Search for scalar top quark production in the top corridor region and Run 2 combination with the CMS experiment

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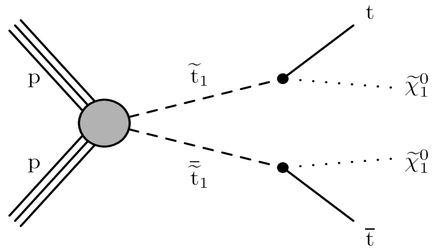
Introduction

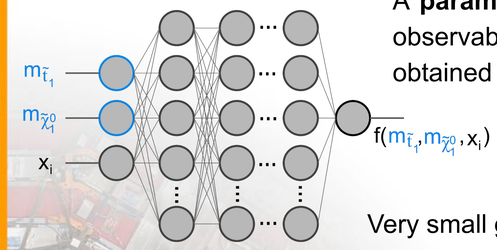
Stop quarks play an essential role in understanding SUSY. Several searches have been performed by CMS using the Run 2 data, excluding stop quark masses up to about 1.2 TeV.
The **top quark corridor** is a special region in the $m_{\tilde{t}_1}, m_{\tilde{\chi}_1^0}$ phase space in which the final state is very similar to the **tt background**. A **dedicated search targeting this region** is needed.



A dataset of **137 fb^{-1}** recorded by CMS during the LHC Run 2 is used to search for stop quarks in the top quark corridor. Previous searches in final states with 0, 1, or 2 leptons using the **full Run 2 dataset** by CMS are **combined** to increase the sensitivity and **extend the exclusion limits**.

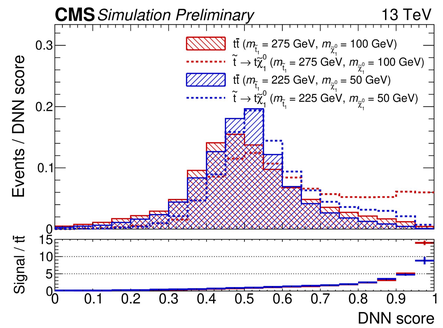
The decay into top quarks and neutralinos (LSP) in the **T2tt simplified model** is considered.

Strategy



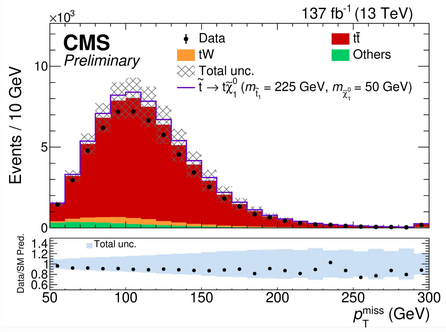
A **parametric neural network** is trained using a set of kinematic observables and $m_{\tilde{t}_1}, m_{\tilde{\chi}_1^0}$ as parameters. A **optimal separation** is obtained **for each target signal point**.

Very small gain for low masses in the central line of the corridor, close to the point (175, 1), where sensitivity comes mainly from the cross section. Improved **discrimination at high values of the neural network** score for larger masses.



Event selection

Selected events contain 2 opposite-sign leptons, at least two jets, at least one b-tagged jet, and a **missing transverse energy of at least 50 GeV**.



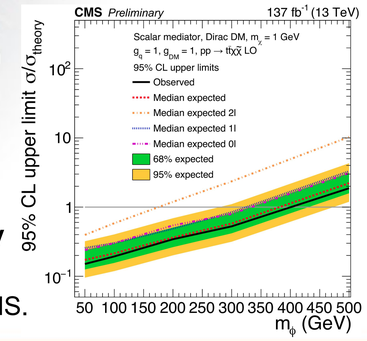
The $\mathbf{m_{T2}}$ **observable** has an endpoint at the mass of the W boson for tt events, but not for signal events. A requirement of $m_{T2} > 80$ GeV is set.

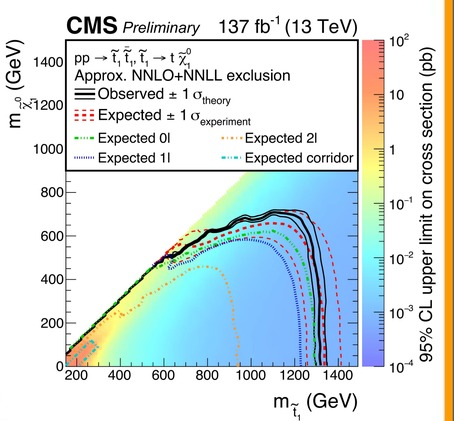
The background is **dominated by tt and tW** events. These backgrounds are estimated from MC. DY, diboson, tt+X events or nonprompt leptons have a small contribution. A **parametric neural network** is trained to optimize the **separation between signal and tt background**.

Combination

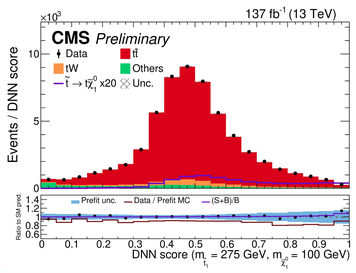
Signal regions with 0, 1, and 2 leptons in the final state, are combined. Limits to **stop quark production** are set. The combined results are also interpreted in a search for **dark matter in association with top quarks**.

The combination **improves previous limits by 50 GeV** in the stop quark mass. The **top corridor** region is unblanked and **fully excluded** for the first time by CMS.



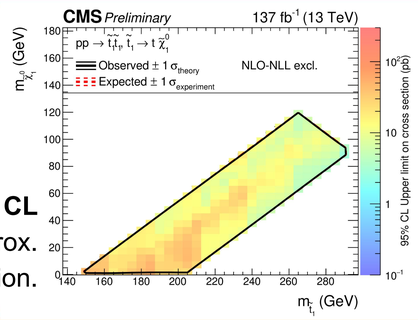


Corrisor results



No excess is observed over the background prediction. Upper limits on the production cross section are set.

The full search region **is excluded at 95% CL** for the fist time considering the approx. NNLO+NNLL signal cross section.



References

Top quark corridor and combination:
CMS-PAS-SUS-20-002
Inclusive searches:
(0ℓ) arXiv:2103.01290 (submitted to PRD)
(1ℓ) JHEP 05 (2020) 032
(2ℓ) Eur. Phys. J. C 81 (2021) 3

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