Summary of *Update of the $B^0 \to K^{*0}\ \mu^+\ \mu^-$ angular analysis at LHCb*

Nils Breer

11. Juli 2020

The stated Process is of such importance because the $b \to s\mu\mu$ transition is forbidden at tree level due to FCNC. A study of this is preferebly done with indirect searches because the energy scales can be set much larger than in in direct searches, therefore new Physics(NP)is more accesible.

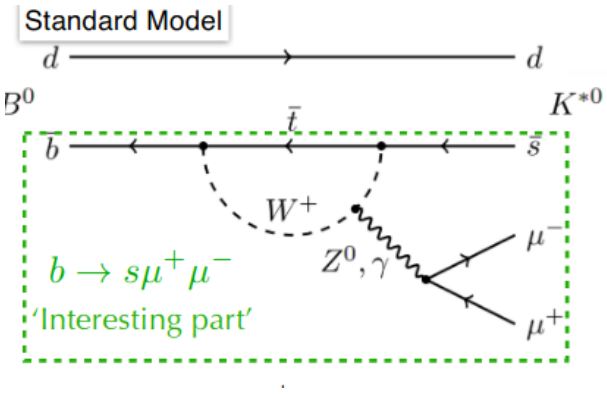

Abbildung 1: Process in standard model.

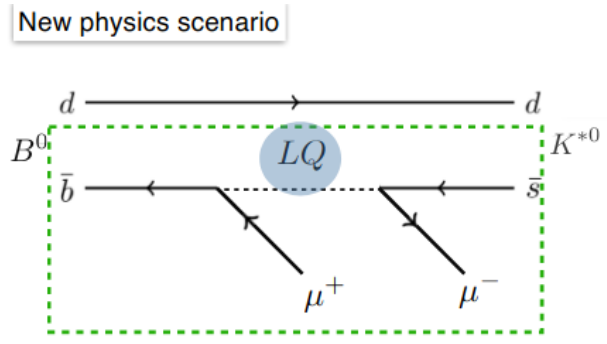

Abbildung 2: Process in new physics model.

In figure 2, instead of a suppressed loop via a W-boson which decays weak into a neutral gauge boson and then further into two muons, the NP model suggest a leptoquark as "gauge boson". Leptoquarks (mostly denoted as X- and Y-Boson) are particles postulate by the GIM model, which provides a way to change a quark into a lepton via the decay channel

$$X \to l^+ + \bar{\mathrm{D}}$$

1 transition in effective theory

Instead of calculating the well known transition via box diagram, we now factorize out the loops and replace them with an effective coupling (analogous to 4f coupling). This results in a 4-particle-vertex which is now described with Wilson coefficents with are sensitive to NP.
With these changes an effective Hamiltonian H_{eff} can be written as

$$H_{eff} = -\frac{4G_f}{\sqrt{2}} \mathrm{V}_{tb}\mathrm{V}_t s^* \sum_i (C_i \cdot O_i + C_i' \cdot O_i')$$

where C_i are the short ranged ilson coefficents which we ant to study. The O_i are the long distance, low energy QCD operators which follow the formfactors.

2 Angular Analysis

With the angular analysis we want to measure the decay rate of a process as a function of the final state decay angles, which are schematically shown in figure 3.
The three important angles are θ_k, θ_l and ϕ. Because the two leptons and the Kaon and Pion are produced in sort of opposite directions, θ_k is the angle between the Kaon and the vector sum of the Kaon and the Pion, which is the general flight direction. For θ_l it is the same argumentation but for the positive lepton and the fligh direction of the leptons.

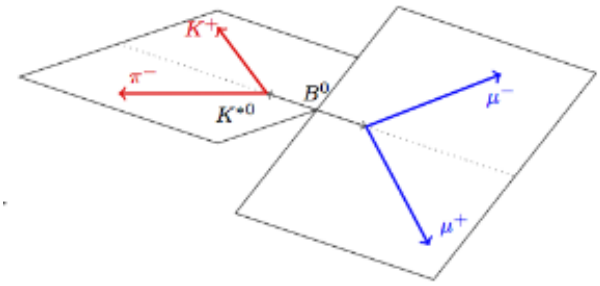

Abbildung 3: schematical image of decay angles.

In general, the leptons do not fly in the exact same direction, so their dircetion vector span a plane. This is also true for the Pion and the Kaon. The angle ϕ is the the angle between the normalvector of the K-π-plane and the μ-μ-plane. This analysis can give access to more observables with reduced uncertainties.