

DM@Collider summary plots for Snowmass

Plans for DM simplified models

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Our goal for DM@Collider plots for Snowmass

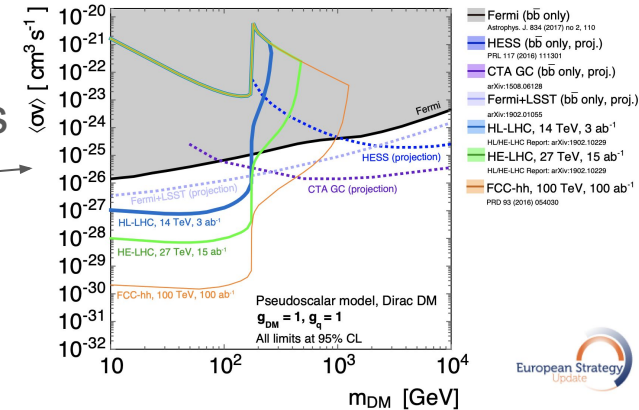
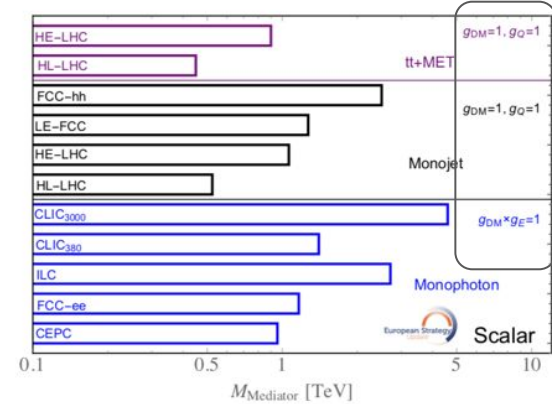
European Strategy:
fixed couplings

- Prepare Dark Matter summary plots like European strategy for HL-LHC and future colliders, with varying couplings

- Models used so far: from LHC Dark Matter Working Group [arxiv 1507.00966]
 - Vector/axial vector simplified model
 - Scalar/pseudoscalar simplified model

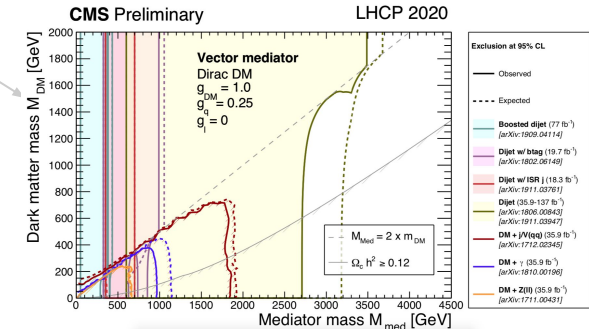
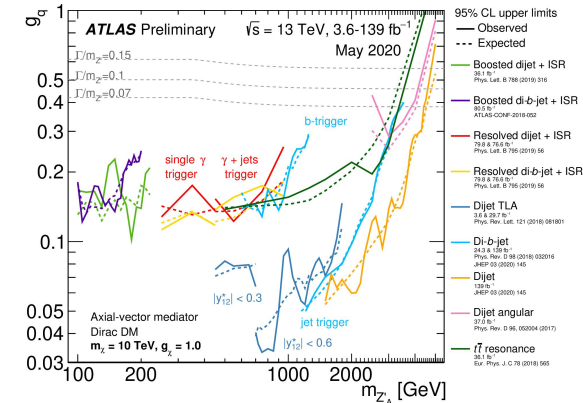
- Connect these plots to other experiments and Frontiers

- Cosmic Frontier: direct detection and indirect detection
- Rare/precision Frontier: accelerator-based / fixed target experiments
- Will need to agree on benchmarks models and presentation of results with them



List of plots, analyses and collider options

- The list of plots we can contribute to the Snowmass process
 - DM-SM coupling as a function of mediator mass
 - DM mass - mediator mass plots
 - Summary plots that include collider experiments
- The list of analyses we can put on these plots
 - Jet+MET
 - Photon+MET
 - $t\bar{t}$ + MET
 - Di-jet / di-lepton
- The list of colliders
 - HL-LHC
 - Future colliders (including muon collider)
 - options will be discussed at upcoming joint Energy and Accelerator Frontier meeting



Work plan

- These plots need individual inputs
 - We can start from DM simplified model results at a given coupling and mass
 - With an analytical interpretation (already done in CMS for visible results) we can make plots for other couplings as well → can discuss this in detail in another meeting
- After we agree on models, we could talk to future colliders / HL-LHC and collect the inputs from these searches
 - Preliminary work: agree on benchmark models, and validate Madgraph UFO and settings
 - Ongoing discussion with John Stupak III from MC task force
 - Some results already there from European Strategy, start with those
- Connect to other frontier and make summary plots
- We would like to write a LOI / whitepaper for Snowmass with those plots
 - Happy to work with others that want to make similar plots

Thank you!

Backup slides

DM ID plot for European strategy briefing book

- Comparison of projected limits from future colliders with constraints from current and future indirect detection experiments (bottom right figure)
 - In the context of simplified s-channel pseudoscalar DM model
 - The collider limits are transferred via equations:

- For quarks:

$$\langle \sigma v_{rel} \rangle_q = \frac{3m_q^2}{2\pi v^2} \frac{g_q^2 g_{DM}^2 m_{DM}^2 \sqrt{1 - \frac{m_q^2}{m_{DM}^2}}}{(M_{med}^2 - 4m_{DM}^2)^2 + M_{med}^2 \Gamma_{med}^2}$$

- For gluons:

$$\langle \sigma v_{rel} \rangle_g = \frac{\alpha_s^2}{2\pi^3 v^2} \frac{g_q^2 g_{DM}^2 |\sum_q m_q^2 f(\frac{m_q^2}{m_x^2})|^2}{(M_{med}^2 - 4m_{DM}^2)^2 + M_{med}^2 \Gamma_{med}^2}$$

