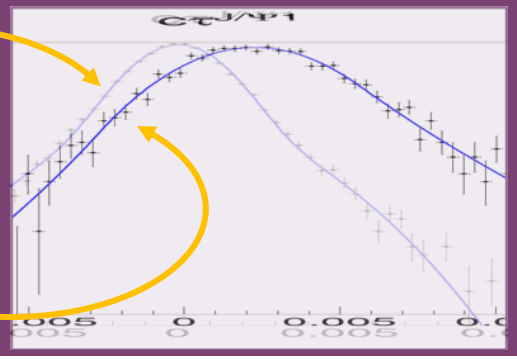
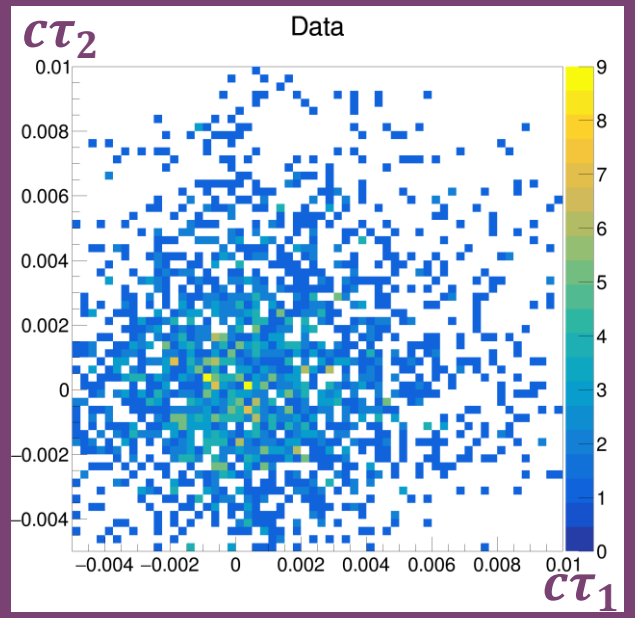
Review of the last week

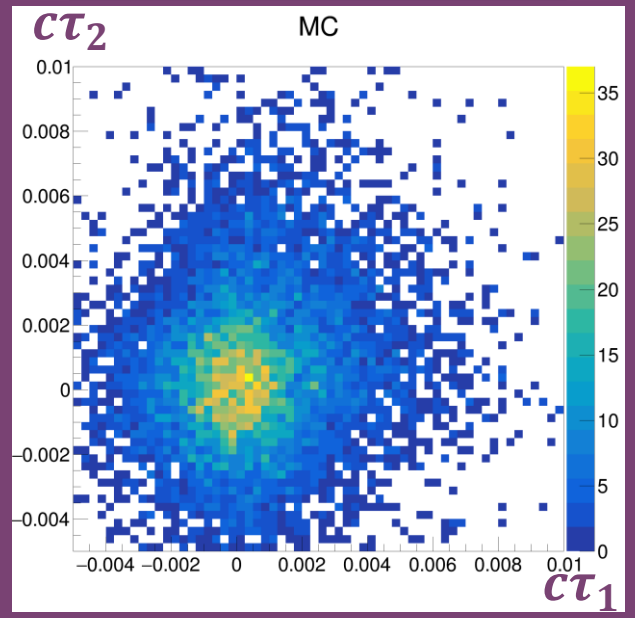
- Discussion about prompt + non-prompt combination
  - Square of the single dimension fraction can only be used when the correlation of two J/ψ is small enough
    Would check the correlation this week
  - Our function did not fit the greater lifetime variable well
- Lifetime parameters should be totally fixed in the fitting, for both prompt and non-prompt
- The lifetime shape of the combinatorial background would be extracted from the side band dataset
- The fitting to the artificial sample was not good enough

Correlation between J/ψ pair





2016 dataset



A mixing sample

- It's hard to say if there is any correlation between the J/ψ pair just from the scatter plots
  - Width (variance) of the distribution is too large
  - Distance between two distributions is too small

Correlation between J/ψ pair

- Developed some codes to calculate the correlation coefficient between $c\tau_1$ and $c\tau_2$

$$E[c\tau_1 c\tau_2] - E[c\tau_1]E[c\tau_2]$$

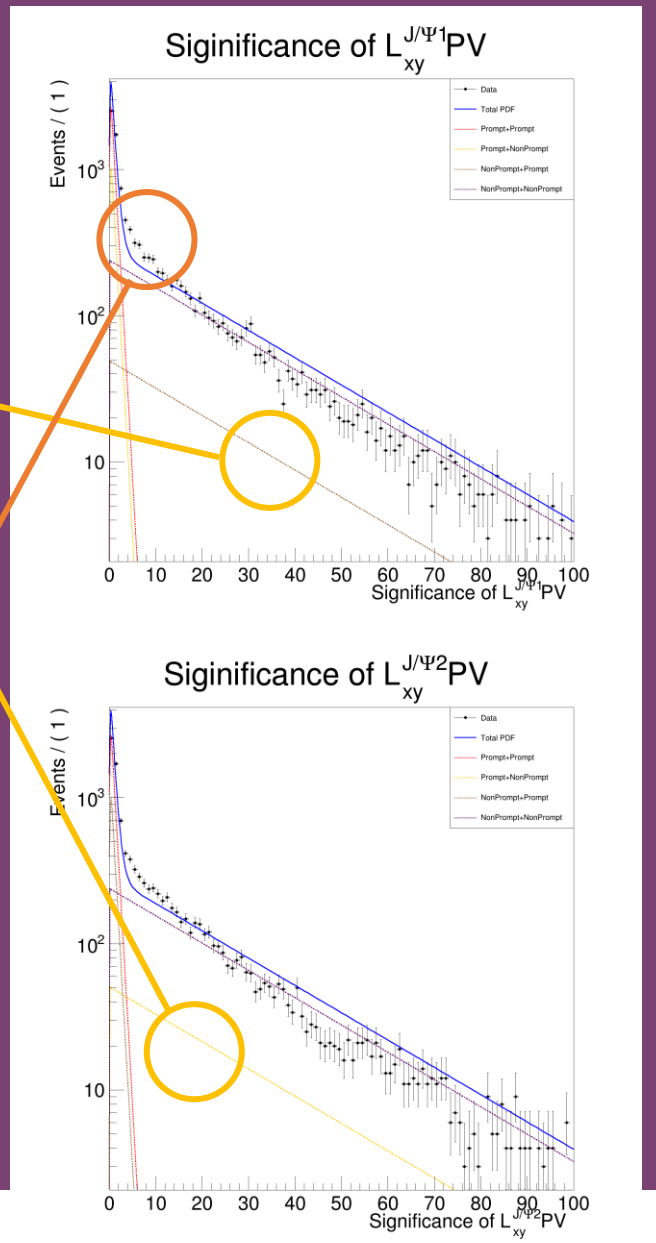
$$\rho_{c\tau 1 c\tau 2} = COV[c\tau_1, c\tau_2] / \sigma_{c\tau 1}\sigma_{c\tau 2}$$

$$\sqrt{E[c\tau_1^2] - E^2[c\tau_1]}$$

- The expectation value is the average of the variable
- Result:
  - 2016 data: 0.15
  - The mixing sample: 0.11
- May not be a good variable to clarify the correlation because of the same reason on the last page

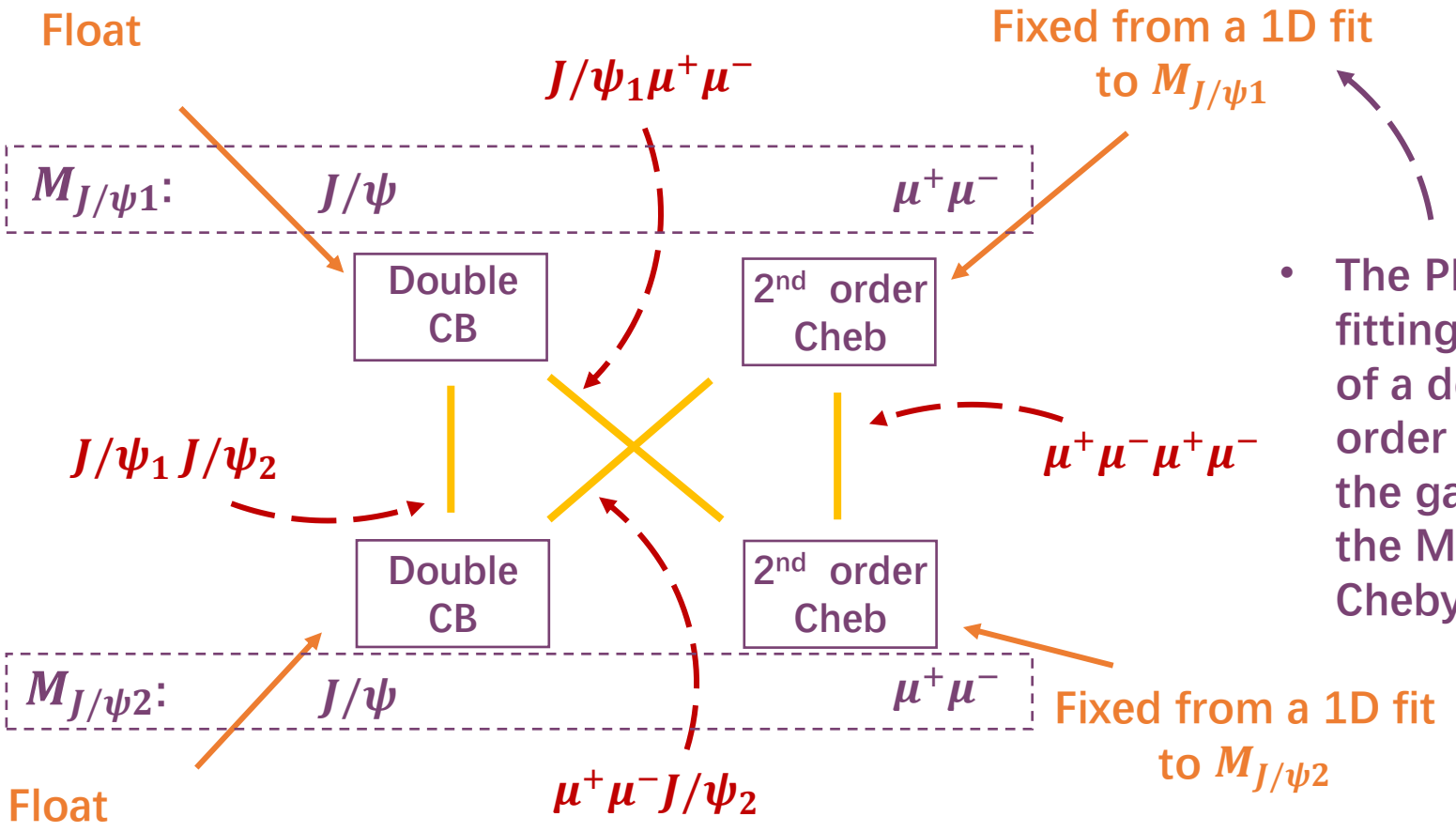
A 2D fit to the 2016 dataset

- Some prompt + non-prompt components can be extracted from the fitting, although the fraction is small (PP:NPNP:PNP:NPP ~ 3:5:1:1)
- Little idea about what it will become after the vertex cut
- The fitting is imperfect (maybe because of the improper 1D shape and the combinatorial bckground), may improve it later



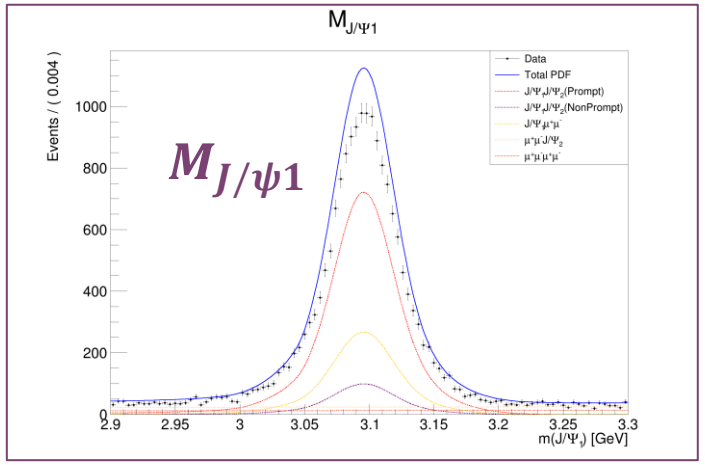
Fitting to the artificial sample

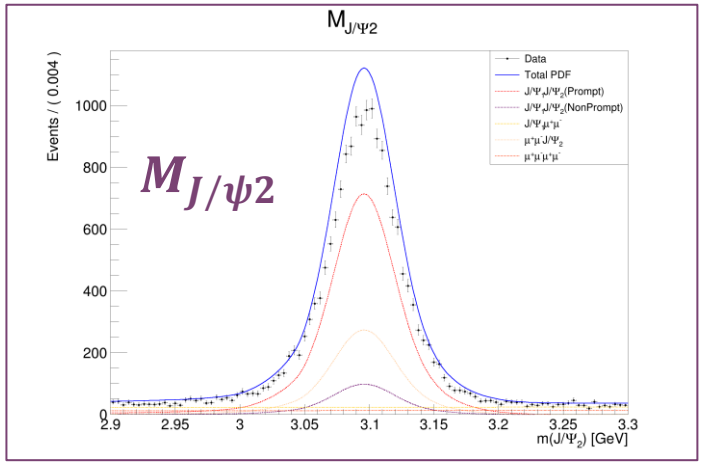
- Float all the parameters in the mass dimensions did not work well
- Try thesis style fitting

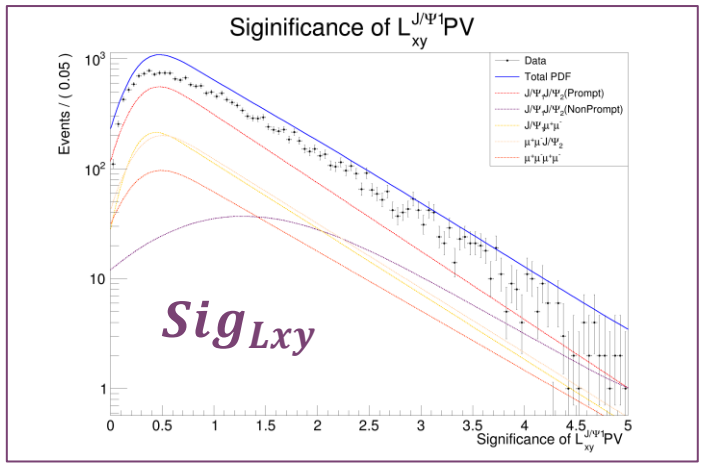


- The PDF used in this fitting is a combination of a double CB and a 2nd order Chebyshev, where the gaussian is fixed by the MC and the Chebyshev is float

Fitting to the artificial sample







Previous result

		Prompt	Non-prompt
11.10	Cheb fixed from side band	17300 ± 300	1800 ± 300
11.17	Float	12000 ± 200	1630 ± 140

- Fitting quality is even worse than the last week
- Estimation:
  - prompt: $\mathbf{12600 \pm 200}$ (compare to 12K)
  - Non-prompt: $\mathbf{1700 \pm 140}$ (compare to 2K)
- Prompt estimation is worse, but the non-prompt one is slightly better

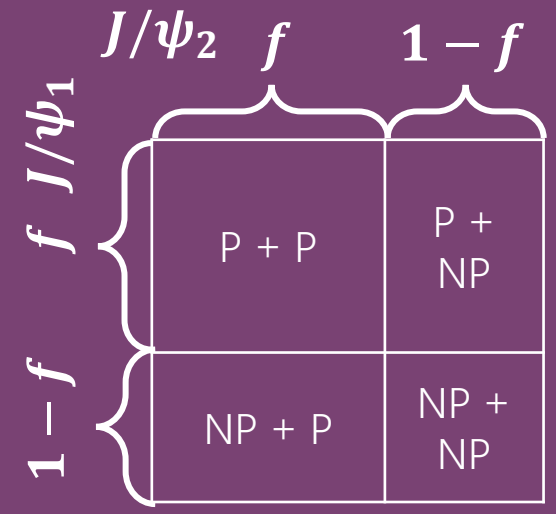
Summary

- Correlation between the J/ψ pair
  - Hard to pronounce if there is any correlation between two J/ψ or any prompt + non-prompt components just from the scatter plot
  - The correlation coefficient has been calculated, but it may be a good variable to measure the correlation in our case
- A preliminary 2D fit has been applied on the 2016 dataset
  - Some prompt + non-prompt components can be noticed
  - The fitting need to be improved
- Continue to fit to the artificial sample
  - Result is still unsatisfying

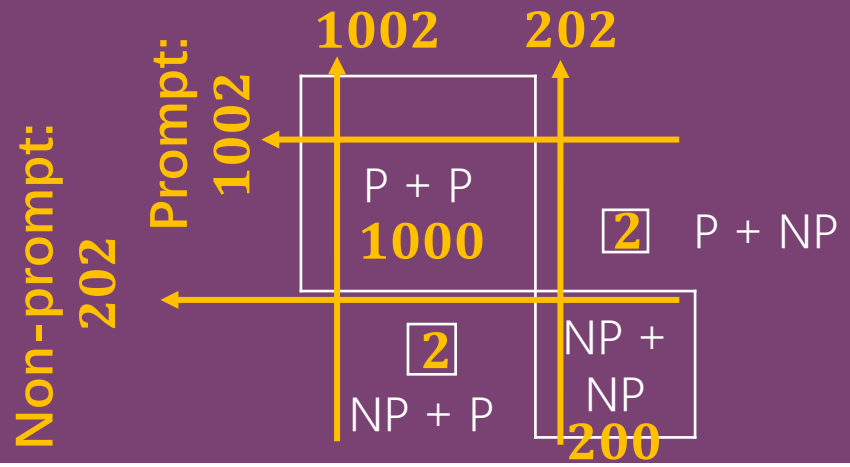
Back Up

Prompt + non-prompt components

——square of 1D fraction?



- $^{p+p}/_{All} = f^2$
- A fatal assumption: J/ψ_1 and J/ψ_2 are not related to each other

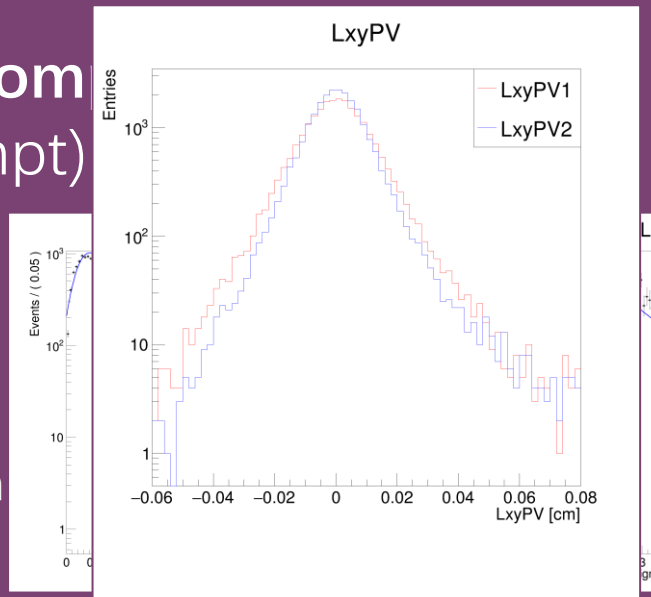


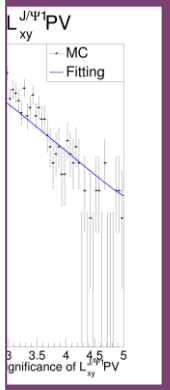
- True value: $^{p+p}/_{All} = {}^{1000}/_{(1000+2+2+200)} = 83\%$
- f acquired from 1D: $f = {}^{1002}/_{(1002+202)} = 83\%$
- $f^2 = 0.83^2 = 69\%$

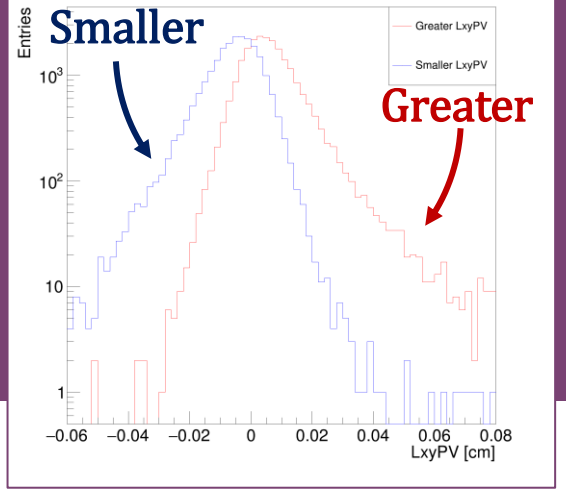
Prompt + non-prompt components

——using the greater lifetime variable?

- **Advantage: we can keep the 3D fit and no additional com**
  will be added (P+NP, NP+P, NP+NP will all be non-prompt)
- **Issues need to be solved:**
  - We have reached an agreement on the Sig_{Lxy}, but there may be no significant rank between prompt and non-prompt J/ψ
    - We may need to change the distinguishment variable
  - Non-prompt lifetime variable (e.g. $L_{xy}PV$) is not certainly larger than the prompt one
    - May regard it as an error
    - 4D fit may help
  - The sorting may change the shape of the distribution
    - We need to redo all the 1D fit
    - We have no idea what will be the shape of the prompt + non-prompt components after the sorting
  - We can not validate this method





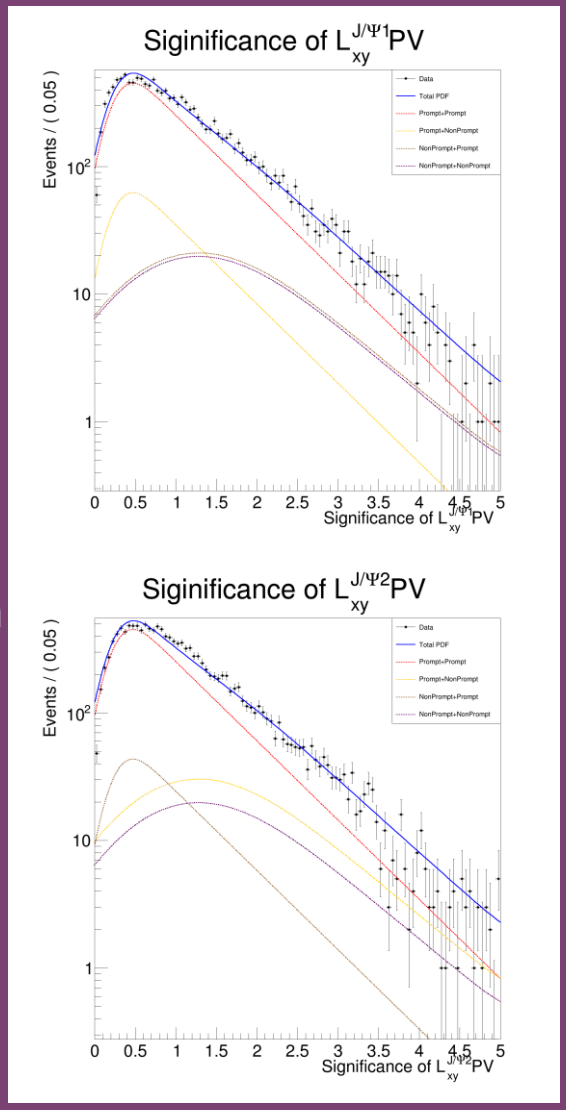


$L_{xy}PV$ distribution

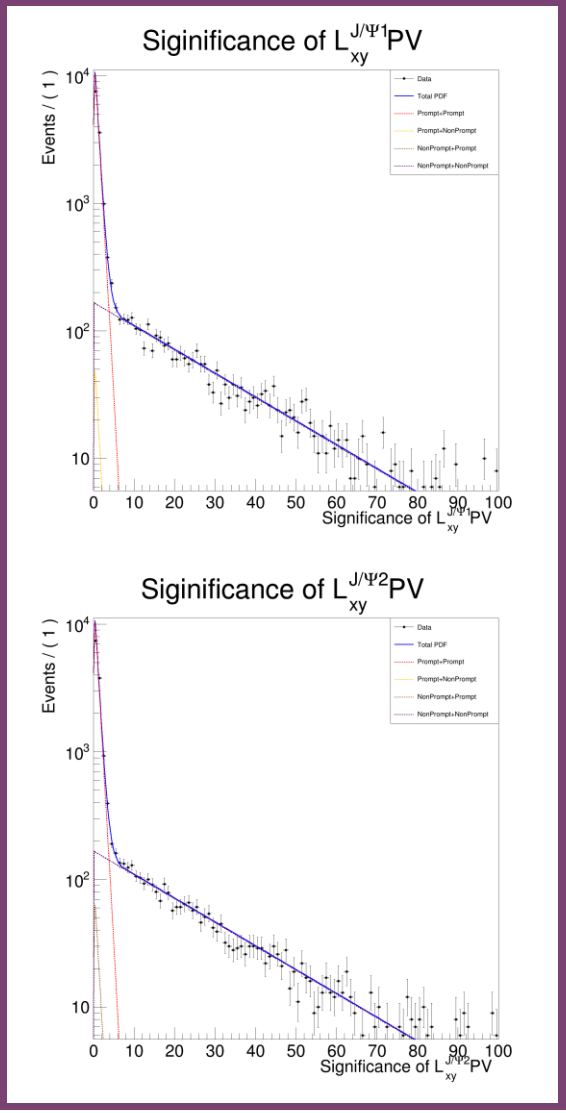
Prompt + non-prompt components

——4D fit?

- May be the only available method as for now
- Issue need to be considered:
  - The shape of the prompt and non-prompt is similar after the vertex cut, which may cause big uncertainty in the fitting
- We may need to take a step back and do the fit without the vertex cut

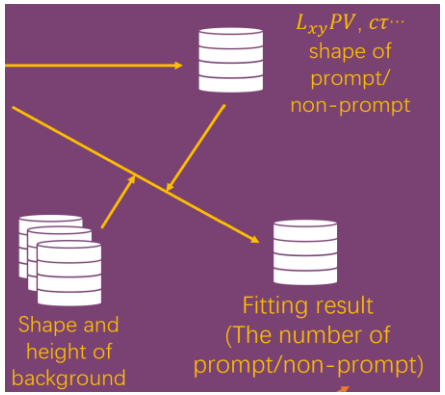


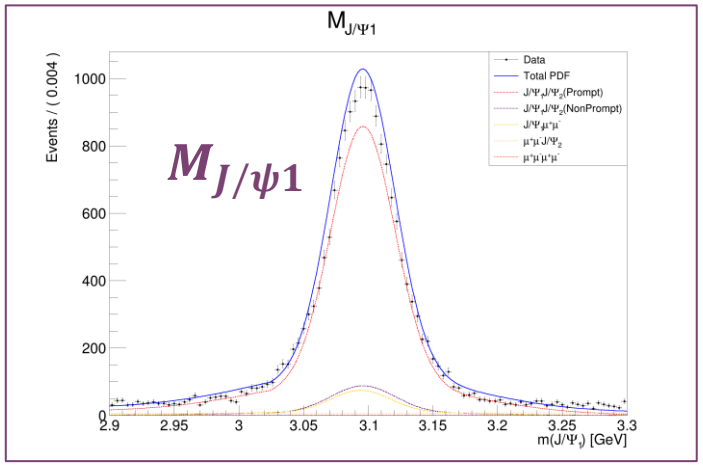
2D fit with the vertex cut

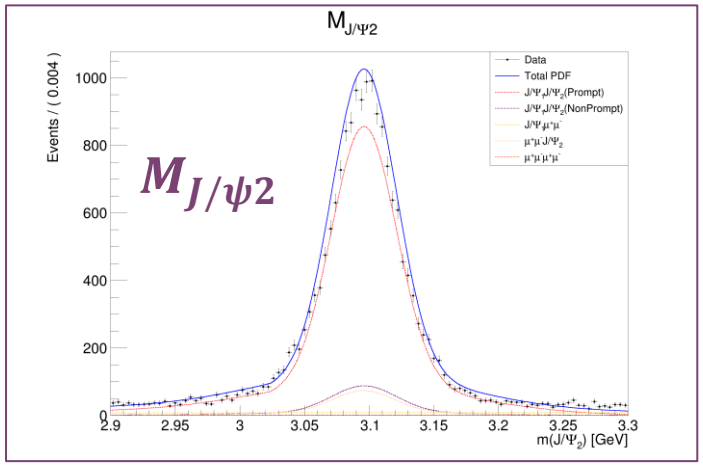


2D fit without the vertex cut

Study of the combinatorial background

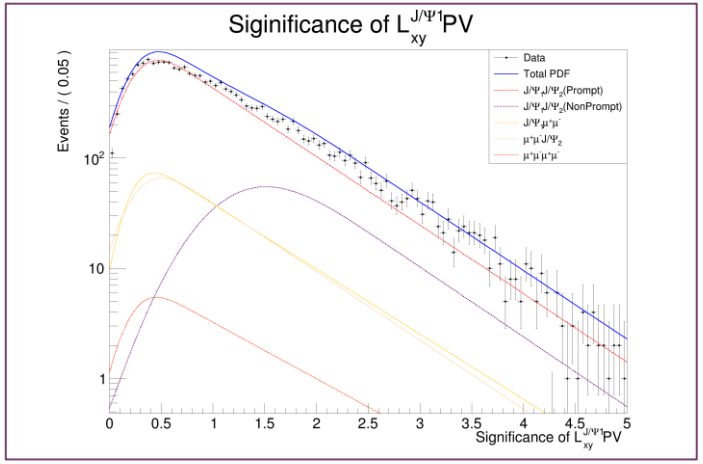






11.10

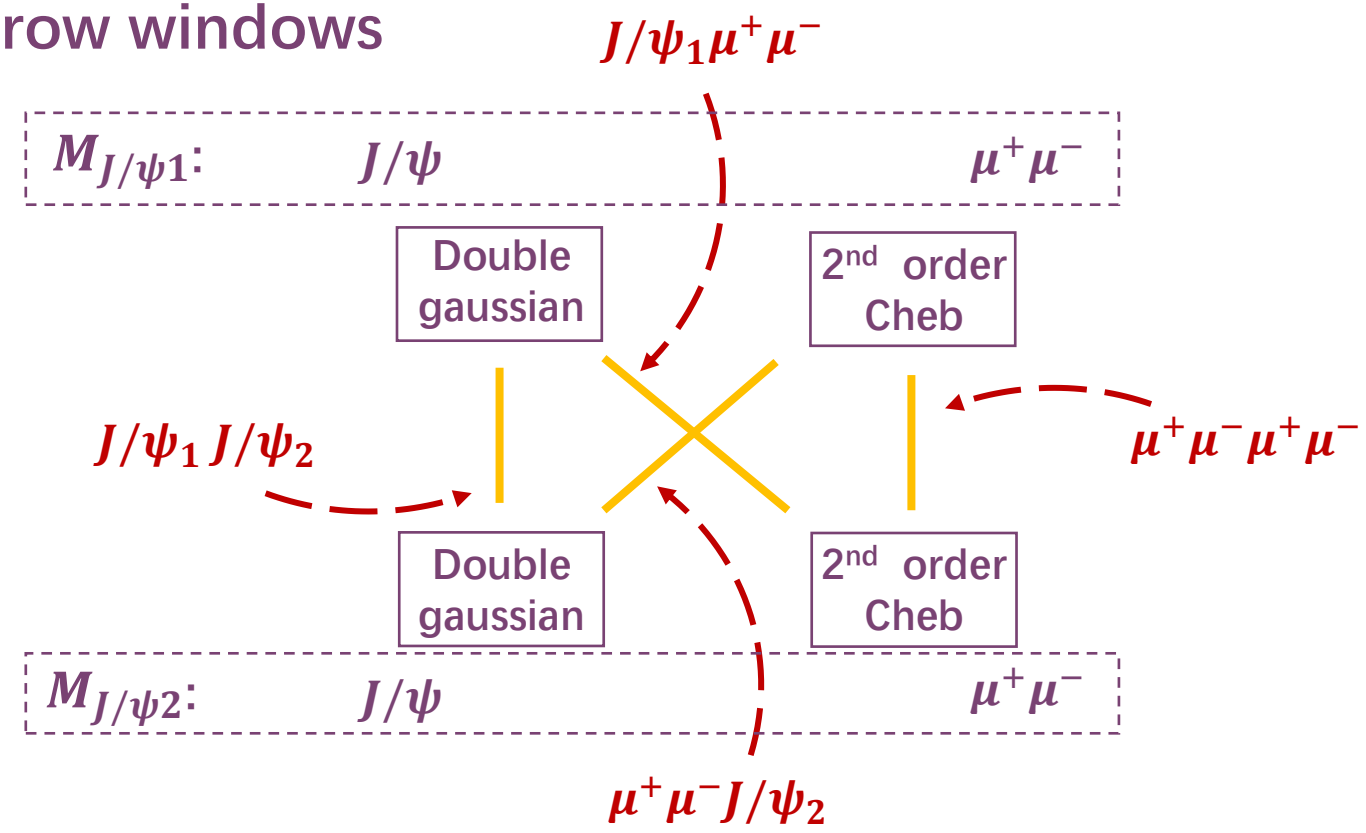
Sig_{Lxy}



- Fitting quality is not good
- Estimation:
  - prompt: 17300 ± 300 (compare to 12K)
  - Non-prompt: 1800 ± 300 (compare to 2K)
- To improve or to abandon?

Fitting to the artificial sample

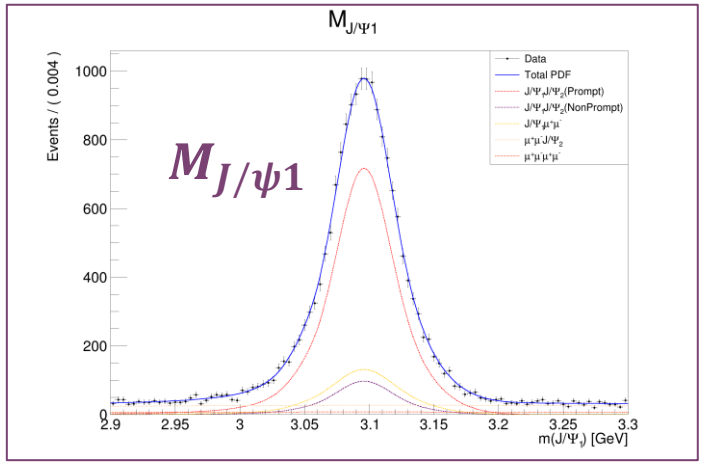
- The side band can be noticed in the “narrow” mass windows: directly fit in the narrow windows

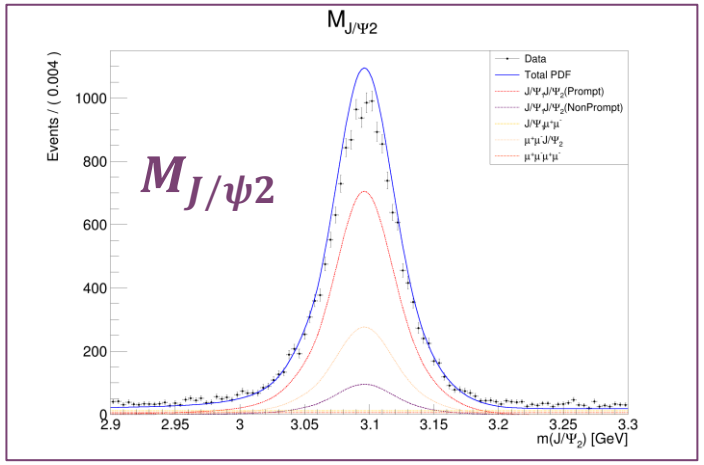


11.17

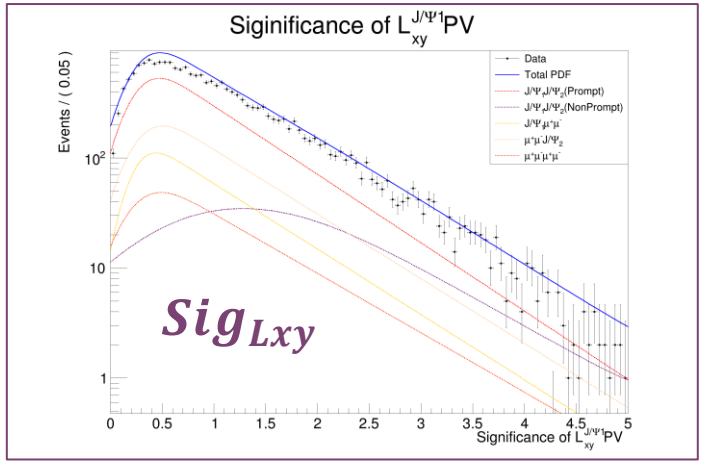
- The shape parameters of mass dimensions are left to float
- The distributions of lifetime dimensions of the combinatorial background are determined by the sub-range dataset

Fitting to the artificial sample



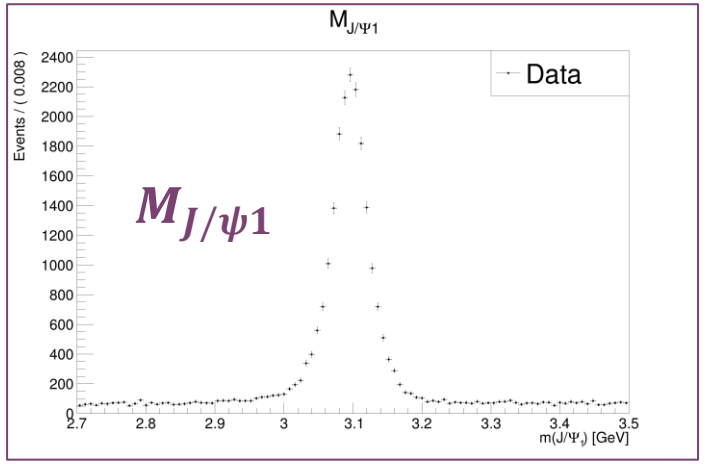


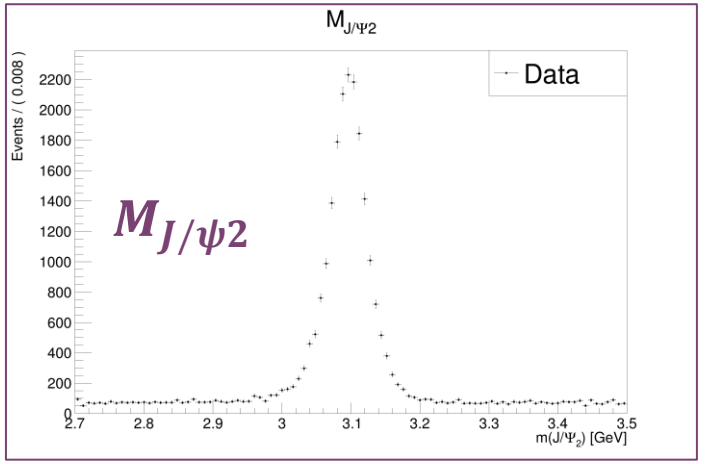
11.17

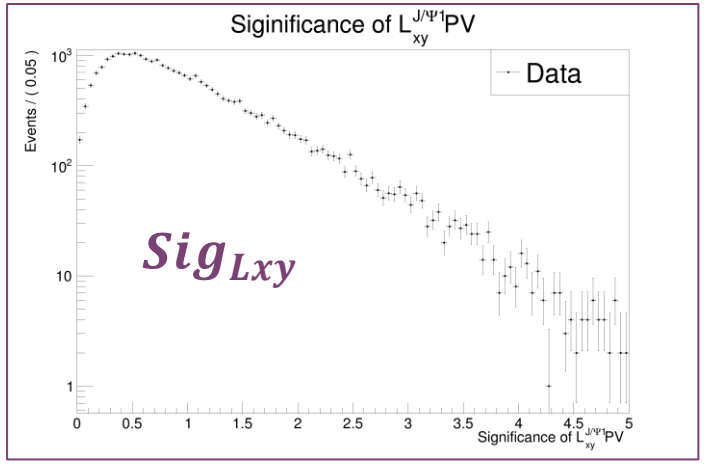


- Fitting quality is still not satisfying
- Estimation:
  - prompt: 12000 ± 200 (compare to 12K)
  - Non-prompt: 1630 ± 140 (compare to 2K)
- Prompt estimation is much better, but the non-prompt one is worse

Artificial sample

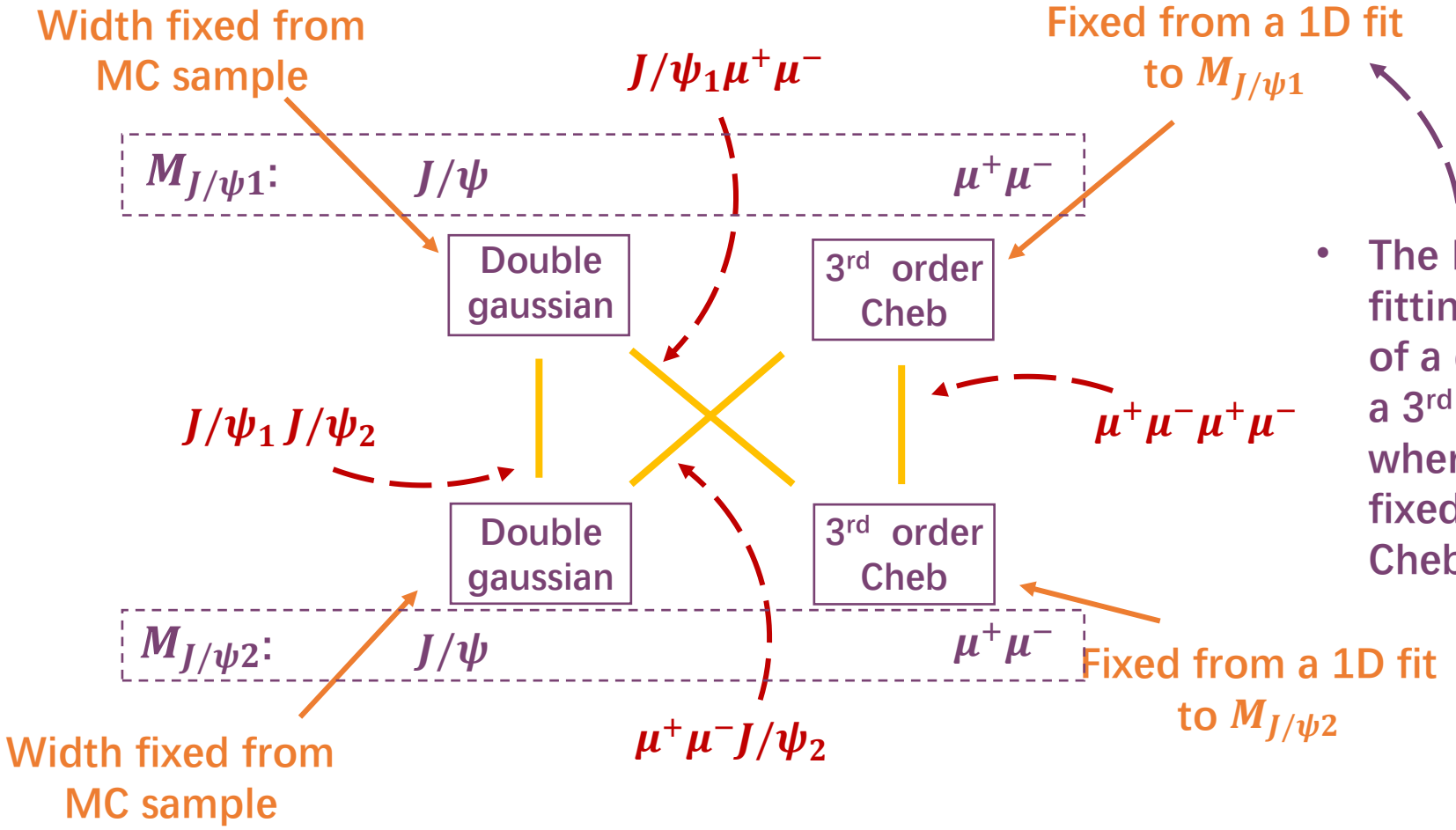






- 8K SPS+4K DPS+2K B decay (mixing of MC sample)
- 5K $J\mu\mu$+5K $\mu\mu J$+2K $\mu\mu\mu\mu$ (generated dataset)

Combinatorial background determination in the thesis



- The PDF used in this fitting is a combination of a double gaussian and a 3rd order Chebyshev, where the gaussian is fixed by the MC and the Chebyshev is float

- The distributions of lifetime dimensions of the combinatorial background are determined by the sub-range dataset