Exotic Searches at ATLAS

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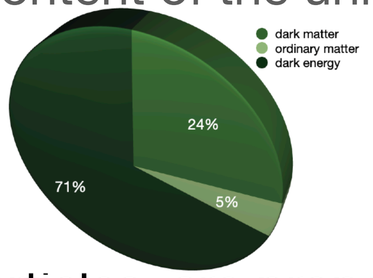
New Frontiers in Physics - August 2024

Outline

BSM searches

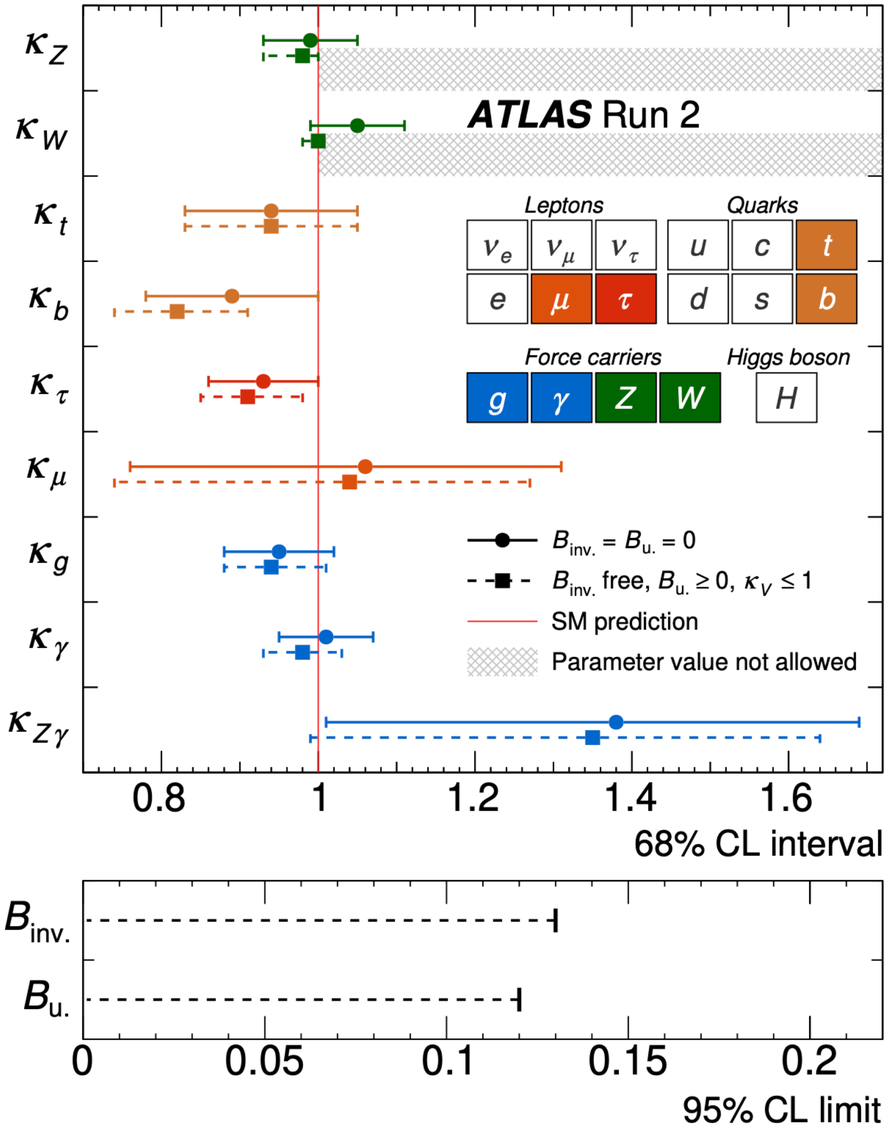
- The Standard Model (SM) currently provides the most accurate and comprehensive description of the subatomic world, yet it does not offer a complete explanation of all observed phenomena.
  - mH, mv, quark and lepton masses and mixings...
  - matter-antimatter asymmetry, "dark" content of the universe

e: 0.5 ..... t: 173300 MeV



- Several BSM theories, introducing new particles, are proposed to answer the open questions.
  - This talk is about exotic model searches with a focus on Dark Matter candidates mostly motivated by Higgs Branching results

- CERN-ATLAS Experiment presents results from 6 different searches using the full Run 2 data
  - $\sqrt{s} = 13\text{TeV}$ and $\mathscr{L} \approx 140\ \text{fb}^{-1}$

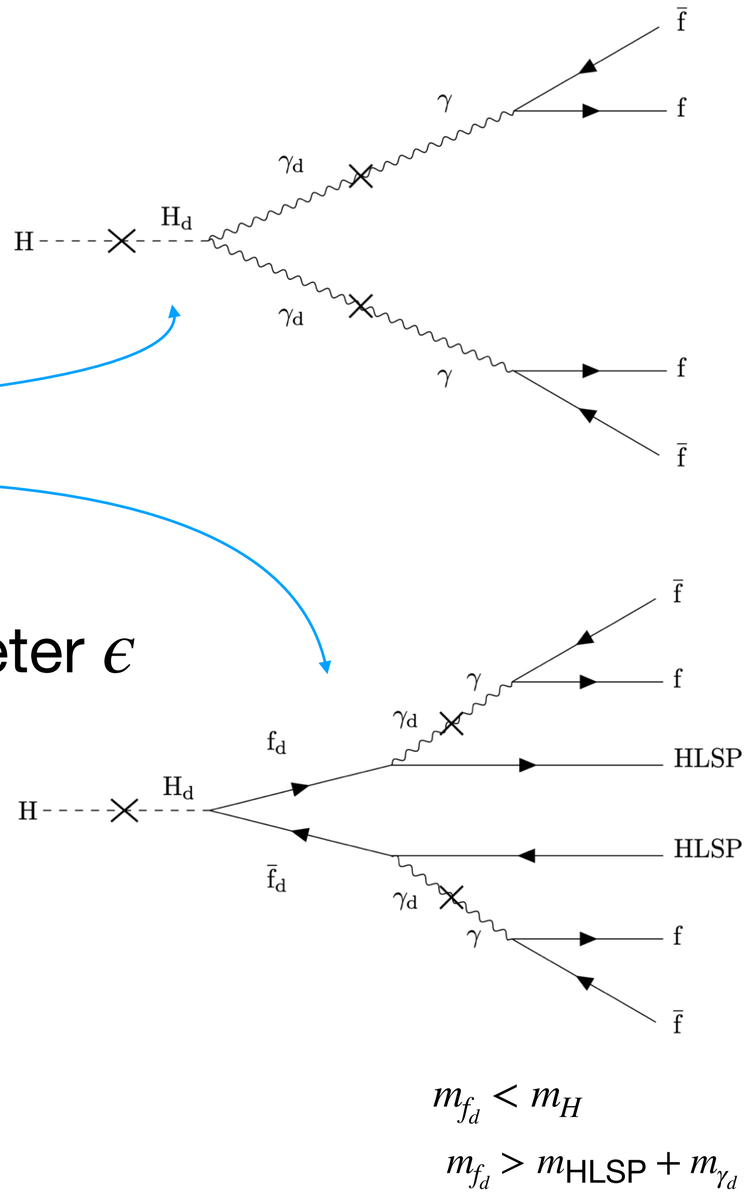


Dark Photon γ_d

CERN-EP-2024-183

pair production

- Additional generic U(1) addition to SM
  - Hidden Abelian Higgs Model (HAHM)
  - Falkowski-Ruderman-Volansky-Zupan model (FRVZ)
    - f_d: hidden fermion, HLSP: stable hidden fermion
- γ_d mixing with γ and Z, coupling (kinetic mixing) parameter ϵ
  - $\epsilon \geq 10^{-5} - 10^{-3}$: prompt γ_d decay
  - expected m(γ_d) <10 GeV
- SM decays:
  - $\gamma_d \to \ell^+ \ell^- \qquad \ell = e, \mu$
  - $\gamma_d \to \tau^+ \tau^-, q\,\bar{q}$ not considered.



$m_{f_d} < m_H$

$m_{f_d} > m_{\text{HLSP}} + m_{\gamma_d}$

Analysis strategy

- electron channel and muon channel
  - e-channel important for m(γ_d) < 2 m(μ)
- Search for Lepton Jets (LJs) collimated e/μs
  - LJ: highest pT lepton + same flavour lepton in $\Delta R = 0.4$
    - if another flavour in the cone, LJ is discarded.
    - eLJ: $|\eta|$ < 1.37 & pT(trk[0]) > 5 GeV, at least 1e and 2 trks
    - eLJ: $pT_{imb} = |\frac{pT(trk[0]) - pT(trk[1])}{pT(trk[0]) + pT(trk[1])}|$, small for resonance decays <0.8
    - eLJ: $R\phi = \frac{Eem_{3x3}}{Eem_{3x7}} < 0.96$
  - SM background from vector bosons and off-shell γs
  - at least 2 LJs required to reduce SM bg.
- signal samples 17 MeV to 20 GeV
  - SM background: Z+jets, $t\bar{t}$

Muon-channel Signal Regions

Requirement / Region	μLJ–μLJ	μLJ–eLJ
Number of μLJs	≥ 2	≥ 1
Number of eLJs	0	≥ 1
muon triggers	yes	yes
electron-muon triggers	–	yes
electron triggers	–	yes
eLJ $p_{\mathrm{T}}^{\mathrm{imb}}$	–	< 0.8
$\Delta\phi(\mu\mathrm{LJ}, e\mathrm{LJ})$	–	> 2

Analysis Regions for e- channel

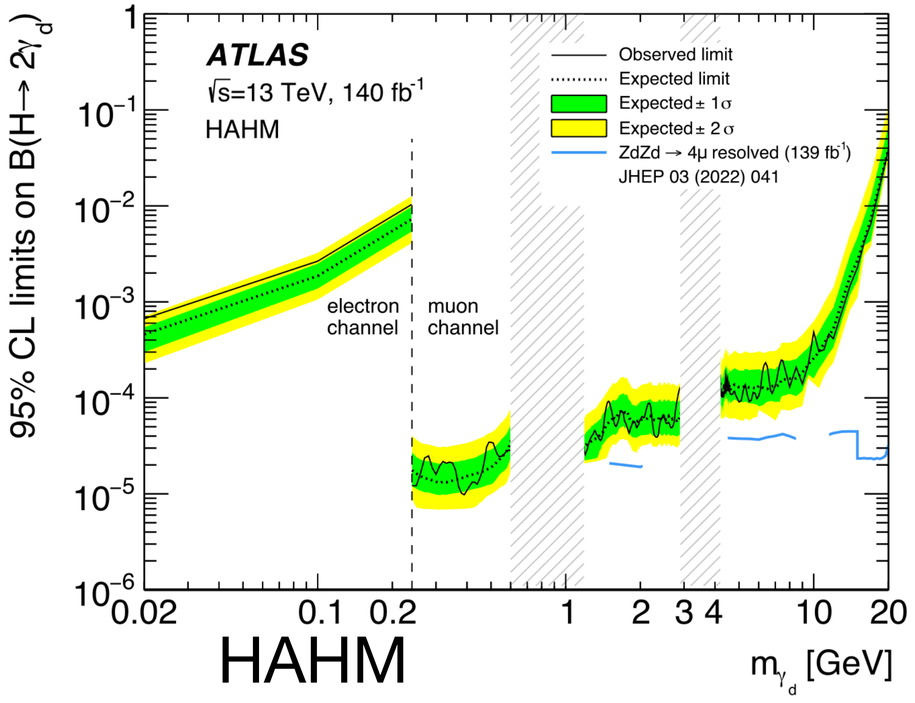
Requirement / Region	SR	CR B	CR C	CR D	VR$_Z$
Applied to both leading and farthest eLJ					
Number of EM clusters in eLJ			1		
eLJ mass imbalance			< 0.8		
Selection on event-level variables					
$\Delta\phi(e\mathrm{LJ}, e\mathrm{LJ})$			> 2.5		
Number of jets (p_{T} > 40 GeV)			0		
$m(e\mathrm{LJ}, e\mathrm{LJ}) \notin [80, 100]$ GeV	yes	yes	yes	yes	veto
Leading eLJ $p_{\mathrm{T}}^{\mathrm{imb}}$	< 0.8	< 0.8	> 0.8	> 0.8	–
Farthest eLJ R_ϕ	< 0.96	> 0.96	< 0.96	> 0.96	–

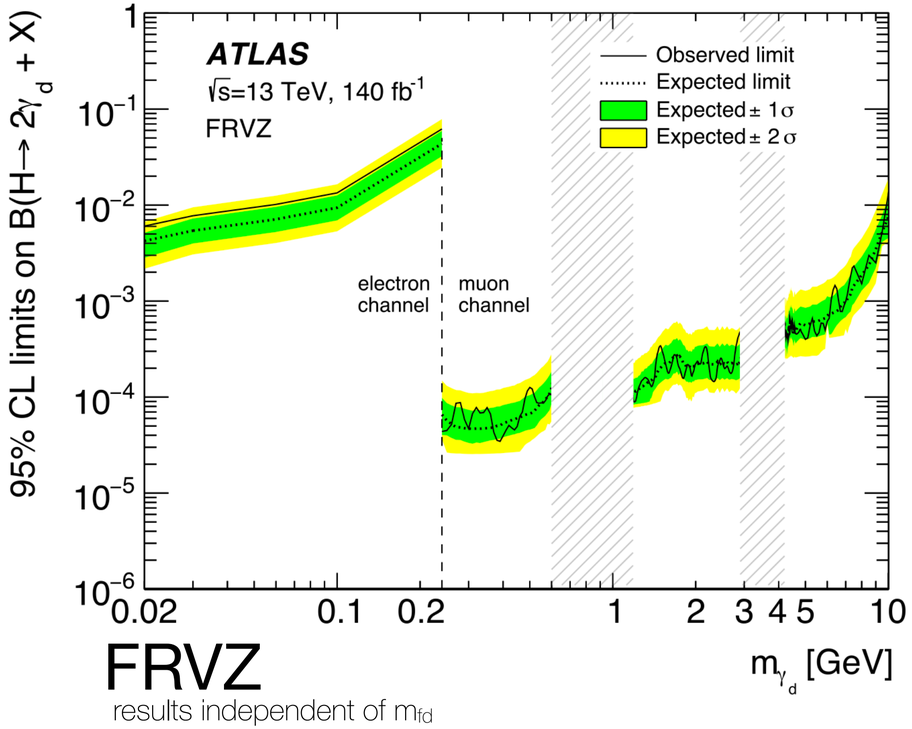
2eLJs, 2es in each
80> m(eLJ, eLJ) >100
bg from data w/ ABCD
$N_{bg}=N_A = (N_B \times N_C)/N_D$

Results

No significant excess of data over the expected background is observed.

- Improves Run 1 results by factor 50 due to better background estimation
- gray regions: limits are not extracted at regions on SM background resonances
- high mass: LJ reconstruction inefficient due to larger opening angle of the leptons
- for dark photon mass from 17 MeV to 20 GeV, limits set to B($H \rightarrow \gamma_d\gamma_d$)
  - from 0.001% to 1% for the HAHM model and from 0.004% and 5% for the FRVZ model





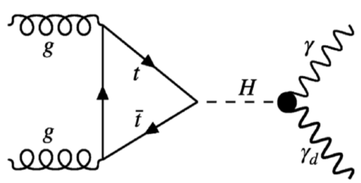
Dark Photon γ_d

CERN-EP-2024-152

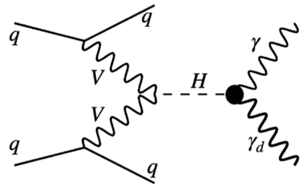
single production

- Same motivation: additional $U(1)_d$
  - massless γ_d
- 3 channels used: ggF, VBF, ZH

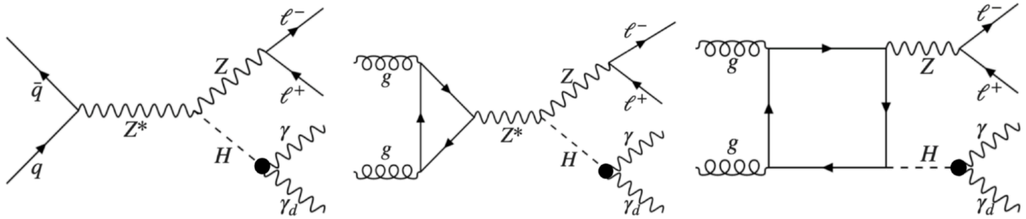
H_{BSM} H_{SM}



γ+MET



γ+MET+VBF jets



γ+MET+$Z \to \ell^+\ell^-$

- ggF & VBF use H_{BSM}, VBF & ZH use H_{SM}
  - 400GeV < m(H_{BSM}) < 3TeV

Analysis strategy

- isolated γ + MET + jets & leptons
- VBF: 10SR (m_{jj}, m_T), 4CR (Weγ, Wμγ, Zvvγ, e-γ)
  - beware of j_{VBF} definition
  - Dominant Bgs: W(e/μ)γj Z(vv)γj
- ZH: BDT for Si-Bg separation
  - additional selections
    - no b-tagged j_3
    - $m_{\ell\ell\gamma} > 100$ GeV
    - $\Delta\phi(E_T^{\text{miss}}, pT(\ell\ell\gamma)) > 2.4$
  - Dominant Bgs: Zj & Zγj
- ggF:
  - additional selections
    - $\Delta\phi(\gamma, E_T^{\text{miss}}) > 0.4$
    - $|\Delta z_\gamma| < 250$mm
  - Dominant Bgs: real or fake γs

j_{VBF}: $pT(j_0) > 60$ & $pT(j_1) > 50$ & $m(j_0j_1) > 250$ & $|\Delta\eta(j_0, j_1)| > 3$ & $|\Delta\phi(j_0, j_1)| < 2$

Main Event Selections

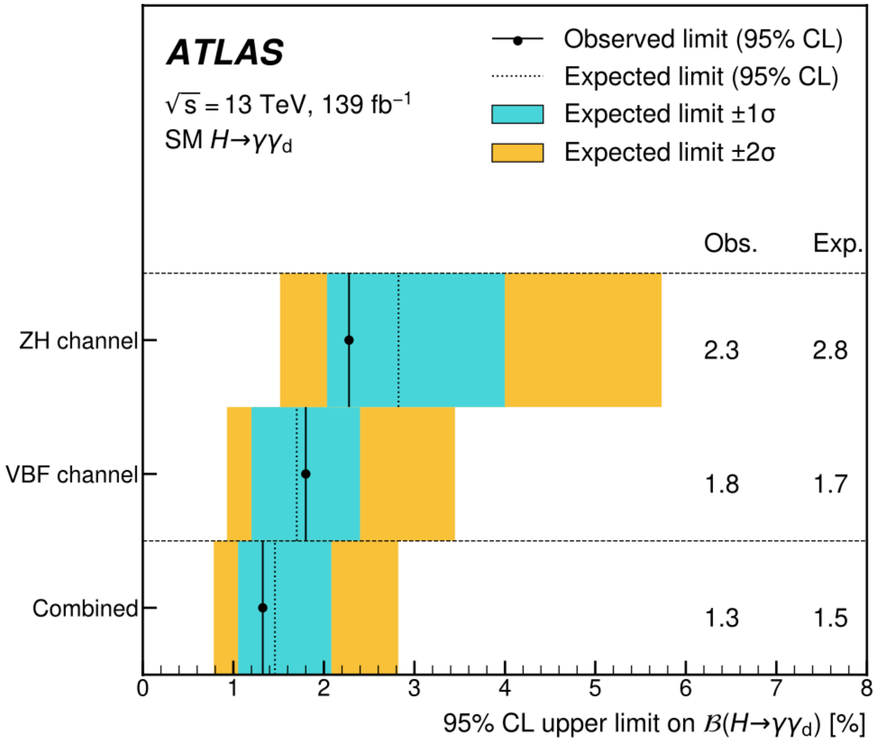
Channels	VBF	ZH	ggF
Trigger	$E_{\text{T}}^{\text{miss}}$	Lepton(s)	Photon
Photons	$= 1, C_\gamma > 0.4$	$= 1$	≥ 1
E_{T}^{γ} [GeV]	$\in (15, \max(110, 0.733 \times m_{\text{T}}))$	> 25	> 150
$E_{\text{T}}^{\text{miss}}$ [GeV]	> 150	> 60	> 200
Jets	2 or 3, $m_{j_1 j_2} > 250$ GeV, $\lvert\Delta\eta_{j_1 j_2}\rvert > 3$ $\eta_{j_1} \cdot \eta_{j_2} < 0$, $\Delta\phi_{j_1 j_2} < 2$, $C_{j_3} < 0.7$	≤ 2	≤ 1
Leptons	$= 0$ (e, μ)	$= 2$, SFOC $m_{\ell\ell} \in (76, 116)$ GeV	$= 0$ (e, μ, τ)
Disc. variables	m_{jj} and m_{T} in SR and 4 CRs	BDT score and 1 CR	$E_{\text{T}}^{\text{miss}}$

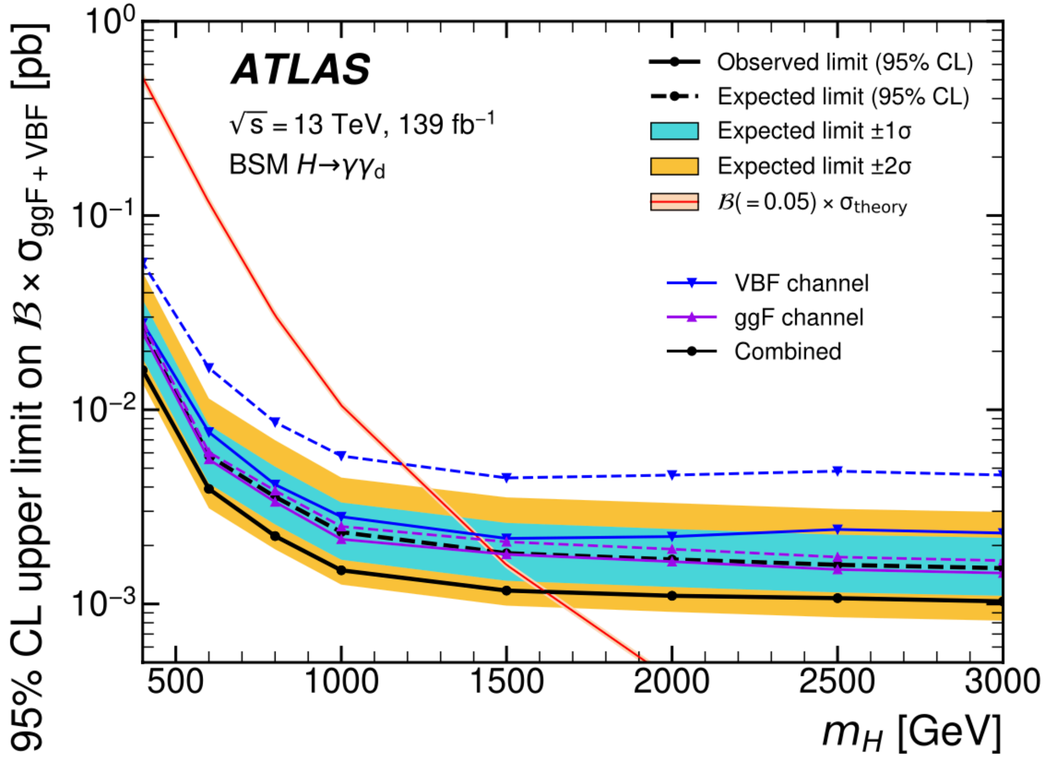
$$m_{\text{T}}(\gamma, E_{\text{T}}^{\text{miss}}) = \sqrt{2E_{\text{T}}^{\gamma} E_{\text{T}}^{\text{miss}} \left[1 - \cos(\phi_\gamma - \phi_{E_{\text{T}}^{\text{miss}}})\right]}$$

$$C_i = \exp\left[-\frac{4}{(\eta_{j_1} - \eta_{j_2})^2}\left(\eta_i - \frac{\eta_{j_1} + \eta_{j_2}}{2}\right)^2\right]$$

Results

No significant excess of data over the expected background is observed.





Theory σ from Handbook of LHC Higgs Cross Sections: 4. Deciphering the Nature of the Higgs Sector, (2017), arXiv: 1610.07922

- SM: B($H \rightarrow \gamma\gamma_d$)< 1.3% @95% CL
- BSM: for B($H_{\text{BSM}} \rightarrow \gamma\gamma_d$)=5%, m(H_{BSM}) <1500 GeV @95% CL

Dark Matter

CERN-EP-2024-128

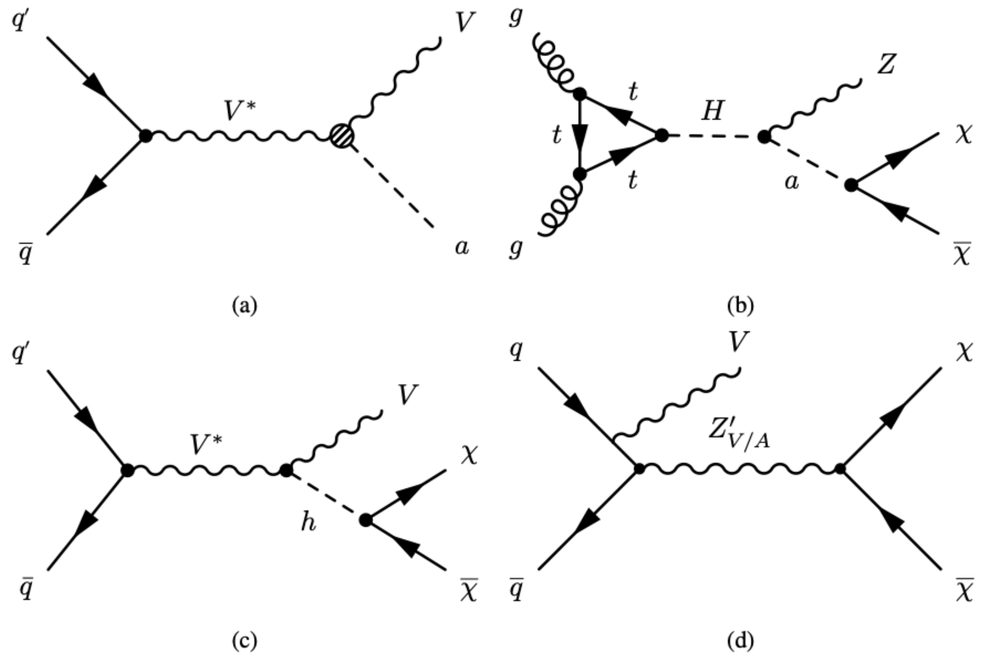
MET+V signature, hadron only channel

m(a)=1MeV
f_a=1-5TeV

$m_A = m_H = m_{H^\pm}$

$\lambda_{P1} = \lambda_{P2} = \lambda_3 = 3, g_\chi = 1$

$\sin(\beta - \alpha) = 1$



- Motivation from 4 distinct models
  - (a) Axion-Like-Particles, 2HDM (+pseudoscalar) (b)
  - (c) Invisible Higgs decays, Simplified DM (WIMP) (d)
- Signature: MET+V, V=Z,W
  - LHC DarkMatter Working Group recommended parameters and scans used
  - low pT: resolved jets, high pT: single jet w/ sub-structure
- Dominant Bgs
  - $Z_{\nu\nu}j\ W_{\tau\nu}j\ W_{e/\mu\nu}j$
  - $t\bar{t}$, dibosons

$m(Z'_{V/A})$ =100 GeV to 1.7 TeV

$m(Z'_{V/A}) = 2m(\chi)$

Analysis strategy

- V boson hadronic reconstruction
  - using both merged & resolved jets
- No leptons in SR, only in CR
- Object based E_T^{miss} significance $\mathcal{S}$
  - based on cov. matrix & corr. factors in Longitudinal & Transverse directions:

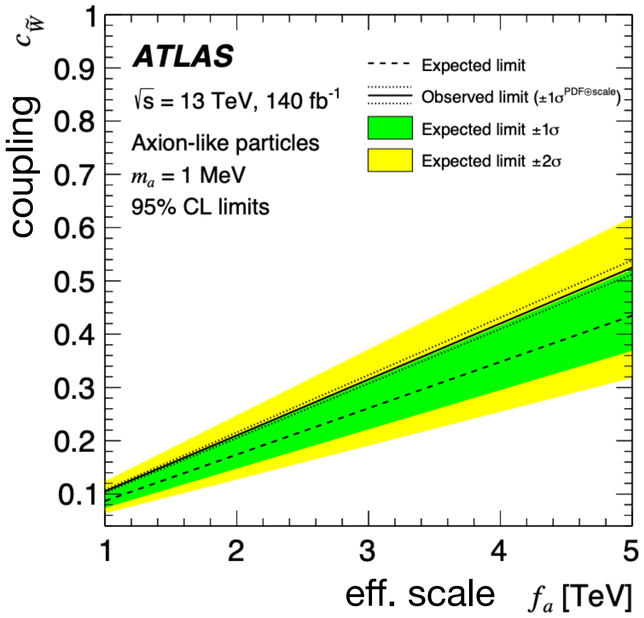
$$\mathcal{S} = \frac{E_{\text{T}}^{\text{miss}}}{[\sigma_L^2(1-\rho_{LT}^2)]^{1/2}}$$

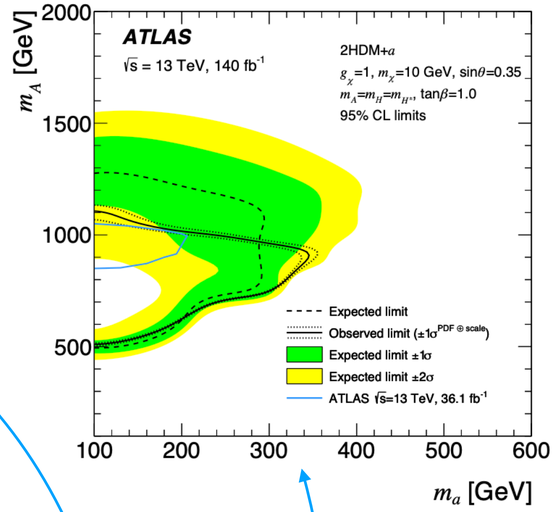
- Likelihood fit for bg estimation

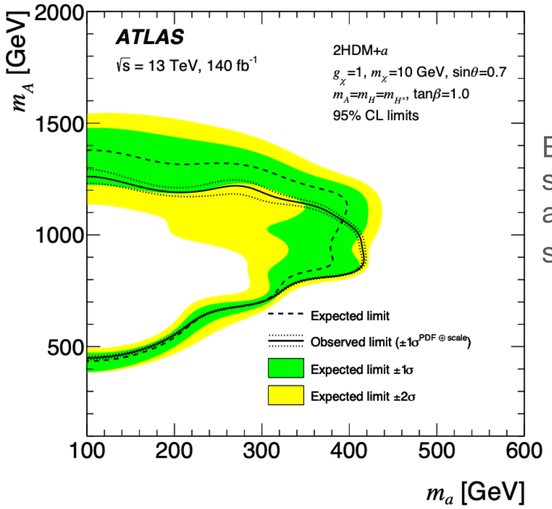
	Merged					**Resolved**				
Preselection	Data cleaning Primary vertex with at least two tracks with $p_{\text{T}} > 500$ MeV No τ-leptons $p_{\text{T},\ell}^{\text{miss}} > 30$ GeV $\min_i(\Delta\phi(\boldsymbol{E}_{\text{T},\ell}^{\text{miss}}, j_i)) > 20°$ $\Delta\phi(\boldsymbol{E}_{\text{T},\ell}^{\text{miss}}, \boldsymbol{p}_{\text{T},\ell}^{\text{miss}}) < 90°$									
$\Delta\phi(\boldsymbol{E}_{\text{T},\ell}^{\text{miss}}, V)$	$\Delta\phi(\boldsymbol{E}_{\text{T},\ell}^{\text{miss}}, J_1) > 120°$					$\Delta\phi(\boldsymbol{E}_{\text{T},\ell}^{\text{miss}}, j_1 j_2) > 120°$				
$E_{\text{T},\ell}^{\text{miss}}$	> 250 GeV					> 200 GeV				
Jets	$\geq 1J$; $\leq 4j$ $p_{\text{T}}^{J_1} > 200$ GeV b-tagged track jet veto outside J_1					$\geq 2j$; $\leq 4j$ $p_{\text{T}}^{j_1} > 45$ GeV $\sum_i p_{\text{T}}^{j_i} \geq 120\,(150)$ GeV for $2j$ ($\geq 3j$)				
V-tag	**High purity:** mass and substructure **Low purity:** mass and inverted substructure					$\Delta\phi(j_1, j_2) < 140°$; $\Delta R(j_1, j_2) < 1.4$ $m_{j_1 j_2} \in [65, 105]$ GeV				
	SR	CR2mu	CR2el	CR1mu0b	CR1mu1b	SR	CR2mu	CR2el	CR1mu0b	CR1mu1b
Trigger	$E_{\text{T}}^{\text{miss}}$	$E_{\text{T}}^{\text{miss}}$	Electron	$E_{\text{T}}^{\text{miss}}$	$E_{\text{T}}^{\text{miss}}$	$E_{\text{T}}^{\text{miss}}$	$E_{\text{T}}^{\text{miss}}$	Electron	$E_{\text{T}}^{\text{miss}}$	$E_{\text{T}}^{\text{miss}}$
e	0	0	2	0	0	0	0	2	0	0
μ	0	2	0	1	1	0	2	0	1	1
$\mathcal{S}$	>8	-	-	-	-	>8	-	-	-	-
$m_{\ell\ell}$ [GeV]	-	$\in [66, 116]$	$\in [66, 116]$	-	-	-	$\in [66, 116]$	$\in [66, 116]$	-	-
$m_{\mu\nu}^{\text{T}}$ [GeV]	-	-	-	$\in [30, 100]$	$\in [30, 100]$	-	-	-	$\in [30, 100]$	$\in [30, 100]$
$n_{b\in J}$	-	-	-	0	≥ 1	-	-	-	-	-
n_b	-	-	-	-	-	-	-	-	0	≥ 1

Results

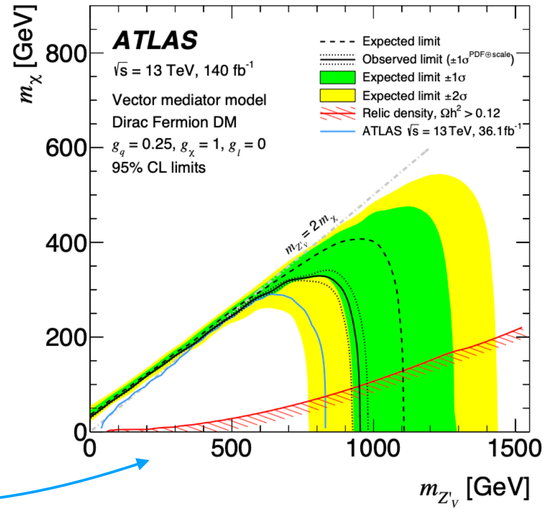
No significant excess of data over the expected background is observed.

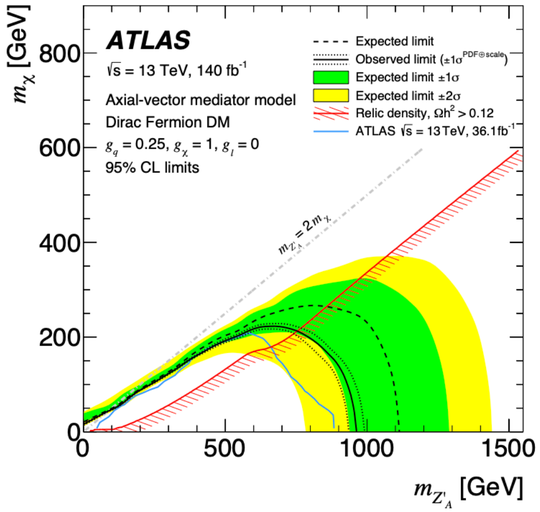






Benchmark scenario 1: 2D scans in the m_A-m_a plane, assuming tanβ = 1.0 with sinθ = 0.35 or sinθ = 0.7





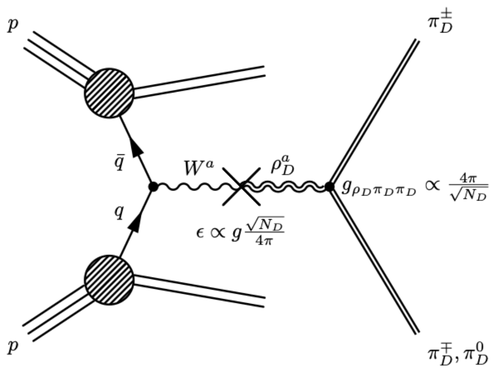
- SM: B($H \rightarrow inv.$) <0.34 @95% CL
- ALP: for m_a=1MeV..1GeV, Limit in c_W-f_a plane
- 2HDM+a: example Limit in mA-ma plane for fixed tanβ & sinθ
- SDM: for vec. & axial couplings in m_X - m_V plane

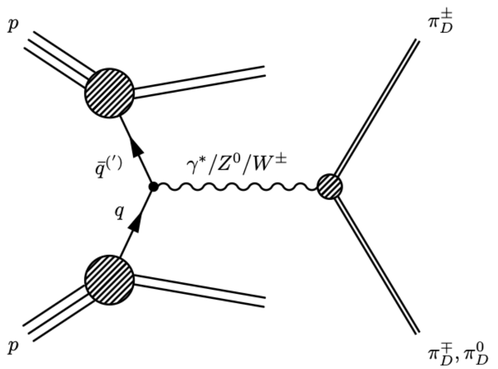
Dark Mesons

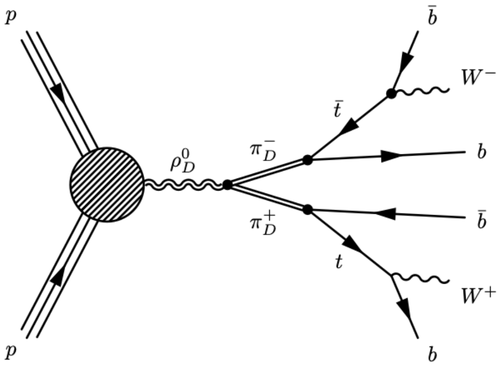
CERN-EP-2024-150

decaying to t and b

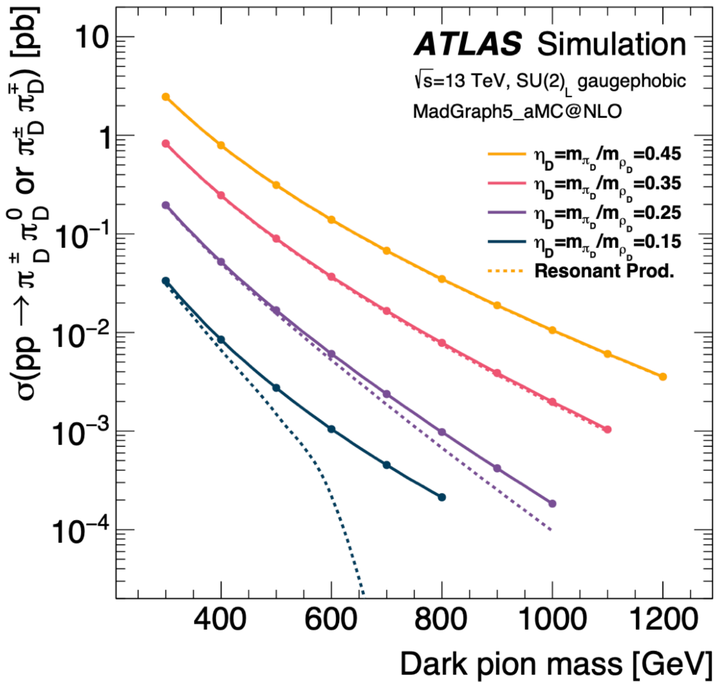
- Motivation: Additional dark SU(2)
  - Strongly coupled Dark Matter, QCD-like dark sector
  - Stable dark scalar baryon as DM candidate
  - Stealth Dark Matter
  - $\sigma SU2_L > \sigma SU2_R$
- 2 new particles are considered
  - pseudoscalar triplet of dark pions, π_D
  - vector triplet of dark mesons, ρ_D
- 3 free parameters
  - m (π_D) m (ρ_D) $N_{Dcolours}$ =4
  - 300< m (π_D) < 1200 GeV
  - η_D = m (π_D) / m (ρ_D)
  - 0.15 < η_D < 0.45
    - $\rho_D \rightarrow 2\ \pi_D$







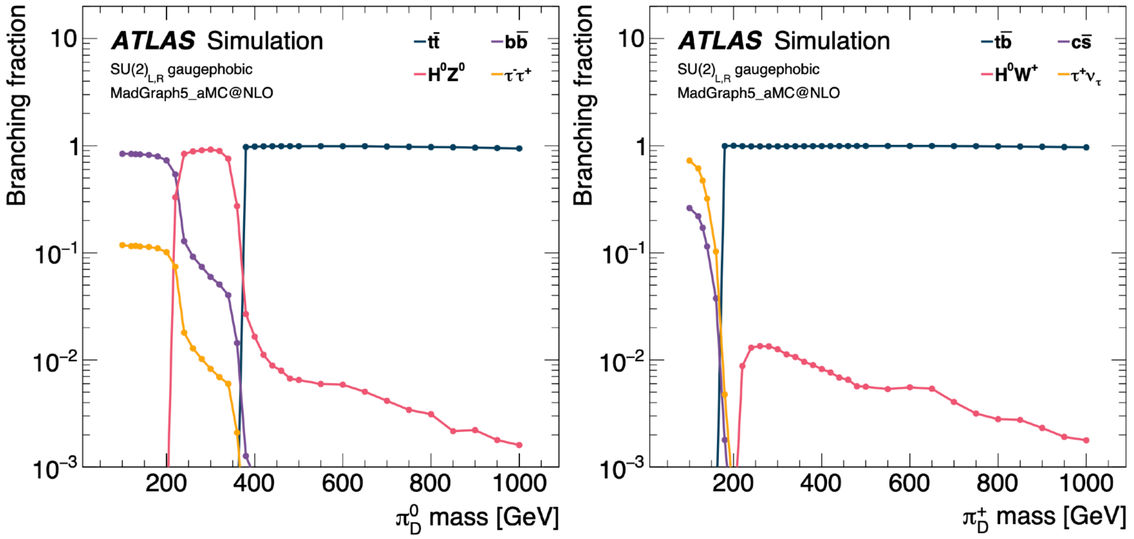
Dark Pion production



Analysis strategy

Gaugephobic decays are considered

- Decays to SM particles
  - High π_D mass: decay to t & b
  - Low π_D mass: decay to b , c & τ
- Channels & Dominant Bgs
  - All hadronic: MultiJets
  - 1 lepton: $t\bar{t}$ HF, V+jets
- Reconstruction
  - dark pion as a large-R jet (R=1.2): LJ
    - Preselection based on Nj, Nl,HT
  - All hadronic: 8 to 10 jets w/ >=4 b-taged
    - m_{LJ0} > 300 GeV m_{LJ1} > 250 GeV
    - m_{bb} / pT_{bb} > 0.25 && $\Delta R(j, b_2)$<1.0
  - 1 lepton: 5 to 7 jets w/ >=3 b-tagged
    - $\Delta R(\ell, b2) < 2.7$ angle between the lepton in the event and the second closest b-jet to this lepton
    - $m_{bb,\min\Delta R} > 100$ GeV invariant mass of the two b-jets in the event that are closest to each other

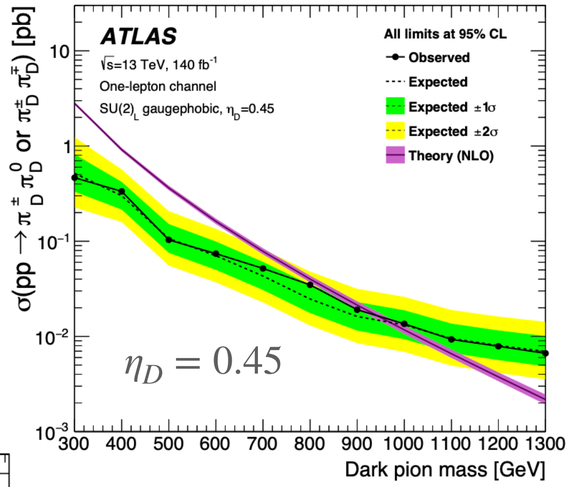


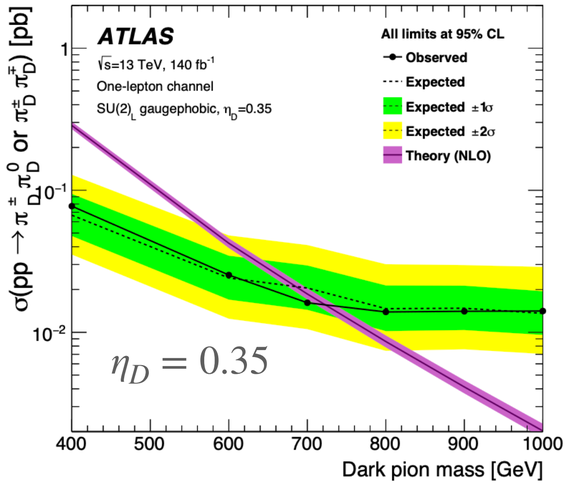
Variable	All-hadronic channel	One-lepton channel
N_{lep}(baseline)	0	1
N_{lep}(signal)	-	1
$N_{jets}(R = 0.4)$	≥ 6	≥ 5
$N_{jets}(R = 1.2)$	≥ 2	-
$N_{b\text{-jets}}$	≥ 3	≥ 3
H_T	≥ 1150 GeV	≥ 300 GeV

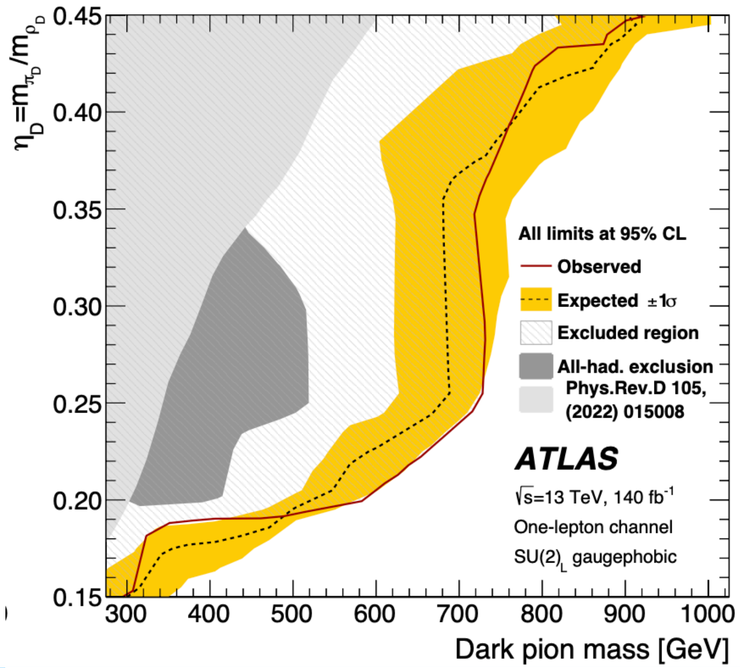
Results

No significant excess of data over the expected background is observed.

- Dark pion exclusions
  - SU(2)R - not sensitive due to low production cross-section
- 1-lepton channel fully covers all hadronic results
  - $\eta_D = 0.15$ excl : < 315 GeV
  - $\eta_D = 0.25$ excl : < 740 GeV
  - $\eta_D = 0.35$ excl : < 720 GeV
  - $\eta_D = 0.45$ excl : < 940 GeV







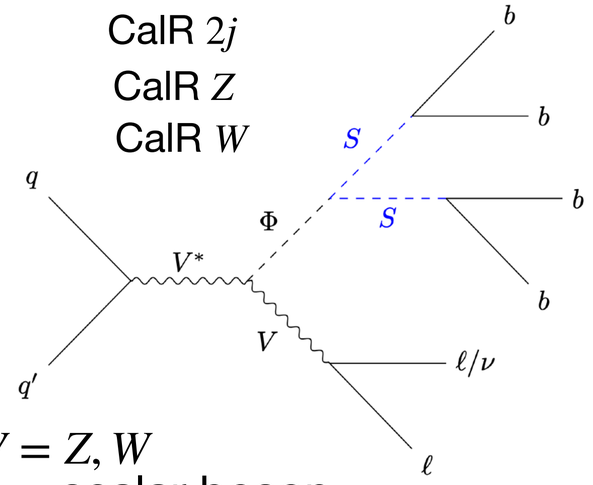
Neutral LLPs

CERN-EP-2024-181

also the SUSY-LLP talk by R. USHIODA

- Motivated by: SuSy, HiddenSector, AxionLike Particles, DarkMatter...
- Neutral, lifetime long enough to decay after a few cm to ~10 m
  - No signal in tracker, decays hadronically in or after EMcalo, small EM signal.
  - define CalR = E_h / E_{em}
- 3-Channel search: CalR +2j, CalR+W, CalR+Z
- Dominant Bgs: SM multiJets, W/Z+jets, $t\bar{t}$, singleTop
  Cosmic & Beam bg

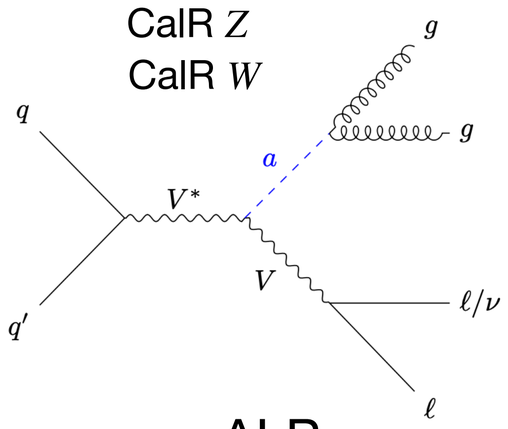
CalR $2j$
CalR Z
CalR W



$V = Z, W$
Φ = scalar boson
S = LLP

pair production

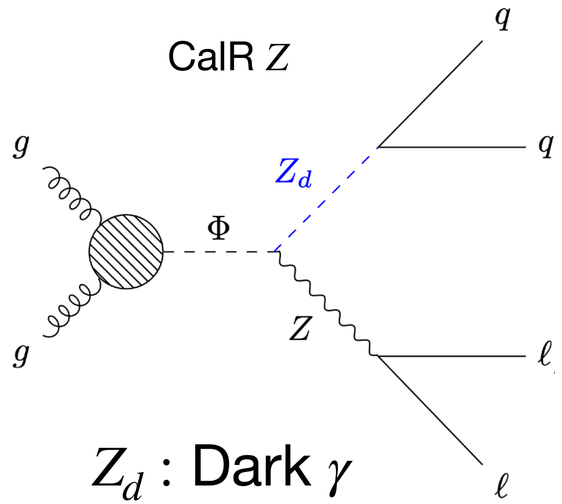
CalR Z
CalR W



a = ALP

single production

CalR Z



Z_d : Dark γ

single production

Analysis strategy

- Selection
  - per-jet NN to discriminate signal-like jets, BIB-like jets & SM multijets
  - per-event ML selection signal-bg seperation
  - SRs covering
    - Pair of LLPs decaying to jets
    - Single LLP + Z/W
    - Pair of LLPs + Z/W
- Channels
  - CalR+2J
    - 1 displaced+2trackless jets
    - ABCD method for bg estimation
    - HS models
  - CalR+W
    - only 1 lepton, >=1 trackless jet w/ pT>40GeV
    - BDT for 3 regions: ALP, mΦ<200, mΦ>200
  - CalR+Z
    - 2 OS leptons, >=1 trackless jet w/ pT>40GeV
    - HS,ALP,Z_d : BDT for 2 regions: m_Φ<250, m_Φ>250

Selection	CalR+2J
Trigger	Satisfy CalRatio trigger
Number of clean jets	≥ 3
$\sum \Delta R_{\text{min}}$	> 0.5
Trigger matching	At least one signal candidate
Signal/BIB jet candidate time	-3 ns $< t <$ 15 ns
Signal/BIB jet candidate $\log_{10}(E_{\text{H}}/E_{\text{EM}})$	> -1.5
Signal jet candidate η	$\notin (1.45, 1.55)$
$\text{NN}_{\text{CalR+2J}}$	≥ 3
Region A	$\sum \Delta R_{\text{min}} \geq 0.71$ $\text{NN}_{\text{CalR+2J}} \geq 7.61$

Selection	CalR+W $WALP$	CalR+W low-E_{T}	CalR+W high-E_{T}
Vector boson candidates	0 Z, 1 W	0 Z, 1 W	0 Z, 1 W
BDT score	$\text{BDT}^{\text{ALP}}_{\text{CalR+}W} > 0.82$	$\text{BDT}^{\text{low-}E_{\text{T}}}_{\text{CalR+}W} > 0.92$	$\text{BDT}^{\text{high-}E_{\text{T}}}_{\text{CalR+}W} > 0.89$
$j^{\text{sig1}\ell}$ $\log_{10}(E_{\text{H}}/E_{\text{EM}})$	> 1	> 1	–
$j^{\text{sig1}\ell}$ p_{T}	> 70 GeV	> 60 GeV	> 100 GeV
Lepton p_{T}	–	> 40 GeV	> 60 GeV
$\Delta\phi$(lepton, E_T^{miss})	< 1.5	–	–
Region A	$\text{BDT}^{\text{ALP}}_{\text{CalR+}W} \geq 0.975$ $\sum \Delta R_{\text{min}} \geq 1.1$	$\text{BDT}^{\text{low-}E_{\text{T}}}_{\text{CalR+}W} \geq 0.985$ $\sum \Delta R_{\text{min}} \geq 1.4$	$\text{BDT}^{\text{high-}E_{\text{T}}}_{\text{CalR+}W} \geq 0.99$ $\sum \Delta R_{\text{min}} \geq 1.1$

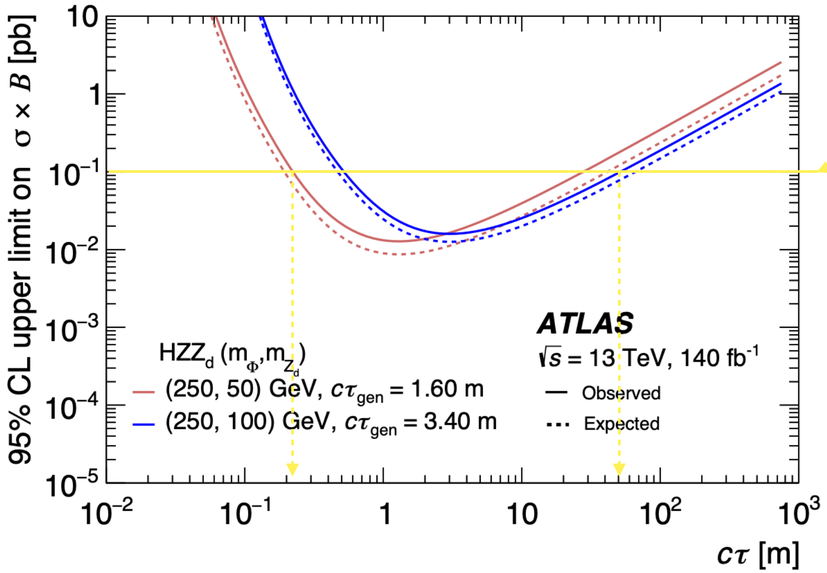
Selection	CalR+Z low-E_{T}	CalR+Z high-E_{T}
Vector boson candidates	1 Z, 0 W	1 Z, 0 W
BDT score	$\text{BDT}^{\text{low-}E_{\text{T}}}_{\text{CalR+}Z}$ score > 0.6	$\text{BDT}^{\text{high-}E_{\text{T}}}_{\text{CalR+}Z}$ score > 0.7
$j^{\text{sig1}\ell}$ $\log_{10}(E_{\text{H}}/E_{\text{EM}})$	> 0.8	> 0.8
$j^{\text{sig1}\ell}$ p_{T}	> 80 GeV	> 70 GeV
Lepton p_{T}	> 70 GeV	> 60 GeV
Region A	$\text{BDT}^{\text{low-}E_{\text{T}}}_{\text{CalR+}Z}$ score > 0.99 $\sum \Delta R_{\text{min}} \geq 0.9$	$\text{BDT}^{\text{high-}E_{\text{T}}}_{\text{CalR+}Z}$ score > 0.985 $\sum \Delta R_{\text{min}} \geq 1$

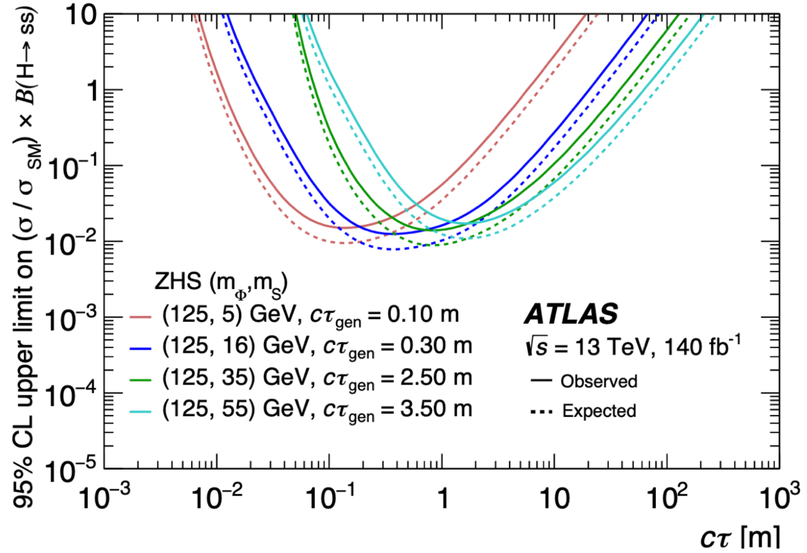
Results

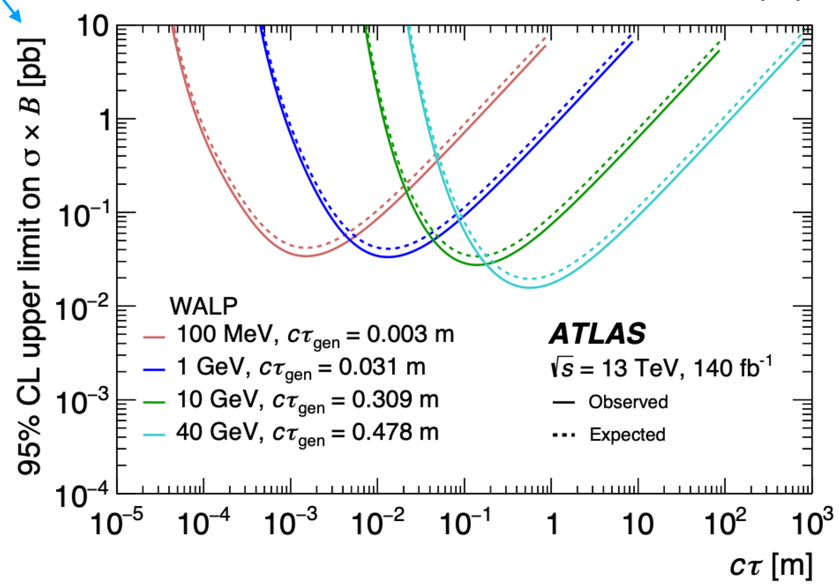
No significant excess of data over the expected background is observed.

- HS
  - exclude B(H→2*S*) > 1% for LLP decay len. >30cm & <4.5m
- ALP +Z/W
  - exclude σ_{prod} >0.1pb for decay len. >10mm & <10m.
- Z_d +Z
  - exclude σ_{prod} >0.1pb for decay len. >20cm & <50m.

see the yellow guidelines



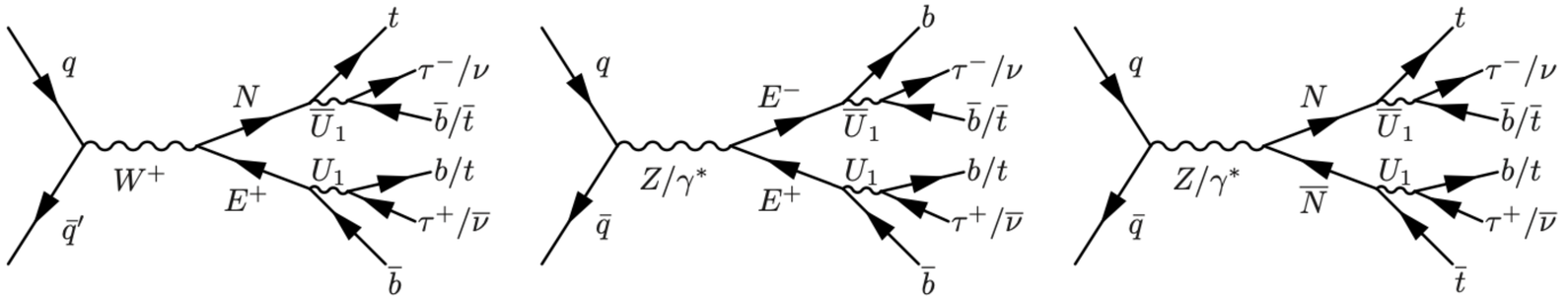




Vector Like Leptons

ATLAS-CONF-2024-008

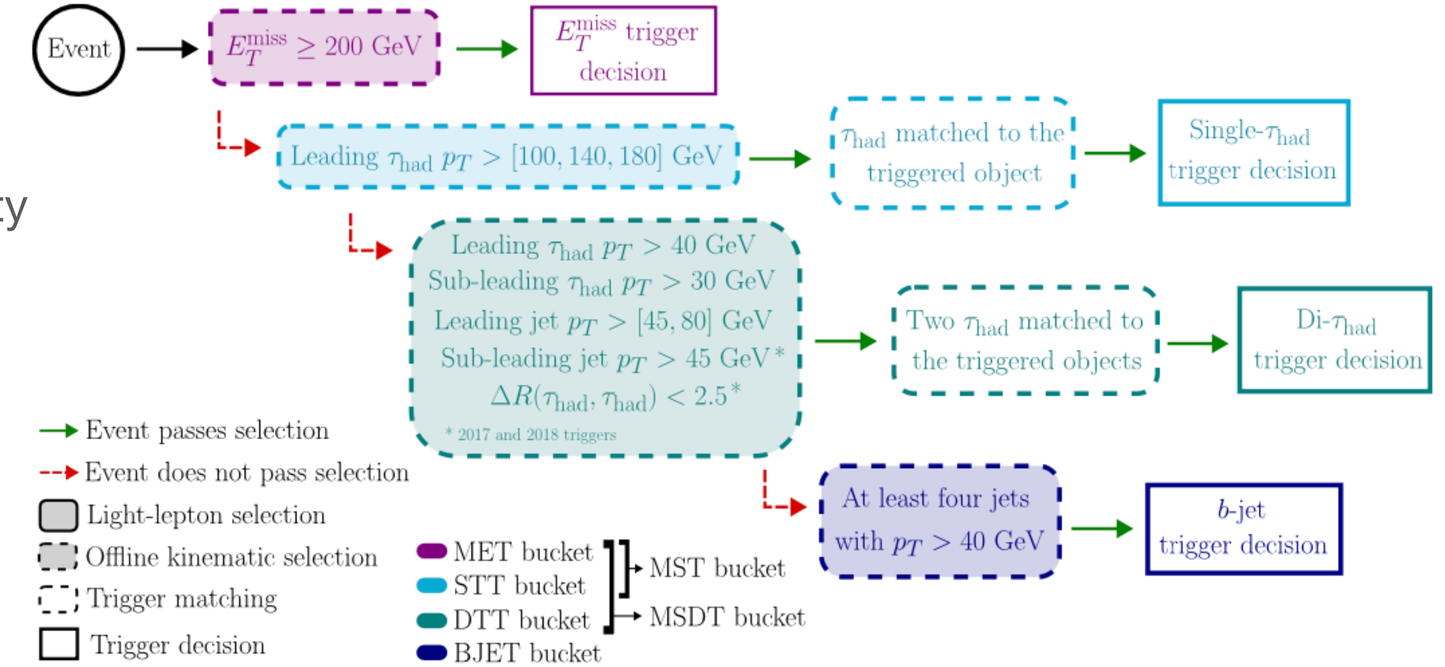
- Motivated by: 4321 model, SU(4)xSU(3)'xSU(2)$_L$xU(1)'
  - Lqs (U_1), 3 new gauge bosons, vector-like leptons (E/N) and quarks (U/D)
  - VLL: possible solution to hierarchy problem
- Earlier study by CMS 2.8σ excess m_{VLL}~600GeV (Phys. Lett. B 846 (2023) 137713)
- This study on E & N pair production.
  - Z', G' pushed to 100 - 5 TeV scale, irrelevant
  - m(U_1) ~ 3.5 TeV, coupling to 3rd gen. fermions only BR($U_1 \to b\tau^+$)= BR($U_1 \to t\overline{\nu_\tau}$)=0.5
  - m(VLL) ~ [200 , 1500] GeV free parameter
- Dominant Bgs: $t\bar{t}$, Z/W+jets



τ focused search

Analysis strategy

- 0ℓ + >=1 τ_{had} : SR & CR
  - different trigger "bucket"s to max. sensitivity
  - decision tree for
    - MET, SingleTauTrig., DiTauTrig., BJTrig.
- >= 1ℓ : Scale and Validation regions
- NN based classification
  - training with kinetic variables in 3 evt classes
  - NN score as discriminant



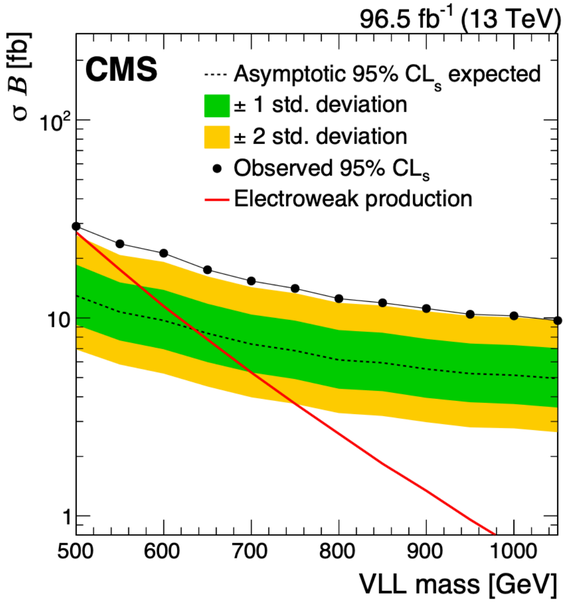
Variable	Event category		
	$1\tau_{\text{had}} \geq 3b$ MST	$1\tau_{\text{had}} \geq 3b$ BJET	$\geq 2\tau_{\text{had}} \geq 3b$ MSDT
n^{trig}	✓		✓
$p_{\text{T},0}^{\tau_{\text{had}}}$	✓	✓	✓
$p_{\text{T},1}^{\tau_{\text{had}}}$			✓
$p_{\text{T},2}^{\tau_{\text{had}}}$			✓
N_{jets}	✓	✓	✓
$N_{\tau_{\text{had}}}$			✓
$H_{\text{T,jets}}$	✓	✓	✓
$E_{\text{T}}^{\text{miss}}$	✓	✓	✓
$m(\tau_{\text{had},0}, \tau_{\text{had},1})$			✓
$m(\tau_{\text{had},0}, b_0)$	✓	✓	✓
$m(b_0 b_1, \tau_{\text{had},0})$	✓	✓	✓
$m(b_0 b_1, E_{\text{T}}^{\text{miss}})$	✓	✓	✓
Σb^{PCB}	✓		✓
$n^{\tau_{\text{had}}\text{ID}}$			✓
$\min(\Delta\phi(E_{\text{T}}^{\text{miss}}, \text{jets}))$	✓	✓	✓
$\min(\Delta\phi(E_{\text{T}}^{\text{miss}}, \tau_{\text{had}}))$	✓	✓	✓
$N_{\text{trk}}^{\tau_{\text{had}}}$	✓	✓	✓
$Q_{\tau_{\text{had},0}}$	✓	✓	✓
$\Sigma Q_{\tau_{\text{had}}}$			✓

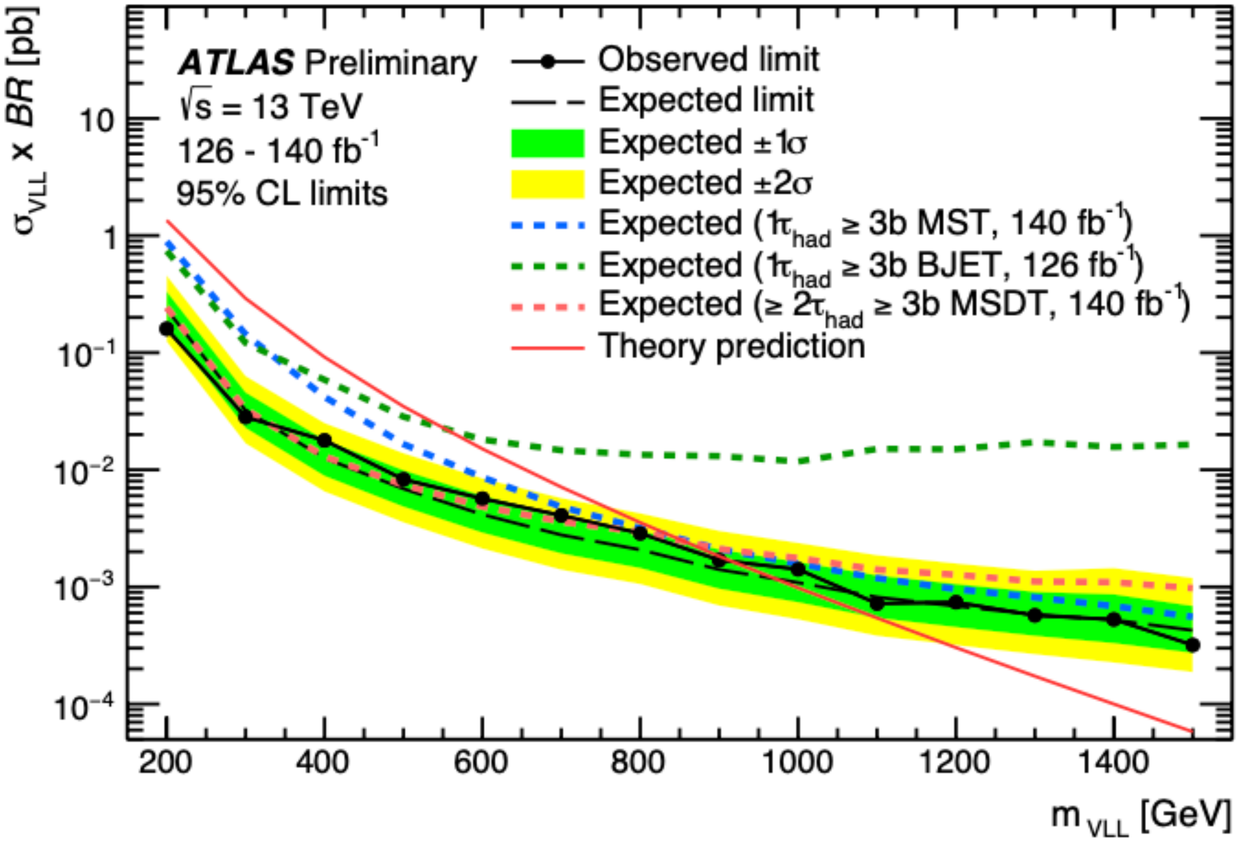
Signal Region	$1\tau_{\text{had}}3b$ MST	$1\tau_{\text{had}} \geq 4b$ MST	$1\tau_{\text{had}}3b$ BJET	$1\tau_{\text{had}} \geq 4b$ BJET	$\geq 2\tau_{\text{had}} \geq 3b$ MSDT		
Trigger bucket	MET ∪ STT		BJET		MET	STT	DTT
Number of τ_{had}	1				≥ 2	2 (OS) or ≥ 3	
τ_{had} identification	Tight				≥ 1 Loose	≥ 1 Medium	≥ 2 Medium
Number of b-tags @77%	3	≥ 4	3	≥ 4	≥ 3		
Number of jets	≥ 4				≥ 3		
NN score distribution	NN ($1\tau_{\text{had}}$ MST)		NN ($1\tau_{\text{had}}$ BJET)		NN ($\geq 2\tau_{\text{had}}$ MSDT)		

Results

No significant excess of data over the expected background is observed.

- Shape fit over NN score distribution
  - 5SR 7CR
- results incompatible w/ previous excess @600GeV
- Obs.(exp.) 910 (970) GeV @95% CL





Summary:

No significant excess of data over the expected background is observed.

Measurements so far consistent with SM expectations,no evidence of new physics yet.

Next:

More analyses are being finalized,

More results soon…

Thank you for your attention

CERN-EP-2024-183	arXiv:2407.09168
CERN-EP-2024-128	arXiv:2406.01272
CERN-EP-2024-181	arXiv:2407.09183
CERN-EP-2024-152	arXiv:2406.01656
CERN-EP-2024-150	arXiv:2405.20061
ATLAS-CONF-2024-008	

Links to Covered Analyses