

BSM $gg \rightarrow H \rightarrow hh \rightarrow WW\gamma\gamma$ Search with $lnu\gamma\gamma$ final state

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Cut flow

all photon Selection from HSG1

$120\text{GeV} < \text{Mass}_{yy} < 130\text{GeV}$

At least 2jets and the invariant mass of two jets most close to W mass

At least 1lepton :

No B-jet(reject event if it has a jet $mv_1 > 0.81$)

$\text{MET} > 10\text{GeV}$

Cut efficiency and expected events number

Mass(GeV)	Events left	Events all	Efficiency	expected
260	2851	53897	0.052	0.541
300	6798	107756	0.063	0.66
350	3937	53475	0.074	0.77
400	4450	53368	0.083	0.86
500	4955	53770	0.092	0.96
SM	8717	105516	0.083	0.86

BKG	Continuous	TTH	WH	ZH
	2.3	0.14	0.09	0.001

Systematics

Signal:

only Jet systematics at the moment.

the biggest systematic is JES_PileupTopo(2%)

Standard model background:

Both jet and MET systematics are done.

quite small

Continuous background

As the background number is estimated by non electron mass sideband

sample this shape difference will give about 1% uncertainty

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JES_Nom : 0.00342877
JES_BJES_down : 0.00768817
JES_BJES_up : -0.00657021
JES_FlavComp_down : -0.00486888
JES_FlavComp_up : 0.00272003
JES_FlavResp_down : -0.00286979
JES_FlavResp_up : 0.00151848
JES_MU_down : -0.00229513
JES_MU_up : 0.000304741
JES_NPV_down : 0.00121026
JES_NPV_up : -0.00208791
JES_Nuisance_10_down : -0.00065824
JES_Nuisance_10_up : 7.13964e-05
JES_Nuisance_11_down : 0
JES_Nuisance_11_up : 0
JES_Nuisance_12_down : -0.000766205
JES_Nuisance_12_up : -6.61722e-05
JES_Nuisance_13_down : 0.00189113
JES_Nuisance_13_up : -0.00101
JES_Nuisance_14_down : -0.000611222
JES_Nuisance_14_up : 7.83619e-05
JES_Nuisance_15_down : 0
JES_Nuisance_15_up : 0
JES_Nuisance_16_down : -0.000142793
JES_Nuisance_16_up : 0.000501516
JES_Nuisance_1_down : -0.000844567
JES_Nuisance_1_up : 2.08965e-05
JES_Nuisance_2_down : -3.48275e-06
JES_Nuisance_2_up : -0.000571171
JES_Nuisance_3_down : -0.000766205
JES_Nuisance_3_up : -6.61722e-05
JES_Nuisance_4_down : 0.00279142
JES_Nuisance_4_up : -0.00284018
JES_Nuisance_5_down : -0.000132344
JES_Nuisance_5_up : -0.000670429
JES_Nuisance_6_down : -0.000844567
JES_Nuisance_6_up : 2.08965e-05
JES_Nuisance_7_down : -0.000644309
JES_Nuisance_7_up : -0.000224637
JES_Nuisance_8_down : -0.000579878
JES_Nuisance_8_up : -0.000132344
JES_Nuisance_9_down : 0
JES_Nuisance_9_up : 0
JES_PileupPt_down : -0.000134086
JES_PileupPt_up : -0.000153241
JES_PileupTopo_down : 0.00451016
JES_PileupTopo_up : -0.00415666
JVF_down : 0
JVF_up : 0.00340787
Pileuprand : 0.000165431
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Backup

Back up1 calculation

WH

$$\text{lumi} * \text{xs}(\text{pp} \rightarrow \text{wh}) * \text{Br}(\text{h} \rightarrow \text{yy}) * \text{Br}(\text{w} \rightarrow \text{lv}) * \text{eff} = 20000 * 0.7046 * 0.0029 * 0.31 * 0.006 = 0.09$$

TTH Just consider the W give a lepton and jets come from W or from PU

$$\text{lumi} * \text{xs}(\text{tth}) * \text{Br}(\text{h} \rightarrow \text{yy}) * \text{Br}(\text{w} \rightarrow \text{lv}) * 2 * \text{eff} = 0.1293 * 20000 * 0.0029 * 0.3 * 0.7 * 2 * 0.02 = 0.14 \text{ with pU}$$

ZH

$$\text{lumi} * \text{xs}(\text{pp} \rightarrow \text{ZH}) * \text{Br}(\text{h} \rightarrow \text{yy}) * \text{Br}(\text{z} \rightarrow \text{lx}) * \text{eff} = 20000 * 0.4 * 0.003 * 0.1 * 0.003 = 0.001$$

Expected events in signal region

$$\text{xs}(\text{pp} \rightarrow \text{H} \rightarrow \text{hh}) * 2 * \text{Br}(\text{h} \rightarrow \text{yy}) * \text{Br}(\text{h} \rightarrow \text{ww}) * 2 * \text{Br}(\text{w} \rightarrow \text{lv}) * \text{Br}(\text{w} \rightarrow \text{jj}) * \text{eff} * \text{lumi}$$

$$= \text{xs} * 0.0028 * 0.215 * 0.324 * 0.676 * 4 * 20000$$

$$= 10.4 * \text{eff}$$