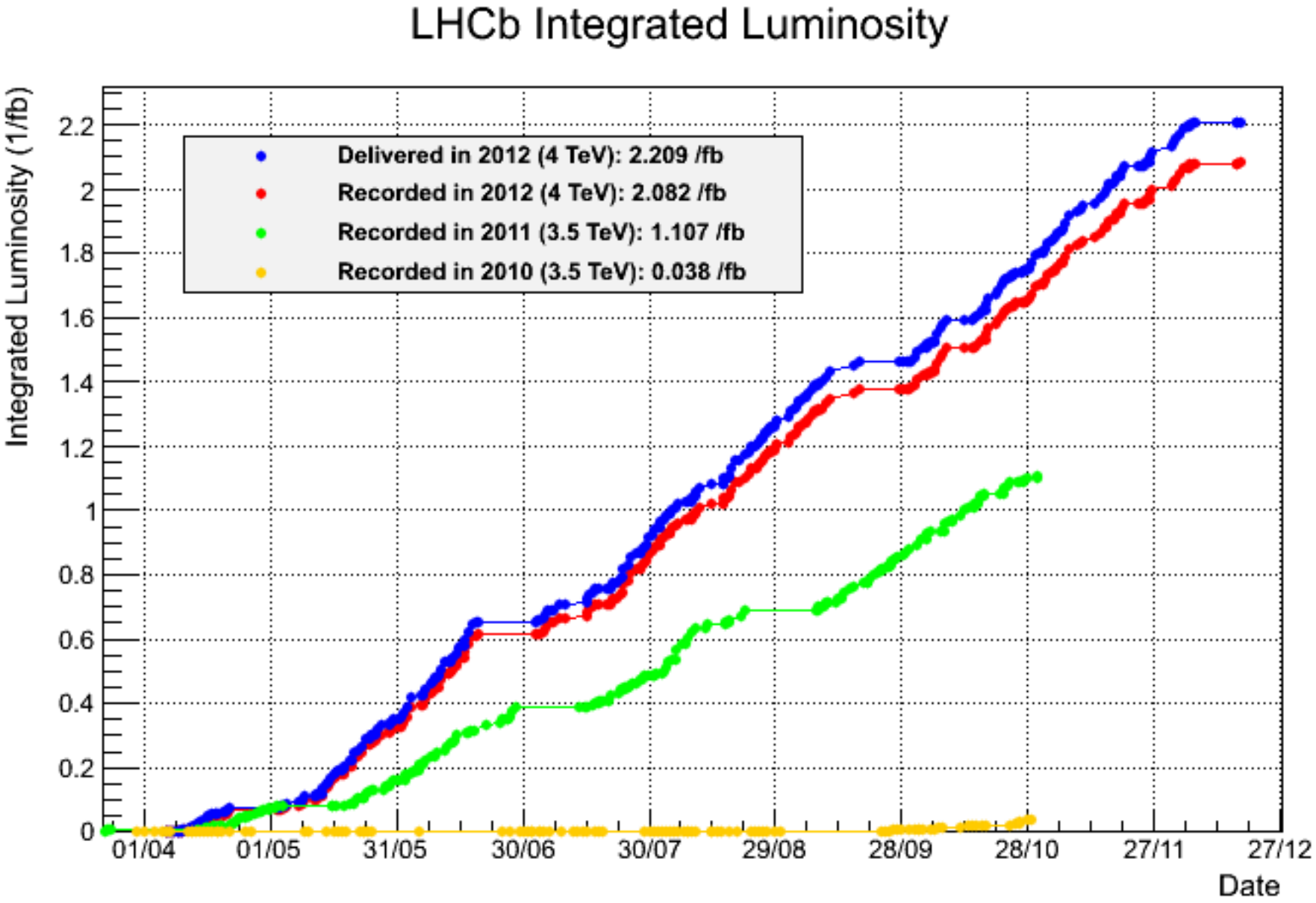
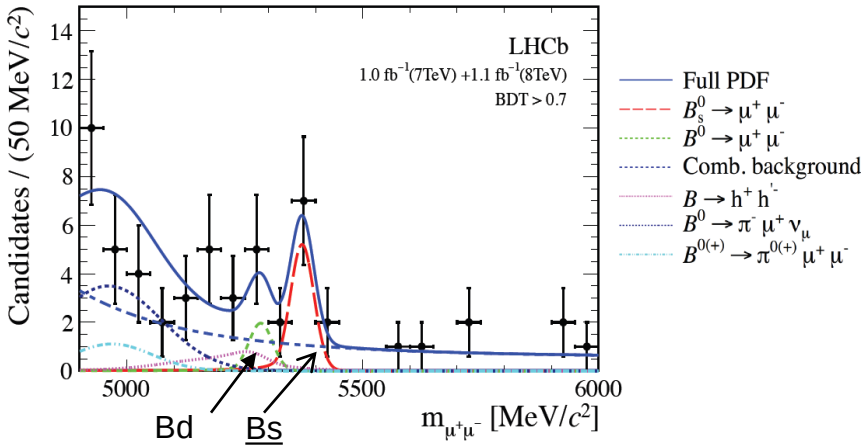
LHCb at Moriond


LHCb Integrated Luminosity
Integrated Luminosity (1/fb)
Delivered in 2012 (4 TeV): 2.209 /fb
Recorded in 2012 (4 TeV): 2.082 /fb
Recorded in 2011 (3.5 TeV): 1.107 /fb
Recorded in 2010 (3.5 TeV): 0.038 /fb
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
01/04
01/05
31/05
30/06
30/07
29/08
28/09
28/10
27/11
27/12
Date

В эксперименте LHCb обнаружен редкий распад Bs на два мюона

Phys.Rev.Letters 110 (2013)

1.1 fb^{-1}(8 TeV) + 1.0 fb^{-1} (7TeV)



Полученное согласие со Стандартной Моделью является одним из самых серьезных ограничений на возможный вклад “новой физики”, в частности на вклад различных вариантов суперсимметрии.

LHCb

Bs→μμ = (3.2 +1.5/-1.2) 10^{-9}

Стандартная Модель

Bs→μμ = (3.23 +/- 0.27) 10^{-9}

LHCb

Bd→μμ < 9.4 ·10^{-10}

Стандартная Модель

Bd→μμ = (1.07 +/- 0.10) 10^{-10}

Осцилляции B -мезонов

$B^0s \rightarrow$ anti B^0s

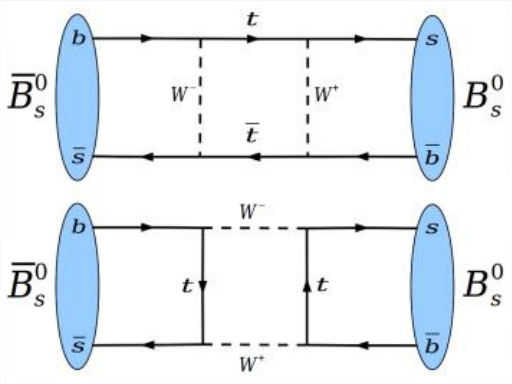
$B^0d \rightarrow$ anti B^0d

$D^0 \rightarrow$ anti D^0

Mass eigenstates ≠ flavour eigenstates → mass difference ∝ osc. frequency

$$|B_L\rangle = k|B_s^0\rangle + l|\overline{B_s^0}\rangle$$
$$|B_H\rangle = k|B_s^0\rangle - l|\overline{B_s^0}\rangle$$

$$\Delta m_q = m_H - m_L = 2|M_{12}^q|$$

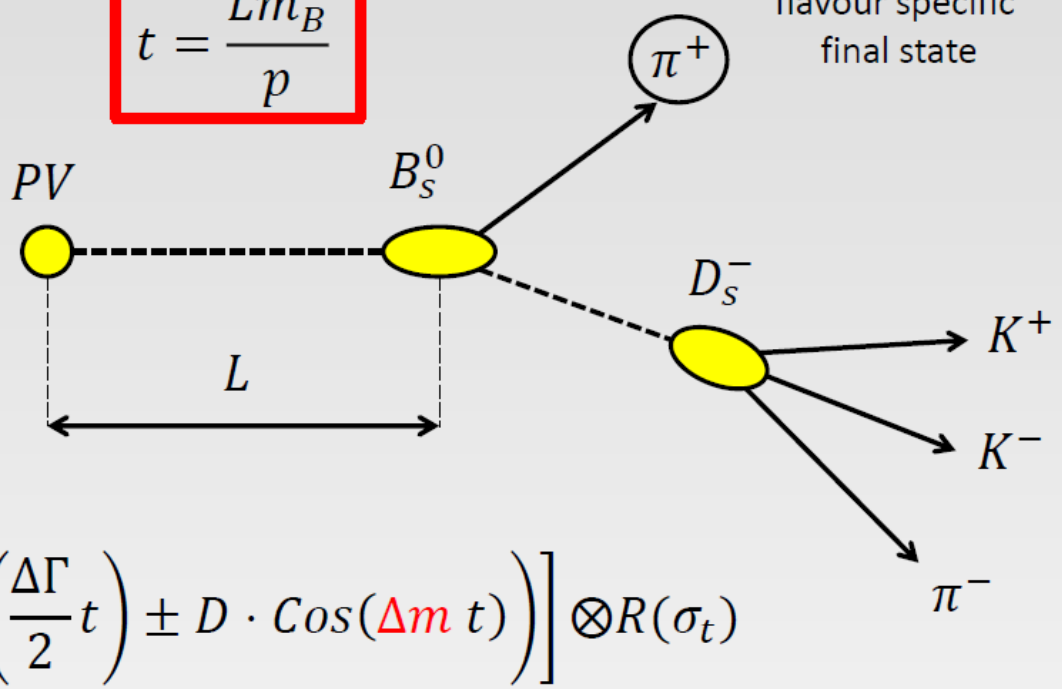


Dominant Feynman diagrams
(Standard Model)

Метод измерения

Need decay time dependent analysis

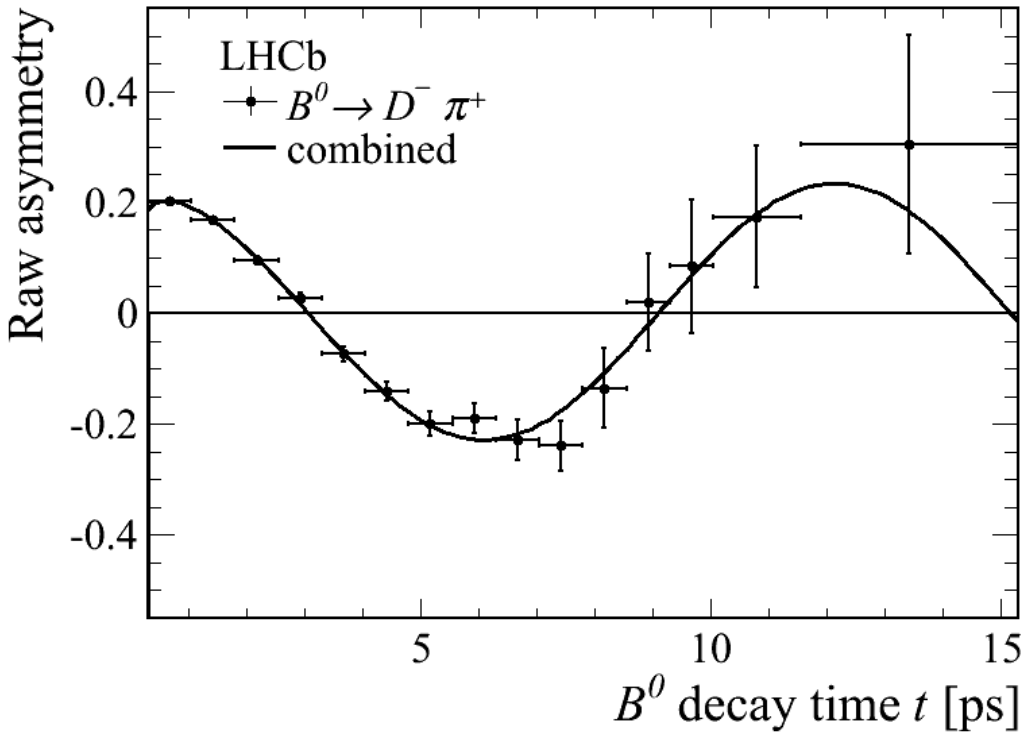
$$t = \frac{Lm_B}{p}$$



Decay time PDF:

$$PDF \propto \left[e^{-\Gamma t} \cdot \left(Cosh\left(\frac{\Delta\Gamma}{2} t\right) \pm D \cdot Cos(\Delta m\, t) \right) \right] \otimes R(\sigma_t)$$

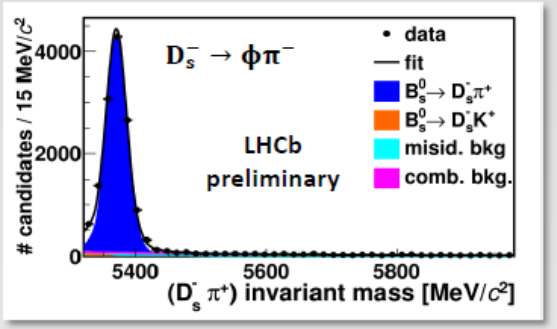
Осцилляции Bd -мезонов

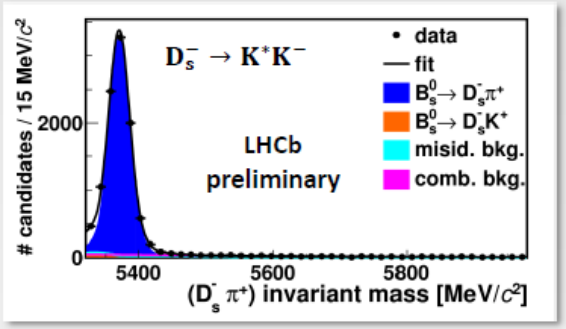


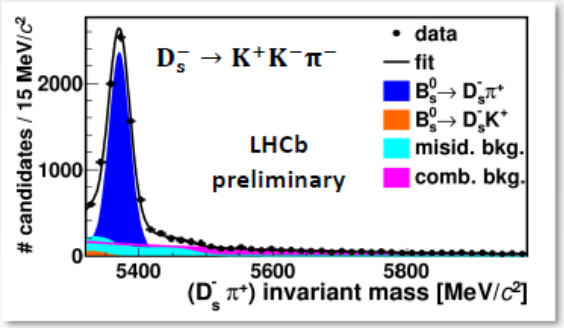
$\Delta m_d = 0.5156 \pm 0.0051 \pm 0.0033$ ps-1]

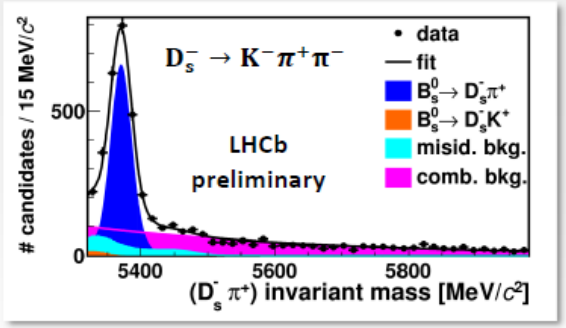
Осцилляции Bs -мезонов

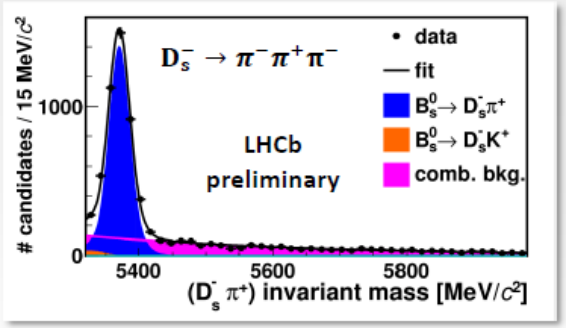
- Use data set taken in 2011 (integrated luminosity 1 fb^{-1})
- Reconstruct $B_s^0 \to D_s^- \pi^+$ in 5 different D_s^- decay modes
- $\sim$ 34000 signal candidates
- Mean decay time resolution 44 fs
- Need flavour at production → flavour tagging algorithms
- Use invariant mass to separate signal from background
- Unbinned maximum likelihood fitter in mass and decay time
- Blinded analysis





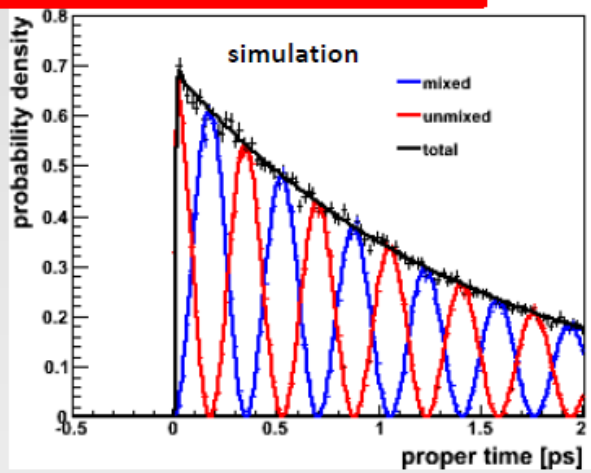






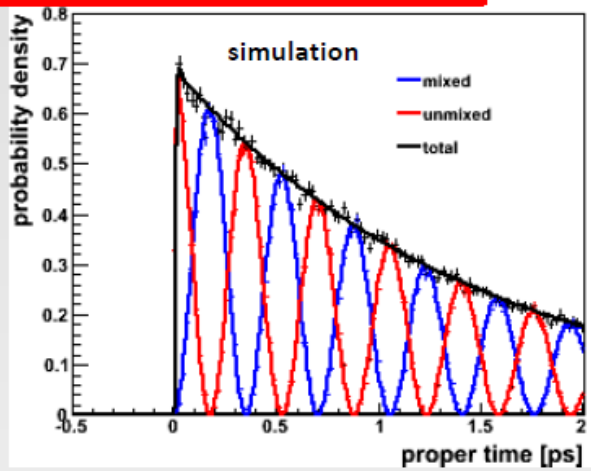
Осцилляции Bs -мезонов

perfect tagging + resolution

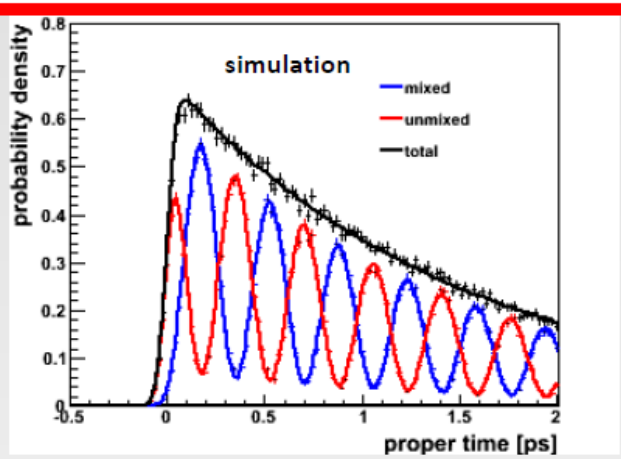


Осцилляции Bs -мезонов

perfect tagging + resolution

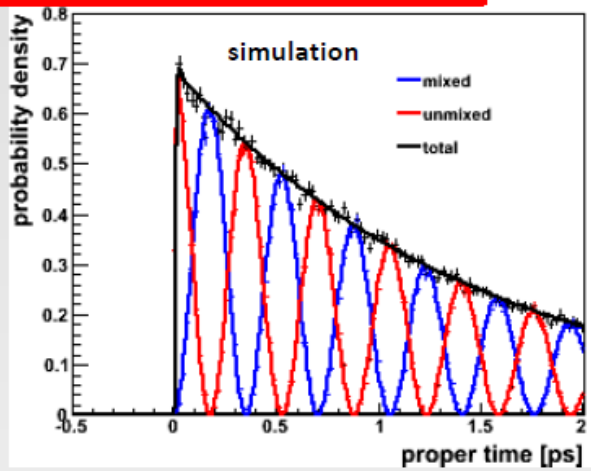


perfect tagging, realistic resolution

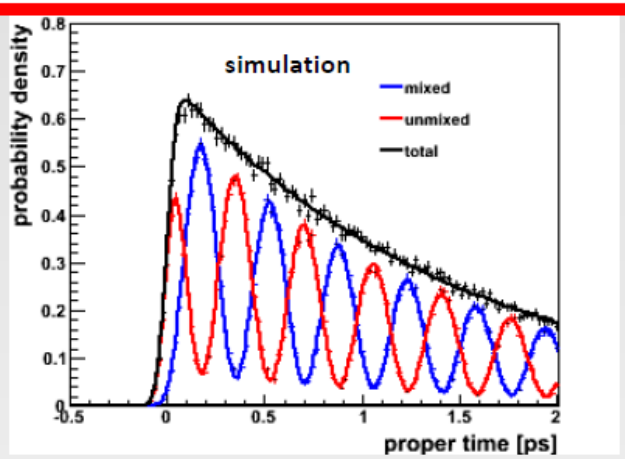


Осцилляции Bs -мезонов

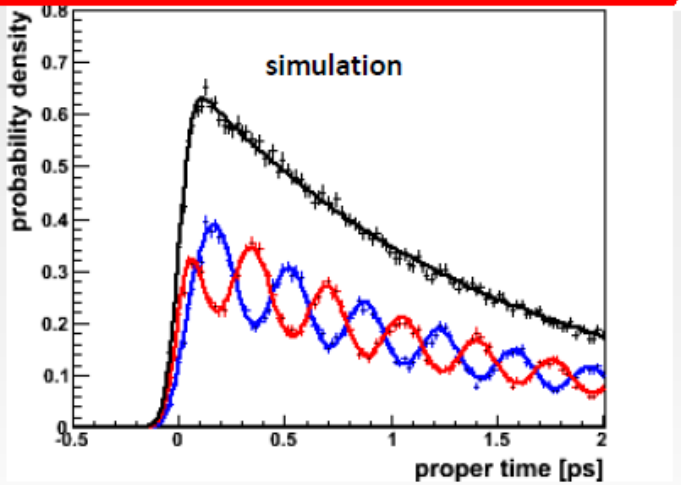
perfect tagging + resolution



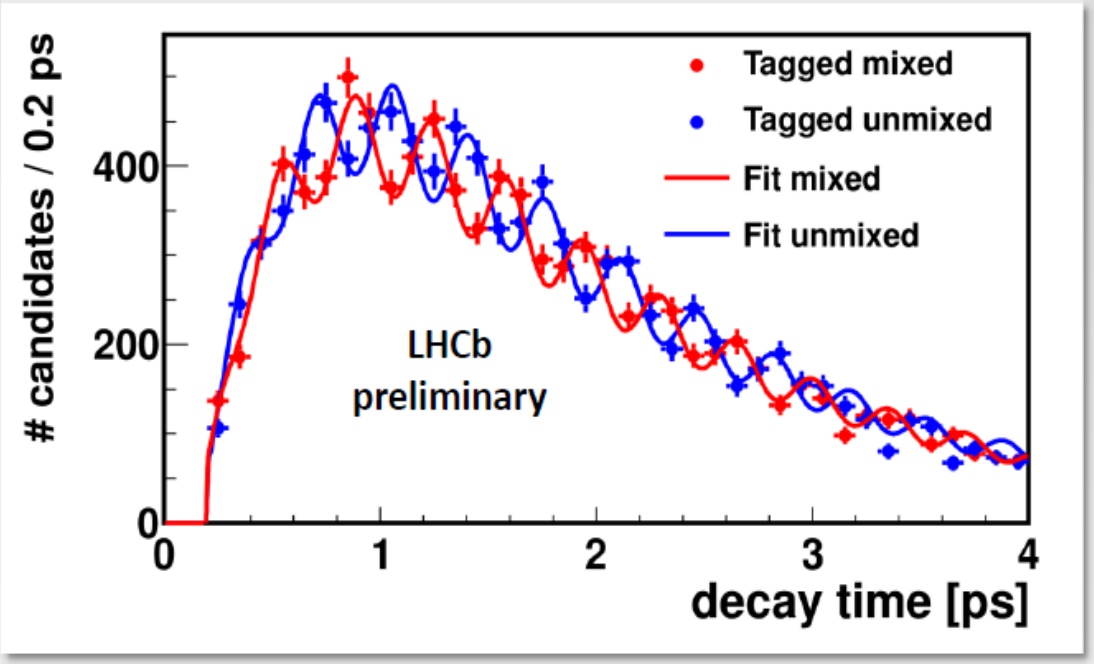
perfect tagging, realistic resolution



realistic tagging, realistic resolution



Осцилляции Bs -мезонов



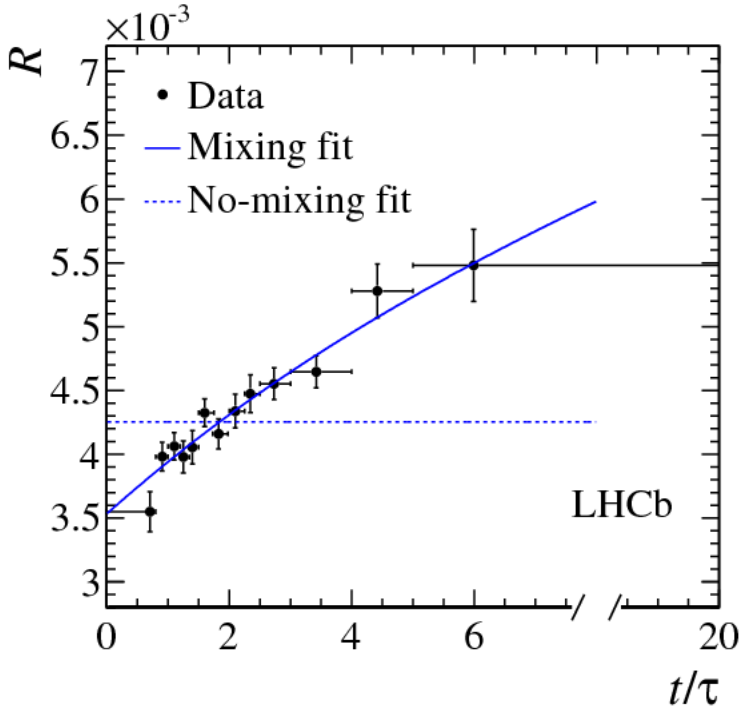
New result (preliminary)

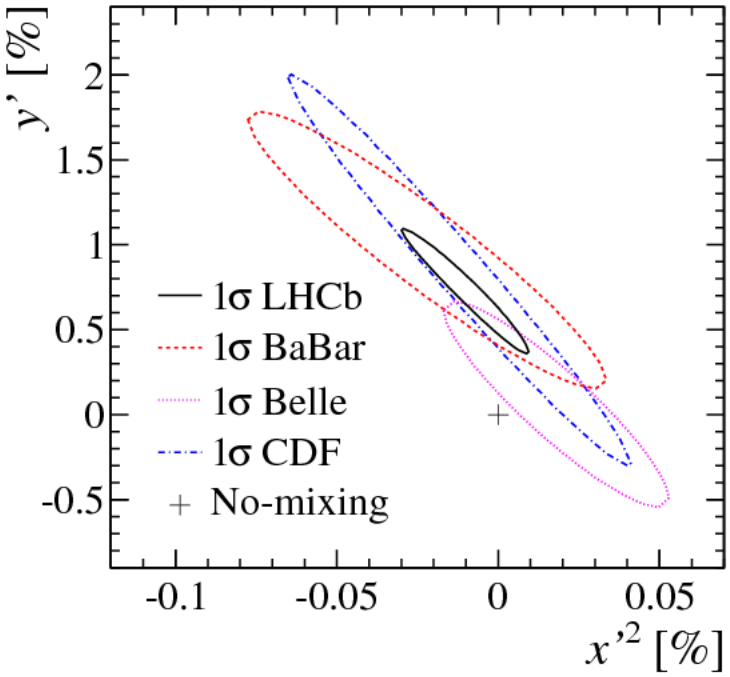
$$\Delta m_s = 17.768 \pm 0.023(stat) \pm 0.006(syst)\ ps^{-1}$$

Осцилляции D^0 мезонов

$D^{*+} \rightarrow D^0 \pi^+$ (D^0 tagging)

$R = N(\text{anti}D^0 \rightarrow K^+\pi^-) / N(D^0 \rightarrow K^-\pi^+)$

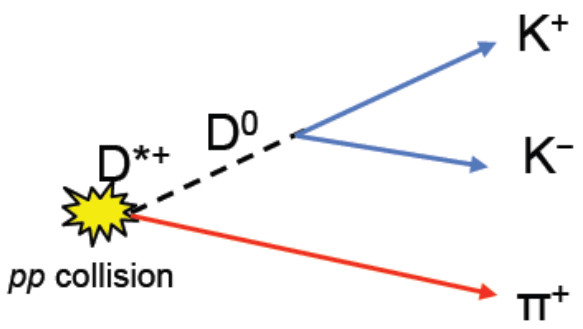


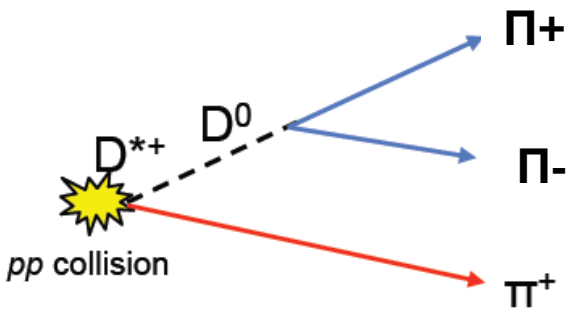


. The LHCb results exclude the no-mixing hypothesis by more than 5 σ for the first time and therefore can be classified as the first observation of this effect.

CP – нарушение в распадах D0 мезонов

$$A_{CP} = \{N(D^0 \to f) - N(\text{anti } D^0 \to f)\} / \{N(D^0 \to f) + N(\text{anti } D^0 \to f)\}$$





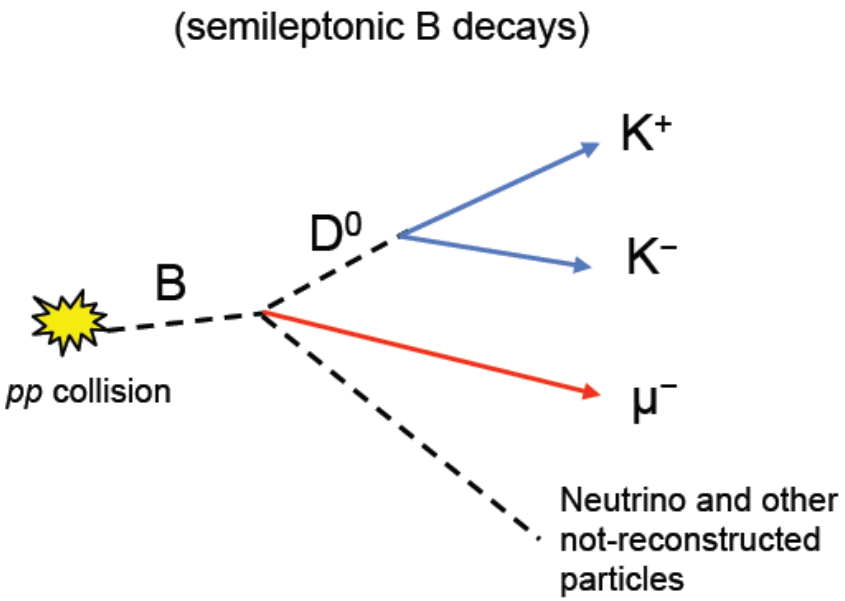
$$\Delta A_{CP} = A_{CP}(K^+K^-) - A_{CP}(\pi^+\pi^-)$$

CP – нарушение в распадах D0 мезонов

LHCb	**ΔA_{CP} = (- 0.82 ± 0.21 ±0.11)%**	**PRL 108 (2012)111602, arXiv:1112.0938**
CDF	**ΔA_{CP} = (- 0.62 ± 0.21 ±0.10)%**	**PRL 109 (2012) 11180 arXiv:1207.2158**
Belle	**ΔA_{CP} = (- 0.87 ± 0.41 ±0.06)%**	**arXiv: 1212.1975**

World average **ΔA_{CP} = (- 0.68 ± 0.15)%**

CP – нарушение в распадах D0 мезонов



$\Delta A_{CP} = (+ 0.49 \pm 0.30 \pm 0.14)\%$

CP – *нарушение* в распадах D0 мезонов

Preliminary update of pion-tagged analysis

$$\Delta A_{CP} = [-0.34 \pm 0.15\ (\text{stat}) \pm 0.10\ (\text{syst})]\%$$

[LHCb-CONF-2013-003]

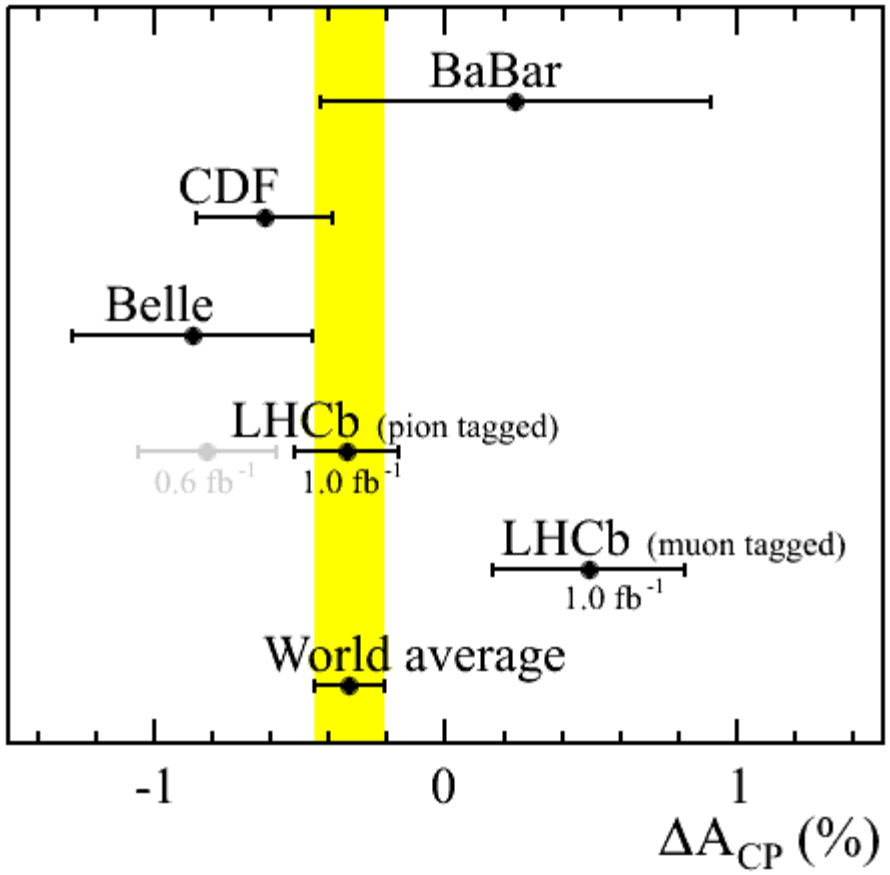
New measurement of muon-tagged analysis

$$\Delta A_{CP} = [+0.49 \pm 0.30\ (\text{stat}) \pm 0.14\ (\text{syst})]\%$$

[arXiv:1303.2614]

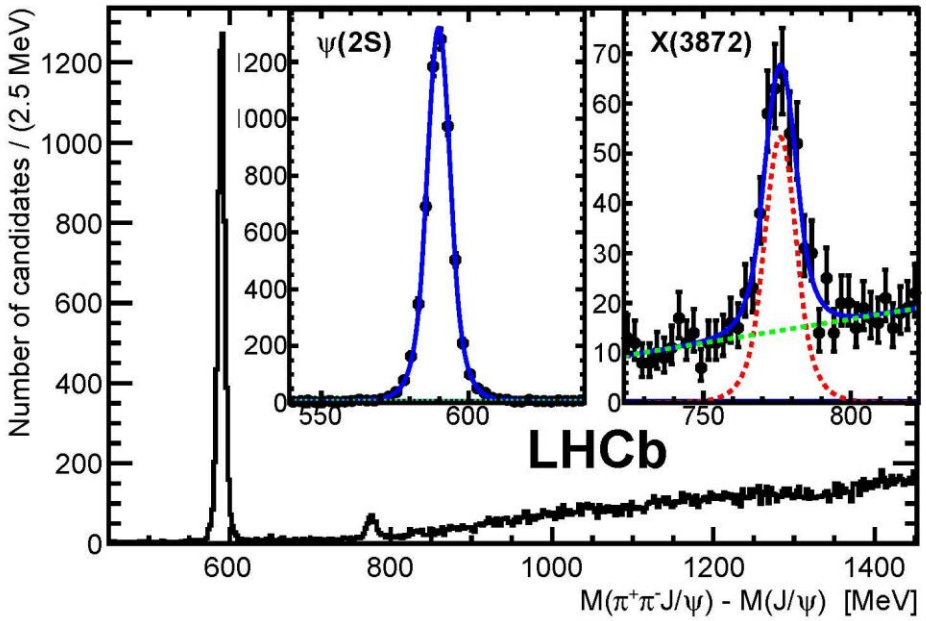
- Difference between two results: 2.2 σ.
- Preliminary weighted LHCb average: $\Delta A_{CP} = (-0.15 \pm 0.16)\%$

CP – нарушение в распадах D0 мезонов



Quantum numbers of X(3872)

J^{PC}



C = + **from** **X(3782) → γ J/ψ**

CDF and Belle 1^{++} **or** 2^{-+}

BaBar 2^{-+}

B+ → X(3872)K+
X(3782) → π+π- J/ψ
J/ψ → μ+μ-

LHCb 1^{++}

2^{-+} **исключен на уровне 8σ**