Ongoing work on SUSY

G. Polesello
On behalf of the involved groups

Motivations

- As a result of theoretical speculations, decided that it is still worth to explore consequences of naturalness in the form of SUSY models
- Based on the constraints from LHC run 1 explore a model with:
  - An additional higgs singlet
  - A low scale of SUSY breaking
- Theorists actively at work to develop a benchmark for such a model
- We would like to explore the experimental consequences in the parameter space of the model for a variety of future facilities

Strategy

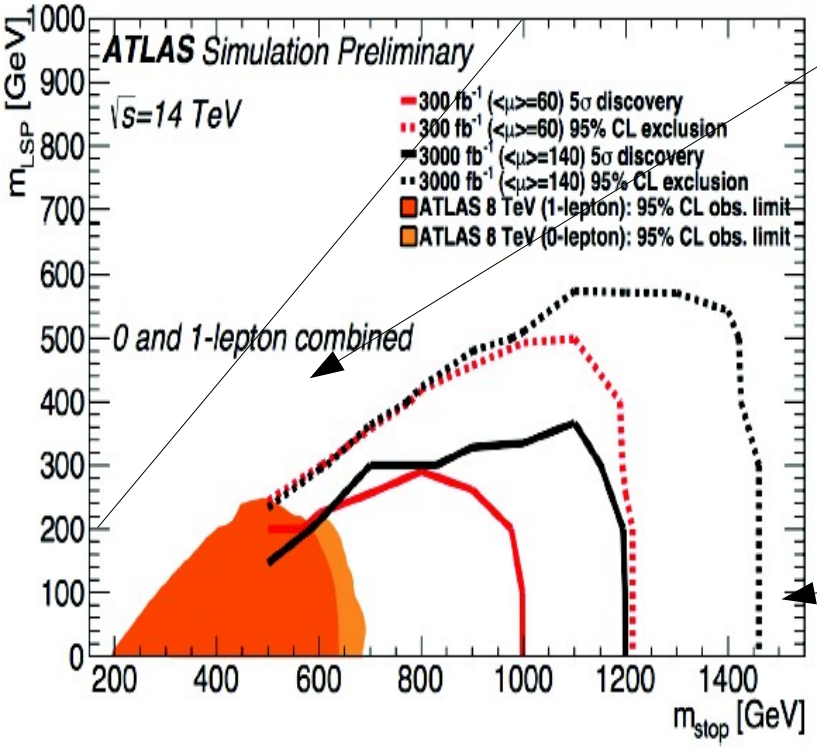
- Not much in the literature (Snowmass+ECFA) specifically devoted to the SUSY phenomenology of nMSSM models
- BUT a large amount of studies based on 'simplified models' which can be applied to final states which will appear in nMSSM models
- Threefold experimental strategy:
  - Apply existing studies to 'standard' SUSY signatures, e.g. stronq squark-gluino production
  - Study important generic signatures non yet seriously addressed in existing studies
  - Study specific signatures appearing in nMSSM models, e.g. different patterns of ewkino spectra emerging from the enlarged gaugino mixing matrix

Operative approach

- Group of theorist discussing about an explicit implementation of a relevant model
  - See talk by A. Romanino
  - Expect soon to converge to a specific model for which to produce spectra and input files fo madgraph
- Group of experimentalist explicitly simulating the final state and verifying the coverage for interesting points in parameters space
  - Generate models with MADGRAPH
  - Generate relevant backgrounds with available MCs: POWHEG, PYTHIA8, HERWIG++ etc.
  - Output produced both as Delphes ntuples and as truth level ntuples
  - Establish reach

Initial work on experimental signatures

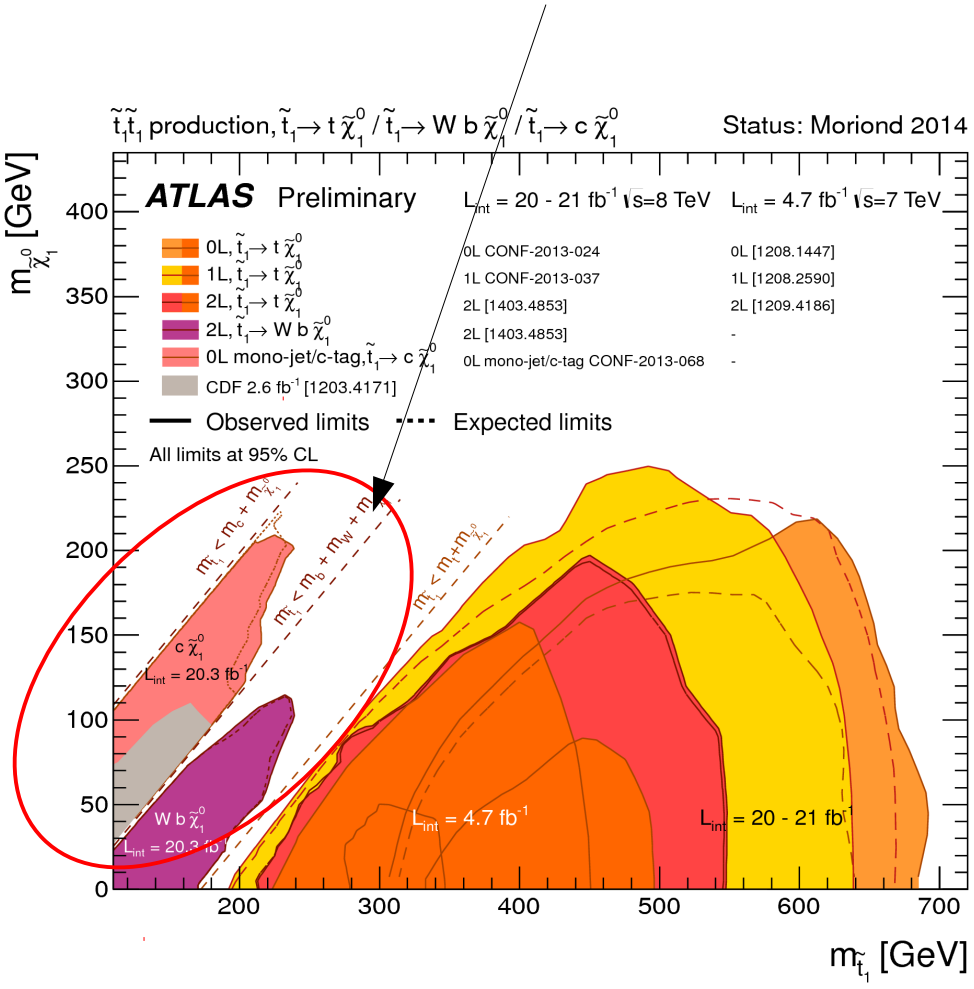
Example: searching for the stop squark: main ingredient in naturalness
Because of its high Yukawa



Need to cover complete
Space, also area where
Stop and LSP almost degenerate

Available projections focused
On high masses and
High mass difference stop-LSP

Studies of compressed stop already being vigorously pursued With existing data



When stop and LSP almost Degenerate stop decays

Loop: stop → charm chi01

3-body: stop → W b chi01

4-body: stop → f f b chi01

Little phase space for Visible decay products: → Only soft leptons and jets In the event

Searches rely on additional Hard jets recoiling against Stop-stop system

We are going to apply a similar strategy to projection to future facilities

Some 'proof of existence' plots

Start looking at 14 TeV for potential for scalar top degenerate with neutralino (Dm=20 GeV)

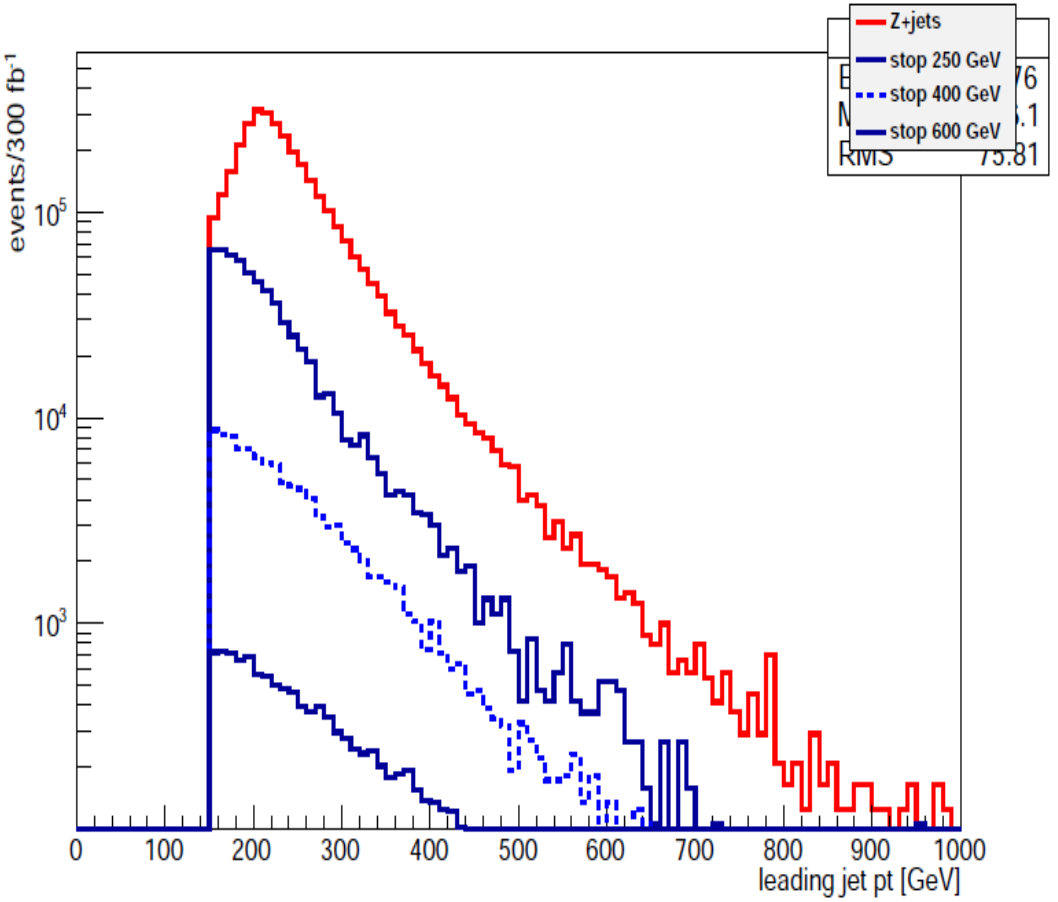
Signature with hard jet and Etmiss from QCD initial state radiation

Define Basic preselection cuts:

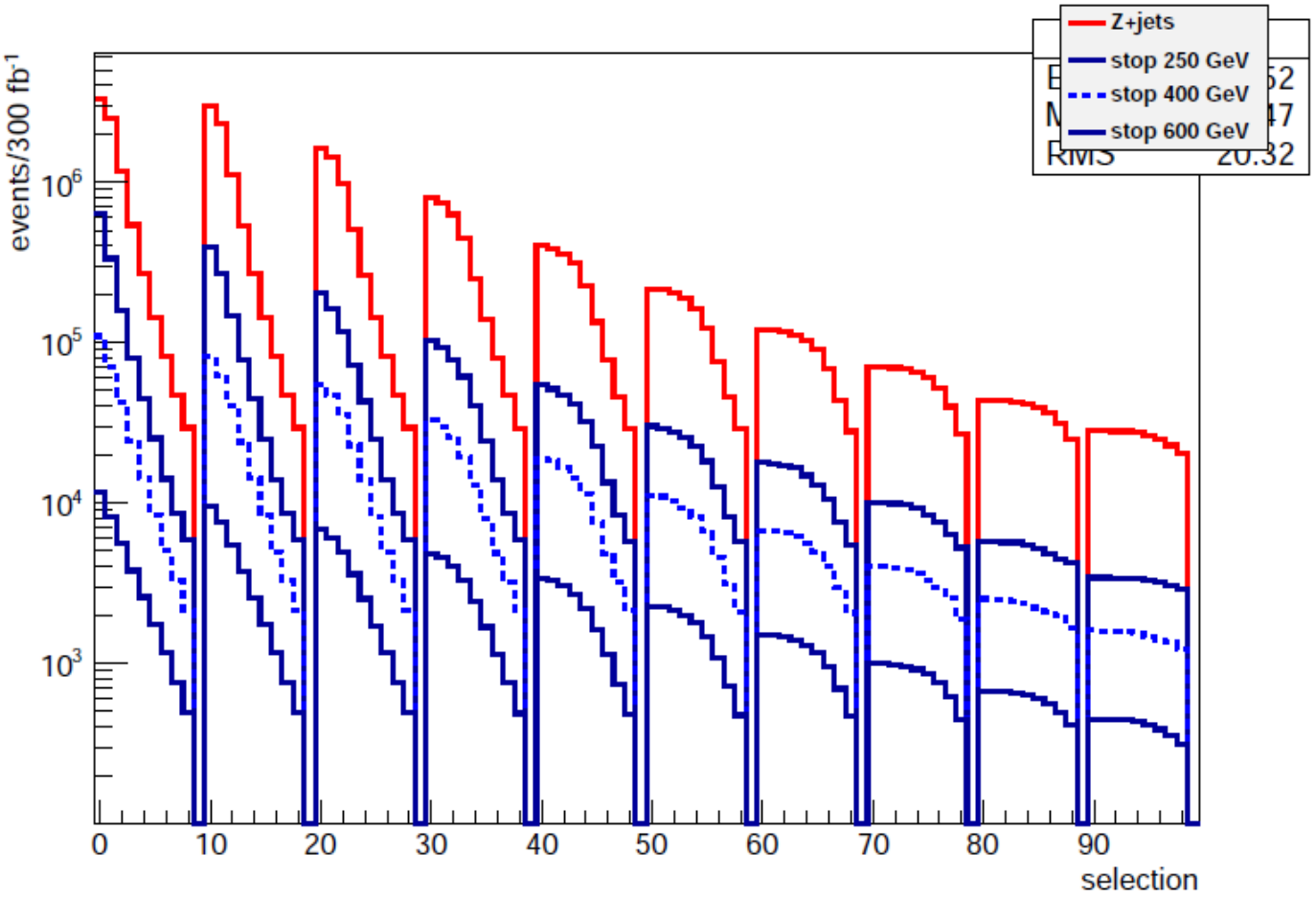
- Etmiss>150 GeV
- Pt leading jet>150 GeV
- Njet<4
- Dphi(Etmiss, Jet)<0.4

Plot pt of leading jet for Three sample stop masses: 250 GeV, 400 GeV, 600 GeV

And main background: Z+Jets. $Z \rightarrow \nu\nu$



Scan on Etmiss and PT of leading jet



Seems difficult, need to add specialised cuts addressing the boosted debris of stop

Conclusions

- In the framework of what next combined theoretical-experimental activity started
- Try to assess visibility of benchmark models addressing naturalness for various future facilities
- Address in experiment-independent way signatures neglected in Snowmass/ECFA studies
- Work started, mostly addressing technicalities in the last two months
- Time horizont driven by What Next process, order one year, converging into a document
- Benchmark models chosen as a viable example, additional effort from people willing to address other models very welcome