Effective WIMPs

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With
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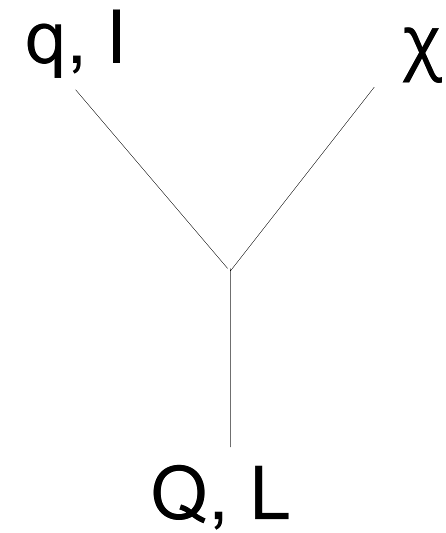
Based on:
Quark Partners: arXiv:1307.8120
Lepton Partners: arXiv:1402.7358

Similar Work:
Quark Partners:
arXiv:1308.0612 Yang Bai & Joshua Berger
arXiv: 1308.0592 An, Wang, & Zhang
arXiv:1308.2679 DiFranzo, Nagao, Rajaraman, & Tait
Lepton Partners:
ArXiv:1402.6696 Yang Bai & Joshua Berger

Our Models: Basics



2 New Particles:

χ, Dark Matter

Gauge Singlet

Q or L, Standard Model Partner

Same as SM

1 New Coupling, λ

Flavor Diagonal

3 Parameters → 2 Parameters

Relic Abundance

Our Models: Motivations

- Minimal New Content
- Preserve "WIMP Miracle"
  - Thermal Relic DM
  - Renormalizable Interactions
- Comparison of Collider & Direct Detection
- Generality
  - Spin, Flavor Structure Variations
  - Own Antiparticle vs. Not
  - SM: Quark or Lepton

Our Model: Variations

Spin	0	1/2	1
Own Antiparticle	χ: Real Scalar Q: Dirac Fermion	χ: Majorana Fermion Q: Complex Scalar	χ: Real Vector Q: Dirac Fermion
Not Own Antiparticle	χ: Complex Scalar Q: Dirac Fermion	χ: Dirac Fermion Q: Complex Scalar	χ: Complex Vector Q: Dirac Fermion

SM Particle = Quarks or Leptons

3 Flavor Variations:

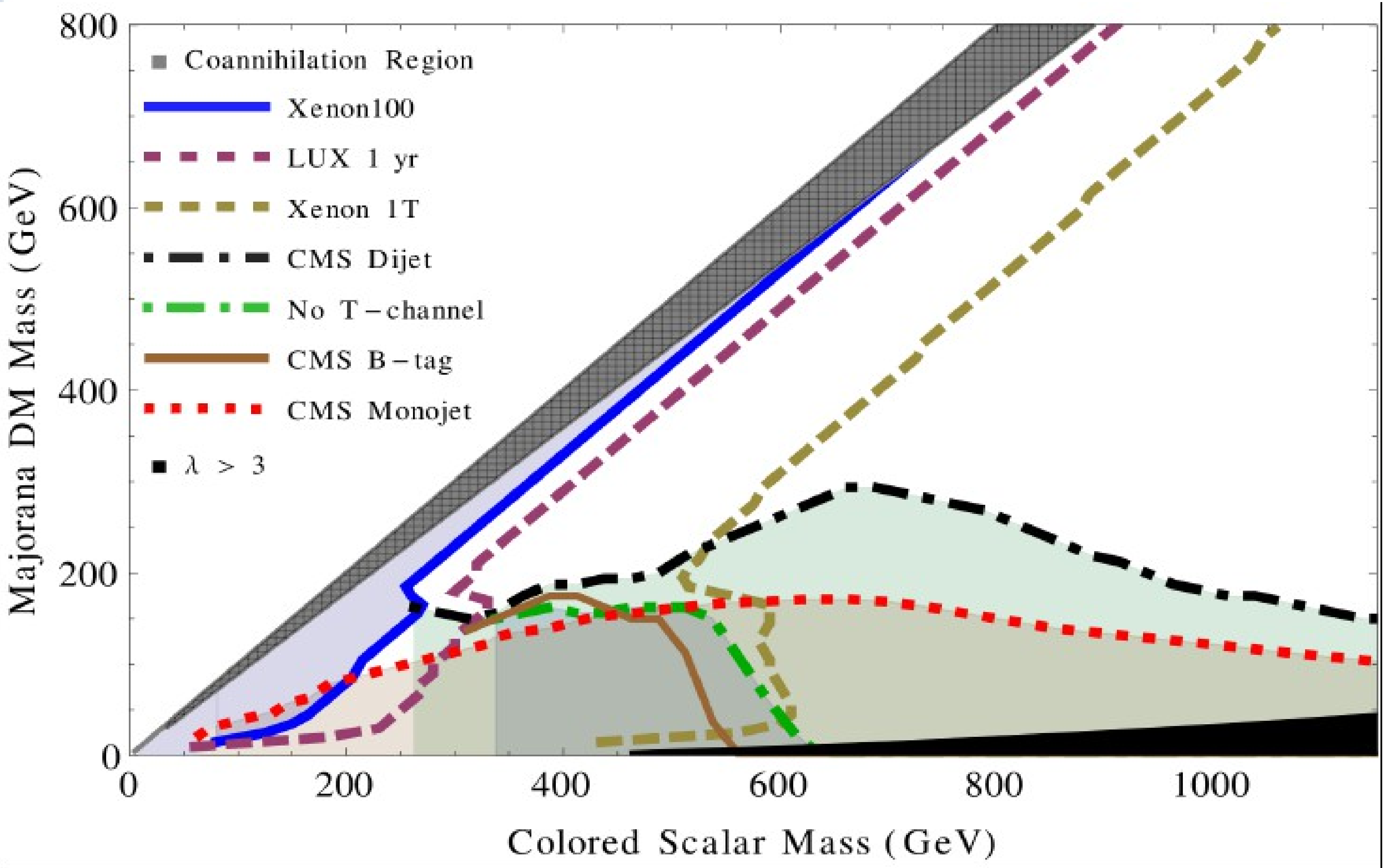
Universal Coupling

$$\overbrace{u \;\; d \;\; c \;\; s \;\; t \;\; b}$$

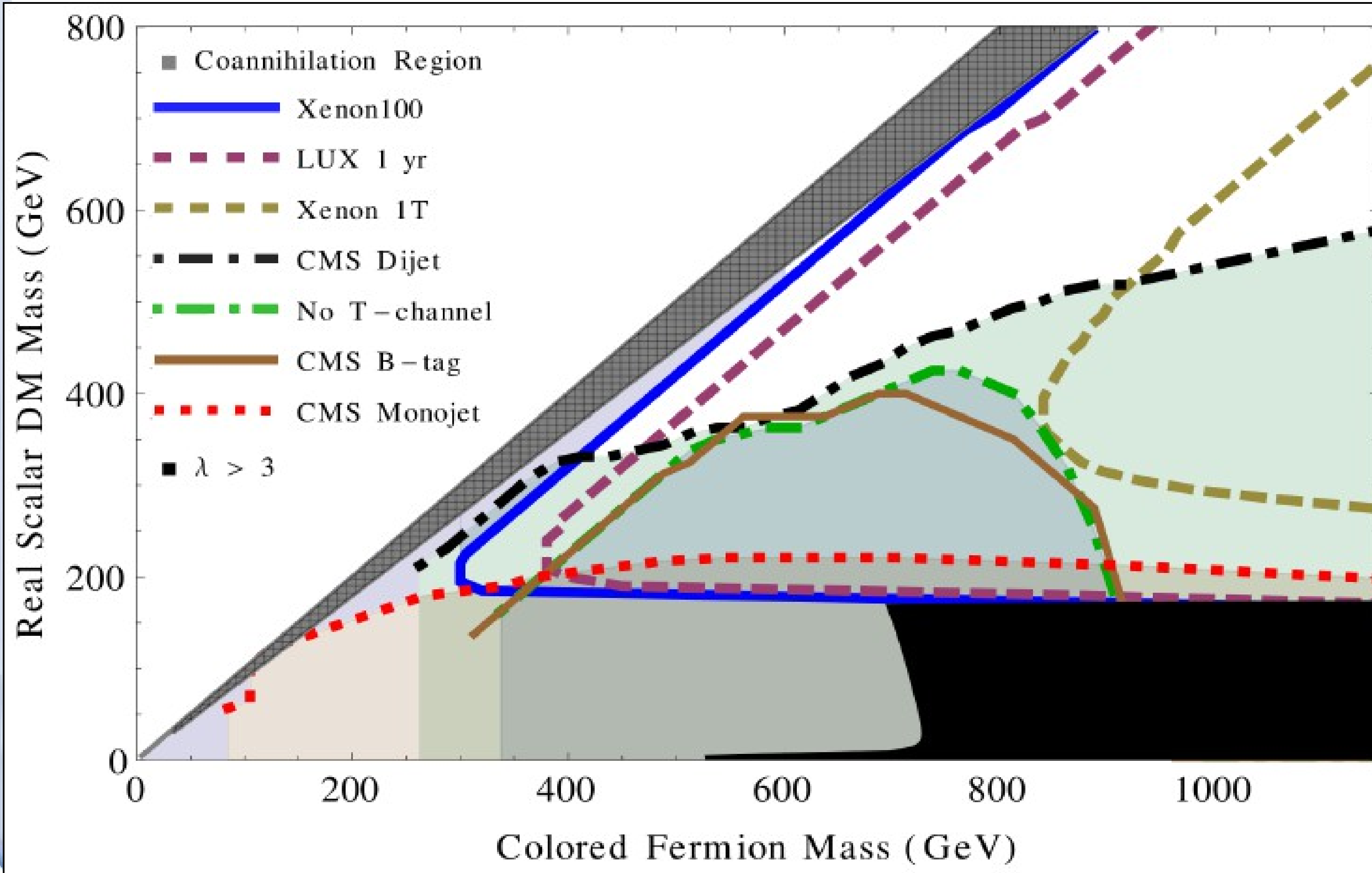
or

$$\underbrace{\nu_e \; e \; \nu_\mu \; \mu}_{\text{2 Generations}} \; \underbrace{\nu_\tau \; \tau}_{\text{3rd Generation}}$$

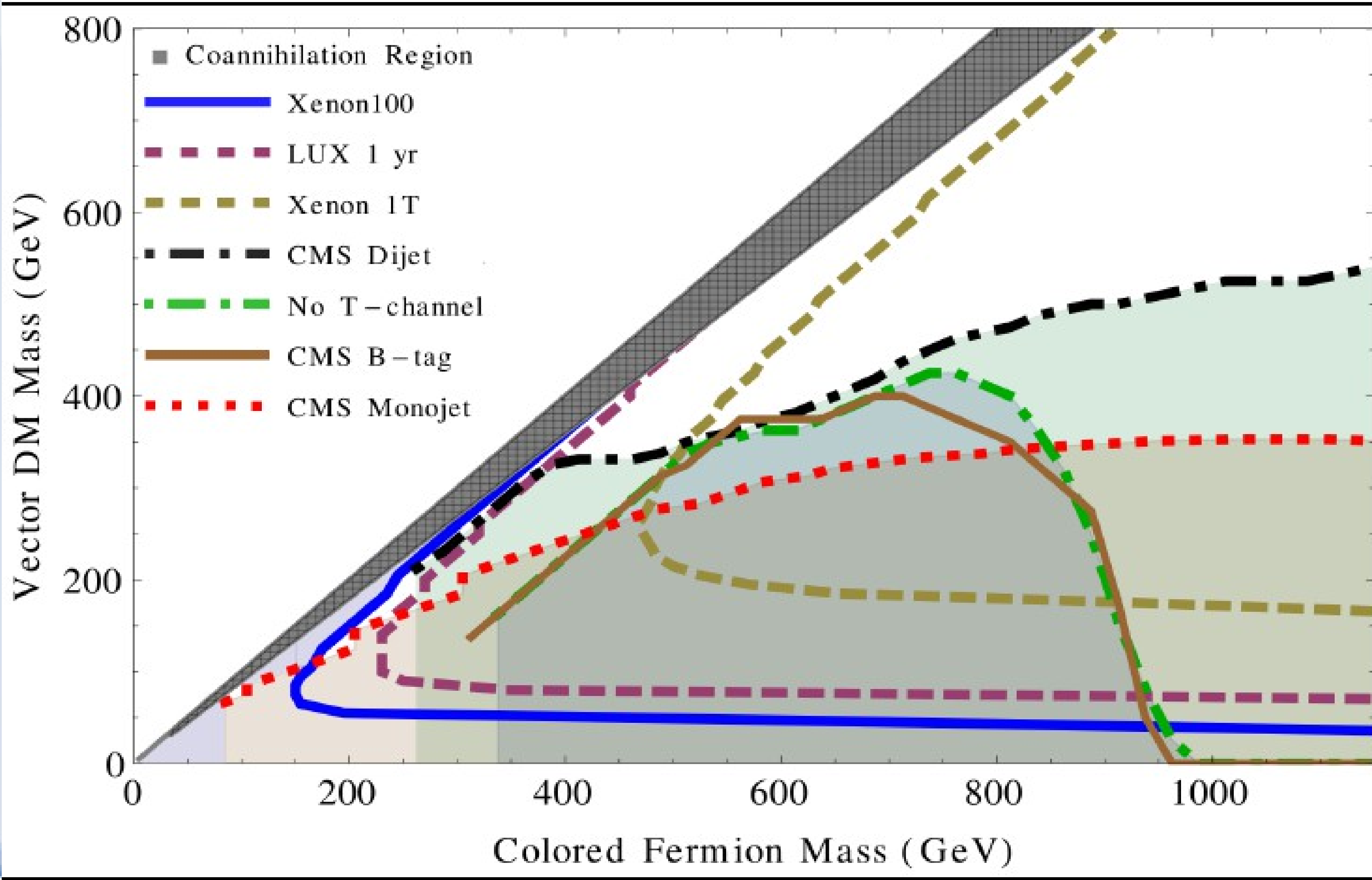
Quark Partner & Majorana Dark Matter



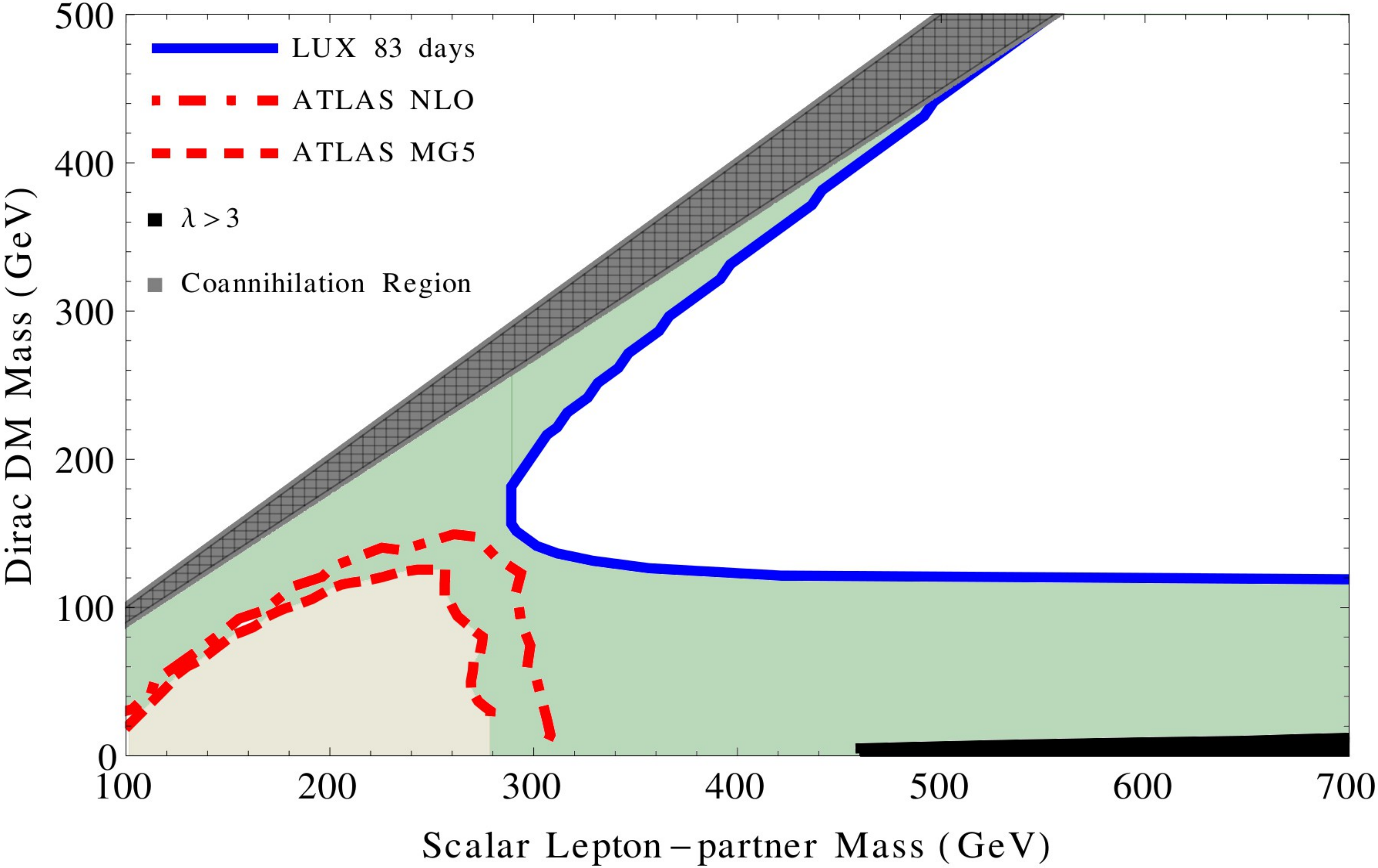
Quark Partner & Real Scalar Dark Matter



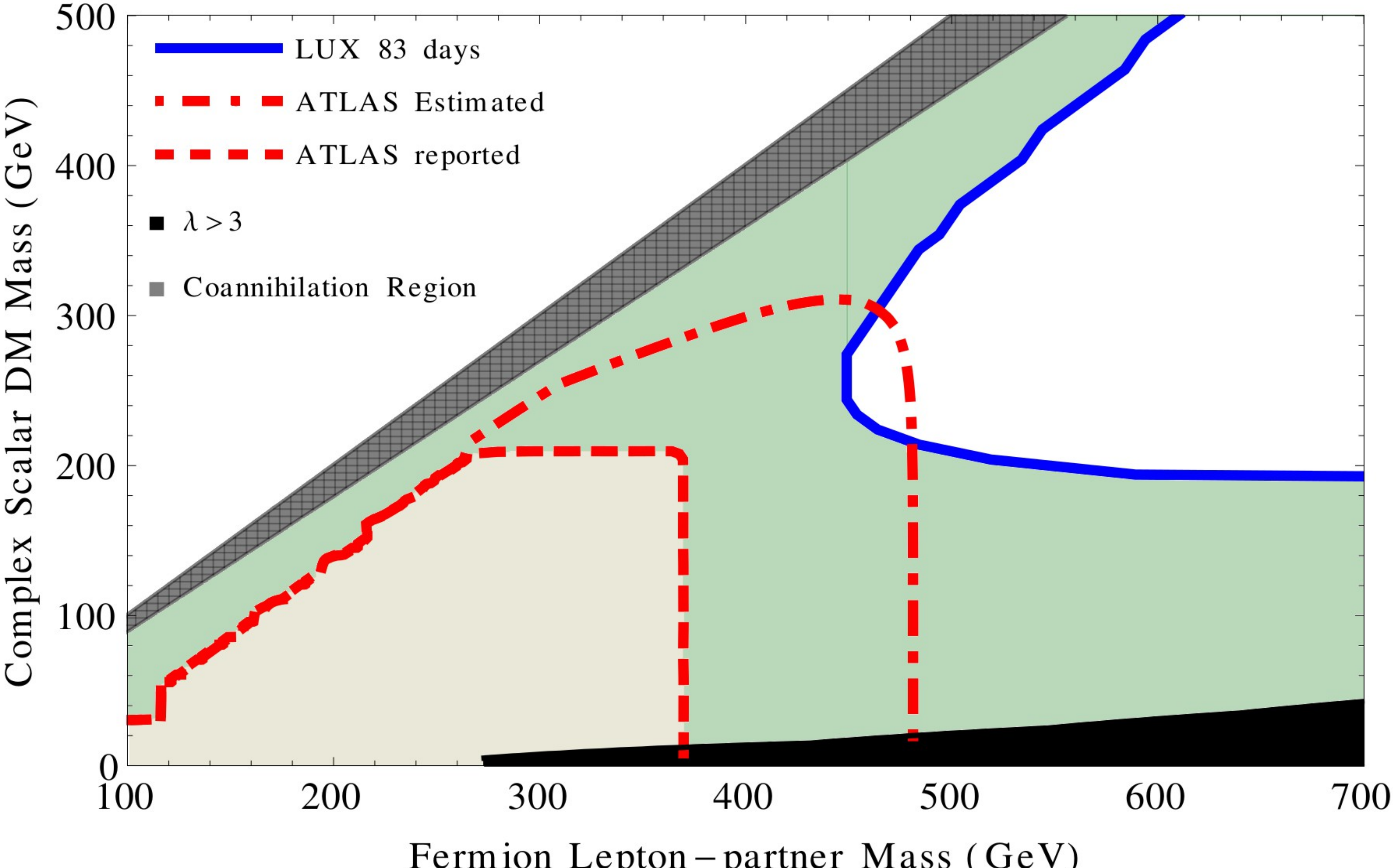
Quark Partner & Real Vector Dark Matter



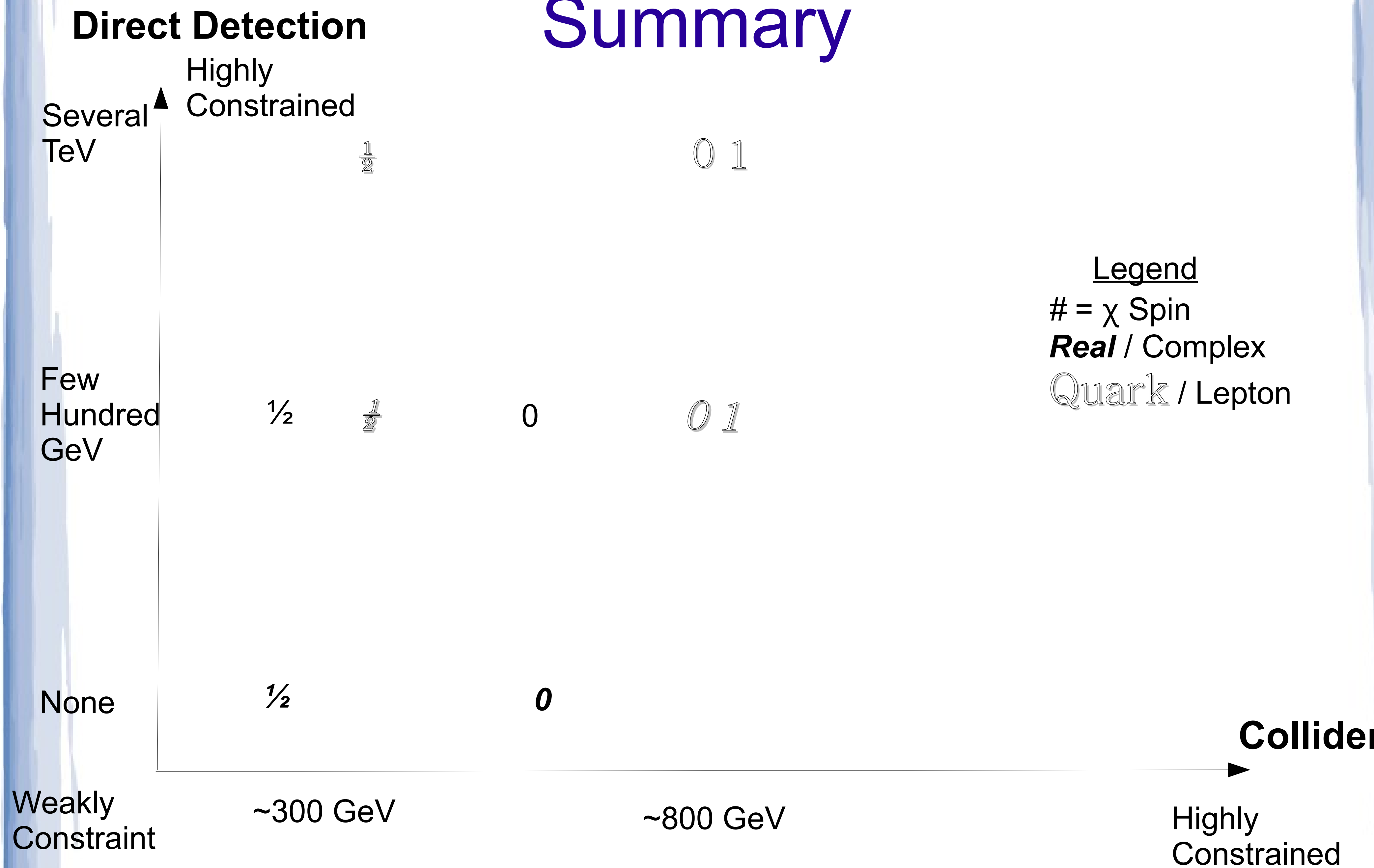
Lepton Partner & Dirac Dark Matter



Lepton Partner & Complex Scalar Dark Matter



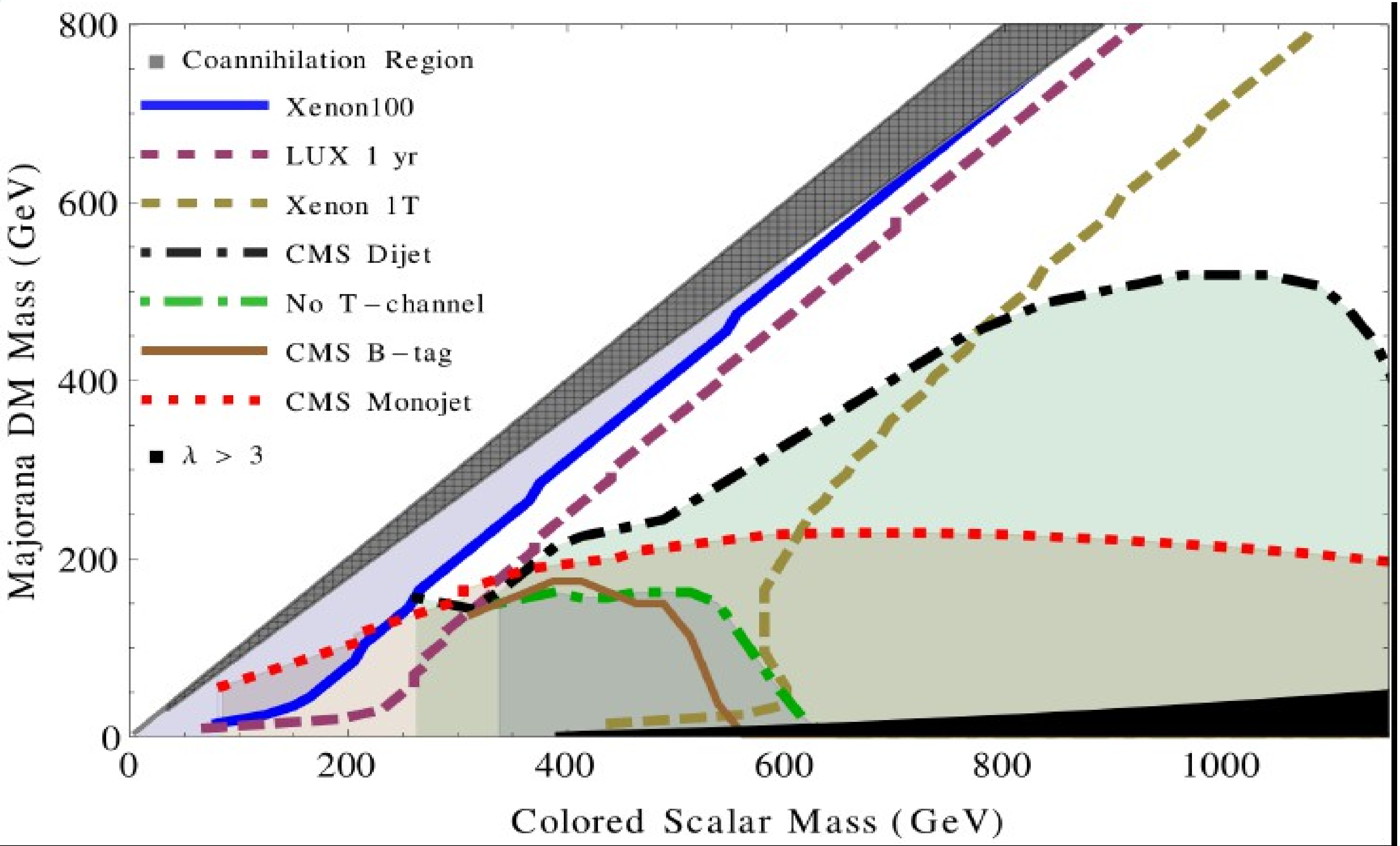
Summary



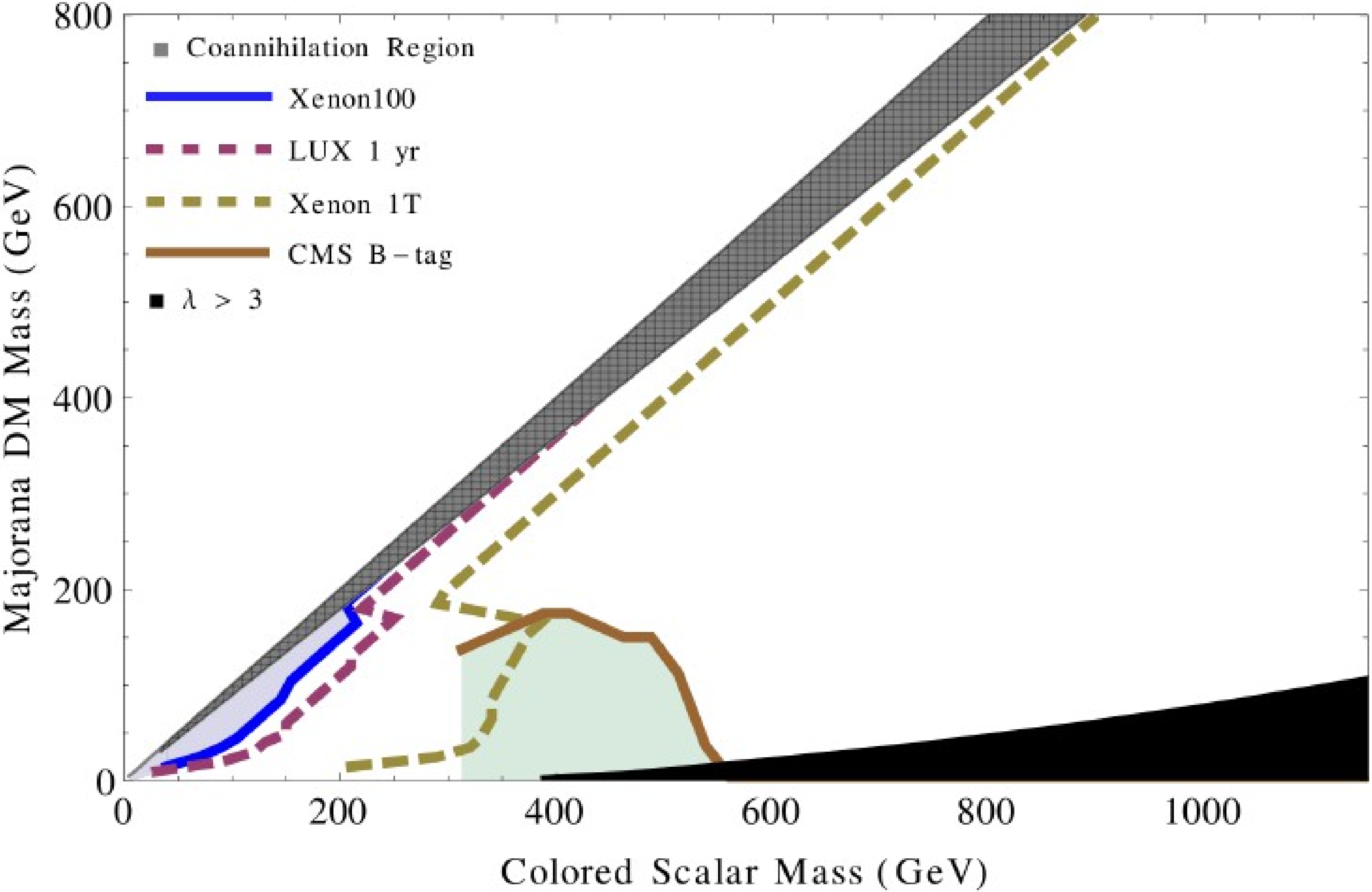
Direct Detection
Highly Constrained
Several TeV
½ 0 1
Few Hundred GeV
½ ½ 0 0 1
None
½ 0
Collider
Weakly Constraint
~300 GeV
~800 GeV
Highly Constrained
Legend
= χ Spin
Real / Complex
Quark / Lepton

Back Up Slides

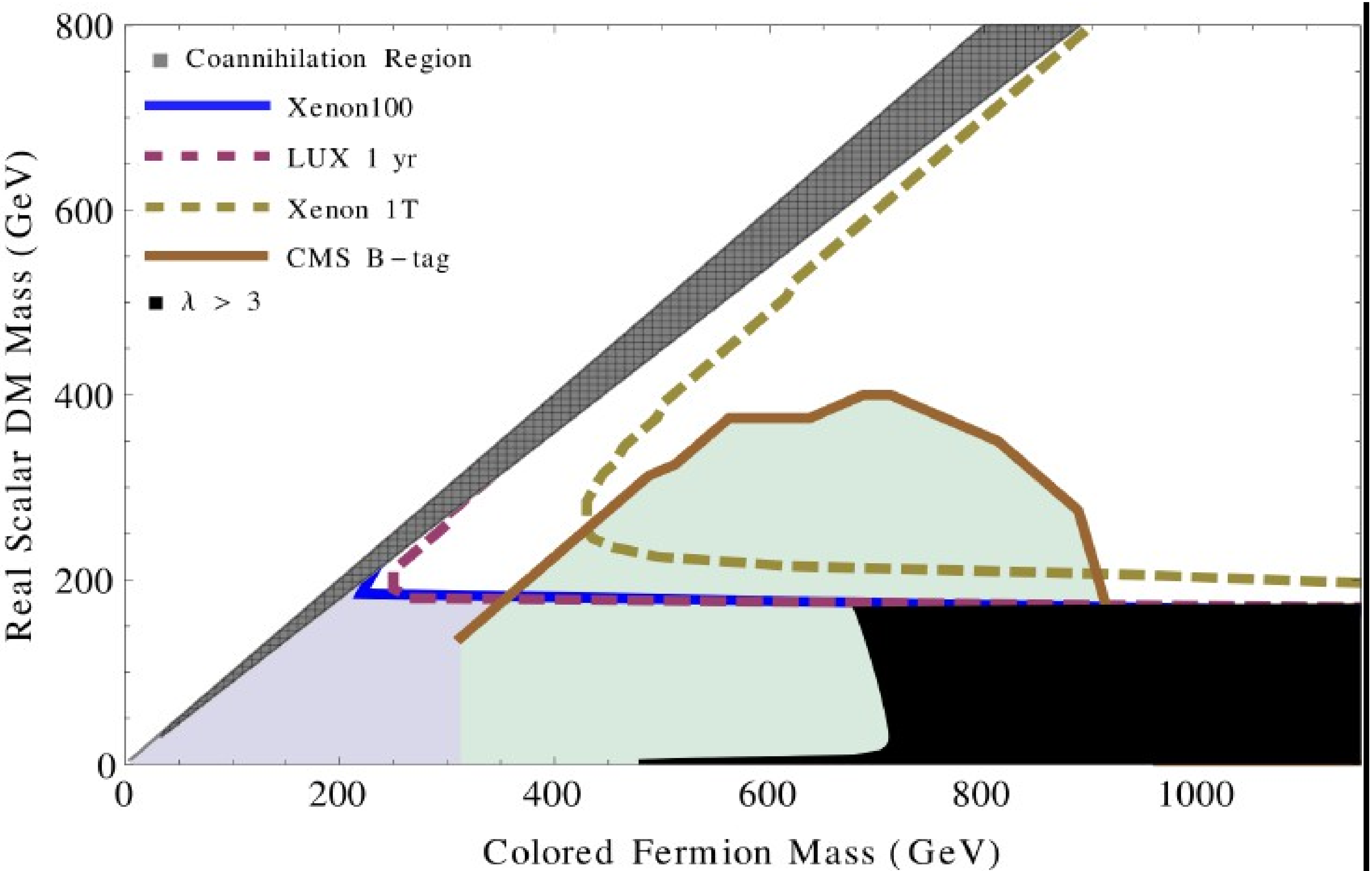
Quark Partner & Majorana Dark Matter (2 Gen.)



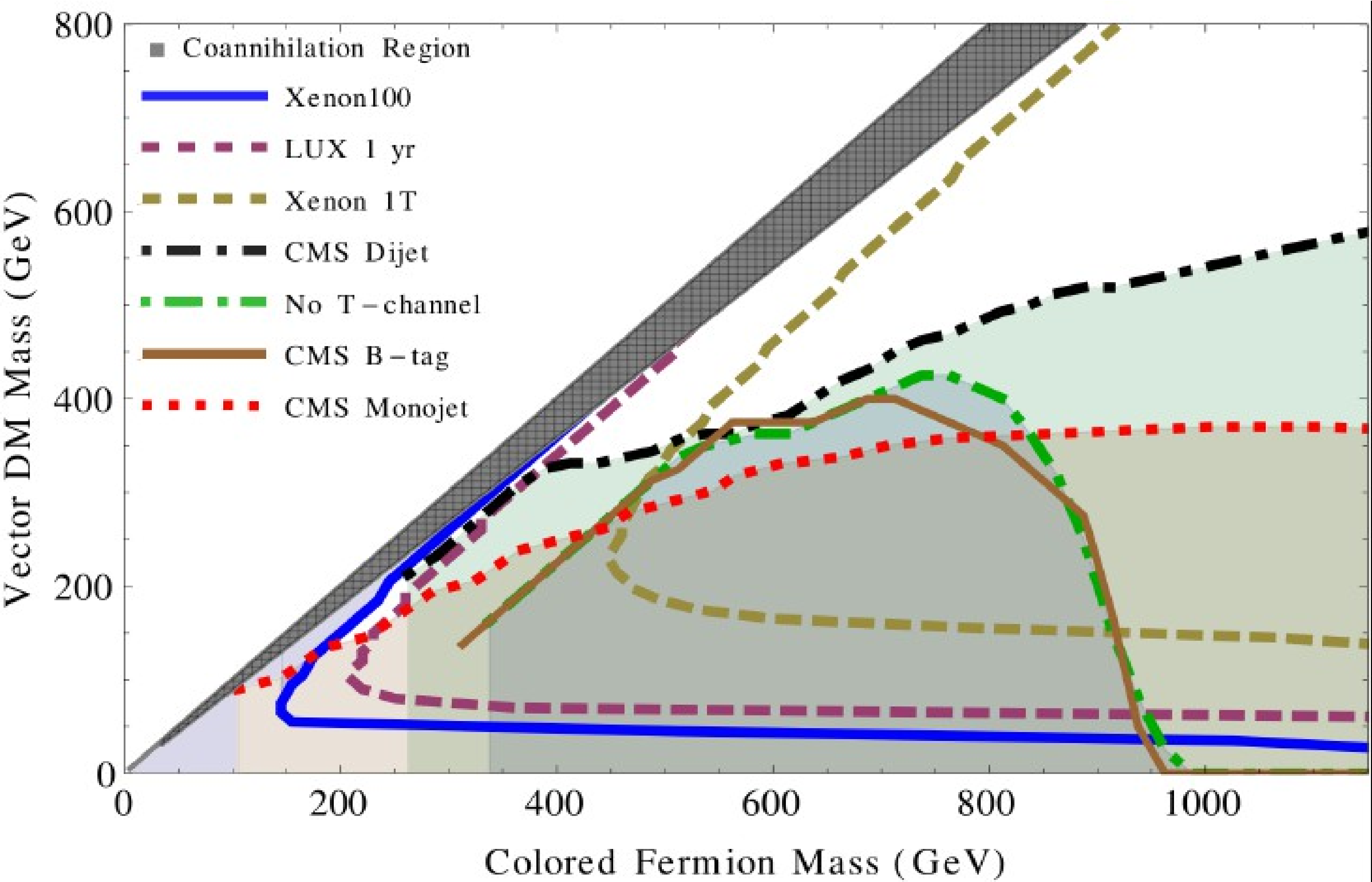
Quark Partner & Majorana Dark Matter (3rd Gen.)



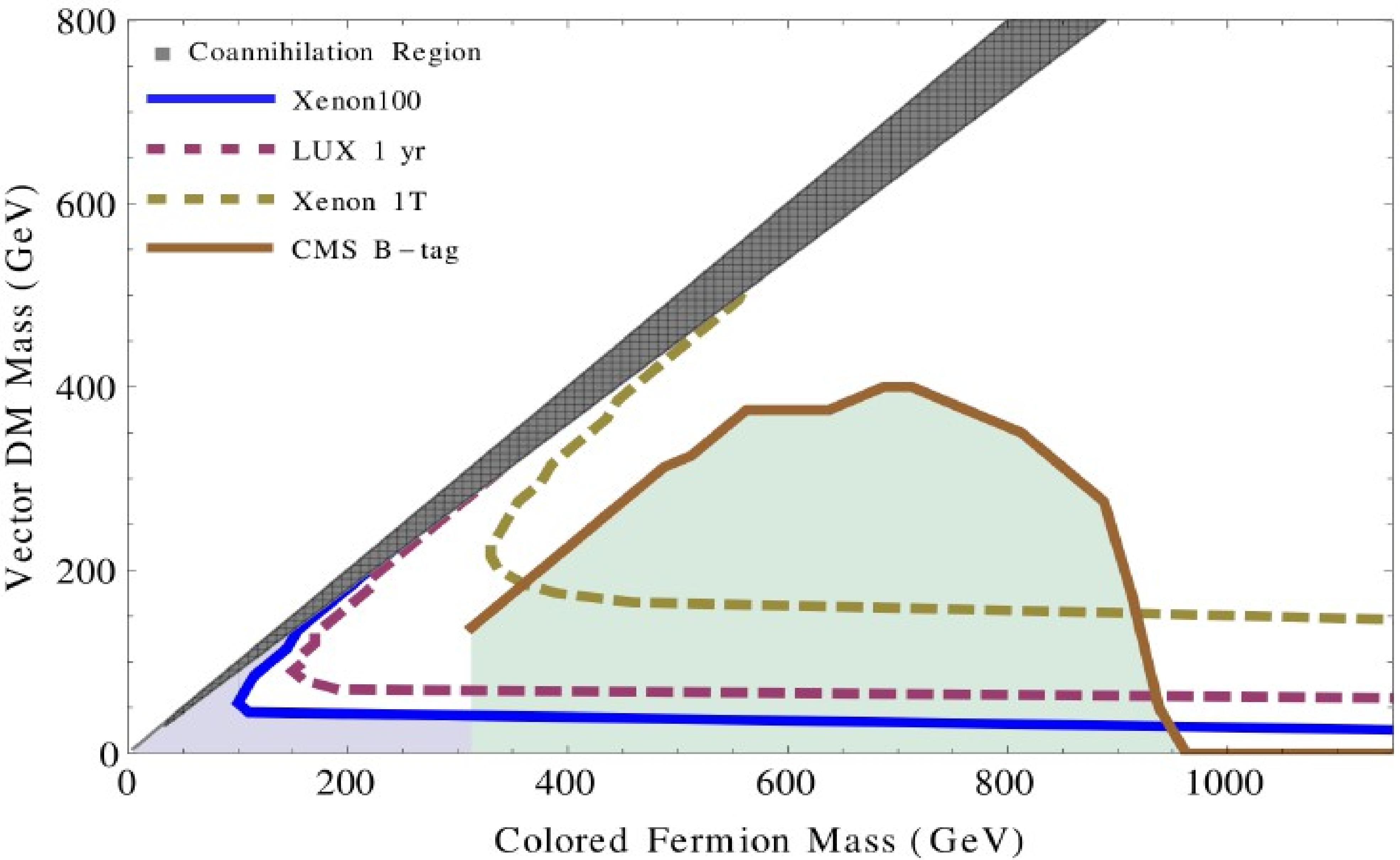
Quark Partner & Real Scalar Dark Matter (3rd Gen.)



Quark Partner & Real Vector Dark Matter (2 Gen.)

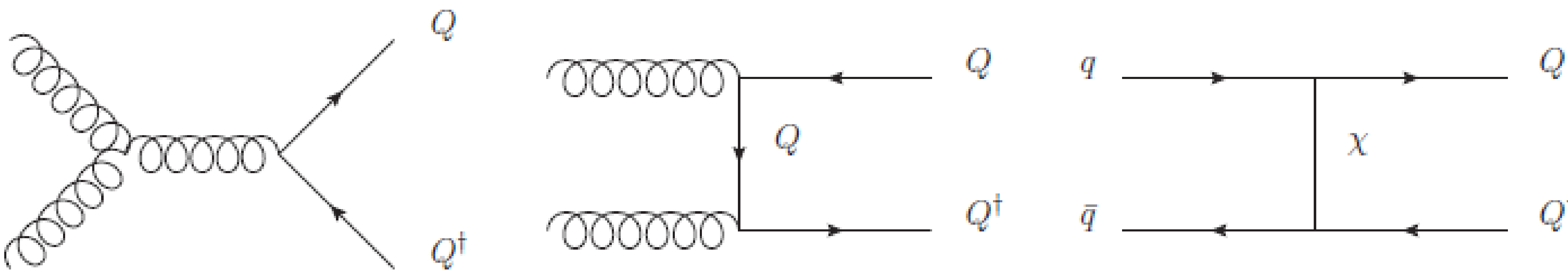


Quark Partner & Real Vector Dark Matter (3^{rd} Gen.)



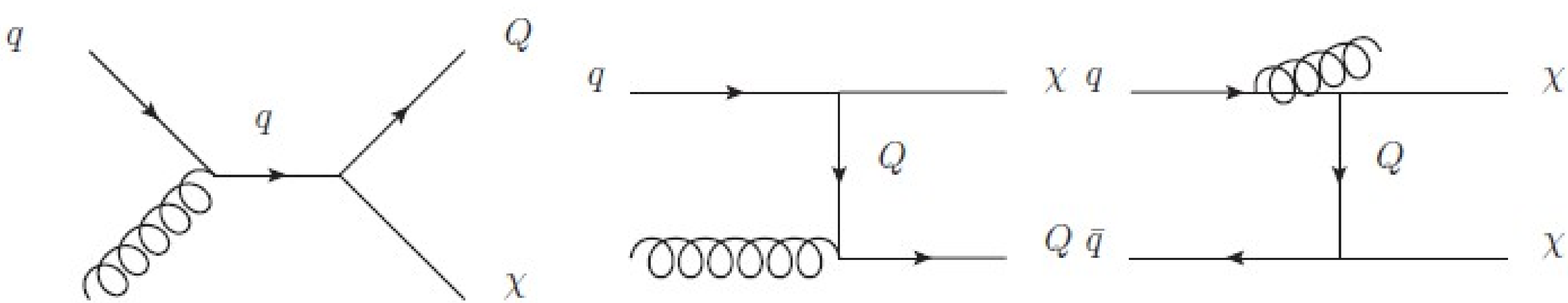
Quark Partner Collider Production

Jets+MET Production



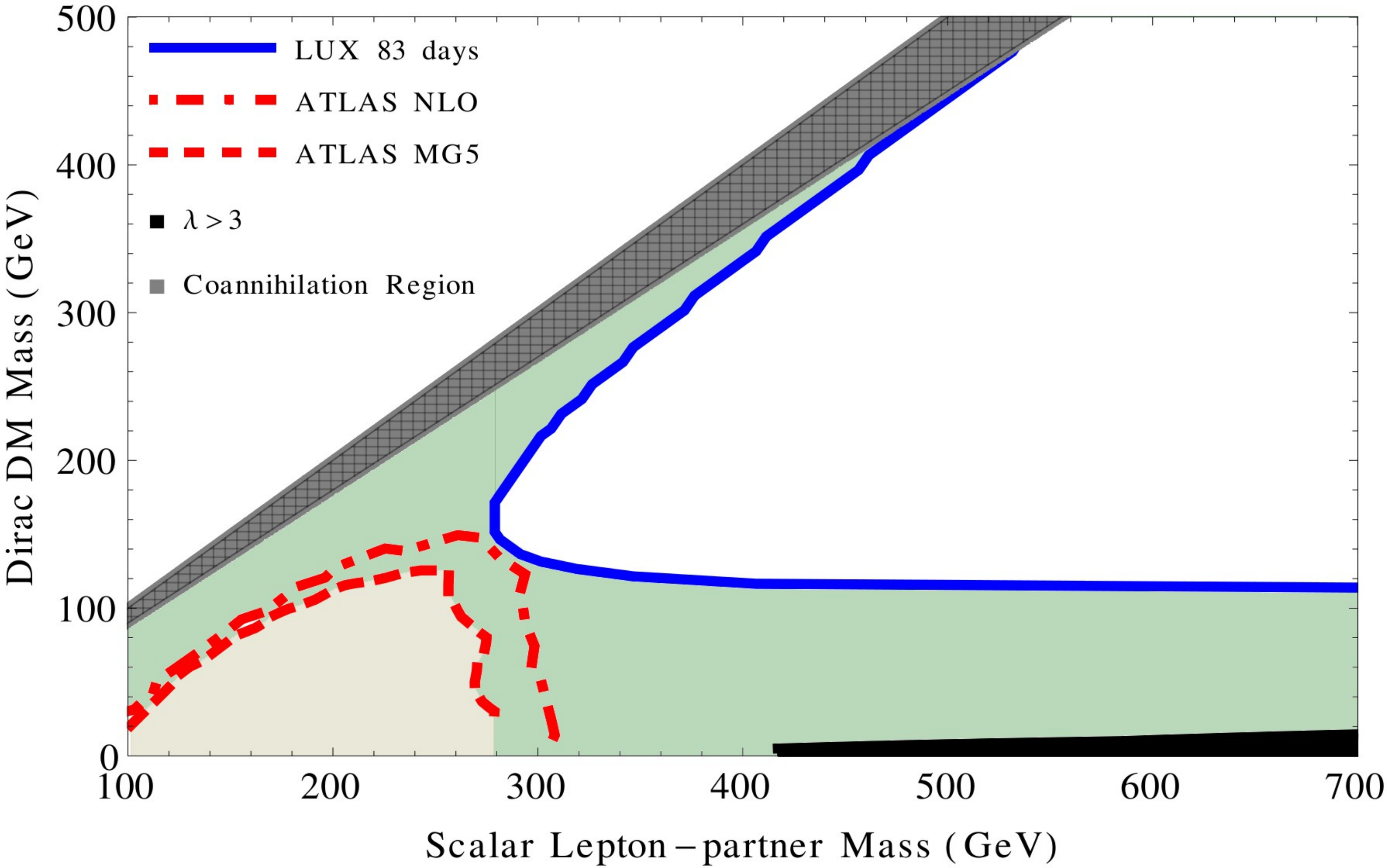
$\sim g_s^2$ $\sim g_s^2$ $\sim |\lambda|^2$

Monojet Production



$\sim g_s\lambda$ $\sim g_s\lambda$ $\sim g_s|\lambda|^2$

Lepton Partner & Dirac Dark Matter (2 Gen.)



Lepton Partner & Complex Scalar Dark Matter (2 Gen. Coupling)