



Deutsches Elektronen-Synchrotron DESY
Ein Forschungszentrum der Helmholtz-Gemeinschaft



Double Jpsi



p_T [GeV]	$\langle p_T \rangle$ [GeV]	$B d\sigma^2/dp_T dy$														
		$ y < 0.3$			$0.3 < y < 0.6$			$0.6 < y < 0.9$			$0.9 < y < 1.2$			$ y < 1.2$		
		[pb/GeV]	stat %	syst %	[pb/GeV]	stat %	syst %	[pb/GeV]	stat %	syst %	[pb/GeV]	stat %	syst %	[pb/GeV]	stat %	syst %
20–21	20.5	4.68E+01	1.7	5.3	4.63E+01	1.3	4.6	4.47E+01	1.2	4.5	4.51E+01	1.3	4.6	4.58E+01	0.7	4.6
21–22	21.5	3.52E+01	1.3	5.4	3.65E+01	1.2	4.8	3.52E+01	1.2	4.6	3.42E+01	1.3	4.8	3.53E+01	0.6	4.8
22–23	22.5	2.72E+01	1.4	5.2	2.80E+01	1.3	4.5	2.75E+01	1.3	4.4	2.69E+01	1.3	4.6	2.74E+01	0.7	4.6
23–24	23.5	2.14E+01	1.5	5.0	2.25E+01	1.4	4.5	2.18E+01	1.4	4.3	2.12E+01	1.5	4.4	2.18E+01	0.7	4.5
24–25	24.5	1.80E+01	1.6	5.0	1.81E+01	1.5	4.5	1.76E+01	1.5	4.3	1.66E+01	1.6	4.5	1.76E+01	0.8	4.5
25–26	25.5	1.46E+01	1.8	5.0	1.50E+01	1.7	4.5	1.38E+01	1.7	4.3	1.39E+01	1.8	4.5	1.43E+01	0.9	4.5
26–27	26.5	1.21E+01	1.9	5.1	1.22E+01	1.8	4.4	1.13E+01	1.9	4.3	1.11E+01	1.9	4.5	1.17E+01	0.9	4.5
27–28	27.5	1.00E+01	2.1	5.0	1.00E+01	2.0	4.4	9.76E+00	2.0	4.3	9.17E+00	2.1	4.5	9.75E+00	1.0	4.5
28–29	28.5	8.14E+00	2.3	5.1	8.31E+00	2.2	4.5	7.88E+00	2.2	4.3	7.67E+00	2.3	4.5	7.99E+00	1.1	4.5
29–30	29.5	6.68E+00	2.5	5.2	6.92E+00	2.4	4.5	6.78E+00	2.4	4.4	6.39E+00	2.5	4.6	6.70E+00	1.2	4.5
30–32	31.0	5.47E+00	1.9	5.2	5.44E+00	1.9	4.5	5.03E+00	1.9	4.3	4.91E+00	2.0	4.6	5.20E+00	1.0	4.6
32–34	33.0	3.84E+00	2.3	5.4	3.84E+00	2.2	4.6	3.72E+00	2.2	4.4	3.50E+00	2.3	4.8	3.72E+00	1.1	4.7
34–36	35.0	2.78E+00	2.7	5.7	2.84E+00	2.5	4.9	2.76E+00	2.5	4.9	2.62E+00	2.7	5.1	2.75E+00	1.3	5.0
36–38	37.0	2.12E+00	3.1	6.2	2.03E+00	2.9	5.4	2.02E+00	3.0	5.3	1.85E+00	3.1	5.6	2.00E+00	1.5	5.5
38–42	39.8	1.45E+00	2.6	6.4	1.40E+00	2.5	5.7	1.39E+00	2.5	5.6	1.33E+00	2.6	5.9	1.39E+00	1.3	5.8
42–46	43.8	8.33E-01	3.3	6.9	8.33E-01	3.2	6.1	7.74E-01	3.3	5.9	7.47E-01	3.4	6.5	7.96E-01	1.7	6.2
46–50	47.8	5.34E-01	4.2	7.0	5.48E-01	4.0	6.1	4.96E-01	4.2	6.1	4.54E-01	4.5	6.7	5.08E-01	2.1	6.3
50–60	54.2	2.79E-01	3.7	7.8	2.74E-01	3.5	7.1	2.49E-01	3.7	7.1	2.14E-01	4.1	7.7	2.54E-01	1.9	7.2
60–75	66.0	8.96E-02	5.4	8.0	9.05E-02	5.0	6.9	8.23E-02	5.6	6.9	6.64E-02	6.2	8.2	8.28E-02	2.7	7.3
75–95	82.7	2.54E-02	9.0	7.7	2.62E-02	8.5	6.4	2.37E-02	8.7	6.4	2.03E-02	9.6	7.6	2.39E-02	4.4	6.3
95–120	104.7	8.37E-03	15	8.3	8.56E-03	15	8.2	7.16E-03	15	7.3	5.61E-03	19	9.1	7.42E-03	7.7	7.9
120–150	131.1													1.53E-03	17	7.9

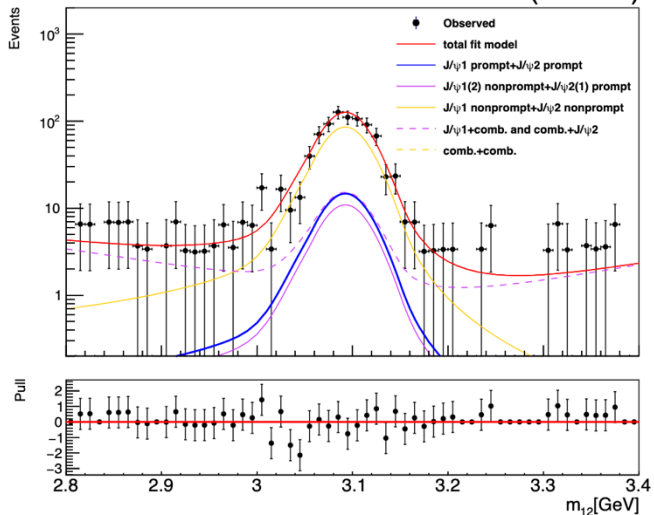
$$BR(\rightarrow \mu\mu) \times \frac{d^2\sigma}{dp_T dy} = \frac{N^{q\bar{q}}(p_T, y)}{L\Delta y \Delta p_T} \cdot \langle \frac{1}{\epsilon(p_T, y) \mathcal{A}(p_T, y)} \rangle$$

$$45.8+35.3+27.4+21.8+17.6+14.3+11.7+9.75+7.99+6.70+5.20*2+3.72*2+2.75*2+2.00*2+1.39*4 \\ +0.796*4+0.508*4+0.254*10+0.0828*15+0.0239*15+0.00742*25+0.00153*30 = 240.8279\text{pb}$$

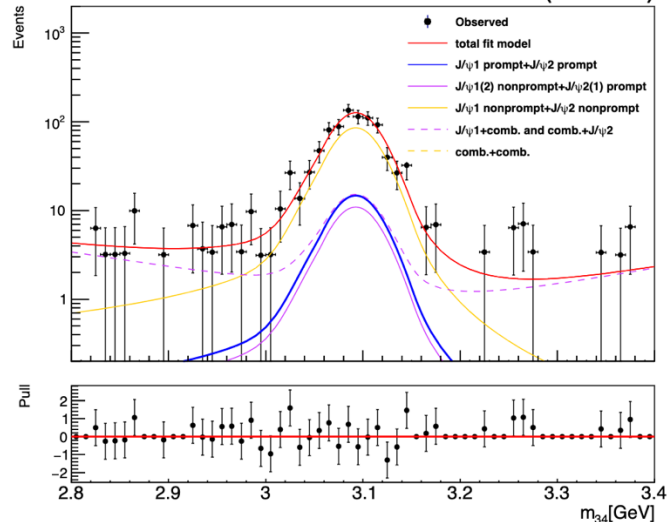
$$240.8279\text{pb} / 0.0593 = 4061.2\text{pb}$$

$$\sigma_{eff} = \frac{\sigma_{J\psi}^2}{2\sigma_{DPS \rightarrow J\psi J\psi}} = \frac{(4061.2\text{pb})^2}{2*(0.83*0.66)\text{pb}} = 0.015\text{mb}$$

2016 (13 TeV)

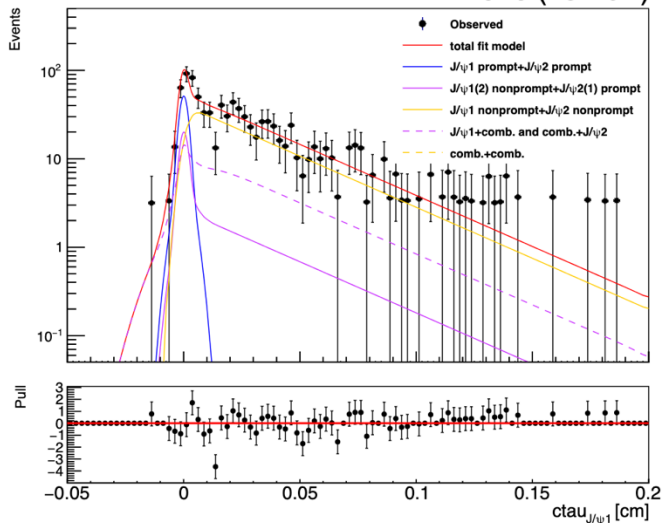


2016 (13 TeV)

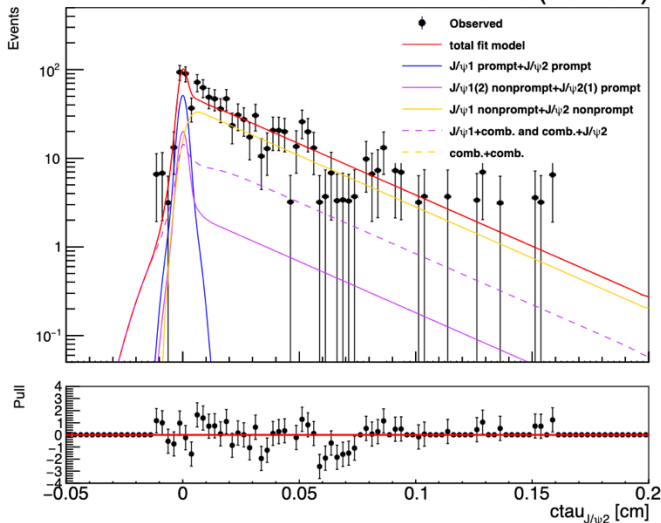


Phase space: Jpsi: $p_t > 20 \text{ GeV}$, $|y| < 1.2$
 Muon: $p_t > 4 \text{ GeV}$, $|y| < 1.4$

2016 (13 TeV)



2016 (13 TeV)



Double Jpsi cross section : 0.80 pb

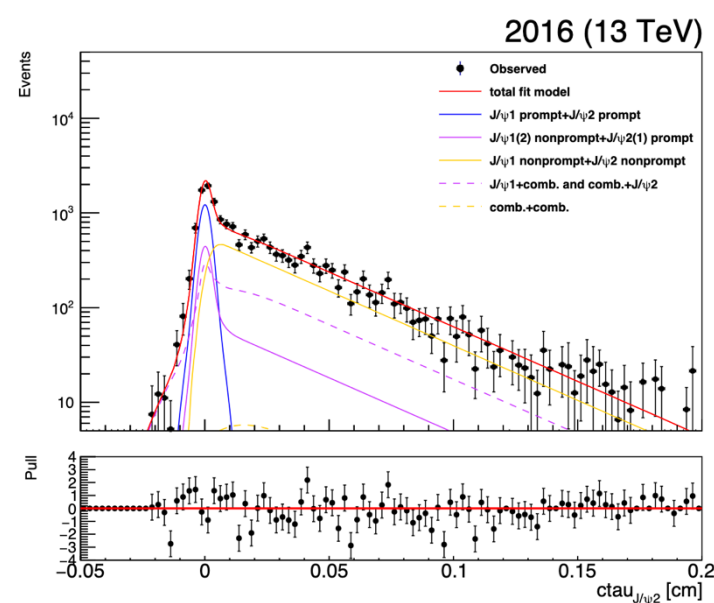
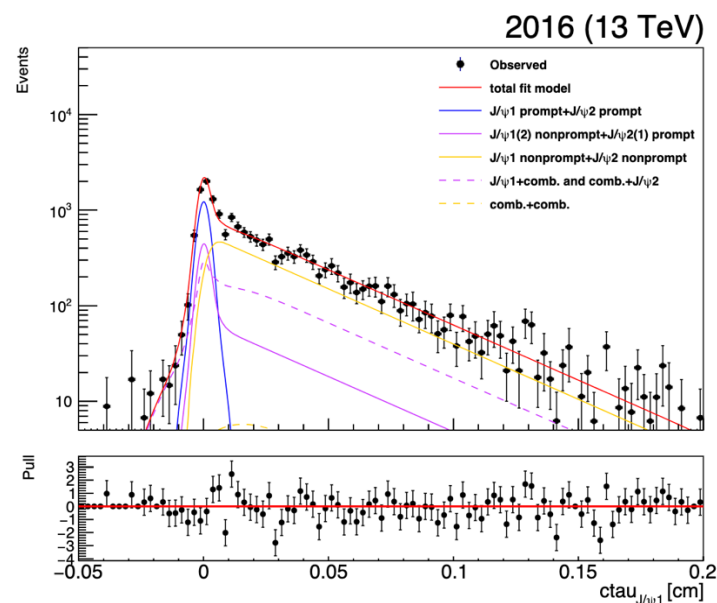
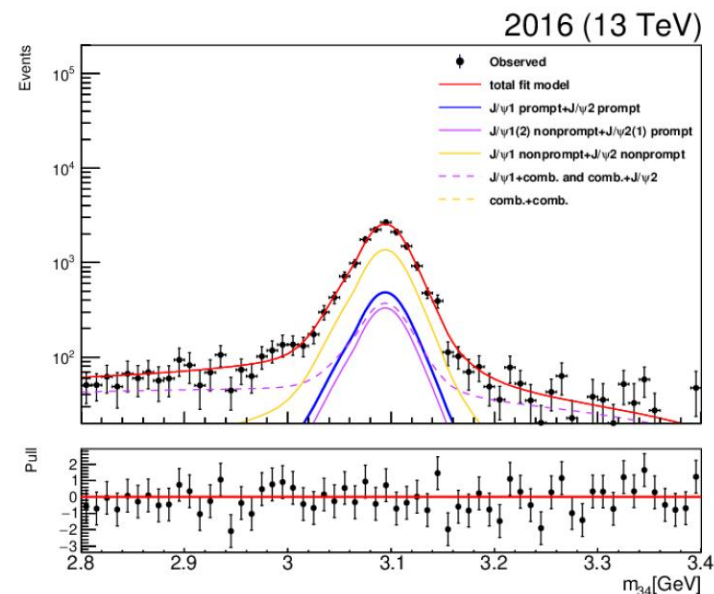
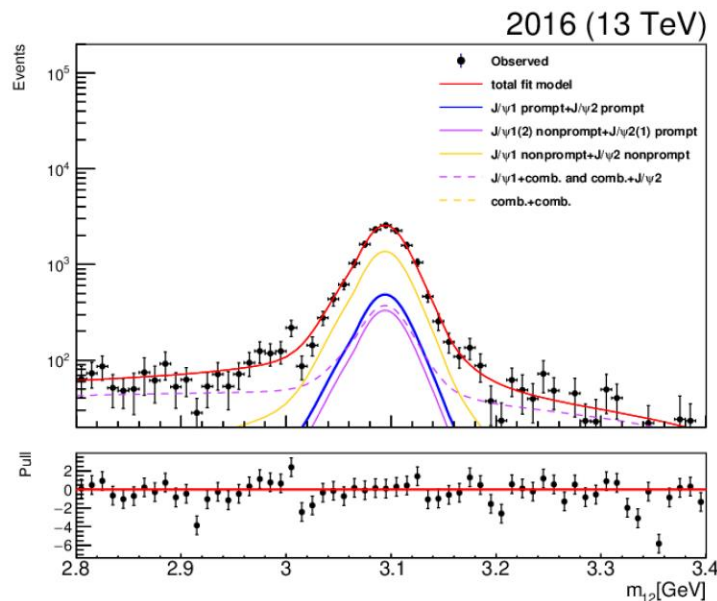
Table 18: J/ψ cross sections

p_T	$\langle p_T \rangle$	$\langle \mathcal{A} \rangle$	$\langle \epsilon \rangle$	$\langle \frac{1}{\mathcal{A}\epsilon} \rangle$	$\sigma \times BR[pb]$
$ y < 1.2$					
10-11	10.50	0.23	0.46	10.395 ± 0.019	2421.93 ± 26.97
11-12	11.49	0.29	0.56	6.308 ± 0.007	1293.31 ± 14.88
12-13	12.48	0.35	0.60	4.887 ± 0.005	822.42 ± 10.14
13-14	13.48	0.39	0.61	4.238 ± 0.004	562.05 ± 7.67
14-15	14.48	0.43	0.66	3.502 ± 0.003	384.42 ± 5.71
15-16	15.48	0.47	0.67	3.185 ± 0.003	246.73 ± 4.22
16-18	17.09	0.25	0.57	7.872 ± 0.010	168.58 ± 1.71
18-20	18.99	0.42	0.67	3.628 ± 0.002	87.22 ± 0.81
20-22	20.96	0.56	0.71	2.502 ± 0.001	48.87 ± 0.49
22-26	23.77	0.66	0.73	2.095 ± 0.001	24.01 ± 0.21
26-30	27.79	0.71	0.73	1.933 ± 0.001	10.51 ± 0.13
30-38	33.26	0.76	0.73	1.816 ± 0.001	4.11 ± 0.06
38-54	43.78	0.81	0.72	1.725 ± 0.003	0.86 ± 0.02
$1.2 < y < 1.8$					
16-18	17.02	0.29	0.53	6.803 ± 0.010	151.68 ± 2.14
18-20	18.97	0.47	0.62	3.482 ± 0.003	77.83 ± 1.07
20-22	20.95	0.61	0.64	2.586 ± 0.002	41.32 ± 0.65
22-26	23.72	0.70	0.65	2.247 ± 0.002	20.77 ± 0.30
26-30	27.78	0.74	0.65	2.108 ± 0.002	8.68 ± 0.19
30-38	33.11	0.79	0.63	2.057 ± 0.003	3.07 ± 0.07
38-54	43.39	0.83	0.60	2.089 ± 0.008	0.59 ± 0.02

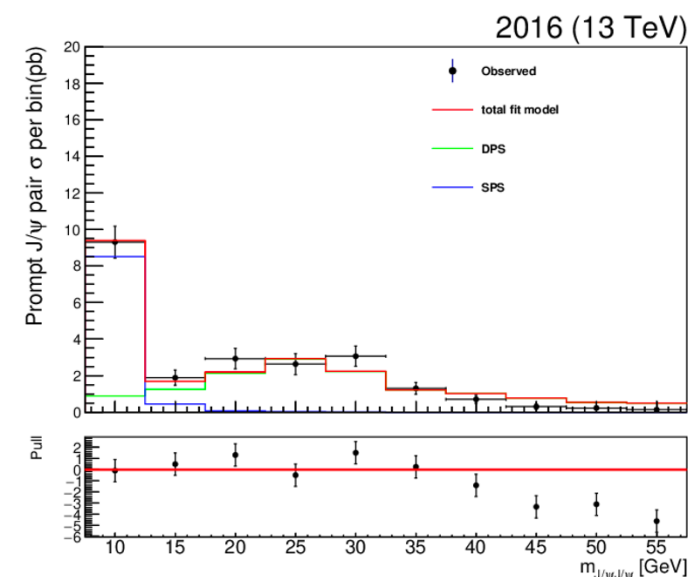
$$2421.9 + 1293.3 + 822.4 + 562.0 + 384.4 + 246.7 + 168.6 \times 2 + 87.22 \times 2 + 48.9 \times 2 + 24.0 \times 4 + 10.5 \times 4 + 4.11 \times 8 + 0.86 \times 16 = 6524.7800 \text{ pb}$$

$$6524.8 \text{ pb} / 0.0593 = 110030.02 \text{ pb}$$

$$\bullet \sigma_{eff} = \frac{\sigma_{J/\psi}^2}{2\sigma_{DPS \rightarrow J\psi J\psi}} = \frac{(110030.02 \text{ pb})^2}{2 \times (23.11 \times 0.59) \text{ pb}} = 0.44 \text{ mb}$$

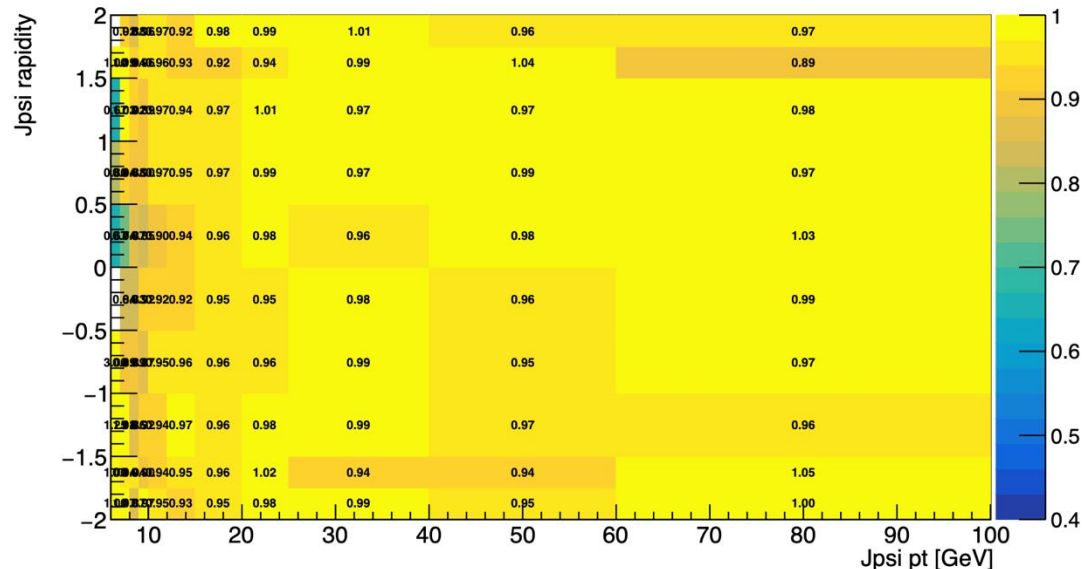


Phase space: J/ψ : $p_t > 10 \text{ GeV}$, $|y| < 1.2$
 Muon: $p_t > 4 \text{ GeV}$, $|y| < 1.4$

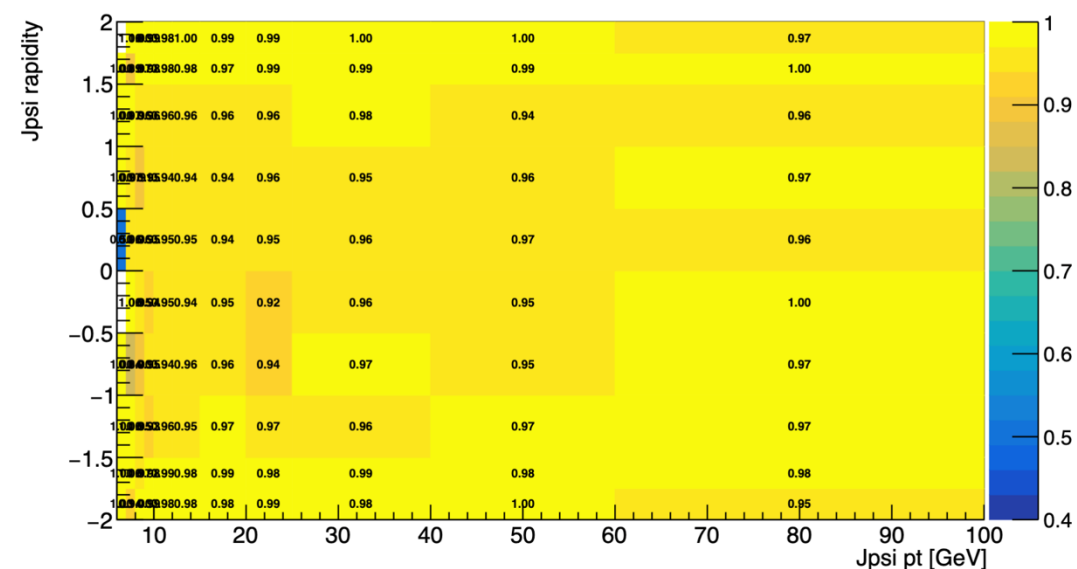


Double J/ψ cross section : 23.11 pb
 DPS fraction: 0.59

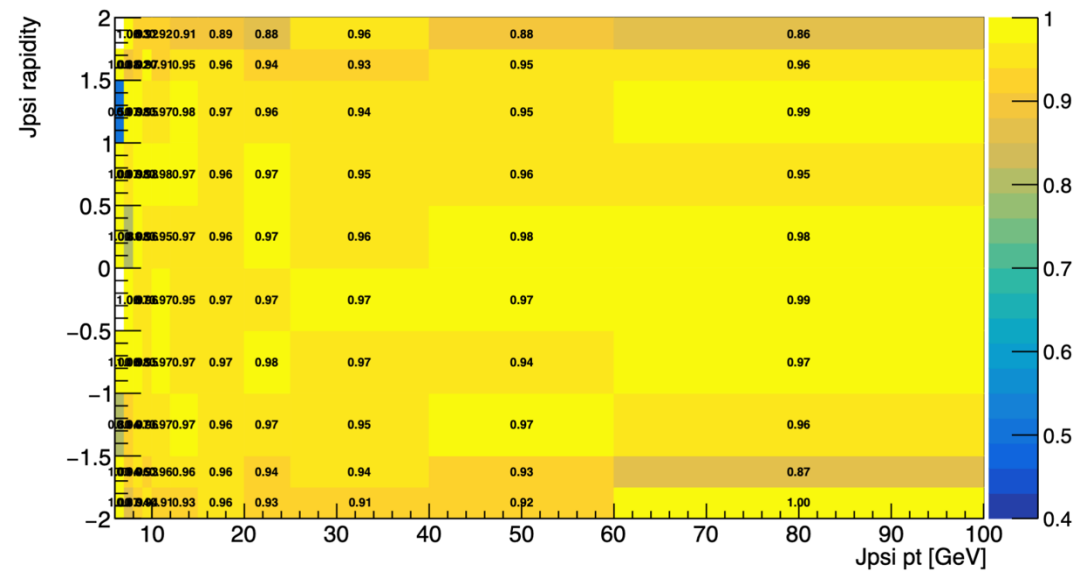
reconstruct probability



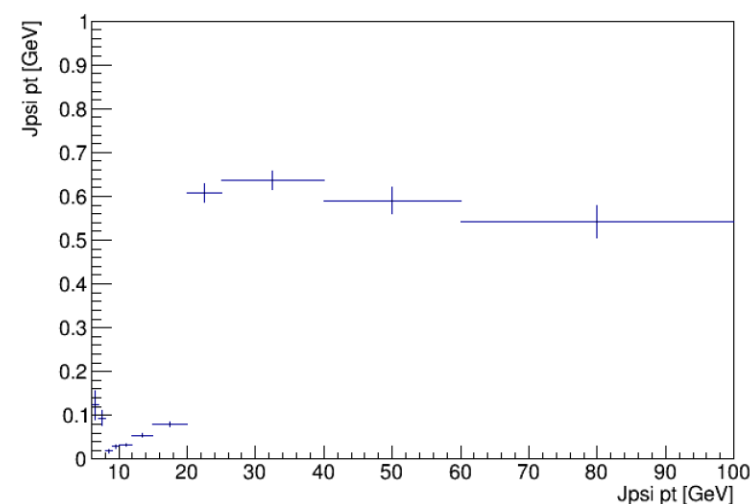
selection probability



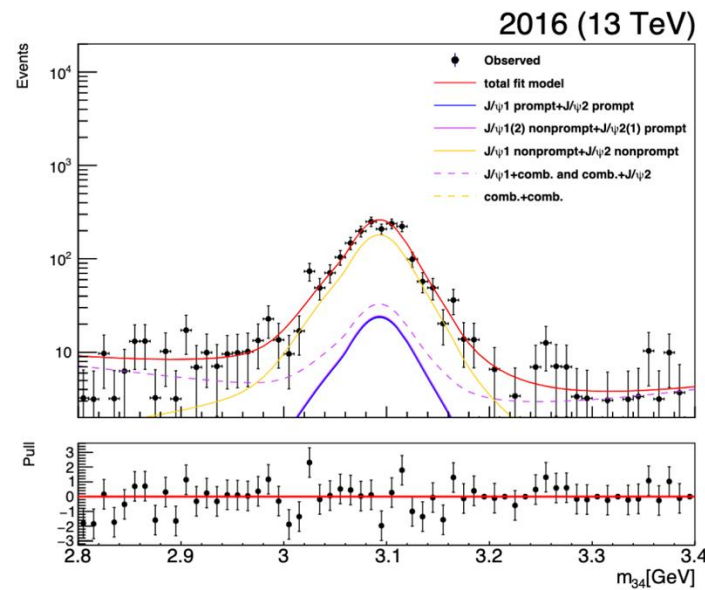
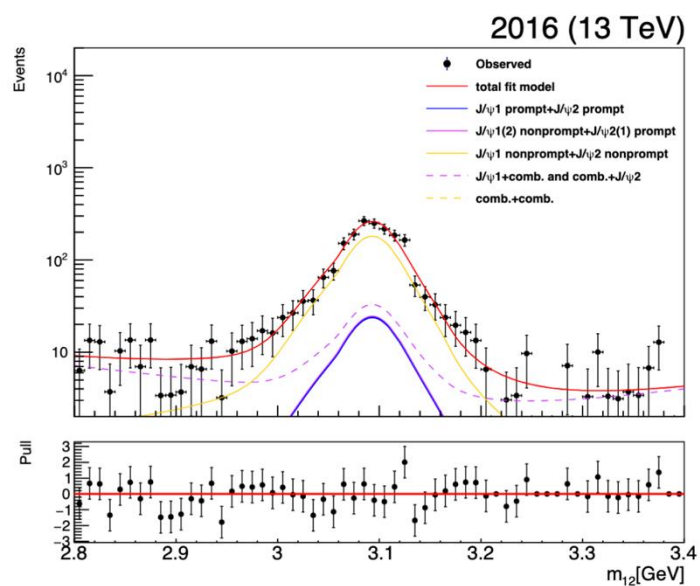
vertex probability



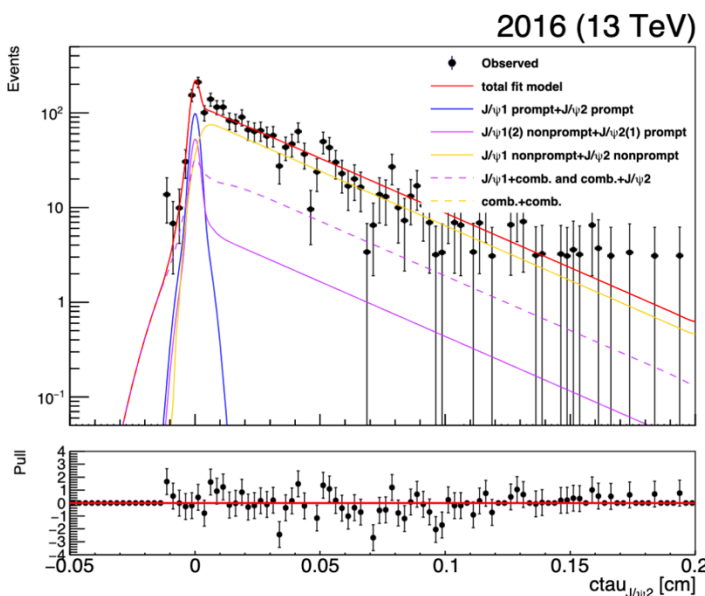
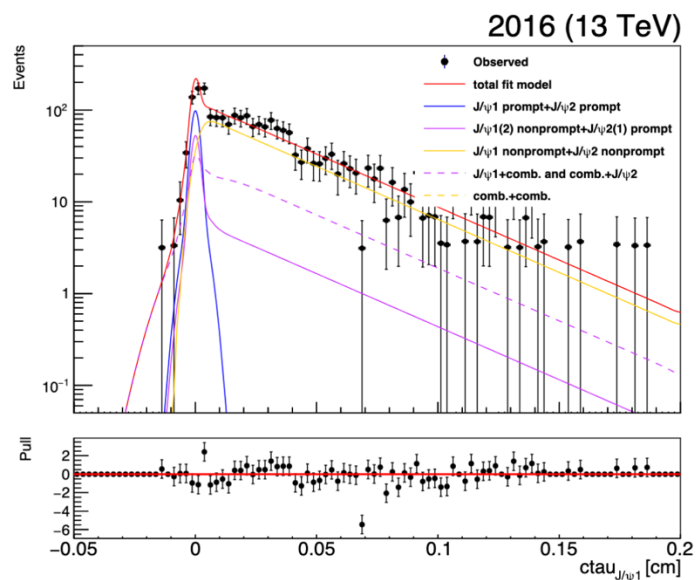
pass HLT probability



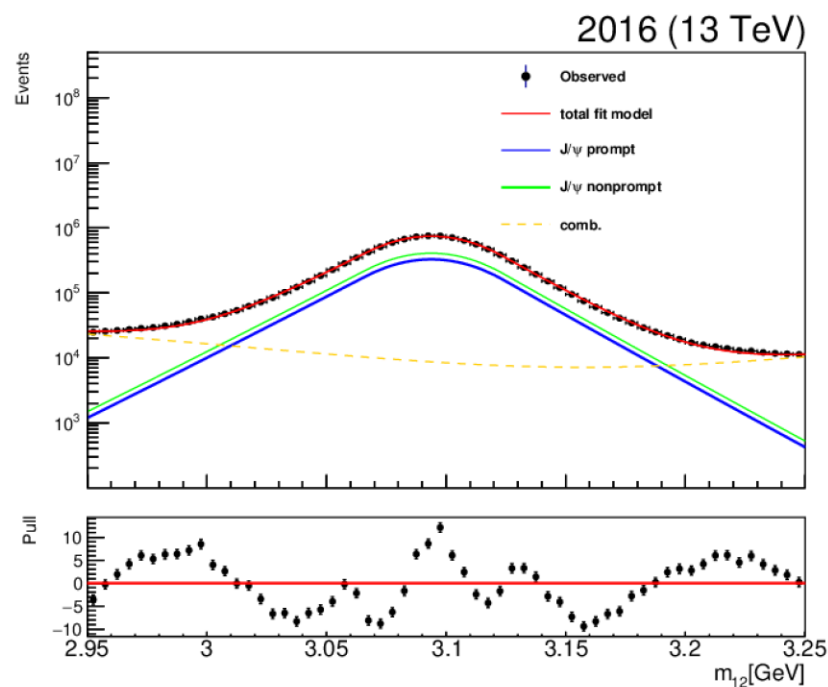
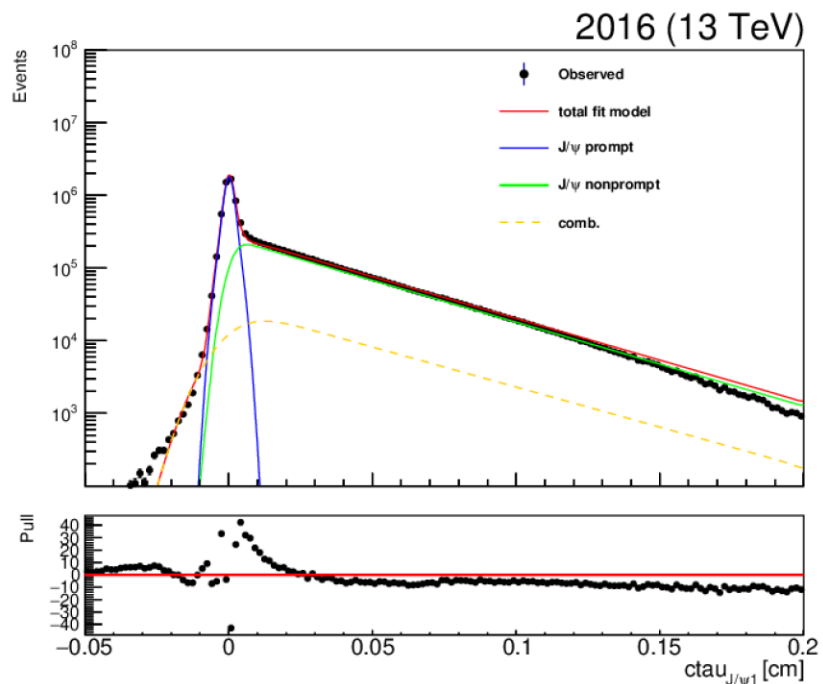
HLT_Dimuon20_Jpsi



- Phase space: Jpsi: $p_t > 20 \text{ GeV}$, $|y| < 2$
- Muon: $p_t > 3.5 \text{ GeV}$, $|y| < 2.4$



- Double Jpsi cross section : $1.39 \pm 0.22 \text{ pb}$



cross section: 13171.8pb

$$\bullet \sigma_{eff} = \frac{\sigma_{J/\psi}^2}{2\sigma_{DPS \rightarrow J\psi J\psi}} = \frac{(13171.8 pb)^2}{2 * (1.39 * 0.59) pb} = 0.15 mb$$

- Phase space: Jpsi: $pt > 20 \text{ GeV}$, $|y| < 2$
- Muon: $pt > 3.5 \text{ GeV}$, $|y| < 2.4$