The `BabaYaga@NLO` event generator

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in collaboration with
the historical (since ∼25 years) authors
C.M. Carloni Calame, G. Montagna, O. Nicrosini
plus young fellows:
G. Balossini, L. Barzè, C. Bignamini, E. Budassi, M. Ghilardi, A. Gurgone, F.P. Ucci

Main references

- E. Budassi et al., arXiv:2409.03469   BabaYaga@NLO for $e^+e^- \to \pi^+\pi^-$

- C.M. Carloni Calame et al., Phys. Lett. B **798** (2019) 134976   BabaYaga@NLO
  EW corrections at high energies for $e^+e^- \to \gamma\gamma$

- L. Barzè et al., Eur. Phys. J. C **71** (2011) 1680   BabaYaga with dark photon

- G. Balossini et al., Phys. Lett. **663** (2008) 209   BabaYaga@NLO for $e^+e^- \to \gamma\gamma$

- G. Balossini et al., Nucl. Phys. **B758** (2006) 227   BabaYaga@NLO for Bhabha

- C.M. Carloni Calame et al., Nucl. Phys. Proc. Suppl. **131** (2004) 48
  BabaYaga for $\mu^+\mu^-$, $\gamma\gamma$, $\pi^+\pi^-$

- C.M. Carloni Calame, Phys. Lett. B **520** (2001) 16   improved PS BabaYaga

- C.M. Carloni Calame et al., Nucl. Phys. B **584** (2000) 459   BabaYaga

- ⋆ In the last ~20 years `BabaYaga/BabaYaga@NLO` has been developed for high-precision luminometry at flavour factories

- ⋆ It simulates QED processes
  - ↪ $e^+e^- \to e^+e^-$ $(+n\gamma)$
  - ↪ $e^+e^- \to \mu^+\mu^-$ $(+n\gamma)$
  - ↪ $e^+e^- \to \gamma\gamma$ $(+n\gamma)$

  with multiple-photon emission in a QED Parton Shower framework, matched with exact NLO matrix elements

- ⋆ A theoretical precision at the 0.5×10^{-3} level is achieved (at least for Bhabha), with a systematic comparison to independent calculations/codes and assessing the size of missing higher-order corrections (part of the $\mathcal{O}(\alpha^2 L)$ contributions)

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- ⋆ future improvements
  - ⋆ addition of pion final state

Pion pair production in e^+e^- annihilation at next-to-leading order matched to Parton Shower

Ettore Budassi,[a,b] Carlo M. Carloni Calame,[b] Marco Ghilardi,[a] Andrea Gurgone,[a,b]
Guido Montagna,[a,b] Mauro Moretti,[c,d] Oreste Nicrosini,[b] Fulvio Piccinini,[b] and
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- NLOPS in sQED
- pion form factor in three approaches

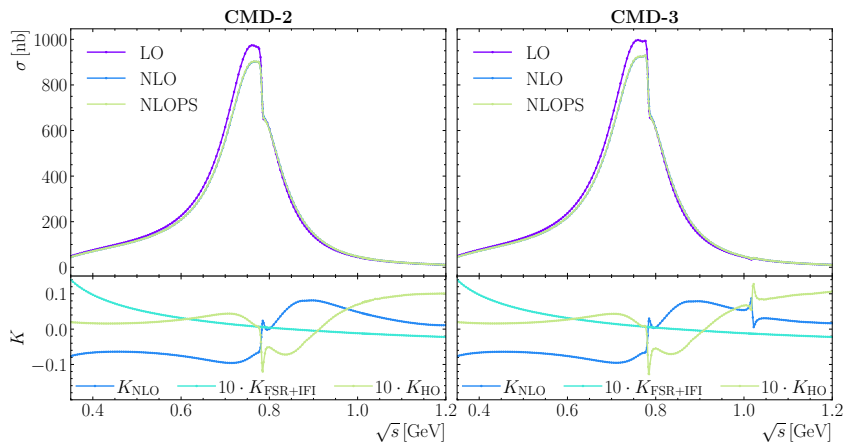## Pion pair production in e^+e^- annihilation at next-to-leading order matched to Parton Shower

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- NLOPS in sQED
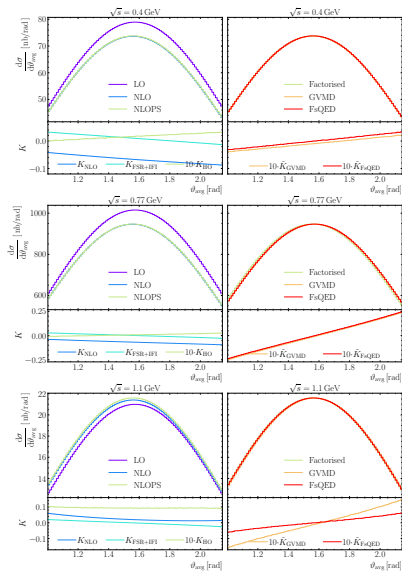- pion form factor in three approaches
  - F×sQED
  - GVMD
  - FsQED

arXiv:2409.03469

Extension to di-pion final state
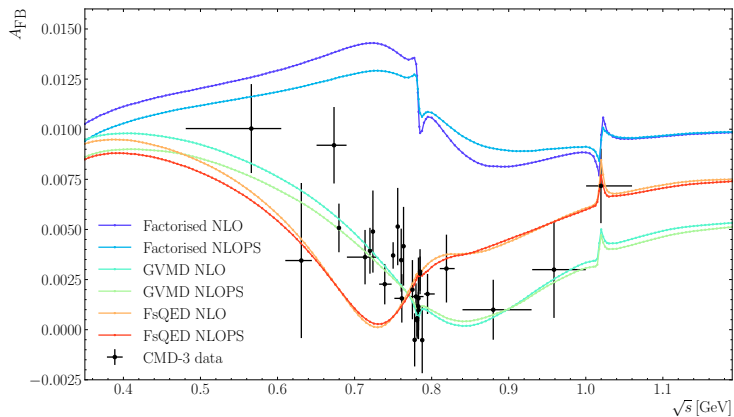
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- NLOPS accuracy for radiative signatures
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- first preliminary NLO results for $e^+e^- \to \mu^+\mu^-\gamma$ and $e^+e^- \to e^+e^-\gamma$

  (KLOE-I event selection of arXiv:2410.22882)