Searches for low-mass dark matter mediators decaying to jets with the ATLAS detector

Low-mass mediator dijet searches [1]

Dark matter mediator models: ATLAS has a wide, complementary search programme.

Issue at low mass: huge QCD multijet background. Unprescaled jet trigger $p_T$ thresholds typically too high to probe hadronically decaying mediator masses $\lesssim 1$ TeV.

E.g. Trigger Level Analysis uses smaller-sized trigger-level objects, storing more events triggered by the lower-threshold hardware trigger.

To reach even lower masses: trigger on high-$p_T$ associated objects, using jet substructure techniques for highly boosted resonance decays:

(resolved) dijet+ISR analysis [2]

Requiring additional high-$p_T$ object (e.g. $\gamma$) lowers the event rate: can access very low $p_T$ jets.

Also: 2b final state—very sensitive even with universal quark couplings!

Dark matter vector mediator summary [1]

Communicate complementarity of the ATLAS search programme, inform decisions about future searches: individual analysis limits compiled in summary plots.

But each analysis can assume different scenarios, models and parameter spaces. Thus, results need to be reinterpreted into a common model space.

Previous method [4,5] required generating signal samples with correct parameters; takes weeks. But reinterpretation can be done purely analytically [6] in seconds!

Analytical reinterpretation

Write analysis-excluded cross-section, equate to cross-section expressed in summary parameters:

$$\sigma_{\text{analysis}}(g_q, M_{Z'}, P) = \sigma_{\text{summary}}(m_{DM}, M_{Z'}, Q).$$

Cross-sections are known functions, so invert RHS to get excluded summary model parameters in terms of analysis quantities!

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