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CATERINA DOGLIONI
ON BEHALF OF THE LHC DMWG ORGANISERS
WITH HELP FROM THE SPEAKERS/MANY OTHERS

Summary of discussion on DM summary plots & lepton couplings



Horizon 2020
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ON BEHALF OF MANY

Summary
of the summaries
of the ATLAS/CMS summary plots

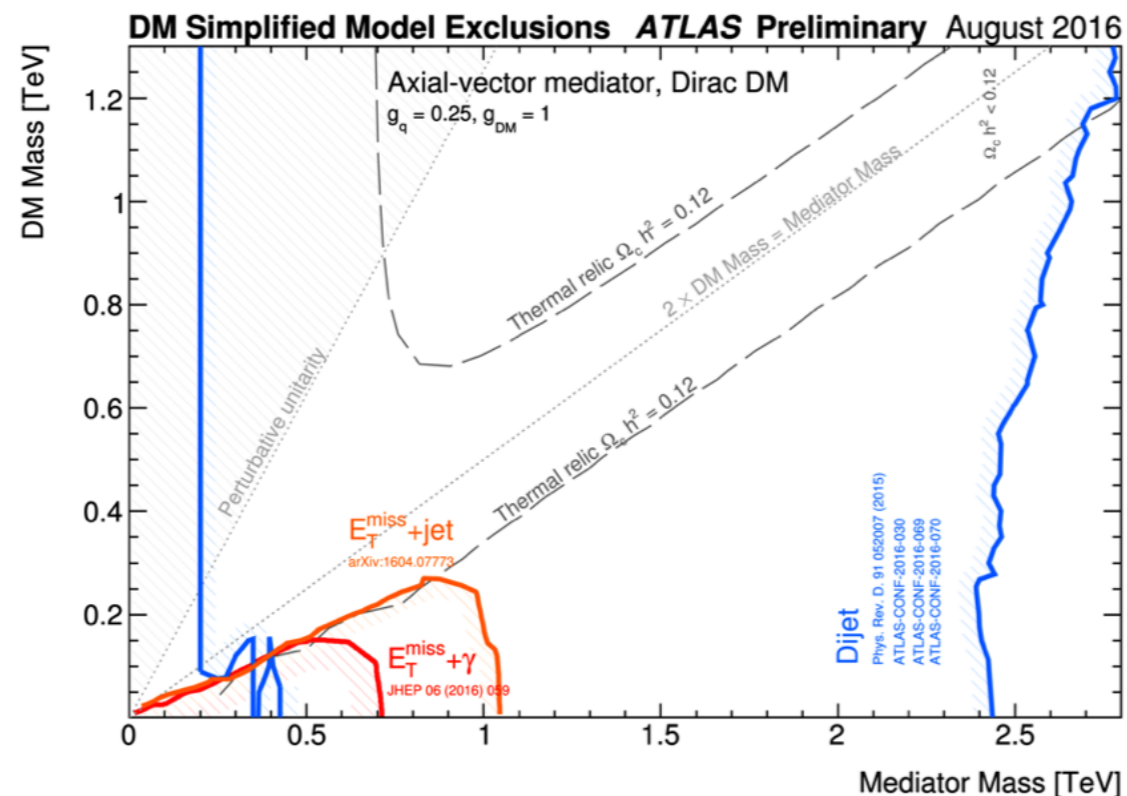
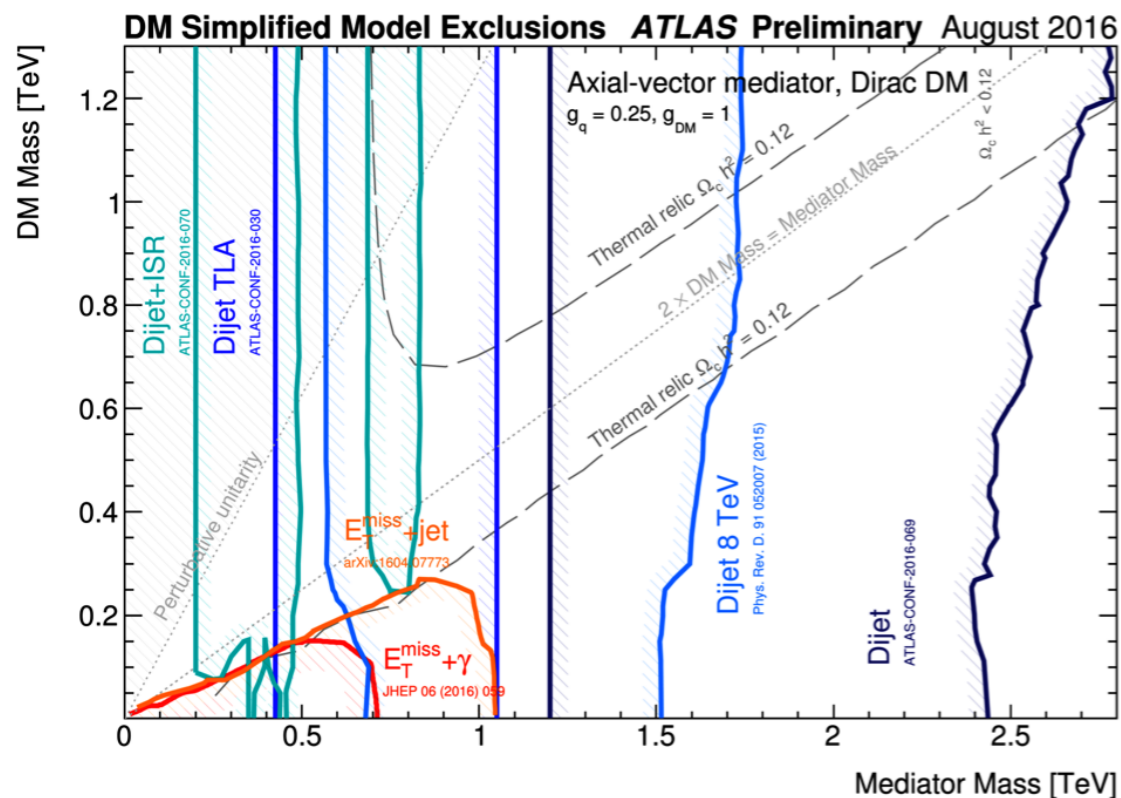


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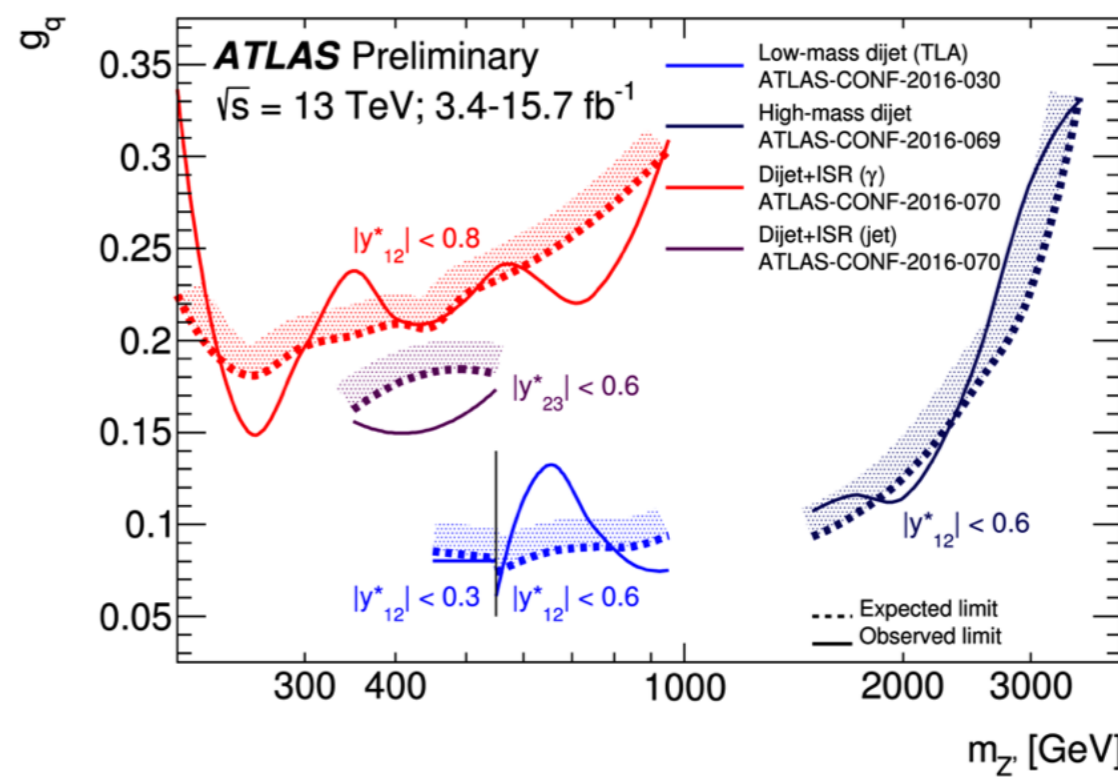
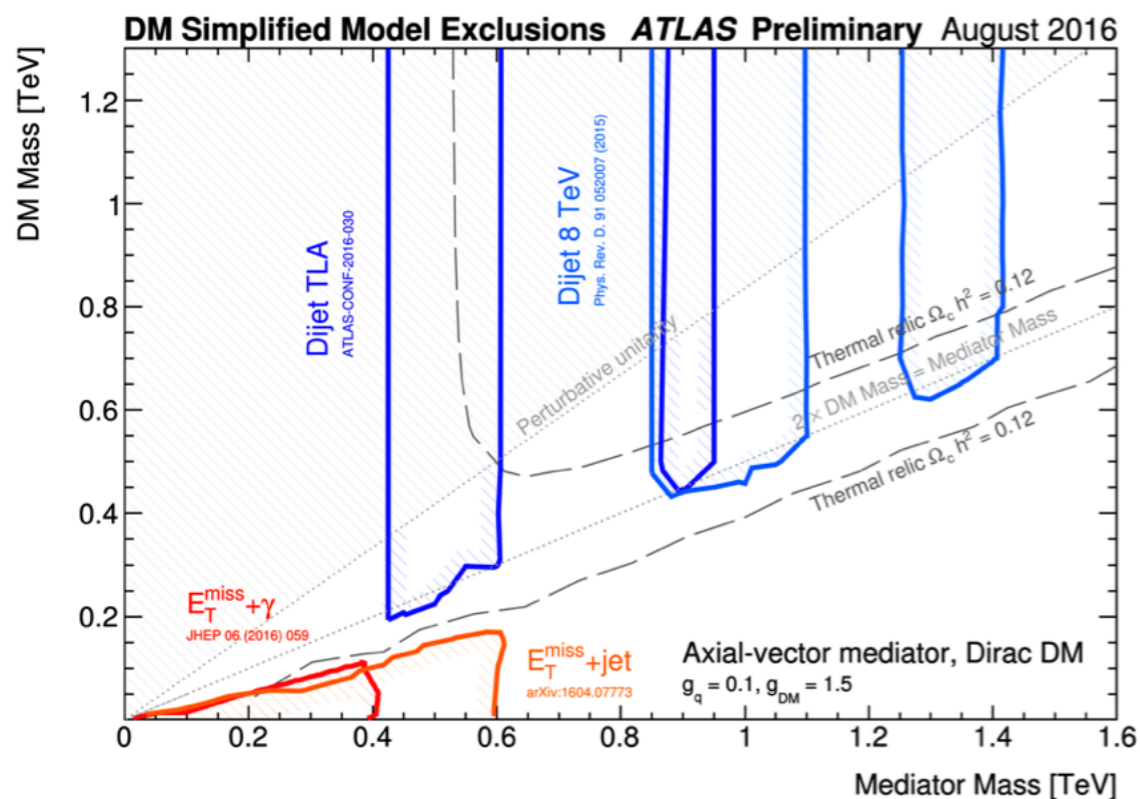
ATLAS summary plots

<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/EXOTICS/index.html>

DM mass - Mediator mass, fixed couplings
Mono-jet/photon and dijet searches



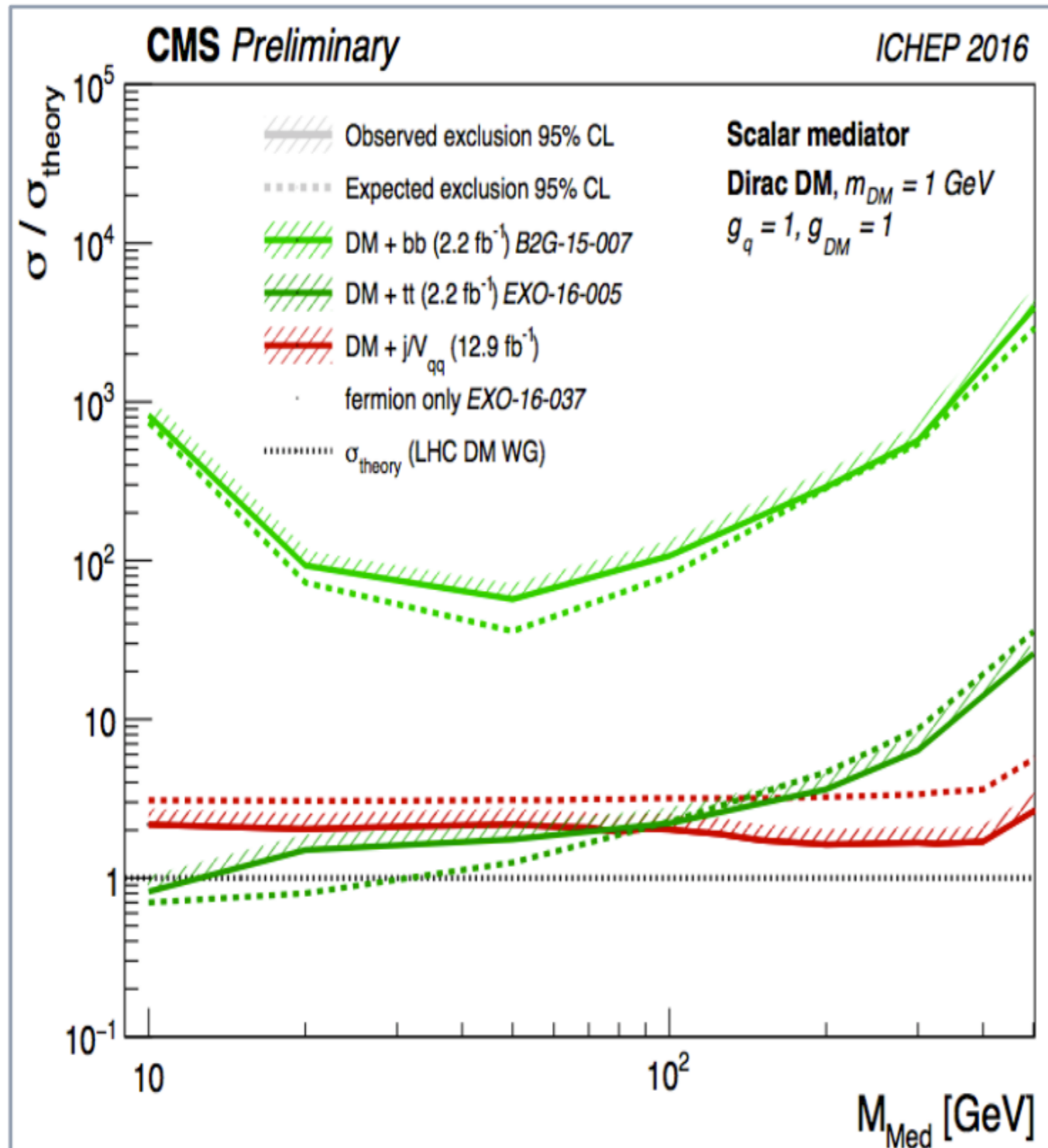
SM coupling - Mediator mass
Fixed DM mass (off-shell), dijet searches only



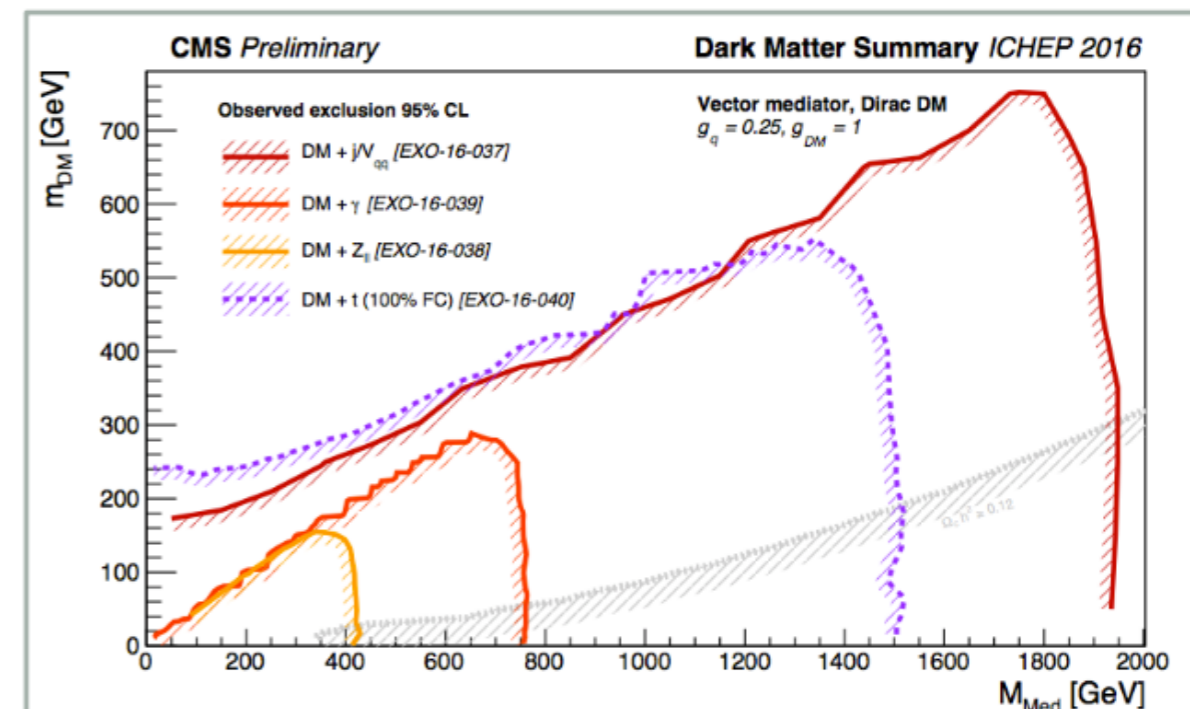
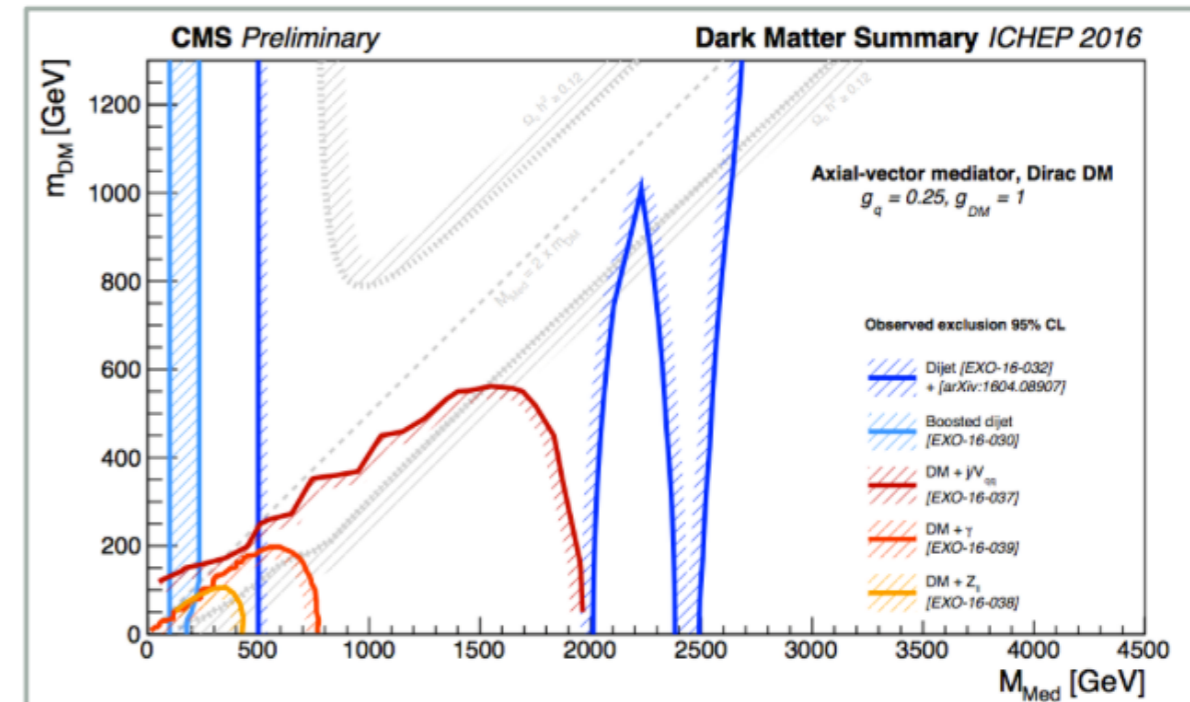
CMS summary plots

<https://cds.cern.ch/record/2208044>

Scalar & Pseudoscalar



V&A (M,M) incl. dijet



Treatment of heavy quarks: agreement

- Use MadGraph DMSimp package to generate axial vector mediator
 - Include b quarks in the proton in Madgraph
 - Include all quarks in the width (recalculated, then imposed)
 - Do not include top quarks in the branching fraction (automatic unless asked for)
 - [to be agreed upon:] Use full NLO model for dijets? Or is LO sufficient?

Alternative couplings: proposal

Proposal = at the end of today's meeting, we collect our thoughts and send them to the DMWG-contributors mailing list. Aim to reach consensus in ~a week, then write it up.

- Keep current benchmark for comparison: axial vector, $g_{DM} = 1.0$, $g_{SM} = 0.25$
- Add one benchmark point:
 - To be decided among:
 - $g_{DM}=1.5$ (or 1.0, not much difference), $g_{SM} = 0.1$
 - $g_{DM}=1.5$ (or 1.0), $g_{SM} = 0.05$
 - Reasoning: luminosity scaling of ATLAS/CMS Trigger-Level analysis/Data scouting searches (limit on coupling scales like $(\text{luminosity ratio})^{-1/4}$)
- For future iterations (possibly for Moriond 2017, if time allows):
define alternative coupling ratio / mass plane: discussion on dmwg-contributors@cern.ch

Looking for dedicated help and contributors to this topic!

See also next slide for further discussion: topic tied to lepton coupling treatment

Lepton couplings: summary

Consensus: important to convey information about lepton couplings in summary plot

Why adding lepton couplings:

- 1) [1510.02110] UV-complete axial vector model with no extra Higgs sector prefers equal lepton couplings with $g_q = g_l$
- 2) [1401.0221, 1607.06680...] many UV-complete model include leptons (g_q can be $\neq g_l$)

Turning to specific simplified models:

Vector model case:

- No constraints on relative size of g_q , g_l , and g_{DM}

Axial-Vector (AV) case:

- If no extended Higgs sector, $g_l \sim g_q$
-> mediator searches for dileptons would dominate over mono-X and di-jet searches

Related outstanding question for all summary plots:

- Are there regions in dijet or dilepton searches where large g_{DM} -> wide resonances? How do non-resonant searches fare in this region?
- **Looking for dedicated help and contributors to this topic!**

Dilepton couplings: discussion

Discussion = at the end of today's meeting, we collect our thoughts and send them to the DMWG-contributors mailing list. Aim to reach consensus in ~two weeks, then write it up.

Vector model case: no constraints on relative size of g_q , g_l , and g_{DM}

- show dijets and mono-X only (can turn off g_l)

Axial-Vector (AV) case with no extended Higgs sector ($g_l \sim g_q$):

- Option 1: show dijets and mono-X only, mention dilepton searches cover this region
- Option 2: show dilepton and mono-X only

Axial-Vector (AV) case with extended Higgs sector (no constraints on relative size of g_l and g_q):

- Find a scenario where g_q , g_l , and g_{DM} allow for complementary searches ($g_l < g_q < g_{DM}$)
 - Q: How arbitrary can the scenario be to make our complementarity point?
 - A: Discussion still ongoing.
 - Q: Can we come up (now, or later) with a model reference justifying this plot?
 - A: Possibly, and can be written up.

Ideally, would like to have a crisp write-up and not too many summary plots

Looking for dedicated help and contributors to this topic
(especially theory input!)

Plot options (F. Kahloefer)

