Mono-Higgs Dark Matter Search at ATLAS

JiaJian Teoh, for the ATLAS Collaboration

Lake Louise Winter Institute
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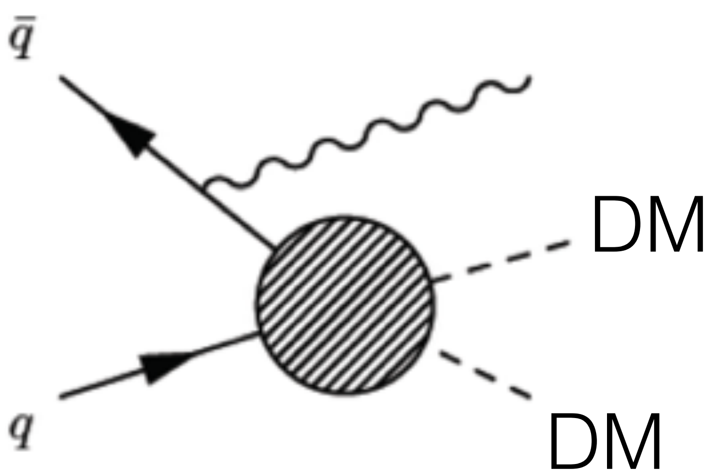
Poster session

Reference: arXiv:1510.06218, submitted to Phy. Rev. D

Motivations

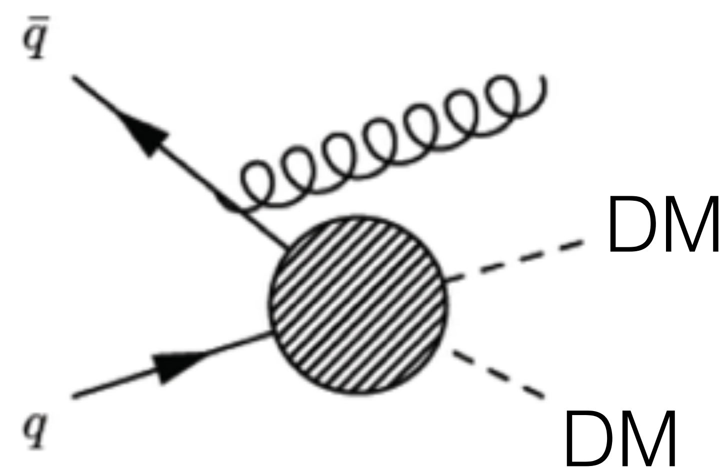
- Complementary to direct and indirect detection

Extensive "**mono-X**" programs at ATLAS
have set limits, no discovery so far.



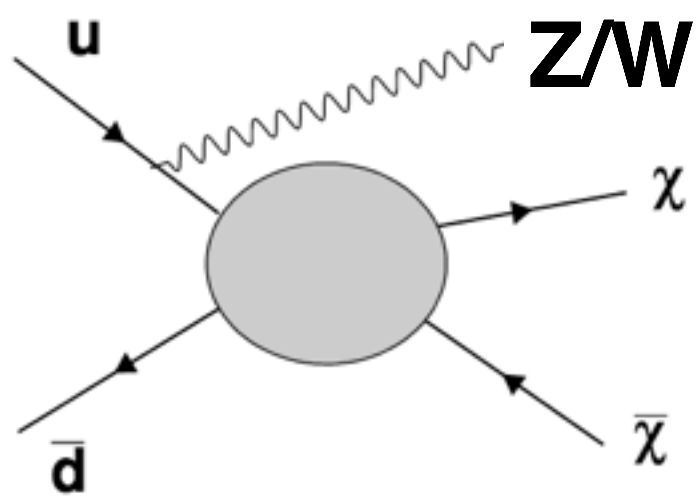
Mono-photon

Phys. Rev. D91 (2015) 012008



Mono-jet

Eur.Phys.J. C75 (2015) 7, 299



Mono-W/Z

Phys. Rev. D90 (2014) 012004
Phys. Rev. Lett. 112 (2014) 041802

- Discovery of Higgs boson ➡ new playground
- Gain insight into DM coupling to the SM Higgs (that is unlikely to come from initial state radiation)

Analysis strategy

- Br($h \to bb$) ≈ 0.6,   Br($h \to \gamma\gamma$) ≈ 0.002

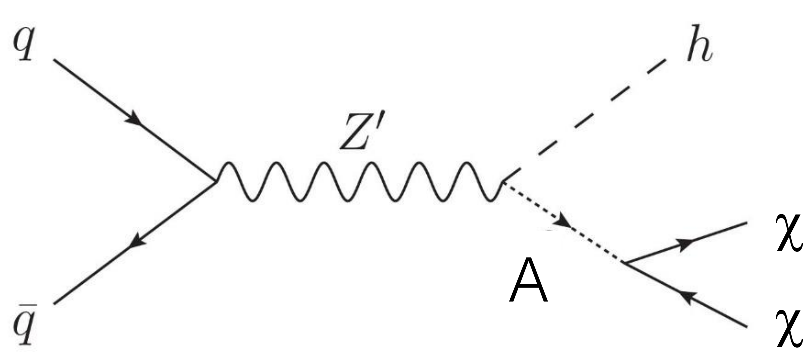
we consider this channel

Phys. Rev. Lett. 115.13 (2015)

- Two complementary approaches:

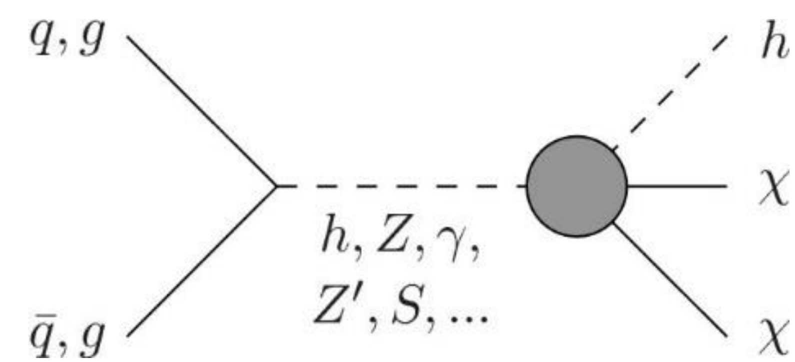
poster focuses on

Resolved channel

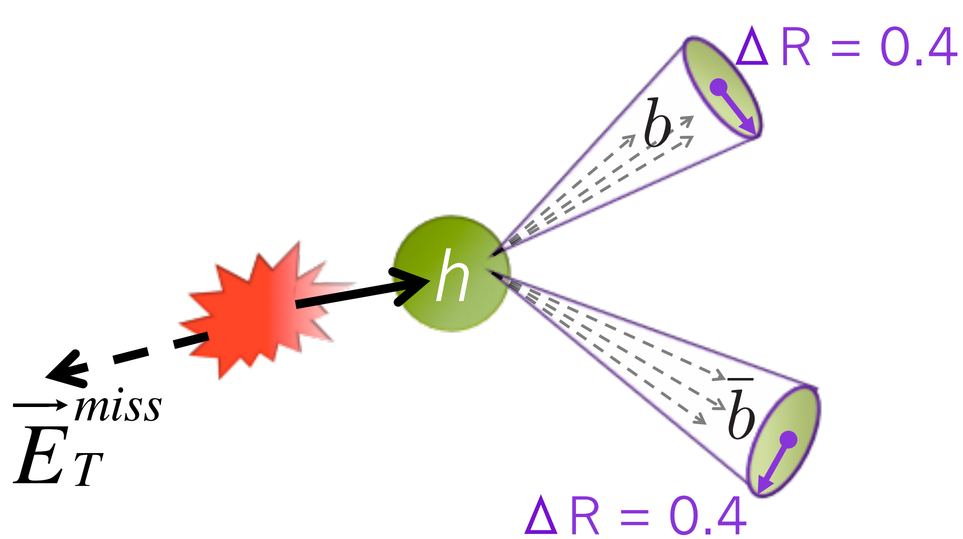


Simplified Model   (Z'-2HDM)

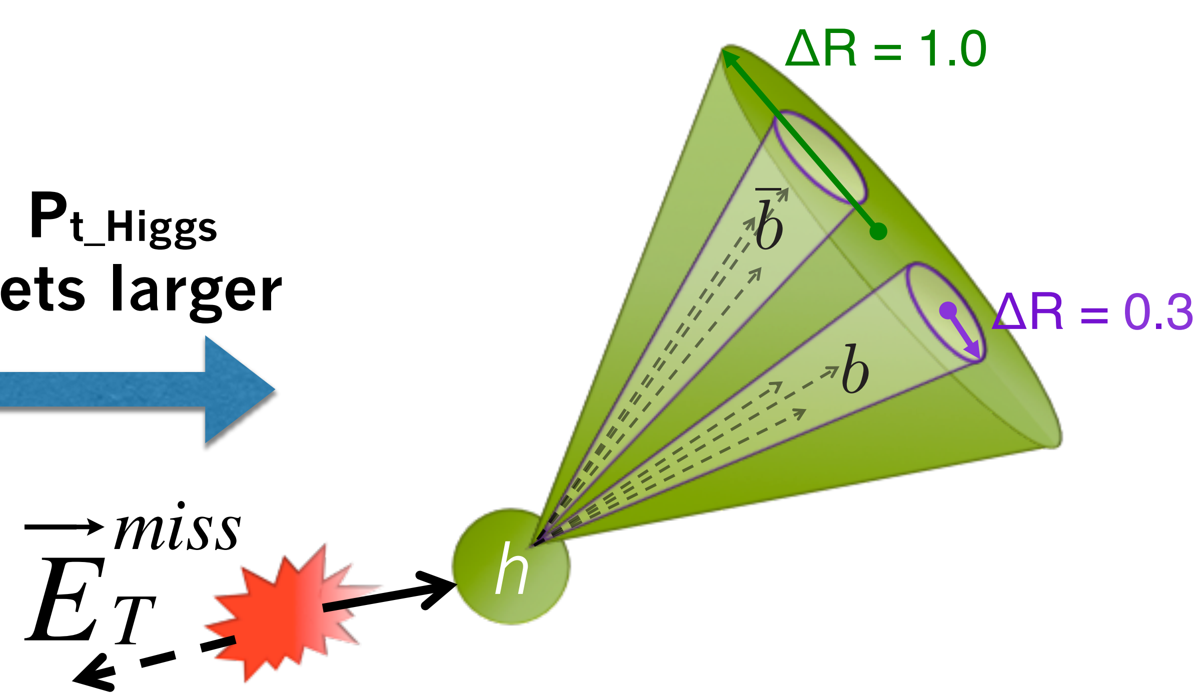
Boosted channel



EFT Model

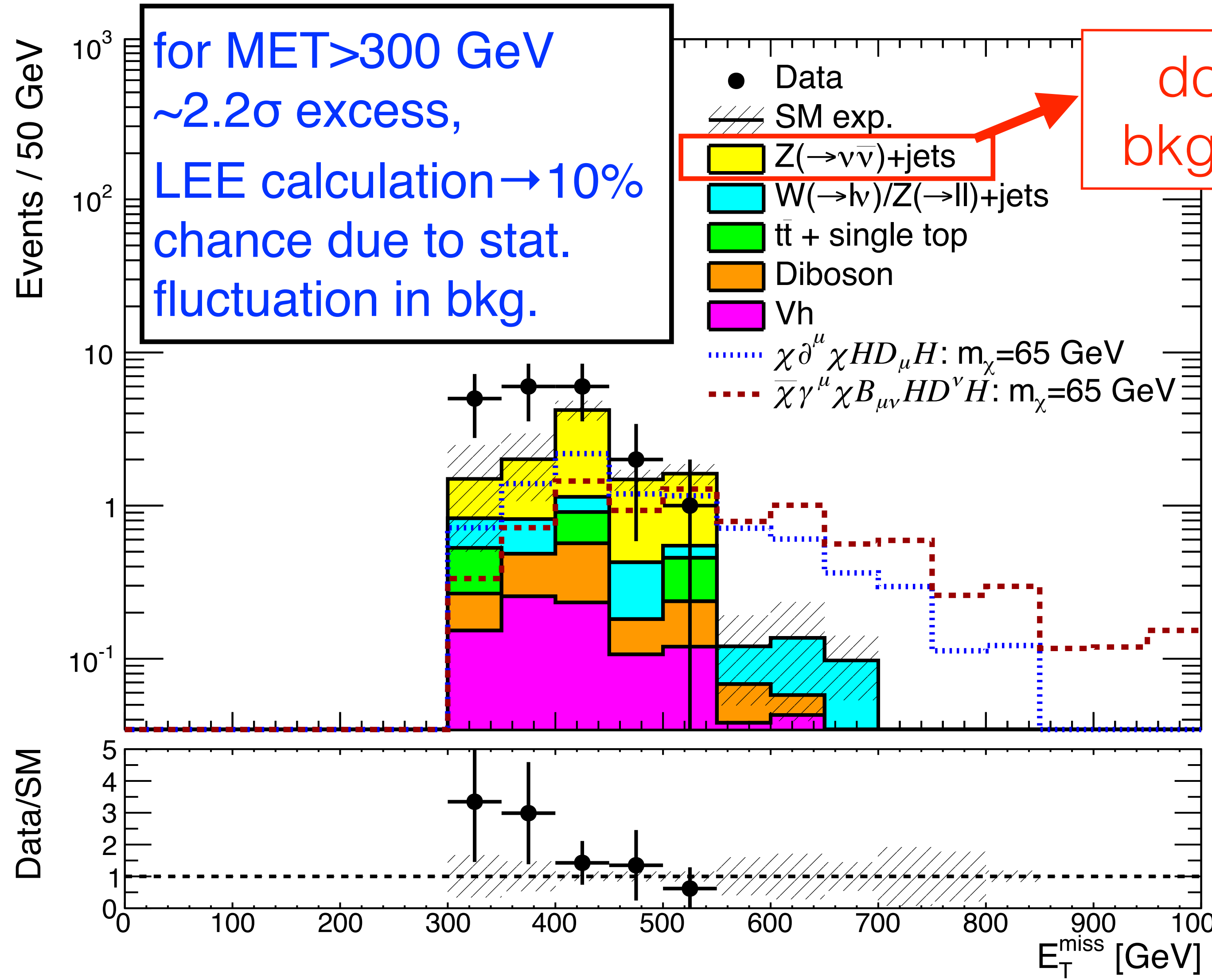


P_{t_Higgs} gets larger



Backgrounds & Observed Events

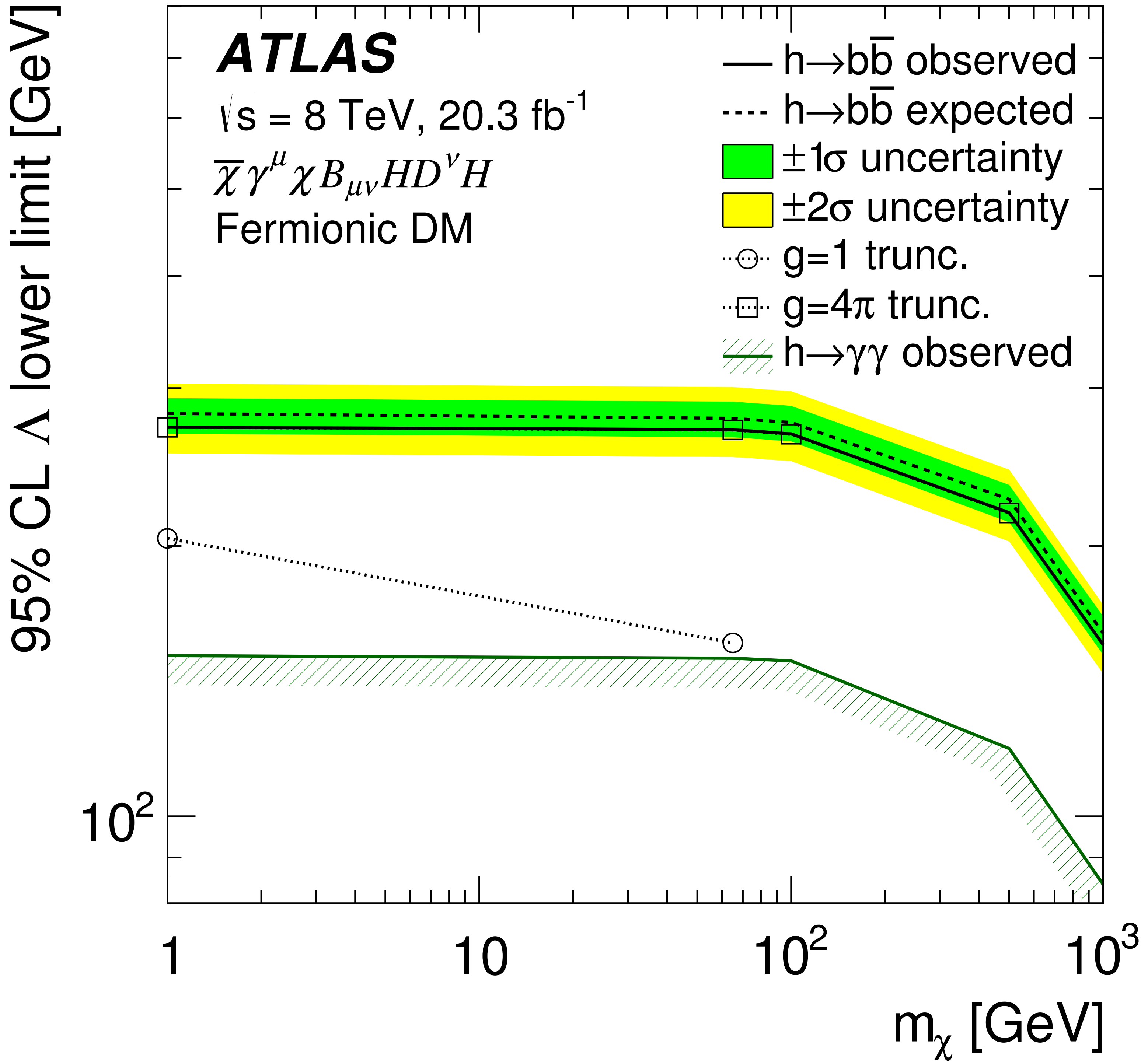
- bkgds estimation: ➡ $Z(\rightarrow\nu\nu)$+jets (dominant): data-driven
  ➡ V+jets, Top, Diboson & Vh: semi-data driven/MC
  ➡ Multi-jets (negligible): data-driven
- bkgds prediction describes data very well in control regions.
- two signal regions (SRs): E_T^{miss} > 300 or 400 GeV
- total bkgds. and data consistent within 1σ for MET>400 GeV



for MET>300 GeV
~2.2σ excess,
LEE calculation→10% chance due to stat. fluctuation in bkg.

dominant bkg, **> 60 %**

Limits

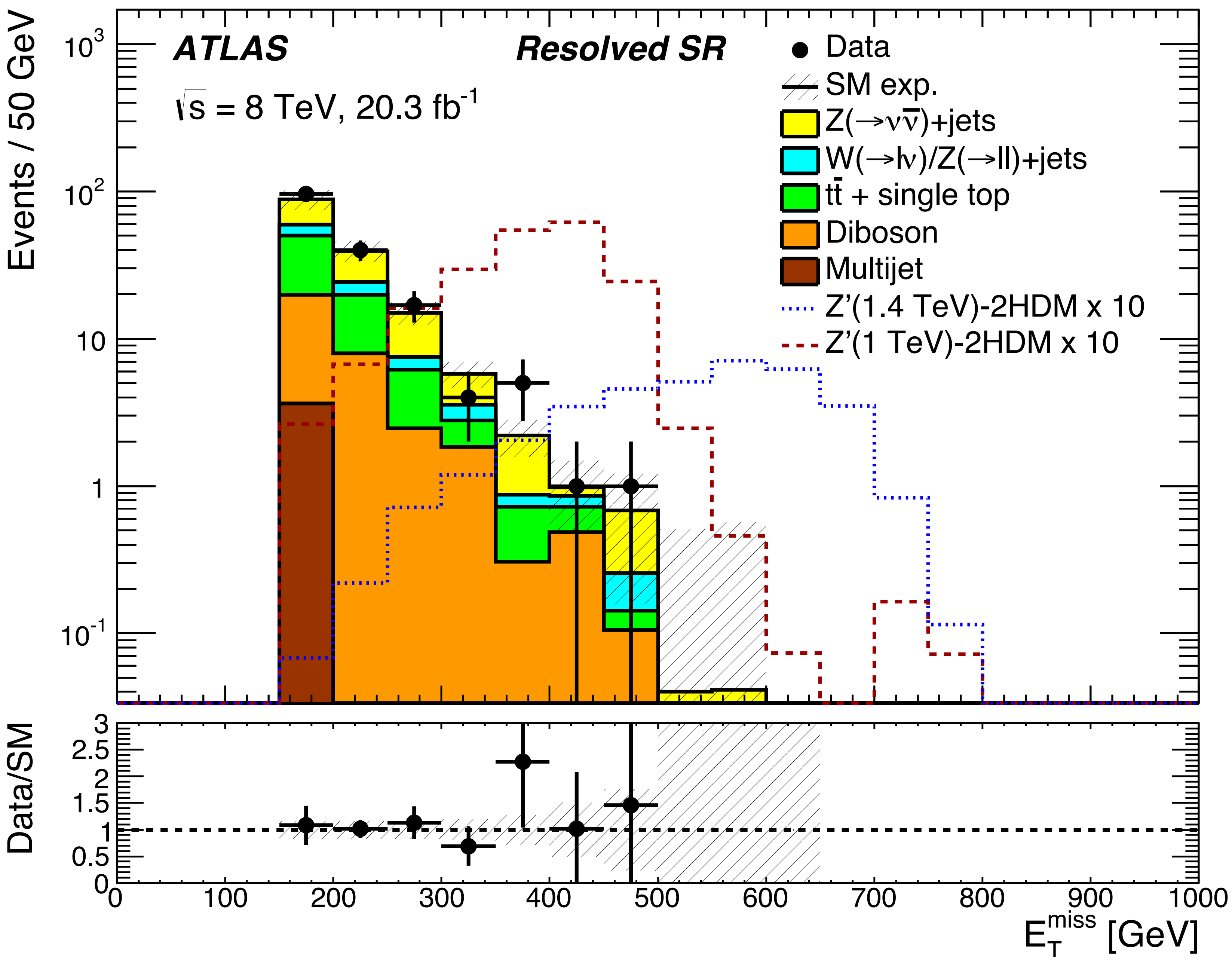


- **most stringent limits for this EFT operator**
- **few times higher than mono-Higgs(→γγ)**

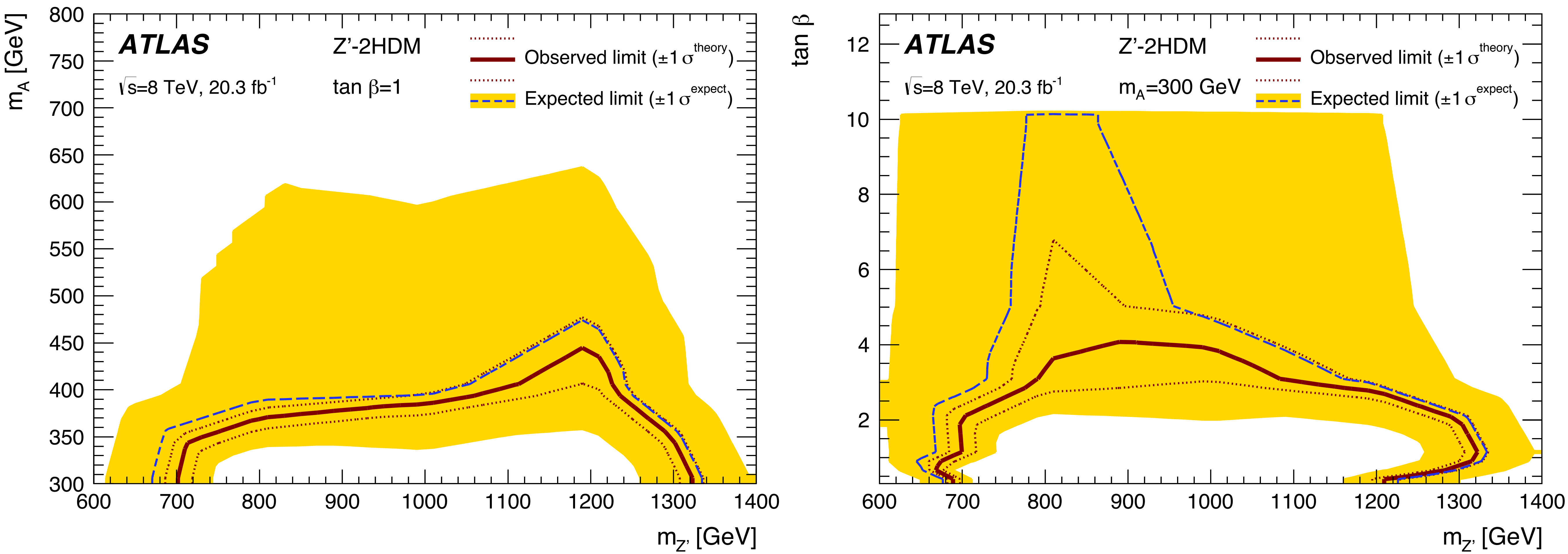
Additional Slides

Observed Events in SR (Resolved Ch.)

- four signal regions (SRs): MET > 150, 200, 300, or 400 GeV
- total bkgds. and data consistent within 1σ

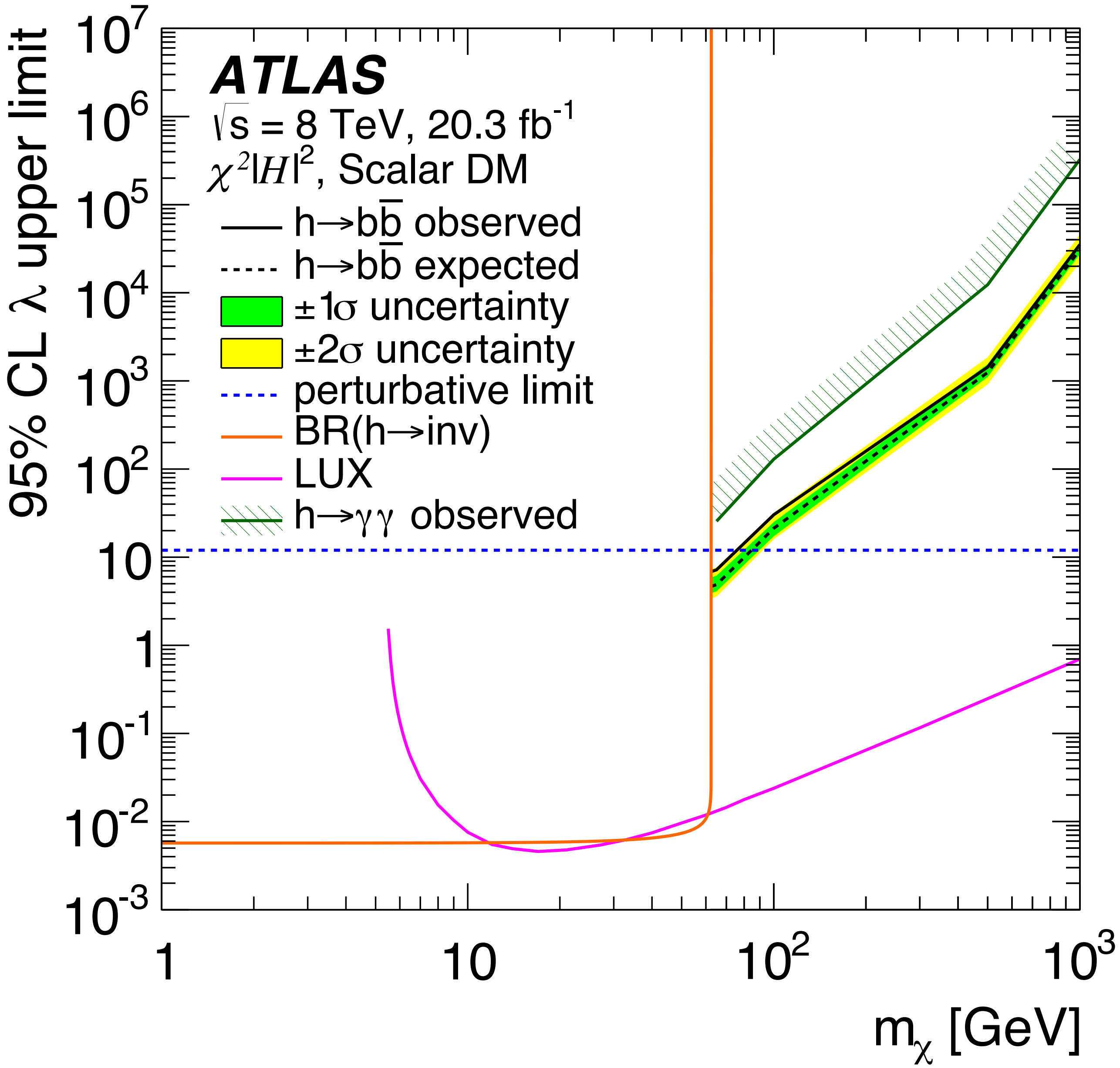


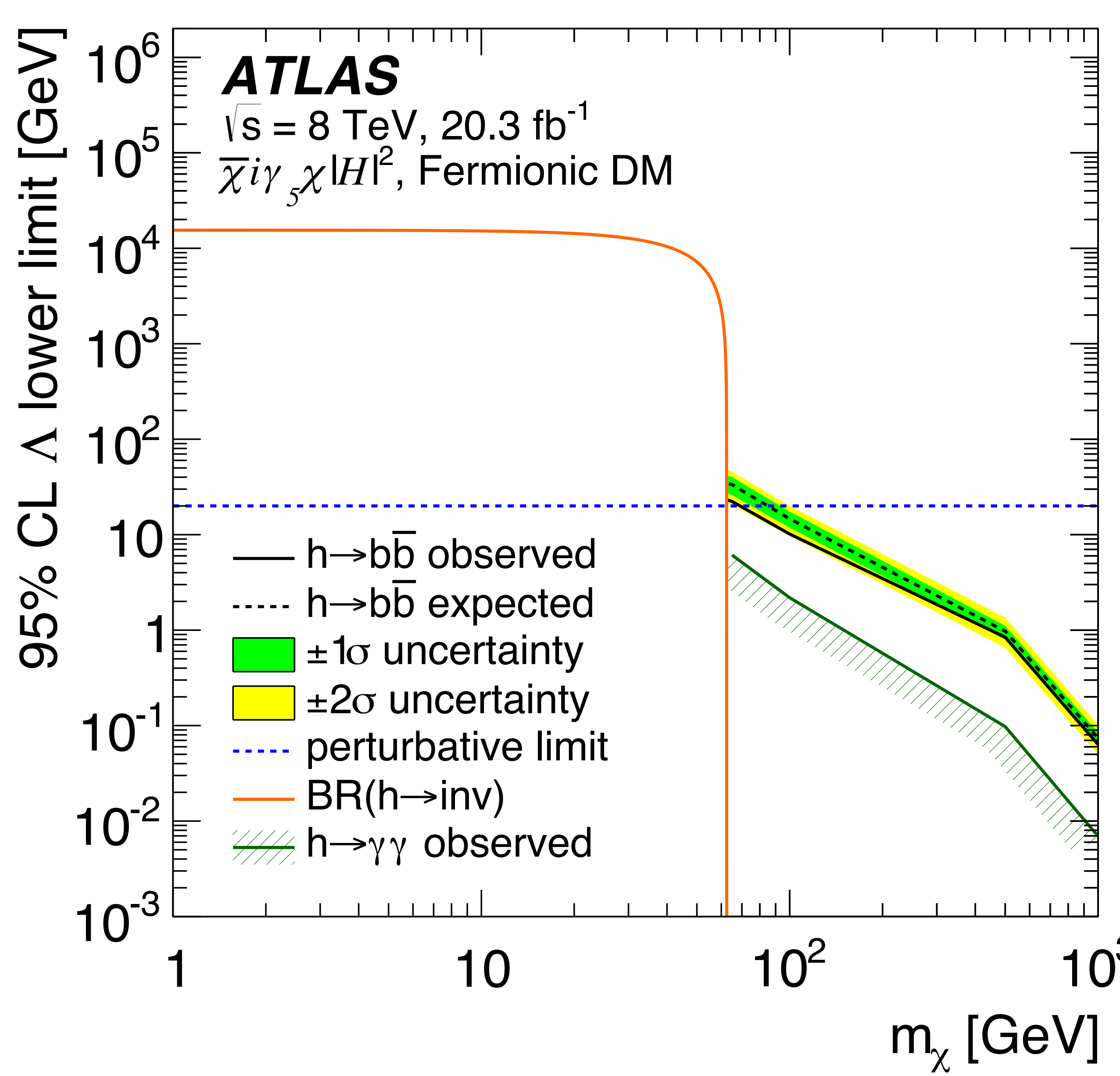
Limits (Resolved Channel)



- **first benchmark for Z'-2HDM model**

Limit for other EFT models





Model-independent XS limit

Table 5: Model-independent upper limits for the resolved and boosted channels. Left to right: signal region (SR) $E_{\mathrm{T}}^{\mathrm{miss}}$ requirement, number of observed events, number of expected background events, 95% CL upper limits on the visible cross-section ($\langle\sigma_{vis}\rangle_{\mathrm{obs}}^{95}$) and the number of non-SM events ($N_{BSM}{}_{\mathrm{obs}}^{95}$). The sixth column ($N_{BSM}{}_{\mathrm{exp}}^{95}$) shows the expected 95% CL upper limit on the number of non-SM events, given the estimated number and the $\pm1\sigma$ uncertainty of background events. The last column shows the p-value for the background-only hypothesis ($p(s = 0)$).

	$E_{\mathrm{T}}^{\mathrm{miss}}$ **cut**	N_{obs}	N_{bkgd}	$\langle\sigma_{vis}\rangle_{\mathrm{obs}}^{95}$[fb]	$N_{BSM}{}_{\mathrm{obs}}^{95}$	$N_{BSM}{}_{\mathrm{exp}}^{95}$	$p(s = 0)$
Resolved	$\geq$ 150 GeV	164	148	3.6	72	62^{+22}_{-14}	0.31
	$\geq$ 200 GeV	68	62	1.3	26	$21^{+8.8}_{-3.3}$	0.27
	$\geq$ 300 GeV	11	9.4	0.49	9.9	$8.2^{+3.3}_{-1.8}$	0.31
	$\geq$ 400 GeV	2	1.7	0.24	4.8	$4.6^{+1.7}_{-1.0}$	0.38
Boosted	> 300 GeV	20	11.2	0.90	18	$10^{+4.1}_{-3.2}$	0.03
	> 400 GeV	9	7.7	0.45	9.1	$7.8^{+3.4}_{-2.3}$	0.37