Universidade Federal do ABC

SModelS Fest XI

André Lessa

December 17th, 2024

In collaboration with C. Ramos, Y. Villamizar, L. Ramos and J. Gargalionis

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)

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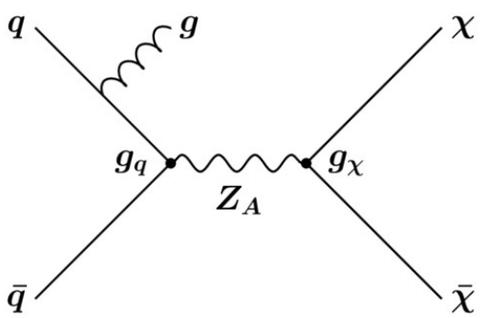
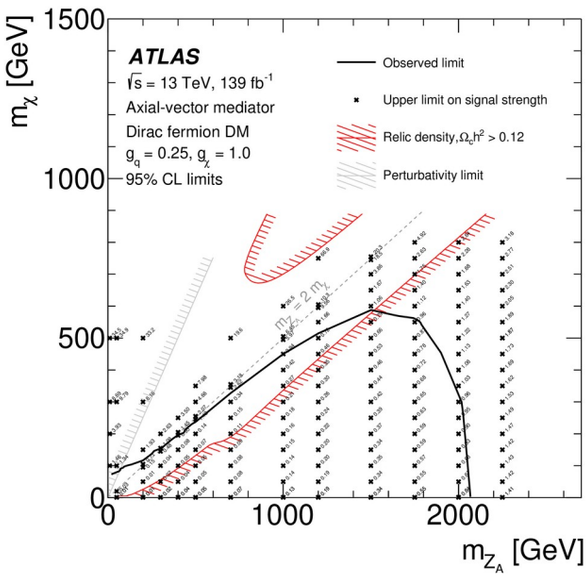
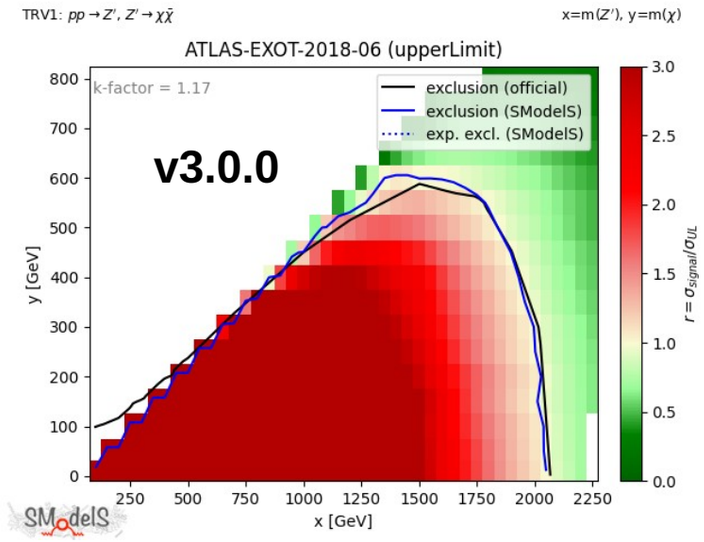
  - **ATLAS-EXOT-2018-06 (monojet):** Upper Limits





$$\mu_{\mathrm{UL}} \rightarrow \sigma_{\mathrm{UL}}$$



$$\sigma_{\mathrm{UL}} = \mu_{\mathrm{UL}} \sigma_{\mathrm{th}}(m_{Z'}) BR_{\mathrm{th}}(m_{Z'}, m_\chi)$$

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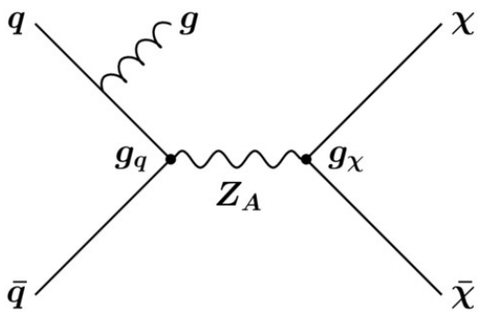

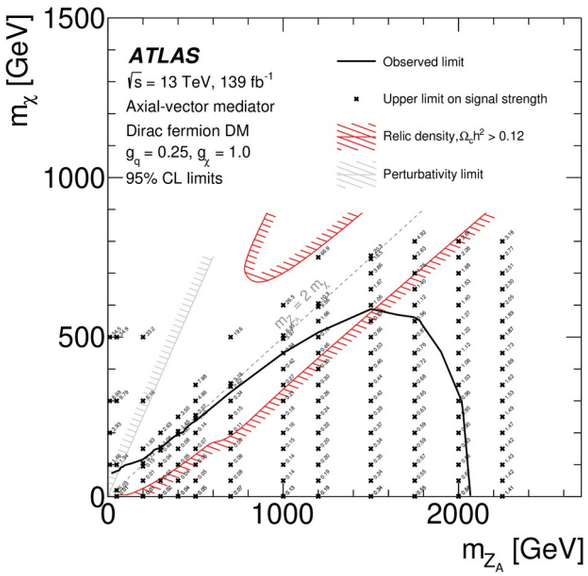

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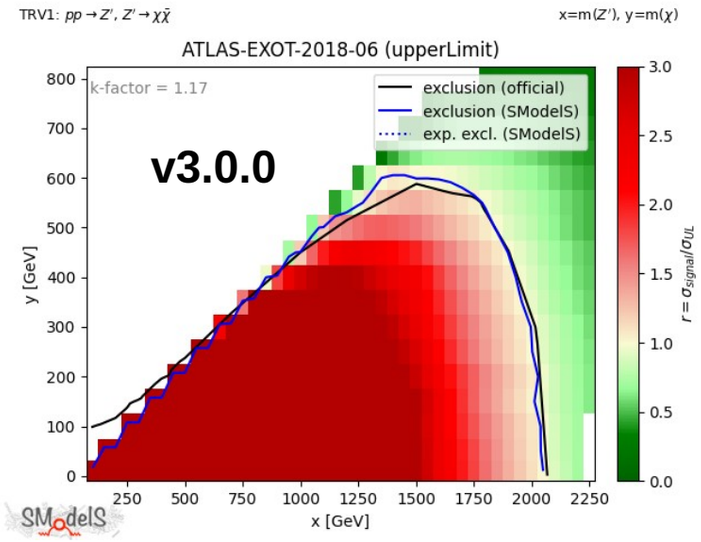

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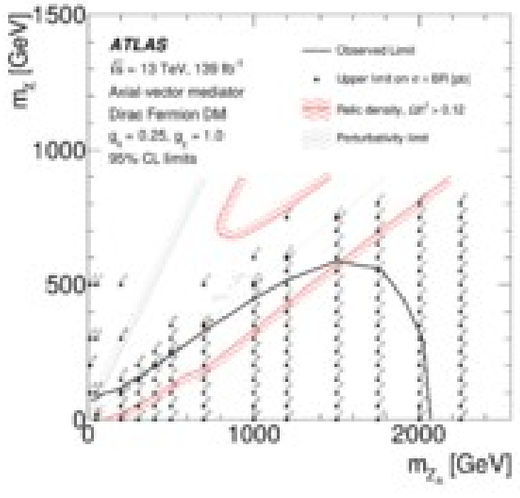
- Since then ATLAS has provided limits on cross-sections x BR(?)



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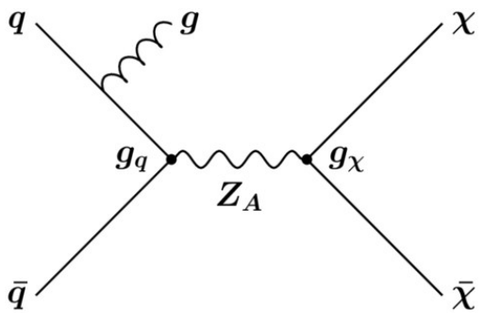
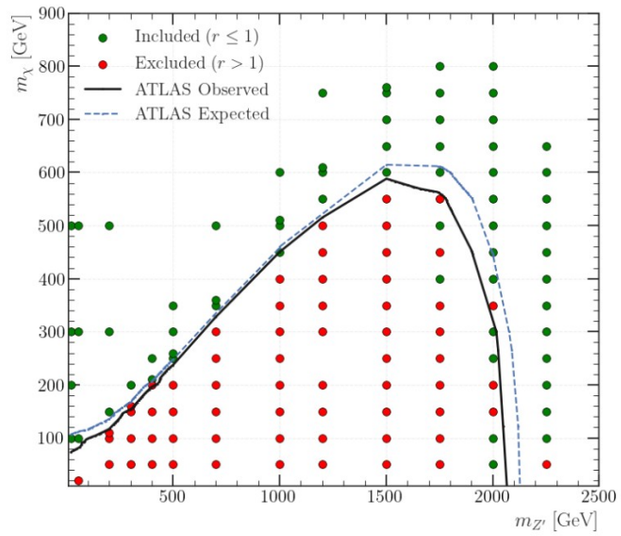
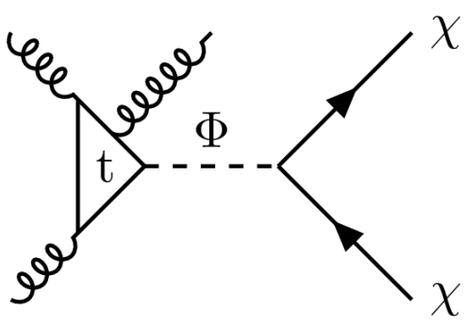
  - **ATLAS-EXOT-2018-06 (monojet):** Efficinecy Maps
    - Analysis is implemented in MadAnalysis







Under production….

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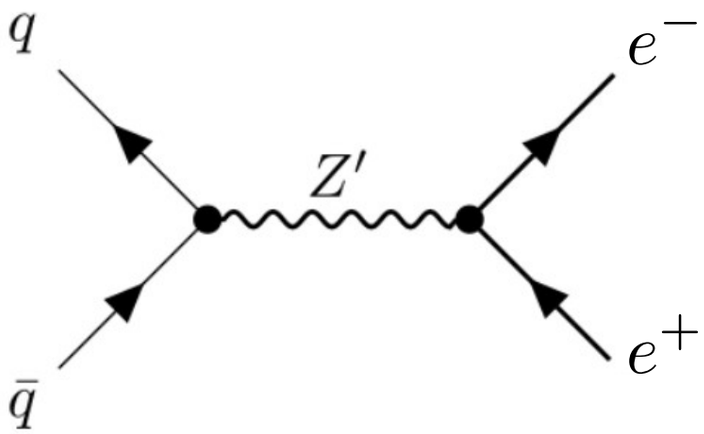

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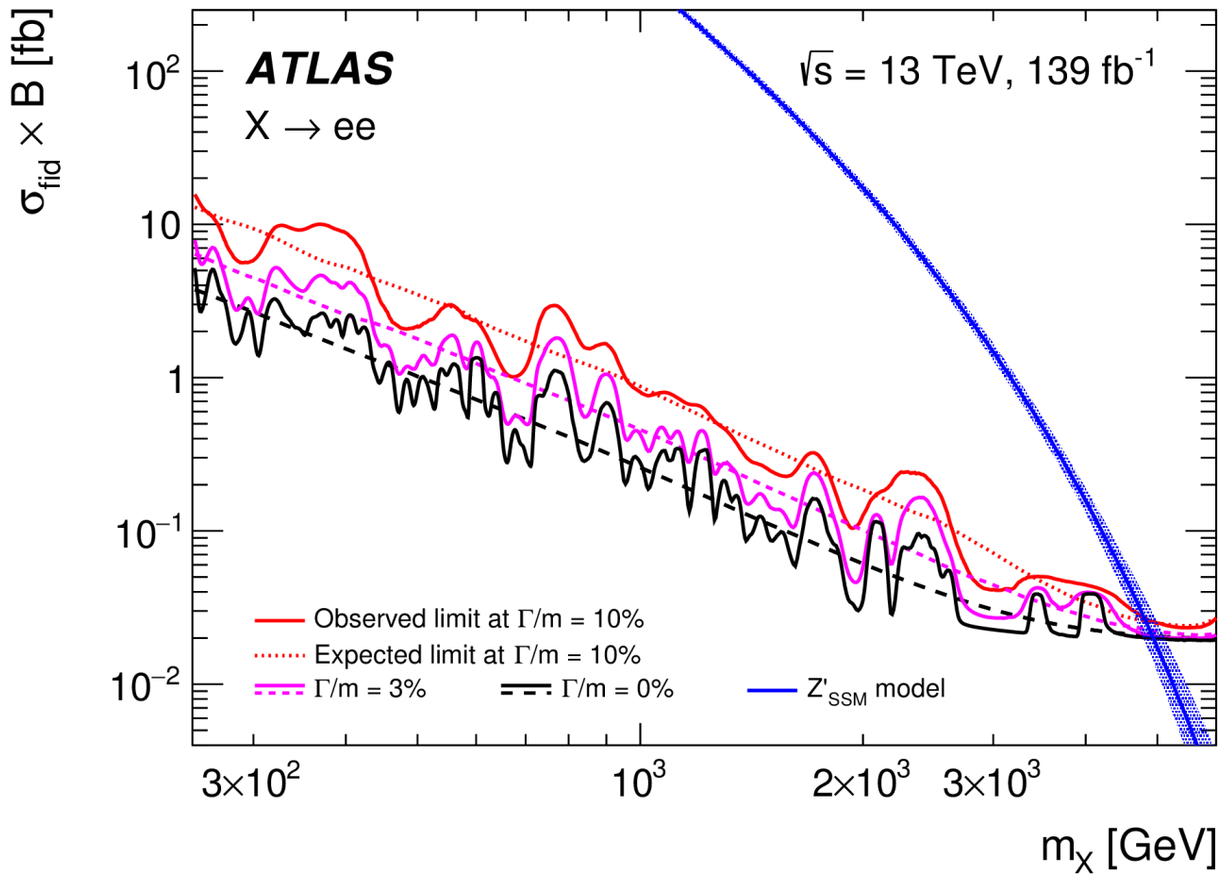

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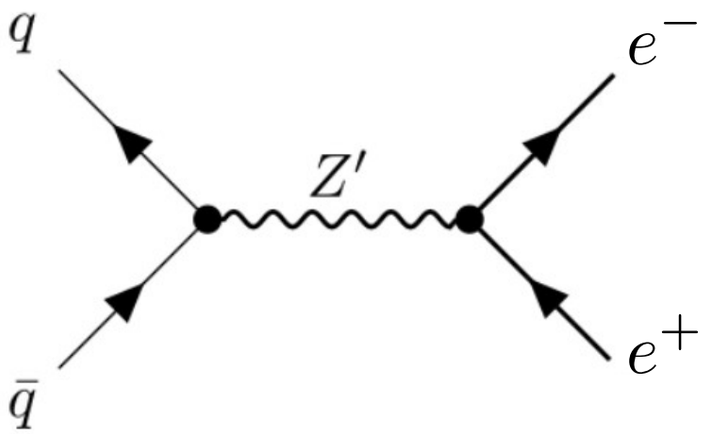

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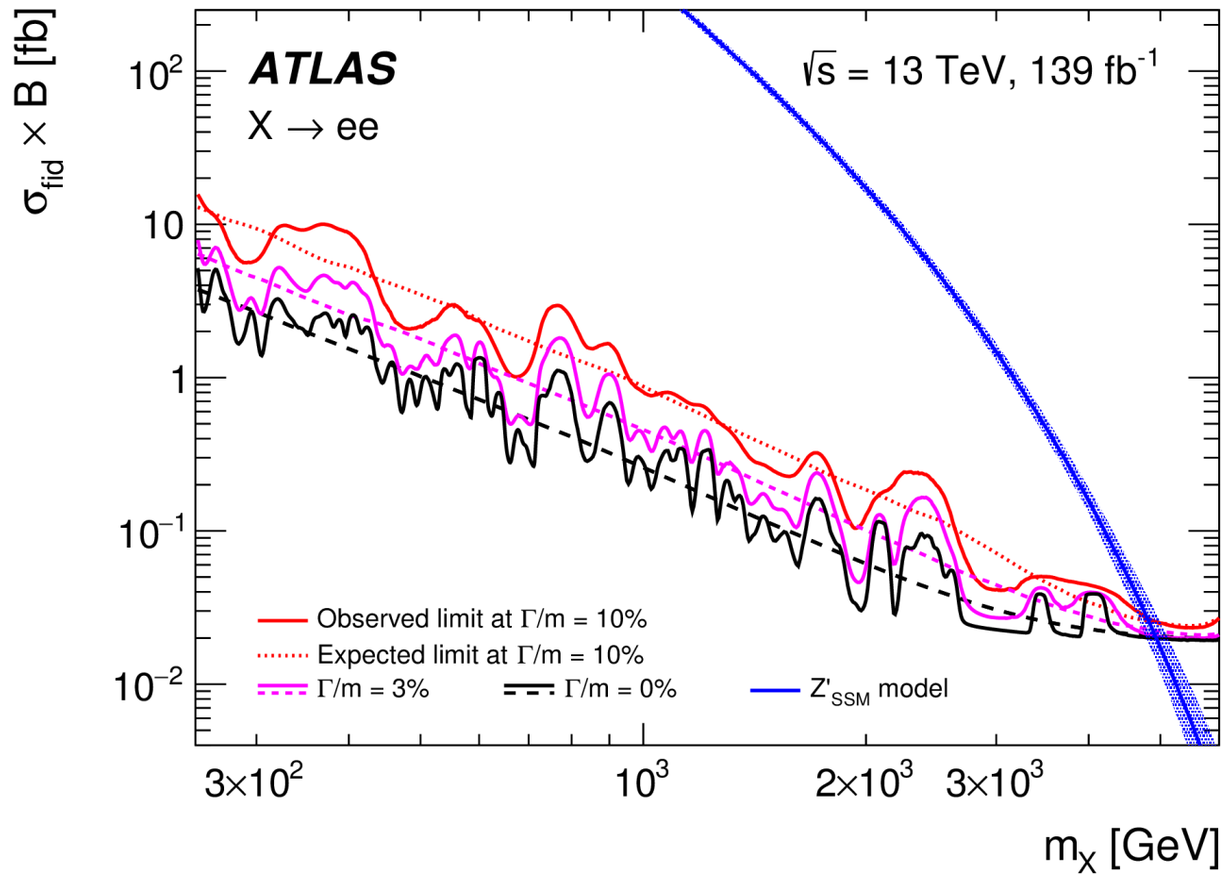

- Acceptance has to be computed for each mass point/width

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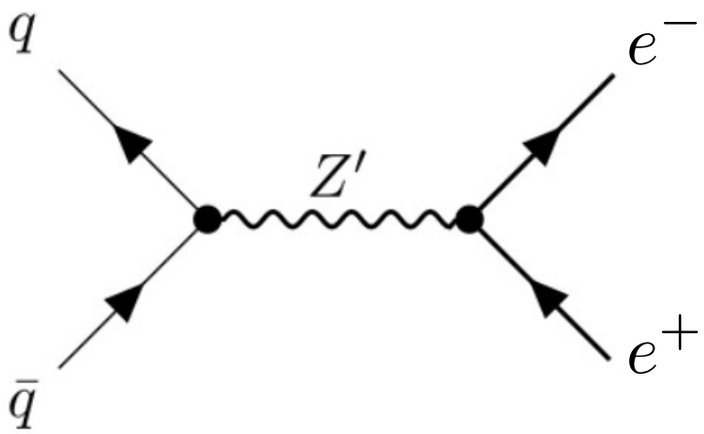

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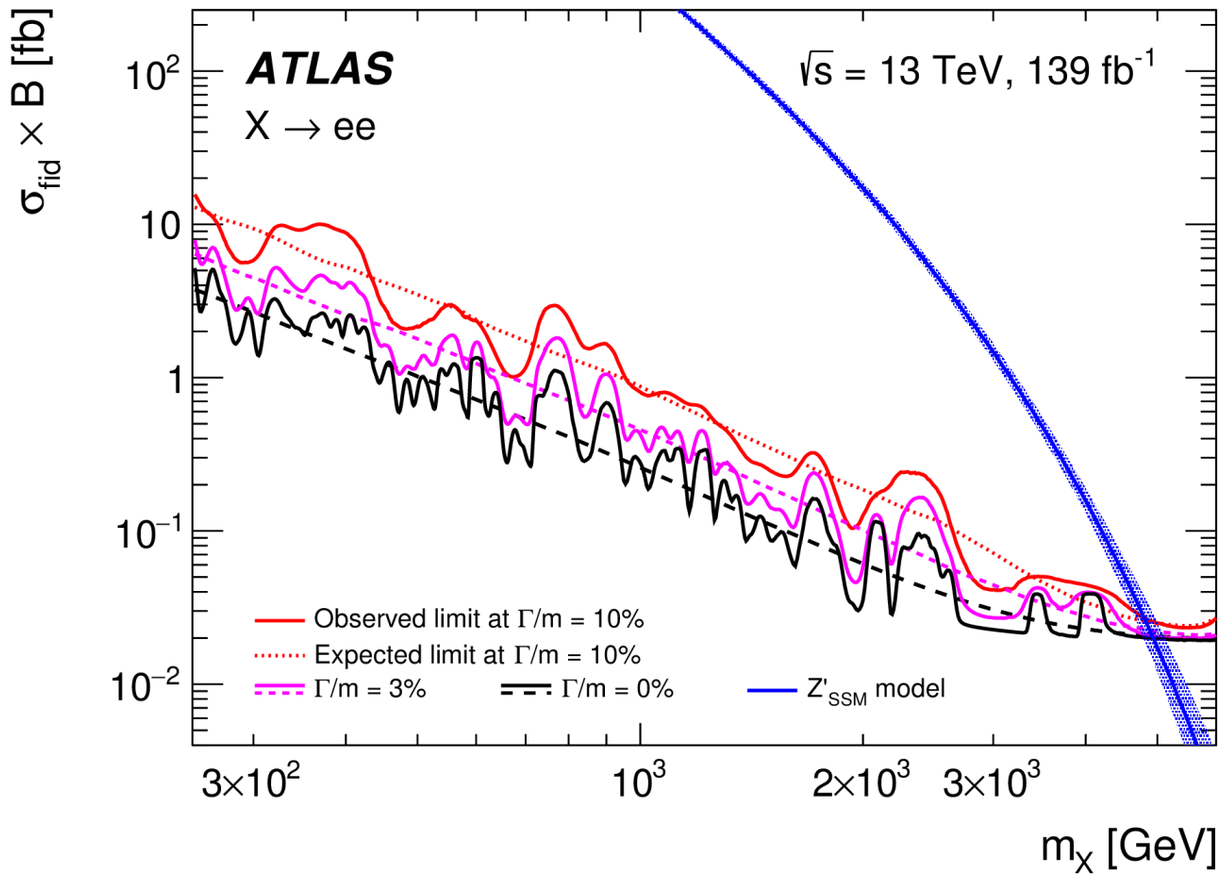

- Acceptance has to be computed for each mass point/width
- Limits for decay to muons are also available (~3x weaker)

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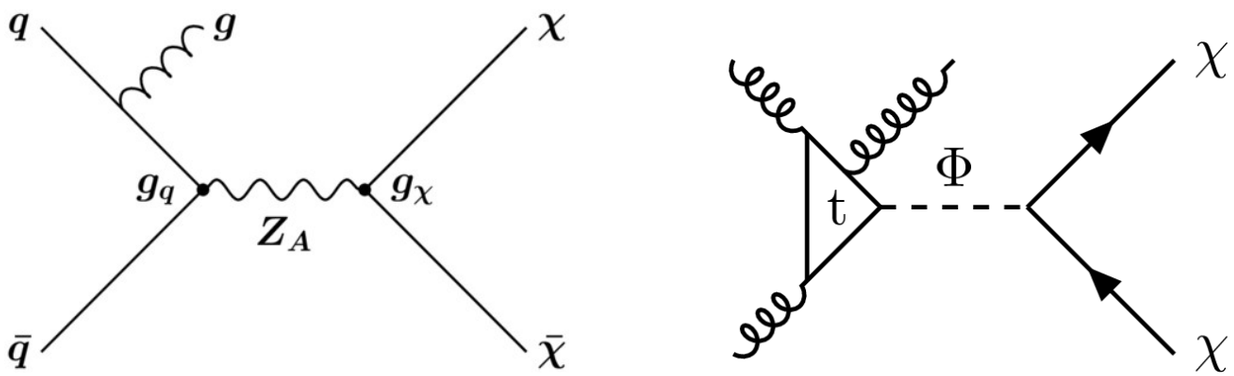

  - Mediator is on-shell
  - Spin “fixes” the production mode and initial states
  - ISR is “fixed” by these restrictions

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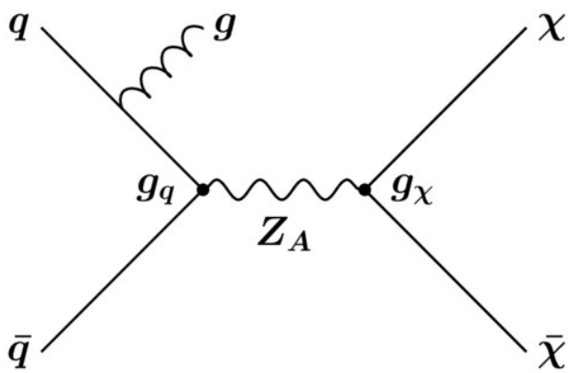

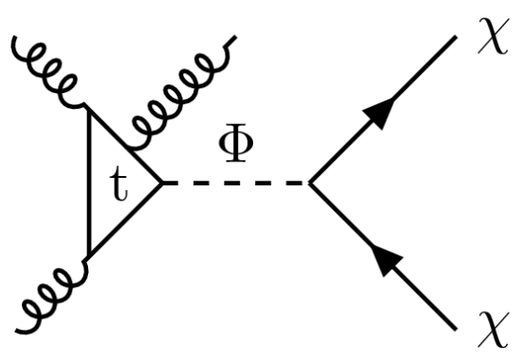

    - Mediator is on-shell
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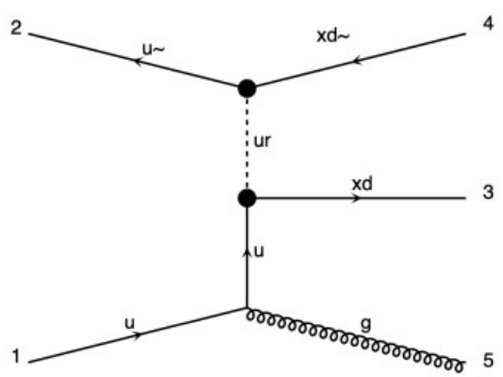
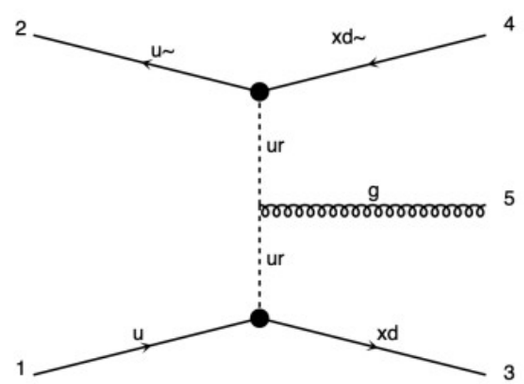
    - ISR is “fixed” by these restrictions

- What about other production channels (t-channel)?





“squark” mediator

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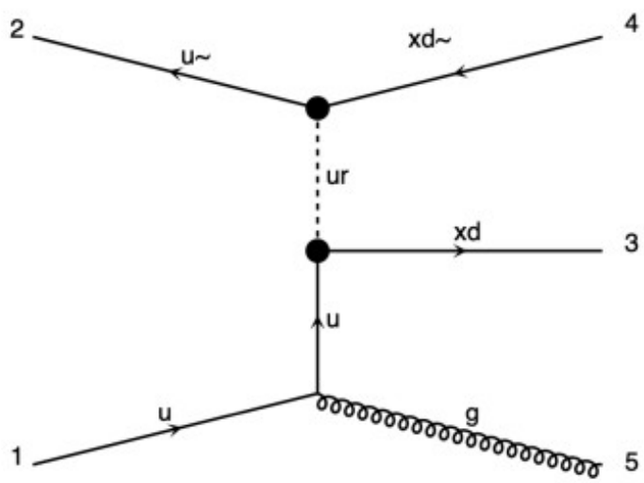

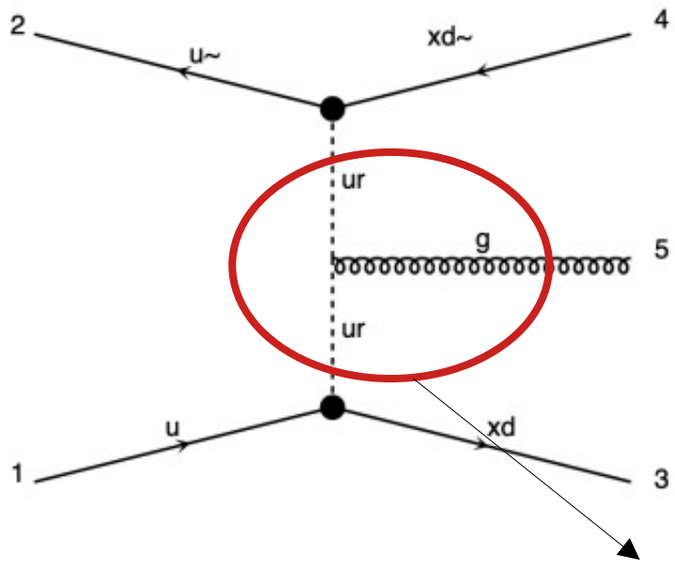

Radiation from mediator is sudominant

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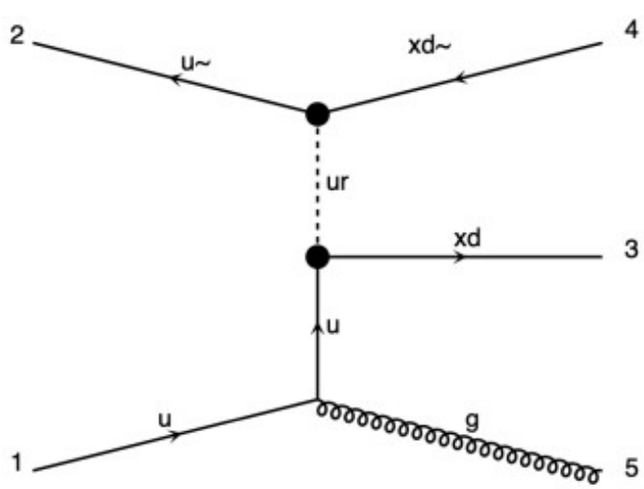

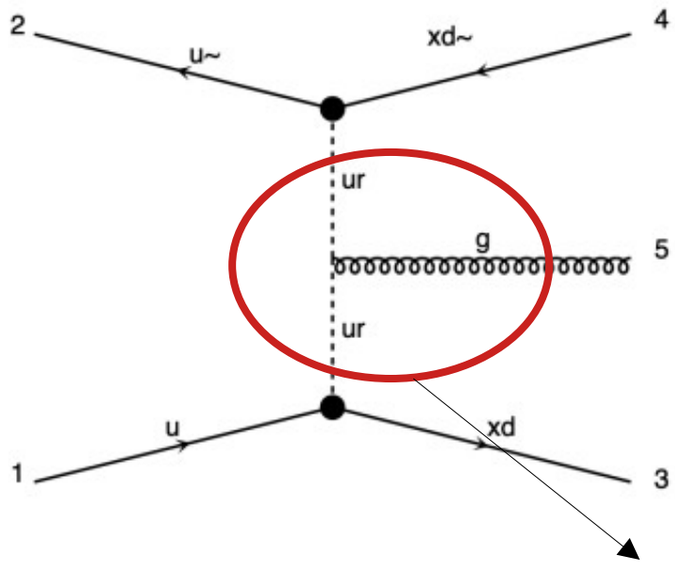

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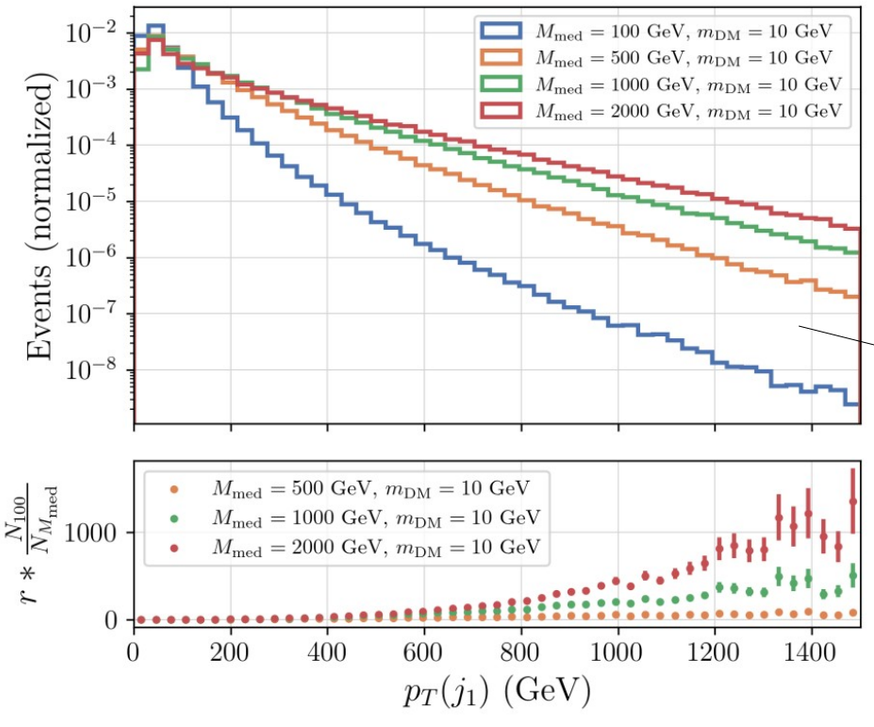

But the dependence on the mediator mass can not be ignored!

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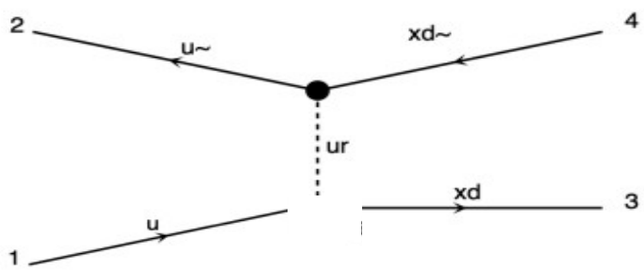

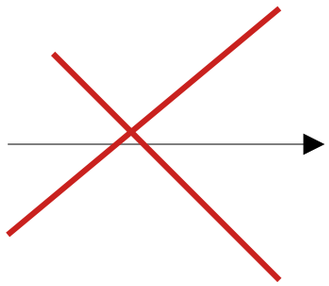

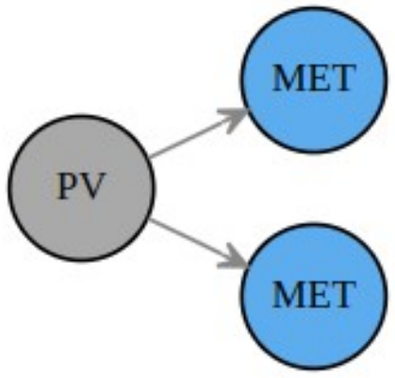

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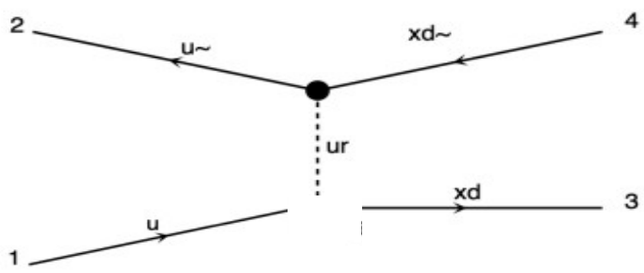

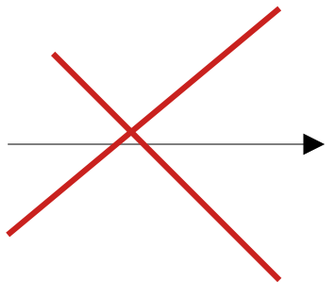

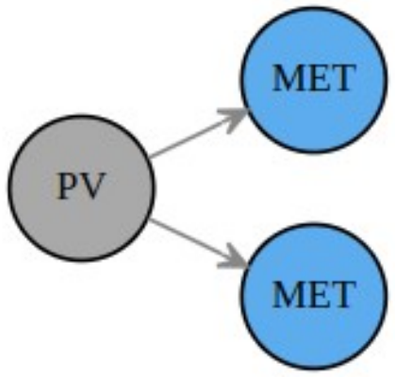

- We need to “resolve” the primary vertex → Lucas’ talk tomorrow

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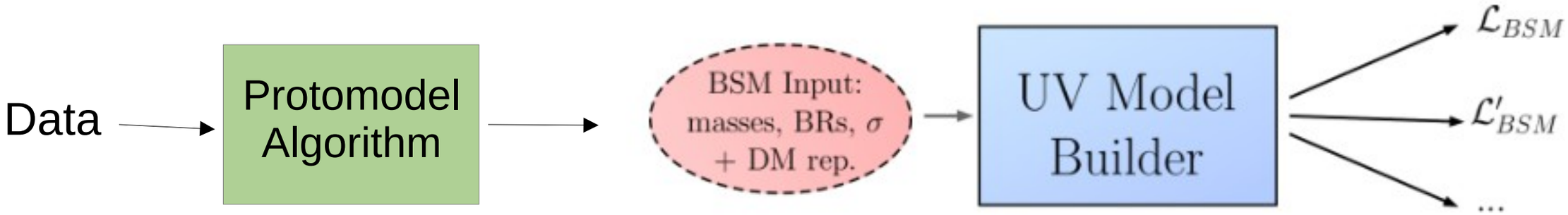
- Building minimal UV models from protomodels (with J. Gargalionis)



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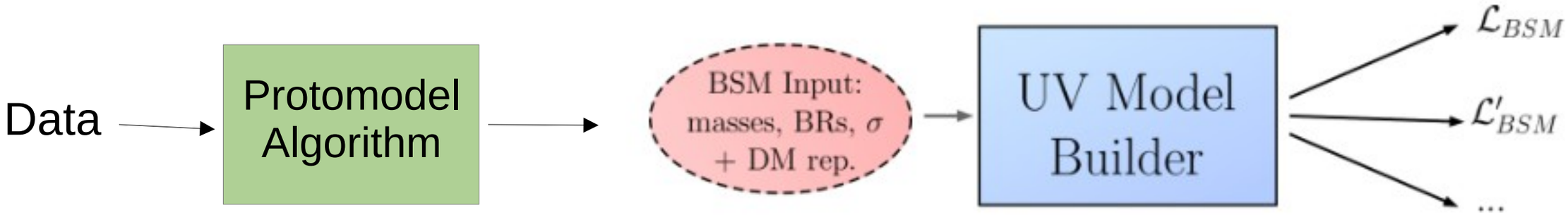

Some simplifying assumptions:

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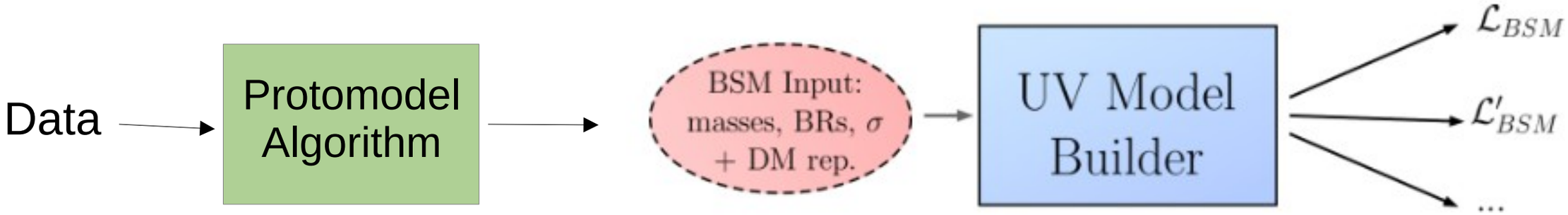

Some simplifying assumptions:

1) Only BSM scalars and fermions (no new gauge bosons)

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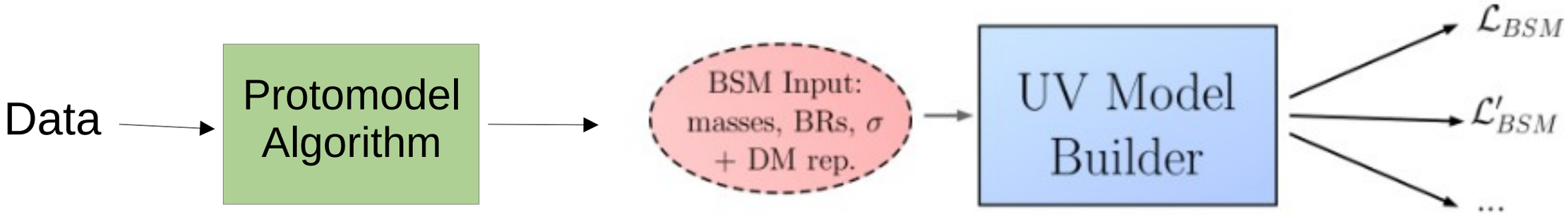

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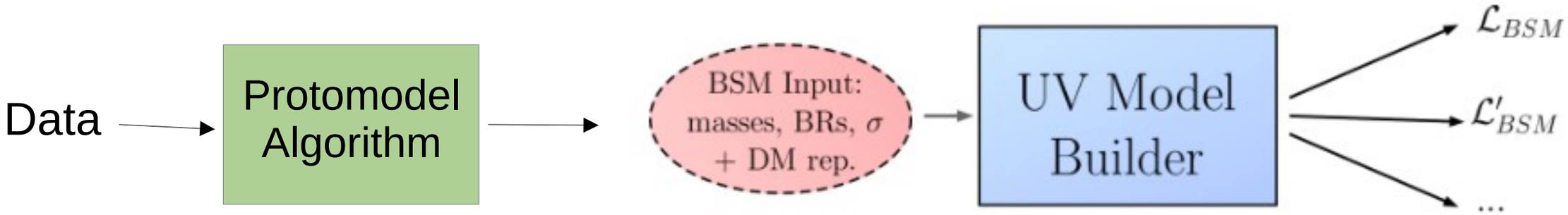

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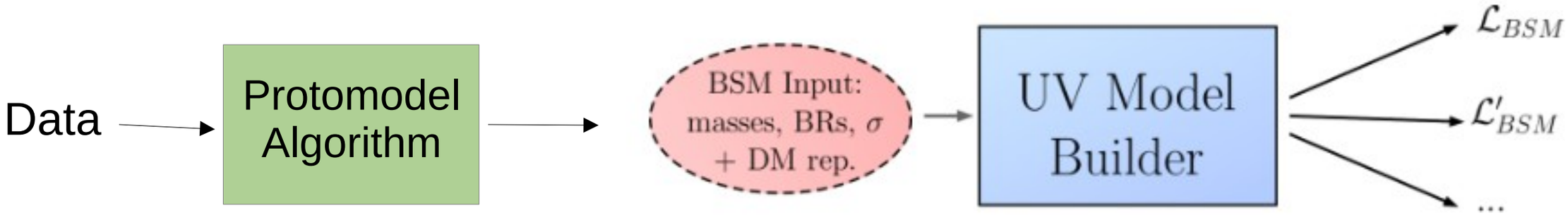

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$$\mathcal{L}_{mass} = ... + M_a^2|\phi_a|^2 + M_b^2|\phi_b|^2 + \lambda\langle h\rangle\phi_a\phi_b,$$

$$\lambda \neq 0 \rightarrow \text{ mixing after EWSB} \Rightarrow \lambda v \ll M_a$$

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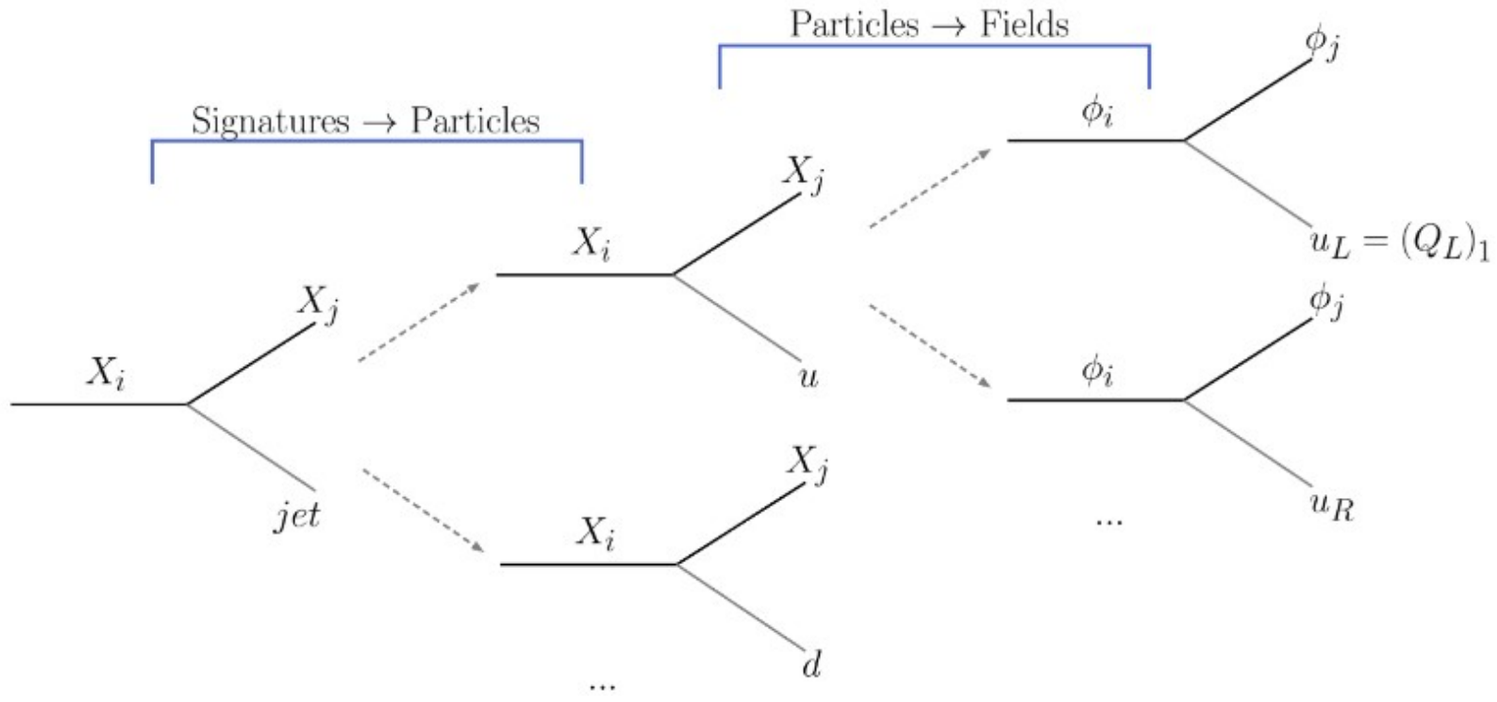

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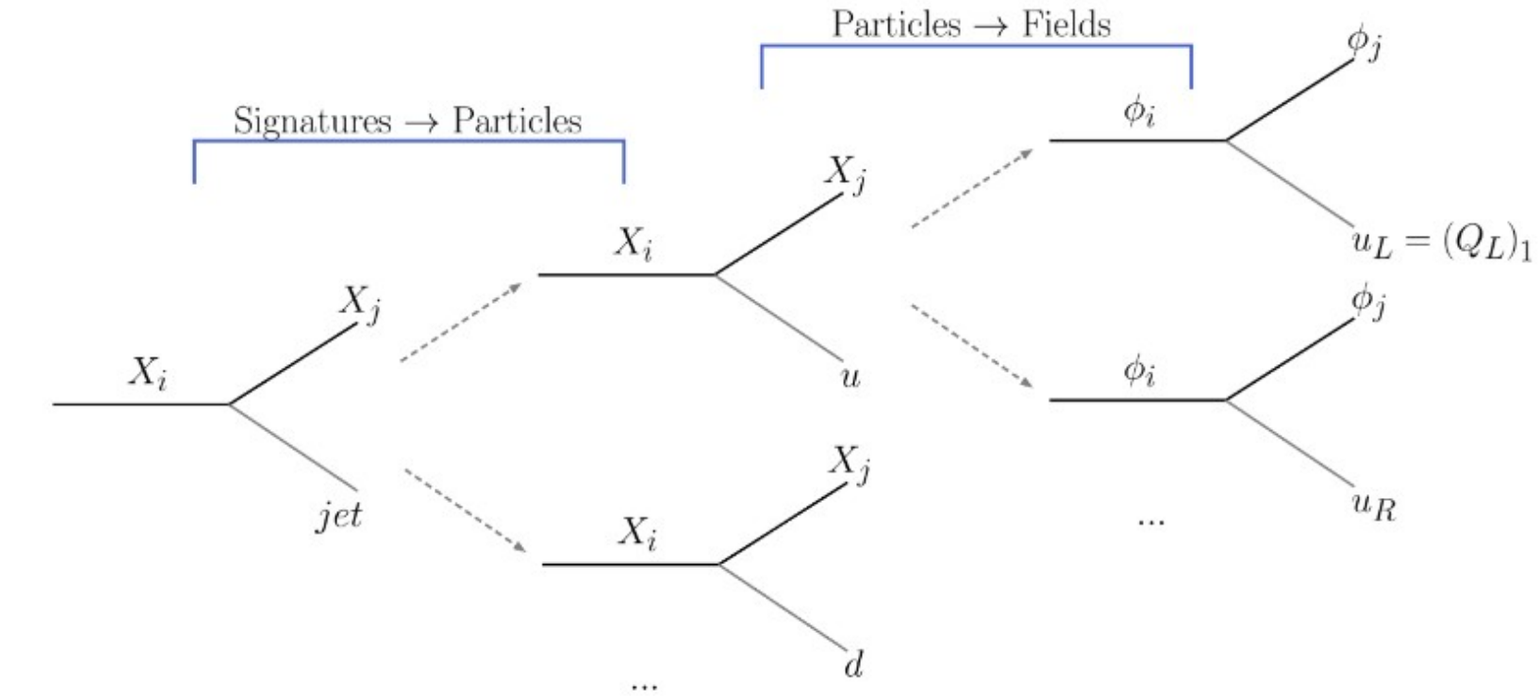

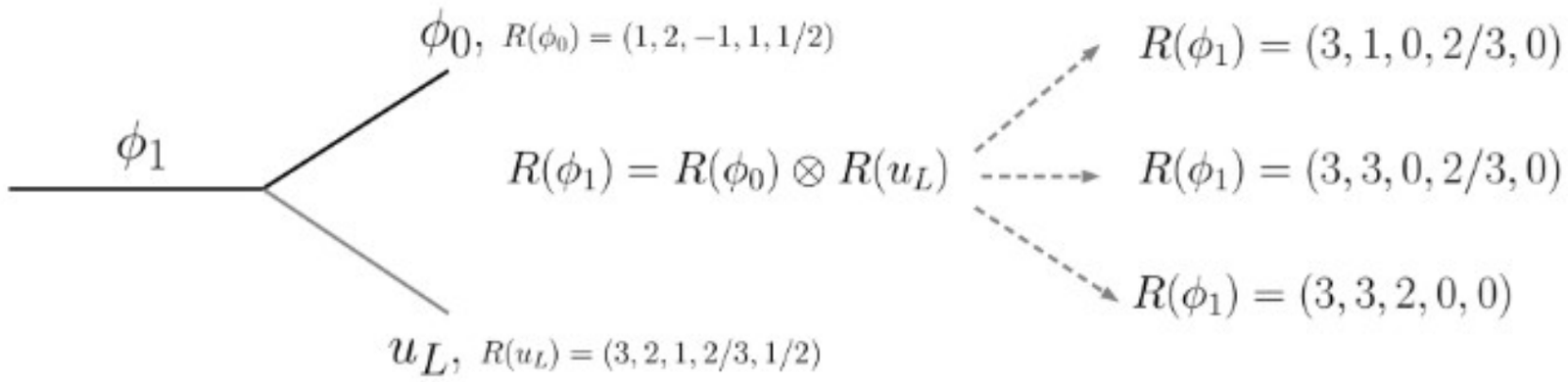

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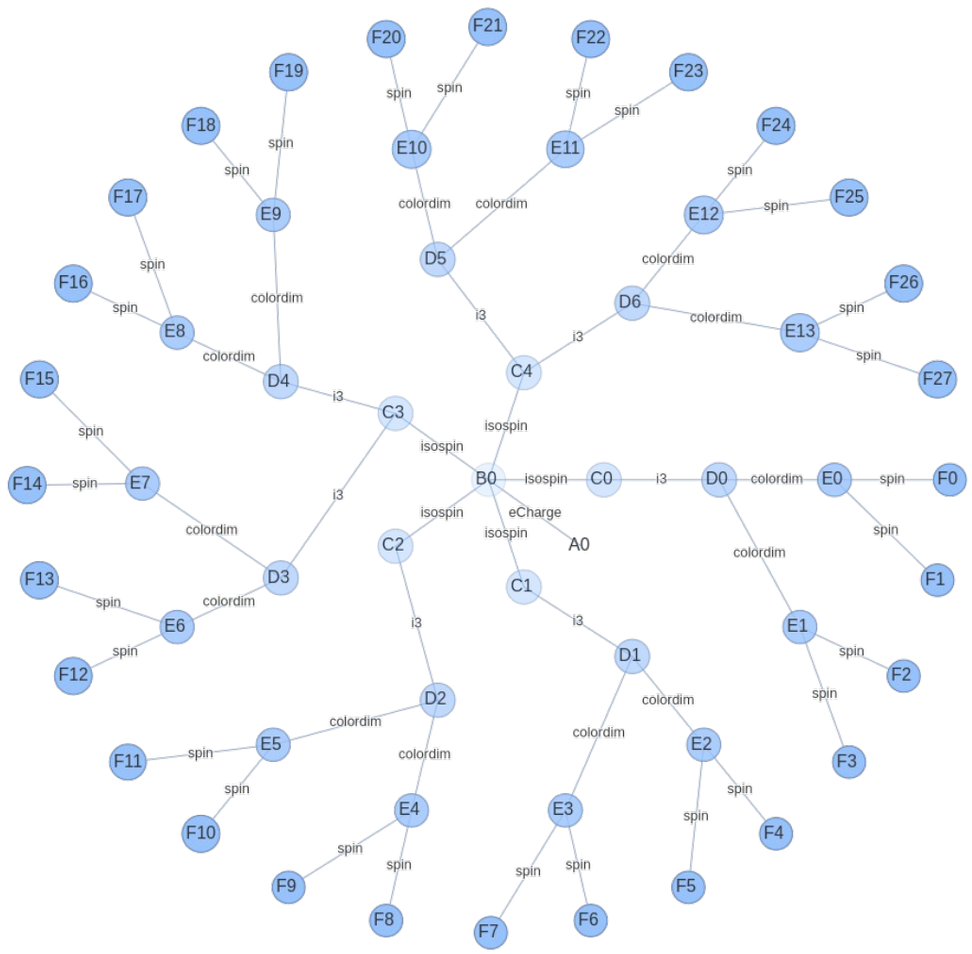

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  - From fields to $SU(2)_L$ multiplets:

$$\Phi = \begin{pmatrix} \phi_1 \\ \phi_2 \\ \dots \end{pmatrix} \Rightarrow m_{\phi_i} - m_{\phi_j} < \Delta M, \forall i, j$$

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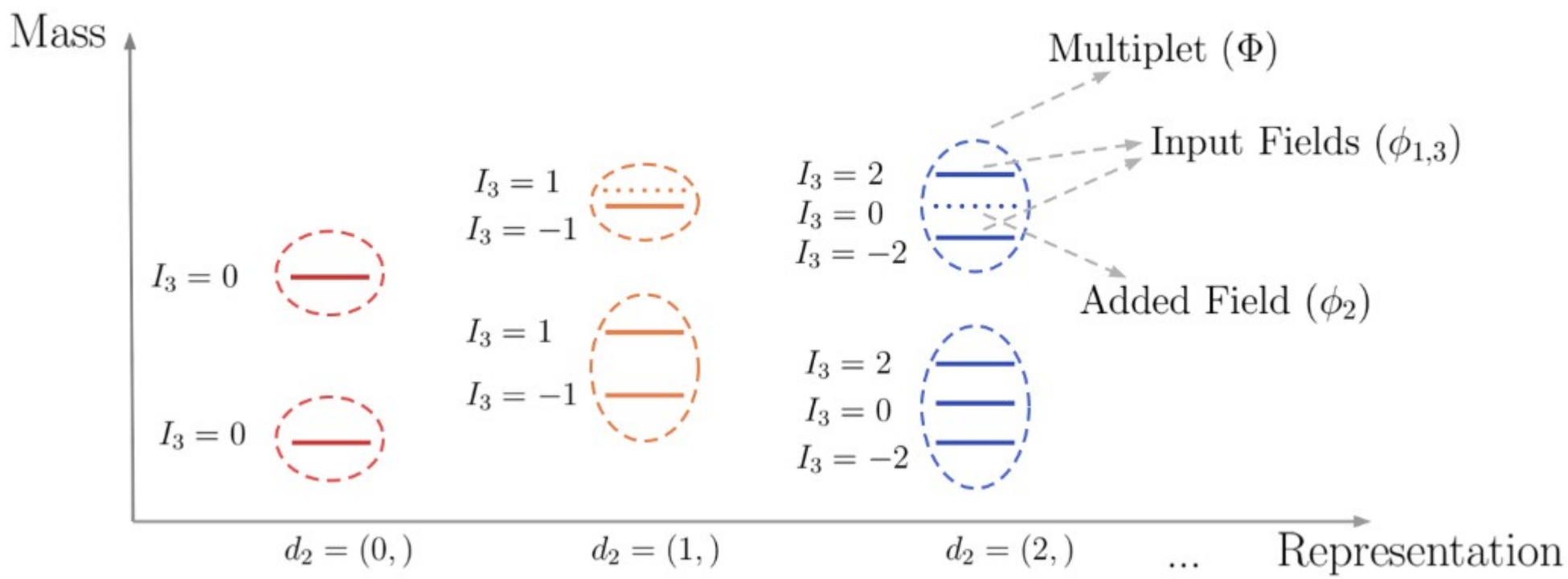

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$$\mathcal{L} = \lambda_{ijk}\Phi_i\Phi_j\Phi_k^{\mathrm{SM}} + \lambda_{ijkl}\Phi_i\Phi_j\Phi_k^{\mathrm{SM}}\Phi_l^{\mathrm{SM}}$$

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1) Construct all singlet operators
2) Determine number of independent couplings
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→ We are here!

- From the BSM lagrangian to the input protomodel model:

1) Fit input parameters to BRs
2) Fit input parameters to cross-sections
3) Check consistencies
4) Add higher-dimensional operators for production cross-sections?

Backup

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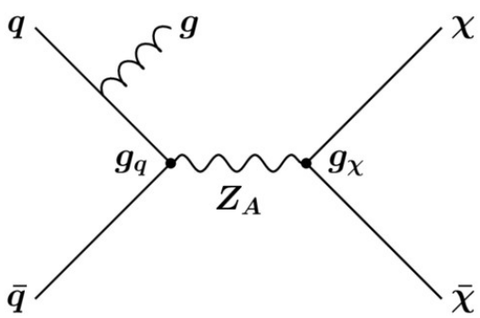
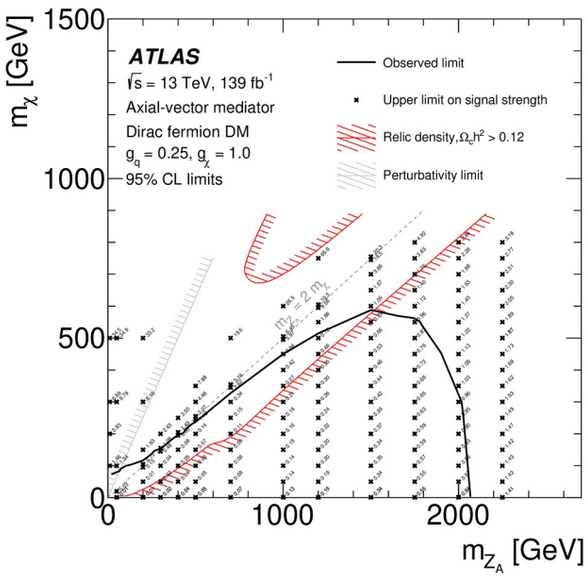
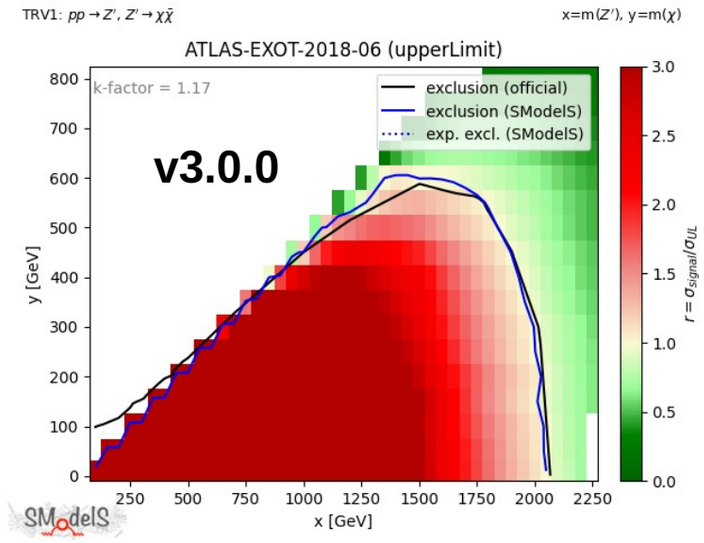
  - **ATLAS-EXOT-2018-06 (monojet):** Upper Limits





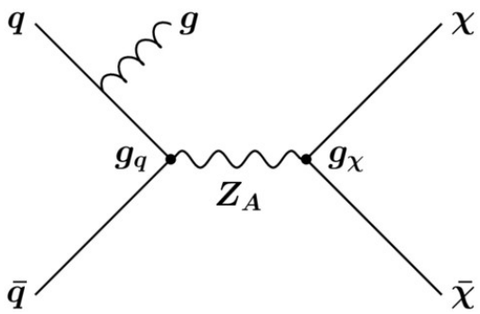
$$\mu_{\mathrm{UL}} \rightarrow \sigma_{\mathrm{UL}}$$

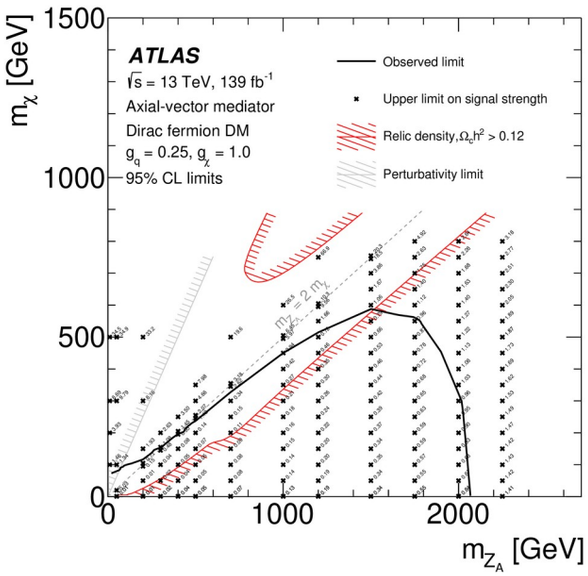


$$\sigma_{\mathrm{UL}} = \mu_{\mathrm{UL}} \sigma_{\mathrm{th}}(m_{Z'}) BR_{\mathrm{th}}(m_{Z'}, m_\chi)$$

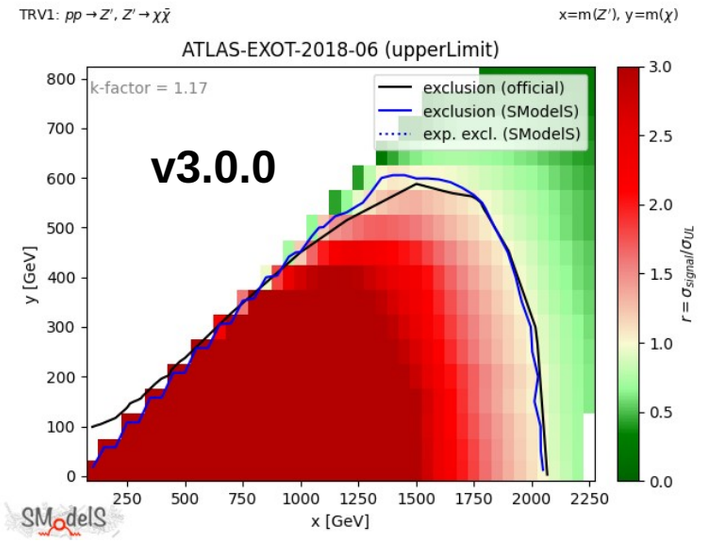
Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-06 (monojet):** Upper Limits



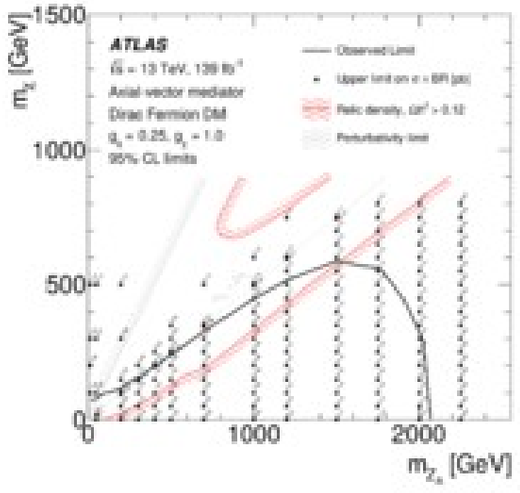


$$\mu_{\mathrm{UL}} \rightarrow \sigma_{\mathrm{UL}}$$



$$\sigma_{\mathrm{UL}} = \mu_{\mathrm{UL}} \sigma_{\mathrm{th}}(m_{Z'}) BR_{\mathrm{th}}(m_{Z'}, m_\chi)$$

- Since then ATLAS has provided limits on cross-sections x BR(?)

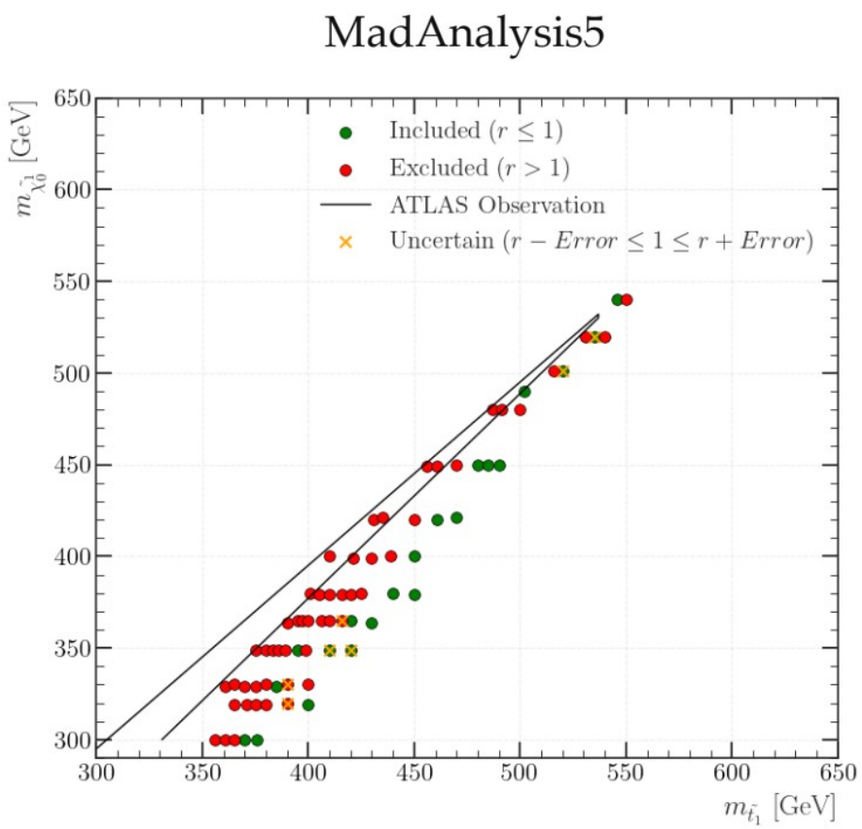


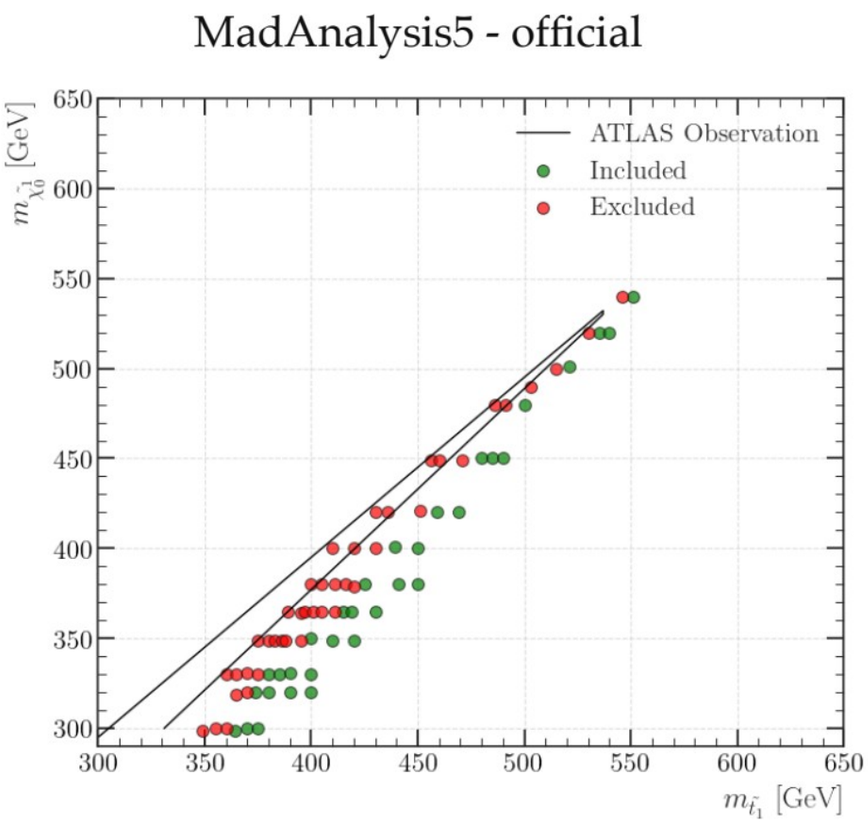
Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-06 (monojet):** Efficinecy Maps

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-06 (monojet):** Efficinecy Maps
    - Analysis is implemented in MadAnalysis





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  - **ATLAS-EXOT-2018-06 (monojet):** Efficinecy Maps
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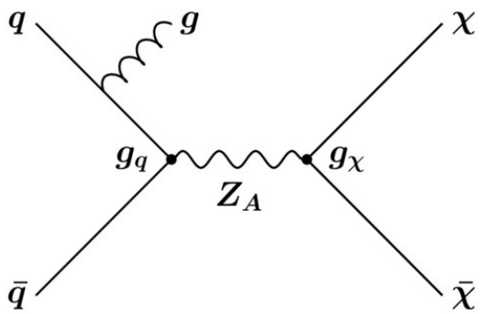
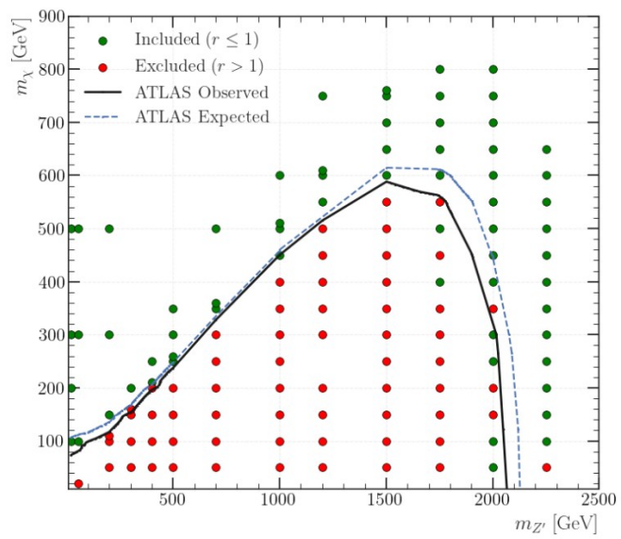
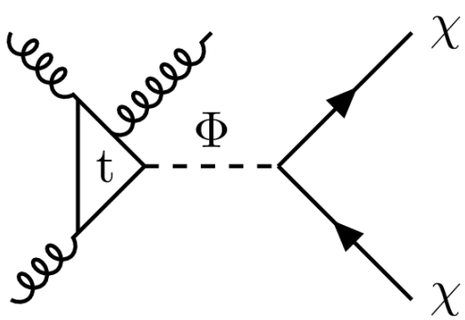


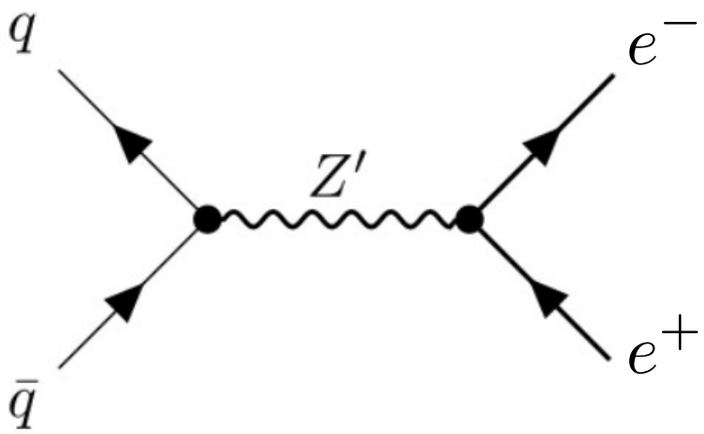




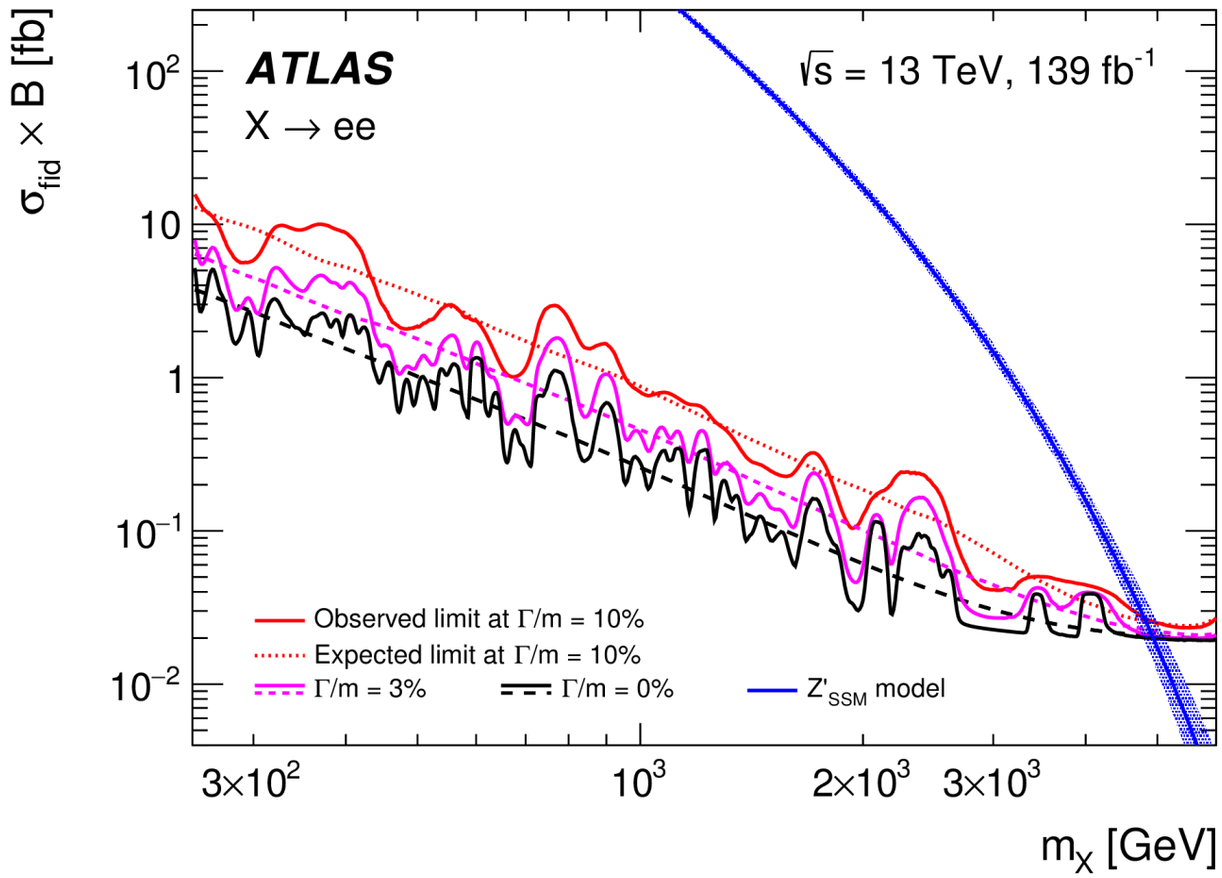
Under production….

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit



$$\sigma_{\mathrm{UL}} = \frac{1}{\mathcal{A}} \sigma_{\mathrm{UL}}^{\mathrm{fid}} \times BR$$



Status – Sao Paulo

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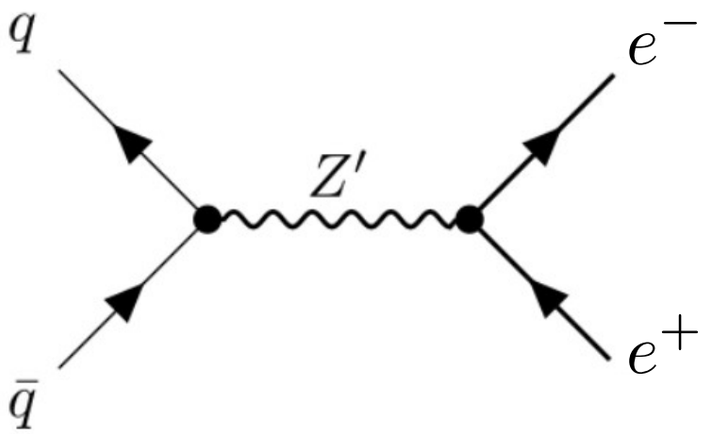
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit



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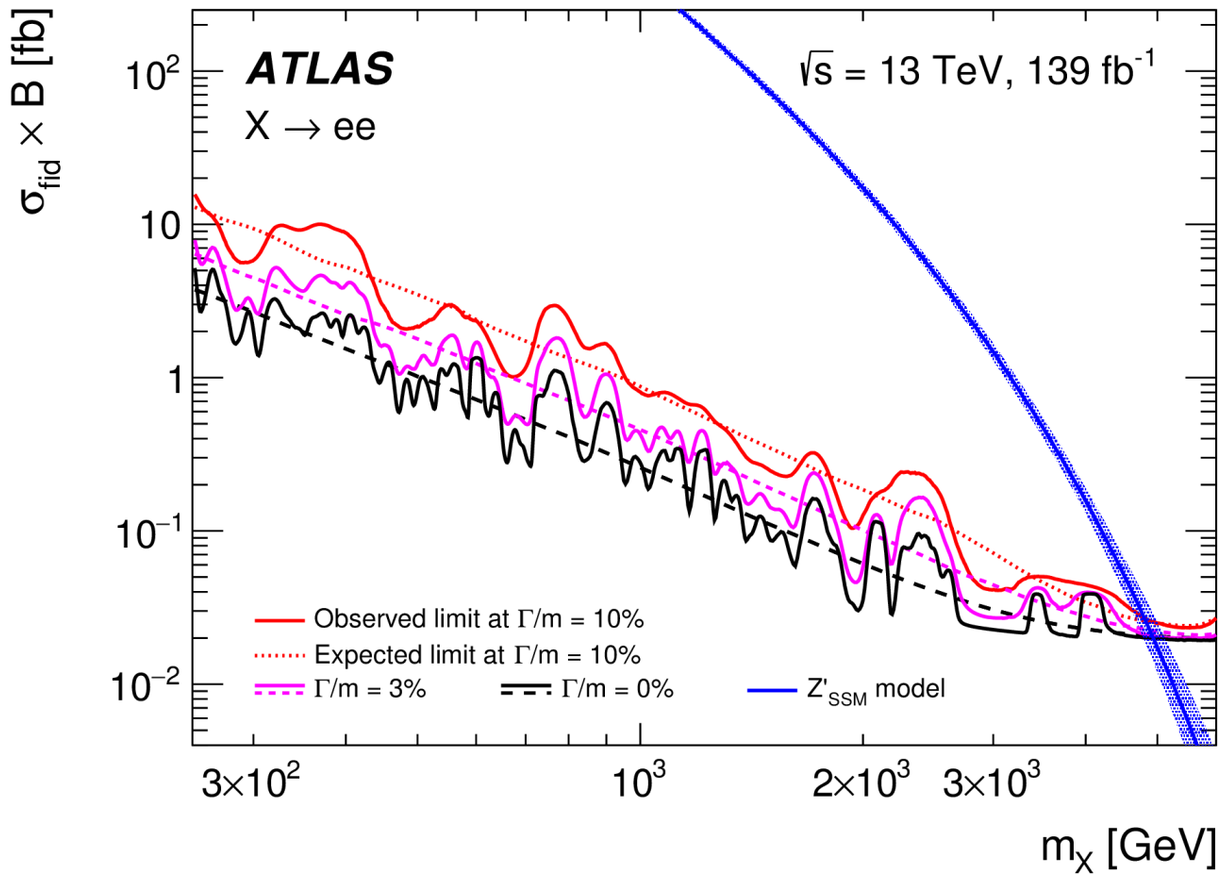
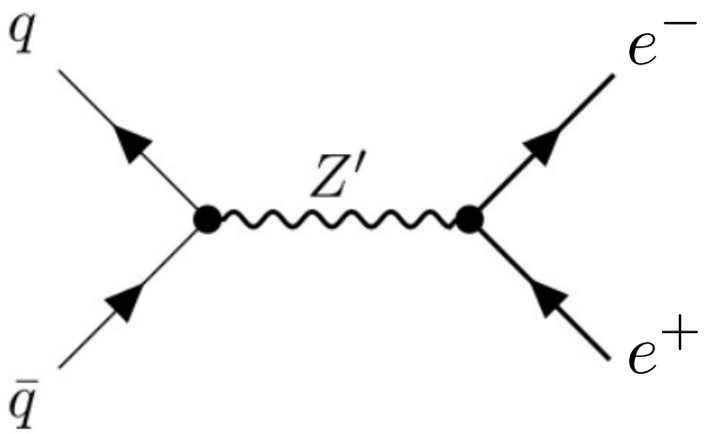


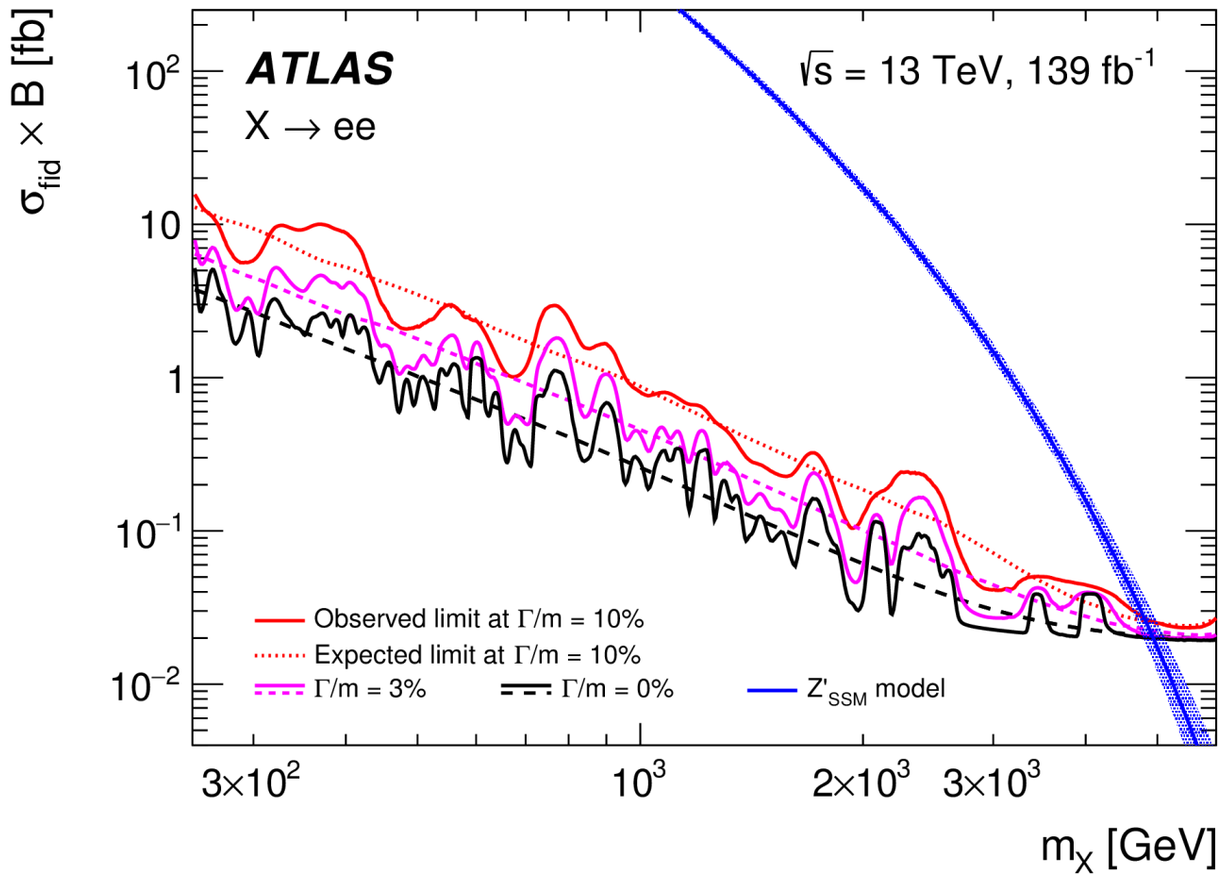
- Acceptance has to be computed for each mass point/width

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit



$$\sigma_{\mathrm{UL}} = \frac{1}{\mathcal{A}} \sigma_{\mathrm{UL}}^{\mathrm{fid}} \times BR$$



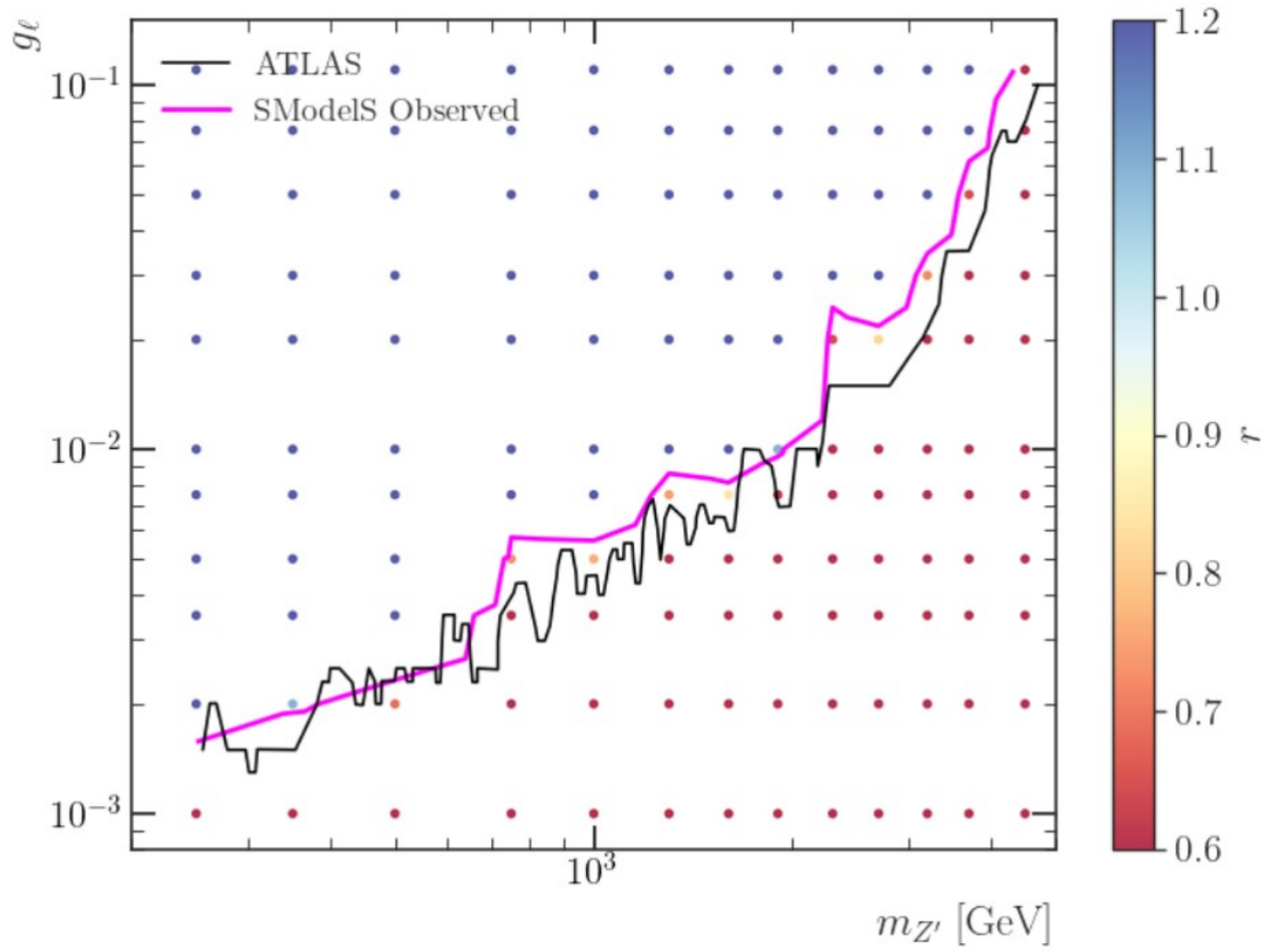
- Acceptance has to be computed for each mass point/width
- Limits for decay to muons are also available (~3x weaker)

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit

Validation: ATLAS-EXOT-2018-62

Assumes specific (simplified) model:
- g_l sets the BR to leptons
- $m_{Z'}$ sets the production cross-section

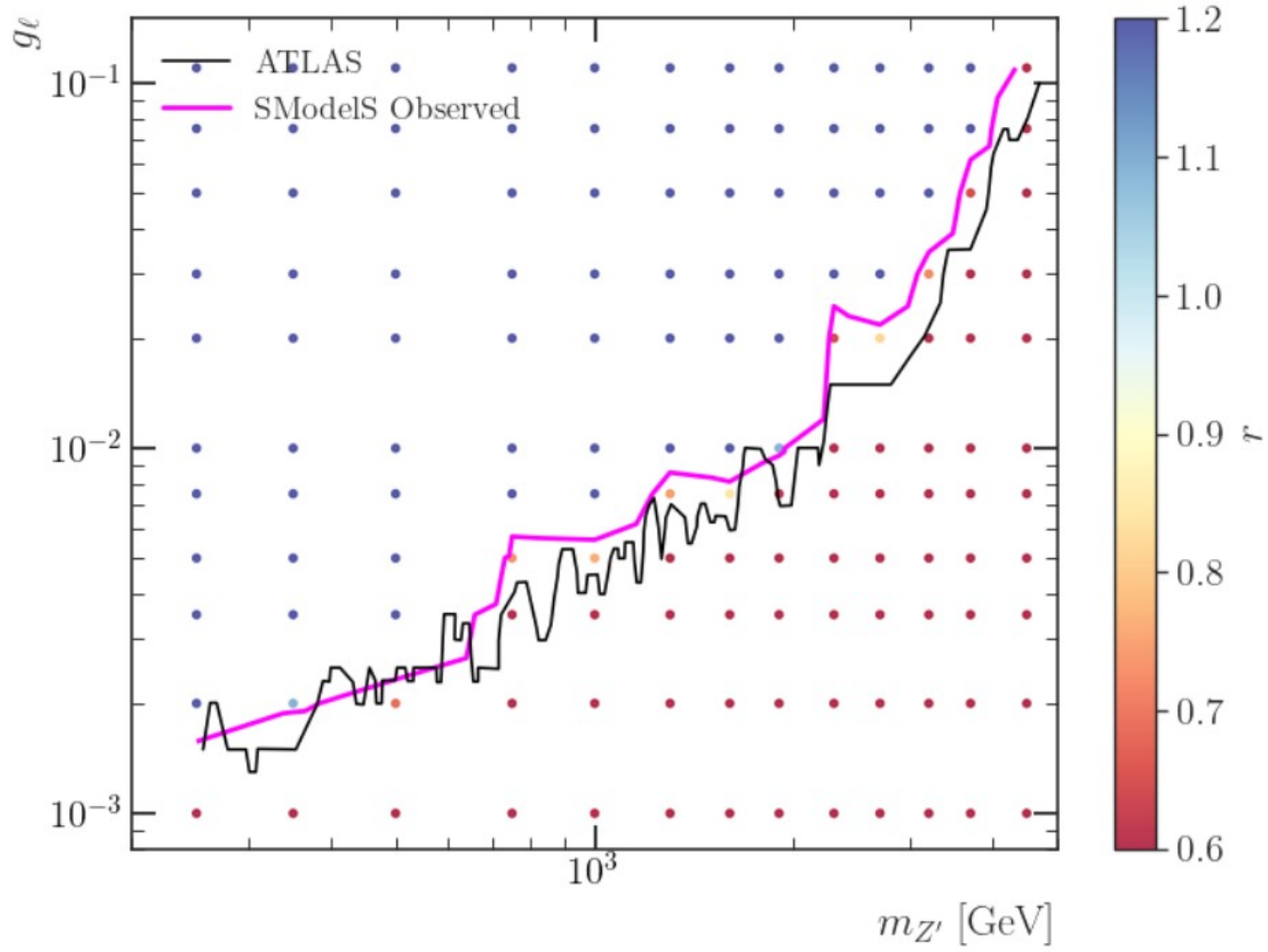


Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit

Validation: ATLAS-EXOT-2018-62

Assumes specific (simplified) model:
- g_l sets the BR to leptons
- $m_{Z'}$ sets the production cross-section



- Large number of grid points (13K). How to trim it?

Status – Sao Paulo

- New resonance results in the Database (Y. Villamizar)
  - **ATLAS-EXOT-2018-08 (dilepton resonance):** Upper Limit

Validation: ATLAS-EXOT-2018-62

Assumes specific (simplified) model:
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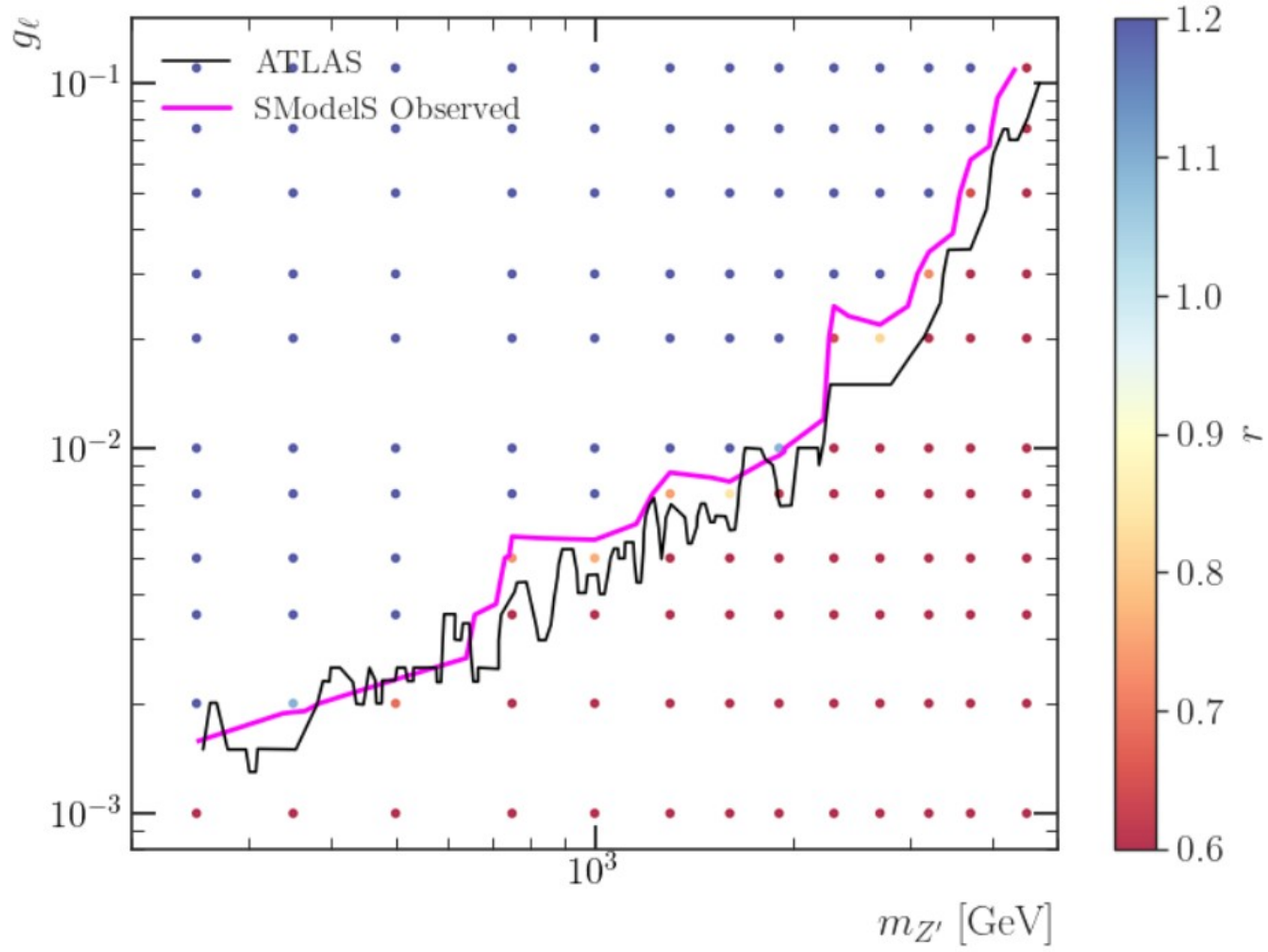

- Large number of grid points (13K). How to trim it?
- Still need to add muon SMS!