Final–state radiation in electron–positron annihilation into pion pair

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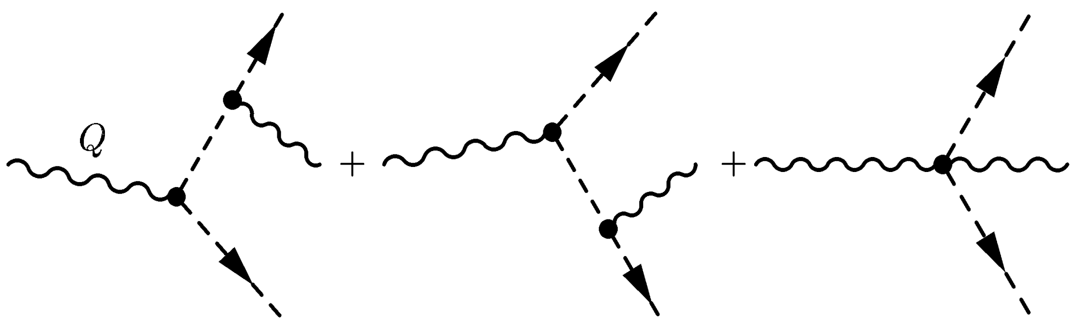
- $(g-2)_\mu$: hadronic contribution is the main source of uncertainty in theoretical calculations

- Radiative return in meson factories:

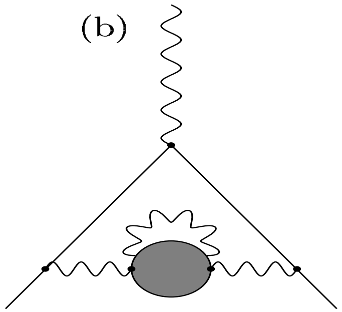
$$\frac{d\sigma(e^+e^- \to \pi^+\pi^-\gamma)}{dq^2} = H(q^2)\sigma(e^+e^- \to \pi^+\pi^-)$$

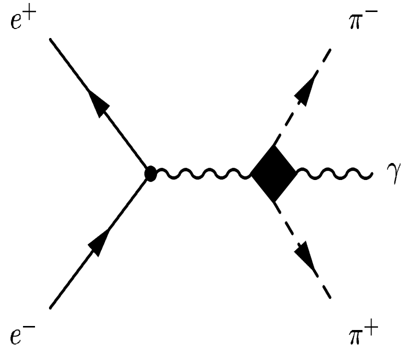
is questionable with FSR photon, FSR is unavoidable background to radiative return $\to$ suppress FSR or subtract FSR (model–dependent) $\leftarrow$ asymmetry test

- FSR in the framework of scalar Quantum Electrodynamics (sQED)

$F_\pi(Q^2)\times$ 

- NLO hadronic contribution is of experimental accuracy $a_\mu^\gamma \sim 4.3 \times 10^{-10}$





- Chiral Perturbation Theory with vector $\rho(770)$ and $a_1(1260)$

$$
\begin{aligned}
L = & \; ieB^\mu(\pi^-\partial_\mu\pi^+ - \pi^+\partial_\mu\pi^-) + e^2 B_\mu B^\mu \pi^+\pi^- + e\frac{F_V}{2}F^{\mu\nu}\rho^0_{\mu\nu}(1 - \frac{\pi^+\pi^-}{f_\pi^2}) \\
& + i\frac{G_V}{f_\pi^2}\rho^0_{\mu\nu}(\partial^\mu\pi^+\partial^\nu\pi^- - \partial^\mu\pi^-\partial^\nu\pi^+) + ie\frac{F_A}{2f_\pi}F^{\mu\nu}(a^+_{1\mu\nu}\pi^- - a^-_{1\mu\nu}\pi^+) \\
& + e\frac{G_V}{f_\pi^2}\rho^0_{\mu\nu}[B^\mu(\pi^+\partial^\nu\pi^- + \pi^-\partial^\nu\pi^+) - B^\nu(\pi^+\partial^\mu\pi^- + \pi^-\partial^\mu\pi^+)].
\end{aligned}
$$

The process of e^+e^- annihilation into $\pi^+\pi^-$ pair with radiation of the photon is considered. The amplitude of the reaction $e^+e^- \to \pi^+\pi^-\gamma$ consists of the model independent initial-state radiation (ISR) and model dependent final-state radiation (FSR). The general structure of the FSR tensor is constructed from Lorentz covariance, gauge invariance and discrete symmetries in terms of the three invariant functions. To calculate these functions we apply Chiral Perturbation Theory (ChPT) with vector and axial-vector mesons. Prediction of ChPT and the dominant contribution in sQED are compared.