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

Gabriel Palacino
on behalf of the ATLAS Collaboration

Pheno 2018
University of Pittsburgh

May 8, 2018
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.
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
- $H \rightarrow ZZ/WW/ZW$
- $A \rightarrow Zh/ZH$
- Higgs to fermions

**Charged Higgs**
- $H^{\pm \pm} \rightarrow \ell^+ \ell^-$
\[ H \rightarrow \gamma\gamma \]


- Generic search for diphoton resonances across 200 < m_{\gamma\gamma} < 2700 GeV and \( \Gamma_H = [0\% - 10\%] \)
- 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
• Requirement of same-flavor calorimeter and track isolated lepton pair for Z boson selection
• Z→qq is reconstructed using resolved and merged jets
• Missing transverse energy required in vvqq search
• Only boosted Z→qq scenario considered in vvqq search

ATLAS
√s = 13 TeV, 36.1 fb⁻¹

H→ZZ→llqq/νν

VBF

Gluon fusion

VBF tag-jets used for event classification
H→WW→ℓνqq

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- 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
- 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}

- 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
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
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

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

• 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