high-mass resonance searches from ATLAS

emphasis on *MSSM / 2HDM*

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(Harvard University)
for the ATLAS Collaboration

LHCP2016

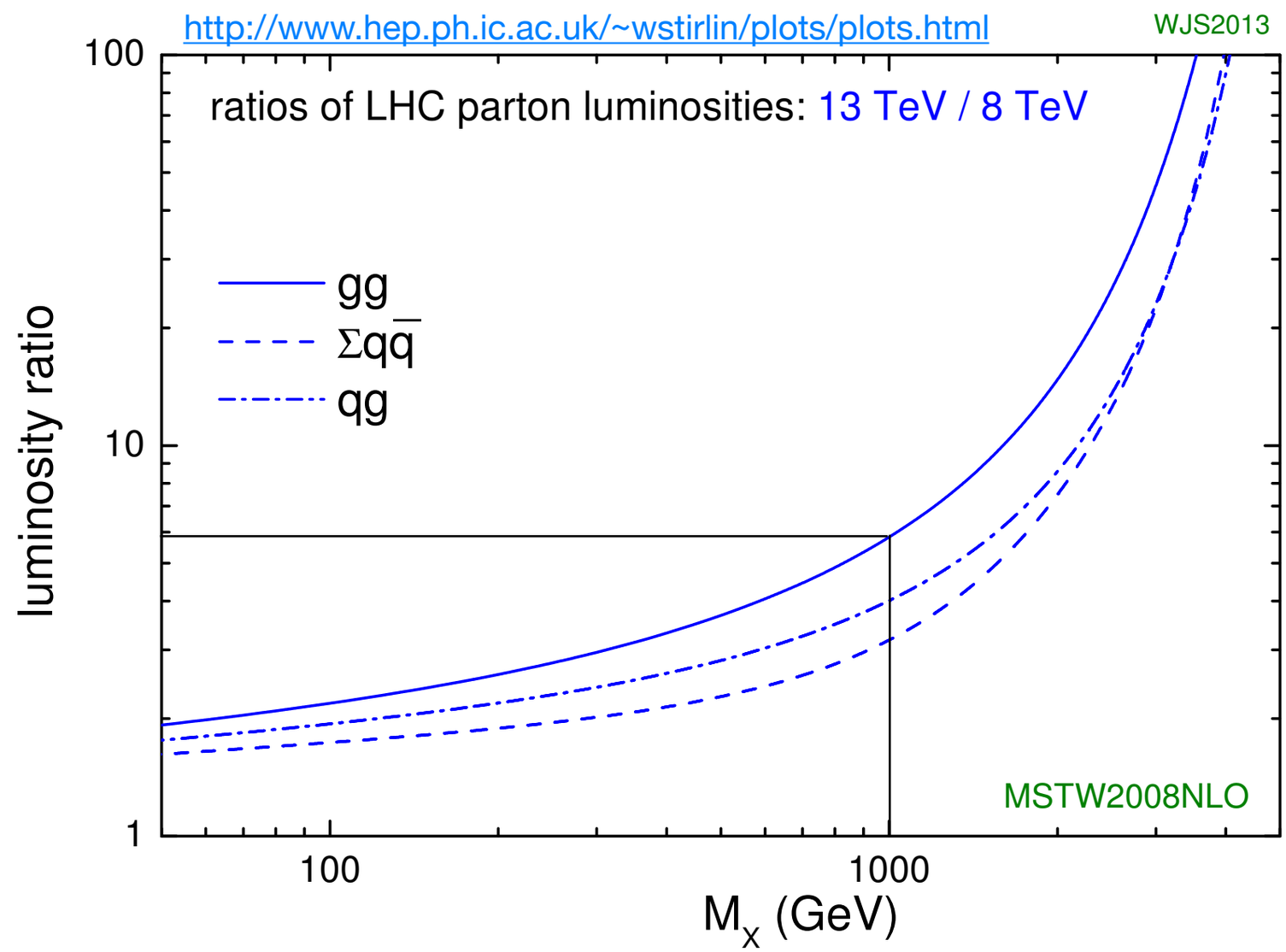
searching for heavy resonances

emphasis on *MSSM / 2HDM*

LHC colliding protons
at 13 TeV

bread and butter:
resonance searches

big increase as function of
collision energy



searching for heavy resonances

emphasis on *MSSM / 2HDM*

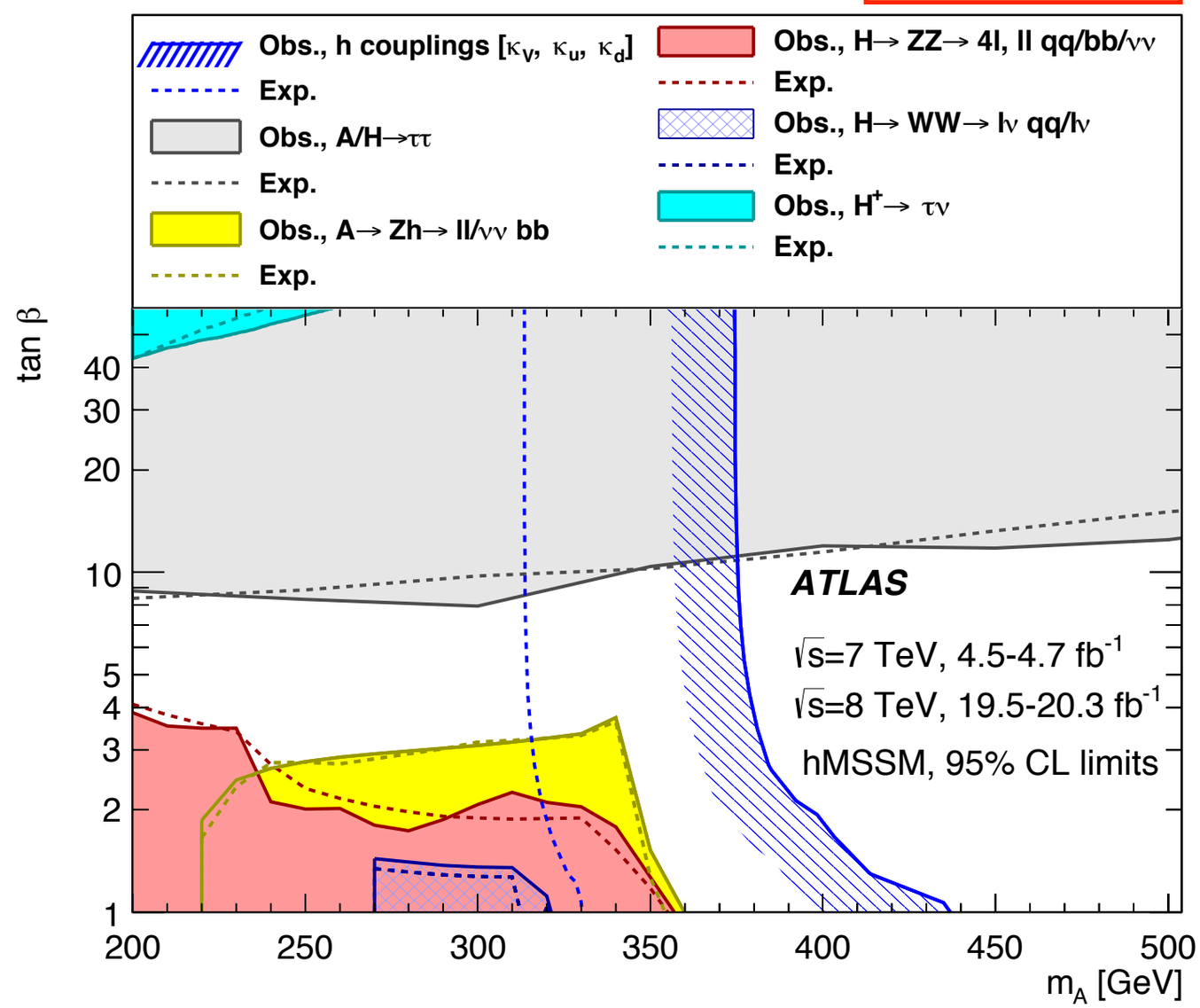
features of *2HDM / MSSM*

many "Higgs"s
2 CP-even (h, H), 1 CP-odd (A)
2 charged ($H^{\pm}$)

outcome of 8 TeV searches:
limits on new physics models

this talk: updates with 13 TeV

8 TeV



searching for heavy resonances

emphasis on *MSSM / 2HDM*

8 TeV

<u>discuss in some detail</u>

$X \to \tau\tau$

$X \to Zh$

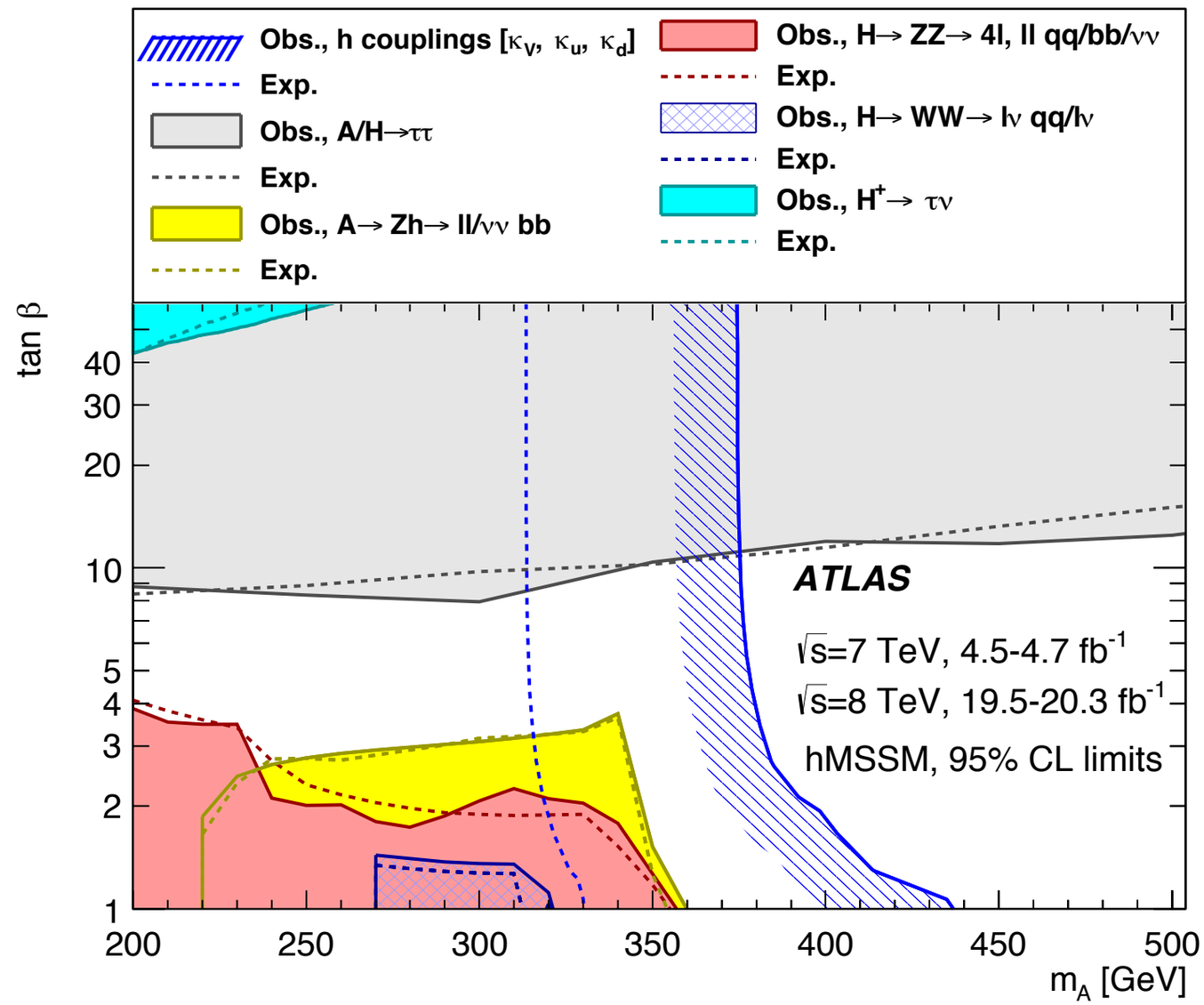
<u>quick mention</u>

$X \to WW$

$X \to ZZ$

$X \to HH$

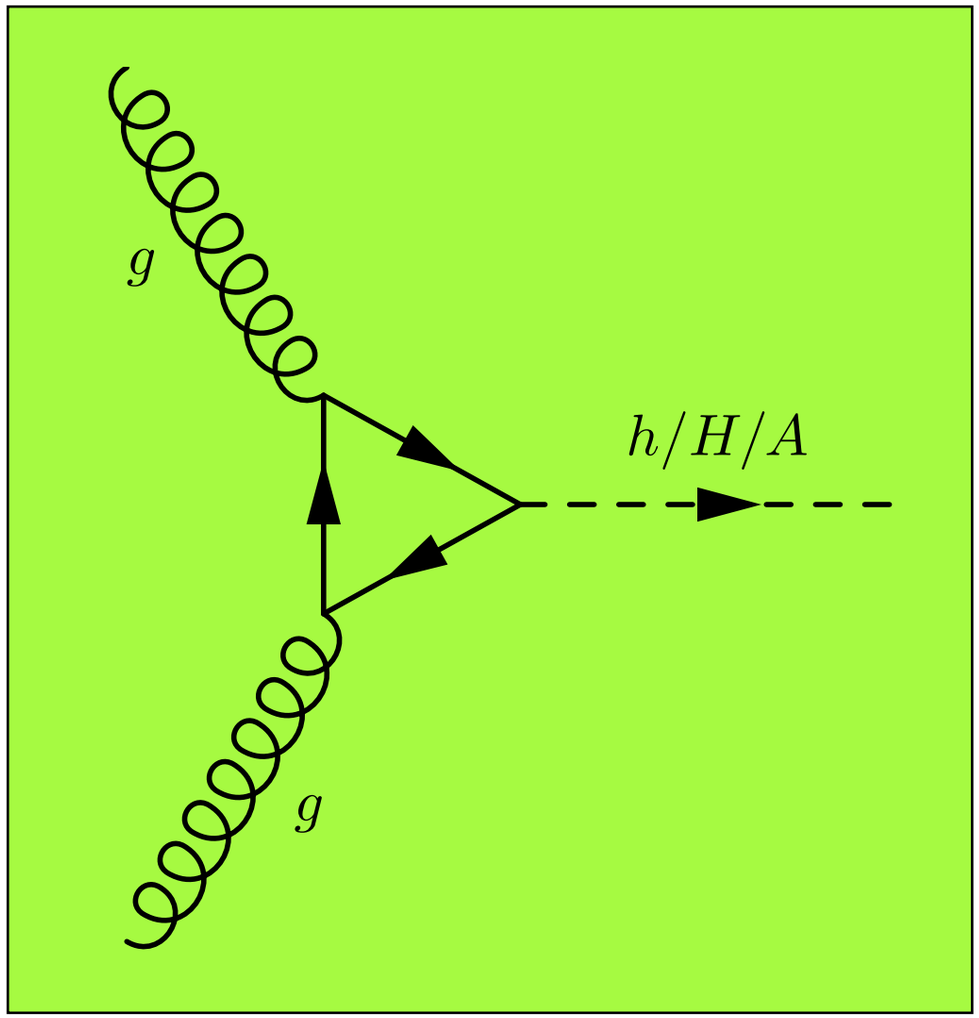
see Henrik's talk for $H^{\pm} \to \tau\nu$!



$H / A \rightarrow \tau\tau$

see Mark's talk from yesterday for more detail

H / A → ττ



τ → hν

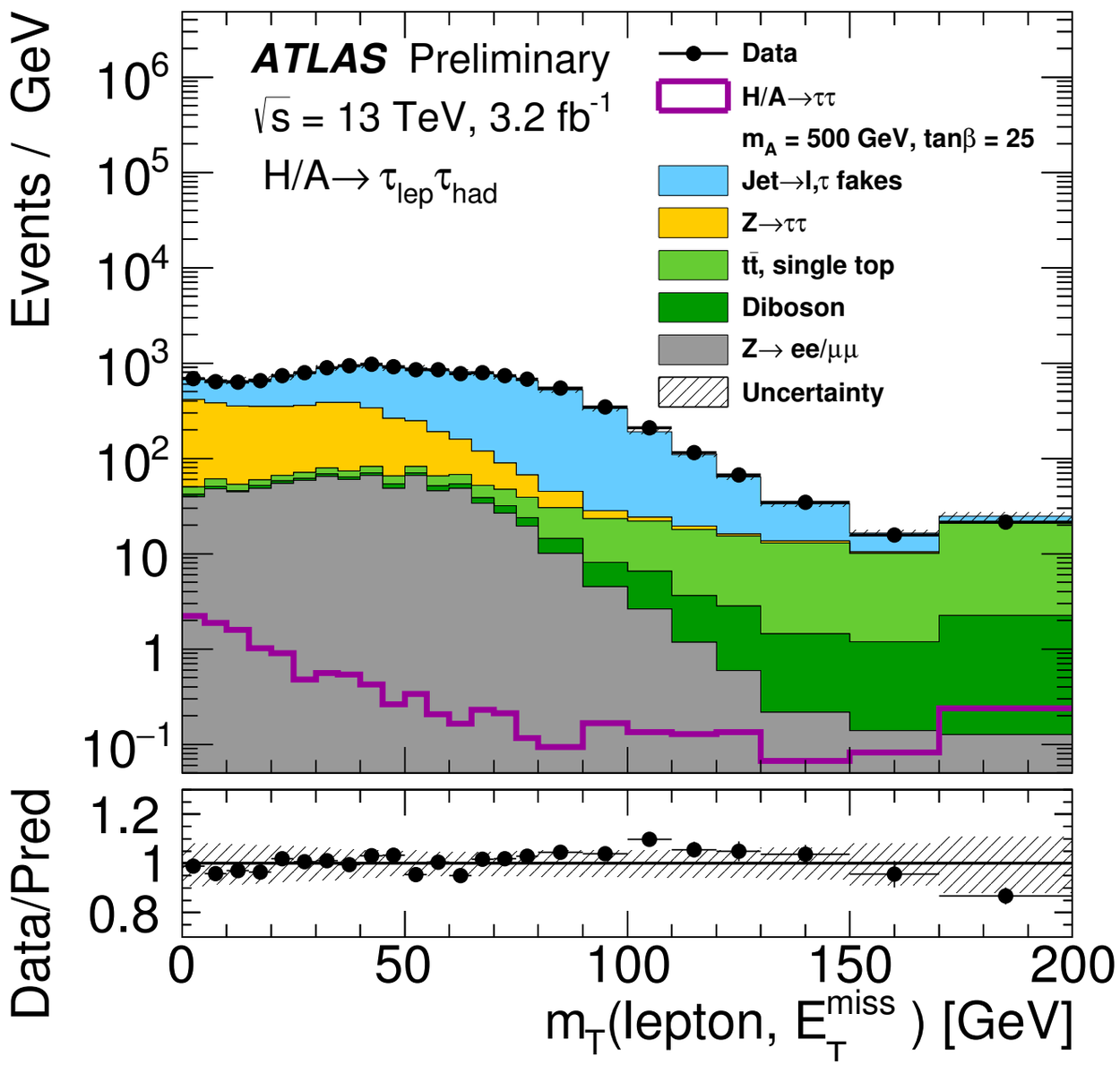
τ → hν or ℓνν

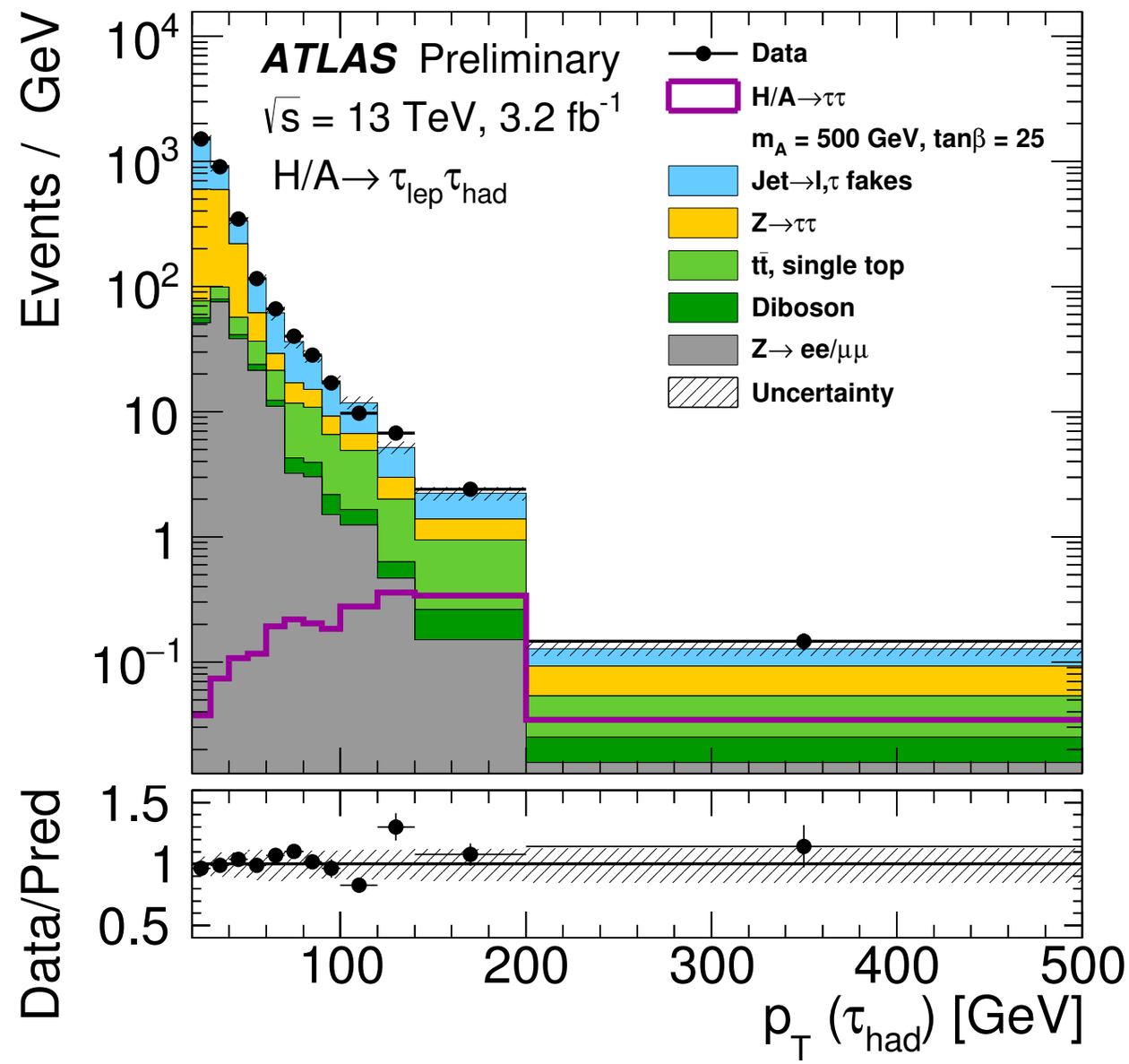
"h" ==
$\pi^{\pm}$, $\pi^{\pm}\pi^{0}$, …

≥2 neutrinos!
degrades m(ττ)
resolution

searches typically target ~inclusive *h*/*H*/*A* production
MSSM also likes *b*-associated

H / A → ττ

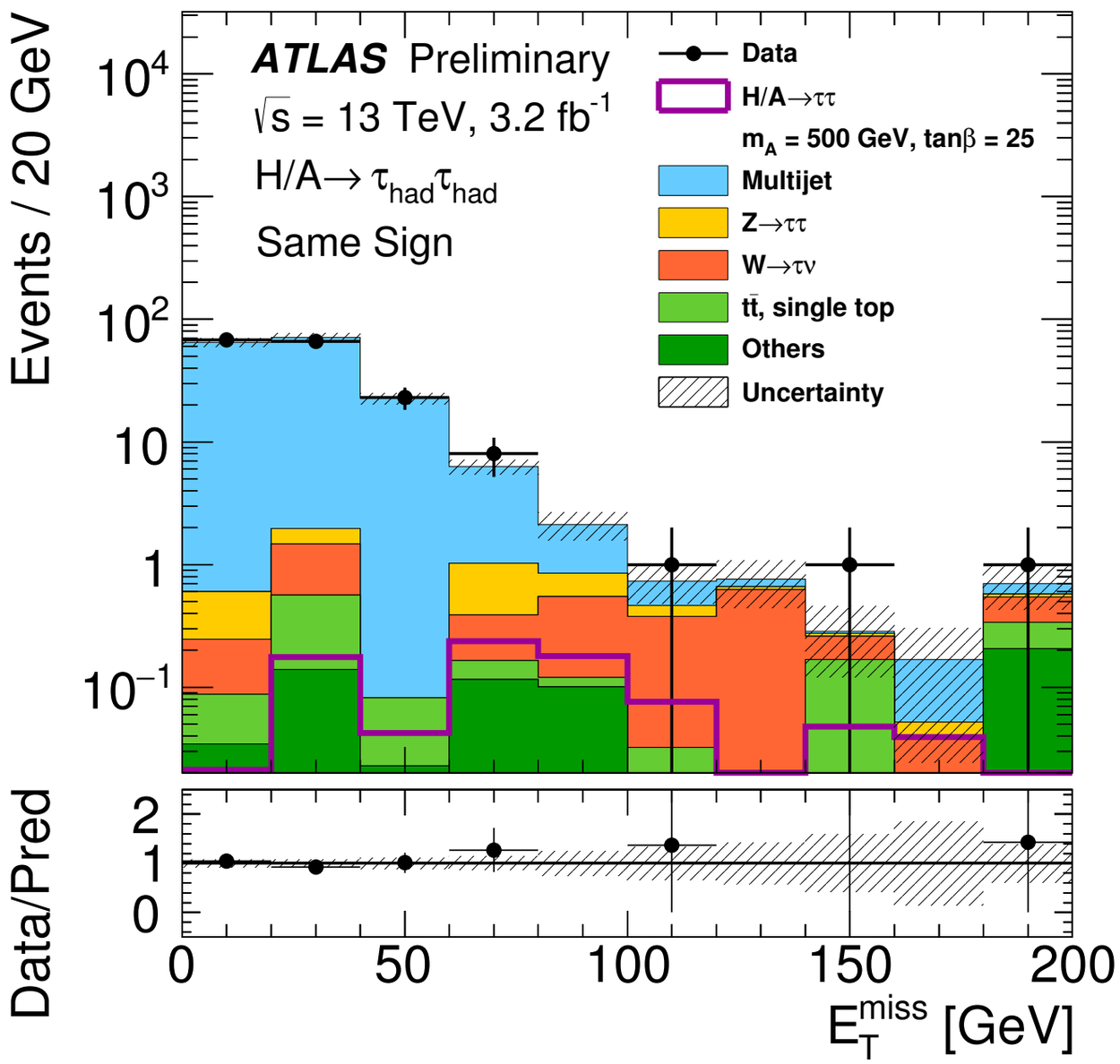


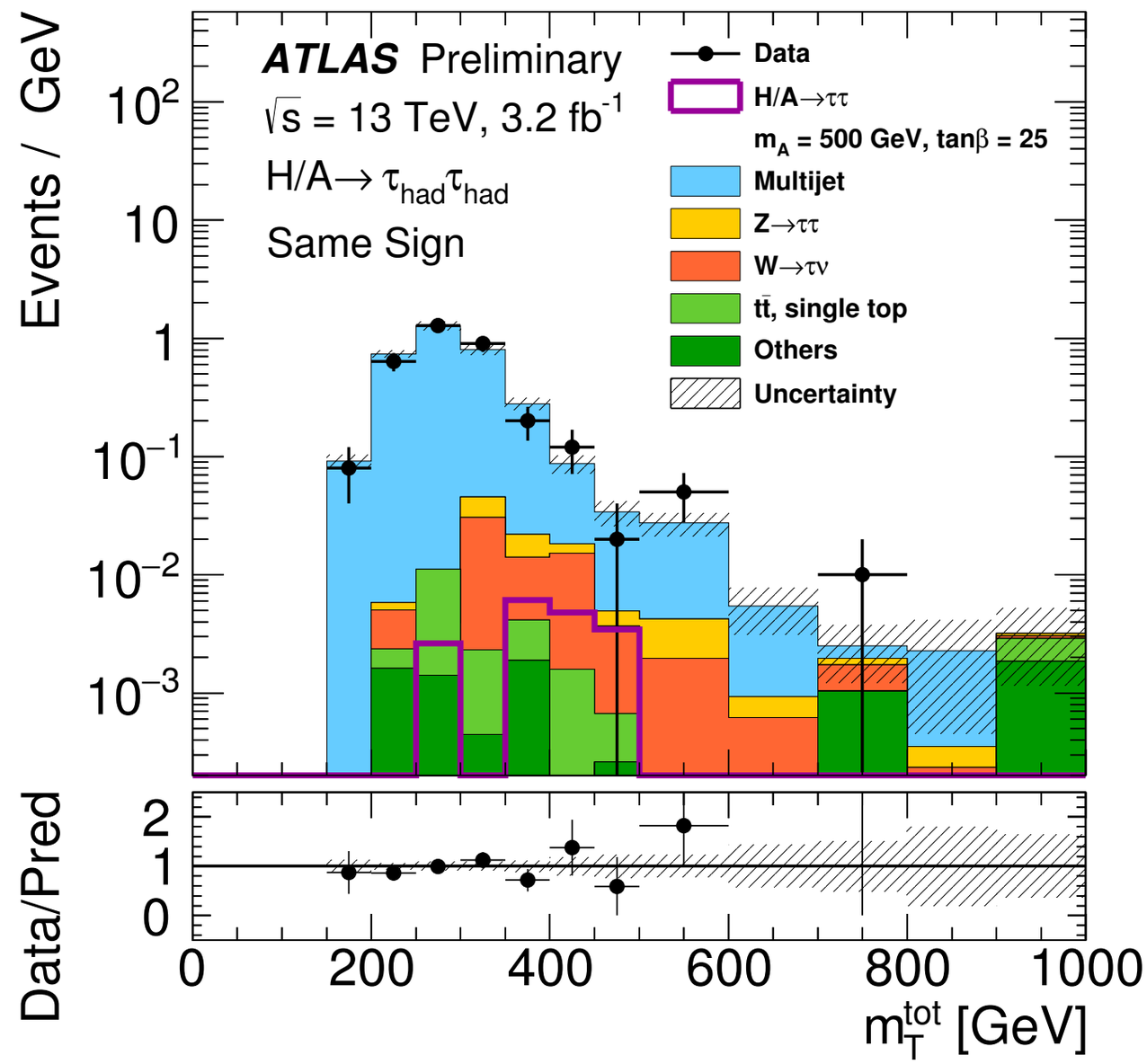


$\tau_{lep}\tau_{had}$ major SM backgrounds: jets mis-id'd as τ_{had}

$tt \rightarrow bb\tau_{had}\ell\nu\nu\nu$

H / A → ττ





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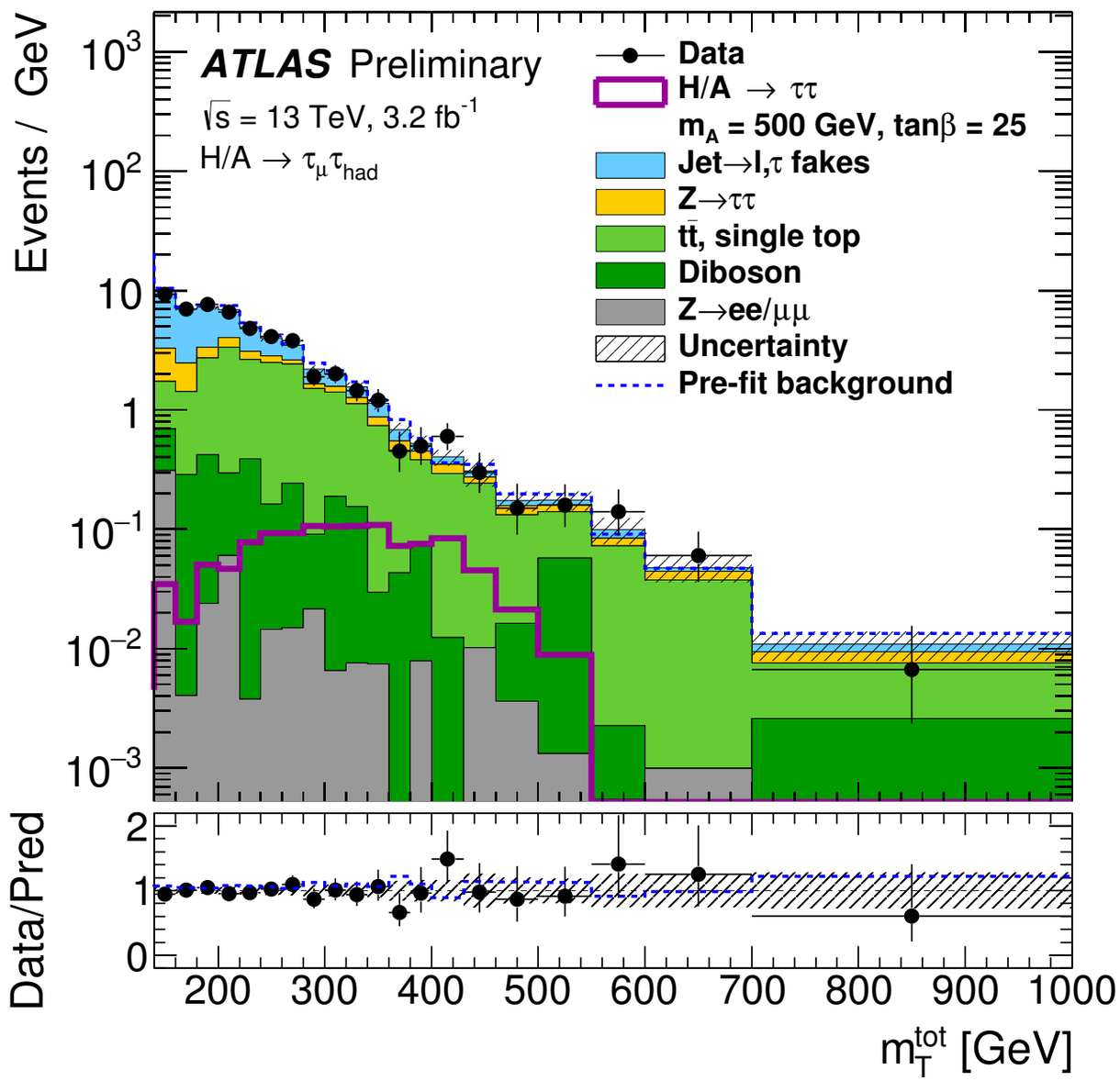
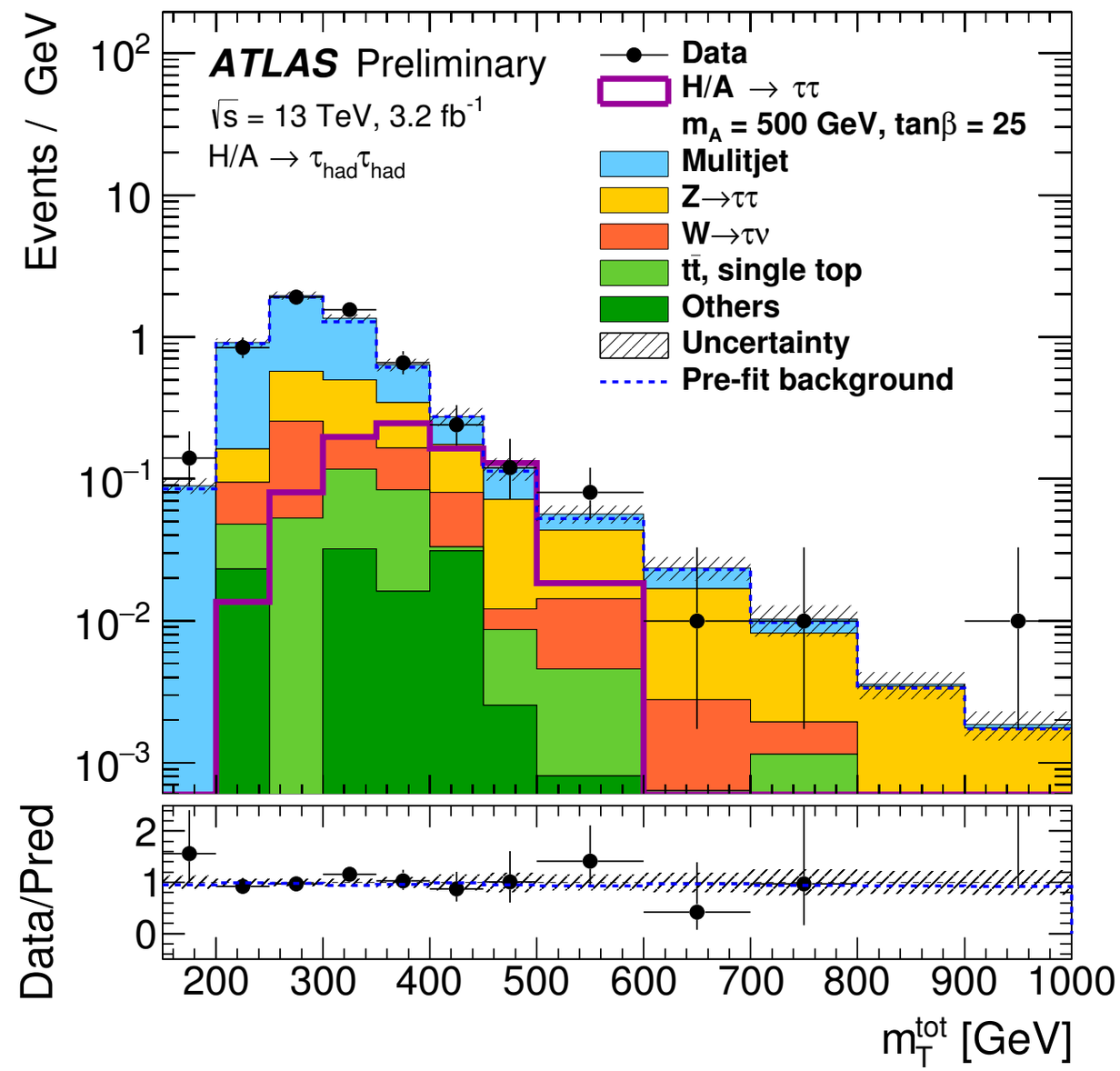
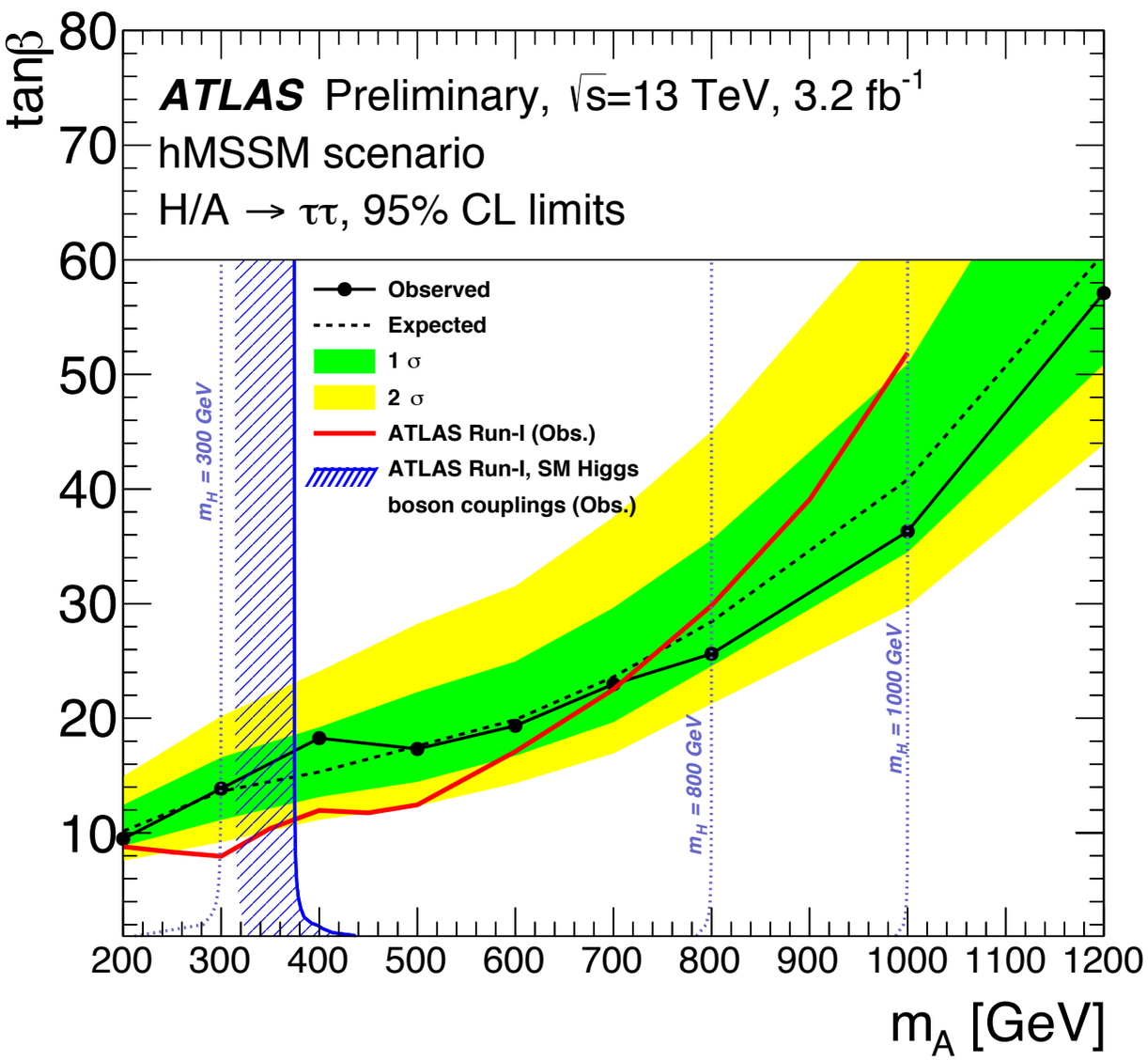
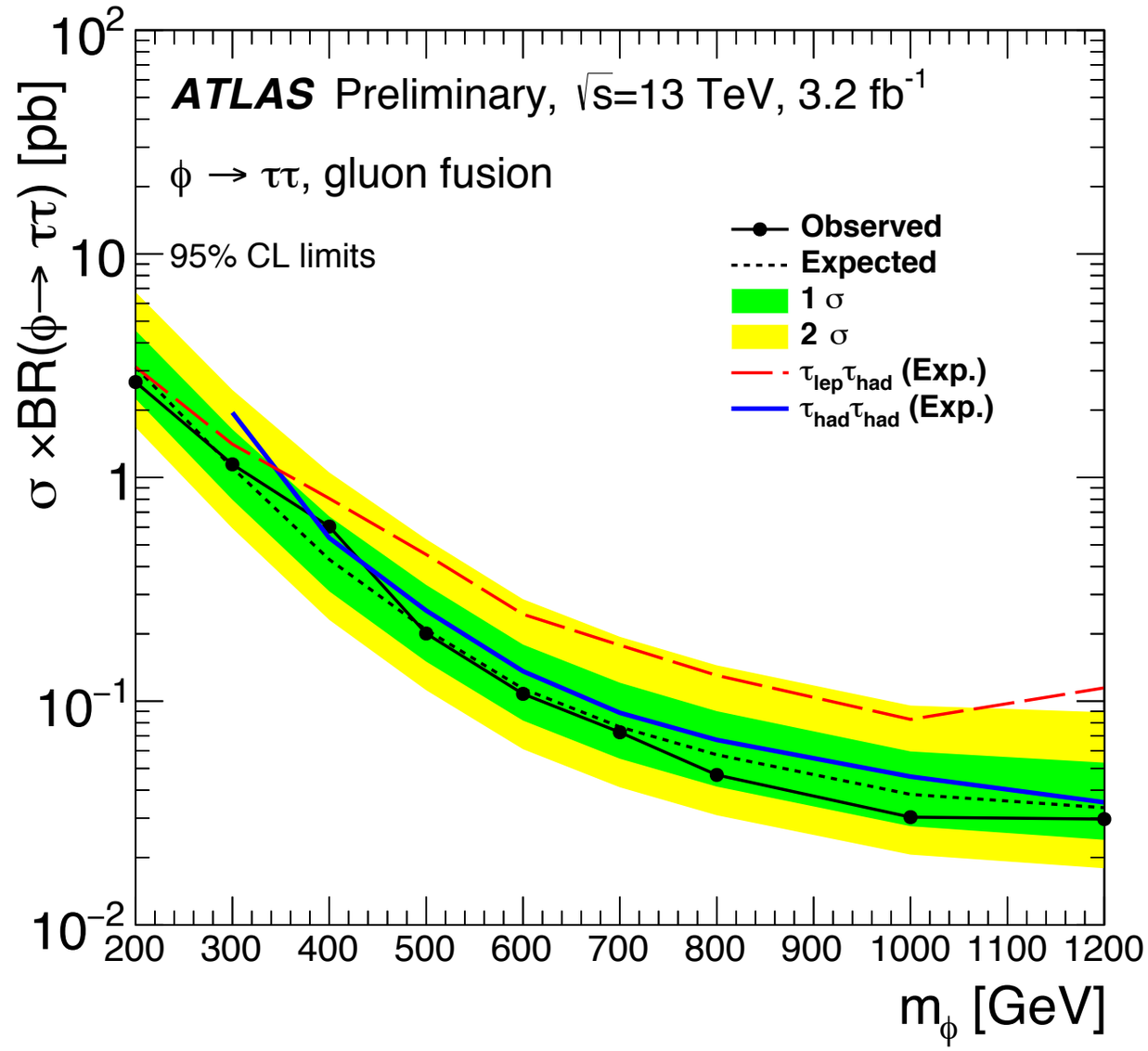




no significant excesses above background prediction

H / A → ττ





set 95% CL limits on the production

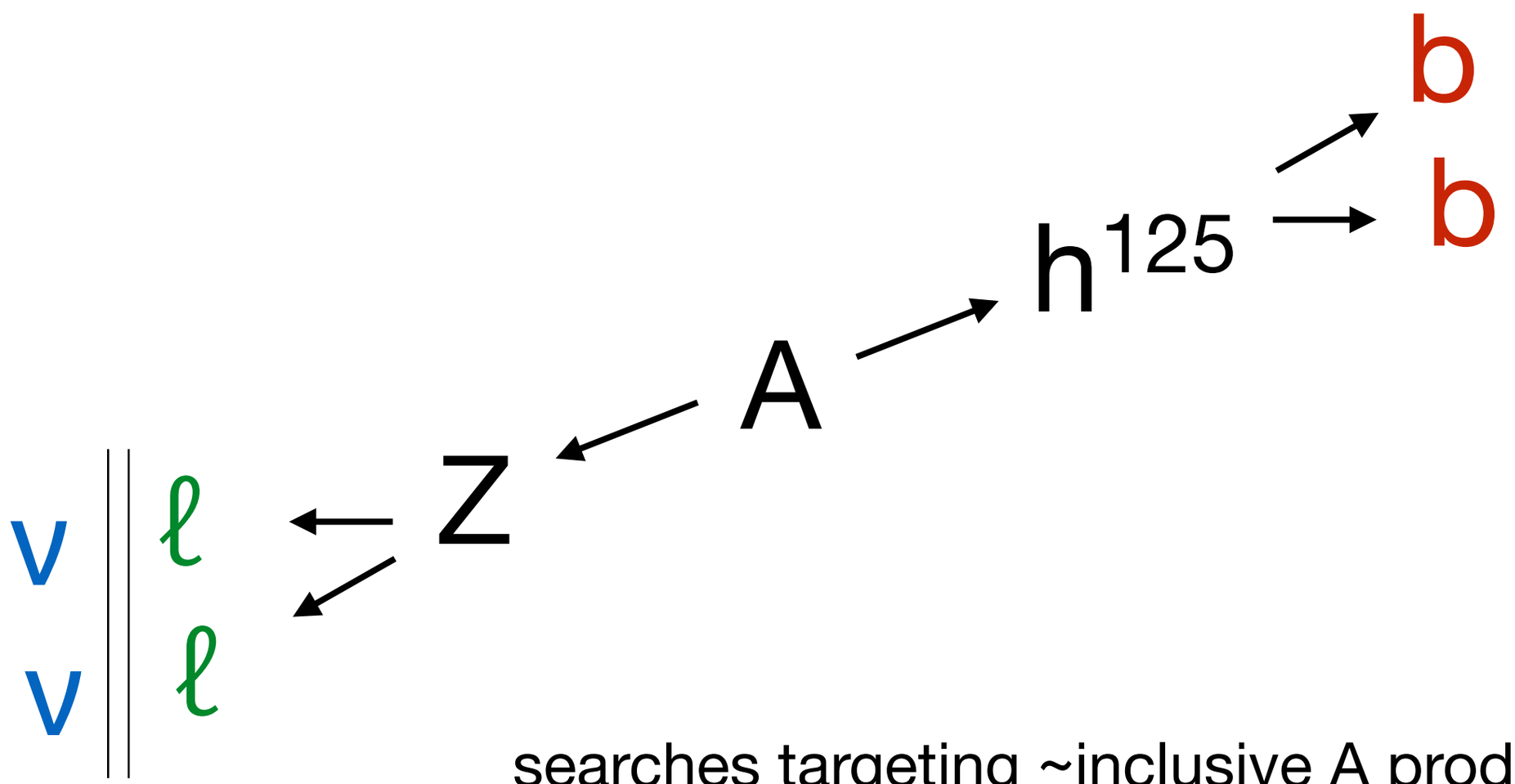
better than Run 1 at high masses, despite much smaller dataset!

$A \rightarrow Zh$

$\rightarrow (\ell\ell \text{ or } \nu\nu)bb$

see Kristian's talk tomorrow for more detail

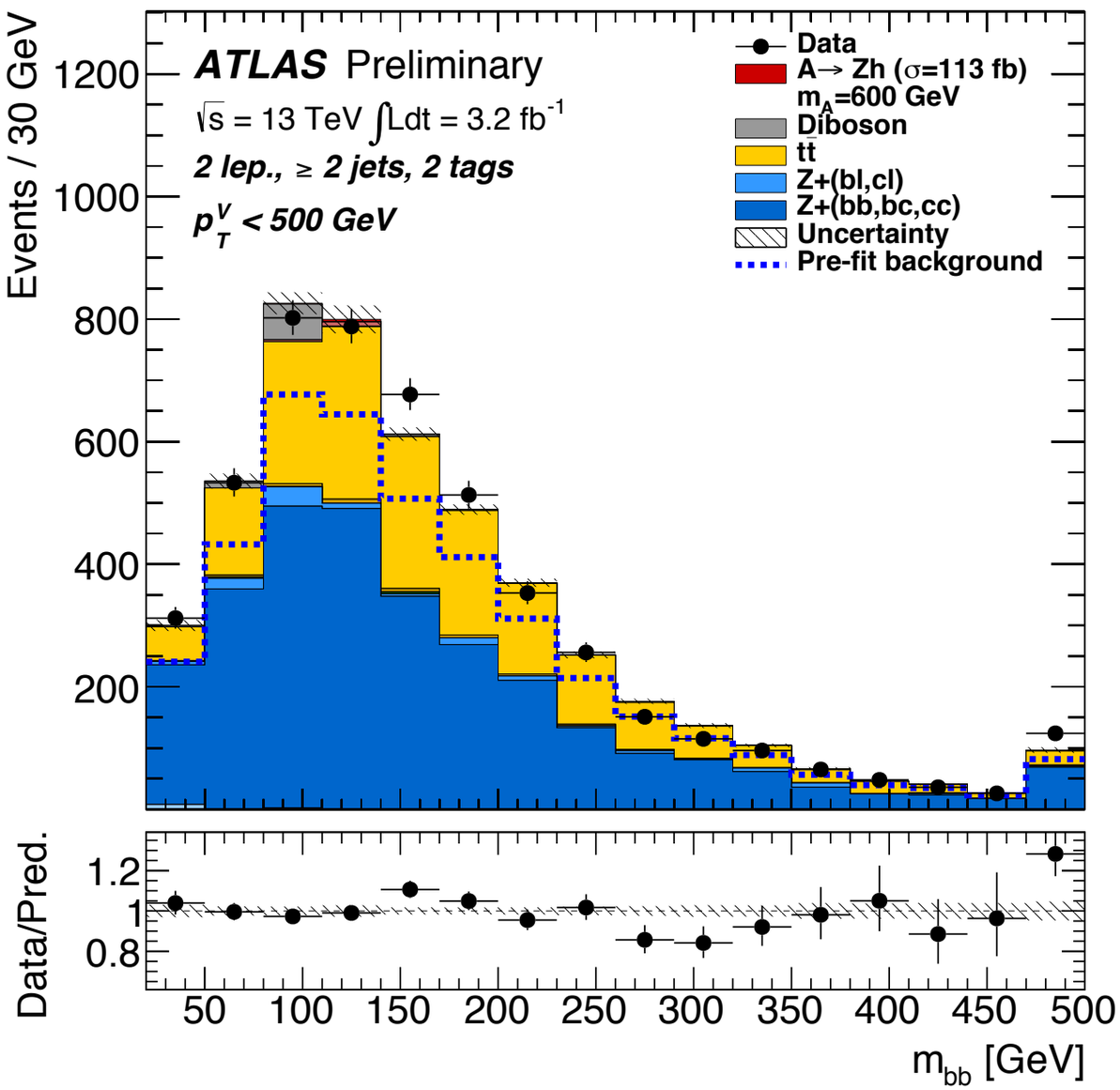
A → Zh → (ℓℓ or νν)bb

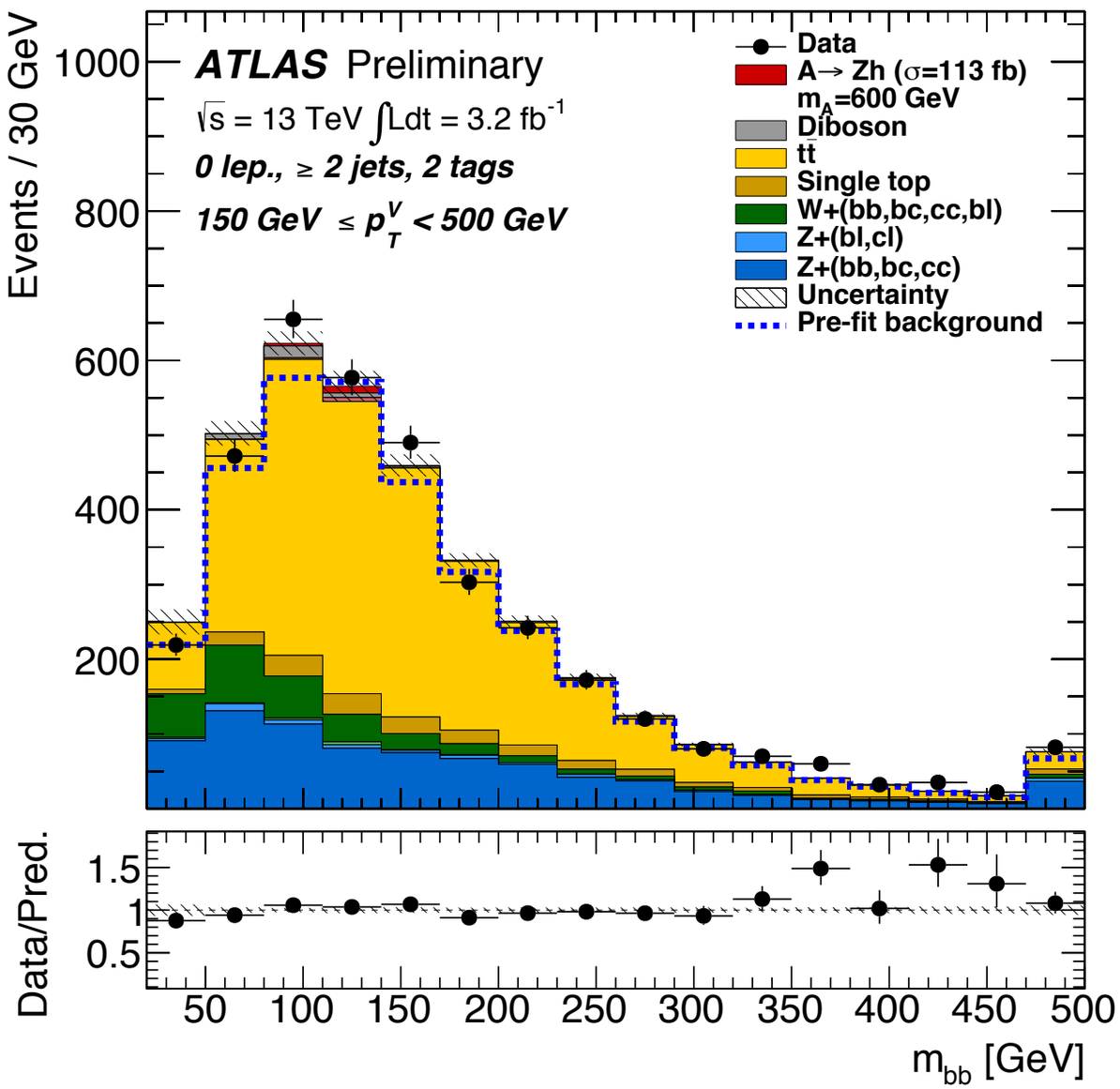


searches targeting ~inclusive A production

focus on h→bb for large BR
focus on Z→ℓℓ or νν for clean signatures

A → Zh → (ℓℓ or νν)bb

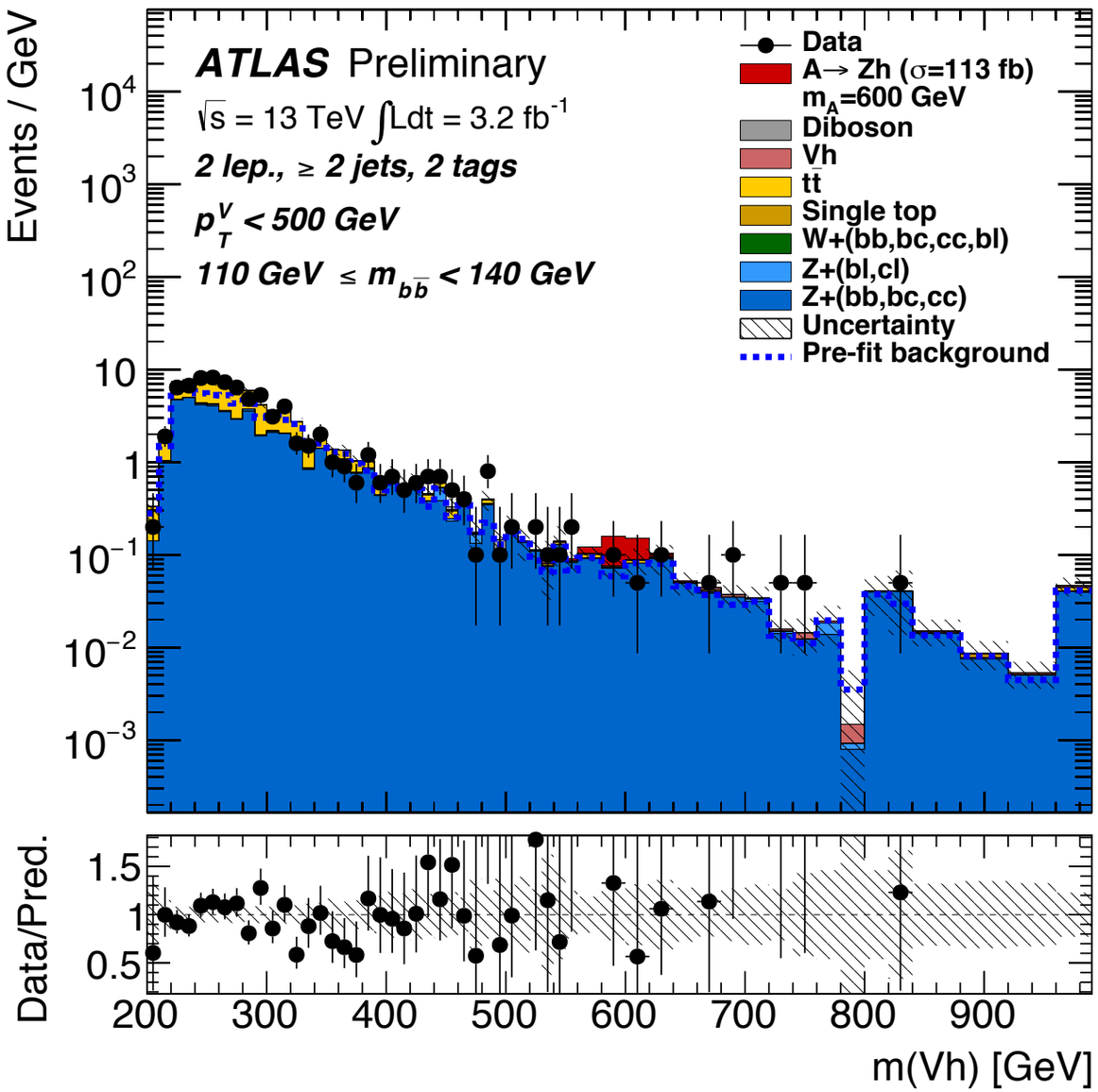


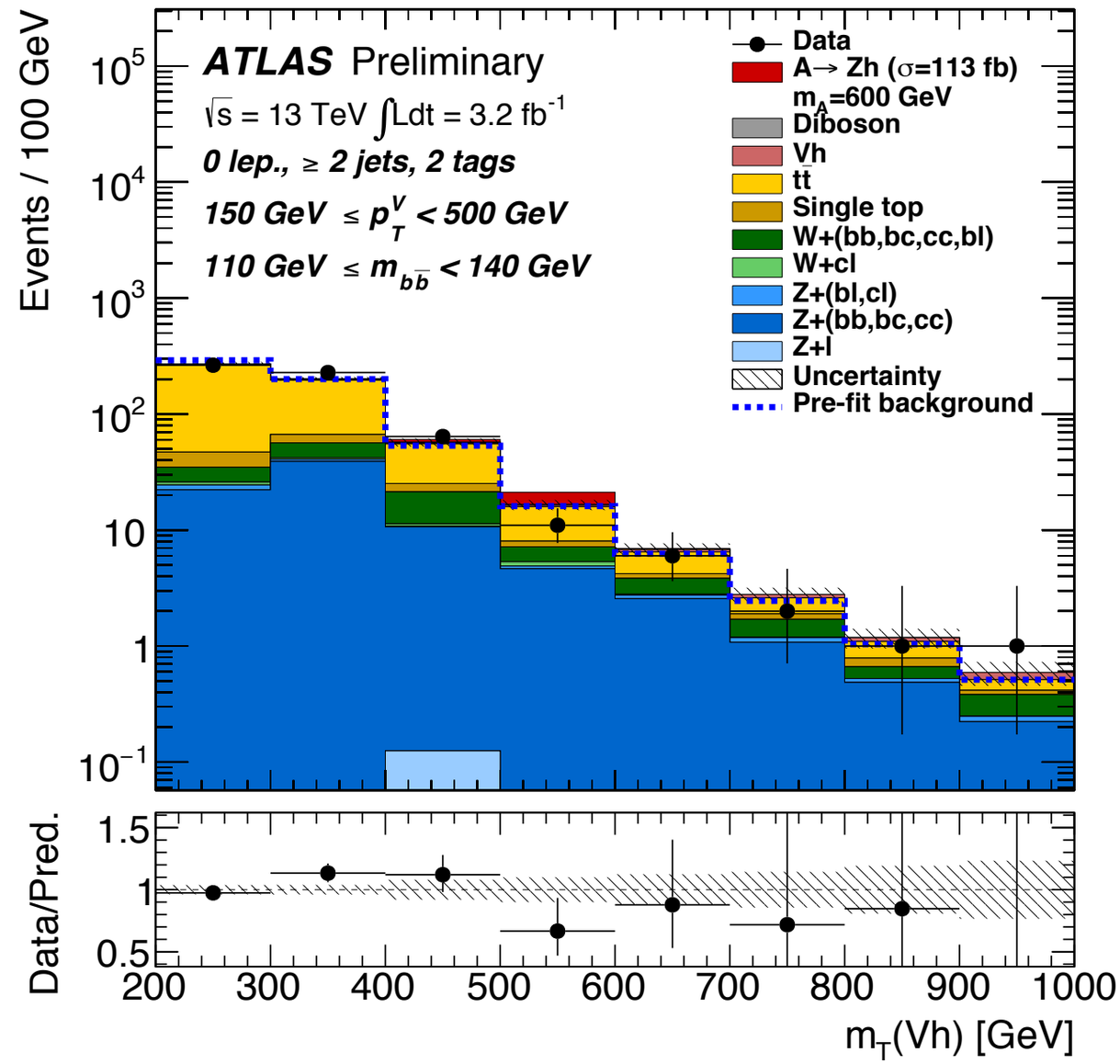


large backgrounds: tt, Z(ℓℓ or νν) + HF

control predictions with data outside m(bb) window

A → Zh → (ℓℓ or νν)bb

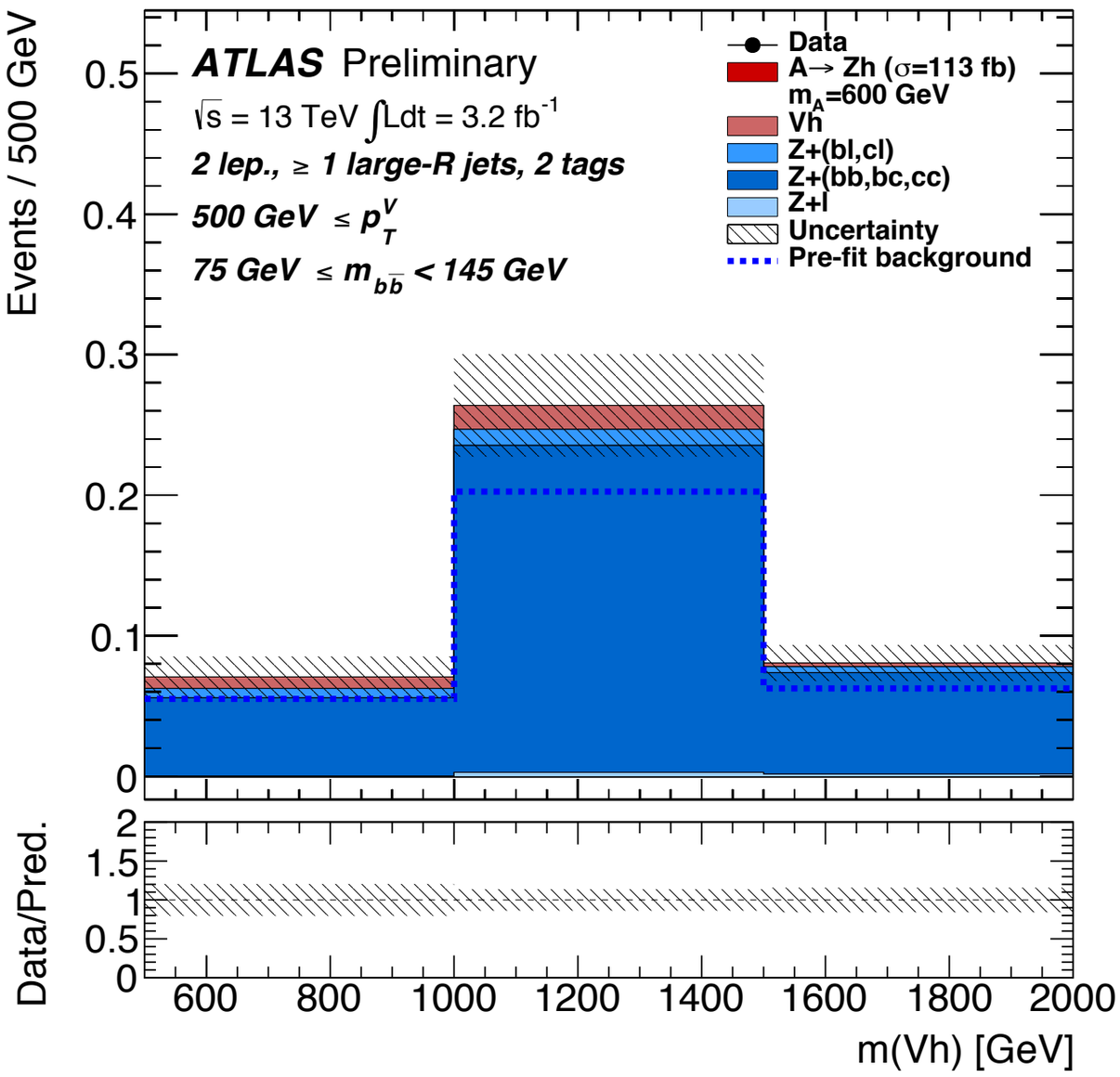


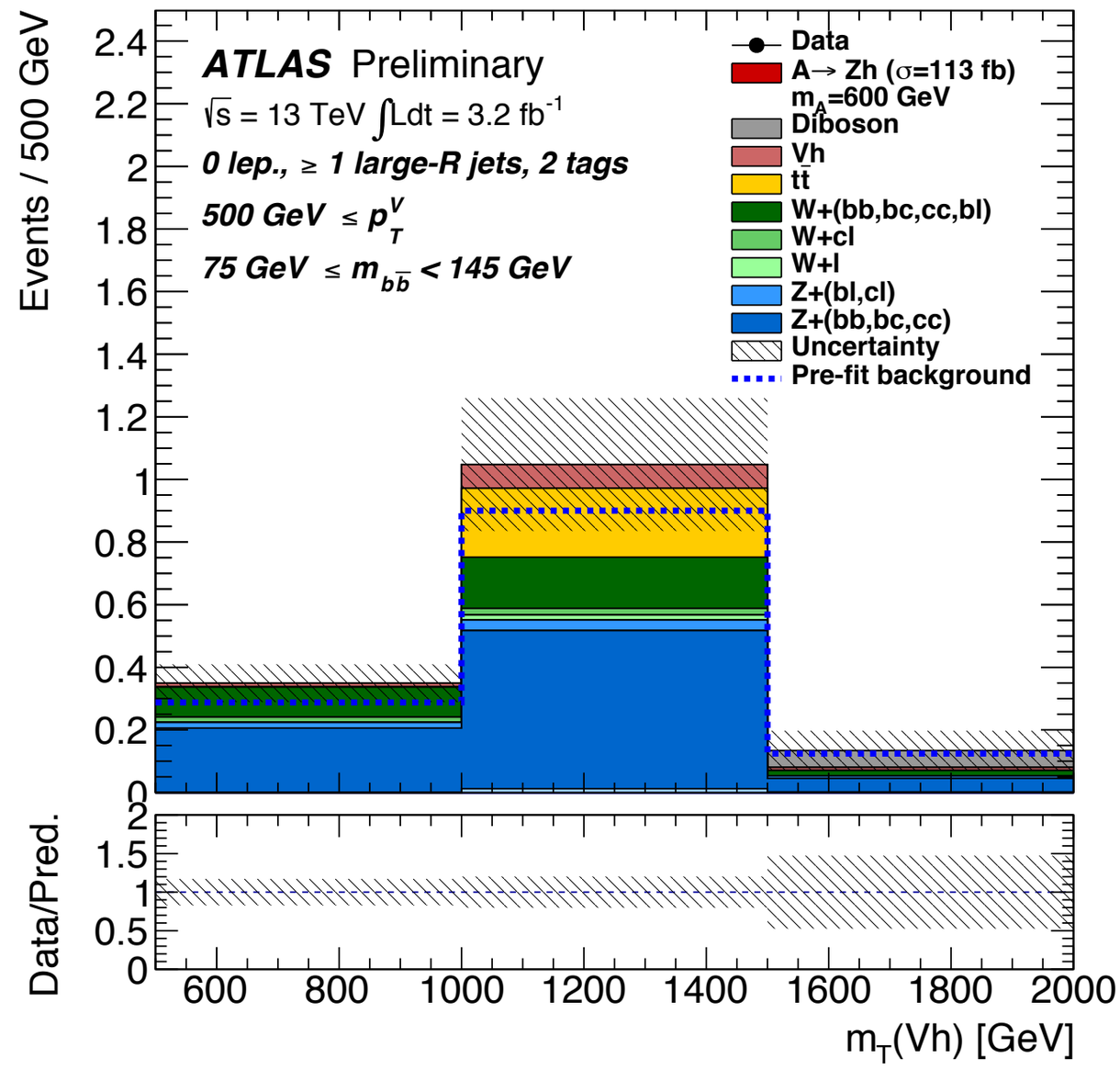


no significant excesses above background prediction

$p_T(Z) < 500$ GeV: reconstruct 2 *b*-jets

A → Zh → (ℓℓ or νν)bb

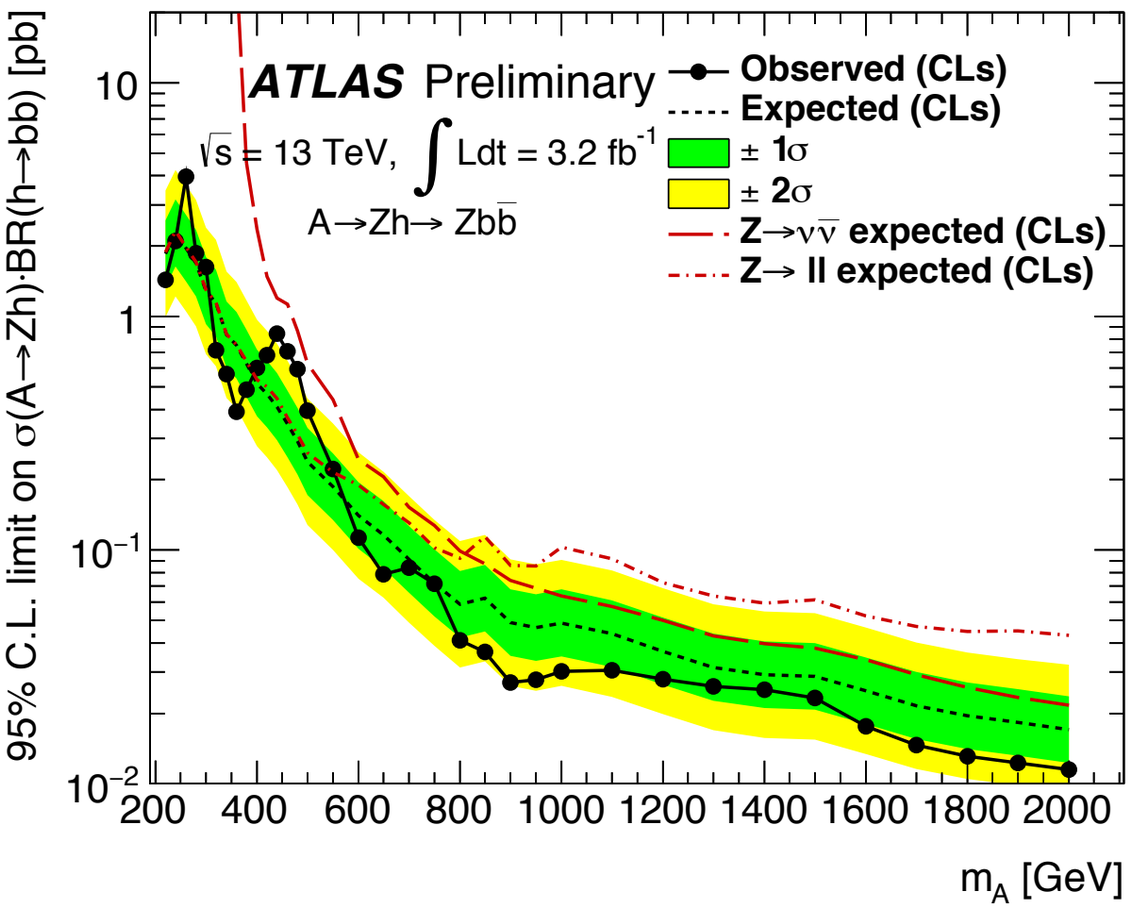


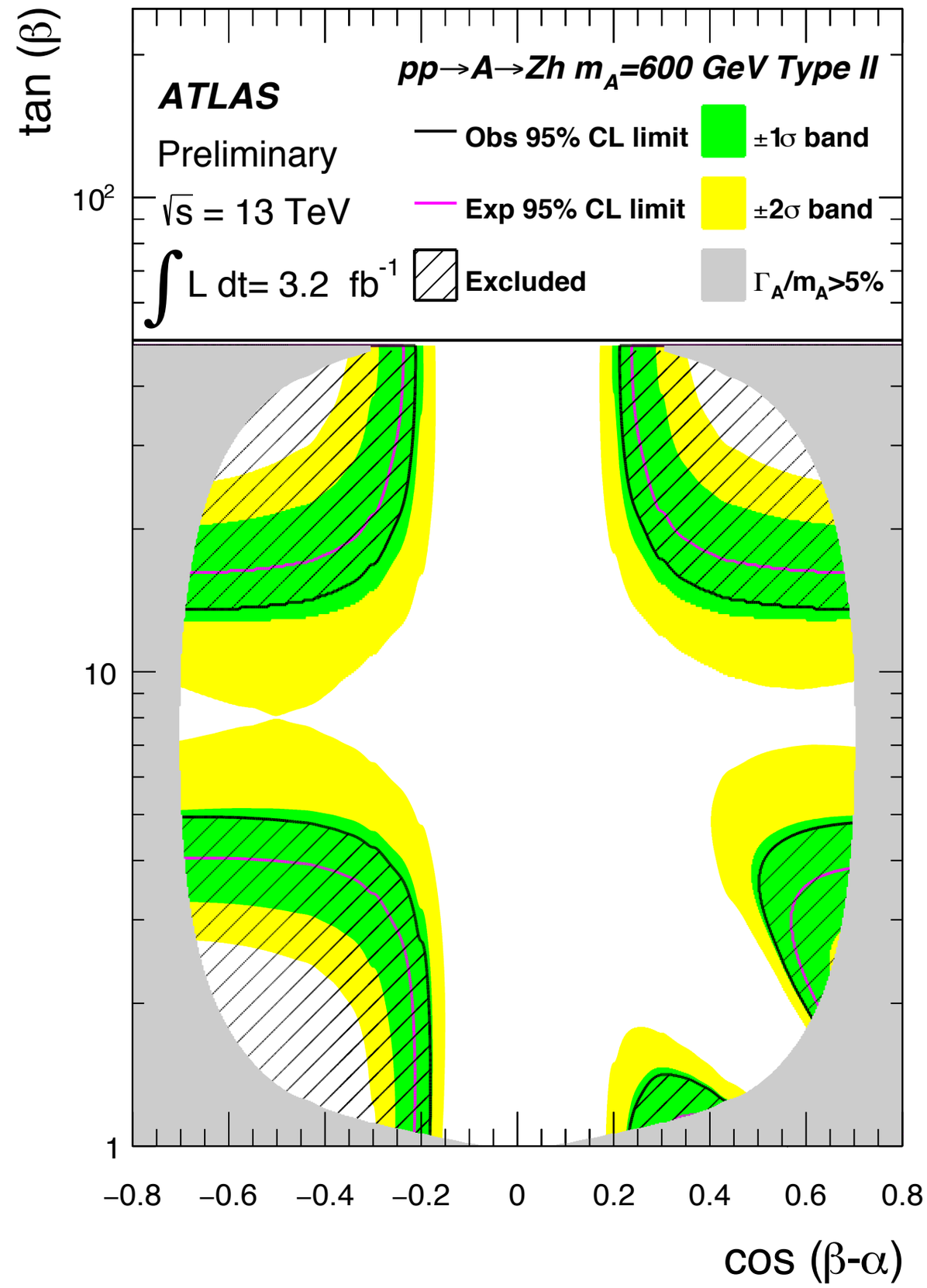


no significant excesses above background prediction

$p_T(Z) > 500$ GeV: reconstruct 1 large jet with 2 *b*-jets inside

A → Zh





set 95% CL limits on the production

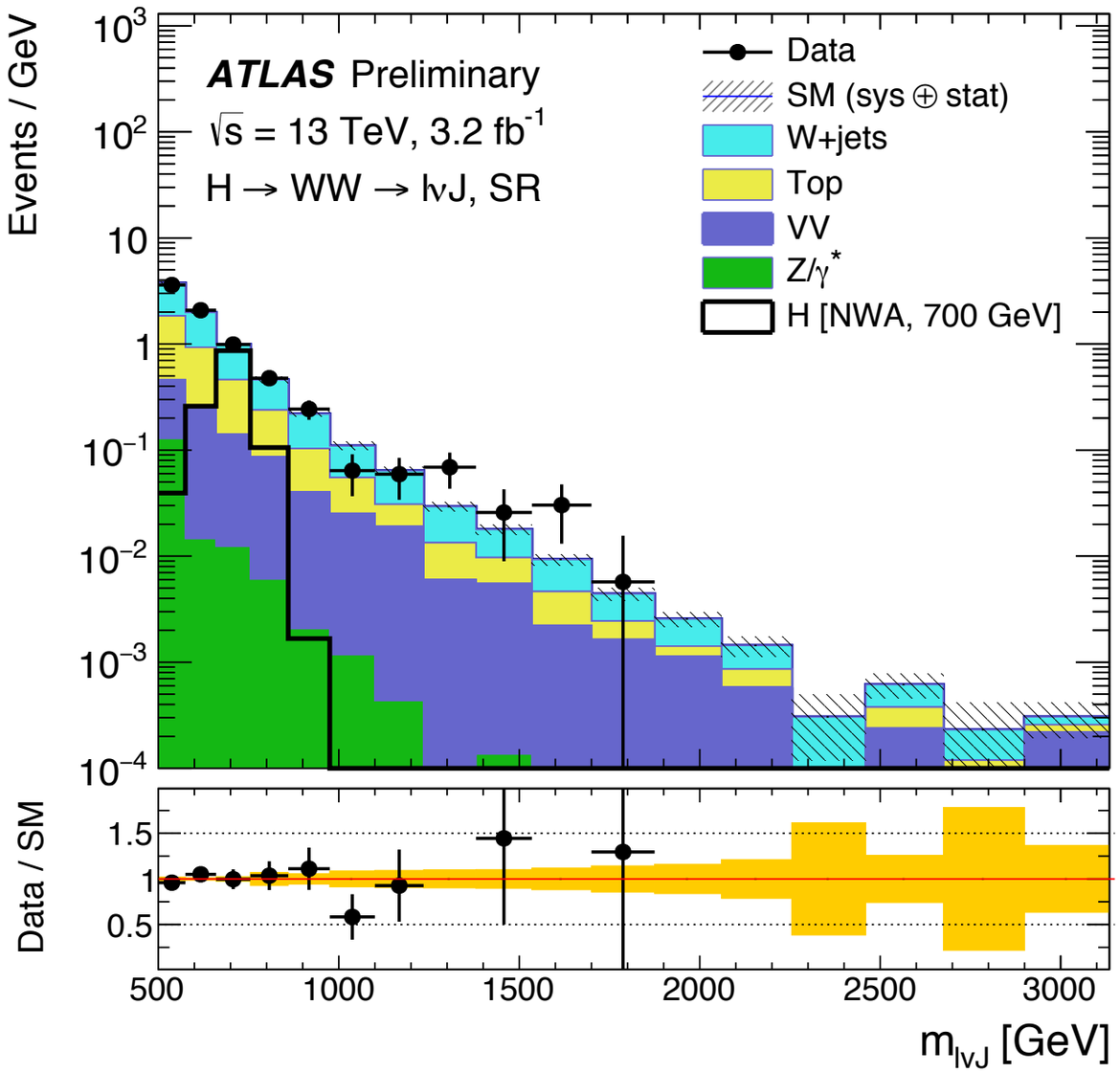
$X \to W$ or HH

in brief

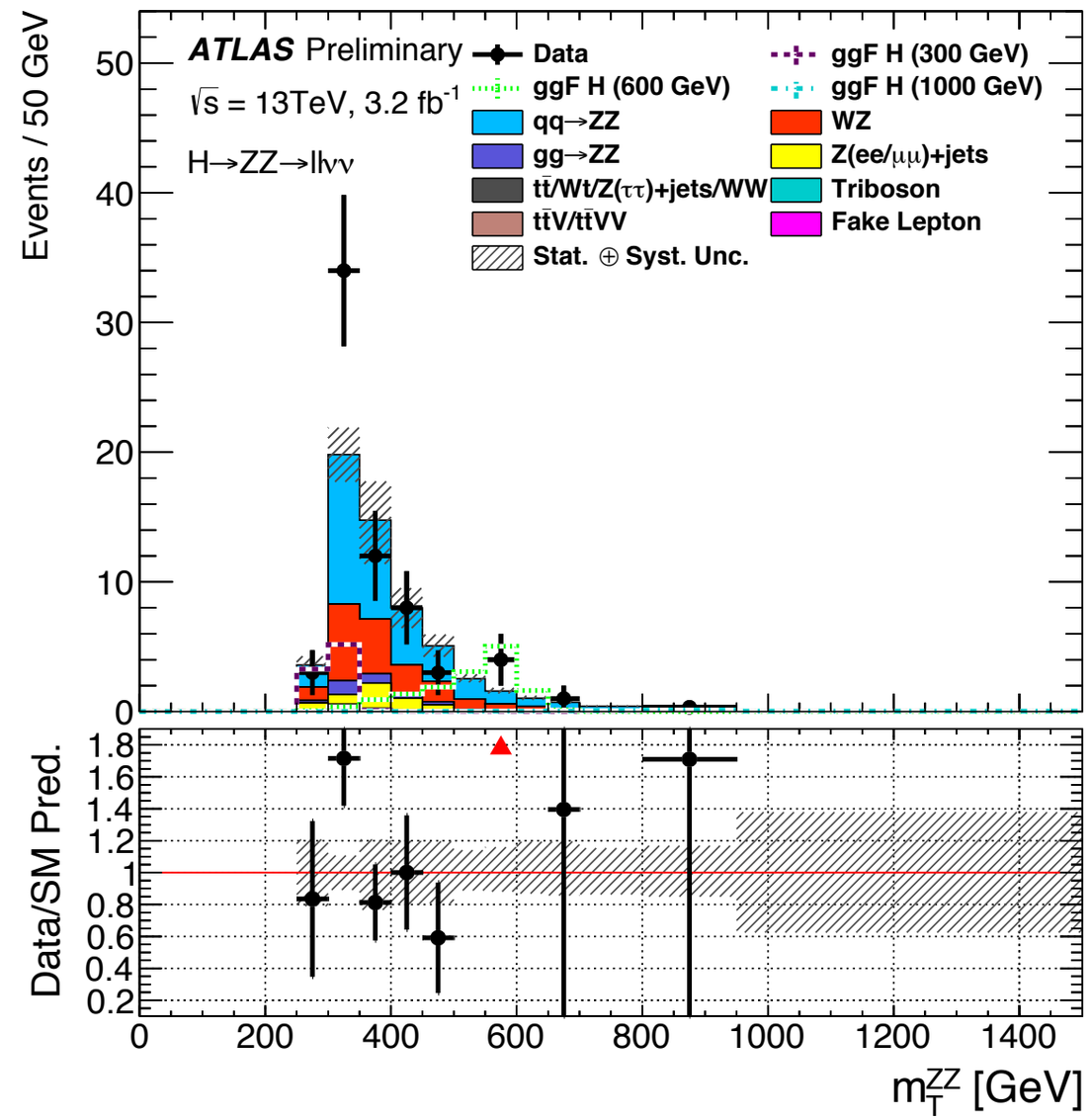
see Kristian's talk tomorrow for more detail

A / H / X → WW or ZZ

H → WW → ℓνJ



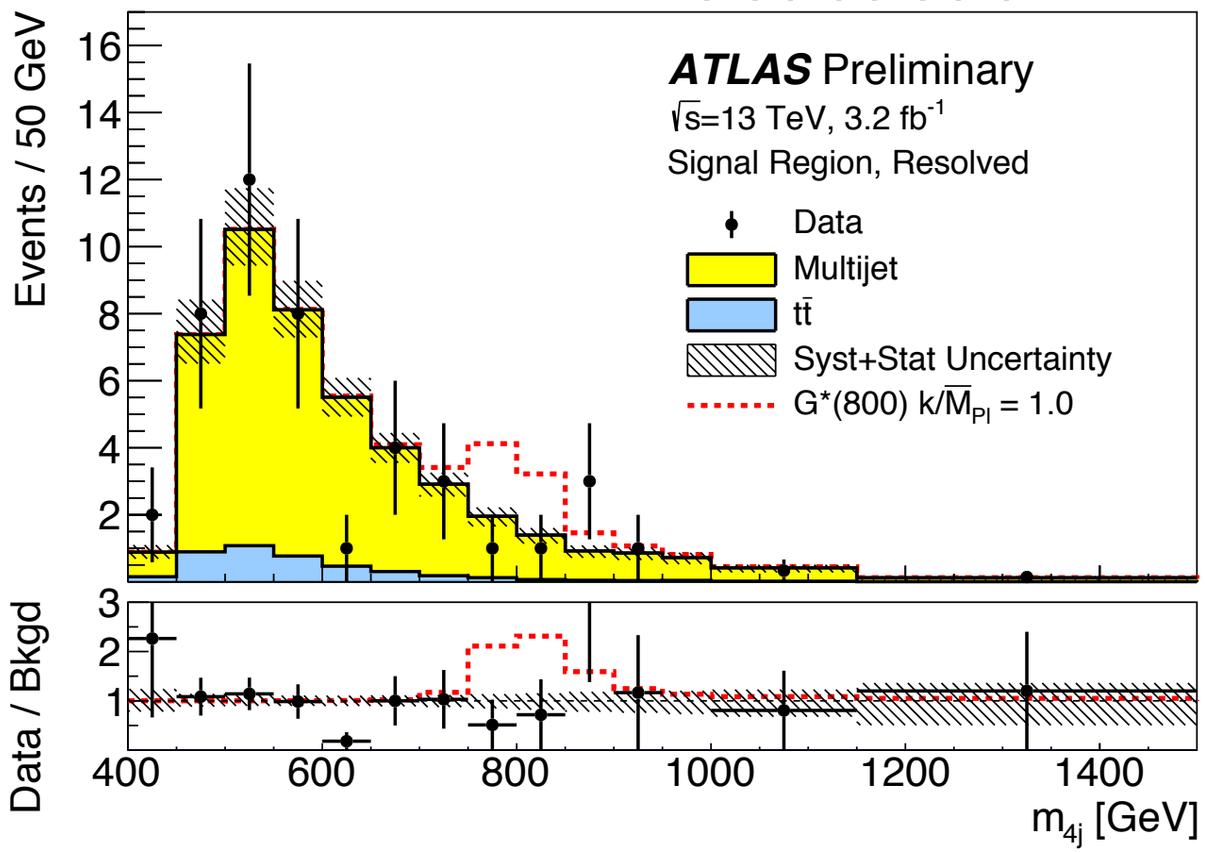
H → ZZ → ℓℓνν



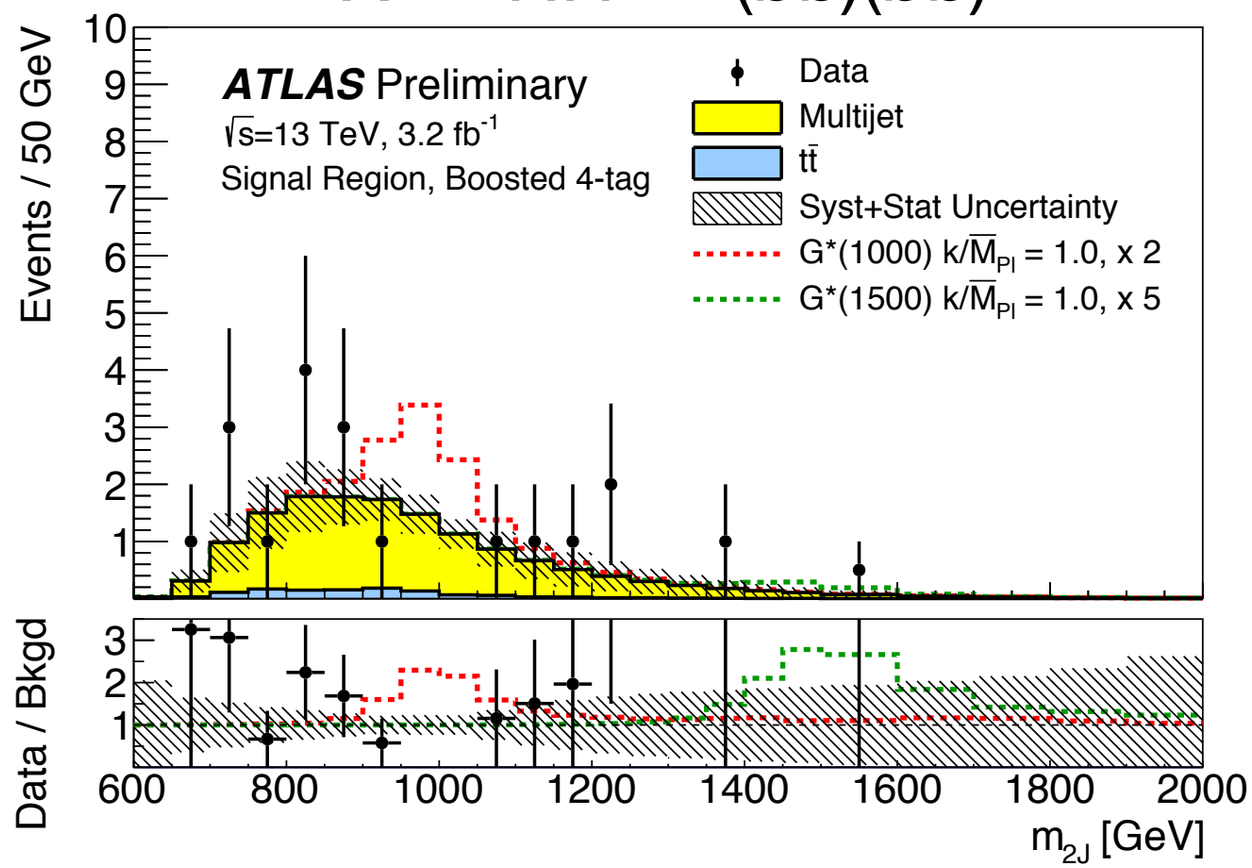
see dedicated talks tomorrow on VV / VH / HH resonances!

A / H / X → H(bb)H(bb)

X → HH → (b)(b)(b)(b)



X → HH → (bb)(bb)



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summary

summary

huge program of searching for new resonances at LHC

first year of 13 TeV data already exceeding Run 1 in high mass regime

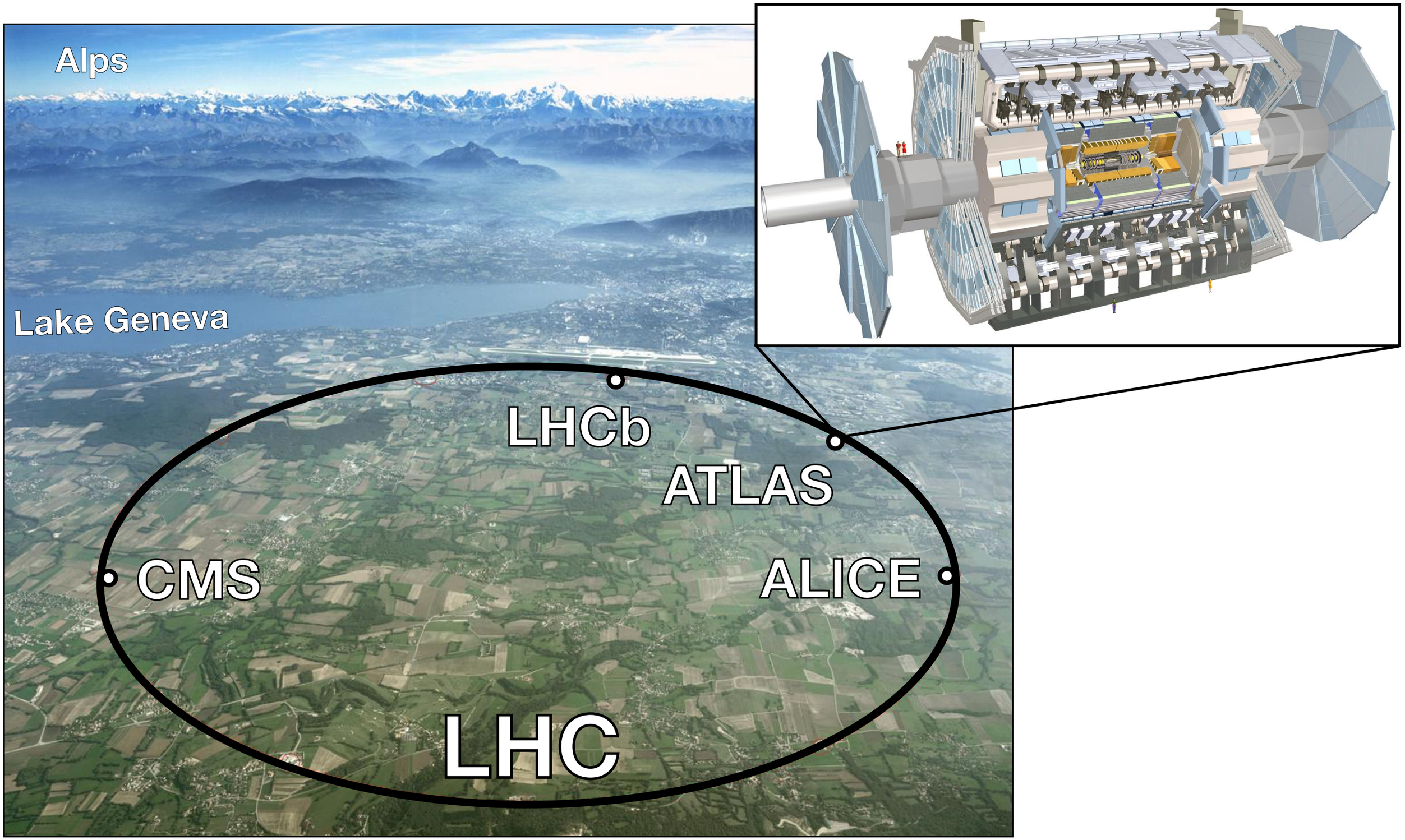
no hints of new physics in highlighted searches aiming at MSSM

bonus

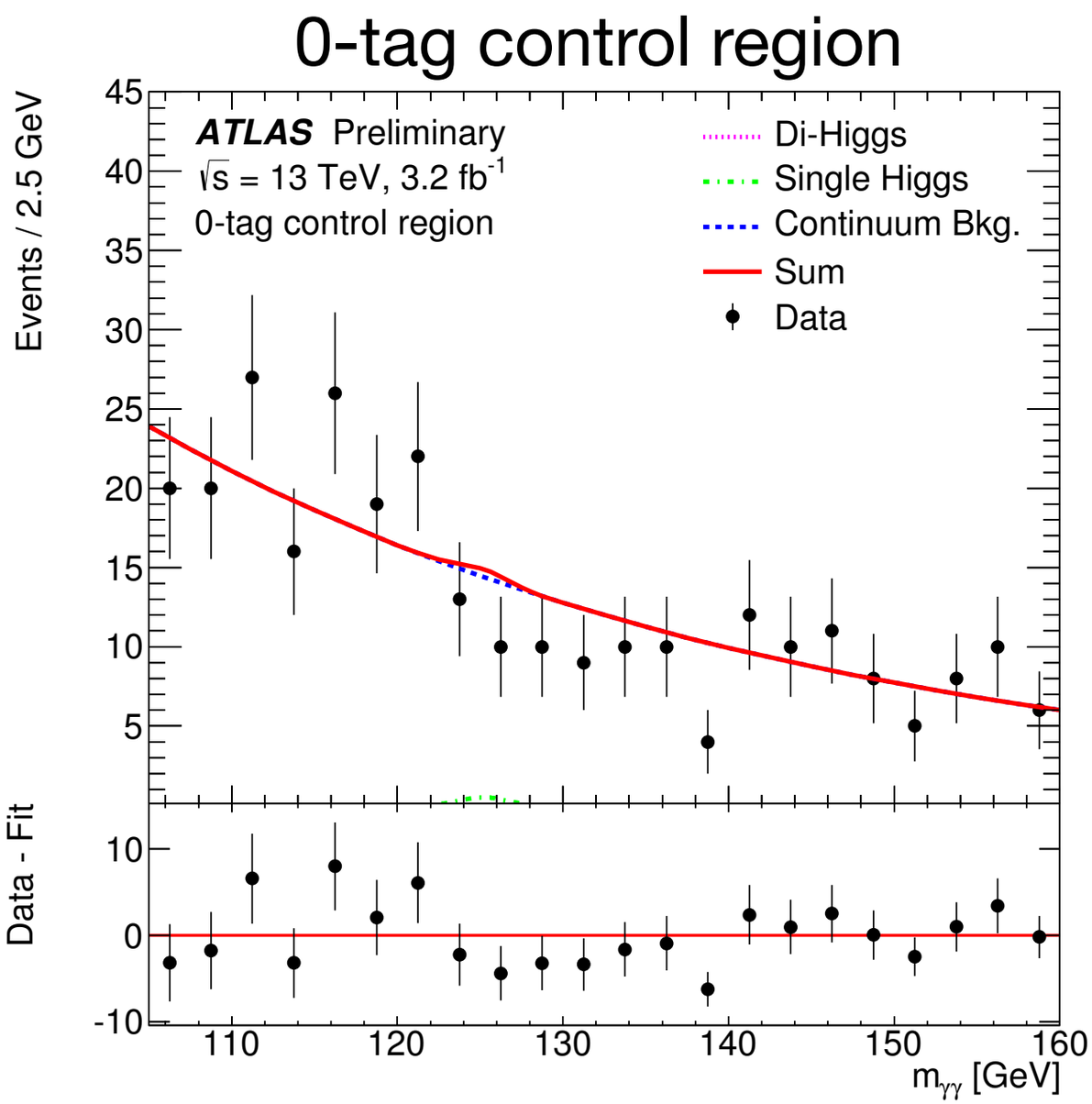
library

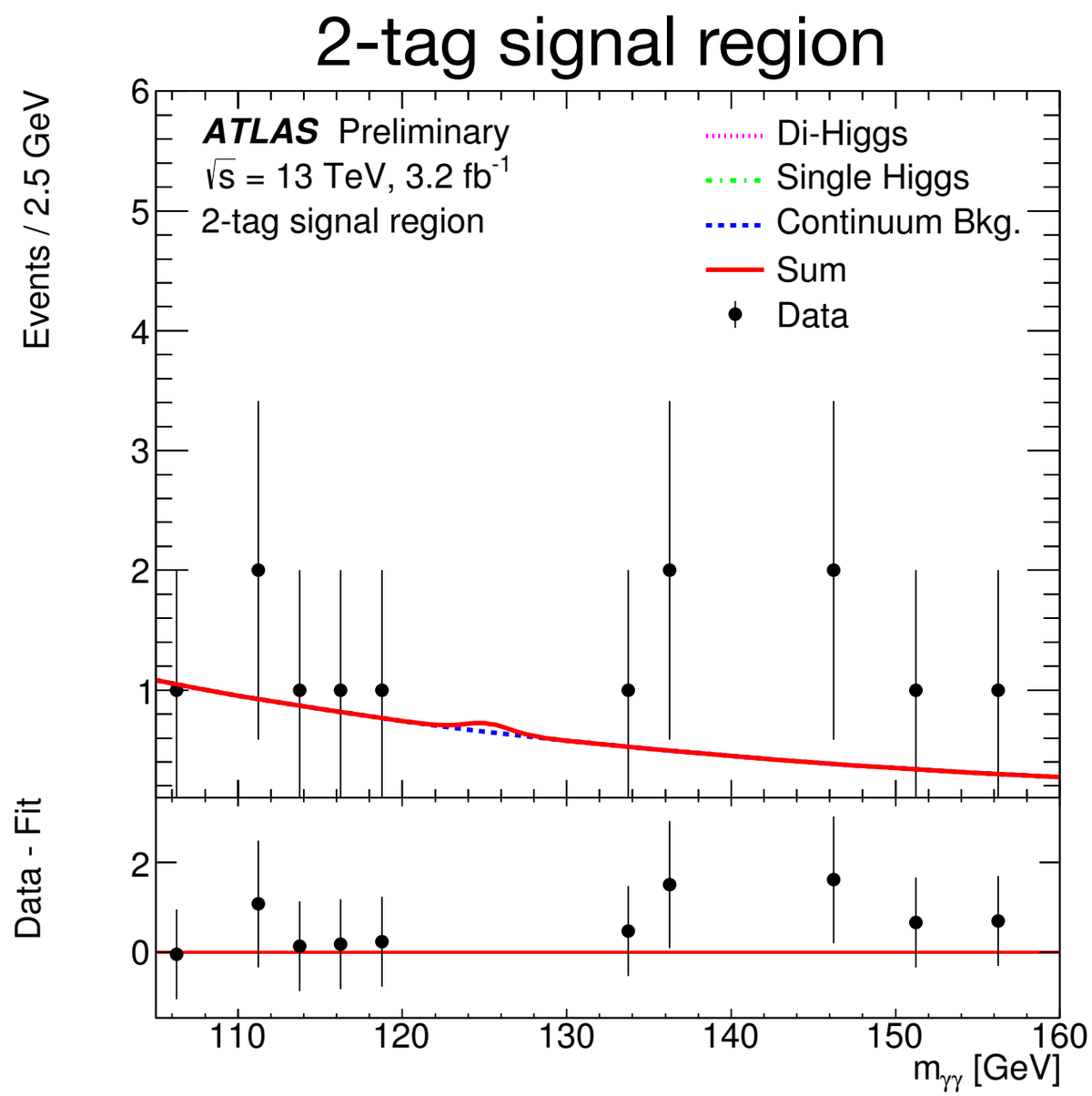
topic	preliminary or paper?	identifier
W(lν)W(lν or qq)	prelim.	ATLAS-CONF-2016-021
H(bb)H(bb)	prelim.	ATLAS-CONF-2016-017
Z(ll or νν)H(bb)	prelim.	ATLAS-CONF-2016-015
ττ	prelim.	ATLAS-CONF-2015-061
H(bb)H(γγ)	prelim.	ATLAS-CONF-2016-004
V(ll lν νν)H(bb)	prelim.	ATLAS-CONF-2015-074
H(4l) & H(γγ)	prelim.	ATLAS-CONF-2015-069
8 TeV combo	JHEP 11 (2015) 206	HIGG-2015-03

the LHC & ATLAS



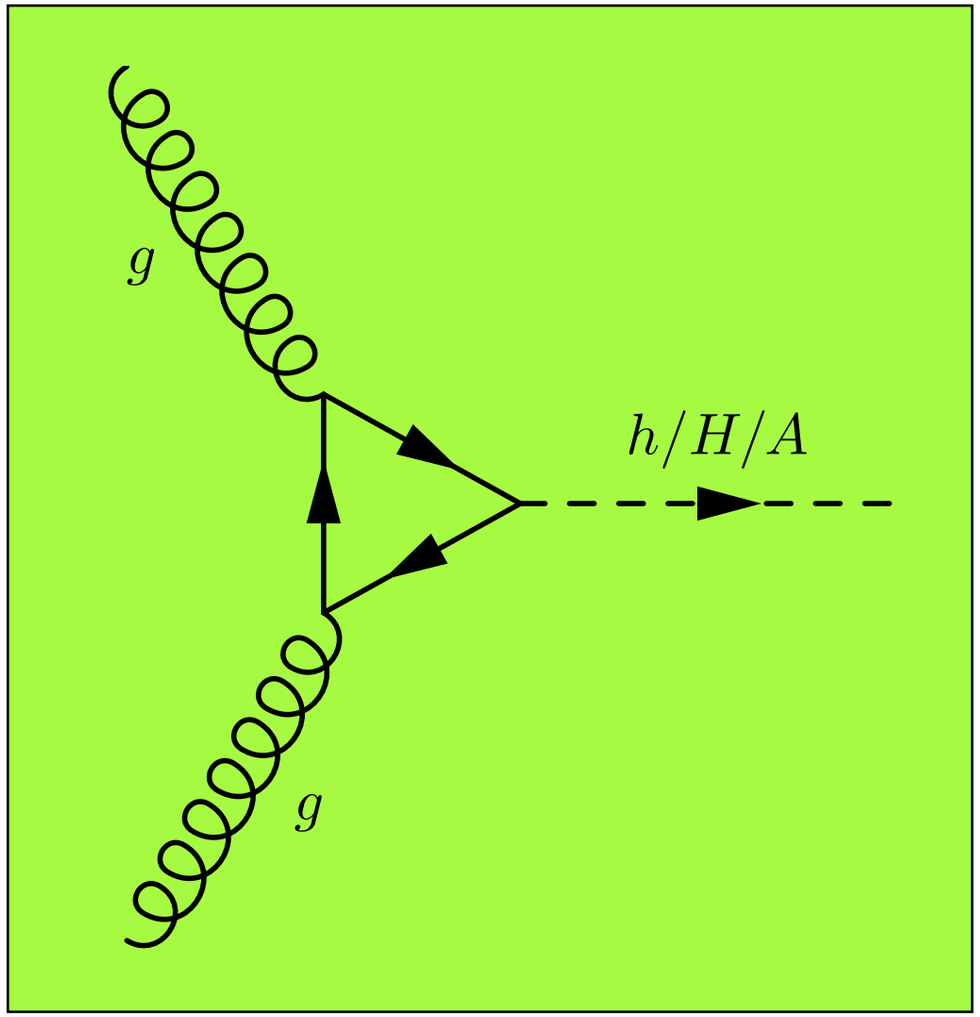
A / H / X → H(bb)H(γγ)

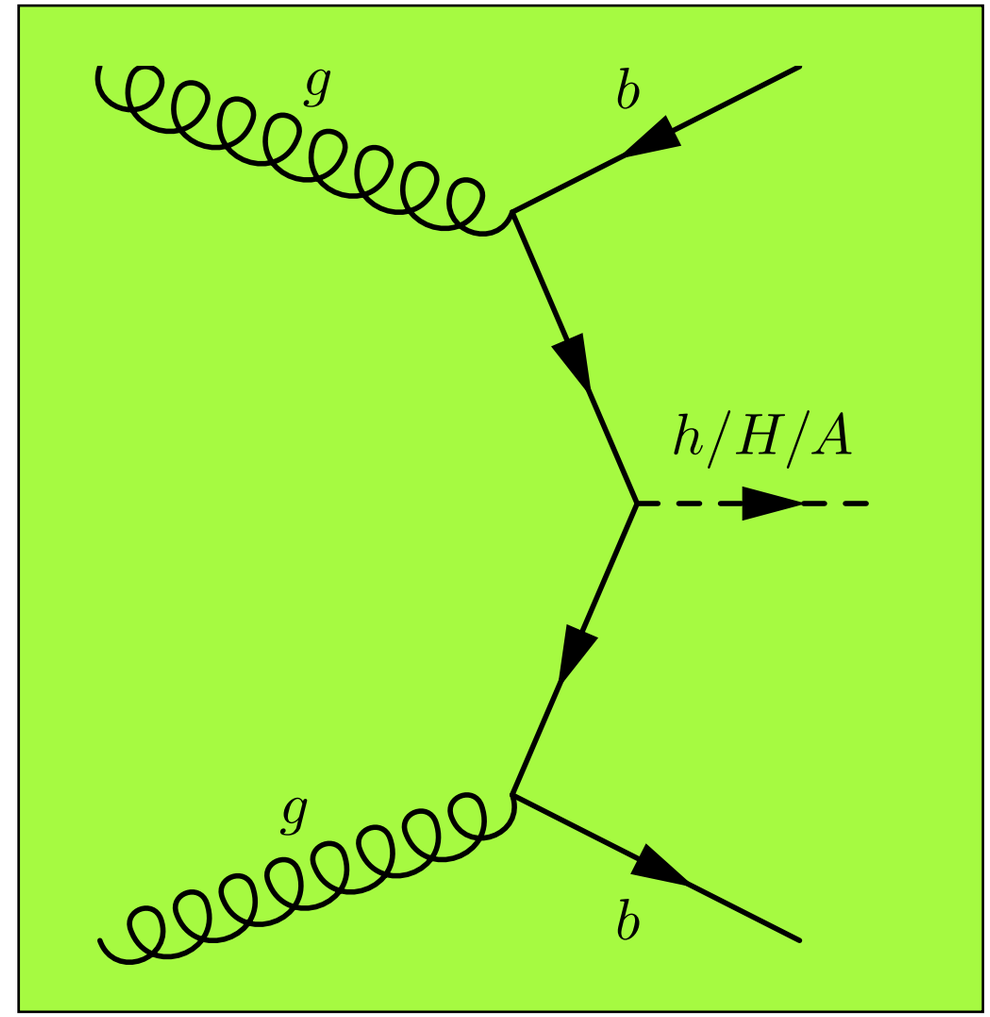




see dedicated talks tomorrow on VV / VH / HH resonances!

H / A → ττ





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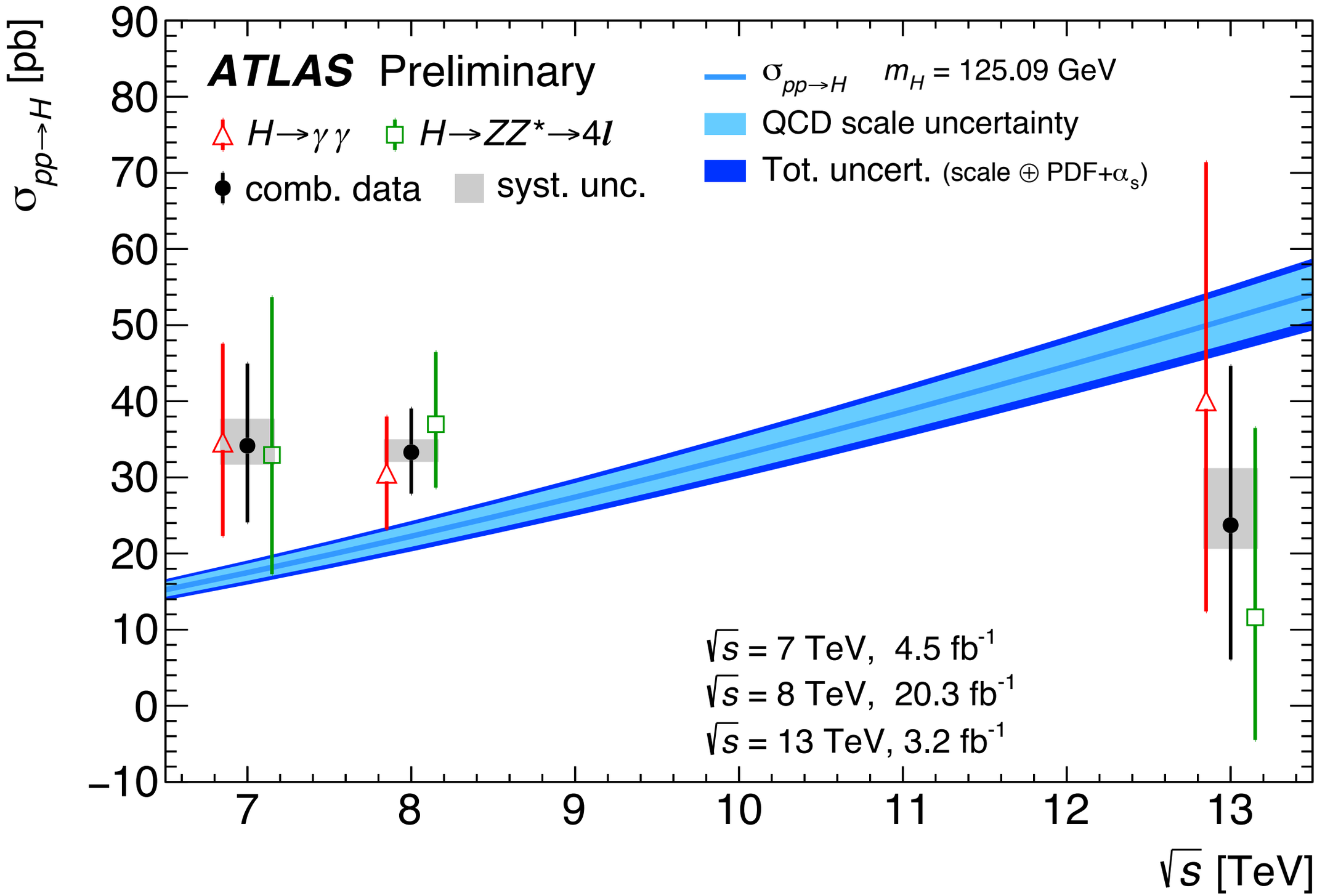
MSSM also likes *b*-associated

ATLAS Higgs 4ℓ & γγ