Filling Gaps near Compression Lines in Supersymmetric Top Quark Searches

- W. S. Cho - Journal Club (July 10 2015)

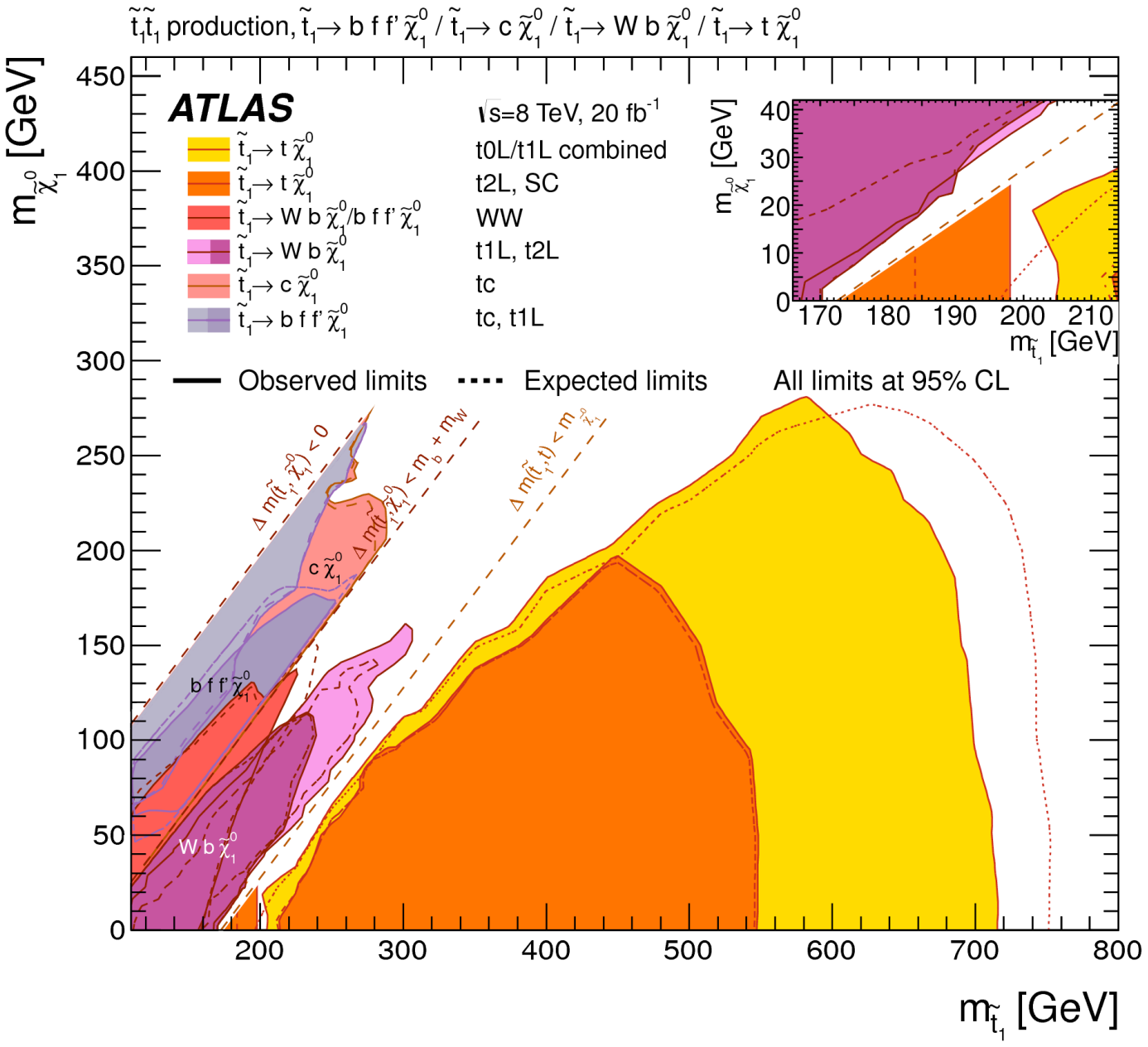
Ref 1) arXiv: 1506.00653 “Opening up the compressed region of stop searches at 13 TeV LHC”, Haipeng. An, and Lian-Tao Wang

Ref 2) arXiv: 1506.07885 “Revealing compressed stops using high-momentum recoils”, Sebastian Macaluso, Michael Park, David Shih, and Brock Tweedie

Current Experimental Limits

- Benchmark simplified model : $\tilde{t} \to t^{(*)} + \tilde{\chi}_0$
  - $8\ \mathrm{TeV}\ \mathrm{Run\text{-}I} : M_{\tilde{t}} > 700\,\mathrm{GeV} \quad (95\%\mathrm{C.L.})$
- Top-compression line (+ Stealth point)
- W-compression line
- Complete squeezing line

Up-to-Date Search Limit



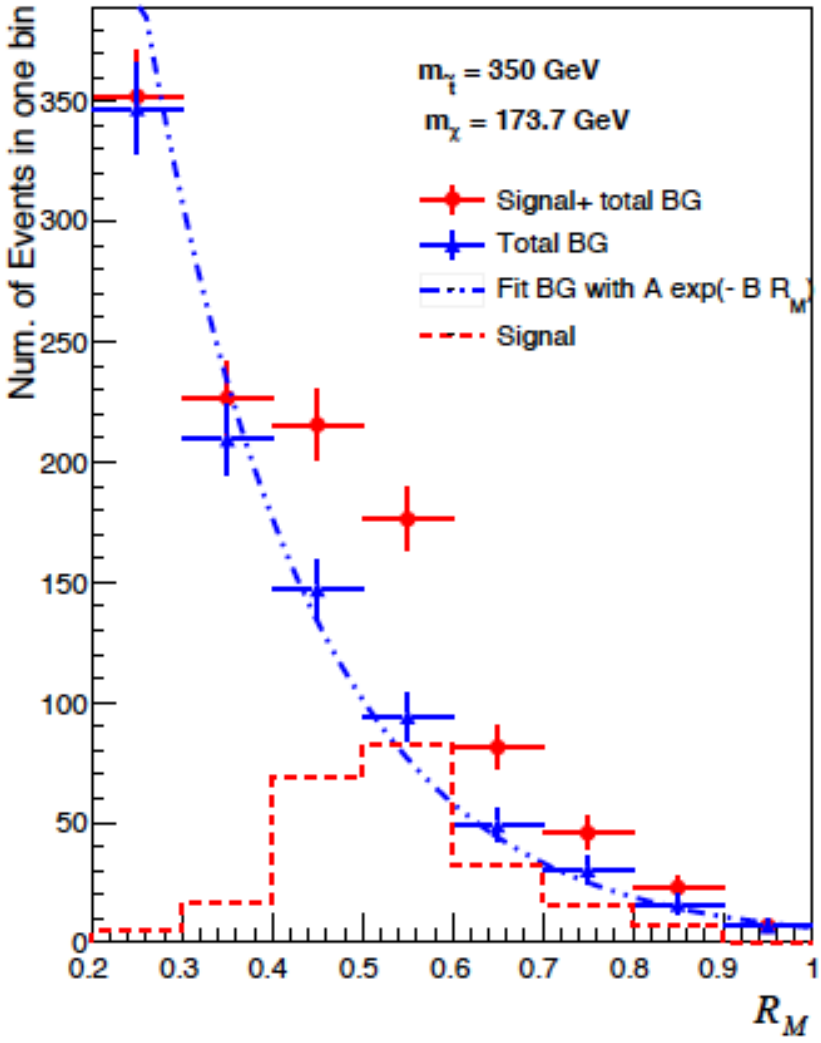
Contents

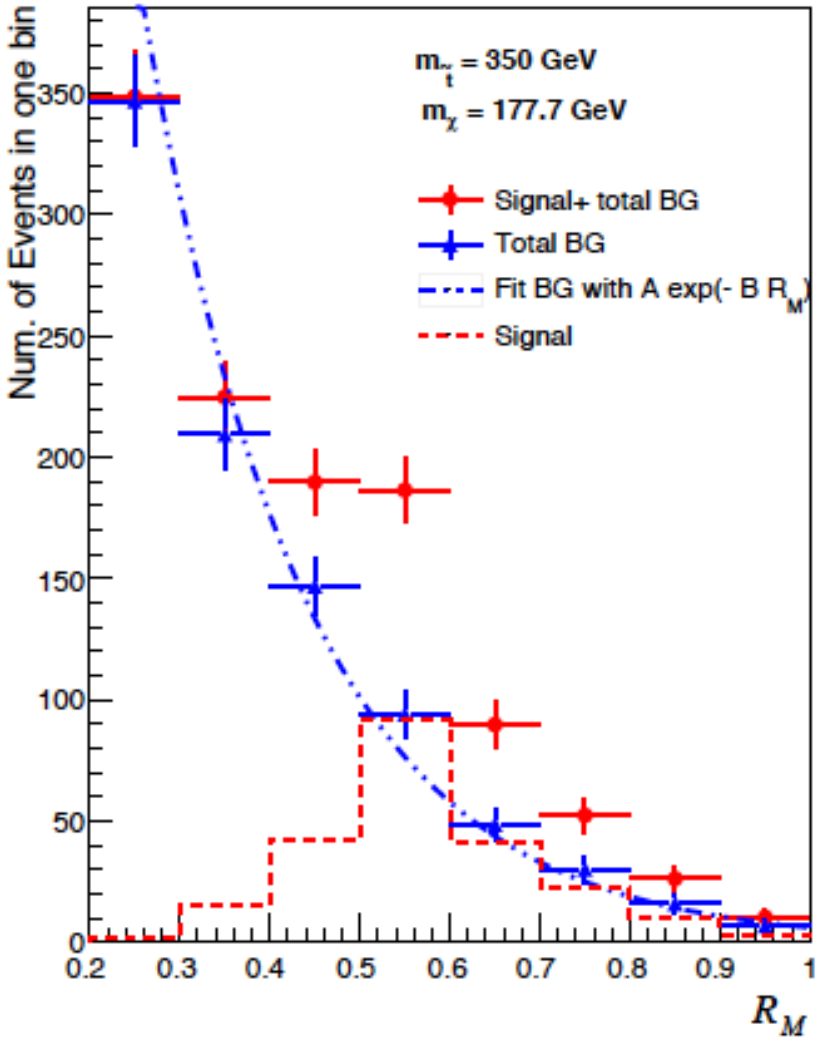
- Why there exist the uncovered valleys near the compression lines ?
  - MET from two LSPs in back-to-back directions, is vanished. Signal becomes almost ttbar-like.
- Idea : Utilising a special peak region in MET,
  1. which can appear from (threshold decay system) + (transverse recoiling)
  2. where its location can be determined by $(M_{\tilde{\chi}}, M_{\tilde{t}})$
     $\Rightarrow$ signal region can be optimised by the mass parameters, while being scanned.

- $R_M \equiv \dfrac{E_T}{P_T(ISR-jet)} \sim \dfrac{M_{\tilde{\chi}}}{M_{\tilde{t}}}$
- The R_M peak is smeared by
  - non-zero mass difference
  - soft radiations, detector effects …
- Peak becomes sharper around the compression line. (even in the t^*, W^* region $\Rightarrow$ virtual mass square q^2 prefers pole mass $\Rightarrow$ tends to get higher value within $q_0 \leq M_{\tilde{t}} - M_{\tilde{\chi}}$ $\Rightarrow$ LSP likely to be at rest in the stop rest frame $\Rightarrow$ R_M peak with recoiling…)

- Search Strategy utilising the MET & R_M peak (13/14 TeV)
  - Lepton veto (MET only from LSP) : $W \to j\,j$
  - $N_{jet} \geq 7 \quad \& \quad N_{bjet} = 1 \text{ or } 2$
  - $P_T(ISR-jet) > 500 \to 700\,\mathrm{GeV}$
  - $\vec{\not{E}}_T \parallel -\vec{P}_T(ISR-jet)$
  - Top jets within a small range

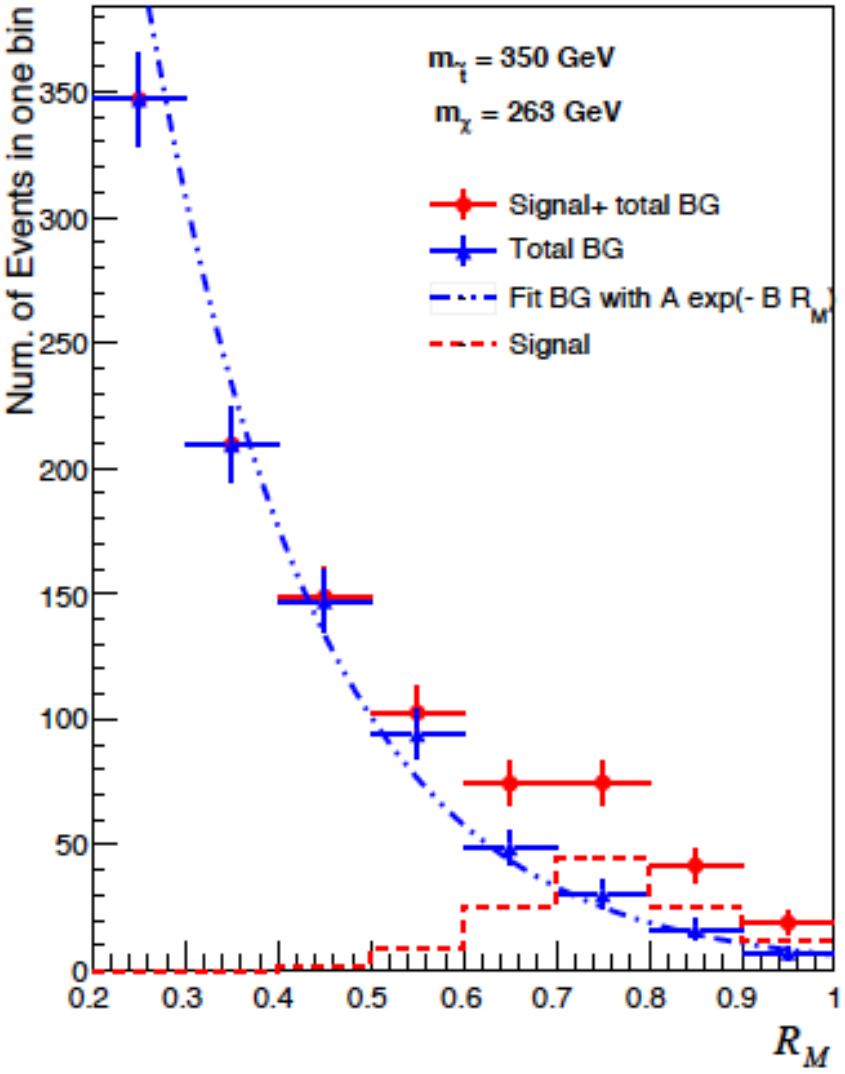
- R_M peaks of the benchmark points around the top-compression line

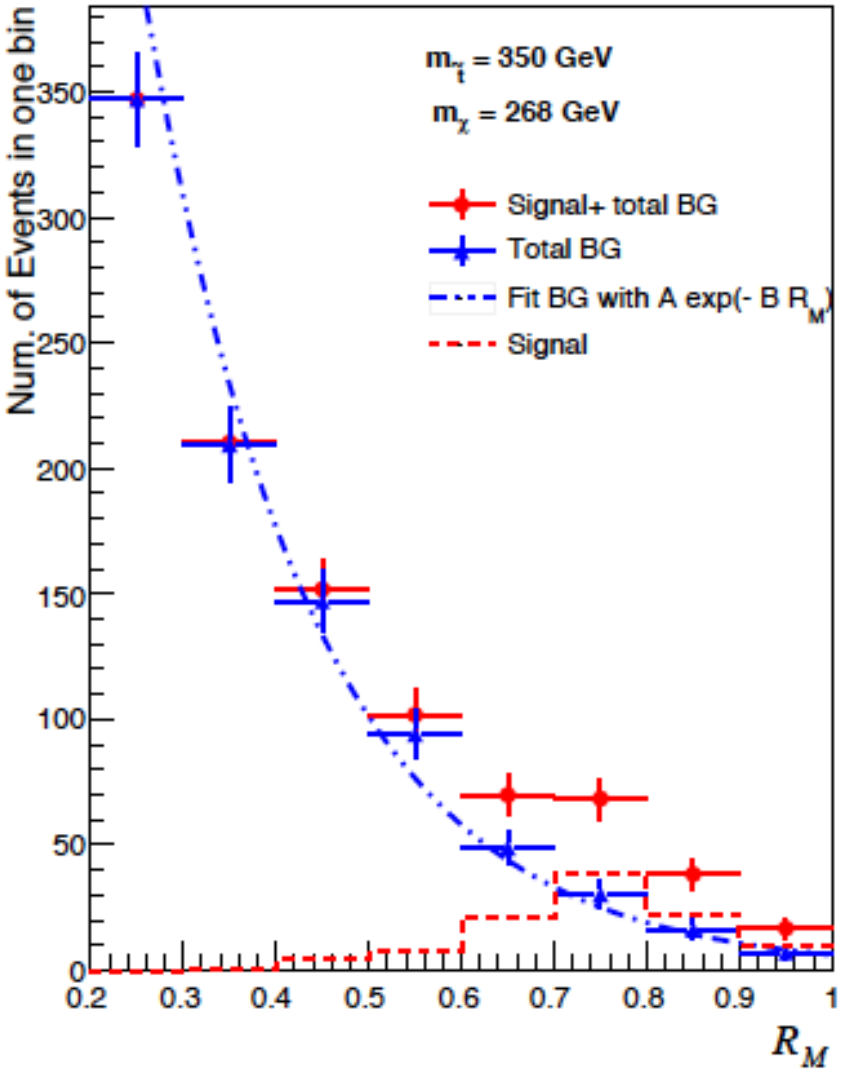




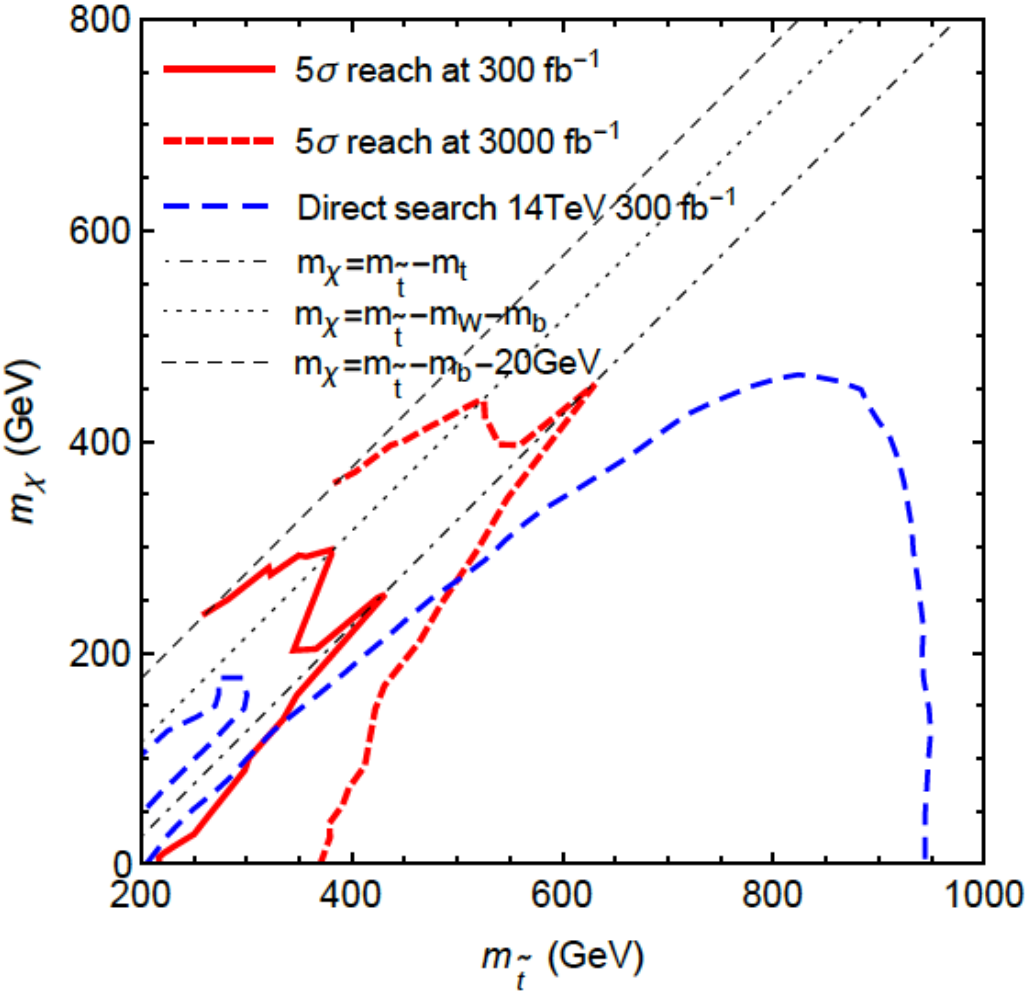
- R_M ~ 0.5

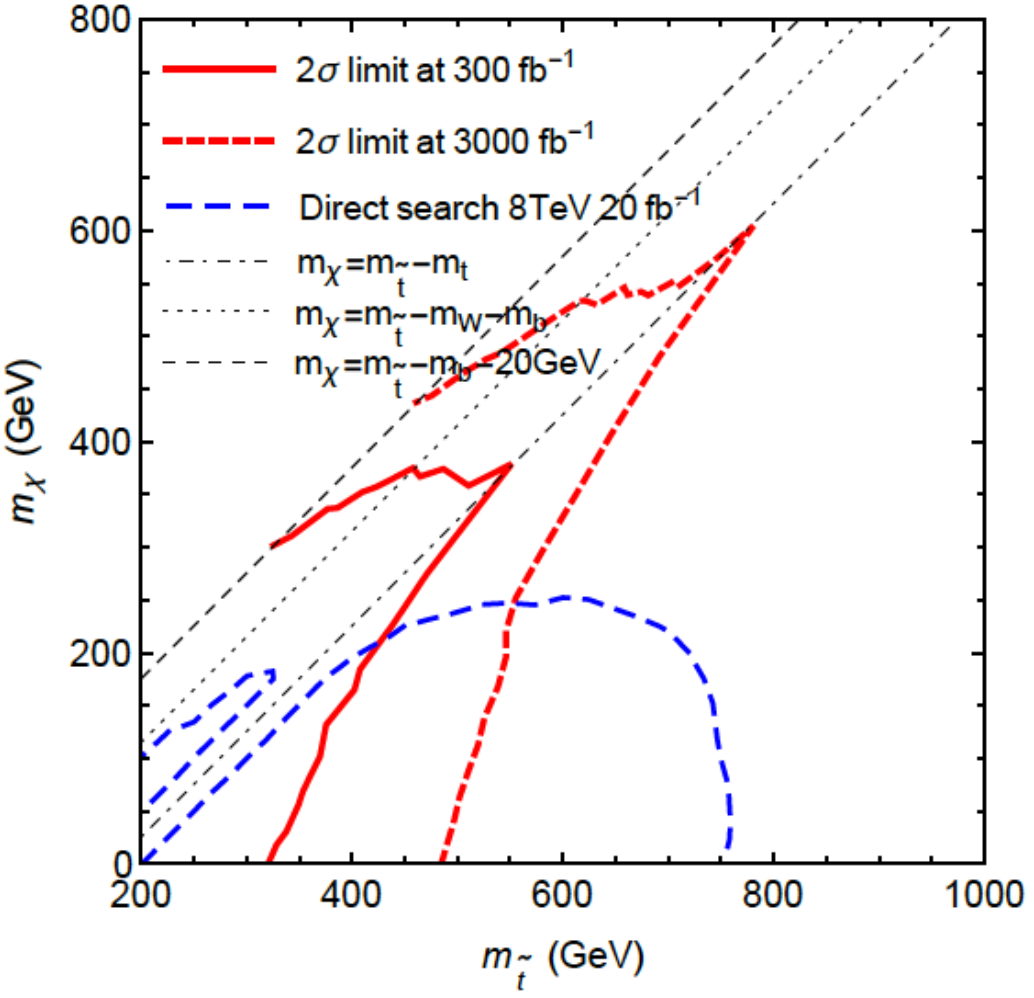
- R_M peaks of the benchmark points around the W-compression line





- Projected 5-sigma Discovery & 2-sigma Exclusion Limit

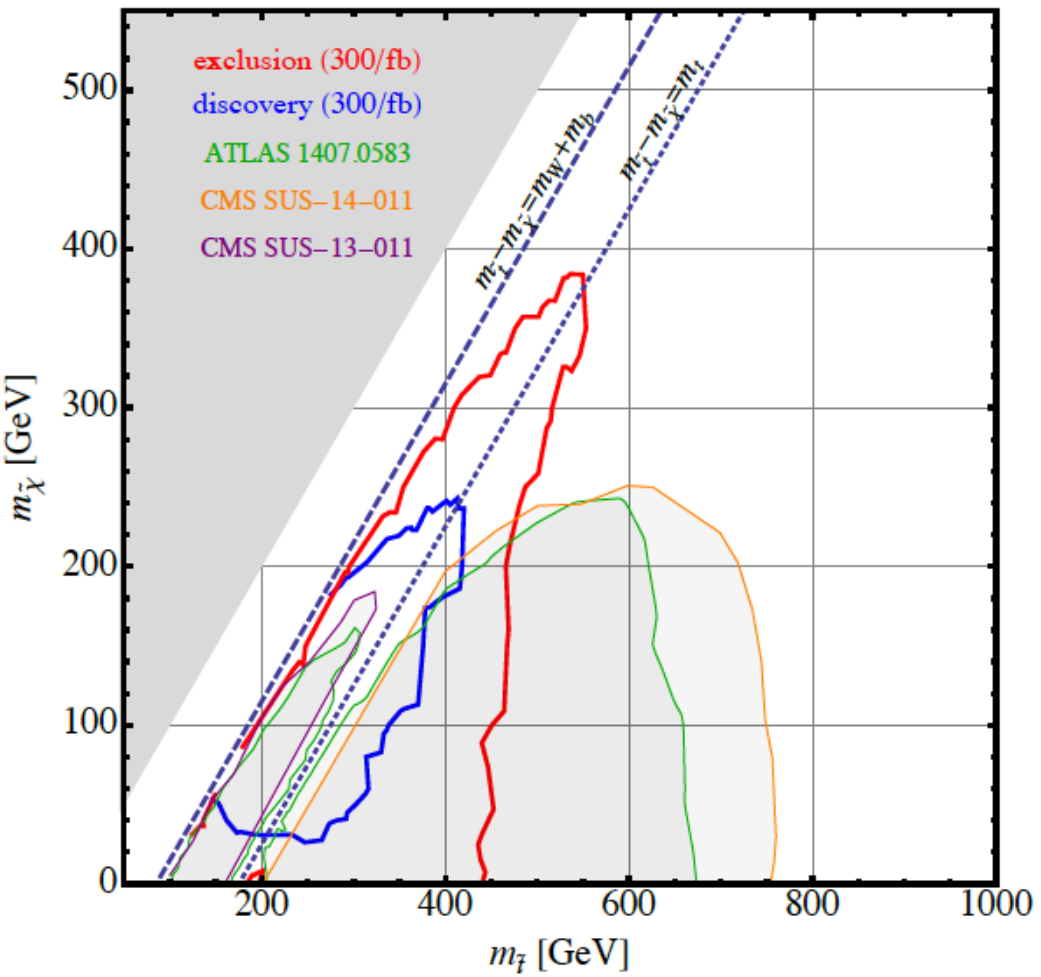




- Spikes along the lines (R_M peak becomes shaper)
- Less sensitivity in split region with small M_{LSP}

($\Rightarrow$ R_M peak at near 0, buried in severe BG.)

- Projected 5-sigma Discovery & 2-sigma Exclusion Limit



- In the ref 2), including the result near stealth point (still uncovered), but w/o scanning over the W-compression region