- Systematic uncertainty
  - Parameterization of Barrier radius: r=0.728656 -> 0.5 or 1.5
  - Parameterization of f0(500):

$E791$ type: $\Gamma(s) = \sqrt{1-\frac{4m_{\pi^\pm}^2}{s}}\Gamma$ → Zou and Bugg's approach: $\Gamma(s) = g_1\frac{\rho_{\pi\pi}(s)}{\rho_{\pi\pi}(M_\sigma^2)} + g_2\frac{\rho_{4\pi}(s)}{\rho_{4\pi}(M_\sigma^2)}$ with $g_1 = f(s)\frac{s-m_\pi^2/2}{M_\sigma^2-m_\pi^2/2}e^{-\frac{s-M_\sigma^2}{a}}$

  - Parameterization of f0(980):
    g1 = 0.165±0.018 GeV2, g2/g1 =4.2 ± 0.33, vary by one time error
  - Mψ(3686) region:
    Signal: [3.68,3.692]GeV -> [3.682,3.69] GeV
    Sideband: [3.658,3.67]&[3.702, 3.714]GeV -> [3.66, 3.668]&[3.704, 3.712] GeV
  - Zc(4020) mass and width:
    scanned result: (4023.0 ± 0.9)MeV/c2 and (11.4 ±1.8)MeV/c2, varied by one time error

- Zc decay parameters: Zc->pi psip coupling parameter fixed in nominal fit, varied by one time error

- Parameterization of Zc(3900):
  Nominal: 3897.6 MeV/c2 and 43.5 MeV/c2 -> results of liaolz: 3884.15 ± 0.76 MeV/c2 and Γ = 36.14 ± 1.37 MeV/c2

- Parameterization of Zc(4020): Breit-Wigner -> flatte $$BW(s) = \frac{1}{s - M^2 + i\left(g_1\rho_{\pi^\pm\psi(3686)}(s) + g_2\rho_{D^*\bar{D}^*}(s)\right)}$$

- Fitte Performance: With IO check result: $\sqrt{\mu^2 + \Delta\mu^2} \times \delta_{stat}$

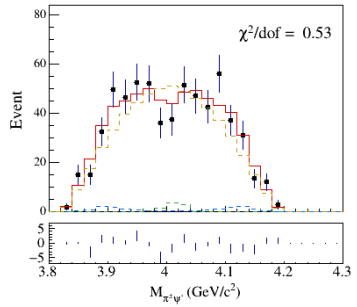
Source	4180	4190	4200	4210	4220	4230	4237	4246	4260	4270
Barrier radius	3.65	13.85	1.89	3.14	11.50	6.99	1.30	1.62	0.90	5.73
$f_0(500)$ parameterization	10.67	26.90	17.32	16.84	13.58	2.27	5.47	10.84	6.54	8.73
$f_0(980)$ parameterization	2.12	7.14	0.10	1.13	4.31	2.27	2.54	0.62	0.14	1.32
$M_{\psi(3686)}$ signal region	5.01	8.17	28.00	2.33	20.78	2.76	15.36	17.43	0.90	0.64
$Z_c(4020)$ mass and width	-	-	-	-	-	-	-	-	-	-
Z_c decay parameters	16.90	15.43	9.04	4.34	23.82	2.76	4.77	1.97	1.18	8.64
$Z_c(3900)$ parameterization	11.51	11.01	8.02	20.56	8.64	9.91	43.50	29.75	25.61	51.77
$Z_c(4020)$ parameterization	-	-	-	-	-	-	-	-	-	-
Fitter performance	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total	24.72	37.80	35.63	27.89	38.01	14.44	47.17	36.73	27.16	53.87

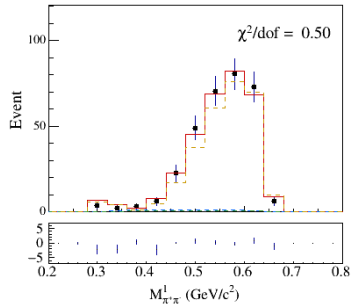
Source	4280	4290	4315	4340	4360	4380	4400	4420	4440
Barrier radius	0.86	1.18	6.71	10.68	9.74	0.48	0.71	2.37	4.00
$f_0(500)$ parameterization	1.70	2.88	23.84	209.40	3.25	18.62	50.78	37.78	36.25
$f_0(980)$ parameterization	0.50	0.53	2.78	2.99	1.30	0.48	0.43	1.63	0.38
$M_{\psi(3686)}$ signal region	18.50	7.30	12.27	116.67	2.60	33.65	8.27	27.85	13.50
$Z_c(4020)$ mass and width	-	-	8.10	1.71	3.25	2.39	4.28	10.22	3.62
Z_c decay parameters	2.69	0.76	7.87	50.00	8.44	11.46	8.27	4.44	2.00
$Z_c(3900)$ parameterization	1.85	0.64	52.55	56.41	66.23	26.49	6.85	30.22	2.75
$Z_c(4020)$ parameterization	-	-	2.78	0.00	2.60	6.68	6.70	8.15	3.25
Fitter performance	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total	19.82	10.01	60.86	251.60	68.01	48.98	53.50	57.89	39.80

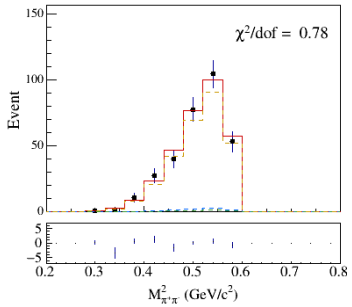
Table 13: Summary of systematic uncertainties for $Z_c(4020)$ fraction in percentage.

Source	4315	4340	4360	4380	4400	4420	4440
Barrier radius	1.25	1.53	0.49	1.04	0.88	0.90	0.52
$f_0(500)$ parameterization	21.29	31.30	23.81	25.74	53.43	25.65	1.90
$f_0(980)$ parameterization	1.88	0.76	0.82	1.04	0.88	0.36	0.09
$M_{\psi(3686)}$ signal region	15.87	3.82	14.29	23.21	17.05	0.18	7.39
$Z_c(4020)$ mass and width	9.19	21.37	1.81	0.74	2.64	4.93	2.51
Z_c decay parameters	1.04	6.11	1.97	3.87	1.41	1.17	2.46
$Z_c(3900)$ parameterization	12.11	24.43	1.15	6.99	8.96	1.97	5.31
$Z_c(4020)$ parameterization	5.43	12.21	3.12	5.80	6.50	3.05	3.11
Fitter performance	3.44	3.44	3.44	3.44	3.44	3.44	3.44
Total	31.36	47.42	28.32	36.24	57.36	26.63	10.98

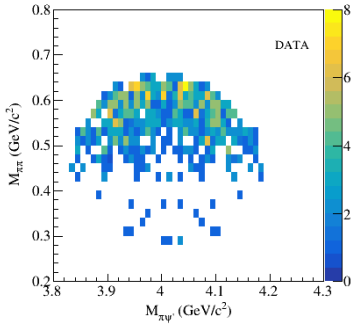
Source	Mass	Width
Barrier radius	0.00	1.85
$f_0(500)$ parameterization	0.02	49.93
$f_0(980)$ parameterization	0.00	1.40
$M_{\psi(3686)}$ signal region	0.02	2.18
$Z_c(3900)$ parameterization	0.01	0.02
$Z_c(4020)$ parameterization	0.04	-
Fitter performance	0.01	2.18
Total	0.05	50.04

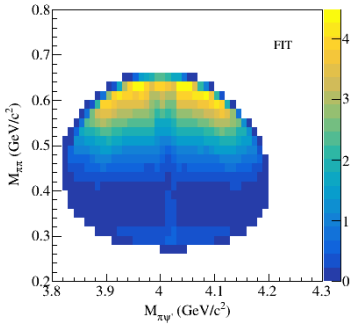


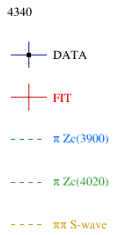




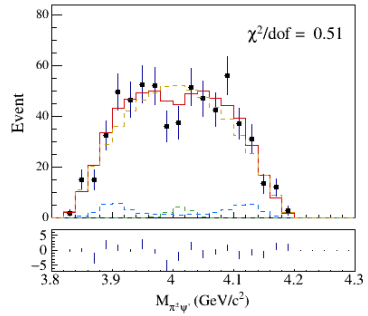
$E791$ type: $\Gamma(s) = \sqrt{1 - \frac{4m_{\pi^\pm}^2}{s}}\Gamma$

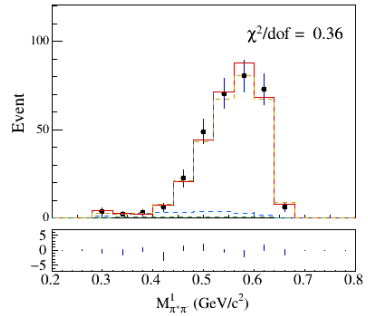


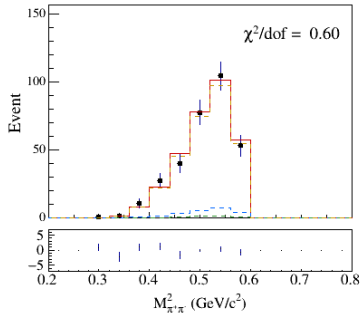




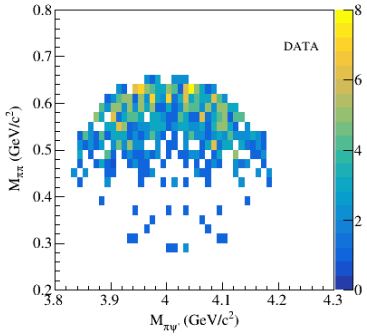
	#pi Zc(3900)|	#pi Zc(4020)|	#pi#pi S-wave
#pi Zc(3900)|	0.0252|	-0.00329|	0.0988
#pi Zc(4020)|		0.0141|	-0.0393
#pi#pi S-wave|				0.905

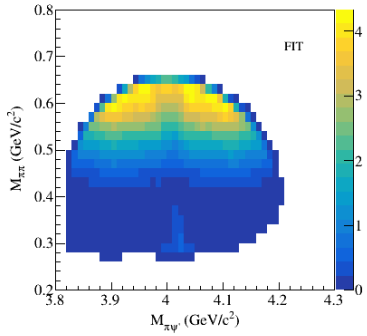


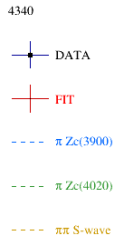




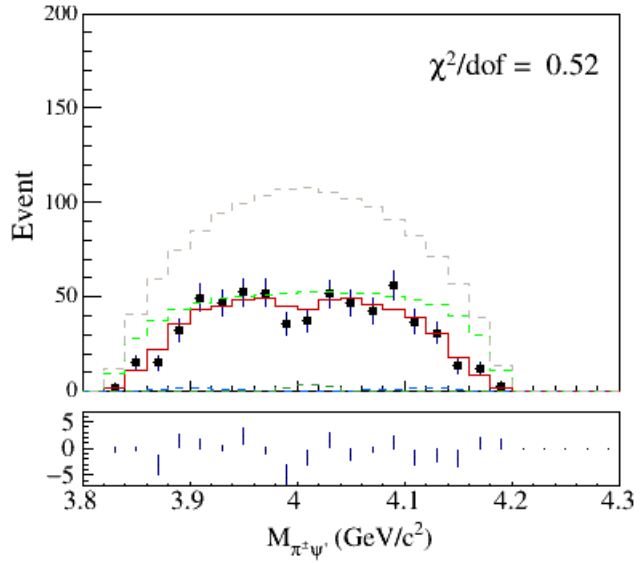
Zou and Bugg's approach: $\Gamma(s) = g_1 \frac{\rho_{\pi\pi}(s)}{\rho_{\pi\pi}(M_\sigma^2)} + g_2 \frac{\rho_{4\pi}(s)}{\rho_{4\pi}(M_\sigma^2)}$ with $g_1 = f(s)\frac{s-m_\pi^2/2}{M_\sigma^2 - m_\pi^2/2} e^{-\frac{s-M_\sigma^2}{a}}$

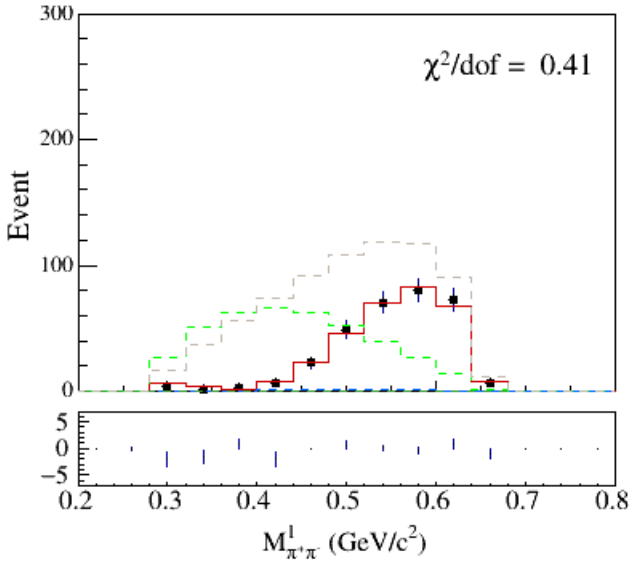




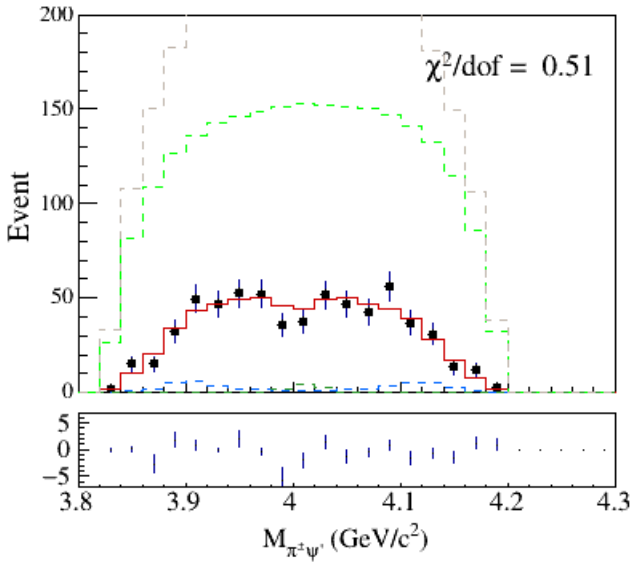


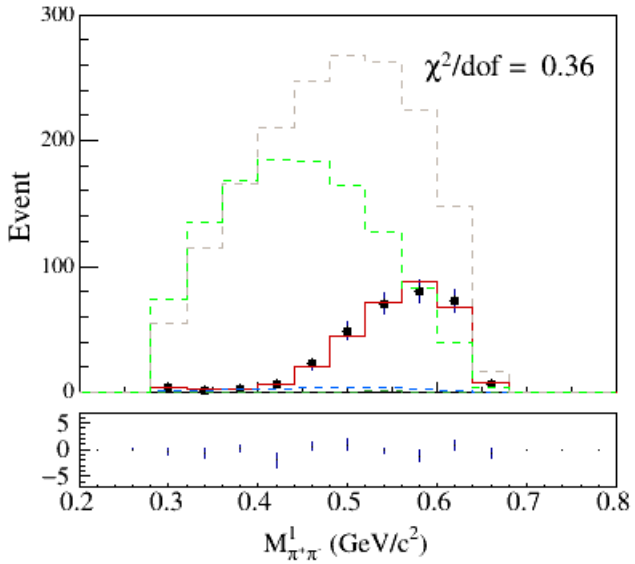
|#pi Zc(3900)	|#pi Zc(4020)	|#pi#pi S-wave	
#pi Zc(3900)|	0.0724|	-0.00946|	-0.00799
#pi Zc(4020)|		0.0172|	-0.031
#pi#pi S-wave|				0.959





*E*791 type: $\Gamma(s) = \sqrt{1-\frac{4m^2_{\pi^\pm}}{s}}\Gamma$





Zou and Bugg's approach: $\Gamma(s) = g_1\frac{\rho_{\pi\pi}(s)}{\rho_{\pi\pi}(M^2_\sigma)} + g_2\frac{\rho_{4\pi}(s)}{\rho_{4\pi}(M^2_\sigma)}$ with $g_1 = f(s)\frac{s-m^2_\pi/2}{M^2_\sigma - m^2_\pi/2}e^{-\frac{s-M^2_\sigma}{a}}$

Table 7: The significances of $Z_c(3900)$ for $J^P = 1^+$ over other J^P

J^P assumption	$\Delta(-\ln\mathcal{L})$	$\delta(NDF)$	Significance
1^+over 0^-	47.7	22	6.6σ
1^+over 1^-	31.7	22	4.5σ
1^+over 2^-	42.1	22	5.9σ
1^+over 2^+	38.0	22	5.4σ
1^-over 1^+	8.8	10	1.9σ

Table 8: The significances of $Z_c(4020)$ for $J^P = 1^+$ over other J^P

J^P assumption	$\Delta(-\ln\mathcal{L})$	$\delta(NDF)$	Significance
1^+over 0^-	40.8	14	6.8σ
1^+over 1^-	25.6	14	4.6σ
1^+over 2^-	43.9	14	7.1σ
1^+over 2^+	47.9	14	7.6σ
1^-over 1^+	17.1	6	4.5σ

1-

$$U_{\mu\nu(PP)} = (\epsilon_{\mu\alpha\beta\gamma}p^{\alpha}_{(Y)}\tilde{T}^{\beta}_{(Z_c^+\pi^-)})g^{\gamma\rho}(\epsilon_{\rho\delta\sigma\nu}p^{\delta}_{(Z_c)}\tilde{t}^{\sigma}_{(\psi'\pi^+)}) + (\epsilon_{\mu\alpha\beta\gamma}p^{\alpha}_{(Y)}\tilde{T}^{\beta}_{(Z_c^-\pi^+)})g^{\gamma\rho}(\epsilon_{\rho\delta\sigma\nu}p^{\delta}_{(Z_c)}\tilde{t}^{\sigma}_{(\psi'\pi^-)}),$$

Zc3900:
H0: f0500+f0980+Zc(0−/1−/2−/2+)
H1: f0500+f0980+Zc(0−/1−/2−/2+) + Zc(1+)

Zc4020:
H0: f0500+f0980+Zc(0−/1−/2−/2+)
H1: f0500+f0980+Zc3900+Zc(0−/1−/2−/2+) + Zc(1+)

1+

$$U^{\mu\nu}_{(Y\to Z_c^\pm\pi^\mp)SS} = \tilde{g}^{\mu\nu}_{(Z_c^+)}f^{(Z_c^+)} + \tilde{g}^{\mu\nu}_{(Z_c^-)}f^{(Z_c^-)}$$
$$U^{\mu\nu}_{(Y\to Z_c^\pm\pi^\mp)SD} = \tilde{t}^{(2)\mu\nu}_{(\psi'\pi^+)}f^{(Z_c^+)} + \tilde{t}^{(2)\mu\nu}_{(\psi'\pi^-)}f^{(Z_c^-)}$$
$$U^{\mu\nu}_{(Y\to Z_c^\pm\pi^\mp)DS} = \tilde{T}^{(2)\mu\lambda}_{(Z_c^+\pi^-)}\tilde{g}_{(Z_c^+)\lambda\sigma}g^{\sigma\nu}f^{(Z_c^+)} + \tilde{T}^{(2)\mu\lambda}_{(Z_c^+\pi^+)}\tilde{g}_{(Z_c^-)\lambda\sigma}g^{\sigma\nu}f^{(Z_c^-)},$$
$$U^{\mu\nu}_{(Y\to Z_c^\pm\pi^\mp)DD} = \tilde{T}^{(2)\mu\lambda}_{(Z_c^+\pi^-)}\tilde{t}^{(2)}_{(\psi'\pi^+)\lambda\sigma}g^{\sigma\nu}f^{(Z_c^+)} + \tilde{T}^{(2)\mu\lambda}_{(Z_c^-\pi^+)}\tilde{t}^{(2)}_{(\psi'\pi^-)\lambda\sigma}g^{\sigma\nu}f^{(Z_c^-)}$$

$$\sigma_i = R_i \times \sigma(e^+e^- \to \pi^+\pi^-\psi(3686)),$$

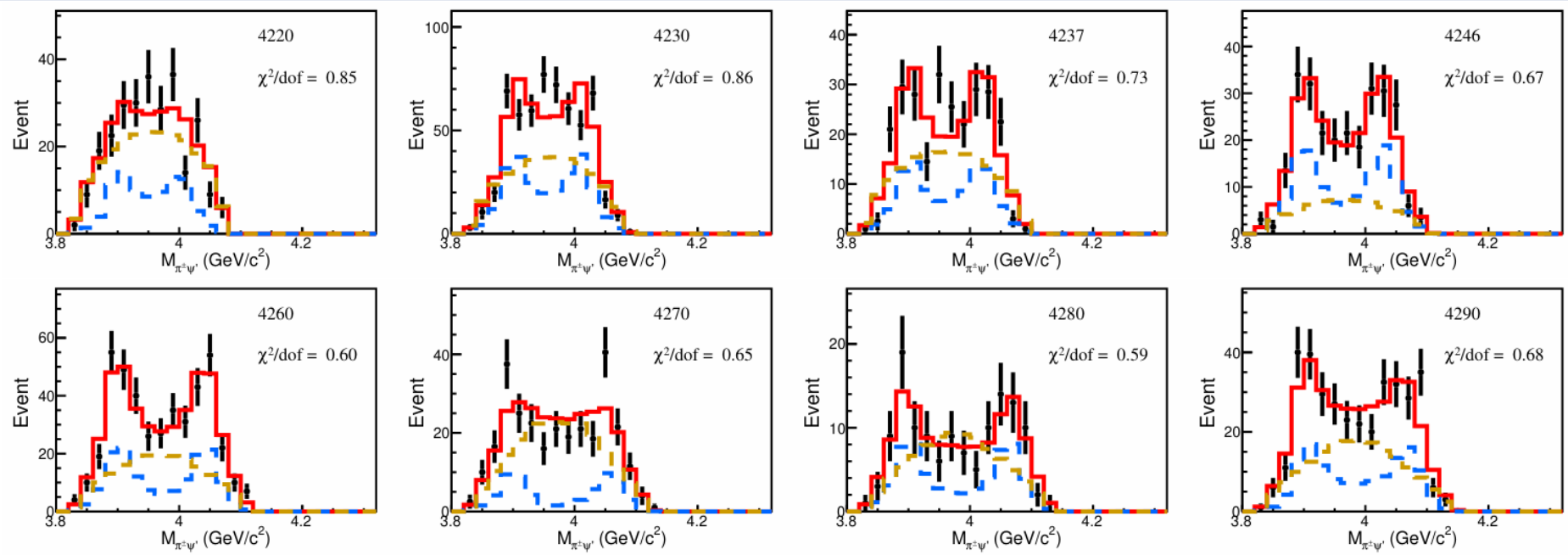
$$e^+e^- \to \pi^+\pi^-\psi(3686)$$

$$\psi(3686) \to \pi^+\pi^- J/\psi$$

$$J/\psi \to l^+l^-$$

The branching fraction of two sub-decays?

Zc3900 from pingrg



Zc3900 from liaolz