Branching ratio of $B_s^0 \to D_s^{\mp} K^{\pm}$

Towards a time-dependent measurement of γ

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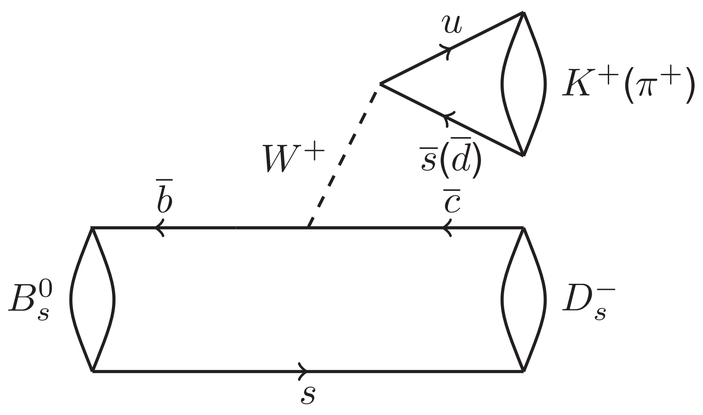
MOTIVATION

Branching ratio

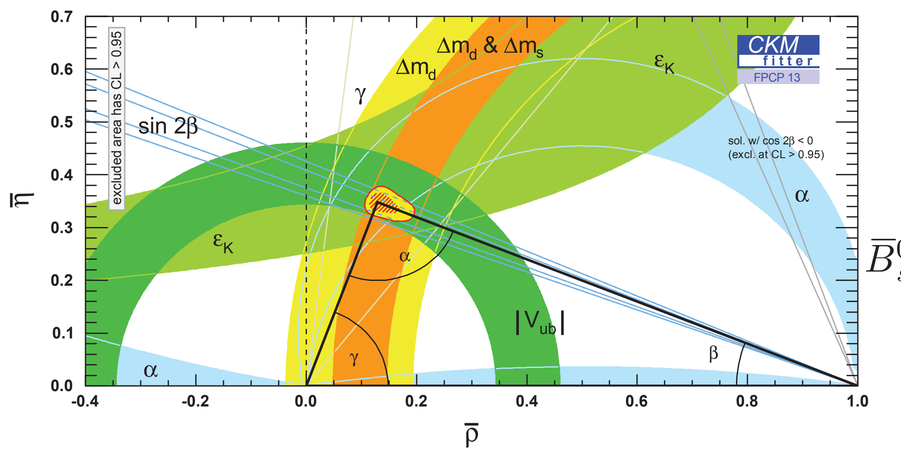
- We measure the branching ratio of $B_s^0 \to D_s^{\mp} K^{\pm}$ relative to the normalisation channel $B_s^0 \to D_s^- \pi^+$.
- It is predicted that this value has a lower bound: [3]

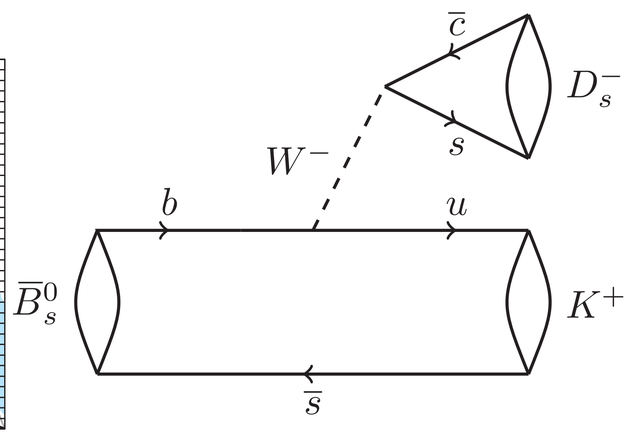
$$\frac{\mathcal{B}(B_s^0 \to D_s^{\mp} K^{\pm})}{\mathcal{B}(B_s^0 \to D_s^- \pi^+)} \geq 0.080 \pm 0.007$$



The angle γ

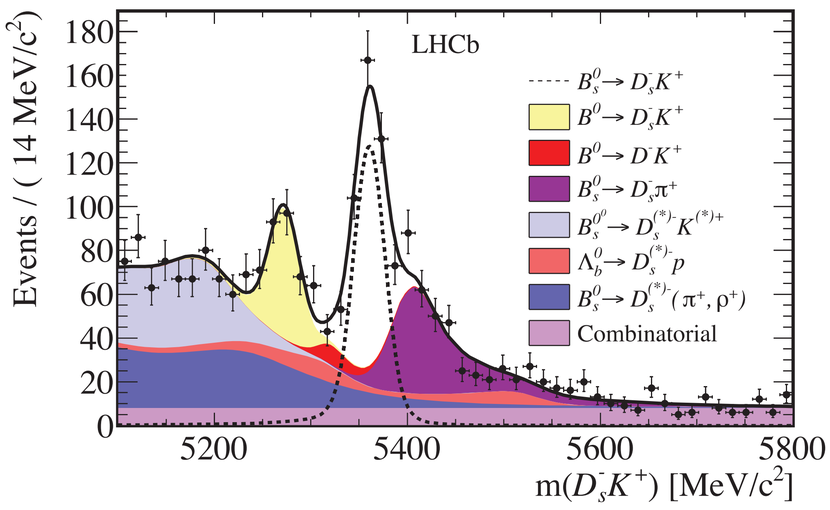
- **Interference** between two diagrams of similar amplitude allows a measurement of the unitarity triangle angle γ.
- A **time-dependent** analysis measures the unitarity triangle angle γ, one of the **least well-known** Standard Model parameters.



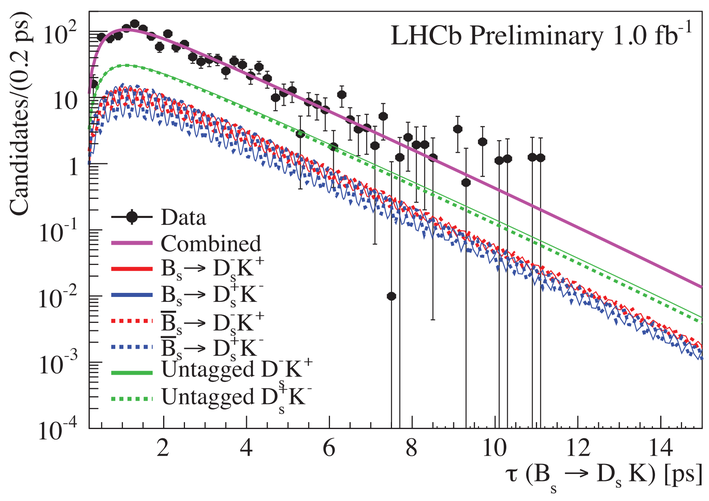


METHOD

To obtain the branching ratio, a **mass fit** is made. The fit plotted below uses 336 pb^{-1} of data. [1]



To obtain γ, a fit is made to the **lifetime**. This is a simultaneous fit to the four different decay channels of $B_s^0 \to D_s^{\mp} K^{\pm}$, using 1 fb^{-1}. [2]



Total $B_s^0 \to D_s^{\mp} K^{\pm}$ yield from this fit (error is statistical only):

406 ± 26

OUTLOOK

Several new developments:

- **3 fb^{-1}** of data with new reconstruction;
- Using the **wrong-sign** data for estimation of combinatorial yield;
- Refinement of **partially reconstructed** backgrounds.

Expected $B_s^0 \to D_s^{\mp} K^{\pm}$ yield with these adjustments:

4500

RESULTS

Results for the **branching ratio** with 336 pb^{-1} of data: [1]

$$\mathcal{B}(B_s^0 \to D_s^{\mp} K^{\pm}) / \mathcal{B}(B_s^0 \to D_s^- \pi^+) = \mathbf{0.0646} \pm 0.0043 \pm 0.0025$$

$$\mathcal{B}(B_s^0 \to D_s^- \pi^+) = \left(\mathbf{3.04} \pm 0.19 \pm 0.23^{+0.18}_{-0.16}\right) \times 10^{-3}$$

$$\mathcal{B}(B_s^0 \to D_s^{\mp} K^{\pm}) = \left(\mathbf{1.97} \pm 0.18^{+0.19+0.11}_{-0.20-0.10}\right) \times 10^{-4}$$

The uncertainties are statistical, systematical, and related to B hadron production.

Preliminary results with 1 fb^{-1} of data, in terms of **cartesian coordinates**: [2]

$$C = \mathbf{1.01} \pm 0.50 \pm 0.23$$
$$S_f = -\mathbf{1.25} \pm 0.56 \pm 0.24$$
$$S_{\bar{f}} = \mathbf{0.08} \pm 0.68 \pm 0.28$$
$$D_f = -\mathbf{1.33} \pm 0.60 \pm 0.26$$
$$D_{\bar{f}} = -\mathbf{0.81} \pm 0.56 \pm 0.26$$

Value of γ not yet established, but publication is expected soon!

REFERENCES

[1] LHCb collaboration, Measurements of the branching fractions of the decays $B_s^0 \to D_s^{\mp} K^{\pm}$ and $B_s^0 \to D_s^- \pi^+$, LHCb-PAPER-2011-022

[2] LHCb collaboration, Measurement of time-dependent CP-violation observables in $B_s^0 \to D_s^{\mp} K^{\pm}$, LHCb-CONF-2012-029

[3] K. de Bruyn et al., Exploring $B_s^0 \to D_s^{(*)\pm} K^{\mp}$ decays in the presence of a sizeable width difference $\Delta\Gamma_s$, Nuclear Physics B 868 (2013) 351-367