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Renormalization of the radiative jet function and its zero-bin subtraction

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We show how to compute directly the renormalization/evolution of the radiative jet function that appears in the factorization theorems for $B \to \gamma\ell\nu$ and $H \to \gamma\gamma$ through a b-quark loop. We point out that, in order to avoid double counting of soft contributions, one should use in the factorization theorems a subtracted radiative jet function, from which soft contributions have been removed. The soft-contribution subtractions are zero-bin subtractions in the terminology of soft-collinear effective theory. We show that they can be factored from the radiative jet function and that the resulting soft-subtraction function gives rise to a nonlocal renormalization of the subtracted radiative jet function. This is a novel instance in which zero-bin subtractions lead to a nonlocality in the renormalization of a subtracted quantity that is not present in the renormalization of the unsubtracted quantity. We demonstrate the use of our formalism by computing the order-α_s evolution kernel for the subtracted radiative jet function.

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