# $B \to K^*\mu^+\mu^-$ Decays in the Standard Model and Beyond

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The rare decay $B \to K^*(\to K\pi)\mu^+\mu^-$ is regarded as one of the crucial channels for $B$ physics as the polarization of the $K^*$ allows a precise angular reconstruction resulting in many observables that offer new important tests of the Standard Model (SM) and its extensions.

In a recent paper [1] we have analysed all angular observables in the rare decay $B \to K^*(\to K\pi)\mu^+\mu^-$. They can be measured at the LHC and later at an upgraded Belle and a Super-B facility. These angular observables can be expressed in terms of CP-conserving and CP-violating quantities and offer new important tests of the SM and its extentions. To this end we have improved on previous studies in a number of ways.

Having identified angular observables with small to moderate dependence on hadronic quantities and large impact of New Physics we have analysed these observables first within the SM and subsequently within a number of its extentions like

- models with Minimal Flavour Violation,
- the flavour-blind minimal supersymmetric standard model (FBMSSM) with new flavour conserving, but CP-violating phases,
- the Littlest Higgs model with T-parity (LHT),
- a general MSSM with generic flavour violating soft terms.

Our model independent study shows that pseudoscalar operators are numerically irrelevant in the decay $B \to K^*\mu^+\mu^-$. On the other hand a study of the angular distributions allows, in a way which is theoretically clean and complementary to $B_s \to \mu^+\mu^-$, to probe the scalar sector of a theory beyond the SM.

Probably the most interesting results are found in the FBMSSM. In this framework, the Cabibbo-Kobayashi-Maskawa (CKM) matrix remains the only source of flavour violation, while new flavour conserving, but CP-violating phases are present in the soft sector. In the FBMSSM, several angular observables differ significantly, even by orders of magnitude from the SM results (see Fig. 1), and there exists a number of striking correlations among the observables discussed here and also correlations between the angular observables $A_7$ (and $A_8$) and the direct CP asymmetry in $b \to s\gamma$ and the time dependent CP asymmetries in the decays $B \to (\phi, \eta')K_S$.

As expected, in a general MSSM, the very large space of parameters does not allow for clear-cut conclusions. Almost all observables considered in our paper can significantly differ from the SM results and the pattern of deviations can differ from those found in the FBMSSM and LHT models. This should allow these three models to be distinguished from each other.

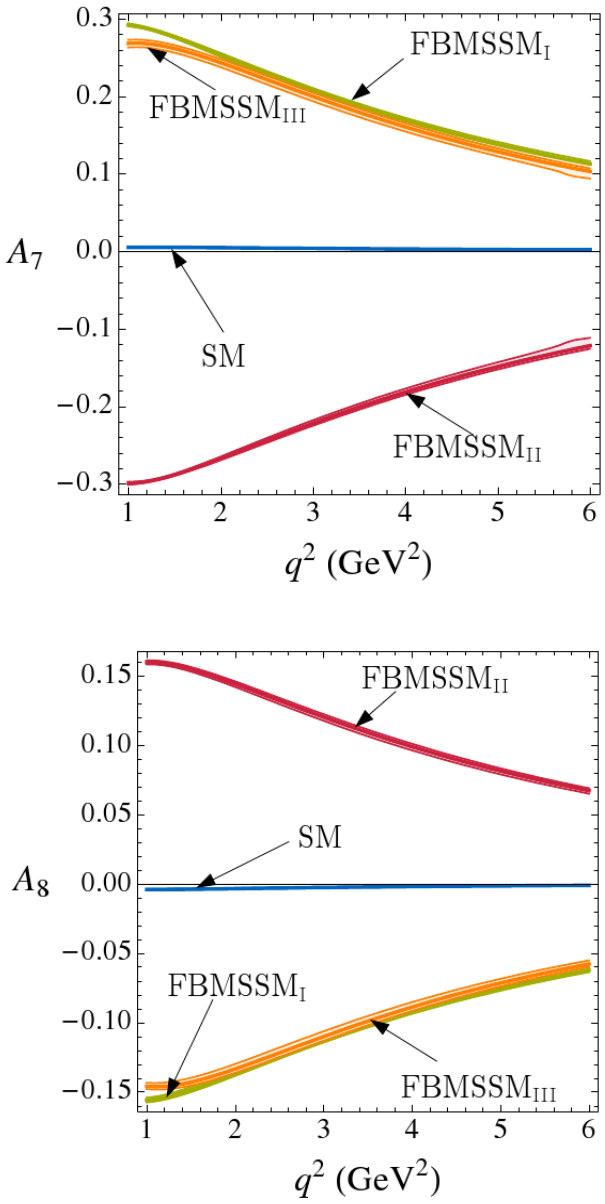


Fig. 1: The angular observables $A_7$ and $A_8$ as a function of the invariant mass $q^2$ of the lepton pair in the SM (blue band) and three FBMSSM scenarios.

Clearly, it will be very exciting to monitor the upcoming LHC, Belle upgrade and eventually Super-B factory in this and in the next decade to see whether the angular observables discussed in our paper will give a hint for any of the extensions of the SM.

## References

[1] W. Altmannshofer, P. Ball, A. Bharucha, A.J. Buras, D.M. Straub and M. Wick, JHEP **0901** (2009) 019 arXiv:0811.1214 [hep-ph].