$K^{\pm}$ decay Measurements @J-PARC: Some comments

stopped and quasi-stopped kaon beams

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Rare Kaon decays- Why one wants to study them?

1. Searches for explicit violation of the Standard Model
2. Measurement of Standard Model parameters
3. Searches for CP violation
4. Studies of strong interactions at low energy

PDG(2004)

Diverse kaon decays besides the gold plated $\pi\nu\nu$ branchings.

We concentrate on 3 &4.

Several decays probe CP and T Violations in $K^{\pm}$ decays

Decay mode	Branching	Observable	FSI	Models
$K_{\mu 3}$	3.3%	P-T	$<10^{-5}$	10^{-3}
$K_{\mu 2\gamma}$	0.55%	P-T	$\sim 5 \times 10^{-4}$	$\sim 10^{-2}$
$K_{\mu 3\gamma}$	0.006%	Asym*	$<3 \times 10^{-4}$	
$K_{e3\gamma}$	0.026%	Asym*	$< 10^{-4}$	

*Asymmetry

$$A_{\xi} = \frac{N_{+} - N_{-}}{N_{+} + N_{-}}$$

$$\xi = \hat{p}_{\gamma} \cdot \left[\hat{p}_{\pi} \times \hat{p}_{l} \right]$$

Hadronic decays as tests of CP violation

$$K^{\pm} \rightarrow \pi^{\pm}\,\pi^{0}\pi^{0}$$
$$\rightarrow \pi^{\pm}\,\pi^{+}\pi^{-}$$

$$|M|^2 \propto 1 + g.u + h.u^2 + k.v^2$$

g,h,k are coefficients and u, v are kinematic factors.

If CP is good, g,h,k are identical for $K^{\pm}$

$$A_g = \frac{g^+ - g^-}{g^+ + g^-}$$

Models $A_g < 10^{-4}$

Expt: $(-7 \pm 5) \times 10^{-3}$ (~1970)

Likely improvement in NA48

CP tests in Radiative decays

$K^{\pm} \to \pi^{\pm} \gamma\gamma$

$\Delta\Gamma = \Gamma(K^{+} \to \pi^{+} \gamma\gamma) - \Gamma(K^{-} \to \pi^{-} \gamma\gamma)$

$$\frac{\Delta\Gamma(K^{\pm} \to \pi^{\pm} \gamma\gamma)}{2\Gamma(K^{\pm} \to \pi^{\pm} \gamma\gamma)} < 1 \times 10^{-3}$$

CHPT parameters in semi-leptonic and hadronic decays:

Scattering lengths in K_{l4} Decays
- Shimizu's talk

Scattering lengths in $K_{\pi 3}$ decays
- work in progress

Lagrangian coupling constants from variety of modes sensitive to Chiral anomaly terms etc.

$K^{\pm} \rightarrow \pi^{\pm} \gamma\gamma$

$K^{\pm} \rightarrow \pi^{\pm} \pi^{0}\gamma$

$K^{\pm} \rightarrow \pi^{\pm} \pi^{+}\pi^{-}\gamma$

$K^{\pm} \rightarrow \pi^{\pm} \pi^{0}\pi^{0}\gamma$

Necessitate decay spectrum measurements

J-PARC can provide both K^+ and K^- beams

High flux of kaons with good K/π ratios are very welcome change. Good statistics for several decay modes.

Large detector acceptance will allow to study the entire decay spectrum in one setting, reducing the systematic erros

Detector can be tuned to measure several decay modes simultaneously.

Same detector system for both K^+ and K^- decay measurements will minimize systematic errors

$K^{\pm}$ beams at J-PARC along with an upgraded E246 setup and/or a well designed new spectrometer for stopped/quasi-stopped beams will allow one to

a) Explore the symmetry tests in various modes of decays
b) Make precision measurements of the scattering lengths of importance to hadronic physics
c) Determine the parameters to constrain the CHPT inspired Lagrangians

We are working towards the year 2008/2009 beamtime availability