

MINI-WORKSHOP: COLLIDER RESULTS AND DARK MATTER

Caterina Doglioni, University of Geneva (ATLAS)

Suchita Kulkarni, Hephy Wien

Francesco D'Eramo, Berkeley









Goals: discuss **experimentalist-friendly** suggestions on

1. Comparing collider and DD/ID search results highlighting their complementarity
2. Present direct collider searches for mediators (e.g. dilepton/dijet resonance searches) in a DM-aware fashion

24/02/2015 – Dark MALT @ MIAPP

Discussion-oriented!

(possibly continuing within ATLAS/CMS Dark Matter Forum framework)

- 14:30 - 15:30 Mini-workshop - theme: collider results: Part I: Comparison of collider and DD/ID results 
- In this workshop we aim to discuss two recommendations that collider experimentalists can follow when comparing their results to direct and indirect detection. The two questions we want to answer are:*
- 1) what is the best way to compare collider and direct/indirect detection results, for EFTs and simplified models?*
 - 2) in the context of specific simplified models, how do we present and integrate results on direct mediator searches (e.g. Z' searches, decaying to dilepton and dijets?)*
- Conveners: Ms. Caterina Doglioni (Universite de Geneve (CH)), Francesco D'Eramo (UC Berkeley)
- 14:30 **Current options for collider/DD/ID plots 15'** 
- Speaker: Ms. Caterina Doglioni (Universite de Geneve (CH))
- 14:45 **Connecting energy scales of Collider/DD/ID 15'** 
- Speaker: Francesco D'Eramo (UC Berkeley)
- 15:00 **Discussion 30'** 
- 15:30 - 16:35 Mini-workshop - theme: collider results: Part II: Dijet and dilepton constraints on DM 
- Conveners: Ms. Caterina Doglioni (Universite de Geneve (CH)), Suchita Kulkarni (CERN)
- 15:30 **ATLAS dijet results 10'** 
- Speaker: Ms. Caterina Doglioni (Universite de Geneve (CH))
- 15:40 **Reinterpretation tools 15'** 
- Speaker: Suchita Kulkarni (CERN)
- 15:55 **Discussion 35'** 

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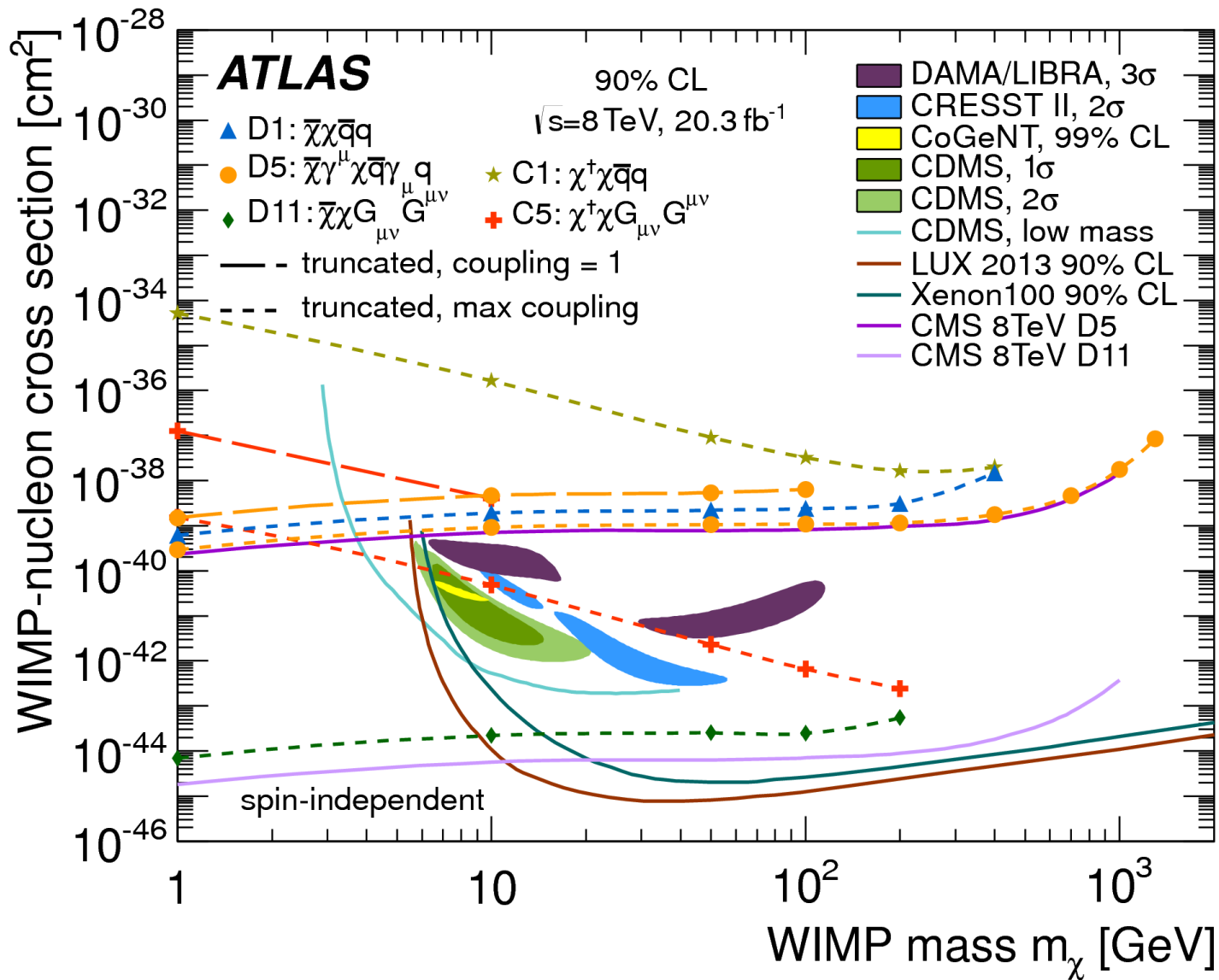
Suchita Kulkarni, Hefhy Wien

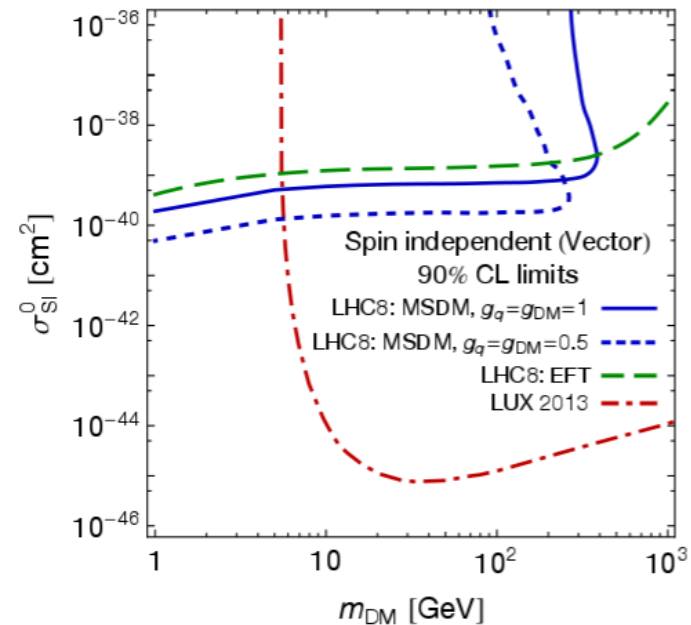
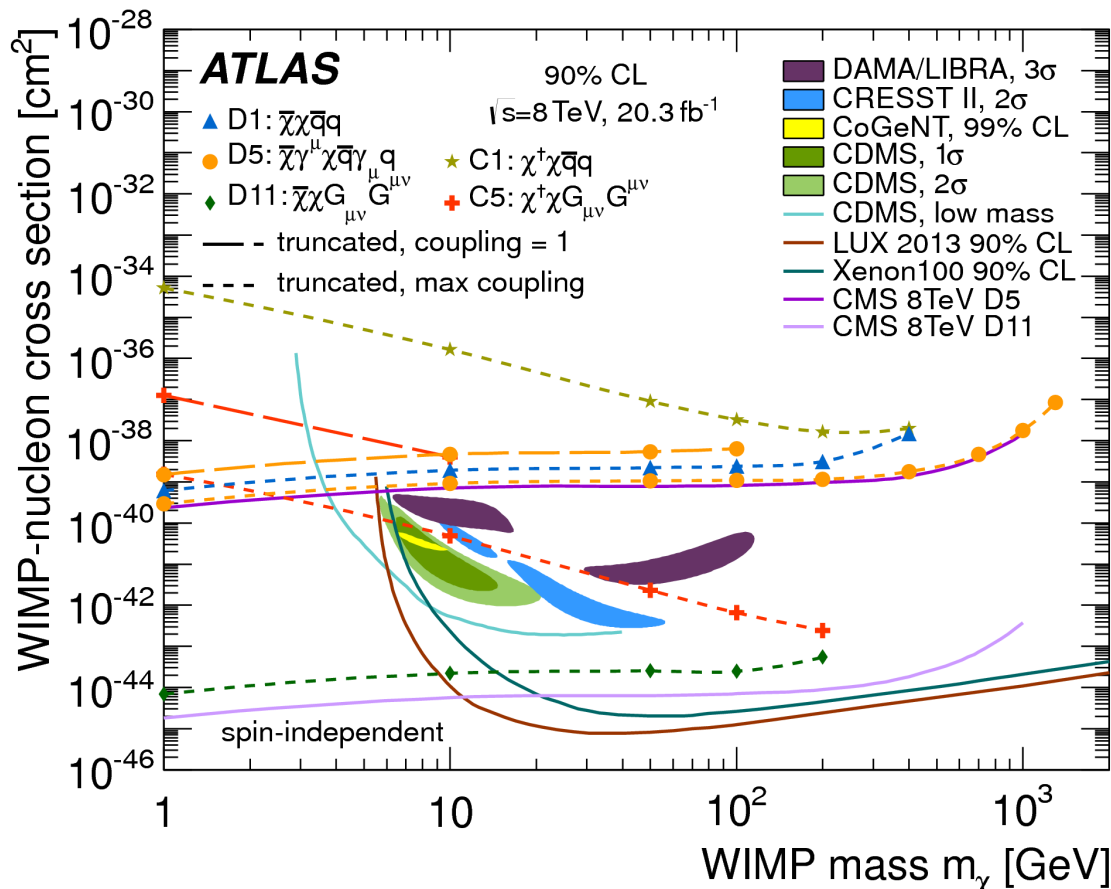
Francesco D'Eramo, Berkeley

First goal: discuss **experimentalist-friendly** suggestions on

Comparing **collider** and **DD/ID** search results
highlighting their **complementarity**

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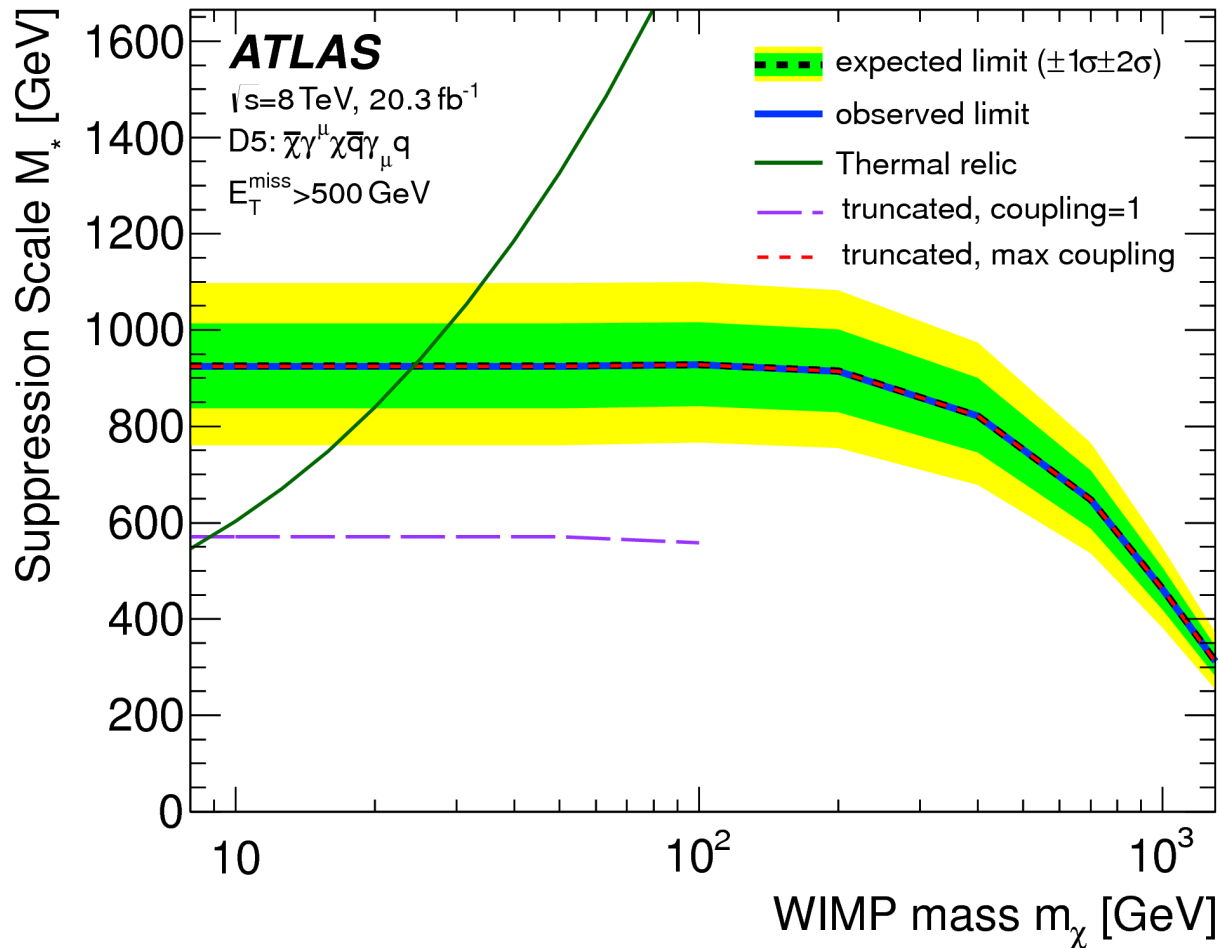




General comments (discussion-starters):

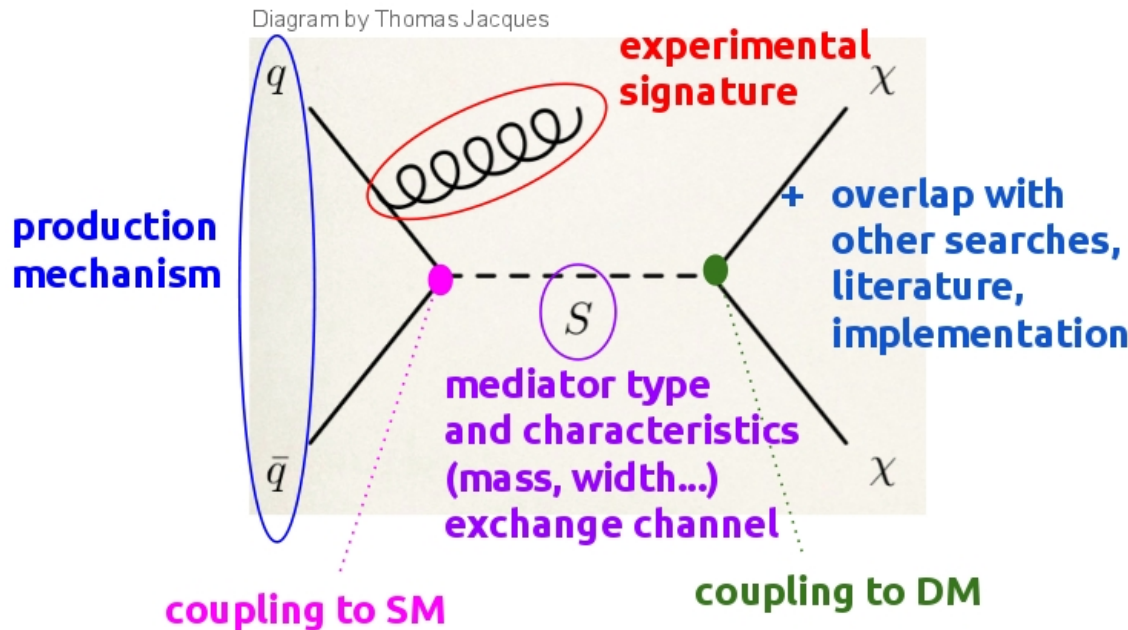
- How to display astrophysical/experimental uncertainties on DD/ID?
- How to make sure all results are included? (e.g. missing CRESST low-mass)
- Collider results: generally EFT only (with truncation: a step forward!) → simp models?
- scales of EFT operators: comparing apples to apples? See Francesco's talk

Any other criticism?



Option: add ID/DD onto these plots → see Francesco's talk
 Extend plots to lower WIMP mass

Simplified model: building blocks for more complicated/complete models



ATLAS/CMS DM Forum:

compile prioritized list and minimal grid scans only where kinematics changes are seen

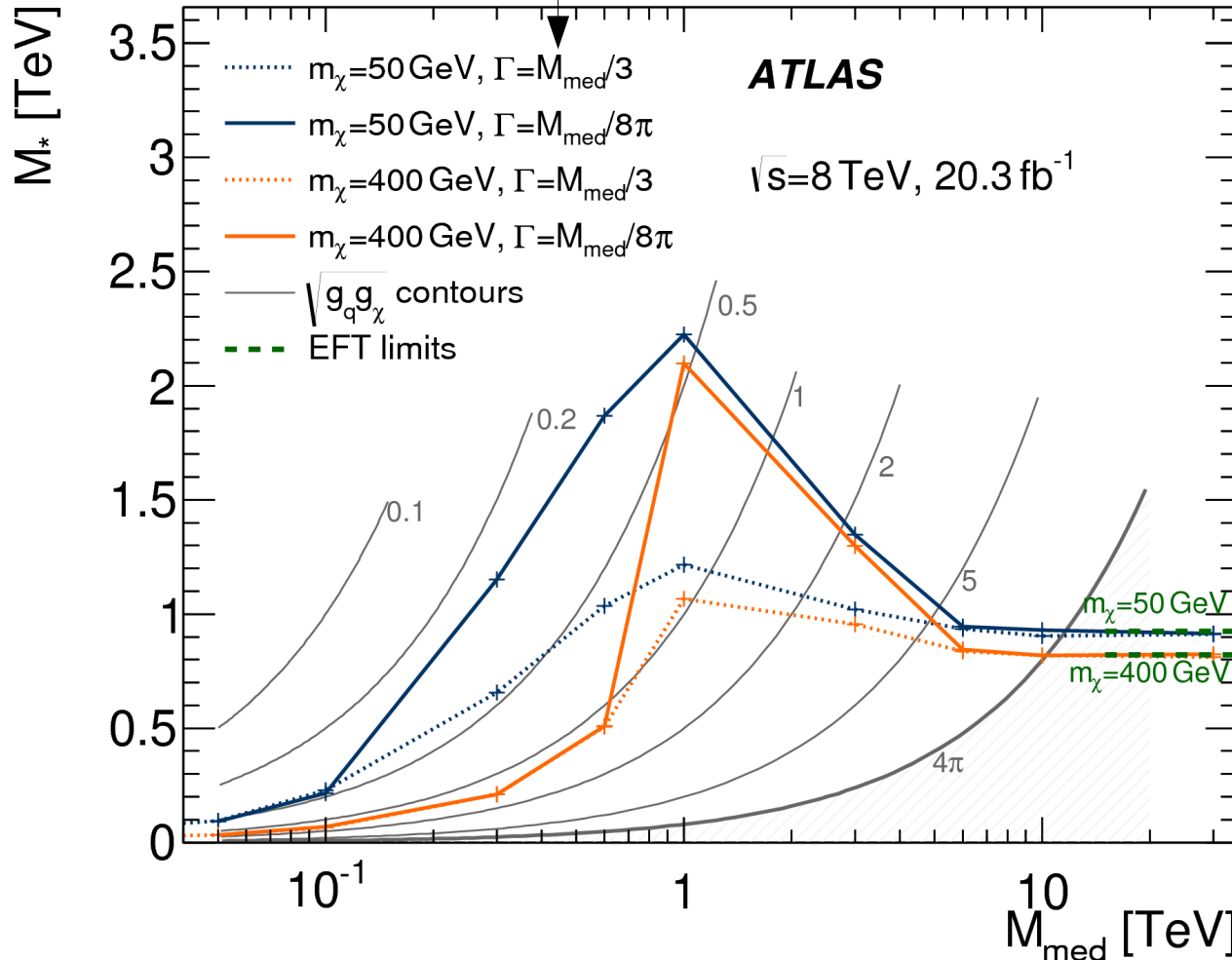
Experiments:

still want to plot **sample results** from simplified models in a meaningful way (and let theorists reinterpret the rest)

A 4/5-D scan isn't suitable for "one plot"
→ need to fix something: what?

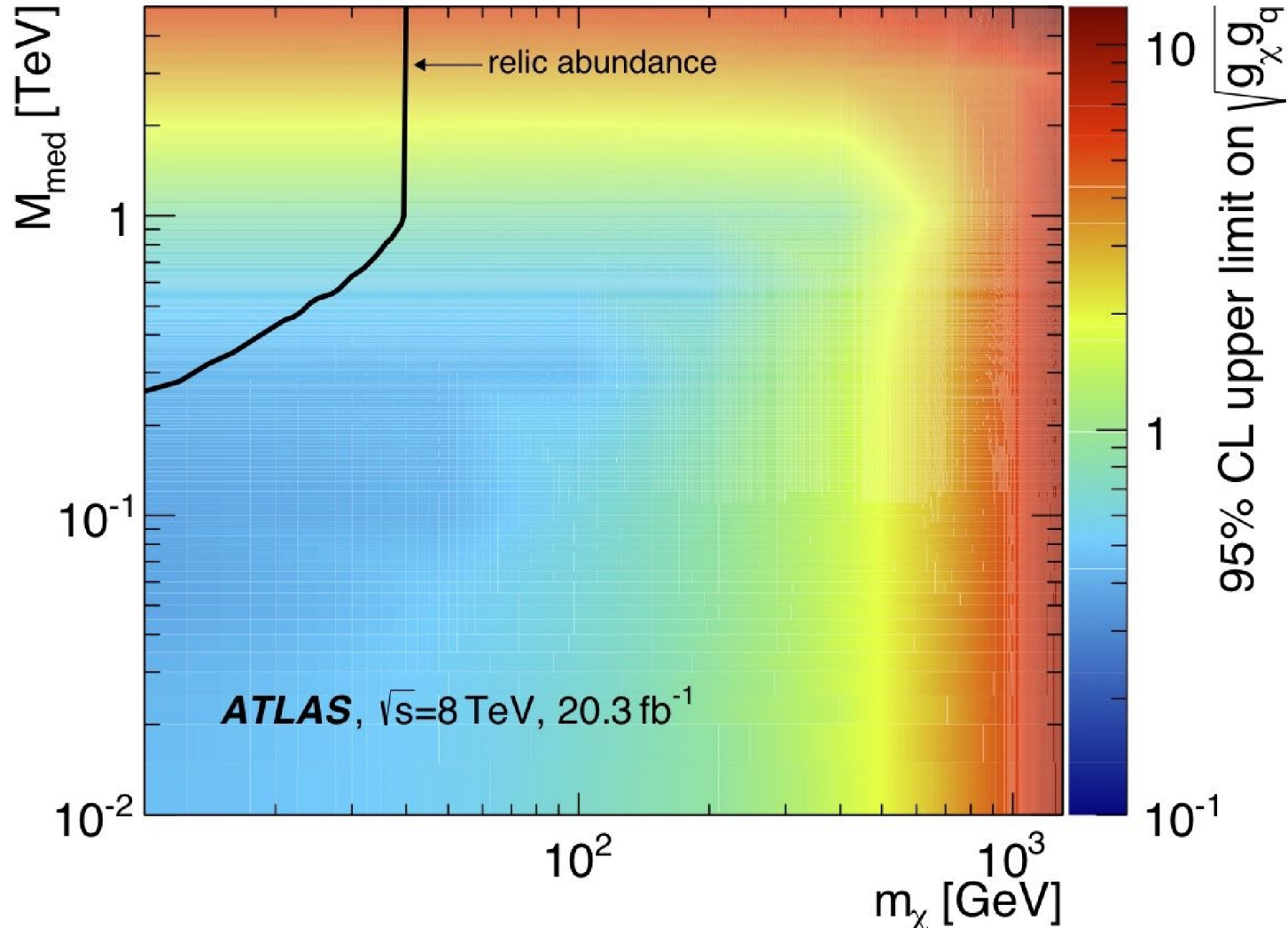
Potential issue with this plot:

couplings not connected to the width, would prefer to scan minimal width + some multiples



Nice feature: can show EFT limit

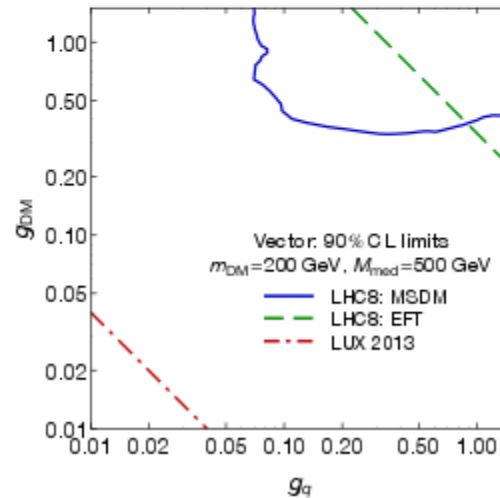
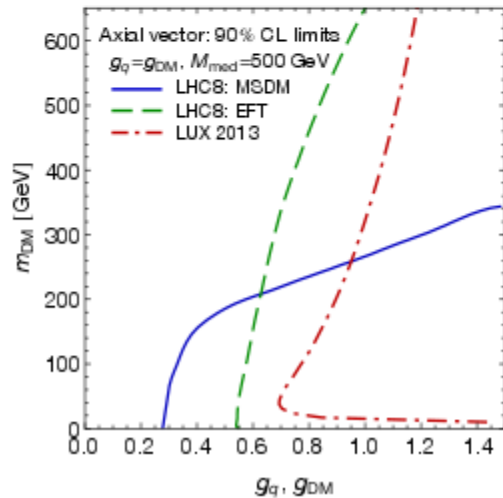
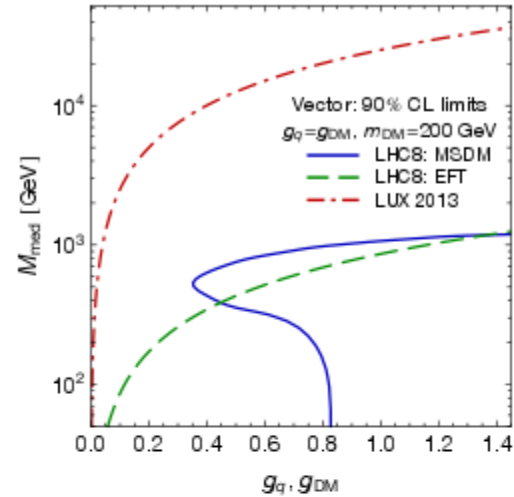
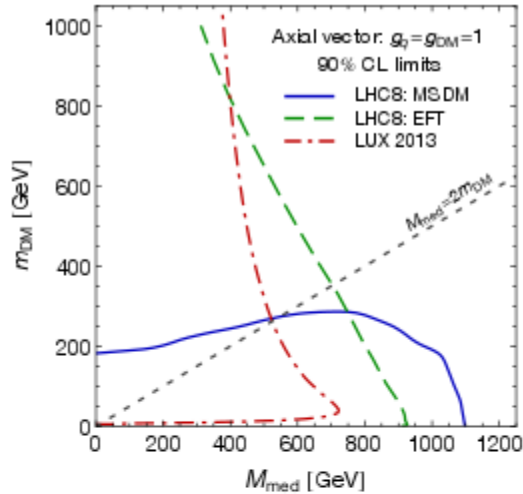
Example of vector mediator (Z'-like)



How to put DD/ID on this plot? Overlaying 2D plots isn't easy

Proposal slides from Bristol workshop (1407.8257)

Maybe plot m_{DM} on the x axis, (on log scale)



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2nd goal: discuss **experimentalist-friendly** suggestions on

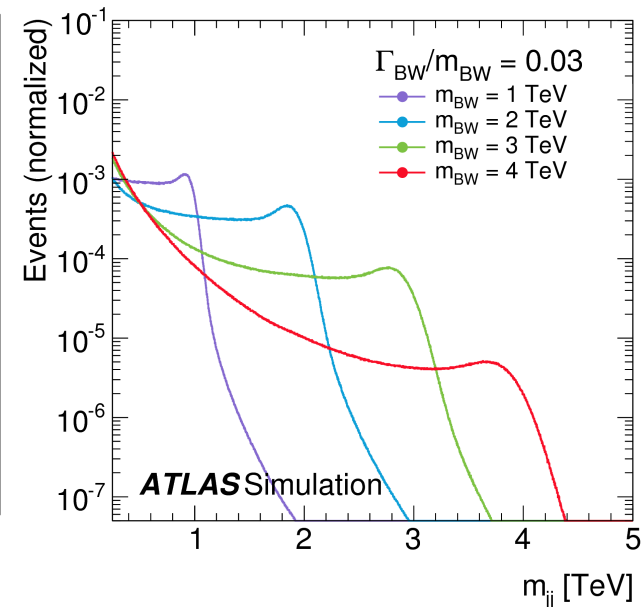
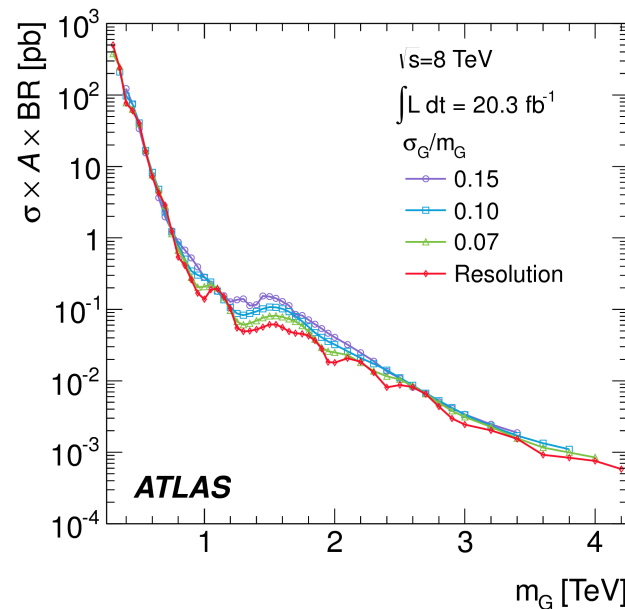
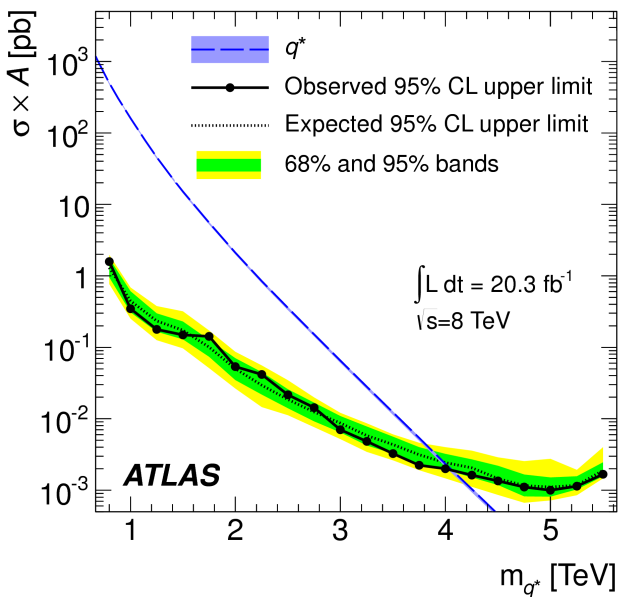
Presentation of **direct collider searches for mediators**

(e.g. dilepton/dijet resonance searches)

in a **DM-aware** fashion

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1. Model-dependent results (qq/qg/gg, Z_B)
2. Model-independent results:
 - a. simple Gaussian signal with different widths
 - b. parton-level (+) PDF (+) parton showering (+) detector resolution



background provided on HEPData - is this sufficient info for reinterpretation? See also: Suchita's slides

Last week's mini-workshop, F. Kahlofer's talk

Backup

Complementarity of monojet searches and direct detection (left) and of monojet searches and dijet searches (right)

Buchmueler et al., arXiv:1407.8257

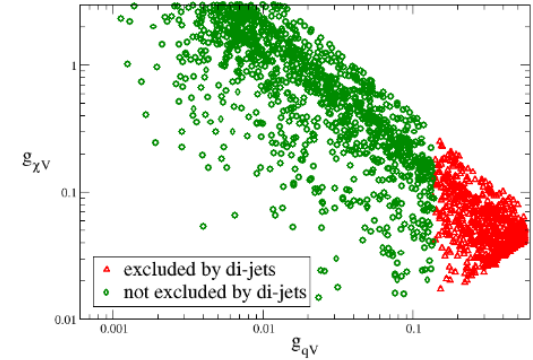
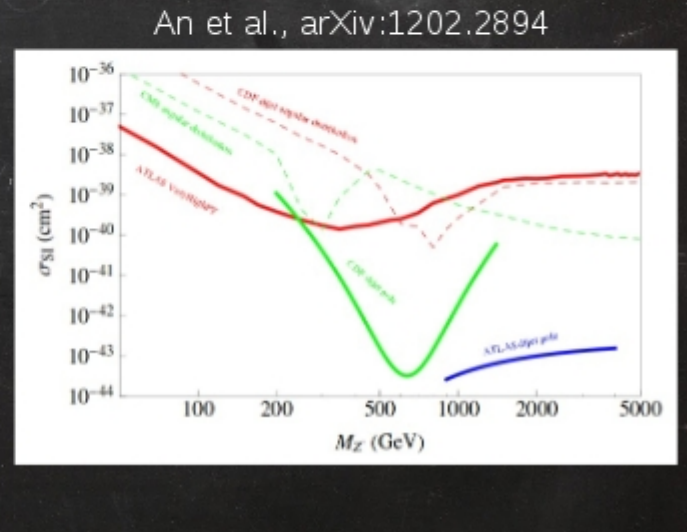
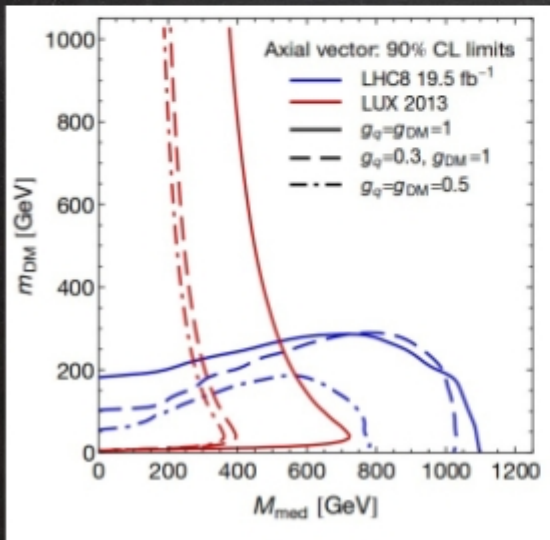
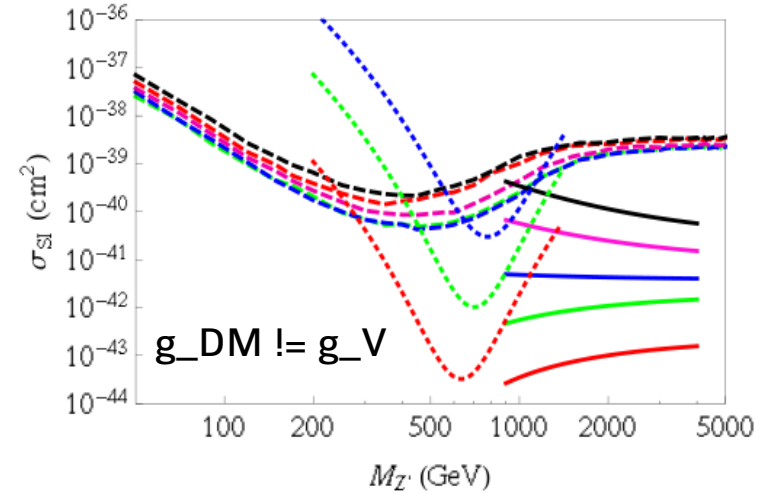
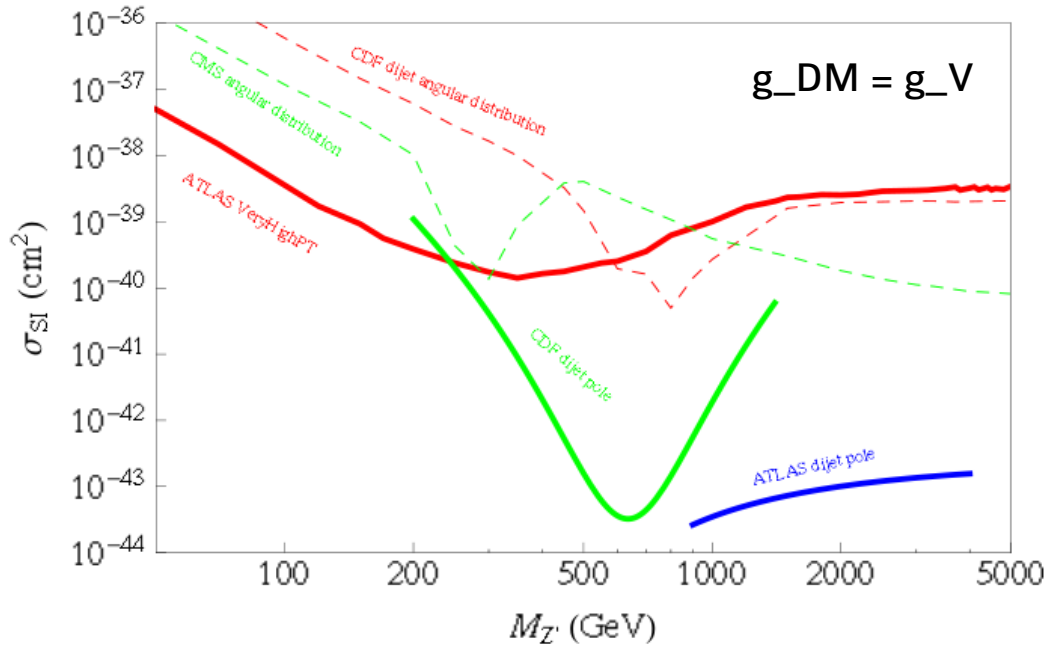


FIG. 4: *Dijet limits and expected exclusions from a 14 TeV LHC with 300 fb⁻¹ shown as the couplings of the points which pass LUX, red triangles excluded by 14 TeV dijets.*

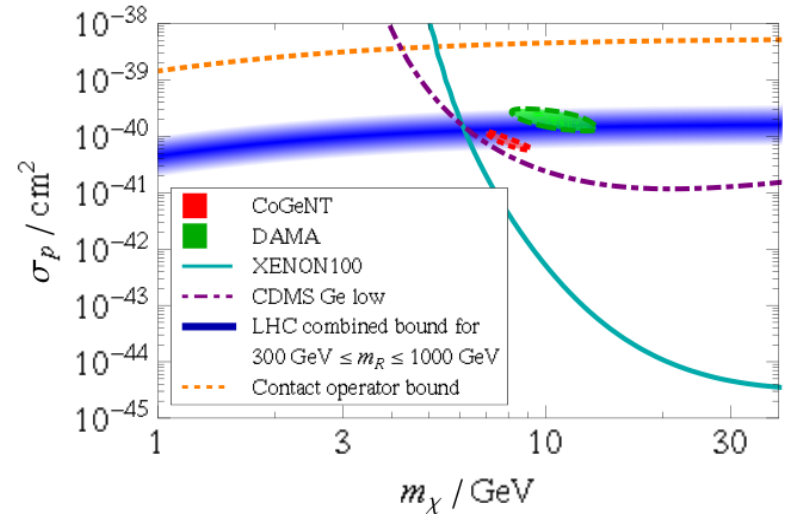


Fixed m_{DM} , can rescale limits for different m_{DM}



Dijet constraints depend on:

- Mediator mass
- Mediator width
- Mediator couplings
(both to DM and to SM)



General comments (discussion-starters):

Simplified models: building blocks → how to interpret interpretation?

“Easiest” thing to do: **generate models based on grid scan** in reinterpretation tool, changing decay from DM to SM. This would take care of everything (width, resonance...), can be plotted e.g. on plots of slide 10.

Can something **simpler** be done, maybe **numerically**, with the **results we have**?

Any other ideas?