contribution from $B^0 \to J/\psi\pi\pi$ on the $B_s^0 \to J/\psi\pi\pi$ channel.
May 24 2017

feedback from LHCP: the lifetime measurements presented by Nuno at LHCP were well received by the community. However, a comment was raised by LHCb regarding the $B_s^0 \to J/\psi\pi\pi$ channel which deserves our consideration. A contribution from $B^0 \to J/\psi\pi\pi$ is quite visible in the $J/\psi\pi\pi$ mass plot at around 5.27 GeV: it should be taken into account (or removed) in the final analysis. I hope that you can address this issue quickly.

Answer: Following the comment, we add a component in the pdf to take into account the $B^0 \to J/\psi\pi\pi$ contribution. The mass will be modeled by a gaussian function with the mean fixed from the pdg value and the width shared with the width used for B_s^0 gaussian signal, which is a free parameter of the fit.The fraction (the number of events, N_{B^0}) for this component is a free parameter of the fit too.
For ct, this component is modeled by an exponential decay convoluted with the resolution. The lifetime for this contribution is fixed to the B^0 lifetime taken from the PDG, being corrected by the factor $M_{B^0}/M_{B_s^0}$, since the ct variable was calculated using the B_s^0 mass. The invariant mass and ct distributions obtained from data are shown with the fit results superimposed Fig. 1. The average B_s^0 lifetime obtained from the fits is $ct = 502.5 \pm 10.2\ \mu m$, which is in agreement with the previous one.

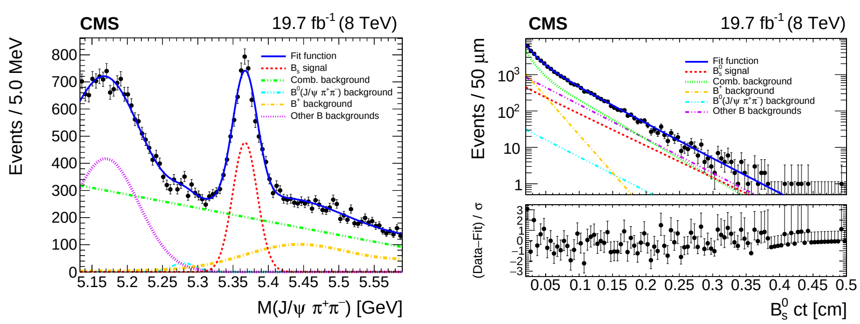

Figure 1: Invariant mass (left) and ct (right) distributions for B_s^0 candidates reconstructed from $B_s^0 \to J/\psi\pi\pi$ decays. The curves are projections of the maximum-likelihood fit to the data, with the contributions from signal (dashed), background (dotted), misidentified $B^+ \to J/\psi K^+$ background (dashed-dotted), $B^0 \to J/\psi\pi\pi$ contribution (dashed-dotted-dotted-dotted) , partially reconstructed and (other) misidentified B backgrounds (dashed-dotted-dotted) and the sum of signal and background (solid) shown. The bottom panel of the right figure show the difference between the observed data and the fit divided by the data uncertainty.

Jonatan questions: 1) Can you try floating the width of the B0 peak? In principle, it shouldn't be the same as that for the Bs signal.
Answer: Yes you are right, in principle they shouldn't be the same. In fact, the width of the B^0 is corrected by a factor of $M_{B^0}/M_{B^0_s}$.

2) How does the fit improve (or not) with the inclusion of the B^0 peak?
Answer: The reduced chi2 of the fits are basically the same, 1.058 for the nominal model and 1.063 when the B^0 component is included.

3) Sorry if I didn't notice before, but the signal peak looks like would be better fit with 2 gaussians sharing the mean value. Did you try?
Answer: In the past we tried that and the fit did not converge well (obtained unreasonable result). On the other hand, please take a look to Fig. 2, this is exactly the same (unbinned) fit shown using different binning. So we believe one Gaussian is good enough to model the signal peak.

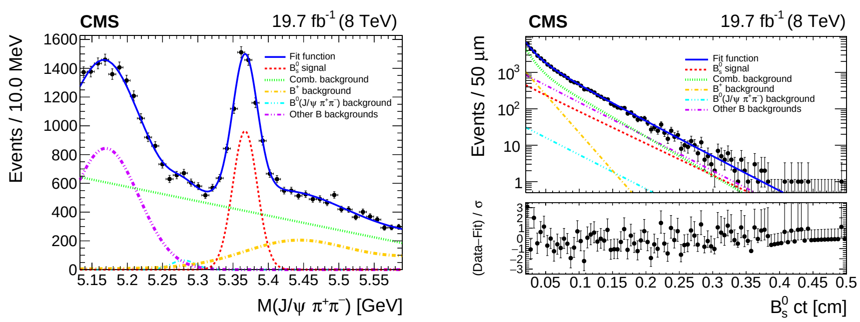

Figure 2: Invariant mass (left) and ct (right) distributions for B_s^0 candidates reconstructed from $B_s^0 \to J/\psi\pi\pi$ decays. The curves are projections of the maximum-likelihood fit to the data, with the contributions from signal (dashed), background (dotted), misidentified $B^+ \to J/\psi K^+$ background (dashed-dotted), $B^0 \to J/\psi\pi\pi$ (dashed-dotted-dotted-dotted) contribution, partially reconstructed and (other) misidentified B backgrounds (dashed-dotted-dotted) and the sum of signal and background (solid) shown. The bottom panel of the right figure show the difference between the observed data and the fit divided by the data uncertainty.