Milano SUSY programs

- **People involved:** Clara Troncon, Tommaso Lari (staff), Umberto De
- Sanctis, Simone Montesano (PhD), Masimiliano Uslenghi (borsista)
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- **Activities:**
- gluino/suark production in 2 lepton+EtMiss+jets channel
- light stop production
- low-scale SUSY contamination in ttbar selection (see top talk)

It's some years we are involved in Supersymmetry searches.

Here I will speak of searches – how to find or exclude SUSY with the data of the next couple of years.

Post-discovery activities (how to measure masses, constraint model parameters etc.) are in 2nd priority now and probably not very relevant for this meeting.

2-lepton channel: activities

•Collaboration with Lecce, Pavia, Napoli for CSC studies:
• An analysis framework (susyphys, running on AOD and producing
•ntuples) was developed and mantained together.
• Ntuples were produced on the Tier-2 at Milano and distributed to other institutes (15 versions, few milion events, 10 GB/version)
• Muon performance/trigger studies done mostly in Lecce, electron performance/trigger studies mostly in Milano

For post-CSC activities we focused so far on preparing an AthenaROOTAccess based analysis framework [used also for top and tau studies in Milano]

2-lepton channel: signature

Two isolated leptons, missing energy (typically > 100 GeV), a few energetic jets (typically > 50-100 GeV).

Few hundred signal events/fb-1 and S/B ~ 5 for “typical” benchmark. Main (95%) background is ttbar.

Signal generally has same flavour lepton pairs from chi02 -> chi01 l+l- decays.
Most backgrounds (except Z, expected very small) have same number of ee, mm, em pairs – flavour subtraction can be used for searches with small systematics.

Two leptons: short term (FDR) plans

SUSY somewhat in less priority than top/W/Z analysis (statistics...) but we still would like to do a lot of things like:

- Start from electron and muon streams
- Plot the EtMiss and MT(l,Etmiss) distributions for events with two isolated leptons and two jets (say above 50 GeV or so). This should be dominated by ttbar and other SM for MT<100 GeV and EtMiss < 80 GeV or so. Check from MC SU4 contamination.
- Compare these distribution for e+e-, mu+mu-, e+mu- (are they the same?). DiLepton invariant mass (how much Z contamination?). Apply efficiency corrections (from data) - how much this affects the result of flavour subtraction?
- That's also a useful diagnostic tool. Example: if large EtMiss tail in e+e- only, check where it comes from...
- Can we say something about EtMiss-vs-MT correlation ? How can we avoid signal contamination?
- lepton isolation distributions (with Z tag?) - what is a reasonable cut ?
- EtMiss trigger efficiency
- Compare measured distributions with release 12 MC
- Derive a limits on SUSY (not trivial! Requires an estimate of the systematics on flavour subtraction or the MT-EtMiss technique to estimate the background)
- Add SU4 to FDR data: do we have a significant excess ?

Longer term (post-FDR2) dilepton plans

- Learn from FDR experience, get tools and code ready.
- **Define best cuts for control samples (i.e. ttbar-dominated, little SUSY expected, little Z and DY backgrounds).**
- **Compare for the control samples e+e-, mu+mu-, e+m-. Prove flavour subtraction works. Estimate systematics and correct for acceptance and efficiencies.**
- Study the techniques for background estimation without flavour subtraction. Start from CSC techniques (MT-EtMiss seems the most promising to me), study them in detail, evaluate systematics. Bring this to the same maturity as the 1-lepton mode background estimation of CSC notes.
- Compare lepton stream based and etmiss stream based approach ? Probably we need both (cross check effiencies and trigger bias...)
- Create a database of key distributions from the 10 TeV MC production, to be compared with the data (are we seeing what we expect for control samples?)
- Best analysis cuts, thiking about low mass SUSY and 10 pb-1 or so.
- how much the uncertainties on JES, missing et, lepton efficiency etc. are afftecting our analysis ?

When data comes...

Understand key combined performance issues, contribute to the commissioning of some of these, for the others be in contact with people doing the analysis and know how the systematics on those affect us (for example for JES).

- **electron selection and isolation**
- muon selection and isolation
- jet scale
- **etmiss**

Study the background with control sample. Build on FDR and post-FDR experience.

- **top cross section...**
- **flavour subtraction checks**
- **check relevant background-dominated distributions. Compare with MC. Do we understand the data?**

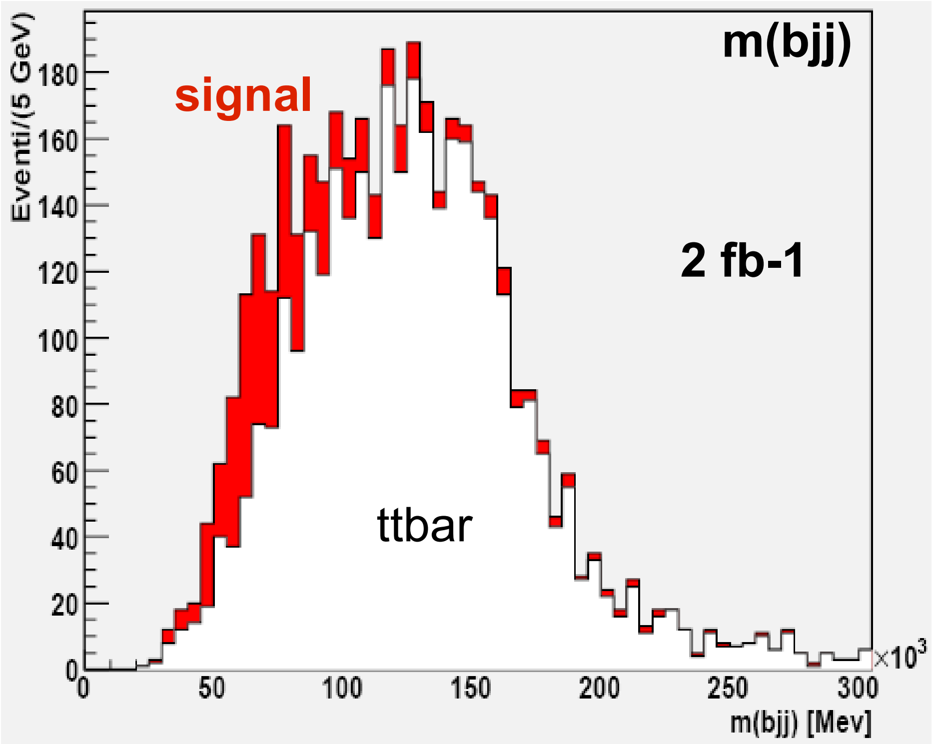
Once we are confident on detector systematics and background control, evaluate background in signal region (background subtraction tecnhiques and signal region need to be fixed before first collisions!) with its systematic error, place a limit or quote signal significance.

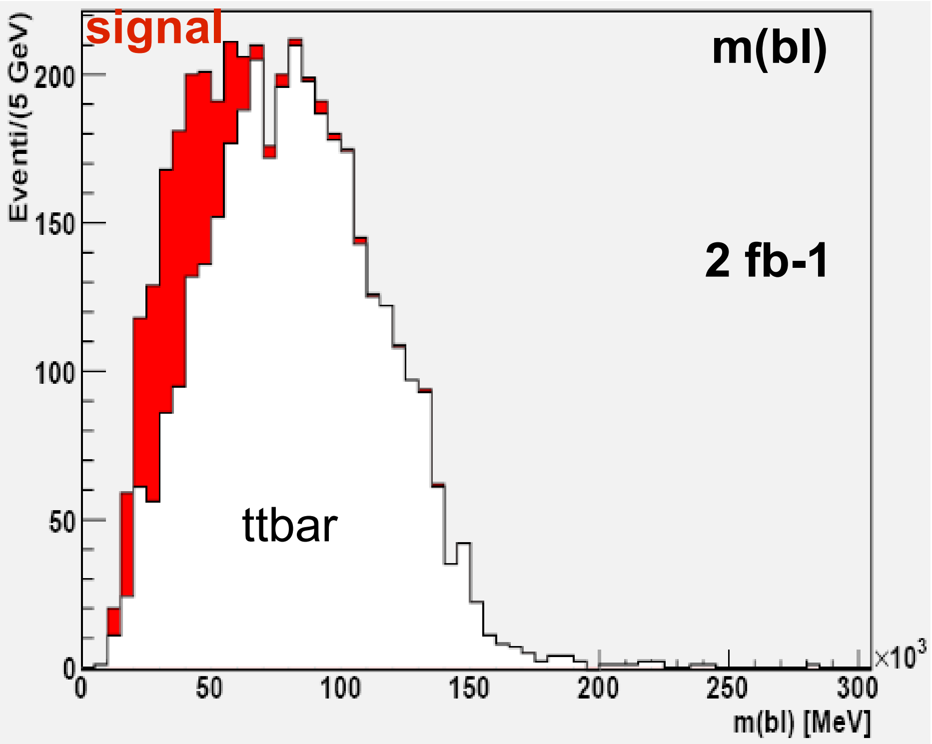
Light stop search

•Analysis developed with Pavia.

Signature: production of a pair of light (mass 100-150 GeV,
•xsec 200-400 pb) scalar top quarks.
• Each of them decays into b χ+ -> b χ W* (virtual W)
• Since neutralino is invisible, similar to ttbar, but **softer** leptons, jets, and
•missing energy, and no W mass peak
• Not unsurprisingly, biggest background is ttbar, then W+jets
•
•**Strategy:**
•similar cuts to top commissioning analysis (semileptonic channel) but add
•a W invariant mass veto. Only analysis with b-tagging done so far.
•Do tight cuts on lepton leg to select ttbar and estimate background shape
•on the hadronic side (and the other way around...)

Plans: We are interested to do this analysis as soon as possible.
But since understanding (in detail!) of ttbar background essential
and ~1 fb-1 at 14 TeV is most likely needed, it is in lower priority
than top studies this year


m(bjj)
signal
2 fb-1
ttbar
Eventi/(5 GeV)
m(bjj) [Mev]
×10³


signal
m(bl)
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Eventi/(5 GeV)
m(bl) [MeV]
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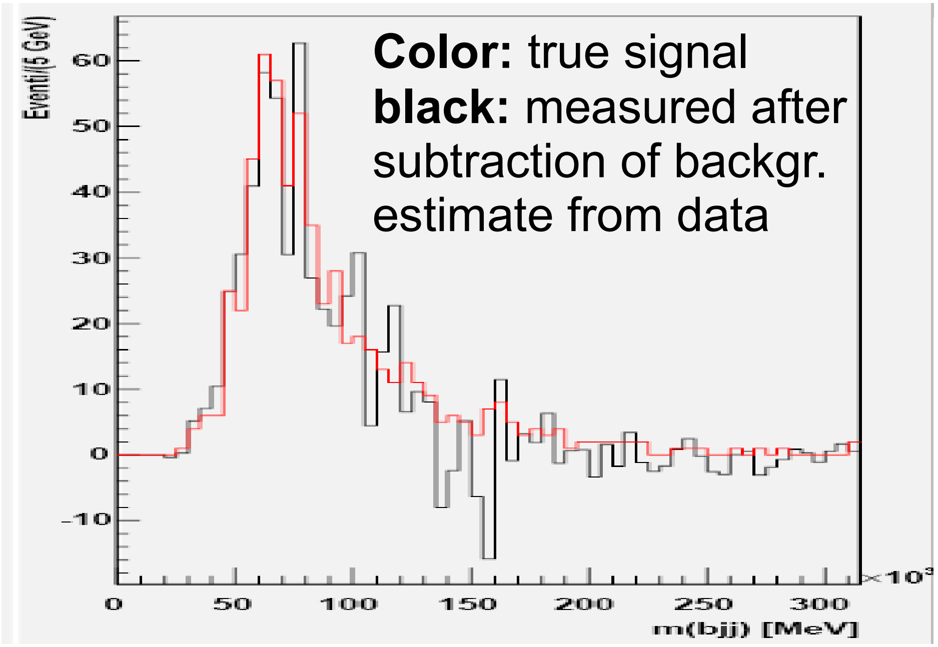
Color: true signal
black: measured after subtraction of backgr. estimate from data
Eventi/(5 GeV)
m(bjj) [MeV]
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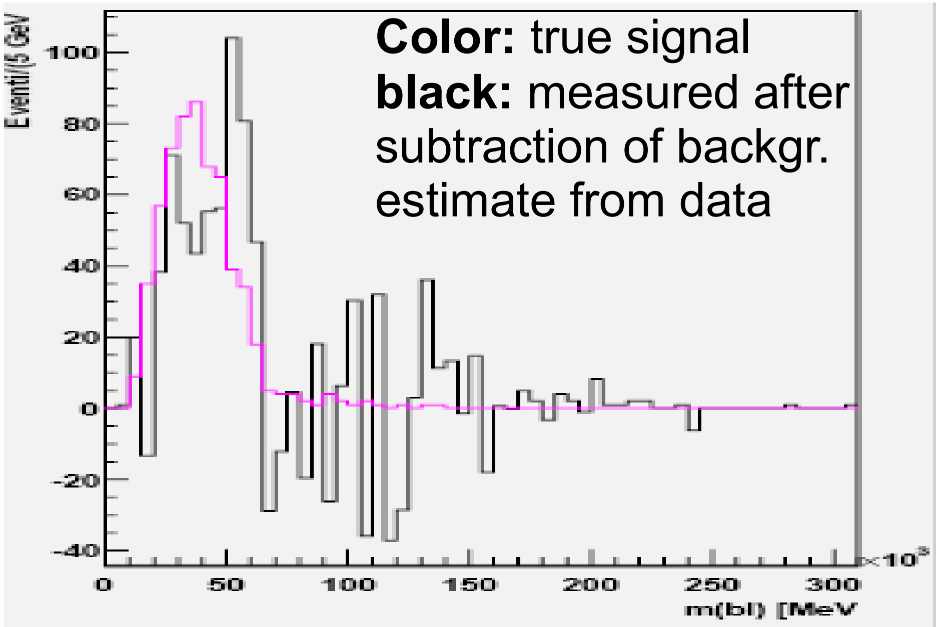
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