

Update cross section of $e^+e^- \rightarrow \gamma X(3872)$

Hang Zhou, Zhiqing Liu

Shandong University

hang-zhou@outlook.com

April 23, 2019

Update on $e^+e^- \rightarrow \gamma X(3872)$ cross section measurement with data of new energy points.

Charged Tracks:

- $|z| < 10$ cm, $r < 1$ cm, $|\cos \theta| < 0.93$;
- $n_{\text{Good}}=4$ && $n_{\text{Charge}}=0$;
- $p_{\text{lepton}} > 1.0$ GeV/c, $p_{\pi} < 1.0$ GeV/c;
- $E_e > 1.1$ GeV, $E_{\mu} < 0.35$ GeV.

Good Photons:

- $E_{\gamma} \geq 25$ MeV in barrel EMC ($|\cos \theta| \leq 0.8$);
- $E_{\gamma} \geq 50$ MeV in end-cap ($0.86 \leq |\cos \theta| \leq 0.92$);
- $\Delta_{\text{angle}} \geq 20$;
- $0 < t < 14$ (in unit of 50 ns).

Kinematic Fit:

- 4C fit for $\gamma\pi^+\pi^-l^+l^-$, $\chi^2 < 200$.

BOSS Version:

- BOSS.7.0.3.

Generator:

- $Y(4260) \rightarrow \gamma X(3872)$ P2GC1;
- $X(3872) \rightarrow \rho^0 J/\psi$ PHSP;
- $\rho^0 \rightarrow \pi^+ \pi^-$ VSS;
- $J/\psi \rightarrow e^+ e^- / \mu^+ \mu^-$ PHOTOS VLL;

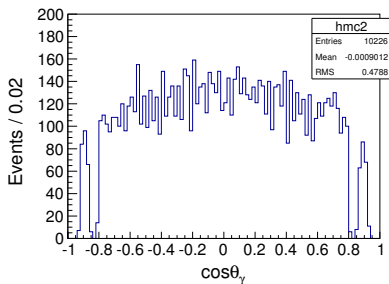
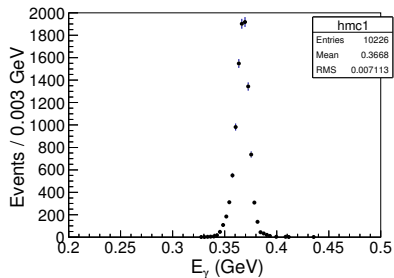
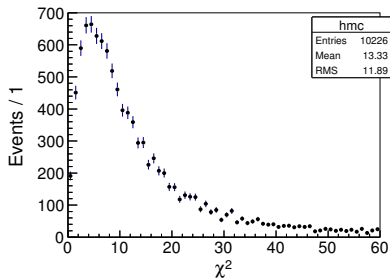
Signal MC:

- $Y(4260)$ is generated by 'KKMC'
- 'EvtGen' for the following decays
- Energy point: **4.258 GeV**
- Run number: **29677-30367**
- Signal MC events: **30000**

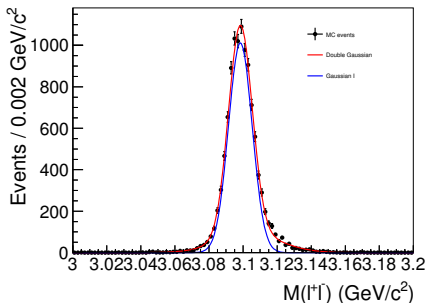
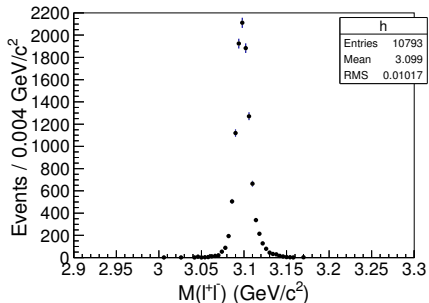
Cut flow

Total	30000
nGood=4&&nCharge=0	21554
$1 \leq n_{\text{Gam}} \leq 5$	17968
$1\pi^+1\pi^-1l^+1l^-$	15940
$2.8 < M_{J/\psi} < 4.0$	15341
after vertex fit	14949
pass 4C ($\chi^2 < 200$)	12395
pass 4C ($\chi^2 < 60$)	10819
e^+e^- events	5287
$\mu^+\mu^-$ events	6406
$\cos(\pi^+\pi^-) < 0.98$	10816
$M_{\gamma\pi^+\pi^-} > 0.6$	10793
$3.08 < M_{J/\psi} < 3.12$	10226
final efficiency	34.1%

Signal MC



J/ψ invariant mass combined

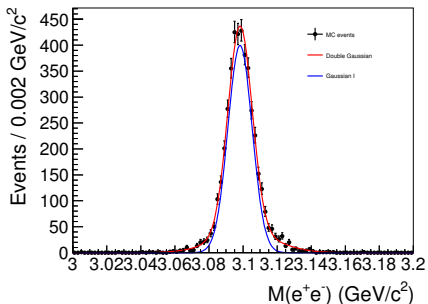
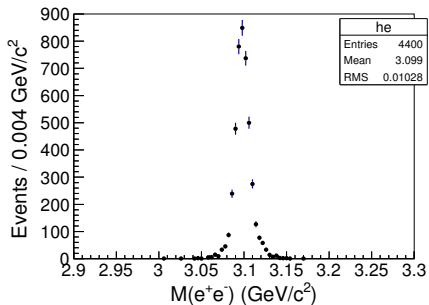


Double Gaussian Fit

$$M(J/\psi) = 3098.41 \quad \text{MeV}$$

$$\sigma = 6.93592 \quad \text{MeV}$$

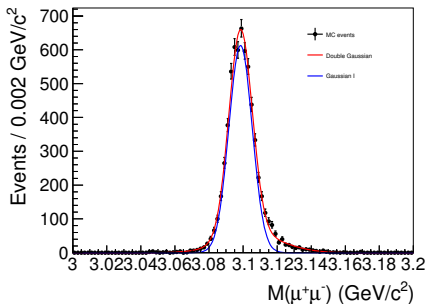
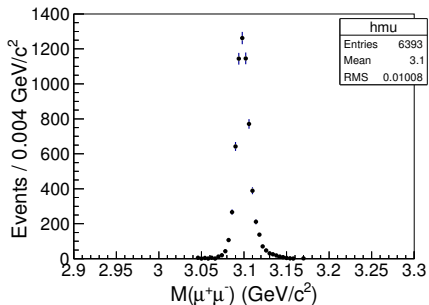
J/ψ invariant mass for e^+e^- pair



$$M(J/\psi) = 3098.22 \text{ MeV}$$

$$\sigma = 7.07563 \text{ MeV}$$

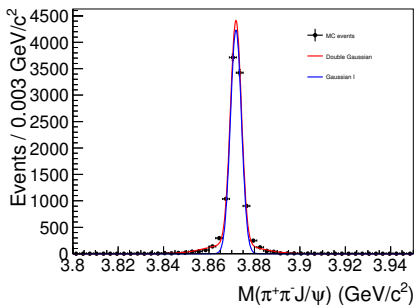
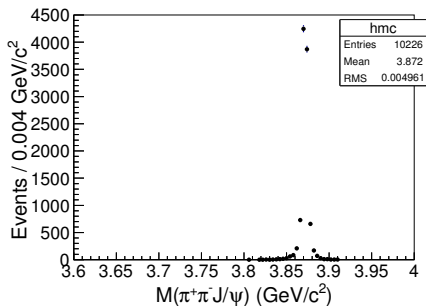
J/ψ invariant mass for $\mu^+\mu^-$ pair



$$M(J/\psi) = 3098.52 \text{ MeV}$$

$$\sigma = 6.84147 \text{ MeV}$$

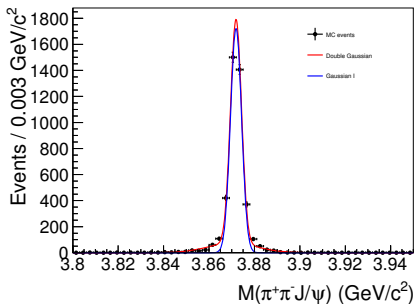
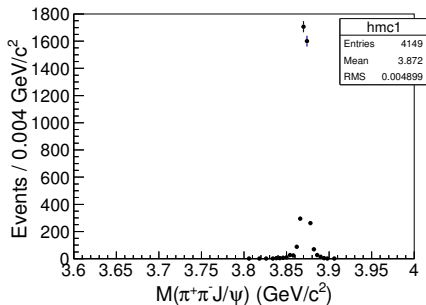
X(3872) invariant mass combined



$$M(X(3872)) = 3871.87 \text{ MeV}$$

$$\sigma = 2.42326 \text{ MeV}$$

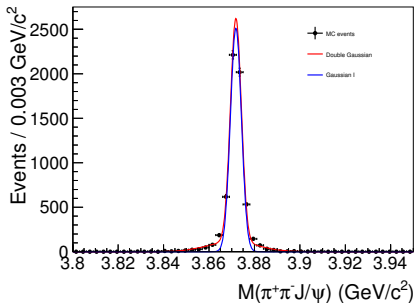
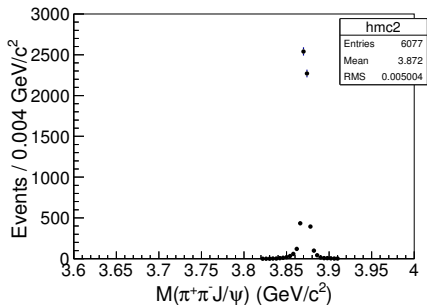
X(3872) invariant mass for e^+e^- pair



$$M(J/\psi) = 3871.90 \text{ MeV}$$

$$\sigma = 2.43661 \text{ MeV}$$

X(3872) invariant mass for $\mu^+\mu^-$ pair



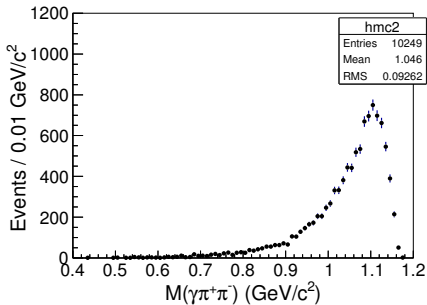
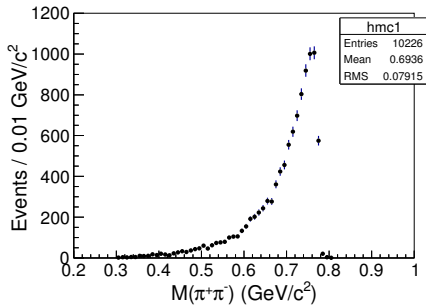
$$M(J/\psi) = 3871.85 \text{ MeV}$$

$$\sigma = 2.41358 \text{ MeV}$$



Lots of work to do!

Thanks for your attention!



$$N(M(\gamma\pi^+\pi^-) < 0.6) = 23$$