

Journal club minutes and notes: Dark Matter - Part 3

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May 30th 2018 - Journal club meeting minutes
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Neha chairs, Karol guides. Last session of Dark Matter paper.

Topics:

- Neha leads us in discussion of Figures 7-9.
- We talk about jet trigger searches.
- We talk about Figure 9 and the DSP overproduction, specifically at the mediator DM-mass diagonals.

Details:

- We talked about mono-jet last week and the analysis strategies. This week we look at dijet.
- On figure 7 we have all of the exclusion plots.
- The associated dijet moves onto the lower end of the mediator mass which is why UA2 is now rendered obsolete by the ATLAS measurements. UA2 was colliding at lower centre of mass energy which is why it hit those bounds before.
- The event topology is such that if you have Z or another dark matter particle you probe less than the p_T .
- What's the gap in figure 8? To first order the DM mass doesn't matter in the dijet searches, but second order corrections from it change the mediator-diet coupling. Wiggles are due to stats. See coupling summary plot: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/EXOTICS/ATLAS_DarkMatterCoupling_Summary/ATLAS_DarkMatterCoupling_Summary.png
- We then talk about how the jet trigger searches work (take uncalibrated jets that were already in triggered events and save the 4-vectors.).
- $t\bar{t}$ could show up in loop corrections. They look at tevatron rather than LHC as the gluon production cross-section goes up with CoM and Tevatron was at 2 TeV.
- We have been talking about the mediator to be spin-1/2, if instead its spin-0 then we do have constraints on the coupling to different generations of quarks. If it is spin-0, it could mix with Higgs and we know how the Higgs couples to different quarks. So we just say that it couples preferentially to top quarks. There's also the 2 Higgs doublet models which are ways you can add a larger Higgs. One parameter with the heavy Higgs is that you can flip the bottom and top quark couplings, so di b-jet searches, could be more interesting and are easier to do than $t\bar{t}$ searches.
- Figure 9: The red curve, the relic density, has some features, e.g. in bottom right,

along those dotted diagonals that denote mediator mass equal to or double the DM mass. The idea with the latter is that, the red shows regions where the relic density would require overproduction of DM. If the DM mass is half the mediator mass the DM production would blow up and so there would be *less* overproduction - hence the white sliver extending into the red region.

NEXT WEEK

WW-scattering again!