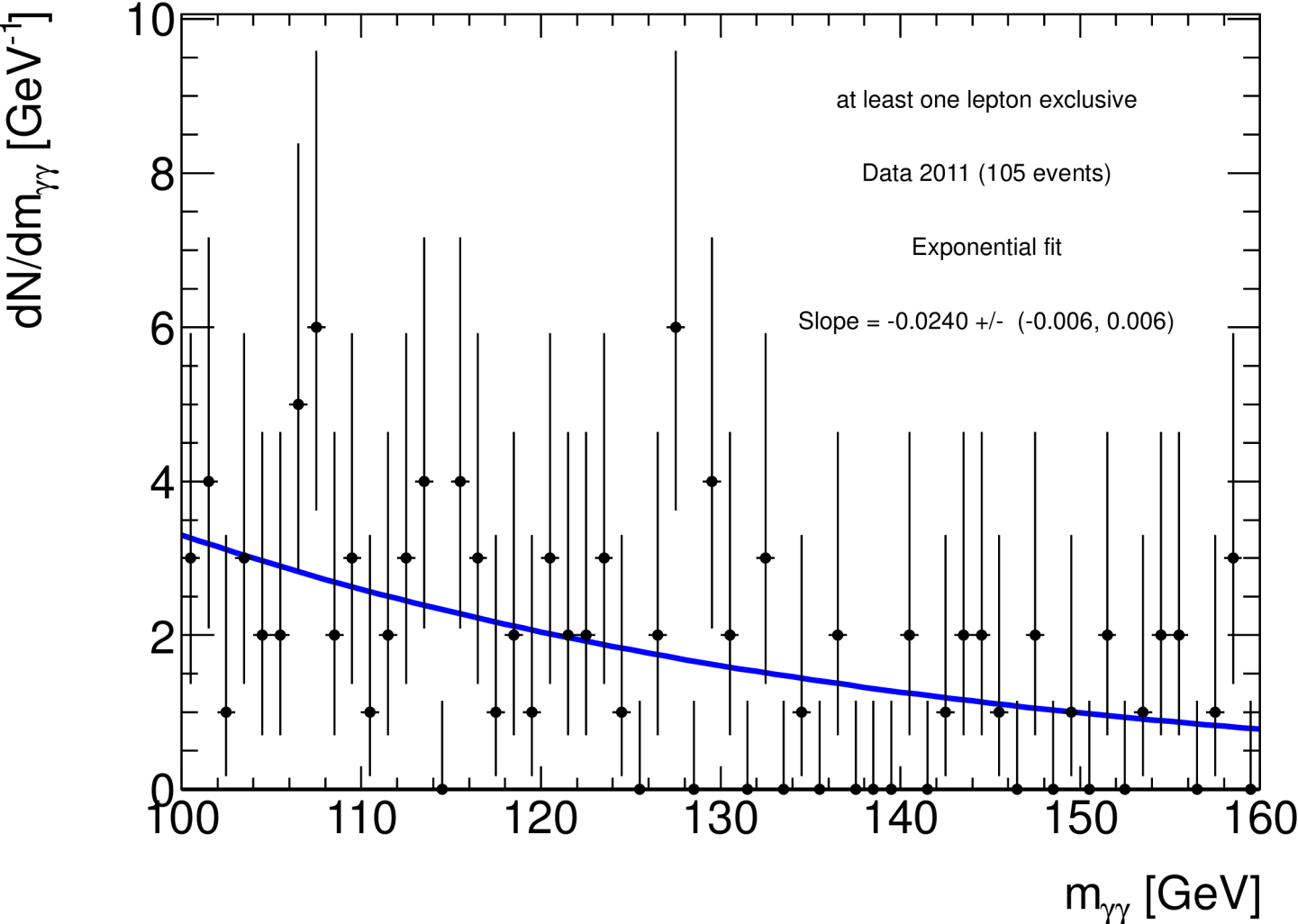


Selection for at least one lepton category

- This category could be significant for WH/ZH channel.
- -- pass preselection
 - pass kinetics ($pT\text{-lead} > 40\text{GeV}$ && $pT\text{-subl} > 30\text{GeV}$)
 - pass NN ID && pass topo isolation ($< 4\text{GeV}$)
 - at least one electron or muon
 - electron: $-\eta < 2.4$ && $pT > 20\text{GeV}$
 - medium_PP && isolated($E_{\text{tccone40_corrected}} < 5\text{GeV}$)
 - overlap remove : $dR(\text{photon}\&\text{electron}) > 0.1$
 - muon: $-\eta < 2.4$ && $pT > 20\text{GeV}$
 - medium && isolated($\mu_{\text{ptcone40}} / pt < 0.2$)

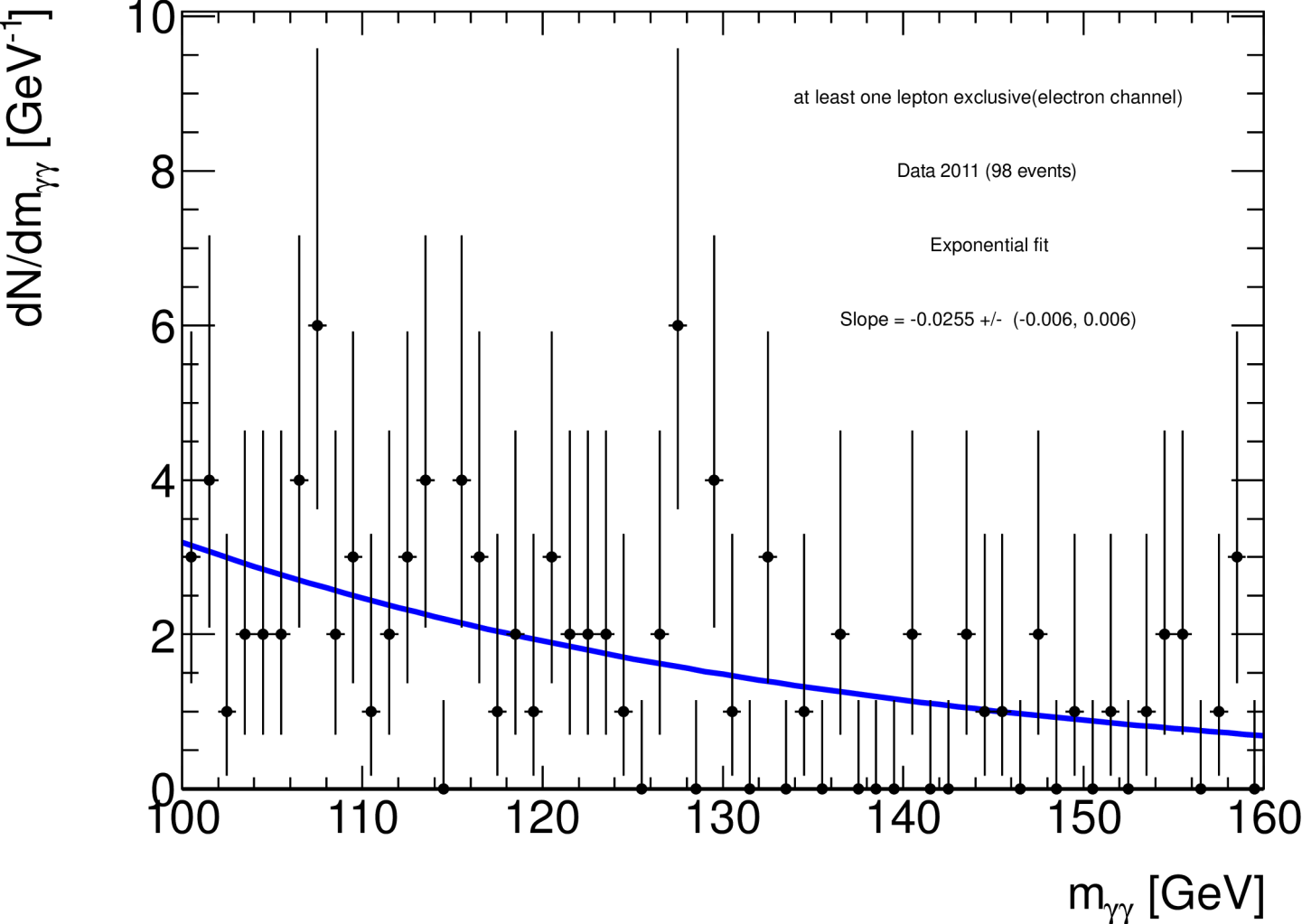
Invariant mass distribution

- At least one lepton category: the leptons are mostly dominated by electrons



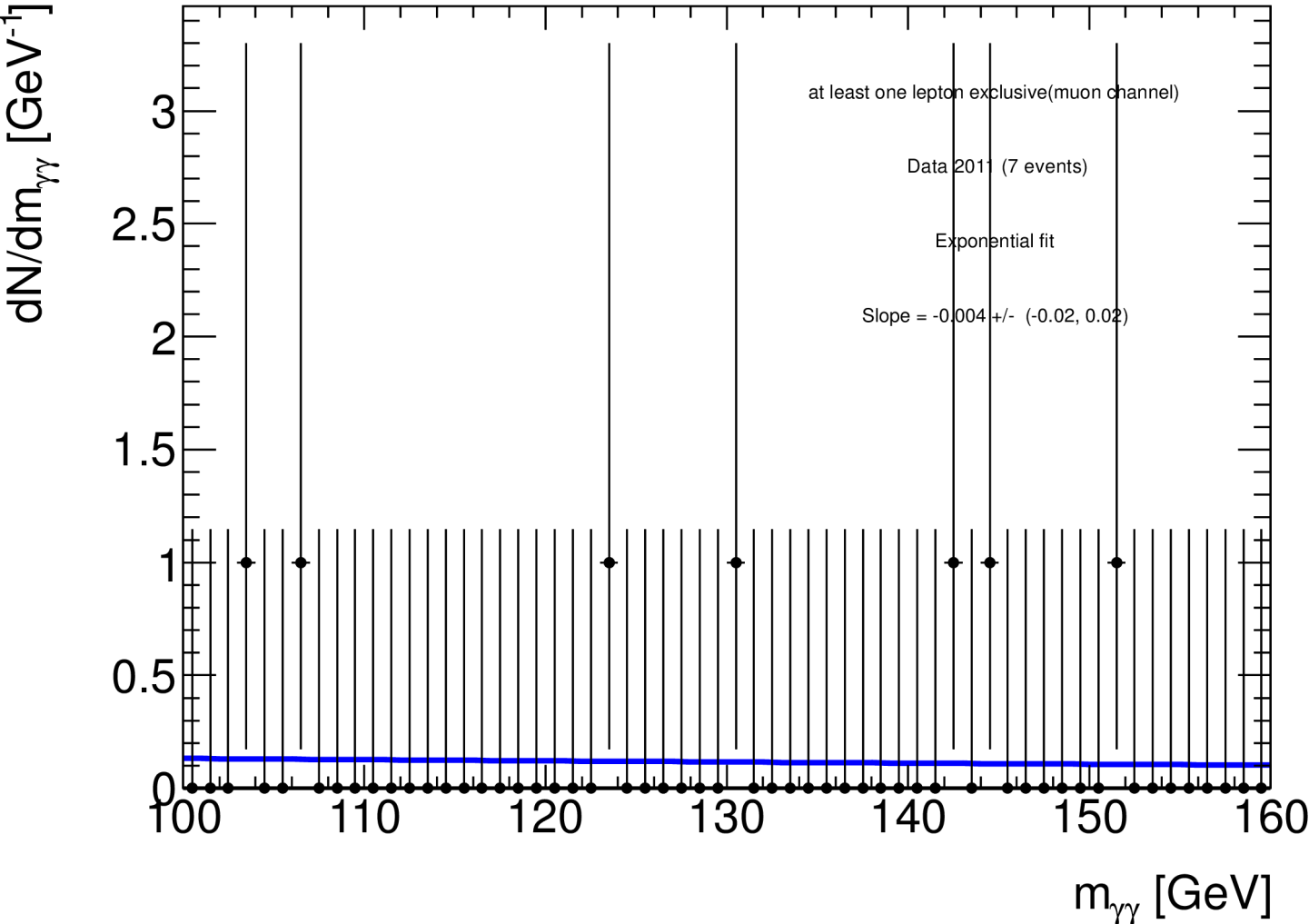
Invariant mass distribution

- At least one lepton category (electron channel)



Invariant mass distribution

- At least one lepton category(muon channel): very little events



Signal and Background Parameters

- Selection: – pass preselection
 - pass kinetics (p_T -leading $>40\text{GeV}$ && p_T -subleading $>30\text{GeV}$)
 - pass NN ID && pass topo isolation ($>4\text{GeV}$)
- Mass window[GeV]: [100, 160], Signal region[GeV]: [121.5,128.5]
- Expected signal and background yields in signal region

Category	C1	C2	C3	C4	C5	C6	C7	C8	C9	VBF	1 lep
ggf	7.77	1.42	15.7	2.43	4.93	0.93	14.5	2.37	5.66	0.64	0.20
VBF	0.68	0.52	1.28	0.89	0.43	0.31	1.17	0.85	0.66	1.97	0.02
WH	0.22	0.18	0.47	0.34	0.14	0.11	0.45	0.35	0.28	0.01	0.44
ZH	0.12	0.10	0.27	0.18	0.07	0.06	0.25	0.17	0.14	0.01	0.10
ttH	0.04	0.06	0.07	0.08	0.03	0.04	0.06	0.09	0.04	0.00	0.14
Total	8.83	2.28	17.79	3.92	5.6	1.45	16.43	3.83	6.78	2.63	0.90
bkg	240.84	11.62	870.40	54.98	176.68	9.17	1014.68	63.17	438.39	10.51	15.61
S/B	0.037	0.2	0.02	0.071	0.032	0.16	0.016	0.061	0.015	0.25	0.057

Signal and Background Parameters

- At least one lepton category: If you see the muon channel, the S/B is about 0.37, which is enhance little by the ttH channel. But the S/B in one lepton channel could be significantly.

Category	total(electron+muon)	electron	muon
ggf	0.20	0.19	0.0059
VBF	0.02	0.02	0.0006
WH	0.44	0.19	0.25
ZH	0.10	0.05	0.05
ttH	0.14	0.06	0.08
Total	0.90	0.52	0.39
bkg	15.61	14.46	1.06
S/B	0.057	0.036	0.37