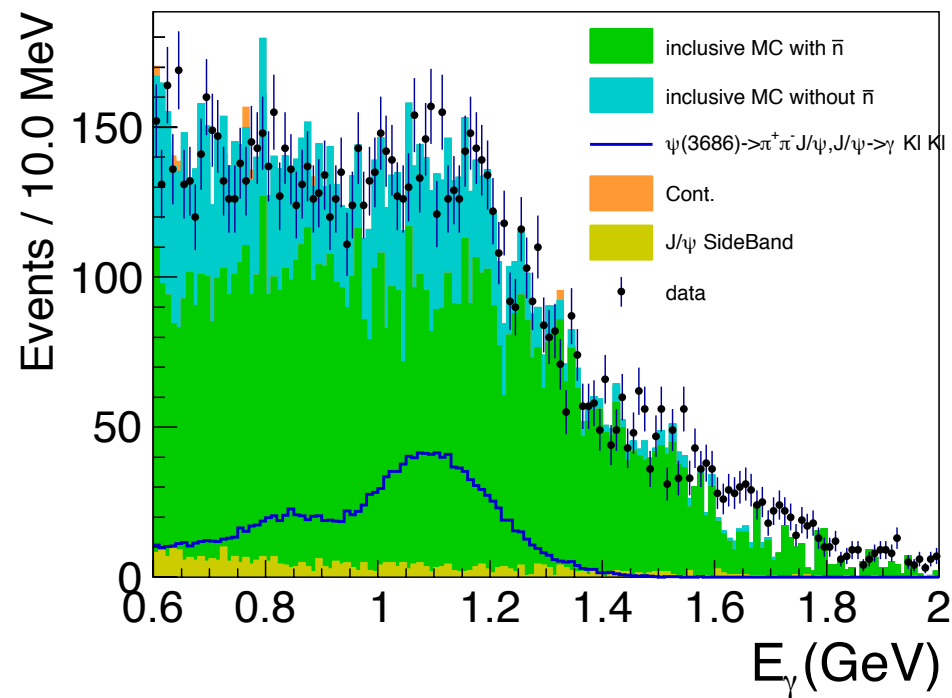


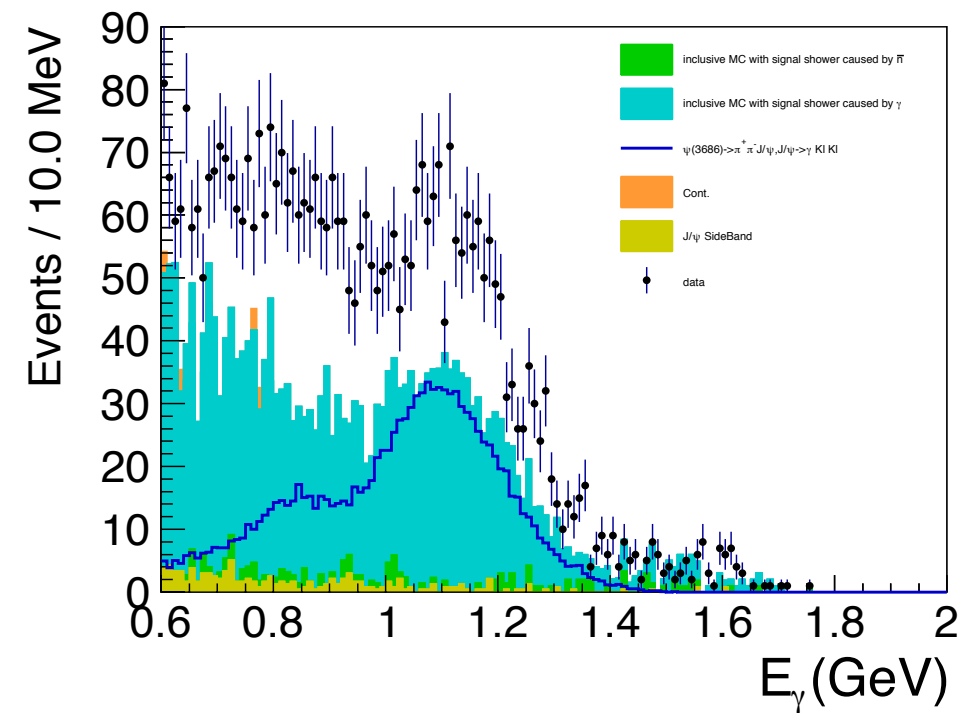
Update on searching for $J/\psi \rightarrow \gamma + \text{invisible}$

Shi Xiaodong, Peng Haiping
State Key Laboratory of Particle Detection and Electronics
USTC

Review



Before $n\text{-}\bar{n}$ veto



After $n\text{-}\bar{n}$ veto

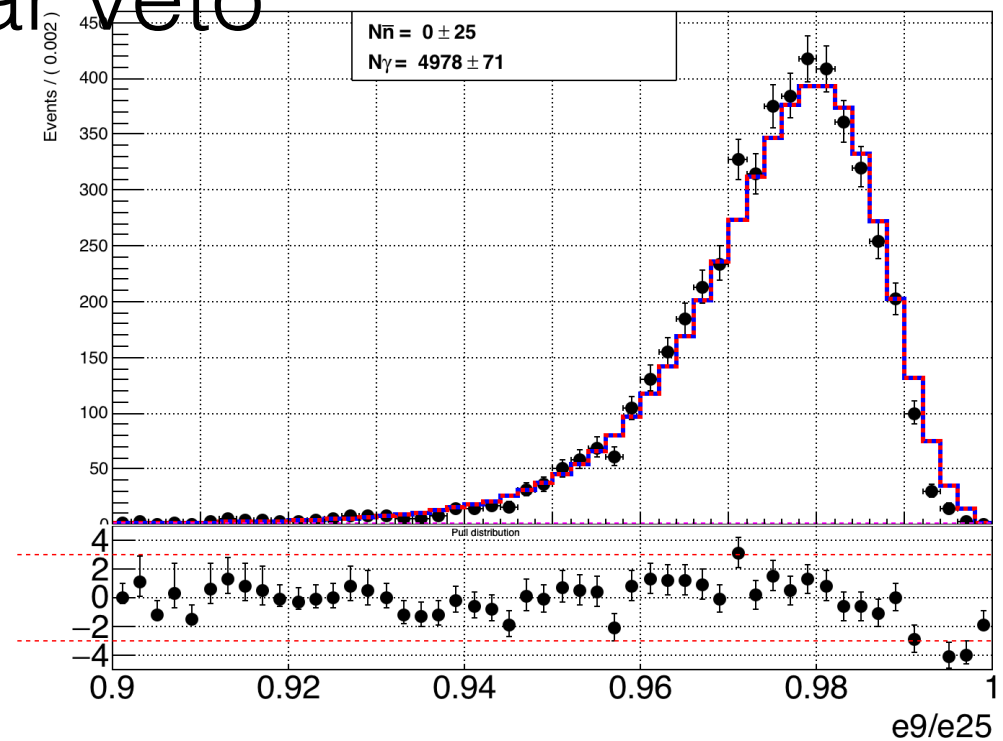
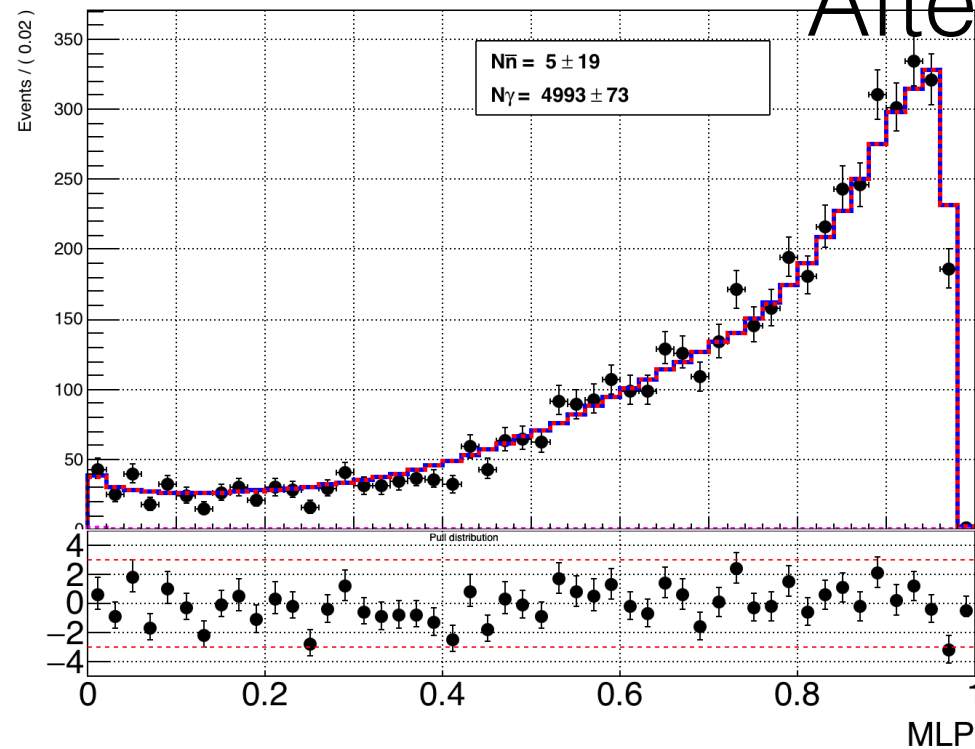
Then I scaled $n\text{-}\bar{n}$ part and gamma part.

Prof. Wang Dayong has comment:

- The big difference of Data vs MC after $m\text{-}\bar{v}$ veto should be further understood before applying reweighting. Especially, it is more reasonable to find the most dominant process and do some correction/reweighting than reweighting the whole inclusive MC. If possible, a data-driven method is more encouraged.

try to understand difference bet. Data & MC

After n-bar veto



In data, anti-n is also negligible. Same as MC.
So the difference is caused by channels with γ .

Exclusive MC

J/ ψ ->	$\gamma\eta$	$\gamma\eta'$	$\gamma\eta_c$	$\gamma\pi^0$	$\gamma\eta$ (1405)	$\gamma K K \bar{K}$	$\gamma\pi^0\pi^0$	$\gamma\pi^+\pi^-$
branch ratio	1.104E-03	5.15E-03	1.7%	3.49E-05	4.9E-03	8.1E-04	1.15E-03	1.15E-03
MC quantity	1M	1.2M	1M	0.2M	0.2M	1M	1M	1M
data quantity	40619	189482	625474	1284.1	180284	29802	42311	42311
scale factor	0.04	0.16	0.63	0.006	0.9	0.03	0.04	0.04
data survived	85.79	41.21	11.26	2.26	27.94	1130	41	11.25

2-body decay's BR from PDG.

3-body decay's BR from Jake's PWA work.

Other channels from inclusive MC

No.	decay chain	final states	iTopology	nEvt	nTot
0	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \rho^- \pi^+, \rho^- \rightarrow \pi^- \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	3	179	179
1	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \rho^+ \pi^-, \rho^+ \rightarrow \pi^+ \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	2	141	320
2	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^0 \bar{K}^0 \pi^0$	$\pi^- \pi^0 K_L K_L \pi^+$	6	123	443
3	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \mu^+ \mu^- \gamma_{FSR}$	$\mu^+ \pi^- \mu^- \pi^+$	5	74	517
4	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^* \bar{K}^0, K^* \rightarrow K^0 \pi^0$	$\pi^- \pi^0 K_L K_L \pi^+$	16	68	585
5	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \bar{K}^* K^0, \bar{K}^* \rightarrow \bar{K}^0 \pi^0$	$\pi^- \pi^0 K_L K_L \pi^+$	1	65	650
6	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow e^+ e^- \gamma_{FSR}$	$e^+ \pi^- e^- \pi^+$	10	54	704
7	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \pi^+ \pi^- \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	23	31	735
8	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow e^+ e^- \gamma_{FSR} \gamma_{FSR}$	$e^+ \pi^- e^- \pi^+$	20	22	757
9	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^{*-} K^+, K^{*-} \rightarrow K^- \pi^0$	$\pi^- K^- \pi^0 \pi^+ K^+$	14	12	769
10	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^{*+} K^-, K^{*+} \rightarrow K^+ \pi^0$	$\pi^- K^- \pi^0 \pi^+ K^+$	25	11	780
11	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \rho^+ \pi^- \gamma_{FSR}, \rho^+ \rightarrow \pi^+ \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	93	9	789
12	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \omega \eta, \omega \rightarrow \pi^0 \gamma, \eta \rightarrow \gamma \gamma$	$\pi^- \pi^0 \pi^+ \gamma \gamma \gamma$	73	7	796
13	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma f_0(1710), f_0(1710) \rightarrow K^0 \bar{K}^0, K_S \rightarrow \pi^0 \pi^0$	$\pi^- \pi^0 \pi^0 K_L \pi^+ \gamma$	26	6	802
14	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \pi^0 K^0 \bar{K}^*, \bar{K}^* \rightarrow \bar{K}^0 \pi^0$	$\pi^- \pi^0 \pi^0 K_L K_L \pi^+$	24	6	808
15	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma K^0 \bar{K}^*, \bar{K}^* \rightarrow \bar{K}^0 \pi^0$	$\pi^- \pi^0 K_L K_L \pi^+ \gamma$	80	6	814
16	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma \eta \pi^+ \pi^-, \eta \rightarrow \gamma \gamma$	$\pi^- \pi^- \pi^+ \pi^+ \gamma \gamma \gamma$	18	6	820
17	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma \bar{\Lambda} \Lambda, \bar{\Lambda} \rightarrow \bar{p} \pi^+, \Lambda \rightarrow n \pi^0$	$\pi^- \bar{p} \pi^0 \pi^+ \pi^+ n \gamma$	17	5	825
18	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^0 \pi^0$	$\pi^- \pi^- \pi^0 \pi^0 \pi^+ \pi^+ \gamma$	92	5	830
19	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma f'_2, f'_2 \rightarrow K_L K_L, K_L \rightarrow \pi^- \nu_e e^+$	$e^+ \pi^- \pi^- \nu_e K_L \pi^+ \gamma$	9	5	835
20	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	4	4	839
21	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^0 \pi^0$	$\pi^- \pi^- \pi^0 \pi^0 \pi^+ \pi^+$	4	4	843
22	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^{*+} K^-, K^{*+} \rightarrow K^0 \pi^+, K_S \rightarrow \pi^0 \pi^0$	$\pi^- K^- \pi^0 \pi^0 \pi^+ \pi^+$	49	4	847
23	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \omega \pi^+ \pi^-, \omega \rightarrow \pi^0 \gamma$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+ \gamma$	57	4	851
24	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \rho^- \pi^+ \gamma_{FSR}, \rho^- \rightarrow \pi^- \pi^0$	$\pi^- \pi^- \pi^0 \pi^+ \pi^+$	70	4	855
25	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma p \bar{p}$	$\pi^- \bar{p} \pi^+ \gamma p$	71	4	859
26	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \gamma f_2(1950), f_2(1950) \rightarrow K^+ K^-$	$\pi^- K^- \pi^+ \gamma K^+$	19	4	863
27	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^+ K^- \pi^0$	$\pi^- K^- \pi^0 \pi^+ K^+$	0	4	867
28	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow \bar{K}^0 K^0$	$\pi^- K_L K_L \pi^+$	82	4	871
29	$\psi' \rightarrow J/\psi \pi^+ \pi^-, J/\psi \rightarrow K^0 \bar{K}^0 \pi^0, K_L \rightarrow \pi^- \nu_e e^+$	$e^+ \pi^- \pi^- \pi^0 \nu_e K_L \pi^+$	29	4	875

Main channels' BR is same with PDG value.

Any suggestions?

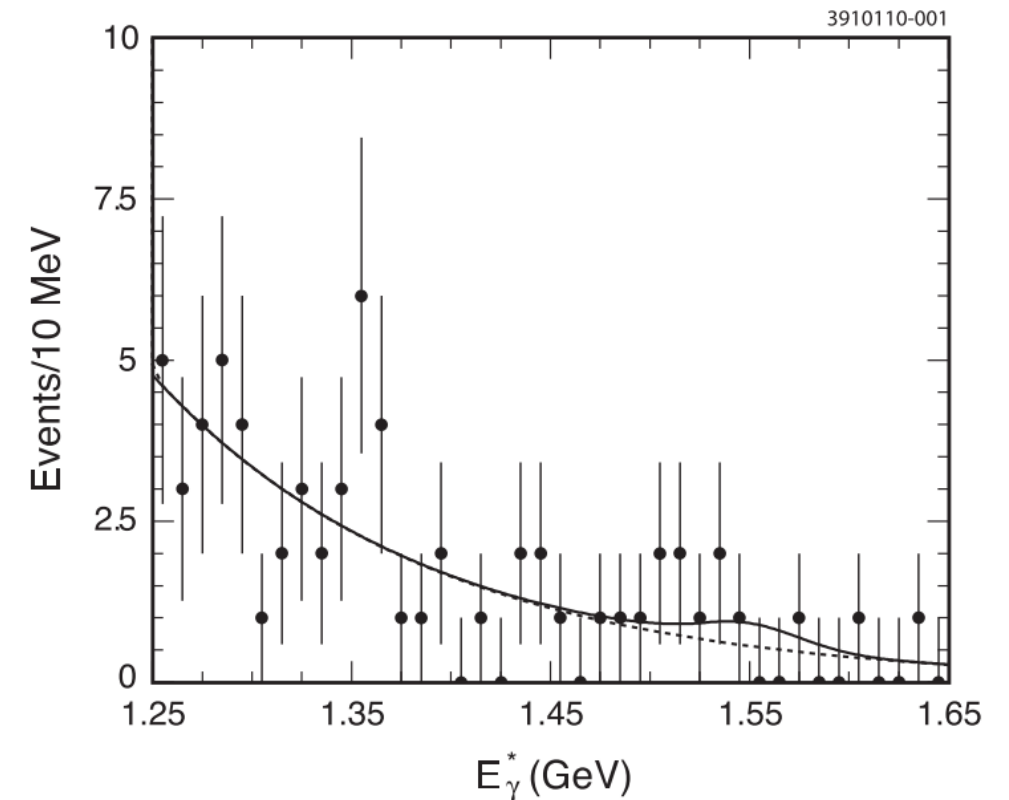
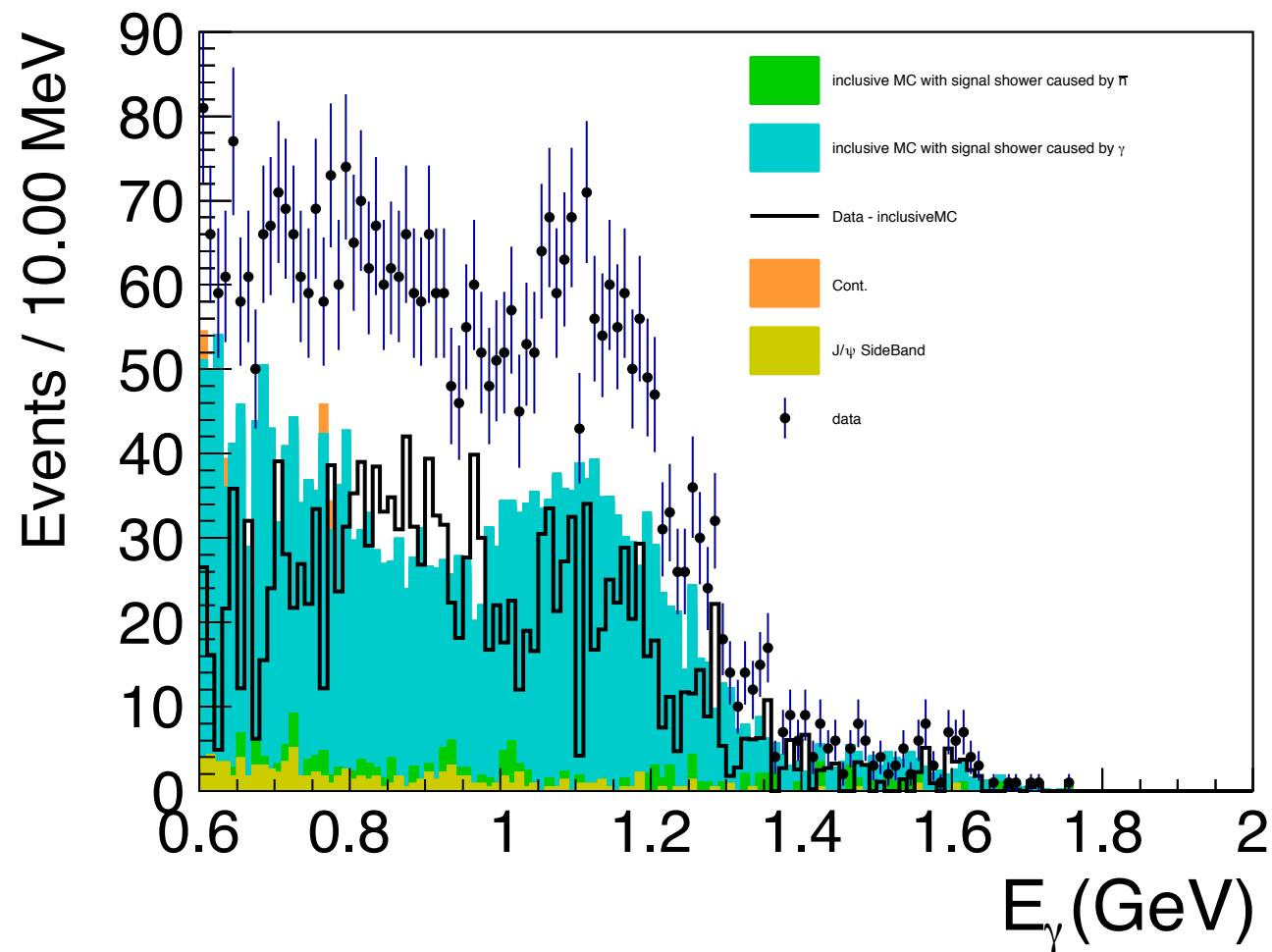


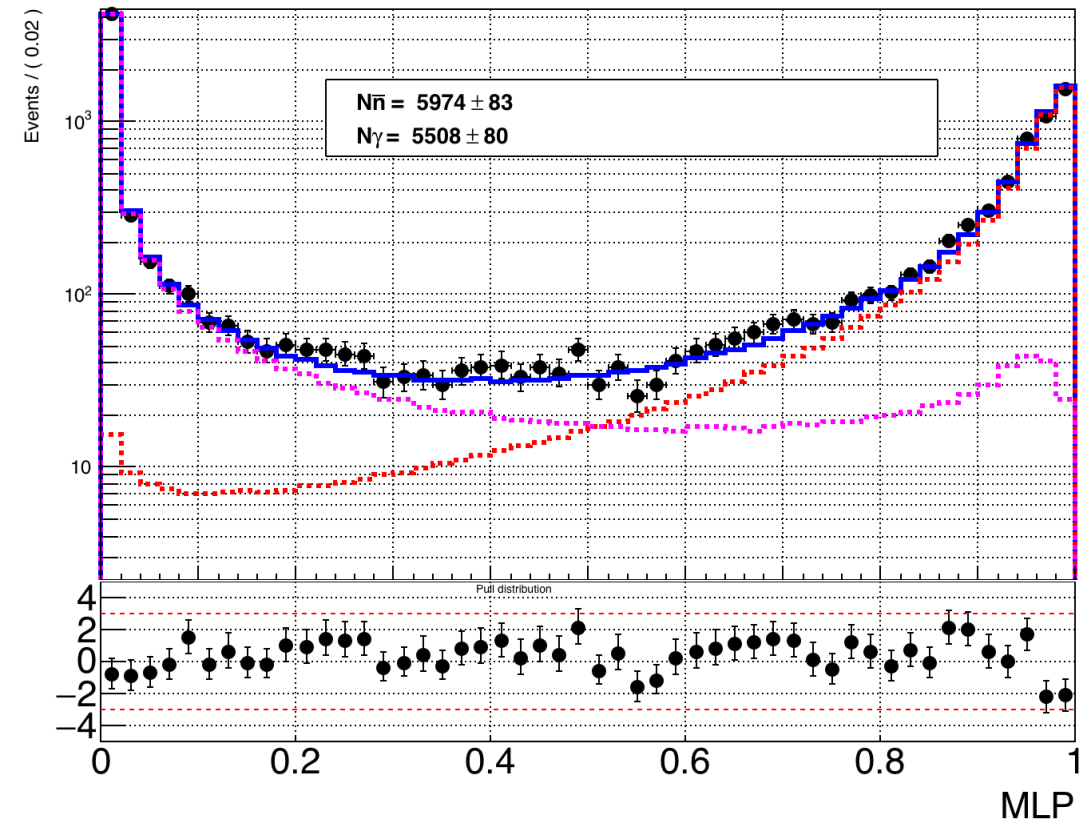
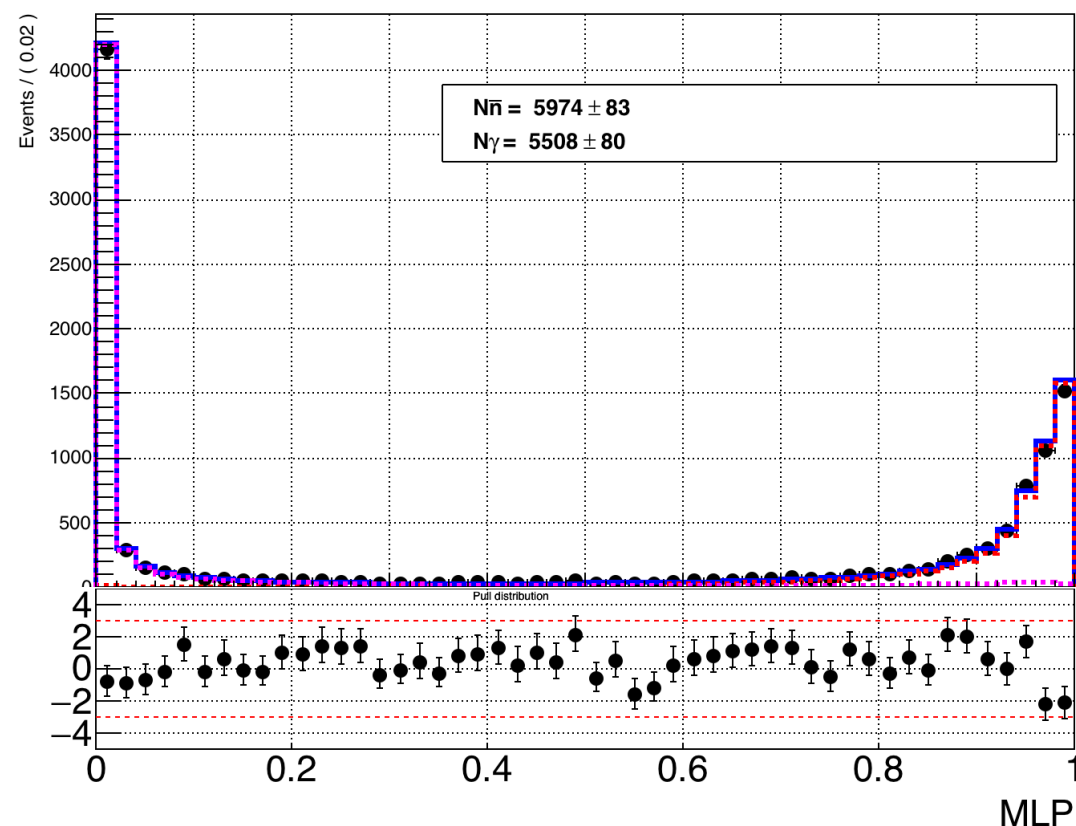
FIG. 3. Fit to determine the branching fraction at $E_\gamma^* = 1.548$ GeV, corresponding to $m_X = 0$. The data are the same as in Fig. 2(a) but with finer binning. The solid line is the total fitted spectrum, and the dashed line shows the background contribution to the fit.

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Shall I ignore this difference,
just use function to describe non-peak bkg?
Or shall I just do in the $[1.25, 1.65]$ GeV?
Like what cleo-c did?

Back-up

Try to get the ratio of gamma to nbar



Before $n\bar{n}$ veto

In inclusive MC, $n(\text{gamma})=3532, n(\text{anti-bar})=7855$

From data, $n(\text{gamma})=5508, n(\text{anti-bar})=5974$

Need to correct the ratio of gamma in inclusive MC