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# PHOKHARA at the frontier of NNLO

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Electron–positron annihilation into hadrons accompanied by an energetic photon provides a powerful tool to measure the hadronic cross-section across a broad energy range at high-luminosity flavour factories such as DAPHNE, CESR, PEP-II, KEK-B, SuperKEKB, and BESIII. The Monte Carlo event generator PHOKHARA has been widely used and simulates this process with next-to-leading order (NLO) accuracy, incorporating both virtual and soft photon corrections for single-photon emission, as well as events with two hard real photons. In this talk, we present recent progress in extending PHOKHARA towards next-to-next-to-leading order (NNLO) precision. The discussion is divided into two parts: (i) we revisit the radiative return process $e^+e^- \to \pi^+\pi^-\gamma$, refining the hadronic current by incorporating the Generalised Vector Dominance Model (GVDM) as an improvement over the standard scalar QED (sQED) approximation; and (ii) we outline the preliminary evaluation of two-loop scattering amplitudes that form the building blocks of full NNLO predictions. The results presented build upon those discussed in https://arxiv.org/abs/2410.22882.

## Secondary track

T05 - QCD and Hadronic Physics

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