Recent results on BSM searches at LHC

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Introduction

After ten years of the discovery of a Higgs boson at LHC

- Measurements of the Higgs sector with Run1+Run2 data
  → Consistent with the SM
- But, many theoretical and experimental motivations to search for physics beyond SM

Large number of BSM searches at LHC:

BSM Searches in the Higgs Sector:

- Complimentary to the investigation of properties of the observed Higgs boson
- Includes
  - Searches for more complex Higgs sector
    - Prediction of additional Higgs bosons from many models beyond SM
  - Search for exotic decays not expected within the SM.

Other BSM Searches

- Searches for Resonances
- Non-resonance searches
- Long Lived Particles
- ….

Only a few recent results are presented here

Searches for Additional Higgs bosons

Many extensions of the SM adds scalar doublets, triplets etc.. to the Higgs sector

- 2HDM
- 3HDM
- 2HDM + Scalar
- Higgs Triplets
- ….

These models predict additional scalar bosons:

- h, H, A, $H^{\pm}$, $H^{\pm\pm}$

Searches performed in final states with

- Di-bosons ($\gamma\gamma$, $Z\gamma$, VV)
- Di-leptons ($e\mu$, $\mu\mu$, $\tau\tau$ etc..)
- Other complex final states

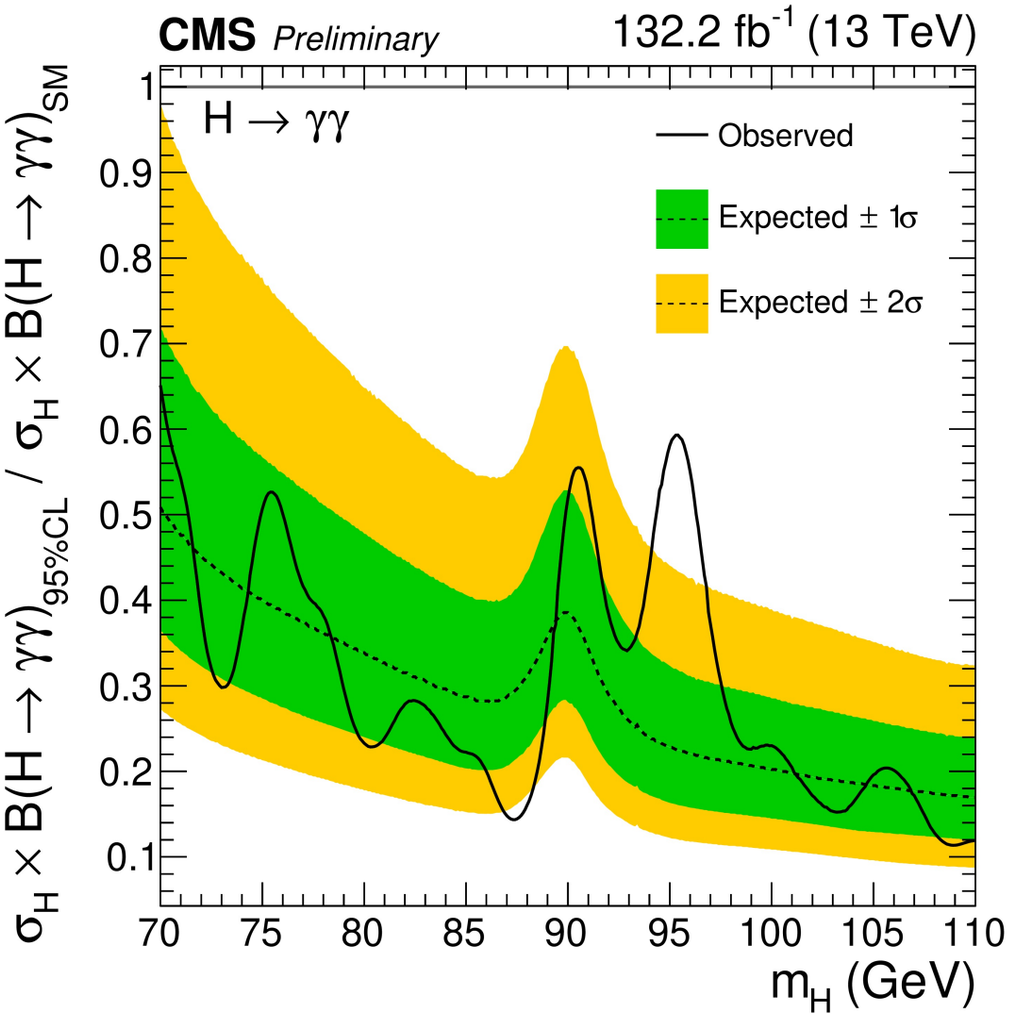
Resonant Di-Higgs searches: X → hh, X → hY, X → YY

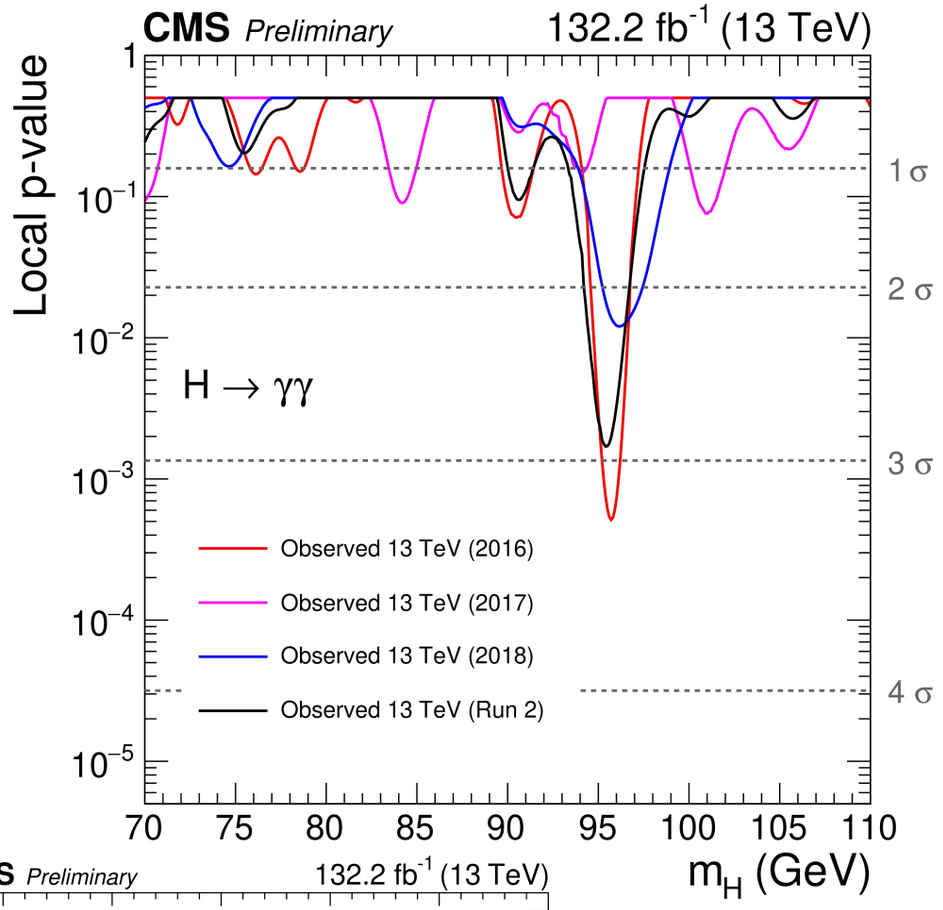
Low mass h → γγ

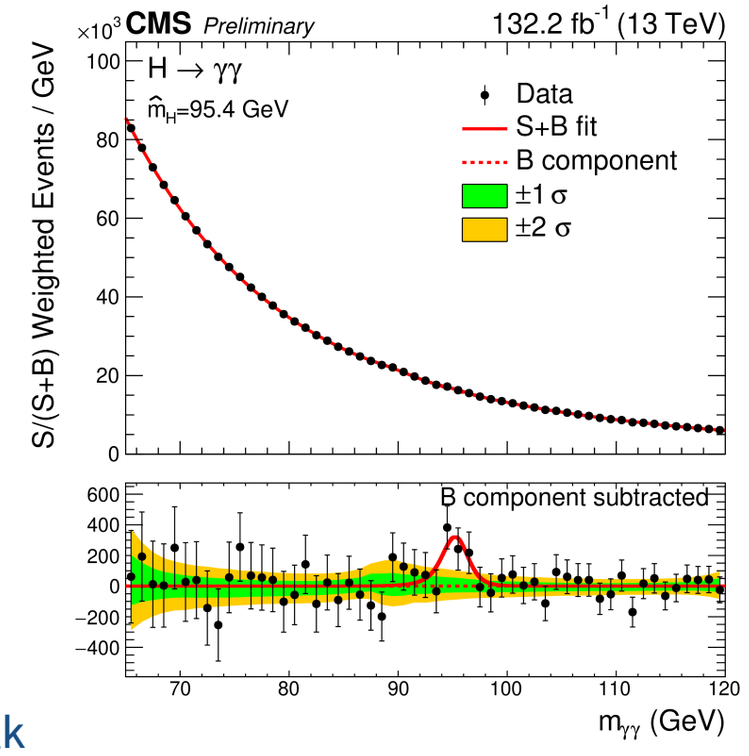
ATLAS-CONF-2023-035
JHEP 07 (2023) 155
CMS PAS HIG-20-002

Additional Higgs bosons decaying to a pair of photons
Mass range: 70 – 110 GeV
SM-like benchmark

CMS: 2.9σ local (1.3σ global) at 95.4 GeV







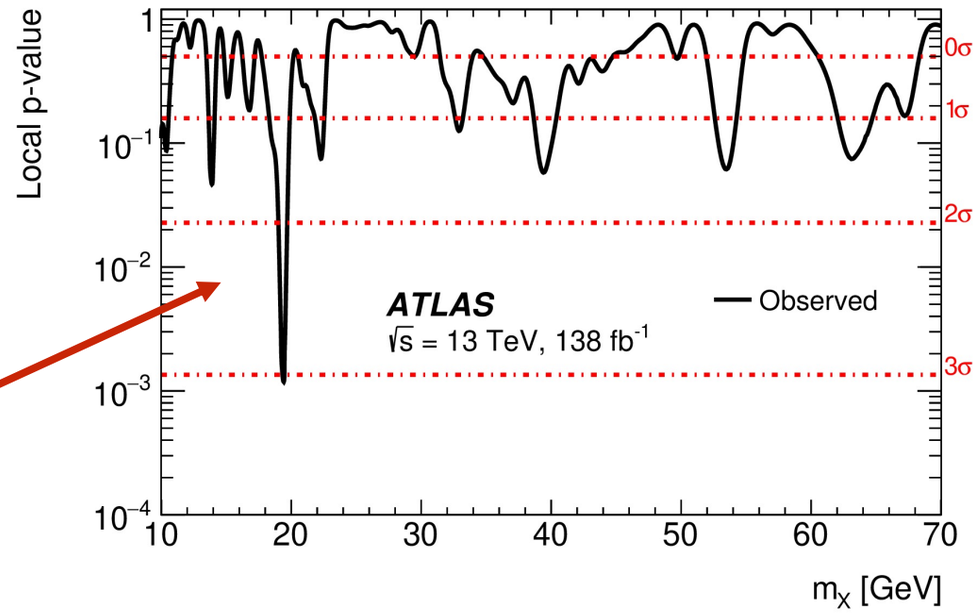
Low mass h → γγ

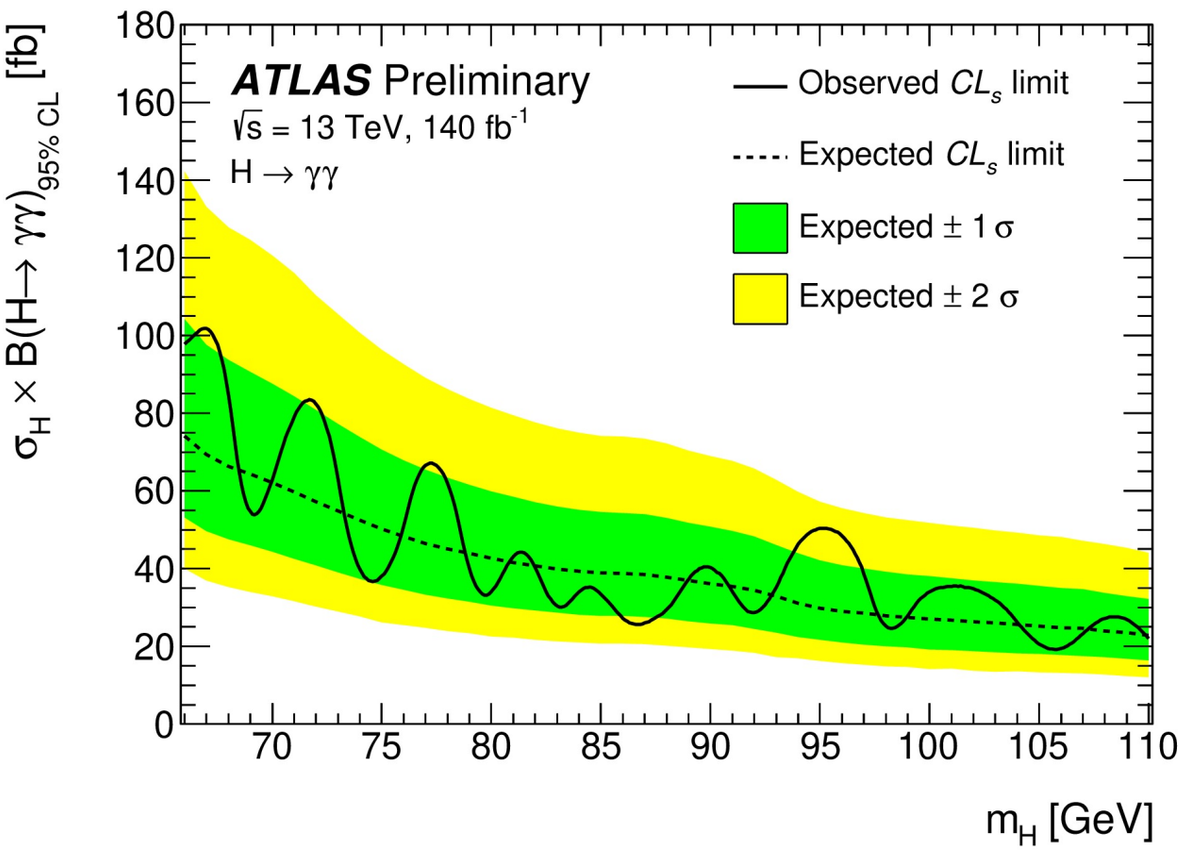
ATLAS-CONF-2023-035
JHEP 07 (2023) 155
CMS PAS HIG-20-002

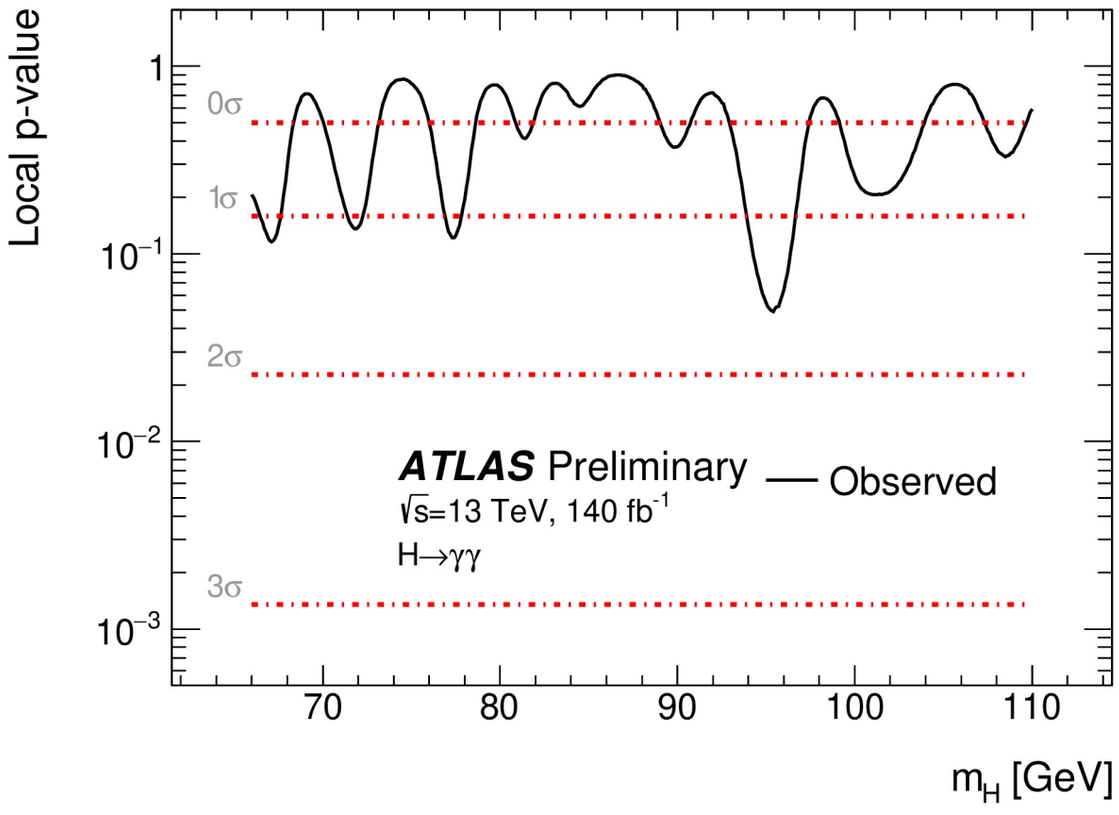
Mass range: 70 – 110 GeV
SM-like benchmark

CMS: 2.9σ local (1.3σ global) at 95.4 GeV
ATLAS: local 1.7σ at 95.4 GeV

Boosted diphoton resonance search @ ATLAS:
local 3.1σ (global 1.5σ) at 19.4 GeV







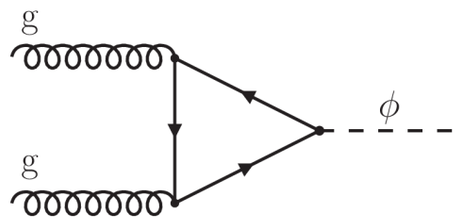
Additional H → ττ

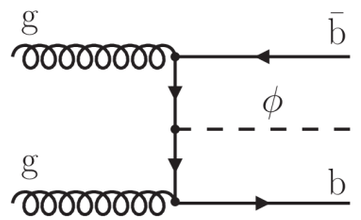
JHEP 07(2023)073

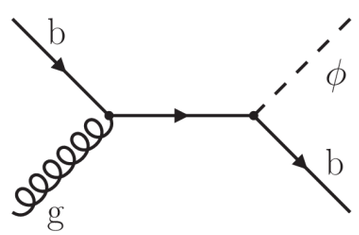
Most promising channel for MSSM

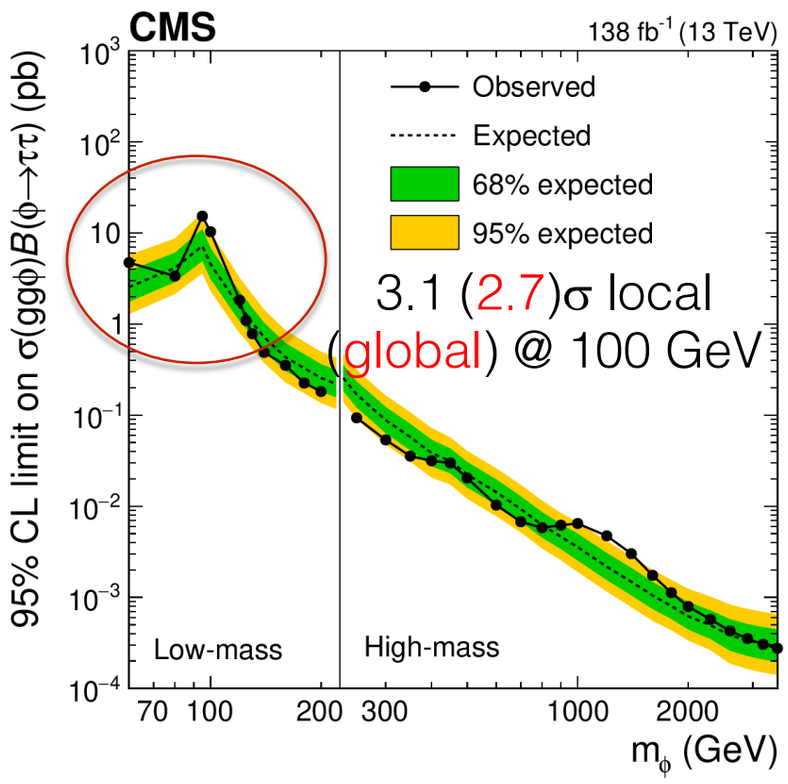
Strategy:

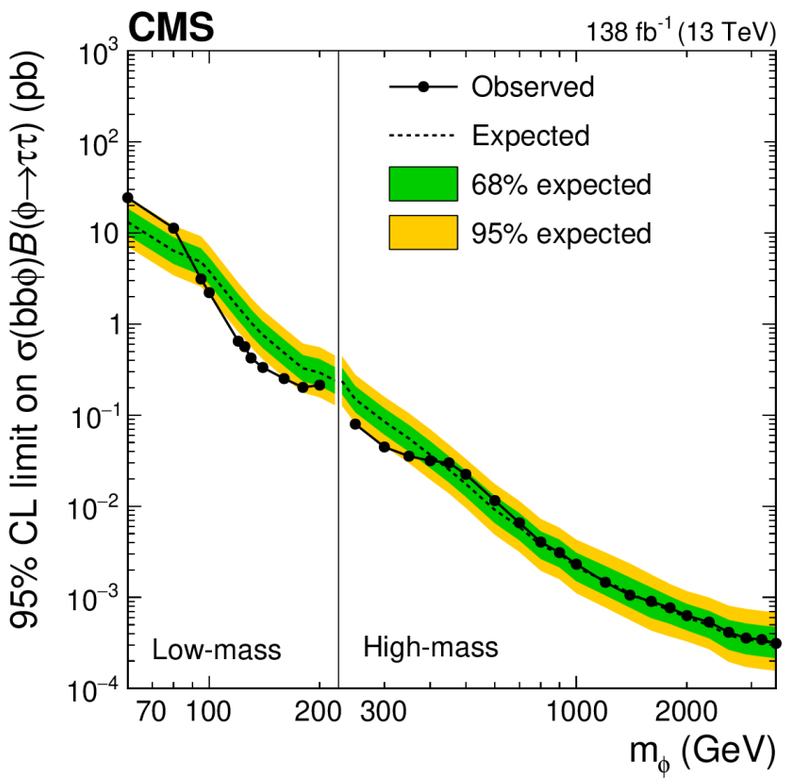
- Fitting m_T in categories for $m_\phi > 250$ GeV
- NN based analysis for $m_\phi < 250$ GeV

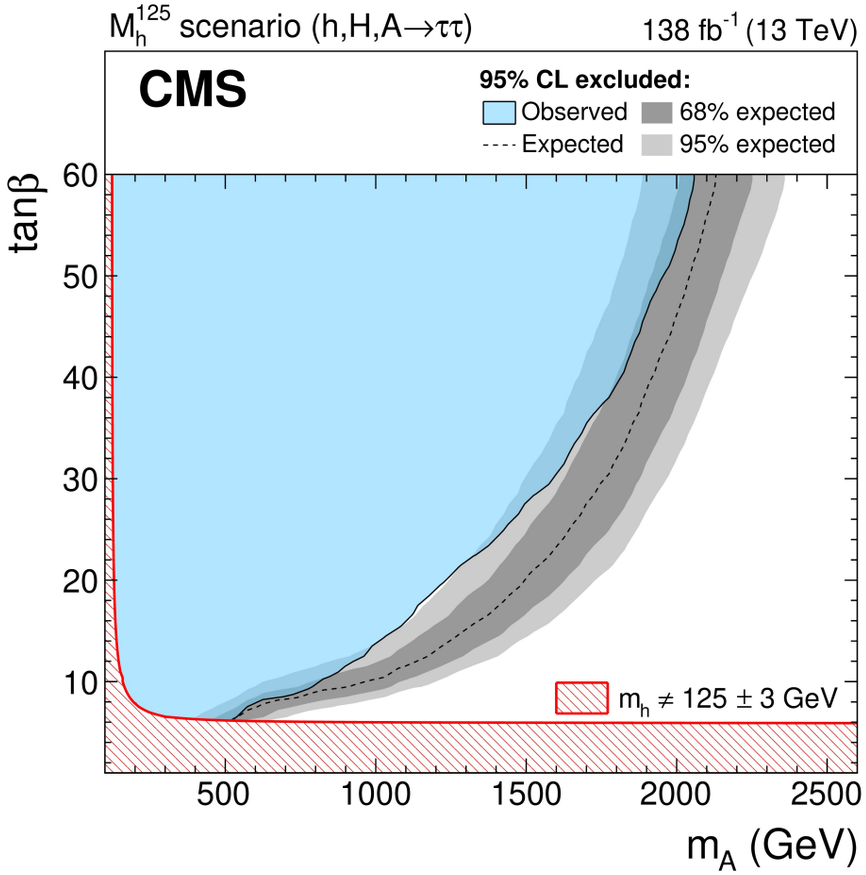








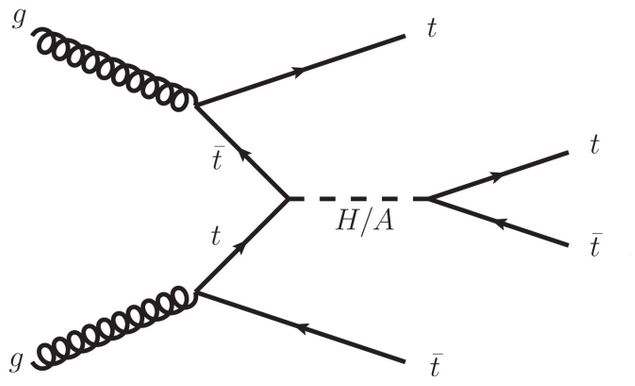




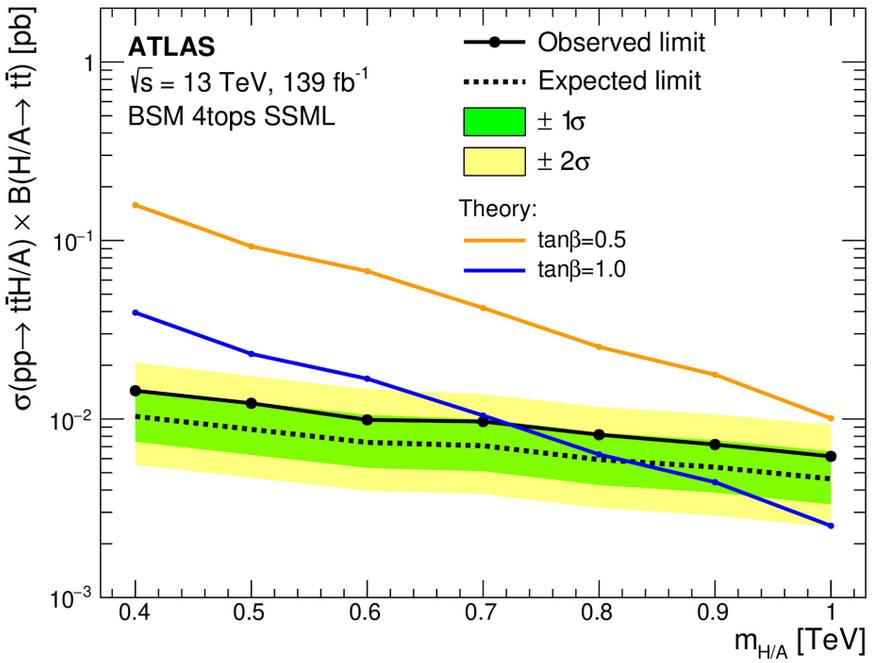
Additional Higgs bosons with masses below 350 GeV are excluded at 95% CL in M^{125}_h and $M^{125}_{h,\,EFT}$ MSSM benchmark scenarios

Higgs decaying to Top quarks

ttH/A→tttt [JHEP 07 (2023) 203]

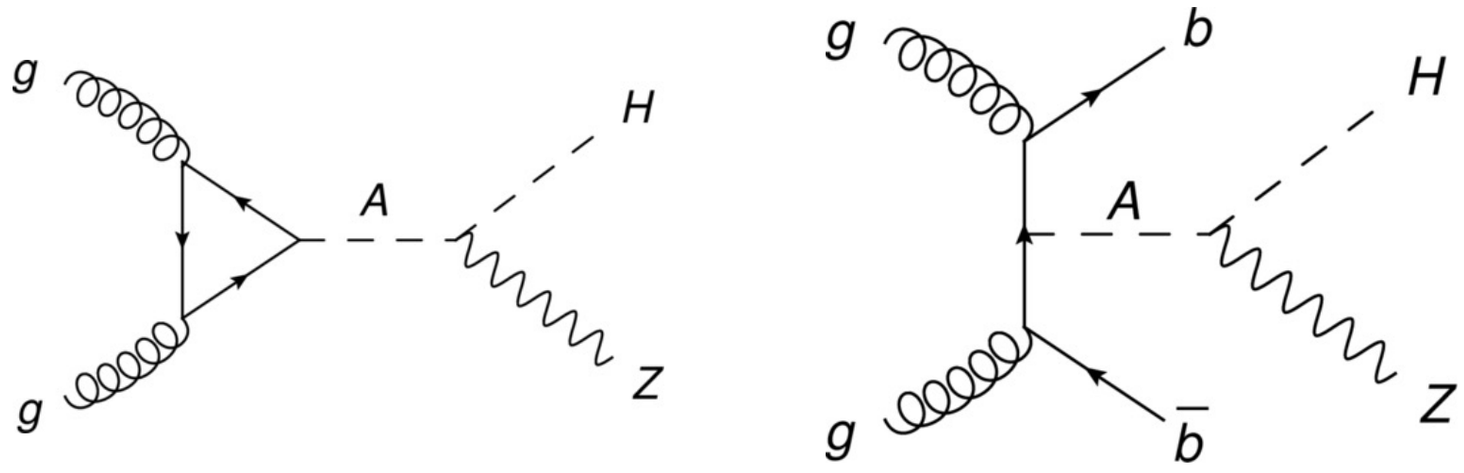


benchmark: type-II 2HDM

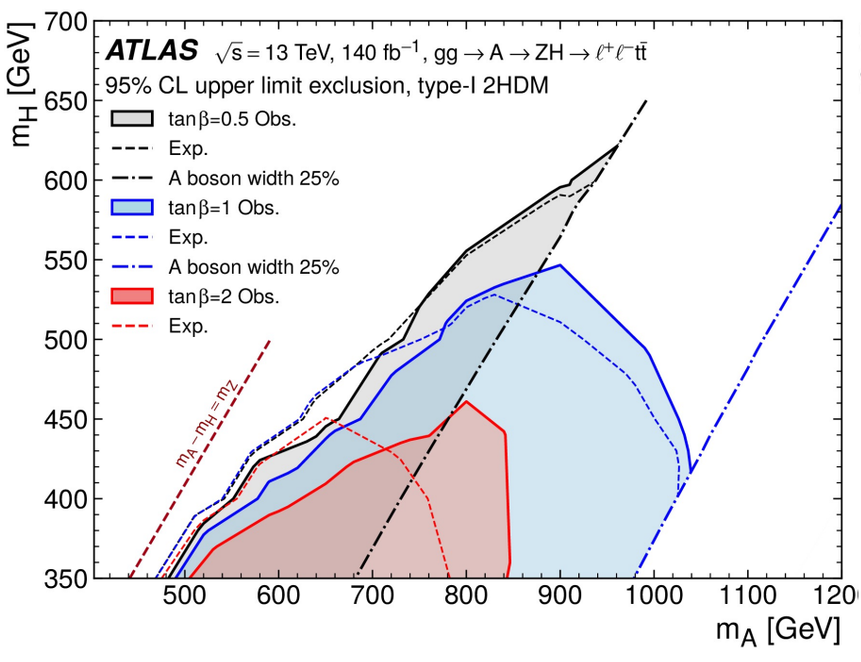


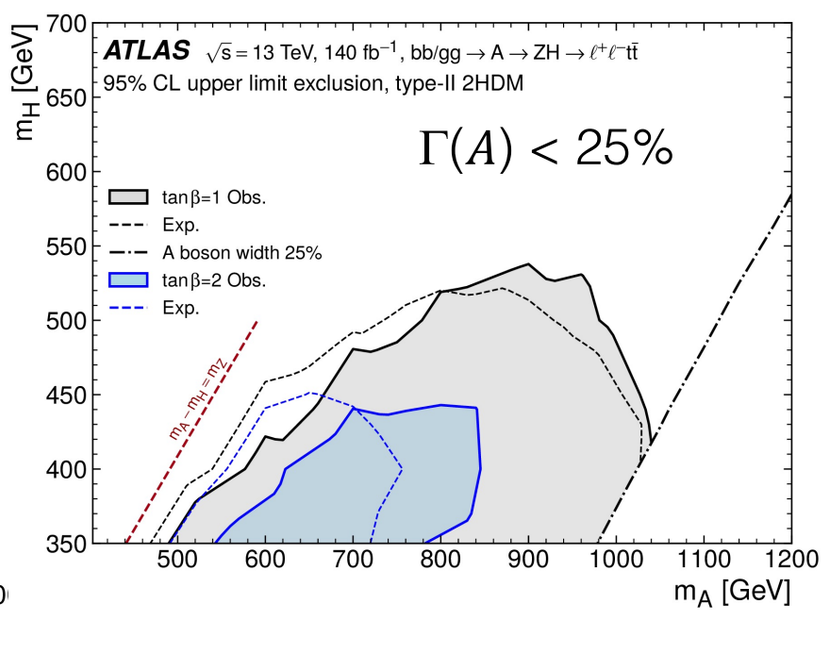
tanβ < 1.2 or 0.5 excluded for $m_{H/A}$ = 400 GeV or 1000 GeV, respectively

A → ZH → ℓℓtt, νν̄bb [arXiv:2311.04033]



benchmark: type-I & type-II 2HDM



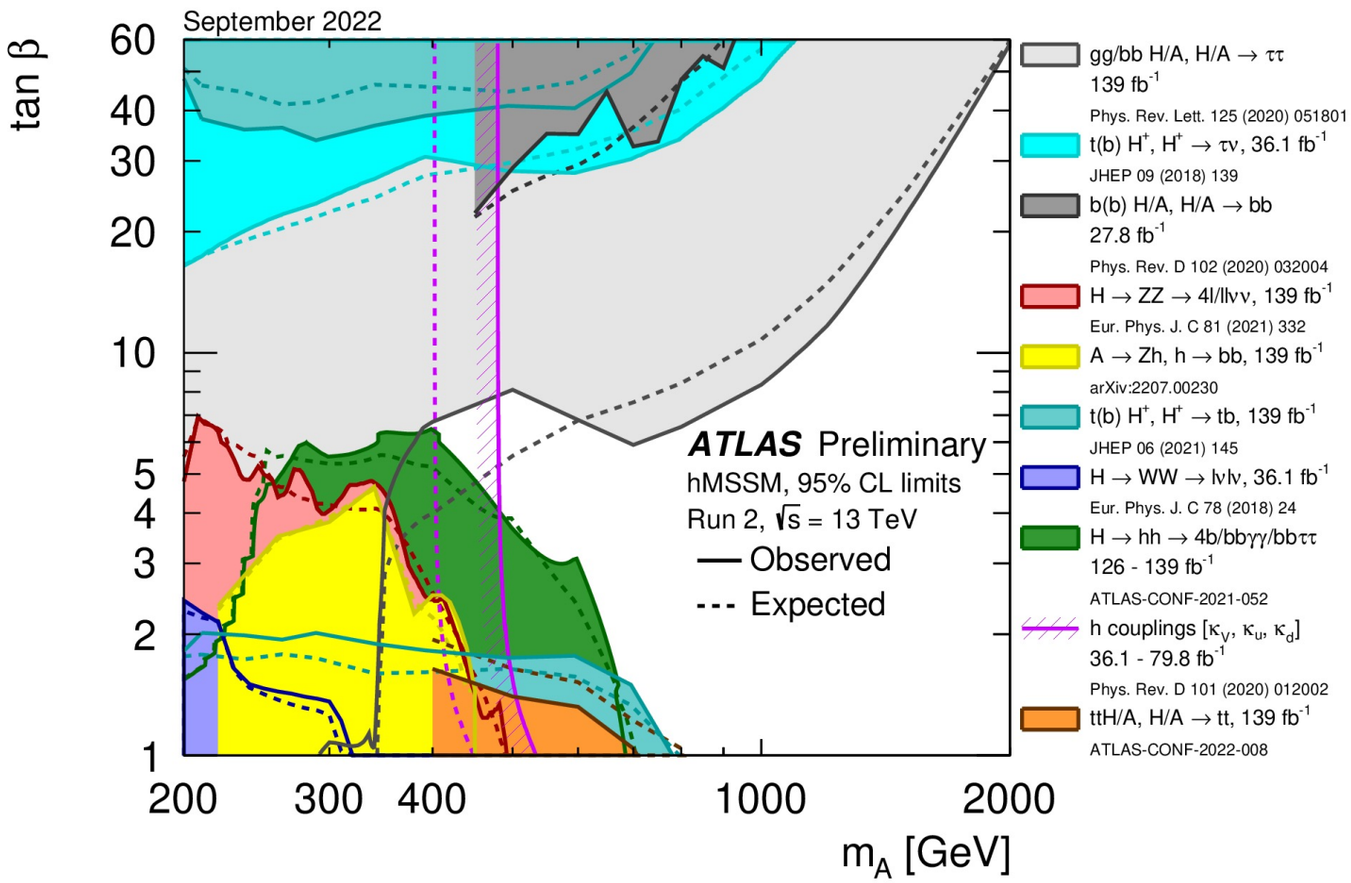


Significant improvement from previous results

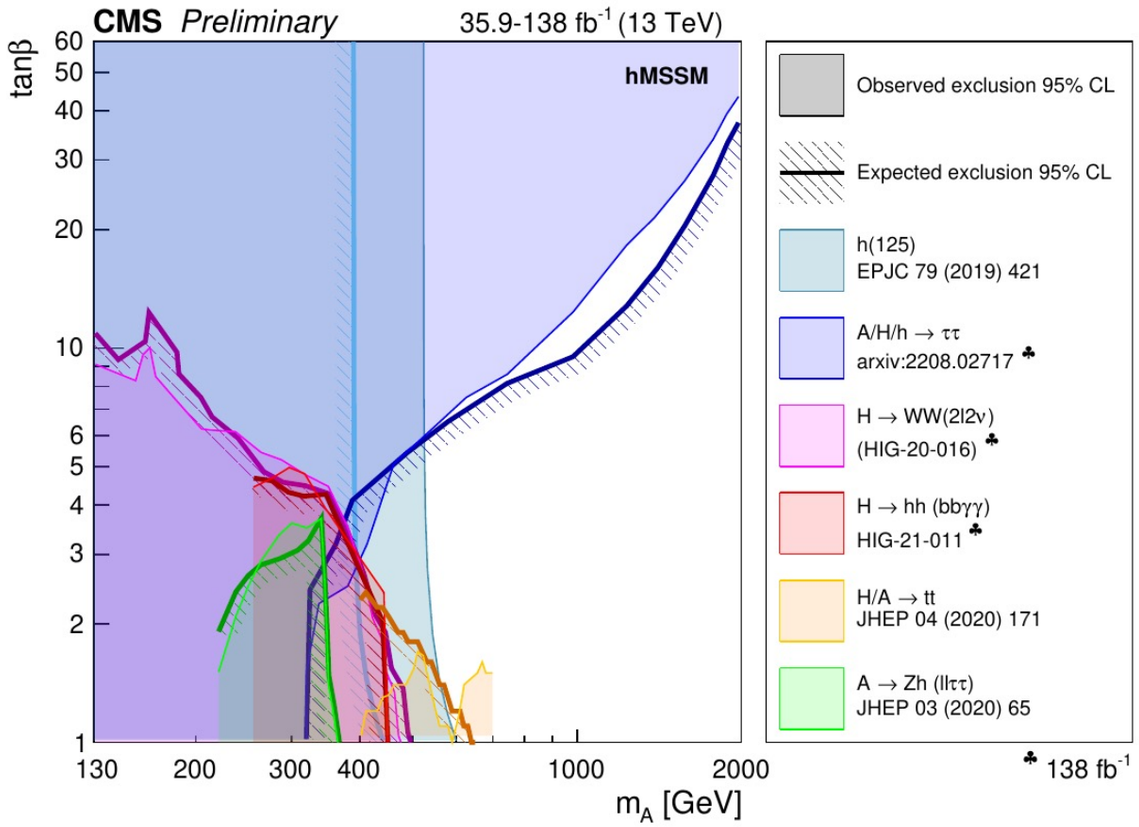
Interpretations in MSSM

Interpretation in hMSSM scenario (as proposed in arxiv:1307.5205, 1502.05653)

Exclusion of MSSM parameter space via direct searches for heavy Higgs bosons



ATL-PHYS-PUB-2022-043



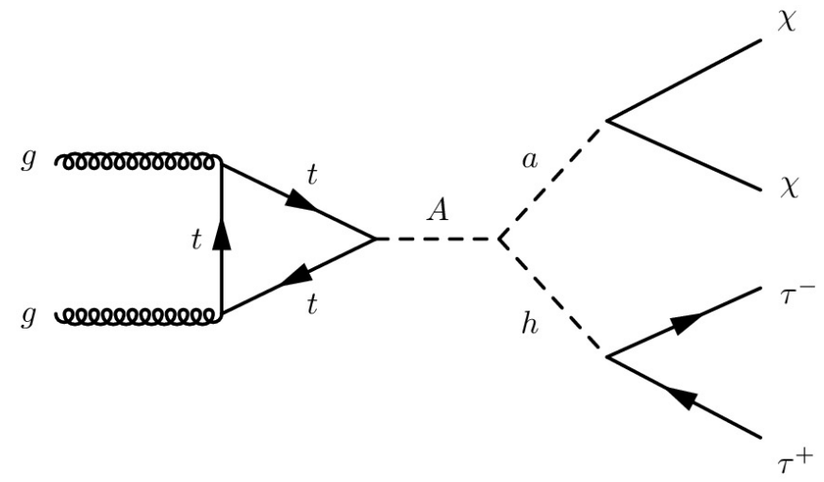
CMS Summary_of_MSSM_Higgs_Boson

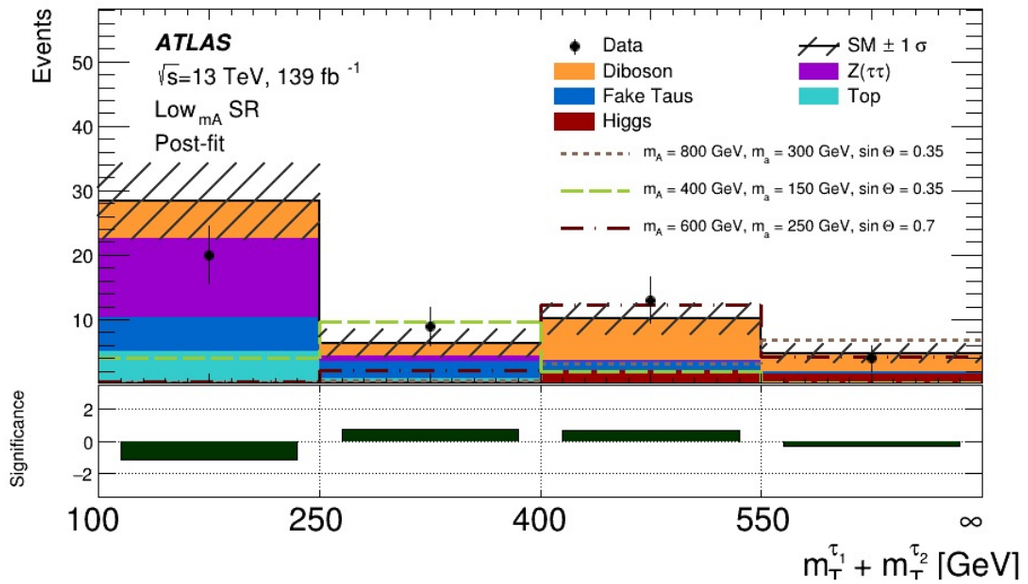
A → aH, H → ττ, a →Invisible

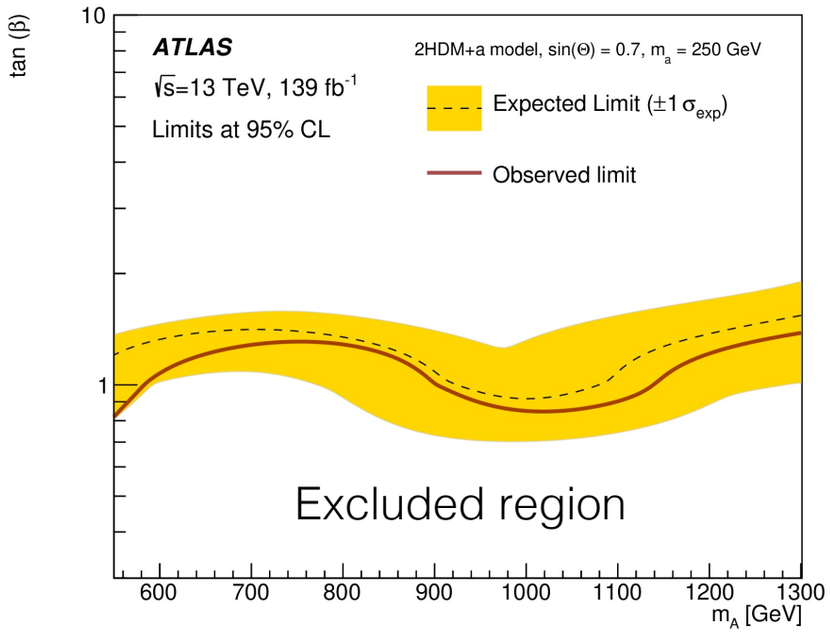
JHEP 09 (2023) 189

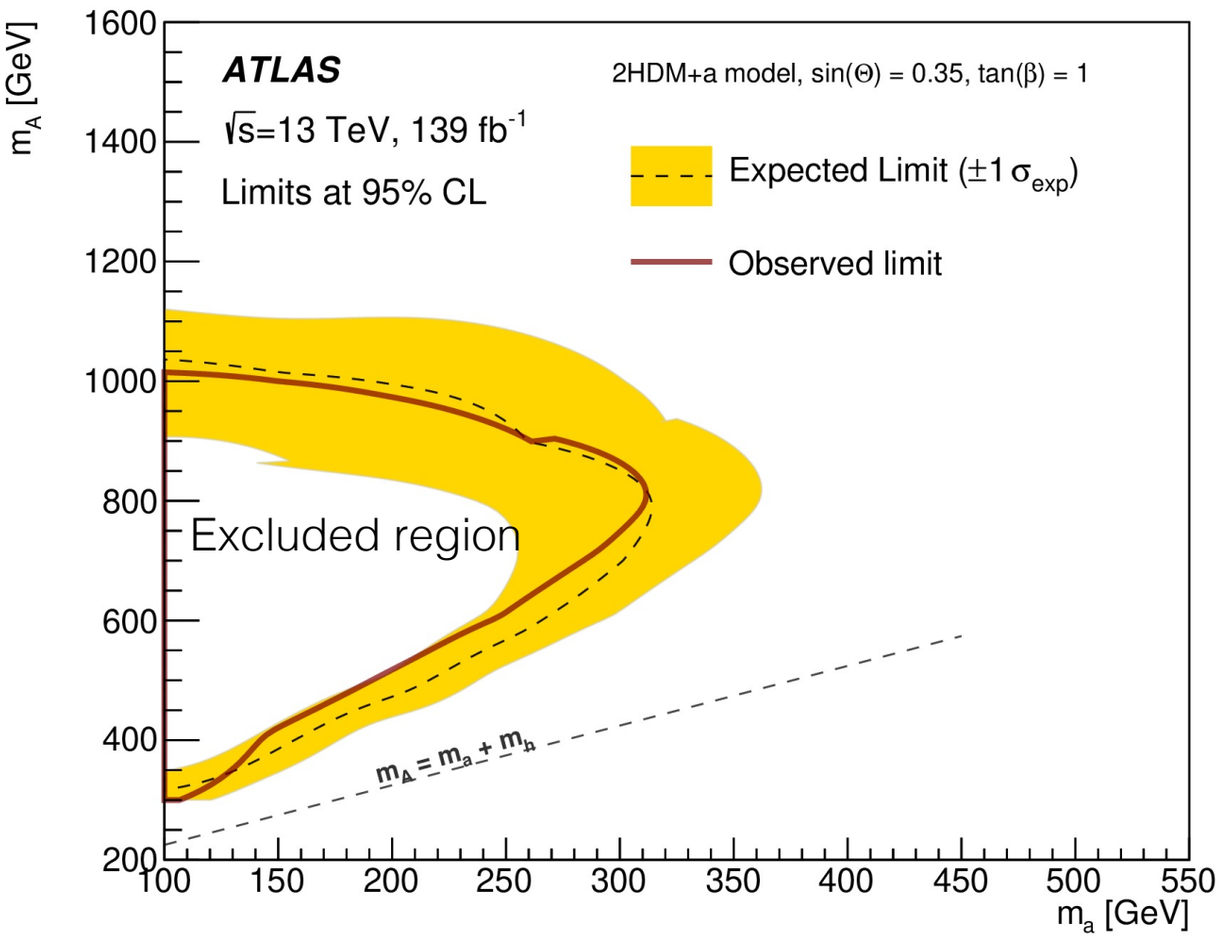
2HDM+a model (portal to DM) (arxiv:1701.07427)

- Final state: 2τ + MET
- SR for low m_A and high m_A







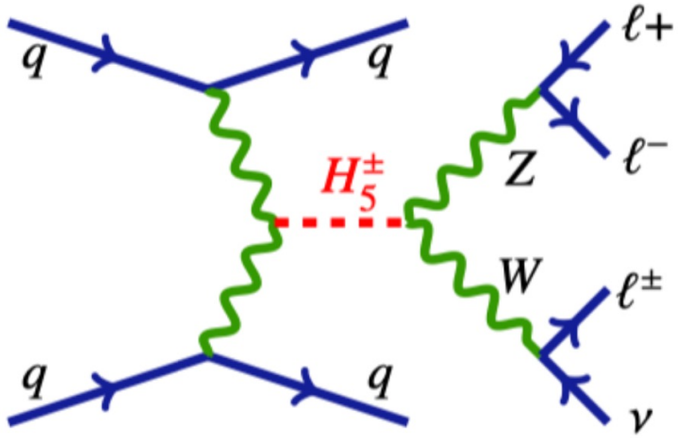


$H^+ \to WZ$ and $H^{++} \to W^+W^+$

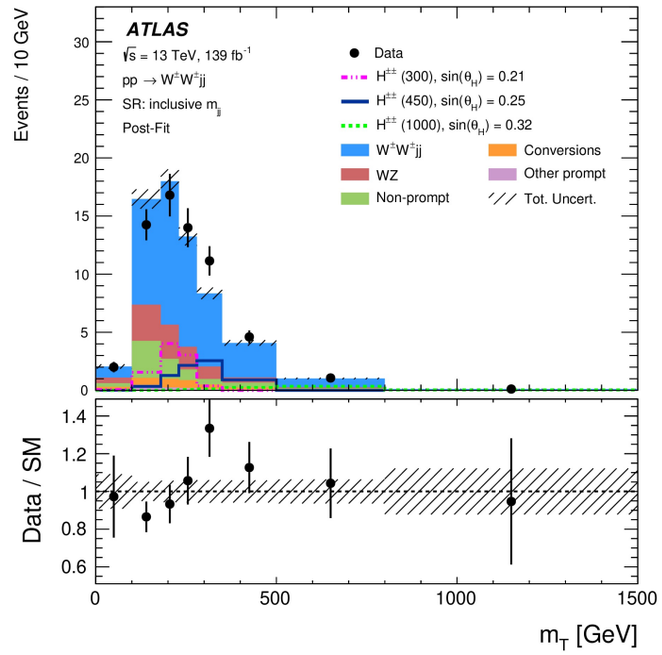
arXiv:2312.00420
arXiv:2207.03925

Georgi-Machacek model (Fermiophobic Higgs fiveplet)

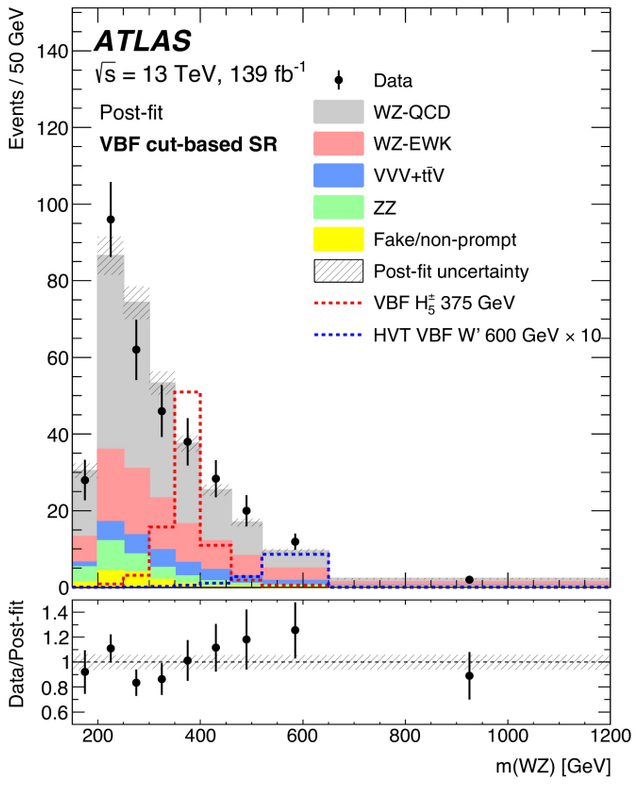
H^{++} produced in VBF and decays to VV (multi-lepton final state)

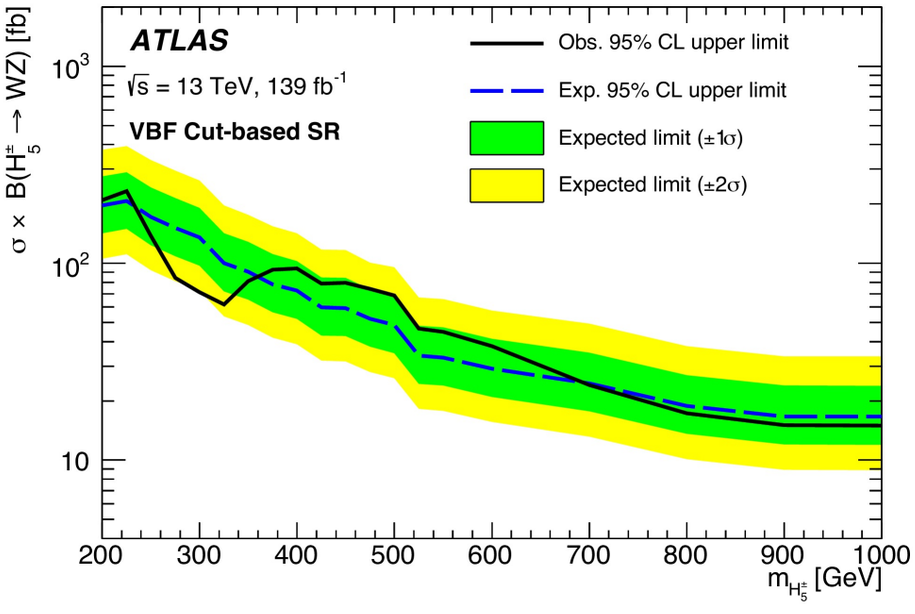


$H^{++} \to W^+W^+$

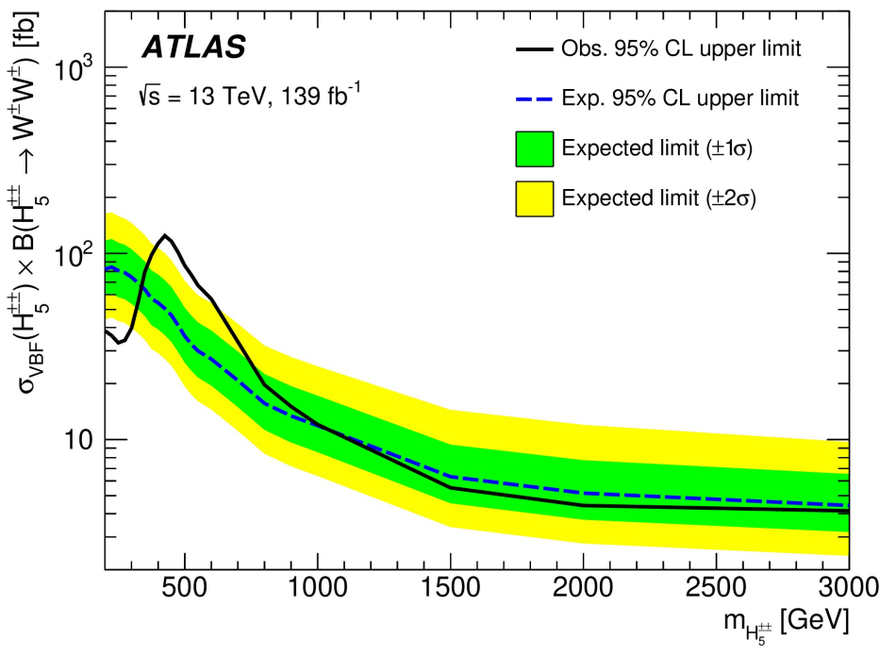


$H^+ \to WZ$





2.8σ local significance at 375 GeV



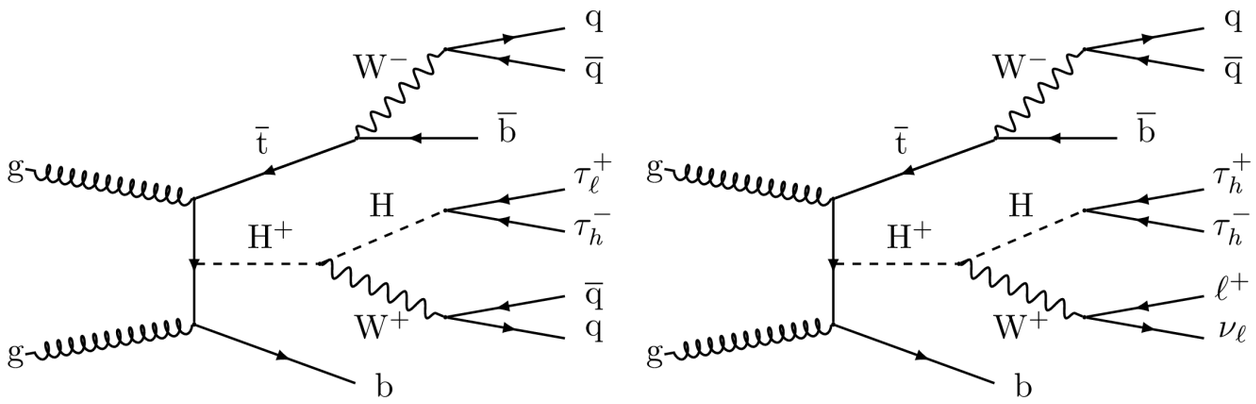
$3.2\sigma(2.5\sigma)$ local(global) at 450 GeV

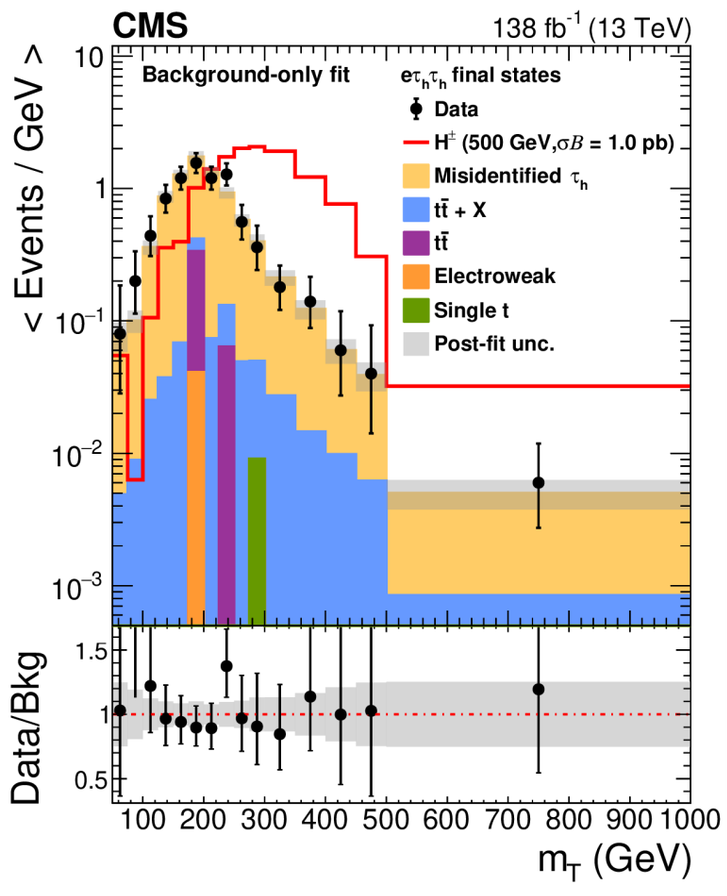
$H^+ \rightarrow WH, H \rightarrow \tau\tau$

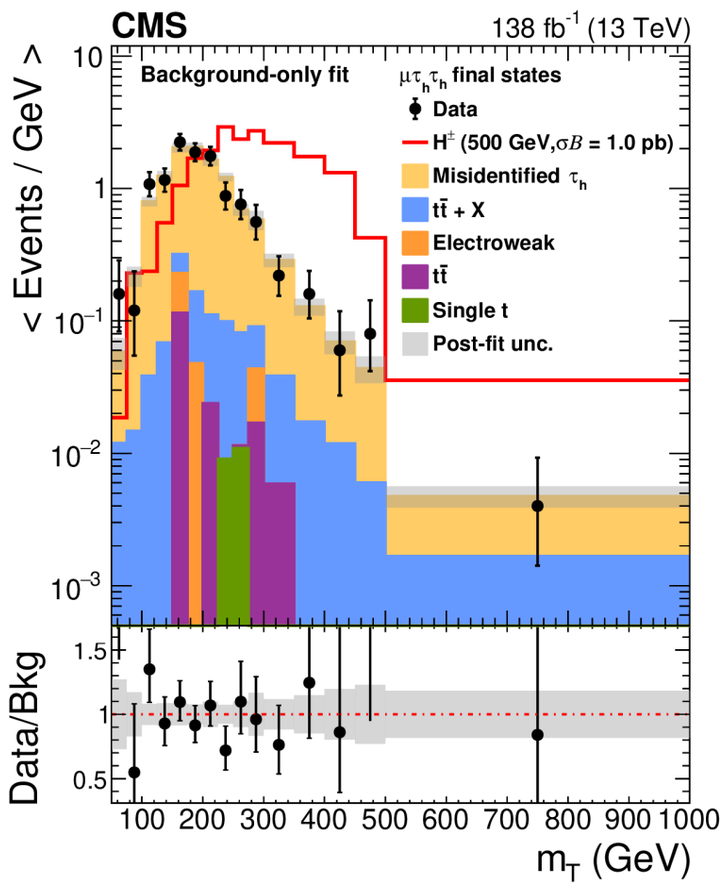
JHEP 09 (2023) 032

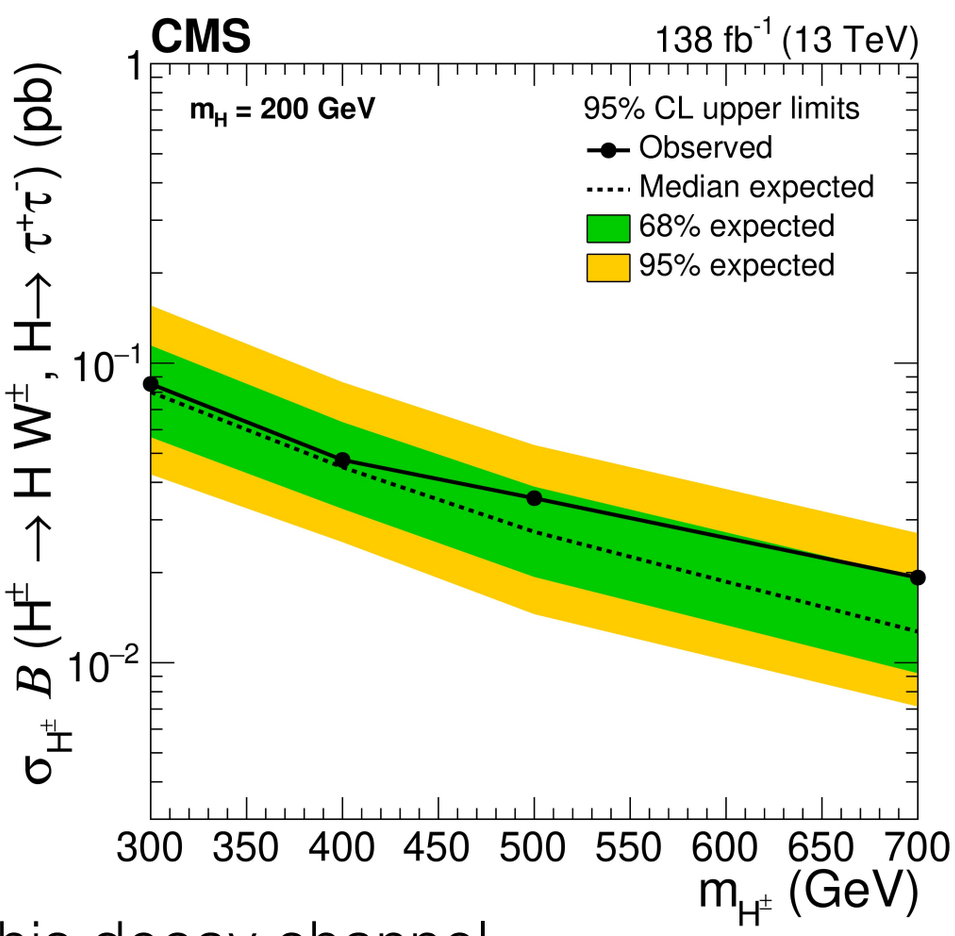
Benchmark: 2HDM

- m_H = 200 GeV, m_h = 125 GeV
- $\ell\tau_h$, $\ell\tau_h\tau_h$ final states split by lepton flavor/charge
- m_T ($\ell\tau_h\tau_h$) or BDT ($\ell\tau_h$) as discriminant







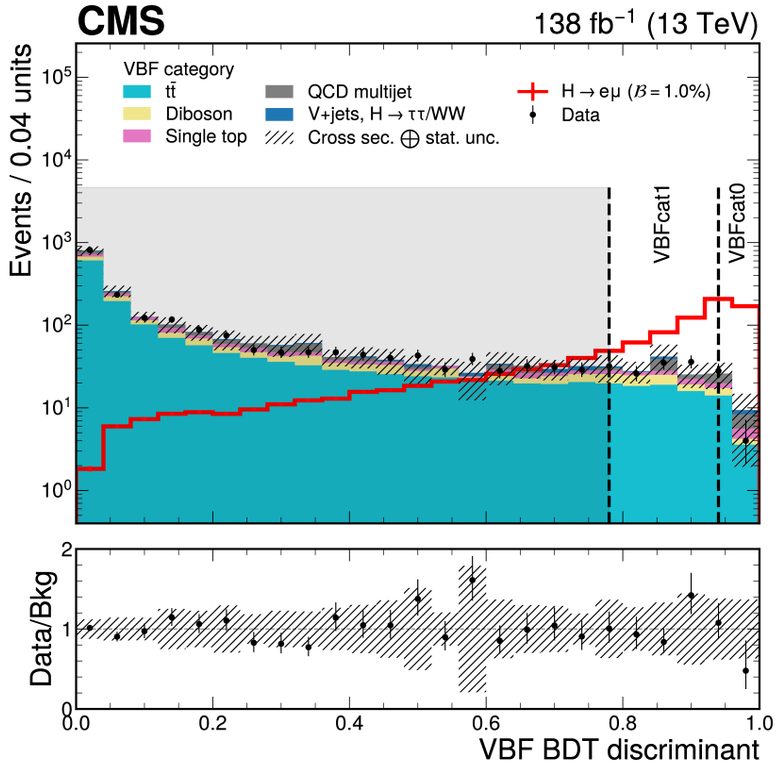


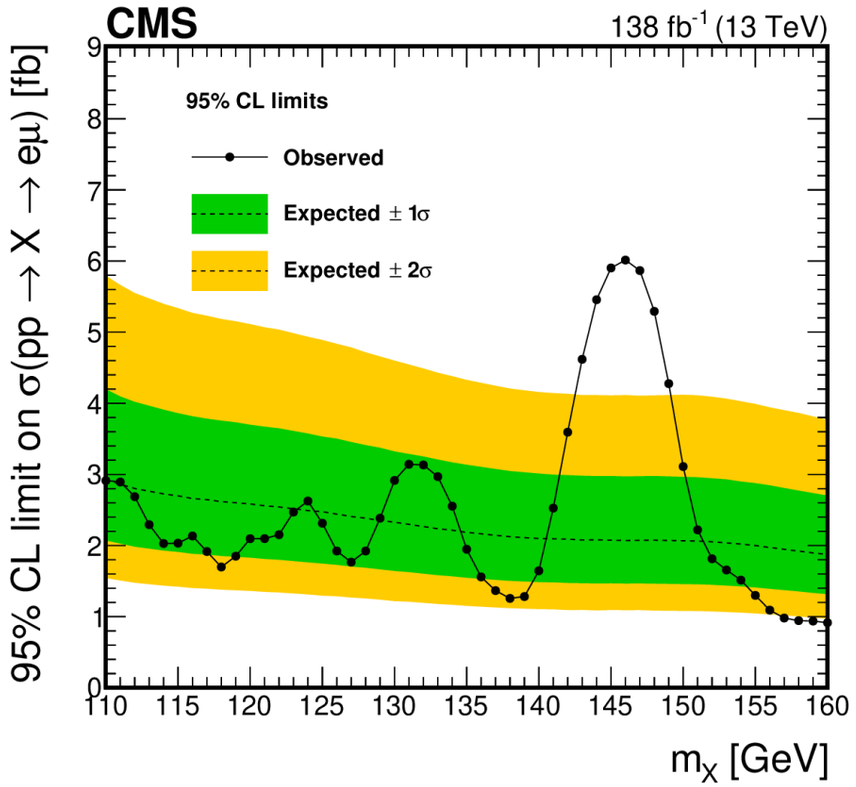
First limits on this decay channel

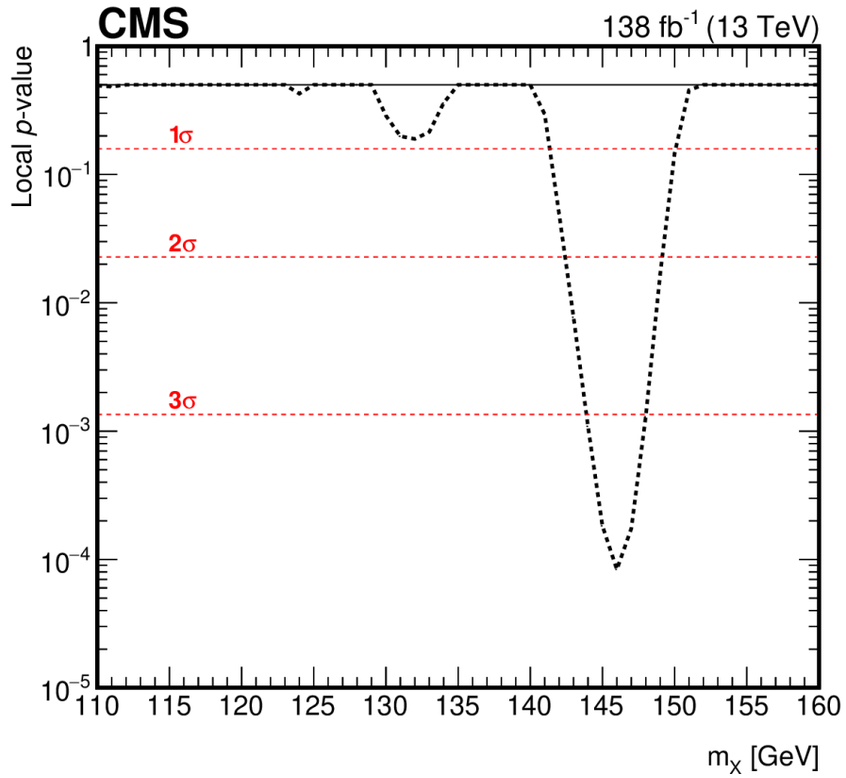
LFV X →eμ

Phys.Rev.D 108(2023)072004

- LFV decays of additional Higgs bosons (X) in Type III 2HDM
- For $m_X > 2m_W$, the dominant decay mode is $X \rightarrow WW$
  - Limit the search region to 100-160 GeV.
- Events categorized using BDT
- Fitting $m_{e\mu}$ distribution in signal regions







Largest excess: 3.8σ(2.8σ) local (global) at 146 GeV

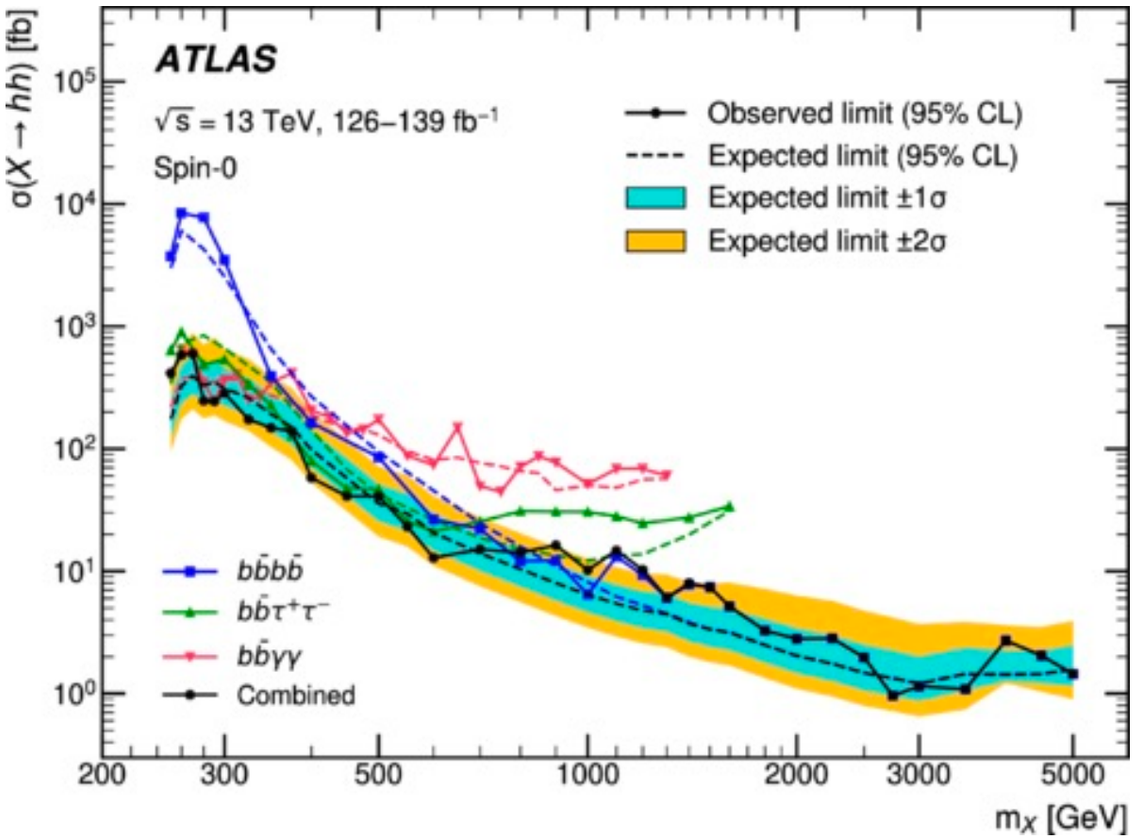
Resonant Di-Higgs Searches

X→hh (h = h_{125})

Benchmark models:
2HDM (e.g. MSSM), real singlet etc..

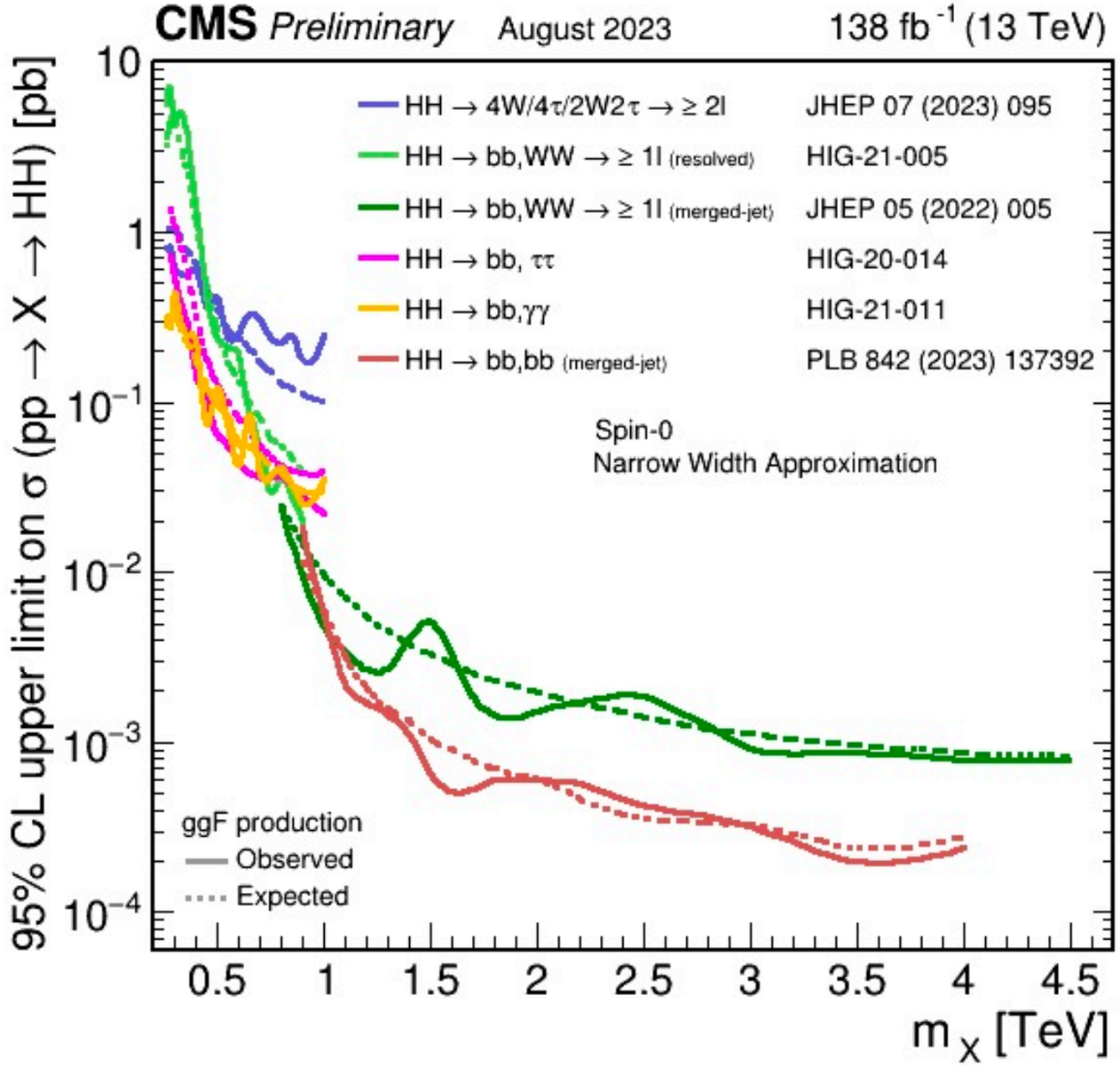
For m_X > 250 GeV

Combination of bbγγ, bbττ, bbbb channels



HDBS-2023-17

Additional hh → bbWW and multilepton channels
Improved sensitivity with bbbb merged-jet



CMS B2G summary plots

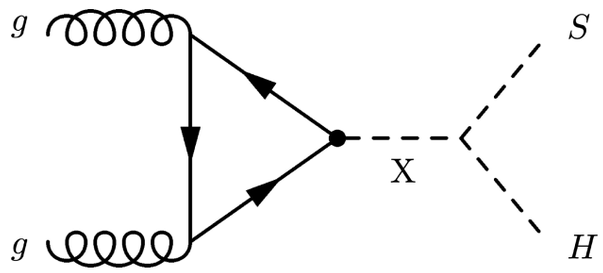
X→Yh

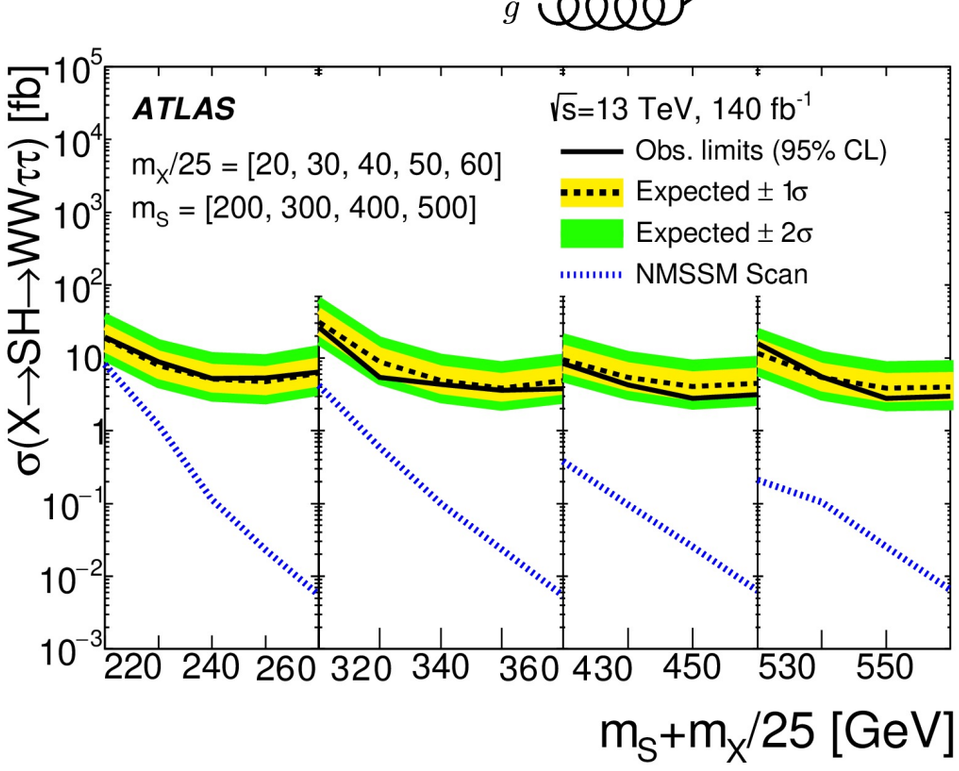
arXiv:2310.01643
JHEP 10 (2023) 009
PLB 842 (2023) 137392
PRD 108 (2023) 052009

Larger extended Higgs sectors:
Such as two additional singlets (TRSM), 2HDM+S (including NMSSM)

ATLAS: bb+ generic hadronic, ττ+WW/ZZ

X→Yh→WW/ZZ + ττ

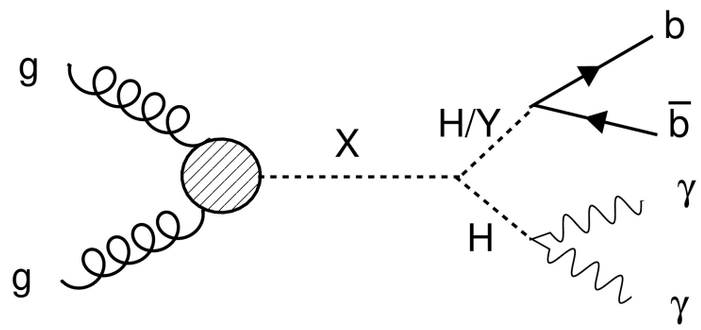




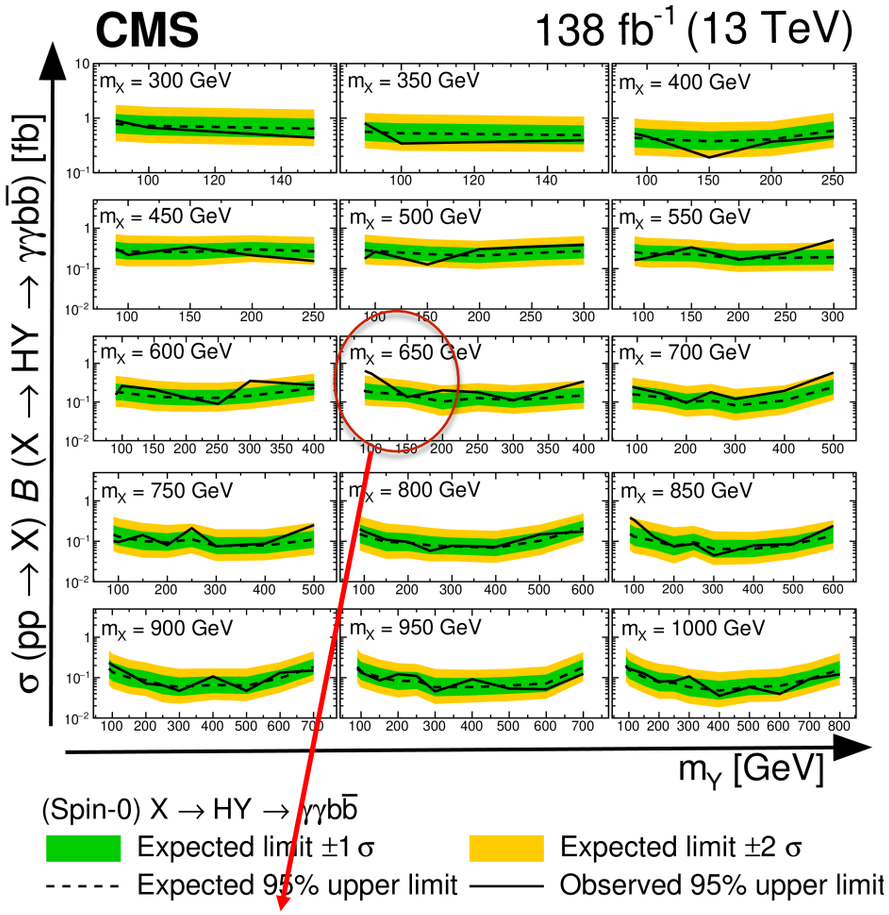
Approaching NMSSM cross sections at the lowest masses

(max. allowed cross sections from NMSSMTools 5.5.0)

CMS. : bbbb (merged jet), bbγγ, bbττ



Parametric fit in $m_{\gamma\gamma} - m_{bb}$ plane



3.8 (2.8)σ local (global) at
m_X = 650 GeV and m_Y = 90 GeV

X→Yh

arXiv:2310.01643
JHEP 10 (2023) 009
PLB 842 (2023) 137392
PRD 108 (2023) 052009

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Such as two additional singlets (TRSM), 2HDM+S (including NMSSM)

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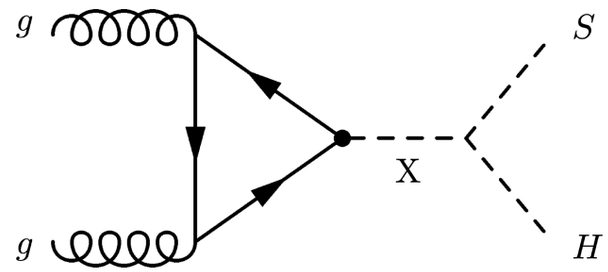

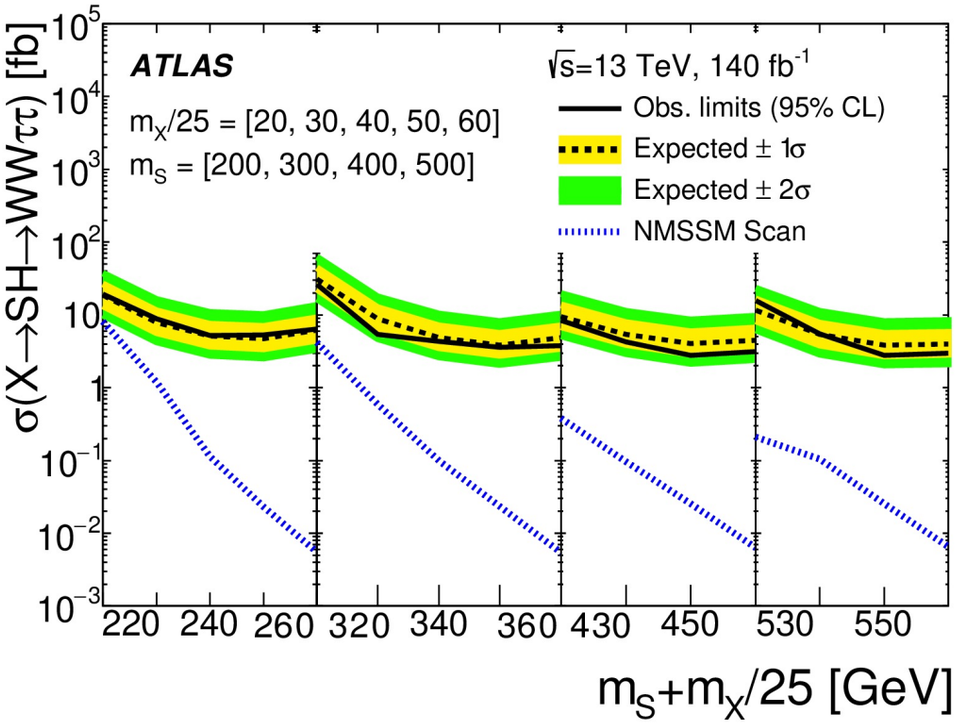

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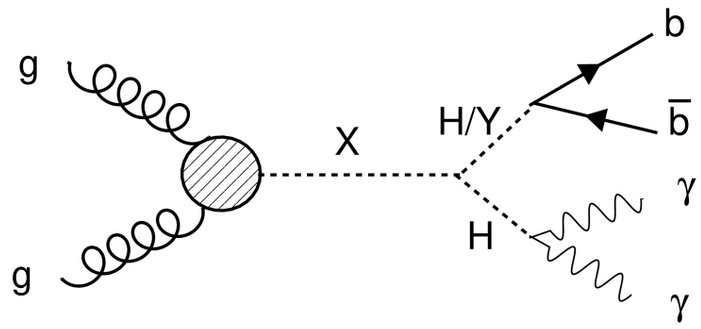
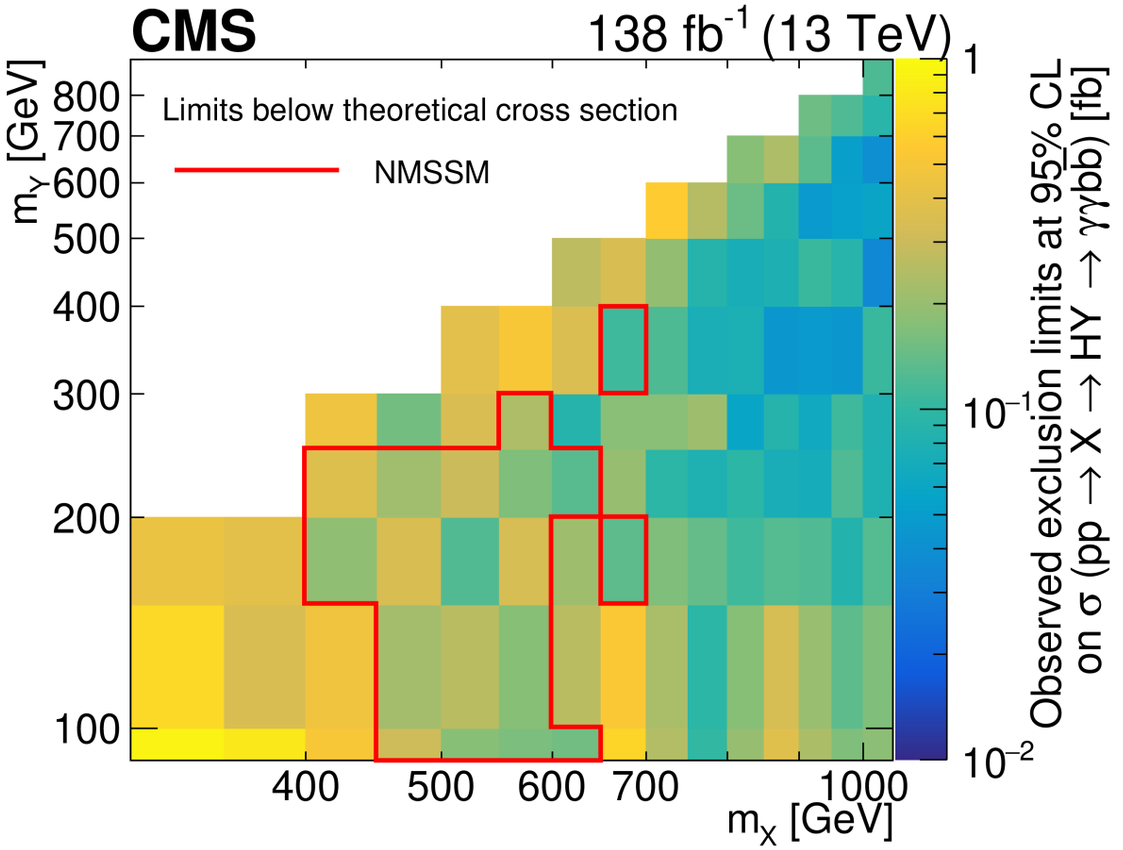
CMS. : bbbb (merged jet), bbγγ, bbττ



Parametric fit in $m_{\gamma\gamma}$ – m_{bb} plane

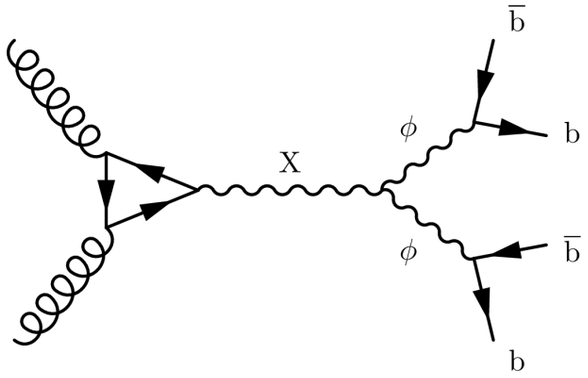


Sensitive to NMSSM predictions

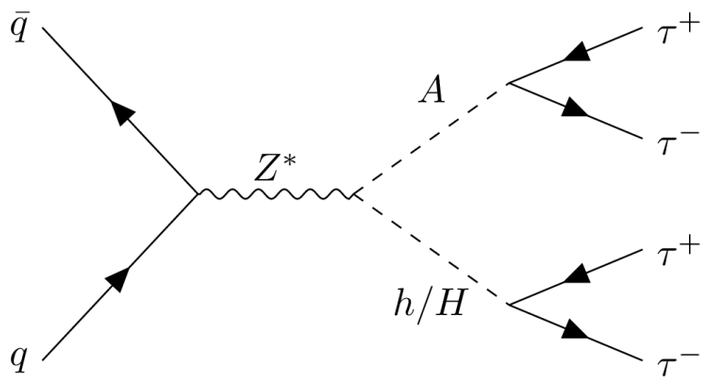
(max. allowed cross sections from NMSSMTools 5.5.0)

X → YY and Z*→HA

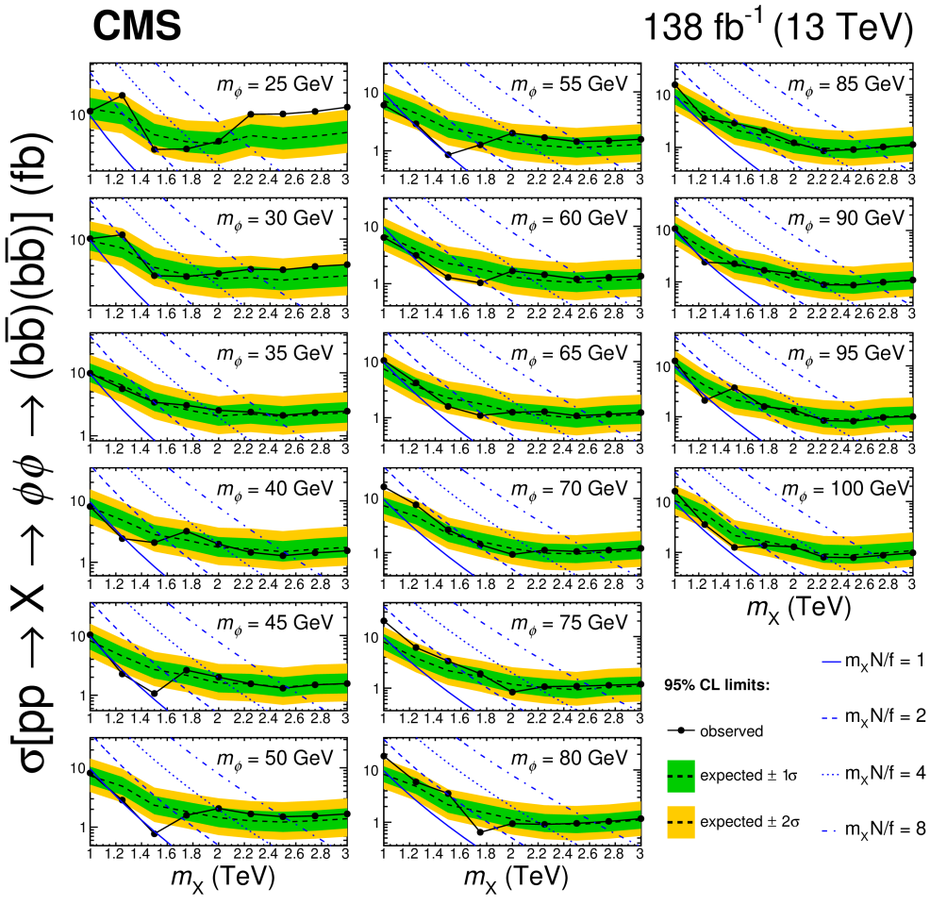
PLB 835 (2022) 137566
CMS-PAS-SUS-23-007

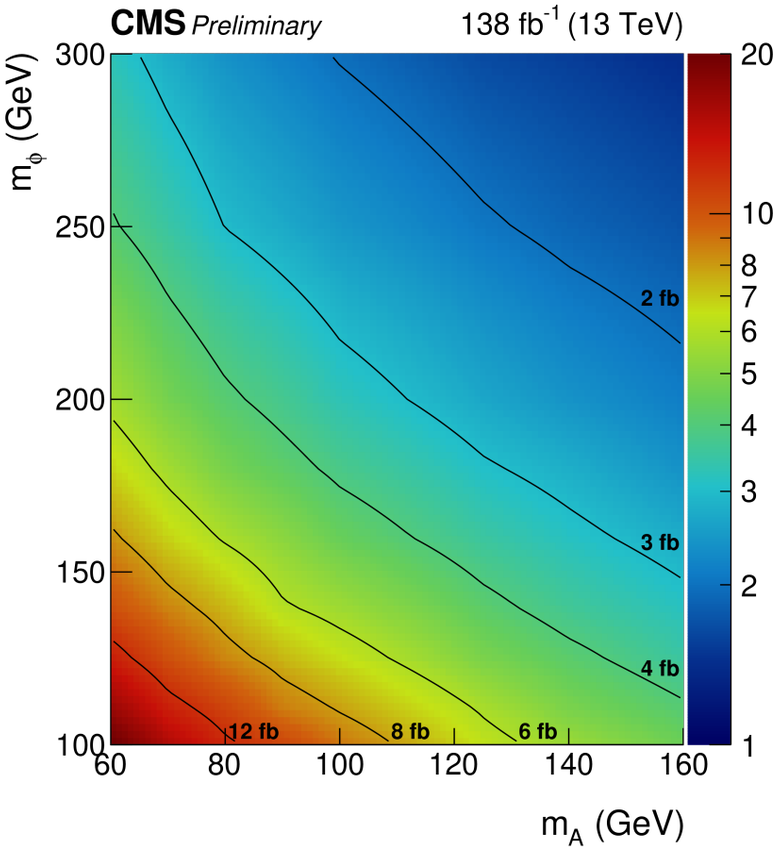


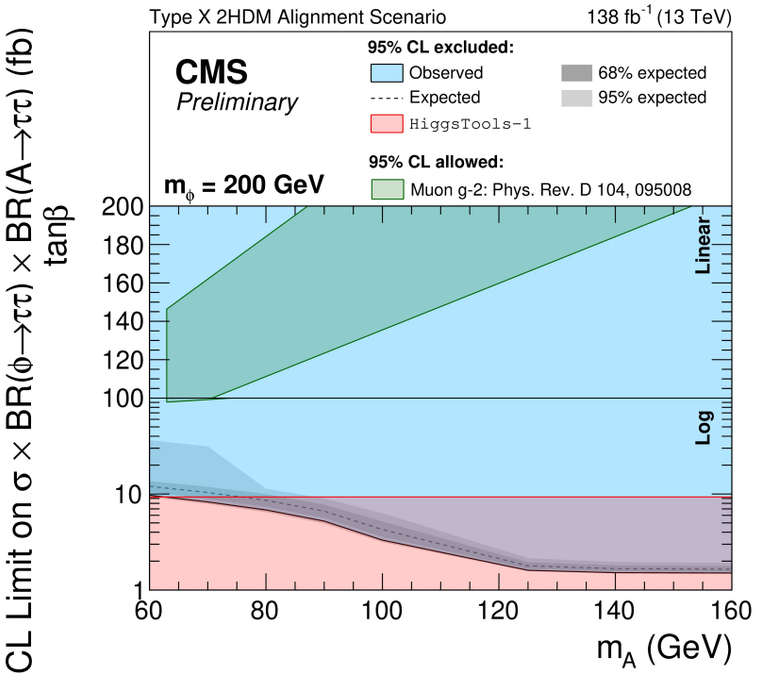
Merged Jets
M_X: 1-3 TeV
M_ϕ: 25-100 GeV



- lepton-specific (or type X) 2HDM at large tanβ
- direct A/H production strongly suppressed
- Fit m_T^{tot} distribution ($4\tau_{vis}$ + p_T^{miss})



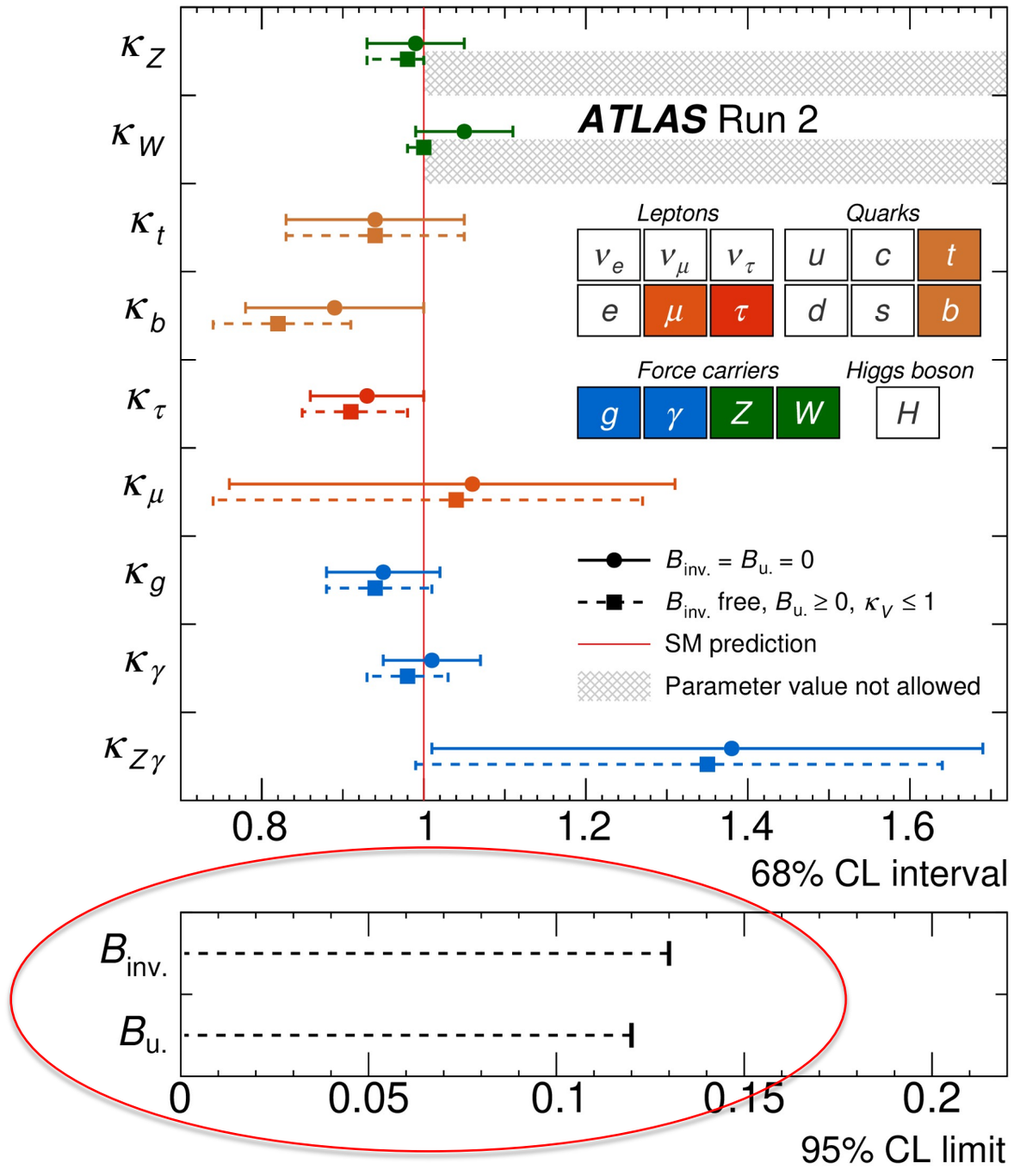




Excludes Type-X 2HDM in probed mass range

Non-standard Higgs decays

- Width of SM Higgs is small ➔ small coupling to BSM can result in detectable branching fractions
- Constraint on *Br* (h ➔ undetected), from combination of Higgs measurements, still allows for O(10%) decays into unobserved particles.
- BSM models predict exotic decays of the SM H(125):
  - Decays to (pseudo) scalars
  - Invisible decays (e.g. Dark Sectors)
  - Lepton Flavor Violation (LFV)
  - Decays to Long-Lived Particles (LLPs)



h(125) → aa searches

- h(125) → aa decay mode possible in NMSSM scenarios, where "a" stands for just a Higgs boson that could be scalar or pseudo-scalar
- Many final states analyzed for varying m_a values, up to $m_a \leq m_h/2$
- The decay products of "a" boson boosted for low m_a values:
  - Challenging final states
  - Special care needed to reconstruct and identify leptons
- Results are presented in terms of upper limits on cross section times branching fractions

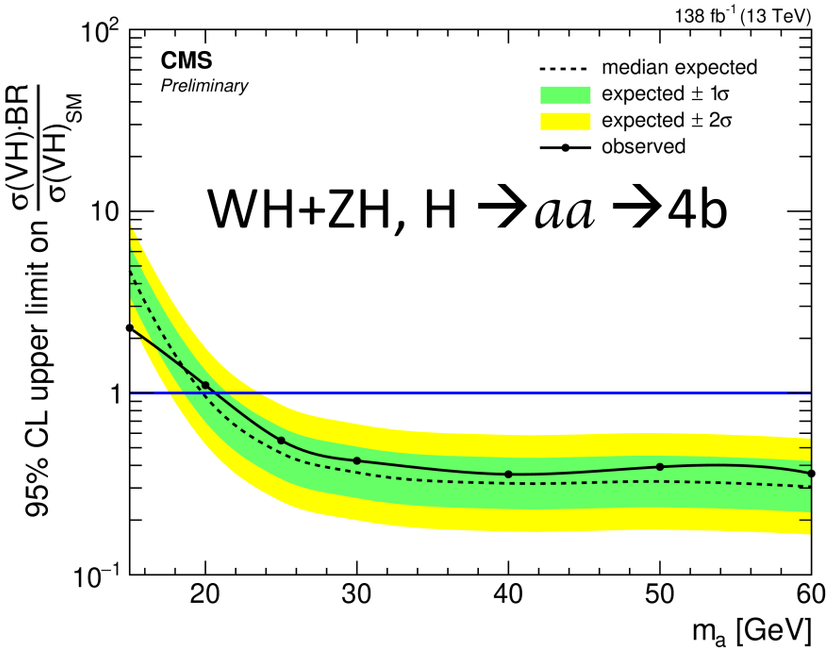
Large number of searches at LHC

$h \rightarrow aa \rightarrow$

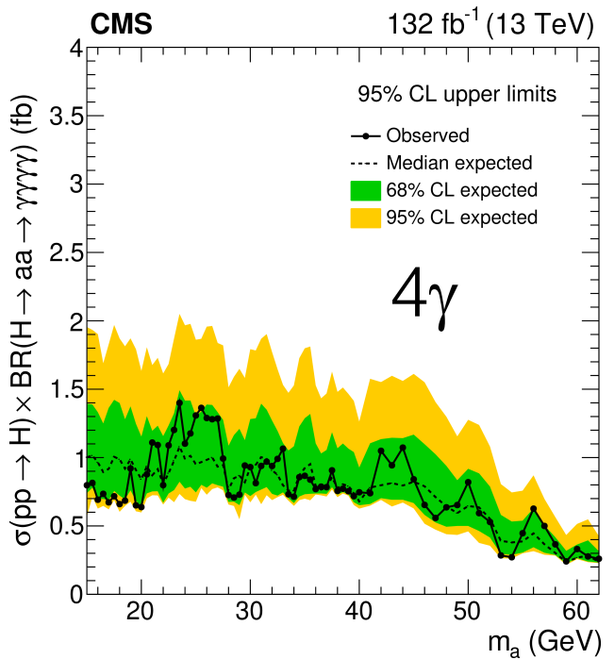
- $(\gamma\gamma)(\gamma\gamma)$
- $(\gamma\gamma)(gg)$
- $(\mu\mu)(\mu\mu)$
- $(\mu\mu)(\tau\tau)$
- $(bb)(\mu\mu)$
- $(bb)(bb)$
- $(bb)(\tau\tau)$
- $(\tau\tau)(\tau\tau)$

h(125) → aa

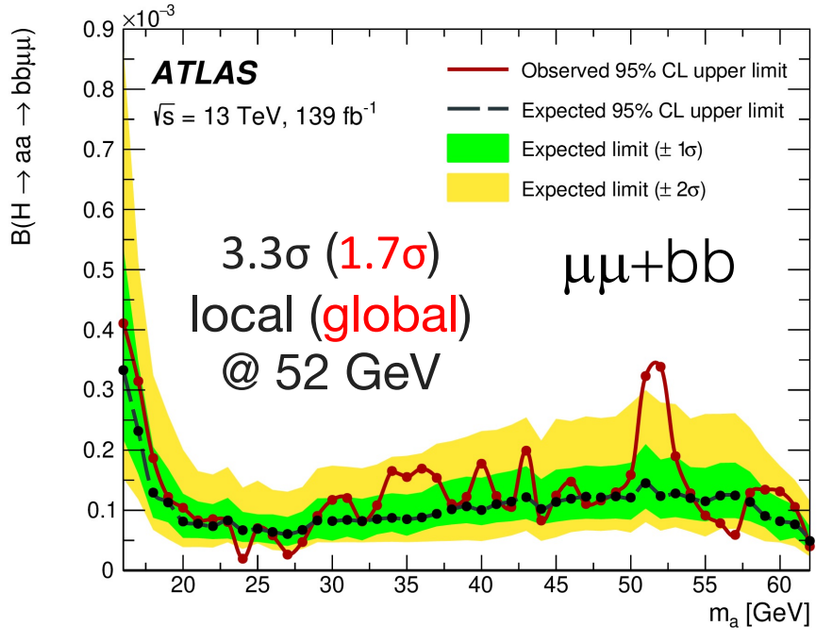
CMS-PAS-HIG-18-026



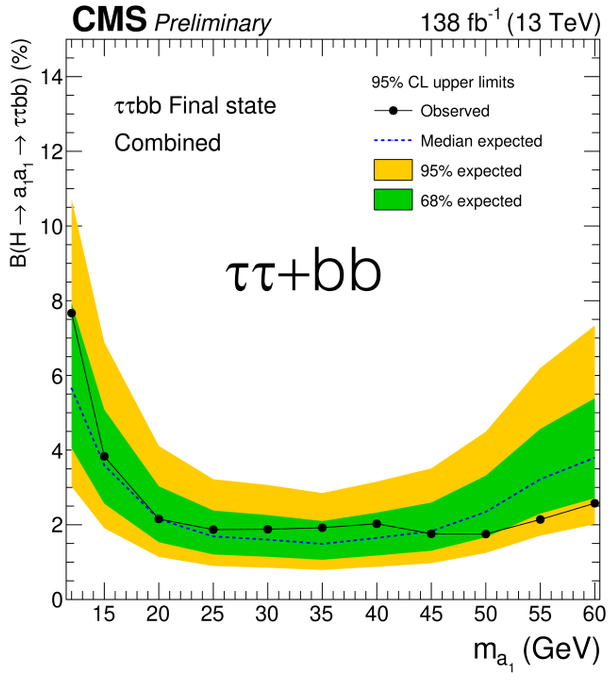
JHEP 07 (2023) 148



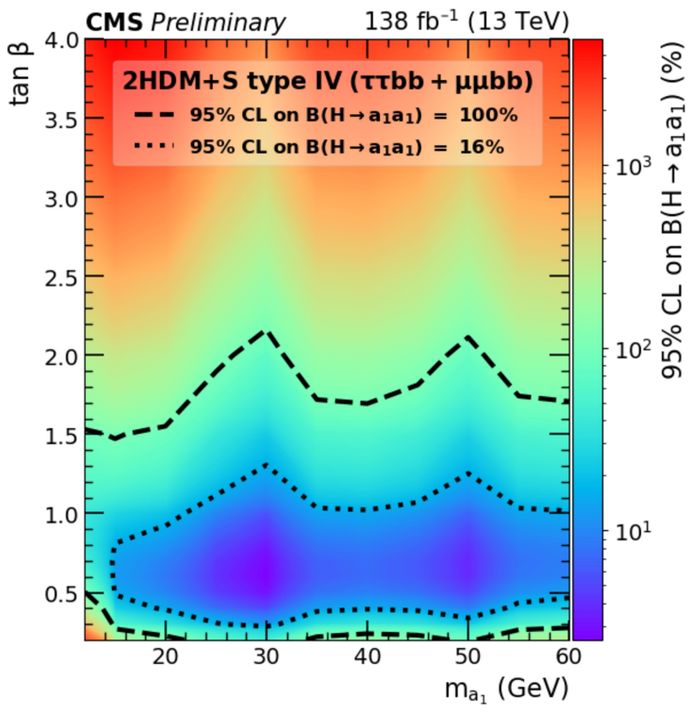
PRD 105 (2022) 012006



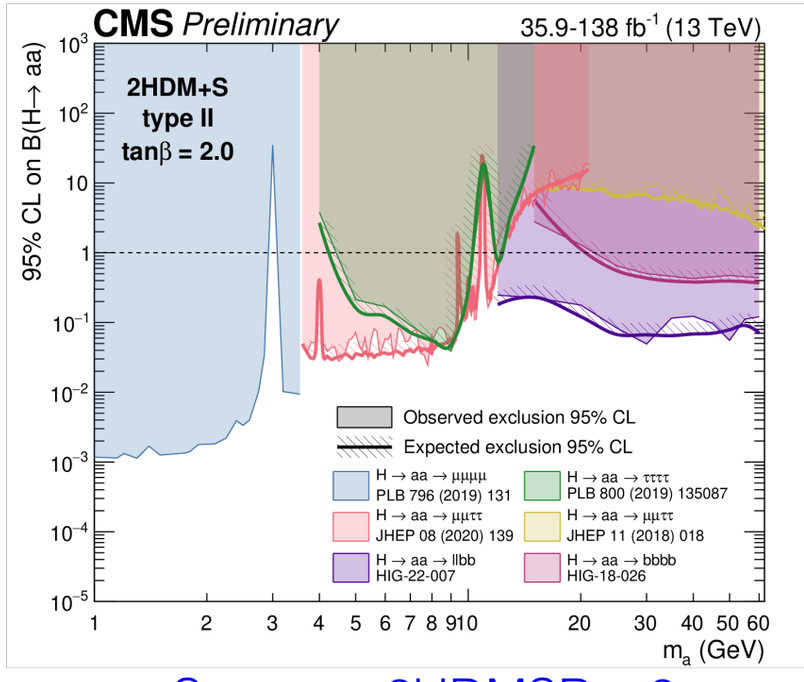
CMS-PAS-HIG-22-007



Limits on $B(H \to aa)$ for Type IV of 2HDM+S



Limits on $B(\mathrm{h} \to aa)$ for Type II ($\tan\beta$ = 2) of 2HDM+S



Summary2HDMSRun2

h(125) → AA (ALPs) →4γ

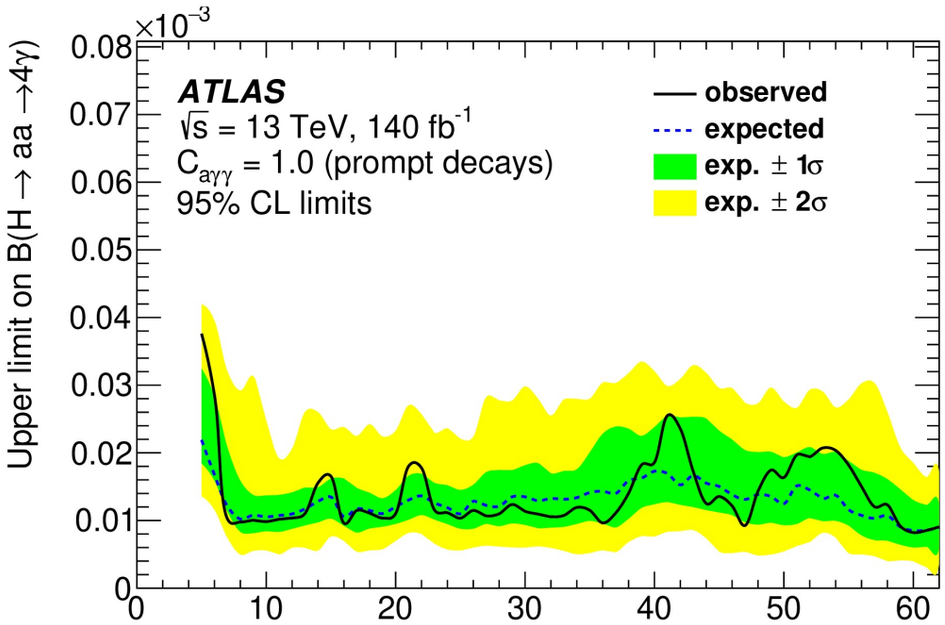
Search for ALPs in Higgs decay, with ALP → 2γ

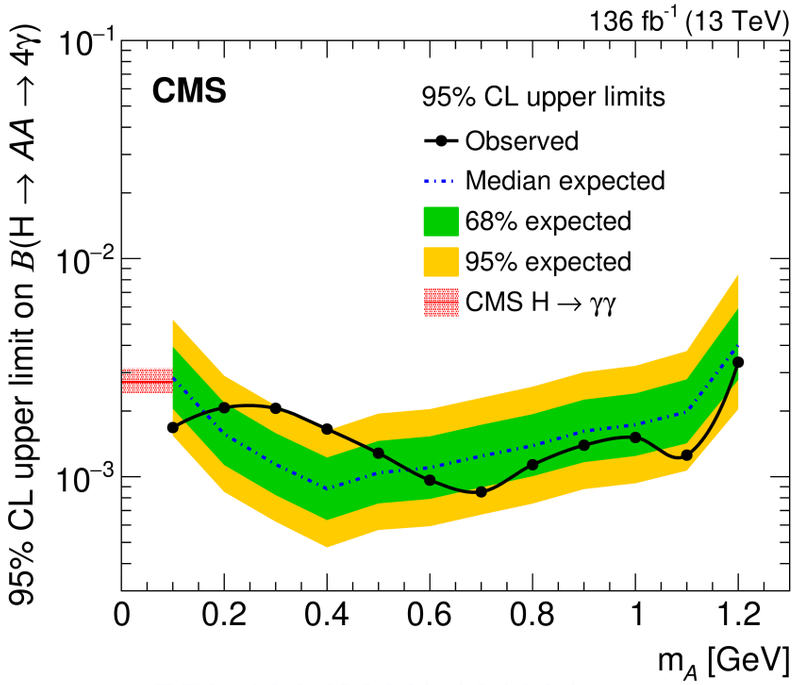
ATLAS: Search for wider mass range (0.1 – 62 GeV)

- Prompt (short-lived), large Γ:
  $m_a >$ 5 GeV
- Long-lived,small Γ:
  m_a >0.1 GeV

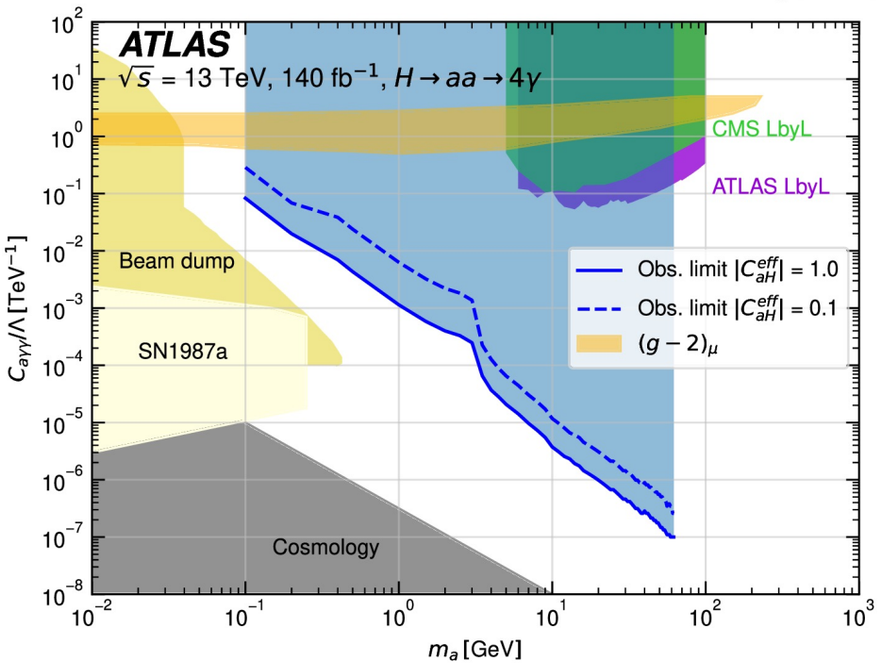
CMS: Low mass ALPs in Higgs decay

- Merged γγ reconstructed as a single photon-like objects
- Regressor trained to predict m(A) based on low-level detector information





PRL 131 (2023) 101801



ATLAS-CONF-2023-040

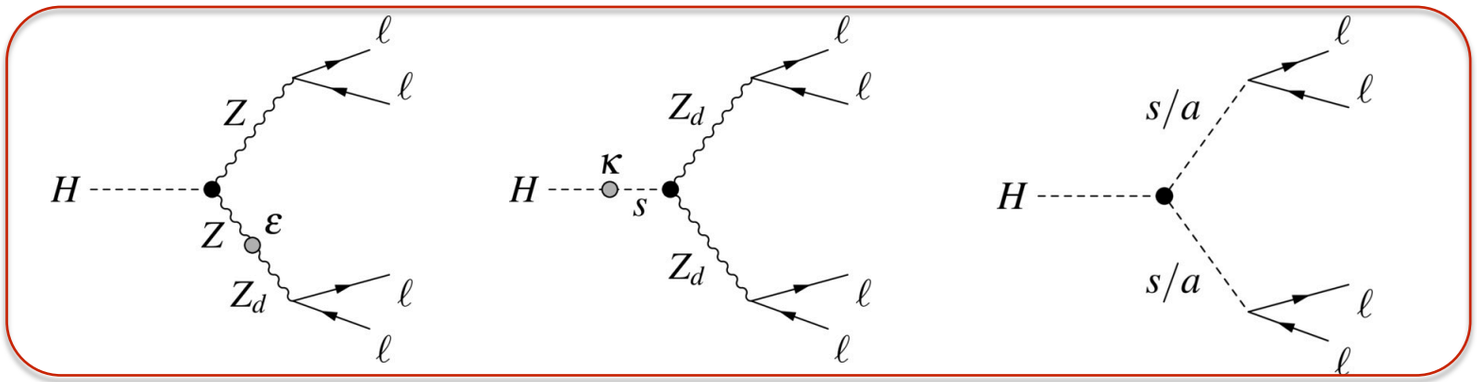
h → ZX/XX → 4ℓ

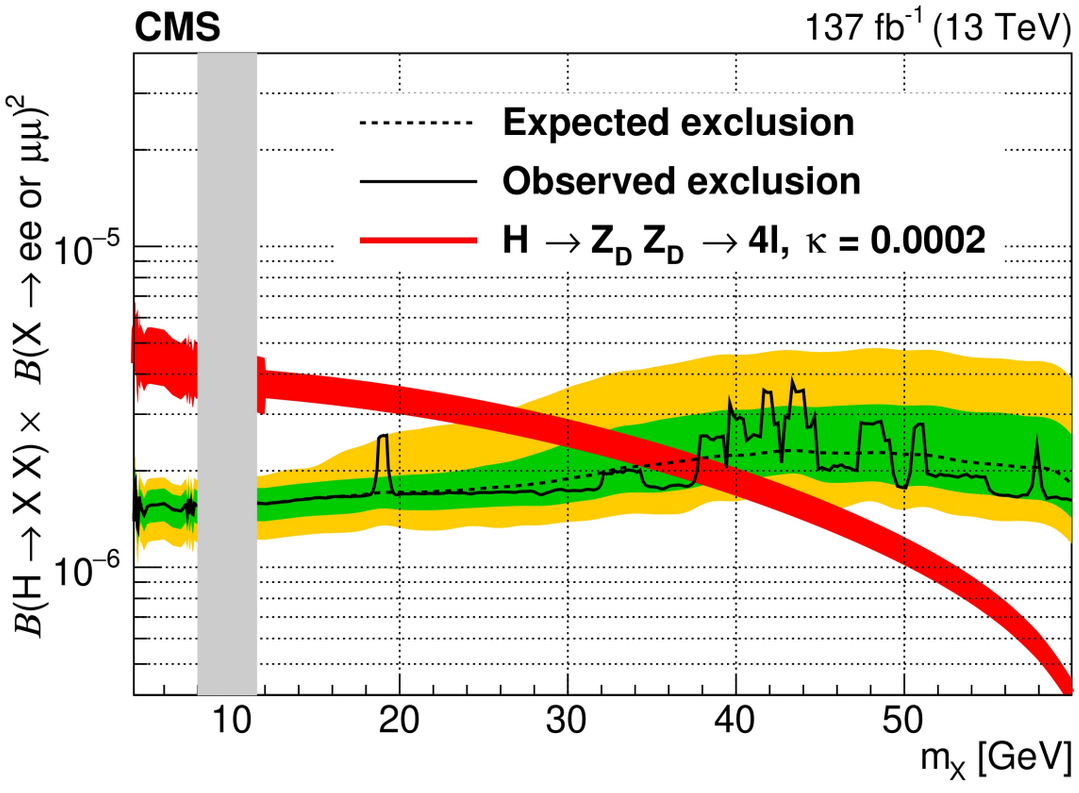
JHEP 03 (2022) 041
EPJC 82 (2022) 290

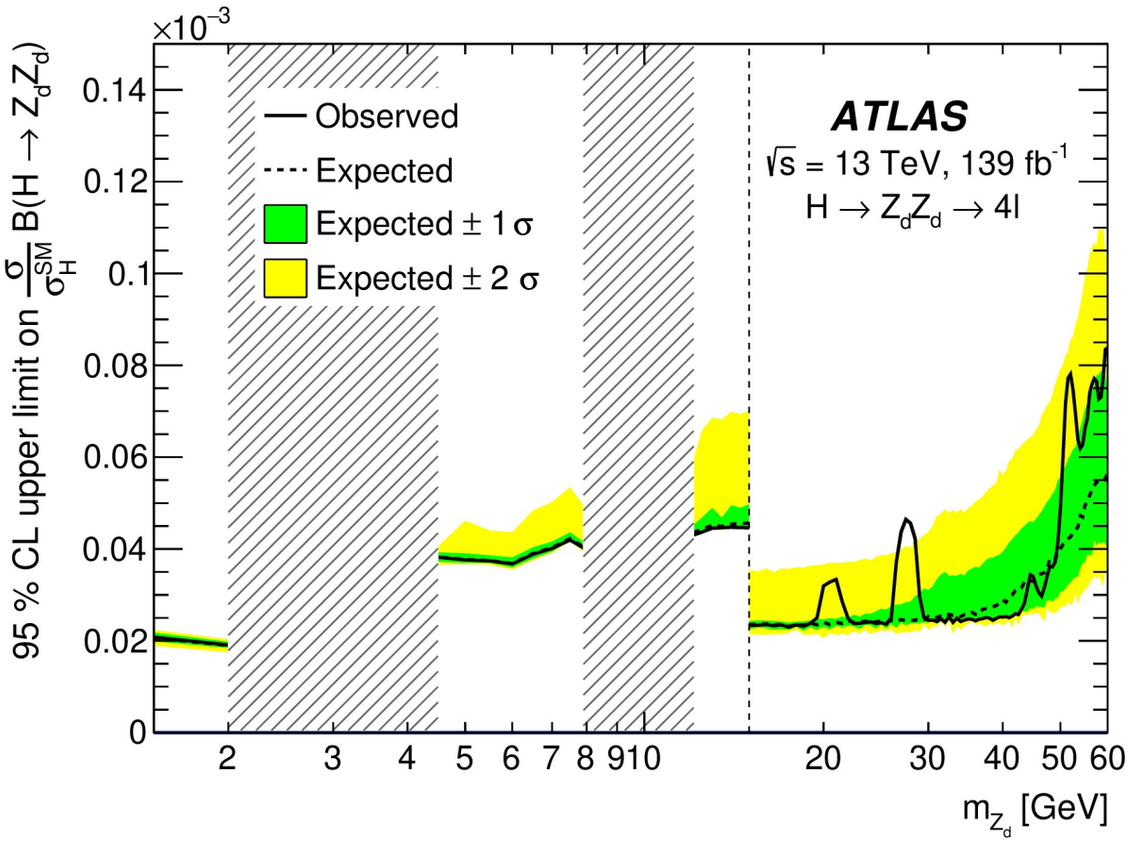
Motivated by **DM models with scalar/vector portal,** which include mediator Z between dark/hidden sector and SM

➔searches for

h → XX/ZX → 4ℓ (ℓ = e or μ)







Limits set also in other channels

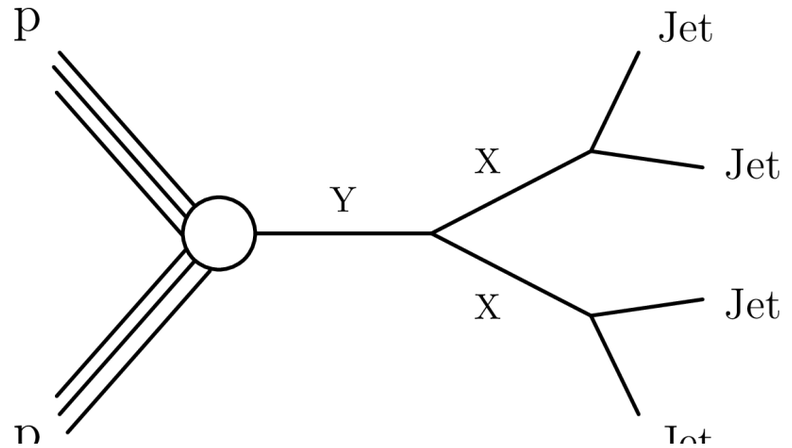
Searches for Resonances

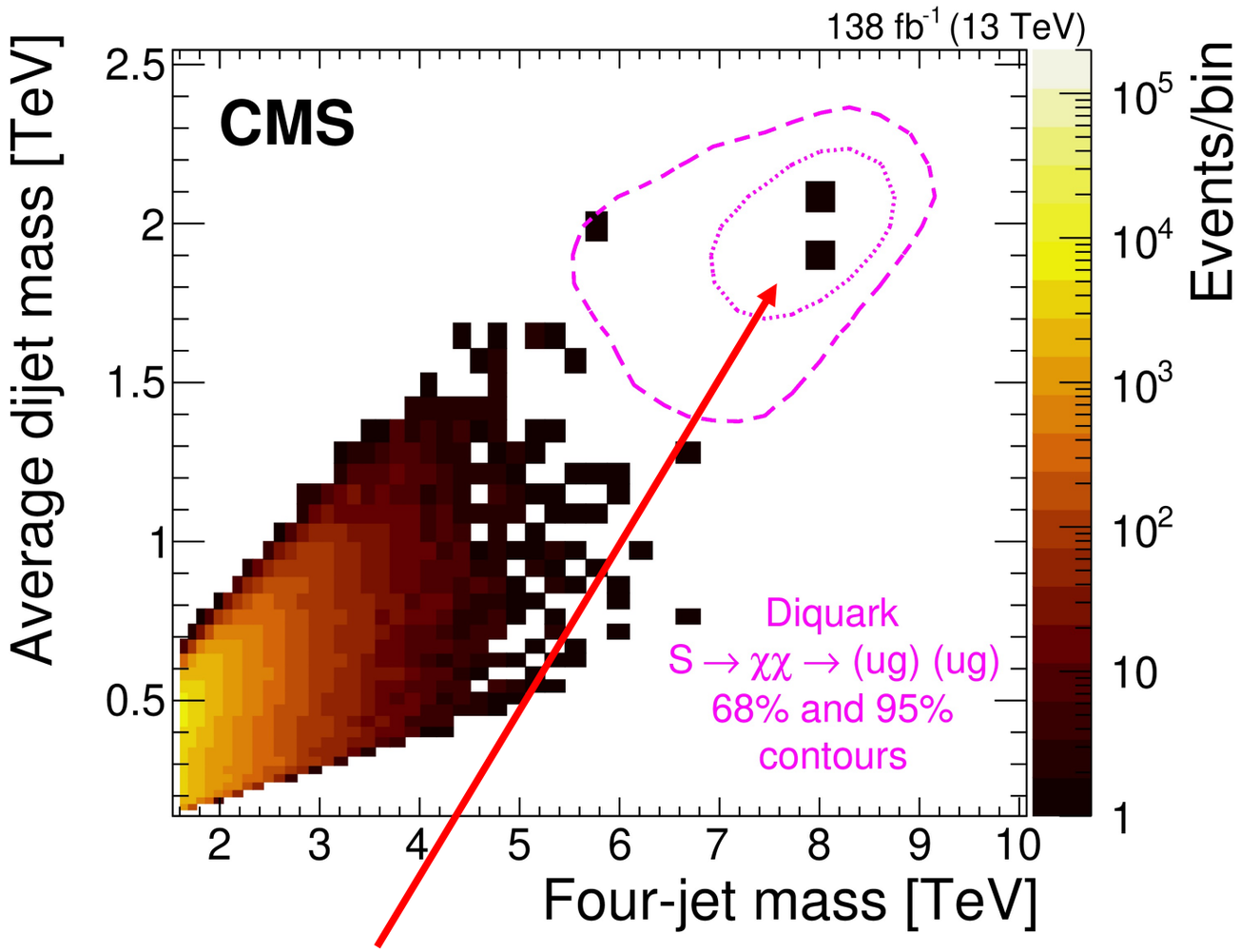
Multijet Resonance Searches

JHEP 07 (2023) 161
arXiv:2307.14944

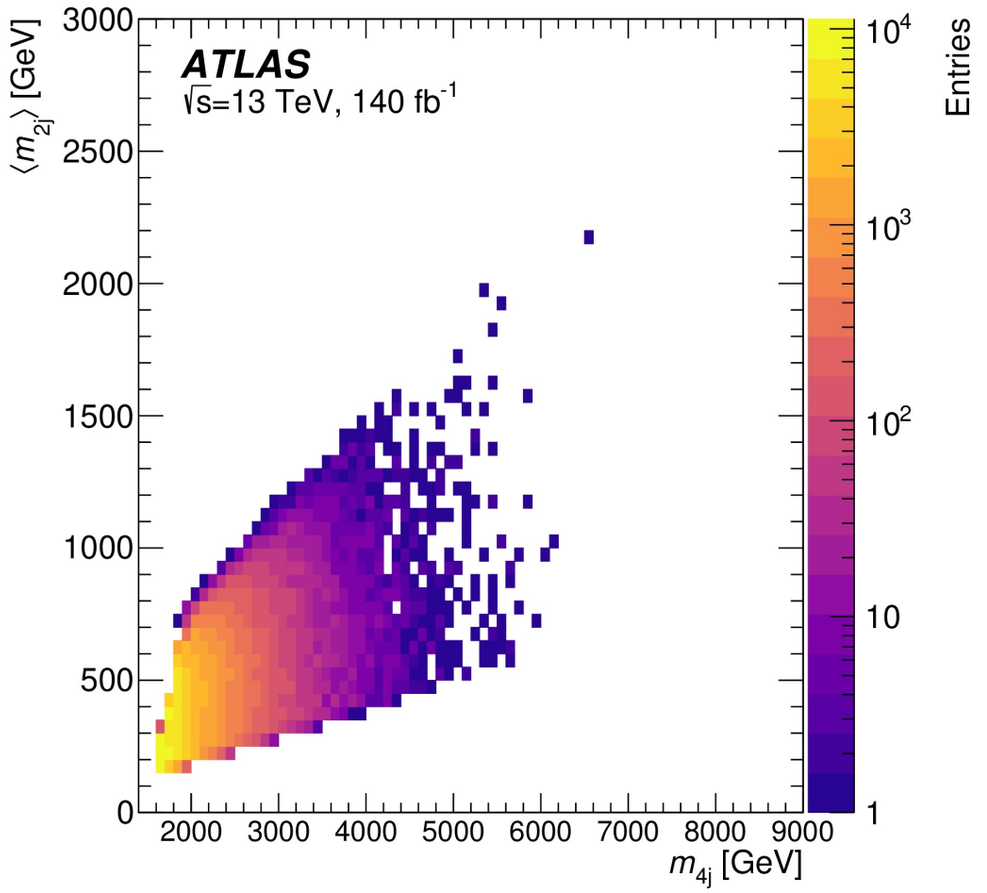
Search for Resonance Y → XX → 4jets

Search for excess in
M_{4j} (Y) vs average $<M_{2j}>$ (X) plane





CMS: 3.9 local (1.6 global) excess at
M4j = 8 TeV and $<M_{2j}>$ =2 TeV



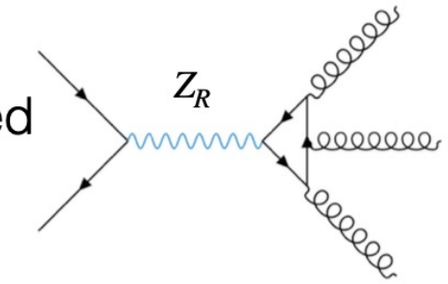
No events in ATLAS around 8 TeV

Multijet Resonance Searches

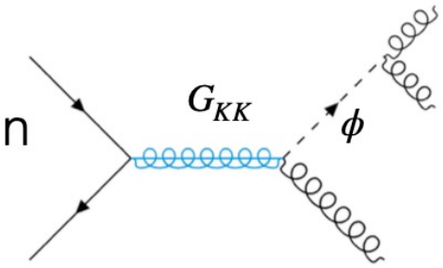
arXiv:2310.14023

Search for narrow resonances decaying to three well separated jets

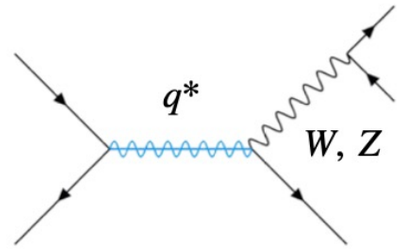
Right-handed Z boson

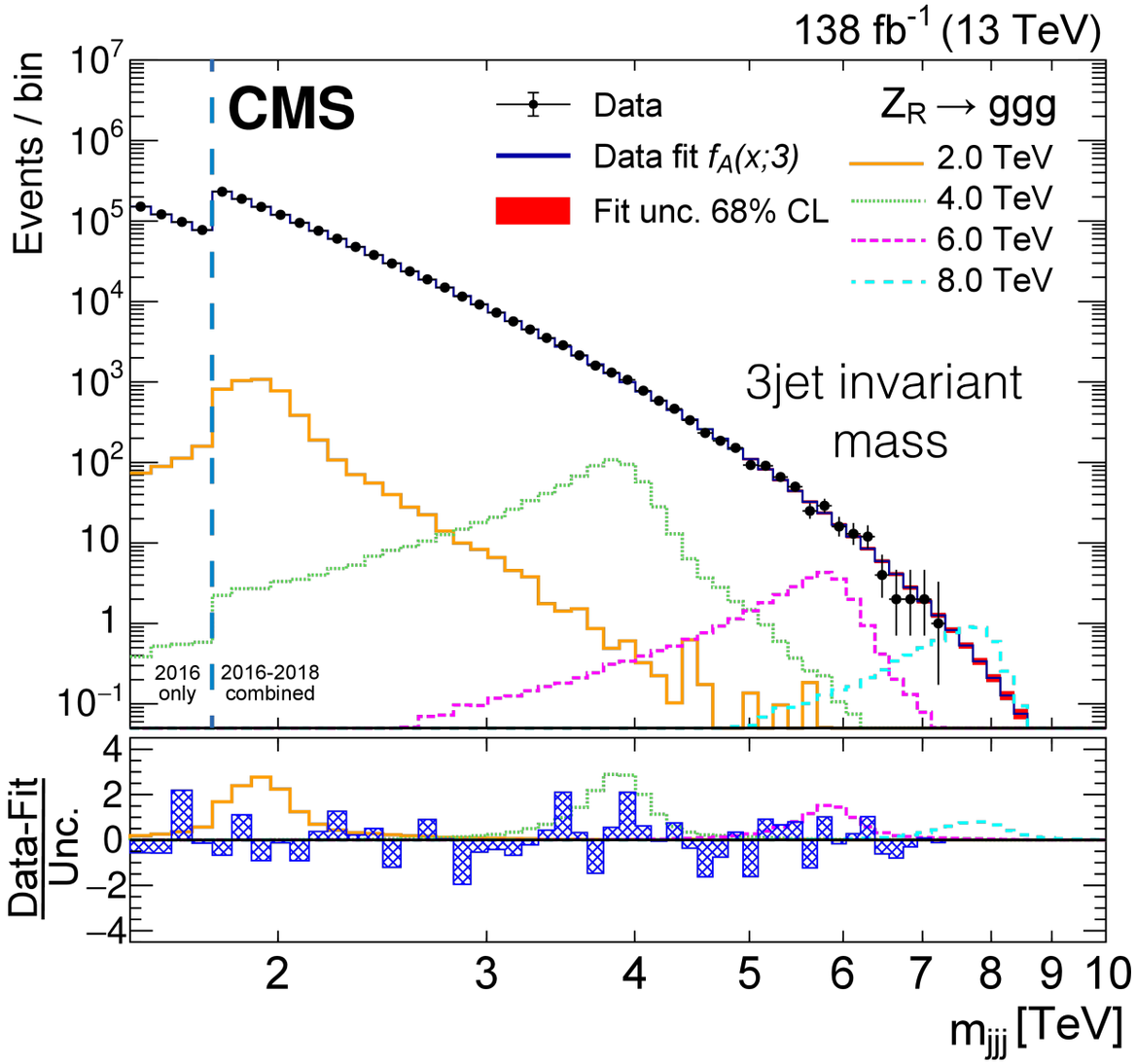


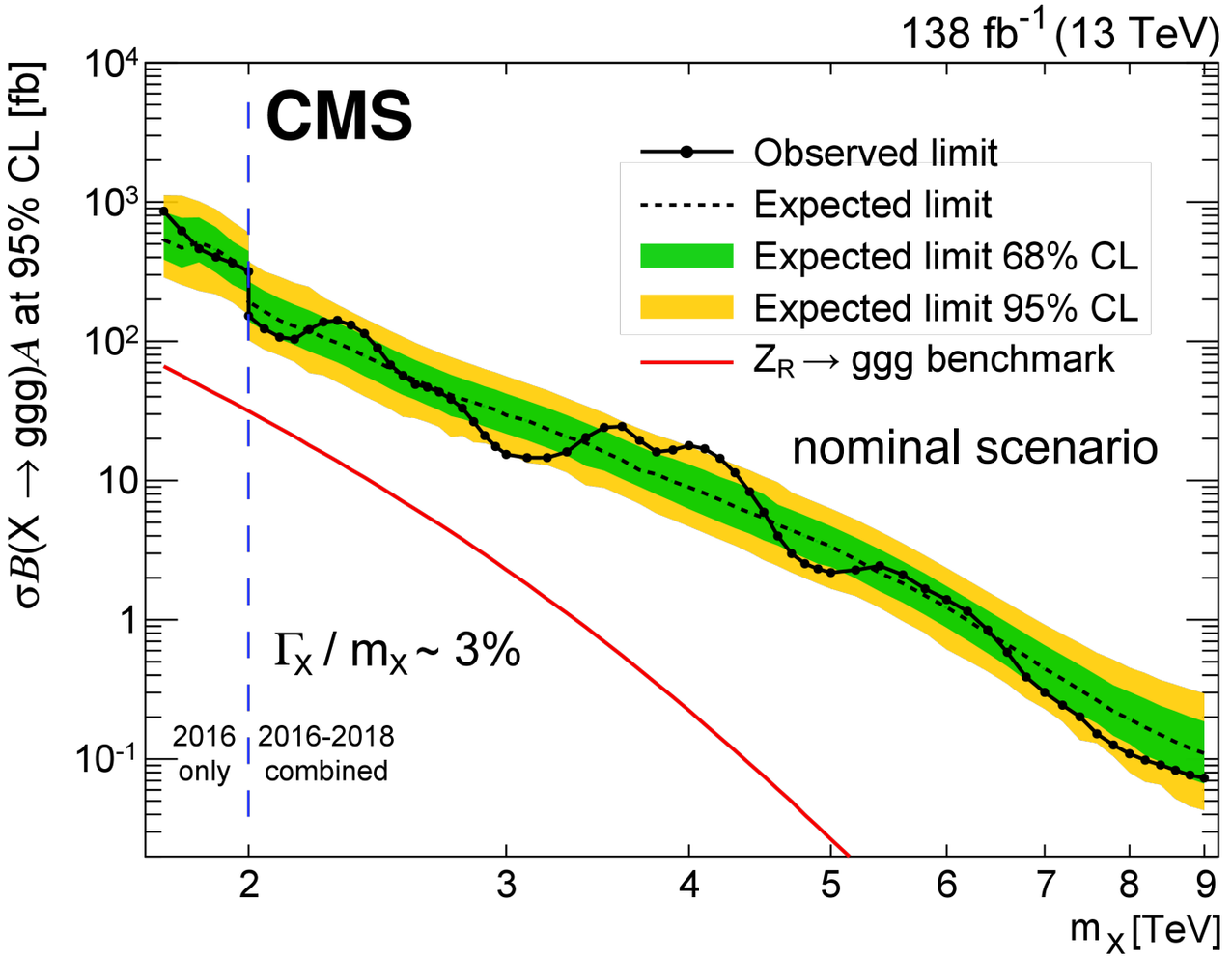
Kaluza-klein gluon



Excited quark







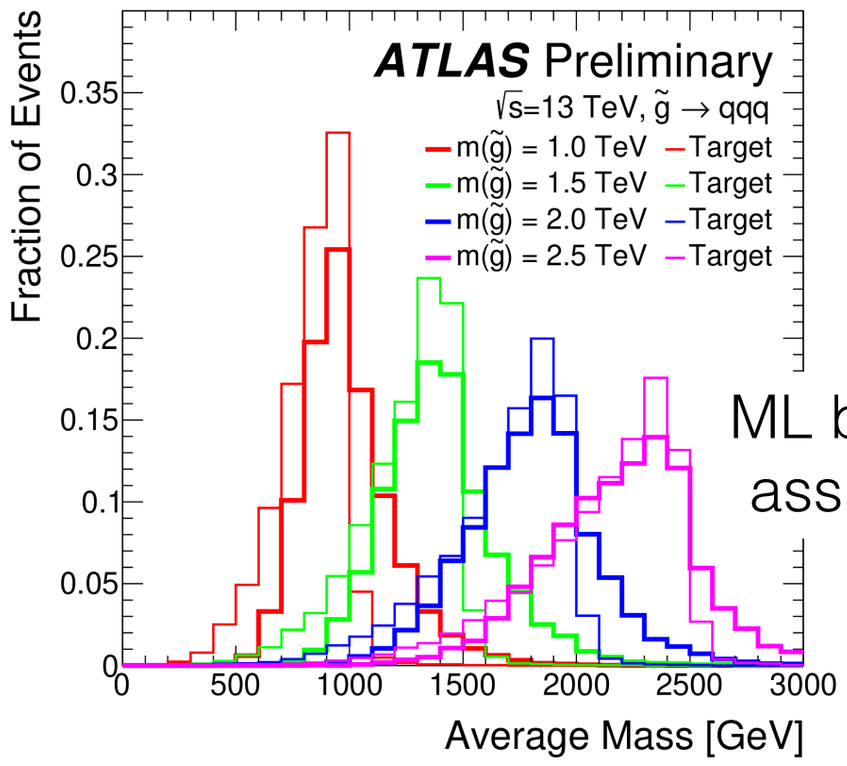
Probing mass region 1.75 – 9 TeV

Also limits for narrow width scenario ($\Gamma_X/m_X \sim 0.01\%$)

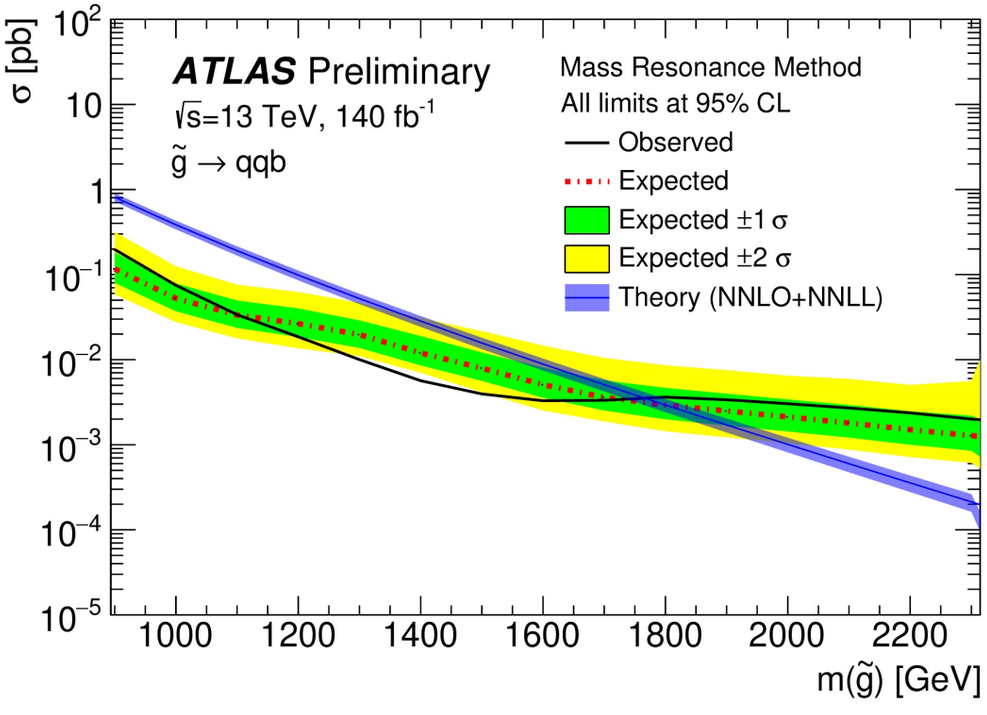
Multijet Resonance Searches

ATLAS-CONF-2023-049

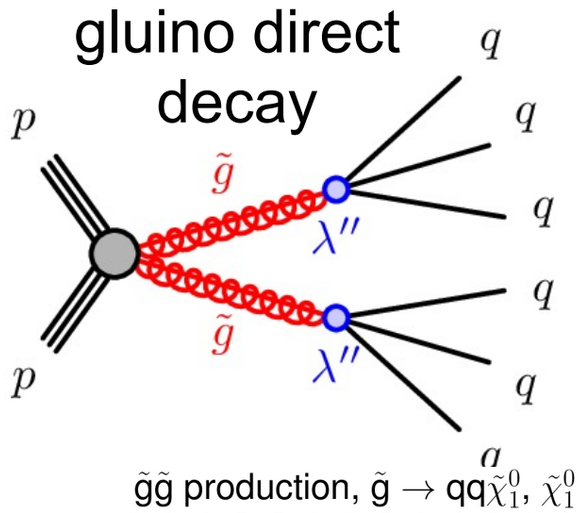
Search for pair-produced multijet signals



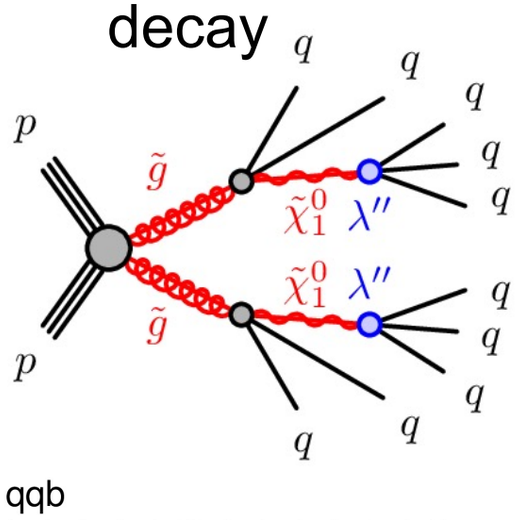
ML based jet assignment

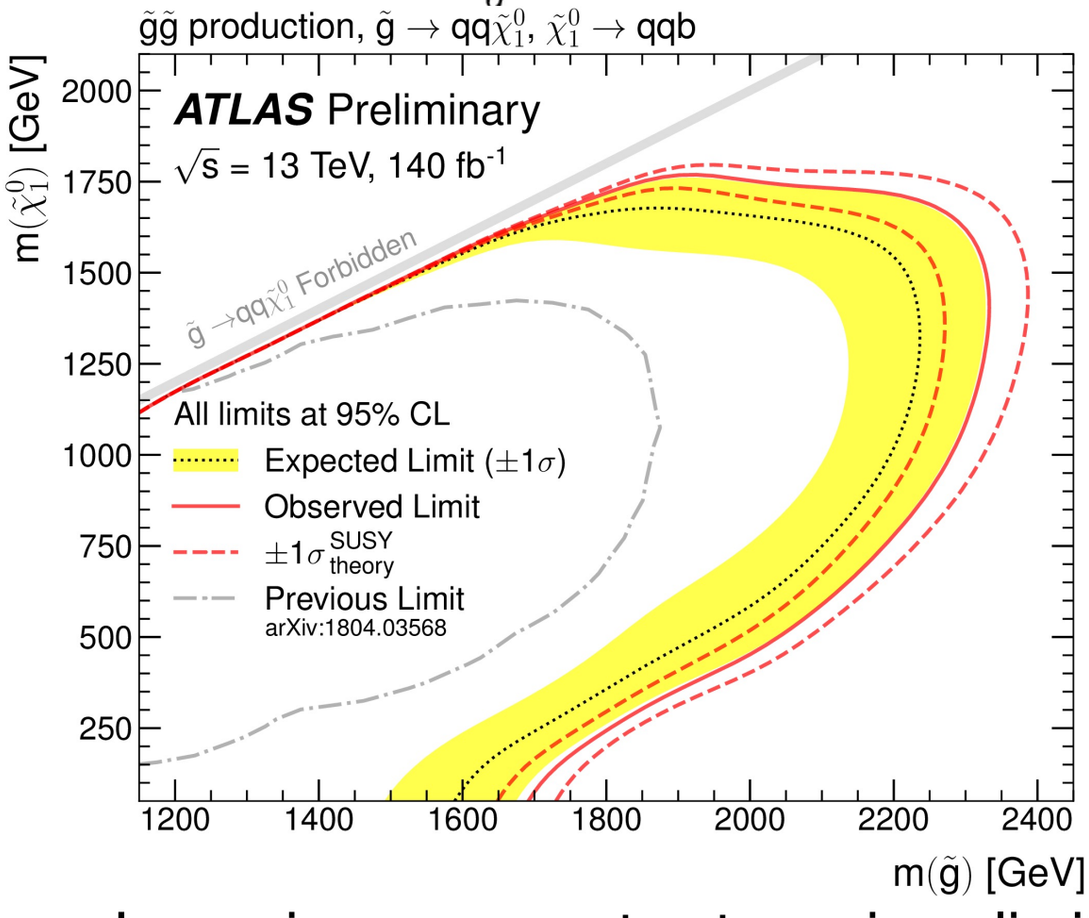


gluino direct decay



gluino cascade decay

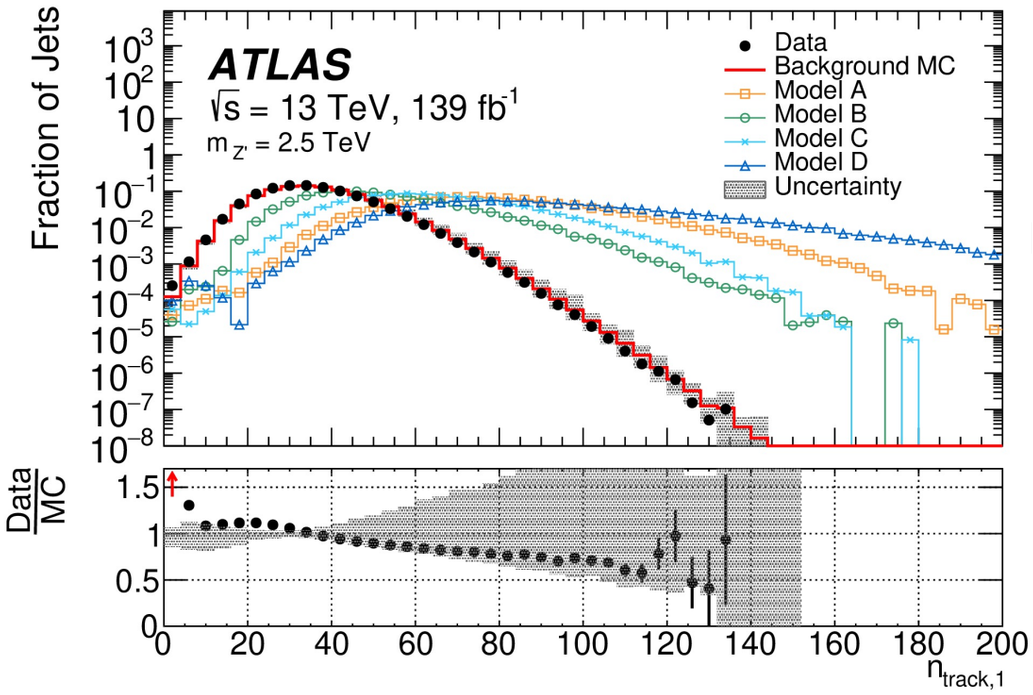




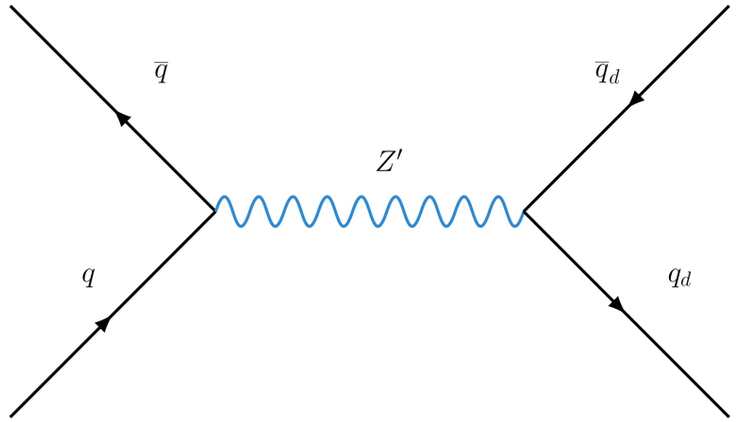
Large improvement wrt previous limits

Multijet Resonance Searches arXiv:2311.03944

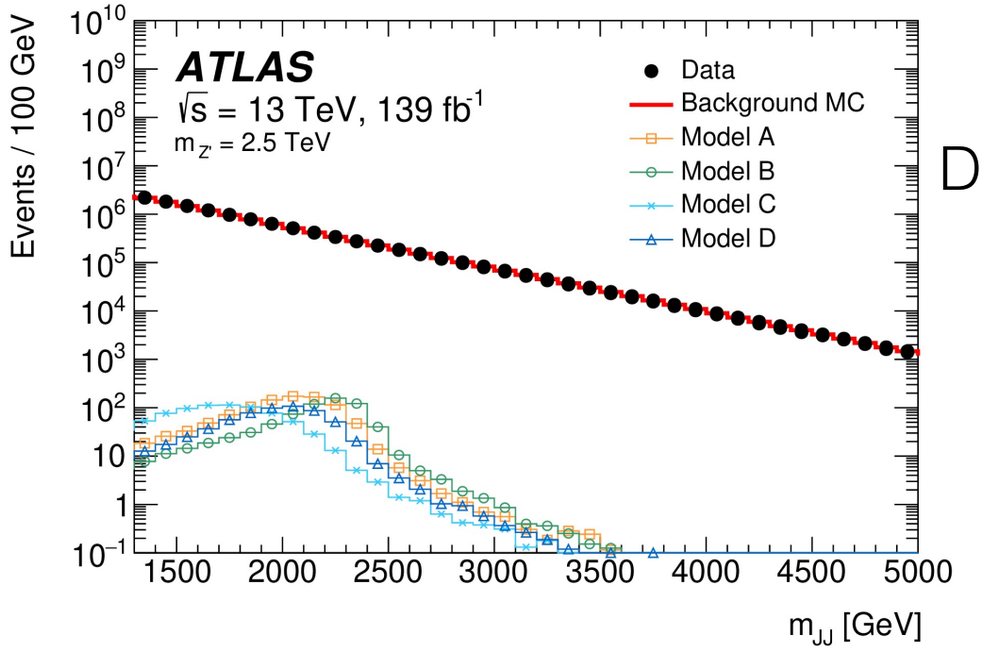
Search for a new Z' resonance decaying into a **pair of dark quarks** which hadronize into dark hadrons before promptly decaying back as Standard Model particles
→ jets with high charged-particle multiplicity



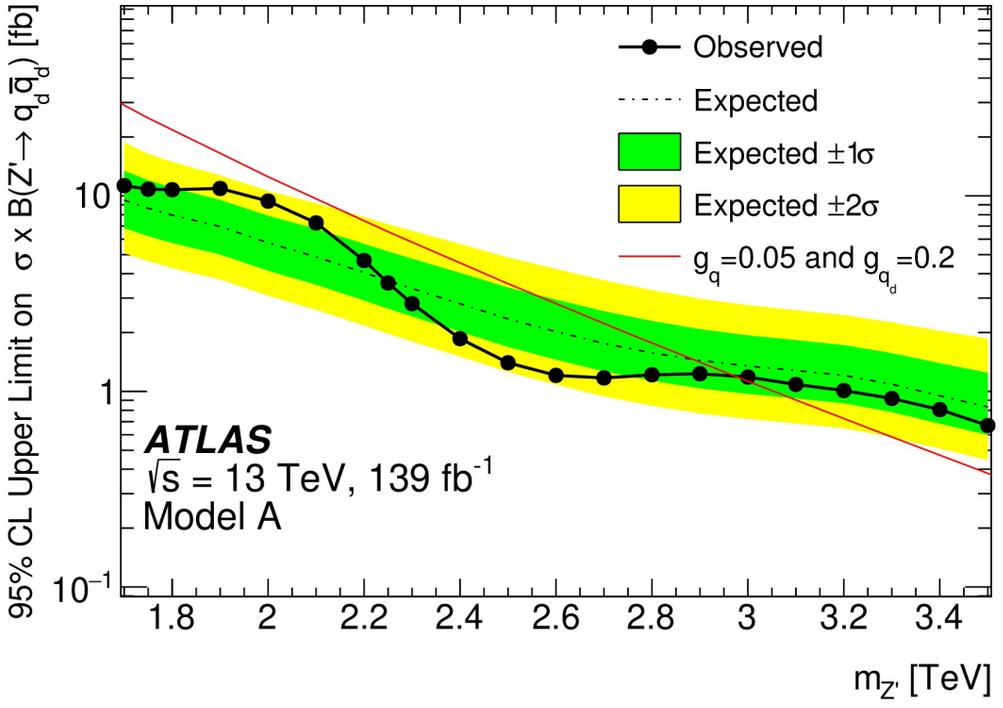
Track multiplicity of jets



Benchmark models from arXiv:1712.09279



Di-(dark)jets invariant mass



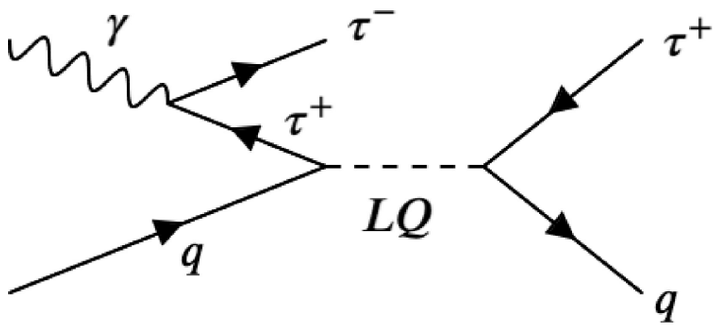
Probes mass range up to 3 TeV

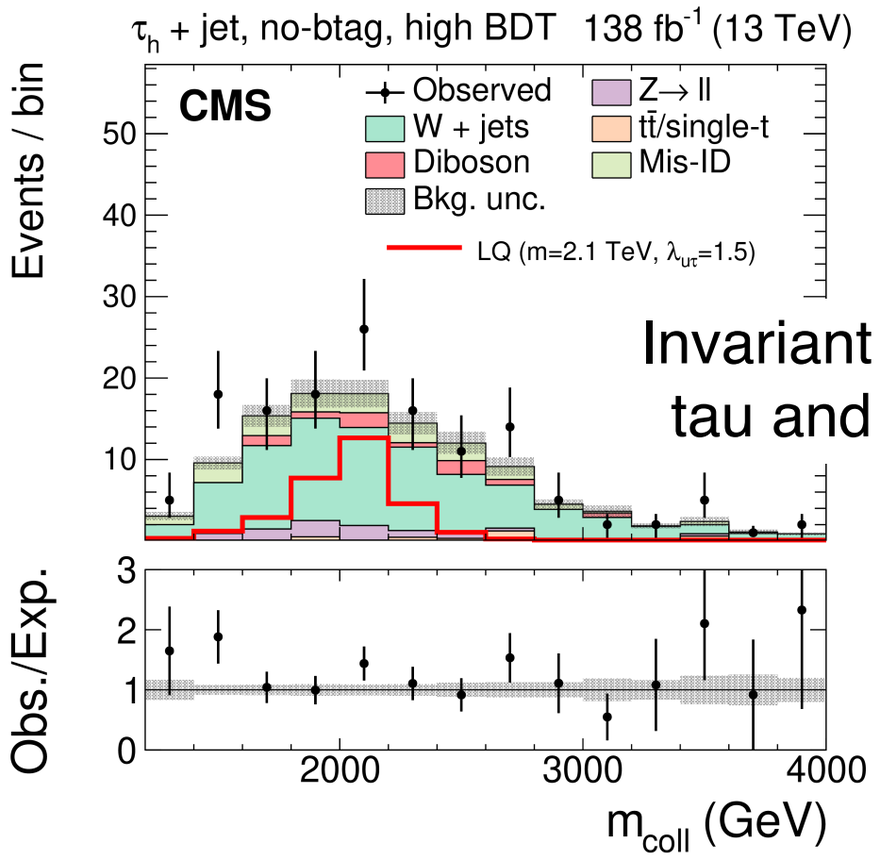
Leptoquark searches

arXiv:2308.06143

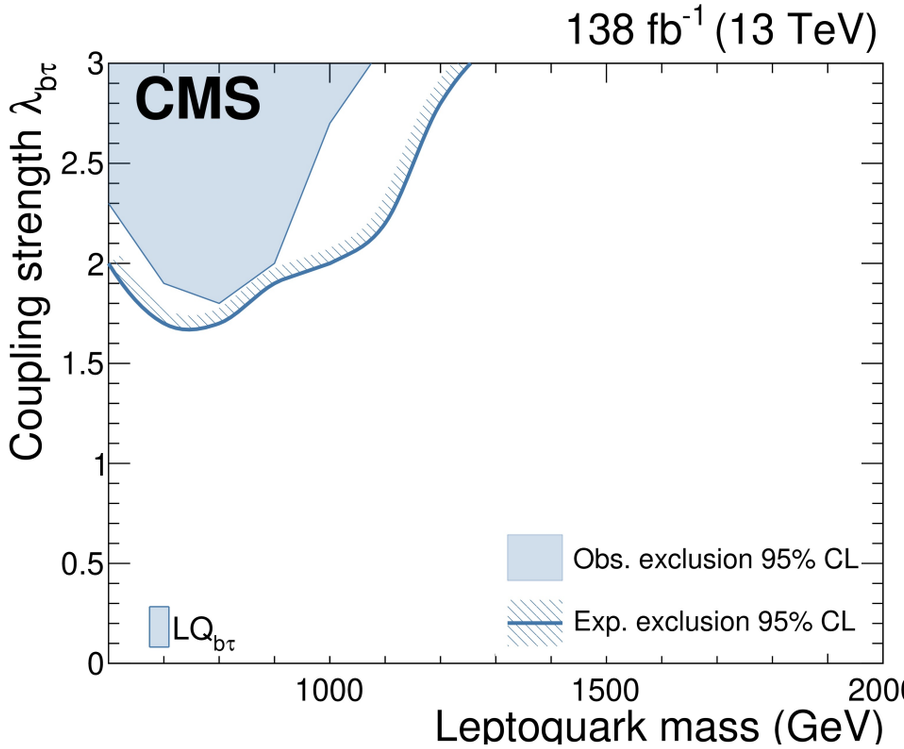
Search for a resonance decaying to a lepton and a jet

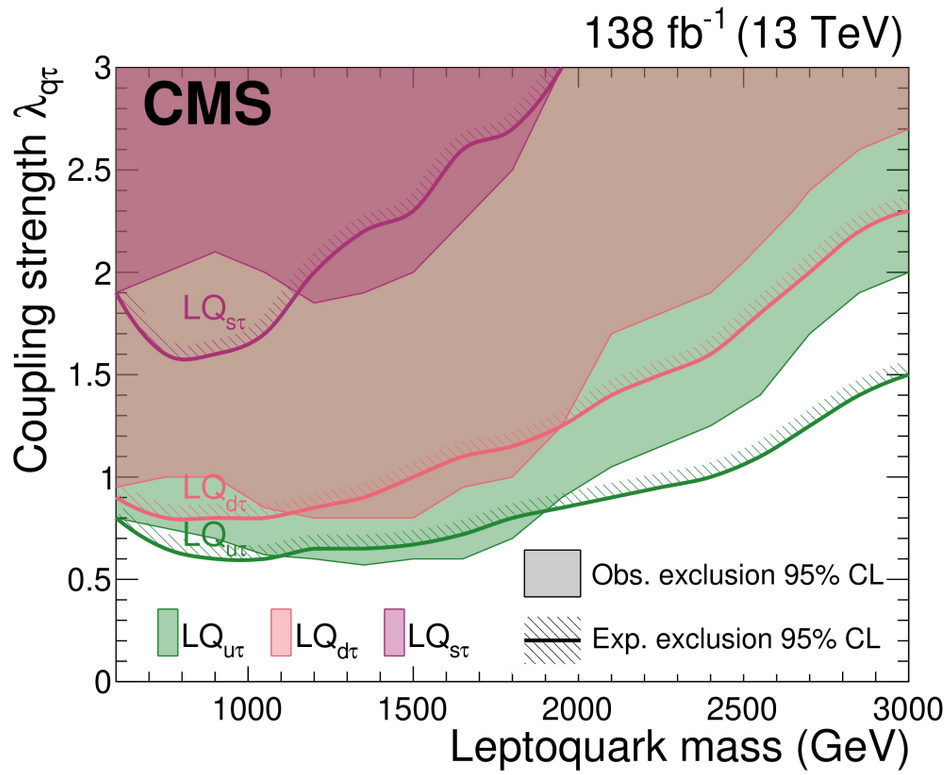
Lepton induced single production of LQs





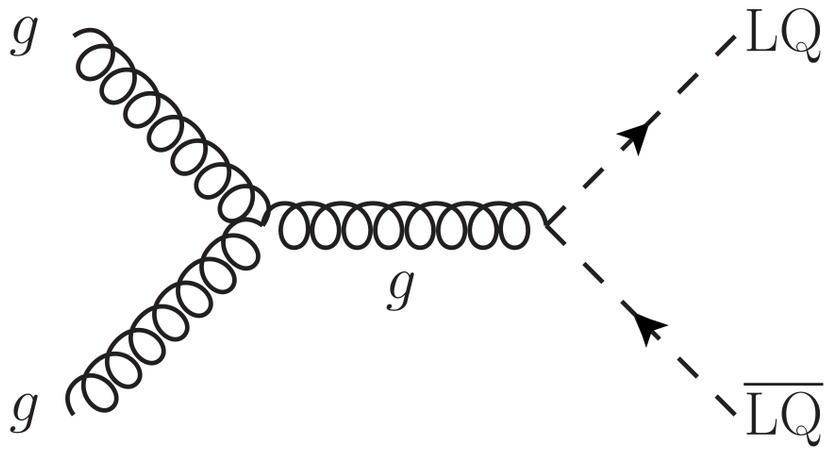
Invariant mass of tau and jet pair

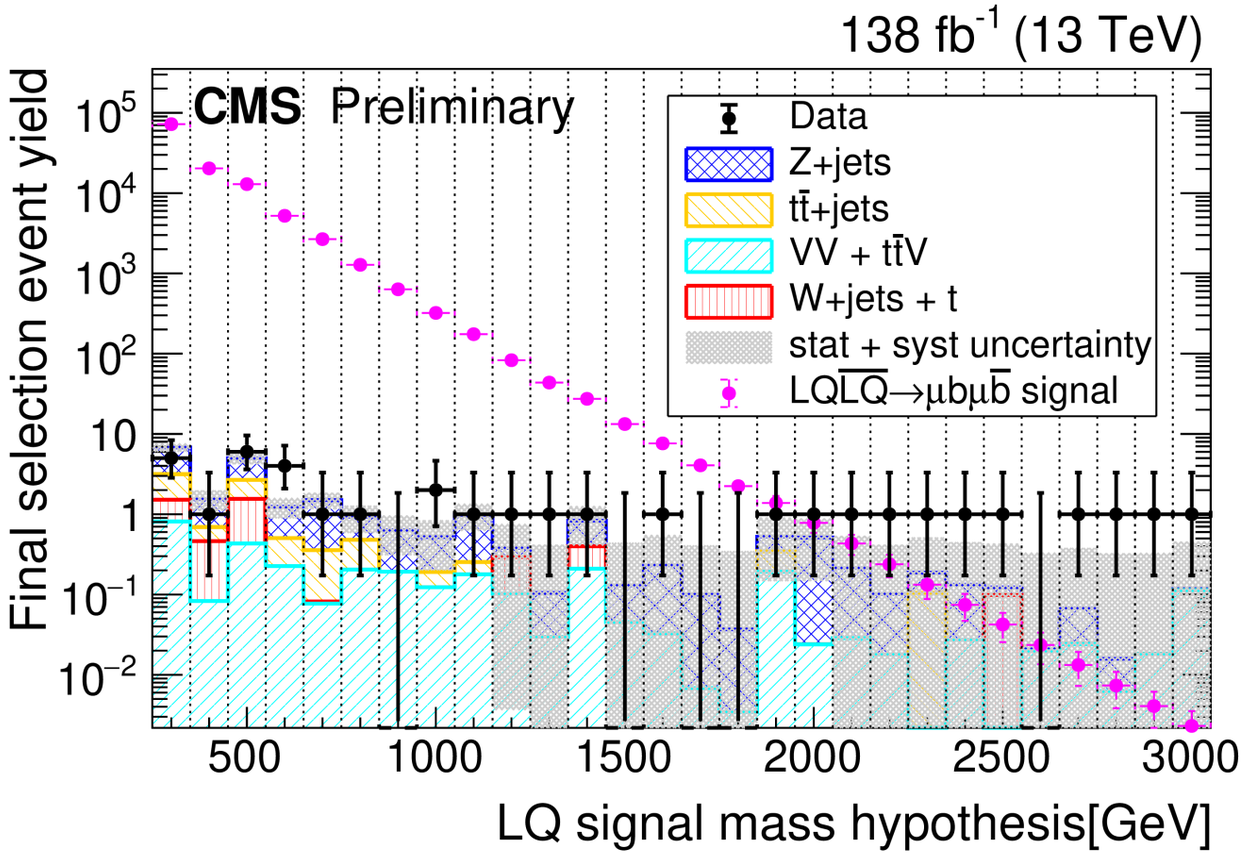


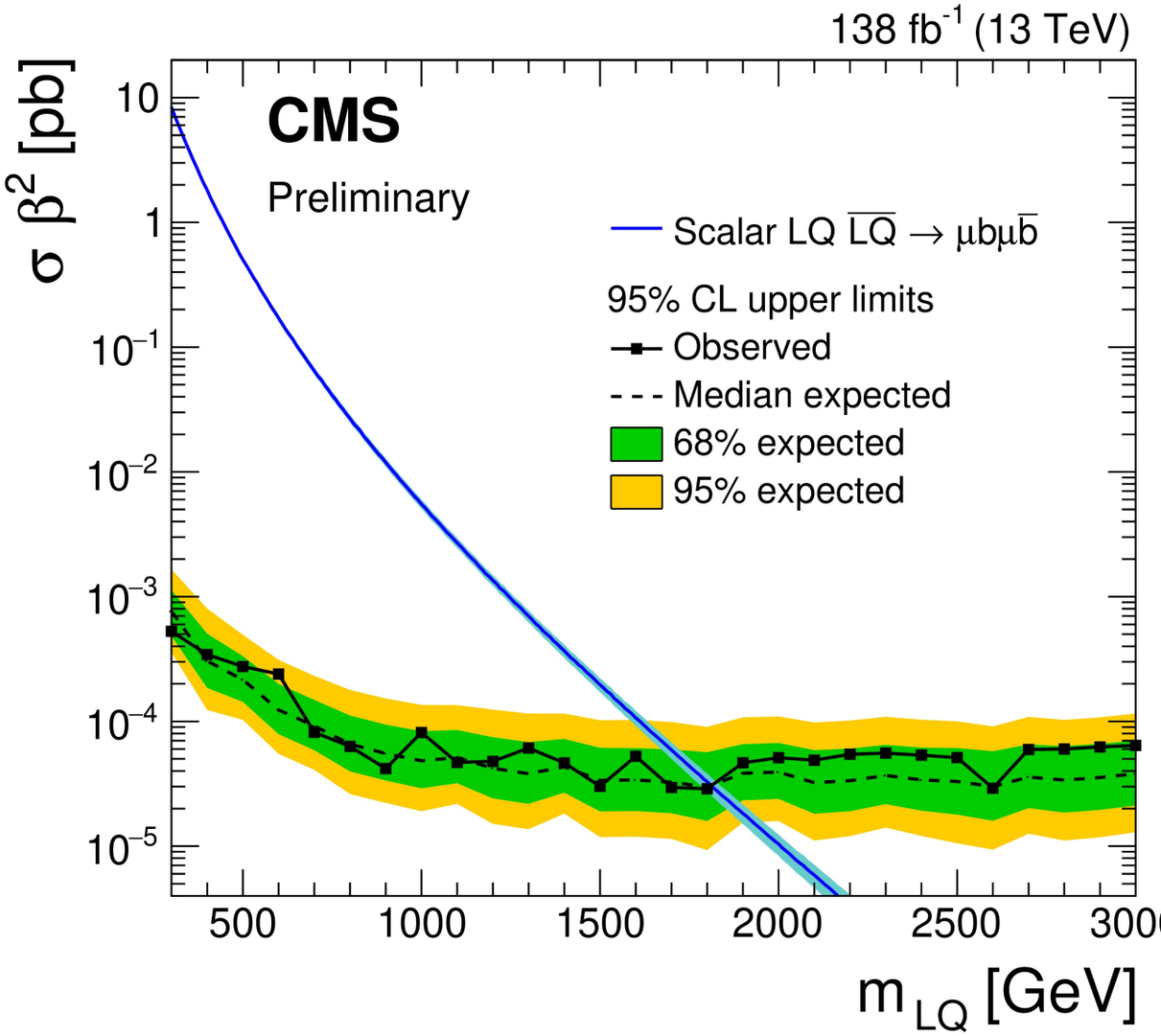


Leptoquark searches

Search for a resonance decaying to a muon and a b-jet







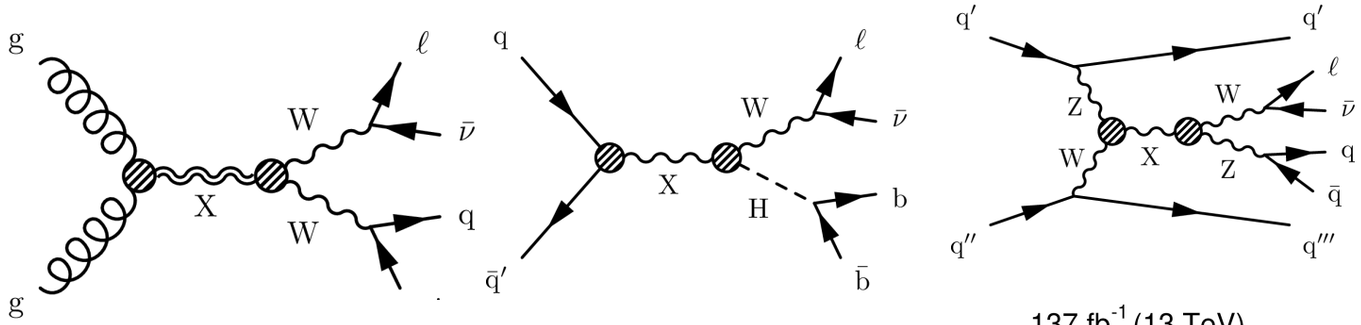
Scalar LQs with masses <1.8 TeV are excluded, assuming a 100% Br to mb.

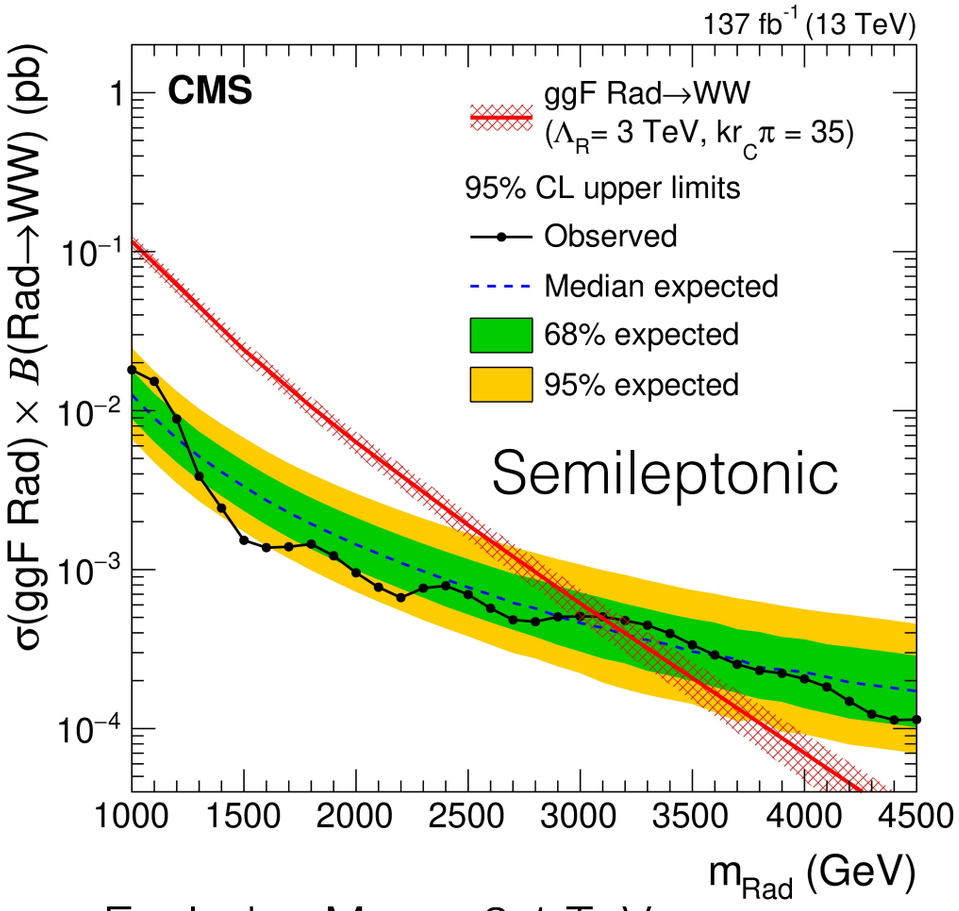
Heavy Resonances → VV, VH

CMS-B2G-20-009
CMS-B2G-19-002

Radion/Graviton in Randall-Sundrum model with warped extra dimensions

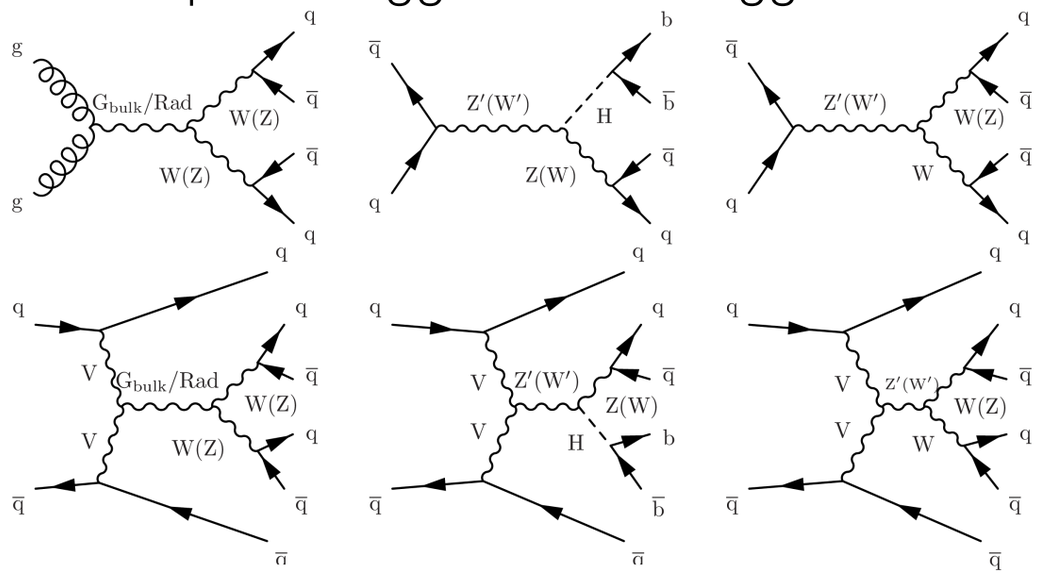
Bosons reconstructed in 2 Anti-kT (R=0.8) jets or leptons+MET

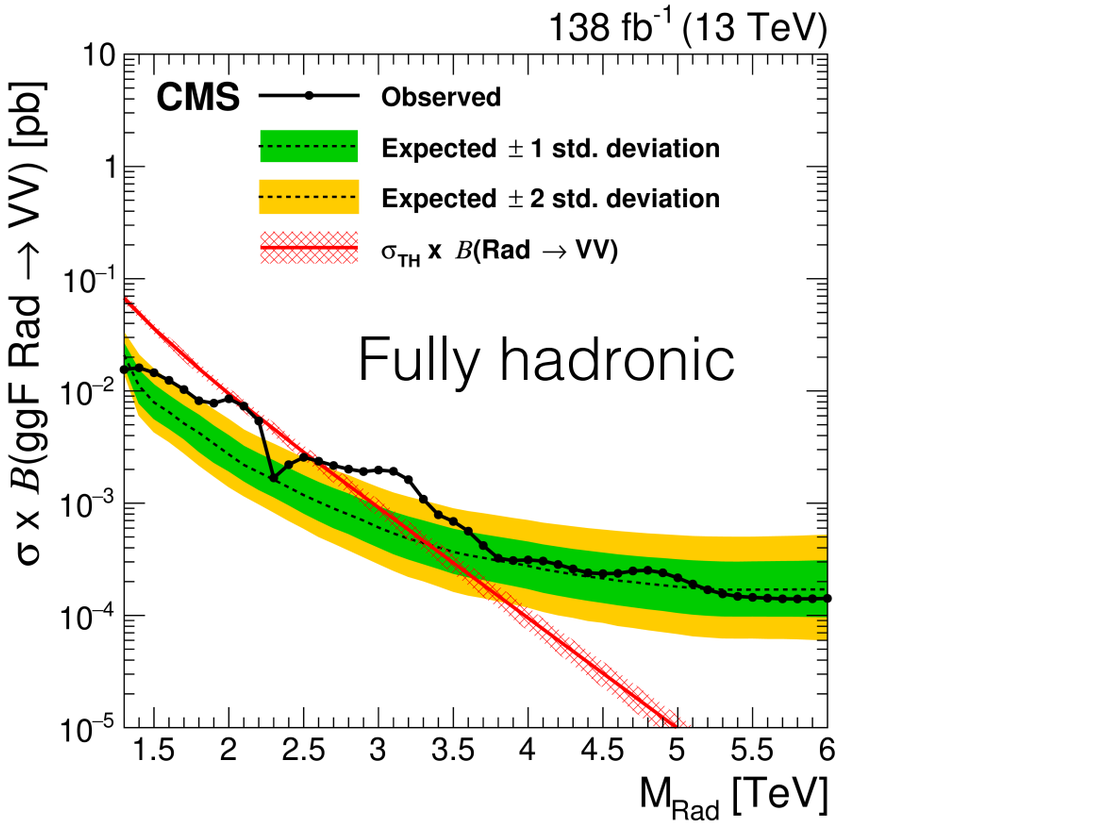




Excludes M_{RAD}< 3.1 TeV

W'/Z' in composite Higgs and little Higgs models





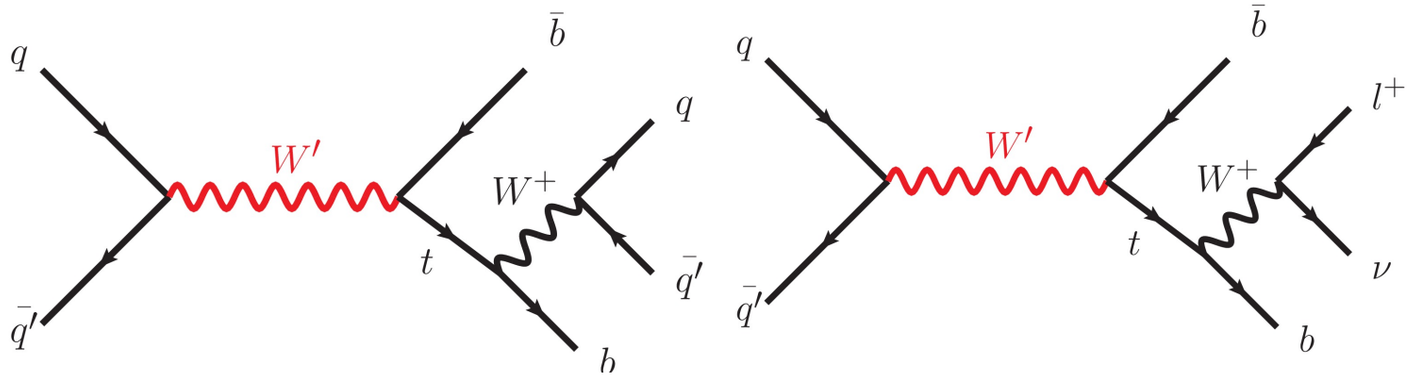
Excludes M_{RAD} < 2.7 TeV

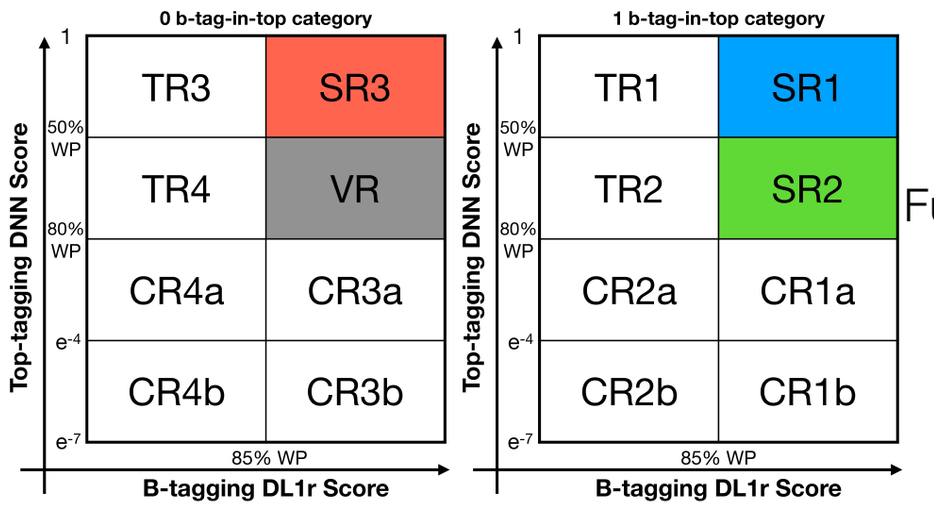
3.6σ (2.3σ) at 2.1 TeV and 2.9 TeV local (global)

Search for Heavy Vector bosons

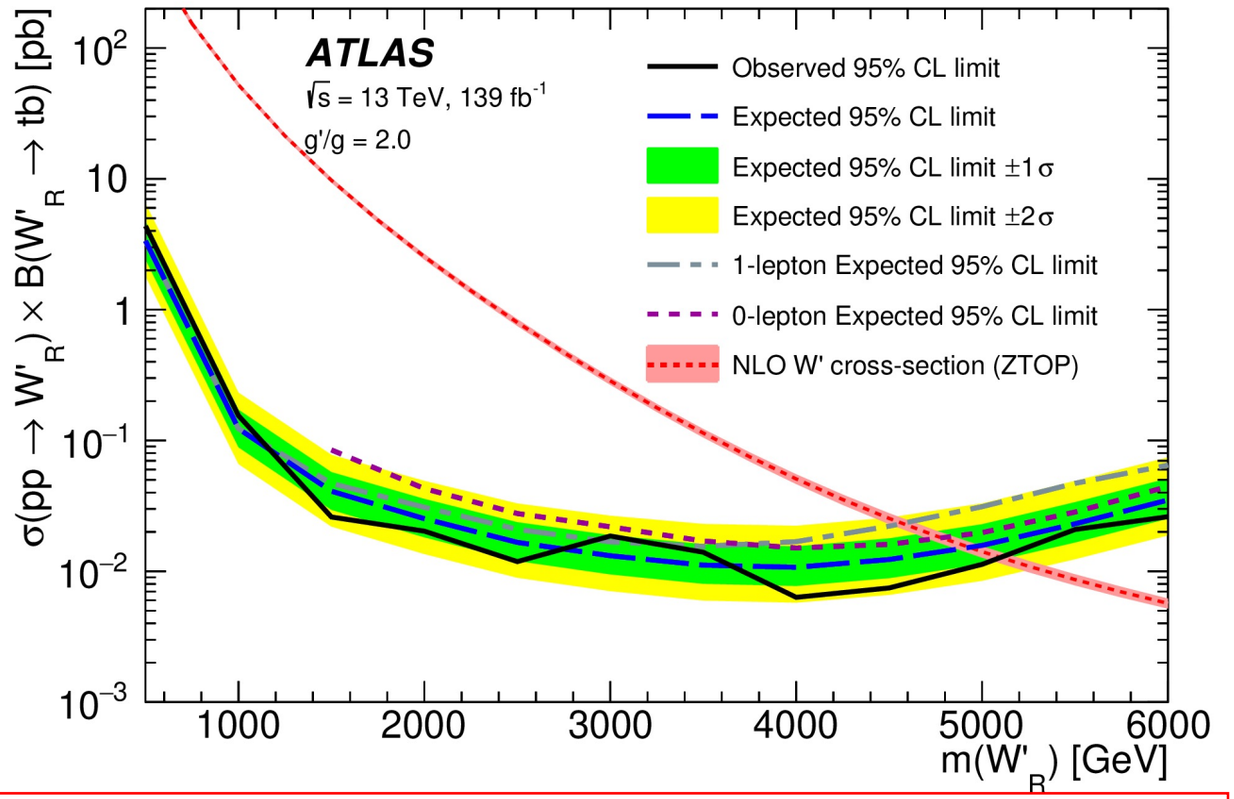
arXiv:2308.08521

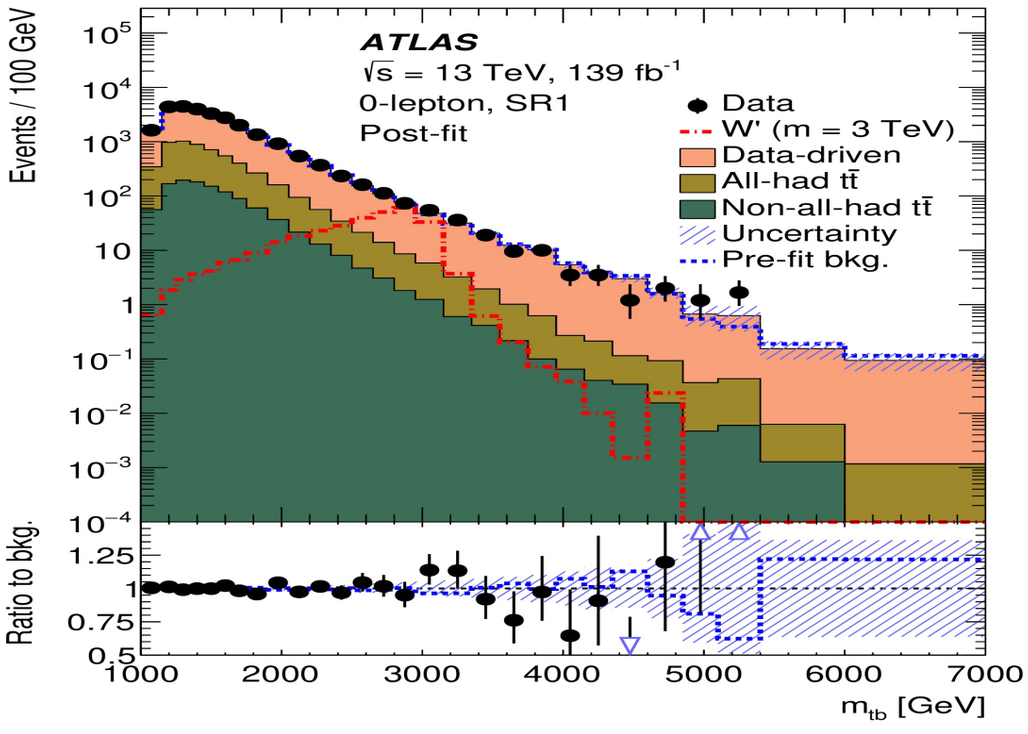
Search for heavy vector bosons decaying to 3rd generation quarks





Fully hadronic event categories





Probing W' with masses up to ~5 TeV
(both left and right handed couplings)

Search for Z' + b-jets: JHEP 10 (2023) 043

Search for Z' + E_T^{miss}: ATLAS-CONF-2023-045

Searches for Long-Lived Particles

Many searches for Long Lived Particles (LLPs)

- Predicted by several BSM models
- Unconventional Signatures:
  - Emerging jets
  - Heavy charged LLPs
  - Delayed jets
  - Displaced jets
  - Displaced lepton Jets
  - Disappearing tracks
  - Displaced muons
  - Displaced Vertices
  - …..

Summary of LLP searches

CMS_Long_lived_particle_summary

ATL-PHYS-PUB-2023-008

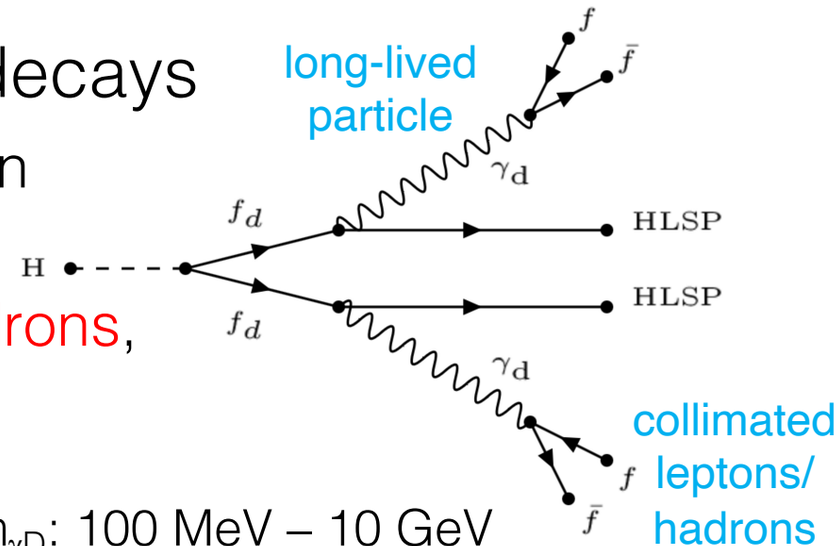
Dedicated triggers in Run-3

Displaced Lepton Jets

ATLAS-CONF-2023-051

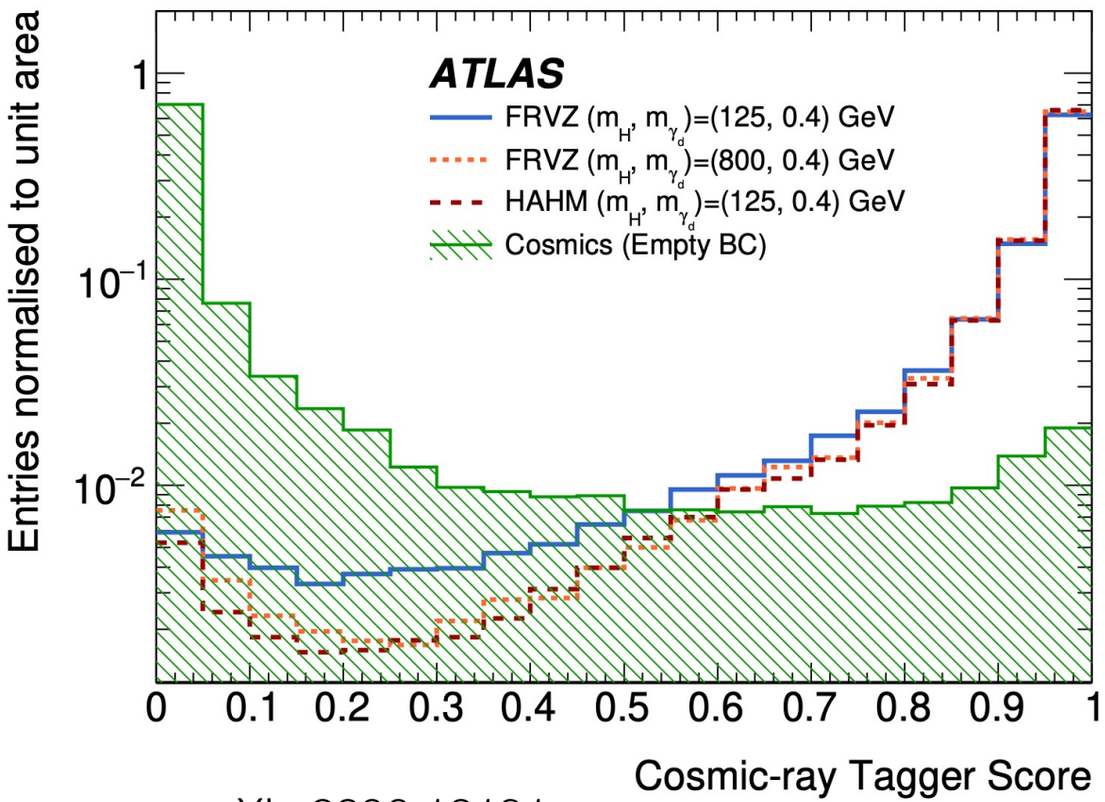
Search for displaced dark photons in exotic Higgs decays

- Falkowski–Ruderman–Volansky–Zupan (FRVZ) dark photon model
- **Signature:** displaced collimated jets of leptons or light hadrons, reconstructed in calorimeter or muon spectrometer

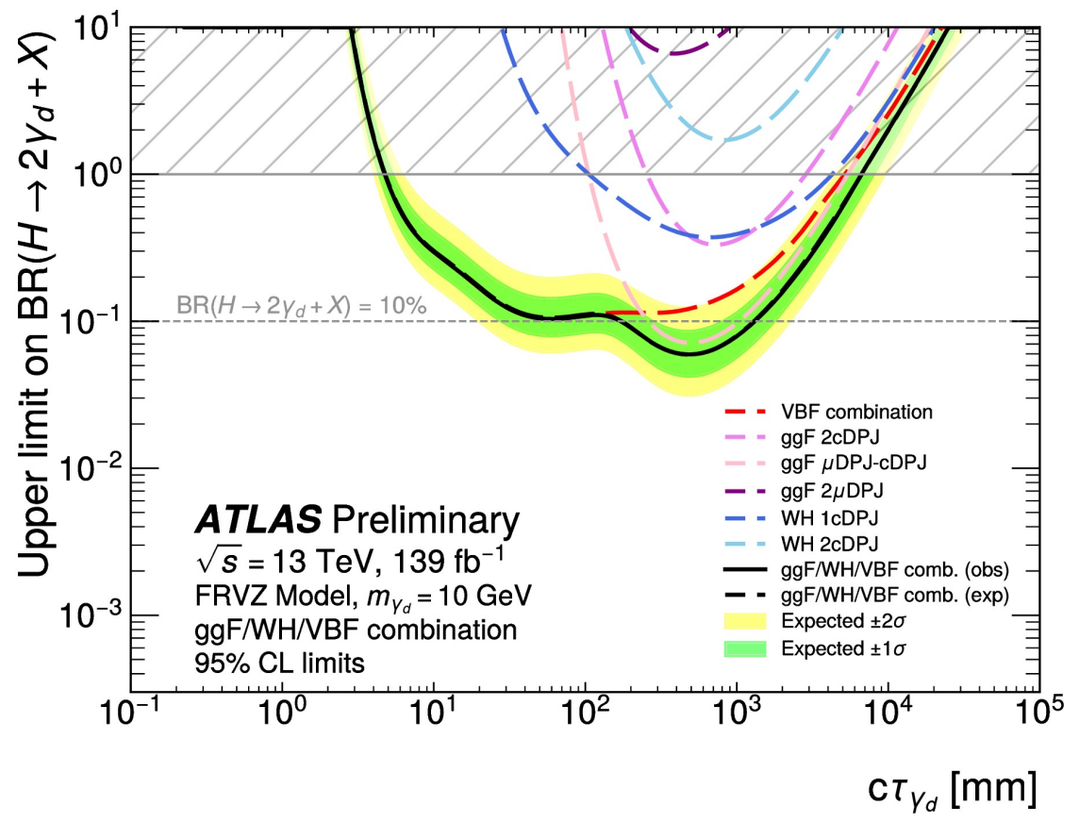


$m_{\gamma D}$: 100 MeV – 10 GeV

Dedicated taggers to reject backgrounds



arXiv:2206.12181



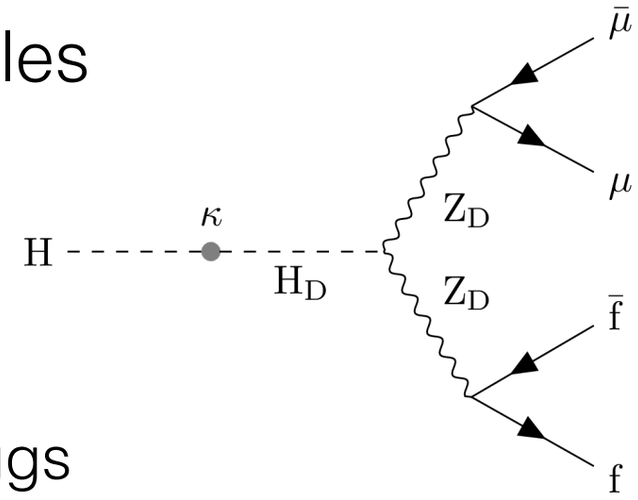
Branching fractions >10% excluded for proper decay length 173 - 1296 mm for $m_{\gamma d}$ ~ 10 GeV

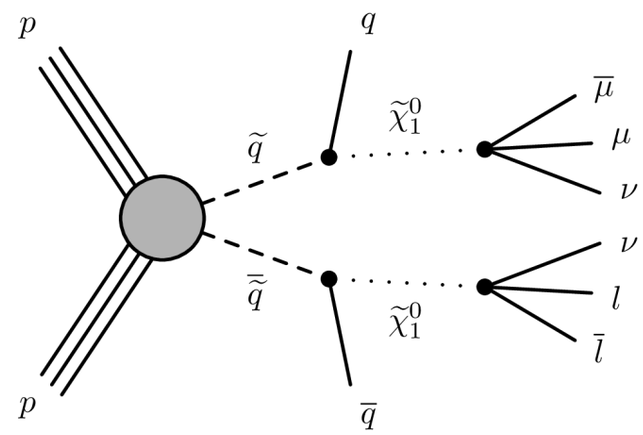
Search for Displaced muons

CMS-PAS-EXO-23-014

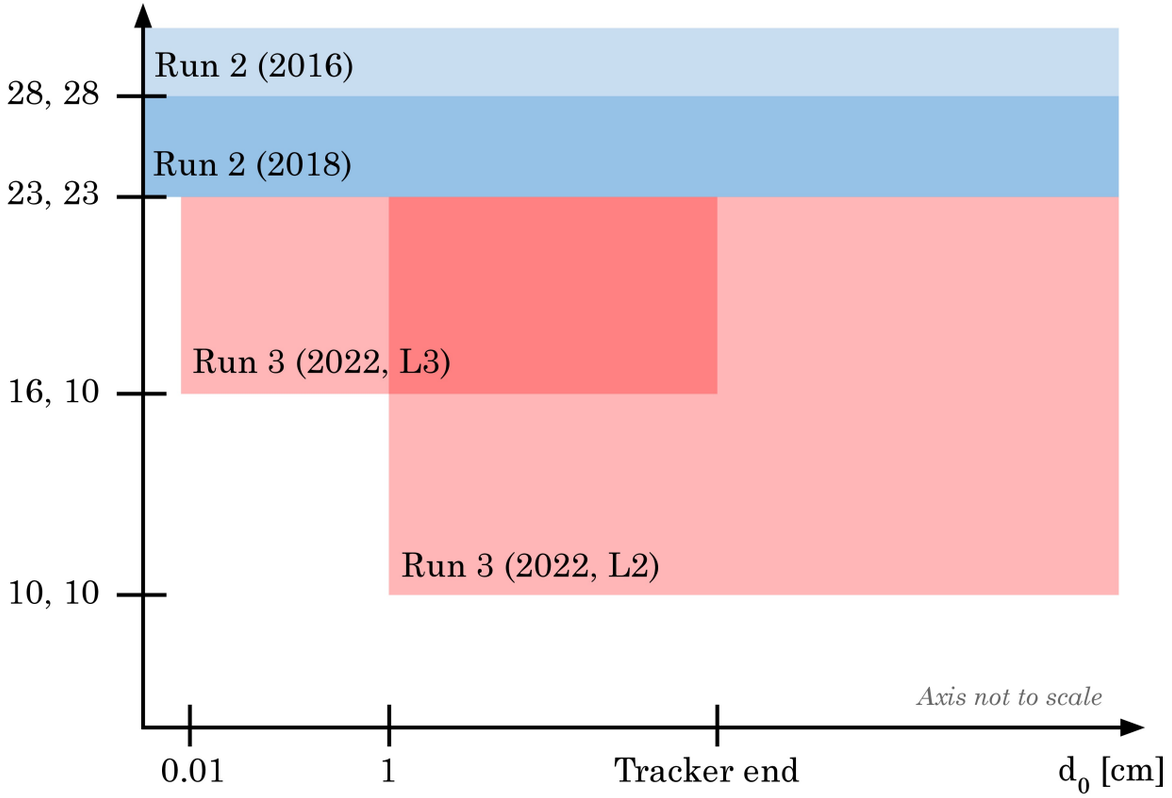
Search for long-lived exotic particles decaying to a pair of muons

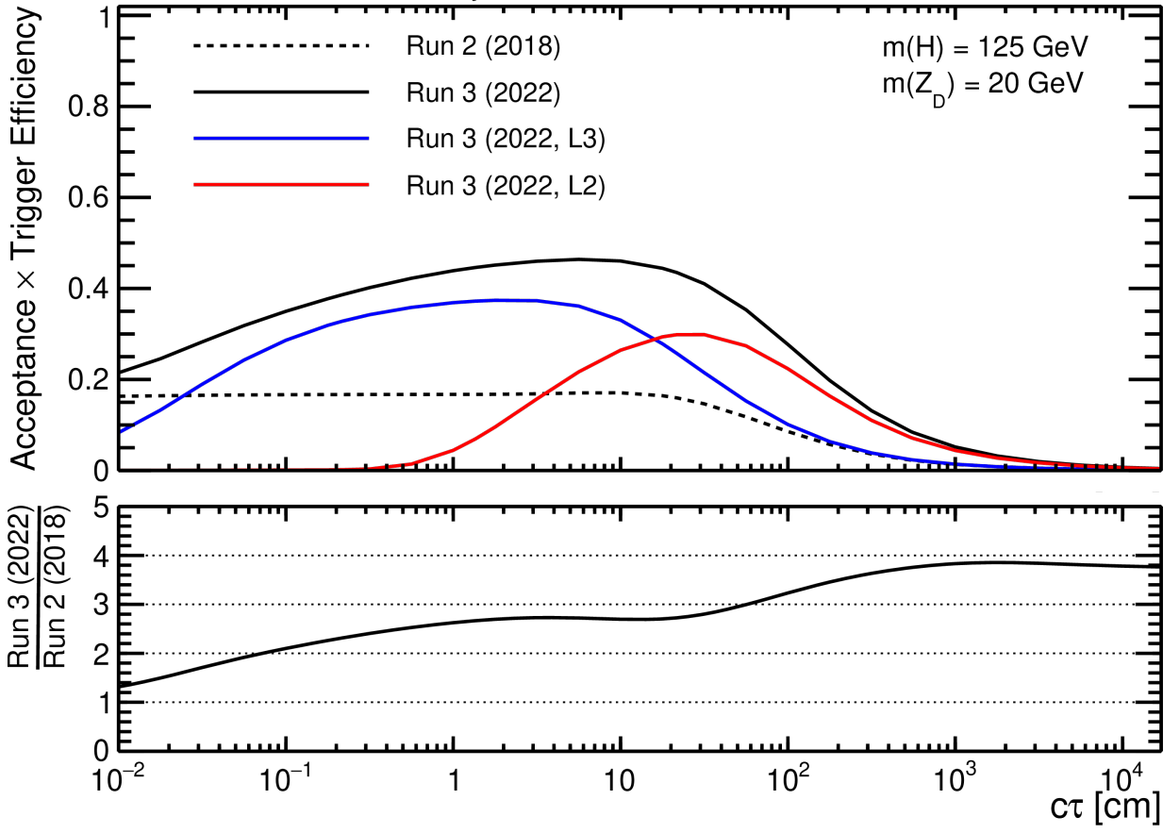
- Uses 2022 Run-3 data
  - Improved sensitivity due to lower trigger thresholds
- Interpretations in Hidden Abelian Higgs model (HAHM) and RPV SUSY model





$10 \lesssim m_{ZD} \lesssim 60$ GeV





Search for Displaced muons

CMS-PAS-EXO-23-014

Search for long-lived exotic particles decaying to a pair of muons

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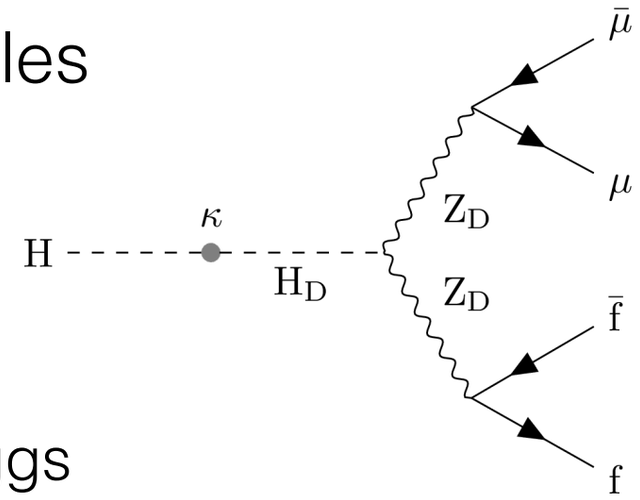
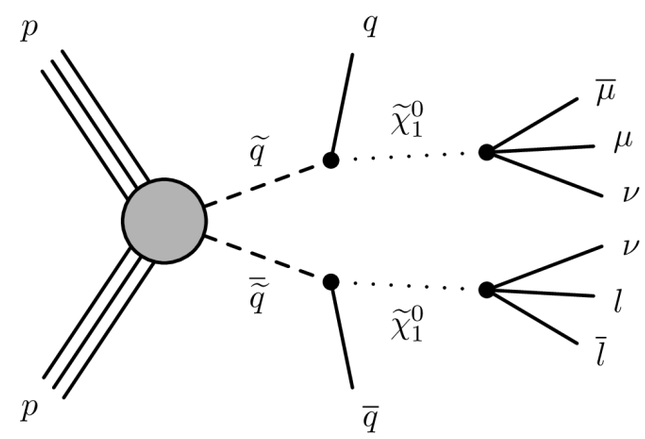
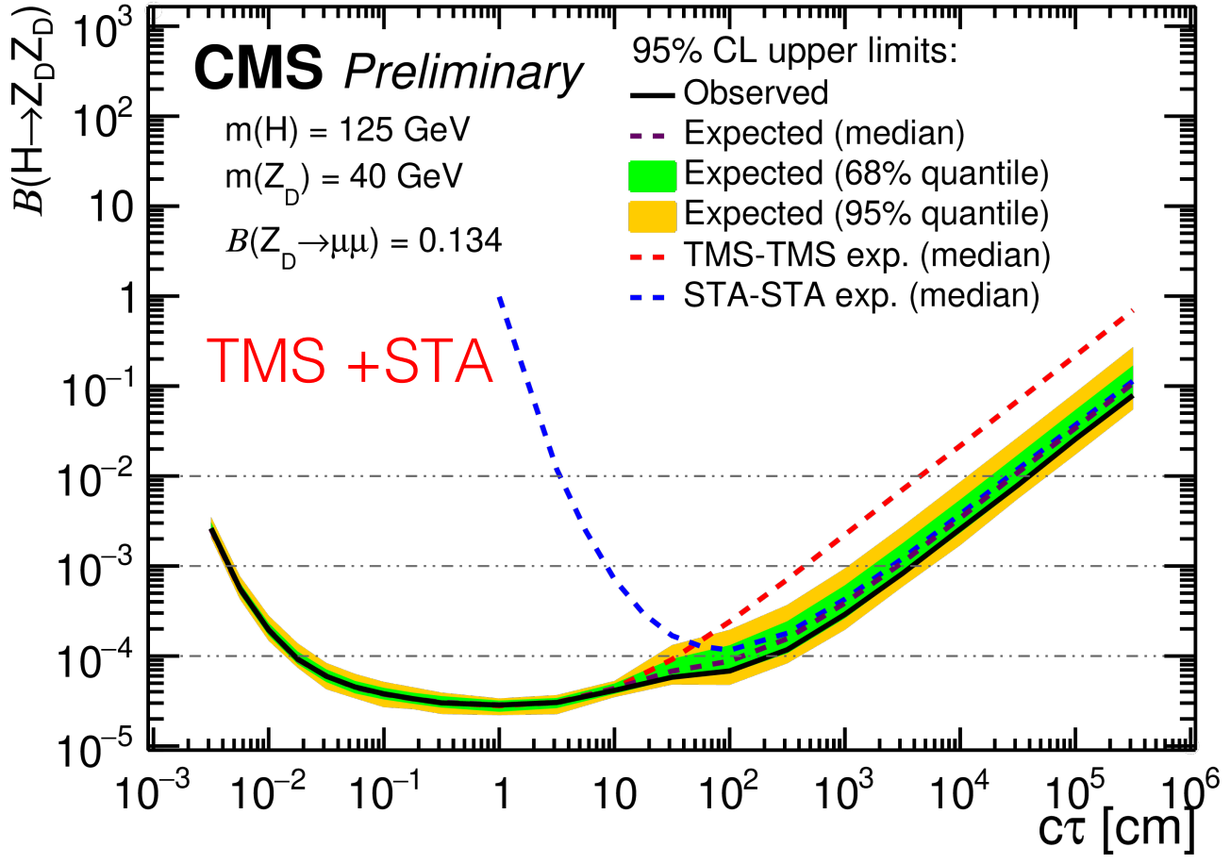
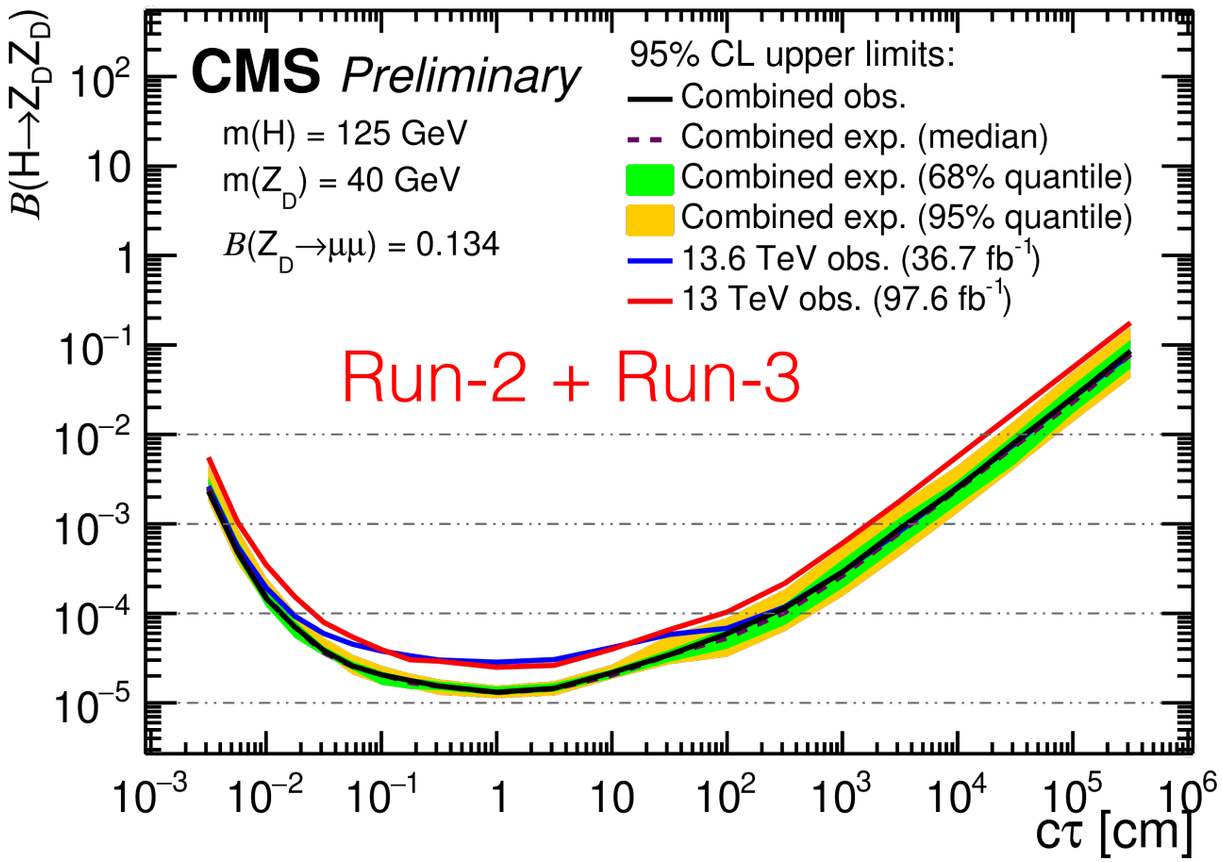




$10 \lesssim m_{ZD} \lesssim 60$ GeV





Improved sensitivity with Run-3

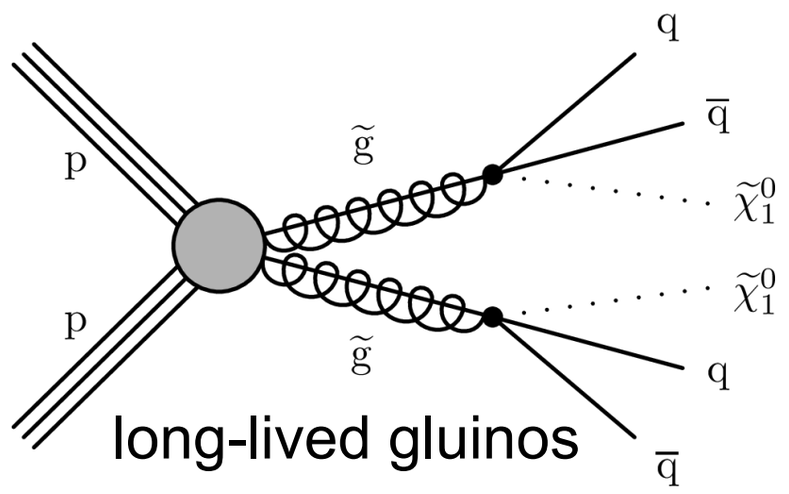
Search for displaced vertices

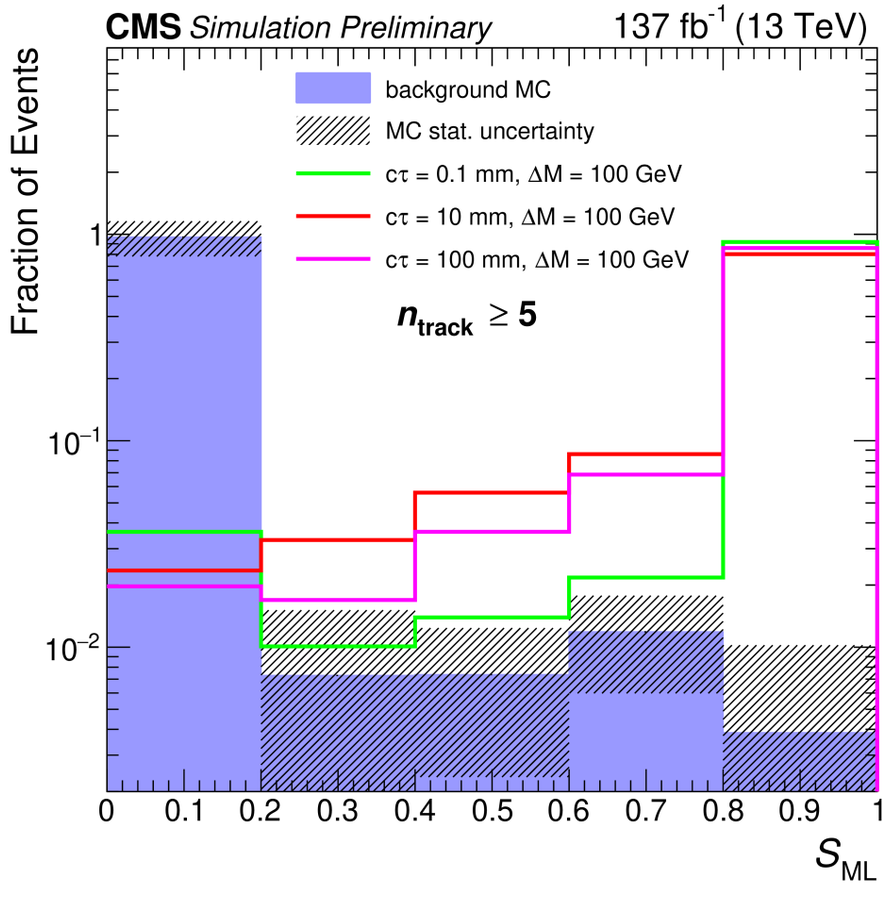
CMS-PAS-EXO-22-020

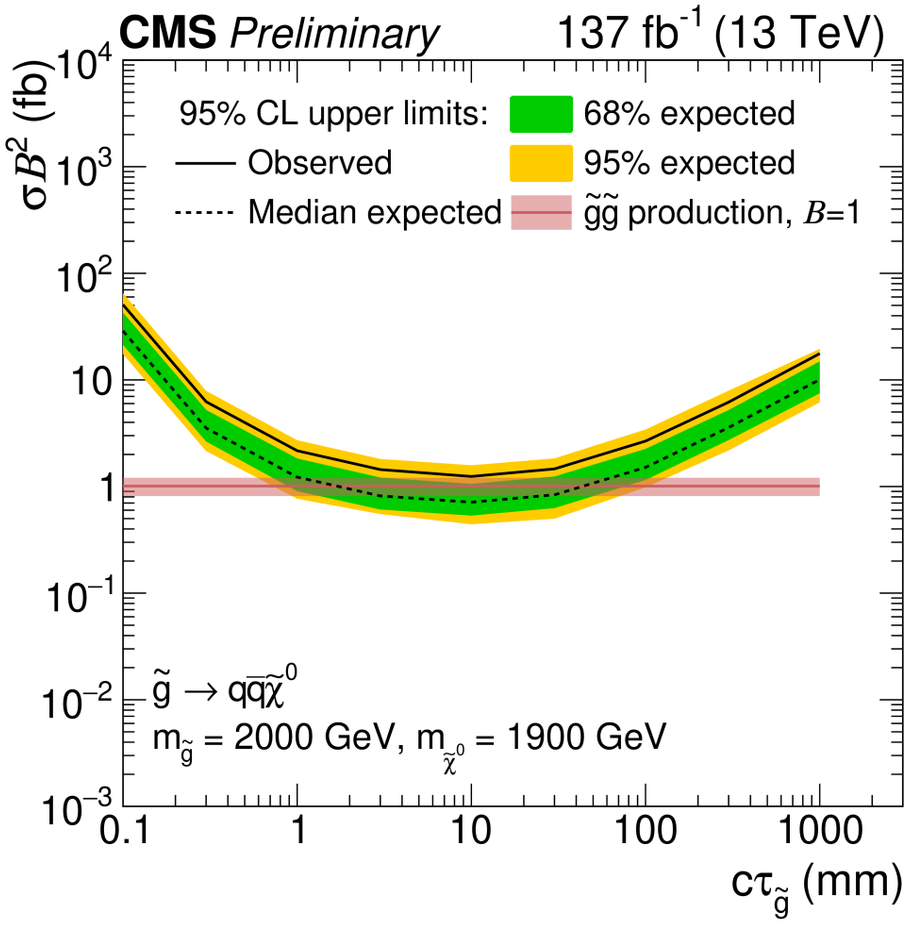
Search for long-lived particles with at least one displaced vertex and missing transverse momentum

- Sensitive to long-lived particles with mean proper decay lengths between 0.1 and 1000 mm
- ML based analysis for discrimination of background displaced vertices

Split SUSY signal model







Gluinos with $c\tau$ = 1 to 100 mm excluded @ 95% CL for gluino mass < 1.8 and 2 TeV, when ΔM = 100 and 200 GeV

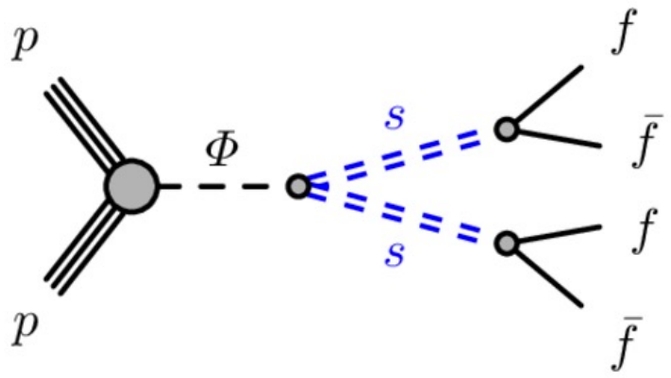
most stringent for models with $c\tau$ < 100mm

Higgs decay to LLP

PRD 106, (2022) 032005

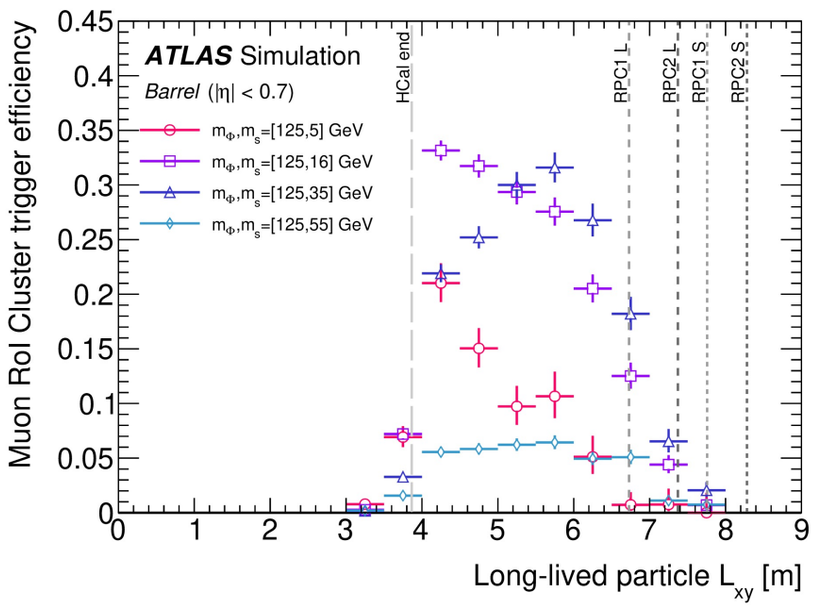
- Hidden sector models predict exotic Higgs decays to LLP

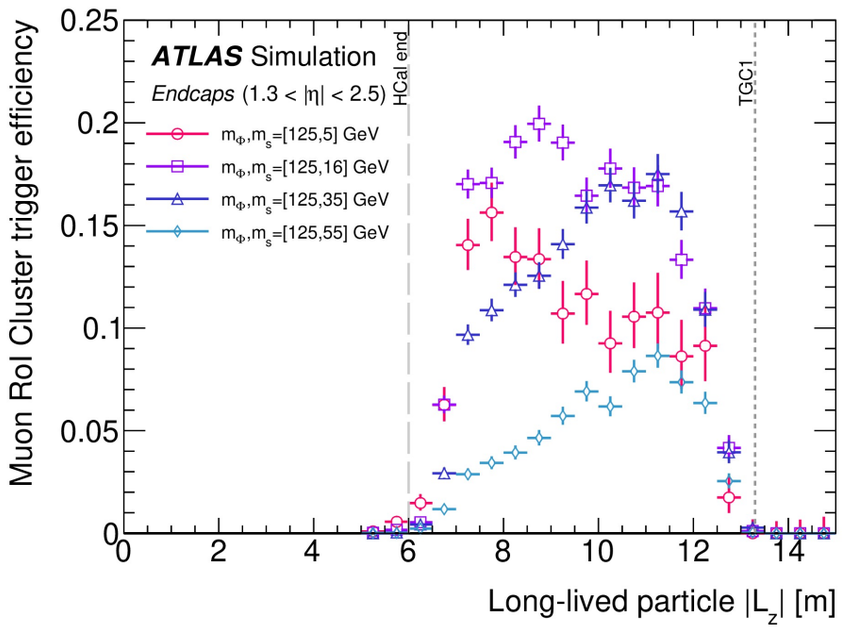
  → Search for events with two displaced vertices from long-lived particles (LLP) pairs
- Requires reconstructing vertices of LLPs decaying to jets in the muon spectrometer, displaced between 3m and 14m with respect to the primary vertex
  - Dedicated muon spectrometer multi-RoI trigger and track segment and vtx reconstruction in muon spectrometer
  - Background from punch-through jets suppressed with track & calo isolation

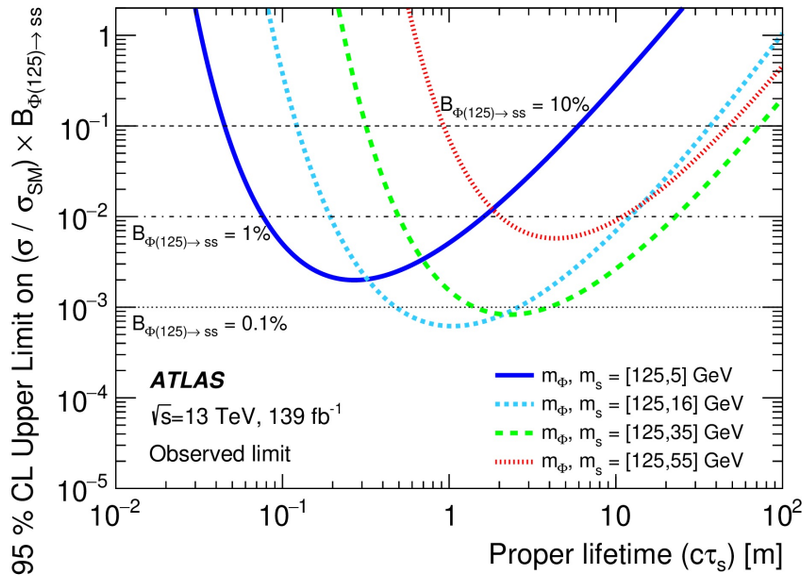


0 events observed with
0.32 ± 0.05 expected bkg

BR(Φ(125)→*ss*) =10%
excluded for cτ(*s*) in range
4 cm — 7.8 m
for m_s = 5 GeV





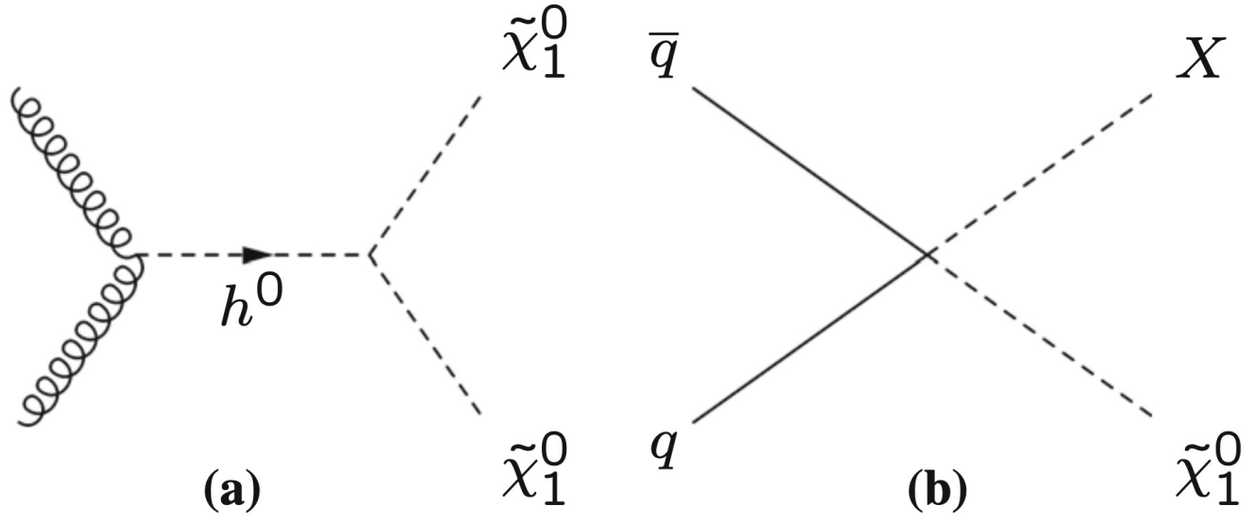


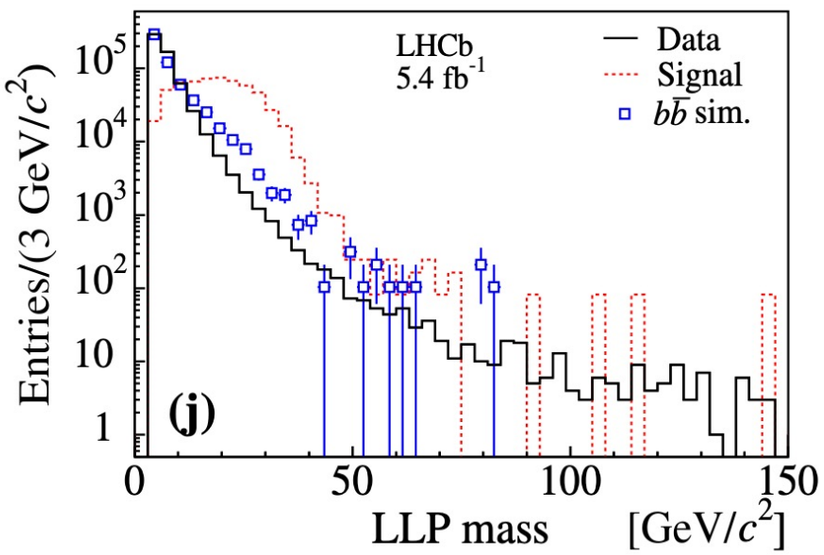
Also limits for $m_\phi \neq 125$

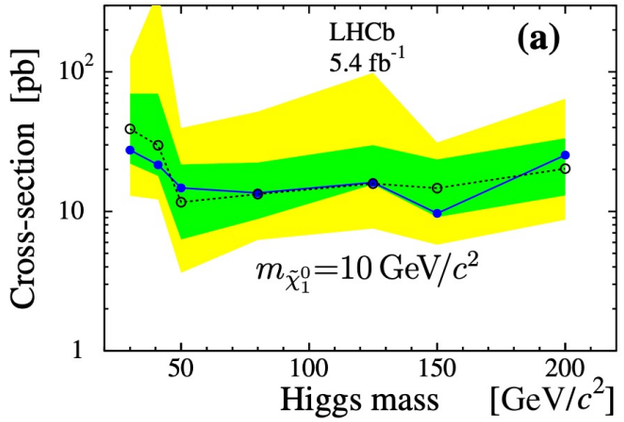
Higgs decay to LLP @ LHCb

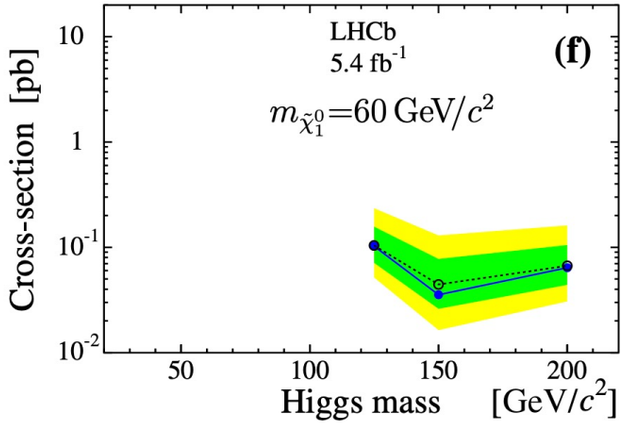
EPJC 82 (2022) 4, 373

- Two LLP production processes:
  - A Higgs-like boson (mass 30 to 200 GeV) decaying into LLPs (τ: 5 to 200 ps)
  - Direct LLP production from quark interactions (mass: 10 to 90 GeV), where X is a stable particle, with mass identical to the LLP
- The LLP decays into a muon and two quarks ($\tilde{\chi}_1^0 \to \mu^+ q_i q_j$)

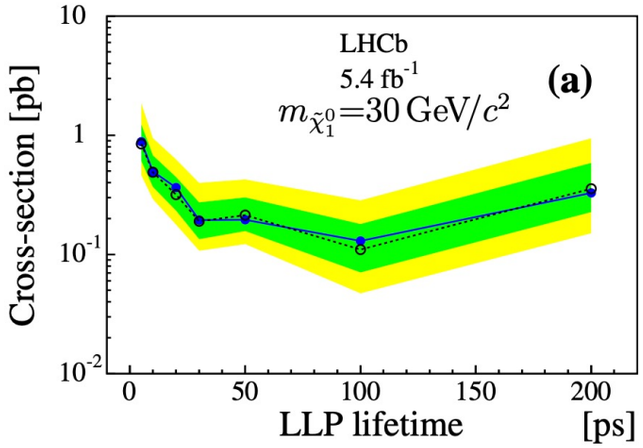


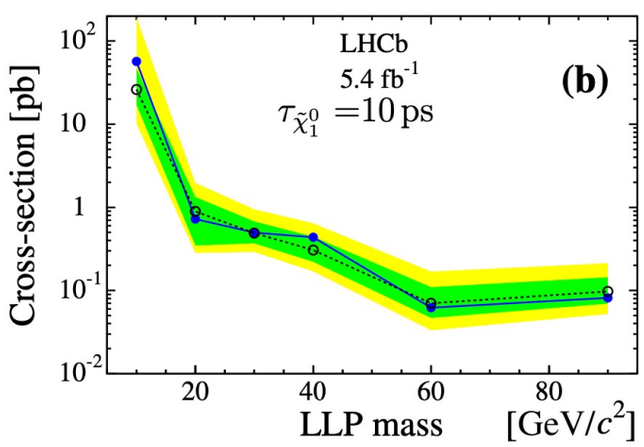






From Higgs Decay





Non-Resonant production

Summary

- Large number of BSM searches at LHC
  - Stringent limits in several models with Run1+Run2 data
  - A few small excesses observed
    - More data needed to make conclusive statement
- Analysis of Run-3 data starting to ramp up
  - With improved analysis techniques and extending to uncovered regimes

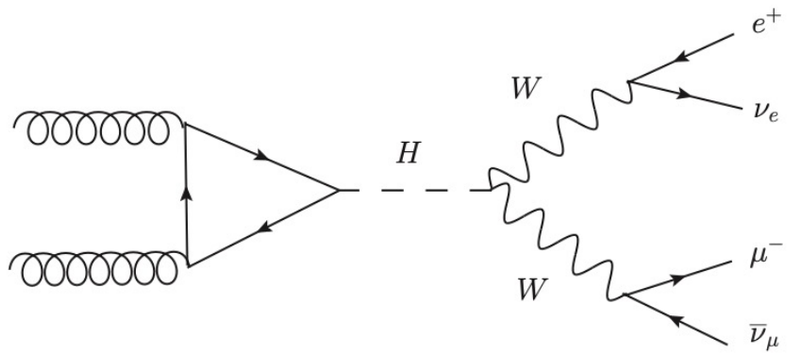
Stay Tuned

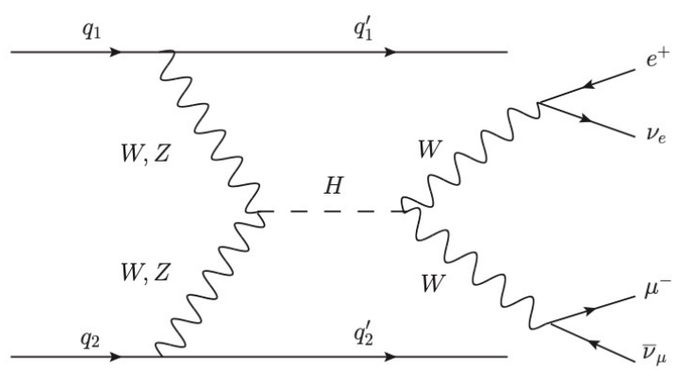
Thank You

High mass H → WW

CMS-PAS-HIG-20-016

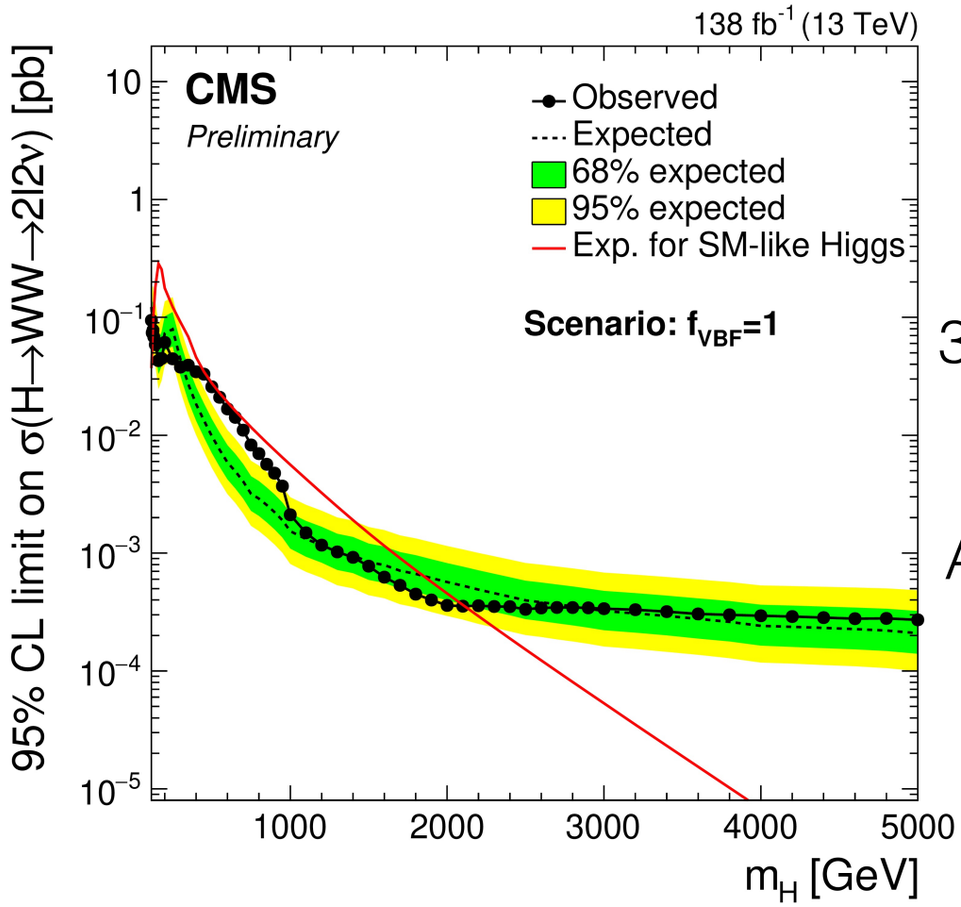
Dilepton Analysis:
H→ WW → eμ + νν
H→ WW → ee/μμ + νν





Events categorized by multiclass DNN:
- ggF
- VBF
- background

Search in four scenarios:
- f_{VBF} = 0 (ggF only)
- f_{VBF} = 1 (VBF only)
- Floating f_{VBF} (ggF only)
- SM f_{VBF}



3.8 (2.6)σ local (global) @ 650 GeV

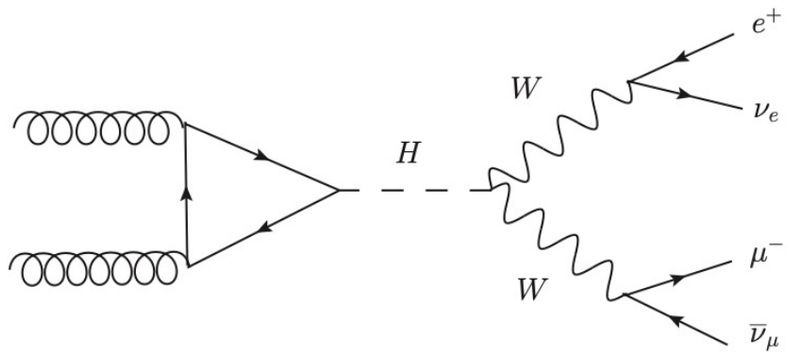
Assuming 2% relative signal width

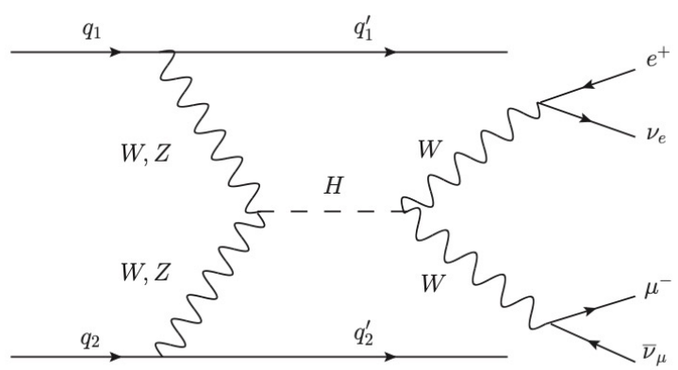
Scenario	Mass [GeV]	ggF cross sec. [pb]	VBF cross sec. [pb]	Local signi. [σ]	Global signi. [σ]
SM f_{VBF}	800	0.16	0.057	3.2	1.7 ± 0.2
$f_{VBF} = 1$	650	0.0	0.16	3.8	2.6 ± 0.2
$f_{VBF} = 0$	950	0.19	0.0	2.6	0.4 ± 0.6
floating f_{VBF}	650	2.9×10^{-6}	0.16	3.8	2.4 ± 0.2

High mass H → WW

CMS-PAS-HIG-20-016

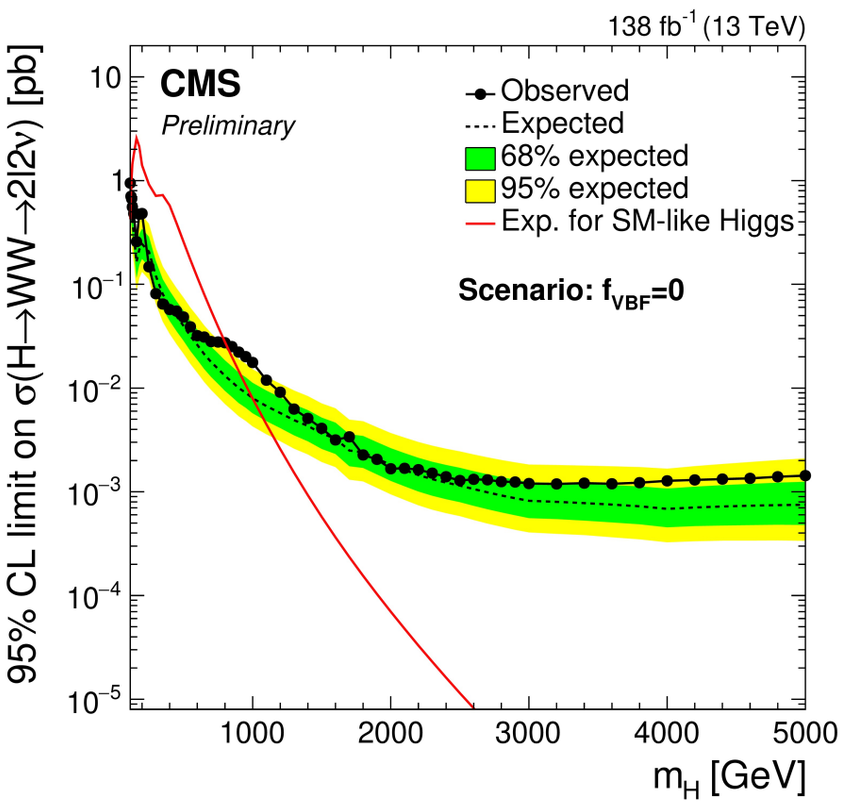
Dilepton Analysis:
H→ WW → eμ + νν
H→ WW → ee/μμ + νν

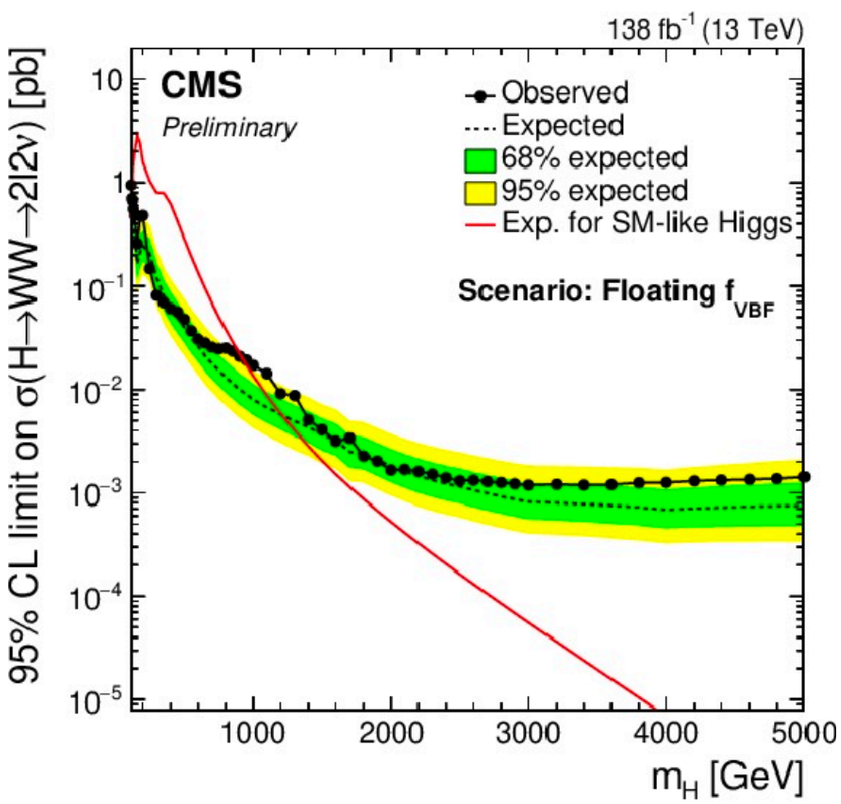


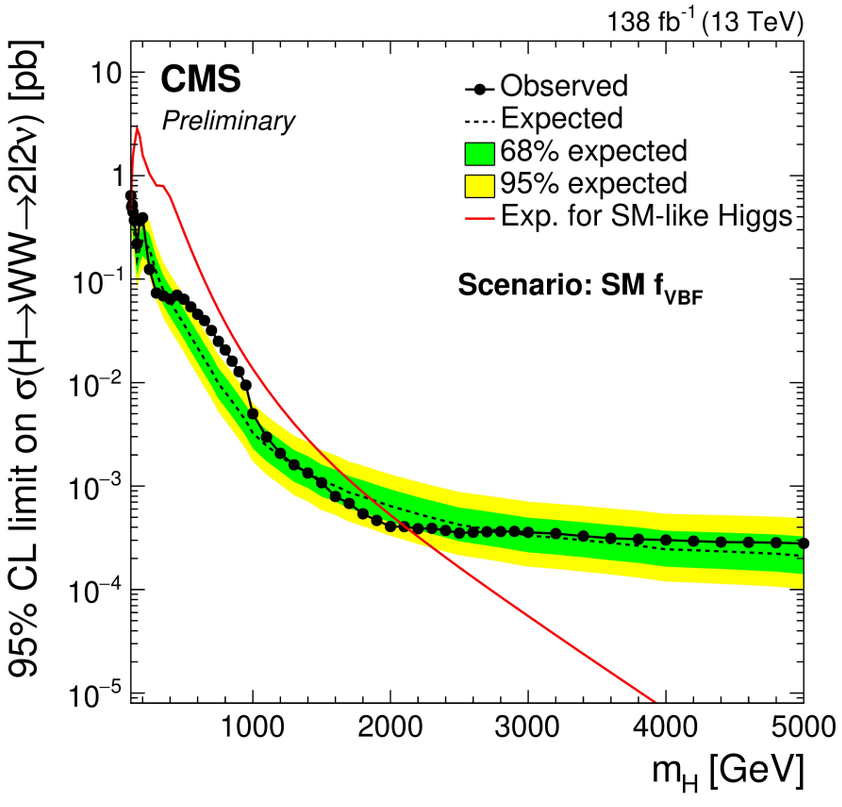


Events categorized by DNN:
- ggF
- VBF
- background

Other scenarios







High mass H → WW

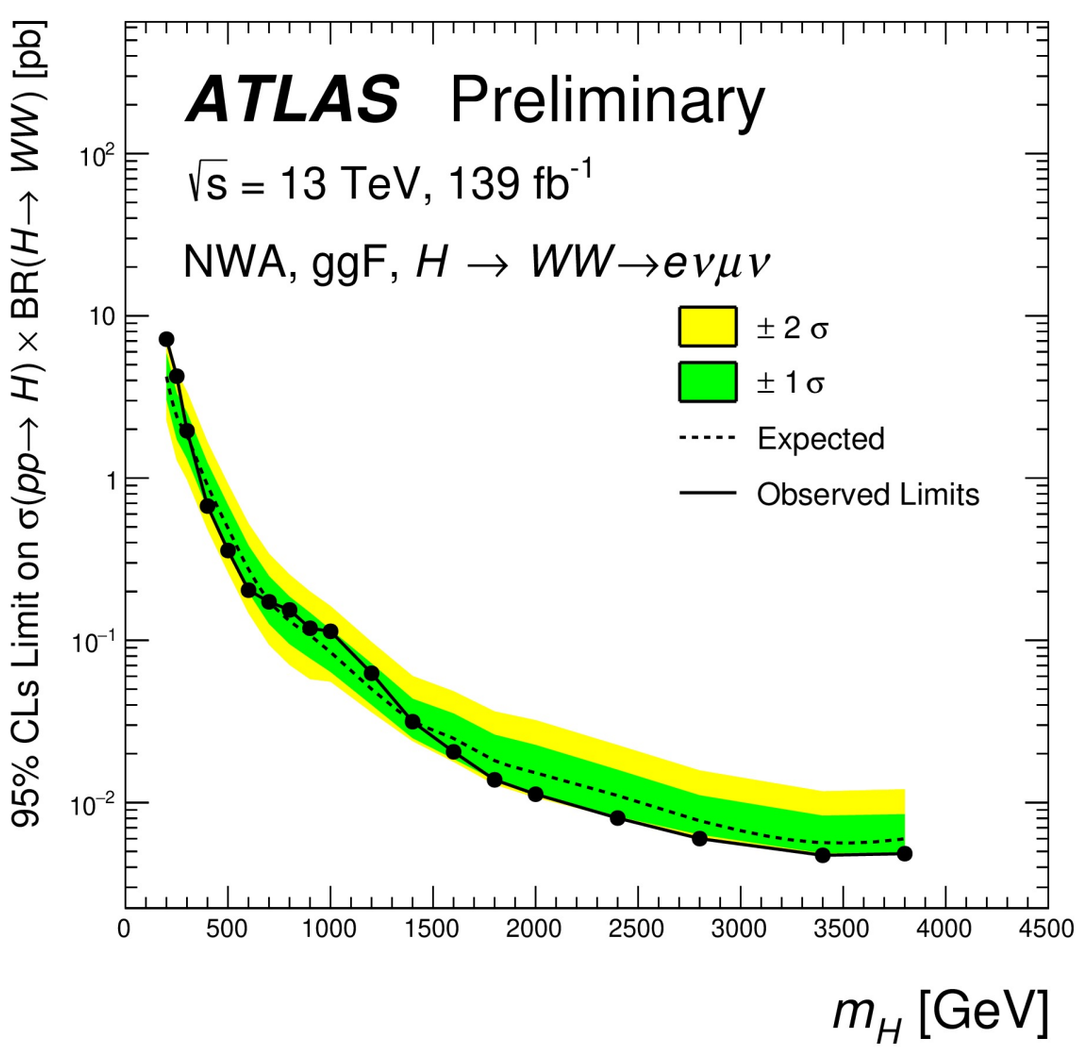
ATLAS-CONF-2022-066

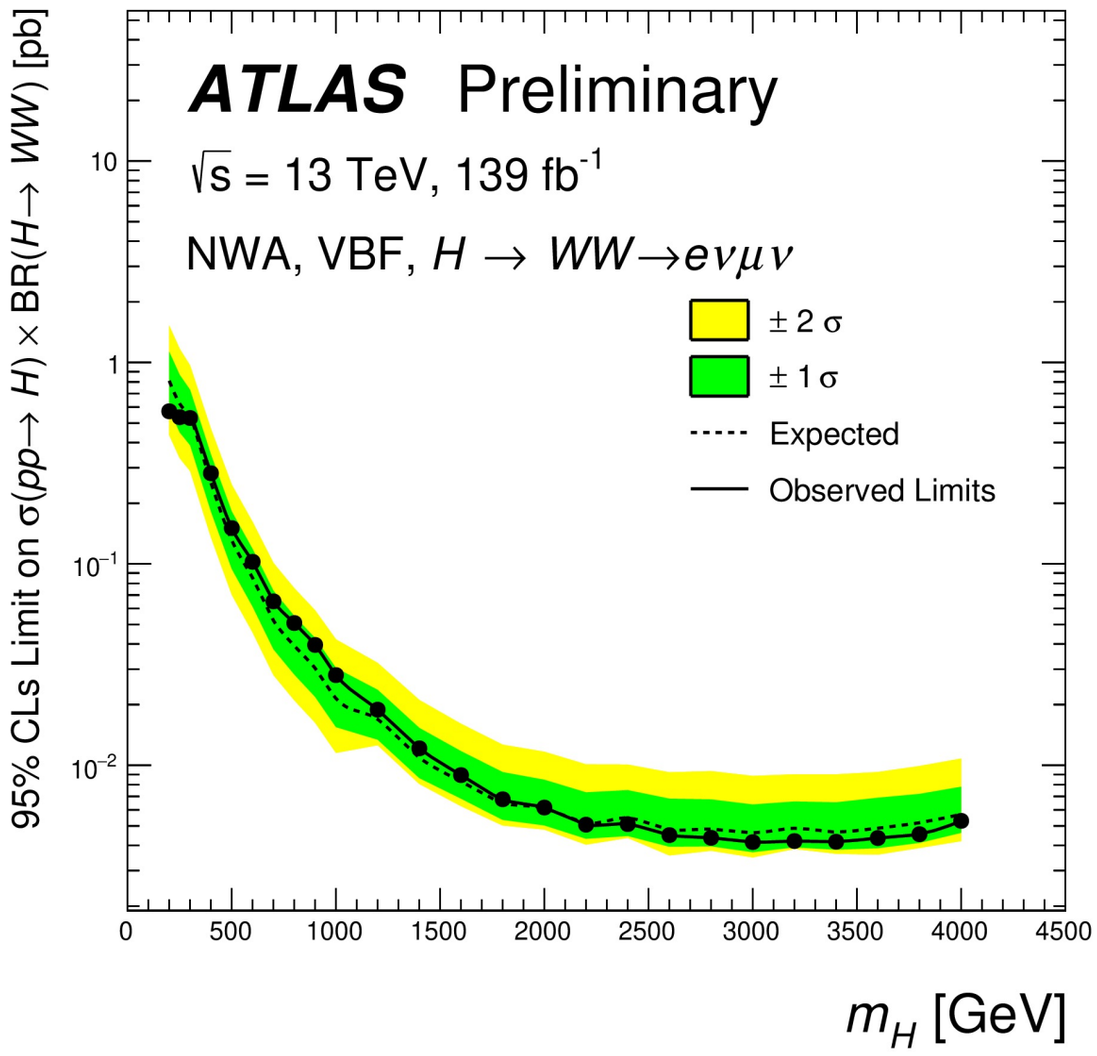
ATLAS:

Dilepton Analysis:

H→ WW → eμ + νν

Cut based analysis:
Categorised to VBF and ggF based on cuts



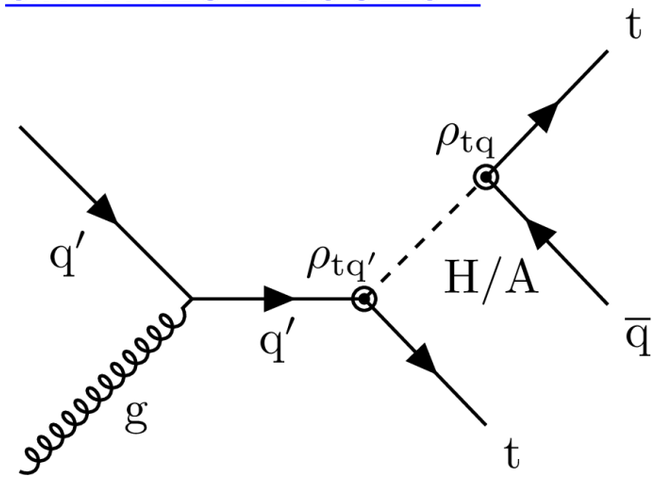


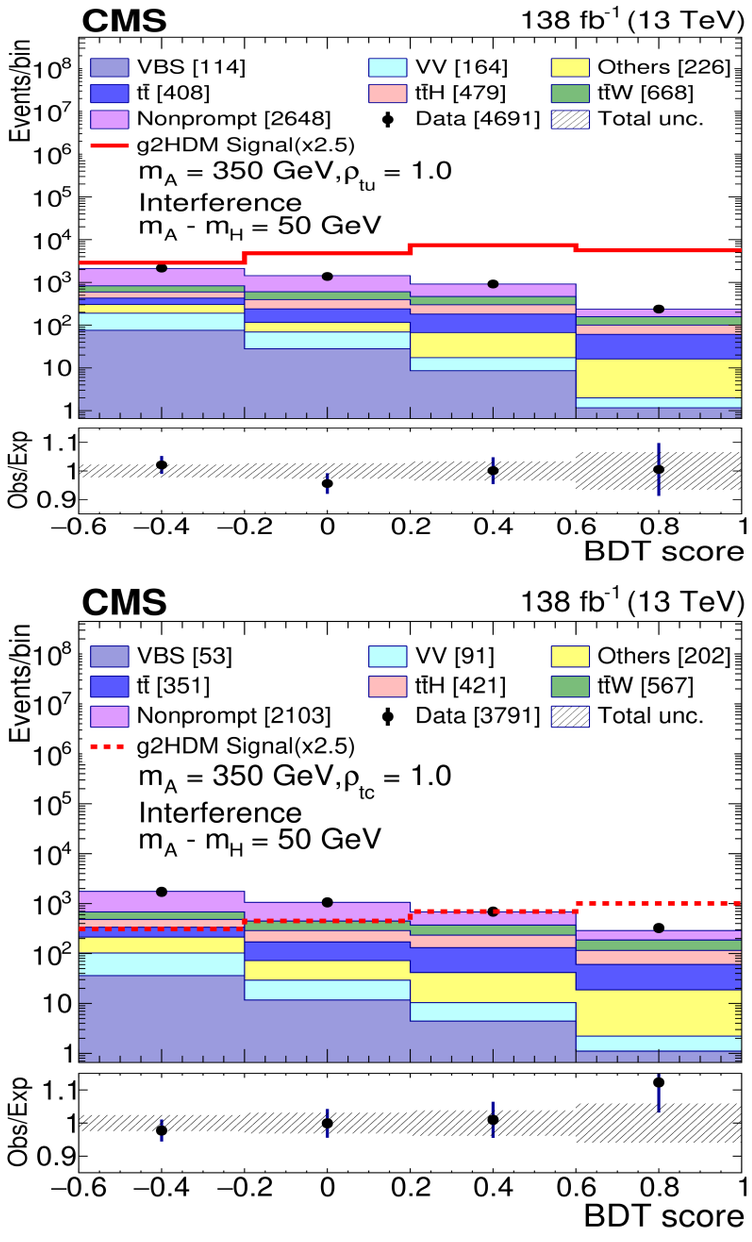
Same-sign top pair production via H/A

Benchmark model: Generic 2HDM

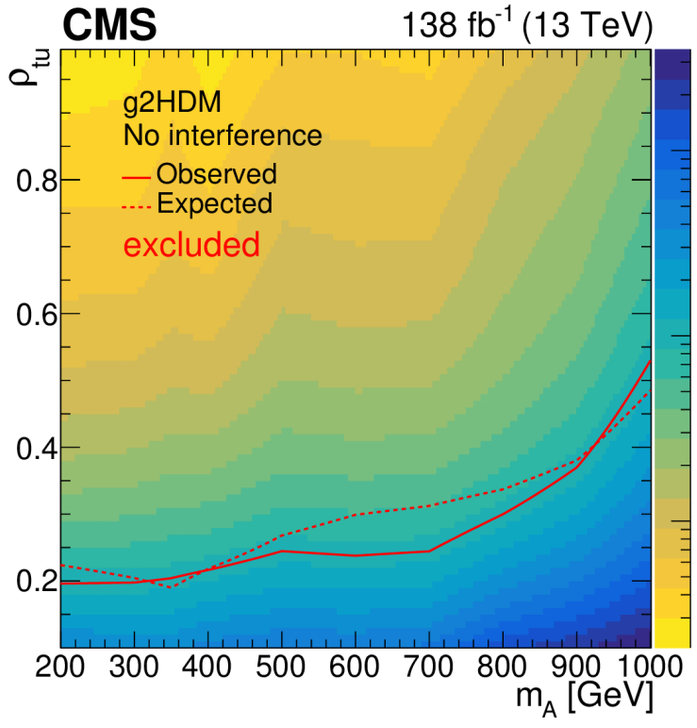
- Event selection: same-sign di-lepton, 3 jets
- Signal extraction: BDT based on kinematics and jet flavor-tagging scores

arXiv:2311.03261

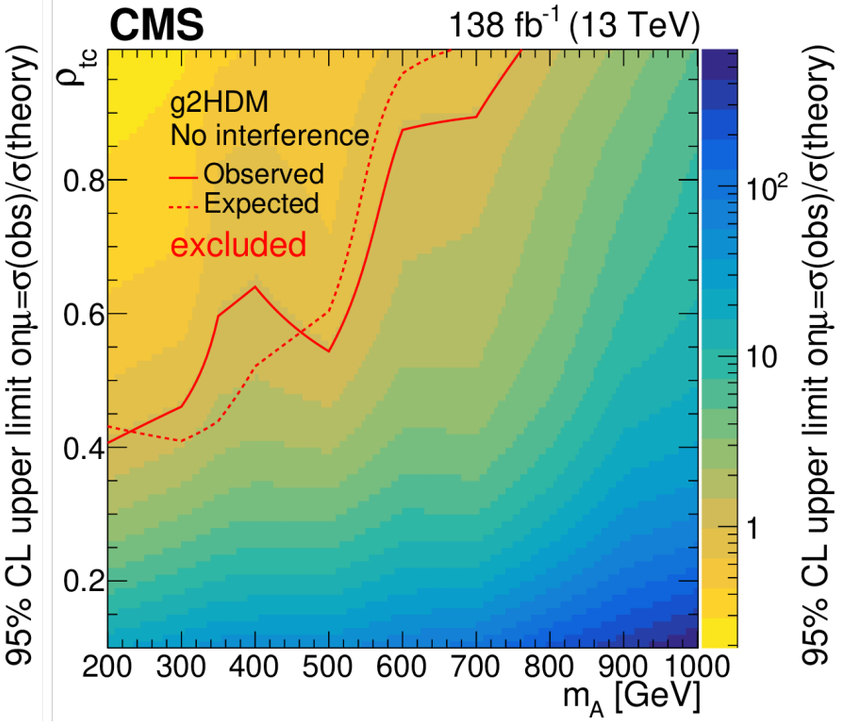




ρ_{tu} vs. m_A



ρ_{tc} vs. m_A



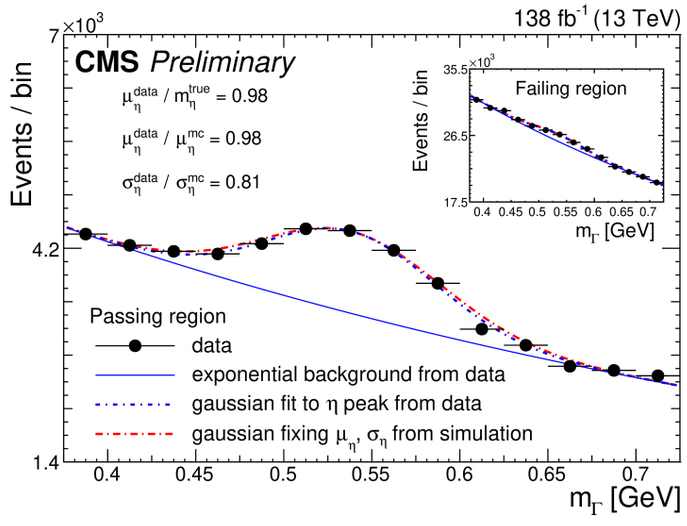
without the A-H interference
(Interpretations also with A-H interference)

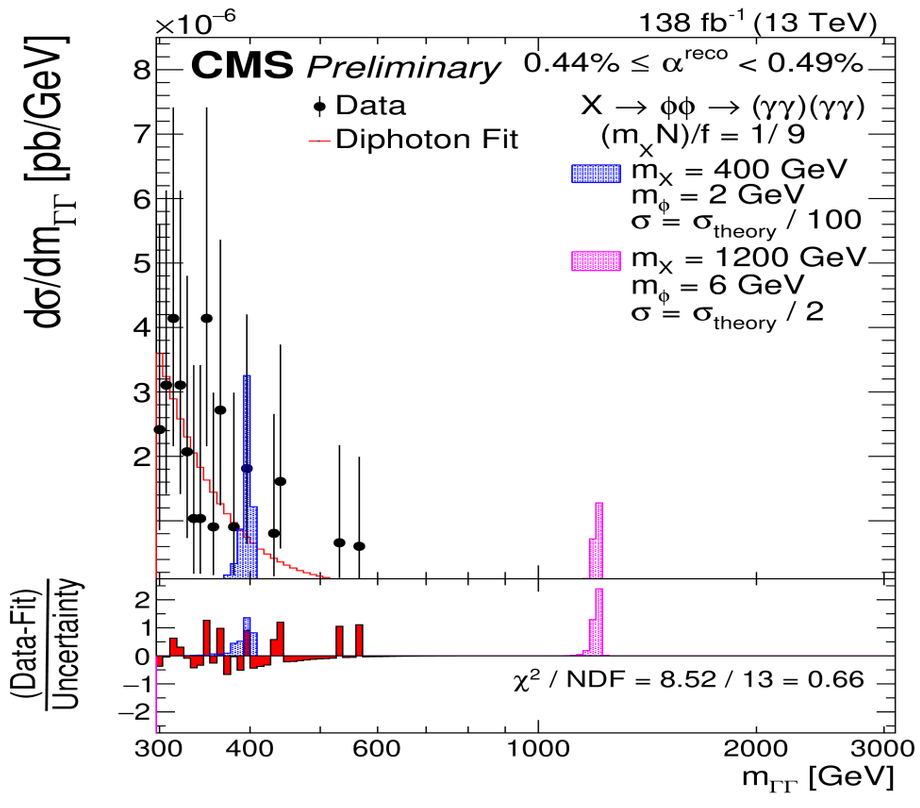
$X \to \phi\phi \to (\gamma\gamma)(\gamma\gamma)$ (merged diphotons)

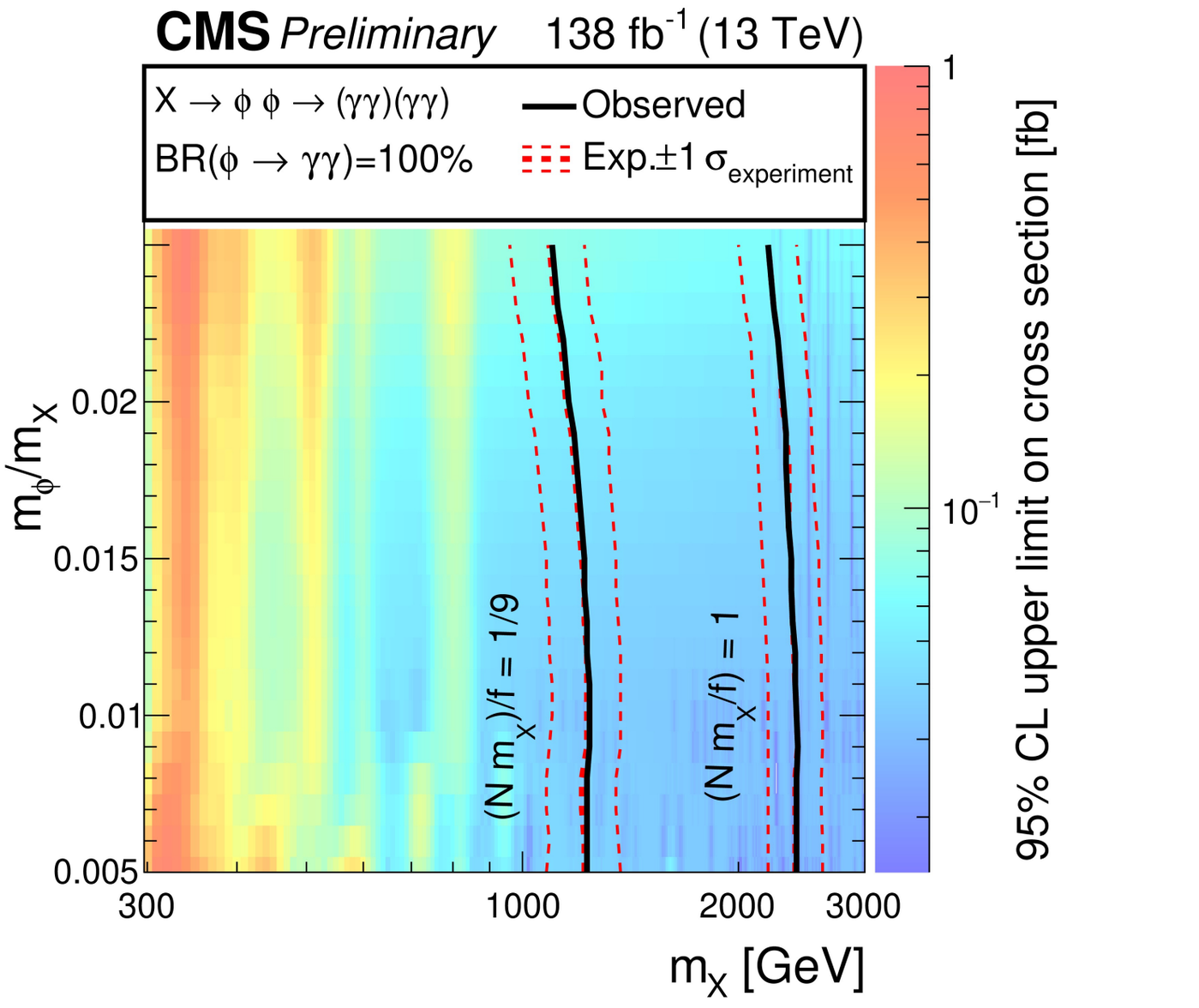
CMS-PAS-EXO-22-022

Search for a massive resonance XX decaying to a pair of spin-0 bosons $\phi \to \gamma\gamma$

m_X : 0.3 and 3 TeV,
m_ϕ/m_X: 0.5% -- 2.5%







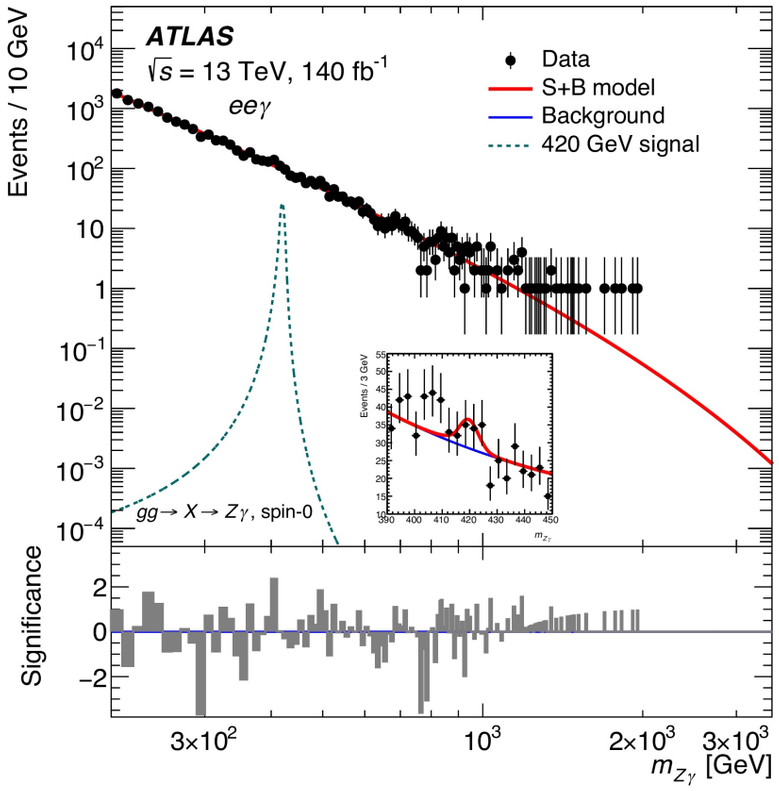
most sensitive search of its kind at the LHC

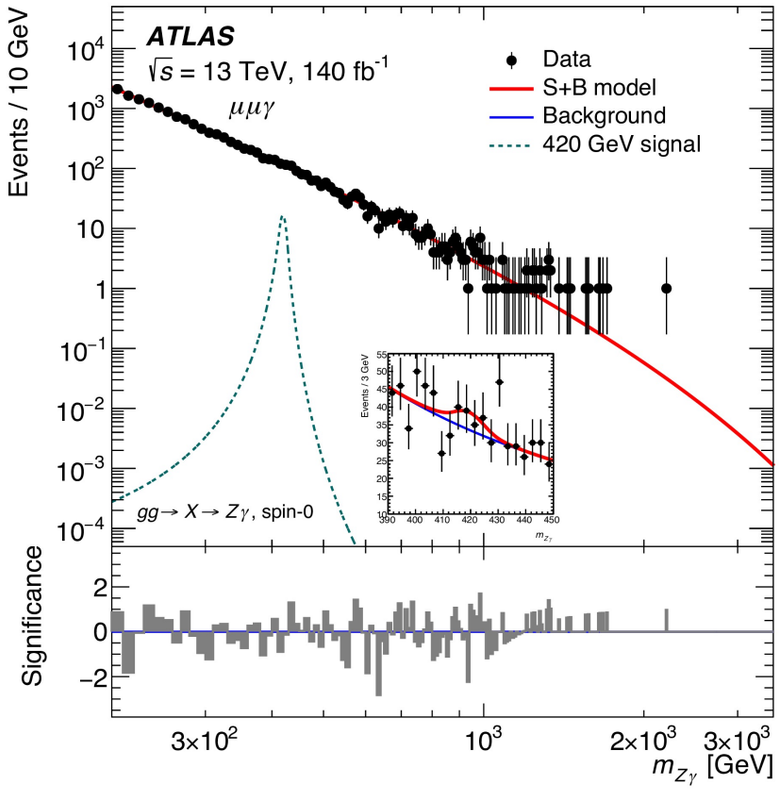
High mass $X \to Z\gamma$

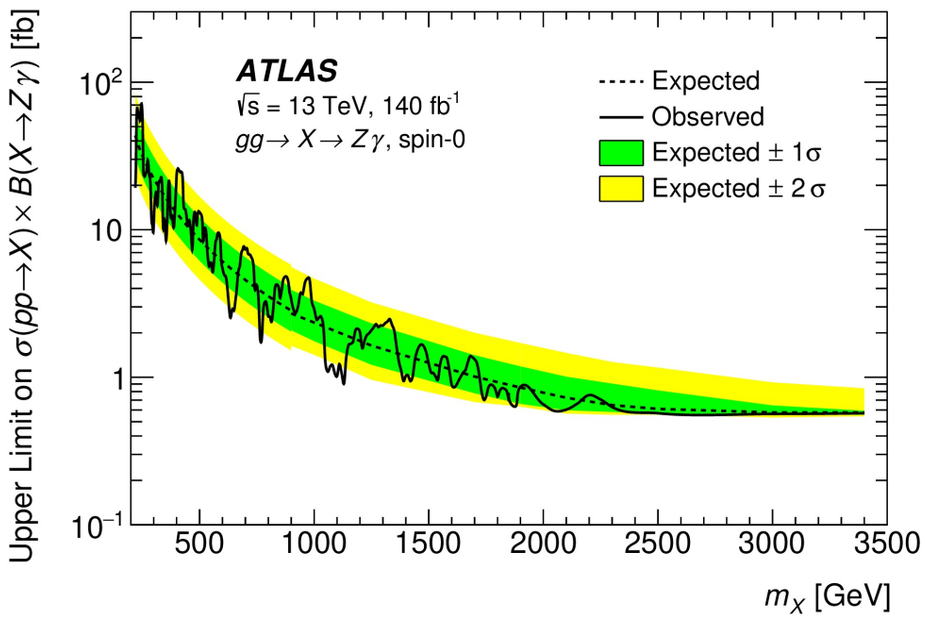
arXiv:2309.04364

Signal benchmark:

Higgs Characterisation Model
(https://arxiv.org/pdf/1306.6464.pdf)





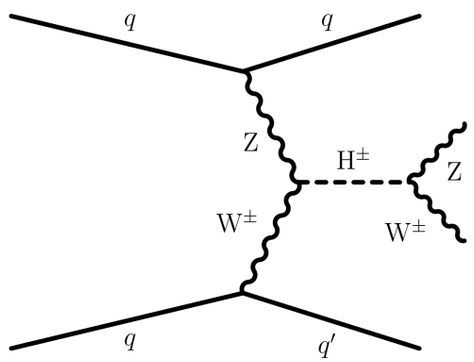


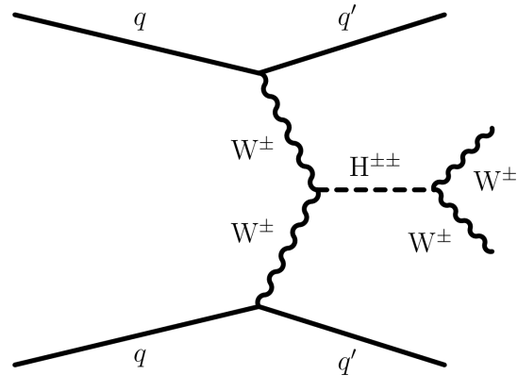
Highly boosted Z boson for high mass X
XGBoost to reconstruct collinear electrons

Charged Higgs decay to Vector bosons

VBF production of $H^{\pm\pm} \rightarrow W^{\pm\pm}W^{\pm\pm}$ / $H^{\pm} \rightarrow W^{\pm}Z$

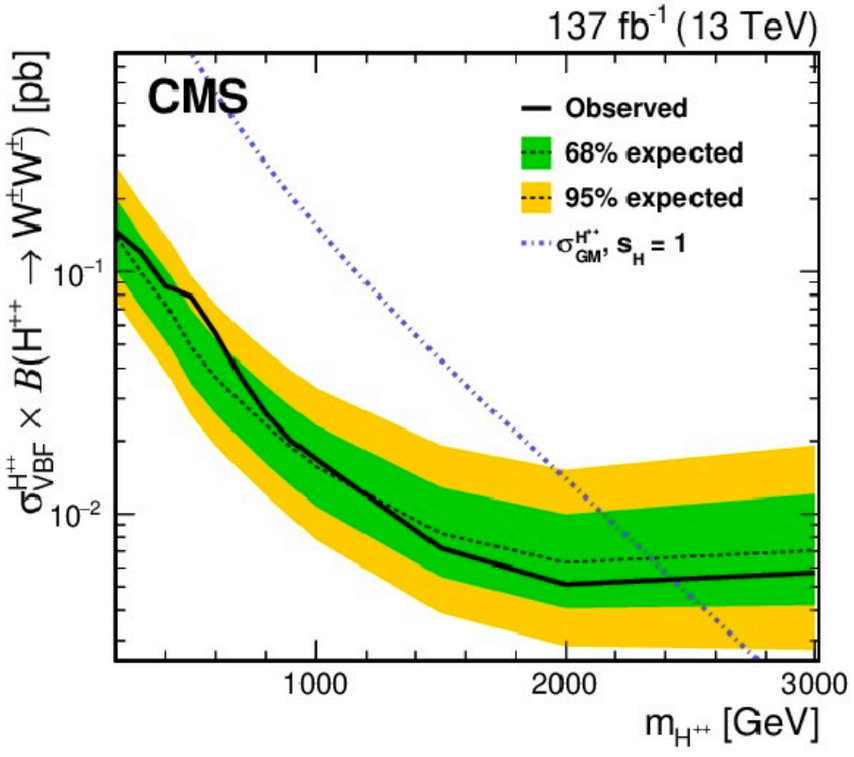
EPJC 81 (2021) 723

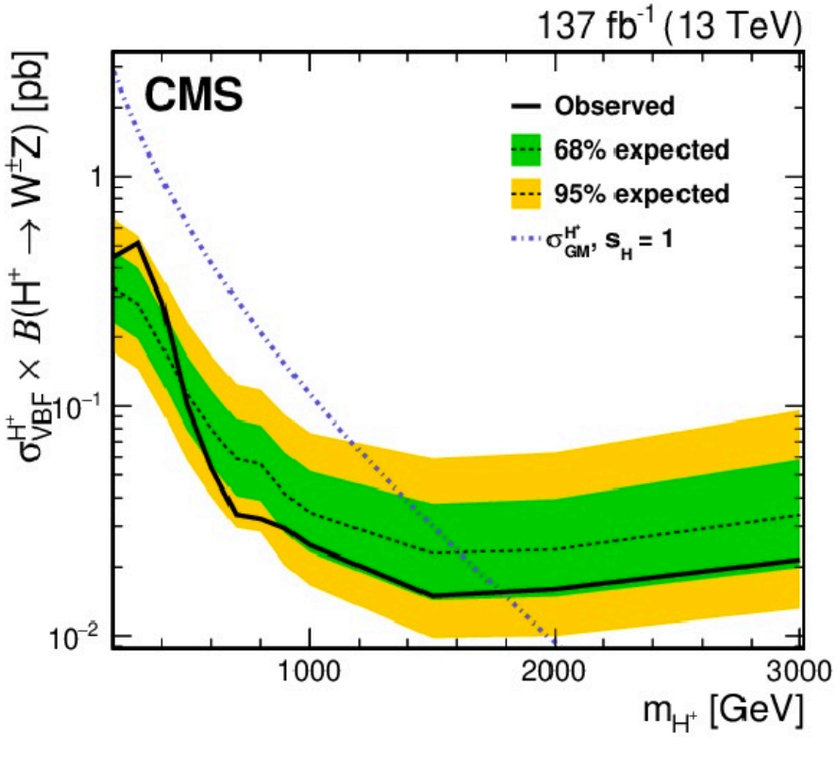


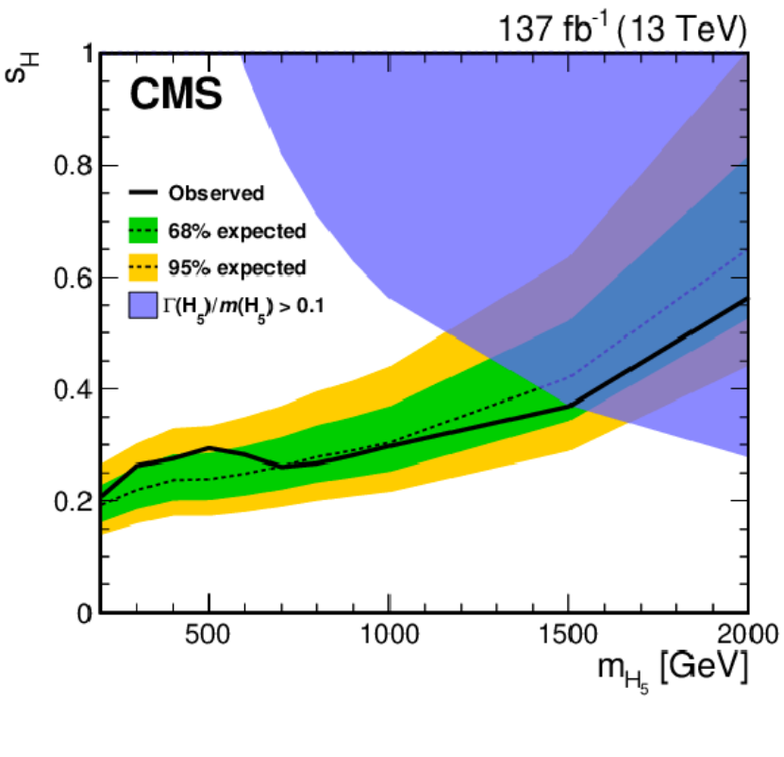


Searches for VBF production of charged Higgs boson, and decaying to pair of gauge bosons
→ Motivated by the Georgi–Machacek model, with SU(2) scalar triplets

- Clean signature: two isolated same-sign lepton (2ℓss) or three isolated lepton (3ℓ), with two VBF jets
- Signal extraction using binned max. likelihood fit of 2D distribution (M_T^{VV} and m_{jj})



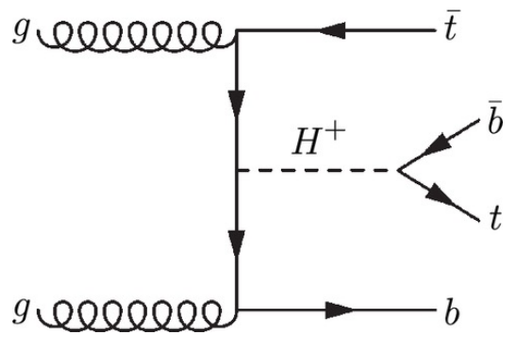




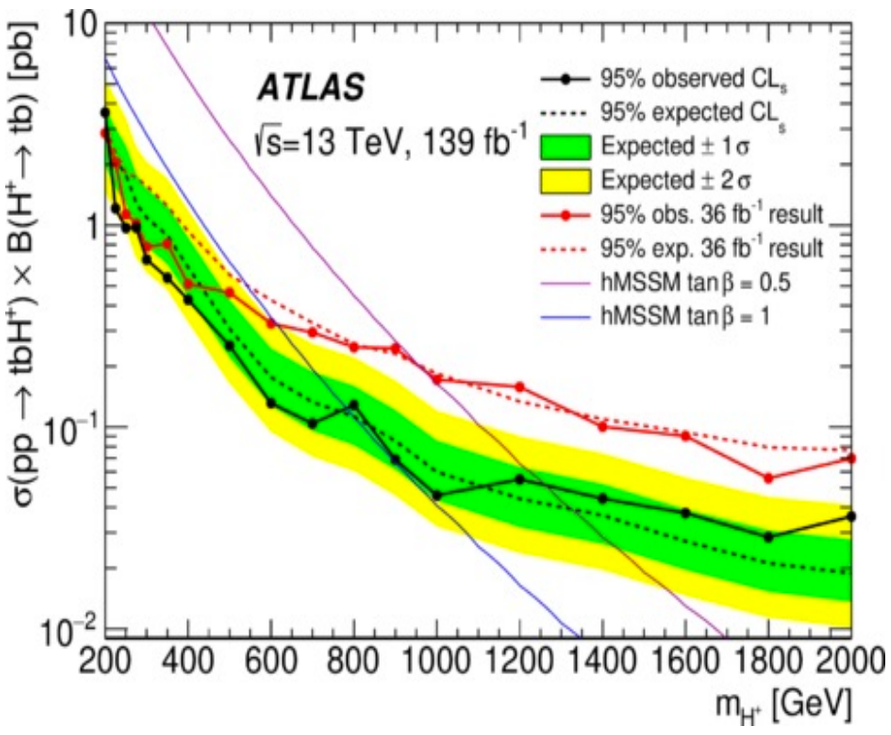
$H^+ \rightarrow tb$

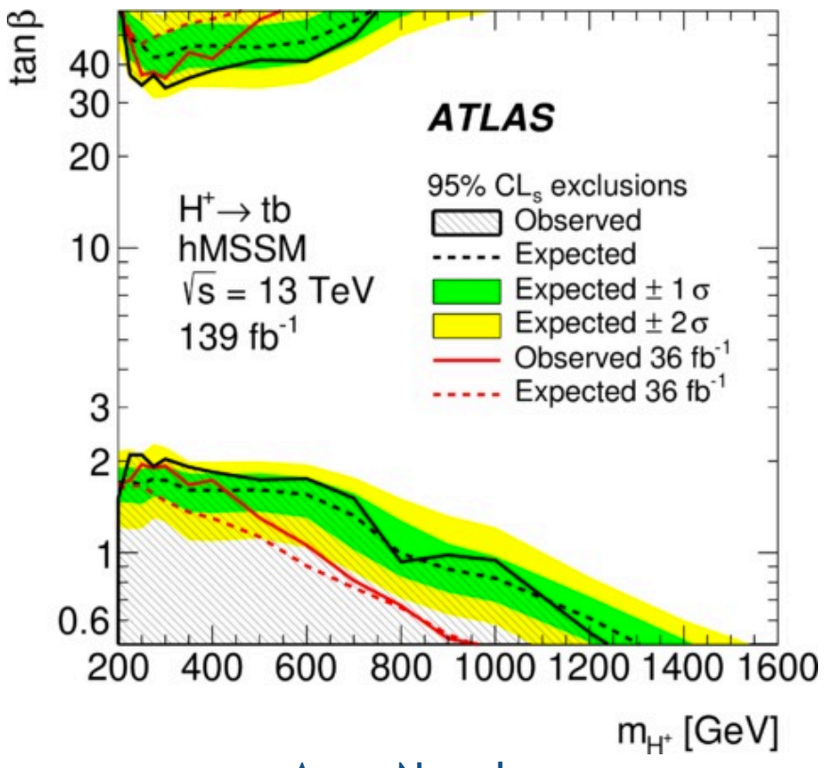
JHEP 06 (2021) 145

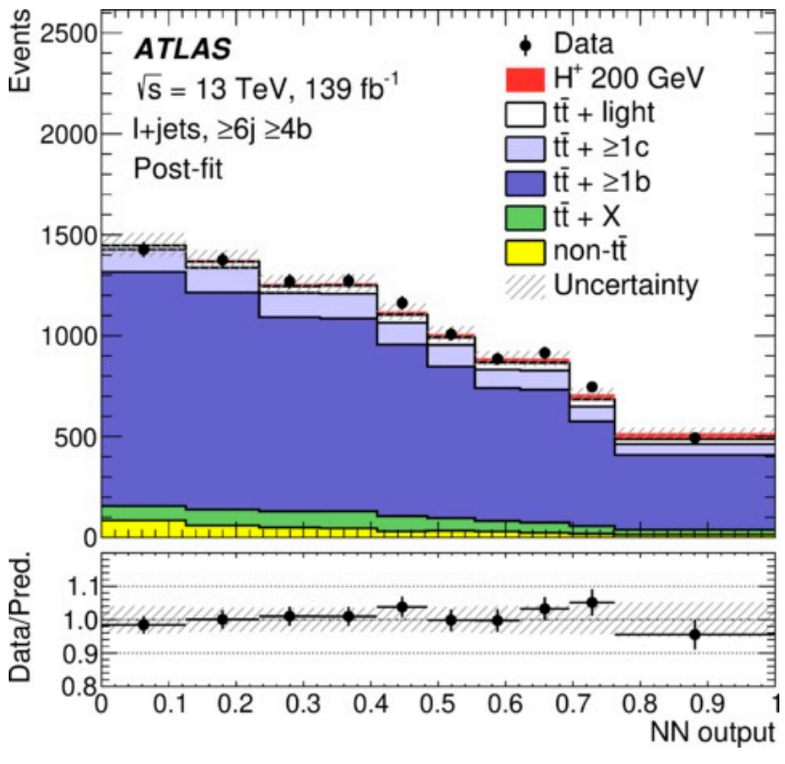
Searches for the production of tbH^+, $H^+ \rightarrow tb$, in the mass range 200 GeV – 2 TeV.



- Final state: 1ℓ + jets
  - Events categorized according to no. of jets and b-jets
  - Neural Network to discriminate signal from background
  - Background dominated by tt+jets (normalized from control regions)
- Limits on production cross section times branching fraction, and interpretations in MSSM scenarios.



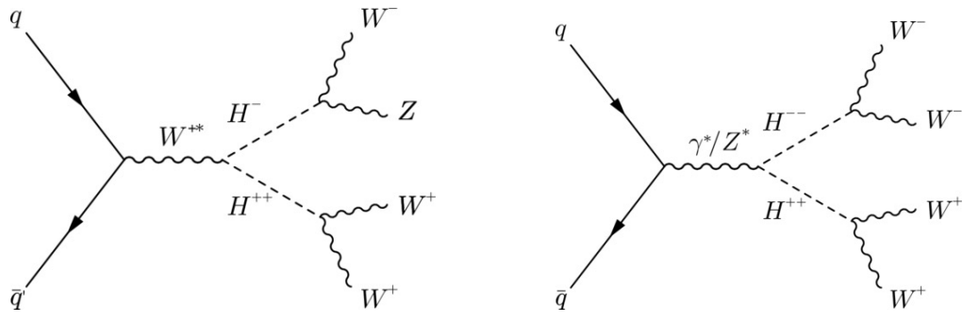


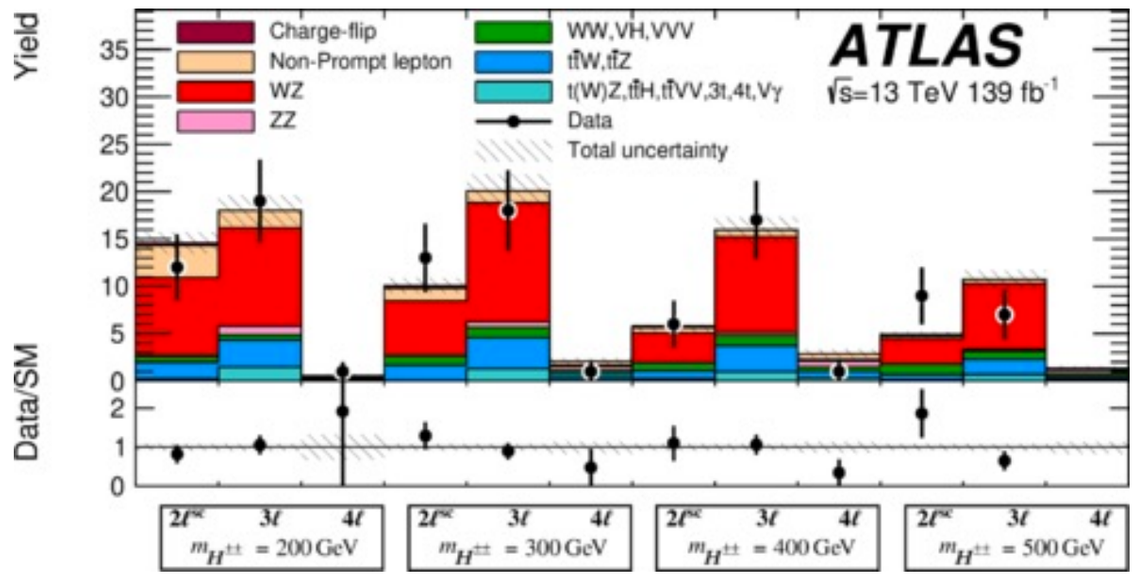


Charged Higgs decay to Vector bosons

Pair production of $H^{\pm\pm}$, associated production of $H^{\pm}$ and $H^{\pm\pm}$.

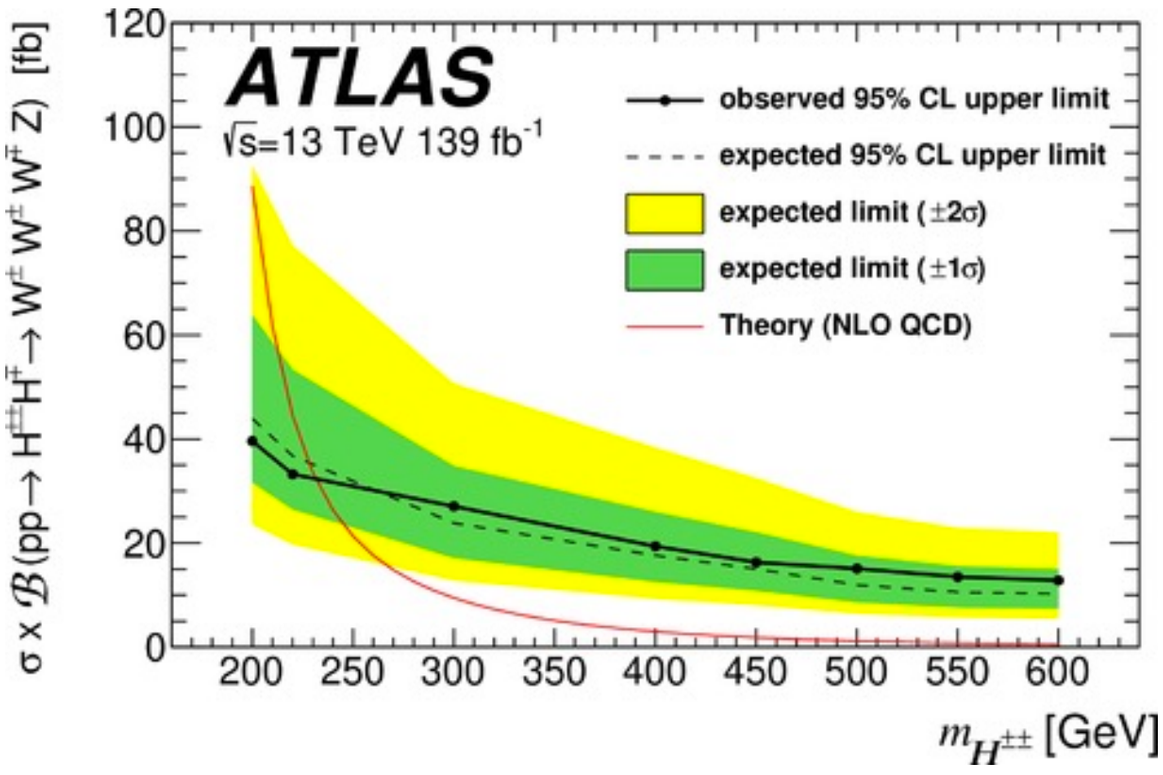
→ Motivated by Type II seesaw model

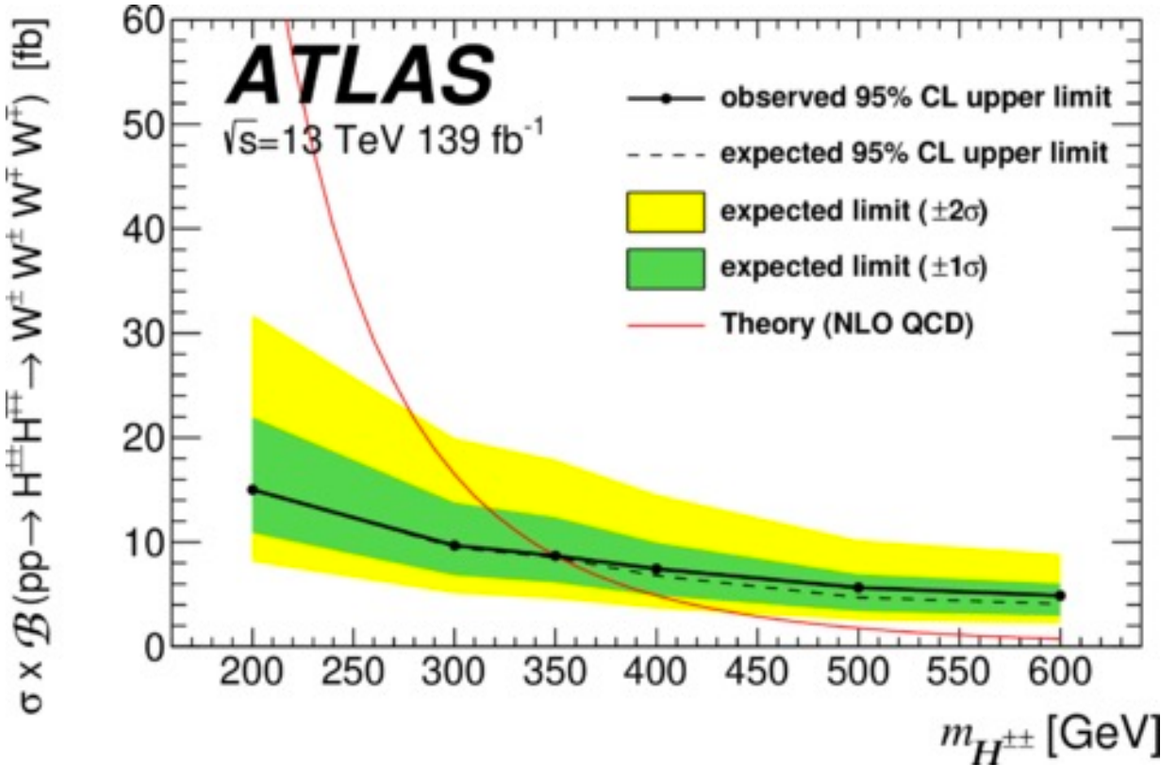




Clean signatures: two same-sign leptons ($2\ell ss$), three leptons (3ℓ) and four leptons (4ℓ).

Strong limits on σ × BR





X → S(VV)H, H→ττ

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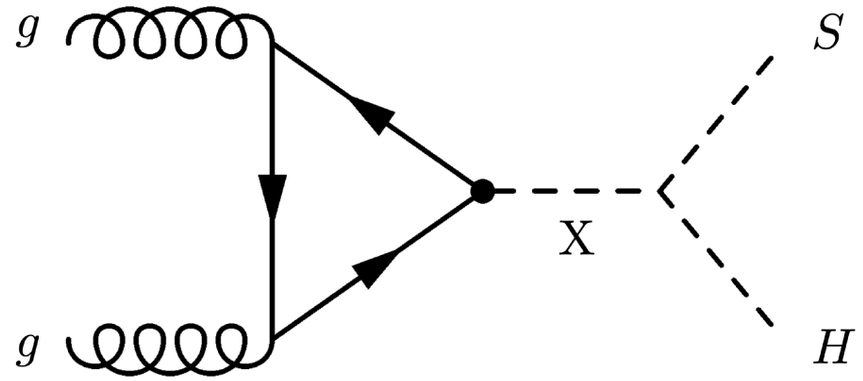
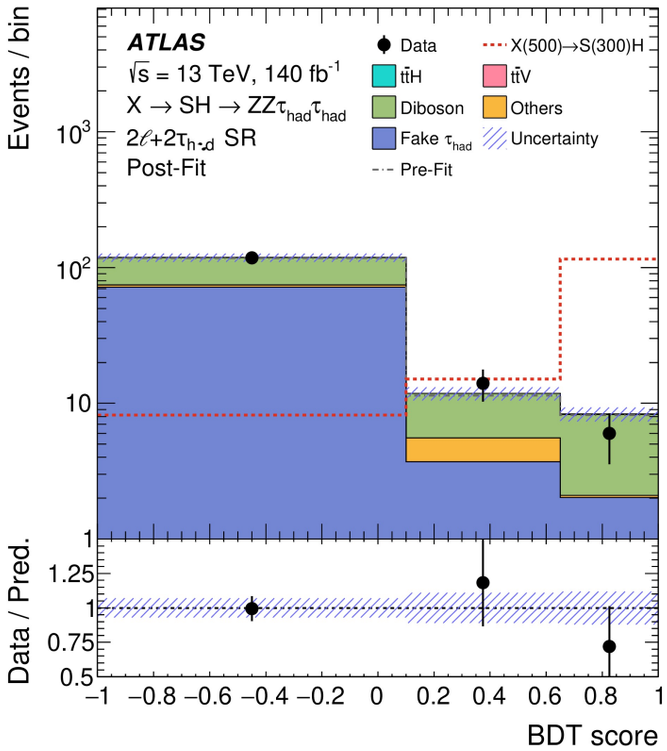
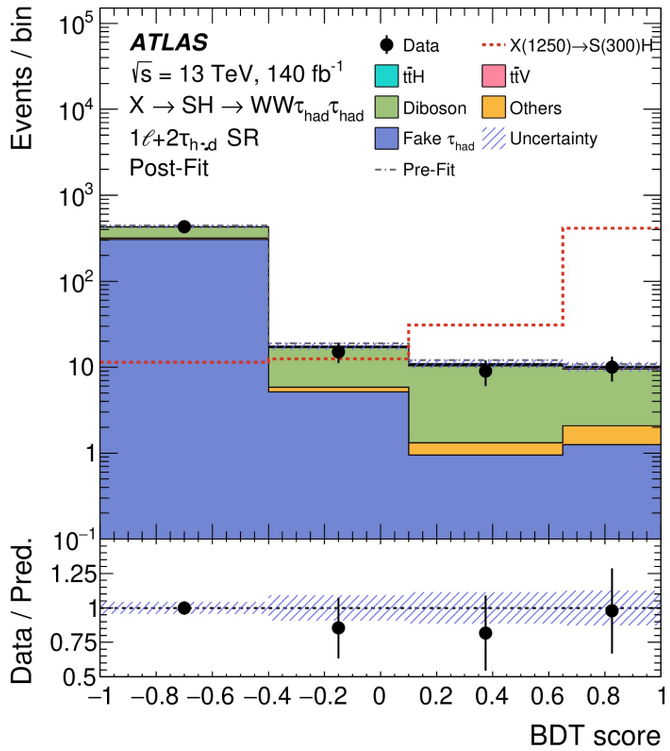
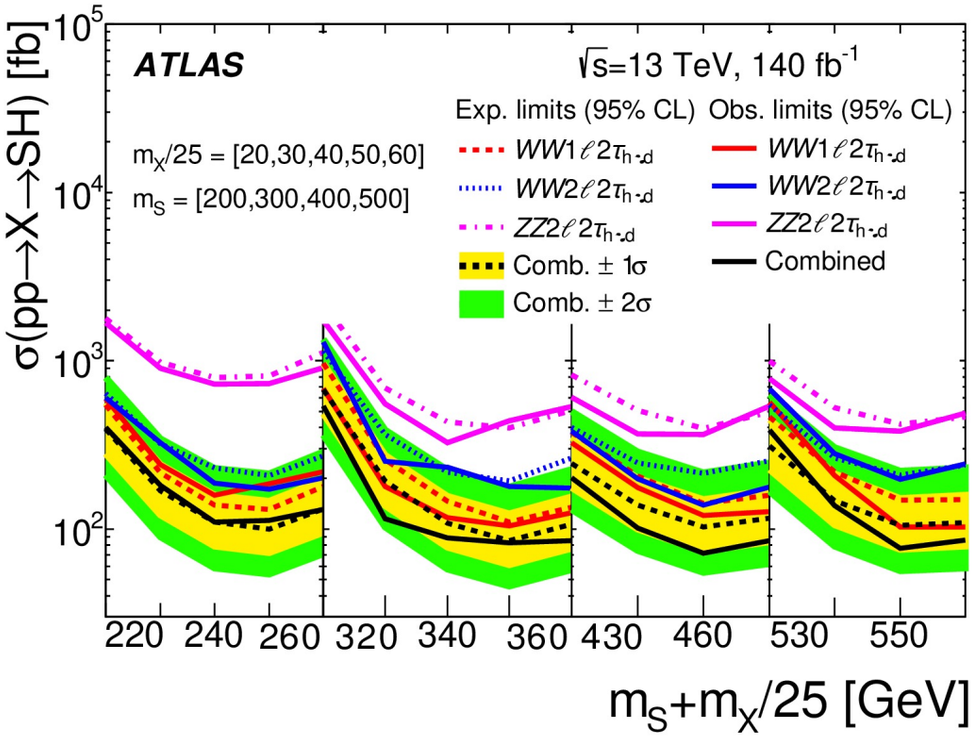
2HDM+S model (e.g, NMSSM)

- X → SH, H → ττ and S → VV (1 or 2 ℓs)
- *Mx*: 0.5-1.5 TeV, *Ms*: 200-500 GeV
- BDT to suppress background in each SR







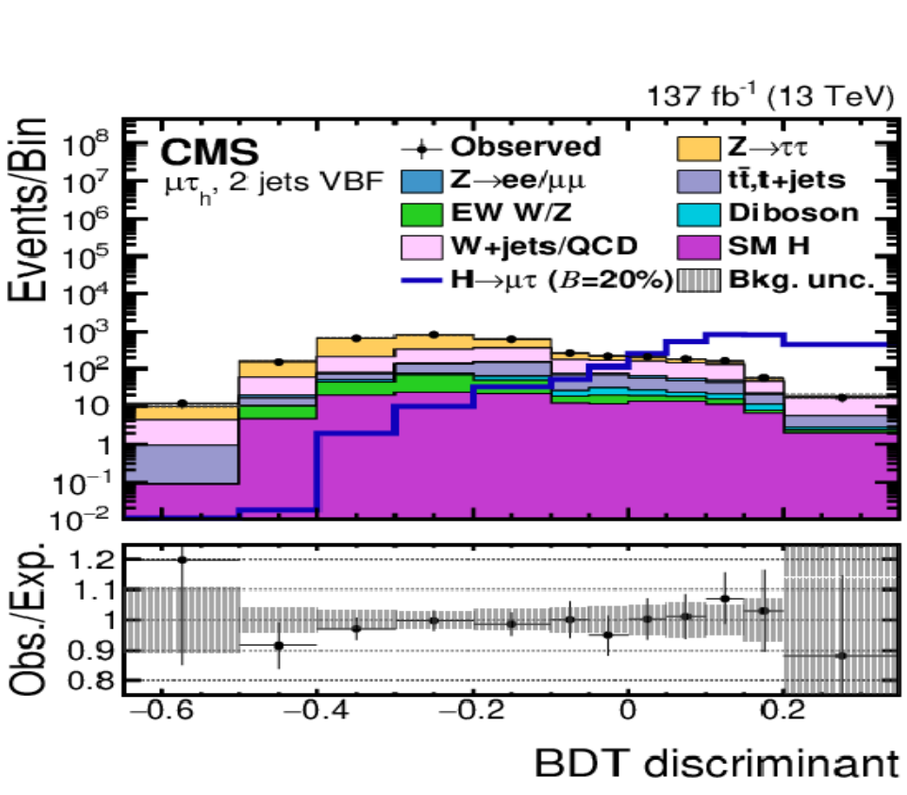


LFV Higgs decays

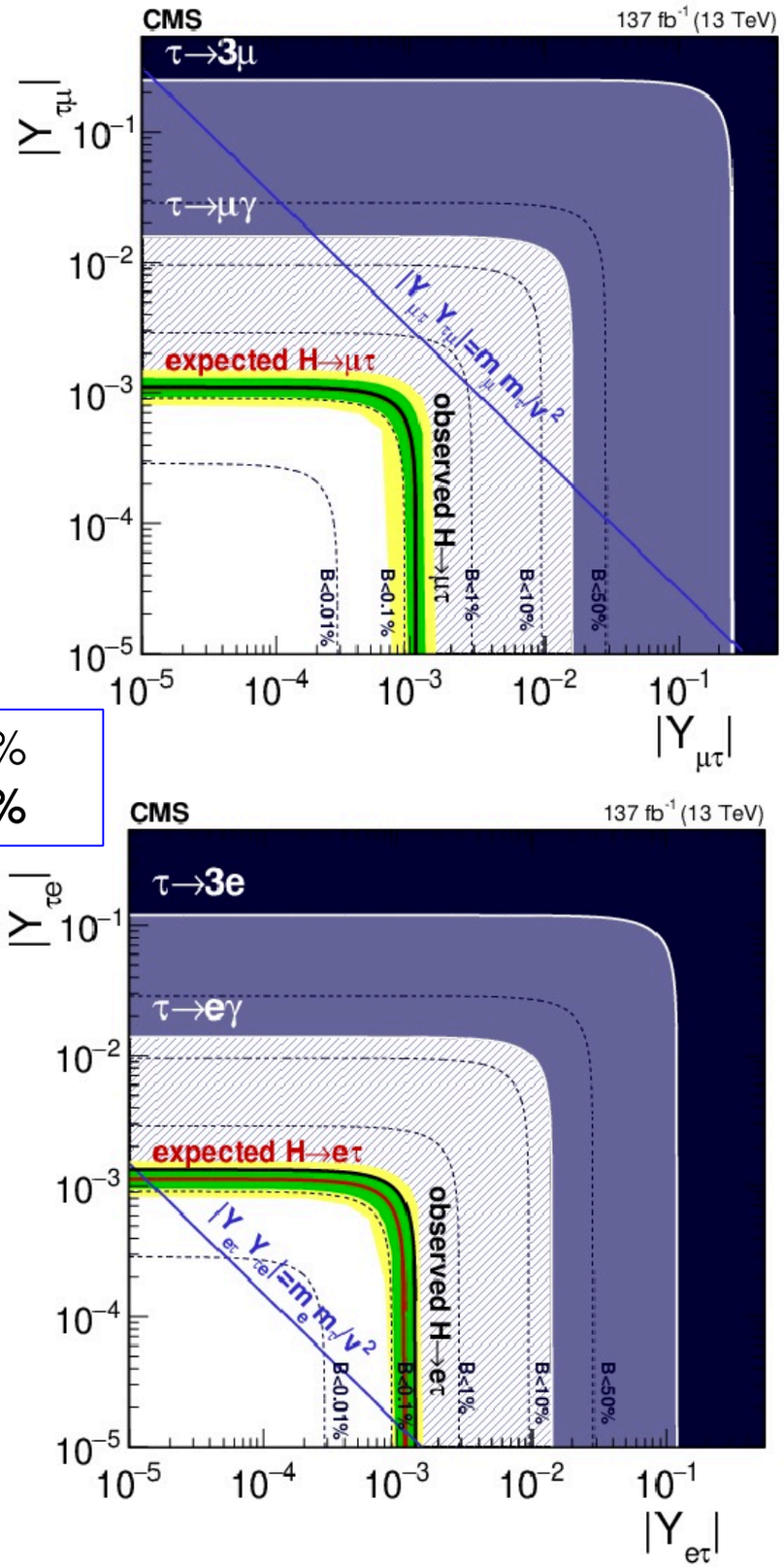
CMS-HIG-20-009

Search for H→eτ and μτ decays

- Forbidden in SM, but allowed in many BSM models
- 2 tau decay modes: τ_h or $\tau_{\mu/e}$
- Jet based categories designed to enhance the contribution of different Higgs production mechanisms: **0-jet, 1-jet, 2-jets (ggH), and VBF**
- BDT classifier to extract signal



$\mathcal{B}(h \rightarrow \mu\tau) < 0.15\ (0.15)\%$
$\mathcal{B}(h \rightarrow e\tau) < 0.22\ (0.16)\%$



LFV Higgs decays

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Search for H→eμ decays

- Events with b-jets and significant MET are rejected to suppress backgrounds
- Events categorized according to $p_T^{e\mu}$, $\eta^{e\mu}$, and VBF