Searches for Neutral and Charged BSM Higgs Bosons with the ATLAS Detector

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on behalf of the ATLAS Collaboration

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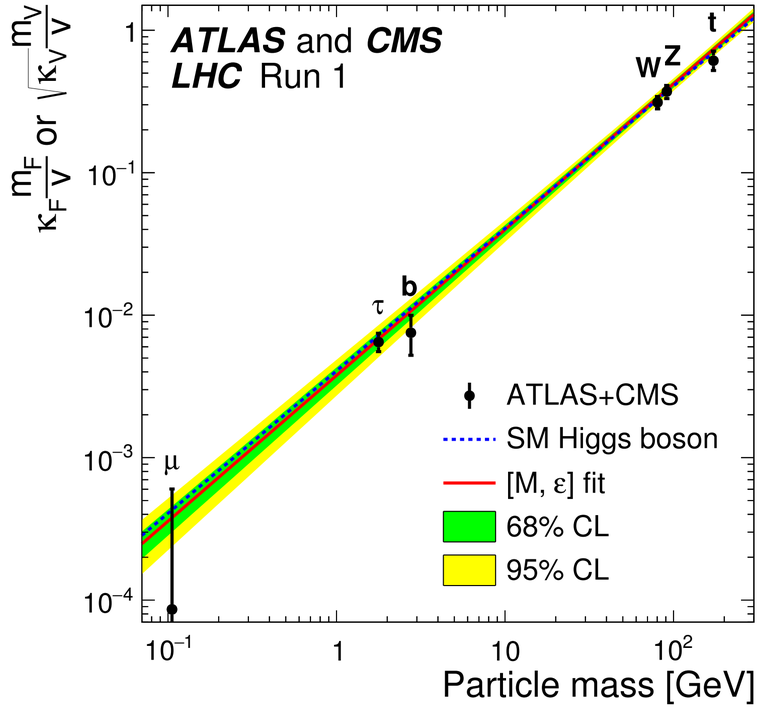
The BSM Higgs boson

So far…

- Higgs boson properties are consistent within uncertainties with those predicted by the Standard Model
- Consistency with SM doesn't exclude Beyond SM scenarios

Where can we look for BSM Higgs?

- Models with extended scalar sectors: MSSM, axions, etc.
- Searches for 125 GeV scalar can be adapted to lower and higher mass scenarios



Is the Higgs fundamental or composite?
Are there other Higgs bosons?
Origin of coupling to fermions?
Couplings to dark matter?

Plat du jour

- Results presented use the full 2015+2016 (36.1 fb^{-1}) *pp* collision dataset at 13 TeV
- Focus on scalar sector interpretations

Heavy neutral Higgs

- Di-photon resonances
- H—>ZZ/WW/ZW
- A—>Zh/ZH
- Higgs to fermions

Charged Higgs

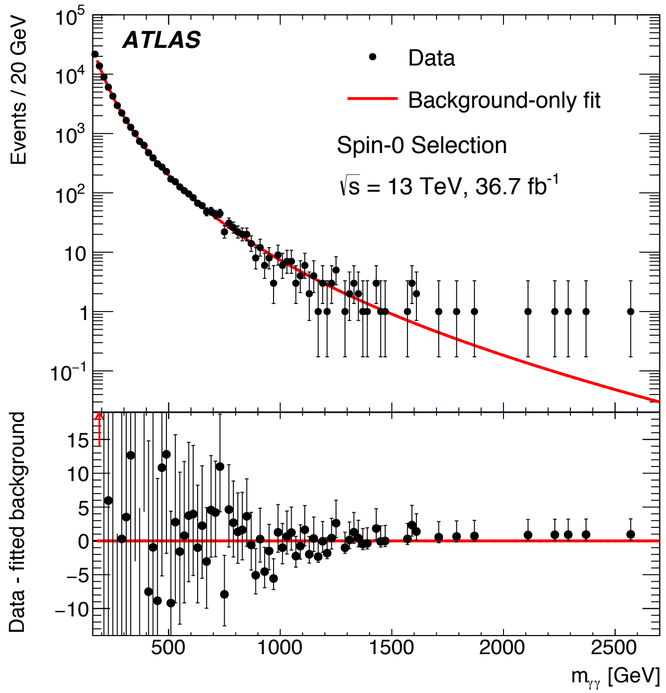
- $H^{\pm\pm} \rightarrow l^{\pm} l^{\pm}$

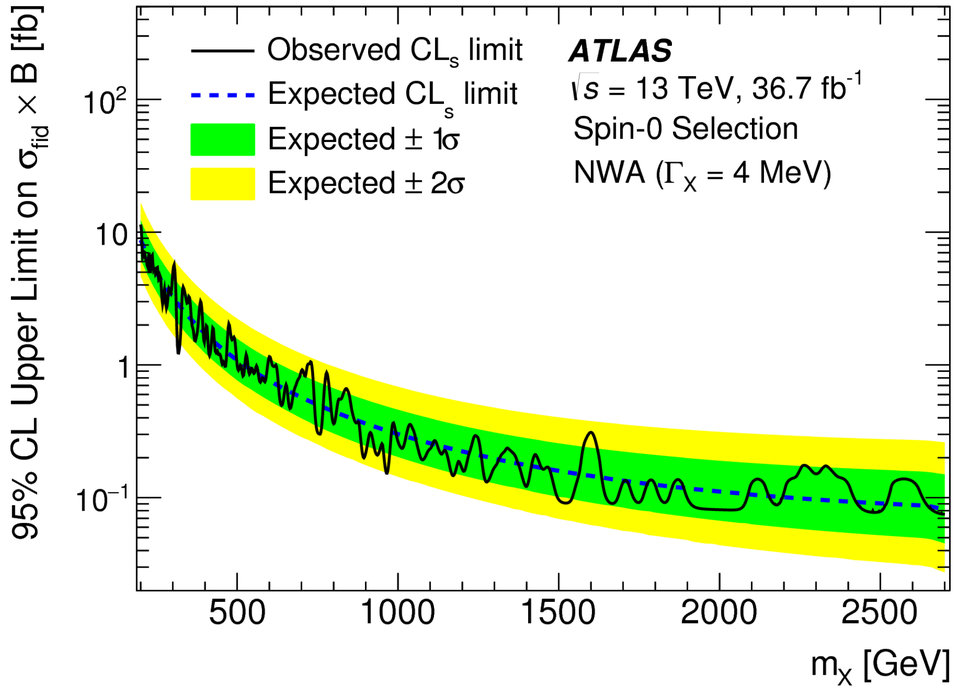
H—>γγ

Phys. Lett. B 775 (2017) 105

- Generic search for diphoton resonances across 200< $m_{\gamma\gamma}$ <2700 GeV and Γ_H = [0% - 10%]
- Search for two calorimeter and track isolated central photons

- No significant excess observed with respect to background-only hypothesis
- Upper limits on fiducial production cross section were obtained





H—>ZZ—>llqq/vvqq

JHEP 03 (2018) 009

Leptons+jets

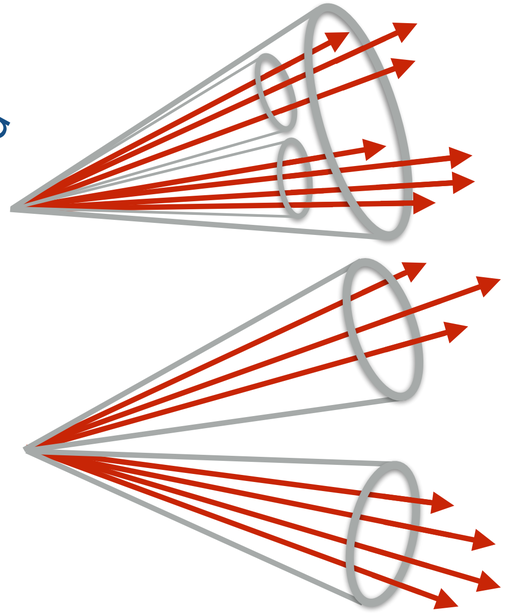
- Requirement of same-flavor calorimeter and track isolated lepton pair for Z boson selection
- Z—>qq is reconstructed using resolved and merged jets

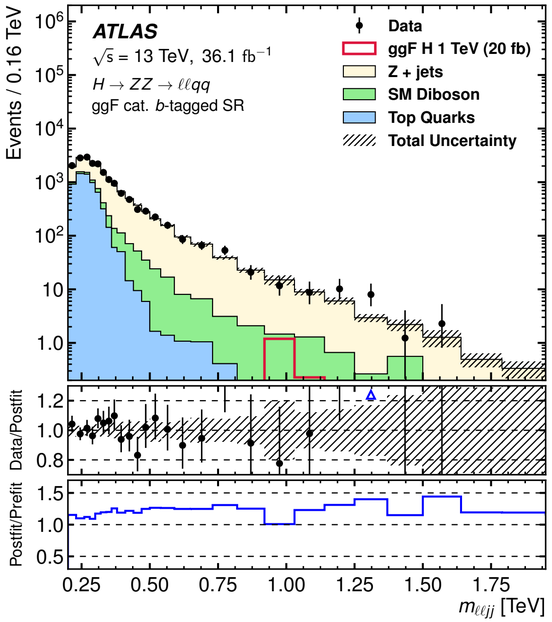
Missing E_T+ jets

- Missing transverse energy required in vvqq search
- Only boosted Z—>qq scenario considered in vvqq search

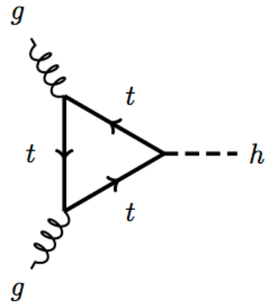
Boosted/ Merged

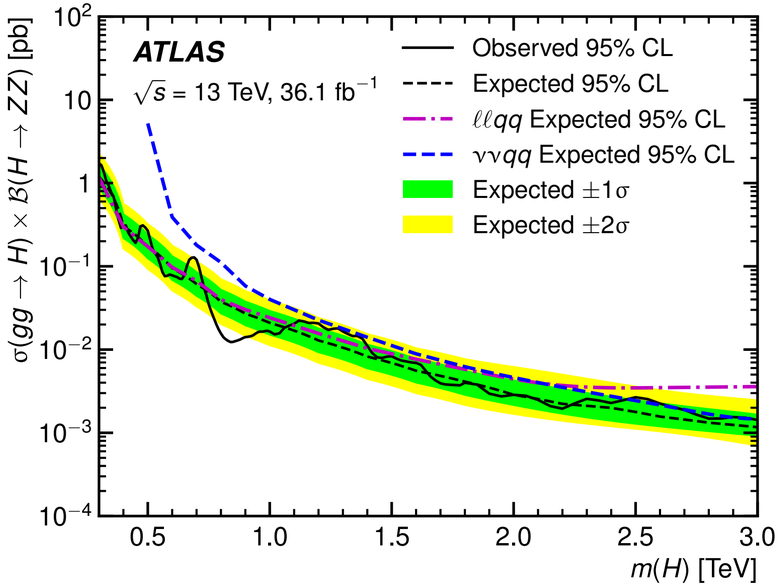
Resolved



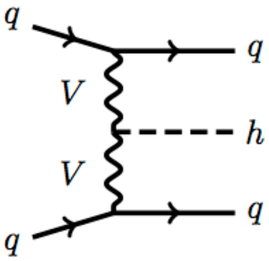


Gluon fusion

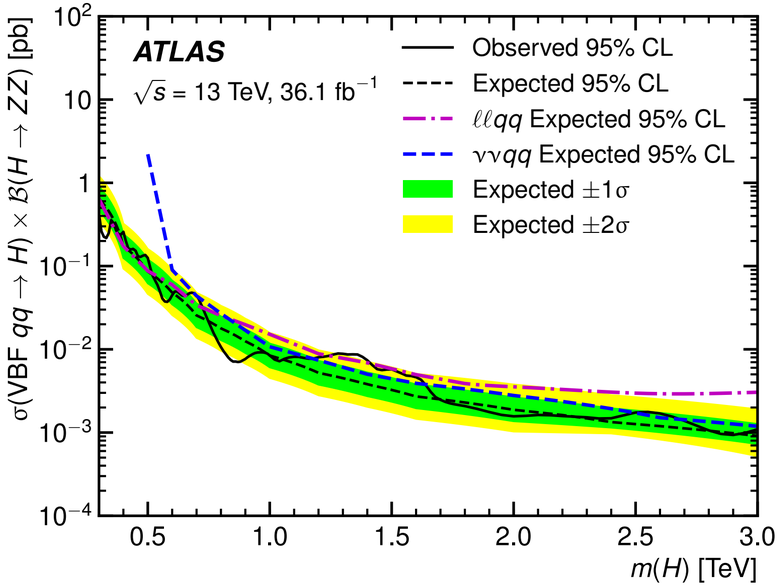




VBF



VBF tag-jets used for event classification



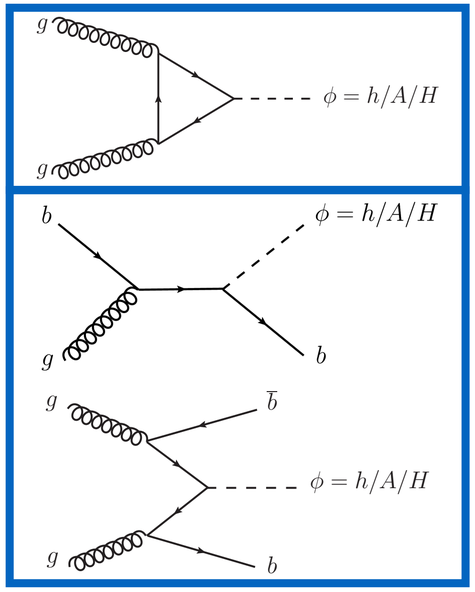
H—>WW—>lvqq

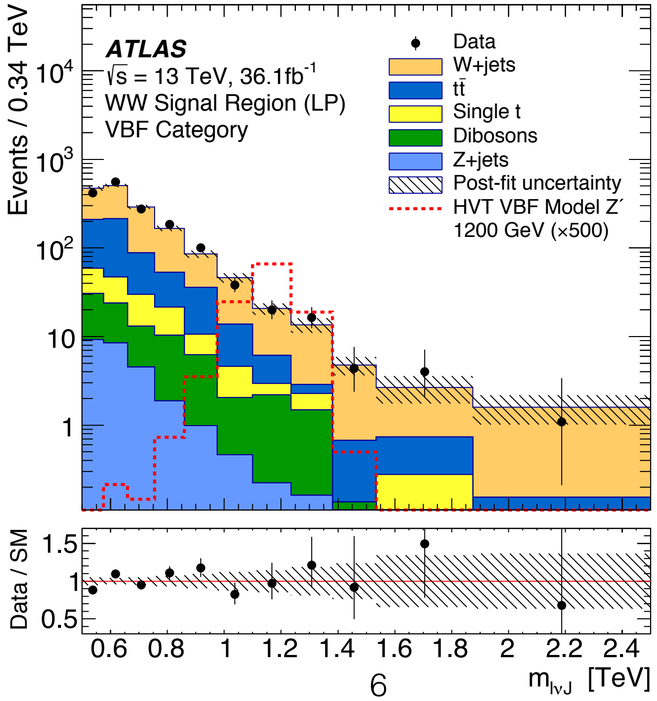
JHEP 03 (2018) 042

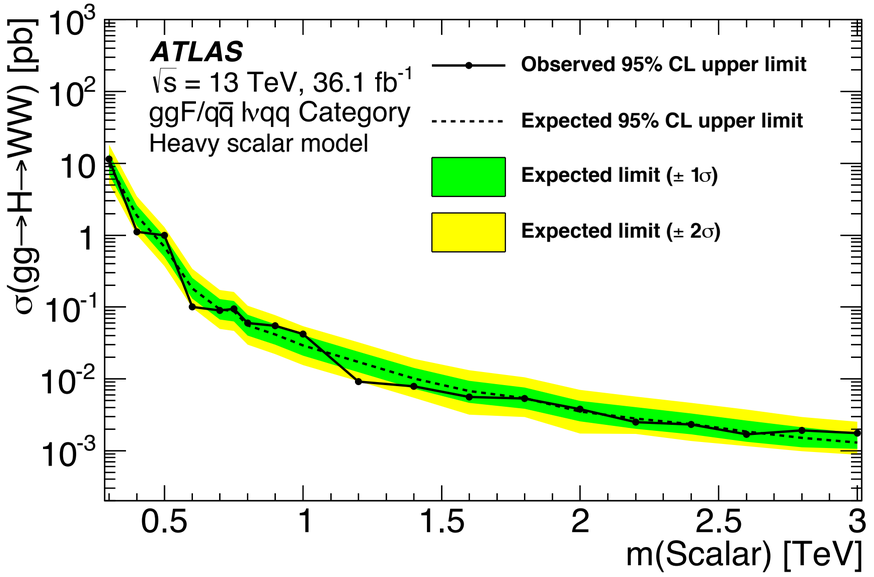
- Search for isolated lepton, missing transverse energy in association with jets
  - Merged and resolved regimes considered
- Combines track and calorimeter information for improved jet mass resolution
- Narrow width in range 300< m_H <3000 GeV interpretation considering gluon fusion/quark association and VBF production

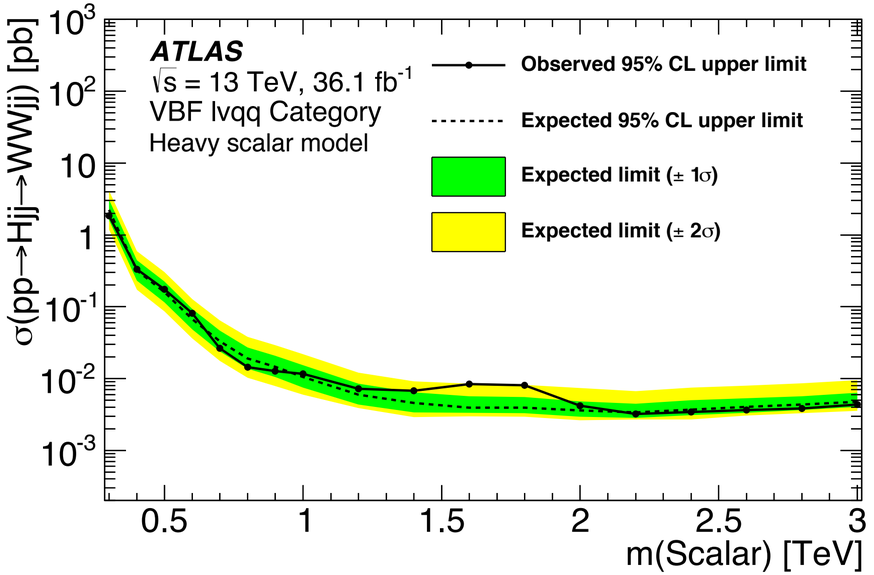
Gluon fusion

Quark association









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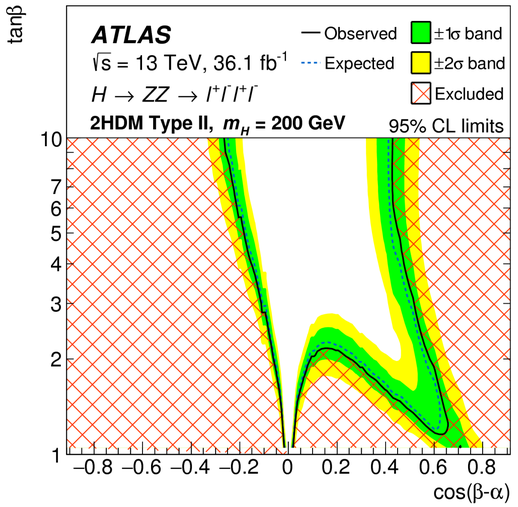
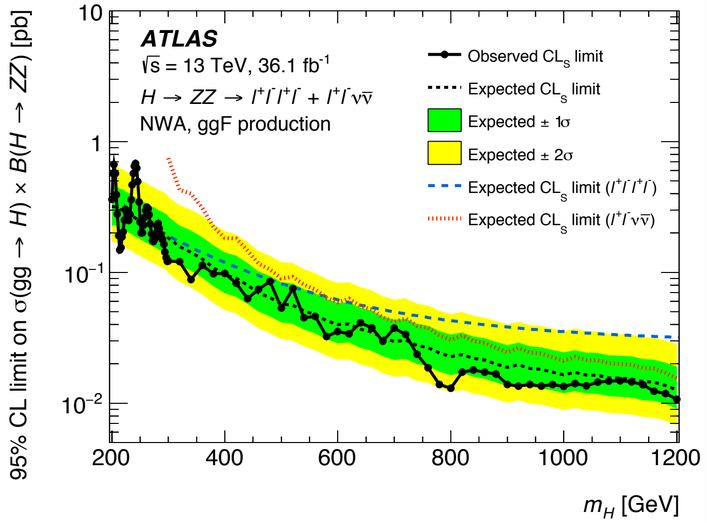
H—>WW/ZZ —> fully leptonic final states

H—>ZZ—>4l/llvv (Eur. Phys. J. C 78 (2018) 293)

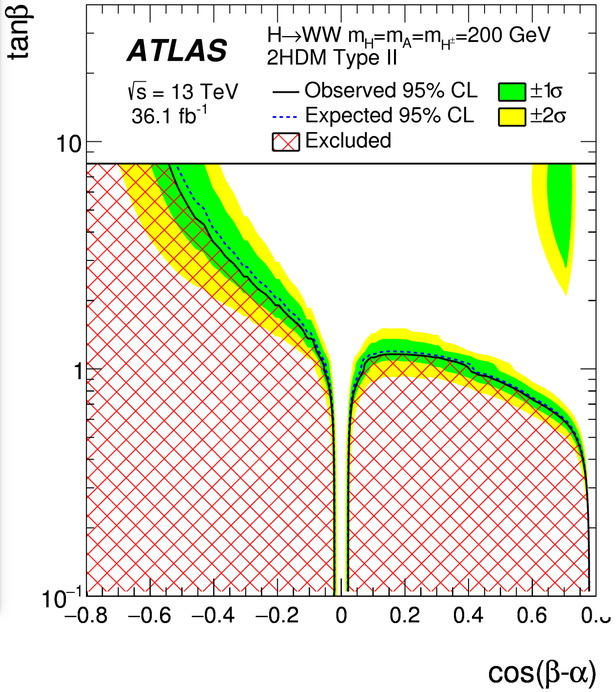
- Four leptons opposite-charge same-flavor lepton pairs are required in 4l channel
- Events with two same-flavor opposite-charge leptons are selected in association with missing E_T

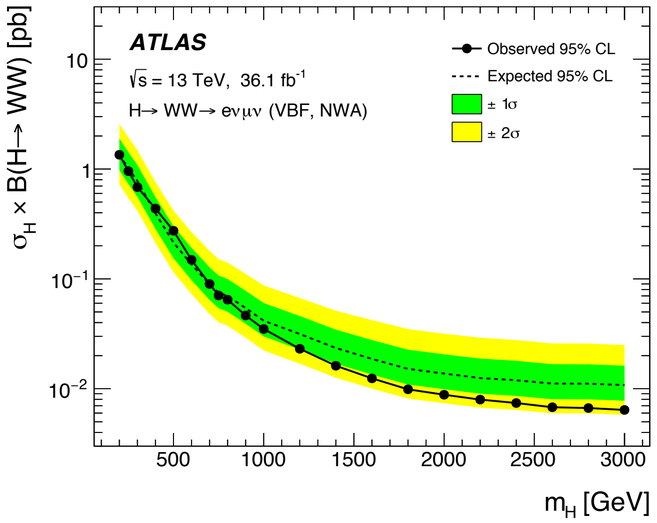




H—>WW—>evμv (Eur. Phys. J. C 78 (2018) 24)

- Events with two opposite-charge and different flavor leptons are selected
- Results are interpreted in the NWA, LWA, 2HDM and Georgi-Machacek (VBF production) models

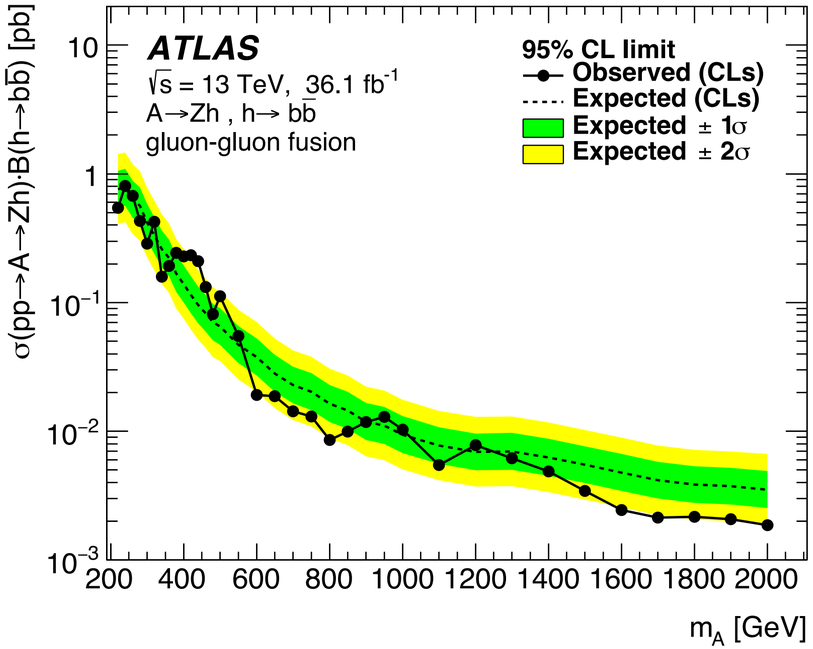


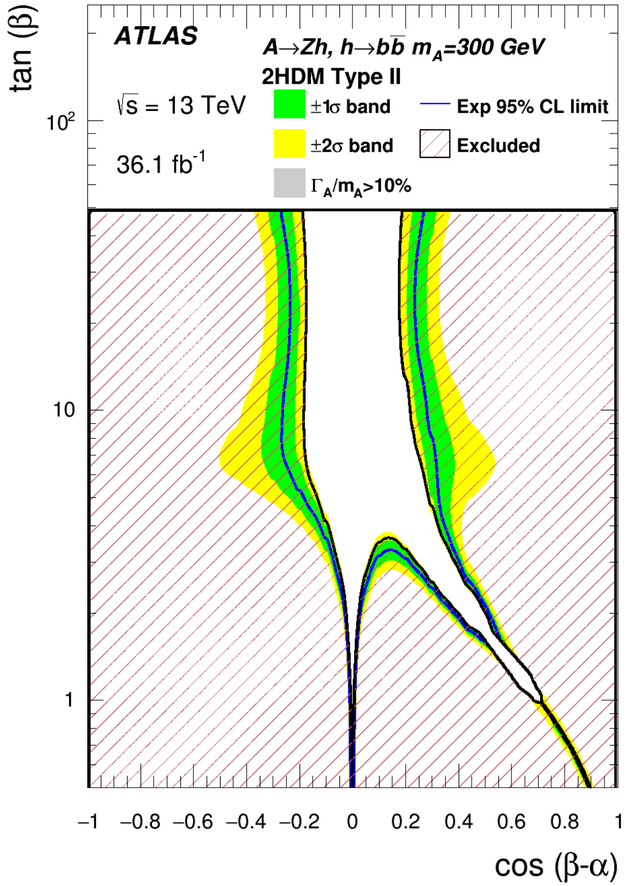


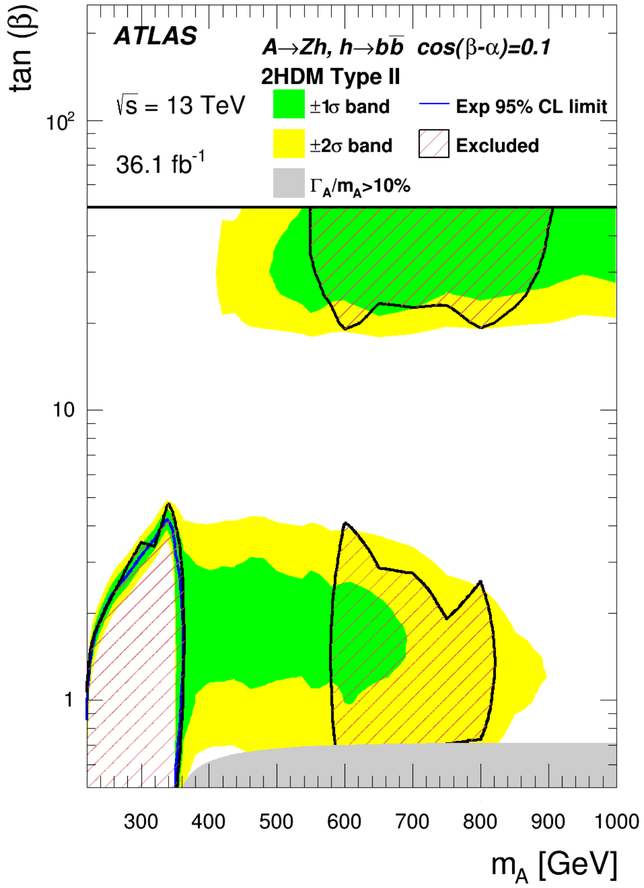
A—>Zh(bb)

JHEP 03 (2018) 174

- Search for same-flavor opposite-sign calorimeter and track isolated lepton pair or missing transverse energy in association with b-tagged jets
- Cross section limit results combine 0- and 2-lepton searches
- 2HDM exclusion results combine gluon fusion and b-associated production



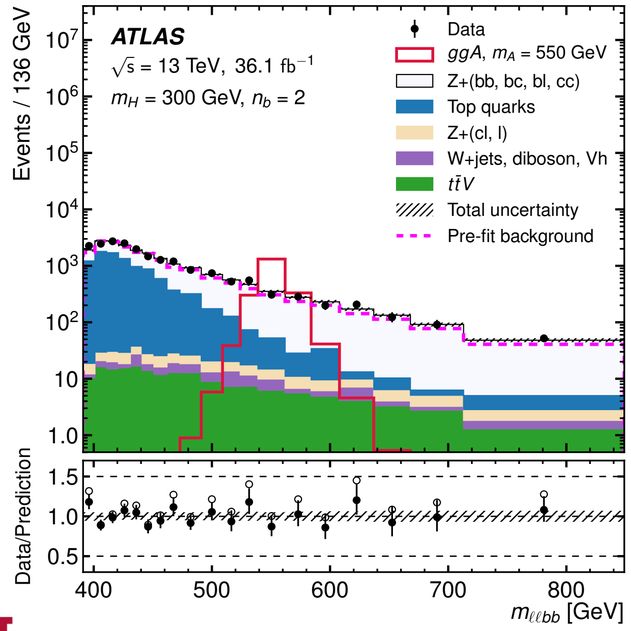


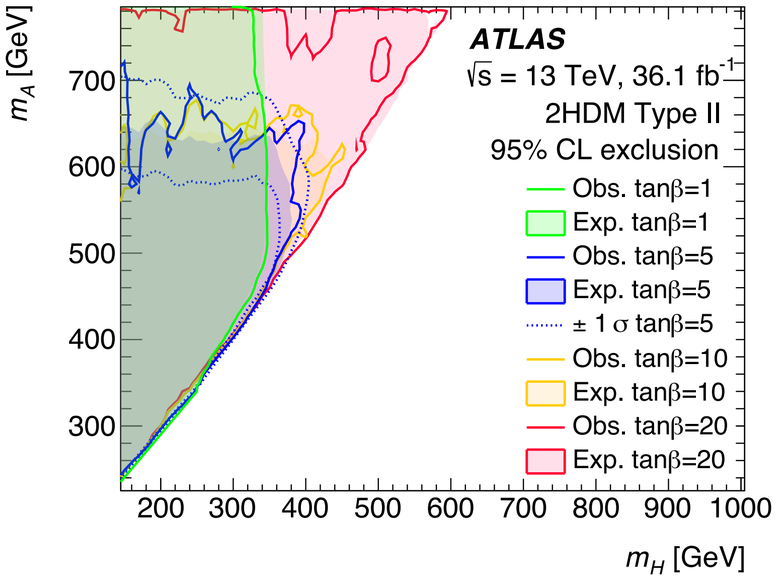


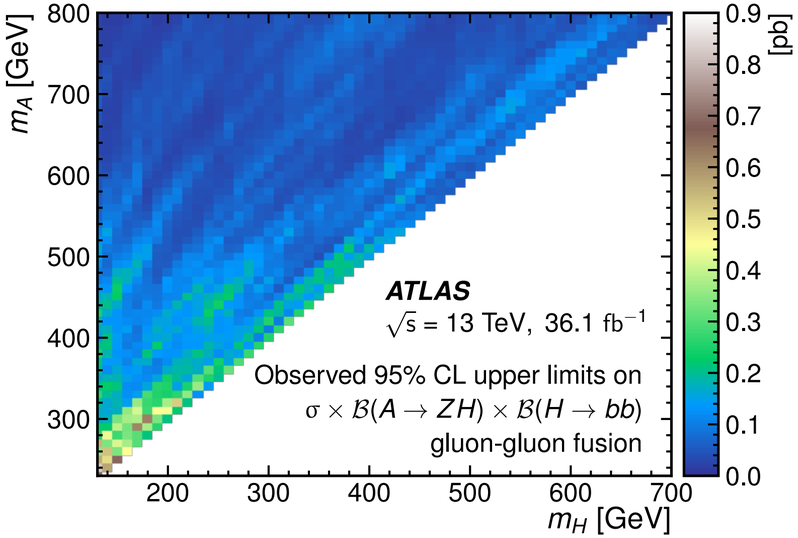
A—>ZH—>llbb

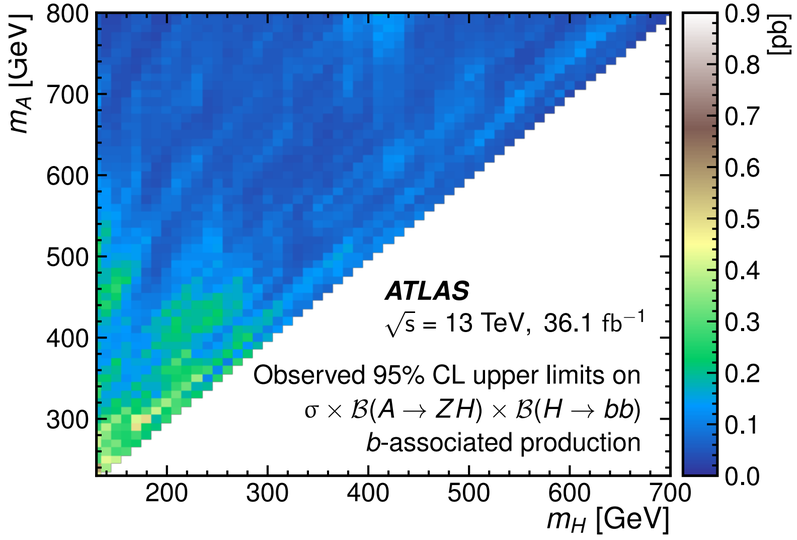
arXiv:1804.01126

- Electroweak baryogenesis scenarios in 2HDM require that $m_A > m_H$
- Search for same-flavor lepton pair in association with b-tagged jets
- Additional b-tagged jets can be found if A boson is produced through b-associated production
- Results are interpreted individually for gluon-gluon fusion and b-associated production





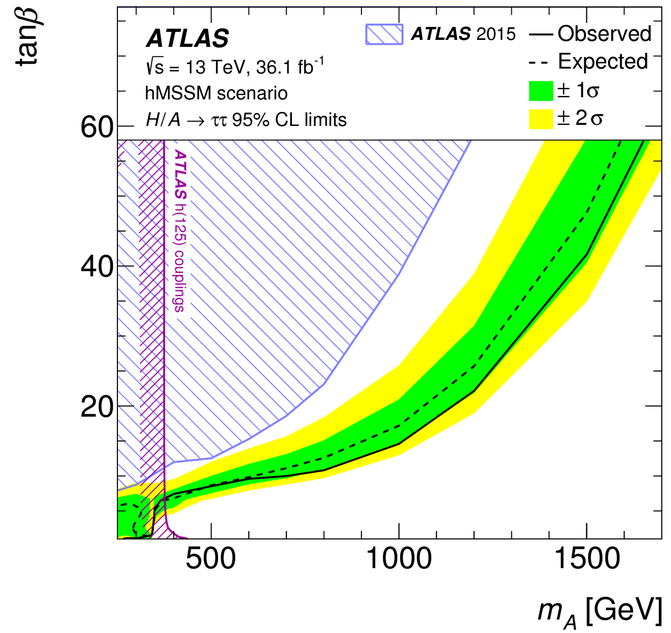


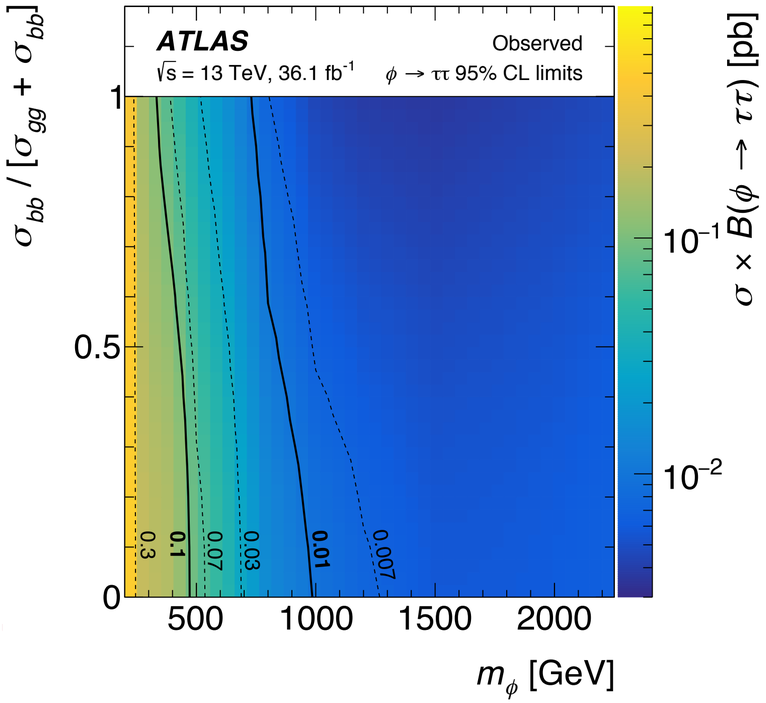


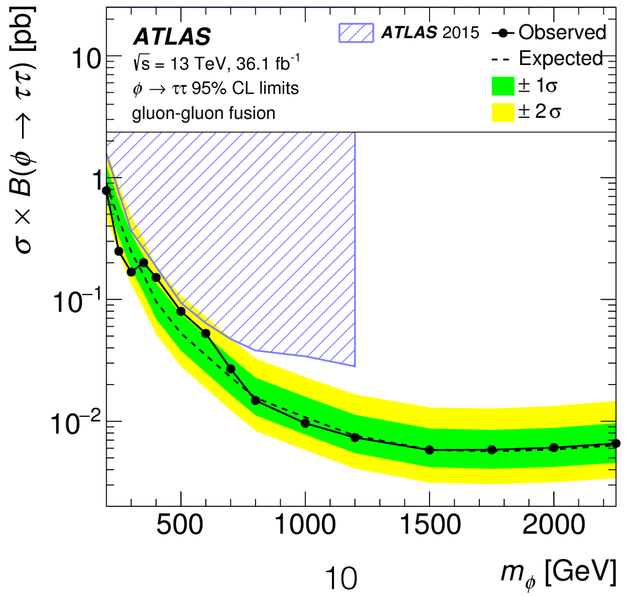
A/H—>ττ

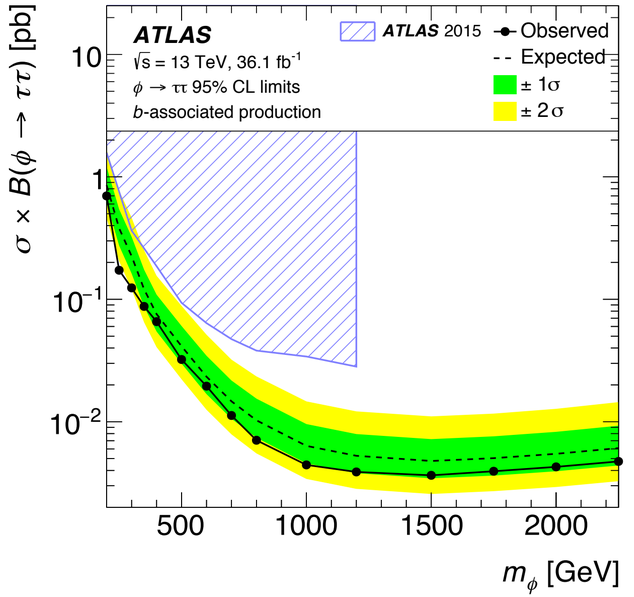
JHEP 01 (2018) 055

- Search for ττ resonances across 200< $m_{ττ}$ < 2250 GeV
- Gluon fusion and b-associated production considered
- $\tau_{had}\tau_{had}$ and $\tau_{lep}\tau_{had}$ decay modes considered
- Results interpreted in the context of MSSM
  - Narrow resonances in the parameter space scanned







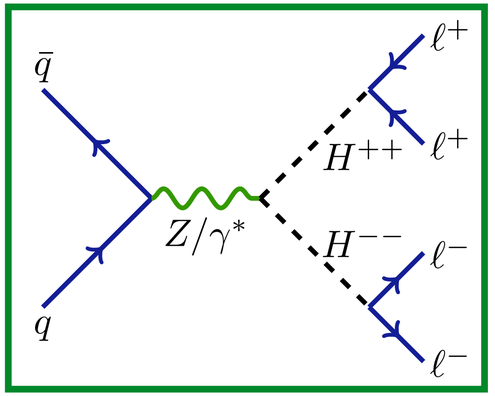


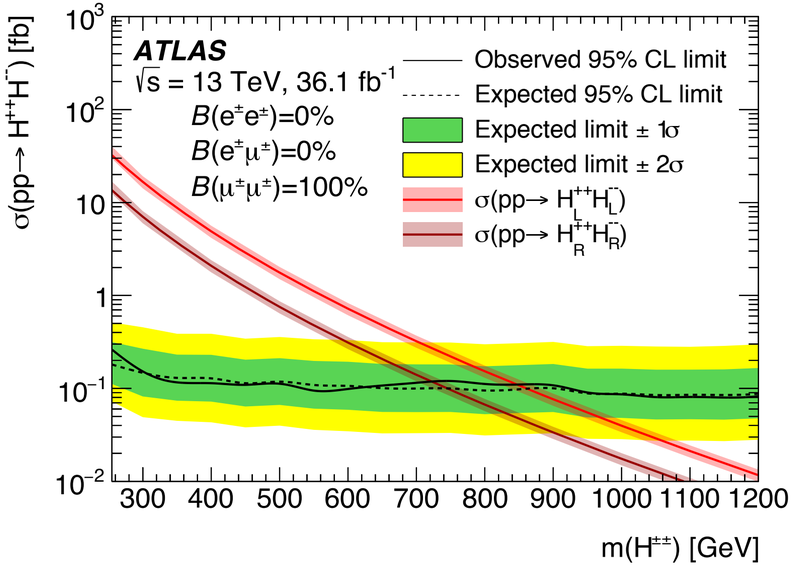
acino

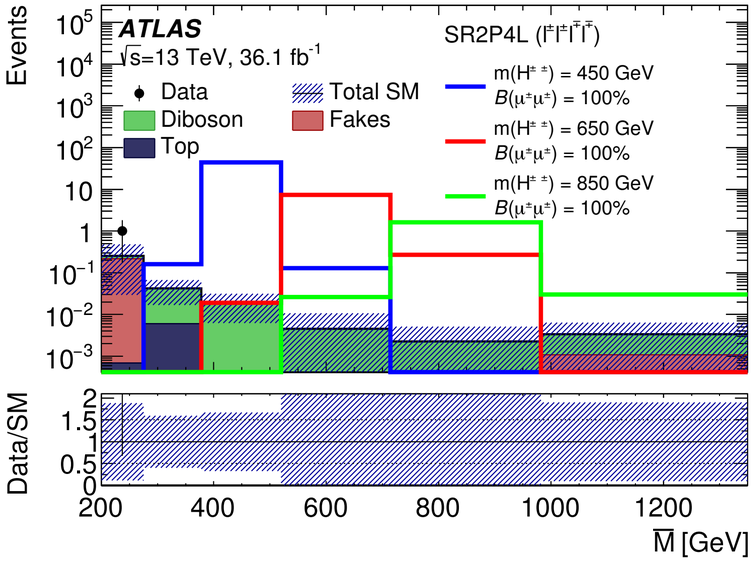
$H^{++} \rightarrow l^{+}l^{+}$

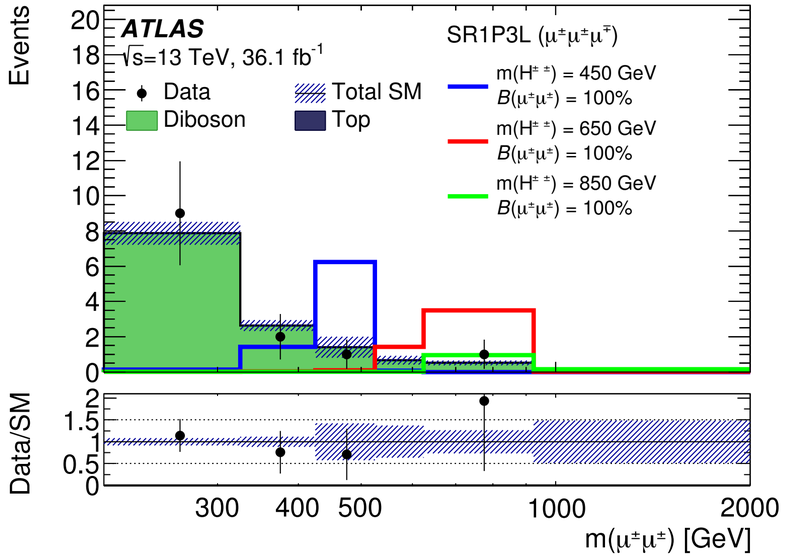
Eur. Phys. J. C 78 (2018) 199

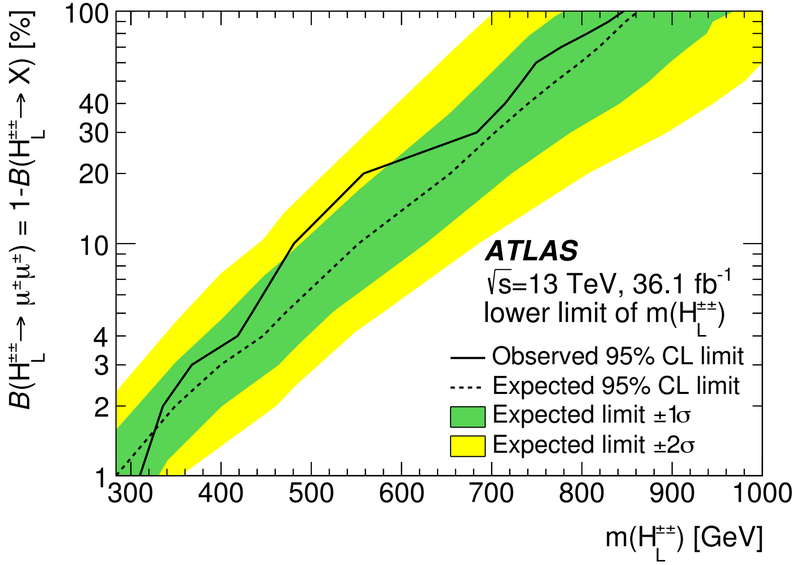
- Pair production model assumed
- Search for **same-sign** isolated lepton pairs in range 250 < m_{ll} <1200 GeV
- Considers 2, 3 and 4-lepton categories.
- Results interpreted in context of Left-Right Symmetric Model







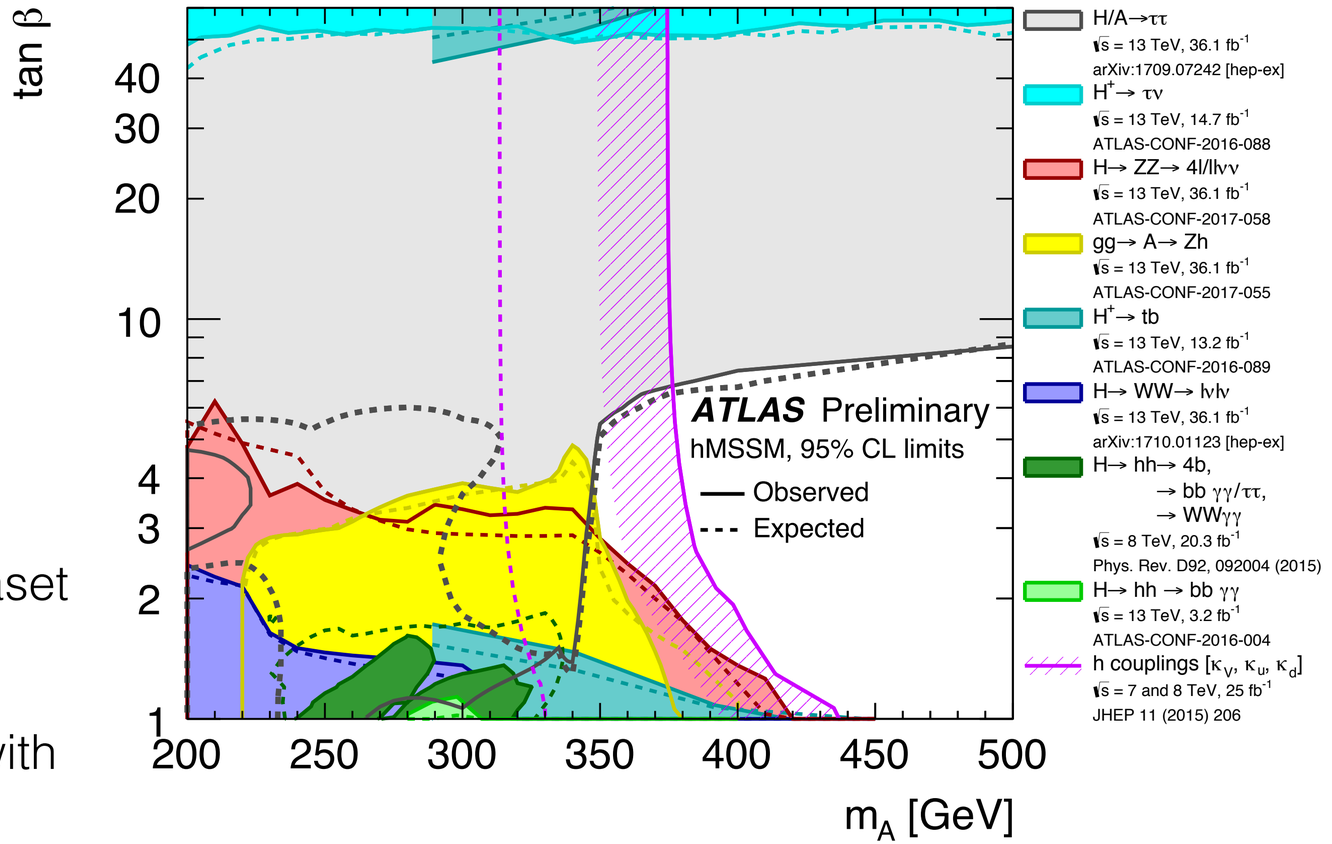




Summary and outlook

Summary

- Large number of searches performed with ATLAS
- Results from 13 TeV show agreement with Standard Model
- More results at https://twiki.cern.ch/twiki/bin/view/AtlasPublic

What's next?

- Expect more updates with full 2015+2016 13 TeV dataset
- Range of signatures expanded: new results to come.
- Many analyses will have greatly improved sensitivity with the addition of 2018 data