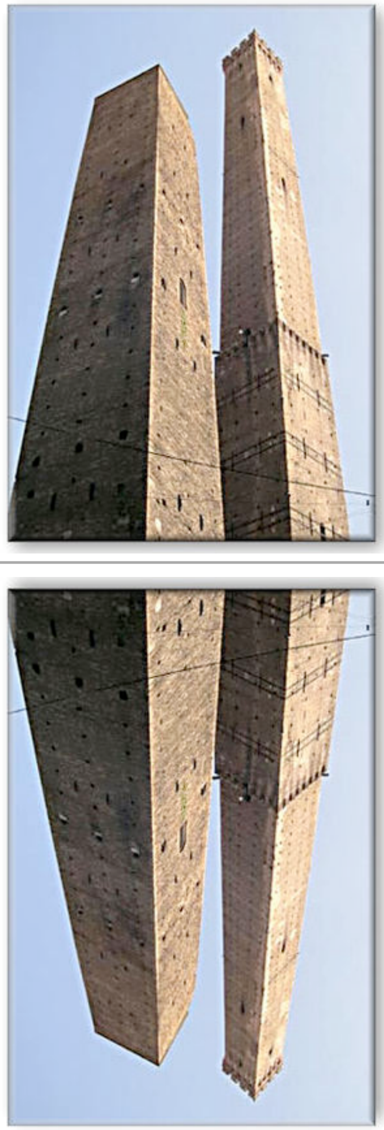
Top and SUSY @ Bo



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Outline

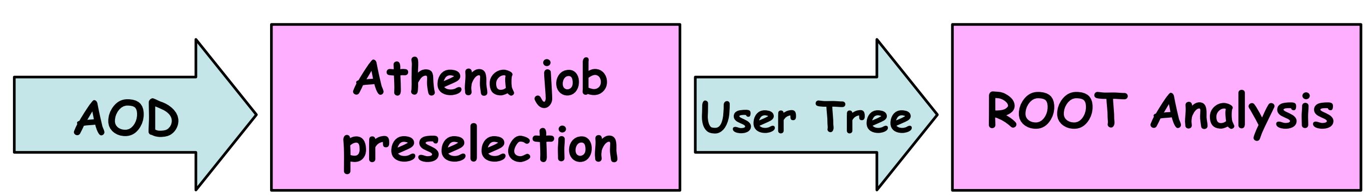
- Top: streamtest data analyses
    - Near future: FDRII *tt* studies
- SUSY: Inclusive searches and CSC Note 5
    - ...Back to the future: shape analysis on M_{eff}

Esercizio con gli streamtest data
Sezione d'urto *tt* nel canale leptone + jets

- Versione software 12.06
- Streamtest campioni inclusivi di elettroni e muoni, L~15 pb-1
- MC tt e principali fondi (W+jets, WW, single top), $L_{MC} >> L_{ST}$
- Tagli semplici ed affidabili (commissioning analysis)
  - Studi preliminari di calibrazione usando $Z0 \rightarrow ee/\mu\mu$ (lepton energy scale, trigger efficiency, jet energy scale)
  - Studi di possibili effetti sistematici (JES, Top mass, signal simulation, bg normalization, missing Et)

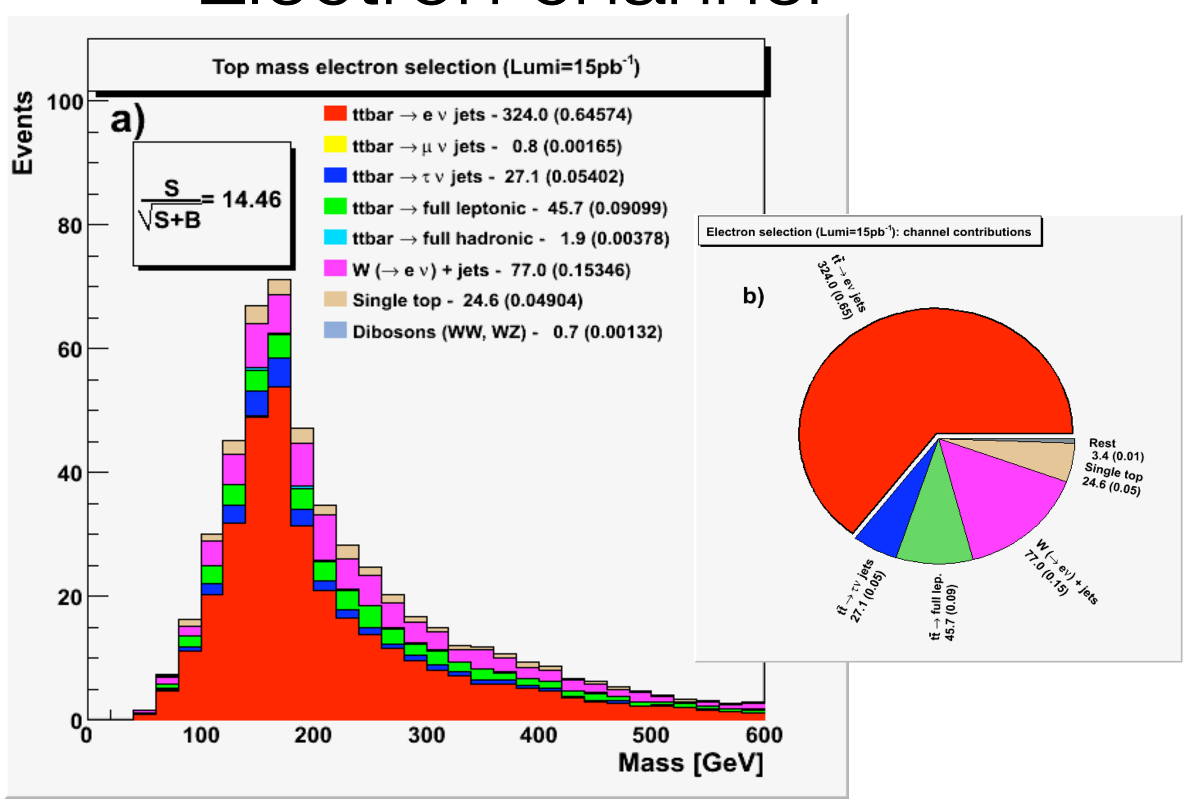
✓ Report in fase avanzata di preparazione

- Level 1 and Level 2 triggers;
- One lepton Pt > 20 GeV and R>0.4 wrt closest jet;
- Missing Et > 20 GeV;
- $\geq$ 4 jets with Pt > 20 GeV;
- $\geq$ 3 jets with Pt > 40 GeV;
- The 3 jets with highest vector sum Pt assigned to the top (hadronic decay) and used to reconstruct the top mass.
- Mtop < 500 GeV

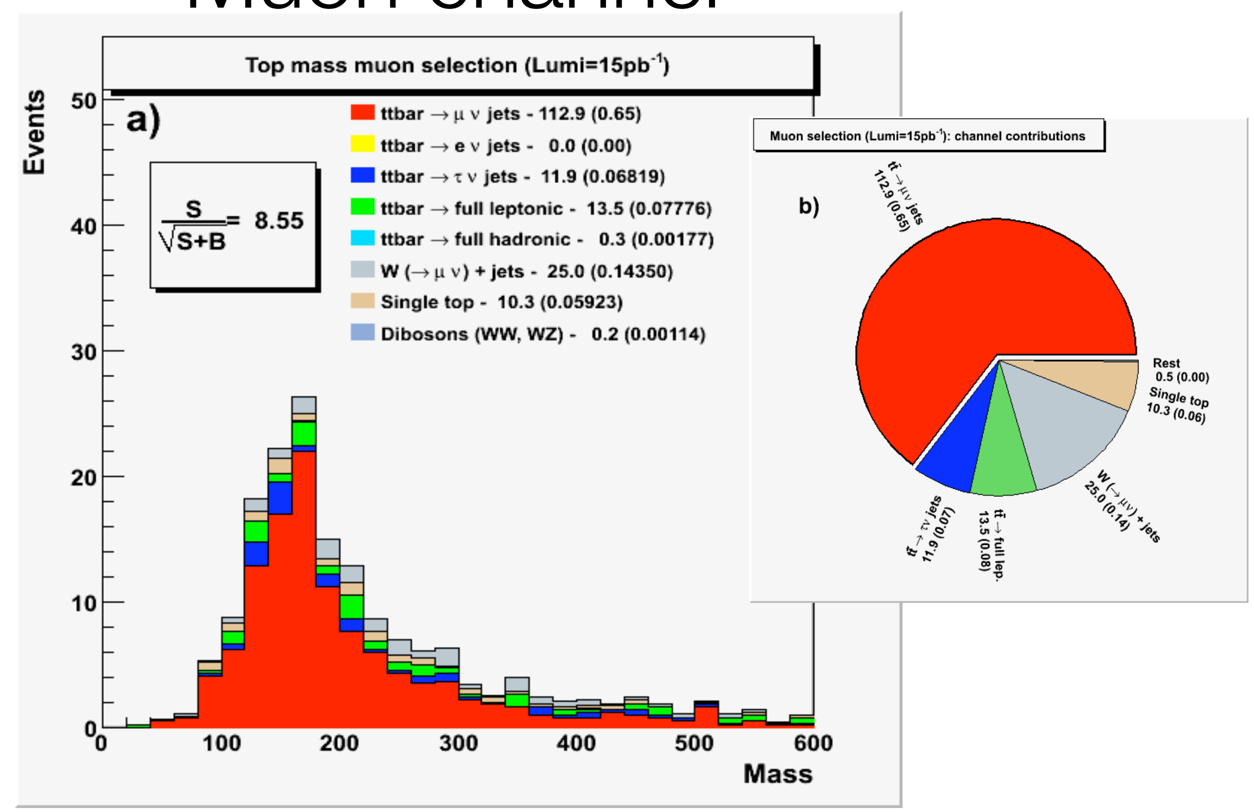


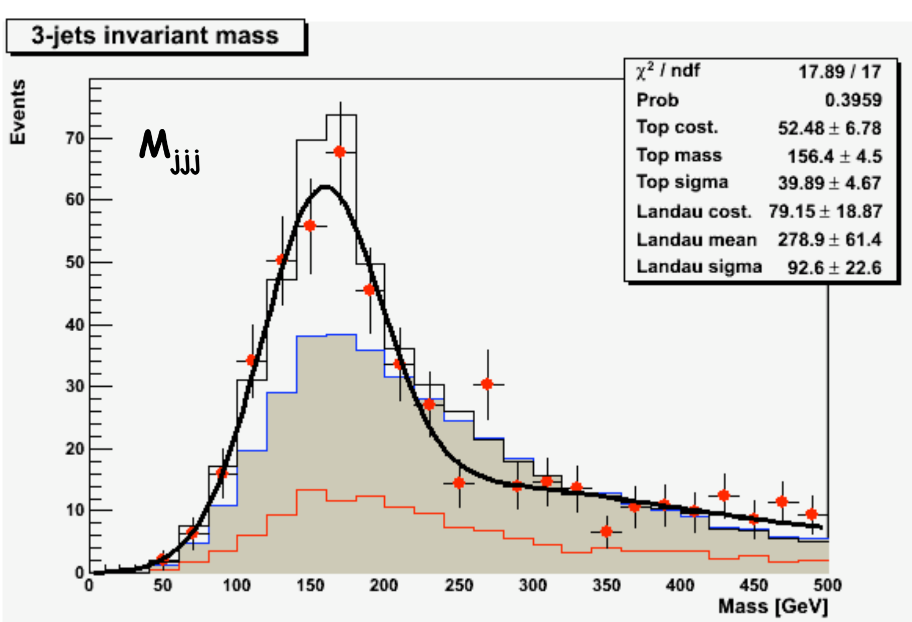
Streamtest - MC comparison

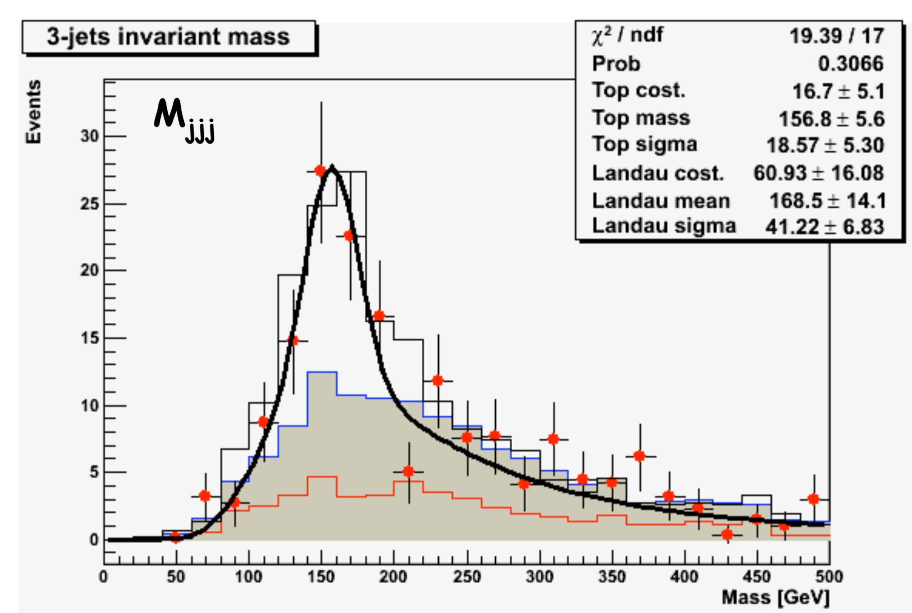
Electron channel



Muon channel







Systematic uncertainties

Source of syst. uncertainty	error on $\sigma_{t\bar{t}}$ (e-channel)	error on $\sigma_{t\bar{t}}$ (μ-channel)
Jet energy scale ±5%	$^{+13}_{-11}\%$	$^{+13}_{-10}\%$
Signal simulation AcerMC vs Mc@NLO	-11%	-10%
ΔM_{top} 170GeV ÷ 175GeV	$\pm 3\%$	$\pm 2\%$
W+jets cross section ±15%	$\pm 3\%$	$\pm 3\%$
Single top cross section	$\pm 1\%$	$\pm 1\%$
Missing E_t ±10%	$^{+4}_{-2}\%$	$^{+3}_{-2}\%$
Total syst. error	$^{+14}_{-16}\%$	$^{+14}_{-15}\%$
Statistical error	$\pm 6\%$	$\pm 11\%$

$$\sigma_{t\bar{t}} = \frac{N_{obs} - N_{bg}}{Lumi \cdot \epsilon \cdot Br}$$

N_{obs} = events from streamtest data

N_{bg} = predicted bg

Lumi = integrated luminosity

ε = selection efficiency for tt → lepton+jets or leptons

Br = Branching ratio for tt → lepton+jets or leptons

$$\sigma_{t\bar{t}}^{e-ch.} = 845 \pm 53(stat.)^{+110}_{-93}(JES)_{-93}(MCsim.)^{+51}_{-39}(others)$$

$$\sigma_{t\bar{t}}^{\mu-ch.} = 689 \pm 78(stat.)^{+89}_{-69}(JES)_{-69}(MCsim.)^{+34}_{-32}(others)$$

Per il prossimo futuro...

- Stiamo portando i tools alla v14.2.0
  - Q: Che workflow utilizzare?

    AOD → D2PDMaker → ARA

    TopPhysDPDMaker → D2PD/D3PD → ROOT
- Ripetere l'analisi di Lorenzo, questa volta con FDR2 usando la versione 14 e tools di analisi piu' recenti e standard
  - Migliorare e studiare meglio l'isolamento del μ
  - Studiare le sistematiche da PDF
  - Misura di σ_{tt}, dσ/dpT, dσ/dη

Inclusive searches and CSC Note 5

- Inclusive searches are the most general ones: we don’t look at a specific channel but we just count the number of events that pass some selection criteria

- With ~1/fb of well-understood data it should be possible to see an excess over background compatible with Supersymmetry

- The Bologna group joined the CSC Note 5; the speaker edited the 0 lepton / 4 jets sub-chapter

0 leptons 4 jets events

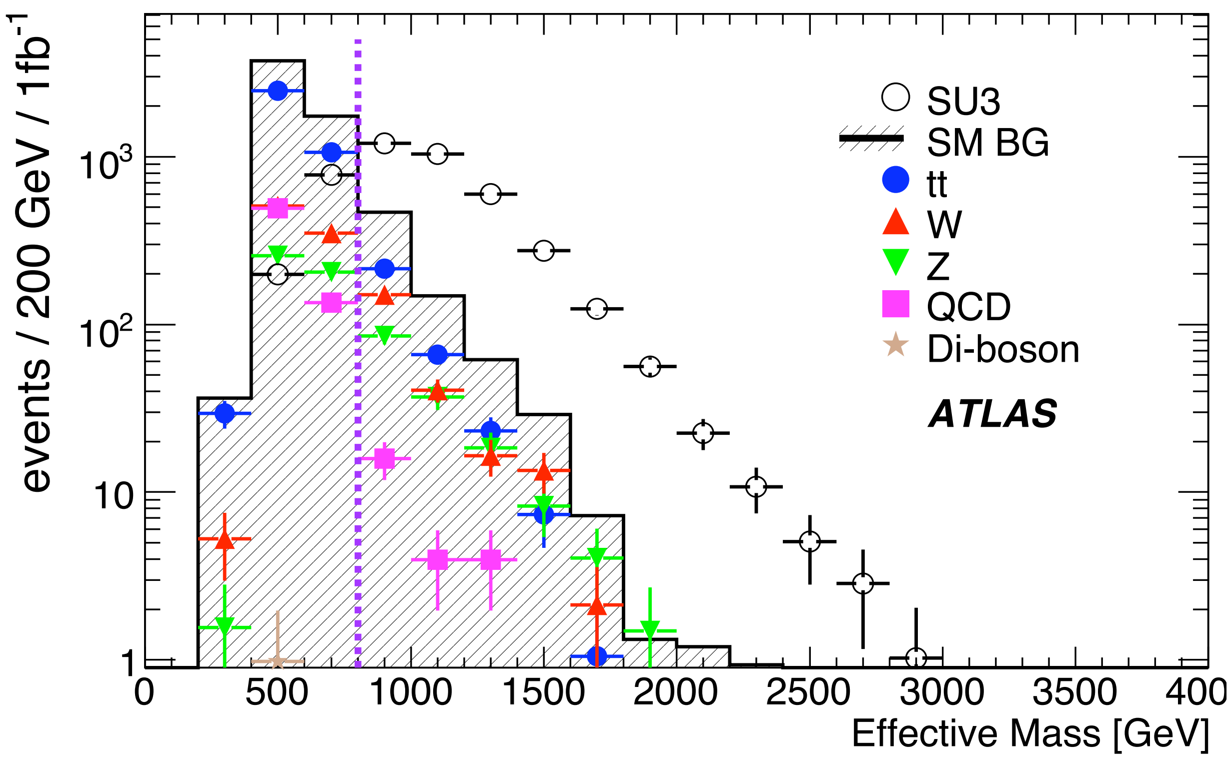
- Multi-jet topologies are expected to give a good statistical significance for the discovery of a large range of SUSY models
- The requirement of high jet multiplicity strongly reduces leading backgrounds from W/Z+jet and QCD jet production
- RP-conserving SUSY such as mSUGRA events may yield a large number of jets associated with a lot of MissingET (carried away by χ^0_1 neutralinos)

1. Four jets, the hardest with $p_T > 100$ GeV and the fourth with $p_T > 50$ GeV, and m$E_T > 100$ GeV.
2. m$E_T > 0.2 M_{eff}$.
3. Transverse sphericity $S_T > 0.2$.
4. $\delta\phi(jet1 - mE_T) > 0.2$, $\delta\phi(jet2 - mE_T) > 0.2$ $\delta\phi(jet3 - mE_T) > 0.2$.
5. Reject events with a e or a μ.
6. J70 X70 Trigger.
7. $M_{eff} > 800$ GeV.

against multi-jet evts { (items 2–3)

against fake mET (item 4)

Final plots



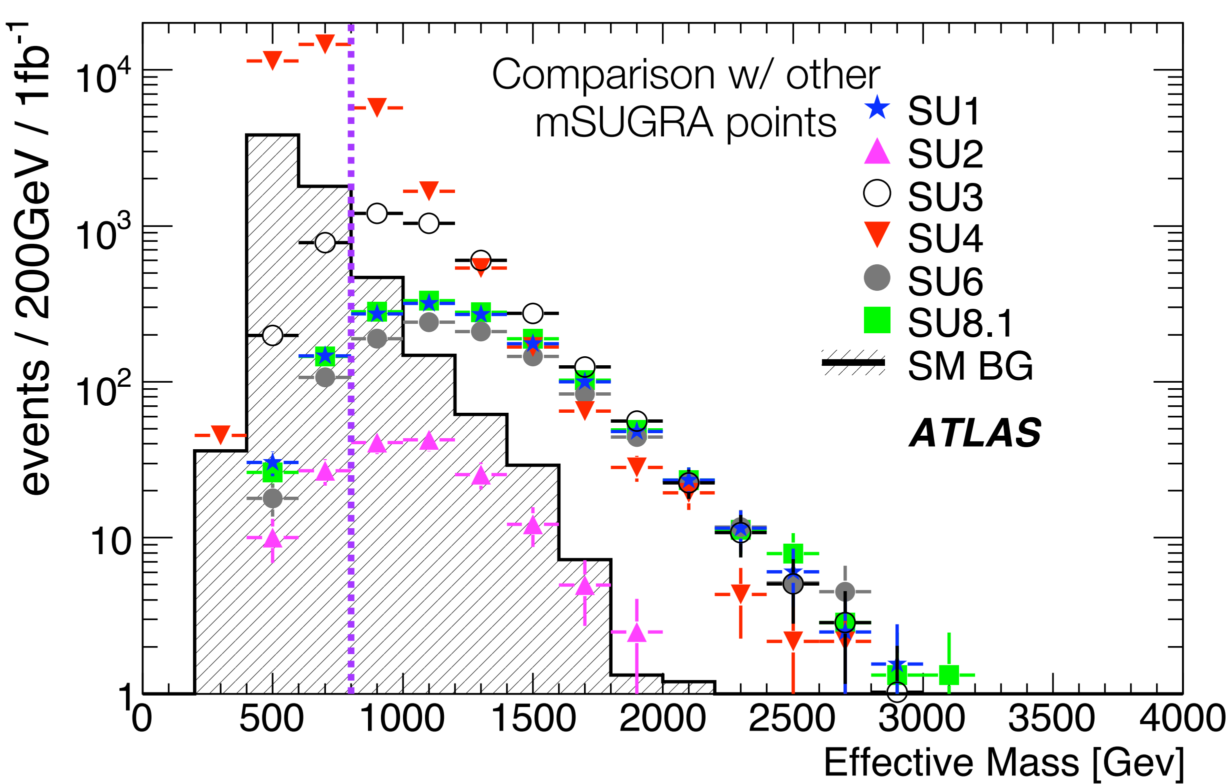


Table 2: M_{eff} cut flow table for 4-jets analysis normalized to 1fb^{-1} using NLO cross sections. Cuts defined in the text.

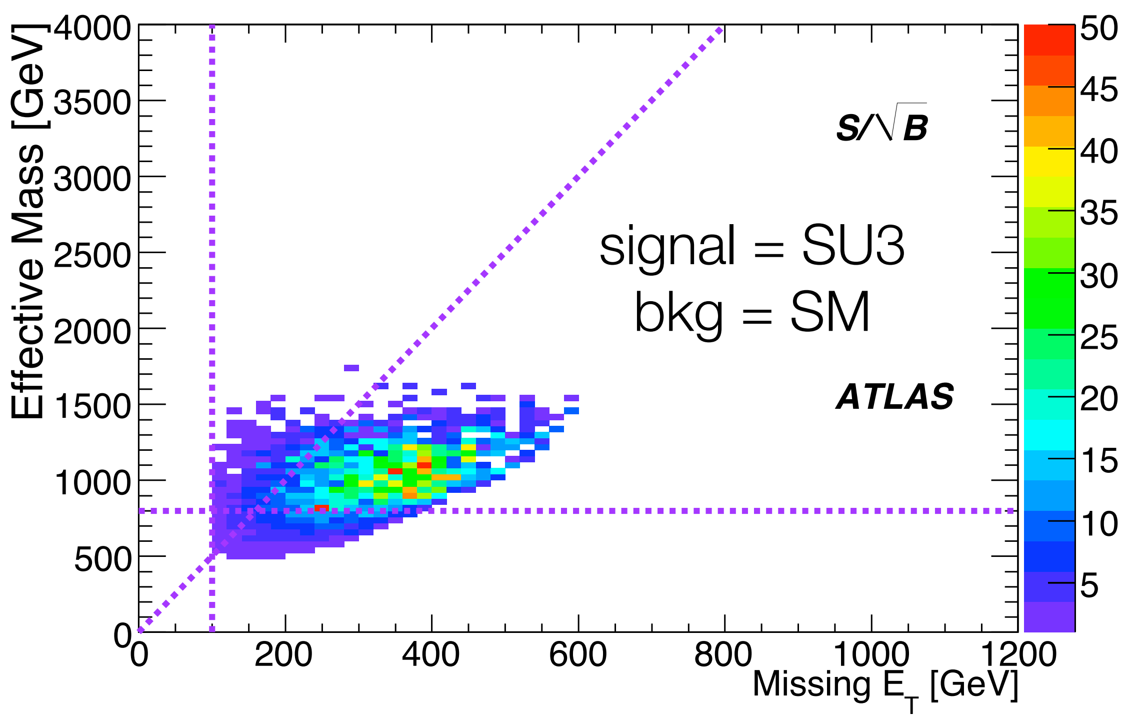
Sample	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Trigger	M_{eff} Cut
SU3	9694	7573	5614	5299	4328	4320	3339
SU1	3522	2866	2015	1920	1410	1409	1232
SU2	607	365	305	276	169	167	130
SU4	79510	57128	45749	42099	34716	34207	8219
SU6	2581	2070	1474	1389	1084	1083	958
SU8.1	3142	2541	1780	1693	1454	1452	1281
MC@NLO $t\bar{t}$	13065	8949	6530	5905	4088	3884	312
Pythia QCD	23119	5762	3811	848	848	782	24
Alpgen Z	1599	1019	713	646	630	621	156
Alpgen W	4045	2346	1621	1473	1127	1087	225
Herwig WZ	21	14	9	8	4	2	1
Total SM	41849	18090	12678	8880	6695	6376	717
SU3 S/B	0.2	0.4	0.4	0.6	0.7	0.7	4.6
SU3 Z_n	0.6	1.4	1.5	2.6	2.7	2.9	12.9
SU3 eff (excl)	35.0%	78.1%	74.1%	94.4%	81.7%	99.8%	77.3%
SU3 eff (incl)	35.0%	27.4%	20.3%	19.1%	15.6%	15.6%	12.1%

mSUGRA Point	Z_n
SU1	6
SU2	1
SU3	13
SU4	24
SU6	5
SU8.1	6

Table 22: Z_n significances for all mSUGRA points after all 4-jets analysis cuts.

What we've learned

- SUSY searches require "well understood" data, but it's time to gain knowledge on SM backgrounds
  - We can control W/Z+jet bkg
  - We can control QCD bkg BUT biggest systematic uncertainty (~50%)
  - Our worst enemies are the *tt* events

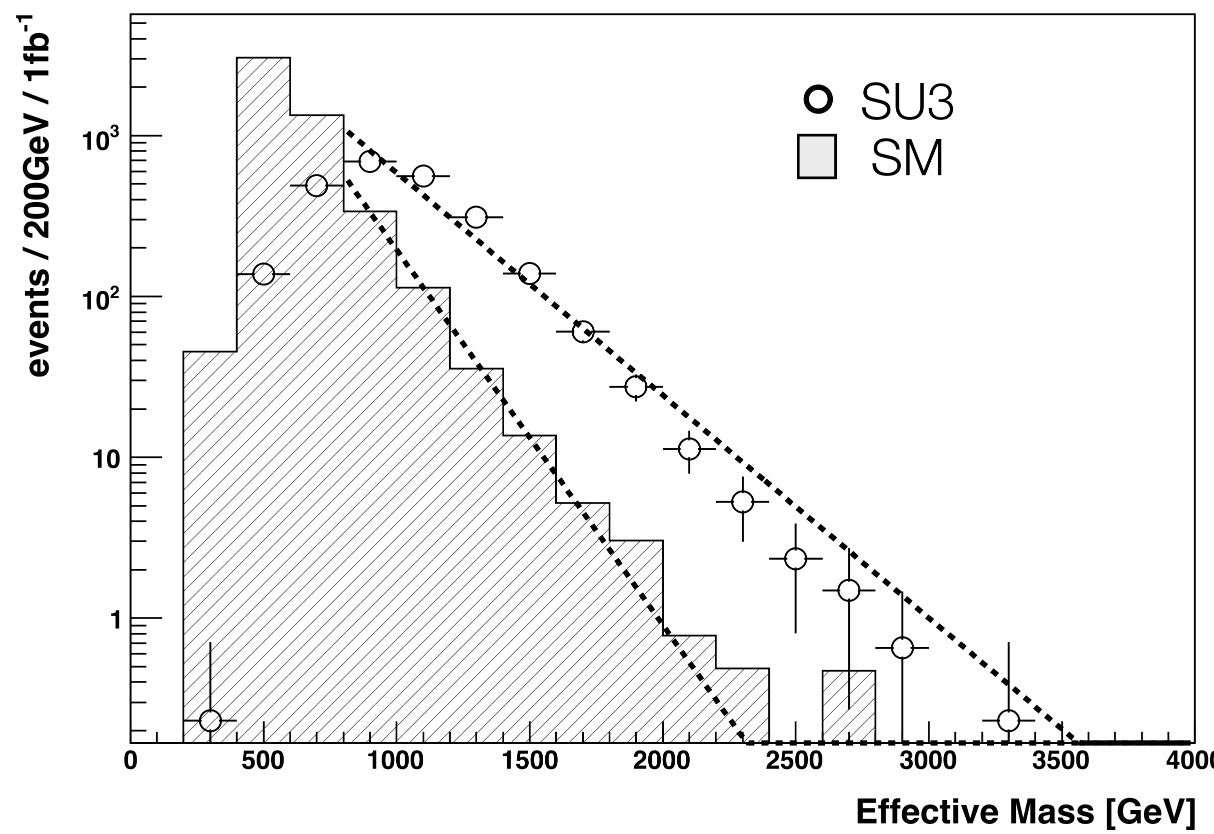


If there's something out there we have a real chance to see it!

Next Step: M_{eff} shape analysis

- Still very preliminary
- Assuming a very good knowledge of SM bkg, one can fit it in the signal region (>800GeV) with a straight line and calculate its slope
- SM and SU3+SM behave differently: The simulation shows a very promising 11σ separation
- Systematic uncertainties not considered so far

M_{eff} after last cut



Sample	Slope [GeV $^{-1}$]	χ^2 / ndf	Prob
SU3	$(-3.7 \pm 0.1) * 10^{-3}$	7 / 12	83%
bkgSM	$(-6.2 \pm 0.2) * 10^{-3}$	11 / 7	13%
bkgSM+SU3	$-(3.9 \pm 0.1) * 10^{-3}$	4 / 8	84%

Conclusioni

- Con Streamtest abbiamo acquisito familiarità con gli eventi tt, ora possiamo andare più a fondo con FDR
- E' necessario decidere quale workflow utilizzare (che sia un buon compromesso tra velocità, flessibilità e affidabilità)
- Con CSC5 abbiamo imparato a trattare i fondi SM per la SUSY, in particolare abbiamo visto che bisogna prestare attenzione a QCD e Top
- Studi preliminari mostrano che mE_T e M_{eff} possono ancora riservare nuove sorprese, a patto che siano misurate affidabilmente