

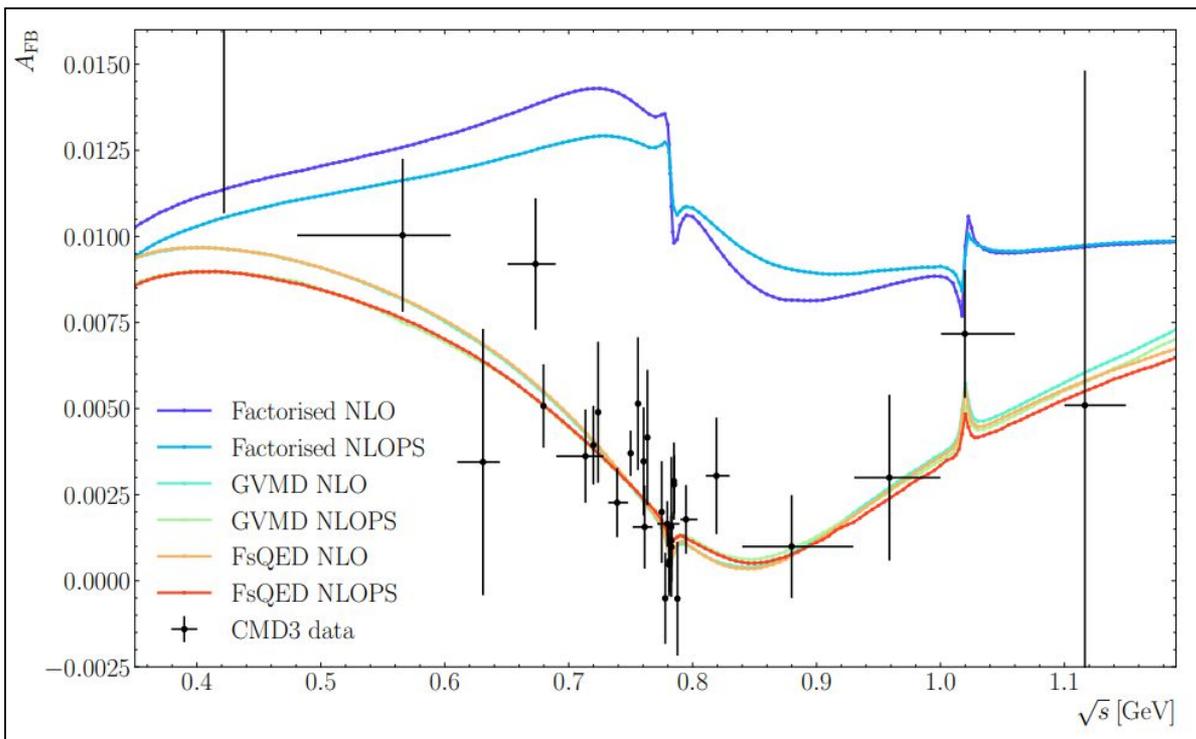
Radiative return meets GVMD

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In collaboration with O. Shekhovtsova,
W.J.Torres Bobadilla, based on [2603.13171]



Motivation – The energy scan case



In $e^+e^- \rightarrow \pi^+\pi^-$, we use FxsQED, but

- **Disagreement** between CMD3 data and MC predictions for the forward-backward asymmetry.
- Need for **improved MC**, including models like GVMD and FsQED.
- What happens in $e^+e^- \rightarrow \pi^+\pi^-\gamma$?

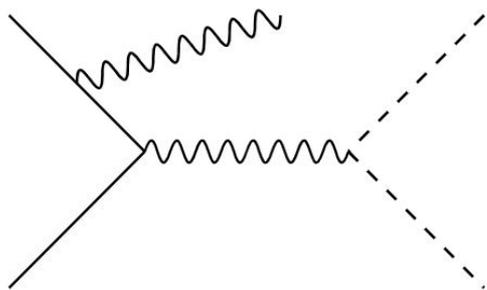
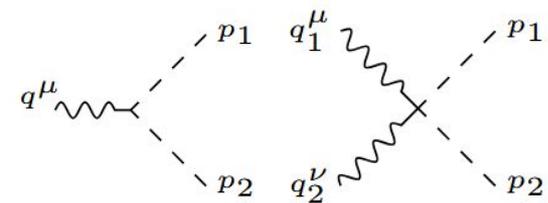
FxsQED

vs

GVMD

vs

FsQED



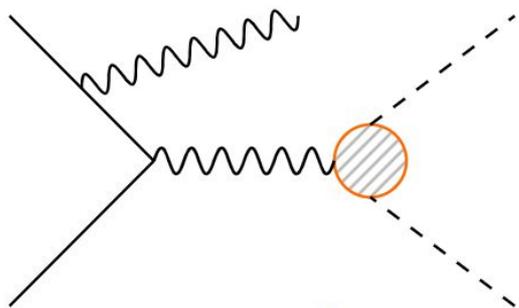
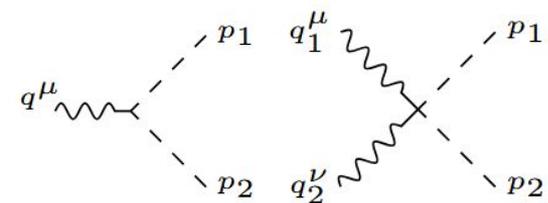
FxsQED

vs

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$F_\pi(q^2)$

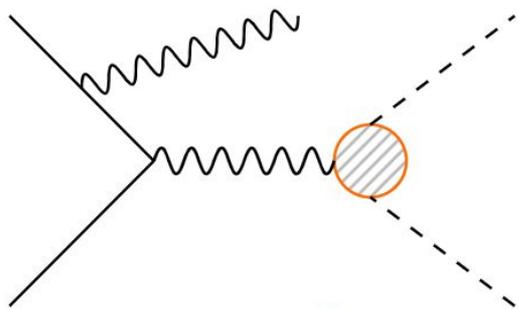
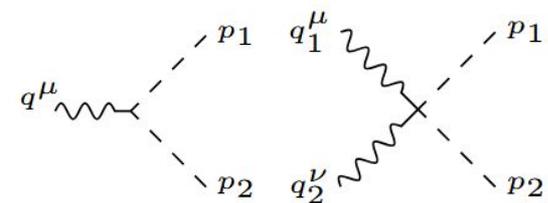
FxsQED

vs

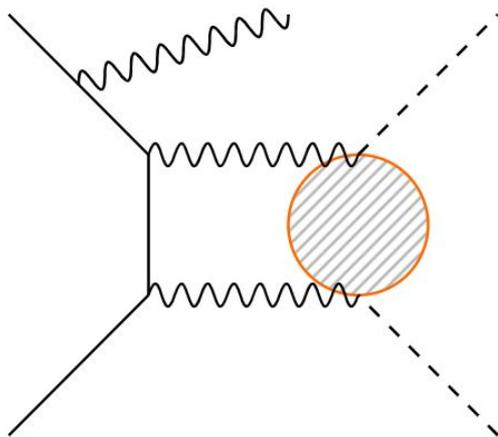
GVMD

vs

FsQED



$$F_\pi(q^2)$$



?

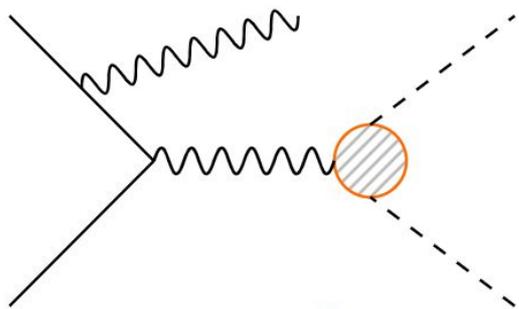
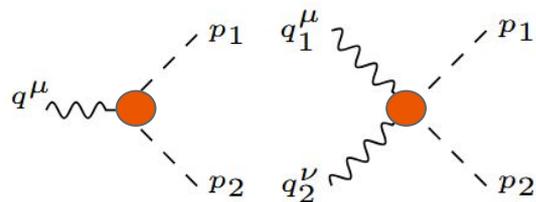
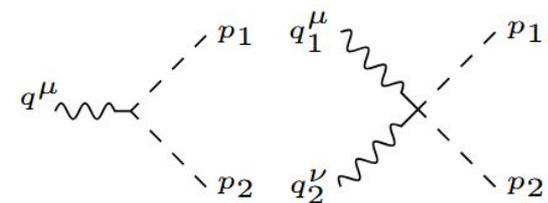
FxsQED

vs

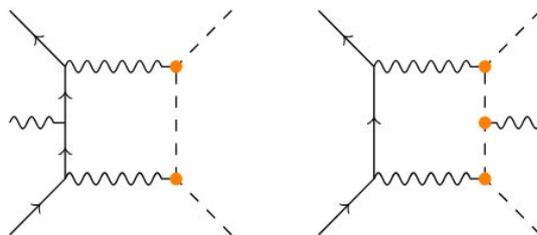
GVMD

vs

FsQED



$$F_\pi(q^2)$$



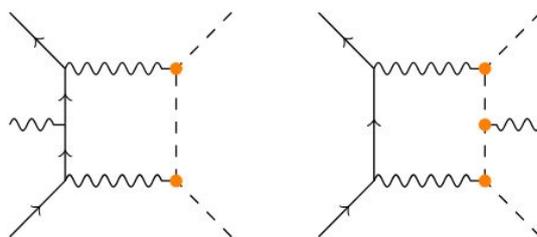
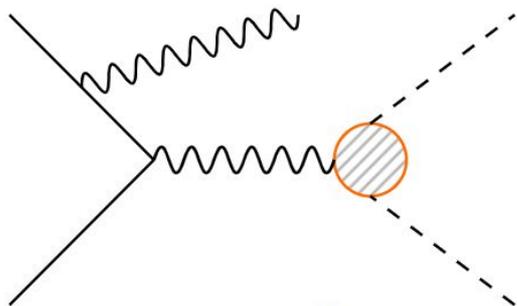
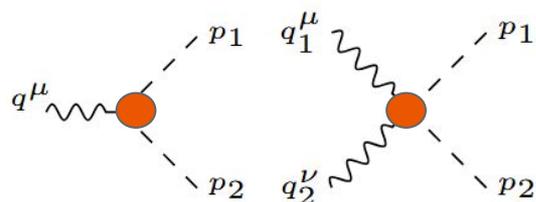
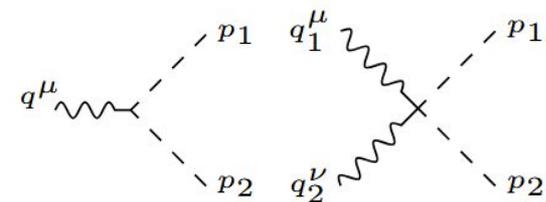
FxsQED

vs

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vs

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$$F_\pi(q^2)$$

$$\sum_v a_v \left(1 + \frac{q^2}{\Lambda_v - q^2} \right)$$

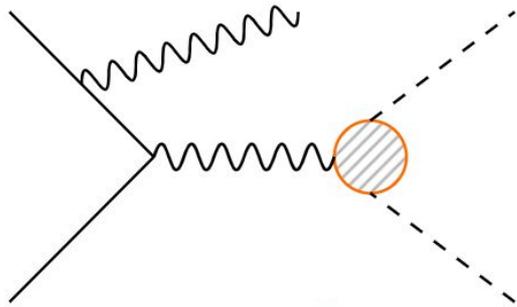
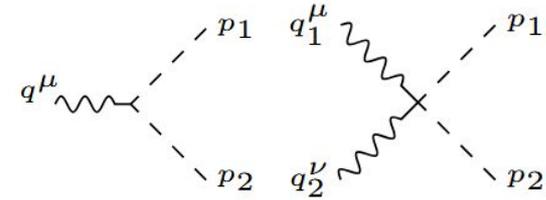
FxsQED

vs

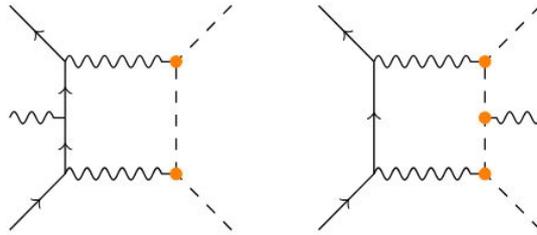
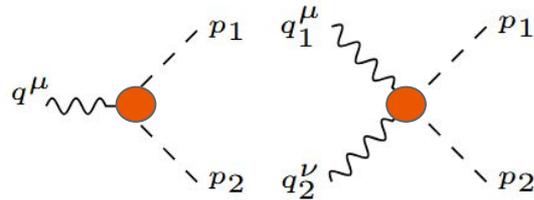
GVMD

vs

FsQED



$$F_\pi(q^2)$$



$$\sum_v a_v \left(1 + \frac{q^2}{\Lambda_v - q^2} \right)$$

$$1 + \frac{q^2}{\pi} \int_{4m_\pi^2}^{\infty} \frac{ds'}{s'} \frac{\text{Im} F_\pi(s')}{s' - q^2 - i\epsilon'}$$

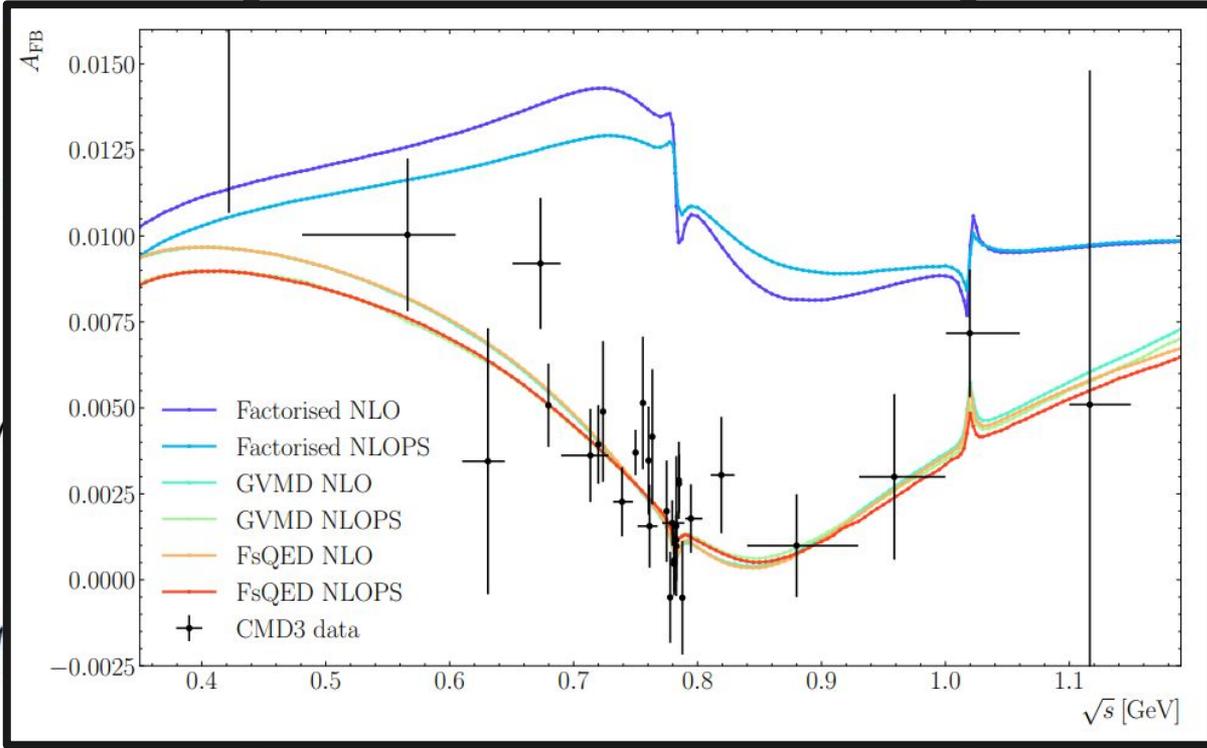
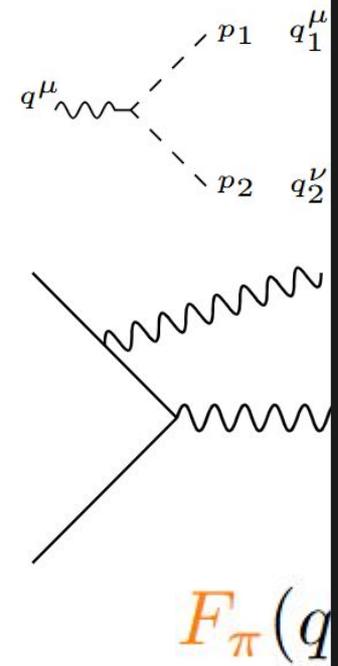
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GVMD

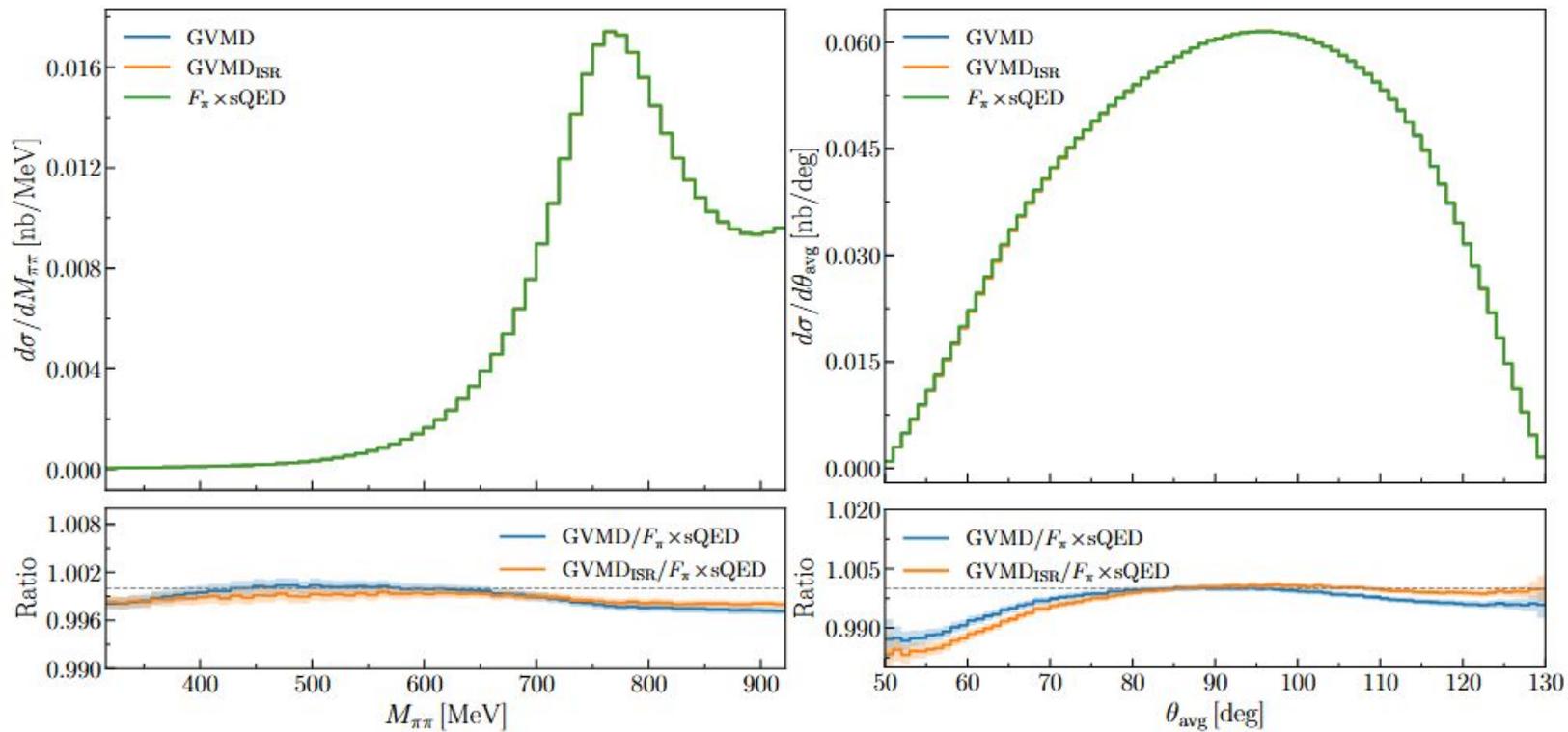
vs

FsQED

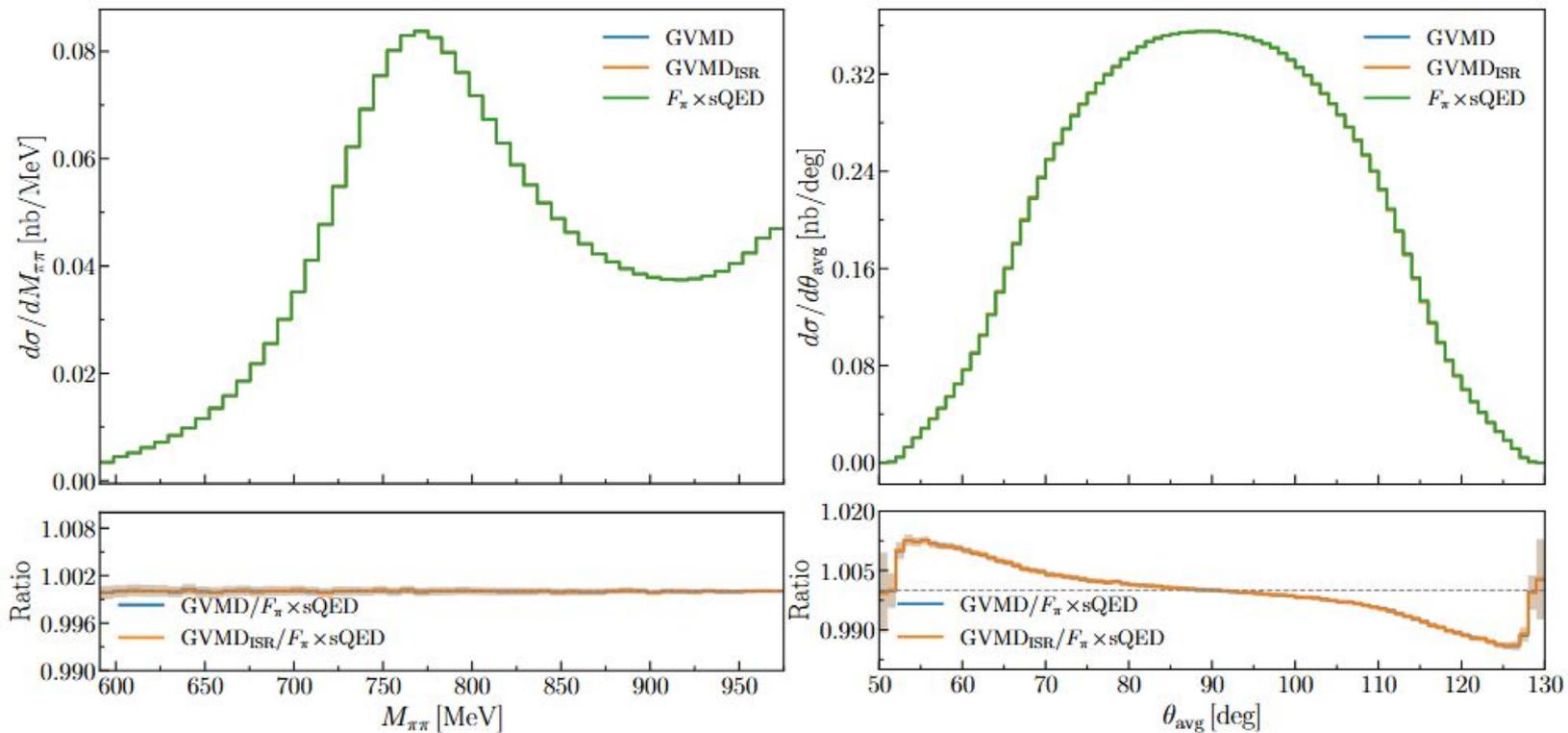


$$\frac{d}{ds'} \frac{\text{Im} F_\pi(s')}{s' - q^2 - i\epsilon'}$$

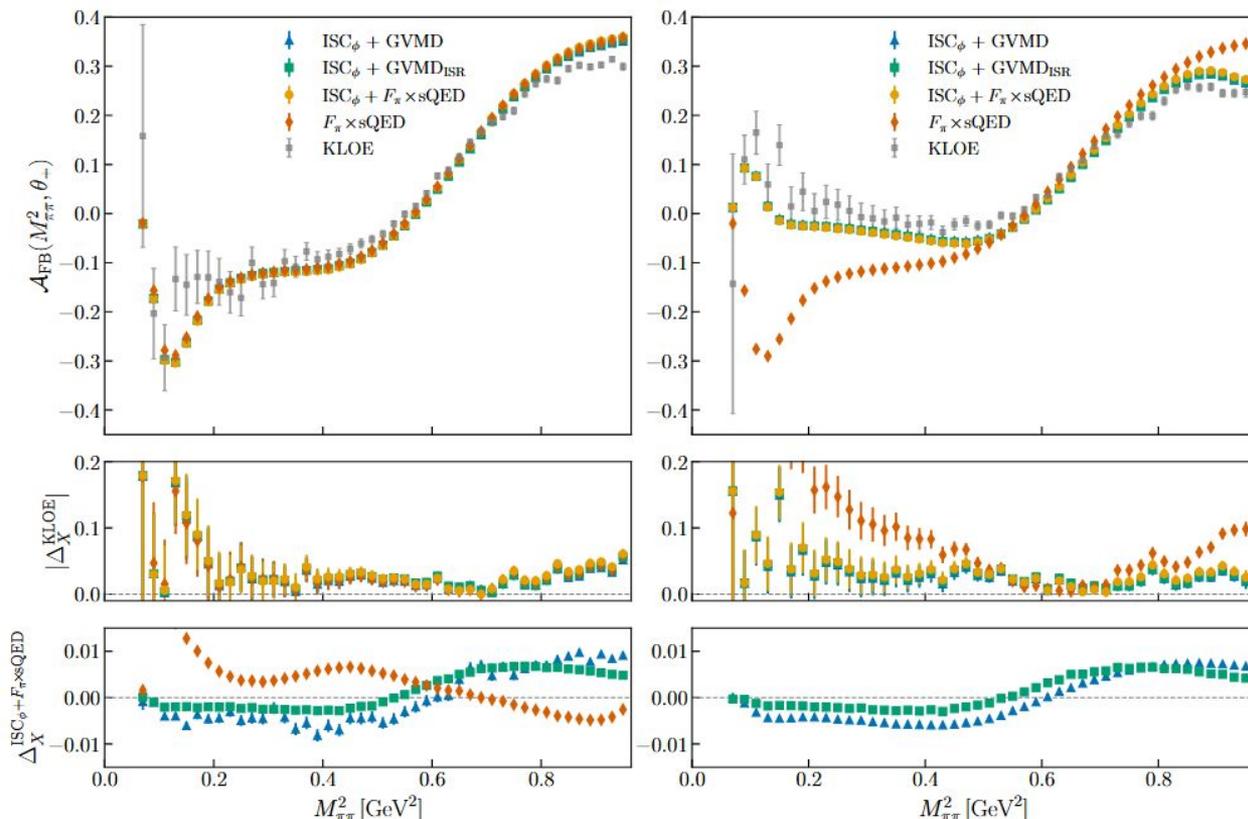
KLOE large angle



KLOE small angle



KLOE forward–backward asymmetry



Open questions

- How can we improve the modeling of the forward–backward asymmetry?
- Will GVMD differ from FsQED?
- Is the model actually better at describing KLOE data?
- What about applying GVMD to FSR?
- Can we give a theoretical error estimate steaming from pion modelling?

THANKS!