$hh \rightarrow WW\gamma\gamma$

Qi Li

Monday, July 04, 2016

Introduce

- Check the effect from the sizeable fake photons while fitting to $m(\gamma\gamma)$
- Check fitting to the sideband CR with exponential with 2nd order term and the fitting to the sideband
- Check the mu distribution w/o the PRW applied

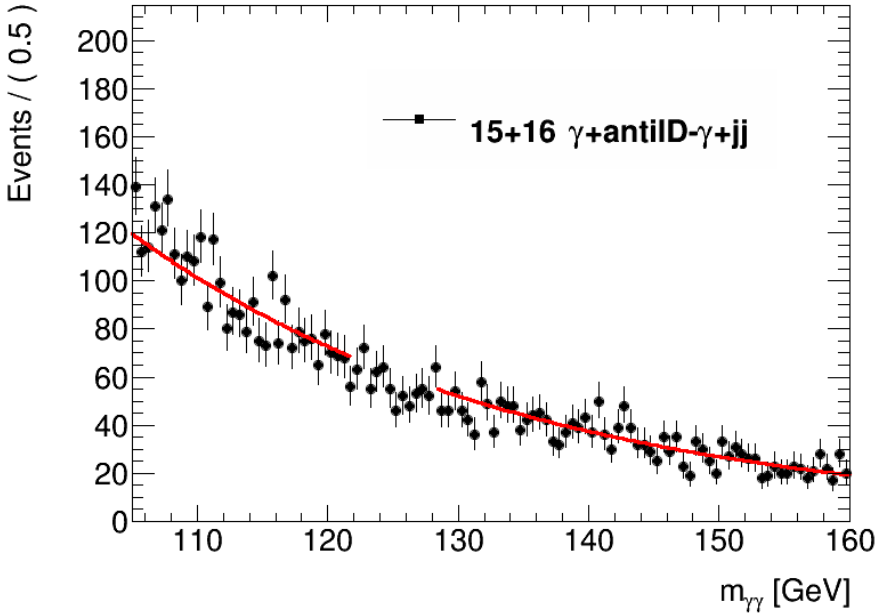
Checks 1 (1)

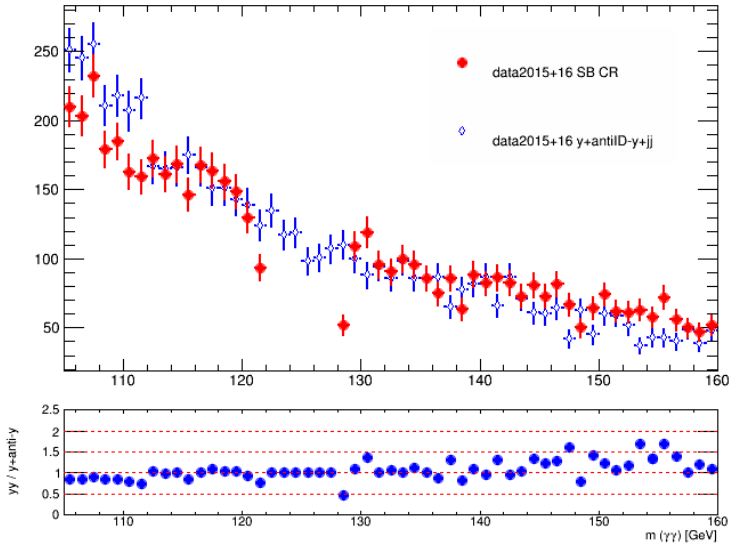
- TODO: ==> check $\gamma + anti - \gamma + jj$ to check what happens when one photon is not real"

exponential	ε(γγ)	Para A	Error A
Data 2015+2016	0.138413	-3.31357e-02	2.05289e-03

Anti-γ : pass loose ID but not tight
The nominal estimate ε(γγ)= 0.1376 (with 2 ID-γ)
The relative difference is **0.6%**
The impact is small

Checks 1 (2)


Events / (0.5)
15+16 γ+antiID-γ+jj
m$_{\gamma\gamma}$ [GeV]


data2015+16 SB CR
data2015+16 y+antiID-y+jj
yy / y+anti-y
m (γγ) [GeV]

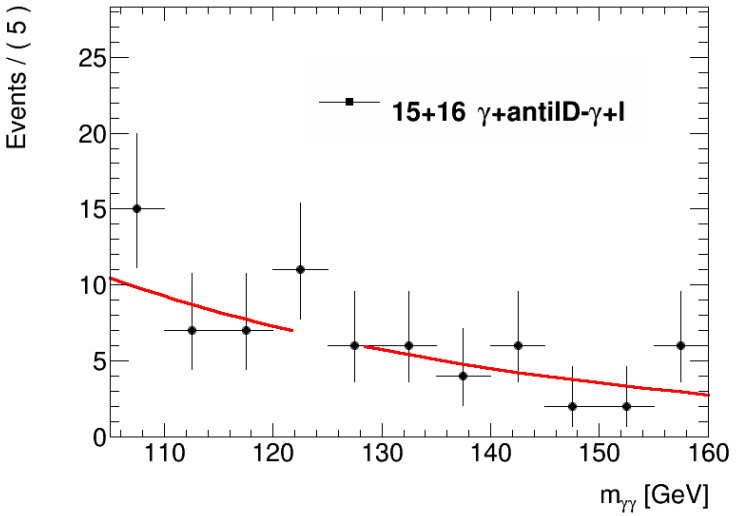
Check 1(3)

- Check the **impact from lepton** with anti-ID photons
- Test with y + anti-ID y in data CR sideband (>=**1 lep**)
- few events left if >=2 jets, remove jet number requirement

Data set	ε(γγ)	Param A	Error A
Data 2015+2016	0.137669	-2.40809e-02	1.84444e-02

Compare this with $\gamma + antiID - \gamma + jj$ ε(γγ)=0.138413 from 0 lep

The difference 0.5% quantifies the lepton impact on ε(γγ) with $antiID - \gamma$



Check 2 (1)

- "TODO==> other function to be used, address the above points."
- **Test with exp(2nd-order polynomial)**
- **Test fit in SR (27 evens in sideband)**

2015+2016	ε(γγ)	Param A	Error A	Param B	Error B
exponential with 2nd order poly	0.135871	-4.14198e-02	**1.65441e-02**	6.46894e-05	**6.06618e-05**

In the fit, parameters' errors are **very large**, which indicates that likelihood has small dependence on them and the complexity needs to be reduced

Check2 (2)

Fit in the sideband aside signal region

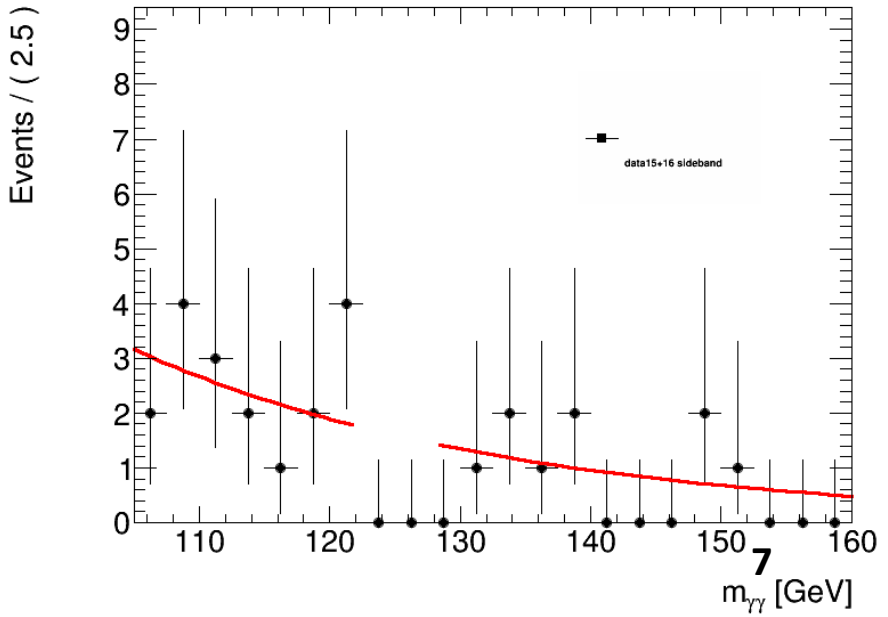
Rather large error on the fitted parameter due to low stats aside signal region (>=1lep)

2015+2016	ε(γγ)	Para A	Error A
Fit with sideband aside SR/ expo	0.138345	-3.41439e-02	**2.98378e-02**

For ICHEP, we stick to fit in control region sideband, where large stats ensure the errors of fitted parameters small enough

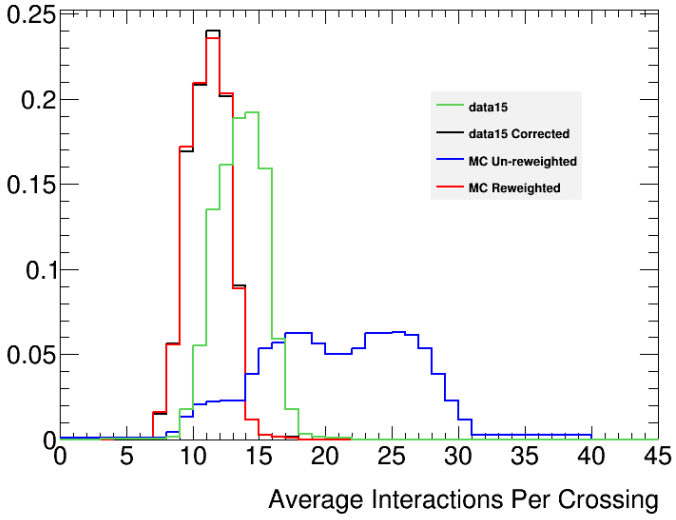
The relative error for Para A: 87.4%

The relative error for $\epsilon(m_{\gamma\gamma})$: 12.9%

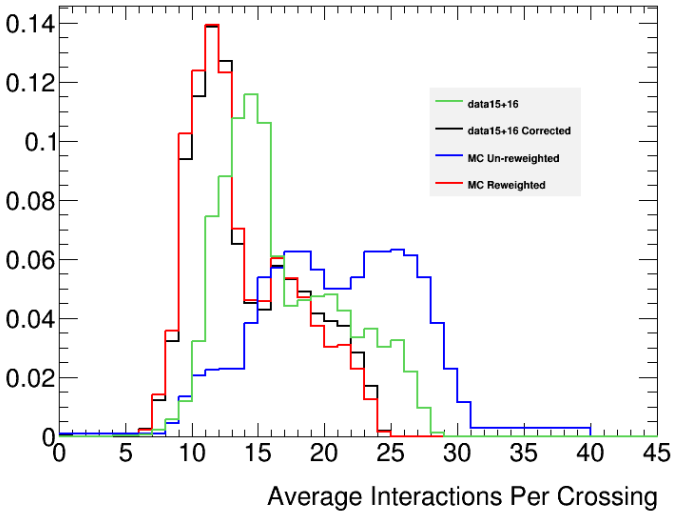


Check 3

- Check mu reweighting properly implemented
- Reweighted MC agree with corrected data



data15



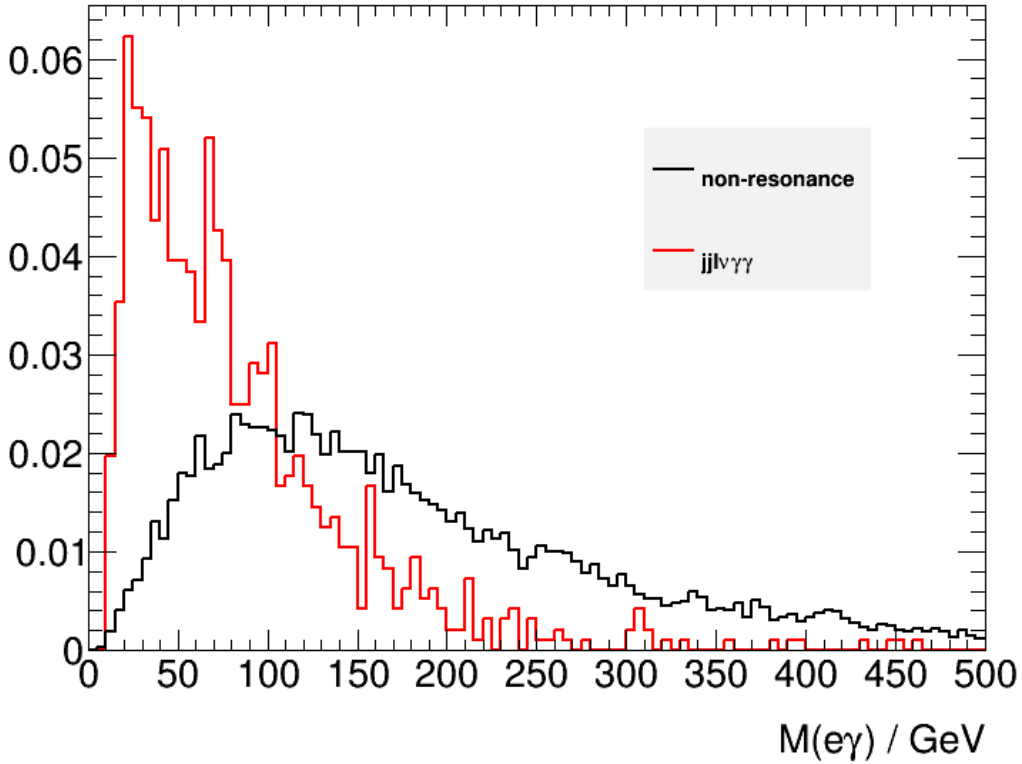
Data15+16

Check 4

- Plot m(e,y) distribution
- Can be explored more post-ICHEP

The photon in the two leading di-photon is closest to the electron

No tight mass window cut on continuum background



Event Yields

Modes	ggh	VBF	Wh	Zh	tth
yields	0.0111	0.00261	0.0906	0.0373	0.126
yields / corrected					

	SM Higgs bkg	Continuum bkg	Sginal ϵ	Signal Yields $5.8\ fb^{-1}$	significance
Non-res	0.267	4.31	10.2%	0.274	0.127
Non-res / corrected		4.31	10.3%	0.275	

Pileup weight was uncorrected as the wrong input for PRW tool.

Corrected: pileup reweighting

Sys and B-tag sys

- Will include b-tag sys after moving to h013, CDI file is missing
- Object systematics: are running
- Check-list: complete sys list and Upper limits

Summary

- A bit little diff when one leptons is not real
- Exponential is currently nominal function after fitting the sideband CR with exponential with 2nd order term
- In the sideband, there are 27 events, the exponential share almost same result with fitting to sideband CR but the error for fit parameter is large
- Mu distribution implies the uncorrected pileup weight, have corrected, the events yields should be close to what are presented before correction