

B-Mesogenesis

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The Standard Model (SM) remains the most stringently tested theory in physics, yet it leaves several open questions, including the nature of dark matter and the mechanism behind baryogenesis. Investigations of B-mixing and b-hadron lifetimes serves as a sensitive probe of QCD dynamics and offer an indirect window into BSM physics. The heavy quark expansion (HQE) expresses the total decay rate of b-hadrons as a series in inverse powers of the b-quark mass, allowing a systematic separation of short-distance Wilson coefficients from long-distance hadronic matrix elements.

In my project “Constraining B-mesogenesis models with inclusive and exclusive decays” (JHEP 08 (2025) 141) in collaboration with Prof. Dr. Alex Lenz and Ali Mohamed, I studied a BSM model where decays of B-mesons to a dark sector account for both dark matter and the baryon asymmetry. My roles included computing inclusive one and two loop contributions and interpreting exclusive decay constraints from BABAR. By comparing theory predictions for the inclusive and exclusive rates, we derived a novel lower bound on the couplings, indicating that the entire viable parameter space could be probed in future experiments.

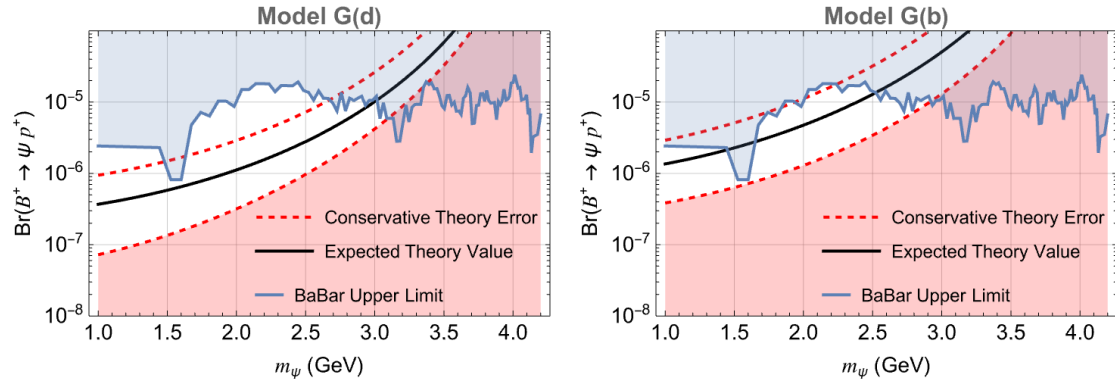


Figure 1: The red shaded region corresponds to the excluded region if one assumes the B mesogenesis model to work. The blue shaded region corresponds to the 90% CL excluded region from the BABAR upper limit of $\text{Br}(B^+ \rightarrow p^+ \psi)$. The remaining allowed region is given in white.

We also investigated the new physics effects of this model in the lifetime ratio $\tau(B^+)/\tau(B_d)$. However, the large uncertainty in the Standard Model value for this ratio is too large, making any constraints from this observable weak.