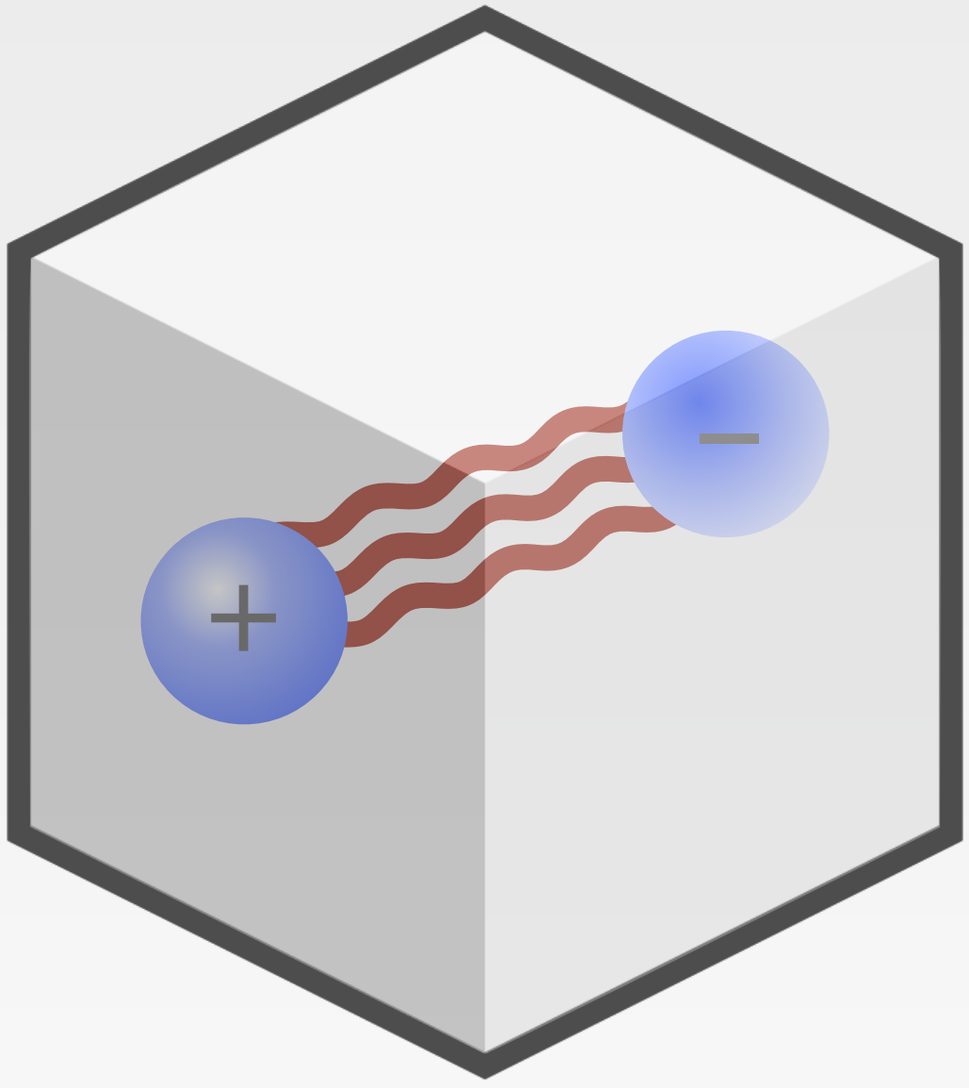

Electromagnetic finite-size effects on the two-pion contribution to the HVP

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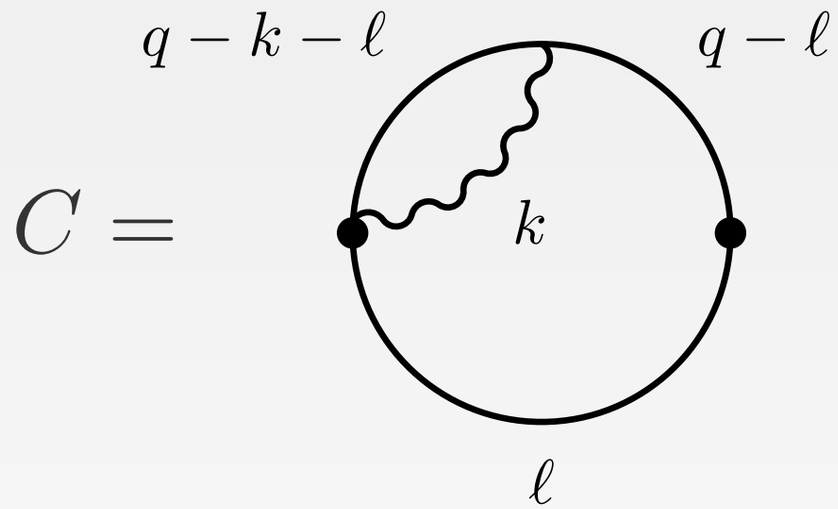
THE UNIVERSITY *of* EDINBURGH

Main results

[Bijnens et al., PRD 100(1), 014508, 2019]

- Because of off-shellness, at worse $1/(M_\pi L)^2$ effects.
- Because of neutrality, actually $1/(M_\pi L)^3$.
- Proved in the full theory through properties of EM and LbL form factors. Checked w/ 2-loop scalar QED.
- Impact: for $M_\pi L > 4$, less than 2% on $\mathcal{O}(\alpha)$ contribution; expect $0.1 \text{ — } 0.01 \times 10^{-10}$ on a_μ^{HVP} .

Explicit example



$$\Delta\Pi_C(z) = \frac{c_1\left[\sqrt{z(z+4)} + (z+4)\log(2) - (z+4)\log\left(\sqrt{z}+\sqrt{z+4}\right)\right]}{32\pi^3 L^2 m^2 \sqrt{z^3(z+4)}}$$
$$- \frac{z\left(3z - 8\sqrt{z+4} + 12\right) - 8\sqrt{z+4} - \frac{96}{\sqrt{z+4}} + 64}{384\pi L^3 m^3 z^3} + \cdots$$

In case this is a worry

- $1/(M_\pi L)^3$ can probably be determined analytically, but need lattice input for $q^2 = 0$ form factors and derivatives.

- Bigger problem: at $M_\pi L \sim 4$, $1/(M_\pi L)^3 \sim e^{-M_\pi L}$ numerically, so power corrections not enough.

- Previous point: infinite-volume lattice methods won't help much as they only remove the power part.

- Ultimately 2-3 lattice volumes at physical masses might be necessary, or one $M_\pi L \gg 4$.

Thank you!

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