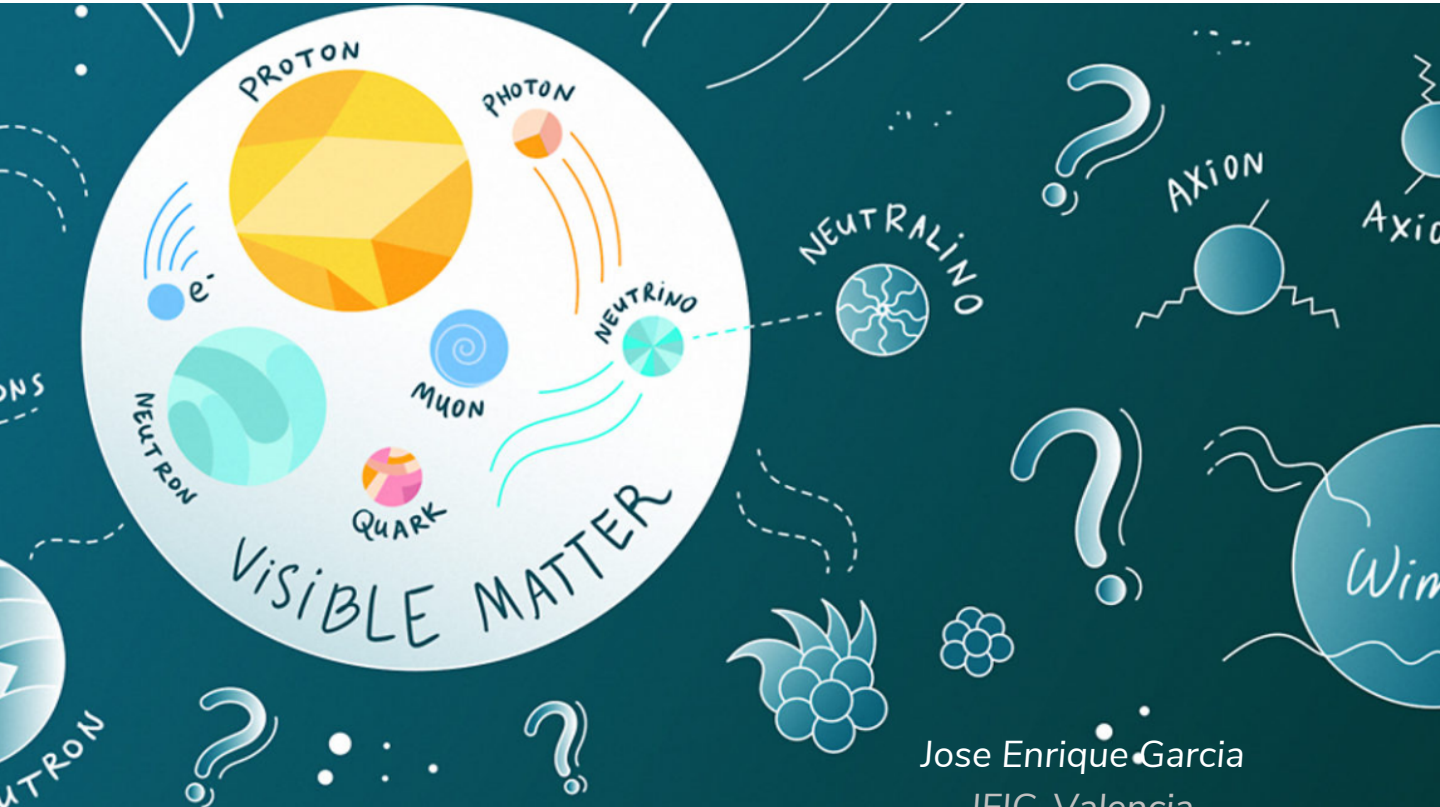


MONOTOP SEARCHES AT LHC

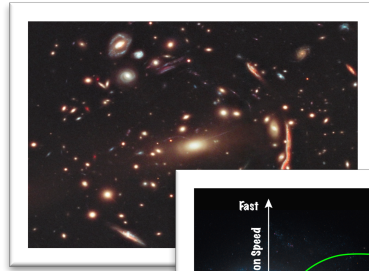


EXCELENCIA
SEVERO
OCHOA

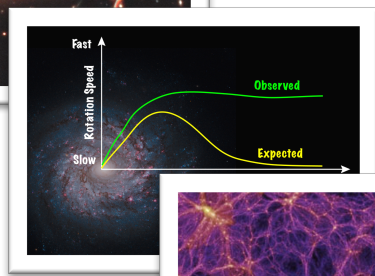


Jose Enrique Garcia
IFIC-Valencia

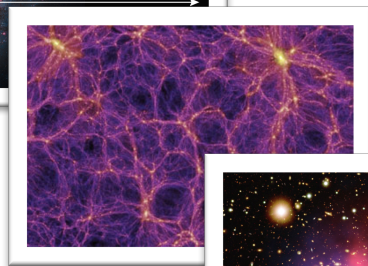
Dark Matter : Evidences



Galactic Clusters & GR Lensing



Galactic Rotation Curve



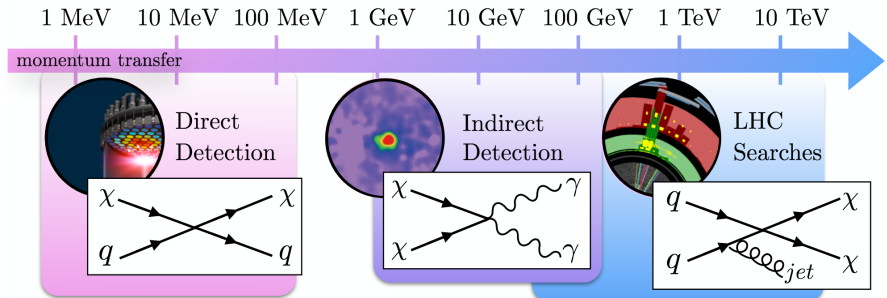
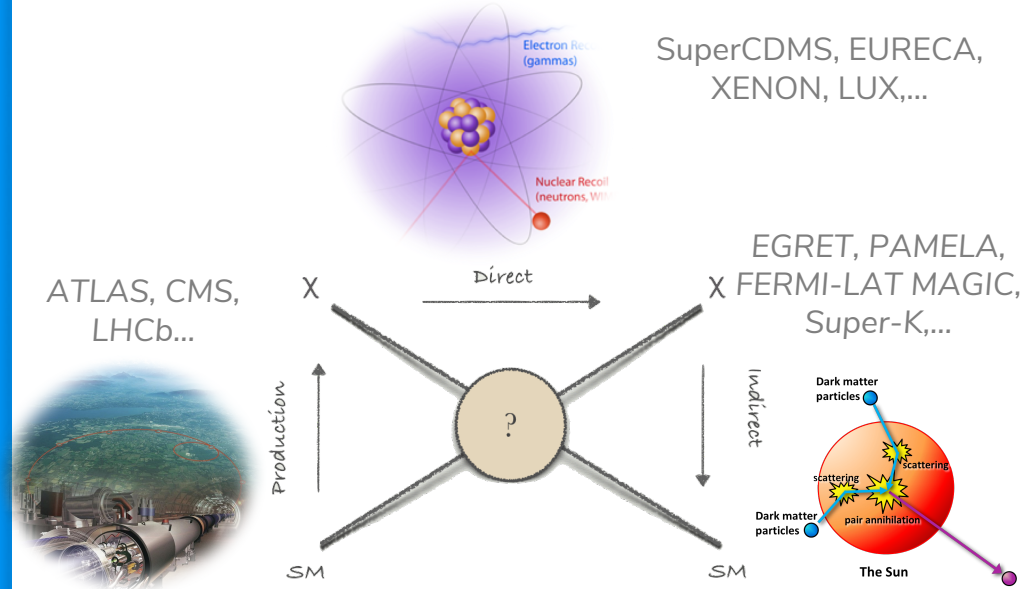
CMB



Bullet Clusters

... these are some of the evidences

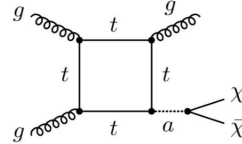
Dark Matter



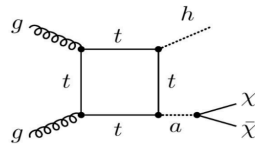
Mono-X Final States

Dark Matter Mono-X

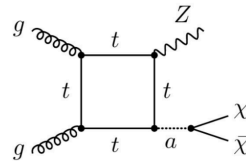
DM in 2HDM



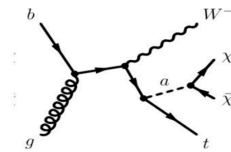
Mono-jet



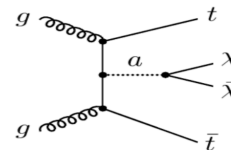
Mono-Higgs



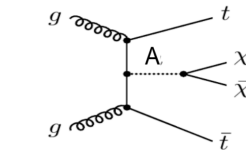
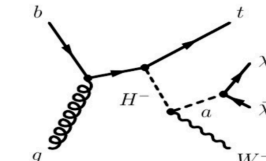
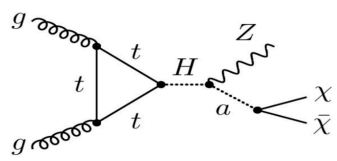
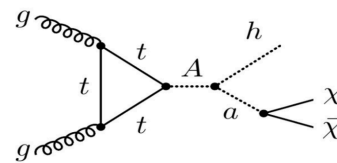
Mono-Z



DM + Wt



DM + tt



1.

MONOTOP

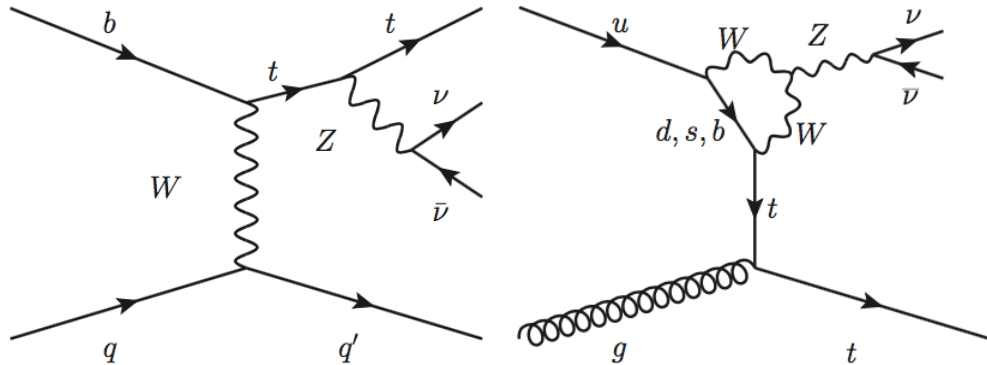


Mono-top Final States

- "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

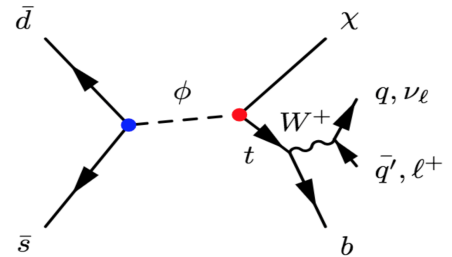
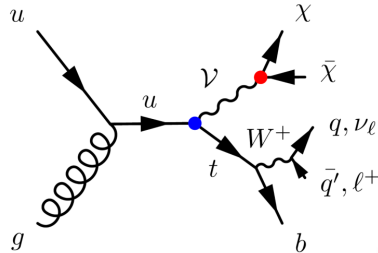
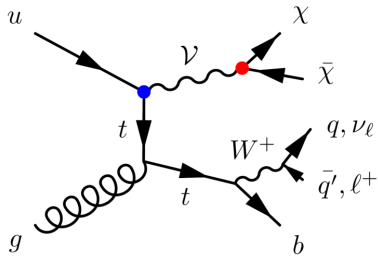
Mono-top in Theories

- 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](#)

Dark Matter Benchmark Models for Early LHC Run-2
Searches: Report of the ATLAS/CMS Dark Matter Forum",
[arXiv:1507.00966](#).



Monotop Searches at Run-II



Non-resonant Mono-top

Resonant Mono-top

Vector mediator ν decays to invisible fermion pair as DM

FCNC interactions in u - t - ν vertex

Additional scenario using ν directly as DM

Coloured, charged scalar ϕ decaying to top and DM

Majorana fermion as DM

Monotop Searches at Run-II

- **ATLAS** performed analysis at 8 TeV using leptonic decay of the top.
 - Analysis in process to be approved using 13 TeV data combined hadronic (boosted topology) and leptonic decay of the top
- **CMS** already published analysis at 13 TeV using hadronic (boosted) decay of the top.

- **Non Resonant (FCNC)**

$$g_u^V = g_d^V \equiv g_q^V, \text{ and } g_u^A = g_d^A \equiv g_q^A$$

$$\mathcal{L}_{\text{int}} = V_\mu \bar{\chi} \gamma^\mu (g_\chi^V + g_\chi^A \gamma^5) \chi + \bar{q}_u \gamma^\mu (g_u^V + g_u^A \gamma^5) q_u V_\mu + \bar{q}_d \gamma^\mu (g_d^V + g_d^A \gamma^5) q_d V_\mu + \text{h.c.},$$

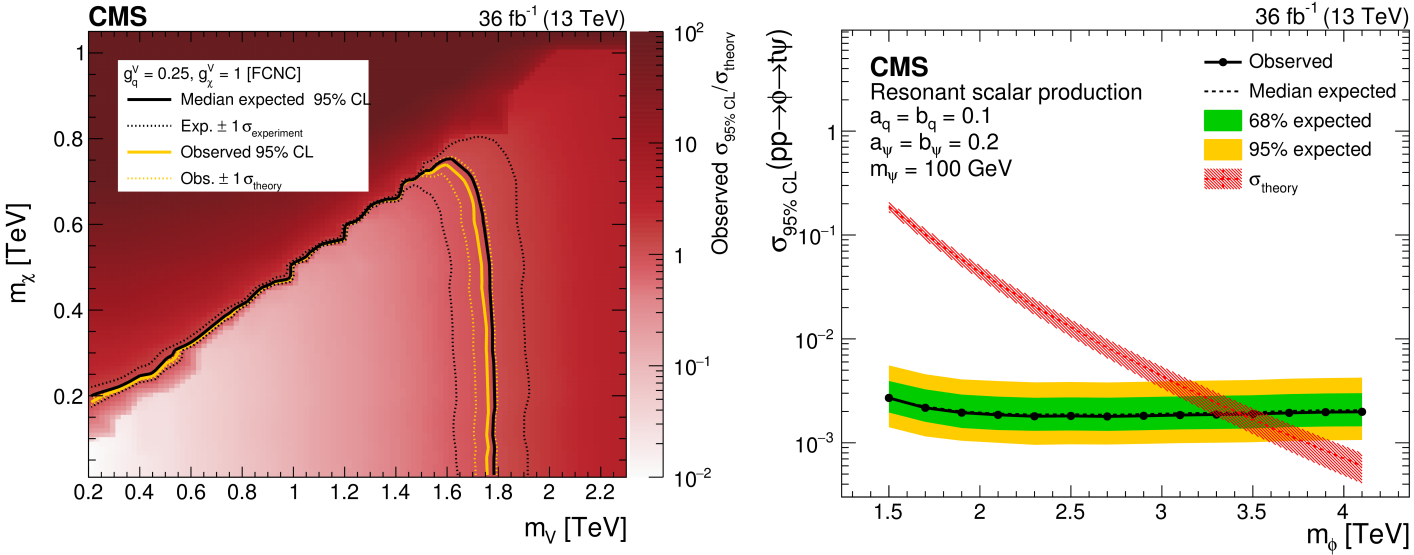
Limits as a function of masses and couplings : $m_V, m_X, g_X^{V,A}, g_q^{V,A}$

- **Resonant :**

$$\mathcal{L}_{\text{int}} = \phi \bar{d}_i^C [(a_q)^{ij} + (b_q)^{ij} \gamma^5] d_j + \phi \bar{t} [a_\psi + b_\psi \gamma^5] \psi + \text{h.c.}$$

Limits for mediator particle (m_ϕ) for fixed set of couplings and mass (m_ψ).

Monotop Searches at Run-II



Non-resonant Mono-top

Resonant Mono-top

- No Limits expected for

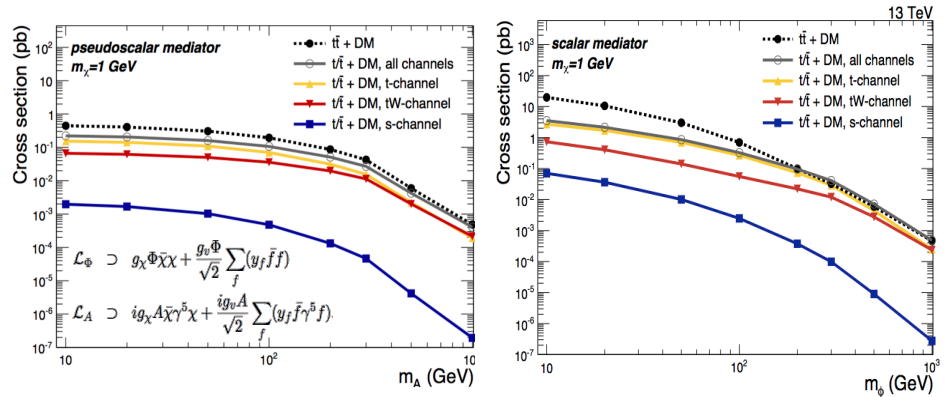
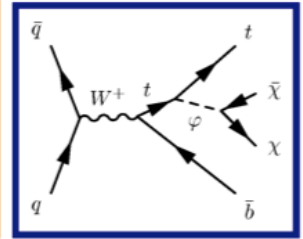
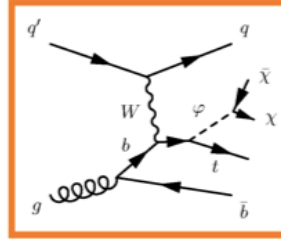
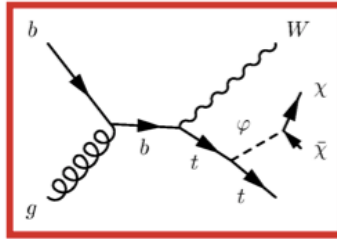
2.

MODELS

Mono-top Family is growing



Monotop Simplified Model

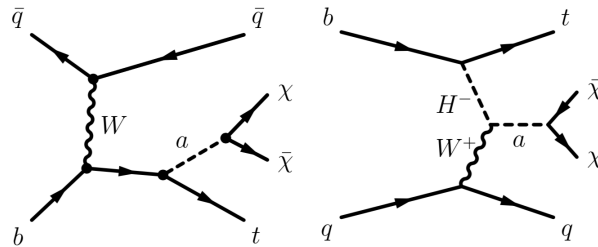


⇒ Pinna, Zucchetta, Buckley, Canelli (2017)

⇒ Plehn, Thompson, Westhoff (2017)

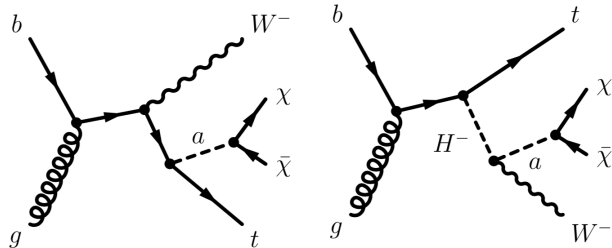
Single Top + a Production in 2HDM

★ What about UV-complete models, e.g. 2HDM+a?



(a)

(b)

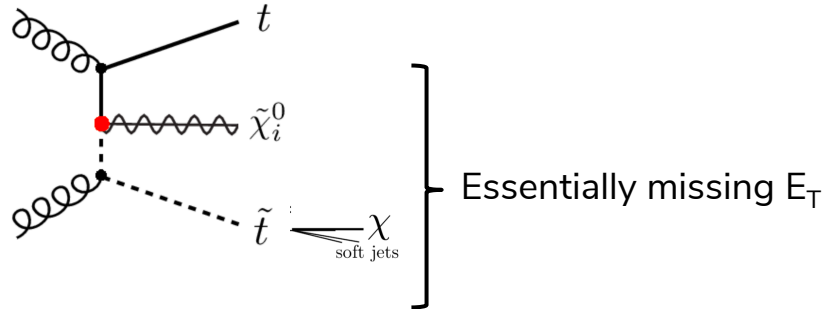


[Pani,Polesello] arXiv:1712.03874

Monotop SUSY

Natural SUSY scenarios with small stop-higgsino mass differences

Usually this channel explored with mono-jet but mono-top is a good alternative.



Mono-top Signature from Supersymmetric
ttH Channel ([arXiv:1604.03938](https://arxiv.org/abs/1604.03938))

Advantage different particles can be probed at once (but unfortunately hides information about them)

Discussion

