

Search for top squarks and dark matter particles in opposite-charge dilepton final states at CMS

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on behalf of the CMS collaboration



based on

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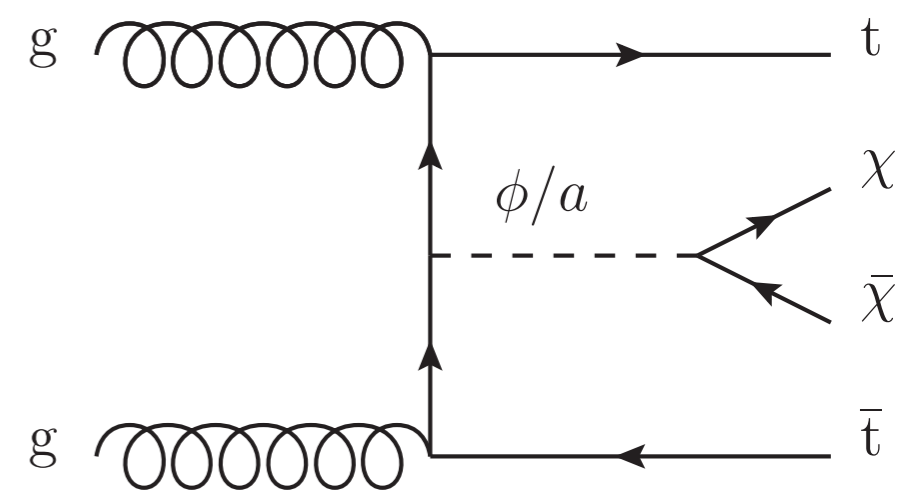
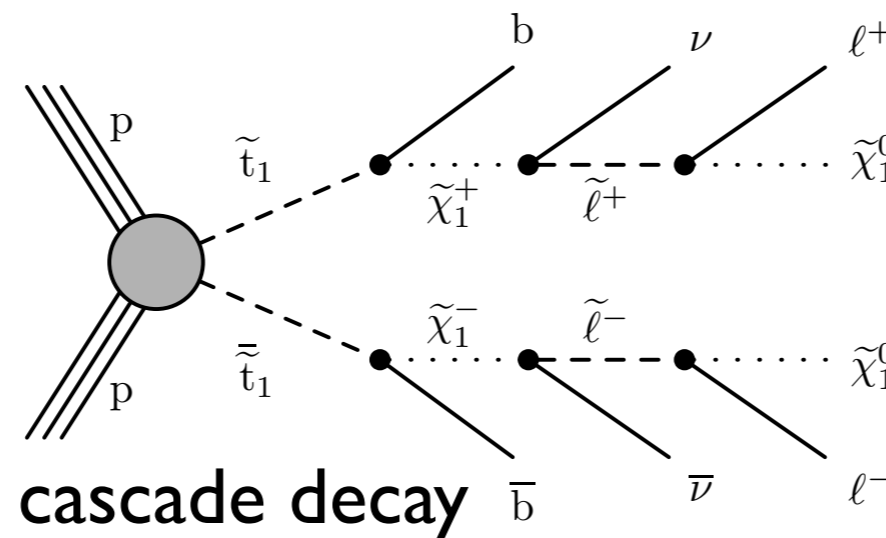
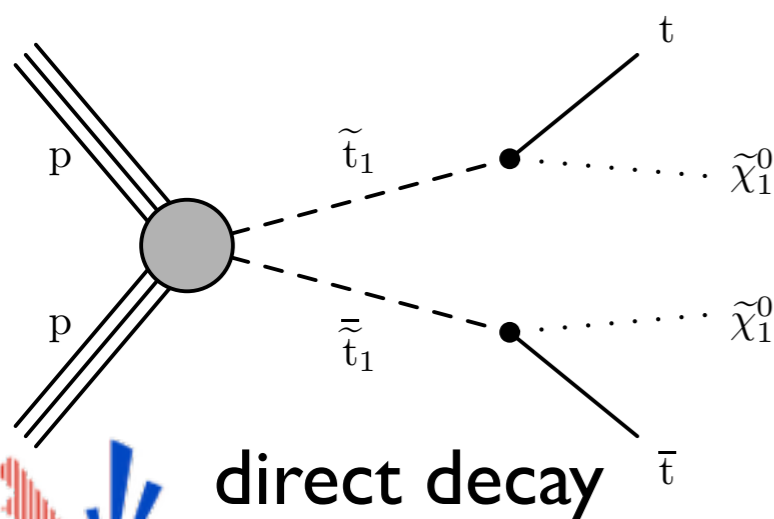
What are we looking for?

Pair production: Simplified SUSY Models

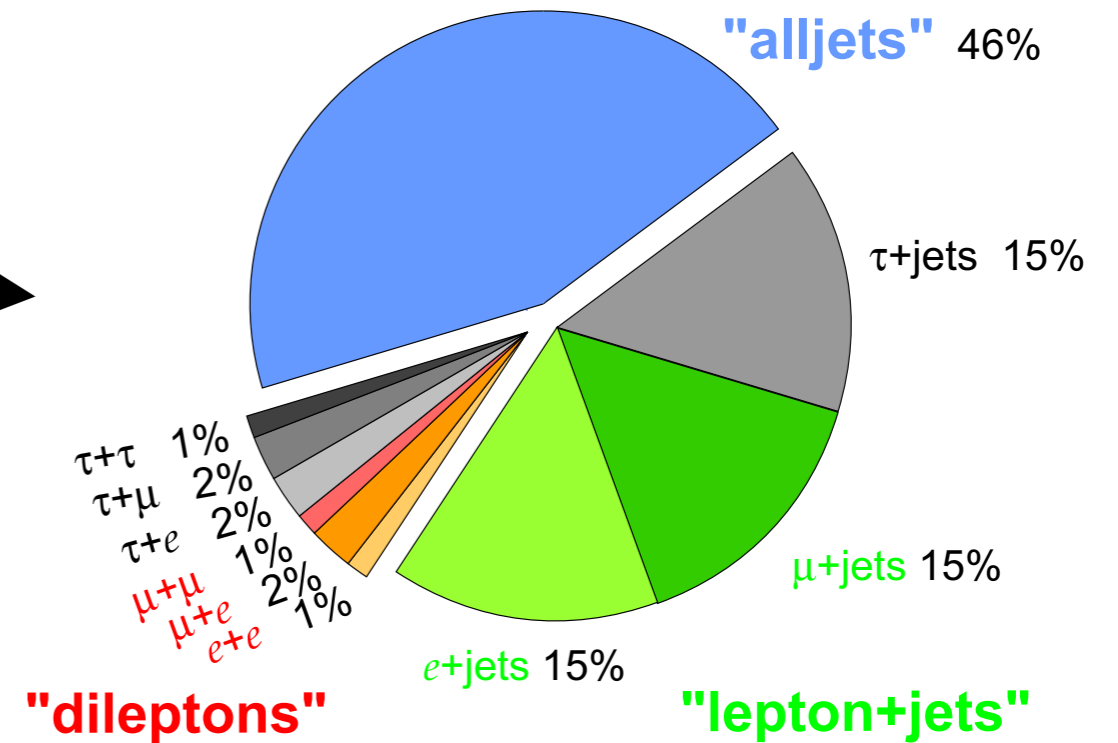
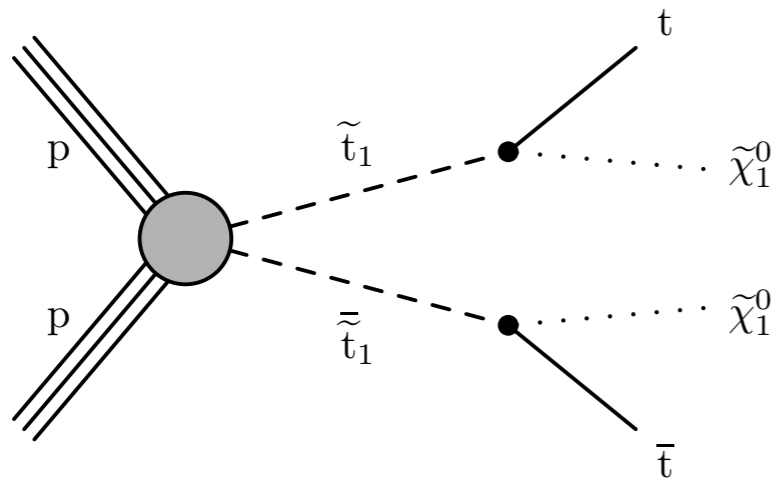
- R-parity conservation assumed
- Following naturalness requirements, top squark should have mass in TeV range
- Different decay chains of top squark, e.g. involving charginos or sleptons

Single production: Simplified Dark Matter Models

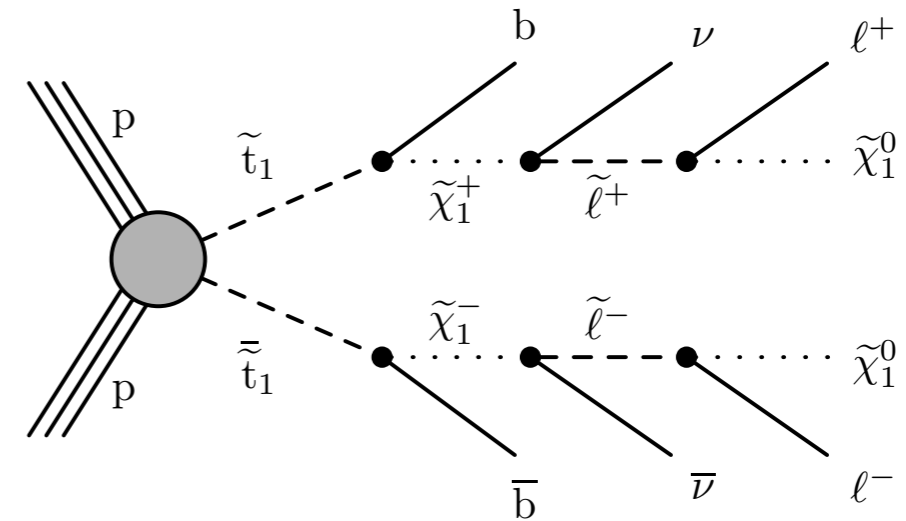
- (Pseudo)scalar mediator produced in top/antitop t-channel
- Assume DM to be Dirac fermion
- Same coupling as Higgs boson assumed
- No mixing with Higgs in simplified models



Why dilepton final state?



- BR from top quark pairs into two leptons (e/ μ): 4% \rightarrow small compared to lepton+jets and alljets final states
- But: *clean* final state!
- Multijet background (dominant in hadron colliders) negligible
- Complementarity allows combination with other searches
- In other simplified models, BR can go up to 40%

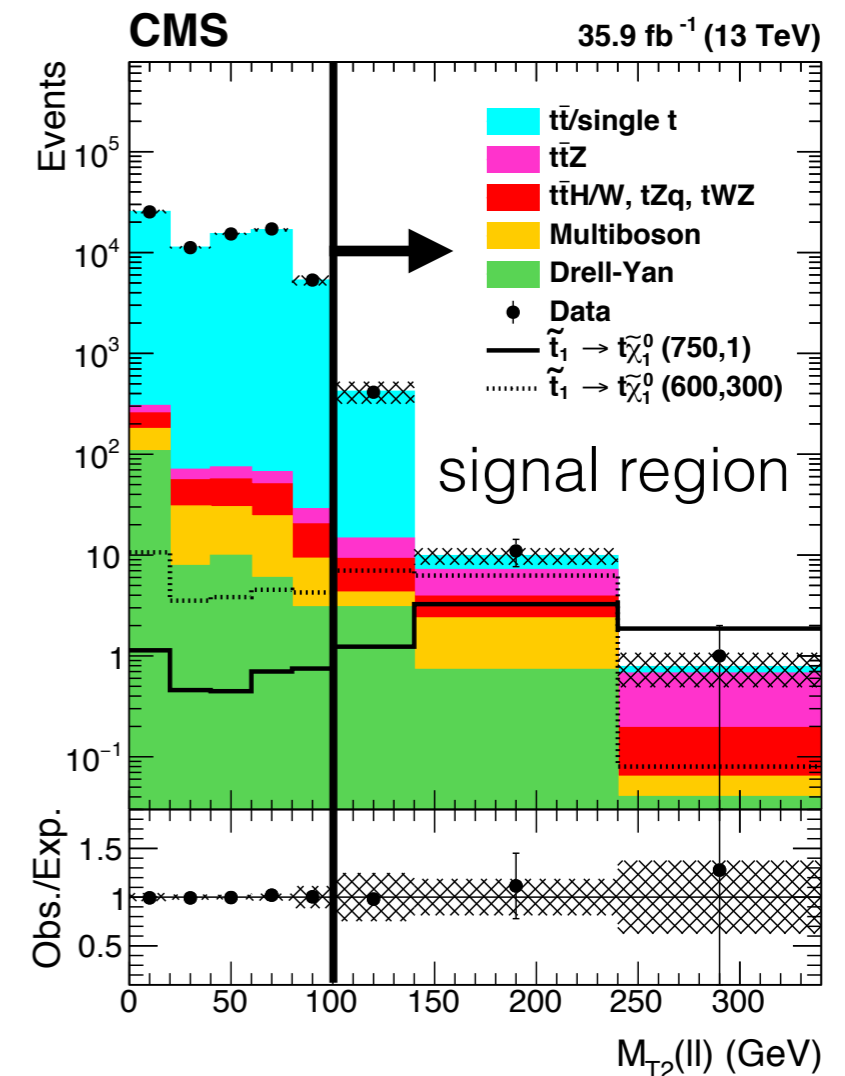
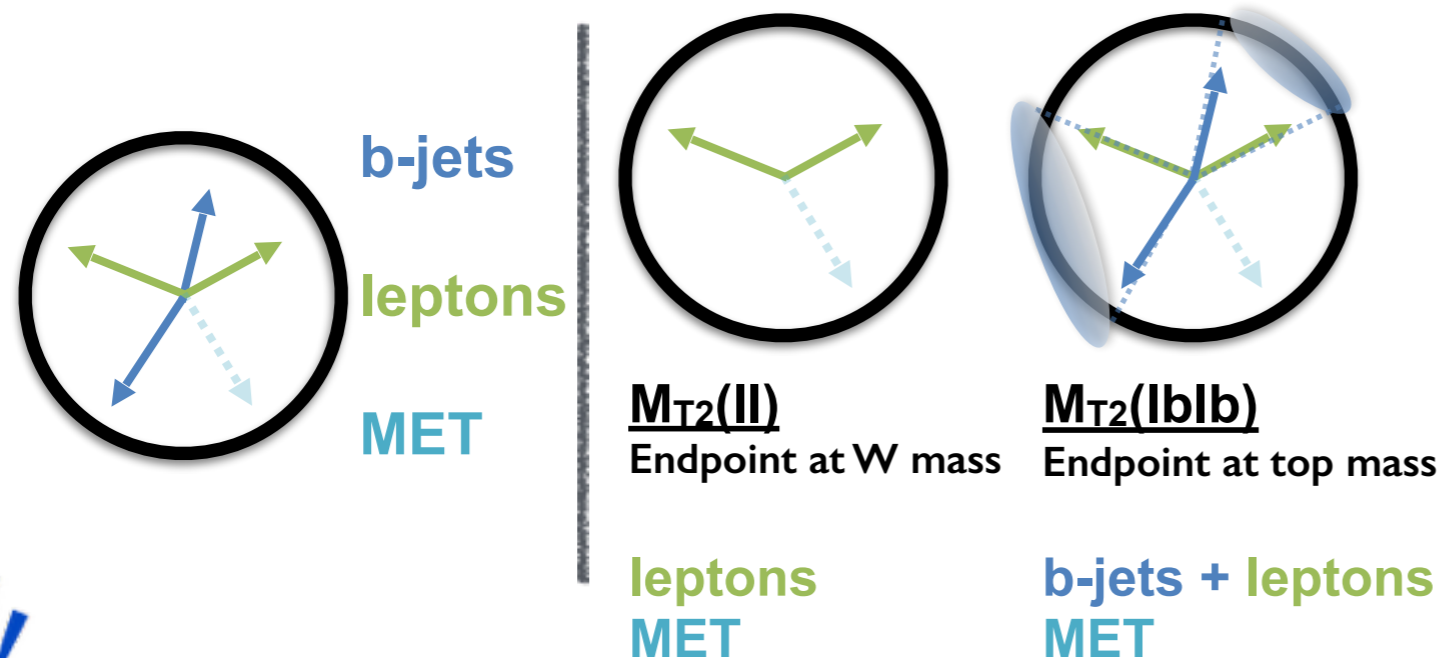


Strategy

- Opposite sign lepton pair used to obtain the “stransverse mass”

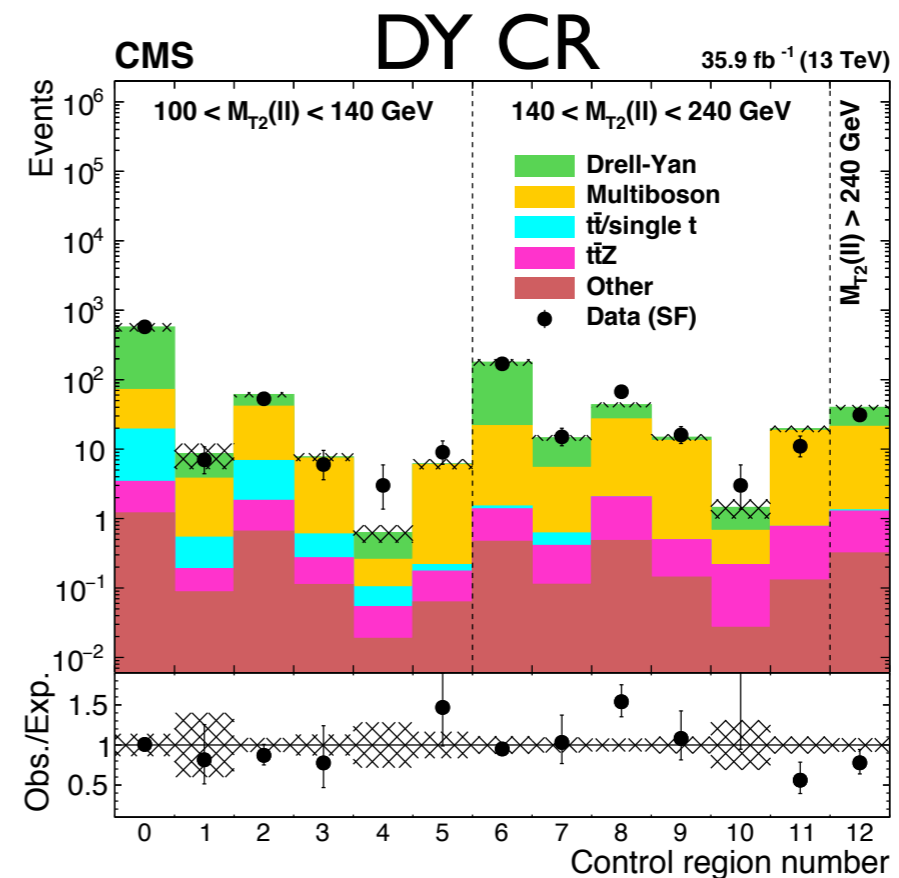
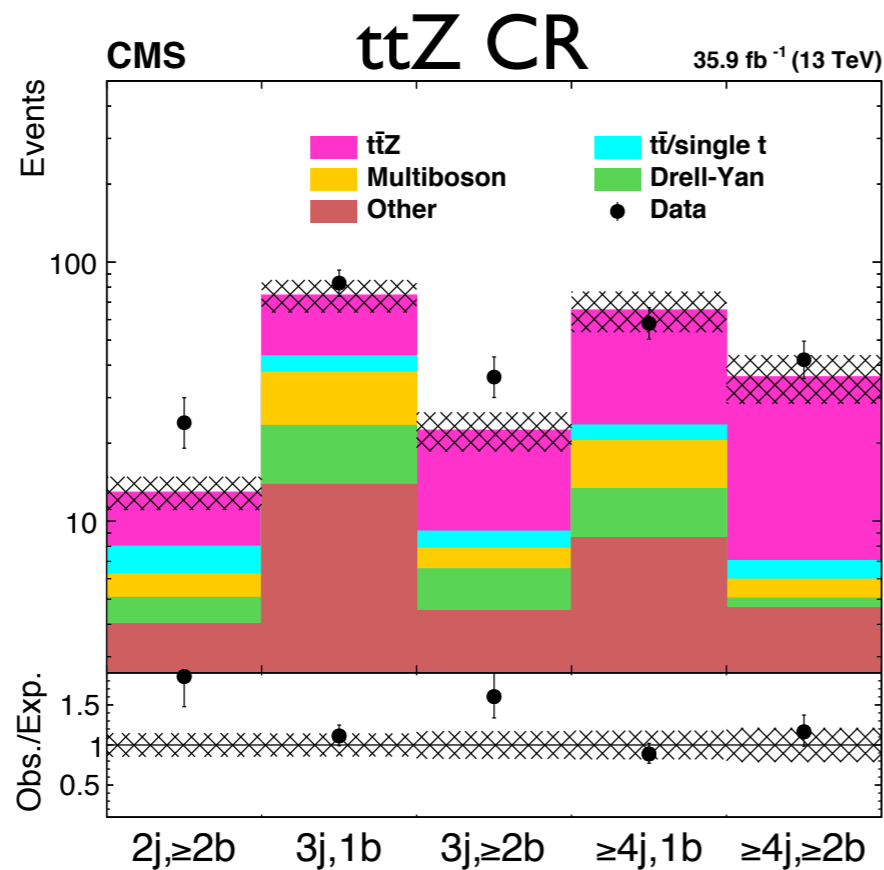
$$M_{T2}^2(II) = \min_{\mathbf{p}'_1 + \mathbf{p}'_2 = \mathbf{p}'_T} [\max \{m_T^2(\mathbf{p}_{l1}, \mathbf{p}'_1), m_T^2(\mathbf{p}_{l2}, \mathbf{p}'_2)\}]$$

- Construct two leptonically decaying W systems from leptons and MET
- Final state involves b-jets: combination with b-jets used as well
- Top quark background reduced by several orders of magnitude with $M_{T2}(II)$ cut



Background control

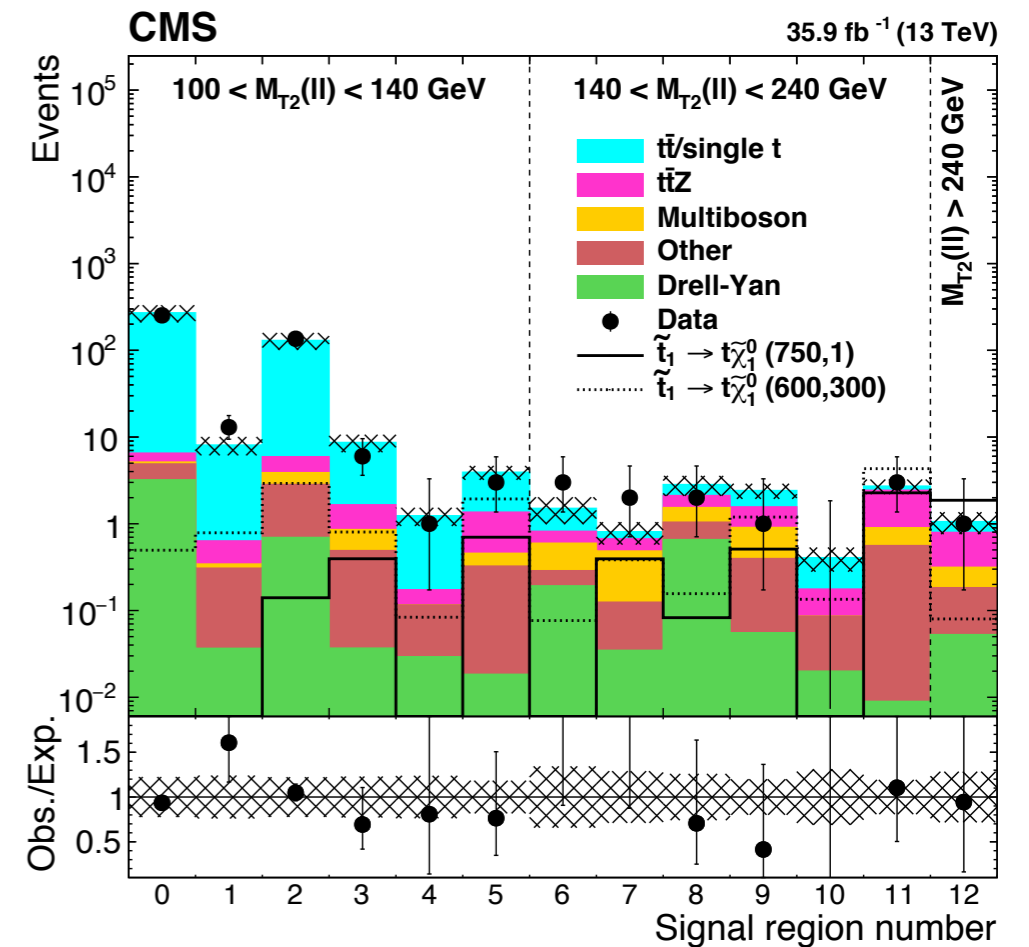
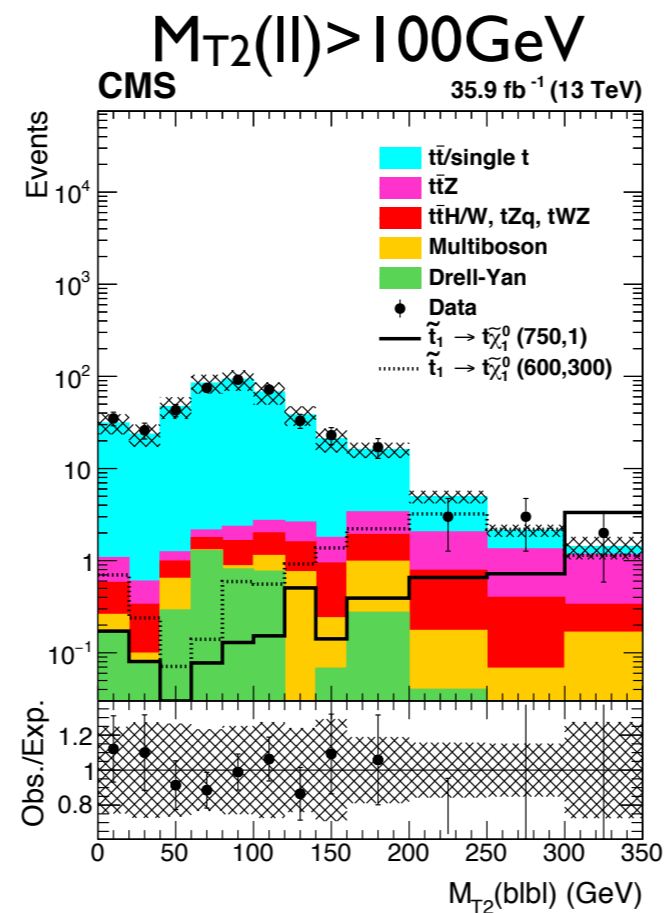
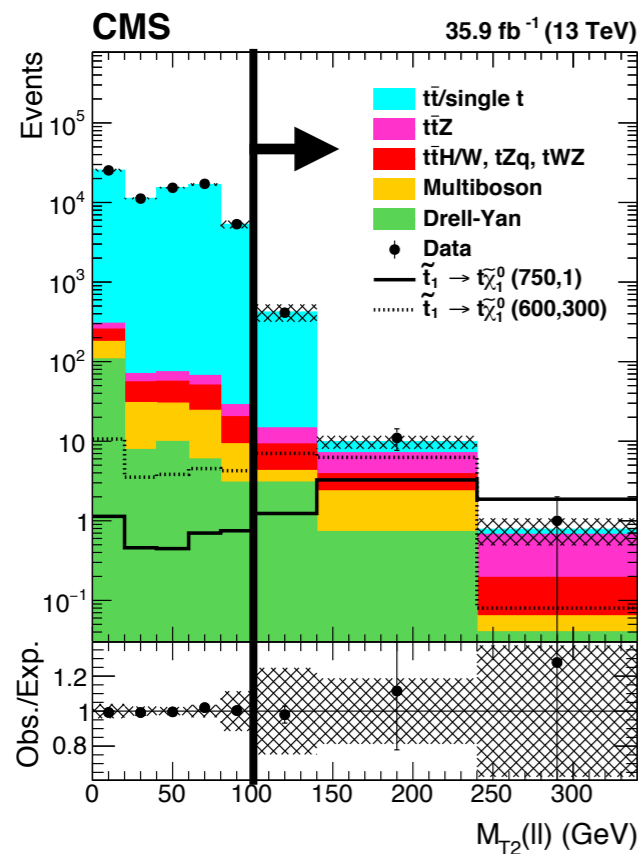
- Several cross checks in data control samples performed to verify modelling of kinematic distributions in simulated samples
- Fit simulated shapes to data in independent control samples to constrain background normalization
- $t\bar{t}Z$ (irreducible background) constrained in 3 lepton control region
- Drell-Yan/multiboson: events with dilepton invariant mass close to Z selected



Results

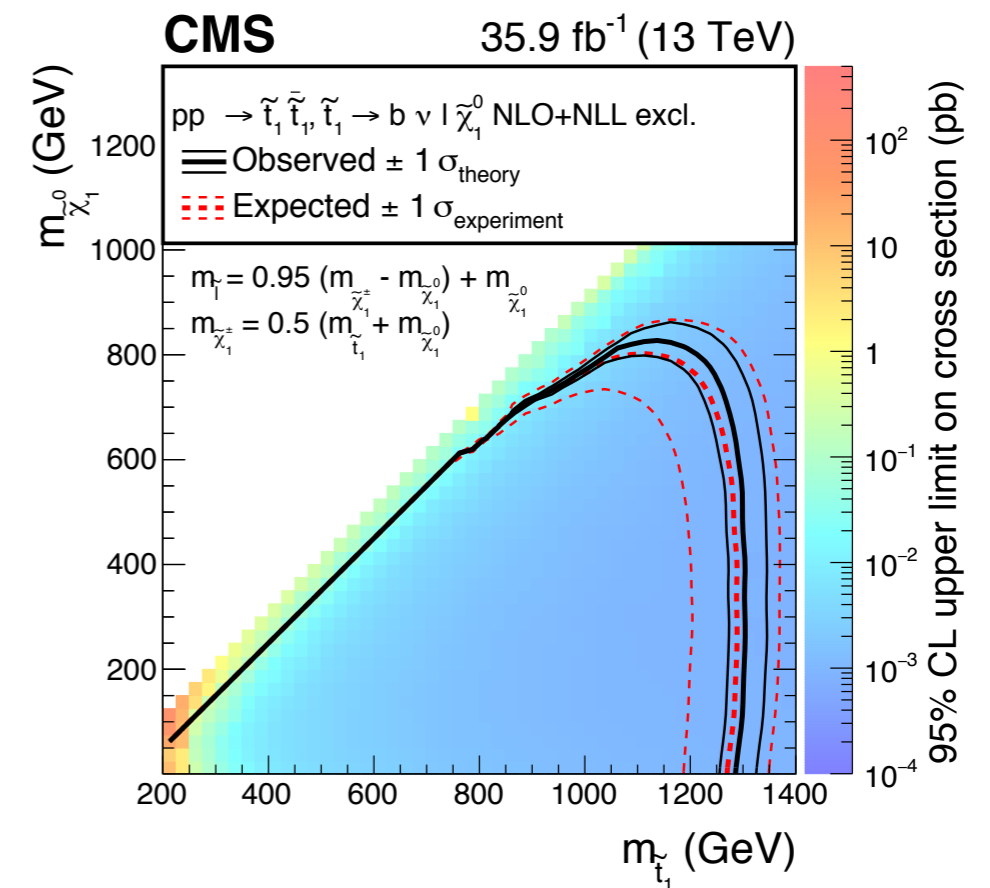
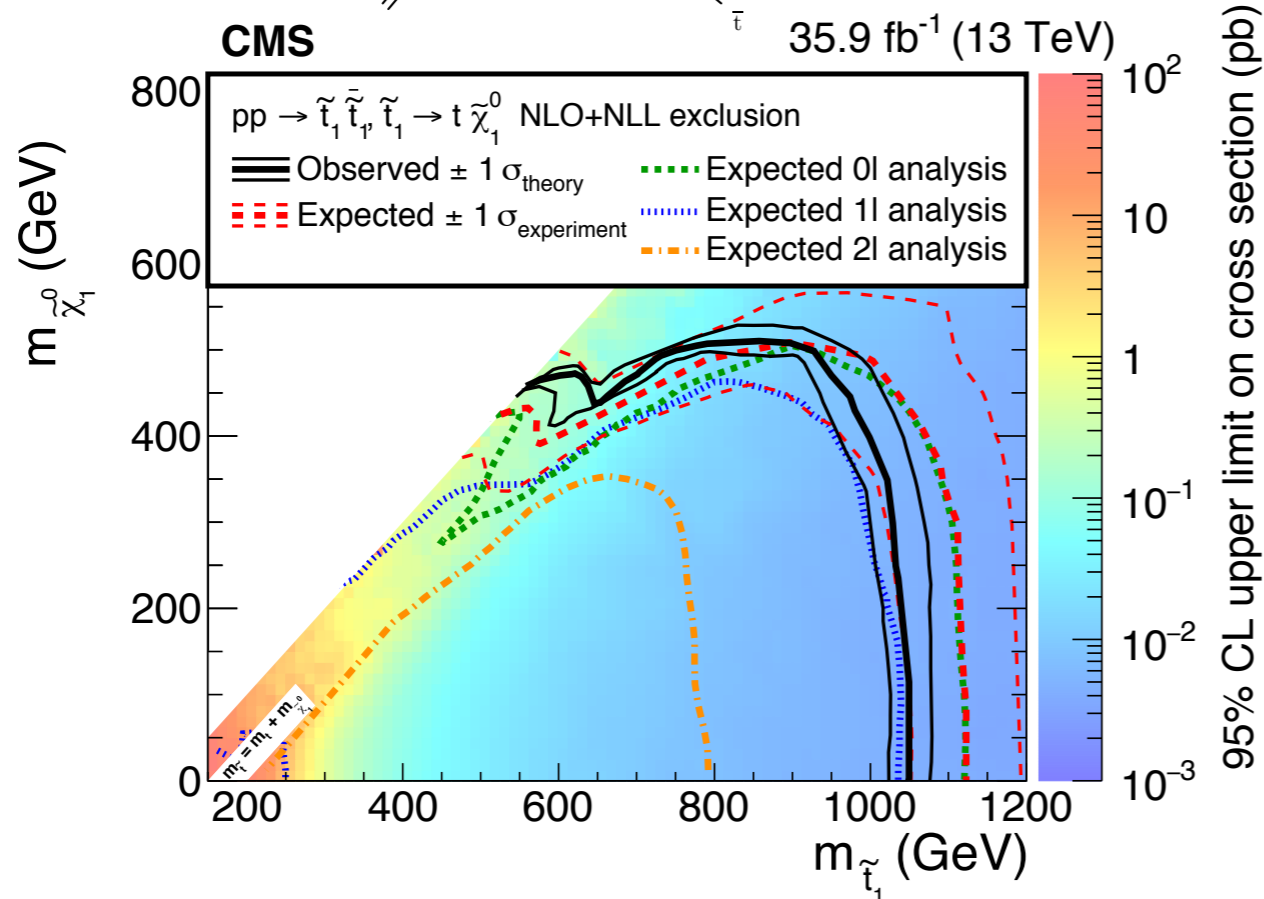
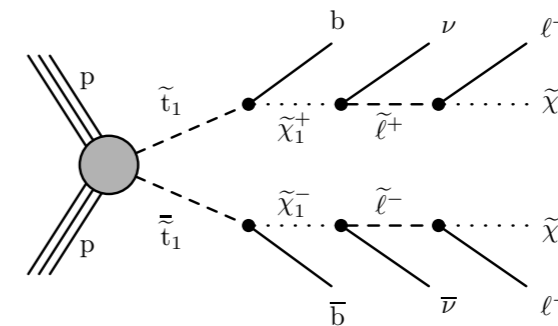
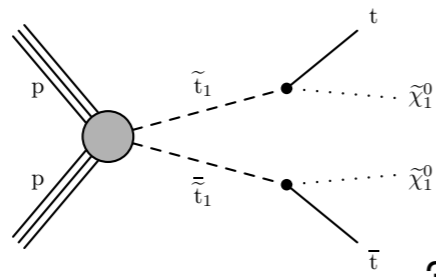
- Good agreement between predicted background and observation in signal regions
- Set exclusion limits on production cross section of new particles within simplified model assumptions

13 signal regions, in bins of $M_{T2}(II)$, $M_{T2}(blbl)$ and E_T^{miss}



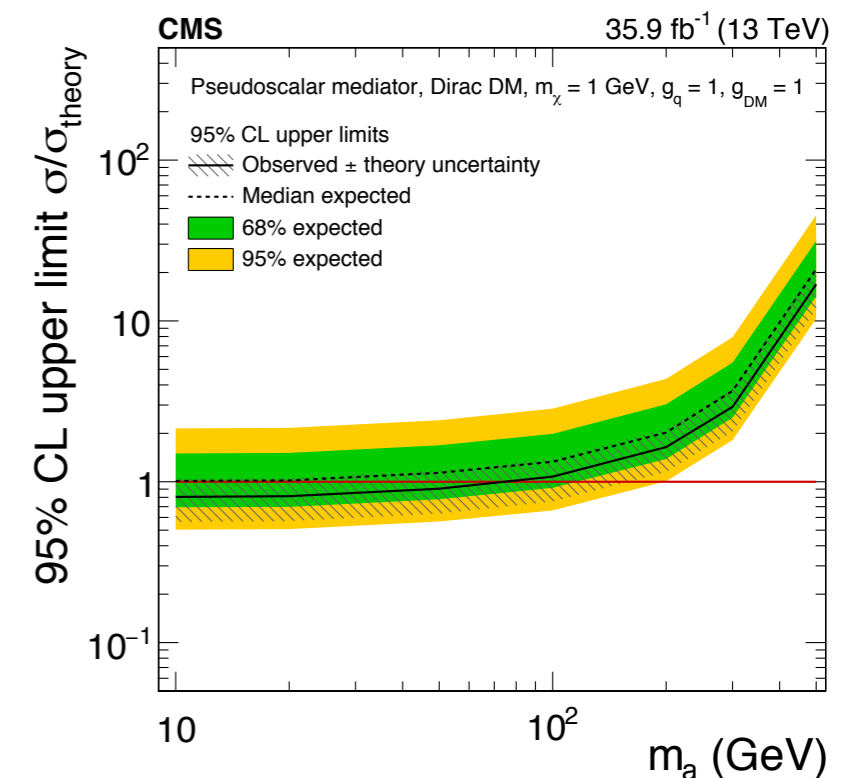
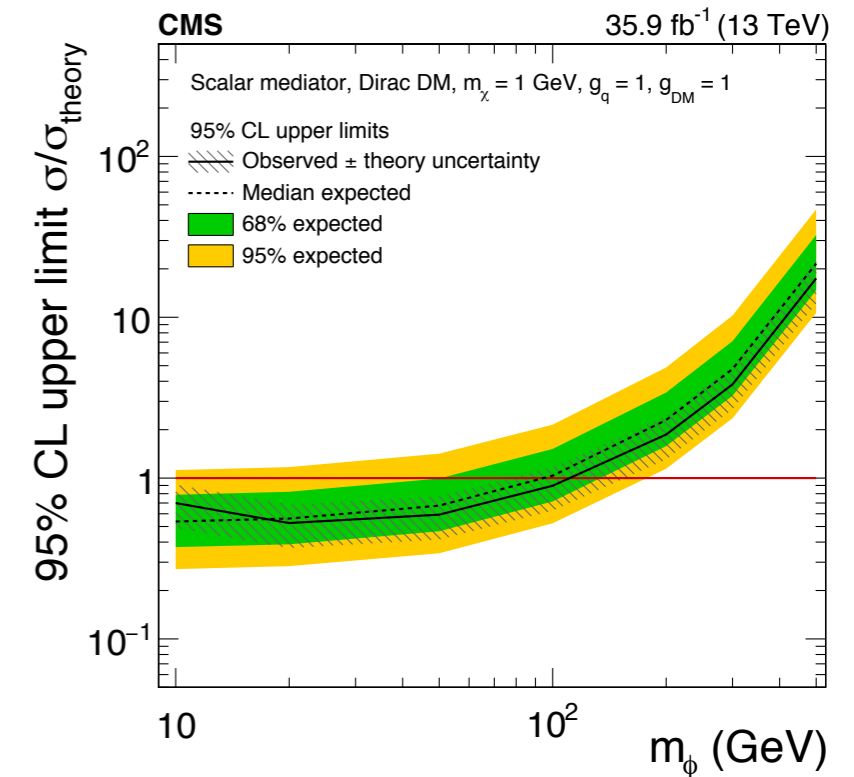
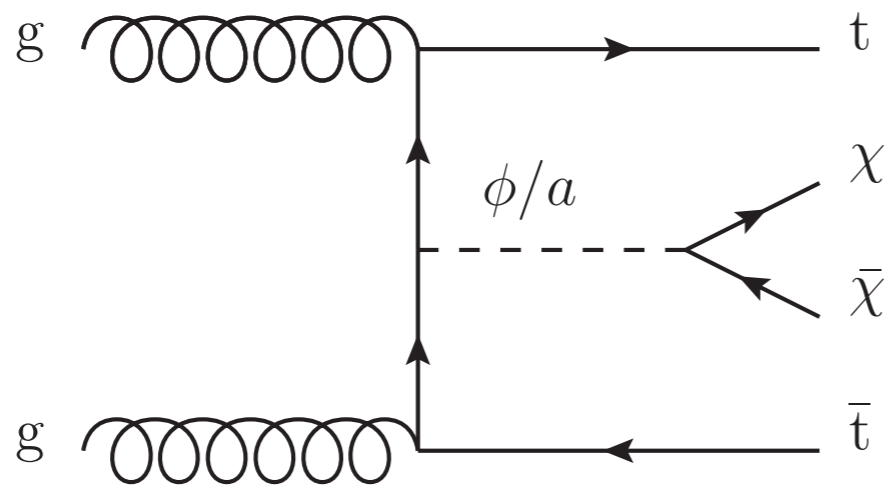
SUSY interpretation

- Exclusion of pair production of top squarks with masses up to 1050 GeV in combined result with alljets and lepton+jets analysis
- Under certain model assumptions exclusion limits reach up to top squark masses of 1300 GeV



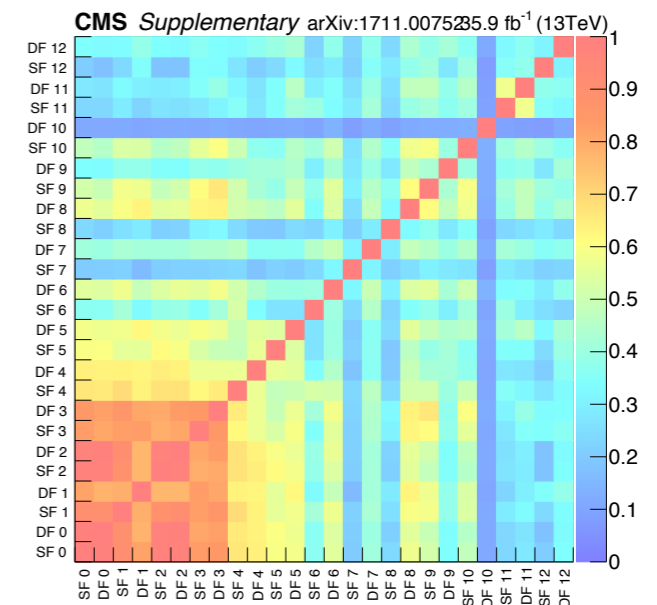
Dark Matter interpretation

- Dark Matter particles produced in t-channel via (pseudo)scalar mediator
- Same coupling as Higgs boson assumed
- No mixing with Higgs in simplified models
- Results allow to exclude (pseudo)scalar mediators with masses up to 100 GeV for DM particles with 1 GeV



Summary

- Dilepton channel complementary to alljets and lepton+jets searches for classical SUSY searches
- Sensitive to models with higher branching ratios to two leptons
- No significant excess of data over estimated background observed - exclude top squarks up to 1.3 TeV in simplified models
- First limit on masses of scalar mediators in simplified Dark Matter models
- A lot of material to facilitate reinterpretation public: aggregate signal regions, correlation matrices, signal cut-flow etc.
 - **HEPData** entry to go online soon!



BACKUP
