

# **2017 Data-Quality Checks**

## **Using Exclusive $X + J/\psi$ Channels**

*Ryan Mitchell*

*June 13, 2017*

# Basic Event Selection

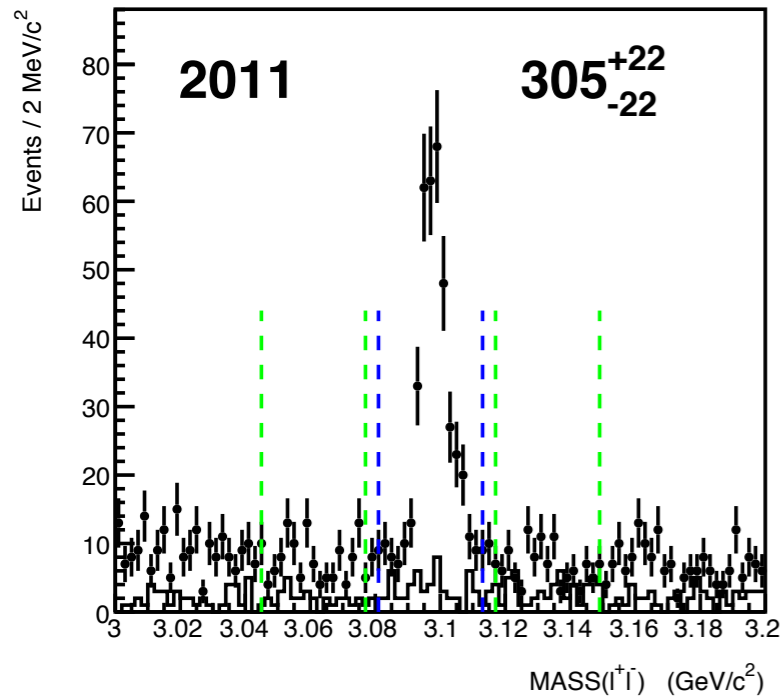
Look at the largest channels of the form  $e^+e^- \rightarrow XJ/\psi$  ( $\pi^+\pi^-J/\psi$ ,  $\pi^0\pi^0J/\psi$ ,  $\gamma_{ISR}\psi(2S)$ , *etc.*).

For all reactions, make the following basic selections:

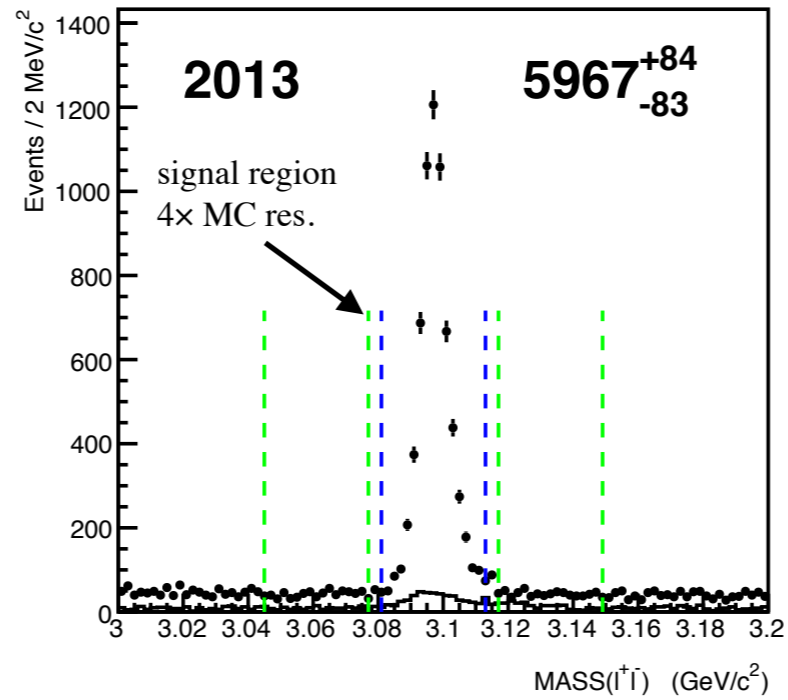
- \* Reconstruct  $\pi^0 \rightarrow \gamma\gamma$ ,  $\eta \rightarrow \gamma\gamma$ ,  $\mathbf{K}_S \rightarrow \pi^+\pi^-$ , and  $\mathbf{J}/\psi \rightarrow e^+e^-$  or  $\mu^+\mu^-$ .
- \* Use standard **track quality cuts** ( $V_R < 1\text{cm}$ ;  $|V_Z| < 10\text{cm}$ ;  $|\cos(\vartheta)| < 0.93$ ).
- \* For every  $\mathbf{K}_S$ , require  $L/\sigma > 2$ .
- \* For every **charged kaon**, require kaon probability  $>$  pion probability.
- \* To suppress  $\gamma \rightarrow e^+e^-$ , require the cosine of the opening angle between all oppositely charged tracks be less than 0.98.
- \* **Separate e and  $\mu$**  using  $E/p$ : for  $e^+e^-$ , at least one of them has  $E/p > 0.75$ ; for  $\mu^+\mu^-$ , both tracks have  $E/p < 0.25$ .
- \* Perform a **kinematic fit** to the initial four-momentum (4C), and include an additional mass constraint (1C) for every  $\pi^0 \rightarrow \gamma\gamma$ ,  $\eta \rightarrow \gamma\gamma$ , and  $\mathbf{K}_S \rightarrow \pi^+\pi^-$ . Require  $\chi^2/\text{dof} < 5$ .

# (I) Checks Using: $\pi^+\pi^-J/\psi$

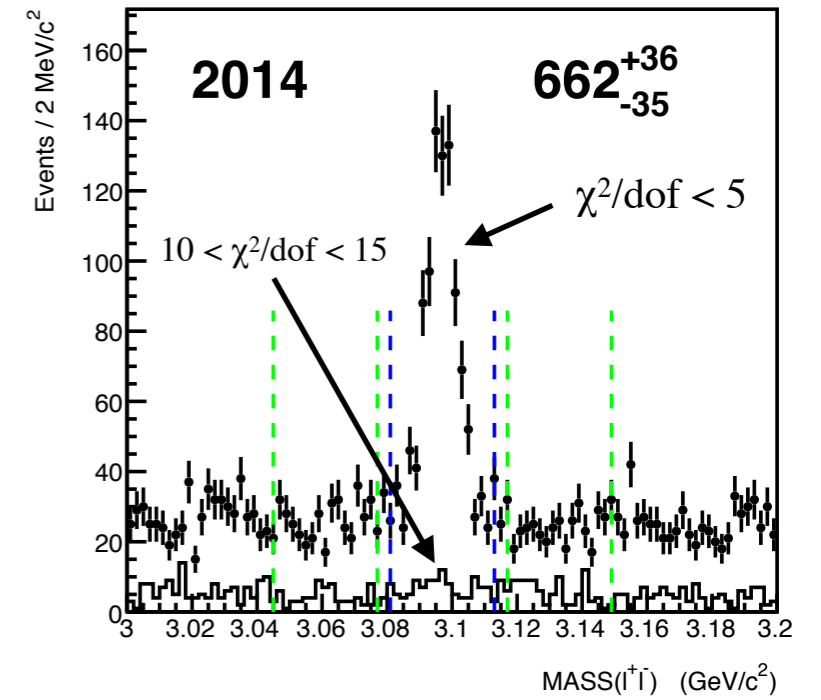
$\pi^+ \pi^- J/\psi$



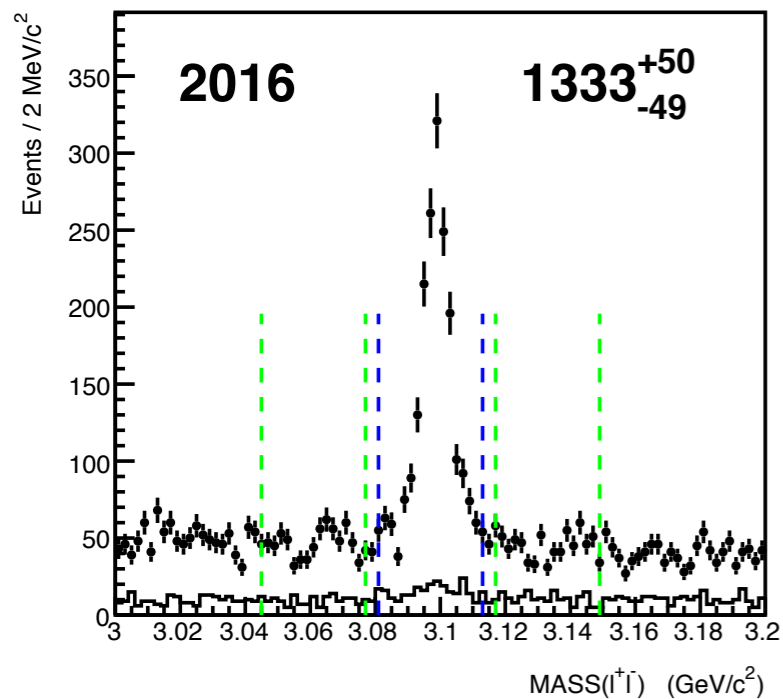
$\pi^+ \pi^- J/\psi$



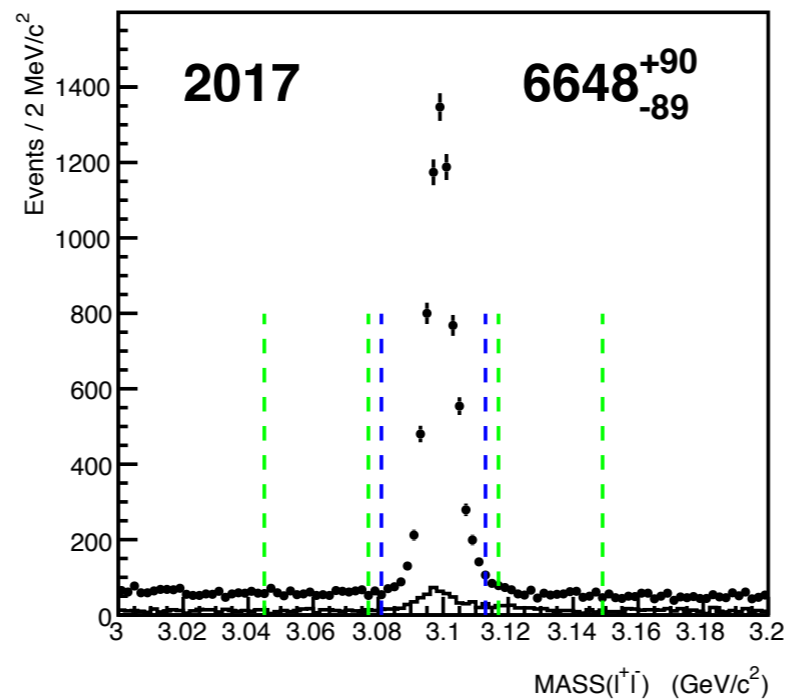
$\pi^+ \pi^- J/\psi$



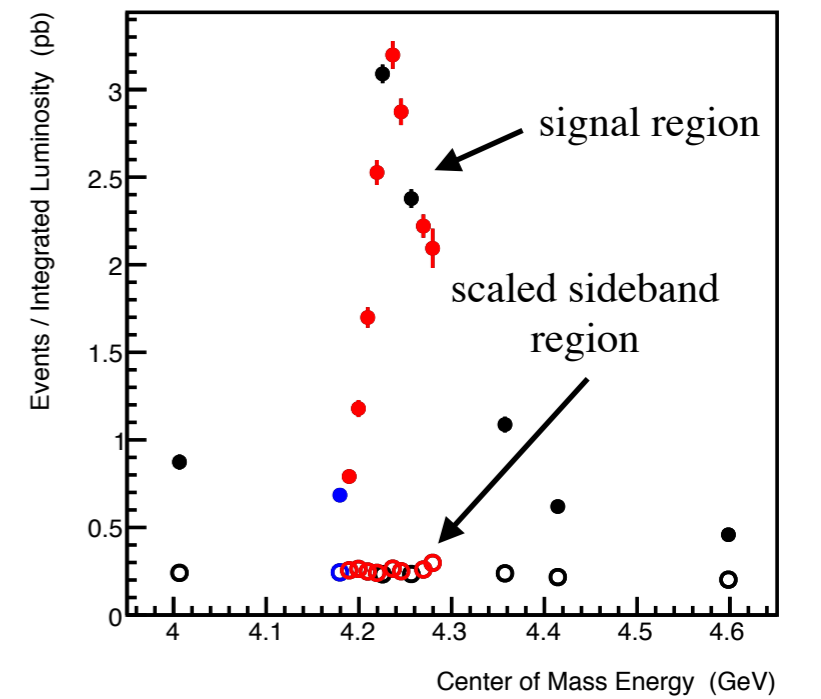
$\pi^+ \pi^- J/\psi$



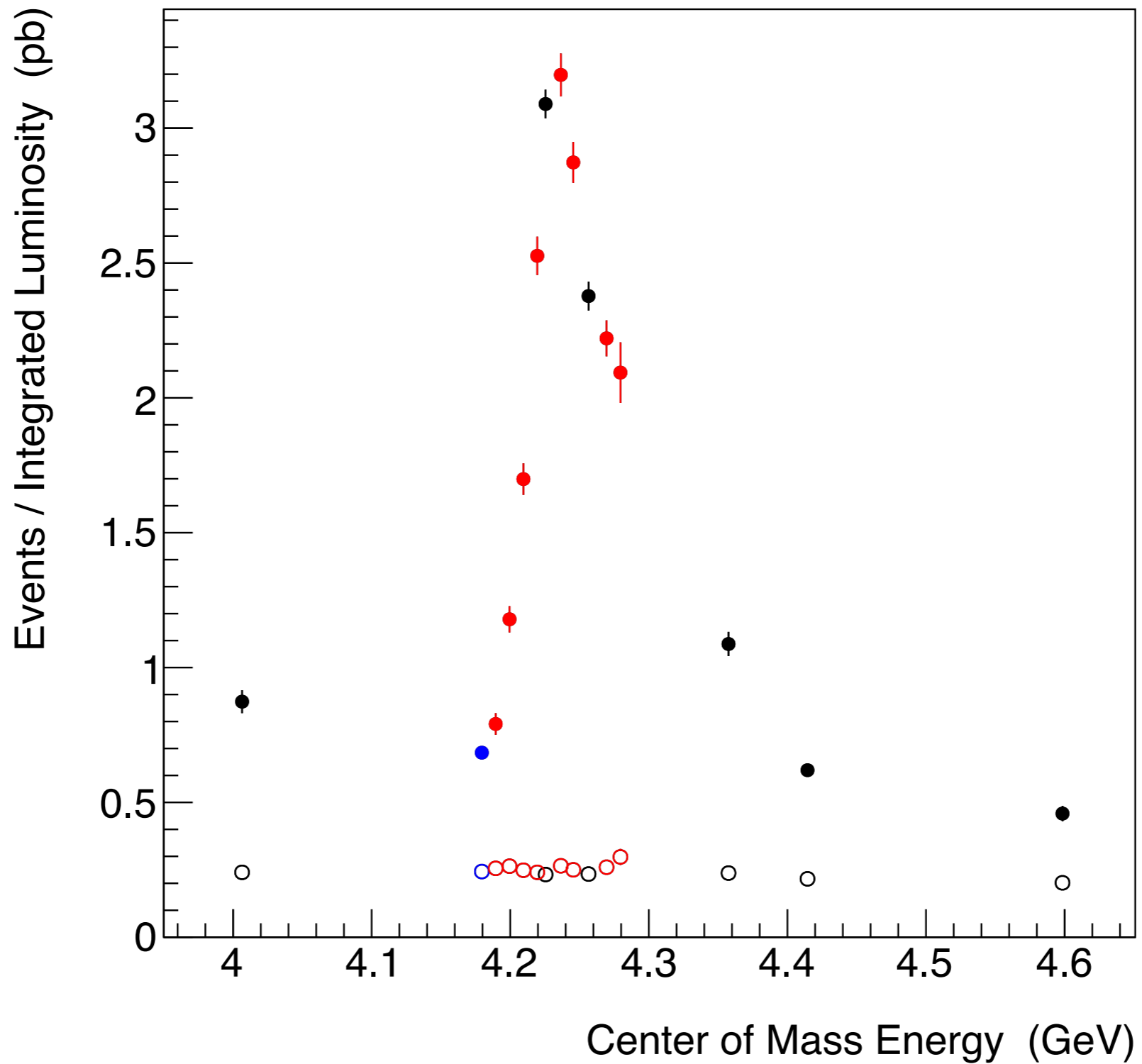
$\pi^+ \pi^- J/\psi$



$\pi^+ \pi^- J/\psi$

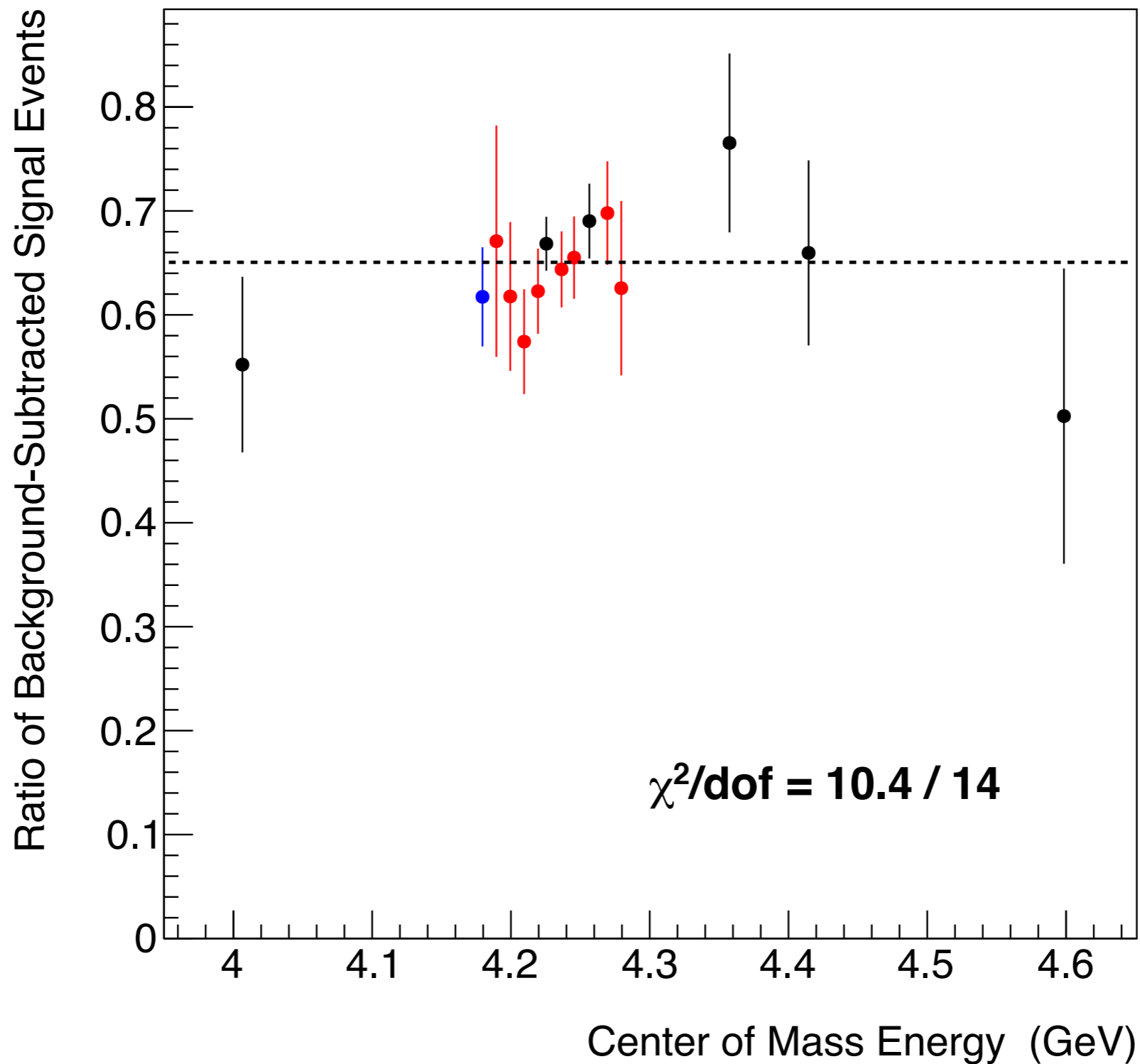


# (I) Checks Using: $\pi^+\pi^-J/\psi$



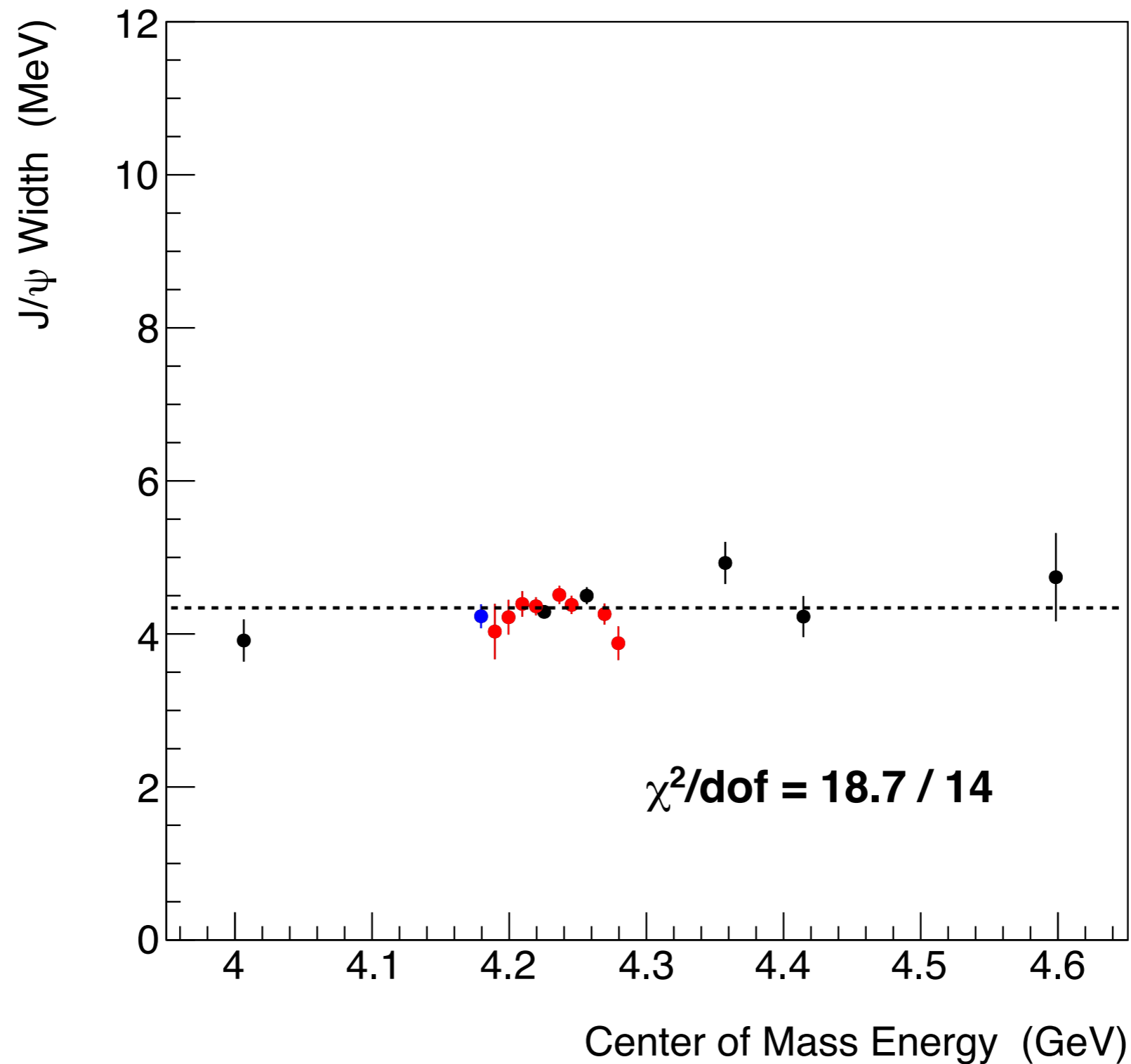
# (I) Checks Using: $\pi^+\pi^-J/\psi$

Ratio of  $\pi^+\pi^-J/\psi(ee)$  and  $\pi^+\pi^-J/\psi(\mu\mu)$



# (I) Checks Using: $\pi^+\pi^-J/\psi$

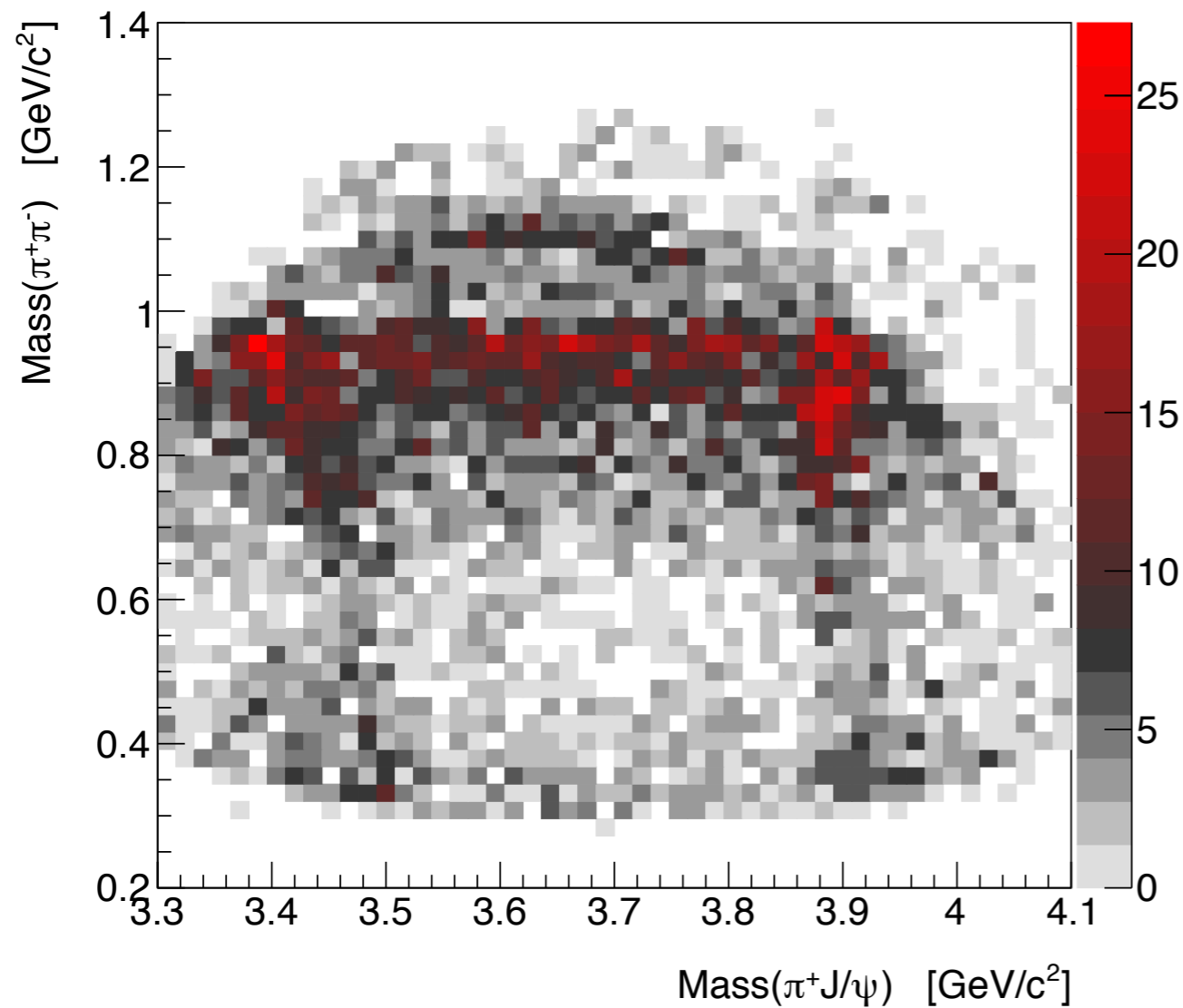
Use Gaussian fits to the  $J/\psi$  peak to probe the resolution...



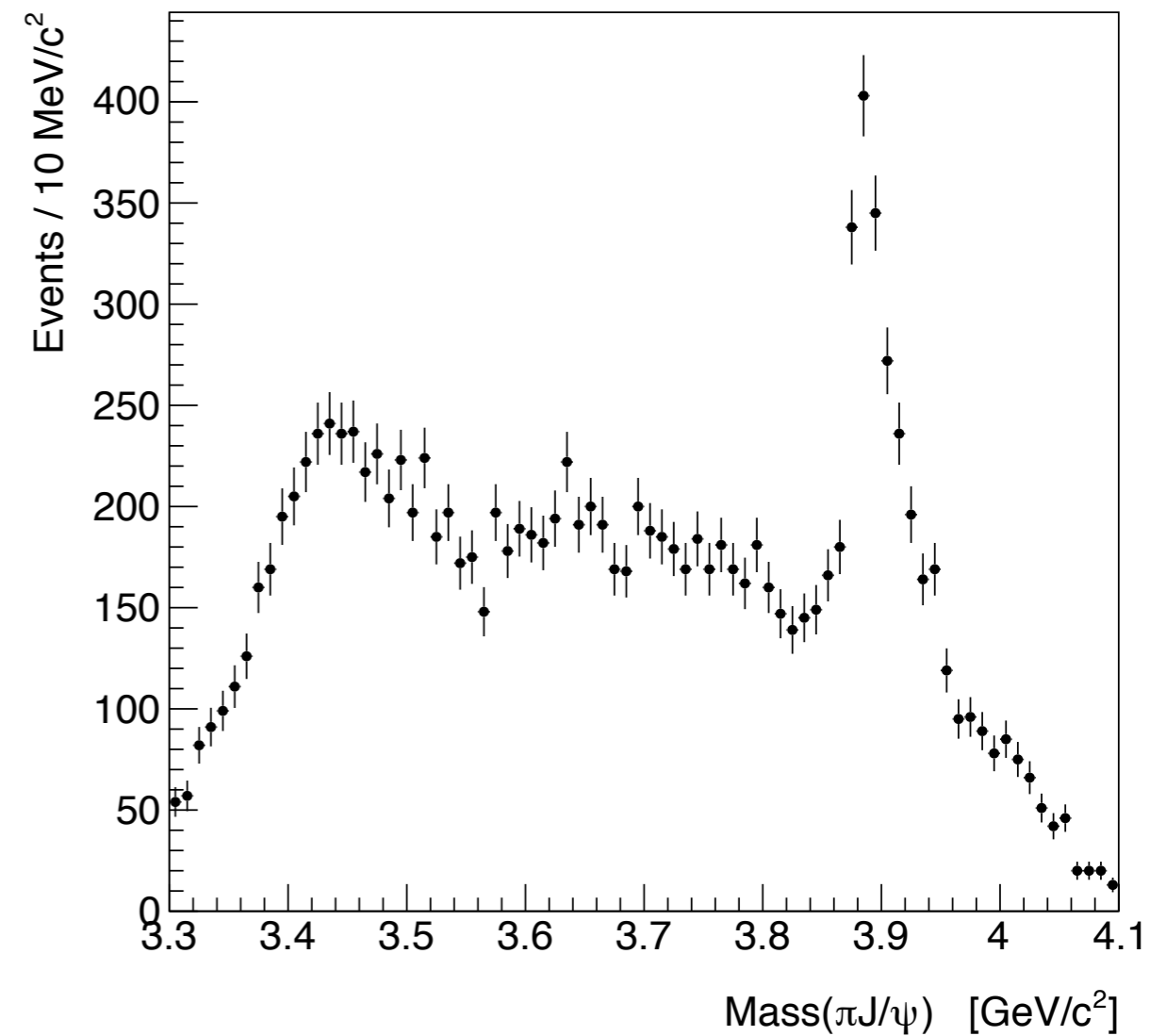
# (I) Checks Using: $\pi^+\pi^-J/\psi$

Take a peak at the  $Z_c(3900)$ ...

$\pi^+ \pi^- J/\psi$  for year 2013



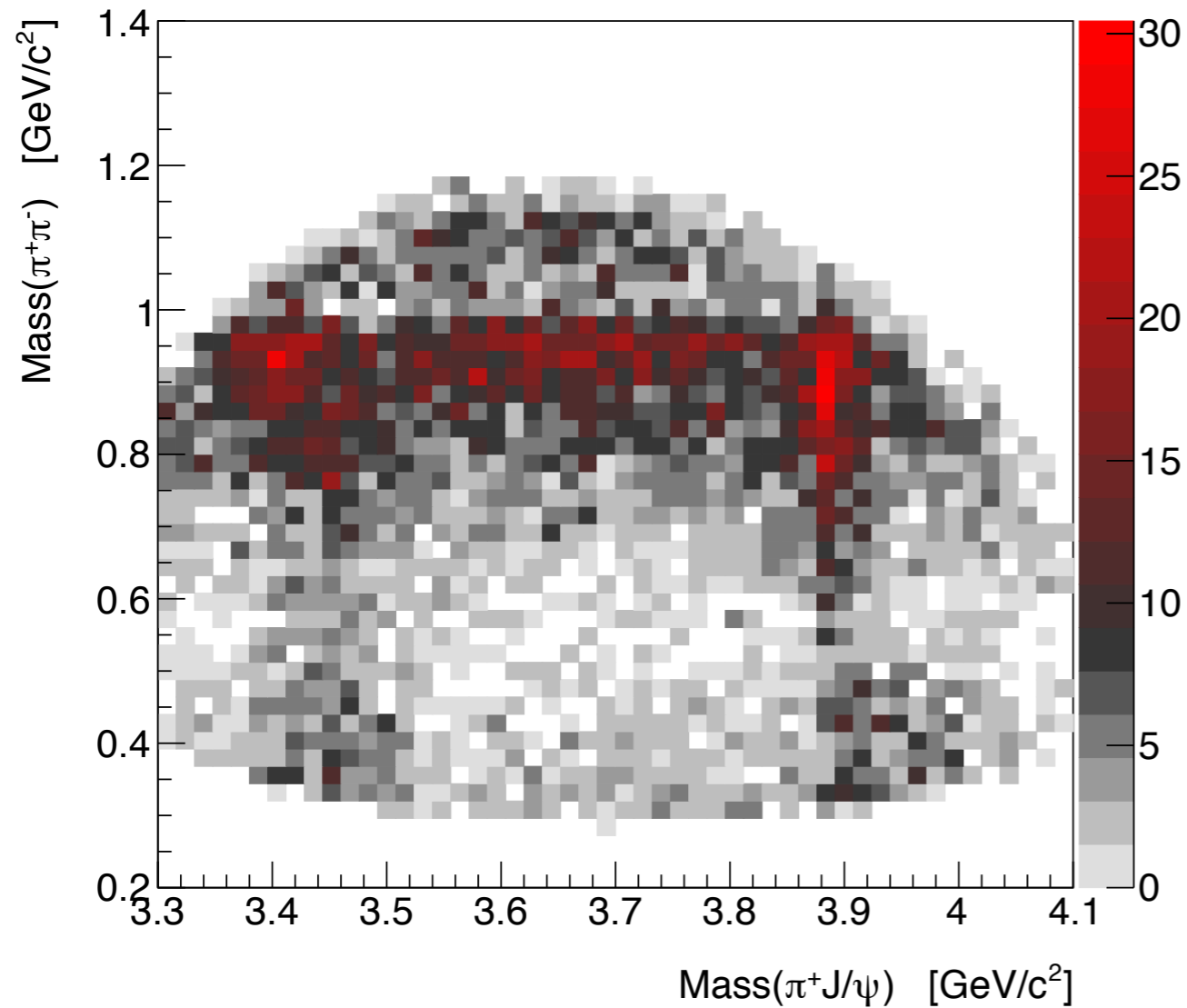
$\pi^+ \pi^- J/\psi$  for year 2013



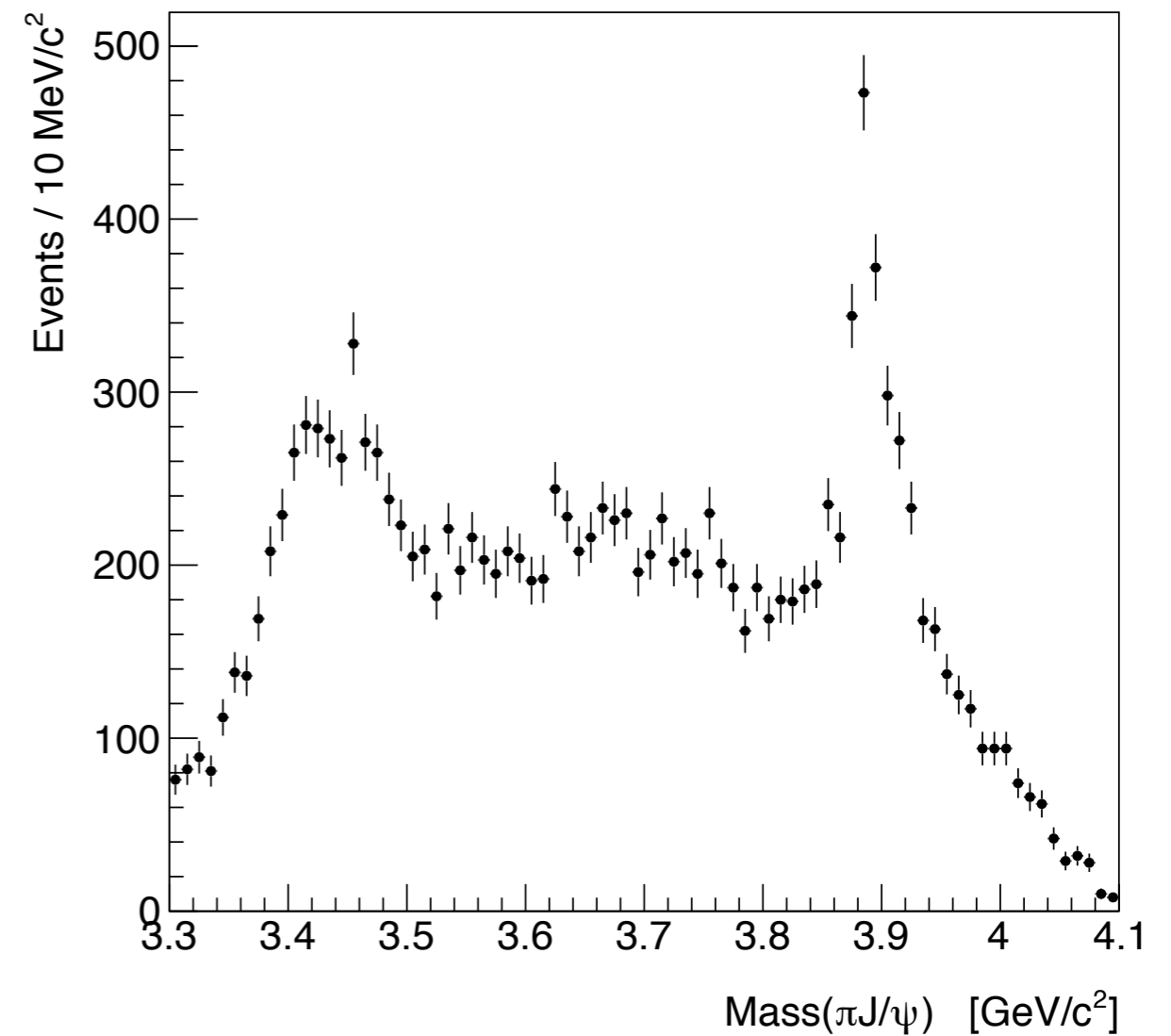
# (I) Checks Using: $\pi^+\pi^-J/\psi$

Take a peak at the  $Z_c(3900)$ ...

$\pi^+ \pi^- J/\psi$  for year 2017



$\pi^+ \pi^- J/\psi$  for year 2017

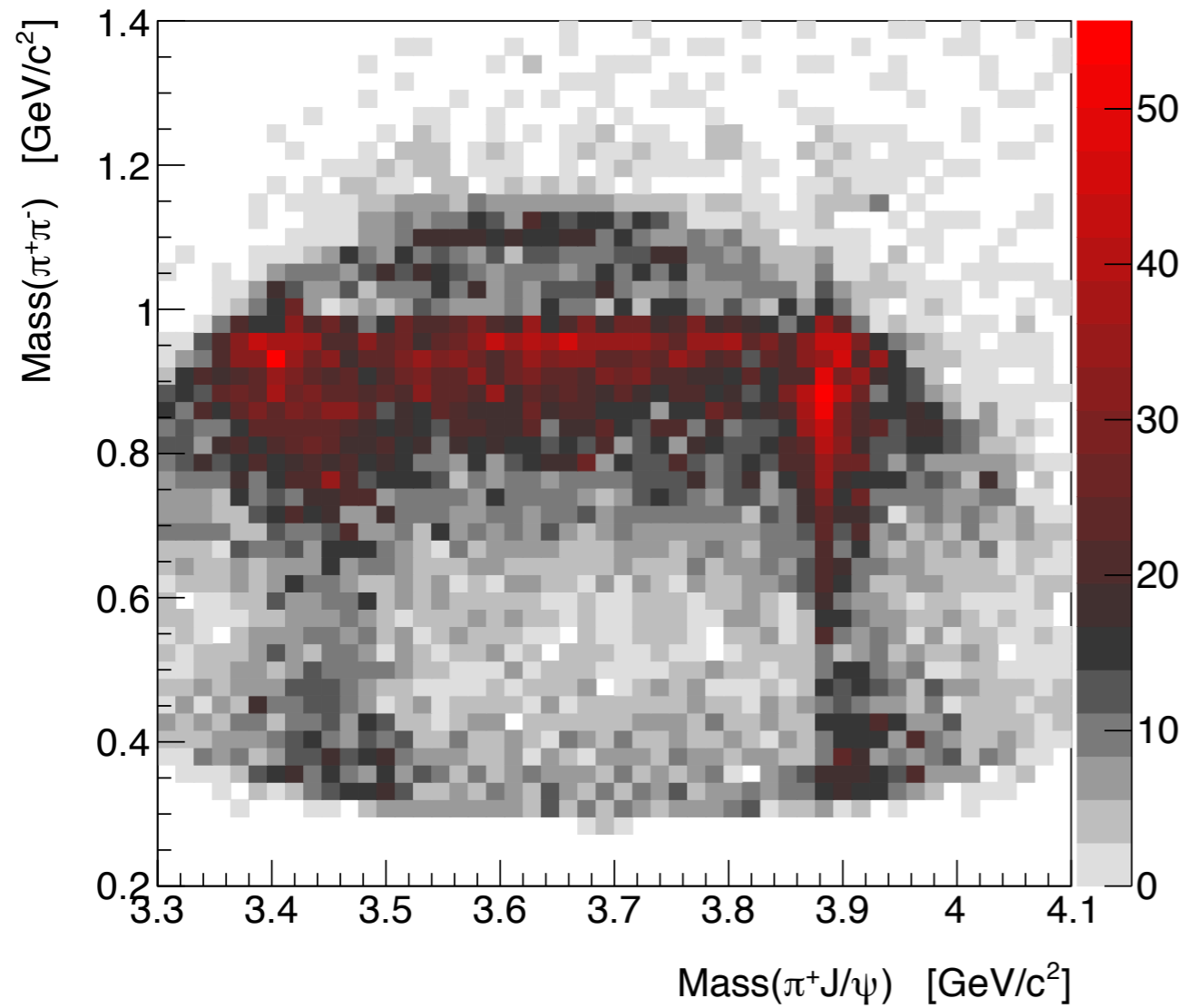




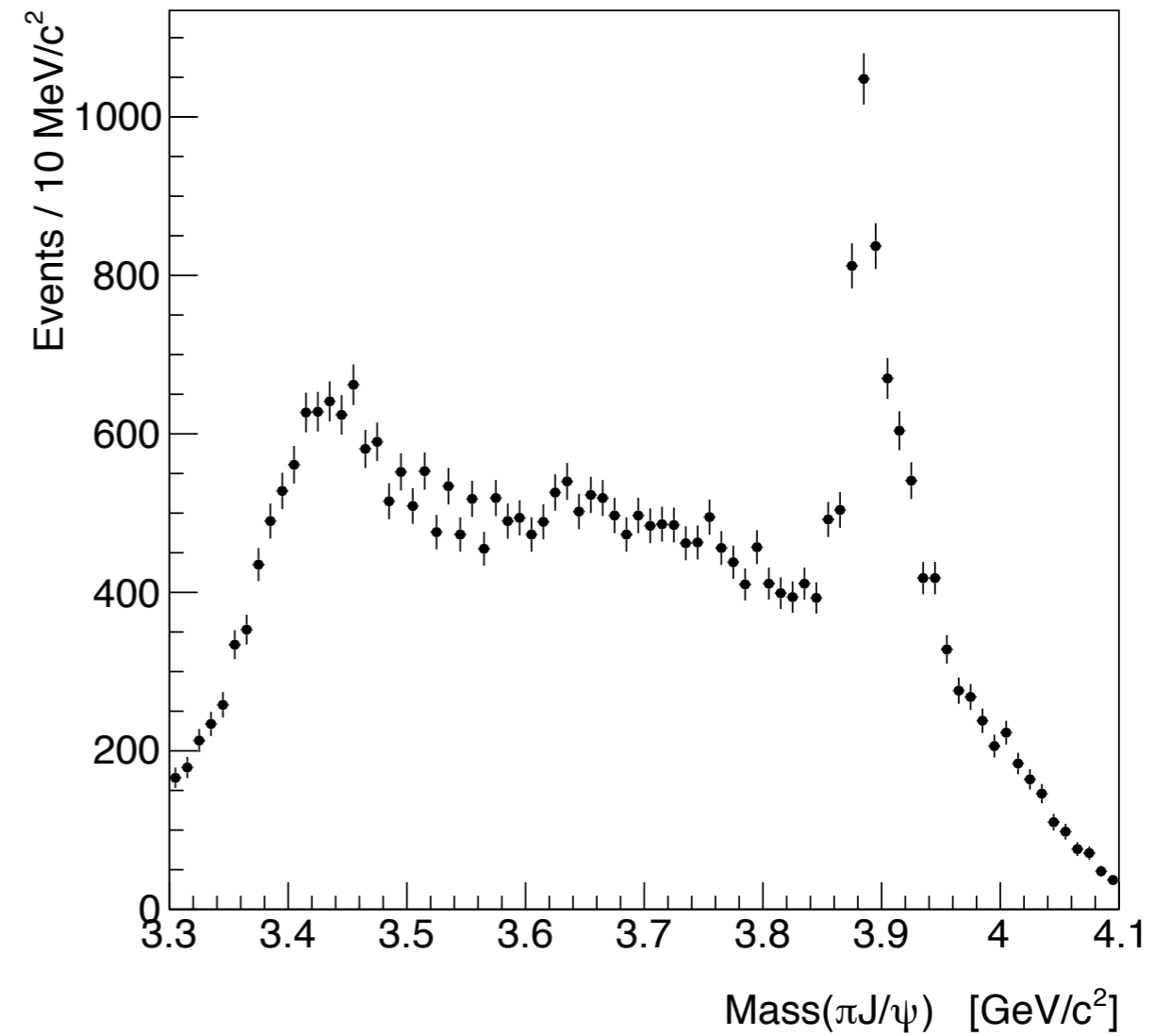
# (I) Checks Using: $\pi^+\pi^-J/\psi$

Take a peak at the  $Z_c(3900)$ ...

$\pi^+ \pi^- J/\psi$  for all  $E_{CM}$

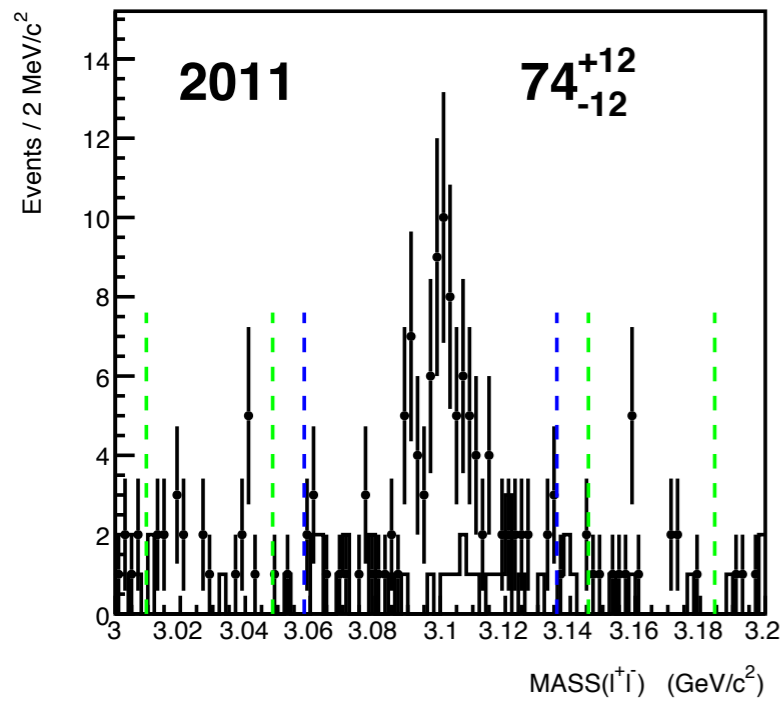


$\pi^+ \pi^- J/\psi$  for all  $E_{CM}$

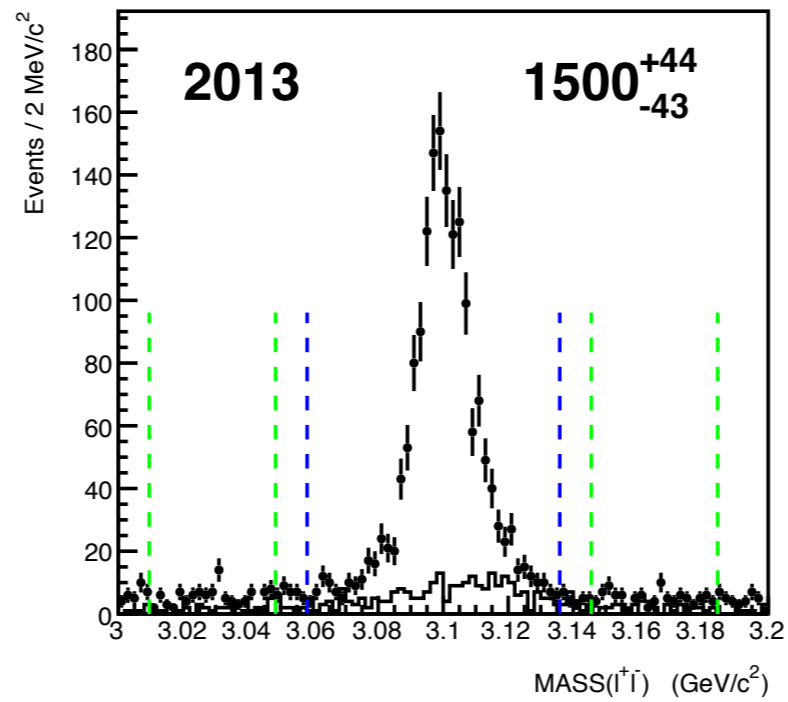


# (II) Checks Using: $\pi^0\pi^0 J/\psi$

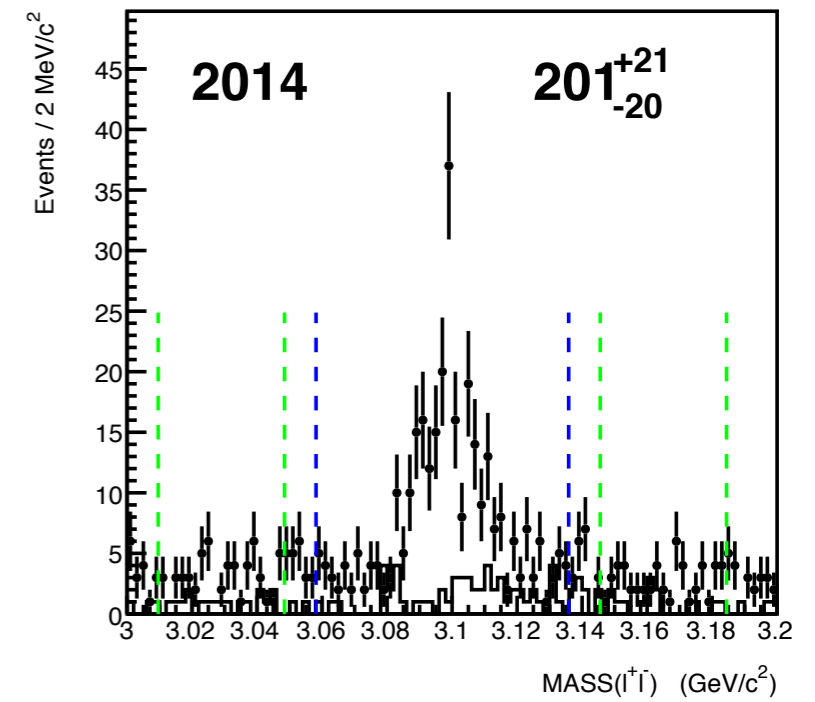
$\pi^0 \pi^0 J/\psi$



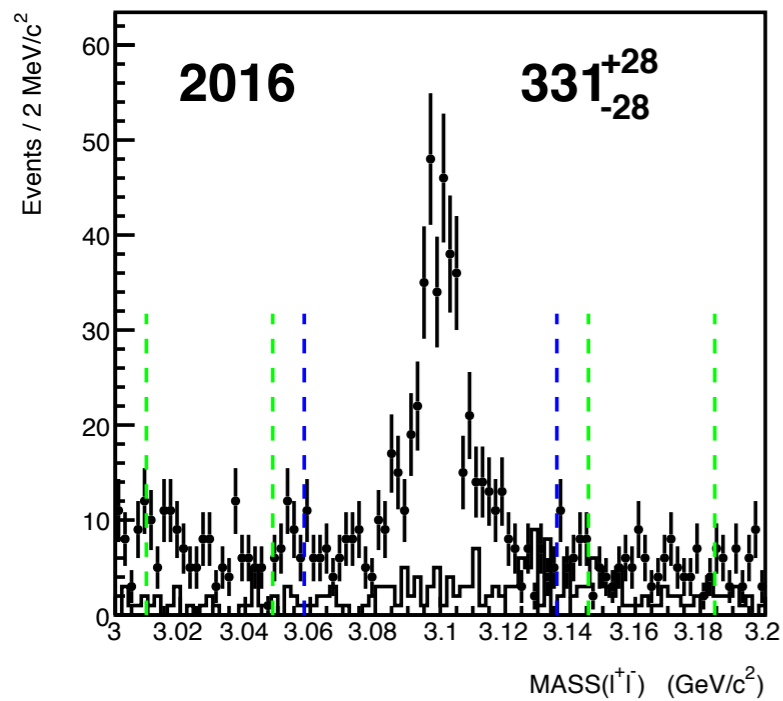
$\pi^0 \pi^0 J/\psi$



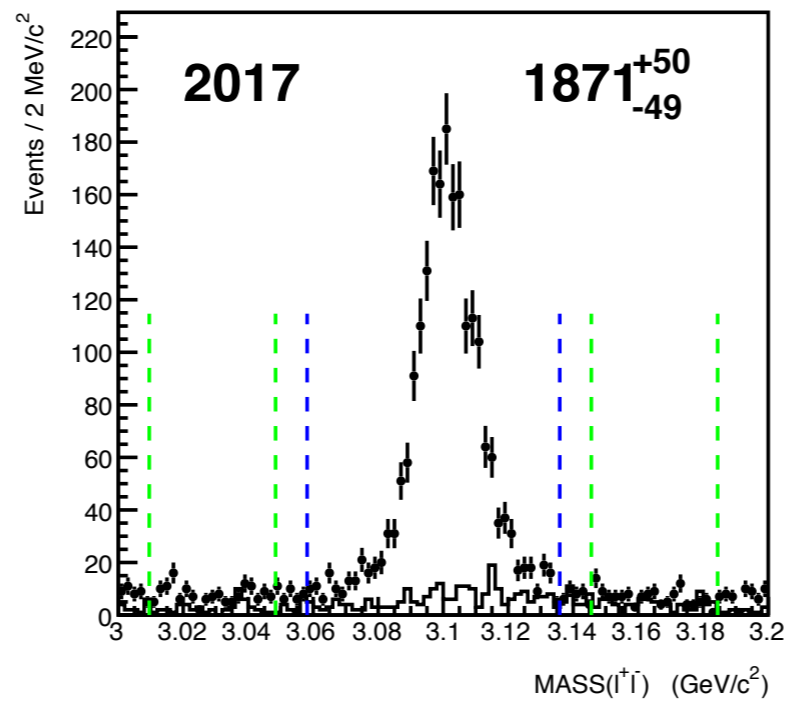
$\pi^0 \pi^0 J/\psi$



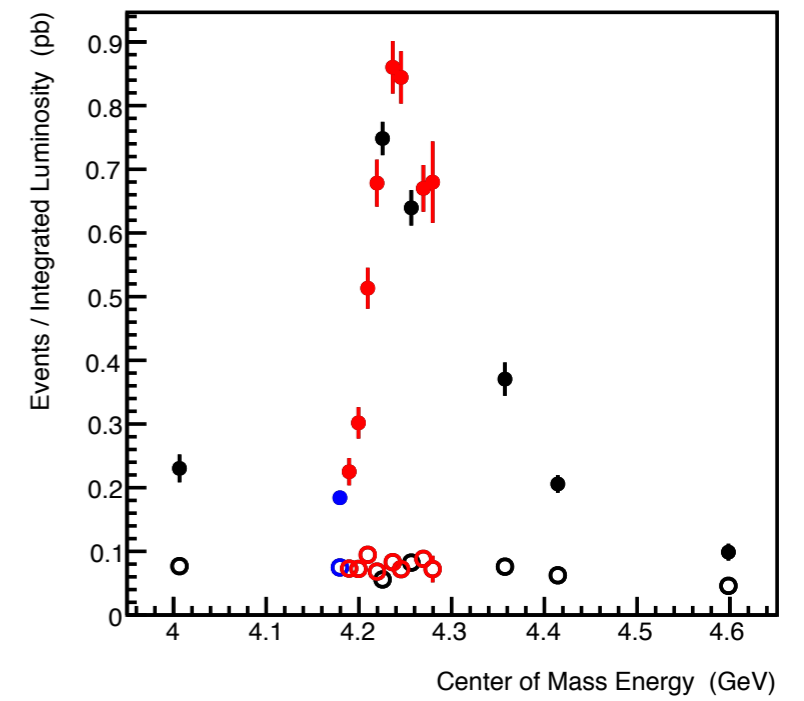
$\pi^0 \pi^0 J/\psi$



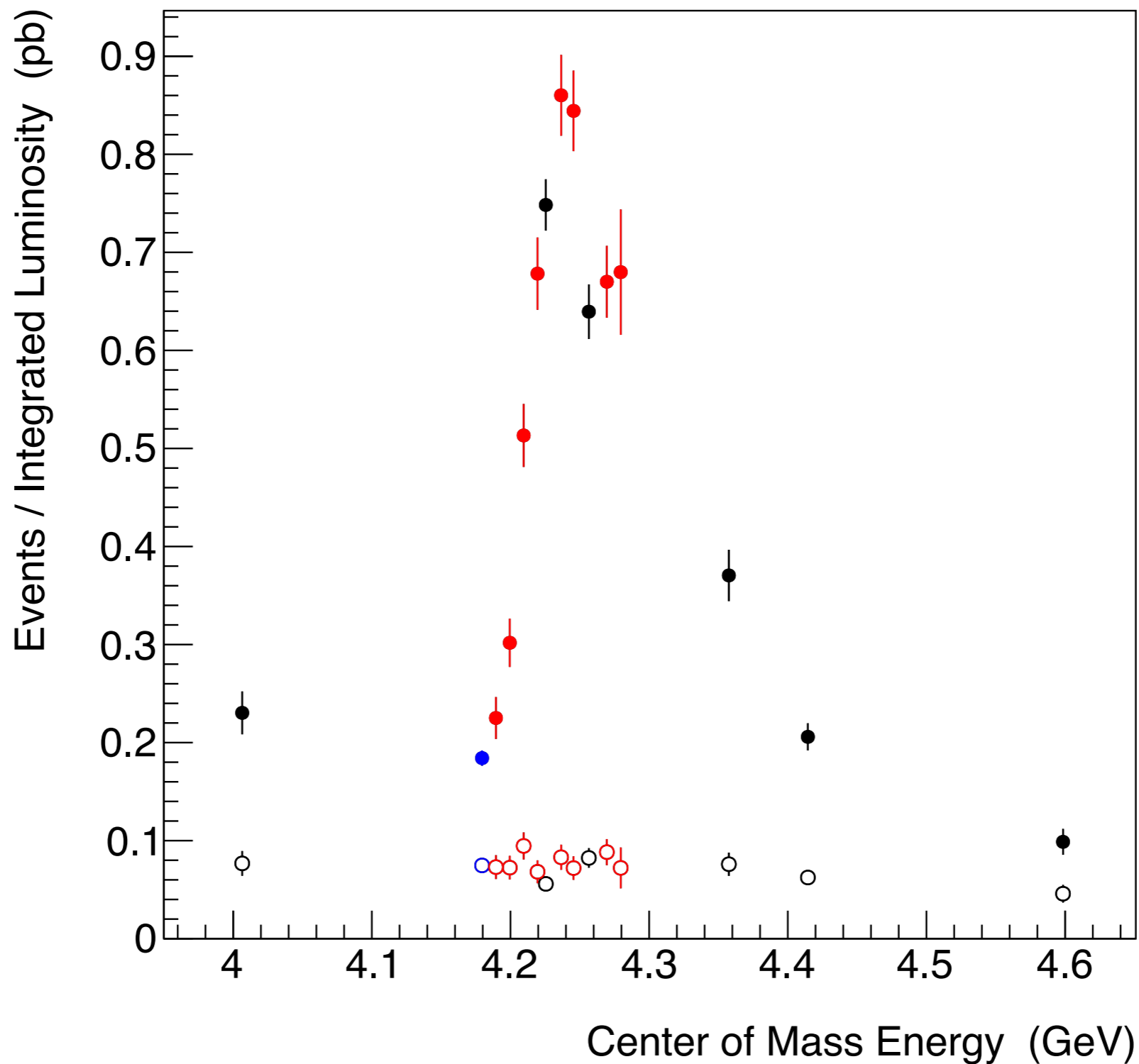
$\pi^0 \pi^0 J/\psi$



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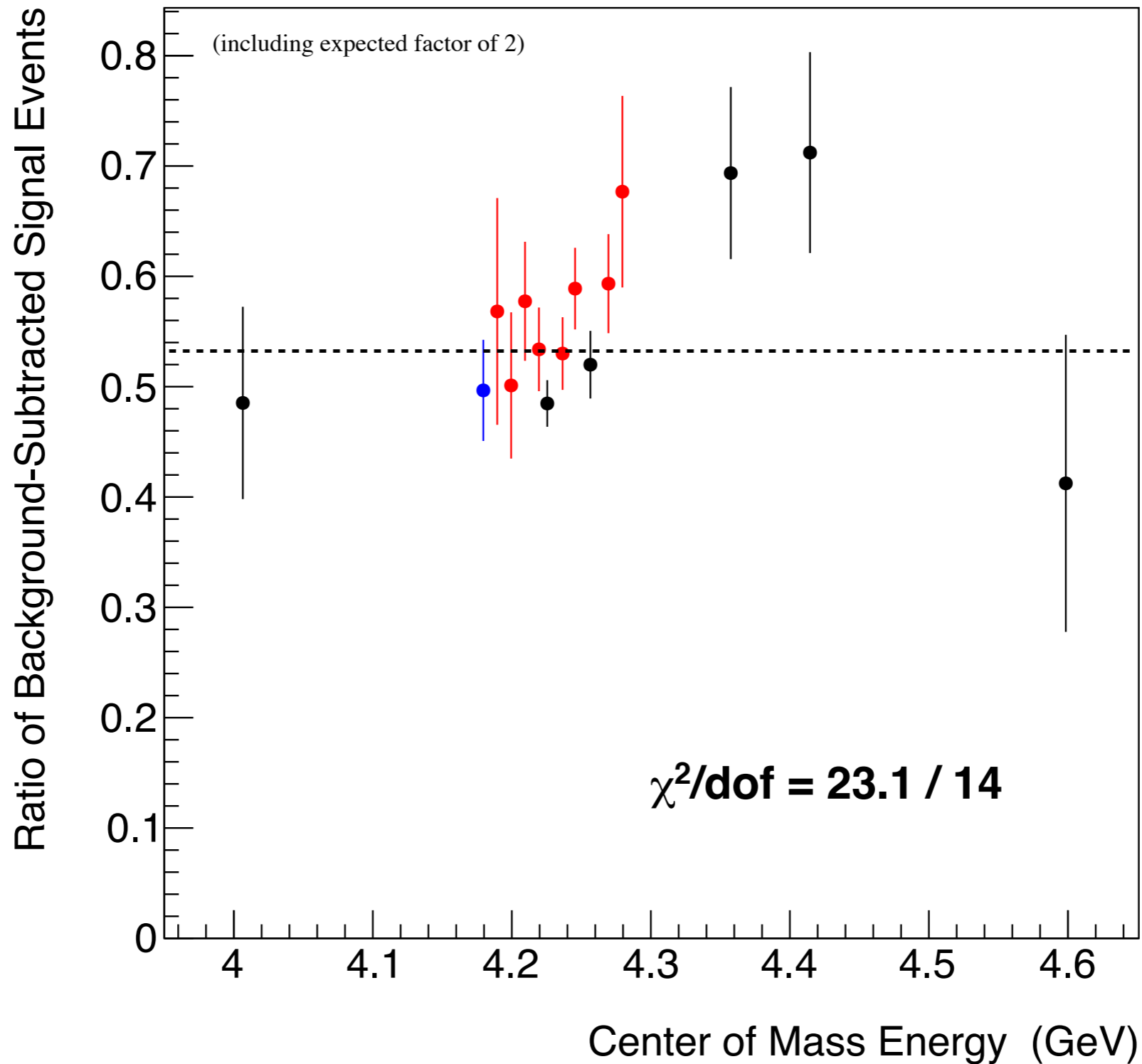


## (II) Checks Using: $\pi^0\pi^0 J/\psi$



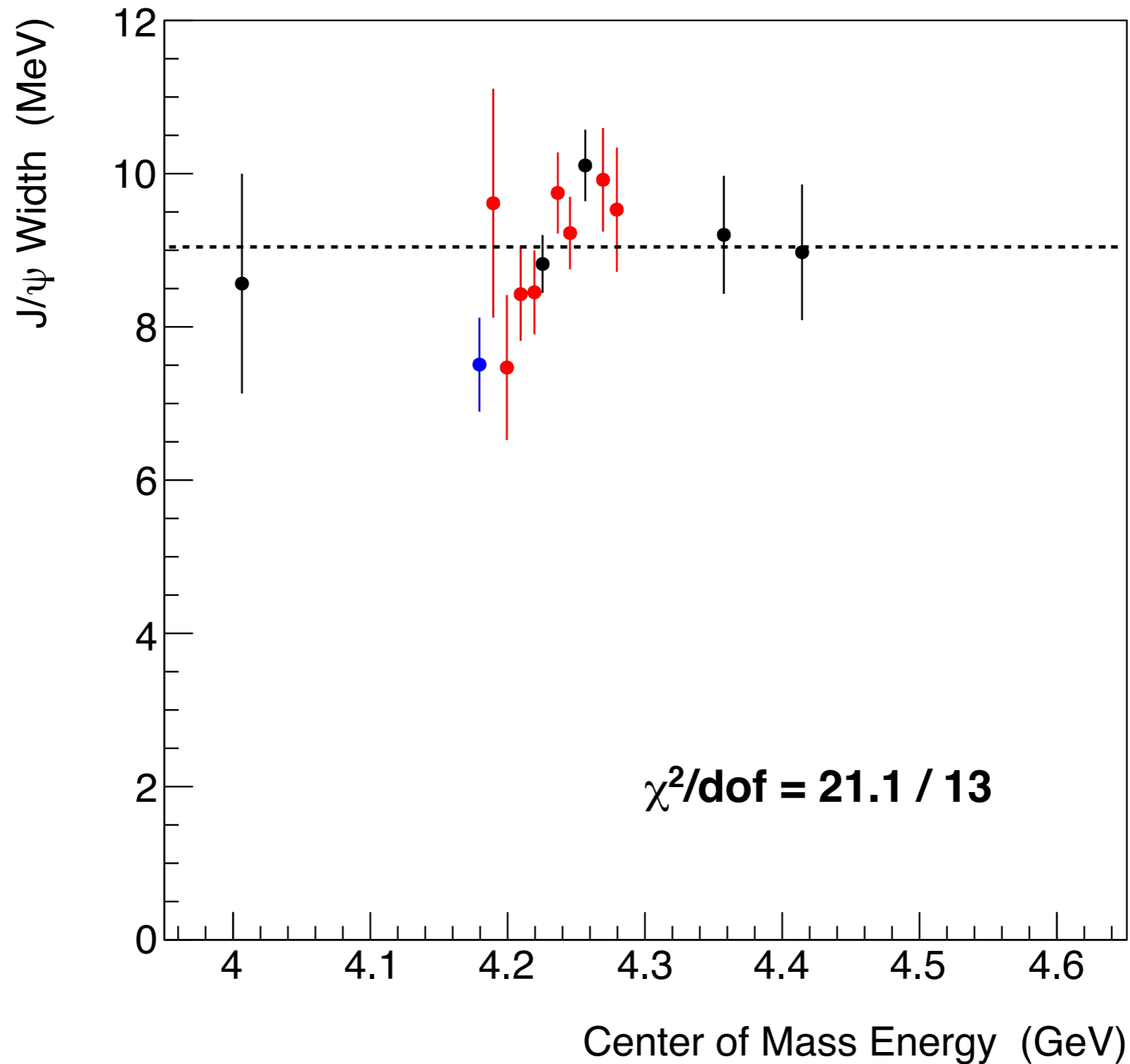
## (II) Checks Using: $\pi^0\pi^0 J/\psi$

Ratio of  $\pi^0\pi^0 J/\psi$  and  $\pi^+\pi^- J/\psi$



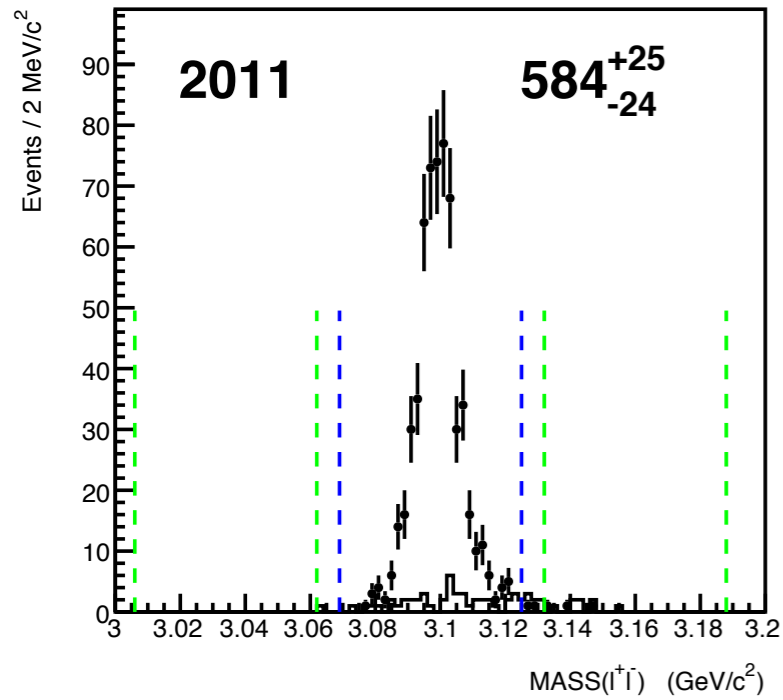
## (II) Checks Using: $\pi^0\pi^0 J/\psi$

Use Gaussian fits to the  $J/\psi$  peak to probe the resolution...

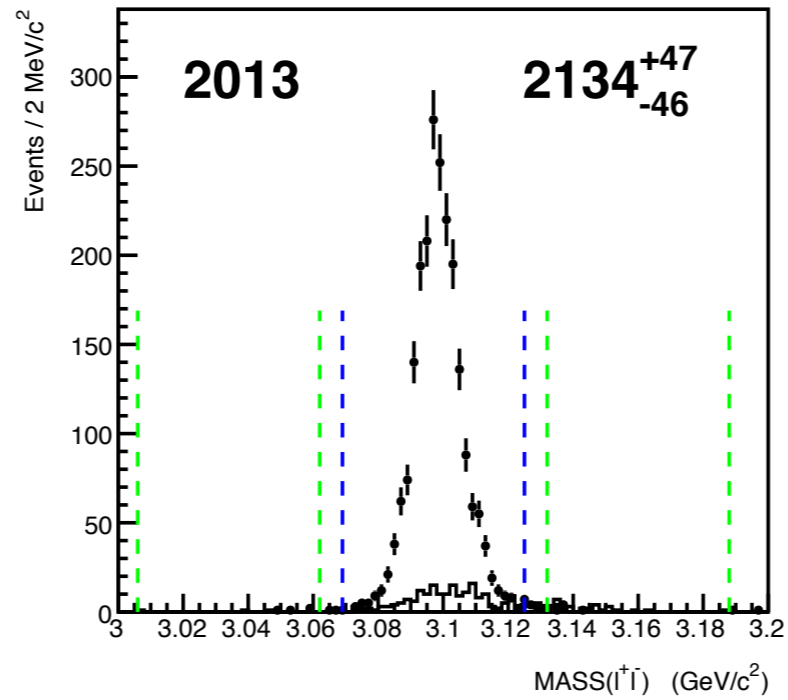


# (III) Checks Using: $\gamma\psi(2S)$ with $\psi(2S) \rightarrow \pi^+\pi^-J/\psi$

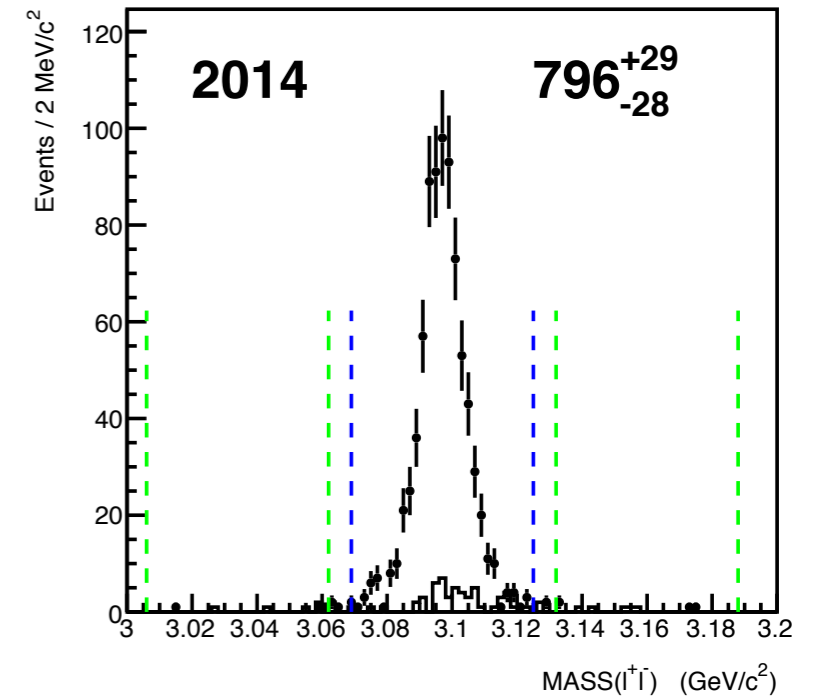
$\gamma \psi(2S)$



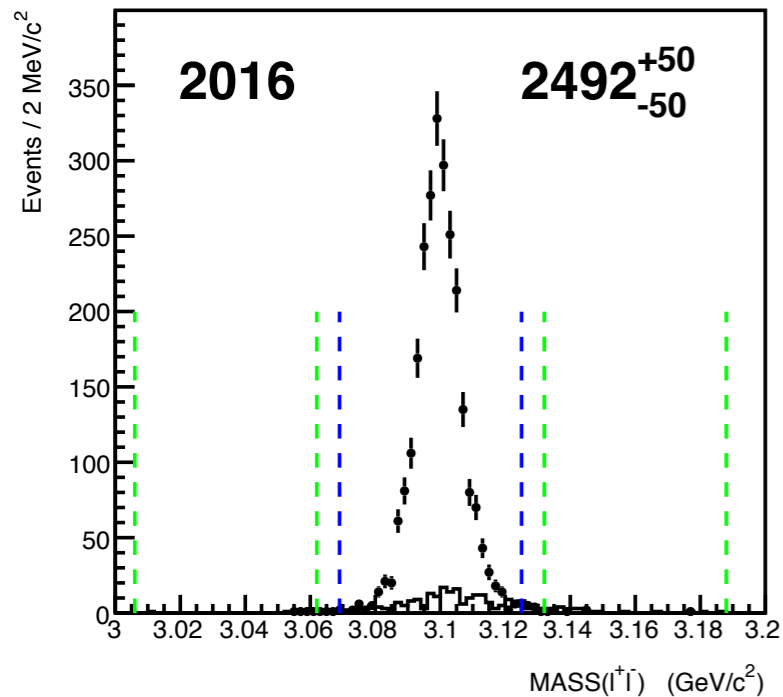
$\gamma \psi(2S)$



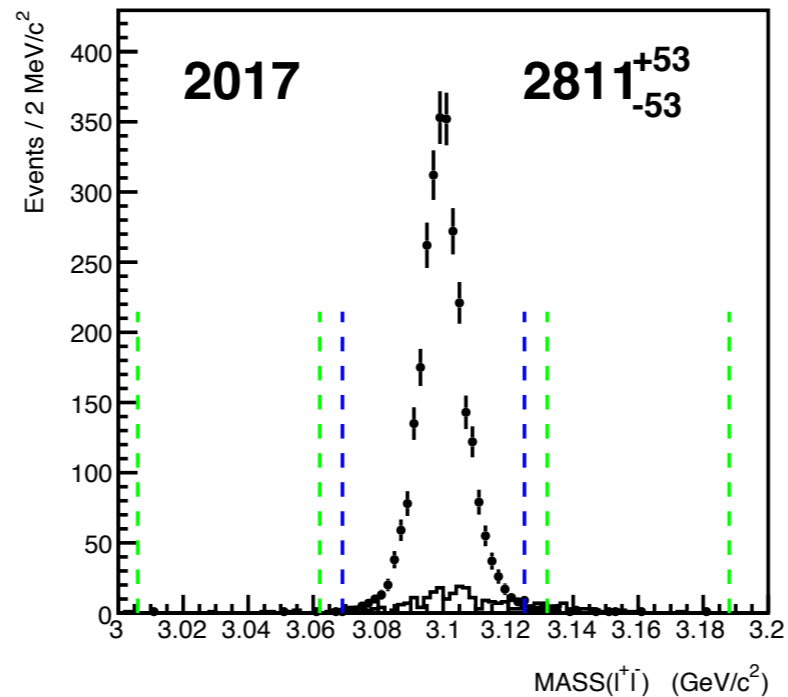
$\gamma \psi(2S)$



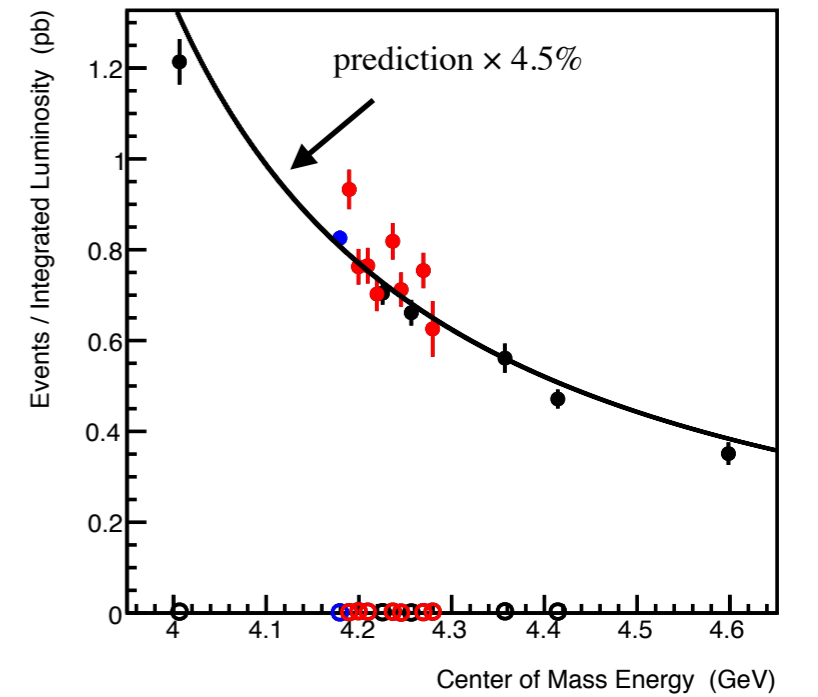
$\gamma \psi(2S)$



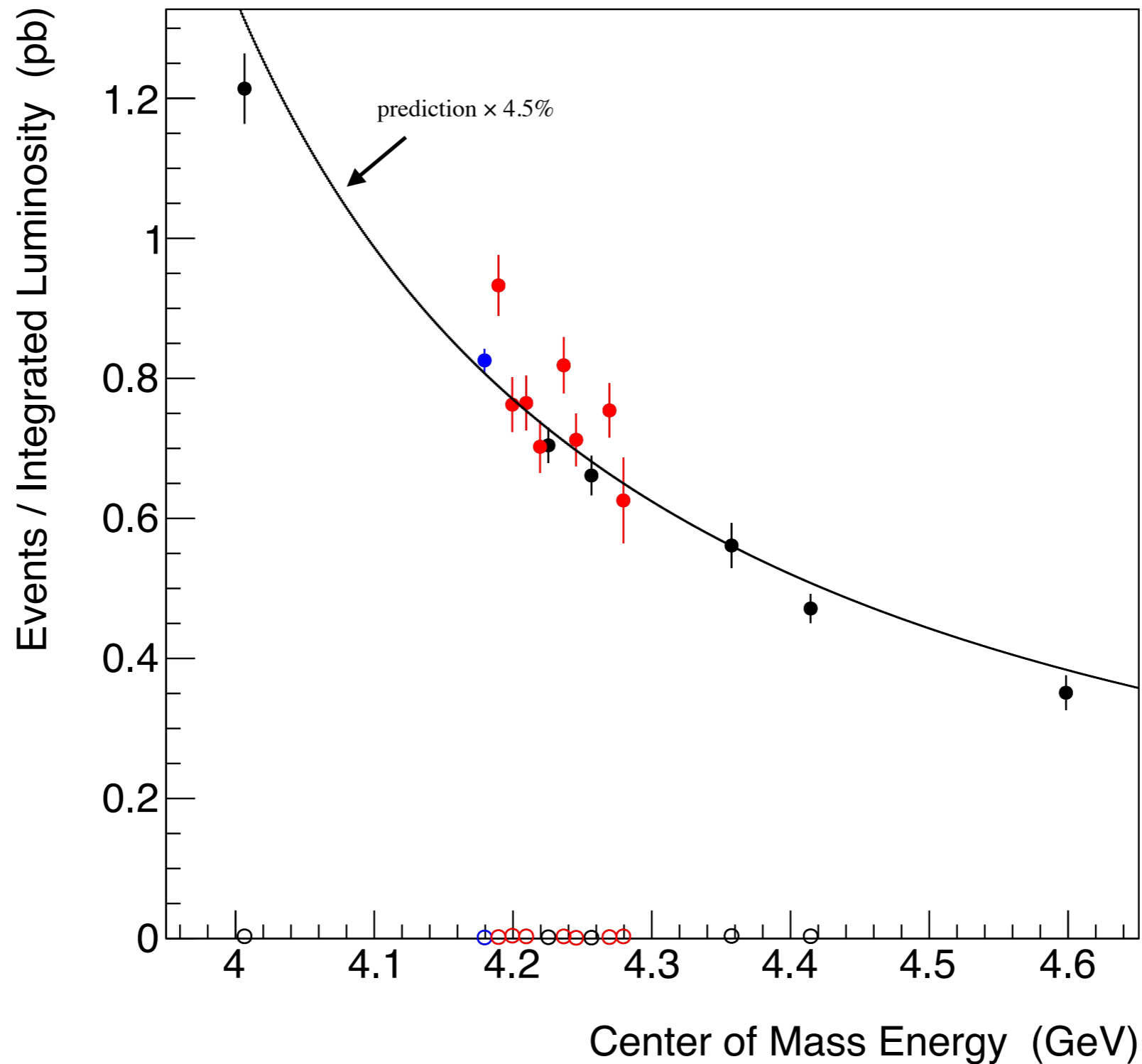
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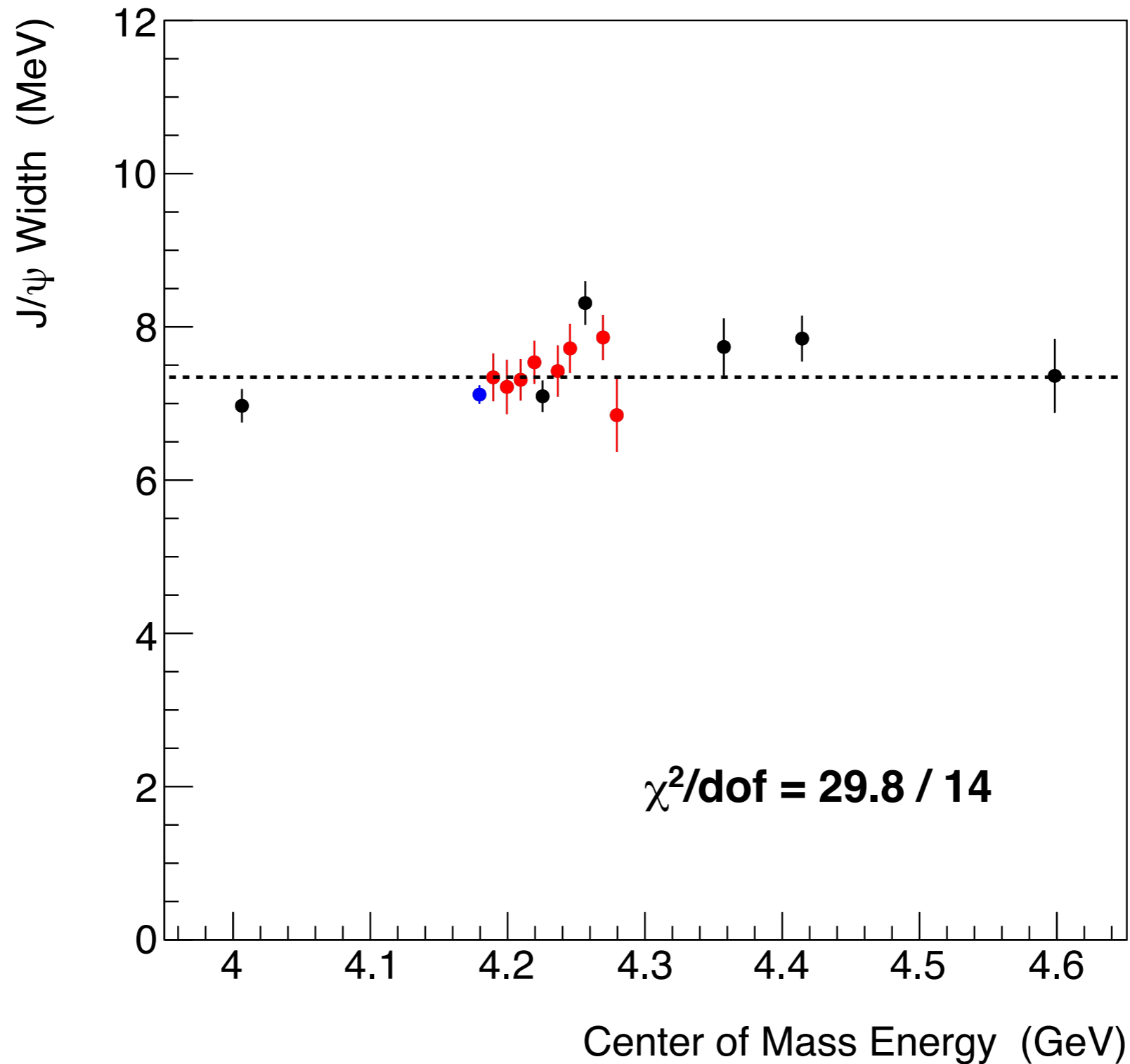


# (III) Checks Using: $\gamma\psi(2S)$ with $\psi(2S) \rightarrow \pi^+\pi^-J/\psi$



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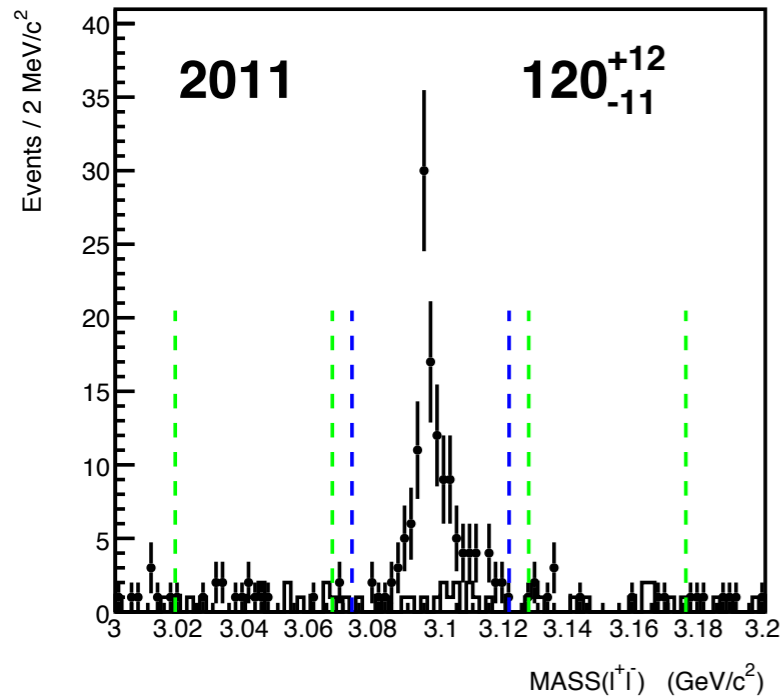
Use Gaussian fits to the  $J/\psi$  peak to probe the resolution...



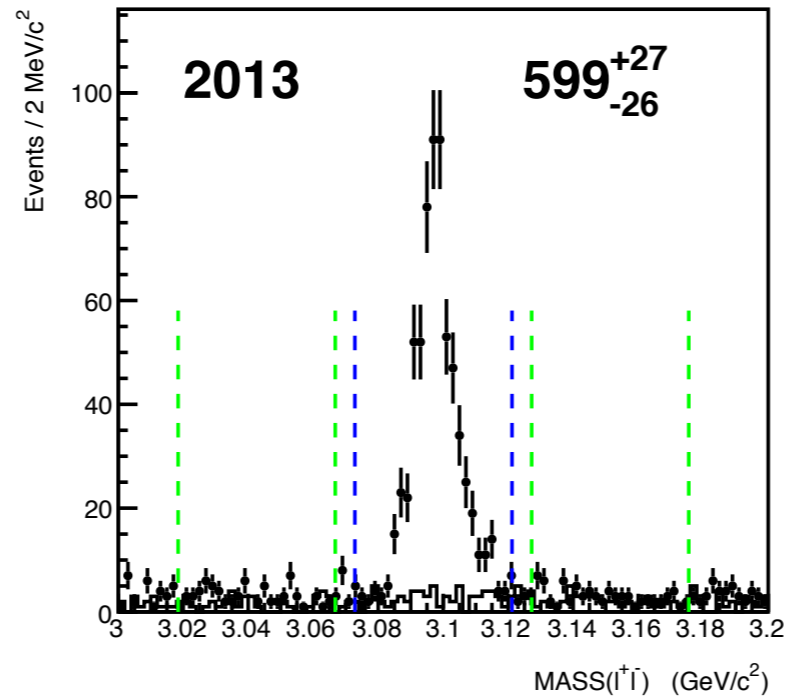


# (IV) Checks Using: $\eta J/\psi$

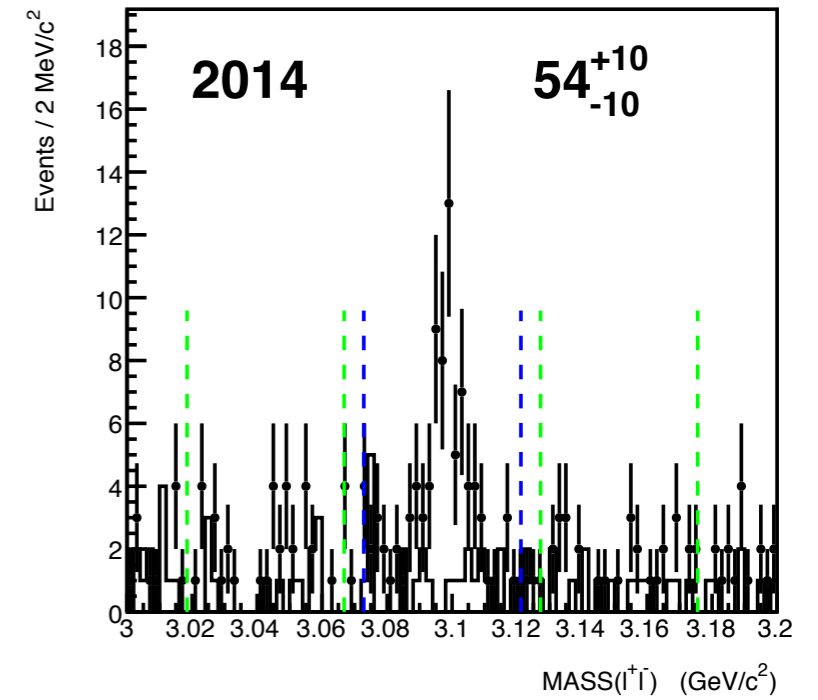
$\eta J/\psi$



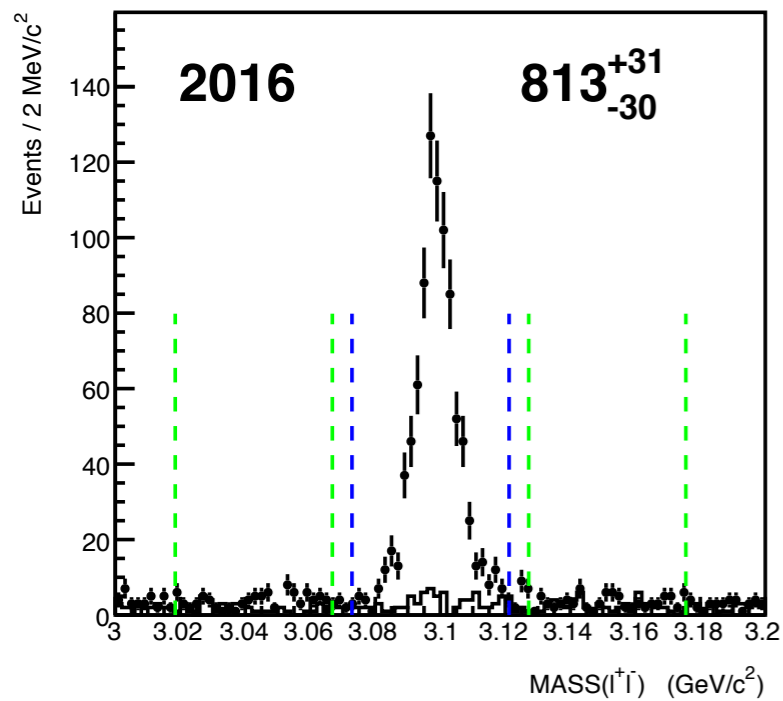
$\eta J/\psi$



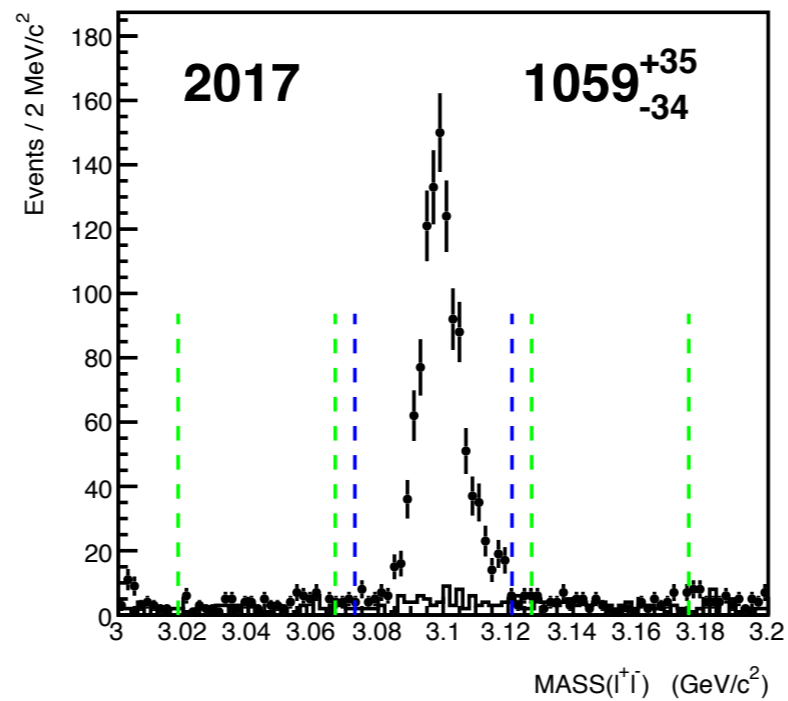
$\eta J/\psi$



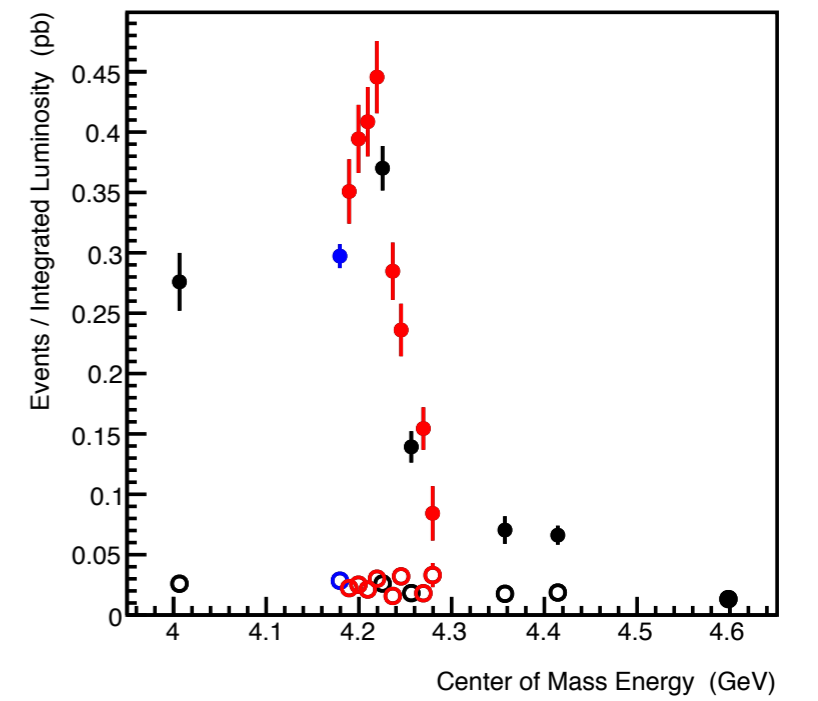
$\eta J/\psi$



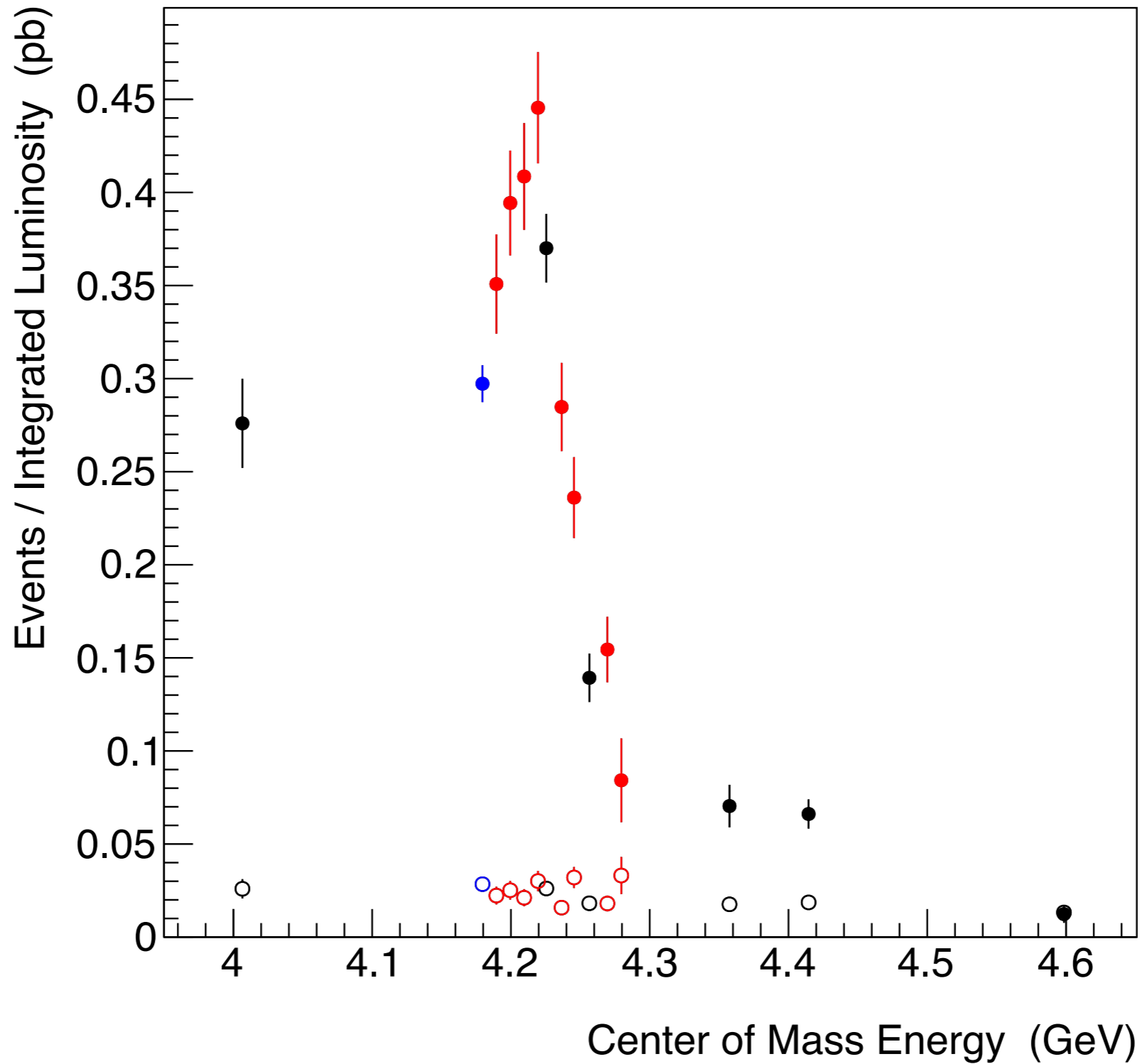
$\eta J/\psi$



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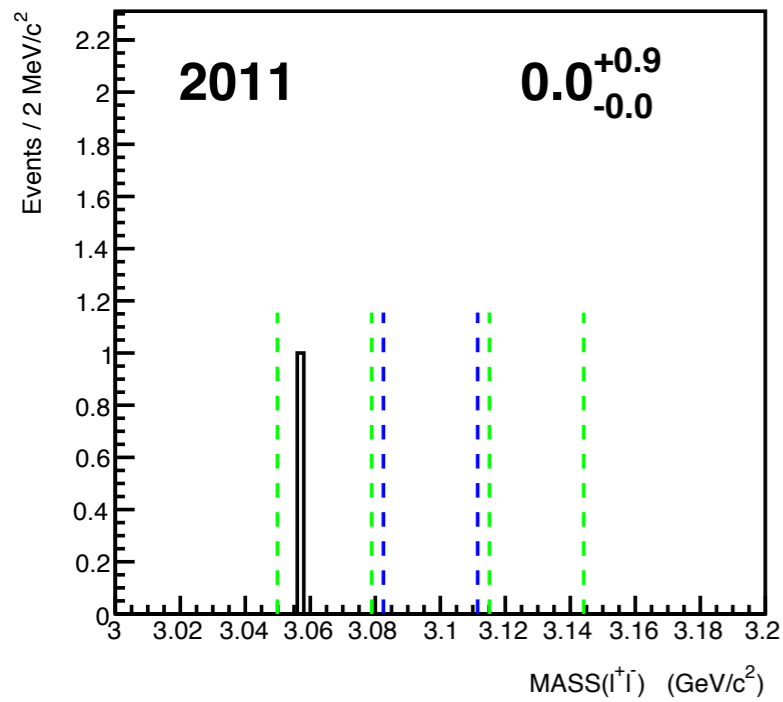


# (IV) Checks Using: $\eta J/\psi$

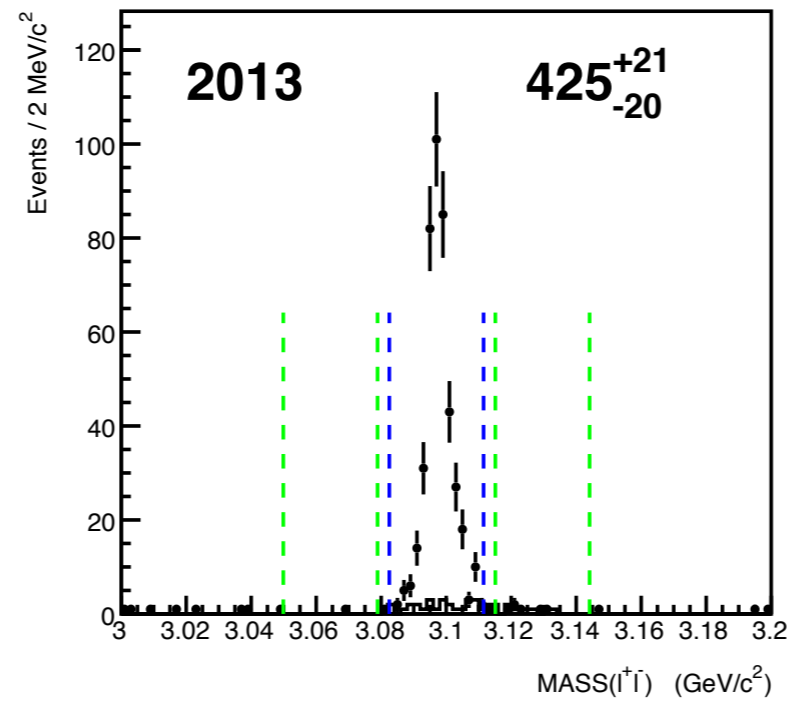


# (V) Quick Look at Other Channels

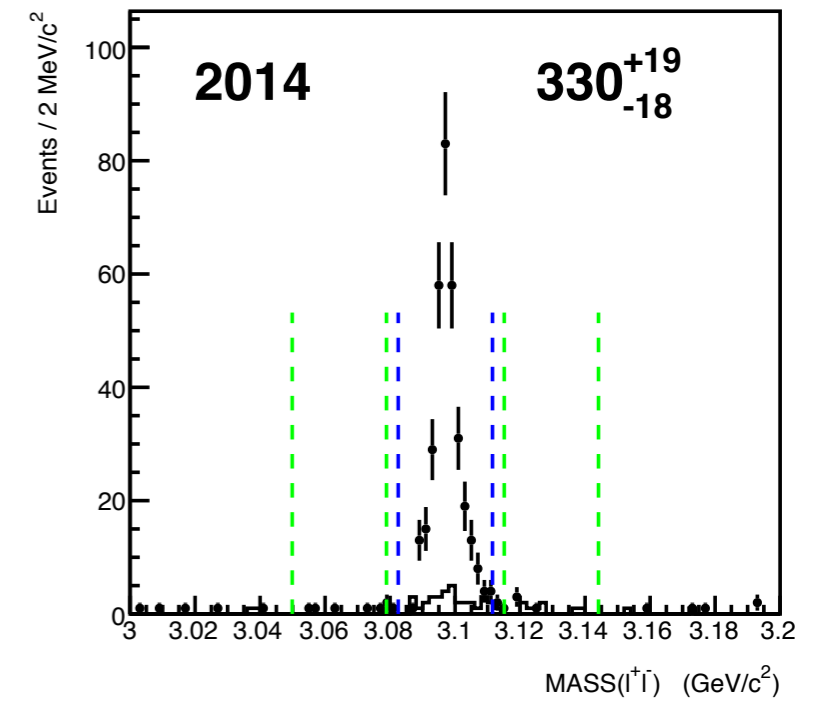
$\pi^+ \pi^- \psi(2S)$



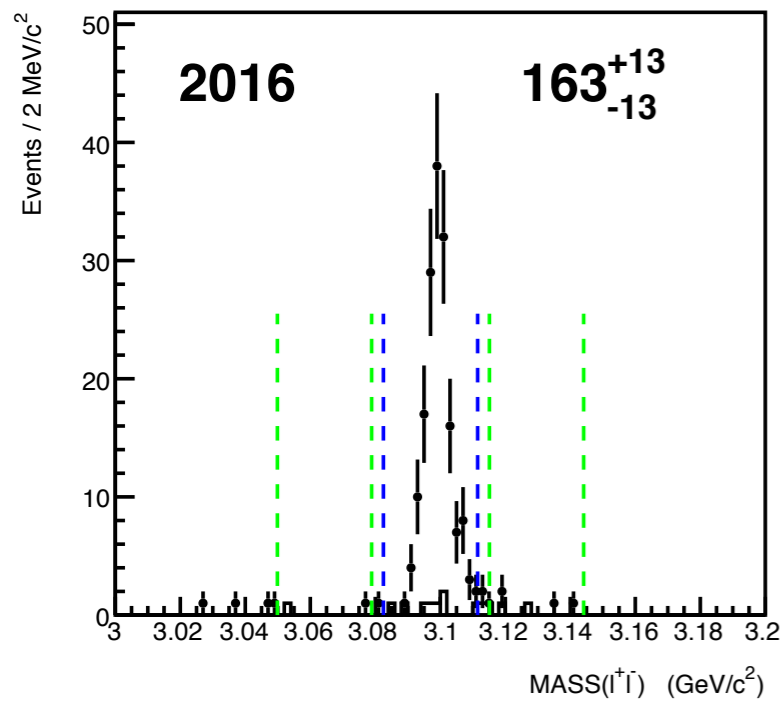
$\pi^+ \pi^- \psi(2S)$



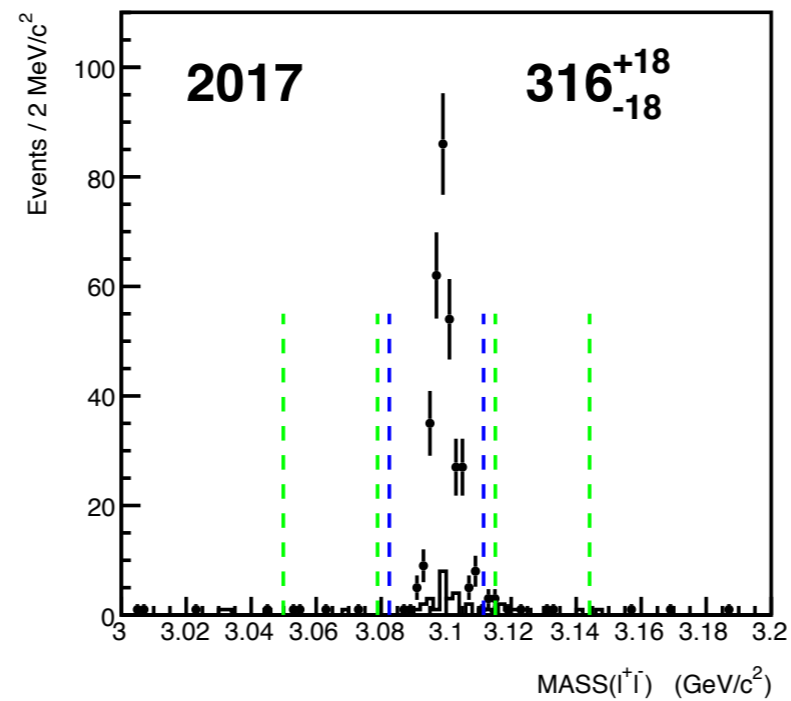
$\pi^+ \pi^- \psi(2S)$



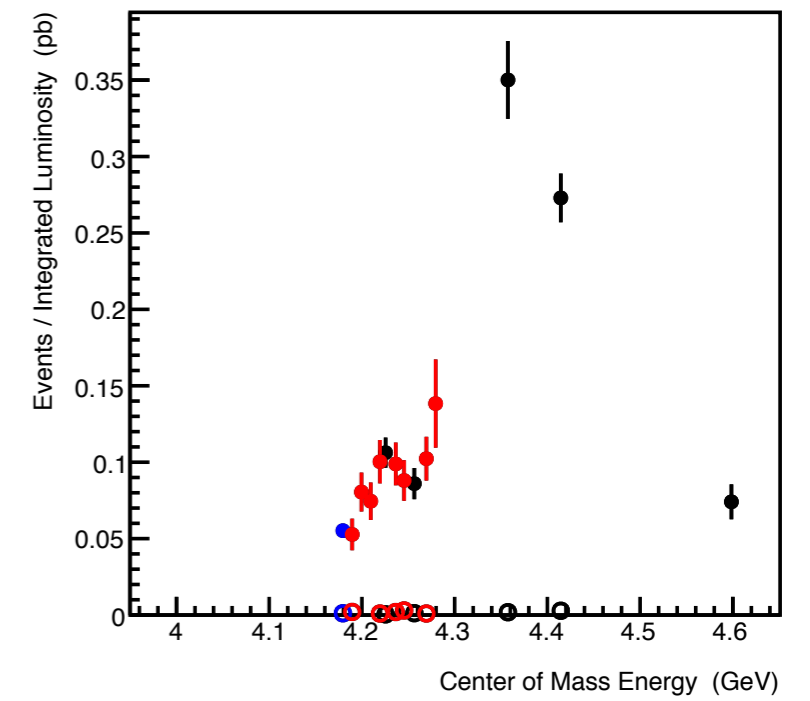
$\pi^+ \pi^- \psi(2S)$



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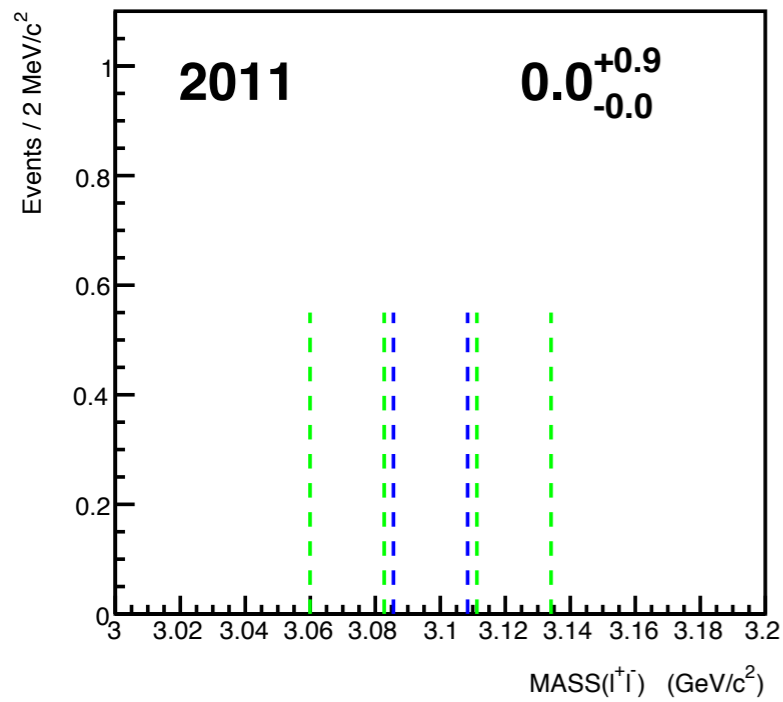


$\pi^+ \pi^- \psi(2S)$

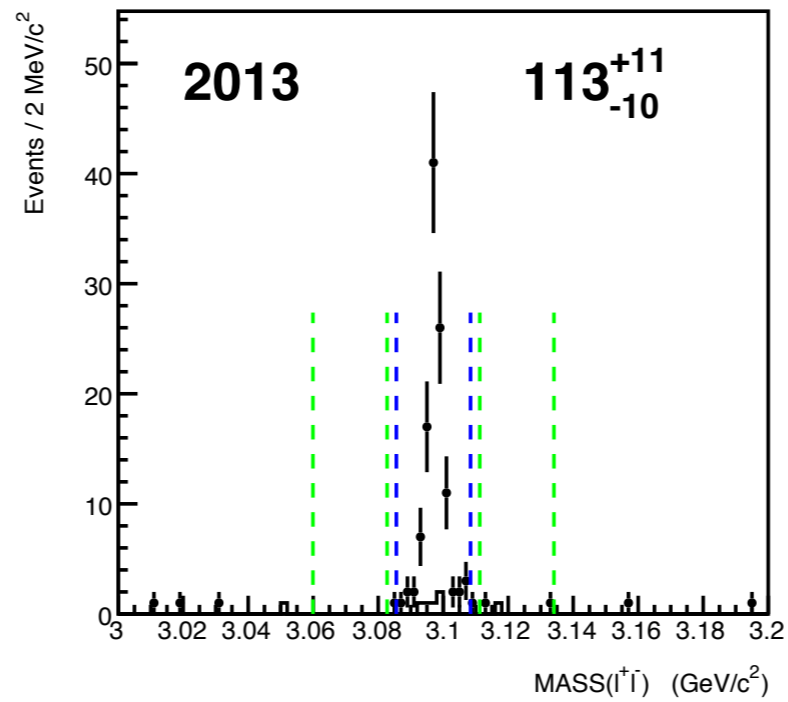


# (V) Quick Look at Other Channels

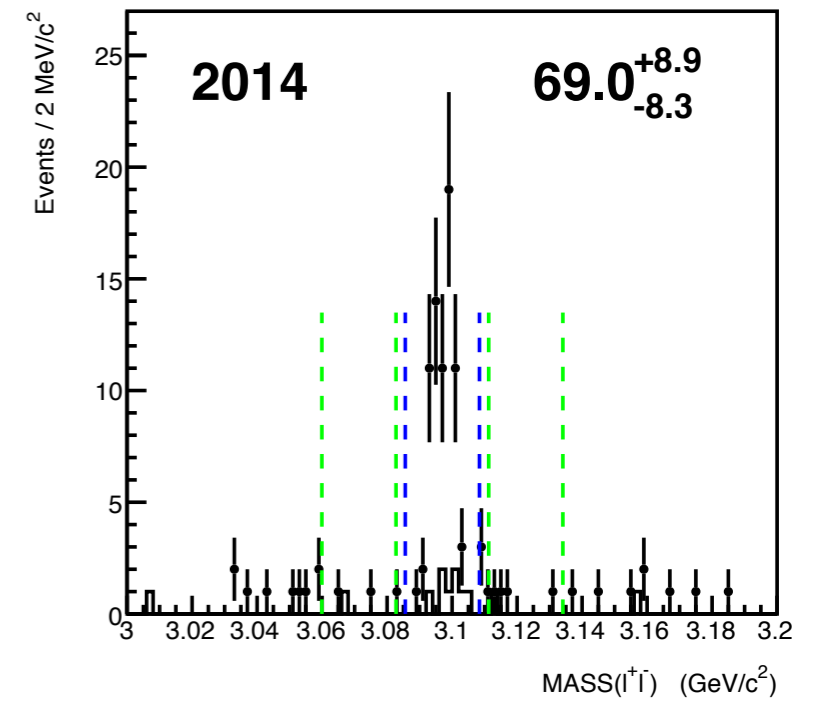
$K^+ K^- J/\psi$



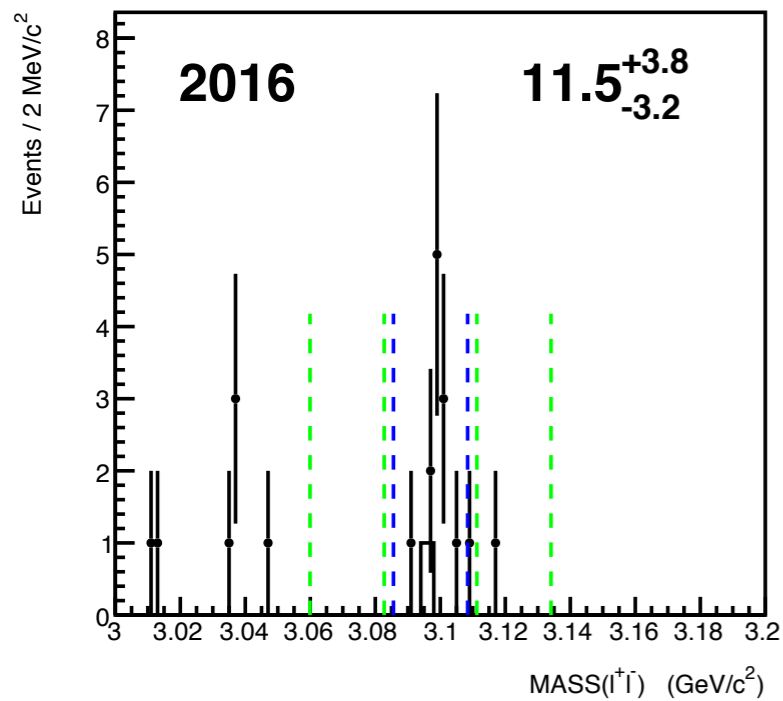
$K^+ K^- J/\psi$



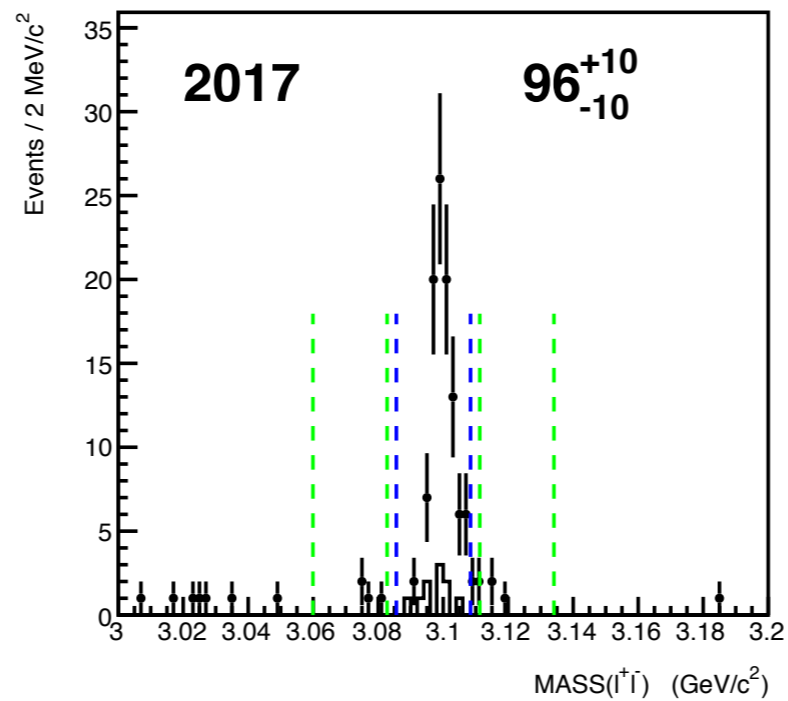
$K^+ K^- J/\psi$



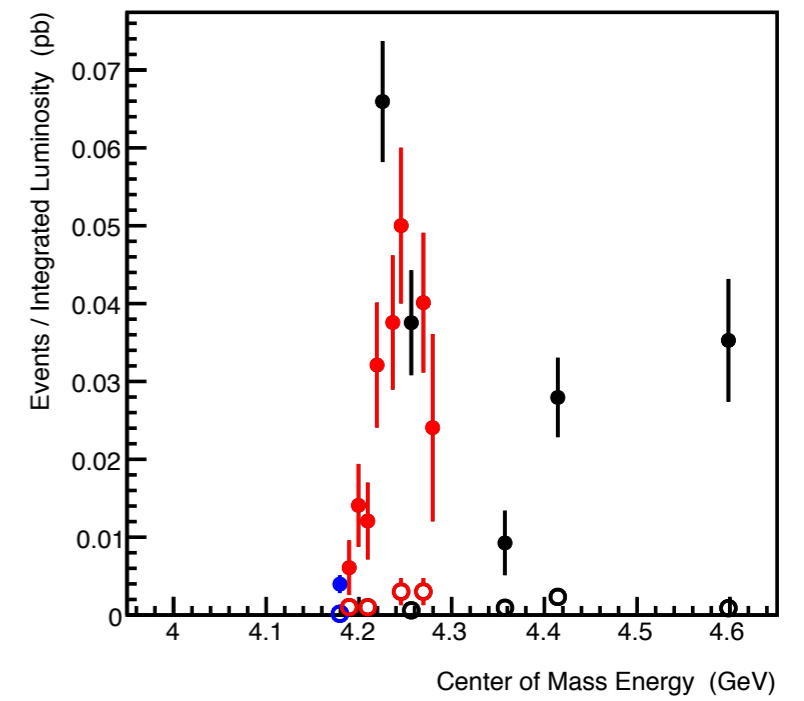
$K^+ K^- J/\psi$



$K^+ K^- J/\psi$

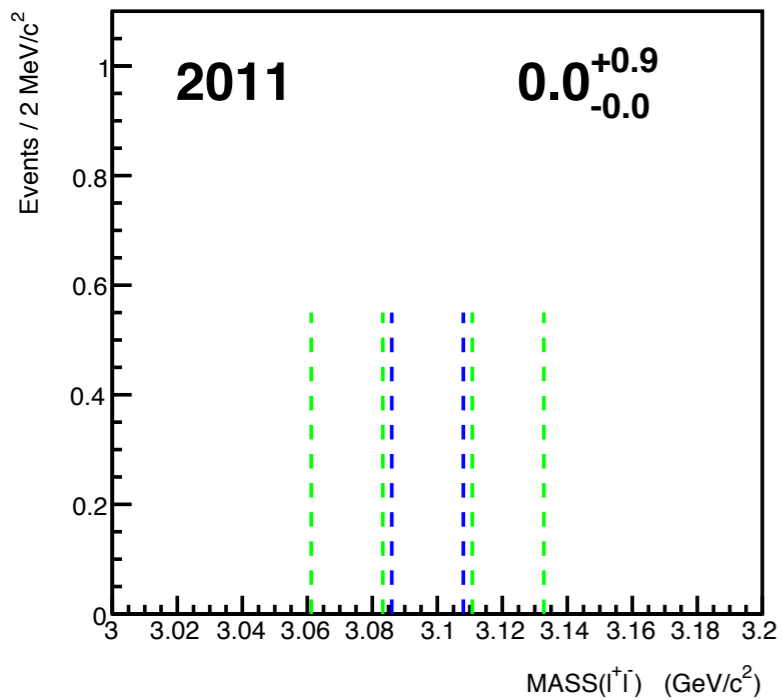


$K^+ K^- J/\psi$

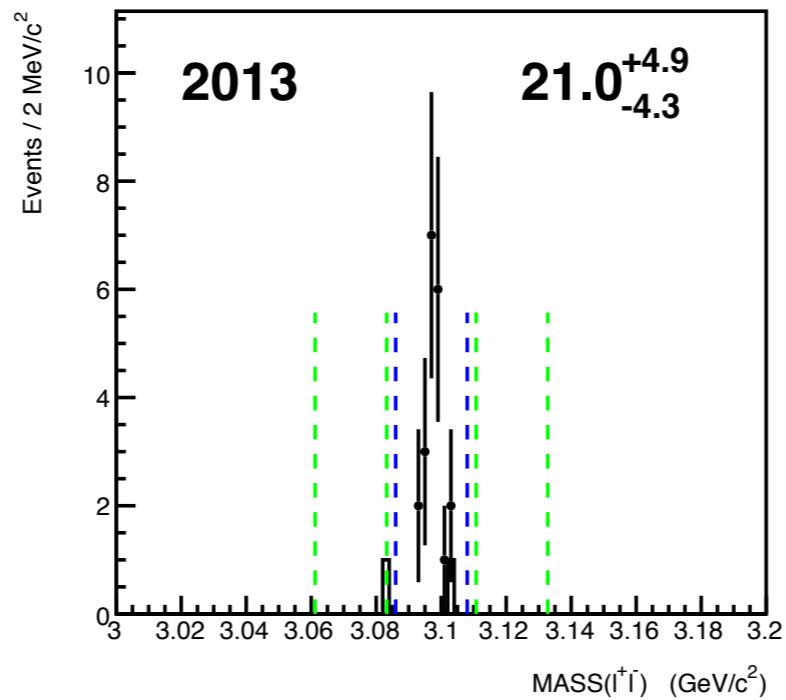


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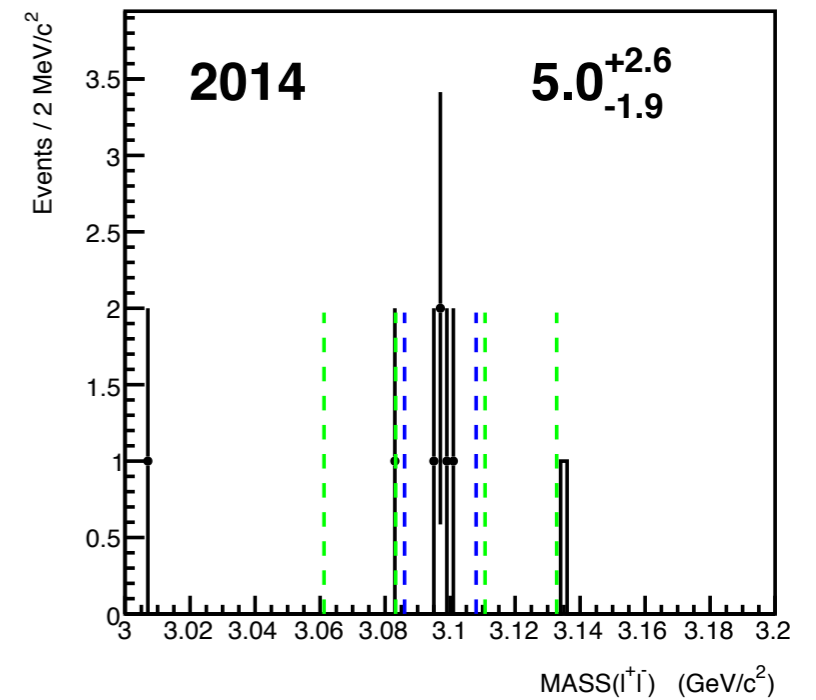
$K_S K_S J/\psi$



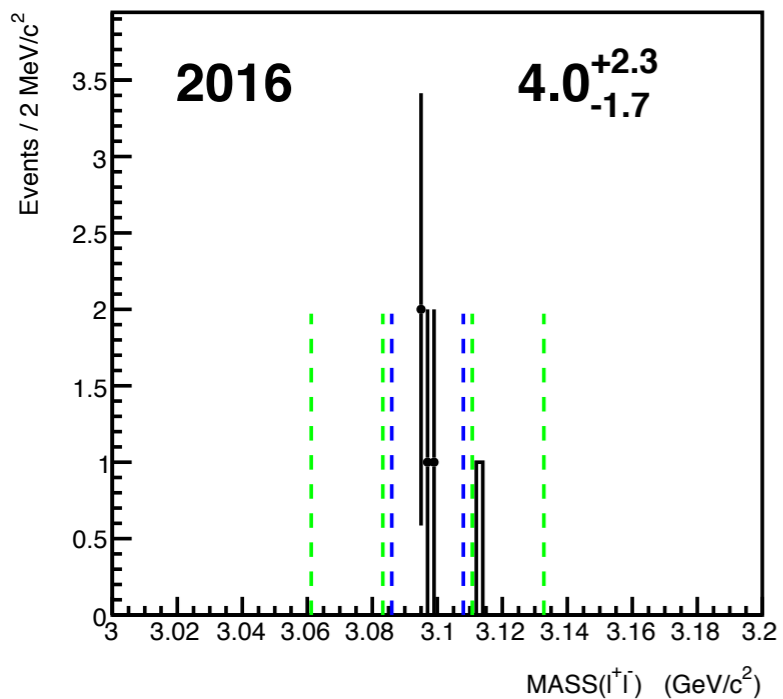
$K_S K_S J/\psi$



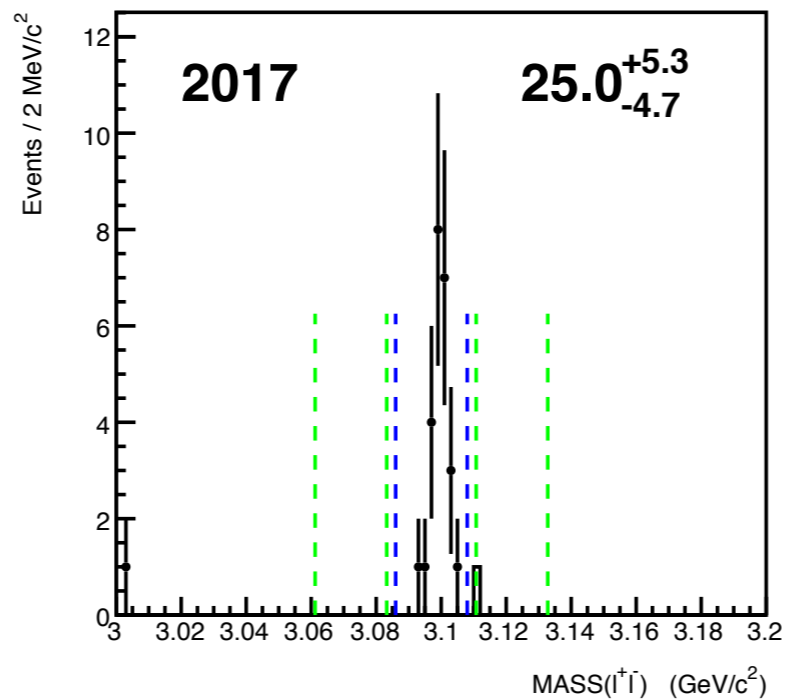
$K_S K_S J/\psi$



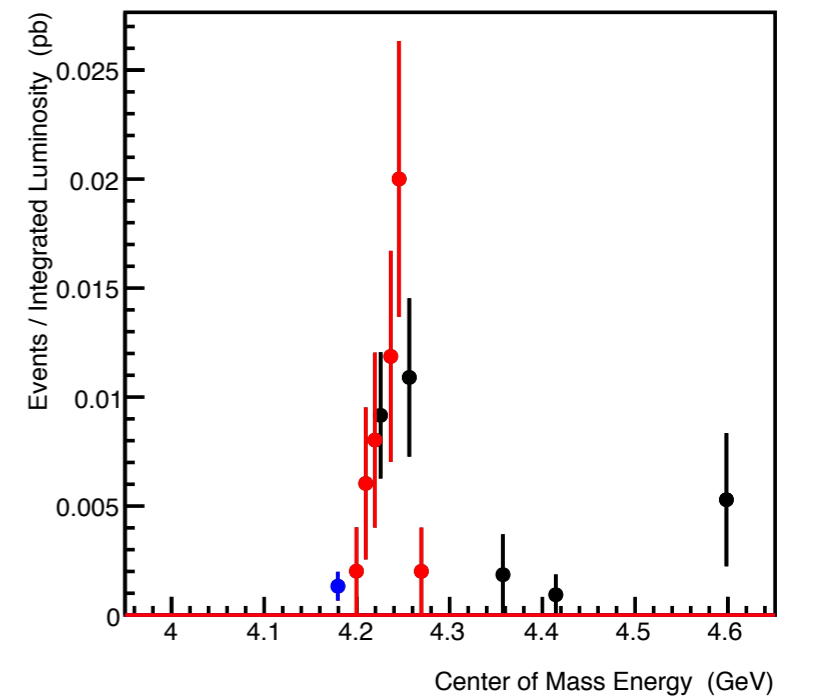
$K_S K_S J/\psi$



$K_S K_S J/\psi$



$K_S K_S J/\psi$



# Observations

Resolutions and efficiencies appear to be consistent with previous years  
*(although statistical errors are rather large for this study...)*

There are no obvious problems with data quality.

Some cross sections, like  $\eta J/\psi$ , look very interesting...