mono-tops

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ATLAS
EXPERIMENT

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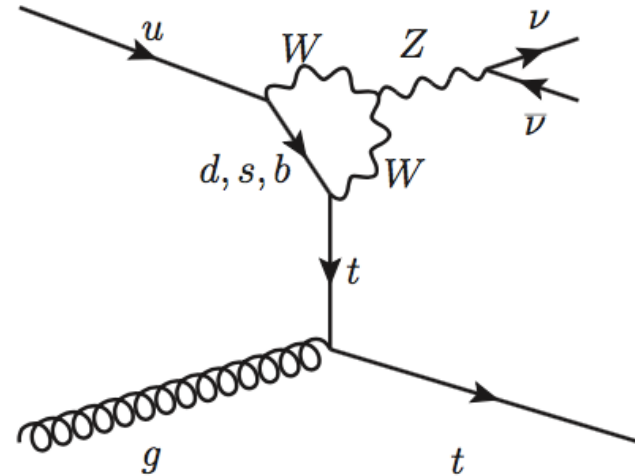
- "Monotop" : one top-quark + missing (transverse) energy

- In the Standard Model : GIM- and CKM-suppressed !

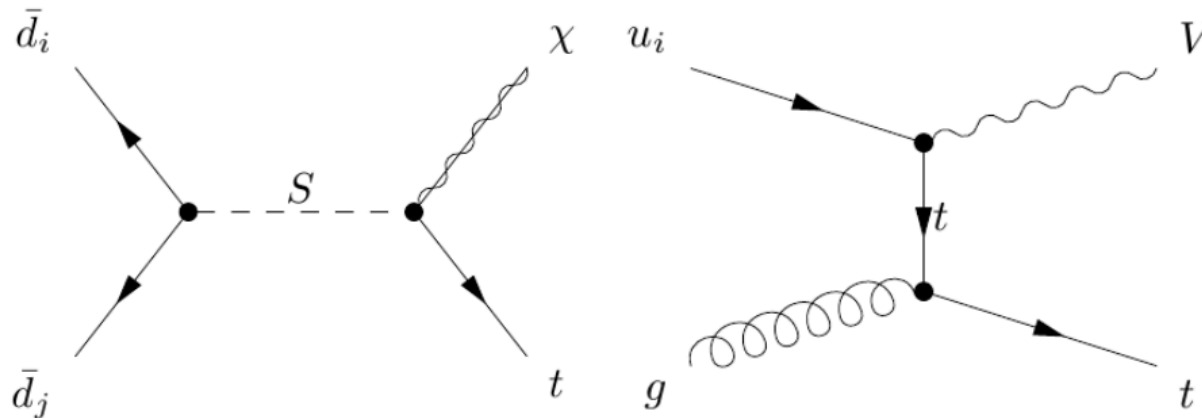single-top + invisible + 1 jet (SM)   loop-induced monotop (SM)
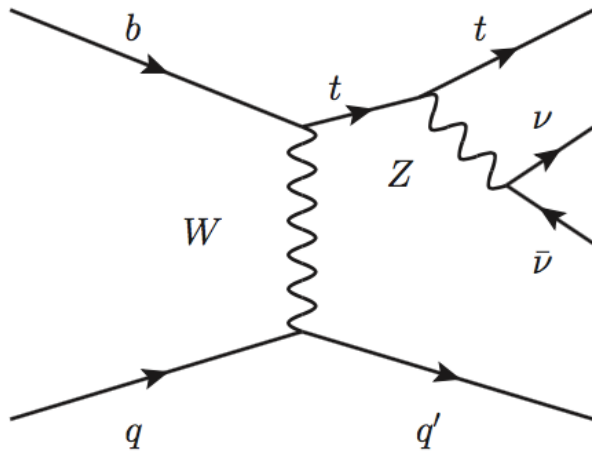
- At LHC energies, no top in protons, monotop final state is a clear BSM signature
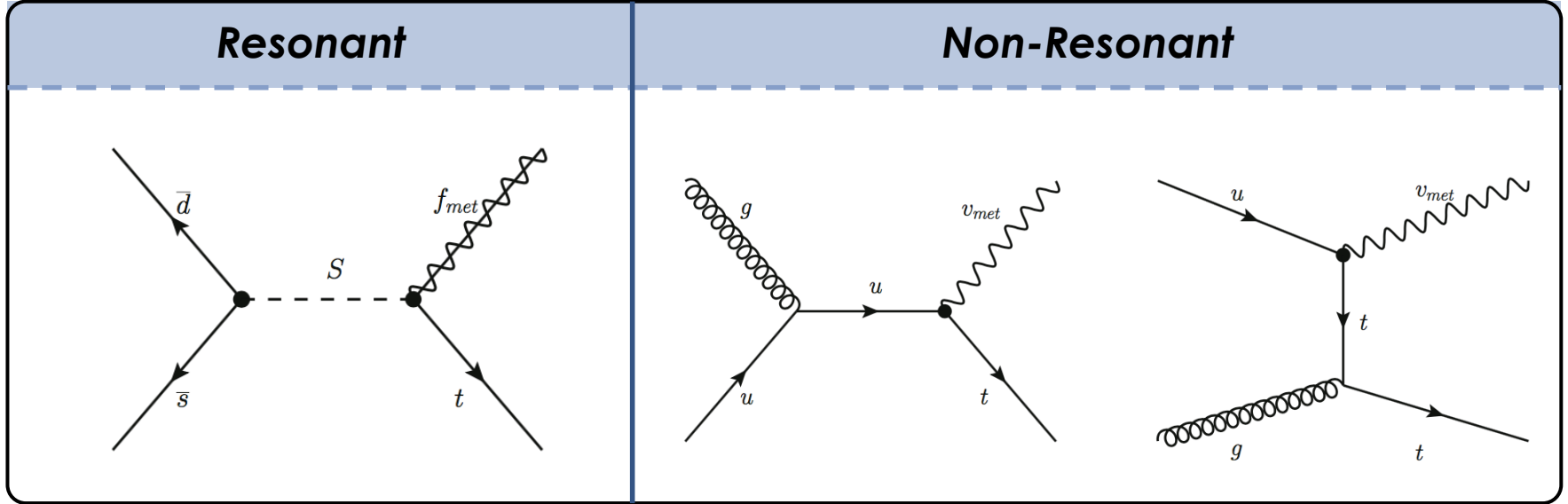
Mono-top Theoretical Models

- *Leptoquark to top+neutrino :*
  - SU(5)GUTs
- *Top-squark to top+long-lived neutralino :*
  - RPV SUSY Eur.Phys.J.C75(2015)7
- *Hylogenesis models :*
  - dark matter, baryogenesis Phys.Rev.D91(2015)035005
- *Majorana neutrinos :*
  - dark matter, neutrino mass Phys.Rev.D90(2014)095018
- *Neutralinos + top :*
  - RPC SUSY
- *Neutral boson X with invisible decay :*
  - Z0, Z-mediated FCNC, type-III 2HDM + scalar DM
  - Phys.Rev. D 89 (2014) 1, 014016
- *"Top-flavoured" dark matter :*
  - dark matter, Phys.Rev. D 88 (2013) 075012

- Effective model proposed by Andrea, Fuks, Maltoni Phys. Rev. D 84 (2011) 074025
  - general Lagrangian for monotop where Missing Energy = new particle with invisible signature

- Two kind of models
  - **resonant** : spin 0/1 boson produced on-shell, decays in to top + invisible fermion
  - **non-resonant** : invisible spin 0/1 boson produced in association with a top

Mono-top Model for RUN - II

Resonant	Non-Resonant

$$\mathcal{L} = \left[\varphi \bar{d}^c \left[a_{SR}^q + b_{SR}^q \gamma_5 \right] d + \varphi \bar{u} \left[a_{SR}^{1/2} + b_{SR}^{1/2} \gamma_5 \right] \chi + \text{h.c.} \right]$$

$$a_{SR}^q = b_{SR}^q = \frac{1}{2}\lambda_s \qquad a_{SR}^{1/2} = b_{SR}^{1/2} = \frac{1}{2}y_s^*$$

$$\mathcal{L} = \left[V_\mu \bar{u} \gamma^\mu \left[a_{FC}^1 + b_{FC}^1 \gamma_5 \right] u + \text{h.c.} \right] \qquad a_{FC}^1 = b_{FC}^1 = \frac{1}{2}a_R$$

* Dark Matter Benchmark Models for Early LHC Run-2 Searches: Report of the ATLAS/CMS Dark Matter Forum", arXiv:1507.00966.
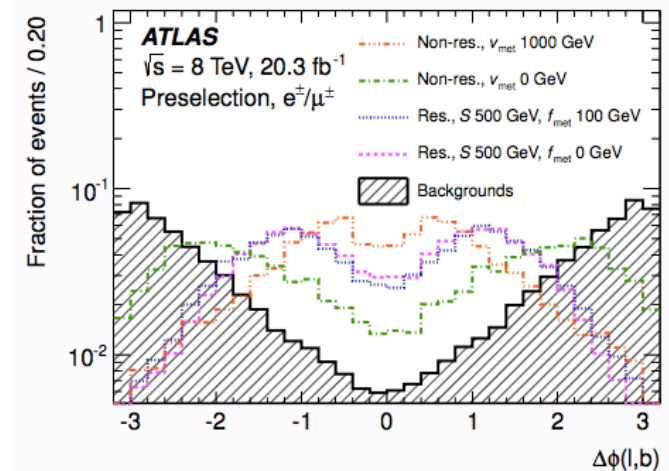
- **Preselection :**
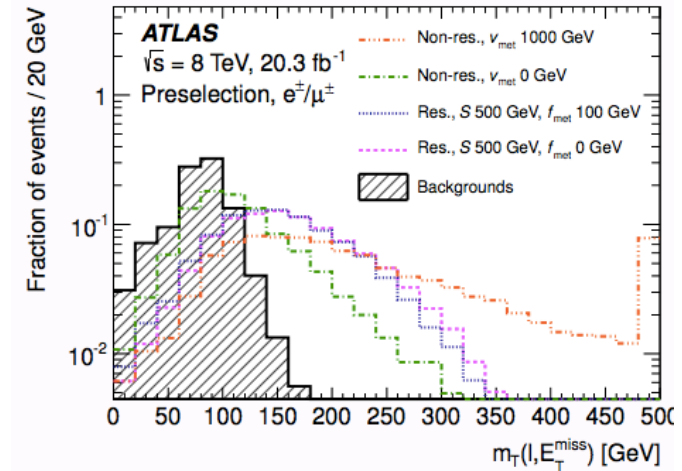 - single lepton trigger
  - 1 isolated e/μ , 1 central jet b-tagged
  - Missing E_T > 35 GeV,
  - $m_T(W)$ + missing E_T > 60 GeV

- *"Cut-and-count"*, 1 signal region for each signal
  - $m_T(W)$ and $|\Delta\Phi(l,b)|$
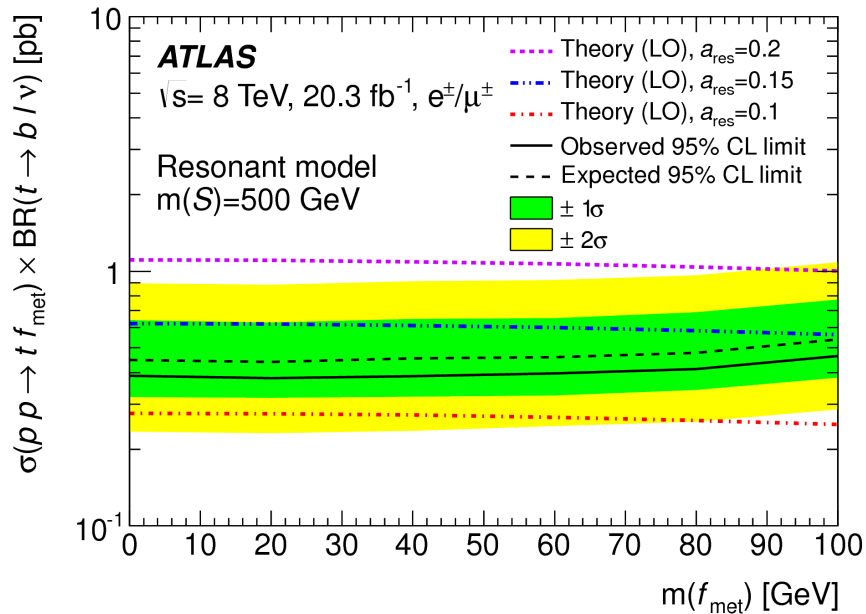 - Optimised for best limits

- **Backgrounds :**
  - **Main** : ttbar, W+jets (MC)
  - **Others** : single top, Z +jets, Diboson (MC), multijets (data)
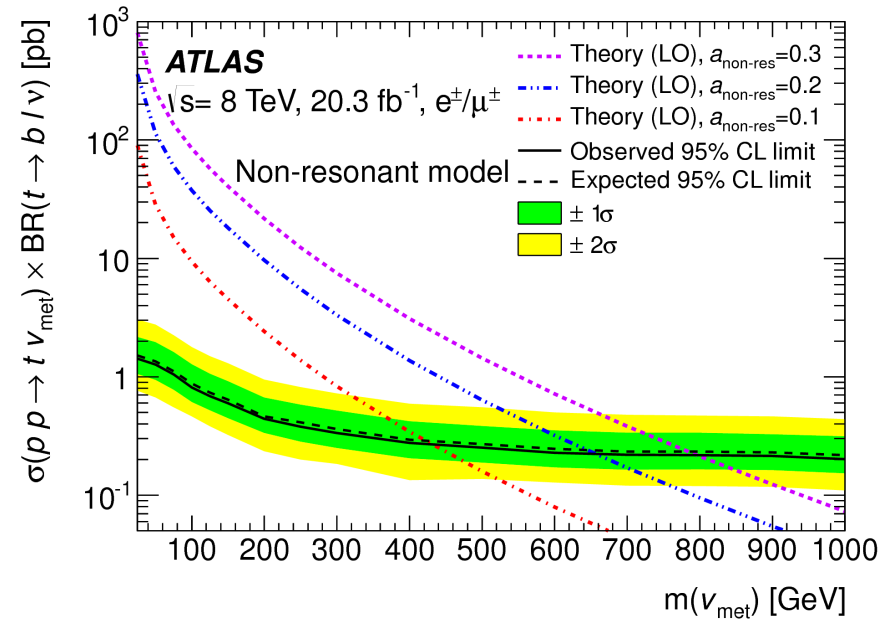
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Resonant

Non-Resonant

Limits on the effective coupling a_{RES}
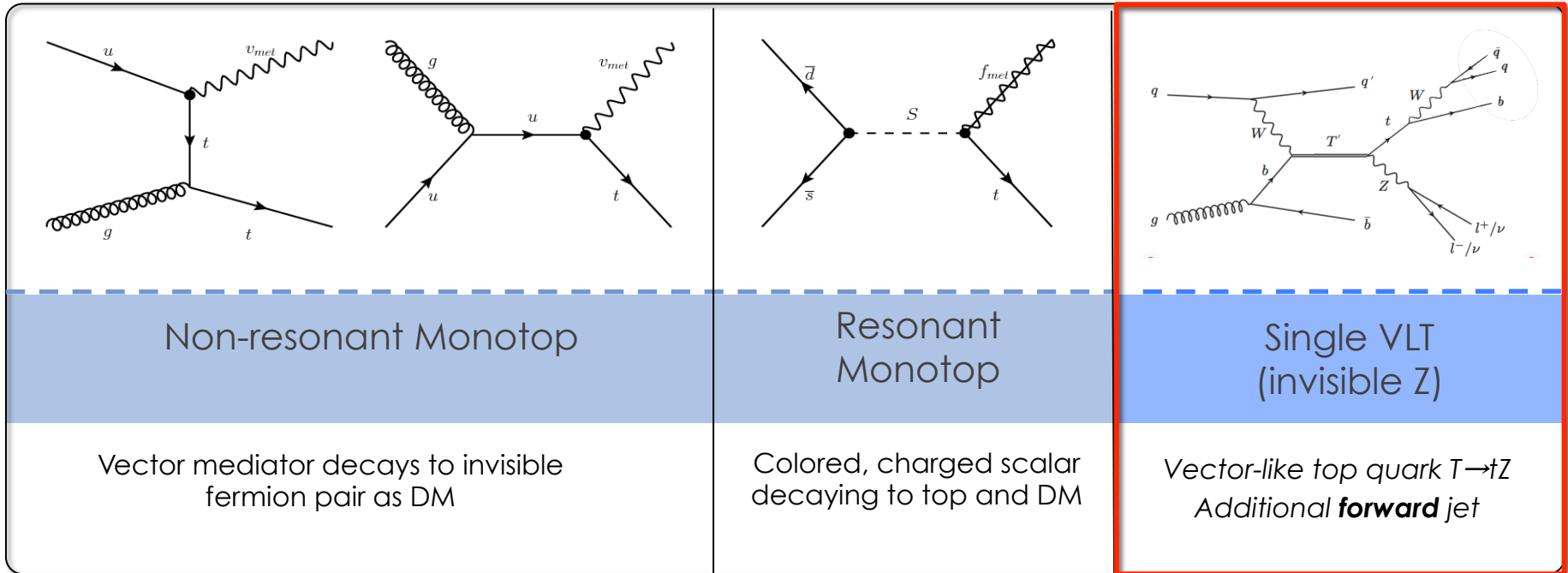
a_{RES} = 0.15 excluded for
m(S)= 500 GeV and
m(f_{MET})=0-100 GeV

Limits on the effective coupling $a_{NON\text{-}RES}$

$a_{NON\text{-}RES}$ = 0.2
excluded for V_{MET}
=0-657 GeV

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Non-resonant Monotop	Resonant Monotop	Single VLT (invisible Z)
Vector mediator decays to invisible fermion pair as DM	Colored, charged scalar decaying to top and DM	*Vector-like top quark T→tZ* *Additional* **forward** *jet*

- Combined group leptonic and hadronic decay of the top working together for the measurement. IFIC is performing the leptonic analysis :
  - Analysis based on 8 TeV mono-top search with additional optimizations to improve the limit.
  - Added new interpretation and region looking for Vector-like Top (VLT) with decay to top and invisible Z.