FIRST OBSERVATION AND MEASUREMENT OF THE BRANCHING FRACTION FOR THE DECAY $B^0_s \to D_s^* K$

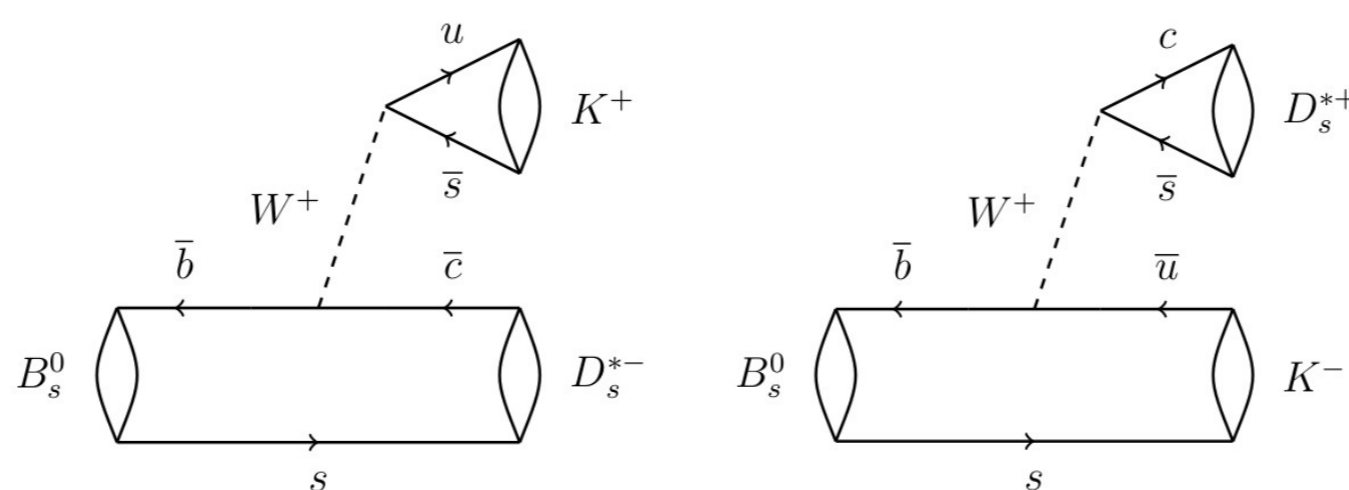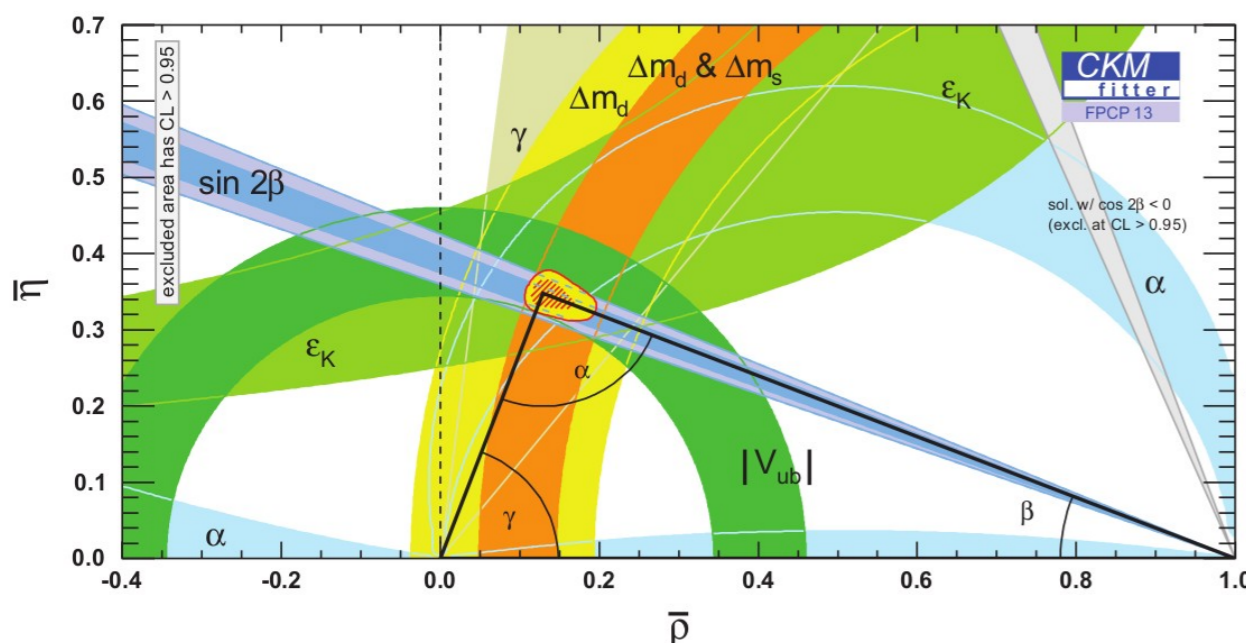**Lorenzo Sestini, on behalf of the LHCb collaboration**
LHCC, 4 march 2015

MOTIVATION

γ is the least well known parameter of the CKM matrix. It can be extracted by a time-dependent analysis of channel like $B^0_s \to D_s^{(*)} K$. The sensitivity to γ depends on the interference between $b \to c$ and $b \to u$ transitions that occur through B^0_s mixing.
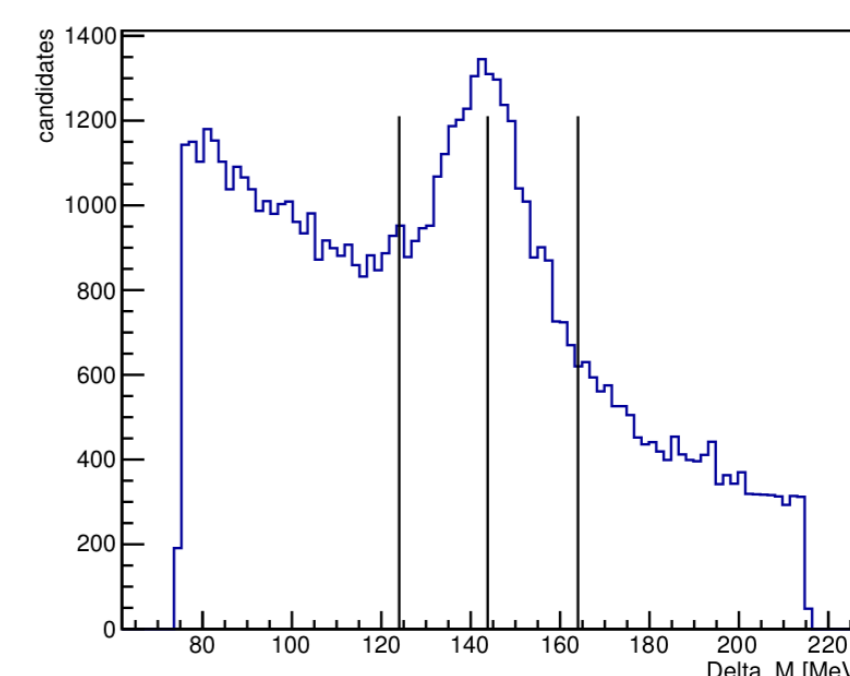

OUR MEASUREMENT

We observed for the first time the $B^0_s \to D_s^* K$ decay and we measured the ratio:

$$\mathcal{R}^* \equiv \frac{\mathcal{B}(B^0_s \to D_s^{*\mp} K^{\pm})}{\mathcal{B}(B^0_s \to D_s^{*-} \pi^+)} = \frac{N_{K^{\pm}}}{N_{\pi^+}} \frac{\varepsilon_{\pi^+}}{\varepsilon_{K^{\pm}}}$$
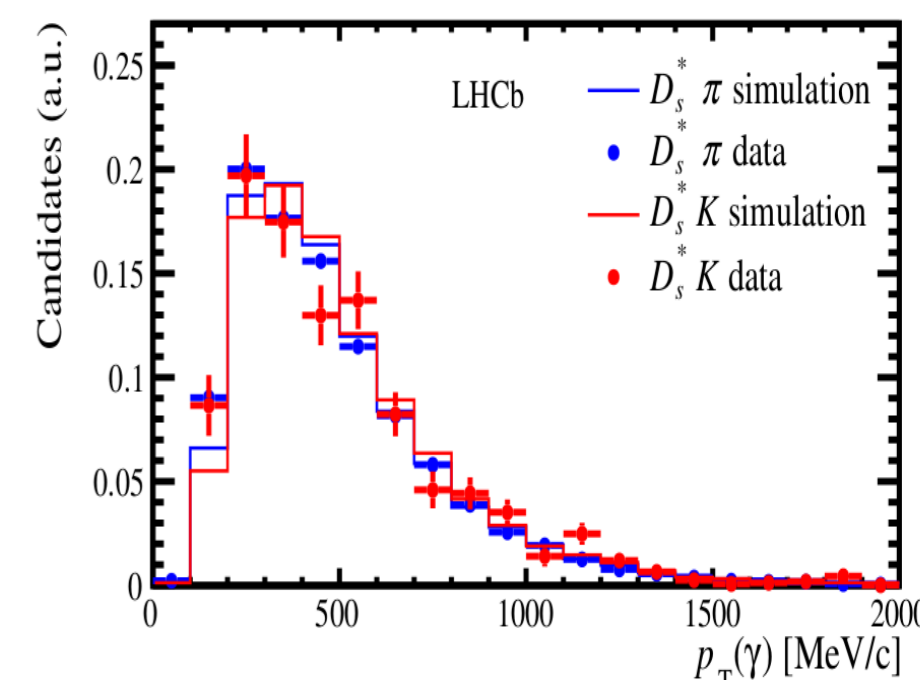
$\Delta_M = M(D_s^*) - M(D_s)$

SELECTION

→ D_s mesons are reconstructed through the decay $D_s \to K K \pi$.

→ D_s candidates are combined with a photon to form a D_s^*. A cut on the variable $\Delta_M = M(D_s^*) - M(D_s)$ is applied to reduce the combinatorial background due to fake photons.

→ Particle Identification requirements (PID) are applied to the final state "bachelor" hadron (K or π).

→ Finally a multivariate approach is applied to further reduce the combinatorial background.
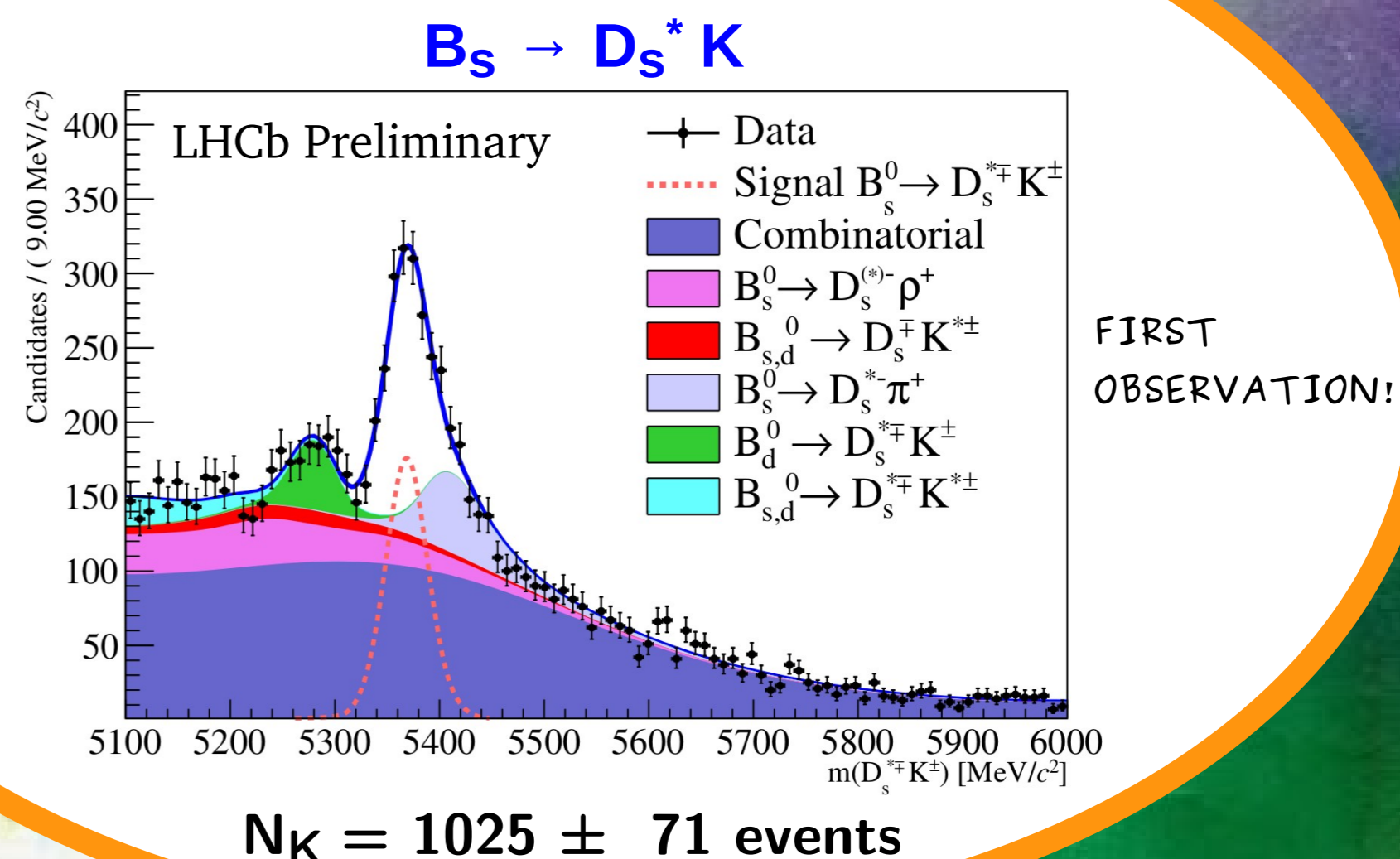
SOFT PHOTONS

Photons from $D_s^* \to D_s \gamma$: the P_T spectrum is obtained from the invariant mass fit using the *sWeight* technique.

INVARIANT MASS FIT: $B_s \to D_s^* \pi$

$N_{\pi} = 16513 \pm 227$ events

INVARIANT MASS FIT: $B_s \to D_s^* K$

FIRST OBSERVATION!

$N_K = 1025 \pm 71$ events
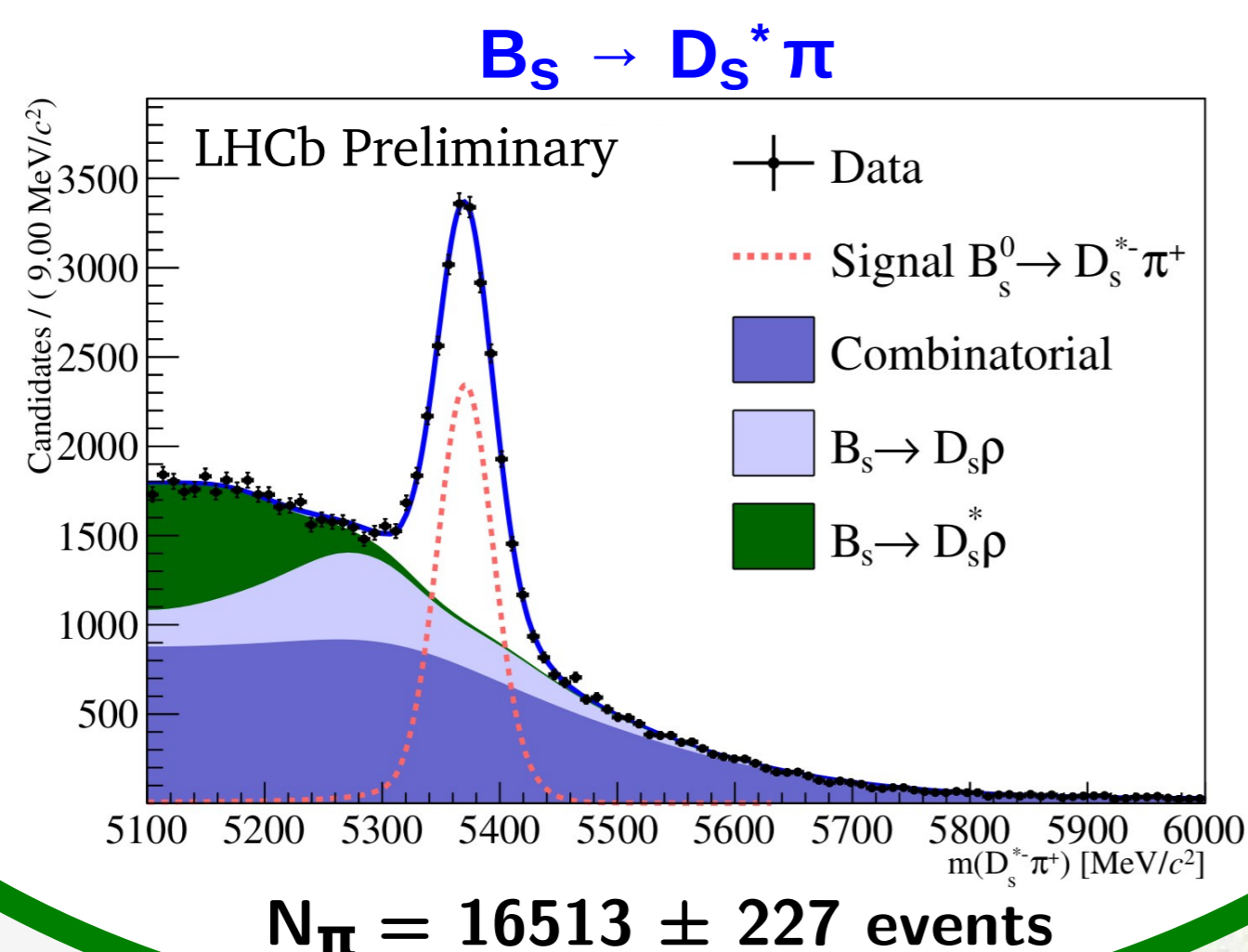
RESULTS

→ Our result is:
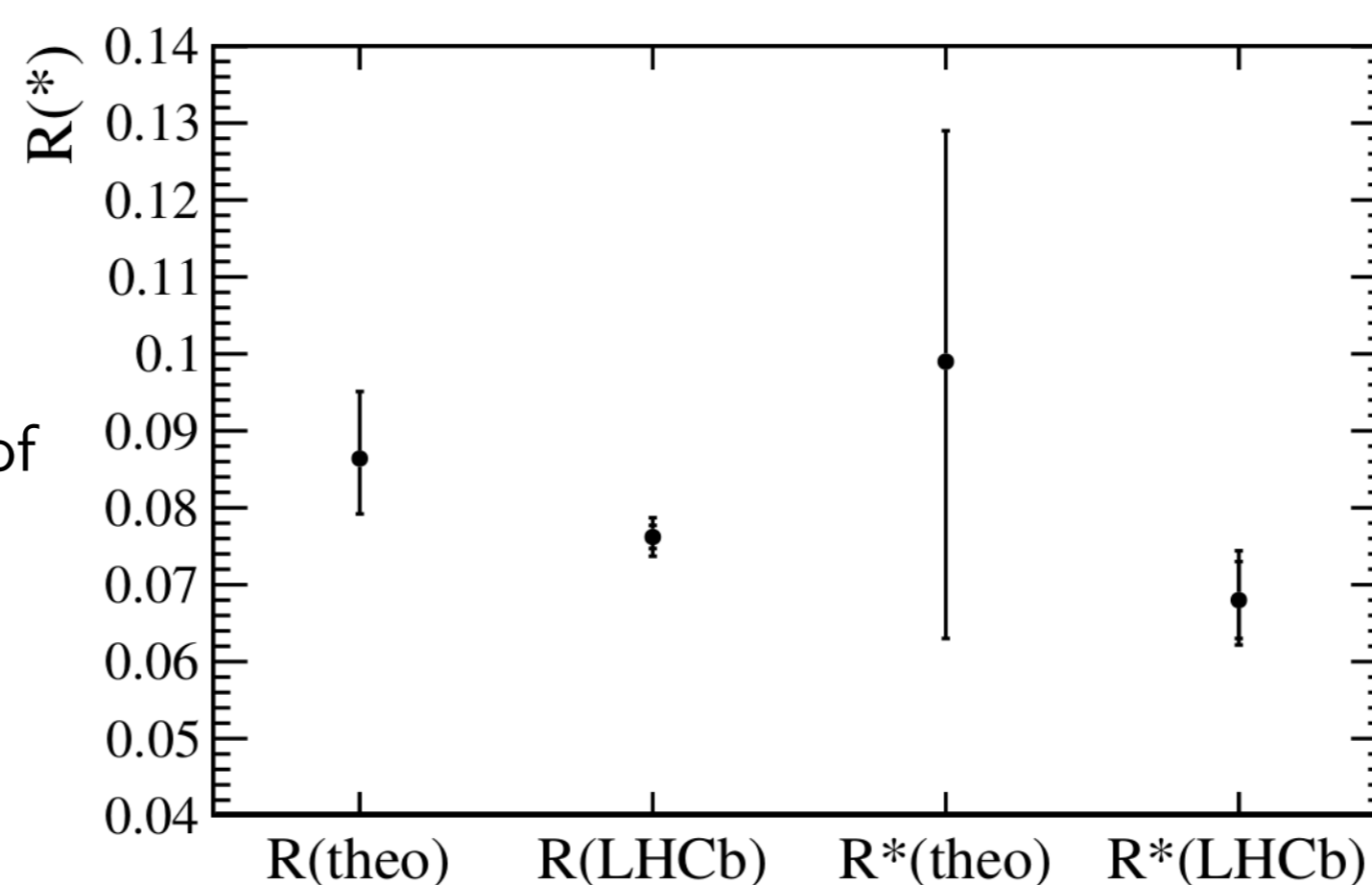
$$\mathcal{R}^* = 0.068 \pm 0.005 \,(\text{stat.}) \,^{+0.004}_{-0.003} \,(\text{sys.})$$

→ The value of R^* and the recently measured value of R [1] (analogous of R^* for $B^0_s \to D_s K$) are compared to the corresponding prediction [2].

→ Using the Belle measurement for $B^0_s \to D_s^* \pi$ [3]:

$$\mathcal{B}(B^0_s \to D_s^{*\mp} K^{\pm}) = 16.3 \pm 1.2 \,(\text{stat.}) \,^{+1.0}_{-0.7} \,(\text{sys.}) \pm 4.8 \,(\text{bf}) \times 10^{-5}$$

→ **This is the first step towards the measurement of time dependent CP asymmetry in these decays.**

REFERENCES

[1] LHCb collaboration, R. Aaij et al., *Determination of the branching fractions of $B^0_s \to D_s K$ and $B^0 \to D_s K$*, submitted to JHEP.

[2] K. De Bruyn et al., *Exploring $B_s \to D_s^{(*)} K$ decays in presence of a sizable width difference $\Delta\Gamma_s$*, Nucl. Phys. B868 (2012) 351.

[3] Belle collaboration, L. Louvot et al., *Observation of $B^0_s \to D_s^* \pi$, $B^0_s \to D_s^* \rho$, and measurement of $B^0_s \to D_s^* \rho$ polarization*, Phys. Rew. Lett. (104) 2010 231801.