Review of the last week...

8000	16000	20000
4000	4000	4000
12000	20000	24000
2000	2000	1000
6700 ± 600	14500 ± 700	18200 ± 800
4900 ± 500	4800 ± 600	4900 ± 700
11600 ± 800	19300 ± 1000	23100 ± 1100
1980 ± 120	1950 ± 140	1050 ± 140
8000 ± 300	17300 ± 400	22000 ± 400
3400 ± 300	1700 ± 400	600 ± 400
11500 ± 400	19000 ± 500	22600 ± 600
2070 ± 70	2290 ± 80	1540 ± 70

- Enlarge the dimuon mass windows
- Try to add the significance of $L_{xy}PV$ (Sig_{Lxy}) and significance of vertex distance ($d^{J/\psi}$) into the multi-dimensional fit
  - Result was terrible
- Will merge SPS and DPS into one again
- Test four variables about the distance one by one
- Start to process the data sample

Data sample processing

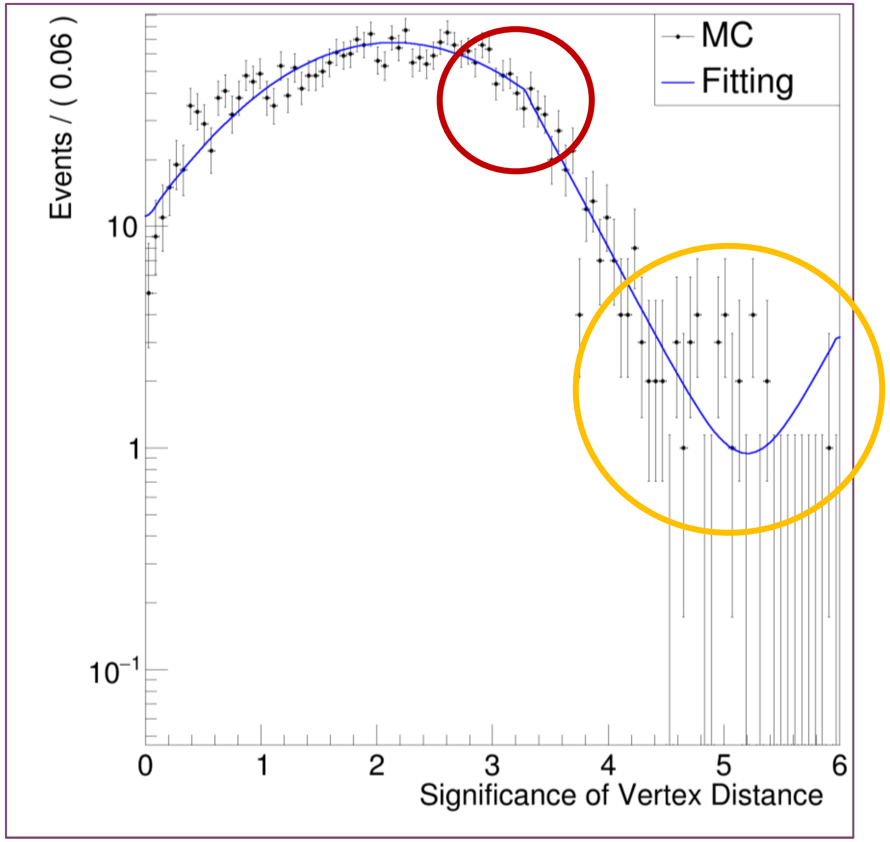
- There is a SKIM dataset on the THU farm, but processing this dataset by HTCondor can be slow
- We decided to start from the AOD dataset, but try to merge SKIM and Ntuple steps into one to reduce the time and storage consumed
- The repository for this purpose is developed:
  - JinfengLiu97/HeavyFlavorAnalysis (github.com)
- The Ntuple is in production now:
  - 2018: Taozhe; 2017: Shunliang; 2016: Jinfeng

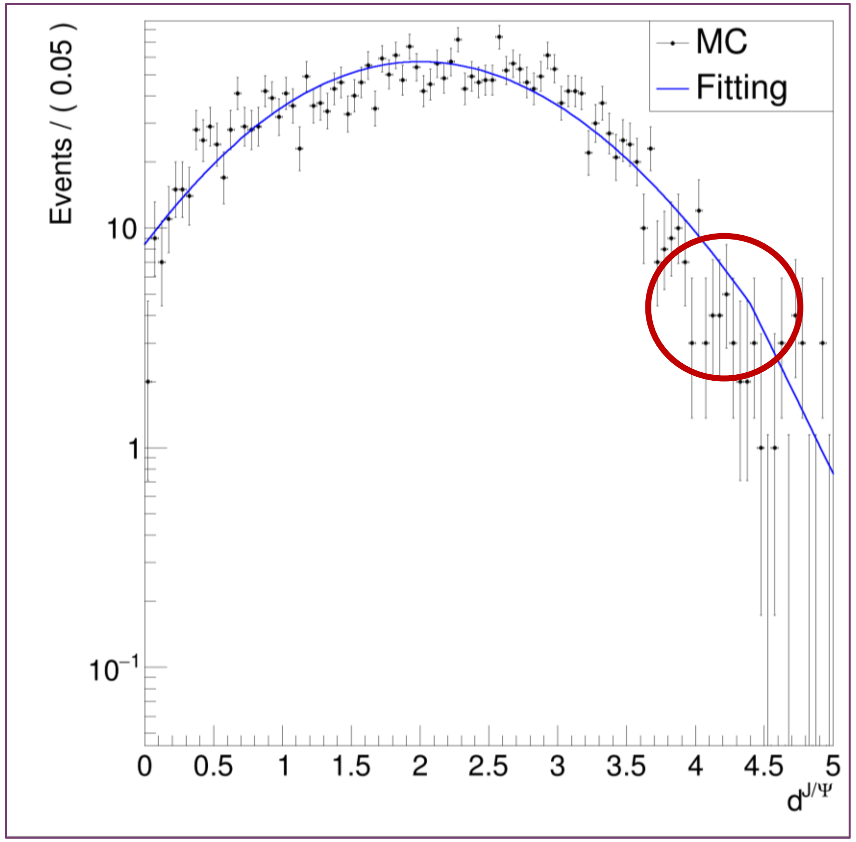
Variables about the distinguishment

- As for now, we have four variables that have the capability of differentiating prompt component from non-prompt one:
  - $L_{xy}PV$ – double Gaus (prompt) and double-side CB (non-prompt)
  - $c\tau$: pseudoproper decay time – double Gaus (prompt) and double-side CB (non-prompt)
  - Sig_{Lxy}: Significance of $L_{xy}PV$ – convolution of a Gaus and an exponent
  - $d^{J/\psi}$: Significance of Jpsi decay vertexes distance – convolution of a Gaus and an exponent
- We first applied the 1D fit to fix their shape for different samples
- We then add these variables as a new dimension (besides the $M_{J/\psi1}$, $M_{J/\psi2}$)one by one into the 3D fit to test their capability of distinguishing the prompt component

Variables about the distinguishment

- About the shape of the significance ($Gaus \otimes Exp$)





- Sub-range fitting didn't help
- The turn-on at the end is invisible but the angle can’t be eliminated

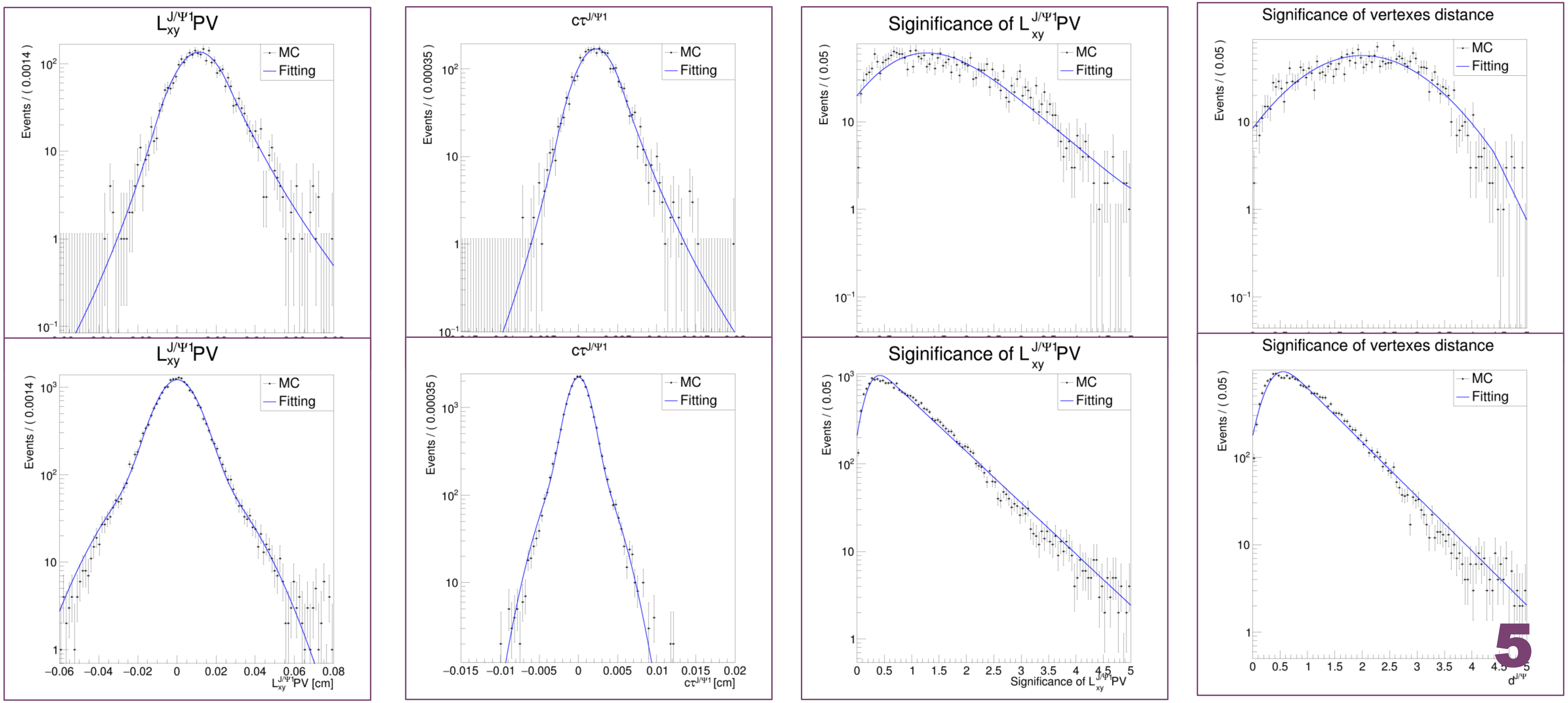
Variables about the distinguishment

- 1D fit to fix variables' shape

$L_{xy}PV$ | $c\tau$ | Sig_{Lxy} | $d^{J/\psi}$

B Decay

SPS



Variables about the distinguishment

- 3D fit: $M_{J/\psi 1}, M_{J/\psi 2}, \boldsymbol{L_{xy}PV}$

Sample	SPS	4000	4000	8000	16000	20000	2000	2000
	DPS	4000	4000	4000	4000	4000	4000	8000
	Prompt	8000	8000	12000	20000	24000	6000	10000
	Non-Prompt	2000	500	2000	2000	1000	2000	2000
Fitting	Prompt	7750 ± 120	7700 ± 110	11430 ± 140	18810 ± 180	22370 ± 190	5909 ± 110	10010 ± 130
	Non-Prompt	1940 ± 90	530 ± 70	2130 ± 100	2500 ± 120	1830 ± 120	1860 ± 90	1650 ± 100

- Overall status is not bad, but the result can be ridiculous in some cases

Variables about the distinguishment

- 3D fit: $M_{J/\psi 1}, M_{J/\psi 2}, \boldsymbol{c\tau}$

Sample	SPS	4000	4000	8000	16000	20000	2000	2000
	DPS	4000	4000	4000	4000	4000	4000	8000
	Prompt	8000	8000	12000	20000	24000	6000	10000
	Non-Prompt	2000	500	2000	2000	1000	2000	2000
Fitting	Prompt	7710 ± 110	7710 ± 110	11730 ± 130	19860 ± 170	23760 ± 170	5690 ± 100	9390 ± 130
	Non-Prompt	1990 ± 90	520 ± 70	1830 ± 90	1450 ± 100	440 ± 80	2080 ± 80	2270 ± 90

- Overall status is similar with the last page

Variables about the distinguishment

- 3D fit: $M_{J/\psi 1}, M_{J/\psi 2}, \boldsymbol{Sig_{Lxy}}$

Sample	SPS	4000	4000	8000	16000	20000	2000	2000
	DPS	4000	4000	4000	4000	4000	4000	8000
	Prompt	8000	8000	12000	20000	24000	6000	10000
	Non-Prompt	2000	500	2000	2000	1000	2000	2000
Fitting	Prompt	7870 ± 140	7880 ± 130	11840 ± 160	19700 ± 200	24600 ± 200	5859 ± 120	9740 ± 150
	Non-Prompt	1830 ± 110	350 ± 100	1720 ± 130	1570 ± 150	550 ± 150	1920 ± 110	1920 ± 120

- The prompt is slightly better, but the non-prompt is worse (tend to underestimate the non-prompt)
- Uncertainties are much larger

Variables about the distinguishment

- 3D fit: $M_{J/\psi 1}, M_{J/\psi 2}, \boldsymbol{d^{J/\psi}}$

Sample	SPS	4000	4000	8000	16000	20000	2000	2000
	DPS	4000	4000	4000	4000	4000	4000	8000
	Prompt	8000	8000	12000	20000	24000	6000	10000
	Non-Prompt	2000	500	2000	2000	1000	2000	2000
Fitting	Prompt	7700 ± 110	7790 ± 130	11830 ± 130	20030 ± 170	240400 ± 180	5640 ± 100	9270 ± 130
	Non-Prompt	2000 ± 80	440 ± 60	1740 ± 90	1208 ± 100	160 ± 90	2130 ± 80	2400 ± 90

- Overall status is better, but the results can still be unacceptable sometimes

Variables about the distinguishment

- Compare between different variables (relative error[%])

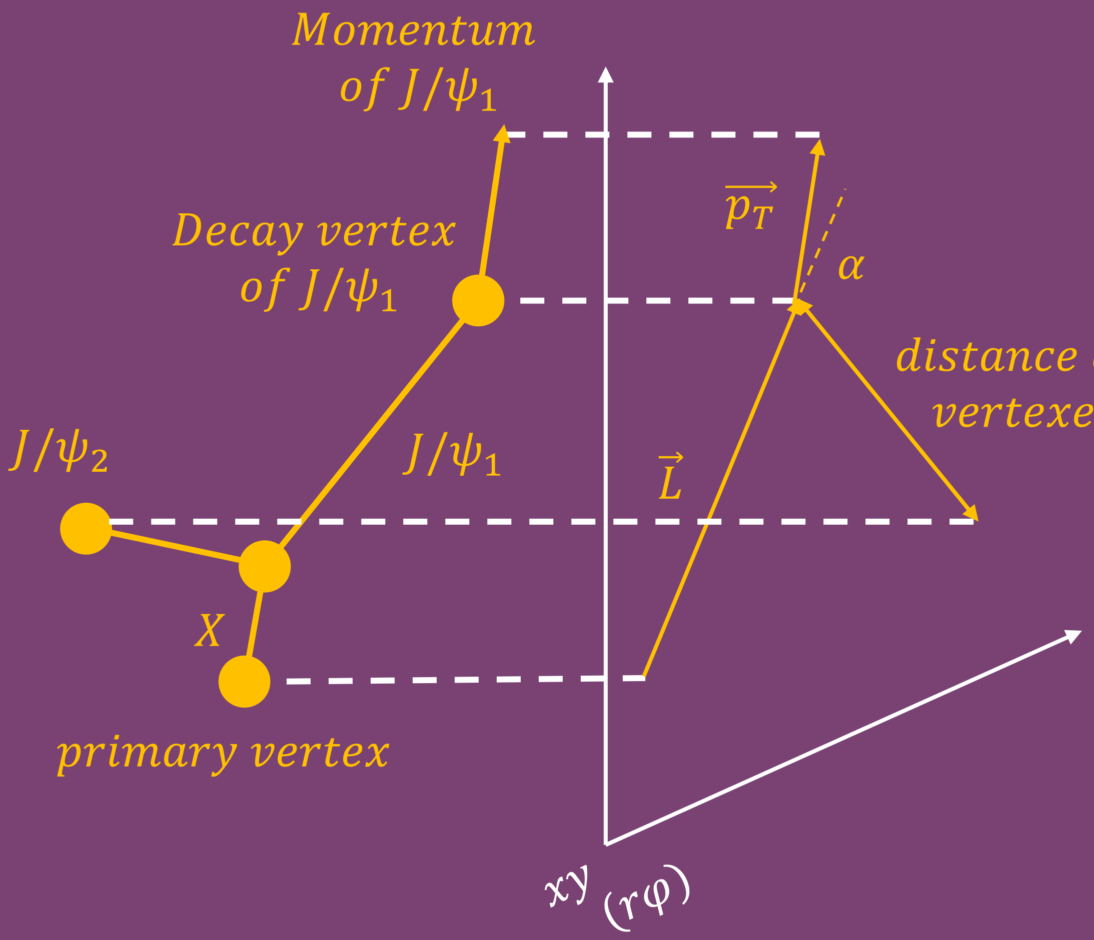
Sample	SPS	4000	4000	8000	16000	20000	2000	2000
	DPS	4000	4000	4000	4000	4000	4000	8000
	Prompt	8000	8000	12000	20000	24000	6000	10000
	Non-Prompt	2000	500	2000	2000	1000	2000	2000
$L_{xy}PV$	Prompt	3.07	3.75	4.71	5.97	6.83	1.51	0.14
	Non-Prompt	3.00	6.64	6.31	25.05	83.31	7.08	17.56
$c\tau$	Prompt	3.63	3.65	2.26	0.71	1.01	5.22	6.10
	Non-Prompt	0.73	4.94	8.37	27.57	56.35	4.06	13.66
Sig_{Lxy}	Prompt	1.63	1.52	1.29	1.30	1.48	2.53	2.61
	Non-Prompt	8.72	29.16	14.19	21.69	45.16	4.01	3.79
$d^{J/\psi}$	Prompt	3.75	2.65	1.45	0.15	0.16	6.04	7.27
	Non-Prompt	0.24	11.04	13.25	36.15	84.36	6.53	19.50

- If the non-prompt can be neglected, the overall status is not bad (**especially for the Sig_{Lxy}**)
- The capability of computing the non-prompt component gets lost somehow

Summary

- **The repository of merged SKIM and Ntuple is developed, Ntuple of data samples are in production**
- **The capability of differentiating prompt and non-prompt components is tested by adding different distinguishment variables to the 3D fit**
  - Four variables are tested: $L_{xy}PV$, $c\tau$, Sig_{Lxy}, $d^{J/\psi}$
  - The calculation of prompt component is not bad for in the cases (**especially for Sig_{Lxy}**)
  - The calculation of non-prompt component is really terrible
- **What else can we do to improve the fitting?**

Extraction of new variables



cosAlpha: $\cos\alpha = \vec{L}\cdot\overrightarrow{p_T} / |\vec{L}|\cdot|\overrightarrow{p_T}|$

lxy: $|\vec{L}|$

lxyPV: $L_{xy}PV = \vec{L}\cdot\overrightarrow{p_T} / |\overrightarrow{p_T}| = L_{xy} \times \cos\alpha$

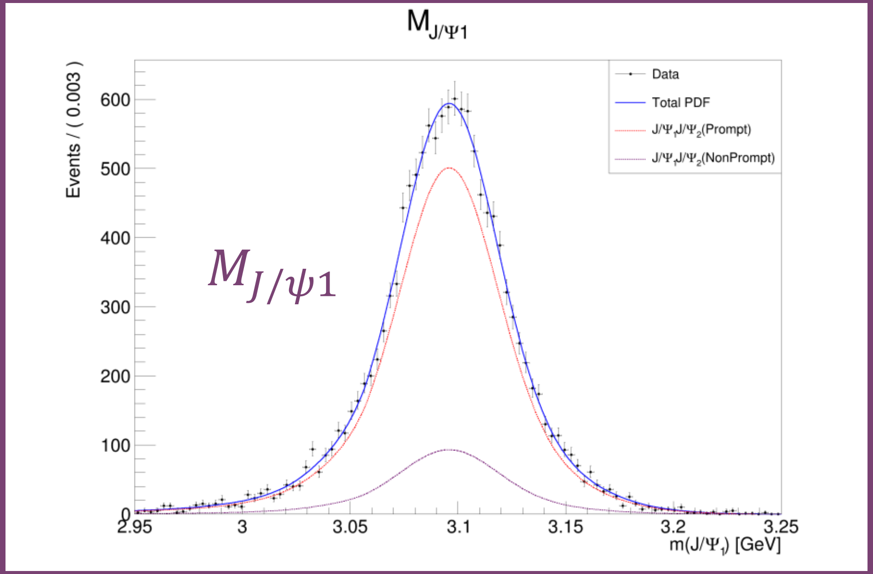
Significance of $L_{xy}PV$:$Sig_{Lxy} = L_{xy}PV / \epsilon_{L_{xy}PV}$

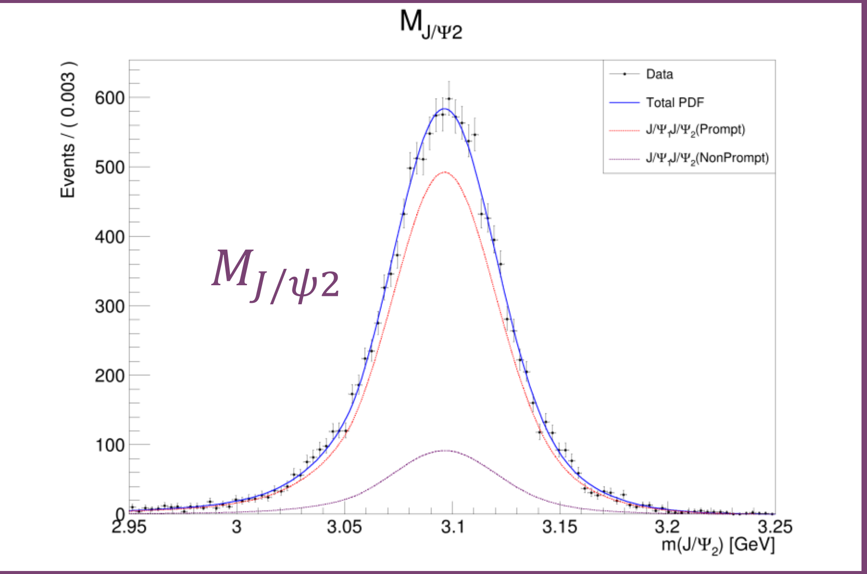
- $\epsilon_{L_{xy}PV} = \epsilon_{L_{xy}} \times \cos\alpha$

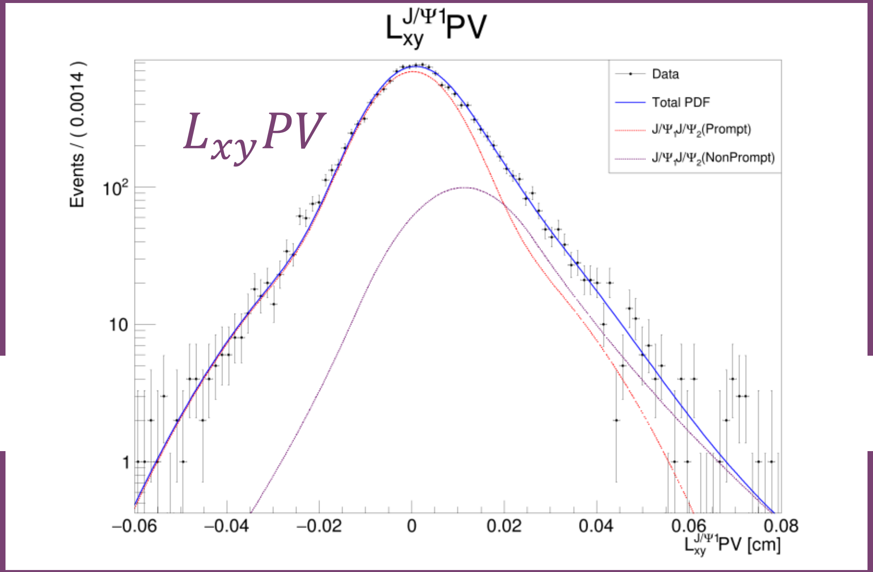
Significance of the vertex distance $d^{J/\psi}$

Representative multi dimensional fit plots

- $M_{J/\psi1}, M_{J/\psi1}, L_{xy}PV$

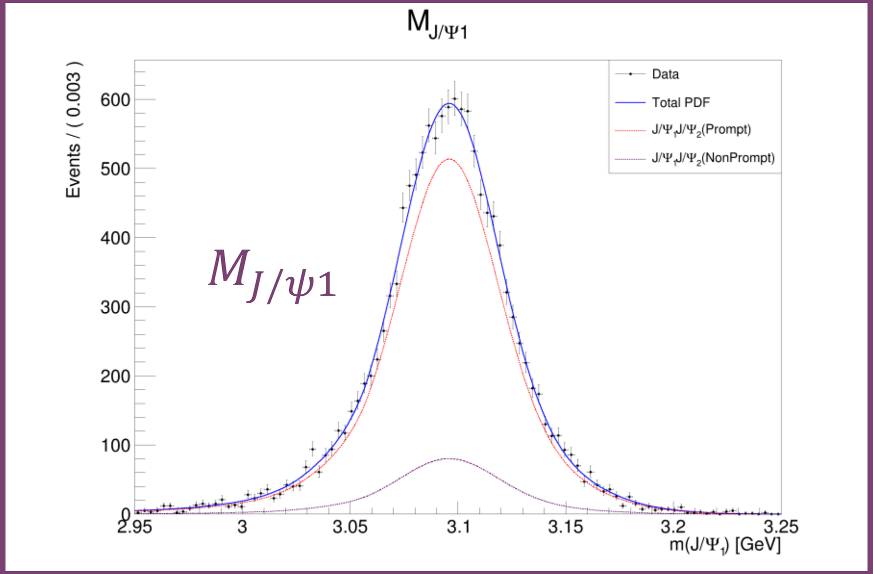


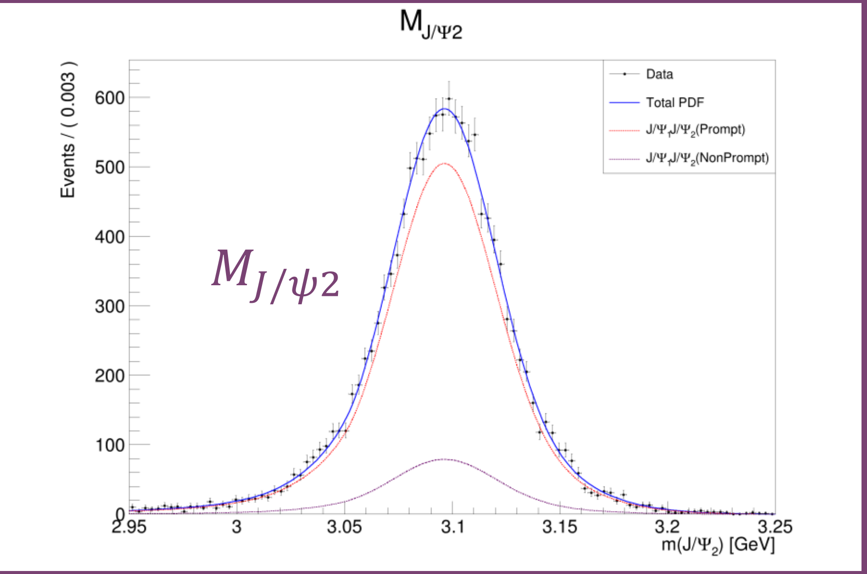


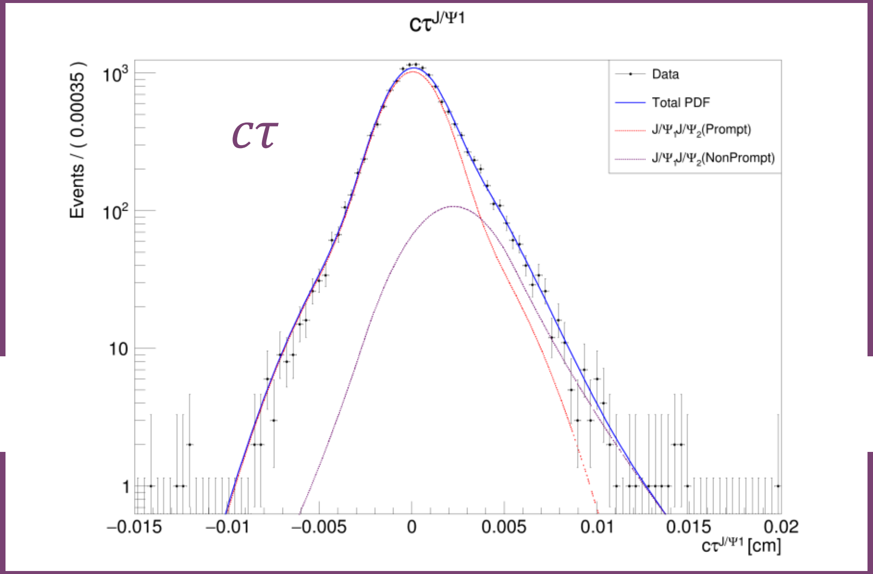


Representative multi dimensional fit plots

- $M_{J/\psi1}$, $M_{J/\psi1}$, $c\tau$

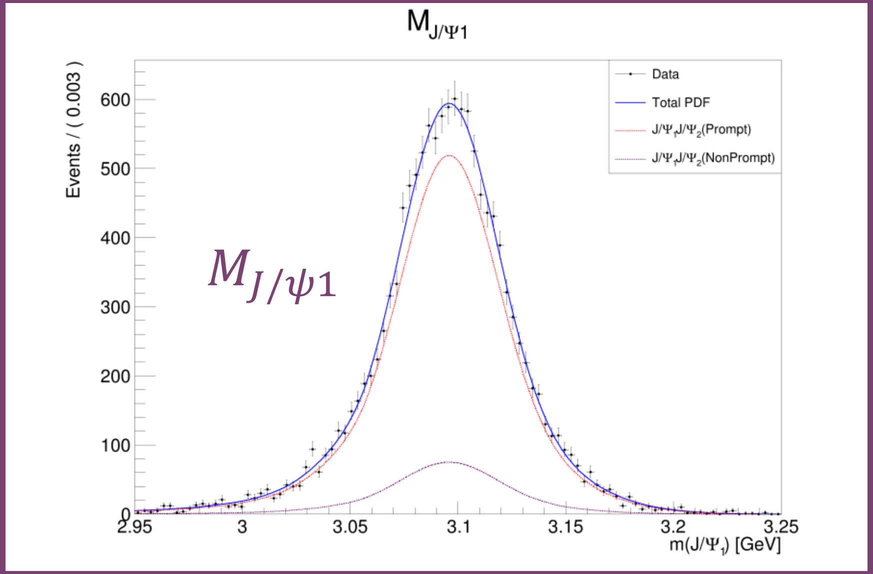


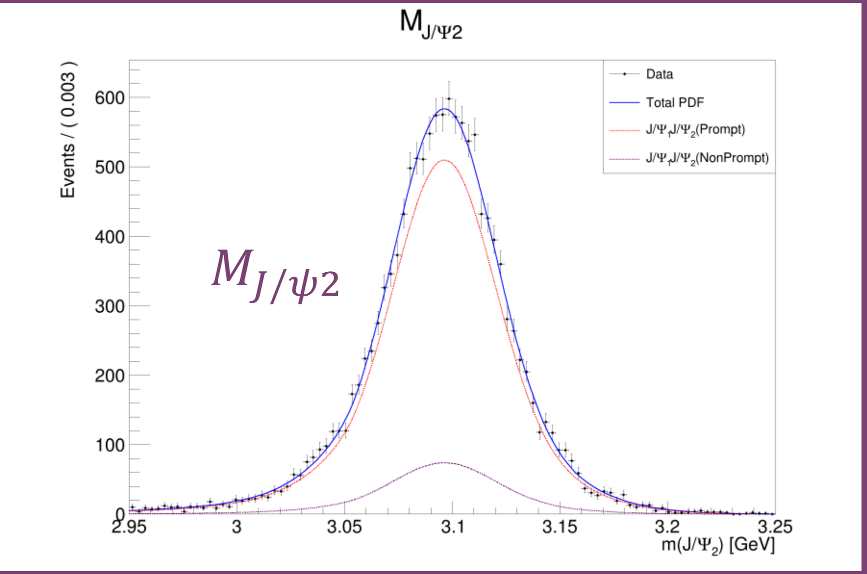


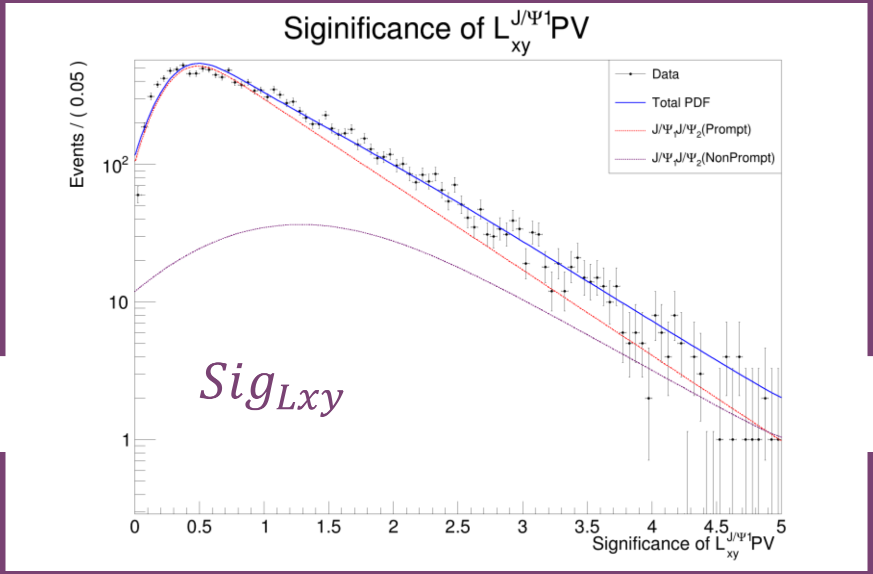


Representative multi dimensional fit plots

- $M_{J/\psi 1}, M_{J/\psi 1}, Sig_{Lxy}$







Representative multi dimensional fit plots

- $M_{J/\psi 1}$, $M_{J/\psi 1}$, $d^{J/\psi}$