

スピン2の粒子を媒介とした 暗黒物質模型へのLHCからの制限

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大阪ワークショップ
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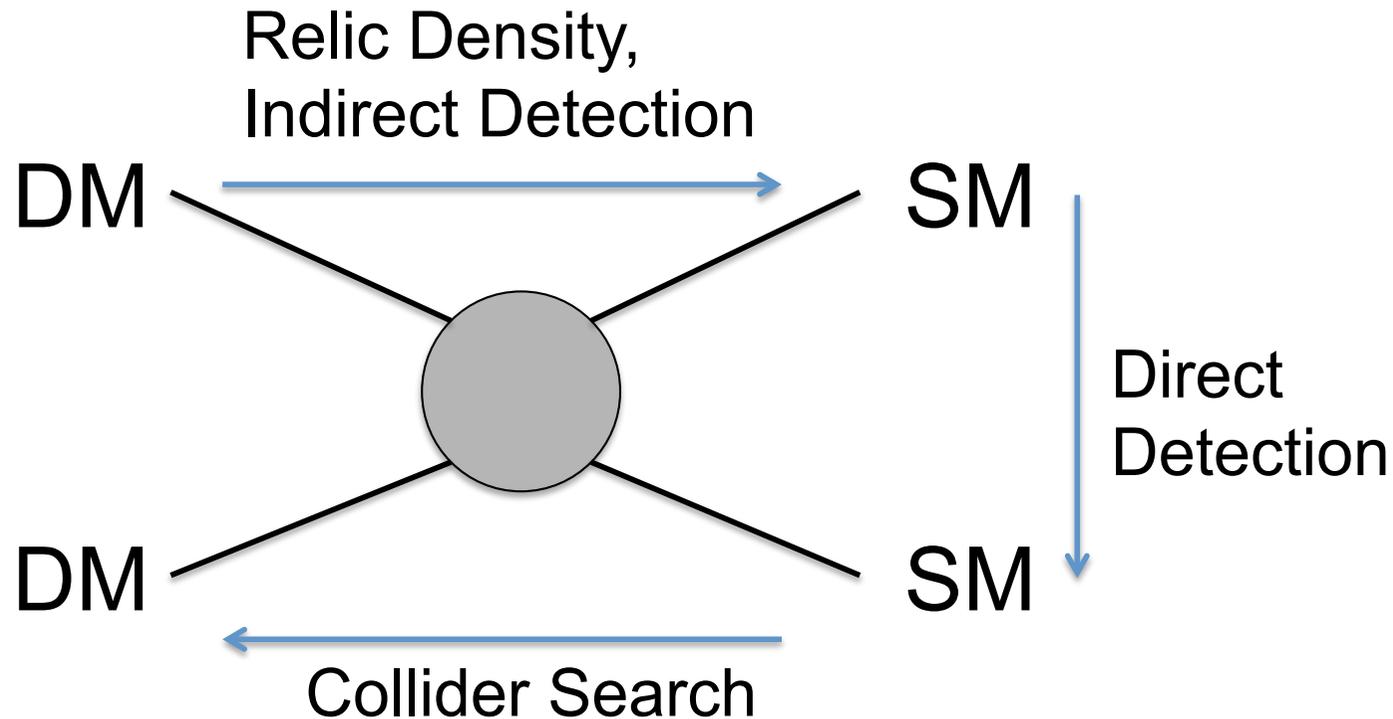
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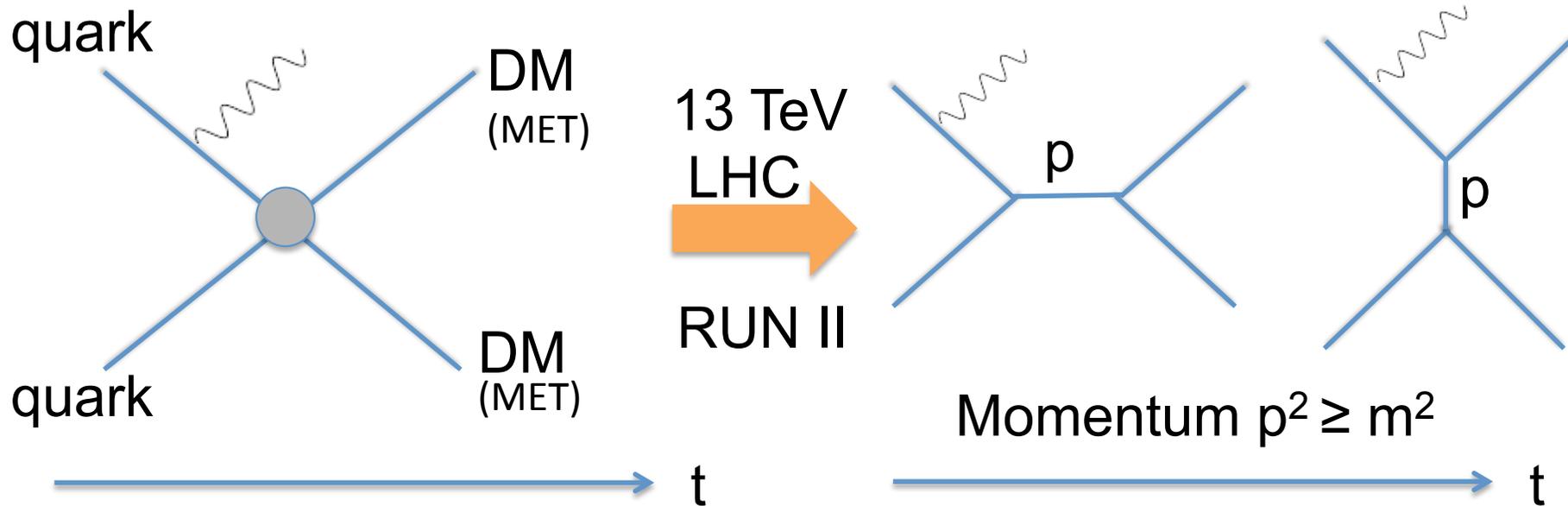
4. Summary

Introduction: Dark matter searches



In this talk: LHC searches

Dark matter searches at the LHC



Contact interactions have been used especially @LHC Run I

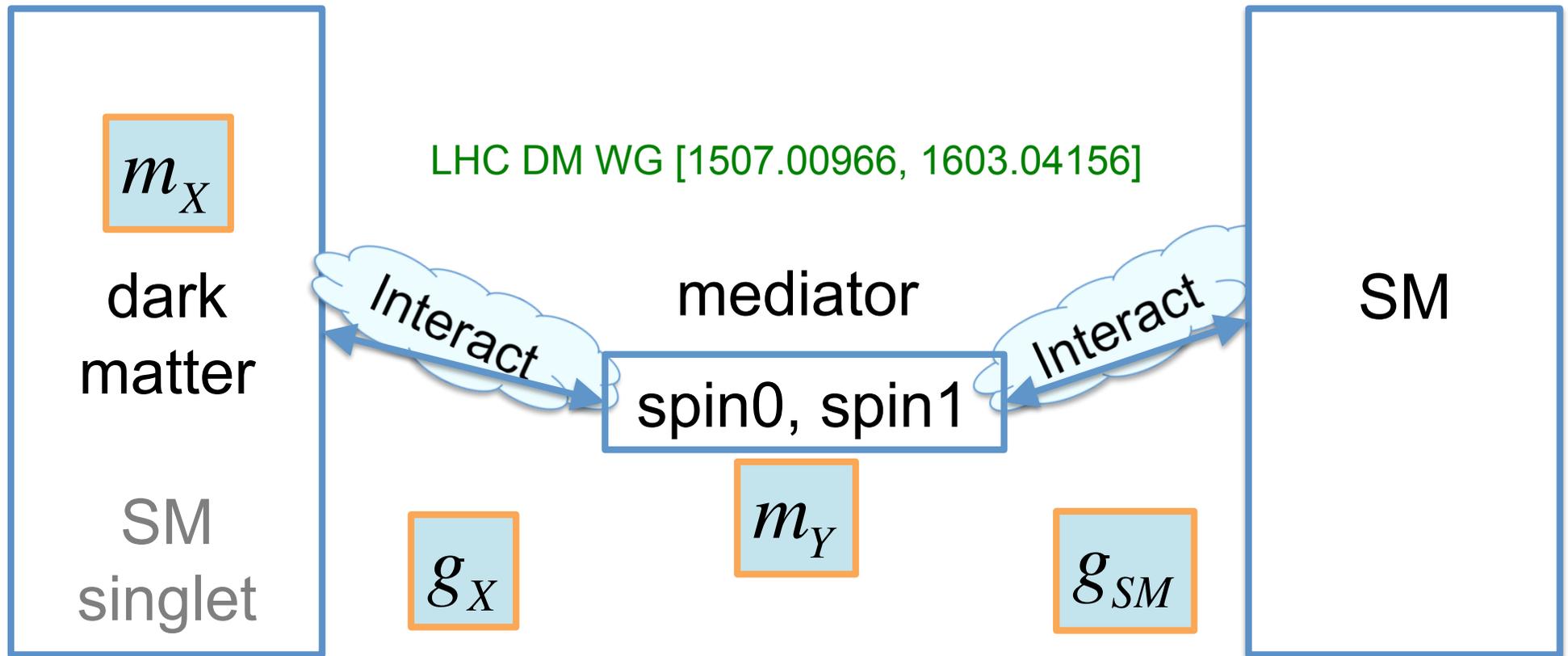
If the mediator mass is a TeV scale or bellow, the structure should be considered

A Dark Matter candidate couples to the SM particles via a mediator

Simplified Dark Matter models

s-channel simplified DM models

Model Parameter: m_X, m_Y, g_X, g_{SM}



Spin2-mediated simplified DM model

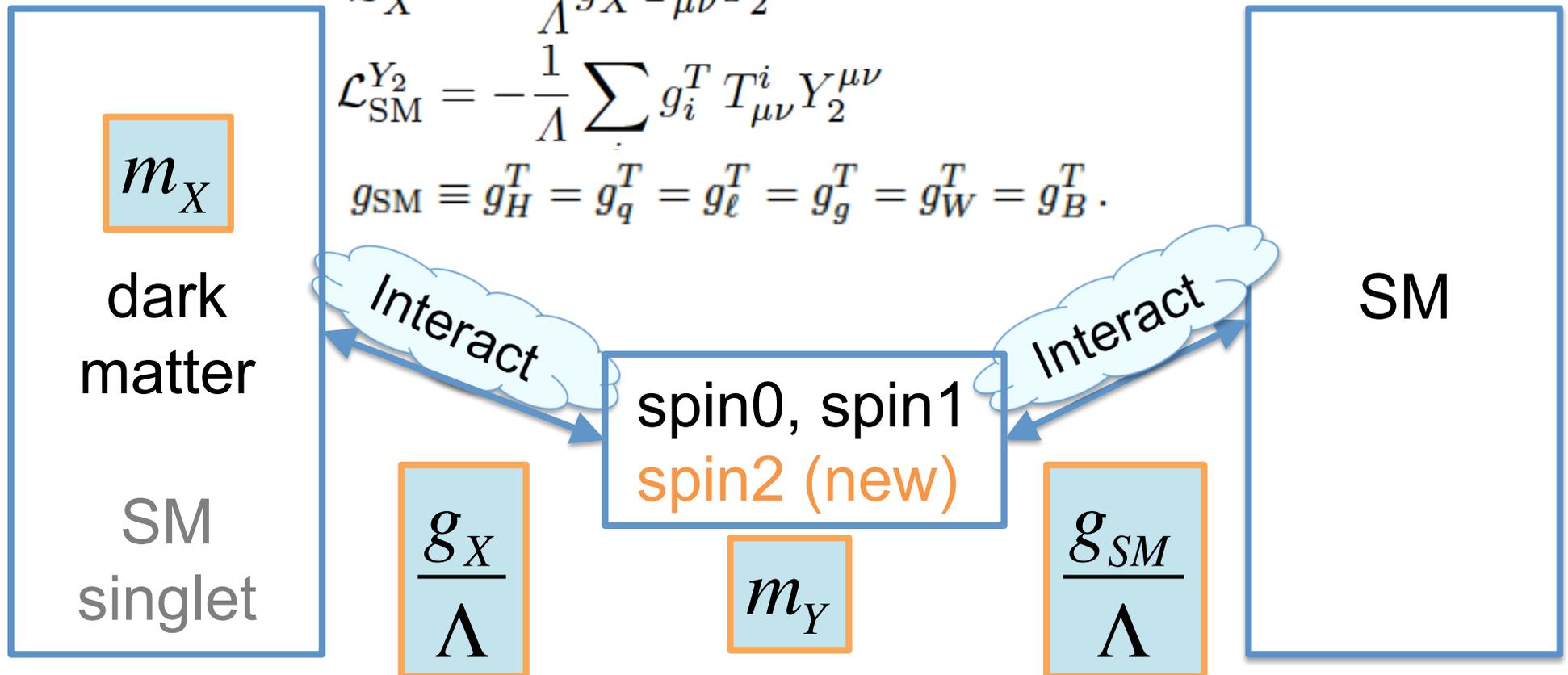
Gravity-mediated DM:
 Lee, Park, Sanz
 [1306.4107, 1401.5301]

Model Parameter: $m_X, m_Y, \frac{g_X}{\Lambda}, \frac{g_{SM}}{\Lambda}$

$$\mathcal{L}_X^{Y_2} = -\frac{1}{\Lambda} g_X^T T_{\mu\nu}^X Y_2^{\mu\nu}$$

$$\mathcal{L}_{SM}^{Y_2} = -\frac{1}{\Lambda} \sum_i g_i^T T_{\mu\nu}^i Y_2^{\mu\nu}$$

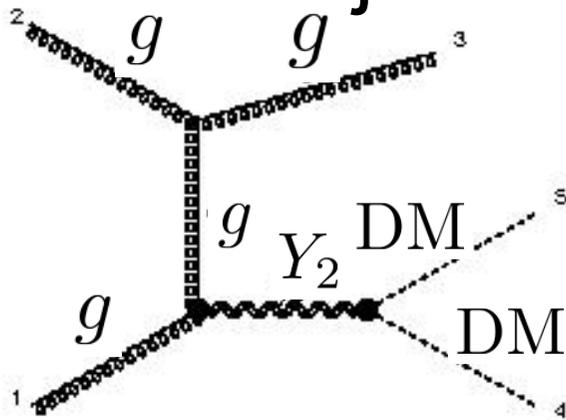
$$g_{SM} \equiv g_H^T = g_q^T = g_l^T = g_g^T = g_W^T = g_B^T.$$



Λ : scale parameter of the theory

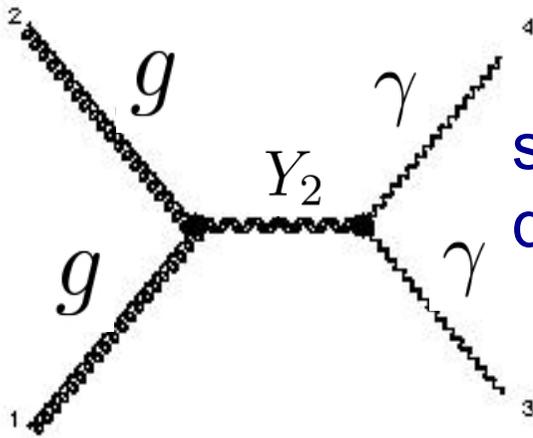
LHC search

- monojet/multijet + missing E_T (DM search)



spin2 mediator
decay into DM/neutrinos

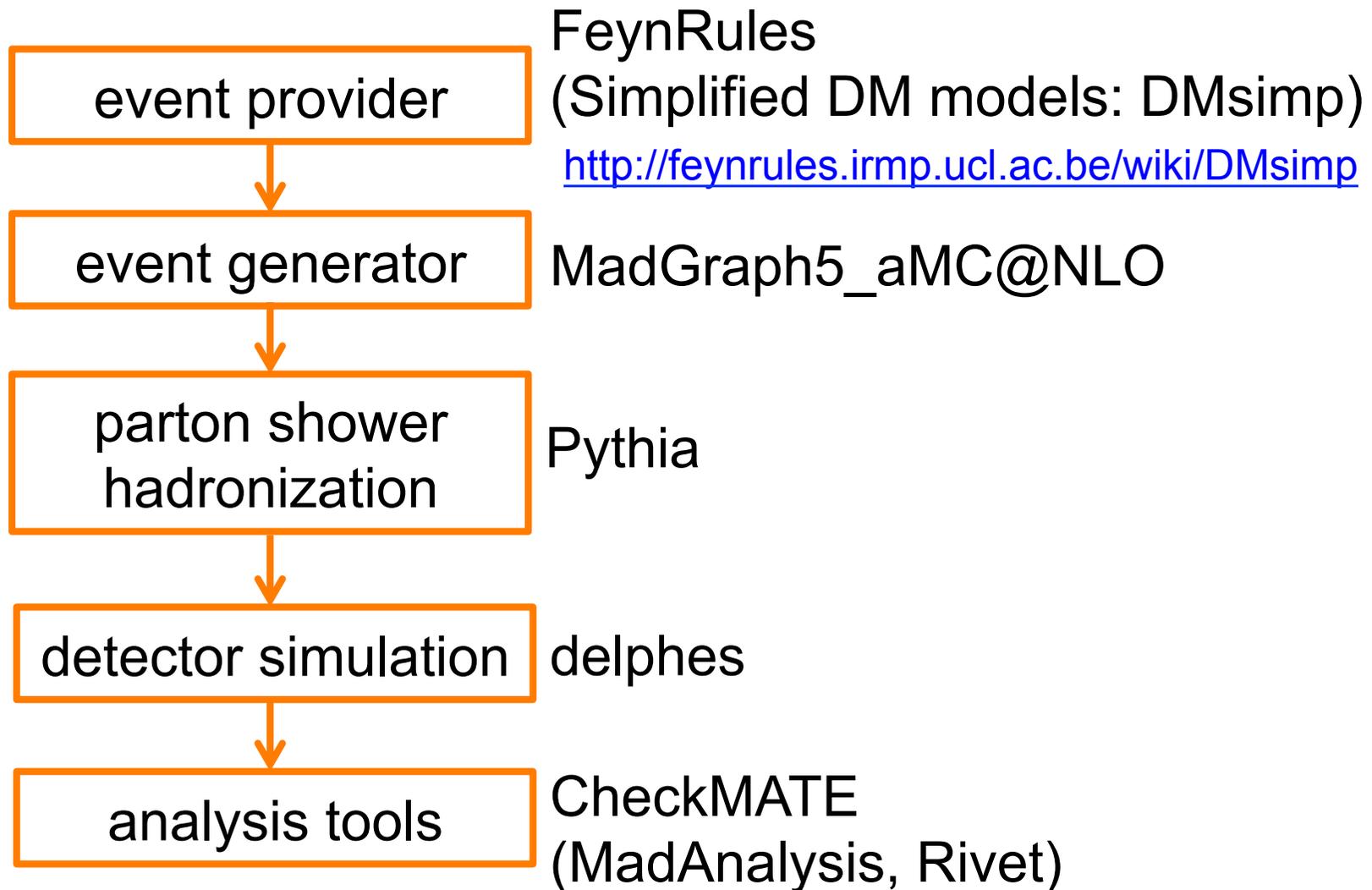
- resonance search



spin2 mediator
decay into SM

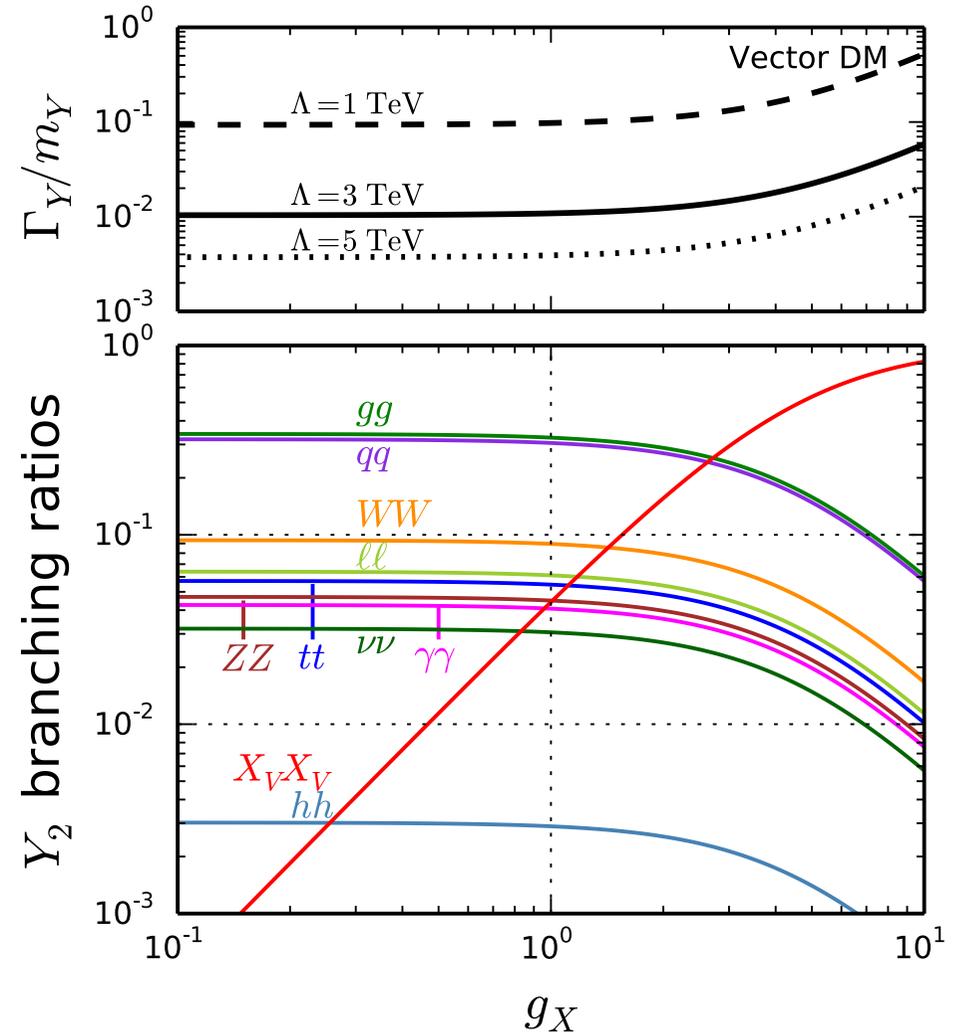
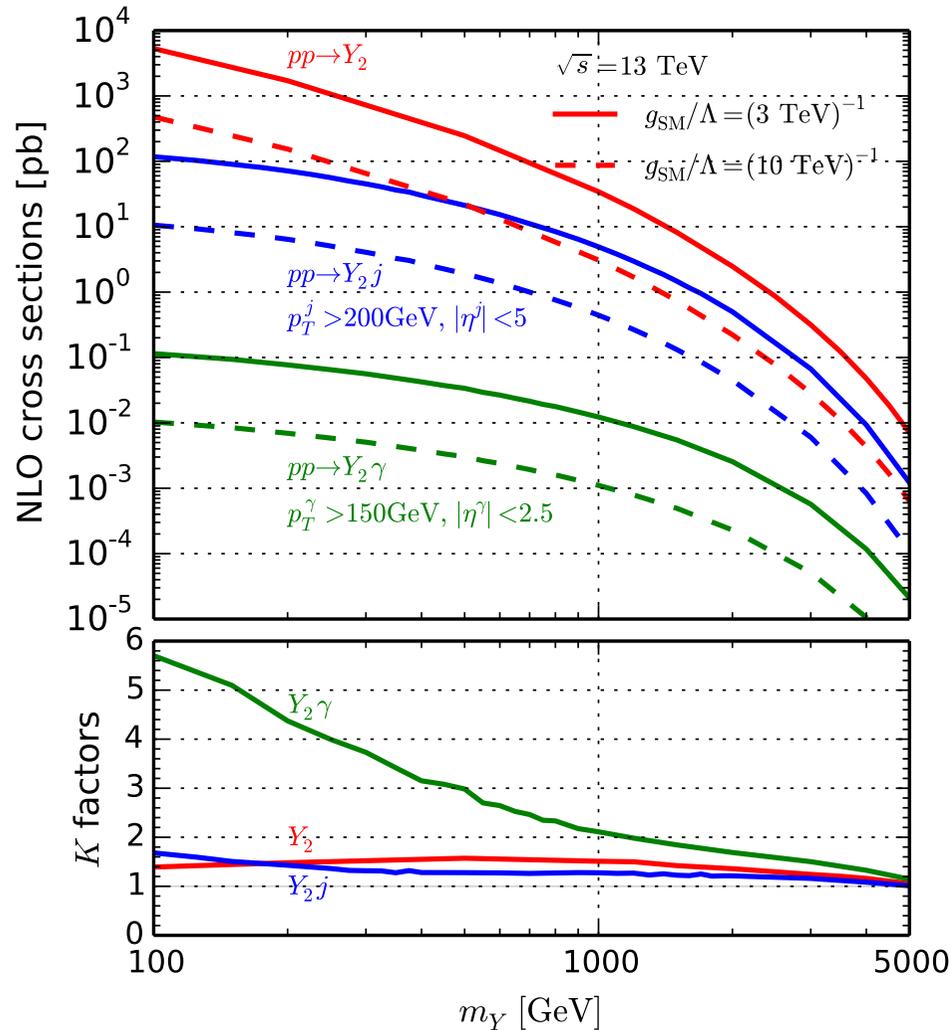
Decay mode	References
jj	ATLAS-CONF-2016-069
$jj(+j/\gamma)$	ATLAS-CONF-2016-070
WW	ATLAS-CONF-2016-062
bb	ATLAS-CONF-2016-06 ^o
tt	CMS-PAS-B2G-15-002
ZZ	ATLAS-CONF-2016-082
$\gamma\gamma$	CMS 1609.02507
$\ell\ell$	ATLAS-CONF-2016-045
hh	ATLAS-CONF-2016-049
$\gamma\gamma$	ATLAS 1407.6583
	CMS 1506.02301

Simulation tools



Spin2 mediator production and decay

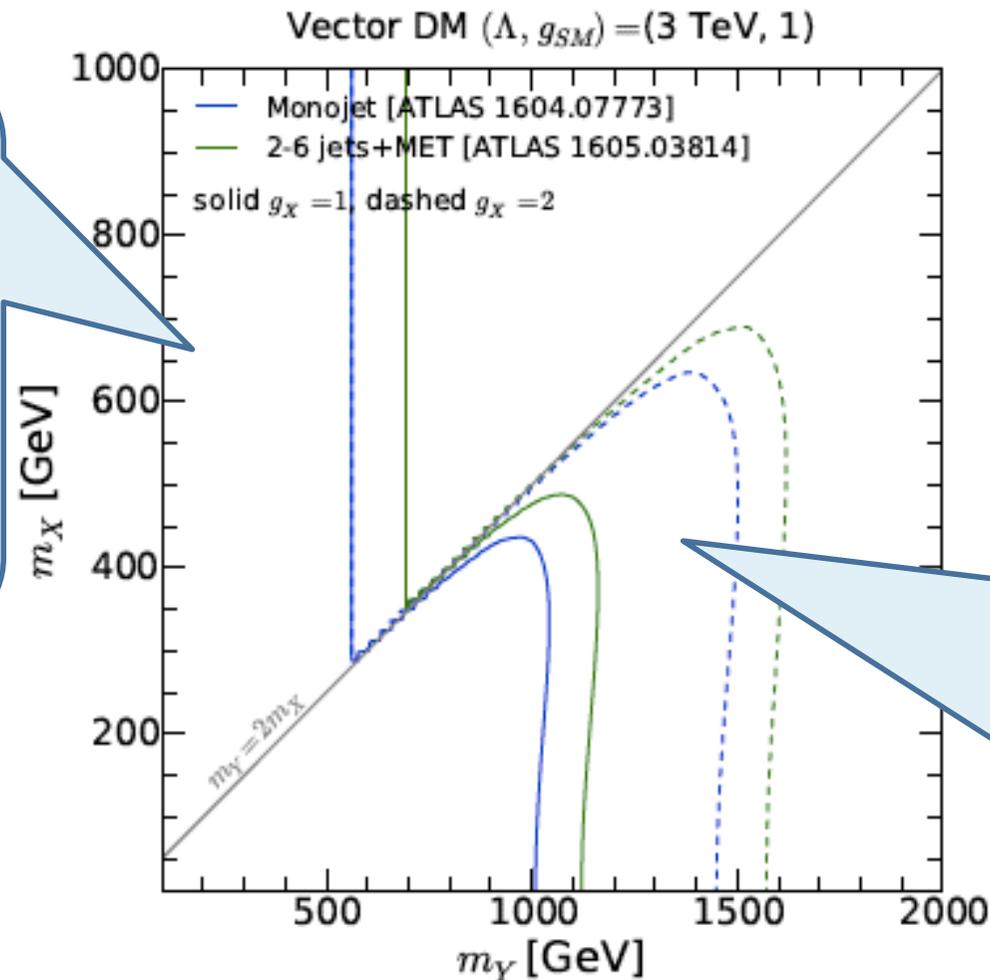
$(g_{\text{SM}}, m_X, m_Y) = (1, 10\text{GeV}, 1\text{TeV})$



dark matter production =
mediator production \times Br(dark matter)

Constraints from missing E_T searches (1/2)

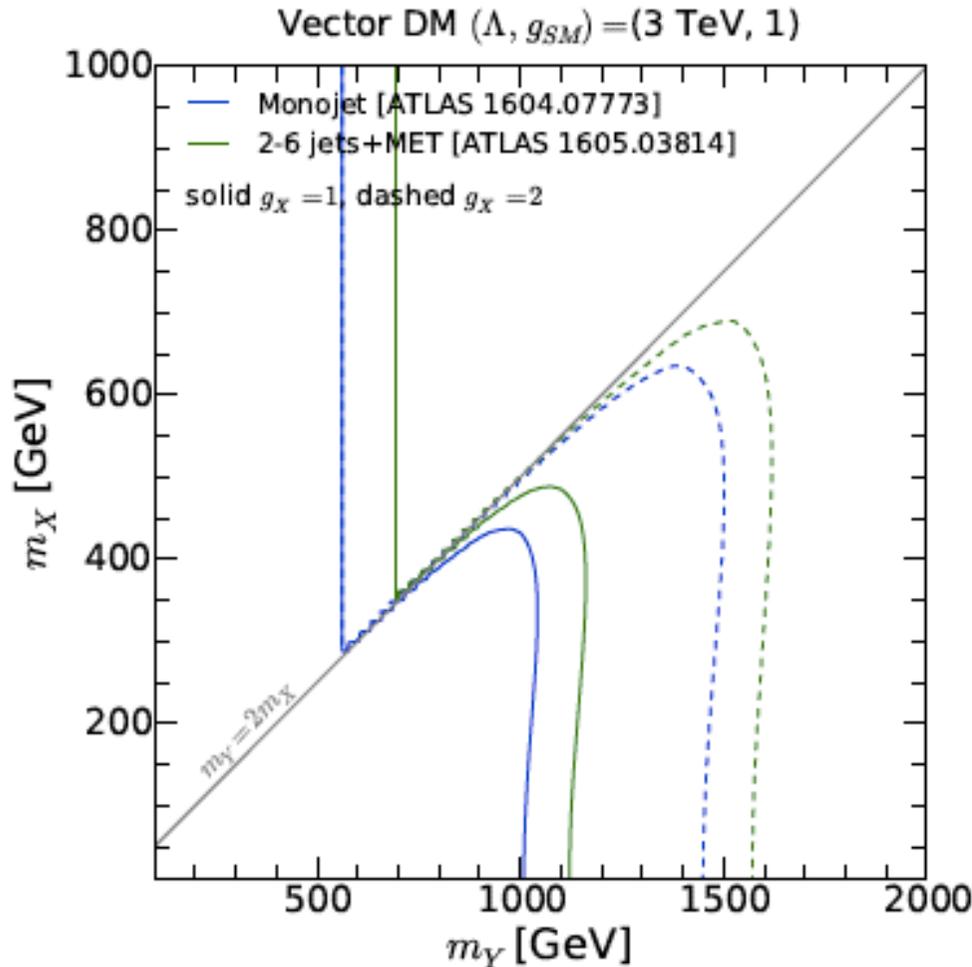
Constraints come from spin2 mediator \rightarrow neutrino decay



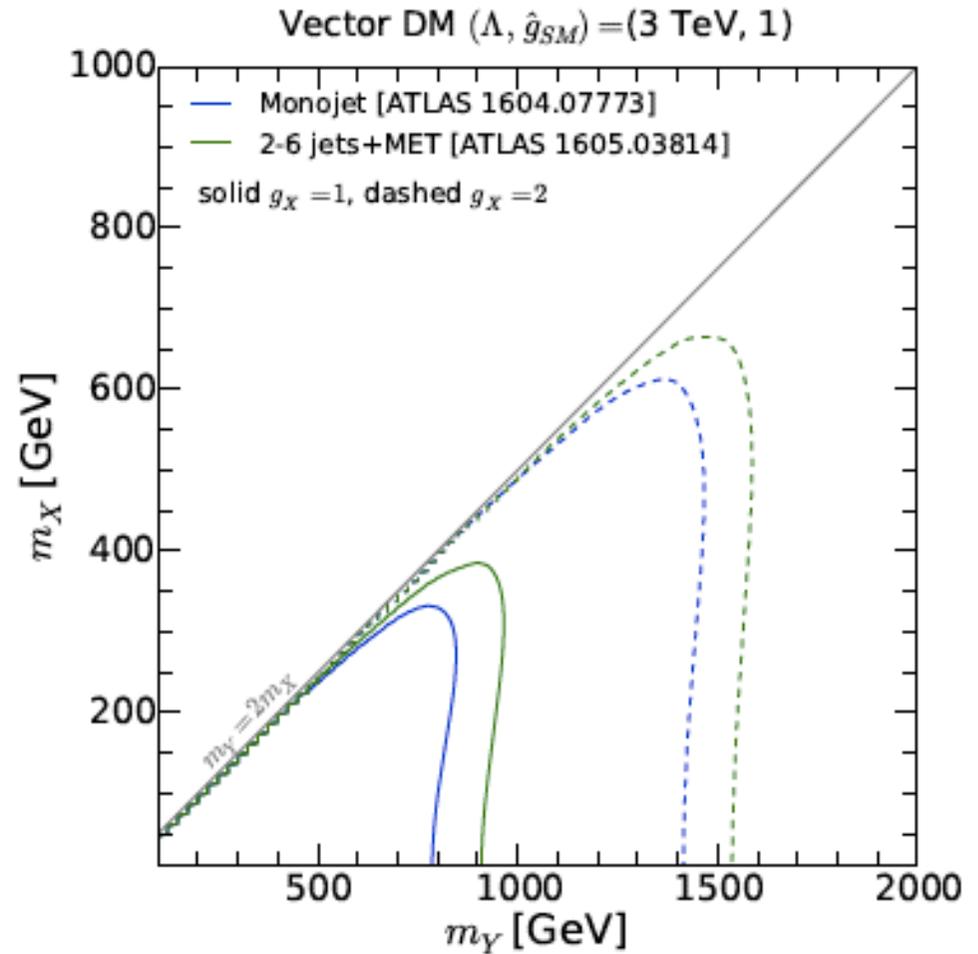
Constraints come from spin2 mediator \rightarrow dark matter + neutrino decay

universal g_{SM} $g_{SM} \equiv g_H^T = g_q^T = g_\ell^T = g_g^T = g_W^T = g_B^T.$

Constraints from missing E_T searches (2/2)



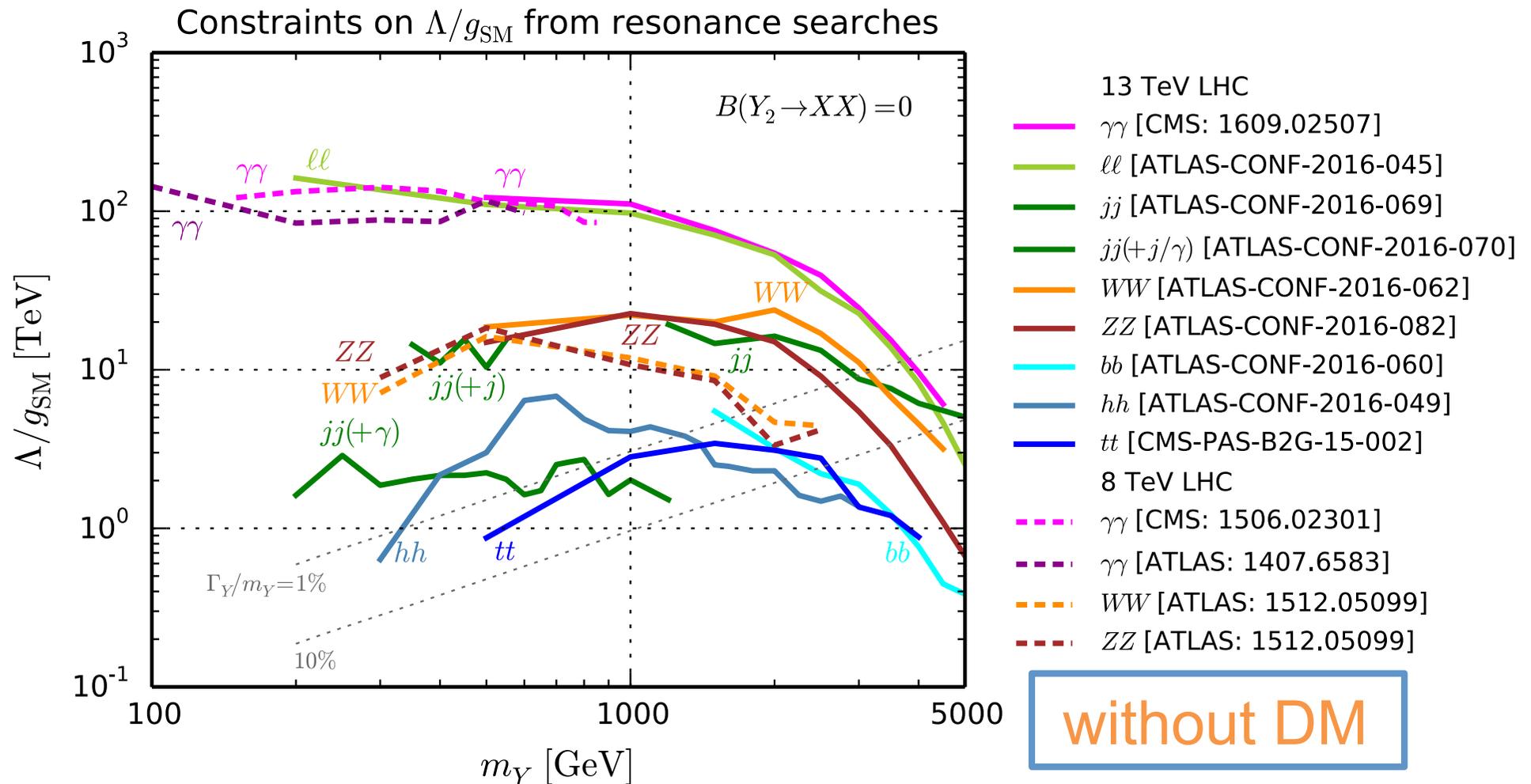
universal g_{SM}



leptophobic

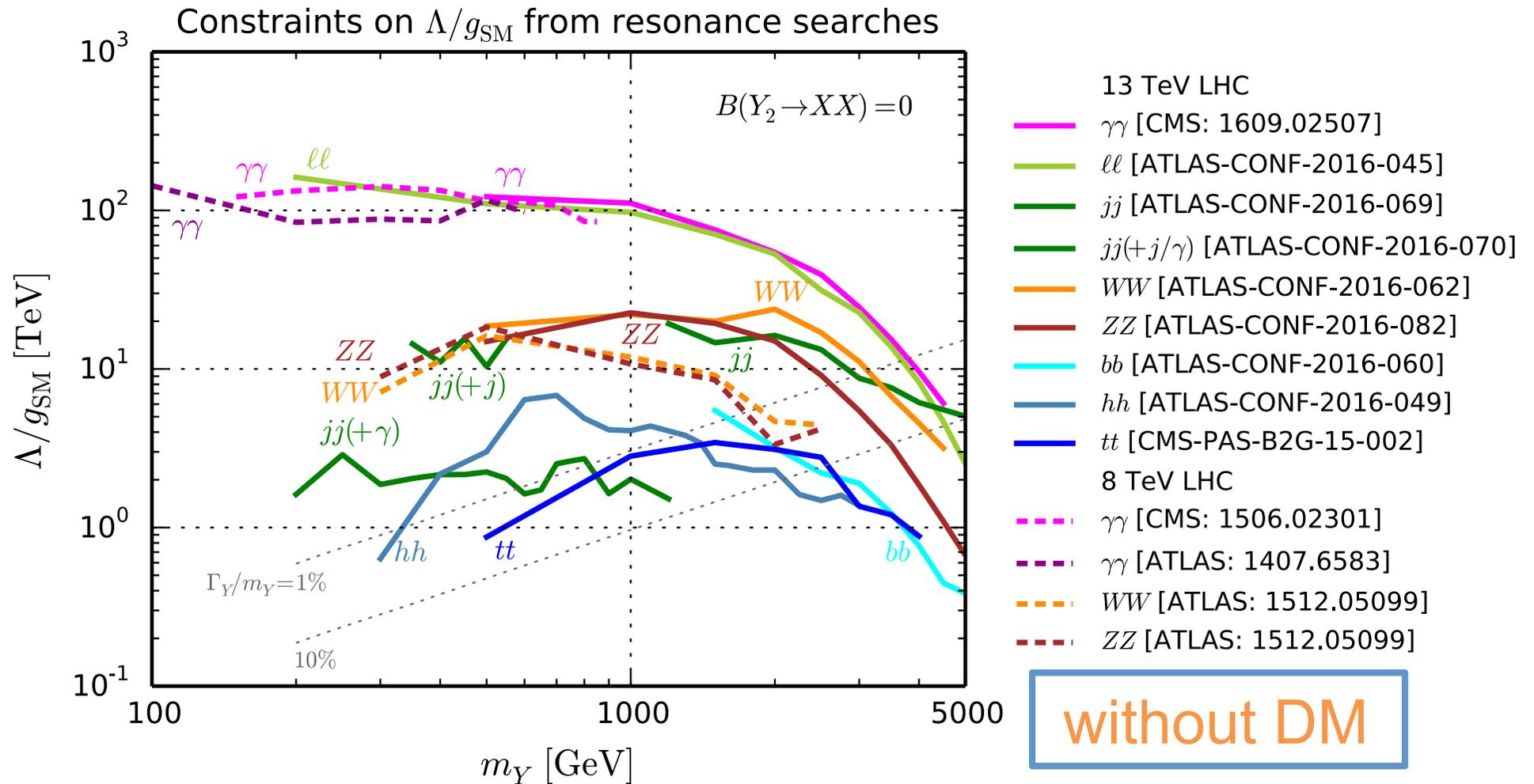
$$g_{SM} \equiv g_H^T = g_q^T = g_\ell^T = g_g^T = g_W^T = g_B^T. \quad g_\ell^T \ll \hat{g}_{SM} \equiv g_H^T = g_q^T = g_g^T = g_W^T = g_B^T$$

Constraints from resonance searches (1/2)



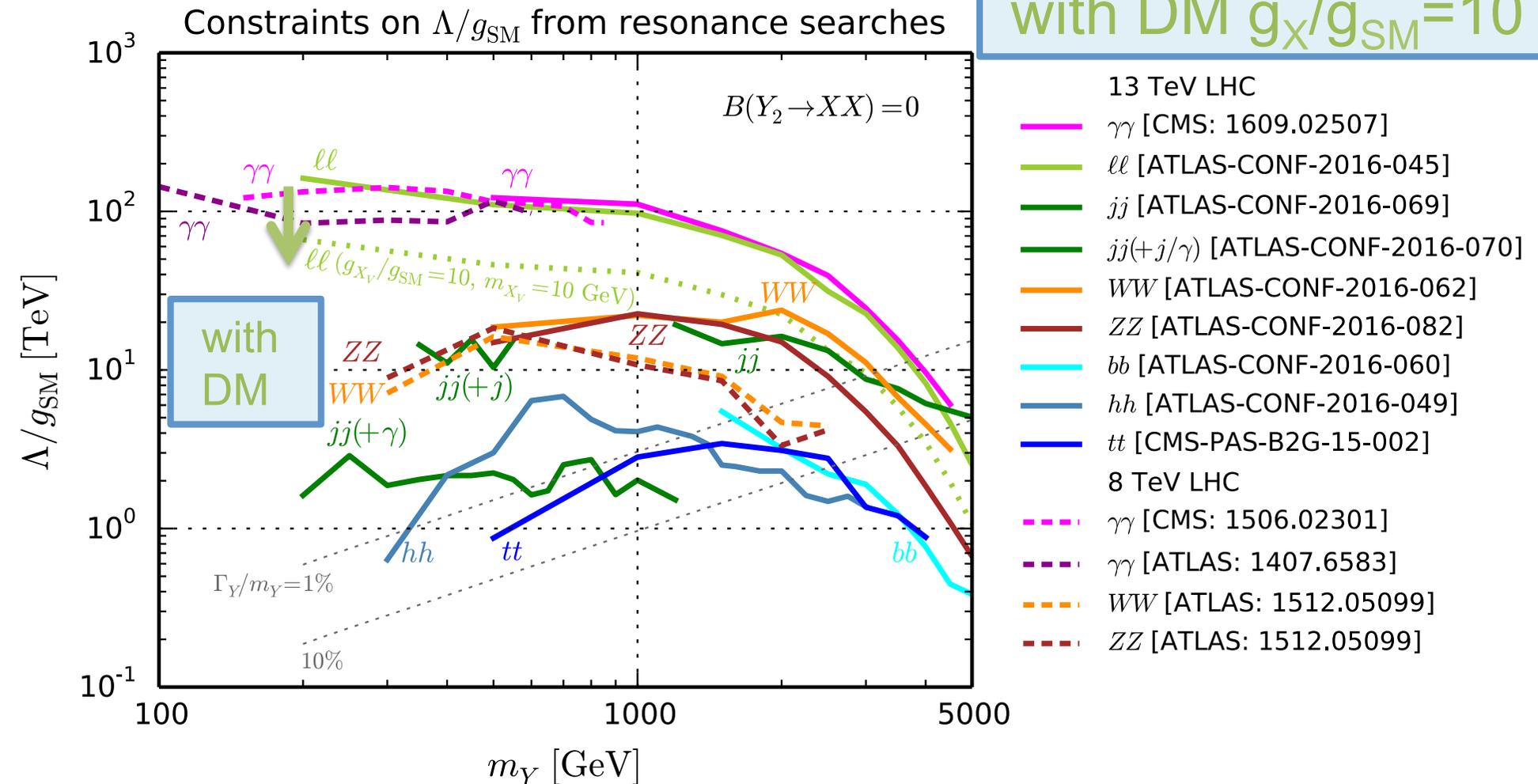
decaying into di-leptons and di-photons gives the strongest limit.

Constraints from resonance searches (1/2)



\approx with DM $g_X/g_{\text{SM}} = 1$

Constraints from resonance searches (2/2)

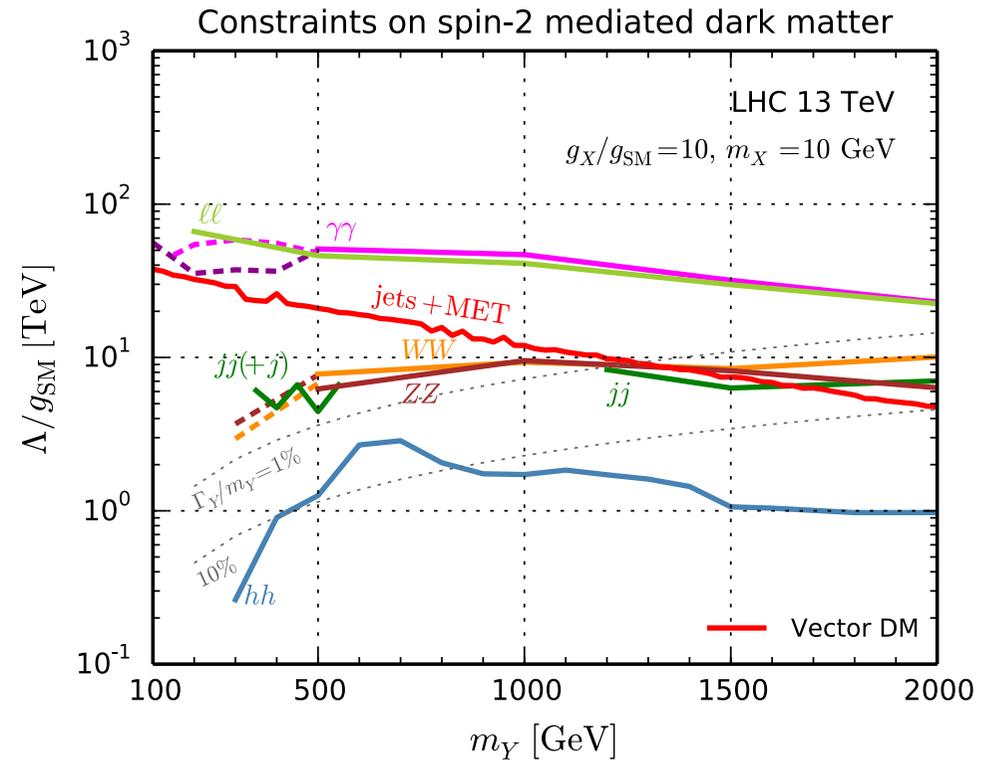
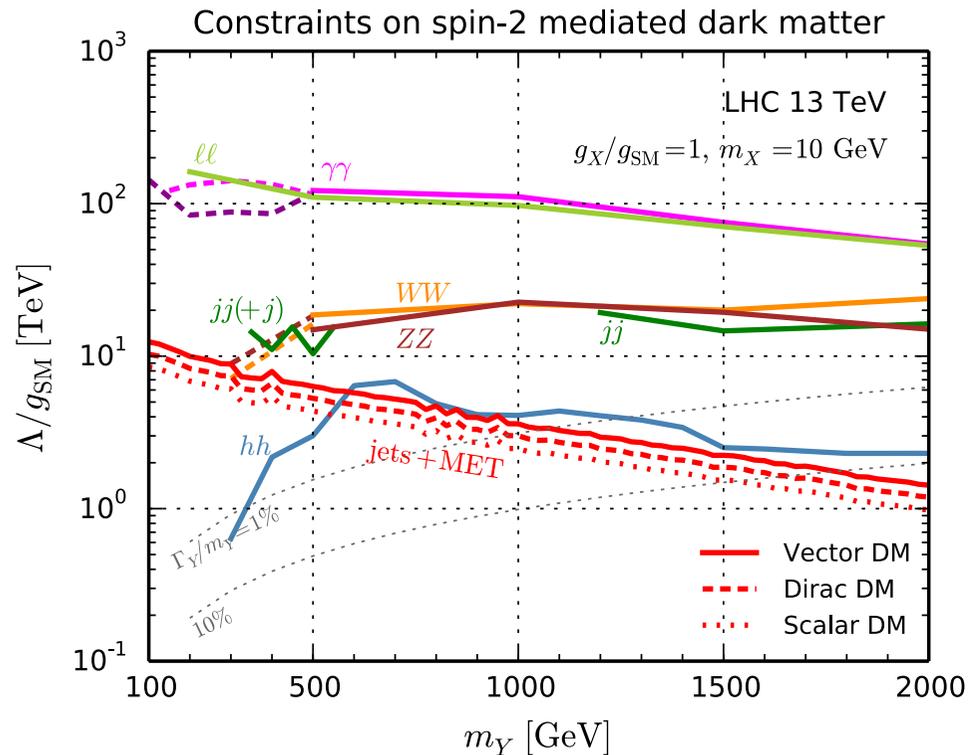


Branching ratio decaying into SM particles becomes lower, so that limits become weaker.

Comparison between MET & resonance searches

$$g_X = g_{\text{SM}} = 1$$

$$g_X = 10 \quad g_{\text{SM}} = 1$$



For $g_X=10$, the dilepton and diphoton constraints are weakened by about a factor of 2 but still give the strongest constraints

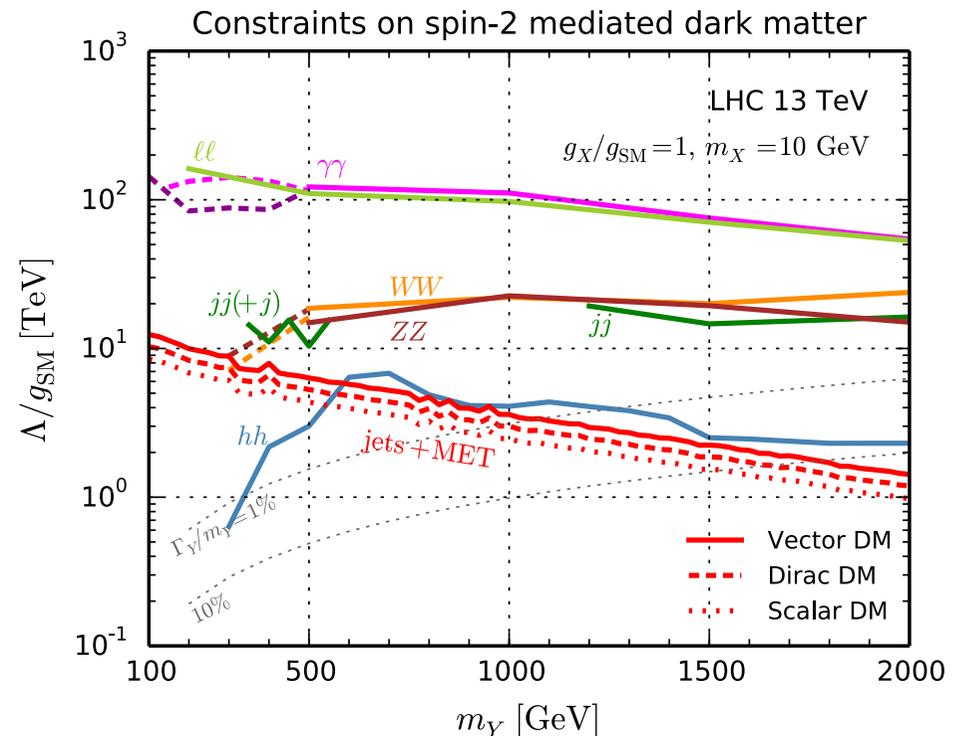
Summary

1. We considered spin-2-mediated simplified DM Model, and studied the current LHC constraints:

- monojet/multijet + missing E_T
- resonance searches

2. We show the complementarity among different searches

- dilepton/diphoton resonance searches
-> strongest constraint
- Missing E_T searches
-> only if dilepton/diphoton modes are suppressed, these searches can be competitive in constraining dark matter models with spin-2 mediators



Summary

1. We considered spin-2-mediated simplified DM Model, and

We hope our work will be useful to find reasonable benchmark scenarios for spin-2 mediated DM searches.

2. Combining different searches

- dilepton/diphoton resonance searches
-> strongest constraint
- Missing E_T searches
-> only if dilepton/diphoton modes are suppressed, these searches can be competitive in constraining dark matter models with spin-2 mediators

