The 38th International Symposium on Lattice Field Theory

LATTICE 21

JULY 26-30 2021, ZOOM/GATHER@MIT

Contribution ID: **47** Type: **Oral presentation**

# Comparison of lattice QCD+QED predictions for radiative leptonic decays of light mesons with experimental data

*Wednesday, 28 July 2021 05:15 (15 minutes)*

We present a comparison of existing experimental data for the radiative leptonic decays $P \to \ell\nu_\ell\gamma$, where $P = K$ or $\pi$ and $\ell = e$ or $\mu$, from the KLOE, PIBETA, E787, ISTRA+ and OKA collaborations performed in Ref. [1] using the theoretical predictions based on the recent non-perturbative determinations of the structure-dependent vector and axial-vector form factors, $F_V$ and $F_A$ respectively, obtained in Ref. [2]. These were obtained using lattice QCD+QED simulations at order $O(\alpha_{\rm em})$ in the electromagnetic coupling.
We find good agreement with the KLOE data on $K \to e\nu_e\gamma$ decays from which the form factor $F^+ = F_V + F_A$ can be determined. For $K \to \mu\nu_\mu\gamma$ decays we observe differences of up to 3 - 4 standard deviations at large photon energies between the theoretical predictions and the data from the E787, ISTRA+ and OKA experiments and similar discrepancies in some kinematical regions with the PIBETA experiment on radiative pion decays.
A global study of all the kaon-decay data within the Standard Model results in a poor fit, largely because at large photon energies the KLOE and E787 data cannot be reproduced simultaneously in terms of the same form factor $F^+$. The discrepancy between the theoretical and experimental values of the form factor $F^- = F_V - F_A$ is even more pronounced.These observations motivate future improvements of both the theoretical and experimental determinations of the structure-dependent form factors $F^+$ and $F^-$, as well as further theoretical investigations of models of "new physics" which might for example, include possible flavor changing interactions beyond $V - A$ and/or non-universal corrections to the lepton couplings.

[1] R. Frezzotti et al., Phys. Rev. D103 (2021) no.5, 053005 [arXiv:2012.02120 [hep-ph]].

[2] A. Desiderio et al., Phys. Rev. D103 (2021) no.1, 014502 [arXiv:2006.05358 [hep-lat]]

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**Session Classification:** QCD in searches for physics beyond the Standard Model

**Track Classification:** QCD in searches for physics beyond the Standard Model