Weak Form Factors from Rare K^+ Decays and Tests of Chiral QCD Perturbation Theory Predictions

Peter Truöl

Physik-Institut, Universität Zürich, CH-8057 Zürich, Switzerland
for the BNL-E865 collaboration[1]

Experiment E865 at the Brookhaven AGS [1] was set up primarily to search for the lepton flavor violating decay $K^+ \to \pi^+\mu^+e^-$ $(K_{\pi\mu e})$ [2] with more than an order of magnitude increased sensitivity. The flexibility of the apparatus allowed also to obtain high statistics event samples on the following decay modes, where existing data were scarce:

$$\pi^+e^+e^- \ (K_{\pi ee}) \ [3]; \ \pi^+\mu^+\mu^- \ (K_{\pi\mu\mu}) \ [4];$$

$$\pi^+\pi^-e^+\nu_e \ (K_{e4}) \ [5]; \ \mu^+e^+e^-\nu_\mu; \ e^+e^+e^-\nu_e \ (K_{\ell\nu\gamma^*}) \ [6]$$

From the $K_{\pi\mu\mu}$ and the K_{e4} data considerably reduced upper limits for other lepton flavor violating decay modes like $\pi^+e^+\mu^-$, $\pi^-\mu^+e^+$, $\pi^-\mu^+\mu^+$, and $\pi^-e^+e^+$ [7] were extracted, too.
The analysis of the flavor changing neutral current decays $K_{\pi ee}$ and $K_{\pi\mu\mu}$, of the radiative decays $K_{\ell\nu\gamma^*}$ and of the low branching ratio K_{e4} has allowed to extract form factors of the weak hadronic currents, which may be compared to a variety of recent chiral QCD perturbation theory predictions (ChPT), or even serve as input quantities for the parameters of the ChPT-Hamiltonian. The s-wave $\pi\pi$ scattering length determined in K_{e4} decay is the most prominent example for a key quantity for which ChPT predictions exist.

References

[1] R. Appel *et al.*, Nucl. Instr. Meth. **A479** (2002), 349.
[2] R. Appel *et al.*, Phys. Rev. Lett. **85** (2000), 2450.
[3] R. Appel *et al.*, Phys. Rev. Lett. **83** (1999), 4482.
[4] H. Ma *et al.*, Phys. Rev. Lett. **84** (2000), 2580.
[5] S. Pislak *et al.*, Phys. Rev. Lett. **87** (2001), 221801-1.
[6] A.A. Poblaguev *et al.*, subm. to Phys. Rev. Lett. (2002), hep-ex/0204006.
[7] R. Appel *et al.*, Phys. Rev. Lett. **85** (2000), 2877.

[1]R. Appel[4], G.S. Atoyan[8], B. Bassalleck[7], D.R. Bergmann[4], N. Cheung[3], S. Dhawan[4], H. Do[4], J. Egger[2], S. Eilerts[7], W.D. Herold[2], V.V. Issakov[8], H. Kaspar[2,4], D.E. Kraus[3], D.M. Lazarus[1], P. Lichard[3], J. Lowe[7], J. Lozano[4], H. Ma[1], W. Menzel[5], S. Pislak[6,4], A.A. Poblaguev[8], P. Rehak[1], Alexandre Sher [3], Aleksey Sher [6], J.A. Thompson[3], P. Truöl[6,4], M.E. Zeller[4]
BNL[1] - NEW MEXICO[7] - PITTSBURGH[3] - YALE[4] - INR MOSCOW[8] - BASEL[5] - PSI[2] - ZÜRICH[6]