ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

LHCb

LPHE

2012 CHIPP Winter School : Students Presentations

Search for CP Violation in $B_s^0 \to J/\psi\phi$ at the LHCb experiment

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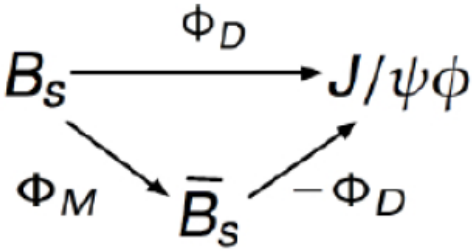
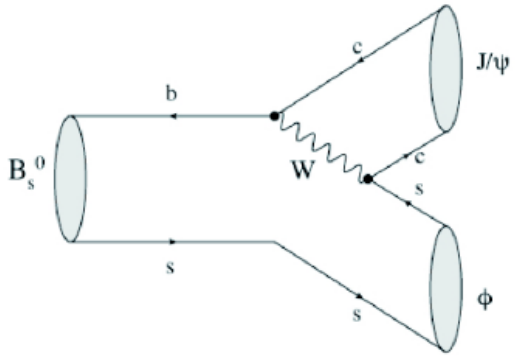
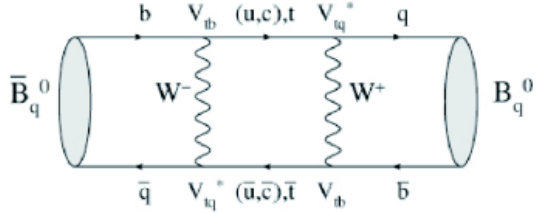
CP Violation in $B_s \to J/\psi\phi$

- The interference between B_s^0 decay to $J/\psi\phi$ either directly or via B_s^0–$\bar{B}_s^0$ oscillation gives rise to a CP violating phase $\phi_s^{J/\psi\phi}$.





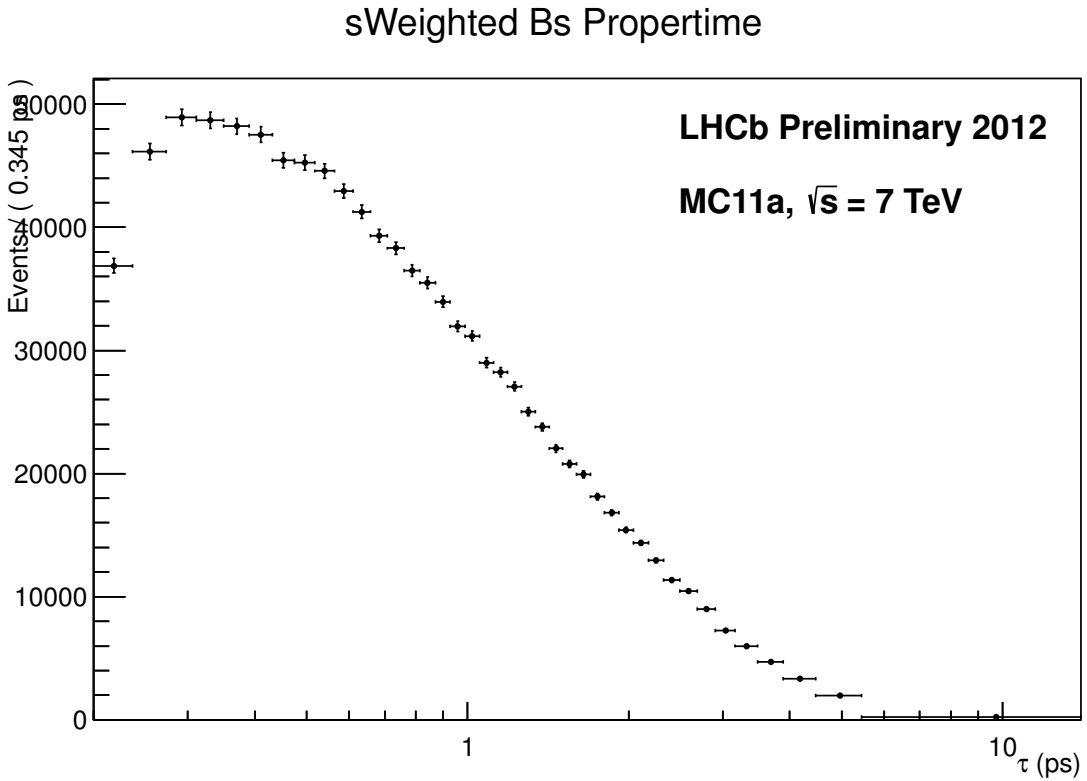


- Within the SM, $\phi_s^{J/\psi\phi} \approx -2\beta_s = (0.0363 \pm 0.0017)$ rad. β_s is the analog angle to β of the 2$^{\text{nd}}$ unitary triangle for B_s mesons.
- New Physics can enlarge significantly $\phi_s^{J/\psi\phi}$ with new particles involed in the $B_s^0 - \bar{B}_s^0$ mixing box diagram.
- To extract $\phi_s^{J/\psi\phi}$, a time-dependent tagged analysis is required and in addition we have a $P \to VV$ decay therefore a full angular analysis is also needed to disentangle CP-even and CP-odd decays.
- LHCb measured (300 pb^{-1}) : $\phi_s^{J/\psi\phi} = 0.15 \pm 0.18(\text{stat}) \pm 0.06(\text{syst})$ rad

Propertime and Lower Acceptance

Propertime

- Since it is a time-dependent analysis, a fit to the decay-time spectrum is required. A basic fit function made of an exponential convoluted with a resolution function is not enough because it needs to account for lower propertime acceptance effects.



Lower Propertime Acceptance from Trigger

DiMuons Triggers

- We trigger on dimuons with a cut on their decay length significance (larger than 3). The unbiased dimuons line has been prescaled by a factor 5 during the Summer.
- So for the full 2011 dataset analysis, we need to use the biased line.

Trigger acceptance from overlap method in data

- Among unbiased events, look for events passing the biased line :
- Trigger Acceptance $= \frac{\text{Analysis } \tau \text{ (Biased \&\& Unbiased)}}{\text{Analysis } \tau \text{ (Unbiased)}}$
- Possible since Biased line $\subset$ Unbiased line.

Stripping acceptance

$B_s \to J/\psi\phi$ Stripping line

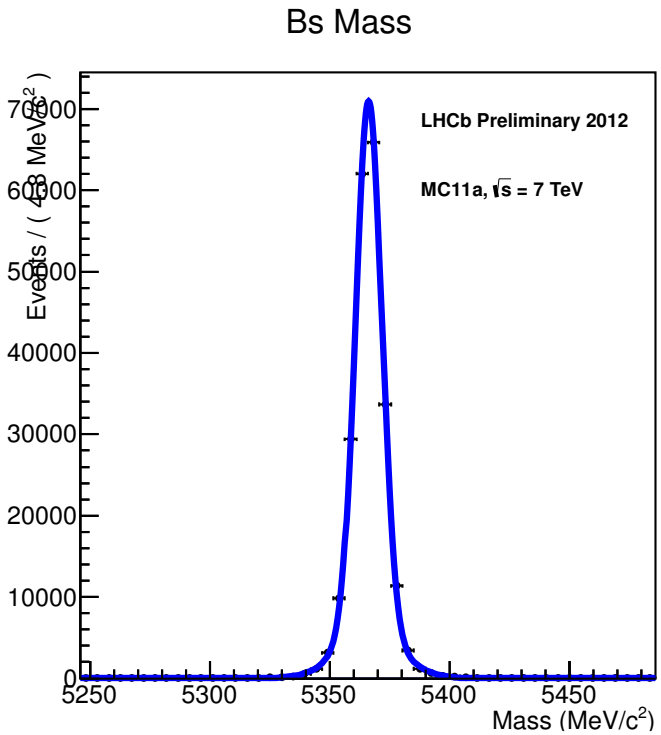
- A cut of 0.2 ps on the B propertime is applied at the stripping level to get ride of all the prompt J/ψ background. The relevent point for the lower acceptance is that the 0.2 ps cut is applied on a simpler lifetime measurement than the one used in the analysis $\to$ acceptance effect.

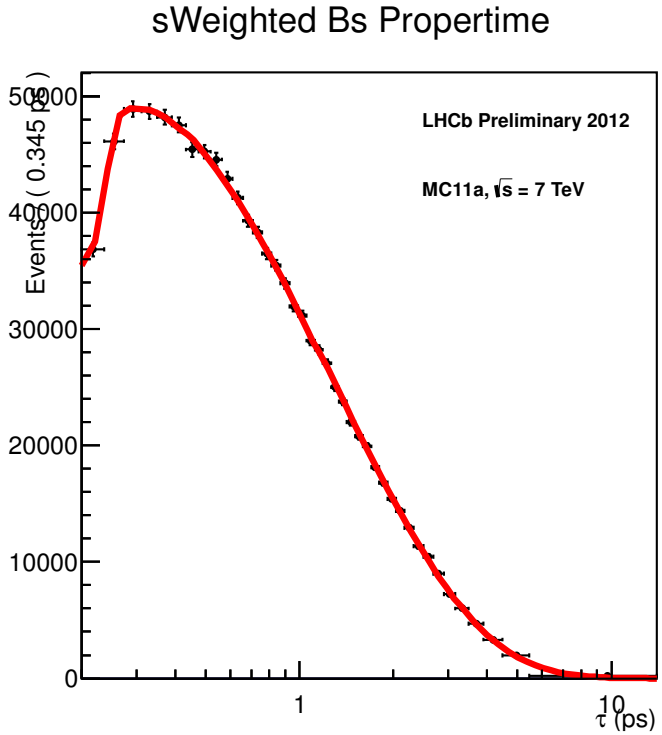
Stripping acceptance from prescaled stripping in data

- We have a prescaled stripping line without the 0.2 ps cut. So using these events, the cut on the simplified lifetime τ can be applied once looking to the analysis τ spectrum with respect to the propertime distribution without any cut :
- Stripping Acceptance $= \frac{\text{Analysis } \tau \text{ (Stripping } \tau > 0.2 \text{ ps)}}{\text{Analysis } \tau \text{ (no cut)}}$

MC B_s^0 propertime fit with lower decay-time acceptances

- Fit function $= \mathrm{Acc}_{Trigger}(t) * \mathrm{Acc}_{Stripping}(t) * e^{-t/\tau}$

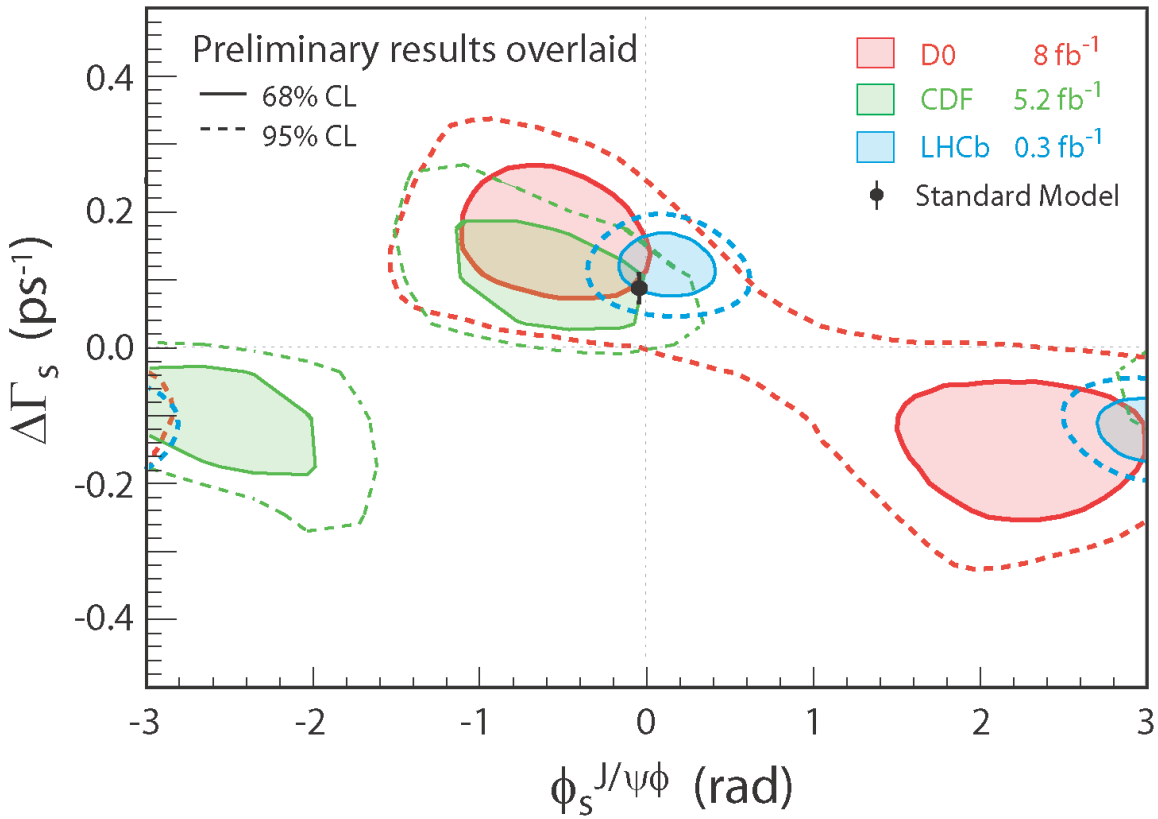




- Stripping acceptance does not go further than 0.3 ps, which is exactly where we cut for the analysis, therefore this acceptance is ignored.
- Using the acceptances taken from data are able to describe pretty well the decay-time spectrum and are used for 2012 ϕ_s Moriond analysis.

Conclusion

- A method to extract lower propertime acceptances has been presented that can be used with LHCb trigger and stripping and is used for the 2012 ϕ_s Moriond analysis ... which is a piece of the puzzle to extract ϕ_s !



$\Delta\Gamma_s - \phi_s^{J/\psi\phi}$: 300 pb^{-1} analysis $\to$ arXiv:1112.3183