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B to K(*) $\mu^+\mu^-$: theory interpretation

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Rare B decays constitute one of the cornerstones of the searches for the fundamental theory beyond SM. One of the golden modes in this search is the 4-body angular distribution $B \rightarrow K^*(\rightarrow K\pi)\mu^+\mu^-$. Sometime ago we proposed a basis of optimized observables called P_i to fully describe this distribution and extract all the information from the Wilson coefficients. In 2013 LHCb presented the result of the measurement of our basis of optimized observables with 1fb^{-1} dataset finding a clear and coherent pattern of deviations in different observables, specially in the observable P_2 (3σ in the second bin) and P'_5 (4σ in the third bin, usually referred as “the anomaly”). We proposed a possible explanation of the observed deviations in terms of a new contribution to the Wilson coefficient C_9 of one of the semileptonic operators.

In this talk I will present the theoretical status of this analysis with particular emphasis on the recent progress in the understanding of different SM sources of hadronic uncertainties: factorizable and non-factorizable power corrections, charm-loop effects as well as S-wave contribution. I will detail how these new SM contributions can be computed in a systematic way and how they affect the observables. Using the symmetries of the distribution we will present new links and implications between the P_i observables that can help to disentangle hadronic from electroweak effects and open new directions in the search for New Physics. We will provide the most recent and precise theoretical predictions for the basis of optimized observables in the SM.

We will also present the analysis of other decay modes like $B^+ \rightarrow K^+\mu^+\mu^-$ and $B^0 \rightarrow K^0\mu^+\mu^-$ that nicely confirms the same deviation observed in $B \rightarrow K^*\mu^+\mu^-$. Finally we will discuss a possible explanation of the observed anomaly within a specific model.

Auteur principal: Prof. MATIAS, Joaquim (Universitat Autònoma de Barcelona)

Orateur: Prof. MATIAS, Joaquim (Universitat Autònoma de Barcelona)

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