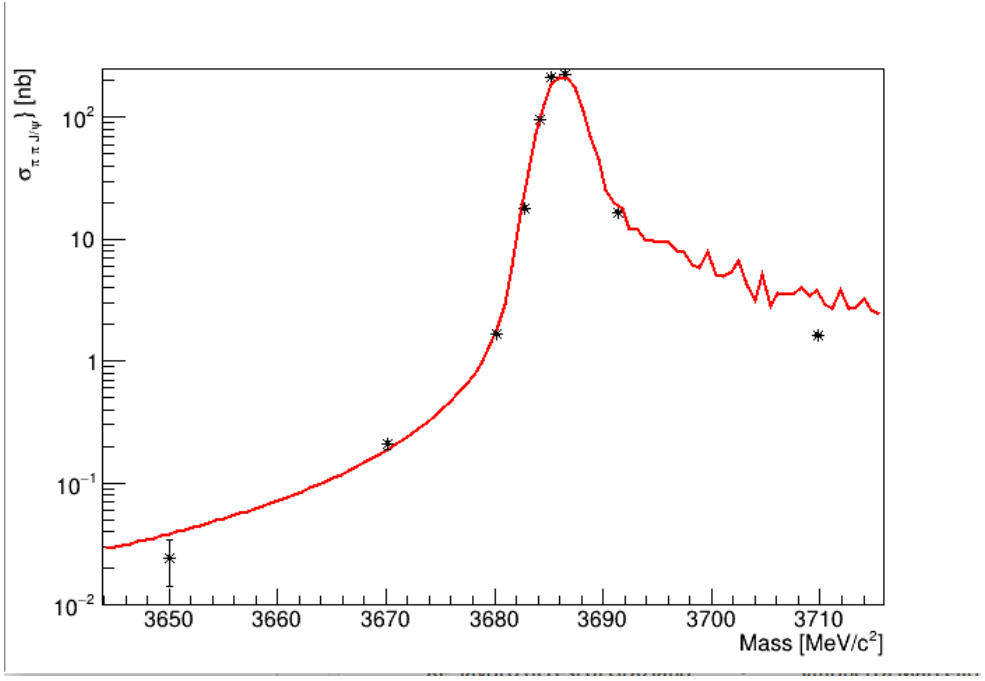
Update on the measurements of $e^+e^- \rightarrow$ pipi J/psi

Giulio

Where we left?



Fase (rad)	1.03639e-05	1.92755e+00
Cont (3 GeV)	9.99995e-08	7.68446e-08
BR	3.30097e-01	4.83255e-03
Width	2.94000e-01	fixed
Mass	3.68607e+03	1.22418e-02

A results, yet with several flaws

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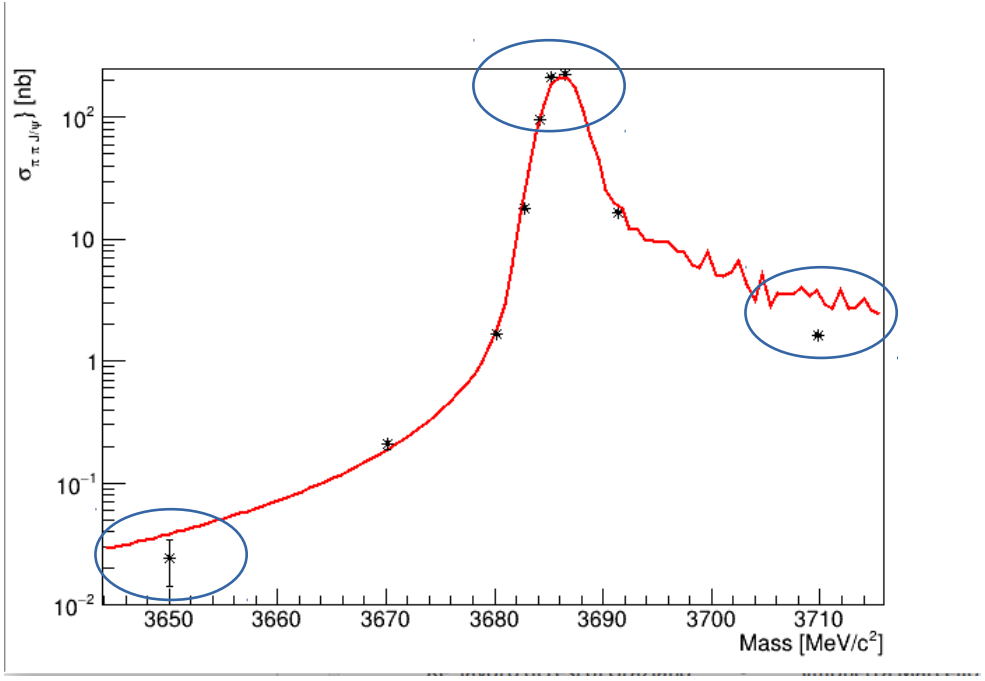

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Tackling the flaws

1) check of the selection

- Event selection follows similar criteria of other pipiJ/psi final state analyses (PRL 118, 092001 (2017))
- Event Selections:
  - 4 charged tracks with 0 net charge
  - $|\cos\theta| < 0.93$
  - $|V_{z,poca}| < 10$ cm
  - $|V_{xy,poca}| < 1$ cm
  - $\mathbf{p} > 1.06$ – track is a lepton
  - $\mathbf{p} < 0.45$ – track is a pion
  - 4C kinematic fit is applied

- Radiative Bhabha and radiative dimuons background are suppressed by a cut on the opening angle between the two pions ($\cos|\theta_{pipi}| < 0.98$) and non-radiative Bhabha events are further suppressed with a cut on the opening angle between the two lepton ($\cos|\theta_{ee}| < 0.98$).

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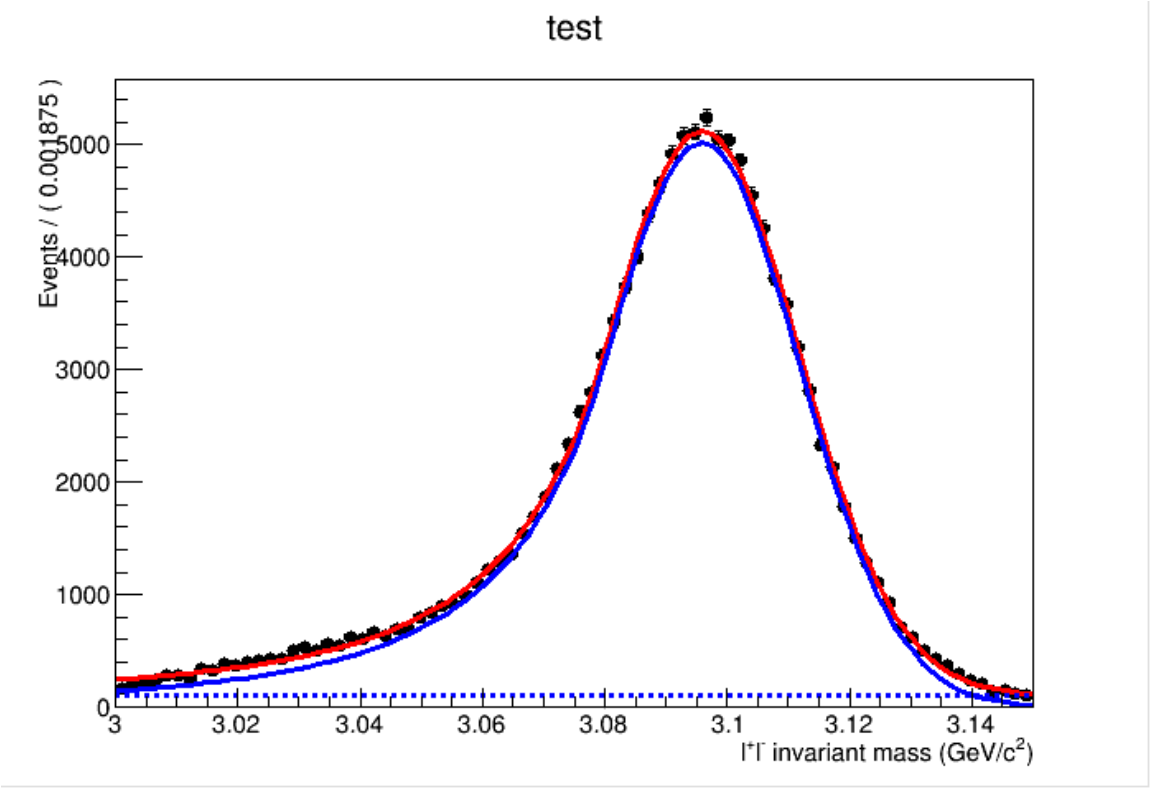

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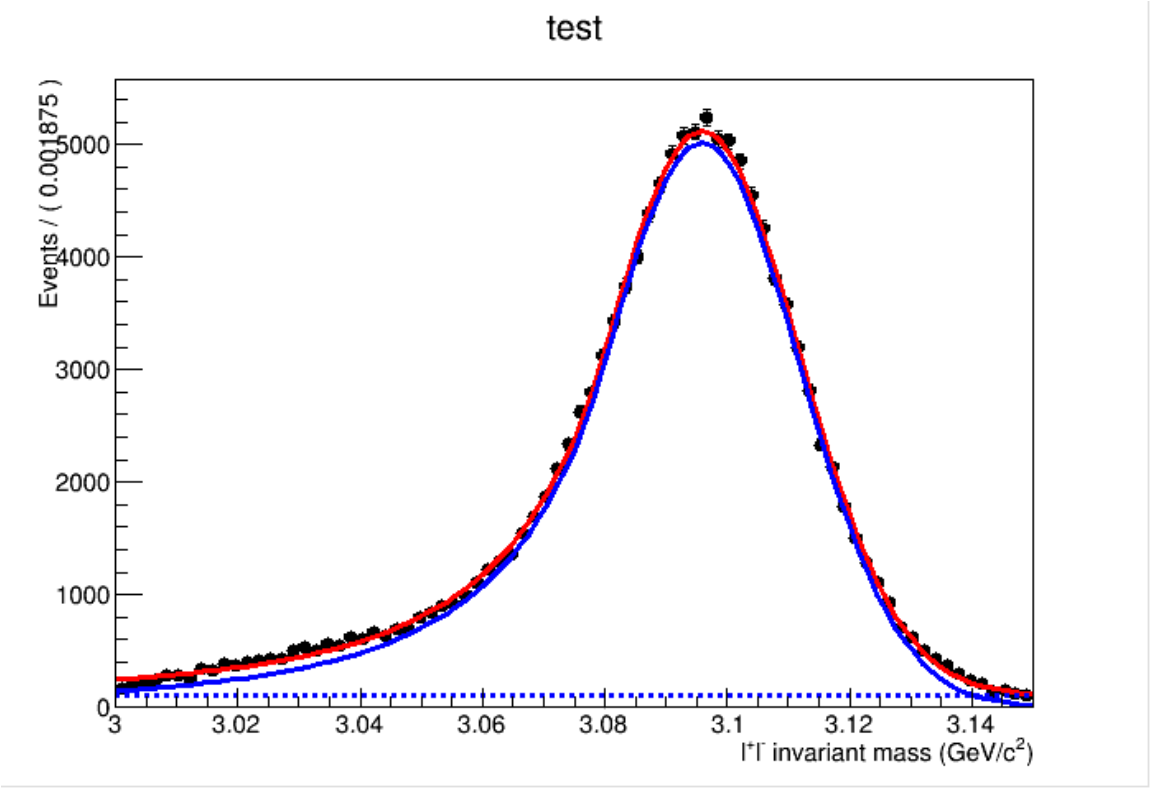

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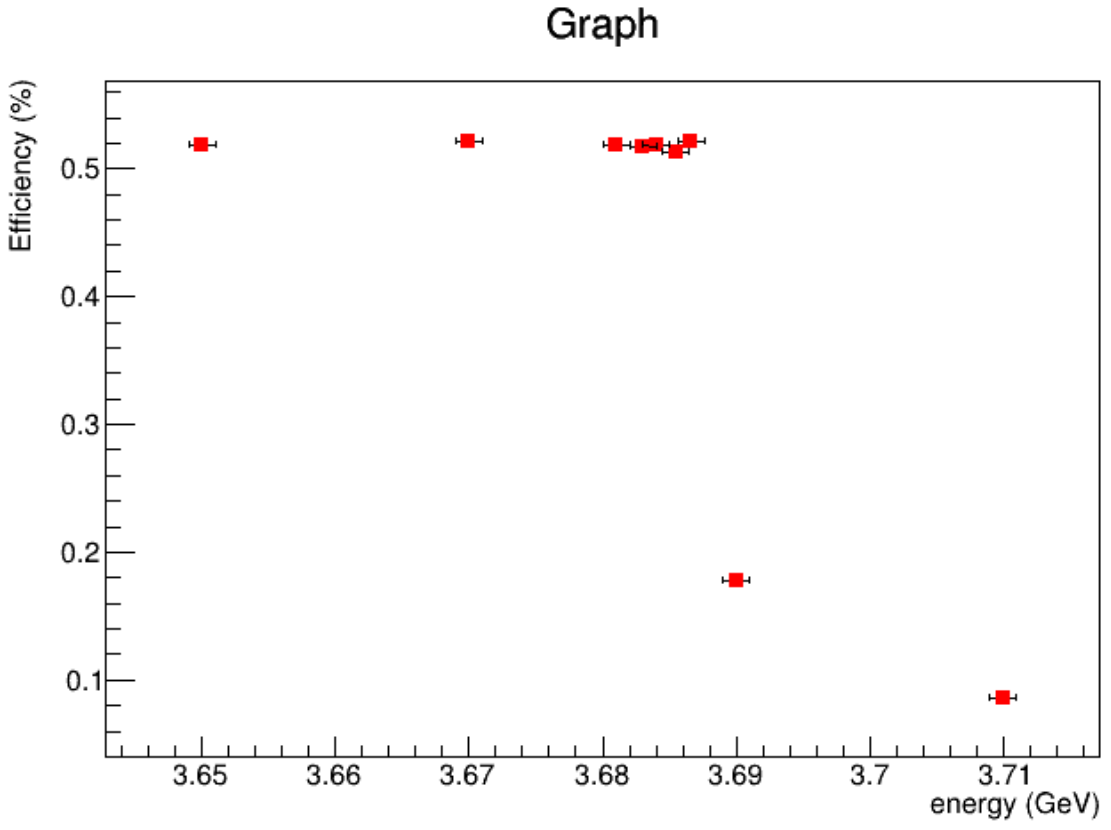
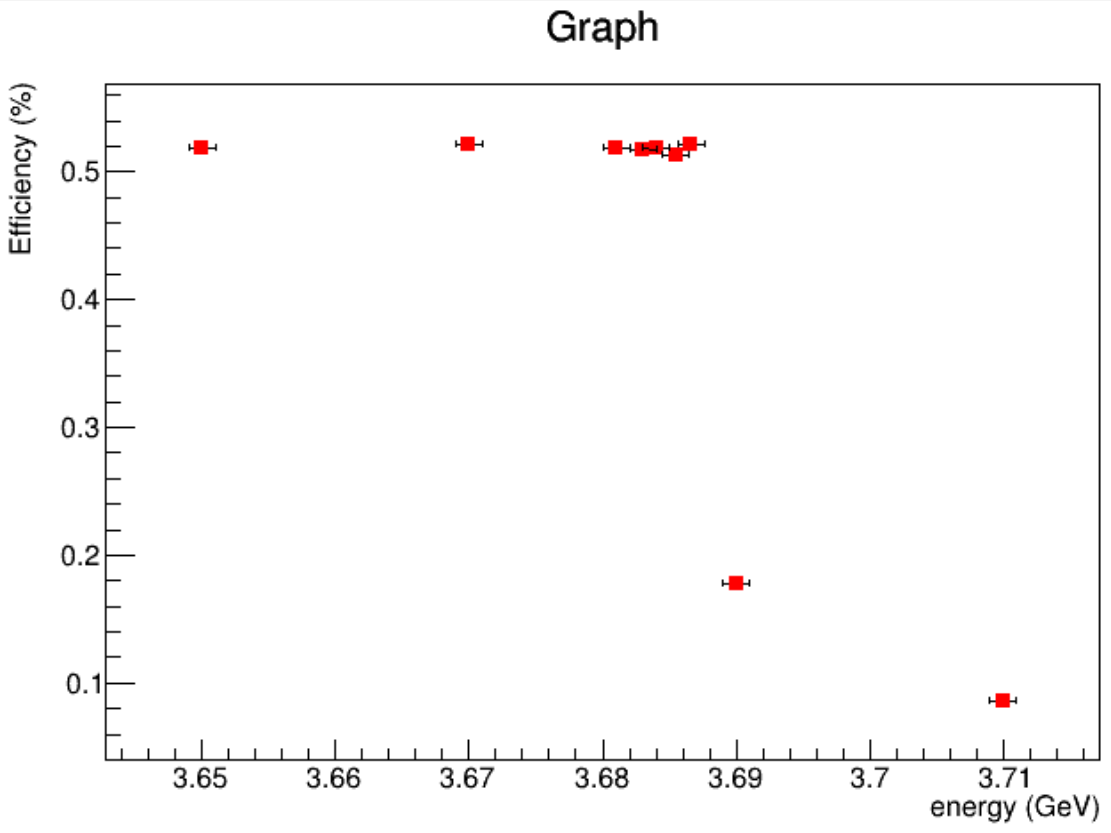
This was too stringent for the data @ 3710 MeV

2) efficiency?



What is efficiency?

2) efficiency?



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In our understanding, it shall contains only the "detector" effects, since the radiative corrections are simulated in the routine

In our case, simulation is then repeated without radiation correction effects

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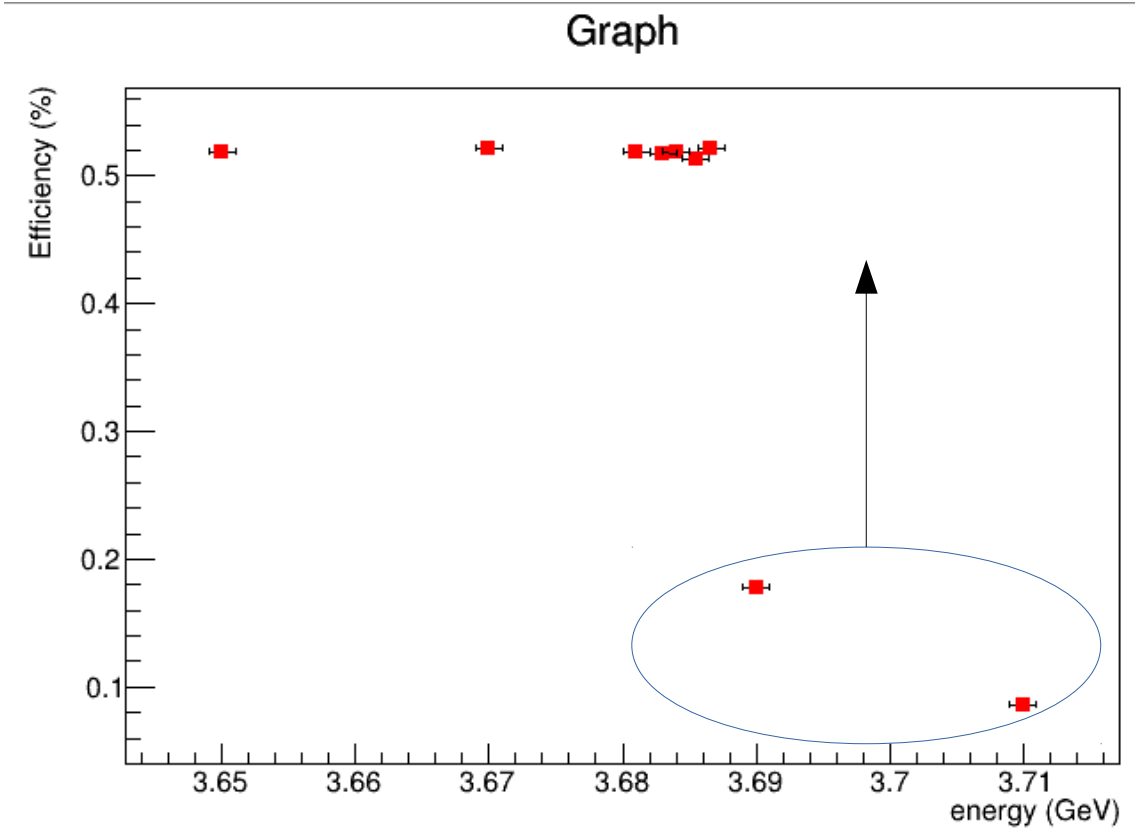

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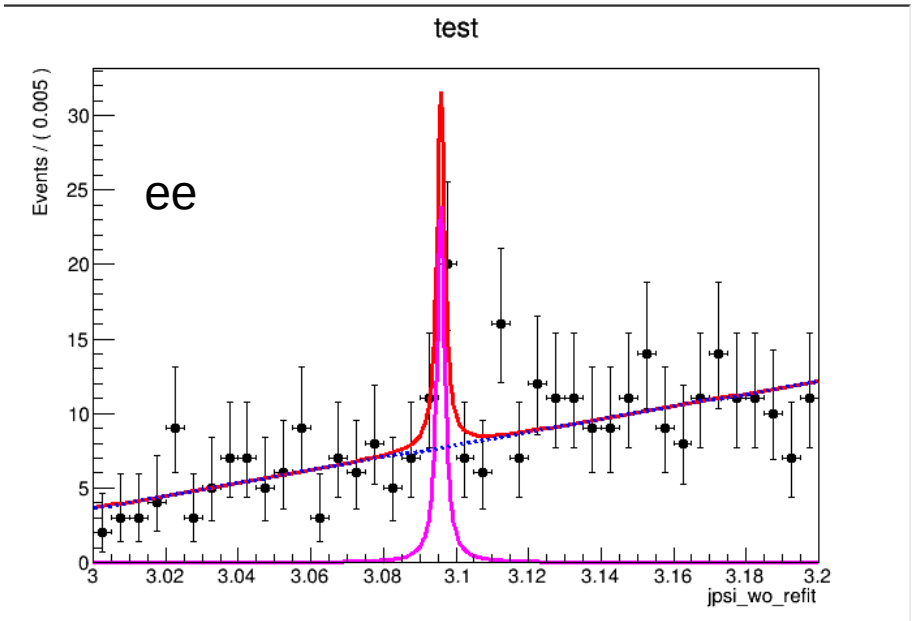
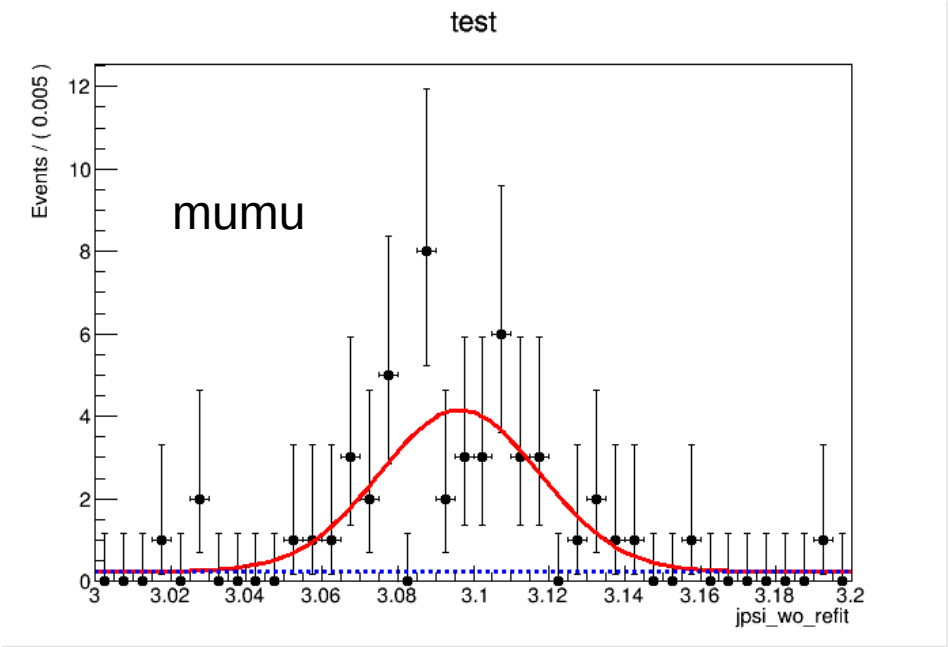
3) 3650 MeV



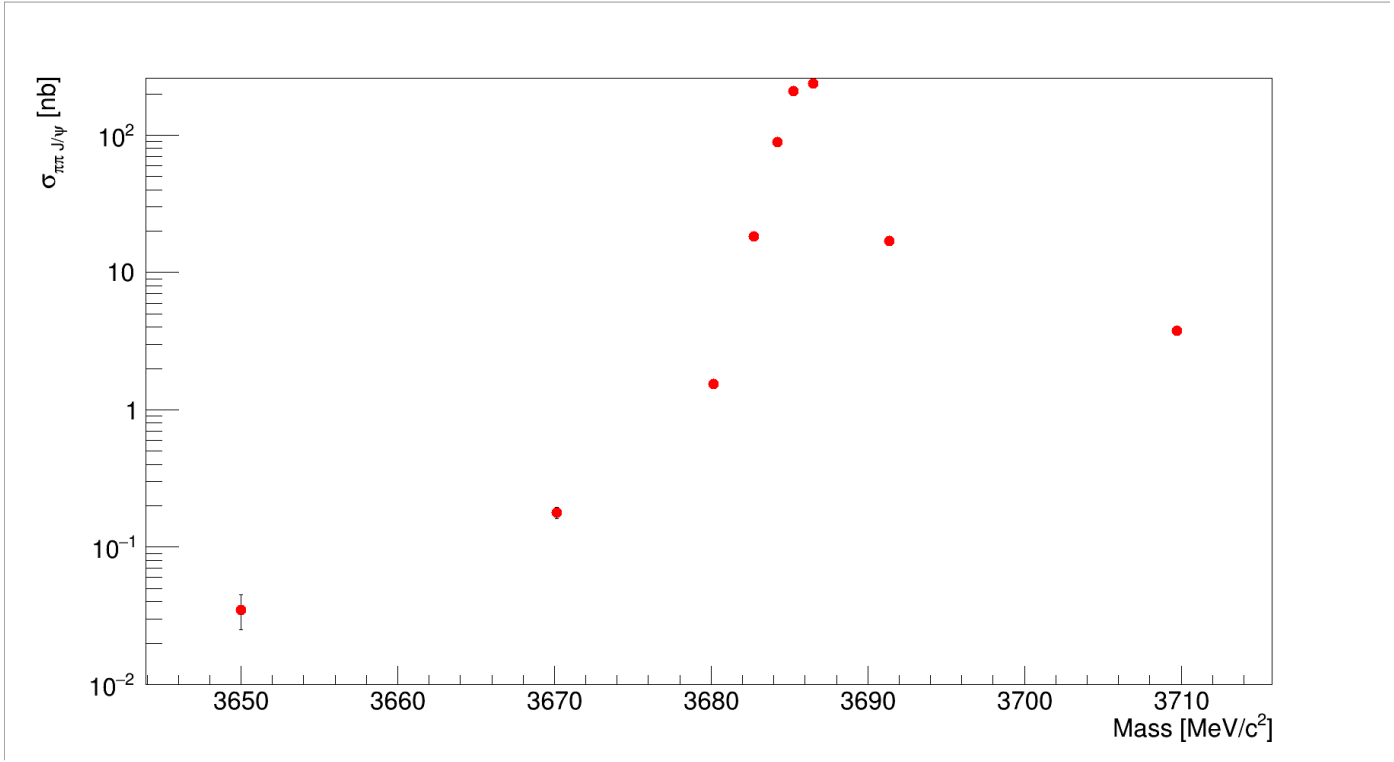


The results in electron final state has lower statistical significance → we mainly use the muonic final state (that is much cleaner)

Fitting

FIT PANDA

The data



Ecm(GeV)	$\mathcal{L}$ (pb^{-1})
3.5815	84.604±0.082
3.6702	83.582±0.084
3.6801	83.060±0.083
3.6828	28.175±0.049
3.6842	27.840±0.048
3.6853	25.342±0.046
3.6865	24.481±0.045
3.6914	68.647±0.076
3.7098	69.326±0.077

Preparing the routine

- Based on the experience at the J/psi, we know that, measured the cross sections, one shall be able to fit the data to the nominal values of mass and width of psi(2S)
- Two parameters ought to be optimized to do so:
  - Center of mass spread
  - Global shift

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  - A temptative value is placed in input
  - Fit is performed
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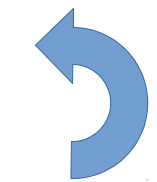
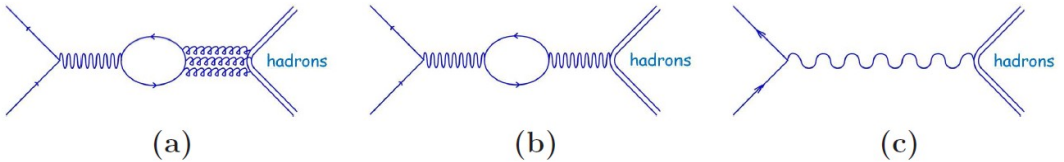


Found values:

Center of mass spread = 1.26 MeV
Global shift = 0.127 MeV

The continuum/EM conundrum

- There are 3(+1) contributions to describe the process

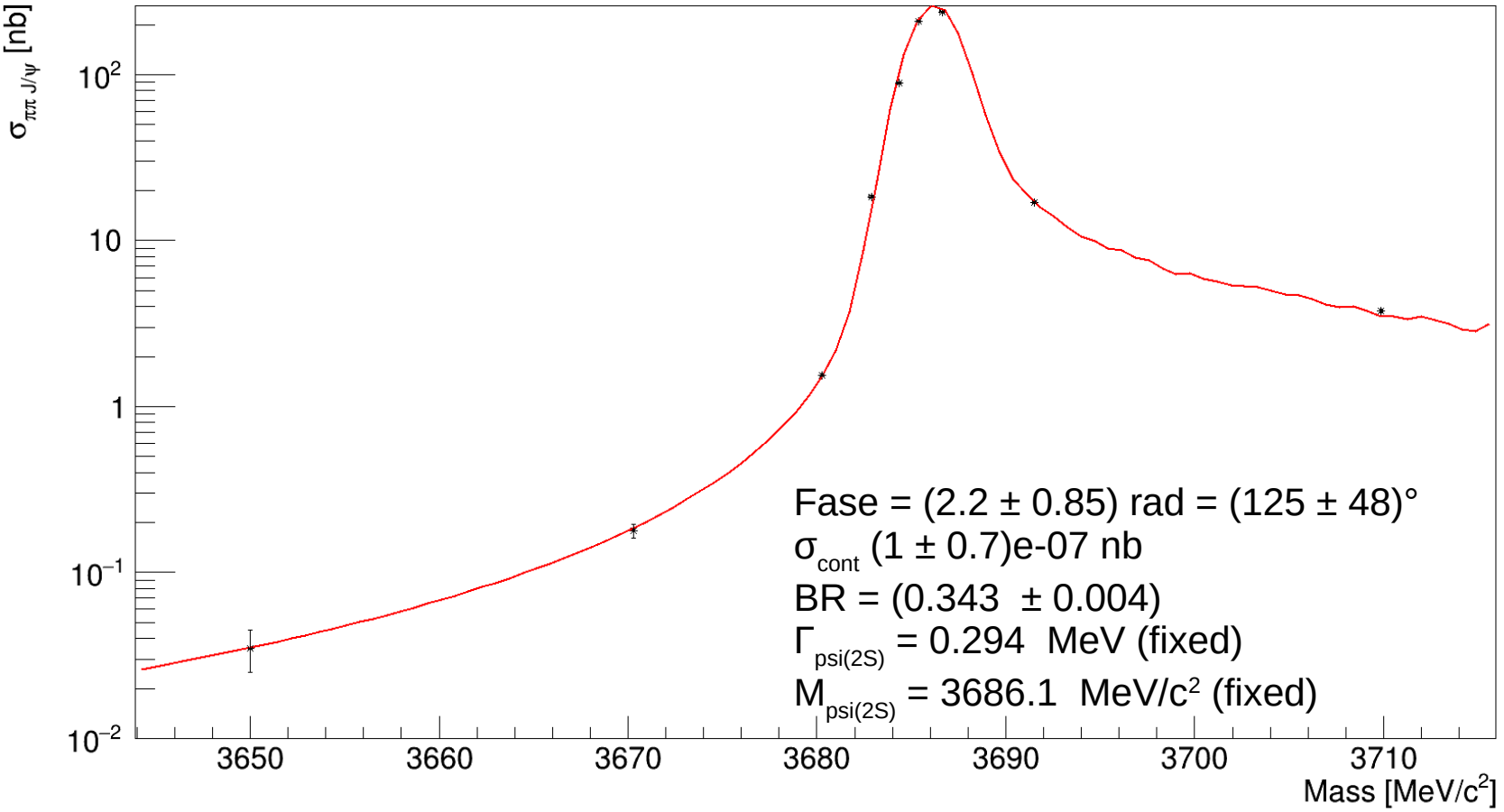


  Modeled in such way that (b) is proportional to (c)
- C has a dependence with the energy like the one shown in formula

$$C = \sqrt{\sigma(3000)\left(\frac{3000}{W}\right)^{PWW}}$$

- However, our process is probably dominated by the strong amplitude, thus the I decided to parametrize the continuum as a constant term fixed at the born cross section @ 3.5 GeV (where the process opens); the cross section is then extracted as fit parameter

Fit!


$\sigma_{\pi\pi J/\psi}$ [nb]
10^2
10
1
10^{-1}
10^{-2}
3650
3660
3670
3680
3690
3700
3710
Mass [MeV/c^2]
Fase = (2.2 ± 0.85) rad = (125 ± 48)°
σ_{cont} (1 ± 0.7)e-07 nb
BR = (0.343 ± 0.004)
$\Gamma_{psi(2S)}$ = 0.294 MeV (fixed)
$M_{psi(2S)}$ = 3686.1 MeV/c^2 (fixed)

A glance of systematics

- 1% per charged pions
- 1% per charged leptons
- Luminosity errors
- σ_{BR} of J/psi → l^+l^- from PDG
- ...

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To be added in quadrature to the statistical errors in each energy value

Summary and outlook

- Fixed few flaws remaining in the selection
- Tested a new approach to the fit

- Working on the systematics
- Memo in “preparation”