

NLO corrections to inclusive $\bar{B} \rightarrow X_s \gamma$ decays at subleading power

Theoretical predictions in hadron physics are often limited by non-perturbative uncertainties in QCD. Nevertheless, several phenomenologically important processes require improved theoretical control. Effective field theories, such as Soft-Collinear Effective Theory (SCET) and Heavy Quark Effective Theory (HQET), provide powerful tools to overcome these limitations by exploiting factorisation.

A particularly interesting class of observables arises in flavour physics, and in particular in inclusive $\bar{B} \rightarrow X_s \gamma$ decays. Among the resolved contributions to this process, the dominant theoretical uncertainty currently originates from the interference between the WET operators O_1 and O_7 , which corresponds to non-local subleading power corrections.

In this work, we derive a factorisation formula for the O_1 – O_7 interference that is suitable for the inclusion of perturbative α_s corrections. The factorised expression involves four distinct functions. We present explicit results for all of them, with particular emphasis on the renormalisation-group evolution of the shape function g_{17} , a generalised light-cone distribution amplitude depending on both light-cone directions, and the two-loop penguin jet function, which was computed fully analytically.

These ingredients complete the $\mathcal{O}(\alpha_s)$ corrections to the O_1 – O_7 interference. Moreover, they provide important insight into the technical structure of these higher-order corrections. These results are expected to be highly relevant for future precision studies at subleading power.

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