Weekly meeting

Qi Li

Monday, April 11, 2016

Event Selection

- Start with the $\gamma\gamma$ selections
- At least one lepton
- B-veto
  - To reject events once there is ≥ 1 b-jet
  - B-tag Working point: MV2c20_FixedCutBEff_85
  - Tight mass window: $\left|\mathrm{m}_{\gamma\gamma} - 125.09\right| < 2\sigma$
- Missing ET Significance: ${E_T}^{miss} \Big/ \sqrt{\sum(E_T)} > 1$
- Here, the $pT(leptons) \geq 10.7\ GeV$

ϵ	SM Higgs Pair
Generated	100%
Trigger	74.2%
GRL	74.2%
Detector DQ	74.2%
has PV	74.2%
2 loose photons	59.7%
e-y ambiguity	59.1%
tight ID	49.1%
Isolation	43.0%
rel.Pt cuts	39.4%
mass γγ cut	39.2%
At least two jets	34.8%
At least one lepton	16.7%
B-veto	13.4%
Tight mass Window	11.1%
MET significance	9.5%

Optimization

- $pT(leptons) \geq 10.7\ GeV$
- $MET\ significance \geq 1$
- $Z(max) = \sqrt{2[(S+B) \times ln\left(\frac{S+B}{B}\right) - S]} = 0.15$
- *Keep at least 80 % signal*

Process	Events Yield (3.2 fb^{-1}, $\sigma = 1$pb)
smhh	0.14
continuum	0.64
ttH	0.039
ggH	Negligible (0.00020)
VBF	Negligible (0.0080)
WH	0.098
ZH	0.028

Expected limits (asymptotic)
+2sigma: 55.4549
+1sigma: 35.3523
-1sigma: 16.7865
-2sigma: 12.5039
Median: 23.2966

Event Yield

- $pT(leptons) \geq 10\ GeV$
- $MET\ significance \geq 2.6$
- $Z(max) = \sqrt{2[(S+B) \times ln\left(\frac{S+B}{B}\right) - S]} = 0.14$

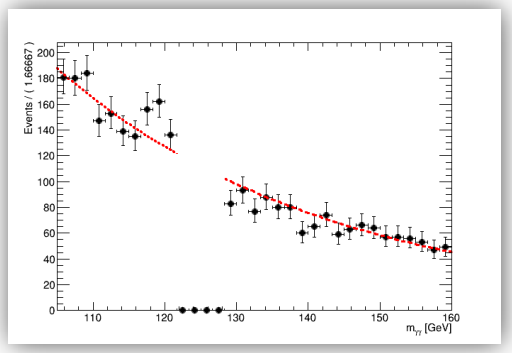
Process	Events Yield (3.2 fb^{-1}, σ = 1pb)	Events Yield (3.2 fb^{-1}, σ = 4pb)	Events Yield (20.3 fb^{-1}, σ = 1pb)	Events Yield (20.3 fb^{-1}, σ = 4pb)
smhh	0.077	0.31	0.49	1.9
continuum	0.16	0.16	1.0	1.0
ttH	0.031	0.031	0.20	0.20
ggH	Negligible (0.00014)	Negligible (0.00014)	Negligible (0.00090)	Negligible (0.00090)
VBF	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)
WH	0.060	0.060	0.38	0.38
ZH	0.010	0.010	0.062	0.062

The sensitivity

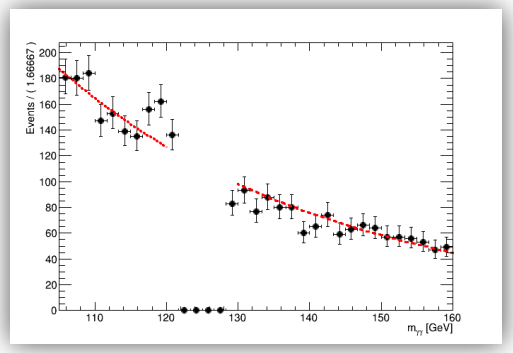
- $Z = \sqrt{2[(S+B) \times ln\left(\frac{S+B}{B}\right) - S]} = 0.14$
  - If set the $L = 13.2\, fb^{-1},\ \sigma = 1\text{pb}, Z = 0.29$
  - If set the $L = 20.3\, fb^{-1},\ \sigma = 1\text{pb}, Z = 0.36$
- Expected limits (without sys/asymptotic)
  - assume the $L = 3.2\, fb^{-1},\ \sigma = 1pb$
  - Median: 32.9138
  - assume the $L = 3.2\, fb^{-1},\ \sigma = 4pb$
  - Median: 8.18045
  - assume the $L = 20.3\, fb^{-1},\ \sigma = 1pb$
  - Median: 8.07241
  - assume the $L = 20.3\, fb^{-1},\ \sigma = 4pb$
  - Median: 2.06544/ 2.36048 (with ATLAS_STAT_continuum = 100%)
- Run1 results ($20.3 fb^{-1}, \sigma(pp \to hh) = 1pb$)
  - Median: 6.66

Continuum Background Estimation – Validation of $\epsilon^{B}_{\gamma\gamma}$

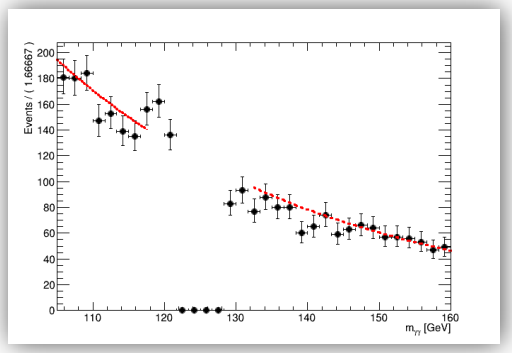
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(e^{ax}) = 0.1380$
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(120-130) = 0.1380$
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(117.5-132.5) = 0.1380$
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(e^{ax+bx^2}) = 0.1295$
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(lvjj\gamma\gamma) = 0.1364$
$\epsilon^{\mathrm{B}}_{\gamma\gamma}(\gamma\gamma jj) = 0.1363$



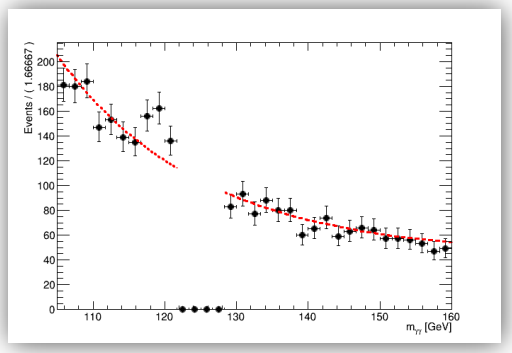
The efficiency $\epsilon^{B}_{\gamma\gamma}$ using e^{ax} for continuous background extracted with 2jets+2photons +0lepton events



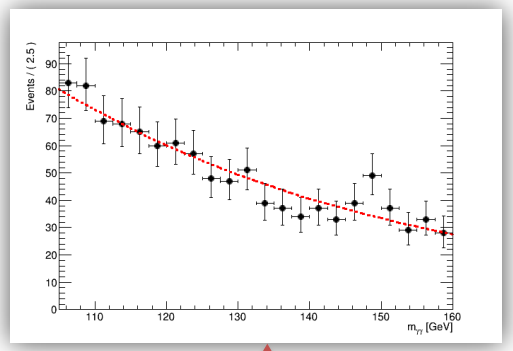
$m_{\gamma\gamma}$ fit with the window from 120 GeV to 130 GeV



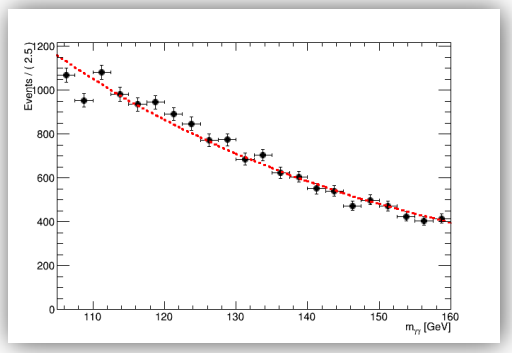
$m_{\gamma\gamma}$ fit with the window from 117.5GeV to 132.5 GeV



The efficiency $\epsilon^{B}_{\gamma\gamma}$ using e^{ax+bx^2} for continuous background extracted with 2jets+2photons+0lepton events



The invariant mass distributions in SM $lv\gamma\gamma jj$ MC samples



The invariant mass distributions in SM $jj\gamma\gamma$ MC samples

$pT \geq 10.7\ GeV;$
$Met\ significance \geq 1$

Summary

- Quit generating the $l\nu\gamma\gamma$ sample
- Systematics

- The last schedule
  - Get the BKG yields directly by calling the lumiXsecWeight (), the code only run on the MAOD