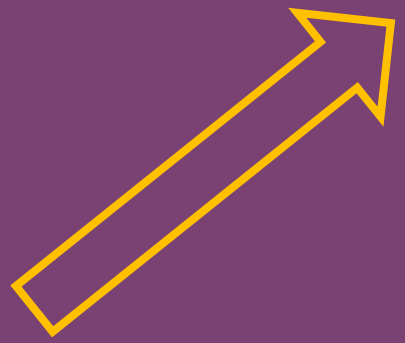
Closure Test (Distinguishment variables)

- 1D fit to determine the shape
- 4D fit to do the test

$c\tau_1$	$c\tau_2$
$LxySig_1$	$LxySig_2$
$d_{J/\psi}$	



$c\tau_1 + c\tau_2$

$c\tau_1 + LxySig_2$

$c\tau_1 + d_{J/\psi}$

$LxySig_1 + LxySig_2$

$LxySig_1 + d_{J/\psi}$

- The shapes of two J/ψs are same
- Test w/wo vertex probability

Closure Test (Distinguishment variables)

- Mixing 17 sample and 18 sample according to their luminosities
- 17 ~ 36.734 $\mathbf{fb^{-1}}$; 17 ~ 59.97 $\mathbf{fb^{-1}}$

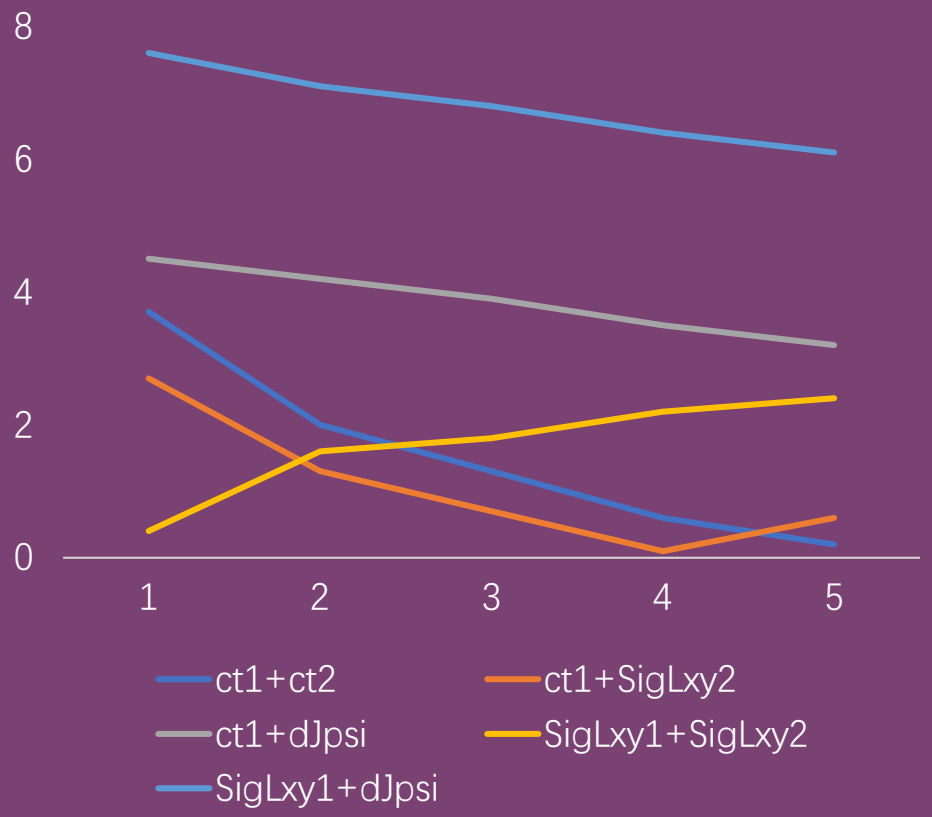
- 17:18 ~ 4:6
- **SPS18:DPS18:DPS17 – 8K:2.4K:1.6K** (we do not have SPS17 sample)

- Prompt + non-prompt component is not considered

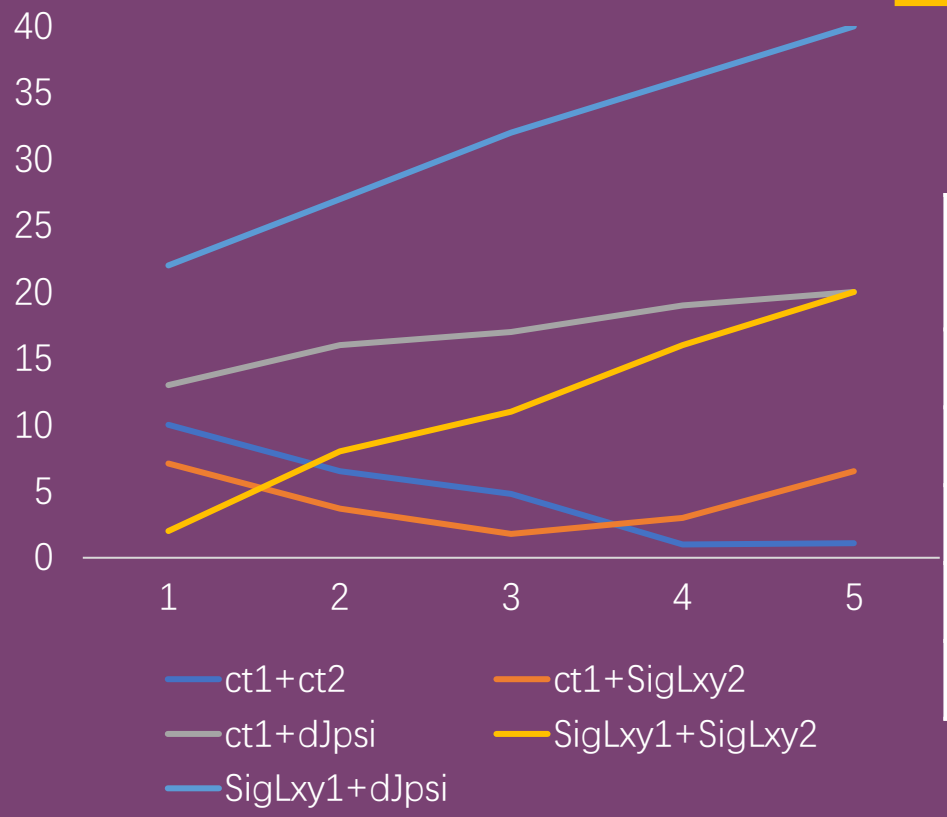
Closure Test (Distinguishment variables)

With vertex cut

Relative Error [%]



Prompt



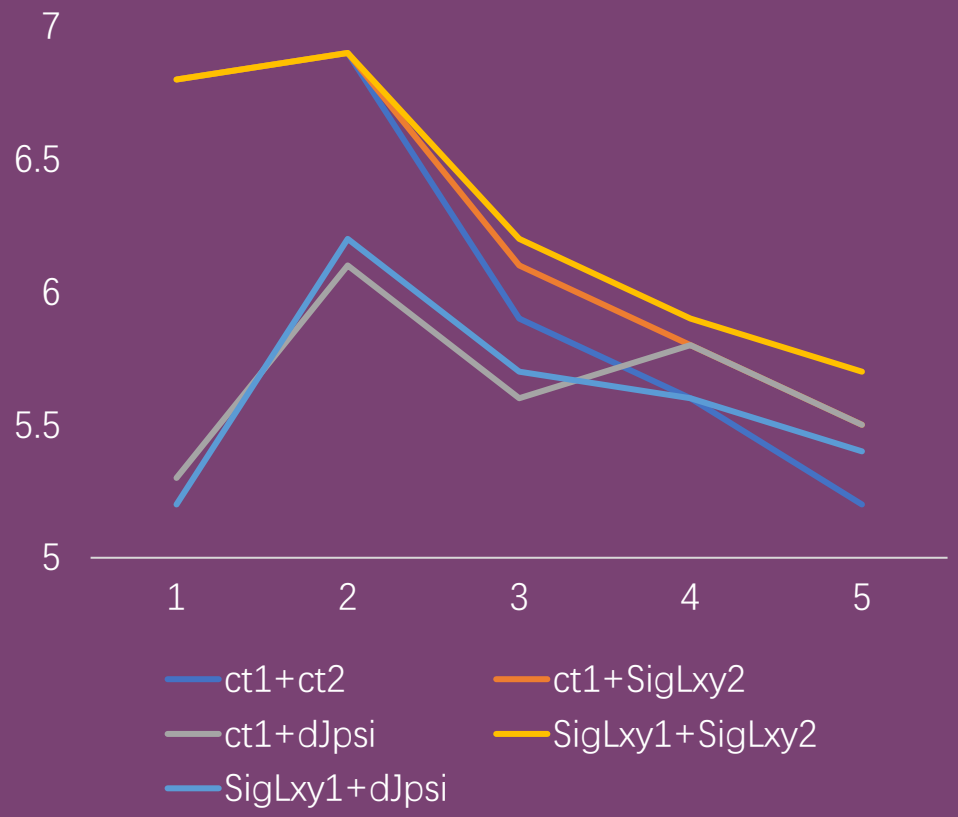
Non-prompt

	Prompt	Non-prompt
1	6K	2K
2	8K	2K
3	10K	2K
4	12K	2K
5	14K	2K

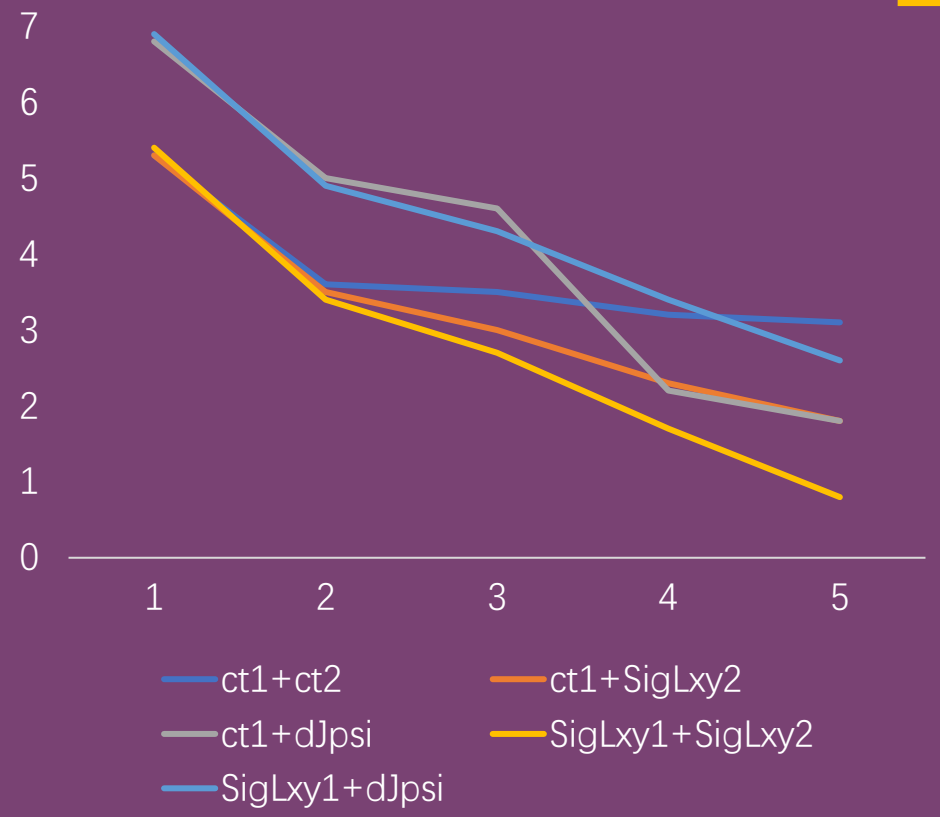
Closure Test (Distinguishment variables)

Without vertex cut

Relative Error [%]



Prompt



Non-prompt

	Prompt	Non-prompt
1	8K	8K
2	8K	4K
3	12K	4K
4	16K	4K
5	20K	4K

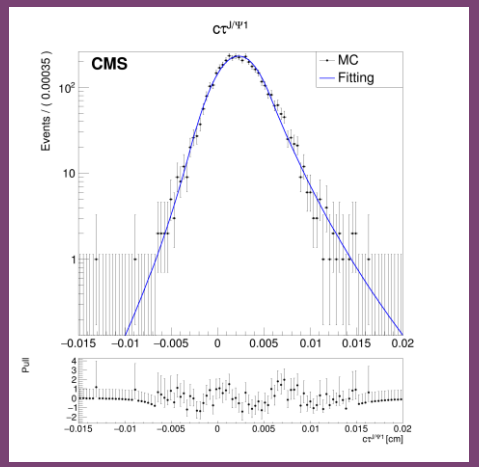
Closure Test (Distinguishment variables)

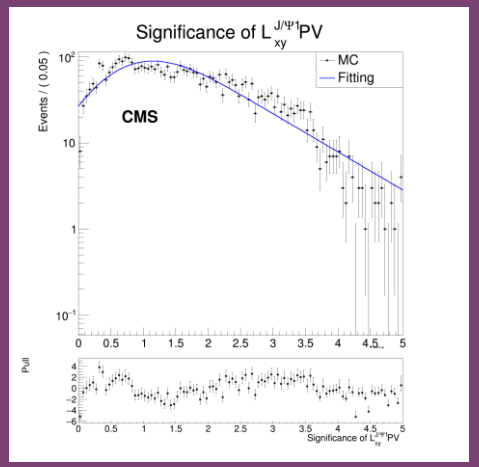
Average relative error [%]		$c\tau_1 + c\tau_2$	$c\tau_1 + LxySig_2$	$c\tau_1 + d_{J/\psi}$	$LxySig_1 + LxySig_2$	$LxySig_1 + d_{J/\psi}$
With vertex cut	Prompt	1.56	1.07	3.85	1.69	6.80
	Non-prompt	4.69	4.42	16.78	11.24	31.42
Without vertex cut	Prompt	6.10	6.24	5.68	6.33	5.62
	Non-prompt	3.73	3.17	4.10	2.78	4.39

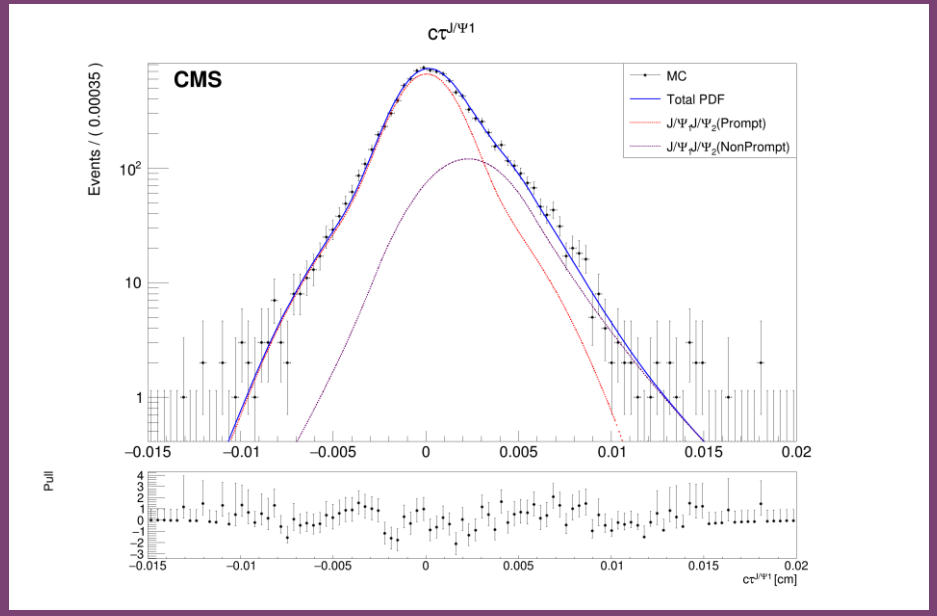
- To remove the vertex cut can have a better performance on the non-prompt estimation, although the prompt estimation is similar among different cases

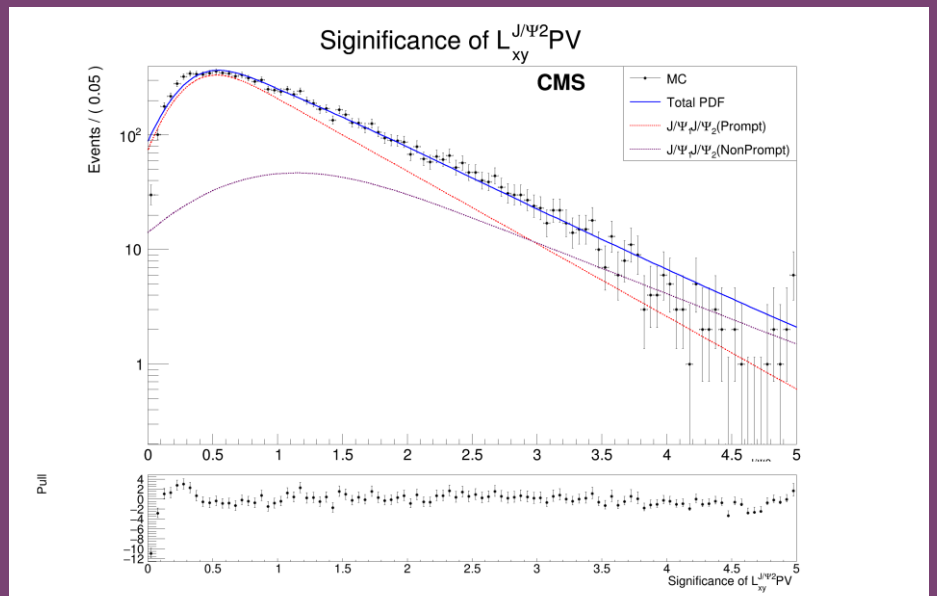
Closure Test (Distinguishment variables)

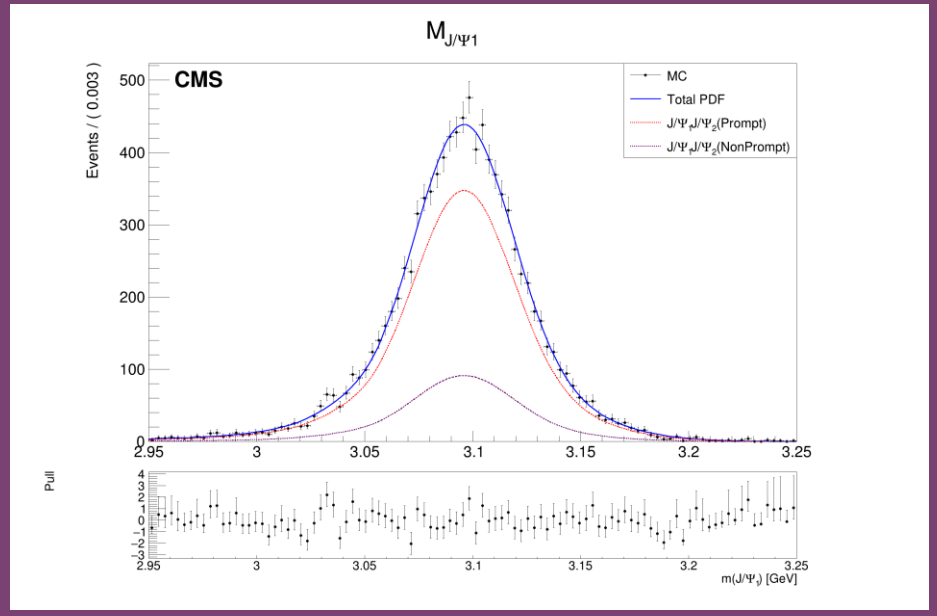
- The overall result of the closure test is acceptable
  - Especially for prompt component estimation
- Results of using different combinations are comparable
- Fitting with $c\tau_1$ and $c\tau_2$ can be time consuming
- $d^{J/\psi}$ is not suitable to differentiate the prompt + non-prompt component
  - We have no idea what is the distribution of the component on this dimension

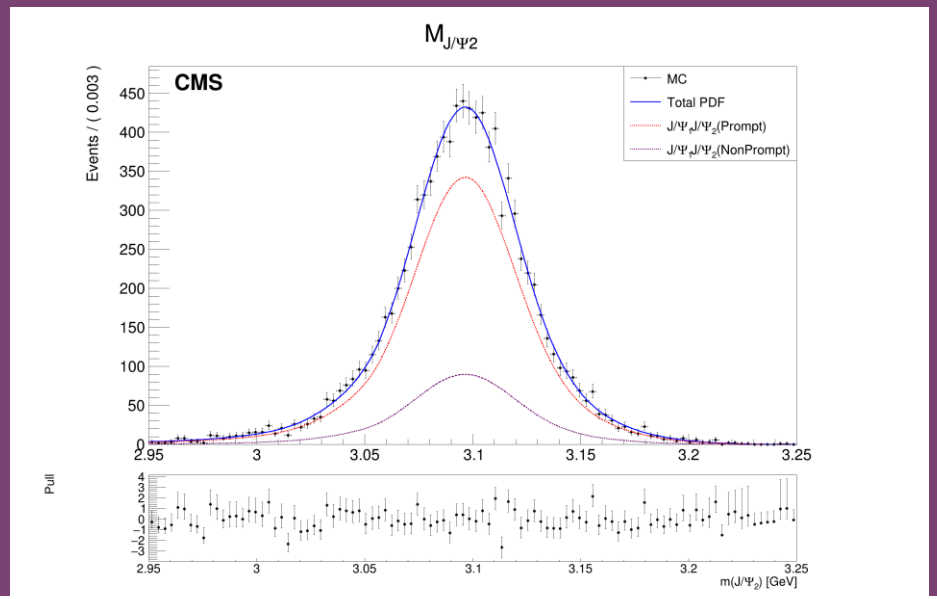

cτ^J/Ψ1
CMS
MC
Fitting
Events / (0.00035)
Pull
cτ^J/Ψ1 [cm]

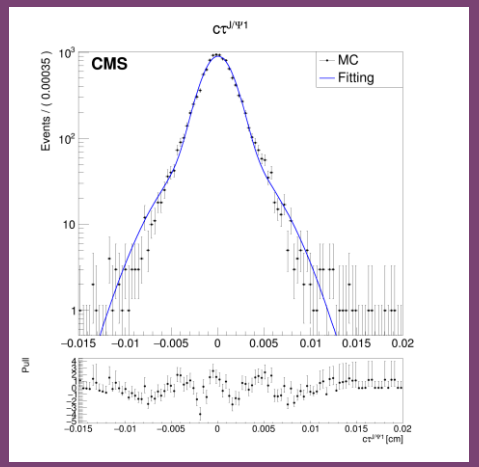

Significance of L_xy^J/Ψ1PV
CMS
MC
Fitting
Events / (0.05)
Pull
Significance of L_xy^J/Ψ1PV

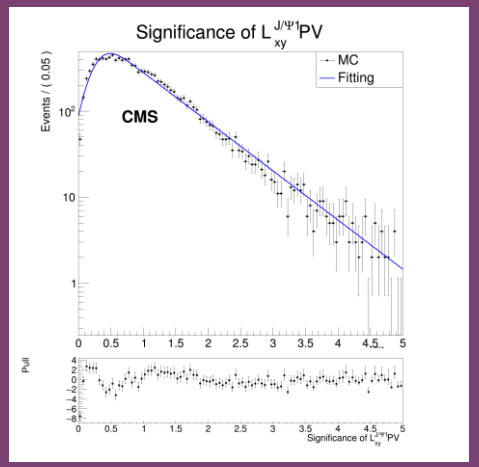

cτ^J/Ψ1
CMS
MC
Total PDF
J/Ψ1J/Ψ2(Prompt)
J/Ψ1J/Ψ2(NonPrompt)
Events / (0.00035)
Pull
cτ^J/Ψ1 [cm]

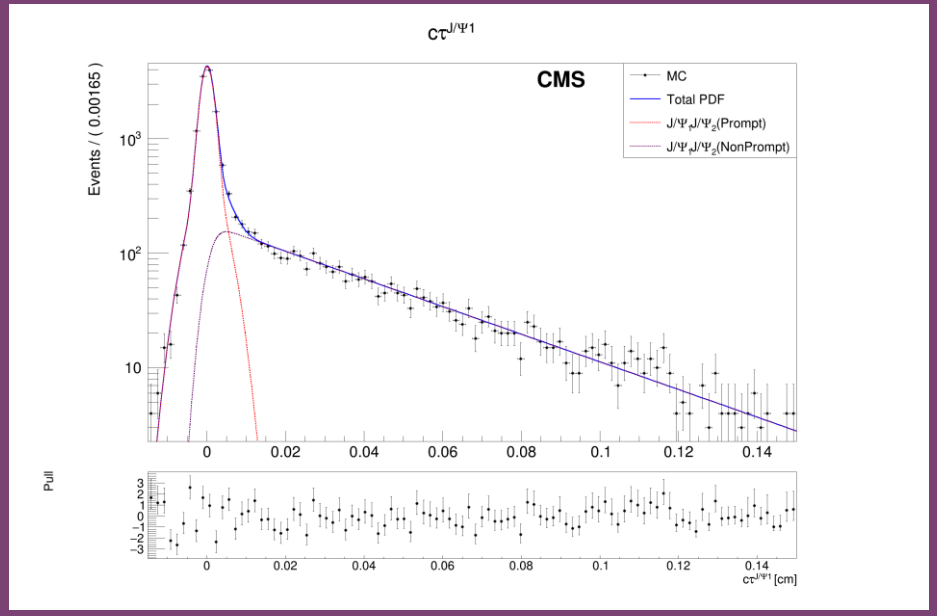

Siginificance of L_xy^J/Ψ2PV
CMS
MC
Total PDF
J/Ψ1J/Ψ2(Prompt)
J/Ψ1J/Ψ2(NonPrompt)
Events / (0.05)
Pull
Significance of L_xy^J/Ψ2PV

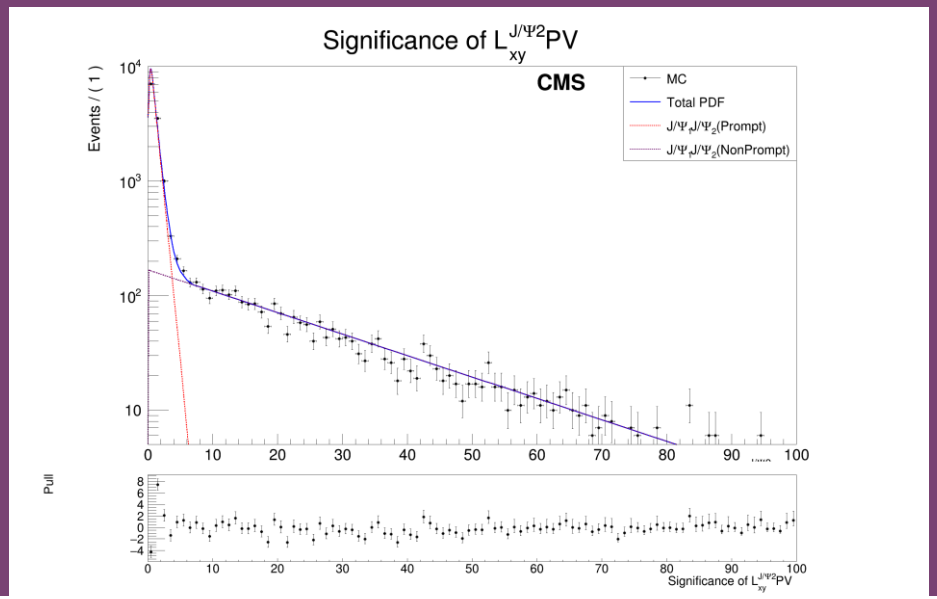

M_J/Ψ1
CMS
MC
Total PDF
J/Ψ1J/Ψ2(Prompt)
J/Ψ1J/Ψ2(NonPrompt)
Events / (0.003)
Pull
m(J/Ψ1) [GeV]

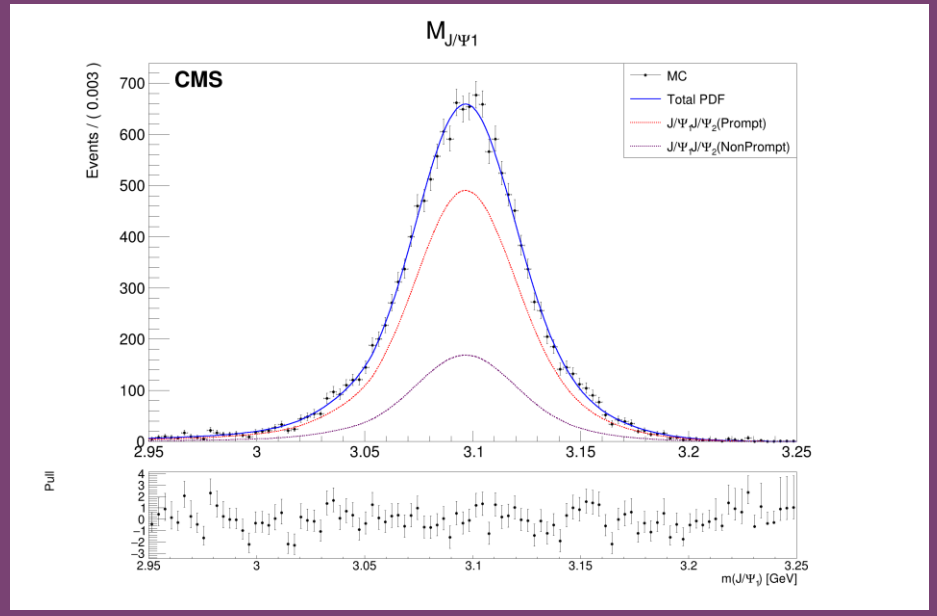

M_J/Ψ2
CMS
MC
Total PDF
J/Ψ1J/Ψ2(Prompt)
J/Ψ1J/Ψ2(NonPrompt)
Events / (0.003)
Pull
m(J/Ψ2) [GeV]

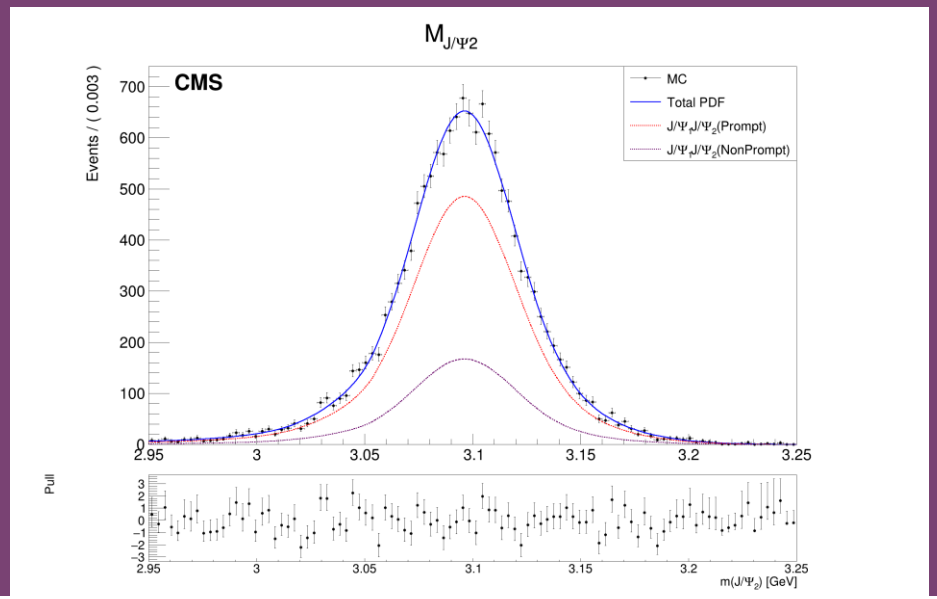

$c\tau^{J/\Psi 1}$
CMS
MC
Fitting
Events / (0.00035)
Pull
$c\tau^{J/\Psi 1}$ [cm]


Significance of $L_{xy}^{J/\Psi 1}$PV
CMS
MC
Fitting
Events / (0.05)
Pull
Significance of $L_{xy}^{J/\Psi 1}$PV


$c\tau^{J/\Psi 1}$
CMS
MC
Total PDF
$J/\Psi_1 J/\Psi_2$(Prompt)
$J/\Psi_1 J/\Psi_2$(NonPrompt)
Events / (0.00165)
Pull
$c\tau^{J/\Psi 1}$ [cm]


Significance of $L_{xy}^{J/\Psi 2}$PV
CMS
MC
Total PDF
$J/\Psi_1 J/\Psi_2$(Prompt)
$J/\Psi_1 J/\Psi_2$(NonPrompt)
Events / (1)
Pull
Significance of $L_{xy}^{J/\Psi 2}$PV


$M_{J/\Psi 1}$
CMS
MC
Total PDF
$J/\Psi_1 J/\Psi_2$(Prompt)
$J/\Psi_1 J/\Psi_2$(NonPrompt)
Events / (0.003)
Pull
$m(J/\Psi_1)$ [GeV]


$M_{J/\Psi 2}$
CMS
MC
Total PDF
$J/\Psi_1 J/\Psi_2$(Prompt)
$J/\Psi_1 J/\Psi_2$(NonPrompt)
Events / (0.003)
Pull
$m(J/\Psi_2)$ [GeV]