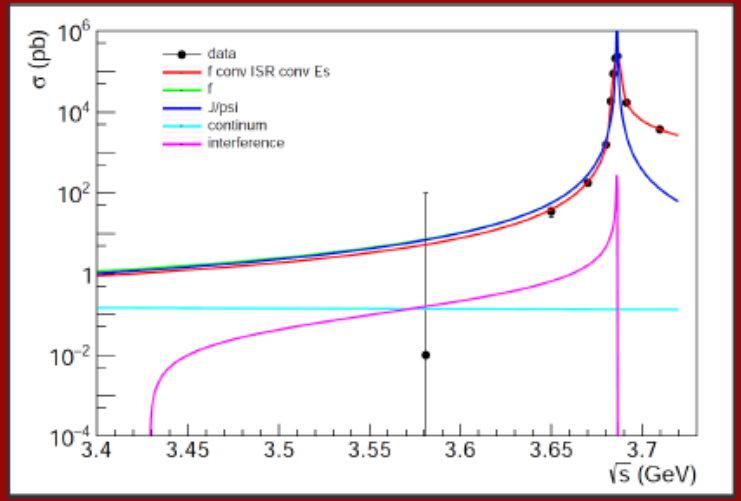
Status update on pipiJpsi around psi(2S) mass

G Mezzadri on behalf of the working group

Where we left?

Second fit

Using only the J/psi → μμ final state, adding a "tentative" upper limit on 3.581 GeV.
Efficiency without ISR.



Free parameters are BR, σ(3.5 Gev), phase, Spread, but results do not improve

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Where we left?

Further steps

- Test additional points using τ threshold and χ_{c1} data to try to constrain better the continuum
  - Also update few points with more recent data
- Test ConExc in simulation to have better description of ISR in simulation
- Continue testing the fit

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Where we left?

Further steps - II

During the discussion, I have received few comments from LI Haibo:

- To improve statistics, test reconstruction of only the pipi and search for J/psi in the recoil mass
- Evaluate the effect of the psi(3770) tail at high center-of-mass energies, also using the psi(3770) fast scan
- He stressed the importance to understand whether there is a continuum process, that may be related to BESIII (slightly) higher R measurement wrt to pQCD predictions

1. ConExc with ‘18 psi(2s) scan data

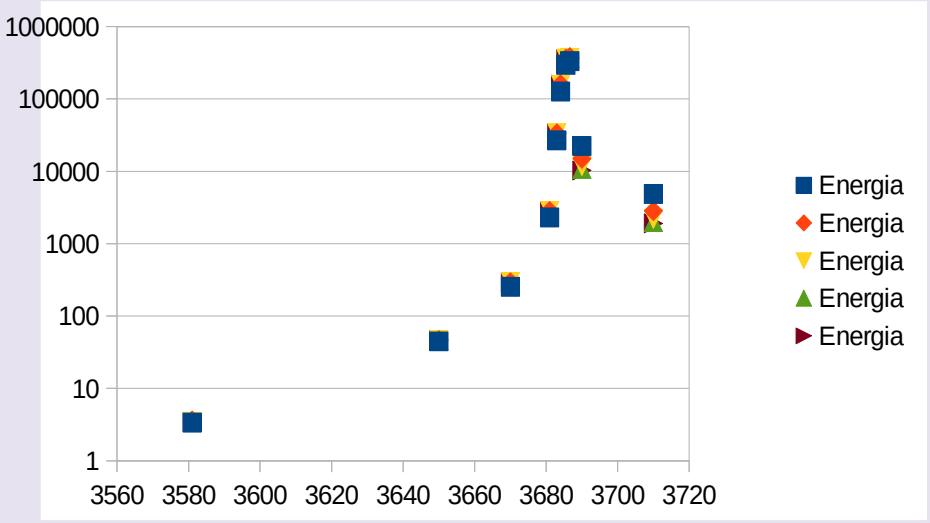
- Test ConExc in simulation to have better description of ISR in simulation

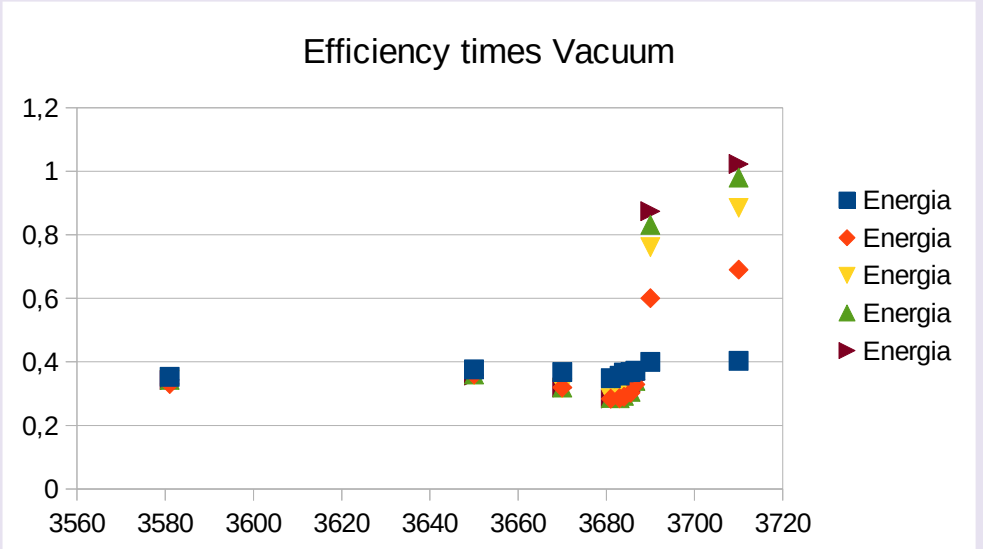
ConExc

- Event Generator for BESIII
- Several operation mode
  - We use DIY cross section
- Calculates ISR contribution via iterative process
  - Return also listed/extrapolated value of the Vacuum polarization for each energy point

- Starting point: flat cross section (usually set to 1 a.u.)
- Arrival point: difference of the product (1+delta)*efficiency < 1% in last two iteraction

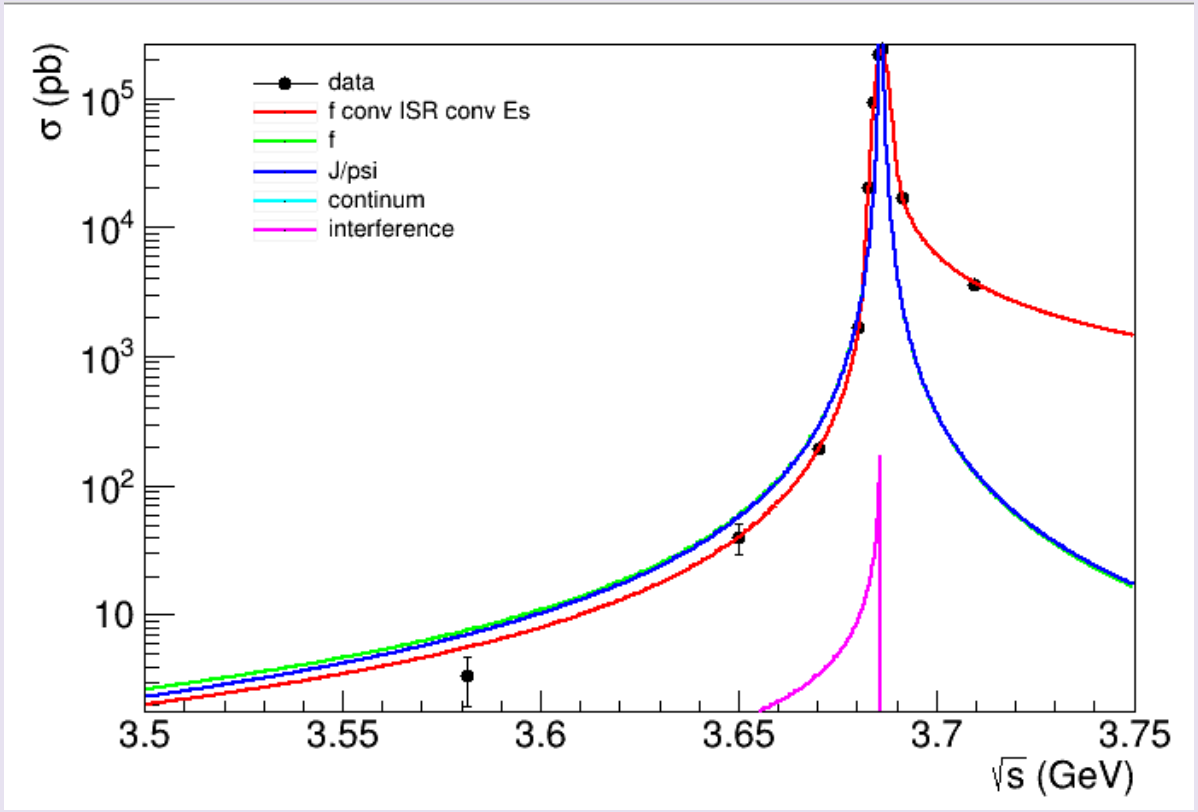
Learing with psi(2S) scan data





At the end, the observed cross section is ready to be fitted with USTC routine

Fit



chi2 is 26.315

BR = 0.387732 +/- 0.00408434
phi_s = 179.256 +/- 151.795
cont(3.4GeV) = 0.0120443 +/- 0.0612404
spread = 0.00139069 +/- 2.17958e-05

Still not satisfactory, though…

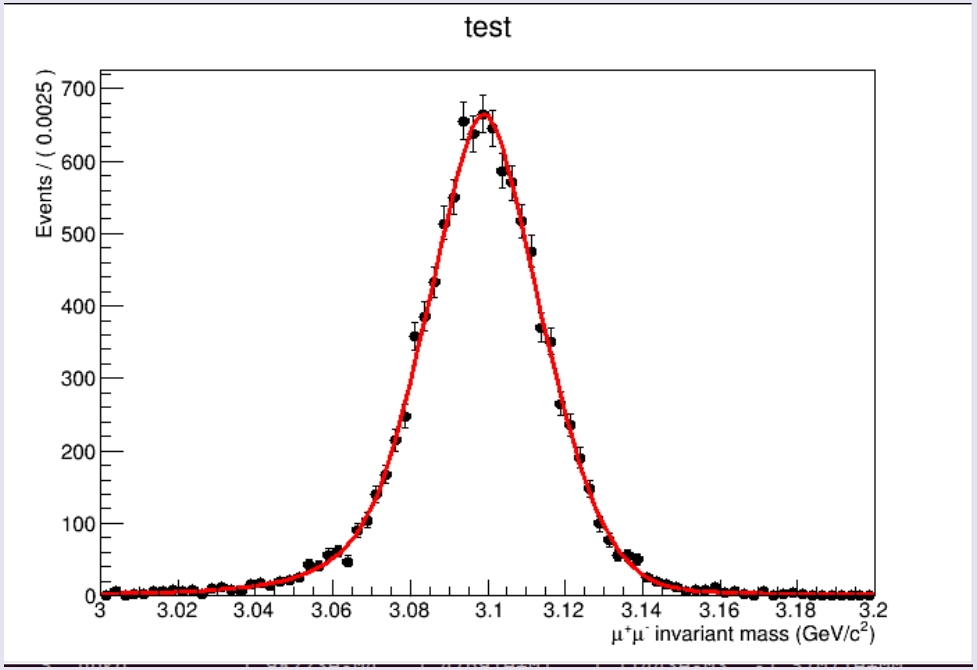
2. Recoil mass

- To improve statistics, test reconstruction of only the pipi and search for J/psi in the recoil mass

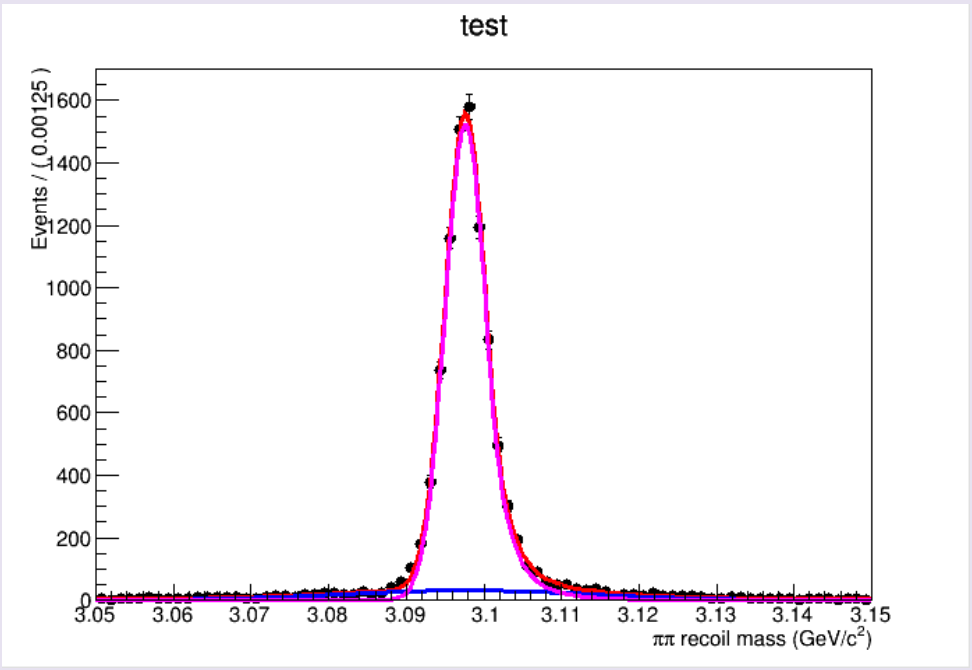
Event selection

- Event selection follows similar criteria of other pipiJ/psi final state analyses
- 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 ($\cos|\theta_{ee}| < 0.98$).

MC @ 3.686 GeV

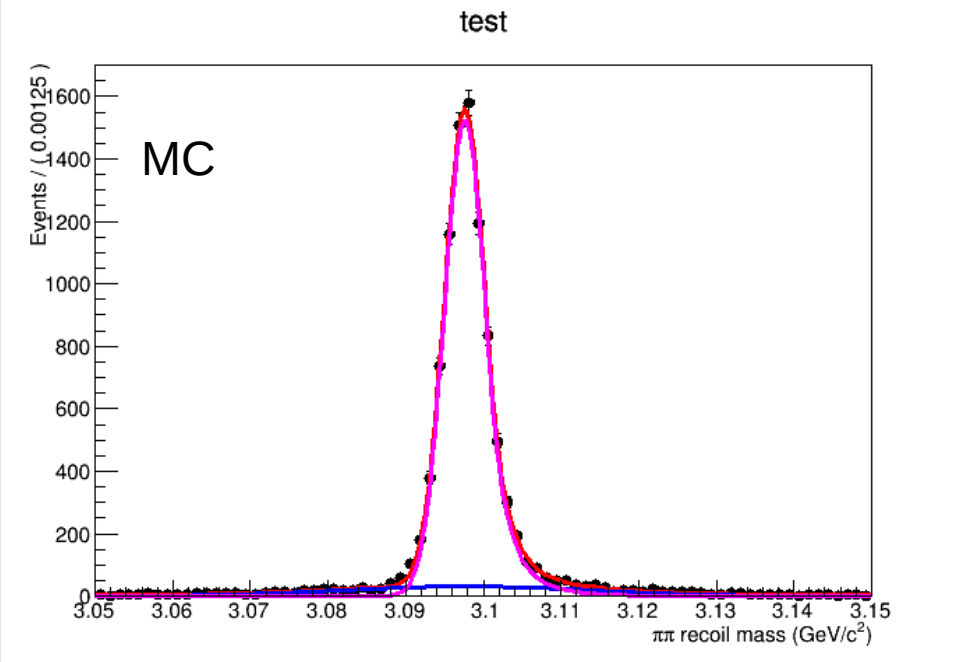


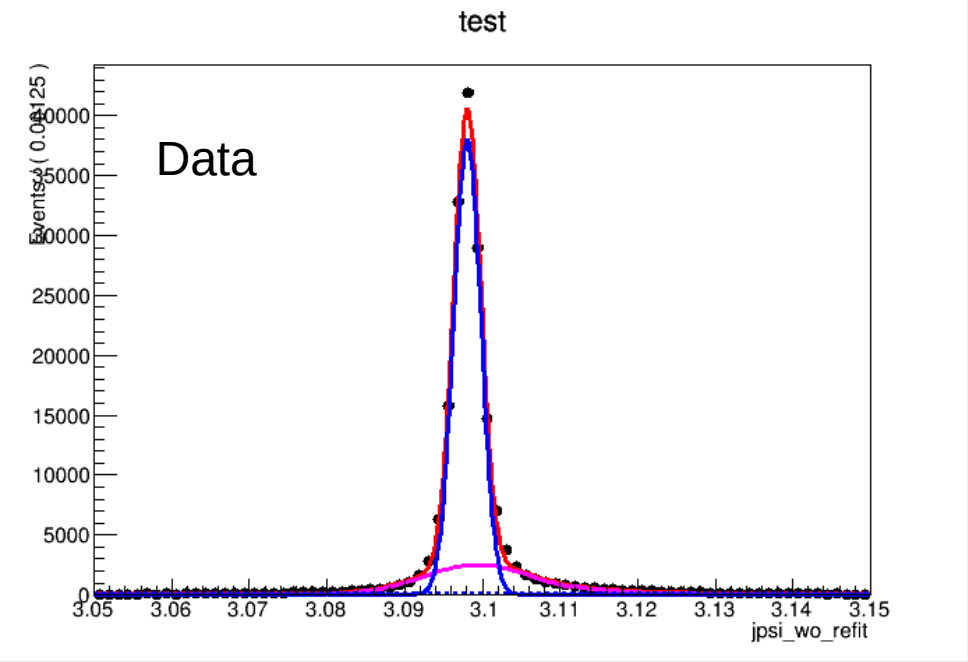
Lepton-Lepton invariant mass



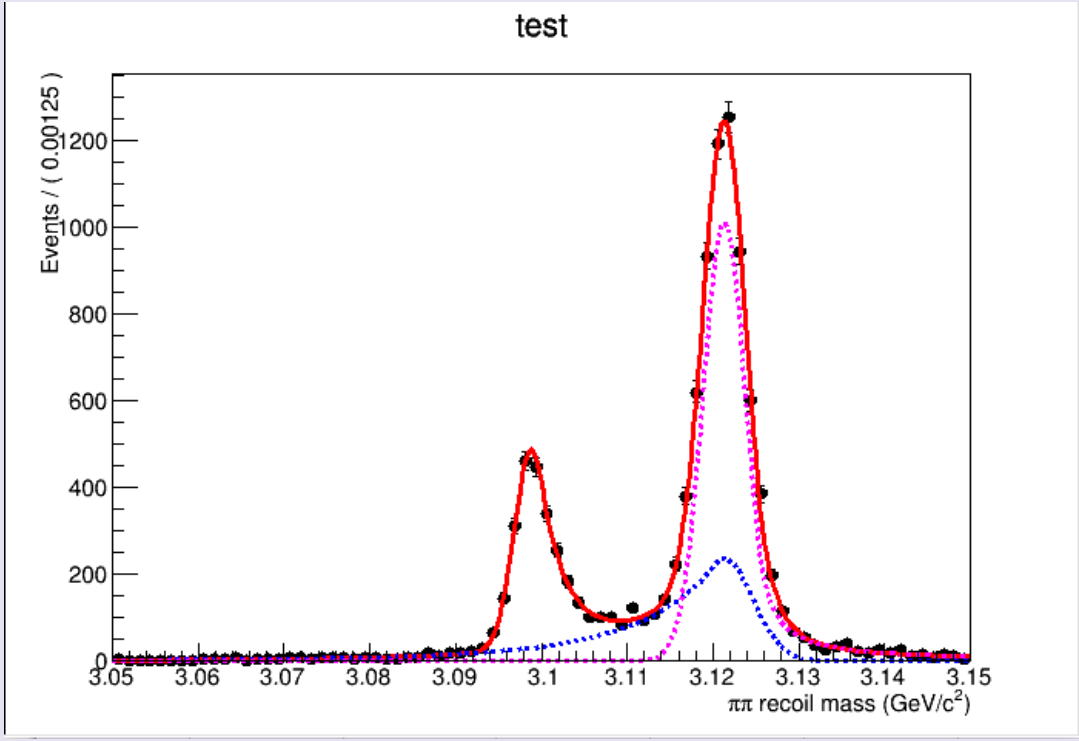
pipi recoil mass
but still lepton ID requirements

MC-Data @ 3.686 GeV





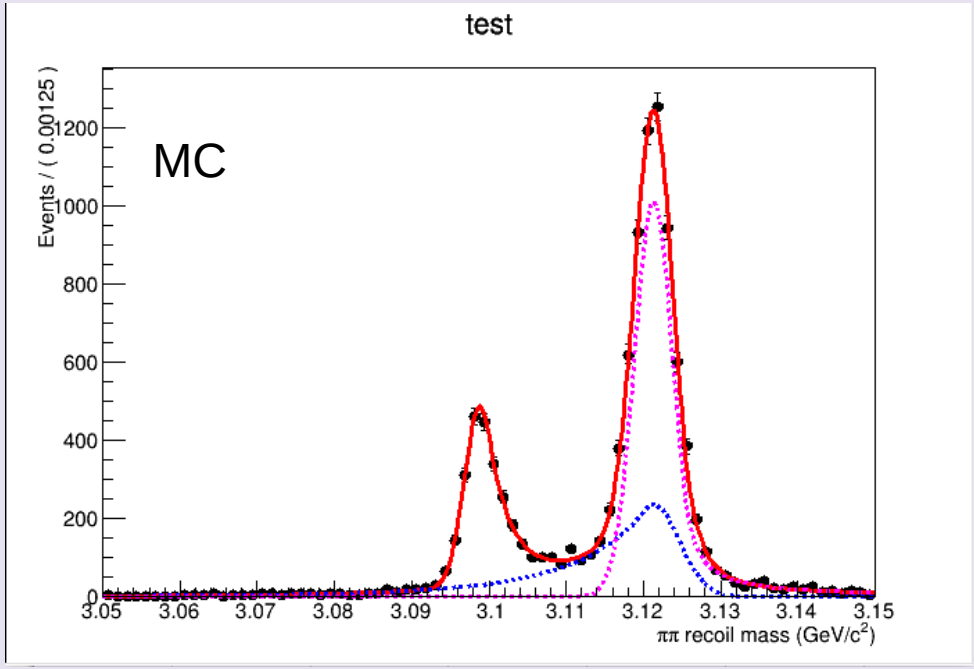
MC Above psi(2S) peak

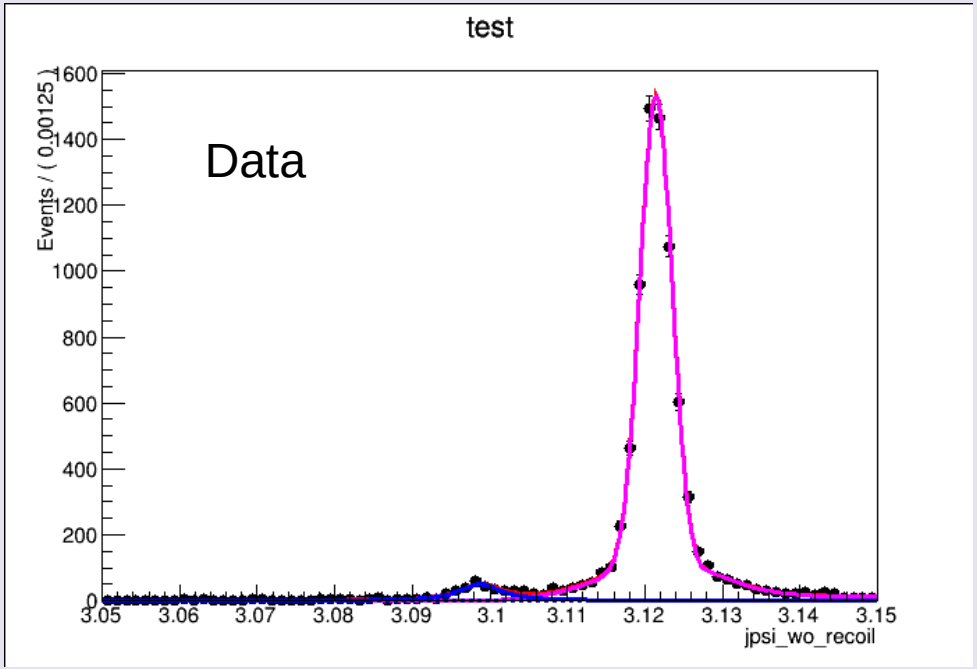


pipi recoil mass

but still lepton ID requirements

MC-Data above psi(2S) peak





3. Adding new energies

- Test additional points using τ threshold and χ_{c1} data to try to constrain better the continuum

2018 psi(2S) scan data

Requested Energy (MeV)	Requested Luminosity (nb^{-1})	Run number	Energy (MeV)	Spread (MeV)	$\mathcal{L}$ (pb^{-1})
3580	85	55375-55461	3581.543 ± 0.060	1.493 ± 0.060	84.604 ± 0.082
3670	85	55462-55541	3670.158 ± 0.063	1.410 ± 0.053	83.582 ± 0.084
3681	85	55542-55635	3680.144 ± 0.061	1.517 ± 0.060	83.060 ± 0.083
3683	55	55636-55662	3682.752 ± 0.115	1.710 ± 0.104	28.175 ± 0.049
-	-	55663-55690	3684.224 ± 0.119	1.547 ± 0.122	27.840 ± 0.048
3685.5	25	55691-55716	3685.264 ± 0.105	1.478 ± 0.111	25.342 ± 0.046
3686.6	25	55717-55737	3686.496 ± 0.120	1.594 ± 0.117	24.481 ± 0.045
3690	70	55738-55795	3691.363 ± 0.075	1.541 ± 0.074	68.647 ± 0.076
3710	70	55796-55859	3709.755 ± 0.074	1.460 ± 0.075	69.326 ± 0.077

Luminosity with Bhabha and two photons

2018 tau mass data

τ-threshold scan

point	W^{BEMS}, MeV	L^{online}, pb^{-1}	BES3 runs
1	3538.957 ± 0.159	25.5026	55115–55139, 55143–55155
1′	3550.828 ± 0.028	3.99513	55157–55161
2	3552.810 ± 0.045	42.5698	55162–55177, 55179–55199
3	3553.897 ± 0.018	27.1458	55200–55231
4	3560.285 ± 0.026	8.28263	55232–55239
5	3599.524 ± 0.051	14.9628	55240–55257
6	3601.385 ± 0.110	14.8606	55347–55361

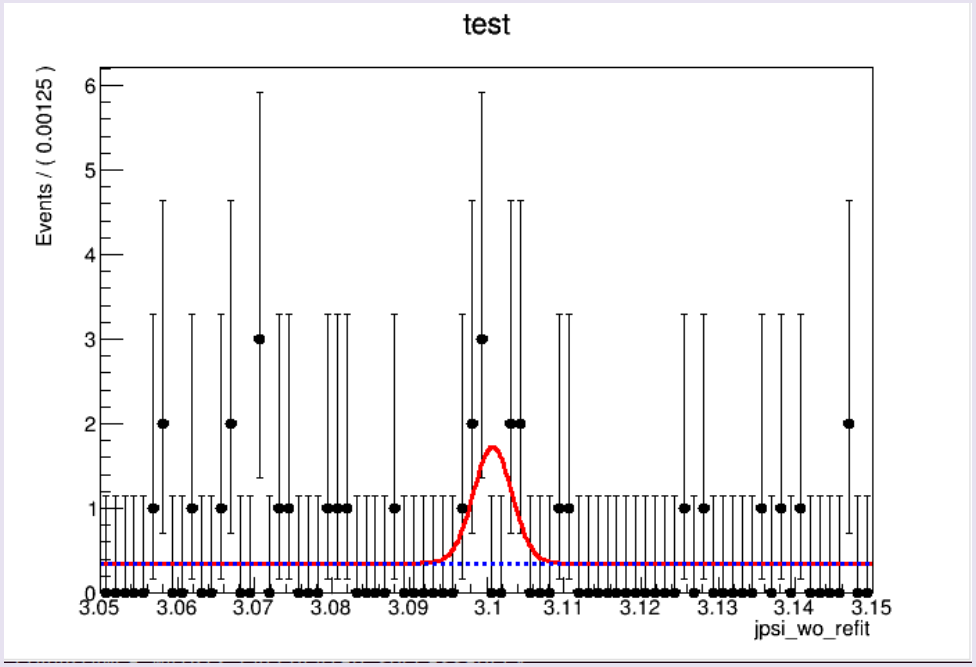
Tau mass data taking

$\psi(2S)$ scan

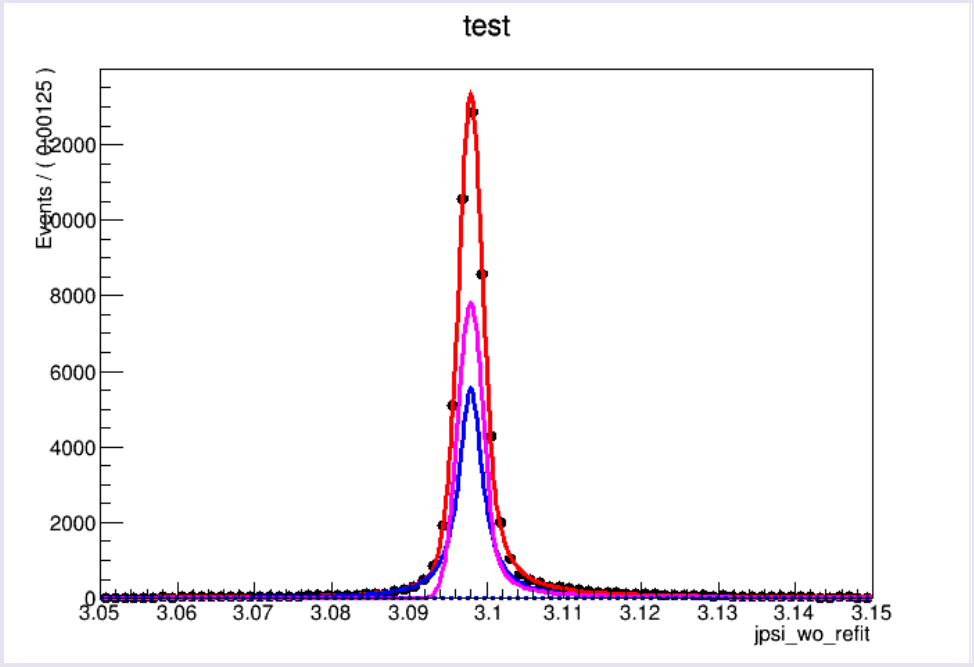
point	W^{BEMS}, MeV	L^{online}, pb^{-1}	BES3 runs
1	3675.442 ± 0.191	5.17638	55258–55263
2	3683.193 ± 0.096	15.60458	55264–55276
4	3684.193 ± 0.115	2.18118	55286, 55288
3	3684.393 ± 0.201	3.30610	55278–55285
5	3685.306 ± 0.101	4.62110	55289–55294
6	3685.833 ± 0.095	7.38168	55295–55308
7	3686.302 ± 0.096	6.12081	55309–55318
8	3687.305 ± 0.101	5.13150	55319–55325
9	3687.993 ± 0.096	5.08032	55326–55332
10	3689.773 ± 0.098	5.97002	55333–55339
11	3694.027 ± 0.098	5.03245	55340–55346

psi(2S) fast scan

Results



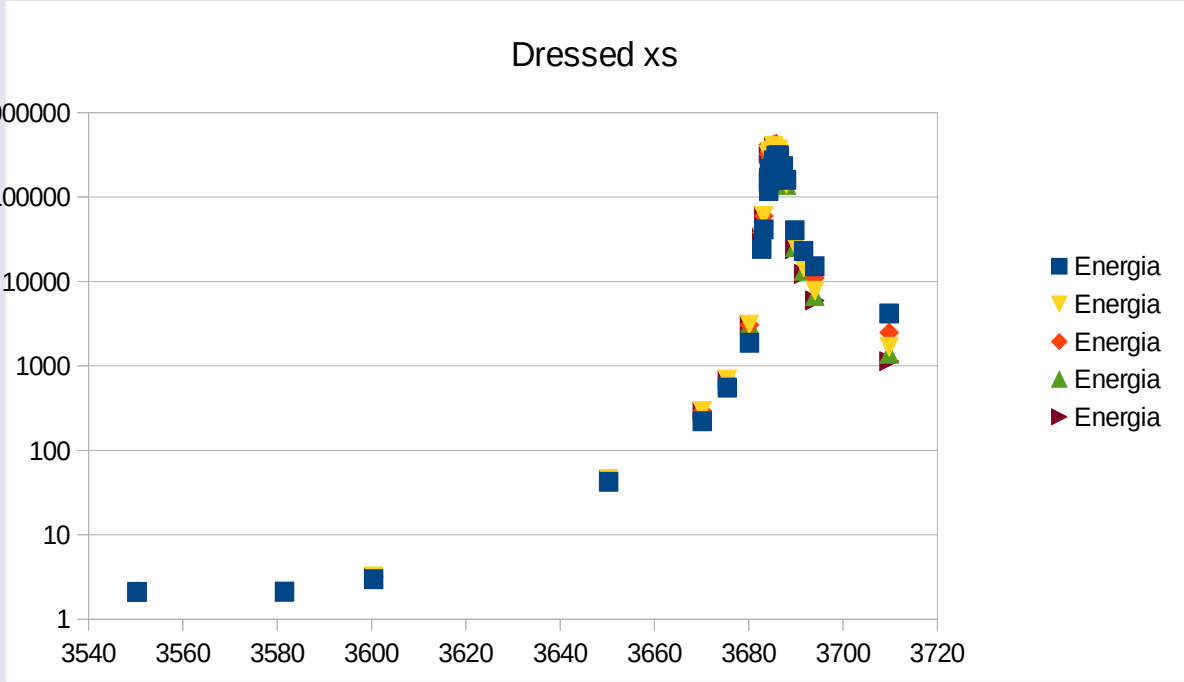
Tau data



Fast psi(2S) scan data

4. Fit with the full dataset

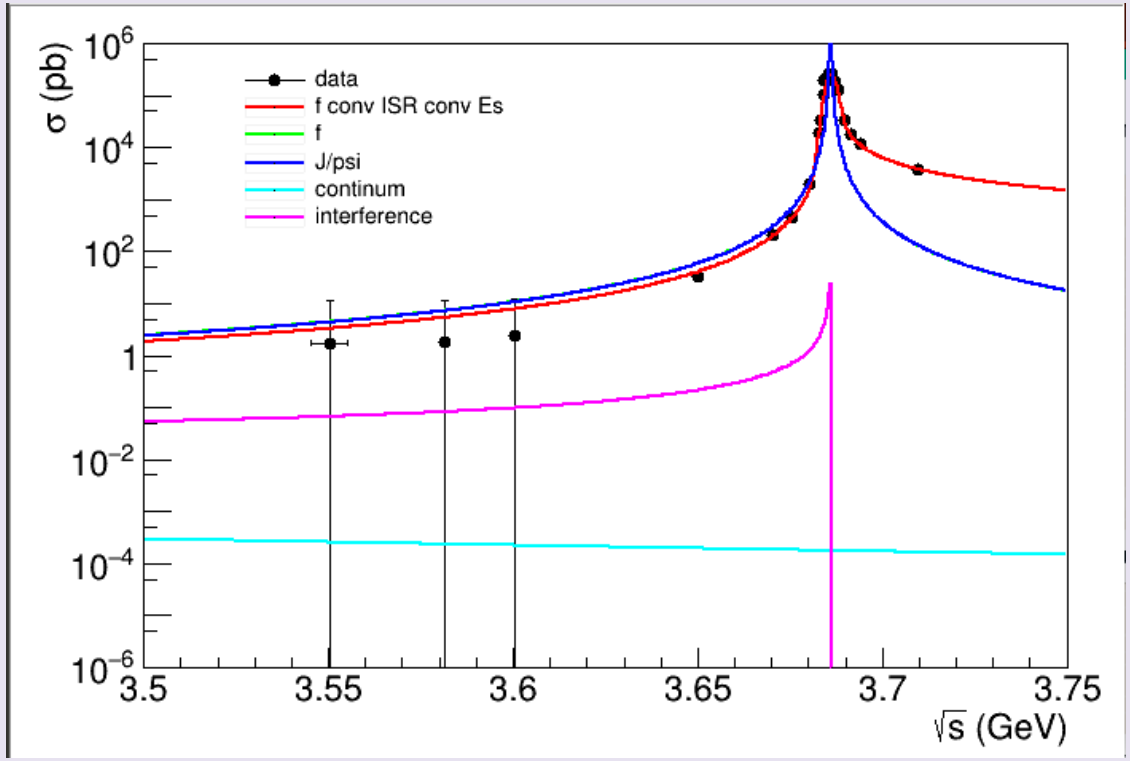
ConExc



For narrow resonances, vacuum polarization is set to 1 for few energies nearby the peak

To iterate, move from born to dressed

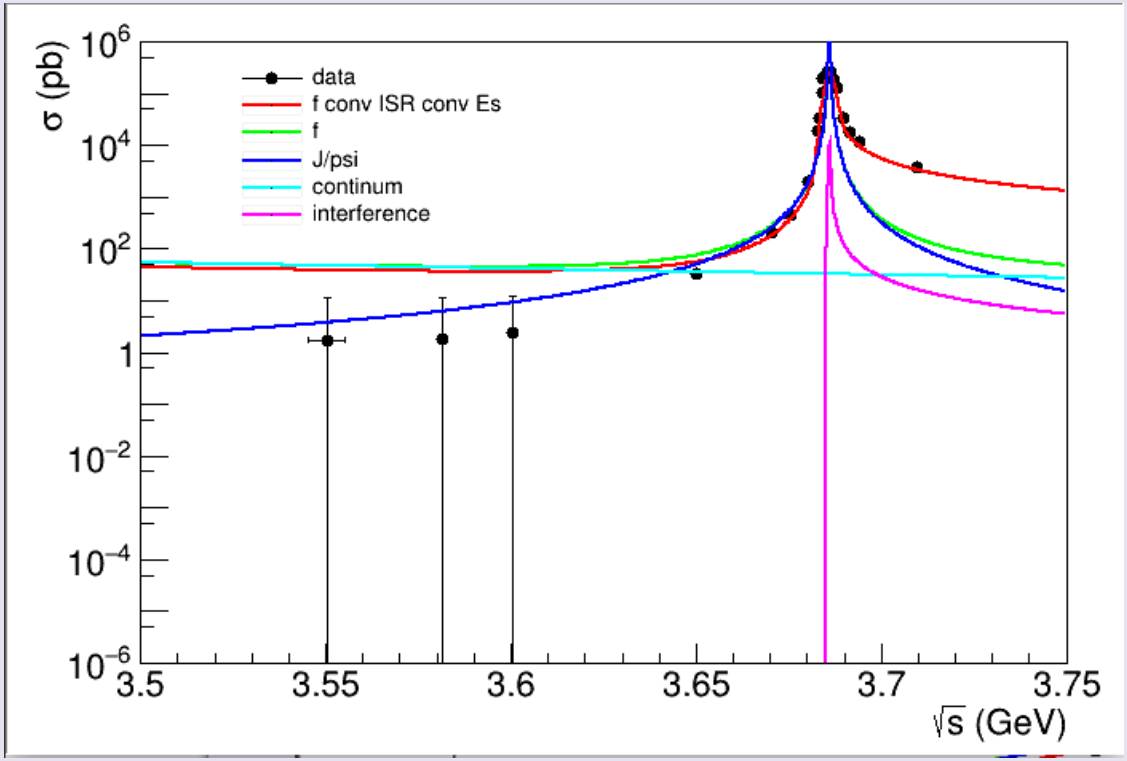
Fit – free parameters



chi2 is 233.901

BR = 0.401214 +/- 0.00174886
phi_s = 180 +/- 133.937
cont(3.8GeV) = 0.000128093 +/- 0.000530082
spread = 0.00132747 +/- 8.55279e-06

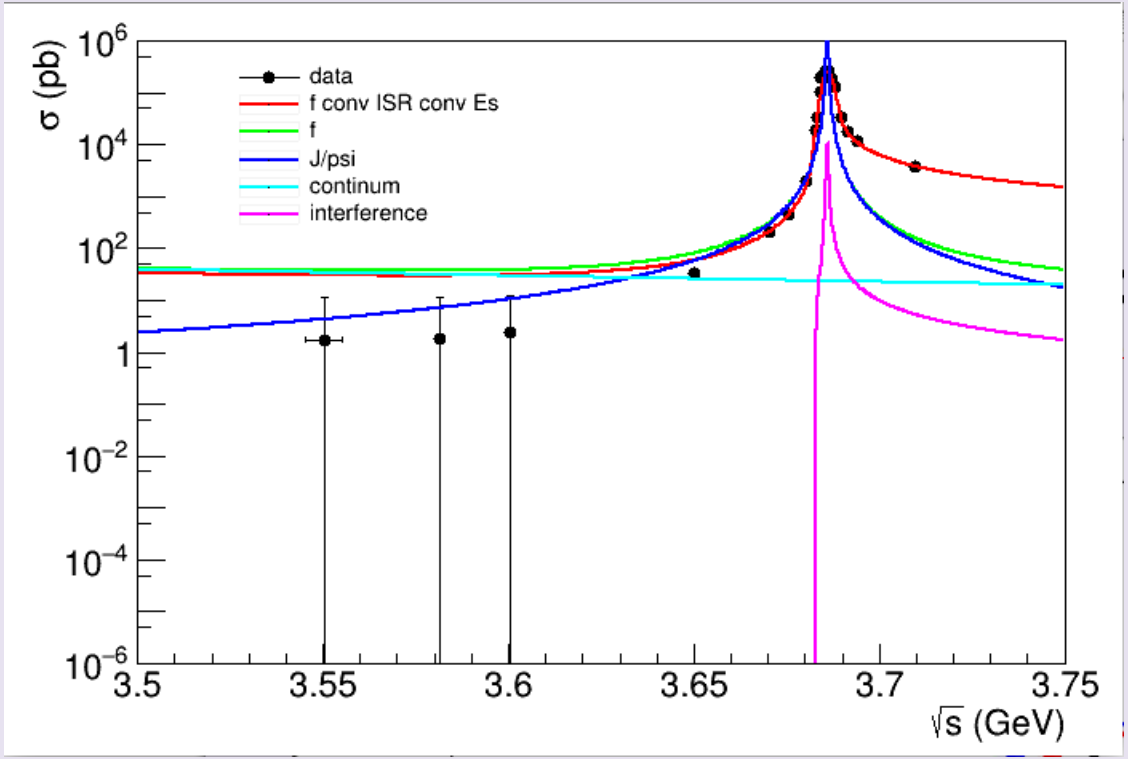
Fit – fixing the BR to PDG



chi2 is 1110.21

BR = 0.3467 +/- 0
phi_s = 83.0358 +/- 3.24692
cont(3.8GeV) = 23.6307 +/- 3.22402
spread = 0.00119308 +/- 7.63368e-06

Fit – fixing continuum



chi2 is 283.129

BR = 0.397004 +/- 0.00183242
phi_s = 87.9934 +/- 3.41034
cont(3.4GeV) = 17 +/- 0
spread = 0.00131999 +/- 1.17806e-05

5. Some Comments and Outlook

What I have learned

- ConExc simulation: Be careful on the starting point
- Full control on the fitting routine
- Understood the ISR contribution
- Tau and fast scan helpful to have more constrains
  - But few open points on the rise of the cross section
- (very) little continuum before the resonance
  - Use constraint from higher energy

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- ConExc simulation: Be careful on the starting point
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  - But few open points on the rise of the cross section
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Still, BR is out of range…

Outlook

- Tests remains:
  - Fast psi(3770) scan to study its effect
  - Use more/newer data for 3681 and 3650
  - Check again the continuum description
  - Release J/psi -> ll requirement

- I am preparing a memo with many details to be discussed within the working group to unveil potential mistakes in event selection code, fitting, simulation, etc…