1 Introduction

In the Standard Model (SM), the flavour-changing neutral current (FCNC) decay $A_b \rightarrow \Lambda \phi$ proceeds via a $b \rightarrow s$ penguin process. A Feynman diagram of the gluonic penguin process that contributes to this decay is given in Figure 1. This is therefore the same as the $B^0_s \rightarrow \phi \phi$ decay, which is a golden mode for the LHCb upgrade. New particles entering the penguin loop could induce non-SM $CP$ violation. In the $B^0_s \rightarrow \phi \phi$ decay, this is tested through the measurement of $CP$ violation in the interference between mixing and decay, characterised through the $CP$-violating phase, $\phi_s^{exs}$. An LHCb measurement of the phase has provided a value of $\phi_s^{exs} = -0.17 \pm 0.15 (\text{stat}) \pm 0.03 (\text{syst}) \text{ rad} [1]$. The SM can also be tested with triple product asymmetries, which also provide a measure of $CP$ violation [2]. For the case of the $B^0_s \rightarrow \phi \phi$ decay, which is a pseudo-scalar to vector vector transition, the triple product asymmetries exploit the helicity angles of the decay to isolate the interference terms between the $CP$-even and $CP$-odd polarisations. The two $CP$-even polarisations therefore allow for two triple product asymmetries, denoted by $A_U$ and $A_V$. An LHCb measurement of these triple product asymmetries has provided values of $A_U = 0.003 \pm 0.017 (\text{stat}) \pm 0.006 (\text{syst})$ and $A_V = 0.017 \pm 0.017 (\text{stat}) \pm 0.006 (\text{syst}) [1]$, that are currently limited by statistical uncertainties.

![Feynman diagram](image)

Figure 1: Gluonic penguin Feynman diagram contributing to the $A_b \rightarrow \Lambda \phi$ decay.

The decays of $A_b$ baryons are largely unexplored compared to those of $B$ mesons. While mixing phenomenology is not present in $A_b$ decays, a wealth of observables is present that allow for tests of SM predictions. These consist of branching fraction and polarisation measurements, in addition to triple product asymmetries.

A large polarisation has been measured for $A_b$ barons produced in $e^+e^-$ colliders [3, 4, 5], in line with theoretical predictions. Corresponding predictions of the polarisation of $A_b$ baryons at hadron colliders anticipate values between 10-20% [6, 7], though this can be diluted due to the small Feynman variable, $x_F = 2p_L/\sqrt{s}$, where $p_L$ is the longitudinal