Summary of Monotop Models

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DM-LHC Forum
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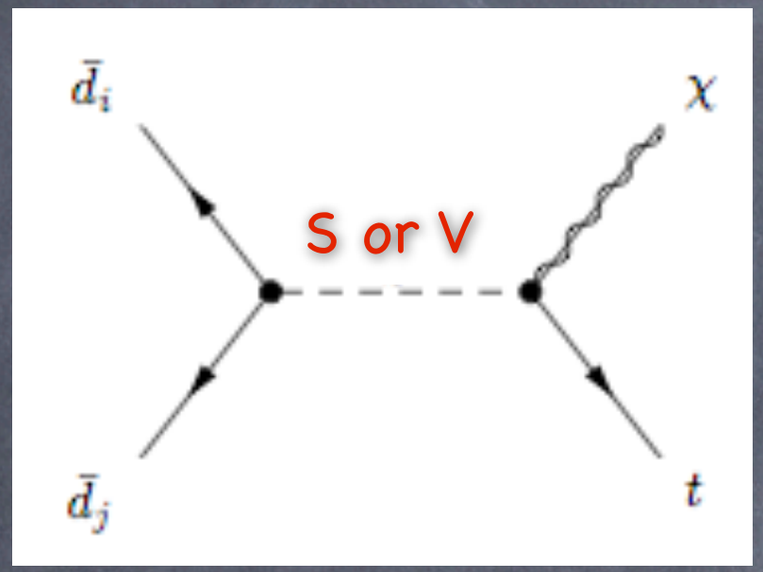
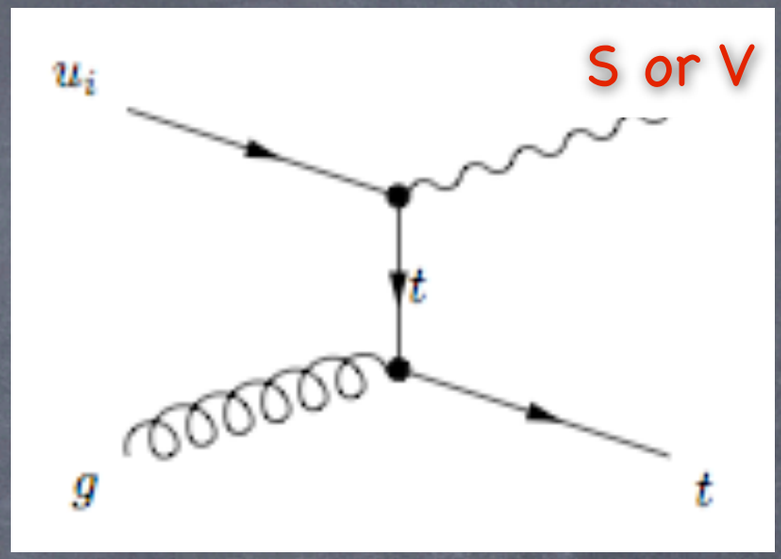
Resonant and non-resonant



(see also 1109.5963)



(see also 1310.7600)

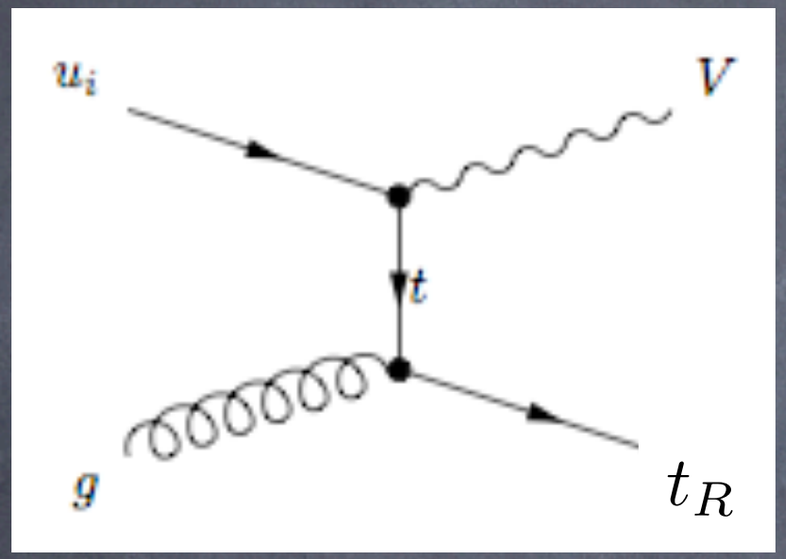
$$
\begin{aligned}
\mathcal{L} = \; & \mathcal{L}_{SM} \\
& + \phi \bar{u} \left[a^0_{FC} + b^0_{FC} \gamma_5 \right] u + V_\mu \bar{u} \left[a^1_{FC} \gamma^\mu + b^1_{FC} \gamma^\mu \gamma_5 \right] u \\
& + \epsilon^{ijk} \varphi_i \bar{d}^c_j \left[a^q_{SR} + b^q_{SR} \gamma_5 \right] d_k + \varphi_i \bar{u}^i \left[a^{1/2}_{SR} + b^{1/2}_{SR} \gamma_5 \right] \chi \\
& + \epsilon^{ijk} \tilde{\varphi}_i \bar{d}^c_j \left[\tilde{a}^q_{SR} + \tilde{b}^q_{SR} \gamma_5 \right] u_k + \tilde{\varphi}_i \bar{d}^i \left[\tilde{a}^{1/2}_{SR} + \tilde{b}^{1/2}_{SR} \gamma_5 \right] \chi \\
& + \epsilon^{ijk} X_{\mu,i} \; \bar{d}^c_j \left[a^q_{VR} \gamma^\mu + b^q_{VR} \gamma^\mu \gamma_5 \right] d_k \\
& + X_{\mu,i} \; \bar{u}^i \left[a^{1/2}_{VR} \gamma^\mu + b^{1/2}_{VR} \gamma^\mu \gamma_5 \right] \chi + \text{h.c.},
\end{aligned}
\tag{1}
$$

1106.6199, 1311.6478

MG implementation
by B.Fuks et al.

Constraining the parameters using the SM: non-resonant case

1407.7529

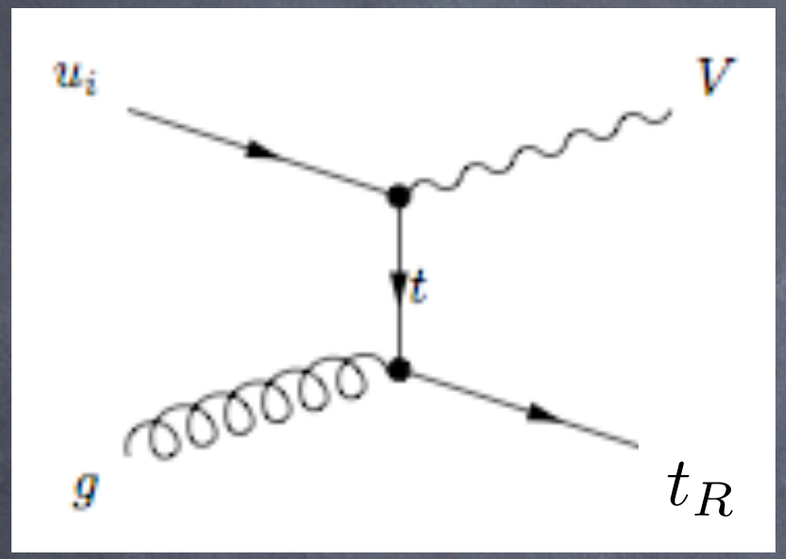


+ s-channel

- Why not S?
- the only scalar that can couple to quarks is a doublet (additional states);
- else, it needs to mix to the Higgs (additional couplings).

Constraining the parameters using the SM: non-resonant case

1407.7529

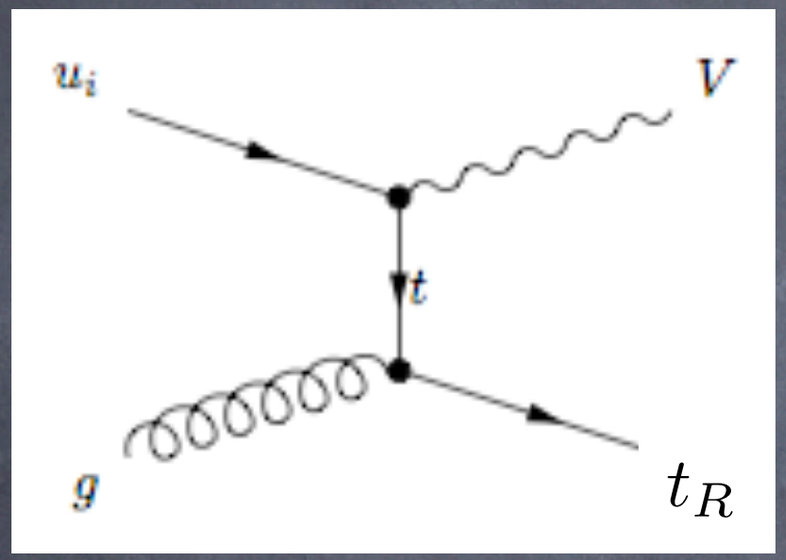


+ s-channel

- Why not tL?
- gauge invariance requires a coupling V bL bL;
- decays V -> bb must be taken into account (invisible BR?)

Constraining the parameters using the SM: non-resonant case

1407.7529



+ s-channel

$$\mathcal{L} = \mathcal{L}_{SM} + V_\mu \bar{u}\left[a^1_{FC}\gamma^\mu + b^1_{FC}\gamma^\mu\gamma_5\right]u \quad (1)$$

$$a^1_{FC} = b^1_{FC}$$

- The minimal model is V, with couplings to right-handed quarks only!
- Simplification of the couplings:

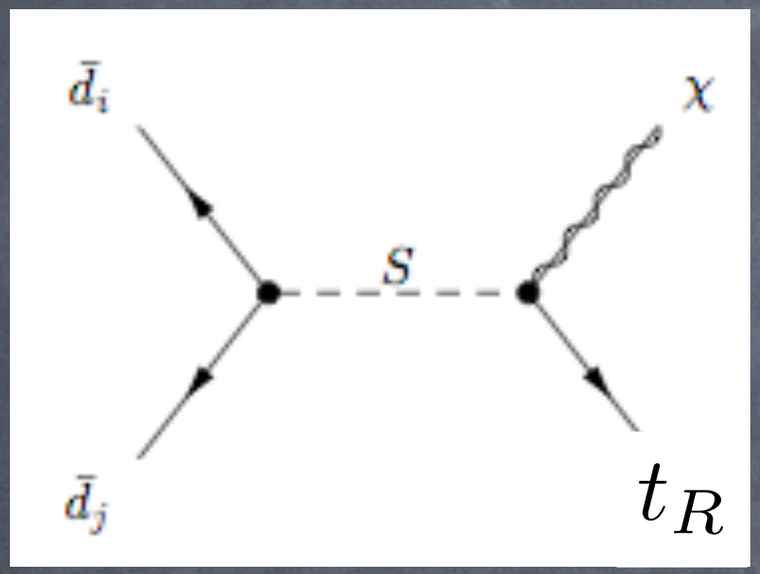
2 free parameters

V is a messenger, the invisible rate is

$$V \to \chi\chi$$

Constraining the parameters using the SM: resonant case

1407.7529



- S is a stop(R) in RPV SUSY!
- 3 free parameters

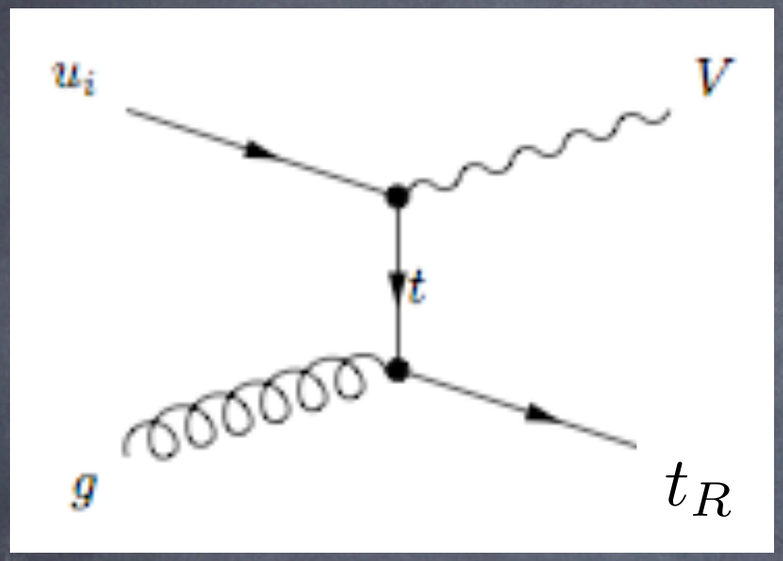
$$\mathcal{L} = \mathcal{L}_{SM}$$

$$+\epsilon^{ijk}\varphi_i\bar{d}_j^c\left[a_{SR}^q+b_{SR}^q\gamma_5\right]d_k+\varphi_i\bar{u}^i\left[a_{SR}^{1/2}+b_{SR}^{1/2}\gamma_5\right]\chi \quad (1)$$

$$a_{SR}^q = b_{SR}^q$$

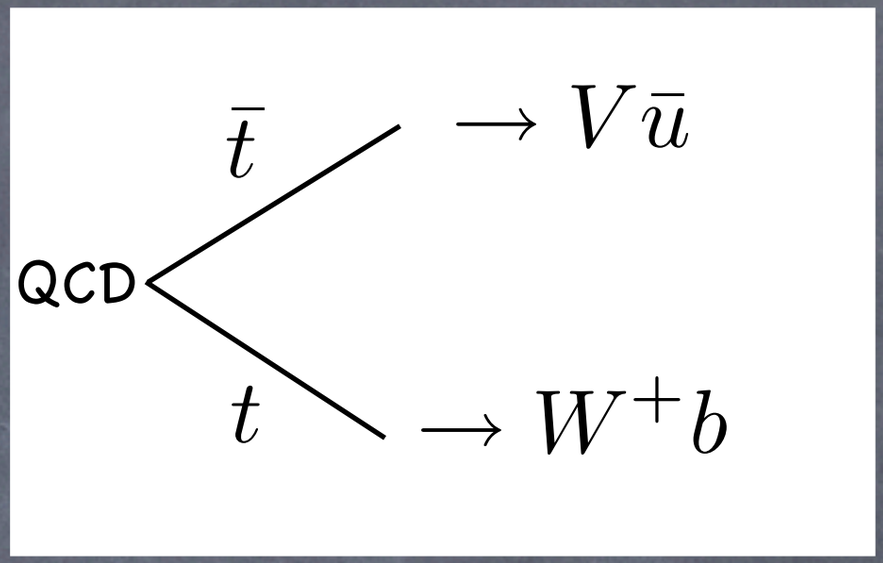
$$a_{SR}^{1/2} = -b_{SR}^{1/2}$$

"Pollution" of the signal region: the non-resonant case



+ s-channel

VS.

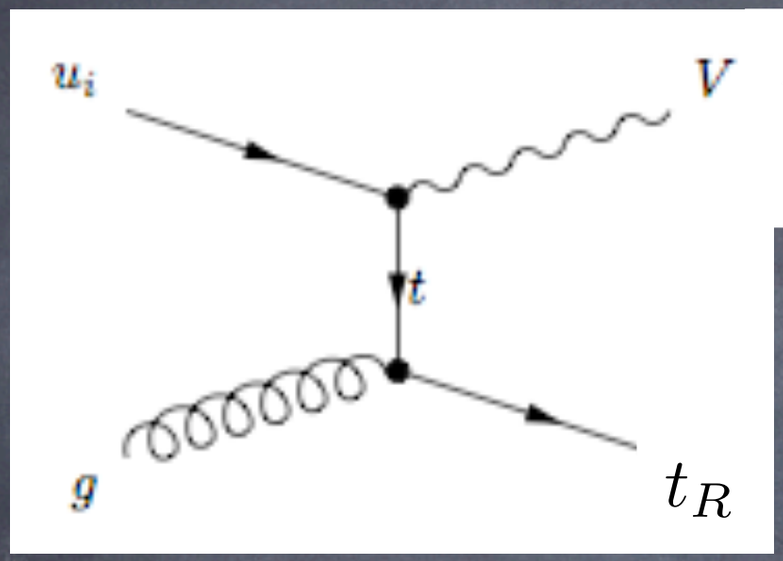


If $m_V < m_{top}$

$$\frac{N_{ev}(t\bar{t} \to tV\bar{u})}{N_{ev}(ug \to tV)}$$

only depends on mV, and the experimental acceptance

Interplay with other searches: the non-resonant case



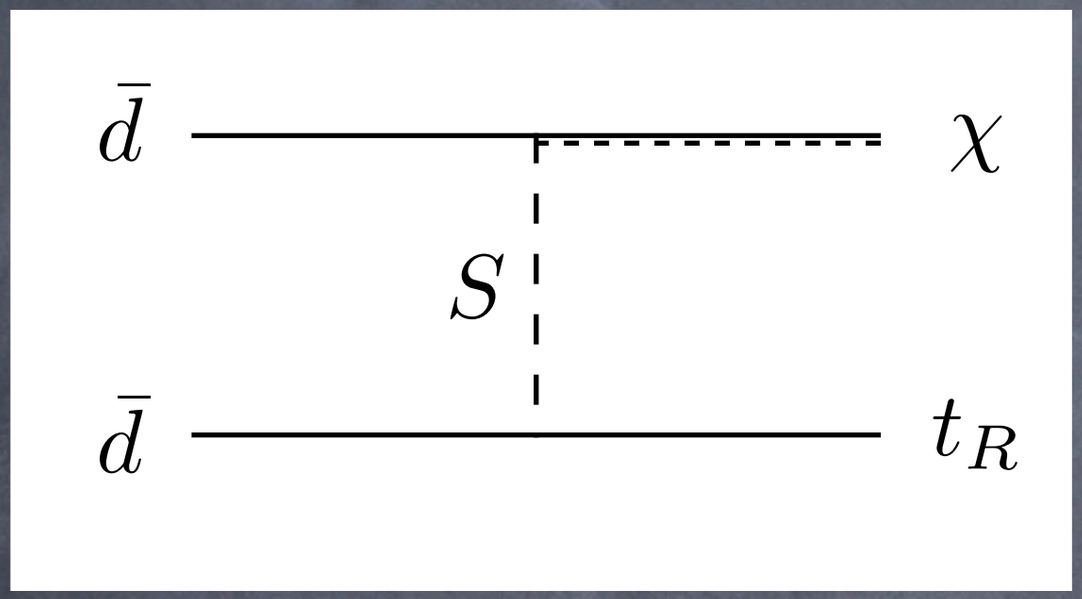
$\longrightarrow t\bar{u}$

If $m_V > m_{top}$

+ s-channel

Romain's talk!

Other simple models



t-channel
scalar mediator

$$\mathcal{L} = \mathcal{L}_{SM}$$

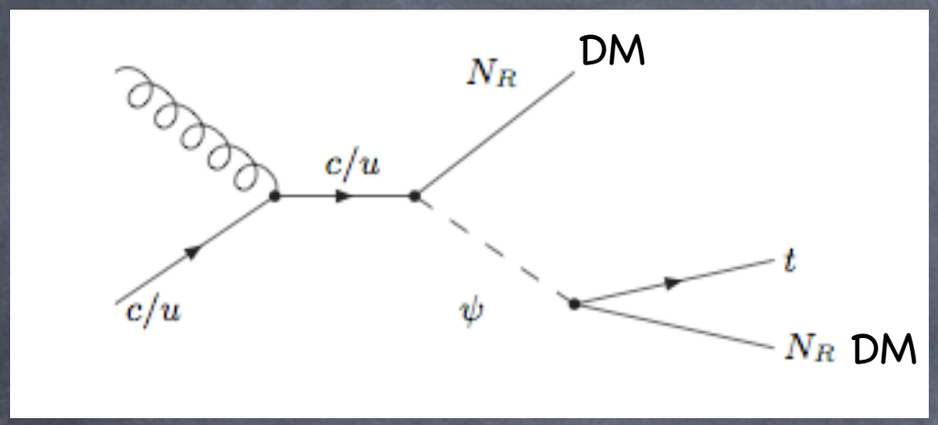
$$\tilde{a}^q_{SR} = \tilde{b}^q_{SR}$$

$$+\epsilon^{ijk}\tilde{\varphi}_i \bar{d}^c_j \left[\tilde{a}^q_{SR} + \tilde{b}^q_{SR}\gamma_5\right] u_k + \tilde{\varphi}_i \bar{d}^i \left[\tilde{a}^{1/2}_{SR} + \tilde{b}^{1/2}_{SR}\gamma_5\right] \chi \quad (1)$$

$$\tilde{a}^{1/2}_{SR} = -\tilde{b}^{1/2}_{SR}$$

- S is a sbot(R) in RPV SUSY!
- 3 free parameters

Other simple models



- However, pair production of the coloured mediator must be checked:
  - jj + MET, ttbat + MET

Monotop may be not competitive:
see 1404.1415