



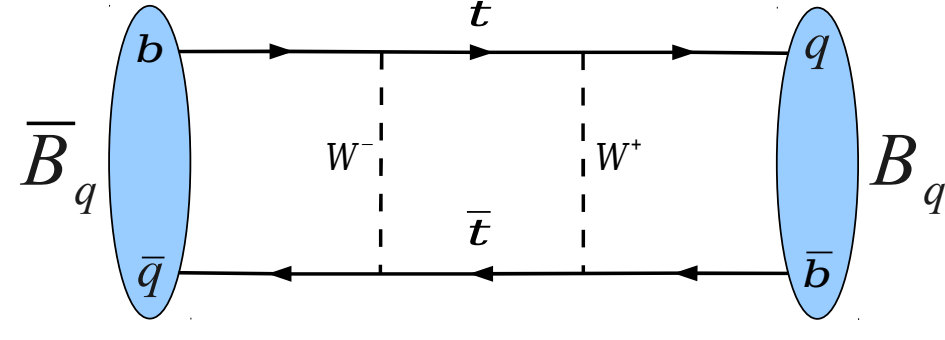
B-mixing

Neutral mesons can oscillate into their anti-particles

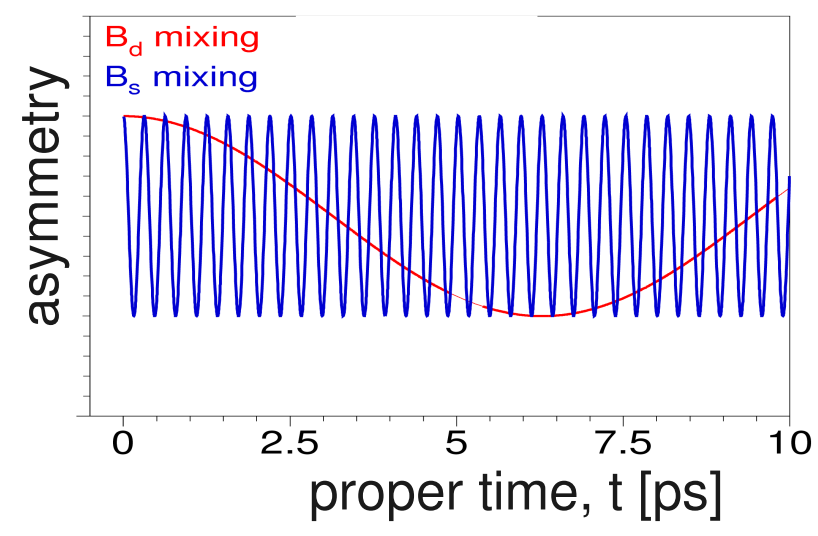
$$\begin{aligned} |B_L\rangle &= p|B_q\rangle + q|\bar{B}_q\rangle \\ |B_H\rangle &= p|B_q\rangle - q|\bar{B}_q\rangle \end{aligned}$$

Mass eigenstates B_L and $B_H \neq$ weak eigenstates B_S and \bar{B}_S

Dominant Feynman diagram for B_S mixing



Mixing frequency Δm corresponds to mass difference between B_L and B_H



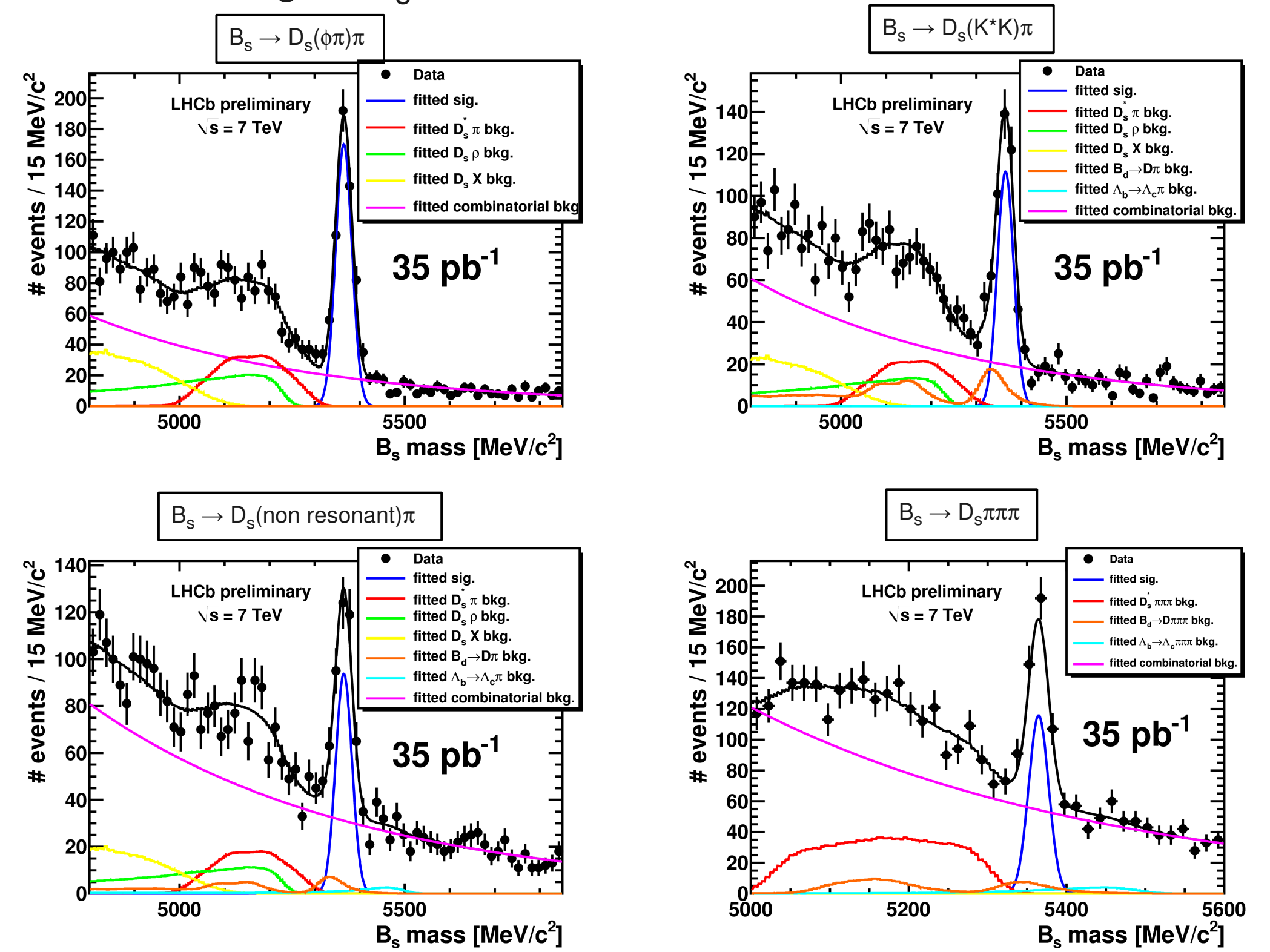
- Rapid oscillation in B_S system \rightarrow need excellent proper time resolution

Current world average

$$\Delta m_s = 17.77 \pm 0.10(\text{stat.}) \pm 0.07(\text{syst.}) \text{ ps}^{-1} \text{ [2]}$$

Mass fits

- Simultaneous fit of four different decay modes
- In total ~ 1100 signal B_S candidates



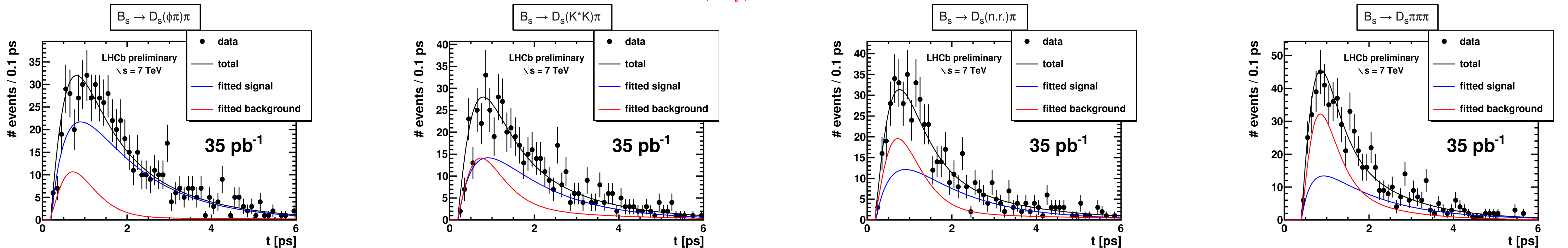
Lifetime fits

- Exclude candidates with mass $< m_{B_S} - 3\sigma$ for lifetime and mixing fits \rightarrow reduce physics background significantly

- Average proper time resolution calibrated on data

$$\langle \sigma_t \rangle = 36 - 44 \text{ fs}$$

- Combinatorial bkg model obtained from high mass sideband



Mixing fits

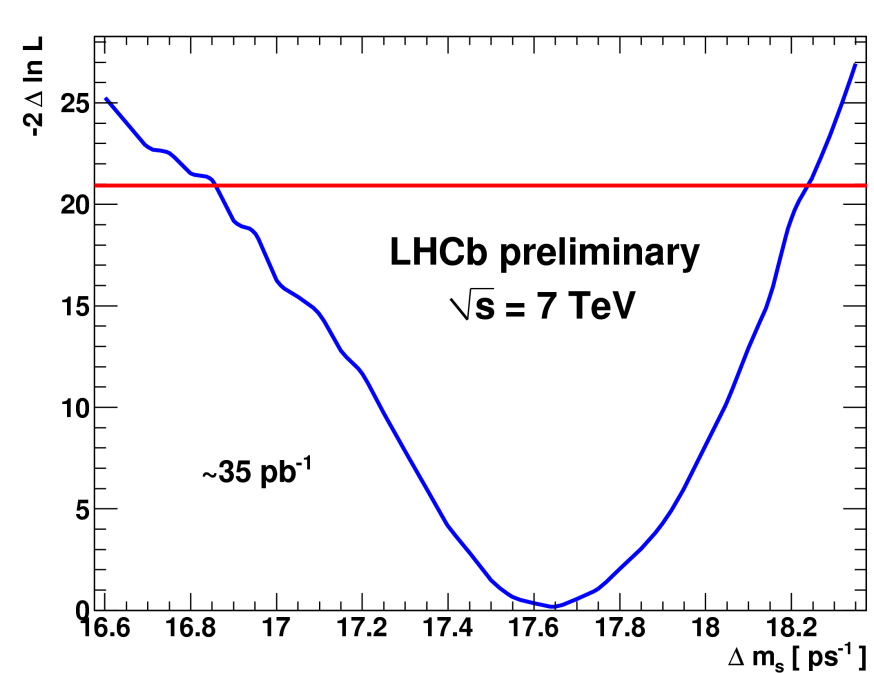
Time dependent measurement of mixing asymmetry

$$A_{\text{mix}}(t) = \frac{N_{\text{unmixed}}(t) - N_{\text{mixed}}(t)}{N_{\text{unmixed}}(t) + N_{\text{mixed}}(t)}$$

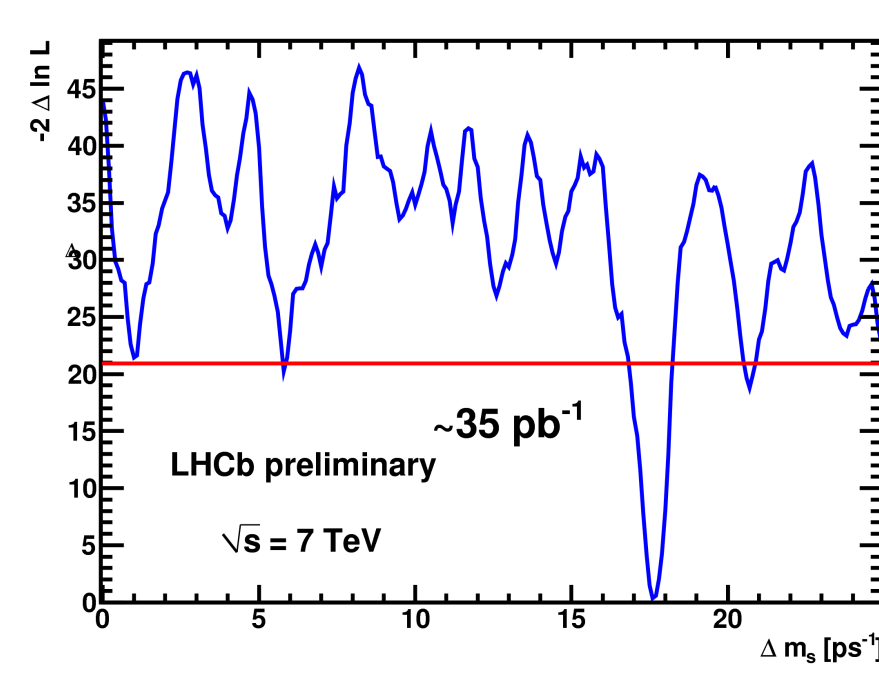
Need to know flavour of B meson at decay (\rightarrow use flavour specific final state) and at production (\rightarrow flavour tagging algorithms, see poster by Emilie Amandine Maurice)

Flavour tagging in this analysis:

- Opposite side taggers used only
- Tagging performance constraint to calibration obtained on $B_d \rightarrow D\pi$ data
- Tagging power ($\epsilon D^2 = 3.8 \pm 2.1\%$)



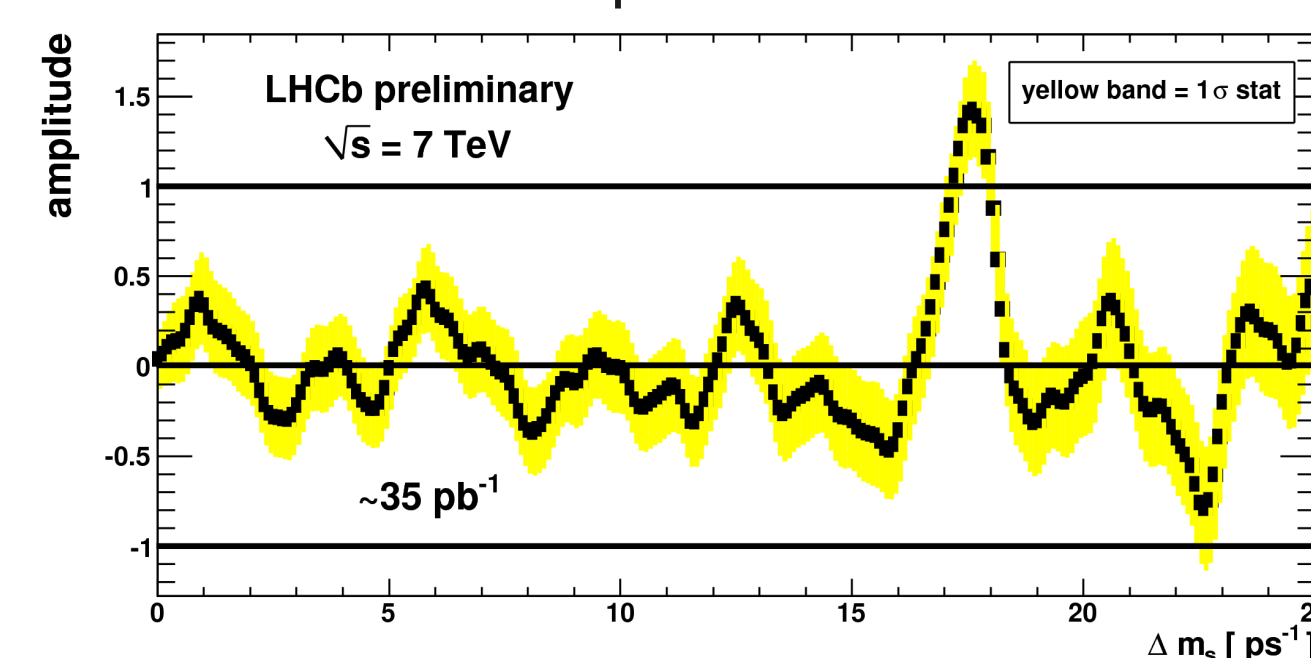
Likelihood profile



Red line indicates value for $\Delta m_s \rightarrow \infty$

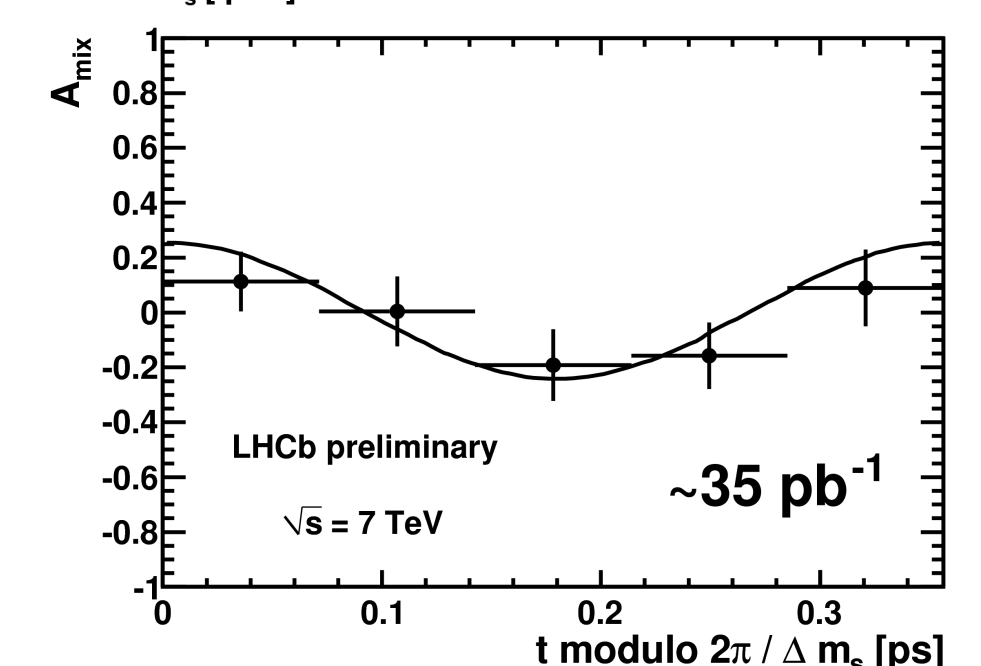
$\rightarrow 20.96 \hat{=} 4.6\sigma$ significance

Amplitude scan



Amplitude at peak position $A = 1.41 \pm 0.26$

Fitted mixing asymmetry



Variety of systematic studies performed:

- Proper time resolution models
 - Mass models
 - Different values for $\Delta\Gamma$
 - Overall z-scale of the detector
 - Momentum scale
 - PDF for event-by-event properties
- } Leading systematic uncertainties

References:

- [1] LHCb-CONF-2011-005
- [2] Phys.Rev.Lett.97:242003,2006

$$\Delta m_s = 17.63 \pm 0.11(\text{stat.}) \pm 0.04(\text{syst.}) \text{ ps}^{-1}$$