

Dark Showers

Tim Cohen
(U Oregon)

Snowmass 2021

Deep Thoughts



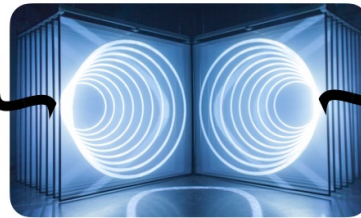
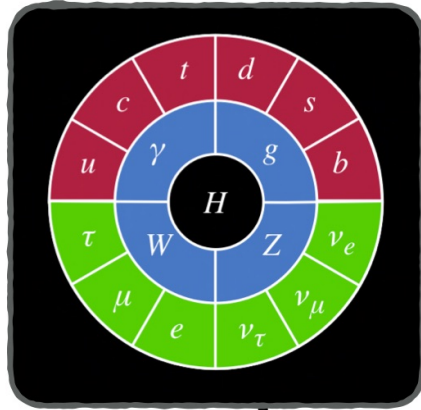
Practical Thoughts

How do we ensure
discovery????

Can we better optimize
searches????

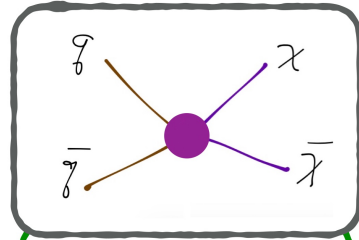


Dark Sector Paradigm

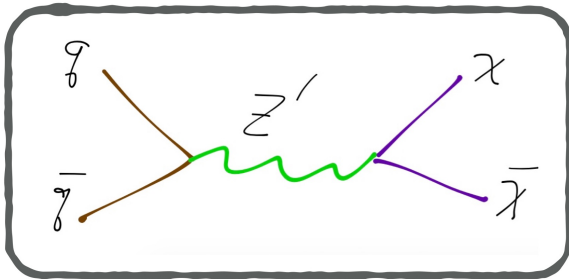


Portals for LHC

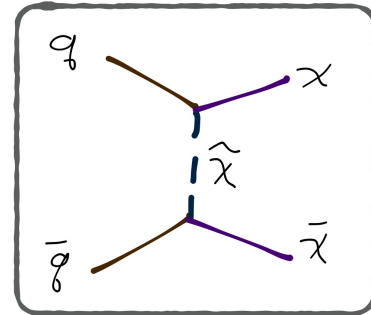
contact operator



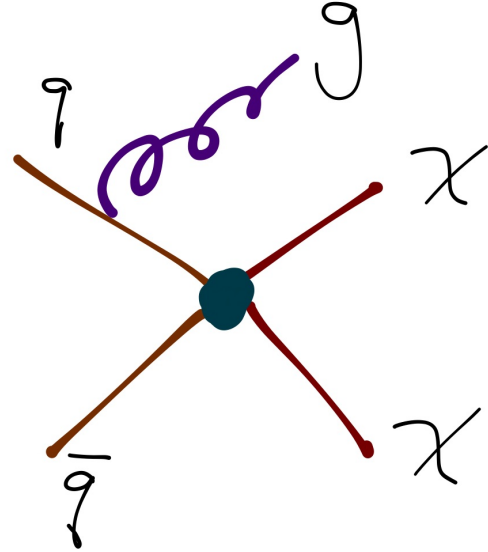
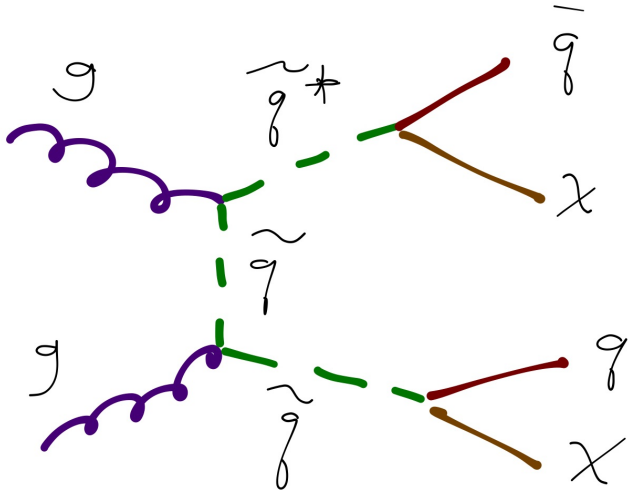
s-channel



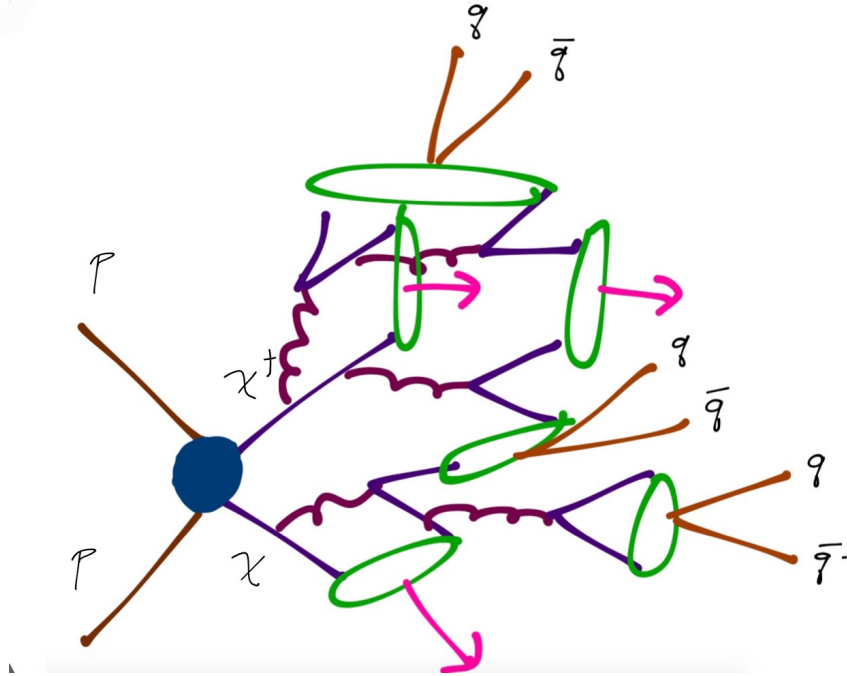
t-channel



Weakly Coupled

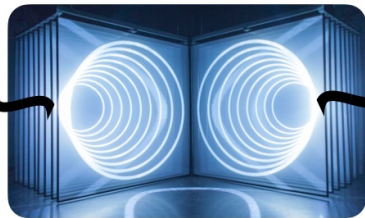
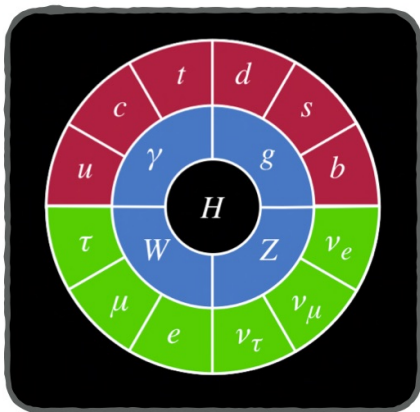


Strongly Coupled



Overwhelming Theory Space

Fixed \rightarrow

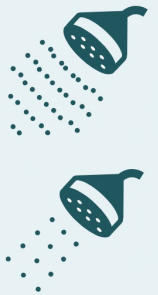



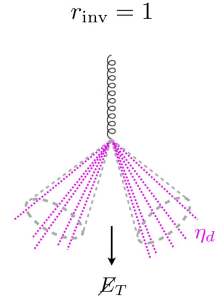
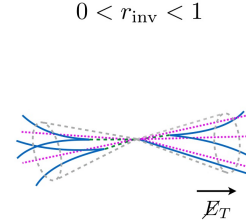
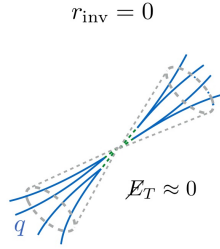
\leftarrow Three
(renormalizable)
options

Phenomena Driven

- Semi-visible jets
- Lepton jets
- Emerging jets
- Soft bombs
- Quirks
- Your awesome new idea!

Semi-visible Jets

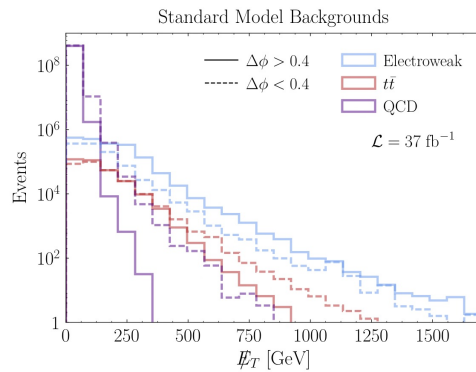
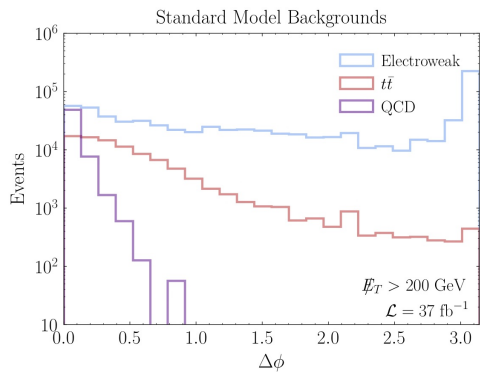
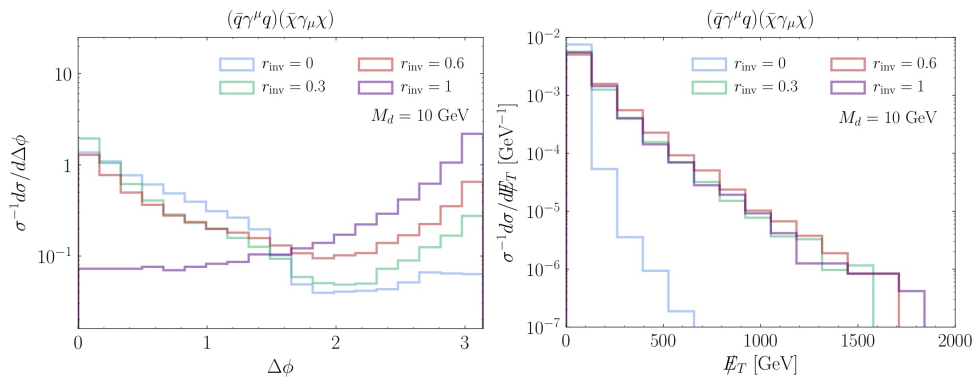
Shower Strength		Invisible ratio	
$\alpha_d(1\text{TeV})$		r_{inv}	
larger $\alpha_d(\Lambda)$		larger r_{inv}	



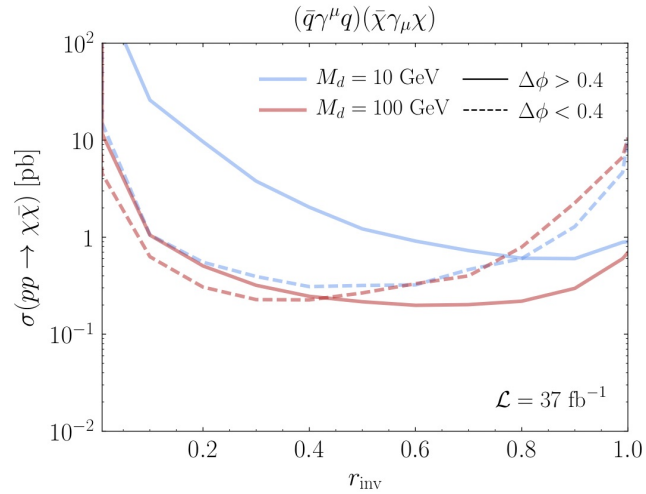
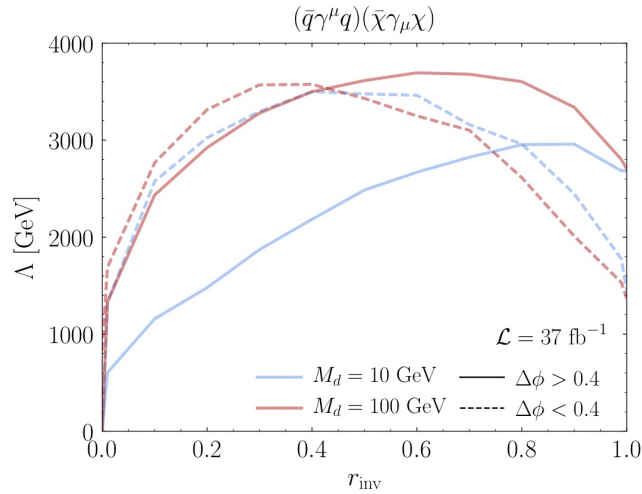
Pheno parametrization:

- α_d (or Λ_d)
- r_{inv}
- M_d
- σ_{portal}

Signal vs Background



Projected Limits



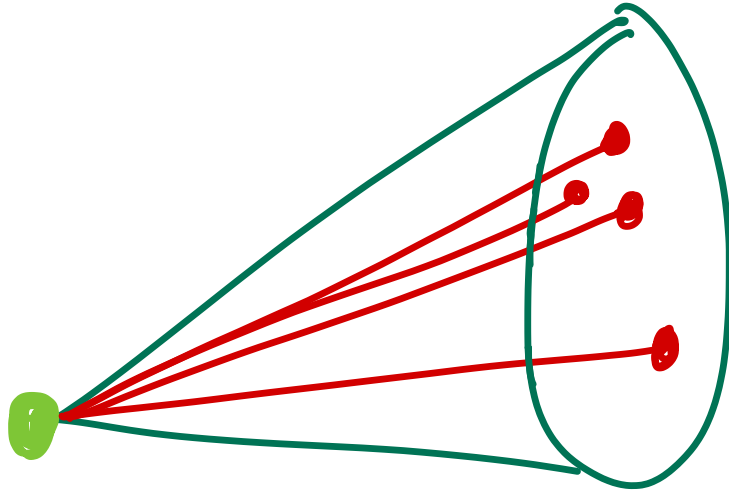
For s-channel + t-channel,
see arXiv:1707.05326

Frontiers

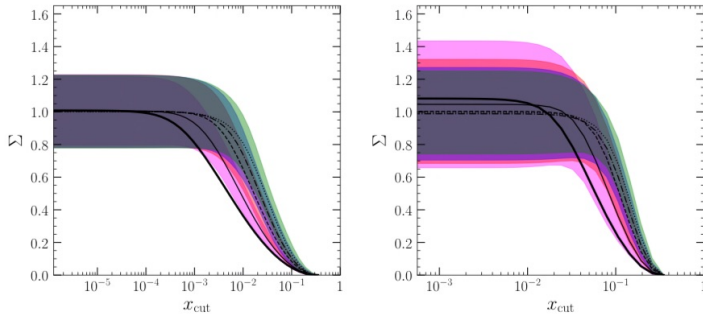
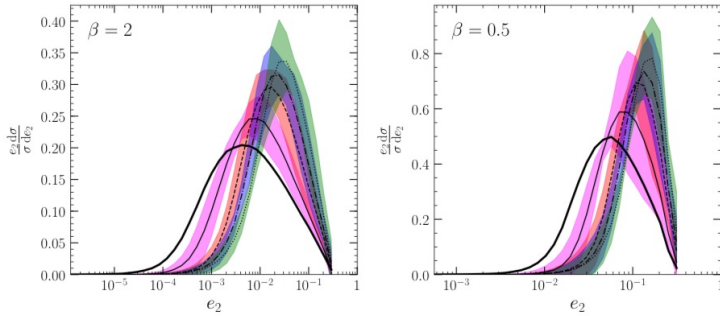


New Observables

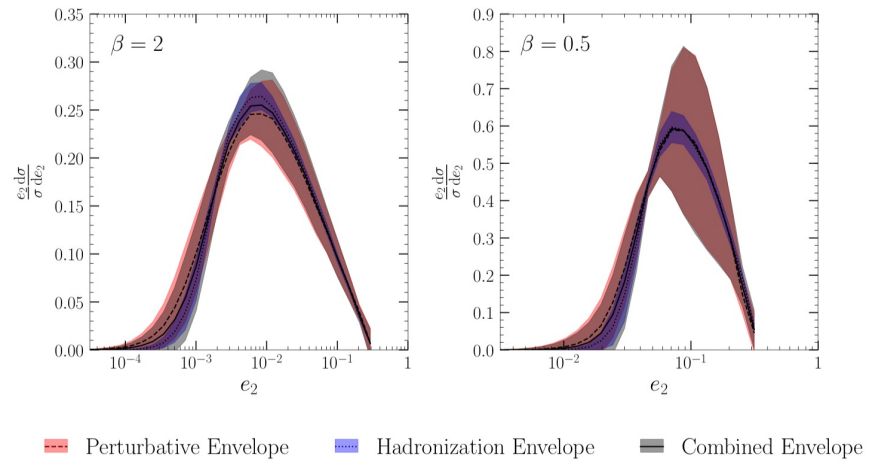
Eg: jet substructure



Theoretical Error Bars



— QCD $\tilde{\Lambda} = 1 \text{ GeV}$ 5 GeV 10 GeV 20 GeV



--- Perturbative Envelope --- Hadronization Envelope --- Combined Envelope

TC, Doss, Freytsis
arXiv: 2004.00631

New Phenomena



Benchmarking

- Pick a portal: contact operator
- Pick some parameters: $\Lambda_d = 20 \Lambda_{QCD}$
 $\Gamma_{inv} = 0.5$
 $m_d = 10 \text{ GeV}$
- Determine limit on O_{portal}

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